SRMJEEE Physics Sample Paper – 3

Duration: 41 Minutes **Maximum Marks: 35**

Instructions

- This paper contains **35** Multiple Choice Questions (Single Correct Answer), modelled on the Physics section of **SRMJEEE** (SRM Joint Engineering Entrance Examination).
- Each correct answer carries **+1 mark**. There is **no negative marking**; an unattempted or wrong answer scores 0.
- Only **one** option is correct. Choose carefully.
- The actual SRMJEEE is a **computer-based test** conducted in remote-proctored online mode, with all sections sharing a common time window and no per-section limit.
- Personal calculators, mobile phones, log tables and other electronic gadgets are strictly prohibited.

Q1. The lengths of three rods are measured as 12.5 cm, 0.046 cm and 2.34 cm. When these are added, the sum reported to the correct number of significant figures (decimal places) is:

(A) 14.886 cm

(B) 14.9 cm

(C) 14.89 cm

(D) 15 cm

Q2. Which one of the following pairs of physical quantities has the *same* dimensional formula?

(A) Work and torque

(B) Force and momentum

(C) Pressure and energy

(D) Power and force

Q3. A person of mass 60 kg stands on a weighing scale inside a lift that is accelerating *downward* at 2 m s^{-2}. Taking $g = 10$ m s^{-2}, the reading of the scale (the apparent weight) is:

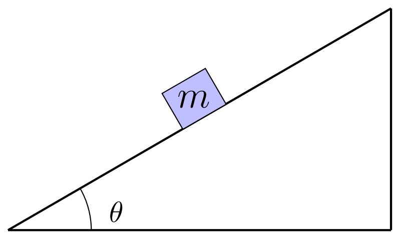
(A) 600 N

(B) 720 N

(C) 120 N

(D) 480 N

Q4. A block placed on a rough inclined plane is on the verge of sliding when the inclination is gradually raised to θ, as shown. If the coefficient of static friction between the block and the surface is $\mu_s = \dfrac{1}{\sqrt{3}}$, the angle of repose θ is:



(A) $45°$

(B) $60°$

(C) $30°$

(D) $15°$

Q5. A boat that can move at 5 m s^{-1} in still water heads straight across a river whose current flows at 3 m s^{-1} parallel to the banks. The resultant speed of the boat relative to the ground is:

(A) $\sqrt{34}$ m s^{-1}

(B) 8 m s^{-1}

(C) 2 m s^{-1}

(D) 4 m s^{-1}

Q6. A pump lifts 600 kg of water through a height of 10 m in 20 s. Taking $g = 10 \text{ m s}^{-2}$ and neglecting losses, the power output of the pump is:

(A) 6000 W

(B) 1500 W

(C) 3000 W

(D) 300 W

Q7. A ball is dropped from a height of 5 m onto a hard floor and rebounds to a height of 1.25 m. The coefficient of restitution between the ball and the floor is:

(A) 0.25

(B) 0.5

(C) 0.75

(D) 0.4

Q8. Because of the Earth's daily rotation, the effective acceleration due to gravity measured at a point on the surface (away from the poles) is, compared with the value it would have if the Earth did not rotate:

(A) greater, and largest at the equator

(B) unchanged at all latitudes

(C) greater at the poles only

(D) smaller, and the reduction is largest at the equator

Q9. A satellite orbits the Earth in a circular orbit of radius r with period T. A second satellite is placed in a circular orbit of radius $4r$. Its orbital period is:

(A) $4T$

(B) $8T$

(C) $2T$

(D) $16T$

Q10. A stretched wire of a given material is subjected to a stress that produces a strain in it. The elastic energy stored *per unit volume* of the wire is:

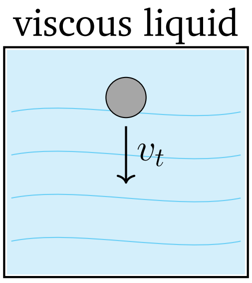
(A) stress $\times$ strain

(B) $2 \times$ stress $\times$ strain

(C) $\frac{1}{2} \times$ stress $\times$ strain

(D) $\frac{1}{4} \times$ stress $\times$ strain

Q11. A small solid sphere of radius r falls steadily (at terminal velocity) through a viscous liquid, as shown. If a second sphere of the same material but radius $2r$ is dropped through the same liquid, its terminal velocity compared with that of the first sphere is:



(A) 4 times as large

(B) 2 times as large

(C) the same

(D) half as large

Q12. Three point charges are fixed on a straight line: a charge $+q$ at $x = 0$, a charge $+q$ at $x = 2d$, and a charge $+q$ at $x = d$ (the midpoint). The net electrostatic force on the middle charge is:

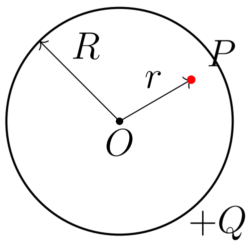
(A) $\dfrac{kq^2}{d^2}$ directed toward $x = 0$

(B) $\dfrac{2kq^2}{d^2}$ directed toward $x = 2d$

(C) $\dfrac{4kq^2}{d^2}$

(D) zero

Q13. A thin spherical conducting shell of radius R carries a uniformly distributed charge Q, as shown. The magnitude of the electric field at a point inside the shell (at distance $r < R$ from the centre) is:



(A) $\dfrac{kQ}{r^2}$

(B) zero

(C) $\dfrac{kQ}{R^2}$

(D) $\dfrac{kQ}{R^3}\,r$

Q14. Three capacitors of $2\ \mu$F, $3\ \mu$F and $5\ \mu$F are connected in parallel. The equivalent capacitance of the combination is:

(A) $0.97\ \mu$F

(B) $1.0\ \mu$F

(C) $10\ \mu$F

(D) $30\ \mu$F

Q15. Two point charges $q_1 = +2\ \mu$C and $q_2 = +3\ \mu$C are held a distance 0.6 m apart. Taking $k = 9 \times 10^9$ N m^2 C^{-2}, the electrostatic potential energy of this pair of charges is:

(A) 9×10^{-2} J

(B) 9×10^{-3} J

(C) 5.4×10^{-2} J

(D) 1.8×10^{-1} J

Q16. In a balanced Wheatstone bridge the four arms have resistances $P = 2\ \Omega$, $Q = 4\ \Omega$, $R = 3\ \Omega$ in three arms; the fourth arm S (so that no current flows through the galvanometer) must be:

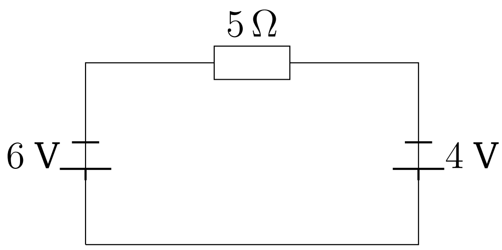
(A) $1.5\ \Omega$

(B) $9\ \Omega$

(C) $2.4\ \Omega$

(D) $6\ \Omega$

Q17. In the circuit shown, two cells of emf 6 V and 4 V (negligible internal resistance) drive current through a single $5\ \Omega$ resistor, the cells aiding each other. The current through the resistor is:



(A) 2 A

(B) 0.4 A

(C) 1.2 A

(D) 5 A

Q18. The resistance of a metallic conductor is $20\ \Omega$ at $0°$C. Its temperature coefficient of resistance is $4 \times 10^{-3}\,°\text{C}^{-1}$. The resistance of the conductor at $100°$C is:

(A) $24\ \Omega$

(B) $20\ \Omega$

(C) $28\ \Omega$

(D) $22\ \Omega$

Q19. A straight wire of length 0.2 m carries a current of 5 A and is placed perpendicular to a uniform magnetic field of 0.4 T. The force experienced by the wire is:

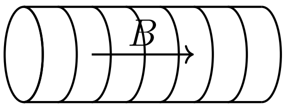
(A) 0.04 N

(B) 0.4 N

(C) 4 N

(D) 2 N

Q20. A long solenoid has 500 turns wound uniformly over a length of 0.25 m and carries a current of 2 A, as shown. Taking $\mu_0 = 4\pi \times 10^{-7}$ T m A^{-1}, the magnetic field near the centre of the solenoid is:



$N = 500,\ \ell = 0.25$ m

(A) $\pi \times 10^{-3}$ T

(B) $4\pi \times 10^{-3}$ T

(C) $2\pi \times 10^{-4}$ T

(D) $1.6\pi \times 10^{-3}$ T

Q21. Two long parallel wires, 0.4 m apart, carry *equal* currents of 10 A each in the *same* direction. The magnitude of the net magnetic field at the midpoint between the two wires is:

(A) zero

(B) 2×10^{-5} T

(C) 1×10^{-5} T

(D) 4×10^{-5} T

Q22. A galvanometer of resistance $50\ \Omega$ shows full-scale deflection for a current of 2 mA. To convert it into a voltmeter reading up to 10 V, the resistance that must be connected *in series* with it is:

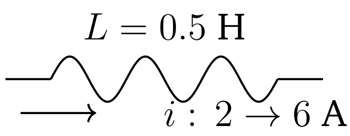
(A) $5000\ \Omega$

(B) $4950\ \Omega$

(C) $50\ \Omega$

(D) $500\ \Omega$

Q23. The current through the coil (inductor) shown changes steadily from 2 A to 6 A in 0.1 s. If the self-inductance of the coil is 0.5 H, the magnitude of the induced emf is:



(A) 2 V

(B) 10 V

(C) 20 V

(D) 40 V

Q24. In a series RLC circuit the resistance is $R = 8\ \Omega$, the inductive reactance is $X_L = 12\ \Omega$ and the capacitive reactance is $X_C = 6\ \Omega$. The impedance of the circuit is:

(A) $26\ \Omega$

(B) $8\ \Omega$

(C) $14\ \Omega$

(D) $10\ \Omega$

Q25. Which type of electromagnetic wave is commonly used in the remote controls of television sets and other household appliances?

(A) Infrared waves

(B) Gamma rays

(C) Microwaves

(D) Ultraviolet waves

Q26. A converging (convex) lens has a focal length of 25 cm. The power of this lens, in dioptres, is:

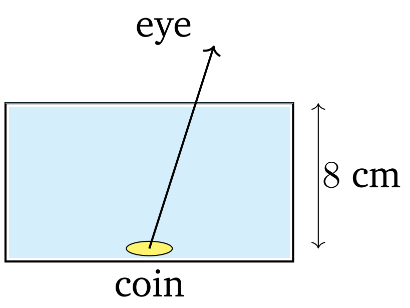
(A) -4 D

(B) $+4$ D

(C) $+2.5$ D

(D) $+0.25$ D

Q27. A coin lies at the bottom of a tank filled with water to a real depth of 8 cm, as shown. Viewed from directly above, the coin appears raised. If the refractive index of water is $\frac{4}{3}$, the apparent depth of the coin is:



(A) 10.7 cm

(B) 8 cm

(C) 6 cm

(D) 4 cm

Q28. In Young's double-slit experiment with light of wavelength 600 nm, the fringe width on the screen is β. Keeping the geometry of the apparatus unchanged, the source is now replaced by one of wavelength 450 nm. The new fringe width is:

(A) $0.75\,\beta$

(B) $1.33\,\beta$

(C) β

(D) $0.50\,\beta$

Q29. Light is incident on the surface of a transparent medium of refractive index $\sqrt{3}$. The angle of incidence at which the reflected light is completely plane-polarised (Brewster's angle) is:

(A) 30°

(B) 45°

(C) 90°

(D) 60°

Q30. An electron and a proton are accelerated so that they have the *same* kinetic energy. If λ_e and λ_p are their de Broglie wavelengths, then (since $\lambda = h/\sqrt{2mE}$):

(A) $\lambda_e = \lambda_p$

(B) $\lambda_e < \lambda_p$

(C) $\lambda_e > \lambda_p$

(D) $\lambda_e = \lambda_p/2$

Q31. For the hydrogen atom, the shortest wavelength (series limit) of the Balmer series corresponds to the transition $n = \infty \to n = 2$. Using the Rydberg constant $R = 1.097 \times 10^7\ \text{m}^{-1}$, this wavelength is approximately:

(A) 912 nm

(B) 365 nm

(C) 656 nm

(D) 122 nm

Q32. For a radioactive sample, the mean life τ and the half-life $T_{1/2}$ are related by:

(A) $\tau = T_{1/2}$

(B) $\tau = 0.693\,T_{1/2}$

(C) $\tau = 2\,T_{1/2}$

(D) $\tau = 1.44\,T_{1/2}$

Q33. In a nuclear reaction, the total rest-mass of the reactants exceeds that of the products by a mass defect $\Delta m = 0.005$ u. Taking 1 u $\equiv 931.5$ MeV, the energy released (Q-value) of the reaction is approximately:

(A) 4.66 MeV

(B) 0.93 MeV

(C) 9.32 MeV

(D) 46.6 MeV

Q34. A two-input logic gate has the truth table shown below, where the output $Y = 1$ only when *both* inputs are 1. The gate is:

A	B	Y
0	0	0
0	1	0
1	1	1

(row $1, 0$ omitted: $Y = 0$)

(A) an OR gate

(B) an AND gate

(C) a NOT gate

(D) a NOR gate

Q35. A Zener diode is used as a voltage regulator. In the circuit it is always connected:

(A) in forward bias, in series with the load

(B) in forward bias, in parallel with the load

(C) in reverse bias, in parallel with the load

(D) in reverse bias, in series with the load

Detailed Solutions

Q1.

Solution

Concept — Significant figures in addition: When quantities are added, the result is rounded to the *least number of decimal places* present among the terms.

Step 1 — Add the raw values: $12.5 + 0.046 + 2.34 = 14.886$ cm.

Step 2 — Apply the decimal-place rule: The term 12.5 has only one decimal place (the fewest), so the sum is rounded to one decimal place: $14.886 \to 14.9$ cm.

Why other options are wrong:

- (A) 14.886 keeps all digits, ignoring the precision limit.
- (C) 14.89 keeps two decimal places; (D) 15 over-rounds to no decimals.

Final Answer: Sum $= 14.9$ cm $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q1

Q2.

Solution

Concept — Same dimensions: Two quantities are dimensionally identical when their formulae match, even if they are physically different.

Step 1 — Work and torque: Work $=$ force $\times$ distance and torque $=$ force $\times$ perpendicular distance, both $[\text{ML}^2\text{T}^{-2}]$.

Step 2 — Reject the rest: Force $[\text{MLT}^{-2}]$ vs momentum $[\text{MLT}^{-1}]$; pressure $[\text{ML}^{-1}\text{T}^{-2}]$ vs energy $[\text{ML}^2\text{T}^{-2}]$; power $[\text{ML}^2\text{T}^{-3}]$ vs force $[\text{MLT}^{-2}]$ — none match.

Why other options are wrong:

- (B),(C),(D) each pair differs in the powers of L and/or T as shown above.

Final Answer: Work and torque share dimensions $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q2

Q3.

Solution

Concept — Apparent weight in a lift: For downward acceleration a, the scale reads $N = m(g - a)$.

Step 1 — Substitute: $N = 60\,(10 - 2) = 60 \times 8 = 480$ N.

Step 2 — Sense check: Accelerating downward means you feel lighter, so the reading must be *less* than $mg = 600$ N; $480 < 600$ ✓.

