JCECE Physics Sample Paper – 3

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. Planck's constant h appears in $E = h\nu$, where E is energy and ν is frequency. The dimensional formula of h is:

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

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

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

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

Q2. Two lengths are measured as 8.27 m and 0.6 m. Their difference, reported to the correct number of significant figures (decimal places), is:

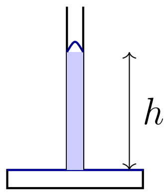
(A) 7.67 m

(B) 7.670 m

(C) 8 m

(D) 7.7 m

Q3. Water rises to a height $h = 2.8$ cm in a clean glass capillary of radius 0.25 mm (contact angle $0°$, $\rho = 1000$ kg/m^3, $g = 10$ m/s^2), as shown. The surface tension of water is:



(A) 3.5×10^{-2} N/m

(B) 7.0×10^{-2} N/m

(C) 1.4×10^{-2} N/m

(D) 2.8×10^{-2} N/m

Q4. A wire stretches by 0.5 mm when a load of 200 N is suspended from it. The elastic potential energy stored in the wire is:

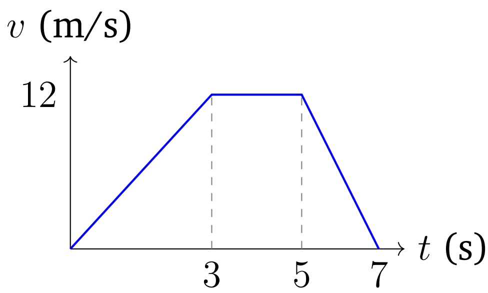
(A) 0.10 J

(B) 0.05 J

(C) 0.20 J

(D) 0.025 J

Q5. The velocity–time graph of a particle is shown. The acceleration of the particle during the first phase (0 to 3 s) is:



(A) 2 m/s^2

(B) 3 m/s^2

(C) 6 m/s^2

(D) 4 m/s^2

Q6. A projectile is fired with speed 20 m/s at 30° above the horizontal ($g = 10 \text{ m/s}^2$). Its total time of flight is:

(A) 1 s

(B) 4 s

(C) 2 s

(D) 0.5 s

Q7. A boat heads straight across a river with a speed of 3 m/s relative to the water. The river current flows at 4 m/s. The resultant speed of the boat relative to the ground is:

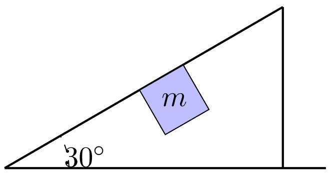
(A) 1 m/s

(B) 5 m/s

(C) 7 m/s

(D) 3.5 m/s

Q8. A block of mass 2 kg rests on a smooth incline of angle 30° as shown ($g = 10 \text{ m/s}^2$). The normal reaction exerted by the incline on the block is:



(A) $10\sqrt{3}$ N

(B) 10 N

(C) 20 N

(D) $5\sqrt{3}$ N

Q9. A car moving at 10 m/s brakes on a road where the coefficient of friction is 0.5 ($g = 10 \text{ m/s}^2$). The distance it travels before stopping is:

(A) 5 m

(B) 20 m

(C) 10 m

(D) 25 m

Q10. A bob of mass 2 kg moves as a conical pendulum with the string making an angle of 60° with the vertical ($g = 10$ m/s^2). The tension in the string is:

(A) 10 N

(B) 20 N

(C) 34.6 N

(D) 40 N

Q11. A particle of mass 2 kg, initially at rest, has a net work of 36 J done on it. Its final speed is:

(A) 6 m/s

(B) 36 m/s

(C) 18 m/s

(D) 3 m/s

Q12. A person of mass 60 kg climbs a flight of stairs of vertical height 3 m in 2 s ($g = 10$ m/s^2). The average power developed is:

(A) 1800 W

(B) 900 W

(C) 450 W

(D) 600 W

Q13. A body of mass 2 kg moving at 9 m/s makes a head-on elastic collision with a stationary body of mass 4 kg. After the collision, the velocity of the first body is:

(A) $+3$ m/s

(B) 0 m/s

(C) -3 m/s

(D) $+6$ m/s

Q14. A thin circular ring of mass 2 kg and radius 0.5 m rotates about an axis through its centre perpendicular to its plane. Its moment of inertia is:

(A) 0.25 kg·m^2

(B) 1.0 kg·m^2

(C) 2.0 kg·m^2

(D) 0.5 kg·m^2

Q15. A satellite orbits close to the Earth's surface ($R = 6.4 \times 10^6$ m, $g = 10$ m/s^2). Its orbital speed is approximately:

(A) 11.2 km/s

(B) 8 km/s

(C) 4 km/s

(D) 16 km/s

Q16. A Carnot engine operates between a source at 600 K and a sink at 300 K. Its efficiency is:

(A) 25%

(B) 40%

(C) 60%

(D) 50%

Q17. 2 mol of a monatomic ideal gas is heated at constant volume so that its temperature rises by 100 K ($R = 8.31$ J/mol·K, $C_V = \frac{3}{2}R$). The change in internal energy is:

(A) 2493 J

(B) 1662 J

(C) 4986 J

(D) 831 J

Q18. The mean translational kinetic energy of a gas molecule at 300 K ($k = 1.38 \times 10^{-23}$ J/K) is:

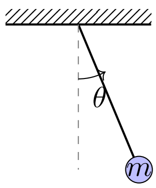
(A) 4.14×10^{-21} J

(B) 2.07×10^{-21} J

(C) 6.21×10^{-21} J

(D) 1.24×10^{-20} J

Q19. A simple pendulum of length 0.9 m oscillates with small amplitude as shown ($g = 10$ m/s^2). Its time period is:



(A) 0.3π s

(B) 0.6π s

(C) 0.9π s

(D) 1.2π s

Q20. A particle executes SHM with angular frequency $\omega = 10$ rad/s and amplitude $A = 0.05$ m. Its speed when its displacement is $A/2$ is:

(A) 0.25 m/s

(B) 0.50 m/s

(C) 0.30 m/s

(D) 0.43 m/s

Q21. An open organ pipe of length 0.5 m is sounded (speed of sound $= 340$ m/s). Its fundamental frequency is:

(A) 170 Hz

(B) 680 Hz

(C) 340 Hz

(D) 255 Hz

Q22. A tuning fork of frequency 500 Hz produces 5 beats per second with a second fork. When the second fork is loaded with a little wax, the beat frequency falls to 3 per second. The original frequency of the second fork is:

(A) 505 Hz

(B) 495 Hz

(C) 500 Hz

(D) 510 Hz

Q23. Two point charges exert a Coulomb force of 8 N on each other. If the separation between them is doubled (charges unchanged), the new force is:

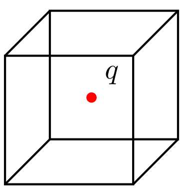
(A) 4 N

(B) 2 N

(C) 16 N

(D) 1 N

Q24. A point charge of $5.31\ \mu$C is placed at the centre of a cube ($\varepsilon_0 = 8.85 \times 10^{-12}$ C^2/N·m^2). The electric flux through one face of the cube is:



(A) 1×10^5 N·m^2/C

(B) 6×10^5 N·m^2/C

(C) 5×10^4 N·m^2/C

(D) 1×10^6 N·m^2/C

Q25. An electric dipole of dipole moment 4×10^{-9} C·m is placed at 30° to a uniform field of 2×10^5 N/C. The torque on the dipole is:

(A) 8×10^{-4} N·m

(B) 4×10^{-4} N·m

(C) 6.9×10^{-4} N·m

(D) 2×10^{-4} N·m

Q26. A charged capacitor stores $18\ \mu$J of energy. It is then disconnected from the source and a dielectric of constant $K = 3$ is inserted to fill the gap. The new stored energy is:

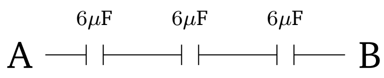
(A) $54\ \mu$J

(B) $18\ \mu$J

(C) $6\ \mu$J

(D) $9\ \mu$J

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



(A) $18\ \mu$F

(B) $3\ \mu$F

(C) $6\ \mu$F

(D) $2\ \mu$F

Q28. A copper wire of length 2 m and cross-sectional area 1×10^{-6} m^2 has resistivity $1.7 \times 10^{-8}\,\Omega \cdot$ m. Its resistance is:

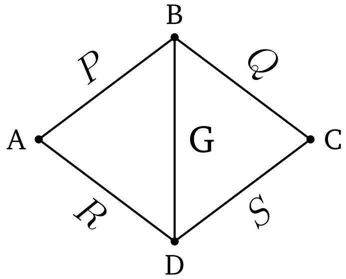
(A) $3.4 \times 10^{-2}\,\Omega$

(B) $1.7 \times 10^{-2}\,\Omega$

(C) $6.8 \times 10^{-2}\,\Omega$

(D) $3.4 \times 10^{-1}\,\Omega$

Q29. In the Wheatstone bridge shown, the galvanometer G shows zero deflection. This balanced condition corresponds to:



(A) $\dfrac{P}{Q} = \dfrac{S}{R}$

(B) $\dfrac{P}{Q} = \dfrac{R}{S}$

(C) $PQ = RS$

(D) $P + Q = R + S$

Q30. A cell of EMF 2 V drives a current through an external resistance of $3\,\Omega$, and its terminal voltage falls to 1.5 V. The internal resistance of the cell is:

(A) $1\,\Omega$

(B) $0.5\,\Omega$

(C) $2\,\Omega$

(D) $3\,\Omega$

Q31. A 1000 W electric heater runs for 4 hours. If electrical energy costs Rs.5 per unit (1 unit $= 1$ kWh), the cost of running it is:

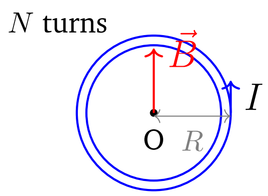
(A) Rs.5

(B) Rs.10

(C) Rs.20

(D) Rs.40

Q32. A circular coil of 100 turns and radius 0.1 m carries a current of 2 A, as shown ($\mu_0 = 4\pi \times 10^{-7}$ T·m/A). The magnetic field at its centre is:



(A) 1.26×10^{-4} T

(B) 6.28×10^{-4} T

(C) 2.51×10^{-3} T

(D) 1.26×10^{-3} T

Q33. An electron ($m = 9.1 \times 10^{-31}$ kg, $e = 1.6 \times 10^{-19}$ C) moves at 2.0×10^{6} m/s perpendicular to a uniform magnetic field of 2.0×10^{-4} T. The radius of its circular path is approximately:

(A) 2.8×10^{-2} m

(B) 5.7×10^{-2} m

(C) 1.1×10^{-1} m

(D) 2.8×10^{-3} m

Q34. A long solenoid has 1000 turns per metre and carries a current of 5 A ($\mu_0 = 4\pi \times 10^{-7}$ T·m/A). The magnetic field inside it is:

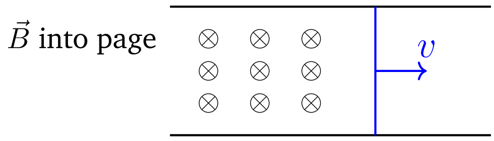
(A) 3.14×10^{-3} T

(B) 1.26×10^{-3} T

(C) 6.28×10^{-3} T

(D) 1.26×10^{-2} T

Q35. A conducting rod of length 0.2 m slides at 10 m/s on rails of total circuit resistance $2\,\Omega$, in a field of 0.5 T into the page, as shown. The external force needed to keep the rod moving at constant speed is:



(A) 0.5 N

(B) 0.1 N

(C) 0.25 N

(D) 0.05 N

Q36. An inductor of inductance 0.1 H is connected to an a.c. source of frequency 50 Hz. Its inductive reactance is:

(A) $31.4\,\Omega$

(B) $15.7\,\Omega$

(C) $62.8\,\Omega$

(D) $10\,\Omega$

Q37. The peak value of an alternating voltage is 311 V. Its root-mean-square value is approximately:

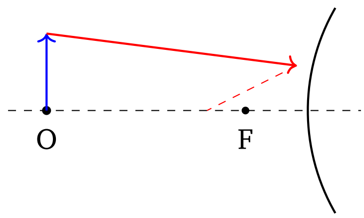
(A) 311 V

(B) 220 V

(C) 440 V

(D) 156 V

Q38. A convex 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) -10 cm

(C) $+10$ cm

(D) $+15$ cm

Q39. The critical angle for a glass–air interface is 30°. The refractive index of the glass is:

(A) 1.5

(B) $\sqrt{2}$

(C) $\sqrt{3}$

(D) 2

Q40. A convex lens of focal length 20 cm is placed in contact with a concave lens of focal length 30 cm. The focal length of the combination is:

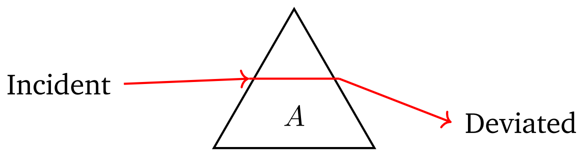
(A) 12 cm

(B) 50 cm

(C) -60 cm

(D) 60 cm

Q41. A prism of refractive index $\sqrt{2}$ produces a minimum deviation of 30° for a ray passing through it, as shown. The refracting angle of the prism is:



(A) 30°

(B) 45°

(C) 60°

(D) 90°

Q42. In a Young's double-slit experiment, light of wavelength 600 nm illuminates slits separated by 0.5 mm, with the screen 1.5 m away. The fringe width is:

(A) 0.9 mm

(B) 1.8 mm

(C) 3.6 mm

(D) 0.45 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 is:

(A) 5×10^{-3} rad

(B) 2.5×10^{-3} rad

(C) 1×10^{-2} rad

(D) 1.25×10^{-3} rad

Q44. Light of wavelength 300 nm falls on a metal of work function 3.3×10^{-19} J ($h = 6.6 \times 10^{-34}$ J·s, $c = 3 \times 10^8$ m/s). The maximum kinetic energy of the emitted photoelectrons is:

(A) 6.6×10^{-19} J

(B) 3.3×10^{-19} J

(C) 9.9×10^{-19} J

(D) 1.65×10^{-19} J

Q45. A proton of mass 1.67×10^{-27} kg has kinetic energy 3.3×10^{-21} J ($h = 6.6 \times 10^{-34}$ J·s). Its de Broglie wavelength is approximately:

(A) 1 Å

(B) 4 Å

(C) 2 Å

(D) 0.5 Å

Q46. In Bohr's model of the hydrogen atom, the energy of the ground state is -13.6 eV. The energy of the electron in the $n = 2$ level is:

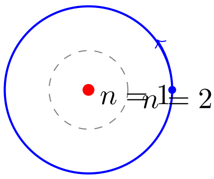
(A) -13.6 eV

(B) -6.8 eV

(C) -1.51 eV

(D) -3.4 eV

Q47. In Bohr's model of hydrogen, the speed of the electron in the nth orbit is $v_n = \dfrac{2.18 \times 10^6}{n}$ m/s. The speed in the second orbit ($n = 2$), shown below, is:



(A) 1.09×10^6 m/s

(B) 2.18×10^6 m/s

(C) 4.36×10^6 m/s

(D) 0.73×10^6 m/s

Q48. A radioactive sample contains 2×10^{20} undecayed nuclei and has a decay constant of 1.0×10^{-4} s^{-1}. Its activity is:

(A) 2×10^{24} Bq

(B) 2×10^{16} Bq

(C) 2×10^{14} Bq

(D) 1×10^{16} Bq

Q49. In a nuclear fission event, the total mass defect is 0.2148 u. Taking 1 u $= 931$ MeV$/c^2$, the energy released is approximately:

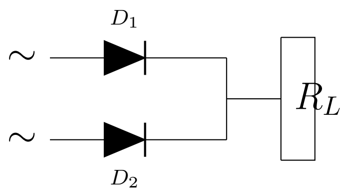
(A) 100 MeV

(B) 50 MeV

(C) 200 MeV

(D) 400 MeV

Q50. In the full-wave rectifier circuit shown, two diodes feed a common load R_L so that current flows through the load in the same direction during both halves of the a.c. cycle. The output across R_L consists of:



(A) Both half-cycles of the input, in one direction

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

(C) A pure ripple-free direct current

(D) No current at all

Detailed Solutions

Q1.

Solution

Concept — Dimensions of Planck's constant: From $E = h\nu$, $h = \dfrac{E}{\nu}$. Energy $[E] = \mathrm{ML^2T^{-2}}$ and frequency $[\nu] = \mathrm{T^{-1}}$.

Step 1 — Write energy dimension: $[E] = \mathrm{ML^2T^{-2}}$.

Step 2 — Write frequency dimension: $[\nu] = \mathrm{T^{-1}}$.

Step 3 — Form the ratio: $[h] = \dfrac{\mathrm{ML^2T^{-2}}}{\mathrm{T^{-1}}}$.

Step 4 — Subtract the time exponents: $\mathrm{T^{-2-(-1)}} = \mathrm{T^{-1}}$, so $[h] = \mathrm{ML^2T^{-1}}$.

Why other options are wrong:

- (A) is the dimension of energy alone.
- (B) has only one power of length.
- (D) carries an extra factor of $\mathrm{T^{-1}}$ (that is power).

Final Answer: $[h] = [\mathrm{ML^2T^{-1}}] \Rightarrow \boxed{\mathrm{C}}$

Answer: (C) **Go Back to Q1**

Q2.

Solution

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

Step 1 — Count decimals: 8.27 has 2 decimal places; 0.6 has 1 decimal place.

Step 2 — The smaller is: 1 decimal place.

Step 3 — Subtract the numbers: $8.27 - 0.6 = 7.67$.

Step 4 — Round to 1 decimal place: $7.67 \to 7.7$.

Why other options are wrong:

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

Final Answer: Difference = 7.7 m ⇒ $\boxed{\text{D}}$

Answer: (D) Go Back to Q2

Q3.

Solution

Concept — Surface tension from capillary rise (inverse): From $h = \dfrac{2T\cos\theta}{r\rho g}$, solve for $T = \dfrac{hr\rho g}{2\cos\theta}$.

Step 1 — List data: $h = 2.8$ cm $= 2.8 \times 10^{-2}$ m, $r = 0.25$ mm $= 2.5 \times 10^{-4}$ m, $\rho = 1000$ kg/m^3, $g = 10$ m/s^2, $\theta = 0°$ so $\cos\theta = 1$.

Step 2 — Numerator: $hr\rho g = 2.8 \times 10^{-2} \times 2.5 \times 10^{-4} \times 1000 \times 10$.

Step 3 — Multiply step by step: $2.8 \times 10^{-2} \times 2.5 \times 10^{-4} = 7.0 \times 10^{-6}$; then $\times 1000 = 7.0 \times 10^{-3}$; then $\times 10 = 7.0 \times 10^{-2}$.

Step 4 — Divide by $2\cos\theta = 2$: $T = \dfrac{7.0 \times 10^{-2}}{2} = 3.5 \times 10^{-2}$ N/m.

Why other options are wrong:

- (B) forgets the factor of 2 in the denominator.
- (C) uses a wrong radius.
- (D) mishandles the powers of ten.

Final Answer: $T = 3.5 \times 10^{-2}$ N/m ⇒ $\boxed{\text{A}}$

Answer: (A) Go Back to Q3

Q4.

Solution

Concept — Elastic potential energy of a stretched wire: $U = \frac{1}{2} \times$ force $\times$ extension $= \frac{1}{2}F\,\Delta L$.

Step 1 — List data: $F = 200$ N, $\Delta L = 0.5$ mm $= 5 \times 10^{-4}$ m.

Step 2 — Multiply force and extension: $F\,\Delta L = 200 \times 5 \times 10^{-4} = 0.1$.

Step 3 — Take half: $U = \frac{1}{2} \times 0.1 = 0.05$ J.

Why other options are wrong:

- (A) forgets the factor of $\frac{1}{2}$.

