



तत् त्वं पूषन् अपावृणु  
केन्द्रीय विद्यालय संगठन

# KENDRIYA VIDYALAYA SANGATHAN

## COMPETENCY-BASED QUESTION BANK

### SCIENCE | CLASS IX

5-Day Offline Workshop on the Orientation Course  
for Master Trainers on the New Textbook in Science



**Duration:** 20.07.2026 to 24.07.2026



**KVS ZONAL INSTITUTE OF  
EDUCATION AND TRAINING, MYSURU**

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| KVS ZONAL INSTITUTE OF EDUCATION AND TRAINING MYSURU                                                |                         |                |                              |           |
|-----------------------------------------------------------------------------------------------------|-------------------------|----------------|------------------------------|-----------|
| 5-day offline workshop on the orientation course for Master Trainers on the new textbook in Science |                         |                |                              |           |
| Duration: 20.07.2026to 24.07.2026                                                                   |                         |                |                              |           |
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| 4                                                                                                   | RAMESH KUMAWAT          | TGT (SCIENCE)  | HUTTI                        | BENGALURU |
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| 18 | C RESISHMI                   | TGT<br>( SCIENCE) | PM SHRI KV THRISSUR              | ERNAKUL<br>AM |
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| 20 | MRS. SHEENA C<br>GEORGE      | TGT<br>( SCIENCE) | PM SHRI KV RB<br>KOTTAYAM        | ERNAKUL<br>AM |
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| 26 | YOGESH TOMAR                 | TGT<br>( SCIENCE) | RAJAMPET                         | HYDERAB<br>AD |
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| 2     | Mrs. Sheena C George | TGT (Science) | PM SHRI KV RB KOTTAYAM | Ernakulum |
| 3     | Mrs. Anjali Yadav    | TGT (Science) | KV CHENNAI ,IIT        | Chennai   |
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| S.No. | NAME OF THE TEACHER     | DESIGNATION   | NAME OF KV              | REGION    |
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| S.No. | NAME OF THE TEACHER     | DESIGNATION   | NAME OF KV                | REGION    |
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| 1     | Mrs. Sahana S U         | TGT (Science) | PM SHRI KV SHIVAMOGGA     | Bengaluru |
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### **GROUP 4**

| S.No. | NAME OF THE TEACHER    | DESIGNATION   | NAME OF KV               | REGION    |
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| <b>S.No.</b> | <b>NAME OF THE<br/>TEACHER</b>          | <b>DESIGNATIO<br/>N</b> | <b>NAME OF KV</b>                      | <b>REGION</b>         |
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# **COMPETENCY-BASED QUESTION BANK**

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## Chapter 2 :THE BUILDING BLOCK OF LIFE

### Topic: Golgi apparatus, lysosomes, mitochondria, plastids, vacuoles, cell division

| Prepared by                 | Designation                                                                                                                 | School                            | Region    |
|-----------------------------|-----------------------------------------------------------------------------------------------------------------------------|-----------------------------------|-----------|
| ANIL KUMAR                  | TGT SCIENCE                                                                                                                 | PM SHRI KENDRIYA VIDYALAYA MYSURU | BENGALURU |
| Section A -1 Mark questions |                                                                                                                             |                                   |           |
| QNo                         | Question                                                                                                                    | Marks                             |           |
| 1                           | Which cell organelle is known as the "powerhouse of the cell"?<br>a) Golgi apparatus b) Lysosome c) Mitochondria d) Vacuole | 1                                 |           |
| 2                           | Lysosomes contain:<br>a) Chlorophyll b) Digestive enzymes c) DNA d) Ribosomes                                               | 1                                 |           |
| 3                           | Which plastid is responsible for photosynthesis?<br>a) Chromoplast b) Leucoplast c) Chloroplast d) Amyloplast               | 1                                 |           |
| 4                           | Golgi apparatus mainly helps in:<br>a) Protein packaging and secretion<br>b) Respiration c) Photosynthesis d) Cell division | 1                                 |           |
| 5                           | The largest vacuole is found in:<br>a) Animal cell b) Plant cell c) Bacterial cell d) Virus                                 | 1                                 |           |
| 6                           | Which plastids store food?<br>a) Chloroplasts b) Chromoplasts c) Leucoplasts d) Ribosomes                                   | 1                                 |           |
| 7                           | During mitosis, the chromosome number in daughter cells is:<br>a) Half b) Double c) Same as parent cell d) Zero             | 1                                 |           |
| 8                           | Which organelle is called the "suicidal bag" of the cell?<br>a) Vacuole b) Lysosome c) Mitochondria d) Plastid              | 1                                 |           |
| 9                           | ATP is mainly produced in:<br>a) Golgi apparatus b) Vacuole c) Mitochondria d) Nucleus                                      | 1                                 |           |
| 10                          | Golgi apparatus is closely associated with:<br>a) Endoplasmic Reticulum b) Cell wall<br>c) Ribosome only d) Chromosomes     | 1                                 |           |

**Section B – 2 Mark Questions**

| <b>QNo.</b> | <b>Question</b>                                                    | <b>Mark<br/>s</b> |
|-------------|--------------------------------------------------------------------|-------------------|
| 11          | State any two functions of the Golgi apparatus.                    | 2                 |
| 12          | Why are lysosomes called the "suicidal bags" of the cell?          | 2                 |
| 13          | Differentiate between chloroplast and leucoplast (any two points). | 2                 |
| 14          | Write two differences between plant vacuoles and animal vacuoles.  | 2                 |

**Section C – 3 Mark Questions**

| <b>QNo.</b> | <b>Question</b>                                                     | <b>Mark<br/>s</b> |
|-------------|---------------------------------------------------------------------|-------------------|
| 15          | Explain the structure and functions of mitochondria.                | 3                 |
| 16          | Describe the different types of plastids with one function of each. | 3                 |
| 17          | Explain the importance of vacuoles in plant cells.                  | 3                 |
| 18          | What is mitosis? Explain its stages briefly.                        | 3                 |

**Section D – 5 Mark Questions**

| <b>QNo.</b> | <b>Question</b>                                                                                                                    | <b>Mark<br/>s</b> |
|-------------|------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| 19          | Explain the structure and functions of the following organelles:<br>(a) Golgi apparatus<br>(b) Lysosomes<br>(c) Mitochondria       | 5                 |
| 20          | Explain the process of mitosis with the help of a neat labelled diagram. State its importance in growth, repair, and reproduction. | 5                 |

**Section E – Case-Based Questions**

| <b>Q No.</b> | <b>Question</b>                                                                                                                                                                                                                           | <b>Mark<br/>s</b> |
|--------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------|
| 21           | Case Study questions<br><br>A scientist observed a plant cell under a microscope. The cell contained green organelles, a large central vacuole, and mitochondria. The green organelles were helping the cell prepare food using sunlight. | 4                 |

|    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |   |
|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|
|    | <p>Answer the following:</p> <ol style="list-style-type: none"><li>1. Name the green organelles.</li><li>2. Which pigment is present in them?</li><li>3. What is the function of the large central vacuole?</li><li>4. Why are mitochondria also present in this cell?</li></ol>                                                                                                                                                                                                                             |   |
| 22 | <p>A skin cell undergoes repeated cell division to replace damaged cells after an injury. During this process, two daughter cells are formed, each having the same number of chromosomes as the parent cell.</p> <p>Answer the following:</p> <ol style="list-style-type: none"><li>1. Name the type of cell division.</li><li>2. Why is this type of division important?</li><li>3. How many daughter cells are produced?</li><li>4. What happens to the chromosome number in the daughter cells?</li></ol> | 4 |

## Marking scheme

| Q NO. | Answer                                                                                                                                                                                                                                                                               | Marks |
|-------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 1     | (c) Mitochondria                                                                                                                                                                                                                                                                     |       |
| 2     | (b) Digestive enzymes                                                                                                                                                                                                                                                                |       |
| 3     | (c) Chloroplast                                                                                                                                                                                                                                                                      |       |
| 4     | (a) Protein packaging and secretion                                                                                                                                                                                                                                                  |       |
| 5     | (b) Plant cell                                                                                                                                                                                                                                                                       |       |
| 6     | (c) Leucoplasts                                                                                                                                                                                                                                                                      |       |
| 7     | (c) Same as parent cell                                                                                                                                                                                                                                                              |       |
| 8     | (b) Lysosome                                                                                                                                                                                                                                                                         |       |
| 9     | (c) Mitochondria                                                                                                                                                                                                                                                                     |       |
| 10    | (a) Endoplasmic Reticulum                                                                                                                                                                                                                                                            |       |
| 11    | Modifies, packages, and transports proteins and lipids.<br>Forms secretory vesicles and lysosomes.                                                                                                                                                                                   |       |
| 12    | Lysosomes contain powerful digestive enzymes.<br>If the cell is damaged, these enzymes may digest the cell itself (autolysis).<br>Hence, they are called the "suicidal bags" of the cell.                                                                                            |       |
| 13    | <div>Chloroplast</div> <div>Leucoplast</div> <div>Green in colour due to chlorophyll</div> <div>Colourless plastid</div> <div>Performs photosynthesis</div> <div>Stores starch, oils, and proteins</div>                                                                             |       |
| 14    | <div>Plant Vacuole</div> <div>Animal Vacuole</div> <div>One large central vacuole</div> <div>Small and many vacuoles</div> <div>Maintains turgidity and stores cell sap</div> <div>Mainly stores water, food, and wastes</div>                                                       |       |
| 15    | <p>Mitochondria are double-membrane organelles.</p> <p>The inner membrane is folded into cristae.</p> <p>They contain their own DNA and ribosomes.</p> <p>Functions:</p> <p>Site of cellular respiration.</p> <p>Produces ATP (energy), hence called the powerhouse of the cell.</p> |       |

|    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |  |
|----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
|    | Helps in metabolic activities                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |
| 16 | <p>1. Chloroplast – Contains chlorophyll and performs photosynthesis.</p> <p>2. Chromoplast – Contains coloured pigments and gives colour to fruits and flowers.</p> <p>3. Leucoplast – Stores starch, proteins, and oils.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |  |
| 17 | <p>Store water, food, pigments, and wastes.</p> <p>Maintain turgor pressure.</p> <p>Provide support and rigidity to the cell.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |  |
| 18 | <p>Mitosis is a type of cell division that produces two genetically identical daughter cells with the same chromosome number as the parent cell.</p> <p>Stages:</p> <p>Prophase: Chromosomes become visible; nuclear membrane disappears.</p> <p>Metaphase: Chromosomes align at the equator.</p> <p>Anaphase: Sister chromatids separate and move to opposite poles.</p> <p>Telophase: Nuclear membrane reforms and cytokinesis produces two daughter cells.</p>                                                                                                                                                                                                                                                    |  |
| 19 | <p>(a) Golgi Apparatus</p> <p>Structure:</p> <p>Consists of a stack of flattened, membrane-bound sacs called cisternae.</p> <p>Has two faces:</p> <p>Cis face (forming face): Receives materials from the endoplasmic reticulum (ER).</p> <p>Trans face (maturing face): Sends modified materials to different parts of the cell.</p> <p>Functions:</p> <p>Modifies, sorts, and packages proteins and lipids.</p> <p>Forms secretory vesicles for transport.</p> <p>Produces lysosomes.</p> <p>Helps in the formation of the cell plate during plant cell division.</p> <p>(b) Lysosomes</p> <p>Structure:</p> <p>Small, spherical, single membrane-bound organelles.</p> <p>Contain powerful digestive enzymes.</p> |  |

|    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |  |
|----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
|    | <p>Functions:</p> <p>Digest food particles and foreign materials.</p> <p>Destroy worn-out or damaged cell organelles (autophagy).</p> <p>Break down dead cells (autolysis), so they are called the "suicidal bags" of the cell.</p> <p>Help keep the cell clean by recycling cellular waste.</p> <p>(c) Mitochondria</p> <p>Structure:</p> <p>Double membrane-bound organelles.</p> <p>Outer membrane is smooth.</p> <p>Inner membrane is folded into cristae.</p> <p>The inner space (matrix) contains enzymes, DNA, and ribosomes.</p> <p>Functions:</p> <p>Site of cellular respiration.</p> <p>Produces ATP (Adenosine Triphosphate), the energy currency of the cell.</p> <p>Supplies energy for all cellular activities.</p> <p>Can synthesize some of its own proteins because it contains its own DNA and ribosomes; therefore, it is called the powerhouse of the cell and a semi-autonomous organelle.</p> |  |
| 20 | <p>Mitosis is the division of a parent cell into two identical daughter cells.</p> <p>Stages:</p> <p>Prophase</p> <p>Metaphase</p> <p>Anaphase</p> <p>Telophase</p> <p>Cytokinesis</p> <p>Importance:</p> <p>Growth of multicellular organisms.</p> <p>Repair and replacement of damaged cells.</p> <p>Asexual reproduction in many organisms.</p> <p>Maintains the chromosome number in daughter cells.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |  |
| 21 | Case Study                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |  |

|    |                                                                                                                                                                                                                                                                                                                |  |
|----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
|    | <p>Answers:</p> <ol style="list-style-type: none"><li>1. Chloroplasts</li><li>2. Chlorophyll</li><li>3. Stores water and cell sap, maintains turgidity, and provides support to the plant cell.</li><li>4. Mitochondria release energy (ATP) by cellular respiration for various cellular activities</li></ol> |  |
| 22 | <ol style="list-style-type: none"><li>1. Mitosis</li><li>2. It helps in growth, repair, and replacement of damaged cells</li><li>3. Two daughter cells</li><li>4. The chromosome number remains the same as that of the parent cell.</li></ol>                                                                 |  |

## Chapter: 3 Tissues in action

### Topic: Musculoskeletal system, Types of joints, Totipotency

| Prepared by    | Designation | School   | Region    |
|----------------|-------------|----------|-----------|
| RAMESH KUMAWAT | TGT SCIENCE | KV HUTTI | BENGALURU |

#### Section A -1 Mark questions

| QNo | Question                                                                                                                                                                                                           | Mark<br>s |
|-----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| 1   | Ravi accidentally touches a hot iron and immediately pulls his hand away. Which tissue enables this quick response?<br><br>A. Epithelial tissue<br>B. Connective tissue<br>C. Nervous tissue<br>D. Muscular tissue | 1         |
| 2   | Which part of a neuron receives signals from other neurons?<br><br>A. Axon<br>B. Axon terminal<br>C. Dendrite<br>D. Nucleus                                                                                        | 1         |
| 3   | A basketball player rotates his arm in all directions before taking a shot. Which joint allows this movement?<br><br>A. Hinge joint<br>B. Pivot joint<br>C. Ball and socket joint<br>D. Fixed joint                | 1         |
| 4   | A student bends only his elbow while writing. Which type of joint is involved?<br><br>A. Ball and socket joint<br>B. Hinge joint<br>C. Pivot joint<br>D. Fixed joint                                               | 1         |
| 5   | A person shakes his head to indicate "No". Which joint enables this movement?<br><br>A. Ball and socket joint                                                                                                      | 1         |

|    |                                                                                                                                                                                                                                                                                                                                                                                                                                                         |   |
|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|
|    | <p>B. Hinge joint</p> <p>C. Pivot joint</p> <p>D. Fixed joint</p>                                                                                                                                                                                                                                                                                                                                                                                       |   |
| 6  | <p>Why can't bones move by themselves?</p> <p>A. Bones are soft.</p> <p>B. Bones need muscles to pull them.</p> <p>C. Bones have no joints.</p> <p>D. Bones are hollow.</p>                                                                                                                                                                                                                                                                             | 1 |
| 7  | <p>Which structure connects muscles to bones?</p> <p>A. Ligament</p> <p>B. Cartilage</p> <p>C. Tendon</p> <p>D. Vertebra</p>                                                                                                                                                                                                                                                                                                                            | 1 |
| 8  | <p>A football player suffers a rib injury and finds breathing painful. The main reason is that the rib cage:</p> <ul style="list-style-type: none"> <li>• Produces blood cells.</li> <li>• Expands and contracts during breathing.</li> <li>• Stores minerals only.</li> <li>• Supports the backbone only.</li> </ul> <p>Which tissue acts as a cushion between two vertebrae?</p> <p>A. Bone</p> <p>B. Muscle</p> <p>C. Cartilage</p> <p>D. Tendon</p> | 1 |
| 9  | <p>Which tissue acts as a cushion between two vertebrae?</p> <p>A. Bone</p> <p>B. Muscle</p> <p>C. Cartilage</p> <p>D. Tendon</p>                                                                                                                                                                                                                                                                                                                       | 1 |
| 10 | <p>Which pair of organs is mainly protected by the rib cage?</p> <p>A. Liver and stomach</p> <p>B. Brain and eyes</p>                                                                                                                                                                                                                                                                                                                                   | 1 |

|  |                                                |  |
|--|------------------------------------------------|--|
|  | C. Heart and lungs<br>D. Kidneys and intestine |  |
|--|------------------------------------------------|--|

### Section B – 2 Mark Questions

| QNo | Question                                                                                                                                                                                              | Marks |
|-----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 11  | Riya fractured one of her ribs while playing. She experiences difficulty in breathing.<br>1. Why does a rib injury affect breathing?<br>2. Name the structure that connects ribs to the sternum.      | 2     |
| 12  | A student turns his head to look behind without moving his shoulders.<br>1. Which type of joint enables this movement?<br>2. Where is this joint located?                                             | 2     |
| 13  | During yoga practice, Meena performs Surya Namaskar daily.<br>1. Mention one benefit of yoga on the musculoskeletal system.<br>2. Name one body part whose flexibility improves through regular yoga. | 2     |
| 14  | Scientists successfully developed a complete carrot plant from a single phloem cell.<br>1. What is this ability called?<br>2. Name one condition required for this process.                           | 2     |

### Section C – 3 Mark Questions

| QNo | Question                                                                                                                                                                                                                                                                                                                | Marks |
|-----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 15  | A badminton player swings the racket repeatedly during practice. His muscles contract and relax continuously to produce movement.<br><br>Questions:<br>a) Which two systems work together to produce this movement? (1)<br>b) What is the role of tendons in movement? (1)<br>c) Why can't bones move on their own? (1) | 3     |
| 16  | A physiotherapist asks three patients to perform different movements:<br><ul style="list-style-type: none"> <li>● Patient A rotates the shoulder.</li> <li>● Patient B bends the elbow.</li> <li>● Patient C turns the head sideways.</li> </ul>                                                                        | 3     |

|    |                                                                                                                                                                                                                                                                                                                                            |   |
|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|
|    | <p>Questions:</p> <p>a) Identify the type of joint in each case. (1½)</p> <p>b) Which joint allows movement in only one direction? (½)</p> <p>c) Which joint allows circular movement? (1)</p>                                                                                                                                             |   |
| 17 | <p>A cyclist suffers a rib injury after falling from a bicycle. The doctor advises complete rest because breathing has become painful.</p> <p>Questions:</p> <p>a) Why does a rib injury affect breathing? (1)</p> <p>b) Which organs are protected by the rib cage? (1)</p> <p>c) What connects the ribs to the sternum? (1)</p>          | 3 |
| 18 | <p>Neha performs Surya Namaskar every morning and notices improved flexibility and posture after a few months.</p> <p>Questions:</p> <p>a) Mention one benefit of yoga for bones and muscles. (1)</p> <p>b) Name one habit, other than yoga, that keeps bones healthy. (1)</p> <p>c) Why is maintaining correct posture important? (1)</p> | 3 |

#### Section D – 5 Mark Questions

| Q No | Question                                                                                                                                                                                                                                                                                                                                                   | Marks |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 19   | <p>During a basketball match, Rohan rotates his shoulder to throw the ball, bends his knees while jumping, and turns his head to pass the ball to his teammate.</p> <p>Questions:</p> <p>a) Identify the type of joint present in the shoulder, knee and neck. (3)</p> <p>b) Which of these joints allows movement in all directions? Explain why. (2)</p> | 5     |
| 20   | <p>A doctor asks a patient to rotate the shoulder, bend the elbow and turn the head.</p> <p>Questions:</p> <p>a) Name the joints involved. (3)</p> <p>b) Which joint is injured if the patient cannot rotate the shoulder? (1)</p> <p>c) Mention one daily activity that becomes difficult due to this injury. (1)</p>                                     | 5     |

### Section E – Case-Based Questions

| QNo. | Question                                                                                                                                                                                                                                                                                                                                                                                                                                           | Marks |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 21   | <p>Rohan spends most of his time playing mobile games. His friend Aman exercises daily, practises yoga and eats a balanced diet.</p> <p>Questions:</p> <p>a) Mention one benefit of yoga on the musculoskeletal system. (1)</p> <p>b) State one benefit of regular exercise. (1)</p> <p>c) Why is maintaining correct posture important? (1)</p> <p>d) Suggest one habit Rohan should adopt. (1)</p>                                               | 4     |
| 22   | <p>Scientists cultured a single carrot phloem cell in a nutrient medium containing sugars and hormones. After some time, it developed into a complete carrot plant.</p> <p>Questions:</p> <p>a) Name the property shown by the carrot cell. (1)</p> <p>b) Which tissue was used in this experiment? (1)</p> <p>c) Name the scientist who demonstrated this phenomenon. (1)</p> <p>d) Mention one commercial application of this technique. (1)</p> | 4     |

