ICSE PHYSICS 8

CHAPTER 1. Matter

Check Point 1

1. (a) identical (b) increases (c) vibrational (d) gaseous

Check Point 2

1. (a) melting (b) condensation (c) 0

2. (a) During condensation process, a substance releases that much heat as the same substance absorbs during boiling process.

(b) The boiling point of water at atmospheric pressure is 100°C.

Check Point 3

1. (a) solid; gaseous (b) opposite (c) deposition

2. (a) False (b) True (c) True (d) False

Check Point 4

1. (a) Rate of evaporation (b) cooling

2. (a) Alcohol is more volatile than water.

(b) The water present in clothes evaporates faster in sunlight due to increase in temperature. So, clothes dry up quicker in sunlight than in shade.

TEST YOURSELF

A. 1. mass **2.** space **3.** cohesive; adhesive **4.** gas **5.** solid **6.** freezing point **7.** camphor **8.** evaporation

B. 1. Intermolecular force **2.** Latent heat **3.** Sublimation **4.** Condensation **5.** Melting **6.** Evaporation **7.** Desublimates

C. 1. Force of adhesion: The intermolecular force of attraction amongst molecules of two different substances is called the force of adhesion.

2. Change of state: The process of the change of a substance from one physical state to another physical state by changing its temperature is called change of state.

3. Freezing point: The fixed temperature at which a substance changes from liquid state to solid state at standard atmospheric pressure is called its freezing point.

4. Boiling: The process by which a substance changes from liquid state to gaseous state on heating at a fixed temperature is called boiling.

5. **Deposition:** The process by which a substance in its gaseous (vapour) form, on cooling, directly changes into solid state without passing through the intermediate liquid state is called deposition.
6. **Evaporation:** The phenomenon of transition of a liquid into its vapour form at all temperatures below its boiling point is called evaporation.

D. 1.

Melting	Liquefaction
The process by which a substance in solid state on heating changes into liquid state at a fixed temperature is called melting.	The process by which a substance in vapour state on cooling changes into liquid state at a fixed temperature is called liquefaction.

2.

Solids	Liquids
1. The molecules in solids are closely packed, i.e., the intermolecular spaces are extremely small.	1. The molecules in liquids are less tightly packed than in solids, i.e., intermolecular spaces are more than solids.
2. The intermolecular forces are very strong.	2. The intermolecular forces are weaker than solids.

3.

Melting point	Sublimation point
The fixed temperature at which a substance in solid state changes into a liquid at standard atmospheric pressure is called its melting point.	The fixed temperature at which a substance in solid state changes into gaseous state directly without passing through the intermediate liquid state is called sublimation point.

4.

Liquids	Gases
1. The molecules in liquids are less tightly packed than solid.	1. The molecules in gases are loosely packed.
2. Liquids have definite volume and indefinite shape of their own and they can flow.	2. Gases have neither a definite shape nor a definite volume.

5.

Fusion	Condensation
1. The process by which a substance in solid state changes into liquid state on heating at fixed temperature is called fusion.	1. The process by which a substance in vapour state changes into liquid state on cooling at fixed temperature is called condensation.
2. The fusion or melting point of ice is 0°C.	2. Steam condenses into water at 100°C.

6.

Evaporation	Boiling
1. The phenomenon of transition of a liquid into its vapour form at all temperatures below its boiling point is called evaporation.	1. The process by which a substance in liquid state changes into gaseous state at a fixed temperature is called boiling.
2. Evaporation is a slow process.	2. Boiling is a rapid process.

E. 1. The three main points of kinetic theory of matter are as follows:

(a) Every matter is made up of tiny particles called molecules.

(b) Molecules of a substance are identical in shape, size and mass. However, molecules of different substances may have different masses, shapes, sizes and compositions.

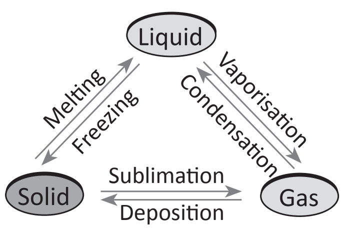
(c) Molecules are continuously in a state of random motion. Motion of molecules is different in different states of matter.

2. Solids < Liquids < Gases

3. Gases < Liquids < Solids

4. The freezing point of water is 0°C and boiling point of water is 100°C.

5. The change of a substance from one physical state to another physical state by changing its temperature is called change of state. The complete cycle of change of state of a substance is as follows:



Schematic diagram showing change of states of matter

6. The three important characteristic properties of a solid on the basis of molecular model of atom are as follows:

(a) The molecules in a solid are closely packed, i.e., the intermolecular spaces are extremely small.

(b) The intermolecular forces between molecules of a solid are very strong and hence, the positions of molecules are fixed. As a result, the solid has a definite volume and definite shape.

(c) The molecules of a solid can only have vibrational motion.

7. Aim: To show that liquids have intermolecular spaces

Materials Required: A glass, a table, sugar and water

Procedure: Take a glass and put it on the table. Fill it with water up to the brim. Add a small quantity of powdered sugar (or salt) carefully to the glass.

Observation: We observe that the sugar is dissolved in water and water does not spill over. It clearly shows that water has intermolecular spaces and sugar molecules have occupied these spaces.

8. The process by which a substance changes from solid state to liquid state on heating at a fixed temperature is called melting. The fixed temperature at which a substance changes from solid state to liquid state is called melting point.

9. At a particular temperature, called the melting point of solid, molecules of solid acquire sufficient energy so as to overcome the intermolecular force of attraction and become free to move within the substance and the solid substance changes into liquid state.

During the melting process, heat energy absorbed by the substance does not raise its temperature. The energy absorbed is utilised for doing work against the intermolecular forces of attraction so as to increase the molecular separation.

10. The process by which a substance in liquid state changes into gaseous state on heating at a definite temperature is called boiling.

The fixed temperature at which a substance from liquid state changes into gaseous state is called boiling point.

11. At a particular temperature, called the boiling point of liquid, the kinetic energy of molecules of liquid becomes sufficient so as to overcome the force of attraction between them. So, the molecules become free to leave the liquid surface. Now, the molecules can move freely in space and the liquid changes into vapour (gaseous) state. During the process of vaporisation, the heat energy absorbed by molecules of liquid is fully utilised to do work against molecular attraction force so as to increase the distance between them and make them independent and free.

12. The process of changing of a substance directly from solid state to gaseous state without passing through the intermediate liquid state on heating is called sublimation, e.g., camphor, ammonium chloride, etc.

13. The solid carbon dioxide is called dry ice. The main application of dry ice is to use it as a cooling agent.

14. Yes, intermolecular force in solids, which undergo sublimation, is comparatively less. Their molecules are loosely packed as compared to other solids.

15. The process of transition of a liquid into its vapour form at all temperatures below its boiling point is called evaporation.

16. The three factors on which rate of evaporation of a liquid depends are as follows:

(a) Nature of the liquid

(b) Temperature

(c) Surface area

17. Ether > mercury > water > glycerine > coconut oil

18. The two applications of evaporation are as follows:

(a) During summer, water contained in an earthen pot gets cooled due to evaporation.

(b) We feel comfortable under a fan when we perspire due to evaporation of sweat from our body.

F. 1. False; Molecules of whole universe are **not identical.**

2. False; Molecules of a **liquid** can move freely within it.

3. True

4. True

5. False; Solids are closely packed, whereas **liquids are less closely packed.**

6. False; A liquid can be compressed slightly but **a gas can be compressed easily.**

7. True

8. False; Gases have **neither definite volume nor definite shape.**

9. False; **Steam** at 100°C has more heat energy than **water** at 100°C.

10. True

11. True

12. True

13. False; The process of a gas converting directly into a solid is called **deposition.**

14. True

G. 1.–(c) **2.**–(e) **3.**–(b) **4.**–(a) **5.**–(f) **6.**–(d)

H. 1. Force of gravity: It is the force with which the earth attracts an object towards itself, others are forces acting on molecules of a substance.

2. Sublimation: Because in this process, the solid gets converted into gas directly without passing through intermediate liquid state while in other processes, conversion occurs one step ahead.

I. 1. The intermolecular spaces between the solid molecules are extremely small because their molecules are closely packed. So, the molecules cannot have translatory or rotational motion. These molecules can only vibrate to and fro about their mean respective mean positions, so, they can have only vibrational motion.

2. The intermolecular spaces between gaseous molecules are very large. Since, gas molecules can have independent translatory motion in all possible directions throughout the space, so, average kinetic energy of gas molecules is more as compared to solids and liquids.

3. As heat supplied/released during a change of state does not lead to change in temperature, it is called latent heat.

4. During change of state, the heat absorbed (or released) by the substance does not change the average kinetic energy of molecules, so, the temperature of the substance remains constant.

5. An earthen pitcher has small pores in it. When water is put into the pot, some water seeps out of these pores and gets evaporated. The heat required for evaporation is taken from the water stored in the pitcher. Therefore, water stored in the earthen pitcher becomes cold.

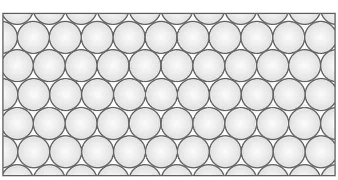
6. The size of naphthalene balls decreases because naphthalene balls sublime, i.e., directly change into vapour form when left open for some time.

7. As the water of the cotton strip evaporates, it takes heat from the body of the patient. As a result, the body temperature of the patient falls. That is why, a doctor suggests putting of wet cotton strip on the forehead of a patient having high fever.

8. Hot tea cools faster in saucer than in cup because as the surface area of tea increases in saucer, evaporation takes place at a faster rate and its temperature falls. As a result, we can sip tea comfortably kept in a saucer than in a cup.

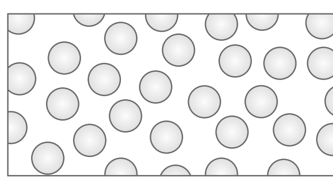
J. **1.**–(c) **2.**–(b) **3.**–(b) **4.**–(a) **5.**–(b) **6.**–(a) **7.**–(d) **8.**–(d)

K. 1. (a)



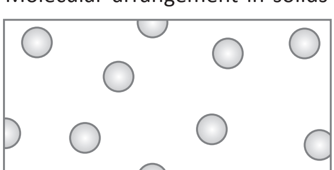
Molecular arrangement in solids

(b)



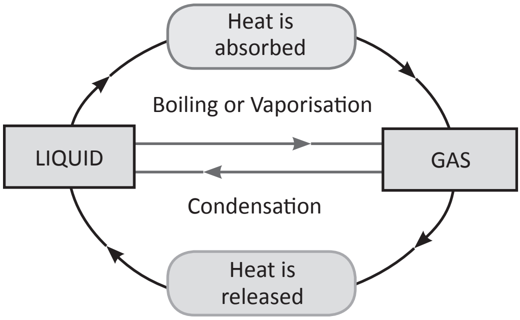
Molecular arrangement in liquids

(c)



Molecular arrangement in gases

2.



Process of boiling and condensation

3. (a)–Melting (b)–Freezing (c)–Vaporisation or Boiling (d)–Condensation (e)–Sublimation (f)–Deposition

THINK ZONE

- Since evaporation is faster on a hot windy day as compared to a cold humid day, so, wet clothes dry up easily on a hot windy day.
- On mixing impurity (salt) to ice, the melting point of ice gets lowered due to melting point depression. Due to melting point depression, ice melts slowly and helps to make kulfi effectively.
- Only those solids sublime which have weak intermolecular forces of attraction. Since, most solids have very strong intermolecular forces, they do not exhibit the property of sublimation.

CHAPTER 2. Physical Quantities and Measurement

Check Point 1

1. (a) material (b) kg/m^3 (c) 1

2. (a) A measuring cylinder is a graduated glass cylinder which is used to measure the volume of liquids.

(b) Iron

Check Point 2

1. (a) 4ºC (b) Relative density (c) Density

2. (a) The relative density has no units.

(b) If temperature of a substance is increased, its density decreases.

