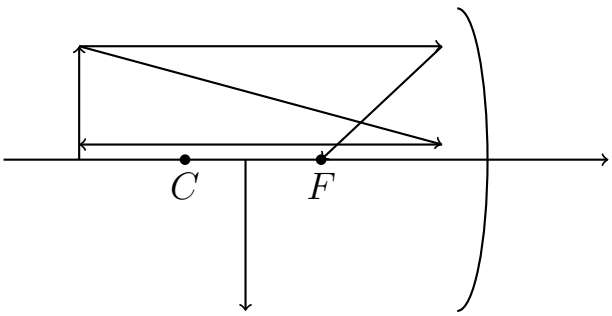
JEECUP Group A Physics Sample Paper – 9

Duration: 45 Minutes **Maximum Marks: 100**

Instructions

- This paper contains **25** Multiple Choice Questions (Single Correct).
- Each correct answer carries **+4 marks**. No marks will be deducted for incorrect answers. Unattempted questions carry **0** marks.
- Only **one** option is correct for each question.
- Use of mobile phones, smartwatches, or any electronic gadgets is strictly prohibited.

Q1. A ray of light is incident on a concave mirror parallel to its principal axis. After reflection, the ray passes through a point situated at a distance of 15 cm from the pole of the mirror. If another ray passes through the centre of curvature before striking the mirror, then the reflected ray will:



(A) Pass through focus

(B) Retrace its path

(C) Become parallel to principal axis

(D) Diverge away from mirror

Q2. An object is placed at a distance of 18 cm from a convex lens of focal length 12 cm. The image formed by the lens is real, inverted and magnified. The distance of the image from the lens is:

(A) 24 cm

(B) 30 cm

(C) 36 cm

(D) 72 cm

Q3. A light ray travels from air into a transparent medium. The angle of incidence is 45° and the angle of refraction becomes 30°. The refractive index of the medium is closest to:

(A) 1.21

(B) 1.41

(C) 1.73

(D) 2.00

Q4. Two thin lenses of focal lengths $+20$ cm and -30 cm are placed coaxially in contact with each other. The nature and focal length of the equivalent lens system will be:

(A) Convex, 60 cm

(B) Concave, 60 cm

(C) Convex, 12 cm

(D) Concave, 12 cm

Q5. An object of height 5 cm is placed in front of a concave mirror of focal length 10 cm at a distance of 15 cm. The height of the image formed will be:

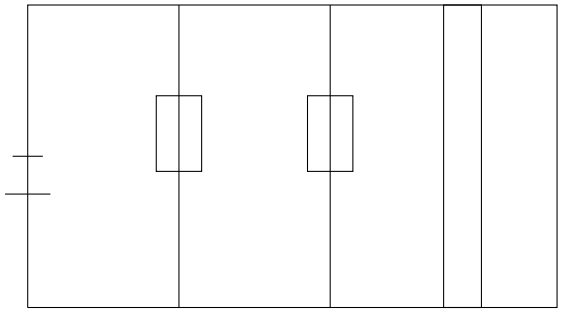
(A) 5 cm

(B) 7.5 cm

(C) 10 cm

(D) 15 cm

Q6. A conductor carries a current of 4 A when connected across a potential difference of 24 V. If the potential difference is increased to 48 V while keeping temperature constant, the current through the conductor becomes:



(A) 2 A

(B) 4 A

(C) 6 A

(D) 8 A

Q7. Three resistors each of resistance 6Ω are connected such that two are in parallel and the combination is in series with the third resistor. The equivalent resistance of the arrangement is:

(A) 3Ω

(B) 6Ω

(C) 9Ω

(D) 12Ω

Q8. An electric heater connected to a 220 V supply draws a current of 5 A. The electrical energy consumed by the heater in 2 hours will be:

(A) 1.1 kWh

(B) 2.2 kWh

(C) 3.3 kWh

(D) 4.4 kWh

Q9. A current of 2 A flows through a resistor of resistance 10Ω for 5 minutes. The heat produced in the resistor is:

(A) 1200 J

(B) 6000 J

(C) 12000 J

(D) 24000 J

Q10. In household electric wiring, all appliances are connected in parallel instead of series because in parallel combination every appliance:

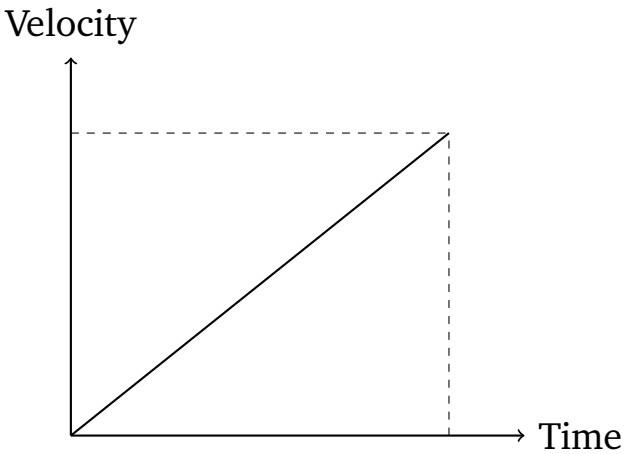
(A) Receives equal current

(B) Receives equal voltage

(C) Receives low resistance

(D) Consumes equal power

Q11. A car initially moving with a speed of 10 m/s accelerates uniformly at the rate of 2 m/s^2 for 5 seconds. The final velocity of the car will be:



(A) 10 m/s

(B) 15 m/s

(C) 20 m/s

(D) 25 m/s

Q12. A gun recoils backward when a bullet is fired from it. This phenomenon is best explained by:

(A) Newton's first law

(B) Newton's second law

(C) Newton's third law

(D) Law of gravitation

Q13. A body of mass 5 kg moving with a velocity of 8 m/s collides with another body. The momentum of the first body before collision is:

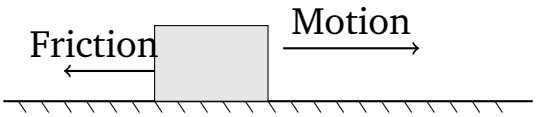
(A) 13 kg m/s

(B) 20 kg m/s

(C) 40 kg m/s

(D) 80 kg m/s

Q14. A wooden block is pushed over a rough horizontal surface. The force responsible for opposing the motion of the block acts:



(A) In the direction of motion

(B) Opposite to motion

(C) Vertically upward

(D) Vertically downward

Q15. A force of 50 N acts on a body and displaces it through a distance of 8 m in the direction of the force. The work done by the force is:

(A) 58 J

(B) 200 J

(C) 400 J

(D) 800 J

Q16. A body of mass 10 kg moving with a velocity of 6 m/s possesses kinetic energy equal to:

(A) 60 J

(B) 120 J

(C) 180 J

(D) 360 J

Q17. A motor does work at the rate of 1500 J in 30 seconds. The power developed by the motor is:

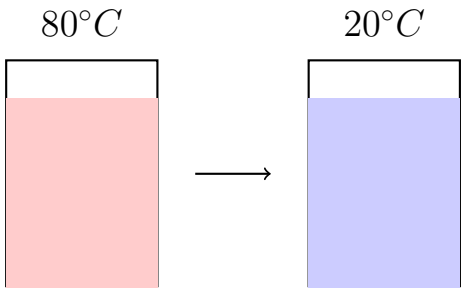
(A) 25 W

(B) 50 W

(C) 75 W

(D) 150 W

Q18. A metal spoon becomes hot when one end of it is placed inside hot tea for some time. The mode of heat transfer responsible for this process is:



(A) Radiation

(B) Conduction

(C) Convection

(D) Reflection

Q19. A metallic lid fixed tightly on a glass bottle can be opened easily by pouring warm water over it because the metallic lid:

(A) Contracts on heating

(B) Expands on heating

(C) Melts partially

(D) Becomes lighter

Q20. The quantity of heat required to raise the temperature of 2 kg of water by $5^{\circ}C$ is calculated using the concept of:

(A) Latent heat

(B) Specific heat capacity

(C) Thermal conductivity

(D) Mechanical equivalent of heat

Q21. A person standing at a distance from a cliff hears the echo of his shout after 3 seconds. If the speed of sound in air is 340 m/s, the distance of the person from the cliff is:

(A) 170 m

(B) 340 m

(C) 510 m

(D) 1020 m

Q22. The frequency of a sound wave determines which of the following characteristics of sound perceived by the human ear?

(A) Loudness

(B) Pitch

(C) Quality

(D) Intensity

Q23. During radioactive decay, a nucleus emits an α-particle. The resulting nucleus will have:

(A) Atomic number decreased by 2

(B) Mass number increased by 4

(C) Atomic number unchanged

(D) Mass number unchanged

Q24. Among α, β, and γ radiations emitted during radioactive disintegration, the radiation having maximum penetrating power is:

(A) α-radiation

(B) β-radiation

(C) γ-radiation

(D) All have same penetrating power

Q25. A diver experiences greater pressure at greater depths inside a sea because the pressure exerted by a liquid depends upon:

(A) Volume of liquid only

(B) Shape of container only

(C) Depth of liquid column

(D) Colour of liquid

Detailed Solutions

Q1.

Solution

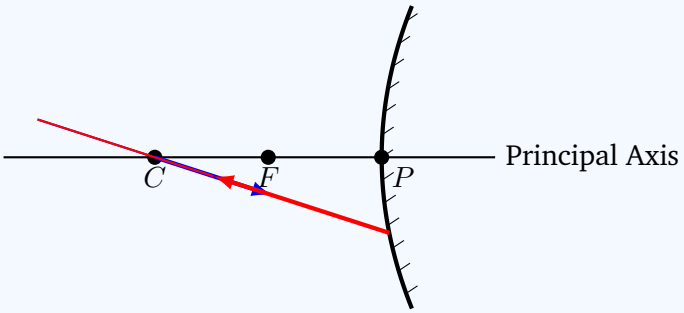
Concept: The rules of reflection for spherical mirrors dictate how specific rays behave after striking the mirror:

- A ray parallel to the principal axis reflects and passes through the focus (F). The distance from the pole to the focus is the focal length (f).
- A ray passing through the centre of curvature (C) strikes the mirror surface normally (along the radius) and thus reflects back along the same line, retracing its path.