## Marking scheme

| Q NO. | Answer                                                                                                                                                                                                                                                 | Marks |
|-------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 1     | C                                                                                                                                                                                                                                                      |       |
| 2     | C                                                                                                                                                                                                                                                      |       |
| 3     | C                                                                                                                                                                                                                                                      |       |
| 4     | B                                                                                                                                                                                                                                                      |       |
| 5     | C                                                                                                                                                                                                                                                      |       |
| 6     | B                                                                                                                                                                                                                                                      |       |
| 7     | C                                                                                                                                                                                                                                                      |       |
| 8     | B                                                                                                                                                                                                                                                      |       |
| 9     | C                                                                                                                                                                                                                                                      |       |
| 10    | C                                                                                                                                                                                                                                                      |       |
| 11    | 1 Rib cage expands during breathing;<br>2 Cartilage.                                                                                                                                                                                                   |       |
| 12    | 1 Pivot joint;<br>2 Between the skull and vertebral column.                                                                                                                                                                                            |       |
| 13    | 1 Improves flexibility/maintains posture;<br>2 Joints or muscles.                                                                                                                                                                                      |       |
| 14    | 1 Totipotency;<br>2 Nutrient medium/light/air/hormones (any one appropriate condition).                                                                                                                                                                |       |
| 15    | 1) The muscular system and skeletal system work together to produce movement. 2) Tendons attach muscles to bones and transmit the force produced by muscles to the bones.<br>3) Bones cannot move on their own because they need muscles to pull them. |       |
| 16    | 1) Shoulder – Ball and socket joint<br>Elbow – Hinge joint<br>Neck – Pivot joint<br>2) Hinge joint allows movement in only one direction.<br>3) Ball and socket joint allows circular movement and movement in all directions.                         |       |

|    |                                                                                                                                                                                                                                                                                                                 |  |
|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| 17 | <p>1) Rib injury affects breathing because the rib cage expands and contracts during breathing.</p> <p>2) The heart and lungs are protected by the rib cage.</p> <p>3) Cartilage connects the ribs to the sternum and provides flexibility.</p>                                                                 |  |
| 18 | <p>1) Yoga improves flexibility, posture and joint movement.</p> <p>2) Regular exercise and a balanced diet (any one) help keep bones healthy.</p> <p>3) Correct posture reduces strain, prevents stiffness and keeps the musculoskeletal system healthy.</p>                                                   |  |
| 19 | <p>a) Shoulder – Ball and socket joint (1)</p> <p>Knee – Hinge joint (1)</p> <p>Neck – Pivot joint (1)</p> <p>b) The ball and socket joint allows movement in all directions because the rounded head of one bone fits into a cup-like socket of another bone, allowing rotation and circular movement. (2)</p> |  |
| 20 | <p>a) Shoulder – Ball and socket joint (1)</p> <p>Elbow – Hinge joint (1)</p> <p>Neck – Pivot joint (1)</p> <p>b) Ball and socket joint. (1)</p> <p>c) Activities such as combing hair, wearing clothes or throwing a ball become difficult. (1)</p>                                                            |  |
| 21 | <p>a) Improves flexibility.</p> <p>b) Strengthens bones and muscles.</p> <p>c) It prevents stiffness and supports healthy bones.</p> <p>d) Regular exercise/yoga or a balanced diet.</p>                                                                                                                        |  |
| 22 | <p>a) Totipotency</p> <p>b) Phloem tissue</p> <p>c) F. C. Steward</p> <p>d) Plant tissue culture/mass propagation of plants/genetic engineering.</p>                                                                                                                                                            |  |

## Chapter 5 : Describing Motion Around Us

### Topic: Equations for Motion and Uniform Circular Motion

| Prepared by       | Designation | School                  | Region    |
|-------------------|-------------|-------------------------|-----------|
| Dr. Mathew Chacko | TGT Science | K.V. BRBNMPL,<br>Mysuru | Bengaluru |

#### Section A -1 Mark questions

| QNo | Question                                                                                                                                                                                                                                                                                                                              | Marks |
|-----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 1   | A cyclist starting from rest pedals with uniform acceleration and wants to know his velocity after a given time, without calculating the distance travelled first. Which kinematic equation should he use directly?<br><b>(a)</b> $s = ut + \frac{1}{2}at^2$ <b>(b)</b> $v = u + at$ <b>(c)</b> $v^2 = u^2 + 2as$ <b>(d)</b> $s = vt$ | 1     |
| 2   | A car, starting from rest, covers a distance of 100 m in 10 s under uniform acceleration. Its acceleration is:<br><b>(a)</b> 1 m/s <sup>2</sup> <b>(b)</b> 2 m/s <sup>2</sup> <b>(c)</b> 4 m/s <sup>2</sup> <b>(d)</b> 10 m/s <sup>2</sup>                                                                                            | 1     |
| 3   | To completely describe the position of an object moving on a flat playground with respect to a fixed corner, a student needs:<br><b>(a)</b> only 1 coordinate <b>(b)</b> 2 coordinates <b>(c)</b> 3 coordinates <b>(d)</b> no coordinates                                                                                             | 1     |
| 4   | The equation $v^2 = u^2 + 2as$ is most useful when a problem does NOT give you information about:<br><b>(a)</b> initial velocity <b>(b)</b> final velocity <b>(c)</b> time <b>(d)</b> acceleration                                                                                                                                    | 1     |
| 5   | A ball thrown vertically upward decelerates as it rises and then accelerates while falling back. Which quantity stays constant in magnitude and direction throughout its flight (ignoring air resistance)?<br><b>(a)</b> velocity <b>(b)</b> speed <b>(c)</b> displacement <b>(d)</b> acceleration due to gravity                     | 1     |
| 6   | The path traced by a cricket ball hit high into the air, moving both horizontally and vertically at the same time, is an example of:                                                                                                                                                                                                  | 1     |

|    |                                                                                                                                                                                                                                                                                                                         |                                                                 |   |
|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------|---|
|    | <b>(a)</b> motion in a straight line<br><b>(c)</b> an object at rest                                                                                                                                                                                                                                                    | <b>(b)</b> motion in a plane<br><b>(d)</b> periodic motion only |   |
| 7  | A scooter's velocity changes uniformly from 5 m/s to 15 m/s in 4 s. The distance covered in this time is:<br><b>(a)</b> 20 m <b>(b)</b> 40 m <b>(c)</b> 60 m <b>(d)</b> 80 m                                                                                                                                            |                                                                 | 1 |
| 8  | Which of the following correctly relates displacement (s), initial velocity (u), time (t) and constant acceleration (a)?<br><b>(a)</b> $s = ut + \frac{1}{2} at^2$ <b>(b)</b> $s = ut - \frac{1}{2} at^2$ <b>(c)</b> $s = u^2t + at$ <b>(d)</b> $s = at^2$                                                              |                                                                 | 1 |
| 9  | A body starts from rest and moves with a non-zero constant acceleration. Which statement is correct after some time $t > 0$ ?<br><b>(a)</b> Its velocity is still zero<br><b>(b)</b> Its displacement is zero<br><b>(c)</b> Its velocity and displacement are both non-zero<br><b>(d)</b> Its acceleration becomes zero |                                                                 | 1 |
| 10 | A delivery drone flying from one building to another change both its East-West and North-South position simultaneously. Its motion is best classified as:<br><b>(a)</b> rest<br><b>(b)</b> uniform straight-line motion<br><b>(c)</b> motion in a plane<br><b>(d)</b> non-uniform straight-line motion                  |                                                                 | 1 |

### Section B – 2 Mark Questions

| Question No. | Question                                                                                                                                                                           | Marks |
|--------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 11           | A train starting from rest attains a velocity of 72 km/h in 5 minutes. Assuming the acceleration to be uniform, find the acceleration of the train (convert units before solving). | 2     |
| 12           | Why does describing the position of an object moving on a flat ground require two coordinates (x and y), while an object moving along a                                            | 2     |

|    |                                                                                                                                                          |   |
|----|----------------------------------------------------------------------------------------------------------------------------------------------------------|---|
|    | straight road needs only one? Give one real-life example of each type of motion.                                                                         |   |
| 13 | State the three kinematic equations for motion in a straight line with uniform acceleration, clearly defining each symbol used in them.                  | 2 |
| 14 | A car moving with a speed of 20 m/s is brought to rest by applying brakes uniformly in 4 s. Calculate the distance travelled by the car before it stops. | 2 |

### Section C – 3 Mark Questions

| Question No. | Question                                                                                                                                                                                                     | Marks |
|--------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 15           | Derive the equation $s = ut + \frac{1}{2}at^2$ for a body moving with uniform acceleration, using the velocity-time graph method.                                                                            | 3     |
| 16           | A stone is dropped from the top of a tower and reaches the ground in 4 s. Calculate: (i) the height of the tower, and (ii) the velocity with which the stone strikes the ground.                             | 3     |
| 17           | Explain, with one suitable example each, the difference between ‘motion in a straight line’ and ‘motion in a plane’. How does the number of coordinates required to specify position change between the two? | 3     |
| 18           | List three examples each of (i) motion in a straight line and (ii) motion in a plane, from everyday life. Justify your classification for any one example from each list.                                    | 3     |

### Section D – 5 Mark Questions

| Question No. | Question                                                                                                                                                                | Marks |
|--------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 19           | Using a velocity-time graph, derive the three equations of motion for an object moving with uniform acceleration: $v = u + at$ , $s = ut + \frac{1}{2}at^2$ , and $v^2$ | 5     |

|    |                                                                                                                                                                                                                                    |   |
|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|
|    | $= u^2 + 2as$ . Draw the graph clearly and label all quantities used in the derivation.                                                                                                                                            |   |
| 20 | An athlete completes one round of a circular track of diameter 200 m in 40 s. Calculate: (i) the distance covered, and (ii) the magnitude of displacement of the athlete, at the end of 2 minutes 20 seconds. (Take $\pi = 22/7$ ) | 5 |

### Section E – Case-Based Questions

| Question No. | Question                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Marks |
|--------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 21           | <p><b>Read the passage carefully and answer the questions that follow.</b></p> <div style="border: 1px solid black; padding: 10px; margin: 10px 0;"> <p><b>Case Study — Testing a New Bicycle</b></p> <p>Rohan is testing his new bicycle on a straight, empty road. He starts pedalling from rest and manages to move with a uniform (constant) acceleration of <math>2 \text{ m/s}^2</math>. He continues pedalling with this same acceleration for the first 6 seconds of his ride.</p> </div> <p>(i). What is the initial velocity (<math>u</math>) of Rohan's bicycle at the start of the ride?</p> <p>(ii). Name the kinematic equation Rohan should use to find his velocity after 6 s, without first calculating the distance travelled.</p> <p>(iii). Calculate the velocity of the bicycle at the end of 6 seconds.</p> <p style="text-align: center;"><b>OR</b></p> <p>(iii). Calculate the distance covered by the bicycle in these 6 seconds.</p> | 4     |
| 22           | <p><b>Read the passage carefully and answer the questions that follow.</b></p> <div style="border: 1px solid black; padding: 10px; margin: 10px 0;"> <p><b>Case Study — The Treasure Hunt</b></p> <p>During a school treasure hunt, Meera starts from the base point and walks 40 m towards the East. She then turns and walks 30 m towards the North to finally reach the spot where the treasure is hidden.</p> </div> <p>(i). Is Meera's overall motion an example of motion in a straight line or motion in a plane? Give a reason.</p> <p>(ii). How many coordinates are needed to specify the position of the treasure spot with respect to Meera's starting point?</p>                                                                                                                                                                                                                                                                                  | 4     |

|  |                                                                                                                                             |  |
|--|---------------------------------------------------------------------------------------------------------------------------------------------|--|
|  | <p><b>(iii).</b> Using the Pythagoras theorem, find the magnitude of Meera's displacement from the starting point to the treasure spot.</p> |  |
|--|---------------------------------------------------------------------------------------------------------------------------------------------|--|

**OR**

|  |                                                                                           |  |
|--|-------------------------------------------------------------------------------------------|--|
|  | <p><b>(iii).</b> Find the total distance travelled by Meera during the treasure hunt.</p> |  |
|--|-------------------------------------------------------------------------------------------|--|

## Marking scheme

| Q. No. | Answer                                                                                                                                                                                                                                                                  | Marks           |
|--------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------|
| 1      | (b) $v = u + at$                                                                                                                                                                                                                                                        | 1               |
| 2      | (b) $2 \text{ m/s}^2$                                                                                                                                                                                                                                                   | 1               |
| 3      | (b) 2 coordinates                                                                                                                                                                                                                                                       | 1               |
| 4      | (c) time                                                                                                                                                                                                                                                                | 1               |
| 5      | (d) acceleration due to gravity                                                                                                                                                                                                                                         | 1               |
| 6      | (b) motion in a plane                                                                                                                                                                                                                                                   | 1               |
| 7      | (b) 40 m                                                                                                                                                                                                                                                                | 1               |
| 8      | (a) $s = ut + \frac{1}{2} at^2$                                                                                                                                                                                                                                         | 1               |
| 9      | (c) velocity and displacement both non-zero                                                                                                                                                                                                                             | 1               |
| 10     | (c) motion in a plane                                                                                                                                                                                                                                                   | 1               |
| 11     | $u = 0, v = 72 \text{ km/h} = 20 \text{ m/s}, t = 5 \text{ min} = 300 \text{ s}$<br>$\Rightarrow a = (v-u)/t = 20/300$<br>$= 0.067 \text{ m/s}^2 \text{ (approx.)}$                                                                                                     | 1<br>0.5<br>0.5 |
| 12     | Two coordinates (x, y) are needed for plane motion since position changes along two independent directions simultaneously; one coordinate suffices for straight-line motion.<br><br>Examples: object on a table-top (plane); train on a straight track (straight line). | 1<br><br><br>1  |
| 13     | $v = u + at$ ; $s = ut + \frac{1}{2} at^2$ ; $v^2 = u^2 + 2as$ , with $u$ = initial velocity, $v$ = final velocity, $a$ = uniform acceleration, $t$ = time, $s$ = displacement                                                                                          | 2               |
| 14     | $u = 20 \text{ m/s}, v = 0, t = 4 \text{ s}$<br>$\Rightarrow s = (u+v)/2 \times t = 40 \text{ m.}$                                                                                                                                                                      | 1<br><br>1      |
| 15     | Standard graphical derivation using area under the v-t graph (a trapezium split into rectangle + triangle).                                                                                                                                                             | 3               |
| 16     | $u = 0, t = 4 \text{ s}, g = 10 \text{ m/s}^2$<br>$\Rightarrow h = \frac{1}{2} g t^2 = 80 \text{ m};$<br>$v = u + gt = 40 \text{ m/s.}$                                                                                                                                 | 1<br>1<br>1     |
| 17     | Straight-line motion needs 1 coordinate (e.g., a train on a track);<br>plane motion needs 2 coordinates (e.g., a ball rolling on the ground).                                                                                                                           | 1.5<br>1.5      |

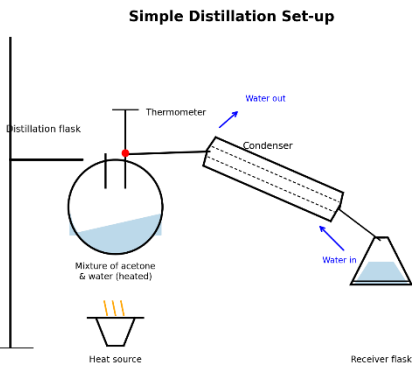
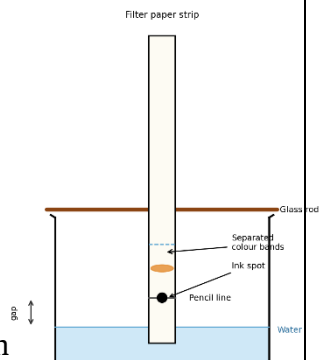
|    |                                                                                                                                                                                                                                                                                                                                                                                                                               |                                                            |
|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------|
| 18 | <p>Straight line: lift moving up/down, a sprinter on a 100 m track, a car on a straight highway.</p> <p>Plane: a kite flying, a football rolling on a field, an ant walking on a table-top.</p>                                                                                                                                                                                                                               | 1.5                                                        |
| 19 | <p>Assumption</p> <p>slope gives <math>v = u + at</math>;</p> <p>area gives <math>s = ut + \frac{1}{2}at^2</math>;</p> <p>elimination of <math>t</math> gives <math>v^2 = u^2 + 2as</math>.</p>                                                                                                                                                                                                                               | 0.5<br>1.5<br>1.5<br>1.5                                   |
| 20 | <p><math>r = 100</math> m,</p> <p>circumference <math>= 2\pi r</math></p> <p><math>= 628.57</math> m <math>\approx 628.6</math> m in 40 s.</p> <p>In 140 s <math>\Rightarrow</math> 3.5 rounds</p> <p><math>\Rightarrow</math> distance <math>= 3.5 \times 628.6 \approx 2200</math> m;</p> <p>after 3.5 rounds athlete is diametrically opposite</p> <p><math>\Rightarrow</math> displacement <math>= 2r = 200</math> m.</p> | 0.5<br><br>0.5<br><br>0.5<br><br>1.5<br><br>0.5<br><br>1.5 |
| 21 | <p>(i) <math>u = 0</math></p> <p>(ii) <math>v = u + at</math></p> <p>(iii) <math>v = 0 + 2 \times 6 = 12</math> m/s OR <math>s = 0 \times 6 + \frac{1}{2} \times 2 \times 6^2 = 36</math> m</p>                                                                                                                                                                                                                               | 1<br>1<br>2                                                |
| 22 | <p>(i) Motion in a plane, since Meera's position changes along two perpendicular directions</p> <p>(ii) 2 coordinates</p> <p>(iii) Displacement <math>= \sqrt{(40^2 + 30^2)} = 50</math> m OR Distance <math>= 40 + 30 = 70</math> m</p>                                                                                                                                                                                      | 1<br><br>1<br><br>2                                        |

## Chapter 5 : Describing Motion Around Us

### Topic: Equations for Motion and Uniform Circular Motion

| Prepared by            | Designation | School                  | Region  |
|------------------------|-------------|-------------------------|---------|
| JAYANTA KUMAR<br>SABAR | TGT Science | PM SHRI KV HVF<br>AVADI | CHENNAI |

#### Section A - 1 Mark questions

| Q.No | Question                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Marks |
|------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 1    | <p>Which of the following conditions is essential to prepare large, well-shaped pure crystals of copper sulfate from its saturated solution as per the laboratory activity?</p> <p>a) Cooling the hot saturated solution rapidly in ice<br/>b) Cooling the hot saturated solution slowly at room temperature<br/>c) Evaporating the solvent completely to dryness<br/>d) Adding excess solvent to the mixture</p>                                                                                                                                                          | 1     |
| 2    | <p>In the given distillation apparatus used for separating a homogeneous mixture of acetone and water, what is the primary function of the water condenser?</p> <p>a) To heat the mixture uniformly<br/>b) To cool and condense the vapours of the lower-boiling liquid back into liquid<br/>c) To measure the exact temperature of the escaping vapours<br/>d) To increase the boiling point of the solution</p>  <p style="text-align: center;"><b>Simple Distillation Set-up</b></p> | 1     |
| 3    | <p>In the given setup for paper chromatography, why is the initial water level kept strictly below the marked ink spot?</p> <p>a) To prevent the ink spot from dissolving directly into the bulk of the water<br/>b) To allow the chromatographic paper to dry quickly<br/>c) To stop the water from rising through capillary action<br/>d) To make the separated ink colours appear darker</p>  <p style="text-align: center;"><b>Paper Chromatography Set-up</b></p>                 | 1     |

|   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |   |
|---|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|
| 4 | <p>While observing the paper chromatography of black ink, you notice the ink separating into different colour spots as the water rises. What principle is responsible for this separation?</p> <p>a) Differences in the boiling points of the dye components</p> <p>b) Differences in the solubilities and interactions of the components with the solvent and the paper</p> <p>c) Differences in the densities of the colour pigments</p> <p>d) Differences in the melting points of the colours</p>                        | 1 |
| 5 | <p>A student accidentally mixed a small amount of acetone (boiling point 56°C) with water (boiling point 100°C). Which technique should they use to safely recover both liquids, and why?</p> <p>a) Evaporation, because water will evaporate first</p> <p>b) Crystallization, because water forms crystals on cooling</p> <p>c) Distillation, because their boiling points differ by more than 25°C</p> <p>d) Filtration, because acetone is completely insoluble in water</p>                                              | 1 |
| 6 | <p>While performing paper chromatography with black ink, what happens to the most soluble colour component in the chosen solvent?</p> <p>a) It remains strictly at the bottom pencil line</p> <p>b) It rises the fastest and travels the highest on the paper strip</p> <p>c) It forms shiny crystals on the paper</p> <p>d) It vaporizes instantly upon contact with water</p>                                                                                                                                              | 1 |
| 7 | <p>Ramesh is given a homogeneous mixture of two miscible liquids with boiling points 60°C and 80°C. Which of the following statements is scientifically correct regarding their separation?</p> <p>a) They can be effectively separated by simple distillation.</p> <p>b) They cannot be separated by simple distillation as the difference in boiling points is less than 25°C.</p> <p>c) They can be separated easily by using a separating funnel.</p> <p>d) They can be separated by the process of crystallization.</p> | 1 |
| 8 | <p>A student is tasked with separating salt from seawater for commercial purposes. Which naturally occurring process is utilized in traditional salt pans near coastal areas?</p> <p>a) Paper Chromatography</p> <p>b) Evaporation and Crystallization</p> <p>c) Fractional Distillation</p> <p>d) High-speed Centrifugation</p>                                                                                                                                                                                             | 1 |
| 9 | <p>Assertion (A): A homogeneous mixture of two miscible liquids like acetone and water can be separated by simple distillation.</p> <p>Reason (R): Simple distillation can be effectively used when the difference in boiling points of the two miscible liquids is at least about 25°C.</p>                                                                                                                                                                                                                                 | 1 |

|    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |   |
|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|
|    | <p>Choose the correct option:</p> <p>a) Both A and R are true, and R is the correct explanation of A.</p> <p>b) Both A and R are true, but R is not the correct explanation of A.</p> <p>c) A is true, but R is false.</p> <p>d) A is false, but R is true.</p>                                                                                                                                                                                                                                                                                  |   |
| 10 | <p>Assertion (A): Crystallization is generally considered a better technique than simple evaporation for obtaining a pure solid from a solution.</p> <p>Reason (R): Evaporation requires no heating, while crystallization always requires continuous heating until dryness.</p> <p>Choose the correct option:</p> <p>a) Both A and R are true, and R is the correct explanation of A.</p> <p>b) Both A and R are true, but R is not the correct explanation of A.</p> <p>c) A is true, but R is false.</p> <p>d) A is false, but R is true.</p> | 1 |

