केन्द्रीय विद्यालय संगठन

Kendriya Vidyalaya Sangathan

विज्ञान/ SCIENCE

कक्षा/Class: IX

2024-25

विद्यार्थी अध्ययन सामग्री

Student Support Material

संदेश

विद्यालयी शिक्षा में शैक्षिक उत्कृष्टता प्राप्त करना केन्द्रीय विद्यालय संगठन की सर्वोच्च वरीयता है। हमारे विद्यार्थी, शिक्षक एवं शैक्षिक नेतृत्व कर्ता निरंतर उन्नति हेतु प्रयासरत रहते हैं। राष्ट्रीय शिक्षा नीति 2020 के संदर्भ में योग्यता आधारित अधिगम एवं मूल्यांकन संबन्धित उद्देश्यों को प्राप्त करना तथा सीबीएसई के दिशा निर्देशों का पालन, वर्तमान में इस प्रयास को और भी चुनौतीपूर्ण बनाता है।

केन्द्रीय विद्यालय संगठन के पांचों **आंचलिक शिक्षा एवं प्रशिक्षण संस्थान** द्वारा संकलित यह 'विद्यार्थी सहायक सामाग्री' इसी दिशा में एक आवश्यक कदम है । यह सहायक सामग्री कक्षा 9 से 12 के विद्यार्थियों के लिए सभी महत्वपूर्ण विषयों पर तैयार की गयी है । केन्द्रीय विद्यालय संगठन की 'विद्यार्थी सहायक सामग्री' अपनी गुणवत्ता एवं परीक्षा संबंधी सामाग्री-संकलन की विशेषज्ञता के लिए जानी जाती है और अन्य शिक्षण संस्थान भी इसका उपयोग परीक्षा संबंधी पठन सामग्री की तरह करते रहे हैं । शुभ-आशा एवं विश्वास है कि यह सहायक सामग्री विद्यार्थियों की सहयोगी बनकर सतत मार्गदर्शन करते हुए उन्हें सफलता के लक्ष्य तक पहुंचाएगी ।

शुभाकांक्षा सहित ।

निधि पांडे
आयुक्त, केन्द्रीय विद्यालय संगठन

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2	MS. PALLAVI SINHA	PM SHRI KV AMBARNATH	CHAPTER 2- IS MATTER AROUND US PURE?
3	MS. DIVYA VYAS	PM SHRI KV INS MANDOVI	CHAPTER 3- ATOMS AND MOLECULES
4	MS. AMRITA SINGH	PM SHRI KV INS LONAVLA	CHAPTER 4- STRUCTURE OF THE ATOM
5	MS. AMRITA SINGH	PM SHRI KV INS LONAVLA	CHAPTER 5- THE FUNDAMENTAL UNIT OF LIFE
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CLASS IX
SCIENCE
STUDENTS SUPPORT MATERIAL

CBSE CURRICULUM
SCIENCE
(Code No. 086)
Classes: IX (2024-25)

The subject of Science plays an important role in developing well-defined abilities in cognitive, affective and psychomotor domains in children. It augments the spirit of enquiry, creativity, objectivity and aesthetic sensibility.

Upper primary stage demands that a number of opportunities should be provided to the students to engage them with the processes of Science like observing, recording observations, drawing, tabulation, plotting graphs, etc., whereas the secondary stage also expects abstraction and quantitative reasoning to occupy a more central place in the teaching and learning of Science. Thus, the idea of atoms and molecules being the building blocks of matter makes its appearance, as does Newton's law of gravitation.

The present syllabus has been designed around seven broad themes viz. Food; Materials; The World of The Living; How Things Work; Moving Things, People and Ideas; Natural Phenomenon and Natural Resources. Special care has been taken to avoid temptation of adding too many concepts than can be comfortably learnt in the given time frame. No attempt has been made to be comprehensive.

At this stage, while Science is still a common subject, the disciplines of Physics, Chemistry and Biology begin to emerge. The students should be exposed to experiences based on hands on activities as well as modes of reasoning that are typical of the subject.

General Instructions:

1. There will be an Annual Examination based on the entire syllabus.

2. The Annual Examination will be of 80 marks and 20 marks weightage shall be for Internal Assessment.

3. For Internal Assessment:

a. There will be Periodic Assessment that would include:

For 5 marks- Three periodic tests conducted by the school. Average of the best two tests to be taken that will have a weightage of 05 marks towards the final result.

For 5 marks- Diverse methods of assessment as per the need of the class dynamics and curriculum transaction. These may include - short tests, oral test, quiz, concept maps, projects, posters, presentations and enquiry based scientific investigations etc. and use rubrics for arguing them objectively. This will also have a weightage of 05 marks towards the final result.

b. Practical / Laboratory work should be done throughout the year and the student should maintain record of the same. Practical Assessment should be continuous. There will be weightage of 5 marks towards the final result. All practicals listed in the syllabus must be completed.

c. Portfolio to be prepared by the student- This would include classwork and other sample of student work and will carry a weightage of 5 marks towards the final results.

COURSE STRUCTURE CLASS IX

(Annual Examination) Marks: 80 Unit No.	**Unit**	**Marks**
I	Matter - Its Nature and Behaviour	25
II	Organization in the Living World	22
III	Motion, Force and Work	27
IV	Food; Food Production	06
Total		**80**
Internal assessment		**20**
Grand Total		**100**

Theme: Materials

Unit I: Matter-Nature and Behaviour

Definition of matter; solid, liquid and gas; characteristics - shape, volume, density; change of state- melting (absorption of heat), freezing, evaporation (cooling by evaporation), condensation, sublimation.

Nature of matter: Elements, compounds and mixtures. Heterogeneous and homogenous mixtures, colloids and suspensions. Physical and chemical changes (excluding separating the components of a mixture).

Particle nature and their basic units: Atoms and molecules, Law of Chemical Combination, Chemical formula of common compounds, Atomic and molecular masses.

Structure of atoms: Electrons, protons and neutrons, Valency, Atomic Number and Mass Number, Isotopes and Isobars.

Theme: The World of the Living

Unit II: Organization in the Living World

Cell - Basic Unit of life : Cell as a basic unit of life; prokaryotic and eukaryotic cells, multicellular organisms; cell membrane and cell wall, cell organelles and cell inclusions; chloroplast, mitochondria, vacuoles, endoplasmic reticulum, Golgi apparatus; nucleus, chromosomes - basic structure, number.

Tissues, Organs, Organ System, Organism:

Structure and functions of animal and plant tissues (only four types of tissues in animals; Meristematic and Permanent tissues in plants).

Theme: Moving Things, People and Ideas Unit III: Motion, Force and Work

Motion: Distance and displacement, velocity; uniform and non-uniform motion along a straight line; acceleration, distance-time and velocity-time graphs for uniform motion and uniformly accelerated motion, elementary idea of uniform circular motion.

Force and Newton's laws : Force and Motion, Newton's Laws of Motion, Action and Reaction forces, Inertia of a body, Inertia and mass, Momentum, Force and Acceleration.

Gravitation: Gravitation; Universal Law of Gravitation, Force of Gravitation of the earth (gravity), Acceleration due to Gravity; Mass and Weight; Free fall.

Floatation: Thrust and Pressure. Archimedes' Principle; Buoyancy.

Work, Energy and Power: Work done by a Force, Energy, power; Kinetic and Potential energy; Law of conservation of energy (excluding commercial unit of Energy).

Sound: Nature of sound and its propagation in various media, speed of sound, range of hearing in humans; ultrasound; reflection of sound; echo.

Theme: Food

Unit IV: Food Production

Plant and animal breeding and selection for quality improvement and management; Use of fertilizers and manures; Protection from pests and diseases; Organic farming.

Note for the Teachers:

1. The chapter Natural Resources (NCERT Chapter 14) will not be assessed in the year-end examination. However, learners may be assigned to read this chapter and encouraged to prepare a brief write up on any concept of this chapter in their Portfolio. This may be for Internal Assessment and credit may be given for Periodic Assessment/Portfolio.

2. The NCERT text books present information in boxes across the book. These help students to get conceptual clarity. However, the information in these boxes would not be assessed in the year-end examination.

PRACTICALS

Practical should be conducted alongside the concepts taught in theory classes.

(LIST OF EXPERIMENTS)

1. Preparation of: **Unit-I**

a) a true solution of common salt, sugar and alum

b) a suspension of soil, chalk powder and fine sand in water

c) a colloidal solution of starch in water and egg albumin/milk in water and distinguish between these on the basis of

transparency

filtration criterion

stability

2. Preparation of **Unit-I**

a) A mixture

b) A compound

using iron filings and sulphur powder and distinguishing between these on the basis of:

(i) appearance, i.e., homogeneity and heterogeneity

(ii) behaviour towards a magnet

(iii) behaviour towards carbon disulphide as a solvent

(iv) effect of heat

3. Perform the following reactions and classify them as physical or chemical changes: **Unit-I**

a) Iron with copper sulphate solution in water

b) Burning of magnesium ribbon in air

c) Zinc with dilute sulphuric acid

d) Heating of copper sulphate crystals

e) Sodium sulphate with barium chloride in the form of their solutions in water

4. Preparation of stained temporary mounts of (a) onion peel, (b) human cheek cells & to record observations and draw their labeled diagrams. **Unit-II**

5. Identification of Parenchyma, Collenchyma and Sclerenchyma tissues in plants, striped, smooth and cardiac muscle fibers and nerve cells in animals, from prepared slides. Draw their labeled diagrams. **Unit-II**

6. Determination of the melting point of ice and the boiling point of water. **Unit-I**

7. Verification of the Laws of reflection of sound. **Unit-III**

8. Determination of the density of solid (denser than water) by using a spring balance and a measuring cylinder. **Unit-III**

9. Establishing the relation between the loss in weight of a solid when fully immersed in **Unit-III**

a) Tap water

b) Strongly salty water with the weight of water displaced by it by taking at least two different solids.

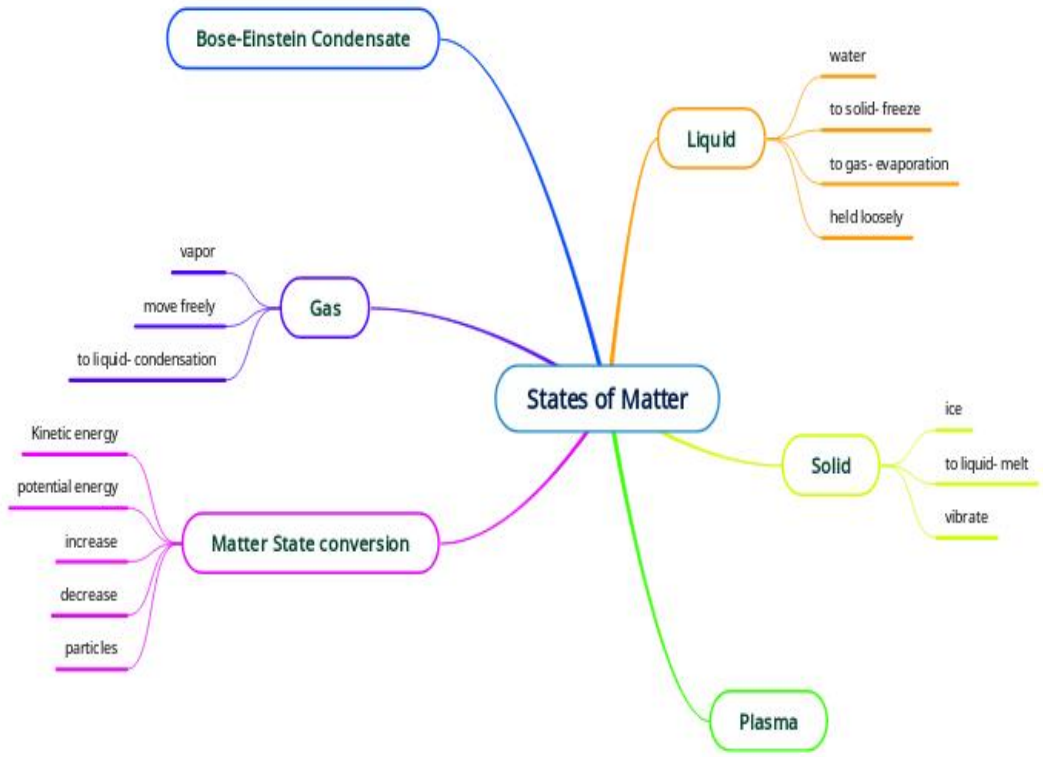
10. Determination of the speed of a pulse propagated through a stretched string/slinky (helical spring). **Unit-III**

11. Verification of the law of conservation of mass in a chemical reaction. **Unit-III**

CHAPTER-01

MATTER IN OUR SURROUNDINGS

MIND MAP



SUMMARY

Matter

Anything that occupies space and has mass and is felt by senses is called matter.
Matter is the form of five basic elements the Panch tatva – air , earth ,fire , sky and water.

Characteristics of particles of matter/ Particle Nature of Matter

Made of tiny particles. Vacant spaces exist in particles. Particles are in continuous motion. Particles are held together by forces of attraction.

States of Matter

Basis of Classification of Types

Based upon particle arrangement
Based upon energy of particles
Based upon distance between particles

We can classify our body into three states of matter i.e.,
Bones and teeth are solids.
Blood and water present in our body are liquids.
Air in our lungs is gaseous and also there is 70% of water is in our body.

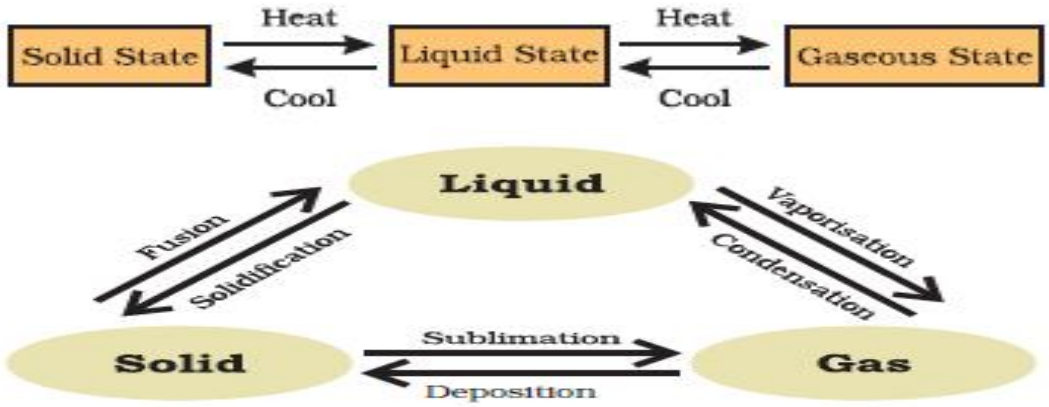
Property	(i) SOLID	(ii) LIQUID	(iii) GAS
Shape and volume	Fixed shape and definite volume.	Not fixed shape but fixed volume.	Neither fixed shape nor fixed volume.
Interparticle space	Inter particle distances are smallest.	Inter particle distances are larger.	Inter particle distances are largest.
Compressibility	Incompressible.	Almost incompressible.	Highly compressible.
Movement	High density and do not diffuse.	Density is lower than solids and diffuse.	Density is least and diffuse.
Forces of attraction	Inter particle forces of attraction are strongest.	Inter particle forces of attraction are weaker than solids .	Inter particle forces of attraction are weakest.
Arrangement of molecules	Constituent particles are very closely packed.	Constituent particles are less closely packed.	Constituent particles are free to move about.
Fluidity	Cannot flow	Flows from higher to lower level	Flows in all directions

(iv) Plasma (non –evaluative)
A plasma is an ionized gas.
A plasma is a very good conductor of electricity and is affected by magnetic fields.
Plasma, like gases have an indefinite shape and an indefinite volume. Ex. Ionized gas
(v) Bose-Einstein condensate (non –evaluative)
A BEC is a state of matter that can arise at very low temperatures.
The scientists who worked with the Bose-Einstein condensate received a Nobel Prize for their work in 1995.
The BEC is all about molecules that are really close to each other (even closer than atoms in a solid).

Interchange in states of matter -Matter Can Change its State

Water can exist in three states of matter –

- Solid, as ice ,
- Liquid, as the familiar water, and
- Gas, as water vapour.



Sublimation : The changing of solid directly into vapours on heating & vapours into solid on cooling. Ex. Ammonium chloride , camphor & iodine.

a) Effect of change in temperature

The temperature effect on heating a solid varies depending on the nature of the solid & the conditions required in bringing the change .

On increasing the temperature of solids, the kinetic energy of the particles increases which overcomes the forces of attraction between the particles thereby solid melts and is converted to a liquid.

The temperature at which a solid melts to become a liquid at the atmospheric pressure is called its melting point. The melting point of ice is 273.16 K.

The process of melting, that is, change of solid state into liquid state is also known as fusion.

Boiling point: The boiling point of a liquid is defined as the temperature at which the vapour pressure of the liquid is equal to the atmospheric pressure. For water this temperature is 373 K (100°C = 273 + 100 = 373 K).

b) Effect of Change of Pressure

Increasing or decreasing the pressure can change the state of matter. Applying pressure and reducing temperature can liquefy gases.

Solid carbon dioxide (CO_2) is stored under high pressure. Solid CO_2 gets converted directly to gaseous state on decrease of pressure to 1 atmosphere without coming into liquid state. This is the reason that solid carbon dioxide is also known

as dry ice.

Latent Heat :

The hidden heat which breaks the force of attraction between the molecules during change of state.

Latent Heat of Fusion	Latent Heat of Vaporisation
Heat energy required to change 1kg of solid into liquid.	Heat energy required to change 1kg of liquid to gas at atmospheric pressure at its boiling point.

Thus, we can say that pressure and temperature determine the state of a substance , whether it will be solid, liquid or gas.

Evaporation & Boiling

Particles of matter are always moving and are never at rest.

At a given temperature in any gas, liquid or solid, there are particles with different amounts of kinetic energy.

In the case of liquids, a small fraction of particles at the surface, having higher kinetic energy, is able to break away from the forces of attraction of other particles and gets converted into vapour .

This phenomenon of change of a liquid into vapours at any temperature below its boiling point is called evaporation.

Factors Affecting Evaporation

Temperature: The rate of evaporation increases with an increase in temperature.
Surface area: The rate of evaporation increases with an increase in surface area.
Humidity: The rate of evaporation decreases with an increase in humidity.

Wind speed: The rate of evaporation increases with an increase in wind speed.

Evaporation cause cooling.

The particles of liquid absorb energy from the surrounding to regain the energy lost during evaporation,

For example, sweating cools down our body.

Applications of Evaporative Cooling

• To keep water cool, it is kept in earthenware containers. Similar to the pores in cotton fabric, the pores in the earthen pot's surface area allow for more evaporation.

• To keep our body cool, we sweat a lot. Evaporation is what transpiration ultimately is. Our body's water evaporates, using energy in the process and lowering our body temperature as a result.

• We dress in cotton during the summer. Since cotton is a powerful water absorbent, it

allows more perspiration to come into touch with the air, promoting more evaporation. We have a cooling effect when wearing cotton clothing because of this.

Evaporation Vs Boiling

S.No.	Evaporation	Boiling
1	It takes place at any place.	It takes place at definite temperature called boiling point ofliquid.
2.	Temperature of liquid decreases during evaporation.	Temperature of liquid does not change during boiling.
3.	Evaporation is a surface phenomenon; it takes place only at the surface of the liquid.	Boiling is the bulk phenomenon; it takesplace in the whole mass of the liquid.
4.	Evaporation is a slowand silent process.	Boiling is a rapid andviolent process.

Kelvin & Celsius Scale

Kelvin is the SI unit of temperature, 0 ℃ =273.16 K. we take 0 ℃ = 273 K.

SI unit of temperature is Kelvin. T (K)= T (0 ℃) +273

Kelvin scale of temperature has always positive sign , hence regarded as better scale than Celsius.

Atmosphere (atm) is a unit of measuring pressure exerted by a gas. The SI unit of pressure is Pascal (Pa):

1 atmosphere = 1.01×10^5 Pa. The pressure of air in atmosphere is called atmospheric pressure. The atmospheric pressure at sea level is 1 atmosphere, and is taken as the normal atmospheric pressure.

MULTIPLE CHOICE QUESTIONS

1. In all the three states of water, (i. e. ice, liquid and vapour) chemical composition of water remains same

(a) only the physical state is different. (b) the physical state remains same

(c) sometimes same and sometimes different (d) none of the above

Ans: (a)

2. Which of the following statements is incorrect about the state of matter?

(a) The force of attraction between the gas particles is very less.

(b) Plasma consists of super energetic and super excited particles.

(c) The plasma glows with a special colour depending on the nature of the gas.

(d) Bose-Einstein condensate is formed by heating gas of extremely low density.

Ans: (d)

3. When heat is constantly supplied by a burner to boiling water, then the temperature of the water during vaporization:
(a) Rises very slowly (b) Rises rapidly until steam is produced
(c) First rises and then becomes constant (d) Does not rise at all
Ans: (d)

4. Which of the following phenomena would increase on rising temperature?
(a) Diffusion, evaporation, compression of gases
(b) Evaporation, compression of gases, solubility
(c) Evaporation, diffusion, expansion of gases
(d) Evaporation, solubility, diffusion, compression of gases
Ans: (c)

5. Which of the following conditions is most favorable for converting gas into liquid?
(a) High pressure, low temperature
(b) Low pressure, low temperature
(c) Low pressure, high temperature
(d) High pressure, high temperature
Ans: (a)

6. The evaporation of water increases under the following conditions :
(a) increase in temperature, decrease in surface area
(b) increase in surface area, decrease in temperature
(c) increase in surface area, rise in temperature
(d) increase in temperature, increase in surface area, addition of common salt
Ans: (c)

7. On converting 25°C, 38°C and 66°C to kelvin scale, the correct sequence of temperature will be
(a) 298 K, 311 K and 339 K (b) 298 K, 300 K and 338 K
(c) 273 K, 278 K and 543 K (d) 298 K, 310 K and 338 K
Ans: (a)

8. Choose the correct statement of the following
(a) conversion of solid into vapours without passing through the liquid state is called sublimation.
(b) conversion of vapours into solid without passing through the liquid state is called vapourisation..
(c) conversion of vapours into solid without passing through the liquid state is called freezing.
(d) conversion of solid into liquid is called sublimation
Ans: (a)

9. In which of the following conditions, the distance between the molecules of hydrogen gas would increase?
(i) increasing pressure on hydrogen contained in a closed container
(ii) some hydrogen gas leaking out of the container
(iii) increasing the volume of the container of hydrogen gas
(iv) adding more hydrogen gas to the container without increasing the volume of the container
(a) (i) and (iii) (b) (i) and (iv) (c) (ii) and (iii) (d) (ii) and (iv)

Ans: (c)

10. Which of the following factors are responsible for the change in state of solid carbon dioxide when kept exposed to air ?
(i) increase in pressure (ii) increase in temperature
(iii) decrease in pressure (iv) decrease in temperature
(a) (i) and (ii) (b) (i) and (iii) (c) (ii) and (iii) (d) (ii) and (iv)
Ans: (c)

11.In which form, do the water molecules have less kinetic energy?
(a) Ice (b) Water (c) Steam (d) All of them have equal kinetic energy

Ans : (a)

12.Which of the following statements about evaporation is incorrect?
1. It is bulk phenomena.
2. It is a fast process.
3. It takes place at all temperatures.
(a) 2 and 3 (b) 1 and 2 (c) 1 and 3 (d) 1, 2 and 3
Ans : (b) 1 and 2, Evaporation is a surface phenomena and it is a slow process.

13.Evaporation is directly proportional to
1. humidity
2. surface area
3. temperature
4. wind speed
(a) 1 and 4 (b) 2 and 3 (c) 3 and 4 (d) 2, 3 and 4

Ans : (d) 2, 3 and 4

14. The phenomenon of change of a liquid into vapors at any temperature below its boiling point is called:

(a) Boiling (b) Freezing (c) Evaporation (d) Condensation

Ans : (c)

15. The property to flow is unique to fluids. Which one of the following statements is correct?

(a) Only gases behave like fluids (b) Gases and solids behave like fluids

(c) Gases and liquids behave like fluids (d) Only liquids are fluids

Ans : (c)

16. Which of the following remains constant when a liquid undergoes freezing?

(a) energy level of particles (b) size of particles

(c) distance between particles (d) attractive forces between particles

Ans: b

17. What happens to the particles of object during freezing-

(a) decrease in speed and move closer together

(b) decrease in speed and move farther apart

(c) increase in speed and move closer together

(d) increase in speed and move farther apart

Ans: (a)

18. Which of the following substances contains particles that move the fastest at 28 ℃

(a) ice (b) oxygen (c) petrol (d) water

Ans: (b) oxygen

ASSERTION REASON TYPE Questions

Direction: In each of the following questions, a statement of Assertion is given followed by a corresponding statement of Reason. Of the statements, mark the correct answer as

A. Both assertion and reason are true and reason is the correct explanation of assertion

B. Both assertion and reason are true but reason is not the correct explanation of assertion

C. Assertion is true but reason is false

D. Assertion is false but reason is true

1. Assertion : A gas can easily be compressed by applying pressure.
Reason : Since the inter-particle spaces between gases are very large, they can decrease by applying pressure.
Answer: A

2. Assertion : Gases exert pressure on the walls of the container.
Reason : The intermolecular force of attraction is very strong in gases.
Answer: C
3. **Assertion :** It is easier to cook food at sea level as compared to higher altitudes.
Reason : The boiling point of water increases at high altitudes.
Answer: C
4. Assertion : When a solid melts, its temperature remains the same.
Reason : The heat gets used up in changing the state by overcoming the forces of attraction between the particles.
Answer: A
5.**Assertion :** Liquids diffuses more easily as compared to gases.
Reason : Intermolecular forces are greater in liquids than in gases.
Answer: D

SHORT ANSWER TYPE

1. We can get the smell of perfume sitting several metres away, why?
   Ans : This is because perfumes **diffuse** very fast and can reach to people sitting several metres away.
2. Arrange the following substances in increasing order of force of attraction between their particles (keeping the substance having the minimum force of attraction first) :
   Water, Sugar, Oxygen
   Ans: Oxygen < Water < Sugar,
3. Name the state of water at 100 degree Celsius, zero degree Celsius and 4 degree Celsius.
   Ans : The state of water at 100 degree Celsius is gas, at 0 degree Celsius it is solid and at 4 degree Celsius it is liquid.
4. Convert the following temperature to Celsius scale:
   a. 300 K b. 573 K.
   Ans. a. 27 ℃ b. 300 ℃
5. Why do we see water droplets on the outer surface of a glass containing ice-cold water?
   Ans : If we take some ice-cold water in a glass, after some time we will see small droplets of water deposited on the outer walls of the glass. Because water vapour present in air come into the contact of cold wall of glass, lose energy and converted into liquid state which can be seen in the form of small droplets.
6. A piece of chalk can be broken into small pieces when hammered but it is not possible in case of iron bar. Why?
   Ans : The force that keeps the particles together is lesser in chalk; hence it could be easily broken down into pieces on hammering. Whereas, the magnitude of this intermolecular force is more in iron, hence it cannot be broken into small pieces on hammering.
7. Liquids and gases can be compressed but it is difficult to compress solids. Why?
   Ans : Liquids and gases have intermolecular space; on applying pressure externally on

them the molecules can come closer thereby minimizing the space between them. But in case of solids, there is no intermolecular space to do so.

8. Why is it advisable to use pressure cooker at higher altitudes?
   Ans : At higher altitudes, the atmosphere pressure is low and the water boils very fast and evaporates at faster rate, therefore, the pressure is required to increase the cooking process and this is done by using pressure cooker which increases the pressure inside the container and cooks food faster.
9. Two cubes of ice are pressed hard between two palms and after releasing the pressure, the cubes join together. Why?
   Ans : Pressure is directly proportional to temperature when we apply pressure, temperature increases then the ice in contact melts and it turns into water. When pressure is removed, the temperature decreases again and melted ice again freezes. Hence, cubes join together
10. Why does the temperature remain constant during the change of state, for any substance?
    Ans : On increasing the temperature of solids, the kinetic energy of the particles increases which is used up in changing the state as it overcome the forces of attraction between the particles, therefore, the temperature remains constant during the change of state.

LONG ANSWER QUESTIONS

1. Give reasons
(a) A gas fills completely the vessel in which it is kept.
(b) A gas exerts pressure on the walls of the container.
(c) A wooden table should be called a solid.
(d) We can easily move our hand in air but to do the same through a solid block of wood we need a karate expert.
(e) On a hot sunny day, why do people sprinkle water on the roof or open grounds?

Ans. (a) There is a low force of attraction between gas particles. The particles in the filled vessel are free to move about.
(b) Gaseous particles have the weakest attraction force. They are always moving in a haphazard manner. When a gas particle collides with the container's walls, it exerts force and thus pressure on the wall.
(c) There is a distinct contour and volume to the hardwood table. The wood particles are tightly packed. They do not conform to the container's shape. As a result, the solid features of a hardwood table are satisfied.
(d) The boundaries between air particles are quite loose. They are a long way apart and have a lot of space between them. As a result, we may move our hands freely in the air. The particles in a solid block, on the other hand, are bound together by a strong force of attraction. As a result, there is either some or no space between them. As a result, we'll require a karate expert.
(e) During hot sunny day, the surface of roof or ground absorbs large amount of heat and

remains hot. On sprinkling water on these surfaces, the water absorbs large amount of heat from the surface of roof and water evaporates thereby causing cooling effect.
2. What is the role of temperature and pressure in the interconversion of states of matter? Explain with an example.

Answer: Temperature and pressure play crucial roles in the interconversion of states of matter. By altering these two factors, we can change the state of a substance.

- **Temperature:** Increasing the temperature provides energy to the particles, allowing them to overcome intermolecular forces and change state. For example, heating ice (solid) increases its temperature until it melts into water (liquid). Further heating converts the water into steam (gas).
- **Pressure:** Increasing the pressure on a gas can force the particles closer together, changing it into a liquid. Decreasing the pressure can have the opposite effect. For example, carbon dioxide can be converted into dry ice (solid) by applying high pressure and low temperature.

Example:

- **Water:** At 1 atm pressure, water exists as a solid (ice) below 0°C, as a liquid between 0°C and 100°C, and as a gas (steam) above 100°C. By increasing the pressure, water can be converted into ice at temperatures above 0°C, and by decreasing the pressure, it can be converted into steam at temperatures below 100°C.

CASE BASED/ COMPETENCY BASED

Do we always need to heat or change pressure for changing the state of matter? Can you quote some examples from everyday life where change of state from liquid to vapour takes place without the liquid reaching the boiling point? In the case of liquids, a small fraction of particles at the surface, having higher kinetic energy, is able to break away from the forces of attraction of other particles and gets converted into vapour. This phenomenon of change of a liquid into vapors at any temperature below its boiling point is called evaporation.

i.) Evaporation of liquid takes place at

a.) Boiling point
b.) Above boiling point
c.) Below boiling point
d.) None of these

ii.) Evaporation takes place at surface of liquid because

a.) They are heavy as compare to other particles
b.) They have sufficient kinetic energy to break the force
c.) They are light weight as compare to other particles
d.) None of these

iii.) During evaporation particles of liquid change into vapour

a.) From the surface

b.) From the bottom

c.) From all over the liquid

d.) None of these

iv.) Define evaporation.

v.) Explain process of evaporation

Answer key

i.) c

ii.) b

iii.) a

iv.) The phenomenon of change of a liquid into vapors at any temperature below its boiling point is called evaporation.

v.) In the case of liquids, a small fraction of particles at the surface, having higher kinetic energy, is able to break away from the forces of attraction of other particles and gets converted into vapour. This phenomenon of change of a liquid into vapors at any temperature below its boiling point is called evaporation.

2. Imagine you are a scientist studying the properties of matter. You have been given a sample of an unknown substance. Design an experiment to determine whether the given substance is a solid, liquid, or gas. Your experiment should include the following steps:

(a) Planning: Outline the steps you would take to plan your experiment, including the materials and equipment you would need.

(b) Procedure: Describe the procedure you would follow to conduct the experiment, including the measurements and observations you would make.

(c) Analysis: Explain how you would analyze the data collected from your experiment to determine the state of the unknown substance (solid, liquid, or gas).

Answer:

(a) **Planning:**

- Materials and Equipment: Thermometer, beaker, burner (or heat source), stopwatch, unknown substance sample.
- Procedure:
  - Collect the unknown substance sample in a beaker.
  - Note down the initial temperature of the substance using a thermometer.

(b) **Procedure:**

- Heat the substance gradually using a burner, while stirring gently.
- Note the temperature at which the substance starts melting or boiling.
- Continue heating until all the substance has melted (for solids) or evaporated (for liquids).
- Record the final temperature when the substance completely changes state.
- Measure the time taken for the substance to change state (optional).

(c) **Analysis:**

- Solid: If the substance melts at a specific temperature, it is a solid. The melting point can

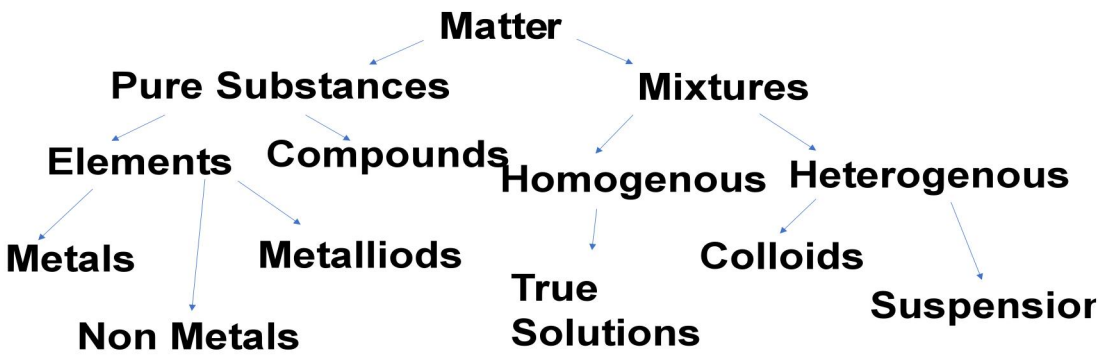
help identify the substance.

- Liquid: If the substance starts boiling at a specific temperature, it is a liquid. The boiling point can help identify the substance.
- Gas: If the substance evaporates without a definite boiling point, it is a gas. The rapid change from liquid to gas indicates a volatile substance.

By following this experiment, you can determine the state of the unknown substance and analyze its properties to identify whether it is a solid, liquid, or gas

CHAPTER 2 IS MATTER AROUND US PURE

MIND MAP



Introduction

Matter can be classified into pure substances and mixtures.
Pure substances consist of a single type of particle, while mixtures contain two or more different types of particles.

Pure Substances
Elements: A pure substance that cannot be broken down into simpler substances by chemical means. Examples include oxygen, gold, and iron.
Compounds: A pure substance composed of two or more elements chemically combined in a fixed proportion. Examples include water (H_2O), carbon dioxide (CO_2), and sodium chloride (NaCl).
Mixtures
Homogeneous Mixtures (Solutions): Mixtures that are uniform throughout. The components are not visually distinguishable. Examples include salt water, sugar solution, and air.
Heterogeneous Mixtures: Mixtures that are not uniform throughout. The components are visually distinguishable. Examples include a mixture of sand and salt, oil and water, and cereal in milk.
Solutions
Solute: The component of a solution that is dissolved (e.g., salt in salt water).
Solvent: The component of a solution that dissolves the solute (e.g., water in salt water).
Concentration: The amount of solute present in a given quantity of solvent or solution. Common units include grams per liter (g/L) and molarity (M).
Colloids and Suspensions

Colloids: Mixtures where the particle size is intermediate between true solutions and suspensions. The particles do not settle out on standing and cannot be separated by filtration. Examples include milk, fog, and jelly.

Suspensions: Heterogeneous mixtures where the particles are large enough to settle out on standing. They can be separated by filtration. Examples include muddy water and sand in water.

Properties of Colloids

Tyndall Effect: The scattering of light by colloidal particles. This effect is used to distinguish between colloids and true solutions.

Brownian Motion: The random movement of colloidal particles, which prevents them from settling down.

DIFFERENCE BETWEEN COMPOUNDS AND MIXTURES

SN	Compounds	Mixtures
1	Compounds are pure substances.	Mixtures are impure substances.
2	Compounds are made up of two or more elements combined chemically.	Mixtures are made up of two or more substances mixed physically.
3	The components of a compound are present in a fixed ratio.	The components of a mixture are present in different ratio.
4	Compounds have same properties throughout the compound part.	Mixtures do not have same properties throughout the mixture part.
5	A new substance is formed.	No new substance is formed.
6	The components of a compound can be separated only by chemical methods.	The components of a mixture can be separated by physical methods.

Types of Mixtures

True	Colloidal	Suspension
Size of solute particles smallest. $< 10^{-9}$m.	Size of solute particles bigger than true but smaller than suspension. In between 10^{-9} to 10^{-6} m.	Size of particles biggest. $> 10^{-6}$ m.
Solute particles can't be seen with naked eye.	Solute particles can't be seen with Naked eye.	Can be seen with naked eye.

Homogenous mixture.	Seems homogenous but actually heterogenous mixture.	Heterogenous mixture.
Particles can't be separated by filtration.	Particles can't be separated by filtration.	Can be Separated by filtration.
Transparent	Translucent	Opaque
Stable solutions - i.e., solute particles do not settle on keeping.	Stable solutions.	Unstable solution – solute particles settle upon keeping.
Do not show Tyndall effect.	Show Tyndall effect.	May or may not show Tyndall effect.
Solution diffuse rapidly through filter paper as well as parchment paper.	Colloid particles pass through filter paper but not through parchment paper.	Suspension particles do not pass through filter paper as well as parchment paper.
e.g., Sugar in water.	e.g., Milk, blood.	e.g., Sand/mud in water.

TYPES OF COLLOIDS

Dispersal Phase (Solute)	**Dispersion Medium (Solvent)**	**Type**	**Example**
Liquid	Gas	Aerosol	Fog, cloud
Solid	Gas	Aerosol	Smoke
Gas	Liquid	Foam	Shaving Cream
Liquid	Liquid	Emulsion	Milk, face cream, emulsion paint
Solid	Liquid	Sol	Mud, Digene
Gas	Solid	Foam	Foam, rubber sponge

Liquid	Solid	Gel	Jelly, cheese
Solid	Solid	Solid sol	Colored gemstones, glass (milky, coloured)

Gas in gas is not a colloidal solution - it is called a mixture.

DIFFERENCE BETWEEN PHYSICAL CHANGE AND CHEMICAL CHANGE

SN	Physical changes	Chemical changes
(i)	Changes take place only in properties such as colour, physical state, density, etc.	Change results in the formation of new chemical substance(s).
(ii)	Change is temporary.	Change is permanent.
(iii)	Original substance(s) can be obtained back easily.	Original substance(s) cannot be obtained back easily.
(iv)	Chemical properties of a substance remain unchanged even after the change.	New substance(s) with different properties are formed.
	E.g., ice melting	E.g., Wood burning

MULTIPLE CHOICE QUESTIONS

1. **Which of the following is a pure substance?**
(a) Milk (b) Air (c) Water (H_2O) (d) Steel

2. **Which of the following is not a property of a solution?**
(a) It is homogeneous. (b) The solute particles can be seen by the naked eye.
(c) It does not scatter light. (d) The solute cannot be separated by filtration.

3. **Which of the following is a heterogeneous mixture?**
(a) Vinegar (b) Sugar solution (c) Oil and water (d) Air

4. **What is the term used for the scattering of light by colloidal particles?**
(a) Brownian motion (b) Tyndall effect (c) Chromatography (d) Filtration

5. **In a salt solution, salt is the:**
(a) Solvent (b) Solute (c) Solution (d) None of these

6. **A suspension is characterized by:**
(a) Particles that are invisible to the naked eye.
(b) Particles that do not settle down when left undisturbed.
(c) Particles that scatter a beam of light.

(d) Particles that form a true solution.

7. **Which of the following is not a compound?**
(a) Water (b) Carbon dioxide (c) Iron (d) Sodium chloride

8. **Which of the following is an example of a pure substance?**
(a) Brass (b) Bronze (c) Oxygen gas (d) Sea water

9. **Which of the following statements is true about a homogeneous mixture?**
(a) The components are easily distinguishable.
(b) The components are uniformly distributed.
(c) The components can be separated by filtration.
(d) It always contains water.

10. **What is the main difference between a suspension and a colloid?**
(a) Particle size (b) Type of solvent (c) Type of solute (d) Method of separation

11. **Which of the following is a solution?**
(a) Milk (b) Muddy water (c) Salt water (d) Smoke

12. **Which of the following is a characteristic of mixtures?**
(a) Fixed melting and boiling points
(b) Components retain their individual properties
(c) Always homogeneous
(d) Chemically combined

13. **What kind of mixture is blood?**
(a) Homogeneous mixture (b) Heterogeneous mixture
(c) Compound (d) Element

14. **The particle size in a colloid is:**
(a) Larger than 100 nm (b) Less than 1 nm
(c) Between 1 nm and 100 nm (d) Does not affect the state of the colloid

15. **Which one of the following is not a property of a compound?**
(a) It has a definite composition.
(b) It can be separated into its components by physical methods.
(c) It has properties different from its constituent elements.
(d) It is a pure substance.

16. Which of the following is a mixture of elements only-
(a) air (b) brass (c) chalk (d) water

17. Which of the following applications does not depend on water as the solvent-

(a) Making alcoholic drinks (b) Making cooking oil
(c) Making detergent (d) Making shampoo

18. A mixture can be classified as solution, colloids and suspension. Which of the following methods will not allow you to distinguish between a solution

(a) allow the mixture to stand for a period of time
(b) shine a beam of light through the mixture
(c) filter the mixture
(d) heat the mixture strongly

Answers:

1. (c) Water (H_2O)
2. (b) The solute particles can be seen by the naked eye.
3. (c) Oil and water
4. (b) Tyndall effect
5. (b) Solute
6. (c) Particles that scatter a beam of light
7. (c) Iron
8. (c) Oxygen gas
9. (b) The components are uniformly distributed.
10. (a) Particle size
11. (c) Salt water
12. (b) Components retain their individual properties
13. (b) Heterogeneous mixture
14. (c) Between 1 nm and 100 nm
15. (b) It can be separated into its components by physical methods.
16. (b) brass
17. (b)
18. (d) heat the mixture strongly

Assertion and Reason Questions

Direction: In each of the following questions, a statement of Assertion is given followed by a corresponding statement of Reason. Of the statements, mark the correct answer as

a) Both A and R are true, and R is the correct explanation of A.
b) Both A and R are true, but R is not the correct explanation of A.
c) A is true, but R is false.
d) A is false, but R is true.

1. **Assertion (A):** A solution of salt in water is a homogeneous mixture.
   Reason (R): The components of a homogeneous mixture are uniformly distributed

throughout the mixture.

2. **Assertion (A):** Air is a mixture.
   Reason (R): Air can be separated into its components by physical methods like fractional distillation.

3. **Assertion (A):** Milk is a colloid.
   Reason (R): Colloids are heterogeneous mixtures in which the particle size is intermediate between those in true solutions and suspensions.

4. **Assertion (A) :** When a beam of light is passed through a colloidal solution, its path becomes visible
   Reason (B): Light do not gets scattered by colloidal particles.

5. **Assertion :** Milk is an aerosol
   Reason : Milk contains liquid as dispersed phase in liquid as dispersion medium.

Answers:

1. a) Both A and R are true, and R is the correct explanation of A.
2. a) Both A and R are true, and R is the correct explanation of A.
3. a) Both A and R are true, and R is the correct explanation of A.
4. c) A is true, but R is false.
5. d) A is false, but R is true.

Short Answer Questions

1. What is a pure substance?

Answer: A pure substance is a material that has a constant composition and has consistent properties throughout the sample. Examples include elements like gold and compounds like water.

2. Define a mixture and give two examples.

Answer: A mixture is a combination of two or more substances where each substance retains its chemical properties. Examples include air (a mixture of gases) and soil (a mixture of organic matter, minerals, gases, liquids, and organisms).

3. What is the difference between a homogeneous mixture and a heterogeneous mixture?

Answer: A homogeneous mixture has a uniform composition throughout, such as salt dissolved in water. A heterogeneous mixture has a non-uniform composition with distinct phases, such as sand in water.

4. Explain why alloys are considered mixtures.

Answer: Alloys are considered mixtures because they consist of two or more metals (or

a metal and a non-metal) physically combined without forming new chemical bonds, and their components retain their individual properties.

5. What are the characteristics of a solution?

Answer: A solution is a homogeneous mixture of two or more substances. It has a uniform composition, the solute particles are very small, they do not settle out, and they cannot be separated by filtration. Solutions do not scatter light.

6. Describe the Tyndall effect and mention where it is observed.

Answer: The Tyndall effect is the scattering of light by particles in a colloid or in a very fine suspension. It is observed in colloidal solutions, such as milk and fog.

7. What is a colloid? Give an example.

Answer: A colloid is a mixture where very small particles of one substance are evenly distributed throughout another substance. The particles do not settle out and cannot be seen with the naked eye. An example is milk.

8. What is a suspension? Give an example.

Answer: A suspension is a heterogeneous mixture in which the solute particles do not dissolve but remain suspended throughout the solvent. The particles are visible and will settle over time. An example is sand in water.

9. How can you distinguish between a colloid and a suspension?

Answer: In a colloid, the particles are smaller, do not settle out, and exhibit the Tyndall effect by scattering light. In a suspension, the particles are larger, visible to the naked eye, and will eventually settle out on standing.

10. What are the main components of air?

Answer: The main components of air are nitrogen (approximately 78%), oxygen (approximately 21%), and small amounts of other gases such as argon, carbon dioxide, neon, helium, methane, krypton, hydrogen, and water vapor.

LONG ANSWER QUESTIONS

1. Explain in detail the difference between elements, compounds, and mixtures, and provide examples for each.

Answer: Elements, compounds, and mixtures are different forms of matter that can be distinguished based on their composition and properties.

Elements: An element is a pure substance that cannot be broken down into simpler substances by chemical means. Elements consist of only one type of atom. They have

unique physical and chemical properties. Examples of elements include oxygen (O), hydrogen (H), gold (Au), and iron (Fe). Each element has its own set of properties, such as melting point, boiling point, density, and reactivity.