Solution: Step 1: The first parallel ray passes through a point 15 cm from the pole after reflection. This point is the focus (F), so the focal length of the mirror is:

$$f = 15 \text{ cm}$$

Step 2: The distance of the centre of curvature (C) from the pole is $R = 2f = 30$ cm.
Step 3: Any ray of light that passes through the centre of curvature (C) is incident perpendicular (normal) to the mirror's spherical surface. According to the law of reflection, the angle of incidence is 0°, so the angle of reflection must also be 0°.
Step 4: Therefore, the reflected ray will retrace its path.



Final Answer: Retrace its path

Answer: (B)

Go Back to Question 1

Q2.

Solution

Concept: For a thin lens, the relation between the object distance (u), image distance (v), and focal length (f) is given by the Lens Formula:

$$\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$$

Solution: Step 1: Apply Cartesian sign conventions to the given parameters:

$$\text{Object distance, } u = -18 \text{ cm}$$
$$\text{Focal length of convex lens, } f = +12 \text{ cm}$$

Step 2: Substitute these values into the Lens Formula:

$$\frac{1}{v} - \frac{1}{-18} = \frac{1}{12}$$

$$\frac{1}{v} + \frac{1}{18} = \frac{1}{12}$$

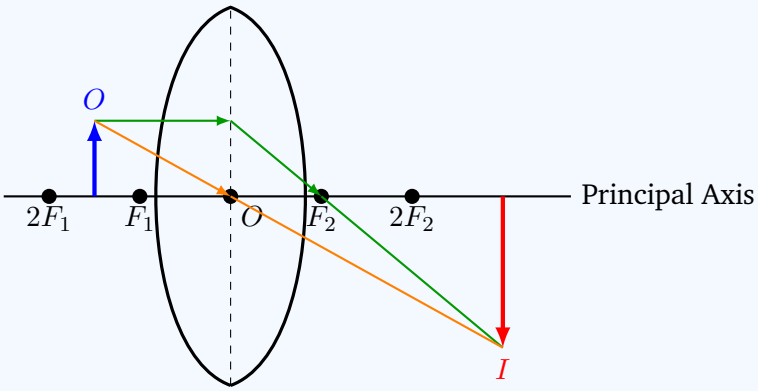
Step 3: Isolate and solve for $\frac{1}{v}$:

$$\frac{1}{v} = \frac{1}{12} - \frac{1}{18}$$
$$\frac{1}{v} = \frac{3-2}{36} = \frac{1}{36}$$

Step 4: Take the reciprocal to find the image distance (v):

$$v = 36 \text{ cm}$$

The distance of the real, inverted, and magnified image from the lens is 36 cm.



Final Answer: 36 cm

Answer: (C)

Go Back to Question 2

Q3.

Solution

Concept: According to Snell's Law of refraction, when light travels from air (refractive index $\mu_1 = 1$) into a medium of refractive index μ_2, the relation is:

$$\mu_1 \sin i = \mu_2 \sin r \implies \mu = \frac{\sin i}{\sin r}$$

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

Solution: Step 1: Identify the given angles:

$$\text{Angle of incidence, } i = 45^\circ$$
$$\text{Angle of refraction, } r = 30^\circ$$

Step 2: Calculate the sine of each angle:

$$\sin 45^\circ = \frac{1}{\sqrt{2}} \approx 0.707$$

$$\sin 30^\circ = 0.5$$

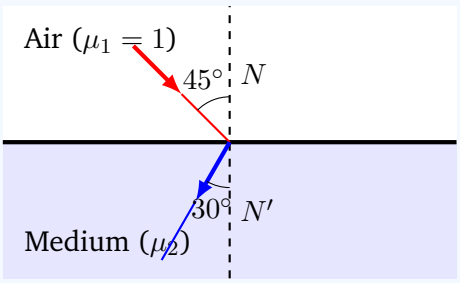
Step 3: Substitute the values into Snell's Law to calculate the refractive index (μ):

$$\mu = \frac{\sin 45^\circ}{\sin 30^\circ} = \frac{1/\sqrt{2}}{1/2} = \sqrt{2}$$

Step 4: Evaluate the numerical value:

$$\mu \approx 1.414$$

The refractive index of the medium is closest to 1.41.



Final Answer: $\boxed{1.41}$

Answer: (B)

Go Back to Question 3

Q4.

Solution

Concept: When two thin lenses of focal lengths f_1 and f_2 are placed in contact, their equivalent focal length F is given by:

$$\frac{1}{F} = \frac{1}{f_1} + \frac{1}{f_2}$$

The sign of F determines the nature of the equivalent system:

- If $F > 0$, the equivalent lens is convex (converging).
- If $F < 0$, the equivalent lens is concave (diverging).

Solution: Step 1: Identify the given focal lengths:

$$f_1 = +20 \text{ cm}$$
$$f_2 = -30 \text{ cm}$$

Step 2: Substitute these values into the equivalent focal length equation:

$$\frac{1}{F} = \frac{1}{20} + \frac{1}{-30}$$

$$\frac{1}{F} = \frac{1}{20} - \frac{1}{30}$$

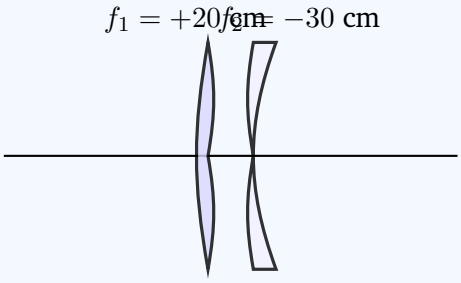
Step 3: Find a common denominator to simplify:

$$\frac{1}{F} = \frac{3-2}{60} = \frac{1}{60}$$

Step 4: Solve for F:

$$F = +60 \text{ cm}$$

Since the equivalent focal length is positive ($+60$ cm), the combined lens system acts as a convex lens.



