

Teacher's Hand Book 7th Physics

EXERCISE - 1

I. Choose the correct answer:

- Kinematics is the study of Science related to _____. **Ans:** (a) Motion
- If an object is changing its position, then it is in _____. **Ans:** (b) Motion
- The motion exhibited by objects moving with constant speed is called _____. **Ans:** (c) Uniform motion
- The motion exhibited by objects moving with varying speed is called _____. **Ans:** (b) Non-uniform motion
- Displacement is a _____. **Ans:** (b) Vector
- The speed of an object is _____. **Ans:** (a) Distance moved / time
- The SI unit of velocity is _____. **Ans:** (a) Meter/sec
- The SI unit of displacement is _____. **Ans:** (a) Meter
- The SI unit of Distance is _____. **Ans:** (b) Meter
- The average speed of an object is _____. **Ans:** (a) Total distance covered / total time taken

II. Say True or False:

- Distance and displacement are the same. **Ans:** False
- Speed is a Vector. **Ans:** False
- Velocity is a scalar. **Ans:** False
- The velocity of an object can be zero. **Ans:** True
- When a vehicle moves with respect to a static electric pole, it is called at rest. **Ans:** False

III. Concept Questions:

1. What is uniform motion?

Ans: Motion where an object covers equal distances in equal intervals of time (constant speed) is called uniform motion.

Example: A car moving at a constant speed of 60 km/h on a straight road.

2. What is rest?

Ans: An object is said to be at rest if it does not change its position with respect to its surroundings over time.

Example: A book lying on a table is at rest.

3. How can you find the average velocity?

Ans: Average velocity = Total displacement / Total time taken

4. Write the difference between speed and velocity.

Ans:

Speed	Velocity
It is the rate of motion without direction.	It is the rate of motion with direction.
It is a scalar quantity.	It is a vector quantity.
Speed = Distance / Time	Velocity = Displacement / Time

5. Write the difference between distance and displacement.

Ans:

Distance	Displacement
It is the total path covered by an object.	It is the shortest path between the initial and final position.
It is a scalar quantity.	It is a vector quantity.
It is always positive.	It can be positive, negative, or zero.

IV. Multi Correct Choice Type:

1. Which among these are examples of uniform motion?

Ans: (a) Movement of Earth

2. Which among these are correct about displacement?

Ans: (b) The minimum distance between two points is called displacement, (c) Displacement is a vector.

3. Which among these are correct about distance?

Ans: (a) Distance is a scalar, (c) Distance can be measured in meter.

4. Which among these are correct about speed?

Ans: (a) The SI unit of speed is m/sec, (b) Speed is a scalar.

5. Which among these are correct about rest?

Ans: (b) When an object does not change position, it is called rest, (c) A stationary object is at rest.

V. Reasoning Type Questions:

1. **Statement-1** : Velocity is a scalar.

Statement-2 : Velocity is not related to direction.

Ans: (e) Both statements are false (velocity is a vector and depends on direction).

2. **Statement-1** : Distance is a scalar.

Statement-2 : Distance is not related to direction.

Ans: (a) Both statements are correct, and Statement-2 explains Statement-1.

3. **Statement-1** : Object 'A' is changing its position; so object A is at rest.

Statement-2 : A thing is at rest if it is moving.

Ans: (e) Both statements are false (changing position implies motion).

4. **Statement-1** : Rate of change of velocity is displacement.

Statement-2 : Rate of change of displacement is velocity.

Ans: (d) Statement-1 is false (rate of velocity change is acceleration), Statement-2 is true.

5. **Statement-1** : Speed can be zero for a moving object.

Statement-2 : Speed cannot be zero for a moving object.

Ans: (c) Statement-1 is true (e.g., at turnaround point), Statement-2 is false.

Application Skill Achiever

1. A car moved 80 km to the South. What is its displacement?

Ans: 80 km South (Displacement includes both magnitude and direction.)

2. A car moved 60 km East and 90 km West. What is the distance?

Ans: Distance = 60 km + 90 km = 150 km

3. A car moved 60 km East and 90 km West. What is the displacement?

Ans: Displacement = Final position – Initial position
= 90 km – 60 km = 30 km West

4. What is the average velocity of a car that moved 60 km in 3 hours?

Ans: Average velocity = Total displacement / Total time
= 60 km / 3 hr = 20 km/h

5. What is the average velocity of a car that moved 40 km East and 80 km West in 2 hours?

Ans: Displacement = 80 – 40 = 40 km West
Average velocity = 40 km / 2 hr = 20 km/h West

6. How far will a car travel in 25 min at 12 m/s?

Ans: Convert 25 min to seconds: $25 \times 60 = 1500 \text{ s}$
Distance = speed $\times$ time = $12 \times 1500 = 18,000 \text{ m}$ or 18 km

7. How far will a car travel in 2 hours at 20 m/s?

Ans: 2 hours = $2 \times 3600 = 7200 \text{ seconds}$
Distance = $20 \times 7200 = 144,000 \text{ m}$ or 144 km

8. If car A is at 40 km/h and car B is at 10 km/h in the opposite direction, what is the velocity of car A relative to car B?

Ans: Relative velocity = $40 + 10 = 50 \text{ km/h}$

9. If you are walking at constant velocity of 8 km/h and a car passed you by at 30 km/h from behind, what is the car's velocity from your viewpoint?

Ans: Relative velocity = $30 - 8 = 22 \text{ km/h}$

10. If a car moves 12 km North, 19 km East, and 12 km South, what is its displacement?

Ans: Net North-South = $12 \text{ km North} - 12 \text{ km South} = 0$
Only East remains $\rightarrow$ Displacement = 19 km East

11. An object starts at 20 m/s and reduces to 10 m/s in 2 seconds. Find its acceleration and the distance travelled. How far further will it move before coming to a halt?

Ans: Acceleration = (Final – Initial velocity) / Time
 $= (10 - 20) / 2 = -5 \text{ m/s}^2$

Distance travelled in this time:

$$s = \frac{(u + v)}{2} \times t = \frac{(20 + 10)}{2} \times 2 = 15 \times 2 = 30 \text{ m}$$

Further distance before coming to halt:

$$v^2 = u^2 + 2as \Rightarrow 0 = 10^2 + 2(-5)s \\ \Rightarrow s = 100/10 = 10 \text{ m}$$

12. A ball is thrown upwards at 20 m/s. Find the time taken by it before reaching a height of 15 m. Assume $g = 10 \text{ m/s}^2$.