Compounds: A compound is a pure substance composed of two or more elements that are chemically combined in fixed proportions. The properties of a compound are different from those of its constituent elements. For example, water (H_2O) is a compound made from hydrogen and oxygen. While hydrogen is a highly flammable gas and oxygen supports combustion, water is a liquid that extinguishes fire. Other examples of compounds include carbon dioxide (CO_2), sodium chloride (NaCl), and glucose ($C_6H_{12}O_6$).

Mixtures: A mixture is a combination of two or more substances (elements or compounds) that are not chemically combined. The components of a mixture retain their individual properties and can be present in any proportion. Mixtures can be homogeneous or heterogeneous. In a homogeneous mixture, the composition is uniform throughout, such as in saltwater or air. In a heterogeneous mixture, the composition is not uniform, and the different components can be easily distinguished, such as in a mixture of sand and iron filings or a salad.

The key differences between these forms of matter are:

Composition: Elements have a single type of atom, compounds have fixed ratios of different atoms, and mixtures have variable compositions.

Properties: Elements and compounds have specific properties, while mixtures retain the properties of their individual components.

Separation: Compounds can only be separated into their elements by chemical means, while mixtures can be separated by physical methods.

2. Discuss the properties of colloids and how they differ from solutions and suspensions, providing examples for each type of mixture.

Answer: Colloids, solutions, and suspensions are all types of mixtures, but they differ in terms of particle size, uniformity, and behavior. Here, we will discuss the properties of each and highlight their differences.

Colloids: A colloid is a mixture where one substance is dispersed evenly throughout another. The particles in a colloid are intermediate in size between those in solutions and suspensions, typically ranging from 1 nm to 100 nm. Colloidal particles do not settle out on standing and cannot be separated by filtration. One key property of

colloids is the Tyndall effect, where the particles scatter light, making the path of light visible through the mixture. Examples of colloids include milk.

Solutions: A solution is a homogeneous mixture where the solute particles are completely dissolved in the solvent. The particle size in a solution is less than 1 nm, and the mixture is uniform throughout. Solutions do not exhibit the Tyndall effect, as the particles are too small to scatter light. They are also stable and do not separate on standing. Examples of solutions include saltwater, sugar in water, and air (a solution of gases).

Suspensions: A suspension is a heterogeneous mixture where the solute particles are large enough to be visible and do not dissolve in the solvent. The particle size in a suspension is greater than 100 nm. Suspensions are unstable; the particles will settle out over time if left undisturbed. Suspensions can also be separated by filtration. Unlike solutions and colloids, suspensions do not exhibit the Tyndall effect. Examples of suspensions include sand in water, muddy water, and flour in water.

Differences:

Particle Size: Solutions have the smallest particles (<1 nm), colloids have intermediate-sized particles (1-100 nm), and suspensions have the largest particles (>100 nm).

Uniformity: Solutions are homogeneous, colloids appear homogeneous but are microscopically heterogeneous, and suspensions are heterogeneous.

Stability: Solutions and colloids are stable and do not separate on standing, while suspensions are unstable and particles settle out over time.

Tyndall Effect: Colloids exhibit the Tyndall effect, while solutions do not. Suspensions do not exhibit the Tyndall effect because the particles are too large and settle out.

Separation: Solutions cannot be separated by filtration, colloids cannot be separated by ordinary filtration but can be by ultrafiltration, and suspensions can be separated by filtration.

COMPETENCY BASED QUESTIONS

1. You are given a sample of water from a river and a sample of distilled water. How would you determine which one is the pure substance and which one is a mixture? Explain the reasoning behind your method.

Answer: To determine which sample is the pure substance and which is a mixture, you

can use the following steps:

- **Observation:** Visually inspect both samples. Distilled water should be clear and colorless, while river water may appear turbid or contain visible particles.
- **Boiling Point Test:** Measure the boiling points of both samples. Pure substances have a fixed boiling point. Distilled water will boil at 100°C at standard atmospheric pressure. If the river water sample contains dissolved impurities or other substances, its boiling point may be higher or lower and may vary during boiling.
- **Conductivity Test:** Test the electrical conductivity of both samples. Distilled water has very low electrical conductivity because it lacks ions. River water, which contains dissolved salts and minerals, will conduct electricity.
- **Evaporation Test:** Allow a small amount of each sample to evaporate in separate clean dishes. Distilled water will leave no residue upon evaporation, indicating its purity. River water is likely to leave behind residues of dissolved solids and impurities.

By conducting these tests, you can conclude that the sample with a consistent boiling point of 100°C, low electrical conductivity, and no residue after evaporation is distilled water (a pure substance), while the river water sample is a mixture.

2. A teacher shows you two clear liquids in separate beakers. One is a solution of salt in water, and the other is a colloid of milk. Without tasting or smelling, how can you identify which beaker contains the solution and which contains the colloid? Provide a detailed explanation.

Answer: To identify which beaker contains the solution of salt in water and which contains the colloid of milk, you can use the following methods:

- **Tyndall Effect Test:** Shine a beam of light, such as from a laser pointer, through each beaker. A colloid will scatter the light, making the path of the beam visible within the liquid (Tyndall effect). Milk, being a colloid, will exhibit this scattering. The salt solution, on the other hand, will not scatter the light because the dissolved salt particles are too small to affect the light beam, and the path of the light will not be visible.
- **Appearance and Uniformity:** Observe the appearance of the liquids. Milk is typically opaque and slightly white due to the dispersion of fat and protein particles, which are large enough to scatter light but too small to settle out. The salt solution will be clear and transparent, as the dissolved salt ions are uniformly distributed and do not scatter light.

By using the Tyndall effect test and observing the appearance and uniformity of the liquids, you can determine that the beaker showing light scattering (Tyndall effect) and opacity contains the colloid (milk), while the clear and transparent liquid is the salt solution.

CHAPTER 3 ATOMS AND MOLECULES

MIND MAP

TOPICS FROM SYLLABUS:- Atoms and molecules, Law of Chemical Combination, Chemical formula of common compounds, Atomic and molecular masses.

Chapter Summary

Introduction to Atoms and Molecules:

The concept of atoms was first proposed by the ancient Indian and Greek philosophers. The word 'atom' comes from the Greek word 'atoms' which means indivisible.

Modern understanding of atoms has evolved significantly, and atoms are now known to be divisible into subatomic particles.

Laws of Chemical Combination:

Law of Conservation of Mass:

Proposed by Antoine Lavoisier.
States that mass can neither be created nor destroyed in a chemical reaction.
The total mass of reactants equals the total mass of products.
e.g., A + B → C + D Reactants → Products Mass of reactants = Mass of products

Law of Constant Proportion (Definite Proportions):

Proposed by Joseph Proust.

States that a chemical compound always contains the same elements in the same proportion by mass. E.g., in water, the ratio of the mass of hydrogen to the mass of oxygen is always 1 : 8 respectively.

Dalton's Atomic Theory:

Proposed by John Dalton in 1808.

Key postulates include:

- Matter is made up of tiny particles called atoms.
- Atoms are indivisible and indestructible.
- All atoms of a given element are identical in mass and properties.
- Atoms of different elements have different masses and properties.
- Compounds are formed by the combination of atoms of different elements in fixed, simple, whole-number ratios.
- Chemical reactions involve the rearrangement of atoms, not their creation or

destruction.

Limitations of Dalton's Atomic Theory

- This theory does not account for subatomic particles. Dalton's Atomic Theory stated that atoms are indivisible. This postulate was disproved by the discovery of subatomic particles (such as protons, electrons, and neutrons).
- It doesn't account for isotopes. Dalton's Atomic Theory states that all elements have the same masses and densities. As shown by hydrogen, tritium and deuterium, different elements can have different atomic masses.

Atoms:

The smallest unit of an element that retains the properties of that element. Consists of subatomic particles: protons, neutrons, and electrons. Protons and neutrons are located in the nucleus, while electrons orbit around the nucleus. For single element Atomicity is 1 means monoatomic.

Valency:

The electrons in the atom's outermost orbit are referred to as valence electrons. The valency of an atom is determined by its ability to lose, gain, or share valence electrons in order to complete its octet.

Valency	Metallic ions	Symbol	Non-metallic ions	Symbol	Polyatomic ions	Symbol
1	Sodium	Na^+	Hydrogen	H^+	Ammonium	NH_4^+
	Potassium	K^+	Hydride	H^-	Hydroxide	OH^-
	Silver	Ag^+	Chloride	Cl^-	Nitrate	NO_3^-
	Copper	Cu^+	Bromide	Br^-	bicarbonate	HCO_3^-
			Iodide	I^-		
2	Magnesium	Mg^{2+}	Oxide	O^{2-}	Carbonate	CO_3^{2-}
	Calcium	Ca^{2+}	Sulphide	S^{2-}	Sulphite	SO_3^{2-}
	Zinc	Zn^{2+}			Sulphate	SO_4^{2-}
	Iron (II)	Fe^{2+}				
	Copper (II)	Cu^{2+}				
3	Aluminium	Al^{3+}	Nitride	N^{3-}	Phosphate	PO_4^{3-}
	Iron (III)	Fe^{3+}				

Atomic Mass:

The mass of an atom is primarily due to protons and neutrons since electrons have

negligible mass.

The atomic mass unit (amu) is defined as one-twelfth the mass of a carbon-12 atom.

Element	Atomic Mass
Hydrogen	1 u
Carbon	12 u
Nitrogen	14 u
Oxygen	16 u
Sodium	23 u
Magnesium	24 u
Sulphur	32 u
Chlorine	35.5 u
Calcium	40 u

Molecules:

A molecule is a group of two or more atoms chemically bonded together.
Molecules can be elements (e.g., O_2) or compounds (e.g., H_2O).
Molecule of Element :- Molecule of a element contains atoms of same (Homo atomic) types of elements.
E.g. H_2, O_2, Cl_2 (Diatomic- **Atomicity** (number of atoms present in molecule) =2)
O_3(Triatomic- Atomicity =3), P_4 (tetra atomic- Atomicity= 4)
Molecule of compounds :-
Molecule of a compound contains atoms of two or more different types (Hetero atomic) of elements.
E.g. CO, HCl, NaCl (Diatomic)
CO_2, H_2O (triatomic)
NH_3 (tetra atomic)

The molecular formula represents the number and type of atoms in a molecule.
Molecular Mass:
The sum of the atomic masses of all the atoms in a molecule.
Calculated by adding the atomic masses of the constituent atoms in the molecular formula.
For example,
Molecular mass of H_2O= 2 × Mass of one H-atom + Mass of one O-atom
= 2 ×1 + 16 = 18 u.

Ions:

Atoms or groups of atoms with a net electric charge due to the loss or gain of electrons.
Cations are positively charged ions (e.g., Na^+).
Anions are negatively charged ions (e.g., Cl^-).

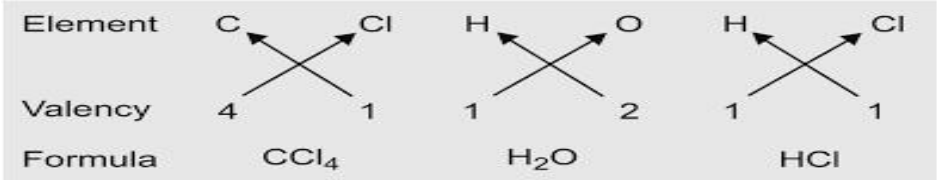
Chemical Formulae:

Represent the composition of molecules and compounds.
Empirical formula shows the simplest whole-number ratio of atoms in a compound.
Molecular formula shows the actual number of atoms of each element in a molecule.

Writing Chemical Formulae:

Rules for writing chemical formulae include:

- Write the symbol of the elements involved.
- Write the valency of each element.
- Cross-over the valency numbers to balance the charges.



MULTIPLE CHOICE QUESTIONS

1. Who proposed the law of conservation of mass?
(a) John Dalton (b) Joseph Proust (c) Antoine Lavoisier (d) Amedeo Avogadro
Answer: c) Antoine Lavoisier

2. Which of the following statements is true according to Dalton's atomic theory?
(a) Atoms are destructible.
(b) Atoms of the same element have different masses.
(c) Atoms combine in simple whole-number ratios to form compounds.
(d) Atoms are composed of subatomic particles.
Answer: c) Atoms combine in simple whole-number ratios to form compounds.

3. What is the relative atomic mass unit based on?
(a) Hydrogen-1 atom (b) Oxygen-16 atom
(c) Carbon-12 atom (d) Nitrogen-14 atom
Answer: c) Carbon-12 atom

4. **The molecular formula of water is:**

(a) H_2O_2 (b) H_2O (c) HO (d) H_2 **Answer:** b) H_2O

5. **Which of the following is a molecule of an element?**
(a) CO_2 (b) H_2O (c) O_2 (d) NaCl **Answer:** c) O_2

6. **Which law states that a chemical compound always contains the same elements in the same proportion by mass?**
(a) Law of Conservation of Mass (b) Law of Constant Proportion
(c) Avogadro's Law (d) Boyle's Law

Answer: b) Law of Constant Proportion

7. **The atomic number of an element is defined as:**
(a) The number of neutrons in an atom (b) The number of electrons in an atom.
(c) The number of protons in an atom. (d) The number of nucleons in an atom.
Answer: c) The number of protons in an atom.

8. **Which of the following is a cation?**
(a) Cl^- (b) O^{2-} (c) Na^+ (d) H_2
Answer: c) Na^+

9. **The smallest particle of an element that retains its chemical properties is:**
(a) Molecule (b) Atom (c) Electron (d) Ion
Answer: b) Atom

10. **What is the molecular mass of CO_2? (Atomic masses: C = 12 u, O = 16 u)**
(a) 28 u (b) 32 u (c) 44 u (d) 48 u **Answer:** c) 44 u

11. **Which of the following is not a postulate of Dalton's atomic theory?**
(a) Atoms can be created or destroyed.
(b) All atoms of a given element are identical in mass and properties.
(c) Compounds are formed by a combination of different atoms.
(d) Atoms of different elements have different masses and properties.
Answer: a) Atoms can be created or destroyed.

12. **The formula of Ammonium Sulphate is ————————**
(a) NH_4SO_4 (b) NH_4SO_2 (c) $(NH_4)_2SO_4$ (d) NH_2SO_4
Ans: (c) $(NH_4)_2SO_4$

13. **A student heats 25g of reactant 'A' with 50g of reactant 'B'. He obtains 50g of product 'C' and recovers 25 g of unreacted 'B'. Which of the following law is confirmed in the following reaction?**

(a) Law of constant proportion

(b) Law of conservation of mass

(c) Law of conservation of mass and Law of constant proportion

(d) Law of multiple proportion

Ans: (c) Law of conservation of mass and Law of constant proportion

14. If the formula of a chloride of a metal M is MCl_3, then what will be the formula of the phosphate of metal M?

A. M_3PO_4 B.$M_3(PO_4)_3$ C. $M(PO_4)_3$ D.MPO_4

Ans: D

1.In MCl_3, it is clear that M is trivalent ion i.e. M^{3+}.

2.Phosphate is also a trivalent anion $(PO_4)^{3-}$.

3. Therefore the formula becomes MPO_4.

15. The formula of ethanol is C_2H_5–OH. What will be its molecular mass?

I. 46 u II. 34 u III. 34 g IV. 46 g

Ans. (a) 46u

Assertion and Reason Question

Direction: In each of the following questions, a statement of Assertion is given followed by a corresponding statement of Reason. Of the statements, mark the correct answer as

(a) Both assertion and reason are true and reason is the correct explanation of assertion.

(b) Both assertion and reason are true but reason is not the correct explanation of assertion.

(c) Assertion is true but reason is false.

(d) Assertion is false but reason is true.

1. Assertion: Atomicity of ozone is three while that of oxygen is two.
Reason: Atomicity is the number of atoms constituting a molecule.
Ans. (a) Both assertion and reason are true and reason is the correct explanation of assertion.

2. **Assertion**: For the formation of a molecule at least two atoms are needed.
Reason: Molecules are formed by bonding between different atoms of different elements or complexes without any exception.
Ans. A molecule forms when two or more atoms of the same elements join together by forming chemical bonds. So, the assertion is correct but the reason is not correct.
For example:
$Cl+Cl \rightarrow Cl_2$ (Chlorine molecule) Hence, the correct option is B.

3.ASSERTION-Atom is the smallest unit of molecule
REASON-Atoms are combined with each other forming molecule.
Ans. B, Both Assertion and Reason are correct, and Reason is not the correct explanation for Assertion.

4. **ASSERTION-Mass can neither be created nor destroyed in chemical reaction**
REASON-Mass can convert its own form while chemical reaction been complete.
ANS-C, Assertion is true but Reason is false.

5. **Assertion:** N_2 and H_2O are molecules.
Reason: A molecule can have only similar kind of atoms.
Ans. The correct option is C Only Statement-1 is true
A molecule is an electrically neutral group of two or more atoms of same or different elements held together by chemical bonds. So, both N2 and H2O are molecules.

Short answer type Questions:

1. What are ionic and molecular compounds? Give examples.
Answer: Atoms of different elements join together in definite proportions to form molecules of compounds. For example, water, ammonia, carbon dioxide. Compounds composed of metals and non-metals contain charged species. The charged species are known as ions. An ion is a charged particle and can be negatively or positively charged. A negatively charged ion is called an anion and the positively charged ion is called cation. For example, sodium chloride, calcium oxide.

2.Name a diatomic gas.
Ans. E.g. Hydrogen (H_2)

3. How many atoms are present in H_2SO_4 .

Ans. A molecule of sulfuric acid (H_2SO_4) contains 2 hydrogen atoms, 1 sulfur atom, and 4 oxygen atoms. So, the total number of atoms in a molecule of H_2SO_4 is 2 + 1 + 4 = 7 atoms.

4. What is an ion? Give one example.
Answer: The negatively and positively charged particles are called ions.
For example: Cl^- , Br^- , SO_4^{2-},PO_4^{3-},H^+, Pb^{2+} , etc.

5. What is the empirical formula of a compound? Provide an example.
Answer: The empirical formula of a compound represents the simplest whole-number ratio of atoms of each element in the compound. For example, the empirical formula of glucose ($C_6H_{12}O_6$) is CH_2O.

6. Differentiate between atoms and molecules.

Answer: Atoms are the smallest units of an element that retain the properties of that element, while molecules are groups of two or more atoms chemically bonded together. For example, O_2 (oxygen molecule) consists of two oxygen atoms bonded together.

7. Define the law of conservation of mass.
Answer: The law of conservation of mass states that mass can neither be created nor destroyed in a chemical reaction. The total mass of the reactants is equal to the total mass of the products.

8. Write the cations and anions present (if any) in the following compounds:
(a) CH_3COONa (b) NaCl

(c) H_2O (d) NH_4NO_3

Answer:

Anions	Cations
(a) CH_3COO^-	Na^+
(b) Cl^-	Na^+
(c) H^+	O^{2-}
(d) NO_3^-	NH_4^+

9. Calculate the molecular mass of the following:

(a) H_2CO_3 (b) C_2H_5OH (C) $MgSO_4$

Answer:

(a) Molecular mass of $H_2CO_3 = 2 \times 1 + 1 \times 12 + 3 \times 16$
$= 2 + 12 + 48 = 62$ u

(b) Molecular mass of $C_2H_5OH = 2 \times 12 + 5 \times 1 + 1 \times 16 + 1$
$= 24 + 5 + 16 + 1 = 46$ u

(c) Molecular mass of $MgSO_4 = 1 \times 24 + 1 \times 32 + 4 \times 16$
$= 24 + 32 + 64 = 120$ u

10. Write down the names of compounds represented by the following formulae:

(i) $Al_2(SO_4)$ (ii) $CaCl_2$ (iii) K_2SO_4 (iv) KNO_3 (v) $CaCO_3$.

Ans. (i) $Al_2(SO_4)_3$ – Aluminium sulphate

(ii) $CaCl_2$ – Calcium chloride

(iii) K_2SO_4 – Potassium sulphate

(iv) KNO_3 – Potassium nitrate

(v) $CaCO_3$ – Calcium carbonate

Long answer type Questions:

1. **Question:** Describe Dalton's atomic theory. Discuss its postulates and explain how modern atomic theory differs from Dalton's original theory.

Answer: Dalton's atomic theory, proposed in the early 19th century, was a significant advancement in understanding the nature of matter. Its key postulates were:

1. All matter is composed of indivisible particles called atoms.
2. Atoms of the same element are identical in mass and properties, while atoms of different elements have different masses and properties.
3. Atoms combine in simple whole-number ratios to form compounds.
4. Chemical reactions involve the rearrangement of atoms; atoms are neither created

nor destroyed in chemical reactions.

However, modern atomic theory has evolved based on new discoveries. Modern atomic theory includes the concept of subatomic particles (protons, neutrons, and electrons) within atoms, which Dalton's theory did not account for. Additionally, modern atomic theory acknowledges isotopes, which are atoms of the same element with different numbers of neutrons, leading to variations in atomic mass.

2. **Question:**

a. What is meant by the term chemical formula?

b. What are polyatomic ions? Give examples.

c. State 3 points of difference between an atom and an ion.

Answer:a) The term chemical formula of a compound is said to be the symbolic representation of its composition or it is a notation that shows the type and number of atoms in a molecule of a compound with the help of atomic symbols and numbers. They provide information on the elements that constitute the molecules of a compound and the ratio in which the atoms of those elements combine to form the molecules. Example: A molecule of water, which is a compound, contains two molecules of hydrogen and one molecule of oxygen. Its chemical formula is H_2O .
Answer:b) Polyatomic ions are a group of atoms carrying a charge. They are typically clusters of atoms that act as an ion, which carry a fixed charge on them. Examples: ● Ammonium – NH_4^+ ● Hydroxide – OH^- ● Nitrate – NO_3^- ● Hydrogen carbonate – HCO_3^-

Answer:c)

Atom	**Ion**
An atom has no charge.	An ion has either positive or negative charge.
Number of electrons = number of protons.	Number of electrons ≠ number of protons.
Atom is reactive	Ion is stable

Competency-Based Question

1: Competency: Analysing Chemical Formulas and Equations

Question: Scenario: Atoms of most elements are not able to exist independently.

Atoms of same elements or different elements combine to form molecules and ions. (atoms exist as molecules or ions) Atoms of the same element or of different elements can join together to form molecules. The molecules of an element are constituted by the same type of atoms. Atoms of different elements join together in definite proportions to form molecules of compounds.

(i) What is the ratio between masses of carbon and oxygen in CO_2?
(a) 12:32 (b) 12:16 (c) 24:16 (d) 24:32
(ii) Which of the following statements is not true about an atom.
(a) Atoms are not able to exist independently.
(b) Atoms are the basic unit from which molecules and ions are formed.
(c) Atoms are always neutral in nature.
(d) Atoms aggregate in large numbers to form the matter that we can we see , feel or touch. (iii) Hydrogen and oxygen combine in the ratio of 1:8 by mass to form water. What mass of oxygen gas would be required to react completely with 3 gram of hydrogen gas? (a) 23g 4 (b) 12g **(c) 24g**
(d) 16g (iv) Select the atom which forms triatomic molecule. (a) Hydrogen
(b) Oxygen (c) Chlorine (d) Bromine

2.Competency: Understanding the Laws of Conservation of Mass and Atoms

A student conducts an experiment to verify the law of conservation of mass. They burn a piece of paper in a closed container and measure the mass of the container before and after the combustion. Answer the following questions based on the experiment:

(a) State the law of conservation of mass and explain its significance in chemical reactions.

(b) Describe the procedure the student should follow to ensure accurate measurement of the mass before and after the combustion.

(c) If the initial mass of the container and paper is 25 grams, what would you expect the final mass to be after complete combustion?

Answer (a) Law of Conservation of Mass: The law states that in a closed system, the total mass of reactants is equal to the total mass of products in a chemical reaction. Mass is neither created nor destroyed.

Significance: The law is significant because it demonstrates that matter is conserved

in chemical reactions, providing a fundamental principle of chemistry.

Answer (b) (Measurement Procedure):

Procedure for accurate measurement:

Use a balance with high precision to measure the mass of the container and paper before and after combustion.

Ensure the container is completely sealed during combustion to prevent the escape of gases, which could lead to mass loss.

Allow the container to cool before measuring the final mass to avoid errors due to condensation of gases.

(c) (Expected Final Mass):

The expected final mass after complete combustion would be 25 grams, as per the law of conservation of mass. Mass of reactant and product will be same.

SOLVE WITH THE HELP OF TEACHER

3. Raghu and Vansh were performing an activity related to conservation of mass in chemistry lab of their school. They mixed a solution of barium chloride and sodium sulphate. Raghu suggested that as they already knew the amount of both compounds taken by them, they need not to measure the amount of final solution. On the contrary, Vansh insisted to measure the amount of final solution, which had barium sulphate and sodium chloride. Atomic mass of ions: Ba^{2+} = 137 units, Cl^{-} = 35.5 units, Na^{+} = 23 units, S^{2-} = 32 units, O^{2-} = 16 units.

Determine the molecular mass of

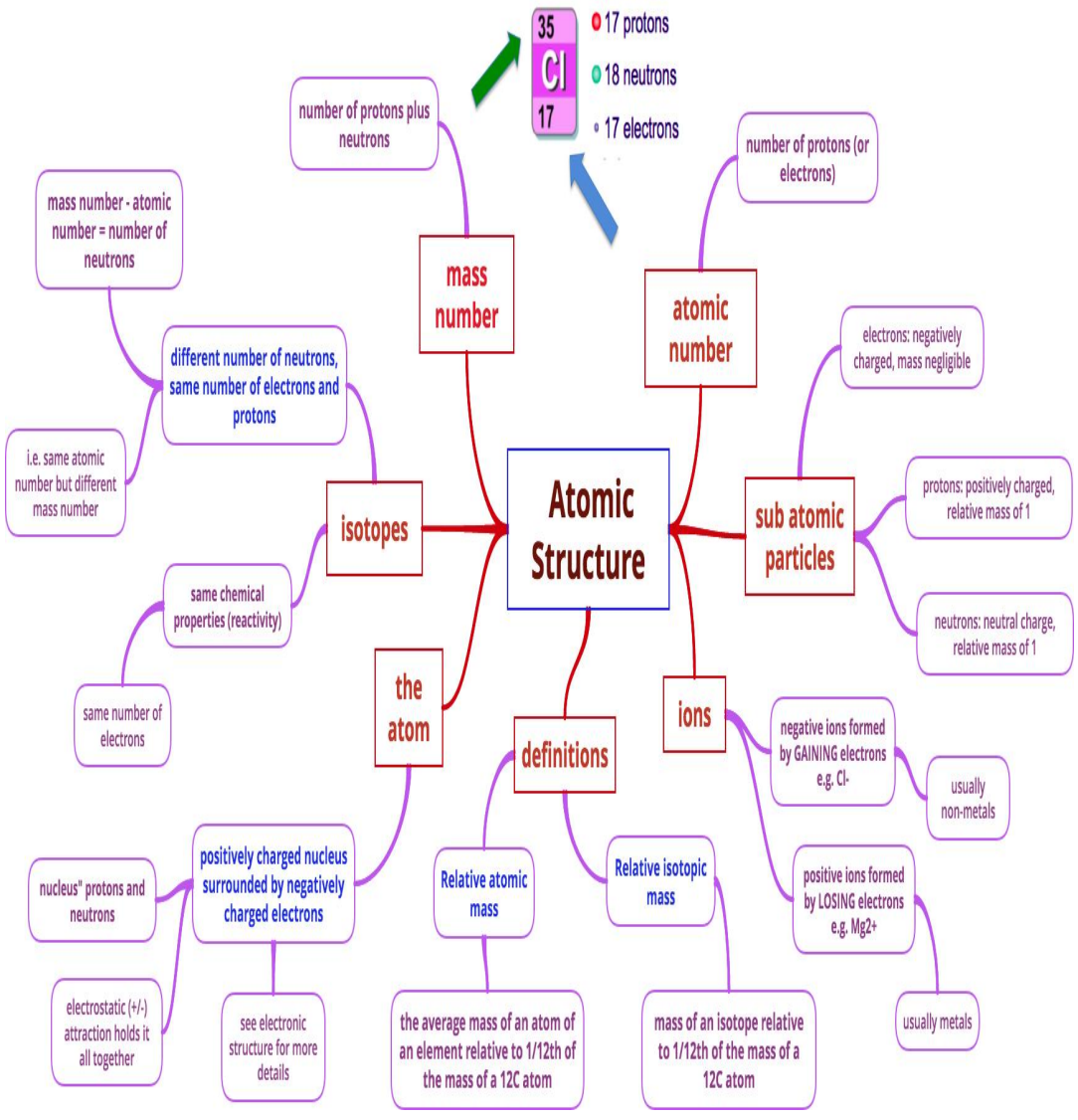
a) Barium chloride b) Barium sulphate c) Sodium sulphate d) Sodium chloride

· Comment on Vansh's Insistence to complete the activity.

*****----------*****

CHAPTER STRUCTURE OF ATOM

MIND MAP



SUMMARY

Structure of atoms: An atom contains three basic particles namely electrons,

protons and neutrons. Atom contains electrons, protons and neutrons where electrons are negatively charged particles, protons are positively charged and neutrons are neutral.
The electrons are located at the outermost regions called the electron shell.
Electron: J. J. Thomson, in 1897, discovered negatively charged particles emitted by the cathode towards the anode in a cathode ray experiment. These **negatively charged** particles are Electrons.
Protons: Ernest Goldstein, in 1886, discovered that with a different condition in the same chamber, anode emitted **positively charged** particles known as Canal rays or later named as Protons.
Neutrons: J. Chadwick discovered a subatomic particle with **no charge** and a mass equivalent to protons in the nucleus of all atoms. These neutrally charged particles are Neutrons.

The properties of electrons, protons, and neutrons:

Property	Electrons	Protons	Neutrons
Charge	Negatively Charged	Positively Charged	No Charge
Affinity	Attracts to positively charged	Attracts to negatively charged	Get attracted neither to positive nor negative
Mass	Mass is negligible	1 a.m.u	1 a.m.u
Location	Outside the nucleus	Within the nucleus	Inside the nucleus

Ions: The charged particles (atoms) are called ions, they charge or negative charge on it:
Negatively charged ion is called anion ($C1^-$).
Positively charge ion is called cation (Na^+).

- **Atomic Number**: The number of protons in an atom, which determines the element's identity.
- **Mass Number**: The total number of protons and neutrons in an atom.

Number of Protons present in an atom **= Atomic number (Z)**
Number of Electrons present in an atom**= Atomic number (Z)**
Number of Neutrons = **Mass number (A) - Atomic number (Z)**
Mass Number = Atomic Number + Number of Neutrons in the Nucleus
$A = Z + n$

- **Isotopes**: Atoms of the same element with different numbers of neutrons. They have the same atomic number but different mass numbers.

Hydrogen has three isotopes: *Protium ($_1H^1$), Deuterium ($_1H^2$), and Tritium ($_1H^3$)*.
Isobars: The atoms of different molecules with the same mass number.

For Example, in Argon, atomic number 18, Calcium, atomic number 20, the mass number of both these elements is 40. $_{18}Ar^{40}$, $_{20}Ca^{40}$

ISOTOPES	ISOBARS
Chemically same , physically different	Chemically different , physically same
Number of electrons is same	Number of electrons is different .
Cannot be separated by chemical means	Can be separated by chemical means

- **Electronic Configuration**: The arrangement of electrons in different energy levels around the nucleus.
- **Valency:** The combining capacity of an element is known as its valency. Valency is used to form a chemical compound.

Table 4.1: Composition of Atoms of the First Eighteen Elements with Electron Distribution in Various Shells

Name of Element	Symbol	Atomic Number	Number of Protons	Number of Neutrons	Number of Electrons	Distribution of Electrons				Vale-ncy
						K	L	M	N	
Hydrogen	H	1	1	-	1	1	-	-	-	1
Helium	He	2	2	2	2	2	-	-	-	0
Lithium	Li	3	3	4	3	2	1	-	-	1
Beryllium	Be	4	4	5	4	2	2	-	-	2
Boron	B	5	5	6	5	2	3	-	-	3
Carbon	C	6	6	6	6	2	4	-	-	4
Nitrogen	N	7	7	7	7	2	5	-	-	3
Oxygen	O	8	8	8	8	2	6	-	-	2
Fluorine	F	9	9	10	9	2	7	-	-	1
Neon	Ne	10	10	10	10	2	8	-	-	0
Sodium	Na	11	11	12	11	2	8	1	-	1
Magnesium	Mg	12	12	12	12	2	8	2	-	2
Aluminium	Al	13	13	14	13	2	8	3	-	3
Silicon	Si	14	14	14	14	2	8	4	-	4
Phosphorus	P	15	15	16	15	2	8	5	-	3,5
Sulphur	S	16	16	16	16	2	8	6	-	2
Chlorine	Cl	17	17	18	17	2	8	7	-	1
Argon	Ar	18	18	22	18	2	8	8		0

Multiple choice questions

1. What is the charge of a proton?

A) Positive B) Negative C) Neutral D) None of the above

Answer: A) Positive

2. Which subatomic particle has a mass approximately equal to 1 amu?
A) Proton B) Neutron C) Electron D) Positron
Answer: A) Proton

3. Where are electrons located in an atom?
A) Nucleus B) Proton C) Neutron D) Orbiting the nucleus
Answer: D) Orbiting the nucleus

4. What is the charge of an electron?
A) Positive B) Negative C) Neutral D) None of the above
Answer: B) Negative

5. What is the atomic number of an element?
A) Number of protons B) Number of neutrons
C) Number of electrons D) Total number of protons and neutrons
Answer: A) Number of protons

6. Which subatomic particle has negligible mass?
A) Proton B) Neutron C) Electron D) Positron
Answer: C) Electron

7. What is the total number of protons and neutrons in an atom called?
A) Atomic mass B) Mass number C) Atomic number D) Valency
Answer: B) Mass number

8. Which of the following is an isotope of hydrogen?
A) Deuterium B) Tritium C) Protium D) All of the above
Answer: D) All of the above

9. What is the combining capacity of an atom called?
A) Atomic mass B) Atomic number C) Valency D) Mass number
Answer: C) Valency

10. What is the number of electrons in the outermost shell of an atom called?
A) Atomic number B) Valency electrons C) Mass number D) None of the above
Answer: B) Valency electrons

11. Which subatomic particle is responsible for the chemical properties of an element?
A) Proton B) Neutron C) Electron D) Positron
Answer: C) Electron

12. Which of the following statements about isotopes is correct?
    A) Isotopes have different atomic numbers.
    B) Isotopes have different numbers of protons.
    C) Isotopes have different numbers of neutrons.
    D) Isotopes have different numbers of electrons.
    Answer: C) Isotopes have different numbers of neutrons.

13. Which of the following statements about atomic number is correct?
    A) It is the same for all isotopes of an element.
    B) It is the sum of protons and neutrons.
    C) It is the same as the mass number.
    D) It is different for each isotope of an element.
    Answer: A) It is the same for all isotopes of an element.

14. Which subatomic particle is located in the nucleus of an atom?
    A) Proton B) Neutron C) Electron D) Positron
    Answer: A) Proton

15. What is the maximum number of electrons that can be accommodated in the first shell of an atom?
    A) 2 B) 4 C) 6 D) 8
    Answer: A) 2

16. Which of the following are true for an element?
    (i) Atomic number = number of protons + number of electrons
    (ii) Mass number = number of protons + number of neutrons
    (iii) Atomic mass = number of protons = number of neutrons
    (iv) Atomic number = number of protons = number of electrons
    (a) (i) and (ii) (b) (i) and (iii) (c) (ii) and (iii) (d) (ii) and (iv)
    Ans: (d)

17. Mass number of the atom is 27 and the number of neutrons is 14. What is the number of electrons in the ion?
    (a) 13 (b) 10 (c) 14 (d) 16
    Ans: (a)

ASSERTSION AND REASON TYPE QUESTIONS

Direction: In each of the following questions, a statement of Assertion is given followed by a corresponding statement of Reason. Of the statements, mark the correct answer as

(a) Both assertion and reason are true and reason is the correct explanation of

assertion.
(b) Both assertion and reason are true but reason is not the correct explanation of assertion.
(c) Assertion is true but reason is false.
(d) Assertion is false but reason is true.

1. **Assertion**: Isotopes of an element have the same chemical properties.
   Reason: Isotopes have the same number of protons and electrons.

2. **Assertion:** Valency of an element is determined by the number of protons in its nucleus.
   Reason: Valency is the combining capacity of an element, which is determined by the number of electrons in its outermost shell.

3. **Assertion**: Electrons are located in the nucleus of an atom.
   Reason: Electrons are negatively charged particles that orbit the nucleus of an atom in specific energy levels or shells.

4. **Assertion:** Mass number of an element is always an integer.
   Reason: Mass number is the sum of the number of protons and neutrons in an atom, both of which are whole numbers.

5. **Assertion:** The atomic number of an element can change in a chemical reaction.
   Reason: Atomic number is the number of protons in an atom, which remains constant during a chemical reaction.
   Answers: 1 (a) 2 (c) 3. (c) 4. (a) 5 (c)

1. **What are subatomic particles? Name them.**
   Answer: Subatomic particles are particles that are smaller than an atom. The three main subatomic particles are protons, neutrons, and electrons.

2. **What is the charge of a neutron?**
   Answer: Neutrons have no charge; they are neutral.

3. **What is the atomic number of an element?**
   Answer: The atomic number of an element is the number of protons in the nucleus of an atom of that element.

4. **What is the mass number of an atom?**
   Answer: The mass number of an atom is the total number of protons and neutrons in the nucleus of that atom.

5. **Define isotopes.**
   Answer: Isotopes are atoms of the same element that have the same number of protons but different numbers of neutrons.

6. **What is the valency of an element?**
   Answer: The valency of an element is the number of electrons an atom of that element gains, loses, or shares to achieve a stable electron configuration.

7. **How are electrons distributed in an atom?**
   Answer: Electrons are distributed in specific energy levels or shells around the nucleus of an atom.

8. **What is the maximum number of electrons in the first energy level of an atom?**
   Answer: The maximum number of electrons in the first energy level of an atom is 2.

9. **How do isotopes of an element differ from each other?**
   Answer: Isotopes of an element have the same number of protons but differ in the number of neutrons in their nuclei.

10. **If number of electrons in an atom is 8 and number of protons is also 8, then**
    (i) what is the atomic number of the atom?
    (ii) what is the charge on the atom?
    Ans. (i) The atomic number of an atom is the same as the number of protons in that atom, hence its atomic number is 8.
    (ii) In an atom, the number of protons is equal to the number of electrons. Hence both the charges – positive and negative neutralize each other. Therefore, the atom does not possess any charge.

11. Explain why the atomic number is more fundamental to the identity of an element than its mass number.

Answer: The atomic number represents the number of protons in an atom, which determines the element's identity and its position in the periodic table, whereas the mass number is the sum of protons and neutrons and can vary among isotopes.

12. What is the valency of an element with atomic number 15? Explain.

Answer: The element with atomic number 15 is phosphorus. Its electronic configuration is 2, 8, 5. It can gain 3 electrons to complete its octet, so its valency is 3.

13. How does the concept of isotopes explain the presence of elements with fractional atomic masses?

Answer: The atomic mass of an element is the weighted average of all its isotopes' masses, considering their natural abundance. This averaging results in a fractional atomic mass.

LONG ANSWER TYPE

1. Explain the concept of isotopes with suitable examples.

Answer: Isotopes are atoms of the same element that have the same number of protons but different numbers of neutrons in their nuclei. This means that isotopes of an element have the same atomic number (since the number of protons determines the element) but different mass numbers (since the mass number is the sum of protons and neutrons).

For example, hydrogen has three isotopes: protium, deuterium, and tritium. Protium has one proton and no neutrons in its nucleus, deuterium has one proton and one neutron, and tritium has one proton and two neutrons. They all have one electron and thus exhibit similar chemical properties but differ in their physical properties due to their different masses.

2. Describe the structure of an atom and explain how the number of protons, neutrons, and electrons determines the identity of an element.

Answer: An atom consists of a nucleus containing protons and neutrons, surrounded by electrons in energy levels or shells. Protons are positively charged particles, neutrons are neutral, and electrons are negatively charged. The number of protons in the nucleus determines the atomic number of the element, which in turn determines the element's identity.

Neutrons and protons contribute to the mass number of the atom. Isotopes of an element have the same number of protons (and hence the same atomic number) but different numbers of neutrons, leading to different mass numbers. Electrons determine the chemical behavior of an element since they are involved in bonding with other atoms.

COMPETENCY BASED QUESTIONS

Question 1: Explain how isotopes are used in carbon dating. Why is carbon-14 preferred for this purpose?

Answer: Isotopes are used in carbon dating to determine the age of archaeological artifacts and fossils. Carbon-14 is preferred for this purpose because it is radioactive and undergoes radioactive decay at a known rate. This decay is used to

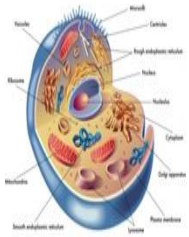
estimate the age of the sample. When an organism dies, it stops taking in carbon, including carbon-14. By measuring the remaining carbon-14 in the sample and comparing it to the initial amount, scientists can determine how long ago the organism died.

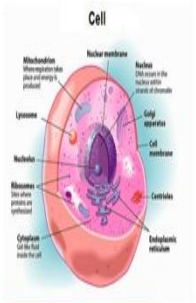
Question 2: Question: How does the concept of valency help in understanding the chemical behavior of elements? Give an example.

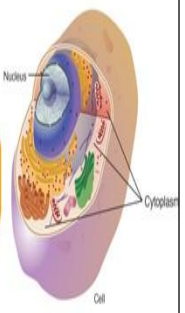
Answer: Valency is the combining capacity of an atom, which is determined by the number of electrons in its outermost shell. The number of electrons in the outermost shell determines how easily an atom can gain, lose, or share electrons to achieve a stable electron configuration. This helps in predicting the type of bonds an element can form and its chemical behavior.
For example, sodium (Na) has one electron in its outermost shell, which it can easily lose to achieve a stable electron configuration. This makes sodium highly reactive, especially with elements that can easily gain an electron, such as chlorine (Cl). When sodium reacts with chlorine, it loses its outer electron to form a positively charged sodium ion (Na^+), which then combines with a negatively charged chloride ion (Cl^-) to form the stable compound sodium chloride (NaCl), or table salt.

CHAPTER FUNDAMENTAL UNIT OF LIFE

MIND MAP







ENDOPLASMIC RETICULUM (ER)
Involved in synthesis, folding, modification and transport of proteins –RER (rough ER, with ribosome's), SER (smooth ER)

CYTOPLASM
Clear, jelly-like fluid inside the cell

VACUOLES
Might store food or any variety of nutrients

THE FUNDAMENTAL ORGANISATIONAL UNIT OF LIFE IS THE CELL

CELL MEMBRANE
Surrounds the cell and protects the inner components

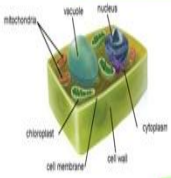
LYSOSOMES
Contain digestive enzymes,-like the stomach of the cell

CELL ORGANELLES

THE FUNDAMENTAL UNITS OF LIFE

STRUCTURAL ORGANIZATION OF CELL

GOLGI APPARATUS
Involve in transporting, modifying, and packaging proteins and lipids

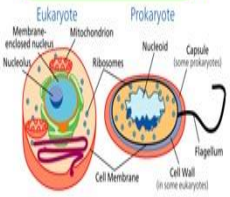


CELL WALL
Rigid, semi-permeable protective layer surrounding certain cells. It is cellulosic in plants.

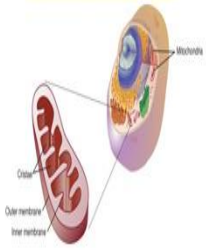
PLASTIDS
Related to making and storing food,-Chloroplast(green in plants), Chromoplast(colored), Leucoplast (Colorless)

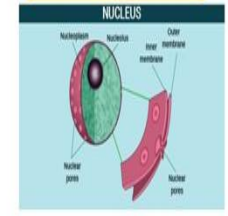
MITOCHONDRIA
The powerhouse of the cell as respiration occur

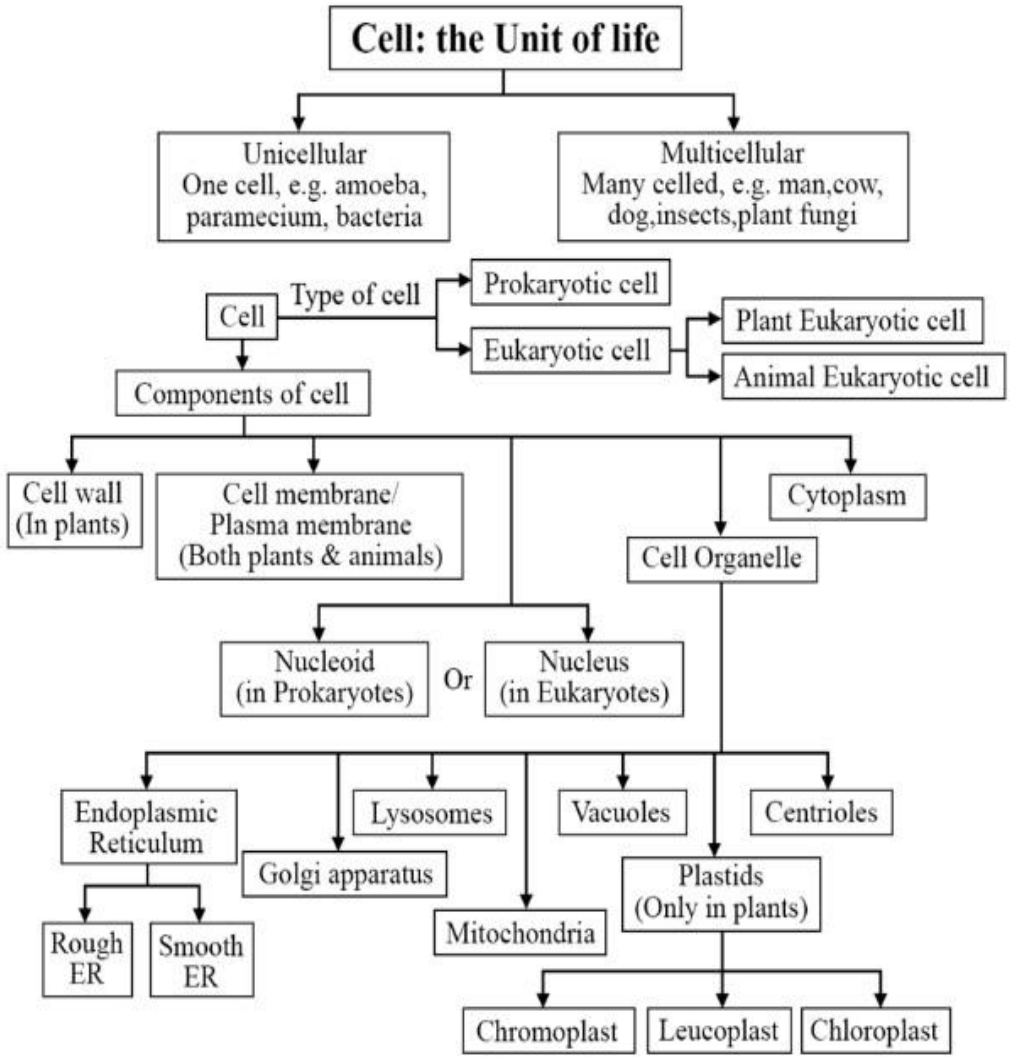
PROKARYOTIC CELLS AND EUKAYOTIC CELLS



NUCLEUS A central structure that holds your genetic information (DNA)







SUMMARY

Introduction to the Cell

The cell is the smallest unit of life, capable of independent existence and performing essential life functions. Robert Hooke discovered the cell in 1665 while observing a thin slice of cork under a microscope. Anton van Leeuwenhoek later observed living cells in pond water.