Check Point 3

1. (a) less (b) more (c) floats

2. (a) An instrument used to measure the purity of milk by measuring its density is called lactometer.
   (b) Hydrometer is used to check the density of acid solution.

TEST YOURSELF

A. **1.** more **2.** liquid **3.** floats; less **4.** floats **5.** more **6.** Lactometer **7.** decreases **8.** sinks; floats

B. **1.** Density **2.** Relative density **3.** Principle of floatation **4.** Hydrometer

C. **2.**

Density	Relative density
1. The mass of an object contained per unit volume is called density of the material of that object.	1. The ratio of the density of the substance to the density of pure water at 4°C is called the relative density of the given substance.
2. The SI unit of density is kg/m^3.	2. It has no units.

2.

Floating	Sinking
A state of rest or movement of a lighter object on the surface of heavier object is called floating.	A state of rest or movement of a heavier object below the surface of a lighter object (liquid) is called sinking.

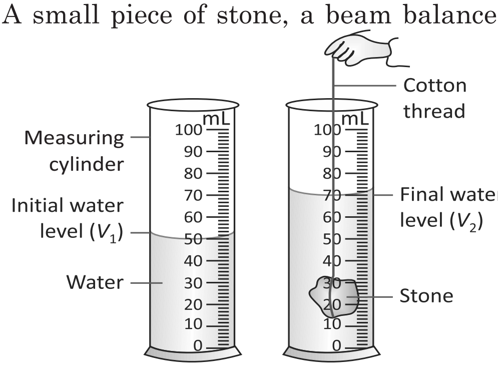
D. **1.** The mass of an object contained per unit volume is called density of a material of an object. The SI unit of density is kg/m^3.

2. The density of a substance does not depend on its shape and size. Yes, the density of the substance depends on the material of the substance.

3. **Aim:** To determine the density of an irregular solid heavier than water and insoluble in it

Materials Required: A small piece of stone, a beam balance, a thread, a measuring cylinder and water

Procedure: Take a small piece of stone and find its mass by using a beam balance. Let it be *M*. Take a clean measuring cylinder and fill it nearly half with water.



When water level is steady, note down the reading of water level. Let it be V_1. Tie a thread around the stone and gently immerse it into water. The stone piece must be fully immersed into water but should not touch the walls or the base of the measuring cylinder. The water level in the measuring cylinder rises. Note down the reading of water level again. Let it be V_2.

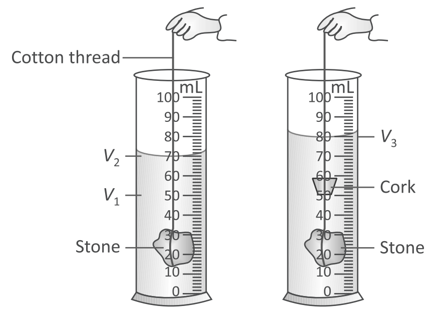
$$\text{Volume of the stone, } V = \text{Volume of displaced water} = V_2 - V_1$$

$$\therefore \quad \text{Density of the stone, } D = \frac{M}{V} = \frac{M}{V_2 - V_1}$$

4. Aim: To determine the density of a cork piece using a sinker and a measuring cylinder

Materials Required: A piece of cork, a beam balance, a measuring cylinder, a thread, a stone piece and water

Procedure: Take a small piece of cork and find its mass by using a beam balance. Let it be M. Take a measuring cylinder and fill it nearly half with water. Note down the reading of the water level. Let it be V_1. Now, take a heavy sinker (say, a stone piece) and tie a fine thread to it. Gently, immerse it into water and record the new water level. Let it be V_2. Now, gently remove the stone from water. Tie the cork piece along with stone. Gently, immerse them into water so that both sink into water. Again, record the water level. Let it be V_3.



Then, volume of the cork, $V = V_3 - V_2$

$$\therefore \quad \text{Density of the cork, } D = \frac{M}{V} = \frac{M}{V_3 - V_2}$$

5. Aim: To determine the density of oil (liquid) using a density bottle

Materials Required: A density bottle, the stopper, a liquid (oil or glycerine), a tissue paper or a piece of dry cloth and a beam balance

Procedure: Take an empty and dry density bottle of known capacity (V). Weigh it accurately along with the stopper using a sensitive beam balance. Let its mass be M_1. Now, fill the bottle with given liquid (say, oil or glycerine) up to the brim and insert the stopper. The extra liquid overflows through the hole in the stopper. Wipe the overflown liquid using a tissue paper or a piece of dry cloth. Weigh the bottle again. Let the combined mass of the liquid and density bottle be M_2.

Calculation:

Volume of density bottle, $V =$ ______ mL = ______ cm^3

Mass of empty density bottle, $M_1 =$ ______ g

Mass of density bottle with liquid, $M_2 =$ ______ g

Mass of liquid, $M = (M_2 - M_1)$ g

$$\therefore \quad \text{Density of liquid, } D = \frac{\text{Mass } (M)}{\text{Volume } (V)}$$

$$= \left(\frac{M_2 - M_1}{V}\right) \text{g/cm}^3$$

6. The ratio of the density of a substance to the density of pure water at 4°C is called relative density.

Relative density has no unit because it is the ratio of two densities.

7. The density of an object decreases if the temperature of the object increases. On the other hand, the density of the object increases if the temperature of the object decreases.

8. According to the principle of floatation, a solid will sink in a liquid if its density is more than the density of the liquid but a solid will float on a liquid if its density is less than the density of the liquid.

9. A piece of cork, ice cube and a piece of soft wood are three floating bodies.

10. Hydrogen < air < cork < water < iron < mercury

11. Mercury > copper > water > ice > alcohol > air

12. The ice will not float in the given oil because the density of the ice is greater than oil. On the other hand, ice will float on water because density of ice is lower than water.

13. When a liquid is heated:

(a) volume will increase.

(b) mass remains constant.

(c) density will decrease.

14. A special type of ship which may sink or float over the sea water as per its convenience is called submarine.

A submarine works on the principle of floatation.

E. 1. False; A piece of wood and a piece of copper having some mass will **have different volumes.**

2. False; The SI unit of density is kg/$\mathbf{m^3}$**.**

3. False; Density of a liquid **decreases** with increase in temperature. (or Density of a liquid increases with **decrease** in temperature).

4. False; Density of ice is **lesser** than density of water.

5. True

6. True

7. True

8. False; **Relative density has no unit.**

9. False; A **lactometer** is used to determine purity of a sample of milk.

10. True

F. 1.–(b) **2.**–(c) **3.**–(d) **4.**–(a)

G. 1. Since the density of a substance is the amount of mass of the substance present in its unit volume, and SI units of mass and volume are kg and m^3 respectively, so, the SI unit of density is kg/m^3.

2. The relative density is a ratio of two densities, hence, it is a unitless quantity.

3. The density of a wooden piece is less than water, so, it floats on water. On the other hand, the density of an iron piece is more than the density of water, so, it sinks in water.

4. Since the density of ice is less than water, therefore, a very large-sized iceberg floats on sea water.

5. Density of iron is much more than the density of water, so, an iron needle sinks in water. On the other hand, an iron ship is designed in such a way that it is mostly hollow from within. As a result, the volume of the iron ship becomes very large as compared to its mass, hence, its effective density becomes less than that of water. Therefore, a ship floats on water.

6. The density of sea water is more than the density of freshwater due to salts present in it. Therefore, it is easier to swim in sea water than in freshwater.

7. The volume is directly proportional to temperature, i.e., when the temperature of a substance increases, its volume also increases. As we know, the density of a substance is inversely proportional to its volume. So, when volume of a substance increases on increase in temperature, its density decreases.

8. As the density of a balloon filled with hydrogen is less than the density of air, so, a balloon filled with hydrogen gas rises in air.

H. 1. Density $= \dfrac{\text{Mass}}{\text{Volume}}$

$$= \frac{624}{80} = 7.8 \text{ g/cm}^3$$

2. Density $= \dfrac{\text{Mass}}{\text{Volume}}$

$$= \frac{225}{75} = 3 \text{ g/cm}^3$$

3. Density of copper $= 8.9 \text{ g/cm}^3$

$$= 8.9 \times 1000 \text{ kg/m}^3 \quad (\because 1 \text{ g/cm}^3 = 1000 \text{ kg/m}^3)$$

$$= 8900 \text{ kg/m}^3$$

4. Density $= \dfrac{\text{Mass}}{\text{Volume}}$

$$= \frac{1.35 \text{ kg}}{(15 \text{ cm})^3}$$

$$= \frac{1.35 \text{ kg}}{\left(\frac{15}{100}\right)^3 \text{m}^3}$$

$$= \frac{1.35 \times 100 \times 100 \times 100 \text{ kg}}{15 \times 15 \times 15 \text{ m}^3}$$

$$= \frac{135 \times 100 \times 100}{15 \times 15 \times 15} = 400 \text{ kg/m}^3$$

5. Volume of a metal sphere $= \dfrac{4}{3}\pi r^3$

$$= \frac{4}{3} \times 3.14 \times (3)^3$$

$$= \frac{4}{3} \times 3.14 \times 27$$

$$= 36 \times 3.14$$

$$= 113.04 \text{ cm}^3$$

$\because$ Density $= \dfrac{\text{Mass}}{\text{Volume}}$

$\therefore$ Mass = Density × Volume

$$= 7 \text{ g/cm}^3 \times 113.04 \text{ cm}^3$$

$$= 791.28 \text{ g} \simeq 792 \text{ g}$$

6. $\because$ Density $= \dfrac{\text{Mass}}{\text{Volume}}$

$$\therefore \quad \text{Volume} = \frac{\text{Mass}}{\text{Density}}$$

$$= \frac{280}{800} = 0.35 \text{ m}^3$$

7. Here, volume of density bottle, $V = 25 \text{ mL} = 25 \text{ cm}^3$

Mass of the liquid, $M = (43.8 - 22.6) \text{ g}$

$= (21.2) \text{ g} = 21.2 \text{ g}$

Density of the given liquid, $D = \frac{M}{V}$

$$= \frac{21.2 \text{ g}}{25 \text{ cm}^3}$$

$= 0.848 \text{ g/cm}^3$

$= 0.848 \times 1000$

$= 848 \text{ kg/m}^3$

8. Here, mass of the given liquid, $M = 84.2 \text{ g}$

Volume of solid, $V = 60 \text{ mL} - 36 \text{ mL}$

$= 24 \text{ mL}$

$= 24 \text{ cm}^3$

$$\therefore \quad \text{Density} = \frac{\text{Mass}}{\text{Volume}}$$

$$= \frac{84.2}{24}$$

$= 3.5 \text{ g/cm}^3$

9. Here, initial volume of water, $V_1 = 24 \text{ cm}^3$

Volume of the water and sinker, $V_2 = 56 \text{ cm}^3$

Now, Volume of water, sinker and cork, $V_3 = 88 \text{ cm}^3$

and mass of the cork piece, $M = 12.5 \text{ g}$

$\therefore$ Volume of the sinker $= V_2 - V_1$

$= (56 - 24) \text{ cm}^3 = 32 \text{ cm}^3$

$\therefore$ Volume of the cork piece $= V_3 - V_2$

$= (88 - 56) \text{ cm}^3 = 32 \text{ cm}^3$

$$\therefore \quad \text{Density of the cork piece, } D = \frac{\text{Mass of the cork piece}}{\text{Volume of the cork piece}}$$

$$= \frac{12.5}{32} = 0.391 \text{ g/cm}^3$$

$\because \quad 1\ g/cm^3 = 1000\ kg/m^3$

$\therefore \quad 0.391\ g/cm^3 = 1000 \times 0.391\ kg/m^3$

$= 391\ kg/m^3$

I. **1.** (b) **2.** (a) **3.** (b) **4.** (b) **5.** (d) **6.** (d) **7.** (a)

J. **1. Iron;** The density of iron is more than water and density of others is less than water.

2. Iceberg; Iceberg floats on water and others sink in water. (Or Density of iceberg is less than water and density of others is more than water).