Ans: Use formula: $s = ut - \frac{1}{2}gt^2$
 $15 = 20t - 5t^2$
 $\Rightarrow 5t^2 - 20t + 15 = 0$
Divide by 5: $t^2 - 4t + 3 = 0$
Solve: $t = 1$ or 3 seconds

It reaches 15 m at 1 s while going up and 3 s while coming down

EXERCISE - 2

I. Choose the correct answer.

1. Velocity is the _____

Ans: (b) Speed of an object in a specific direction

2. When a moving bus suddenly stops _____

Ans: (b) The passengers in the bus tend to move forward

3. When a blanket is given a sudden jerk, the dust particles in it fall off due to _____

Ans: (b) Inertia at rest of the dust particles

4. Which among these is a fact related to inertia? _____

Ans: (b) An object at rest tends to stay at rest

5. An object in motion tends to move at constant speed in a straight line, is due to _____

Ans: (b) Inertia

6. A rider on a running horse is thrown forward when the horse stops suddenly due to _____

Ans: (a) Inertia of motion

7. Which among these is correct about balanced force?

Ans: (a) Balanced forces are considered to be in a state of equilibrium.

8. The momentum of a body is equal to _____

Ans: (a) Product of mass and velocity

9. The first law of Newton is referred as _____

Ans: (b) Law of Inertia

10. When a person jumps out of a moving vehicle, He _____

Ans: (c) Falls forward due to inertia of motion

II. Say True or False.

1. When an object is at rest or moving at a constant velocity, all the forces acting on it are balanced.

Ans: True

2. In the expression $P = M \times V$, P stands for momentum.

Ans: True

3. The dimensional formula of momentum is MLT^{-1} .

Ans: True

4. Unbalanced force causes change of motion (speed and direction).

Ans: True

5. The mass of an object is a quantitative value.

Ans: True

III. Concept Questions.

1. Write two events that appear due to inertia of rest.

- Ans:**
- o Dust falls off a carpet when beaten.
 - o A book stays in place when a tablecloth is pulled quickly.

2. What is inertia?

Ans: Inertia is the tendency of an object to resist changes in its state of motion or rest.

3. Write two events that appear due to inertia of motion.

- Ans:**
- o Passengers jerk forward when a bus stops suddenly.
 - o A moving ball continues rolling until friction stops it.

4. What is the output of balanced forces?

Ans: No change in motion (object remains at rest or moves at constant velocity).

5. What is the output of unbalanced forces?

Ans: Change in motion (acceleration, deceleration, or change in direction).

IV. Multi Correct Choice Type:

1. Which among these are correct about velocity?

Ans: (b) Velocity is a vector, (c) Velocity is the speed of an object in a specified direction

2. Which among these are correct about mass?

Ans: (a) Mass is measured in kg, (c) Mass is a physical property

3. Which among these are correct about inertia?

Ans: (a) Heavy objects have more inertia, (b) Lighter objects have less inertia, (c) Inertia is related to mass

4. An object at rest _____

Ans: (a) Remains at rest, (b) Tends to stay at rest

5. The momentum of an object is associated with its

Ans: (a) Mass, (c) Velocity

V. Reasoning Type Questions.

1. Statement-1 : When a moving bus stops, the passengers inside tend to move forward.

Statement-2 : Due to inertia, a moving object has a tendency to move in the same direction.

Ans: (a) Both statements are correct and statement-2 is the correct explanation of statement-1.

2. Statement-1 : Velocity is the displacement of an object.

Statement-2 : Inertia is related to its mass.

Ans: (b) Both statements are correct but statement-2 is not the correct explanation of statement-1.

3. Statement-1 : When a person jumps out of a moving vehicle, he falls forward due to inertia of motion.

Statement-2 : An object in motion tends to move in the same direction.

Ans: (a) Both statements are correct and statement-2 is the correct explanation of statement-1.

4. Statement-1 : Force needs to be applied to move a body at rest.

Statement-2 : Inertia of an object can be zero.

Ans: (c) Statement-1 is true & statement-2 is false. (Inertia depends on mass and cannot be zero.)

5. Statement-1 : When two forces are balanced, there is no change in direction.

Statement-2 : More than two forces can be applied to a body.

Ans: (b) Both statements are correct but statement-2 is not the correct explanation of statement-1.

Application Skill Achiever

1. What will be the momentum of a stone having mass of 10 kg when it is thrown with a velocity of 2 m/s?

Ans: Momentum = mass $\times$ velocity = 10 kg $\times$ 2 m/s = 20 kg·m/s

2. Calculate the momentum of a bullet of 25 g when it is fired from a gun with a velocity of 100 m/s.

Ans: Convert 25 g to kg = 0.025 kg

Momentum = 0.025 kg $\times$ 100 m/s = 2.5 kg·m/s

3. Calculate the momentum of a bullet having mass of 25 g thrown using hand with a velocity of 0.1 m/s.

Ans: Mass = 0.025 kg

Momentum = 0.025 kg $\times$ 0.1 m/s = 0.0025 kg·m/s

4. The mass of a goods lorry is 4000 kg and the mass of goods loaded on it is 20000 kg. If the lorry is moving with a velocity of 2 m/s, what will be its momentum?

Ans: Total mass = 4000 + 20000 = 24000 kg

Momentum = 24000 kg $\times$ 2 m/s = 48000 kg·m/s

5. A car having mass of 1000 kg is moving with a velocity of 0.5 m/s. What will be its momentum?

Ans: Momentum = $1000 \text{ kg} \times 0.5 \text{ m/s} = 500 \text{ kg}\cdot\text{m/s}$

6. A force of 10 N causes a displacement of 2 m in a body in its own direction. Calculate the work done by the force.

Ans: Work = Force $\times$ Displacement = $10 \text{ N} \times 2 \text{ m} = 20 \text{ Joules}$

7. A body of mass 2 kg is moving with a speed of 20 m/s. Find the kinetic energy.

Ans: K.E. = $\frac{1}{2} \times m \times v^2 = \frac{1}{2} \times 2 \times (20)^2 = 1 \times 400 = 400 \text{ Joules}$

8. A car of 800 kg is moving at a speed of 12 km/hr. A bike of 120 kg is moving at a speed of 90 km/hr. Find the difference in their momentum.

Ans: Convert speeds:

12 km/hr = 3.33 m/s, 90 km/hr = 25 m/s

Momentum of car = $800 \times 3.33 \approx 2664 \text{ kg}\cdot\text{m/s}$

Momentum of bike = $120 \times 25 = 3000 \text{ kg}\cdot\text{m/s}$

Difference = $3000 - 2664 = 336 \text{ kg}\cdot\text{m/s}$

9. A body of mass 14 kg is moving with a speed of 40 km/sec. What is its kinetic energy?

Ans: Convert speed: 40 km/sec = 40000 m/s

K.E. = $\frac{1}{2} \times 14 \times (40000)^2 = 7 \times 1.6 \times 10^9 = 11.2 \times 10^9 \text{ Joules}$

10. The momentum of a car is found to be 12000 kg·m/s. If its mass is 1000 kg, what is its speed?

Ans: Speed = Momentum / Mass = $12000 / 1000 = 12 \text{ m/s}$

EXERCISE - 3

I. Choose the correct answer.

1. The rate of change of momentum is _____.

Ans: (c) Directly proportional to force applied

2. When a force (unbalanced) is applied _____.

Ans: (a) The object moves along the direction of applied force

3. The unit of force is _____.

Ans: (b) Newton equivalent to kg m/s^2

4. Which among these is correct about force applied and mass? _____.

Ans: (a) If the applied force is more the acceleration is more

5. Which among these is correct about air resistance force? _____.

Ans: (c) It opposes the motion of the object in the air

6. Two massive objects attract each other, due to _____.

Ans: (c) Gravitational force

7. Which among these is correct about magnetic force? _____.

Ans: (b) Magnetic force is a non-contact force

8. A comb attracts bits of paper, due to _____.

Ans: (c) Electrostatic force

II. Say True or False.

1. The weight of an object is due to the force of gravity.

Ans: True

2. Electrostatic force is a contact force.

Ans: False

3. Force which is applied to an object by another object is applied force.

Ans: True

4. Gravitational force is a contact force. **Ans:** False
5. Tension force is transmitted through spring, ropes, or cables. **Ans:** True

III. Concept Questions.

1. Write Newton's second law of motion.

Ans: The acceleration of an object is directly proportional to the net force acting on it and inversely proportional to its mass.