Cell Theory

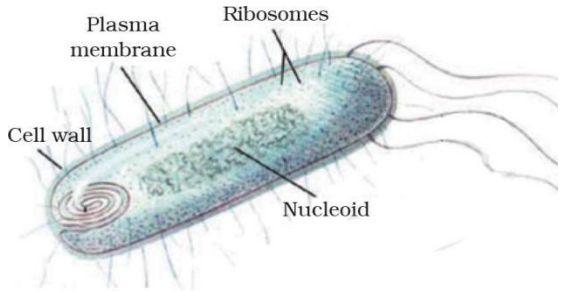
Proposed by **Schleiden and Schwann**, later refined by Rudolf Virchow.
States that all living organisms are composed of cells, cells are the basic unit of structure and function in organisms, and all cells arise from pre-existing cells.

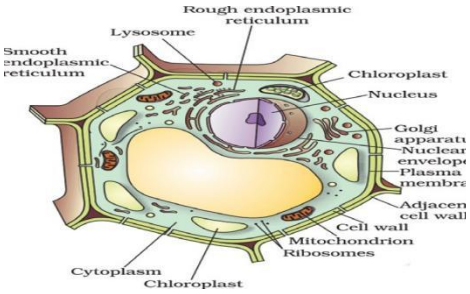
Types of Cells

Prokaryotic Cells: Lack a well-defined nucleus and membrane-bound organelles. Example: Bacteria.

Eukaryotic Cells: Have a well-defined nucleus and membrane-bound organelles. Examples: Plant and animal cells.

Prokaryotes	**Eukaryotes**
Size: generally small (1-10 μm)	Size: generally large. (5-500 μm)
Nuclear region: Not well defined and not surrounded by a nuclear membrane & known as nucleoids.	Nuclear region: Well defined and surrounded by a nuclear membrane
Chromosome: Single	Chromosome: More than one chromosome
Membrane-bound cell organelles absent	Membrane-bound cell organelles present
Eg- bacteria, blue green algae	Eg fungi, plant cell and animal cell.





Structure of the Cell

Cell Size: Size of cell is variable depending upon the type of organism. Some are microscopic while some are visible with naked eyes. Their size may vary from 0.2 um to 18cm. Size of typical cell in a multicellular organism ragnism ranges from 20-30um.

The largest cell is ostrich egg (15 cm long 13cm wide & weight 1.4 kg)

The longest cell is never cell (up to l m).

Smallest cells so far known are PPLOs e.g., mycoplasma

Components of Cell

There is an occurrence of division of labour within a Eukaryotic cell as they all got certain specific components called 'Cell organelles'. Each of them perform a specific function. The three basic components of all the cells are :

Plasma membrane (ii) Nucleus (iii) Cytoplasm

Plasma Membrane:

A selectively permeable membrane that controls the entry and exit of substances.
Made up of a lipid bilayer with embedded proteins. It helps in diffusion and osmosis.

Diffusion: movement of substance from high concentration to low concentration. E.g.; exchange of carbon dioxide or oxygen with external environment.
Osmosis: it is the passage of water from the region of high water concentration to a region of low water concentration through a selective permeable membrane.
(a) The cell gains water, if the medium surrounding the cell has a higher water concentration (**Hypotonic solution**) than the cell.
(b) The cell maintains the same water concentration as the cell (**Isotonic solution**); water crosses the cell membrane in both directions.
(c) The cell loses water, if the medium has lower water concentration (**Hypertonic solution**) than the cell.

Types of Solutions on the Basis of Concentration and its effect on cell:

Hypotonic Solution	**Isotonic Solution**	**Hypertonic Solution**
External solution having higher concentration of water than the cell cytoplasm is known as hypotonic solution.	External solution having exactly the same concentration of water as that of cell cytoplasm is called isotonic solution.	External solution having lower concentration of water than a cell cytoplasm is called hypertonic solution.
Cell swells up in this solution.	Cell size does not alter.	Cell shrinks in this solution.

Endomosis : Movement of solvent into the cell is called as Endomosis.
Exosmosis : Movement of solvent outside the cell is called as Exomosis

Cell Wall:
Found in plant cells, fungi, and some bacteria.
Provides rigidity, protection, and structural support. Composed of cellulose in plants.
Functions of Cell Wall:
It provides definite shape to the cell.
It provides strength to the cell.
It is permeable and allows entry of molecules of different sizes.

Nucleus:

Nucleus is the most important cell organelle which directs and controls all its cellular activities.

It is called as 'Headquarter of the cell'/controller of cell.

It was discovered by Robert Brown in 1831.

In Eukaryotes, a well-defined nucleus is present while in Prokaryotes, a well-defined nucleus is absent.

Prokaryotes contain a primitive nucleus called Nucleoid.

It has double layered covering called as nuclear membrane.

Nuclear membrane has pores which regulate the movement of materials in & out of the cell.

Besides nuclear membrane, nucleus also contains nucleolus and chromatin material made up of chromatin. Chromatin made up of DNA and Protein that ultimately condense and form chromosome.

Chromosomes or chromatin material consists of DNA which stores and transmits hereditary information for the cell to function, grow and reproduce.

The Functional Segment of DNA (Deoxyribonucleic acid) is known as GENEs.

Functions of Nucleus:

It controls all the metabolic activities of the cell and regulates the cell cycle.

It helps in transmission of hereditary characters from parents to their offsprings.

Surrounded by a nuclear envelope with pores that regulate the exchange of materials.

Contains nucleolus, which is involved in ribosome synthesis.

Chromatin	**Chromosomes**	**Genes**
It is a fine network of thread-like structure made up of DNA or RNA. It gets condensed to form chromosomes.	The chromosomes are made from chromatin material and are located in the cell.	Genes are found in chromosomes.

Cytoplasm:

A jelly-like substance that fills the cell and holds the organelles.

Site of many metabolic activities.

Cell Organelles:

Endoplasmic Reticulum (ER):

Rough ER: Studded with ribosomes; involved in protein synthesis.

Smooth ER: Lacks ribosomes; involved in lipid synthesis and detoxification.

Smooth endoplasmic reticulum	Rough endoplasmic reticulum
It looks smooth.	It looks rough.
SER helps in the manufacturing of fat molecules or lipids.	Ribosomes are attached to RER which synthesize proteins.

Function of ER:

It is the only organelle which serves as a channel for the transport of materials between various regions of cytoplasm and between cytoplasm and nucleus.

It also functions as a cytoplasmic framework to provide surface some of the biochemical

activities. It forms endoskeleton of cell.

It helps in synthesis of fats, protein, steroids, cholesterol etc.

SER plays a crucial role in detoxification of drugs and poisonous by products.

Membrane biogenesis: Protein & Lipids produced by ER are used to produced cell membrane.

Golgi Apparatus:

Modifies, sorts, and packages proteins and lipids for storage or transport.

Functions of Golgi apparatus*:*

Its function include the storage, modification, Packaging & secretion of products in vesicles.

It involved in the formation of lysosomes.

It is secretary in nature.

It helps in melanin synthesis.

It involved in the synthesis of cell wall & plasma membrane also

Lysosomes:

They are tiny membrane bound vesicles containing powerful digestive enzymes for intracellular digestion. Lysosome absent in RBC's. Lysosomes are synthesized by Golgi body & enzyme present in it are synthesized by RER.

Functions:-

(a) Their main function is phagy = digestion.

(b) They are kind of waste disposal system.

(c) They help in digesting foreign materials & cells.

Suicidal Bag : During disturbances in cellular metabolism (i.e., in case of cell damage). lysosomes burst and their enzymes are released into the cytoplasm and they digest their own cell. So they are also called 'Suicidal Bag'.

Mitochondria:
It is a rod-shaped structure found in cytoplasm of all eukaryotic cells except mammalian RBC's. These are also absent in prokaryotes. It was first seen by Kolliker in insect cells in 1880. It is also called as **'Power House of the Cell'** or the **'Storage Battery'**.
It is double membranous structure where outer membrane has specific proteins while inner membrane is folded inside to form chambers called Cristae.
Mitochondria has its own DNA& Ribosomes
Functions of Mitochondria:
Its main function is to produce store and release the energy in the form of ATP. (Adenosine Triphosphate) The energy currency of the cell.
It is the site for cellular respiration (Kreb cycle) in which ATP are produced.

Plastids:
It is double membranous discoidal structure, found only in plant cells.
Besides being discoidal of rhombic in plant cells, they occur in variable shapes like in (algae.) They can be 'U' - shaped, spiral, coiled, ribbon- shaped etc.

Depending upon the type of pigment present in them, they are of following three types:
chloroplasts (photosynthesis), chromoplasts (pigment synthesis), and leucoplasts (storage).
Leucoplast – White or colourless plastids
The primary functions is storage of starch, oil, proteins**.**
Chromoplast- These are coloured plastids except green it **imparts colour** to fruits
& flowers.
Chloroplast- Green in colour, found in aerial parts of plants.
These are found only in plant cell. It helps in the process of photosynthesis so it is called the 'Kitchen of cell" in plants.

Chloroplast have following two parts:
Grana : It constitutes the lamellar system. These are found layered on top of each other. These stacks are called Grana. Each granum of the chloroplast is formed by superimposed closed compartments called Thylakoids.
Function : They are the sites of light reaction of photosynthesis as they contain photosynthetic pigment "chlorophyll".
Stroma : It is a granular transparent substance also called as matrix. Grana are embedded in it. Besides Grana they also contain lipid droplets, starch grains, ribosomes etc.

Function : This is the site of dark reaction of photosynthesis. Also helps in

protein synthesis due to presence of ribosomes.

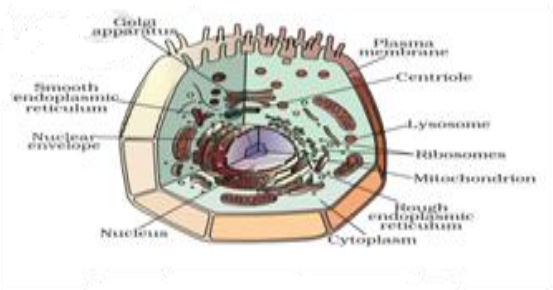
Vacuoles:
Storage sacs for water, nutrients, and waste. Larger in plant cells.
Functions:
It helps in maintaining osmotic pressure in a cell & stores toxic metabolic products (Waste product water, sugar, protein etc.) of plant cell.

Ribosomes:
Sites of protein synthesis.
Can be free-floating in the cytoplasm or attached to the rough ER.

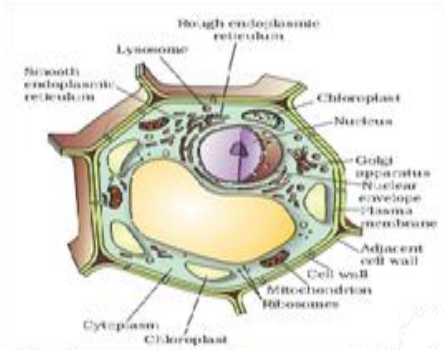
Cytoskeleton:
Network of protein filaments and tubules providing shape, support, and movement.
Includes microfilaments, intermediate filaments, and microtubules.

Functions of the Cell
Metabolism: All chemical reactions occurring within the cell.
Growth and Development: Increase in cell size and number.
Reproduction: Cell division (mitosis and meiosis) for growth, repair, and reproduction.
Response to Stimuli: Ability to react to environmental changes.
Homeostasis: Maintenance of a stable internal environment.

S.No	**ANIMAL CELL**	**PLANT CELL**
1.	Cell wall absent	Cell wall present
2.	Plasma membrane is the outer layer which provides turgidity to the cell	Cell wall is the outer layer which gives rigidity and turgidity to the cell.
3.	Vacuoles are small in size	Vacuoles are big in size
4.	Plastids are absent	Plastids are present
5.	Nucleus lies in the center.	Nucleus lies on one side
6.	Lysosome always present in animal cells.	Lysosomes are rare.
7.	Reserve food is usually glycogen.	Reserve food is generally in the form of starch.



ANIMAL CELL



PLANT CELL

Cell Division: New cells are formed in organisms in order to grow, to replace old, dead and injured cells, and to form gametes required for reproduction. The process by which new cells are made is called cell division.
The are two main types of cell division:

i) **Mitosis** : The process of cell division by which most of the cells divide for growth is called mitosis. In this process, each cell called mother cell divides to form two identical daughter cells. The daughter cells have the same number of chromosomes as mother cell. It helps in growth and repair of tissues in organisms.

ii) **Meiosis** : Specific cells of reproductive organs or tissues in animals and plants divide to form gametes, which after fertilisation give rise to offspring. They divide by a different process called meiosis which involves two consecutive divisions. When a cell divides by meiosis it produces four new cells instead of just two. The new cells only have half the number of chromosomes than that of the mother cells.

Multiple choice questions

1. Which scientist discovered cells by observing a thin slice of cork?
(a) Anton van Leeuwenhoek (b) Robert Hooke
(c) Matthias Schleiden (d) Theodor Schwann
Answer: b) Robert Hooke

2. Which of the following is not a part of the cell theory?
a) All living organisms are composed of cells
b) Cells are the basic unit of structure and function in organisms
c) All cells have a nucleus
d) All cells arise from pre-existing cells
Answer: c) All cells have a nucleus

3. Prokaryotic cells lack:
(a) Cytoplasm (b) Cell membrane (c) Nucleus (d) Ribosomes

Answer: c) Nucleus

4. Which organelle is responsible for protein synthesis in a cell?
(a) Golgi apparatus (b) Lysosome (c) Mitochondria (d) Ribosome
Answer: d) Ribosome

5. Which of the following is not found in animal cells?
(a) Cell wall (b) Nucleus (c) Vacuole (d) Mitochondria
Answer: a) Cell wall

6. The Golgi apparatus is responsible for:
(a) Energy production (b) Protein synthesis
(c) Lipid synthesis (d) Modifying, sorting, and packaging proteins
Answer: d) Modifying, sorting, and packaging proteins

7. Which organelle is known as the powerhouse of the cell?
(a) Golgi apparatus (b) Lysosome (c) Mitochondria (d) Endoplasmic reticulum
Answer: c) Mitochondria

8. The cell wall of plant cells is mainly composed of:
(a) Cellulose (b) Chitin (c) Peptidoglycan (d) Lipids
Answer: a) Cellulose

9. Which organelle contains enzymes for digesting worn-out cell parts and food particles?
(a) Nucleus (b) Ribosome (c) Lysosome (d) Vacuole
Answer: c) Lysosome

10. The fluid-filled sac found in plant cells that stores water, nutrients, and waste products is called:
(a) Nucleus (b) Ribosome (c) Lysosome (d) Vacuole
Answer: d) Vacuole

11. Which of the following is a function of the cytoskeleton?
(a) Protein synthesis (b) Cell division (c) Cell movement (d) Energy production
Answer: c) Cell movement

12. The process by which cells take in substances from the outside environment is called:
(a) Exocytosis (b) Endocytosis (c) Osmosis (d) Diffusion
Answer: b) Endocytosis

13. Which of the following is true about prokaryotic cells?
(a) They have a well-defined nucleus
(b) They are usually larger than eukaryotic cells
(c) They do not have membrane-bound organelles
(d) They are found only in multicellular organisms
Answer: c) They do not have membrane-bound organelles

14. The site of photosynthesis in plant cells is the:
(a) Chloroplast (b) Golgi apparatus (c) Endoplasmic reticulum (d) Mitochondria
Answer: a) Chloroplast

15. Which of the following is not a characteristic of living organisms?
(a) Reproduction (b) Growth (c) Movement (d) Respiration
Answer: c) Movement

Direction: In each of the following questions, a statement of Assertion is given followed by a corresponding statement of Reason. Of the statements, mark the correct answer as
(a) Both assertion and reason are true and reason is the correct explanation of assertion.
(b) Both assertion and reason are true but reason is not the correct explanation of assertion.
(c) Assertion is true but reason is false.
(d) Assertion is false but reason is true.

1. **Assertion (A):** The cell membrane is selectively permeable.
Reason (R): The cell membrane allows only certain substances to pass through it while restricting others.
Answer: a) Both A and R are true, and R is the correct explanation of A.

2. **Assertion (A):** Mitochondria are known as the powerhouses of the cell.
Reason (R): Mitochondria are the sites of photosynthesis in plant cells.
Answer: c) A is true, but R is false.

3. **Assertion (A):** Vacuoles are storage sacs found in animal cells.
Reason (R): Vacuoles store water, nutrients, and waste materials.
Answer: d) A is false, but R is true.

4. **Assertion (A):** The cell wall is found in both plant and animal cells.
Reason (R): The cell wall provides structural support and protection to the cell.
Answer: d) A is false, but R is true.

5. **Assertion (A):** Endoplasmic reticulum (ER) is involved in protein synthesis.

Reason (R): Rough ER is studded with ribosomes, which are the sites of protein synthesis.
Answer: a) Both A and R are true, and R is the correct explanation of A.

SHORT ANSWER TYPE QUESTIONS

1. What is a cell? Mention its significance in living organisms.
   Answer: A cell is the basic structural and functional unit of life. It is the smallest unit capable of performing all the functions necessary for life. Cells are significant in living organisms as they are the building blocks of tissues, organs, and organ systems, and they carry out various functions essential for the organism's survival.

2. Differentiate between prokaryotic and eukaryotic cells.
   Answer: Prokaryotic cells are simpler cells that lack a well-defined nucleus and membrane-bound organelles. Eukaryotic cells, on the other hand, have a true nucleus and membrane-bound organelles. Prokaryotic cells are typically smaller and include bacteria, while eukaryotic cells are larger and are found in plants, animals, fungi, and protists.

3. Describe the structure and function of the nucleus.
   Answer: The nucleus is a spherical, membrane-bound organelle that contains the cell's genetic material (DNA). It controls the cell's activities, including growth, metabolism, and reproduction, by regulating gene expression. The nucleus also contains a nucleolus, which is involved in ribosome synthesis.

4. Explain the role of mitochondria in a cell.
   Answer: Mitochondria are known as the powerhouse of the cell because they are the sites of cellular respiration, where energy (ATP) is produced. They convert glucose and oxygen into ATP through a series of biochemical reactions, providing the cell with the energy it needs to carry out its functions.

5. What is the function of the cell membrane?
   Answer: The cell membrane, or plasma membrane, is a selectively permeable barrier that regulates the passage of substances into and out of the cell. It protects the cell and maintains its internal environment by controlling the exchange of ions, nutrients, and waste products with the external environment.

6. Describe the structure and function of chloroplasts in plant cells.
   Answer: Chloroplasts are organelles found in plant cells that are responsible for photosynthesis, the process by which plants convert light energy into chemical energy (glucose). Chloroplasts contain chlorophyll, a green pigment that captures light energy, and various enzymes necessary for photosynthesis.

7. How do lysosomes function in a cell?

Answer: Lysosomes are membrane-bound organelles that contain digestive enzymes. They break down macromolecules such as proteins, lipids, and carbohydrates into smaller molecules that can be used by the cell. Lysosomes also play a role in cell renewal and waste disposal.

8. What are vacuoles? Mention their role in plant cells.
   Answer: Vacuoles are membrane-bound organelles found in plant cells that store water, nutrients, and waste products. They help maintain turgor pressure in plant cells, which is important for structural support. Vacuoles also contain pigments that give flowers and fruits their color.

9. Explain the significance of ribosomes in a cell.
   Answer: Ribosomes are the cellular structures responsible for protein synthesis. They translate the genetic information from mRNA into proteins, which are essential for cell structure, function, and regulation. Ribosomes can be found free in the cytoplasm or attached to the endoplasmic reticulum.

10. Describe the structure and function of the endoplasmic reticulum (ER).
    Answer: The endoplasmic reticulum (ER) is a network of membrane-bound tubes and sacs called cisternae. It comes in two forms: rough ER, which is studded with ribosomes and involved in protein synthesis and processing, and smooth ER, which lacks ribosomes and is involved in lipid synthesis, detoxification, and calcium storage.

LONG ANSWER TYPE QUESTIONS

1. Describe the structure and function of the cell membrane.
   Answer: The cell membrane, also known as the plasma membrane, is a thin, semi-permeable membrane that surrounds the cytoplasm of a cell. It is composed of a phospholipid bilayer with embedded proteins and cholesterol molecules. The main functions of the cell membrane include:
   Selective Permeability: The cell membrane regulates the passage of substances into and out of the cell, allowing only certain molecules to pass through while restricting others.
   Cell Signaling: The cell membrane contains receptors that allow the cell to communicate with its environment and respond to external signals.
   Cell Adhesion: The cell membrane helps cells adhere to each other and to extracellular matrix proteins, maintaining tissue structure and integrity.
   Protection: The cell membrane provides a barrier that protects the cell from its external environment, preventing harmful substances from entering the cell.

2. Explain the process of endocytosis and its significance in cells.
   Answer: Endocytosis is a cellular process by which cells absorb molecules (such as

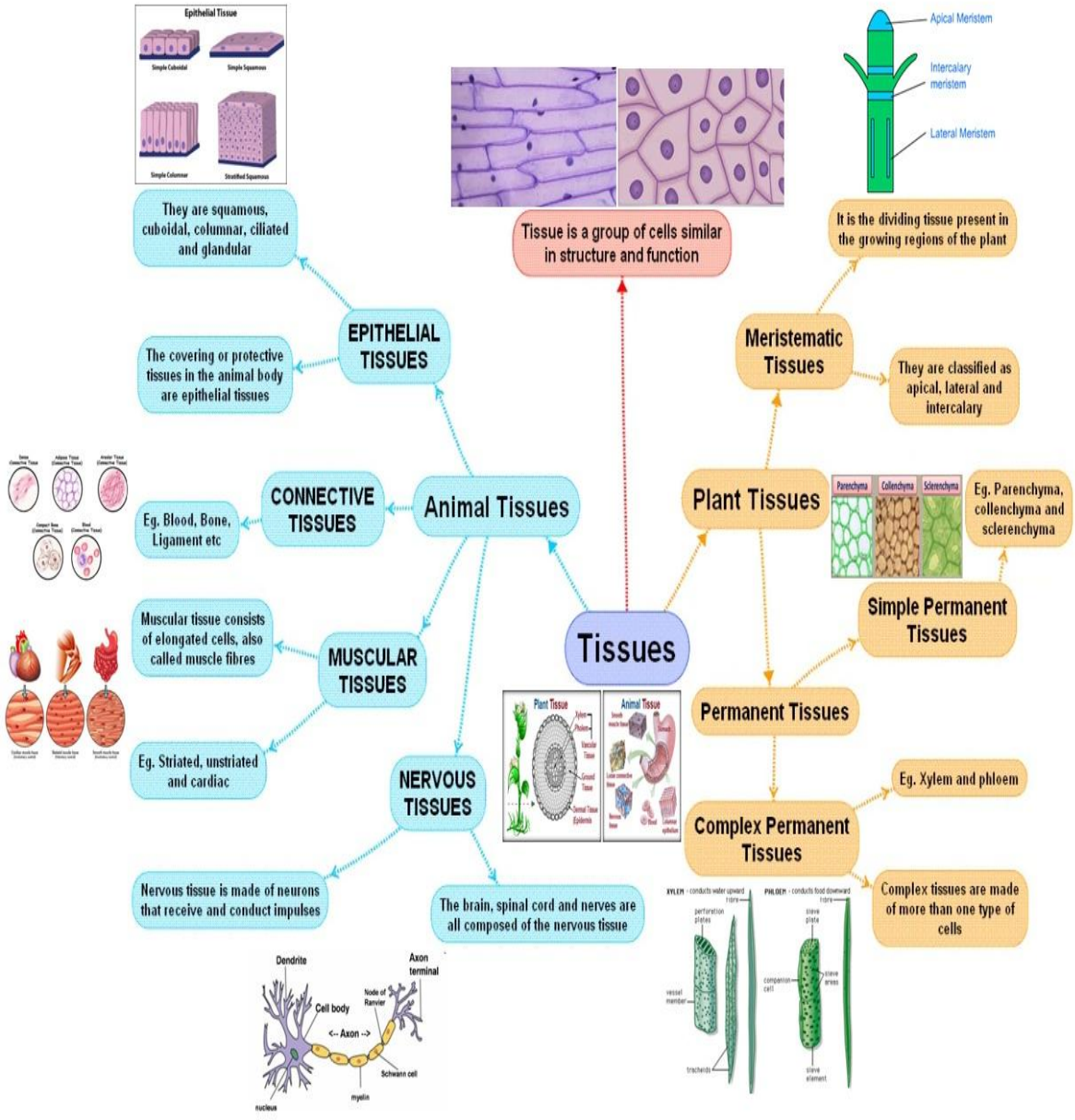
proteins) and other particles by engulfing them. It involves the formation of vesicles from the cell membrane to bring substances into the cell. There are two main types of endocytosis:
Phagocytosis: The cell engulfs solid particles, such as bacteria or cellular debris, forming a phagosome that is later fused with a lysosome for digestion.
Pinocytosis: The cell engulfs liquid droplets from the extracellular fluid, forming small vesicles containing the absorbed substances.
Endocytosis is significant in cells for several reasons:
It allows cells to take in nutrients, such as proteins and lipids, from the external environment.
It plays a role in immune response, as phagocytic cells engulf and destroy pathogens.
It helps in the regulation of signaling molecules and receptors on the cell surface.
It is involved in the uptake of specific molecules, such as hormones, into the cell for cellular processes and signaling.

COMPETENCY BASED QUESTIONS

1. A student observed two cells under a microscope and noticed that one cell had a well-defined nucleus and membrane-bound organelles, while the other cell did not have a well-defined nucleus and lacked membrane-bound organelles. Based on this observation, explain how the student can determine whether the cells are prokaryotic or eukaryotic.
   Answer: Based on the observation, the cell with a well-defined nucleus and membrane-bound organelles is likely to be a eukaryotic cell, while the cell lacking these features is likely to be a prokaryotic cell. Eukaryotic cells, such as those found in plants and animals, have a true nucleus enclosed within a nuclear membrane and contain membrane-bound organelles. Prokaryotic cells, such as bacteria, lack a well-defined nucleus and membrane-bound organelles. The presence or absence of these features can help determine whether the cells are prokaryotic or eukaryotic.
2. An experiment was conducted to study the movement of materials across a cell membrane. The experiment involved placing a cell in a solution and observing changes in the cell's volume over time. Based on the results of the experiment, explain how the student can determine whether the cell membrane is selectively permeable.
   Answer: If the cell's volume changes in response to the solution, it indicates that the cell membrane is selectively permeable. A selectively permeable membrane allows only certain substances to pass through while restricting others. In the experiment, if the cell's volume increases, it suggests that water is moving into the cell through osmosis, indicating that the membrane allows water molecules to pass through. If the cell's volume decreases, it suggests that water is moving out of the cell, indicating that the membrane allows water molecules to pass out. By observing the changes in the cell's volume, the student can determine whether the cell membrane is selectively permeable.

CHAPTER TISSUE

CONCEPT MAP



Tissue: ***A group of cells that are similar in structure and work together to perform a particular function.***

MERISTEMATIC TISSUE

The growth of plants occurs only in certain specific regions. This is because the dividing tissue, also known as meristematic tissue, is located only at these points. Depending on the region where they are present, meristematic tissues are classified as apical, lateral and intercalary.

Type	Location	Function
Apical Meristem	Growing tip of shoot and root.	Increase the length of stem and root.
Intercalary Meristem	At the base of leaves and internode	Increase the length of internode or leaf.
Lateral Meristem (Cambium)	On the side of stem and root.	Increase the girth of stem and root

PERMANENT TISSUE

- The permanent tissues are formed from those meristematic cells which have lost their capability to divide.
- The division & differentiation of the cells of meristematic tissues give rise to permanent tissues.
- They have definite shape, size and thickness. The permanent tissue may be dead or living.
- As a result of cell differentiation, the meristematic tissues tend to form different type of permanent tissues complex forms to perform specialized functions.

Depending upon the structure and composition the permanent tissue is classified into two types:

(A) Simple Permanent Tissues (Supporting tissue)

(B) Complex Permanent Tissue

(A) Simple Permanent Tissues:

- These are made up of one type of cells which are similar structurally and functionally. These are supportive in function and are of three types:

- Parenchyma:-

- It is basic (simple) type of packaging tissue.
- Has relatively unspecialised living cells.
- Thin cell wall and large intercellular spaces between the cell.
- It stores food and provide support to plant.
- Found in soft parts of plants.
- Parenchyma contains chlorophyll and perform photosynthesis it is called chlorenchyma.
- In aquatic plants, parenchyma has large air space to provide buoyancy to plants and exchange of gases it is called aerenchyma.

- Collenchyma: Contains elongated living cells irregularly thickened at the corners. Intercellular space is less. Provide flexibility and mechanical support to leaves and stem and allow easy bending without break. Found in leaf stalks below the epidermis.

Sclerenchyma: Consist of long, narrow, thick walled dead cell.

- Cell wall contains lignin which act as cement and harden them.
- Intercellular space absent.
- It provides strength and rigidity to plant and make them hard and stiff.
- Present around vascular bundles, in leaf veins, in the hard covering of seed, husk of coconut and nuts.

Protective Tissues: These tissues are primarily protective in functions. They *Consist of;*

(i) Epidermis

- Epidermis forms one cell thick outermost layer of various body organs of plants such as leaves, flowers, stems and roots.
- Epidermis is covered outside by cuticle. Cuticle is a water Proof layer of waxy substance called as cutin which is secreted by the epidermal cells provide protection against loss of water and provide protection against loss of water and invasion by microbes.
- Cells of epidermis of leaves are not continuous at some places due to the presence of small pores called as stomata.
- Each stoma is guarded by a pair of bean-shaped cells called as guard cells. These are the only epidermal cells which possess chloroplasts, the rest being colourless.

(ii) **Cork or Phellem**

- In older roots and stems, tissues at the periphery become cork cells or phellem cells.
- Cork is made up to dead cells with thick walls and do not have any intercellular spaces.

- The cell walls in cork deposit waxy substance called as suberin.
- The cells of cork become impermeable to water and gases due to the deposition of suberin.
- The cork cells are without any protoplasm but are filled with resins or tannins.

Functions of Cork:

Cork is protective in function. Cork cells prevent desiccation, infection and mechanical injury. Imperviousness, lightness, toughness, compressibility and elasticity make the cork commercially valuable.

(B) COMPLEX PERMANENT TISSUE

- They are made up of more than one type of cells.
- Xylem and phloem are examples.
- Both are conducting tissue and form vascular bundles.
- They made possible survival of vascular plant in terrestrial environment.

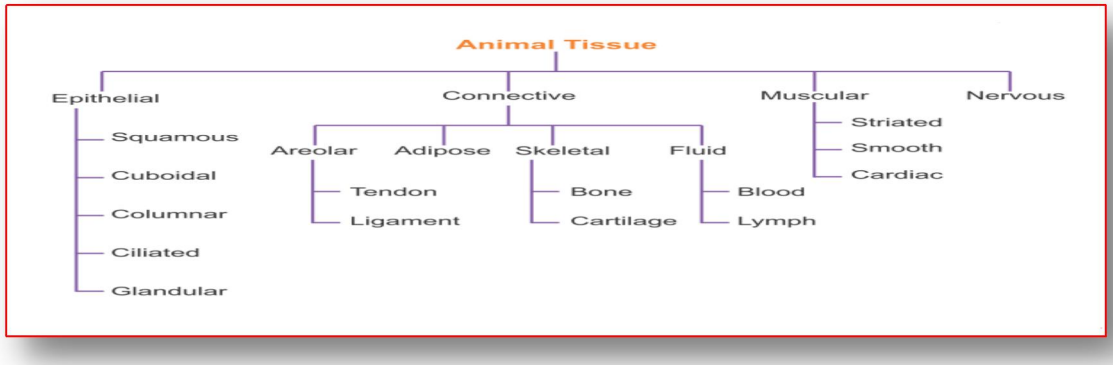
Xylem

- It consists of tracheids, vessels, xylem fibre and xylem parenchyma.
- Contains thick cell walls.
- Except xylem parenchyma all are dead Cells.
- Xylem fibre are provide support.
- Parenchyma store food and do sidewise conduction.
- Tracheids and vessels are tubular structure which conduct water and minerals vertically.

Phloem

- Made up of four elements sieve tubes, companion cells, phloem fibres and phloem parenchyma.
- Except phloem fibre all are living cells.
- Sieve tubes are tubular cells with perforated walls.
- Phloem transport food.
- Phloem transport is bidirectional.

ANIMAL TISSUES



1. Epithelial tissue (Epithelium)

- It is the covering or protective tissue of animals.
- Made up of tightly packed cell which form continuous layer with no intercellular spaces.
- Separated from underlying tissue by fibrous basement membrane.
- The permeability of epithelial cells regulates the exchange of material between body and environment.

TYPES OF EPITHELIAL TISSUES

Type of epithelium	Characteristics	Location	Function
Squamous epithelium	Cells are thin and flat.	Lung's alveoli, Blood Vessels, Oesophagus Lining of mouth	Protection, Exchange of substances between blood and cells and at alveoli
Stratified Squamous epithelium	Flat cells arranged in many layers to prevent wear and tear.	Skin	Protection
Columnar epithelium	Tall pillar like cells. Nucleus at the base	Inner lining of intestine,	Absorption and secretion
Ciliated columnar epithelium	Tall cells with cilia	Respiratory tract	Pushes the mucus forward to clear respiratory tract
Cuboidal epithelium	Cube cells	Kidney tubules, ducts of salivary glands.	Mechanical support
Glandular epithelium	Epithelial cells folds inward and form multicellular gland, acquire additional specialisation as glands	Goblet cells are present in mucus membrane	Secretion

2. CONNECTIVE TISSUE

- It connects various tissues in an organ.
- Loosely packed Cells are embedded in matrix.
- Matrix may be jelly like, fluid, dense or rigid.

BLOOD

- Matrix is fluid called plasma.
- Plasma contains protein, salts and hormones.
- Plasma RBC, WBC and PLATELETS are suspended.
- Blood transport materials to different parts of body.

BONE

- Bone Is Strong and Nonflexible Tissue.
- Matrix Is Hard.
- It Is Made Up of Salts of Calcium and Phosphorus.
- Matrix Contains Bone Cells or Osteocytes.
- Bone Form Skeleton That Supports Body and Anchors the Muscle.

LIGAMENT AND TENDONS

- Ligament is very elastic and have little matrix.
- Ligament connect bone to bone.
- Tendons are fibrous tissue less flexibility but great strength.
- Connects muscles to bones

CARTILAGE

- Matrix is solid composed of sugars and protein.
- Cells (chondrocytes) are widely spaced and present in matrix.
- Cartilage is softer than bone due to presence of sugar and protein.
- It is found in nose, ear, trachea, larynx and smoothens the bone surface at joint.

AREOLAR TISSUE

- Matrix is semifluid containing different types of cells and fibers.
- It holds organs in place and provide support to them.

- Found between skin and muscles, around blood vessels, nerves and in
- bone marrow.
- It helps in repair of tissues.

- **ADIPOSE TISSUE**
- It contains fat cells called adipocyte.
- Cells are filled with fat globules.
- Found below skin and between internal organs.
- It stores fat and also act as insulator.

MUSCULAR TISSUE

- It consists of elongated muscle cells called muscle fibre.
- Muscle contains contractile proteins which contract and relax.
- It brings movement in body.

TYPE OF MUSCULAR TISSUE

STRIATED /SKELETAL MUSCLES

- Structure-Long, cylindrical, unbranched, multinucleated muscle cells with alternate light and dark band or striations.
- Location-Present in limbs, mostly attach to bones so also called skeletal muscles.
- Function-Help in body movement, they move as per our will so called voluntary muscles.

SMOOTH / UNSTRIATED MUSCLES

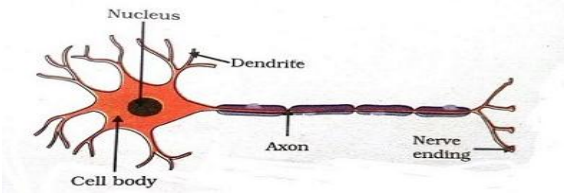
- Structure-Long, Spindle shaped, Uninucleate cells, having no Striations
- Location- Found in alimentary canal, Blood vessels, Iris of eye, in ureters, bronchi of lungs
- Function-Movement of food in alimentary canal and internal organs, they are involuntary muscles.

CARDIAC MUSCLE

- Structure-Cylindrical, branched and uninucleate muscle cells with striations.
- Location-Wall of heart
- Function-Rhythmic contraction and relaxation of heart throughout life they are involuntary muscles.

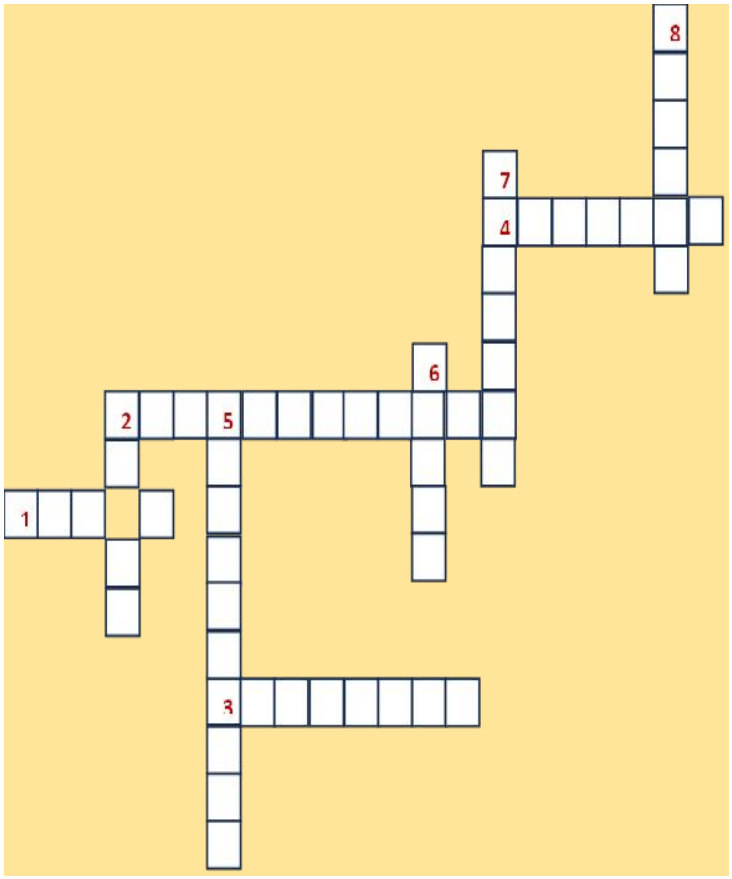
NERVOUS TISSUE

- They are highly specialized tissue due to which the animals are able to perceive and respond to the stimuli.
- Their functional unit is called as nerve cell or neuron.
- Cell body is cyton covered by plasma membrane.
- Short hairy like extensions rising from cyton are Dendron which are further subdivided into dendrites.
- Axon is long, tail like cylindrical process with fine branches at the end Axon is covered by a sheath.



- Nerve Ending of one neuron is very closely placed to the dendrons of another neuron to carry impulses from one to another neuron in the form of electrochemical waves.This close proximity is called as synapse.

CROSSWORD PUZZLE



CLUES

Across

1.fluid connective tissue

2.dead cells which have lignified walls and give strength and rigidity to plants

3. connects bone to bone

4. tissue that stores fat and acts as insulator

Down

2. opening of stomata

5. covering/ protective tissue of animals

6. trachieds and vessels are elements of this complex permanent tissue.

7. involuntary. Branched, cylinder shaped, uninucleated muscle fibres which do not get fatigued.

8. structural and functional unit of nervous tissue.

MULTIPLE CHOICE QUESTIONS

1. Which of the following is not a type of animal tissue?
a) Epithelial tissue b) Muscular tissue c) Plant tissue d) Nervous tissue
Answer: c) Plant tissue

2. The tissue that forms the inner lining of our mouth is:
a) Epithelial tissue b) Connective tissue c) Muscular tissue d) Nervous tissue
Answer: a) Epithelial tissue

3. The tissue that connects muscles to bones in humans is:
a) Epithelial tissue b) Connective tissue c) Muscular tissue d) Nervous tissue
Answer: b) Connective tissue

4. Which of the following is a function of connective tissue?
a) Contraction b) Support c) Conduction of impulses d) Control and coordination
Answer: b) Support

5. Cardiac muscle is a type of:
a) Skeletal muscle b) Smooth muscle c) Involuntary muscle d) Voluntary muscle
Answer: c) Involuntary muscle

6. Meristematic tissue in plants is responsible for:
a) Providing mechanical support b) Growth and development
c) Photosynthesis d) Transport of water and nutrients
Answer: b) Growth and development

7. Which of the following is not a function of epithelial tissue?
a) Protection b) Secretion c) Contraction d) Absorption
Answer: c) Contraction

8. Adipose tissue is a type of:
a) Epithelial tissue b) Connective tissue c) Muscular tissue d) Nervous tissue
Answer: b) Connective tissue

9. The tissue that is responsible for transmitting electrical impulses in the body is:
a) Epithelial tissue b) Connective tissue c) Muscular tissue d) Nervous tissue
Answer: d) Nervous tissue

10. Which of the following is a function of muscular tissue?
a) Providing support b) Transmitting electrical impulses
c) Movement d) Absorption
Answer: c) Movement

11. The tissue that forms the outermost layer of the skin is:
a) Epithelial tissue b) Connective tissue c) Muscular tissue d) Nervous tissue
Answer: a) Epithelial tissue

12. The tissue that stores fat in our body is:
a) Epithelial tissue b) Connective tissue c) Muscular tissue d) Nervous tissue
Answer: b) Connective tissue

13. Smooth muscle is found in the walls of:
a) Blood vessels b) Heart c) Skeletal muscles d) None of the above
Answer: a) Blood vessels

14. Collagen is a protein found in:
a) Epithelial tissue b) Connective tissue c) Muscular tissue d) Nervous tissue
Answer: b) Connective tissue

15. The tissue that forms the brain and spinal cord is:
a) Epithelial tissue b) Connective tissue c) Muscular tissue d) Nervous tissue
Answer: d) Nervous tissue

ASSERTION- REASON TYPE QUESTIONS

Direction: In each of the following questions, a statement of Assertion is given followed by a corresponding statement of Reason. Of the statements, mark the correct answer as
(a) Both assertion and reason are true and reason is the correct explanation of assertion.
(b) Both assertion and reason are true but reason is not the correct explanation of assertion.
(c) Assertion is true but reason is false.
(d) Assertion is false but reason is true.

1. Assertion (A): Epithelial tissues are tightly packed and form a protective barrier.

Reason (R): Epithelial tissues have a high rate of cell division to replace damaged cells.
Answer: a) Both A and R are true, and R is the correct explanation of A.

2. Assertion (A): Connective tissues provide structural support to organs and tissues.
Reason (R): Connective tissues are mainly composed of cells that can contract and relax.
Answer: c) A is true, but R is false.

3. Assertion (A): Muscular tissues are specialized for contraction and movement.
Reason (R): Muscular tissues are composed of cells that can change shape and size.
Answer: b) Both A and R are true, but R is not the correct explanation of A.

4. Assertion (A): Nervous tissues are responsible for transmitting electrical impulses.
Reason (R): Nervous tissues are composed of cells called neurons.
Answer: a) Both A and R are true, and R is the correct explanation of A.

5. Assertion (A): Meristematic tissues are found in the regions of the plant that grow.
Reason (R): Meristematic cells are specialized and have lost the ability to divide.
Answer: (c) Assertion (A) is true but Reason (R) is false.

VERY SHORT ANSWER TYPE QUESTIONS

Question 1: Define tissue. Name the four types of tissues found in animals.
Answer: Tissue is a group of cells that are similar in structure and work together to perform a specific function. The four types of tissues found in animals are epithelial tissue, connective tissue, muscular tissue, and nervous tissue.

Question 2: What is the function of epithelial tissue?
Answer: Epithelial tissue covers the surfaces of the body, lines internal organs and cavities, and forms glands. Its main functions include protection, secretion, absorption, and excretion.

Question 3: Name the three types of muscle tissues found in the human body.

Answer: The three types of muscle tissues found in the human body are skeletal muscle, smooth muscle, and cardiac muscle.

Question 4: What is the function of nervous tissue?
Answer: Nervous tissue is responsible for transmitting electrical impulses throughout the body. It forms the brain, spinal cord, and nerves, and helps in coordinating body activities and responding to stimuli.

Question 5: Define meristematic tissue. Where is it found in plants?
Answer: Meristematic tissue is a type of plant tissue composed of actively dividing cells. It is found in regions of the plant that undergo growth, such as the tips of roots and stems.

