

Teacher's Hand Book 9th Physics

EXERCISE - 1

I. Choose the correct answer:

1. A group of stars with a recognizable pattern is called as _____. **Ans:** (c) Constellations
2. The planet nearest to Sun is _____. **Ans:** (a) Mercury
3. The largest planet in the solar system is _____. **Ans:** (b) Jupiter
4. The second largest planet in the solar system is _____. **Ans:** b) Saturn
5. Which among these is correct about the moon? **Ans:** (c) The same face of moon is visible to earth.
6. The moon takes ____ days to complete one revolution around earth. **Ans:** (a) 27.3
7. The path of a comet is _____. **Ans:** (b) Elliptical

II. Say True or False:

1. Asteroids are minor planets. **Ans:** True
2. Mars is a reddish planet. **Ans:** True
3. Venus is the closest planet to earth. **Ans:** True
4. The Kuiper belt is beyond the orbit of Neptune. **Ans:** True
5. Asteroids are rocky airless worlds that orbit around the Sun. **Ans:** True

III. Concept Questions:

1. What is a constellation?

Ans: A constellation is a group of stars that form a recognizable pattern, often named after mythological figures or objects.

2. Write the names of the planets of the solar system?

Ans: Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune.

3. What is the average distance of the moon from earth?

Ans: The average distance is approximately 384,400 km.

4. What is a comet?

Ans: A comet is a small, icy celestial body that, when near the Sun, heats up and releases gas, forming a glowing coma and sometimes a tail.

5. What is the difference between asteroids & meteoroids?

Ans: o Asteroids are larger rocky bodies orbiting the Sun, mostly found in the asteroid belt.
o Meteoroids are smaller fragments of asteroids or comets that become meteors when entering Earth's atmosphere.

6. What is lunar eclipse?

Ans: A lunar eclipse occurs when Earth passes between the Sun and Moon, casting a shadow on the Moon.

7. What is solar eclipse?

Ans: A solar eclipse occurs when the Moon passes between the Sun and Earth, blocking sunlight partially or completely.

8. What is an artificial satellite?

Ans: An artificial satellite is a human-made object placed into orbit around Earth or another celestial body for purposes like communication, navigation, or research.

IV. Multi Correct Choice Type:

1. The solar system consists of _____.

Ans: (a) Sun, (b) Planets, (c) Moons of planets

2. Which among these are correct about Jupiter?

Ans: (b) Jupiter is the largest planet, (c) Jupiter has no solid surface

3. Which among these are correct about Saturn?

Ans: (a) It is the second largest planet in the solar system, (b) It has rings

4. Which among these are correct about Mercury?

Ans: (b) It is the smallest planet in the solar system, (c) It is the nearest planet to the sun

5. Which among these are correct about the moon?

Ans: (a) It orbits around the earth, (b) The same face of the moon appears to the earth

V. Reasoning Type Questions:

1. **Statement-1 :** Solar eclipse appears on full moon day.

Statement-2 : In full moon day the sun comes in between the earth and the moon.

Ans: (e) Both statements are false.

2. **Statement-1 :** Full moon appears once in a year.

Statement-2 : On full moon day the earth comes in between the sun & the moon.

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

3. **Statement-1 :** Lunar eclipse appears on full moon day.

Statement-2 : On lunar eclipse the sun is partly visible.

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

4. **Statement-1 :** Artificial satellites rotate around the Earth.

Statement-2 : The moon is an artificial satellite.

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

5. **Statement-1 :** Asteroids orbit the moon.

Statement-2 : Asteroids are rocky.

Ans: (e) Both statements are false.

EXERCISE - 2

I. Choose the correct answer:

1. A unit of a measurement is a _____.

Ans: (b) Definite magnitude of a quantity

2. The three basic quantities of dimension are mass, length and _____.

Ans: (a) Time

3. Speed is measured in _____.

Ans: (b) Meters per second

4. The SI unit of area is _____.

Ans: (a) M^2

5. The dimension of density is _____.

Ans: (b) $M^1L^{-3}T^0$

6. The SI unit of frequency is _____.

Ans: (b) Hertz

7. The SI unit of force is _____.

Ans: (c) Newton

8. The SI unit to measure kinetic energy is _____.

Ans: (c) Joule

9. The SI unit of E.M.F is _____.

Ans: (b) Volt

10. Which among the following has no SI unit? _____.

Ans: (c) Specific Gravity

II. Concept Questions:

1. **What are the three basic quantities?**

Ans: Mass (M), Length (L), and Time (T).

2. **What are the uses of dimensional equations?**

Ans: o To check the correctness of physical equations.

o To derive relationships between physical quantities.

o To convert units from one system to another.

3. Write the derived quantity for the dimension $M^1L^2T^0$.

Ans: Moment of Inertia (or Torque).

4. Write the derived quantity for the dimension $M^1L^{-1}T^{-2}$.

Ans: Force (or Weight).

III. Say True or False:

- Speed is a derived quantity. **Ans:** True
- The SI units of speed and velocity are the same. **Ans:** True
- Pressure is measured as force per area. ($P = \text{Force/Area}$) **Ans:** True.
- Ohm is used to measure electric resistance. **Ans:** True.
- Electric power is measured in farad. **Ans:** False

IV. Reasoning Type Questions:

- Statement-1 :** Specific gravity has no units.
Statement-2 : Specific gravity = Density of water/ Density of substance

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

- Statement-1 :** Frequency is measured in hertz.
Statement-2 : Dimensional formula of frequency is $M^0L^0T^0$.

Ans: (b) Both statements are correct, but Statement-2 is not the correct explanation.

- Statement-1 :** Power = Work/Time
Statement-2 : Power is measured in watt.

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

- Statement-1 :** Unit of pressure is Pascal.
Statement-2 : Pressure = Area/Force

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

- Statement-1 :** Kelvin is used to measure temperature.
Statement-2 : The dimensional formula of temperature is K.

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

V. Multi Correct Choice Type

- Which among these are correct about area?

Ans: (b) The dimensional formula of area is $M^0L^2T^0$, (c) Area is a derived quantity.

- Which among these are correct about density?

Ans: (a) Density = mass/volume., (c) The dimensional formula of density is $M^1L^{-3}T^0$.

- Which among these have no units? **Ans:** (b) Strain, (c) Angle

- Which among these have the same SI units? **Ans:** (a) Force, (c) Weight

- Which among these are measured in Joule? **Ans:** (b) Kinetic energy, (c) Potential energy

Application Skill Achiever

- Derive the dimension of acceleration

Ans: Formula:

$$\text{Acceleration} = \frac{\text{Velocity}}{\text{Time}} = \frac{\text{Length}}{\text{Time}^2}$$

Dimensions:

$$[\text{Acceleration}] = [LT^{-2}]$$

2. Derive the dimension of potential energy

Ans: **Formula:**

$$\text{Potential Energy} = m \cdot g \cdot h$$

Where: m = mass $\rightarrow [M]$, g = acceleration $\rightarrow [L T^{-2}]$, h = height $\rightarrow [L]$

Dimensions:

$$[M] \cdot [L T^{-2}] \cdot [L] = [M L^2 T^{-2}]$$

3. Derive the dimension of kinetic energy

Ans: **Formula:**

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

Where: m = mass $\rightarrow [M]$, v = velocity $\rightarrow [L T^{-1}]$

$$[M] \cdot [L T^{-1}]^2 = [M L^2 T^{-2}]$$

Dimensions:

$$[M L^2 T^{-2}]$$

4. Derive the dimension of pressure energy

Ans: **Formula:**

$$\text{Pressure Energy} = \frac{\text{Force}}{\text{Area}} \times \text{Volume}$$

But pressure energy per unit volume is the same as pressure, so:

Formula:

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

$$\text{Force} = m \cdot a = [M L T^{-2}]$$

$$\text{Area} = [L^2]$$

$$\text{Dimensions of pressure} = \frac{[M L T^{-2}]}{[L^2]} = [M L^{-1} T^{-2}]$$

5. Derive the dimension of power. Hint: Power = Work / Time

Ans: Work = Force $\times$ Distance = $[M L T^{-2}] \cdot [L] = [M L^2 T^{-2}]$

$$\text{So, Power} = \frac{[M L^2 T^{-2}]}{[T]} = [M L^2 T^{-3}]$$

6. Derive the dimension of force. Hint: Force = Mass $\times$ Acceleration

Ans: Force = $[M] \cdot [L T^{-2}] = [M L T^{-2}]$

7. Write the dimensions of the following. (i) Pressure (ii) Angle (iii) Volume (iv) Frequency

Ans: (i) Pressure: $[M L^{-1} T^{-2}]$

(ii) Angle (Angle is dimensionless): $[1]$ or $[M^0 L^0 T^0]$

(iii) Volume (Length³): $[L^3]$

(iv) Frequency (1 / Time): $[T^{-1}]$

EXERCISE - 3

I. Choose the correct answer:

1. The natural phenomenon by which all objects with mass attract each other is called _____

Ans: (b) Gravitation

2. Which among these is not a correct result of gravitation? _____

Ans: (c) Movement of dust particles in air

3. The moon is revolving around the earth because _____

Ans: (a) The gravitational pull of earth and moon to each other

4. The planets move around the sun in _____

Ans: (b) Elliptic path

5. Which among these is correct about G? _____

Ans: (a) G doesn't depend on the medium between the bodies

6. A heavier object and a lighter object of same material are allowed to fall from certain height; which among these is correct? _____

