विज्ञान
Science

कक्षा / Class IX

2025-26

विद्यार्थी सहायक सामग्री
Student Support Material

केन्द्रीय विद्यालय संगठन~Kendriya Vidyalaya Sangathan

संदेश

विद्यालयी शिक्षा में शैक्षिक उत्कृष्टता प्राप्त करना एवं नवाचार द्वारा उच्च - नवीन मानक स्थापित करना केन्द्रीय विद्यालय संगठन की नियमित कार्यप्रणाली का अविभाज्य अंग है। राष्ट्रीय शिक्षा नीति 2020 एवं पी. एम. श्री विद्यालयों के निर्देशों का पालन करते हुए गतिविधि आधारित पठन-पाठन, अनुभवजन्य शिक्षण एवं कौशल विकास को समाहित कर, अपने विद्यालयों को हमने ज्ञान एवं खोज की अद्‌भुत प्रयोगशाला बना दिया है। माध्यमिक स्तर तक पहुँच कर हमारे विद्यार्थी सैद्धांतिक समझ के साथ-साथ, रचनात्मक, विश्लेषणात्मक एवं आलोचनात्मक चिंतन भी विकसित कर लेते हैं। यही कारण है कि वह बोर्ड कक्षाओं के दौरान विभिन्न प्रकार के मूल्यांकनों के लिए सहजता से तैयार रहते हैं। उनकी इस यात्रा में हमारा सतत योगदान एवं सहयोग आवश्यक है - केन्द्रीय विद्यालय संगठन के पांचों आंचलिक शिक्षा एवं प्रशिक्षण संस्थान द्वारा संकलित यह विद्यार्थी सहायक-सामग्री इसी दिशा में एक आवश्यक कदम है । यह सहायक सामाग्री 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 सामग्री संकलन की विशेषज्ञता के लिए जानी जाती है और शिक्षा से जुड़े विभिन्न मंचों पर इसकी सराहना होती रही है। मुझे विश्वास है कि यह सहायक सामग्री विद्यार्थियों की सहयोगी बनकर निरंतर मार्गदर्शन करते हुए उन्हें सफलता के लक्ष्य तक पहुँचाएगी।

शुभाकांक्षा सहित ।

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General Instructions for Assessment:

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:

i) 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 4 scientific investigations etc. and use of rubrics for assessing them objectively. This will also have a weightage of 05 marks towards the final result.

ii) For 5 marks - Practical / Laboratory work that is done throughout the year. The students should maintain record of the same. Practical Assessment should be continuous. All practical work listed in the syllabus must be completed.

iii) For 5 marks - Portfolio that includes classwork and other sample of student's work.

COURSE STRUCTURE CLASS IX (2025-26) (Annual Examination) Time: 03 Hours Marks: 80

Unit	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 Behavior

Matter in Our Surroundings: Definition of matter; Particulate Nature of Matter; States of Matter: solid, liquid and gas and their characteristics; change of state- melting (absorption of heat), freezing, evaporation (cooling by evaporation), condensation, sublimation.

Is Matter Around Us Pure: Elements, compounds and mixtures. Heterogeneous and homogenous mixtures, colloids and suspensions. Physical and chemical changes (excluding separating the components of a mixture); Pure and Impure substances.

Atoms and Molecules: Atoms and molecules, Law of Chemical Combination, Chemical formula of common compounds, Atomic and molecular masses.

Structure of atom: Sub-atomic particles: Electrons, protons and neutrons, Models of atom; 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

LIST OF CONTENTS

Matter in Our Surroundings

Matter:- It is a substance which occupies space and has mass.

Air, Earth, Fire, Sky and water are five basic elements, '*The PanchTatwa*' according to the earlier Indian Philosophers everything i.e. living or non-living is made up of these five elements.

Characteristics of particles of matter:

i). Matter is made up of particles.

ii). Particles of matter are very small in size beyond our imagination.

iii). Particles of matter have space between them. The space between particles is known as inter particle space or intermolecular space.

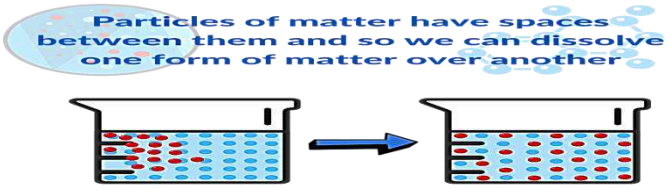


Fig: Particles of matter have space between them.

Particles of one type of matter get into the spaces between particles of the other. This shows that there is enough space between particles of matter.

Ex. The particles of sugar and salt get evenly distributed in water.

iv). Particles of matter are continuously moving:

Moving particles have kinetic energy. Particles move faster when temperature rises. Particles of solids have very less kinetic energy while gaseous have high kinetic energy.

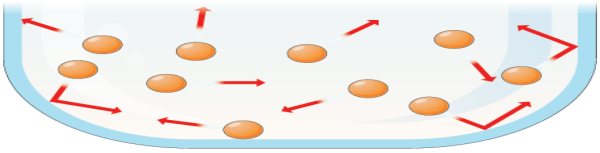


Fig: Moving particles possess kinetic energy

Kinetic energy:

The energy possesses by moving object is called kinetic energy.

Increasing temperature, the kinetic energy of the particles increases.

Diffusion:

The process of flow of matter from a region of high concentration to a region of low concentration is called diffusion.

On heating, the diffusion will become faster because kinetic energy of particles will increase. So, particles will move faster and intermixing with same or different particles.

v). *Particles of matter attract each other*.

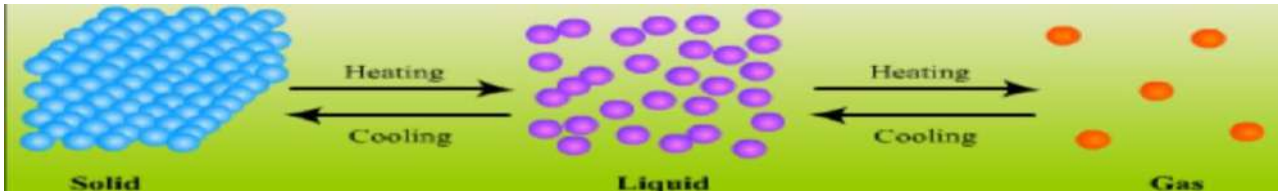
The particles of matter have force acting between them. This force keeps the particles together. Particles of *solid have highest attraction force*. So that these particles are very close.

Three States of Matter

Comparison of the characteristics of three states of matter:

Property	Solid state	Liquid state	Gaseous state
Nature	Hard & rigid	Fluid	Very fluid
Shape & volume	Definite shape & volume	indefinite shape but definite volume	Both are indefinite
Density	High	Less than solid but greater than gaseous	Very less density
Inter molecular space	Very small	Intermediate of solid and gas	Very large
Inter molecular force	Very strong	Weak	Very weak
Compressibility	Negligible	Very small	Highly compressible
Kinetic energy	Low	High than solid	Very high
Diffusion	Negligible	Slow	Very fast

Effect of Change in Temperature:



The state of matter can be changed into another state by changing the temperature. Solid can change into liquid while liquid can change into vapour upon heating.

Melting point:
The temperature at which solid melts and become a liquid at the atmospheric pressure is called melting point. Ex. The melting point of ice is 0^0C.

Fusion:
The process in which solid state change into liquid state by melting is known as fusion.

The Latent Heat of Fusion:
The amount of heat energy required to change 1 kg of solid into liquid at atmosphere pressure at its melting point is known as the latent heat of fusion.

Boiling point:
The temperature at which a liquid starts boiling at the atmospheric pressure is known as its melting point. It is a bulk phenomenon**.** Ex. The boiling point of water is 100^0C.

The latent heat of vaporisation:
The amount of heat energy that is required to change 1 kg of liquid into vapour at atmosphere pressure at its boiling point is known as the latent heat of fusion.

Sublimation:
The change of solid directly into the gaseous state without coming through the liquid state upon heating is called sublimation.
Ex. Iodine, Ammonia chloride, camphor, naphthalene, solid CO_2 etc.

Deposition:
The change of gas directly into the solid state without coming through the liquid state upon heating is called deposition.

Conversion of temperature:

(a). Conversion of Celsius scale (^{0}C) into Kelvin scale (k):

To convert temperature on Celsius scale to Kelvin scale, add 273 from the Celsius scale.

Ex. (a). $O^0C + 273 = 273$ K (b). $25^0C + 273 = 298$ K

(b). Conversion of Kelvin scale (k) into Celsius scale (^{0}C):

To convert temperature on Kelvin scale to Celsius scale, subtract 273 from the Kelvin scale.

Ex. (a). $300\ K - 273 = 27^0C$ (b). $393\ K - 273 = 120^0C$

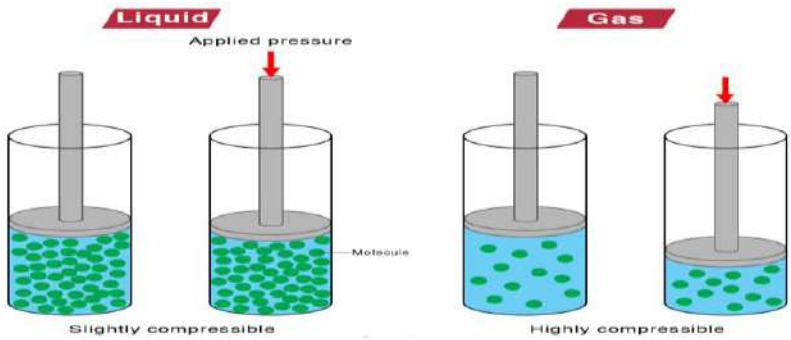
Comparison between fusion & Vaporisation:

Fusion	Vaporisation
Fusion is the process of melting, in which solid turns into its liquid state.	Vaporisation is the process of conversion of a liquid state into vapour state.
The required heat for fusion is known as latent heat of fusion.	The required heat for vaporisation is known as latent heat of vaporisation.
It is an effect of temperature	It is also an effect of temperature.
Ex. Conversion of ice into water	Ex. Conversion of water into water vapour.

Effects of Change of Pressure:

A gas can liquefy by increasing pressure and decreasing temperature. By this process the particles of gas get compressed and the space between particles become less. As a result, the gaseous state change into liquid state.

Fig: Compressibility

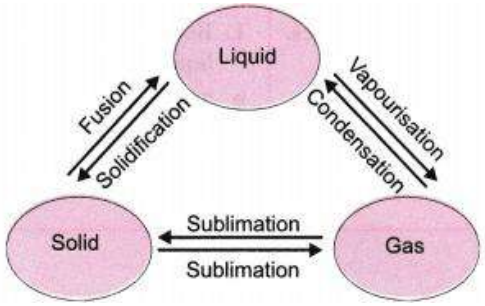


**Solid carbon dioxide is also known as dry ice.

Solid CO_2 looks like ice but does not wet a piece of paper or glass. It is therefore, called dry ice.

If the pressure on solid carbon dioxide is reduced nearly to one atmosphere, it directly changes to the vapour state without coming the liquid state.

Fig: Interconversion of the states of matter



Evaporation:

The phenomenon of change of liquid to the vapour state at any temperature below the boiling melting point of the liquid is called evaporation.Evaporation is a surface phenomenon.

Factors affecting the rate of evaporation:

- *Increase of surface area:*
- *Increase of temperature:*
- *Temperature increases the rate of evaporation.*

- *Increase in wind speed:*
- *Decrease in humidity:*

Difference between Boiling and Evaporation:

Boiling	Evaporation
Boiling occurs only when a liquid is heated on its boiling point.	Evaporation of a liquid occurs naturally.
It happens at the specific temperature.	It takes place at all the temperature.
No physical conditions affect the boiling process.	It is affected by temperature, surface area, wind speed and humidity etc.
It does not cause cooling on the surface.	It causes cooling during evaporation.
It is a bulk phenomenon.	It is a surface phenomenon.

Evaporation causes cooling

When water changes into vapour, it loses its energy. It regains energy from the surrounding. This process makes the surrounding cool.

What happens when?

a). When pour some acetone on your palm?

When some acetone pours on hand, the particles of acetone gain energy from the palm and surrounding and evaporate. So, it makes palm cool.

b). When water sprinkles on the hot surface during summer?

When water sprinkles on the hot surface, it absorbs heat from the hot surface. As a result, cooling is caused.

c). When a cold-drink bottle keeps in open?

When a cold-drink bottle keeps in open, the water vapour present in the air coming in contact of the surface of cold-drink bottle. Water vapour loses energy and get converted to liquid state. We can see the water droplets on the surface of cold-drink bottle.

d). If we wear white or cotton clothes in summer?

The cotton clothes are good absorber of water helps in absorbing the sweat and exposing it to the surface for easy evaporation. Then our sweat change into vapour. After this process, our body feels comfortable as being cool.

CHAPTERWISE QUESTION BANK

Multiple Choice Questions (1mark each)

1. A student observes that a substance changes from solid to liquid at a certain temperature. What can be inferred about the substance?

(a) It has a high melting point (b) It has a low melting point

(c) It is a pure substance (d) It is a mixture.

Hint- (c) It is a pure substance

2. A student is given a substance that sublimes easily. What can be done to prevent it from subliming?

(a) Increase the temperature (b) Decrease the temperature

(c) Increase the pressure (d) Decrease the pressure

Hint.- (b) Decrease the temperature

3. What will happen if we increase temperature of the particles of a substance?

(a) Particles come close together (b) Particles move slower

(c)) Particles move faster (d) Particles remain stationary

Hint.- (c) Particles move faster

4. Severe burns will be produce by which of the following?

(a) cold water (b) hot water (c) boiling water (d) steam

Hint.- (d) steam

5 During summer, water kept in earthen pot becomes cool due to phenomenon of

(a) Diffusion (b) Transpiration (c) Distillation (d) Evaporation

Hint.- (d) Evaporation

6 The most favourable conditions for converting gas into liquid are

(a) High pressure, low temperature (b) Low pressure, low temperature

(c) Low pressure, high temperature (d) High pressure, high temperature

Hint. (a) High pressure, low temperature

Assertion-Reason Based Questions (1mark each)

(a) Both A and R are true and R is correct explanation of A

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

(c) A is true, but R is false.

(d) A is false, but R is true.

7. Assertion: Air is a mixture.

Reason: Air consists of various gaseous compounds and particulate matters.

Hint.- definition of mixture.

8. Assertion: Sublimation is the process of conversion of a solid to a gas.

Reason: Sublimation occurs when the particles of a substance gain enough energy to overcome the intermolecular forces.

Hint. Sublimation

9. Assertion: Liquids take the shape of their container.

Reason: The particles of a liquid are free to move and have no fixed position.

Hint. Comparative analysis of solid, liquid, gas.

10. Assertion: Wet clothes do not dry in dark.

Reason: Evaporation also occurs in the dark.

Hint. Factors affecting evaporation

Very Short Answer Questions(2 marks each)

11. Liquids generally have lower density as compared to solids. But you must have observed that ice floats on water. Why?

Hint: As Density= Mass/Volume.

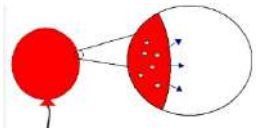
12. During inter- conversion of states of matter the temperature remains constant. Explain.

Hint: Heat supplied to a substance is getting used during changing its state to overcome the force of attraction between the particles.

13.a) Gases are compressible but not liquids. justify?

(b) The property of gases helps aquatic plants and animals to survive in water.how is it possible?

Hint: (a) Due to weak force of attraction. (b)strong force of attraction as compared to gases.



14. The gases exert more pressure on the walls of the container than the solids. Identify the reason?

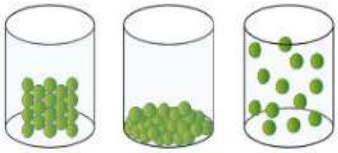
Hint: In gases, the particles high speed collides.

15 We see water droplets on the outer surface of a glass containing ice cold water. From where does this water come?

Hint: The water vapour present in the air.

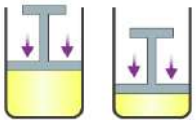
Short Answer Questions (3 marks each)

16. (a) Observe and identify the different states of matter given in the diagram.



(b) Compare the different states of matter on the basis of intermolecular force of attraction

and intermolecular space.
Hint: States of matter, intermolecular force of attraction.
17. Amit perspires a lot on a hot humid day. Explain the reason.
Hint- evaporation gets cooling effect.
18 It is advisable to use pressure cooker at higher altitudes. Suggest the reason.
Hint: atmospheric pressure.
19 The high compressibility property of gas useful to us. Explain with real life examples?
Hint: (1) LPG (liquefied petroleum gas) is in liquid state.
(2) Oxygen cylinders.
(3) CNG (compressed natural gas) is compressed.



Long Answer Questions (5 marks each)
20 Explain giving examples the various factors on which rate of evaporation depends
Hint: The rate of evaporation depends on the factors:
21 (a) How solids, liquids and gases exhibit the following properties?
(i) Rigidity (ii) Diffusion (iii) Compressibility
Hint: Arrange them in ascending order.

Case study Based Questions (4 marks each)
22 *A matter is anything that has mass and occupies space. Pen, paper, clips, sand, air, ice, etc. are different forms of matter. Every matter is made up of small particles. These particles are so tiny that they can't be seen with naked eyes. Let's see about the different characteristics of particles of matter.*
All matter is made up of very small particles.
.Particles of matter has spaces between them.
Particles of matter are continuously moving.
Particles of matter attract each other.
Answer the following questions by referring above paragraph.
i.) Which of following is not matter?
(a.) Pen (b.) air (c.) smell of perfume (d.) None of these
ii.) Thoughts coming in our mind are example of matter. True or false
(a.) True (b.) False (c.) None of these (d) both True and False
iii.) Enlist any two properties of particles of matter

23 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 vapours 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) Distinguish between evaporation and boiling.
Hint-
(i) c (ii) b (iii) differences.

****

2

Is Matter Around Us Pure?

All the substances around us have different shape, size and texture. Everything in the universe is made up of matter.

Substance:
A pure substance is a single kind of matter which cannot be separated into other kind of matter by any physical method. Ex. Elements (like Sodium, Hydrogen, Magnesium, Gold etc.) and compounds (like Sodium chloride (NaCl), Silver nitrate ($AgNO_3$), Potassium sulphate (K_2SO_4) etc.)

Elements:
Element word was used first time by Robert Boyle (1661).
Antoine L. Lavoisier gave the definition of an element.
The basic form of substance which cannot be broken down into simpler substances is called elements.
Element is made up of one kind of atoms only.
Elements are arranged systematically in the Modern Periodic table. **Total elements are 118.**
a). Naturally occurring elements:
Out of them 94 elements are known as naturally occurring elements.
Ex. Hydrogen (1) to Plutonium (94).
b). Man-made elements:
Remaining 24 elements are known as man-made or synthetic elements.
Ex. Americium (95) to Oganesson (118).
Types of elements (based on their physical states):
Three types:
a). Solid Elements:
Ex. Gold (Au), silver (Ag), copper (Cu), platinum (Pt), lead (Pb), sodium (Na), iodine (I) etc.
b). Liquid Elements:
Mercury (Hg) and Bromine (Br) are only two elements are found in **liquid state** at room temperature. Gallium (Ga) and Caesium (Cs) are also become liquid at a temperature above room temperature (30^0C). These elements can melt on our palm.
c). Gaseous Elements:
These are 11 elements which found in gaseous state at room temperature.
Ex. Hydrogen (H), oxygen (O), Nitrogen (N), Fluorine (F), Chlorine (Cl) and all noble gases (Helium (He), Neon (Ne), Argon (Ar), Krypton (Kr), Xenon (Xn) and Radon (Rn)).

Types of elements (based on their characteristics):
a). Metals:
The elements which can lose electron easily and having positive charge are known as metals.
Metals are lustre, malleable, ductile, sonorous, good conductors of heat and electricity.
Lustre: have shining surface
Malleable: Metals become thin sheet by beating.
Ductile: Metal can be drawn into wire by pulling.
Sonorous: Metals generate ringing sound.

b). Non-metals:

The elements which can gain electron easily and having negative charge are known as non-metals.
These are non-lustre (dull), non-malleable, non-ductile, non-sonorous, bad conductors of heat and electricity etc.

c). Metalloids:

The elements which possess both characteristics of metals and non-metals are known as metalloids. These are also known as semi-solids.
These are found in a zig-zag line in periodic table. Metalloids separate the metals and non-metals in the periodic table.
Ex. Boron (B), Silicon (Si), Germanium (Ge), etc.

Compounds:

The pure substance which made up of two or more than two elements combined chemically together in fixed proportion by mass is called compound.
Compounds can be broken down into their elements by chemical reactions and electrochemical reactions.
Compounds have their chemical formula.
Ex. Sodium chloride (NaCl) (it is made up of Sodium (Na) and Chlorine (Cl).

Mixture:

The combination of two or more than two substances which are physically mixed but not chemically mixed with each other are known as mixture.
Mixtures have not their any chemical formula.
Ex. Fruit juice, sugar or salt solution, soil solution, copper sulphate solution etc.

Types of mixture:

a). Homogeneous mixture:

The mixture in which substances are presented uniformly mixed throughout the mixture, is known as homogeneous mixture.

Homogeneous mixture has no any clear boundary of separation.
Solution is an example of homogenous mixture.
Ex. Salt solution, sugar solution, copper sulphate solution with water, air.

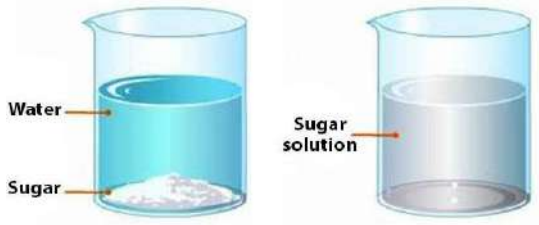


Fig: Sugar solution

Fig: Muddy water

b). Heterogeneous mixture:

The mixture in which contains physically distinct parts and have non-uniformly compositions, is called heterogeneous mixture. Heterogeneous mixture has visible boundaries of separation between two constituents.
Ex. Sand and common salt mixture, oil and water mixture, mixture of sand etc.
**We can divide the heterogeneous mixture into Suspension & Colloidal.

Concentration of a solution:

Dilute solution: If a solution has less solute present in it, it is called dilute solution.
Concentrated solution: If a solution has more solute present in it, it is called dilute solution.
Saturated solution: A solution having maximum amount of the solute dissolved at a particular temperature is known as saturated solution.
Unsaturated solution: If the amount of solute contained in a solution is less than the saturation level, it is called unsaturated solution.
Solubility: The amount of solute present in the saturated solution at the given temperature

is called its solubility.
Expressing the concentration of a solution:
By three ways:

a). Mass by Mass percent:

$$\frac{Mass\ of\ solute}{Mass\ of\ solution} \times 100$$

b). Mass by Volume percent:

$$\frac{Mass\ of\ solute}{Volume\ of\ solution} \times 100$$

c). Volume by Volume percent:

$$\frac{Volume\ of\ solute}{Volume\ of\ solution} \times 100$$

Suspension

A mixture in which the solute particles do not dissolve but remain suspended throughout the bulk of the medium, is called suspension.
Ex. Chalk powder, muddy water, milk of magnesia, some paints etc.

Properties of suspension:

I). Suspension is a heterogenous mixture. Particles size is more than 100 nm (10^{-7} m).
ii). The particles of a suspension can be seen by the naked eyes.
iii). The particles of a suspension scatter a beam of light and make its path visible.
iv). The particles of suspension can be separated through filtration.

Colloid or Colloidal solution

The heterogeneous mixture in which the particles are uniformly spread throughout the solution but cannot be seen the particles, is called colloidal.
Ex. Milk, blood, smoke etc.

Properties of a colloid:

i). A colloid is a heterogeneous mixture.
ii). The size of particles is 1 nm to 100 nm.
iii). The size of particles of a colloid is too small to seen by naked eyes.
iv). Colloid are big enough to scatter a beam of light passing through it. It makes its path visible.

Tyndall effect:

The phenomenon of scattering of a beam of light when it passing through a colloid**.**
Tyndall effect name is given after a scientist John Tyndall (1859) who discovered this effect.
Tyndall effect is also observed when a fine beam of light enters a room through a small hole.
This happens due to scattering of light by the small particles of dust and smoke in the air.

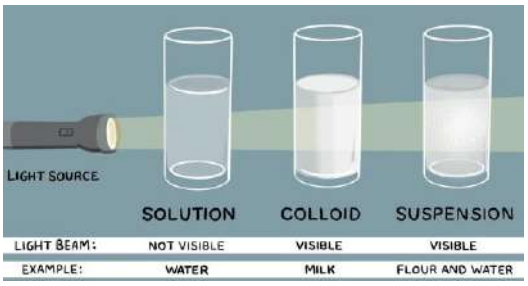
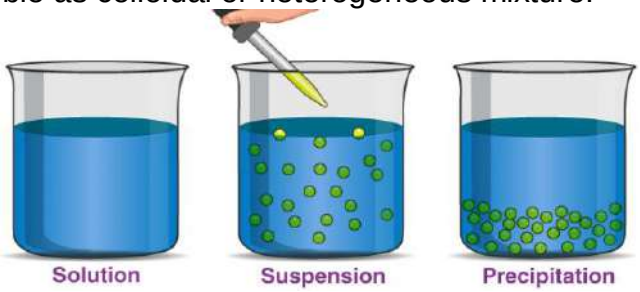


Fig: Tyndall effect in milk & flour and water

Some examples of colloids:

Dispersed phase	Dispersing medium	Type of colloid	Examples
Solid	Solid	Solid sol	Milky glass, coloured gemstone
Solid	Liquid	Sols	Milk of magnesia, mud, starch solution, gold sol
Solid	Gas	Aerosol	Smoke, dust storm, automobile exhaust
Liquid	Solid	Gel	Jelly, cheese, butter, curd, boot polish
Liquid	Liquid	Emulsion	Milk, face cream, tonic in liquid
Liquid	Gas	Aerosol	Fog, clouds, mist, insecticide spray
Gas	Solid	Foam	Foam, rubber, sponge, bread
Gas	Liquid	Foam	Soap, shaving cream, soda water

** Gas-gas is not possible as colloidal or heterogeneous mixture.



Differences between solution, suspension and colloidal:

Property	Solution	Suspension	Colloidal
Nature	Homogeneous	Heterogeneous	Heterogeneous
Particle size	Less than 1nm	More than 100nm	b/w 1 to 100nm
Visibility (by naked eyes)	Cannot be seen	Can be seen	Cannot be seen
Filterability	pass through filter paper	Cannot pass	Can pass
Settle down	No	Yes	No
Appearance	Transparent	Opaque	Generally transparent
Tyndall effect	Does not show	Shows	Shows
Diffusion	Rapidly	Does not diffuse	Slowly
Example	Salt and sugar solution	Muddywater,chalk-water	Milk, ink, blood, smoke

Physical change & chemical change:

Physical change	Chemical change
1. In a physical change, only physical properties such as colour, physical state, density, volume, etc. change; chemical properties remain unchanged.	1. In a chemical change, the chemical composition and chemical properties undergo a change.
2. No new substance is formed in a physical change.	2. A new substance is formed in a chemical change.
3. Very little or no energy in the form of heat, light or sound is usually absorbed or given out in a physical change.	3. A chemical change is always accompanied by absorption or evolution of energy.
4. A physical change is a temporary change.	4. A chemical change is a permanent change.
5. The original form of substance can be regained by simple physical methods.	5. Original substance cannot be obtained by simple physical methods.
6. A physical change is reversible.	6. A chemical change is irreversible.

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CHAPTERWISE QUESTION BANK

Multiple Choice Questions (1mark each)

1. Which of the following best describes a pure substance?
   (a) A substance composed of two or more elements physically mixed
   (b) A substance composed of only one type of atom or molecule
   (c) A substance that can be separated into components by physical means
   (d) A substance that has variable composition

Hint- pure substance is made up of only one type of atom or molecule

2. Which of the following is an example of a homogeneous mixture?
   (a) Sand and water (b) Oil and water (c) Sugar dissolved in water (d) Salt and pepper

Hint.-property of homogenous mixture.

3. Which of the following is a method used to separate a mixture of ammonium chloride and sodium chloride?

(a) Filtration (b) Sublimation (c) Centrifugation (d) Distillation

Hint.- directly solid to gases conversion

4. Which of the following substances, on sufficient cooling, produces a solid which undergoes sublimation under normal conditions?

(a) Water vapour (b) Ammonia (c) Carbon dioxide (d) Chlorine

Hint. – CO_2

5. **For which of the following mixtures, the same method of separation can be followed as a mixture of naphthalene and sand?**

(a) Iron fillings and camphor
(b) Iodine in carbon tetrachloride
(c) Sulphur in carbon disulphide
(d) Camphor and ammonium chloride

Hint.- (a) Iron fillings and camphor

6. A student crushed a piece of chalk and mixed the chalk powder in 100 mL water. The water appeared white and cloudy. After some time the particles settled at the bottom of the container. She claims that the mixture is a suspension. What justifies her claim?

(a) The particles mix completely with water.
(b) The particles of chalk form a separate layer.
(c) The particles of chalk are visible through the naked eye.
(d) The particles of chalk are uniformly distributed in water.

Hint.- (c) The particles of chalk are visible through the naked eye as particles are bigger in size.

Assertion-Reason Based Questions (1mark each)

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

7. Assertion: When a beam of light is passed through a colloidal solution placed in a dark place the path of the beam becomes visible.

Reason: Light gets scattered by the colloidal particles.

Hint.- Light is scattered by colloidal particles, making the path of the beam visible.

8 Assertion: A mixture of sugar and benzoic acid can be separated by shaking with ether.

Reason: Sugar is insoluble in water.

Hint: Sugar is soluble in water and insoluble in ether.

9 Assertion: A mixture of sand and water can be separated by filtration.

Reason: Sand particles are larger than water particles.

Hint- particle size

10 Assertion: Pure water is a compound.

‘ Reason: Pure water has a fixed composition and properties.

Hint. Properties of compound

Very Short Answer Questions(2 marks each)

11. Sucrose (sugar) crystals obtained from sugarcane and beetroot are mixed together. Will it be a pure substance or a mixture? Give reasons for the same.

Hint: It is a pure substance because chemical composition of sugar crystals is same

irrespective of its source.

12. Identify the physical changes from the examples given below:
Melting of iron metal, rusting of iron, bending of iron rod, drawing a wire of iron metal
Hint: properties of physical changes

13**.** Mohnish has saturated solution in a beaker and he wants to get it converted into unsaturated solution. Suggest a method for it.
Hint: **Heating , volume of solvent**

14. A solution of alcohol in water has been prepared by mixing 150 ml of alcohol with 600 ml of water. Calculate the volume. Percentage of the solution.
Hint: % by volume = Volume of alcohol / Volume of alcohol X 100

15. Copper sulphate solution in water does not show Tyndall effect but mixture of water and milk shows .
Hint: size of particles

Short Answer Questions (3 marks each)

16. (a) Give any one point of difference between true solution, colloidal solution and suspension.
(b) 20 g of sodium chloride is dissolved in 100 mL of water. How will you test whether the given solution is saturated or unsaturated at the given temperature?
(c) Suggest any one method by which we can increase the solubility of saturated solutions.
Hint: (a) properties/ differences (b) saturated solution.(c) increase temperature, effect solubility.

17. (a) List any three characteristic of colloid.
(b) Name the two components of a colloid.
(c) Identify colloid from the following mixtures: Muddy water, sugar in water, ink, blood, soda water, foam
Hint: refer notes

18. Differentiate between a true solution and a colloid.
Hint: Any three differences.

Q.19 Distinguish between physical change and chemical change.
Hint: Any three differences.

Long Answer Questions (5 marks each)

20 Three students A, B and C prepared mixtures using chalk powder, common salt and milk respectively in water. Whose mixture:
(i) would not leave residue on filter paper after filtration?
(ii) would show Tyndall effect?
(iii) would give transparent/clear solution?
(iv) would settle down at the bottom when left undisturbed?
(v) could be filtered by filter paper?
Hint: think & identify.

21. During an experiment the students were asked to prepare a 10% (Mass/Mass) solution of sugar in water. Mohnish dissolved 10g of sugar in 100g of water while Harshita prepared it by dissolving 10g of sugar in water to make 100g of the solution.
(a) Are the two solutions of the same concentration
(b) Compare the mass % of the two solutions.

Hint: (a) calculate & compare concentrations
(b) Mass%= Mass of solute/Mass of solvent X 100

Case study Based Questions (4 marks each)

22. *A homogeneous mixture of two or more substances is called a true solution. it consists of solute and solvent. The particle size of the true solution is less than 1 nanometer. A suspension is a heterogeneous mixture in which the solute particle does not dissolve but remains suspended throughout the bulk of the medium. A colloid is a mixture that is actually heterogeneous but appears to be homogeneous as the particles are uniformly spread throughout the solution.*

(i) Which one of the following is most stable?
(a)True solution (b)Suspensions (c)Colloids (d) both A and B

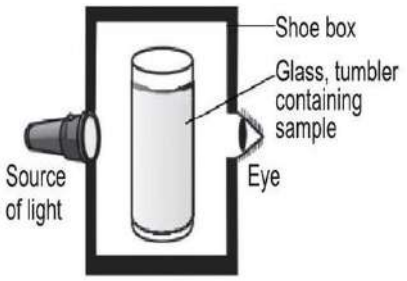
(ii) which type of mixture can be separated by filtration?
(a)True solution (b)Suspensions (c)Colloids (d) All of these

(iii) Which statement is incorrect about the Tyndall effect. *
(a)True solution shows Tyndall effect (b)Suspensions show the Tyndall effect
(c)Colloid show Tyndall effect (d)Both B and C show the Tyndall effect

(iv) Which is the correct order of stability of solution?
(a) True < Colloid<Suspension (b)Colloid<Suspension<True
(c)Colloid<True<Suspension (d)Suspension<Colloid<True

Hint: answer on the basis of text

23. *A group of students took an old shoe box and covered it with a black paper from all sides. They fixed a source of light (a torch) at one end of the box by making a hole in it and made another hole on the other side to view the light. They placed a milk sample contained in a tumbler in the box as shown in the figure below. They were amazed to see that milk taken in the tumbler was illuminated. They tried the same activity by taking a salt solution but found that light simply passed through it.*



Read the given passage carefully and give the answer of the following questions:
(a) Explain why the milk sample was illuminated? Name the phenomenon involved.
(b) Same results were not observed with a salt solution. Explain.
(c) Can you suggest two more solutions which would show the same effect as shown by the milk solution?
(d) Give one example of above phenomenon observed in our surroundings.

Hint: (a) colloidal solution. (b) true solution would not scatter light.
(c) Soap solution and ink solution. (d)Tyndall effect in real life.