Question 6: Name two types of permanent tissues in plants. Describe their functions.
Answer: Two types of permanent tissues in plants are simple permanent tissues and complex permanent tissues. Simple permanent tissues, such as parenchyma, collenchyma, and sclerenchyma, provide support, storage, and photosynthesis. Complex permanent tissues, such as xylem and phloem, transport water, nutrients, and food throughout the plant.

Question 7: What is the function of connective tissue?
Answer: Connective tissue provides support, protection, and structure to the body. It also helps in binding and connecting different tissues and organs together.

Question 8: Differentiate between smooth muscle and skeletal muscle.
Answer: Smooth muscle is involuntary and is found in the walls of internal organs, while skeletal muscle is voluntary and is attached to bones for movement.

Question 9: What is the role of epithelial tissue in the digestive system?
Answer: Epithelial tissue in the digestive system forms the lining of the digestive tract and helps in the absorption of nutrients from food.

Question 10: How do neurons in nervous tissue differ from other cells?
Answer: Neurons in nervous tissue are specialized cells that can transmit electrical impulses. They have long extensions called axons and dendrites that allow them to communicate with other neurons and cells in the body.

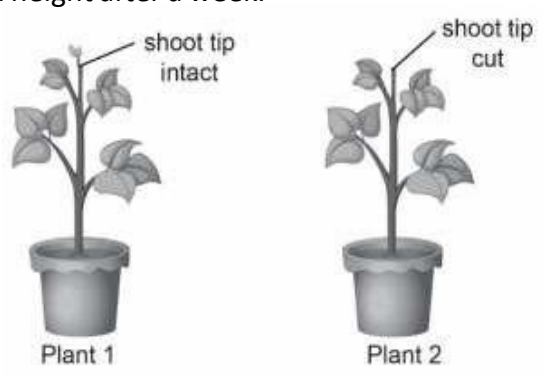
LONG ANSWER TYPE QUESTIONS

Question 1: Explain the structure and function of xylem and phloem in plants.
Answer: Xylem and phloem are complex permanent tissues found in plants responsible for the transport of water, nutrients, and food throughout the plant. Xylem is responsible for transporting water and minerals from the roots to the leaves. It is composed of four types of cells: tracheids, vessel elements, xylem fibers, and xylem parenchyma. Tracheids and vessel elements are long, tube-like cells that are dead at maturity and form continuous pipelines for water transport. Xylem fibers provide structural support, and xylem parenchyma stores food and helps in lateral conduction of water.
Phloem, on the other hand, is responsible for transporting food (mainly sugars) produced in the leaves to other parts of the plant. It is composed of four types of cells: sieve tubes, companion cells, phloem fibers, and phloem parenchyma. Sieve tubes are long, narrow cells that are alive at maturity and are connected end-to-end to form sieve tubes. Companion cells are located next to sieve tubes and provide them with metabolic support. Phloem fibers provide structural support, and phloem parenchyma stores food and helps in lateral conduction of food.
Together, xylem and phloem form vascular bundles that are responsible for the transportation system in plants, allowing them to grow and function effectively.

Question 2: Describe the structure and function of nervous tissue in animals.
Answer: Nervous tissue is a specialized tissue found in animals that is responsible for transmitting electrical impulses throughout the body. It is composed of two main types of cells: neurons and neuroglia.
Neurons are the primary cells of the nervous system and are responsible for transmitting electrical impulses. They have a cell body, dendrites (short branched extensions that receive signals from other neurons), and an axon (long extension that transmits signals to other neurons). Neurons communicate with each other through synapses, which are junctions between the axon of one neuron and the dendrite of another neuron.
Neuroglia, or glial cells, are support

COMPETENCY BASED QUESTIONS

Apical meristem is a type of tissue that helps plants grow in length. Tina took two identical potted plants and cut the shoot tip of one of them. She observed if the two plants grew in height after a week.



1. What was Tina trying to find out about shoot tips through her experiment?
   ANS: Whether shoot tips contain apical meristem?

2. Which of these conditions would have made Tina's experiment invalid? Circle 'Yes' or 'No' to mark your responses.

Would this have made the experiment invalid?	Yes or No
Keeping one plant in sunlight and the other in a dark room	Yes/No
Watering both the plants equally	Yes/No
Adding manure to the soil of plant 1 only	Yes/No

   ANS: Yes
   No
   Yes

3. Why do cells of apical meristem lack vacuoles?
   A. They store food materials.
   B. They have thin cell walls.
   C. They contain dense cytoplasm.
   D. They are actively dividing cells.
   ANS: D. They are actively dividing cells

4. Which of these is correct about connective tissues? Circle 'Yes' or 'No' to mark your responses.

ANS: No
Yes
No

The picture shows three types of tissues found in the human body.

5. The inner lining of alveoli (air sacs in lungs) is very thin and delicate. Which type of tissue forms the inner lining of alveoli?

Is the statement correct?	**Yes/No**
All connective tissues are highly flexible.	Yes/No
All connective tissues contain cells that are either placed in a fluid or in a solid matrix.	Yes/No
All connective tissues form frameworks that provide support to organs.	Yes/No

ANS: Tissue 1

6. Which of these cells is the longest?

(a) Bone cell (b) Nerve cell (c) Stomach cell (d) Heart muscle cell

ANS: B. Nerve cell

7. A student observed two types of tissues under a microscope: one with densely packed cells and no intercellular spaces, and the other with loosely packed cells and abundant intercellular spaces. Based on this observation, explain how the student can determine the types of tissues and their functions.

Answer: The tissue with densely packed cells and no intercellular spaces is likely to be epithelial tissue, which forms the protective covering of organs and body surfaces. The tissue with loosely packed cells and abundant intercellular spaces is likely to be connective tissue, which provides support and connects different tissues and organs in the body. By examining the arrangement of cells and the

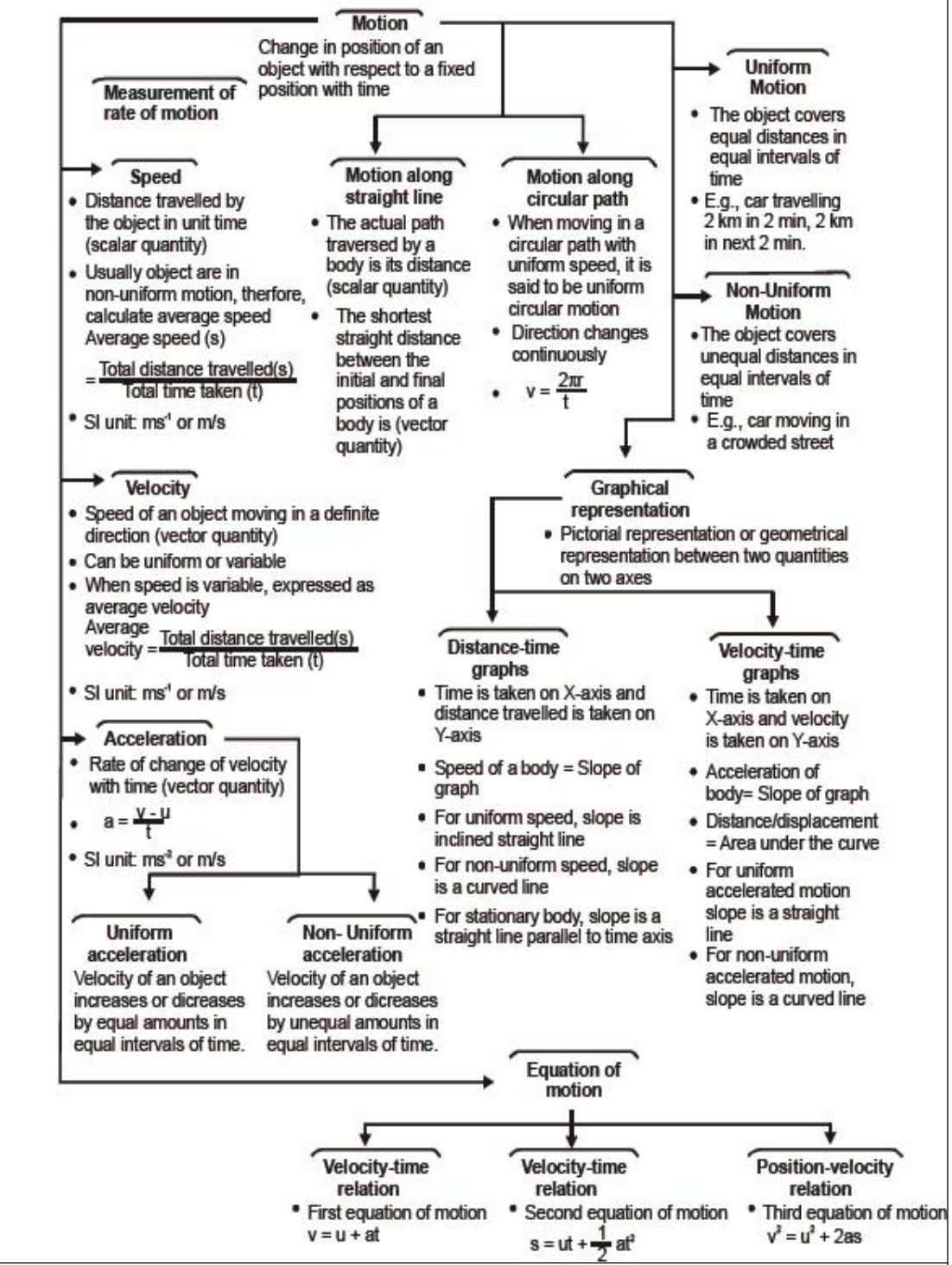
presence of intercellular spaces, the student can determine the types of tissues and their functions.

8. During a field trip, a student collected samples of plant tissues from different parts of a tree. The student observed that the tissues from the growing tips of the tree were different from those in the mature stem. Based on this observation, explain how the student can determine the types of tissues and their roles in plant growth and development.

Answer: The tissues from the growing tips of the tree are likely to be meristematic tissues, which are responsible for growth and development in plants. These tissues are actively dividing and give rise to new cells that differentiate into various types of permanent tissues found in mature plants. By examining the location and characteristics of the tissues, the student can determine the types of tissues and their roles in plant growth and development.

CHAPTER
MOTION

Basic Concepts — A Flow Chart



Motion is the change in the position of an object with time.
An object is said to be in motion if it changes its position with respect to its surroundings in a given time.
Rest and motion are relative terms.

2. Describing Motion

To describe the motion of an object, we need to specify its position with respect to a reference point, which is called the origin.
The path followed by an object is called its trajectory.

3. Types of Motion

Rectilinear Motion: Motion along a straight line.
Circular Motion: Motion along a circular path.
Periodic Motion: Motion that repeats itself after regular intervals of time, such as the motion of a pendulum.

4. Distance and Displacement

Distance: The length of the actual path travelled by an object. It is a scalar quantity.

Displacement: The shortest distance between the initial and final positions of an object. It is a vector quantity.

Scalar quantity	Vector quantity
Physical quantities having only magnitude.	Physical quantities having both magnitude and direction.
Examples: Mass, Time, Temperature, Volume,Speed	Examples: Weight, Velocity, Acceleration, Forces

Distance	Displacement
The magnitude of the length covered by a moving object is called distance	Displacement is the shortest distance between two points or the distance between the starting and final positions with respect to time
It has no direction (Scalar quantity)	It has magnitude as well as direction (vector quantity)
Distance remains positive, can't be zero or negative	Displacement can be positive, negative or zero
Distance can be equal to displacement (in linear path)	Displacement can be equal to distance or its lesser than distance.

5. Uniform and Non-Uniform Motion

Uniform Motion: When an object covers equal distances in equal intervals of time.

Non-Uniform Motion: When an object covers unequal distances in equal intervals of time.

6. Speed and Velocity

Speed: The rate of change of distance with time. It is a scalar quantity. Formula: Speed=Distance/Time

Velocity: The rate of change of displacement with time. It is a vector quantity. Formula: Velocity=Displacement/Time

7. Acceleration

Acceleration is the rate of change of velocity with time. It is a vector quantity. Formula: Acceleration=Change in Velocity/Time Taken

Positive Acceleration: When velocity increases with time.

Negative Acceleration (Deceleration): When velocity decreases with time.

8. Graphical Representation of Motion

Distance-Time Graphs: Represent the motion of an object over time. The slope of a distance-time graph gives the speed.

Velocity-Time Graphs: Represent the velocity of an object over time. The slope of a velocity-time graph gives the acceleration, and the area under the graph gives the displacement.

9. Equations of Motion

There are three equations of motion that relate the initial velocity (u), final velocity (v), acceleration (a), time (t), and displacement (s):

(i) $v = u + at$
(ii) $v^2 - u^2 = 2as$
(iii) $s = ut + (1/2)at^2$

10. Uniform Circular Motion

When an object moves in a circular path with uniform speed, it is said to be in uniform circular motion.

Although the speed is constant, the direction of motion changes continuously,

which means the velocity is changing, implying that the object is accelerating.

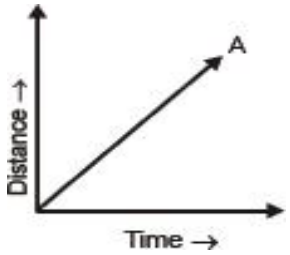
If a body moves in a circular path, velocity $v = 2\pi r/t$

GRAPHS

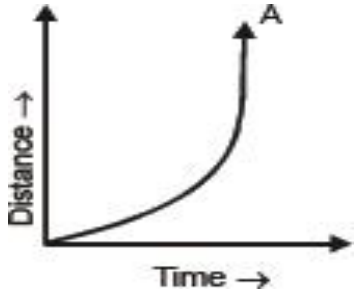
DISTANCE-TIME GRAPHS

For a body at rest- As the slope is zero, so speed of the body is zero.

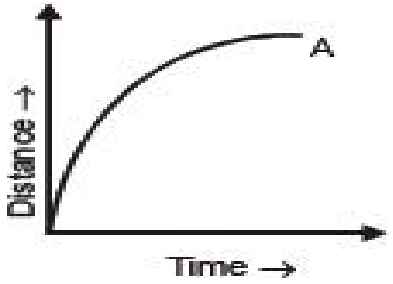
For a body moving with uniform speed



For accelerated motion.
The slope of graph is increasing with time

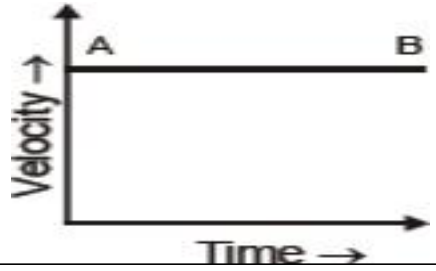


For decelerated (speeding down) motion.
Slope of graph is decreasing with time

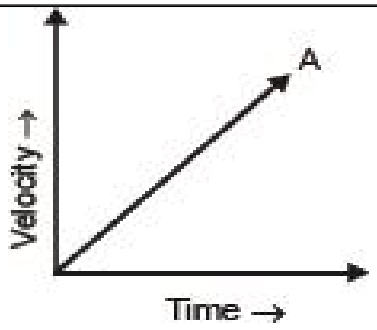


Velocity-Time Graphs

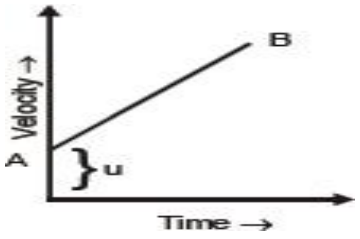
When a body moving with a uniform velocity.
The slope of AB indicates zero acceleration



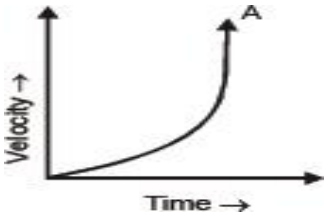
When a body starts from rest and moves with uniform acceleration.
Greater is the slope of v-t graph, greater will be the acceleration



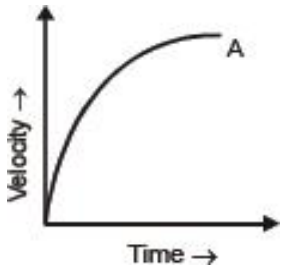
When a body is moving with uniform acceleration and its initial velocity is not zero.



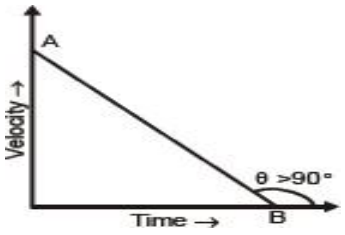
When a body is moving with increasing acceleration. Slope increases with time.



When a body is moving with decreasing acceleration. Slope decreases with time.



When a body is moving with a uniform retardation and its initial velocity is not zero. As θ> 90°, graph has a negative slope.



MULTIPLE CHOICE QUESTIONS

1. **What is the SI unit of distance?**
   a) Meter b) Kilometer c) Centimeter d) Millimeter
2. **Which of the following is a vector quantity?**
   a) Distance b) Speed c) Time d) Displacement
3. **When an object covers equal distances in equal intervals of time, it is said to be in:**
   a) Non-uniform motion b) Uniform motion c) Circular motion d) Oscillatory

motion

4. **The rate of change of displacement is known as:**
   a) Speed b) Acceleration c) Velocity d) Distance

5. **Which graph can be used to find the acceleration of an object?**
   a) Distance-time graph b) Velocity-time graph
   c) Speed-time graph d) Displacement-time graph

6. **The slope of a distance-time graph represents:**
   a) Velocity b) Speed c) Acceleration d) Displacement

7. **An object is moving with uniform acceleration. Its velocity after time t is given by:**
   a) $v=u+at$ b) $v=u-at$
   c) $v=ut+1/2at^2$ d) $v^2=u^2+2as$

8. **Which of the following is a correct unit for acceleration?**
   a) m/s b) m/s^2 c) km/h d) cm/s

9. **If an object covers 20 meters in 5 seconds, what is its speed?**
   a) 4 m/s b) 5 m/s c) 10 m/s d) 15 m/s

10. **The area under a velocity-time graph represents:**
    a) Speed b) Distance c) Displacement d) Acceleration

11. **In uniform circular motion, the speed of the object:**
    a) Increases b) Decreases c) Remains constant d) Varies

12. **The acceleration of an object moving with uniform velocity is:**
    a) Positive b) Negative c) Zero d) Infinity

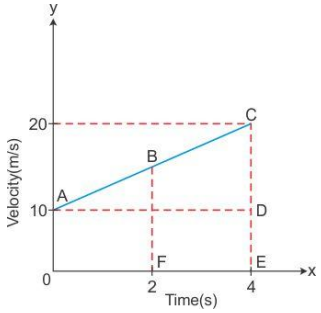
13. **The equation** $s=ut+1/2at^2$ **represents:**
    a) Distance covered in uniform motion b) Distance covered in non-uniform motion
    c) Velocity after time t d) Acceleration after time t

14. **When an object falls freely under gravity, its acceleration is:**
    a) Zero b) $9.8\ m/s^2$ c) $-9.8\ m/s^2$ d) $1\ m/s^2$

15. **If the initial velocity of an object is zero and it moves with an acceleration of 5 m/s^2, what will be its velocity after 2 seconds?**
    a) 5 m/s b) 10 m/s c) 2.5 m/s d) 7.5 m/s

16. **The velocity-time graph AC of a moving particle is shown in the figure**

below. The acceleration of the particle is:



(a) 2.5 m/s^2 (b) 5 m/s^2 (c) 10 m/s^2 (d) 20 m/s^2

17. A car travels 3 km of distance in 10 minutes to reach the destination. On the return journey, the car travels the same distance in 15 minutes. What is the average speed of car in entire journey?

(a) 5 m/s (b) 4 m/s (c) 6 m/s (d) 3 m/s

Answers:

1. a) Meter
2. d) Displacement
3. b) Uniform motion
4. c) Velocity
5. b) Velocity-time graph
6. b) Speed
7. a) v=u+at and c) v=ut+1/2at^2
8. b) m/s^2
9. a) 4 m/s
10. c) Displacement
11. c) Remains constant
12. c) Zero
13. b) Distance covered in non-uniform motion
14. b) 9.8 m/s^2
15. b) 10 m/s

16. Ans: (a) 2.5 m/s^2

17. Ans: (b) 4 m/s

Direction: In each of the following questions, a statement of Assertion is given followed by a corresponding statement of Reason. Of the statements, mark the correct answer as

(a) Both assertion and reason are true and reason is the correct explanation of assertion.

(b) Both assertion and reason are true but reason is not the correct explanation of assertion.

(c) Assertion is true but reason is false.

(d) Assertion is false but reason is true.

1. **Assertion (A):** Distance is always smaller than or equal to the displacement.
   Reason (R): Distance is the length of the actual path travelled by an object, whereas displacement is the shortest distance between the initial and final positions of an object.

2. **Assertion (A):** An object moving in a circular path with uniform speed is accelerating.
   Reason (R): The direction of the velocity changes continuously in circular motion.

3. **Assertion (A):** A car moving on a straight road with constant speed has zero acceleration.
   Reason (R): Acceleration is defined as the rate of change of distance.

4. **Assertion (A):** The slope of a distance-time graph of an object in uniform motion is a straight line.
   Reason (R): In uniform motion, equal distances are covered in equal intervals of time.

5. **Assertion (A):** For a body moving with uniform velocity, the average velocity over any time interval is equal to the instantaneous velocity at any instant.
   Reason (R): In uniform velocity, the speed and direction of motion remain constant.

Answers:

1. D 2. a) 3. C 4. a) 5. a.

SHORT ANSWER QUESTIONS

1: Differentiate between speed and velocity.

Answer:

Speed	Velocity
Speed is the rate at which an object covers distance	Velocity is the rate at which an object changes its position
It is a scalar quantity	It is a vector quantity
Speed=Distance/Time	Velocity=Displacement/Time

2: What is uniform circular motion? Give an example.

Answer: Uniform circular motion is the motion of an object traveling at a constant speed along a circular path. Although the speed remains constant, the direction of motion continuously changes, implying a change in velocity and therefore acceleration. An example of uniform circular motion is the motion of the Earth around the Sun.

3: Give the difference between distance and displacement.
Answer:
Distance is the total path length travelled by an object, regardless of the direction. It is a scalar quantity and can never be negative.
Displacement is the shortest distance between the initial and final positions of an object. It is a vector quantity and can be positive, negative, or zero, depending on the direction of motion.

4: Derive the first equation of motion, v=u+at.
Answer: The first equation of motion can be derived as follows:
Initial velocity: u, Final velocity: v, Acceleration: a, Time: t
By definition, acceleration a is the rate of change of velocity: a=v−u/t
Rearranging the equation to solve for v: v=u+at

5: What is meant by the term 'acceleration'? How is it different from velocity?
Answer: Acceleration is the rate of change of velocity with respect to time. It is a vector quantity and is given by the formula
Acceleration=Change in Velocity/Time Taken . It indicates how quickly an object's velocity changes.
Difference between acceleration and velocity:
Velocity is the rate of change of displacement and indicates how fast an object is moving and in which direction.
Acceleration indicates how quickly the velocity of an object is changing.

6: State the three equations of uniformly accelerated motion.
Answer: Equations of Uniformly Accelerated Motion:
(i) $v = u + at$ (ii) $v^2 – u^2 = 2as$ (iii) $s = ut + (1/2)at^2$

7: How is the motion of an object represented by a distance-time graph?
Answer: In a distance-time graph, time is plotted on the x-axis and distance on the y-axis. For uniform motion, the graph is a straight line. For non-uniform motion, the graph can be a curved line.

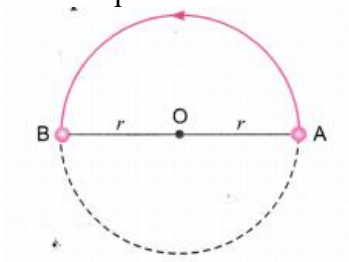
8: Define average velocity and how it is calculated.
Answer: Average velocity is the total displacement divided by the total time taken. It is calculated as: Average velocity=Total displacement/Total time

9: What is meant by the term 'retardation'?
Answer: Retardation (or deceleration) is the rate at which an object slows down. It is the negative acceleration that reduces the velocity of an object over time.

10: How do we determine the acceleration of an object from a velocity-time graph?
Answer: The acceleration of an object can be determined from a velocity-time

graph by calculating the slope of the graph. The slope of a velocity-time graph represents the acceleration. If the graph is a straight line, the acceleration is uniform. If the graph is a curve, the acceleration is non-uniform.

11. A particle is moving in a circular path of radius r. What would be the distance covered and displacement after half a circle?



Answer: Distance covered= circumference of half a circle= $2\pi r/2= \pi r$

Displacement= AB = Shortest distance between initial and final positions

$= r + r = 2r$

LONG ANSWER QUESTIONS

1: Explain the concept of uniform circular motion. How can we calculate the centripetal force acting on an object in a uniform circular motion? Provide examples to illustrate your explanation.

Answer :

Uniform Circular Motion: Uniform circular motion occurs when an object moves in a circular path with a constant speed. Although the speed is constant, the direction of the object changes continuously. Therefore, the velocity (which is speed with direction) of the object changes, implying the presence of acceleration. This acceleration is called centripetal acceleration, and it is always directed towards the center of the circular path.

Centripetal Force: The force required to keep an object moving in a circular path with uniform speed is called centripetal force. It acts towards the center of the circle. The magnitude of the centripetal force F can be calculated using the formula: $F=mv^2/r$

where m is the mass of the object, v is the velocity of the object, and r is the radius of the circular path.

Examples:

Satellite Orbiting Earth: A satellite moving in a circular orbit around the Earth is in uniform circular motion. The gravitational force between the Earth and the satellite provides the necessary centripetal force.

Car on a Circular Track: When a car moves along a circular track, the frictional force between the tires and the road provides the centripetal force that keeps the car moving in a circle.

Electron Orbiting Nucleus: In an atom, electrons move in circular orbits around

the nucleus due to the electrostatic force of attraction between the negatively charged electrons and the positively charged nucleus.
These examples illustrate the necessity of centripetal force in maintaining uniform circular motion. Without this force, the object would move in a straight line due to inertia.

2: Describe the concept of relative motion. How do you determine the relative velocity of one object with respect to another? Give an example to explain your answer.
Answer:
Relative Motion: Relative motion is the calculation of the motion of an object with respect to another moving object. It is a measure of how fast and in what direction one object is moving relative to another object. The concept of relative motion is crucial because all motion is relative to some frame of reference.
Relative Velocity: The relative velocity of an object A with respect to object B (denoted as V_{AB}) is the velocity of object A as observed from the reference frame of object B. It is calculated by subtracting the velocity vector of object B from the velocity vector of object A:
$V_{AB}=V_A-V_B$
where V_A is the velocity of object A and V_B is the velocity of object B.
Example: Consider two cars, Car A and Car B, moving in the same direction along a straight road. If Car A has a velocity of 60 km/h and Car B has a velocity of 40 km/h, then the relative velocity of Car A with respect to Car B is:
$V_{AB}=V_A-V_B$ =60 km/h−40 km/h=20 km/h
This means Car A appears to move at a speed of 20 km/h relative to Car B.
Conversely, if Car B is moving in the opposite direction to Car A, with the same speeds, the relative velocity would be:
$V_{AB}=V_A-V_B$ =60 km/h−(−40 km/h)=100 km/h
This indicates that Car A appears to move at 100 km/h relative to Car B when they are moving in opposite directions.
Illustration: Consider two trains on parallel tracks. If one train moves at 50 km/h and the other at 30 km/h in the same direction, a passenger on the slower train would observe the faster train moving past them at 20 km/h (50 - 30 km/h). If the trains move in opposite directions, the relative speed would be the sum of their speeds, 80 km/h (50 + 30 km/h). This illustrates how relative motion depends on both the speeds and directions of the objects involved.

3: A train travels between two stations 120 km apart. It starts from rest, accelerates uniformly at 1 m/s2 for the first 5 minutes, moves at a constant speed for the next 40 minutes, and then decelerates uniformly to come to rest in the final 5 minutes.
(a) Calculate the maximum speed reached by the train.
(b) Determine the distance covered during the acceleration phase.
Answers:

(a) Calculate the maximum speed reached by the train.

Acceleration phase:

Acceleration, $a = 1\ m/s^2$

Time, $t = 5$ minutes$=5\times60 = 300$ seconds

Using the first equation of motion:

$v = u+at=0+(1\times300) = 300$ m/s

Maximum speed reached by the train is 300 m/s.

(b) Determine the distance covered during the acceleration phase.

Using the second equation of motion:

$s = ut+1/2at^2 = 0+1/2\times1\times(300)^2 =1/2\times90000 = 45000$ meters$=45$ kms

Distance covered during the acceleration phase is 45 km.

4. A car starts from rest and moves along the x-axis with constant acceleration $5m/s^2$ in 8 seconds. If it then continues with constant velocity, what distance will the car cover in 12 seconds since it started from the rest?

Answer: Given, $u=0$, $a=5m/s^2$, $t=8$ sec

Distance travelled by car in first eight seconds,

$s_1= ut+ ½\ at^2$

$= 0+1/2\ x5x8 =160m$

Velocity of car at 8 seconds,

$v= u+at =0 + (5x8) = 40$ m/s

Distance travelled by car in next 4 seconds,

Since car travels with constant velocity in next 4 seconds therefore, acceleration will be zero during this interval.

$s_2= ut+ ½\ at^2$

$= 40x4=160m$

Total distance travelled by car$= s_1 + s_2 = 160 +160 =320$ m

5. A cyclist moving on a circular track of radius 70 m completes one revolution in 3 minutes. What is his

(i) average speed (ii) average velocity in one full revolution?

Answer: Distance travelled in one revolution$= 2\pi r = 2x\ (22/7)\ x\ 70= 440m$

Total time taken$= 3x\ 60s = 180$ s

Total displacement= zero as initial and final position is the same

Average speed= Total distance/ Total time $= 440/ 180 =2.44$ m/s

Average velocity= Total displacement/ Total time $= 0/180 = 0$

Competency based questions

A car travels along a straight road and covers distances of 50 km, 60 km, and 70 km at speeds of 40 km/h, 60 km/h, and 80 km/h, respectively.

(a) Calculate the total time taken by the car to cover the entire journey.

(b) Determine the average speed of the car for the whole journey.
(c) If the car had traveled the entire distance at its average speed, how much time would it have taken?

Answer :

(a) Total Time Taken:

For the first segment (50 km at 40 km/h):

t_1=50 km/ 40 km/h=1.25 hours

For the second segment (60 km at 60 km/h): t_2=60 km/60 km/h=1 hour

For the third segment (70 km at 80 km/h): t_3=70 km/80 km/h=0.875 hour

Total time: $t_{total}=t_1+t_2+t_3=1.25+1+0.875=3.125$ hours

(b) Average Speed:

Total distance = 50 km + 60 km + 70 km = 180 km

Average speed:
Average speed=Total distance/Total time=180 km/3.125 hours≈57.6 km/h

(c) Time Taken at Average Speed:

Time taken if traveling at average speed:
Time=Total distance/Average speed=180 km/57.6 km/h≈3.125 hours
This shows that the car would take the same amount of time (3.125 hours) if it had traveled the entire distance at its average speed of 57.6 km/h.

2. A ball is thrown vertically upwards and then comes back down to the thrower's hand. Assume there is no air resistance.

(a) Explain the concepts of speed, velocity, and acceleration during the ball's ascent and descent.
(b) Discuss how the direction of motion affects the sign of the velocity and acceleration.
(c) Describe what happens to the ball's velocity and acceleration at the highest point of its trajectory.

Answer :

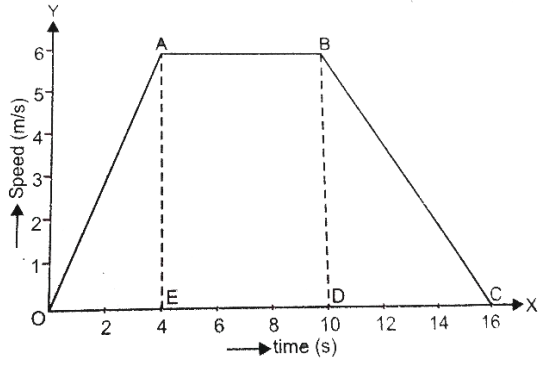
(a) Speed, Velocity, and Acceleration:

Speed: Speed is a scalar quantity representing how fast the ball is moving regardless of direction. The ball's speed decreases as it ascends and increases as it descends.

Velocity: Velocity is a vector quantity that includes both the magnitude of speed and the direction of motion. During the ascent, the velocity is positive (upwards), and during the descent, the velocity is negative (downwards).
Acceleration: Acceleration due to gravity is constant and acts downwards throughout the motion. It slows the ball down as it ascends and speeds it up as it descends.
(b) Direction of Motion and Sign of Velocity and Acceleration:
During the ascent, the ball's velocity is positive as it moves upwards, but acceleration due to gravity is negative because it acts downwards, opposing the motion.
During the descent, the ball's velocity is negative as it moves downwards, and acceleration due to gravity is positive, now aiding the motion.
(c) At the Highest Point of Trajectory:
Velocity: At the highest point, the ball's velocity is zero because it momentarily stops before changing direction to descend.

Acceleration: The acceleration due to gravity remains constant and acts downwards. Even at the highest point, the acceleration is not zero. The ball is still under the influence of gravity, which will soon cause it to start descending.

3. Study the speed time graph of a body shown in Figure. and answer the following questions:



(a) What type of motion is represented by OA?
(b) What type of motion is represented by AB?
(c) What type of motion is represented by BC?
(d) Find out acceleration of the body from O to A.
(e) Find out retardation of the body.
(f) Find out the distance travelled by the body from A to B.
Answers: (a) As speed - time graph OA is a straight line with a positive slope, the motion is uniformly accelerated motion.
(b) As AB is parallel to time axis, its slope is zero. Therefore, acceleration of the body is zero. The body is moving with a uniform velocity.

(c) As speed - time graph BC is a straight line with negative slope, the motion is uniformly decelerated motion(retardation).

(d) From O to A ,

change in speed = 6−0= 6m/s

time taken = 4−0 = 4s

Thus , acceleration =change in speed/time taken=$6ms^{-1}/4s=1.5m/s^2$

(e) From B to C

change in speed = 0−6 = − 6m/s

time taken =16−10 = 6s

Thus , acceleration =change in speed/time taken= $-6ms^{-1}/6s = -1m/s^2$

Negative sign indicates retardation.

(f) From A to B , the velocity is uniform.

∴ distance travelled from A to B = Area of rectangle ABDE= AD x DE =6x6 = 36m

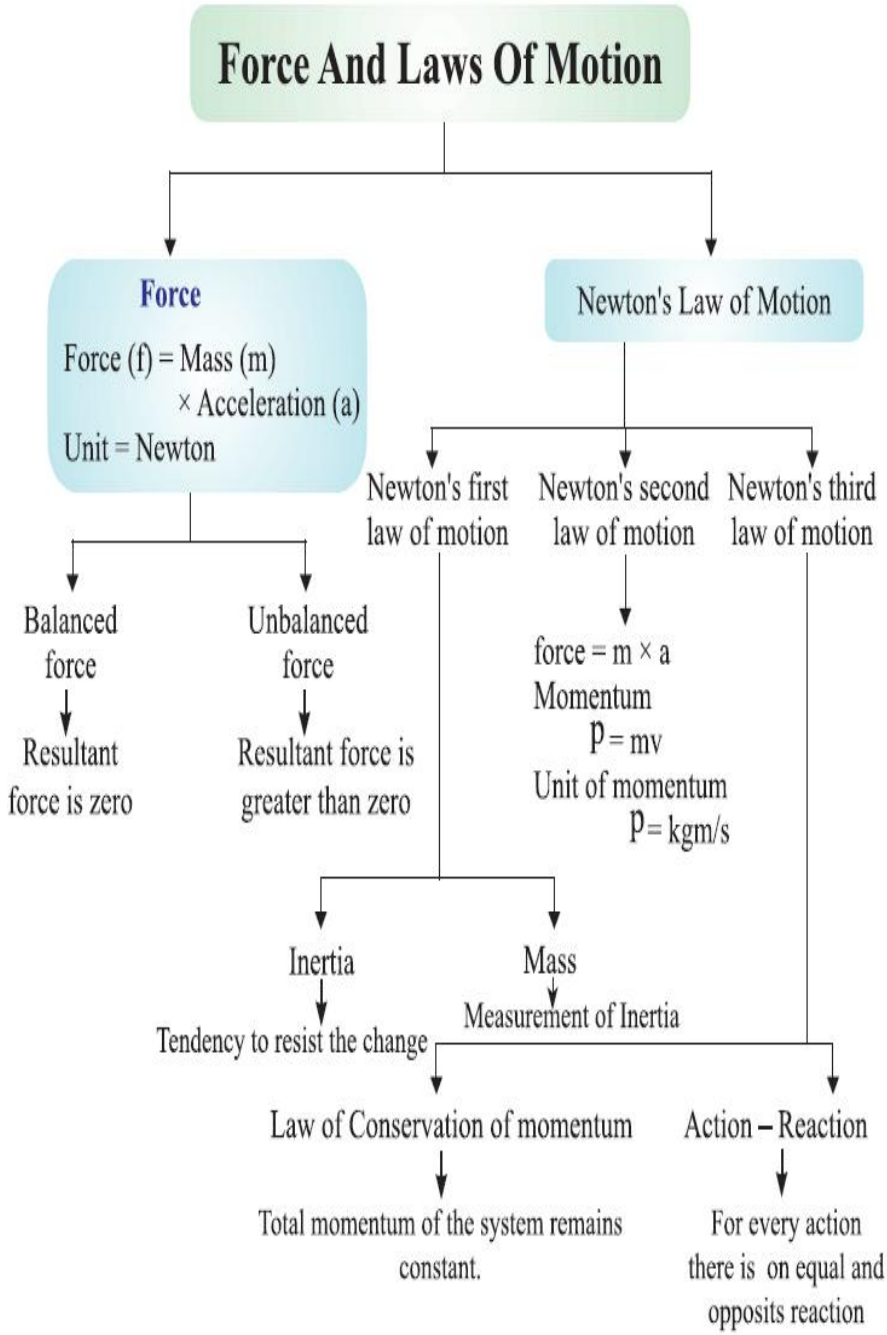
Alternate method:

Distance= velocity x time

=6×(10−4)=36m

FORCE AND LAW OF MOTION

CONCEPT MAPPING



Topics from syllabus:- Force and Motion, Newton's Laws of Motion, Action and Reaction forces, Inertia of a body, Inertia and mass, Momentum, Force and Acceleration.

CHAPTER SUMMARY

Force and Motion:

A force is applied to push the cart, a driver applies force either to stop the car or bus or in order to change the speed or direction of motion, and a football player kicks the ball in order to set it in motion.
In all the examples given above, the force is applied on a body that brings about the following changes:
a. Change in the state of rest of a body or change in its position**.**
b. To change the speed of the body.
c. To change the direction of motion of a body.

Force is defined as any external agent that changes the state of rest or uniform motion of a body along a straight line.

Units of force :-

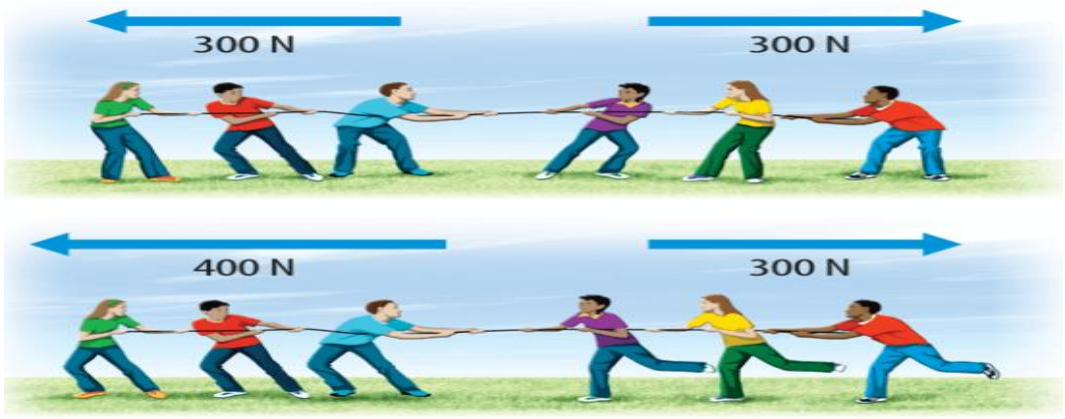
- In S.I system, force is measured in Newton's represented by letter "N" while as in C.G.S system its values are represented in dynes.

Newton :-

- The force applied is said to be one dyne if it produces acceleration of 1cm/sec²and in a body of mass 1Kg.

Dyne :-

- The force applied is said to be one dyne if it produces acceleration of 1cm/sec²⁻ in a body of mass 1 gram.



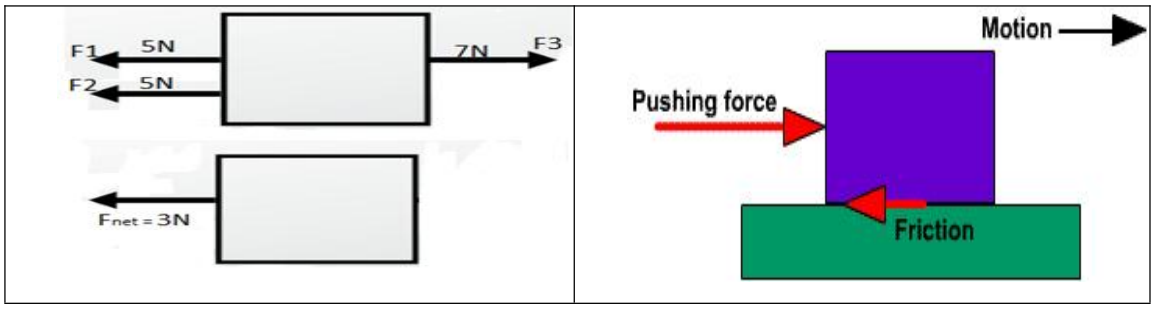
Balanced and Unbalanced Forces

When **balanced forces** are applied to an object, there will be no net effective force acting on the object. Balanced forces do not cause a change in motion. e.g.

Unbalanced forces acting on an object change its speed and/or direction of motion. It moves in the direction of the force with the highest magnitude. The forces applied are unequal and opposite to each other.

Net Force

When multiple forces act on a body, they can be resolved into one component known as the net force acting on the object. The net force decides the direction of motion.



Frictional Force

The force that opposes relative motion is called friction. It arises between the surfaces in contact. Example: When we try to push a table and it does not move is because it is balanced by the frictional force. (Above fig.)

Galileo's Observation and Origin of Newton Mechanics:

Galileo observed when a ball rolls down on an inclined plane, its speed is increased. In the same way, when rolled up the inclined plane, its speed decreased. He then rolled the ball on a horizontal plane. Galileo repeated this experiment on a smooth surface. He noticed that the ball continued to move. Galileo suggested that the speed of the ball moving on a horizontal plane remains constant when no external force or force of friction acts on it. Galileo noticed that it is the natural tendency of all bodies to oppose any change in their state of rest or motion.

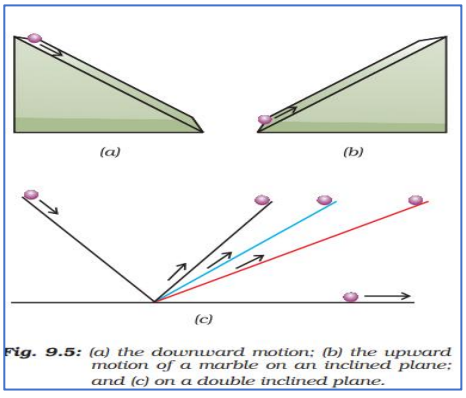
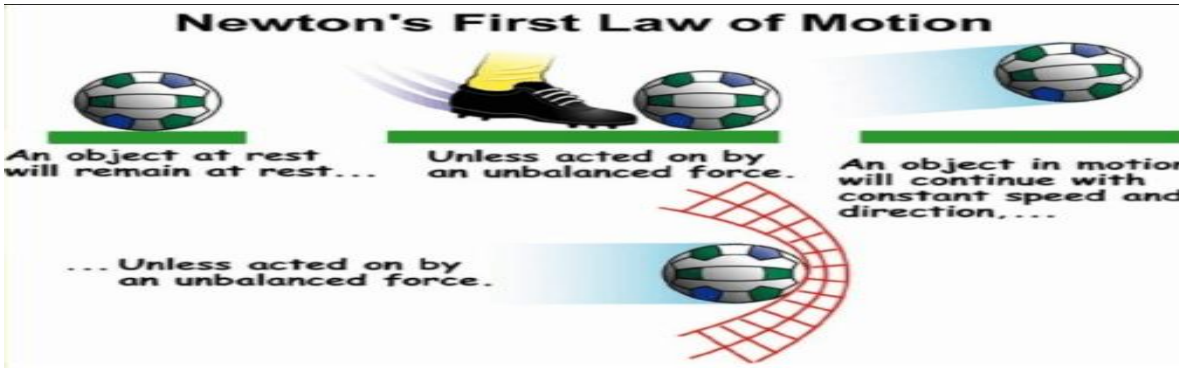


Fig. 9.5: *(a) the downward motion; (b) the upward motion of a marble on an inclined plane; and (c) on a double inclined plane.*

First Law of Motion (Law of inertia)

A body continues to be in the state of rest or uniform motion in a straight line unless acted upon by an external unbalanced force. The First Law is also called the Law of Inertia.



Inertia

Basically, all objects have a tendency to resist the change in the state of motion or rest. This tendency is called inertia. All bodies do not have the same inertia. Inertia depends on the mass of a body. The mass of an object is the measure of its inertia.

There are two conditions on which the 1st law of motion is dependent:
Objects at rest: When an object is at rest, velocity ($v = 0$) and acceleration ($a = 0$) are zero. Therefore, the object continues to be at rest.
Objects in motion: When an object is in motion, velocity is not equal to zero ($v \neq 0$), while acceleration ($a = 0$) is equal to zero. Therefore, the object will continue to be in motion with constant velocity and in the same direction.

Inertia of Rest
An object stays at rest, and it remains at rest until an external force affects it. Example: When a car accelerates, passengers may feel as though their bodies are moving backwards. In reality, inertia is making their bodies stay in place as the car moves forward.