Why other options are wrong:

- (A) 600 N is the static (no-acceleration) weight.
- (B) 720 N uses $g + a$ (upward acceleration); (C) 120 N uses ma alone.

Final Answer: Reading $= 480$ N $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q3

Q4.

Solution

Concept — Angle of repose: The block is on the verge of sliding when $mg\sin\theta = \mu_s\,mg\cos\theta$, i.e. $\tan\theta = \mu_s$.

Step 1 — Solve for θ: $\tan\theta = \mu_s = \dfrac{1}{\sqrt{3}} \Rightarrow \theta = 30°$.

Step 2 — Meaning: The angle of repose is the maximum incline at which the block stays at rest; here it equals $30°$ and is independent of the mass.

Why other options are wrong:

- (A) $45°$ needs $\mu_s = 1$; (B) $60°$ needs $\mu_s = \sqrt{3}$.
- (D) $15°$ gives $\tan 15° \approx 0.27$, not $1/\sqrt{3} \approx 0.58$.

Final Answer: $\theta = 30° \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q4

Q5.

Solution

Concept — Relative velocity (perpendicular components): The boat's velocity across the river and the current along the river are perpendicular, so the resultant speed is $\sqrt{v_b^2 + v_c^2}$.

Step 1 — Substitute: $v = \sqrt{5^2 + 3^2} = \sqrt{25 + 9} = \sqrt{34}$ m s^{-1} ≈ 5.83 m s^{-1}.

Why other options are wrong:

- (B) 8 simply adds the speeds (valid only if they were parallel).
- (C) 2 subtracts them (valid only if anti-parallel); (D) 4 has no basis.

Final Answer: Resultant $= \sqrt{34}$ m s^{-1} $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q5

Q6.

Solution

Concept — Power against gravity: The useful work is $W = mgh$, and power $P = \dfrac{W}{t} = \dfrac{mgh}{t}$.

Step 1 — Substitute: $P = \dfrac{600 \times 10 \times 10}{20} = \dfrac{60000}{20} = 3000$ W.

Step 2 — Equivalent form: Since $\dfrac{m}{t} = 30$ kg s^{-1}, $P = \dot{m}\,gh = 30 \times 10 \times 10 = 3000$ W ✓.

Why other options are wrong:

- (A) 6000 W omits the division by $t = 20$ correctly but doubles; (B) 1500 W halves the result.
- (D) 300 W drops a factor of ten.

Final Answer: $P = 3000$ W $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q6

Q7.

Solution

Concept — Coefficient of restitution for a bounce: For a ball dropped from height h and rebounding to height h', $e = \sqrt{\dfrac{h'}{h}}$.

Step 1 — Substitute: $e = \sqrt{\dfrac{1.25}{5}} = \sqrt{0.25} = 0.5$.

Step 2 — Why the square root: Speed just before impact is $\sqrt{2gh}$ and just after is $\sqrt{2gh'}$, so $e = \dfrac{\sqrt{2gh'}}{\sqrt{2gh}} = \sqrt{h'/h}$.

Why other options are wrong:

- (A) 0.25 is the ratio h'/h itself, not its square root.
- (C),(D) do not satisfy $e = \sqrt{h'/h}$.

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

Answer: (B) Go Back to Q7

Q8.

Solution

Concept — Effect of Earth's rotation on g: Rotation provides a centrifugal reduction $g_{\text{eff}} = g - \omega^2 R\cos^2\lambda$, where λ is the latitude.

Step 1 — Largest reduction at the equator: At the equator $\lambda = 0$, $\cos^2\lambda = 1$, so the term $\omega^2 R$ is largest and g is reduced the most.

Step 2 — At the poles: $\lambda = 90°$, $\cos\lambda = 0$, so rotation has no effect there.

Why other options are wrong:

- (A) rotation *decreases* effective g, never increases it.
- (B) the effect varies with latitude; (C) the poles are unaffected, not increased.