#### Section B – 2 Mark Questions

| Q.No | Question                                                                                                                                                                                                         | Marks |
|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 11   | Define the term 'crystallization'. State the fundamental principle on which purification of solids by crystallization is based.                                                                                  | 2     |
| 12   | <p>Name the separation technique used to separate the components of the following mixtures:</p> <p>a) Different colour pigments present in black ink.</p> <p>b) A homogeneous mixture of acetone and water.</p>  | 2     |
| 13   | You are given a homogeneous mixture of two miscible liquids 'A' (boiling point 78°C) and 'B' (boiling point 100°C). Can they be efficiently separated by simple distillation? Justify your answer.               | 2     |
| 14   | If a hot, saturated solution of copper sulfate is cooled rapidly in ice-cold water, how will the resulting crystals differ in appearance from those formed if the solution is cooled slowly at room temperature? | 2     |

#### Section C – 3 Mark Questions

| Q.No | Question                                                                                                                                                                                                                                                                                                                                                                                              | Marks |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 15   | <p>Give scientific reasons for the following statements:</p> <p>a) A drop of dilute sulfuric acid is added while preparing a saturated solution of copper sulfate for crystallization.</p> <p>b) Acetone and water can be separated using distillation but not by using a separating funnel.</p> <p>c) In paper chromatography, a pencil is used to draw the starting line instead of an ink pen.</p> | 3     |

|    |                                                                                                                                                                                                                                                                                                                                                                                               |   |
|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|
| 16 | Give reasons for the following laboratory observations:<br>a) When making candy sugar (mishri) crystals, the concentrated solution is left undisturbed to cool slowly.<br>b) The initial solvent level must be kept strictly below the ink spot in a chromatography jar.<br>c) The water condenser in a distillation setup is connected to a continuous flow of cold water.                   | 3 |
| 17 | Based on the paper chromatography activity, answer the following:<br>a) What would you observe on the paper strip if you use a green food colour spot instead of black ink?<br>b) Is it absolutely necessary that water will act as a solvent in every chromatography experiment? If not, what else can be used?<br>c) State the underlying principle behind this chromatographic separation. | 3 |
| 18 | A student performs an activity to prepare copper sulfate crystals but fails to get well-shaped pure crystals because they boiled the solution to complete dryness.<br>a) What is this incorrect method called?<br>b) Why is crystallization considered a significantly better technique than the incorrect method used by the student? (Give two reasons)                                     | 3 |

#### Section D – 5 Mark Questions

| Q.No | Question                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | Marks |
|------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 19   | Describe the step-by-step activity to obtain pure crystals of copper sulfate from an impure sample.<br>a) What is the first step regarding the solvent and the impure solid?<br>b) Why is heating in a water bath preferred while making the saturated solution instead of direct heating?<br>c) What is the specific role of filtration before the cooling step?<br>d) How should the cooling of the filtrate be done to obtain large, well-defined crystals?<br>e) What remains in the mother liquor (filtrate) after the pure crystals have formed? | 5     |
| 20   | A mixture of two miscible liquids, Liquid X (boiling point 56°C) and Liquid Y (boiling point 100°C), is to be separated in a school laboratory.<br>a) Identify the most suitable separation technique for this mixture.<br>b) Why is a separating funnel completely unsuitable for separating this specific mixture?<br>c) Name the specific apparatus where the vapour of the lower-boiling liquid is converted back into a liquid state.<br>d) Which liquid will be collected first in the receiver flask and why?                                   | 5     |

|  |                                                                                                                                      |  |
|--|--------------------------------------------------------------------------------------------------------------------------------------|--|
|  | e) What critical condition is necessary regarding the boiling points of the two miscible liquids for this technique to be effective? |  |
|--|--------------------------------------------------------------------------------------------------------------------------------------|--|

### Section E – Case-Based Questions

| Q.No | Question                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | Marks |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 21   | <p>Case: The Fragrance and Flavour Development Centre in Kannauj supports farmers in cultivating fragrance-producing plants. In Kannauj, a town in Uttar Pradesh, a beautiful natural perfume called "Mitti ka Ittar" (earthy fragrance) is made using a traditional method called Deg-Bhapka. The process relies on capturing natural fragrances and turning them into perfumes by utilizing heat and differences in volatilities of the components.</p> <p>a) Which modern laboratory separation technique is conceptually similar to the traditional Deg-Bhapka method?</p> <p>b) Name the state in which Kannauj is located and mention the famous title given to this town.</p> <p>c) If a mixture containing volatile fragrant oils and water is heated, which component vaporises more easily?</p> <p>d) What is the scientific purpose of passing the hot vapours through a cooling system (Bhapka) in such extraction processes?</p>                     | 4     |
| 22   | <p>Case: A student was investigating ink from a suspicious note found in the classroom. They took a strip of filter paper, drew a line with a pencil near the bottom, and placed a spot of the ink on the line. They then placed the paper vertically in a beaker with a small amount of water, ensuring the ink spot was just above the water level. As the water rose up the paper via capillary action, the original black ink separated into three distinct coloured spots (blue, red, and yellow) at different heights.</p> <p>a) Identify the specific separation technique being used by the student.</p> <p>b) Explain why the single black ink spot separated into three different coloured spots at various heights.</p> <p>c) Why was the initial reference line drawn with a pencil and not a standard ink pen?</p> <p>d) What does the appearance of three distinct coloured spots indicate about the chemical nature of the original black ink?</p> | 4     |

## Answer Key & Marking Scheme

### SECTION A (1 Mark Each)

1. b) Cooling the hot saturated solution slowly at room temperature (1m)
2. b) To cool and condense the vapours of the lower-boiling liquid back into liquid (1m)
3. a) To prevent the ink spot from dissolving directly into the bulk of the water (1m)
4. b) Differences in the solubilities and interactions of the components with the solvent and the paper (1m)
5. c) Distillation, because their boiling points differ by more than 25°C (1m)
6. b) It rises the fastest and travels the highest on the paper strip (1m)
7. b) They cannot be separated by simple distillation as the difference in boiling points is less than 25°C. (1m)
8. b) Evaporation and Crystallization (1m)
9. a) Both A and R are true, and R is the correct explanation of A. (1m)
10. c) A is true, but R is false. (1m - R is false because crystallization does not require heating to complete dryness, evaporation does).

### SECTION B (2 Marks Each)

11. The process of forming crystals from a saturated solution is called crystallization (1m). Principle: It is based on the differences in the solubility of a substance at different temperatures (1m).
12. a) Paper chromatography (1m). b) Distillation (1m).
13. No, they cannot be efficiently separated by simple distillation (1m). The difference in their boiling points ( $100 - 78 = 22^{\circ}\text{C}$ ) is less than  $25^{\circ}\text{C}$ , so fractional distillation is required (1m).
14. Rapid cooling yields smaller, less well-formed crystals (1m). Slow cooling at room temperature allows particles enough time to arrange, resulting in larger, well-shaped crystals (1m).

### SECTION C (3 Marks Each)

15. a) It helps in making pure crystals by preventing unwanted chemical reactions/hydrolysis (1m).

b) They are miscible liquids and mix uniformly, thus they do not form separate layers required for a separating funnel (1m).

c) Pen ink contains dyes that would dissolve in the solvent and interfere with the separation, while graphite in pencils does not dissolve (1m).

16. a) Leaving it undisturbed allows particles sufficient time to come together and grow into large, shiny crystals (1m).

b) If kept above the level, the sample spot will directly dissolve into the solvent pool instead of travelling up the paper (1m).

c) Continuous flow of cold water ensures maximum condensation efficiency by keeping the condenser walls sufficiently cold (1m).

17. a) It separates into its constituent colour pigments (e.g., blue and yellow) (1m).

b) No, it is not necessary. In some cases, different solvents like alcohol or a mixture of solvents are used (1m).

c) The principle is based on the difference in solubilities and interactions of the components with the solvent and the paper (1m).

18. a) Evaporation to dryness (1m).

b) i) Some solids decompose or get charred on heating to dryness. ii) Soluble impurities remain mixed with the solid upon complete evaporation, whereas in crystallization, impurities remain in the filtrate (1m + 1m).

## SECTION D (5 Marks Each)

19. a) Dissolve the impure sample in a minimum amount of water (1m).

b) A water bath ensures gentle, controlled, and uniform heating without decomposing the substance (1m).

c) Filtration removes any insoluble impurities from the hot solution (1m).

d) The solution should be allowed to cool slowly at room temperature without disturbing it (1m).

e) Soluble impurities remain behind in the mother liquor (filtrate) (1m).

20. a) Simple distillation (1m).

b) Because Liquid X and Liquid Y are miscible and dissolve uniformly into each other, failing to form distinct density-based layers (1m).

c) Water condenser (1m).

d) Liquid X (acetone) will be collected first because it has a lower boiling point ( $56^{\circ}\text{C}$ ) and will vaporise before Liquid Y (1m).

e) The difference in their boiling points must be at least about  $25^{\circ}\text{C}$  (1m).

### **SECTION E (4 Marks Each)**

21. a) Distillation (1m).

b) Uttar Pradesh; "Perfume capital of India" (1m).

c) The volatile fragrant oil vaporises easily (1m).

d) To cool and condense the fragrant vapours back into a liquid state so they can be collected as perfume (1m).

22. a) Paper chromatography (1m).

b) Different components of the ink have different solubilities in water. The most soluble component rises faster and higher, separating them at different heights (1m).

c) Pen ink dissolves in water and would interfere with the chromatogram, whereas pencil graphite is insoluble (1m).

d) It indicates that the black ink is not a single pure substance, but a mixture of at least three different coloured dyes (1m).

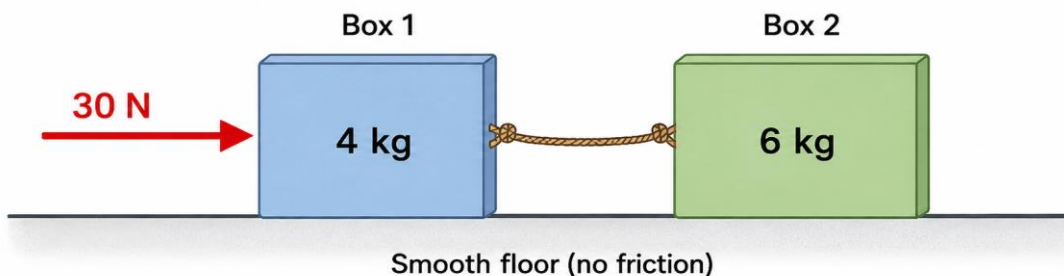
## Chapter 6 : HOW FORCES AFFECT MOTION

### Topic: Newton's Second Law of Motion, Newton's Third Law of Motion and Forces on System of Objects

| Prepared by          | Designation | School                          | Region  |
|----------------------|-------------|---------------------------------|---------|
| Mrs. SHILPI KHANDURI | TGT-SCIENCE | PM SHRI KENDRIYA VIDYALAYA CLRI | CHENNAI |

#### Section A -1 Mark questions

| Q. No. | Question                                                                                                                                                                                                                                                                                                                                                                                                                                    | Marks |
|--------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 1      | <p>A school bus suddenly stops due to an obstacle. Students wearing seat belts experience fewer injuries than those not wearing them.</p> <p>Which statement best explains this observation?</p> <p>A. Seat belts increase the student's mass.</p> <p>B. Seat belts increase the time taken to stop the body, reducing the force acting on it.</p> <p>C. Seat belts reduce gravity.</p> <p>D. Seat belts decrease the speed of the bus.</p> | 1     |
| 2      | <p>Riya and her father push a heavy cupboard together with forces of 150 N and 100 N in the same direction. The cupboard has a mass of 125 kg and friction is neglected.</p> <p>What is the acceleration of the cupboard?</p> <p>A. <math>0.5 \text{ m s}^{-2}</math></p> <p>B. <math>1.0 \text{ m s}^{-2}</math></p> <p>C. <math>2.0 \text{ m s}^{-2}</math></p> <p>D. <math>2.5 \text{ m s}^{-2}</math></p>                               | 1     |
| 3      | <p>A student pushes an empty shopping cart and a fully loaded shopping cart with the same force.</p> <p>Which statement is correct?</p> <p>A. The loaded cart has greater acceleration.</p> <p>B. The empty cart has greater acceleration.</p> <p>C. Both carts have the same acceleration.</p>                                                                                                                                             | 1     |

|   |                                                                                                                                                                                                                                                                                                                                                                                                                                  |   |
|---|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|
|   | D. The acceleration depends only on the distance travelled.                                                                                                                                                                                                                                                                                                                                                                      |   |
| 4 | <p>A balloon filled with air is released without tying its mouth.</p> <p>Which statement correctly explains why the balloon moves?</p> <p>A. Air pulls the balloon forward.</p> <p>B. The balloon moves due to balanced forces.</p> <p>C. Escaping air pushes backward, and the balloon experiences an equal and opposite force.</p> <p>D. Gravity pushes the balloon forward.</p>                                               | 1 |
| 5 | <p>Two boxes of masses 4 kg and 6 kg are tied together on a smooth floor. A force of 30 N is applied to the first box.</p>  <p>The acceleration of the system is-</p> <p>A. <math>2 \text{ m s}^{-2}</math></p> <p>B. <math>3 \text{ m s}^{-2}</math></p> <p>C. <math>4 \text{ m s}^{-2}</math></p> <p>D. <math>5 \text{ m s}^{-2}</math></p> | 1 |
| 6 | During a boat race, Team A paddles harder than Team B.                                                                                                                                                                                                                                                                                                                                                                           | 1 |



Why does Team A's boat move faster?

- A. The water offers less resistance.
- B. The paddle exerts a larger backward force on the water, so the water exerts a larger forward force on the boat.
- C. Gravity becomes weaker.
- D. The boat becomes lighter.

7

A football player kicks a football.

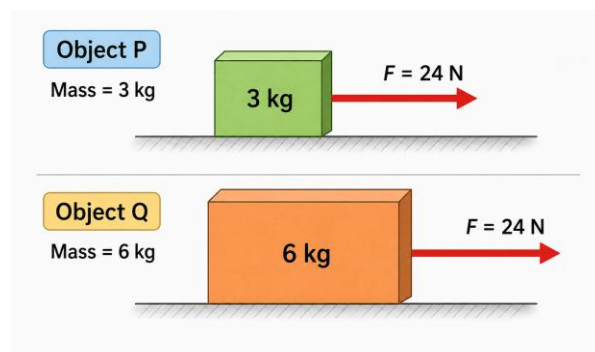
Which of the following is the correct action–reaction pair?

- A. Force of the foot on the ball and force of the ball on the foot.
- B. Weight of the ball and force of the ground on the ball.
- C. Friction and weight acting on the ball.
- D. Force of the player and gravitational force.

1

8

A force of 24 N acts separately on two objects.



Which statement is correct?

- A. Both objects have the same acceleration.
- B. Object P has greater acceleration.

1

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                                                                                                                                                                                                                                                  |   |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|
|                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | <p>C. Object Q has greater acceleration.</p> <p>D. Both remain at rest.</p>                                                                                                                                                                      |   |
| <p><b>Questions 9 and 10 have two statements – ASSERTION(A) and REASON(R).</b></p> <p><b>Choose the correct option:</b></p> <p><b>A. Both Assertion (A) and Reason (R) are true, and R is the correct explanation of A.</b></p> <p><b>B. Both Assertion (A) and Reason (R) are true, but R is not the correct explanation of A.</b></p> <p><b>C. Assertion (A) is true, but Reason (R) is false.</b></p> <p><b>D. Assertion (A) is false, but Reason (R) is true.</b></p> |                                                                                                                                                                                                                                                  |   |
| 9                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <p><b>Assertion (A):</b> Airbags reduce the chances of serious injury during a car collision.</p> <p><b>Reason (R):</b> Airbags increase the time over which the passenger comes to rest, thereby reducing the force acting on the passenger</p> | 1 |
| 10                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | <p><b>Assertion (A):</b> Two objects of different masses experience the same acceleration when the same force acts on them.</p> <p><b>Reason (R):</b> According to Newton's Second Law, acceleration depends on both force and mass.</p>         | 1 |

### Section B – 2 Mark Questions

| Question No. | Question                                                                                                                                                                                                                                       | Marks |
|--------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 11           | <p>At an airport, a passenger pushes an empty luggage trolley and then a loaded trolley with the same force.</p> <p><b>(a)</b> Which trolley will accelerate more?</p> <p><b>(b)</b> Give a reason based on Newton's Second Law of Motion.</p> | 2     |
| 12           | <p>A child pushes a bicycle forward while standing beside it. The bicycle starts moving immediately.</p>                                                                                                                                       | 2     |

|    |                                                                                                                                                                                                             |   |
|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|
|    | <p><b>(a)</b> Why does the bicycle accelerate when pushed?</p> <p><b>(b)</b> State the relationship between force and acceleration.</p>                                                                     |   |
| 13 | <p>A coach asks students to catch the ball by moving their hands backward.</p> <p><b>(a)</b> Why is this technique safer?</p> <p><b>(b)</b> Which law of motion explains this?</p>                          | 2 |
| 14 | <p>During a rocket launch, large amounts of hot gases are expelled downward.</p> <p><b>(a)</b> Why does the rocket move upward?</p> <p><b>(b)</b> Name the pair of action and reaction forces involved.</p> | 2 |

### Section C – 3 Mark Questions

| Question No. | Question                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Marks |
|--------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 15           | <p>A railway engine pulls two coaches connected by a coupling on a straight track. The engine exerts a constant pulling force, and both coaches move together with the same acceleration.</p> <p><b>(a)</b> Explain why the two coaches can be treated as a single system while calculating their acceleration.</p> <p><b>(b)</b> If the masses of the two coaches are 20,000 kg and 30,000 kg, and the engine exerts a net pulling force of 50,000 N, calculate the acceleration of the system.</p> | 3     |
| 16           | <p>Two students push a desk in the same direction with forces of <b>30 N</b> and <b>20 N</b>.</p> <p><b>(a)</b> What is the net force acting on the desk?</p> <p><b>(b)</b> If the desk has a mass of <b>25 kg</b>, calculate its acceleration (ignore friction).</p>                                                                                                                                                                                                                                | 3     |
| 17           | <p>During a boat race, a student observes that the boat moves forward only when the paddler pushes the water backward using the paddle.</p> <p><b>(a)</b> Explain why the boat moves forward when the paddle pushes the water backward.</p> <p><b>(b)</b> Name the law of motion illustrated in this situation.</p> <p><b>(c)</b> Predict what will happen if the paddler stops paddling while the boat is still moving. Give a reason for your answer.</p>                                          | 3     |

|    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |   |
|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|
| 18 | <p>During a science exhibition, two spring balances are connected together and pulled in opposite directions by two students. Both spring balances show a reading of 10 N.</p> <p>(a) Why do both spring balances show the same reading?</p> <p>(b) What does this activity demonstrate about action and reaction forces?</p> <p>(c) If one student pulls with a force of 15 N instead of 10 N, what will be the reading on each spring balance? Justify your answer.</p> | 3 |
|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|

### Section D – 5 Mark Questions

| Question No. | Question                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Marks |
|--------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 19           | <p>An ambulance is carrying an injured patient to the hospital. While travelling, the driver suddenly applies the brakes to avoid hitting another vehicle. The patient is safely secured to the stretcher using safety straps.</p> <p>Answer the following questions:</p> <p>(a) Why is it important to secure the patient with safety straps during sudden braking?</p> <p>(b) Which law of motion explains this situation? State the law.</p> <p>(c) Suggest one more safety device used in vehicles that works on the same principle.</p> | 5     |
| 20           | <p>A supermarket employee uses a motorized cart to transport goods. Initially, the cart carries only a few boxes.</p>                                                                                                                                                                                                                                                                                                                                    | 5     |

|  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |
|--|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
|  | <p>Later, many more boxes are loaded onto the cart. In both cases, the motor provides the same driving force.</p> <p>Answer the following questions:</p> <p><b>(a)</b> In which situation will the cart have greater acceleration? Give a reason.</p> <p><b>(b)</b> If the total mass of the loaded cart is <b>80 kg</b> and the driving force is <b>160 N</b>, calculate its acceleration.</p> <p><b>(c)</b> Why can all the boxes and the cart be treated as a single system while calculating the acceleration?</p> |  |
|--|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|

### Section E – Case-Based Questions

| Question No. | Question                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Marks |
|--------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 21           | <p><b>Airport Baggage Conveyor System</b></p> <p>An airport uses a conveyor belt to transport passengers' luggage. A worker places two suitcases on the moving conveyor belt. One suitcase has a mass of 15 kg, while the other has a mass of 30 kg. Both suitcases are pushed with the same force to move them onto the belt. The worker notices that the lighter suitcase speeds up more quickly. Once both suitcases are placed on the moving conveyor belt, they move together with the belt at the same speed.</p> <p>Answer the following questions.</p> <p>(a) Which suitcase experiences greater acceleration when pushed with the same force?</p> <p>(b) State the law of motion that explains your answer.</p> <p>(c) Why does the lighter suitcase accelerate more than the heavier suitcase?</p> <p>(d) After both suitcases start moving together on the conveyor belt, can they be considered as a single system? Give a reason.</p> | 4     |
| 22           | <p><b>Firefighter Using a Water Hose</b></p> <p>A firefighter directs a powerful stream of water towards a burning building. As the water rushes out of the hose at high speed, the firefighter feels the hose being pushed backward. The firefighter holds the hose firmly to control its motion.</p> <p>Answer the following questions.</p> <p>(a) Why does the hose move backward when water is sprayed forward?</p> <p>(b) Name the law of motion illustrated in this situation.</p> <p>(c) Identify the action force and the reaction force in this activity.</p>                                                                                                                                                                                                                                                                                                                                                                             | 4     |

|  |                                                                                                             |  |
|--|-------------------------------------------------------------------------------------------------------------|--|
|  | (d) What is likely to happen if the firefighter does not hold the hose firmly?<br>Give a scientific reason. |  |
|--|-------------------------------------------------------------------------------------------------------------|--|