Inertia of Motion
An object will continue to be in motion until a force acts on it. Example: A hockey puck will continue to slide across the ice until acted upon by an outside force.
Inertia of Direction
Inertia of direction is defined as a body's ability to resist changes in its motion direction. Ex: A stone whirling in a horizontal circle is attached to a thread. If the string tears, the stone will fly away in a tangential direction.
Inertia and Mass

- The inertia of an object is dependent upon its mass.
- Lighter objects have less inertia, that is, they can easily change their state of rest or motion.
- Heavier objects have large inertia and therefore they show more resistance.

- Hence 'Mass' is called a measure of the inertia of an object
  More the mass → more the inertia and vice versa.

Newton's Second Law of Motion

Newton's second law of motion says that the rate of change of momentum is directly proportional to the applied force and takes place in the same direction as the applied force.

Momentum:-The momentum, p of an object is defined as the product of its mass, m and velocity, v. That is, **p = mv**

Momentum has both direction and magnitude. Its direction is the same as that of velocity, v. The SI unit of momentum is kilogram-metre per second (kg m s^{-1}).

MATHEMATICAL FORMULATION OF SECOND LAW OF MOTION

Suppose an object of mass, m is moving along a straight line with an initial velocity, u. It is uniformly accelerated to velocity, v in time, t by the application of a constant force, F throughout the time, t.The initial and final momentum of the object will be, p_1 = mu and p_2 = mv respectively.

The change in momentum $\propto p_2 - p_1$

$\propto mv - mu$

$\propto m \times (v - u)$

Or, the applied force,

$$F \propto \frac{m \times (v-u)}{t}$$

$$F = \frac{km \times (v-u)}{t}$$

$$= kma$$

Force and acceleration:- Here **a = (v – u)/t** is the **acceleration**, which is the rate of change of velocity. The quantity, k is a constant of proportionality (k=1). The SI units of mass and acceleration are kg and m s^{-2} respectively. **F = ma**. The unit of force is kg m s^{-2} or newton, which has the symbol N. after putting value of a in F …

F = m(v-u)/t

Impulse:

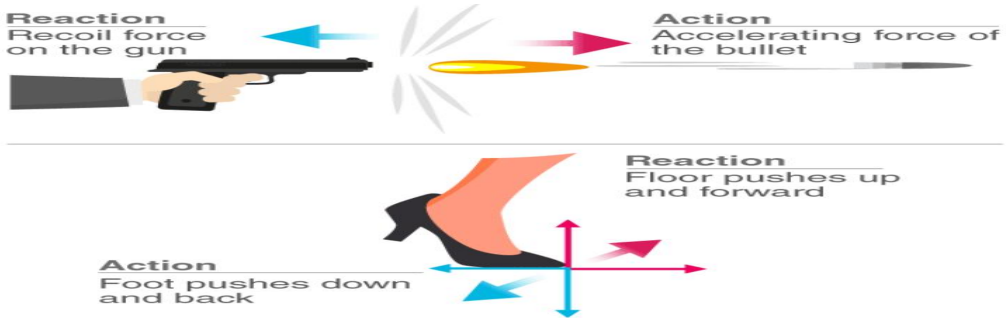
The mathematical representation second law of motion is F = mv−mu/t,

Ft = mv – mu. When forces are acting on a body for a short interval of time then it is defined as an impulse. SI unit of impulse = kg m/s.

When a person kicks a football, the kick lasts only for seconds. This force is an example of an impulsive force.

Newton's Third Law of Motion

It states that when one object exerts a force on another object, the second object instantaneously exerts a force back on the first. These two forces are always equal in magnitude but opposite in direction. The two opposing forces are also known as **action and reaction forces.** Every action has an equal and opposite reaction. Action and reaction forces are equal, opposite and acting on different bodies.



Some Examples of Newton's Third Law of Motion:

a. While walking on the ground, our foot pushes the ground backward (action force) whereas the ground in turn exerts a force on the foot (reaction force) causing the foot to move forward.

b. When a person jumps from a diving board, he pushes the diving board (action force) whereas the board, in turn, pushes the man forward in the opposite direction (reaction force).

MULTIPLE CHOICE QUESTIONS

Question 1. Which of the following statements is not correct for an object moving along a straight path in an accelerated motion?
(a) Its speed keeps changing (b) Its velocity always changes
(c) It always goes away from the Earth (d) A force is always acting on it

Question 2. According to the third law of motion, action and reaction
(a) always act on the same body
(b) always act on different bodies in opposite directions
(c) have same magnitude and directions
(d) act on either body at normal to each other

Question 3. A goalkeeper in a game of football pulls his hands backwards after holding the ball shot at the goal. This enables the goalkeeper to
(a) exert larger force on the ball
(b) reduce the force exerted by the balls on the hands
(c) increase the rate of change of momentum
(d) decrease the rate of change of momentum

Question 4. The inertia of an object tends to cause the object
(a) to increase its speed (b) to decrease its speed
(c) to resist any change in its state of motion (d) to decelerate due to friction

Question 5 A passenger in a moving train tosses a coin which falls behind him. It means that motion of the train is
(a) accelerated (b) uniform (c) retarded (d) along circular tracks

Question 6. An object of mass 2 kg is sliding with a constant velocity of 4 ms^{-1} on a frictionless horizontal table. The force required to keep the object moving with the same velocity is
(a) 32 N (b) 0 N (c) 2 N (d) 8 N

Question 7. A force cannot change the speed of a moving object.
A) True B) False C) Can't say D) Partially true/false

Question 8. A water tanker filled up to 23 of its height is moving with a uniform speed. On a sudden application of brakes, the water in the tank would
(a) move backward (b) move forward (c) be unaffected (d) rise upwards

Question 9 Newton's second law of motion is mathematically represented as ___.
A) F = ma B) F = mv C) F = m/a D) F = m + a

Question 10. When a number of forces acting simultaneously on a body bring about a change in its state of rest or of uniform motion in a straight line, then these forces acting on the body are said to be
(a) balanced forces (b) equal forces (c) unbalanced forces (d) opposite forces

Question 11 When a car at high speed makes a sharp turn, the driver in a car tends to get thrown to the side opposite to the turn. This is due to the
(a) inertia of motion (b) inertia of time (c) inertia of rest (d) inertia of direction

Question 12. A man is standing on a boat in still water. If he walks towards the shore, then the boat will
(a) move away from the shore (b) move towards the shore
(c) remain stationary (d) none of these

Question 13. Which of the following is an incorrect statement?
(a) Mass is measure of inertia of a body.
(b) Newton's first law of motion is the law of inertia.
(c) Unbalanced force produces constant velocity.
(d) Newton's third law talks about the direction of the force.

Question 14. A ball is thrown vertically upward in a train moving with uniform velocity. The ball will
(a) fall behind the thrower (b) fall ahead of the thrower

(c) return back to the thrower (d) fall on the left of the thrower

Question 15. An object of mass 2 kg is sliding with a constant velocity of $4ms^{-1}$on a frictionless horizontal table. The force required to keep the object moving with the same velocity is

A) 32N B) 0N C) 2N D) 8N

ANSWERS(MULTIPLE CHOICE QUESTIONS)

1(d) A force is always acting on it
2 (b) always act on different bodies in opposite directions
3 (d) decrease the rate of change of momentum
4 (c) to resist any change in its state of motion
5 (a) accelerated
6 (b) 0 N
7. B **Solution :** A force can change following factors. Speed of object, Direction of motion, Size and shape of object.
8 (b) move forward
9 A) F = ma
10 (d) opposite forces
11 (a) inertia of motion
12 (a) move away from the shore
13 (c) Unbalanced force produces constant velocity.
14 (c) return back to the thrower
15. B Solution :[b] Given, mass m = 2 kg, velocity v = 4 ms^{-1}As the object is moving with a constant velocity i. e., a ms^{-1} so the acceleration of the object is zero i.e., a = 0 and according to the property of inertia if there is no external force acting on the body, then body remains as it is i.e., if the body is at rest, remains at rest and if it is in motion, remains in motion.

Assertion Reason type questions

DIRECTION : In each of the following questions, a statement of Assertion is given and a corresponding statement of Reason is given just below it. Of the statements, given below, mark the correct answer as:
(a) Both assertion and reason are true and reason is the correct explanation of assertion.
(b) Both assertion and reason are true but reason is not the correct explanation of assertion. (c) Assertion is true but reason is false.
(d) Both Assertion and Reason are false.

1. **Assertion** : If the net external force on the body is zero, then its acceleration is zero.
Reason : Acceleration does not depend on force.
2. **Assertion** : When we sit on a chair, our body exerts a force downward and that chair needs to exert an equal force upward or the chair will collapse.
Reason : The third law says that for every action there is an equal and opposite reaction.
3. **Assertion**: A football has lesser inertia than a stone of the same size.
Reason: Massive object has less inertia.
4. **Assertion** : While walking on ice, one should take small steps to avoid slipping.
Reason : This is because smaller steps ensure smaller friction
5. **Assertion** (A) : Newton's laws can be applied to bigger bodies
Reason (R) : During any kind of collision the centre of mass of the system is not accelerated

Answers:-
1.(c) Assertion is true but reason is false.
According to Newton's second law,
force = acceleration x mas i.e., if net external force on the body is zero (F = 0), then, the acceleration of a body is also zero.
2.A 3.C 4. A 5.B

SHORT ANSWER TYPE QUESTION:-

1. (i) Define force?
Ans. Force is a push or pull acting on an object due to its interaction with another object. It can change the state of motion or shape of the object.

(ii) A bullet fired against a glass window pane makes a hole in it, and the glass pane is not cracked. But on the other hand, when a stone strikes the same glass pane, it gets smashed. Why is it so?
Answer:
When the bullet strikes the glass pane, the part of the glass pane which comes in contact with the bullet immediately shares the large velocity of bullet and makes a hole, while the remaining part of the glass remains at rest and is therefore not smashed due to inertia of rest.

2. State Newton's first law of motion.
Ans. Newton's first law of motion states that an object will remain at rest or in uniform motion in a straight line unless acted upon by an external force.

3. (i)What is inertia?
Ans. Inertia is the tendency of an object to resist a change in its state of motion. The greater the mass of an object, the greater its inertia.

(ii) Explain why some of the leaves may get detached from a tree if we vigorously shake its branch.

Ans: Some of the leaves may get detached from a tree if we vigorously shake its branch because the branches of the tree will come into motion while the leaves tend to continue in their state of rest. This is due to the inertia of rest of the leaves. The force of shaking will act on the leaves with the change in direction rapidly, which results in the leaves detaching and falling off from the tree.

4. Explain Newton's second law of motion.
Ans. Newton's second law of motion states that the rate of change of momentum of an object is directly proportional to the applied force and takes place in the direction of the force. Mathematically,
Force= mass × acceleration

5. Discuss the importance of seat belts in cars from the perspective of physics.
Ans. Seat belts in cars are designed to restrain passengers during sudden stops or collisions. According to Newton's first law of motion, an object in motion will stay in motion unless acted upon by an external force. In the event of a crash, the seat belt applies a force to the passenger, bringing them to a stop along with the car and preventing them from continuing to move forward, thus reducing the risk of injury.

6. A particle of 10 kg is moving in a constant acceleration 2m/s^2 starting from rest. What is its momentum and velocity per the table given below

S. No	time	Momentum	Velocity
1	1sec		
2	1.5 sec		
3	2 sec		
4	2.5 sec		

Answer Velocity can find using

$v=u+at$ For u=0. $v=at$
Momentum. P=mv

S. No	time	Momentum	Velocity
1	1sec	20 Kg m/s	2 m/
2	1.5 sec	30 kg m/s	3 m/s
3	2 sec	40 kg m/s	4 m/s
4	2.5 sec	50 kg m/s	5 m/s

7. How much net force is required to accelerate a 1000 kg car at 4.00 m/s^2?
Answer $F=ma$
Given a=4.00 m/s^2 m=1000kg
Therefore , $F=ma$=1000×4=4000 N

8. A body of mass 1 kg undergoes a change of velocity of 4m/s in 4s what is the force acting on it?
Answer Given Δv=4m/s ,t=4 s ,m=1kg
Acceleration is given by $a=\Delta vt$. a=1 m/s^2
Now force is given by. $F=ma$. F=1 N

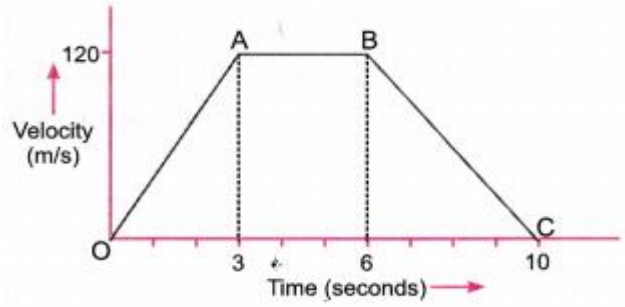
9. A person is standing on a frictionless surface and throws a ball. Explain the motion of the person and the ball according to Newton's third law.
Answer: According to Newton's third law, for every action, there is an equal and opposite reaction. When the person throws the ball, they exert a force on the ball (action), and the ball exerts an equal and opposite force on the person (reaction). As a result, the person moves backward.

10. How does a rocket propel forward in space, considering Newton's third law?
Answer: A rocket propels forward in space by expelling gas out of its engines at high speeds. The action is the expulsion of gas, and the reaction is the forward motion of the rocket.

Long answer type question

1. Which of the following has more inertia:
a. A rubber ball and a stone of the same size?
Ans: Inertia depends on the mass of the object. The larger the mass, the greater will be its inertia and vice-versa. In the case of a rubber ball and a stone of the same size, it is clear that the stone will have greater inertia than the ball. It is because, despite being the same size, the stone weighs more than the rubber ball.
b. A bicycle and a train?
Ans: Inertia depends on the mass of the object. The larger the mass, the greater will be its inertia and vice-versa. In the case of a bicycle and a train, it is clear that the train will have greater inertia than the bicycle because the train weighs more than the bicycle.
c. A five rupees coin and a one-rupee coin?
Ans: Inertia depends on the mass of the object. The larger the mass, the greater will be its inertia and vice-versa. In the case of a five rupees coin and a one-rupee coin, the five rupees coin will have greater inertia than the one-rupee coin because five rupees coin weighs more than a one-rupee coin.

2. (i) Two balls of the same size of different materials, rubber and iron are kept on the smooth floor of a moving train. The brakes are applied suddenly to stop the train. Will the balls start rolling? If so, in which direction? Will they move with the same speed? Give reasons for your answer.
(ii) The velocity-time graph of an object of mass m = 50 g is shown in figure. Observe the graph carefully and answer the following questions.
(a) Calculate the force on the object in time interval 0 to 3 s.
(b) Calculate the force on the object in the time interval 6 to 10 s.
(c) Is there any time interval in which no force acts on the object? Justify your answer.



ANSWER:-
(i) Yes, the balls will start rolling in the direction in which the train was moving. Due to the application of the brakes, the train comes to rest but due to inertia the balls try to remain in motion, therefore, they begin to roll. Since the masses of the balls are not the same, therefore, the inertial forces are not same on both the balls. Thus, the balls will move with different speeds.

- (ii) (a) Acceleration during interval 0 to 3 s

$$a_1 = \frac{v-u}{t} = \frac{120-0}{3} = 40 \text{ m/s}^2$$

$$\text{Given mass, } m = 50 \text{ g} = \frac{50}{1000} \text{ kg}$$

$$\therefore \text{Force, } F_1 = ma_1 = \left(\frac{50}{1000}\right) \times 40 = 2\text{N}$$

(b) Acceleration during interval 6 to 10 s

$$a_2 = \frac{v_2 - v_1}{t} = \frac{0-120}{(10-6)}$$

$$= -\frac{120}{4} = -30 \text{ m/s}^2$$

Force, $F_2 = ma_2 = (50/1000) * (-30) = -1.5$ N

(c) During time interval 3 to 6 s, the velocity of object is constant, so in this time interval, acceleration is zero and hence force, F (= ma) is zero.]

NUMERICALS:-

1. A sedan car of mass 200kg is moving with a certain velocity. It is brought to rest by the application of brakes, within a distance of 20m when the average resistance being offered to it is 500N.What was the velocity of the motor car?

Answer F=ma

or. $a=F/m$

or. a= -500/200=-2.5 m/s^2

Now

$v^2=u^2+2as$

Now v=0, s=20 m, a=-2.5 m/s^2. So, u=10 m/s

2. A driver accelerates his car first at the rate of 4 m/s^2 and then at the rate of 8 m/s^2 . Calculate the ratio of the forces exerted by the engines?

Answer $F_1= ma_1$. and. $F_2= ma_2$

So, Ratio of force exerted is given by

$F_1/F_2=ma_1/ma_2=a_1/a2$=1:2

3. Which would require a greater force - accelerating a 2 kg mass at 5 m/s^2 or a 6 kg mass at 2 m/s^2?

Answer. we have $F=ma$.

Here we have m_1=2 kg and $a1=5m/s^2$

and m_2=6 kg and $a_2=2m/s^2$.

So,

$F_1=m_1a_1=2\times5=10N$

$F_2=m_2a_2=6\times2=8N$.

Here $F1<F2$. Thus, accelerating a 6 kg mass at 2 m/s^2 would require a greater force.

4. The velocity-time graph of a ball moving on the surface of floor is shown in the figure. Calculate the force acting on the ball, if mass of the ball is 100 g.

Answer:

The velocity-time graph shows that the velocity of the ball at t = 0 is zero. Initial

velocity of ball, u = 0

Velocity of ball at t = 4 s is 20 ms^{-1}

That is, final velocity, v = 20 ms^{-1}

Time, t = 4 s

∴ Acceleration of the ball, a = (v-u) / t

or, $a = \dfrac{20\ \text{ms}^{-1} - 0}{4\ \text{s}}$

$\Rightarrow \quad a = \mathbf{5\ ms^{-2}}$

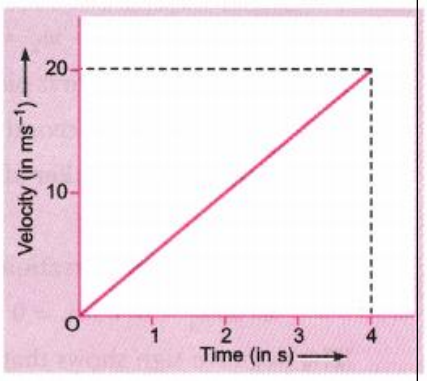
Also, mass of ball,

$$m = 100\ \text{g} = \frac{100}{1000}\ \text{kg} = \frac{1}{10}\ \text{kg}$$

∴ Force acting on the ball, $F = ma$

or, $F = \dfrac{1}{10}\ \text{kg} \times 5\ \text{ms}^{-2}$

$= 0.5\ \text{kg ms}^{-2} = \mathbf{0.5\ N} \quad [\because 1\ \text{kg ms}^{-2} = 1\ \text{N}]$



5. A force of 5 N produces an acceleration of 8 ms^{-2} on a mass m_1 and an acceleration of 24 ms^{-2} on a mass m_2. What acceleration would the same force provide if both the masses are tied together?

Answer: We know, F=m a = 5 N or 5kg ms^{-2}

$$m_1 = \frac{F}{a_1} = \frac{5}{8}\ \text{kg}$$

$$m_2 = \frac{F}{a_2} = \frac{5}{24}\ \text{kg}$$

$$M = \left(\frac{5}{8} + \frac{5}{24}\right)\text{kg} = \left(\frac{5}{6}\right)\text{kg}$$

Acceleration produced in M,

$$a = \frac{F}{M} = \frac{5}{5/6} = \mathbf{6\ ms^{-2}}$$

6. A force of 15N acts for 5s on a body of mass 5kg which is initially at rest. Calculate.

(a) Final velocity of the body

Ans: Given: Mass of body: m=5kg

Initial velocity of body: u=0ms−1(as it starts from rest)

Force acting on the body: F=15N

Time: t=5s

To find the final velocity of the body.First we need to find the acceleration produced.

F=ma a=Fm ⇒a=15/5 ⇒a= 3 $ms-2$.

It is known that – v=u+at. Thus, v=0+(3×5). v=15$ms-1$

(b) The displacement of the body

Ans: Given: Mass of body: m =5kg

Initial velocity of body: u=0$ms-1$(as it starts from rest)

Force acting on the body: F=15N
Time: t=5s
To find the displacement of the body.

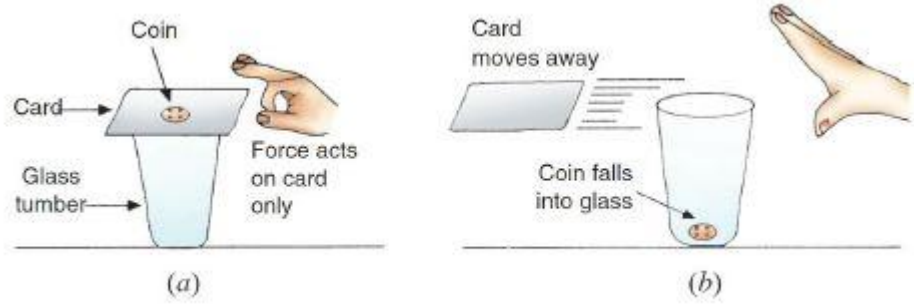
Next, the distance of penetration:

s= ut+1/2at^2
⇒s=(0×5)+12(3×52). ⇒s=(0)+(37.5). ⇒s=37.5m

CASE BASED QUESTIONS

1. Competency: Understanding of Newton's First Law of Motion

Q.1We take a glass tumbler and place a thick square card on its mouth as shown in Figure (a). A coin is then placed above this card in the middle. Let us flick the card hard with our fingers. On flicking, the card moves away but the coin drops into the glass tumbler [see Figure (b)].



(i) Give reason for the above observation.
(a) The coin possesses inertia of rest, it resists the change and hence falls in the glass.
(b) The coin possesses inertia of motion; it resists the change and hence falls in the glass.
(c) The coin possesses inertia of rest, it accepts the change and hence falls in the glass.
(d) The coin possesses inertia of rest, it accepts the change and hence falls in the glass.

(ii) Name the law involved in this case.

(a) Newton's second law of motion	(b**) Newton's first law of motion.**
(c) Newton's third law of motion.	(d) Law of conservation of energy

(iii) If the above coin is replaced by a heavy five rupee coin, what will be your observation. Give reason.
(a) Heavy coin will possess more inertia so it will not fall in tumbler.
(b) Heavy coin will possess less inertia so it will fall in tumbler.
(c) Heavy coin will possess more inertia so it will fall in tumbler.
(d) Heavy coin will possess less inertia so it will not fall in tumbler.

(iv) Name the law which provides the definition of force.

(a) Law of conservation of mass	(b) Newton's third law.
(c) Newton's first law	(**d) Newton's second law**.

(v) State Newton's first law of motion.
(a) Energy can neither be created nor be destroyed, it can be converted from one form to another, total amount of energy always remains constant.
(b) A body at rest remains at rest or, if in motion, remains in motion at constant velocity unless it is acted upon by an external unbalanced force.
(c) For every action in nature there is an equal and opposite reaction.
(d) The acceleration in an object is directly related to the net force and inversely related to its mass.

Q.2. Competency: Understanding of Newton's Third Law of Motion
Newton's Third law of Motion
A force is a push or a pull that acts upon an object as a result of its interaction with another object. Forces result from interactions! some forces result from *contact interactions* (normal, frictional, tensional, and applied forces are examples of contact forces) and other forces are the result of action-at-a-distance interactions (gravitational, electrical, and magnetic forces). According to Newton, whenever objects A and B interact with each other, they exert forces upon each other. When you sit in your chair, your body exerts a downward force on the chair and the chair exerts an upward force on your body. There are two forces resulting from this interaction - a force on the chair and a force on your body. These two forces are called *action* and *reaction* forces and are the subject of Newton's third law of motion. Formally stated, Newton's third law is:
Q1 According to the third law of motion, action and reaction
A. always acts on the same body
B. always acts on different bodies in opposite directions
C. have same magnitude and directions
D. act on either body at normal to each other

Q2 The forward movement in swimming takes place because of

A. Third law of motion B. Fourth law of motion

C. Second law of motion D. First law of motion

Q3 A horse pulling A tanga moves forward due to_____

A. The horse on the ground with his feet

B. The horse on the tonga

C. The ground on the horse's feet

D. The tonga on the horse

Q4 When a force is exerted on the object ,it can change its

A State B Position C shape D all the above

Q 5 The action and reaction referred to in third law

A. Must act on different objects B. must act on the same object

C. May act on different objects D. Need not be equal in magnitude but act in the same direction

Answers :- Q1 B Q2 A Q3 A Q4 D Q 5 C

#Solve by the help of teacher:-

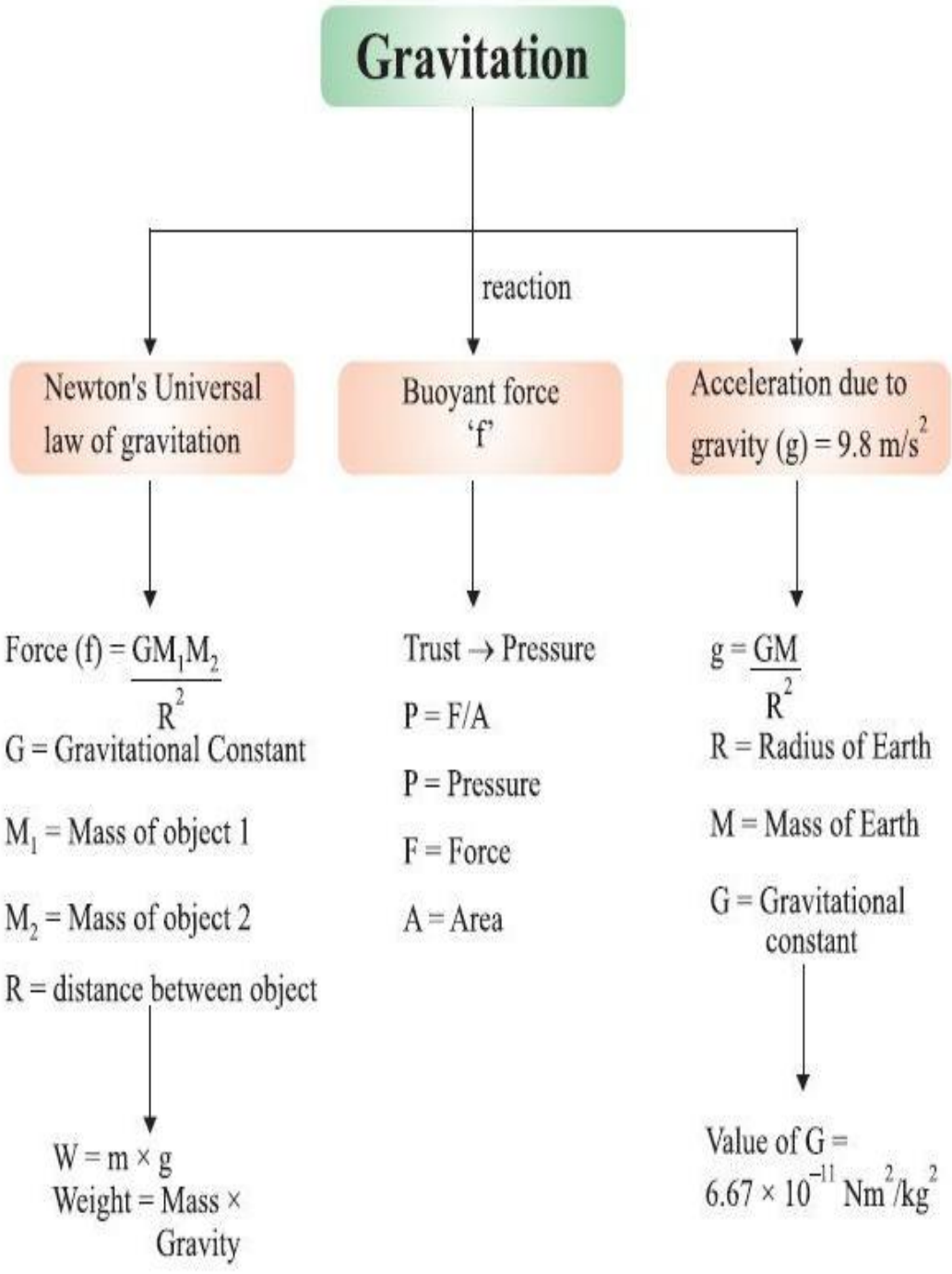
1. A boy of mass 50 kg running 5 m/s jumps on to a 20 kg trolley travelling in the same direction at 1.5 m/s. find their common velocity.
2. The velocity of body of mass 1 kg changes from 15m/s to 25m/s in 5 seconds, due to the action of a constant force acting on it. Find magnitude of the force.
3. A particle of mass 20kg, which is initially at rest, is acted upon by a constant force of 10 N for 10 seconds. Find velocity attained by the particle after 10s and distanced covered by it in the same time

***** _____ *****

Chapter: Gravitation

MIND MAP

Thrust



SUMMARY

Introduction to Gravitation

Gravitation is the force of attraction that exists between any two objects in the universe.

Sir Isaac Newton first described this force and formulated the law of universal gravitation.

Newton's Law of Gravitation

- Every object in the universe attracts every other object with a force that is directly proportional to the product of their masses and inversely proportional to the square of the distance between their centers.
- The formula for the gravitational force F between two objects of masses m1 and m2 separated by a distance r is given by $F=G\times m_1\times m_2/r^2$, where G is the universal gravitational constant.

Eg :- If a body is dropped from a certain height, it falls downwards due to earth's gravity. If a body is thrown upwards, it reaches a certain height and then falls downwards due to the earth's gravity.

Gravitation may be the attraction between objects in outer space.

Eg :- Attraction between the earth and moon.

Attraction between the sun and planets.

Importance of universal law of gravitation

The force that binds us to the earth.

The motion of moon around the earth.

The motion of earth around the sun.

The tides due to moon in the sea.

Free Fall

An object is said to be in free fall if it is only under the influence of gravity, with no other forces acting on it.

The acceleration due to gravity (g) near the Earth's surface is approximately 9.8 m/s^2 and is directed towards the center of the Earth.

To calculate the value of "g" (acceleration due to gravity)

The acceleration due to gravity is denoted by g.

The unit of g is same as the unit of acceleration

From the second law of motion, force is the product of mass and acceleration. F = ma

For free fall, force is the product of mass and acceleration due to gravity.

F=mg or $mg=\frac{GMm}{r^2}$

or $g=\frac{GM}{r^2}$

where M is the mass of the Earth and r is the distance between the object and the earth.

Equation of motion when an object is falling freely towards earth or thrown vertically upwards *:*

Important points to remember:

1.When a body is allowed to fall freely from a height, it`s initial velocity (u)is zero.
2.When a body is falling vertically downwards, it`s velocity goes on increasing. Therefore its acceleration is positive. g= +9.8m/s^2
3. When a body is thrown vertically upwards, it`s velocity goes on decreasing due to opposing gravity. Therefore it`s acceleration is negative. g= -9.8m/s^2
4. In differences between mass and weight, in denotation it should be formulae and formulas.

Case

Case 1. When an object is falling towards earth with initial velocity *(u),* then Velocity *(v)* after *t* seconds, $v = u + gt$,

Height covered in *t* seconds, $h = ut + \frac{1}{2}gt^2$

Relation between *v* and *u* when *t* is not mentioned :

$$v^2 = u^2 + 2gh$$

Case 2. When object is falling from rest position means initial velocity $u = 0$ (zero), then

Velocity *(v)* after *t* seconds, $v = gt$

Height covered in *t* seconds, $h = \frac{1}{2}gt^2$ Relation between *v* and *u* when *t* is not

$$v^2 = 2gh$$

mentioned :

Case 3. When an object is thrown vertically upwards with initial velocity *u,* the gravitational acceleration will be negative (- g), then

Velocity *(v)* after *t* seconds, $v = u - gt$

Height covered in *t* seconds, $h = ut - \frac{1}{2}gt^2$

Relation between *v* and *u* when *tis* not mentioned :

$$v^2 = u^2 - 2gh$$

Mass and Weight
Mass is the amount of matter contained in an object, and it remains constant

regardless of the location.
Weight is the force with which an object is attracted towards the Earth, and it varies with the acceleration due to gravity.
Weight =Fg=GmMe /R^2=mg

Differentiating Property	Mass	Weight
Definition	Mass is simply the measure of the amount of matter in a body.	Weight is the measure of the amount of force acting on a mass due to acceleration due to gravity.
Denotation	Mass is denoted by "M".	Weight is denoted by "W".
Formula	Mass is always constant for a body and there are several formulas to calculate mass.	Weight is the measure of the gravitational force acting on a body.
	One way to calculate mass is:	Weight can be calculated from the following formula:
	Mass = volume × density	**Weight = mass × acceleration due to gravity**
Quantity Type	Mass is a base quantity.	Weight is a derived quantity.
	Mass only has magnitude and so, it is a scalar quantity.	Weight has both magnitude and direction (towards the centre of gravity) and so, it is a vector quantity.
Unit of Measurement	The SI unit of mass is Kilogram (Kg).	The SI unit of weight is Newton (N).
Gravitational Effect	Mass does not depend upon gravity and is constant everywhere.	Weight is dependent on gravity and so, it varies from place to place.
	Mass can never be zero.	Weight can be zero where there is no gravity (like space).
Measuring Instrument	Mass can be easily measured using any ordinary balance like beam balance, lever balance, pan balance, etc.	Weight can be measured by a spring balance or by using its formula.

Weight Of The Object On Moon

The mass of the moon is less than the mass of the earth. So the moon exerts lesser force on the objects than the earth. The weight of an object on the moon is one sixth (1/6th) of its weight on the earth. The weight of an object on the earth is the force with which the earth attracts the object and the weight of an object on the moon is the force with which the moon attracts the object.

Thrust and Pressure

Thrust is the force acting perpendicular to a surface, and pressure is the force acting per unit area.

Pressure P is given by $P=FA$, where F is the force applied perpendicular to the surface and A is the area over which the force is applied.

Factors on which pressure depends Pressure depends on two factors :

Force applied

Area of surface over which force acts

Examples:

The base of high buildings is made wider so that weight of walls act over a large surface area and pressure is less.

School bags are having broad strap so that the weight of school bags fall over a larger area of the shoulder and produce less pressure and becomes less painful.

The blades of knives are made sharp so very small surface area and on applying force, it produces large pressure and cuts the object easily.

All liquids and gases are fluids and they exert pressure in all directions.

Archimedes' Principle

Archimedes' principle states that when a body is immersed fully or partially in a fluid, it experiences an upward force called the buoyant force, which is equal to the weight of the fluid displaced by the body.

Relative Density

Relative density is the ratio of the density of a substance to the density of water at 4°C.

It has no units and is a pure number.

Thrust and Pressure in Fluids

Pressure exerted by a fluid depends on its depth and density.

The pressure at a point in a fluid is the same in all directions and is transmitted equally in all directions.

Atmospheric Pressure

The pressure exerted by the air in the atmosphere is called atmospheric pressure.

It decreases with an increase in altitude.

Buoyancy

Buoyancy is the upward force exerted by a fluid on an object immersed in it.

It is responsible for the apparent loss of weight of objects immersed in a fluid.

Force of gravitational attraction of the earth on the surface of the object < buoyant force exerted by fluid on the surface of the object.
Result: The object floats.
Force of gravitational attraction of the earth on the surface of the object > buoyant force exerted by fluid on the surface of the object.
Result: The object sinks.
That is why, allpin sinks and boat/ship floats on the surface of water.(Archimedes' principle)

Why do Objects Float or Sink?
Whether an object floats or sinks in a fluid depends on its density relative to the density of the fluid.
An object floats if its density is less than the density of the fluid and sinks if its density is greater.
Applications of Archimedes' Principle :
It is used in determining relative density of substances.
It is used in designing ships and submarines.
Hydrometers and lactometers are made on this principle.

Motion of Objects through Fluids
The speed of an object moving through a fluid depends on its shape, size, and mass, as well as the density of the fluid.
Objects with streamlined shapes experience less fluid resistance.

MCQ

1. Which of the following is true about the gravitational force?
a) It is always attractive b) It is always repulsive
c) It can be both attractive and repulsive d) It has no direction
Answer: a) It is always attractive

2. The force of gravitation between two objects is directly proportional to:
a) The sum of their masses b) The difference in their masses
c) The product of their masses d) The square of the distance between them
Answer: c) The product of their masses

3. The value of acceleration due to gravity on the surface of the Earth is:
a) 9.8 m/s^2 b) 8.9 m/s^2 c) 7.8 m/s^2 d) 6.8 m/s^2
Answer: a) 9.8 m/s^2

4. If the distance between two objects is doubled, the gravitational force between them becomes:
a) Half b) Double c) One-fourth d) Four times
Answer: c) One-fourth

5. The universal gravitational constant (G) was experimentally determined by:
a) Isaac Newton b) Albert Einstein c) Henry Cavendish d) Johannes Kepler
Answer: c) Henry Cavendish

6. The weight of an object is:
a) The same everywhere in the universe b) Zero at the center of the Earth
c) Minimum at the poles d) Independent of the gravitational field
Answer: b) Zero at the center of the Earth

7. The value of gravitational constant (G) is:
a) 6.67×10^{-11} N m²/kg² b) 9.8 m/s² c) 1.6×10^{-19} J d) 3×10^{8} m/s
Answer: a) 6.67×10^{-11} N m²/kg²

8. If the mass of one object is doubled and the distance between the objects is halved, the gravitational force between them will be:
a) Doubled b) Quadrupled c) Halved d) Increased by 8 times
Answer: d) Increased by 8 times

9. Which of the following statements is true about weight?
a) It remains constant everywhere b) It is a vector quantity
c) It is a scalar quantity d) It is measured in kilograms
Answer: b) It is a vector quantity

10. The gravitational force between two objects does not depend on:
a) The mass of the objects b) The distance between the objects
c) The gravitational constant d) The medium between the objects
Answer: d) The medium between the objects

11. The acceleration due to gravity on the Moon is approximately:
a) 9.8 m/s² b) 6.67 m/s² c) 1.67 m/s² d) 3.33 m/s²
Answer: c) 1.67 m/s²

12. An object weighs 10 N on Earth. Its weight on the Moon will be approximately:
a) 1.67 N b) 3.33 N c) 5 N d) 10 N
Answer: a) 1.67 N

13. The gravitational force between two masses is F. If both masses are doubled,

the new force will be:
a) F b) 2F c) 4F d) 8F
Answer: c) 4F

14. The value of acceleration due to gravity, g, is maximum at:
a) The center of the Earth b) The poles c) The equator d) The surface of the Moon
Answer: b) The Poles

15. Which of the following affects the gravitational pull of an object?
a) Its speed b) Its color c) Its mass d) Its temperature
Answer: c) Its mass

16. Archimedes' principle is related to:
a) Pressure b) Buoyant force c) Thrust d) Weight
Answer: b) Buoyant force

17. The upward force exerted by a fluid on an object immersed in it is called:
a) Thrust b) Weight c) Buoyant force d) Pressure
Answer: c) Buoyant force

18. The pressure exerted by a fluid at a point depends on:
a) The density of the fluid b) The depth of the point
c) Both A and B d) Neither A nor B
Answer: C) Both A and B

19. Relative density is the ratio of the density of a substance to the density of:
a) Mercury b) Air c) Water d) Iron
Answer: c) water

20. The pressure in a fluid at a point:
a) Increases with depth b) Decreases with depth
c) Is the same at all depths d) Is zero at all depths
Answer: A) Increases with depth

21. Which of the following statements is true?
a) Pressure decreases with an increase in altitude
b) Pressure increases with an increase in altitude
c) Pressure remains constant with an increase in altitude
d) None of the above
Answer: A) Pressure decreases with an increase in altitude

22. An object floats in a fluid if its density is:
a) Less than the density of the fluid b) Greater than the density of the fluid

c) Equal to the density of the fluid d) Unrelated to the density of the fluid
Answer: A) Less than the density of the fluid

23. Buoyancy is responsible for the apparent loss of weight of objects immersed in a fluid. (True/False)
Answer: true
24. The motion of planets around the Sun is governed by:
A) Gravitational force B) Magnetic force C) Electric force D) None of the above
Answer: A) Gravitational force
25. The speed of an object moving through a fluid depends on:
a) Its shape b) Its size c) Its mass d) All of the above
Answers: d) All of the above

26. An object weighs 10 N in air. When immersed fully in water, it weighs only 8 N. The weight of the liquid displaced by the object will be
(a) 2 N (b) 8 N (c) 10 N (d) 12 N
Ans. (a) 2 N

27. A girl stands on a box having 60 cm length, 40 cm breadth and 20 cm width in three ways. In which of the following cases, pressure exerted by the brick will be
(a) maximum when length and breadth form the base
(b) maximum when breadth and width form the base
(c) maximum when width and length form the base
(d) the same in all the above three cases
Ans. (b) maximum when breadth and width form the base

Assertion-Reason Questions

Question No. 1 to 9 consist of two statements – Assertion (A) and Reason (R). Answer these questions selecting the appropriate option given below:
a) Both A and R are true, and R is the correct explanation of A.
b) Both A and R are true, and R is not the correct explanation of A.
c) A is true but R is false.
d) A is false but R is true.

1. **Assertion (A):** The weight of an object on the Moon is about one-sixth of its weight on the Earth.
(R): The acceleration due to gravity on the Moon is about one-sixth of that on the Earth.
Answer: a) Both A and R are true, and R is the correct explanation of A.

2. **Assertion (A):** The gravitational force between two objects is inversely proportional to the square of the distance between them.
Reason (R): If the distance between two objects is doubled, the gravitational force between them is halved.

Answer: c) A is true, but R is false.

3. **Assertion (A):** The mass of an object is constant everywhere in the universe.
   Reason (R): The weight of an object is the gravitational force acting on it and varies with the location.
   Answer: a) Both A and R are true, and R is the correct explanation of A.

4. **Assertion (A):** Gravitational force acts only between objects that are in contact with each other.
   Reason (R): Gravitational force is a long-range force that acts between any two masses regardless of the medium between them.
   Answer: d) A is false, but R is true.

5. **Assertion (A):** The value of the gravitational constant (G) is the same everywhere in the universe.
   Reason (R): The gravitational constant (G) determines the strength of the gravitational force between two objects with unit masses separated by a unit distance.
   Answer: a) Both A and R are true, and R is the correct explanation of A.

6. **Assertion:** A person weighs less at the top of a mountain than at the sea level.
   Reason: The value of acceleration due to gravity decreases with an increase in altitude.
   Answer: Assertion and Reason are both correct, but the Reason is NOT the correct explanation for the Assertion.

7. **Assertion:** Objects float on the surface of water because the buoyant force acting on them is greater than their weight.
   Reason: The density of the object is less than the density of water.
   Answer: Assertion and Reason are both correct, and the Reason is the correct explanation for the Assertion.

8. **Assertion:** The weight of an object on the Moon is less than its weight on Earth.
   Reason: The acceleration due to gravity on the Moon is greater than on Earth.
   Answers: Assertion is correct, but the Reason is incorrect.

9. **Assertion:** The pressure exerted by a fluid at a point is independent of the area of the surface in contact with the fluid.
   Reason: Pressure is a scalar quantity and does not depend on direction.
   Answer: Assertion is correct, but the Reason is incorrect.

Short Answer Questions

Question 1: Define gravitational force.
Answer: Gravitational force is the attractive force that acts between any two objects with mass. It is governed by Newton's law of universal gravitation, which states that every point mass attracts every other point mass by a force acting along the line intersecting both points. The force is directly proportional to the product of the two masses and inversely proportional to the square of the distance between them.

2. State Newton's law of universal gravitation.
Answer: Newton's law of universal gravitation states that every mass in the universe attracts every other mass with a force that is directly proportional to the product of their masses and inversely proportional to the square of the distance between their centers. Mathematically, it is expressed as
$F=Gm_1m_2/r^2$, where
F is the gravitational force, G is the gravitational constant,
m_1 and m_2 are the masses, and r is the distance between the centers of the two masses.

3. What is the value of the gravitational constant (G)?
Answer: The value of the gravitational constant (G) is 6.67×10^{-11} N m²/kg².

4. How does the gravitational force between two objects change if the distance between them is doubled?
Answer: If the distance between two objects is doubled, the gravitational force between them becomes one-fourth of the original force. This is because gravitational force is inversely proportional to the square of the distance between the objects.

5. What is meant by the acceleration due to gravity?
Answer: The acceleration due to gravity is the acceleration experienced by an object due to the gravitational force exerted by the Earth (or any other celestial body). On the surface of the Earth, it has a standard value of approximately 9.8 m/s², denoted by g.

6. Why do objects weigh less on the Moon than on Earth?
Answer: Objects weigh less on the Moon than on Earth because the Moon's gravitational force is weaker. The acceleration due to gravity on the Moon is about one-sixth of that on Earth, which means that an object's weight on the Moon is about one-sixth of its weight on Earth.

7. Explain why the weight of an object varies from place to place, but its mass remains constant.
Answer: The weight of an object is the force with which it is attracted towards the

center of a celestial body, such as the Earth. This force depends on the local acceleration due to gravity, which can vary slightly depending on altitude, latitude, and geological formations. However, the mass of an object, which is the amount of matter it contains, remains constant regardless of its location.

8. What is free fall?
Answer: Free fall is the motion of an object under the influence of gravitational force only. During free fall, the only force acting on the object is gravity, causing it to accelerate towards the center of the Earth (or other celestial body) at a constant rate, which is the acceleration due to gravity (g).

9. Describe how the concept of gravitational force explains why the planets orbit the Sun.
Answer: The planets orbit the Sun due to the gravitational force exerted by the Sun. This force provides the necessary centripetal force to keep the planets in their elliptical orbits around the Sun. According to Newton's law of gravitation, the force is stronger when the planet is closer to the Sun and weaker when it is farther away, maintaining the stable orbits of the planets.

10. What factors affect the gravitational force between two objects?
Answer: The gravitational force between two objects is affected by two main factors: the masses of the objects and the distance between them. The force is directly proportional to the product of the masses of the objects and inversely proportional to the square of the distance between their centers.

11. Gravitational force acts on all objects in proportion to their masses. Why then does a heavy object not fall faster than a light object?
Solution:
All objects fall from the top with a constant acceleration called acceleration due to gravity (g). This is constant on earth and therefore the value of ‘g’ doesn’t depend on the mass of an object. Hence, heavier objects don’t fall quicker than light-weight objects provided there‘s no air resistance.