THINK ZONE

- Density of water in dead sea is more than that of the body of a person. So, a person cannot sink in dead sea even if he so desires.
- The value of relative density of a substance is independent of the unit system because it is a ratio of two densities.

CHAPTER 3. Force and Pressure

Check Point 1

1. (a) turning effect

(b) newton metre

2. (a) The two effects of a force are as follows:

(i) A force may bring a moving object at rest or *vice versa.*

(ii) A force may change the shape and size of an object.

(b) Moment of a force is also called turning effect of a force.

Check Point 2

1. (a) 1 (b) sharp; blunt (c) camel

2. (a) For a given thrust, the pressure is inversely proportional to the surface area of the object, i.e., pressure increases when area of contact is decreased.

(b) The SI unit of pressure is N/m^2 or pascal.

Check Point 3

1. (a) liquid

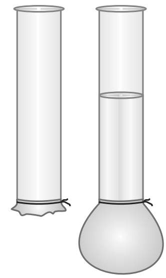
(b) increases

(c) does not depend

2. (a) **Aim:** To show that a liquid exerts pressure

Materials Required: A glass tube, a thin stretched rubber membrane and water

Procedure: Take a glass tube of about 2–3 cm wide, 10–15 cm long and open at both the ends. Tie a thin stretched rubber membrane on one end of the tube. Hold the tube in vertical position. Now, pour water into the tube so that nearly half of it is filled with water.



Observation: There is a bulge produced in the rubber membrane. It is caused by the pressure exerted by the water due to its own weight.

(b) (i) Liquid pressure depends on the density of a liquid.

(ii) Liquid pressure depends on the depth of a liquid.

Check Point 4

1. (a) decreases (b) 1.013×10^5 Pa (c) atmospheric pressure
2. (a) Yes, atmosphere exerts a pressure.
   (b) Mercury is used as a barometric liquid for measuring atmospheric pressure.

TEST YOURSELF

A. **1.** perpendicular **2.** turning moment of a force **3.** inversely **4.** decrease **5.** depends **6.** equal **7.** atmospheric pressure **8.** sea level

B. **1.** Thrust **2.** Moment of the force **3.** Pressure **4.** Lateral pressure **5.** Atmosphere

C. **1. Moment of a force:** If an object is pivoted at a point, then a force applied on the object produces a turning effect on the object about an axis passing through the pivoted point. The turning effect of a force is called the moment of a force.

2. Pressure: The normal force acting per unit area on a surface is called pressure. The SI unit of pressure is N/m^2 or pascal.

$$\text{Pressure} = \frac{\text{Force}}{\text{Area}}$$

3. Atmospheric pressure: The pressure exerted by air column above us is called atmospheric pressure. The value of atmospheric pressure is 1.013×10^5 Pa.

4. Thrust: Total normal force exerted by an object on a given surface is equal to its weight and is called thrust.

5. A pascal: A pascal is the SI unit of pressure. If a force of 1 N is acting per square metre area of an object, the pressure exerted on this area is 1 pascal or a pascal.

D. 1.

Clockwise moment	Anticlockwise moment
If a force produces clockwise rotation in an object, the moment of a force is said to be a clockwise moment.	If a force produces anticlockwise rotation in an object, the moment of force is said to be an anticlockwise moment.

2.

Thrust	Pressure
1. Total normal force exerted by an object on a given surface is equal to its weight and is called thrust.	1. The normal force acting per unit area on a surface is called pressure.
2. The SI unit of thrust is newton.	2. The SI unit of pressure is pascal.

3.

Liquid pressure	Atmospheric pressure
The pressure exerted by a liquid is called liquid pressure. A liquid contained in a vessel exerts thrust at all points below its free surface.	The pressure exerted by air column above us is called the atmospheric pressure. The value of atmospheric pressure is 1.013×10^5 Pa.

E. 1. If an object is pivoted at a point, then a force applied on the object produces a turning effect on the object about an axis passing through the pivoted point. The turning effect of a force is called the moment of the force.

The SI unit of the moment of a force is newton metre (N m).

2. The two factors on which moment of a force depends are as follows:

(a) Magnitude of a force.

(b) Perpendicular distance of the force from the point of pivot.

3. Two examples showing a turning effect are as follows:

(a) The steering wheel of an automobile.

(b) Working of a see-saw.

4. Torque of a force about a given axis of rotation is denoted by τ (tau).

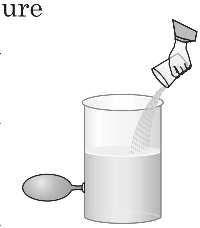
$$\text{Torque } (\tau) = \text{Force } (F) \times \text{perpendicular distance } (d)$$

5. When the steering wheel of an automobile is rotated, a force acts tangentially to the rim of the steering wheel which produces turning moment and the steering wheel is rotated about its axis.

6. Pressure acting on a surface depends on force or thrust and surface area of the object.

The SI unit of pressure is newton per square metre (N/m^2) also called pascal (Pa). If a force of 1 N is acting per square metre area of an object, the pressure is said to be 1 pascal.

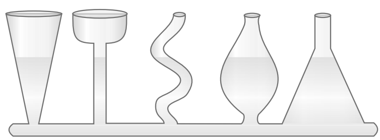
7. Tips and edges of cutting and piercing tools are made sharp because on sharpening, the area of contact decreases and pressure on the object increases. As a result, the cutting and piercing actions become smooth and easier.
8. Heavy trawlers are fitted with a large number of wheels so that area of contact with the ground is increased and the pressure on the ground is reduced.
9. **Aim:** To show that a liquid exerts lateral pressure



Materials Required: A glass jar, a deflated balloon and water

Procedure: Take a glass jar with an opening on its side. Tie a deflated balloon on the opening. Pour water into the jar from the top.

Observation and conclusion: The balloon starts bulging out. As we pour more water, the balloon is inflated more and more. It shows that water exerts lateral pressure.
10. No, liquid pressure at a point does not depend on the shape and size of the container but it increases with the depth from the free surface of the liquid.
11. **Aim:** To show that a liquid seeks its own level

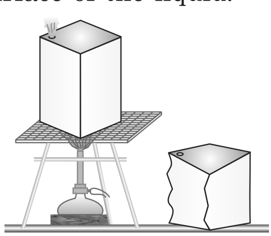


Materials Required: A number of vessels and water

Procedure: A number of vessels of different shapes and capacities are interconnected as shown in the given figure. Pour water into any one of these vessels.

Observation: The water stands at the same level in these vessels irrespective of their shapes and sizes.

This shows that a liquid seeks its own level.
12. Pressure at a point inside a liquid depends upon (a) the density of a liquid, and (b) depth from the free surface of the liquid.
13. **Aim:** To show that air exerts pressure



Materials Required: A tin can, water, a tripod stand and a burner

Procedure: Take a thin-walled tin can of about 2 L capacity and pour about 250 mL of water into it. Place the can on a tripod stand and heat it with a burner. When water starts boiling, the steam formed will drive out the air. Now, screw the mouth of the can tightly and stop heating the can. Pour some cold water over it and observe.

Observation and conclusion: The can gets crushed. On pouring cold water, the steam inside the can condenses into water leaving a partial vacuum in the can. So, the air from outside exerts pressure on the walls of the can and crushes it.

14. The pressure exerted by air column above us is called atmospheric pressure. The numerical value of atmospheric pressure at sea level is 1.013×10^5 Pa.

15. The two effects of atmospheric pressure are as follows:

(a) Liquid rises in a syringe, when its piston is pulled up, due to atmospheric pressure.

(b) Ink gets filled in a fountain pen due to atmospheric pressure.

F. 1. True

2. False; The moment of a force increases on **increasing** the perpendicular distance between force and axis of rotation.

3. True

4. False; Steering wheel of a car is used to **turn its wheels.**

5. False; Pressure is exerted by solids, liquids **as well as gases.**

6. True

7. False; A camel can walk easily on a sandy surface because it has **broad** feet.

8. False; Water in tank exerts pressure **not only on its bottom but also on its walls.**

9. True

10. False; The numerical value of atmospheric pressure is 1.013×10^5 pascal.

11. True

12. True

13. False; Liquid pressure **depends on its density.**

14. True

G. 1.–(b) **2.**–(d) **3.**–(a) **4.**–(e) **5.**–(c) **6.**–(g) **7.**–(f)

H. 1. By pushing a door near its edge, the moment of a force increases and the door opens easily.

2. The handle of a hand-operated flour grinder is provided near its rim so that the perpendicular distance between point of application of force and the axis of the grinder is maximum. As a result, more moment of force is obtained and the hand-operated flour grinder can be rotated easily even with a less force.

3. A sharp-pointed pin has less area of contact, so, it exerts greater pressure. As a result, a sharp-pointed pin pierces easily through the pile of papers.

4. While carrying loads, porter wears turban on his head because it helps him in increasing the area of contact, which reduces the pressure of load on his head.
5. Wide concrete sleepers have larger surface area. Thus, the pressure exerted by train on railway track is lesser. So, wide concrete sleepers are fixed below a railway track.
6. Shoes with wide and flat sole exert less pressure on the ground because of more area of contact as compared to shoes with pointed heels which have less area of contact and exert more pressure on the ground. So, shoes with wide and flat sole are more comfortable than high-heeled shoes.
7. A steering wheel of a large diameter offers a large perpendicular distance between pivot point and force applied. This results in more moment of the force for easy turning of wheels. So, we prefer a steering wheel of larger diameter.
8. A dam has broader walls at the bottom than at the top to withstand the pressure of stored water which is maximum at the base of the ground.
9. In the sea, pressure exerted by water increases with depth. To go deep down the sea water, sea divers wear a special type of suits that can withstand such high pressures. As a result, the divers remain safe.
10. At high altitudes, the atmospheric pressure is low as compared to the blood pressure of a person. As a result, blood vessels of the person get bursted, i.e., even having nose bleeding.

I. 1. Moment of a force, τ = Force, $F \times$ distance, d

$$= 16 \times 0.5$$
$$= 8.0 \text{ N m}$$

2. Moment of the force, τ = Force, $F \times$ distance, d

$$= 3.0 \text{ N} \times 20 \text{ cm}$$
$$= 3.0 \text{ N} \times \frac{20}{100} \text{ m} = 3.0 \times 0.2 = 0.6 \text{ N m}$$

3. Moment of the force, τ = Force, $F \times$ distance, d

$$= 20 \text{ kgf} \times 1.5 \text{ m}$$
$$= 20 \times 10 \text{ N} \times 1.5 \text{ m}$$
$$= 300 \text{ N m}$$

4. Moment of the force, τ = Force, $F \times$ distance, d

$$= 6.0 \text{ N} \times \frac{30}{100} \text{ m}$$
$$= \frac{180}{100} \text{ N m} = 1.8 \text{ N m}$$

5. Pressure $= \dfrac{\text{Force}}{\text{Area}}$

$$= \frac{400 \text{ N}}{80 \text{ cm}^2}$$

$$= \frac{400 \text{ N}}{80 \text{ cm} \times 1 \text{ cm}}$$

$$= \frac{400 \text{ N}}{\frac{80}{100} \text{m} \times \frac{1}{100} \text{m}} = \frac{400 \times 100 \times 100}{80} \text{ N m}^{-2}$$

$$= 5 \times 10^4 \text{ N m}^{-2} = 5 \times 10^4 \text{ Pa}$$

6. $\because$ Pressure $= \dfrac{\text{Force}}{\text{Area}}$

$\therefore$ Force = Pressure × area

$$= 2 \times 10^4 \text{ Pa} \times 200 \text{ cm}^2$$

$$= 2 \times 10^4 \text{ N m}^{-2} \times \frac{200}{100 \times 100} \text{ m}^2$$

$$= \frac{2 \times 10^4 \times 200}{100 \times 100} \text{ N} = 400 \text{ N}$$

7. $\because$ Pressure $= \dfrac{\text{Force}}{\text{Area}}$

$\therefore$ Area $= \dfrac{\text{Force}}{\text{Pressure}}$

$$= \frac{2500}{50{,}000} = \frac{1}{20} = 0.05 \text{ m}^2$$

8. Pressure $= \dfrac{\text{Force}}{\text{Area}}$

$$= \frac{80{,}000 \text{ N}}{5 \text{ m} \times 4 \text{ m}}$$

$$= \frac{80{,}000 \text{ N}}{20 \text{ m}^2} = 4000 \text{ N m}^{-2} = 4000 \text{ Pa}$$