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Laws of chemical combination:

(a). Law of conservation of mass:

"Mass can neither be created nor destroyed in a chemical reaction."

(b). Law of constant proportions:

"In a chemical substance the element are always present in definite proportions by mass."

Ex. (i) In ammonia (NH_3), Nitrogen and hydrogen are always present in the ratio of 3:1 by mass.

(ii)In water (H_2O), Hydrogen 1g while oxygen is 8g (ratio of 1:8).

Dalton's atomic theory

British chemist John Dalton provided the basic theory about the nature of matter.

The postulates of his theory are as:

(a). All matter is made of tiny particles called atoms, participate in chemical reactions.

(b). Atoms are indivisible particles.it cannot be created or destroyed in a chemical reaction.

(c). Atoms of a given element are identical in mass and chemical properties.

(d). Atoms of different elements have different masses and chemical properties.

(e). Atoms combine in the ratio of small whole numbers to form compounds.

(f). The relative numbers and kinds of atoms are constant in a given compound.

IUPAC (International Union of Pure and Applied Chemistry) approves the names, symbol of elements and units.

Symbols of some elements are formed from the first letter of the name and a letter appearing later in the name.

Ex. Copper (Cu), Argon (Ar), cobalt (Co).

Other symbols have been taken from the names of element in Latin, German or Greek.

Name of element	Latin/German/Greek word)	Symbol
Sodium	Natrium	Na
Potassium,	Kalium	K
Iron	Ferrum	Fe
Copper	Cuprum	Cu
Silver	Argentum	Ag
Mercury	Hydrargyrum	Hg
Gold	Aurum	Au

Atomic mass:

The definition of atomic mass was universally accepted in 1961. It is as:

"The atomic mass is a mass unit equal to exactly one-twelfth (1/12th) the mass of one atom of carbon-12."

Carbon-12 is an isotope of carbon which is used as the reference for measuring atomic mass.

The atomic mass measures in 'amu' (atomic unit mass) but recently IUPAC accepted 'u' (unified mass) instead of amu.

Atomic masses of some elements:

At. No. (Z)	Name of element	Atomic mass (in u)	At. No. (Z)	Name of element	Atomic mass (in u)
1	Hydrogen	1	10	Neon	20
2	Helium	4	11	Sodium	23
3	Lithium	7	12	Magnesium	24
4	Beryllium	9	13	Aluminium	27
5	Boron	11	14	Silicon	28
6	Carbon	12	15	Phosphorus	31
7	Nitrogen	14	16	Sulphur	32
8	Oxygen	16	17	Chlorine	35.5*
9	Fluorine	19	18	Argon	40

Existences of atoms:

Atoms are not able to exist independently. Atoms are found in form molecules and ions. These molecules and ions aggregate in large numbers to form the matter (compounds).

Molecule:

"A molecule is a group of two or more atoms that are chemically bonded together."

OR

"A molecule can be defined as the smallest particle of an element or a compound that is capable of an independent existence and shows all the properties of that substance."

Molecule can be of elements or compounds.

Ex. **H_2** It is formed by the two atoms of hydrogen element.

H_2O It is formed by two atoms of hydrogen and one atom of oxygen.

(A). Molecules of Elements:

In an element, all the atoms are same. Some elements (noble gases He, Ne, Ar, Kr, Xn etc.) are made up of only one atom of that elements. But molecules of many other elements made up of two or more atoms.

Ex. a molecule of oxygen consists of two atoms of oxygen, So, it is a diatomic molecule.

Atomicity:

The number of atoms that constituting a molecule is known as atomicity.

Table: Atomicity of some elements:

Name of element	Atomicity	Name of element	Atomicity
Hydrogen	Di-atomic	Noble gases (He, Ne, Ar)	Mono-atomic
Nitrogen	Di-atomic	Phosphorus	Tetra-atomic
Oxygen*	Di-atomic	Sulphur	Poly-atomic
Chlorine	Di-atomic		

*Oxygen is tri-atomic in Ozone (O_3).

Metals and carbon do not have a simple structure but consists of a very large and indefinite number of atoms bonded together.

(B). Molecules of Compounds:

Atoms of different elements join together in define proportions to form molecules of compounds.

Table: Molecules of some compounds:

Compound	Combining Elements	Ratio by Mass
Water (H_2O)	Hydrogen, Oxygen	1:8
Ammonia (NH_3)	Nitrogen, Hydrogen	14:3
Carbon dioxide (CO_2)	Carbon, Oxygen	3:8
Carbon monoxide (CO)	Carbon, Oxygen	3:4
Sulphur dioxide (SO_2)	Sulphur, Oxygen	1:1

Ions:

(a). Cation:

The positively charged (+) ion is called as cation. All the metals have positive charge.

Ex. Sodium ion (Na^+), Magnesium ion (Mg^{+2})

(b). Anion:

The negatively charged (-) ion is called as anion. All the non-metals have negative charges.
Ex. Chlorine ion (Cl^-), Oxygen ion (O^{-2})

(c). Polyatomic ion:

A group of atoms carrying a charge is known as polyatomic ion.
Ex. Ammonium ion (NH_4^+), Carbonate ion (CO_3^{-2})

Table: Name and symbols of some ions:

Valency	Metallic ion (Cation)		Non-metallic ion (Anion)		Polyatomic ion	
1	1.	Sodium (Na^+)	1.	Hydrogen (H^+)	1.	Ammonium (NH_4^+)
	2.	Potassium (K^+)	2.	Hydride (H^-)	2.	Hydroxide (OH^-)
	3.	Silver (Ag^+)	3.	Chloride (Cl^-)	3.	Nitrate (NO_3^-)
	4.	Copper (Cu^+)	4.	Bromide (Br^-)	4.	Hydrogencarbonate (HCO_3^-)
			5.	Iodide (I^-)		
2	1.	Magnesium(Mg^{+2})	1.	Oxide (O^{-2})	1.	Carbonate (CO_3^{-2})
	2.	Calcium (Ca^{+2})	2.	Sulphide (S^{-2})	2.	Sulphite (SO_3^{-2})
	3.	Zinc (Zn^{+2})			3.	Sulphate(SO_4^{-2})
	4.	Iron (II) Fe^{+2})			4.	Nitrite (NO^{-3})
	5.	Copper (II) (Cu^{+2})				
3	1.	Aluminium (Al^{+3})	1.	Nitride (N^{-3})	1.	Phosphate (PO_4^{-3})
	2.	Iron (III) (Fe^{+3})				
	3.	Copper(III) (Cu^{+3})				

Writing Chemical Formulae:

Formula of Hydrogen sulphide:

Symbol: **H** **S**

Valency: **+1** **-2**

Formula: **H_2S**

Formula Unit Mass:

Calculation of formula unit mass of ZnO.
Calculation: Atomic mass of Zn = 65u
Atomic mass of O = 16u
Formula unit mass = 65+16=81u

Formula of Magnesium chloride:

Symbol: **Mg** **Cl**

Valency: **+2** **-1**

Formula: **$MgCl_2$**

Molecular Mass (u):

Calculation of molecular mass of CH_3OH.
Calculation: Atomic mass of C = 12u
Atomic mass of H =1u; atomic mass of O = 16u
Molecular mass = 12+3x1+16+1
= 12+3+16+1=32u

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CHAPTERWISE QUESTION BANK

Multiple Choice Questions (1mark each)

1 Which law is supported when the total mass of reactants equals the total mass of products in a chemical reaction?

(a) Law of constant proportions (b) Law of multiple proportion
(c) Law of conservation of mass (d) Law of conservation of energy

Hint.- Law of Conservation of Mass

2 Dalton's atomic theory could explain the Law of Constant Proportions because it proposed that:

(a) Atoms can be divided (b) Atoms of different elements have identical mass
(c) Atoms combine in fixed ratios (d) Atoms can be created or destroyed

Hint- Dalton's theory.

3 During a classroom discussion on the molecular forms of non-metals, a student identified that elemental phosphorus exists as P_4. Based on this information, what is the atomicity of phosphorus?
(a) Diatomic (b) Monoatomic (c) Tetra-atomic (d) Polyatomic
Hint. Phosphorus exists as P_4.

4 Which of the following compounds has a molecular mass of 18 u?
(a) HNO_3 (b) CO_2 (c) H_2O (d) CH_4
Hint. (H_2O): 2×1 + 16

5 While learning about isotopes, a student observed that carbon exists as both Carbon-12 and Carbon-14, which have different masses but are the same element. Based on this observation, which postulate of Dalton's atomic theory is invalidated by the discovery of isotopes?
(A) Atoms combine in fixed ratios (B) Atoms are indivisible
(C) Atoms of same element have same mass (D) Atoms participate in chemical reactions
Hint-Isotopes, contradicting Dalton's postulate.

6 Carbon dioxide (CO_2) is a compound made up of one carbon atom and two oxygen atoms.
Given that the atomic mass of carbon (C) is 12 u and the atomic mass of oxygen (O) is 16 u,
What is the molecular mass of carbon dioxide (CO_2)?

(A) 32 u (B) 28u (C) 44u (D) 30u
Hint. CO_2 = 12 (C) + 2×16 (O)

Assertion-Reason Based Questions (1mark each)
(a) Both A and R are true and R is correct explanation of A
(b) Both A and R are true, but R is not correct explanation of the assertion.
(c) A is true, but R is false.
(d) A is false, but R is true.

7 Assertion: Atoms always combine to form molecule and ions.
Reason: Atoms of most element are not able to exist independently.
Hint.- atomic property

8 Assertion: Atomicity of ozone is three while that of oxygen is two.
Reason: Atomicity is the number of atoms constituting a molecule.
Hint.- atomicity
.
9 Assertion: Atomic mass of aluminium is 14.
Reason: An atom of aluminium is 27 times heavier than 1/12th of the mass of carbon-12 atom.
Hint.- analyse

10 Assertion: The valency of aluminium is 3 and oxygen is 2.
Reason: The chemical formula of aluminium oxide is Al_3O_2.
Hint. Calculate formula.

Very Short Answer Questions(2 marks each)
11. 2.8 g of nitrogen gas was allowed to react with 0.6 g of hydrogen gas to produce 3.4 g of ammonia. Show that these observations are in agreement with the law of conservation of mass . State the law of conservation of mass.
Hint: Mass of nitrogen + Mass of hydrogen= mass of ammonia

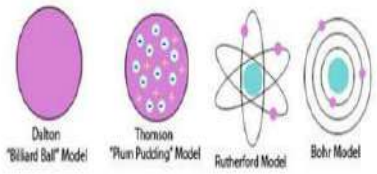
12 Metals such as copper and aluminium are good conductors of electricity, while non-metals like sulphur and oxygen are not. Based on the atomic structure of metals and non-metals, explain why metals conduct electricity and non-metals do not.
Hint: Properties of metal and non metal

13. As per the law of definite proportions carbon and oxygen combine in a ratio of 3 : 8. Compute the mass of oxygen gas that would be required to react completely with 6 g carbon.
Hint: 16 g of oxygen.

14. Find an element that is:
(a) Malleable and ductile (b) conductor of electricity
(c) a constituent of water (d) liquid at room temperature.
Hint: (a) Gold (b) Copper (c) Hydrogen and oxygen (d) Mercury

15. You are given a list of substances: oxygen (O_2), carbon dioxide (CO_2), iron (Fe), and water (H_2O).
Which of these are compounds, and why?
Hint: Compounds are made of two or more different elements chemically combined.

Short Answer Questions (3 marks each)



16. Dalton's atomic theory was an important step in the development of atomic science, but some of its ideas were later found to be incorrect. State any two drawbacks of Dalton's atomic theory.

Hint: Dalton assumed atoms were indivisible and identical for each element, but later discoveries proved otherwise.

17. In a reaction, 5.3 g of sodium carbonate reacted with 6 g of ethanoic acid. The products were 2.2 g of carbon dioxide, 0.9 g water and 8.2 g of sodium ethanoate. Show that these observations are in agreement with the law of conservation of mass, sodium carbonate + ethanoic acid —> sodium ethanoate + carbon dioxide + water.
Hint: Mass of reactants before experiment = Mass of products

18. Classify the following compounds diatomic, triatomic and polyatomic molecules:
HCl, H_2, H_2O, NH_3, CH_3OH, PCl_5
Hint: Classification on the basis of no. of atom

19. Write the formulae of
(a) Magnesium hydroxide (b) Hydrogen sulphide (c) Barium Chloride
Hint; (a) $Mg(OH)_2$ (b) H_2S (C) $BaCl_2$

Long Answer Questions (5 marks each)
20.(a) You are provided with a fine white coloured powder which is either sugar or salt. How would you identify it without tasting?
(b) Calculate the molecular mass of the following:
(i)H_2CO_3 (ii)C_2H_5OH (iii) $MgSO_4$
Hint: (a) conduction of electricity. (b) 62u, 46u, 120u

21. (a) You are studying substances that are formed through the transfer of electrons between atoms. These substances consist of charged particles that attract each other strongly to form compounds. Describe what such charged particles are called and give three examples of compounds formed by them.
(b) Write chemical formulae of: (i) Sodium carbonate (ii) Ammonium chloride.
Hint: (a)Ions. NaCl, K_2O, FeS
(b)Na_2CO_3, NH_4Cl

Case study Based Questions (4 marks each)

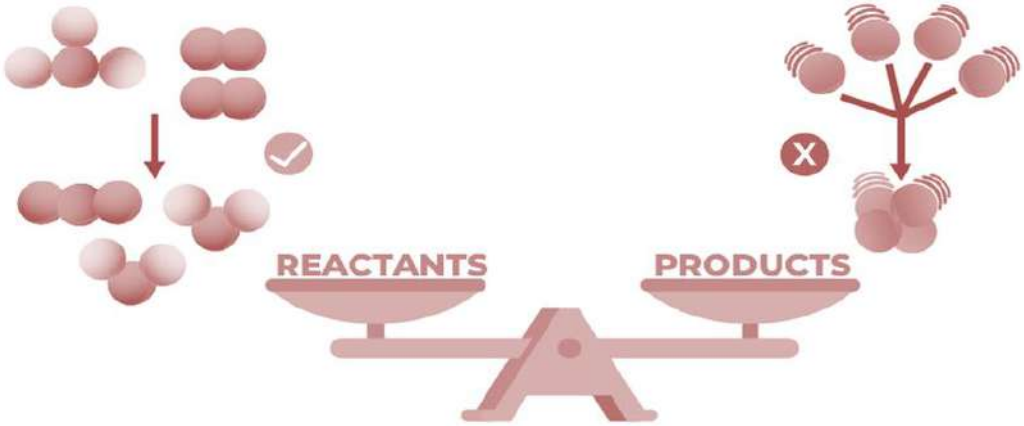
22. *Read the following passage and answer the questions that follow :*

Atoms and molecules are the building blocks of matter. An atom is the smallest unit of an element that retains its chemical properties, while a molecule is a group of two or more atoms held together by chemical bonds. Atoms consist of a positively charged nucleus, which contains protons and neutrons, surrounded by negatively charged electrons in energy levels or shells. The number of protons in an atom determines its atomic number and defines its unique identity as an element. The electrons in an atom occupy specific energy levels, and the outermost shell is known as the valence shell. Atoms gain, lose, or share electrons to achieve a stable electron configuration, forming chemical bonds and giving rise to molecules. Understanding the concept of atoms and molecules is crucial for comprehending various chemical reactions and the composition of substances.

(i) The smallest unit of an element that retains its chemical properties:
(a) Proton (b) Electron (c) Nucleus (d) Atom
(ii) A group of two or more atoms held together by chemical bonds called:
(a) Element (b) Compound (c) Molecule (d) Nucleus
(iii) What are the positively charged particles present in the nucleus of an atom called?
(a) Electrons (b) Protons (c) Neutrons (d) Valence electrons
(iv)Which part of an atom contains electrons in energy levels or shells?
(a) Protons (b) Neutrons (c) Nucleus (d) Valence shell
Hint: (i) Atom (ii) Molecule : (iii) Protons **(**iv) Valence shell

23. Read the following passage and answer the questions that follow:

A student was asked by his teacher to verify the law of conservation of mass in the laboratory. He prepared 5 % aqueous solution of NaCl and Na_2SO_4. He mixed 12 ml of both these solutions in a conical flask. He weighed the flask on a weigh balance. He then stirred the flask with a rod and weighed it after sometime. There was no change in mass.



:

(i) Was the student able to verify the law of conservation of mass?
(ii) If not, What was the mistake committed by him?
(iii) In your opinion , what he should have done?
(iv) What is the value based information associated with this ?
Hint: (i) No, he could not verify the law of conservation of mass inspite of the fact that there was no change in mass.

(ii) No chemical reaction takes place between NaCl and Na_2SO_4 . This means that no reaction took place in the flask.

(iii) He should have performed the experiment by using aqueous solution of $BaCl_2$ and Na_2SO_4 and chemical reaction takes place in this case and a white precipitate of BaSO4 is formed.

(iv) While working in the Chemistry laboratory, a student must select those chemical substances which react with each other. Only then products will be formed.

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Atoms:
All mater is made of very tiny particles called atoms which is divisible and consists of charged particles.

Sub-atomic particles:
The sub-atomic particles are electron, proton, neutron, meson, photon, muon etc. But we will include only protons, electrons and neutrons etc.

Electron:
The electron identified by J. J. Thomson in 1897.
It is represented by $\mathbf{e^-}$ (it is a negative charged particle). The mass of an electron is considered to be negligible and its charge is minus one.

Proton:
E. Goldstein observed proton as H^+ in 1886 in a gas discharge and called them canal rays*.
Proton was also identified by Ernest Rutherford in during 1917-1920. It is represented by $\mathbf{P^+}$.
*Canal rays: These are positively charged radiations that consist of particles having charges equal in magnitude.

Neutrons:
Neutron was discovered by James Chadwick in 1932.
Neutrons are present in the nucleus of all atoms, except hydrogen and represented as **n**.
The mass of an atom is calculated by the sum of the masses of protons and neutrons present in the nucleus.

$$\boldsymbol{Atomic\ mass\ (A) = protons\ (p) + neutrons\ (n)}$$

Conclusion:
An atom is composed of protons and electrons and mutually balancing their charges.
Nucleus:
The positively charged centre in an atom called the nucleus. **Nucleus was discovered by Ernest Rutherford** from the alpha particle scattering experiment.
The Structure of an Atom (Atomic models)
There are various atomic models which proposed by many scientists.
a). Thomson's Model of an Atom
b). Rutherford's Model of an Atom
c). Bohr's Model of Atom

J. J.Thomson's Model of an Atom (Plum-pudding model)

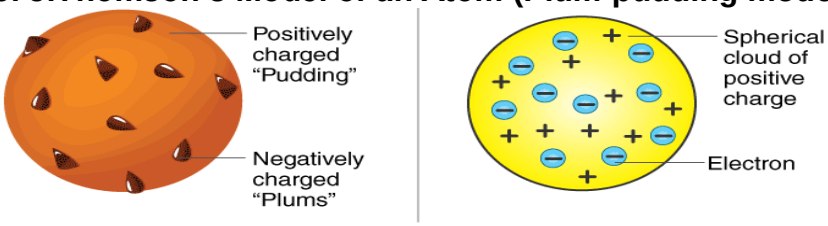
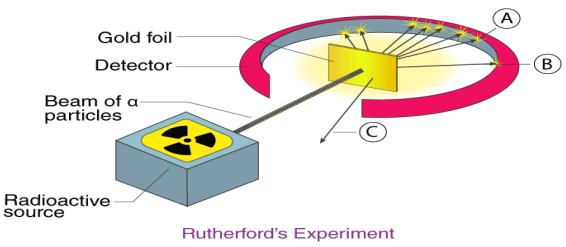


Fig: Thomson's model of an atom
The two main postulates of his model are as:
a). An atom consists of a positively charged sphere and the electrons are embedded in it.
b). The negative and positive charges are equal in magnitude. So, the atom as a whole is electrically neutral.

Drawback of Thomson's model:
Other scientists were unable to find practically that atoms are electrically neutral.

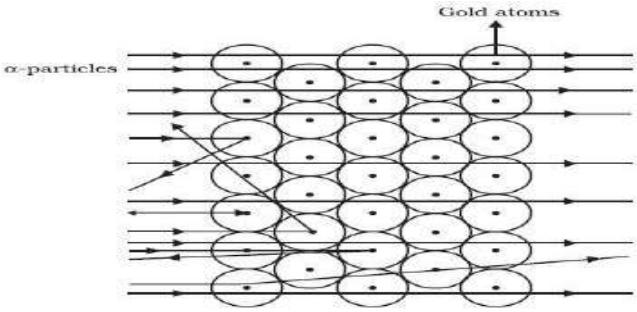
Rutherford's Model of an Atom (Rutherford's α-particles scattering experiment)



Rutherford's Experiment

Reason for selection of gold foil:
Gold is most malleable and ductile metal. It was possible to make only 1000 atoms thick foil of gold.
His reason of selected alpha (α) particles: Alpha-particles has 2 protons and 2 neutrons (double-charged helium ions). Mass of alpha-particles is 4u. They are fast-moving have considerable amount of energy.
He was expected that α-particles were much heavier than the protons and would be deflected by the sub-atomic particles in the gold foil.

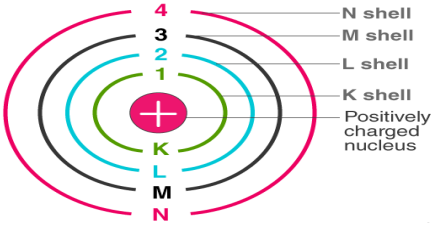
Results of his α-particles scattering particles:
i). Most of alpha particles passed straight through the gold foil.
ii). Some of the alpha-particles were deflected by the foil by small angle.
ii). One out of every 12000 alpha-particles appeared to rebound (deflected 180^0 angle).
Rutherford's conclusions of the experiment:



Neils Bohr's Model of Atom
According him atom consists a small nucleus (positive charged) surrounded by negative electrons around the nucleus in orbits.
If an electron is located away from the nucleus, it has more energy. If it is located near the nucleus, it has less energy.

The main postulations of his model as:
i). Electrons revolve in a definite circular path called orbits or shells.
ii). Only certain special orbits known as discrete orbits of electrons, are allowed inside the atom.
iii). While revolving in discrete orbits the electrons do not radiate energy.

Electron distribution in Orbits or shells:
The distribution of electrons into different orbits of an atom was suggested by Neils Bohr and R Burry. Some rules are as:



(i). The maximum number of electrons present in a shell is given by a formula $2n^2$. Where n= 1, 2, 3, 4, 5,…

Number of shells (n)	Name of orbits or shells	Maximum Electron capacity in the shells ($2n^2$)
1	K	$2 \times 1^2 = 2$
2	L	$2 \times 2^2 = 8$
3	M	$2 \times 3^2 = 18$
4	N	$2 \times 4^2 = 32$
5	O	$2 \times 5^2 = 50$

ii). The maximum number of electrons that can be accommodated in the outermost orbit is 8. It is called the octet rule.
iii). Electrons should be filled in the shells in a step-wise manner **K→L→M→N**.

Valency:
The combining capacity of the element is known as valency. The electrons present in the outermost shell of an atom are known as the valence electrons.
According the Bohr-Burry scheme, the outermost shell of an atom can accommodate a maximum of 8 electrons.
Z= Atomic number; p= Proton; e= Electron; A= Atomic number; V= Valency.

Some Important terms & Definitions:

1). Atomic Number:

The total number of protons or electrons in an element is called atomic number.
Atomic number is denoted by **Z**.

$$\boldsymbol{Atomic\ number = protons = electrons}$$
$$\boldsymbol{Z = p = e}$$

2). Atomic Number:

The sum of the number of protons and neutrons in an element is called atomic mass.
Atomic mass is denoted by **A**.

$$\boldsymbol{Atomic\ mass = protons + neutrons}$$
$$\boldsymbol{A = p + n}$$

Ex. $Atomic\ mass\ of\ sodium = 11 + 12 = 23$

Neutron can be calculated by the formula:

$$\boldsymbol{Neutrons = Atomic\ mass - protons}$$
$$\boldsymbol{n = A - p}$$

Q. 1. Atomic mass of an element is 40 and atomic number is 18. Calculate the neutron in this element.

Ans: $\boldsymbol{n = A - p}$

$n = 40 - 18$=22

The atomic number and atomic mass are to be written on an element:

$$Symbol\ of\ element^{Atomic\ mass}_{Atomic\ number}$$
$$E^{A}_{Z}$$

Ex. For sodium: Na^{23}_{11}

3). Isotopes:

The elements which have same atomic numbers but have different atomic mass number are called isotopes.
Three isotopes of hydrogen.
(i). Protium (H): H^{1}_{1} (ii). Deuterium (D): H^{2}_{1} (iii). Tritium (T): H^{3}_{1}
Two isotopes of carbon: (i). Carbon-12: C^{12}_{6} (ii). Carbon-14: C^{14}_{6}
Two isotopes of chlorine: (i) Chlorine-35: Cl^{35}_{17} (ii) Chlorine-37: Cl^{37}_{17}
Ex. Chlorine occurs in nature in two isotopes with mass 35u and 37u in the ratio of 3:1. The average atomic mass of chlorine atom:

$$\left(35 \times \frac{75}{100} + 37 \times \frac{25}{100}\right)$$
$$= \left(\frac{105}{4} + \frac{37}{4}\right)$$
$$= \frac{142}{4} = 35.5u$$

Applications of Isotopes:
i). An isotope of uranium (U-235) is used as a fuel in nuclear reactions.
ii). An isotope of cobalt (Co-60) is used in the treatment of cancer.
iii). An isotope of iodine (I-131) is used in the treatment of goitre disease.
iv). An isotope of carbon (C-14) is used in carbon dating method for measure the age of fossils or other ancient materials.

4). Isobars:

Atoms of different elements with different atomic numbers, which have the same mass numbers, are known as isobars.
Ex. Argon (Ar^{40}_{18}), Potassium (K^{40}_{19}) and Calcium (Ca^{40}_{20})

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CHAPTERWISE QUESTION BANK

Multiple Choice Questions (1mark each)

1. The sub atomic particles like proton is different from electron. How?
(a) An electron is much heavier than a proton
(b) An electron carries more charge than a proton
(c) A proton is easily removed from an atom, but not an electron
(d) A proton is positively charged, whereas an electron is negatively charged.
Hint: charge

2. An atom has 4 electrons and 4 protons and 4 neutrons. The atom is electrically neutral. Which difference in the properties of protons and electrons affects the electrical neutrality of the atom?
(a) Electron's are 2000 times lighter than protons.
(b) Electrons and protons have the same charge and mass.
(c) Electrons and protons have opposite charges of the same magnitude.
(d) Electrons are present in the outer side of the atom compared to the protons
Hint: charge

3. Thomson's Model of an atom failed because?
i. It could not explain the screening of negative charges from that of positive
ii. It did not tell about the presence of electrons
iii. It did not give an idea about the discrete energy levels
iv. It explained the atom as a whole to be electrically neutral.
Choose the correct option from the following:
(a) Only (iii) (b) Both (i) & (iii) (c) Only (i) (d) Both (ii) & (iv)
Hint: Analyse and answer.

4. Which of the following statements is incorrect about the structure of an atom?
i. The whole mass of an atom is concentrated in the nucleus
ii. The atom is an indivisible particle
iii. The atom as a whole is neutral
iv. All the atoms are stable in their basic state
Choose the right option among the following:
(a) (i) and (iii) (b) only (ii) (c) (ii) and (iv) (d) none of these
Hint: Analyse and answer.

5. Which of the following is an incorrect statement in reference with observation in Rutherford's particle scattering experiment?
(a) Some of the α-particles rebound after hitting the gold foil
(b) Some of the particles deflected from their path
(c) Some of the particles not pass through the gold foil
(d) Most of the particles pass straight through the gold foil
Hint: Rutherford's particle scattering experiment

6. The electronic configuration of chlorine is
(a) 2,7 (b) 2,8,8,7 (c) 2,8,7 (d) 2,7,8
Hint: electronic configuration

Assertion-Reason Based Questions (1mark each)

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

7. **Assertion:** For noble gases, valency is zero.
Reason: Noble gases have 8 valence electrons.
Hint: relationship valance electron & valency.

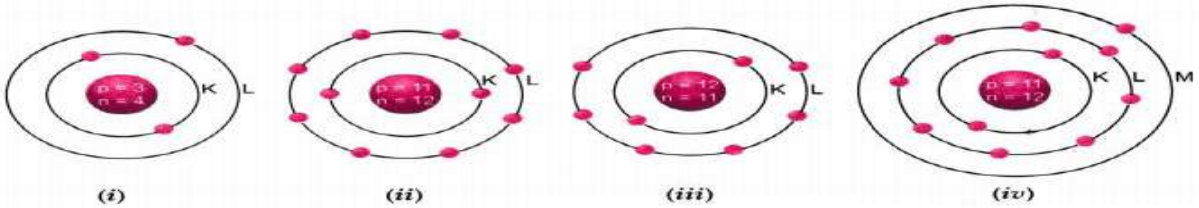
8. **Assertion:** The mass of the total number of protons and neutrons is a measure of the approximate mass of an atom.
Reason: The mass of an electron is negligible.

Hint: compare mass of sub atomic particles.
9. **Assertion:** Isotopes are electrically neutral.
Reason: Isotopes are species with same mass number but different atomic number
Hint: defining isotopes.
10. Assertion: The size of the nucleus is very small as compared to the size of the atom.
Reason: The electrons revolve around the nucleus of the atom
Hint: Rutherford's Model of an Atom

Very Short Answer Questions(2 marks each)
11. An element 'X' has mass number 4 and atomic number 2. Write the valency of this element. Will it react with other atoms of different elements?
Hint:In the atom of 'X' element there are only two electrons since atomic number is 2.

12. An element 'A' has valency +3, while another element 'B' has valency -2. Give the formula of their compound formed when 'A' reacts with 'B'.
Hint: Chemical formula = A_2B_3
13. The atomic number of calcium and argon are 20 and 18 respectively, but the mass number of both these elements is 40. What is the name given to such a pair of elements?
Hint: Isobars
14. Find out the valency of the atoms represented by the Figs. (a) and (b)

Hint: (a) 0 (b) 1)
15. Identify the Na^+ ion from the following figures. What is the valency of sodium atom? Give reason



Hint: The valency of sodium atom is one because stable (octet) electronic configuration is obtained after loss of one electron.

Short Answer Questions (3 marks each)
16. Compare and contrast the atomic models proposed by J.J. Thomson and Ernest Rutherford by identifying at least three key differences in terms of structure, experimental basis, and explanation of atomic behaviour.
Hint: any three differences between the models proposed
17. Calculate the valency of the following elements
(i) A (Atomic number 5) (ii) B (Atomic number 12) (iii) C(Atomic number 14)
Hint: (i) Valency of element 'A' =3 (ii) 'B'=2 (iii) 'C'=4
18. Complete the table on the basis of information available in the symbols given below

(a) $^{35}_{17}CI$ (b) $^{12}_{6}C$ (c) $^{81}_{35}Br$

Element	n_p	n_n

Hint:

Element	n_p	n_n
Cl	17	18
C	6	6
Br	35	46

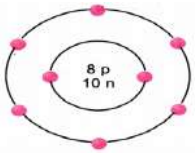
19. Write the molecular formulae for the following compounds:
(a) Copper (II) bromide (b) Aluminium (III) nitrate (c) Calcium (II) phosphate
Hint: (a) $CuBr_2$ (b) $Al(NO_3)_2$ (c) $Ca_3(PO_4)_2$

Long Answer Questions (5 marks each)

20. (a) Calculate the number of neutrons present in the nucleus of an element X which is represented as $^{31}X_{15}$.

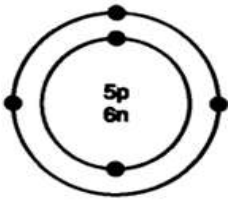
(b) An element 'Z' forms the following compound when it reacts with hydrogen, chlorine, oxygen and phosphorous.ZH_3, ZCl_3, Z_2O_3 and ZP
(i) What is the valency of element 'Z'?
(ii) Element 'Z' is metal or non-metal?
Hint: (a)Mass number = No. of protons + No. of neutrons
Hint: (b)(i) The valency of 'Z' is 3. (ii) Element 'Z' is a metal

21. (a) The given figure depicts the atomic structure of an atom of an element 'X'. Write the following information about the element 'X'.



(i) Atomic number of 'X' (ii) Atomic mass of 'X
(iii) Valency of 'X' (iv) 'X' should be metal or non-metal.

(b) Radhika could not solve the following question in the group; his group mate explained him and solved his difficulty. The question was as follows:
What information do you get from the given figure about the atomic number, mass number and valency of the given atom X'. (a)
What is the answer for-the above question? (b)
Name the element X'. (c)
What value of Aryan's friend is reflected in this behaviour?



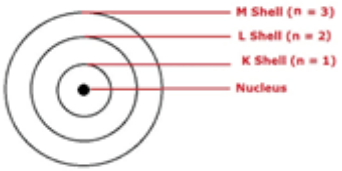
Hint: (a) Atomic number = 8 (b) Atomic mass= 16 u (c) Valency of 'X' = 2 (d) 'X' should be non-metal .
Hint: (a) The mass number is 11 and the valency is 3 (b) Boron.
(c) Aryan's friend showed the value of helping and caring nature.