12. If the moon attracts the earth, why does the earth not move towards the moon?
Solution:
According to the universal law of gravitation and Newton‘s third law, we all know that the force of attraction between two objects is the same, however in the opposite directions. So the earth attracts the moon with a force same as the moon attracts the earth but in opposite directions. Since earth is larger in mass compared to that of the moon, it accelerates at a rate lesser than the acceleration rate of the moon towards the Earth. Therefore, for this reason the earth does not move towards the moon.

13. Why will a sheet of paper fall slower than one that is crumpled into a ball?

Solution:
A sheet of paper has a larger surface area when compared to a crumpled paper ball. A sheet of paper will face a lot of air resistance. Thus, a sheet of paper falls slower than the crumpled ball.

14. State Archimedes' principle.
Answer: Archimedes' principle states that when a body is immersed fully or partially in a fluid, it experiences an upward force called the buoyant force, which is equal to the weight of the fluid displaced by the body.

15. Define relative density.
Answer: Relative density is the ratio of the density of a substance to the density of water at 4°C. It has no units and is a pure number.

16. Why do objects float or sink in a fluid?
Answer: Whether an object floats or sinks in a fluid depends on its density relative to the density of the fluid. An object floats if its density is less than the density of the fluid and sinks if its density is greater.

17. What is atmospheric pressure?
Answer: Atmospheric pressure is the pressure exerted by the air in the atmosphere. It decreases with an increase in altitude.

18. Suppose gravity of earth suddenly becomes zero, then in which direction will the moon begin to move if no other celestial body affects it?
Answer: The moon will begin to move in a straight line in the direction in which it was moving at that instant because the circular motion of moon is due to the centripetal force provided by the gravitational force of earth and if gravitational force becomes zero it means no centripetal force is there to help the moon to move in circular orbit. Therefore, it will move in a straight line.

19. Why a block of plastic when released under water come up to the surface of water?
Answer: The density of plastic is lesser than that of water. Therefore, the force of buoyancy on plastic block will be greater than the weight of plastic block. Hence, the acceleration of plastic block is going to be in the upward direction. So, the plastic block comes up to the surface of water.

NUMERICALS/LONG ANSWER TYPE

1. What happens to the force between two objects, if
(i) The mass of one object is doubled?
(ii) The distance between the objects is doubled and tripled?
(iii) The masses of both objects are doubled?

Solution:
(i) According to universal law of gravitation, the force between 2 objects (m1 and m2) is proportional to their plenty and reciprocally proportional to the sq. of the distance(R) between them.
If the mass is doubled for one object.
$F = 2F$, so the force is also doubled. $F = (Gm_1m_2)/(R)^2$

(ii) If the distance between the objects is doubled and tripled
If it's doubled
Hence,
$F = ¼$, $F = (Gm_1m_2)/(2R)^2$
$F = F/4$
Force thus becomes one-fourth of its initial force.
Now, if it's tripled
Hence,
$F = (Gm_1m_2)/(3R)^2$
$F = 1/9\ (Gm_1m_2)/R^2$
$F = F/9$
Force thus becomes one-ninth of its initial force.
(iii)
If masses of both the objects are doubled, then
$F = 4F$, Force will therefore be four times greater than its actual value.

2. Amit buys few grams of gold at the poles as per the instruction of one of his friends. He hands over the same when he meets him at the equator. Will the friend agree with the weight of gold bought? If not, why? [Hint: The value of g is greater at the poles than at the equator.]
Solution:
The weight of a body on the earth's surface;
$W = mg$ (where m = mass of the body and g = acceleration due to gravity)
The value of g is larger at poles when compared to the equator. So gold can weigh less at the equator as compared to the poles. Therefore, Amit's friend won't believe the load of the gold bought.

3. Gravitational force on the surface of the moon is only 1/6 as strong as gravitational force on the earth. What is the weight in newton's of a 10 kg object on the moon and on the earth?
Solution:
Given data:
Acceleration due to earth's gravity = ge or $g = 9.8\ m/s^2$
Object's mass, m = 10 kg
Acceleration due to moon gravity = gm
Weight on the earth= We

Weight on the moon = Wm
Weight = mass x gravity
gm = (1/6) ge (given)
So Wm = m gm = m x (1/6) ge
Wm = 10 x (1/6) x 9.8 = 16.34 N
We = m x ge = 10 x 9.8
We = 98N

4. A ball is thrown vertically upwards with a velocity of 49 m/s. Calculate
(i) The maximum height to which it rises,
(ii) The total time it takes to return to the surface of the earth.
Solution:
Given data:
Initial velocity u = 49 m/s
Final speed v at maximum height = 0
Acceleration due to earth gravity g = -9.8 m/s2 (thus negative as ball is thrown up).
By third equation of motion,
$2gH = v^2 – u^2$
$2 \times (- 9.8) \times H = 0 – (49)^2$
– 19.6 H = – 2401
H = 122.5 m
Total time T = Time to ascend (Ta) + Time to descend (Td)
v = u + gt
0 = 49 + (-9.8) x Ta
Ta = (49/9.8) = 5 s
Also, Td = 5 s
Therefore T = Ta + Td
T = 5 + 5
T = 10 s

5. A stone is released from the top of a tower of height 19.6 m. Calculate its final velocity just before touching the ground.
Solution:
Given data:
Initial velocity
u = 0
Tower height = total distance = 19.6m
$g = 9.8 \text{ m/s}^2$
Consider third equation of motion
$v^2 = u^2 + 2gs$
$v^2 = 0 + 2 \times 9.8 \times 19.6$
$v^2 = 384.16$
$v = \sqrt{(384.16)}$

v = 19.6m/s

6. A stone is thrown vertically upward with an initial velocity of 40 m/s. Taking g = 10 m/s^2, find the maximum height reached by the stone. What is the net displacement and the total distance covered by the stone?

Solution:

Given data:

Initial velocity u = 40m/s

g = 10 m/s^2

Max height final velocity = 0

Consider third equation of motion

$v^2 = u^2 – 2gs$ [negative as the object goes up]

$0 = (40)^2 – 2 \times 10 \times s$

$s = (40 \times 40) / 20$

Maximum height s = 80m

Total Distance = s + s = 80 + 80

Total Distance = 160m

Total displacement = 0 (The first point is the same as the last point)

7. The volume of 50 g of a substance is 20 cm^3. If the density of water is 1 g cm^{-3}, will the substance float or sink?

Solution:

To find the Density of the substance the formula is

Density = (Mass/Volume)

Density = (50/20) = 2.5g/cm3

Density of water = 1g/cm^3

Density of the substance is greater than density of water. So the substance will sink.

8. The volume of a 500 g sealed packet is 350 cm^3. Will the packet float or sink in water if the density of water is 1 g cm^{-3}? What will be the mass of the water displaced by this packet?

Solution:

Density of sealed packet = 500/350 = 1.42 g/cm^3

Density of sealed packet is greater than density of water

Therefore the packet will sink.

Considering Archimedes Principle,

Displaced water volume = Force exerted on the sealed packet.

Volume of water displaced = 350cm^3

Therefore displaced water mass = ρ x V

= 1 × 350

Mass of displaced water = 350g.

Competency based Questions

A stone is thrown vertically upwards with a certain velocity from the surface of the Earth.

1. Will the stone return to the surface of the Earth?
2. How does the acceleration due to gravity acting on the stone change as it goes higher?
3. What is the maximum height reached by the stone?

Answers:

1. Yes, the stone will return to the surface of the Earth due to the gravitational pull of the Earth.
2. The acceleration due to gravity acting on the stone decreases as it goes higher because the distance between the stone and the center of the Earth increases.
3. The maximum height reached by the stone can be calculated using the formula: $h=u^2/2g$, where h is the maximum height, u is the initial velocity of the stone, and g is the acceleration due to gravity.

1. A satellite is orbiting the Earth at a height of 300 km above the surface. Calculate its orbital speed. Assume the radius of the Earth is 6400 km and the mass of the Earth is 6×10^{24} kg.

   Answer:

   To calculate the orbital speed v of the satellite, we use the formula for orbital speed:

   $v=\sqrt{GM/r}$

   where G is the gravitational constant (6.67×10^{-11}N m²/kg²),

   M is the mass of the Earth (6×10^{24} kg),

   r is the distance from the center of the Earth to the satellite.

   The distance r is the sum of the Earth's radius and the height of the satellite:

   r=6400 km+300 km =6700 km =6700×103 m

   Now, substitute the values into the formula:

   $v=\sqrt{6.67\times10^{-11}\times6\times10^{24}/6700\times10^{3}}$

   Simplify the expression:

   $v=\sqrt{4.002\times10^{14}/6.7\times10^{6}}$

   $v=\sqrt{5.97\times10^{7}}$

   $v\approx7.72\times10^{3}$ m/s

   Therefore, the orbital speed of the satellite is approximately 7.72 km/s.

2. Explain why astronauts in the International Space Station (ISS) experience a sensation of weightlessness, even though gravity is still acting on them.

   Answer:

   Astronauts in the International Space Station (ISS) experience weightlessness because they are in a state of continuous free fall towards the Earth. Although gravity is still acting on them, the ISS and the astronauts inside it are both falling

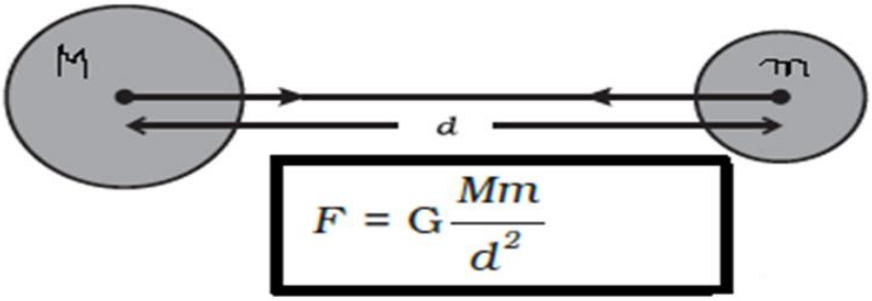
towards the Earth at the same rate. This creates a condition where the normal force that we usually feel as weight is absent.

Here's a more detailed explanation:

The ISS orbits the Earth at a high speed, roughly 28,000 km/h, which creates a centrifugal force that balances the gravitational pull from the Earth.
This balance means that the ISS is constantly "falling" towards the Earth but also moving forward at such a speed that it keeps missing the Earth, resulting in a stable orbit.
Inside the ISS, everything, including the astronauts, is falling at the same rate due to gravity. There are no contact forces pushing back on the astronauts to give them a sensation of weight.
This phenomenon is called microgravity or free fall, and it creates the sensation of weightlessness experienced by astronauts in orbit.

You have a bag of cotton and an iron bar, each indicating a mass of 100 kg when measured on a weighing machine. In reality, one is heavier than other. Can you say which one is heavier and why?
Solution:
The correct answer is the cotton bag is heavier than an iron bar. The bag of cotton is heavier than the bar of iron. The cotton bag experiences a larger air thrust than the iron bar. Therefore, the weighing machine indicates less weight than its actual weight for the cotton bag. The reason is
True weight = (apparent weight + up thrust)
The cotton bag‘s density is less than that of the iron bar, so the volume of the cotton bag is more compared to the iron bar. So, the cotton bag experience more upthrust due to the presence of air.
Therefore, in the presence of air, the cotton bag true weight is more compared to the true weight of the iron bar.

3. Every object in the universe attracts every other object with a force which is proportional to the product of their masses and inversely proportional to the square of the distance between them. The force is along the line joining the centers of two objects.



This is called Universal Law of Gravitation, and the equation is applicable everywhere in the Universe.
G is called universal gravitational constant. (6.7×10^{-11} SI Unit)
Force of attraction between the earth and fruits of different masses on its surface are given as follow.

S. No.	Fruits with mass	Force of gravity (Gravitational force between the earth and the fruits)
1	Malda Mango (1kg)	9.8 N
2	Papaya (2Kg)	19.6 N
3	Pine apple(3Kg)	29.4N
4	Water melon(4Kg)	39.2N
5	A dozen of bananas(1kg)	9.8 N

Q1. Using the above table can you find the force of gravity of any object of known mass
YES/ NO, justify

FULL CREDIT - Yes
F=Mg
Example
For 1kg, 1X9.8 = 9.8N
PARTIALL CREDIT - Yes
NO CREDIT – NO, Any irrelevant explanation

Q2. Will the force of gravity be the same on a tall person of mass 60 kg and a short person of same mass. Justify

FULL CREDIT - Yes force of gravity does not depend on shape of a person or body

Q3. The term GM/d^2 is called acceleration due to gravity and M is the mass of the earth. Using above table find its value.
FULL CREDIT - $GM/d^2=F/m$ =any force from table divided by corresponding mass=9.8 N/kg
NO CREDIT - For any other answer

Q4. In Q3, Is any value of G, M, and d is required to find GM/d^2 if we use above information
FULL CREDIT - No
NO CREDIT - YES OR OTHER EXPLANATION

2. Weight

The weight of an object is the force, with which it is attracted towards the earth, the SI unit of weight is the same as that of force, that is, Newton (N). The weight is a force acting vertically downwards; it has both magnitude and direction. The weight of an object is given by

$$W = m \times g$$

Where, m=mass of an object and g is called acceleration due to gravity
Weight of a body decreases with altitude as well as depth up to centre of the earth. Because of g.

$$g = G\frac{M}{R^2}$$

G is universal Gravitational constant, R the radius of the earth and M mass of the earth.
Mass of a body remains same everywhere.

Following table shows height & mass of a person with his Age

Name	Height	Mass(kg)	Age (Years)
Ram Narayan	150cm	68	13
Rahim Ali	145cm	45	10
Ravindra Singh	170cm	63	12

Remo D'Souza	137cm	59	9
R.R. Raju	140cm	48	10
Rohan Mohanty	150 cm	54	10
Rahul Raj	148 cm	65	10

Q2. 1
(a) As per above data Can we say that weight of a person changes with height of a same person ($g = 9.8m/s^2$)? Justify
FULL CREDIT - No, because it depends on mass of the person
PARTIALL CREDIT - No
NO CREDIT - For any other answer

(b) Can we say that weight of a person changes with Age of a same person ($g = 9.8m/s^2$)? Justify
FULL CREDIT - No it only depends on mass
PARTIALL CREDIT - No
NO CREDIT - For any other answer

The earth is not a perfect sphere, but bulges at equator. Therefore if a body is taken from pole to equator its distance from the centre of the earth will change.
Radius at equator is smaller compared to radius at poles. Consequently, the gravity also varies.

Q 2.2 Can you be able to find the variation of weight of a body when it is going from Pole of Earth to the Equator. (The earth is flat about its equator.)

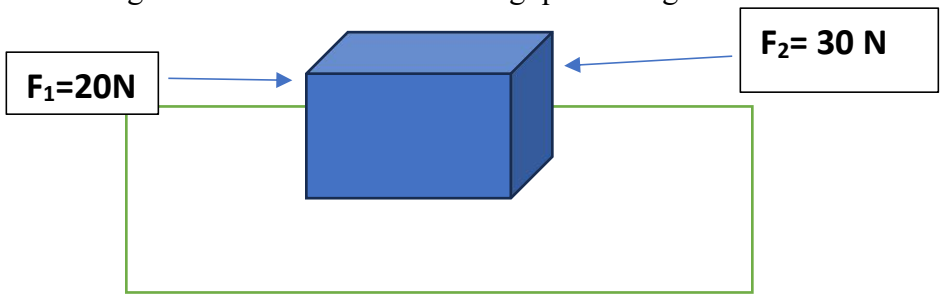
FULL CREDIT - yes, decreases as radius Increases
PARTIALL CREDIT - yes
NO CREDIT - For any other answer

Q2.3 What is the ratio of weight of person`s having height less than 145cm?

FULL CREDIT - 49/58 OR 58/49
NO CREDIT - For any other answer

CASE BASED QUESTION. GRAVITATION.

1.Observe the diagram and answer the following questions given below.



Two forces F_1 =20N and F_2= 30 N are acting on the object as shown in the figure:
a) Find the net force acting on the body?
b) State the direction of the net force acting on the object.
c)If the object still does not move under the application of these forces, what can be the possible reason for this?

OR

Why no force is required to move an object with a constant velocity?

Ans a)Net force acting on the object = F_2 - F_1=30N – 20 N = 10 N.
b)Net force acts in the direction of force F_2 .As F2 is greater than F1.
c)All forces acting on the object are balanced and that is why the object does not move. It needs unbalanced force for movement.

OR

We know, F=ma. When, velocity is constant, then acceleration, a =0. Hence, F=0.Hence, no force is required to move an object with constant velocity.

(Higher Order Thinking Skills)

Question 1.
Why does formation of tides takes place in sea or ocean?
Answer:
The tides in the sea formed by the rising and falling of water level in the sea are due to the gravitational force of attraction which the sun and the moon exert on the water surface in the sea.

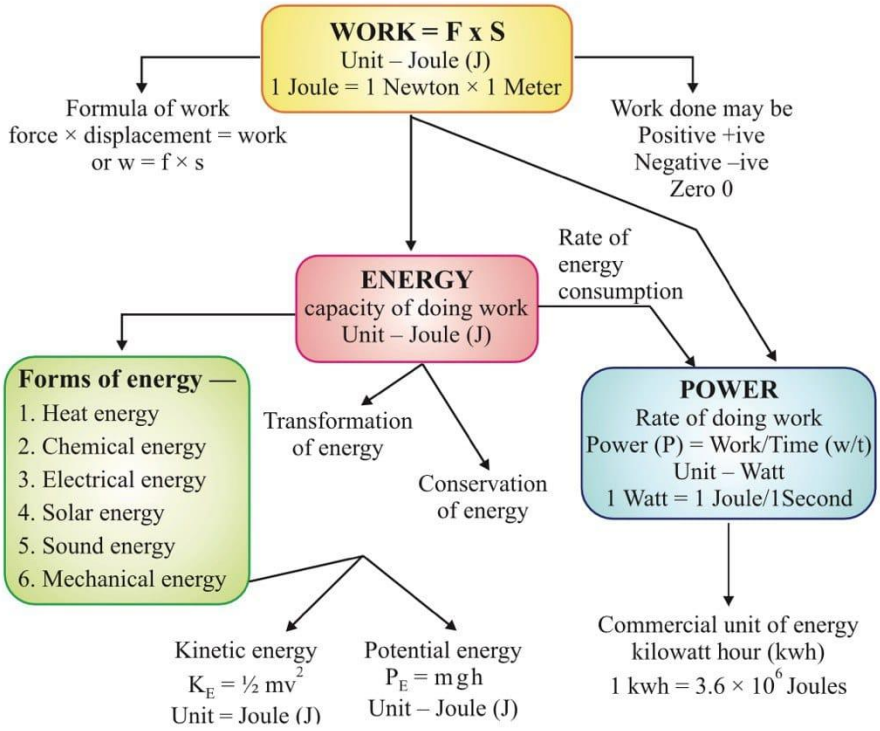
Question 2.
Why does a body orbiting in space possess zero weight with respect to a spaceship?
Answer:
The astronaut and the spaceship are orbiting with same acceleration hence, the body does not exert any force on the sides of the spaceship. Therefore, the body appears to be floating weightlessly. It also implies that a body orbiting in space has zero weight with respect to a spaceship.

Question 3.
Identical packets are dropped from two aeroplanes—one above the equator and other above the north pole, both at height h. Assuming all conditions to be identical, will those packets take same time to reach the surface of earth? Justify your answer.
Answer:
The value of 'g' at the equator of the earth is lesser than that at poles. Therefore, the packets fall slowly at equator in comparison to the poles. Thus, the packets will remain in air for longer time interval, when it is dropped at the equator.

Question 4.
How does the force of attraction between the two bodies depend upon their masses and distance between them? A student thought that two bricks tied together would fall faster than a single one under the action of gravity. Do you agree with his hypothesis or not? Comment.
Answer:
$F \propto m_1 m_2$ and $F \propto 1/r^2$
This hypothesis is not correct. The two bricks like a single body, fall with the same speed to reach the ground at the same time in case of free fall. This is because acceleration due to gravity is independent of the mass of the falling body.

WORK AND ENERGY

CONCEPT MAPPING



SCIENTIFIC CONCEPTION OF WORK

Two conditions need to be satisfied for work to be done:
*A force should act on an object, and
*The object must be displaced.

WORK DONE BY A CONSTANT FORCE

We define work to be equal to the product of the force and displacement.
Work done = force × displacement
$W = F\,s$

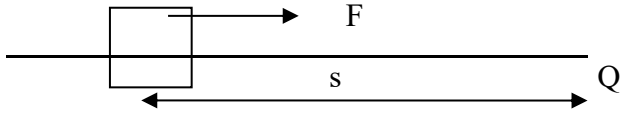
**Work is a scalar quantity*
*If F = 1 N and s = 1 m then the work done by the force will be 1 N m.
The unit of work is newton metre (N m) or joule (J).
Thus 1 J is the amount of work done on an object when a force of 1 N displaces it by 1 m along the line of action of the force.

WORK DONE CAN BE POSITIVE, NEGATIVE OR ZERO:

CASE -1: IF THE FORCE IS ACTING IN THE DIRECTION OF DISPLACEMENT

Let a block placed at a point P and acted upon by a constant force F and the block is displaced through a distance s to a new position Q. Then,

W = Fs

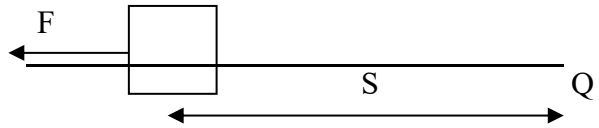


(The work done W by the force F is equal to the product of the force and the displacement s)

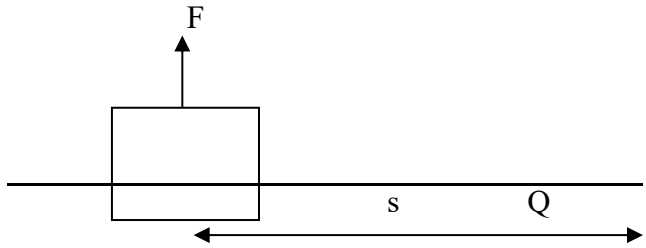
CASE 2: IF THE FORCE IS ACTING IN THE DIRECTION OPPOSITE TO THE DISPLACEMENT

In this case, the work done is Negative, i.e.

W = - Fs



(This happens when the force retarding the motion. E.g. work done by the frictional force is negative. Next, if an object is thrown up, its displacement is in the upward direction, whereas the force acting on it due to the gravity of earth is in the downward direction. So, the work done by gravity on an object thrown upward is negative.)



CASE 3: IF THE FORCE IS ACTING PERPENDICULAR TO THE DISPLACEMENT

In this case, there is no displacement in the direction or parallel to the force.

Work done in this case is zero. i.e.

Therefore -

W = F X 's' = F X 0 = 0 (because the displacement is zero)

CASE 4: IF THE FORCE IS CAUSING NO DISPLACEMENT –

In this case displacement is zero, therefore

$$\mathbf{W = F\,s = 0}$$

(This may happen when someone holding a heavy weight, as there is no displacement although force is there. and so in the case of pushing a huge rock and it does not move)

ENERGY

*An object having a capability to do work is said to possess energy.
*The object which does the work loses energy and the object on which the work is done gains energy.
*The unit of energy is, therefore, the same as that of work, that is, joule (J).
* 1 J is the energy required to do 1 joule of work.
*Sometimes a larger unit of energy called kilo joule (kJ) is used. 1 kJ equals 1000 J.

FORMS OF ENERGY

The various forms include mechanical energy (potential energy + kinetic energy), heat energy, chemical energy, electrical energy and light energy.

KINETIC ENERGY

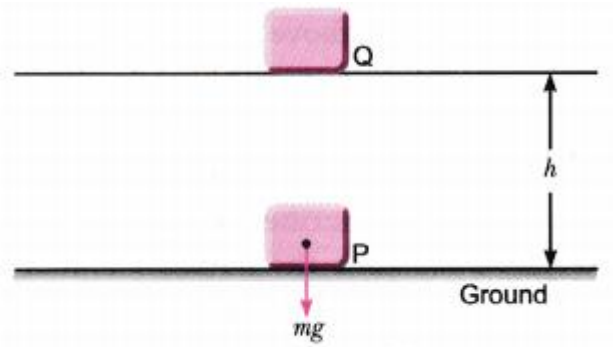
*Kinetic energy is the energy possessed by an object due to its motion.
*The kinetic energy of an object increases with its speed.
*By definition, we say that the kinetic energy of a body moving with a certain velocity is equal to the work done on it to make it acquire that velocity.
e.g a moving bullet, blowing wind, a rotating wheel, a speeding stone etc.
The kinetic energy possessed by an object of mass, *m* and moving with a uniform velocity, *v*

$E=(1/2)\ m.v^2$

POTENTIAL ENERGY

The potential energy possessed by the object is the energy present in it by virtue of its position or configuration.
e.g when you stretch a rubber band the energy transferred to the band is its potential energy.

POTENTIAL ENERGY OF AN OBJECT AT A HEIGHT



Measurement of potential energy

Consider an object of mass, *m*. Let it be raised through a height, *h* from the ground. A force is required to do this. The minimum force required to raise the object is equal to the weight of the object, *mg.* The object gains energy equal to the work done on it. Let the work done on the object against gravity be *W*. That is, work done,

W = force × displacement

$= mg \times h$

$= mgh$

Since work done on the object is equal to *mgh*, an energy equal to *mgh* units is gainedby the object. This is the potential energy (*EP*) of the object.

$Ep = mgh$

*It is useful to note that the work done by gravity depends on the difference in vertical heights of the initial and final positions of the object and not on the path along which the object is moved.

LAW OF CONSERVATION OF ENERGY

*According to this law, energy can only be converted from one form to another; it can neither be created or destroyed. The total energy before and after the transformation remains the same.

*The law of conservation of energy is valid in all situations and for all kinds of transformations.

*The sum of kinetic energy and potential energy of an object is its total mechanical energy.

*We find that during the free fall of the object, the decrease in potential energy, at any point in its path, appears as an equal amount of increase in kinetic energy. That is,

potential energy + kinetic energy = constant

Rate of Doing Work

*Power measures the speed of work done, that is, how fast or slow work is done. Power is defined as the rate of doing work or the rate of transfer of energy.
*If an agent does a work *W* in time *t,* then power is given by:
Power = work/time
*The unit of power is watt
*1 watt is the power of an agent, which does work at the rate of 1 joule per second.
*We can also say that power is 1 W when the rate of consumption of energy is 1 J s^{-1}.
*1 watt = 1 joule/second or 1 W = 1 J s^{-1}.
*We express larger rates of energy transfer in kilowatts (kW).
1 kilowatt = 1000 watts
1 kW = 1000 W
1 kW = 1000 J s^{-1}.

MCQ

1.Which of the following is the correct unit of work and energy?
a) Newton b) Kilogram c) Joule d) Watt

2.What is the formula for calculating work?
a) Work = Force × Velocity b) Work = Mass × Acceleration
c) Work = Force × Displacement × cos(θ) d) Work = Mass × Height × Gravity

3.When is work said to be done?
a) When there is displacement in any direction
b) When there is a force acting on an object
c) When there is a change in velocity
d) When there is no displacement

4.Which of the following is NOT a form of mechanical energy?
a) Kinetic energy b) Potential energy c) Thermal energy d) Elastic potential energy

5.What happens to the kinetic energy of an object when its velocity is doubled?
a) It is halved b) It remains the same c) It is doubled d) It quadruples

6.Which law states that energy can neither be created nor destroyed, but can only be transformed from one form to another?

a) Law of inertia b) Law of conservation of energy
c) Newton's third law of motion d) Law of gravitation

7.What is the SI unit of power?
a) Watt b) Joule c) Newton d) Kilogram

8.Which of the following is a renewable source of energy?
a) Coal b) Petroleum c) Solar energy d) Natural gas

9.Which form of energy is associated with the flow of electric charge?
a) Thermal energy b) Chemical energy c) Electrical energy d) Nuclear energy

10.What is the total mechanical energy of an object in motion?
a) Kinetic energy only b) Potential energy only
c) Sum of kinetic and potential energy d) Zero

11.What is the commercial unit of energy in India?
a) Joule b) Kilowatt-hour c) Newton d) Erg

12.Which of the following is a non-renewable source of energy?
a) Wind energy b) Solar energy c) Nuclear energy d) Biomass

13.What is the formula to calculate power?
a) Power = Work / Time b) Power = Force × Distance
c) Power = Energy × Time d) Power = Mass × Acceleration

14.Which type of energy is associated with the temperature of an object?
a) Mechanical energy b) Thermal energy c) Chemical energy d) Electrical energy

15.When is work done said to be positive?
a) When the force and displacement are in opposite directions
b) When the force and displacement are perpendicular to each other
c) When the force and displacement are in the same direction
d) When there is no displacement

Answers:
1.c) Joule
2.c) Work = Force × Displacement × cos(θ)
3.a) When there is displacement in any direction

4.c) Thermal energy
5.d) It quadruples
6.b) Law of conservation of energy
7.a) Watt
8.c) Solar energy
9.c) Electrical energy
10.c) Sum of kinetic and potential energy
11.b) Kilowatt-hour
12.c) Nuclear energy
13.a) Power = Work / Time
14.b) Thermal energy
15.c) When the force and displacement are in the same direction

ASSERTION AND REASON

Direction: In each of the following questions, a statement of Assertion is given followed by a corresponding statement of Reason. Of the statements, mark the correct answer as
(a) Both assertion and reason are true and reason is the correct explanation of assertion.
(b) Both assertion and reason are true but reason is not the correct explanation of assertion.
(c) Assertion is true but reason is false.
(d) Assertion is false but reason is true.

1.Assertion: Work is done when there is a displacement is perpendicular to the direction of the force.
Reason: If there is no displacement, work done is zero.

2.Assertion: Kinetic energy of an object depends on its mass.
Reason: Kinetic energy is directly proportional to the square of the velocity of the object.

3.Assertion: Potential energy of an object decreases as it falls freely towards the ground.
Reason: The potential energy of an object depends on its mass and height above the reference level.

4.Assertion: Energy can be converted from one form to another.
Reason: According to the law of conservation of energy, total energy remains constant in any process.

5.Assertion: Power is the rate at which work is done or energy is transferred or transformed.
Reason: Power is measured in joules.

Answers:
1.d) Assertion is false, but the Reason is true.
2.b) Both Assertion and Reason are true, and the Reason is not the correct explanation of the Assertion.
3.a) Both Assertion and Reason are true, but the Reason is the correct explanation of the Assertion.
4.a) Both Assertion and Reason are true, but the Reason is the correct explanation of the Assertion.
5.c) Assertion is true, but the Reason is false.

SHORT ANSWER QUESTIONS

1.List two conditions which need to be satisfied for the work to be done on an object.
Answer:
$W = Fs$
Work is done when
(a) a force acts on an object
(b) object is displaced.
2.Explain the following terms with one example each:
(a) Positive work (b) Zero work
Answer:
(a) When force acts in the direction of motion of body work done is positive. When a lawn roller is pulled forward, work done is positive.
(b) When force is perpendicular to the direction of motion, work done is zero. A porter carrying load does no work.

3.A coolie is walking on a railway platform with a load of 27 kg on his head. What is the amount of work done by him?
Answer:
Work done by the coolie is zero, as $W = Fs \cos 90° = 0$.

4.State the law of conservation of energy.
Answer:
The law of conservation of energy states that energy can neither be created nor destroyed, it can only be transformed from one form to another.

5.When an arrow is shot from its bow, it has kinetic energy. From where does it get this kinetic energy?
Answer:
A stretched bow possesses potential energy on account of a change in its shape. When the arrow is released, the potential energy of the bow gets converted into the kinetic energy of the arrow.

6.What is the amount of work done by a man in pressing a rigid wall with a force of 400 N?
Answer:
Zero because there is no displacement.

7.What is energy? What is unit of energy?
Answer:
The capacity of a body to do work is called energy possessed by the body. It is a scalar quantity and is measured in joule (J).
Generally, for practical purposes, a bigger unit called kilojoule (kj) is used (1 kj = 1000 J)

8.What kind of energy transformation takes place when a body is dropped from a certain height?
Answer:
When a body falls, its potential energy gradually gets converted into kinetic energy. On reaching the ground, the whole of the potential energy of the body gets converted into kinetic energy.

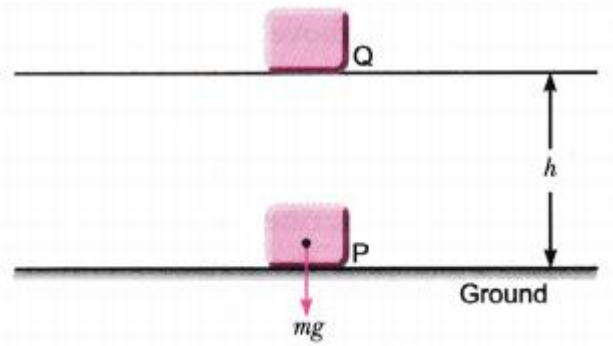
9.What is power? How do you differentiate kilowatt from kilowatt hour?
Answer:
Power is the rate of doing work. Kilowatt is the unit of power and kilowatt hour is the unit of energy.

10.Give one example each of potential energy
(i) due to position
(ii) due to shape.
Answer:
(i) Potential energy due to position: Water stored in dam has potential energy.
(ii) Potential energy due to shape: In a toy car, the wound spring possesses potential energy, and as the spring is released, its potential energy changes into kinetic energy due to which the car moves.

LONG ANSWER QUESTIONS

1.Briefly describing the gravitational potential energy, deduce an expression for the gravitational potential energy of a body of mass m placed at a height h, above the ground.

Answer:



Measurement of potential energy

When an object is raised through a certain height above the ground, its energy increases. This is because the work is done on it, against gravity. The energy present in such an object is called gravitational potential energy. Thus, the gravitational potential energy of an object at a point above the ground is defined as the work done in raising it from the ground to that point against gravity. Consider a body of mass m lying at point P on the Earth's surface, where its potential energy is taken as zero. As weight, mg acts vertically downwards, so to lift the body to another position Q at a height h, we have to apply a minimum force which is equal to mg in the upward direction. Thus, work is done on the body against the force of gravity.

We know that,

Work done, W = Fs …(i)

As F = mg and s = h

Putting these values in equation (i), we get

$W = mg \times h = mgh$

This work done on the body is equal to the gain in energy of the body. This is the potential energy of the body.

∴ Potential energy PE = mgh

2.A light and a heavy object have the same momentum, find out the ratio of their kinetic energies.

Which one has a larger kinetic energy ?

Answer:

Linear momentum of first object, $p_1 = m_1v_1$ and of second object, $p_2 = m_2v_2$

But, $p_1 = p_2$

or, $m_1v_1 = m_2v_2$

If $m_1 < m_2$ then $v_1 > v_2$

$$(\text{K.E.})_1 = \frac{1}{2}(m_1v_1)v_1 = \frac{1}{2}p_1v_1$$

and

$$(\text{K.E.})_2 = \frac{1}{2}(m_2v_2)v_2 = \frac{1}{2}p_2v_2$$

So,

$$\frac{(\text{K.E.})_1}{(\text{K.E.})_2} = \frac{\frac{1}{2}p_1v_1}{\frac{1}{2}p_2v_2} = \frac{v_1}{v_2}$$

But, $v_1 > v_2$

Therefore, $(\text{K.E.})_1 > (\text{K.E.})_2$

NUMERICALS

1.Calculate the work done in lifting 200 kg of a mass through a vertical distance of 6 m. Assume g = 10 m/s^2.

Solution:

Work in lifting the mass is done against gravity.

Therefore, the work done is W = mgh

We know, m = 200 kg, g = 10 m/s^2 and h = 6 m .

W = mgh

= 200 × 10 × 6 = 12000J.

2.Find the velocity of a body of mass 100 g having a kinetic energy of 20 J.

Solution:

Here, mass of the body, m = 100 g = 0.1 kg

Kinetic energy, K.E. = 20 J = 20 Nm = 20 kg $(m/s)^2$

Kinetic energy = 12 mv^2

$$\Rightarrow \quad v = \sqrt{\frac{2 \times \text{kinetic energy}}{m}}$$

$$= \sqrt{\frac{2 \times 20\ \text{kg m}^2/\text{s}^2}{0.1\ \text{kg}}} = \mathbf{20\ m/s}$$

So, the velocity of the body is 20 m/s.

3.A machine raises a load of 750 N through a height of 16 m in 5 seconds. Calculate the power at which the machine works.

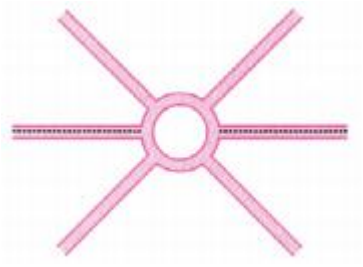
Solution:

Given force, F = 750 N, displacement = height, h = 16 m and time, t = 5

Work done by machine,

W = Force × Displacement = F × h
= 750 N × 16 joule
Power of machine, P = W/t=750N×16J/5s = 2400 watt.

4.A boy is moving on a straight road against a friction force of 5 N. After travelling a distance of 1.5 km he forgot the correct path at a round about (Fig.) of radius 100 m. However, he moves on the circular path for one and half cycle and then he moves forward up to 2.0 km. Calculate the work done by him.



Solution:
Force F = 5N; s = 1500 m + (1.5 × 2 x 3.14 x 100 m) + 2000 m
Work done, W = F. s
W= 22210 J.
5.If an electric iron of 1200 W is used for 30 minutes every day, find the electric energy consumed in the month of April.
Solution:
Power, P = 1200/1000 = 1.2 kW
Time, t = 3060 = 0.5 h
Electric energy, E = Power × time × days
= 1.2 × 0.5 × 30
= 18 kWh.

COMPETENCY BASED QUESTIONS

1.a) A body thrown at a certain angle to the ground moves in a curved path and falls back to the ground. The initial and final points of the path of the object lie on the same horizontal line. What is the work done by the force of gravity on the object?
(b) You lift a heavily packed carton of mass m in vertically upward direction through a height h. What is the work done

- by you on the carton,
- by force of gravity on the carton?

(c) Anil is doing work at a rapid rate but works for only one hour. Ashok does work at a somewhat slower rate but continues to work for six hours. Who has greater

power? Who has more energy?
Answer:
a) Work done is zero. This is because equal and opposite work is done in the two paths.
(b)

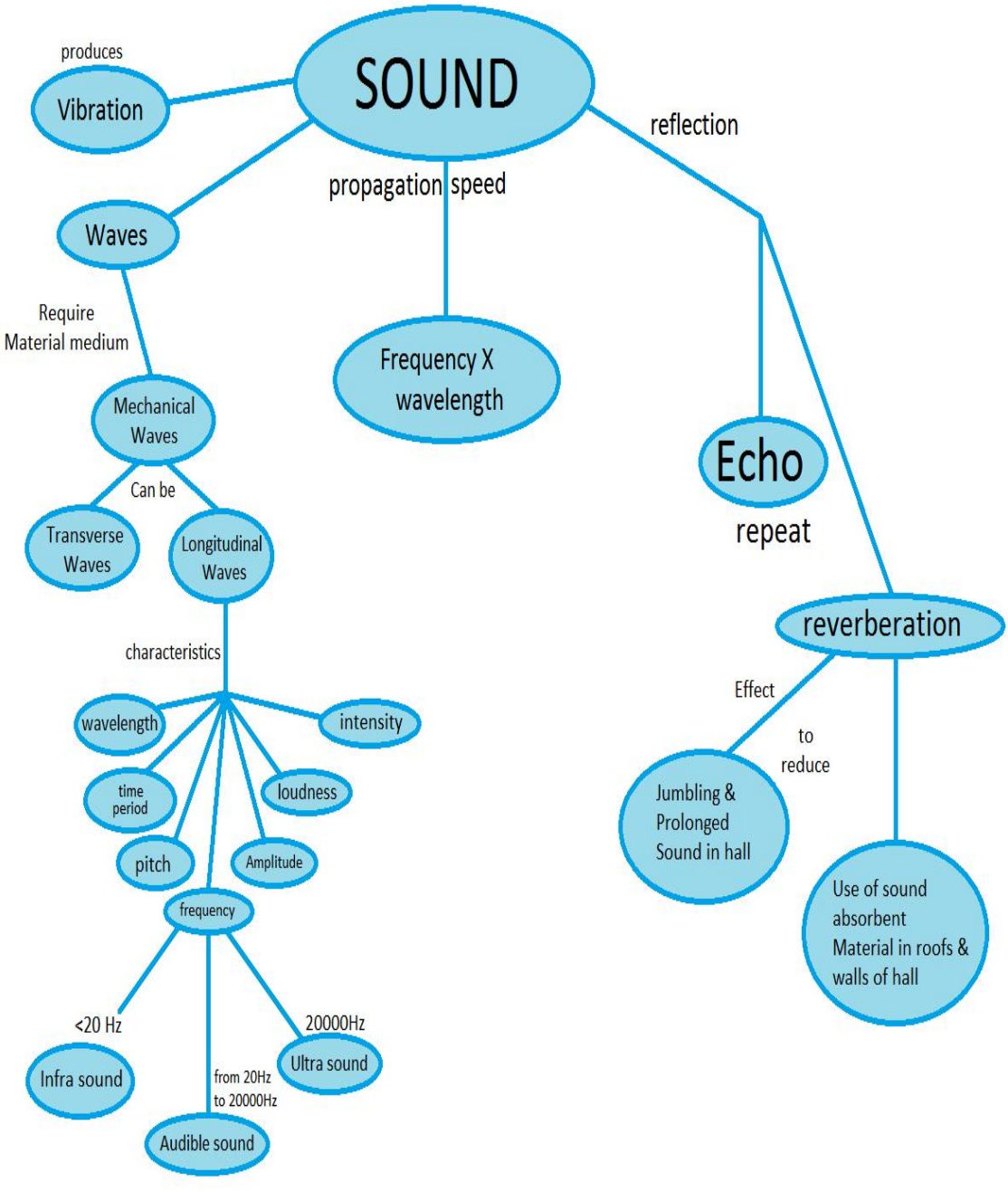
- Work done by me is positive and having a value = mgh. This is because I am applying force in vertically upward direction on the carton to hold it and displacement is also in the same direction.
- Work done by the force of gravity on the carton= – mgh. This in because force is vertically – downward but motion is vertically upward.

(c) Anil has greater power because his rate of doing work is more. Ashok has more energy as he worked for a longer time and the total work done by him in definitely more.

2.Four men lift a 250 kg box to a height of 1 m and hold it without raising or lowering it.
(a) How much work is done by the men in lifting the box?
(b) How much work do they do in just holding it?
(c) Why do they get tired while holding it? ($g = 10\ ms^{-2}$)
Answer:
(a) $F = 250\ kg \times 10\ ms^{-2}$ ($g = 10\ ms^{-2}$)
$= 2500\ N$
$s = 1\ m$
$W = F.s$
$= 2500\ N \times 1\ m$
$= 2500\ Nm = 2500\ J$
(b) Zero, as the box does not move at all while holding it.
(c) In order to hold the box, men are applying a force which is opposite and equal to the gravitational force acting on the box. While applying the force, muscular effort is involved. So, they feel tired.

CHAPTER SOUND

MIND MAP



Introduction to Sound:

Sound is a form of energy that produces a sensation of hearing in our ears.

It is produced by vibrating objects and travels through a medium such as air, water, or solids.

Propagation of sound :

The sound produced by a vibrating object travels through a medium to a listener. The medium can be solid, liquid or gas.

When an object vibrates, the particles around the medium vibrates. The particle in contact with the vibrating object is first displaced from its equilibrium position. It then exerts a force on the adjacent particle and the adjacent particle is displaced from its position of rest. After displacing the adjacent particle the first particle comes back to its original position. This process repeats in the medium till the sound reaches the ear.

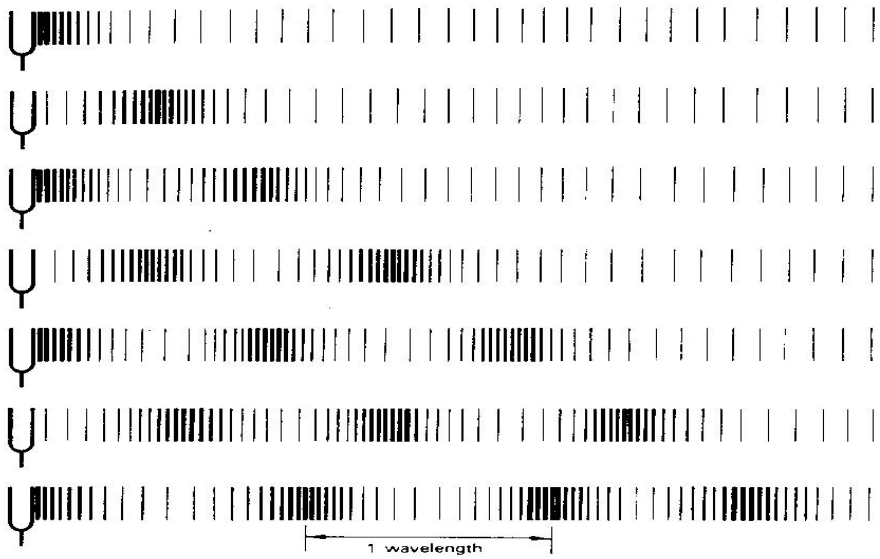
The disturbance produced by the vibrating body travels through the medium but the particles do not move forward themselves.

A wave is a disturbance which moves through a medium by the vibration of the particles of the medium. So sound is considered as a wave. Since sound waves are produced due to the vibration of particles of the medium sound waves are called mechanical waves.

Propagation of sound through air

Air is the most common medium through which sound travels. When a vibrating object moves forward, it pushes and compresses the air in front of it forming a region of high pressure called compression (C). The compression moves away from the vibrating object. When the vibrating object moves backward, it forms a region of low pressure called rarefaction (R). As the object moves to and fro rapidly, it produces a series of compressions and rarefaction in the air which makes the sound to propagate in the medium.

A vibrating object producing a series of compressions (C) and rarefaction (R)



Sound needs a medium to travel :

Sound is a mechanical wave and needs a medium for propagation. Sound travels through solids, liquids and gases. Sound does not travel in vacuum.

