JCECE Physics Sample Paper – 5

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 dimensional formula of angular momentum L is the same as that of:

(A) Planck's constant h, $[\mathrm{ML^2T^{-1}}]$

(B) moment of force (torque), $[\mathrm{ML^2T^{-2}}]$

(C) force, $[\mathrm{MLT^{-2}}]$

(D) linear momentum, $[\mathrm{MLT^{-1}}]$

Q2. A quantity $Z = AB$ is computed from A and B. If the percentage error in A is 2% and in B is 3%, the maximum percentage error in Z is:

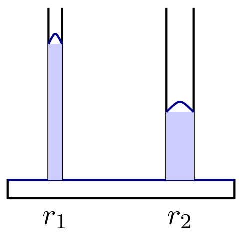
(A) 1%

(B) 5%

(C) 6%

(D) 2.5%

Q3. Two clean capillary tubes of radii r_1 and r_2 with $r_1 : r_2 = 1 : 2$ are dipped in the same liquid (same contact angle), as shown. The ratio of the capillary rise heights $h_1 : h_2$ is:



(A) 1 : 1

(B) 1 : 2

(C) 1 : 4

(D) 2 : 1

Q4. A wire of length 3 m and cross-sectional area 2 mm^2 has Young's modulus 2×10^{11} N/m^2. The force required to stretch it by 1.5 mm is:

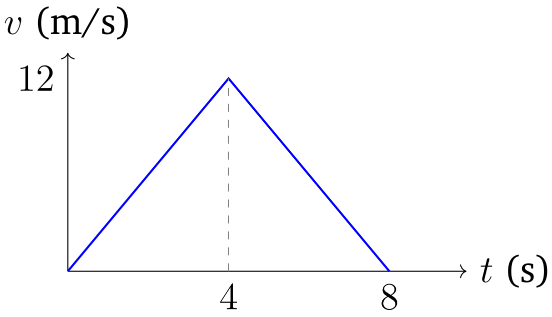
(A) 100 N

(B) 150 N

(C) 300 N

(D) 200 N

Q5. The velocity–time graph of a particle is the triangle shown. The total distance covered in 8 s is:



(A) 24 m

(B) 36 m

(C) 48 m

(D) 96 m

Q6. For a projectile launched with a fixed speed, two angles of projection give the same horizontal range. If one angle is $25°$, the other angle is:

(A) $50°$

(B) $115°$

(C) $65°$

(D) $75°$

Q7. Two cars start 600 m apart on a straight road and move directly towards each other with speeds 12 m/s and 8 m/s. The time after which they meet is:

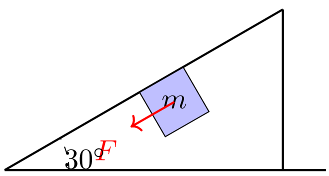
(A) 30 s

(B) 50 s

(C) 20 s

(D) 60 s

Q8. A block of mass 4 kg rests on a smooth incline of angle $30°$, as shown. The force applied parallel to the incline needed to keep it in equilibrium ($g = 10$ m/s^2) is:



(A) 40 N

(B) 20 N

(C) 34.6 N

(D) 10 N

Q9. A block is placed on an incline of angle $30°$. The minimum coefficient of static friction needed so that the block does not slide down is:

(A) 0.27

(B) $\sqrt{3}$

(C) 0.58

(D) 1.73

Q10. A stone of mass 0.5 kg is whirled in a horizontal circle of radius 2 m at a constant speed of 4 m/s. The centripetal force on it is:

(A) 2 N

(B) 4 N

(C) 8 N

(D) 16 N

Q11. A force acting on a particle along the x-axis varies with position as shown: it is constant at 6 N from $x = 0$ to $x = 2$ m, then falls linearly to zero at $x = 4$ m. The work done from $x = 0$ to $x = 4$ m is:

(A) 12 J

(B) 24 J

(C) 6 J

(D) 18 J

Q12. A machine does 9000 J of useful work in 30 s. Its average power output is:

(A) 300 W

(B) 270 W

(C) 30 W

(D) 900 W

Q13. A ball is dropped from a height of 5 m onto a hard floor and rebounds to a height of 1.8 m. The coefficient of restitution between ball and floor is:

(A) 0.36

(B) 0.5

(C) 0.6

(D) 0.8

Q14. A wheel of moment of inertia 5 kg·m^2 experiences an angular acceleration of 4 rad/s^2. The torque acting on it is:

(A) 20 N·m

(B) 1.25 N·m

(C) 9 N·m

(D) 0.8 N·m

Q15. The acceleration due to gravity at a height equal to the radius of the Earth R (i.e. at $h = R$) above the surface, compared with the surface value g, is:

(A) g

(B) $g/2$

(C) $g/3$

(D) $g/4$

Q16. A Carnot engine operating between 400 K and 300 K absorbs 800 J of heat from the source per cycle. The heat rejected to the sink per cycle is:

(A) 600 J

(B) 200 J

(C) 400 J

(D) 100 J

Q17. In a thermodynamic process a gas absorbs heat while its internal energy increases by 150 J and it does 100 J of work on the surroundings. The heat supplied to the gas is:

(A) 50 J

(B) 250 J

(C) 100 J

(D) 150 J

Q18. Two gases, oxygen (molar mass 32) and hydrogen (molar mass 2), are at the same temperature. The ratio of the rms speed of hydrogen to that of oxygen is:

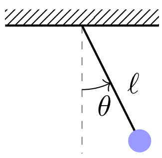
(A) 1 : 4

(B) 4 : 1

(C) 1 : 16

(D) 16 : 1

Q19. A simple pendulum of length 1.0 m oscillates as shown ($g = 10$ m/s^2, take $\pi^2 = 10$). Its time period is:



(A) 2 s

(B) 1 s

(C) 2π s

(D) π s

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

(A) 1/4

(B) 3/4

(C) 1/2

(D) 1

Q21. A stretched string of linear mass density 0.05 kg/m is held under a tension of 80 N. The speed of a transverse wave on the string is:

(A) 20 m/s

(B) 30 m/s

(C) 40 m/s

(D) 60 m/s

Q22. An observer moves towards a stationary source of frequency 500 Hz at 34 m/s. Taking the speed of sound as 340 m/s, the frequency heard by the observer is:

(A) 550 Hz

(B) 450 Hz

(C) 500 Hz

(D) 600 Hz

Q23. The electrostatic force between two point charges is F. If the distance between them is doubled while the charges are unchanged, the new force becomes:

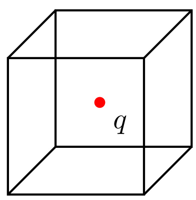
(A) $F/4$

(B) $F/2$

(C) $2F$

(D) $4F$

Q24. A point charge q is placed at the centre of a cube as shown. The electric flux through one face of the cube is:



(A) $\dfrac{q}{\varepsilon_0}$

(B) $\dfrac{q}{2\varepsilon_0}$

(C) $\dfrac{q}{6\varepsilon_0}$

(D) $\dfrac{q}{8\varepsilon_0}$

Q25. An electric dipole of moment 4×10^{-9} C·m is placed at 30° to a uniform field of 5×10^4 N/C. The torque on the dipole is:

(A) 2×10^{-4} N·m

(B) 1.73×10^{-4} N·m

(C) 1×10^{-4} N·m

(D) 4×10^{-4} N·m

Q26. A capacitor charged to a constant voltage by a battery (battery remains connected) is filled with a dielectric of constant $K = 4$. Compared with the air value, the charge stored becomes:

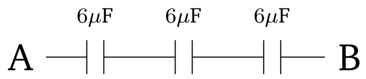
(A) halved

(B) 4 times the original

(C) unchanged

(D) one-fourth the original

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



(A) $18\ \mu$F

(B) $6\ \mu$F

(C) $2\ \mu$F

(D) $3\ \mu$F

Q28. A wire of length 4 m and cross-sectional area 2×10^{-7} m^2 is made of a material of resistivity $5 \times 10^{-7}\,\Omega \cdot$ m. Its resistance is:

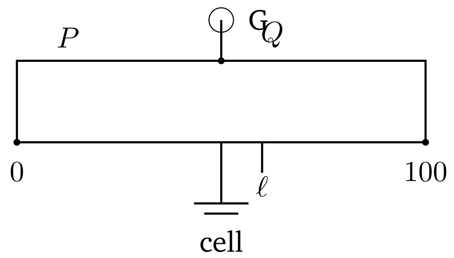
(A) $10\,\Omega$

(B) $2.5\,\Omega$

(C) $5\,\Omega$

(D) $20\,\Omega$

Q29. In the metre-bridge shown, the balance point is found at a length ℓ from one end where the left-gap resistance $P = 3\,\Omega$ balances against the right-gap resistance $Q = 2\,\Omega$. The balancing length ℓ (from the left end) is:



(A) 60 cm

(B) 50 cm

(C) 40 cm

(D) 66.7 cm

Q30. Two resistors of $12\,\Omega$ and $6\,\Omega$ are connected in parallel. The equivalent resistance of the combination is:

(A) $18\,\Omega$

(B) $9\,\Omega$

(C) $6\,\Omega$

(D) $4\,\Omega$

Q31. An electric appliance rated 2 kW is used for 3 hours daily. If electricity costs Rs. 5 per kWh, the cost of running it for 10 days is:

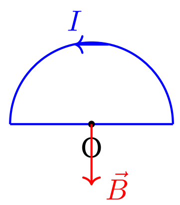
(A) Rs. 60

(B) Rs. 150

(C) Rs. 300

(D) Rs. 30

Q32. A wire is bent into a semicircular arc of radius 0.05 m and carries a current of 4 A, as shown. The magnetic field at the centre O of the arc is ($\mu_0 = 4\pi \times 10^{-7}$ T·m/A):



(A) 6.28×10^{-6} T

(B) 1.26×10^{-5} T

(C) 2.51×10^{-5} T

(D) 5.03×10^{-5} T

Q33. A charge of 2×10^{-6} C moves at 5×10^{5} m/s perpendicular to a magnetic field of 0.4 T. The magnetic force on it is:

(A) 0.2 N

(B) 0.4 N

(C) 0.8 N

(D) 4 N

Q34. A solenoid has 500 turns wound over a length of 0.5 m, with cross-sectional area 4×10^{-4} m^2 ($\mu_0 = 4\pi \times 10^{-7}$ T·m/A). Its self-inductance is approximately:

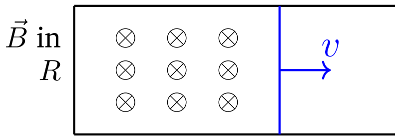
(A) 1.26×10^{-4} H

(B) 6.28×10^{-4} H

(C) 1.0×10^{-3} H

(D) 2.51×10^{-4} H

Q35. A conducting rod of length 0.4 m slides at 5 m/s perpendicular to a field of 0.5 T into the page on rails closed by a $2\,\Omega$ resistor, as shown. The induced current in the rod is:



(A) 0.25 A

(B) 0.5 A

(C) 0.75 A

(D) 1.0 A

Q36. In a series LCR circuit, $R = 30\,\Omega$, $X_L = 80\,\Omega$ and $X_C = 40\,\Omega$. The power factor of the circuit is:

(A) 0.6

(B) 0.8

(C) 1.0

(D) 0.5

Q37. An ideal step-up transformer has 200 turns in the primary and 1000 turns in the secondary. If 50 V is applied to the primary, the secondary output voltage is:

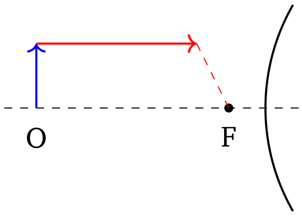
(A) 10 V

(B) 100 V

(C) 200 V

(D) 250 V

Q38. A concave mirror of focal length 12 cm forms an image of an object placed 18 cm in front of it, as shown. The image distance is:



(A) -18 cm

(B) $+36$ cm

(C) -36 cm

(D) -24 cm

Q39. A ray of light travelling in air strikes the surface of a medium of refractive index $\sqrt{2}$ at an angle of incidence of 45°. The angle of refraction in the medium is:

(A) 45°

(B) 30°

(C) 60°

(D) 15°

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

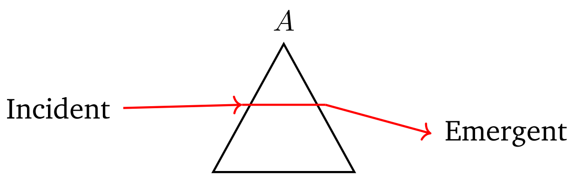
(A) $+2.5$ D

(B) -4 D

(C) $+25$ D

(D) $+4$ D

Q41. A thin prism of refracting angle 6° is made of glass of refractive index 1.5, as shown. The angle of deviation produced is:



(A) 6°

(B) 1.5°

(C) 4.5°

(D) 3°

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

(A) 1.5 mm

(B) 2 mm

(C) 3 mm

(D) 0.5 mm

Q43. In single-slit diffraction with slit width 0.2 mm and light of wavelength 500 nm, the angular width of the central maximum (between the two first minima) is:

(A) 5×10^{-3} rad

(B) 1.25×10^{-3} rad

(C) 2.5×10^{-3} rad

(D) 1×10^{-2} rad

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

(A) 2 V

(B) 5 V

(C) 7 V

(D) 3 V

Q45. An electron is accelerated through a potential difference of 54 V. Its de Broglie wavelength is approximately:

(A) 0.5 Å

(B) 1.67 Å

(C) 3.3 Å

(D) 0.17 Å

Q46. In the Bohr model of hydrogen the energy of the nth level is $E_n = -\dfrac{13.6}{n^2}$ eV. The energy of the electron in the $n = 2$ level is:

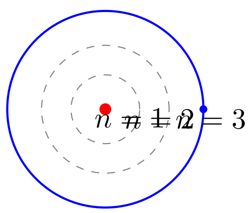
(A) -13.6 eV

(B) -6.8 eV

(C) -3.4 eV

(D) -1.51 eV

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



(A) 1.59 Å

(B) 4.77 Å

(C) 2.12 Å

(D) 5.30 Å

Q48. A radioactive nuclide has a decay constant $\lambda = 0.0693$ per second. Its half-life is (take $\ln 2 = 0.693$):

(A) 5 s

(B) 20 s

(C) 14.4 s

(D) 10 s

Q49. In a nuclear reaction the total rest mass decreases by 3 u. Taking 1 u $=$ 931 MeV$/c^2$, the energy released is:

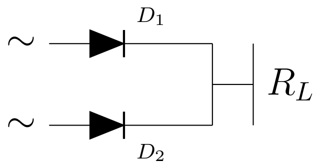
(A) 2793 MeV

(B) 931 MeV

(C) 310 MeV

(D) 1862 MeV

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



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

(B) Both half-cycles, rectified into the same direction

(C) A pure ripple-free direct current

(D) No current at all

Detailed Solutions

Q1.

Solution

Concept — Angular momentum dimensions: Angular momentum $L = I\omega$ or $L = mvr$, so $[L] = [\text{mass}][\text{velocity}][\text{length}]$.

Step 1 — Write the building blocks: $[\text{mass}] = \text{M}$, $[\text{velocity}] = \text{LT}^{-1}$, $[\text{length}] = \text{L}$.

Step 2 — Multiply: $[L] = \text{M} \cdot \text{LT}^{-1} \cdot \text{L} = \text{ML}^2\text{T}^{-1}$.

Step 3 — Compare with Planck's constant: From $E = h\nu$, $[h] = \dfrac{[\text{energy}]}{[\text{frequency}]} = \dfrac{\text{ML}^2\text{T}^{-2}}{\text{T}^{-1}} = \text{ML}^2\text{T}^{-1}$.

Step 4 — Match: $[L] = [h] = \text{ML}^2\text{T}^{-1}$.

Why other options are wrong:

- (B) is torque, ML^2T^{-2}, with one extra inverse-time factor.
- (C) is force, MLT^{-2}, missing a length factor.
- (D) is linear momentum, MLT^{-1}, missing a length factor.

Final Answer: $[L] = \text{ML}^2\text{T}^{-1}$, same as Planck's constant $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q1

Q2.

Solution

Concept — Percentage error in a product: For $Z = AB$, the relative errors add: $\dfrac{\Delta Z}{Z} = \dfrac{\Delta A}{A} + \dfrac{\Delta B}{B}$.

Step 1 — List the errors: $\dfrac{\Delta A}{A} = 2\%$, $\dfrac{\Delta B}{B} = 3\%$.

Step 2 — Add them: $\dfrac{\Delta Z}{Z} = 2\% + 3\%$.

Step 3 — Evaluate: $= 5\%$.

Why other options are wrong:

- (A) subtracts the errors.
- (C) treats it as a power AB wrongly (adds an extra 1%).
- (D) averages the two errors.

Final Answer: Maximum error $= 5\% \Rightarrow \boxed{B}$

Answer: (B) Go Back to Q2

Q3.

Solution

Concept — Capillary rise and radius: $h = \dfrac{2T\cos\theta}{r\rho g}$, so for the same liquid and tube $h \propto \dfrac{1}{r}$.

Step 1 — Write the proportionality: $\dfrac{h_1}{h_2} = \dfrac{r_2}{r_1}$.

Step 2 — Insert the radius ratio: $r_1 : r_2 = 1 : 2$, so $\dfrac{r_2}{r_1} = 2$.

Step 3 — Conclude: $\dfrac{h_1}{h_2} = 2$, i.e. $h_1 : h_2 = 2 : 1$.

Why other options are wrong:

- (A) ignores the inverse dependence.
- (B) uses $h \propto r$ instead of $h \propto 1/r$.
- (C) uses $h \propto 1/r^2$.

Final Answer: $h_1 : h_2 = 2 : 1 \Rightarrow \boxed{D}$

Answer: (D) Go Back to Q3

Q4.

Solution

Concept — Young's modulus rearranged for force: From $Y = \dfrac{FL}{A\,\Delta L}$, we get $F = \dfrac{YA\,\Delta L}{L}$.

Step 1 — List data: $Y = 2 \times 10^{11}$ N/m^2, $A = 2$ mm$^2 = 2 \times 10^{-6}$ m^2, $\Delta L = 1.5$ mm $= 1.5 \times 10^{-3}$ m, $L = 3$ m.

Step 2 — Numerator $YA\,\Delta L$: $2 \times 10^{11} \times 2 \times 10^{-6} \times 1.5 \times 10^{-3}$.

Step 3 — Multiply mantissas: $2 \times 2 \times 1.5 = 6$.

Step 4 — Add exponents: $10^{11-6-3} = 10^2$, so numerator $= 6 \times 10^2 = 600$.

Step 5 — Divide by L: $F = \dfrac{600}{3} = 200$ N.

