JCECE Physics Sample Paper – 1

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 quantity $\frac{P}{\rho g}$, where P is pressure, ρ is density and g is acceleration due to gravity, has the dimensional formula:

(A) $[\mathrm{M^0LT^0}]$

(B) $[\mathrm{MLT^{-2}}]$

(C) $[\mathrm{ML^{-1}T^{-2}}]$

(D) $[\mathrm{M^0L^2T^0}]$

Q2. Two lengths are measured as 5.74 m and 0.6 m. Their sum, reported to the correct number of significant figures (decimal places), is:

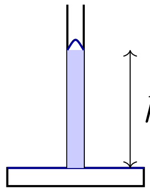
(A) 6.34 m

(B) 6.340 m

(C) 6.3 m

(D) 6 m

Q3. Water of surface tension 7.0×10^{-2} N/m rises in a clean glass capillary of radius 0.2 mm (contact angle $0°$, $\rho = 1000$ kg/m^3, $g = 10$ m/s^2). The capillary rise h is:



(A) 3.5 cm

(B) 7.0 cm

(C) 1.4 cm

(D) 14.0 cm

Q4. A steel wire of length 2 m and cross-sectional area 1 mm^2 stretches by 1 mm under a load of 100 N. The Young's modulus of steel is:

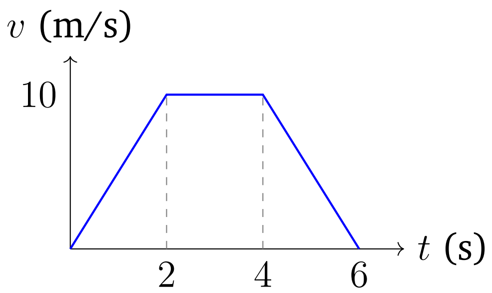
(A) 1×10^{11} N/m^2

(B) 4×10^{11} N/m^2

(C) 1×10^{10} N/m^2

(D) 2×10^{11} N/m^2

Q5. The velocity–time graph of a particle is shown. The total distance covered in 6 s is:



(A) 20 m

(B) 30 m

(C) 40 m

(D) 60 m

Q6. A projectile is fired with speed 20 m/s at 30° above the horizontal ($g = 10$ m/s^2). Its maximum height is:

(A) 2.5 m

(B) 5 m

(C) 10 m

(D) 20 m

Q7. A train 150 m long moving at 25 m/s overtakes another train 250 m long moving at 15 m/s in the same direction on a parallel track. The time to completely overtake is:

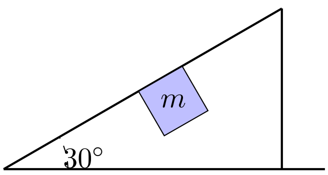
(A) 40 s

(B) 10 s

(C) 16 s

(D) 25 s

Q8. A block is released from rest on a smooth incline of angle 30° as shown. Starting from rest, its speed after sliding 4 m along the incline ($g = 10$ m/s^2) is:



(A) 4 m/s

(B) 5.6 m/s

(C) 6.3 m/s

(D) 8.9 m/s

Q9. A body just begins to slide down an incline when the angle of inclination is 45°. The coefficient of static friction between body and surface is:

(A) 1

(B) 0.5

(C) $\sqrt{3}$

(D) $1/\sqrt{2}$

Q10. A car can move on a horizontal circular track of radius 40 m with coefficient of friction 0.4. The maximum safe speed ($g = 10$ m/s^2) is:

(A) 8 m/s

(B) 12.6 m/s

(C) 16 m/s

(D) 20 m/s

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

(A) 4 J

(B) 6 J

(C) 8 J

(D) 10 J

Q12. A pump raises 120 kg of water per minute through a height of 10 m ($g = 10$ m/s^2). The power of the pump is:

(A) 100 W

(B) 150 W

(C) 200 W

(D) 1200 W

Q13. A body of mass 2 kg moving at 6 m/s makes a head-on elastic collision with a stationary body of mass 2 kg. After collision, the speed of the first body is:

(A) 0 m/s

(B) 3 m/s

(C) 6 m/s

(D) 12 m/s

Q14. A solid sphere rolls without slipping on a horizontal surface. The ratio of its rotational kinetic energy to its total kinetic energy is:

(A) $5/7$

(B) $2/7$

(C) $1/2$

(D) $2/5$

Q15. A planet revolves around the Sun in an orbit of radius 9 times that of Earth. Its period of revolution (in Earth-years) is:

(A) 3

(B) 9

(C) 18

(D) 27

Q16. A Carnot engine works between a source at 500 K and a sink at 375 K. Its efficiency is:

(A) 15%

(B) 20%

(C) 25%

(D) 33%

Q17. 2 mol of an ideal gas expands isothermally and reversibly from volume V to $2V$ at temperature T ($R = 8.31$ J/mol·K). The work done by the gas is:

(A) $2RT \ln 2$

(B) $RT \ln 2$

(C) RT

(D) $2RT$

Q18. If the absolute temperature of an ideal gas is increased to 4 times its initial value, the rms speed of its molecules becomes:

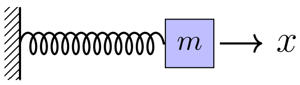
(A) Halved

(B) Doubled

(C) Quadrupled

(D) Unchanged

Q19. A mass of 0.2 kg attached to a spring of force constant 80 N/m executes SHM as shown. The time period of oscillation is:



(A) 0.1π s

(B) 0.2π s

(C) 0.1 s

(D) 0.4π s

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

(A) $1/2$

(B) $1/4$

(C) $3/4$

(D) 1

Q21. A string of linear mass density 0.04 kg/m is stretched with a tension of 36 N. The speed of a transverse wave on the string is:

(A) 15 m/s

(B) 20 m/s

(C) 25 m/s

(D) 30 m/s

Q22. A source of sound of frequency 600 Hz moves towards a stationary observer at 33 m/s. Taking the speed of sound as 330 m/s, the observed frequency is:

(A) 545 Hz

(B) 600 Hz

(C) 700 Hz

(D) 667 Hz

Q23. Two point charges 3 μC and 4 μC are placed 0.3 m apart in vacuum ($k = 9 \times 10^9$ N·m^2/C^2). The magnitude of the Coulomb force between them is:

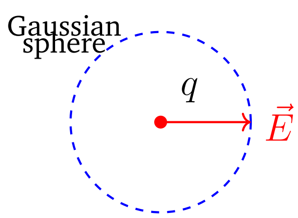
(A) 0.6 N

(B) 2.4 N

(C) 3.6 N

(D) 1.2 N

Q24. A charge of 8.85 μC is placed at the centre of a closed Gaussian sphere as shown ($\varepsilon_0 = 8.85 \times 10^{-12}$ C^2/N·m^2). The total electric flux through the surface is:



(A) 1×10^5 N·m^2/C

(B) 5×10^5 N·m^2/C

(C) 1×10^6 N·m^2/C

(D) 1×10^7 N·m^2/C

Q25. The electric field on the axis of a short dipole varies with distance r from its centre (for $r \gg$ dipole length) as:

(A) $\propto 1/r^3$

(B) $\propto 1/r^2$

(C) $\propto 1/r$

(D) $\propto 1/r^4$

Q26. A parallel-plate capacitor of capacitance $6\ \mu$F in air is completely filled with a dielectric of constant $K = 3$. Its new capacitance is:

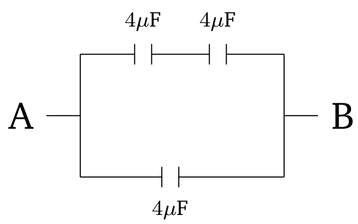
(A) $2\ \mu$F

(B) $18\ \mu$F

(C) $9\ \mu$F

(D) $6\ \mu$F

Q27. In the network shown, two $4\ \mu$F capacitors in series are connected in parallel with a third $4\ \mu$F capacitor. The equivalent capacitance between A and B is:



(A) $2\ \mu$F

(B) $4\ \mu$F

(C) $8\ \mu$F

(D) $6\ \mu$F

Q28. A conductor of cross-section $2\ \text{mm}^2$ carries a current of 3.4 A. With free-electron density $n = 8.5 \times 10^{28}\ \text{m}^{-3}$ and $e = 1.6 \times 10^{-19}$ C, the drift speed of electrons is approximately:

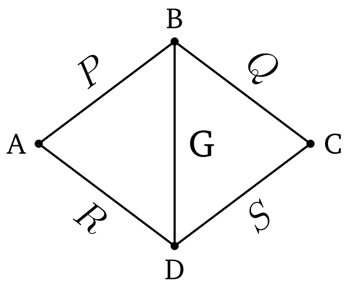
(A) 1.25×10^{-5} m/s

(B) 2.5×10^{-4} m/s

(C) 1.25×10^{-4} m/s

(D) 2.5×10^{-5} m/s

Q29. In the balanced Wheatstone bridge shown, $P = 4\,\Omega$, $Q = 8\,\Omega$ and $R = 6\,\Omega$. The unknown resistance S is:



(A) $3\,\Omega$

(B) $12\,\Omega$

(C) $18\,\Omega$

(D) $24\,\Omega$

Q30. A cell of EMF 1.5 V and internal resistance $1\,\Omega$ is connected to an external resistance of $4\,\Omega$. The terminal voltage across the cell is:

(A) 1.2 V

(B) 1.5 V

(C) 0.3 V

(D) 0.75 V

Q31. An electric heater is rated 500 W at 250 V. Its hot resistance is:

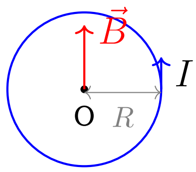
(A) $62.5\,\Omega$

(B) $250\,\Omega$

(C) $500\,\Omega$

(D) $125\,\Omega$

Q32. A circular loop of radius 0.05 m carries a current of 4 A as shown ($\mu_0 = 4\pi \times 10^{-7}$ T·m/A). The magnetic field at its centre is:



(A) 1.6×10^{-5} T

(B) 3.2×10^{-5} T

(C) 5.0×10^{-5} T

(D) 1.0×10^{-4} T

Q33. A straight wire of length 0.5 m carrying 6 A lies perpendicular to a uniform magnetic field of 0.4 T. The force on the wire is:

(A) 0.6 N

(B) 0.8 N

(C) 1.0 N

(D) 1.2 N

Q34. A long solenoid has 2000 turns per metre and carries a current of 2 A ($\mu_0 = 4\pi \times 10^{-7}$ T·m/A). The magnetic field inside it is:

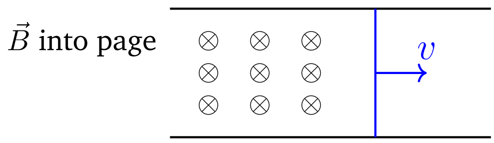
(A) 5.03×10^{-3} T

(B) 2.51×10^{-3} T

(C) 1.26×10^{-3} T

(D) 1.0×10^{-2} T

Q35. A conducting rod of length 0.25 m slides at 8 m/s perpendicular to itself across rails in a uniform field of 0.5 T directed into the page, as shown. The induced EMF is:



(A) 0.5 V

(B) 0.8 V

(C) 1.0 V

(D) 2.0 V

Q36. In a series LCR circuit, $R = 8\,\Omega$, $X_L = 10\,\Omega$ and $X_C = 4\,\Omega$. The impedance of the circuit is:

(A) $8\,\Omega$

(B) $10\,\Omega$

(C) $14\,\Omega$

(D) $22\,\Omega$

Q37. An ideal step-down transformer has 1000 turns in the primary and 100 turns in the secondary. If the primary voltage is 220 V, the secondary voltage is:

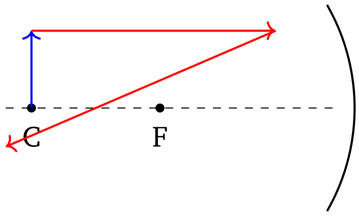
(A) 2200 V

(B) 110 V

(C) 44 V

(D) 22 V

Q38. A concave mirror of focal length 15 cm forms an image of an object placed 30 cm in front of it, as shown. The image distance is:



(A) -30 cm

(B) $+30$ cm

(C) -15 cm

(D) -60 cm

Q39. The critical angle for total internal reflection at a glass–air interface is θ_c. If the refractive index of the glass is $\sqrt{2}$, then θ_c equals:

(A) 30°

(B) 45°

(C) 60°

(D) 90°

Q40. A biconvex lens has both radii of curvature equal to 30 cm in magnitude and is made of glass of refractive index 1.5. Its focal length is:

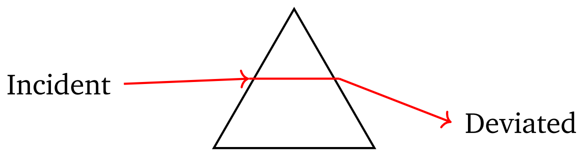
(A) 15 cm

(B) 20 cm

(C) 30 cm

(D) 60 cm

Q41. A ray passes through an equilateral prism of refractive index $\sqrt{2}$ at minimum deviation, as shown. The angle of minimum deviation is:



(A) 15°

(B) 45°

(C) 60°

(D) 30°

Q42. In a Young's double-slit experiment, light of wavelength 500 nm illuminates slits separated by 0.25 mm, and the screen is 1 m away. The fringe width is:

(A) 2 mm

(B) 1 mm

(C) 0.5 mm

(D) 4 mm

Q43. In single-slit diffraction with slit width 0.1 mm and light of wavelength 600 nm, the angular position of the first minimum is:

(A) 3×10^{-3} rad

(B) 6×10^{-3} rad

(C) 1.2×10^{-2} rad

(D) 6×10^{-2} rad

Q44. The work function of a metal is 3.3×10^{-19} J ($h = 6.6 \times 10^{-34}$ J·s). Its photoelectric threshold frequency is:

(A) 2.5×10^{14} Hz

(B) 1×10^{15} Hz

(C) 5×10^{14} Hz

(D) 2×10^{15} Hz

Q45. An electron is accelerated through a potential difference of 150 V. Its de Broglie wavelength is approximately:

(A) 1 Å

(B) 0.1 Å

(C) 10 Å

(D) 0.5 Å

Q46. In a graph of stopping potential V_s against incident frequency ν for the photoelectric effect, the slope of the straight line equals:

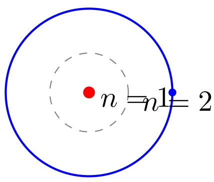
(A) h

(B) h/e

(C) e/h

(D) ϕ/e

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 second orbit ($n = 2$) is shown below. Its value is:



(A) 0.53 Å

(B) 1.06 Å

(C) 4.77 Å

(D) 2.12 Å

Q48. A radioactive sample of initial mass 80 g has a half-life of 5 years. The mass of the sample remaining undecayed after 15 years is:

(A) 20 g

(B) 40 g

(C) 10 g

(D) 5 g

Q49. The mass defect in the formation of a certain nucleus is 0.05 u. Taking $1\text{ u} = 931\text{ MeV}/c^2$, the binding energy released is approximately:

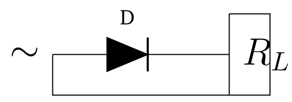
(A) 46.6 MeV

(B) 93.1 MeV

(C) 9.31 MeV

(D) 23.3 MeV

Q50. In the half-wave rectifier circuit shown, the diode conducts only when its anode is positive with respect to its cathode. For an a.c. input, the output across the load R_L consists of:



(A) Both half-cycles of the input

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

(C) A pure direct current with no ripple

(D) No current at all

Detailed Solutions

Q1.

Solution

Concept — Dimensional analysis: Form the ratio of dimensions of P, ρ and g. Pressure $[P] = \mathrm{ML^{-1}T^{-2}}$, density $[\rho] = \mathrm{ML^{-3}}$, acceleration $[g] = \mathrm{LT^{-2}}$.

Step 1 — Write numerator: $[P] = \mathrm{ML^{-1}T^{-2}}$.

Step 2 — Write denominator: $[\rho g] = \mathrm{ML^{-3}} \cdot \mathrm{LT^{-2}} = \mathrm{ML^{-2}T^{-2}}$.

Step 3 — Divide: $\dfrac{[P]}{[\rho g]} = \dfrac{\mathrm{ML^{-1}T^{-2}}}{\mathrm{ML^{-2}T^{-2}}}$.

Step 4 — Cancel: $= \mathrm{M^{1-1}L^{-1-(-2)}T^{-2-(-2)}} = \mathrm{M^0L^1T^0}$.

Why other options are wrong:

- (B) and (C) retain mass/time dimensions that cancel.
- (D) has $\mathrm{L^2}$, an extra length factor.

Final Answer: $\dfrac{P}{\rho g}$ has dimension of length, $[\mathrm{M^0LT^0}] \Rightarrow \boxed{\mathrm{A}}$

Answer: (A) Go Back to Q1

Q2.

Solution

Concept — Significant figures in addition: In addition (or subtraction), the result keeps as many decimal places as the term with the fewest decimal places.

Step 1 — Count decimals: 5.74 has 2 decimal places; 0.6 has 1 decimal place.

Step 2 — The smaller is: 1 decimal place.

Step 3 — Add the numbers: $5.74 + 0.6 = 6.34$.

Step 4 — Round to 1 decimal place: $6.34 \to 6.3$.

Why other options are wrong:

- (A) keeps 2 decimals, more precision than justified.
- (B) implies 3 decimals, unjustified.
- (D) drops the decimal entirely, too coarse.

Final Answer: Sum $= 6.3$ m $\Rightarrow \boxed{\mathrm{C}}$

Answer: (C) Go Back to Q2

Q3.

Solution

Concept — Capillary rise: For a liquid that wets the tube, $h = \dfrac{2T\cos\theta}{r\rho g}$, where T is surface tension, θ the contact angle, r the tube radius.

Step 1 — List data: $T = 7.0\times10^{-2}$ N/m, $\theta = 0°$ so $\cos\theta = 1$, $r = 0.2$ mm $= 2\times10^{-4}$ m, $\rho = 1000$ kg/m^3, $g = 10$ m/s^2.

Step 2 — Numerator: $2T\cos\theta = 2 \times 7.0 \times 10^{-2} \times 1 = 1.4 \times 10^{-1}$ N/m.

Step 3 — Denominator: $r\rho g = 2 \times 10^{-4} \times 1000 \times 10 = 2.0$ N/m^2·m... numerically $= 2.0$.

Step 4 — Divide: $h = \dfrac{1.4 \times 10^{-1}}{2.0} = 7.0 \times 10^{-2}$ m.

Step 5 — Convert to cm: 7.0×10^{-2} m $= 7.0$ cm.

Why other options are wrong:

- (A) drops the factor of 2.
- (C) uses a wrong radius.
- (D) doubles the correct value.

Final Answer: $h = 7.0$ cm $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q3

Q4.

Solution

Concept — Young's modulus: $Y = \dfrac{F/A}{\Delta L/L} = \dfrac{FL}{A\,\Delta L}$.

Step 1 — List data: $F = 100$ N, $L = 2$ m, $A = 1$ mm^2 $= 1 \times 10^{-6}$ m^2, $\Delta L = 1$ mm $= 1 \times 10^{-3}$ m.

Step 2 — Numerator: $FL = 100 \times 2 = 200$.

Step 3 — Denominator: $A\,\Delta L = 1 \times 10^{-6} \times 1 \times 10^{-3} = 1 \times 10^{-9}$.

Step 4 — Divide: $Y = \dfrac{200}{1 \times 10^{-9}} = 2 \times 10^{11}$ N/m^2.

