JCECE Physics Sample Paper – 4

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. From Newton's law of gravitation $F = \frac{Gm_1m_2}{r^2}$, the dimensional formula of the universal gravitational constant G is:

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

(B) $[\mathrm{M^{-1}L^2T^{-2}}]$

(C) $[\mathrm{M^{-1}L^3T^{-2}}]$

(D) $[\mathrm{M^{-1}L^3T^{-1}}]$

Q2. Two masses are measured as (20.0 ± 0.4) g and (30.0 ± 0.6) g. The percentage error in their total mass is:

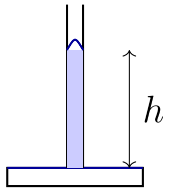
(A) 2%

(B) 1%

(C) 4%

(D) 5%

Q3. Water rises to a height of 4 cm in a clean glass capillary on Earth, as shown. If the same tube is taken to the Moon, where the acceleration due to gravity is $g/6$, the new capillary rise is:



(A) 4 cm

(B) 0.67 cm

(C) 12 cm

(D) 24 cm

Q4. A metal wire has Young's modulus 2×10^{11} N/m^2. The tensile stress required to produce a strain of 0.001 in the wire is:

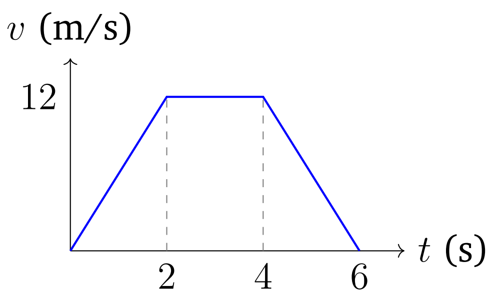
(A) 1×10^{8} N/m^2

(B) 2×10^{8} N/m^2

(C) 2×10^{11} N/m^2

(D) 2×10^{14} N/m^2

Q5. The velocity–time graph of a particle moving in a straight line is shown. The average velocity over the 6 s interval is:



(A) 12 m/s

(B) 8 m/s

(C) 6 m/s

(D) 4 m/s

Q6. A projectile is fired with speed 40 m/s at 60° above the horizontal ($g = 10$ m/s^2). Its speed at the highest point of the trajectory is:

(A) 20 m/s

(B) 40 m/s

(C) $20\sqrt{3}$ m/s

(D) 0 m/s

Q7. Rain is falling vertically with a speed of 10 m/s. A man walks horizontally at 10 m/s. To protect himself, he should hold his umbrella at an angle to the vertical of:

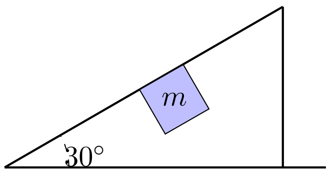
(A) 30°

(B) 60°

(C) 45°

(D) 90°

Q8. A block is released from rest at the top of a smooth incline of angle 30° and length 4 m, as shown ($g = 10$ m/s^2). The time it takes to reach the bottom is:



(A) 0.8 s

(B) 1.0 s

(C) 1.26 s

(D) 2.0 s

Q9. A block of mass 5 kg moves on a horizontal floor with coefficient of kinetic friction 0.2 ($g = 10$ m/s^2). The kinetic friction force opposing its motion is:

(A) 50 N

(B) 25 N

(C) 10 N

(D) 5 N

Q10. A stone of mass 0.5 kg tied to a string of length 1 m is whirled in a vertical circle. At the topmost point its speed is 5 m/s ($g = 10$ m/s^2). The tension in the string at the top is:

(A) 5 N

(B) 12.5 N

(C) 17.5 N

(D) 7.5 N

Q11. A block of mass 2 kg is moved 5 m up a frictionless incline of angle $30°$ ($g = 10$ m/s^2). The work done against gravity is:

(A) 20 J

(B) 25 J

(C) 100 J

(D) 50 J

Q12. A constant force does 600 J of work on a body in 20 s. The average power developed is:

(A) 20 W

(B) 30 W

(C) 60 W

(D) 120 W

Q13. A ball dropped from a height of 5 m rebounds to a height of 1.25 m after striking the floor. The coefficient of restitution between ball and floor is:

(A) 0.5

(B) 0.25

(C) 0.75

(D) 0.4

Q14. A skater spinning at 2 rev/s pulls her arms in, reducing her moment of inertia to one-third of its initial value. Her new angular speed is:

(A) 2 rev/s

(B) 6 rev/s

(C) 3 rev/s

(D) 0.67 rev/s

Q15. The acceleration due to gravity at the Earth's surface is g. At a height equal to the Earth's radius R above the surface, its value is:

(A) $g/2$

(B) $g/3$

(C) $g/4$

(D) $g/9$

Q16. A Carnot engine operates between a source at 400 K and a sink at 300 K. Its efficiency is:

(A) 75%

(B) 33%

(C) 50%

(D) 25%

Q17. At constant volume, 80 J of heat is supplied to a gas. The change in its internal energy is:

(A) 80 J

(B) 0 J

(C) 40 J

(D) 160 J

Q18. At the same temperature, the ratio of the rms speed of hydrogen molecules ($M = 2$) to that of oxygen molecules ($M = 32$) is:

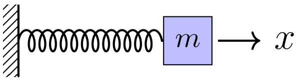
(A) $1:4$

(B) $4:1$

(C) $1:16$

(D) $16:1$

Q19. A simple pendulum of length 1 m oscillates with small amplitude as shown ($g = \pi^2$ m/s^2). Its time period is:



(A) 1 s

(B) 4 s

(C) 2 s

(D) π s

Q20. For a particle executing SHM of amplitude A, its kinetic energy equals its potential energy at displacement:

(A) A

(B) $A/4$

(C) $A/2$

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

Q21. A stretched string fixed at both ends has a fundamental frequency of 100 Hz. The frequency of its third harmonic is:

(A) 100 Hz

(B) 200 Hz

(C) 150 Hz

(D) 300 Hz

Q22. A source of sound of frequency 500 Hz moves away from a stationary observer at 50 m/s. Taking the speed of sound as 350 m/s, the observed frequency is:

(A) 437.5 Hz

(B) 500 Hz

(C) 583 Hz

(D) 400 Hz

Q23. Two charges of $+2\,\mu$C each are placed at two corners of an equilateral triangle of side 0.1 m. The magnitude of the net force on a $+2\,\mu$C charge at the third corner ($k = 9 \times 10^9$ N·m^2/C^2) is:

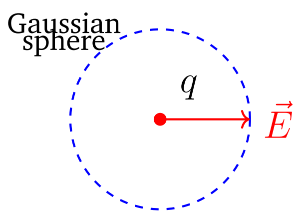
(A) 3.6 N

(B) 6.2 N

(C) 7.2 N

(D) 1.8 N

Q24. A point charge q is enclosed by a Gaussian sphere of radius R, as shown. If the radius of the sphere is doubled to $2R$ (the charge unchanged), the total electric flux through the surface:



(A) Becomes one-fourth

(B) Becomes double

(C) Remains the same

(D) Becomes one-half

Q25. An electric dipole of moment 4×10^{-9} C·m is placed in a uniform field of 5×10^{4} N/C, aligned parallel to the field. Its potential energy is:

(A) $+2 \times 10^{-4}$ J

(B) Zero

(C) $+1 \times 10^{-4}$ J

(D) -2×10^{-4} J

Q26. A parallel-plate capacitor of air capacitance $4\ \mu$F has a dielectric slab of constant $K = 3$ inserted so that it completely fills the gap. The new capacitance is:

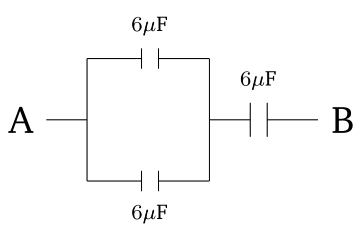
(A) $12\ \mu$F

(B) $4\ \mu$F

(C) $1.33\ \mu$F

(D) $7\ \mu$F

Q27. In the network shown, two $6\ \mu$F capacitors are connected in parallel, and this combination is joined in series with a $6\ \mu$F capacitor. The equivalent capacitance between A and B is:



(A) $18\ \mu$F

(B) $4\ \mu$F

(C) $12\ \mu$F

(D) $9\ \mu$F

Q28. A wire of length 2 m and cross-sectional area 0.5 mm^2 has a resistance of $4\,\Omega$. The resistivity of the material is:

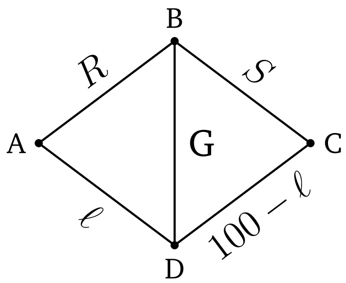
(A) $1 \times 10^{-6}\,\Omega \cdot \text{m}$

(B) $2 \times 10^{-6}\,\Omega \cdot \text{m}$

(C) $4 \times 10^{-6}\,\Omega \cdot \text{m}$

(D) $0.5 \times 10^{-6}\,\Omega \cdot \text{m}$

Q29. In the metre-bridge shown, a resistance $R = 4\,\Omega$ in the left gap is balanced by a resistance $S = 6\,\Omega$ in the right gap. The balancing length ℓ measured from the left end is:



(A) 50 cm

(B) 40 cm

(C) 60 cm

(D) 66.7 cm

Q30. Two resistors of $6\,\Omega$ and $3\,\Omega$ are connected in parallel. Their equivalent resistance is:

(A) $2\,\Omega$

(B) $9\,\Omega$

(C) $4.5\,\Omega$

(D) $1.5\,\Omega$

Q31. An electric bulb is rated 100 W at 200 V. Its resistance under operating conditions is:

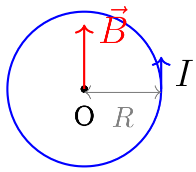
(A) $200\,\Omega$

(B) $100\,\Omega$

(C) $800\,\Omega$

(D) $400\,\Omega$

Q32. A circular loop of radius 0.1 m carries a current of 5 A as shown ($\mu_0 = 4\pi \times 10^{-7}$ T·m/A). The magnetic field at its centre is:



(A) 1.57×10^{-5} T

(B) 2.0×10^{-5} T

(C) 6.28×10^{-5} T

(D) 3.14×10^{-5} T

Q33. A proton of mass 1.6×10^{-27} kg and charge 1.6×10^{-19} C moves at 2×10^5 m/s perpendicular to a magnetic field of 0.5 T. The radius of its circular path is:

(A) 2×10^{-3} m

(B) 4×10^{-3} m

(C) 8×10^{-3} m

(D) 1×10^{-3} m

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

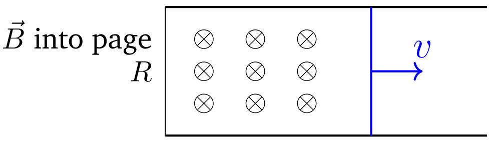
(A) 1.26×10^{-4} H

(B) 6.28×10^{-4} H

(C) 2.51×10^{-4} H

(D) 5.0×10^{-4} H

Q35. A conducting rod of length 0.5 m slides at 4 m/s perpendicular to a field of 0.5 T across rails closed by a resistance of $1\,\Omega$, as shown. The power dissipated in the resistor is:



(A) 1 W

(B) 2 W

(C) 0.5 W

(D) 4 W

Q36. A capacitor of $50\,\mu$F is connected to an AC source of angular frequency 200 rad/s. Its capacitive reactance is:

(A) $200\,\Omega$

(B) $50\,\Omega$

(C) $400\,\Omega$

(D) $100\,\Omega$

Q37. An ideal step-up transformer has 200 turns in the primary and 1000 turns in the secondary. If the primary voltage is 230 V, the secondary voltage is:

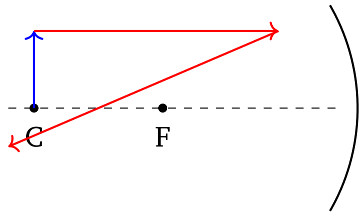
(A) 46 V

(B) 1150 V

(C) 230 V

(D) 2300 V

Q38. A concave mirror of focal length 10 cm forms an image of an object placed 15 cm in front of it, as shown. The image distance is:



(A) -30 cm

(B) -15 cm

(C) -6 cm

(D) $+30$ cm

Q39. An object lies at the bottom of a tank of water (refractive index $4/3$) at a real depth of 16 cm. Viewed from directly above, its apparent depth is:

(A) 16 cm

(B) 21.3 cm

(C) 12 cm

(D) 8 cm

Q40. A plano-convex lens has its curved surface of radius 20 cm and is made of glass of refractive index 1.5. Its focal length is:

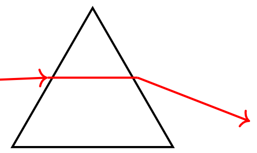
(A) 20 cm

(B) 10 cm

(C) 60 cm

(D) 40 cm

Q41. A thin prism produces a minimum deviation of $4°$ for a ray passing through it. If the material has refractive index 1.5, as shown, the refracting angle of the prism is:



(A) $4°$

(B) $8°$

(C) $6°$

(D) $2°$

Q42. In a Young's double-slit experiment, the fringe width is 0.6 mm. The distance of the third bright fringe from the central maximum is:

(A) 0.6 mm

(B) 1.2 mm

(C) 1.8 mm

(D) 3.0 mm

Q43. In single-slit diffraction, light of wavelength 600 nm passes through a slit of width 0.2 mm and the screen is 1 m away. The width of the central maximum on the screen is:

(A) 3 mm

(B) 1.5 mm

(C) 9 mm

(D) 6 mm

Q44. Light of energy 5 eV falls on a metal of work function 3 eV. The stopping potential for the emitted photoelectrons is:

(A) 5 V

(B) 2 V

(C) 8 V

(D) 3 V

Q45. A particle has a momentum of 3.3×10^{-24} kg·m/s ($h = 6.6 \times 10^{-34}$ J·s). Its de Broglie wavelength is:

(A) 1×10^{-10} m

(B) 4×10^{-10} m

(C) 2×10^{-10} m

(D) 5×10^{-10} m

Q46. In Bohr's model, the energy of the ground state of the hydrogen atom is -13.6 eV. The energy required to ionise a hydrogen atom from its ground state is:

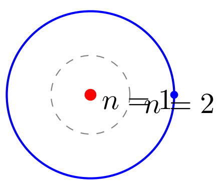
(A) 13.6 eV

(B) 3.4 eV

(C) 27.2 eV

(D) 6.8 eV

Q47. In Bohr's model of hydrogen, the energy of the nth level is $E_n = -\dfrac{13.6}{n^2}$ eV. The Bohr orbits are shown; the energy of the second orbit ($n = 2$) is:



(A) -13.6 eV

(B) -3.4 eV

(C) -6.8 eV

(D) -1.51 eV

Q48. A radioactive nuclide has a decay constant of 0.0693 per year. Its half-life is approximately:

(A) 5 years

(B) 20 years

(C) 10 years

(D) 14.4 years

Q49. In a nuclear reaction, a mass of 2×10^{-30} kg is converted entirely into energy ($c = 3 \times 10^8$ m/s). The energy released is:

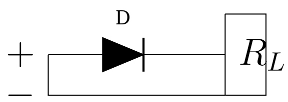
(A) 6×10^{-22} J

(B) 9×10^{-14} J

(C) 6×10^{-14} J

(D) 1.8×10^{-13} J

Q50. In the circuit shown, a silicon p–n junction diode D is connected to a battery such that its n-side is at a higher potential than its p-side. The diode is therefore:



(A) Forward biased and conducts a large current

(B) Destroyed immediately

(C) Reverse biased and conducts only a tiny current

(D) Acting as a perfect conductor

Detailed Solutions

Q1.

Solution

Concept — Dimensions from a physical law: Rearrange the law to isolate G, then substitute the dimensions of force, mass and length. $[F] = \mathrm{MLT^{-2}}$, $[m] = \mathrm{M}$, $[r] = \mathrm{L}$.

Step 1 — Make G the subject: $G = \dfrac{Fr^2}{m_1 m_2}$.

Step 2 — Numerator dimensions: $[Fr^2] = \mathrm{MLT^{-2}} \cdot \mathrm{L^2} = \mathrm{ML^3T^{-2}}$.

Step 3 — Denominator dimensions: $[m_1 m_2] = \mathrm{M} \cdot \mathrm{M} = \mathrm{M^2}$.

Step 4 — Divide: $[G] = \dfrac{\mathrm{ML^3T^{-2}}}{\mathrm{M^2}} = \mathrm{M^{-1}L^3T^{-2}}$.

Why other options are wrong:

- (A) has $\mathrm{M^{+1}}$ instead of $\mathrm{M^{-1}}$.
- (B) has $\mathrm{L^2}$, dropping one length factor.
- (D) has $\mathrm{T^{-1}}$, an error in the time power.

Final Answer: $[G] = [\mathrm{M^{-1}L^3T^{-2}}] \Rightarrow \boxed{\mathrm{C}}$

Answer: (C) Go Back to Q1

Q2.

Solution

Concept — Error in a sum: When quantities are added, their absolute errors add. The percentage error is (total absolute error)/(total value)×100.

Step 1 — Add the absolute errors: $\Delta m = 0.4 + 0.6 = 1.0$ g.

Step 2 — Add the values: $m = 20.0 + 30.0 = 50.0$ g.

Step 3 — Form the ratio: $\dfrac{\Delta m}{m} = \dfrac{1.0}{50.0} = 0.02$.

Step 4 — Convert to percent: $0.02 \times 100 = 2\%$.

Why other options are wrong:

- (B) uses only one error term.
- (C) doubles the result.
- (D) divides by a wrong total.

Final Answer: Percentage error $= 2\% \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q2

Q3.

Solution

Concept — Capillary rise and gravity: $h = \dfrac{2T\cos\theta}{r\rho g}$, so for fixed T, r, ρ and θ, $h \propto \dfrac{1}{g}$.

Step 1 — Write the proportionality: $\dfrac{h_{\text{moon}}}{h_{\text{earth}}} = \dfrac{g_{\text{earth}}}{g_{\text{moon}}}$.

Step 2 — Insert $g_{\text{moon}} = g/6$: $\dfrac{g_{\text{earth}}}{g_{\text{moon}}} = \dfrac{g}{g/6} = 6$.

Step 3 — Solve for the new rise: $h_{\text{moon}} = 6 \times h_{\text{earth}} = 6 \times 4$.

Step 4 — Evaluate: $h_{\text{moon}} = 24$ cm.

Why other options are wrong:

- (A) assumes gravity has no effect.
- (B) divides by 6 instead of multiplying.
- (C) uses a factor of 3.

Final Answer: $h_{\text{moon}} = 24\text{ cm} \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q3

Q4.

Solution

Concept — Stress, strain and Young's modulus: $Y = \dfrac{\text{stress}}{\text{strain}}$, so stress $= Y \times$ strain.

Step 1 — List data: $Y = 2 \times 10^{11}\ \text{N/m}^2$, strain $= 0.001 = 1 \times 10^{-3}$.

Step 2 — Multiply: stress $= 2 \times 10^{11} \times 1 \times 10^{-3}$.

Step 3 — Combine powers of ten: $10^{11} \times 10^{-3} = 10^{8}$.

Step 4 — Evaluate: stress $= 2 \times 10^{8}\ \text{N/m}^2$.

