JCECE Physics Sample Paper – 2

Duration: 60 Minutes **Maximum Marks: 50**

Instructions

- This paper contains **50** Multiple Choice Questions (Single Correct Answer), modelled on the Physics portion of **JCECE** entrance.
- Each correct answer carries **+1 mark**. There is -0.25 **mark** for each incorrect answer; unattempted questions get 0.
- Only **one** option is correct. Choose carefully.
- Syllabus level: **Class 11 and Class 12 NCERT Physics (Jharkhand JAC / CBSE aligned).**
- Use of mobile phones, calculators, or electronic gadgets is strictly prohibited.

Q1. The coefficient of viscosity η appears in the relation $F = \eta A \frac{dv}{dx}$, where F is force, A is area and $\frac{dv}{dx}$ is the velocity gradient. The dimensional formula of η is:

(A) $[\mathrm{ML^{-1}T^{-1}}]$

(B) $[\mathrm{MLT^{-1}}]$

(C) $[\mathrm{ML^{-2}T^{-2}}]$

(D) $[\mathrm{M^0L^{-1}T^{-1}}]$

Q2. A rectangular plate has length 2.5 cm and breadth 1.24 cm. Its area, reported to the correct number of significant figures, is:

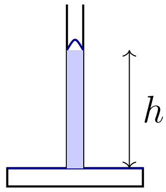
(A) $3.10\ \mathrm{cm^2}$

(B) $3.100\ \mathrm{cm^2}$

(C) $3.1000\ \mathrm{cm^2}$

(D) $3.1\ \mathrm{cm^2}$

Q3. A liquid of surface tension 6.0×10^{-2} N/m and density 1200 kg/m^3 rises in a clean glass capillary of radius 0.25 mm (contact angle $0°$, $g = 10$ m/s^2). The capillary rise h is:



(A) 4.0 cm

(B) 2.0 cm

(C) 8.0 cm

(D) 1.0 cm

Q4. A steel wire of length 3 m and cross-sectional area 2 mm^2 carries a load of 200 N. If Young's modulus of steel is 2×10^{11} N/m^2, the elongation of the wire is:

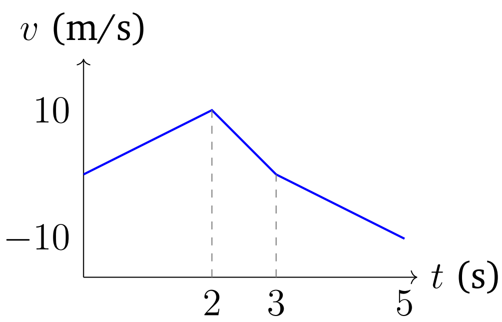
(A) 0.75 mm

(B) 1.5 mm

(C) 0.5 mm

(D) 3.0 mm

Q5. The velocity–time graph of a particle moving on a straight line is shown. The net displacement in 6 s is:



(A) 15 m

(B) 5 m

(C) 25 m

(D) 0 m

Q6. A projectile is fired with speed 40 m/s at 45° above the horizontal ($g = 10$ m/s^2). Its horizontal range is:

(A) 160 m

(B) 80 m

(C) 320 m

(D) 120 m

Q7. Two trains, 120 m and 80 m long, move towards each other on parallel tracks at 20 m/s and 30 m/s respectively. The time taken for them to completely cross each other is:

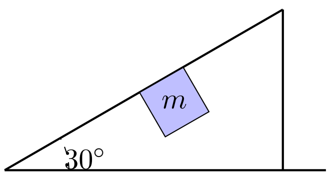
(A) 10 s

(B) 20 s

(C) 4 s

(D) 8 s

Q8. A block slides down a rough incline of angle 30° with coefficient of kinetic friction 0.2 between block and surface, as shown ($g = 10$ m/s^2). The acceleration of the block down the incline is:



(A) 5.0 m/s^2

(B) 3.3 m/s^2

(C) 1.7 m/s^2

(D) 8.7 m/s^2

Q9. A car moving at 20 m/s on a horizontal road brakes; the coefficient of kinetic friction between tyres and road is 0.5 ($g = 10$ m/s^2). The distance the car travels before stopping is:

(A) 20 m

(B) 80 m

(C) 10 m

(D) 40 m

Q10. A road is to be banked so that a car can take a circular turn of radius 50 m at 10 m/s without relying on friction ($g = 10$ m/s^2). The required angle of banking θ satisfies:

(A) $\tan\theta = 0.5$

(B) $\tan\theta = 1.0$

(C) $\tan\theta = 0.2$

(D) $\tan\theta = 0.1$

Q11. A variable force $F = 3x^2$ N acts on a particle along the x-axis. The work done in moving the particle from $x = 0$ to $x = 2$ m is:

(A) 8 J

(B) 12 J

(C) 6 J

(D) 24 J

Q12. A car experiences a constant resistive force of 500 N while travelling at a steady speed of 20 m/s. The power developed by its engine is:

(A) 25 W

(B) 500 W

(C) 10 kW

(D) 40 kW

Q13. A body of mass 3 kg moving at 8 m/s collides head-on and sticks to a stationary body of mass 1 kg. The common velocity of the combined mass after collision is:

(A) 8 m/s

(B) 2 m/s

(C) 4 m/s

(D) 6 m/s

Q14. A uniform circular disc of mass M and radius R has moment of inertia $\frac{1}{2}MR^2$ about an axis through its centre and perpendicular to its plane. Its moment of inertia about a diameter is:

(A) $\dfrac{1}{4}MR^2$

(B) $\dfrac{1}{2}MR^2$

(C) $\dfrac{1}{3}MR^2$

(D) MR^2

Q15. The escape velocity from the surface of a planet of radius 6.4×10^6 m where the acceleration due to gravity is 10 m/s^2 is approximately:

(A) 8.0 km/s

(B) 22.6 km/s

(C) 5.6 km/s

(D) 11.3 km/s

Q16. A refrigerator works between an inside temperature of 250 K and room temperature 300 K. Its maximum (Carnot) coefficient of performance is:

(A) 6

(B) 1.2

(C) 0.2

(D) 5

Q17. When 200 J of heat is supplied to a gas kept in a rigid (constant-volume) container, the increase in its internal energy is:

(A) 0 J

(B) 100 J

(C) 200 J

(D) 400 J

Q18. The rms speed of oxygen molecules ($M = 32 \times 10^{-3}$ kg/mol) at 300 K is approximately ($R = 8.3$ J/mol·K):

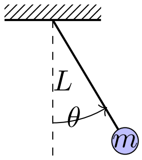
(A) 245 m/s

(B) 483 m/s

(C) 966 m/s

(D) 120 m/s

Q19. A simple pendulum of length 1.0 m oscillates at a place where $g = \pi^2$ m/s^2. The mass attached to the spring-like restoring system shown executes SHM. The time period of the pendulum is:



(A) 1 s

(B) 4 s

(C) π s

(D) 2 s

Q20. For a particle executing SHM of amplitude A, the ratio of its kinetic energy to its total energy when the displacement is $A/2$ is:

(A) $1/4$

(B) $1/2$

(C) 1

(D) 3/4

Q21. A pipe closed at one end has length 0.25 m. Taking the speed of sound as 340 m/s, the fundamental frequency of the air column is:

(A) 170 Hz

(B) 340 Hz

(C) 680 Hz

(D) 85 Hz

Q22. Two tuning forks of frequencies 256 Hz and 260 Hz are sounded together. The number of beats heard per second is:

(A) 4 beats/s

(B) 258 beats/s

(C) 516 beats/s

(D) 2 beats/s

Q23. Two point charges experience a force of 8 N when placed a fixed distance apart in vacuum. If the space between them is filled with a medium of dielectric constant $K = 4$, the force becomes:

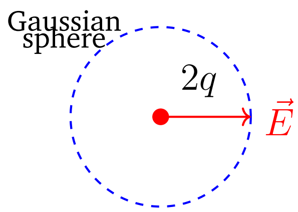
(A) 32 N

(B) 2 N

(C) 4 N

(D) 0.5 N

Q24. A point charge q at the centre of a Gaussian sphere produces a total flux $\Phi_0 = 2 \times 10^5$ N·m^2/C through its surface. If the charge is doubled (radius unchanged), as shown, the new total flux is:



(A) 4×10^5 N·m^2/C

(B) 2×10^5 N·m^2/C

(C) 1×10^5 N·m^2/C

(D) 8×10^5 N·m^2/C

Q25. The magnitude of the electric field at a point on the equatorial line (perpendicular bisector) of a short dipole of dipole moment p, at distance r from its centre, is:

(A) $\frac{1}{4\pi\varepsilon_0}\frac{2p}{r^3}$

(B) $\frac{1}{4\pi\varepsilon_0}\frac{p}{r^3}$

(C) $\frac{1}{4\pi\varepsilon_0}\frac{p}{r^2}$

(D) $\frac{1}{4\pi\varepsilon_0}\frac{2p}{r^2}$

Q26. A parallel-plate capacitor of capacitance $5\ \mu$F is charged by a battery to 20 V and kept connected to the battery. A dielectric of constant $K = 2$ is then inserted, filling the gap. The additional charge that flows onto the plates is:

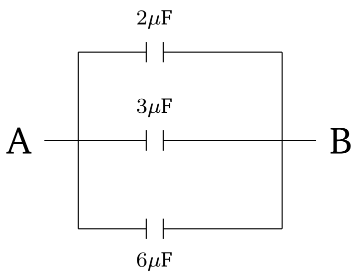
(A) $50\ \mu$C

(B) $200\ \mu$C

(C) $300\ \mu$C

(D) $100\ \mu$C

Q27. Three capacitors of $2\ \mu$F, $3\ \mu$F and $6\ \mu$F are connected in parallel between A and B as shown. The equivalent capacitance is:



(A) $11\ \mu$F

(B) $1\ \mu$F

(C) $6\ \mu$F

(D) $5\ \mu$F

Q28. A wire of resistivity $1.6 \times 10^{-8}\,\Omega \cdot$ m, length 4 m and cross-sectional area 2×10^{-7} m^2 has resistance:

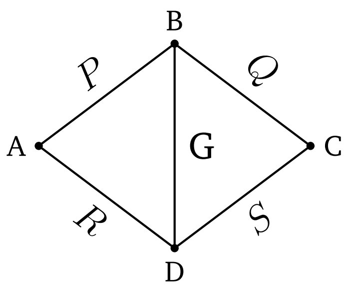
(A) $0.16\,\Omega$

(B) $0.64\,\Omega$

(C) $0.32\,\Omega$

(D) $1.28\,\Omega$

Q29. In the balanced Wheatstone bridge shown, $P = 2\,\Omega$, $Q = 6\,\Omega$ and $R = 5\,\Omega$. The unknown resistance S is:



(A) $1.67\,\Omega$

(B) $30\,\Omega$

(C) $15\,\Omega$

(D) $7.5\,\Omega$

Q30. A cell of EMF 2.0 V and internal resistance $0.5\,\Omega$ is connected across an external resistance of $3.5\,\Omega$. The current drawn from the cell is:

(A) 0.4 A

(B) 0.5 A

(C) 4.0 A

(D) 1.0 A

Q31. An electric iron rated 1000 W is used for 3 hours. If electrical energy costs Rs. 5 per kWh, the cost of running the iron is:

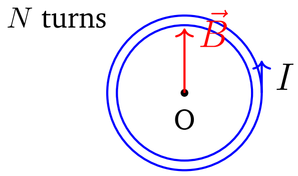
(A) Rs. 15

(B) Rs. 5

(C) Rs. 3

(D) Rs. 30

Q32. A circular coil of 50 turns and radius 0.1 m carries a current of 2 A, as shown ($\mu_0 = 4\pi \times 10^{-7}$ T·m/A). The magnetic field at its centre is:



(A) 1.6×10^{-4} T

(B) 3.2×10^{-4} T

(C) 1.26×10^{-5} T

(D) 6.28×10^{-4} T

Q33. A charge of 2×10^{-6} C moves at 5×10^{4} m/s perpendicular to a uniform magnetic field of 0.3 T. The magnetic force on the charge is:

(A) 1.5×10^{-2} N

(B) 6.0×10^{-2} N

(C) 3.0×10^{-2} N

(D) 1.5×10^{-1} N

Q34. A long solenoid is wound with 500 turns over a length of 0.5 m and carries a current of 5 A ($\mu_0 = 4\pi \times 10^{-7}$ T·m/A). The magnetic field inside it is:

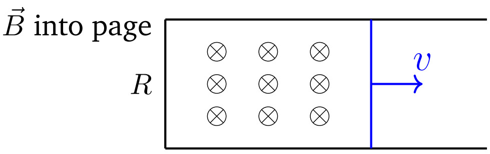
(A) 3.14×10^{-3} T

(B) 1.26×10^{-2} T

(C) 6.28×10^{-3} T

(D) 2.0×10^{-3} T

Q35. A conducting rod of length 0.4 m slides at 5 m/s perpendicular to itself across rails of total circuit resistance $2\,\Omega$ in a uniform field of 0.5 T into the page, as shown. The induced current in the rod is:



(A) 1.0 A

(B) 0.2 A

(C) 0.5 A

(D) 2.0 A

Q36. In a series LCR circuit, $L = 2$ H and $C = 8\,\mu$F. The resonant angular frequency ω_0 of the circuit is:

(A) 250 rad/s

(B) 500 rad/s

(C) 125 rad/s

(D) 1000 rad/s

Q37. An ideal transformer steps voltage down from 240 V to 24 V. If the current in the primary is 0.5 A, the current in the secondary is:

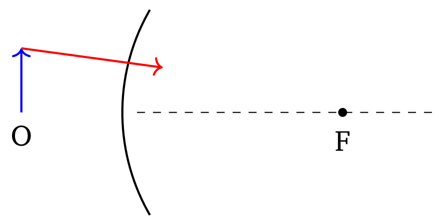
(A) 0.05 A

(B) 5 A

(C) 0.5 A

(D) 50 A

Q38. An object is placed 20 cm in front of a convex mirror of focal length 20 cm, as shown. The image distance is:



(A) $+20$ cm

(B) -10 cm

(C) $+10$ cm

(D) -20 cm

Q39. For a glass–air interface with refractive index of glass $n = 1.5$, the critical angle for total internal reflection is closest to:

(A) 42°

(B) 30°

(C) 48°

(D) 60°

Q40. A thin convex lens has a focal length of 25 cm. Its power is:

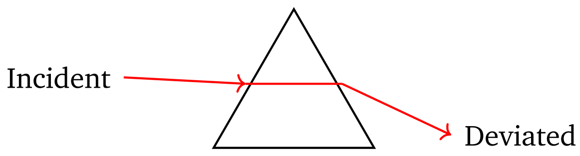
(A) $+2.5$ D

(B) $+4$ D

(C) -4 D

(D) $+0.25$ D

Q41. An equilateral prism ($A = 60°$) produces a minimum deviation of $60°$ for a certain colour of light, as shown. The refractive index of the prism material for that colour is:



(A) 1.33

(B) 1.41

(C) 1.5

(D) $\sqrt{3}$

Q42. In a Young's double-slit experiment, light of wavelength 600 nm falls on slits separated by 0.3 mm, with the screen 1.5 m away. The fringe width is:

(A) 3.0 mm

(B) 0.3 mm

(C) 1.5 mm

(D) 6.0 mm

Q43. Light is incident on a glass surface of refractive index $\sqrt{3}$. The angle of incidence (Brewster's angle) at which the reflected light is completely plane polarised is:

(A) $30°$

(B) $60°$

(C) $45°$

(D) $90°$

Q44. Light of energy 5 eV falls on a metal of work function 2 eV. The maximum kinetic energy of the emitted photoelectrons is:

(A) 2 eV

(B) 7 eV

(C) 3 eV

(D) 2.5 eV

Q45. An electron is accelerated through a potential difference of 600 V. Its de Broglie wavelength is approximately:

(A) 1.0 Å

(B) 0.25 Å

(C) 0.1 Å

(D) 0.5 Å

Q46. In Bohr's model of hydrogen, the energy of the ground state $(n = 1)$ is -13.6 eV. The energy of the electron in the second excited state $(n = 3)$ is:

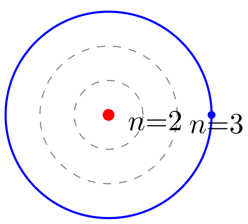
(A) -3.4 eV

(B) -13.6 eV

(C) -1.51 eV

(D) -0.85 eV

Q47. In Bohr's model of hydrogen the radius of the nth orbit is $r_n = n^2 a_0$ with $a_0 = 0.53$ Å. The radius of the third orbit $(n = 3)$, shown below, is:



(A) 1.59 Å

(B) 4.77 Å

(C) 2.12 Å

(D) 0.53 Å

Q48. A radioactive sample has a half-life of 4 years. The fraction of the original nuclei that has decayed after 12 years is:

(A) $1/8$

(B) $1/2$

(C) $3/4$

(D) $7/8$

Q49. A nucleus of mass number $A = 16$ has a total binding energy of 128 MeV. The binding energy per nucleon is:

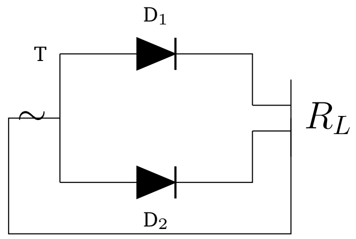
(A) 16 MeV

(B) 8 MeV

(C) 128 MeV

(D) 4 MeV

Q50. In the full-wave rectifier circuit shown using two diodes and a centre-tapped transformer, the diodes conduct alternately. For an a.c. input, the output across the load R_L consists of:



(A) No current at all

(B) A pure ripple-free direct current

(C) Only the positive half-cycles of the input

(D) A unidirectional current for both half-cycles of the input

Detailed Solutions

Q1.

Solution

Concept — Dimensional analysis of viscosity: Rearrange $F = \eta A \frac{dv}{dx}$ to $\eta = \frac{F}{A\,(dv/dx)}$ and substitute dimensions. $[F] = \mathrm{MLT^{-2}}$, $[A] = \mathrm{L^2}$, velocity gradient $[dv/dx] = \frac{\mathrm{LT^{-1}}}{\mathrm{L}} = \mathrm{T^{-1}}$.

Step 1 — Numerator: $[F] = \mathrm{MLT^{-2}}$.

Step 2 — Denominator: $[A][dv/dx] = \mathrm{L^2 \cdot T^{-1}} = \mathrm{L^2T^{-1}}$.

Step 3 — Divide: $[\eta] = \frac{\mathrm{MLT^{-2}}}{\mathrm{L^2T^{-1}}}$.

Step 4 — Subtract exponents: $\mathrm{M^1L^{1-2}T^{-2-(-1)}} = \mathrm{ML^{-1}T^{-1}}$.

Why other options are wrong:

- (B) keeps a positive power of L and a wrong time power.
- (C) matches a pressure-gradient form, not viscosity.
- (D) drops the mass dimension, which viscosity must retain.

Final Answer: $[\eta] = \mathrm{ML^{-1}T^{-1}} \Rightarrow \boxed{\mathrm{A}}$

Answer: (A) Go Back to Q1

Q2.

Solution

Concept — Significant figures in multiplication: In multiplication (or division), the result is rounded to the same number of significant figures as the factor having the fewest significant figures.

Step 1 — Count significant figures: 2.5 has 2 significant figures; 1.24 has 3 significant figures.

Step 2 — The smaller count is: 2 significant figures.

Step 3 — Multiply the numbers: $2.5 \times 1.24 = 3.10\ \mathrm{cm^2}$.

Step 4 — Round to 2 significant figures: $3.10 \rightarrow 3.1\ \mathrm{cm^2}$.

Why other options are wrong:

- (A) keeps 3 significant figures, more than justified.
- (B) keeps 4 significant figures.
- (C) keeps 5 significant figures, far too many.

Final Answer: Area $= 3.1$ cm$^2 \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q2

Q3.

Solution

Concept — Capillary rise: For a wetting liquid, $h = \dfrac{2T\cos\theta}{r\rho g}$.

Step 1 — List data: $T = 6.0 \times 10^{-2}$ N/m, $\theta = 0°$ so $\cos\theta = 1$, $r = 0.25$ mm $= 2.5 \times 10^{-4}$ m, $\rho = 1200$ kg/m^3, $g = 10$ m/s^2.

Step 2 — Numerator: $2T\cos\theta = 2 \times 6.0 \times 10^{-2} \times 1 = 1.2 \times 10^{-1}$.

Step 3 — Denominator: $r\rho g = 2.5 \times 10^{-4} \times 1200 \times 10 = 3.0$.

Step 4 — Divide: $h = \dfrac{1.2 \times 10^{-1}}{3.0} = 4.0 \times 10^{-2}$ m.

Step 5 — Convert to cm: 4.0×10^{-2} m $= 4.0$ cm.

Why other options are wrong:

- (B) halves the correct value.
- (C) doubles it.
- (D) divides by an extra factor of 4.

Final Answer: $h = 4.0$ cm $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q3

Q4.

Solution

Concept — Elongation from Young's modulus: From $Y = \dfrac{FL}{A\,\Delta L}$, the elongation is $\Delta L = \dfrac{FL}{AY}$.

Step 1 — List data: $F = 200$ N, $L = 3$ m, $A = 2$ mm$^2 = 2 \times 10^{-6}$ m^2, $Y = 2 \times 10^{11}$ N/m^2.