Sound waves are longitudinal waves :

Sound propagates in a medium as a series of compressions (C) and rarefactions (R).

In these waves the particles move back and forth parallel to the direction of propagation of the disturbance. Such waves are called longitudinal waves.

There is another kind of waves called transverse waves. In these waves the particles oscillate up and down perpendicular to the propagation of the direction of disturbance.

Characteristics of a sound wave :

Characteristics of Sound:

Sound wave can be described by its frequency, amplitude and speed.

Sound can be graphically represented as a wave. There is changes in the density and pressure as sound moves in a medium.

Compressions are the regions of high pressure and density where the particles are crowded and are represented by the upper portion of the curve called crest.

Rarefactions are the regions of low pressure and density where the particles are spread out and are represented by the lower portion of the curve called trough.

The distance between two consecutive compressions (crests) or two consecutive troughs is called wave length. It is represented by the symbol . (*Greek letter lamda*). Its SI unit is metre (m).

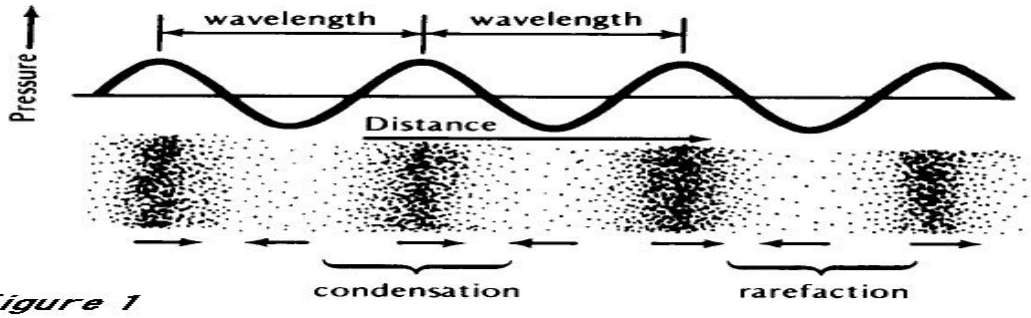
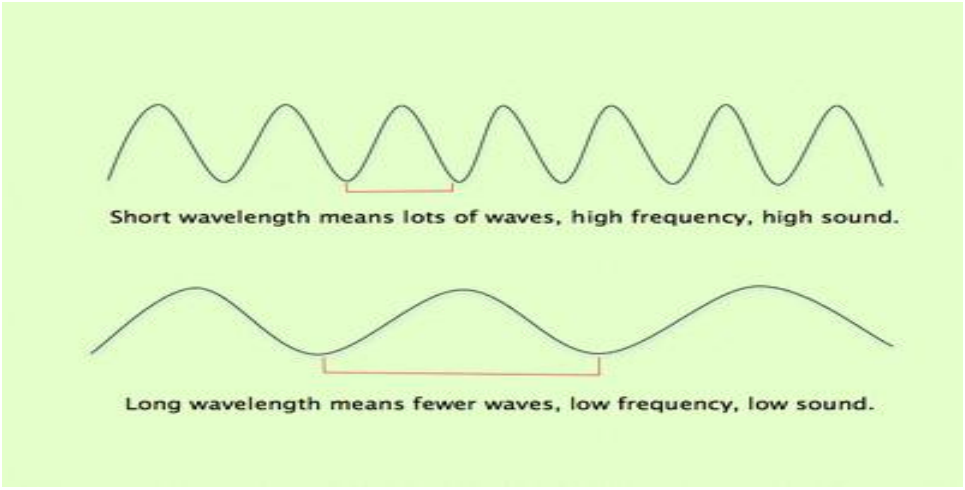


Figure 1

Frequency of sound wave :-

When sound is propagated through a medium, the density of the medium oscillates between a maximum value and a minimum value. The change in the density of the medium from a maximum value to a minimum value and again to the maximum value is one oscillation.

The number of oscillations per unit time is called the frequency of the sound wave. It is represented by the symbol *ν (Greek letter nu).* Its SI unit is hertz (Hz).



Time period of sound wave :

The time taken for the change in the density of the medium from a maximum value to a minimum value and again to the maximum value is the time period of the sound wave. Or

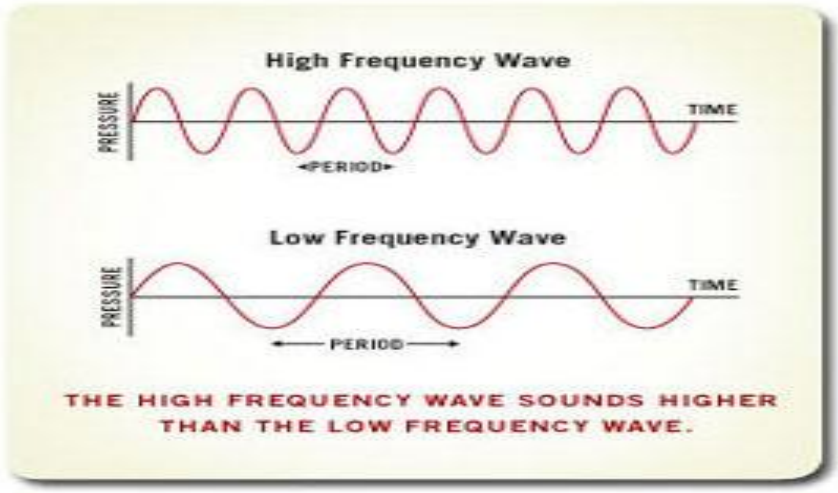
The time taken for one complete oscillation in the density of the medium is called the time period of the sound wave.

It is represented by the letter T. The SI unit is second (s).

Frequency and time are represented as follows :-

ν for one oscillation

$T = 1/\nu$ or $\nu = 1/T$

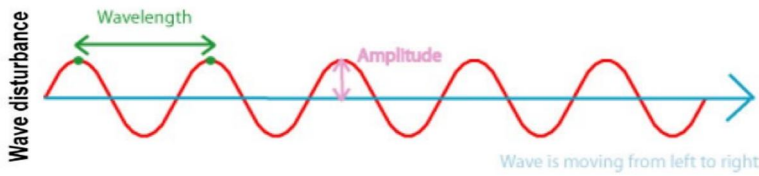


Amplitude of sound wave :-

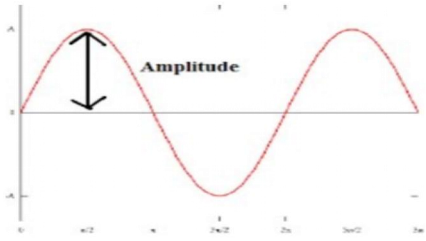
The magnitude of the maximum disturbance in the medium on either side of the mean value is the amplitude of the sound wave. Or

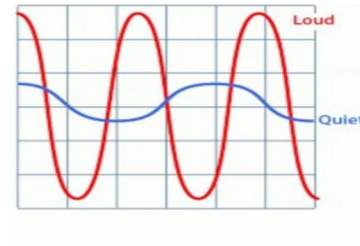
The amplitude of sound wave is the height of the crest or tough.

It is represented by the letter A. The SI unit is the same as that of density or pressure.



Wavelength and Amplitude

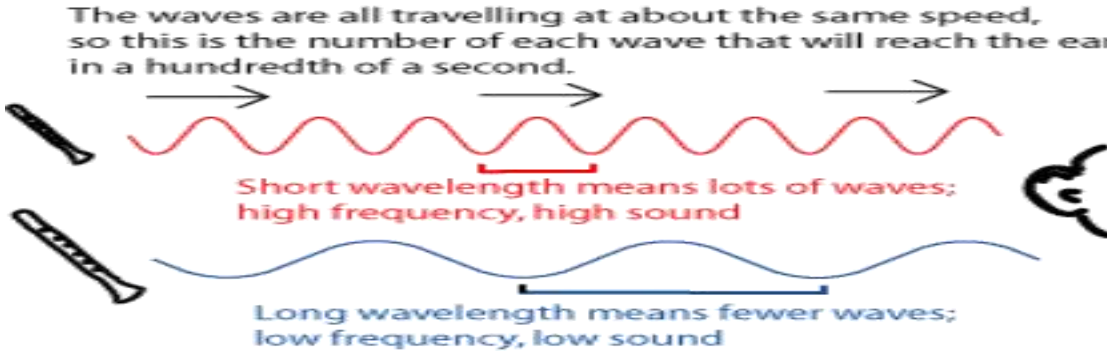




Pitch and loudness of sound :-

The pitch of sound (shrillness or flatness) depends on the frequency of vibration.

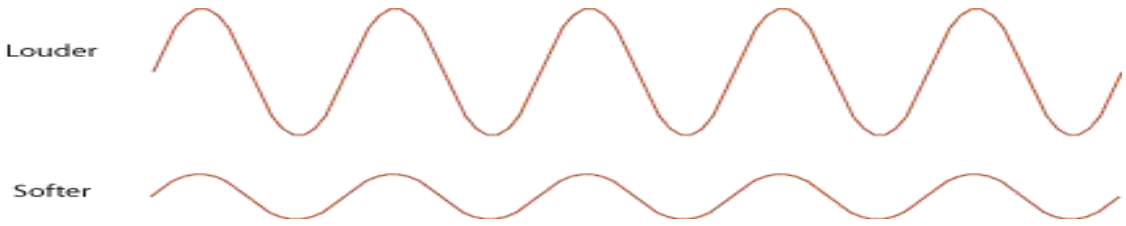
If the frequency is high, the sound has high pitch and if the frequency is low, the sound has low pitch.



Since the sounds are travelling at about the same speed, the one with the shorter wavelength will go by more frequently; it has a higher frequency, or pitch. In other words, it sounds higher

The loudness of sound depends upon the amplitude of vibration.

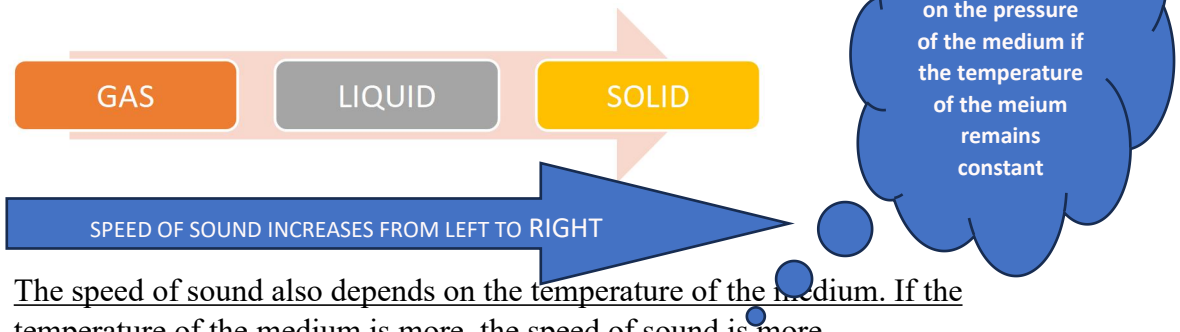
If the amplitude is bigger, the sound is loud and if the amplitude is smaller, the sound is soft.



Amplitude is Loudness

The size of a wave (how much it is "piled up" at the high points) is its *amplitude*. For sound waves, the bigger the amplitude, the louder the sound.

SPEED OF SOUND IN DIFFERENT MEDIUM



The speed of sound also depends on the temperature of the medium. If the temperature of the medium is more, the speed of sound is more.

Relationship between Speed (v), frequency (ϒ) and wave length (λ)

Speed = wave length x frequency

$v = \lambda \times \gamma$

Speed of sound in different media at 25^0C.

State	Substance	Speed in m/s
Solid	**Aluminium**	**6420**
	Steel	**5960**
	Iron	**5950**
	Brass	**4700**

	Glass	**3980**
Liquid	**Water (Sea)**	**1531**
	Water (Distilled)	**1498**
	Ethanol	**1207**
	Methanol	**1103**
Gas	**Hydrogen**	**1284**
	Helium	**965**
	Air	**346**
	Oxygen	**316**
	Sulphur dioxide	**213**

Reflection of sound :-

Like light, sound gets reflected at the surface of a solid or liquid and follows the laws of reflection.

i) The angle of incidence is equal to the angle of reflection.

ii) The incident ray, the reflected ray and normal at the point of incidence all lie in the same plane.

Echo :- If we shout or clap near a reflecting surface like tall building or a mountain, we hear the same sound again. This sound which we hear is called echo. It is caused due to the reflection of sound.

To hear an echo clearly, the time interval between the original sound and the echo must be at least 0.1 s.

Since the speed of sound in air is 344 m/s, the distance travelled by sound in 0.I s = 344 m/s x 0.1 s = 34.4 m

So to hear an echo clearly, the minimum distance of the reflecting surface should be half this distance, that is 17.2 m.

Reverberation :

Echoes may be heard more than once due to repeated or multiple reflections of sound from several reflecting surfaces. This causes persistence of sound called reverberation.

In big halls or auditoriums to reduce reverberation, the roofs and walls are covered by sound absorbing materials like compressed fibre boards, rough plaster or draperies.

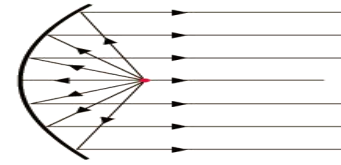
Uses of multiple reflection of sound :-

i) Megaphones, horns, musical instruments like trumpets, shehnais etc. are deigned to send sound by multiple reflection in a particular direction without spreading in all directions.

ii) Doctors listen to sounds from the human body through a stethoscope. The sound of heartbeat reaches the doctor's ears by multiple reflection.

iii) Generally the ceilings of cinema halls and auditoriums are curved so that sound after multiple reflection reaches all parts of the hall.

Sometimes a curved sound board is placed behind the stage so that sound after multiple reflection spreads evenly across the hall.



Range of Hearing :-

Human beings can hear sound frequencies between 20 Hz and 2000 Hz.

Sound whose frequency is less than 20 Hz is called infrasonic sound. Animals like dogs, elephants, rhinoceros, whales etc. produce and hear infrasonic sound.

Sound whose frequency is more than 2000 Hz is called ultrasonic sound. Animals like dolphins, bats, rats propoises etc. produce and hear ultrasonic sound.

Bats use reflection of ultrasonic sound waves to detect an obstacle or its prey.

Uses of ultrasonic sound :-

i) Ultrasonic sound is used to clean objects like electronic components. The components to be cleaned are kept in a cleaning solution and ultrasonic waves are sent into the solution. Due to the high frequency, the dirt particles get detached from the components.

ii) Ultrasonic sound is used to detect cracks in metal blocks. Ultrasonic waves are sent through the metal blocks and if there are cracks, the waves are reflected back and the cracks can be detected.

iii) Ultrasonic sound is used in ultra sound scanners for getting images of internal organs of the human body.

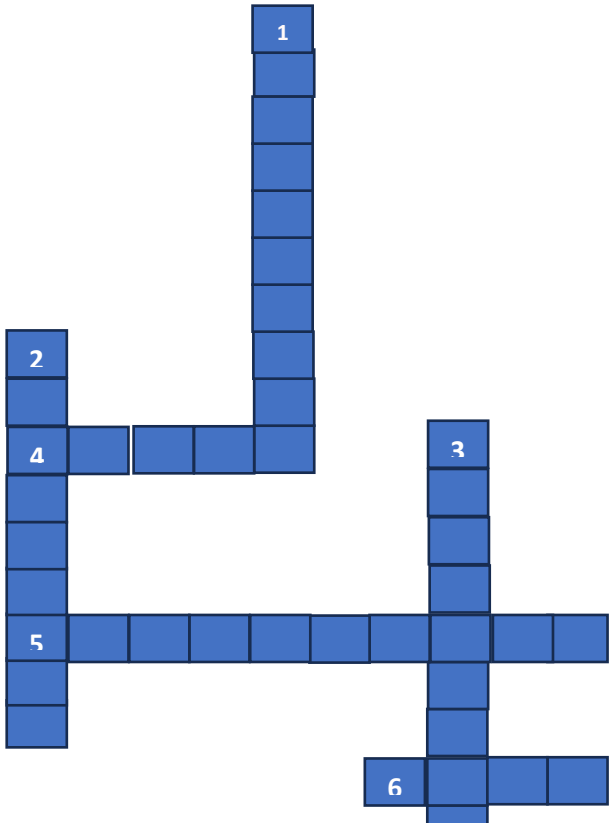
iv) Ultrasonic sound is used to break small stones formed in the kidneys into fine grains so that they are removed through the urine.

Sound Pollution:

Excessive and unwanted sounds in the environment, known as noise pollution, can have harmful effects on human health and wildlife.

Measures to control noise pollution include soundproofing buildings, using ear protection, and implementing noise regulations.

CROSSWORD PUZZLE



CLUES

Down

1. Distance between two consecutive rarefactions or two consecutive compressions
2. Distinguishes between loud and feeble sound
3. No. of waves that pass a point in unit time

Across

4. depends on frequency of sound
5. sound waves with frequency above 20000 Hz
6. sound returning back towards the source after suffering reflection from a distant obstacle

MULTIPLE CHOICE QUESTIONS

1. Sound waves are:
A) Transverse waves B) Longitudinal waves
C) Electromagnetic waves D) None of the above

2. The speed of sound in air is approximately:
A) 343 m/s B) 300,000,000 m/s C) 30,000 m/s D) 3,000 m/s

3. The loudness of a sound depends on its:
A) Frequency B) Amplitude C) Wavelength D) Speed

4. The unit of frequency is:
A) Hertz B) Decibel C) Watt D) Ohm

5. The characteristic of sound that distinguishes a flute from a guitar is:
A) Pitch B) Loudness C) Quality D) Timbre

6. Which of the following materials allows sound to travel the fastest?
A) Air B) Water C) Steel D) Wood

7. When sound waves strike a surface and bounce back, it is called:
A) Absorption B) Refraction C) Reflection D) Transmission

8. The human ear can detect sound waves in the frequency range of:
A) 0 Hz to 100 Hz B) 20 Hz to 20,000 Hz C) 50 Hz to 50,000 Hz D) 100 Hz to 100,000 Hz

9. Ultrasound waves have frequencies:
A) Below 20 Hz B) Between 20 Hz and 20,000 Hz C) Above 20,000 Hz D) Between 1 Hz and 1,000 Hz

10. The medical procedure that uses high-frequency sound waves to visualize internal organs is called:
A) Radiography B) Ultrasonography C) MRI D) CT scan

11. Noise pollution can have harmful effects on:
A) Human health B) Wildlife C) Both A and B D) Neither A nor B

12. Which of the following is a measure to reduce noise pollution?
A) Using ear protection B) Implementing noise regulations
C) Soundproofing buildings D) All of the above

ANSWER KEY

1. B) Longitudinal waves
2. A) 343 m/s
3. B) Amplitude
4. A) Hertz
5. C) Quality
6. C) Steel
7. C) Reflection
8. B) 20 Hz to 20,000 Hz
9. C) Above 20,000 Hz
10. B) Ultrasonography
11. C) Both A and B
12. D) All of the above

ASSERTION REASON TYPE QUESTIONS

Direction: In each of the following questions, a statement of Assertion is given followed by a corresponding statement of Reason. Of the statements, mark the correct answer as
(a) Both assertion and reason are true and reason is the correct explanation of assertion.
(b) Both assertion and reason are true but reason is not the correct explanation of assertion.
(c) Assertion is true but reason is false.
(d) Assertion is false but reason is true.

Assertion: Sound cannot travel in vacuum.
Reason: Sound requires a medium for propagation.
Answer: A, Both Assertion and Reason are correct, and the Reason is the correct explanation for the Assertion.

Assertion: The speed of sound is maximum in solids and minimum in gases.
Reason: The particles of solids are closely packed, allowing sound waves to travel faster through them.
Answer: B, Both Assertion and Reason are correct, but the Reason is not the correct explanation for the Assertion.

Assertion: A sound wave with a higher amplitude is perceived as louder.
Reason: Amplitude is the measure of the energy carried by the wave.
Answer: A, Both Assertion and Reason are correct, and the Reason is the correct explanation for the Assertion.

Assertion: Ultrasonic waves are used in medical imaging.
Reason: Ultrasonic waves have high penetrating power and can pass through tissues.
Answer: A, Both Assertion and Reason are correct, and the Reason is the correct explanation for the Assertion.

Assertion: Noise pollution can lead to hearing loss.
Reason: Prolonged exposure to loud noises can damage the eardrum and inner ear structures.
Answer: A, Both Assertion and Reason are correct, and the Reason is the correct explanation for the Assertion.

SHORT ANSWER TYPE QUESTIONS

What is sound?
Sound is a form of energy that produces a sensation of hearing in our ears when it travels through a medium such as air, water, or solids.

How is sound produced?
Sound is produced by vibrating objects, which set the particles of the medium around them into vibration, creating sound waves.

What is the difference between pitch and loudness of sound?
Pitch refers to the highness or lowness of a sound, which depends on the frequency of the sound wave. Loudness, on the other hand, refers to the intensity or volume of a sound, which depends on the amplitude of the sound wave.

Explain the propagation of sound in air.
Sound waves travel in the form of longitudinal waves, where the particles of the air vibrate parallel to the direction of wave propagation. The speed of sound in air is approximately 343 m/s at room temperature.

What is an echo?
An echo is a reflected sound wave that is heard distinctly after the original sound has ceased, usually produced when sound reflects off a hard surface.

How is the range of human hearing defined?
The range of human hearing is defined by the frequencies of sound waves that humans can detect, which typically ranges from 20 Hz to 20,000 Hz.

What are ultrasonic waves?
Ultrasonic waves are sound waves with frequencies above the range of human hearing, typically above 20,000 Hz. They are used in various applications, including medical imaging and sonar technology.

How does noise pollution affect human health?
Noise pollution can have harmful effects on human health, including hearing loss, stress, sleep disturbances, and cardiovascular issues.

What are some measures to control noise pollution?
Some measures to control noise pollution include soundproofing buildings, using ear protection in noisy environments, implementing noise regulations, and promoting the use of quieter technologies.

NUMERICALS

1. A person is listening to a tone of 500 Hz sitting at a distance of 450m from the source of the sound. What is the time interval between successive compressions from the source? [Speed of sound in air = 330m/s]

ANS: The time interval between successive compressions from the source is equal to the time period and time period is reciprocal of the frequency. Therefore, it can be calculated as follows:

$T = 1/F$

$T = 1/500$

$T = 0.002$ s.

2. A stone is dropped from a 500 m tall building into a pond. When is sound of splash heard at the top? (g=10m/s^2 , speed of sound in air= 340m/s)?

ANS: Here we need to first find the time for the stone to drop in pond

$s=ut+12gt^2$

Here s=500m, u=0,g=10m/s^2

$500=12\times10\times t2500=12\times10\times t^2$

or t=10 sec

Now time for the sound to travel to peak of tower

=500/340=1.47 sec

So total time to heard the sound=10 + 1.47=11.47 sec

3. In tank, 10 ripples are produced in one sec. If the distance between a crest and trough is 10cm, find?

(a)Wavelength

(b)Frequency

(c)Velocity of the wave?

ANS: The wavelength of a wave is the distance between two consecutive crests or troughs. Here, the distance between a crest and next trough is half of the wavelength.

$\lambda 2=10\lambda 2=10$ cm

$\lambda\lambda=20$ cm =.2 m

Frequency is the number of oscillations per unit time.

f=10 hz

Now, velocity of the wave,

$v=\lambda v=.2\times10=2v=\lambda v=.2\times10=2$ m/s

4. A sound wave has a frequency 2 kHz and wavelength 40 cm. How long will it take to travel 1.6 km?

ANS: $v=2000v=2000$ hz

$\lambda=.4\lambda=.4$ m

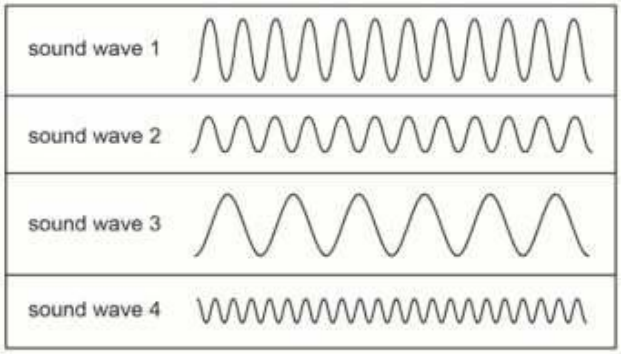
Speed of the sound

$v=\lambda v=2000\times.4=800v=\lambda v=2000\times.4=800$ m/s

Time taken to cover 1.6 km = 1600/800=2 sec

COMPETENCY BASED QUESTIONS

The picture shows four sound waves.



1 Which sound wave has the highest frequency?

A. Sound wave 1
B. Sound wave 2
C. Sound wave 3
D. Sound wave 4

Ans: D. Sound wave 4

2 Which two sound waves have almost the same loudness?

A. Sound wave 1 and sound wave 2
B. Sound wave 2 and sound wave 4
C. Sound wave 1 and sound wave 3
D. Sound wave 3 and sound wave 4

Ans: C. Sound wave 1 and sound wave 3

3 Which of these is the frequency of an infrasound?

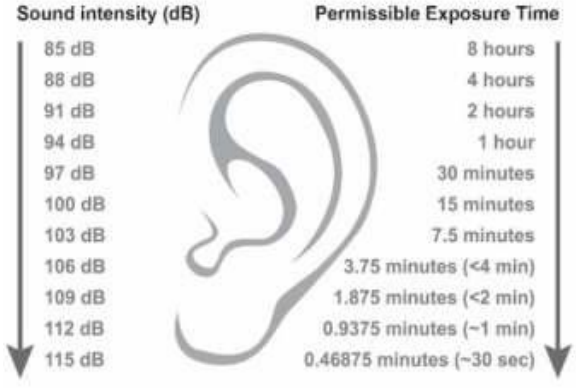
A. 10 Hz
B. 75 Hz
C. 15000 Hz
D. 35000 Hz

Ans: A. 10 Hz

30 dB	140 dB	70 dB	100 dB

Sound intensity is the total amount of energy in a sound wave. Decibel (dB) is the unit of intensity.

The chart shows the permissible time for listening to different sounds



4. Which of these actions does not follow the permissible exposure time of hearing?

A. Reading in a library for 5 hours
B. Riding a sports bike for 10 minutes
C. Dining at a restaurant table for an hour
D. Sitting in the front row of a rock concert for 30 minutes

Ans: D. Sitting in the front row of a rock concert for 30 minutes

Which of these depends on the intensity of a sound? Circle 'Yes' or 'No' for the correct response.

Does this depend on the intensity of the sound?	Yes or No
speed of the sound	Yes / No
loudness of the sound	Yes / No
frequency of the sound	Yes / No

Ans: No
Yes
No

Question: Imagine you are designing a soundproof room for a recording studio. Explain how you would ensure that the room effectively absorbs sound.

(a) What materials would you use for the walls, ceiling, and floor of the room, and why?

(b) How would you design the doors and windows of the room to minimize sound transmission?

(c) What other measures would you take to ensure that the room is acoustically isolated from external noise?

Ans: (a) For the walls, ceiling, and floor of the soundproof room, I would use materials with high sound absorption coefficients, such as acoustic foam panels, fiberglass insulation, and heavy curtains. These materials absorb sound waves and prevent them from reflecting back into the room.

(b) To minimize sound transmission through doors and windows, I would use thick, solid doors with weather stripping to create a tight seal. Windows would be double-paned with laminated glass to reduce sound transmission.

(c) To ensure acoustic isolation from external noise, I would ensure that the room is well-sealed, with no gaps or openings that could allow sound to leak in. Additionally, I would consider the placement of air vents and ducts to minimize sound transmission through these openings.

Question: You are a sound engineer tasked with setting up a concert venue for a live performance. Describe the steps you would take to ensure optimal sound quality for the audience.

(a) How would you position the speakers and microphones to achieve the best sound distribution?

(b) What considerations would you make for the acoustics of the venue to minimize echo and reverberation?

(c) How would you manage sound levels to ensure that the music is loud enough for the audience without causing discomfort or hearing damage?

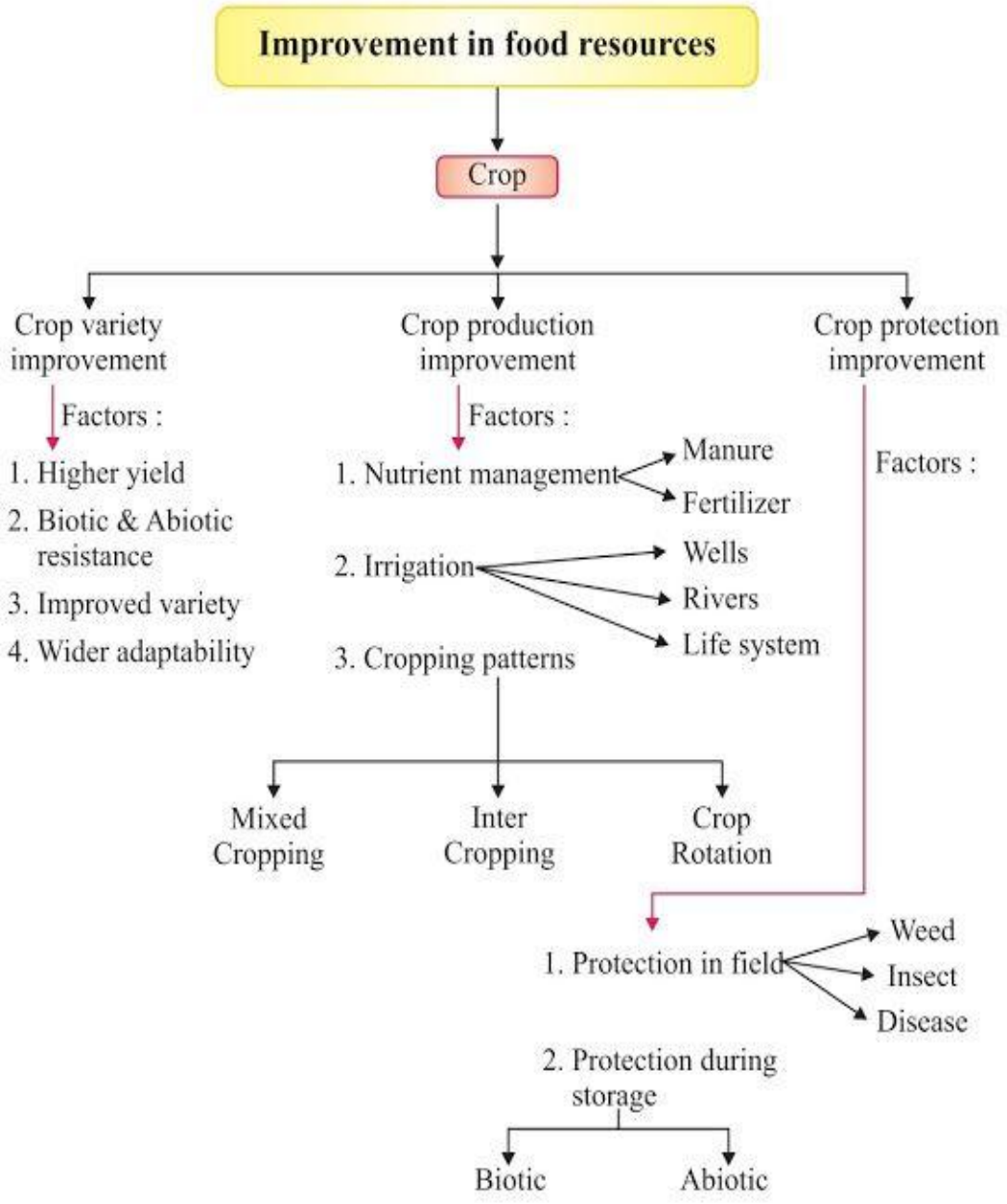
Ans: (a) I would position the speakers and microphones strategically to achieve even sound distribution throughout the venue. This would involve placing speakers at optimal heights and angles to cover the entire audience area, and positioning microphones to capture the best sound from performers.

(b) To minimize echo and reverberation, I would consider the acoustics of the venue, including its size, shape, and materials. I would use sound-absorbing materials such as acoustic panels and drapes to reduce reflections off walls and ceilings.

(c) To manage sound levels, I would use a sound level meter to monitor the volume of the music and ensure it is within safe limits for the audience. I would also consider using sound-limiting devices to prevent the music from exceeding a certain decibel level.

CHAPTER 12 IMPROVEMENT IN FOOD RESOURCES

MIND MAP



Introduction

Agriculture is the primary source of food for humans. Improving food resources

involves enhancing agricultural practices to increase food production.

Crop Variety Improvement

Crop variety improvement involves developing new varieties of crops with desirable traits.

Techniques include selection, hybridization, and genetic engineering.

Crop Production Management

Effective crop production management involves selecting suitable crops, preparing the soil, sowing seeds, adding manure and fertilizers, irrigation, and protecting crops from pests and diseases.

Animal Husbandry

Animal husbandry involves the management and care of farm animals for obtaining milk, wool, meat, and other products.

Practices include breed improvement, feeding, and healthcare.

Bee-keeping, Fisheries, and Poultry Farming

Bee-keeping involves rearing bees for honey production.

Fisheries involve the cultivation of fish for food.

Poultry farming involves rearing birds like chickens for eggs and meat.

Plant Breeding

Plant breeding is the process of developing new plant varieties with desired characteristics.

Techniques include hybridization, mutation breeding, and genetic engineering.

Biological Control of Pests and Diseases

Biological control involves using natural enemies of pests to reduce their population.

It is an eco-friendly alternative to chemical pesticides.

Organic Farming

Organic farming is a method of agriculture that relies on natural substances and processes.

It avoids the use of synthetic fertilizers and pesticides.

Manure and Fertilizers

Manure and fertilizers are used to replenish nutrients in the soil.

Manure	Fertilizers
These are organic substances.	These are inorganic substances
These are made up of natural substances (decomposition of plant and animal waste).	These are made of chemical substances
These have less amount of nutrient.	These have large amount of nutrients.
These are cheap and are prepared in rural homes or fields.	These are costly and are prepared in factories.
Manures are slowly absorbed by the plants since they are insoluble in	Fertilizers are easily absorbed by the plants since they are soluble in water.

water	
It is difficult to store and transport.	Their storage and transportation is easy

Irrigation

Irrigation involves supplying water to crops.

Techniques include traditional methods like canal irrigation and modern methods like drip irrigation.

Storage of Grains

Grains are stored in warehouses or silos to protect them from pests and spoilage.

Proper storage conditions are essential to maintain grain quality.

Conclusion

Improvement in food resources is crucial for ensuring food security for the growing population.

Sustainable agricultural practices are necessary to protect the environment and ensure long-term food production.

Some other important points:

Green Revolution: Green revolution is a programme introduced in many countries to increase food production by use of modern technology, proper irrigation, improved seeds etc.

White Revolution: White revolution is a programme in India to increase production of milk in India. This programme made India self-sufficient in production of milk.

Properties to be possessed by improved seeds Or Factors for which variety improvement in crops is done

i) **Higher yield :** To increase the productivity of the crop per acre.
ii) **Improved quality:** Quality of crop products vary from crop to crop.
iii) **Biotic & Abiotic resistances :** Crop production reduces due to biotic and abiotic factors. Varieties resistant to these factors can improve crop production.
iv) **Wider adaptability:** Crops which can grow in different conditions, will help in setting high production.
v) **Desired agronomic traits :** Crops which contain desired agronomic traits (height, branching, leafs), sets high production.

Crop rotation : Crop rotation is policy of growing different crops one after another on the same field.

If some crop is grown again and again on the same field, same nutrients are extracted from soil again and again. So we should choose different crops so that all nutrients of soil are used.

Advantages :

A. Soil fertility is maintained.

B. It controls pests and weeds.

C. Several crops can be grown in succession with only one soil preparation.

Pest control during growth : Pest is any destructive organism which can destroy or harm crops or products obtained from them. Pests are of many types:

Weeds : Unwanted plants in the cultivated field e.g., xanthium.

Insects : Insects can harm plants in following ways :

(a) They cut the root, stem and leaf.

(b) They suck the cell sap from various parts of the plant.

Pathogens : Any organism such as bacteria, fungi and viruses which cause diseases in plants are called pathogens. They are transmitted through air, water, soil.

DIFFERENCES

Compare ***Kharif crops and Rabi crops:***

SN	Crop	Season	Example
1	***Kharif crops***	June to October (Rainy Season)	*Paddy, Soya bean, and maize*
2	***Rabi crops***	November to April (winter season)	Wheat, gram, peas, and mustard

HYBRIDIZATION TYPE

SN	Type	Context
1	Intervarietal Hybridization	between different varieties
2	Interspecific Hybridization	between different species
3	Intergeneric Hybridization	between different genera
4	Genetically Modified Crops (GMC).	Another way of improving the crop is by introducing a gene that would provide the desired characteristic.

NUTRIENTS

SN	**Macronutrient**	**Micronutrient**
1	Six elements are required in larger quantity	Other seven elements are required in small quantity
2	Ex. Nitrogen, phosphorus, calcium, Potassium, magnesium, sulphur	Ex. Iron, manganese, boron, zinc, copper, molybdenum, chlorine

CROPPING PATTERNS

Mixed cropping	Inter-cropping	Crop rotation
Two or more crops grown simultaneously on the same piece of land	Two or more crops grown simultaneously on the same piece of land in a definite pattern	Growing different crops on a piece of land in a pre-planned succession
Ex. Wheat+ Gram; Wheat+ Mustard; Wheat+ gram; Groundnut+ sunflower.	Soyabean + maize/bajra+Cowpea.	Two or three crops can be grown in a year depending upon the duration.
A type of insurance against failure of one of the crops.	A few rows of one crop alternate with a few rows of a second crop. Crops are selected such that their nutrient requirements are different. This ensures the maximum utilization of the nutrients supplied and prevents pests and diseases spreading in the crop field.	The availability of moisture and irrigation facilities decides the choice of the crop to be cultivated.

Crop protection improvement/ management: Field crops are infested by large number of weeds, insects pests, diseases & storage of grains

Weeds	Insect pests	Diseases	Storage of grains
Weeds are unwanted plants in the crop field	Insect pest is nuisance in the crop field	Disease is caused by pathogens in the field	Different factors are responsible.
Weeds take up nutrients and reduce the growth	Insect pest affect the health of crop and reduce the yield.	Diseases alter the physiology of crops and reduce the yield	Different factors reduce the quality of stored grains
Ex. Xanthium, Parthenium	Ex. Caterpillars, dragonfly	Ex. Bacteria, Virus	Biotic factors: insects, rodents, fungi Abiotic factors: moisture & temperature
Removal of weeds at an	Spread of chemicals	Spread of chemicals to	Systematic management of

early stage is recommended. Spray weedicides	such as pesticides	kill pathogens	ware house.

Content	**Cattle farming**	**Poultry farming**	**Fish farming**	**Bee Keeping.**
Purpose	Milk (milch animals) and draught labour (draught animals) in agriculture.	Meat, chicken, egg production	Cheap source of animal protein. Fish production is aquaculture. Growing of marine fishes is called mariculture.	Honey, wax, medicinal preparations. Additional income to the farmer.
Cross breeding: To get desired qualities	Exotic- quality of lactation Indigenous breeds- quality of disease resistance	Exotic & Indigenous breeds	Both Exotic & Indigenous fishes are used	Exotic- high honey collection capacity &stingless. Indigenous bees- are used
Desirable maintenance	Good ventilation in sheds Roughage/ concentrates Protection from parasites & skin diseases Vaccination	Good ventilation in sheds Roughage/ concentrates Protection from parasites & skin diseases Vaccination	Fish farming/ locating large schools of fish/ use of satellites and echo-sounds In Composite fish culture seed is wild, mixed with other species. Hormonal stimulation to bring desired	Value or quality depends upon the pasturage or the flowers available for the taste of honey.

			quality in fish production.	
Example	Exotic or foreign breeds (Jercy, brown Swiss) Local breeds (Red sindhi, Sahiwal)	Exotic- Leghorn Indigenous breeds- Aseel	Fresh water (Macrobrachium) & Marine(Peneaus) prawns Fresh water fishes Marine fishes(Bombay duck, sardines)	Apis ceranaindica dorsata A. florae

MULTIPLE CHOICE QUESTIONS

Which of the following is not a method of crop production?
(a) Traditional farming (b) Organic farming (c) Modern farming (d) Aerial farming

Which of the following is not a crop variety improvement technique?
(a) Selection (b) Hybridization (c) Genetic engineering (d) Pest control

What is the primary goal of animal husbandry?
(a) Increase crop yield (b) Improve soil fertility
(c) Enhance animal productivity (d) Reduce water usage

Which of the following is not a product of animal husbandry?
(a) Milk (b) Honey (c) Wool (d) Fertilizer
Which of the following is a benefit of bee-keeping?
(a) Increased crop yield (b) Pollination of flowers
(c) Reduction of pests (d) Improved soil fertility

What is the purpose of fisheries?
(a) Rearing bees for honey (b) Cultivation of fish for food
(c) Rearing poultry for meat (d) Production of milk

What is the primary aim of plant breeding?
(a) Increase crop yield (b) Improve crop quality
(c) Enhance crop resistance to pests (d) All of the above

Which of the following is an example of biological control of pests?
(a) Use of chemical pesticides (b) Introducing natural enemies of pests
(c) Crop rotation (d) Use of insecticides

What is the main principle of organic farming?
(a) Use of synthetic fertilizers (b) Use of chemical pesticides
(c) Use of natural substances and processes (d) All of the above

Which of the following is an advantage of organic farming?
(a) Lower cost of production (b) Reduced environmental impact
(c) Higher crop yields (d) Longer shelf life of produce

What is the purpose of using manure and fertilizers in agriculture?
(a) Increase soil acidity (b) Improve soil structure
(c) Replenish soil nutrients (d) Reduce soil erosion

Which of the following is a modern method of irrigation?
(a) Canal irrigation (b) Drip irrigation (c) Flooding (d) Furrow irrigation
What is the main advantage of drip irrigation?
(a) Reduced water wastage (b) Higher crop yields
(c) Lower cost of irrigation (d) Faster crop growth

How are grains stored to protect them from pests and spoilage?
(a) In open containers (b) In damp places (c) In warehouses or silos (d) In direct sunlight

Which of the following is not a sustainable agricultural practice?
(a) Organic farming (b) Crop rotation
(c) Overuse of chemical fertilizers (d) Use of biological control of pests

Answers:

1. D) Aerial farming
2. D) Pest control
3. C) Enhance animal productivity
4. D) Fertilizer
5. B) Pollination of flowers
6. B) Cultivation of fish for food
7. D) All of the above
8. B) Introducing natural enemies of pests
9. C) Use of natural substances and processes
10. B) Reduced environmental impact

11. C) Replenish soil nutrients
12. B) Drip irrigation
13. A) Reduced water wastage
14. C) In warehouses or silos
15. C) Overuse of chemical fertilizers

ASSERTION REASON TYPE Questions

Direction: In each of the following questions, a statement of Assertion is given followed by a corresponding statement of Reason. Of the statements, mark the correct answer as

(a) Both assertion and reason are true and reason is the correct explanation of assertion.

(b) Both assertion and reason are true but reason is not the correct explanation of assertion.

(c) Assertion is true but reason is false.

(d) Assertion is false but reason is true.

1. **Assertion (A):** Green manure helps in improving soil fertility.
Reason (R): Green manure plants are plough back into the soil before they mature.
Answer:
Correct Answer: A

2. **Assertion (A):** Drip irrigation is an efficient method of irrigation in water-scarce areas. **Reason (R):** Drip irrigation provides water directly to the roots of plants, reducing water wastage.
Correct Answer: A

3. **Assertion (A):** Use of bio-fertilizers is beneficial for the environment.
Reason (R): Bio-fertilizers are synthetic chemicals that enhance soil fertility.
Correct Answer: C

4. **Assertion (A):** Crossbreeding in cattle can lead to improved milk production.
Reason (R): Crossbreeding introduces new genes that can enhance desirable traits in cattle.
Correct Answer: A

5. **Assertion (A):** Use of pesticides can have harmful effects on human health.
Reason (R): Pesticides are designed to kill pests that affect crop production.
Correct Answer: B

SHORT ANSWER QUESTIONS

1. What is the importance of crop rotation in agriculture?
Answer: Crop rotation helps in maintaining soil fertility, controlling pests and

diseases, and improving crop yield by alternating the types of crops grown in a particular area.

2. How does genetic engineering contribute to crop improvement?
Answer: Genetic engineering allows scientists to modify the genetic makeup of crops to introduce desirable traits such as pest resistance, disease resistance, and increased yield.

3. What are the advantages of using organic fertilizers over chemical fertilizers?
Answer: Organic fertilizers improve soil structure, increase water retention capacity, and enhance microbial activity in the soil without causing harm to the environment or human health.

4. Why is it important to conserve plant genetic resources?
Answer: Conserving plant genetic resources ensures the availability of diverse genetic material for future crop improvement programs, helps in maintaining biodiversity, and protects against the loss of valuable plant species.

5. How does bee-keeping benefit agriculture?
Answer: Bee-keeping helps in pollination, which is essential for the reproduction of many plant species, including crops, leading to increased yield and quality of agricultural produce.

6. Discuss the advantages and disadvantages of modern irrigation methods.
Answer: Modern irrigation methods such as drip irrigation and sprinkler irrigation have several advantages, including efficient water use, reduced water wastage, and improved crop yield and quality. However, these methods require high initial investment and maintenance costs. They can also lead to soil salinity and waterlogging if not managed properly. Overall, modern irrigation methods are beneficial but require careful planning and management.

7. Discuss the role of animal husbandry in agriculture.
Answer: Animal husbandry involves the management and care of farm animals for various purposes, including milk, meat, wool, and other products. It plays a crucial role in agriculture by providing additional income to farmers, enhancing soil fertility through manure, and providing valuable products for human consumption. Animal husbandry also helps in maintaining the ecological balance by utilizing animal waste as a source of energy and reducing the environmental impact of agricultural practices.

8. Give two examples of each of micronutrients and macronutrients.
Ans: (i) Macronutrients: nitrogen, phosphorus (ii) Micronutrients: iron, manganese

9. If there is low rainfall in a village throughout the year, what measures will you suggest to the farmers for better cropping?
Ans: (i) using drought-resistant and early maturing varieties of crops.
(ii) add more humus to the soil as it increases the water-holding capacity and retains water for longer duration.