Final Answer: Convex, 60 cm

Answer: (A)

Go Back to Question 4

Q5.

Solution

Concept: For a spherical mirror, magnification is:

$$m = \frac{h_i}{h_o} = -\frac{v}{u}$$

The image distance (v) is found using:

$$\frac{1}{f} = \frac{1}{v} + \frac{1}{u}$$

Solution: Step 1: Given values:

$$h_o = 5 \text{ cm}, \quad f = -10 \text{ cm}, \quad u = -15 \text{ cm}$$

Step 2: Using the mirror formula:

$$\frac{1}{-10} = \frac{1}{v} + \frac{1}{-15}$$

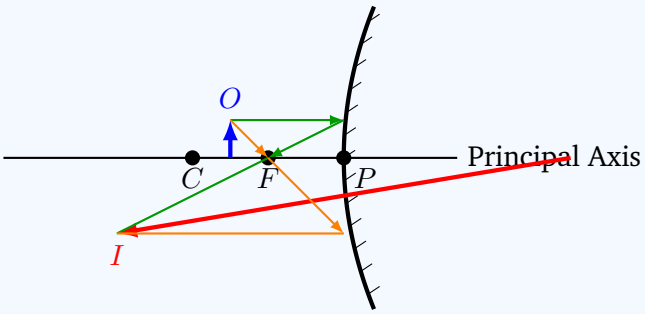
$$\frac{1}{v} = -\frac{1}{30} \Rightarrow v = -30 \text{ cm}$$

Step 3: Magnification:

$$m = -\frac{v}{u} = -\frac{-30}{-15} = -2$$

Step 4: Image height:

$$m = \frac{h_i}{h_o} \Rightarrow -2 = \frac{h_i}{5} \Rightarrow h_i = -10 \text{ cm}$$



Final Answer: 10 cm

Answer: (C)

Go Back to Question 5

Q6.

Solution

Concept: Ohm's Law states that at a constant temperature, the electric current (I) flowing through a conductor is directly proportional to the potential difference (V) applied across its ends:

$$V \propto I \implies V = I \cdot R$$

Since temperature remains constant, the resistance (R) is constant. Thus:

$$\frac{V_1}{I_1} = \frac{V_2}{I_2}$$

Solution: Step 1: Identify the initial values:

$$\text{Initial potential difference, } V_1 = 24 \text{ V}$$
$$\text{Initial current, } I_1 = 4 \text{ A}$$

Step 2: Identify the final potential difference:

$$\text{Final potential difference, } V_2 = 48 \text{ V}$$

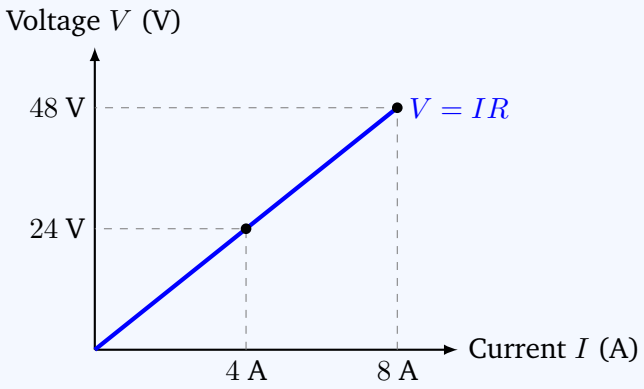
Step 3: Apply the Ohm's Law proportion:

$$\frac{24 \text{ V}}{4 \text{ A}} = \frac{48 \text{ V}}{I_2}$$

Step 4: Solve for I_2:

$$I_2 = 48 \cdot \frac{4}{24} = 8 \text{ A}$$

The current through the conductor becomes 8 A.



Final Answer: $\boxed{8 \text{ A}}$

Answer: (D)

Go Back to Question 6

Q7.

Solution

Concept: To find the equivalent resistance of a mixed combination circuit:

- Simplify the parallel portion of the circuit first:

$$\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2}$$

- Add any remaining series resistors to the parallel equivalent:

$$R_{eq} = R_p + R_3$$

Solution: Step 1: Calculate the equivalent resistance of the two $6\ \Omega$ resistors in parallel (R_p):

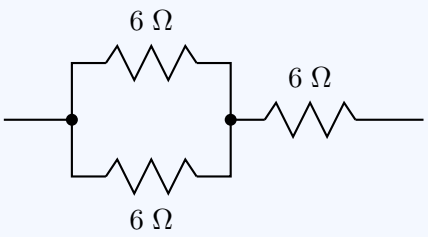
$$R_p = \frac{6 \cdot 6}{6+6} = \frac{36}{12} = 3\ \Omega$$

Step 2: Add this parallel equivalent value to the third $6\ \Omega$ resistor, which is in series:

$$R_{eq} = R_p + 6\ \Omega$$

$$R_{eq} = 3\ \Omega + 6\ \Omega = 9\ \Omega$$

The equivalent resistance of the entire arrangement is $9\ \Omega$.