Why other options are wrong:

- (A) and (B) use wrong elongation or area.
- (C) forgets to divide by $L = 3$ m.

Final Answer: $F = 200$ N $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q4

Q5.

Solution

Concept — Area under a v–t graph: For unidirectional motion the distance equals the area between the curve and the t-axis; here the graph is a triangle.

Step 1 — Identify the triangle: The velocity rises from 0 to 12 m/s at $t = 4$ s and falls back to 0 at $t = 8$ s, forming a triangle.

Step 2 — Base of the triangle: The base along the time axis is 8 s.

Step 3 — Height of the triangle: The peak velocity is 12 m/s.

Step 4 — Apply triangle area: Area $= \frac{1}{2} \times$ base $\times$ height $= \frac{1}{2} \times 8 \times 12$.

Step 5 — Evaluate: $= \frac{1}{2} \times 96 = 48$ m.

Why other options are wrong:

- (A) uses only half the base.
- (B) uses a wrong height.
- (D) takes the full rectangle 8×12.

Final Answer: Distance $= 48$ m $\Rightarrow$ $\boxed{\text{C}}$

Answer: (C) Go Back to Q5

Q6.

Solution

Concept — Complementary angles give equal range: Two projection angles θ and $90^\circ - \theta$ produce the same horizontal range for a fixed speed.

Step 1 — Identify the rule: The other angle is $90^\circ - \theta$.

Step 2 — Substitute $\theta = 25^\circ$: $90^\circ - 25^\circ$.

Step 3 — Evaluate: $= 65^\circ$.

Why other options are wrong:

- (A) doubles the angle.
- (B) is the supplement $180^\circ - 65^\circ$, not a valid projection.
- (D) is an arbitrary value not satisfying $\theta + \theta' = 90^\circ$.

Final Answer: Other angle $= 65^\circ \Rightarrow \boxed{C}$

Answer: (C) Go Back to Q6

Q7.

Solution

Concept — Approaching bodies: When two bodies move directly towards each other, the gap closes at the relative speed (sum of speeds); time $= \frac{\text{gap}}{\text{relative speed}}$.

Step 1 — Relative speed: $12 + 8 = 20$ m/s.

Step 2 — Initial gap: 600 m.

Step 3 — Divide: $t = \frac{600}{20}$.

Step 4 — Evaluate: $= 30$ s.

Why other options are wrong:

- (B) uses the difference of speeds.
- (C) and (D) use wrong arithmetic.

Final Answer: $t = 30$ s $\Rightarrow \boxed{A}$

Answer: (A) Go Back to Q7

Q8.

Solution

Concept — Equilibrium on a smooth incline: A force along the incline must balance the gravity component along the incline, $F = mg\sin\theta$.

Step 1 — List data: $m = 4$ kg, $g = 10$ m/s^2, $\theta = 30^\circ$.

Step 2 — Find $\sin\theta$**:** $\sin 30^\circ = 0.5$.

Step 3 — Compute mg**:** $4 \times 10 = 40$ N.

Step 4 — Multiply by $\sin\theta$**:** $F = 40 \times 0.5 = 20$ N.

Why other options are wrong:

- (A) uses the full weight mg.
- (C) uses $mg\cos\theta$ (the normal component).
- (D) halves the result again.

Final Answer: $F = 20$ N $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q8

Q9.

Solution

Concept — Block held by friction on an incline: To prevent sliding down, friction must supply at least $mg\sin\theta$, so $\mu_{\min} = \tan\theta$.

Step 1 — Identify the angle: $\theta = 30^\circ$.

Step 2 — Apply formula: $\mu_{\min} = \tan 30^\circ$.

Step 3 — Evaluate: $\tan 30^\circ = \dfrac{1}{\sqrt{3}} \approx 0.58$.

Why other options are wrong:

- (A) is tan of a smaller angle.
- (B) is $\sqrt{3} = \tan 60^\circ$.
- (D) is $\tan 60^\circ$ as a decimal.

Final Answer: $\mu_{\min} \approx 0.58 \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q9

Q10.

Solution

Concept — Centripetal force: $F = \dfrac{mv^2}{r}$.

Step 1 — List data: $m = 0.5$ kg, $v = 4$ m/s, $r = 2$ m.

Step 2 — Square the speed: $v^2 = 4^2 = 16$.

Step 3 — Numerator: $mv^2 = 0.5 \times 16 = 8$.

Step 4 — Divide by r: $F = \dfrac{8}{2} = 4$ N.

Why other options are wrong:

- (A) forgets to divide correctly.
- (C) omits dividing by r.
- (D) doubles the value.

Final Answer: $F = 4 \text{ N} \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q10

Q11.

Solution

Concept — Work as area under the F–x graph: Work equals the area enclosed between the force curve and the x-axis.

Step 1 — First part (rectangle): Constant 6 N from $x = 0$ to $x = 2$ m gives area $= 6 \times 2 = 12$ J.

Step 2 — Second part (triangle): Force falls from 6 N to 0 over $x = 2$ to $x = 4$ m, a triangle of base 2 m and height 6 N.

Step 3 — Triangle area: $\frac{1}{2} \times 2 \times 6 = 6$ J.

Step 4 — Add the two: $W = 12 + 6 = 18$ J.

Why other options are wrong:

- (A) counts only the rectangle.
- (B) treats the whole as a rectangle 6×4.
- (C) counts only the triangle.

Final Answer: $W = 18 \text{ J} \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q11

Q12.

Solution

Concept — Average power: $P_{avg} = \frac{\text{work done}}{\text{time taken}}$.

Step 1 — List data: $W = 9000$ J, $t = 30$ s.

Step 2 — Divide: $P = \frac{9000}{30}$.

Step 3 — Evaluate: $= 300$ W.

Why other options are wrong:

- (B) and (C) use wrong arithmetic.
- (D) multiplies instead of dividing by the right factor.

Final Answer: $P = 300 \text{ W} \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q12

Q13.

Solution

Concept — Coefficient of restitution from bounce heights: For a ball bouncing off a fixed floor, $e = \sqrt{\frac{h_2}{h_1}}$, where h_1 is the drop height and h_2 the rebound height.

Step 1 — List data: $h_1 = 5$ m, $h_2 = 1.8$ m.

Step 2 — Form the ratio: $\frac{h_2}{h_1} = \frac{1.8}{5} = 0.36$.