9. $\because$ Pressure $= \dfrac{\text{Thrust}}{\text{Area}}$

$\therefore$ Thrust = Pressure × area

$$= 6 \times 10^3 \text{ Pa} \times 0.5 \text{ m}^2$$

$$= 3 \times 10^3 = 3000 \text{ N}$$

10. Here, total normal force = 32 kgf

$= 32 \times 10 = 320$ N

$\therefore$ Pressure $= \dfrac{\text{Force}}{\text{Area}}$

$= \dfrac{320 \text{ N}}{80 \text{ cm}^2}$

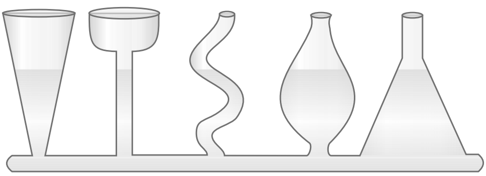
$= \dfrac{320 \text{ N}}{\dfrac{80}{100 \times 100} \text{ m}^2}$

$= \dfrac{320 \times 100 \times 100}{80}$ N m^{-2} or Pa

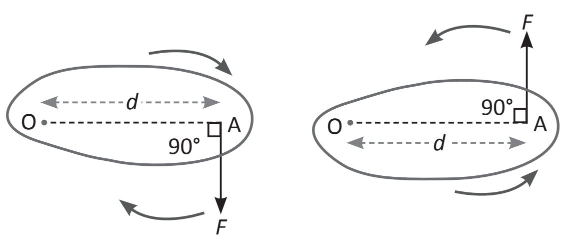
$= 4 \times 10^4$ Pa

J. **1.** (a) **2.** (c) **3.** (b) **4.** (b) **5.** (c) **6.** (b) **7.** (a) **8.** (d) **9.** (d) **10.** (b)

K. **1.**



2.



Clockwise moment Anticlockwise moment

THINK ZONE

- No, a turning effects is produced only when an object is pivoted at some point and the force applied is tangentially to the object.
- No, we cannot suck a cold drink with a straw in the absence of atmospheric pressure. This is because there will be no pushing force acting on the surface of cold drink.
- At high altitudes, atmospheric pressure is low as compared to blood pressure of a child. That is why, blood vessels of the child get bursted and nose starts bleeding.

CHAPTER 4. Energy

Check Point 1

1. (a) She is not doing some work because there is no displacement in her position.

(b) Yes, he is doing a work because force is applied for kicking ball and it is displaced at certain distance in the direction of force applied.

2. (a) True (b) False (c) False (d) True

Check Point 2

1. (a) potential energy (b) 9 times (c) mass; height

2. (a) The two kinds of mechanical energy are as follows:
(i) potential energy (ii) kinetic energy

(b) Elastic potential energy is stored in a compressed spring.

Check Point 3

1. (a) potential energy; kinetic energy (b) potential; kinetic (c) watt

2. (a) Ram has greater power. (b) Pinky has done more work.

TEST YOURSELF

A. 1. zero **2.** joule **3.** force; displacement **4.** Gravitational potential **5.** kinetic **6.** elastic potential energy **7.** total mechanical energy **8.** power

B. 1. Kinetic energy **2.** Gravitational potential energy **3.** Work **4.** Power **5.** Elastic potential energy

C. 1. Work: Work is said to be done when on applying force, an object moves in the direction of force.

2. A joule: When an object under a force of 1 N moves in the direction of force through a distance of 1 m, the work done is said to be one joule.

3. Mechanical energy: The energy possessed by an object by virtue of its state of motion and specific position and configuration, even when it is at rest, is called mechanical energy.

4. Power: The rate of doing work or rate of energy supplied or consumed is called the power.

$$\text{Power } (P) = \frac{\text{Work } (W)}{\text{Time } (t)}$$

5. A watt: If one joule of work is being done (or one joule energy is being supplied or consumed) in every one second time, the power is said to be 1 watt.

D. 1.

Kinetic energy	Gravitational potential energy
1. The energy possessed by an object in motion is called its kinetic energy.	1. The energy stored in an object due to its position even when it is at rest is called gravitational potential energy.
2. A bird flying in the sky possesses kinetic energy.	2. A child sitting on the top of a slide possesses gravitational potential energy.

2.

Power	Work
1. The rate of doing work is called power of a person/machine/system.	1. Work is said to be done when on applying force, an object moves in the direction of force.
2. The SI unit of power is watt.	2. The SI unit of energy is joule.

3.

Energy	Power
1. The capacity of doing work is called energy.	1. The rate of doing work is called power of a person/machine/system.
2. The SI unit of energy is joule.	2. The SI unit of power is watt.

E. 1. The two essential conditions for doing work in term of Physics are as follows:

(a) A force must be applied on an object.

(b) The object must move through a certain distance in the direction of the force applied.

2. (a) No work done

(b) Work done

(c) No work done

(d) No work done

(e) No work done

3. Work done, $W =$ Force applied, $F \times$ distance moved in the direction of force, s

4. The SI unit of work is joule. When an object under a force of 1 N moves in the direction of force through a distance of 1 m, the work done is said to be one joule.

5. The capacity of doing work is called energy. The SI unit of energy is joule.

6. Anything having a capability to do work is said to possess energy.

7. The energy possessed by an object by virtue of its state of motion and specific position and configuration, even when it is at rest, is called mechanical energy. The two kinds of mechanical energy are potential energy and kinetic energy.

8. The energy possessed by an object in motion is called its kinetic energy, e.g., flowing water, speeding electric fan, etc.

9. The two factors on which kinetic energy of an object depends are as follows:
(a) Mass of the object
(b) Speed of the object

10. If an object of mass m is moving with a speed of v, then

$$\text{Kinetic energy, } KE = \frac{1}{2} mv^2$$

11. (a) The kinetic energy of an object gets doubled, if its mass is doubled.
(b) The kinetic energy of an object gets quadrupled, if its speed is doubled.

12. The energy stored in an object at rest due to its position or configuration is called its potential energy, e.g., a fruit on a tree, a child sitting on the top of a slide, etc.

13. (a) Kinetic energy
(b) Gravitational potential energy
(c) Elastic potential energy
(d) Kinetic energy
(e) Kinetic energy
(f) Kinetic energy

14. The two factors on which gravitational potential energy depends are as follows:
(a) Mass of an object
(b) Height of an object from the earth's surface.

If an object of mass m is placed at a height h from the earth's surface, then

$$\text{Potential energy, } PE = mgh$$

15. The two examples of elastic potential energy are a stretched spring and a stone piece on a stretched catapult.

16.
$$\text{Kinetic energy of toycar A} = \frac{1}{2} mv^2$$
$$= \frac{1}{2} \times 100 \times v^2$$
$$= 50v^2$$

Kinetic energy of toycar B $= \frac{1}{2} mv^2$

$= \frac{1}{2} \times 200 \times v^2$

$= 100v^2$

$\therefore$ Toycar B has greater kinetic energy.

17. (a) Water stored at height in a dam has potential energy. It gets converted into kinetic energy when the gate of the dam is opened and water is made to fall from height.

(b) A stretch bow and arrow has potential energy. When the arrow is released, the potential energy gets converted into kinetic energy and the arrow moves rapidly forward.

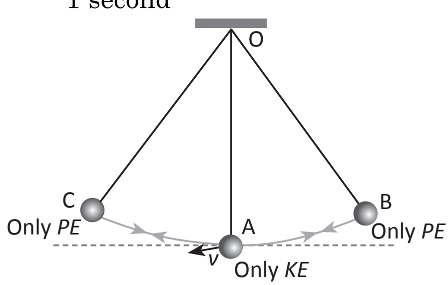
18. Law of conservation of mechanical energy states that decrease in potential energy is exactly equal to increase in kinetic energy and vice versa but total mechanical energy must remain unchanged. The essential condition for law of conservation of mechanical energy is that no nonconservative forces act on the body.

19. The rate of doing work is called power. If work W is being done in time t, then power, $P = \frac{W}{t}$.

20. The SI unit of power is watt or joule per second. Power is said to be 1 watt if one joule of work is being done (or one joule energy is being supplied) in every one second time.

Thus, $$1 \text{ watt} = \frac{1 \text{ joule}}{1 \text{ second}}$$

21. Consider oscillation of a simple pendulum as shown in the figure. When the pendulum bob is at its extreme position (the highest point of its motion) B or C, it solely possesses gravitational potential energy E_p. When the bob reaches its mean position A (the lowest point), it has maximum speed v and consequently, maximum kinetic energy E_k. Experimentally, it is found that



$$(E_p)_B = (E_k)_A = (E_p)_C$$

Thus, interconversion of energy takes place from one form to another form but total mechanical energy remains constant for an oscillating pendulum.

22. Riding on a roller-coaster involves motion along a zig-zag curved path with a continuously changing level. If, at some place, motion is down the slope, then potential energy is transformed into kinetic energy and motion is speeded up. If, at another place, motion is up the slope, then kinetic energy is converted into potential energy and motion slows down. However, total sum of kinetic and potential energies remains unchanged at all points of the ride.

23. In the production of hydroelectricity, water stored at height in a dam has gravitational potential energy. When the gate of the dam is opened, water falls down and potential energy is converted into kinetic energy and water gushes out with a high speed. The gushing water rotates the turbine of electric generator and in the process, kinetic energy is transformed into electrical energy.

24. Yes, an object possesses energy even when at rest. This energy is called gravitational potential energy. The two examples with respect to gravitational potential energy are as follows:

(a) A rock resting at the top of a hill.

(b) A kite skillfully balanced at a height in the sky.

F. 1. False; A child sitting on the back seat of a car is **not** doing work.

2. True

3. True

4. False; Kinetic energy possessed by an object is proportional to square of its speed.

5. True

6. True

7. True

8. True

G. 1.–(d) **2.**–(e) **3.**–(b) **4.**–(a) **5.**–(f) **6.**–(c)

H. 1. No work is done because there is no displacement of wall when a person pushes a strong wall.

2. A girl reading a book is doing no work. This is because there is no displacement in a girl while she is reading a book.

3. When water falls from a height, its potential energy is converted into kinetic energy. As a result, water gushes out with a high speed. The gushing water rotates the turbine of a hydel power plant.

4. A heavier hammer possesses more kinetic energy due to its mass, therefore, a nail penetrates deeper into a wooden board when a heavier hammer strikes it.

5. Since the mass of a horse is more than the mass of a dog, so, the horse has more kinetic energy than a dog running at the same speed.

6. Since power is inversely proportional to time taken, hence, more is the power if work is done in less time. Thus, power is more if work is performed in lesser time.