Case study Based Questions (4 marks each)

22. *Rutherford (1871-1937) was known as the 'Father' of nuclear physics. Ernest Rutherford was interested in knowing how the electrons are arranged within an atom. Rutherford designed an experiment for fast moving alpha (α)-particles were made to fall on a thin gold foil. On the basis of his experiment, Rutherford put forward the nuclear model of an atom, which had the following features:*
There is a positively charged centre in an atom called the nucleus. Nearly all the mass of an atom resides in the nucleus.
The electrons revolve around the nucleus in circular paths.
The size of the nucleus is very small as compared to the size of the atom.
Drawbacks of Rutherford's model of the atom: The revolution of the electron in a circular orbit is not expected to be stable. Any particle in a circular orbit would undergo acceleration. During acceleration, charged particles would radiate energy. Thus, the revolving electron would lose energy and finally fall into the nucleus. If this were so, the atom should be highly unstable and hence matter would not exist in the form that we know. We know that atoms are quite stable.
(1) Which of the following scientist was known as the 'Father of nuclear physics?
(a) J.J. Thomson (b) John Dalton (c) E. Rutherford (d) Neil's Bohr
(2) Positively charged centre in an atom is termed as

(a) Nucleus (b) Molecule (c) Atom (d) Protons
(3) Identify the correct statement
Statement 1 – Positively charged centre in an atom called the nucleus.
Statement 2 – The electrons revolve around the nucleus in circular paths.
Statement 3 – Nearly all the mass of an atom resides in the nucleus.
Statement 4 – The size of the nucleus is very small as compared to the size of the atom.
(a) Only 2 (b) Both 3 & 4 (c) Both 1 & 2 (d) All of the above
(4) Write the features of Rutherford's nuclear model of an atom?
Hint: (1) c (2) a (3) d (4) Any two features of model

23. *Neil's Bohr got the Nobel Prize for his work on the structure of atom in 1922.*
In order to overcome the objections raised against Rutherford's model of the atom, Neil's Bohr put forward the following postulates about the model of an atom:
Only certain special orbits known as discrete orbits of electrons, are allowed inside the atom.
While revolving in discrete orbits the electrons do not radiate energy. These orbits or shells are called energy levels. Energy levels in an atom are shown in Fig. A few energy levels in an atom These orbits or shells are represented by the letters K,L,M,N,… or the numbers, n=1,2,3,4



(1) The orbits or shells are represented by
(a) Letters (b) Numbers (c) Both a & b (d) Special symbols
(2) These orbits or shells are called
(a) Energy levels (b) Discrete orbit (c) Atomic levels (d) None of the above
(3) Which of the following book is written by Professor Bohr's
(a) The Theory of Spectra and Atomic Constitution (b) Atomic Theory
(c) The Description of Nature (d) All of the above
(4) Identify the correct statement
Statement 1 – The orbits or shells are represented by letters only.
Statement 2 – The orbits or shells are represented by numbers only.
Statement 3 – While revolving in discrete orbits the electrons do not radiate energy.
Statement 4 – Certain special orbits known as discrete orbits of electrons.
(a) Both 1 & 2 (b) both 3 & 4 (c) Only 3 (d) All of the above
Hint: (1) c (2) a (3) d (4) b

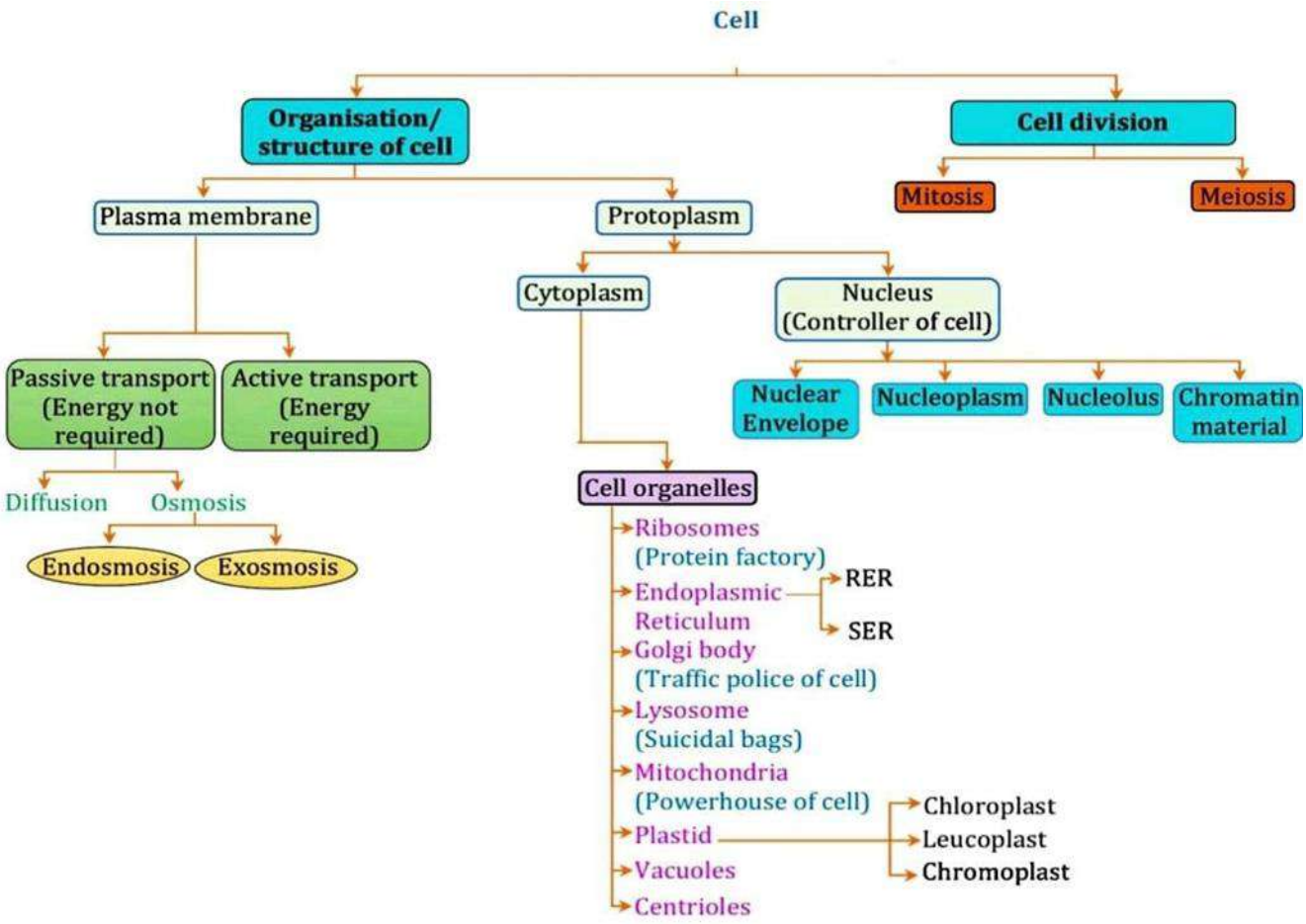
****

5

The Fundamental Unit Of Life

- Cell is the structural and functional unit of all living organisms.
- In 1665, Robert Hooke first discovered and introduced the term 'cell'.
- In 1674, Leeuwenhoek discovered the free living cells in pond water.
- Schleiden and Schwann proposed cell theory.

MIND MAP



Type Of Cells

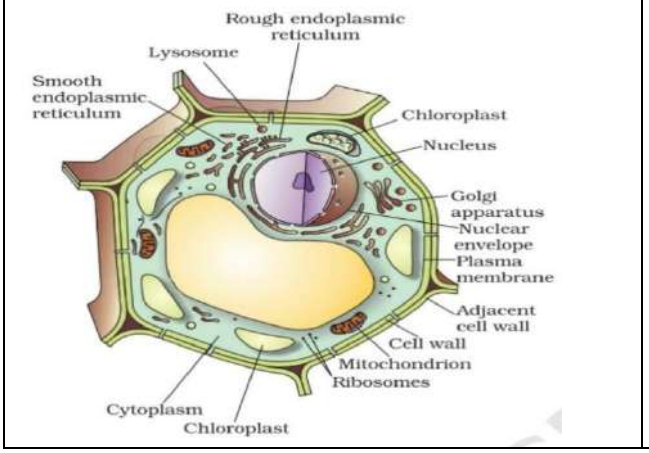
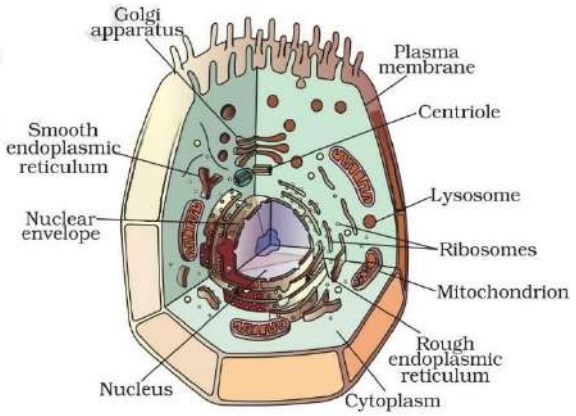
- Unicellular: Single-celled organisms like Amoeba.
- Multicellular: Have many cells like Human.

Difference Between Prokaryotic Cell And Eukaryotic Cell

Feature	Prokaryotic Cell	Eukaryotic Cell
Nucleus	Absent	Present
Size	1–10 µm	5–100 µm
Chromosome	Single	More than one
Organelles	No membrane-bound	Membrane-bound present

Difference Between Plant Cell And Animal Cell

Plant Cell	Animal Cell
Have cell wall	Do not have a cell wall
Usually possess Chloroplast	No Chloroplast
Large and central Vacuole	Small and many Vacuole

Centriole present only in few lower plants	Centriole present
	

Cell Structure And Function

- Cell Membrane: Semi-permeable membrane. Allows selective movement of substances.
- Cell Wall: Only in plants. Made of cellulose. Provides rigidity and protection.
- Cytoplasm: Jelly-like substance. Contains all cell organelles.
- Nucleus: Control center. Contains chromosomes (DNA).

Cell Organelles

Cell Organelles	Function
Endoplasmic Reticulum (ER)	Forms endoskeleton of cell. Helps in synthesis of fats, protein, etc. SER plays a crucial role in detoxification of drugs and poisonous by products. Membrane biogenesis
Golgi Apparatus	Storage, modification and packaging of products in vesicles. Formation of lysosomes.
Lysosomes	Digest any foreign material which enters the cell (like bacteria, virus)
Mitochondria	Site of cellular respiration Provides energy (in the form of ATP)
Plastids Leucoplast Chromoplast	 Storage of starch, oil and protein granules Provide colour to fruits and flowers
Vacuoles	Storage sacs for solid or liquid content
Ribosomes	Sites of protein synthesis

Movement Of Substances In And Out Of The Cell

Diffusion: Movement of particles from high to low concentration.

Osmosis: Movement of water from a region of higher to lower concentration through a semi-permeable membrane.

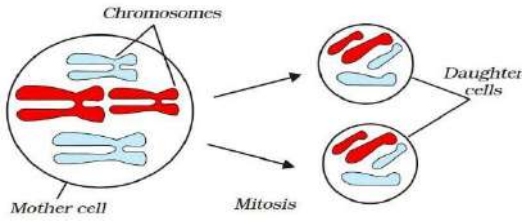
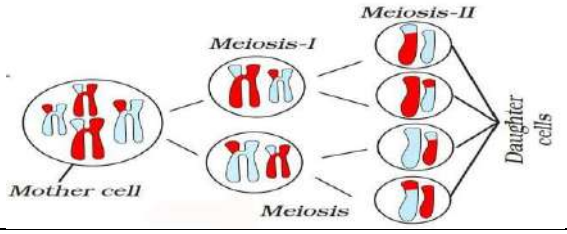
Types of Solutions on the Basis of Concentration and its effect on cell:

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.	Cell size does not alter.	Cell shrinks in this solution.

Cell Division

It is a process where new cells are produced from the existing ones in order to help in growth, replacement, repair and reproduction in all living organisms.

Types of Cell division

Mitosis	Meiosis
The type of cell division in which a cell divides into two daughter cell, each containing same number of chromosomes similar to the parent cell.	The type of cell division in which a diploid cell divides into four new cells in two successive divisions. The new cells have only half the number of chromosomes in comparison to parent cell.
	

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CHAPTERWISE QUESTION BANK

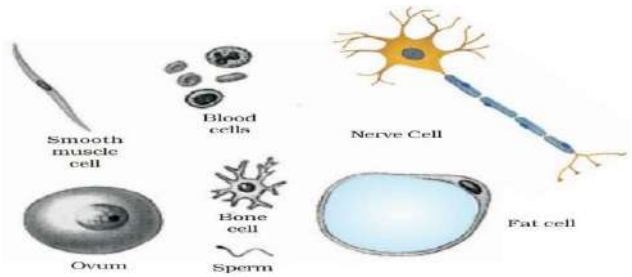
Multiple Choice Questions (1 Marks)

1. A student is studying the history of cell biology and learns about the discovery of "cells." Which scientist first observed and named "cells" after examining a thin section of cork under a microscope?

(a) Anton van Leeuwenhoek (b) Robert Hooke
(c) Matthias Schleiden (d) Theodor Schwann

Hint-discovery of cell

2. The image shows various types of cells. Based on the image, what could be the reason for the different shapes and sizes of the cells?



(a) To suit their function
(b) As they are formed first or last in the body
(c) As they are all animal cells
(d) As some are plant cells and some are animal cells

Hint-function

3. What will likely happen if an animal cell and a plant cell are placed in a sugar solution that has a higher water concentration than that of the animal and plant cells?

(a) Both the animal and plant cell will burst.
(b) Both the animal and plant cell will swell.
(c) Animal cell will swell while the plant cell will burst.
(d) Animal cell will burst while the plant cell will swell.

Hint-plasmolysis

4. A student is observing different cell organelles under an electron microscope. She notes that some organelles are surrounded by a single membrane, while others have double membranes. Based on this observation, which of the following organelles is most likely to be surrounded by a single membrane?

(a) Mitochondria (b) Lysosome (c) Plastid (d) All of these

Hint-cell organelles

5. What is one of the primary roles of the smooth endoplasmic reticulum in a cell?
(a) Expelling excess water and waste from the cell (b) Producing ATP molecules
(c) Digesting small foreign particles (d) Detoxifying harmful drugs
Hint- cell organelles function

6. During summer, the leaves of a potted plant droop when the soil dries up. Which cell organelle is mainly responsible for this drooping due to water loss?
(a) Nucleus- as it stops making DNA (b) Cell wall- as it starts to shrink
(c) Lysosome- as it releases digestive enzymes (d) Vacuole- as it loses all the water
Hint- cell organelles function

Assertion Reason Based Questions (1 Marks)

(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.

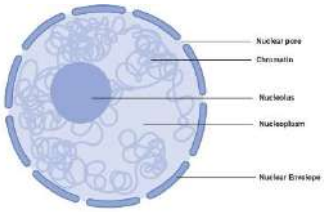
7. Assertion: Lysosomes are called 'suicide bags' of the cell.
Reason: They digest foreign substances and worn-out cell organelles.
Hint- enzymes digest foreign substances potentially breaking down the cell itself.

8. Assertion: Nucleus controls all cellular activities.
Reason: It is located outside the cytoplasm.
Hint-function & location of Nucleus

9. Assertion: Mitochondria are abundant in active cells like muscle cells.
Reason: Mitochondria provide energy required for cell activities.
Hint- produce energy (ATP).

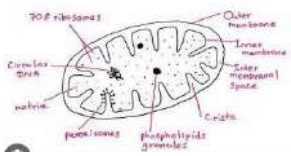
10. Assertion (A): Plasma membrane is called a selectively permeable membrane.
Reason (R): It allows only water molecules to pass through it.
Hint- Plasma membrane allows selective movement of various substances.

Very Short Answer Questions (2 Marks)



11. Why is the nucleus called the control center of the cell? Mention one function it performs.
Hint: DNA / Genetic Material

12. What is the role of the plasma membrane in the functioning of a cell? Mention one property that allows this function.
Hint: Selective permeability / Transport



13. A student learns that certain cell organelles help release energy for various functions of the body. Which organelle performs this function, and why is it commonly called the “powerhouse of the cell”?
Hint: ATP / Energy production

14. A student observes that raisins swell when kept in water and explains it using a cellular transport process. Identify the process and explain how it differs from diffusion.
Hint: Osmosis / Diffusion / Semi-permeable membrane

15. While observing cells under a microscope, a student notes that some cells have a well-defined nucleus while others do not. Classify these two types of cells and mention any two key differences between them.
Hint: Nucleus / Membrane-bound organelles / Prokaryotic / Eukaryotic

Short Answer Questions (3 Marks)

16. While preparing a slide of onion peel, a student observes a distinct boundary layer and a central dense structure. Identify these structures and explain their functions.
Hint: Cell wall, Cell membrane, Nucleus

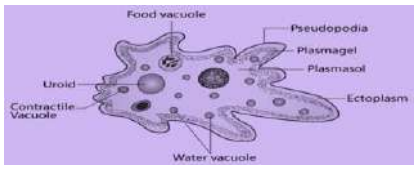
17. A student notices that the skin on their fingers shrinks after washing clothes for a long time in soapy water. Explain this observation using the concept of osmosis.
Hint: Osmosis / Hypertonic solution / Water loss

18. Explain what will happen to a plant cell when placed in (i) a hypotonic solution, (ii) a hypertonic solution, and (iii) an isotonic solution.
Hint: Turgid, Plasmolysis, No net movement

19. A student learns that growth and repair in the human body involve the formation of new cells. Identify the type of cell division involved and explain how it helps in these processes.
Hint: Mitosis / Growth / Repair

Long Answer Questions (5 Marks)
20. Analyze each of the following situations based on your understanding of the structure and functions of cell organelles and membranes. Explain what would happen in each case and why.
a) A student soaks dry apricots in plain water for a few hours and then transfers them into a concentrated sugar solution. What changes will be observed in both stages?
Hint: Movement of water across membranes (osmosis).
b) A red blood cell is placed in a concentrated saline (salt) solution. Predict and explain the result.
Hint: Hypertonic solution and water movement out of cell.
c) What would happen to a cell if its plasma membrane is damaged or broken?
Hint: Barrier and selective transport functions are lost.
d) Boiled Rheo leaf is used in an experiment with sugar syrup. Why does the expected osmosis effect not occur?
Hint: Effect of boiling on cell membrane and osmosis.
e) What might happen to a cell if its Golgi apparatus is removed?
Hint: Packaging and transport of proteins and lipids.

21. a) Why can't Amoeba use a digestive system like humans?
Hint: It carries out all life processes within a single cell and doesn't have organs.
Identify and explain the biological phenomenon responsible when a person vomits after consuming a concentrated salt solution.



Hint: Osmosis, Concentration gradient, Cell shrinkage due to water loss, Body's protective reflex (vomiting)

Case study Based Questions (4 Marks)
22. Riya observed onion peel under a microscope during her biology lab. She noted that the cells were rectangular and arranged in rows. Each cell had a thick boundary and a dense, round structure in the center. Later, she examined cheek cells and found them irregular in shape but also

had a prominent central structure.
(a) What is the dense, round structure Riya observed in both onion and cheek cells, and what is its primary function?
Hint: It's the control center of the cell, responsible for genetic material and regulating cell functions.
(b) What is the difference between the outer boundary of onion cells and cheek cells, and why is there a difference?
Hint: One has a rigid covering, the other has a flexible membrane — think about plants needing structure and support.
(c) Based on Riya's observation, compare plant and animal cells in terms of shape, outer boundary, and presence of specific cell structures.
Hint: Think about cell wall, chloroplasts, shape (regular/irregular), and vacuoles.

23. In a science project, Meena compared the activities of a cell to a city. She identified certain organelles that function like power stations, storage units, waste disposal systems, and factories. Her analogy helped her understand how the cell works efficiently like a well-organized city.
(a) Which organelle is referred to as the "powerhouse" of the cell, and why is it given this name?
Hint: Think about which organelle produces energy (ATP) needed for cell activities.
(b) Meena compared the Golgi apparatus to a courier service in the city. Justify this comparison by explaining its function.
Hint: It's involved in modifying, packaging, and transporting proteins and lipids.
(c) Based on Meena's analogy, explain the role of lysosomes and vacuoles in a cell. How do they contribute to cell maintenance and survival?
Hint: One digests waste, and the other stores useful or harmful substances. Link this to cleanliness and storage in a city.

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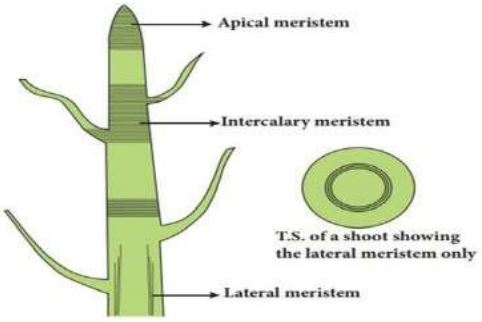
6
Tissues

Tissue

- A group of cells that are similar in structure and work together to perform a particular function.
- Tissues provide structural strength, mechanical strength, show division of labour.

PLANT TISSUE



Meristematic tissues and their location.

Meristematic Tissue

Found at the growth region of the plant.

These cells have the following characteristics:

- These are very active.
- The cellulose cell wall of these cells is thin.
- They have dense cytoplasm.
- They have lack vacuoles.
- Have prominent nucleus (slightly large sized nucleus).

Meristematic Tissue	Location	Function
Apical Meristem	Present at growing tip of shoot and root	Increase the length of stem and root
Intercalary Meristem	Present at the base of leaves and internode	Increase the length of internode or leaf
Lateral Meristem	Present on the side of stem and root	Increase the girth of stem and root

Permanent Tissue

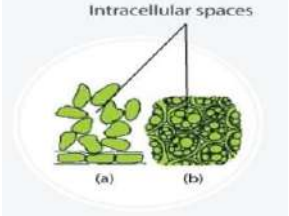
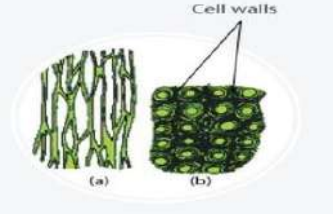
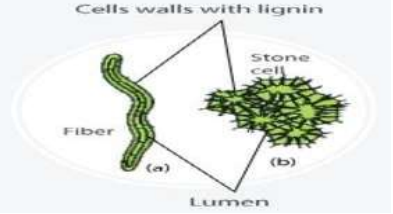
They are are formed from those meristematic cells which have lost their capability to divide.

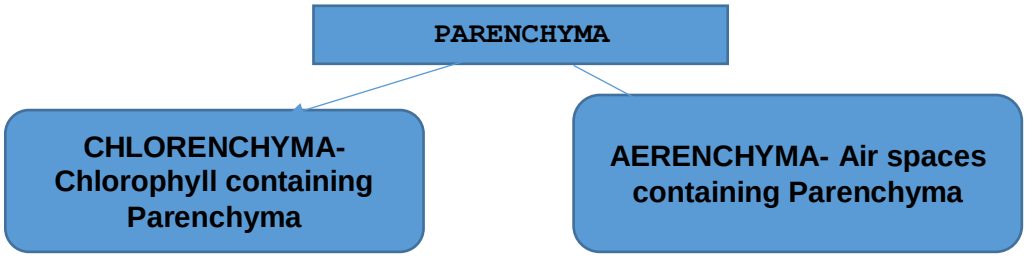
Types of Permanent tissues:(a) Simple permanent tissues, (b) Complex permanent tissues

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	Collenchyma	Sclerenchyma
Cell	Large intercellular space	Less intercellular space	No intercellular space
Function	Stores food, provides mechanical support	Flexibility, mechanical support	Makes the plant hard and stiff
Cell Wall	Thin cell wall	Cells are elongated with cell wall irregularly thick at corners	Thick cell wall (made of Lignin)
Type	Live cells	Live cells	Dead cells
Location	Almost in all parts of plant body	Present in leaf stalk	Seed coat, coconut husk
Diagram			



Complex Permanent Tissues

They are made up of more than one type of cells.

Xylem and phloem are examples. Both are conducting tissue and form vascular bundles.

Xylem	Phloem
It consists of tracheids, vessels, xylem fibre and xylem parenchyma.	Made up of four elements sieve tubes, companion cells, phloem fibres and phloem parenchyma.
Except xylem parenchyma all are dead cells	Except phloem fibre all are living cells.
Xylem helps in transport of water from roots to other parts of plant.	Phloem transport food.
Tracheids and vessels are tubular structure which conduct water and minerals vertically.	Phloem transport is bidirectional

ANIMAL TISSUES

Types of Animal Tissues

Tissue Type	Function
Epithelial	Protection, absorption, secretion
Connective	Connection, support, transport
Muscular	Movement
Nervous	Control and coordination

1)Epithelial Tissue (Covering Tissue)

Type	Structure	Location	Function
Squamous	Flat, thin cells	Lining of blood vessels, alveoli	Diffusion, protection
Cuboidal	Cube-shaped cells	Kidney tubules, glands	Absorption, secretion
Columnar	Tall, pillar-like	Intestine, stomach	Absorption, secretion
Ciliated	Columnar + cilia	Respiratory tract	Moves mucus
Glandular	Modified columnar/cuboidal	Glands	Secretion of enzymes/hormones

2)Connective Tissue (Binding Tissue)

Type	Components	Function	Examples
Areolar	Fibres + cells (fibroblasts, mast cells)	Binds skin to muscles	Under skin
Adipose	Fat-storing cells	Insulation, energy storage	Below skin, around organs
Bone	Hard matrix (calcium + phosphorus)	Support, protection, blood formation	Skeleton
Cartilage	Flexible, chondrin matrix	Smooth surface for joints	Ear, nose, windpipe

Ligaments	Bone to bone, elastic	Support joints	Knee, elbow
Tendons	Muscle to bone, less elastic	Attach muscles	Biceps, triceps
Blood	Fluid (plasma + cells)	Transport (O_2, CO_2, nutrients)	Whole body
Lymph	Clear fluid, no RBC	Immunity, return of tissue fluid	Lymph nodes

3)Muscular Tissue (Movement Tissue)

Type	Appearance	Control	Location	Function
Striated	Striped, multinucleated	Voluntary	Skeleton muscles	Body movement
Smooth	Spindle-shaped, no stripes	Involuntary	Stomach, intestine	Involuntary movement
Cardiac	Striated + branched	Involuntary	Heart only	Rhythmic heartbeat

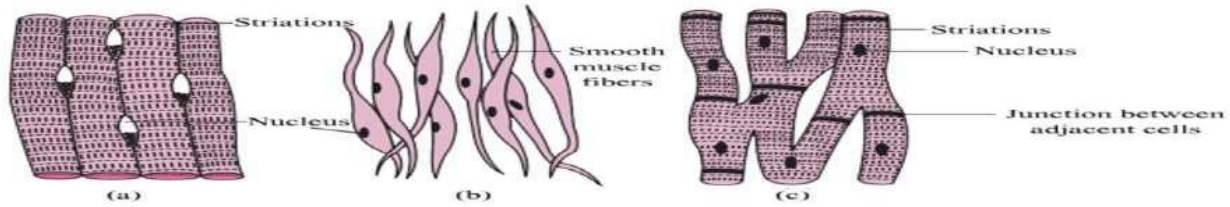
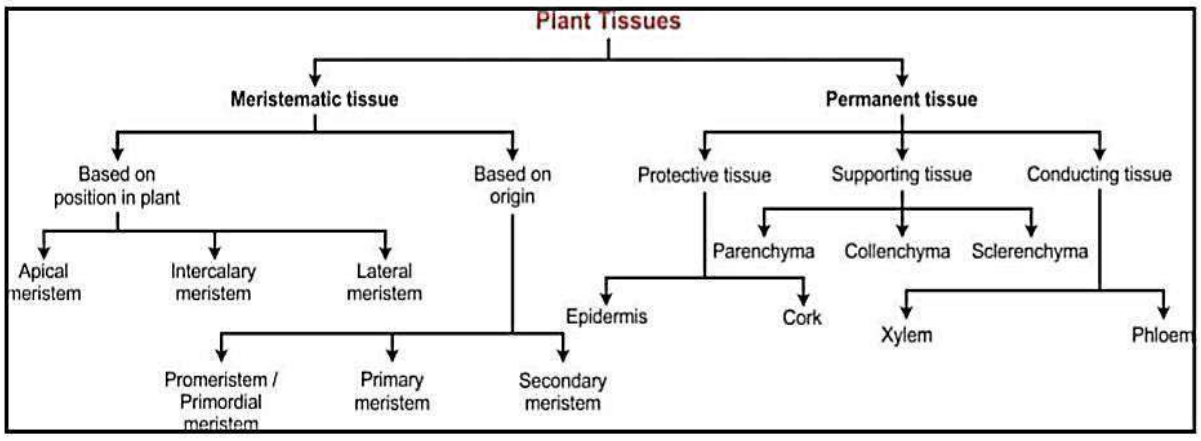


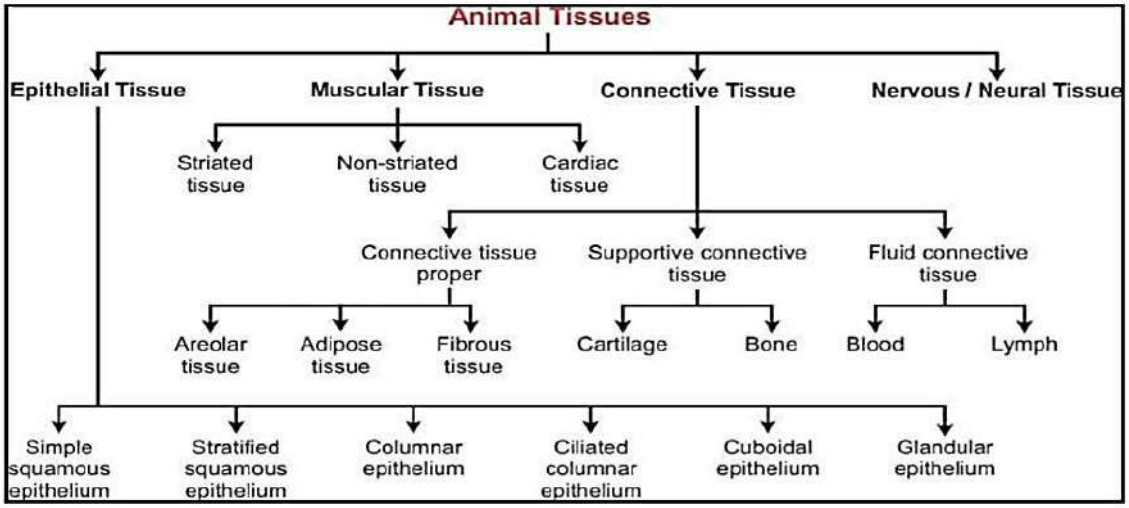
Fig: (a). Skeletal muscle (b). Smooth muscle (c). Cardiac muscle

4)Nervous Tissue- Transmit messages from brain to body and back

Neuron—a unit of nervous tissue

MIND MAP





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CHAPTERWISE QUESTION BANK

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Multiple Choice Questions (1 mark each)

1. A student is observing a cross-section of a plant stem under a microscope. Which of the following tissues would they expect to find primarily responsible for supporting the stem and providing structural integrity, especially in older parts of the plant?

(a) Meristematic tissue (b) Parenchyma tissue

(c) Sclerenchyma tissue (d) Xylem tissue

Hint-Function of plant tissue

2. A farmer is trying to understand why some of his crops are wilting, even though he has watered them sufficiently. He notices that the leaves are drooping and have a lighter color. Which of the following plant tissue types is most likely the cause of the wilted leaves?

(a) Epidermis (b) Xylem (c) Phloem (d) Meristem

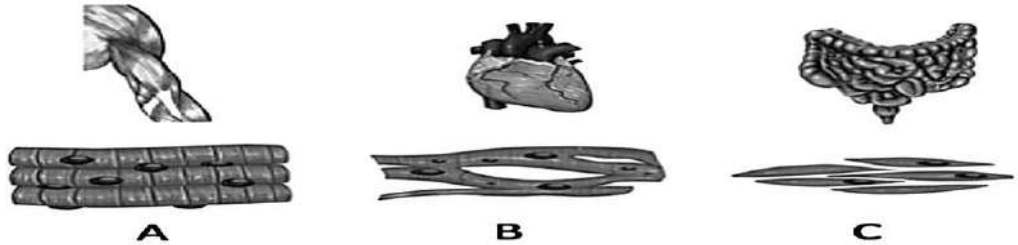
Hint-Transportation of water

3. Consider a plant that is being stressed by dry conditions. Which type of plant tissue would you expect to be most important for protecting the plant from water loss?

(a) Meristematic tissue (b) Sclerenchyma tissue (c) Epidermis (d) Phloem

Hint-Outer layer

4. The image below shows different types of muscle tissues labeled A, B, and C.



Based on its structure and characteristics, which function is most likely performed by tissue B?

(a) Movement of body
(b) Contraction and relaxation of heart
(c) Rapid movement of iris of the eye
(d) All of these

Hint-Cardiac muscle

5. During a sprinting race, Meera suddenly felt a pull where her calf muscles attached to her leg bone. Her coach explained that a specific tissue was strained, which connects muscles to bones and enables movement. Which type of tissue was he referring to?
(a) Ligament (b) Tendon (c) Cartilage (d) Bone
Hint-Connective tissue

6. In a science experiment, Aisha was blindfolded and asked to identify objects by touch. She could still feel textures, temperatures, and shapes and responded accordingly. Which tissue made this sensory recognition and quick response possible?
(a) Epithelial tissue (b) Connective tissue (c) Nervous tissue (d) Muscular tissue
Hint-Control and coordination

Assertion-Reason Based Questions (1mark each)
(a) Both A and R are true and R is correct explanation of A
(b) Both A and R are true, but R is not correct explanation of the assertion.
(c) A is true, but R is false.
(d) A is false, but R is true.

7. Assertion: Meristematic tissue is responsible for plant growth and development.
Reason: Meristematic cells are actively dividing and can differentiate into various permanent tissues.
Hint Function of plant tissue

8. Assertion: Collenchyma cells have unevenly thickened cell walls.
Reason: The thickening of walls provides flexibility and mechanical support to growing parts of the plant.
Hint-Function of plant tissue.

9. Assertion (A): Ligaments connect muscles to bones.
Reason (R): Ligaments are made of elastic tissue and provide flexibility to joints.
Hint-Function of connective tissue

10. Assertion (A): Cardiac muscles do not get tired easily.
Reason (R): Cardiac muscles work continuously and are resistant to fatigue.
Hint- Function cardiac tissue

Very Short Answer Questions(2 marks each)

11. During a lab visit, students observed tiny openings on the surface of leaves under a microscope. The teacher explained that these structures help in maintaining the plant's internal balance.
What are these structures called, and explain two important functions they perform in plants?
Hint: These openings help the plant "breathe" and also control water loss.

12. A biology teacher shows students a diagram of the human body and points to different locations like the mouth, under the skin, bloodstream, and brain. She then asks them to identify the specific tissues present at each of these sites based on their structure and function. Name the following tissues based on their function and location:
(a) Tissue that forms the inner lining of our mouth.
(b) Tissue that stores fat in our body.
(c) Connective tissue with a fluid matrix.
(d) Tissue present in the brain.

Hint: (a) Squamous epithelium (b) Adipose tissue (c) Blood (d) Nervous tissue

13. While visiting a pond, Anil observed that water hyacinth plants were floating on the water surface without sinking. Why do water hyacinths float on water?
Hint: Think about plant structures that might help in buoyancy or lightness.

