SRMJEEE Physics Sample Paper – 9

Duration: 41 Minutes **Maximum Marks: 35**

Instructions

- This paper contains **35** Multiple Choice Questions (Single Correct Answer), modelled on the Physics section of **SRMJEEE** (SRM Joint Engineering Entrance Examination).
- Each correct answer carries **+1 mark**. There is **no negative marking**; an unattempted or wrong answer scores 0.
- Only **one** option is correct. Choose carefully.
- The actual SRMJEEE is a **computer-based test** conducted in remote-proctored online mode, with all sections sharing a common time window and no per-section limit.
- Personal calculators, mobile phones, log tables and other electronic gadgets are strictly prohibited.

Q1. The length and breadth of a rectangular plate are measured as 4.5 cm and 1.2 cm respectively. The area of the plate, expressed to the correct number of significant figures, is:

(A) 5.40 cm^2

(B) 5.4 cm^2

(C) 5.400 cm^2

(D) 5 cm^2

Q2. The dimensional formula of electrical resistance is:

(A) $[ML^2T^{-2}A^{-2}]$

(B) $[ML^2T^{-3}A^{-1}]$

(C) $[ML^2T^{-3}A^{-2}]$

(D) $[MLT^{-3}A^{-2}]$

Q3. Two blocks of masses 2 kg and 3 kg are connected by a light string and placed on a frictionless horizontal floor. A horizontal force of 20 N is applied to the 3 kg block, pulling the system so that the 2 kg block trails behind. The tension in the connecting string is:

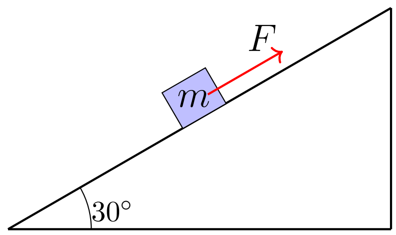
(A) 20 N

(B) 12 N

(C) 4 N

(D) 8 N

Q4. A block of mass $m = 2$ kg is pushed *up* a rough incline of angle 30° at constant velocity, as shown. The coefficient of kinetic friction between the block and the incline is $\mu = \dfrac{1}{2\sqrt{3}}$. Taking $g = 10$ m s^{-2}, the applied force F acting along the incline is:



(A) 15 N

(B) 10 N

(C) 5 N

(D) 20 N

Q5. A body starts from rest and moves with a uniform acceleration of 4 m s^{-2}. Its velocity after 6 s is:

(A) 12 m s^{-1}

(B) 48 m s^{-1}

(C) 24 m s^{-1}

(D) 10 m s^{-1}

Q6. The kinetic energy of a body is related to its linear momentum p and mass m by $K = \frac{p^2}{2m}$. If the momentum of a body is increased to three times its initial value while the mass is unchanged, its kinetic energy becomes:

(A) 9 times

(B) 3 times

(C) 6 times

(D) unchanged

Q7. A body A of mass m moving with speed u makes a head-on collision with an identical stationary body B. If the coefficient of restitution is $e = \frac{1}{2}$, the speed of body B just after the collision is:

(A) $u/4$

(B) $3u/4$

(C) $u/2$

(D) u

Q8. The value of the acceleration due to gravity at a depth d below the surface of the Earth (radius R) is given by $g' = g\left(1 - \frac{d}{R}\right)$. At the centre of the Earth, its value is:

(A) zero

(B) g

(C) $g/2$

(D) infinite

Q9. A satellite revolves around the Earth in a circular orbit of radius r. If it is shifted to a new circular orbit of radius $4r$, its orbital speed becomes (initial orbital speed $= v$):

(A) $4v$

(B) $v/4$

(C) $2v$

(D) $v/2$

Q10. A load of 100 N stretches a steel wire by 0.5 mm. Assuming the wire obeys Hooke's law, the work done in stretching the wire is:

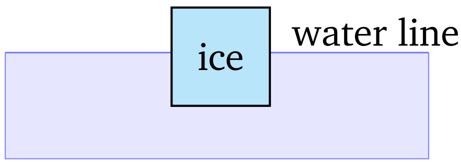
(A) 0.05 J

(B) 0.025 J

(C) 0.5 J

(D) 50 J

Q11. A block of ice of density 0.9 g cm^{-3} floats in sea water of density 1.0 g cm^{-3}, as shown. The fraction of the volume of the block that remains *submerged* below the surface is:



(A) 1.0

(B) 0.1

(C) 0.9

(D) 0.8

Q12. Two point charges separated by a distance r exert a force F on each other. If one of the charges is made three times its original value and the separation between them is doubled, the new force becomes:

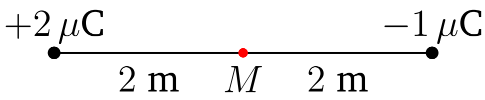
(A) $\dfrac{3F}{4}$

(B) $\dfrac{3F}{2}$

(C) $3F$

(D) $\dfrac{F}{4}$

Q13. Two point charges $q_1 = +2\ \mu$C and $q_2 = -1\ \mu$C are placed 4 m apart, as shown. The electric potential at the midpoint M of the line joining them is $\left(k = 9 \times 10^9\ \text{N m}^2\text{C}^{-2}\right)$:



(A) 13.5×10^3 V

(B) zero

(C) 9×10^3 V

(D) 4.5×10^3 V

Q14. Two capacitors of $3\ \mu$F and $6\ \mu$F are connected in series, and this series combination is connected in parallel with a $4\ \mu$F capacitor. The equivalent capacitance of the whole arrangement is:

(A) $13\ \mu$F

(B) $6\ \mu$F

(C) $2\ \mu$F

(D) $9\ \mu$F

Q15. A particle of charge q and mass m, initially at rest, is accelerated from rest through a potential difference V. The speed it acquires is:

(A) $\dfrac{2qV}{m}$

(B) $\sqrt{\dfrac{qV}{2m}}$

(C) $\sqrt{\dfrac{2qV}{m}}$

(D) $\dfrac{qV}{m}$

Q16. Two identical cells, each of emf 2 V and internal resistance $1\ \Omega$, are connected in parallel (like terminals joined). The equivalent emf and equivalent internal resistance of the combination are respectively:

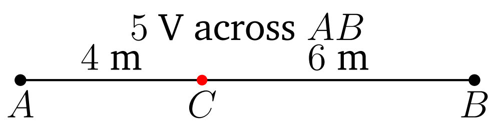
(A) 2 V and $0.5\ \Omega$

(B) 4 V and $2\ \Omega$

(C) 2 V and $2\ \Omega$

(D) 4 V and $0.5\ \Omega$

Q17. A uniform potentiometer wire AB of length 10 m carries a steady current, and the potential difference across its full length is 5 V, as shown. The potential difference across the portion AC, where C is 4 m from A, is:



(A) 5 V

(B) 3 V

(C) 1 V

(D) 2 V

Q18. A current of 2 A flows through a resistor of $5\ \Omega$ for 10 s. The heat produced in the resistor is:

(A) 100 J

(B) 50 J

(C) 200 J

(D) 400 J

Q19. A charged particle moves in a circular path in a uniform magnetic field. The time period T of its circular motion is $T = \dfrac{2\pi m}{qB}$. If the speed of the particle is doubled (everything else unchanged), the time period:

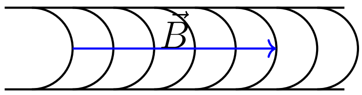
(A) becomes twice as large

(B) remains unchanged

(C) becomes half

(D) becomes four times as large

Q20. A long solenoid has 500 turns per metre and carries a current of 4 A, as shown. The magnitude of the magnetic field inside the solenoid is $\left(\mu_0 = 4\pi \times 10^{-7}\ \text{T m A}^{-1}\right)$:



$n = 500$ turns/m, $I = 4$ A

(A) $8\pi \times 10^{-4}$ T

(B) $2\pi \times 10^{-4}$ T

(C) $4\pi \times 10^{-4}$ T

(D) $\pi \times 10^{-4}$ T

Q21. At a certain point, two long straight wires set at right angles to each other produce magnetic fields of magnitudes 3×10^{-6} T and 4×10^{-6} T respectively, the two fields being mutually perpendicular. The resultant magnetic field at that point is:

(A) 7×10^{-6} T

(B) 1×10^{-6} T

(C) 12×10^{-6} T

(D) 5×10^{-6} T

Q22. Which of the following statements about magnetic susceptibility χ is correct?

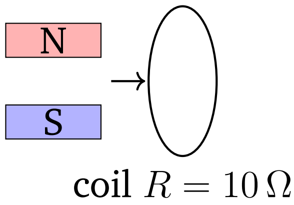
(A) For a diamagnetic material χ is small and positive.

(B) For a diamagnetic material χ is small and negative, while for a paramagnetic material it is small and positive.

(C) For a paramagnetic material χ is large and negative.

(D) For both diamagnetic and paramagnetic materials χ is negative.

Q23. A coil of resistance $10\ \Omega$ is placed near a magnet, as shown. When the magnet is moved, the magnetic flux linked with the coil changes by 2 Wb. The total charge that flows through the coil during this change is $\left(q = \dfrac{\Delta\Phi}{R}\right)$:



(A) 0.2 C

(B) 20 C

(C) 2 C

(D) 0.02 C

Q24. A pure inductor of inductance $L = \dfrac{1}{\pi}$ H is connected to a 50 Hz alternating supply of rms voltage 100 V. The rms current in the circuit is:

(A) 2 A

(B) 0.5 A

(C) 1 A

(D) 100 A

Q25. An electromagnetic wave has a wavelength of 3 m in vacuum. Its frequency is $\left(c = 3 \times 10^8 \text{ m s}^{-1}\right)$:

(A) 10^6 Hz

(B) 10^8 Hz

(C) 9×10^8 Hz

(D) 10^9 Hz

Q26. An object is placed in front of a convex mirror. The image formed by a convex mirror of a real object is always:

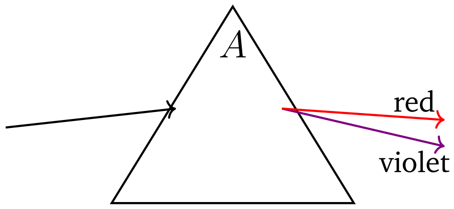
(A) real, inverted and magnified

(B) real, erect and diminished

(C) virtual, inverted and magnified

(D) virtual, erect and diminished

Q27. A thin prism produces a deviation of 4.0° for the violet ray and 3.2° for the red ray, as shown. The angular dispersion produced by the prism (between the violet and red rays) is:



(A) 7.2°

(B) 3.6°

(C) 0.8°

(D) 1.25°

Q28. In Young's double-slit experiment the fringe width is β when the screen is at a distance D from the slits. If the screen is moved so that its distance becomes $3D$ (slit separation and wavelength unchanged), the new fringe width is:

(A) 3β

(B) $\beta/3$

(C) β

(D) 9β

Q29. In single-slit diffraction, the angular half-width of the central maximum is given by $\theta = \frac{\lambda}{a}$, where a is the slit width. If the slit width a is doubled, the angular width of the central maximum:

(A) doubles

(B) remains the same

(C) becomes four times

(D) becomes half

Q30. A monochromatic source emits light of wavelength 600 nm at a power of 3.3×10^{-3} W. The number of photons emitted per second is approximately $\left(h = 6.6 \times 10^{-34}\text{ J s},\ c = 3 \times 10^{8}\text{ m s}^{-1}\right)$:

(A) 10^{15}

(B) 10^{16}

(C) 10^{18}

(D) 10^{20}

Q31. In the Bohr model of the hydrogen atom the radius of the n-th orbit is $r_n \propto n^2$. The ratio of the radius of the third orbit to that of the first orbit, $r_3 : r_1$, is:

(A) $3 : 1$

(B) $1 : 9$

(C) $9 : 1$

(D) $1 : 3$

Q32. A radioactive sample has a half-life of 5 years. The ratio of the number of undecayed nuclei present after 10 years to that after 15 years is:

(A) $2 : 1$

(B) $1 : 2$

(C) $3 : 2$

(D) $4 : 1$

Q33. The radius of a nucleus is related to its mass number by $R = R_0 A^{1/3}$. The ratio of the nuclear radii of two nuclei with mass numbers $A = 27$ and $A = 8$ is:

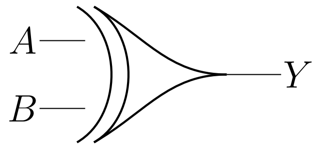
(A) $27 : 8$

(B) $9 : 4$

(C) $\sqrt{3} : \sqrt{2}$

(D) $3 : 2$

Q34. Identify the logic gate whose symbol is shown below. Its output Y is 1 only when the two inputs A and B are *different*, and 0 when they are the same.



(A) NAND gate

(B) XOR gate

(C) AND gate

(D) NOR gate

Q35. In a common-emitter transistor configuration, the base current is $20\ \mu$A and the resulting collector current is 4 mA. The current gain β of the transistor is:

(A) 20

(B) 100

(C) 200

(D) 400

Detailed Solutions

Q1.

Solution

Concept — Significant figures in multiplication: The result of a multiplication or division is rounded to the *least* number of significant figures present in any of the factors.

Step 1 — Count the significant figures: 4.5 has 2 significant figures and 1.2 has 2 significant figures.

Step 2 — Compute and round: $4.5 \times 1.2 = 5.40$, which must be rounded to 2 significant figures, giving 5.4 cm^2.

Why other options are wrong:

- (A) 5.40 keeps 3 significant figures, more than the data justify.
- (C) 5.400 shows 4 figures, far too many.
- (D) 5 keeps only 1 figure, discarding genuine precision.

Final Answer: Area $= 5.4$ cm$^2 \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q1

Q2.

Solution

Concept — Dimensions of resistance: From Ohm's law $R = \frac{V}{I}$, and $V = \frac{W}{q} = \frac{\text{energy}}{\text{charge}}$, with charge $=$ current $\times$ time.

Step 1 — Dimensions of potential difference: $V = \frac{[\text{ML}^2\text{T}^{-2}]}{[\text{AT}]} = [\text{ML}^2\text{T}^{-3}\text{A}^{-1}]$.

Step 2 — Divide by current: $R = \frac{V}{I} = \frac{[\text{ML}^2\text{T}^{-3}\text{A}^{-1}]}{[\text{A}]} = [\text{ML}^2\text{T}^{-3}\text{A}^{-2}]$.