- (C) doubles the result.
- (D) halves it once too often.

Final Answer: $U = 0.05$ J $\Rightarrow \boxed{B}$

Answer: (B) Go Back to Q4

Q5.

Solution

Concept — Acceleration from a v–t graph: Acceleration equals the slope of the velocity–time line, $a = \dfrac{\Delta v}{\Delta t}$.

Step 1 — Read the first phase: Velocity rises from 0 to 12 m/s as time goes from 0 to 3 s.

Step 2 — Change in velocity: $\Delta v = 12 - 0 = 12$ m/s.

Step 3 — Change in time: $\Delta t = 3 - 0 = 3$ s.

Step 4 — Divide: $a = \dfrac{12}{3} = 4$ m/s^2.

Why other options are wrong:

- (A) and (B) use wrong time or velocity intervals.
- (C) doubles the slope.

Final Answer: $a = 4$ m/s^2 $\Rightarrow \boxed{D}$

Answer: (D) Go Back to Q5

Q6.

Solution

Concept — Time of flight of a projectile: $T = \dfrac{2u\sin\theta}{g}$.

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 — Numerator: $2u\sin\theta = 2 \times 20 \times 0.5 = 20$.

Step 4 — Divide by g: $T = \dfrac{20}{10} = 2$ s.

Why other options are wrong:

- (A) drops the factor of 2.
- (B) uses a wrong angle.
- (D) inverts the division.

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

Answer: (C) Go Back to Q6

Q7.

Solution

Concept — Resultant of perpendicular velocities: When the boat's velocity (across) and the current (along) are perpendicular, the ground speed is $v = \sqrt{v_b^2 + v_r^2}$.

Step 1 — List data: $v_b = 3$ m/s (across), $v_r = 4$ m/s (current).

Step 2 — Square each: $v_b^2 = 9$, $v_r^2 = 16$.

Step 3 — Add: $9 + 16 = 25$.

Step 4 — Take square root: $v = \sqrt{25} = 5$ m/s.

Why other options are wrong:

- (A) subtracts the speeds.
- (C) adds them directly.
- (D) averages them.

Final Answer: $v = 5$ m/s $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q7

Q8.

Solution

Concept — Normal force on an incline: For a block resting on a frictionless incline, the surface supports the perpendicular component of weight, $N = mg\cos\theta$.

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

Step 2 — Compute mg: $mg = 2 \times 10 = 20$ N.

Step 3 — Find $\cos\theta$: $\cos 30° = \dfrac{\sqrt{3}}{2}$.

Step 4 — Multiply: $N = 20 \times \frac{\sqrt{3}}{2} = 10\sqrt{3}$ N.

Why other options are wrong:

- (B) uses $mg \sin\theta$ (the component along the incline).
- (C) takes the full weight mg.
- (D) halves the correct value.

Final Answer: $N = 10\sqrt{3} \approx 17.3$ N $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q8

Q9.

Solution

Concept — Stopping distance under friction: Friction gives a retardation $a = \mu g$; then $s = \frac{v^2}{2a}$ with the car coming to rest.

Step 1 — List data: $v = 10$ m/s, $\mu = 0.5$, $g = 10$ m/s^2.

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

Step 3 — Square the speed: $v^2 = 10^2 = 100$.

Step 4 — Divide by $2a$: $s = \frac{100}{2 \times 5} = \frac{100}{10} = 10$ m.

Why other options are wrong:

- (A) drops a factor of 2.
- (B) ignores μ.
- (D) uses a wrong retardation.

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

Answer: (C) Go Back to Q9

Q10.

Solution

Concept — Conical pendulum tension: The vertical component of tension balances gravity: $T\cos\theta = mg$, so $T = \frac{mg}{\cos\theta}$.

Step 1 — List data: $m = 2$ kg, $g = 10$ m/s^2, $\theta = 60°$.

Step 2 — Compute mg: $mg = 2 \times 10 = 20$ N.

Step 3 — Find $\cos\theta$: $\cos 60^\circ = 0.5$.

Step 4 — Divide: $T = \dfrac{20}{0.5} = 40$ N.

Why other options are wrong:

- (A) takes only $mg\cos\theta$.
- (B) reports mg itself.
- (C) uses $mg/\sin\theta$ wrongly.

Final Answer: $T = 40\text{ N} \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q10

Q11.

Solution

Concept — Work–energy theorem: The net work equals the change in kinetic energy: $W = \frac{1}{2}mv^2 - \frac{1}{2}mu^2$. With $u = 0$, $v = \sqrt{\dfrac{2W}{m}}$.

Step 1 — List data: $m = 2$ kg, $W = 36$ J, $u = 0$.

Step 2 — Numerator: $2W = 2 \times 36 = 72$.

Step 3 — Divide by m: $\dfrac{72}{2} = 36$.

Step 4 — Take square root: $v = \sqrt{36} = 6$ m/s.

Why other options are wrong:

- (B) forgets the square root.
- (C) and (D) use wrong arithmetic.

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

Answer: (A) Go Back to Q11

Q12.

Solution

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

Step 1 — List data: $m = 60$ kg, $g = 10$ m/s^2, $h = 3$ m, $t = 2$ s.

Step 2 — Work done: $mgh = 60 \times 10 \times 3 = 1800$ J.

Step 3 — Divide by time: $P = \dfrac{1800}{2}$.

Step 4 — Evaluate: $P = 900$ W.

Why other options are wrong:

- (A) forgets to divide by the time.
- (C) divides twice.
- (D) uses wrong arithmetic.

Final Answer: $P = 900 \text{ W} \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q12

Q13.

Solution

Concept — Elastic collision (unequal masses): For a 1-D elastic collision with the target at rest, $v_1' = \dfrac{m_1 - m_2}{m_1 + m_2} u$.

Step 1 — List data: $m_1 = 2$ kg, $m_2 = 4$ kg, $u = 9$ m/s.

Step 2 — Numerator: $m_1 - m_2 = 2 - 4 = -2$.

Step 3 — Denominator: $m_1 + m_2 = 2 + 4 = 6$.

Step 4 — Form the factor: $\dfrac{-2}{6} = -\dfrac{1}{3}$.

Step 5 — Multiply by u: $v_1' = -\dfrac{1}{3} \times 9 = -3$ m/s (it rebounds).

Why other options are wrong:

- (A) misses the sign (direction).
- (B) would need equal masses.
- (D) keeps the original speed.

Final Answer: $v_1' = -3 \text{ m/s} \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q13

Q14.

Solution

Concept — Moment of inertia of a ring: For a thin ring about an axis through its centre perpendicular to its plane, $I = MR^2$.

Step 1 — List data: $M = 2$ kg, $R = 0.5$ m.