## MARKING SCHEME

| Q. NO. | ANSWERS                                                                                                                                                                                                                                                                                                                             | MARKS |
|--------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 1.     | B                                                                                                                                                                                                                                                                                                                                   | 1     |
| 2.     | C                                                                                                                                                                                                                                                                                                                                   | 1     |
| 3.     | B                                                                                                                                                                                                                                                                                                                                   | 1     |
| 4.     | C                                                                                                                                                                                                                                                                                                                                   | 1     |
| 5.     | B                                                                                                                                                                                                                                                                                                                                   | 1     |
| 6.     | B                                                                                                                                                                                                                                                                                                                                   | 1     |
| 7.     | A                                                                                                                                                                                                                                                                                                                                   | 1     |
| 8.     | B                                                                                                                                                                                                                                                                                                                                   | 1     |
| 9.     | A                                                                                                                                                                                                                                                                                                                                   | 1     |
| 10.    | D                                                                                                                                                                                                                                                                                                                                   | 1     |
| 11.    | <p><b>(a)</b> The empty trolley will accelerate more.</p> <p><b>(b)</b> According to Newton's Second Law of Motion, acceleration is directly proportional to the applied force and inversely proportional to the mass (<math>a = F/ma = F/ma = F/m</math>). Since the empty trolley has less mass, it has greater acceleration.</p> | 2     |
| 12.    | <p><b>(a)</b> The bicycle accelerates because an unbalanced force acts on it.</p> <p><b>(b)</b> According to Newton's Second Law, acceleration is directly proportional to the applied force (for a constant mass).</p>                                                                                                             | 2     |
| 13.    | <p><b>(a)</b> Moving the hands backward increases the time taken to stop the ball, thereby reducing the force acting on the hands.</p> <p><b>(b)</b> This is explained by Newton's Second Law of Motion.</p>                                                                                                                        | 2     |
| 14.    | <p><b>(a)</b> The rocket moves upward because the expelled gases push downward, and the gases exert an equal and opposite force on the rocket.</p> <p><b>(b)</b></p> <p><b>Action:</b> Rocket pushes hot gases downward.</p> <p><b>Reaction:</b> Hot gases push the rocket upward.</p>                                              | 2     |

|     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |   |
|-----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|
|     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |   |
| 15. | <p><b>(a)</b> The two coaches can be treated as a single system because they are connected and move together with the same acceleration. The external pulling force acts on the entire system.</p> <p><b>(b)</b> Total mass = 20,000 kg + 30,000 kg = 50,000 kg</p> $a = F/m = 50,000/50,000 = 1 \text{ m/s}^2$                                                                                                                                                                                                                                                                                                                                           | 3 |
| 16. | <p><b>(a)</b> Net force = 30 N + 20 N = 50 N</p> <p><b>(b)</b> <math>a = F/m = 50/25 = 2 \text{ m/s}^2</math></p> <p>Acceleration = 2 m/s<sup>2</sup></p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 | 3 |
| 17. | <p><b>(a)</b> When the paddler pushes the water backward with the paddle, the water exerts an equal and opposite force on the paddle and the boat, causing the boat to move forward.</p> <p><b>(b)</b> Newton's Third Law of Motion.</p> <p><b>(c)</b> The boat will continue moving forward for some time due to its inertia, but its speed will gradually decrease and eventually stop because of water resistance and air resistance acting opposite to its motion.</p>                                                                                                                                                                                | 3 |
| 18. | <p><b>(a)</b> Both spring balances show the same reading because the force transmitted through the connection is the same throughout. Each balance measures the magnitude of the pulling force.</p> <p><b>(b)</b> This activity demonstrates Newton's Third Law of Motion: for every action, there is an equal and opposite reaction. The forces are equal in magnitude, opposite in direction, and act on different objects.</p> <p><b>(c)</b> Each spring balance will read 15 N, provided both students pull steadily with a force of 15 N. The action and reaction forces are always equal in magnitude, so both balances measure the same force.</p> | 3 |
| 19. | <p><b>(a)</b> During sudden braking, the patient's body tends to continue moving forward due to inertia. The safety straps increase the time over which the body comes to rest, reducing the force acting on the patient and preventing serious injury.</p> <p><b>(b)</b> Newton's Second Law of Motion: The rate of change of momentum of an object is directly proportional to the applied net force and occurs in the direction of the force. Increasing the stopping time reduces the force experienced.</p>                                                                                                                                          | 5 |

|     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |   |
|-----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|
|     | (c) Airbags (or seat belts) work on the same principle by increasing the stopping time and reducing the impact force.                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |   |
| 20. | <p>(a) The cart carrying fewer boxes will have greater acceleration because, according to Newton's Second Law, for the same force, acceleration is inversely proportional to mass.</p> <p>(b)</p> $a = F/m = 160/80 = 2 \text{ m/s}^2$ <p>Acceleration = <math>2 \text{ m/s}^2</math></p> <p>(c) The cart and all the boxes move together with the same acceleration. Therefore, they can be treated as a single system, and only the external driving force is considered while internal forces between the boxes and the cart do not affect the acceleration of the whole system.</p> | 5 |
| 21. | <p>(a) The 15 kg suitcase.</p> <p>(b) Newton's Second Law of Motion.</p> <p>(c) For the same force, acceleration is inversely proportional to mass. Therefore, the lighter suitcase has greater acceleration.</p> <p>(d) Yes. Once both move together with the conveyor belt, they can be considered as a single system because they move with the same acceleration.</p>                                                                                                                                                                                                               | 4 |
| 22. | <p>(a) As water is pushed forward, it exerts an equal and opposite force on the hose, causing it to move backward.</p> <p>(b) Newton's Third Law of Motion.</p> <p>(c) <b>Action:</b> The hose pushes the water forward.</p> <ul style="list-style-type: none"> <li><b>Reaction:</b> The water pushes the hose backward with an equal and opposite force.</li> </ul> <p>(d) The hose will jerk or recoil backward because of the reaction force exerted by the fast-moving water. The firefighter must hold it firmly to balance and control this force.</p>                            | 4 |

## Chapter 7 : WORK,ENERGY AND SIMPLE MACHINES

### Topic: POWER AND SIMPLE MACHINES

| Prepared by  | Designation | School     | Region  |
|--------------|-------------|------------|---------|
| G GEETHARANI | TGT         | COIMBATORE | CHENNAI |

#### Section A -1 Mark questions

| QNo | Question                                                                                                                                                                                                                                                                                                                   | Marks |
|-----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 1   | Two students lift identical school bags to the same height. Student A takes 10 s and Student B takes 20 s. Which statement is correct?<br><br>A. Student A does more work.<br>B. Student B does more work.<br>C. Both do the same work, but Student A develops more power.<br>D. Both do the same work and the same power. | 1     |
| 2   | A motor lifts a 500 N load through a height of 4 m in 10 s. What is its power?<br><br>A. 100 W    B. 200 W    C. 400 W    D. 500 W                                                                                                                                                                                         | 1     |
| 3   | Ravi and Kiran climb the same staircase. Ravi reaches the top in 15 s, while Kiran takes 30 s. Which conclusion is correct?<br><br>A. Ravi does more work.                      B. Kiran does less work.<br>C. Ravi develops greater power. D. Both develop equal power.                                                   | 1     |
| 4   | A machine completes the same amount of work in half the time compared to another machine. Its power is<br><br>A. Half as much                      B. Twice as much<br>C. Four times as much    D. Equal                                                                                                                   | 1     |
| 5   | Which situation shows greater power?<br><br>A. Lifting a box slowly to a shelf.<br>B. Lifting the same box to the same shelf quickly.<br>C. Holding the box without moving it.<br>D. Pushing the box without displacement.                                                                                                 | 1     |
| 6   | .A school installs a ramp at the entrance for wheelchair users.<br><br>Which simple machine does the ramp represent?<br><br>A. Lever                      B. Wheel and axle<br>C. Inclined plane    D. Pulley                                                                                                              | 1     |

|    |                                                                                                                                                                                                                                              |   |
|----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|
| 7  | Which of the following tools is NOT primarily designed to increase mechanical advantage?<br>A. Bottle opener      B. Nutcracker<br>C. Tweezers      D. Crowbar                                                                               | 1 |
| 8  | A student tested two levers.<br>Lever   Effort (N)   Load (N)<br>X      20      80<br>Y      30      60<br>Which lever provides greater mechanical advantage?<br>A. Lever X    B. Lever Y    C. Both are equal.    D. Cannot be determined.  | 1 |
| 9  | Workers have to move heavy cement bags into a truck.<br>Which option will require the least effort?<br>A. Lift the bags vertically.<br>B. Push the bags up a ramp.<br>C. Throw the bags into the truck.<br>D. Drag the bags on rough ground. | 1 |
| 10 | A farmer wants to lift water from a well using the least effort. Which arrangement would be most suitable?<br>A. Fixed pulley<br>B. Single movable pulley<br>C. Combination of fixed and movable pulleys<br>D. Inclined plane                | 1 |

#### Section B – 2 Mark Questions

| Question No. | Question                                                                                                                                                                | Marks |
|--------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 11           | A labourer and a crane lift the same load to the same height. The crane completes the task in much less time.<br>a) Which one develops more power?<br>b) Give a reason. | 2     |
| 12           | A worker uses a ramp instead of lifting a heavy box directly onto a truck.                                                                                              | 2     |

|    |                                                                                                                                                          |   |
|----|----------------------------------------------------------------------------------------------------------------------------------------------------------|---|
|    | a) Name the simple machine used.<br>b) State one advantage of using it.                                                                                  |   |
| 13 | A flag is hoisted using a rope passing over a pulley.<br>a) What is the function of the pulley?<br>b) Does it always reduce the effort? Explain briefly. | 2 |
| 14 | A child uses a bottle opener to remove a bottle cap.<br>a) Which simple machine is used?<br>b) How does it make the work easier?                         | 2 |

#### Section C – 3 Mark Questions

| Question No. | Question                                                                                                                                                                                                                                               | Marks |
|--------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 15           | A motor does 6000 J of work in 30 s.<br>Find:<br>1. The power of the motor.<br>2. If the same work is completed in 15 s, what will be the new power?                                                                                                   | 3     |
| 16           | A student carries a load by applying a force of 250 N through a vertical height of 4 m in 10 s.<br>Calculate:<br>1. The work done.<br>2. The power developed.                                                                                          | 3     |
| 17           | A pulley system lifts a load of 600 N by applying an effort of 200 N.<br>Calculate:<br>1. Mechanical Advantage (MA).<br>2. State whether the machine multiplies force.                                                                                 | 3     |
| 18           | A construction worker uses a long plank to push a heavy drum into a truck instead of lifting it directly.<br>a) Name the simple machine used.<br>b) How does it reduce the effort required?<br>c) State one disadvantage of using this simple machine. | 3     |

#### Section D – 5 Mark Questions

| Q No. | Question | Marks |
|-------|----------|-------|
|-------|----------|-------|

|    |                                                                                                                                                                                                                                                                                                                                                                                                                 |   |
|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|
| 19 | <p>Two machines, A and B, are used to lift the same 600 N load through a height of 5 m. Machine A takes 15 s, while Machine B takes 25 s.</p> <p>Answer the following:</p> <p>a) Calculate the work done by each machine. (2 Marks)</p> <p>b) Calculate the power of each machine. (2 Marks)</p> <p>c) Which machine would you recommend for a busy warehouse? Justify your answer. (1 Mark)</p>                | 5 |
| 20 | <p>A mechanic uses a lever to lift a heavy engine part. The load is 900 N, and the effort applied is 300 N. He then lifts the same engine part to a height of 2 m in 18 s.</p> <p>Answer the following:</p> <p>a) Calculate the mechanical advantage (MA) of the lever. (2 Marks)</p> <p>b) Calculate the work done in lifting the engine part. (2 Marks)</p> <p>c) Calculate the power developed. (1 Mark)</p> | 5 |

#### Section E – Case-Based Questions

| Qu No. | Question                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Marks |
|--------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 21     | <p>.Ravi wanted to remove a nail from a wooden board. He first tried using his hands but failed. Then he used the claw of a hammer and removed the nail easily. Later, he used a wheelbarrow to carry bricks in his garden.</p> <p>Answer the following:</p> <p>a) The claw of a hammer is an example of which simple machine? (1 Mark)</p> <p>b) Why was Ravi able to remove the nail easily using the hammer? (1 Mark)</p> <p>c) Which class of lever is a wheelbarrow? (1 Mark)</p> <p>d) Mention one everyday use of a lever other than those given above. (1 Mark)</p> | 4     |
| 22     | <p>Two students, Anil and Bala, were asked to carry the same load of 30 kg to the first floor of their school. Both did the same amount of work, but Anil reached the first floor in 2 minutes, while Bala took 4 minutes.</p> <p>Answer the following questions:</p>                                                                                                                                                                                                                                                                                                       | 4     |

a) Did both students do the same amount of work? Give a reason. (1 Mark)

b) Who developed more power? (1 Mark)

c) State the reason for your answer in (b). (1 Mark)

d) Write the SI unit of power. (1 Mark)

## Marking scheme

| R. No. | Answer                                                                                                                                                                                                                                                                                                                       | Marks |
|--------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 1      | <b>C. Both do the same work, but Student A develops more power.</b>                                                                                                                                                                                                                                                          | 1     |
| 2      | <b>B. 200 W</b>                                                                                                                                                                                                                                                                                                              | 1     |
| 3      | <b>C. Ravi develops greater power</b>                                                                                                                                                                                                                                                                                        | 1     |
| 4      | <b>B. Twice as much</b>                                                                                                                                                                                                                                                                                                      | 1     |
| 5      | <b>B. Lifting the same box to the same shelf quickly.</b>                                                                                                                                                                                                                                                                    | 1     |
| 6      | <b>C. Inclined plane</b>                                                                                                                                                                                                                                                                                                     | 1     |
| 7      | <b>C. Tweezers</b>                                                                                                                                                                                                                                                                                                           | 1     |
| 8      | <b>A. Lever X</b>                                                                                                                                                                                                                                                                                                            | 1     |
| 9      | <b>B. Push the bags up a ramp.</b>                                                                                                                                                                                                                                                                                           | 1     |
| 10     | <b>C. Combination of fixed and movable pulleys</b>                                                                                                                                                                                                                                                                           | 1     |
| 11     | a) The <b>crane</b> develops more power.<br>b) Power is the rate of doing work. Since the crane does the same amount of work in less time, it develops more power.                                                                                                                                                           | 2     |
| 12     | a) Inclined plane (ramp).<br>b) It reduces the effort required to lift the box by increasing the distance over which the force is applied.                                                                                                                                                                                   | 2     |
| 13     | a) The pulley changes the direction of the applied force, making it easier to lift the flag.<br>b) <b>No.</b> A single fixed pulley only changes the direction of the force and does not reduce the effort. Only certain pulley systems (such as movable pulleys or block-and-tackle arrangements) reduce the effort needed. | 2     |
| 14     | a) Lever<br>b) It multiplies the applied force, so less effort is needed to remove the bottle cap.                                                                                                                                                                                                                           | 2     |
| 15     | a) $\text{Power} = 6000/30 = \mathbf{200\ W}$<br>b) $\text{New Power} = 6000/15 = \mathbf{400\ W}$                                                                                                                                                                                                                           | 3     |
| 16     | a) $\text{Work} = 250 \times 4 = \mathbf{1000\ J}$<br>b) $\text{Power} = 1000/10 = \mathbf{100\ W}$                                                                                                                                                                                                                          | 3     |

|    |                                                                                                                                                                                                                                                                                        |       |
|----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
|    |                                                                                                                                                                                                                                                                                        |       |
| 17 | a) $MA = \text{Load}/\text{Effort} = 600/200 = 3$<br>b) Yes, the machine acts as a <b>force multiplier</b> .                                                                                                                                                                           | 3     |
| 18 | a) Inclined plane (ramp).<br>b) It reduces the effort by increasing the distance over which the force is applied.<br>c) It requires moving the object over a longer distance.                                                                                                          | 3     |
| 19 | a) Work done = $600 \times 5 = 3000 \text{ J}$ (both machines)<br>b) Power of A = $3000/15 = 200 \text{ W}$<br>Power of B = $3000/25 = 120 \text{ W}$<br>C) Recommend <b>Machine A</b> because it performs the same work in less time and has greater power.                           | 2+2+1 |
| 20 | a) $MA = \text{Load} \div \text{Effort} = 900 \div 300 = 3$<br>b) Work done = $900 \times 2 = 1800 \text{ J}$<br>c) Power = $1800 \div 18 = 100 \text{ W}$                                                                                                                             | 2+2+1 |
| 21 | a) <b>Lever</b><br>b) It provides mechanical advantage, reducing the effort needed to pull out the nail.<br>c) <b>Second-class lever</b><br>d) Any one: <ul style="list-style-type: none"> <li>• Bottle opener</li> <li>• Nutcracker</li> <li>• Scissors</li> <li>• Crowbar</li> </ul> | 4     |
| 22 | a) Yes. Both did the same amount of work because they lifted the same load to the same height.<br>b) <b>Anil</b> developed more power.                                                                                                                                                 | 4     |

|  |                                                                                                                   |  |
|--|-------------------------------------------------------------------------------------------------------------------|--|
|  | <p>c) Power is the rate of doing work. Since Anil completed the same work in less time, his power is greater.</p> |  |
|--|-------------------------------------------------------------------------------------------------------------------|--|

|  |                           |  |
|--|---------------------------|--|
|  | <p>d) <b>Watt (W)</b></p> |  |
|--|---------------------------|--|

## Chapter 8: JOURNEY INSIDE THE ATOM

### Topic: Rutherfords experiment

| Prepared by  | Designation | School                      | Region    |
|--------------|-------------|-----------------------------|-----------|
| C V PRASANNA | TGT SCIENCE | PM SHRI KV<br>KELTRON NAGAR | ERNAKULAM |

#### Section A -1 Mark questions

| QNo | Question                                                                                                                                                                                                                             | Marks |
|-----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 1   | <b>1. Which sub-atomic particle was discovered as a result of Rutherford's scattering experiment?</b><br>(a) Electron<br>(b) Proton<br>(c) Nucleus<br>(d) Neutron                                                                    | 1     |
| 2   | <b>2. Which material did Rutherford use as a thin foil in his alpha particle scattering experiment?</b><br>(a) Silver<br>(b) Gold<br>(c) Platinum<br>(d) Copper                                                                      | 1     |
| 3   | <b>What are alpha alpha particles made of?</b><br>(a) Fast-moving electrons<br>(b) Doubly-charged helium ions<br>(c) Hydrogen nuclei<br>(d) Neutral neutrons                                                                         | 1     |
| 4   | <b>What was the thickness of the gold foil used in Rutherford's experiment?</b><br>(a) Approximately 1000 atoms thick<br>(b) Approximately 100 atoms thick<br>(c) Approximately 10,000 atoms thick<br>(d) Approximately 1 atom thick | 1     |
| 5   | <b>Which of the following observations was NOT made by Rutherford during his experiment?</b><br>(a) Most alpha particles passed straight through the foil                                                                            | 1     |

|    |                                                                                                                                                                                                                                                                                                                                                         |   |
|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|
|    | (b) Some alpha particles were deflected by small angles<br>(c) A very small fraction of alpha particles rebounded<br>(d) All alpha particles were deflected at an angle of 90 degrees.                                                                                                                                                                  |   |
| 6  | <b>Based on the observation that most alpha particles passed straight through the gold foil, Rutherford concluded that:</b><br>(a) The atom is completely solid.<br>(b) Most of the space inside an atom is empty.<br>(c) The nucleus is positively charged.<br>(d) Alpha particles are heavier than gold atoms.                                        | 1 |
| 7  | <b>Why was a very small fraction of alpha particles deflected by 180 degrees(rebounding)?</b><br>(a) Due to the collision with fast-moving electrons.<br>(b) Because the entire mass and positive charge of the atom are concentrated in a very small volume.<br>(c) Because the gold foil was too thick.<br>(d) Because atoms contain neutral neutrons | 1 |
| 8  | <b>According to Rutherford's atomic model, what type of path do electrons follow around the nucleus?</b><br>(a) Straight line paths<br>(b) Circular paths<br>(c) Random zig-zag paths<br>(d) Elliptical paths                                                                                                                                           | 1 |
| 9  | <b>9. What is a major drawback/limitation of Rutherford's atomic model?</b><br>(a) It failed to explain the presence of protons.<br>(b) It could not explain the neutrality of the atom.<br>(c) It could not explain the stability of the atom.<br>(d) It suggested that the atom is mostly empty space.                                                | 1 |
| 10 | <b>10. How does the size of the atomic nucleus compare to the total size of the atom?</b><br>(a) The nucleus is roughly equal in size to the atom.<br>(b) The nucleus is much smaller than the atom.<br>(c) The nucleus is much larger than the atom.<br>(d) The atom does not have a distinct nucleus size.                                            | 1 |

**Section B – 2 Mark Questions**

| <b>Question No.</b> | <b>Question</b>                                                                                        | <b>Marks</b> |
|---------------------|--------------------------------------------------------------------------------------------------------|--------------|
| 11                  | What were the observations made by Rutherford when alpha particles were bombarded on a thin gold foil? | 2            |
| 12                  | State two major limitations of Rutherford's nuclear model of the atom.                                 | 2            |
| 13                  | How did Neils Bohr overcome the limitation of Rutherford's atomic model?                               | 2            |
| 14                  | Write any two properties of cathode rays (or canal rays) as observed in early atomic experiments.      | 2            |