Why other options are wrong:

- (A) halves the value.
- (C) forgets to multiply by the strain.
- (D) multiplies instead of using the correct power of ten.

Final Answer: Stress $= 2 \times 10^8$ N/m^2 $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q4

Q5.

Solution

Concept — Average velocity: For unidirectional motion, average velocity $= \frac{\text{total displacement}}{\text{total time}}$, where displacement equals the area under the v–t graph.

Step 1 — Identify the shape: Velocity rises from 0 to 12 m/s in 0–2 s, stays 12 m/s in 2–4 s, falls to 0 in 4–6 s. This is a trapezium.

Step 2 — Parallel sides: top $= 4 - 2 = 2$ s, base $= 6$ s.

Step 3 — Area (displacement): $\frac{1}{2}(2+6) \times 12 = \frac{1}{2} \times 8 \times 12 = 48$ m.

Step 4 — Divide by total time: $\bar{v} = \frac{48}{6} = 8$ m/s.

Why other options are wrong:

- (A) quotes the peak velocity, not the average.
- (C) and (D) come from arithmetic slips in the area.

Final Answer: $\bar{v} = 8$ m/s $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q5

Q6.

Solution

Concept — Speed at the top of a projectile: At the highest point the vertical velocity is zero; only the horizontal component $u\cos\theta$ remains.

Step 1 — List data: $u = 40$ m/s, $\theta = 60°$.

Step 2 — Horizontal component: $u\cos 60° = 40 \times 0.5$.

Step 3 — Evaluate: $= 20$ m/s.

Step 4 — State result: The speed at the top is 20 m/s.

Why other options are wrong:

- (B) uses the full launch speed.
- (C) uses $u \sin 60^\circ$ instead of the cosine.
- (D) wrongly assumes the speed vanishes.

Final Answer: Speed at top $= 20$ m/s $\Rightarrow \boxed{A}$

Answer: (A) Go Back to Q6

Q7.

Solution

Concept — Rain–man problem: The umbrella must point along the rain's velocity relative to the man. The angle θ from the vertical satisfies $\tan\theta = \dfrac{v_{\text{man}}}{v_{\text{rain}}}$.

Step 1 — List data: $v_{\text{rain}} = 10$ m/s (vertical), $v_{\text{man}} = 10$ m/s (horizontal).

Step 2 — Form the ratio: $\tan\theta = \dfrac{10}{10} = 1$.

Step 3 — Solve for θ: $\theta = \tan^{-1}(1) = 45^\circ$.

Why other options are wrong:

- (A) is $\tan^{-1}(1/\sqrt{3})$.
- (B) is $\tan^{-1}(\sqrt{3})$.
- (D) would need the man's speed to dominate completely.

Final Answer: $\theta = 45^\circ$ from the vertical $\Rightarrow \boxed{C}$

Answer: (C) Go Back to Q7

Q8.

Solution

Concept — Time to slide down a smooth incline: Acceleration $a = g\sin\theta$; with $u = 0$, $L = \frac{1}{2}at^2$, so $t = \sqrt{\dfrac{2L}{a}}$.

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

Step 2 — Form $2L/a$: $\dfrac{2 \times 4}{5} = \dfrac{8}{5} = 1.6$.

Step 3 — Take square root: $t = \sqrt{1.6}$.

Step 4 — Evaluate: $\sqrt{1.6} \approx 1.26$ s.

Why other options are wrong:

- (A) and (B) come from using a wrong acceleration.
- (D) drops the factor of 2 in the kinematic relation.

Final Answer: $t \approx 1.26$ s $\Rightarrow$ $\boxed{\text{C}}$

Answer: (C) Go Back to Q8

Q9.

Solution

Concept — Kinetic friction: The kinetic friction force on a body sliding on a horizontal surface is $f_k = \mu_k N = \mu_k mg$.

Step 1 — List data: $\mu_k = 0.2$, $m = 5$ kg, $g = 10$ m/s^2.

Step 2 — Normal force: $N = mg = 5 \times 10 = 50$ N.

Step 3 — Multiply by μ_k: $f_k = 0.2 \times 50$.

Step 4 — Evaluate: $f_k = 10$ N.

Why other options are wrong:

- (A) is the normal force N, not the friction.
- (B) uses a wrong coefficient.
- (D) drops a factor of 2.

Final Answer: $f_k = 10$ N $\Rightarrow$ $\boxed{\text{C}}$

Answer: (C) Go Back to Q9

Q10.

Solution

Concept — Vertical circular motion at the top: At the topmost point, $T + mg = \frac{mv^2}{r}$, so $T = \frac{mv^2}{r} - mg$.

Step 1 — List data: $m = 0.5$ kg, $v = 5$ m/s, $r = 1$ m, $g = 10$ m/s^2.

Step 2 — Centripetal term: $\frac{mv^2}{r} = \frac{0.5 \times 25}{1} = 12.5$ N.

Step 3 — Weight term: $mg = 0.5 \times 10 = 5$ N.

Step 4 — Subtract: $T = 12.5 - 5 = 7.5$ N.

Why other options are wrong:

- (A) quotes only the weight.
- (B) forgets to subtract the weight.
- (C) adds the weight instead of subtracting.

Final Answer: $T = 7.5 \text{ N} \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q10

Q11.

Solution

Concept — Work against gravity on an incline: Only the vertical rise matters: $W = mgh$, where $h = L \sin \theta$.

Step 1 — List data: $m = 2$ kg, $g = 10$ m/s^2, $L = 5$ m, $\theta = 30^\circ$.

Step 2 — Vertical height: $h = L \sin 30^\circ = 5 \times 0.5 = 2.5$ m.

Step 3 — Compute work: $W = mgh = 2 \times 10 \times 2.5$.

Step 4 — Evaluate: $W = 50$ J.

Why other options are wrong:

- (A) uses a wrong height.
- (B) mis-multiplies.
- (C) uses the full length 5 m as the height.

Final Answer: $W = 50 \text{ J} \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q11

Q12.

Solution

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

Step 1 — List data: $W = 600$ J, $t = 20$ s.

Step 2 — Form the ratio: $P = \dfrac{600}{20}$.

Step 3 — Evaluate: $P = 30$ W.

Why other options are wrong:

- (A) and (C) use wrong arithmetic.
- (D) divides by half the time.

Final Answer: $P = 30 \text{ W} \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q12

Q13.

Solution

Concept — Coefficient of restitution from bounce heights: For a ball bouncing off a fixed floor, $e = \sqrt{\dfrac{h_{\text{rebound}}}{h_{\text{drop}}}}$.

