JEECUP Group-A Physics Sample Paper – 27

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

Instructions

- This paper contains **25** Multiple Choice Questions (Single Correct).
- Each correct answer carries **+4** marks. Incorrect answers carry -1 mark. 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. The velocity-time graph of a body is a straight line passing through the origin with a positive slope. The motion of the body is:

(A) Uniform motion (zero acceleration)

(B) Uniformly retarded motion

(C) Uniformly accelerated motion

(D) Non-uniform acceleration (curved graph)

Q2. A clinical thermometer reads $98.4\,°\text{F}$. The equivalent temperature on the Celsius scale is:

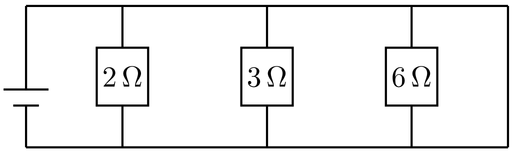
(A) $36.9\,°\text{C}$

(B) $37.5\,°\text{C}$

(C) $38.0\,°\text{C}$

(D) $36.0\,°\text{C}$

Q3. Three resistors of $2\,\Omega$, $3\,\Omega$ and $6\,\Omega$ are connected in parallel as shown below. The equivalent resistance of the combination is:



Three resistors in parallel

(A) $11\,\Omega$

(B) $3\,\Omega$

(C) $2\,\Omega$

(D) $1\,\Omega$

Q4. A convex mirror is preferred as a rear-view mirror in vehicles because it:

(A) Always forms a real and inverted image of objects behind the vehicle

(B) Provides a wider field of view of the traffic behind

(C) Magnifies objects so that the driver can see them more clearly

(D) Focuses incoming light rays to produce a sharp, bright image

Q5. A car starts from rest and attains a speed of $72\,\mathrm{km/h}$ in 10 seconds. The acceleration of the car is:

(A) $2\,\mathrm{m\,s^{-2}}$

(B) $7.2\,\mathrm{m\,s^{-2}}$

(C) $0.2\,\mathrm{m\,s^{-2}}$

(D) $20\,\mathrm{m\,s^{-2}}$

Q6. A body of mass $5\,\mathrm{kg}$ moves with a velocity of $10\,\mathrm{m\,s^{-1}}$. The linear momentum of the body is:

(A) $2\,\mathrm{kg\cdot m\,s^{-1}}$

(B) $0.5\,\mathrm{kg\cdot m\,s^{-1}}$

(C) $50\,\mathrm{kg\cdot m\,s^{-1}}$

(D) $500\,\mathrm{kg\cdot m\,s^{-1}}$

Q7. The work done by a force on a moving body is zero when:

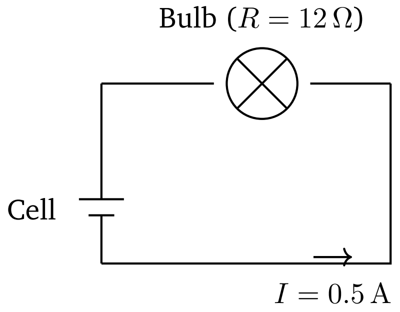
(A) The applied force is very small in magnitude

(B) The body moves with constant speed

(C) The applied force equals the weight of the body

(D) The direction of force is perpendicular to the direction of displacement

Q8. In the electric circuit shown below, a bulb of resistance $12\,\Omega$ is connected to a cell. If the current through the circuit is $0.5\,\text{A}$, the voltage of the cell is:



(A) $24\,\text{V}$

(B) $6\,\text{V}$

(C) $0.04\,\text{V}$

(D) $12\,\text{V}$

Q9. The value of acceleration due to gravity (g) at the surface of the Earth is approximately:

(A) $9.8\,\text{m}\,\text{s}^{-2}$

(B) $6.67 \times 10^{-11}\,\text{N}\,\text{m}^2\,\text{kg}^{-2}$

(C) $1.63\,\text{m}\,\text{s}^{-2}$

(D) $6.67\,\text{m}\,\text{s}^{-2}$

Q10. Which of the following waves **cannot** travel through vacuum?