Step 3 — Take the square root: $e = \sqrt{0.36}$.

Step 4 — Evaluate: $= 0.6$.

Why other options are wrong:

- (A) is the ratio h_2/h_1 without the square root.
- (B) and (D) come from wrong height ratios.

Final Answer: $e = 0.6 \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q13

Q14.

Solution

Concept — Rotational analogue of Newton's law: $\tau = I\alpha$.

Step 1 — List data: $I = 5$ kg·m^2, $\alpha = 4$ rad/s^2.

Step 2 — Multiply: $\tau = 5 \times 4$.

Step 3 — Evaluate: $= 20$ N·m.

Why other options are wrong:

- (B) divides I by α.
- (C) and (D) use wrong arithmetic.

Final Answer: $\tau = 20$ N·m $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q14

Q15.

Solution

Concept — Variation of g with height: $g_h = g\dfrac{R^2}{(R+h)^2}$.

Step 1 — Insert $h = R$: $g_h = g\dfrac{R^2}{(R+R)^2} = g\dfrac{R^2}{(2R)^2}$.

Step 2 — Simplify the denominator: $(2R)^2 = 4R^2$.

Step 3 — Cancel: $g_h = g\dfrac{R^2}{4R^2} = \dfrac{g}{4}$.

Why other options are wrong:

- (A) ignores the height.
- (B) uses $(R+h)$ to the first power.
- (C) uses a factor of 3 instead of 4.

Final Answer: $g_h = g/4 \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q15

Q16.

Solution

Concept — Carnot heat rejected: For a Carnot engine $\frac{Q_C}{Q_H} = \frac{T_C}{T_H}$, so $Q_C = Q_H \frac{T_C}{T_H}$.

Step 1 — List data: $T_H = 400$ K, $T_C = 300$ K, $Q_H = 800$ J.

Step 2 — Temperature ratio: $\frac{T_C}{T_H} = \frac{300}{400} = 0.75$.

Step 3 — Multiply by Q_H: $Q_C = 800 \times 0.75$.

Step 4 — Evaluate: $= 600$ J.

Why other options are wrong:

- (B) is the work done, not the heat rejected.
- (C) and (D) use wrong ratios.

Final Answer: $Q_C = 600 \text{ J} \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q16

Q17.

Solution

Concept — First law of thermodynamics: $Q = \Delta U + W$, where W is the work done by the gas.

Step 1 — List data: $\Delta U = 150$ J, $W = 100$ J.

Step 2 — Add: $Q = 150 + 100$.

Step 3 — Evaluate: $= 250$ J.

Why other options are wrong:

- (A) subtracts W from ΔU.
- (C) counts only the work.
- (D) counts only ΔU.

Final Answer: $Q = 250 \text{ J} \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q17

Q18.

Solution

Concept — rms speed and molar mass: At the same temperature, $v_{rms} = \sqrt{\frac{3RT}{M}}$, so $v_{rms} \propto \frac{1}{\sqrt{M}}$.

Step 1 — Form the ratio: $\frac{v_H}{v_O} = \sqrt{\frac{M_O}{M_H}}$.

Step 2 — Insert molar masses: $\frac{M_O}{M_H} = \frac{32}{2} = 16$.

Step 3 — Take square root: $\sqrt{16} = 4$.

Step 4 — Conclude: $v_H : v_O = 4 : 1$.

Why other options are wrong:

- (A) inverts the ratio.
- (C) forgets the square root.
- (D) inverts and forgets the root.

Final Answer: $v_H : v_O = 4 : 1 \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q18

Q19.

Solution

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

Step 1 — List data: $\ell = 1.0$ m, $g = 10$ m/s^2, $\pi^2 = 10$.

Step 2 — Form ℓ/g: $\frac{1.0}{10} = 0.1$ s^2.

Step 3 — Square root: $\sqrt{0.1} = \frac{1}{\sqrt{10}}$.

Step 4 — Multiply by 2π: $T = 2\pi \times \frac{1}{\sqrt{10}} = \frac{2\pi}{\sqrt{10}}$.

Step 5 — Use $\pi^2 = 10$: $\frac{2\pi}{\sqrt{10}} = \frac{2\pi}{\pi} = 2$ s.

Why other options are wrong:

- (B) halves the result.

- (C) forgets to evaluate $\sqrt{\ell/g}$.
- (D) drops the factor of 2.

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

Answer: (A) Go Back to Q19

Q20.

Solution

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

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**:** $\frac{K}{E} = 1 - \frac{1}{4}$.

Step 3 — Evaluate: $= \frac{3}{4}$.

Why other options are wrong:

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

Final Answer: $K/E = 3/4 \Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q20

Q21.

Solution

Concept — Transverse wave speed on a string: The speed of a transverse wave on a stretched string is $v = \sqrt{\frac{T}{\mu}}$, where T is the tension and μ the linear mass density.

Step 1 — List data: $T = 80$ N, $\mu = 0.05$ kg/m.

Step 2 — Form the ratio: $\frac{T}{\mu} = \frac{80}{0.05}$.

Step 3 — Evaluate the ratio: $\frac{80}{0.05} = 1600$.

Step 4 — Take the square root: $v = \sqrt{1600} = 40$ m/s.

Why other options are wrong:

- (A) takes $\sqrt{T/\mu}$ with a wrong ratio.
- (B) underestimates the square root.
- (D) uses T/μ without the square root scaled wrongly.

Final Answer: $v = 40$ m/s $\Rightarrow$ $\boxed{\text{C}}$

Answer: (C) Go Back to Q21

Q22.

Solution

Concept — Doppler effect, observer approaching: $f' = f\dfrac{v + v_o}{v}$ when the observer moves towards a stationary source.

Step 1 — List data: $f = 500$ Hz, $v = 340$ m/s, $v_o = 34$ m/s.

Step 2 — Numerator: $v + v_o = 340 + 34 = 374$ m/s.

Step 3 — Form the ratio: $\dfrac{374}{340} = 1.1$.

Step 4 — Multiply by f: $f' = 500 \times 1.1$.

Step 5 — Evaluate: $= 550$ Hz.

Why other options are wrong:

- (B) uses $v - v_o$ (receding observer).
- (C) ignores the observer's motion.
- (D) over-estimates the shift.

Final Answer: $f' = 550$ Hz $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q22

Q23.