Step 1 — List data: $h_{\text{drop}} = 5$ m, $h_{\text{rebound}} = 1.25$ m.

Step 2 — Form the ratio: $\dfrac{h_{\text{rebound}}}{h_{\text{drop}}} = \dfrac{1.25}{5} = 0.25$.

Step 3 — Take the square root: $e = \sqrt{0.25}$.

Step 4 — Evaluate: $e = 0.5$.

Why other options are wrong:

- (B) forgets the square root (uses the ratio directly).
- (C) and (D) come from arithmetic slips.

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

Answer: (A) Go Back to Q13

Q14.

Solution

Concept — Conservation of angular momentum: With no external torque, $I_1\omega_1 = I_2\omega_2$, so $\omega_2 = \omega_1 \dfrac{I_1}{I_2}$.

Step 1 — List data: $\omega_1 = 2$ rev/s, $I_2 = \frac{1}{3} I_1$.

Step 2 — Form the inertia ratio: $\dfrac{I_1}{I_2} = \dfrac{I_1}{I_1/3} = 3$.

Step 3 — Multiply: $\omega_2 = 2 \times 3$.

Step 4 — Evaluate: $\omega_2 = 6$ rev/s.

Why other options are wrong:

- (A) ignores the change in inertia.
- (C) uses a factor of 1.5.
- (D) divides instead of multiplying.

Final Answer: $\omega_2 = 6$ rev/s $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q14

Q15.

Solution

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

Step 1 — Insert $h = R$: $\frac{R}{R+R} = \frac{R}{2R} = \frac{1}{2}$.

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

Step 3 — Multiply by g: $g_h = \frac{g}{4}$.

Why other options are wrong:

- (A) forgets to square the ratio.
- (B) uses a wrong ratio.
- (D) corresponds to $h = 2R$.

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

Answer: (C) 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: $\frac{T_C}{T_H} = \frac{300}{400}$.

Step 2 — Simplify: $\frac{300}{400} = 0.75$.

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) quotes the ratio T_C/T_H as a percent.
- (B) and (C) use wrong temperature ratios.

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

Answer: (D) Go Back to Q16

Q17.

Solution

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

Step 1 — Identify the process: Volume is constant, so $\Delta V = 0$.

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

Step 3 — Apply first law: $\Delta U = Q - W = 80 - 0$.

Step 4 — Evaluate: $\Delta U = 80$ J.

Why other options are wrong:

- (B) wrongly assumes all heat becomes work.
- (C) splits the heat in half.
- (D) doubles the heat.

Final Answer: $\Delta U = 80 \text{ J} \Rightarrow \boxed{A}$

Answer: (A) Go Back to Q17

Q18.

Solution

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

Step 1 — Insert molar masses: $\frac{M_O}{M_H} = \frac{32}{2} = 16$.

Step 2 — Take the square root: $\sqrt{16} = 4$.

Step 3 — State the ratio: $\frac{v_H}{v_O} = 4$, i.e. $4 : 1$.

Why other options are wrong:

- (A) inverts the ratio.
- (C) forgets the square root.
- (D) inverts and forgets the square 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: $T = 2\pi\sqrt{\frac{L}{g}}$.

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

Step 2 — Form L/g**:** $\frac{1}{\pi^2}$.

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 2π factor.
- (B) squares instead of taking the root.
- (D) keeps a stray π.

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

Answer: (C) Go Back to Q19

Q20.

Solution

Concept — KE and PE in SHM: $U = \frac{1}{2}kx^2$ and $KE = \frac{1}{2}k(A^2 - x^2)$. Setting $KE = U$ gives $A^2 - x^2 = x^2$.

Step 1 — Set the energies equal: $\frac{1}{2}k(A^2 - x^2) = \frac{1}{2}kx^2$.

Step 2 — Cancel and rearrange: $A^2 - x^2 = x^2 \Rightarrow A^2 = 2x^2$.

Step 3 — Solve for x^2: $x^2 = \dfrac{A^2}{2}$.

Step 4 — Take the square root: $x = \dfrac{A}{\sqrt{2}}$.

Why other options are wrong:

- (A) holds only when $KE = 0$.
- (B) and (C) do not satisfy $A^2 = 2x^2$.

Final Answer: $x = A/\sqrt{2} \Rightarrow \boxed{D}$

Answer: (D) Go Back to Q20

Q21.

Solution

Concept — Harmonics of a string: The nth harmonic frequency is $f_n = nf_1$, where f_1 is the fundamental.

Step 1 — List data: $f_1 = 100$ Hz, $n = 3$.

Step 2 — Multiply: $f_3 = 3 \times 100$.

Step 3 — Evaluate: $f_3 = 300$ Hz.

Why other options are wrong:

- (A) is the fundamental.
- (B) is the second harmonic.
- (C) is 1.5 times the fundamental, not an allowed harmonic.

Final Answer: $f_3 = 300 \text{ Hz} \Rightarrow \boxed{D}$

Answer: (D) Go Back to Q21

Q22.

Solution

Concept — Doppler effect, source receding: $f' = f\dfrac{v}{v+v_s}$ when the source moves away from a stationary observer.

Step 1 — List data: $f = 500$ Hz, $v = 350$ m/s, $v_s = 50$ m/s.

Step 2 — Denominator: $v + v_s = 350 + 50 = 400$ m/s.

Step 3 — Form the ratio: $\dfrac{v}{v+v_s} = \dfrac{350}{400} = 0.875$.

Step 4 — Multiply by f: $f' = 500 \times 0.875 = 437.5$ Hz.

Why other options are wrong:

- (B) ignores the source motion.
- (C) uses $v - v_s$ (approaching case).
- (D) is a rounding error.

Final Answer: $f' = 437.5 \text{ Hz} \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q22

Q23.

Solution

Concept — Net force from two equal charges at $60°$: Each pair force has equal magnitude F; the two forces act at $60°$ to each other, so the resultant is $F_{\text{net}} = \sqrt{F^2 + F^2 + 2F^2\cos 60°} = F\sqrt{3}$.

Step 1 — Single-pair force: $F = \dfrac{kq^2}{r^2} = \dfrac{9 \times 10^9 \times (2 \times 10^{-6})^2}{(0.1)^2}$.

Step 2 — Square the charge: $(2 \times 10^{-6})^2 = 4 \times 10^{-12}$.

Step 3 — Numerator: $9 \times 10^9 \times 4 \times 10^{-12} = 36 \times 10^{-3} = 0.036$.

Step 4 — Divide by $r^2 = 0.01$: $F = \dfrac{0.036}{0.01} = 3.6$ N.

