

Prodigy
PHYSICS

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YEAR ANNIVERSARY
SOUVENIR
PUBLISHERS PVT. LTD.
(Since 1972)

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PRODIGY
PHYSICS- 8

ANSWER KEY

Chapter-1 Matter

Quiz Zone (Page 10)

1. True
2. False: The kinetic energy of particles in liquids is higher than in solids. In the liquid state, particles have more freedom of movement, contributing to higher kinetic energy.
3. True
4. False: The kinetic energy of particles increases upon heating. Heating adds energy to the system, leading to increased kinetic energy of the particles.
5. False: Molecules are closely arranged in solids. In liquids the molecules have more intermolecular spaces. In gases the molecules are haphazardly placed with large intermolecular spaces.

A. MCQs

1. b) The particles in the fluid
2. b) Have fixed volume
3. b) The volume of the substance in the gaseous state decreases
4. c) Matter is made of tiny particles which move
5. d) The intermolecular force of attraction is more than gases
6. b) of evaporation
7. b) Weaker than the adhesive force of glass (that is why water molecules stick to glass panes.)
8. b) In boiling the kinetic energy of all the particle is the same.
9. c) the volume of the substance can decrease
10. d) Insoluble impurities

B. State True or False and correct the false statement giving reason

1. False: The sugar molecules occupy intermolecular spaces between the water molecules.
2. False: Matter is made up of small particles, but these particles are not fused as a block. They have spaces between them.
3. True
4. True
5. True
6. False: Solids expand less than liquids upon heating.
7. False: Intermolecular attraction can be affected by heating. Heating can increase the kinetic energy of particles, weakening intermolecular forces.
8. True

9. False: Intermolecular attraction is inversely proportional to intermolecular space. As the intermolecular space increases, the attractive forces decrease.
10. False: When the average kinetic energy of a substance is very high, its temperature must be quite high, not low. Temperature is directly related to the average kinetic energy of particles.

C. Fill in the blanks

1. melting
2. decreases
3. gases
4. intermolecular space
5. weak
6. increases
7. decrease
8. increase
9. deposition
10. remains constant

D. Match the column (Physical changes with the correct description)

1. Freezing (d) KE decreases and molecular arrangement becomes regular
2. Deposition (c) KE and space between molecules decreases
3. Melting (a) KE and space between molecules increases
4. Condensation (e) KE decrease and volume becomes fixed
5. Sublimation (f) KE increases much more and molecules vibrate randomly
6. Evaporation (b) KE increases and it occupies available volume

E. Short answer type questions

1. Brownian movement is the random and continuous motion of tiny particles in a fluid, like water or air, caused by its kinetic energy.
2. Solids cannot be compressed easily because their particles are closely packed together with little room for movement. The structured arrangement of particles in solids limits their ability to be compressed.
3. In solids, the intermolecular space is very small because particles are tightly packed and have fixed positions. In liquids, the intermolecular space is larger than in solids, allowing particles to move more freely.
4. Gases are easily compressed because their particles have a lot of space between them. This allows gases to be compressed into a smaller volume when pressure is applied.
5. The force of adhesion is the attractive force between molecules of different substances. It's the force that causes different substances to stick together.

6. Hammering a stone applies force to the particles in the stone, causing them to move and break apart. The force disrupts the attractive force between the particles in the stone, leading to its breakage.
7. Evaporation is change of state from liquid to gaseous state. It happens at every temperature from the surface of the liquid. Our wet clothes dry by this process. Some liquids change to gaseous state much more quickly than others at a particular temperature and pressure. These are called volatile liquids.
8. An example of sublimation is when solid camphor turns directly into vapor without passing through the liquid state.
9. The particles in gases are much further apart allowing greater movement in different directions because of greater kinetic energy. The movement of particles in gases goes on till they hit the wall of the container (or hit another particle). That is how gases occupy all the available space.
10. Upon heating, the kinetic energy of a liquid increases. The added heat energy causes the particles in the liquid to move more rapidly.

F. Long answer type questions

1. **Solids** have the strongest intermolecular attraction. This is because the particles in solids are very close together and have very little kinetic energy. **Liquids** have less intermolecular attraction than solids, but more than gases. This is because the particles in liquids are closer together than the particles in gases, but not as close together as the particles in solids. The particles in liquids have more kinetic energy than the particles in solids, which allows them to move more than particles in solids. **Gases** have the weakest intermolecular attraction of the three states of matter. This is because the particles in gases are very far apart and have a lot of kinetic energy. The weak intermolecular attraction allows the particles to move around freely.
2. We can prove that matter is made of numerous tiny particles by a simple experiment.
 - a) Pour few drops of Dettol liquid in a beaker to make a milky solution. It will give a strong smell of the antiseptic Dettol.
 - b) Take just few drops of this Dettol solution and put it in a glass of fresh water. Even though the water doesn't look milky we can still smell the Dettol in it.

This simple activity proves that the initial few drops of Dettol contained numerous Dettol particles. Even after repeated dilution there were enough particles in the water that produced its characteristic smell.

3. The forces responsible for the vibration of particles in solids are the intermolecular forces of attraction. When atoms are very close together as in case of solids, the forces between them is electromagnetic in nature. The net result is:
 - a) When two atoms or molecules are more than a certain distance apart the resultant force between them is zero.
 - b) When they are closer than this “certain distance” they repel each other.
 - c) When further apart than the above, they attract each other causing the vibration.
4. Evaporation is change of state from liquid state to gaseous state at any temperature. Some liquids change to gaseous state much more quickly than others at a particular temperature and pressure. These are called volatile liquids. Apart from volatility the conditions that affect evaporation are temperature, surface area, and wind speed.
 - Temperature: The higher the temperature, the faster the particles in a liquid will move. This means that more particles will have the kinetic energy to escape from the liquid's surface and evaporate.
 - Surface area: The greater the surface area of a liquid, the more particles can escape from the surface.
 - Wind speed: Wind can help to remove the evaporated particles from above the liquid's surface, which prevents a saturated environment above the liquid surface.
5. Freezing is the process by which a liquid turns into a solid. From the point of view of the kinetic theory of matter, freezing can be explained as a decrease in the kinetic energy of the particles in the liquid. When a liquid is cooled, the particles slow down and have less kinetic energy. As the particles slow down, they start to get closer together and the intermolecular forces of attraction become stronger. Eventually, the intermolecular forces of attraction become strong enough to hold the particles in a fixed position, and the liquid turns into a solid.

6.

Solids	Liquids	Gases
Definite shape and volume	Definite volume, but no definite shape	No definite shape or volume
Cannot flow	Can flow along a slope	Can flow in any direction
Expand very little on heating.	On heating they expand more than solids.	On heating they expand more than even liquids.

7. During evaporation, the following parameters of the kinetic theory of matter change:

We know that temperature of a body is a measure of the average kinetic energy possessed by the particles of matter in the body.

a) The collision of particles (in a container) lead to bouncing of particles to the surface and it may escape into atmosphere. The particles on the surface can also gather energy from sunlight and create an imbalance of kinetic energy amongst the particles.

b) Thus at any time in a liquid there would be many particles with higher kinetic energy than the average which balance those with lower kinetic energy than the average.

c) Thus in a liquid whose temperature is not high enough for boiling, there will be some particles with enough energy to break away from the surface of the liquid overcoming the pull of other molecules or atoms. This slow (but steady) escape of the liquid as gas particles from the surface is the cause of evaporation.

d) Since the particles with relatively more kinetic energy manage to escape, the kinetic energy of the remaining liquid is reduced.

8. The molecular model of liquids the molecules are still close together, but they have more freedom to move compared to a solid.

- **Particle Arrangement:** In a liquid, molecules are not as tightly packed as in solids. They have more space between them. However, they are still attracted to each other, which keeps them close and gives the liquids its fixed volume.

- **Motion of Molecules:** The molecules in a liquid are in constant motion. They vibrate, rotate, and move around. This movement is what gives a liquid its ability to flow and take the shape of its container.
 - **Energy:** The molecules in a liquid have more energy compared to those in a solid. This extra energy allows them to move more freely.
 - **Density:** Liquids are generally denser than gases but less dense than solids. This is because the molecules are still close together, but they have more freedom to move.
9. When an ice cube is heated, the kinetic energy of the water molecules increases. This causes the molecules to vibrate more and move around more freely. Eventually, the kinetic energy of the molecules becomes so high that they are able to break free from the intermolecular forces of attraction that hold them together in the solid state. This is when the ice cube melts and turns into liquid water.
 10. Gases expand much more than solids and liquids upon heating because the particles in gases are much farther apart and have much less intermolecular attraction.
In contrast, the particles in solids and liquids are much closer together and have much stronger intermolecular attraction.

Application based questions

1. Naphthalene balls work as insect repellents due to the sublimation process. Sublimation is when a substance changes directly from a solid to a gas without passing through the liquid phase. Naphthalene balls undergo sublimation, its fumes that is toxic to insects like moths and larvae. This gas interferes with the insects' ability to breathe and disrupts their life cycle, preventing them from damaging clothes.
2. Dew and frost formation are both related to the condensation of water vapor in the air.
Dew Formation: Dew forms when the temperature of surfaces, such as grass or car windows, drops below the dew point. Dew formation is the result of condensation.
Frost Formation: Frost occurs when instead of water droplets, water vapor directly transforms into ice crystals on surfaces. The process called deposition.
3. Clothes dry slower in the monsoon season due to the high humidity in the air. Humidity is the amount of moisture present in the air. When the air is already saturated with moisture, as is often the case during the monsoon season, it hinders the evaporation of water from wet clothes.

Multi-disciplinary questions

1. The skin is wiped with alcohol before giving injections to disinfect the area and reduce the risk of infection. Alcohol kills the germs (if present) by dehydrating the germs. Thus injection does not lead to any kind of infection through the needle puncture.
2. The large surface area of our lungs allows for efficient gas exchange and water loss. The alveoli, which are the tiny air sacs in the lungs, have a very thin membrane that allows for gases to diffuse easily between the air and the blood. The large surface area of the alveoli also allows for more water to evaporate from the lungs, which makes the exhaled air very humid (it has a humidity of 66-76%).
3. Perspiring and transpiration are both cooling processes because they involve the evaporation of water. When water evaporates, it absorbs heat from the surrounding environment. This is why our skin feels cooler after we sweat and the reason why plants are able to stay cool even in hot weather.

Both perspiration and transpiration are essential for humans and plants respectively. In addition transpiration has a great effect on weather and climate of a region and it is an important part of "water cycle".

Play and Learn

1. A sponge is a solid. However, we are able to compress it easily because of the numerous air pockets in it.
2. A jar of sugar takes the shape of the container because here we have numerous small solid particles of sugar which can roll over each other. Taking the shape of the jar here, does not make the sugar a liquid, also because the shape of the individual sugar particle has all the property of solids.

VALUES AND LIFE SKILLS

1. Attempt yourself
2. Attempt yourself

Image based questions

1. Melting
2. Evaporation
3. Condensation
4. Freezing

Chapter-2 Physical Quantities and Measurement

Quiz Zone (Page 31)

1. False. Relative density of a substance is the ratio of the mass of any volume of it to the mass of equal volume of water at 4°C . As it is a ratio it has no unit.
2. True
3. False. When the net density of a body is more, it will never float on a less dense liquid.
4. False. When a body is immersed in a fluid wholly or partially it experiences an up thrust equal to the weight of the displaced fluid.
5. True

A. MCQs

1. c) Body having lower density will have greater volume
2. c) The mass of substance with lower density will be more
3. c) It is the final weight of the body in the fluid.
4. c) Four degree Celsius
5. d) None of the above
6. a) Weight of the displaced liquid
7. c) The mass of substance with lower density will be more
8. c) Same for both the cubes
9. a) Balloons of same volume filled with air or hydrogen will have same up-thrust.
10. c) Stay stable beneath the surface of the liquid

B. State True or False and correct the false statement giving reasons

1. True
2. False. To measure mass we should use a beam balance.
3. False. The zero marking in a measuring cylinder is at the bottom.
4. False. Density of any object, regular or irregular, can be calculated by dividing its mass by its volume.
5. True
6. False. Iron ball sinks in mercury because density of iron is less than mercury.
7. False. A brick weighs less in water than in air because it experiences an up-thrust equal to the weight of the water it displaces.
8. False. Density of water is more than ice.
9. False. Rules of floatation apply to all fluids, including gases.
10. True

C. Match the column

1. Density of a liquid increases (b) on contraction
2. Floatation improves (d) as the density of the body decreases
3. Mass is measured on (e) beam balance
4. Buoyancy is (a) weight of water displaced
5. Pressure in liquids (c) increases with depth

D. Fill in the blanks

1. Volume
2. B – A
3. Volume
4. Decreases
5. less than its weight
6. less than the density of water
7. less than in mercury
8. greater
9. it is denser than fresh water.
10. 7.5 times

E. Short answer type questions

1. Density is a measure of how much mass is packed into a given volume of a substance. It is calculated by dividing the mass of a substance by its volume. The unit of density in the SI system is kilograms per cubic meter (kg/m³).
2. Up-thrust is the upward force exerted by a fluid that opposes the weight of a partially or fully immersed object. It is equal to the weight of the displaced fluid. It is so called because it acts in the upward direction.
3. Density bottle is a small globular glass bottle. It has a ground glass stopper with a overflow outlet. The bottle can store a fixed volume of liquid which is usually 25 ml or 50 ml. It is used to measure density of unknown liquids.
Density of the liquid = Mass of the liquid / Volume of the liquid
4. Submarines can sink and come back to the surface of the sea by adjusting their buoyancy. They have tanks that can be filled with water to increase their density and sink, or emptied of water to decrease their density and rise.
5. Each material has a unique density. By comparing the measured density of a substance with known values, one can identify the material. Additionally, the density of a material can provide clues about its composition and characteristics.