I. 1. Here,

$$\text{work done, } W = Fs$$
$$= 80 \text{ N} \times 5 \text{ m}$$
$$= 400 \text{ N m or joule}$$

2. Here,

$$\text{work done, } W = Fs$$
$$= 600 \times 400$$
$$= 240000 \text{ joule}$$
$$= 2.4 \times 10^5 \text{ joule}$$

3. Here, mass of Rita, $m = 36$ kg and $g = 10$ m/s^2

∴ Force applied by Rita while climbing,

$$F = mg = 36 \times 10 = 360 \text{ N}$$

$$\therefore \quad \text{Work done, } W = Fs$$
$$= 360 \times 15$$
$$= 5400 \text{ J}$$

4. Here,

$$\text{work} = \text{Force} \times \text{Displacement}$$
$$3000 \text{ J} = 200 \text{ N} \times \text{Displacement}$$
$$\therefore \quad \text{Displacement} = \frac{3000}{200} = 15 \text{ m}$$

5. Here,

$$\text{kinetic energy, } KE = \frac{1}{2} mv^2$$
$$= \frac{1}{2} \times 30 \times 6 \times 6$$
$$= 540 \text{ J}$$

6. Here,

$$\text{kinetic energy, } KE = \frac{1}{2} mv^2$$
$$= \frac{1}{2} \times 50 \times 10 \times 10$$
$$= 2500 \text{ J}$$

7.

$$\therefore \quad \text{Change in kinetic energy} = \frac{1}{2} mv_2^2 - \frac{1}{2} mv_1^2$$
$$= \frac{1}{2} \times 2 \times 16^2 - \frac{1}{2} \times 2 \times 8^2$$
$$= 16^2 - 8^2 = 24 \times 8 = 192 \text{ J}$$

8. $\therefore$ Kinetic energy of the bullet, $KE = \frac{1}{2} mv^2$

$$= \frac{1}{2} \times \frac{20}{1000} \times 400 \times 400$$

$$\left(\because 1 \text{ g} = \frac{1}{1000} \text{ kg}\right)$$

$$= 1600 \text{ J}$$

9. Here, potential energy, $PE = mgh$

$$= 20 \times 10 \times 4.0$$

$$= 800 \text{ joule}$$

10. Here, potential energy, $PE = mgh$

$$= 25 \times 10 \times 1.5$$

$$= 375 \text{ joule}$$

11. Change in potential energy $= mgh_2 - mgh_1$

$$= mg(h_2 - h_1)$$

$$= 12 \times 10 \, (15.0 - 3.0)$$

$$= 120 \times 12 = 1440 \text{ joule}$$

12. In this case, kinetic energy = Potential energy

$$= mgh = 2.0 \times 10 \times 60 = 1200 \text{ joule}$$

13. Here, power of the machine $= \frac{\text{Work}}{\text{Time}}$

$$= \frac{2700}{30} = 90 \text{ watt}$$

14. $\because$ Power $= \frac{\text{Work}}{\text{Time}}$

$\therefore$ Work = Power × Time

$$= 60 \times 5 \times 60 = 18000 \text{ joule}$$

15. (a) Work done by Monty against the force of gravity,

$W_1 = Fs$ ($\because$ Work is independent of time)

$$= mg \times h$$

$$= 15 \times 10 \times h$$

$$= 150 \, h$$

Work done by Pintu against the force of gravity,

$W_2 = Fs$ ($\because$ Work is independent of time)

$$= mg \times h$$
$$= 15 \times 10 \times h$$
$$= 150\ h$$

$$\therefore \quad \frac{W_1}{W_2} = \frac{150\ h}{150\ h} = 1 : 1$$

(b) $\therefore$ Power of Monty, $P_1 = \frac{W_1}{t}$

$$= \frac{150\,h}{2}$$

$$= 75\ h$$

$\therefore$ Power of Pintu, $P_2 = \frac{W_2}{t}$

$$= \frac{150h}{1.5}$$

$$= 100\ h$$

$$\therefore \quad \frac{P_1}{P_2} = \frac{75\ h}{100\ h} = \frac{3}{4} = 3 : 4$$

J. 1. (b) **2.** (c) **3.** (c) **4.** (b) **5.** (c) **6.** (a) **7.** (d) **8.** (a)

<u>THINK ZONE</u>

- Work done by coolie, walking on level road with load on his head, is zero because the angle made between the direction of force and direction of displacement is perpendicular.
  So, $W = Fs \cos\theta$
  $= Fs \cos 90°$
  $= 0$
- When a fast moving bullet hits a metal target, the kinetic energy of bullet gets converted into heat energy which raises the temperature of metal target.
- Here, work done by Ram $= Fs$
  $= mg \times h$
  $= 10 \times g \times h$
  Work done by Shyam $= 10 \times g \times h$
  $\therefore$ Work done by Ram = Work done by Shyam
  So, they had done same work.
  Power of Ram, $P = \frac{\text{Work}}{\text{Time}}$
  $= \frac{10 \times g \times h}{2} = 5gh$

$$\text{Power of Shyam, } P = \frac{\text{Work}}{\text{Time}}$$
$$= \frac{10 \times g \times h}{3} = 3.3gh$$

Above calculation shows that Ram has more power.

Since energy does not depend on time, so, both have same energy.

- Kinetic energy cannot be stored.

CHAPTER 5. Light Energy

Check Point 1

1. incident ray **2.** less **3.** Snell's law **4.** raised

Check Point 2

1. (a) concave
(b) centre of curvature
(c) real; virtual

2. (a) A part of a hollow sphere of a glass having a polished surface on one of its faces is called a spherical mirror.
(b) Convex mirror is known as the driver's mirror.
(c) A convex mirror forms a virtual, erect and smaller image.

Check Point 3

1. dispersion **2.** towards the base of the prism **3.** VIBGYOR

TEST YOURSELF

A. 1. centre **2.** centre of curvature **3.** real; virtual **4.** real
5. Refraction of light **6.** rarer; denser **7.** air; glass **8.** seven

B. 1. Refraction of light **2.** Dispersion of light **3.** Spherical mirrors
4. Convex mirror **5.** Pole **6.** Focal length **7.** Centre of curvature
8. Spectrum

C. 1. Refractive index: The ratio of speed of light in vacuum (or air) to the speed of light in the given medium is called refractive index of the medium.

2. Refraction of light: Bending of a ray of light incident obliquely at the boundary of two transparent media is called refraction of light.

3. Principal focus of a concave mirror: The point on the principal axis where a beam of light travelling parallel to principal axis, after reflection actually meets is called the principal focus (F) of the concave mirror.

4. **Principal axis:** The imaginary line passing through the pole and the centre of curvature is called the principal axis.
5. **Radius of curvature:** The radius of the sphere of which the spherical mirror forms a part is called the radius of curvature.
6. **Dispersion of light:** The phenomenon of splitting of white light into its seven constituent colours while undergoing refraction through a prism is called dispersion of light.

D. 1.

Concave mirror	Convex mirror
1. If the outer surface of a spherical mirror is polished and the inner surface behaves as the reflecting surface, then it is called a concave mirror.	1. If the inner surface of a spherical mirror is polished and the outer surface behaves as the reflecting surface, then it is called a convex mirror.
2. The reflecting surface of a concave mirror is curved inwards.	2. The reflecting surface of a convex mirror is bulged outwards.

2.

Real image	Virtual image
1. Real image is formed when light rays starting from a point object, after reflection, actually meet (intersect) at one point.	1. Virtual image is formed when light rays starting from a point object, after reflection, do not actually meet but appear to meet at a point.
2. Real image can be obtained on a screen.	2. Virtual image cannot be obtained on a screen.
3. Real image is an inverted image.	3. Virtual image is an erect image.

3.

Reflection of light	Refraction of light
1. The phenomenon of bouncing back of light in the given medium itself, on incidence on a smooth surface is called reflection of light.	1. The phenomenon of bending of light from its original path when it passes obliquely from one transparent medium to another is called refraction of light.
2. Angle of reflection is equal to the angle of incidence.	2. Angle of refraction may be smaller or greater than the angle of incidence.
3. For reflection, we need a polished mirror.	3. For refraction, we need two transparent media.

4.

Diminished image	Enlarged image
1. If the object is placed beyond centre of curvature, diminished image is formed.	1. When the object is placed between centre of curvature and focus, or between focus and pole, enlarged image is obtained in both cases.
2. Image is formed between focus and centre of curvature.	2. Image is formed beyond the centre of curvature in first case and behind the mirror in second case.

E. 1. A part of a hollow sphere of a glass having polished surface on one of its faces is called a spherical mirror. Two kinds of a spherical mirror are concave and convex mirrors.

2. Pole: The geometric centre of a spherical mirror is called its pole. It is denoted by P.

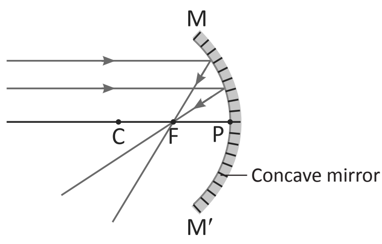
Centre of curvature: The centre of the sphere of which the spherical mirror forms a part is called centre of curvature. It is denoted by C.

Radius of curvature: The radius of the sphere of which the spherical mirror forms a part is called radius of curvature.

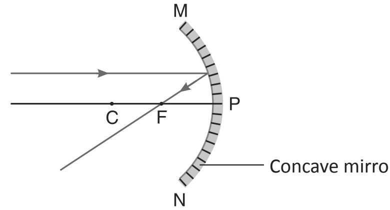
Radius of curvature is the distance between the pole and the centre of curvature of a mirror. It is denoted by R.

Principal axis: The imaginary line passing through the pole and the centre of curvature is called the principal axis of the mirror. It is denoted by PCX.

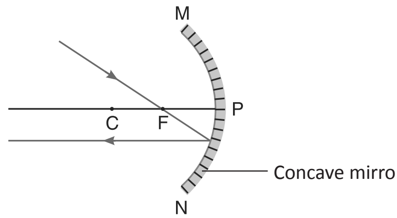
3. The point on the principal axis where a beam of light travelling parallel to principal axis, after reflection, actually meets is called the focus point of a concave mirror. It is denoted by F.



4. Rule 1: A ray travelling parallel to the principal axis of a concave mirror passes through the principal focus after reflection.



Rule 2: A ray passing through the principal focus of a concave mirror gets reflected parallel to its principal axis.



5. (a) To obtain an inverted and diminished image, the object should be placed beyond the centre of curvature of a concave mirror.

(b) To obtain an inverted and enlarged image, the object should be placed between focus and centre of curvature.

6. Two uses of concave mirrors are as follows:

(a) Concave mirrors are used as make-up mirrors at beauty parlours.

(b) They are used as reflectors in torches, headlights of vehicles and in projections.

7. Convex mirror is used as rear-view mirror in vehicles.

8. Bending of a ray of light incident obliquely at the boundary of two transparent media is called refraction of light.

9. **Incident ray:** The ray travelling in first medium and falling on the surface separating the two media is called the incident ray.

Refracted ray: The ray travelling in second medium after undergoing refraction is called the refracted ray.

Angle of incidence: The angle subtended by the incident ray from the normal is called the angle of incidence. It is denoted by $\angle i$.

Angle of refraction: The angle subtended by the refracted ray from the normal is called the angle of refraction. It is denoted by $\angle r$.

10. (a) When a light ray passes from a rarer to a denser medium, it bends towards the normal.

(b) When a light ray passes from a denser to a rarer medium, it bends away from the normal.

11. Two laws of refraction are as follows:

(a) The incident ray, the refracted ray and the normal drawn on the refracting surface at the point of incidence lie in the same plane.

(b) For a given pair of media, the ratio of the sine of the angle of incidence and the sine of the angle of refraction is a constant.

Mathematically, $$\frac{\sin i}{\sin r} = \text{a constant}$$

12. The medium in which speed of light is comparatively less or refractive index is more is called optically denser medium.

On the other hand, the medium in which speed of light is comparatively more or refractive index is less is called optically rarer medium.

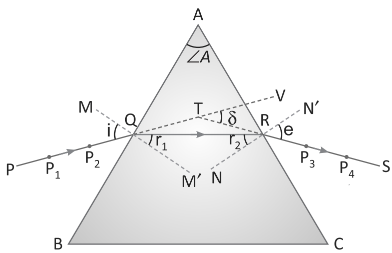
13. Water is optically denser because its refractive index is more than air.

14. (a) Yes, water is optically denser than air.
(b) No, water is optically rarer than glass.

15. The ratio of the speed of light in vacuum or air to the speed of light in the given medium is called refractive index of the medium. The refractive index has no units.

16. When light rays pass through the atmosphere, they undergo refraction while passing from one layer of air to another layer of different optical densities. This phenomenon is called atmospheric refraction.