Why other options are wrong:

- (A) drops the factor from $L = 2$ m.
- (B) doubles incorrectly.
- (C) has a power-of-ten slip.

Final Answer: $Y = 2 \times 10^{11}$ N/m$^2 \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q4

Q5.

Solution

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

Step 1 — Identify shape: Velocity rises from 0 to 10 m/s in 0–2 s, stays 10 m/s in 2–4 s, falls to 0 in 4–6 s. This is a trapezium.

Step 2 — Parallel sides of trapezium: The top (constant part) has length $4-2 = 2$ s; the base (total time) has length 6 s.

Step 3 — Apply trapezium area: Area $= \frac{1}{2}(\text{sum of parallel sides}) \times \text{height} = \frac{1}{2}(2+6) \times 10$.

Step 4 — Evaluate: $= \frac{1}{2} \times 8 \times 10 = 40$ m.

Why other options are wrong:

- (A) counts only one triangle.
- (B) omits part of the area.
- (D) treats the whole as a full rectangle 6×10.

Final Answer: Distance $= 40$ m $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q5

Q6.

Solution

Concept — Maximum height of a projectile: $H = \dfrac{u^2 \sin^2 \theta}{2g}$.

Step 1 — List data: $u = 20$ m/s, $\theta = 30°$, $g = 10$ m/s^2.

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

Step 3 — Square it: $\sin^2 30° = 0.25$.

Step 4 — Numerator: $u^2 \sin^2 \theta = (20)^2 \times 0.25 = 400 \times 0.25 = 100$.

Step 5 — Divide by $2g$**:** $H = \dfrac{100}{2 \times 10} = \dfrac{100}{20} = 5$ m.

Why other options are wrong:

- (A) forgot to square $\sin\theta$ correctly (used $\sin^2 = 0.125$).
- (C) used $\theta = 45°$.
- (D) ignored the factor of $2g$.

Final Answer: $H = 5$ m $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q6

Q7.

Solution

Concept — Relative velocity in overtaking: Time $= \dfrac{\text{sum of lengths}}{\text{relative speed}}$ for same-direction motion.

Step 1 — Relative speed: $25 - 15 = 10$ m/s.

Step 2 — Total length to clear: $150 + 250 = 400$ m.

Step 3 — Divide: $t = \dfrac{400}{10} = 40$ s.

Why other options are wrong:

- (B) and (C) drop one train's length.
- (D) uses the sum of speeds (head-on).

Final Answer: $t = 40$ s $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q7

Q8.

Solution

Concept — Smooth incline kinematics: Acceleration along the incline is $a = g\sin\theta$; then use $v^2 = u^2 + 2as$ with $u = 0$.

Step 1 — Find acceleration: $a = g\sin 30° = 10 \times 0.5 = 5$ m/s^2.

Step 2 — Apply $v^2 = 2as$**:** $v^2 = 2 \times 5 \times 4 = 40$.

Step 3 — Take square root: $v = \sqrt{40}$.

Step 4 — Evaluate: $\sqrt{40} \approx 6.3$ m/s.

Why other options are wrong:

- (A) just quotes the distance.
- (B) uses a wrong acceleration.
- (D) used the full g instead of $g\sin\theta$.

Final Answer: $v \approx 6.3$ m/s $\Rightarrow$ $\boxed{\text{C}}$

Answer: (C) Go Back to Q8

Q9.

Solution

Concept — Angle of repose: The body just slides when the incline angle equals the angle of repose θ_r, where $\mu_s = \tan\theta_r$.

Step 1 — Identify θ_r**:** The body just begins to slide at $45°$, so $\theta_r = 45°$.

Step 2 — Apply formula: $\mu_s = \tan 45°$.

Step 3 — Evaluate: $\tan 45° = 1$.

Why other options are wrong:

- (B) is $\tan$ of a smaller angle.
- (C) is $\tan 60°$.
- (D) is $\sin 45°$, not the tangent.

Final Answer: $\mu_s = 1 \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q9

Q10.

Solution

Concept — Maximum speed on an unbanked curve: Friction supplies the centripetal force, giving $v_{\max} = \sqrt{\mu r g}$.

Step 1 — List data: $\mu = 0.4$, $r = 40$ m, $g = 10$ m/s^2.

Step 2 — Multiply inside the root: $\mu r g = 0.4 \times 40 \times 10 = 160$.

Step 3 — Take square root: $v_{\max} = \sqrt{160}$.

Step 4 — Evaluate: $\sqrt{160} \approx 12.6$ m/s.

Why other options are wrong:

- (A) takes $\sqrt{\mu r}$ only.
- (C) and (D) overestimate by dropping μ.

Final Answer: $v_{\max} \approx 12.6$ m/s $\Rightarrow \boxed{\text{B}}$

Answer: (B) 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: $W = \int_0^2 (2x + 3)\,dx$.

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

Step 3 — Evaluate at $x = 2$: $2^2 + 3 \times 2 = 4 + 6 = 10$.

Step 4 — Evaluate at $x = 0$: $0 + 0 = 0$.

Step 5 — Subtract: $W = 10 - 0 = 10$ J.

Why other options are wrong:

- (A) integrates only the $2x$ term.
- (B) integrates only the constant.
- (C) drops one contribution.

Final Answer: $W = 10$ J $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q11

Q12.

Solution

Concept — Power of a pump: Power $= \dfrac{\text{work done against gravity}}{\text{time}} = \dfrac{mgh}{t}$.

Step 1 — List data: $m = 120$ kg, $g = 10$ m/s^2, $h = 10$ m, $t = 60$ s (one minute).

Step 2 — Work done: $mgh = 120 \times 10 \times 10 = 12000$ J.

Step 3 — Divide by time: $P = \dfrac{12000}{60}$.

Step 4 — Evaluate: $P = 200$ W.

Why other options are wrong:

- (A) and (B) use wrong arithmetic.
- (D) forgets to divide by 60 s.

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

Answer: (C) Go Back to Q12

Q13.

Solution

Concept — Elastic collision of equal masses: In a one-dimensional elastic collision between equal masses, the moving body stops and the stationary body moves off with the original speed (velocities are exchanged).

Step 1 — Recall the result: For $m_1 = m_2$ with target at rest, $v_1' = 0$ and $v_2' = u$.

Step 2 — Apply to data: $u = 6$ m/s, so $v_1' = 0$ m/s.

Step 3 — Check by conservation: Momentum $2 \times 6 = 2 \times 0 + 2 \times 6$; KE $\frac{1}{2} \cdot 2 \cdot 6^2 = \frac{1}{2} \cdot 2 \cdot 6^2$; both balance.