Final Answer: $\boxed{9\ \Omega}$

Answer: (C)

Go Back to Question 7

Q8.

Solution

Concept: Electrical power (P) is given by:

$$P = V \cdot I$$

Electrical energy consumed (E) is the product of power (P) and the time (t) the appliance operates:

$$E = P \cdot t$$

To express energy in kilowatt-hours (kWh), convert power from watts (W) to kilowatts (kW) and express time in hours.

Solution: Step 1: Calculate the power rating (P) of the heater in kilowatts (kW):

$$P = 220 \text{ V} \cdot 5 \text{ A} = 1100 \text{ W}$$

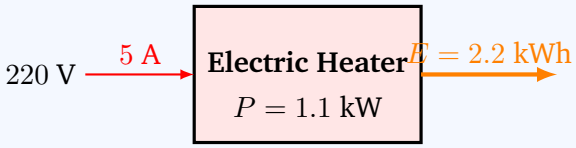
$$P = \frac{1100}{1000} \text{ kW} = 1.1 \text{ kW}$$

Step 2: Identify the operating time:

$$t = 2 \text{ hours}$$

Step 3: Calculate the total electrical energy consumed:

$$E = 1.1 \text{ kW} \cdot 2 \text{ hours} = 2.2 \text{ kWh}$$



Final Answer: $\boxed{2.2 \text{ kWh}}$

Answer: (B)

Go Back to Question 8

Q9.

Solution

Concept: According to Joule's Law of Heating, the amount of heat energy (H) generated in a resistor of resistance R due to a current I flowing through it for a time interval t is:

$$H = I^2 \cdot R \cdot t$$

The time (t) must be expressed in seconds (SI units).

Solution: Step 1: Identify the given values and convert time to seconds:

$$\text{Current, } I = 2 \text{ A}$$
$$\text{Resistance, } R = 10\ \Omega$$
$$\text{Time, } t = 5 \text{ minutes} = 5 \cdot 60 \text{ s} = 300 \text{ s}$$

Step 2: Substitute these values into Joule's heating equation:

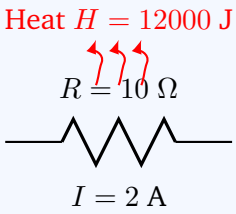
$$H = (2 \text{ A})^2 \cdot 10\ \Omega \cdot 300 \text{ s}$$

Step 3: Perform the calculations:

$$H = 4 \cdot 10 \cdot 300$$

$$H = 12000 \text{ J}$$

The heat produced in the resistor is 12000 Joules.



Final Answer: $\boxed{12000 \text{ J}}$

Answer: (C)

Go Back to Question 9

Q10.

Solution

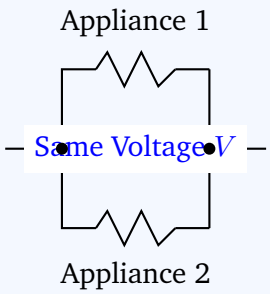
Concept: The fundamental properties of parallel electrical connections are:

- The potential difference (voltage) across every branch is identical and equal to the supply voltage.
- Every appliance operates independently. If one appliance is switched off or fails, the others continue to work normally.

Solution: Step 1: Contrast series and parallel arrangements. In a series connection, the voltage is divided among appliances, and if one appliance breaks, the entire circuit is broken.

Step 2: In a parallel connection, all appliances are connected directly across the supply lines.

Step 3: This ensures that every household appliance receives the full, rated operating voltage of the mains supply (typically 220 V), allowing them to function at their optimal power rating.



Final Answer: Receives equal voltage

Answer: (B)

Go Back to Question 10

Q11.

Solution

Concept: For an object moving with a uniform acceleration (a), its final velocity (v) after a time interval (t) starting with an initial velocity (u) is given by the first equation of motion:

$$v = u + a \cdot t$$

Solution: Step 1: Identify the given values:

$$\text{Initial velocity, } u = 10 \text{ m/s}$$
$$\text{Acceleration, } a = 2 \text{ m/s}^2$$
$$\text{Time, } t = 5 \text{ s}$$

Step 2: Substitute these values into the equation of motion:

$$v = 10 \text{ m/s} + (2 \text{ m/s}^2 \cdot 5 \text{ s})$$

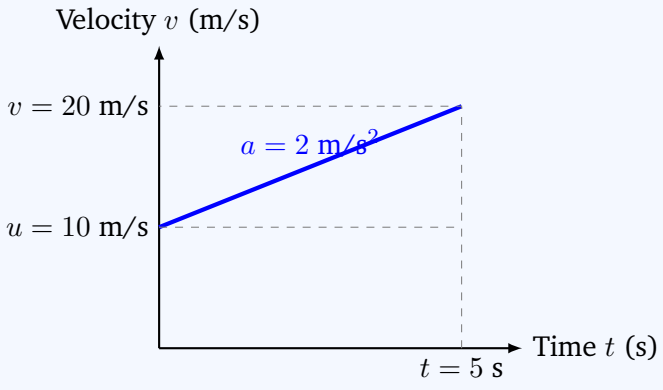
Step 3: Calculate the product of acceleration and time:

$$a \cdot t = 10 \text{ m/s}$$

Step 4: Sum the initial velocity and the velocity change:

$$v = 10 + 10 = 20 \text{ m/s}$$

The final velocity of the car is 20 m/s.