6. A sinker is a small, heavy object that is used to measure the volume of an irregular-shaped object. A sinker is used for objects that float in water. In such cases the volume of the sinker is found out beforehand. Then the body whose volume is to be found is attached to the sinker and the process for finding volume is followed.
7. Gases have the lowest density among the three states of matter—solid, liquid, and gas. Gases have molecules that are more spread out compared to liquids and solids.
8. Ice floats in water because it is less dense than water.
9. Eggs float in salt-water because the salt increases the density of the water. The higher density of the salt-water allows the egg to float.
10. No, a body will not experience the same buoyancy in water and mustard oil. Mustard oil floats on water, hence it is less dense than water, so a body will experience less buoyancy in mustard oil than in water.

F. Long answer type questions

1. To calculate the density of a potato, follow these steps:
 - **Step 1: Measure the mass of the potato.**
Use a beam balance to measure the mass of the potato in grams (g). This provides the "mass" value in the density formula.
 - **Step 2: Measure the volume of the potato.**
Use displacement method with a graduated cylinder. Fill the graduated cylinder with a known volume of water, note the initial volume. Carefully lower the potato into the water, and measure the new volume. The change in volume represents the volume of the potato.
 - **Step 3: Calculate the density.**
Use the formula: $\text{Density} = \text{Mass} / \text{Volume}$. Substitute the mass and volume values into the formula. The unit of density will be grams per cubic centimeter (g/cm^3).
2. The floating ability of a body depends on the following factors:
 - **Density:** A body will float if its density is less than the density of the fluid it is placed in.
 - **Volume:** Larger volumes increase buoyancy. If the volume of a body is enough to displace a volume of fluid equal to its own weight, it will float.
3. Yes, if a body sinks in water, its apparent weight in water is still less than its weight in air. The apparent weight in water is the actual weight of the body minus the buoyant force acting on it. When a body sinks, it displaces water, and the buoyant force exerted by the water partially counteracts the weight

of the body. As a result, the apparent weight in water is reduced compared to the weight in air.

4. Swimming is easier in the sea compared to a river due to two main reasons:

- **Buoyancy in seawater:**

The density of seawater is higher than that of freshwater in rivers. This higher density provides greater buoyancy, making it easier for the human body to float and swim in the sea.

- Salt content in seawater: Seawater contains dissolved salts, increasing its density. The higher density enhances buoyancy, allowing swimmers to float more effortlessly compared to freshwater.

5. A ship floats in water because its overall density is less than that of water. Ships are designed to displace a large volume of water, and the weight of the displaced water creates an upward buoyant force, supporting the ship's weight.

On the other hand, an iron nail sinks because its overall density is greater than that of water. The weight of the iron nail is not sufficiently counteracted by the buoyant force, causing it to sink.

6. Density is a measure of how much mass is contained in a given volume. Relative density is the ratio of the density of a substance to the density of water. The connection lies in the comparison: while density is an absolute measure, relative density is a dimensionless comparison, providing insight into how dense a substance is relative to another.

7. Objects float in water when their density is less than the density of water. The buoyant force exerted by the water is greater than the weight of the object, allowing it to stay afloat. Objects that sink have a greater density than water, and the buoyant force is not sufficient to counteract their weight.

8. Up-thrust, also known as buoyant force, is the result of a difference in pressure acting on the upper and lower surfaces of a submerged body. When an object is immersed in a liquid, pressure is exerted on it from all sides. The forces acting horizontally on the sides are equal and cancel out. However the downward pressure exerted on the upper face is less than the upward pressure. It is so because as we know pressure in liquids increases with depth. The difference between the pressure acting downwards on the upper face and the pressure acting upward on the bottom face leads to the net upward force –up-thrust.

9. The force of buoyancy acting on an object is equal to the weight of the fluid displaced by the object. This is known as Archimedes' principle.

Mercury is denser than water, which means that it has a greater mass per unit volume. Therefore, the same volume of mercury has a greater weight than the same volume of water.

This means that the weight of mercury displaced by the iron ball will be greater. Therefore, the force of buoyancy acting on the iron ball in mercury will be greater than the force of buoyancy acting on the iron ball in water.

G. Application based questions

1. Flood waters are able to deposit heavy debris in the river banks because of the buoyancy they provide to the immersed stones and rocks. That is how larger and heavier pieces of debris are deposited along the river banks, while the smaller and lighter pieces of debris are carried further downstream.
2. When the ice melts, it contracts, which means that it occupies less volume. The net change in volume is zero, so the water does not overflow the glass.
3. Helium is a gas that is less dense than air. This means that a balloon filled with helium will have a lower average density than the air around it. The buoyant force acting on a balloon filled with helium is greater than the weight of the balloon. This is because the balloon displaces a volume of air that has a greater weight than the weight of the balloon itself.

Image based questions

1. Upthrust provided by air for helium balloon will be more than its weight. So this balloon will rise.
2. Upthrust for the air balloon will be almost the same as the weight of the balloon. So this balloon will not rise.
3. The upthrust provided by air to the water balloon will be less than the weight of the water balloon. It will hand downwards.

Experiential learning questions

1. a) Earth's magnetism originates from the Earth's mantle.
2. Yes, we can say that in the interior of the Earth, one layer floats on the layer below. This is because the layers of the Earth have different densities. The denser layers are closer to the center of the Earth, while the less dense layers are closer to the surface.
For example, the continental crust is less dense than the oceanic crust, so the continental crust floats on the oceanic crust. Similarly, the mantle is less dense than the core, so the mantle floats on the core.

Multi-disciplinary questions

1. To weld two pieces of iron, we use a process called fusion welding. In fusion welding, the two pieces of iron are heated to their melting point, and then a

filler metal is added to melt and fuse the two pieces together.

The property of metals that is used in welding is their malleability.

Malleability is the ability of a metal to be deformed without breaking. Iron is malleable, so it can be heated and melted without breaking. This allows us to fuse two pieces of iron together to create a strong joint.

2. The air at high altitude is thinner than the air at sea level. This is because the air pressure decreases as we go to the hills. When the air is thin (of less dense) there will be less number of oxygen molecules in every intake of breath.

Chapter-3 Force and Pressure

Quiz Zone (Page 50)

1. School bags are often equipped with wide straps to distribute the weight of the bag more evenly across a larger surface area. This helps to reduce pressure on the shoulders and prevent discomfort or pain. When the weight is concentrated on a smaller area, such as with thin straps, it can put excessive pressure on the shoulder muscles and nerves, leading to fatigue, soreness, and even potential injuries.
2. Porters wear a turban so as to spread the weight of the luggage over a larger area (when the luggage is carried on the head).
3. The broad walls of deep reservoirs, like dams or water tanks, are designed to withstand the immense hydrostatic pressure exerted by the water column. Hydrostatic pressure increases with depth, and the broader walls provide a larger surface area to counteract this force. If the walls were thin, the pressure would potentially causing the walls to crack or collapse.
4. The instrument shown is a sphygmomanometer. It is used to measure blood pressure.
5. Scuba divers wear special suits, to protect themselves from high water pressure on their bodies. Pressure of water increases as they go in to deeper waters.
6. Drinking from a straw involves the principle of atmospheric pressure. When we suck on the straw, we create a low-pressure area in the mouth. This pressure difference between the pressure on the surface of liquid and inside the straw draws the liquid up the straw and into your mouth. The straw acts as a conduit, allowing the liquid to flow from the cup to your mouth without the need to tilt the cup.

A. MCQs

1. c) Far from the pivot
2. c) Newton meter
3. b) Force acting perpendicularly on a surface
4. d) Pressure = Thrust /Area
5. c) Area of application decreases
6. c) Atmospheric pressure above our head depends on the column of air above it.
7. c) At the same depth pressure is same in all direction.
8. c) To spread the heavy load over larger area so the wheels don't sink.
9. a) Density and height of the liquid column above the point of measurement.
- 10.c) The cups create a vacuum and then they are pressed to the walls by air pressure.

B. State True or False and correct the false statement giving reasons

1. False: Turning forces create rotatory motion, not translational motion. Translational motion is motion in a straight line, while rotational motion is motion around a fixed point.
2. False: Water exerts pressure throughout the reservoir, not just at the bottom. The pressure at a point in a liquid is equal to the weight of the liquid column above the point. This means that the pressure increases with depth in the reservoir.
3. True
4. True
5. False: The pressure created on the ground by a brick is not the same when placed on any of its faces. The pressure created the brick on the ground is more when it is places on its smallest surface.
6. True
7. False: When the surface area is increased, the pressure decreases.
8. False: Feet of camels create low pressure on the desert sand. This is because the wide surface area of their feet helps to distribute their weight over a larger area, reducing the pressure per square inch. This is an adaptation that helps camels to walk on soft sand without sinking.
9. False: The only reason for low air pressure on hills is not that there is less pollution. Air pressure decreases with altitude because there is a smaller column of air above a point at a higher altitude. This is true regardless of the level of pollution.
- 10.True

C. Fill in the blanks

1. near
2. force and perpendicular distance from the pivot
3. lower
4. Newton meter (N·m)
5. perpendicularly
6. all directions
7. high pressure
8. perpendicular distance
9. weight
10. air should go in and out.

D. Match the column

1. Sharp edge of knife (e) has very high pressure
2. A balloon expands because (d) air inside is at high pressure
3. Liquid pressure (a) is more for denser liquid
4. Pressure under water (b) increases with depth
5. Unit of thrust per unit area (c) pascal

E. Short answer type questions

1. The moment of force, also known as torque, is a measure of the turning effect of a force about a fixed point.
2. Pressure is inversely proportional to area. This means that if the area of contact between a force and a surface increases, the pressure decreases. This is because the force is spread over a larger area, so there is less pressure per unit area.
3. The SI unit of thrust is the newton (N). The SI unit of pressure is the pascal (Pa). One pascal is equal to one newton per square meter (N/m^2).
4. Sleepers are put under the rail tracks to distribute the weight of the train over a larger area, so the pressure on the ground is lower. This helps to prevent the tracks from sinking into the ground and also helps to reduce the amount of vibration that is transmitted to the ground.
5. Sharp pins work better than blunt pins because sharp tips have a smaller surface area. This means that the pressure exerted by the pin is greater, which makes it easier to penetrate the object.
6. We can increase pressure when the thrust is low by decreasing the area of contact. This is because pressure is inversely proportional to area. For example, if you use a smaller hammer to hit a nail, it will still be effective if the nail has a sharp point.

7. Deep sea divers wear special suits to protect themselves from the high pressure of the deep sea. The suits are made of a material that is resistant to compression and also provide insulation from the cold.
8. Atmospheric pressure decreases with altitude. This is because there is a smaller column of air above a point at a higher altitude. Therefore, the atmospheric pressure on hills is lower than the atmospheric pressure on plains.
9. When we drink from a straw, we create a vacuum inside the straw. This vacuum is created by sucking on the straw, which lowers the pressure inside the straw compared to the pressure on the liquid surface. The pressure difference then draws the liquid up the straw and into the mouth.

F. Long answer type questions

1. Clockwise Moment:

A clockwise moment occurs when a force is applied to an object in such a way that it tends to rotate the object in the direction of a clock's hands. In other words, the force creates a tendency for the object to turn in a clockwise direction around a pivot point.

Anticlockwise Moment:

Conversely, an anticlockwise moment is when a force is applied in a manner that tends to rotate the object in the opposite direction, akin to the counter-clockwise rotation of a clock's hands around an axis.

2. We can do the following experiment:

Take a plastic bottle. Put some warm water in it keeping the cap open let it rest for few minutes. Drain the water and put the cap tightly on the bottle put some cold water on the bottle and wait for few minutes.

It will be notice that the pet bottle gets crushed inwardly quite violently. This is because of the atmospheric pressure outside the bottle, which is much more than the air pressure inside the bottle.

3. The relationship between thrust, area, and pressure is expressed in the following formula:

$$\text{Pressure} = \text{Thrust} / \text{Area}$$

This formula tells us that pressure is directly proportional to thrust and inversely proportional to area. This means that if we increase the thrust, the pressure will increase. If we decrease the area, the pressure will increase. And if we decrease the thrust or increase the area, the pressure will decrease.

4. When a door is large and heavy it can be difficult to operate. If the door is made wide the distance between the handle and the hinge becomes long.

The longer line of application of force makes the operation easy because the door is not perceived as heavy.

5. Shoes with pointed heels create deeper impacts on soft soil because they have a smaller surface area. This means that the pressure exerted by the heel is greater, which makes it easier to penetrate the soil.
6. The pressure in liquids depends on two main factors:
 - The density of the liquid: The pressure in a liquid is directly proportional to the density of the liquid. This means that denser liquids exert more pressure than less dense liquids.
 - The depth of the liquid: The pressure in a liquid increases with depth. This is because there is a greater column of liquid above the point of measurement.
7. As fluids, both water and air exert pressure in all directions. The pressure exerted by water and air is also both directly proportional to the density (.). While pressure in liquid increases with depth. Air (atmospheric) pressure decreases with altitude.
8. The foundations of high-rise buildings are made broader to distribute the weight of the building over a larger area. This reduces the pressure exerted by the building on the ground, making it less likely to sink into the ground.
9. Our understanding of liquid pressure has many practical applications. Two examples are:
 - a) The walls of the dam are made thicker at the bottom because there is much more water pressure in dams at the bottom. This is because of the increased height of the water column over that point.
 - b) Deep sea divers wear special suits which protect them from high pressure at greater depths under water. For every about 10 m depth the pressure increases by one atmosphere under water.