Why other options are wrong:

- (B) would hold only for a perfectly inelastic equal-mass collision (they move together at 3 m/s), not elastic.
- (C) would require the masses to pass through.
- (D) violates momentum conservation.

Final Answer: First body's speed $= 0$ m/s $\Rightarrow \boxed{A}$

Answer: (A) Go Back to Q13

Q14.

Solution

Concept — Rolling kinetic energy split: For a body rolling without slipping, $\dfrac{KE_{rot}}{KE_{total}} = \dfrac{I/MR^2}{1 + I/MR^2}$. For a solid sphere $I = \frac{2}{5}MR^2$.

Step 1 — Insert I/MR^2: For a solid sphere, $\dfrac{I}{MR^2} = \dfrac{2}{5}$.

Step 2 — Numerator of ratio: $\dfrac{2}{5}$.

Step 3 — Denominator: $1 + \dfrac{2}{5} = \dfrac{7}{5}$.

Step 4 — Divide: $\dfrac{2/5}{7/5} = \dfrac{2}{7}$.

Why other options are wrong:

- (A) is the translational fraction $(5/7)$.
- (C) and (D) ignore the rolling constraint.

Final Answer: $KE_{rot}/KE_{total} = 2/7 \Rightarrow \boxed{B}$

Answer: (B) Go Back to Q14

Q15.

Solution

Concept — Kepler's third law: $T^2 \propto r^3$, so $T = \left(\dfrac{r}{r_E}\right)^{3/2}$ Earth-years when measured relative to Earth.

Step 1 — Ratio of radii: $\dfrac{r}{r_E} = 9$.

Step 2 — Cube it: $9^3 = 729$, so $T^2 = 729$.

Step 3 — Take square root: $T = \sqrt{729} = 27$ years.

Step 4 — Cross-check: $9^{3/2} = (3^2)^{3/2} = 3^3 = 27$.

Why other options are wrong:

- (A) takes $\sqrt{9}$ only.
- (B) takes r/r_E directly.
- (C) doubles incorrectly.

Final Answer: $T = 27$ years $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q15

Q16.

Solution

Concept — Carnot efficiency: $\eta = 1 - \frac{T_C}{T_H}$, with temperatures in kelvin.

Step 1 — Form the ratio: $\frac{T_C}{T_H} = \frac{375}{500}$.

Step 2 — Simplify: $\frac{375}{500} = 0.75$.

Step 3 — Subtract from 1**:** $\eta = 1 - 0.75 = 0.25$.

Step 4 — Convert to percent: $0.25 = 25\%$.

Why other options are wrong:

- (A), (B), (D) use wrong temperature ratios.

Final Answer: $\eta = 25\% \Rightarrow$ $\boxed{\text{C}}$

Answer: (C) Go Back to Q16

Q17.

Solution

Concept — Isothermal work: For n moles, $W = nRT \ln \frac{V_2}{V_1}$.

Step 1 — Volume ratio: $\frac{V_2}{V_1} = \frac{2V}{V} = 2$.

Step 2 — Substitute $n = 2$**:** $W = 2RT \ln 2$.

Why other options are wrong:

- (B) uses $n = 1$.
- (C) and (D) drop the logarithm.

Final Answer: $W = 2RT \ln 2 \Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q17

Q18.

Solution

Concept — rms speed and temperature: $v_{rms} = \sqrt{\frac{3RT}{M}}$, so $v_{rms} \propto \sqrt{T}$.

Step 1 — Form the ratio: $\frac{v_2}{v_1} = \sqrt{\frac{T_2}{T_1}}$.

Step 2 — Insert $T_2 = 4T_1$: $\frac{v_2}{v_1} = \sqrt{4}$.

Step 3 — Evaluate: $\sqrt{4} = 2$, so the new speed is twice the original.

Why other options are wrong:

- (A) inverts the relation.
- (C) takes T instead of $\sqrt{T}$.
- (D) ignores the temperature change.

Final Answer: The rms speed is doubled $\Rightarrow$ $\boxed{B}$

Answer: (B) Go Back to Q18

Q19.

Solution

Concept — Spring–mass SHM period: $T = 2\pi\sqrt{\frac{m}{k}}$.

Step 1 — List data: $m = 0.2$ kg, $k = 80$ N/m.

Step 2 — Form m/k: $\frac{0.2}{80} = 0.0025$ s^2.

Step 3 — Take square root: $\sqrt{0.0025} = 0.05$ s.

Step 4 — Multiply by 2π: $T = 2\pi \times 0.05 = 0.1\pi$ s.

Why other options are wrong:

- (B) doubles the correct period by mis-taking the root of m/k.
- (C) drops the 2π factor and just reports the root.
- (D) uses $8\pi\sqrt{m/k}$, inflating the 2π coefficient.

Final Answer: $T = 0.1\pi$ s $\Rightarrow$ $\boxed{A}$

Answer: (A) Go Back to Q19

Q20.

Solution

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

Step 1 — Insert $x = A/2$**:** $\dfrac{U}{E} = \dfrac{(A/2)^2}{A^2}$.

Step 2 — Square the numerator: $(A/2)^2 = \dfrac{A^2}{4}$.

Step 3 — Divide: $\dfrac{A^2/4}{A^2} = \dfrac{1}{4}$.

Why other options are wrong:

- (A) forgets to square the half.
- (C) is the kinetic-energy fraction.
- (D) would need $x = A$.

Final Answer: $U/E = 1/4 \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q20

Q21.

Solution

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

Step 1 — List data: $T = 36$ N, $\mu = 0.04$ kg/m.

Step 2 — Form T/μ**:** $\dfrac{36}{0.04} = 900\ \text{m}^2/\text{s}^2$.

Step 3 — Take square root: $v = \sqrt{900} = 30$ m/s.

Why other options are wrong:

- (A), (B), (C) come from arithmetic slips in T/μ.

Final Answer: $v = 30$ m/s $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q21

Q22.

Solution

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

Step 1 — List data: $f = 600$ Hz, $v = 330$ m/s, $v_s = 33$ m/s.

Step 2 — Denominator: $v - v_s = 330 - 33 = 297$ m/s.

Step 3 — Form the ratio: $\dfrac{v}{v - v_s} = \dfrac{330}{297}$.

Step 4 — Simplify: $\dfrac{330}{297} = \dfrac{10}{9}$.

Step 5 — Multiply by f: $f' = 600 \times \dfrac{10}{9} = \dfrac{6000}{9} \approx 667$ Hz.

Why other options are wrong:

- (A) uses $v + v_s$ (receding case).
- (B) ignores the source motion.
- (C) overestimates.