Step 2 — Numerator: $FL = 200 \times 3 = 600$.

Step 3 — Denominator: $AY = 2 \times 10^{-6} \times 2 \times 10^{11} = 4 \times 10^{5}$.

Step 4 — Divide: $\Delta L = \dfrac{600}{4 \times 10^{5}} = 1.5 \times 10^{-3}$ m.

Step 5 — Convert: 1.5×10^{-3} m $= 1.5$ mm.

Why other options are wrong:

- (A) halves the result.
- (C) drops the factor from $L = 3$ m.
- (D) doubles the value.

Final Answer: $\Delta L = 1.5$ mm $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q4

Q5.

Solution

Concept — Displacement from a v–t graph: Displacement equals the signed area between the curve and the t-axis; area below the axis is negative.

Step 1 — Positive area (0–3 s): The velocity rises from 0 to 10 m/s at $t = 2$ s and falls back to 0 at $t = 3$ s, forming a triangle of base 3 s and height 10 m/s. Area $= \frac{1}{2} \times 3 \times 10 = +15$ m.

Step 2 — Negative area (3–5 s): The velocity goes from 0 to -10 m/s, a triangle of base 2 s and height 10 m/s below the axis. Area $= \frac{1}{2} \times 2 \times 10 = 10$ m, taken as -10 m.

Step 3 — Net displacement: $+15 + (-10) = +5$ m.

Step 4 — Interpret sign: Positive means the net displacement is 5 m in the forward direction.

Why other options are wrong:

- (A) keeps only the positive triangle area and ignores the negative part.
- (C) sums the magnitudes $(15 + 10)$ instead of taking the signed total.
- (D) wrongly assumes the areas cancel.

Final Answer: Net displacement $= 5$ m forward $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q5

Q6.

Solution

Concept — Horizontal range of a projectile: $R = \dfrac{u^2 \sin 2\theta}{g}$.

Step 1 — List data: $u = 40$ m/s, $\theta = 45°$, $g = 10$ m/s^2.

Step 2 — Evaluate $\sin 2\theta$**:** $\sin(2 \times 45°) = \sin 90° = 1$.

Step 3 — Square the speed: $u^2 = (40)^2 = 1600$.

Step 4 — Numerator: $u^2 \sin 2\theta = 1600 \times 1 = 1600$.

Step 5 — Divide by g**:** $R = \dfrac{1600}{10} = 160$ m.

Why other options are wrong:

- (B) halves the result.
- (C) doubles it.
- (D) uses an incorrect $\sin 2\theta$.

Final Answer: $R = 160 \text{ m} \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q6

Q7.

Solution

Concept — Relative velocity, opposite directions: For trains moving towards each other, the relative speed is the sum of the speeds, and the time to cross is $\dfrac{\text{sum of lengths}}{\text{relative speed}}$.

Step 1 — Relative speed: $20 + 30 = 50$ m/s.

Step 2 — Total length to clear: $120 + 80 = 200$ m.

Step 3 — Divide: $t = \dfrac{200}{50} = 4$ s.

Why other options are wrong:

- (A) and (B) use the difference of speeds (same-direction case).
- (D) drops one train's length.

Final Answer: $t = 4 \text{ s} \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q7

Q8.

Solution

Concept — Sliding down a rough incline: The acceleration down the incline is $a = g(\sin\theta - \mu\cos\theta)$.

Step 1 — List data: $\theta = 30°$, $\mu = 0.2$, $g = 10$ m/s^2.

Step 2 — Evaluate trig values: $\sin 30° = 0.5$, $\cos 30° = 0.866$.

Step 3 — Friction term: $\mu\cos\theta = 0.2 \times 0.866 = 0.173$.

Step 4 — Inside the bracket: $\sin\theta - \mu\cos\theta = 0.5 - 0.173 = 0.327$.

Step 5 — Multiply by g: $a = 10 \times 0.327 \approx 3.3$ m/s^2.

Why other options are wrong:

- (A) ignores friction ($g\sin\theta$ only).
- (C) subtracts too much friction.
- (D) uses $g\cos\theta$.

Final Answer: $a \approx 3.3$ m/s$^2 \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q8

Q9.

Solution

Concept — Stopping distance with friction: Friction gives a deceleration $a = \mu g$; then $v^2 = u^2 - 2as$ with final speed 0 gives $s = \dfrac{u^2}{2\mu g}$.

Step 1 — Deceleration: $a = \mu g = 0.5 \times 10 = 5$ m/s^2.

Step 2 — Square the initial speed: $u^2 = (20)^2 = 400$.

Step 3 — Denominator: $2a = 2 \times 5 = 10$.

Step 4 — Divide: $s = \dfrac{400}{10} = 40$ m.

Why other options are wrong:

- (A) drops the square on u improperly.
- (B) doubles the value.
- (C) halves the deceleration step.

Final Answer: $s = 40$ m $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q9

Q10.

Solution

Concept — Banking without friction: For the ideal banking angle, $\tan\theta = \frac{v^2}{rg}$.

Step 1 — List data: $v = 10$ m/s, $r = 50$ m, $g = 10$ m/s^2.

Step 2 — Square the speed: $v^2 = (10)^2 = 100$.

Step 3 — Denominator: $rg = 50 \times 10 = 500$.

Step 4 — Divide: $\tan\theta = \frac{100}{500} = 0.2$.

Why other options are wrong:

- (A) and (B) overestimate the ratio.
- (D) carries a power-of-ten slip.

Final Answer: $\tan\theta = 0.2 \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q10

Q11.

Solution

Concept — Work by a variable force: $W = \int_{x_1}^{x_2} F\,dx$.

Step 1 — Set up integral: $W = \int_0^2 3x^2\,dx$.

Step 2 — Integrate: $\int 3x^2\,dx = x^3$.

Step 3 — Evaluate at $x = 2$: $2^3 = 8$.

Step 4 — Evaluate at $x = 0$: $0^3 = 0$.

Step 5 — Subtract: $W = 8 - 0 = 8$ J.

Why other options are wrong:

- (B) uses a wrong upper-limit substitution.
- (C) integrates as if $F = 3x$.

- (D) doubles the result.

Final Answer: $W = 8\text{ J} \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q11

Q12.

Solution

Concept — Power as force times velocity: At constant speed the engine force balances the resistive force, so $P = Fv$.

Step 1 — List data: $F = 500$ N, $v = 20$ m/s.

Step 2 — Multiply: $P = 500 \times 20 = 10000$ W.

Step 3 — Convert: 10000 W $= 10$ kW.

Why other options are wrong:

- (A) divides instead of multiplying.
- (B) drops the velocity factor.
- (D) overestimates by a factor of 4.

Final Answer: $P = 10\text{ kW} \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q12

Q13.

Solution

Concept — Perfectly inelastic collision: The bodies stick together; momentum is conserved, giving common velocity $v = \dfrac{m_1 u_1}{m_1 + m_2}$.

Step 1 — List data: $m_1 = 3$ kg, $u_1 = 8$ m/s, $m_2 = 1$ kg, $u_2 = 0$.

Step 2 — Initial momentum: $m_1 u_1 = 3 \times 8 = 24$ kg·m/s.

Step 3 — Total mass: $m_1 + m_2 = 3 + 1 = 4$ kg.