G. Application based questions

1. No, we cannot drink from a straw if we close the opening of the soft drink bottle. This is because as the level of soft drink goes down the pressure over the liquid will fall. This is because atmospheric pressure in the bottle will not be applied as the opening of the bottle is closed tightly. As the pressure over the liquid falls liquid will not be pushed in the mouth through the straw.
2. Snow shoes have spikes to prevent the wearer from slipping on the snow. These shoes are used to climb on snow covered mountains hence the climber needs traction. Snow skates do not have spikes because they are designed to glide across the surface of the snow. Spikes would add friction

and make it more difficult to glide. Snow skates rely on their smooth surfaces and the thin layer of water that forms between the skate and the snow to glide smoothly.

Image based questions

1. Large head of the thumb pin makes it easy to push. The thrust on a large area is transferred to the small tip of the pin. Hence it easily goes into the board.
2. Rail tracks are clamped on wide sleepers, which are covered with ballast. The load of the train is transferred over a large area of the broad sleepers. Ballasts facilitate drainage; and prevent the growth of vegetation. . Ballast also holds the track in place.
3. Though the column of liquid in the two test tubes is the same the test tube containing mercury will have much more pressure at the bottom. This is because the density of mercury is much more than water.

VALUES AND LIFE SKILLS

1. First we draw the medicine in the dropper. It is done by squeezing out air by pressing the rubber bulb and releasing the bulb to create low pressure inside the tube of the dropper.

Medicine rushes in because of atmospheric pressure over its surface.

To release the medicine the rubber bulb of the dropper is pressed. This creates high pressure over the medicine inside the tube which is more than the atmospheric pressure.

Thus drops of medicine come out in a controlled way.

2. Mountain climbers are advised to acclimatize for a few days before making a high altitude climb. This is because the body needs time to adjust to the lower levels of oxygen at higher altitudes.

Altitude sickness is a condition that can cause a variety of symptoms, such as headache, nausea, vomiting, dizziness, and fatigue.

Experiential learning questions

1. (a) Air pressure can increase in tyres in summer without adding air.
2. When we enter a room, you displace a volume of air equal to the volume of the body. This displaced air has to move out of the room to make space for us. Thus an equal volume of air will move out of the room through the door, window etc.

Multi-disciplinary question

Breathing difficulties at high altitudes are primarily caused by the reduced air pressure. As you ascend to higher elevations, the air pressure decreases, leading difficulty in inhalation by the lungs; in addition lower concentration of oxygen molecules in the atmosphere. This reduced oxygen availability can trigger a range of symptoms collectively known as altitude sickness, which can range from mild discomfort to severe health complications.

Chapter-4 Energy

Quiz Zone (Page 65)

1. True
2. True
3. False: People sitting in a train with luggage do not do any work. Work is done when a force is applied to an object that causes it to move in the direction of the force.
4. False. The unit of energy is joule (J).
5. False: A stone lying at the top of a roof has potential energy. Potential energy is the energy stored in an object due to its position or configuration. In the case of a stone at the top of a roof, it has potential energy due to its height above the ground.

A. MCQs

1. c) On application of force the body moves in the direction of the force.
2. a) The movement is perpendicular to the direction of application of force.
3. b) work is not done because there is no net displacement.
4. b) Energy in a flying projectile before it reaches its destination.
5. d) Will become four times
6. b) Becomes double
7. c) Kinetic energy keeps increasing
8. c) Potential energy

B. State True or False and correct the false statement giving reasons

1. False: Getting tired does not necessarily mean that work has been done. Tiredness can also be caused by other factors, such as lack of sleep, stress, or boredom.
2. False: The SI unit of work is the joule (J). A watt is a unit of power.
3. False. For a porter having luggage on the head force is acting upwards (to hold the luggage). However, the porter will walk in a direction that is perpendicular to the force of holding the luggage. Thus the movement is

not in the direction of applied force. Hence the porter is doing no work on the luggage.

4. False: A moving body can have both kinetic energy and potential energy. Kinetic energy is the energy of motion, while potential energy is the energy stored in an object due to its position or configuration. For example, a car moving down a hill has both kinetic energy due to its motion and potential energy due to its height above the ground.
5. True
6. True
7. False. When mass of a body doubles its kinetic energy also becomes double.
8. True
9. False. Potential energy in the form of chemical energy changes to light energy.
10. True

C. Match the column

1. Dynamo (d) Mechanical energy changes to electrical energy
2. Electric press (g) Electrical energy change to heat energy
3. Photosynthesis (b) Light energy changes to chemical energy
4. Electric bulb (e) Electrical energy changes to light energy
5. Microphone (a) Electrical energy changes to Sound energy

D. Fill in the blanks

1. Zero
2. Displacement in the direction of force.
3. Joule (J)
4. Joule (J)
5. Four times
6. Thermal energy
7. Potential energy
8. Potential energy (PE)
9. Per unit time
10. 746 watts

E. Short answer type questions

1. Work done depends on two factors: force and displacement. The amount of work done is directly proportional to the force applied and the distance moved in the direction of the force.
2. One joule of work is done when one newton of force is applied for a displacement of one meter in the direction of the force.

3. Energy is the capacity to do work. It is the ability to perform an action or produce an effect. Energy can exist as kinetic energy and potential energy. One form of energy can be changed to another form of energy.
4. Work and energy are closely related. When energy is spent on a body it becomes capable of doing work (as defined in physics). For example when we carry a stone from the ground to the roof of a building energy is spent to overcome the force of gravity. In this case energy is spent by the person (decreased) and the energy of the stone is increased. When the stone falls from a height the stone 'does work' hence its energy decreases (and is converted to another kind of energy) When work is done energy is spent. In other words 'work' is transferred energy and doing work can be called the act of transferring the energy. The amount of work done is equal to the change in energy of the system.
5. Elastic energy is the potential energy stored in an elastic material due to its deformation. For instance, a stretched rubber band or a compressed spring possesses elastic energy
6. Energy transformation is never 100% efficient. Some energy is always lost during the conversion process. For example, when electrical energy is converted into light energy in an incandescent bulb, a significant portion of the energy is lost as heat.
7. As a child slides down a slider, their potential energy decreases, and their kinetic energy increases. This is because the child's height above the ground decreases, and child's speed increases.
8. Increased height directly corresponds to an increase in gravitational potential energy. Gravitational potential energy is proportional to the mass of the object and its height above a reference point. So, as the height increases, the potential energy increases.
9. When there is no motion, a body can have potential energy. Potential energy is the stored energy of an object due to its position or configuration. For instance, a ball held at a height above the ground has potential energy due to its height.
10. A fired bullet has kinetic energy. Kinetic energy is the energy of motion. As the bullet moves through the air, it possesses kinetic energy due to its velocity.

F. Long answer type questions

1. Work is said to be done (in physics) when the point of application of a force moves and is measured by the product of the force and the distance moved in the direction of the force. When force 'F' is applied on a body which

moves in the direction of the force (from A to B) by a distance 'd' the work done by the force is (F x d). Work done can become zero if either 'F' or 'd' is zero. Work done = force X distance moved in the direction of the force

2. The potential energy of a body depends on two factors:

- **Mass of the body:** Potential energy is directly proportional to the mass of the body. This means that the more massive an object is, the more potential energy it has.
- **Position of the body:** Potential energy is also dependent on the position of the body relative to a reference point. For example, a ball held at a height above the ground has more potential energy than a ball sitting on the ground.

The formula for gravitational potential energy is: $PE = mgh$

Where:

$PE = mgh$ (m is the mass of the object in kg, h is the change in height in metres.

(The "g" converts the mass of the body into weight in newton (N). The value of g is $10/s^2$).

3. The person is already having the luggage on the head after that no work is being done on the luggage because he is walking in a different direction to the force applied on the luggage. When the person is wheeling his luggage work is being done on the luggage as the movement is in the direction of the force applied.

4. **Factors Affecting Kinetic Energy:**

The kinetic energy of a moving body depends on the following two factors:

a) Kinetic energy increases if the mass of the body increases When the mass of a body moving at a certain speed, is doubled its kinetic energy is also doubled.

b) Kinetic energy increases if the speed of movement of the body increases When the speed of a moving body is doubled, its kinetic energy goes up by four times.

5. In a simple pendulum, energy is transferred between kinetic and potential energy as the pendulum oscillates. At the maximum amplitude, the potential energy is maximum, and kinetic energy is minimum. At the midpoint, kinetic energy is maximum, and potential energy is minimum. Energy is continually exchanged, but the total mechanical energy (kinetic + potential) remains constant if there is no external force.

6. Mechanical energy is the sum of kinetic energy and potential energy.

Kinetic energy is the energy of motion, while potential energy is the stored

energy of an object due to its position or configuration. When mechanical energy changes to other forms of energy, it first changes to kinetic energy because motion comes into play. For example a stretched bow throws an arrow at high speed the potential energy is converted to kinetic energy. A compressed spring or the stretched rubber of the catapult can throw a projectile at high speed. In the next step the energy can be changed to other forms.

7. Kinetic energy is the energy of motion, and it can easily change to other forms of energy due to the principle of conservation of energy. This principle states that energy cannot be created or destroyed, only transferred or transformed.

Here are some examples of how kinetic energy can change to other forms of energy:

Kinetic energy can change to thermal energy. For example, when a car brakes, the kinetic energy of the car is converted into thermal energy as the brakes heat up.

Kinetic energy can change to sound energy. For example, when a hammer hits a nail, the kinetic energy of the hammer is converted into sound energy.

Kinetic energy can change to potential energy. For example, when a ball is thrown into the air, its kinetic energy is converted into potential energy as it reaches its peak height.

- 8.

Power	Energy
1. Power is the amount of energy transferred in unit time.	1. Energy is the capacity to do work.
2. Power has a time component.	2. It does not have a time component.
3. The SI unit is watt (W).	3. The SI unit is joule (J)
4. It is a measure of energy consumed in unit time.	4. One form of energy can convert to another form of energy.
5. We cannot store power	5. Energy can be stored by converting it into another form.

9.

Work	Power
1. Work done is the product of the force applied and the distance moved in the direction of the force.	1. Power is the rate of doing work in unit time
2. Work done does not depend on time consumed.	2. Power consumed is measured in time interval.
3. SI unit of work is joule (J).	3. SI unit of power is watt (W).

10. The potential energy of an object is given by the formula:

$$PE = mgh$$

where PE is potential energy, m is mass, g is acceleration due to gravity, and h is height.

In this case, $m = 4 \text{ kg}$, $g = 10 \text{ m/sec}^2$, and $h = 100 \text{ m}$. Plugging these values into the formula, we get:

$$PE = (4 \text{ kg})(10 \text{ m/sec}^2)(100 \text{ m}) = 4,000 \text{ joules}$$

Therefore, the potential energy of the rock is 4,000 joules.

G. Application based questions

1. Though force in the form of effort is applied to hold the bag, there is no movement in the direction of the applied force. Hence no work is done.
2. When an arrow is released from a stretched bow, there is a transformation of energy from potential energy to kinetic energy. The potential energy is stored in the stretched bowstring, and when the bowstring is released, this potential energy is transferred to the arrow, giving it kinetic energy. The arrow then flies through the air until its kinetic energy is converted to other forms of energy, such as thermal energy and sound energy.

Image based questions

1. Energy is spent in holding the load however, no work is done on the load because movement from A to B, is not in the direction of application of force.
2. In this case work is done because the load is lifted from X to Y. Here the movement is in the direction of application of force hence work is done on the load.
3. Potential energy is maximum at X and Y. It is minimum at O. Kinetic energy is maximum at O. It is minimum at X and Y.

Experiential learning questions

1. b) Biofuels come from newly harvested plants.
2. The current trends in producing biofuels include:

Currently scientists are focussing on microalgae which has a reasonable oil content.

A new process called 'co-firing' is being used. Here coal is mixed with upto twenty percent of a biomass product in a boiler in a power plant. This reduces the operating costs and leads to less pollution.

Multi-disciplinary questions

1. Both fossil fuels and biofuels are ultimately derived from the process of photosynthesis. Photosynthesis is the process by which plants convert sunlight into chemical energy, by the process of carbon capture. In the case of fossil fuels, the chemical energy stored in plants millions of years ago was converted into coal, oil, and natural gas through a process called fossilization. In case of biofuels also photosynthesis is the key process by which plants capture carbon of the atmosphere. In all the cases of combustion the captured carbon is burnt.

2. India's energy needs are growing rapidly, driven by increasing population, urbanization, and economic growth. The advent of 5G technology is expected to further exacerbate this demand, as 5G networks require more energy to operate than their predecessors.

To meet this growing energy demand in a sustainable manner, India should focus on tapping into renewable energy sources, including

- **Solar energy:** India's vast solar potential, with abundant sunshine throughout the year, makes it an ideal location for solar energy development. Solar farms can generate clean electricity without producing greenhouse gas emissions.
- **Wind energy:** India has a long coastline and several mountainous regions with strong winds, making it suitable for wind energy generation. Wind turbines can harness wind power to produce electricity without polluting the environment.
- **Hydropower:** India has significant hydropower potential from its rivers and mountains. Hydroelectric dams can generate clean and reliable electricity, contributing to a sustainable energy mix.