Why other options are wrong:

- (A) $[\text{ML}^2\text{T}^{-2}\text{A}^{-2}]$ is the dimension of inductance.
- (B) $[\text{ML}^2\text{T}^{-3}\text{A}^{-1}]$ is the dimension of potential difference.
- (D) $[\text{MLT}^{-3}\text{A}^{-2}]$ drops a power of length.

Final Answer: $[R] = [\text{ML}^2\text{T}^{-3}\text{A}^{-2}] \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q2

Q3.

Solution

Concept — Blocks connected by a string: First find the common acceleration of the whole system, then isolate the trailing block to find the tension.

Step 1 — Acceleration of the system:

$$a = \frac{F}{m_1 + m_2} = \frac{20}{2+3} = 4 \text{ m s}^{-2}.$$

Step 2 — Tension from the trailing 2 kg block: The only horizontal force on it is the string tension, so

$$T = m_1 a = 2 \times 4 = 8 \text{ N}.$$

Why other options are wrong:

- (A) 20 N is the full applied force, not the internal tension.
- (B) 12 N would be $m_2 a$, the net force on the front block.
- (C) 4 N uses only the acceleration, forgetting the mass.

Final Answer: $T = 8 \text{ N} \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q3

Q4.

Solution

Concept — Constant-velocity push up a rough incline: At constant velocity the net force is zero, so the applied force balances both the gravity component and kinetic friction (both acting down the incline):

$$F = mg\sin\theta + \mu mg\cos\theta.$$

Step 1 — Gravity component: $mg\sin 30^\circ = 2 \times 10 \times \frac{1}{2} = 10$ N.

Step 2 — Friction force: $\mu mg\cos 30^\circ = \dfrac{1}{2\sqrt{3}} \times 2 \times 10 \times \dfrac{\sqrt{3}}{2} = \dfrac{20\sqrt{3}}{4\sqrt{3}} = 5$ N.

Step 3 — Add them: $F = 10 + 5 = 15$ N.

Why other options are wrong:

- (B) 10 N ignores friction (smooth-incline answer).
- (C) 5 N is only the friction term.
- (D) 20 N over-counts the friction contribution.

Final Answer: $F = 15 \text{ N} \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q4

Q5.

Solution

Concept — Uniform acceleration from rest: $v = u + at$ with $u = 0$.

Step 1 — Substitute: $v = 0 + 4 \times 6 = 24 \text{ m s}^{-1}$.

Why other options are wrong:

- (A) 12 uses $t = 3$ s.
- (B) 48 doubles the correct value (using $a = 8$).
- (D) 10 has no basis in the given data.

Final Answer: $v = 24 \text{ m s}^{-1} \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q5

Q6.

Solution

Concept — Kinetic energy and momentum: $K = \dfrac{p^2}{2m}$, so at fixed mass $K \propto p^2$.

Step 1 — Scale the momentum: $p \to 3p \Rightarrow K \to (3)^2 K = 9K$.

Why other options are wrong:

- (B) 3 times treats $K \propto p$, missing the square.
- (C) 6 times has no basis in $K \propto p^2$.
- (D) "unchanged" ignores the dependence on p entirely.

Final Answer: K becomes 9 times $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q6

Q7.

Solution

Concept — Head-on collision with restitution: For equal masses with A moving at u and B at rest, conservation of momentum gives $v_A + v_B = u$, and the restitution relation gives $v_B - v_A = eu$.

Step 1 — Solve the two equations: Adding them, $2v_B = u(1+e)$, so

$$v_B = \frac{u(1+e)}{2}.$$

Step 2 — Substitute $e = \frac{1}{2}$**:** $v_B = \dfrac{u(1+\frac{1}{2})}{2} = \dfrac{u \cdot \frac{3}{2}}{2} = \dfrac{3u}{4}$.

Why other options are wrong:

- (A) $u/4$ is the speed of body A after the collision, not B.
- (C) $u/2$ would be the result for a *perfectly inelastic* ($e = 0$, stuck together) case.
- (D) u holds only for a perfectly elastic collision ($e = 1$).

Final Answer: $v_B = \dfrac{3u}{4} \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q7

Q8.

Solution

Concept — Variation of g with depth: $g' = g\left(1 - \dfrac{d}{R}\right)$, so g decreases linearly as we go deeper.

Step 1 — Reach the centre: At the centre, $d = R$, hence

$$g' = g\left(1 - \frac{R}{R}\right) = g(1-1) = 0.$$

Step 2 — Physical meaning: Only the mass within radius r contributes; at the centre there is no enclosed mass pulling in any net direction, so $g' = 0$.

Why other options are wrong:

- (B) g is the surface value, where $d = 0$.
- (C) $g/2$ corresponds to a depth $d = R/2$, not the centre.

- (D) g never becomes infinite anywhere inside the Earth.

Final Answer: $g' = 0$ at the centre $\Rightarrow \boxed{A}$

Answer: (A) Go Back to Q8

Q9.