Step 4 — Divide: $v = \dfrac{24}{4} = 6$ m/s.

Why other options are wrong:

- (A) ignores the added mass.
- (B) and (C) use wrong total mass.

Final Answer: $v = 6$ m/s $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q13

Q14.

Solution

Concept — Perpendicular-axis theorem: For a planar disc, $I_z = I_x + I_y$. By symmetry the two diameters are equivalent, $I_x = I_y = I_d$, so $I_z = 2I_d$.

Step 1 — Write I_z: For a disc, $I_z = \frac{1}{2}MR^2$.

Step 2 — Apply theorem: $I_z = 2I_d$, so $I_d = \dfrac{I_z}{2}$.

Step 3 — Substitute: $I_d = \dfrac{1}{2} \times \dfrac{1}{2}MR^2 = \dfrac{1}{4}MR^2$.

Why other options are wrong:

- (B) is the perpendicular-axis value, not the diameter.
- (C) is the value for a different body.
- (D) is the value for a ring about its axis.

Final Answer: $I_d = \dfrac{1}{4}MR^2 \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q14

Q15.

Solution

Concept — Escape velocity: $v_e = \sqrt{2gR}$.

Step 1 — List data: $g = 10$ m/s^2, $R = 6.4 \times 10^6$ m.

Step 2 — Product inside root: $2gR = 2 \times 10 \times 6.4 \times 10^6 = 1.28 \times 10^8$.

Step 3 — Take square root: $v_e = \sqrt{1.28 \times 10^8}$.

Step 4 — Evaluate: $\sqrt{1.28 \times 10^8} \approx 1.13 \times 10^4$ m/s $= 11.3$ km/s.

Why other options are wrong:

- (A) is the orbital speed $\sqrt{gR}$.
- (B) doubles the value.
- (C) carries an arithmetic slip.

Final Answer: $v_e \approx 11.3$ km/s $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q15

Q16.

Solution

Concept — Carnot refrigerator COP: $\text{COP} = \dfrac{T_C}{T_H - T_C}$, with temperatures in kelvin.

Step 1 — List data: $T_C = 250$ K, $T_H = 300$ K.

Step 2 — Temperature difference: $T_H - T_C = 300 - 250 = 50$ K.

Step 3 — Form the ratio: $\text{COP} = \dfrac{250}{50}$.

Step 4 — Evaluate: $\dfrac{250}{50} = 5$.

Why other options are wrong:

- (A) uses T_H in the numerator.
- (B) inverts and mis-scales.
- (C) takes the reciprocal-like efficiency value.

Final Answer: $\text{COP} = 5 \Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q16

Q17.

Solution

Concept — First law at constant volume: $Q = \Delta U + W$, and at constant volume the work done $W = P\Delta V = 0$, so $\Delta U = Q$.

Step 1 — Identify the process: Rigid container $\Rightarrow \Delta V = 0$.

Step 2 — Work done: $W = P\Delta V = 0$.

Step 3 — Apply first law: $\Delta U = Q - W = 200 - 0$.

Step 4 — Evaluate: $\Delta U = 200$ J.

Why other options are wrong:

- (A) wrongly assumes all heat becomes work.

- (B) splits the heat in half.
- (D) doubles the value.

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

Answer: (C) Go Back to Q17

Q18.

Solution

Concept — rms speed: $v_{rms} = \sqrt{\frac{3RT}{M}}$.

Step 1 — List data: $R = 8.3$ J/mol·K, $T = 300$ K, $M = 32 \times 10^{-3}$ kg/mol.

Step 2 — Numerator: $3RT = 3 \times 8.3 \times 300 = 7470$.

Step 3 — Divide by M: $\frac{7470}{32 \times 10^{-3}} = 2.334 \times 10^5$.

Step 4 — Take square root: $v_{rms} = \sqrt{2.334 \times 10^5} \approx 483$ m/s.

Why other options are wrong:

- (A) halves the value.
- (C) doubles it.
- (D) carries a power-of-ten error.

Final Answer: $v_{rms} \approx 483 \text{ m/s} \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q18

Q19.

Solution

Concept — Simple pendulum period: $T = 2\pi\sqrt{\frac{L}{g}}$.

Step 1 — List data: $L = 1.0$ m, $g = \pi^2$ m/s^2.

Step 2 — Form L/g: $\frac{1.0}{\pi^2}$.

Step 3 — Take square root: $\sqrt{\frac{1}{\pi^2}} = \frac{1}{\pi}$.

Step 4 — Multiply by 2π: $T = 2\pi \times \frac{1}{\pi} = 2$ s.

Why other options are wrong:

- (A) drops the factor of 2.
- (B) squares the period.
- (C) forgets one factor of π cancellation.

Final Answer: $T = 2$ s $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q19

Q20.

Solution

Concept — SHM energy split: Total energy $E = \frac{1}{2}kA^2$; potential energy at displacement x is $U = \frac{1}{2}kx^2$; kinetic energy is $KE = E - U$, so $\frac{KE}{E} = 1 - \frac{x^2}{A^2}$.

Step 1 — Insert $x = A/2$: $\frac{x^2}{A^2} = \frac{(A/2)^2}{A^2} = \frac{1}{4}$.

Step 2 — Subtract from 1: $\frac{KE}{E} = 1 - \frac{1}{4} = \frac{3}{4}$.

Why other options are wrong:

- (A) is the potential-energy fraction.
- (B) would need $x = A/\sqrt{2}$.
- (C) would need $x = 0$.

Final Answer: $KE/E = 3/4 \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q20

Q21.

Solution

Concept — Closed-pipe fundamental: A pipe closed at one end has fundamental frequency $f = \frac{v}{4L}$.

Step 1 — List data: $v = 340$ m/s, $L = 0.25$ m.

Step 2 — Denominator: $4L = 4 \times 0.25 = 1.0$ m.

Step 3 — Divide: $f = \frac{340}{1.0} = 340$ Hz.

Why other options are wrong:

- (A) uses $\frac{v}{8L}$.
- (C) uses the open-pipe formula $\frac{v}{2L}$.
- (D) uses $\frac{v}{16L}$.

Final Answer: $f = 340 \text{ Hz} \Rightarrow \boxed{B}$

Answer: (B) Go Back to Q21

Q22.

Solution

Concept — Beats: The beat frequency equals the magnitude of the difference of the two frequencies, $f_{beat} = |f_1 - f_2|$.

Step 1 — List data: $f_1 = 256$ Hz, $f_2 = 260$ Hz.

Step 2 — Take the difference: $260 - 256 = 4$.

Step 3 — Conclude: $f_{beat} = 4$ beats/s.

Why other options are wrong:

- (B) averages the two frequencies.
- (C) sums the frequencies.
- (D) halves the difference.

Final Answer: $f_{beat} = 4$ beats/s $\Rightarrow \boxed{A}$

Answer: (A) Go Back to Q22

Q23.

Solution

Concept — Coulomb force in a dielectric: Filling the gap with a medium of dielectric constant K reduces the force to $F' = \frac{F_{vac}}{K}$.

Step 1 — List data: $F_{vac} = 8$ N, $K = 4$.

Step 2 — Divide: $F' = \frac{8}{4}$.

Step 3 — Evaluate: $F' = 2$ N.

Why other options are wrong:

- (A) multiplies by K instead of dividing.