VALUES AND LIFE SKILLS

- Enhancing the working conditions and earning potential of individuals engaged in physical labor can be achieved through the implementation of simple devices and improved work environments. Here are some specific examples:

1. **Carts and Wheelbarrows:** Implementing carts and wheelbarrows for transporting heavy materials can significantly reduce physical strain and exertion, leading to improved health and productivity.
2. **Ergonomic Hand Tools:** Replacing traditional hand tools with ergonomically designed ones can prevent repetitive strain injuries and musculoskeletal disorders
3. **Personal Protective Equipment (PPE):** Providing adequate PPE, such as gloves, safety boots, and protective eyewear, can safeguard workers from injuries caused by falling objects, sharp edges, and hazardous materials.

Chapter-5 Light Energy

Quiz Zone (Page 79)

1. True
2. True
3. False. If light travels from water to glass, the refracted ray will bend towards the normal. This is because the refractive index of glass is higher than the refractive index of water. Light travels slower in glass than in water, so when it enters the glass, it bends towards the normal.
4. False. Mirage effect on the road is caused by refraction of light from the heated air above the road surface. The heated air is less dense than the cooler air above it, so light bends as it passes from the cooler air to the hotter air.
5. True

A. MCQs

1. b) 1.55
2. c) Speed of the component lights have different speed in glass.
3. c) Its optical density must be high.
4. b) Light is travelling from denser medium to rarer medium.
5. c) Stars behave as point source of light that undergoes refraction through layers of the air.
6. b) Distance between the pole and the focus is called focal length.
7. c) Meeting of at least two reflected ray from the mirror
8. c) The image formed is inverted and highly diminished
9. b) As a rear-view mirror in a car
10. b) It can be obtained on a screen.

B. State True or False and correct the false statement giving reasons

1. False. Light striking as normally does not change direction.

2. False. Physical density and optical density are not the same thing. Physical density is a measure of the mass of a substance per unit volume, while optical density is a measure of how much a substance bends light.
3. False. The speed of all colors of light is reduced when passing through a glass slab. However, the speed of violet light is reduced the most, while the speed of red light is reduced the least. This is why a prism separates white light into its constituent colors.
4. True
5. False. The value of μ for light keeps changing from medium to medium.
6. False. The geometric center of a curved mirror is not its focus. The focus of a curved mirror is the point where the reflected rays from the mirror converge. The geometric center of a curved mirror is double of the focal length.
7. True
8. True
9. False. A convex mirror cannot be conveniently used as a shaving mirror. This is because convex mirrors produce virtual images that are always smaller than the object. This would make it difficult to see the face clearly in a convex mirror.
10. False. Convex mirrors are divergent because of its bulging reflecting surface. It can have low or high focal length.

C. Fill in the blanks

1. Perpendicular
2. the normal
3. dispersion
4. denser
5. virtual rays
6. centre of curvature
7. inverted
8. radius of curvature
9. virtual
10. convex

D. Match the column

1. Object at infinite distance \rightarrow (e) Image is formed at F
2. Object beyond the centre of curvature \rightarrow (a) Image between C and F
3. Object between focus and centre of curvature \rightarrow (b) Image is formed beyond C
4. Object at the centre of curvature \rightarrow (d) Image is formed at C

5. Object between Pole and focus → (c) Image is formed behind the mirror

E. Short answer type questions

1. a) Center of curvature of a curved mirror

It is the centre of the sphere from which the spherical mirror is cut out. It is depicted as (Point C), on the principal axis.

b) Focal length of a concave mirror

It is the linear distance between the pole and the principal focus on the principal axis. Focal length is always half of the radius of the curvature

c) Principal axis of a curved mirror

It is an imaginary line passing through the pole and the centre of curvature of a spherical mirror.

2. The refractive index of a medium is defined as the ratio of the speed of light in a vacuum to the speed of light in the medium. It is denoted by the letter n . It can be calculated by dividing the speed of light in vacuum by the speed of light in that particular medium.

For example refractive index of water is $3 \times 10^8 / 2.24 \times 10^8$

The refractive index of a medium can also be calculated using the following formula: $n = \sin(i) / \sin(r)$

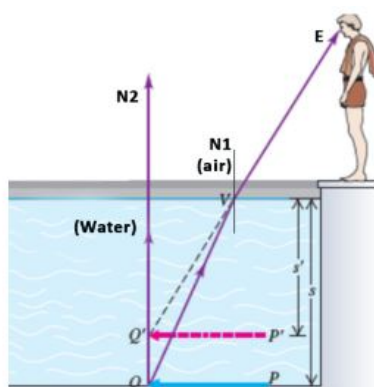
where i is the angle of incidence and r is the angle of refraction.

3. Refraction is the bending of light when it passes from one medium to another, resulting in a change in its speed and direction.

4. **Angle of incidence:** The angle formed between the incident ray and the normal (a line perpendicular to the surface) at the point of incidence.

Angle of refraction: The angle formed between the refracted ray and the normal at the point of refraction.

5.



Light coming from the bottom of the pool (let us take a point Q) bends away from normal (N1) at point 'v'. Again light coming from the point Q striking the surface of water perpendicularly (N2) goes out without

deviation. If the ray VE, is extended backwards it meets the other ray from Q at Q'. Thus Q' is the image of Q. For the observer the apparent depth of the pool becomes S'— which is less than the real depth of the pool S.

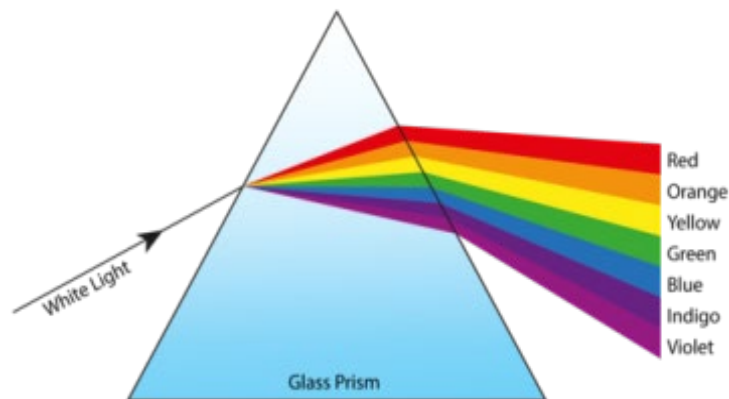
6. A mirage is an optical illusion that is caused by the refraction of light. The mirage is formed by refraction of light through the layers of hot air. A common refraction phenomenon is a pool of water that appears to lie on the road some distance ahead on a sunny day. The pool of water is a mirage (a type of illusion), formed by light rays from the road travelling through different layers of air of varying density (and hence varying refractive index). Similarly mirage are seen in deserts. These notoriously give the illusion of water at a distance.
7. A convergent lens is a lens that bends light rays inwards, causing them to converge at a point. It is also called a convex lens.
8. Two properties of a real image are:
 - Real images are formed by the actual convergence of light rays.
 - Real images can be projected onto a screen.
9. Conjugate foci are any pair of points such that an object placed at one of them gives rise to real image at the other point. This follows the principle of reversibility of light.
10. The properties of a virtual image are :
 - When two or more rays appear to meet at a point when extended backwards the image formed is virtual.
 - virtual image cannot be obtained on a screen.
 - The image is upright and it is always formed behind the mirror.

F. Long answer type questions

1. Stars are at a very large distance from the Earth and hence are called point sources of light. The starlight passes through various layers of the atmosphere before reaching the Earth. As the atmosphere gets gradually denser hence has greater refractive index near the Earth's surface. So, the starlight is bent towards the normal. When we see this light from the Earth, the star appears to be slightly higher than its actual position. Because the atmospheric conditions are not stable and keep changing, the apparent position of the star keeps fluctuating giving rise to a flickering effect, which we call twinkling. The planets do not twinkle because they are not very far off and hence do not behave as a point source of light.
2. Due to atmospheric refraction, at sunset due to atmospheric refraction, we see the Sun slightly above its actual position (above the horizon), even after it has crossed the horizon (actually set). So we see the Sun even after

it sets, for two/ three minutes more. Thus because of refraction we manage to get extra sunlight for few minutes every day.

3. Dispersion of white light is the separation of white light into its constituent colors when it passes through a prism. Light of all component colours (of white light) travel at the same speed in vacuum (and nearly so in air). However, light of different colours travel at different speed in all other transparent media. Because of varying speed, they bend at different angles with respect to the incident beam since the prism is made of a material of high optical density, Red, having the greatest velocity bends the least when it passes through the prism. Violet, bends the most as it has the least velocity. Speed of red light is 1.65 times greater than violet light. In this way, white light is split into its seven distinguishable constituent colours.



4. The refractive index of a medium is defined as the ratio of the speed of light in a vacuum to the speed of light in the medium. It is denoted by the letter n .

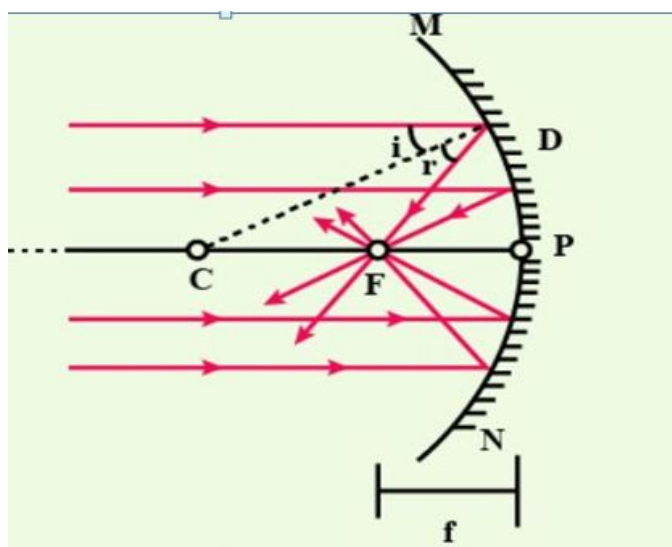
Refractive indices of water, glass and diamond from the known speed of light in some mediums can be calculated as follows: Water $\mu = 3 \times 10^8 \text{ m/s} / 2.25 \times 10^8 \text{ m/s} = 1.33$ (ii) Glass $\mu = 3 \times 10^8 \text{ m/s} / 2.00 \times 10^8 \text{ m/s} = 1.50$ (iii) Diamond $\mu = 3 \times 10^8 \text{ m/s} / 1.25 \times 10^8 \text{ m/s} = 2.40$

5. The following rules are taken as conventional standard practices:
 - The object is always kept on the left side of the reflecting surface and it is always kept on the principal axis such that its base touches the principal axis.
 - Solid lines are used to represent real rays, objects and real images. Dotted lines are used to represent virtual rays and images. All rays should have arrows to show direction.
 - We know that an infinite number of rays travel from an object to the mirror. However, to obtain an image we need to know about at least two incident rays whose path can be traced after reflection.

- Any two of the following ‘convenient rays’ can be taken as incident rays. These are rays passing through the center, rays parallel to the principal axis, rays passing through the focus and the rays incident on the pole.
6. Convenient rays for studying reflection through a curved mirror include:
- Ray passing through the centre of the curvature is reflected along its own path without any deviation.
 - Rays parallel to the principal axis are reflected through the principal focus in case of concave mirror. The reflected rays appear to emerge from the principal focus in case of convex mirror.
 - Rays through the principal focus (in case of concave mirror) or appearing to pass through principal focus (in case of convex mirror) are reflected parallel to the principal axis.
 - Rays incident at the pole are reflected making the same angle with the principal axis. So that the angle of incidence is equal to the angle of reflection.
7. A concave mirror has its reflecting surface on the inner side.

Focus or principal focus – It is a point on the principal axis. Here all the rays parallel to the principal axis meet in case of concave mirror after reflection.

Focal length - is the linear distance between the pole and the principal focus on the principal axis. Focal length is always half of the radius of the curvature.



8. Concave mirrors are mirrors that curve inwards, while convex mirrors are mirrors that curve outwards. Concave mirrors reflect light rays inwards, causing them to converge, while convex mirrors reflect light rays outwards,

causing them to diverge. In case of concave mirror the image formed is real, except when the object is between focus and pole of the mirror. In case of convex mirror the image formed is always virtual.

9. (a) A plane mirror always forms a virtual, erect, and of the same size of an object at any distance, including infinity.
(b) A concave mirror forms a real, inverted, and diminished image of an object at infinity.
10. Convex mirrors are preferred as rear-view mirrors in vehicles because they provide a wider field of view, allowing drivers to see more of the road behind them. However, the distances of the vehicles coming from the rear appear farther than they actually are. The curved shape of convex mirrors helps in minimizing blind spots and enhancing safety during lane changes and maneuvers.

G. Application based questions

1. Red light has the greatest velocity in varying density of atmosphere and bends or deviates the least. Biologically 50% of the cones in the human retina are sensitive to red colour. Hence red light is most likely to be perceived.
2. The legend of Archimedes using mirrors to burn ships is often associated with the use of "Archimedes' mirrors" or "burning mirrors." According to the legend, during the Siege of Syracuse, Archimedes used large mirrors to focus sunlight onto Roman ships, setting them on fire. While the historical accuracy of this event is debated, the principle behind it is plausible. Large mirrors, known as "burning mirrors" or "solar mirrors," could focus sunlight onto a specific point. If the mirrors were properly aligned, they could focus sunlight onto a ship's sails or other flammable materials, potentially causing them to catch fire.

VALUES AND LIFE SKILLS

Answer yourself. (Hint: When times are difficult we must gather our wits and courage and find the correct course of action.)