Step 2 — Square the radius: $R^2 = (0.5)^2 = 0.25\ \text{m}^2$.

Step 3 — Multiply by mass: $I = 2 \times 0.25 = 0.5\ \text{kg·m}^2$.

Why other options are wrong:

- (A) uses $\frac{1}{2}MR^2$ (a disc).
- (B) and (C) carry arithmetic slips.

Final Answer: $I = 0.5\ \text{kg·m}^2 \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q14

Q15.

Solution

Concept — Orbital velocity near the surface: For a satellite skimming the Earth, gravity provides the centripetal force, giving $v = \sqrt{gR}$.

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

Step 2 — Multiply inside the root: $gR = 10 \times 6.4 \times 10^6 = 6.4 \times 10^7$.

Step 3 — Take square root: $v = \sqrt{6.4 \times 10^7} = \sqrt{64 \times 10^6} = 8 \times 10^3$ m/s.

Step 4 — Convert: $v = 8$ km/s.

Why other options are wrong:

- (A) is the escape speed ($\sqrt{2gR}$).
- (C) halves the value.
- (D) doubles it.

Final Answer: $v \approx 8\ \text{km/s} \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q15

Q16.

Solution

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

Step 1 — Form the ratio: $\frac{T_C}{T_H} = \frac{300}{600}$.

Step 2 — Simplify: $\frac{300}{600} = 0.5$.

Step 3 — Subtract from 1**:** $\eta = 1 - 0.5 = 0.5$.

Step 4 — Convert to percent: $0.5 = 50\%$.

Why other options are wrong:

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

Final Answer: $\eta = 50\% \Rightarrow \boxed{\text{D}}$

Answer: (D) **Go Back to Q16**

Q17.

Solution

Concept — Internal energy at constant volume: $\Delta U = nC_V\Delta T$, with $C_V = \frac{3}{2}R$ for a monatomic gas.

Step 1 — List data: $n = 2$ mol, $C_V = \frac{3}{2} \times 8.31 = 12.465$ J/mol·K, $\Delta T = 100$ K.

Step 2 — Multiply n **and** C_V**:** $2 \times 12.465 = 24.93$.

Step 3 — Multiply by ΔT**:** $\Delta U = 24.93 \times 100 = 2493$ J.

Why other options are wrong:

- (B) uses $n = 1$.
- (C) doubles the result.
- (D) uses $C_V = R$ and $n = 1$.

Final Answer: $\Delta U = 2493 \text{ J} \Rightarrow \boxed{\text{A}}$

Answer: (A) **Go Back to Q17**

Q18.

Solution

Concept — Mean translational KE per molecule: $\bar{E} = \frac{3}{2}kT$.

Step 1 — List data: $k = 1.38 \times 10^{-23}$ J/K, $T = 300$ K.

Step 2 — Multiply k and T: $1.38 \times 10^{-23} \times 300 = 4.14 \times 10^{-21}$.

Step 3 — Multiply by $\frac{3}{2}$: $\bar{E} = 1.5 \times 4.14 \times 10^{-21} = 6.21 \times 10^{-21}$ J.

Why other options are wrong:

- (A) omits the $\frac{3}{2}$ factor.
- (B) uses $\frac{1}{2}$ instead of $\frac{3}{2}$.
- (D) doubles the value.

Final Answer: $\bar{E} = 6.21 \times 10^{-21}$ J $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q18

Q19.

Solution

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

Step 1 — List data: $L = 0.9$ m, $g = 10$ m/s^2.

Step 2 — Form L/g: $\frac{0.9}{10} = 0.09$ s^2.

Step 3 — Take square root: $\sqrt{0.09} = 0.3$ s.

Step 4 — Multiply by 2π: $T = 2\pi \times 0.3 = 0.6\pi$ s.

Why other options are wrong:

- (A) drops the factor of 2.
- (C) and (D) mis-take the square root of L/g.

Final Answer: $T = 0.6\pi$ s $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q19

Q20.

Solution

Concept — Velocity in SHM: $v = \omega\sqrt{A^2 - x^2}$.

Step 1 — List data: $\omega = 10$ rad/s, $A = 0.05$ m, $x = A/2 = 0.025$ m.

Step 2 — Square the terms: $A^2 = 0.0025$, $x^2 = (0.025)^2 = 0.000625$.

Step 3 — Subtract: $A^2 - x^2 = 0.0025 - 0.000625 = 0.001875$.

Step 4 — Take square root: $\sqrt{0.001875} \approx 0.0433$.

Step 5 — Multiply by ω: $v = 10 \times 0.0433 \approx 0.43$ m/s.

Why other options are wrong:

- (A) uses $x = A$ (zero speed region) wrongly.
- (B) is the maximum speed ωA.
- (C) carries an arithmetic slip.

Final Answer: $v \approx 0.43$ m/s $\Rightarrow \boxed{D}$

Answer: (D) Go Back to Q20

Q21.

Solution

Concept — Open organ pipe fundamental: For a pipe open at both ends, $f = \frac{v}{2L}$.

Step 1 — List data: $v = 340$ m/s, $L = 0.5$ m.

Step 2 — Denominator: $2L = 2 \times 0.5 = 1$ m.

Step 3 — Divide: $f = \frac{340}{1} = 340$ Hz.

Why other options are wrong:

- (A) uses $4L$ (a closed pipe).
- (B) doubles the value.
- (D) uses a wrong length factor.

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

Answer: (C) Go Back to Q21

Q22.

Solution

Concept — Beats and wax loading: A beat frequency f_b means the second fork has frequency $500 \pm f_b$. Loading a fork with wax adds mass, which always lowers its frequency. How the beat frequency changes on loading tells us which sign to keep.

Step 1 — Two candidate frequencies: With 5 beats per second, the second fork is $500 + 5 = 505$ Hz or $500 - 5 = 495$ Hz.

Step 2 — Effect of wax: Adding wax lowers the loaded fork's frequency.

Step 3 — Test the 505 Hz case: If the fork was 505 Hz, loading lowers it towards 500, so the gap $505 \to$ lower shrinks and the beat frequency drops from 5 to 3.

Step 4 — Test the 495 Hz case: If the fork was 495 Hz, loading lowers it further below 500, so the gap widens and the beat frequency would rise above 5.

Step 5 — Match the observation: The beats fell ($5 \to 3$), which matches the 505 Hz case.

Why other options are wrong:

- (B) 495 Hz would make the beat frequency rise on loading, not fall.
- (C) 500 Hz would give zero beats, contradicting the 5 beats heard.
- (D) 510 Hz differs from 500 by 10, giving 10 beats, not 5.

Final Answer: Original frequency $= 505$ Hz $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q22

Q23.

Solution

Concept — Coulomb force varies as $1/r^2$: $F \propto \dfrac{1}{r^2}$, so doubling r divides the force by $2^2 = 4$.