- (C) divides by 2 only.
- (D) divides by K^2.

Final Answer: $F' = 2\text{ N} \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q23

Q24.

Solution

Concept — Gauss's law: Total flux $\Phi = \frac{q_{enc}}{\varepsilon_0}$ depends only on the enclosed charge, not on the radius of the surface. Doubling the charge doubles the flux.

Step 1 — Original flux: $\Phi_0 = \frac{q}{\varepsilon_0} = 2 \times 10^5$ N·m^2/C.

Step 2 — New enclosed charge: $q' = 2q$.

Step 3 — New flux: $\Phi' = \frac{2q}{\varepsilon_0} = 2\Phi_0$.

Step 4 — Evaluate: $\Phi' = 2 \times 2 \times 10^5 = 4 \times 10^5$ N·m^2/C.

Why other options are wrong:

- (B) ignores the change in charge.
- (C) halves the flux.
- (D) wrongly quadruples it.

Final Answer: $\Phi' = 4 \times 10^5$ N·m^2/C $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q24

Q25.

Solution

Concept — Equatorial field of a short dipole: On the perpendicular bisector, the axial components cancel and the field is $E_{eq} = \frac{1}{4\pi\varepsilon_0}\frac{p}{r^3}$.

Step 1 — Recall the standard result: The equatorial field is half the axial field and falls as $1/r^3$.

Step 2 — Write the expression: $E_{eq} = \frac{1}{4\pi\varepsilon_0}\frac{p}{r^3}$.

Why other options are wrong:

- (A) is the axial field (twice as large).
- (C) has the wrong power of r.
- (D) mixes the axial factor of 2 with a wrong power of r.

Final Answer: $E_{eq} = \frac{1}{4\pi\varepsilon_0}\frac{p}{r^3} \Rightarrow \boxed{\text{B}}$

Answer: (B) **Go Back to Q25**

Q26.

Solution

Concept — Dielectric at constant voltage: With the battery connected, V stays fixed while $C \to KC$. The new charge is $Q' = KCV$, and the extra charge that flows is $\Delta Q = Q' - Q = (K-1)CV$.

Step 1 — List data: $C = 5\ \mu\text{F}$, $V = 20\ \text{V}$, $K = 2$.

Step 2 — Initial charge: $Q = CV = 5 \times 20 = 100\ \mu\text{C}$.

Step 3 — Final charge: $Q' = KCV = 2 \times 5 \times 20 = 200\ \mu\text{C}$.

Step 4 — Additional charge: $\Delta Q = Q' - Q = 200 - 100 = 100\ \mu\text{C}$.

Why other options are wrong:

- (A) uses $V/2$ wrongly.
- (B) quotes the final charge, not the additional charge.
- (C) adds an extra contribution.

Final Answer: $\Delta Q = 100\ \mu\text{C} \Rightarrow \boxed{\text{D}}$

Answer: (D) **Go Back to Q26**

Q27.

Solution

Concept — Capacitors in parallel: The equivalent capacitance is the sum, $C_{eq} = C_1 + C_2 + C_3$.

Step 1 — List values: $C_1 = 2\ \mu\text{F}$, $C_2 = 3\ \mu\text{F}$, $C_3 = 6\ \mu\text{F}$.

Step 2 — Add: $C_{eq} = 2 + 3 + 6$.

Step 3 — Evaluate: $C_{eq} = 11\ \mu\text{F}$.

Why other options are wrong:

- (B) is the series equivalent.
- (C) takes only the largest capacitor.
- (D) drops one capacitor from the sum.

Final Answer: $C_{eq} = 11\ \mu\text{F} \Rightarrow \boxed{\text{A}}$

Answer: (A) **Go Back to Q27**

Q28.

Solution

Concept — Resistance from resistivity: $R = \dfrac{\rho L}{A}$.

Step 1 — List data: $\rho = 1.6 \times 10^{-8}\,\Omega\cdot\text{m}$, $L = 4$ m, $A = 2 \times 10^{-7}$ m^2.

Step 2 — Numerator: $\rho L = 1.6 \times 10^{-8} \times 4 = 6.4 \times 10^{-8}$.

Step 3 — Divide by A: $R = \dfrac{6.4 \times 10^{-8}}{2 \times 10^{-7}}$.

Step 4 — Mantissa and exponent: $\dfrac{6.4}{2} = 3.2$ and $10^{-8-(-7)} = 10^{-1}$, so $R = 3.2 \times 10^{-1} = 0.32\,\Omega$.

Why other options are wrong:

- (A) halves the value.
- (B) doubles it.
- (D) is four times too large.

Final Answer: $R = 0.32\,\Omega \Rightarrow \boxed{\text{C}}$

Answer: (C) **Go Back to Q28**

Q29.

Solution

Concept — Balanced Wheatstone bridge: At balance, $\dfrac{P}{Q} = \dfrac{R}{S}$, so $S = \dfrac{QR}{P}$.

Step 1 — List data: $P = 2\,\Omega$, $Q = 6\,\Omega$, $R = 5\,\Omega$.

Step 2 — Numerator: $QR = 6 \times 5 = 30$.

Step 3 — Divide by P: $S = \frac{30}{2} = 15\,\Omega$.

Why other options are wrong:

- (A) inverts the ratio.
- (B) forgets to divide by P.
- (D) halves the result.

Final Answer: $S = 15\,\Omega \Rightarrow \boxed{C}$

Answer: (C) Go Back to Q29

Q30.

Solution

Concept — Current in a simple circuit: $I = \dfrac{E}{R+r}$.

Step 1 — List data: $E = 2.0$ V, $R = 3.5\,\Omega$, $r = 0.5\,\Omega$.

Step 2 — Total resistance: $R + r = 3.5 + 0.5 = 4.0\,\Omega$.

Step 3 — Divide: $I = \frac{2.0}{4.0} = 0.5$ A.

Why other options are wrong:

- (A) uses a wrong total resistance.
- (C) ignores the resistances (divides incorrectly).
- (D) doubles the value.

Final Answer: $I = 0.5 \text{ A} \Rightarrow \boxed{B}$

Answer: (B) Go Back to Q30

Q31.

Solution

Concept — Electrical energy and cost: Energy in kWh $=$ power (kW) $\times$ time (h); cost $=$ energy $\times$ rate.

Step 1 — Convert power: 1000 W $=$ 1 kW.

Step 2 — Energy used: 1 kW $\times$ 3 h $=$ 3 kWh.

Step 3 — Multiply by rate: Cost $= 3 \times 5 = Rs.\ 15$.

Why other options are wrong:

- (B) charges for 1 kWh only.
- (C) confuses hours with cost.
- (D) doubles the value.

Final Answer: Cost $= Rs.\ 15 \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q31

Q32.

Solution

Concept — Field at the centre of an N-turn coil: $B = \dfrac{\mu_0 N I}{2R}$.

Step 1 — List data: $\mu_0 = 4\pi \times 10^{-7}$, $N = 50$, $I = 2$ A, $R = 0.1$ m.

Step 2 — Numerator: $\mu_0 N I = 4\pi \times 10^{-7} \times 50 \times 2 = 400\pi \times 10^{-7}$.

Step 3 — Denominator: $2R = 2 \times 0.1 = 0.2$.