Formula: $F = ma$.

2. What is air resistance force?

Ans: A frictional force that opposes the motion of objects moving through air, increasing with speed and surface area.

3. Write the name of any three non-contact forces.

Ans:

- o Gravitational force
- o Magnetic force
- o Electrostatic force

4. What is electrochemical force?

Ans: A force arising from chemical reactions that produce electric charges (e.g., battery operation).

5. Write any three contact forces.

Ans:

- o Frictional force
- o Tension force
- o Normal force

IV. Multi Correct Choice Type:

1. Which among these describe the 2nd law of Newton?

Ans: (b) The rate of change of momentum is directly proportional to the applied force.,
(c) The change of momentum is along the direction of the applied force.

2. Which among these are correct about acceleration?

Ans: (a) Unbalanced force makes an object accelerated, (b) Acceleration is always in the direction of force

3. Which among these are correct about force?

Ans: (b) Unit of force is Newton, (c) $F = ma$

4. Which among these are correct about magnetic force?

Ans: (b) This is a non-contact force, (c) This force exists between magnets and magnetic materials

5. Which among these help us while diving a parachute?

Ans: (a) Air resistance force

V. Reasoning Type Questions.

1. Statement-1 : Acceleration is inversely related to mass.

Statement-2 : If mass is more, acceleration will be less if the applied force is constant.

Ans: (a) Both statements are correct and statement-2 explains statement-1.

2. Statement-1 : Kicking a ball is an example of contact force.

Statement-2 : In contact force; force is applied by means of physical contact.

Ans: (a) Both statements are correct and statement-2 explains statement-1.

3. Statement-1 : When you comb your hair and then the comb picks up bits of paper.

Statement-2 : Static electricity is formed by rubbing (or combing) the comb with hair.

Ans: (a) Both statements are correct and statement-2 explains statement-1.

4. **Statement-1** : Newton discovered the unit of force.

Statement-2 : Dyne is a unit of force.

Ans: (b) Both statements are correct but unrelated.

5. **Statement-1** : Tension force is transmitted through a string, rope, or cable.

Statement-2 : The tension force pulls the objects equally on the opposite ends of the wire.

Ans: (a) Both statements are correct and statement-2 explains statement-1.

Application Skill Achiever

1. What net force is required to accelerate a car at a rate of 2 m/s^2 if the car has a mass of 3,000 kg?

Ans: Force = mass $\times$ acceleration = $3000 \times 2 = 6000 \text{ N}$

A net force of 6000 Newtons is required.

2. A 10 kg bowling ball would require what force to accelerate down an alleyway at a rate of 3 m/s^2 ?

Ans: Force = $10 \times 3 = 30 \text{ N}$

The required force is 30 Newtons.

3. Sally has a car that accelerates at 5 m/s^2 . If the car has a mass of 1000 kg, how much force does the car produce?

Ans: Force = $1000 \times 5 = 5000 \text{ N}$

The car produces a force of 5000 Newtons.

4. What is the mass of a falling rock if it produces a force of 147 N? (Assume $g = 9.8 \text{ m/s}^2$)

Ans: Force = mass $\times$ gravity $\rightarrow 147 = m \times 9.8$

Mass = $147 / 9.8 = 15 \text{ kg}$

The mass of the rock is 15 kilograms.

5. What is the mass of a truck if it produces a force of 14,000 N while accelerating at 5 m/s^2 ?

Ans: Mass = Force / acceleration = $14000 / 5 = 2800 \text{ kg}$

The mass of the truck is 2800 kilograms.

6. What is the force of attraction of two lead balls of mass 80 kg and 120 kg respectively, placed 2 meters apart?

Ans: Use formula: $F = \frac{G.m_1m_2}{r^2}$

Where: $G = 6.674 \times 10^{-11} \text{ Nm}^2/\text{kg}^2$

$m_1 = 80 \text{ kg}$, $m_2 = 120 \text{ kg}$, $r = 2 \text{ m}$

$$F = \frac{6.674 \times 10^{-11} \times 80 \times 120}{2^2} = \frac{6.674 \times 10^{-11} \times 9600}{4} = \frac{6.406 \times 10^{-7}}{1} = 6.406 \times 10^{-7} \text{ N}$$

The force of attraction is approximately $6.41 \times 10^{-7} \text{ N}$.

7. A body is moving with an acceleration of 20 m/s^2 . If the mass of the body is 400 kg, what is the force applied?

Ans: Force = $400 \times 20 = 8000 \text{ N}$

The applied force is 8000 Newtons.

8. A force of 40 N is applied to an iron ball with an acceleration of 20 m/s^2 . If the same force is applied to a lead

Ans: ball of half the mass, what is the acceleration?

Step 1: Mass of iron ball = $F / a = 40 / 20 = 2 \text{ kg}$

Step 2: Mass of lead ball = $2 / 2 = 1 \text{ kg}$

Step 3: New acceleration = $F / m = 40 / 1 = 40 \text{ m/s}^2$

The lead ball accelerates at 40 m/s^2 .

9. What is the force of a rock of mass 400 kg falling with an acceleration of 9.8 m/s²?

Ans: Force = mass × acceleration = 400 × 9.8 = 3920 N
The falling rock exerts a force of 3920 Newtons.

10. What is the gravitational force between Earth and a satellite of 800 kg (mass of Earth = 6×10^{24} kg), at a distance of 40,000 km?

Ans: Convert distance to meters: 40,000 km = 4×10^7 m
Use formula:

$$F = \frac{G.M.m}{r^2} = \frac{6.674 \times 10^{-11} \times 6 \times 10^{24} \times 800}{(4 \times 10^7)^2} = \frac{3.204 \times 10^{17}}{1.6 \times 10^{15}} = 200.25 \text{ Newtons}$$

The gravitational force is approximately 200.25 Newtons.