Solution

Concept — Inverse-square law: $F \propto \frac{1}{r^2}$, so doubling r changes the force by a factor $\frac{1}{2^2}$.

Step 1 — Write the ratio: $\frac{F'}{F} = \left(\frac{r}{r'}\right)^2 = \left(\frac{r}{2r}\right)^2$.

Step 2 — Simplify: $\left(\frac{1}{2}\right)^2 = \frac{1}{4}$.

Step 3 — Conclude: $F' = \frac{F}{4}$.

Why other options are wrong:

- (B) uses $1/r$ instead of $1/r^2$.
- (C) and (D) increase the force instead of decreasing it.

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

Answer: (A) Go Back to Q23

Q24.

Solution

Concept — Gauss law and symmetry: A charge at the centre of a cube has its total flux $\frac{q}{\varepsilon_0}$ shared equally among the 6 identical faces.

Step 1 — Total flux: $\Phi_{total} = \frac{q}{\varepsilon_0}$.

Step 2 — Number of faces: A cube has 6 faces.

Step 3 — Divide by symmetry: $\Phi_{face} = \frac{1}{6} \times \frac{q}{\varepsilon_0} = \frac{q}{6\varepsilon_0}$.

Why other options are wrong:

- (A) is the total flux, not per face.
- (B) divides by 2.
- (D) divides by 8 (corners, not faces).

Final Answer: $\Phi_{face} = \frac{q}{6\varepsilon_0} \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q24

Q25.

Solution

Concept — Torque on a dipole: $\tau = pE\sin\theta$.

Step 1 — List data: $p = 4 \times 10^{-9}$ C·m, $E = 5 \times 10^4$ N/C, $\theta = 30°$.

Step 2 — Product pE: $4 \times 10^{-9} \times 5 \times 10^4 = 20 \times 10^{-5} = 2 \times 10^{-4}$.

Step 3 — Insert $\sin 30°$: $\sin 30° = 0.5$.

Step 4 — Multiply: $\tau = 2 \times 10^{-4} \times 0.5 = 1 \times 10^{-4}$ N·m.

Why other options are wrong:

- (A) omits the $\sin\theta$ factor.
- (B) uses $\sin 60°$.
- (D) doubles the result.

Final Answer: $\tau = 1 \times 10^{-4}$ N·m $\Rightarrow$ $\boxed{\text{C}}$

Answer: (C) Go Back to Q25

Q26.

Solution

Concept — Dielectric at constant voltage: With the battery connected, V is fixed; since $C' = KC_0$ and $Q = CV$, the charge scales with K.

Step 1 — New capacitance: $C' = KC_0 = 4C_0$.

Step 2 — Charge at fixed V: $Q' = C'V = 4C_0V = 4Q_0$.

Step 3 — Conclude: The charge becomes 4 times the air value.

Why other options are wrong:

- (A) and (D) would apply if charge were fixed and voltage changed.
- (C) ignores the capacitance increase.

Final Answer: Charge becomes 4 times $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q26

Q27.

Solution

Concept — Capacitors in series: For equal capacitors C in series, $C_{eq} = \frac{C}{n}$.

Step 1 — Apply the formula: $\frac{1}{C_{eq}} = \frac{1}{6} + \frac{1}{6} + \frac{1}{6}$.

Step 2 — Add the terms: $= \frac{3}{6} = \frac{1}{2}$.

Step 3 — Invert: $C_{eq} = 2\,\mu\text{F}$.

Why other options are wrong:

- (A) adds them as if in parallel.
- (B) divides by 1 instead of 3.
- (D) divides 6 by 2 instead of 3.

Final Answer: $C_{eq} = 2\,\mu\text{F} \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q27

Q28.

Solution

Concept — Resistance of a wire: $R = \frac{\rho L}{A}$.

Step 1 — List data: $\rho = 5 \times 10^{-7}\,\Omega\text{·m}$, $L = 4$ m, $A = 2 \times 10^{-7}$ m^2.

Step 2 — Numerator ρL: $5 \times 10^{-7} \times 4 = 20 \times 10^{-7} = 2 \times 10^{-6}$.

Step 3 — Divide by A: $R = \frac{2 \times 10^{-6}}{2 \times 10^{-7}}$.

Step 4 — Evaluate: $= 10^1 = 10\,\Omega$.

Why other options are wrong:

- (B) halves the result.
- (C) uses $L = 2$ m.
- (D) doubles the value.

Final Answer: $R = 10\,\Omega \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q28

Q29.

Solution

Concept — Metre-bridge balance: At balance $\frac{P}{Q} = \frac{\ell}{100-\ell}$, where ℓ is the balancing length from the left end (in cm).

Step 1 — Insert $P = 3$, $Q = 2$: $\frac{3}{2} = \frac{\ell}{100-\ell}$.

Step 2 — Cross-multiply: $3(100-\ell) = 2\ell$.

Step 3 — Expand: $300 - 3\ell = 2\ell$.

Step 4 — Collect terms: $300 = 5\ell$.

Step 5 — Solve: $\ell = \frac{300}{5} = 60$ cm.

Why other options are wrong:

- (C) gives $100-\ell$ instead of ℓ.
- (B) assumes equal arms.
- (D) uses a ratio of 2.

Final Answer: $\ell = 60 \text{ cm} \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q29

Q30.

Solution

Concept — Resistors in parallel: $\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2}$.

Step 1 — Insert values: $\frac{1}{R_{eq}} = \frac{1}{12} + \frac{1}{6}$.

Step 2 — Common denominator: $\frac{1}{12} + \frac{2}{12} = \frac{3}{12}$.

Step 3 — Simplify: $\frac{3}{12} = \frac{1}{4}$.

Step 4 — Invert: $R_{eq} = 4\,\Omega$.

Why other options are wrong:

- (A) adds them as if in series.
- (B) and (C) use wrong reciprocals.

Final Answer: $R_{eq} = 4\,\Omega \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q30

Q31.

Solution

Concept — Energy in kWh and cost: Energy = power (kW) × time (h); cost = energy × rate.

Step 1 — Daily energy: 2 kW $\times$ 3 h $= 6$ kWh.

Step 2 — Energy in 10 **days:** $6 \times 10 = 60$ kWh.

Step 3 — Multiply by the rate: cost $= 60 \times 5$.

Step 4 — Evaluate: $=$ Rs. 300.