Image based questions

(Rank of speed of light in the materials will be speed in $b > \text{speed in } c > \text{speed in } a$.)

Experiential learning questions

- b) Though rainbows are formed at night, we don't see them because of darkness.

Multi-disciplinary question

Einstein proposed that the speed of light in a vacuum is a universal constant (approximately 300,000 kilometers per second), denoted by the symbol 'c.' This means that no matter how fast the source of light is moving, the speed of light emitted from that source will always be 'c' relative to an observer at rest. In the example given, even if a bike is traveling at 10% the speed of light (30,000 km/sec), the light emitted from the bike will still move away from it at the constant speed of light (c), not at the sum of the bike's speed and the speed of light.

Chapter-6 Heat Transfer

Quiz Zone (Page 101)

1. True
2. False. A substance boils at a specific temperature, not over a range of temperatures. The boiling point is the temperature at which the vapor pressure of a liquid is equal to the atmospheric pressure.
3. False. Thermal expansion can occur in all directions, not just one direction. When a substance is heated, its molecules vibrate more rapidly. This increased vibration causes the molecules to move farther apart from each other, which increases the volume of the substance.
4. True
5. False. The steel rod mesh that are used as reinforcement in concrete structures has the same expansion as that of concrete for a rise in temperature. If it was not so buildings would crack in summer months.

A. MCQs

1. c) Liquid is more volatile
2. a) It evaporates faster
3. b) At high altitudes
4. b) They are not heated at the same temperature
5. c) In the beginning the container expands on heating
6. b) Rod Y will expand less than rod X, because its initial temperature is more.
7. d) Thermal expansion in solids is less than gases but more than liquids.
8. d) Expansion of the cables
9. b) They have high intermolecular spaces.
10. d) When we heat liquids their density usually decreases.

B. State True or False and correct the false statement giving reasons

1. False. The process that dries clothes in the Sun is called evaporation, not superficial expansion. Evaporation is the process by which a liquid changes into a gas. Superficial expansion is the expansion of a material at its surface.
2. True
3. True
4. False. On heating, steel expands more than glass. The coefficient of thermal expansion of steel is greater than the coefficient of thermal expansion of glass.
5. True
6. True
7. False. The density of a liquid at a higher temperature will be lower. This is because on heating the volume of the liquid will expand.
8. False. The expansion in liquids is not of a superficial type. Liquids expand in terms of their total volume.

C. Match the column

1. Sublimation → (c) Solid to gas
2. Vaporization → (e) Liquid to gas
3. Deposition → (a) Gas to solid
4. Condensation → (b) Gas to liquid
5. Melting → (d) Solid to liquid
6. Freezing → (f) Liquid to solid

D. Fill in the blanks

1. Surface area
2. The boiling point
3. Deposition
4. A higher
5. Increases
6. surface area
7. More
8. 4°C
9. uniform
10. Less

E. Short answer type questions

1. In liquids at room temperature, the molecules near the surface which are more energetic and happen to be moving faster than average escape from the attraction of the molecules in the vicinity. The escape of molecules is assisted if there is a breeze. In this way the liquid loses its more energetic

molecules. What are left are relatively less energetic molecules. Thus the average kinetic energy of the remaining molecules falls. This results in a drop in temperature.

2. (a) Evaporation is faster when the temperature of the liquid that is kinetic energy of the molecules is high.
(b) Exposed area of the liquid is large. When spilled water on the floor is spread thinly it dries up fast.
(c) Nature of the liquid. Volatile liquids with low boiling points such as alcohol, ether, gasoline etc. evaporate very fast.
(d) Removal of air saturated with molecules of the liquid above its surface. When we blow air over hot soup it cools faster.
(e) Level of humidity : Our clothes dry faster in winter because of low humidity even though the temperature is lesser than in rainy season. In the latter case the temperature is high but humidity is high too.
3. The density of a solid increases when its temperature falls. This is because the space between the molecule reduces leading to drop in volume.
4. When ice melts, its volume falls till 4° C; after this temperature on further heating the volume of water expands.
5. The coefficient of linear expansion is defined as the ratio of increase in length to its original length for one degree of rise in temperature. This is commonly represented by the Greek letter (called alpha).
6. Electrical cables sag in summer because they expand when heated. This is due to the thermal expansion of the metal wires in the cables. There can be some expansion because of heat generated by transmission of current also. As much as 5% electricity is lost in transmission.
7. Railway lines have gaps between them to allow for thermal expansion. In modern practice the railway lines are welded together to form a long continuous length. In such cases only the last 50-100 m of the rails show expansion on heating. This is taken care of by designing overlaps.
8. Liquids and gases do not have linear expansion because the molecules in these phases are not arranged in a regular lattice structure. Liquids and gases occupy the shape of vessel. They do not have individual length and area. Hence, liquids and gases have no linear expansions.
9. A practical application of the thermal expansion of liquids is in the use of thermometers. Thermometers work by measuring the expansion of a liquid, such as mercury or alcohol, in a sealed glass tube. As the temperature of the liquid increases, it expands and fills more of the tube. The height of the liquid in the tube is then used to measure the temperature.

10. Water boils at a lower temperature at higher altitudes because the atmospheric pressure is lower. When water boils at lower temperature cooking of items like pulses can be a problem; that is why pressure cookers are used.

F. Long answer type questions

1. Temperature of a body is a measure of the average kinetic energy possessed by the particles of matter in the body. In a liquid kept in a container the particles would be moving randomly and often colliding with each other. The collision of particles lead to bouncing of particles to the surface and it may escape into atmosphere. The particles on the surface can also gather energy from sunlight and create an imbalance of kinetic energy amongst the particles. At any time in a liquid there are many particles with higher kinetic energy than the average which balance out , those with lower kinetic energy than the average. Thus in a liquid there will be some particles with enough energy to break away from the surface of the liquid overcoming the pull of other molecules or atoms. This slow (but steady) escape of the liquid as gas particles from the surface is the cause of evaporation.
2. Evaporation and boiling are two different processes by which a liquid changes into a gas. However, there are three key differences between the two processes:
 - **Rate of evaporation:** Evaporation occurs at a much slower rate than boiling. This is because evaporation only occurs at the surface of a liquid, while boiling occurs throughout the liquid.
 - **Temperature:** Evaporation can occur at any temperature below the boiling point of the liquid, while boiling only occurs at the boiling point of the liquid.
 - **Cooling:** When evaporation takes place the temperature of the remaining liquid decreases. In boiling Temperature remains constant as long as the boiling continues. Evaporation takes place as long as the air above the liquid remains unsaturated. Boiling takes place when the internal liquid pressure is equal to the external pressure.
3. The linear expansion of a solid is the amount that the length of the solid will change for a given change in temperature.
There are two main factors that affect the linear expansion of a solid:
Material: Different materials have different coefficients of linear expansion. This means that some materials will expand more than others for the same change in temperature.

Temperature change: The greater the change in temperature, the greater the linear expansion of the solid.

4. There are three main types of expansion in solids: linear expansion, superficial expansion, and cubical expansion.
 - **Linear expansion:** Linear expansion is the amount that the length of a solid will change for a given change in temperature.
 - **Superficial expansion:** Superficial expansion is the amount that the area of a solid will change for a given change in temperature.
 - **Cubical expansion:** **Cubical expansion** is the amount that the volume of a solid will change for a given change in temperature.

The relationship between these three types of expansion is that they are all proportional to each other. The three coefficients of expansion of solids : alpha, beta and gamma are related as 1:2 :3.

5. A bimetallic strip is a strip of two different metals that are bonded together. When the bimetallic strip is heated, the two metals expand at different rates. This causes the strip to bend, with the metal with the higher coefficient of thermal expansion expanding more than the metal with the lower coefficient of thermal expansion. Bimetallic strips are used in a variety of applications, such as thermostats and thermometers. In a thermostat, a bimetallic strip is used to turn a switch on or off when the temperature reaches a certain level. The bending of the bimetallic strip away from an electrical point disconnects the electrical circuit.
6. The volume expansion of a metal ball depends on three factors:
The volume increase of a solid on heating depends on:
 - (i) Initial volume of the solid: Larger the initial volume more is the increase in volume.
 - (ii) The rise in temperature: Greater the rise in temperature more is the increase in volume.
 - (iii) The material of the solid: Objects of certain material expand more than others for the same rise in temperature. For example between equal sized balls of aluminum and steel; the aluminum ball expands more than a steel ball for the same rise in temperature.
7. When a liquid is boiling, the temperature of the liquid remains constant at the boiling point. This is because the energy being added to the liquid is being used to overcome the intermolecular forces of attraction between the molecules of the liquid, to ensure phase change. As a result, the temperature of the liquid remains constant until all of the liquid has been vaporized. If the heating is stopped, the temperature of the liquid will

begin to lose kinetic energy. This decrease in kinetic energy will result in a decrease in the temperature of the liquid.

8. Fill four same sized glass bulbs with narrow necks with equal quantity of different liquids. Do the filling carefully so that there are no air bubbles and the liquid should reach the neck of each bottle. Keep the bulbs in a bath of water and heat it slowly. You will notice that at first the levels of liquids fall and then begin to rise in the neck of all the bulbs. However the rise in level of the liquid is different for the different liquids. The initial fall in the level of liquid is attributed to the expansion of the glass bulbs in which the liquids are kept. The liquids begin to expand as they become hot. The uneven rise in level of the liquids happen because each one has different coefficient of volume expansion.
9. Substances expand upon heating because the molecules of the substance are vibrating more rapidly. When a substance is heated, intermolecular space between the molecules expand. The kinetic energy of the molecules also increases leading to their greater movement. The amount of expansion that occurs depends on the coefficient of thermal expansion of the substance. The coefficient of thermal expansion is a measure of how much a substance will expand for a given change in temperature.
10. In liquids and gases the intermolecular attraction is much less than solids. Hence upon heating the molecules are able to move more vigorously because of their increased kinetic energy.

G. Application based questions

1. Pressure cookers help in cooking by raising the boiling point of water. Water boils at 100°C (212°F) at standard atmospheric pressure, but in a pressure cooker, the pressure is increased, which raises the boiling point. This allows food to cook at a higher temperature, which can shorten the cooking time and make the food more tender.
2. Bimetallic strips are used in a variety of applications, including:
 - **Thermostats:** Thermostats are used to control the temperature of appliances, such as ovens and refrigerators. Bimetallic strips are used in thermostats because they bend when heated, and this bending can be used to open or close a switch.
 - **Safety devices:** Bimetallic strips are also used in some safety devices, such as fire alarms and sprinkler systems. In these devices, the bimetallic strip is used to activate a warning or safety mechanism when the temperature reaches a certain level.

3. We should avoid having a tank full of fuel in motor cars because fuel expands when heated. If the tank is completely full, there is no room for the fuel to expand, and this can cause the fuel to leak. This can result in a fire or explosion.

Image based questions

1. The image shows an experiment showing expansion of air (in the bottle) when it is heated from 25 °C. to 80 °C.
2. The cloth in (fig-1) will dry faster because it is spread, thus has a larger surface area for evaporation.

Experiential learning questions

1. b) Heat capacity of water is four times more than air.
2. Dipping a frozen packet of milk in water is a better option for thawing because water has a higher heat capacity than air. The passage explains that for a given mass of water and air, water has about four times the heat capacity. Additionally, the volume of water is much smaller than the volume of air. According to the passage the heat exchange in water will be 4000, times faster than in air.

Multi-disciplinary questions

1. Hypothermia is a medical emergency, and it is important to seek medical attention as soon as possible. While waiting for medical attention, there are a few things you can do to help a victim of hypothermia:
 - **Move the victim to a warm place.** This could be indoors, in a car, or even wrapping the victim in blankets.
 - **Remove any wet clothing.** Wet clothing can draw heat away from the body, so it is important to remove it as soon as possible.
 - **Dry the victim's skin.** This will help to prevent the victim from losing heat through evaporation.
 - **Give the victim warm fluids.** Warm fluids, such as soup or tea, can help to raise the victim's body temperature.
2. Hot water should not be poured into thick glass tumblers because the sudden change in temperature on one surface can cause the glass to crack. This is because the glass expands when heated but in case of thick walls one side has unequal expansion. This can cause the glass to crack or even shatter. Pre-heating the glass can prevent a crack by allowing the glass to expand uniformly.

VALUES AND LIFE SKILLS

Answer yourself (Hint: Think of huge amount of heat loss from the body of the patient and its consequences if cold i.v. is given).

Chapter-7 Sound

Quiz Zone (Page 116)

1. False. Pitch is measured in hertz (Hz), not decibels (dB). Pitch is the rate at which vibrations are produced. Decibels are a measure of loudness.
2. False. Smaller vibrating bodies produce higher pitched sounds. This is because smaller objects vibrate more quickly than larger objects.
3. True
4. False. Loudness is measured in decibels (dB).
5. False. Monotone sounds have one frequency.

A. MCQs

1. b) Air particles transmit the disturbance in the form of a wave.
2. d) Loud
3. a) The pitch become high
4. c) Harmonium
5. b) Drum, Tabla, Violin
6. b) Hertz
7. a) More than that of an adult male
8. d) Will be loud and shrill
9. b) A sound of frequency of 10 Hz
10. b) The thick string will be plucked

B. State True or False and correct the false statements and giving reasons

1. True
2. True
3. False. In longitudinal waves, the particles vibrate in the direction of wave propagation.
4. False. A sound of low frequency is not shrill. Shrillness is associated with high-frequency sounds.
5. True
6. False. A sound of 10 dB will just be heard or may not be heard. Human hearing range is 10 dB to 120 dB.
7. True
8. False. A sound of 120 dB cannot be soft. 120 dB is considered an extremely loud sound, close to the threshold of pain.