EXERCISE - 4

I. Choose the correct answer.

1. For every action there exists _____.

Ans: (b) Equal and opposite reaction

2. Forces always exist _____.

Ans: (a) In action-reaction pairs

3. When a pair of forces acts on two interacting objects, which among these is correct? _____.

Ans: (c) The size of the force on the first object equals the size of the force on the second object

4. If the wings of a bird push air downwards, then the bird moves _____.

Ans: (a) Upwards

5. When a bus moves forward, the wheels of the bus exert a _____ force against the road.

Ans: (b) Backward

6. When a bullet is fired from a rifle, _____.

Ans: (a) The rifle moves backward

7. When you hit a baseball with a bat, the ball moves forward; this indicates _____.

Ans: (b) Force is applied to the baseball by the bat, and the ball also exerts the same amount of force on the bat

8. A fish uses its fins to push water backwards, then _____.

Ans: (a) The fish moves forward

II. Say True or False.

1. Single force can never exist.

Ans: True

2. For every action, there is a reaction in the opposite direction.

Ans: True

3. It is generally customary in a free-body diagram to represent the object by a box.

Ans: True

4. In a free-body diagram, the direction of the arrow shows the direction of the acting force.

Ans: True

5. A free-body diagram is a special example of vector diagrams.

Ans: True

III. Concept Questions.

1. Write the third law of Newton.

Ans: For every action, there is an equal and opposite reaction. The forces act on two different objects.

2. How do rockets apply the third law of Newton?

Ans: Rockets expel exhaust gases downward (action), and the gases push the rocket upward (reaction).

3. Write any two examples related to the third law of Newton.

- Ans:**
- o Walking: Pushing the ground backward (action) → Ground pushes you forward (reaction).
 - o Swimming: Pushing water backward (action) → Water pushes you forward (reaction).

4. What is a free-body diagram?

- Ans:** A simplified drawing showing all forces acting on an object, represented as arrows with direction and magnitude.

Application Skill Achiever

1. If a gun of 20 kg fired a bullet of 150 g in 20 m/sec speed, calculate the speed of the gun's backward movement.

- Ans:** **Given:** Mass of gun = 20 kg
 Mass of bullet = 150 g = 0.15 kg
 Speed of bullet = 20 m/s
 Let speed of gun (recoil) = v

Using law of conservation of momentum:

Total momentum before firing = Total momentum after firing

Initial momentum = 0 (both at rest)

So,

Final momentum = momentum of gun + momentum of bullet = 0

$$m_{\text{gun}} \cdot v + m_{\text{bullet}} \cdot v_{\text{bullet}} = 0$$

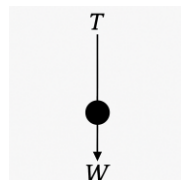
$$20 \cdot v + 0.15 \cdot 20 = 0$$

$$20v = -3 \Rightarrow v = -\frac{3}{20} = -0.15 \text{ m/s}$$

The gun moves backward with a speed of 0.15 m/s

2. A weight is suspended by a rope. Draw the Free Body Diagram for it:

- Ans:** Here is a simple representation of the Free Body Diagram:



Explanation:

The object is at rest.

T is the upward tension in the rope.

W is the downward force due to gravity (weight).

EXERCISE - 5

I. Choose the correct answer.

- Which among these is correct about heat transfer? **Ans:** (b) Heat flows from hotter system to cooler system
- Heat is a measure of _____. **Ans:** (a) Energy
- Two bodies are in thermal equilibrium if _____.
Ans: (a) No net transfer of heat occurs when they are in contact
- Liquid thermometers are based on _____. **Ans:** (b) Thermal expansion of liquids
- Thermometry is the study of _____. **Ans:** (b) Measurement of temperature
- Gas thermometers are based on _____. **Ans:** (a) Thermal expansion of gas
- The melting point of ice at normal pressure is _____. **Ans:** (b) 0°C
- The boiling point of water at normal pressure is _____. **Ans:** (b) 100°C
- The SI unit of temperature is _____. **Ans:** (c) Kelvin
- If two bodies A and B are in thermal equilibrium, then _____. **Ans:** (a) A and B are of equal temperature

II. Say True or False.

- The heat capacity per unit mass is called specific heat. **Ans:** True
- The density of aluminum is different than the density of iron. **Ans:** True
- Radiation thermometers are based on expansion of solids. **Ans:** False
- Kelvin scale is a unit to measure temperature. **Ans:** True
- Rankine is used to measure temperature. **Ans:** True

III. Concept Questions.

1. What is specific heat?

Ans: The amount of heat required to raise the temperature of 1 gram of a substance by 1°C (unit: $\text{J/g}^{\circ}\text{C}$ or $\text{cal/g}^{\circ}\text{C}$).

2. Explain the Zeroth Law of Thermodynamics.

Ans: "If two systems are each in thermal equilibrium with a third, they are in equilibrium with each other." This defines temperature as a measurable property.

3. What is thermometry?

Ans: The science of temperature measurement using devices like thermometers and scales (Celsius, Fahrenheit, Kelvin).

4. Write the name of any three temperature scales.

Ans: ☐ Celsius ($^{\circ}\text{C}$)
☐ Fahrenheit ($^{\circ}\text{F}$)
☐ Kelvin (K)

5. What is thermal equilibrium?

Ans: A state where two objects in contact have the same temperature, resulting in no net heat flow.

IV. Multi Correct Choice Type.

1. When two objects with different temperatures are in contact with each other than _____

Ans: (a) Cooler system becomes hotter, hotter system becomes cooler,
(c) Heat flows from hotter to cooler system

2. Increase of heat in a system implies

Ans: (c) Increase in mechanical energy

3. Which among these are correct relation between heat capacity, mass, and specific heat?

Ans: (a) $C = Q/m\Delta T$, (c) $Q = c.m\Delta T$

4. Which among these are correct about temperature?

Ans: (b) Heating raises temperature, (c) Thermometers measure temperature

5. Which among these are correct about melting and boiling points of water?

Ans: (a) Melting point = 0°C, (b) Boiling point > Melting point

V. Reasoning Type Questions.

1. **Statement-1 :** A hot aluminum cube is attached to a cool iron cube and the iron cube becomes hotter.

Statement-2 : Heat moves from hot system to cool system.

Ans: (a) Both are correct, and Statement-2 correctly explains Statement-1.

2. **Statement-1 :** When a small piece of ice is placed in a bucket of hot water, the bucket of hot water converts to steam.

Statement-2 : Adding ice to hot water makes the ice melt.

Ans: (c) Statement-1 is false — hot water does not completely convert to steam just by adding a small piece of ice. But Statement-2 is true.

3. **Statement-1 :** The degree of hotness and coldness of a body is called temperature.

Statement-2 : A hot body has more temperature than a cold body.

Ans: (a) Both statements are true, and Statement-2 explains Statement-1 correctly.

4. **Statement-1 :** Liquid thermometers are based upon thermal expansion of liquids.

Statement-2 : Different scales are used to measure temperature.

Ans: (b) Both are correct, but the use of different scales does not explain thermal expansion of liquids.