14. Draw a well-labelled diagram of a neuron.
Hint: Refer Page no.69 Fig.6.12 of textbook

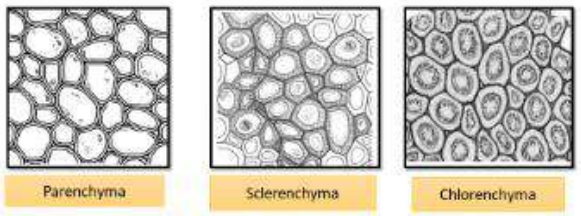
15. Which plant structure provides the first line of defense against the invasion of parasites, and how does it help in protection?
Hint: It's a protective tissue found on the outer surface of roots, stems, and leaves.

Short Answer Questions (3 Marks)

16.Riya placed a potted plant under a glass jar. After a few hours, she noticed water droplets forming on the inner surface of the glass. Why did water vapours appear on the walls of the glass jar?
Hint: Think about how plants lose water through their leaves.

17. A teacher shows two plant tissue samples under a microscope. One appears to have thick, dead cells tightly packed with no spaces. The other shows living cells with thin walls and large spaces between them.
Hint: Differentiate between sclerenchyma and parenchyma tissues

18. During a science activity, students examined plant tissues under a microscope and later ate pear fruit. They discussed the structure of plant tissues based on what they saw and experienced. Give reasons for the following observations:
(a) Intercellular spaces are absent in sclerenchymatous tissues.
(b) It is difficult to pull out the husk of a coconut tree.
(c) We get a crunchy and granular feeling when we chew pear fruit.
Hint: Think about how plant cells provide support or texture.



19. A student was studying plant tissues and noticed that xylem and phloem consist of different types of cells working together. Why are xylem and phloem called complex tissues? How are they different from one another?
Hint: A student was studying plant tissues and noticed that xylem and phloem consist of different types of cells working together.

Long Answer Questions (5 Marks)

20.(a) Animals of colder region and fishes of cold water have thicker layer of subcutaneous fat. Describe why?
(b) State the functions of the three types of muscle fibres in the human body. Also, name the structural features of each type that support its function.
Hint: (a)Think about how animals maintain body temperature and survive in extremely cold conditions.
(b)Think about where these muscles are found in the body (e.g., limbs, heart, stomach) and how their structure (striations, nuclei, control) relates to their role.

21. (a) Fibre A helps in voluntary body movements, Fibre B is found in the walls of internal org**Hint-**and works involuntarily. Together, Fibre A and Fibre B, along with Fibre C which is found only in the heart, form Tissue D. Identify A, B, C, and D.

Hint: A – Skeletal muscle, B – Smooth muscle, C – Cardiac muscle, D – Muscular tissue

(b) Identify the following tissues:
a) Dead part of phloem
b) Form cilia in the respiratory tract
c) Provides flexibility in plants
Hint: (a)Phloem fiber (b)Epithelial tissue (c) Collenchyma

Case study Based Questions (4 Marks)
22. A young athlete named Raj, who is a long-distance runner, experiences muscle soreness and fatigue after a grueling training session. His legs feel weak and stiff, and he's unable to continue his workout. He has also been feeling short of breath.
(a) What type of muscle tissue is primarily responsible for Raj's leg movement, enabling him to run?
(b) Describe two main characteristics of the type of muscle tissue that allows Raj to run long distances without fatigue.
(c) What other types of tissues are involved in Raj's running, and how do they work together to support his movement?
Hint: (a)This muscle tissue is under voluntary control and helps in moving body parts.
(b) Think of the muscle type found in the heart that works continuously and involuntarily.
(c)Think of tissues that connect bones and muscles, and those that transmit signals

23. A farmer noticed that one of his sugarcane plants was not growing as tall as the others in his field. He observed that the plant had thin stems and its leaves appeared smaller. On consulting an agricultural expert, he learned that this issue could be due to improper functioning or damage to a specific type of plant tissue responsible for support and conduction.
(a) Which plant tissue is primarily responsible for the transport of water in plants?
(b) Name the plant tissue that provides flexibility and mechanical support in growing parts of plants.
(c) How do xylem and phloem differ in their functions? Mention one component of each.
Hint: (a)Think about the vascular tissue that conducts water from the roots to all parts of the plant. It mainly consists of vessels and tracheids.
(b) This tissue found in leaf stalks and young stems, it helps the plant bend without breaking.
(c) One of these tissues transports water and minerals, while the other transports food.
Try to recall the main components like vessels, sieve tubes, and companion cells.

****

7
Motion

Motion and rest

Rest	Motion
An object is said to be in the state of rest if it does not change its position with time with respect to its surroundings.	An object is said to be in the state of motion if it changes its position with time and with respect of its surroundings.

Types of Motion

Linear motion: Motion along a straight line.
Circular motion: Motion along a circular path.
Oscillatory motion: Repetitive to and fro motion of an object at regular interval of time.
Random motion: Motion of the object which does not fall in any of the above categories.

Types of Physical quantities

Scalar quantity	Vector quantity
the physical quantity that has only magnitude and not direction. Ex. Distance, speed, time etc.	the physical quantity that has both magnitude as well as direction. Ex. Displacement,velocity,acceleration etc.

Distance and Displacement

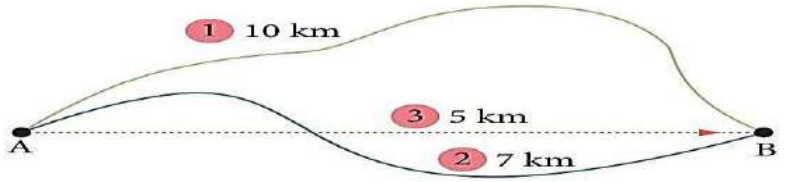
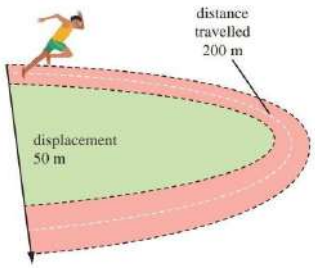


Figure shows the motion of a person between two places A and B.

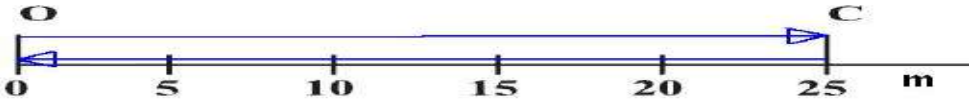


Which path is : (a)the shortest ……(b)the longest …….. (options - path 1/2/3)

Distance	Displacement
Distance is the total path which is covered by an object with given time . It is a scalar quantity.	Displacement is the shortest distance from the initial position to the final position of the object during a given time. It is a vector quantity.

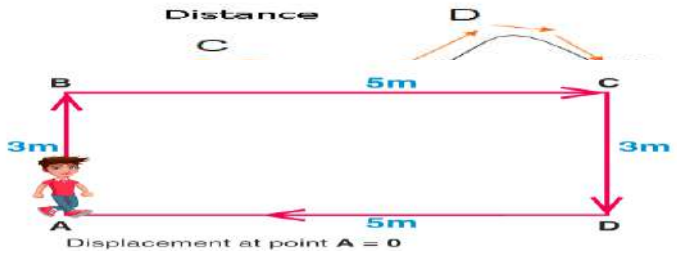
SI unit of Distance and displacement – metre (m)

- Displacement is equal to the distance if an object moves in a straight line.



Distance = 25 m , Displacement = 25 m

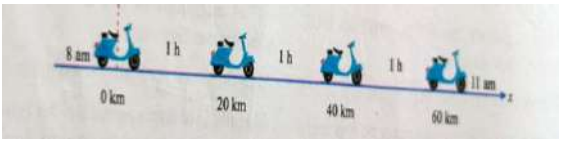
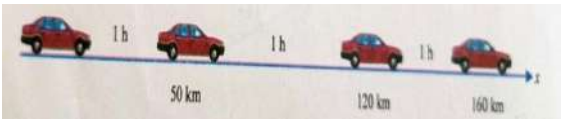
-
- Displacement is less than distance if the direction is changed.



- Displacement can be zero if object comes back its original position.
  Distance = 16 m , Displacement = 0 m

Odometer - A device that measures the distance travelled. (Fitted in automobiles)

Types of Motion

Uniform motion	Non-uniform motion
When an object covers equal distance in equal intervals of time. This type of motion is called uniform motion . 	When an object covers unequal distances in equal intervals of time. This type of motion is called non-uniform motion. car is moving on a crowded street. 

Speed and Velocity

Speed	Velocity (speed with direction)
It is the distance travelled by an object in unit time. speed = $\frac{Distance}{Time}$ It is scalar unit.	The displacement of the object per unit time. *Velocity* = $\frac{Displacement}{Time}$ It is vector quantity.

Speed and Velocity have the same unit **m/s**. Larger unit **km/h or km h^{-1}**.

Average speed is the ratio of total distance travelled by the object to the total time taken to cover that distance.

Average speed = $\frac{Total\ distance\ travelled}{Total\ time\ taken}$ $v_{av} = \frac{s}{t}$

Average Velocity is the ratio of total displacement of the object to the total time taken for that displacement.

Average Velocity = $\frac{Total\ displacement}{Total\ time}$ $v_{av} = \frac{s}{t}$

If the velocity of an object in linear motion is changing at a uniform motion rate, the average velocity of the object is given by the arithmetic mean of initial velocity and final velocity of the given time interval.

Average Velocity = $\frac{Initial\ velocity + final\ velocity}{2}$ $v_{av} = \frac{u+v}{2}$

Acceleration is a measure of the change of velocity of an object per unit time.

The rate of change of velocity is called acceleration.
SI unit of a metre/second^2 or m/s^2 m s^{-2}.

Acceleration = $\frac{Change\ in\ velocity}{Time\ taken}$ $a = \frac{v-u}{t}$

Change in velocity = Final velocity (v) – initial velocity (u) = v – u

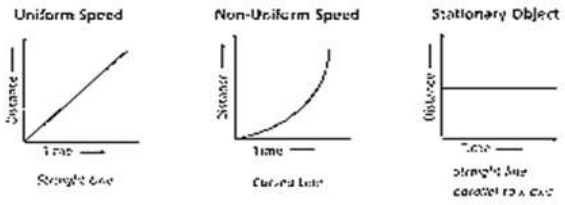
Types of Acceleration by its value in +/-

Positive acceleration	NegativeAcceleration/ Retardation.
If the direction of acceleration of an object is the same as the direction of the velocity, the acceleration of the object is said to be positive. (v > u) Ex. A train starts from rest from a station and speed up.	In this case , the direction of acceleration is opposite to the direction of velocity. *(v < u)* Ex. When an aeroplane lands, the speed of aeroplane decreased as it approaches the ground.

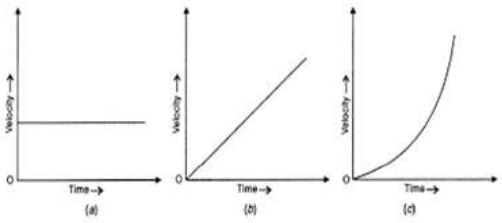
Uniform Acceleration	Non-uniform Acceleration
If an object travels in a straight line and its velocity increases or decreases by equal amounts in equal intervals of time. Motion of an object with uniform acceleration is known as uniformly accelerated motion. Ex. (i). Free fall of a ball thrown from a height.	If the velocity of an object changes by unequal amounts in equal intervals of time. Motion of an object with non-uniform acceleration is known as non-uniformly accelerated motion. Ex. (i). The motion of a car on a busy road with high traffic flow changes with time. The driver uses accelerator and breaks off and on.

Graphical Representation of Motion

a). Distance-time graphs



b). Velocity-time graphs



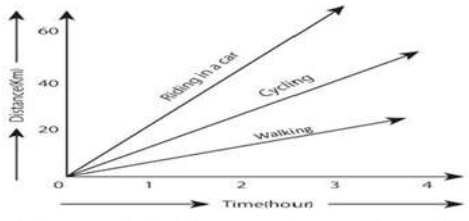


Figure 2.3 Comparison of speed

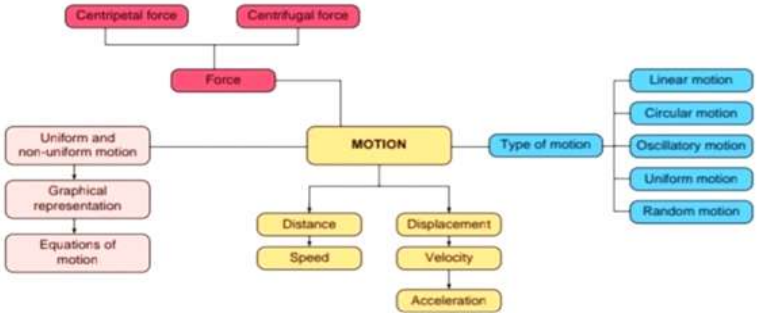
The slope of the line on the distance - time graph becomes steeper and steeper as the speed increases

Equations of Motion:

(i) $v = u + at$

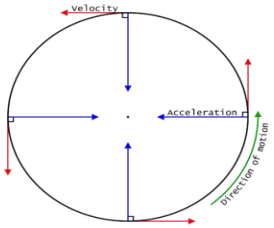
(ii) $s = ut + + \frac{1}{2} at^2$

(iii) $2\,a\,s = v^2 - u^2$



Uniform Circular Motion:

If an object moving with constant speed along a circular path is called uniform circular motion.



In uniform circular motion, the direction of motion is continuously changing and velocity of the object in circular motion is also continuously changing. So, the acceleration of an object in uniform circular motion is only because of change in the direction of its motion.

Examples of uniform circular motion:

a). Motion of moon around earth.

b). Motion of a satellite around its planets.

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CHAPTERWISE QUESTION BANK

.Multiple Choice Questions (1mark each)

1. Which physical quantity does a car's speedometer measure, and how does it help in understanding the motion of the vehicle at a given moment?"

Choose the correct answer:

(a) Average speed (b) Average velocity (c) Instantaneous speed (d) Displacement

Hint- It shows how fast the car is moving at a specific moment, not over a period of time.

2. When final position of an object in motion coincides with its initial position. In this case-

(a) both displacement and distance are zero (b) displacement is zero, but distance is not zero

(c) distance is zero, but displacement is not zero(d) distance and displacement both are non-zero.

Hint-Distance & displacement

3. A cyclist moving on a circular track of radius 40 m completes half a revolution in 40 s. Its average velocity is -

(a) zero (b) 2m / s (c) 2πm/s (d) 4πm/s

Hint-Numerical

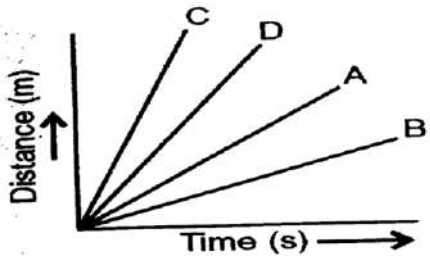
4. Retardation of a body is -

(a) negative speed of the body (b) negative acceleration of the body

(c) negative velocity of the body (d) none of the above.

Hint-Deacceleration

5. Four cars A, B, C and D are moving on a levelled road. Their distance versus time graphs are shown in figure. Choose the correct statement :



(a) Car A is faster than car D.

(b) Car B is the slowest.

(c) Car D is faster than car C.

(d) Car C is the slowest.

Hint- The slope steeper the speed increases

6. For a uniformly accelerated body with initial and final velocities as u and v m /s respectively, the average velocity is -

(a) a/2 (b) v/2 (c) (u + v)/2 (d) (v - u)/2

Hint-total displacement/time

Assertion-Reason Based Questions (1mark each)

(a) Both A and R are true and R is correct explanation of A

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

(c) A is true, but R is false.

(d) A is false, but R is true.

7. Assertion: There is no difference between distance and displacement.

Reason: Distance and displacement have same units.
Hint-Distance & displacement
8. Assertion:When final position of a body coincides with its initial position, the body is at rest.
Reason: This is because distance is scalar and displacement is vector.
Hint-Distance & displacement
9. Assertion: Uniform circular motion is also called accelerated motion.
Reason: Direction of motion changes at every point. So velocity is not constant.
Hint-types of motion
10. Assertion: The slope of distance time graph gives acceleration of the body.
Reason: Greater the slope of distance time graph, more is the speed of the body.
Hint- The slope steeper the speed increases

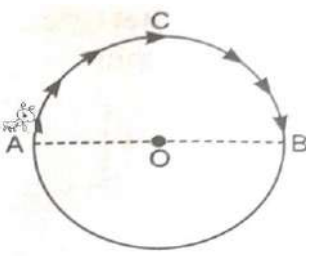
Very Short Answer Questions(2 marks each)

11. A van travels on a straight road with a velocity of 25 km/hour in first one hour and in the next one hour it changes its speed to 35 km/hour. What is the average velocity of the van ?
Hint- *Average Velocity* = $\frac{Initial\ velocity + final\ velocity}{2}$
12. The length of minute hand of a clock is 14 cm. Calculate the speed at which the tip of minute hand moves.
Hint- Radius of clock dial = Length of minute hand
13. How would you identify whether an object is accelerating or retarding in a given situation? Use examples to support your explanation.
Hint- Check if the object's speed is increasing (acceleration) or decreasing (retardation) over time.
14. Observe and describe two examples of uniform circular motion from your daily environment, and explain how the speed remains constant while the direction changes.
Hint-Practical life example
15. A mini bus accelerates uniformly from 54km/h to 72km/h in 10 seconds. Calculate its acceleration.
Hint- conversion of unit in m/s,use formula of acceleration

Short Answer Questions (3 marks each)

16. What does the odometer of an automobile measure? Which of the following is moving faster? Justify your answer.

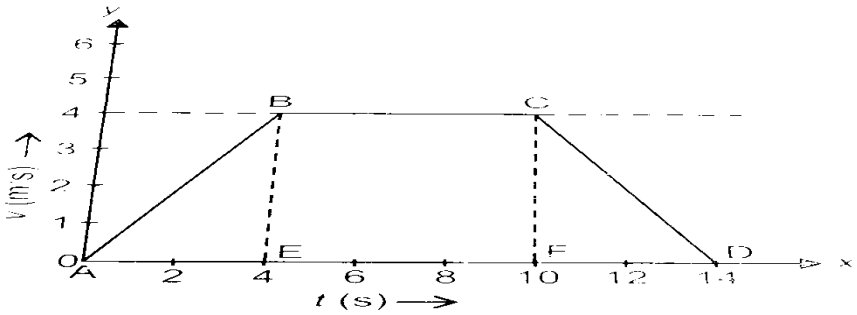
(a) A scooter moving with a speed of 300 m per minute.
(b) A car moving with a speed of 36 km per hour.
Hint- Convert into same unit and compare
17. Analyze the difference between uniform and non-uniform motion using real-life examples, and explain how you can identify each type of motion through observation or measurement.
Hint- If an object covers equal distances in equal time intervals.
18. A body is accelerating at a constant rate of 10m / s^2 . If the body starts from rest, how much distance will it cover in 2 seconds?
Hint- s =ut +½ at^2
19. An ant moves along a circular path of radius 10 cm with a constant speed. It takes 1 min to move from a point on the path to the diametrically opposite point, find



(a) the distance covered (b) the speed(c) the displacement
Hint- distance covered = Length of arc AB ,speed =Distance/time

Long Answer Questions (5 marks each)

20. (a) Study the given graph and answer the following questions.



(i) Which part of the graph shows accelerated motion?

(ii) Which part of the graph shows retarded motion?

(iii) Calculate the distance travelled by the body in first 4 seconds of journey graphically.

Hint-area of triangle ABE

(b) Write any 2 point of difference between Speed and Velocity.

21 (a) Draw the distance-time graph for the following situations:

(i) When a body is stationary.

(ii) When a body is moving with a uniform speed.

(iii) When a body is moving with non-uniform speed.

(b) An auto is moving along a circular path of radius r .What will be the distance and displacement of the body when it completes half revolution?

Hint-circumference

Case study Based Questions (4 marks each)

22. *Rahul travels from his home to his school, which is 2.4 km away, in 10 minutes by bicycle. On his way back, he takes a longer route due to road repairs and covers 3.2 km in 16 minutes.*

Answer the following questions:

(a) Calculate Rahul's average speed for the entire journey.

(b) What is his average velocity for the entire journey?

(c) Why is the average speed greater than or equal to the magnitude of average velocity in such cases?

Hint-use formula of average speed and Velocity

23. *Seeta went for a morning walk in a rectangular park. The length of the park is 100 meters and the breadth is 60 meters. She started from the southwest corner of the park, walked along the boundary in a clockwise direction, and stopped at the northwest corner after covering three sides of the rectangle.*

Answer the following questions based on the above case: (1mark each)

(a) What is the total distance covered by Seeta?

(b) What is her displacement from the starting point?

(c) Why is the distance greater than the displacement in this case?

(d) If Seeta completes one full round along the park's boundary, what will be the distance and displacement?

Hint-shape of path is rectangular ,distance is actual path length, displacement is the shortest path

****

8

Force and Laws of Motion

1.4.2 Force

Force is an external effort in the form of push or pull, which:

1. produces or tries to produce the motion of a static body.
2. stops or tries to stop a moving body.
3. changes or tries to change the direction of motion of a moving body.

Force has both magnitude and direction. So, it is a vector quantity.

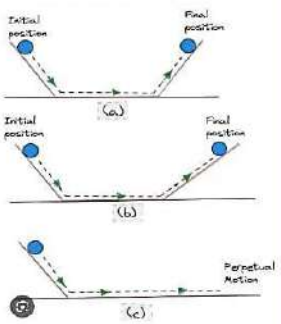
Galileo proposed the following concepts about force, motion and inertia of bodies:

(i) The natural state of all earthly bodies is either the state of rest or the state of uniform motion.

(ii) A body in motion will continue to be in the same state of motion as long as no external force is applied.

(iii) When a force is applied on bodies, they resist any change in their state. This property of bodies is called 'inertia'.

(iv) When dropped from a height in vacuum, bodies of different size, shape and mass fall at the same rate and reach the ground at the same time.



FORCE AND ITS EFFECTS GALILEO'S IDEAS

Formula F = m×a SI UNIT - **NEWTON (N)**

Difference between balanced and unbalanced forces

Balanced Forces	Unbalanced Forces
Balanced forces are those that are opposite in direction and equal in size. Balanced forces are considered to be in a state equilibrium." When forces are balanced there is no change in direction. Combined forces that are balanced are always equal. Balanced forces cannot change the motion or direction of an object. A balanced force keeps an object moving at a constant velocity. Example: An object floating in water.	**"When the forces acting on an object are not equal and opposite ,the resulting net force called unbalanced force."** Unbalanced forces are always cause a change in motion of object (change in both direction and speed of object) When two unbalanced forces are exerted in opposite directions, the combined force is the difference between both forces. When the forces are at right angles the net force is equal to the resultant. **Example** : An object sinking in water.

Laws of motion: Newton further studied Galileo's ideas on force and motion. Then he gave three fundamental laws of motion. These laws are also known as **Newton's laws of motion.**
First Law of Motion: "An object remains in a state of rest or uniform motion in a straight line unless compelled to change that state by an applied force." First law of motion is also known as the law of inertia**.**
Inertia: The tendency of undisturbed objects to stay at rest or keep moving with the same velocity is called inertia.
Inertia and Mass: **"Inertia is the natural tendency of an object to resist a change in its motion or of rest. The mass of an object is a measure of its inertia."** Ex. Heavier or massive objects have larger inertia.

1.2.2 Examples of Inertia

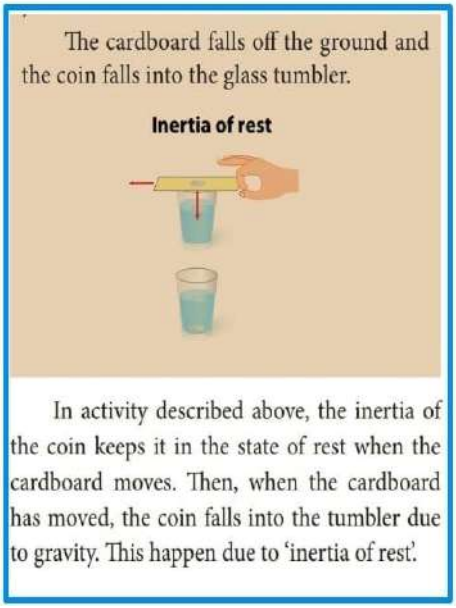
- An athlete runs some distance before jumping. Because, this will help him jump longer and higher. (Inertia of motion)
- When you make a sharp turn while driving a car, you tend to lean sideways, (Inertia of direction).
- When you vigorously shake the branches of a tree, some of the leaves and fruits are detached and they fall down, (Inertia of rest).

a) **Inertia of rest:** The resistance of a body to change its state of rest is called inertia of rest.

b) **Inertia of motion:** The resistance of a body to change its state of motion is called inertia of motion.

Figure 1.1 Inertia of motion

c) **Inertia of direction:** The resistance of a body to change its direction of motion is called inertia of direction.

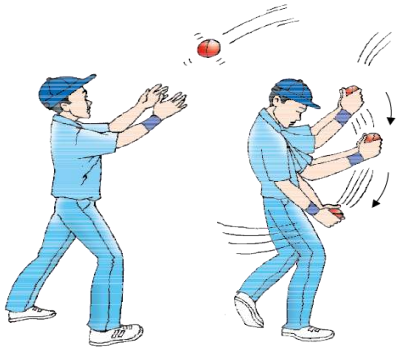


In activity described above, the inertia of the coin keeps it in the state of rest when the cardboard moves. Then, when the cardboard has moved, the coin falls into the tumbler due to gravity. This happen due to 'inertia of rest'.

Second Law of Motion: "The rate of change of momentum of an object is proportional to the applied unbalanced force in the direction of force."

Momentum: Momentum is the product of mass of an object and its velocity.

- It is expressed by p. **p = mv**
- Momentum has both direction and magnitude.
- The SI unit of momentum is kilogram metre per second
- ($kgms^{-1}$).
- The change of momentum of an object is depends on the magnitude of the force as well as time rate at which the momentum is changed.



The SI unit of force: kg m s^{-2} Or Newton (N).

Thus, the second law of motion gives a method to measure the force acting on an object as a product of its mass and acceleration.

Ex. Second law of motion is in everyday life.

Catching a ball by a cricket fielder. He pulls his hands gradually with the moving ball after catching. Actually, he wants to increase the time for decrease the acceleration. Therefore, the impact of catching fast moving ball is also reduced. If he does not it or stop the ball suddenly, the fast-moving ball may hurt the palm of the fielder. The rate of change of momentum will be large due to velocity decrease to zero. And large force will impact on his palm.

Third Law of Motion: "For every action, there is an equal and opposite reaction."
OR **"Whenever one object exerts a force on another, the second object exerts an equal and opposite on first."**

- The action and reaction forces are always equal in magnitude.
- These forces may not produce acceleration of equal magnitudes because both forces act on a different object that may have a different mass.

Ex. i). When a gun is fired, it exerts a forward (←) force on the bullet. The bullet exerts an equal and opposite force on the gun. This results in the recoil (→) of the gun.

Explanation: The gun has much mass than the bullet, the acceleration of the gun is much less than the acceleration of the bullet.

ii). When a sailor jumps out of a rowing boat. As the sailor jumps forward (←), the force on the boat moves it backward (→)

8.4.1 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 $\propto p_2 - p_1$
$\propto mv - mu$
$\propto m \times (v - u)$.

The rate of change of momentum $\propto \frac{m \times (v-u)}{t}$

Or, the applied force,

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

$$F = \frac{kmv \times (v-u)}{t} \quad (8.2)$$

$$= kma \quad (8.3)$$

Here a [$= (v - u)/t$] is the acceleration, which is the rate of change of velocity. The quantity, k is a constant of proportionality. The SI units of mass and acceleration are kg and m s^{-2} respectively. The unit of force is so chosen that the value of the constant, k becomes one. For this, one unit of force is defined as the amount that produces an acceleration of 1 m s^{-2} in an object of 1 kg mass. That is,

1 unit of force $= k \times$ (1 kg) $\times$ (1 m s^{-2}).

Thus, the value of k becomes 1. From Eq. (8.3)

$$F = ma \quad (8.4)$$

The first law of motion can be mathematically stated from the mathematical expression for the second law of motion. Eq. (8.4) is

$$F = ma$$

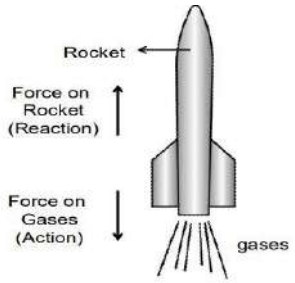
or $$F = \frac{m(v-u)}{t} \quad (8.5)$$

or $$Ft = mv - mu$$

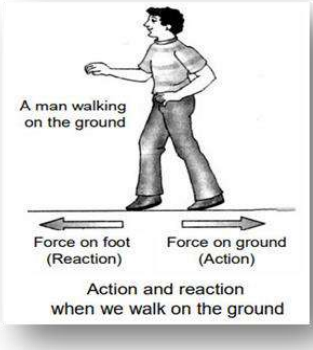
That is, when $F = 0$, $v = u$ for whatever time, t is taken. This means that the object will continue moving with uniform velocity, u throughout the time, t. If u is zero then v will also be zero. That is, the object will remain at rest.

iii) Flying of jet plane or rocket. The fuel is burnt to produce a large quantity of hot gases with a great force (action↓) and rocket forward with a great speed (reaction↑).
iv). Walking, swimming, rowing a boat, rebounding a ball etc

Action and reaction action on a boy during swimming



Action and reaction in the case of a rocket



Action and reaction when we walk on the ground

CHAPTERWISE QUESTION BANK

Multiple Choice Questions (1mark each)

1. What type of force is being applied by the person on the car?

(a) Gravitational Force (b) Frictional Force
(c) Muscular Force (d) Magnetic Force

2. A football lying still on the ground. According to Newton's first law, the ball will move only if:

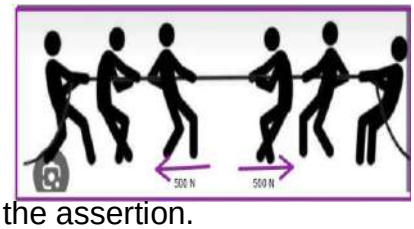
(a) Gravity acts on it (b) Wind blows over it
(c) A net force acts on it (d) It is left undisturbed

3. A person standing in a moving bus that suddenly stops, the person tends to:
(a) Fall backward (b) Remain standing
(c) Fall sideways (d) Fall forward

4. Two people pushing a truck and a bicycle with equal force. The bicycle accelerates more than the truck because:
(a) It is smaller in size (b) It has less mass
(c) It has no brakes (d) It is slippery

5. A person is rowing a boat. Which is the reaction force in this situation?
(a) Water pushes the oar (b) Oar pushes the water
(c) Boat floats on water (d) Person pulls the oar

6. What kind of force is given in the picture?



(a) Balanced (b) Unbalanced
(c) Frictional (d) Gravitational

Assertion-Reason Based Questions (1mark each)

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

7. Assertion: A body remains in uniform motion unless an external force acts on it.
Reason: Inertia is the tendency of a body to resist any change in its state of motion or rest.

8. Assertion : A man jumping out of a moving train falls forward.
Reason : The upper part of the body continues to move with the velocity of the train while the feet come to rest immediately.

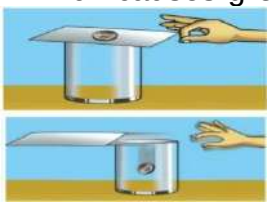
9. Assertion : A body at rest does not move on its own.
Reason : A body cannot change its state of rest or motion without an external force.

10. Assertion : The inherent property of a body by virtue of which it cannot change its direction of motion is called inertia of direction.
Reason : A rocket works on the principle of conservation of linear momentum.

Very short 2 marks each

11. A cricket ball and a tennis ball placed side by side.Which ball has more inertia and why?
Hint :comparative mass

12. A person hit by a slow-moving bicycle vs. a fast-moving car. Which causes greater impact and why?
Hint :Car; greater mass



13. Observe the picture and answer the questions:
(a) Why does coin fall in the beaker ?
(b) Why do thick paper move forward ?
Hint : Inertia of rest

14. How is mass and momentum related ? Give one example.

15.Two students pushing a trolley—Student A pushes an empty trolley, while Student B pushes a heavily loaded one.

(a) Which trolley will accelerate more and why?
(b) Which law of motion explains this behavior?
Hint. Student B's trolley, IInd law.

Short Answer Questions (3 marks each)

16.A man jumps off a boat and the boat moves in the opposite direction. a) Identify the action and reaction forces. b) State the law of motion involved.

Hint : Man pushes the boat backward while jumping.(Action)

17.Sita and Gita are tugging a rope with equal force from opposite sides (no movement).

(a) Is the force on the rope balanced or unbalanced?

(b) Define this force.

(c) What will happen if Sita suddenly pulls with more force?

Hint: Balanced forces.

18. Is mass related to inertia? Give one example. Define inertia.

19. Name the physical quantity that is product of mass of object and velocity. Write its SI unit. Is it a vector or a scalar quantity ?

Long Answer Questions (5 marks each)

20. During shaking of branches of a tree , some leaves and fruits fall down. Why? Which law of motion is related to it? State this law. Write SI unit of force. (2 +2 +1)

Hint : inertia of rest ,Newton's First Law of Motion

21. a) A force of 10 N gives a m_1, an acceleration of 20 m/s^2 and a mass m_2 , an acceleration of 40 m/s^2. What acceleration would it give if both the masses were tied together ? (3 marks)

Hint : find the value of m_1 and m_2 using formula , m = f/a .

Then use same formula for a combined mass.)

b) How do balanced forces differ from unbalanced forces? (2 marks)

Case study Based Questions (4 marks each)

22. At Gwalior airport, Rohit has a trolley bag. He pushes the trolley on a smooth floor of airport. Initially, the trolley is at rest. After applying a continuous force, the trolley begins to move and picks up speed.

(a) Which law of motion explains why the trolley starts moving?

(b) What is the direction of the force applied by the boy?

(c) Name the property of the trolley that resists the start of motion.

(d) What happens to the acceleration of the trolley if the same force is applied to a heavier trolley?

23.Sita was watching an interesting cricket match between India and Pakistan team in Lucknow. During match, a cricket player lowers his hands backward for catching a fast-moving ball. The umpire gave decision of out.

(a). Why does the player lower his hands while catching the ball?

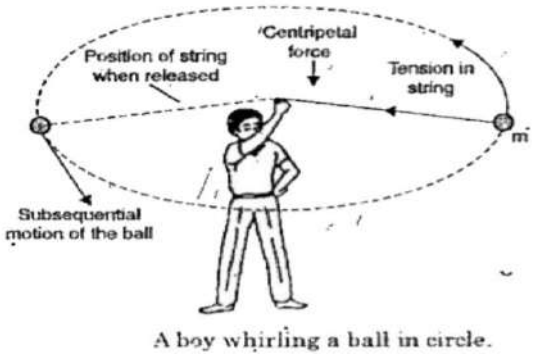
(b). Which law is involved in this action?