Ans: (c) Both the objects fall with equal acceleration

7. The velocity of a freely falling body _____

Ans: (a) Increases at steady rate

8. The symbol for acceleration due to gravity is _____

Ans: (b) g

9. _____ is the speed that an object needs to travel to break free of planets, moons or stars gravity

Ans: (b) Escape Velocity

10. Objects that travel in uniform circular motion around the earth are said to be in _____

Ans: (b) Orbit

II. Say True or False:

1. The moon is in orbit due to gravitation

Ans: True

2. The gravitational force of two objects is inversely proportional to the square of their distance

Ans: True

3. The mass of an object depends upon the gravitational force of earth on the object

Ans: False

4. Mass is a scalar quantity

Ans: True

5. The mass of a body can't be zero

Ans: True

III. Concept Questions:

1. Write Kepler's first law of planetary motion.

Ans: All planets move in elliptical orbits with the Sun at one focus.

2. What is gravitation?

Ans: The force of attraction between any two objects with mass.

3. Write Kepler's second law of planetary motion

Ans: A planet sweeps out equal areas in equal intervals of time (law of equal areas).

4. Write Kepler's third law of planetary motion

Ans: The square of the orbital period (T) is proportional to the cube of the semi-major axis (a) of its orbit ($T^2 \propto a^3$).

5. Write any two characteristics of G

Ans: o Universal constant (same everywhere in the universe).

o Independent of the medium between masses.

6. What is escape velocity?

Ans: The minimum speed needed for an object to break free from a planet's gravitational pull without further propulsion.

7. What is orbital velocity?

Ans: The velocity required for an object to stay in a stable orbit around a planet.

8. What is the difference between mass and weight?

Ans: o **Mass:** Scalar quantity, measures matter (unit: kg).
o **Weight:** Vector quantity, measures gravitational force (unit: N).

IV. Multi Correct Choice Type:

1. Which among these are correct about Newton's law of gravitation?

Ans: (a) Every object attracts other objects in the universe.
(b) The force of gravitation is directly proportional to the product of the masses.

2. Which among these are characteristics of G?

Ans: (b) G does not depend upon the medium between two bodies, (c) G is a constant.

3. Which among these are correct about mass and weight?

Ans: (b) Mass can't be zero, (c) Weight can be zero.

4. Which among these are not fundamental properties?

Ans: (a) Weight, (c) Acceleration.

5. Which among these are correct about escape velocity?

Ans: (a) Objects moving more than the escape velocity free themselves from gravity.
(c) Escape velocity is more than orbital velocity.

V. Reasoning Type Questions:

1. Statement-1 : The path of earth about the sun is elliptical.

Statement-2 : The path of moon about the earth is elliptical.

Ans: (b) Both correct, but Statement-2 doesn't explain Statement-1.

2. Statement-1 : The g is a vector quantity.

Statement-2 : The G is a scalar quantity.

Ans: (b) Both correct, but no direct explanation.

3. Statement-1 : A planet covers equal area in equal time.

Statement-2 : A planet covers equal distance in equal time.

Ans: (c) Statement-1 is true (Kepler's 2nd law); Statement-2 is false.

4. Statement-1 : The speed of moon is more than its escape velocity.

Statement-2 : The satellite should rotate with escape velocity to remain in orbit.

Ans: (e) Both false (Moon's speed < escape velocity; orbital velocity $\neq$ escape velocity).

5. Statement-1 : If orbital velocity = $1/\sqrt{2}$, then escape velocity = $\sqrt{2}$.

Statement-2 : Orbital velocity depends on planet's mass.

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

6. Statement-1 : Kepler's 3rd law is called the law of harmonics.

Statement-2 : $T^2 \propto a^3$.

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

7. Statement-1 : Spring balance measures weight.

Statement-2 : Common balance measures mass.

Ans: (a) Both correct, and Statement-2 explains the difference.

Application Skill Achiever

1. An artificial satellite is orbiting around the earth with an orbital velocity 3600 m/s. What is its distance from the center of the earth?

Solution: Formula: $v = \sqrt{\frac{GM}{r}} \Rightarrow r = \frac{GM}{v^2}$

Substitute: $r = \frac{6.674 \times 10^{-11} \times 5.98 \times 10^{24}}{(3600)^2} = \frac{3.991 \times 10^{14}}{1.296 \times 10^7} = 3.08 \times 10^7 \text{ m}$

Ans: $3.08 \times 10^7 \text{ m}$

2. Find out the force of gravitation between the sun and the earth. Mass of sun is $1.989 \times 10^{30} \text{ kg}$ and mass of earth is $5.98 \times 10^{24} \text{ kg}$.

Solution: Given:

Mass of the Sun (M_1) = $1.989 \times 10^{30} \text{ kg}$

Mass of the Earth (M_2) = $5.98 \times 10^{24} \text{ kg}$

Distance between Sun and Earth (R) = $1.496 \times 10^{11} \text{ m}$

Gravitational constant (G) = $6.674 \times 10^{-11} \text{ m}^3/\text{kg}/\text{s}^2$

Using the formula for gravitational force:

$$F = \frac{GM_1M_2}{r^2}$$

$$F = \frac{6.674 \times 10^{-11} \cdot 1.989 \times 10^{30} \cdot 5.98 \times 10^{24}}{(1.496 \times 10^{11})^2} = 3.54 \times 10^{22} \text{ N}$$

Ans: $3.54 \times 10^{22} \text{ N}$

3. The distance from earth to sun is $1.496 \times 10^8 \text{ km}$. If the mass of sun is $1.989 \times 10^{30} \text{ kg}$, what is the orbital velocity of the earth?

Solution: Given:

Distance from Earth to Sun (r) = $1.496 \times 10^8 \text{ km} = 1.496 \times 10^{11} \text{ m}$

Mass of the Sun (M) = $1.989 \times 10^{30} \text{ kg}$

Gravitational constant (G) = $6.674 \times 10^{-11} \text{ m}^3/\text{kg}/\text{s}^2$

Using the formula for orbital velocity:

$$v = \sqrt{\frac{GM}{r}}$$

$$v = \sqrt{\frac{6.674 \times 10^{-11} \cdot 1.989 \times 10^{30}}{1.496 \times 10^{11}}} = \sqrt{8.87 \times 10^8} = 29800 \text{ m/s}$$

Ans: 29.8 km/s

4. Find the force of gravitation between the earth and the moon. If the mass of earth is $5.98 \times 10^{24} \text{ kg}$ and the mass of moon is $7.342 \times 10^{22} \text{ kg}$.

Solution: Given:

F = Gravitational force (in Newtons, N)

G = Gravitational constant = $6.67430 \times 10^{-11} \text{ N m}^2 \cdot \text{kg}^{-2}$

m_1 = Mass of Earth = $5.98 \times 10^{24} \text{ kg}$

m_2 = Mass of Moon = $7.342 \times 10^{22} \text{ kg}$

r = Distance between Earth and Moon (average) = $3.844 \times 10^8 \text{ m}$

Formula: $F = \frac{GM_1M_2}{r^2}$

$$F = \frac{6.674 \times 10^{-11} \cdot 5.98 \times 10^{24} \cdot 7.342 \times 10^{22}}{(3.844 \times 10^8)^2} = 1.98 \times 10^{20} \text{ N}$$

Ans: $1.98 \times 10^{20} \text{ N}$

5. Satellite A is 5 times farther from a planet than satellite B. If A takes 22 weeks to complete a full orbit around the planet, how long will satellite B to travel to complete a full orbit.

Solution: Kepler's 3rd Law

$$\left(\frac{T_A}{T_B}\right)^2 = \left(\frac{r_A}{r_B}\right)^3 = 5^3 = 125$$

$$\Rightarrow T_B = \frac{T_A}{\sqrt{125}} = \frac{22}{\sqrt{125}} = 1.96 \text{ weeks}$$

Ans: $T_B = 1.96 \text{ weeks}$

6. Find the force of gravitation between the earth and a matter of 1200 kg located at a distance of $8 \times 10^7 \text{ m}$ from the centre of earth. (mass of earth = $5.98 \times 10^{21} \text{ kg}$).