5. **Statement-1 :** Two bodies A and B are in thermal equilibrium, and A & C are in thermal equilibrium.

Statement-2 : B and C are in thermal equilibrium.

Ans: (a) This is based on the Zeroth Law of Thermodynamics, so both statements are true and Statement-2 explains Statement-1.

Application Skill Achiever

1. Convert 12 °C to Fahrenheit

Ans: $^{\circ}\text{F} = \left(\frac{9}{5} \times ^{\circ}\text{C}\right) + 32 = \left(\frac{9}{5} \times 12\right) + 32 = 21.6 + 32 = 53.6 ^{\circ}\text{F}$

2. Convert 45 °F to Kelvin

Ans: **Step 1:** Convert Fahrenheit to Celsius:

$$^{\circ}\text{C} = \frac{5}{9} (^{\circ}\text{F} - 32) = \frac{5}{9} (45 - 32) = \frac{5}{9} \times 13 = 7.22 ^{\circ}\text{C}$$

Step 2: Convert Celsius to Kelvin

$$\text{K} = ^{\circ}\text{C} + 273.15 = 7.22 + 273.15 = 280.37 ^{\circ}\text{K}$$

3. The temperature of object A is 12 °C. The temperature of object B is 35 °F. Which is hotter.

Ans: Convert 35 °F to °C:

$$^{\circ}\text{C} = \frac{5}{9} (35 - 32) = \frac{5}{9} \times 3 = 1.67 ^{\circ}\text{C}$$

4. How much heat must be absorbed by 375 grams of water to raise its temperature by 25° C?

Ans: $Q = mc\Delta T$, where $c = 4.18 \text{ J/g } ^{\circ}\text{C}$ for water

$$Q = 375 \times 4.18 \times 25 = 39,187.5 \text{ J}$$

5. What mass of water can be heated from 25.0° C to 50.0° C by the addition of 2825 J?

Ans: $Q = mc\Delta T \Rightarrow m = \frac{Q}{c\Delta T} = \frac{2825}{4.18 \times (50 - 25)} = 27.03 \text{ g}$

6. What is the final temperature when 625 grams of water at 75.0° C loses 7.96 × 10⁴ J?

$Q = mc\Delta T \Rightarrow \Delta T = \frac{Q}{mc} = \frac{7.96 \times 10^4}{625 \times 4.18} = \frac{79600}{2612.5} = 30.46^\circ \text{C}$

7. A copper cylinder has a mass of 76.8 g and a specific heat of 0.092 cal/g C. It is heated to 86.5° C and then put in 68.7 g of turpentine whose temperature is 19.5° C. The final temperature of the mixture is 31.9° C. What is the specific heat of the turpentine?

Ans: Heat lost by copper = Heat gained by turpentine

$$m_c c_c (T_i - T_f) = m_t c_t (T_f - T_i)$$

Given:

$$m_c = 76.8 \text{ g}, c_c = 0.092 \text{ cal/g}^\circ\text{C}, T_{i,c} = 86.5^\circ \text{C}$$

$$m_t = 68.7 \text{ g}, T_{i,t} = 19.5^\circ \text{C}, T_f = 31.9^\circ \text{C}$$

$$76.8 \times 0.092 \times (86.5 - 31.9) = 68.7 \times c_t \times (31.9 - 19.5)$$

$$76.8 \times 0.092 \times 54.6 = 68.7 \times c_t \times 12.4$$

$$385.25 = 852.84 \times c_t \Rightarrow c_t = 0.452 \text{ cal/g}^\circ\text{C}$$

8. A 65.0 g piece of iron at 525° C is put into 635 grams of water at 15.0° C. What is the final temperature of the water and the iron?

Ans: Use:

Specific heat of iron = 0.450 J/g°C

Water = 4.18 J/g°C

Let final temp = T:

$$m_{\text{iron}} c_{\text{iron}} (T_i - T) = m_{\text{water}} c_{\text{water}} (T - T_i)$$

$$65.0 \times 0.45 \times (525 - T) = 635 \times 4.18 \times (T - 15)$$

$$29.25(525 - T) = 2655.3(T - 15)$$

$$15,356.25 - 29.25T = 2655.3T - 39,829.5$$

$$55,185.75 = 2684.55T \Rightarrow T = 20.55^\circ \text{C}$$

EXERCISE - 6

I. Choose the correct answer.

1. Which among these is a good conductor of heat?

Ans: (a) Aluminum

2. Which among these is a bad conductor of heat?

Ans: (c) Glass

3. Matter exists in _____ stages.

Ans: (b) 3

4. The process during which a solid changes to a liquid by absorbing heat is called _____.

Ans: (a) Fusion or melting

5. The fixed temperature at which a solid substance gets converted into a liquid is _____.

Ans: (a) Fusion point or melting point

6. The fixed temperature at which a liquid gets converted into vapour state is called _____.

Ans: (b) Boiling point

7. The fixed temperature at which vapours change into liquid state is called _____.

Ans: (a) Condensation point

8. The process during which a liquid changes to a solid state at some fixed temperature is called _____.

Ans: (c) Freezing

9. The fixed temperature at which a liquid substance gets converted into a solid is called _____.

Ans: (b) Freezing point

10. The process during which vapours are converted into liquid state at some fixed temperature is called _____.

Ans: (a) Condensation

II. Say True or False.

1. Heat can be converted into mechanical work.

Ans: True

2. Non-metals are good conductors of heat.

Ans: False

3. The physical states of matter can be changed by heating or cooling.

Ans: True

4. Water vapour is in gaseous state.

Ans: True

5. The conversion of liquid into vapour below the boiling point is called evaporation.

Ans: True

III. Concept Questions.

1. What happens when heat is supplied to a system?

Ans: o Temperature may rise (if no phase change occurs).
o State may change (e.g., solid to liquid) at fixed temperatures.

2. Name three good conductors of heat.

Ans: Silver, Copper, Aluminum

3. Name three bad conductors of heat.

Ans: Wood, Glass, Plastic

4. What is boiling point?

Ans: The temperature at which a liquid's vapour pressure equals external pressure, causing rapid vaporization.

5. What is latent heat?

Ans: Heat absorbed or released during a phase change (e.g., melting or boiling) without temperature change.

IV. Multi Correct Choice Type.

1. When heat is supplied to a system, it may:

Ans: (b) Change the temperature, (c) Change the state

2. When two bodies of different temperature are brought in thermal contact than _____

Ans: (b) Cooler body becomes hotter, (c) Hotter body becomes cooler

3. Which among the given statement correctly show the relation between Q, M, C, and ΔT ?

Ans: (b) $M = Q/C\Delta T$, (c) $\Delta T = Q/M.C$

4. Which among these are correct about good conductors of heat?

Ans: (b) Allow heat flow, (c) Used in cooking vessels

5. Which among these are correct about matter?

Ans: (a) States change by cooling, (b) Exists in three states, (c) States change by heating

V. Reasoning Type Questions.

1. **Statement-1 :** Glass is a bad conductor of heat.