9. False. Musical notes have regular vibrations, producing a consistent pitch and tone.

10. True

C. Fill in the blanks

1. lower frequency sound

2. vacuum

3. frequency

4. high frequency

5. high pitch

6. its wave form

7. frequency

8. timbre

9. decibels (dB)

10. higher-pitched

D. Match the features of musical instruments with sound output

1. Thin strings - (c) High frequency sound

2. Longer string - (a) Lower frequency sound

3. Long vibrating column of air - (d) Grave sound

4. Small tight membrane - (b) High pitch sound

E. Short answer type questions

1. The amplitude of a sound wave is the displacement of its particles from their equilibrium positions. The larger the amplitude, the louder the sound.

2. A longitudinal wave is a type of wave in which the particles of the medium vibrate in the same direction as the direction of wave propagation. This creates alternating regions of compression and rarefaction.

3. Time period is the time taken by a vibrating particle to complete one oscillation. Frequency is the number of oscillations per unit time.

4. An increase in amplitude corresponds to an increase in loudness. This is because a larger amplitude means that the particles of the medium are vibrating more vigorously, which produces a louder sound.

5. The ratio of their loudness is 4:9. This is because the loudness of a sound is proportional to the square of its amplitude.

6. Resonance is the phenomenon of sound waves being amplified when they encounter a resonant frequency. In musical instruments, resonance is used to produce clear, distinct notes.

7. As the container fills with water, the pitch of the sound becomes high. This is because the length of the air column inside the container is decreasing, which makes the sound shrill.

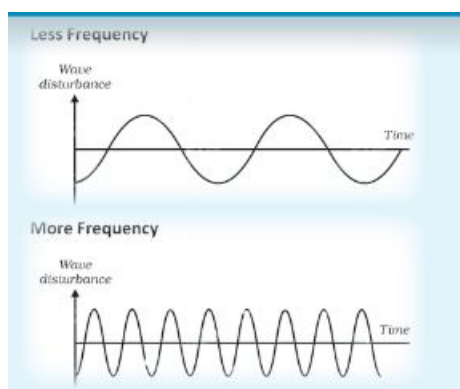
8. (a) Guitar, (b) Flute, (c) Drum

9. The frequency of vibration of a string depends on its thickness –thicker strings produce lower frequencies than thinner strings. That is why strings of different thickness are used.

10. When the membrane is large, the amplitude of the vibrations increases. This results in a louder sound.

F. Long answer type questions

1.

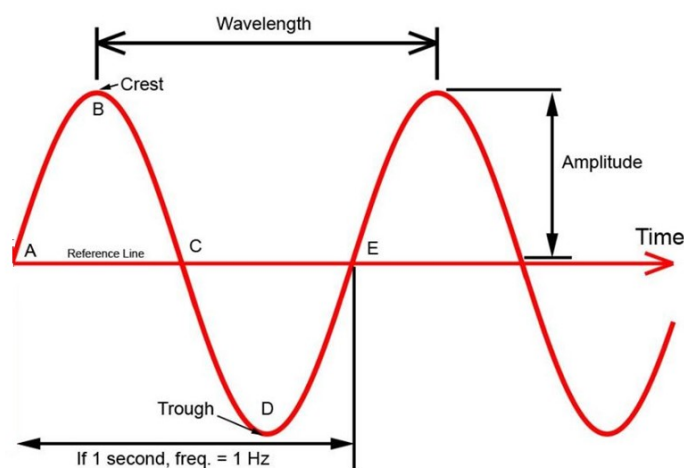


Sound is produced by the vibration of a body. Sound travels from the source to the ears in the form of waves of compression and rarefaction. As in the case of a tuning fork: When it is hit with a rubber hammer it begins to vibrate. The vibrating arm hits the air column adjacent to it. As the arm A, begins its vibration it hits the air molecules adjacent to it, which hits the next molecule and so on. This happens at a very high speed of 1220 km/ hr (320 m/sec). 1. Before the air pressure can adjust itself a compression front which has a large number of air molecules crowded together is formed. 2. As the compression moves forward the arm of the tuning fork moves in the opposite direction. The air column next to it which has fewer air molecule forms a front of rarefaction. The compression front moves back to its original position creating a vibration, while the disturbance continues to moves forward. One complete to and fro

motion of the (A) arm of the tuning fork creates one compression and rarefaction, which makes one longitudinal wave. In this wave the particle vibrate about their mean position and the disturbance is transmitted in the direction of propagation of sound. Though the air molecules vibrate back and forth the medium remains in its place and don't travel with the sound. This disturbance reaches the ears vibrate the eardrums and produce the sensation of sound.

2. **Amplitude:** Amplitude is the maximum displacement of a vibrating particle from its equilibrium position. It represents the loudness of a sound. A sound with a larger amplitude is louder than a sound with a smaller amplitude.

Frequency: Frequency is the number of oscillations per second. It represents the pitch of a sound. A sound with a higher frequency has a higher pitch than a sound with a lower frequency.

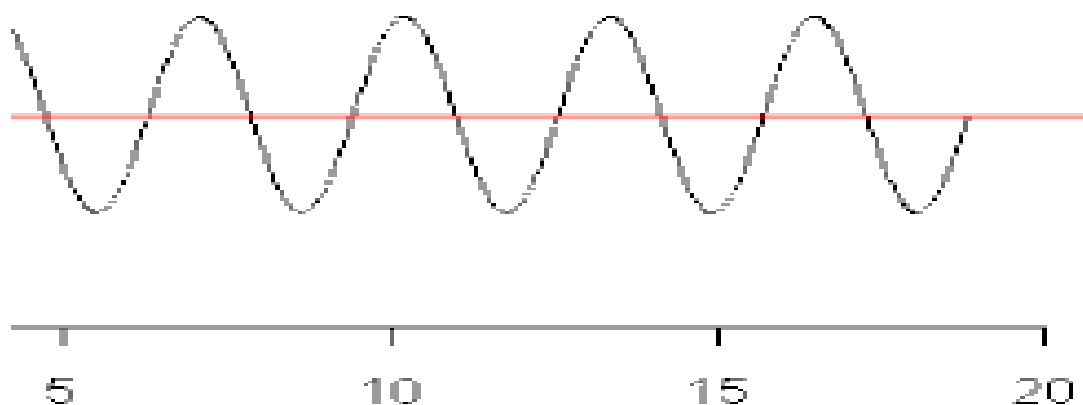


3.

Feature	Music	Noise
Definition	A pleasant or agreeable sequence of sounds	Unwanted or unpleasant sounds
Order	A musical note is produced by regular vibrations of an instrument or vocal chords.	A noise is produced by irregular vibrations of an instrument or vocal chords.
Purpose	To create an aesthetically	To convey information or

	pleasing experience	simply be present
Emotional impact	Can evoke a range of emotions, such as joy, sadness, or excitement	Generally considered to be unpleasant or distracting

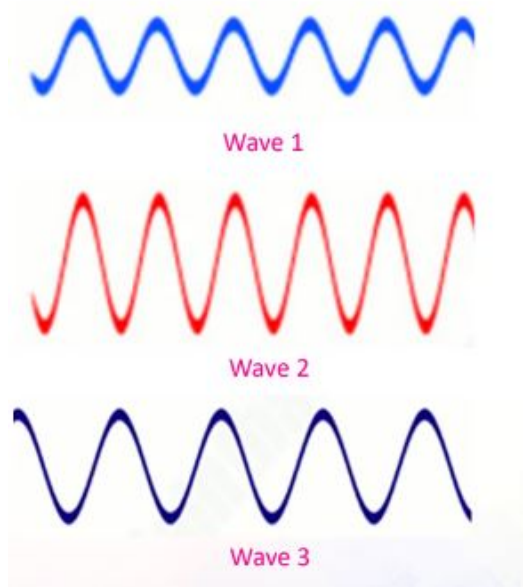
4. When two sound waves of equal amplitude and opposite phase meet, they can produce a phenomenon called destructive interference, which results in a complete cancellation of sound. This is because the crest of one wave coincide with the troughs of the other wave, effectively canceling each other out.
5. Pitch is a subjective perception of frequency. It is the perceived highness or lowness of a sound. Frequency, on the other hand, is an objective measure of the number of oscillations per unit time. The higher the frequency of a sound, the higher its pitch. Conversely, the lower the frequency of a sound, the lower its pitch.
6. A shrill and loud sound can be represented by a wave with a high frequency and a large amplitude. This indicates that the sound has a high pitch and is also very loud.



7. Changes in amplitude, frequency, and the choice of instrument can significantly impact the quality of music.
 - **Amplitude:** Changes in amplitude affect the loudness of the sound.
 - **Frequency:** Changes in frequency affect the pitch of the sound. Melodies and harmonies are created by varying the pitch of the notes, while rhythm is created by varying the timing of the notes.
 - **Instrument:** The choice of instrument affects the timbre of the sound, which is its unique quality that distinguishes it from other instruments.

8. The frequency of a sound produced by a string instrument is primarily determined by three factors:
- **Length of the string:** The shorter the string, the higher the frequency. This is because a shorter string vibrates more rapidly than a longer string.
 - **Tension of the string:** The tighter the string, the higher the frequency.
 - **Thickness of the string :** Thicker strings produce lower frequencies than thinner strings.
 - Where the string is plucked – When plucked closer to one fixed end, sound of higher pitch is obtained.

9.



Two sound waves with the same frequency but different amplitudes will have the same pitch, but different loudness. The sound wave with the larger amplitude will be four times louder than the sound wave with the smaller amplitude. The frequency of both sounds is the same, as indicated by the equal spacing of their peaks and troughs.

10. Loudness and sound intensity are two terms that are often used interchangeably, but there is a subtle difference between the two. Loudness is a subjective measure of the strength of a sound as perceived by the human ear. It is determined by the amplitude of the sound wave, which is the displacement of the particles in the medium from their equilibrium positions. The larger the amplitude, the louder the sound. Sound intensity, on the other hand, is an objective measure of the amount of sound energy per unit area per

unit time. Loudness of sound is measured in decibels (dB). This is a measure of intensity, which relates to how much energy the pressure wave has. Decibels are a relative measurement. Loudness of the sound increases by square of the amplitude of the vibration.

H. Application based questions

1. Light rays are electromagnetic in nature whereas sound waves are mechanical waves, and they travel through matter by causing the particles in the medium to vibrate leading to its transmission. That is why transmission of sound needs a medium whereas transmission of light does not need a medium.
2. A monotone refers to a sound or a musical note that has a constant pitch, meaning it has only one frequency. Monotones are often perceived as dull or lacking in variation. Monotones can be heard in various contexts, such as in a monotonous speech or religious recitations.
3. There are several differences between music performances in an auditorium and in open air. These differences are due to the different acoustic properties of the two environments. In an auditorium, the sound is reflected off the walls, ceiling, and floor, which can create a more immersive and intense sound experience. The auditorium also has the potential to amplify the sound, making it louder for the audience.

Image based questions

1. The loudness of both the sound will be the same. The pitch of first sound is high and that of second sound is low.
2. The sound (A) is a musical sound while sound (B) is most likely noise.

Experiential learning questions

1. d) Sound waves are made of alternate compressions and rarefaction.
2. When sound waves reach our ears, they compress and decompress the air in our ear canals. This causes our eardrums to vibrate. The vibrations of our eardrums are then transmitted to our inner ears, where they are converted into electrical signals that our brains can interpret as sound.

VALUES AND LIFE SKILLS

1. Music easily converts to noise if it is played very loudly. Particularly during festivals in the name of celebrations very loud music is played which is annoying to many people particularly elders. Thus music for one becomes noise for others. We should be considerate for others and play music at moderate loudness.

- Ototoxic drugs are drugs that can damage the auditory system and lead to hearing loss. Some common ototoxic drugs include certain antibiotics, painkillers, and diuretics. Some people may take these drugs without a medical prescription, which can increase their risk of hearing loss. The chemist shops should not be allowed to sell such drugs without prescription of registered doctors.

Chapter-8 Electricity

Quiz Zone (Page 133)

- True
- False. The earthing is connected to the green wire and it is connected to the thickest pin usually at the top.
- False. Our electricity bills come in the units of kilowatt-hours (kWh). A kilowatt-hour is a unit of energy equal to one kilowatt of power used for one hour.
- False. The power line is connected first to the electric meter and then the main switch and then the fuse on the main distribution switch board.

5. True

A. MCQs

- b) Positive terminal to negative terminal
- b) Conductors have free electrons; insulators have very few free electrons.
- c) Kilowatt-hours
- d) Live wire
- c) Live wire
- b) Movement of electrons from the fur to the rod.
- a) Insulators
- c) It will conduct any charge that develops.
- b) Same charge develops at the far end of the conductor to be charged.
- b) Positively charged

B. State True or False and correct the false statements giving reasons.

- False. A fuse wire must have high resistance and a low melting point. This is because the fuse wire is designed to melt when the current flowing through it exceeds a certain safe level.
- True
- True
- False. A thicker fuse wire will allow more current to flow through it before it melts. This means that it will not protect the circuit from damage as effectively as a thinner fuse wire.
- True

6. False. An atom is neutral because the number of protons in its nucleus is equal to the number of electrons in its electron cloud. Neutrons have no charge, so they do not affect the overall charge of the atom.
7. False. When an ebonite rod is rubbed with fur, electrons move from the fur to the rod. This gives the rod a negative charge, and the fur a positive charge.
8. True
9. True
10. False. The sharp points of a lightning conductor are made of metal, typically copper. The sharp points help to ionize the air around the conductor, which makes it easier for the lightning to strike the conductor.