(A) X-rays

(B) Gamma rays

(C) Radio waves

(D) Sound waves

Q11. The SI unit of heat energy is:

(A) Calorie

(B) Joule

(C) Watt

(D) Kelvin

Q12. The refractive index of glass with respect to air is 1.5. If the speed of light in air is $3 \times 10^8\,\mathrm{m\,s^{-1}}$, the speed of light in glass is:

(A) $4.5 \times 10^8\,\mathrm{m\,s^{-1}}$

(B) $3.0 \times 10^8\,\mathrm{m\,s^{-1}}$

(C) $2.0 \times 10^8\,\mathrm{m\,s^{-1}}$

(D) $1.5 \times 10^8\,\mathrm{m\,s^{-1}}$

Q13. A ball is thrown vertically upward with an initial velocity of $20\,\mathrm{m\,s^{-1}}$. Taking $g = 10\,\mathrm{m\,s^{-2}}$, the time taken to reach the maximum height is:

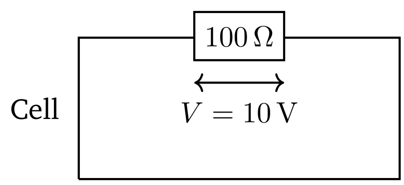
(A) $2\,\mathrm{s}$

(B) $4\,\mathrm{s}$

(C) $1\,\mathrm{s}$

(D) $0.5\,\mathrm{s}$

Q14. The voltage across a $100\,\Omega$ resistor in a circuit is $10\,\mathrm{V}$. The power dissipated in the resistor is:



(A) $10\,\mathrm{W}$

(B) $100\,\mathrm{W}$

(C) $0.1\,\mathrm{W}$

(D) $1\,\mathrm{W}$

Q15. A body of mass $2\,\mathrm{kg}$ is raised vertically through a height of $5\,\mathrm{m}$. Taking $g = 10\,\mathrm{m\,s^{-2}}$, the gravitational potential energy gained is:

(A) $25\,\mathrm{J}$

(B) $100\,\mathrm{J}$

(C) $50\,\mathrm{J}$

(D) $200\,\mathrm{J}$

Q16. The number of significant figures in the measurement $0.00350\,\mathrm{m}$ is:

(A) 6

(B) 5

(C) 3

(D) 2

Q17. According to Newton's third law of motion, the action and reaction forces:

(A) Act on two different bodies and are equal in magnitude but opposite in direction

(B) Act on the same body in the same direction

(C) Act on the same body but are opposite in direction

(D) Are unequal in magnitude though opposite in direction

Q18. Pressure is defined as the force acting per unit:

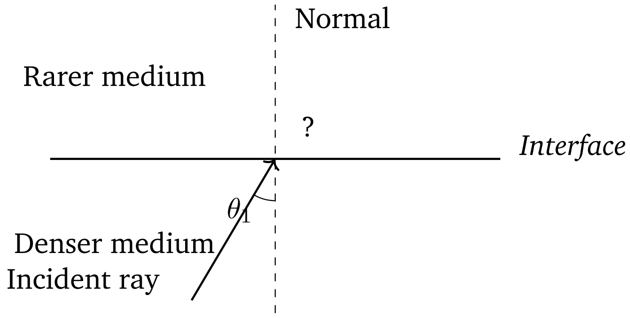
(A) Volume

(B) Mass

(C) Length

(D) Area

Q19. A ray of light travels from a denser medium into a rarer medium as shown. The refracted ray will:



(A) Bend towards the normal (angle of refraction < angle of incidence)

(B) Travel along the normal without bending

(C) Bend away from the normal (angle of refraction > angle of incidence)

(D) Return back into the denser medium along the same path

Q20. Among the following materials, which is the **best conductor** of heat?

(A) Glass

(B) Copper

(C) Wood

(D) Rubber

Q21. The range of frequencies of sound that can be heard by a normal human ear is:

(A) $20\,\text{Hz}$ to $20{,}000\,\text{Hz}$

(B) $0\,\text{Hz}$ to $50\,\text{Hz}$

(C) $20{,}000\,\text{Hz}$ to $2{,}00{,}000\,\text{Hz}$

(D) $1\,\text{Hz}$ to $1{,}000\,\text{Hz}$

Q22. According to Ohm's law, for a metallic conductor at constant temperature, the ratio V/I (potential difference to current) is:

(A) Directly proportional to the current I

(B) Inversely proportional to the potential difference V

(C) A constant equal to the resistance R of the conductor

(D) Zero for all conductors

Q23. The weight of an object on the surface of the Moon is what fraction of its weight on the surface of the Earth?