17. A transparent material bounded by two plane rectangular refracting surfaces is called prism.



18. The process of splitting of white light into its seven constituent colours is called dispersion of light.

F. 1. True

2. True

3. False; When an object is placed between principal focus and pole of a concave mirror, the image formed is **virtual image.**

4. False; The distance between pole and focus point of a spherical mirror is called its **focal length.**

5. True

6. False; A **concave** mirror is used as a reflector in a solar cooker.

7. False; A ray of light on passing from glass to air bends **away from** the normal.

8. True

9. True

10. True

11. False; A ray of light passing through the focus of a mirror **becomes parallel to its principal axis after reflection.**

12. True

13. False; When white light is dispersed by a prism, the deviation of red colour is **less** than the deviation of violet colour.

14. True

G. 1. **Dispersion of light;** It is related to splitting of colours while others are related to refraction of light.

2. **Rear-view mirror;** Convex mirror is used as rear-view mirror while concave mirror is used in others.

3. **Refractive index;** It is related to speed of light in a medium while other are related to spherical mirrors.

H. 1. The speed of light in the glass is less than the speed of light in air as glass is an optically denser medium than air. When light passes from air to glass, its speed decreases and consequently, it bends towards the normal.

2. When a pencil is partly immersed in water obliquely, then the ray of light travels from pencil to observer, i.e., from denser medium to rarer medium. As a result, it bends away from normal and hence, pencil appears to be bent.

3. A coin placed at the bottom of a tumbler filled with water appears to be raised because the apparent depth of the coin appears to be less than its true depth due to refraction of light.

4. The sun is visible for two minutes even before sunrise (or even after sunset) due to atmospheric refraction of light.

5. The principal focus is a real point for a concave mirror because it lies in front of it. The principal focus is a virtual point for a convex mirror because it lies behind the mirror.

6. Concave mirror is used as a reflector in a car headlight to focus light of the bulb at a point.

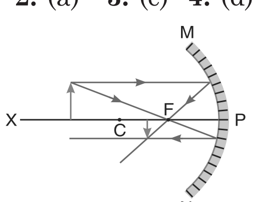
7. Convex mirror is used as rear-view mirror so as to increase the field of view of drivers for seeing the traffic coming from behind.

8. Virtual image cannot be obtained on a screen because it is not formed by actual meeting of light rays.

I. **1.**–(c) **2.**–(d) **3.**–(f) **4.**–(a) **5.**–(e) **6.**–(b)

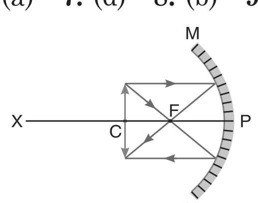
J. **1.** (b) **2.** (a) **3.** (c) **4.** (d) **5.** (b) **6.** (a) **7.** (d) **8.** (b) **9.** (a)

K. 1. (a)



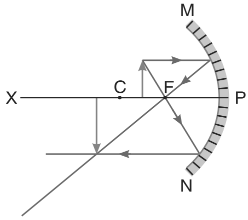
When object is placed beyond the centre of curvature

(b)



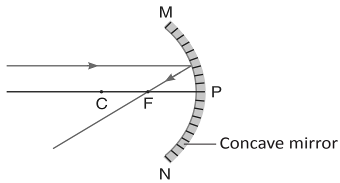
When object is placed at the centre of curvature

(c)

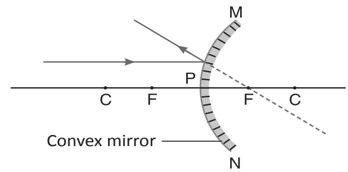


When object is placed between the focus and the centre of curvature

2. (a)



(b)



3. (a) **Refraction of light:** Bending of a light ray incident obliquely at the boundary of two transparent media is called the refraction of light.

(b) Incident ray – IO
Normal – NN′
Refracted ray – OR

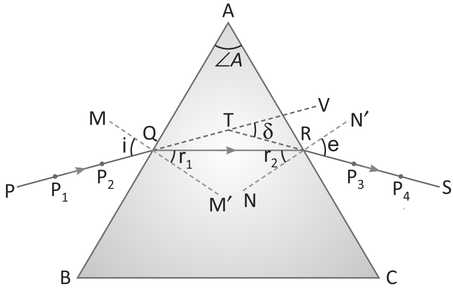
(c) Angle of incidence, $\angle i = 45°$
Angle of refraction, $\angle r = 30°$

(d) Medium A : Optically rarer

Medium B : Optically denser

This is because the light ray passing from optically rarer to optically denser medium bends towards the normal.

4.



Incident Ray	=	PQ
Refracted Ray	=	QR
Emergent Ray	=	RS
Angle of prism	=	$\angle A$
Angle of deviation	=	$\angle \delta$

THINK ZONE

- Vehicles coming from behind appear smaller and nearer in the rear-view mirror of a car because this mirror forms erect and diminished images of vehicles coming from behind. This helps to increase the field of view of drivers while driving.

- Large-sized concave mirrors are used in solar furnaces to focus the sun's radiation at a place.
- Zero (0), because when the objects is at centre of curvature, its real and inverted image is formed at the centre of curvature itself.
- Yes, when a light ray obliquely passes from one transparent medium to another transparent medium, it bends from its original path at the boundary of separation of two media.

CHAPTER 6. Heat Transfer

Check Point 1

1. slow; fast **2.** different **3.** increases

Check Point 2

1. more **2.** $\frac{1}{3}$ **3.** three

Check Point 3

1. volume **2.** more **3.** loosen/sag

TEST YOURSELF

A. 1. absorbed **2.** cooling **3.** expand; contract **4.** gases **5.** thermal expansion **6.** rod or wire **7.** volume

B. 1. Linear expansion **2.** Area expansion **3.** Bimetallic strip

C. 1. Coefficient of linear expansion: The increase in the length of the solid rod or wire per unit original length per degree rise in temperature is called coefficient of linear expansion.

2. Coefficient of superficial expansion: The increase in the area of a thin sheet of solid per unit original area per degree rise in temperature is called coefficient of superficial expansion.

3. Coefficient of volume expansion: The increase in the volume of bulk solid per unit original volume per degree rise in temperature is called coefficient of volume expansion.

D. 1. Aim: To show that solids expand on heating

Materials Required: A metal bar, a gauge and a burner

Procedure: Take a metal bar and a gauge such that the bar exactly fits into the gauge. Take the bar out and heat it over a burner for few minutes. Now, try to fit it again into the gauge. You will not be able to fit it now. This is because the bar has expanded on heating.

Conclusion: The solids expand on heating.

2. The linear expansion of a metal rod on heating depends on:
(a) Original length (L),
(b) Rise in temperature (ΔT), and
(c) Nature of the solid material

3. The unit of linear expansion coefficient of a solid is K^{-1}. This unit is also expressed in /°C or $°C^{-1}$ (per degree Celsius). The brass expands more.

4. Coefficient of linear expansion,

$$\alpha = \frac{\text{Increase in length}}{\text{Original length} \times \text{Rise in temperature}}$$

$$= \frac{\Delta L}{L \times \Delta T} \quad \text{...(i)}$$

Coefficient of superficial expansion,

$$\beta = \frac{\text{Increase in surface area}}{\text{Original area} \times \text{Rise in temperature}}$$

$$= \frac{\Delta A}{A \times \Delta T} \quad \text{...(ii)}$$

$\because$ $\beta = 2\alpha$

or $\beta = \dfrac{2\Delta L}{L \times \Delta T}$

Coefficient of volume expansion,

$$\gamma = \frac{\text{Increase in volume}}{\text{Original volume} \times \text{Rise in temperature}}$$

$$= \frac{\Delta V}{V \times \Delta T} \quad \text{...(iii)}$$

$$\gamma = 3\alpha$$

$$= \frac{3\Delta L}{L \times \Delta T}$$

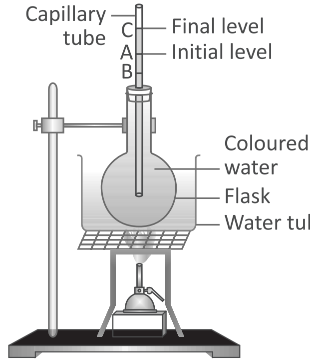
$\therefore$ $\alpha : \beta : \gamma = \dfrac{\Delta L}{L \times \Delta T} : \dfrac{2\Delta L}{L \times \Delta T} : \dfrac{3\Delta L}{L \times \Delta T}$

or $\alpha : \beta : \gamma = 1 : 2 : 3$

5. If the given thin sheet of solid is heated, its surface area increases and the thermal expansion is called superficial expansion. The superficial expansion depends on:
(a) Original area (A)
(b) Rise in temperature (ΔT)
(c) Nature of solid material

6. **Aim:** To show that liquids expand more than solids for a given rise in temperature.

Materials Required: A glass flask, a capillary tube, a rubber cork, a stand and water



Procedure: Take a glass flask fitted with a capillary tube and a rubber cork as shown in the figure. Fill the flask fully with coloured water and fix it in a stand. Note the initial level A of water in the capillary tube. Using a water tub and a burner, start heating the flask. Observe carefully the water level in the capillary tube.

Observation and conclusion: You will observe that, initially, the water level falls to B, but then begins to rise again and finally reaches C. Analyse the cause. Initially, water level falls due to thermal expansion of the flask. Later on, water is heated up and expands.

This shows that liquids expand more than solids for a given rise in temperature.

7. The three practical applications of thermal expansion of solids are as follows:
   (a) A small gap is left between two successive rails to make room for thermal expansion while laying rail tracks. If it is not done, the rail may bend due to thermal expansion in summer and it may cause accidents.
   (b) Concrete floors are laid in small blocks with small gaps between the blocks. It allows expansion of blocks during summer and the floor does not crack.
   (c) When telephones and electric wires/cables are connected between two poles in summer, they are intentionally kept loose. This is done to prevent their snapping when they contract in winter.
8. Thermal expansion of liquids, e.g., mercury/alcohol is used in thermometers.
9. A strip consisting of brass and iron rods of equal lengths welded together is called bimetallic strip. The bimetallic strip bends on heating due to unequal expansion for the same rise in temperature.
10. The two rods expand unequally because they have different diameters and thus, different areas.

E. 1. False; All solids expand **differently** when heated to same rise in temperature.

2. True
3. True
4. True
5. False; Expansion coefficient of pyrex glass is **less than** that of ordinary glass.
6. True
7. True
8. False; **Both** mercury and alcohol expand on heating.

F. **1.**–(b) **2.**–(d) **3.**–(e) **4.**–(f) **5.**–(c) **6.**–(a)

G. **1.** While laying a rail track, a small gap is left between two successive rails to make room for thermal expansion in summer.

2. Concrete floors are laid in small blocks having small gaps between the blocks. This provides room for the blocks to expand during summer and the floors does not crack.

3. The iron rim of a wooden wheel is made a little smaller in diameter than the wheel to make them fit tightly over the wheel. The rims are heated before fitting over the wheels and then cold water is poured on rim after fitting so that they contract and grip the wheel tightly.

4. One end of steel girder in a bridge is kept on rollers instead of fixing it to avoid any damage to the bridge due to expansion of girders in summer and contraction in winter.

5. Some empty space is left in sealed wine bottles in order to allow room for thermal expansion of the liquid. If no space is left, especially in summers, the bottles will burst.

6. Metal pipes used for carrying steam have joints in the form of loops because the pipes expand and contract due to change in temperature. As a result, the curvature of loops changes and there is no damage to the pipeline.