Final Answer: $f' \approx 667 \text{ Hz} \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q22

Q23.

Solution

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

Step 1 — List data: $q_1 = 3 \times 10^{-6}$ C, $q_2 = 4 \times 10^{-6}$ C, $r = 0.3$ m, $k = 9 \times 10^9$.

Step 2 — Product of charges: $q_1q_2 = 3 \times 10^{-6} \times 4 \times 10^{-6} = 12 \times 10^{-12}$ C^2.

Step 3 — Square the distance: $r^2 = (0.3)^2 = 0.09$ m^2.

Step 4 — Numerator: $kq_1q_2 = 9 \times 10^9 \times 12 \times 10^{-12} = 108 \times 10^{-3} = 0.108$.

Step 5 — Divide by r^2: $F = \dfrac{0.108}{0.09} = 1.2$ N.

Why other options are wrong:

- (A) halves the result.
- (B) and (C) use a wrong power of ten or distance.

Final Answer: $F = 1.2\ \text{N} \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q23

Q24.

Solution

Concept — Gauss's law: The total flux through a closed surface is $\Phi = \dfrac{q_{enc}}{\varepsilon_0}$, independent of the surface shape.

Step 1 — List data: $q = 8.85 \times 10^{-6}$ C, $\varepsilon_0 = 8.85 \times 10^{-12}$ C^2/N·m^2.

Step 2 — Form the ratio: $\Phi = \dfrac{8.85 \times 10^{-6}}{8.85 \times 10^{-12}}$.

Step 3 — Cancel the 8.85**:** $\Phi = \dfrac{10^{-6}}{10^{-12}}$.

Step 4 — Subtract exponents: $10^{-6-(-12)} = 10^{6}$ N·m^2/C.

Why other options are wrong:

- (A) and (B) mis-handle the powers of ten.
- (D) is two orders too large.

Final Answer: $\Phi = 1 \times 10^{6}\ \text{N·m}^2/\text{C} \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q24

Q25.

Solution

Concept — Dipole field on the axis: For a short dipole, the axial field is $E_{axial} = \dfrac{1}{4\pi\varepsilon_0}\dfrac{2p}{r^3}$.

Step 1 — Read the r**-dependence:** The only power of r is r^3 in the denominator.

Step 2 — Conclude: $E_{axial} \propto \dfrac{1}{r^3}$.

Why other options are wrong:

- (B) is the field of a single point charge.
- (C) is the potential of a point charge.
- (D) would apply to a quadrupole.

Final Answer: $E_{axial} \propto 1/r^3 \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q25

Q26.

Solution

Concept — Dielectric in a capacitor: Filling the gap with a dielectric of constant K multiplies the capacitance: $C' = KC_0$.

Step 1 — List data: $C_0 = 6\,\mu$F, $K = 3$.

Step 2 — Multiply: $C' = 3 \times 6 = 18\,\mu$F.

Why other options are wrong:

- (A) divides instead of multiplying.
- (C) takes $K/2$ wrongly.
- (D) ignores the dielectric.

Final Answer: $C' = 18\,\mu\text{F} \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q26

Q27.

Solution

Concept — Series then parallel: Two equal capacitors C in series give $C/2$; this combination in parallel with a third C adds directly.

Step 1 — Two $4\,\mu$F in series: $\frac{1}{C_s} = \frac{1}{4} + \frac{1}{4} = \frac{2}{4} = \frac{1}{2}$, so $C_s = 2\,\mu$F.

Step 2 — Parallel with the third $4\,\mu$F: $C_{eq} = C_s + 4 = 2 + 4$.

Step 3 — Add: $C_{eq} = 6\,\mu$F.

Why other options are wrong:

- (A) gives only the series part.
- (B) ignores the parallel branch.
- (C) adds all three in parallel.

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

Answer: (D) Go Back to Q27

Q28.

Solution

Concept — Drift velocity: $I = nAev_d$, so $v_d = \dfrac{I}{nAe}$.

Step 1 — List data: $I = 3.4$ A, $n = 8.5 \times 10^{28}$ m^{-3}, $A = 2 \times 10^{-6}$ m^2, $e = 1.6 \times 10^{-19}$ C.

Step 2 — Compute the denominator nAe: $8.5 \times 10^{28} \times 2 \times 10^{-6} \times 1.6 \times 10^{-19}$.

Step 3 — Multiply the mantissas: $8.5 \times 2 \times 1.6 = 27.2$.

Step 4 — Add the exponents: $10^{28-6-19} = 10^3$, so $nAe = 27.2 \times 10^3 = 2.72 \times 10^4$.

Step 5 — Divide: $v_d = \dfrac{3.4}{2.72 \times 10^4} = 1.25 \times 10^{-4}$ m/s.

Why other options are wrong:

- (A) and (D) carry a power-of-ten error.
- (B) doubles the value.

Final Answer: $v_d \approx 1.25 \times 10^{-4}$ m/s $\Rightarrow$ 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: $P = 4\,\Omega$, $Q = 8\,\Omega$, $R = 6\,\Omega$.

Step 2 — Numerator: $QR = 8 \times 6 = 48$.

Step 3 — Divide by P: $S = \dfrac{48}{4} = 12\,\Omega$.

Why other options are wrong:

- (A) inverts the ratio.
- (C) and (D) use wrong pairings of arms.

Final Answer: $S = 12\,\Omega \Rightarrow$ B

Answer: (B) Go Back to Q29

Q30.

Solution

Concept — Terminal voltage: Current $I = \frac{E}{R+r}$; terminal voltage $V = IR = E\frac{R}{R+r}$.

Step 1 — Total resistance: $R + r = 4 + 1 = 5\,\Omega$.

Step 2 — Current: $I = \frac{1.5}{5} = 0.3$ A.

Step 3 — Terminal voltage: $V = IR = 0.3 \times 4 = 1.2$ V.

Why other options are wrong:

- (B) is the EMF (no internal drop).
- (C) is the internal drop Ir.
- (D) uses wrong arithmetic.

Final Answer: $V = 1.2\text{ V} \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q30

Q31.

Solution

Concept — Power and resistance: $P = \frac{V^2}{R}$, so $R = \frac{V^2}{P}$.

Step 1 — List data: $V = 250$ V, $P = 500$ W.

Step 2 — Square the voltage: $V^2 = (250)^2 = 62500$.

Step 3 — Divide by power: $R = \frac{62500}{500} = 125\,\Omega$.

Why other options are wrong:

- (A) halves the result.
- (B) and (C) use wrong arithmetic.

Final Answer: $R = 125\,\Omega \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q31

Q32.