Step 5 — Resultant of two forces at $60°$: $F_{\text{net}} = F\sqrt{3} = 3.6 \times 1.732 \approx 6.2$ N.

Why other options are wrong:

- (A) is just one pair force F.
- (C) wrongly adds the two forces arithmetically.
- (D) halves the single-pair force.

Final Answer: $F_{\text{net}} \approx 6.2$ N $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q23

Q24.

Solution

Concept — Gauss's law: The total flux through a closed surface depends only on the enclosed charge: $\Phi = \frac{q_{enc}}{\varepsilon_0}$. The size or shape of the surface does not matter.

Step 1 — Identify what changes: Only the radius changes; the enclosed charge q is unchanged.

Step 2 — Apply the law: $\Phi = \frac{q}{\varepsilon_0}$ regardless of the radius.

Step 3 — Conclude: The flux remains the same.

Why other options are wrong:

- (A), (B), (D) wrongly tie the flux to the surface area or radius.

Final Answer: The flux remains the same $\Rightarrow$ $\boxed{\text{C}}$

Answer: (C) Go Back to Q24

Q25.

Solution

Concept — Potential energy of a dipole: $U = -pE\cos\theta$, where θ is the angle between the dipole moment and the field. When aligned parallel, $\theta = 0°$.

Step 1 — List data: $p = 4 \times 10^{-9}$ C·m, $E = 5 \times 10^{4}$ N/C, $\theta = 0°$.

Step 2 — Evaluate $\cos\theta$: $\cos 0° = 1$.

Step 3 — Product pE: $4 \times 10^{-9} \times 5 \times 10^{4} = 20 \times 10^{-5} = 2 \times 10^{-4}$.

Step 4 — Apply the sign: $U = -pE\cos 0° = -2 \times 10^{-4}$ J.

Why other options are wrong:

- (A) drops the negative sign (this is the maximum, antiparallel, energy).

- (B) corresponds to $\theta = 90^\circ$.
- (C) uses a wrong product.

Final Answer: $U = -2 \times 10^{-4}$ J $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q25

Q26.

Solution

Concept — Dielectric filling the whole gap: When a dielectric of constant K completely fills the capacitor, the capacitance becomes $C' = KC_0$.

Step 1 — List data: $C_0 = 4\,\mu$F, $K = 3$.

Step 2 — Multiply: $C' = 3 \times 4$.

Step 3 — Evaluate: $C' = 12\,\mu$F.

Why other options are wrong:

- (B) ignores the dielectric.
- (C) divides by K instead of multiplying.
- (D) adds K instead of multiplying.

Final Answer: $C' = 12\,\mu\text{F} \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q26

Q27.

Solution

Concept — Parallel then series: Two equal capacitors C in parallel give $2C$; this in series with a third C gives $C_{eq} = \dfrac{(2C)(C)}{2C + C}$.

Step 1 — Parallel pair: $C_p = 6 + 6 = 12\,\mu$F.

Step 2 — Series with the third $6\,\mu$F: $\dfrac{1}{C_{eq}} = \dfrac{1}{12} + \dfrac{1}{6}$.

Step 3 — Common denominator: $\dfrac{1}{12} + \dfrac{2}{12} = \dfrac{3}{12} = \dfrac{1}{4}$.

Step 4 — Invert: $C_{eq} = 4\,\mu$F.

Why other options are wrong:

- (A) adds all three in parallel.
- (C) gives only the parallel pair.
- (D) mishandles the series step.

Final Answer: $C_{eq} = 4\,\mu\text{F} \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q27

Q28.

Solution

Concept — Resistivity: $R = \dfrac{\rho L}{A}$, so $\rho = \dfrac{RA}{L}$.

Step 1 — List data: $R = 4\,\Omega$, $A = 0.5\text{ mm}^2 = 0.5 \times 10^{-6}\text{ m}^2$, $L = 2$ m.

Step 2 — Numerator RA: $4 \times 0.5 \times 10^{-6} = 2 \times 10^{-6}$.

Step 3 — Divide by L: $\rho = \dfrac{2 \times 10^{-6}}{2}$.

Step 4 — Evaluate: $\rho = 1 \times 10^{-6}\,\Omega{\cdot}\text{m}$.

Why other options are wrong:

- (B) forgets to divide by the length.
- (C) doubles the result.
- (D) halves the result.

Final Answer: $\rho = 1 \times 10^{-6}\,\Omega{\cdot}\text{m} \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q28

Q29.

Solution

Concept — Metre-bridge balance: At balance $\dfrac{R}{S} = \dfrac{\ell}{100 - \ell}$, where ℓ is the balancing length from the left end.

Step 1 — Insert the resistances: $\dfrac{R}{S} = \dfrac{4}{6} = \dfrac{2}{3}$.

Step 2 — Set up the balance: $\dfrac{\ell}{100 - \ell} = \dfrac{2}{3}$.

Step 3 — Cross-multiply: $3\ell = 2(100 - \ell) = 200 - 2\ell$.

Step 4 — Solve: $5\ell = 200 \Rightarrow \ell = 40$ cm.

Why other options are wrong:

- (A) assumes equal arms.
- (C) corresponds to $R/S = 3/2$.
- (D) uses a wrong ratio.

Final Answer: $\ell = 40$ cm $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q29

Q30.

Solution

Concept — Resistors in parallel: $\dfrac{1}{R_{eq}} = \dfrac{1}{R_1} + \dfrac{1}{R_2}$, i.e. $R_{eq} = \dfrac{R_1 R_2}{R_1 + R_2}$.

Step 1 — List data: $R_1 = 6\,\Omega$, $R_2 = 3\,\Omega$.

Step 2 — Product: $R_1 R_2 = 6 \times 3 = 18$.

Step 3 — Sum: $R_1 + R_2 = 6 + 3 = 9$.

Step 4 — Divide: $R_{eq} = \dfrac{18}{9} = 2\,\Omega$.

Why other options are wrong:

- (B) adds the resistors as if in series.
- (C) averages them.
- (D) uses a wrong ratio.

Final Answer: $R_{eq} = 2\,\Omega \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q30

Q31.

Solution

Concept — Resistance from power rating: $P = \dfrac{V^2}{R}$, so $R = \dfrac{V^2}{P}$.

Step 1 — List data: $V = 200$ V, $P = 100$ W.

Step 2 — Square the voltage: $V^2 = (200)^2 = 40000$.

Step 3 — Divide by power: $R = \dfrac{40000}{100}$.

Step 4 — Evaluate: $R = 400\,\Omega$.