Step 1 — Original force: $F = 8$ N.

Step 2 — Distance factor: $r \to 2r$, so $\dfrac{1}{r^2} \to \dfrac{1}{4r^2}$.

Step 3 — Apply the factor: $F' = \dfrac{8}{4} = 2$ N.

Why other options are wrong:

- (A) divides by 2 instead of 4.
- (C) multiplies instead of dividing.
- (D) divides by 8.

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

Answer: (B) Go Back to Q23

Q24.

Solution

Concept — Flux through one face of a cube: By symmetry, the total flux $\Phi = \dfrac{q}{\varepsilon_0}$ is shared equally among the 6 faces, so each face has $\dfrac{q}{6\varepsilon_0}$.

Step 1 — List data: $q = 5.31 \times 10^{-6}$ C, $\varepsilon_0 = 8.85 \times 10^{-12}$ C^2/N·m^2.

Step 2 — Total flux: $\Phi = \dfrac{5.31 \times 10^{-6}}{8.85 \times 10^{-12}} = 6 \times 10^5$ N·m^2/C.

Step 3 — Divide by 6 faces: $\Phi_{face} = \dfrac{6 \times 10^5}{6} = 1 \times 10^5$ N·m^2/C.

Why other options are wrong:

- (B) is the total flux, not per face.
- (C) and (D) mishandle the division.

Final Answer: $\Phi_{face} = 1 \times 10^5\text{ N·m}^2\text{/C} \Rightarrow \boxed{\text{A}}$

Answer: (A) 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, $E = 2 \times 10^5$ N/C, $\theta = 30°$.

Step 2 — Multiply p and E: $pE = 4 \times 10^{-9} \times 2 \times 10^5 = 8 \times 10^{-4}$.

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

Step 4 — Multiply: $\tau = 8 \times 10^{-4} \times 0.5 = 4 \times 10^{-4}$ N·m.

Why other options are wrong:

- (A) forgets the $\sin\theta$ factor.

- (C) uses $\sin 60°$.
- (D) halves the result once too often.

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

Answer: (B) Go Back to Q25

Q26.

Solution

Concept — Energy at constant charge: With the charge fixed, $U = \dfrac{Q^2}{2C}$. Inserting a dielectric multiplies C by K, so U is divided by K: $U' = \dfrac{U}{K}$.

Step 1 — List data: $U = 18\ \mu$J, $K = 3$.

Step 2 — Divide by K: $U' = \dfrac{18}{3}$.

Step 3 — Evaluate: $U' = 6\ \mu$J.

Why other options are wrong:

- (A) multiplies by K (that is the constant-voltage case).
- (B) ignores the dielectric.
- (D) divides by 2 instead of 3.

Final Answer: $U' = 6\ \mu\text{J} \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q26

Q27.

Solution

Concept — Capacitors in series: For equal capacitors C in series, $\dfrac{1}{C_{eq}} = \dfrac{n}{C}$, so $C_{eq} = \dfrac{C}{n}$.

Step 1 — Sum reciprocals: $\dfrac{1}{C_{eq}} = \dfrac{1}{6} + \dfrac{1}{6} + \dfrac{1}{6} = \dfrac{3}{6}$.

Step 2 — Simplify: $\dfrac{3}{6} = \dfrac{1}{2}$.

Step 3 — Invert: $C_{eq} = 2\ \mu$F.

Why other options are wrong:

- (A) adds them in parallel.
- (B) uses $C/2$.
- (C) takes one capacitor's value.

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

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

Q28.

Solution

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

Step 1 — List data: $\rho = 1.7 \times 10^{-8}\,\Omega\cdot\text{m}$, $L = 2$ m, $A = 1 \times 10^{-6}$ m^2.

Step 2 — Numerator: $\rho L = 1.7 \times 10^{-8} \times 2 = 3.4 \times 10^{-8}$.

Step 3 — Divide by A: $R = \dfrac{3.4 \times 10^{-8}}{1 \times 10^{-6}}$.

Step 4 — Subtract exponents: $10^{-8-(-6)} = 10^{-2}$, so $R = 3.4 \times 10^{-2}\,\Omega$.

Why other options are wrong:

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

Final Answer: $R = 3.4 \times 10^{-2}\,\Omega \Rightarrow \boxed{\text{A}}$

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

Q29.

Solution

Concept — Wheatstone bridge balance: The bridge is balanced (no current through the galvanometer) when the ratios of the arms satisfy $\dfrac{P}{Q} = \dfrac{R}{S}$.

Step 1 — Identify the arm pairs: P and Q form one branch (A–B–C); R and S form the other (A–D–C).

Step 2 — Balance condition: Equal potential at B and D requires $\dfrac{P}{Q} = \dfrac{R}{S}$.

Step 3 — Conclude: Option (B) states exactly this condition.

Why other options are wrong:

- (A) inverts one ratio.
- (C) and (D) are not the bridge balance relation.

Final Answer: $\frac{P}{Q} = \frac{R}{S} \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q29

Q30.

Solution

Concept — Internal resistance from terminal voltage: The current is $I = \frac{V}{R}$ and the internal drop is $E - V = Ir$, so $r = \frac{(E-V)R}{V}$.

Step 1 — List data: $E = 2$ V, $V = 1.5$ V, $R = 3\,\Omega$.

Step 2 — Current in circuit: $I = \frac{V}{R} = \frac{1.5}{3} = 0.5$ A.

Step 3 — Internal voltage drop: $E - V = 2 - 1.5 = 0.5$ V.

Step 4 — Divide by current: $r = \frac{0.5}{0.5} = 1\,\Omega$.

Why other options are wrong:

- (B) halves the value.
- (C) and (D) use wrong arithmetic.

Final Answer: $r = 1\,\Omega \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q30

Q31.

Solution

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

Step 1 — Power in kW: 1000 W $= 1$ kW.

Step 2 — Energy used: 1 kW $\times$ 4 h $= 4$ kWh $= 4$ units.

Step 3 — Multiply by the rate: cost $= 4 \times$ Rs.$5 =$ Rs.20.

Why other options are wrong:

- (A) and (B) use too few units.
- (D) doubles the cost.

Final Answer: Cost = Rs.20 $\Rightarrow$ $\boxed{\text{C}}$

Answer: (C) Go Back to Q31

Q32.

Solution

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

Step 1 — List data: $\mu_0 = 4\pi \times 10^{-7}$, $N = 100$, $I = 2$ A, $R = 0.1$ m.

Step 2 — Numerator: $\mu_0 N I = 4\pi \times 10^{-7} \times 100 \times 2 = 8\pi \times 10^{-5}$.

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

Step 4 — Divide: $B = \dfrac{8\pi \times 10^{-5}}{0.2} = 40\pi \times 10^{-5} = 4\pi \times 10^{-4}$.