Solution: Given:

Mass of Earth (m_1) = $5.98 \times 10^{24} \text{ kg}$

Mass of object (m_2) = 1200 kg

Distance (r) = $8 \times 10^{21} \text{ m}$

Gravitational constant (G) = $6.67430 \times 10^{-11} \text{ N} \cdot \text{m}^2 \cdot \text{kg}^{-2}$

Formula: $F = \frac{GM_1M_2}{r^2}$

$$F = \frac{6.674 \times 10^{-11} \times 5.98 \times 10^{21} \times 1200}{(8 \times 10^7)^2}$$

$$F = \frac{4.789 \times 10^{14}}{6.4 \times 10^{15}} = 0.0748 \text{ N}$$

Ans: $F = 0.075 \text{ N}$

7. A satellite is orbiting the earth at a velocity of 4000 m/sec. What is its orbital radius?

Solution: Given:

Orbital velocity (v) = 4000 m/s

Mass of Earth (M) = $5.98 \times 10^{24} \text{ kg}$

Gravitational constant (G) = $6.67430 \times 10^{-11} \text{ N m}^2 \cdot \text{kg}^{-2}$

Formula: $v = \sqrt{\frac{GM}{r}} \Rightarrow r = \frac{GM}{v^2}$

$$r = \frac{6.674 \times 10^{-11} \times 5.98 \times 10^{24}}{4000^2} = 2.49 \times 10^7 \text{ m}$$

Ans: $r = 2.49 \times 10^7 \text{ m}$

8. A satellite is located at a distance of 4.6×10^6 m. What is its orbital velocity?

Solution: Given:

Orbital radius (r) = 4.6×10^6 m (46,000 km from Earth's center)

Mass of Earth (M) = 5.98×10^{24} kg

Gravitational constant (G) = 6.67430×10^{-11} N m²·kg⁻²

Formula:
$$v = \sqrt{\frac{GM}{r}}$$

$$v = \frac{6.674 \times 10^{-11} \times 5.98 \times 10^{24}}{4.6 \times 10^6} = 9511 \text{ m/s}$$

Ans: $v = 9511$ m/s

9. A satellite is moving around the earth at a distance of 5.2×10^6 m. What is the escape velocity of the satellite to escape from the gravity of the earth?

Solution: Formula:

$$v_e = \sqrt{\frac{2GM}{r}} = \sqrt{2} \times \sqrt{\frac{GM}{r}} = \sqrt{2} \times \text{orbital velocity}$$

$$v_e = \frac{2 \times 6.674 \times 10^{-11} \times 5.98 \times 10^{24}}{5.2 \times 10^6} = 13500 \text{ m/s}$$

Ans: $v_e = 13.5$ m/s

EXERCISE - 4

I. Choose the correct answer:

1. Work done by the force is equal to the _____
2. Work is _____ quantity.
3. In static and dynamic equilibrium; the resultant force is _____.
4. Which among these is a non-conservative force? _____
5. Energy is a _____ quantity.
6. Which among these is a conservative force? _____
7. The rate of work done by a body is called its _____.
8. The _____ of kinetic and potential energies through at the motion.
9. If the kinetic energy of an object is increased than its potential energy _____.
10. According to Einstein _____.

Ans: (a) Force $\times$ displacement

Ans: (b) A scalar

Ans: (a) Zero

Ans: (c) Frictional force

Ans: (b) Scalar

Ans: (c) Magnetic force

Ans: (c) Power

Ans: (a) Sum

Ans: (a) Is reduced

Ans: (a) $E = mc^2$

II. Say True or False:

1. Potential energy of an object is by virtue of its position or configuration.
2. Kilowatt is a unit of power.
3. In elastic collision the momentum and the kinetic energy of the system is conservative.
4. The energy possess by the nucleus of an atom is called kinetic energy.
5. Gravitational force is a conservative force.

Ans: True

Ans: True

Ans: True

Ans: False

Ans: True

III. Concept Questions:

1. What is work?

Ans: Work is the product of force and displacement in the direction of the force ($W = F \times d$).

2. What is power?

Ans: Power is the rate of doing work ($P = \text{Work/Time}$).

3. What is the difference between kinetic energy and potential energy?

- Ans:** o **Kinetic Energy (KE):** Energy due to motion ($KE = \frac{1}{2}mv^2$).
o **Potential Energy (PE):** Energy due to position or configuration ($PE = mgh$ for gravitational PE).

4. What is elastic collision?

Ans: A collision where both momentum and kinetic energy are conserved (e.g., billiard balls).

5. What is inelastic collision?

Ans: A collision where momentum is conserved but kinetic energy is not (e.g., clay sticking to a wall).

IV. Multi Correct Choice Type:

1. Which among these are correct explanations of work?

Ans: (a) If force increases, work also increases

2. Which among these are correct about power?

Ans: (b) Power is measured in watt, (c) Power is a scalar.

3. Which among these are correct about energy?

Ans: (a) Energy of a body is its capacity of doing work, (b) Heat is a form of energy.

4. Which among these are correct about KE & PE?

Ans: (a) $KE + PE$ is constant, (b) KE is a type of mechanical energy, (c) PE is a type of mechanical energy.

5. When a body of mass m is raised to a height h from the surface of earth then _____

Ans: (a) Its potential energy is increased

V. Reasoning Type Questions:

1. Statement-1 : Power = Work done/Time taken.

Statement-2 : Work = force $\times$ displacement.

Ans: (b) Both correct, but Statement-2 doesn't explain Statement-1.

2. Statement-1 : In an inelastic collision, momentum remains conserved.

Statement-2 : In an inelastic collision, kinetic energy remains conserved.

Ans: (c) Statement-1 is true; Statement-2 is false (KE is not conserved in inelastic collisions).

3. Statement-1 : Elastic collisions conserve momentum and kinetic energy.

Statement-2 : In elastic collisions, all forces are conservative.

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

4. Statement-1 : 1 Joule = 10^7 erg.

Statement-2 : Erg is a unit of energy.

Ans: (a) Both correct, and Statement-2 supports Statement-1 (conversion factor).

5. Statement-1 : Mass and energy are not conserved separately (per quantum physics).

Statement-2 : Mass can be converted to energy.

Ans: (a) Both correct, and Statement-2 explains Statement-1 ($E = mc^2$).

Application Skill Achiever

1. Calculate the work done by a lift which lifts up a load of 200 kg vertically up to a height of 20 meters.

Ans: Work done = $mgh = 200 \times 9.8 \times 20 = 39,200$ J

2. How much energy can be derived from a mass of 0.5 kg if the total mass is to be converted into energy? The velocity of light is 3×10^8 m/s⁻¹.

Ans: Energy = $mc^2 = 0.5 \times (3 \times 10^8)^2 = 0.5 \times 9 \times 10^{16} = 4.5 \times 10^{16}$ J

3. Find the gravitational potential energy of an apple of mass 0.25 kg located at a height of 7 meters.

Ans: $GPE = mgh = 0.25 \times 9.8 \times 7 = 17.15 \text{ J}$

4. A force of 20 N displaces a ball by 3 meters in the same direction of the applied force. Find out the work done.

Ans: $Work = F \times d = 20 \times 3 = 60 \text{ J}$

5. A hot air balloon pulls up a man of 80 kg to a height of 48 m. Calculate the work done by the balloon.

Ans: $Work \text{ done} = mgh = 80 \times 9.8 \times 48 = 37,632 \text{ J}$

6. Find the gravitational potential energy between two iron cubes of masses 800 kg and 900 kg separated by a distance of 1.2 meters.