**Section C – 3 Mark Questions**

| <b>Question No.</b> | <b>Question</b>                                                                                                                                 | <b>Marks</b> |
|---------------------|-------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| 15                  | Describe Thomson's model of an atom. What were its two main postulates, and what was its major limitation?                                      | 3            |
| 16                  | Based on his alpha-particle scattering experiment, what three major conclusions did Rutherford draw about the structure of an atom?             | 3            |
| 17                  | State the three main postulates of Bohr's model of an atom. Draw a neat, labeled sketch of Bohr's model for an atom showing four energy shells. | 3            |
| 18                  | Differentiate between electrons, protons, and neutrons based on their relative charge, relative mass, and absolute location within an atom.     | 3            |

**Section D – 5 Mark Questions**

| <b>Question No.</b> | <b>Question</b>                                                                                                                                                                                                                                                                                                             | <b>Marks</b> |
|---------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| 19                  | <b>Describe Rutherford's alpha-particle scattering experiment in detail. Your answer should include:</b><br><b>(a) The experimental setup and why gold foil was selected.</b><br><b>(b) The observations recorded during the experiment.</b><br><b>(c) The nuclear model of the atom proposed based on this experiment.</b> | 5            |
| 20                  | <b>Compare and contrast the atomic models proposed by J.J. Thomson, Ernest Rutherford, and Niels Bohr. Explain how each model improved upon the previous one to address its limitations.</b>                                                                                                                                | 5            |

**Section E – Case-Based Questions**

| <b>Question No.</b> | <b>Question</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | <b>Marks</b> |
|---------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| 21                  | <p><b>Read the passage given below and answer the following questions:</b></p> <p>In 1911, Ernest Rutherford and his co-workers performed a groundbreaking experiment to understand the structure of an atom. They selected a thin gold foil because they wanted a layer that was as thin as possible. Fast-moving alpha particles (alpha particles), which are doubly-charged helium ions <math>\text{He}^{2+}</math> carrying two units of positive charge and four units of mass, were directed at this foil. The results of the experiment completely contradicted the popular plum-pudding model proposed by J.J. Thomson, leading to the discovery of the atomic nucleus.</p> <p><b>1. Why did Rutherford choose a gold foil specifically for his experiment?</b></p> <p>(a) Gold is a highly reactive metal.<br/>(b) Gold is extremely malleable and can be beaten into an ultra-thin layer.<br/>(c) Gold absorbs all alpha particles.<br/>(d) Gold contains only neutrons in its nucleus.</p> | 4            |

|    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |   |
|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|
|    | <p><b>2. What is the nature and composition of the alpha -particles used in this setup?</b></p> <p>(a) They are negatively charged electrons with a mass of 1u<br/> (b) They are neutral particles with no charge.<br/> (c) They are doubly-charged helium ions <math>\text{He}^{2+}</math> with a mass of 4u<br/> (d) They are single-charged hydrogen ions <math>\text{H}^+</math> with a mass of 2u</p> <p><b>3. Which surprising observation led Rutherford to conclude that the positive charge and mass of the atom are concentrated in an incredibly small space?</b></p> <p>(a) Most alpha particles passed straight through without any deflection.<br/> (b) Some alpha particles were deflected by very small angles.<br/> (c) Approximately 1 out of 12,000 alpha particles completely rebounded by 180degrees.<br/> (d) All alpha particles were absorbed by the gold atoms.</p> <p><b>4. What major feature of the atom was discovered through this experiment?</b></p> <p>(a) The electron<br/> (b) The neutron<br/> (c) The nucleus<br/> (d) The circular orbit</p> |   |
| 22 | <p><b>Read the passage given below and answer the following questions:</b></p> <p>While Rutherford's nuclear model was a massive leap forward, it faced a severe structural challenge from classical laws of physics. According to electromagnetic theory, any charged particle accelerated along a curved path must continuously emit radiation and lose energy. Since a revolving electron experiences continuous centripetal acceleration, it should radiate energy, lose speed, and spiral inward until it collapses into the nucleus. To overcome this fatal flaw, Danish physicist Niels Bohr proposed a modified model in 1913, introducing the concept of quantised energy shells.</p> <p><b>1. What was the primary limitation of Rutherford's nuclear model highlighted in the passage?</b></p> <p>(a) It failed to explain the presence of electrons.<br/> (b) It could not account for the electrical neutrality of the atom.<br/> (c) It predicted that the atom would be completely unstable and</p>                                                                 | 4 |

collapse.

(d) It stated that protons are located outside the nucleus.

**2. How did Niels Bohr resolve the problem of energy loss for revolving electrons?**

(a) He claimed electrons move in a straight line instead of circular paths.

(b) He postulated that electrons revolve only in specific, non-radiating paths called discrete orbits.

(c) He suggested that the nucleus supplies continuous energy to the electrons.

(d) He stated that electrons stop moving when they get close to the nucleus.

**3. What are the discrete orbits or energy levels in Bohr's model designated as?**

(a) Orbits 0, 1, 2, 3... or shells A, B, C, D...

(b) Orbits 1, 2, 3, 4... or shells K, L, M, N...

(c) Orbits X, Y, Z... or shells alpha, beta, gamma...

(d) Orbits s, p, d, f... or shells 10, 20, 30...

**4. An electron moving within a particular discrete shell in Bohr's atom:**

(a) Continuously gains energy.

(b) Continuously radiates and loses energy.

(c) Maintains a constant, fixed amount of energy without radiating any.

(d) Alternates between positive and negative charges.

## Chapter 9 : Atomic Foundation of Matter

### Topic: Law of Conservation of Mass, Law of Constant Proportion

| Prepared by     | Designation | School                    | Region    |
|-----------------|-------------|---------------------------|-----------|
| Subhadra Sankar | TGT Science | P M SHRI KV<br>MALAPPURAM | ERNAKULAM |

#### Section A -1 Mark questions

| QNo | Question                                                                                                                                                                                                                                                                                                                                                            | Marks |
|-----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 1   | Riya dissolved 10 g of common salt in 100 mL of water. She measured the mass before and after dissolution and found both values to be the same. Which conclusion is most appropriate?<br><br>A. Salt loses mass after dissolving.<br>B. A physical change does not change the total mass.<br>C. Water gains mass from air.<br>D. Salt changes into a new substance. | 1     |
| 2   | During an experiment, baking soda reacted with vinegar in an open flask. The final mass was less than the initial mass because<br><br>A. matter was destroyed.<br>B. carbon dioxide escaped into the atmosphere.<br>C. vinegar evaporated completely.<br>D. baking soda disappeared.                                                                                | 1     |
| 3   | Which experimental setup best verifies the Law of Conservation of Mass during the reaction between vinegar and baking soda?<br><br>A. Open beaker<br>B. Closed flask with balloon attached<br>C. Heating the mixture in an open vessel<br>D. Mixing chemicals separately                                                                                            | 1     |
| 4   | A student purified water collected from a river, a lake and rainwater. The ratio of hydrogen to oxygen by mass was found to be the same in every sample. This observation supports<br><br>A. Dalton's Atomic Theory<br>B. Law of Conservation of Mass                                                                                                               | 1     |

|    |                                                                                                                                                                                                                                                                        |   |
|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|
|    | C. Law of Constant Proportions<br>D. Law of Multiple Proportions                                                                                                                                                                                                       |   |
| 5  | Zinc reacts with dilute hydrochloric acid inside a closed container. Which statement is correct?<br><br>A. Total mass decreases.<br>B. Total mass increases.<br>C. Total mass remains constant.<br>D. Mass cannot be measured.                                         | 1 |
| 6  | A student mixed sodium sulfate and barium chloride solutions. A white precipitate formed, but the balance reading remained unchanged. Which law is verified?<br><br>A. Law of Constant Proportions<br>B. Law of Conservation of Mass<br>C. Boyle's Law<br>D. Ohm's Law | 1 |
| 7  | According to Dalton's Atomic Theory, compounds are formed because atoms<br><br>A. disappear during reactions.<br>B. combine in simple whole-number ratios.<br>C. change into energy.<br>D. are destroyed during chemical reactions.                                    | 1 |
| 8  | A compound always contains 25% element X and 75% element Y by mass, irrespective of its source. Which scientific law explains this?<br><br>A. Law of Conservation of Mass<br>B. Law of Constant Proportions<br>C. Newton's Third Law<br>D. Avogadro's Law              | 1 |
| 9  | A closed container has reactants weighing 56 g. After the reaction is complete, what should be the total mass of products?<br><br>A. 54 g<br>B. 56 g<br>C. 58 g<br>D. Depends on the colour of products                                                                | 1 |
| 10 | Which statement correctly explains why the balloon inflates during the vinegar–baking soda experiment?                                                                                                                                                                 | 1 |

|  |                                                                                                                                                        |  |
|--|--------------------------------------------------------------------------------------------------------------------------------------------------------|--|
|  | <p>A. Oxygen is produced.</p> <p>B. Carbon dioxide gas is produced.</p> <p>C. Hydrogen is produced.</p> <p>D. Air enters the balloon from outside.</p> |  |
|--|--------------------------------------------------------------------------------------------------------------------------------------------------------|--|

### Section B – 2 Mark Questions

| Q No. | Question                                                                                                                                                                                       | Marks |
|-------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 11    | A student tears a sheet of paper into small pieces and weighs all the pieces together. Will the total mass differ from the mass of the original, uncut sheet? Justify your answer using a law. | 2     |
| 12    | State two postulates of Dalton's Atomic Theory that together explain why the Law of Conservation of Mass holds true during a chemical reaction.                                                | 2     |
| 13    | Water from a river, borewell and glacier was purified and analysed. Explain why each sample showed the same mass ratio of hydrogen and oxygen. Name the law involved.                          | 2     |
| 14    | 2.4 g of carbon reacts completely with oxygen to form 8.8 g of carbon dioxide. Calculate the mass of oxygen that combined with the carbon in this reaction.                                    | 2     |

### Section C – 3 Mark Questions

| Question No. | Question                                                                                                                                                                                                                                                                                                                    | Marks |
|--------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 15           | Cinnabar, when heated, always yields mercury and sulfur in a mass percentage of about 86.22% and 13.78% respectively. It was also found that grinding mercury and sulfur together in this same ratio could form cinnabar. Which law of chemical combination does this best illustrate, and how does the example support it? | 3     |
| 16           | <p>In a closed container, 5 g of magnesium reacts completely with 3.3 g of oxygen.</p> <p>(i) Calculate the total mass of magnesium oxide formed.</p> <p>(ii) State the law verified.</p> <p>(iii) Explain your answer.</p>                                                                                                 | 3     |
| 17           | Design an experiment (different from the vinegar–baking soda setup) to verify the Law of Conservation of Mass using zinc and dilute hydrochloric acid. Mention the apparatus, observations and conclusion.                                                                                                                  | 3     |

|                                     |                                                                                                                                                                                                                                                                                                                                                                                                                  |              |
|-------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| 18                                  | A compound contains carbon and oxygen in the mass ratio 3 : 8. Calculate the mass of oxygen required to react completely with 9 g of carbon. Show all steps.                                                                                                                                                                                                                                                     | 3            |
| <b>Section D – 5 Mark Questions</b> |                                                                                                                                                                                                                                                                                                                                                                                                                  |              |
| <b>QNo.</b>                         | <b>Question</b>                                                                                                                                                                                                                                                                                                                                                                                                  | <b>Marks</b> |
| 19                                  | <p>A student wants to verify the Law of Conservation of Mass using the reaction between vinegar and baking soda.</p> <p>(a) Explain why the mass decreases when the experiment is performed in an open flask. (2)</p> <p>(b) Describe how the experiment can be modified to prove that mass is actually conserved. (2)</p> <p>(c) State the scientific conclusion obtained from the modified experiment. (1)</p> | 5            |
| 20                                  | <p>(a) A student burns 10 g of ethanol completely in an open beaker and finds that no residue is left in the beaker afterwards. Does this mean the Law of Conservation of Mass has been violated? Explain your reasoning. (3)</p> <p>(b) When 20 g of hydrogen reacts completely with 160 g of oxygen, calculate the mass of water formed, according to the Law of Conservation of Mass. (2)</p>                 | 5            |

|                                         |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |              |
|-----------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|
| <b>Section E – Case-Based Questions</b> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |              |
| <b>Question No.</b>                     | <b>Question</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | <b>Marks</b> |
| 21                                      | <p>While performing an experiment, students took vinegar in a conical flask and baking soda in a balloon. The balloon was fixed tightly to the mouth of the flask. When the baking soda was allowed to fall into the vinegar, brisk effervescence was observed and the balloon inflated. The balance reading before and after the reaction remained the same. The students concluded that although a gas was produced, the total mass of the system did not change because the gas remained inside the closed system.</p> <p>Answer the following questions:</p> <p>(i) Which gas caused the balloon to inflate? (1)</p> <p>A. Oxygen</p> <p>B. Hydrogen</p> <p>C. Carbon dioxide</p> <p>D. Nitrogen</p> <p>(ii) Why did the balance reading remain unchanged? (1)</p> | 4            |

|    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |   |
|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|
|    | <p>(iii) What would happen if the same experiment were performed without attaching the balloon?(1)</p> <p>(iv) Suggest one reason why the balloon should be tightly fixed before the reaction starts.(1)</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |   |
| 22 | <p>A chemist analysed samples of pure water collected from different places including a river, glacier and borewell. In every sample, hydrogen and oxygen were present in the mass ratio 1 : 8. Later, the chemist studied Dalton's Atomic Theory and realised that compounds always contain atoms in fixed ratios.</p> <p>Answer the following questions.</p> <p>(i) Which law explains the fixed mass ratio observed? (1)</p> <p>A. Law of Conservation of Mass</p> <p>B. Law of Constant Proportions</p> <p>C. Boyle's Law</p> <p>D. Newton's Law</p> <p>(ii) If 18 g of water is decomposed, what mass of oxygen is obtained?(1)</p> <p>(iii) Why does water collected from different sources have the same composition after purification?(1)</p> <p>(v) State one practical importance of the Law of Constant Proportions in chemistry.(1)</p> | 4 |

## Chapter 10 : SOUND WAVES CHARACTERISTICS AND APPLICATION

### Topic: CHARACTERISTICS OF SOUND WAVES

| Prepared by   | Designation | School                       | Region    |
|---------------|-------------|------------------------------|-----------|
| ATHIRA S NAIR | TGT SCIENCE | PM SHRI KV<br>PATTOM SHIFT 2 | ERNAKULAM |

#### Section A -1 Mark questions

| QNo   | Question                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Marks |                |   |     |   |     |   |
|-------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|----------------|---|-----|---|-----|---|
| 1     | <p>A student uses the <b>Phyphox</b> app to record the frequency of two sounds.</p> <table><thead><tr><th>Sound</th><th>Frequency (Hz)</th></tr></thead><tbody><tr><td>A</td><td>250</td></tr><tr><td>B</td><td>500</td></tr></tbody></table> <p>Which statement is correct?</p> <p>A. Sound A has a higher pitch.<br/>B. Sound B has a higher pitch.<br/>C. Both sounds have the same pitch.<br/>D. Pitch depends only on loudness</p>                                                                                                                                                                                                                                                                                                      | Sound | Frequency (Hz) | A | 250 | B | 500 | 1 |
| Sound | Frequency (Hz)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |       |                |   |     |   |     |   |
| A     | 250                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |       |                |   |     |   |     |   |
| B     | 500                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |       |                |   |     |   |     |   |
| 2     | <p>During a science activity, two groups generated sound waves using a mobile app. They recorded the following observations</p> <table><thead><tr><th>Wave</th><th>Wavelength</th></tr></thead><tbody><tr><td>P</td><td>2 m</td></tr><tr><td>Q</td><td>4 m</td></tr></tbody></table> <p>While discussing their results, one student asked, "What exactly does the wavelength of 4 m represent?"</p> <p>Choose the most appropriate answer.</p> <p>A. The distance between two consecutive compressions only<br/>B. The distance between two consecutive rarefactions only<br/>C. The distance between two consecutive compressions or two consecutive rarefactions<br/>D. The distance between a compression and the nearest rarefaction</p> | Wave  | Wavelength     | P | 2 m | Q | 4 m | 1 |
| Wave  | Wavelength                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |       |                |   |     |   |     |   |
| P     | 2 m                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |       |                |   |     |   |     |   |
| Q     | 4 m                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |       |                |   |     |   |     |   |

|       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |       |                |   |     |   |     |   |      |   |
|-------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|----------------|---|-----|---|-----|---|------|---|
|       |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |       |                |   |     |   |     |   |      |   |
| 3     | <p>During a classroom activity, students used a <b>Slinky spring</b> to model a sound wave. One group measured the distance between two successive compressions and found it to be <b>1.5 m</b>.</p> <p>What does this measurement represent?1</p> <p>A. Amplitude of the sound wave</p> <p>B. Time period of the sound wave</p> <p>C. Wavelength of the sound wave</p> <p>D. Frequency of the sound wave</p>                                                                                                                       | 1     |                |   |     |   |     |   |      |   |
| 4     | <p>The student concludes that Sound R will have the highest pitch.</p> <table><tr><td>Sound</td><td>Frequency (Hz)</td></tr><tr><td>P</td><td>250</td></tr><tr><td>Q</td><td>500</td></tr><tr><td>R</td><td>1000</td></tr></table> <p>Which statement best supports this conclusion?</p> <p>A. Frequency determines the loudness of a sound.</p> <p>B. A higher frequency produces a higher pitch.</p> <p>C. Frequency determines the speed of sound in a medium.</p> <p>D. A higher frequency always means a greater amplitude</p> | Sound | Frequency (Hz) | P | 250 | Q | 500 | R | 1000 | 1 |
| Sound | Frequency (Hz)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |       |                |   |     |   |     |   |      |   |
| P     | 250                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |       |                |   |     |   |     |   |      |   |
| Q     | 500                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |       |                |   |     |   |     |   |      |   |
| R     | 1000                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |       |                |   |     |   |     |   |      |   |
| 5     | <p>An ultrasound machine used in hospitals emits sound waves of very high frequency to create images of internal organs. One such sound wave has a frequency of <b>2 MHz (<math>2 \times 10^6</math> Hz)</b>.</p> <p>The time period of this sound wave is:</p> <div><p><b>A. <math>5 \times 10^{-7}</math> s</b></p><p><b>B. <math>2 \times 10^6</math> s</b></p><p><b>C. <math>2 \times 10^{-6}</math> s</b></p><p><b>D. <math>5 \times 10^6</math> s</b></p></div>                                                               | 1     |                |   |     |   |     |   |      |   |
| 6     | Communication Technology                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 1     |                |   |     |   |     |   |      |   |

|    |                                                                                                                                                                                                                                                                                                                                                                                                      |   |
|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|
|    | <p>A wireless communication system uses two sound signals with frequencies of 500 Hz and 1000 Hz.</p> <p>Which statement is correct?</p> <p>A. The 500 Hz signal has the smaller time period.</p> <p>B. Both signals have the same time period.</p> <p>C. The 1000 Hz signal has the smaller time period.</p> <p>D. Time period is independent of frequency</p>                                      |   |
| 7  | <p>Wildlife Application</p> <p>Bats use ultrasonic sound waves to locate insects while flying at night. A bat emits sound waves with a frequency of 50,000 Hz.</p> <p>Compared to a sound wave of frequency 25,000 Hz, the ultrasonic wave has:</p> <p>A. A greater time period</p> <p>B. The same time period</p> <p>C. Half the time period</p> <p>D. Double the time period</p>                   | 1 |
| 8  | <p>An ambulance moves towards a traffic signal while sounding its siren. Rahul notices that the sound becomes shriller as it approaches.</p> <p>Which property of the sound reaching Rahul has increased?</p> <p>A. Amplitude only</p> <p>B. Frequency only</p> <p>C. Time period only</p> <p>D. Speed of sound</p>                                                                                  | 1 |
| 9  | <p>During a cricket match, two spectators are sitting at different distances from the loudspeaker. Both hear the same announcement.</p> <p>Which statement is correct?</p> <p>A. Both hear different frequencies.</p> <p>B. Both hear different wavelengths in air.</p> <p>C. Both hear the same frequency and wavelength but different loudness.</p> <p>D. Both hear different speeds of sound.</p> | 1 |
| 10 | <p>A factory manager wants workers to hear an emergency alarm from a long distance. He increases only the loudness of the alarm.</p>                                                                                                                                                                                                                                                                 | 1 |

|  |                                                                                                        |  |
|--|--------------------------------------------------------------------------------------------------------|--|
|  | Which property of the wave changes?<br>A. Frequency<br>B. Time period<br>C. Amplitude<br>D. Wavelength |  |
|  |                                                                                                        |  |

### Section B – 2 Mark Questions

| Question No. | Question                                                                                                                                                                                                                                                          | Marks |
|--------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 11           | During a school assembly, the teacher asks the operator to increase the volume of the loudspeaker without changing the pitch.<br>(a) Which characteristic of the sound wave should be increased? (1 mark)<br>(b) Which characteristic remains unchanged? (1 mark) | 2     |
| 12           | A guitarist tightens one string before playing.<br>(a) How does the frequency change?<br>(b) What happens to the pitch?                                                                                                                                           | 2     |
| 13           | A sound wave travels from air into water.<br>(a) Which characteristic remains unchanged?<br>(b) Which characteristic changes?                                                                                                                                     | 2     |
| 14           | The school bell produces a sound of frequency 500 Hz. The speed of sound in air is 340 m/s.<br>Calculate the wavelength of the sound.                                                                                                                             | 2     |

### Section C – 3 Mark Questions

| Question No. | Question                                                                                                                                                                                                                                                                                                                                                                                    | Marks |
|--------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 15           | <p>A factory manager wants workers to notice an emergency immediately. He increases only the loudness of the siren without changing its pitch.</p> <p>a) Which characteristic of the sound wave has been increased? (1)</p> <p>b) Which characteristic determines the pitch of sound? (1)</p> <p>c) Why is increasing loudness more useful than increasing pitch in this situation? (1)</p> | 3     |
| 16           | <p>Two Tuning Forks (3 Marks)</p> <p>Two tuning forks A and B have frequencies of 256 Hz and 512 Hz, respectively.</p> <p>a) Which tuning fork produces a higher-pitched sound? (1)</p> <p>b) Which tuning fork has the shorter time period? Give a reason. (1)</p> <p>c) If both are struck with the same force, which property of the waves is likely to be the same? (1)</p>             | 3     |
| 17           | <p>A judge says Singer X has a louder voice, while Singer Y has a higher-pitched voice.</p> <p>a) Which characteristic determines loudness? (1)</p> <p>b) Which characteristic determines pitch? (1)</p> <p>c) Can a sound be loud but low-pitched? Explain. (1)</p>                                                                                                                        | 3     |
| 18           | <p>An engineer wants people sitting at the back of a concert hall to hear the music clearly.</p> <p>a) Which wave property should be increased? (1)</p> <p>b) Should the frequency also be increased? Why or why not? (1)</p> <p>c) What would happen if only frequency were increased? (1)</p>                                                                                             | 3     |

### Section D – 5 Mark Questions

| Question No. | Question                                                                                                              | Marks |
|--------------|-----------------------------------------------------------------------------------------------------------------------|-------|
| 19           | <p>A student says: "If I increase the volume of my Bluetooth speaker, the frequency of the sound also increases."</p> | 5     |

|    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |   |
|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|
|    | <p>Answer the following:</p> <p>a) Do you agree with the statement? (1)</p> <p>b) Justify your answer scientifically. (1)</p> <p>c) Which wave characteristic changes when the volume is increased? (1)</p> <p>d) Which characteristic determines pitch? (1)</p> <p>e) Give one everyday example where loudness changes but pitch remains the same. (1)</p>                                                                                                                                                                                         |   |
| 20 | <p>A student strikes three tuning forks having frequencies 256 Hz, 512 Hz and 1024 Hz.</p> <p>Answer the following:</p> <p>a) Arrange the tuning forks in increasing order of pitch. (1)</p> <p>b) Which tuning fork has the shortest time period? Give a reason. (1)</p> <p>c) Which tuning fork has the longest wavelength in air? (1)</p> <p>d) If all three are struck with equal force, which wave property is likely to be the same? (1)</p> <p>e) Explain why the speed of sound remains the same for all three tuning forks in air. (1)</p> | 5 |

#### Section E – Case-Based Questions

| Question No. | Question                                                                                                                                                                                                                                                                                                                                                          | Marks |
|--------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 21           | <p><b>Mosquito Buzz</b> (4 Marks)</p> <p>While studying, Aryan hears the buzzing of a mosquito. His father says that the buzzing has a higher pitch than the sound of a ceiling fan.</p> <p>Answer the following:</p> <p>a) Which sound has the higher frequency? (1)</p> <p>b) Which sound has the longer wavelength? (1)</p> <p>c) Explain your answer. (2)</p> | 4     |
| 22           | <p>A city hospital purchased two new ambulances. During testing, engineers observed the following:</p>                                                                                                                                                                                                                                                            | 4     |

Ambulance X produces a high-pitched siren.