Step 5 — Evaluate: $4\pi \times 10^{-4} \approx 1.26 \times 10^{-3}$ T.

Why other options are wrong:

- (A) omits a turn factor.
- (B) and (C) carry arithmetic or power-of-ten slips.

Final Answer: $B \approx 1.26 \times 10^{-3}$ T $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q32

Q33.

Solution

Concept — Radius of a charged particle's circular path: The magnetic force supplies the centripetal force, giving $r = \dfrac{mv}{qB}$.

Step 1 — List data: $m = 9.1 \times 10^{-31}$ kg, $v = 2.0 \times 10^{6}$ m/s, $q = 1.6 \times 10^{-19}$ C, $B = 2.0 \times 10^{-4}$ T.

Step 2 — Numerator: $mv = 9.1 \times 10^{-31} \times 2.0 \times 10^{6} = 1.82 \times 10^{-24}$.

Step 3 — Denominator: $qB = 1.6 \times 10^{-19} \times 2.0 \times 10^{-4} = 3.2 \times 10^{-23}$.

Step 4 — Divide: $r = \dfrac{1.82 \times 10^{-24}}{3.2 \times 10^{-23}} = 5.7 \times 10^{-2}$ m.

Why other options are wrong:

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

Final Answer: $r \approx 5.7 \times 10^{-2}$ m $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q33

Q34.

Solution

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

Step 1 — List data: $\mu_0 = 4\pi \times 10^{-7}$, $n = 1000$ m^{-1}, $I = 5$ A.

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

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

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

Why other options are wrong:

- (A) and (B) carry factor errors.
- (D) is an order of magnitude too large.

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

Answer: (C) Go Back to Q34

Q35.

Solution

Concept — Force to drag a rod at constant speed: The induced EMF drives a current, and the external force balances the magnetic force: $F = BIL$, where $I = \dfrac{BLv}{R}$, so $F = \dfrac{B^2L^2v}{R}$.

Step 1 — List data: $B = 0.5$ T, $L = 0.2$ m, $v = 10$ m/s, $R = 2\,\Omega$.

Step 2 — Induced EMF: $\varepsilon = BLv = 0.5 \times 0.2 \times 10 = 1$ V.

Step 3 — Induced current: $I = \dfrac{\varepsilon}{R} = \dfrac{1}{2} = 0.5$ A.

Step 4 — Force: $F = BIL = 0.5 \times 0.5 \times 0.2 = 0.05$ N.

Why other options are wrong:

- (A) and (C) skip the division by R.
- (B) carries an arithmetic slip.

Final Answer: $F = 0.05\text{ N} \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q35

Q36.

Solution

Concept — Inductive reactance: $X_L = \omega L = 2\pi f L$.

Step 1 — List data: $f = 50$ Hz, $L = 0.1$ H.

Step 2 — Compute $2\pi f$**:** $2\pi \times 50 = 100\pi$.

Step 3 — Multiply by L**:** $X_L = 100\pi \times 0.1 = 10\pi$.

Step 4 — Evaluate: $10\pi \approx 31.4\,\Omega$.

Why other options are wrong:

- (B) halves the value.
- (C) doubles it.
- (D) drops the factor of 2π.

Final Answer: $X_L \approx 31.4\,\Omega \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q36

Q37.

Solution

Concept — RMS from peak: $V_{rms} = \dfrac{V_0}{\sqrt{2}}$.

Step 1 — List data: $V_0 = 311$ V.

Step 2 — Divide by $\sqrt{2}$**:** $V_{rms} = \dfrac{311}{1.414}$.

Step 3 — Evaluate: $V_{rms} \approx 220$ V.

Why other options are wrong:

- (A) reports the peak value itself.
- (C) multiplies by $\sqrt{2}$.
- (D) divides by 2.

Final Answer: $V_{rms} \approx 220 \text{ V} \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q37

Q38.

Solution

Concept — Convex mirror formula: $\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$. For a convex mirror $f = +15$ cm and the object distance $u = -30$ cm.

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

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

Step 3 — Common denominator: $\frac{1}{v} = \frac{2}{30} + \frac{1}{30} = \frac{3}{30} = \frac{1}{10}$.

Step 4 — Invert: $v = +10$ cm (virtual image behind the mirror).

Why other options are wrong:

- (A) ignores the convex sign rules.
- (B) gives a wrong sign.
- (D) reports f instead of v.

Final Answer: $v = +10 \text{ cm} \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q38

Q39.

Solution

Concept — Refractive index from critical angle: $\sin\theta_c = \frac{1}{n}$, so $n = \frac{1}{\sin\theta_c}$.

Step 1 — Find $\sin\theta_c$: $\sin 30^\circ = 0.5$.

Step 2 — Take the reciprocal: $n = \dfrac{1}{0.5}$.

Step 3 — Evaluate: $n = 2$.

Why other options are wrong:

- (A), (B), (C) correspond to other critical angles ($\sin^{-1}\frac{1}{1.5}$, $45°$, $\sin^{-1}\frac{1}{\sqrt{3}}$).

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

Answer: (D) Go Back to Q39

Q40.

Solution

Concept — Two thin lenses in contact: $\dfrac{1}{F} = \dfrac{1}{f_1} + \dfrac{1}{f_2}$, with sign convention: convex $f_1 = +20$ cm, concave $f_2 = -30$ cm.

Step 1 — Insert values: $\dfrac{1}{F} = \dfrac{1}{20} + \dfrac{1}{-30} = \dfrac{1}{20} - \dfrac{1}{30}$.

Step 2 — Common denominator 60: $\dfrac{1}{F} = \dfrac{3}{60} - \dfrac{2}{60} = \dfrac{1}{60}$.

Step 3 — Invert: $F = 60$ cm (the combination is converging).

Why other options are wrong:

- (A) adds the magnitudes in series wrongly.
- (B) uses a wrong common denominator.
- (C) gives the wrong sign.

Final Answer: $F = 60$ cm $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q40

Q41.

Solution

Concept — Prism at minimum deviation: $n = \dfrac{\sin\frac{A+D_m}{2}}{\sin\frac{A}{2}}$. Here $n = \sqrt{2}$ and $D_m = 30°$; solve for A.

Step 1 — Test $A = 60°$**:** Then $\dfrac{A}{2} = 30°$ and $\sin 30° = 0.5$.

Step 2 — Numerator angle: $\dfrac{A+D_m}{2} = \dfrac{60+30}{2} = 45°$, and $\sin 45° = \dfrac{1}{\sqrt{2}}$.

Step 3 — Form the ratio: $n = \dfrac{1/\sqrt{2}}{0.5} = \dfrac{1}{\sqrt{2}} \times 2 = \sqrt{2}$.