Why other options are wrong:

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

Final Answer: $R = 400\,\Omega \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q31

Q32.

Solution

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

Step 1 — List data: $\mu_0 = 4\pi \times 10^{-7}$, $I = 5$ A, $R = 0.1$ m.

Step 2 — Numerator: $\mu_0 I = 4\pi \times 10^{-7} \times 5 = 20\pi \times 10^{-7}$.

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

Step 4 — Divide: $B = \dfrac{20\pi \times 10^{-7}}{0.2} = 100\pi \times 10^{-7}$.

Step 5 — Evaluate: $100\pi \times 10^{-7} \approx 3.14 \times 10^{-5}$ T.

Why other options are wrong:

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

Final Answer: $B \approx 3.14 \times 10^{-5}\ \text{T} \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q32

Q33.

Solution

Concept — Radius of circular motion in a magnetic field: The magnetic force provides the centripetal force, giving $r = \dfrac{mv}{qB}$.

Step 1 — List data: $m = 1.6 \times 10^{-27}$ kg, $v = 2 \times 10^5$ m/s, $q = 1.6 \times 10^{-19}$ C, $B = 0.5$ T.

Step 2 — Numerator mv: $1.6 \times 10^{-27} \times 2 \times 10^5 = 3.2 \times 10^{-22}$.

Step 3 — Denominator qB: $1.6 \times 10^{-19} \times 0.5 = 0.8 \times 10^{-19} = 8 \times 10^{-20}$.

Step 4 — Divide: $r = \dfrac{3.2 \times 10^{-22}}{8 \times 10^{-20}} = 0.4 \times 10^{-2} = 4 \times 10^{-3}$ m.

Why other options are wrong:

- (A) and (D) carry power-of-ten errors.
- (C) doubles the result.

Final Answer: $r = 4 \times 10^{-3}$ m $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q33

Q34.

Solution

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

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

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

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

Step 4 — Multiply mantissas and powers: $4 \times 2.5 \times 4 = 40$; powers $10^{-7+5-4} = 10^{-6}$; gives $40\pi \times 10^{-6}$.

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

Why other options are wrong:

- (A) and (B) carry factor or power errors.
- (D) over-rounds π.

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

Answer: (C) Go Back to Q34

Q35.

Solution

Concept — Power dissipated by a sliding rod: The motional EMF is $\varepsilon = BLv$ and the power dissipated in the closing resistance is $P = \dfrac{\varepsilon^2}{R}$.

Step 1 — List data: $B = 0.5$ T, $L = 0.5$ m, $v = 4$ m/s, $R = 1\,\Omega$.

Step 2 — EMF: $\varepsilon = BLv = 0.5 \times 0.5 \times 4 = 1.0$ V.

Step 3 — Square the EMF: $\varepsilon^2 = (1.0)^2 = 1.0$ V^2.

Step 4 — Divide by R: $P = \frac{1.0}{1} = 1$ W.

Why other options are wrong:

- (B) doubles the value.
- (C) halves it.
- (D) forgets to square the EMF before applying it.

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

Answer: (A) Go Back to Q35

Q36.

Solution

Concept — Capacitive reactance: $X_C = \frac{1}{\omega C}$.

Step 1 — List data: $C = 50\,\mu\text{F} = 50 \times 10^{-6}$ F, $\omega = 200$ rad/s.

Step 2 — Form ωC: $200 \times 50 \times 10^{-6} = 10^4 \times 10^{-6} = 10^{-2}$.

Step 3 — Take the reciprocal: $X_C = \frac{1}{10^{-2}}$.

Step 4 — Evaluate: $X_C = 100\,\Omega$.

Why other options are wrong:

- (A) and (B) carry arithmetic slips in ωC.
- (C) doubles the value.

Final Answer: $X_C = 100\,\Omega \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q36

Q37.

Solution

Concept — Transformer turns 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: $V_s = V_p \times 5 = 230 \times 5$.

Step 3 — Evaluate: $V_s = 1150$ V.

Why other options are wrong:

- (A) steps down instead of up.
- (C) ignores the turns ratio.
- (D) uses a ratio of 10.

Final Answer: $V_s = 1150$ V $\Rightarrow \boxed{B}$

Answer: (B) Go Back to Q37

Q38.

Solution

Concept — Mirror formula: $\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$. For a concave mirror, $f = -10$ cm and $u = -15$ cm.

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

Step 2 — Substitute: $\frac{1}{v} = \frac{1}{-10} - \frac{1}{-15}$.

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

Step 4 — Invert: $v = -30$ cm.

Why other options are wrong:

- (B) uses f as the answer.
- (C) mishandles the fraction.
- (D) drops the sign convention.

Final Answer: $v = -30$ cm (real image) $\Rightarrow \boxed{A}$

Answer: (A) Go Back to Q38

Q39.

Solution

Concept — Apparent depth: apparent depth $= \dfrac{\text{real depth}}{n}$.

Step 1 — List data: real depth $= 16$ cm, $n = \dfrac{4}{3}$.

Step 2 — Divide: apparent depth $= \dfrac{16}{4/3} = 16 \times \dfrac{3}{4}$.

Step 3 — Evaluate: $= 12$ cm.

Why other options are wrong:

- (A) ignores refraction.
- (B) multiplies by n instead of dividing.
- (D) divides by 2.

Final Answer: Apparent depth $= 12$ cm $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q39

Q40.

Solution

Concept — Lens maker for a plano-convex lens: $\dfrac{1}{f} = (n-1)\left(\dfrac{1}{R_1} - \dfrac{1}{R_2}\right)$. For a plano-convex lens one surface is flat ($R = \infty$) and the other has radius R.

Step 1 — Insert the radii: $\dfrac{1}{R_1} - \dfrac{1}{R_2} = \dfrac{1}{20} - \dfrac{1}{\infty} = \dfrac{1}{20}$.

Step 2 — Substitute $n = 1.5$: $\dfrac{1}{f} = (1.5 - 1) \times \dfrac{1}{20}$.

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

Step 4 — Multiply: $\dfrac{1}{f} = 0.5 \times \dfrac{1}{20} = \dfrac{1}{40}$.

Step 5 — Invert: $f = 40$ cm.

Why other options are wrong:

- (A) treats both surfaces as curved (factor of 2).
- (B) and (C) come from arithmetic slips.

Final Answer: $f = 40$ cm $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q40

Q41.

Solution

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

Step 1 — List data: $\delta = 4^\circ$, $n = 1.5$.

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

Step 3 — Divide: $A = \frac{4^\circ}{0.5}$.

Step 4 — Evaluate: $A = 8^\circ$.