Ans: $U = -\frac{Gm_1m_2}{r} = -\frac{6.674 \times 10^{-11} \times 800 \times 900}{1.2} = -\frac{6.006 \times 10^{-5}}{1.2} = -5.005 \times 10^{-5} \text{ J}$

Approximated: $-5.0 \times 10^{-5} \text{ J}$

7. The kinetic energy of a missile is found to be 800 J. If its mass is 12 kg, what is its velocity?

Ans: $v = \sqrt{\frac{2 \times KE}{m}} = \sqrt{\frac{2 \times 800}{12}} = \sqrt{133.33} = 11.55 \text{ m/s}$

8. The kinetic energy of a rocket is found as 12000 J. Its mass is 16 kg. What is its momentum?

Ans: $p = \sqrt{2mKE} = \sqrt{2 \times 16 \times 12000} = \sqrt{384000} = 619.68 \text{ kg m/s}$

EXERCISE - 5

I. Choose the correct answer:

- The force of attraction between two opposite charged particles $F = \frac{1}{4\pi\epsilon} \frac{q_1q_2}{r^2}$ **Ans:** (b) $K \frac{q_1q_2}{r^2}$
- In the expression $F = \frac{1}{4\pi\epsilon} \frac{q_1q_2}{r^2}$, ϵ is the **Ans:** (c) Permittivity of the medium
- Relative permittivity is the ratio of the permittivity of a medium and that of **Ans:** (b) Vacuum
- The electric intensity $E = \frac{1}{4\pi\epsilon_0} \frac{q}{r^2}$ **Ans:** (c) $\frac{1}{4\pi\epsilon_0} \frac{q}{r^2}$ Newton / Coulomb
- A system of two equal and opposite charges separated by a fixed distance is called **Ans:** (a) Electric dipole
- The charge of a conductor is Q and the potential due to the charge is V, then capacity $C = \frac{Q}{V}$ **Ans:** (a) Q/V
- The capacity of a spherical conductor $C = 4\pi\epsilon_0 R$ **Ans:** (b) $4\pi\epsilon_0 R$
- The capacity of a parallel plate capacitor $C = \frac{\epsilon_0 A}{d}$ **Ans:** (a) $\frac{\epsilon_0 A}{d}$
- The resultant capacity (c) formula for capacitors connected in series is **Ans:** (b) $\frac{1}{C} = \frac{1}{C^1} + \frac{1}{C^2} + \frac{1}{C^3} + \dots$
- If the capacitors are connected in parallel, then the formula for resultant capacity C is **Ans:** (a) $C_1 + C_2 + C_3 + \dots$

II. Say True or False:

- The SI unit of force is Farad. **Ans:** False
- The relative permittivity is a dimensionless number. **Ans:** True
- Coulomb's law is related to mechanical force. **Ans:** False

4. Capacitors are used to store electric charge and energy. **Ans:** True.
 5. Electric potential is a vector quantity. **Ans:** False

III. Concept Questions:

1) Write Coulomb's law of electrostatic force.

Ans: Coulomb's law states that the electrostatic force between two charged objects is directly proportional to the product of their charges and inversely proportional to the square of the distance between them.

Mathematically,

$$F = \frac{1}{4\pi\epsilon_0} \frac{q_1 q_2}{r^2}$$

Where:

F is the force between the charges
 q1 and q2 are the amounts of the two charges
 r is the distance between the charges
 ϵ_0 is the permittivity of free space

2) What is relative permittivity?

Ans: Relative permittivity (also called dielectric constant) is the ratio of the permittivity of a material to the permittivity of free space.

It shows how much a material can reduce the electric force between two charges compared to vacuum.

$$\epsilon_r = \frac{\epsilon}{\epsilon_0}$$

Where:

ϵ = permittivity of the material
 ϵ_0 = permittivity of free space

3) What is the use of capacitors?

Ans: Capacitors are used to store electrical energy in the form of electric charge. Some common uses include:

- Smoothing current in power supplies
- Timing circuits in electronic devices
- Storing energy in flash cameras
- Tuning radios to specific frequencies

4) What is electric intensity?

Ans: Electric intensity (or electric field intensity) is the force experienced by a unit positive charge placed at a point in an electric field.

$$E = \frac{F}{q}$$

Where:

- E is electric intensity
- F is the force acting on the charge
- q is the magnitude of the charge

Its SI unit is newton per coulomb (N/C) or volt per meter (V/m).

IV. Multi Correct Choice Type:

1. Which among these are correct about capacity?

Ans: (b) Farad is the SI unit of capacity.

2. The dipole moment is related to:

Ans: (a) Charge of the body, (c) Distance between charges

3. Which among these represent correct relation between C, Q, and V?

Ans: (a) $C = Q/V$

4. Which among these are correct about lower potential?

Ans: (b) Objects with lower potential accept electrons.

V. Reasoning Type Questions:

1. **Statement-1** : Any object can be either positively or negatively charged.

Statement-2 : A negative charge is formed by losing electrons.

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

2. **Statement-1** : Coulomb's force law shows about the electrostatic force between two charged particles.

Statement-2 : Coulomb's force law shows relationship between permittivity and relative permittivity.

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

3. **Statement-1** : The Dipole moment increases if the distance between the two charges increases.

Statement-2 : Dipole moment is inversely proportional to the distance between the two charges.

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

4. **Statement-1** : Capacitors store used to store electric charges and energy.

Statement-2 : Capacitors are used to store electricity in large power plants.

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

5. **Statement-1** : Capacity of a spherical conductor $C = \frac{\epsilon_0 A}{d}$

Statement-2 : Capacity of a parallel plate capacitor $C = 4\pi\epsilon_0 r$.

Ans: (e) Both the statements are false

Application skill Achiever

1. Three capacitors of capacitance 10, 30, 60 μF are connected in series. What is the resultant capacitance?

Ans: In Series:

$$\frac{1}{C} = \frac{1}{10} + \frac{1}{30} + \frac{1}{60} = \frac{6+2+1}{60} = \frac{9}{60} = 6.67 \mu F$$

2. Three capacitors of capacitance 20, 40, 50 μF are connected in parallel, what is the resultant capacitance?

Ans: In Parallel:

$$C = 20 + 40 + 50 = 110 \mu F$$

3. Five capacitors of capacitances 6, 7, 2, 5, 8 μF are in series. The potential across the first capacitor is 30 V. What is the potential across the group?

Ans: In series, voltage divides in ratio of inverse of capacitance.

Let total voltage be V. Then:

$$V_1 = V \times \frac{1/C_1}{\sum(1/C)} = V \times \frac{1/6}{1/6+1/7+1/2+1/5+1/8}$$

Calculate total reciprocal capacitance:

$$\frac{1}{6} + \frac{1}{7} + \frac{1}{2} + \frac{1}{5} + \frac{1}{8} = 0.167 + 0.143 + 0.5 + 0.2 + 0.125 = 1.135$$

So,

$$\frac{1}{6} = 0.167 \Rightarrow \frac{V_1}{V} = \frac{0.167}{1.135} \Rightarrow \frac{30}{0.167/1.135} = 204V$$

4. Four capacitors of capacitances 6, 20, 25, 30 μF are in parallel. The charge of the first is 18 μC . What is the total charge in the circuit?

Ans: In parallel, voltage is same:

$$Q_1 = C_1 \times V \Rightarrow 18 = 6 \times V \Rightarrow V = 3 \text{ V}$$

5. What is the work done by bringing a charge of 2000 coulomb from A to B, where the electro static potentials of A and B are 200 and 150 respectively.

Ans: $W = q(V_A - V_B) = 2000 \times (200 - 150) = 2000 \times 50 = 100000 \text{ J}$

6. Find the dipole moment of two oppositely charged balls of +8 coulomb and -8 coulomb separated by 2.1 meters.

Ans: $p = q \times d = 8 \times 2 \times 1 = 16 \text{ C m}$

7. The electro static force between A and B is 720 Newton per coulomb. And the electro static force between B and C is 480 Newton per coulomb. If B is located at the middle of A and C, find the ratio of charge of A and charge of C.

Ans: Since B is equidistant from A and C,

$$F \propto q \Rightarrow \frac{F_{AB}}{F_{BC}} = \frac{q_A}{q_C} = \frac{720}{480} = 3:2$$

8. What is the work done by bringing a charged ball of charge 4 coulomb from A to B where the electrostatic potentials at A and B are 100 and 80 respectively?

Ans: $W = q(V_A - V_B) = 4(100 - 80) = 80 \text{ J}$

9. The force between two charges is 16 N when the distance between them is 4 m. Find the force if the distance between them is changed to 2 cm.

Ans: Force $\propto \frac{1}{r^2}$

$$F_2 = 16 \times \left(\frac{4}{0.02} \right)^2 = 16 \times 200^2 = 16 \times 40000 = 640000 \text{ N}$$

10. The force between two charged particles is 800 N when the charged particles are at distance of 4 m. At what distance the charged particles be to maintain a force of 200 N.

Ans: $F \propto \frac{1}{r^2} \Rightarrow \frac{F_1}{F_2} = \left(\frac{r_2}{r_1} \right)^2 \Rightarrow \frac{800}{200} = \left(\frac{r_2}{4} \right)^2 \Rightarrow 4 = \left(\frac{r_2}{4} \right)^2 \Rightarrow \frac{r_2}{4} = 2 \Rightarrow r_2 = 8 \text{ m}$

EXERCISE - 6

I. Choose the correct answer:

- Sound is produced because of _____
- The traveling of sound is called _____ of sound.
- Sound can't propagate _____
- Loudness of sound is measured in _____
- _____ of a sound determines the pitch of the sound.
- Who among these produces sound of lower frequency? _____
- The audible range of sound for human beings is _____
- Loudness of sound depends upon _____ of the sound wave.
- Sound frequency below 20 Hz is called _____
- Sound frequency above 20000 Hz is called _____

Ans: (a) Vibration of an object

Ans: (c) Propagation

Ans: (b) In vacuum

Ans: (a) Decibel

Ans: (a) Frequency

Ans: (c) Adult male

Ans: (b) 20 to 20000 Hz

Ans: (c) Amplitude

Ans: (a) Infra sound

Ans: (b) Ultra sound

II. Say True or False:

1. Sound can't propagate in the absence of medium. **Ans:** True
2. The frequency of drum sound is more than the frequency of whistle. **Ans:** False
3. Bat produces ultra sound. **Ans:** True
4. Sonar is used to measure distance of object under the sea. **Ans:** True
5. Human beings can hear ultra sounds. **Ans:** False

III. Concept Questions:

1. Define amplitude of sound.

Ans: The amplitude of a sound wave is the maximum displacement of the particles of the medium from their mean position due to the sound wave.
It determines the loudness of the sound — greater the amplitude, louder the sound.