(A) $\frac{1}{3}$

(B) $\frac{1}{6}$

(C) $\frac{1}{4}$

(D) $\frac{1}{2}$

Q24. The phenomenon in which certain metals emit electrons when light of sufficient frequency falls on their surface is called:

(A) Thermionic emission

(B) Field emission

(C) Secondary emission

(D) Photoelectric effect

Q25. The kinetic energy of a body moving with velocity v is doubled. The new velocity of the body becomes:

(A) $\sqrt{2}\,v$

(B) $2v$

(C) $4v$

(D) $\frac{v}{\sqrt{2}}$

Detailed Solutions

Q1.

Solution

Concept — Velocity-Time Graph: In a velocity-time (v-t) graph, the slope of the line represents acceleration; a straight line through the origin means $v = at$ (constant positive acceleration from rest).

Step 1 — A straight v-t line with positive slope means v increases uniformly with time $\Rightarrow$ acceleration $a = \Delta v/\Delta t$ is constant and positive.

Step 2 — Constant positive acceleration starting from the origin defines *uniformly accelerated motion* (also called uniform acceleration).

Why other options are wrong:

- **Option A:** Uniform motion has zero acceleration, giving a horizontal line ($v =$ constant) on the v-t graph, not a sloped line.
- **Option B:** Uniformly retarded motion shows a straight line with a *negative* slope (velocity decreasing with time), opposite to what is shown.
- **Option D:** Non-uniform acceleration would produce a *curved* (non-linear) v-t graph, not a straight line.

Final Answer: Positive-slope straight line through origin $\Rightarrow$ uniformly accelerated motion $\Rightarrow \boxed{(C)}$

Answer: (C) Go Back to Q1

Q2.

Solution

Concept — Fahrenheit to Celsius Conversion: The conversion formula is $C = \frac{5}{9}(F - 32)$.

Step 1 — Substitute $F = 98.4$: $C = \frac{5}{9}(98.4 - 32) = \frac{5}{9} \times 66.4$

Step 2 — $C = \frac{332.0}{9} = 36.89 \approx 36.9\,°\text{C}$

Why other options are wrong:

- **Option B:** $37.5\,°\text{C}$ corresponds to $F = 99.5\,°\text{F}$, not $98.4\,°\text{F}$.
- **Option C:** $38.0\,°\text{C}$ equals $100.4\,°\text{F}$, slightly higher than the given value.
- **Option D:** $36.0\,°\text{C}$ corresponds to $96.8\,°\text{F}$, which is below the given reading.

Final Answer: $C = \frac{5}{9}(98.4 - 32) = 36.9\,°\text{C} \Rightarrow \boxed{(A)}$

Answer: (A) Go Back to Q2

Q3.

Solution

Concept — Parallel Resistance: For resistors in parallel, the equivalent resistance satisfies $\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$.

Step 1 — $\frac{1}{R_{eq}} = \frac{1}{2} + \frac{1}{3} + \frac{1}{6} = \frac{3}{6} + \frac{2}{6} + \frac{1}{6} = \frac{6}{6} = 1$

Step 2 — Therefore $R_{eq} = 1\,\Omega$.

Why other options are wrong:

- **Option A:** $11\,\Omega = 2 + 3 + 6$ is the *series* sum; in parallel, the equivalent resistance is always less than the smallest individual resistance.
- **Option B:** $3\,\Omega$ arises from an arithmetic slip in applying the reciprocal formula.
- **Option C:** $2\,\Omega$ is merely the smallest resistor's value, not the computed parallel equivalent.

Final Answer: Reciprocal sum $= 1$, so $R_{eq} = 1\,\Omega \Rightarrow \boxed{(D)}$

Answer: (D) Go Back to Q3

Q4.

Solution

Concept — Convex Mirror: A convex (diverging) mirror always forms a virtual, erect, and diminished image regardless of the object's position.