(c). What happens to the force if the time of contact increases?

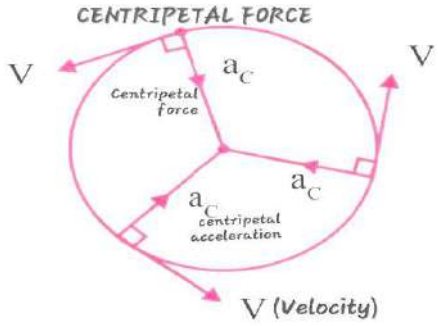
(d). What physical quantity changes when the ball is caught?

****

Gravitation



A boy whirling a ball in circle.



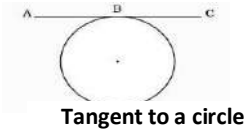
Centripetal force:

centripetal (meaning 'centre - seeking') In uniform circular motion ,a net force acts towards the centre.This net force which change only the direction of the velocity of a body is called centripetal force.

Example- The motion of the moon around the earth. This force is provided by the force of attraction of the earth. If there no such force, the moon would pursue a uniform straight-line motion.

This straight line will be a tangent to the circular path.

Tangent line meets the circle at one and only one point .



Tangent to a circle

We do not see the earth moving towards other objects.

Reason: According to **the third law of motion**, the small objects do attract the earth, but according to the **second law of motion**, for a given force, acceleration is inversely proportional to the mass of an object. The mass of a small object is negligibly small compared to that of the earth.

Gravitational force

All the objects in the universe attract each other by a force. This force of attraction between objects is called the gravitational force.

The Universal Law of Gravitation:(given by Isaac Newton)-

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.

Suppose two objects A and B with masses M and m and lie at the distance d between them. Let the force of attraction between them be F. According to the universal law of gravitation, the force between them is directly proportional to the product of their masses.

$F \propto M \times m$ ---------(i)

And the force is also inversely proportional to the square of the distance between them $F \propto \frac{1}{d^2}$ ---------- (ii)

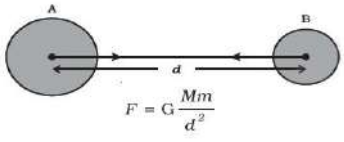


Fig. 10.2: The gravitational force between two uniform objects is directed along the line joining their centres.

The combining form of the above both equations (i) & (ii) is

$$F \propto \frac{M \times m}{d^2} \text{ ---------- (iii)}$$

OR

$$\mathbf{F = G\frac{M \times m}{d^2}}$$

The Universal Gravitation Constant (G)is the constant of proportionality.

$$G = \frac{F\, d^2}{M \times m}$$

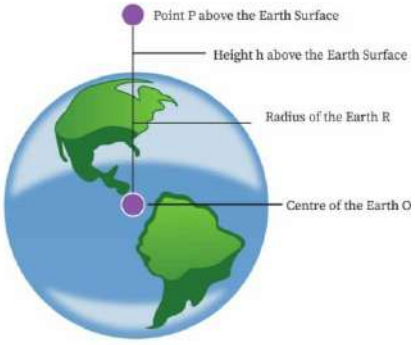
The SI unit of G is **N m^2 kg^{-2}**
The value of G is 6.67 x 10^{-11} N m kg^{-2} (calculated by Henry Cavendish)

Inverse-square rule:
If the distance (d) between two objects is bigger by a factor of 6, F becomes 1/36 times smaller. Because the force is inversely proportional to the square of distance (d).

Importance of the Universal law of Gravitation
i). We can walk, run on the surface of the earth because this force binds us to the earth.
ii). The motion of the moon around the earth is also due to this force.
iii). The tides in the oceans come due to the force of the moon and sun.
iv). The motion around of planets around the sun is also due to this force.

Free Fall
"Earth attracts every object towards it due to gravitational force. If an object falls from a height towards the earth, this is called free fall."
When an object falls from a height towards the earth,
no change in the direction of the motion (straight line motion).The change in magnitude of the velocity due to gravitational force.This acceleration is known as **acceleration due to gravity**.(g)
SI unit of g is m/s^2 or m s^{-2}

Relation between G and g
According to the second law of motion F = m a, a= g (acceleration is due to gravity)



We know that $F = G\frac{M \times m}{d^2}$

$$m\, g = G\frac{M \times m}{d^2} \qquad g = G\frac{M}{d^2}$$

Here M = mass of the earth d = the distance between the falling object and the earth.
If object is near the surface of the earth:
Near the surface of the earth the distance (d) = radius of the earth (R). $g = G\frac{M}{R^2}$

Note: The radius of the earth increases from the poles to the equator due to earth is not a perfect sphere. The value of g becomes greater at the poles than equator. **g = 9.8 m s^{-2}**

Motion of the objects under the influence of gravitational force of the earth **(a is replaced by g)**

1). $v = u + at$ 2). $s = ut + \frac{1}{2}at^2$ 3). $v^2 = u^2 + 2as$

Difference between mass & weight

Mass	Weight
Mass is simply the measure of the amount of matter in a body.	Weight is the measure of the amount of the force acting on a mass due to acceleration due to the gravity.
Mass of an object is always constant anywhere on the earth or universe.	Weight of an object is not same anywhere. It depends on its location.
$Mass = \frac{Volume}{Density}$	Weight = mass x acceleration due to gravity.
It is a scalar quantity.	It is a vector quantity.
The SI unit of mass is kg.	The SI unit is weight is Newton (N).
Mass can never be zero.	Weight can be zero (where there is no gravity)
It can be measured by any ordinary balance.	It can be measured by spring balance .

Weight of an object on the Moon =1/6 x Weight on Earth

Thrust

The force which acting on an object perpendicular to the surface is called thrust.
The effect of the thrust (actually a force) depends on the area on which it acts.
The SI unit of thrust is Newton (N).

When we standing on the loose sand sink more than lying on the same loose sand. During standing position, the weight of our body is acting on a small area equal to our feet. It means the force acts on a small area and our feet go deep into the sand. But when we lie down on the sand, the same force acts on an area equal to the body. It is larger area than the area of our feet and our body will not go that deep in the sand.

Pressure

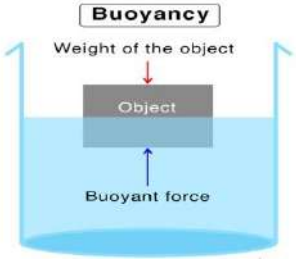
The thrust on unit area is called pressure. **(**Pressure =Thrust/ Area)
The same force acting on a smaller area, it exerts a larger pressure. If it acts on a larger area, it exerts the smaller pressure.
The SI unit of pressure is pascal (Pa) . 1 Pa = N m^2 or N m^{-2}

- *Knives have sharp edges*.The force acting on a small area, it exerts the larger pressure. That's why knives have sharp edges.
- *The foundation of buildings is kept wide* to reduce the pressure on the ground. We know that the pressure is inversely proportional to the area.

Buoyancy or buoyant force

"The upward force exerts by the water on an object when it is immersed in water, this force is called buoyant force or upthrust."

- All the objects experience a force of buoyancy when they are immerged in a fluid. It always opposes the weight of a partially or fully immersed object.
- The magnitude of this force depends on the density of the fluid.



Objects float or sink in water.

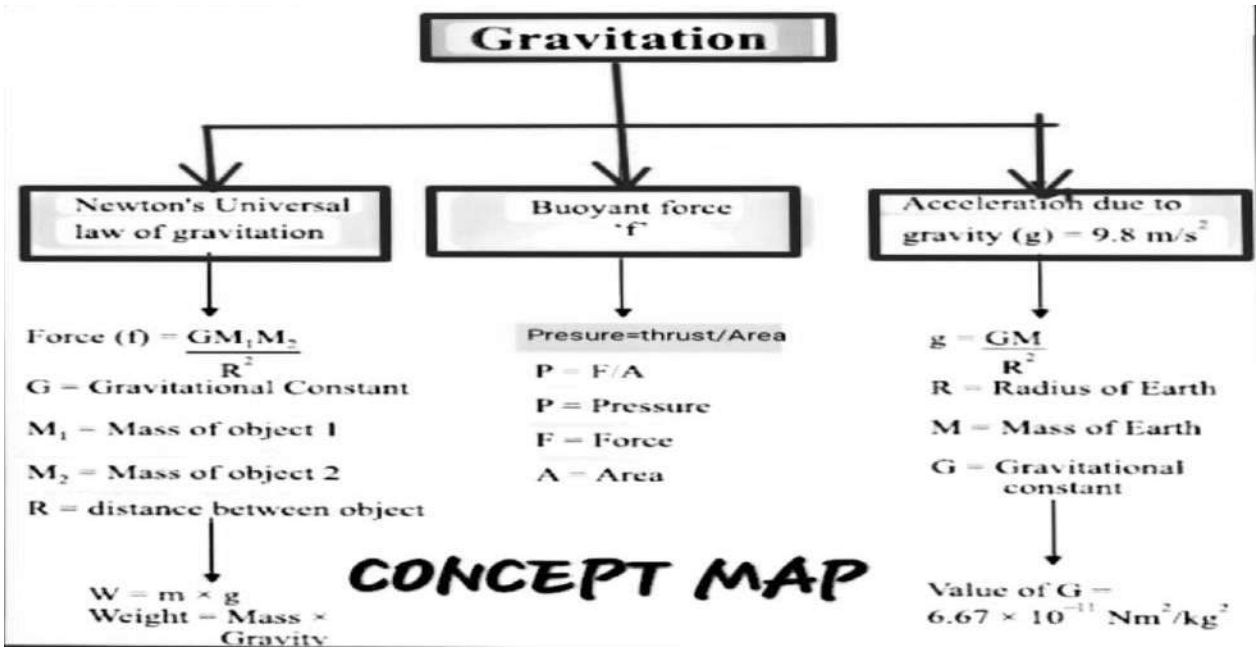
- If the density of object is less than the density of water, the object will float.
- If the density of an object is higher than the density of water, the object will sink.
- The density of an object is less than the density of water. This means that the up-thrust of water on the object is greater than the weight of the object. So, it floats.

Archimedes' Principle (by a Greek scientist Archimedes)

"When a body is immersed fully or partially in a fluid, it experiences an upward force that is equal to the weight of the fluid displaced by it."

Applications : i) It is used in designing ships and submarines.
ii) It is used in making of lactometers.

- **Lactometers** are used to determine the purity of a sample of milk.
- **Hydrometers** are used to determine the density of liquids.



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CHAPTERWISE QUESTION BANK

.Multiple Choice Questions (1mark each)

1. If the mass of an object on earth is 60 kg, what will be its weight on the Moon?
(a) 600 N (b) 100 N (c) 360 N (d) 60 N

Hint: g on Moon = 1/6th of Earth

2. Which of the following quantities remains constant everywhere?
(a) Weight (b) Mass (c) Gravitational force (d) Acceleration due to gravity

Hint: scalar & vector quantity

3. The force of gravitation between two objects depends on:
(a) Their shapes (b) Their temperatures
(c) Their masses and the distance between them (d) Their volumes

Hint: refer formula/ definition

4. An object is thrown vertically upward. Which of the following statements is correct?
a) It moves with increasing speed (b) Its acceleration is zero at the top
c) It decelerates while going up (d) Its velocity is constant

Hint: refer formula/ defination

5. Buoyant force acts in which direction?
(a) Downward (b) Horizontally (c) Upward (d) Same as the object's motion

Hint: Archimedes' principle.

6. An object is dropped from a height and falls freely under gravity. What will be its velocity after 3 seconds?
(a) 19.6 m/s (b) 29.4 m/s (c) 9.8 m/s (d) 39.2 m/s

Hint: Take g = 9.8 m/s²

Assertion-Reason Based Questions (1mark each)

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

7. Assertion: All objects fall at the same rate in a vacuum.
Reason: In a vacuum, there is no air resistance.

Hint: refer concept

8. Assertion: The weight of an object is more at the poles than at the equator.
Reason: The value of 'g' is more at the poles than at the equator.

Hint: value of g depend on position

9. Assertion: Mass of a body changes from Earth to Moon.
Reason: Gravity on the Moon is less than on Earth.

Hint: refer formula/ definition

10. Assertion: A body experiences an upthrust when immersed in a liquid.
Reason: Pressure in a liquid increases with depth.

Hint: Archimedes' principle.

Very Short Answer Questions (2 marks each)

11. State the factors on which the gravitational force between two objects depends.
12. A body weighs 600 N on Earth. What would be its weight on the Moon?
Hint: value of g on Moon = 1/6 g on Earth
13. What do you mean by free fall? What is the acceleration during free fall called?
14.What is the source of centripetal force that a planet requires to revolve around the sun?
15. Earth is continuously pulling the moon towards its centre,still it does not fall to the earth,why?

Short Answer Questions (3 marks each)

16. Demonstrate your understanding of mass and weight by explaining three key differences between them, and describe a situation where confusing the two could lead to an error in real life
Hint:in science, engineering, or space exploration
17. Write the relation between G and g. Write the value of G and g.
18. Calculate the gravitational force on a body of a mass 1 kg lying on the ground. Given- mass of earth = 6×10^{24}kg, radius of earth = 6400 km .

Hint: use formula $\mathbf{F = G\ \frac{M \times m}{d^2}}$

19. Mohan weighs 60 kg on the earth . Will his weight increase as he moves to the top of a hill?
Hint: value of g differ above/below the earth surface)

Long Answer Questions (5 marks each)

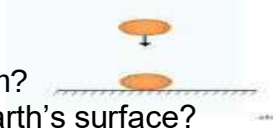
20. State the law of gravitation given by Newton. What is the importance of this law? (3+2)
Hint: write the relation of F, M, m, G, d also.
21 a).what happens to the gravitational force between two objects,if : (1.5+1.5)
i) The mass of one object is doubled?
ii) The distance between the objects are doubled?

Hint : $\mathbf{F = G\ \frac{M \times m}{d^2}}$ **USE FORMULA AND APPLY THE CONDITION)**

b) Define upthrust and pressure . (1+1)

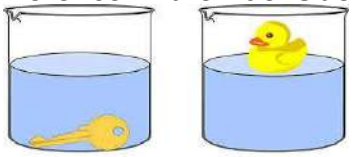
Case study Based Questions (4 marks each)

22. *Ravi went to a science exhibition where he saw a demonstration showing objects falling freely under gravity. The demonstrator dropped a feather and a coin in a vacuum tube. Both hit the bottom of the tube at the same time. Ravi was surprised and asked why this happened.*



a) What force causes objects to fall towards the Earth?
b) Why did both the feather and the coin fall at the same rate in the vacuum?
c) What is the acceleration of objects falling freely under gravity near the Earth's surface?
d) What do you mean by free fall?

23. *Objects having density more than that of liquid in which they are immersed, sink on the surface of the liquid. A block of wood is floating on water while an iron nail sinks when placed in water. The teacher explains that this is due to the difference in their densities and buoyant force acting on them.*



a) What is the condition for an object to float in a liquid?
b) What is buoyant force?
c) Why does the iron nail sink in water?
d) Which principle explains the floating and sinking of objects in fluids?

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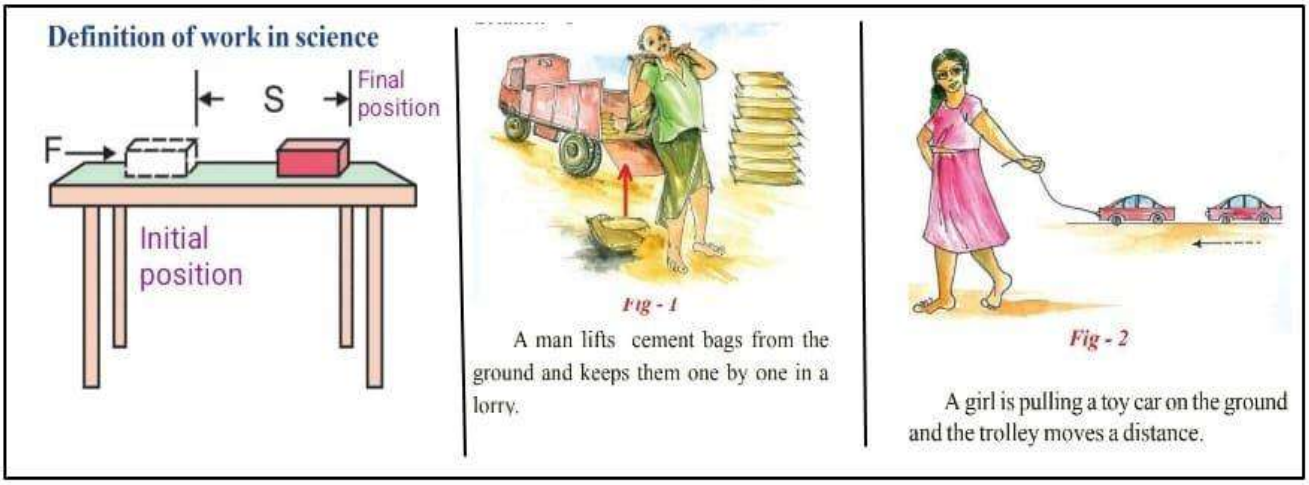
Work



Conditions for work to be done :

1). The force should act on an object. *2). The object must be displaced.*

Work to be equal to **the product of the force and displacement.**

Work done= force × displacement $W = F \times s$

Work has only magnitude and no direction. Work is a scalar quantity.

If Force (F) is 1 N and displacement (s) is 1 metre

then work done by the force = 1N × 1m = 1N m

The unit of work is Newton metre (N m) or Joule (J)

1 Joule *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.*

Positive work	Negative work
Work done is positive when the force acts on the object in the direction of the displacement.	Work done is negative when the force acts on object opposite to the direction of displacement.

Energy

The capability of doing work by an object is called **energy**. The unit of energy is **Joule (J) .** The Larger unit of energy is Kilo-Joule (k J)

1 Joule is the energy required to do 1 Joule of work. (1 k J = 1000 Joule)

Forms of energy:

Light energy, electric energy ,heat energy , wind energy etc.

Law of conservation of energy:

The energy can only be converted from one from to another, it can neither be created or destroyed. The total energy of the universe is constant. The law of conservation of energy is valid in all situations and for all kinds of transformation.

Total energy = $m g h + \frac{1}{2} mv^2$= Constant

Mechanical energy

The sum of the kinetic energy and the potential energy of an object is called its mechanical energy.

Kinetic energy

The energy possessed by an object due to its motion is called kinetic energy.

The Kinetic energy of an object increases with its speed.

When a ball is dropped from a height its gravitational potential energy decreases, but as the ball comes into motion, its kinetic energy increases. Thus a free-fall body possess both potential energy and kinetic energy during its fall to the ground.

Understanding potential energy

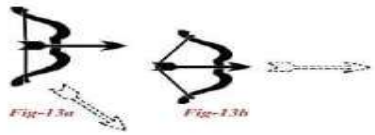
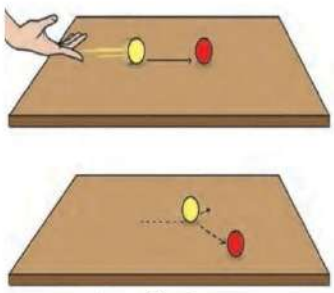


Fig-13a Fig-13b

You may notice that in the first instance, figure13(a), when you release the arrow it gets separated from the bow and falls down on ground. But in second instance, figure13(b), you will notice the arrow flies with great speed into the air.

From this activity we can conclude that the bow in normal shape is not able to push the arrow but when we stretch the string, it acquires energy to throw the arrow into air with a great speed. The energy acquired by the bow due to change in its shape is known as its potential energy.

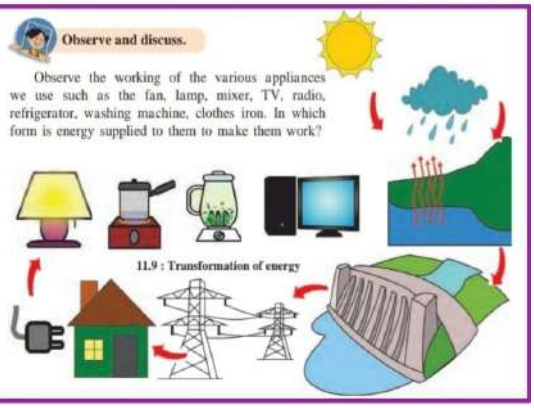


: Kinetic energy

: Potential energy

Observe and discuss.

Observe the working of the various appliances we use such as the fan, lamp, mixer, TV, radio, refrigerator, washing machine, clothes iron. In which form is energy supplied to them to make them work?



11.9 : Transformation of energy

Power

Power is defined as the rate of doing work or rate of transfer of energy.

If an agent does a work W in time t, then power is given by

Power = Work / time

$P = W/t$

The unit of power is 'watt' and denoted by symbol 'W'

1 watt is the power of an agent, which does work at the rate of 1 joule per second.

We express larger rate of energy transfer in kilowatts (kW)

1 kilowatt (kW)	1000 watts (W)
1kW	1000 J. s^{-1}

Potential energy of an object at height (or) Gravitational potential energy

An object increases its energy when it is raised through a height. This is because of the work done on the object against gravity acting on it. The energy of such an object is known as gravitational potential energy.

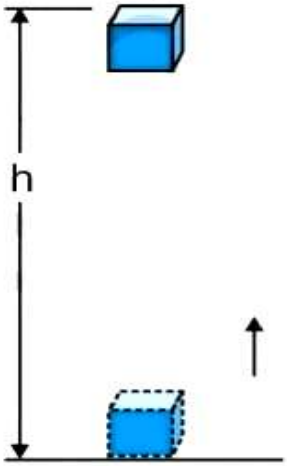


Fig-14

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 an object of mass m raised to 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 x displacement
= mg x h
= mgh.

P.E.

Since the work done on the object is equal to ' mgh' an energy equal to 'mgh' units is gained by the object. This is the potential energy of the object at a height 'h'.

P.E. = mgh.

In the chapter **motion** we studied about equations of uniform accelerated motion. The relation between initial velocity 'u', final velocity 'v', acceleration 'a' and displacement 's' is given by

$v^2 - u^2 = 2as$ or $s = \frac{(v^2 - u^2)}{2a}$ ——(2)

We know by Newton's second law of motion

$F_{net} = ma$ ——————— (3)

From equations (1), (2) and (3)

$W = ma \times \frac{(v^2 - u^2)}{2a}$

$W = \frac{1}{2} m (v^2 - u^2)$

This is called work - energy theorem.

As we have assumed that object is at rest, its initial velocity u = o, then

$W = \frac{1}{2} m v^2$

Thus the work done on the object is equal to $\frac{1}{2} m v^2$

We know that Kinetic Energy of a body moving with certain velocity is equal to work done on the object to acquire that velocity from rest.

Thus the kinetic Energy (K.E.) possessed by an object of mass 'm' and moving with velocity 'v' is equal to $\frac{1}{2} m v^2$

K.E. = $\frac{1}{2} m v^2$

K. E.

CHAPTERWISE QUESTION BANK

Multiple Choice Questions (1mark each)

1. Analyze the given physical quantities and identify which one is a scalar.
(a) Force (b) Velocity (c) Work (d) Acceleration

Hint- scalar have only magnitude

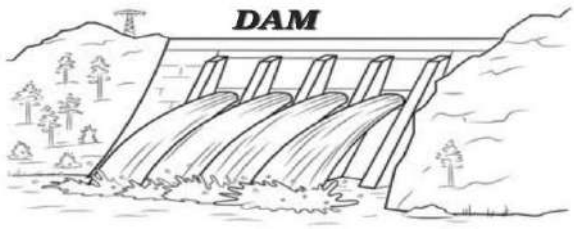
2. When a force moves an object in the direction of the force, it:
(a) Increases the potential energy of the object
(b) Decreases the kinetic energy of the object
(c) Decreases the potential energy of the object
(d) Increases the kinetic energy of the object

Hint- force

3. When a force is applied on an object. Which of the following has zero work done?
(a) Lifting a book (b)Pushing a wall (c)Holding a bag (d)Kicking a ball

Hint- W=Fs

4. Water stored in given picture possesses



(a) No energy
(b) Electrical energy
(c) Potential energy
(d) Kinetic energy

Hint- position/ height

5. The gravitational potential energy of an object depends on its:

(a) Mass only (b)Height above the ground only
(c) Mass and height above the ground (d) Velocity

Hint- position/ height

6. Which of the following is a unit of work?

(a) Nm (b)N/s (c)N/kg (d)N/m

Hint- W=Fs

Assertion-Reason Based Questions (1mark each)

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

7. Assertion : The kinetic energy, with any reference, must be positive.
Reason : In the expression for kinetic energy, the velocity appears with power 2 and mass is a scalar quantity.
Hint: Since velocity is squared and mass is always positive, kinetic energy is always positive regardless of direction.

8.Assertion : A crane P lifts a car upto a certain height in 1 min. Another crane Q lifts the same car upto the same height in 2 min. Then crane P consumes two times more fuel than crane Q.
Reason : Crane P supplies two times more power than crane Q.
Hint: Compare Power

9.Assertion : When the force retards the motion of a body, the work done is negative.
Reason : Work done depends on angle between force and displacement.
Hint: W=Fs

10. Assertion : A winded toy car, when placed on floor, starts moving.
Reason : Toy car has kinetic energy stored in it which facilitates its motion.
Hint: Stored potential energy (spring or elastic), which converts into kinetic energy, not because it initially has kinetic energy.

Very Short Answer Questions(2 marks each)

11. Write an expression for the work done in lifting a body of mass 'm' through a vertical height 'h'

Hint-mgh

12. Will work be done by a man who pushes a wall ?

Hint- w=fxs

13. Define 1 watt of power.

Hint-definition

14. What will happen to the kinetic energy of a body if its velocity is halved ?

Hint-$1/2mv^2$

15.Soni says that the acceleration in an object could be zero even when several forces are acting on it. Do you agree with her? Why?

Hint-Net force 0

Short Answer Questions (3 marks each)

16. A man of mass 60kg runs up a flight of 30 steps in 40s. If each step is 20cm high, calculate his power. ($g = 10m/s^2$)

Hint- Formula of power

17. Find the energy possessed by an object of mass 10 kg when it is raised to a height of 6 m above the ground. ($g = 10m/s^2$)

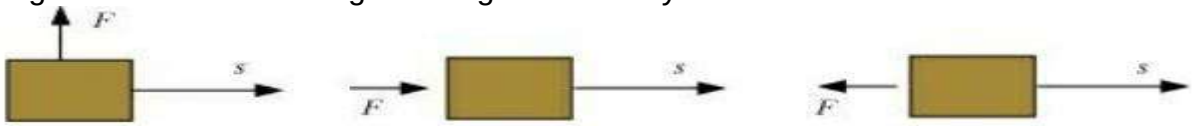
Hint-formula of potential energy

18.Give an example for
(a) Force acting in the direction of displacement
(b)Force acting against the direction of displacement
(c) Force acting perpendicular to the direction of displacement
Hint-examples from real life situation
19.The potential energy of a freely falling object decreases progressively. Does this violate the law of conservation of energy? Why?
It does not violate the law of conservation of energy. Whatever, is the decrease in PE due to loss of height, same is the increase in the KE due to increase in velocity of the body.
Hint-law of conservation and energy conversion
Long Answer Questions (5 marks each)
20. (a)What is the work done on a body moving in a circular path ?
(b) A body performs no work. Does it imply that the body possesses no energy ?
Hint-(a) net work 0 (b) difference between work and energy

21.(a) A cell converts one form of energy into another. Name the two forms.
(b) Name at least three commonly used units of energy.
Hint-(a) energy conversion (b) (i) Joule (ii) Erg (iii) Kilowatt hour

Case study Based Questions (4 marks each)
22. Work is said to be done when the force applied on an object produces a displacement of the object in the direction of force applied. For example, when we push or pull a heavy load or lift it above the floor then we are doing work, but a man carrying heavy load and standing still is not doing any work. Work, which is the product of force and displacement, has only magnitude and no direction. So, it is a scalar quantity.
1. A man raises a box of mass 50 kg to a height of 2 m in 10 s, while another man raises the same box to the same height in 50 s. What is the ratio of work done by them?
2. A coolie lifts a luggage of 10 kg from the ground and put it on his head 1.8 m above the ground. What would be the work done by him on the luggage?
3. Calculate the value of work done in holding a suitcase of 15 kg while waiting for a bus for 40 minutes.

23. In each of the following cases, the force F acts on an object of mass m. The direction of the object's movement is from west to east and is indicated by the longest arrow. Check the given diagram carefully and answer.



(a) The work done by the force is negative, positive, or zero.
(b) Get the expression of the potential energy of an object.
(c) Calculate PE for a body of 10 kg which is resting at a height of 10 m.

****

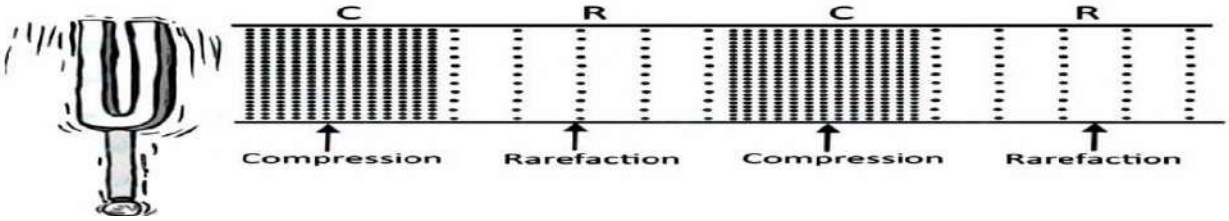
11
Sound

Introduction to sound

- Sound is a form of energy that produces the sensation of hearing.
- It is produced by vibrating objects and needs a medium (solid, liquid, or gas) to travel.
- Sound cannot travel in vacuum.

Propagation of sound

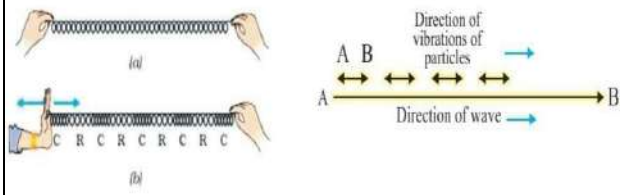
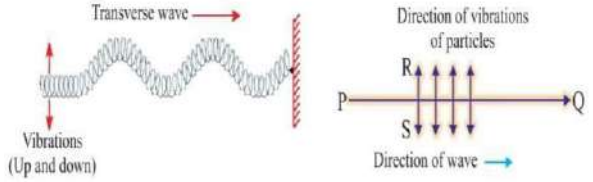
- When an object vibrates, it causes the particles of the surrounding medium to vibrate.
- These vibrations pass from one particle to another, creating a disturbance.
- This disturbance travels as a wave, but the particles do not move with the wave.



Sound as a mechanical wave

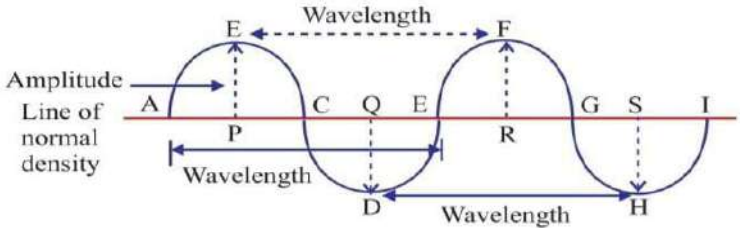
- Sound waves are mechanical because they need a medium to travel.
- They propagate as a series of compressions (high pressure) and rarefactions (low pressure).

Types of Waves

Longitudinal Waves	Transverse Waves
Particles vibrate parallel to the direction of wave motion.	Particles vibrate perpendicular to the direction of wave motion.
Example: Sound waves in air	Example: Water waves
	

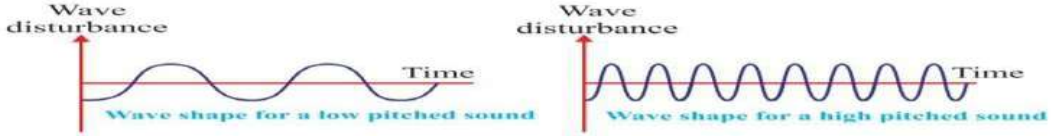
Characteristics of a Sound Wave

Characteristic	Symbol	SI Unit	Description
Wavelength	λ	metre (m)	Distance between two compressions or rarefactions.
Frequency	v	hertz (Hz)	Number of vibrations per second.
Time Period	T	second (s)	Time taken for one complete vibration.
Amplitude	A	metre (m)	Maximum displacement from rest position.
Speed	v	m/s	Speed = Frequency x Wavelength ($v = v\lambda$)



Pitch and Loudness

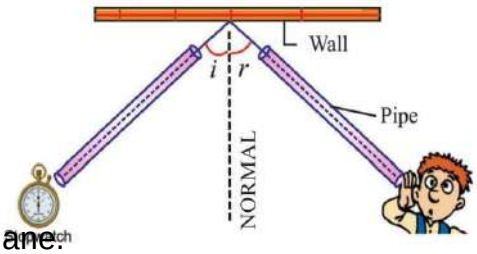
Pitch: Depends on frequency. High frequency = High pitch; Low frequency = Low pitch



Loudness: Depends on amplitude. Greater amplitude = Louder sound; Lesser amplitude = Softer sound

Speed of sound in various mediums

- Speed of sound depends on the nature of material through which it travels. It is slowest in gases, faster in liquids and fastest in solids.
- Speed of sound increases with the rise in temperature.
- Speed of sound increases as humidity of air increases.
- In air, speed of sound is 344 ms^{-1} at 22°C.



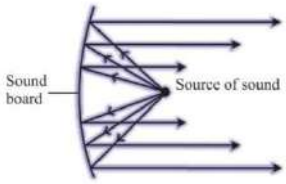
Reflection of Sound

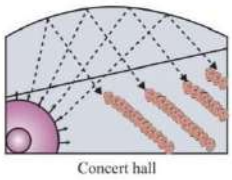
Sound reflects like light and follows:

1) Angle of Incidence = Angle of Reflection
2) Incident ray, reflected ray, and normal lie in the same plane.

Echo

- Echo is the reflected sound heard separately after the original sound.
- Minimum distance for an echo: 17.2 m; Time delay ≥ 0.1 second



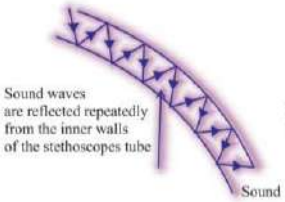


Reverberation

- Persistence of sound due to multiple reflections.
- Reduced by using sound-absorbing materials.