10. Classify the crops on the basis of growing seasons. Also mention one example of each.
Ans: Kharif crop: grown in rainy season (June to October). E.g. – Paddy
Rabi crop: grown in the winter season (November to April). E.g. – wheat

11. Explain composite fish culture and write its advantage.
Ans: Composite fish culture is a method in which 5-6 fish species are grown together in a single fish pond. By this survival rate of fish and their yield increases without affecting the other species.

12. What are fodder crops? Write two examples.
Ans: Fodder crops are used for feeding of cattle. e.g. - berseem, oats.

LONG ANSWER QUESTIONS

1. Explain the various methods of crop production management.
Answer: Crop production management involves several steps, including selection of suitable crops, soil preparation, seed selection and sowing, adding manure and fertilizers, irrigation, and crop protection. Farmers select crops based on soil type, climate, and market demand. Soil is prepared by plowing and leveling to improve aeration and water retention. Seeds are selected based on quality and treated to prevent diseases. Manure and fertilizers are added to replenish soil nutrients. Irrigation methods vary based on water availability, and crop protection involves controlling pests and diseases through natural or chemical means.

2. Question: Describe the process of plant breeding and its significance in agriculture.
Answer: Plant breeding is the process of developing new plant varieties with desirable traits such as high yield, pest resistance, and disease resistance. It involves techniques like hybridization, mutation breeding, and genetic engineering. Plant breeding is significant in agriculture as it helps in developing crops that can adapt to changing environmental conditions, resist pests and diseases, and improve overall crop productivity and quality.

3. Question: Explain the concept of biological control of pests and diseases in agriculture.
Answer: Biological control of pests and diseases involves using natural enemies of

pests, such as predators, parasites, and pathogens, to control their population. This method is eco-friendly and does not harm the environment or human health. Biological control helps in reducing the reliance on chemical pesticides, which can have adverse effects on the environment and non-target organisms.

4. Question: Explain the differences between broilers and layers. What necessary steps have to be taken to prevent the occurrence of infectious diseases in poultry farms?
Ans: Broilers birds are used for meat-production and egg-laying birds are called layers. The requirement of the broilers is protein and fat-rich food. The level of vitamin A and vitamin K is kept high in their feed. Care is taken to avoid mortality and to maintain the feathering and carcass quality. The layers require enough space, proper light, and hygienic conditions.
Necessary steps for prevention of infectious diseases are:
Proper cleaning and sanitation
Effective vaccination to prevent infectious diseases.
Spraying of disinfectants at regular intervals

Competency Based Question:

1. Imagine you are a farmer in a region with irregular rainfall patterns. How would you plan your crop production management to ensure a steady yield of crops throughout the year?

Answer: To ensure a steady yield of crops throughout the year in a region with irregular rainfall patterns, I would adopt the following crop production management practices:

Selection of drought-resistant crops: Choose crop varieties that are resilient to drought and can withstand periods of low rainfall.

Water conservation techniques: Implement water conservation techniques such as rainwater harvesting, mulching, and use of moisture-retentive crops to conserve soil moisture.

Irrigation management: Invest in efficient irrigation systems such as drip irrigation or sprinkler irrigation to provide water to crops during dry periods.

Soil health management: Maintain soil health by adding organic matter, using cover crops, and avoiding over-tillage to improve water retention and soil structure.

Crop rotation and intercropping: Practice crop rotation and intercropping to

utilize water and nutrients more efficiently and reduce the risk of crop failure.

Use of organic fertilizers: Use organic fertilizers to improve soil fertility and water retention capacity, reducing the need for frequent watering.

Pest and disease management: Monitor crops regularly for pests and diseases and use integrated pest management techniques to minimize damage.

2. Imagine you are an agricultural scientist tasked with improving crop yields in a region with poor soil fertility. Suggest a sustainable approach to enhance soil fertility and explain how it would benefit the farmers in the long term.

Answer: To improve crop yields in a region with poor soil fertility, I would suggest the use of green manure and bio-fertilizers as a sustainable approach.

Green Manure: Green manure involves growing specific crops, such as legumes, that are plowed back into the soil while they are still green. These crops decompose and enrich the soil with organic matter and nutrients.

Bio-fertilizers: Bio-fertilizers are natural fertilizers that contain living microorganisms. When applied to seeds, plants, or soil, these microorganisms promote plant growth by increasing the supply of essential nutrients.

Benefits to farmers:

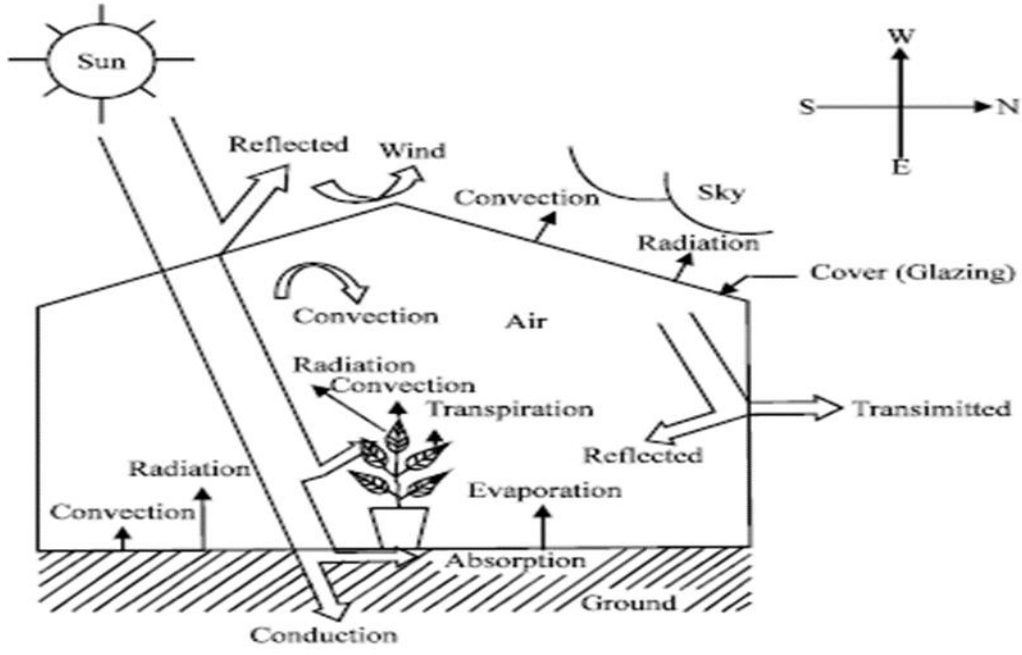
- **Enhanced Soil Fertility:** Green manure adds organic matter, improving soil structure and nutrient content. Bio-fertilizers enhance nutrient availability, especially nitrogen and phosphorus.
- **Sustainability:** Both methods reduce the dependence on chemical fertilizers, which can degrade soil health over time.
- **Cost-Effectiveness:** They are often cheaper than chemical fertilizers and improve soil health in the long term, leading to better yields and reduced costs.
- **Environmental Benefits:** Using green manure and bio-fertilizers reduces pollution and the risk of soil and water contamination from chemical fertilizers.
- **Increased Yields:** Healthier soil with improved fertility supports better plant growth, leading to increased crop yields over time.

Case Based Question-Importance of Greenhouse Technology: *Crop Production*

Around 80% of the world population lives in the developing countries (Anonymous, 1995). Undoubtedly, the agricultural production must be increased to guarantee the food demand of the fast-growing population. In the next 25 years around 50% more food has to be produced, mainly in developing countries (Brown, 1995).

India has attained the self-sufficiency in food and food products. The food grains production has increased from 50.8 million tonnes in year 1951 to 208.9 million tonnes in year 2000 (Anonymous, 2001a) whereas, the area has increased from 97.3 to 123.1 million ha under food grains over these 50 years. India accounts for nearly 10% of world production of fruit crops with annual production of about 44-46 million tonnes. India is the second largest producer of vegetables, next to China. In 1998-99, an estimated production of 87.5 million tonnes, accounted for 14.4% of the world production of vegetables (Anonymous, 2001a).

In the present scenario, to meet the worldwide demand of enhanced production, greenhouse cultivation could serve as a viable solution, facilitating off-season cultivation and protecting crop from unfavourable outdoor conditions. Apart from these, a greenhouse could be a better option for nursery raising, hardening of tissue culture plants, cultivation in regions which are prone to soil problems and extreme climates, also for cultivation of rare as well as medicinal plant**s.**



Energy flow processes in greenhouse system

QUESTION 2.1

Find out the possible reason how Green House increases Crop Production?

_____
_____
_____
_____
_____

QUESTION 2.2

Analyse the fact that increased temperature increases the Crop yield?

_____
_____
_____
_____
_____

QUESTION 2.3

As Green House Effect results into Global Warming. What changes in natural ecosystems are caused by the ongoing global warming process?

_____
_____
_____
_____
_____

QUESTION 2.4.1

Find the correct option

Solar radiations consist of

A) Visible radiation
B) Ultra Violet Radiations
C) Infra-red radiations
D) All of the above radiations.

QUESTION 2.4.2

Out of the following gases find out the gas which is not a greenhouse gas?

A) Methane
B) Carbon di oxide
C) Argon
D) Ozone

QUESTIONS 2.5

Observe the Diagram related to Greenhouse effect at micro level, and identify the short-wave length solar radiation and long wavelength radiation.

Credit Pattern:
Full Credit: 02
Partial Credit: 01
No Credit: 0

DESCRIPTION OF ANSWER KEY AND CREDITS:

2.1 **Full credit**- Conditions are kept at the optimum for growth, including the use of Artificial lighting, trapping of heat from sun.
No Credit: Any other irrelevant answer or missing answer.

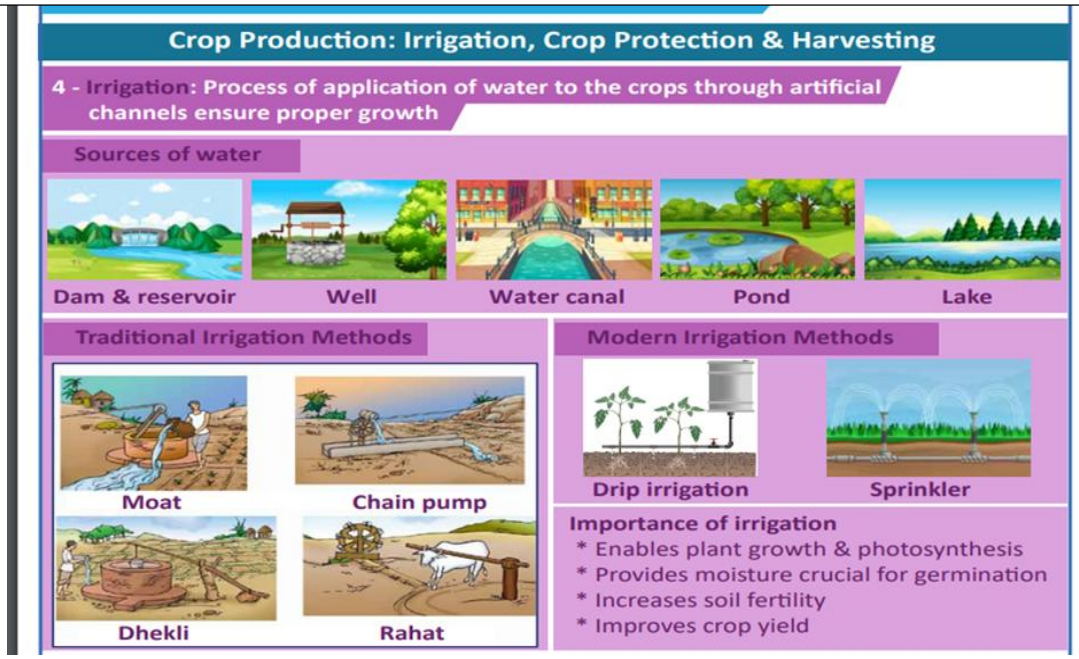
2.2 Full credit : Enzymes work more efficiently at higher temperature making reaction rate faster and we know Enzymes are involved in key growth process and photosynthesis.
Partial Credit: Correct answer for only mentioning faster reaction rate or higher enzyme activity.
No Credit: Any other irrelevant answer or missing answer.

2.3 **Full Credit**: Different species of flora and fauna change their habitats and geographical areas according to climate change and specific geographical environments.
Areas of occurrence of specific species, for example insects in terrestrial areas and fish and arthropods in the seas and oceans, change.
For example, bird habitats change, so migrations of some bird species may also be subject to modification. In the situation when forest areas dry out and turn into steppes and deserts, changes in natural habitats and areas of occurrence of species change and concern simultaneously many species of flora and fauna.

2.3 Partial Credit: Only mentioning about climate change
No Credit: Any other irrelevant answer or missing answer

2.4. **Full Credit**: Correct options 2.4.1 Option D and 2.4.2 Option C
Partial Credit: Any one correct answer.
No Credit: Any other irrelevant answer or missing answer.

2.5 **Full Credit:** Short wave length solar radiations are Visible and UV and Long wave length solar radiation is IR radiations.
No Credit: Any other irrelevant answer or missing answer



QUESTION 5.1

Find out the possible reasons behind irrigating the crop field.

_____

_____

_____

QUESTION 5.2

List out two main advantages of modern methods of irrigation over the traditional ones.

_____

_____

_____

_____

QUESTION 5.3

Suggest two ideas for effective use of Rain water for agriculture.

_____

_____

_____

_____

QUESTION 5.4

Name two methods of irrigation that conserves water.

_____

_____

__

QUESTION 5.5

Which system is a boon in regions of poor availability of water and why?

_____

_____

_____

_____

DESCRIPTION OF ANSWER KEY AND CREDITS:

5.1 Full Credit: Correct answer
Partial Credit: Partially correct answer.
No Credit: Any other irrelevant answer or missing answer.
5.2 Full Credit: Any two correct advantages

Partial Credit: Any one correct advantage.
No Credit: Any other irrelevant answer or missing answer

5.3 Full Credit: Any two correct ideas.
Partial Credit: Any one of the correct ideas.
No Credit: No correct answer or missing answer.
5.4 Full Credit: Drip system and Sprinkler system.
Partial Credit: Any one correct system.
No Credit: Any other irrelevant answer or missing answer

5.4 Full Credit: Drip system and Correct explanation.
Partial Credit: Any one correct system.
No Credit: Any other irrelevant answer or missing answer

WORKSHEET-1

NAME OF THE STUDENT:

CLASS AND SECTION: **ROLL NUMBER:**

Chapter 1: Matter in Our Surroundings

Multiple Choice Questions

1. Which of the following states of matter has a definite shape and volume?

A. Solid B. Liquid C. Gas D. Plasma

Answer:

2. The process of conversion of a solid into a gas without passing through the liquid state is called:

A. Condensation B. Evaporation C. Sublimation D. Melting

Answer:

3. Which of the following statement is correct?

A. 90°C Water produces more severe burns, than 100°C steam

B. 100°C Water produces more severe burns, than 100°C steam

C. 100°C steam produces more severe burns, than 100°C water

D. Both 100°C Water and 100°C steam have same enery

Answer:

4. The boiling point of water is:

A. 0°C B. 100°C C. 273 K D. 373 K

Answer:

5. Which of the following statements about the particles of matter is incorrect?

A. Particles of matter are continuously moving.

B. Particles of matter attract each other.

C. Particles of matter have spaces between them.

D. Particles of matter have fixed positions.

Answer:

Question No. 6 and 7 are assertion and reason type question. Write appropriate answer mention below:

A. Both A and R are true, and R is the correct explanation of A.

B. Both A and R are true, but R is not the correct explanation of A.

C. A is true, but R is false.

D. A is false, but R is true.

6. Assertion (A): Ice at 0°C is hotter than water at 0°C.

Reason (R): Ice has more heat energy than water at 0°C.

Answer:

7. Assertion (A): Evaporation causes cooling.

Reason (R): During evaporation, particles of a liquid absorb energy from the surroundings to overcome the forces of attraction.

Answer:

Short Answer Questions

8. Explain why a gas fills the container in which it is kept.

9. Define the term 'melting point.' How is it different from the freezing point?

10. Give two examples of each of the following: a solid that sublimes and a liquid that evaporates.

11. Describe an experiment to show that particles of matter are continuously moving.

Competency-Based Question

You place a sealed balloon filled with air in a refrigerator and observe changes. What do you observe about the balloon after some time in the refrigerator, and why does this happen?

WORKSHEET 2

NAME OF THE STUDENT:

CLASS AND SECTION: **ROLL NUMBER:**

Chapter 2: Is Matter Around Us Pure

Multiple Choice Questions

1. Which of the following is a pure substance?

A. Air B. Salt water C. Sugar D. Soil

Answer:

2. In ' tincture of iodine ‘, the solute is _____ and the solvent is _____

a. Alcohol, iodine b. Iodine, water c. Iodine, alcohol d. Tin, iodine

Answer:

3. Which of the following statements about colloids is correct?

A. They settle down when left undisturbed.

B. They pass through filter paper.

C. They scatter a beam of light passing through them.

D. They have a clear boundary between the dispersed phase and the dispersion medium.

Answer:

4. Which of the following is a chemical change?

A. Melting of ice B. Dissolving salt in water C. Rusting of iron D. Cutting paper

Answer:

5. Smoke is an example of

a. Gas dispersed in liquid b. Gas dispersed in solid c. Solid dispersed in solid d. Solid dispersed in gas

Answer:

Question No. 6 and 7 are assertion and reason type question. Write appropriate answer mention below:

A. Both A and R are true, and R is the correct explanation of A.

B. Both A and R are true, but R is not the correct explanation of A.

C. A is true, but R is false.

D. A is false, but R is true.

6. Assertion (A): A solution is a homogeneous mixture.

Reason (R): In a solution, solute particles are not evenly distributed in the solvent.

Answer:

7. Assertion (A): Brownian motion provides evidence for the particulate nature of matter.

Reason (R): Brownian motion is the zig-zag motion of particles of a colloid in a dispersion medium.

Answer:

Short Answer Questions

8. A solution contains 40 g of common salt in 320 g of water. Calculate the concentration in terms of mass-by-mass percentage of the solution.

8. Define the following terms: (i) Solute, (ii) Solvent,

9. Give two differences between compounds and mixture

10. Give reasons for the following observations:
Sugar syrup is a homogeneous mixture while sand and iron filings is a heterogeneous mixture.

Competency-Based Question

Scenario: Three mixtures A, B and C are obtained by stirring three different solids in water taken in separate beakers. When mixture A is allowed to stand for some time, then its particles settle at the bottom of the beaker. When a beam of light is passed through mixture A in a dark room, the path of light becomes visible when observed from the side of the beaker. When mixture B is allowed to stand for a considerable time, even then its particles do not settle down. Mixture B, however, scatters the beam of light just like mixture A. The particles of mixture C do not settle down on keeping and it also does not scatter a beam of light passing through it.

(a) What are the mixtures like A known as ? ……..
(b) What are the mixtures like B known as ?.....
(c) What are the mixtures like C known as ?.....
(d) Name the phenomenon exhibited by A and B which occurs on passing a beam of light through them.

WORKSHEET-3

NAME OF THE STUDENT:

CLASS AND SECTION: **ROLL NUMBER:**

Class 9 Science - Chapter 3: Atoms and Molecules

Multiple Choice Questions

1. The mass of one molecule of oxygen (O_2) is:

A. 32 amu B. 16 amu C. 2 amu D. 1 amu

Answer:

2. Which of the following pair represents isobars?

A. 14 C and 14 N B. 35 Cl and 37 Cl C. 6 C and 12 C D. 1 H and 2 H

Answer:

3. The formula of magnesium chloride is:

A. MgCl B. $MgCl_2$ C. Mg_2Cl D. Mg_2Cl_2

Answer:

4. The molecular mass of water (H_2O) is:

A. 18 g/mol B. 20 g/mol C. 16 g/mol D. 10 g/mol

Answer:

5. An element X is divalent and another element Y is tetravalent. The compound formed by these two elements will be:

(a) XY (b) XY_2 (c) X_2Y (d) XY_4

Answer:

Question No. 6 and 7 are assertion and reason type question. Write appropriate answer mention below:

A. Both A and R are true, and R is the correct explanation of A.

B. Both A and R are true, but R is not the correct explanation of A.

C. A is true, but R is false.

D. A is false, but R is true.

6. Assertion (A): The atomic mass of an element is a whole number.

Reason (R): Atoms are indivisible and have a fixed mass.

Answer:

7. Assertion (A): The mass of one atom of an element is called its atomic mass.

Reason (R): Atomic mass is the sum of the masses of protons, neutrons, and electrons in an atom.

Answer:

Short Answer Questions

8. Define the term 'molecule.' How is it different from an atom?

_____

_____

_____

9. Calculate the molecular mass of calcium carbonate ($CaCO_3$).

8. Write down the formulae of
(i) sodium oxide (ii) aluminium chloride (iii) magnesium hydroxide.

9. Calculate the molecular masses of
C_2H_6, NH_3, CH_3OH.

Competency-Based Question

10. You are given the chemical formula of water (H_2O) and carbon dioxide (CO_2).

(i) Explain the significance of the subscripts in the chemical formulas of H_2O and CO_2.

(ii) Describe how the chemical formulas help in understanding the composition of compounds.

WORKSHEET-4

NAME OF THE STUDENT:

CLASS AND SECTION: **ROLL NUMBER:**

Class 9 Science - Chapter 4: Structure of the Atom

Multiple Choice Questions

1. The nucleus of an atom consists of:

A. Protons and electrons B. Protons and neutrons

C. Neutrons and electrons D. Protons, neutrons, and electrons

Answer:

2. The number of electrons in a neutral atom of an element is equal to its:

A. Atomic number B. Mass number C. Valency D. Atomic mass

Answer:

3. The atomic number of sodium is 11 and its mass number is 23. It has

(a) 11 neutrons and 12 protons (b) 12 protons and 11 electrons

(c) 11 electrons and 12 neutrons (d) 12 electrons and 11 neutrons

Answer:

4. The mass of an electron is approximately:

A. 1/2000 times the mass of a proton B. Equal to the mass of a proton

C. 1/2000 times the mass of a neutron D. Negligible compared to the mass of a proton

Answer:

5. The maximum number of electrons that can be accommodated in the M shell is:

A. 2 B. 8 C. 18 D. 32

Answer:

Question No. 6 and 7 are assertion and reason type question. Write appropriate answer mention below:

A. Both A and R are true, and R is the correct explanation of A.

B. Both A and R are true, but R is not the correct explanation of A.

C. A is true, but R is false.

D. A is false, but R is true.

6. Assertion (A): Isotopes of an element have the same atomic number but different mass numbers. Reason (R): Isotopes have the same number of protons but a different number of neutrons.

Answer:

7. Assertion (A): Electrons are attracted towards the nucleus.

Reason (R): The nucleus of an atom is positively charged.

Answer:

Short Answer Questions

8. Define the following terms: (i) Atomic number, (ii) Mass number, (iii) Valency.

9. Write the no. of neutrons in isotopes of hydrogen-protium, deuterium and tritium.

10. Describe Rutherford's alpha-particle scattering experiment. What were its major observations?

11. If number of electrons in an atom is 8 and number of protons is also 8, then
(i) what is the atomic number of the atom?
(ii) what is the charge on the atom?

Competency-Based Question

Provide the no. of protos, electrons, neutrons, valence electrons, electronic configuration of sodium ($_{11}Na^{23}$). Write the formula of its nitrate.

WORKSHEET-5

NAME OF THE STUDENT:

CLASS AND SECTION: **ROLL NUMBER:**

Class 9 Science - Chapter 5: The Fundamental Unit of Life

Multiple Choice Questions

1. The cell theory was proposed by:

A. Robert Hooke B. Anton van Leeuwenhoek

C. Matthias Schleiden and Theodor Schwann D. Rudolf Virchow

Answer:

2. The outermost layer of animal cells is called the:

A. Cell membrane B. Cell wall C. Cytoplasm D. Nucleus

Answer:

3. The jelly-like substance present inside the cell is called the:

A. Nucleus B. Cytoplasm C. Cell membrane D. Mitochondria

Answer:

4. Which of the following is not a function of the cell wall?

A. Provides shape and rigidity to the cell B. Regulates the entry and exit of substances

C. Protects the cell from mechanical injury D. Prevents the cell from bursting

Answer:

5. Which organelle is known as the 'powerhouse of the cell'?

A. Nucleus B. Ribosome C. Mitochondria D. Endoplasmic reticulum

Answer:

Question No. 6 and 7 are assertion and reason type question. Write appropriate answer mention below:

A. Both A and R are true, and R is the correct explanation of A.

B. Both A and R are true, but R is not the correct explanation of A.

C. A is true, but R is false.

D. A is false, but R is true.

6. Assertion (A): Plant cells have a large central vacuole.

Reason (R): The central vacuole helps in maintaining turgidity of the cell.

Answer:

7. Assertion (A): Endoplasmic reticulum is involved in protein synthesis.

Reason (R): Endoplasmic reticulum has ribosomes attached to its surface.

Answer:

Short Answer Questions

8. Draw a labelled diagram of a typical plant cell.

9. What is osmosis? Explain with the help of an example.

10. Differentiate between prokaryotic and eukaryotic cells (any two).

11. How do cells at the tip of the root help in the growth of the root?

Competency-Based Question

12. **Scenario**: A student is given a microscope slide with two types of cells, one from a plant and the other from an animal. The student is asked to identify and compare the two types of cells. Design a step-by-step procedure for this identification and comparison, including the observations to be made and the conclusions to be drawn.

WORKSHEET-6

NAME OF THE STUDENT:

CLASS AND SECTION: **ROLL NUMBER:**

Class 9 Science - Chapter 6: Tissues

Multiple Choice Questions

1. Which of the following is not a type of plant tissue?

A. Meristematic tissue B. Permanent tissue C. Animal tissue D. Complex tissue

Answer:

2. The type of tissue that provides support to plants and helps in transport of water and nutrients is:

A. Epithelial tissue B. Muscular tissue C. Connective tissue D. Vascular tissue

Answer:

3. The tissue that connects muscles to bones in humans is:

A. Nervous tissue B. Adipose tissue C. Ligament D. Tendon

Answer:

4. Which of the following statements about meristematic tissue is correct?

A. It is found in the leaves and stems of plants.

B. It is responsible for growth in length of plant parts.

C. It is a type of permanent tissue.

D. It is not capable of cell division.

Answer:

5. Collenchyma tissue is characterized by:

A. Thick cell walls and living protoplasm B. Thin cell walls and living protoplasm

C. Thick cell walls and dead protoplasm D. Thin cell walls and dead protoplasm

Answer:

Question No. 6 and 7 are assertion and reason type question. Write appropriate answer mention below:

A. Both A and R are true, and R is the correct explanation of A.

B. Both A and R are true, but R is not the correct explanation of A.

C. A is true, but R is false.

D. A is false, but R is true.

6. Assertion (A): Blood is a connective tissue.

Reason (R): Blood consists of cells suspended in a fluid matrix.

Answer:

7. Assertion (A): Parenchyma is a type of permanent tissue.

Reason (R): Parenchyma cells have thin cell walls and large vacuoles.

Answer:

Short Answer Questions

8. Describe the structure and functions of simple epithelial tissue.

_____

_____

9. Explain the difference between xylem and phloem (any two).

10. What is the role of skeletal muscle tissue in the human body?

11. How does the structure of cardiac muscle tissue relate to its function?

Competency-Based Question

12. **Scenario**: A student is given a microscope slide with a tissue sample and is asked to identify the type of tissue. The student is also asked to explain its structure and function. Design a step-by-step procedure for this identification and explanation, including the observations to be made and the conclusions to be drawn.

WORKSHEET-7

NAME OF THE STUDENT:

CLASS AND SECTION: **ROLL NUMBER:**

Class 9 Science - Chapter 8: Motion

Multiple Choice Questions

1. Which of the following quantities is not a vector quantity?

A. Displacement B. Velocity C. Speed D. Acceleration

Answer:

2. The rate of change of velocity of an object is called:

A. Speed B. Acceleration C. Distance D. Displacement

Answer:

3. When a car accelerates on a straight road, its motion is:

A. Linear B. Circular C. Rotational D. Oscillatory

Answer:

4. The area under the velocity-time graph represents:

A. Displacement B. Speed C. Acceleration D. Distance

Answer:

5. An object is moving with a constant velocity of 5 m/s. After 10 seconds, its displacement will be: A. 10 m B. 50 m C. 100 m D. 5 m

Answer:

Question No. 6 and 7 are assertion and reason type question. Write appropriate answer mention below:

A. Both A and R are true, and R is the correct explanation of A.

B. Both A and R are true, but R is not the correct explanation of A.

C. A is true, but R is false.

D. A is false, but R is true.

6. Assertion (A): An object moving in a circular path with constant speed has an acceleration. Reason (R): Acceleration is defined as the rate of change of speed.

Answer:

7. Assertion (A): The acceleration due to gravity is the same for all objects, irrespective of their mass.

Reason (R): All objects fall with the same acceleration in vacuum.

Answer:

Short Answer Questions

8. Define uniform motion and non-uniform motion. Give one example of each.

_____

_____

_____

9. An object is thrown vertically upwards. How does its velocity change during its motion upwards and downwards?

_____

9. A car travels from point A to point B at a speed of 40 km/h and returns from point B to point A at a speed of 60 km/h. Calculate the average speed of the car for the whole journey.

10. State the three equations of motion for uniformly accelerated motion.

Competency-Based Question

11. You drop a ball from the top of a building and observe its motion until it hits the ground. How would you calculate the distance the ball falls after 3 seconds?_

WORKSHEET-8

NAME OF THE STUDENT:

CLASS AND SECTION: **ROLL NUMBER:**

Class 9 Science - Chapter 9: Force and Laws of Motion

Multiple Choice Questions

1. Which of the following is not a contact force?

A. Frictional force B. Tension force C. Magnetic force D. Gravitational force

Answer:

2. According to Newton's first law of motion, an object:

A. At rest will remain at rest B. In motion will remain in motion

C. Will accelerate if no force acts on it D. Will decelerate if no force acts on it

Answer:

3. The force of friction:

A. Always opposes the motion of an object

B. Always supports the motion of an object

C. Depends on the speed of the object

D. Does not depend on the nature of the surfaces in contact

Answer:

4. Which of the following is an example of balanced forces?

A. A book resting on a table B. A car accelerating on a straight road

C. A ball rolling down a hill D. A rocket launching into space

Answer:

5. The acceleration produced by a net force on an object is:

A. Directly proportional to the net force B. Inversely proportional to the net force

C. Equal to the net force D. Unrelated to the net force

Answer:

Question No. 6 and 7 are assertion and reason type question. Write appropriate answer mention below:

A. Both A and R are true, and R is the correct explanation of A.

B. Both A and R are true, but R is not the correct explanation of A.

C. A is true, but R is false.

D. A is false, but R is true.

6. Assertion (A): When a force acts on an object, it changes the state of motion of the object. Reason (R): According to Newton's second law of motion, force is directly proportional to the acceleration produced.

Answer:

7. Assertion (A): A satellite orbiting the Earth experiences weightlessness. Reason (R): The gravitational force acting on the satellite is balanced by the centripetal force.

Answer:

Short Answer Questions

8. State and explain Newton's third law of motion with an example.

9. A force of 10 N is applied to an object of mass 5 kg. Calculate the acceleration produced.

10. Explain why it is easier to pull a lawn roller than to push it.

11. Define momentum. How does the momentum of an object change when its velocity is doubled?

Competency-Based Question

12. A rocket launches into space by expelling gas downwards. Describe the principle behind the rocket's motion using Newton's third law of motion.

WORKSHEET-9

NAME OF THE STUDENT:

CLASS AND SECTION: **ROLL NUMBER:**

Class 9 Science - Chapter 10: Gravitation

Multiple Choice Questions

1. The value of acceleration due to gravity:

A. Decreases with altitude B. Increases with depth

C. Is the same everywhere on Earth D. Is zero at the center of the Earth

Answer:

2. The weight of an object on the Moon is about:

A. One-fourth its weight on Earth B. Half its weight on Earth

C. Equal to its weight on Earth D. Double its weight on Earth

Answer:

3. The force of gravitation between two objects depends on their:

A. Volume B. Surface area C. Masses and the distance between them D. Density

Answer:

4. If the distance between two objects is doubled, the gravitational force between them will:

A. Double B. Halve C. Quadruple D. Remain the same

Answer:

5. The gravitational force between two objects is inversely proportional to the:

A. Square of the distance between them B. Cube of the distance between them

C. Fourth power of the distance between them D. Distance between them

Answer:

Question No. 6 and 7 are assertion and reason type question. Write appropriate answer mention below:

A. Both A and R are true, and R is the correct explanation of A.

B. Both A and R are true, but R is not the correct explanation of A.

C. A is true, but R is false.

D. A is false, but R is true.

6. Assertion (A): The weight of an object is different from its mass.

Reason (R): Weight is a measure of the gravitational force acting on an object.

Answer:

7. Assertion (A): A body weighs more at the poles than at the equator. Reason (R): The value of acceleration due to gravity is greater at the poles than at the equator.

Answer:

Short Answer Questions

8. State Newton's law of universal gravitation. How does it explain the motion of planets around the Sun?

_____

_____

9. Calculate the gravitational force between two objects of masses 10 kg and 20 kg separated by a distance of 5 meters.

10. Explain why astronauts float inside a spacecraft in space.

11. An ice cube is floating in a glass of water, and the water level is marked. The ice cube melts completely. Explain what happens to the water level in the glass once the ice cube melts.

Competency-Based Question

11. An apple falls from a tree towards the ground. Explain why the apple falls towards the ground using the concept of gravitation. How does the mass of the apple and the Earth affect the gravitational force between them?

WORKSHEET-10

NAME OF THE STUDENT:

CLASS AND SECTION: **ROLL NUMBER:**

Class 9 Science - Chapter 11: Work and Energy

Multiple Choice Questions

1. Which of the following is a scalar quantity?

A. Force B. Velocity C. Acceleration D. Work

Answer:

2. The energy possessed by a body due to its motion is called:

A. Potential energy B. Kinetic energy C. Mechanical energy D. Gravitational energy

Answer:

3. The energy stored in a wound-up spring is an example of:

A. Kinetic energy B. Potential energy C. Thermal energy D. Electrical energy

Answer:

4. The work done by a force is zero if:

A. The force is applied at an angle of 90 degrees to the direction of motion

B. The force is applied in the direction of motion

C. The force is applied in the opposite direction of motion

D. The force is applied perpendicular to the direction of motion

Answer:

5. The unit of work is the same as that of:

A. Energy B. Power C. Force D. Momentum

Answer:

Question No. 6 and 7 are assertion and reason type question. Write appropriate answer mention below:

A. Both A and R are true, and R is the correct explanation of A.

B. Both A and R are true, but R is not the correct explanation of A.

C. A is true, but R is false.

D. A is false, but R is true.

6. Assertion (A): Work done by a force is equal to the product of the force and the distance moved in the direction of the force.

Reason (R): Work done is a scalar quantity.

Answer:

7. Assertion (A): The kinetic energy of an object depends on its mass and velocity.

Reason (R): Kinetic energy is a scalar quantity.

Answer:

Short Answer Questions

8. Define the term 'work.' How is it different from energy?

_____

_____

_____

9. Calculate the work done when a force of 20 N moves an object a distance of 5 m in the direction of the force.

10. State the law of conservation of energy. How is this law applied in real-life situations?

11. Explain the concept of potential energy with an example.

Competency-Based Question

1. A boy lifts a 10 kg object to a height of 2 meters. Calculate the gravitational potential energy gained by the object. Describe what happens to the potential energy if the object is dropped.

WORKSHEET-11

NAME OF THE STUDENT:

CLASS AND SECTION: **ROLL NUMBER:**

Class 9 Science - Chapter 12: Sound

Multiple Choice Questions

1. Sound waves are:

A. Transverse waves B. Longitudinal waves C. Electromagnetic waves D. Standing waves

Answer:

2. The speed of sound in air is maximum at:

A. 0°C B. 20°C C. 100°C D. 200°C

Answer:

3. The phenomenon of the persistence of sound after the source has stopped is called:

A. Echo B. Reverberation C. Refraction D. Resonance

Answer:

4. The part of the ear that amplifies sound vibrations is the:

A. Ear canal B. Eardrum C. Cochlea D. Ear ossicles

Answer:

5. The frequency of a sound wave determines its:

A. Loudness B. Pitch C. Quality D. Amplitude

Answer:

Assertion-Reason Questions

Question No. 6 and 7 are assertion and reason type question. Write appropriate answer mention below:

A. Both A and R are true, and R is the correct explanation of A.

B. Both A and R are true, but R is not the correct explanation of A.

C. A is true, but R is false.

D. A is false, but R is true.

6. Assertion (A): Sound cannot travel through a vacuum.

Reason (R): Sound requires a medium for propagation.

Answer:

7. Assertion (A): The speed of sound is maximum in solids and minimum in gases.

Reason (R): The particles in solids are closely packed, allowing sound to travel faster.

Answer:

Short Answer Questions

8. Define the term 'sound.' How does sound differ from noise?

_____

_____

_____

9. Explain why sound travels faster in solids than in liquids or gases.

10. Give the difference between a high-pitched sound and a low-pitched sound produced by the guitar string.

11. What is the principle behind the working of a sonar?

Competency-Based Question

12. A person hears an echo of their voice 0.5 seconds after shouting in an open field. Calculate the distance to the reflecting surface that caused the echo. Explain why an echo is heard in this scenario.

WORKSHEET-12

NAME OF THE STUDENT:

CLASS AND SECTION: **ROLL NUMBER:**

Class 9 Science - Chapter: Improvement in Food Resources

Multiple Choice Questions

1. Which of the following is not a method of crop improvement?

A. Plant breeding B. Tissue culture C. Hydration D. Genetic manipulation

Answer:

2. Which of the following is a Kharif crop?

A. Wheat B. Mustard C. Rice D. Barley

Answer:

3. Which of the following is an example of a rabi crop?

A. Cotton B. Maize C. Sorghum D. Wheat

Answer:

4. Which of the following is a micronutrient required by plants in small quantities?

A. Nitrogen B. Phosphorus C. Iron D. Potassium

Answer:

5. Which of the following is not a method of irrigation?

A. Drip irrigation B. Sprinkler irrigation C. Furrow irrigation D. Rainwater harvesting

Answer:

Question No. 6 and 7 are assertion and reason type question. Write appropriate answer mention below:

A. Both A and R are true, and R is the correct explanation of A.

B. Both A and R are true, but R is not the correct explanation of A.

C. A is true, but R is false.

D. A is false, but R is true.

6. Assertion (A): Tissue culture is a method of vegetative propagation.

Reason (R): Tissue culture involves the use of plant parts to grow new plants under sterile conditions.

Answer:

7. Assertion (A): Crop rotation is a method to improve soil fertility.

Reason (R): Crop rotation helps in replenishing the soil with nutrients and prevents the buildup of pests and diseases.

Answer:

Short Answer Questions

8. Explain the term 'mixed cropping' and give an example.

_____

_____

_____

9. What is organic farming? How is it different from conventional farming practices?

10. Describe the process of seed germination. What are the factors affecting seed germination?

11. Explain the importance of crop rotation in agriculture.

Competency-Based Question

12. **Scenario**: A farmer is facing problems with pests in his crop field. Design an integrated pest management (IPM) plan for the farmer, including the methods and strategies to be used and the benefits of using IPM.

E-CONTENT/VIDEOS

SL NO.	CHAPTER	PAGE NO.
1.	MATTER IN OUR SURROUNDINGS	**https://youtube.com/playlist?list=PLpaxj9SvFEZpfKBdXoXACeVl5B5-vrESa&feature=shared** **PRACTICAL EXPERIMENT** Determination of the melting point of ice and the boiling point of water. https://www.youtube.com/watch?v=38QZEsB2xJM&ab_channel=amritacreate https://www.youtube.com/watch?v=nZXoe0fgJ8Q&ab_channel=amritacreate ***Exemplar Problems** https://ncert.nic.in/pdf/publication/exemplarproblem/classIX/science/ieep101.pdf (Test based on exemplar problems) Test yourself https://docs.google.com/forms/d/1jMN4oyb0AJXBTcTbHQltioOSOcnMOiGH7SipkPuS2xo/edit?usp=drivesdk
2.	IS MATTER AROUND US PURE	https://youtube.com/playlist?list=PLpaxj9SvFEZpkmusSoIl33_qqMVXSXMok&feature=shared ***Exemplar Problems** https://ncert.nic.in/pdf/publication/exemplarproblem/classIX/science/ieep102.pdf Test yourself https://docs.google.com/forms/d/1Lxzl4Qo5a3IvBSuAa3UilzAdnnYigyDxH6vlwUe1yPc/edit?usp=drivesdk
3.	ATOMS AND MOLECULES	**https://youtube.com/playlist?list=PLpaxj9SvFEZoKnr6B668d4t2WWZJTip0d&feature=shared** ***PRACTICAL EXPERIMENT** Verification of the law of conservation of mass in a chemical reaction. https://www.youtube.com/watch?v=casNoSzuma4&ab_channel=amritacreate **Links to Video lesson:** Live Interaction on PMeVIDYA : Chapter 3: Atoms and Molecules - YouTube *NCERT Exemplar problems https://ncert.nic.in/pdf/publication/exemplarproblem/classIX/science/ieep103.pdf
4.	STRUCTURE OF THE ATOM	https://youtube.com/playlist?list=PLpaxj9SvFEZrVZpZgVIy1WYcd-VetNRzM&feature=shared *NCERT Exemplar problems https://ncert.nic.in/pdf/publication/exemplarproblem/classIX/science/ieep104.pdf
5.	THE FUNDAMENTAL UNIT OF LIFE	***PRACTICAL EXPERIMENT** Preparation of stained temporary mounts of (a) onion peel, (b) human cheek cells, to record observations and draw their labelled diagrams. https://www.youtube.com/watch?v=wMgXsrpVrJg&ab_channel=amritacreate **Links to Video lessons:** Part -1 https://www.youtube.com/watch?v=jCVX8Id43Cw

		Part -2 https://www.youtube.com/watch?v=v9JC6rtzjz0 Part -3 https://www.youtube.com/watch?v=Hra_FFpkKbc *NCERT Exemplar problems https://ncert.nic.in/pdf/publication/exemplarproblem/classIX/science/ieep105.pdf
6	TISSUES	*NCERT Exemplar problems https://ncert.nic.in/pdf/publication/exemplarproblem/classIX/science/ieep106.pdf
7.	MOTION	**Links to Video lessons:** https://www.youtube.com/watch?v=dthwJG9hgBE https://www.youtube.com/watch?v=OzENYyB63iI https://www.youtube.com/watch?v=Xo3KBoEMDEo ***NCERT Exemplar problems** https://ncert.nic.in/pdf/publication/exemplarproblem/classIX/science/ieep108.pdf
8.	FORCE AND LAWS OF MOTION	***Suggestive activities** Activities based on Newton's First second and Third law of motion First law of motion https://www.youtube.com/watch?v=NGt1zaAXANc Second law of motion Newton's second law of motion - YouTube Third law of motion Newton's third law of motion - YouTube *NCERT Exemplar problems **(Force and Laws of Motion):** https://ncert.nic.in/pdf/publication/exemplarproblem/classIX/science/ieep109.pdf
9.	GRAVITATION	***PRACTICAL EXPERIMENTS** 1.Determination of the density of solid (denser than water) by using a spring balance and a measuring cylinder https://www.youtube.com/watch?v=md-Qk_g9NEo&ab_channel=amritacreate 2.Establishing the relation between the loss in weight of a solid when fully immersed in a) Tap water b) Strongly salty water with the weight of water displaced by it by taking at least two different solids https://www.youtube.com/watch?v=eIb4VQGoyvI&ab_channel=amritacreate. **Link to Video** To Show that all objects, big or small, heavy or light, all fall at the same rate (using (Eraser, Chalk, Pebble...) https://www.youtube.com/watch?v=E43-CfukEgs NCERT Exemplar problems https://ncert.nic.in/pdf/publication/exemplarproblem/classIX/science/ieep110.pdf
10	WORK ND ENERGY	**Links to Video lessons:** https://www.youtube.com/watch?v=gqyILauETxE https://www.youtube.com/watch?v=38xLDSrMxeE **Links to Video lessons:** **https://www.youtube.com/watch?v=Ej7ETVGBZ34&ab_channel=NCERTOFFICIAL** **NCERT Exemplar problems** https://ncert.nic.in/pdf/publication/exemplarproblem/classIX/science/ieep111.pdf

11.	SOUND	***PRACTICAL EXPERIMENT** 1.To verify the laws of reflections of sound. https://www.olabs.edu.in/?sub=1&brch=1&sim=1&cnt=213 2.To find the velocity of a pulse through a slinky. https://www.olabs.edu.in/?sub=1&brch=1&sim=93&cnt=435 **Links to Video lessons:** Sound and its Production | English - YouTube Bell Jar Experiment - MeitY OLabs - YouTube ***NCERT Exemplar problems** https://ncert.nic.in/pdf/publication/exemplarproblem/classIX/science/ieep112.pdf
12.	IMPROVEMENT IN FOOD RESOURCES	**Links to Video lessons:** Live Interaction on PMeVIDYA: Improvement in Food Resources-1 – YouTube Live Interaction on PMeVIDYA : Improvement in Food resources Part-2 - YouTube Live Interaction on PMeVIDYA : Improvement in Food Resources Part- 3 - YouTube *NCERT Exemplar problems **https://ncert.nic.in/pdf/publication/exemplarproblem/classIX/science/ieep115.pdf**

Question Bank: Class IX Science	https://cbseacademic.nic.in/cbe/documents/Item-Bank---Science-Class-9.pdf
Curriculum Aligned Competency Based Test Items : Class IX Science	https://cbseacademic.nic.in/cbe/documents/SAS_Science-Class-9.pdf
Teacher Energised Resource Manuals: Science Term Hindi Medium	https://cbseacademic.nic.in/https://cbseacademic.nic.in/web_material/term/9science_Hi.pdf
CBSE Handbooks: Practice Book Science 9	https://cbseacademic.nic.in/web_material/Manuals/PracticeBook_Science9.pdf
CBSE Teacher Manuals: Class IX:Science	https://cbseacademic.nic.in/web_material/term/9science.pdf

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