C. Fill in the blanks

1. live
2. earth
3. earth
4. poor insulation on wires
5. higher
6. attract
7. six
8. divergence
9. to protect it from air currents and allow visibility
10. highest point

D. Match the column

1. House wiring – (d) Parallel connection
2. MCB - (e) Connected in series
3. Charging done by conduction - (b) Can be done on a conductor
4. Charging done by induction - (g) Same charge at the far end
5. Lower end of the clouds - (a) Usually negative charge

E. Short answer type questions

1. One benefit of a smart meter is that it enables real-time monitoring and analysis of energy consumption. Users can track their energy usage patterns, identify energy-hungry appliances, and make informed decisions to optimize energy efficiency.
2. An MCB (miniature circuit breaker) is a device that is used to protect electrical circuits from overload. If your MCB has tripped, it means that the circuit has been overloaded and the MCB has cut off the power to the circuit. To reset the MCB, you should first turn off any appliances that were on the circuit when the MCB tripped. Then, you should press the button on

the MCB to reset it. If the MCB trips again, you should investigate the cause of the overload and take steps to correct it.

3. The monthly consumption of electrical energy of an appliance of 150 watts running for eight hours a day in June can be calculated as follows:

Consumption = Power × Time

Consumption = 150 watts × 8 hours/day × 30 days/month

Consumption = 36,000 watt-hours/month

Consumption = 36.0 kilowatt-hours/month

Therefore, the monthly consumption of electrical energy of an appliance of 150 watts running for eight hours a day in June is 36.0 kilowatt-hours.

4. A short circuit is an electrical fault that occurs when the live wire and the neutral wire come into contact with each other. This can cause a dangerous amount of current to flow through the circuit, which can damage the electrical wiring and appliances and even start a fire.
5. Earthing of an electrical appliance involves connecting the metal casing or outer covering of the appliance to the ground (earth) to prevent electric shocks. This is typically done by connecting a wire from metal body of the appliance to a grounding rod or a grounding point in the electrical wiring system.
6. **Two Types of Electroscopes:**
 - Gold-leaf electroscope
 - Pith ball electroscope
7. Repulsion is considered the sure test of charge on a body because only charged objects exhibit repulsion. Like charges (positive with positive or negative with negative) repel each other, while opposite charges attract, but there is attraction between a charged body and an uncharged body as well. If an object shows repulsion, it confirms the presence of charge.
8. Free electrons are electrons in a conductor that are not bound to any particular atom. These electrons are free to move around the conductor, which is why conductors are able to conduct electricity.
9. Dust accumulates on fans quickly because continuous air flow over the blades generate some electrical charge which attracts dust particles on it.
10. Avoid using electrical appliances and unplug them to prevent damage from lightning strikes. Stay indoors and avoid open fields, high ground, or isolated trees to reduce the risk of being struck by lightning.

F. Long answer type questions

1. A fuse is a safety device that is used to protect electrical circuits from excess current supply. This can damage the appliances and even cause a fire

hazard. The fuse wire is designed to melt when the current through it exceeds a certain safe level. This breaks the circuit and stops the flow of current, preventing the wires from overheating and melting.

2. The standard color coding of electric wires is as follows: Live wire: Red or brown Neutral wire: Black or blue Earth wire: Green or yellow
This color coding benefits us by providing a visual indication of the function of each wire, making it easier for electricians and individuals to identify and work with the wires safely. It helps prevent mistakes in wiring that could lead to electrical hazards.
3. Three precautions that we must observe while operating an electrical appliance are:
 - Always check the appliance for any damage before using it.
 - Never use an appliance with wet hands or feet.
 - Never unplug an appliance by pulling on the cord.
4. An ideal fuse wire should have the following characteristics:
 - Fuse wires are small pieces of wires of high resistance and low melting point. An alloy of lead and tin that is commonly used melts at about 200°C .
 - Fuse wires are always connected in series in the live wire. The resistance of the fuse wire has to be higher than the copper wire used in house wiring and the melting point should be lower than that of copper.
 - When the current rating is more a thicker fuse wire is used. For example on the 15 A, line thicker fuse wire is used than on the 5 A, line.
5. Conservation of charge is the principle that states that electric charge can neither be created nor destroyed, only transferred from one object to another. For example, if you rub a balloon against your hair, the balloon will become negatively charged and your hair will become positively charged. This is because electrons have been transferred from your hair to the balloon. The total amount of charge in the system (balloon + hair) has not changed, it has only been redistributed.
6. Charging by conduction-
 - It requires direct contact between charged body and uncharged conductors.
 - In charging by conduction the charge is shared by flow of electrons. Conduction happens till the charges become equal. Hence there is a reduction in amount of charge.
 - The nature of charge developed on the uncharged body is of the same type.
 - On removing the charged body the newly charged body retains the same charge.

Charging by Induction-

- The charged object is brought close to the uncharged body but contact is not made.
- In induction there is no electron flow hence there is no sharing of charges. Hence charge does not diminish.
- The nature of charge developed in the near end of the uncharged body is of opposite kind. At the far end same type of charge develops.
- On removing the charged body the induction stops and the uncharged body loses the charge.

7. An electroscope is a device used to detect and measure electric charge. To check the nature of charge of a charged body using an electroscope, we should first charge the electroscope with a known charge. Let us assume that the electroscope is positively charged.

- Bring the charged body near the knob of the electroscope.
- If the gold leaf diverge further that means the body is positively charged.
- If the gold leaves collapse the body could be uncharged or negatively charged.

The experiment needs to be repeated with a negatively charged electroscope. In such case a further divergence of the gold leaf will indicate that the body is negatively charged (and it is not neutral). This follows the rule that repulsion is the sure test of a charge.

8. A lightning conductor is a device that is used to protect tall buildings from lightning strikes. When a thunder cloud with a huge amount of negative charge passes over a tall building it causes induction on the conducting material of the lightning conductor. It induces positive charge on the pointed metal spikes and a negative charge on the plate that is earthed. This negative charge is immediately dissipated into the Earth. "Point action" also occurs at the spikes leading to attraction of negative ions, which too are discharged to the ground. Thus an electrical discharge is prevented. When there is no lightning conductor the lightning can strike the highest point of the building and the current passes to the ground through the available path of least resistance. The heat generated suddenly expands the building material and cracks it badly. If there is carbon (as in case of fireplace chimneys in olden days) it easily catches fire.

9. Importance of Circuit Breaker and Earthing in House Wiring:

- Circuit Breaker: It protects the wiring and appliances by automatically breaking the circuit in case of a short circuit or overload, preventing overheating and potential fire hazards.
 - Earthing: It provides a path for leaked current on the metal body of the appliances currents to safely dissipate into the ground, reducing the risk of electric shocks and ensuring the safety of individuals and equipment.
10. When we rub a plastic comb on your hair, electrons are transferred from the hair to the comb. This gives the comb a negative charge, and the hair a positive charge. This is because plastic is an insulator, which means that it does not allow electrons to flow freely. When the electrons are transferred from the hair to the comb, they stay there. A metal comb, on the other hand, is a conductor, which means that it allows electrons to flow freely. When we rub a metal comb on your hair, the electrons that are transferred from the hair to the comb are quickly conducted through the hand. Hence no charge is retained.

G. Application based questions

1. The repeated burning of a fuse wire may indicate that the circuit is experiencing excessive current, possibly due to a short circuit or overload. Simply replacing the fuse with a thicker copper wire is not a recommended solution. The fuse is designed to have a specific current-carrying capacity, and using a thicker wire could compromise its protective function. It's crucial to identify and rectify the underlying issue causing the excessive current, such as a faulty appliance or wiring, before replacing the fuse. Using a fuse with the correct rating is essential to ensure proper protection against fire hazards.
2. The handles of umbrellas are made of non-conducting materials to ensure safety during rainy or stormy weather. If the handles were made of conducting materials, such as metal, there would be a risk of lightning striking the umbrella and conducting the electrical charge to the person holding it. By using non-conducting materials for the handles, the umbrella does not provide a path for the electrical current to reach the person, reducing the risk of injury from a lightning strike.

Image based questions

The balloons that are touching must have opposite charges. The balloons that are repulsing must have the same charge.

Experiential learning questions

1. c) Neutron

2. An electrically neutral body can attain charge only in two conditions:
 - a) When the electrons move out of the body giving it a net positive charge.
 - b) When electrons move into a body giving it a net negative charge.

When two bodies are rubbed together, electrons can be transferred from one body to the other. This is because the atoms in the two bodies are very close together, and the electrons can "jump" from one atom to another. If one body loses more electrons than it gains, it will have a positive charge. If the other body gains more electrons than it loses, it will have a negative charge. This is the basic principle of static electricity.

VALUES AND LIFE SKILLS

1. First Aid for Electric Shock Victim:
 - Ensure your safety first by switching off the power source or using a non-conductive object to move the victim away from the electrical source.
 - Call for emergency help immediately.
 - Check the victim's breathing and pulse; start CPR if necessary.
 - If the victim is not breathing and there is no pulse, begin chest compressions until medical help arrives.
2. **Precautions During Thunderstorm:**
 - Seek shelter immediately in a sturdy building or a car.
 - Avoid open fields, high ground, isolated trees, and bodies of water.
 - Stay away from metal objects like fences, umbrellas, and bicycles.
 - Do not use electronic devices or appliances.

Multi-disciplinary questions

1. The heart is a muscular pump that circulates blood throughout the body. It has its own electrical system that coordinates the contractions of the four chambers of the heart. The heart's electrical system consists of specialized cells called pacemaker cells and conduction cells. The pacemaker cells generate electrical impulses that travel through the conduction cells to the heart muscles. These electrical impulses cause the heart muscles to contract in a coordinated sequence, which pumps blood out of the heart.
2. Cotton is a preferred fabric all over the world since ancient times due to its composition of cellulose, which is a poor conductor of electricity. When cotton is rubbed against another material, there is very little transfer of electrons, because there is always some moisture in the cellulose that conducts away the charge. Hence generally rubbing a glass rod on cotton does not produce any charge.

Test Paper–1 (Chap 1 and 2)

A. MCQs

1. a) Liquid
2. b) By the process of evaporation
3. c) The volume of the substance decreases
4. c) The mass of the substance with lower density will be more
5. d) None of the above
6. c) Same for both the cubes

B. Match the column

1. Freezing (d) KE decreases and molecular arrangement becomes regular
2. Deposition (c) KE and space between molecules decreases
3. Melting (a) KE and space between molecules increases
4. Condensation (e) KE decrease and volume becomes fixed
5. Sublimation (f) KE increases much more and molecules vibrate randomly
6. Evaporation (b) KE increases and it occupies available volume

C. Answer the following in one word or one sentence

1. Deposition is the process of a gas changing directly into a solid without passing through the liquid phase.
2. Yes they apply to gases also. That is how a Helium balloon rises in air.
3. Ice floats in water because it is less dense than liquid water. The density of ice is 0.917 g/cm^3 , while the density of liquid water is 1 g/cm^3 .
4. The S.I. unit of density is kilogram per cubic meter (kg/m^3).

D. Give reasons for the following

1. Liquids expand more than solids on heating because the molecules in liquids are less tightly packed and the intermolecular attraction is weak. When a liquid is heated, the molecules gain energy and move faster. This causes the molecules to spread out and the volume of the liquid to increase. In solids, the molecules are held in place by strong intermolecular forces. When a solid is heated, the molecules vibrate more, but they do not move as far apart.
2. Yes substance with a high average kinetic energy must also have a high temperature.

3. When a liquid is cooled, the molecules lose energy and move slower. This causes the molecules to move closer together and the volume of the liquid to decrease.

4. Seawater is more dense than freshwater. Thus seawater produces more buoyant force for the same volume of displaced water. Therefore, it is easier to swim in the sea than in freshwater.

E. Answer the following in short

1. The force of cohesion is the force of attraction that holds molecules of the same substance together.

2. A sponge is a solid because it has a definite shape and volume. However, we are able to compress it and reduce its volume because it has numerous air pockets.

3. A density bottle is a laboratory instrument used to measure the density of liquids. It is a small, calibrated bottle with a stopper that has a narrow opening.

4. Yes, the apparent weight of a body in water will be less than its weight in air. This is because water exerts a buoyant force on the body. Buoyant force is the upward force that a fluid exerts on an object that is immersed in it. The buoyant force is equal to the weight of the fluid displaced by the object.

F. Answer the following in detail

1. Evaporation is the process by which a liquid changes into a gas.

- Evaporation is faster when the temperature of the liquid is high (kinetic energy of the molecules is high).
- Exposed area of the liquid is large. When spilled water on the floor is spread thinly it dries up fast.
- Liquids with low boiling points such as alcohol, ether, gasoline etc. evaporate very fast.
- Removal of air saturated with molecules of the liquid above its surface. When we blow air over hot soup it cools faster.
- Level of humidity (for evaporation of water). Our clothes dry faster in winter because of low humidity even though the temperature is lesser than in rainy season. In the latter case the temperature is high but humidity is high too.