Uses of Multiple Reflection of Sound

- Megaphones, horns, musical instruments
- Stethoscope
- Architecture of halls/auditoriums



Range of Hearing

- Human range: 20 Hz to 20,000 Hz (20 kHz)
- Infrasonic (< 20 Hz): Elephants, whales
- Ultrasonic (> 20 kHz): Bats, dolphins, dogs

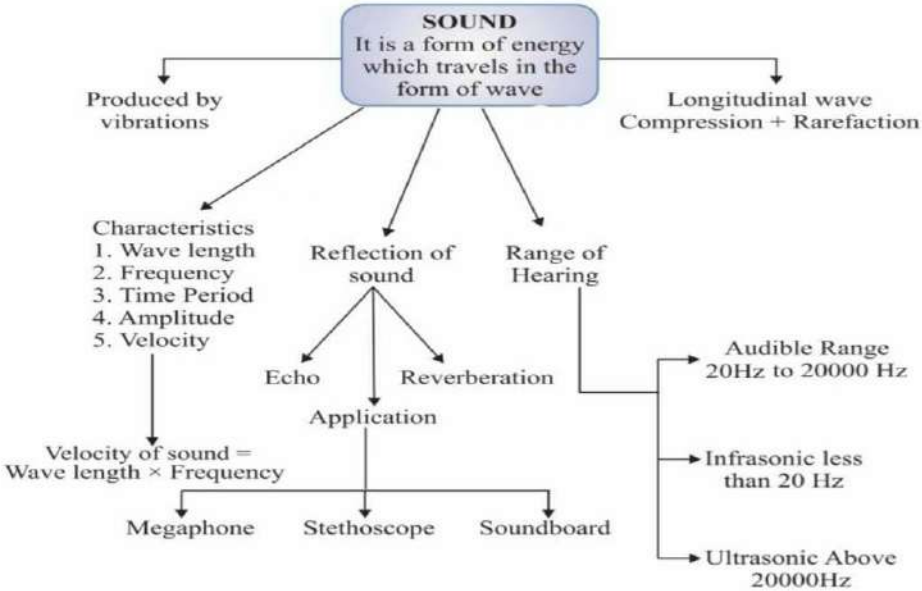
Uses of Ultrasonic Waves

- Cleaning delicate parts
- Detecting cracks in metals
- Medical imaging (Ultrasound)
- Breaking kidney stones (lithotripsy)

Noise Pollution

Caused by: Excessive unwanted sounds from traffic, industry, etc.
Effects: Hearing loss, stress, disturbed sleep
Control Measures:
Use of silencers and soundproof materials, planting trees**,** Noise regulations

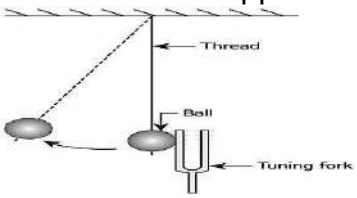
MIND MAP



CHAPTERWISE QUESTION BANK

Multiple Choice Questions (1mark each)

1. The image shows a setup consisting of a tuning fork and a metallic ball suspended by a thread. What happens when the metallic ball strikes the tuning fork?



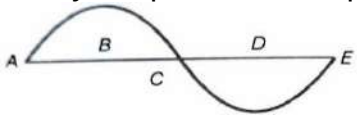
(a) The tuning fork vibrates the ball to produce sound.
(b) The tuning fork vibrates to and fro to produce sound.
(c) The tuning fork gets heated due to the collision with the ball.
(d) The tuning fork generates heat by vibrating to and fro.
Hint- (b)

2. In which of the following mediums will sound waves propagate at the highest speed?
(a) A liquid medium at 25°C temperature
(b) A liquid medium at 50°C temperature
(c) A gaseous medium at 50°C temperature
(d) A gaseous medium at 25°C temperature
Hint- (b)

3. As people grow older, their ability to hear certain sound frequencies declines. Which of the following frequency ranges is still commonly heard by elderly individuals?
(a) 10 Hz – 1,000 Hz (b) 20 Hz – 10,000 Hz
(c) 9,500 Hz – 20,000 Hz (d) 20,000 Hz – 22,000Hz
Hint- (b)

4. Riya was watching a video on her phone with very low volume. She increased the volume so that her grandparents could hear it clearly.
Based on this situation, what physical property of the sound wave did she most likely increase to make the sound louder?
(a) Frequency **(b)** Amplitude **(c)** Velocity **(d)** Wavelength
Hint- (b)

5. From the waveform shown, identify the portion that represents half the wavelength.



(a) AB (b) BD (c) DE (d) AE
Hint- (b)

6. A teacher claps near a wall and hears the sound again after a short gap. What phenomenon is responsible for hearing the sound again?
(a) Reflection of sound (b)Refraction of sound
(c) Absorption of sound (d) Diffraction of sound
Hint- (a)

Assertion-Reason Based Questions (1mark each)

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

7. Assertion: Compression and rarefaction involve changes in density and pressure.
Reason: When particles are compressed, density of medium increases and when they are rarefied, density of medium decreases.
Hint- (a)

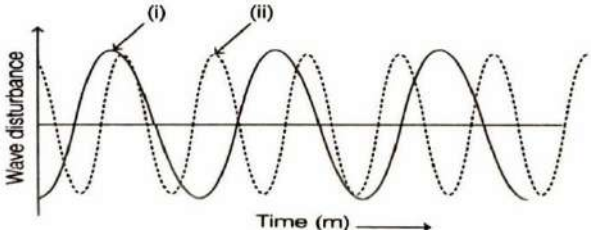
8. Assertion: Sound would travel faster on a hot summer day than on a cold winter day.
Reason: Velocity of sound is directly proportional to the square of its absolute temperature.
Hint- (c)

9. Assertion: Transverse waves can be produced in liquids.
Reason: Light waves are transverse waves.
Hint- (b)

10. Assertion: The flash of lightening is seen before the sound of thunder is heard.
Reason: Speed of sound is greater than speed of light.
Hint- (c)

Very Short Answer Questions (2 Marks)

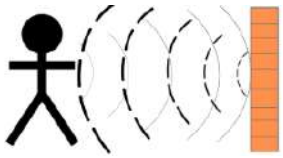
11. Riya was curious why she could hear the buzzing of bees clearly during her walk in the garden, but couldn't hear any sound from a slowly moving pendulum in her classroom. Give a scientific reason why Riya was able to hear the humming sound of bees but not the sound produced by the vibrating pendulum.
Hint: Think about the frequency range that the human ear can detect
12. Which of the two graphs (i) and (ii) representing the human voice is likely to be the male voice? Give reason for your answer.



Hint: Think about pitch and frequency
13. An audiologist is testing a person's hearing range, which spans from 20 Hz to 20 kHz. What are the typical wavelengths of sound waves in air corresponding to these two frequencies? (Speed of sound in air = 344 m/s).
Hint: Use the formula wavelength (λ) = speed of sound (v) ÷ frequency (ν)
14. After seeing lightning, the thunder is heard 10 seconds later. Estimate how far the thundercloud is from the observer. (Speed of sound = 340 m/s)
Hint: *Use distance = speed × time.*
15. While watching a video of underwater diving, Ravi noticed that the diver used hand signals instead of speaking. Why can't divers talk to each other underwater using normal speech? What property of sound is responsible for this?
Hint: *Think about the speed of sound in water and the human ability to produce and receive sound.*

Short Answer Questions (3 Marks)

16. While riding a bicycle through a tunnel, Ayaan shouted and noticed his voice returning after a short delay, even though no one responded. What could be the scientific reason behind Ayaan hearing his own voice again in the tunnel? Explain the principle involved and the condition required for this to happen.



Hint: *Think about sound bouncing back and the minimum distance needed for it to be heard again.*
17. During a lab activity, students used a slinky spring to demonstrate sound wave motion and noticed particles oscillating without shifting position. What type of wave were the students demonstrating? Describe its properties and how this type of motion helps sound to travel through a medium.
Hint: *Think about how particles vibrate in relation to wave direction.*
18. In a large classroom, the teacher's voice was not clear at the back until a mic and speaker were used. Why was it difficult to hear the teacher clearly at the back, and how did the speaker system solve this issue?
Hint: *Consider how sound intensity changes with distance.*
19. A stone falls from the top of a 500 m tall tower into a pond at the base. After how much time will the splash be heard back at the top? (Given: g=10 m/s^2, speed of sound = 340 m/s.)
Hint: *Add the time taken by the stone to fall and the time taken by sound to travel up.*

Long Answer Questions (5 Marks)

20.(a) In an empty hall, Prabhat clapped and noticed the sound returning after a short

delay. Based on Prabhat's observation, explain how the sound returned to him. What principles are involved in this process? State the laws governing this behavior and how they are applied in real-life situations like auditoriums.
Hint: Think about how sound behaves when it hits a surface and what rules it follows, similar to light.
(b) You and your friend are standing a few meters apart on the Moon in a space activity. Your friend calls out to you. Will you be able to hear any sound produced by your friend on the Moon? Explain your answer based on the property of sound.
Hint: *Think about what sound needs to travel from one point to another.*
21. (a) During a visit to a concert hall, Rohan observed that the ceiling and the wall behind the stage were curved, unlike ordinary rooms. What could be the reason for designing the ceiling and the back wall of the concert hall in a curved shape?
Hint: Consider how curved surfaces influence the direction and distribution of sound waves.
(b) Establish the relationship between speed of sound, its wavelength and frequency. If velocity of sound in air is 340 m/s. Calculate (i) Wavelength when frequency is 256 Hz, (ii) frequency when wavelength is 0.85 m.
Hint: Use the formula $v = v \lambda$

Case Based Questions (4 Marks)

22. *Rahul was at a music concert where different instruments were being played — a guitar, drums, and a flute. He observed that even though some instruments were louder, others had sharper or deeper sounds. Later, he discussed with his science teacher why the same song played on different instruments sounds different and how we recognize whether a sound is high-pitched or loud.*
(a) Rahul noticed that the flute produced a high-pitched sound compared to the drum. Which characteristic of the sound wave explains this difference, and why?
(b) The drumbeat was louder than the flute. Which characteristic of the sound wave causes this difference in loudness, and how?
(c) Two musical instruments played the same note at the same loudness, yet Rahul could tell them apart. What property of the sound wave allows us to distinguish between these sounds? Explain.
Hint: (a) Think about the number of vibrations per second
(b) It is related to the energy carried by the wave.
(c) It's not pitch or loudness but something that gives sound its unique quality.
23. *Riya's uncle met with a minor accident, and the doctor recommended an ultrasound scan to check for any internal injuries. At the hospital, Riya noticed that the machine was producing images of her uncle's internal organs without causing any pain. She wondered how sound could help in seeing inside the body. Later, in her science class, her teacher explained the concept of ultrasound waves and their uses in both medical and industrial fields.*
(a) Why is ultrasound used for medical imaging instead of ordinary sound?
(b) Apart from medical diagnosis, mention one other field where ultrasound is used and how.
(c) Explain how ultrasound helps in imaging internal organs. What property of sound is involved in forming the image?
Hint: (a)Think about the frequency range and its ability to penetrate the body.
(b) Consider cleaning or detecting flaws.
(c)Think about reflection and time taken by sound waves to return.

12

Improvement In Food Resources

Introduction

- All living beings need food for energy, growth, and development.
- Food provides nutrients: carbohydrates, fats, proteins, vitamins, and minerals.
- India's growing population needs increased food production.
- Farming on more land is not feasible, so productivity of crops and livestock must be improved.

Revolutions in agriculture

- **Green revolution:** boosted food production using hybrid seeds, fertilizers, irrigation, and machinery.
- **White revolution:** increased milk production through improved dairy farming.

Types of crops

- Cereals (wheat, rice): source of carbohydrates.
- Pulses (gram, pea): source of proteins.
- Oilseeds (mustard, sunflower): source of fats.
- Vegetables, fruits, spices: provide vitamins and minerals.

Crop seasons

- **Kharif season:** grown during rainy season (june to october). Examples: black gram, green gram, pigeon pea, rice, paddy, soyabean.
- **Rabi season:** grown during november to april (winter crops). Examples: wheat, gram, peas, mustard, linseed.

Methods to improve crop yield

1. Crop variety improvement

- Hybridization: crossbreeding plants for desired traits.
- Types: intervarietal, interspecific, intergeneric.
- Genetic modification: introducing desirable genes.
- Properties of improved seeds: high yield, good quality, resistance to biotic/abiotic factors, wider adaptability, desirable agronomic traits, short maturity duration.

2. Crop production improvement

I) nutrient management

- Macronutrients: N, P, K, Ca, Mg, S.
- Micronutrients: Fe, Mn, Zn, Cu, B, Mo, Cl.
- Manure (organic, slow-acting): compost, green manure, vermicompost.
- Fertilizers (chemical, quick-acting): npk-rich but cause pollution.

Difference between manures and fertilizers

Manures	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 water.	Fertilizers are easily absorbed by the plants since they are soluble in water.

Ii) Methods of irrigation

- Dug wells: water collected manually or with pumps.
- Tube wells: deep underground water with motor pump.

- Canals: these get water from rivers.
- River lift system: pumping directly from rivers.
- Tanks: small storage reservoirs.
- Rainwater harvesting: collecting rainwater to use later and prevent soil erosion.

Iii) Cropping patterns

- Mixed cropping: two or more crops on same field. E.g., wheat + gram.
- Intercropping: definite row patterns. E.g., soyabean + maize.
- Advantages: prevents pest spread, better nutrient use.

Crop rotation: growing different crops in sequence. Advantages: maintains fertility, controls pests, several crops can be grown in succession with only one soil preparation.

3. Crop protection management

- Pests include weeds (e.g., parthenium), insects, pathogens.
- Control: weeding, pesticides, crop rotation, proper seedbed, intercropping.

Storage of grains

- Problems: insects, rodents, fungi, moisture.
- Solutions: drying, hygiene, fumigation, proper containers.

Organic farming

- No chemical fertilizers/pesticides.
- Uses:manure, croprotation, biofertilizers (rhizobium, azolla) biopesticides (neem, turmeric).
- Eco-friendly and sustainable.

Animal husbandry

- Scientific management for milk, meat, labour.
- Types: cow (*Bos indicus*), buffalo (*Bos bubalis*).
- Milch animals (milk-producing), draught animals (used for work).
- Lactation period: time between two pregnancies when animal produces milk.
- Breeds:
- Local: red sindhi, sahiwal (disease resistant).
- Exotic: jersey, brown swiss (long lactation).
- Care: cleanliness, ventilated shelter, food (roughage, concentrates, micronutrients), disease prevention (vaccination, hygiene).

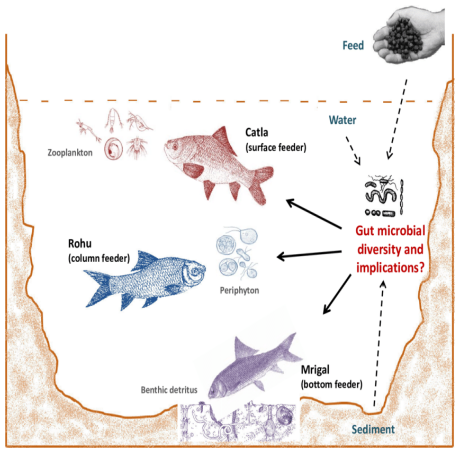
Fish production

- Fish: rich, cheap protein source.
- Types:
- True fishes (finned): rohu, tuna, catla.
- Shellfish (unfinned): prawns, oysters.

Fishing methods

- Capture fishing – natural water bodies.
- Culture fishing – artificial/controlled environment.
- Aquaculture: farming aquatic organisms.

- Mariculture: marine fish farming.
- Brackish water: sea + freshwater (e.g., lagoons).



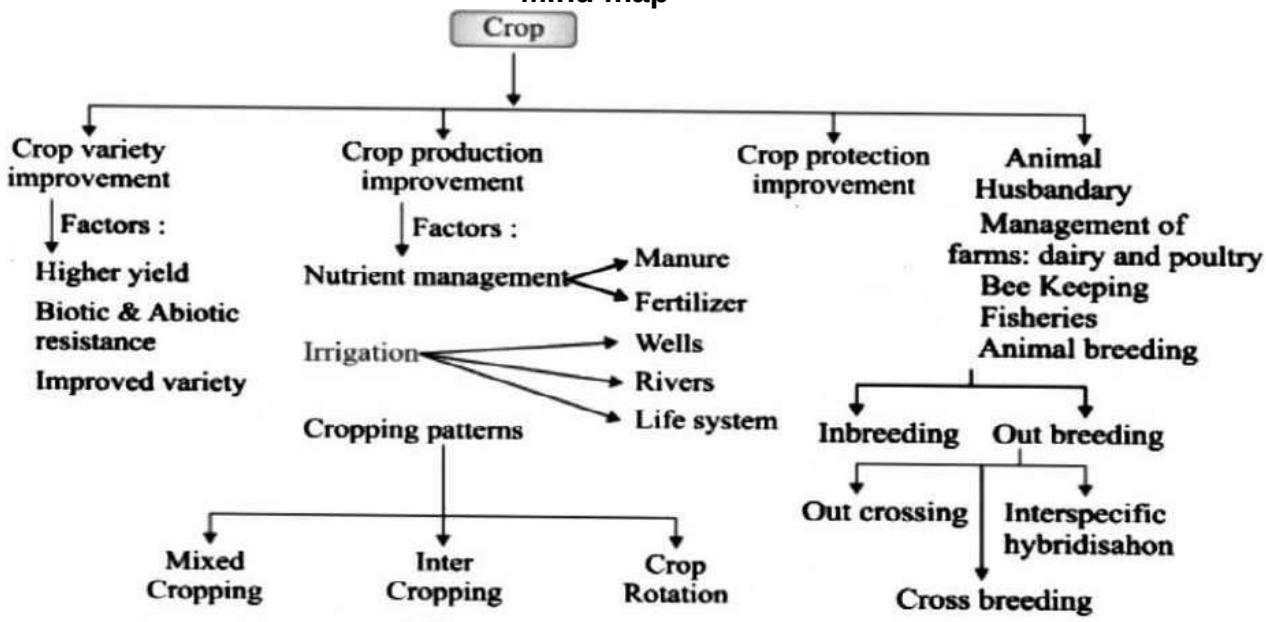
Composite fish culture

- 5–6 species in one pond with different food habits.
- Surface feeders – catla, middle – rohu, bottom – mrigal, common carp, weed feeders – grass carp.
- Advantages: high yield, efficient resource use, economic benefit.
- Problem: breeding only in monsoon
- Solution: hormonal stimulation.

Bee-keeping (apiculture)

- Rearing bees for honey and wax. Extra income source.
- Needs good pasturage (flower supply).
- Species: *Apis cerana indica, Apis florae, Apis dorsata, Apis mellifera* (commercial).
- Advantages of *Apis mellifera*: high yield, fast breeding, stays longer in hive.
- Honey: nutritious, long shelf-life, used as natural sugar and medicine.
- Quality depends on flower type and nectar availability.

Mind map



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CHAPTERWISE QUESTION BANK

Multiple Choice Questions (1mark each)

1. A farmer lives in an area where there is limited rainfall and shortage of water for irrigation. Based on water requirements, which one of the following crops should the farmer avoid growing?

(a) Peas (b) Gram (c) Paddy (d) Wheat

Hint- Irrigation required

2. A scientist is working on developing a new variety of wheat that gives higher yield and is resistant to drought. She uses different techniques to improve the crop variety. Which of the following does not fall under crop variety improvement techniques?

(a) Selection (b) Hybridization (c) Genetic engineering (d) Pest control

Hint- Comparision

3. A soil test report shows that a field has good water-holding capacity but is deficient in phosphorus and potassium. What should a farmer do to improve the quality and yield of crops in that field?

(a) Removing weeds (b) Applying fertilisers

(c) Modifying irrigation system (d) Growing two different crops at the same time
Hint- Soil nutrient

4. Town X is located on the banks of a river, but due to irregular water release from the nearby reservoir, farmers often face crop failures. Which irrigation method would be most suitable for ensuring a reliable water supply to the farms in this situation?
(a) Building tanks (b) Constructing canals
(c) Introducing river lift system (d) Irrigating fields through dug wells
Hint- Irrigation technique

5. A farmer notices that the crop yield is decreasing despite good irrigation and fertilizers. On closer inspection, several unwanted plants are growing alongside the crops. Which of the following is most likely adversely affecting the health of the crops?
(a) Weeds (b) Nutrients (c) Vitamins (d) All of these
Hint- Unwanted plants

6. A farmer wants to start a commercial honey production unit. He is looking for a bee species that is easy to domesticate, has high honey yield, and is widely used in apiculture. Which bee species should he choose?
(a) *Apis florae* (b) *Apis dorsata* (c) *Apis mellifera* (d) *Apis cerana indica*
Hint- Comparative identification

Assertion-Reason Based Questions (1mark each)
(a) Both A and R are true and R is correct explanation of A
(b) Both A and R are true, but R is not correct explanation of the assertion.
(c) A is true, but R is false.
(d) A is false, but R is true.

7. Assertion (a): Hybridisation is a method used to develop improved varieties of crops.
Reason (r): It involves crossing between genetically dissimilar plants to combine desirable traits.
Hint- Think & identify

8. Assertion (a): Use of biofertilizers reduces the dependency on chemical fertilizers.
Reason (r): Biofertilizers add organic matter to the soil but do not fix nitrogen.
Hint- Fertilizer & Manure

9. Assertion (a): Fish culture alone is enough to meet the increasing demand for fish.
Reason (r): Composite fish culture is more efficient as it uses different species with different feeding habits.
Hint- Pisciculture

10. Assertion (a): Mixed cropping helps reduce the risk of crop failure.
Reason (r): Different crops grown together can utilize different nutrients and reduce pest infestation.
Hint- Cropping pattern

Very short answer questions (2 marks)
11. A plant breeder is working to develop an improved crop variety. List any two desirable agronomic characteristics that the breeder should focus on and explain why they are important for crop improvement.
Hint: Think about plant features that help crops withstand strong winds and heavy rain without falling, and traits that allow farmers to grow more than one crop in a year.

12. A farmer notices that a significant portion of his stored grains is getting damaged over time.
List any two factors responsible for the loss of grains during storage.

Hint: Think about living organisms that can damage stored grains and environmental conditions that spoil grains over time.

13. A scientist uses genetic engineering to develop a new crop variety that can resist pests and tolerate drought. Explain how genetic engineering contributes to crop improvement.
Hint: Focus on how genes from other organisms can be introduced into crops to give them new useful traits that are difficult to achieve by traditional methods.

14. A farmer is considering starting cattle farming on his farm. List any two benefits of cattle farming that would help the farmer and explain their importance.
Hint: Think about the products obtained from cattle and how they support farming activities and livelihoods.

15. What is pasturage and why is it essential for successful honey production in beekeeping?
Hint: Think about the plants and flowers that bees visit to collect nectar and pollen, which are essential for honey production.

Short answer questions (3 marks)
16. ***(a)*** Identify the image and differentiate between the role of manure and fertilisers in maintaining soil fertility.

(b) Mention one benefit of using manure and one benefit of using fertilisers.

Hint: Consider how each affects soil health and plant nutrition over time.

17. Dinesh owns a small dairy and poultry farm but has recently observed a drop in productivity and health issues among his cows and hens. Explain the common management practices he should adopt in both farms to improve animal health, welfare, and overall productivity.
Hint: Focus on proper feeding, clean housing, disease prevention, hygiene, and breeding management in both farms.

18. Anil owns a fish pond where he grew only one type of fish, leading to low yield and underuse of resources. He now plans to raise different compatible fish species together in the same pond.name the method Anil is planning to adopt. Explain any two advantages anil can gain by using this method.
Hint: Think about improved resource utilization, increased fish yield, and better ecological balance in the pond.

19. Ravi is a farmer in a water-scarce region and is considering switching from traditional to modern irrigation methods to conserve water and improve crop yield. Discuss any two advantages and one disadvantage of modern irrigation methods that Ravi should consider before making the switch.
Hint: Think about water efficiency, crop productivity,

cost, and maintenance of systems like drip and sprinkler irrigation.

Long answer questions (5 marks)

20.(a) Farmers in Maharashtra reduced bollworm attacks by using a crop genetically modified with a bacterial gene. Based on this case, define a GM crop and name one such crop grown in India.

(b) In a drought-prone village of Rajasthan, farmers shifted to drip irrigation and early-maturing crop varieties to sustain yields. Explain how cultivation practices and crop yield are related to environmental conditions.

Hint: (a) Think of crops genetically engineered for pest resistance.

(b) Think of how factors like rainfall, temperature, and soil quality affect farming methods and output.

21.(a) A group of farmers in Punjab faced crop damage and soil pollution due to overuse of pesticides. Discuss why pesticides should be used in accurate concentration and appropriate manner.

(b) A poultry farm in Tamil Nadu faced heavy losses as large-sized birds unable to tolerate heat died during peak summer. What would happen if poultry birds are larger in size and have no summer adaptability? To obtain small-sized birds with summer tolerance, which method should be used?

Hint: (a)Think about crop safety, environmental impact, and human health.

(b)Think of selective methods used to develop desirable traits in animals

Case study Based questions (4 marks)

22. *A dairy farmer in Haryana noticed a decline in milk yield and increased disease among his cattle. After consulting veterinary experts, he improved feeding practices, ensured regular vaccination, and started selective breeding to enhance productivity.*

(a) What is animal husbandry?

(b) Why is vaccination important in cattle rearing?

(c) Suggest two scientific practices the farmer can adopt to improve the quality and quantity of milk production. Explain how these practices help.

Hint: (a)Think of the branch of agriculture that deals with rearing animals

(b)Think about how vaccines protect animals from specific diseases

(c) Think of improved feeding techniques and breeding methods used to enhance traits.

23*. Meena, a fish farmer in West Bengal, noticed that cultivating only one type of fish gave limited yield. After attending a training program, she began culturing fast-growing species together and paid attention to water quality and fish feed. As a result, her fish production increased significantly.*

A) Why fish culture considered an important part of animal husbandry?

B) What factors should be maintained in a pond for successful fish farming

C) Explain how culturing different species of fish together helps improve productivity. Name this method.

Hint: (a) Think of how it contributes to food supply and rural income.

(b) Think about water quality, oxygen level, and cleanliness.

(c) Think of species using different parts of the pond and not competing for food.

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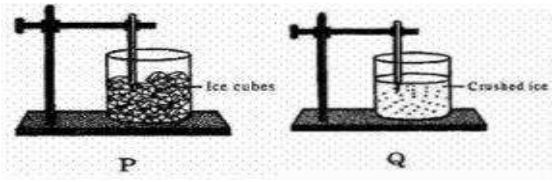
Solved question paper-I

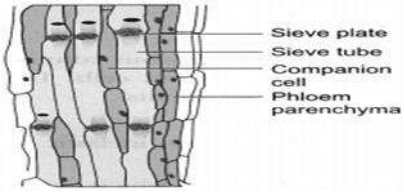
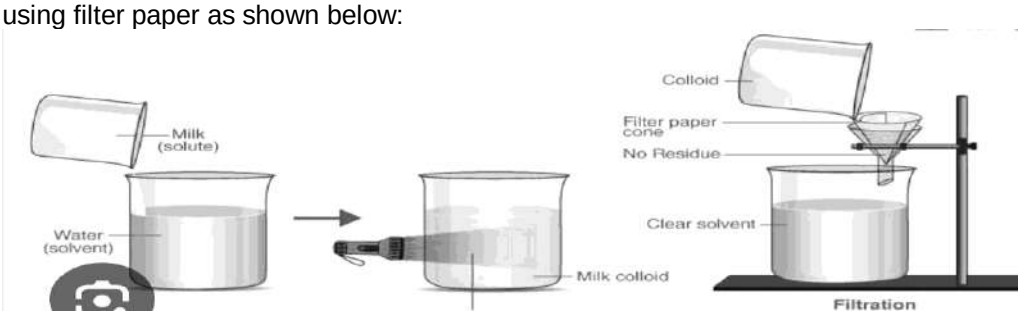
CLASS: IX **SUBJECT: SCIENCE**
TIME: 3 HOURS **M. MARKS: 80**

***General insructions**:*

1. This question paper consists of 39 questions in 5 sections.
2. All questions are compulsory. However, an internal choice is provided in some questions. A student is expected to attempt only one of these questions.
3. Section A consists of 20 Objective Type questions carrying 1 mark each.
4. Section B consists of 6 Very Short questions carrying 02 marks each. Answers to these questions should in the range of 30 to 50 words.
5. Section C consists of 7 Short Answer type questions carrying 03 marks each. Answers to these questions should in the range of 50 to 80 words.
6. Section D consists of 3 Long Answer type questions carrying 05 marks each. Answer to these questions should be in the range of 80 to 120 words.
7. Section E consists of 3 source-based/case-based units of assessment of 04 marks each with sub-parts.

	SECTION A	
1	Which of the following is the high yielding variety of cow? (a) Red Sindhi. (b). Holstein. (c).Dorset. (d).Sahiwal.	**1**
2	When we change feeble sound to loud sound, we increase its: (a) frequency. (b) amplitude. (c) velocity. (d) wavelength	**1**
3	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	**1**
4	Which of the following settle down when allowed to stand on disturbed for sometime? (a) copper sulphate solution. (b) blood. (c) muddy water. (d) solution of egg albumin in water	**1**
5	A scientist observes a plant cell with a large central vacuole and chloroplasts. Which of the following functions are primarily carried out by these structures? (a) The central vacuole stores water, and the chloroplasts perform photosynthesis (b) The central vacuole stores proteins, and the chloroplasts store water (c) The central vacuole produces proteins, and the chloroplasts store starch (d) The central vacuole stores energy, and the chloroplasts store proteins	**1**
6	Which experiment is correct to measure melting point of ice (a) both P&Q. (b) P. (c). Q. (d) neither P & Q 	**1**
7	Roshni is making temporary amount of Indian peel. What precautions should be taken to avoid the entry of air bubbles in the slide? (a) cover slip should be gently dropped over the peel (b) peel should be immersed in stain over an hour (c) peel should be allowed to fold over itself once or twice (d) cover slip should be dropped on the peel from a certain height	**1**
8	Lignified, narrow, elongated and dead cells are found in: (a) Collenchyma. (b)Phloem. (c) parenchyma. (d) sclerenchyma	**1**
9	Usha swims in a 90 m long pool. She covers 180 m in one minute going either way. The average velocity is. (a) 30 m/s. (b) zero. (c) 180 m/s. (d) 90 m/s	**1**
10	An atom with three protons and four neutrons will have the Valency of. (a) 4. (b) 1. (c) 7. (d) 3	**1**

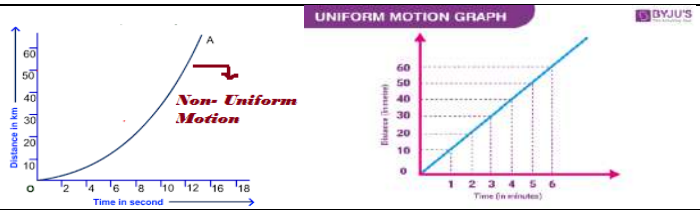
11	What is the correct symbol of Sodium (a). Na. (b). N. (c) S. (d) Se	**1**
12	Correct formula of calcium carbonate (a) CaC_2. (b) CaO. (c) Ca_2O. (d) $CaCO_3$	**1**
13	Nerve cell does not contain (a) Axon. (b) Nerve endings. (c) dendrites. (d) tendon	**1**
14	The speed of a car weighing 1500 kg increases from 36 km/h to 72 km/h uniformly. What will be the change in momentum of the car? (a) 15000 kg km/h (b) 15000 kg m/s. (c) 54000 kg m/s (d) 54000 g m/s	**1**
15	Weeds affect the crop plants by (a) killing of plants in the field before they grow (b) providing nutrients to grow (c) competing for various resources of crops (plants) causing low availability of nutrients (d) all of the above.	**1**
16	Poultry fowl are susceptible to the following pathogens (a)Viruses. (b) Bacteria. (c) Fungi (d) All of the above	**1**
DIRECTIONS: In the following questions 17 -20, a statement of assertion (A) is followed by a statement of reason (R). Mark the correct choice as: (a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A). (b) Both assertion (A) and reason (R) are true but reason (R) is not the correct explanation of assertion (A). (c) Assertion (A) is true but reason (R) is false. (d) Assertion (A) is false but reason (R) is true.		
17	**Assertion:** Ultrasonic waves are used in medical imaging. **Reason:** Ultrasonic waves have high penetrating power and can pass through tissues.	**1**
18	**Assertion:** A football has lesser inertia than a stone of the same size. **Reason:** Massive object has less inertia.	**1**
19	**Assertion:** Epithelial tissues are tightly packed and form a protective barrier. **Reason:** Epithelial tissues have a high rate of cell division to replace damaged cells.	**1**
20	**Assertion :** Milk is an aerosol **Reason :** Milk contains fat as dispersed phase and water as dispersion medium	**1**
SECTION B		
21	When a force of 40 N is applied on a body it moves with an acceleration of $5ms^2$. Calculate the mass of the body.	**2**
22	Helium atom has atomic mass of 4u and has two protons in its nucleus. What is the atomic number of He and how many neutrons does it have?	**2**
23	Why does a dessert cooler cool better on a hot dry day? OR Liquids and gases can be compressed but it is difficult to compress solids. Why?	**2**
24	(a) Name the cell organelles that contain their own genetic material. (b)Write the function of vacuoles in a plant cell.	**2**
25	Draw the distance-time graph for a uniform and non-uniform motion.	**2**
26	The mass of the earth= 6×10^{24} kg and of the moon = $7.4x10^{22}$kg. The distance between the earth and moon is $3.84x10^5$ km. Calculate the force exerted by the earth on the moon. (take $G=6.7x10^{-11}$ $N\ m^2\ kg^{-2)}$ OR What is the difference between the mass of an object and its weight?	**2**
SECTION C		