Final Answer: g is smaller, most reduced at the equator $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q8

Q9.

Solution

Concept — Kepler's third law: $T^2 \propto r^3$, so $\frac{T_2}{T_1} = \left(\frac{r_2}{r_1}\right)^{3/2}$.

Step 1 — Apply the radius ratio 4: $\frac{T_2}{T} = 4^{3/2} = (2^2)^{3/2} = 2^3 = 8$.

Step 2 — Result: $T_2 = 8T$.

Why other options are wrong:

- (A) $4T$ assumes $T \propto r$; (C) $2T$ assumes $T \propto \sqrt{r}$.
- (D) $16T$ assumes $T \propto r^2$.

Final Answer: $T_2 = 8T \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q9

Q10.

Solution

Concept — Elastic energy density: The energy stored per unit volume in a strained wire is the area under the stress–strain line, $u = \frac{1}{2}(\text{stress})(\text{strain})$.

Step 1 — Derive: Within the elastic limit stress $= Y \times$strain, so

$$u = \frac{1}{2}(\text{stress})(\text{strain}) = \frac{1}{2}Y(\text{strain})^2.$$

Step 2 — Read off: The required expression is $\frac{1}{2}\times$ stress $\times$ strain.

Why other options are wrong:

- (A) omits the factor $\frac{1}{2}$ (that would be the total, not the area under the line).
- (B),(D) use the wrong numerical factor.

Final Answer: $u = \frac{1}{2}\text{stress} \times \text{strain} \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q10

Q11.

Solution

Concept — Terminal velocity (Stokes' law): Balancing weight, buoyancy and viscous drag gives $v_t = \dfrac{2r^2(\rho - \sigma)g}{9\eta}$, so $v_t \propto r^2$ for spheres of the same material in the same liquid.

Step 1 — Scale the radius: Doubling r multiplies v_t by $2^2 = 4$.

Step 2 — Result: The larger sphere falls 4 times faster at terminal speed.

Why other options are wrong:

- (B) 2 times assumes $v_t \propto r$; (C) "same" ignores the size dependence.
- (D) half assumes $v_t \propto 1/r$, the wrong direction.

Final Answer: v_t becomes 4 times as large $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q11

Q12.

Solution

Concept — Superposition of Coulomb forces: The net force on a charge is the vector sum of the forces from all the others.

Step 1 — Forces on the middle charge: The two outer $+q$ charges are each a distance d away on opposite sides. Each repels the middle charge with the *same* magnitude $F = \dfrac{kq^2}{d^2}$ but in *opposite* directions.

Step 2 — Add them: The two equal and opposite forces cancel, giving a net force of zero (the middle charge sits at a symmetric equilibrium point).

Why other options are wrong:

- (A),(B) ignore the cancellation by symmetry.
- (C) $\dfrac{4kq^2}{d^2}$ would add the magnitudes instead of subtracting the vectors.

Final Answer: Net force $= 0 \Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q12

Q13.

Solution

Concept — Field inside a charged shell: By Gauss's law, a Gaussian sphere of radius $r < R$ inside a uniformly charged shell encloses *no* charge, so the field there is zero.

Step 1 — Apply Gauss's law: $\oint \vec{E} \cdot d\vec{A} = \frac{q_{\text{enc}}}{\varepsilon_0} = 0 \Rightarrow E = 0$ everywhere inside.

Step 2 — Contrast outside: For $r \geq R$ the shell behaves like a point charge, $E = \frac{kQ}{r^2}$ — but that is the *outside* result, not what is asked.

Why other options are wrong:

- (A) kQ/r^2 is the field *outside* the shell.
- (C) kQ/R^2 is the field right at the surface; (D) is the (wrong) form for a uniformly charged solid sphere.

Final Answer: Inside the shell $E = 0 \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q13

Q14.

Solution

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

Step 1 — Add: $C_p = 2 + 3 + 5 = 10\ \mu\text{F}$.