2. What is frequency of sound?

Ans: The frequency of a sound wave is the number of vibrations or oscillations produced by the source in one second. It is measured in Hertz (Hz). Higher frequency means higher pitch.

3. What is audible sound?

Ans: Audible sound is the range of sound waves that can be heard by the human ear.
The audible range is from 20 Hz to 20,000 Hz.

4. What is the use of sonar?

Ans: SONAR (Sound Navigation and Ranging) is used to detect underwater objects such as submarines, shipwrecks, and the ocean floor.
It works by sending ultrasonic waves and measuring the time taken for the echo to return.

5. Write any two measures to reduce noise pollution.

Ans: Use of silencers in vehicles and machines.
Planting trees and using sound-absorbing materials in buildings to reduce noise levels.

IV. Multi Correct Choice Type:

1. Which among these are correct about propagation of sound?

Ans: (b) Sound travels through air, (c) Sound travels through water

2. Which among these are correct about the frequency of sound?

Ans: (b) The number of vibrations or oscillations per second is called frequency.
(c) Frequency is measured in hertz.

3. Loudness of sound depends upon _____

Ans: (c) Amplitude

4. Which among these are correct about the frequency of roar of a lion and the shrill of a bird?

Ans: (b) The frequency of shrill of bird is more than the roar of lion.

5. The frequency of sound audible to human beings are _____

Ans: (a) 480 Hz, (b) 200 Hz, (c) 3000 Hz

V. Reasoning Type Questions:

1. Statement-1 : Sounds with lower frequency is called as ultra sound.

Statement-2 : Loud and excursive sound is called noise.

Ans: (e) Both the statements are false.

2. Statement-1 : Sound above 80dB is very painful to hear.

Statement-2 : Sonar uses light waves to measure the distance.

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

3. **Statement-1** : In a keyboard, the frequency increases from left to right.

Statement-2 : Unpleasant sound is called a noise.

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

4. **Statement-1** : Time taken to the sound wave to reach the destination is called time period.

Statement-2 : Time required to produce one complete oscillation is called time period.

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

5. **Statement-1** : Decibel is used to measure the loudness of sound.

Statement-2 : Sound with higher frequency is more shrill.

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

Application Skill Achiever

1. A sound wave of frequency 5000 Hz travels in air with speed of 350 m/s. Calculate the wave length.

Ans: Wave length = Speed/Frequency = $350/5000 = 0.07$ m

2. If you hear thunder 5 sec after you see the lightning, how far are you from the lightning occurred?

Ans: Distance = Speed of sound $\times$ Time = $343 \text{ m/s} \times 5 \text{ s} = 1715$ m

3. Calculate the wavelength of a sound whose frequency is 220 Hz and speed is 440 m/s in a given medium.

Ans: Wave length = $440/220 = 2$ m

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

Ans: Frequency = Vibrations/Time = $6000/60 = 100$ Hz

5. A sound wave with frequency 1200 Hz is passing through a special medium. If the speed of sound in the medium is 800 m/s, find out the wavelength.

Ans: Wave length = $800/1200 = 0.67$ m

6. A longitudinal wave of wavelength 1 cm travels in air with a speed of 330 m/s^{-1} . Calculate the frequency of the wave.

Ans: Frequency = $330/0.01 = 33000$ Hz

7. A ship on the surface of water sends a signal and receives it back after 4 seconds from a submarine inside the water. Calculate the distance of the submarine from the ship. The speed of sound in water is 1450 m/s^{-1} .

Ans: Total time = 4 s $\Rightarrow$ Time to reach submarine = $4/2 = 2$ s

Distance = Speed $\times$ Time = $1450 \times 2 = 2900$ m

EXERCISE - 7

I. Choose the correct answer:

1. Materials which allow electric current to pass through are called _____.

Ans: (b) Good conductor

2. Which among these is correct about chromium?

Ans: (a) It is a metal

3. The iron rods used in bridges are coated with _____ to avoid rusting.

Ans: (b) Zinc

4. The irons used to preserve food are coated with _____.

Ans: (c) Tin

5. Depositing a layer of any metal on another material by means of electricity is called _____.

Ans: (b) Electroplating

II. Say True or False:

1. Pure water is a bad conductor of electricity.

Ans: True

2. Graphite is a good conductor of electricity.

Ans: True

3. Salt water is not a conductor of electricity.

Ans: False

4. Copper sulphate solution is a good conductor of electricity.

Ans: True

5. NaOH is synthesized by the process of electrolysis.

Ans: True

III. Concept Questions:

1. Write the name of any two solutions that conduct electric current.

Ans: o Saltwater (Sodium chloride solution)
o Lemon juice

Both contain ions that allow electric current to pass through.

2. Why is groundwater a good conductor whereas pure distilled water is a poor conductor?

Ans: Groundwater contains dissolved salts and minerals which provide free ions, making it a good conductor.
Pure distilled water lacks ions, so it does not conduct electricity well.

3. What is electroplating?

Ans: Electroplating is the process of coating a metal object with a thin layer of another metal using electric current.

It is used to protect metals from rust or to make them look shiny and attractive.

4. What is an electrolyte?

Ans: An electrolyte is a liquid or solution that conducts electricity by allowing the movement of ions.
Examples include salt solution, acid, or base.

5. What do you get by electrolysis of water?

Ans: By electrolysis of water, you get:

- Hydrogen gas at the cathode
- Oxygen gas at the anode

IV. Multi Correct Choice Type:

1. Which among these are good conductors of electricity?

Ans: (a) Gold , (c) HCl solution

2. Which among these are bad conductors of electricity?

Ans: (b) Diamond , (c) Wood

3. Which among these are correct about ions?

Ans: (a) Ions have charge , (b) Positive ions are called cations , (c) Negative ions are called anions

4. Mercury is a _____.

Ans: (b) Good conductor of electricity , (c) Metal

5. Which among these are good conductors of electricity?

Ans: (b) Mercury , (c) Graphite

6. Which among these compounds are produced by electrosynthesis method?

Ans: (a) NaOH

7. Which of the following metals are electroplated in low-cost jewellery?

Ans: (b) Silver , (c) Gold

8. Which among these are obtained by electrolysis?

Ans: (a) Hydrogen , (b) Fluorine , (c) Chlorine

9. Which among these are correct about chromium?

Ans: (a) It is shiny , (b) It does not corrode

10. Which among these are correct about tin?

Ans: (a) It is less reactive than iron , (b) It is used in food-grade containers

V. Reasoning Type Questions:

1. **Statement-1** : Pure water is a good conductor of electricity.

Statement-2 : Pure water contains salts of silicon.

Ans: (e) Both the statements are false.

2. **Statement-1** : HCl is an ionic solution.

Statement-2 : Ionic solutions are bad conductors of electricity.

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

3. **Statement-1** : Heavy water is prepared by electrolysis.

Statement-2 : Coating of sodium is deposited on iron to protect it from rusting.

Ans: (e) Both the statements are false.

4. **Statement-1** : Positive ions are called cations.

Statement-2 : Negative ions are called anions.

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

5. **Statement-1** : Ions are charged items.

Statement-2 : Ions are attracted towards opposite electrodes.

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

EXERCISE - 8

I. Choose the correct answer:

1. Current is defined as the movement of _____.

Ans: (a) Electrons

2. 1 ampere of current = _____ electrons per second.

Ans: (b) 6.241×10^{18}

3. If electrons are moving to the left, then current is moving to _____.

Ans: (a) Right

4. _____ is a variable resistor.

Ans: (c) Rheostat

5. Resistance of a resistor is measured in _____.

Ans: (b) Ohm

6. The capacitance of a capacitor is directly proportional to the _____ of the conductor.

Ans: (a) Charge

7. As per Ohm's law, current = _____.

Ans: (a) Voltage/Resistance

8. In electronic circuits, _____ are used to reduce current flow.

Ans: (a) Resistor

II. Say True or False:

1. Diodes allow electric current to pass in one direction.

Ans: True

2. Transistors have at least three terminals.

Ans: True

3. Light-emitting diodes are transistors.

Ans: False

4. An integrated circuit is called as cheap.

Ans: False

5. The microprocessor of a computer is an integrated circuit.

Ans: True

III. Concept Questions:

1. What is Ohm's law?

Ans: Ohm's law states that the current (I) through a conductor is directly proportional to the voltage (V) across it and inversely proportional to its resistance (R): $V=IR$.