Step 4 — Divide: $B = \dfrac{400\pi \times 10^{-7}}{0.2} = 2000\pi \times 10^{-7}$.

Step 5 — Evaluate: $2000\pi \times 10^{-7} = 2 \times 10^{-4}\pi \approx 6.28 \times 10^{-4}$ T.

Why other options are wrong:

- (A) and (B) carry factor or π errors.
- (C) drops the N factor.

Final Answer: $B \approx 6.28 \times 10^{-4}\ \text{T} \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q32

Q33.

Solution

Concept — Force on a moving charge: $F = qvB\sin\theta$; perpendicular means $\sin\theta = 1$.

Step 1 — List data: $q = 2 \times 10^{-6}$ C, $v = 5 \times 10^{4}$ m/s, $B = 0.3$ T.

Step 2 — Multiply q and v: $qv = 2 \times 10^{-6} \times 5 \times 10^{4} = 10 \times 10^{-2} = 0.1$.

Step 3 — Multiply by B: $F = 0.1 \times 0.3 = 3.0 \times 10^{-2}$ N.

Why other options are wrong:

- (A) halves the value.
- (B) doubles it.
- (D) carries a power-of-ten slip.

Final Answer: $F = 3.0 \times 10^{-2}$ N $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q33

Q34.

Solution

Concept — Field inside a solenoid: $B = \mu_0 n I$, with $n = \dfrac{N}{\ell}$ turns per metre.

Step 1 — Turns per metre: $n = \dfrac{500}{0.5} = 1000\ \text{m}^{-1}$.

Step 2 — Multiply n and I: $nI = 1000 \times 5 = 5000$.

Step 3 — Multiply by μ_0: $B = 4\pi \times 10^{-7} \times 5000 = 2\pi \times 10^{-3}$.

Step 4 — Evaluate: $2\pi \times 10^{-3} \approx 6.28 \times 10^{-3}$ T.

Why other options are wrong:

- (A) halves the value.
- (B) doubles it.
- (D) drops the π factor.

Final Answer: $B \approx 6.28 \times 10^{-3}$ T $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q34

Q35.

Solution

Concept — Induced current from motional EMF: The motional EMF is $\varepsilon = BLv$, and the induced current is $I = \dfrac{\varepsilon}{R}$.

Step 1 — List data: $B = 0.5$ T, $L = 0.4$ m, $v = 5$ m/s, $R = 2\,\Omega$.

Step 2 — Compute EMF: $\varepsilon = BLv = 0.5 \times 0.4 \times 5 = 1.0$ V.

Step 3 — Divide by resistance: $I = \dfrac{1.0}{2} = 0.5$ A.

Why other options are wrong:

- (A) quotes the EMF (in volts) as if it were the current.
- (B) carries an arithmetic slip in BLv.
- (D) forgets to divide by the resistance.

Final Answer: $I = 0.5\ \text{A} \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q35

Q36.

Solution

Concept — Resonance of a series LCR circuit: At resonance $X_L = X_C$, giving $\omega_0 = \frac{1}{\sqrt{LC}}$.

Step 1 — List data: $L = 2\ \text{H}$, $C = 8 \times 10^{-6}\ \text{F}$.

Step 2 — Product: $LC = 2 \times 8 \times 10^{-6} = 16 \times 10^{-6}$.

Step 3 — Take square root: $\sqrt{LC} = \sqrt{16 \times 10^{-6}} = 4 \times 10^{-3}$.

Step 4 — Reciprocal: $\omega_0 = \frac{1}{4 \times 10^{-3}} = 250\ \text{rad/s}$.

Why other options are wrong:

- (B) doubles the value.
- (C) halves it.
- (D) carries a power-of-ten slip.

Final Answer: $\omega_0 = 250\ \text{rad/s} \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q36

Q37.

Solution

Concept — Ideal transformer current ratio: Power is conserved, $V_p I_p = V_s I_s$, so $\frac{I_s}{I_p} = \frac{V_p}{V_s}$.

Step 1 — Voltage ratio: $\frac{V_p}{V_s} = \frac{240}{24} = 10$.

Step 2 — Solve for I_s: $I_s = I_p \times \frac{V_p}{V_s} = 0.5 \times 10$.

Step 3 — Evaluate: $I_s = 5$ A.

Why other options are wrong:

- (A) inverts the ratio.
- (C) ignores the step-down (keeps I_p).
- (D) overestimates by a factor of 10.

Final Answer: $I_s = 5\text{ A} \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q37

Q38.

Solution

Concept — Convex mirror, mirror formula: $\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$. For a convex mirror $f = +20$ cm and the object distance $u = -20$ cm.

Step 1 — Rearrange: $\frac{1}{v} = \frac{1}{f} - \frac{1}{u}$.

Step 2 — Substitute: $\frac{1}{v} = \frac{1}{20} - \frac{1}{-20} = \frac{1}{20} + \frac{1}{20}$.

Step 3 — Add: $\frac{1}{v} = \frac{2}{20} = \frac{1}{10}$.

Step 4 — Invert: $v = +10$ cm.

Why other options are wrong:

- (A) keeps only the focal length.
- (B) drops the sign of a virtual image.
- (D) mishandles the sign convention.

Final Answer: $v = +10$ cm (virtual image behind the mirror) $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q38

Q39.

Solution

Concept — Critical angle: $\sin\theta_c = \frac{1}{n}$ for a glass–air interface.

Step 1 — Substitute $n = 1.5$: $\sin\theta_c = \frac{1}{1.5} = 0.667$.

Step 2 — Take the inverse sine: $\theta_c = \sin^{-1}(0.667)$.

Step 3 — Evaluate: $\theta_c \approx 41.8^\circ \approx 42^\circ$.

Why other options are wrong:

- (B) is $\sin^{-1}(0.5)$.
- (C) overestimates the angle.
- (D) is $\sin^{-1}(\sqrt{3}/2)$.

Final Answer: $\theta_c \approx 42^\circ \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q39

Q40.

Solution

Concept — Power of a lens: $P = \dfrac{1}{f\,(\text{in metres})}$, measured in dioptres.

Step 1 — Convert focal length: $f = 25$ cm $= 0.25$ m.

Step 2 — Take the reciprocal: $P = \dfrac{1}{0.25}$.

Step 3 — Evaluate: $P = +4$ D (positive for a convex lens).

Why other options are wrong:

- (A) uses f in centimetres incorrectly.
- (C) gives the wrong sign.
- (D) takes f as 4 m.

Final Answer: $P = +4$ D $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q40

Q41.

Solution

Concept — Prism at minimum deviation: $n = \dfrac{\sin\frac{A+D_m}{2}}{\sin\frac{A}{2}}$, with $A = 60^\circ$.

Step 1 — Form the top angle: $\dfrac{A+D_m}{2} = \dfrac{60^\circ + 60^\circ}{2} = 60^\circ$.

Step 2 — Form the bottom angle: $\dfrac{A}{2} = \dfrac{60^\circ}{2} = 30^\circ$.

Step 3 — Substitute sines: $n = \dfrac{\sin 60^\circ}{\sin 30^\circ} = \dfrac{\sqrt{3}/2}{1/2}$.

Step 4 — Simplify: $n = \sqrt{3} \approx 1.73$.