Step 1 — Because the image is smaller (diminished), the convex mirror captures a much larger region of the scene behind the vehicle in a relatively small mirror area.

Step 2 — This property gives the driver a wider field of view of traffic, making convex mirrors ideal as rear-view mirrors.

Why other options are wrong:

- **Option A:** Convex mirrors form *virtual and erect* images, never real inverted ones; concave mirrors can form real inverted images.
- **Option C:** Convex mirrors produce *diminished* (smaller) images, not magnified ones; a concave mirror is used for magnification.
- **Option D:** Convex mirrors *diverge* reflected rays; only concave (converging) mirrors can focus light to produce a bright image.

Final Answer: Convex mirror provides a wider field of view of traffic behind $\Rightarrow \boxed{(B)}$

Answer: (B) Go Back to Q4

Q5.

Solution

Concept — Acceleration: Acceleration is the rate of change of velocity: $a = (v - u)/t$. Always convert speeds to SI units ($\mathrm{m\,s^{-1}}$) before substituting.

Step 1 — Convert the final speed: $v = 72\,\mathrm{km/h} = \dfrac{72 \times 1000}{3600} = 20\,\mathrm{m\,s^{-1}}$; initial velocity $u = 0$.

Step 2 — $a = \dfrac{v - u}{t} = \dfrac{20 - 0}{10} = 2\,\mathrm{m\,s^{-2}}$

Why other options are wrong:

- **Option B:** $7.2\,\mathrm{m\,s^{-2}}$ results from using $v = 72$ without converting km/h to m/s (i.e., $72/10$).
- **Option C:** $0.2\,\mathrm{m\,s^{-2}}$ is an arithmetic error: $2/10$ instead of $20/10$.
- **Option D:** $20\,\mathrm{m\,s^{-2}}$ is the final velocity in $\mathrm{m\,s^{-1}}$, not the acceleration.

Final Answer: $a = 20/10 = 2\,\mathrm{m\,s^{-2}} \Rightarrow \boxed{(A)}$

Answer: (A) Go Back to Q5

Q6.

Solution

Concept — Linear Momentum: Linear momentum is the product of mass and velocity: $p = mv$.

Step 1 — $p = m \times v = 5\,\mathrm{kg} \times 10\,\mathrm{m\,s^{-1}} = 50\,\mathrm{kg \cdot m\,s^{-1}}$

Why other options are wrong:

- **Option A:** $2\,\mathrm{kg \cdot m\,s^{-1}}$ has no valid derivation; it appears to come from misapplying a ratio.
- **Option B:** $0.5\,\mathrm{kg \cdot m\,s^{-1}}$ results from dividing $m/v = 5/10$, confusing the ratio with the product.
- **Option D:** $500\,\mathrm{kg \cdot m\,s^{-1}}$ introduces a spurious extra factor of 10, which has no physical justification.

Final Answer: $p = 5 \times 10 = 50\,\mathrm{kg \cdot m\,s^{-1}} \Rightarrow \boxed{(C)}$

Answer: (C) Go Back to Q6

Q7.

Solution

Concept — Work Done by a Force: $W = F\,d\,\cos\theta$, where θ is the angle between the force vector and the displacement vector.

Step 1 — When $\theta = 90^\circ$, $\cos 90^\circ = 0$, so $W = F\,d \times 0 = 0$.

Step 2 — A classic example: the centripetal force on a body in circular motion is always perpendicular to its displacement, so it does zero work.

Why other options are wrong:

- **Option A:** Even a very small force can do non-zero work if it is parallel to the displacement; force magnitude alone does not make $W = 0$.
- **Option B:** Constant speed implies zero *net* work, but each individual force (e.g., friction, normal force) may or may not do zero work independently.
- **Option C:** Equality of applied force and weight means zero net vertical force, not zero work; work depends on direction, not equality of magnitudes.

Final Answer: $W = Fd\cos 90^\circ = 0$ when force $\perp$ displacement $\Rightarrow \boxed{(D)}$

Answer: (D) Go Back to Q7

Q8.

Solution

Concept — Ohm's Law: The potential difference across a resistor equals the product of current and resistance: $V = IR$.