Statement-2 : Non metals are bad conductor of heat.

Ans: (a) Both statements are correct, and Statement-2 correctly explains

2. **Statement-1** : Silver is a good conductor of heat.

Statement-2 : Copper is a good conductor of heat.

Ans: (b) Both are correct, but Statement-2 does not explain Statement-1 (they are just two separate facts).

3. **Statement-1** : The fixed temperature at which a solid substance gets converted into a liquid is called boiling point.

Statement-2 : The fixed temperature at which a liquid substance converts into solid is called boiling point.

Ans: (e) Both statements are false. (The correct term is melting point for solid to liquid, and freezing point for liquid to solid.)

4. **Statement-1** : The fixed temperature at which the vapour state of substance gets converted into liquid state is called condensation point.

Statement-2 : The boiling point of water is less than its freezing point.

Ans: (c) Statement-1 is true, but Statement-2 is false (boiling point is higher than freezing point).

5. **Statement-1** : Steam is in gaseous state.

Statement-2 : By heating more steam converts to water.

Ans: (c) Statement-1 is true, but Statement-2 is false. (Steam turns into water only when cooled, not heated.)

Application Skill Achiever

1. An alloy of 25 gm takes 500 J to heat from 20 °C to 60 °C. What is the specific heat of the alloy?

Ans: Use the formula:

$$Q = mc\Delta T \Rightarrow c = Q/(m\Delta T)$$

Given: $Q = 500 \text{ J}$

$$m = 25 \text{ g} = 0.025 \text{ kg (or use 25 g with J/g}^\circ\text{C)}$$

$$\Delta T = 60 - 20 = 40^\circ\text{C}$$

$$c = \frac{500}{25 \times 40} = \frac{500}{1000} = 0.5 \text{ J/g}^\circ\text{C}$$

2. How much heat energy is required to change 2 kg of ice at 0°C into water at 20°C? [Specific latent heat of fusion of water = 334 000 J/kg; specific heat capacity of water = 4200 J/(kg K).]

Ans: This is a two-part problem:

- **First:** melt the ice (latent heat)
- **Then:** raise the temperature of water (sensible heat)

Step 1: Melt the ice: $Q_1 = m \times L_f = 2 \times 334000 = 668000 \text{ J}$

Step 2: Heat the water from 0°C to 20°C: $Q_2 = mc\Delta T = 2 \times 4200 \times 20 = 168000 \text{ J}$

Total heat = $Q_1 + Q_2 = 668000 + 168000 = 836000 \text{ J}$

3. To change the phase of substance of 8kg is 400 kcal. Find the latent heat of the substance.

Ans: Use:

$$L = Q/m = 400/8 = 50 \text{ kcal/kg}$$

4. The latent heat of a substance is 80k cal/kg. Find out the heat needed for phase transfer of 20kg of the substance.

Ans: $Q = m \times L = 20 \times 80 = 1600 \text{ kcal}$

5. The heat needed to phase transfer of material 'A' of 5kg is 40k cal. The heat needed to phase transfer of material 'B' of 6kg is 30 k cal. Which substance has more latent heat?

Ans: **Material A:** $m = 5 \text{ kg}, Q = 40 \text{ kcal} \Rightarrow L_A = 40/5 = 8 \text{ kcal/kg}$

Material B: $m = 6 \text{ kg}, Q = 30 \text{ kcal} \Rightarrow L_B = 30/6 = 5 \text{ kcal/kg}$

Material A has more latent heat.

EXERCISE - 7

I. Choose the correct answer.

1. The _____ energy is associated with our sense of hearing. **Ans:** (b) Sound
2. Sound is produced by _____. **Ans:** (b) Vibration
3. Sound is propagated by means of _____. **Ans:** (a) Longitudinal waves
4. Which statement among these is correct about sound? **Ans:** (b) Sound cannot be transmitted through vacuum.
5. The SI unit of sound is _____. **Ans:** (d) None of these
6. When an object vibrates faster, the _____ of the sound is higher. **Ans:** (b) Frequency
7. The loudness or softness of a sound is determined by its _____. **Ans:** (b) Amplitude
8. A sound of single frequency is called _____. **Ans:** (c) Tone
9. The pleasant sound produced due to a mixture of several frequencies is called _____. **Ans:** (a) Note
10. The reflected sound we hear is called _____. **Ans:** (c) Echo

II. Say True or False.

1. Sound waves require a medium to propagate. **Ans:** True
2. Sound cannot be transmitted through liquids or solids. **Ans:** False
3. Sound travels at different velocities in different media. **Ans:** True
4. Objects of different sizes and conditions vibrate at different frequencies. **Ans:** True
5. No object can travel faster than sound. **Ans:** False

III. Concept Questions.

1. Why is the thunder heard after the flash of lightning?

Ans: Lightning and thunder happen at the same time, but light travels much faster than sound. So, we see the flash of lightning first and hear the thunder later because sound takes more time to reach us.

2. What is the speed of sound in air at 20 °C?

Ans: The speed of sound in air at 20 °C is approximately 343 meters per second (m/s).
This speed can slightly vary depending on air pressure and humidity.

3. How is the velocity of sound related to bulk modulus of an object?

Ans: The velocity of sound in a medium is given by the formula:
$$v = \sqrt{B/\rho},$$

where B is the bulk modulus and ρ is the density of the medium.
So, sound travels faster in materials with a higher bulk modulus and lower density.

4. What is supersonic speed?

Ans: Supersonic speed is any speed that is faster than the speed of sound in air.
For example, speeds greater than 343 m/s at 20 °C are called supersonic.

5. What are the three main things used to characterize sound waves?

Ans: The three main characteristics of sound waves are:

- Frequency (or pitch)
- Amplitude (or loudness)
- Wavelength (or speed/distance between compressions)

IV. Multi Correct Choice Type.

1. Which among these are correct about sound?

Ans: (a) Sound moves in straight line, (b) Sound is a form of energy

2. In which of the given medium sound can propagate?

Ans: (a) Water, (c) Air

3. Which among these are characteristics of sound?

Ans: (a) Frequency, (b) Wavelength

4. Which among these are correct about wavelength?

Ans: (b) Wavelength is less if frequency is more, (c) Wavelength is the length between two consecutive peaks

5. Which among these are correct about amplitude?

Ans: (b) Louder sound has greater amplitude, (c) Amplitude is the energy of sound

V. Reasoning Type Questions.

1. **Statement-1 :** Sound does not travel in vacuum.

Statement-2 : Sound needs a medium to propagate.

Ans: (a) Both are correct, and Statement-2 correctly explains Statement-1.

2. **Statement-1 :** Time required to produce one complete wave is called time period.

Statement-2 : The SI unit of time period is meter.

Ans: (c) Statement-1 is true & statement-2 is false.

3. **Statement-1 :** Louder sound travels to longer distance.

Statement-2 : Louder sound has more frequency.

Ans: (e) Both the statements are false.