Final Answer: $\boxed{20 \text{ m/s}}$

Answer: (C)

Go Back to Question 11

Q12.

Solution

Concept: Newton's Third Law of Motion states that for every action, there is an equal and opposite reaction:

$$\vec{F}_{\text{action}} = -\vec{F}_{\text{reaction}}$$

This means that forces always occur in matched action-reaction pairs between two interacting bodies.

Solution: Step 1: When a bullet is fired from a gun, the expanding gases push the bullet forward inside the barrel.
This is the action force exerted by the gun on the bullet.

Step 2: According to Newton's third law, the bullet simultaneously exerts an equal and opposite reaction force on the gun in the backward direction.

Step 3: This reaction force causes the heavy gun to move or recoil backward.

Final Answer: Newton's third law

Answer: (C)

Go Back to Question 12

Q13.

Solution

Concept: The linear momentum (p) of a moving body is defined as the product of its mass (m) and velocity (v):

$$p = m \cdot v$$

Momentum is a vector quantity, and its SI unit is kilogram-meter per second (kg m/s).

Solution: Step 1: Identify the given values of the first body before the collision:

$$\text{Mass, } m = 5 \text{ kg}$$
$$\text{Velocity, } v = 8 \text{ m/s}$$

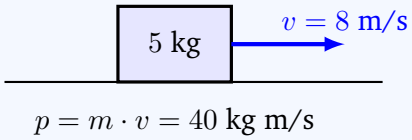
Step 2: Substitute these values into the linear momentum formula:

$$p = 5 \text{ kg} \cdot 8 \text{ m/s}$$

Step 3: Perform the calculation:

$$p = 40 \text{ kg m/s}$$

The momentum of the body before the collision is 40 kg m/s.



$$p = m \cdot v = 40 \text{ kg m/s}$$

Final Answer: $\boxed{40 \text{ kg m/s}}$

Answer: (C)

Go Back to Question 13

Q14.

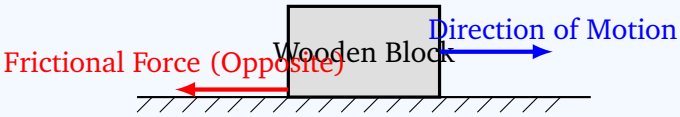
Solution

Concept: Frictional force is a resistive force that acts parallel to the contact surfaces in relative motion. It always acts in a direction that opposes the relative slide or motion between the surfaces.

Solution: Step 1: Identify the forces acting on the wooden block.

Step 2: When the block is pushed forward (in the direction of motion), a rough surface exerts an opposing force at the contact boundary.

Step 3: This opposing force is friction, which operates parallel to the contact surface and opposite to the direction of motion.



Final Answer: Opposite to motion

Answer: (B)

Go Back to Question 14

Q15.

Solution

Concept: Work done (W) by a constant force (F) displacing an object through a distance (d) in the direction of the force ($\theta = 0^\circ$) is given by:

$$W = F \cdot d \cdot \cos\theta = F \cdot d$$

Solution: Step 1: Identify the given values:

$$\text{Force, } F = 50 \text{ N}$$
$$\text{Displacement, } d = 8 \text{ m}$$
$$\text{Angle between force and displacement, } \theta = 0^\circ$$

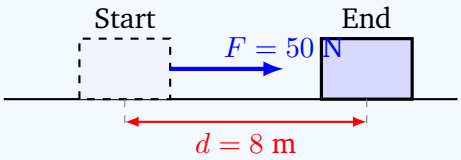
Step 2: Substitute these values into the work formula:

$$W = 50 \text{ N} \cdot 8 \text{ m} \cdot \cos 0^\circ$$

Step 3: Simplify the expression:

$$W = 400 \cdot 1 = 400 \text{ J}$$

The work done by the force is 400 Joules.



Final Answer: $\boxed{400 \text{ J}}$

Answer: (C)

Go Back to Question 15

Q16.

Solution

Concept: The kinetic energy ($K.E.$) of an object is the energy it possesses due to its motion, mathematically expressed as:

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

where m is the mass of the body and v is its velocity.

Solution: Step 1: Identify the given physical parameters:

$$\text{Mass, } m = 10 \text{ kg}$$
$$\text{Velocity, } v = 6 \text{ m/s}$$

Step 2: Substitute these values into the kinetic energy equation:

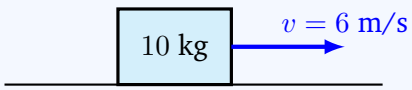
$$K.E. = \frac{1}{2} \cdot 10 \text{ kg} \cdot (6 \text{ m/s})^2$$

Step 3: Perform the calculations:

$$K.E. = 5 \cdot 36$$

$$K.E. = 180 \text{ J}$$

The kinetic energy possessed by the body is 180 Joules.