Why other options are wrong:

- (A) corresponds to a smaller deviation.
- (B) corresponds to $D_m = 30^\circ$ (the Paper-1 case).
- (C) corresponds to $\sin \frac{A+D_m}{2} = 0.75$.

Final Answer: $n = \sqrt{3} \approx 1.73 \Rightarrow \boxed{\text{D}}$

Answer: (D) **Go Back to Q41**

Q42.

Solution

Concept — Fringe width: $\beta = \dfrac{\lambda D}{d}$.

Step 1 — List data: $\lambda = 600$ nm $= 6 \times 10^{-7}$ m, $D = 1.5$ m, $d = 0.3$ mm $= 3 \times 10^{-4}$ m.

Step 2 — Numerator: $\lambda D = 6 \times 10^{-7} \times 1.5 = 9 \times 10^{-7}$.

Step 3 — Divide by d: $\beta = \dfrac{9 \times 10^{-7}}{3 \times 10^{-4}}$.

Step 4 — Evaluate: $= 3 \times 10^{-3}$ m $= 3.0$ mm.

Why other options are wrong:

- (B) divides by an extra factor of ten.
- (C) halves the value.
- (D) doubles the value.

Final Answer: $\beta = 3.0$ mm $\Rightarrow \boxed{\text{A}}$

Answer: (A) **Go Back to Q42**

Q43.

Solution

Concept — Brewster's law: The polarising (Brewster) angle satisfies $\tan\theta_B = n$.

Step 1 — Substitute $n = \sqrt{3}$: $\tan\theta_B = \sqrt{3}$.

Step 2 — Recognise the value: $\tan 60^\circ = \sqrt{3}$.

Step 3 — Conclude: $\theta_B = 60^\circ$.

Why other options are wrong:

- (A) is $\tan^{-1}(1/\sqrt{3})$.
- (C) would need $n = 1$.
- (D) would need an infinite index.

Final Answer: $\theta_B = 60^\circ \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q43

Q44.

Solution

Concept — Einstein's photoelectric equation: $KE_{max} = E_{photon} - \phi$, where ϕ is the work function.

Step 1 — List data: $E_{photon} = 5$ eV, $\phi = 2$ eV.

Step 2 — Subtract: $KE_{max} = 5 - 2$.

Step 3 — Evaluate: $KE_{max} = 3$ eV.

Why other options are wrong:

- (A) quotes the work function.
- (B) adds instead of subtracting.
- (D) splits the difference incorrectly.

Final Answer: $KE_{max} = 3$ eV $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q44

Q45.

Solution

Concept — de Broglie wavelength of an accelerated electron: $\lambda = \frac{12.27}{\sqrt{V}}$ Å, with V in volts.

Step 1 — List data: $V = 600$ V.

Step 2 — Take the square root: $\sqrt{600} \approx 24.5$.

Step 3 — Divide: $\lambda = \frac{12.27}{24.5}$.

Step 4 — Evaluate: $\lambda \approx 0.5$ Å.

Why other options are wrong:

- (A) corresponds to $V = 150$ V.
- (B) and (C) carry arithmetic or power-of-ten slips.

Final Answer: $\lambda \approx 0.5$ Å $\Rightarrow \boxed{\text{D}}$

Answer: (D) **Go Back to Q45**

Q46.

Solution

Concept — Bohr energy levels: $E_n = \frac{-13.6}{n^2}$ eV. The second excited state corresponds to $n = 3$.

Step 1 — Identify n: Ground state $n = 1$, first excited $n = 2$, second excited $n = 3$.

Step 2 — Square n: $n^2 = 3^2 = 9$.

Step 3 — Divide: $E_3 = \frac{-13.6}{9}$.

Step 4 — Evaluate: $E_3 \approx -1.51$ eV.

Why other options are wrong:

- (A) uses $n = 2$.
- (B) uses $n = 1$.
- (D) uses $n = 4$.

Final Answer: $E_3 \approx -1.51$ eV $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q46

Q47.

Solution

Concept — Bohr orbit radius: $r_n = n^2 a_0$.

Step 1 — Insert $n = 3$**:** $r_3 = 3^2 a_0$.

Step 2 — Square: $3^2 = 9$.

Step 3 — Multiply by a_0**:** $r_3 = 9 \times 0.53 = 4.77$ Å.

Why other options are wrong:

- (A) uses $n = 3$ but takes only $3a_0$ partially.
- (C) uses $n = 2$.
- (D) is the ground-state radius.

Final Answer: $r_3 = 4.77$ Å $\Rightarrow \boxed{B}$

Answer: (B) Go Back to Q47

Q48.

Solution

Concept — Fraction decayed: After n half-lives, the remaining fraction is $\left(\frac{1}{2}\right)^n$, so the decayed fraction is $1 - \left(\frac{1}{2}\right)^n$.

Step 1 — Number of half-lives: $n = \dfrac{12}{4} = 3$.

Step 2 — Remaining fraction: $\left(\frac{1}{2}\right)^3 = \dfrac{1}{8}$.

Step 3 — Decayed fraction: $1 - \dfrac{1}{8} = \dfrac{7}{8}$.

Why other options are wrong:

- (A) is the remaining fraction, not the decayed fraction.
- (B) uses $n = 1$.
- (C) uses $n = 2$.

Final Answer: Decayed fraction $= 7/8 \Rightarrow \boxed{D}$

Answer: (D) Go Back to Q48

Q49.

Solution

Concept — Binding energy per nucleon: $\frac{BE}{A} = \frac{\text{total binding energy}}{\text{mass number}}$.

Step 1 — List data: Total $BE = 128$ MeV, $A = 16$.

Step 2 — Divide: $\frac{BE}{A} = \frac{128}{16}$.

Step 3 — Evaluate: $= 8$ MeV.

Why other options are wrong:

- (A) divides by 8 instead of 16.
- (C) quotes the total binding energy.
- (D) divides by 32.

Final Answer: $BE/A = 8$ MeV $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q49

Q50.

Solution

Concept — Full-wave rectifier: With a centre-tapped transformer and two diodes, one diode conducts during the positive half-cycle and the other during the negative half-cycle, so current flows through the load in the same direction during both halves of the input.

Step 1 — Positive half-cycle: Diode D_1 is forward biased and conducts; current flows through R_L in one direction.

Step 2 — Negative half-cycle: Diode D_2 is forward biased and conducts; current again flows through R_L in the same direction.

Step 3 — Conclude: The output is a pulsating unidirectional voltage present during both half-cycles (though it still carries ripple).

Why other options are wrong:

- (A) is false; current does flow each half-cycle.
- (B) ignores the ripple of a rectified output.
- (C) describes a half-wave rectifier, which uses only one half-cycle.

Final Answer: Output is unidirectional for both half-cycles $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q50

Answer Key

Q	Ans	Q	Ans	Q	Ans	Q	Ans	Q	Ans
1	A	2	D	3	A	4	B	5	B
6	A	7	C	8	B	9	D	10	C
11	A	12	C	13	D	14	A	15	D
16	D	17	C	18	B	19	D	20	D
21	B	22	A	23	B	24	A	25	B
26	D	27	A	28	C	29	C	30	B
31	A	32	D	33	C	34	C	35	C
36	A	37	B	38	C	39	A	40	B
41	D	42	A	43	B	44	C	45	D
46	C	47	B	48	D	49	B	50	D