Why other options are wrong:

- (A) is one day's cost.
- (B) uses the wrong rate or hours.
- (D) uses half a day's energy.

Final Answer: Cost $=$ Rs. $300 \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q31

Q32.

Solution

Concept — Field at the centre of a semicircular arc: A full circular loop gives $B = \dfrac{\mu_0 I}{2R}$ at its centre. A semicircle is half of this, so $B = \dfrac{\mu_0 I}{4R}$.

Step 1 — List data: $\mu_0 = 4\pi \times 10^{-7}$ T·m/A, $I = 4$ A, $R = 0.05$ m.

Step 2 — Numerator $\mu_0 I$**:** $4\pi \times 10^{-7} \times 4 = 16\pi \times 10^{-7}$.

Step 3 — Denominator $4R$**:** $4 \times 0.05 = 0.2$.

Step 4 — Divide: $B = \dfrac{16\pi \times 10^{-7}}{0.2} = 80\pi \times 10^{-7} = 8\pi \times 10^{-6}$ T.

Step 5 — Evaluate numerically: $8\pi \times 10^{-6} \approx 2.51 \times 10^{-5}$ T.

Why other options are wrong:

- (A) uses $\frac{\mu_0 I}{8R}$ (a quarter loop).
- (B) halves the correct value.
- (D) uses $\frac{\mu_0 I}{2R}$ (the full-loop field).

Final Answer: $B = 8\pi \times 10^{-6} \approx 2.51 \times 10^{-5}$ T $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q32

Q33.

Solution

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

Step 1 — List data: $q = 2 \times 10^{-6}$ C, $v = 5 \times 10^5$ m/s, $B = 0.4$ T.

Step 2 — Product qv: $2 \times 10^{-6} \times 5 \times 10^5 = 10 \times 10^{-1} = 1$.

Step 3 — Multiply by B: $F = 1 \times 0.4 = 0.4$ N.

Why other options are wrong:

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

Final Answer: $F = 0.4$ N $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q33

Q34.

Solution

Concept — Self-inductance of a solenoid: $L = \frac{\mu_0 N^2 A}{\ell}$.

Step 1 — List data: $\mu_0 = 4\pi \times 10^{-7}$, $N = 500$, $A = 4 \times 10^{-4}$ m^2, $\ell = 0.5$ m.

Step 2 — Square the turns: $N^2 = 500^2 = 2.5 \times 10^5$.

Step 3 — Multiply $\mu_0 N^2 A$: $4\pi \times 10^{-7} \times 2.5 \times 10^5 \times 4 \times 10^{-4}$.

Step 4 — Combine mantissas: $4\pi \times 2.5 \times 4 = 40\pi$; exponents $10^{-7+5-4} = 10^{-6}$, giving $40\pi \times 10^{-6}$.

Step 5 — Divide by ℓ: $L = \dfrac{40\pi \times 10^{-6}}{0.5} = 80\pi \times 10^{-6} \approx 2.51 \times 10^{-4}$ H.

Why other options are wrong:

- (A) drops a factor of 2.
- (B) over-counts by a factor near 2.5.
- (C) carries an exponent slip.

Final Answer: $L \approx 2.51 \times 10^{-4}$ H $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q34

Q35.

Solution

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

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

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

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

Step 4 — State the answer: The induced current is 0.5 A.

Why other options are wrong:

- (A) halves the correct current.
- (C) uses a wrong product of B, L and v.
- (D) forgets to divide by R, quoting the EMF 1.0 V as a current.

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

Answer: (B) Go Back to Q35

Q36.

Solution

Concept — Power factor of series LCR: $\cos\phi = \dfrac{R}{Z}$, with $Z = \sqrt{R^2 + (X_L - X_C)^2}$.

Step 1 — Net reactance: $X_L - X_C = 80 - 40 = 40\,\Omega$.

Step 2 — Impedance: $Z = \sqrt{30^2 + 40^2} = \sqrt{900 + 1600} = \sqrt{2500} = 50\,\Omega$.

Step 3 — Power factor: $\cos\phi = \frac{R}{Z} = \frac{30}{50}$.

Step 4 — Evaluate: $= 0.6$.

Why other options are wrong:

- (B) uses the reactance over impedance ($\sin\phi$).
- (C) implies resonance ($X_L = X_C$).
- (D) uses a wrong impedance.

Final Answer: $\cos\phi = 0.6 \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q36

Q37.

Solution

Concept — Transformer voltage ratio: $\frac{V_s}{V_p} = \frac{N_s}{N_p}$.

Step 1 — Turns ratio: $\frac{N_s}{N_p} = \frac{1000}{200} = 5$.

Step 2 — Solve for V_s: $V_s = V_p \times 5 = 50 \times 5$.

Step 3 — Evaluate: $= 250$ V.

Why other options are wrong:

- (A) steps down instead of up.
- (B) uses a ratio of 2.
- (C) uses a ratio of 4.

Final Answer: $V_s = 250 \text{ V} \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q37

Q38.

Solution

Concept — Mirror formula for a concave mirror: $\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$, with $f = -12$ cm (concave) and $u = -18$ cm (object in front).

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

Step 2 — Substitute: $\frac{1}{v} = \frac{1}{-12} - \frac{1}{-18} = -\frac{1}{12} + \frac{1}{18}$.

Step 3 — Common denominator 36: $-\frac{1}{12} = -\frac{3}{36}$ and $\frac{1}{18} = \frac{2}{36}$.

Step 4 — Add the fractions: $\frac{1}{v} = -\frac{3}{36} + \frac{2}{36} = -\frac{1}{36}$.

Step 5 — Invert: $v = -36$ cm.

Why other options are wrong:

- (A) just echoes the object distance.
- (B) gets the sign wrong (real image is in front, so $v < 0$).
- (D) uses a wrong common denominator.

Final Answer: $v = -36$ cm (real image in front of the mirror) $\Rightarrow$ $\boxed{\text{C}}$

Answer: (C) Go Back to Q38

Q39.

Solution

Concept — Snell's law: $n_1 \sin i = n_2 \sin r$; from air, $\sin i = n \sin r$.

Step 1 — Write the relation: $\sin r = \frac{\sin i}{n}$.

Step 2 — Insert values: $\sin r = \frac{\sin 45^\circ}{\sqrt{2}} = \frac{1/\sqrt{2}}{\sqrt{2}}$.