Ambulance Y produces a low-pitched but louder siren.

Doctors suggested that the siren should be heard clearly by drivers even in heavy traffic. The engineers explained that one property of the sound determines its pitch, while another determines its loudness.

Answer the following:

- a) Which characteristic determines the pitch of the siren? (1)
- b) Which characteristic determines the loudness of the siren? (1)
- c) Which ambulance siren has the greater frequency? (1)
- d) Why is increasing the amplitude more useful than increasing the frequency in traffic? (1)

### Marking scheme

| QNo. | Answer                                                                                                                                                                                    | Marks |
|------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 1    | B. Sound B has a higher pitch                                                                                                                                                             | 1     |
| 2    | C. The distance between two consecutive compressions or two consecutive rarefactions                                                                                                      | 1     |
| 3    | C. Wavelength of the sound wave                                                                                                                                                           | 1     |
| 4    | B. A higher frequency produces a higher pitch.                                                                                                                                            | 1     |
| 5    | A                                                                                                                                                                                         | 1     |
| 6    | C. The 1000 Hz signal has the smaller time period                                                                                                                                         | 1     |
| 7    | C. Half the time period                                                                                                                                                                   | 1     |
| 8    | B. Frequency only                                                                                                                                                                         | 1     |
| 9    | C. Both hear the same frequency and wavelength but different loudness.                                                                                                                    | 1     |
| 10   | C. Amplitude                                                                                                                                                                              | 1     |
| 11   | (a) Amplitude (b) Frequency                                                                                                                                                               | 2     |
| 12   | (a) Frequency increases. (b) Pitch becomes higher                                                                                                                                         | 2     |
| 13   | (a) Frequency (b) Wavelength (also speed changes)                                                                                                                                         | 2     |
| 14   | $\lambda = 340/500 = 0.68 \text{ m}$                                                                                                                                                      | 2     |
| 15   | a) Amplitude b) Frequency<br>c) Higher amplitude makes the sound easier to hear over long distances and background noise without changing its pitch.                                      | 3     |
| 16   | a) B<br>b) B, because time period is inversely proportional to frequency.<br>c) Amplitude (assuming equal force).                                                                         | 3     |
| 17   | a) Amplitude b) Frequency c) Yes. Loudness depends on amplitude, while pitch depends on frequency                                                                                         | 3     |
| 18   | a) Amplitude<br>b) No. Frequency changes pitch, not loudness.<br>c) The music would sound shriller but not necessarily louder.                                                            | 3     |
| 19   | a) No, the statement is incorrect. (1)<br>b) Increasing the volume changes only the amplitude of the sound wave; it does not change its frequency. (1)<br>c) The amplitude increases. (1) | 5     |

|    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |   |
|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|
|    | <p>d) Frequency determines the pitch. (1)</p> <p>e) Example:<br/>Increasing the volume while listening to the same song on a Bluetooth speaker or mobile phone. The song becomes louder, but its pitch remains the same. (1)</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |   |
| 20 | <p>a) <math>256 \text{ Hz} &lt; 512 \text{ Hz} &lt; 1024 \text{ Hz}</math></p> <p>Reason: Pitch is directly proportional to frequency. Higher the frequency, higher the pitch.</p> <p>b) The 1024 Hz tuning fork has the shortest time period.</p> <p>Reason: Time period is inversely proportional to frequency (<math>T=1/f</math>). Since 1024 Hz has the highest frequency, it has the smallest time period.</p> <p>c) The 256 Hz tuning fork has the longest wavelength.</p> <p>Reason: In the same medium, the speed of sound remains constant. Therefore, wavelength is inversely proportional to frequency. The lowest frequency corresponds to the longest wavelength.</p> <p>d) Amplitude is likely to be the same.</p> <p>Reason: Equal force produces vibrations of approximately the same amplitude, resulting in the same loudness.</p> <p>e) The speed of sound depends only on the properties of the medium (air), such as temperature and density, and not on the frequency of the sound. Therefore, all three sound waves travel through air at the same speed, even though their frequencies are different.</p> | 5 |
| 21 | <p>a) Mosquito buzz</p> <p>b) Ceiling fan</p> <p>c) The mosquito's buzzing has a higher frequency, so it has a higher pitch and a shorter wavelength. The fan produces a lower-frequency sound with a longer wavelength.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 4 |
| 22 | <p>a) Frequency</p> <p>b) Amplitude</p> <p>c) Ambulance X</p> <p>d) Increasing amplitude makes the siren louder, allowing it to be heard over traffic noise. Increasing frequency changes only the pitch</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | 4 |

## Marking scheme

| Q NO. | Answer                                                                                                                                                                                                                                                                                                                                        | Marks |
|-------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 1     | B — A physical change (dissolving) does not change the total mass.                                                                                                                                                                                                                                                                            | 1     |
| 2     | B — CO <sub>2</sub> gas escaped into the atmosphere in the open flask, so mass appeared to decrease (Law of Conservation of Mass is not violated; the gas wasn't accounted for).                                                                                                                                                              | 1     |
| 3     | B — Closed flask with balloon attached (traps the gas so no mass escapes).                                                                                                                                                                                                                                                                    | 1     |
| 4     | C — Law of Constant Proportions (same elements combine in the same mass ratio regardless of source).                                                                                                                                                                                                                                          | 1     |
| 5     | C — Total mass remains constant (closed container, no matter enters or leaves).                                                                                                                                                                                                                                                               | 1     |
| 6     | B — Law of Conservation of Mass.                                                                                                                                                                                                                                                                                                              | 1     |
| 7     | B — Atoms combine in simple whole-number ratios.                                                                                                                                                                                                                                                                                              | 1     |
| 8     | B — Law of Constant Proportions.                                                                                                                                                                                                                                                                                                              | 1     |
| 9     | B — 56 g (mass of products = mass of reactants in a closed system).                                                                                                                                                                                                                                                                           | 1     |
| 10    | B — Carbon dioxide gas is produced.                                                                                                                                                                                                                                                                                                           | 1     |
| 11    | No, the total mass will not differ. Tearing paper is only a physical change — no new substance is formed and no matter is added or removed, so by the Law of Conservation of Mass, mass remains the same.                                                                                                                                     | 2     |
| 12    | (i) Atoms are indivisible and cannot be created or destroyed in a chemical reaction.<br>(ii) Atoms of different elements combine in fixed, simple whole-number ratios to form compounds. Together these explain why the total mass of atoms before and after a reaction stays the same — only rearrangement occurs, not creation/destruction. | 2     |
| 13    | Water is a compound, and by the Law of Constant Proportions, the elements in a pure compound are always present in a fixed mass ratio, no matter the source. Hence all purified samples show the same ratio. Law involved: Law of Constant Proportions.                                                                                       | 2     |
| 14    | Mass of O <sub>2</sub> = Mass of CO <sub>2</sub> – Mass of C = 8.8 g – 2.4 g = 6.4 g                                                                                                                                                                                                                                                          | 2     |
| 15    | Law of Constant Proportions. Cinnabar always forms in the same fixed mass ratio of mercury to sulfur (86.22% : 13.78%), regardless of preparation. This supports the law.                                                                                                                                                                     | 3     |
| 16    | (i) Total mass of MgO = 5 g + 3.3 g = 8.3 g.<br>(ii) Law verified: Law of Conservation of Mass.                                                                                                                                                                                                                                               | 3     |

|    |                                                                                                                                                                                                                                                                                                                    |   |
|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|
|    | (iii) Since the container is closed, no matter enters or escapes, so total mass of reactants equals total mass of product.                                                                                                                                                                                         |   |
| 17 | Apparatus: Conical flask with dilute HCl and zinc granules in a small vial, sealed and weighed.<br>Procedure: Tip flask to mix Zn and acid inside the closed flask.<br>Observation: Hydrogen is evolved but remains trapped; balance reading is unchanged.<br>Conclusion: Law of Conservation of Mass is verified. | 3 |
| 18 | C:O = 3:8. For 9 g carbon, oxygen = $9 \times (8/3) = 24$ g.                                                                                                                                                                                                                                                       | 3 |
| 19 | (a) In an open flask CO <sub>2</sub> escapes, so measured mass decreases.<br>(b) Use a closed flask with a balloon so gas remains trapped.<br>(c) In a closed system total mass remains constant, verifying the Law of Conservation of Mass.                                                                       | 5 |
| 20 | (a) No. The law is not violated. Ethanol and oxygen form gaseous CO <sub>2</sub> and water vapour which disperse but total mass is conserved.<br>(b) Mass of water = 20 g + 160 g = 180 g.                                                                                                                         | 5 |
| 21 | (i) C — Carbon dioxide.<br>(ii) CO <sub>2</sub> remained trapped; no matter entered or left.<br>(iii) Without balloon CO <sub>2</sub> escapes and mass appears to decrease.<br>(iv) To prevent gas escaping.                                                                                                       | 4 |
| 22 | (i) B — Law of Constant Proportions.<br>(ii) Oxygen = 16 g.<br>(iii) Water has a fixed composition regardless of source.<br>(iv) Helps determine/verify the correct chemical formula of compounds.                                                                                                                 | 4 |

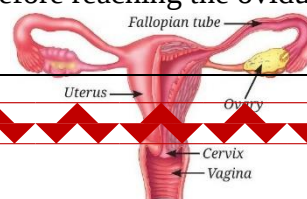
## Chapter 11 : REPRODUCTION: HOW LIFE CONTINUES

### Topic: SEXUAL REPRODUCTION IN HUMAN BEINGS, FERTILISATION

| Prepared by            | Designation | School                                         | Region    |
|------------------------|-------------|------------------------------------------------|-----------|
| VAIBHAV KUMAR<br>KELWA | TGT(SCI)    | PM SHRI KENDRIYA<br>VIDYALAYA NO2,<br>TIRUPATI | HYDERABAD |

#### Section A -1 Mark questions

| QNo | Question                                                                                                                                                                                                                                                                                                                                     | Marks |
|-----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 1   | Ravi is 14 years old. He notices that his voice is getting deeper and his shoulders are broadening. Which organ is responsible for producing the hormone causing these changes?<br><br>(a) Prostate gland<br>(b) Testes<br>(c) Seminal vesicle<br>(d) Vas deferens                                                                           | 1     |
| 2   | A doctor advises a man planning to start a family to avoid tight-fitting underwear and hot baths, as these can raise the temperature around the testes and reduce sperm count. Which structure's normal function is being disturbed by this rise in temperature?<br><br>(a) Vas deferens<br>(b) Urethra<br>(c) Scrotum<br>(d) Prostate gland | 1     |
| 3   | Sperm formed in the testes must travel through several structures before leaving the male body. Arrange the structures in the correct sequence of this journey:<br><br>(a) Testes → Urethra → Vas deferens<br>(b) Testes → Vas deferens → Urethra<br>(c) Scrotum → Urethra → Vas deferens<br>(d) Vas deferens → Testes → Urethra             | 1     |
| 4   | Study Fig. 11.19 (Female reproductive system) given below. Based on the diagram, which structure will the sperm pass through immediately before reaching the oviduct, where the egg is usually present?                                                                                                                                      | 1     |



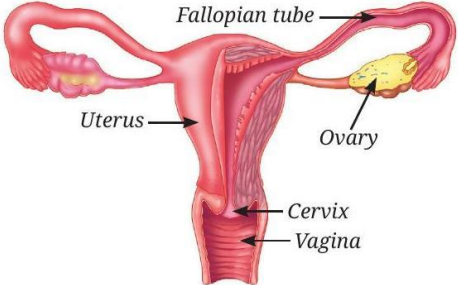
|   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |   |
|---|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|
|   | <p>(a) Ovary</p> <p>(b) Cervix and uterus</p> <p>(c) Fallopian tube directly</p> <p>(d) Scrotum</p>                                                                                                                                                                                                                                                                                                                                                                                                                                              |   |
| 5 | <p>A lab technician viewing two types of human cells under a microscope notes that one type is very small with a long tail and swims actively, while the other is much larger, non-motile, and contains stored nutrients. Which pair of cells is being compared here?</p> <p>(a) Skin cell and nerve cell</p> <p>(b) Sperm and egg</p> <p>(c) Egg and zygote</p> <p>(d) Sperm and zygote</p>                                                                                                                                                     | 1 |
| 6 | <p>A genetic counsellor explains to a couple that both sperm and egg cells carry only 23 chromosomes each, exactly half of what is found in normal body cells. Why is this reduction in chromosome number necessary before fertilisation can take place?</p> <p>(a) So that the sperm can move faster towards the egg</p> <p>(b) So that the zygote formed has the normal chromosome number and not double of it</p> <p>(c) So that the egg can survive longer inside the body</p> <p>(d) So that sperm and egg look identical to each other</p> | 1 |
| 7 | <p>A human sperm carrying 23 chromosomes fuses with a human egg carrying 23 chromosomes during fertilisation. What will be the chromosome number of the zygote that is formed?</p> <p>(a) 23</p> <p>(b) 46</p> <p>(c) 69</p> <p>(d) 92</p>                                                                                                                                                                                                                                                                                                       | 1 |
| 8 | <p>A woman trying to conceive is asked by her doctor to track the day on which her ovary releases a mature egg, since sperm can only fertilise the egg at a specific location soon after this release. In which structure will the released egg most likely be present when it can be fertilised?</p> <p>(a) Uterus</p> <p>(b) Vagina</p>                                                                                                                                                                                                        | 1 |

|    |                                                                                                                                                                                                                                                                                                                                                                                                                                                        |   |
|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|
|    | (c) Oviduct (fallopian tube)<br>(d) Cervix                                                                                                                                                                                                                                                                                                                                                                                                             |   |
| 9  | An ultrasound report describes a woman's uterine lining as "thick and richly supplied with blood vessels" around the middle of her menstrual cycle. What is the biological purpose of this change occurring at this particular time?<br><br>(a) To help release the egg from the ovary<br>(b) To prepare the uterus to receive and nourish a possible zygote<br>(c) To help in the production of sperm<br>(d) To regulate the woman's body temperature | 1 |
| 10 | A couple undergoes fertility counselling, during which the doctor explains that the sperm and egg normally fuse at a specific site inside the female body, well before the resulting embryo reaches the uterus. Identify this site of fertilisation.<br><br>(a) Uterus<br>(b) Oviduct (fallopian tube)<br>(c) Vagina<br>(d) Cervix                                                                                                                     | 1 |

#### Section B – 2 Mark Questions

| Question No. | Question                                                                                                                                                                                                                                                                   | Marks |
|--------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 11           | A student says, "Since the zygote is formed by combining a sperm and an egg, it must have more chromosomes than either of them, or even double the number found in a normal body cell." Is this statement correct? Justify your answer with reasoning.                     | 2     |
| 12           | A man is found to have a normal sperm count on testing, yet he is unable to father a child because his vas deferens is blocked on both sides. Explain, with reasoning, why this blockage causes infertility despite normal sperm production.                               | 2     |
| 13           | A woman who has undergone a surgical procedure to block both her fallopian tubes is unable to conceive naturally, even though her ovaries continue to release eggs normally. Using your understanding of fertilisation, explain why this procedure prevents pregnancy      | 2     |
| 14           | Fish release thousands of eggs at a time, while human ovaries release only one egg roughly every month. Yet, human sperm are produced in millions continuously. Give one reason why such a huge difference exists between the numbers of male and female gametes produced. | 2     |

### Section C – 3 Mark Questions

| Question No. | Question                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Marks |
|--------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 15           | <p>Study Fig. 11.19 (Female reproductive system) given below and answer the questions that follow.</p>  <p><i>Fig. 11.19: Female reproductive system</i></p> <p>(i) Identify the structure in the diagram where fertilisation of the egg normally takes place.</p> <p>(ii) Identify the structure where the fertilised egg (zygote) eventually implants and develops into a foetus.</p> <p>(iii) Based on the diagram, describe the pathway followed by the egg from the time it is released from the ovary to the point where it may be fertilised.</p> | 3     |
| 16           | <p>If, hypothetically, human sperm and eggs were formed by mitosis instead of meiosis, predict what would happen to the chromosome number of the zygote in the very first generation, and explain why this would be biologically problematic if it continued across generations.</p>                                                                                                                                                                                                                                                                                                                                                       | 3     |
| 17           | <p>Explain the process of gametogenesis in humans and describe its importance in keeping the chromosome number constant across generations.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | 3     |
| 18           | <p>Explain the sequence of events that occurs when a sperm meets an egg in the human body, and explain why the zygote must undergo repeated mitotic divisions while it is still travelling towards the uterus, rather than remaining a single cell.</p>                                                                                                                                                                                                                                                                                                                                                                                    | 3     |

### Section D – 5 Mark Questions

| Question No. | Question                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | Marks |
|--------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 19           | <p>Study Fig. 11.18 (Male reproductive system) given below and answer the questions that follow.</p> <p>(a) Identify any four structures in the diagram and write one function of each.</p> <p>(b) Using the diagram, trace and describe the complete pathway followed by sperm from the site of their formation to the point where they leave the male body.</p> <p>(c) The scrotum, which holds the testes, is located outside the main body cavity, unlike most other organs. Explain, with reference to the diagram, why this unusual position is essential for the normal functioning of the testes</p>                                                                                                                                                                                                                                                     | 5     |
| 20           | <p>Study Fig. 11.20 (Process of fertilisation) given below and answer the questions that follow.</p> <div style="text-align: center;"> <p><i>Egg                      Sperm                      Zygote</i></p> <p><i>Fig. 11.20: Process of fertilisation</i></p> </div> <p>(a) Using the diagram, describe the sequence of events starting from ovulation, through the fusion shown in the figure, up to implantation of the zygote in the uterus.</p> <p>(b) Name the type of cell division the zygote undergoes while travelling towards the uterus, and explain why this type of division (and not the one that formed the gametes) is required at this stage.</p> <p>(c) Explain what would happen to the thickened uterine lining if the egg shown in the diagram had not been fertilised, and name the process by which this lining leaves the body.</p> | 5     |