Solution

Concept — Field at the centre of a current loop: $B = \frac{\mu_0 I}{2R}$.

Step 1 — List data: $\mu_0 = 4\pi \times 10^{-7}$, $I = 4$ 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: $2R = 2 \times 0.05 = 0.1$.

Step 4 — Divide: $B = \frac{16\pi \times 10^{-7}}{0.1} = 160\pi \times 10^{-7}$.

Step 5 — Evaluate: $160\pi \times 10^{-7} \approx 5.03 \times 10^{-5}$ T.

Why other options are wrong:

- (A) and (B) use wrong radius or current.
- (D) doubles the value.

Final Answer: $B \approx 5.0 \times 10^{-5}$ T $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q32

Q33.

Solution

Concept — Force on a current-carrying wire: $F = BIL\sin\theta$; perpendicular means $\sin\theta = 1$.

Step 1 — List data: $B = 0.4$ T, $I = 6$ A, $L = 0.5$ m.

Step 2 — Multiply B and I: $0.4 \times 6 = 2.4$.

Step 3 — Multiply by L: $F = 2.4 \times 0.5 = 1.2$ N.

Why other options are wrong:

- (A), (B), (C) come from arithmetic slips.

Final Answer: $F = 1.2$ N $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q33

Q34.

Solution

Concept — Field inside a long solenoid: $B = \mu_0 n I$, where n is turns per metre.

Step 1 — List data: $\mu_0 = 4\pi \times 10^{-7}$, $n = 2000\ \text{m}^{-1}$, $I = 2$ A.

Step 2 — Multiply n and I: $nI = 2000 \times 2 = 4000$.

Step 3 — Multiply by μ_0: $B = 4\pi \times 10^{-7} \times 4000 = 16000\pi \times 10^{-7}$.

Step 4 — Evaluate: $1.6 \times 10^4 \pi \times 10^{-7} = 1.6\pi \times 10^{-3} \approx 5.03 \times 10^{-3}$ T.

Why other options are wrong:

- (B) and (C) carry factor errors.
- (D) over-rounds π.

Final Answer: $B \approx 5.03 \times 10^{-3}\ \text{T} \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q34

Q35.

Solution

Concept — Motional EMF: $\varepsilon = BLv$ for a rod moving perpendicular to both $\vec{B}$ and its length.

Step 1 — List data: $B = 0.5$ T, $L = 0.25$ m, $v = 8$ m/s.

Step 2 — Multiply B and L: $0.5 \times 0.25 = 0.125$.

Step 3 — Multiply by v: $\varepsilon = 0.125 \times 8 = 1.0$ V.

Why other options are wrong:

- (A), (B), (D) come from arithmetic slips.

Final Answer: $\varepsilon = 1.0\ \text{V} \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q35

Q36.

Solution

Concept — Impedance of series LCR: $Z = \sqrt{R^2 + (X_L - X_C)^2}$.

Step 1 — Net reactance: $X_L - X_C = 10 - 4 = 6\,\Omega$.

Step 2 — Square the terms: $R^2 = 8^2 = 64$; $(X_L - X_C)^2 = 6^2 = 36$.

Step 3 — Add: $64 + 36 = 100$.

Step 4 — Take square root: $Z = \sqrt{100} = 10\,\Omega$.

Why other options are wrong:

- (A) ignores the reactance.
- (C) and (D) add reactances arithmetically without the Pythagorean combination.

Final Answer: $Z = 10\,\Omega \Rightarrow \boxed{B}$

Answer: (B) **Go Back to Q36**

Q37.

Solution

Concept — Transformer turns ratio: $\dfrac{V_s}{V_p} = \dfrac{N_s}{N_p}$.

Step 1 — Turns ratio: $\dfrac{N_s}{N_p} = \dfrac{100}{1000} = \dfrac{1}{10}$.

Step 2 — Solve for V_s: $V_s = V_p \times \dfrac{1}{10} = 220 \times \dfrac{1}{10}$.

Step 3 — Evaluate: $V_s = 22$ V.

Why other options are wrong:

- (A) steps up instead of down.
- (B) uses a ratio of $1/2$.
- (C) uses a ratio of $1/5$.

Final Answer: $V_s = 22\text{ V} \Rightarrow \boxed{D}$

Answer: (D) **Go Back to Q37**

Q38.

Solution

Concept — Mirror formula: $\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$. Using the sign convention, a concave mirror has $f = -15$ cm and the object distance $u = -30$ cm.

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

Step 2 — Substitute: $\frac{1}{v} = \frac{1}{-15} - \frac{1}{-30}$.

Step 3 — Common denominator: $\frac{1}{v} = -\frac{2}{30} + \frac{1}{30} = -\frac{1}{30}$.

Step 4 — Invert: $v = -30$ cm.

Why other options are wrong:

- (B) drops the sign convention.
- (C) uses f as v.
- (D) mis-adds the fractions.

Final Answer: $v = -30$ cm (real image at the object distance) $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q38

Q39.

Solution

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

Step 1 — Substitute $n = \sqrt{2}$: $\sin\theta_c = \frac{1}{\sqrt{2}}$.

Step 2 — Recognise the value: $\frac{1}{\sqrt{2}} = \sin 45^\circ$.

Step 3 — Conclude: $\theta_c = 45^\circ$.

Why other options are wrong:

- (A) is $\sin^{-1}(0.5)$.
- (C) is $\sin^{-1}(\sqrt{3}/2)$.
- (D) would need $n = 1$.

Final Answer: $\theta_c = 45^\circ \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q39

Q40.

Solution

Concept — Lens maker's formula: $\frac{1}{f} = (n-1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$. For a biconvex lens $R_1 = +R$, $R_2 = -R$.

Step 1 — Insert radii: $\frac{1}{R_1} - \frac{1}{R_2} = \frac{1}{R} - \frac{1}{-R} = \frac{2}{R}$.

Step 2 — Substitute $n = 1.5$, $R = 30$ **cm:** $\frac{1}{f} = (1.5 - 1) \times \frac{2}{30}$.

Step 3 — Simplify $(n-1)$**:** $1.5 - 1 = 0.5$.

Step 4 — Multiply: $\frac{1}{f} = 0.5 \times \frac{2}{30} = \frac{1}{30}$.

Step 5 — Invert: $f = 30$ cm.

Why other options are wrong:

- (A) and (B) mishandle the factor $2/R$.
- (D) drops the factor of 2 from the two surfaces.

Final Answer: $f = 30 \text{ cm} \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q40

Q41.

Solution

Concept — Prism at minimum deviation: $n = \frac{\sin\frac{A+D_m}{2}}{\sin\frac{A}{2}}$, with $A = 60°$ for an equilateral prism.