Solution

Concept — Orbital speed: For a circular orbit, $v = \sqrt{\frac{GM}{r}}$, so $v \propto \frac{1}{\sqrt{r}}$.

Step 1 — Scale the radius: $r \to 4r \Rightarrow v' = \frac{v}{\sqrt{4}} = \frac{v}{2}$.

Why other options are wrong:

- (A) $4v$ and (C) $2v$ wrongly increase the speed; a larger orbit is slower.
- (B) $v/4$ would need $v \propto 1/r$, not $1/\sqrt{r}$.

Final Answer: $v' = \frac{v}{2} \Rightarrow \boxed{D}$

Answer: (D) Go Back to Q9

Q10.

Solution

Concept — Work done in stretching a wire: A wire obeying Hooke's law behaves like a spring, so the elastic potential energy stored is $W = \frac{1}{2} \times (\text{load}) \times (\text{extension})$.

Step 1 — Substitute the values: load $= 100$ N, extension $= 0.5$ mm $= 0.5 \times 10^{-3}$ m.

$$W = \frac{1}{2} \times 100 \times 0.5 \times 10^{-3} = 0.025 \text{ J}.$$

Why other options are wrong:

- (A) 0.05 J omits the factor of $\frac{1}{2}$.
- (C) 0.5 J uses the extension in millimetres without converting.
- (D) 50 J misplaces the unit of extension entirely.

Final Answer: $W = 0.025 \text{ J} \Rightarrow \boxed{B}$

Answer: (B) Go Back to Q10

Q11.

Solution

Concept — Floating bodies (law of flotation): A floating body displaces its own weight of liquid, so the submerged fraction equals the ratio of the body's density to the liquid's density:

$$\frac{V_{\text{sub}}}{V} = \frac{\rho_{\text{body}}}{\rho_{\text{liquid}}}.$$

Step 1 — Substitute the densities:

$$\frac{V_{\text{sub}}}{V} = \frac{0.9}{1.0} = 0.9.$$

Step 2 — Interpretation: 90% of the ice sits below the surface, and only 10% is visible above the water — the familiar "tip of the iceberg".

Why other options are wrong:

- (A) 1.0 would mean the block is fully submerged (it floats, so it is not).
- (B) 0.1 is the fraction *above* the water, not below.
- (D) 0.8 uses the wrong density ratio.

Final Answer: Submerged fraction $= 0.9 \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q11

Q12.

Solution

Concept — Coulomb's law: $F = \dfrac{kq_1q_2}{r^2}$.

Step 1 — Apply the changes ($q_1 \to 3q_1$, $r \to 2r$):

$$F' = \frac{k(3q_1)q_2}{(2r)^2} = \frac{3kq_1q_2}{4r^2} = \frac{3}{4}F.$$

Why other options are wrong:

- (B) $\frac{3}{2}F$ forgets to square the doubled distance.
- (C) $3F$ ignores the distance change altogether.
- (D) $F/4$ accounts only for the distance, not the tripled charge.

Final Answer: $F' = \dfrac{3F}{4} \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q12

Q13.

Solution

Concept — Potential is a scalar sum: The total potential at a point is the algebraic sum (with signs) of the potentials due to each charge, $V = \sum \frac{kq_i}{r_i}$.

Step 1 — Distances: The midpoint M is 2 m from each charge.

Step 2 — Add the contributions:

$$V = \frac{kq_1}{2} + \frac{kq_2}{2} = \frac{9 \times 10^9}{2}\left(2 \times 10^{-6} - 1 \times 10^{-6}\right).$$

$$V = \frac{9 \times 10^9}{2} \times 1 \times 10^{-6} = 4.5 \times 10^3 \text{ V}.$$

Why other options are wrong:

- (A) 13.5×10^3 adds the magnitudes instead of using the signs.
- (B) "zero" would need equal and opposite charges.
- (C) 9×10^3 comes from the $+2\ \mu$C charge alone.

Final Answer: $V = 4.5 \times 10^3$ V $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q13

Q14.

Solution

Concept — Series then parallel capacitors: Capacitors in series combine reciprocally; the result then adds directly to a parallel capacitor.

Step 1 — Series pair:

$$C_s = \frac{3 \times 6}{3 + 6} = \frac{18}{9} = 2\ \mu\text{F}.$$

Step 2 — Add the parallel $4\ \mu$F:

$$C_{\text{eq}} = C_s + 4 = 2 + 4 = 6\ \mu\text{F}.$$

Why other options are wrong:

- (A) $13\ \mu$F adds all three in parallel $(3 + 6 + 4)$.

- (C) $2\ \mu$F stops at the series pair, ignoring the parallel branch.
- (D) $9\ \mu$F adds the 3 and 6 in series incorrectly.

Final Answer: $C_{\text{eq}} = 6\ \mu\text{F} \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q14

Q15.