### Section E – Case-Based Questions

| Question No. | Question | Marks |
|--------------|----------|-------|
|--------------|----------|-------|

|    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |   |
|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|
| 21 | <p><i>Meera is 24 years old. Her doctor explained that every month, one of her ovaries releases a mature egg which travels into the oviduct. If sperm reach the egg around this time and one of them fuses with it, a new cell is formed. This cell divides repeatedly as it travels towards the uterus. About 6–7 days later, this structure attaches itself firmly to the thickened inner lining of the uterus.</i></p>                                                                                                                                                                                                                                                                                                           | 4 |
|    | <p>(i) Identify the process by which the ovary releases the mature egg.</p> <p>(ii) The passage describes a "new cell" formed by the fusion of sperm and egg. Explain why this cell's chromosome number matches that of a normal human body cell, even though it is formed from two different gametes.</p> <p>(iii) Explain why this new cell divides repeatedly by mitosis (rather than remaining undivided) as it travels towards the uterus.</p> <p>(iv) Explain the biological significance of this structure attaching to the uterine lining, and state what is likely to happen if this attachment does not take place.</p>                                                                                                   |   |
| 22 | <p><i>Rohit, a Class IX student, is learning about the changes his body will go through during puberty. He finds out that his testes will not only produce sperm but also a hormone that brings about various physical changes in boys. He also learns that before sperm can reach and fertilise an egg, they must travel a long path inside the body, aided by fluids added by certain glands.</i></p>                                                                                                                                                                                                                                                                                                                             | 4 |
|    | <p>(i) Explain how the hormone produced by Rohit's testes is responsible for the physical changes he is likely to notice in his body during puberty.</p> <p>(ii) Explain why the fluids added by the seminal vesicle and prostate gland are important for the sperm, beyond simply being present in the semen.</p> <p>(iii) Using the pathway described, arrange and explain the sequence of structures that sperm pass through from the testes to the point they leave the body.</p> <p>(iv) If the tube carrying sperm from the testes (vas deferens) were surgically blocked on both sides, explain the effect this would have on Rohit's fertility, even though his testes continue to produce hormones and sperm normally.</p> |   |

## Marking scheme

| Q. No. | Answer                                                                                                                                                                                                                                                                                               | Marks |
|--------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 1      | (b) Testes                                                                                                                                                                                                                                                                                           |       |
| 2      | (c) Scrotum                                                                                                                                                                                                                                                                                          |       |
| 3      | (b) Testes → Vas deferens → Urethra                                                                                                                                                                                                                                                                  |       |
| 4      | (b) Cervix and uterus (sperm travel vagina → cervix → uterus → oviduct)                                                                                                                                                                                                                              |       |
| 5      | (b) Sperm and egg                                                                                                                                                                                                                                                                                    |       |
| 6      | (b) So that the zygote formed has the normal chromosome number and not double of it                                                                                                                                                                                                                  |       |
| 7      | (b) 46                                                                                                                                                                                                                                                                                               |       |
| 8      | (c) Oviduct (fallopian tube)                                                                                                                                                                                                                                                                         |       |
| 9      | (b) To prepare the uterus to receive and nourish a possible zygote                                                                                                                                                                                                                                   |       |
| 10     | (b) Oviduct (fallopian tube)                                                                                                                                                                                                                                                                         |       |
| 11     | Incorrect. Sperm and egg each carry only 23 chromosomes (half the normal number, due to meiosis). When they fuse, the zygote gets 23 from each, restoring the normal number of 46 — the same as a normal body cell, not more or double                                                               |       |
| 12     | Sperm are produced normally in the testes, but a blocked vas deferens prevents them from travelling from the testes to the urethra and being released during ejaculation. Since sperm cannot reach the female reproductive tract, fertilisation cannot occur, causing infertility                    |       |
| 13     | Fertilisation normally takes place inside the fallopian tube (oviduct). If both tubes are blocked, the egg released from the ovary cannot meet sperm travelling up from the uterus, so fertilisation cannot occur, even though ovulation continues normally.                                         |       |
| 14     | Sperm face huge losses in number while swimming through the female reproductive tract to reach the egg, so millions are produced to increase the chance that at least one succeeds; a single egg, well-protected and nourished, is sufficient since only one is needed for fertilisation each cycle. |       |
| 15     | (i) Oviduct/fallopian tube.<br>(ii) (ii) Uterus.<br>(iii) (iii) The egg is released from the ovary during ovulation and moves into the oviduct, where it may be fertilised by a sperm;                                                                                                               |       |

|    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |  |
|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
|    | the (fertilised) egg then moves towards the uterus for implantation.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |  |
| 16 | If gametes were formed by mitosis, each gamete would carry the full 46 chromosomes; fusion would produce a zygote with 92 chromosomes in the very first generation. If this continued, the chromosome number would keep doubling every generation, which is biologically unsustainable — this is exactly why meiosis (chromosome reduction) is essential before fertilisation.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |  |
| 17 | Gametogenesis is the formation of gametes (sperm/egg) by meiosis, which halves the chromosome number ( $46 \rightarrow 23$ ). This ensures that when sperm and egg fuse, the zygote regains the normal chromosome number (46), keeping it constant across generations.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |  |
| 18 | Sequence: ovulation releases the egg into the oviduct $\rightarrow$ sperm entering through the vagina swim up and may fuse with the egg (fertilisation) $\rightarrow$ a zygote is formed $\rightarrow$ the zygote undergoes repeated mitotic divisions while moving to the uterus, increasing its cell number so that a properly developing embryo (not a single cell) implants and grows in the uterus.                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |  |
| 19 | <p>(a) e.g., Testes — produce sperm and hormone; Vas deferens — carries sperm to urethra; Seminal vesicle/Prostate gland — add fluid to nourish and activate sperm; Urethra — common passage for sperm and urine; Scrotum — holds and protects testes.</p> <p>(b) Testes <math>\rightarrow</math> vas deferens <math>\rightarrow</math> urethra <math>\rightarrow</math> exterior, with seminal vesicle and prostate fluids added along the way.</p> <p>(c) The scrotum keeps testes slightly cooler than normal body temperature, which is essential for proper sperm formation; if testes remained inside the body cavity, the higher internal temperature would impair sperm production</p>                                                                                                                                                                                     |  |
| 20 | <p>(a) Ovulation releases the egg into the oviduct <math>\rightarrow</math> sperm entering through the vagina swim to the oviduct <math>\rightarrow</math> fusion of sperm and egg forms a zygote (as shown in the diagram) <math>\rightarrow</math> the zygote undergoes repeated mitotic divisions while moving towards the uterus <math>\rightarrow</math> it implants into the thickened uterine lining, marking the beginning of pregnancy.</p> <p>(b) Mitosis; it produces genetically identical daughter cells needed to build the many cells of a developing embryo, whereas meiosis (used to form gametes) reduces chromosome number and is not suitable for growth.</p> <p>(c) If the egg is not fertilised, the thickened uterine lining is no longer needed and breaks down and is shed from the body along with some blood — this process is called menstruation.</p> |  |
| 21 | (i) Ovulation                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |  |

|    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |  |
|----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
|    | <p>(ii) The zygote receives 23 chromosomes from the sperm and 23 from the egg, together restoring the normal number of 46 found in body cells.</p> <p>(iii) Repeated mitotic division increases the cell number, allowing the single fertilised cell to develop into a multicellular embryo capable of implanting and growing, rather than remaining a single cell.</p> <p>(iv) This attachment (implantation) allows the developing embryo to receive nourishment from the uterus and marks the beginning of pregnancy; if it does not occur, the embryo cannot survive and pregnancy does not proceed.</p>                                                                                                                                                                                                                                 |  |
| 22 | <p>(i) The hormone (testosterone) produced by the testes brings about physical changes such as deepening of voice, facial/body hair growth, and broadening of shoulders that are typically seen in boys during puberty.</p> <p>(ii) These fluids nourish the sperm and keep them active and motile, which increases their ability to survive the journey through the female reproductive tract and successfully reach and fertilise the egg.</p> <p>(iii) Testes → vas deferens → (joined by seminal vesicle and prostate secretions) → urethra → exterior of the body.</p> <p>(iv) Blocking the vas deferens (as in a vasectomy) prevents sperm from reaching the urethra, so sperm cannot reach the female reproductive tract; this causes infertility even though hormone production and sperm formation in the testes remain normal.</p> |  |

## Chapter: 12 PATTERNS IN LIFE: DIVERSITY AND CLASSIFICATION

### Topic: KINGDOM MONERA TO KINGDOM PLANTAE

| Prepared by  | Designation | School      | Region    |
|--------------|-------------|-------------|-----------|
| YOGESH TOMAR | BIOLOGY     | KV RAJAMPET | HYDERABAD |

#### Section A -1 Mark questions

| QNo | Question                                                                                                                                                                                                                                                                           | Marks |
|-----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 1   | Which of the following unicellular prokaryotes is responsible for the production of biogas from the dung of ruminants? (1 Mark)<br><br>(a) <i>Lactobacillus</i><br>(b) <i>Rhizobium</i><br>(c) Methanogenic Archaea<br>(d) <i>Spirogyra</i>                                        | 1     |
| 2   | A microscopic single-celled eukaryote moves using a flagellum. It performs photosynthesis in the presence of light but behaves as a heterotroph in the dark. It belongs to: (1 Mark)<br><br>(a) Kingdom Monera<br>(b) Kingdom Protista<br>(c) Kingdom Fungi<br>(d) Kingdom Plantae | 1     |
| 3   | The cell wall of multicellular, heterotrophic eukaryotes belonging to Kingdom Fungi is composed of: (1 Mark)<br><br>(a) Cellulose<br>(b) Peptidoglycan<br>(c) Chitin<br>(d) Hemicellulose                                                                                          | 1     |
| 4   | Which of the following plant groups is scientifically termed the "Amphibians of the Plant Kingdom" due to their water-dependency for reproduction? (1 Mark)<br><br>(a) Thallophyta<br>(b) Bryophyta                                                                                | 1     |

|   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |   |
|---|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|
|   | (c) Pteridophyta<br>(d) Gymnosperms                                                                                                                                                                                                                                                                                                                                                                                                                                             |   |
| 5 | <i>Spirogyra</i> possesses an undifferentiated plant body called a thallus and is highly adapted to aquatic habitats. It belongs to: (1 Mark)<br>(a) Bryophyta<br>(b) Thallophyta<br>(c) Pteridophyta<br>(d) Angiosperms                                                                                                                                                                                                                                                        | 1 |
| 6 | A student observes tiny organisms in pond water. They are single-celled, do not have a true nucleus, and reproduce by binary fission. Which kingdom do they belong to?<br>A. Protista<br>B. Fungi<br>C. Monera<br>D. Plantae                                                                                                                                                                                                                                                    | 1 |
| 7 | Riya found two plants near a pond. One plant has rhizoids instead of roots and no vascular tissues. The other has true roots, stems, leaves, and vascular tissues but does not produce seeds. Which option correctly identifies them?<br>A. Bryophyta and Pteridophyta<br>B. Gymnosperm and Angiosperm<br>C. Algae and Fungi<br>D. Monera and Protista                                                                                                                          | 1 |
| 8 | A gardener has two plants. Plant X produces seeds inside fruits, while Plant Y produces naked seeds in cones. Which statement is correct?<br>A. X is a Gymnosperm and Y is an Angiosperm.<br>B. X and Y are both Angiosperms.<br>C. X is an Angiosperm and Y is a Gymnosperm.<br>D. Both X and Y are Bryophytes.                                                                                                                                                                | 1 |
| 9 | <b>Direction: In the following question, a statement of Assertion (A) is followed by a statement of Reason (R). Choose the correct option.</b><br><br><i>Assertion (A):</i> Gymnosperms do not require aquatic conditions for fertilisation.<br><i>Reason (R):</i> Gymnosperm seeds are enclosed within protective fruits. (1 Mark)<br>(a) Both A and R are true and R is the correct explanation of A.<br>(b) Both A and R are true but R is not the correct explanation of A. | 1 |

|    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |   |
|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|
|    | (c) A is true but R is false.<br>(d) A is false but R is true.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |   |
| 10 | <p><b>Direction: In the following question, a statement of Assertion (A) is followed by a statement of Reason (R). Choose the correct option.</b></p> <p><i>Assertion (A):</i> Lichens are highly sensitive bio-indicators used to assess air pollution levels.</p> <p><i>Reason (R):</i> Lichens represent a mutualistic, symbiotic association between an autotrophic alga and a heterotrophic fungus. (1 Mark)</p> <p>(a) Both A and R are true and R is the correct explanation of A.<br/>(b) Both A and R are true but R is not the correct explanation of A.<br/>(c) A is true but R is false.<br/>(d) A is false but R is true.</p> | 1 |

### Section B – 2 Mark Questions

| Question No. | Question                                                                                                                                                                                                   | Marks |
|--------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 11           | Distinguish between the cellular organization of organisms belonging to Kingdom Monera and Kingdom Protista. Give one representative example of each.                                                      | 2     |
| 12           | Based on the traditional knowledge described in your text, explain the ecological role of Lichens ( <i>Patthar ke Phool</i> ) and why villagers collect them as forest produce.                            | 2     |
| 13           | Why are Thallopiphytes (algae) strictly restricted to aquatic or highly moist environments? State two reasons.                                                                                             | 2     |
| 14           | While exploring a cold, dry mountain slope, you observe a tall pine tree (Gymnosperm) growing successfully next to a dry rock face, but you cannot find any mosses (Bryophytes). Justify this observation. | 2     |

### Section C – 3 Mark Questions

| Question No. | Question                                                                                                                                                                                                        | Marks        |             |              |             |   |
|--------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------|-------------|--------------|-------------|---|
| 15           | <p>Compare Bryophytes, Pteridophytes, and Gymnosperms by completing the following comparative matrix:</p> <table><tr><td>Parameter</td><td>Bryophyta</td><td>Pteridophyta</td><td>Gymnosperms</td></tr></table> | Parameter    | Bryophyta   | Pteridophyta | Gymnosperms | 3 |
| Parameter    | Bryophyta                                                                                                                                                                                                       | Pteridophyta | Gymnosperms |              |             |   |

|    |                                                                                                                                                                                           |  |  |  |   |
|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|--|--|---|
|    | <b>Vascular Tissue</b><br>(Xylem/Phloem)                                                                                                                                                  |  |  |  |   |
|    | <b>Seed Formation</b>                                                                                                                                                                     |  |  |  |   |
|    | <b>Water Dependency for Fertilisation</b>                                                                                                                                                 |  |  |  |   |
| 16 | Ram Bux Singh is known as the "Father of Modern Biogas". Highlight three of his major scientific contributions to renewable energy and sustainable development in rural India.            |  |  |  | 3 |
| 17 | You are asked to prepare a "hay infusion" slide in the school laboratory to observe living protists. Outline the step-by-step procedure and state two mandatory safety precautions.       |  |  |  | 3 |
| 18 | Explain the evolutionary sequence of structural changes in the Plant Kingdom from Thallophyta to Angiosperms that helped plants solve the challenges of transitioning from water to land. |  |  |  | 3 |

#### Section D – 5 Mark Questions

| Question No. | Question                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Marks |
|--------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 19           | <p>(i) Design a comprehensive concept flowchart illustrating the five-kingdom classification proposed by Robert H. Whittaker. Your flowchart must clearly show the criteria used: <i>Cell Type (Prokaryotic/Eukaryotic)</i>, <i>Level of Organisation (Unicellular/Multicellular)</i>, <i>Cell Structure (With/Without Cell Wall)</i>, and <i>Mode of Nutrition/Ecological Role</i>. (3 Marks)</p> <p>(ii) Classify the following organisms into their respective Whittaker kingdoms: <i>Paramecium</i>, <i>Rhizopus</i> (Bread mould), <i>Cyanobacteria</i>, and <i>Marchantia</i>. (2 Marks)</p> | 5     |
| 20           | <p>(i) Formulate a comparative analysis between Gymnosperms and Angiosperms based on the following three parameters: (3 Marks)</p> <p>(a) Structure and placement of seeds.</p> <p>(b) Presence of flowers and fruits.</p> <p>(c) Mechanism of pollination and seed dispersal.</p> <p>(ii) Explain how the development of flowers and fruits makes Angiosperms the most dominant, diverse, and evolutionary successful plant group on Earth. (2 Marks)</p>                                                                                                                                         | 5     |

## Section E – Case-Based Questions

| Question No. | Question                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                | Marks  |                                                        |   |                                                                                         |   |                                                                                                            |   |                                                                                            |   |
|--------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|--------------------------------------------------------|---|-----------------------------------------------------------------------------------------|---|------------------------------------------------------------------------------------------------------------|---|--------------------------------------------------------------------------------------------|---|
| 21           | <p><b>Case Study 1: The Pakke Tiger Reserve and Hornbill Conservation</b></p> <p><i>Read the passage below and answer the questions that follow:</i></p> <p>The Pakke Tiger Reserve in Arunachal Pradesh is home to nearly 300 bird species and supports four distinct species of hornbills—the Rufous-necked, Oriental Pied, Great, and Wreathed Hornbills. These large birds nest only in big, old trees with suitable natural cavities and feed on specific forest fruits. Scientists study these distribution patterns to ask precise ecological questions about biodiversity.</p> <p>(i) What is biological classification, and how does classifying the four hornbill species help scientists conserve biodiversity in Pakke Tiger Reserve? (2 Marks)</p> <p>(ii) Predict the ecological consequences on the hornbill population and the forest ecosystem if large, old trees with cavities are cleared for timber. (2 Marks)</p> | 4      |                                                        |   |                                                                                         |   |                                                                                                            |   |                                                                                            |   |
| 22           | <p><b>Case Study 2: Laboratory Sample Characterization</b></p> <p><i>Read the observation data table prepared by students during an ecological survey:</i></p> <table><tr><th>Sample</th><th>Key Structural, Cellular, and Nutritional Observations</th></tr><tr><td>P</td><td>Microscopic; prokaryotic; cell wall present; survives in high salinity and temperature.</td></tr><tr><td>Q</td><td>Multicellular; filamentous body; cell wall of chitin; lacks chlorophyll; absorbs nutrients from dead wood.</td></tr><tr><td>R</td><td>Unicellular; eukaryotic; cell wall of cellulose; contractile vacuole present; flagellated.</td></tr></table> <p>(i) Identify the correct Kingdom for Sample P, Sample Q, and Sample R based on Robert Whittaker's classification system. (3 Marks)</p> <p>(ii) Suggest one physiological characteristic of Sample R that prevents it from being classified under Kingdom Plantae. (1 Mark)</p>  | Sample | Key Structural, Cellular, and Nutritional Observations | P | Microscopic; prokaryotic; cell wall present; survives in high salinity and temperature. | Q | Multicellular; filamentous body; cell wall of chitin; lacks chlorophyll; absorbs nutrients from dead wood. | R | Unicellular; eukaryotic; cell wall of cellulose; contractile vacuole present; flagellated. | 4 |
| Sample       | Key Structural, Cellular, and Nutritional Observations                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |        |                                                        |   |                                                                                         |   |                                                                                                            |   |                                                                                            |   |
| P            | Microscopic; prokaryotic; cell wall present; survives in high salinity and temperature.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |        |                                                        |   |                                                                                         |   |                                                                                                            |   |                                                                                            |   |
| Q            | Multicellular; filamentous body; cell wall of chitin; lacks chlorophyll; absorbs nutrients from dead wood.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |        |                                                        |   |                                                                                         |   |                                                                                                            |   |                                                                                            |   |
| R            | Unicellular; eukaryotic; cell wall of cellulose; contractile vacuole present; flagellated.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |        |                                                        |   |                                                                                         |   |                                                                                                            |   |                                                                                            |   |