2. What is an electronic circuit?

Ans: A closed path consisting of interconnected electronic components (e.g., resistors, capacitors) that allow the flow of electric current to perform a specific function.

3. What are the uses of a rheostat?

Ans: o Adjusting current in a circuit (e.g., dimming lights).
o Controlling motor speed.

4. What is a gang condenser?

Ans: A variable capacitor with multiple parallel plates used to tune frequencies in radios.

5. What is the use of a transformer in electronic circuits?

Ans: To step up or step down AC voltage levels for efficient power transmission or device operation.

IV. Multi Correct Choice Type:

1. In a circuit, the current is moving from A to B, then electrons are moving from _____.

Ans: (b) B to A

2. Which among these are correct about current and potential difference?

Ans: (b) Current is flow of electrons, (c) Current has a direction

3. The correct relation between I, V, and R are _____. **Ans:** (a) $V = IR$, (c) $I = V/R$

4. Which among these is correct about resistance? **Ans:** (b) Resistance is measured in ohm

V. Reasoning Type Questions:

1. Statement-1 : Allowing current to flow through a resistor requires energy.

Statement-2 : Resistors are used in electronic devices.

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

2. Statement-1 : Voltage is the electromotive force to produce the current.

Statement-2 : Voltage is measured in ohm.

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

3. Statement-1 : A triode has three electrodes.

Statement-2 : Triodes are used in amplifiers.

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

4. Statement-1 : Step-up transformer converts AC to DC.

Statement-2 : Step-down transformer converts DC to AC.

Ans: (e) Both the statements are false.

5. Statement-1 : In a step-up transformer, the primary winding is more than the secondary winding.

Statement-2 : A transformer is used to change the voltage.

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

Application Skill Achiever

1. A transformer has 40 turns in the primary winding and 600 turns in the secondary winding. If the current in the primary turn is 20 A, what is the current in the secondary turn?

Ans: Using the transformer current relation:

$$\frac{I_s}{I_p} = \frac{N_p}{N_s} \Rightarrow I_s = I_p \times \frac{N_p}{N_s} = 20 \times \frac{40}{600} = 20 \times \frac{1}{15} = 1.33 \text{ A}$$

2. A transformer has 500 turns of the primary winding and 10 turns of the secondary winding. Determine the secondary voltage if the secondary circuit is open and the primary voltage is 120 V.

Ans: Using voltage-turns ratio:

$$\frac{V_s}{V_p} = \frac{N_s}{N_p} \Rightarrow V_s = V_p \times \frac{N_s}{N_p} = 120 \times \frac{10}{500} = 120 \times 0.02 = 2.4 \text{ V}$$

3. A transformer has 20 primary windings and 100 secondary windings. If the secondary voltage is 25 V, find the primary voltage.

Ans: $\frac{V_s}{V_p} = \frac{N_s}{N_p} \Rightarrow V_p = V_s \times \frac{N_p}{N_s} = 25 \times \frac{20}{100} = 25 \times 0.2 = 5 \text{ V}$

4. A transformer has primary winding 800 turns and secondary winding 200 turns. If a voltage of 400 kV is supplied through the primary winding, what is the voltage across the secondary windings?

Ans: $\frac{V_s}{V_p} = \frac{N_s}{N_p} \Rightarrow V_s = V_p \times \frac{N_s}{N_p} = 400000 \times \frac{200}{800} = 400000 \times 0.25 = 100000 \text{ V} = 100 \text{ kV}$

EXERCISE - 9

I. Choose the correct answer:

1. As per Kirchhoff's current law, _____.

Ans: (a) Total current or charge entering a junction or node is exactly equal to the charge leaving the node.

2. The current law by Kirchhoff is commonly known as _____.

Ans: (c) Conservation of charge

3. According to second law Kirchhoff's _____.

Ans: (c) The algebraic sum of all voltages within a loop is zero.

4. The Voltage law by Kirchhoff is commonly known as _____.

Ans: (b) Conservation of energy

5. A circuit contains two resistors of resistance R_1 and R_2 , connected in series. What is the Resultant resistance?

Ans: (a) $R_1 + R_2$

6. A circuit contains two registers of resistance R_1 & R_2 , connected in parallel. What is the resultant resistance?

Ans: (a) $(R_1 \times R_2) / (R_1 + R_2)$

7. Which is correct about a circuit?

Ans: (b) A circuit is a closed loop conducting path in which an electrical current flows.

II. Say True or False:

1. A node is a junction, connection or terminal within a circuit where two or more circuit elements are connected.

Ans: True

2. A node is indicated by a square.

Ans: False

3. A loop is a simple closed path in a circuit in which no circuit element or node is encountered more than once.

Ans: True

4. A mesh is an open loop which has no closed path.

Ans: False

III. Concept Questions:

1. Explain Kirchhoff's first law (The Current Law):

Ans: The algebraic sum of currents entering and leaving a node (junction) is zero. This is based on the law of conservation of electric charge, meaning that charge does not accumulate at a node.

2. Explain Kirchhoff's second law (Voltage Law):

Ans: The algebraic sum of all the voltages in a closed loop is zero. This law is based on the principle of conservation of energy, indicating that the total energy gained per unit charge is equal to the energy lost per unit charge in a loop.

3. What is a branch in a circuit:

Ans: A branch is a single path in a circuit that connects two nodes and contains electrical components such as resistors, capacitors, or voltage sources.

4. What is a node in a circuit:

Ans: A node is a point in a circuit where two or more components are connected. It serves as a junction for current to split or combine.

IV. Multi Correct Choice Type:

1. To a node four currents (C_1 , C_2 , C_3 , C_4) are entering and one current of C_5 is leaving then

Ans: (b) $C_1 + C_2 + C_3 + C_4 = C_5$

2. Which among these are correct about node?

Ans: (a) Two or more circuit elements can be connected to a node, (b) A node is a junction

3. Which among these are correct about loop?

Ans: (a) In a loop no node is encountered more than once., (c) A loop is a closed path

4. Which among these are correct about loop and mesh?

Ans: (c) A loop is a closed path

5. Which among these are correct about branch?

Ans: (b) A branch is a single or group of components., (c) A resistor can be inside a branch

V. Reasoning Type Questions:

1. Statement-1 : The algebraic sum of all the currents entering and leaving a node must be equal to zero.

Statement-2 : More than one current cannot enter into a node.

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

2. Statement-1 : The algebraic sum of all voltages within the loop must be equal to zero.

Statement-2 : Kirchhoff's 2nd law is known as conservation of energy.

Ans: (a) Both correct; Statement-2 explains Statement-1.

3. Statement-1 : A node indicated by a hyphen.

Statement-2 : A node is a junction.

Ans: (d) Statement-1 is false; Statement-2 is true.

4. Statement-1 : When the resistors are connected in series the current has only one path.

Statement-2 : Resistors can be connected in parallel.

Ans: (b) Both correct but unrelated.

5. Statement-1 : If two resistors are connected in series than the total resistance is equal to the sum of the resistance of two resistors.

Statement-2 : Two resistors can't be connected in parallel.

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

6. Statement-1 : Kilowatt hour is the SI unit of energy.

Statement-2 : As the thickness of the wire increases, the resistance of the conductor decreases.

Ans: (b) Both correct but unrelated.

7. Statement-1 : The SI unit of potential difference is Volt.

Statement-2 : The SI unit of current is Coulomb/sec.

Ans: (a) Both correct; Statement-2 explains Statement-1.

Application Skill Achiever

1. Two resistors are connected in series with resistance 2W and 5W. What is the resultant resistance?

Ans: Given, Resistance of two resistors 2W and 5W; Resultant resistance = ?

$$\text{Resultant resistance} = 2\Omega + 5\Omega = 7\Omega$$

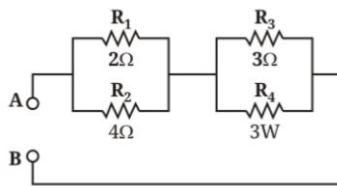
2. Two resistors are connected in parallel. Their resistances are 8W and 12W. What is the resultant resistance?