Solution

Concept — Energy gained equals work done by the field: The kinetic energy acquired equals the work qV done on the charge:

$$\tfrac{1}{2}mv^2 = qV.$$

Step 1 — Solve for the speed:

$$v = \sqrt{\frac{2qV}{m}}.$$

Why other options are wrong:

- (A) $\dfrac{2qV}{m}$ is the value of v^2, not v (units of speed-squared).
- (B) $\sqrt{qV/2m}$ misplaces the factor of 2.
- (D) qV/m is not even a speed dimensionally.

Final Answer: $v = \sqrt{\dfrac{2qV}{m}} \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q15

Q16.

Solution

Concept — Identical cells in parallel: For n identical cells of emf ε and internal resistance r in parallel, the equivalent emf stays ε and the equivalent internal resistance is r/n.

Step 1 — Equivalent emf: Both cells have the same emf, so $\varepsilon_{\text{eq}} = 2$ V.

Step 2 — Equivalent internal resistance: Two equal resistances of $1\ \Omega$ in parallel give

$$r_{\text{eq}} = \frac{1 \times 1}{1+1} = 0.5\ \Omega.$$

Why other options are wrong:

- (B),(D) 4 V is the *series* emf, not the parallel one.
- (C) $2\ \Omega$ adds the internal resistances in series.

Final Answer: 2 V and $0.5\ \Omega \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q16

Q17.

Solution

Concept — Potential divider on a uniform wire: On a uniform wire carrying a steady current, the potential difference is proportional to the length: $V_{AC} = \dfrac{L_{AC}}{L_{AB}} V_{AB}$.

Step 1 — Apply the length ratio:

$$V_{AC} = \frac{4}{10} \times 5 = 2\ \text{V}.$$

Why other options are wrong:

- (A) 5 V is the drop across the whole wire AB.
- (B) 3 V is the drop across the remaining 6 m (CB).
- (C) 1 V uses the wrong length fraction.

Final Answer: $V_{AC} = 2\ \text{V} \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q17

Q18.

Solution

Concept — Joule heating: The heat produced in a resistor is $H = I^2Rt$.

Step 1 — Substitute the values:

$$H = (2)^2 \times 5 \times 10 = 4 \times 5 \times 10 = 200\ \text{J}.$$

Why other options are wrong:

- (A) 100 J uses I instead of I^2.
- (B) 50 J also drops the square and a factor.

- (D) 400 J doubles the current contribution wrongly.

Final Answer: $H = 200$ J $\Rightarrow$ $\boxed{\text{C}}$

Answer: (C) Go Back to Q18

Q19.

Solution

Concept — Period of circular motion in a magnetic field: $T = \dfrac{2\pi m}{qB}$, which contains no velocity term.

Step 1 — Check the dependence on speed: Since T depends only on m, q and B, changing the speed leaves T unchanged. (A faster particle simply moves in a larger circle of radius $r = mv/qB$, completing it in the same time.)

Why other options are wrong:

- (A),(C),(D) all assume T depends on v, but the velocity cancels out of the period.

Final Answer: T remains unchanged $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q19

Q20.

Solution

Concept — Field inside a long solenoid: $B = \mu_0 nI$, where n is the number of turns per unit length.

Step 1 — Substitute the values:

$$B = (4\pi \times 10^{-7})(500)(4) = 4\pi \times 10^{-7} \times 2000 = 8\pi \times 10^{-4} \text{ T}.$$

Step 2 — Numerical size: $8\pi \times 10^{-4} \approx 2.5 \times 10^{-3}$ T.

Why other options are wrong:

- (B) $2\pi \times 10^{-4}$ uses $n = 125$ or a factor-of-four error.
- (C) $4\pi \times 10^{-4}$ uses $I = 2$ A.
- (D) $\pi \times 10^{-4}$ drops a factor of 8.

Final Answer: $B = 8\pi \times 10^{-4}$ T $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q20

Q21.

Solution

Concept — Resultant of two perpendicular fields: When two magnetic fields are mutually perpendicular, they add like vectors at right angles: $B = \sqrt{B_1^2 + B_2^2}$.

Step 1 — Substitute (in units of 10^{-6} T):

$$B = \sqrt{3^2 + 4^2} \times 10^{-6} = \sqrt{9 + 16} \times 10^{-6} = \sqrt{25} \times 10^{-6} = 5 \times 10^{-6}\ \text{T}.$$

Why other options are wrong:

- (A) 7×10^{-6} adds the magnitudes (valid only for parallel fields).
- (B) 1×10^{-6} subtracts them (valid only for anti-parallel fields).
- (C) 12×10^{-6} multiplies them.

Final Answer: $B = 5 \times 10^{-6}\ \text{T} \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q21

Q22.

Solution

Concept — Magnetic susceptibility: Susceptibility χ measures how strongly a material magnetises in response to a field. Diamagnets are weakly repelled (negative χ); paramagnets are weakly attracted (positive χ).

Step 1 — Diamagnetic: χ is small and *negative* (typically $\sim -10^{-5}$), and is essentially independent of temperature.