Why other options are wrong:

- (A) takes $A = \delta$, ignoring $(n-1)$.
- (C) uses a wrong factor.
- (D) multiplies by 0.5 instead of dividing.

Final Answer: $A = 8^\circ \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q41

Q42.

Solution

Concept — Position of a bright fringe: The nth bright fringe lies at $y_n = n\beta$ from the central maximum, where β is the fringe width.

Step 1 — List data: $\beta = 0.6$ mm, $n = 3$.

Step 2 — Multiply: $y_3 = 3 \times 0.6$.

Step 3 — Evaluate: $y_3 = 1.8$ mm.

Why other options are wrong:

- (A) is the first fringe.
- (B) is the second fringe.
- (D) corresponds to $n = 5$.

Final Answer: $y_3 = 1.8 \text{ mm} \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q42

Q43.

Solution

Concept — Width of central maximum: The central maximum spans from the first minimum on one side to the other, giving width $W = \frac{2\lambda D}{a}$.

Step 1 — List data: $\lambda = 600$ nm $= 6 \times 10^{-7}$ m, $D = 1$ m, $a = 0.2$ mm $= 2 \times 10^{-4}$ m.

Step 2 — Numerator: $2\lambda D = 2 \times 6 \times 10^{-7} \times 1 = 1.2 \times 10^{-6}$.

Step 3 — Divide by a: $W = \frac{1.2 \times 10^{-6}}{2 \times 10^{-4}}$.

Step 4 — Evaluate: $W = 0.6 \times 10^{-2} = 6 \times 10^{-3}$ m $= 6$ mm.

Why other options are wrong:

- (A) gives the half-width (drops the factor 2).
- (B) uses a wrong slit width.
- (C) carries a power-of-ten error.

Final Answer: $W = 6$ mm $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q43

Q44.

Solution

Concept — Stopping potential: Einstein's equation gives $eV_s = E_{\text{photon}} - \phi$, so $V_s = \frac{E - \phi}{e}$. With energies in eV, V_s in volts equals the numerical value of $(E - \phi)$ in eV.

Step 1 — List data: $E = 5$ eV, $\phi = 3$ eV.

Step 2 — Maximum KE: $KE_{\text{max}} = E - \phi = 5 - 3 = 2$ eV.

Step 3 — Relate to stopping potential: $eV_s = 2$ eV, so $V_s = 2$ V.

Why other options are wrong:

- (A) ignores the work function.
- (C) adds the energies.
- (D) uses only the work function.

Final Answer: $V_s = 2$ V $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q44

Q45.

Solution

Concept — de Broglie wavelength: $\lambda = \dfrac{h}{p}$.

Step 1 — List data: $h = 6.6 \times 10^{-34}$ J·s, $p = 3.3 \times 10^{-24}$ kg·m/s.

Step 2 — Form the ratio: $\lambda = \dfrac{6.6 \times 10^{-34}}{3.3 \times 10^{-24}}$.

Step 3 — Divide the mantissas: $\dfrac{6.6}{3.3} = 2$.

Step 4 — Subtract the exponents: $10^{-34-(-24)} = 10^{-10}$.

Step 5 — Combine: $\lambda = 2 \times 10^{-10}$ m.

Why other options are wrong:

- (A) halves the value.
- (B) and (D) carry mantissa errors.

Final Answer: $\lambda = 2 \times 10^{-10}$ m $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q45

Q46.

Solution

Concept — Ionisation energy: The ionisation energy is the energy needed to remove the electron from the ground state to infinity, i.e. $E_\infty - E_1 = 0 - (-13.6) = 13.6$ eV.

Step 1 — Ground-state energy: $E_1 = -13.6$ eV.

Step 2 — Energy at infinity: $E_\infty = 0$.

Step 3 — Ionisation energy: $E_\infty - E_1 = 0 - (-13.6) = 13.6$ eV.

Why other options are wrong:

- (B) is the $n = 2$ binding energy.
- (C) doubles the value.
- (D) halves it.

Final Answer: Ionisation energy $= 13.6$ eV $\Rightarrow \boxed{A}$

Answer: (A) Go Back to Q46

Q47.

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: $2^2 = 4$.

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

Step 4 — Evaluate: $E_2 = -3.4$ eV.

Why other options are wrong:

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

Final Answer: $E_2 = -3.4$ eV $\Rightarrow \boxed{B}$

Answer: (B) Go Back to Q47

Q48.

Solution

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

Step 1 — List data: $\lambda = 0.0693$ per year.

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

Step 3 — Evaluate: $T_{1/2} = 10$ years.

Why other options are wrong:

- (A) and (B) come from arithmetic slips.
- (D) uses mean life $1/\lambda$ instead of half-life.

Final Answer: $T_{1/2} = 10$ years $\Rightarrow \boxed{C}$

Answer: (C) Go Back to Q48

Q49.

Solution

Concept — Mass–energy equivalence: $E = mc^2$.

Step 1 — List data: $m = 2 \times 10^{-30}$ kg, $c = 3 \times 10^8$ m/s.

Step 2 — Square the speed of light: $c^2 = (3 \times 10^8)^2 = 9 \times 10^{16}$.

Step 3 — Multiply by mass: $E = 2 \times 10^{-30} \times 9 \times 10^{16}$.

Step 4 — Combine mantissas and powers: $2 \times 9 = 18$; $10^{-30+16} = 10^{-14}$; gives 18×10^{-14}.

Step 5 — Standard form: $E = 1.8 \times 10^{-13}$ J.

Why other options are wrong:

- (A) forgets to square c.
- (B) drops the factor of 2.
- (C) carries a power-of-ten error.

Final Answer: $E = 1.8 \times 10^{-13}$ J $\Rightarrow \boxed{D}$

Answer: (D) Go Back to Q49

Q50.

Solution

Concept — Reverse-biased p–n junction: A diode is reverse biased when its n-side is held at a higher potential than its p-side. In reverse bias the depletion region widens and only a very small reverse saturation (leakage) current flows.

Step 1 — Identify the bias: n-side at higher potential than p-side $\Rightarrow$ reverse bias.

Step 2 — Current behaviour: The junction blocks majority carriers; only a tiny reverse leakage current crosses.

Step 3 — Conclude: The diode is reverse biased and conducts only a very small current.

Why other options are wrong:

- (A) describes forward bias.

- (B) would need a reverse voltage exceeding the breakdown rating.
- (D) is true only of an ideal forward-biased diode.

Final Answer: Reverse biased, tiny leakage current $\Rightarrow \boxed{C}$

Answer: (C) Go Back to Q50

Answer Key

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