27	Draw a well labelled diagram of an animal cell.	**3**
28	Differentiate between parenchyma, collenchyma and sclerenchyma	**3**
29	(a)Which wave property determines (a) loudness, (b) pitch? (b) Calculate the wavelength of a sound wave whose frequency is 220 Hz and speed is 440 m/s in a given medium. OR (a)What is reverberation? (b)Why are the ceilings of concert halls curved?	**3**
30	(a) What will be the state of water at 108^{o} C? (b) Give reason why water is liquid at room temperature?	**3**
31	(a) What is an ion? (b)Give example of a cation and an anion . (c)Write the formula of carbon tetrachloride.	**3**
32	How do you differentiate between capture fishing, mariculture and aquaculture? OR (a)What are the desirable agronomic characteristics for crop improvements? (b)Name any two macronutrients required by the plants.	**3**
33	A car accelerates uniformly from 18 km/h to 36 km/h in 5s. Calculate: (i) the acceleration (ii) the distance covered by the car in that time	**3**
	SECTION D	
34	**Look at the diagram carefully and answer the following questions:** Identify this vascular tissue present in plants.  Write its function. Name the cells present in this tissue.? Which tissue transports water in plants**?** Why are xylem and phloem called complex permanent tissues?	**5**
35	Draw the structure of an atom which has two electrons in its outermost shell M. Write the atomic number of the element? Also mention its name, Electronic configuration, Valency and calculate number of neutrons.	**5**
36	a) The potential energy of a freely falling object decreases progressively. i) Does this variation in potential energy violate the law of conservation of energy? ii) What is the sum total of kinetic energy and potential energy called? b) A mass of 10 kg falls from a height of 50cm. Calculate (i)Velocity of the body. (ii) Kinetic energy of body when it just reaches the ground level. (Take g=10 m/s^2)	**5**
	SECTION E	
37	**Read the following CASE-STUDY based passages and answer the questions-** Roshan made three different solutions using samples of copper Sulphate, Milk and Wheat flour in 100 mL of water in three separate beakers naming X,Y and Z respectively. He left the three beakers undisturbed for some time. Then he passed a beam of light through them one by one and noted down his observations. Later, he also filtered the three mixtures using filter paper as shown below:  	**4**

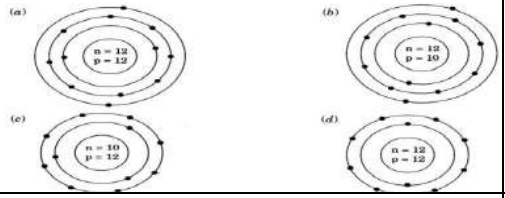
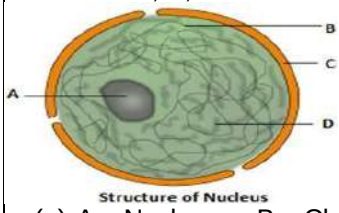
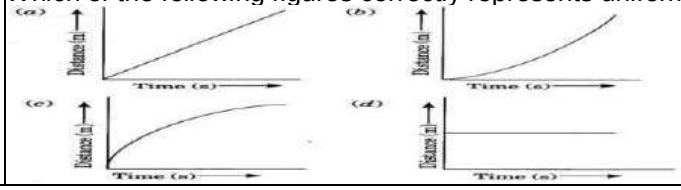
	a) What type of solution is prepared in Beaker – Y? b) Is solution in Beaker Z stable? c) In which solution no residue is found on the filter paper? d) Which of these solutions has particle size less than 1nm- X or Y?	
38	Plant and animal cells have several differences and similarities. For example, animal cells do not have a cell wall or chloroplasts but plant cells do. Plant cells unlike animal cell usually have very few but large central vacuole taking up to almost 60% of cell volume. Plant and animal cells are both eukaryotic cells, so they have several features in common, such as the presence of a cell membrane, and cell organelles, like the nucleus, mitochondria and endoplasmic reticulum. Which cell organelle controls all cellular activities? Name the cell organelle found in Plant cell which helps to carry out photosynthesis. Name the cell organelle(s) present in only plant cell and not in animal cell. **W**hat happens when raisins are kept in hypotonic solution for few hours?	**4**
39	The following table shows the weights (*W*) of objects of equal volume immersed in water (having density = 1000 kg/m^3), observe the table and answer the questions that follow. [Given g = 9.8 m/s^2] OBJECT | WEIGHT (W) IN NEWTON A | 1000 B | 1500 C | 2000 D | 2500 a- On which object is the maximum Buoyant force (up thrust) exerted by water? b- If object C floats inside water (while completely immersed in it), what is the up thrust acting on it? c- State the principle based on which the up thrust acting on an object is obtained. d- A body of mass 2500 kg and volume 5 m^3 is placed on water surface. Will it float or sink in water?	**4**

ANSWER KEY/MARKING SCHEME

	SECTION A	
1	B	1
2	B	1
3	C	1
4	C	1
5	A	1
6	B	1
7	A	1
8	D	1
9	B	1
10	B	1
11	A	1
12	D	1
13	D	1
14	B	1
15	C	1
16	D	1
17	A	1
18	C	1
19	A	1
20	D	1
	SECTION B	
21	8 Kg	2
22	Atomic number – 2, Helium has 2 neutrons	1+1
23	Faster evaporation leads to better cooling OR Solids have strong intermolecular forces and very less space between the constituent particles	2
24	(a)Mitochondria and Chloroplasts (b) Store water, nutrients, and waste products. Maintain turgor pressure for structural support	1+1 = 2

25		1+1 =2
26	$2.02x10^{20}$ N.(applying Newton's law of Gravitation) OR Mass is the quantity of matter contained in a body. Weight is the force of gravity acting on the body	2
	SECTION C	
27	A well labeled diagram of an animal cell	3
28	Correct difference on the basis of structure and function of parenchyma, chollenchyma and sclerenchyma	3
29	• Loudness → Amplitude of the wave • Pitch → Frequency of the wave Applying λ=V/*v* Wavelength = 2 meters OR Reverberation is the **persistence of sound** in a space due to multiple reflections from surfaces such as walls, ceilings, and floors. Curved surfaces help in: 1. Reflecting sound waves uniformly 2. Enhancing sound clarity 3. Reducing excessive reverberation	1+2 = 3 OR 1+2 = 3
30	(a) At 108°C, water exists as steam (gas) because it is above its boiling point. (b) Water is liquid at room temperature because of hydrogen bonding, which keeps the molecules close together, preventing it from turning into gas at room temperature.	1+2 = 3
31	(a) Ion: An atom or molecule that has gained or lost electrons, acquiring a charge. (b) Examples: Cation: Na+ (Sodium ion) Anion: Cl− (Chloride ion) (c) Formula of Carbon Tetrachloride:CCl_4	1+1+1 = 3
32	Correct difference between capture fishing, mariculture and aquaculture. OR Any of the correct desirable characteristics that help to improve crop production. Any two macronutrients	3 OR 2+1
33	(i) Acceleration = 1 m/s² (applying the equation v = u + at) (ii) Distance covered = 37.5 m, Applying the equation $v^2 - u^2 = 2as$ OR $S= ut + 1/2at^2$	1.5+1.5 = 3
	SECTION D	
34	a)phloem b) transports food from leaves to other parts of the plant c) sieve cells, sieve tubes, phloem fibres , phloem parenchyma and companion cells d) Xylem e) Xylem and phloem are called complex permanent tissues, because they are made up of more than one type of cells, these cells coordinate to perform a common function.	1 +1+1+1 +1
35	atomic number is 12 , name of element is magnesium , electronic configuration is 2,8,2 , Valency is 2 and number of neutrons is 12.  (or any other group 2 element.)	½ + ½ + ½ + 1/2 +1 +2

36	a. i) No,it does not violate the law of conservation of energy. As the object falls, its potential energy decreases but the same amount of kinetic energy increases for the body. b. Ii) Sum total of kinetic energy and potential energy is called mechanical energy. c. Mass=10kg, h=50cm=0.5m g=10m/s^2 u=0 i. V^2-u2=2gs ii) K.E=1/2mv2 V^2=0+2*10*0.5 K.E=1/2*10*10*10 V^2=10m/s K.E=500J	1+1 +3
SECTION E		
37	a)Colloidal Solution b) No, unstable c) Solution X d) Solution X (Copper Sulphate solution)	1 *4
38	A. Nucleus B. Chloroplast c) Cell wall, Chloroplast d) they will swell up	1 *4
39	a. The upthrust exerted by water is equal on all objects. b. The upthrust acting on object C is equal to its weight, *i.e.* 200 N. c. **Archimedes' Principle.** It states that if a body is partially or fully immersed in a fluid, it experiences an upthrust which is equal to the weight displaced by d. **Density= Mass/Volume** ->D= 2500/5 =500kg/m3 Density of water(given) =1000kg/m3 As density of object is less than water thus the body will float.	1 mark each

	SECTION A	
1.	It is easier to break a piece of chalk than an iron nail. Which of the following characteristic property of the matter is mentioned here - (a) Particles are continuously moving (b) Particles of matter attract each other. (c) Intermixing of particles of different types. (d) Latent heat of vaporization.	1
2.	Which of the following statements are true for pure substances? (i)Pure substance contain only one kind of particles with definite set of properties. (ii) Pure substance may be compounds or mixtures. (iii) Pure substance have the same composition throughout. (iv) Have a definite melting and boiling point. (a) (i)and (iv) (b) (ii)and (iv) (c) (i) (iii) and (iv) (d) (i),(ii), (iii) and (iv)	1
3.	Which of the following is NOT a sub atomic particle? (a) Neutron (b) Proton (c) Electron (d) Ion	1
4.	An element Ca has a valency 2 , while another element Cl has valency 1 What compound will form when these two elements combine? (a) CaCl (b) $CaCl_2$ (c) Ca_2Cl (d) $CaCl_3$	1
5.	Identify the Magnesium atom and Magnesium ion respectively from the figure where n and p represent the number of neutrons and protons respectively. (a) (a) and (b) (b) (a) and (d) (c) (b) and (c) (d) (c) and (d) 	1
6.	The nucleus controls all the activities of the cell and acts as a site of DNA material and protein synthesis. It is composed of some components which all together give the nucleusits functionality. Here is shown a figure of nucleus with some of its components labeled as A, B, C and D. Arrange these components correctly.  Structure of Nucleus (a) A – Nucleons; B – Chromatin; C – Nuclear membrane; D - Nucleoplasm (b) A – Nucleus; B – Chromatin; C – Nuclear membrane; D – Nucleoplasm (c) A – Nucleolus; B – Chromatin; C – Nuclear membrane; D – Nucleoplasm (d) **A – Nucleolus;B – Chromatin; C – Nuclear membrane; D – Nuclear wall**	1
7.	The process by which water moves through a semi-permeable membrane from a region of high concentration to a region of lower concentration, thereby equalizing water concentration is called: (a) Evaporation (b) Diffusion (c) Osmosis (d) All of the above	1
8.	Which of the following figures correctly represents uniform motion of a moving object? 	1

9. **A person met with an accident in which two long bones of hand were dislocated.Which among the following may be the possible reason?** 1

(a) Tendon break
(b) Break of skeletal muscle
(c) Ligament break
(d) **Areolar tissue break**

10. Which row shows the correct combination? 1

Row	Connective tissue	Functions
P	Ligament	Smoothens bone surfaces at joints
Q	Tendon	Connects muscles to bones
R	Cartilage	Fills the space inside the organs
S	Areolar tissue	Connects two bones

(a) P (b) Q (c) R (d) S

11. The inertia of a moving object depends on- 1
(a) Mass of the object
(b) Momentum of the object
(c) Shape of the object
(d) Speed of the object

12. The law of gravitation describes the gravitational force between: 1
(a) any two bodies having mass
(b) earth and point mass only
(c) earth and Sun only
(d) two charged bodies only

13. Find the work done by gravity on an object of mass 5 kg which moves to the ground when it is released from a height of 10 m. Given, g = 9.8 m/s^2 . 1
(a) 50 J (b) 490 J (c) 980 J (d) 500 J

14. Urjit wants to observe the speed of sound in different objects. He performed experiments and found that the speed of sound is maximum in 1
(a) Iron (b) water (c) air (d) vacuum

15. When we change feeble sound to loud sound we increase its- 1
(a) Frequency (b) Amplitude (c) Velocity (d) Wavelength

16. Carbon, hydrogen, nitrogen , phosphorus, Iron, boron are nutrients , amongst these some are required by plants in small quantities and some are in large quantities. Choose the pair which represents micro-nutrients- 1
(a)Nitrogen,Iron (b)Calcium, Manganese (c)Iron, Manganese (d)Magnesium, boron

INSTRUCTIONS FOR QUESTION NUMBER 17 TO 20

These 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

17. Assertion(A)- Cooling is caused by evaporation 1
Reason(R) - Surface molecules in a liquid take up energy from the surrounding and escape away

18. Assertion(A) - Vascular tissue are complex tissues. 1
Reason(R) - Xylem and phloem are made up of one type of cells.

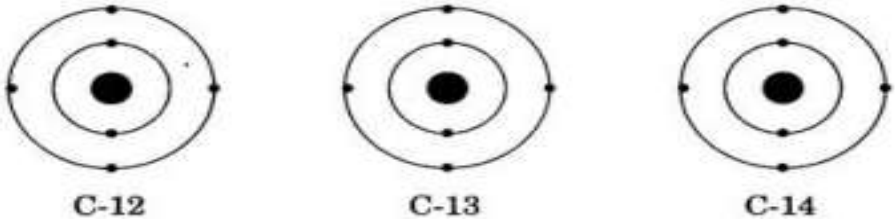
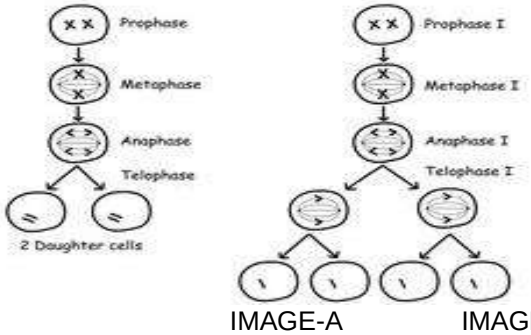
19. Assertion(A) - While walking on ice, one should take small steps to avoid slipping 1
Reason (R) – This is because smaller steps ensure smaller friction.

20. Assertion(A)-fraction of kinetic energy of a falling object convert into heat energy. 1
Reason(R)- Kinetic energy always remains constant.

SECTION B

21. Identify the colloid(i) , the dispersed phase(ii) and dispersion medium(iii) & (iv) in the following - 2

Substance	Dispersed phase	Dispersion medium
Fog	Liquid	**(iii)**
Emulsion	**(ii)**	Liquid
(i)	Gas	Liquid
Sol	Solid	**(iv)**

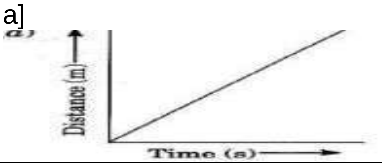
22.	There are three isotopes of carbon which are named as C-12, C-13 and C-14 out of which C-12 is the most abundant isotope. (a) In the given structures of 3 isotopes, what will be the number of protons and neutrons in the nucleus? (b) Give one example of isobars.  **OR** Calculate the atomic number and mass number of the elements 'X' and 'Y' from the following ; (a) X^- ion containing 18 electrons and 18 neutrons (b) Y^{3+} ion containing 10 electrons and 14 neutrons	2
23.	If Arika places a cell in a hypotonic solution, what do you think would happen to the cell ? Justify your answer.	2
24.	A bus decreases its speed from 80 km h^{-1} to 60 km h^{-1} in 5s. Find the acceleration of the bus. **OR** A train starting from a railway station and moving with uniform acceleration attains a speed 40 km h^{-1} in 10 minutes. Find its acceleration.	2
25.	Mention the type of energy used in the following examples. (i) Stretched rubber string (ii) Fast-moving car (iii) The whistling of a cooker due to steam. (iv) A fan running on electricity	2
26.	Compare the use of manures and fertilizers in maintaining soil fertility.[2 points]	2
	SECTION C	
27.	A substance 'X' is in a physical state that has maximum kinetic energy and substance 'Y' is in a physical state with maximum inter-molecular forces of attraction. Identify the physical state of 'X' and 'Y'. comment on the physical state of substance 'X 'when high pressure is applied on it.	3
28	Three samples were kept in a laboratory. Sample 'A' was a beaker containing a mixture of blue copper sulphate in water, sample 'B' was a beaker containing a mixture of chalk powder in water and sample 'C' was a beaker containing a mixture of starch stirred in hot water. Which mixture (i) would not leave residue on filter paper after filtration? (ii) would show Tyndall effect? (iii) would give transparent /clear solution?	3
29.	Identify the images A and B given below and write any 2 points of difference.  IMAGE-A IMAGE-B	3
30.	Which tissue provides rigidity and stiffness to the plants? It is difficult to pull out husk of coconut, Justify this statement. **OR** Tissue A and tissue B constitute C. A carries water while B carries food for the plants. Identify A, B, C Enlist elements of tissue A and B.	3
31.	What happens to the force between two objects, if (a) The mass of one object is doubled? (b) The distance between the objects is doubled ? (c) The masses of both objects are doubled? **OR**	3

	(a) Whether weight is scalar quantity or vector quantity? Justify your answer. (b) Differentiate between mass and weight.[Write 2 main points]	
32.	A car of mass 900 kg is travelling at a steady speed of 30 m/s against a resistive force of 2000 N, as illustrated in figure. (i) Calculate the kinetic energy of the car. (ii) Calculate the work done by the resistive force in 1 second. (iii) What is the minimum power that the car engine has to deliver in 1 second to the wheels? 	3
33.	Differentiate between Inter cropping , mixed cropping and crop rotation by giving suitable example.	3
	SECTION D	
34.	(1) Differentiate between sodium atom and sodium ion based on following point (a).Charge (b).Number of protons and electrons (c) Number of valence electrons. (d).Number of shells (e). Stability according to octet rule. (2) **Find the molecular mass of the following compounds;** (a)Na_2CO_3 (b)H_2SO_4 Atomic mass of H = 1u, C = 12u, N = 14u, O = 16u, Na = 23u and S = 32u **OR** (1) Write chemical formula of following compounds by crossing over valencies Sodium hydrogen carbonate Calcium hydroxide Zinc sulphate (2) Name an element with atomicity 1 . Give any two examples of poly-atomic ions.	5
35.	A. Identify the type of tissue in the following: skin, bark of tree, bone, lining of kidney tubule B. Differentiate the following activities on the basis of voluntary or involuntary - (a) Jumping of frog (b) Pumping of the heart (c) writing with hand Ans: (d) Moving of chocolate in stomach. **C.** Identify the tissues from the images given below-  **OR** A. Draw well labelled diagram of Nervous tissue. B. Differentiate between Cardiac muscles and voluntary muscles. C. Where are fats stored In the body?	5
36.	(a)State Newton's first law of motion (b)You are given a pile of carom coins. Describe in brief an activity to illustrate the property of inertia of rest? **OR** (a)Two objects of masses 100 g and 200 g are moving along the same line and direction with velocities of 2 m/s and 1 m/s respectively. They collide and after the collision the first object moves at a velocity of 1.67 m./s. Determine the velocity of the second object. (b)In the following example, identify the number of times the velocity of the ball changes. Also identify the agent supplying the force in each case. "A football player kicks a football to another player of his team who kicks the football towards the goal. The goalkeeper of the opposite team collects the football and kicks it towards a player of his own team".	5
	SECTION E **Case Based questions**	
37.	In the year 1913, Niels Bohr proposed an atomic structure model, describing an atom as a small, positively charged nucleus surrounded by electrons that travel in circular orbits around the positively charged nucleus like planets around the sun in our solar system, with attraction provided by electrostatic forces, popularly known as Bohr's atomic	4

	model. Electrons revolve around the nucleus in stable orbits without emission of radiant energy. Each orbit has a definite energy and is called an energy shell or energy level. Answer the following questions on the basis of text mentioned above- a) How many electrons will be there in valence shell of Chlorine atom and chloride ion - (a). 8 and 7 (b). 7 and 8 (c). 1 and 8 (d). 8 and 1 b) Maximum number of electrons in L shell is (a) 4 (b). 2 (c). 8 (d). 18 c) Draw the atomic structure of Potassium atom and Potassium ion. **OR** 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? and (ii) What is the charge on the atom?	
38.	The cell is the basic structural and functional unit of all forms of life. To understand the basic structure of plant cells and animal cells we can prepare a temporary stained slide of Onion peel and human check cells. There are some differences between plant cells and animal cells , On the basis of which we can identify them easily. **1]** Arrange the following steps in correct sequence to prepare temporary slide of onion peel- (i) Putting a drop of glycerin on the onion peel on a slide, (ii) Peel a thin layer of epidermis from the onion bulb. (iii) Adding methylene blue stain, and (iv) Placing the cover-slip over the material. (a) (i), (ii), (iii), (iv) (b) (ii), (i), (iv), (iii) (c) (iv), (ii), (iii), (i) (d) (ii), (iii), (i), (iv) **2]** We use glycerin in temporary mount of the material because (a) it avoids drying of the material (b) it provides medium for floating the material (c) it increases the beauty (d) it increases the clarity of the material **3]** Draw a diagram of plant cell and label the following parts- Part which maintains the shape of the cell Heredity vehicle of the cell. **OR** State the functions of the following- Ribosomes Golgi body	4
39.	Sound is produced by vibrating objects. The matter or substance through which sound is transmitted is called a medium. It can be solid, liquid or gas. Sound moves through a medium from the point of generation to the listener. When an object vibrates, it sets the particles of the medium around it vibrating. The particles do not travel all the way from the vibrating object to the ear. Sound waves are characterized by the motion of particles in the medium . When a vibrating object moves forward, it pushes and compresses the air in front of it creating a region is called a compression(C).When the vibrating object moves backwards, it creates a region of low pressure called rarefaction (R). **1.** Sound waves are --- (a) Mechanical (b) Electromagnetic (c) Transverse (d) None of these **2.** Compression is the region of--- (a) High pressure (b) Low pressure (c) Medium pressure (d) None of these **3.** What is velocity of sound? Why does sound travel faster in summer season than in winter? **OR** Why are the ceilings of concert halls are curved ?	4
1	C]	1

MARKING SCHEME

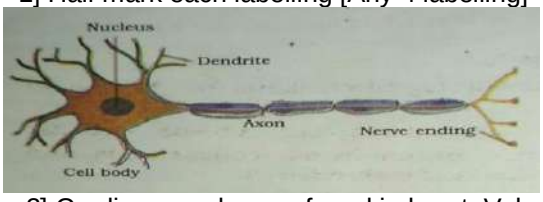
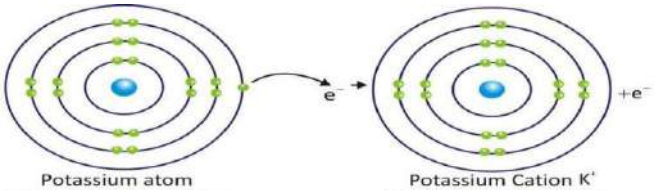
1.	b] Particles of matter attract each other.	1
2.	c] I ,iii and iv	1
3.	d] Ion	1
4.	b] $CaCl_2$	1
5.	b] a and d	1
6.	c] A – Nucleolus; B – Chromatin; C – Nuclear membrane; D – Nucleoplasm	1
7.	c] Osmosis	1

<table>
<tr><td>8.</td><td>a]
 
</td><td>1</td></tr>
<tr><td>9.</td><td>c] Ligament break</td><td>1</td></tr>
<tr><td>10.</td><td>b] Q</td><td>1</td></tr>
<tr><td>11.</td><td>a] Mass of the object.</td><td>1</td></tr>
<tr><td>12.</td><td>a] Any two bodies having mass.</td><td>1</td></tr>
<tr><td>13.</td><td>b] 490 J</td><td>1</td></tr>
<tr><td>14.</td><td>a] Iron</td><td>1</td></tr>
<tr><td>15.</td><td>b.] Amplitude</td><td>1</td></tr>
<tr><td>16.</td><td>c.] Iron ,Mangnese</td><td>1</td></tr>
<tr><td>17.</td><td>a] Both A and R are true and R is the correct explanation of A</td><td>1</td></tr>
<tr><td>18.</td><td>c] A is true but R is false</td><td>1</td></tr>
<tr><td>19.</td><td>c] A is true but R is false</td><td>1</td></tr>
<tr><td>20.</td><td>c] Assertion is true but reason is false</td><td>1</td></tr>
<tr><td>21.</td><td>SECTION- B
<table>
<tr><td>Substance</td><td>Dispersed phase</td><td>Dispersion medium</td></tr>
<tr><td>Fog</td><td></td><td>Gas</td></tr>
<tr><td>Emulsion</td><td>Liquid</td><td>Liquid</td></tr>
<tr><td>Foam</td><td>Gas</td><td>Liquid</td></tr>
<tr><td>Sol</td><td>Solid</td><td>Liquid</td></tr>
</table></td><td>1/2X4 =2</td></tr>
<tr><td>22.</td><td>1] C-12: 6p + 6n, C-13: 6p + 7n, C-14: 6p + 8n
2] Any two examples of Isobars
OR
1] Atomic number-17
Mass number-35
2] Atomic number-13
Mass number-27</td><td>1+1

1+1</td></tr>
<tr><td>23.</td><td>When a cell is placed in a hypotonic solution, (i.e., the solution having solute concentration lower than the cell sap), the water moves into the cell because of the higher concentration of water outside the cell than in the cell. The cell then swells to become turgid due to endoosmosis.</td><td>1+1</td></tr>
<tr><td>24.</td><td>Given ,the initial velocity (u) = 80 km/hour= = 22.22 $m.s^{-1}$
The final velocity (v) = 60km/hour = 60000m/3600s= 16.66 $m.s^{-1}$
Time frame, t = 5 seconds.
Therefore, acceleration (a) =(v-u)/t = (16.66 $m.s^{-1}$ – 22.22 $m.s^{-1}$)/5s
= -1.112 $m.s^{-2}$
Therefore, the total acceleration of the bus is -1.112$m.s^{-2}$. It can be noted that the negative sign indicates that the velocity of the bus is decreasing.
OR
Given parameters
Initial velocity (u) = 0
Final velocity (v) = 40 km/h
v = 40 × (5/18)
v = 11.1111 m/s
Time (t) = 10 minute
t = 60 x 10
t = 600 s
Acceleration (a) =?
Consider the formula
v = u + at</td><td>2

2</td></tr>
</table>

	11.11 = 0 + a × 600 11,11 = 600 a a = 11.11/600	
25.	i) Potential energy (ii) Kinetic energy (iii) Sound energy (iv) Electrical energy	1/2X4 =2
26.	MANURES- 1] Manure improves soil quality with added nutrients. 2] Manures provide extra organic matter called humus to the soil and therefore increasing the water retention capacity of sandy soil and drainage in clayey soil. FERTILISERS- 1] Fertilizer make the soil become too dry and powdered and raise the rate of soil erosion. 2] The nature of the soil changes,either basic or acidic. Any other correct points may be mentioned.	1+1
27.	1] X'- Gas 'Y'-Solid 2] When pressure is applied the molecules come closer, increasing the inter-molecular force of attraction and decreasing the inter-molecular space. Hence it changes a gas into liquid	1+2
28.	(i)Mixture of copper sulphate and water. Mixture of starch and hot water. Mixture of starch and hot water. Ii] Mixture of chalk powder and water , mixture of starch and hot water. (iii)Mixture of copper sulphate and water	1+1+1
29.	Image A- Mitosis Image -B – Meiosis Any 2 points of difference for each	1+1+1
30.	Sclerenchyma provides rigidity and stiffness to the plants. The husk of coconut is made up of sclerenchymatous tissue.They are lignified and make it difficult to pull. OR Tissue A is xylem ,B is phloem and Tissue C is Vascular tissue Xylem elements are - tracheid, vessels, xylem parenchyma, xylem fibers Phloem elements are- sieve tubes, companion cells, phloem parenchyma, phloem fibers.	1+ 2
31.	From Universal law of gravitation, force exerted on an object of mass *m* by earth is given by So as the mass of any one of the object is doubled the force is also doubled. (ii) The force F is inversely proportional to the distance between the objects. So if the distance between two objects is doubled then the gravitational force of attraction between them is reduced to one fourth(1/4) of its original value. (iii) Force F is directly proportional to the product of both the masses. So, if both the masses are doubled then the gravitational force of attraction becomes four times the original value. OR Weight is vector quantity as it has magnitude as well as direction which is always towards centre of a earth. Difference between mass and weight (any 2 Points)	1+1+1 1+2
32.	(i) Kinetic energy = 1212 mv^2 = 1212 × 900 × $(30)^2$ = 1212 × 900 × 900 = 4,05,000 J (ii) Work done against resistive force= Force × Distance = 20,000 × 30 = 60,000 J = 60 kJ (iii) Minimum power = Energy used / Time taken = 60,000 J/ 1s = 60,000 W = 60 kW	1+1+1
33.	Correct difference with suitable examples	1+1+1
34.	<table><tr><th>sodium atom</th><th></th><th>sodium ion</th></tr><tr><td>Charge</td><td>Neutral</td><td>Positive</td></tr><tr><td>Number of protons and</td><td>Protons-11</td><td>Protons-11</td></tr><tr><td>electrons</td><td>Electrons-11</td><td>Electrons-10</td></tr><tr><td>Valence electrons</td><td>1</td><td>8</td></tr><tr><td>Stability according to octet</td><td>Unstable</td><td>Stable</td></tr><tr><td>Mass</td><td>Same</td><td>Same</td></tr><tr><td>Number of shells</td><td>3</td><td>2</td></tr></table> 2] Calculation of molecular mass of Na_2CO_3 and H_2SO_4 OR 1] Correct formula, Crisscrossing 2] O_2,N_2.H_2 Any two examples of polyatomic ions - OH^-, $N0_3^-$, NH_4^+	1/2x6= 3 1+1=2 1-½+1-½ =3 1+1=2 Total 5

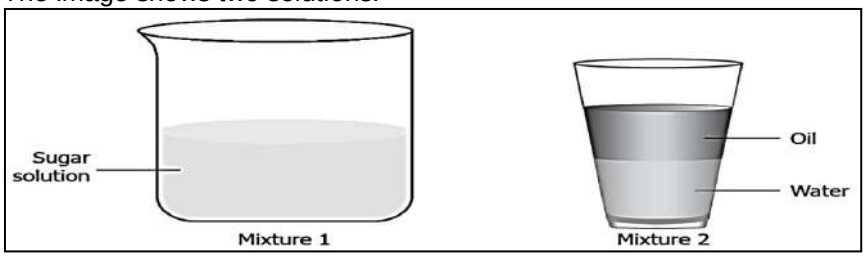
35.	1] The type of tissues of the given is listed below. Skin Squamous - epithelial tissue Bark of tree - Epidermal tissue Bone - Connective tissue Lining of kidney - tubule Cuboidal epithelial tissue 2] (a) Jumping of frog Ans: Voluntary (b) Pumping of the heart Ans: Involuntary (c) writing with hand Ans: Voluntary (d) Moving of chocolate in stomach Ans: Involuntary 3] A- Squamous epithelium B- Cuboidal epithelium OR 1] Half mark each labelling [Any 4 labelling]  2] Cardiac muscles are found in heart ,Voluntary muscles are attached to the bones and are called striated muscles which helps in body movement. Cardiac muscles are not dependent on our will whereas striated muscle moves as per our will or any other correct point. 3} are stored in adipose tissue found below the skin and between Internal organs.	2+2+1 =5 2+2+1 =5
36.	1] Make a pile of similar carom coins on a table. Attempt a sharp horizontal hit at the bottom of the pile using another carrom coin or the striker. If the hit is strong enough, the bottom coin moves out quickly. Once the lowest coin is removed, the inertia of the other coins makes them 'fall' vertically on the table. The inertia of coins tries to maintain its state of rest even when one of the coin moves out. 2] All objects resist a change in their state of motion. In a qualitative way, the tendency of undisturbed objects to stay at rest or to keep moving with the same velocity is called inertia. So the first law of motion is also known as the law of inertia **OR** (a)Determine the velocity (b) identification of the agent supplying the force in each case	3+2=5 3+2=5
37.	1] B] 7 and 8 2] C] 8  3]A] OR No. of electrons = 8 No. of protons = 8 (i) Atomic number = no. of protons = 8 (ii) As Electrons = Protons ⊕ = ⊖ 3B] ∴ Atom is electrically neutral (No charge)	1+1+2 =4
38.	1] d] ii,iii,i ,iv 2] a] It avoids drying of the material. 3] A] Diagram of plant cell B] Cell Wall , Nucleus **OR** A] Ribosome – Protein synthesis B] Golgi body - Transport,Sorting,packaging and modification of protein and lipid or any other correct function	1+1+2 =4
39.	1 a] 2 a] 3. Velocity of sound is the speed of sound in a given medium at a given temperature. As the temperature increases the speed of sound also increases, hence in summer the sound travels faster than in winter. OR Concert halls are very big ,So the sound might not reach every corner of the hall,so ceilings of concert halls are made curved so that after reflecting sound reaches to the entire hall,A curved ceiling acts as a large concave soundboard and reflects sound down onto the audience sitting in the hall.	1+1+2 =4

SECTION A

1. Clothes do not dry quickly when there is more humidity in the air. What explains the phenomenon? **1**

(a) high humidity decreases the rate of evaporation.
(b) high humidity increases the rate of evaporation.
(c) high humidity decreases the rate of condensation.
(d) high humidity increases the rate of condensation.

2. The image shows two solutions. **1**



Observe the images and Choose the correct answer.
(a)Mixture 2 is homogeneous because the components of a homogenous mixture always form separate layers.
(b)Mixture 1 is homogeneous because the composition is uniform throughout the mixture.
(c)Mixture 2 is heterogeneous because the components of heterogeneous mixtures are always liquid.

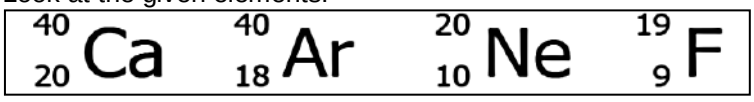
3. A student filled two glasses with 100 mL water in each. To glass 1, she added 5 mL orange food colour, and to glass 2 she added 10 mL orange food colour. Of the two, which water would appear darker? **1**

(a)Glass 1 because it has less solute (b) Glass 2 because it has more solvent.
(c)Glass 1 because it has more solvent (d) Glass 2 because it has more solute.