Step 1 — $V = I \times R = 0.5\,\mathrm{A} \times 12\,\Omega = 6\,\mathrm{V}$

Why other options are wrong:

- **Option A:** $24\,\mathrm{V}$ would require a current of $2\,\mathrm{A}$ $(24/12)$, not $0.5\,\mathrm{A}$.
- **Option C:** $0.04\,\mathrm{V}$ comes from incorrectly dividing $I/R = 0.5/12$, which gives conductance-like quantity, not voltage.
- **Option D:** $12\,\mathrm{V}$ is the resistance value in ohms, not the voltage; one must multiply by the current I.

Final Answer: $V = IR = 0.5 \times 12 = 6\,\mathrm{V} \Rightarrow \boxed{(B)}$

Answer: (B) Go Back to Q8

Q9.

Solution

Concept — Acceleration due to Gravity: The acceleration due to gravity (g) is the free-fall acceleration at Earth's surface, derived from $g = GM/R^2$.

Step 1 — The standard measured value is $g = 9.8\,\mathrm{m\,s^{-2}}$ (often approximated as $10\,\mathrm{m\,s^{-2}}$ in calculations).

Why other options are wrong:

- **Option B:** $6.67 \times 10^{-11}\,\mathrm{N\,m^2\,kg^{-2}}$ is the universal gravitational constant G, not g; they are related but distinct.
- **Option C:** $1.63\,\mathrm{m\,s^{-2}}$ is the acceleration due to gravity on the *Moon*, approximately one-sixth of Earth's value.
- **Option D:** $6.67\,\mathrm{m\,s^{-2}}$ is an incorrect value with no physical basis for Earth's surface gravity.

Final Answer: $g = 9.8\,\mathrm{m\,s^{-2}}$ at Earth's surface $\Rightarrow \boxed{(A)}$

Answer: (A) Go Back to Q9

Q10.

Solution

Concept — Nature of Sound Waves: Sound is a mechanical (longitudinal) wave that requires a material medium (solid, liquid, or gas) to propagate; it cannot travel through vacuum.

Step 1 — Electromagnetic waves (X-rays, gamma rays, radio waves) do not need a medium and travel through vacuum at $c = 3 \times 10^8\,\mathrm{m\,s^{-1}}$.

Step 2 — Sound waves are pressure disturbances passed between neighbouring particles; without matter to vibrate, sound cannot propagate.

Why other options are wrong:

- **Option A:** X-rays are high-energy electromagnetic radiation and travel freely through vacuum; space-based X-ray telescopes exploit this.
- **Option B:** Gamma rays are the most energetic electromagnetic waves and travel through vacuum without any medium.
- **Option C:** Radio waves are long-wavelength electromagnetic waves used for satellite communication through the vacuum of space.

Final Answer: Sound requires a material medium and cannot travel through vacuum $\Rightarrow \boxed{(D)}$

Answer: (D) Go Back to Q10

Q11.

Solution

Concept — SI Unit of Heat: Heat is a form of energy; the SI unit of all forms of energy is the joule (J).

Step 1 — In the International System of Units (SI), energy in any form — mechanical, thermal, electrical — is measured in joules (J).

Why other options are wrong:

- **Option A:** Calorie (cal) is a unit of heat in the older CGS system; $1\,\text{cal} = 4.18\,\text{J}$. It is not the SI unit.
- **Option C:** Watt (W) is the SI unit of *power* (energy per unit time $=$ J/s), not energy.
- **Option D:** Kelvin (K) is the SI unit of *temperature*, a completely different physical quantity from heat energy.

Final Answer: SI unit of heat is the joule (J) $\Rightarrow \boxed{(B)}$

Answer: (B) Go Back to Q11

Q12.

Solution

Concept — Speed of Light in a Medium: The refractive index n of a medium equals c/v, where c is the speed of light in vacuum/air and v is the speed in the medium.

Step 1 — Rearranging: $v = c/n$.