Final Answer: $\boxed{180 \text{ J}}$

Answer: (C)

Go Back to Question 16

Q17.

Solution

Concept: Power (P) is defined as the rate of doing work, or work done (W) per unit time (t):

$$P = \frac{W}{t}$$

Solution: Step 1: List the given values:

$$\text{Work done, } W = 1500 \text{ J}$$

$$\text{Time, } t = 30 \text{ seconds}$$

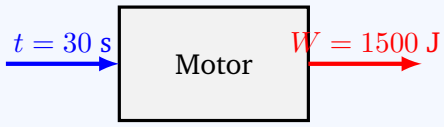
Step 2: Substitute the values into the power equation:

$$P = \frac{1500 \text{ J}}{30 \text{ s}}$$

Step 3: Simplify the expression:

$$P = 50 \text{ W}$$

The power developed by the motor is 50 Watts.



Final Answer: $\boxed{50 \text{ W}}$

Answer: (B)

Go Back to Question 17

Q18.

Solution

Concept: The modes of heat transfer are:

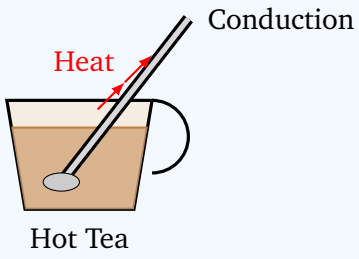
- **Conduction:** Thermal energy transfer in solids through molecular/atomic vibrations and free electron motion without material displacement.
- **Convection:** Heat transfer in fluids (liquids/gases) via mass movement of molecules.
- **Radiation:** Heat transfer via electromagnetic waves requiring no material medium.

Solution: Step 1: The spoon is a solid metal object.

Step 2: When one end of the spoon is placed in hot tea, the molecules at that end absorb thermal energy and vibrate more vigorously.

Step 3: These vibrations are passed along to neighboring molecules, and free electrons in the metal rapidly transfer energy to the cooler end.

Step 4: This process of heat transfer through a solid medium without bulk movement of the material is called conduction.



Final Answer: Conduction

Answer: (B)

Go Back to Question 18

Q19.

Solution

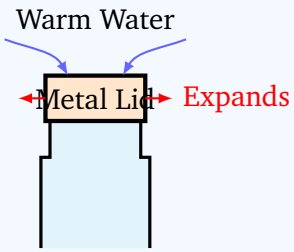
Concept: Materials generally undergo thermal expansion (increase in volume/surface area) when heated. Metals typically have a higher coefficient of thermal expansion compared to glass.

Solution: Step 1: A metal lid is stuck tightly onto a glass bottle neck.

Step 2: Pouring warm water over the metal lid transfers heat to it.

Step 3: This causes the metallic lid to expand and increase in diameter.

Step 4: Since glass expands much less than metal for the same temperature change, the lid loosens and can be opened easily.



Final Answer: Expands on heating

Answer: (B)

Go Back to Question 19

Q20.

Solution

Concept: The quantity of heat (Q) required to raise the temperature of a substance is given by:

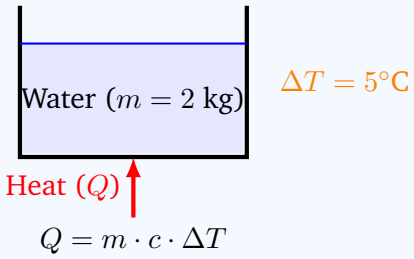
$$Q = m \cdot c \cdot \Delta T$$

where m is the mass, ΔT is the change in temperature, and c is the specific heat capacity.

Solution: Step 1: Identify the components needed to solve the physical problem:

- Mass ($m = 2$ kg)
- Change in temperature ($\Delta T = 5^\circ$C)

Step 2: To calculate the actual heat energy (Q), we must know the constant c, which represents the specific heat capacity of water. Step 3: This relies on the concept of specific heat capacity, which is defined as the heat required to raise the temperature of a unit mass of a substance by 1°C.



Final Answer: Specific heat capacity

Answer: (B)

Go Back to Question 20

Q21.

Solution

Concept: An echo is the reflection of sound waves back to the source. The total path distance traveled by the sound wave to the obstacle and back to the listener's ear is $2d$, where d is the distance to the cliff.

$$\text{Total Distance} = 2d = v \cdot t$$

Solution: Step 1: Identify the given values:

$$\text{Total round trip time, } t = 3 \text{ s}$$
$$\text{Speed of sound in air, } v = 340 \text{ m/s}$$

Step 2: Apply the echo distance formula:

$$2d = v \cdot t \implies d = \frac{v \cdot t}{2}$$

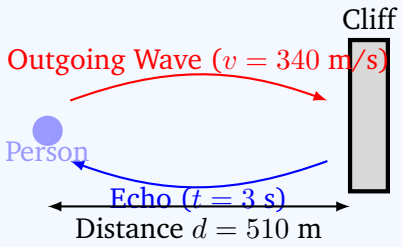
Step 3: Substitute the values into the equation:

$$d = \frac{340 \text{ m/s} \cdot 3 \text{ s}}{2}$$

Step 4: Solve for d:

$$d = 170 \cdot 3 = 510 \text{ m}$$

The distance of the person from the cliff is 510 meters.