Step 2 — Paramagnetic: χ is small and *positive*, and follows Curie's law $\chi \propto \dfrac{1}{T}$.

Why other options are wrong:

- (A) a diamagnet has negative, not positive, χ.
- (C) a paramagnet has small *positive* χ, not large negative.
- (D) only diamagnets have negative χ; paramagnets are positive.

Final Answer: Diamagnetic $\chi < 0$, paramagnetic $\chi > 0 \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q22

Q23.

Solution

Concept — Charge through a coil: The charge that flows is independent of how fast the flux changes; it depends only on the total flux change and the resistance: $q = \dfrac{\Delta\Phi}{R}$.

Step 1 — Substitute the values:

$$q = \frac{\Delta\Phi}{R} = \frac{2}{10} = 0.2 \text{ C}.$$

Why other options are wrong:

- (B) 20 C multiplies instead of dividing by R.
- (C) 2 C ignores the resistance.
- (D) 0.02 C misplaces a power of ten.

Final Answer: $q = 0.2 \text{ C} \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q23

Q24.

Solution

Concept — Inductive reactance: A pure inductor offers reactance $X_L = 2\pi f L$, and the rms current is $I_{\text{rms}} = \dfrac{V_{\text{rms}}}{X_L}$.

Step 1 — Reactance:

$$X_L = 2\pi f L = 2\pi \times 50 \times \frac{1}{\pi} = 100\ \Omega.$$

Step 2 — Current:

$$I_{\text{rms}} = \frac{V_{\text{rms}}}{X_L} = \frac{100}{100} = 1 \text{ A}.$$

Why other options are wrong:

- (A) 2 A uses $X_L = 50\ \Omega$ (drops the 2π correctly but mis-evaluates).
- (B) 0.5 A uses $X_L = 200\ \Omega$.
- (D) 100 A treats the inductor as $1\ \Omega$.

Final Answer: $I_{\text{rms}} = 1 \text{ A} \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q24

Q25.

Solution

Concept — Wave relation: For an electromagnetic wave in vacuum, $c = f\lambda$, so $f = \frac{c}{\lambda}$.

Step 1 — Substitute:

$$f = \frac{3 \times 10^8}{3} = 1 \times 10^8 \text{ Hz}.$$

Why other options are wrong:

- (A) 10^6 misplaces a power of ten.
- (C) 9×10^8 multiplies c by λ instead of dividing.
- (D) 10^9 uses $\lambda = 0.3$ m.

Final Answer: $f = 10^8$ Hz $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q25

Q26.

Solution

Concept — Image in a convex mirror: A convex (diverging) mirror always forms, for any real object, a virtual image that is erect and smaller than the object, located behind the mirror between the pole and the focus.

Step 1 — Reason from the geometry: The reflected rays diverge; their backward extensions meet behind the mirror, giving a virtual, erect, diminished image regardless of object position.

Why other options are wrong:

- (A),(B) a convex mirror never forms a real image of a real object.
- (C) the image is erect, not inverted, and diminished, not magnified.

Final Answer: Virtual, erect and diminished $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q26

Q27.

Solution

Concept — Angular dispersion: The angular dispersion of a prism is the difference in deviation between the violet and red rays: $\Delta = \delta_v - \delta_r$.

Step 1 — Substitute:

$$\Delta = \delta_v - \delta_r = 4.0^\circ - 3.2^\circ = 0.8^\circ.$$

Why other options are wrong:

- (A) 7.2° adds the two deviations.
- (B) 3.6° is the mean deviation, not the dispersion.
- (D) 1.25° is the dispersive power $\times$ something, not the angular dispersion.

Final Answer: $\Delta = 0.8^\circ \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q27

Q28.

Solution

Concept — Fringe width and screen distance: $\beta = \dfrac{\lambda D}{d}$, so at fixed λ and d, $\beta \propto D$.

Step 1 — Triple the screen distance: $D \to 3D \Rightarrow \beta' = \dfrac{\lambda(3D)}{d} = 3\beta$.

Why other options are wrong:

- (B) $\beta/3$ would require *reducing* D.
- (C) β ignores the change in D.
- (D) 9β wrongly squares the factor of 3.

Final Answer: $\beta' = 3\beta \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q28

Q29.

Solution

Concept — Central maximum in single-slit diffraction: The angular half-width is $\theta = \frac{\lambda}{a}$, so the full angular width $\propto \frac{1}{a}$.

Step 1 — Double the slit width: $a \to 2a \Rightarrow \theta' = \frac{\lambda}{2a} = \frac{\theta}{2}$, i.e. the central maximum narrows to half its angular width.

Why other options are wrong:

- (A) doubling would require *halving* a.
- (B) "same" ignores the dependence on a.
- (C) "four times" has no basis in $\theta \propto 1/a$.

Final Answer: The angular width becomes half $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q29

Q30.