Step 2 — $v = \dfrac{3 \times 10^8}{1.5} = 2 \times 10^8\,\text{m}\,\text{s}^{-1}$

Why other options are wrong:

- **Option A:** $4.5 \times 10^8\,\text{m}\,\text{s}^{-1}$ results from *multiplying* $c \times n$ instead of dividing; light *slows down* in a denser medium.
- **Option B:** $3.0 \times 10^8\,\text{m}\,\text{s}^{-1}$ is the speed in air/vacuum; the speed must be reduced upon entering glass.
- **Option D:** $1.5 \times 10^8\,\text{m}\,\text{s}^{-1}$ results from dividing by 2 instead of 1.5, confusing the numerical value of n.

Final Answer: $v = c/n = 3 \times 10^8/1.5 = 2 \times 10^8\,\text{m}\,\text{s}^{-1} \Rightarrow \boxed{(C)}$

Answer: (C) Go Back to Q12

Q13.

Solution

Concept — Time to Maximum Height: At the maximum height during vertical projection, the final velocity becomes zero; using $v = u - gt$ gives $t = u/g$.

Step 1 — At maximum height, $v = 0$. Using $v = u - gt$: $0 = 20 - 10 \times t$

Step 2 — $t = 20/10 = 2\,\text{s}$

Why other options are wrong:

- **Option B:** $4\,\text{s}$ is the *total time of flight* (up + down) $= 2u/g = 4\,\text{s}$, not the time to the peak.
- **Option C:** $1\,\text{s}$ would result if the initial velocity were $10\,\text{m}\,\text{s}^{-1}$; the given initial velocity is $20\,\text{m}\,\text{s}^{-1}$.
- **Option D:** $0.5\,\text{s}$ arises from inverting the formula: using $g/u = 10/20$ instead of u/g.

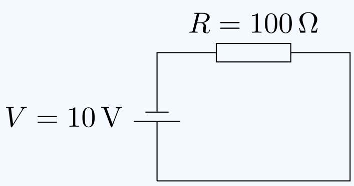
Final Answer: $t = u/g = 20/10 = 2\,\text{s} \Rightarrow \boxed{(A)}$

Answer: (A) Go Back to Q13

Q14.

Solution

Concept — Electrical Power: Power dissipated in a resistor is $P = V^2/R$ when the voltage across it is known.



Step 1 — $P = V^2/R = (10)^2/100 = 100/100$

Step 2 — $P = 1\,\text{W}$

Why other options are wrong:

- **Option A:** $10\,\text{W}$ comes from wrongly using $P = V/R = 0.1$ and then multiplying by 100.
- **Option B:** $100\,\text{W}$ results from forgetting to divide: using $P = V^2 = 100$ without the R.
- **Option C:** $0.1\,\text{W}$ arises from using $P = V/R^2$ instead of V^2/R.

Final Answer: $P = V^2/R = 1\,\text{W} \Rightarrow \boxed{(D)}$

Answer: (D) Go Back to Q14

Q15.

Solution

Concept — Gravitational Potential Energy: $PE = mgh$, where m is mass in kg, $g = 10\,\mathrm{m\,s^{-2}}$, and h is height in metres.

Step 1 — $PE = 2 \times 10 \times 5 = 100\,\mathrm{J}$

Why other options are wrong:

- **Option A:** $200\,\mathrm{J}$ results from using $g = 20\,\mathrm{m\,s^{-2}}$ instead of $10\,\mathrm{m\,s^{-2}}$.
- **Option C:** $50\,\mathrm{J}$ arises from missing the factor of g: using $PE = m \times h = 2 \times 5 \times 5$.
- **Option D:** $10\,\mathrm{J}$ is obtained by confusing m with $1\,\mathrm{kg}$ and using $PE = 1 \times 10 \times 1$.

Final Answer: $PE = mgh = 100\,\mathrm{J} \Rightarrow \boxed{(B)}$

Answer: (B) Go Back to Q15

Q16.

Solution

Concept — Significant Figures: All non-zero digits are significant; zeros between significant digits are significant; trailing zeros after the decimal point are significant.

Analysis of 0.00350:

- Leading zeros (0.00...) are *not* significant.
- The digits 3, 5 are significant.
- The trailing zero (0.0035$\underline{0}$) after a non-zero digit following the decimal *is* significant.

Count: 3, 5, 0 $\Rightarrow$ **3 significant figures**

Why other options are wrong:

- **Option A:** Choosing 5 counts every digit including all leading zeros.
- **Option B:** Choosing 4 includes one leading zero incorrectly.
- **Option D:** Choosing 2 ignores the significant trailing zero.