Why other options are wrong:

- (A) $0.97\ \mu$F is the *series* combination $\left(\frac{1}{2} + \frac{1}{3} + \frac{1}{5}\right)^{-1}$.
- (B) $1.0\ \mu$F rounds the series value; (D) $30\ \mu$F multiplies instead of adding.

Final Answer: $C_p = 10\ \mu\text{F} \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q14

Q15.

Solution

Concept — Potential energy of two point charges: $U = \dfrac{k\,q_1 q_2}{r}$.

Step 1 — Substitute:

$$U = \frac{(9\times10^9)(2\times10^{-6})(3\times10^{-6})}{0.6}.$$

Step 2 — Evaluate: Numerator $= 9\times10^9\times6\times10^{-12} = 5.4\times10^{-2}$; dividing by 0.6 gives $U = 9\times10^{-2}$ J.

Why other options are wrong:

- (B) 9×10^{-3} misplaces a power of ten.
- (C) 5.4×10^{-2} forgets to divide by $r = 0.6$; (D) divides by 0.3.

Final Answer: $U = 9\times10^{-2}$ J $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q15

Q16.

Solution

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

Step 1 — Substitute: $S = \dfrac{Q\,R}{P} = \dfrac{4\times3}{2} = \dfrac{12}{2} = 6\ \Omega$.

Why other options are wrong:

- (A) $1.5\ \Omega$ inverts the ratio (PR/Q flipped wrongly).
- (B) $9\ \Omega$ multiplies all three; (C) $2.4\ \Omega$ uses PR/Q.

Final Answer: $S = 6\ \Omega \Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q16

Q17.

Solution

Concept — Kirchhoff's voltage law (cells aiding): When two cells aid each other in a single loop, their emfs add and the loop current is $I = \dfrac{\varepsilon_1 + \varepsilon_2}{R}$ (internal resistances negligible).

Step 1 — Net emf: $\varepsilon = 6 + 4 = 10$ V.

Step 2 — Current: $I = \dfrac{10}{5} = 2$ A.

Why other options are wrong:

- (B) 0.4 A uses the *difference* $6 - 4 = 2$ V (cells opposing).
- (C) 1.2 A uses 6 V alone; (D) 5 A ignores the resistor value.

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

Answer: (A) Go Back to Q17

Q18.

Solution

Concept — Resistance vs temperature: $R_t = R_0(1 + \alpha\,\Delta T)$.

Step 1 — Substitute: $R_{100} = 20\,[1 + (4 \times 10^{-3})(100)] = 20(1 + 0.4) = 20 \times 1.4$.

Step 2 — Evaluate: $R_{100} = 28\ \Omega$.

Why other options are wrong:

- (A) $24\ \Omega$ uses $\Delta T = 50$; (D) $22\ \Omega$ uses $\Delta T = 25$.
- (B) $20\ \Omega$ ignores the temperature rise entirely.

Final Answer: $R_{100} = 28\ \Omega \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q18

Q19.

Solution

Concept — Force on a current-carrying conductor: $F = BIL\sin\theta$; for a wire perpendicular to $\vec{B}$, $\theta = 90^\circ$ and $F = BIL$.

Step 1 — Substitute: $F = 0.4 \times 5 \times 0.2 = 0.4$ N.

Why other options are wrong:

- (A) 0.04 N misplaces a power of ten.
- (C) 4 N and (D) 2 N multiply by the wrong factor of ten or drop the length.

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

Answer: (B) Go Back to Q19

Q20.

Solution

Concept — Field inside a long solenoid: $B = \mu_0 nI$, where $n = \dfrac{N}{\ell}$ is the number of turns per unit length.

Step 1 — Turns per metre: $n = \dfrac{500}{0.25} = 2000\text{ m}^{-1}$.