Solution

Concept — Photon rate from a source: The number of photons per second is $N = \frac{P}{E_{\text{photon}}}$, where $E_{\text{photon}} = \frac{hc}{\lambda}$.

Step 1 — Energy of one photon:

$$E = \frac{hc}{\lambda} = \frac{(6.6 \times 10^{-34})(3 \times 10^{8})}{600 \times 10^{-9}} = \frac{1.98 \times 10^{-25}}{6 \times 10^{-7}} = 3.3 \times 10^{-19}\ \text{J}.$$

Step 2 — Photon rate:

$$N = \frac{P}{E} = \frac{3.3 \times 10^{-3}}{3.3 \times 10^{-19}} = 1 \times 10^{16}.$$

Why other options are wrong:

- (A) 10^{15} and (C) 10^{18}, (D) 10^{20} all misplace a power of ten in E or N.

Final Answer: $N \approx 10^{16}$ photons per second $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q30

Q31.

Solution

Concept — Bohr orbit radius: $r_n \propto n^2$, so the ratio of radii is the ratio of the squares of the quantum numbers.

Step 1 — Form the ratio:

$$\frac{r_3}{r_1} = \frac{3^2}{1^2} = \frac{9}{1} = 9:1.$$

Why other options are wrong:

- (A) $3:1$ uses $r \propto n$.
- (B) $1:9$ inverts the ratio.
- (D) $1:3$ both inverts and drops the square.

Final Answer: $r_3 : r_1 = 9:1 \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q31

Q32.

Solution

Concept — Radioactive decay: The number of undecayed nuclei after n half-lives is $N = N_0\left(\frac{1}{2}\right)^n$, with $n = t/T_{1/2}$.

Step 1 — Nuclei at the two times: With $T_{1/2} = 5$ years, after 10 years $n = 2$ so $N_{10} = N_0/4$; after 15 years $n = 3$ so $N_{15} = N_0/8$.

Step 2 — Form the ratio:

$$\frac{N_{10}}{N_{15}} = \frac{N_0/4}{N_0/8} = \frac{8}{4} = 2:1.$$

Why other options are wrong:

- (B) $1:2$ inverts the ratio.
- (C) $3:2$ treats decay as linear.
- (D) $4:1$ uses the wrong number of half-lives.

Final Answer: $N_{10} : N_{15} = 2:1 \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q32

Q33.

Solution

Concept — Nuclear radius: $R = R_0 A^{1/3}$, so the ratio of radii is the ratio of the cube roots of the mass numbers.

Step 1 — Form the ratio:

$$\frac{R_1}{R_2} = \left(\frac{A_1}{A_2}\right)^{1/3} = \left(\frac{27}{8}\right)^{1/3} = \frac{3}{2}.$$

Why other options are wrong:

- (A) $27:8$ forgets the cube root.
- (B) $9:4$ uses the square root instead of the cube root.
- (C) $\sqrt{3}:\sqrt{2}$ also uses the wrong root.

Final Answer: $R_1 : R_2 = 3:2 \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q33

Q34.

Solution

Concept — Exclusive-OR (XOR) gate: The XOR gate gives output $Y = 1$ when the two inputs differ and $Y = 0$ when they are the same; logically $Y = A \oplus B = \overline{A}B + A\overline{B}$.

Step 1 — Match the description: "1 only when inputs differ" is exactly the truth table of the XOR gate ($00 \to 0$, $01 \to 1$, $10 \to 1$, $11 \to 0$). The curved double-line input shape in the symbol is the XOR marker.

Why other options are wrong:

- (A) NAND gives 0 only when both inputs are 1.
- (C) AND gives 1 only when both inputs are 1.
- (D) NOR gives 1 only when both inputs are 0.

Final Answer: The gate is an XOR gate $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q34

Q35.

Solution

Concept — Common-emitter current gain: $\beta = \dfrac{I_c}{I_b}$, the ratio of collector current to base current.

Step 1 — Convert to consistent units: $I_c = 4$ mA $= 4 \times 10^{-3}$ A, $I_b = 20$ μA $= 20 \times 10^{-6}$ A.

Step 2 — Compute:

$$\beta = \frac{4 \times 10^{-3}}{20 \times 10^{-6}} = \frac{4000 \times 10^{-6}}{20 \times 10^{-6}} = \frac{4000}{20} = 200.$$

Why other options are wrong:

- (A) 20 ignores the mA-to-μA conversion.
- (B) 100 uses $I_b = 40$ μA.
- (D) 400 doubles the collector current.

Final Answer: $\beta = 200 \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q35

Answer Key

Q	Ans	Q	Ans	Q	Ans	Q	Ans	Q	Ans
1	B	2	C	3	D	4	A	5	C
6	A	7	B	8	A	9	D	10	B
11	C	12	A	13	D	14	B	15	C
16	A	17	D	18	C	19	B	20	A
21	D	22	B	23	A	24	C	25	B
26	D	27	C	28	A	29	D	30	B
31	C	32	A	33	D	34	B	35	C