## Marking scheme

| Q. No. | Answer                                                                                                                                                                                                                                                                                                                                                       | Marks |
|--------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 1      | <b>(c) Methanogenic Archaea</b> [Page 8 - Monera section]                                                                                                                                                                                                                                                                                                    |       |
| 2      | <b>(b)Kingdom Protista</b> ( <i>Euglena</i> shows mixotrophic nutrition) [Page 8 - Protista section]                                                                                                                                                                                                                                                         |       |
| 3      | <b>(c) Chitin</b> [Page 9 - Fungi section]                                                                                                                                                                                                                                                                                                                   |       |
| 4      | <b>(b) Bryophyta</b> [Page 10, 11]                                                                                                                                                                                                                                                                                                                           |       |
| 5      | <b>(b) Thallophyta</b> [Page 10 - Spirogyra]                                                                                                                                                                                                                                                                                                                 |       |
| 6      | <b>(C) Monera</b>                                                                                                                                                                                                                                                                                                                                            |       |
| 7      | <b>(A) Bryophyta and Pteridophyta</b>                                                                                                                                                                                                                                                                                                                        |       |
| 8      | <b>(C) X is an Angiosperm and Y is a Gymnosperm.</b>                                                                                                                                                                                                                                                                                                         |       |
| 9      | <b>(c) A is true but R is false.</b> (Reason is false because Gymnosperm seeds are naked/exposed on cones, not enclosed in fruits). [Page 11]                                                                                                                                                                                                                |       |
| 10     | <b>(b) Both A and R are true but R is not the correct explanation of A.</b> (A is true because lichens change color/die due to atmospheric sulfur dioxide; R is a true statement describing their symbiotic composition but is not the anatomical explanation for bio-indication). [Page 10]                                                                 |       |
| 11     | <b>Monera vs Protista:</b><br><i>Monera:</i> Unicellular <b>prokaryotes</b> (primitive nucleus, unbounded membrane). Example: Bacteria / Cyanobacteria. (1 Mark)<br><i>Protista:</i> Unicellular <b>eukaryotes</b> (membrane-bound true nucleus). Example: <i>Amoeba</i> / <i>Paramecium</i> / <i>Euglena</i> . (1 Mark) [Page 8]                            |       |
| 12     | <b>Lichens (Patthar ke Phool):</b> They are symbiotic partners (Algae + Fungi). (0.5 Mark) Villagers collect them because they serve as an indicator of a pollution-free environment (changing color in response to air quality) (1 Mark) and are used traditionally as a food spice or natural dye. (0.5 Mark) [Page 10]                                    |       |
| 13     | <b>Thallophytes (Algae) Aquatic Habit:</b><br>Their body is highly simplified (thallus) without any differentiation into roots, stem, or leaves, making direct contact with water mandatory for absorption. (1 Mark)<br>They completely lack vascular transport tissues (xylem/phloem) and specialized structures to prevent desiccation. (1 Mark) [Page 10] |       |
| 14     | <b>Pine vs Moss adaptation:</b>                                                                                                                                                                                                                                                                                                                              |       |

|    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |  |
|----|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
|    | <p><i>Pine (Gymnosperm)</i>: Adapted to dry/cold climates due to needle-like leaves (reducing transpiration) and independent of liquid water for reproduction (uses pollen). (1 Mark)</p> <p><i>Moss (Bryophyte)</i>: Lacks vascular tissues, is small, and absolutely requires a film of liquid water for flagellated male gametes to swim to female cells for fertilization. (1 Mark) [Page 11]</p>                                                                                                                |  |
| 15 | <p><b>Plant Class Comparison Matrix:</b> (1 Mark per row)</p> <p><i>Vascular Tissue</i>: Bryophyta (Absent)   Pteridophyta (Present)   Gymnosperms (Present)</p> <p><i>Seed Formation</i>: Bryophyta (Absent)   Pteridophyta (Absent)   Gymnosperms (Present - Naked)</p> <p><i>Water dependency for Fertilisation</i>: Bryophyta (Yes - highly dependent)   Pteridophyta (Yes)   Gymnosperms (No - Wind/Pollen-mediated) [Page 10-12]</p>                                                                           |  |
| 16 | <p><b>Ram Bux Singh Contributions:</b></p> <p>Established India's first scientifically designed biogas plant at Sitapur, UP (1957). (1 Mark)</p> <p>Designed low-cost, highly efficient anaerobic biogas digesters optimized specifically for Indian rural agriculture. (1 Mark)</p> <p>Served as an international consultant, driving sustainable waste management and renewable bio-energy systems worldwide. (1 Mark) [Page 8]</p>                                                                                |  |
| 17 | <p><b>Hay Infusion Slide Preparation:</b></p> <p><i>Procedure</i>: Collect straw/grass in a glass bottle -&gt; fill 1/4th with plant matter -&gt; add stagnant pond water -&gt; cover with muslin cloth and tie -&gt; leave undisturbed for 1 week. Collect a drop from the center using a pipette, place on slide, cover with coverslip. (2 Marks)</p> <p><i>Precautions</i>: Wear hand gloves/mask (smell can be bad). Autoclave/disinfect and safely discard the infusion after analysis. (1 Mark) [Page 8-9]</p> |  |
| 18 | <p><b>Evolutionary Land Adaptations:</b></p> <p><i>Water to simple land transition</i>: Algae (aquatic) evolved into Bryophytes, developing root-like rhizoids to anchor on damp shores, though still dependent on water for reproduction. (1 Mark)</p> <p><i>Structural Transport</i>: Pteridophytes evolved vascular tissues (xylem and phloem) to transport water, allowing plants to grow taller on dry land. (1 Mark)</p>                                                                                       |  |

|    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |
|----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
|    | <p><i>Water Independence:</i> Gymnosperms and Angiosperms evolved pollen tubes (removing the need for swimming sperm) and protective seed structures containing embryos to survive dry conditions. (1 Mark) [Page 10-13]</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |  |
| 19 | <p><b>Robert Whittaker's 5 Kingdom Classification:</b></p> <p>(i) <i>Flowchart elements:</i></p> <p><b>Cell Type:</b> Prokaryotes (Monera) vs Eukaryotes. (1 Mark)</p> <p><b>Level of Organisation:</b> Unicellular Eukaryotes (Protista) vs Multicellular Eukaryotes. (1 Mark)</p> <p><b>Cell Wall &amp; Mode of Nutrition:</b></p> <p>Multicellular with Cell Wall: Autotrophic (Plantae) vs Heterotrophic Decomposers (Fungi).</p> <p>Multicellular without Cell Wall: Heterotrophic Consumers (Animalia). (1 Mark)</p> <p>(ii) Classification:</p> <p><i>Paramecium</i> -&gt; Kingdom Protista (0.5 Mark)</p> <p><i>Rhizopus</i> -&gt; Kingdom Fungi (0.5 Mark)</p> <p><i>Cyanobacteria</i> -&gt; Kingdom Monera (0.5 Mark)</p> <p><i>Marchantia</i> -&gt; Kingdom Plantae (0.5 Mark) [Page 7]</p> |  |
| 20 |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |  |
| 21 | <p><b>Hornbill Conservation Case:</b></p> <p>(i) Biological classification groups similar organisms based on shared traits. Classifying hornbill species allows scientists to map specific environmental needs (tree size, fruit types) of each group, letting them make precise conservation decisions. (2 Marks)</p> <p>(ii) If old trees are cleared, hornbills will lose nesting sites (as they only breed in natural cavities of old trees), leading to a drastic decline in their reproduction. This disrupts the forest food web since hornbills are vital seed-dispersal agents. (2 Marks) [Page 5]</p>                                                                                                                                                                                        |  |
| 22 | <p><b>Sample Matrix Analysis:</b></p> <p>(i) Sample P: Kingdom Monera (unicellular prokaryote, extremophile). (1 Mark)   Sample Q: Kingdom Fungi (multicellular, chitin cell wall, saprophytic). (1 Mark)   Sample R: Kingdom Protista (unicellular eukaryote, flagellated). (1 Mark) [Page 7-9]</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |  |

|  |                                                                                                                                                                              |  |
|--|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
|  | (ii) Sample R is unicellular (Kingdom Protista contains all single-celled eukaryotes), whereas Kingdom Plantae strictly includes multicellular autotrophs. (1 Mark) [Page 7] |  |
|--|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|

**Chapter 13: Earth as a system: Energy, Matter and Life**  
**Topic: Spheres of Earth, Uneven heating of Earth, Interaction of Solar Radiations on Earth's Surface, Latitude and Earth's shape, Role of atmosphere**

| Prepared by         | Designation | School                              | Region    |
|---------------------|-------------|-------------------------------------|-----------|
| Chitra Lekha Sharma | TGT Science | PM Shri Kendriya Vidyalaya Warangal | Hyderabad |

**Section A -1 Mark questions**

| QNo | Question                                                                                                                                                                                                                                                                                                                                                           | Marks |
|-----|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 1   | A town located near a glacier experiences very little snowfall for three consecutive winters. During summer, farmers notice a shortage of irrigation water. Which Earth spheres are directly linked in this situation?<br><br>A. Geosphere and Atmosphere<br>B. Cryosphere and Hydrosphere<br>C. Biosphere and Geosphere<br>D. Atmosphere and Geosphere            | 1     |
| 2   | A company plans to paint the roofs of houses in a desert region either black or white to reduce indoor temperatures. Which option would be most effective?<br><br>A. Black roofs because they absorb more sunlight<br>B. White roofs because they have higher albedo<br>C. Black roofs because they reflect more sunlight<br>D. Both colours are equally effective | 1     |
| 3   | During a science exhibition, two students compare the temperatures of a playground and a nearby lake on a sunny afternoon. The playground is much hotter. The best explanation is that<br><br>A. Water reflects less sunlight than land.<br>B. Land heats up faster than water.<br>C. Water absorbs all solar radiation.<br>D. Land receives more solar radiation. | 1     |
| 4   | If the ozone layer suddenly became much thinner, which change would most directly affect life on Earth?                                                                                                                                                                                                                                                            | 1     |

|   |                                                                                                                                                                                                                                                                                                                                                                                         |   |
|---|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|
|   | <p>A. More infrared radiation would reach Earth.</p> <p>B. More ultraviolet radiation would reach Earth's surface.</p> <p>C. More visible light would be blocked.</p> <p>D. More radio waves would be absorbed.</p>                                                                                                                                                                     |   |
| 5 | <p>Which region of Earth receives the greatest amount of concentrated solar energy?</p> <p>A. Polar regions</p> <p>B. Temperate regions</p> <p>C. Equatorial region</p> <p>D. Mountain peaks</p>                                                                                                                                                                                        | 1 |
| 6 | <p>A city replaces many parks with concrete buildings and wide roads. After a few years, the average night temperature increases. This is mainly because</p> <p>A. Concrete has a higher albedo.</p> <p>B. Concrete stores heat and releases it slowly.</p> <p>C. Trees absorb more heat than buildings.</p> <p>D. Buildings increase rainfall.</p>                                     | 1 |
| 7 | <p>A farmer notices that crop growth has reduced because the monsoon has become irregular after the Arabian Sea became warmer. Which Earth sphere was disturbed first?</p> <p>A. Hydrosphere</p> <p>B. Cryosphere</p> <p>C. Biosphere</p> <p>D. Geosphere</p>                                                                                                                           | 1 |
| 8 | <p>Which statement best explains why Earth remains suitable for life?</p> <p>A. All outgoing heat escapes into space.</p> <p>B. Greenhouse gases trap part of the outgoing infrared radiation.</p> <p>C. The ozone layer absorbs all solar radiation.</p> <p>D. Earth receives equal solar energy everywhere.</p>                                                                       | 1 |
| 9 | <p>A trekking group is planning an expedition to a high-altitude region. Their instructor advises everyone to wear UV-protective sunglasses and sunscreen because the atmosphere provides less protection at higher altitudes.</p> <p>Which atmospheric layer normally protects living organisms by absorbing most of the harmful ultraviolet (UV) radiation?</p> <p>A. Troposphere</p> | 1 |

|    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |   |
|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|
|    | B. Mesosphere<br>C. Stratosphere<br>D. Thermosphere                                                                                                                                                                                                                                                                                                                                                                                                                                       |   |
| 10 | <p>A city records a steady rise in average temperature over the last 20 years. Scientists find that one human activity has significantly increased the amount of carbon dioxide in the atmosphere, strengthening the greenhouse effect.</p> <p>Which activity is most responsible for this change?</p> <p>A. Large-scale afforestation</p> <p>B. Burning fossil fuels for transport and industries</p> <p>C. Rainwater harvesting in urban areas</p> <p>D. Practising organic farming</p> | 1 |

### Section B – 2 Mark Questions

| Question No. | Question                                                                                                                                                                                                         | Marks |
|--------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 11           | A hill station has experienced reduced snowfall for several years. Explain two impacts this change can have on the surrounding ecosystem and local people.                                                       | 2     |
| 12           | Two school buildings are identical except that one has a white roof and the other has a black roof. During summer, the classrooms in one building remain cooler. Explain the reason using the concept of albedo. | 2     |
| 13           | A student says, "If there were no greenhouse gases in the atmosphere, life on Earth would become easier because global warming would stop." Do you agree? Justify your answer with two scientific reasons.       | 2     |
| 14           | Your school wants to reduce the Urban Heat Island effect in the surrounding area. Suggest two scientifically valid measures and explain how each measure helps.                                                  | 2     |

### Section C – 3 Mark Questions

| Question No. | Question                                                                                                                                                                                                                                                                                                                             | Marks |
|--------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 15           | <p>A village near the coast receives unusually heavy rainfall, while another nearby district faces drought during the same monsoon season. Scientists relate this to the warming of the Arabian Sea.</p> <p>A. Explain how warming of sea water influences the southwest monsoon.</p> <p>B. State one impact on the hydrosphere.</p> | 3     |

|    |                                                                                                                                                                                                                                                                                                                                                                                                                                    |   |
|----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|
|    | C. State one impact on the biosphere.                                                                                                                                                                                                                                                                                                                                                                                              |   |
| 16 | <p>A student places equal-sized pieces of black cloth, white cloth and aluminium foil under sunlight for 20 minutes. The black cloth becomes the hottest. Using the concept of absorption and reflection of solar radiation, explain:</p> <p>A. Why the black cloth becomes hotter.</p> <p>B. Why the white cloth remains comparatively cooler.</p> <p>C. How this knowledge can help in designing energy-efficient buildings.</p> | 3 |
| 17 | <p>A team of students wants to install solar panels on the roof of their school. Before doing so, they study the concepts of insolation and latitude. Based on your understanding:</p> <p>A. Explain why India receives abundant solar energy.</p> <p>B. State one advantage of high solar insolation.</p> <p>C. Suggest one factor (other than latitude) that affects the amount of solar radiation reaching Earth's surface.</p> | 3 |
| 18 | <p>A newly discovered planet has an atmosphere similar to Earth's but does not contain ozone. Scientists predict that it may not support complex life. Using your knowledge of the atmosphere, explain:</p> <p>A. Why ozone is important.</p> <p>B. What harmful effect would increased UV radiation have on living organisms?</p> <p>C. Name one atmospheric layer where ozone is mainly found.</p>                               | 3 |

#### Section D – 5 Mark Questions

| Question No. | Question                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            | Marks |
|--------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 19           | <p>Due to global warming, glaciers in the Himalayas are melting rapidly. Scientists warn that this may create serious environmental challenges in the future.</p> <p>Analyse the situation and answer the following:</p> <p>(i) Explain how melting glaciers affect rivers.</p> <p>(ii) Describe its effect on agriculture and water availability.</p> <p>(iii) Explain how rising sea level threatens coastal regions.</p> <p>(iv) Suggest two practical measures to reduce global warming.</p> <p>(v) Explain why reducing greenhouse gas emissions is necessary for sustainable development.</p> | 5     |

|    |                                                                                                                                                                                                                                                                                                                                                                                                                                               |   |
|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|
| 20 | <p>A state government plans to replace a large forest area with industries and residential buildings. Environmentalists oppose the project.</p> <p>Using the concept of Earth as an interconnected system, explain how this single change can affect:</p> <p>(i) Biosphere</p> <p>(ii) Atmosphere</p> <p>(iii) Hydrosphere</p> <p>(iv) Local climate</p> <p>(v) Human life</p> <p>Support your answer with suitable scientific reasoning.</p> | 5 |
|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---|

### Section E – Case-Based Questions

| Question No. | Question                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Marks |
|--------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 21           | <p>A hill town in northern India has witnessed a steady rise in temperature over the last decade. Snowfall has become less frequent, and nearby glaciers are melting faster than before. During summer, rivers initially carry excess water, but later in the season, water levels drop significantly. Farmers are facing irrigation problems, while scientists warn that sea levels may continue to rise if glacier melting persists.</p> <p>A. Which Earth's sphere is directly affected by the melting glaciers? (1 Mark)</p> <p>B. Which factor is mainly responsible for the rapid melting of glaciers? (1 Mark)</p> <p>C. Explain two consequences of rapid glacier melting on human life and the environment. (2 Marks)</p> | 4     |
| 22           | <p>A municipal corporation launched the "Cool City Mission." It replaced dark asphalt with light-coloured paving blocks, planted thousands of roadside trees, and encouraged people to paint rooftops white. Within a few years, the average summer temperature in the city decreased, and electricity consumption for air conditioning was reduced.</p> <p>A. Which property of light-coloured surfaces helped reduce the city's temperature? (1 Mark)</p> <p>B. Which environmental phenomenon was reduced through these measures? (1 Mark)</p>                                                                                                                                                                                  | 4     |

|  |                                                                                                                        |  |
|--|------------------------------------------------------------------------------------------------------------------------|--|
|  | C. Explain how planting trees and using light-coloured surfaces together help in reducing city temperatures. (2 Marks) |  |
|--|------------------------------------------------------------------------------------------------------------------------|--|

## Marking scheme

| Q. No. | Answer                                                                                                                                                                                                                                                                                                                                                                                                                  | Marks |
|--------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------|
| 1      | B                                                                                                                                                                                                                                                                                                                                                                                                                       |       |
| 2      | B                                                                                                                                                                                                                                                                                                                                                                                                                       |       |
| 3      | B                                                                                                                                                                                                                                                                                                                                                                                                                       |       |
| 4      | B                                                                                                                                                                                                                                                                                                                                                                                                                       |       |
| 5      | C                                                                                                                                                                                                                                                                                                                                                                                                                       |       |
| 6      | B                                                                                                                                                                                                                                                                                                                                                                                                                       |       |
| 7      | A                                                                                                                                                                                                                                                                                                                                                                                                                       |       |
| 8      | B                                                                                                                                                                                                                                                                                                                                                                                                                       |       |
| 9      | C                                                                                                                                                                                                                                                                                                                                                                                                                       |       |
| 10     | B                                                                                                                                                                                                                                                                                                                                                                                                                       |       |
| 11     | <ol style="list-style-type: none"> <li>1. Impact on the ecosystem: Reduced snowfall causes glaciers to melt faster and decreases water availability for rivers, affecting plants, animals, and biodiversity.</li> <li>2. Impact on local people: Less water is available for drinking, irrigation, and hydroelectric power generation, affecting agriculture and livelihoods.</li> </ol>                                |       |
| 12     | The white roof has a higher albedo, so it reflects most of the incoming solar radiation and absorbs less heat. In contrast, the black roof has a lower albedo, absorbs more solar radiation, and becomes hotter. Therefore, the building with the white roof remains cooler during summer.                                                                                                                              |       |
| 13     | <p>No, I do not agree.</p> <ol style="list-style-type: none"> <li>1. Greenhouse gases trap some of the Earth's outgoing heat, keeping the planet warm enough to support life. Without them, Earth would become extremely cold.</li> <li>2. Although excess greenhouse gases cause global warming, a natural amount of greenhouse gases is essential to maintain a suitable temperature for living organisms.</li> </ol> |       |
| 14     | <ol style="list-style-type: none"> <li>1. Plant more trees around the school: Trees provide shade and cool the surroundings through transpiration, reducing air temperature.</li> <li>2. Use light-coloured roofs and pavements: These surfaces have a high albedo and reflect more sunlight, reducing heat absorption and keeping the area cooler.</li> </ol>                                                          |       |

|    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |  |
|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
| 15 | <p>(i) Warmer sea water increases evaporation, adding more water vapour to the atmosphere. This disturbs the southwest monsoon, causing uneven rainfall with floods in some regions and droughts in others.</p> <p>(ii) It leads to irregular water availability, causing floods in some areas and water scarcity in others.</p> <p>(iii) Irregular rainfall affects crops, forests, and wildlife, leading to habitat loss and reduced agricultural productivity.</p>                                                                                                                                                                                                                                                                   |  |
| 16 | <p>(i) Black cloth absorbs most of the incoming solar radiation and reflects very little, so it heats up quickly.</p> <p>(ii) White cloth reflects most of the solar radiation due to its higher albedo, so it absorbs less heat.</p> <p>(iii) Using light-coloured roofs and walls with high albedo reflects more sunlight, keeping buildings cooler and reducing the need for air conditioning.</p>                                                                                                                                                                                                                                                                                                                                   |  |
| 17 | <p>(i) India lies mainly in the tropical and subtropical regions, where it receives high solar insolation throughout the year.</p> <p>(ii) It enables efficient generation of renewable electricity using solar panels.</p> <p>(iii) Cloud cover, dust, and atmospheric pollution reduce the amount of solar radiation reaching the Earth's surface.</p>                                                                                                                                                                                                                                                                                                                                                                                |  |
| 18 | <p>(i) The ozone layer absorbs most of the harmful ultraviolet (UV) radiation from the Sun, protecting life on Earth.</p> <p>(ii) Increased UV radiation can damage skin and eyes, increase the risk of skin cancer, and harm plants and other living organisms.</p> <p>(iii) Stratosphere.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                         |  |
| 19 | <p>(i) Initially, rapid glacier melting increases the flow of rivers, causing floods. Over time, as glaciers shrink, rivers receive less meltwater, leading to reduced water flow, especially during dry seasons.</p> <p>(ii) Reduced river flow causes water scarcity for irrigation and drinking purposes, leading to lower crop yields, food insecurity, and difficulty in meeting the water needs of people and livestock.</p> <p>(iii) Rising sea levels can flood low-lying coastal areas, cause coastal erosion, contaminate freshwater sources with seawater, and displace people living in coastal regions.</p> <p>(iv) Increase the use of renewable energy sources such as solar and wind power instead of fossil fuels.</p> |  |

|    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |  |
|----|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--|
|    | <p>Promote afforestation and protect existing forests to absorb atmospheric carbon dioxide.</p> <p>(v) Reducing greenhouse gas emissions helps slow global warming, protects ecosystems and biodiversity, ensures the availability of natural resources for future generations, and supports long-term environmental, social, and economic well-being.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |  |
| 20 | <p>(i) Effect on the Biosphere (1 Mark)</p> <p>Cutting down forests destroys the habitats of plants and animals, leading to loss of biodiversity and disruption of food chains.</p> <p>(ii) Effect on the Atmosphere (1 Mark)</p> <p>Fewer trees absorb less carbon dioxide, increasing greenhouse gas concentration. Industrial activities also release pollutants, causing air pollution and enhancing the greenhouse effect.</p> <p>(iii) Effect on the Hydrosphere (1 Mark)</p> <p>Reduced vegetation decreases rainwater infiltration, lowers groundwater recharge, increases surface runoff, and raises the risk of floods and soil erosion.</p> <p>(iv) Effect on the Local Climate (1 Mark)</p> <p>Loss of trees reduces shade and transpiration, increasing local temperatures and contributing to the Urban Heat Island effect. Rainfall patterns may also become irregular.</p> <p>(v) Effect on Human Life (1 Mark)</p> <p>People may experience poorer air quality, water shortages, higher temperatures, increased risk of floods, reduced agricultural productivity, and loss of livelihoods, ultimately affecting their health and quality of life.</p> |  |
| 21 | <p>A. Cryosphere (1 Mark)</p> <p>B. Global warming due to the enhanced greenhouse effect caused by increased greenhouse gases. (1 Mark)</p> <p>C. (Any two points – 1 mark each)</p> <ul style="list-style-type: none"> <li>• Reduced long-term availability of freshwater.</li> <li>• Flooding due to increased glacier melt.</li> <li>• Rise in sea level threatening coastal regions.</li> <li>• Loss of habitats and biodiversity.</li> <li>• Negative impact on agriculture and livelihoods.</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |  |
| 22 | <p>A. High albedo (greater reflection of solar radiation). (1 Mark)</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |  |

B. Urban Heat Island Effect. (1 Mark)

C. (Any two points – 1 mark each)

- Light-coloured surfaces reflect more sunlight and absorb less heat.
- Trees provide shade and cool the surroundings through transpiration.
- Both measures reduce heat absorption and lower the surrounding air temperature.
- Reduced temperatures decrease the need for air conditioning, saving energy.