Final Answer: 3 significant figures $\Rightarrow \boxed{(C)}$

Answer: (C) Go Back to Q16

Q17.

Solution

Concept — Newton's Third Law of Motion: For every action there is an equal and opposite reaction. Crucially, the action and reaction forces act on *different* bodies.

Step 1 — Action: Earth pulls the ball downward (gravity). Reaction: Ball pulls the Earth upward with the *same magnitude* of force.

Why other options are wrong:

- **Option B:** The reaction force acts on a *different* body (not the same body as the action); therefore they never cancel each other.
- **Option C:** The reaction force is always equal in magnitude to the action force, not greater.
- **Option D:** The reaction force acts *simultaneously* with the action, not after a delay.

Final Answer: Action and reaction are equal, opposite, and act on different bodies $\Rightarrow$ $\boxed{(A)}$

Answer: (A) Go Back to Q17

Q18.

Solution

Concept — Fluid Pressure: Pressure is defined as the force applied perpendicularly per unit area: $P = F/A$.

Step 1 — $P = F/A$ — force divided by the area on which it acts.

Why other options are wrong:

- **Option A:** $P = F \times A$ would increase with area — contrary to physical experience (sharp knife cuts better than blunt one).
- **Option B:** $P = A/F$ inverts the correct relationship.
- **Option C:** $P = F + A$ mixes dimensions (N and m^2) — dimensionally inconsistent.

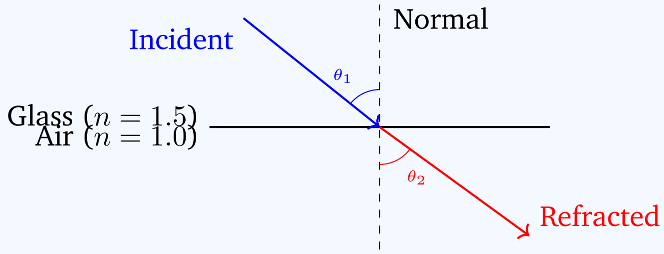
Final Answer: Pressure $= F/A \Rightarrow \boxed{(D)}$

Answer: (D) Go Back to Q18

Q19.

Solution

Concept — Refraction at a Denser-to-Rarer Interface: When light travels from a denser medium (e.g. glass) to a rarer medium (e.g. air), it bends *away* from the normal, so the angle of refraction > angle of incidence.



Why other options are wrong:

- **Option A:** Bending *toward* the normal happens when light goes from rarer to denser medium (opposite case).
- **Option B:** The ray does not travel undeviated (that only happens when it strikes the interface perpendicularly).
- **Option D:** Total internal reflection occurs only when the angle of incidence exceeds the critical angle; at θ_1 shown here it does not.

Final Answer: The refracted ray bends *away* from the normal $\Rightarrow \boxed{(C)}$

Answer: (C) Go Back to Q19

Q20.

Solution

Concept — Thermal Conductivity: The thermal conductivity k ranks how well a material transfers heat. Among common metals: copper ($k \approx 385$ W/m K) > aluminium (≈ 205) > iron (≈ 80) > steel.

Comparison:

Metal	k ($\mathrm{W\,m^{-1}\,K^{-1}}$)
Copper	≈ 385
Aluminium	≈ 205
Iron	≈ 80

Why other options are wrong:

- **Option A:** Iron has lower conductivity than copper.
- **Option C:** Aluminium is a good conductor but not the best among the three listed.
- **Option D:** Wood is a thermal insulator, not a conductor.

Final Answer: Copper is the best conductor of heat $\Rightarrow \boxed{(B)}$

Answer: (B) Go Back to Q20

Q21.

Solution

Concept — Human Audible Range: The human ear can detect sound waves with frequencies between $20\,\text{Hz}$ (lower limit) and $20{,}000\,\text{Hz}$ (upper limit). Below 20 Hz is infrasound; above 20 kHz is ultrasound.