Step 3 — Simplify: $= \frac{1}{\sqrt{2} \cdot \sqrt{2}} = \frac{1}{2}$.

Step 4 — Solve: $\sin r = 0.5 \Rightarrow r = 30^\circ$.

Why other options are wrong:

- (A) assumes no bending.
- (C) bends the ray the wrong way.
- (D) uses a wrong sine value.

Final Answer: $r = 30^\circ \Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q39

Q40.

Solution

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

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

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

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

Why other options are wrong:

- (A) uses f in cm wrongly.
- (B) gives a negative (concave) sign.
- (C) forgets to convert cm to m.

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

Answer: (D) Go Back to Q40

Q41.

Solution

Concept — Thin-prism deviation: For a thin prism $\delta = (n-1)A$.

Step 1 — List data: $n = 1.5$, $A = 6^\circ$.

Step 2 — Compute $(n-1)$**:** $1.5 - 1 = 0.5$.

Step 3 — Multiply by A**:** $\delta = 0.5 \times 6^\circ$.

Step 4 — Evaluate: $= 3^\circ$.

Why other options are wrong:

- (A) ignores the $(n-1)$ factor.
- (B) and (C) use wrong factors.

Final Answer: $\delta = 3^\circ \Rightarrow \boxed{\text{D}}$

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 λD: $6 \times 10^{-7} \times 1.5 = 9 \times 10^{-7}$.

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

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

Why other options are wrong:

- (A), (B), (D) come from power-of-ten or arithmetic slips.

Final Answer: $\beta = 3$ mm $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q42

Q43.

Solution

Concept — Angular width of the central maximum: The full angular width between the two first minima is $2\theta = \dfrac{2\lambda}{a}$.

Step 1 — List data: $\lambda = 500$ nm $= 5 \times 10^{-7}$ m, $a = 0.2$ mm $= 2 \times 10^{-4}$ m.

Step 2 — Single-side angle: $\theta = \dfrac{\lambda}{a} = \dfrac{5 \times 10^{-7}}{2 \times 10^{-4}} = 2.5 \times 10^{-3}$ rad.

Step 3 — Double for full width: $2\theta = 2 \times 2.5 \times 10^{-3}$.

Step 4 — Evaluate: $= 5 \times 10^{-3}$ rad.

Why other options are wrong:

- (C) gives only the half-width θ.
- (B) halves the half-width.
- (D) over-counts by a factor of 2.

Final Answer: $2\theta = 5 \times 10^{-3}$ rad $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q43

Q44.

Solution

Concept — Stopping potential: $eV_s = E_{photon} - \phi$, so $V_s = \dfrac{E_{photon} - \phi}{e}$; in electron-volts V_s (in volts) equals the energy difference (in eV).

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

Step 2 — Maximum kinetic energy: $K_{\max} = 5 - 2 = 3$ eV.

Step 3 — Stopping potential: $V_s = \dfrac{K_{\max}}{e} = 3$ V.

Why other options are wrong:

- (A) is the work function in volts.
- (B) is the photon energy in volts.
- (C) adds them instead of subtracting.

Final Answer: $V_s = 3 \text{ V} \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q44

Q45.

Solution

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

Step 1 — List data: $V = 54$ V.

Step 2 — Take the square root: $\sqrt{54} \approx 7.35$.

Step 3 — Divide: $\lambda = \dfrac{12.27}{7.35}$.

Step 4 — Evaluate: $\lambda \approx 1.67$ Å.

Why other options are wrong:

- (A) corresponds to a much larger accelerating voltage.
- (C) and (D) carry arithmetic or power-of-ten slips.

Final Answer: $\lambda \approx 1.67 \text{ Å} \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q45

Q46.

Solution

Concept — Bohr energy levels: $E_n = -\dfrac{13.6}{n^2}$ eV.

Step 1 — Insert $n = 2$**:** $E_2 = -\dfrac{13.6}{2^2}$.

Step 2 — Square the n**:** $2^2 = 4$.

Step 3 — Divide: $E_2 = -\dfrac{13.6}{4} = -3.4$ eV.

Why other options are wrong:

- (A) is the ground state ($n = 1$).
- (B) divides by 2 instead of 4.
- (D) is the $n = 3$ level.

Final Answer: $E_2 = -3.4$ 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 $n =$ wrong value.
- (C) is the $n = 2$ radius.
- (D) uses $n^2 = 10$.

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

Answer: (B) Go Back to Q47

Q48.

Solution

Concept — Half-life and decay constant: $T_{1/2} = \dfrac{\ln 2}{\lambda} = \dfrac{0.693}{\lambda}$.

Step 1 — List data: $\lambda = 0.0693\ \text{s}^{-1}$, $\ln 2 = 0.693$.

Step 2 — Form the ratio: $T_{1/2} = \dfrac{0.693}{0.0693}$.

Step 3 — Evaluate: $= 10\ \text{s}$.

Why other options are wrong:

- (A) and (B) come from arithmetic slips.
- (C) uses $1/\lambda$ (the mean life) instead of $\ln 2/\lambda$.

Final Answer: $T_{1/2} = 10\ \text{s} \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q48

Q49.

Solution

Concept — Mass–energy equivalence: $E = \Delta m \times 931$ MeV when Δm is in atomic mass units.

Step 1 — List data: $\Delta m = 3$ u, energy per u $= 931$ MeV.

Step 2 — Multiply: $E = 3 \times 931$.

Step 3 — Evaluate: $= 2793$ MeV.

Why other options are wrong:

- (B) uses $\Delta m = 1$ u.
- (C) divides instead of multiplying.
- (D) uses $\Delta m = 2$ u.

Final Answer: $E = 2793\ \text{MeV} \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q49

Q50.

Solution

Concept — Full-wave rectifier: A centre-tapped full-wave rectifier uses two diodes so that one conducts during each half-cycle, sending current through the load in the same direction on both halves.

Step 1 — Positive half-cycle: Diode D_1 is forward biased and conducts through R_L.

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

Step 3 — Conclude: Both half-cycles produce current in R_L in one direction, giving a pulsating but unidirectional output covering both halves.

Why other options are wrong:

- (A) describes a half-wave rectifier.
- (C) ignores the ripple present in a rectified output.
- (D) is false; current flows on both half-cycles.

Final Answer: Output uses both half-cycles, rectified into one direction $\Rightarrow \boxed{B}$

Answer: (B) Go Back to Q50

Answer Key

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