4. **Statement-1 :** Speed of sound $v = s/t$

Statement-2 : Speed of sound $v = t/s$

Ans: (c) Statement-1 is true & statement-2 is false.

5. **Statement-1 :** A sound of single frequency is called note.

Statement-2 : A tone is a mixture of sound of many frequencies.

Ans: (e) Both the statements are false.

Application Skill Achiever

1. **The sound wave has a frequency of 2.5 Hz. Its wavelength is 25 cm. How long will it take to travel 1.6 km?**

Ans: Convert wavelength to meters: $25 \text{ cm} = 0.25 \text{ m}$
Speed of sound = Frequency $\times$ Wavelength = $2.5 \times 0.25 = 0.625 \text{ m/s}$
Distance = $1.6 \text{ km} = 1600 \text{ m}$
Time = Distance / Speed = $1600 / 0.625 = 2560 \text{ seconds}$
→ It will take 2560 seconds to travel 1.6 km.

2. **A person standing near the cliff fires a gun and hears the echo after 1.5 sec. If the speed of sound is 340 m/s, how far is the person from the cliff?**

Ans: Echo time is for to and fro, so time to reach the cliff = $1.5 / 2 = 0.75 \text{ sec}$
Distance = Speed $\times$ Time = $340 \times 0.75 = 255 \text{ meters}$
→ The person is 255 m away from the cliff.

3. **A sound wave of frequency 5000 Hz travels in air with speed 350 m/s. Calculate the wavelength.**

Ans: Wavelength = Speed / Frequency = $350 / 5000 = 0.07 \text{ m} = 7 \text{ cm}$
→ The wavelength is 0.07 meters or 7 centimeters.

4. **If you hear thunder 7 sec after you see the lightning, how far are you from where the lightning occurred?**

Ans: Time = 7 sec, Speed of sound = 340 m/s
Distance = Speed $\times$ Time = $340 \times 7 = 2380 \text{ meters}$
→ You are 2380 m or 2.38 km away from the lightning.

5. A body is vibrating 6000 times in 1 minute. If the velocity of sound in air is 360 m/s, find:

(i) Frequency in Hz (ii) Wavelength of sound

Ans: (i) Frequency = Vibrations / Time = $6000 / 60 = 100$ Hz
(ii) Wavelength = Speed / Frequency = $360 / 100 = 3.6$ m
→ Frequency = 100 Hz, Wavelength = 3.6 meters

EXERCISE - 8

I. Choose the correct answer.

- _____ is a branch of physics which deals with the study of light. **Ans:** (a) Optics
- An object that emits its own light is called _____. **Ans:** (a) Luminous
- An object that doesn't give out its own light but becomes visible when light from a luminous objects falls on it is called _____. **Ans:** (a) Non luminous object
- An optical medium with uniform composition is called _____. **Ans:** (c) Homogeneous medium
- An optical medium which has different composition at different point is called _____. **Ans:** (a) Heterogenous Medium
- Light from a point of source passes through a very narrow path is called _____. **Ans:** (a) Ray
- A collection of rays of light is called _____. **Ans:** (b) Beam of light
- Light from distant object gives _____. **Ans:** (c) Parallel beam of light
- Ray of light which falls on the reflecting surface is called _____. **Ans:** (b) Incident ray
- The point at which the incident ray strikes the reflective surface is called _____. **Ans:** (c) Point of incidence

II. Say True or False.

- Opaque objects don't allow to pass light through it. **Ans:** True
- Pure water is transparent medium. **Ans:** True
- The perpendicular drawn to the surface at the point of incidence is called the angle of reflection. **Ans:** False
- Regular reflection is called defused reflection also. **Ans:** False
- Polarized light waves were vibrations occurs in may planes. **Ans:** False

III. Concept Questions.

1. What is the difference between ray optics and physical optics?

Ans: Ray optics treats light as rays traveling in straight lines, dealing with reflection and refraction. Physical optics considers light's wave nature, explaining phenomena like interference and diffraction.

2. Write any three principle sources of light.

Ans: Sun, electric bulbs, fire (any three natural or artificial light sources)

3. What is the difference between a ray and a beam?

Ans: A ray is a single path of light, while a beam is a collection of many rays.

4. What is parallel beam of light?

Ans: Light rays traveling in the same direction without converging or diverging.

5. What is convergent beam of light?

Ans: Light rays that come together and meet at a single point.

6. What is photoelectric effect?

Ans: Emission of electrons from a material when light of sufficient frequency strikes it.

7. How does the lunar eclipse occur?

Ans: When Earth comes between Sun and Moon, casting its shadow on the Moon.

8. How does the solar eclipse occur?

Ans: When Moon comes between Sun and Earth, blocking sunlight from reaching Earth.

IV. Multi Correct Choice Type:

1. The luminous bodies are **Ans:** (a) Sun, (c) Fire
2. Which among these are opaque medium? **Ans:** (a) Wood, (b) Stone
3. Which among these are homogeneous medium? **Ans:** (a) Glass, (b) Water, (c) Air
4. Which among these allow light to pass through it? **Ans:** (b) Transparent medium, (c) Glass
5. Which among these do not allow light to pass through it? **Ans:** (b) Stone, (c) Wood

V. Reasoning Type Questions.

1. **Statement-1** : Light does not pass through walls.
Statement-2 : Light does not pass through opaque objects.
Ans: (a) Both correct and statement-2 explains statement-1
2. **Statement-1** : If angle of incidence 40° then angle of reflection is 50° .
Statement-2 : Angle of incidence $<$ angle of reflection.
Ans: (e) Both false (angle of reflection equals angle of incidence)
3. **Statement-1** : The perpendicular drawn to the surface at the point of incidence is called the normal.
Statement-2 : The reflected ray passes through the mirror.
Ans: (b) Both correct but statement-2 doesn't explain statement-1
4. **Statement-1** : The angle between the incident ray and the reflecting surface is called the glancing angle of incidence.
Statement-2 : Glancing angle is perpendicular to the reflecting surface.
Ans: (c) Statement-1 true & statement-2 false
5. **Statement-1** : The angle made by the incident ray with the reflected ray called angle of deviation.
Statement-2 : When the angle of incidence equal to 90° the angle of reflection is also equal to 90° .
Ans: (b) Both correct but statement-2 doesn't explain statement-1

Application Skill Achiever

1. If the angle of incidence is 70° . What is the angle of deviation?
Ans: Angle of deviation = $180^\circ - (70^\circ + 70^\circ) = 40^\circ$
2. If the sum of angle of incidence and angle of reflection is 80° . What is the angle of incidence?
Ans: Since angle of incidence = angle of reflection, angle of incidence = 40°
3. The angle of incidence is 30° . What is the glancing angle of incidence?
Ans: Glancing angle = $90^\circ - 30^\circ = 60^\circ$
4. The glancing angle is 40° . What is the angle of reflection?
Ans: Angle of incidence = $90^\circ - 40^\circ = 50^\circ$, so angle of reflection = 50°
5. The angle of deviation is 80° . What is the angle of incidence?
Ans: $80^\circ = 180^\circ - 2\theta \Rightarrow \theta = 50^\circ$
6. The angle of reflection is 80° . What is angle of incidence?
Ans: Angle of incidence = 80° (same as reflection)
7. The angle of incidence is 0. Find the angle of reflection?
Ans: Angle of reflection = 0°
8. The angle of incidence is 0, the glancing angle of incidence is α . Find the value of $0 + \alpha$.
Ans: $0 + \alpha = 90^\circ$ (since $\alpha = 90^\circ - 0$)