Why other options are wrong:

- **Option B:** $2\,\text{Hz}$ to $2000\,\text{Hz}$ is too narrow; the upper limit is $20{,}000\,\text{Hz}$.
- **Option C:** $200\,\text{Hz}$ to $20{,}000\,\text{Hz}$ misses the lower portion (20 to 200 Hz) that humans can hear.
- **Option D:** $20\,\text{Hz}$ to $2000\,\text{Hz}$ underestimates the upper limit by a factor of 10.

Final Answer: Human audible range is $20\,\text{Hz}$ to $20{,}000\,\text{Hz} \Rightarrow \boxed{(A)}$

Answer: (A) Go Back to Q21

Q22.

Solution

Concept — Ohm's Law: For a metallic conductor at constant temperature, the ratio V/I remains constant and equals the resistance R of the conductor. This constant ratio is the mathematical statement of Ohm's Law.

Why other options are wrong:

- **Option A:** V/I decreasing with voltage would mean resistance decreases — true for non-Ohmic devices (diodes), not for metallic conductors.
- **Option B:** V/I being zero implies no resistance — physically a superconductor, not a normal conductor.
- **Option D:** $V \times I =$ power P, which varies with current — not a constant for a given resistance.

Final Answer: $V/I = R =$ constant (Ohm's Law) $\Rightarrow \boxed{(C)}$

Answer: (C) Go Back to Q22

Q23.

Solution

Concept — Weight on the Moon: Gravitational acceleration on the Moon's surface is approximately $1/6$ that on Earth's surface. Since weight $W = mg$, an object weighs $1/6$ as much on the Moon as on Earth.

Step 1 — $g_{\text{Moon}} = g_{\text{Earth}}/6 \approx 9.8/6 \approx 1.63\,\text{m}\,\text{s}^{-2}$

Step 2 — $W_{\text{Moon}} = W_{\text{Earth}}/6$

Why other options are wrong:

- **Option A:** $1/2$ of Earth weight would require Moon's gravity to be half of Earth's — it is much less ($\approx 1/6$).
- **Option C:** Zero weight (weightlessness) is experienced only in free fall or orbital flight, not simply standing on the Moon.
- **Option D:** Equal weight on Moon and Earth would require identical gravitational acceleration — the Moon's g is much smaller.

Final Answer: Weight on Moon $= W_{\text{Earth}}/6 \Rightarrow \boxed{(B)}$

Answer: (B) **Go Back to Q23**

Q24.

Solution

Concept — Photoelectric Effect: The photoelectric effect is the emission of electrons from a metal surface when light of sufficient frequency (above the threshold frequency) falls on it. It was explained by Einstein using the quantum (photon) theory of light: $E_{\text{photon}} = h\nu$.

Historical note: The photoelectric effect demonstrated the particle nature of light and was the work for which Einstein received the 1921 Nobel Prize in Physics.

Why other options are wrong:

- **Option A:** Emission of light by hot objects is *incandescence* (or blackbody radiation), not the photoelectric effect.
- **Option B:** Bending of light around obstacles is *diffraction*, a wave property.
- **Option C:** Splitting of white light into spectrum colours is *dispersion*.

Final Answer: Photoelectric effect = emission of electrons when light falls on a metal surface $\Rightarrow \boxed{(D)}$

Answer: (D) **Go Back to Q24**

Q25.

Solution

Concept — Kinetic Energy and Speed Relation: $KE = \frac{1}{2}mv^2$, so $KE \propto v^2$. If KE doubles, v^2 doubles, giving $v_{\text{new}} = \sqrt{2}\,v_{\text{old}}$.

Step 1 — $KE_1 = \frac{1}{2}mv^2; \quad KE_2 = 2KE_1 = \frac{1}{2}mv_2^2$

Step 2 — $v_2^2 = 2v^2 \;\Rightarrow\; v_2 = \sqrt{2}\,v$

Why other options are wrong:

- **Option B:** $v_2 = 2v$ would require KE to increase by a factor of 4 (since $KE \propto v^2$), not factor of 2.
- **Option C:** $v_2 = 4v$ would require a 16-fold increase in KE.
- **Option D:** $v_2 = v/\sqrt{2}$ implies KE is *halved*, not doubled.

Final Answer: $v_{\text{new}} = \sqrt{2}\,v \Rightarrow \boxed{(A)}$

Answer: (A) Go Back to Q25

Answer Key

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