Ans: Given, Resistance of two resistors 8W and 12W; Resultant resistance = ?

$$\text{Formula for this} \quad \frac{1}{R} = \frac{1}{8} + \frac{1}{12} = \frac{3+2}{24} = \frac{5}{24}$$

$$R = \frac{24}{5} = 4.8\Omega$$

3. Find the total resistance, R_T of the given circuit.



Ans: Total Resistance = Resultant resistance of R_1 and R_2 + Resultant resistance of R_3 and R_4

Let the resultant resistance of R_1 and $R_2 = R_x$

and the resultant resistance of R_3 and $R_4 = R_y$

$$\frac{1}{R_x} = \frac{1}{R_1} + \frac{1}{R_2} = \frac{1}{2} + \frac{1}{4} = \frac{3}{4}$$

$$\Rightarrow R_x = \frac{4}{3} = 1.333\Omega$$

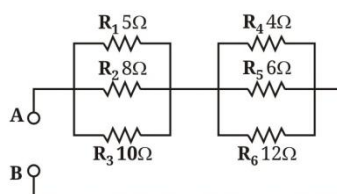
Similarly

$$\frac{1}{R_y} = \frac{1}{R_3} + \frac{1}{R_4} = \frac{1}{3} + \frac{1}{3} = \frac{2}{3}$$

$$\Rightarrow R_y = \frac{3}{2} = 1.5\Omega$$

$$R_T = R_x + R_y = 1.333\Omega + 1.5\Omega = 2.833\Omega$$

4. Find the total resistance, R_T of the given circuit.



Ans: Total Resistance = Resultant ratio of R_1 , R_2 and R_3 + Resultant ratio of R_4 , R_5 and R_6

Let the resultant resistance of R_1 , R_2 and $R_3 = R_x$

and the resultant resistance of R_4 , R_5 and $R_6 = R_y$

$$\frac{1}{R_x} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} = \frac{1}{5} + \frac{1}{8} + \frac{1}{10} = \frac{8+5+4}{40} = \frac{17}{40}$$

$$R_x = \frac{40}{17} = 2.35\Omega$$

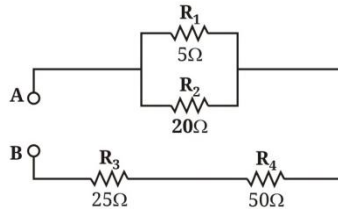
Similarly

$$\frac{1}{R_y} = \frac{1}{R_4} + \frac{1}{R_5} + \frac{1}{R_6} = \frac{1}{4} + \frac{1}{6} + \frac{1}{12} = \frac{3+2+1}{12} = \frac{6}{12} = \frac{1}{2} \Omega$$

$$R_y = 2\Omega$$

$$R_T = R_x + R_y = 2.35\Omega + 2\Omega = 4.35\Omega$$

5. Find the total resistance, R_T of the given circuit.



Ans: Total Resistance = Resultant resistance of R_1 and $R_2 + R_3 + R_4$

Let the resultant resistance of R_1 and $R_2 = R_x$

$$\frac{1}{R_x} = \frac{1}{R_1} + \frac{1}{R_2} = \frac{1}{5} + \frac{1}{20} = \frac{4+1}{20} = \frac{5}{20} = \frac{1}{4}$$

$$\Rightarrow R_x = 4\Omega$$

$$R_T = R_x + R_3 + R_4 = 4\Omega + 25\Omega + 50\Omega = 79\Omega$$

EXERCISE - 10

I. Choose the correct answer:

- Normal temperature of a human body is _____. **Ans:** (b) 98.6° F
- Choose correct statement. **Ans:** (c) 1° F < 1° C
- MP of wax is _____. **Ans:** (a) 60° C
- Mercury boils at _____. **Ans:** (a) 357° C
- The graph between temperature and time is _____. **Ans:** (a) Heating curve
- The thermometer that measures temperature of human body is _____. **Ans:** (b) Clinical thermometer
- No. of divisions in Fahrenheit scale is _____. **Ans:** (b) 180
- Skating is done on _____. **Ans:** (a) Ice
- Melting point of ice is _____. **Ans:** (a) 0° C
- Boiling temperature of water is _____. **Ans:** (b) 100° C
- When ice melts, its temperature _____. **Ans:** (a) Remains constant
- When altitude increases, _____. **Ans:** (d) None of these
- The temperature inside a pressure cooker rises up to _____. **Ans:** (a) 120° C
- With increase of pressure, MP of ice _____. **Ans:** (b) Decreases
- With increase of pressure, BP of water _____. **Ans:** (a) Increases
- Which of the following temperature scales has only positive degrees? **Ans:** (a) Kelvin
- If two systems are in thermal equilibrium, they should have the same _____. **Ans:** (b) Temperature
- Which of the following is the smallest rise in temperature? _____. **Ans:** (c) 1° F
- The temperature on the Celsius scale corresponding to 35.6° F is _____. **Ans:** (c) 2° C
- The numerical value on the Fahrenheit scale that is equal and opposite to the Celsius value is _____. **Ans:** (a) 11.43
- If the temperature of a body rises by 1° C, the corresponding rise on the Kelvin scale will be _____. **Ans:** (c) 1 K

22. If the temperature of a body rises by 10°C , the corresponding rise on the Fahrenheit scale will be _____.
Ans: (d) None of these
23. The thermometer used to measure very high temperature is _____.
Ans: (c) Pyrometer
24. The temperature at which the solid and liquid states of a substance coexist in equilibrium is the _____.
Ans: (b) Melting point
25. The boiling point of water on the Fahrenheit scale is indicated with _____.
Ans: (c) 212°F
26. The physical quantity that remains constant during a change of state of a substance is _____.
Ans: (b) Temperature
27. If the temperature of a body rises by 1 K , the corresponding change on the Celsius scale is _____.
Ans: (c) 1°C
28. The numerical value that is the same on both Celsius and Fahrenheit scales is _____.
Ans: (c) -40
29. Boiling point of water at normal atmospheric pressure is _____.
Ans: (b) 100°C
30. A gas liquefies at -235°C under 20 atm. Its temperature on the Fahrenheit scale is _____.
Ans: (d) None of these
31. The SI unit of specific heat is _____.
Ans: (a) Joule / kg
32. _____ flows from a body at higher temperature to one at lower temperature.
Ans: (b) Heat
33. _____ is a cooling process.
Ans: (b) Evaporation
34. Objects A (10°C) and B (10 K) are in contact; heat will flow from _____.
Ans: (b) A to B
35. The latent heat of fusion of water is _____.
Ans: (c) 80 cal / g
36. Temperature of a body is directly proportional to _____.
Ans: (d) None of these
37. In a closed system, the net heat lost by a hot body equals _____ the cool body.
Ans: (a) Net heat gained by
38. The sultriness on summer days is due to _____.
Ans: (a) High humidity
39. _____ is used as a coolant.
Ans: (c) Water
40. Ice floats on water because ice has _____.
Ans: (b) Less density
41. Which of the following is a warming process? _____.
Ans: (b) Condensation
42. Melting is a process in which the solid phase changes to _____.
Ans: (a) Liquid phase
43. Two bodies A and B are in thermal equilibrium. If A is at 45°C , then B is at _____.
Ans: (b) 45°C
44. The temperature of a steel rod is 330 K . Its temperature in $^{\circ}\text{C}$ is _____.
Ans: (b) 57°C
45. Specific heat $S=S =$ _____.
Ans: (c) $Q/(m\Delta t)$

II. Multiple Answer Questions:

46. The following of the correct one is _____.
Ans: (a) Thermal capacity = ms , (b) $Q = ms\Delta\theta$, (c) Specific heat $S = Q/(m\Delta\theta)$
47. The following physical quantities can be represented by the same unit? **Ans:** (a) Heat, (c) Work
48. The temperature of a normal person _____.
Ans: (a) 37°C , (c) 98.6°F

III. Concept Questions:

49. Write the difference between heat and temperature?

Ans:

Heat	Temperature
Heat is a form of energy that flows from a hotter object to a cooler one.	Temperature is a measure of how hot or cold an object is.
It is the total kinetic energy of all the particles in a substance.	It is the average kinetic energy of the particles.
It depends on the number of particles, their speed, and type of substance.	It does not depend on the size or type of object.
Measured in joules (J).	Measured in degrees Celsius ($^{\circ}\text{C}$), Kelvin (K), or Fahrenheit ($^{\circ}\text{F}$).
Represented by Q in equations.	Represented by T in equations.
Heat flows from high temperature to low temperature.	Temperature determines the direction of heat flow.

50. Wrote the name of the four thermometric scales.

- Ans:**
- Celsius ($^{\circ}\text{C}$)
 - Fahrenheit ($^{\circ}\text{F}$)
 - Kelvin (K)
 - Réaumur ($^{\circ}\text{Ré}$)

51. What is absolute temperature?

Ans: Absolute temperature is the temperature measured from the absolute zero point, where all molecular motion stops.

It is measured in Kelvin (K).

$$0\text{ K} = -273.15\text{ }^{\circ}\text{C}$$

52. Explain thermal equilibrium.

Ans: Thermal equilibrium occurs when two objects in contact no longer transfer heat between each other. This means both objects have reached the same temperature.