H. **1.** Linear coefficient of the metal,

$$\alpha = \frac{\Delta L}{L \times \Delta T}$$

$$= \frac{1.0 \text{ cm}}{3 \text{ m} \times (200 - 0)°\text{C}}$$

$$= \frac{1}{3 \times 100 \times 200}$$

$$= \frac{1 \times 10}{6 \times 10^4 \times 10}$$

$$= \frac{10}{6 \times 10^5} = 1.66 \times 10^{-5}$$

$$\simeq 1.7 \times 10^{-5}/°\text{C}$$

2. Linear expansion coefficient, $\alpha = ?$

Given, volume expansion coefficient of a solid,

$$\gamma = 7.2 \times 10^{-5}/°C$$

As we know, $\gamma = 3\alpha$

or $7.2 \times 10^{-5}/°C = 3\alpha$

$$\therefore \quad \alpha = \frac{7.2 \times 10^{-5}}{3} = 2.4 \times 10^{-5}/°C$$

3. Coefficient of superficial expansion,

$$\beta = \frac{\text{Increase in surface area, } \Delta A}{\text{Original area, } A \times \text{Rise in temperature, } \Delta T}$$

or $$2.4 \times 10^{-5} = \frac{\text{Increase in surface area, } \Delta A}{4 \text{ m} \times 3 \text{ m} \times (80 - 0)}$$

or $2.4 \times 10^{-5} \times 12 \times 80 = \text{Increase in surface area, } \Delta A$

or increase in surface area $= 2.4 \times 96 \times 10^{-4} \text{ m}^2$

$= 2.4 \times 96 \times 10^{-4} \times 10^4 \text{ cm}^2$

$(\because 1\text{m}^2 = 10^4\text{cm}^2)$

$= 230.4 \text{ cm}^2 \cong 230 \text{ cm}^2$

4. Coefficient of volume expansion of liquid,

$$\gamma = \frac{\text{Increase in volume of liquid, } \Delta V}{\text{Original volume of liquid, } V \times \text{Rise in temperature, } \Delta T}$$

or $$12 \times 10^{-4} = \frac{\text{Increase in volume of liquid, } \Delta V}{2 \text{ L} \times (40 - 0)°C}$$

$\therefore$ Increase in volume of liquid, $\Delta V = 12 \times 10^{-4} \times 2 \times 40$

$= 960 \times 10^{-4}$ L

$= 96 \times 10^{-3} \times 10^3$ mL

$(\because 1\text{L} = \text{mL})$

$= 96$ mL

I. 1. (c) **2.** (c) **3.** (b) **4.** (d) **5.** (d)

THINK ZONE

- This is because metals expand more than glass on heating to the same rise in temperature.
- The balloon is filled with air which is a mixture of gases. We know that gases expand on heating and contract on cooling. That is why, a fully inflated balloon shrinks when immersed in ice-cold water.
- High-quality measuring tapes are prepared using an alloy called 'Invar' because it expands very less on heating and the accuracy of tape is maintained.
- The length of the pendulum increases due to thermal expansion during summer, hence, it takes more time to complete one oscillation. As a result, the clock goes slower. On the other

hand, the length of pendulum decreases due to thermal expansion during winter, hence, it takes less time to complete one oscillation. As a result, the clock goes faster.

CHAPTER 7. Sound

Check Point 1

1. longitudinal

2. hertz

3. fastest; slowest

Check Point 2

1. more

2. frequency of vibration

3. reduced

4. increases

Check Point 3

1. (a) decreasing (b) tension

2. (a) The unit of loudness is decibel (dB).

(b) Yes, the loudness of a sound depends on sensitivity of a listener's ear.

TEST YOURSELF

A. 1. vacuum **2.** pitch **3.** increases **4.** more **5.** 60 **6.** prongs; stem **7.** increased **8.** 100 dB

B. 1. frequency **2.** Loudness **3.** Pitch **4.** Amplitude

C. 1. Amplitude: The maximum displacement of a vibrating particle from its mean position on either side is called amplitude.

2. Wavelength: The distance between two consecutive compressions or two consecutive rarefactions is called the wavelength. It is donated by λ (lambda).

3. Longitudinal wave: A wave vibrating in the direction of propagation is called longitudinal wave. Sound waves are longitudinal waves.

4. Pitch: The characteristic of sound which determines its shrillness is called pitch.

5. Monotone: A sound of a single frequency is called monotone. A tuning fork is used to produce monotone.

6. Loudness: The degree of sensation produced in the ear by a sound is called its loudness.

D. 1.

High pitch	Low pitch
1. A shrill (sharp) sound having high frequency is called a high-pitched sound.	1. A hoarse (flat) sound having low frequency is called a low-pitched sound.
2. A female has high-pitched sound.	2. A male has low-pitched sound.

2.

Pitch	Loudness
1. Pitch is the characteristic of a sound which determines its shrillness.	1. Loudness of sound is the degree of sensation produced by it in the ear.
2. Pitch of a sound depends on its frequency. As the frequency of vibration increases, the pitch of sound also increases.	2. Loudness of a sound mainly depends on its amplitude. A sound of small amplitude is a soft sound but a sound of large amplitude is a loud sound.

3.

Loud sound	Soft sound
A sound with greater amplitude of vibration is called a loud sound.	A sound with smaller amplitude of vibration is called a soft sound.

E. 1. The nature of sound wave in air is longitudinal.

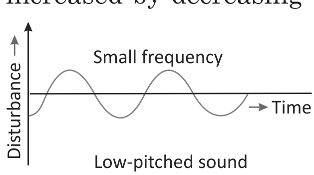
2. The frequency of sound produced by a string instrument depends upon the length, material, thickness and tightness of the string.

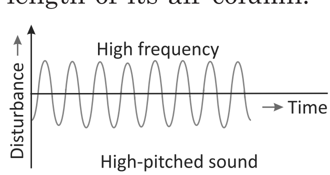
3. The number of vibrations completed per unit time by the sound wave is called its frequency. The SI unit of frequency is hertz.

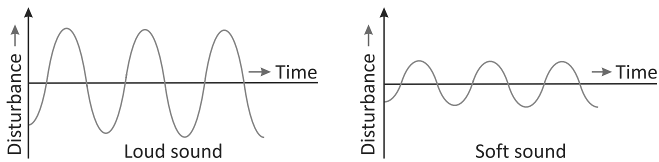
4. The characteristic which determines the shrillness of sound is called the pitch of a sound. The pitch of a sound depends on its frequency of vibration.

5. The pitch of a sound produced by a wind instrument can be increased by decreasing the length of its air column.

6.





7. The pitch of sound produced by a female is more than that of a male. Due to this reason, female's voice appears different from a male's voice.
8. Loudness of a sound depends on following factors:
   (a) Loudness depends on the amplitude of vibration.
   (b) It depends on the distance between the source of sound and the listener.
   (c) It depends on the surface area of vibrating object.
9. 

10. A sound of a single frequency is called a monotone. A monotone can be produced by using a tuning fork.
11. The unit of loudness is decibel. The loudness corresponding to energy level 10^{-12} W/m^2 (i.e., of a normal person) is taken as the reference level which is called 0 dB. If energy level is 10^{-11} W/m^2, loudness is taken to be 10 dB and if energy level is 10^{-10} W/m^2, loudness is taken to be 20 dB.
12. (a) Pitch (b) Loudness

F. **1.** False; The SI unit of frequency is **hertz.**
2. True
3. True
4. False; The pitch of a sound depends on **frequency of vibration.**
5. True
6. True
7. False; The SI unit of loudness is **decibel.**
8. True

G. **1.**–(c) **2.**–(e) **3.**–(a) **4.**–(b) **5.**–(d)

H. **1.** A large drum produces a louder sound than a small drum because its surface area of vibration is more.
2. When one shouts, he uses more energy and amplitude of vibration of his vocal cords is more. As a result, loud sound is produced.
3. Shrillness of a sound depends on pitch. Higher is the pitch, shriller is the sound produced. A cuckoo has high-pitched voice and a crow has low-pitched voice. As a result, a cuckoo's high-pitched voice is shriller as compared to crow's voice.
4. As the loudness of sound depends on the distance between the source of sound and the listener, it decreases when the listener moves away from the source of sound.

5. The length of air column decreases on filling the bucket more. As the length of air column decreases, the pitch of sound increases. Thus, we are able to guess the filling of bucket by hearing the sound produced by water falling in bucket.
6. Smaller the length of air column of a flute, higher is its frequency and also higher is the pitch. A number of holes are made along the length of a flute to produce sounds of different frequencies.

I. 1. Time period of vibration, $T = \frac{1}{\nu}$

$$= \frac{1}{400} = 0.0025 \text{ s}$$

2. Here, speed of sound, v = Frequency, ν × Wavelength, λ

$$= 660 \times 0.5$$

$$= 330 \text{ m/s}$$

3. Given, amplitude of first wave of vibration 256 Hz = x

Likewise, amplitude of second wave of vibration 288 Hz = x

Thus, $$\frac{\text{Loudness of wave 1}}{\text{Loudness of wave 2}} = \frac{x}{x}$$

$= 1 : 1$ ($\because$ Loudness mainly depends on amplitude)

4. Since loudness depends on amplitude of frequency, hence, higher the amplitude, louder is the sound.

Here, sound of lower amplitude = x

and sound of higher amplitude = $2x$

Thus, the sound having the larger amplitude ($2x$) is louder.

J. 1. (c) **2.** (b) **3.** (b) **4.** (d) **5.** (b) **6.** (b)

THINK ZONE

- The voice of a person depends on the pitch of sound produced by him. So we can easily recognise our friend by hearing his voice only.
- Frequency is the most important characteristic of a wave because pitch of a sound wave depends on frequency of its vibration.
- Yes. The speed of light is much more than the speed of sound in air. That is why spectators see the stroke a bit earlier than hearing its sound.

CHAPTER 8. Electricity

Check Point 1

1. ohm **2.** Potential difference **3.** kW h **4.** 3.6×10^6

Check Point 2

1. live
2. safety device
3. parallel
4. severe shock

Check Point 3

1. (a) repel; attract (b) Repulsion (c) negative
2. (a) The process of charging an uncharged conductor by bringing it in electrical contact with a charged body is called charging by conduction.
(b) Positive charge.

Check Point 4

1. (a) electroscope (b) diverge (c) lightning
2. (a) A simple gold leaf electroscope.
(b) The electric charge present and stored in clouds is called atmospheric electricity.

TEST YOURSELF

A. 1. battery **2.** live **3.** parallel **4.** exceeds **5.** kW h **6.** live
7. 200°C **8.** Static **9.** Copper **10.** Attracts
11. Conduction; induction

B. 1. Electric cell **2.** Electric meter **3.** Switch **4.** MCB
5. Electric circuit **6.** Static electricity **7.** Charging by induction
8. Lightning

C. 1. Electric power: The rate at which electrical energy is dissipated in the given electric circuit is called electric power. The SI unit of electric power is watt.

2. The commercial unit of electricity (kW h): One kilowatt hour is the unit of electricity consumed in the circuit when 1 kilowatt of power is used for 1 hour.

$$1 \text{ kW h} = 3.6 \times 10^6 \text{ J}$$

3. Frictional electricity: Frictional electricity is produced due to transfer of equal and opposite charges between two objects when they are rubbed together.

4. **Electric induction:** The process of charging an uncharged conductor by bringing a charged body near it, but not touching it, is called electric induction.
5. **Principal of conservation of charge:** Principle of conservation of charge states that electric charge can neither be created nor be destroyed and so the sum total of charges always remains conserved.
6. **Electroscope:** A device used to detect charge on a body is called an electroscope.
7. **Lightning:** A huge electric spark taking place among the clouds when the moisture content in the clouds becomes large is called lightning.

D. 1.

Live wire	Neutral wire
1. It is the wire in household electric circuit which carries current from mains supply to various appliances.	1. It is the wire in household electric circuit meant for return path for current from the house to mains supply.
2. Live wire is also called phase wire which is maintained at 220 V.	2. It is maintained at 0 V.

2.

Electric power	Electrical energy
1. The rate at which electrical energy is dissipated in the given electric circuit is called electric power.	1. The energy consumed in an electric circuit shown by the product of voltage, current and time of current flow is called electrical energy.
2. The SI unit of electric power is watt.	2. The SI unit of electrical energy is joule.

3.

Charging by conduction	Charging by Induction
1. The charged body is brought in actual contact of the body to be charged.	1. The charged body is brought close to the body to be charged but never in contact with it.
2. Charge is actually transferred by conduction from charged body to the uncharged body.	2. There is no actual transfer of charge from the charged body but charge is induced on the uncharged body.
3. Charge produced on the body being charged is of same nature as the charge on the charged body.	3. Charge produced on the body being charged is opposite to the nature of charge on the charged body.