Step 1 — Insert $A = 60°$**:** $\sin\frac{A}{2} = \sin 30° = 0.5$.

Step 2 — Rearrange: $\sin\frac{A+D_m}{2} = n\sin\frac{A}{2} = \sqrt{2} \times 0.5 = \frac{1}{\sqrt{2}}$.

Step 3 — Solve the sine: $\frac{A+D_m}{2} = 45°$.

Step 4 — Multiply by 2**:** $A + D_m = 90°$.

Step 5 — Subtract A**:** $D_m = 90° - 60° = 30°$.

Why other options are wrong:

- (A) halves the result.

- (B) and (C) use a wrong angle in the sine.

Final Answer: $D_m = 30^\circ \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q41

Q42.

Solution

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

Step 1 — List data: $\lambda = 500$ nm $= 5 \times 10^{-7}$ m, $D = 1$ m, $d = 0.25$ mm $= 2.5 \times 10^{-4}$ m.

Step 2 — Numerator: $\lambda D = 5 \times 10^{-7} \times 1 = 5 \times 10^{-7}$.

Step 3 — Divide by d: $\beta = \dfrac{5 \times 10^{-7}}{2.5 \times 10^{-4}}$.

Step 4 — Evaluate: $= 2 \times 10^{-3}$ m $= 2$ mm.

Why other options are wrong:

- (B), (C), (D) come from power-of-ten slips.

Final Answer: $\beta = 2$ mm $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q42

Q43.

Solution

Concept — Single-slit first minimum: $a \sin\theta = \lambda$; for small angles $\theta \approx \dfrac{\lambda}{a}$.

Step 1 — List data: $a = 0.1$ mm $= 1 \times 10^{-4}$ m, $\lambda = 600$ nm $= 6 \times 10^{-7}$ m.

Step 2 — Form λ/a: $\dfrac{6 \times 10^{-7}}{1 \times 10^{-4}}$.

Step 3 — Evaluate: $= 6 \times 10^{-3}$ rad.

Why other options are wrong:

- (A) halves the value.
- (C) and (D) carry power-of-ten errors.

Final Answer: $\theta = 6 \times 10^{-3}$ rad $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q43

Q44.

Solution

Concept — Threshold frequency: The work function relates to threshold frequency by $\phi = h\nu_0$, so $\nu_0 = \frac{\phi}{h}$.

Step 1 — List data: $\phi = 3.3 \times 10^{-19}$ J, $h = 6.6 \times 10^{-34}$ J·s.

Step 2 — Form the ratio: $\nu_0 = \frac{3.3 \times 10^{-19}}{6.6 \times 10^{-34}}$.

Step 3 — Divide the mantissas: $\frac{3.3}{6.6} = 0.5$.

Step 4 — Subtract exponents: $10^{-19-(-34)} = 10^{15}$.

Step 5 — Combine: $\nu_0 = 0.5 \times 10^{15} = 5 \times 10^{14}$ Hz.

Why other options are wrong:

- (A) and (B) carry mantissa or exponent slips.
- (D) is an order of magnitude too high.

Final Answer: $\nu_0 = 5 \times 10^{14}$ Hz $\Rightarrow$ $\boxed{\text{C}}$

Answer: (C) Go Back to Q44

Q45.

Solution

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

Step 1 — List data: $V = 150$ V.

Step 2 — Take the square root: $\sqrt{150} \approx 12.25$.

Step 3 — Divide: $\lambda = \frac{12.27}{12.25}$.

Step 4 — Evaluate: $\lambda \approx 1.0$ Å.

Why other options are wrong:

- (B) and (D) carry power-of-ten or arithmetic slips.

- (C) overestimates by a factor of ten.

Final Answer: $\lambda \approx 1\ \text{Å} \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q45

Q46.

Solution

Concept — Photoelectric stopping potential: Einstein's relation gives $eV_s = h\nu - \phi$, so $V_s = \frac{h}{e}\nu - \frac{\phi}{e}$.

Step 1 — Identify the linear form: This is $V_s = (\text{slope})\nu + (\text{intercept})$.

Step 2 — Read the slope: The coefficient of ν is $\frac{h}{e}$.

Why other options are wrong:

- (A) is the slope of an energy-versus-frequency plot.
- (C) inverts the ratio.
- (D) is (minus) the intercept, not the slope.

Final Answer: Slope $= h/e \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q46

Q47.

Solution

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

Step 1 — Insert $n = 2$**:** $r_2 = 2^2 a_0$.

Step 2 — Square: $2^2 = 4$.

Step 3 — Multiply by a_0**:** $r_2 = 4 \times 0.53 = 2.12\ \text{Å}$.

Why other options are wrong:

- (A) is the ground-state radius.
- (B) uses n instead of n^2.
- (C) uses $n = 3$.

Final Answer: $r_2 = 2.12\ \text{Å} \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q47

Q48.

Solution

Concept — Radioactive decay: After n half-lives, the remaining mass is $m = m_0\left(\frac{1}{2}\right)^n$.

Step 1 — Number of half-lives: $n = \dfrac{15}{5} = 3$.

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

Step 3 — Multiply by initial mass: $m = 80 \times \dfrac{1}{8} = 10$ g.

Why other options are wrong:

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

Final Answer: $m = 10 \text{ g} \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q48

Q49.

Solution

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

Step 1 — List data: $\Delta m = 0.05$ u, energy per u $= 931$ MeV.

Step 2 — Multiply: $E = 0.05 \times 931$.

Step 3 — Evaluate: $E = 46.55 \approx 46.6$ MeV.

Why other options are wrong:

- (B) uses $\Delta m = 0.1$ u.
- (C) and (D) carry arithmetic slips.

Final Answer: $E \approx 46.6 \text{ MeV} \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q49

Q50.

Solution

Concept — Half-wave rectifier: A single diode in series with the load conducts only when forward biased, i.e. during the half of each a.c. cycle when its anode is positive.

Step 1 — Positive half-cycle: Anode positive $\Rightarrow$ diode forward biased $\Rightarrow$ current flows through R_L.

Step 2 — Negative half-cycle: Anode negative $\Rightarrow$ diode reverse biased $\Rightarrow$ no current.

Step 3 — Conclude: The load current is present only during the positive half-cycles, so the output is a pulsating, unidirectional voltage covering only those halves.

Why other options are wrong:

- (A) describes a full-wave rectifier.
- (C) ignores the ripple of a half-wave output.
- (D) is false; current does flow on positive half-cycles.

Final Answer: Output passes only the positive half-cycles $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q50

Answer Key

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