53. Define internal energy of a system.

Ans: Internal energy is the total energy contained within a system due to the kinetic and potential energy of its molecules.

It includes the energy of motion (kinetic) and the energy of position (potential) of particles.

54. Define (i) Evaporation (ii) Condensation (iii) Humidity

Ans: (i) **Evaporation:** Evaporation is the process by which a liquid changes into a gas at any temperature below its boiling point. It usually occurs at the surface of the liquid.

(ii) **Condensation:** Condensation is the process by which a gas changes into a liquid, usually when the gas is cooled down.

(iii) **Humidity:** Humidity is the amount of water vapor (moisture) present in the air. It is often expressed as a percentage and affects how hot or cold the weather feels.

55. What is the difference between fog and dew?

Ans: Fog and dew are both caused by the condensation of water vapor, but they differ in how and where they form. Fog is a thick cloud of tiny water droplets that form in the air near the ground when warm, moist air cools and condenses. It stays suspended in the air and often reduces visibility, especially in the early morning or evening. On the other hand, dew forms directly on cool surfaces such as grass, leaves, or windows when the air near the surface cools down and the moisture in it condenses. Unlike fog, dew does not float in the air and does not affect visibility.

56. Define (i) Boiling (ii) Melting (iii) Freezing

Ans: Melting: Melting is the process by which a solid changes into a liquid when it is heated. This occurs at a specific temperature known as the melting point. When a solid absorbs enough heat, its particles gain energy and begin to move more freely, breaking the rigid structure of the solid. For example, ice melts into water at 0°C .

Boiling: Boiling is the process in which a liquid turns into a gas when it is heated to its boiling point. During boiling, bubbles of vapor form within the liquid and rise to the surface. The boiling point is the temperature at which the vapor pressure of the liquid equals the atmospheric pressure. For water, this occurs at 100°C under normal conditions.

Freezing: Freezing is the process by which a liquid changes into a solid when it loses heat. This happens at a temperature called the freezing point, which is the same as the melting point for pure substances. During freezing, the particles of the liquid slow down and arrange themselves into a fixed, orderly structure. For example, water freezes into ice at 0°C .

57. Explain latent heat of vaporization.

Ans: Latent heat of vapourization is the amount of heat energy required to change 1 kg of a liquid into vapor without changing its temperature.

Example: Water needs 22.5×10^5 J of energy to vaporize 1 kg at 100°C .

58. Explain Specific heat capacity

Ans: Specific heat capacity is the amount of heat required to raise the temperature of 1 kg of a substance by 1°C (or 1 K). **Symbol:** c, **Unit:** J/kg·K

IV. Reasoning Type Questions:

59. **Statement-1 :** When heat is added to a body, the internal energy of the body remains unaffected.

Statement-2 : Supply of heat rises the temperature of the body.

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

60. **Statement-1 :** Heat is a form of energy.

Statement-2 : It is the energy in transit and a part of internal energy of the body.

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

61. **Statement-1 :** Two bodies at the same temperature possess different amounts of heat.

Statement-2 : Different bodies require different amounts of heat to acquire same temperature.

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

62. **Statement-1 :** A body at a higher temperature contains more heat.

Statement-2 : Temperature is a measure of hotness or coldness of a body.

Ans: (b) Both statements are correct but Statement-2 is not correct

Application Skill Achiever:

63. Convert 100°C to Kelvin. **Ans:** $100^\circ\text{C} + 273.15 = 373.15$ K

64. Convert 104°F to Celsius. **Ans:** $\frac{5}{9}(104 - 32) = 40^\circ\text{C}$

65. Convert 200K to Celsius. **Ans:** $200\text{K} - 273.15 = -73.15^\circ\text{C}$

EXERCISE - 11

I. Choose the correct answer:

- The technology that involves the reaction of atomic nuclei is called **Ans:** (a) Nuclear technology
- Which among these is correct about protons, neutrons and electrons? **Ans:** (c) Protons & neutrons are heavier than electrons
- The nucleus of an atom contains _____. **Ans:** (c) Protons & Neutrons
- The radius of the path of the electron is ___ times greater than the nucleus. **Ans:** (c) 10^5
- The atomic number of an atom is the _____ in the atom. **Ans:** (a) Number of electrons
- The mass number of an atom is sum of the number of _____. **Ans:** (b) Protons & neutrons
- Which among these is a positively charged particle? _____. **Ans:** (a) Proton
- Which among these is negatively charged particle? _____. **Ans:** (c) Electron
- Which among these is un-charged particle? _____. **Ans:** (b) Neutron
- The weight of a proton is equal to the weight of _____. **Ans:** (a) 1800 electrons

II. Say True or False:

- Isotopes are atoms with the same number of protons and different number of electrons. **Ans:** False
- Deuterium is an isotope of carbon. **Ans:** False
- Carbon 14 is used to find the date of fossils. **Ans:** True

4. Alpha particles are negatively charged. **Ans:** False
5. Breaking of a bigger nucleus to smaller nuclei is called nuclear fusion. **Ans:** False

III. Concept Questions:

1. What is the difference between atomic number and mass number?

Ans: **Atomic number** = number of protons in the nucleus; it decides the element's identity and its position in the Periodic Table.

Mass number = total nucleons (protons + neutrons). It tells you how heavy that particular atom is.

2. What are the three sub-atomic particles?

Ans:

- o Proton (positively charged, in the nucleus)
- o Neutron (no charge, in the nucleus)
- o Electron (negatively charged, in shells around the nucleus)

3. What is isotope?

Ans: **Isotope:** atoms of the same element (same Z) that differ in mass number because they have different numbers of neutrons.

4. Write the name of the three isotopes of hydrogen.

Ans:

- o Protium (^1H)
- o Deuterium (^2H)
- o Tritium (^3H)

5. What is carbon dating?

Ans: A technique that estimates the age of once-living materials by measuring how much radioactive carbon-14 (^{14}C) remains in them.

6. What is radio activity?

Ans: The spontaneous emission of radiation (α , β , γ) from unstable atomic nuclei as they transform into more stable nuclei.

7. What is nuclear fission?

Ans: Splitting a heavy nucleus (e.g., U-235) into two lighter nuclei plus a few neutrons, releasing a large amount of energy.

8. What is nuclear fusion?

Ans: Combining two light nuclei (e.g., two hydrogen isotopes) to form a heavier nucleus, also releasing enormous energy; this powers the Sun.

IV. Multi Correct Choice Type:

1. Carbon has _____. **Ans:** (a) 6 electrons , (c) 6 protons
2. Which among these are sub atomic particles? _____. **Ans:** (a) Electrons , (b) Protons , (c) Neutrons
3. Proton of an atom is _____. **Ans:** (a) Located in the nucleus , (c) Positively charged
4. Electron is _____ particle. **Ans:** (a) Subatomic particle, (c) Negatively charged
5. Protium is _____. **Ans:** (a) An isotope of hydrogen

V. Reasoning Type Questions:

1. **Statement-1** : Water with dissolved salt is called heavy water.

Statement-2 : Heavy water contains heavy isotopes of hydrogen.

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

2. **Statement-1** : Carbon 14 is an isotope of carbon

Statement-2 : Carbon 14 contains 14 electrons.

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

3. **Statement-1** : Alpha particles do not travel very far.

Statement-2 : Alpha particles have harmful effect on human body.

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

4. **Statement-1** : Gamma rays are from the nucleus of an atom

Statement-2 : X rays come from the electron shells.

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

5. **Statement-1** : Bigger nucleus break up into smaller by nuclear fission.

Statement-2 : Nuclear fission gives out a lot of energy.

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

Application Skill Achiever

1. If mass of proton = 1.008 amu and mass of neutron = 1.009 amu, then what is the binding energy per 7 nucleon for Li (mass = 7.01653 amu)

SOL:

Given: Mass of proton, $m_p = 1.008$ amu

Mass of neutron, $m_n = 1.009$ amu

Mass of Li-7 nucleus = 7.01653 amu

Number of protons = 3

Number of neutrons = 4

Total number of nucleons = 7

Step 1: Mass of the separated nucleons

$$3m_p + 4m_n = 3(1.008 \text{ amu}) + 4(1.009 \text{ amu}) = 3.024 + 4.036 = 7.060 \text{ amu}$$

Step 2: Mass defect Δm

$$\Delta m = (7.060 - 7.01653) \text{ amu} = 0.04347 \text{ amu}$$

Step 3: Total binding energy EB

$$EB = \Delta m c^2 = 0.04347 \text{ amu} \times 931.5 \frac{\text{MeV}}{\text{amu}} = 40.5 \text{ MeV}$$

Step 4: Binding energy per nucleon

$$\frac{E_B}{A} = \frac{40.5 \text{ MeV}}{7} = 5.8 \text{ MeV per nucleon}$$

Ans: $EB/A = 5.8 \text{ MeV per nucleon}$