2. Wiping the skin with alcohol before giving an injection serves several purposes: When alcohol is rubbed to disinfect the skin there is an immediate cooling effect. It happens because as the alcohol converts to vapour (evaporates from the skin surface) it needs heat which is acquired from the skin. Alcohol kills the germs in the area by dehydrating the germs and the area thus creating an antiseptic skin for injection.
3. We know that the atoms/molecules in liquids are loosely packed and have kinetic energy. On cooling the kinetic energy of the molecules decrease and they come closer leading to increased intermolecular attraction. With more cooling the molecules arrange in patterns giving it a fixed shape. When the change from liquid to solid state happens the molecules have a smaller range of movement.
4. Buoyancy is the upward force exerted by a fluid on an object immersed in it. The magnitude of the buoyant force is equal to the weight of the fluid displaced by the object. The buoyant force on an object in a fluid depends on the density of the fluid. Mercury is denser than water, so the buoyant force it exerts on an object is greater than the buoyant force exerted by water. This is why an iron ball will float in mercury but sink in water.

Test Paper–2 (Chap 3 and 4)

A. MCQs

1. c) Far away from the pivot
2. c) Atmospheric pressure on our head depends on the column of air above it.
3. a) Density and height of the liquid column above the point of measurement
4. b) Work is not done because there is no net displacement
5. d) Will become four times
6. c) Potential energy

B. Answer the following in one word or one sentence

1. Newton meter (N·m)
2. Pressure is force per unit area, while thrust is force acting perpendicularly on a surface.
3. Potential energy
4. 746 watts
5. The ability to do work.

C. Give reasons for the following:

1. Because it provides a greater torque, which is the force applied to an object to cause it to rotate. The torque is equal to the force applied multiplied by the length of the lever arm. In this case, the length of the lever arm is the length of the spanner handle.
2. Because your weight is distributed over a smaller area. When you are standing, your feet are the only points of contact with the floor, so the pressure is concentrated on a small area. When you are lying down, your weight is distributed over your entire body, so the pressure is spread out over a larger area.
3. Because the pressure is caused by the weight of the liquid above the point of measurement. The weight of the liquid is a force that acts vertically downward, so the pressure is also exerted vertically downward. However, the pressure is also exerted in all other directions because the liquid molecules are constantly moving in all directions. As a result, the pressure is exerted equally in all directions.
4. To distribute the application of force over a large area. This force is transmitted on a sharp end leading to high pressure so the pin penetrates the paper easily.
5. Because potential energy is the energy stored in an object due to its position or configuration. The greater the mass of an object, the more potential energy it has. The higher an object is, the more potential energy it has.
6. Because kinetic energy is the energy of motion. That is why when a potential energy is put to use and motion is involved it changes to kinetic energy. For example an object falls, its potential energy is converted into kinetic energy.

D. Answer the following in short

1. When the area of a surface increases, the pressure exerted on the surface decreases. This is because the force is distributed over a larger area, so the pressure is less concentrated.
2. Deep sea divers wear special suits called wetsuits or drysuits to protect themselves from the extreme pressure and cold temperatures of the deep sea.
3. As a child slides down a slider, their potential energy is converted into kinetic energy. Potential energy is the energy stored in an object due to its position or configuration. In this case, the child's potential energy is due to their height above the ground. As they slide down the slider, their potential

energy decreases and their kinetic energy increases. Kinetic energy is the energy of motion.

4. The potential energy of an object is given by the formula $PE = mgh$, where PE is potential energy, m is mass, g is the acceleration due to gravity, and h is height. In this case, $m = 4 \text{ kg}$, $g = 10 \text{ m/s}^2$, and $h = 100 \text{ m}$. Therefore, the potential energy of the rock is $PE = 4 \text{ kg} * 10 \text{ m/s}^2 * 100 \text{ m} = 4000 \text{ J}$.
5. When energy is transformed from one form to another, some of the energy is always lost as heat. This is because no process is 100% efficient. For example, when a light bulb converts electrical energy into light energy, some of the electrical energy is lost as heat.

E. Answer the following in detail:

1. To prove that there is atmospheric pressure around us, we can perform a simple experiment using a glass and a piece of paper.
Fill the glass with water and place a piece of paper over the top of the glass, ensuring it is completely covering the opening.
Carefully turn the glass upside down, ensuring the paper remains in place. Observe that the water does not fall out of the glass. This is because the atmospheric pressure pushing up on the paper is greater than the weight of the water in the glass.
This experiment demonstrates the existence of atmospheric pressure, which is the force exerted by the Earth's atmosphere on all objects within it.
2. Depth: Pressure increases with depth in a fluid.
Density: Pressure is directly proportional to the density of the liquid.
3. Kinetic energy is the energy of motion. It depends on two main factors: mass and velocity. Mass is the amount of matter in an object. The more mass an object has, the more kinetic energy it has when it is moving. Velocity is the speed of an object in a particular direction. The faster an object is moving, the more kinetic energy it has. When mass is doubled kinetic energy is doubled. When velocity doubles kinetic energy quadruples.
4. Holding a heavy grocery bag in a moving train does not qualify as work because work is done when a force is applied to an object in the direction of the displacement. In this case, the force of gravity is pulling the grocery bag down, but the train is moving forward. The displacement of the grocery bag is in the direction of the train's motion, which is perpendicular to the force applied to hold the bag against gravity.
5. Pulling the door at point A or at point B entails the same amount of work done because work is done when a force is applied to an object in the

direction of the displacement. In this case, the force applied to the door is more at A, but the distance moved is less. Whereas the force applied at B, will be less but the distance moved will be more.

Test Paper–3 (Chap 5 and 6)

A. MCQs

1. c) Speed of the different components of light have different speed in glass.
2. c) Its optical density must be high.
3. b) As a rear-view mirror in a car
4. c) Liquid is more volatile
5. b) At high altitudes
6. d) Thermal expansion in solids is less than gases but more than liquids.

B. Answer the following in one word or one sentence

- a. 1.5
- b. Normal ray
- c. Ray passing through the centre of curvature
- d. Gas
- e. No

C. Give reasons for the following:

- a. Stars twinkle at night because the light from them behaves like a point source and passes the Earth's atmosphere, which is constantly in motion. This causes the light to be refracted, or bent, in different directions. As a result, the image of the star appears to shift and twinkle.
- b. The speed of light is reduced in passing through a glass slab because the glass molecules slow down the light waves. This is because the glass has a high optical density.
- c. Red signals are visible from a longer distance because red light has a longer wavelength than other colors of light. Red light refracts less from its path. It is also because 50% of the cones in the retina of our eyes are sensitive to red colour.
- d. The temperature of a liquid remains constant during boiling because the heat energy is being used to overcome the intermolecular forces between the molecules of the liquid and turn them into gas molecules. The energy required to do this is called the heat of vaporization.
- e. Pressure cookers speed up cooking because they trap steam inside the pot, which increases the pressure. The increased pressure raises the boiling point of the water, so the food cooks faster.

D. Answer the following in short

- a. The focal length of a spherical mirror is given by $f=R/2$, where R is the radius of curvature of the mirror.
- b. A mirage is an optical illusion that occurs when light waves are bent as they pass through layers of air with different densities. This can happen when the temperature of the air is not uniform, causing the density of the air to vary.
- c. Concave and convex mirrors can be differentiated by their shape. Concave mirrors are curved inwards, like a bowl, while convex mirrors are curved outwards, like a dome. Concave mirrors converge light, while convex mirrors diverge light. This means that concave mirrors mostly form real images, while convex mirrors only form virtual images.
- d. The coefficient of linear expansion is a measure of how much a solid expands when its temperature is increased. It is defined as the rate of change of unit length per unit degree change in temperature. The coefficient of linear expansion is different for different materials.
- e. Evaporation and boiling are both processes in which a liquid changes into a gas. However, there are two main differences between the two processes:
 - **Temperature:** Evaporation can occur at any temperature, while boiling can only occur at the boiling point of the liquid.
 - **Rate of evaporation:** Evaporation is a slow process, while boiling is a rapid process.
- f. A bi-metallic strip is a composite material made of two different metals bonded together. When the temperature of the bi-metallic strip is changed, the two metals expand at different rates, causing the strip to bend. This bending can be used to make a variety of devices, such as thermostat switches that are used in various devices.

E. Answer the following in detail

- a. The refractive index of a medium is a measure of how much that medium bends light. It is defined as the ratio of the speed of light in a vacuum to the speed of light in the medium.

The speed of light in a vacuum is a constant, so we can use it to calculate the refractive index of any medium. To calculate the refractive index of a medium, we can use the following formula: $n = c / v$
- b. There are two main differences between an image formed by a plane mirror. Image formed by a concave mirror will be diminished and inverted and real. The image formed by a plane mirror will be erect, of the same

size and formed at the same distance behind the mirror (as the object is from the mirror).

- c. The kinetic theory of matter explains that all matter is made up of tiny particles called atoms or molecules. Temperature of a body is a measure of the average kinetic energy possessed by the particles in the body. The collision of particles lead to bouncing of particles to the surface and it may escape into atmosphere. The particles on the surface can also gather energy from sunlight and create an imbalance of kinetic energy amongst the particles. At any time in a liquid there would be many particles with higher kinetic energy than the average which balance out, those with lower kinetic energy than the average. Thus in a liquid whose temperature is not high enough for boiling, there will be some particles with enough energy to break away from the surface of the liquid overcoming the pull of other molecules or atoms. This slow (but steady) escape of the liquid as gas particles from the surface is the cause of evaporation.
- d. Substances expand on heating because the kinetic energy of their molecules increases. As the molecules move faster, they overcome the forces of intermolecular attraction. This causes the molecules to move farther apart, which increases the volume of the substance. The amount of expansion that occurs depends on the coefficient of thermal expansion of the substance. Different substances have different coefficients of thermal expansion, so they will not all expand by the same amount for the same rise in temperature. Gases have the highest coefficients of thermal expansion, followed by liquids, and then solids.

Test Paper–4 (Chap 7 and 8)

A. MCQs

1. b) Air particles transmit the disturbance in the form of a wave.
2. a) More than that of an adult male
3. b) The thick string will be plucked
4. b) Conductors have free electrons; insulators have very few free electrons
5. b) Movement of electrons from the fur to the rod
6. b) Same charge develops at the far end of the conductor to be charged.

B. Answer the following in one word or one sentence

1. The unit of frequency is Hertz (Hz).
2. The unit of loudness is decibel (dB).
3. Lightning discharge is caused by the sudden buildup of opposite charge in the clouds and their coming close together.

4. The resistance of the fuse wire should be higher than the wires used in the house.
5. The monthly consumption of electrical energy of an appliance of 150 watt running for eight hours a day is 36000 watt-hours.

C. Give reasons for the following

1. Longitudinal waves travel as fronts of compression and rarefaction. They travel in the same direction as the propagation of sound. However, even though the air molecules vibrate back and forth the medium remains in its place and don't travel with the sound.
2. The loudness of a sound is determined by the amplitude of the sound wave. The amplitude of a sound wave is the maximum displacement of the particles in the medium from their equilibrium position. Closeness to the source of sound makes the sound louder as the sound waves are more intense.
3. The pitch of a sound is determined by the frequency of the sound wave. The frequency of a sound wave is the number of times that the particles in the medium vibrate in one second. The smaller the air column in a wind instrument, the faster the particles will vibrate, and the higher the pitch of the sound will be.
4. The neutral wire in a live circuit can give an electric shock because it is the return path of the current.
5. Dust accumulates on fans so quickly because the fans create a static charge that attracts dust particles. The static charge is created by the friction between the fan blades and the air.

D. Answer the following in short

1. Longitudinal waves are mechanical waves in which the particles of the medium vibrate in the same direction as the direction of wave propagation.
2. As the water level in the container increases, the pitch of the sound produced by the dripping water decreases. This is because the air column in the container is becoming shorter, which lowers the frequency of the sound wave.
3. Short-circuiting is the unintentional connection of two points in an electrical circuit that are normally at different electrical potentials.
4. Earthing of an electrical appliance is the process of connecting the metal casing of the appliance to a ground rod.

E. Answer the following in detail

1. The frequency of a sound produced by a vibrating string is determined by several factors, including:

- **Length of the string:** The shorter the string, the higher the frequency.
 - **Tension of the string:** The tighter the string, the higher the frequency.
 - **Thickness of the string:** The thicker the string, the lower the frequency.
2. The distinction between music and noise is subjective and can vary depending on individual preferences. However, there are some general characteristics that can help to distinguish between the two.
 - Music is typically organized and has a recognizable structure. It often uses patterns and repetition to create a sense of coherence and flow.
 - Noise, on the other hand, is typically random and chaotic. It lacks a recognizable structure and can be jarring or unpleasant to listen to.
 3. Charging by conduction and charging by induction are two methods of transferring electrical charge.
 - Charging by conduction occurs when there is direct contact between a charged object and another object. The charged object transfers some of its electrons to the other object, giving it a net charge.
 - Charging by induction occurs when a charged object is brought near an uncharged object. The electric field of the charged object polarizes the atoms in the uncharged object, causing them to develop a temporary charge. It develops opposite charge at the near end and same charge at the far end. This temporary charge can then be transferred to another object by conduction.
 4. A lightning conductor is a metal rod that is connected to the ground and runs along the outside of a building. It is designed to provide a safe path for the electrical current of a lightning strike to travel to the ground. When a thunder cloud with a huge amount of negative charge passes over a tall building it causes induction on the conducting material of the lightning conductor. It induces positive charge on the pointed metal spikes and a negative charge on the plate that is earthed. This negative charge is immediately dissipated into the Earth. "Point action" also occurs at the spikes leading to attraction of negative ions, which too are discharged to the ground. Thus a lightning strike avoided.