9. The angle of reflection is 30° . What is the angle of incidence?

Ans: Angle of incidence = 30°

10. The angle of incidence is 80° . What is the angle of deviation?

Ans: Angle of deviation = $180^\circ - (80^\circ + 80^\circ) = 20^\circ$

EXERCISE - 9

I. Choose the correct answer.

1. Materials that permits electrons to flow freely is called _____. **Ans:** (b) Conductors
2. The substances which allow the charges partly through them are called _____. **Ans:** (a) Semi conductors
3. Which among these is correct about charged objects? _____
Ans: (b) Charged objects has unequal number of positive and negative charges
4. Two positively charged particles _____. **Ans:** (b) Repel each other
5. If a comb rubbed with hair, become negatively charged. It implies _____. **Ans:** (a) The comb gained electron
6. A ____ is an instrument used to detect the presence of very weak electrical charges. **Ans:** (b) Electroscope
7. The process of charging uncharged object by bringing it in contact with another charged object is called _____.
Ans: (b) Charging by conduction
8. The process of charging the uncharged object by bring another charged objects near to it but not touching it, is called _____.
Ans: (a) Charging by induction

II. Say True or False.

1. Insulators don't allow flow of electrons in it. **Ans:** True
2. Germanium and silicon are semiconductors. **Ans:** True
3. An uncharged object cannot be charged. **Ans:** False
4. The force of attraction and repulsion between two charges depends upon the medium in which charges are placed. **Ans:** True
5. Gold leaf electroscope is used to detect and measure static electricity or voltage. **Ans:** True

III. Concept Questions.

1. How can you form static electricity in a comb?

Ans: By rubbing the comb through dry hair, electrons transfer from hair to comb, making the comb negatively charged.

2. Write the three methods of electrification.

Ans: Friction, Conduction, and Induction.

3. Explain Coulomb's first law.

Ans: Like charges repel each other, unlike charges attract each other.

4. Explain Coulomb's Second law.

Ans: The force between two charges is directly proportional to the product of their magnitudes and inversely proportional to the square of the distance between them.

5. What are the two types of electroscope?

Ans: Pith-ball electroscope and Gold-leaf electroscope.

IV. Multi Correct Choice Type:

1. Which among these are correct about conductors?

Ans: (b) Conductors permit electrons to flow freely
(c) In conductors the charge is quickly distributed across the entire surface.

2. Which among these are methods of charging an uncharged object?

Ans: (a) Charging by friction., (c) Charging by conduction.

3. Which among these are correct about insulators?

Ans: (b) If charge is transferred to an insulator at a given location, the excess charge remains at the particular location.

(c) The particles of insulator do not permit the free flow of electrons.

4. A and B were neutrals. Due to friction A gained extra electrons and B lost electrons than which among these is true about the final charge of A and B

Ans: (b) B is positive., (c) A is negative.

5. A and B are charged. If A is attracted towards B which among these is correct about A & B.

Ans: (a) A and B are oppositely charged., (c) A is positive if B is negative and A is negative if B is positive.

6. If A is positively charged, B is negative charged and C is uncharged, then which among these are correct.

Ans: (a) A attracts B, (c) B attracts A

7. Which among these are correct about a neutral object?

Ans: (a) A neutral object is an uncharged particle., (b) A neutral object is attracted by a positive charge.

V. Reasoning Type Questions.

1. **Statement-1 :** After combing, the comb became charged.

Statement-2 : When an object is rubbed with another object, the electrons get transferred from one object to another.

Ans: (a) Both statements are correct and statement-2 is the correct explanation of statement-1.

2. **Statement-1 :** Electrostatic is an instrument for detecting the presence of very weak electrical charges.

Statement-2 : Electrostatic can't detect whether the charge is positive or negative.

Ans: (b) Both statements are correct but statement-2 is not correct explanation of statement-1.

3. **Statement-1 :** The bulbs use its own electricity to glow.

Statement-2 : Electrical cell makes its own electricity.

Ans: (e) Both the statements are false.

Application Skill Achiever

1. A point charge (q_1) has a magnitude of 3×10^{-6} C. A second charge (q_2) has a magnitude of -1.5×10^{-6} C and is located 0.12m from the first charge. Determine the electrostatic force each charge exerts on the other.

Ans: Using Coulomb's Law:

$$F = k \times \frac{|q_1 q_2|}{r^2}$$

Substitute: $k = 9 \times 10^9$, $q_1 = 3 \times 10^{-6}$, $q_2 = -1.5 \times 10^{-6}$, $r = 0.12\text{m}$

$$F = 9 \times 10^9 \times \frac{|(3 \times 10^{-6})(-1.5 \times 10^{-6})|}{(0.12)^2}$$

$$F = 9 \times 10^9 \times \frac{(4.5 \times 10^{-12})}{0.0144} = 9 \times 10^9 \times 3.125 \times 10^{-10}$$

$$F = 2.8125 \text{ N}$$

The electrostatic force each charge exerts on the other is 2.81 n (attractive since one charge is negative)

2. Two charged objects of magnitude 12.566 C and -8.8 C are separated by a certain distance. If the electrostatic force between the objects is detected as 10^8 N. Find the distance between them. ($\pi = 3.1415$, Permittivity of the medium = 8.8×10^{12})

Ans: Given: $q_1 = 12.566\text{C}$, $q_2 = -8.8\text{C}$, Force $F = 10^8$ N, $\epsilon = 8.8 \times 10^{12}$, $\pi = 3.1415$.

$$\text{Using: } F = \frac{1}{4\pi\epsilon} \times \frac{|q_1 q_2|}{r^2} \Rightarrow r^2 = \frac{1}{4\pi\epsilon} \times \frac{|q_1 q_2|}{F}$$

Substitute:

$$q_1 = 12.566, \quad q_2 = -8.8, \quad F = 10^8, \quad \pi = 3.1415, \quad \epsilon = 8.8 \times 10^{12}$$

$$r^2 = \frac{1}{4 \times 3.1415 \times 8.8 \times 10^{12}} \times \frac{(12.566)(8.8)}{10^8}$$

$$r^2 = \frac{110.5808}{110.5848 \times 10^{12} \times 10^8} = \frac{110.5808}{1.105848 \times 10^{22}} = 10^{-20}$$

$$r = \sqrt{10^{-22}} = 10^{-10} \text{ m}$$

The distance between them is approximately 1×10^{-10} m