4.

Charge on a glass rod when rubbed with silk fibre	Charge on an ebonite rod when rubbed with wool
1. When a glass rod is rubbed with a silk cloth, some electrons are transferred from the glass rod to the silk cloth.	1. When an ebonite rod is rubbed with wool, some electrons are transferred from wool to the ebonite rod.
2. Silk becomes negatively charged due to having an excess of electrons. On the other hand, glass rod becomes positively charged due to having deficiency of electrons.	2. Ebonite rod becomes negatively charged due to having an excess of electrons. On the other hand, the wool becomes positively charged due to having a deficiency of electrons.

E. 1. The rate of flow of electric charge in an electric circuit is called electric current. The unit of electric current is ampere.

2. No, electric current cannot flow through an insulator because it does not conduct electricity.

3. Electrical energy, E = Voltage, V × Current, I × Time, t

$$= V \times I \times t$$

$$= IR \times I \times t \qquad (\because\ V = IR)$$

$$= I^2Rt$$

4. The rate at which electrical energy is dissipated in the given circuit is called electric power.

As per definition, if E energy is being dissipated in a circuit during the time t, then

$$\text{Electric power, } P = \frac{\text{Energy, } E}{\text{Time, } t}$$

$$= \frac{VIt}{t} \qquad (\because\ E = VIt)$$

$$= VI$$

So, electric power, P = Voltage, V × Current, I

5. The commercial unit of electrical energy is kW h. One kilowatt hour is the electrical energy consumed when 1 kilowatt of power is used for 1 hour.

Electrical energy consumed in kW h,

$$E = \frac{P\text{ (in watts)} \times t\text{ (in hours)}}{1000}$$

$$= \frac{V\text{(in volts)} \times I\text{ (in amperes)} \times t\text{ (in hours)}}{1000} \qquad (\because\ P = VI)$$

6. 1 kW h = 1000 W h

$$= 1000 \text{ W} \times 60 \times 60 \text{ s}$$
$$= 3.6 \times 10^6 \text{ W s} = 3.6 \times 10^6 \text{ J}$$

7.

Wire	Colour of insulation	
	Old code	New code
Live	Red	Brown
Neutral	Black	Light-blue
Earth	Green	Yellow

8. A safety device which limits the current in an electric circuit is called a fuse.

   The electric fuse works by melting and breaking the circuit in case of overloading or short-circuiting.

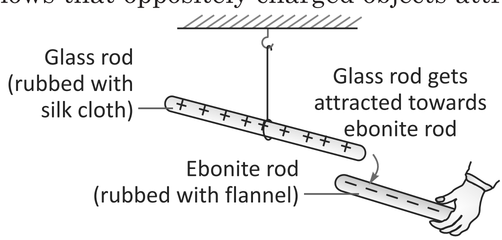
9. An alloy of lead and tin is used to prepare a fuse wire because it has melting point of about 200°C. The thick fuse wire has higher current rating.

10. Different appliances in household electric circuit are connected in parallel. This is done to make the appliances work independently so that if one of these appliances gets fused or broken, others work smoothly.

11. Two types of electric charges are positive and negative charges.

12. When an ebonite rod is rubbed with wool or flannel, electrons are transferred from wool to ebonite rod. The ebonite rod becomes negatively charged due to having an excess of electrons. On the other hand, the wool becomes positively charged due to having deficiency of electrons.

13. Take a glass rod and charge it by rubbing with a silk piece. Suspend it from a rigid stand using a silk thread. Now, take an ebonite rod. Rub it with wool to charge it and then bring it near the suspended glass rod. The glass rod is found to be attracted by the ebonite rod. It shows that oppositely charged objects attract each other.



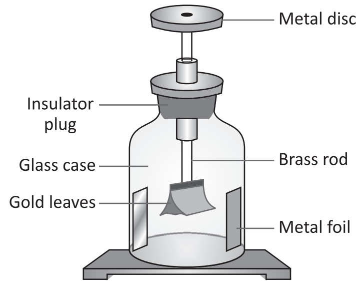
14. The law of conservation of electric charge states that electric charge can neither be created nor be destroyed and so, the sum total of charges always remains conserved.

15. Take a glass rod and a piece of silk. Initially, both are uncharged and thus, total charge present is zero. Now, rub the glass rod with the silk piece so that the glass rod acquires a positive charge. As, in accordance with the principle of conservation of electric charge, total charge must remain zero even now, i.e., the silk piece must have acquired an equal amount of negative charge.

This shows that whenever two objects are charged by rubbing, equal and opposite charges are produced on them.

16. A gold leaf electroscope consists of a metal rod passing through an insulator plug in a glass case.

The top end of the rod is connected to a metal disc and two thin gold leaves are connected at its lower end. Inside the glass case, a metal foil surrounds the glass case in the lower part.

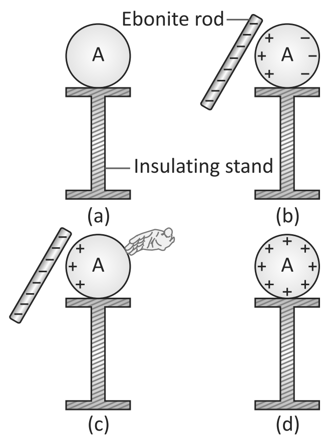


17. Following steps are required to charge a conductor positively by the method of induction.

(i) Put the given conductor A on an insulating stand as shown in Fig. (a).

(ii) Take an ebonite rod and rub it with wool so that it acquires negative charge. Bring the ebonite rod near conductor A but do not touch it. Equal and opposite charge is developed on the conductor as shown in Fig. (b).

(iii) Keeping ebonite rod in its position, touch the conductor A with your finger so that negative induced charge goes to the earth but positive induced charge remains intact as shown in Fig. (c).



(iv) Now, remove your finger and also remove the ebonite rod. The induced positive charge spreads on conductor A and it gets positively charged as shown in Fig. (d).

18. Clouds get charged when water and ice particles move rapidly inside them. It is observed that positively charged particles move to the upper part of clouds and negatively charged particles rest at the lower part of clouds, thereby, making bottom of a cloud as negatively charged. As a result of it, positive charge is induced on the earth's surface. When negative charge on bottom part of the cloud becomes too large, it overcomes the air resistance and flows towards the earth causing lightning.

19. A lightning conductor consists of a thick copper strip fitted on the outside of a building having metal spikes with sharp edges at the top. On the lower side, the copper strip is connected to a metal plate which is buried deep inside the wet soil. When a charged cloud having negative charge at its bottom side comes above a lightning conductor, positive charge is induced on the spikes which may neutralise negative charge of the cloud and lightning is prevented. Even if lightning takes place, then the lightning conductor provides a safe path for electric discharge to flow down to the earth and there is no damage to the building.

F. 1. False; A kilowatt hour is the unit of **electrical energy.**

2. True

3. False; An electric switch is connected with **live wire.**

4. False; One will **not** get an electric shock if one touches an earthed electrical appliance.

5. True

6. True

7. True

8. False; When an ebonite rod is rubbed with wool, the electrons move **from wool to ebonite rod.**

9. False; **Repulsion** is the sure test of electrification.

10. True

11. True

12. False; Lightning is caused when **the moisture content in the clouds becomes large.**

G. 1.–(c) **2.**–(e) **3.**–(d) **4.**–(f) **5.**–(g) **6.**–(a) **7.**–(h) **8.**–(b)

H. 1. An electric heater consumes a power of 1000–1500 W when operated on 220 V electric supply. On the other hand, a LED bulb consumes a power of 1–10 W when operated on 220 V electric supply. As electric heater consumes more power than a LED bulb, therefore, it draws more current.

2. Earth wire is connected to the earth to provide safe path to electric charge in case of leakage of charge. This avoids the risk of electric shock to the user.

3. To identify and distinguish easily between these three wires, they have insulation of different colours.

4. A fuse wire melts on passing an excessive current because it has low melting point of 200°C. This saves the circuit and the appliances from damage.
5. Three-pin plugs are used with an appliance having metallic body so as to make the earth connection. The plug is inserted into a socket having three holes, i.e., two out of them are for tapping electric current and third, i.e., bigger, is earth connector.
6. All electric joints are covered with insulating tapes so as to prevent from any kind of electric shock while working.
7. This is because appliances used in parallel circuits work independently, therefore, if one of the appliances gets damaged, others work smoothly.
8. When a glass rod is rubbed with silk cloth, some electrons are transferred from the glass rod to silk cloth. In this case, the glass rod has a deficiency of electrons, so, it acquires a positive charge.
9. Lightning conductor is made from copper because copper is a good conductor of electricity.

I. 1. Electric power, P = Potential difference, $V \times$ Current, I

$$= 200 \times 0.3 = 60 \text{ W}$$

2. Here, electric power, $P = V \times I$

$$40 = 220I$$

$$\therefore \quad I = \frac{40}{220} = \frac{2}{11} \text{ A}$$

3. Electrical energy in kW h, $E = \dfrac{Pt}{1000}$

$$= \frac{450 \times 6}{1000}$$

$$= \frac{2700}{1000} = 2.7 \text{ kW h}$$

4. Electricity consumed in units, $E = \dfrac{Pt}{1000}$

$$= \frac{(2 \times 75 + 2 \times 40 + 5) \times 6}{1000}$$

$$= \frac{(150 + 80 + 5) \times 6}{1000} = \frac{235 \times 6}{1000}$$

$$= \frac{1410}{1000} = 1.41 \text{ units}$$

5. ∴ Electricity consumed, $E = Pt$

$= 2\ kW \times 2\ h$

$= 4\ kW\ h$

$= 4$ units

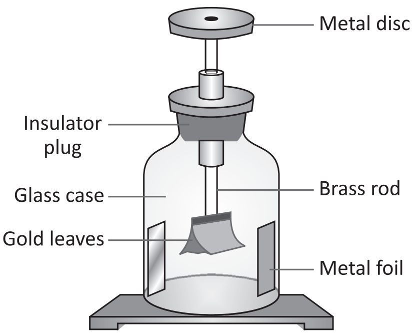
∵ The cost of 1 unit = ₹ 5.5

∴ The cost of 4 units = ₹ 5.5 × 4

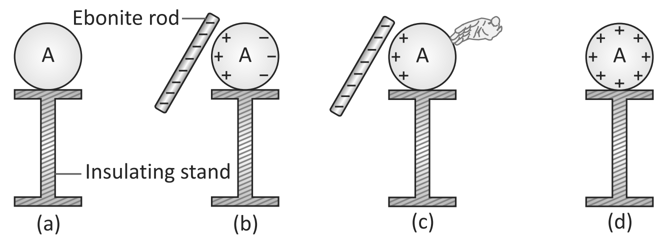
= ₹ 22

J. **1.** (d) **2.** (c) **3.** (a) **4.** (b) **5.** (b) **6.** (b) **7.** (b) **8.** (b) **9.** (a) **10.** (c) **11.** (b) **12.** (d)

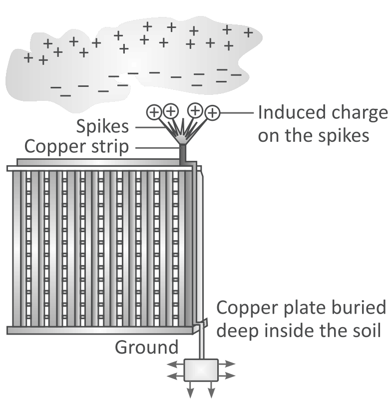
K. (a)



(b)



(c)



THINK ZONE

- Woollen/polyester clothes develop static charge on them due to friction. While taking off our sweater, these charge moves in streams between the sweater and our body, i.e., electric discharge takes place. As a result, we see a spark or hear a crackle.
- No, because conductors cannot be charged in this way as electrons will pass to our body from the metal rod.
- Tungsten metal is used exclusively for designing filaments of electric bulbs because it has very high melting point and does not melt easily.
- Yes, superconductors are metals that allow electricity to pass through them without any resistance below a certain temperature.