Step 4 — Match: This equals the given $n = \sqrt{2}$, so $A = 60°$.

Why other options are wrong:

- (A), (B), (D) do not satisfy the minimum-deviation relation for $n = \sqrt{2}$.

Final Answer: $A = 60° \Rightarrow \boxed{\text{C}}$

Answer: (C) **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, $d = 0.5$ mm $= 5 \times 10^{-4}$ m.

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

Step 3 — Divide by d: $\beta = \dfrac{9 \times 10^{-7}}{5 \times 10^{-4}}$.

Step 4 — Evaluate: $= 1.8 \times 10^{-3}$ m $= 1.8$ mm.

Why other options are wrong:

- (A) drops the factor from $D = 1.5$ m.
- (C) doubles the value.
- (D) halves it.

Final Answer: $\beta = 1.8$ mm $\Rightarrow \boxed{\text{B}}$

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

Q43.

Solution

Concept — Angular width of the central maximum: The central maximum spans from the first minimum on each side, giving width $\frac{2\lambda}{a}$.

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

Step 2 — Form λ/a: $\frac{5 \times 10^{-7}}{2 \times 10^{-4}} = 2.5 \times 10^{-3}$.

Step 3 — Multiply by 2: angular width $= 2 \times 2.5 \times 10^{-3} = 5 \times 10^{-3}$ rad.

Why other options are wrong:

- (B) gives only the half-width (λ/a).
- (C) and (D) carry arithmetic slips.

Final Answer: angular width $= 5 \times 10^{-3}$ rad $\Rightarrow \boxed{A}$

Answer: (A) Go Back to Q43

Q44.

Solution

Concept — Einstein's photoelectric equation: $KE_{\max} = h\nu - \phi = \frac{hc}{\lambda} - \phi$.

Step 1 — List data: $\lambda = 300$ nm $= 3 \times 10^{-7}$ m, $\phi = 3.3 \times 10^{-19}$ J, $h = 6.6 \times 10^{-34}$, $c = 3 \times 10^{8}$.

Step 2 — Photon energy numerator: $hc = 6.6 \times 10^{-34} \times 3 \times 10^{8} = 1.98 \times 10^{-25}$.

Step 3 — Divide by λ: $\frac{1.98 \times 10^{-25}}{3 \times 10^{-7}} = 6.6 \times 10^{-19}$ J.

Step 4 — Subtract the work function: $KE_{\max} = 6.6 \times 10^{-19} - 3.3 \times 10^{-19} = 3.3 \times 10^{-19}$ J.

Why other options are wrong:

- (A) is the photon energy, not the KE.
- (C) adds instead of subtracting.
- (D) halves the answer.

Final Answer: $KE_{\max} = 3.3 \times 10^{-19}$ J $\Rightarrow \boxed{B}$

Answer: (B) Go Back to Q44

Q45.

Solution

Concept — de Broglie wavelength from kinetic energy: $\lambda = \dfrac{h}{\sqrt{2mE}}$.

Step 1 — List data: $h = 6.6 \times 10^{-34}$, $m = 1.67 \times 10^{-27}$ kg, $E = 3.3 \times 10^{-21}$ J.

Step 2 — Product $2mE$**:** $2 \times 1.67 \times 10^{-27} \times 3.3 \times 10^{-21} = 1.102 \times 10^{-47}$.

Step 3 — Square root of $2mE$**:** $\sqrt{1.102 \times 10^{-47}} = 3.32 \times 10^{-24}$.

Step 4 — Divide: $\lambda = \dfrac{6.6 \times 10^{-34}}{3.32 \times 10^{-24}} = 1.99 \times 10^{-10}$ m.

Step 5 — Convert to Å: 1.99×10^{-10} m ≈ 2 Å.

Why other options are wrong:

- (A) halves the value.
- (B) doubles it.
- (D) is a factor of 4 too small.

Final Answer: $\lambda \approx 2$ Å $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q45

Q46.

Solution

Concept — Bohr energy levels: $E_n = \dfrac{E_1}{n^2}$, with $E_1 = -13.6$ eV.

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

Step 2 — Square: $2^2 = 4$.

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

Why other options are wrong:

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

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

Answer: (D) Go Back to Q46

Q47.

Solution

Concept — Electron speed in the nth Bohr orbit: $v_n = \frac{2.18 \times 10^6}{n}$ m/s, so the speed falls as $1/n$.

Step 1 — Insert $n = 2$**:** $v_2 = \frac{2.18 \times 10^6}{2}$.

Step 2 — Divide: $v_2 = 1.09 \times 10^6$ m/s.

Why other options are wrong:

- (B) is the ground-state speed ($n = 1$).
- (C) multiplies instead of dividing.
- (D) uses $n = 3$.

Final Answer: $v_2 = 1.09 \times 10^6$ m/s $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q47

Q48.

Solution

Concept — Activity of a radioactive sample: $A = \lambda N$, where λ is the decay constant and N the number of undecayed nuclei.

Step 1 — List data: $\lambda = 1.0 \times 10^{-4}$ s^{-1}, $N = 2 \times 10^{20}$.

Step 2 — Multiply the mantissas: $1.0 \times 2 = 2$.

Step 3 — Add the exponents: $10^{-4} \times 10^{20} = 10^{16}$.

Step 4 — Combine: $A = 2 \times 10^{16}$ decays/s (Bq).

Why other options are wrong:

- (A) multiplies the exponents instead of adding.
- (C) and (D) carry exponent or mantissa slips.

Final Answer: $A = 2 \times 10^{16}$ Bq $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q48

Q49.

Solution

Concept — Energy released from mass defect: $E = \Delta m \times 931$ MeV when Δm is in atomic mass units.

Step 1 — List data: $\Delta m = 0.2148$ u, energy per u $= 931$ MeV.

Step 2 — Multiply: $E = 0.2148 \times 931$.

Step 3 — Evaluate: $E \approx 200$ MeV.

Why other options are wrong:

- (A) and (B) underestimate by using a smaller Δm.
- (D) doubles the result.

Final Answer: $E \approx 200$ MeV $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q49

Q50.

Solution

Concept — Full-wave rectifier: Two diodes are arranged so that the load receives current in the same direction during both halves of each a.c. cycle.

Step 1 — Positive half-cycle: One diode is forward biased and conducts, sending current one way through R_L.

Step 2 — Negative half-cycle: The other diode conducts, but the circuit routes the current through R_L in the *same* direction.

Step 3 — Conclude: Both half-cycles appear at the output, all in one direction, as a pulsating (though unidirectional) voltage.

Why other options are wrong:

- (B) describes a half-wave rectifier.
- (C) ignores the ripple still present.
- (D) is false; current flows on both halves.

Final Answer: Output uses both half-cycles in one direction $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q50

Answer Key

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