Final Answer: $\boxed{510 \text{ m}}$

Answer: (C)

Go Back to Question 21

Q22.

Solution

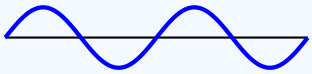
Concept: Sound waves possess several characteristics that relate directly to human perception:

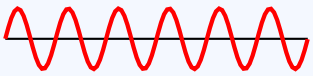
- **Frequency:** Dictates the **pitch** (how high or low the sound is).
- **Amplitude:** Determines the **loudness** or intensity of the sound.
- **Waveform:** Dictates the **quality** or timbre of the sound.

Solution: Step 1: Match physical properties of sound waves with human sensory attributes.

Step 2: Frequency is the rate at which sound waves vibrate per second. High-frequency waves have rapid vibrations, which are perceived as a high-pitched sound. Low-frequency waves have slow vibrations, perceived as a low-pitched sound.

Step 3: Therefore, frequency determines the pitch.

Low Frequency (Low Pitch) 

High Frequency (High Pitch) 

Final Answer: Pitch

Answer: (B)

Go Back to Question 22

Q23.

Solution

Concept: During radioactive alpha (α) decay, a parent nucleus (${}^{A}_{Z}X$) emits an α-particle (${}^{4}_{2}\text{He}$), transforming into a daughter nucleus (${}^{A-4}_{Z-2}Y$):

$$ {}^{A}_{Z}X \longrightarrow {}^{A-4}_{Z-2}Y + {}^{4}_{2}\text{He} $$

where Z is the atomic number and A is the mass number.

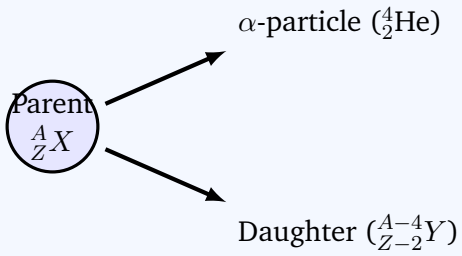
Solution: Step 1: Write down the changes that occur in the nucleus after emission of an alpha particle.

Step 2: An alpha particle contains 2 protons and 2 neutrons.

Step 3: This results in:

- The mass number (A) decreasing by 4.
- The atomic number (Z) decreasing by 2.

Step 4: Looking at the options, the atomic number decreases by 2.



Final Answer: Atomic number decreased by 2

Answer: (A)

Go Back to Question 23

Q24.

Solution

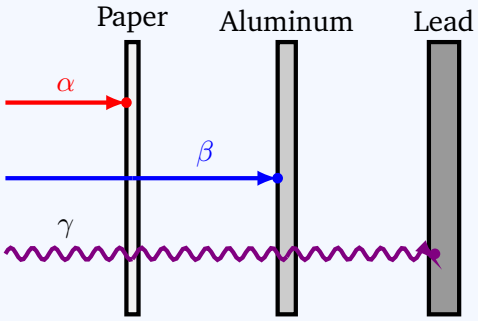
Concept: The penetration depth of nuclear radiation is determined by how easily it interacts with and ionizes matter.

- α-particles have high charge ($+2e$) and large mass, making them highly ionizing but least penetrating.
- β-particles have a smaller charge and mass, having moderate penetrating power.
- γ-rays are neutral electromagnetic wave photons with zero rest mass and charge, making them highly penetrating.

Solution: Step 1: Rank the radiation types based on charge and mass.

Step 2: Because gamma (γ) radiation has no charge and no mass, it interacts the least with the atoms of any absorbing material.

Step 3: Therefore, it possesses the maximum penetrating power of the three.



Final Answer: γ-radiation

Answer: (C)

Go Back to Question 24

Q25.

Solution

Concept: The hydrostatic pressure (P) at any point inside a liquid column depends on:

$$P = \rho \cdot g \cdot h$$

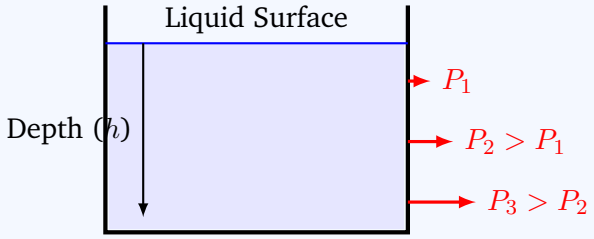
where ρ is the density of the liquid, g is the acceleration due to gravity, and h is the depth of the liquid column.

Solution: Step 1: Analyze the physical factors affecting fluid pressure.

Step 2: Hydrostatic pressure does not depend on the shape or volume of the container.

Step 3: The pressure is directly proportional to the depth (h) below the surface.

Step 4: A diver descending deeper into the sea has a taller column of water above them, increasing h and therefore experiencing greater pressure.



Final Answer: Depth of liquid column

Answer: (C)

Go Back to Question 25

Answer Key

Q	Ans	Q	Ans	Q	Ans	Q	Ans	Q	Ans
1	B	2	C	3	B	4	A	5	C
6	D	7	C	8	B	9	C	10	B
11	C	12	C	13	C	14	B	15	C
16	C	17	B	18	B	19	B	20	B
21	C	22	B	23	A	24	C	25	C