4. Nikhila learns that Aluminium forms compounds with both chlorine and oxygen. She records the valencies of the three elements. (Aluminium: $\mathbf{3^+}$, Chlorine: $\mathbf{1^-}$, Oxygen: $\mathbf{2^-}$ **)** **1**
Which option gives the correct formula of Aluminium oxide and Aluminium chloride?
(a)aluminium oxide: Al_2O_3; aluminium chloride: $AlCl_3$
(b)aluminium oxide: $3AlO_2$; aluminium chloride: $3AlCl_2$
(c)aluminium oxide: Al_3O_2; aluminium chloride: Al_3Cl_2
(d)aluminium oxide: $3(AlO)_2$; aluminium chloride: $2(Al_3Cl)$

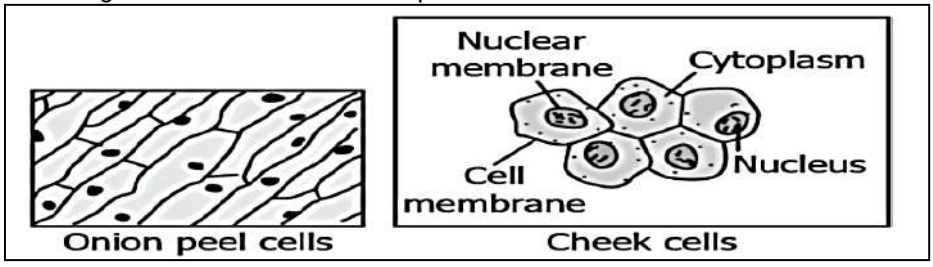
5. A boy walks 10m in a straight path moving away from a lamp pole in a garden and walks 5m back on the same path. What is the displacement of the boy from the lamp pole? **1**
(a)0 m (b) 5m (c) 10 m (d)15 m

6. Look at the given elements. **1**



Which of the two are isobars?
(a) Ar and F (b) Ca and Ar (c) Ca and Ne (d)Ne and F

7. The image shows cells in an onion peel and human cheek. **1**



What can be understood by observing these cells?
(a)All living things are made of cells that look similar.
(b)All living things are made up of cells that are structurally similar but functionally different.
(c)All living things are made up of cells that are functionally similar but structurally different.
(d)All living things are made of cells that look different from each other.

8. One of the following functions is performed by the smooth endoplasmic reticulum. Identify it. **1**
(a)It helps to expel excess water and waste out of the cell. (b) It helps to detoxify the drugs.
(c)It helps to digest small foreign particles. (d) It helps to produce DNA molecules.

9. A large amount of energy is required by the cell to carry out various cellular processes. Which part of mitochondria helps generate enough energy required for various chemical activities and how? **1**

(a)The folds present in the inner mitochondrial membrane decrease the surface area for more ATP production.

(b)The folds present in the outer mitochondrial membrane increase the surface area for more ATP production.

(c)The folds present in the inner mitochondrial membrane increase the surface area for more ATP production.

(d) The folds present in the outer mitochondrial membrane decrease the surface area for more ATP production.

10. Skin is the outermost layer of the body which provides protection from mechanical injuries as well as helps in the secretion of sweat and oils. Which type of epithelium is the skin likely composed of to facilitate all the functions mentioned? **1**

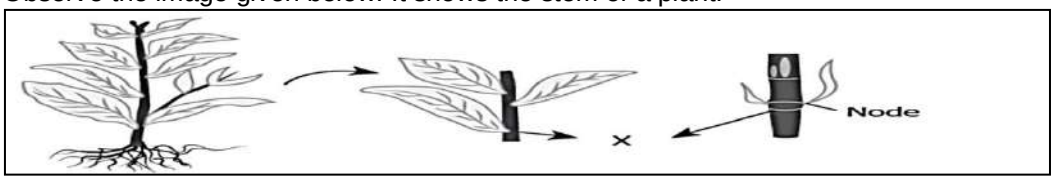
(a)epithelium having flat surface. (b)epithelium with hair-like projections for particle movement.

(c)epithelium with irregular shaped cells (d)epithelium arranged in many layers.

11. A ball of 150 g is hit with a bat; the ball starts travelling with a velocity of 3m/ s. What is the momentum of the ball? **1**

(a)0.05 kg m / s (b)0.45 kg m / s (c)50 kg m / s (d)450 kg m / s

12. Observe the image given below. It shows the stem of a plant. **1**

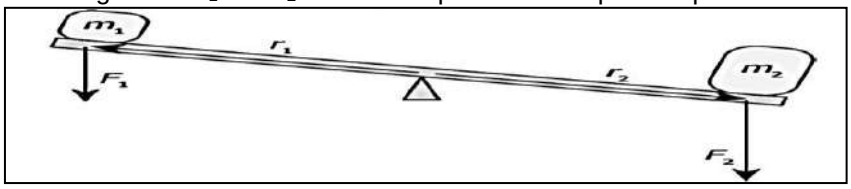


Which type of meristematic tissue is present at the labelled part 'X'?

(a)apical meristem (b)intercalary meristem

(c) lateral meristem (d)both apical and lateral meristem

13. Two blocks of mass m_1 and m_2 are placed on a wooden plank, which is pivoted at its centre. The weights are r_1 and r_2 distances apart from the point of pivot. **1**



Under what conditions do the weights get balanced on the wooden plank?

(a)When $m_1 < m_2$ and $r_1 = r_2$. (b)When $m_1 < m_2$ and $r_1 < r_2$.

(c)When $m_1 > m_2$ and $r_1 > r_2$. (d)When $m_1 = m_2$ and $r_1 = r_2$

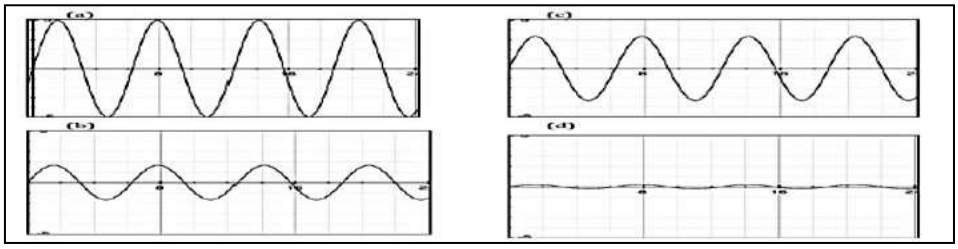
14. Using a horizontal force of 60 N, a person moves a lawn mower over a distance of 125 m. The work done in Joules will be: **1**

(a)+7500 (b) -7500 (c)+2.03 (d)-2.03

15. What would be the kinetic energy possessed by an object of mass, '$2m$' and moving with a uniform velocity, 'v'? **1**

1/2 mv^2 (b) mv^2 (c) $2mv^2$ (d) $4mv^2$

16. Aman, a pianist; was playing several notes which was graphed by a scientist. The scientist has been told that the loudest notes have the highest amplitude. Among the following notes, which one is the loudest note? **1**



Question No. 17 to 20 consist of two statements – **Assertion** (A) and **Reason** (R). Answer these questions by 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.

17. **Assertion (A):** When a firefly hits a bus, each of them exerts the same force. **1**
Reason (R): A firefly has more mass as compared to the windshield.

18. **Assertion (A):** The value of acceleration due to gravity changes with the height, depth and shape of the earth. **1**
Reason (R): Acceleration due to gravity is zero at the centre of the earth.

19. **Assertion (A):** Most of the plant tissues are dead. **1**
Reason (R): Due to sedentary existence of plants, dead cells provide mechanical strength more easily than live ones and need less maintenance.

20. **Assertion (A):** Atoms always combine to form molecules and ions. **1**
Reason (R): Atoms of most elements are not able to exist independently.

SECTION B

21. Alka was making tea in a kettle. Suddenly she felt intense heat from the puff of steam gushing out of the spout of the kettle. She wondered whether the temperature of steam was higher than that of the water boiling in the kettle. Comments on the observation. **2**

22. **(a)** J. Chadwick discovered a sub-atomic particle which has no charge and has a mass nearly equal to that of a proton. Name the particle and give its location in the atom.
(b) Write down the electron distribution of Chlorine atom. How many electrons are there in the L shell? (Atomic number of Chlorine is 17).
OR
(a) If the number of electrons in an atom is 8 and the number of protons is also 8, then:
(i) what is the atomic number of the atom? (ii) what is the charge on the atom?
(b)Na+ has completely filled K and L shells. Explain in brief. **2**

23. (a) Name the only living component of the Xylem tissue and draw a diagram to show its structure.
(b) State the importance of Xylem for plant survival. **2**

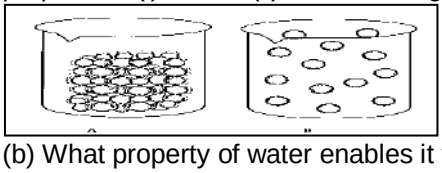
24. (a) What would be the acceleration of a body if its velocity-time graph is a line parallel to the time axis?
(b) Why is the motion in a circle with constant speed called accelerated motion? **2**

25. Justify your answer for each of the following questions with proper reason.
(a) Between a rubber ball and a rock of identical size, which one possesses greater inertia, and why?
(b) What causes the dust particles to detach and disperse when a carpet is struck with a stick?
OR
How does inertia of motion and inertia of direction influence everyday activities? Give one example for each. **2**

26. In what way does green manure contribute to soil fertility? Briefly discuss its importance with an example. **2**

SECTION C

27. (a)Differentiate between the two states of matter shown in the given diagram based on these properties: (i)Volume(ii) Kinetic energy



(b) What property of water enables it to adapt to the shape of its container? **3**

28 **(a)**What is a formula unit mass? How is it different from molecular mass?
(b)Calculate the formula unit mass of $MgSO_4$. (Atomic mass of Mg = 24 u, S = 32 u, O=16u)
OR
(a) Is it possible for the atom of an element to have one electron, one proton and no neutron? If so, name the element and write the symbolic expression with atomic number and mass number.
(b) Why do isotopes show similar chemical properties?
(c) An element 'Z' forms the following compounds when it reacts with hydrogen,chlorine, oxygen and phosphorous. ZH_2, ZCl_2, ZO and ZS.
(i) What is the valency of element 'Z'? (ii) Element 'Z' is a metal or a non-metal? **3**

29. (a) Draw a well labelled diagram of a Prokaryotic cell.
(b) Distinguish between a pro-karyotic and a eu-karyotic cell. **3**

30. Compare voluntary and involuntary muscles based on their structure, function, and location. Give one example of each. Support your answer with appropriate diagrams. **3**

31. (a)The brain, spinal cord and nerves are all composed of a tissue which is made of specialized cells. Specify the name of these cells.
(b) Illustrate the structure of this specialized cell with a labelled diagram. **3**

(b) Write the role (function) of these cells in our body.

32. (a) List two contrasts (differences) between the acceleration due to gravity (g) and the universal gravitational constant (G).
(b) An astronaut takes a pot of soil weighing **60 N** from Earth to the Moon. On the Moon, its weight is **10 N**. Did any soil mass disappear? How much mass was lost? (**g** on Earth =**10 m/s²**, **g** and g

33. (a) Explain echo and reverberation. Provide one application of each.
(b) Sonali heard the sound of a thunderbolt 5 seconds after she saw the flash of lightning. How far is she from the place where lightning occurs? (speed of sound = 330 m/s) **3**

SECTION D

34. **Attempt either option A or B.**

A. (a) Write the reason for Rutherford's choice of gold foil in his alpha scattering experiment.
(b) Which observations in alpha scattering experiment led Rutherford to make the following observations?
(i) Most of the space in an atom is empty. (ii) The nucleus is positively charged.
(c) Mention two drawbacks of Rutherford's model.

OR

B. (a) In order to overcome the objections raised against Rutherford's model of the atom, Neils Bohr put forth certain postulates about the model of an atom. State three postulates of Bohr's model of an atom.
(b)Draw Bohr's model of an atom with valency = 1, number of orbits = 3, mass number = 23. **5**
Also identify the element.

35. **Attempt either option A or B.**

A. (a) What will happen if:
(i) Ribosomes are removed from the cell.
(ii) Golgi apparatus is removed from the cell.
(iii) Plasma membrane ruptures.
(b) Describe the role played by Lysosomes in a cell. Why are they termed as suicidal bags? How do they perform their function?

OR

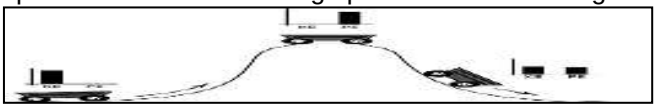
B. (a) List three structural differences between plant and animal cells and explain their significance.
(b) Draw a neat diagram of a plant cell and indicate the parts mentioned by you as the answer to the question given above. **5**

36. **Attempt either option A or B**

A. (a) A **person holds a bundle of hay over his head for 30 minutes and gets tired. Has done some work or not? Justify your answer.**
(b) What is the work done by frictional force on an object when dragged along a rough surface?
(c) Relate Power and Work.
(d) A machine does 1960 Joule of work in 4 minutes. Calculate the Power.

OR

B. (a) Observe the figure given below.
When a rolling object on wheels goes up a hill, it will slow down. While going downhill, it will speed up. This is because moving up or down a hill changes one kind of energy into another.

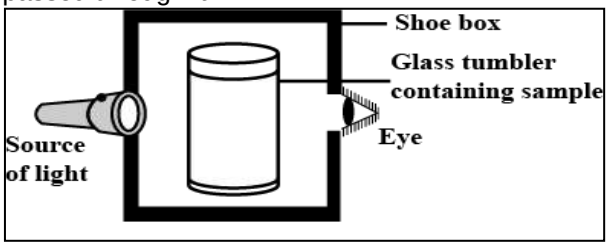


(a) The potential energy of the object decreases progressively on going downhill. Justify giving reason.
(b) Which energy will be maximum when the object is about to touch the ground?
What happens to the total energy at all points during the motion of the object?
(c**) Explain that a flying bird has potential and kinetic energy.**
(d) An object of mass 40 kg is raised to a height of 5 m above the ground. Calculate its Potential energy.

SECTION E
case-based / data-based questions.

37. Read the paragraph given below carefully and answer the questions given.

A group of students took an old shoe box and covered it with a black paper from all sides. They fixed a source of light (a torch) at one end of the box by making a hole in it and made another hole on the other side to view the light. They placed a milk sample contained in a tumbler in the box as shown in the figure below. They were amazed to see that the milk taken in the tumbler was illuminated. They tried the same activity by taking a salt solution but found that light simply passed through it.



A. Why was the path of light visible when the milk sample was illuminated? Name the phenomenon involved.

B. Why were the same results not observed with the salt solution? **4**

C. Can you suggest two more solutions which would show the same effect as shown by the milk

38. We know that the weight of an object is the force with which it is attracted towards the earth. Hence, the SI unit of weight is the same as that of force. Weight is a force acting vertically downwards; it has both magnitude and direction. We have learnt that the value of g is constant at a given place. Therefore, at a given place, the weight of an object is directly proportional to the mass, say m, of the object, that is, W $\propto$ m. It is due to this reason that at a given place, we can use the weight of an object as a measure of its mass.

Answer the following questions.

A. Unit of acceleration due to the gravity (g) is

(a) m/s (b) m/s^2 (c)Newton(N) (d) None of these

B. Direction of weight of any object is

(a)Always towards centre of earth (b)Always away from the centre of earth

(c)Weight does not have direction (d)None of these

C. Which of the following has the same unit?

(a) Mass and weight (b)Weight and force (c)Velocity and acceleration (d)None of these

Attempt either sub-part D or E. **4**

39. Cattle husbandry is done for two purposes— milk and draught labour for agricultural work such as tilling, irrigation and carting. Indian cattle belong to two different species, *Bos indicus*, cows, and *Bos bubalis*, buffaloes. Milk-producing females are called milch animals (dairy animals), while the ones used for farm labour are called draught animals.

Milk production depends on the duration of the lactation period. Exotic or foreign breeds are selected for long lactation periods, while local breeds show excellent resistance to diseases. The two can be cross-bred to get animals with both the desired qualities.

Proper cleaning and shelter facilities for cows and buffaloes are required for humane farming. The food requirements of dairy animals are of two types: (a) maintenance requirement and (b) milk producing requirement. Cattle suffer from a number of diseases. The diseases, besides causing death, reduce milk production.

Answer the following questions.

A. Identify the exotic breed of cow

(a) Red Sindhi (b) Sahiwal (c) Brown Swiss (d) All of the above

B. Identify the correct statements.

Statement 1 – Milk production depends on the duration of the lactation period.

Statement 2 – Exotic or foreign breeds are selected for long lactation periods.

Statement 3 – Local breeds show excellent resistance to diseases.

Statement 4 – Animals used for farm labour are called draught animals.

(a) Both 1 & 2 (b) Only 3 (c) Both 3 & 4 (d) All of the above

C. Milk-producing females are termed as

(a) Milch animals (b) Dairy animals (c) Draught animals (d) Both a & b

Attempt either subpart D or E.

D. Enlist any two Indian cattle species. **4**

E. What are the food requirements of dairy animals?

Unsolved question paper-II

SECTION A

1. The process in which solid is directly converted to vapours state is called ————————
a) Vapourisation (b) Solidification (c) Condensation (d) Sublimation
2. During summer, water kept in an earthen pot becomes cool because of the phenomenon of
a) Diffusion (c) Transpiration b) Osmosis (d) Evaporation
3.Dry ice is-
(a) water in solid state (b) water in gaseous state (c) CO2 in liquid state (d) CO2 in solid state
4.In a water-sugar solution-
(a) Water is solute and sugar is solvent (b) Water is solvent and sugar is solute (c) Wter is solute and water is also solvent (d) None of these
5.Which of the following methods would you use to separate cream from milk?
(a) Fractional distillation (b) Distillation (c) Centrifugation (d) Filtration
6.Mercury and bromine are both
(a) liquid at room temperature (b) solid at room temperature (c) gases at room temperature (d) both (a) and (b)
7.Rutherford's 'alpha (α) particles scattering experiment' resulted in the discovery of
(a) Electron (b) Proton (c) Nucleus in the atom (d) Atomic mass
8.Select the longest animal cell among following: a) Nerve cell b) Muscle cell c) Liver cell (d) Goblet cell
9. What is the Cholrenchyma ?
a) It is a simple permanenet tissue. b) It is a parenchymatous tissue of green leaves and stems. c) It is a photosyntheticin nature. d) All of the above.
10.Which of this acellular?
a) Viruses b) Bacteria c)Protozoans (d) Fungi
11. What is the important function of nucleus?
a) Photosynthesis b) Lipid synthesis c) Cellular reproduction d) Protein synthesis
12.Silver revolution is related to the increase in the production of-
a) Egg b) Milk c) Meat d) Wool
13.The audible range of frequencies for a normal human being is _____ to _____ Hertz.
a) 30 to 30,000 b) 20 to 20,000 c) 40 to 40,000 d) 10 to 10,000
14. The rate of doing work is called _____.
a) Energy b) Power c) Body d) Motion
15. If the distance between two objects is doubled, the gravitational force between them
a) Remains the same b) Gets doubled c) Becomes one fourth d) Gets halved
16. If the force acting on the body is zero, its momentum is _____.
a) Zero b) Negative c) Both d) Constant
Directions: 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) Assertion is false, but reason is true.
17.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.
18. Assertion- All plants and animlas are composed of cells.
Reason- Cell is the basic unit of non-living things.
19. Assertion- The supportive tissue is generally made up of dead cells.
Reason- dead cells always present in liver.
20. 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.

SECTION B

21. Why do helium, neon and argon have a zero valency ?
22. Why there is necessity of animal husbandry?
23. What is osmosis?
24. Name the cell organelles that have thier own DNA and ribosomes. Name the autonomous organelles in the cell.
25. Calculate the wavelength of a sound wave whose frequency is 220 Hz and speed is 440 m/s in a given medium.

OR

A sound wave of wavelength 0.332 m has a time period of 10-3s. If the time period is decreased to 10-

4s, calculate the wavelength and frequency of new wave.
26. Write the main function of Collenchyma?

SECTION C

27.What do you understand by the term 'latent heat of fusion'? How much is the latent heat of fusion of ice?
28.Is water an element or a compound? Give reason in support of your statement.
29. What are the factors for which variety improvement of crop is done?
30. 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.
31. A ball is gently dropped from a height of 20 m. If its velocity increases uniformly at the rate of 10 ms-2, with what velocity will it strike the ground? After what time will it strike the ground?
32. (a) What is loudness of sound? What factors does it depend on?
(b) What is acceleration due to gravity and how is it different from acceleration?

OR

(b) Mention any five phenomena that the universal law of gravitation was able to explain.
33. Difference between Bone and Cartilage .

SECTION D

34. What is the gold foil experiment? Name the scientist who performed this experiment. Write the conclusions and shortcomings of Rutherford's model of atom.
OR
What are the postulates of Bohr's model of an atom?

35. Define permanent tissues with examples and suitable diagram?
36. (a) Certain force acting on a 20 kg mass changes its velocity from 5 ms-1 to 2 ms-1. Calculate the work done by the force.
(b) A battery lights a bulb. Describe the energy changes involved in the process.
(c) An electric heater is rated 1500 W. How much energy does it use in 10 hours?
OR
(a) Explain how bats use ultrasound to catch a prey.
(b) A stone is dropped from the top of a tower 500 m high into a pond of water at the base of the tower. When is the splash heard at the top? Given, g = 10 ms-2 and speed of sound = 340 ms-1.
(c) The frequency of a source of sound is 100 Hz. How many times does it vibrate in a minute?

SECTION E

37.Protons are present in the nucleus of an atom. It is the number of protons of an atom, which determines its atomic number. It is denoted by 'Z'. All atoms of an element have the same atomic number, Z. In fact, elements are defined by the number of protons they possess. For hydrogen, Z = 1, because in hydrogen atom have only one proton is present in the nucleus. Therefore, the atomic number is defined as the total number of protons present in the nucleus of an atom.
The mass of an atom is practically due to protons and neutrons alone. These are present in the nucleus of an atom. Hence protons and neutrons are also called nucleons. Therefore, the mass of an atom resides in its nucleus. For example, mass of carbon is 12 u because it has 6 protons and 6 neutrons, 6 u + 6 u = 12 u. Similarly, the mass of aluminium is 27 u (13 protons+14 neutrons). The mass number is defined as the sum of the total number of protons and neutrons present in the nucleus of an atom. It is denoted by 'A'.
(1) Atomic number is denoted by
(a) X (b) Y (c) Z (d) z
(2) The sum of the total number of protons and neutrons present in the nucleus of an atom.
(a) Atomic number (b) Mass number (c) Atomic weight (d) None of the above
(3) Mass number is denoted by
(a) A (b) a (c) Z (d) z
(4) Identify the correct statement
Statement 1 – Protons are present in the nucleus of an atom.
Statement 2 – Atomic number is the number of protons of an atom.
Statement 3 – Atomic number is denoted by 'Z'.
Statement 4 – The mass of an atom is due to protons and neutrons alone.
(a) Only 2 (b) Both 3 & 4 (c) Both 1 & 2 (d) All of the above
38. Sound bounces off a solid or a liquid like a rubber ball bounce off a wall. Like the light, sound gets reflected at the surface of a solid or liquid and follows the same laws of reflection. The directions in which the sound is incident and is reflected make equal angles with the normal to the reflecting surface at the point of incidence, and the three are in the same plane. If we clap near a suitable reflecting object such as a tall building or a mountain, we will hear the same sound again a little later. This sound that we hear is called an echo.
The sensation of sound persists in our brain for about 0.1 s. To hear a distinct echo, the time interval between the original sound and the reflected one must be at least 0.1s. Hence, for hearing distinct echoes, the minimum distance of the obstacle from the source of sound must be 17.2 m. This distance will change with the temperature of air. Another phenomenon of reflection of sound is reverberation.
A sound created in a big hall will persist by repeated reflection from the walls until it is reduced to a value where it is no longer audible. The repeated reflection that results in this persistence of sound is

called reverberation. Excessive reverberation is highly undesirable. For hearing distinct echoes, what is the minimum distance of the obstacle from the source of sound?

(a) A person makes a sound near an obstacle and heard the echo after 1 s. What is the distance of the obstacle from the person if the speed of the sound, v is taken as 346 m/s?

OR

(a) A sound wave of wavelength 0.332 m has a time period of 10-3s. If the time period is decreased to 10-4s, calculate the wavelength and frequency of new wave.

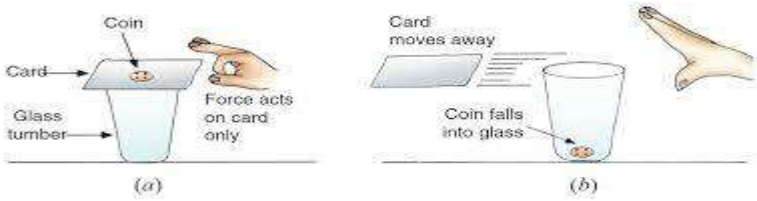
(b) What are the laws of reflection of sound?

39. In the figure below the card is flicked with a push. It was observed that the card moves ahead while coin falls in glass.

a) Give reason for the above observation and name the law involved in this case.

b) If the above coin is replaced by a heavy five-rupee coin, what will be your observation. Give reason.

c) Name the law which provides the definition of force or State Newton's first law of motion



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Unsolved question paper-III

SECTION A

1.When heat is constantly supplied by a burner to boiling water, then the temperature of the water during vaporisation:
(a) Rises very slowly (c) First rises and then becomes constant
(b) Rises rapidly until steam is produced (d) Does not rise at all
2.Weeds affect the crop plants by
(a) Killing of plants in field before they grow (b) Dominating the plants to grow
(c) Competing for various resources of crops (plants) causing low availability of nutrients
(d) All of the above
3.Which of the following is connective tissue?
(a)Ligament (b)Tendon (c)Blood (d)All of the above
4. Which of the following tissues has dead cells?
(a) Parenchyma (b) Sclerenchyma (c) Collenchyma (d) Epithelial tissue
5. Which one of the following nutrients is not available in fertilizers?
(a) Nitrogen (b) Phosphorus (c) Iron (d) Potassium
6. Velocity is defined as _____ per time.
(a)distance (b)displacement (c)power (d)acceleration
7._____ is not found in xylem tissues.
(a)Sieve tubes (b)Xylem parenchyma (c)Tracheid (d)Vessels
8. Find out the correct sentence about manure
(i) Manure contains large quantities of organic matter and small quantities of nutrients.
(ii) It increases the water holding capacity of sandy soil.
(iii) It helps in draining out of excess of water from clayey soil.
(iv) Its excessive use pollutes environment because it is made of animal excretory waste.
(a) (i) and (iii) (b) (i) and (ii) (c) (ii) and (iii) (d) (iii) and (iv)
9. A passenger in a moving train tosses a coin that falls behind him. It means that the motion of train is
(a) Uniform (b) accelerated (c) retarded (d) along circular tracks
10. Which of the following is the SI units of force?
(a)Kgm/s^2 (b)Kgm/s (c)Newton-metre (d)Newton
11. Ribosomes are the sites of
(a)Photosynthesis (b) Respiration (c) Protein synthesis (d) Absorption.
12. Two atoms are said to be Isobars if ————
(a) They have same atomic number but different mass number
(b) They have same number of electrons but different number of neutrons
(c) They have the same number of neutrons but different numbers of electrons.
(d) None of the above
13. How many electrons are occupied in the M shell?
(a) 8 (b) 16 (c) 18 (d) 32
14. A water tank filled upto 2/3 of its height is moving with a uniform speed. On sudden application of the brake, the water in the tank would
(a) Move backward (b) Move forward (c) Come to the rest (d) Be unaffected
15. 1 u or 1 amu means
(a) 1/12th mass of C-12 atoms (c) Mass of O-16 atom
(b) Mass of C-12 atom (d) Mass of Hydrogen molecule
16.The process by which water moves through a semi-permeable membrane from a region of high concentration to a region of lower concentration, thereby equalizing water concentration is called:
(a)Evaporation (b)Diffusion (c)Osmosis (d)All of the above
Directions Q17-Q20
In the following questions, a statement of assertion (A) is followed by a statement of reason (R). Mark the correct choice as:
(a) Both assertion(A) and reason(R) are true and reason(R) is the correct explanation of assertion (A).
(b) Both assertion(A)and reason(R) are true but reason (R) is not the correct explanation of assertion (A).
(c) Assertion (A) is true but reason (R) is false.
(d) Assertion (A) is false but reason (R) is true**.**
17. **Assertion:** A solution of table salt in a glass of water is homogeneous.
Reason: A solution having different composition throughout is homogeneous
18.**Assertion:** Sound is a form of energy which produces a sensation of hearing in our ears.
Reason: When you clap, a sound is produced.
19. **Assertion:** The flash of lightening is seen before the sound of thunder is heard.
Reason: Speed of sound is greater than speed of light.
20. **Assertion:** When a beam of light is passed through a colloidal solution placed in a dark place the path of the beam becomes visible.
Reason: Light gets scattered by the colloidal particles

SECTION B

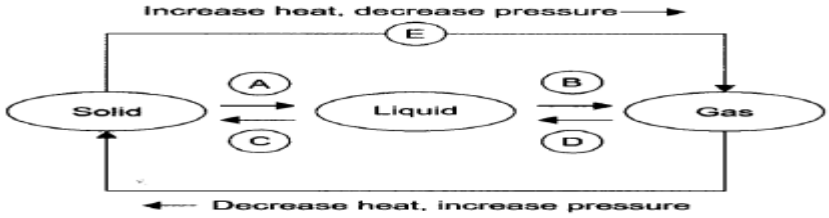
21.Give any two differences between Speed and Velocity.

22. Write down the formulae of
(i) Sodium oxide, (ii)Aluminium chloride
23. Explain Newton's law of motion which is proved by this picture.

24. What do you mean by free fall?
25. Give reasons for the following observations.
(a) Naphthalene balls disappear with time without leaving any solid.
(b) We can get the smell of perfume sitting several meters away.
26. Draw structure of Animal cell.

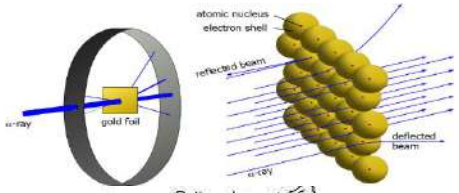
SECTION C

27. Define Crop Rotation. What are the advantages of crop rotation?
28. Name the organelles which show the analogy written as under
(a) Transporting channels of the cell ——
(b) Power house of the cell ——
(c) Packaging and dispatching unit of the cel ——
(d) Digestive bag of the cell ——
(e) Kitchen of the cell ——
(f) Control room of the cell
29. What is sound, and how is it produced?What is the audible range of the average human ear?
30. A bus decreases its speed from 80 km h^{-1} to 60 km h^{-1} in 5 s. Find the acceleration of the bus.
31. Differentiate between meristematic tissue and permanent tissue
32. Calculate the molecular masses of H_2, O_2, Cl_2, CO_2, CH_4, C_2H_6
33.Name A, B, C, D, E and F in the following diagram showing change in its state



SECTION D

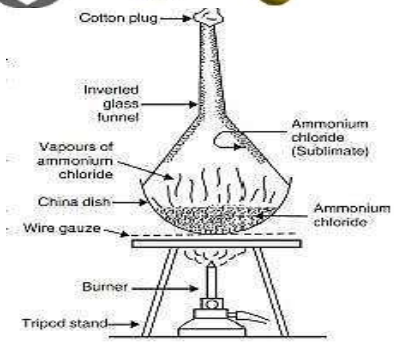
34.What is Tissue. Mention the function of parenchyma, collenchyma and sclerenchyma.
35.Explain power. What is 1 watt of power? Calculate the power if the lamp consumes 1000 J of electrical energy in 10 s.
36. Observe the above picture and name the Rutherford's experiment used for the discovery of Nucleus. Write two conclusions of his experiment. List down limitations of his model.



SECTION E

CASE STUDY BASED QUESTIONS

37. We take some ammonium chloride in a china dish and place the china dish on a tripod stand (see Figure). The china dish is covered with an inverted glass funnel. A loose cotton plug is put in the upper, open end of the funnel to prevent the ammonium chloride vapours from escaping into the atmosphere. The china dish is heated by using a burner. On heating, ammonium chloride changes into white vapours. These vapours rise up and get converted into solid ammonium chloride on coming in contact with the cold, inner walls of the funnel (see Figure). In this way, ammonium chloride collects on the inner sides of the funnel in the form of a sublimate and can be removed.



(i) What name is given to the phenomenon which takes place?
(a) condensation (b) evaporation (c) sublimation (d) vaporisation
(ii) One of the following does not undergo sublimation. This one is :
(a) Iodine (b) Sodium Chloride (c) Ammonium Chloride (d) Camphor
(iii) The conversion of a solid into vapours without passing through the liquid state is called:
(a) vaporisation (b) fusion (c) sublimation (d) freezing
(iv) During summer days, water kept in an earthen pot (pitcher) becomes cool because of the phenomenon of :
(a) diffusion (b) transpiration (c) osmosis (d) evaporation
38. All living Organisms are made up of cells and these cells perform all the functions essential for the survival of the Organism e.g. Respiration, digestion, excretion etc. In Unicellular organisms, a single cell carries out all these functions and in multicellular organisms different group of cells carry out different functions. Cells were first discovered by Robert Hooke in 1665. He observed the cells in a cork slice with the help of a primitive microscope. Leeuwenhoek (1674), with the improved microscope, discovered the free living cells in pond water for the first time. It was Robert Brown in 1831 who discovered the nucleus in

the cell. Purkinje in 1839 coined the term 'protoplasm' for the fluid substance of the cell.

(i) Who discovered the cell?

(a) Robert Hooke (b) Leeuwenhoek (c) Robert Brown (d) T. Schwann

(2) Who discovered the nucleus in the cell?

(a) Robert Hooke (b) Leeuwenhoek (c) Robert Brown (d) T. Schwann

(3) Who coined the term 'Protoplasm'?

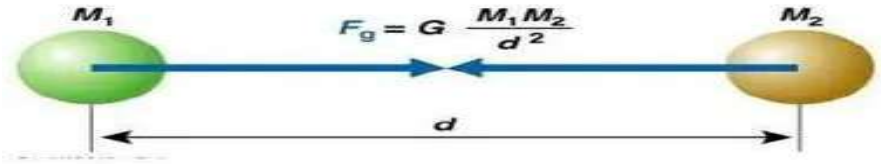
(a) Robert Hooke (b) Leeuwenhoek (c) Robert Brown (d) Purkinje

(4) What is protoplasm?

(a) Unit of life (c) Fluid substance of the cell.

(b) Cell organelle (d) Cytoplasm

39. Every object in the universe attracts every other object with a force which is proportional to the product of their masses (m1*m2) and inversely proportional to the square of the distance (d^2) between them. The force is along the line joining the centers of two objects.



Mathematically,

$F = G\frac{M1*M2}{d2}$

Where,

M_1=mass of one object.

M_2 =mass of another object

d = distance between two objects

G= universal gravitational constant

The value of G was found out by Henry Cavendish (1731 – 1810) by using a sensitive balance. The accepted value of G is $6.673*10^{-11}$ N-m^2/kg^2. Answer the following questions from above case.

(i) Gravitational force does not depend on

(a) Masses of objects (c) Charges on objects

(b) Separation between objects (d) None of these

(ii) Force of gravitation varies with masses of object as

(a) Product of masses (b) Sum of masses (c) Difference of masses (d) None of these

(iii) When mass of one body is doubled then force of gravitation will become

(a) Force will remain same (c) Force will become halved

(b) Force will become double (d) None of these

(iv) What is universal gravitational constant?

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