Step 2 — Field:

$$B = (4\pi \times 10^{-7})(2000)(2) = 4\pi \times 10^{-7} \times 4000 = 1.6\pi \times 10^{-3}\text{ T}.$$

Why other options are wrong:

- (A) $\pi \times 10^{-3}$ drops a factor; (B) $4\pi \times 10^{-3}$ uses $n = 5000$.
- (C) $2\pi \times 10^{-4}$ misplaces a power of ten.

Final Answer: $B = 1.6\pi \times 10^{-3}\text{ T} \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q20

Q21.

Solution

Concept — Fields of two parallel wires (same direction): At the midpoint, the two wires lie on opposite sides, so their fields point in *opposite* directions and tend to cancel.

Step 1 — Equal magnitudes: Both wires carry the same current and are the same distance (0.2 m) from the midpoint, so $B_1 = B_2$.

Step 2 — Net field: Equal and opposite $\Rightarrow B_{\text{net}} = B_1 - B_2 = 0$.

Why other options are wrong:

- (B),(C) would be the field of a single wire at 0.2 m; the second wire cancels it.
- (D) corresponds to *adding* the fields (which happens only for *opposite* currents).

Final Answer: $B_{\text{net}} = 0$ at the midpoint $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q21

Q22.

Solution

Concept — Galvanometer to voltmeter: A high resistance R is added *in series* so that the full-scale current I_g drops the desired voltage V across the combination: $R = \dfrac{V}{I_g} - G$.

Step 1 — Substitute ($V = 10$ V, $I_g = 2 \times 10^{-3}$ A, $G = 50\ \Omega$):

$$R = \frac{10}{2 \times 10^{-3}} - 50 = 5000 - 50 = 4950\ \Omega.$$

Why other options are wrong:

- (A) $5000\ \Omega$ forgets to subtract the coil resistance G.
- (C),(D) are far too small to limit the current to 2 mA at 10 V.

Final Answer: $R = 4950\ \Omega \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q22

Q23.

Solution

Concept — Self-induced emf: $\varepsilon = L\dfrac{di}{dt}$ (magnitude).

Step 1 — Rate of change of current: $\dfrac{di}{dt} = \dfrac{6-2}{0.1} = \dfrac{4}{0.1} = 40\ \text{A s}^{-1}$.

Step 2 — Induced emf: $\varepsilon = L\dfrac{di}{dt} = 0.5 \times 40 = 20$ V.

Why other options are wrong:

- (A) 2 V uses $\Delta i/\Delta t = 4$ without the time conversion.
- (B) 10 V uses $\Delta i = 2$; (D) 40 V forgets the factor $L = 0.5$.

Final Answer: $\varepsilon = 20\ \text{V} \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q23

Q24.

Solution

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

Step 1 — Net reactance: $X_L - X_C = 12 - 6 = 6\ \Omega$.

Step 2 — Impedance: $Z = \sqrt{8^2 + 6^2} = \sqrt{64 + 36} = \sqrt{100} = 10\ \Omega$.

Why other options are wrong:

- (A) 26 Ω adds $R + X_L + X_C$ arithmetically.
- (B) 8 Ω uses R alone; (C) 14 Ω adds R and the net reactance directly.

Final Answer: $Z = 10\ \Omega \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q24

Q25.

Solution

Concept — Uses of EM waves: Television and appliance remote controls transmit coded pulses of *infrared* radiation to the receiver.

Step 1 — Identify the band: Infrared sits just beyond the red end of the visible spectrum and is easily produced by LEDs in remotes.

Why other options are wrong:

- (B) gamma rays are used in radiotherapy and sterilisation, not remotes.
- (C) microwaves are used for radar and cooking; (D) ultraviolet is used for sterilisation.

Final Answer: Remote controls use infrared $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q25

Q26.

Solution

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

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

Step 2 — Compute: $P = \dfrac{1}{0.25} = +4$ D.

Why other options are wrong:

- (A) -4 D would be a diverging (concave) lens.
- (C) $+2.5$ D uses $f = 40$ cm; (D) $+0.25$ D forgets to convert cm to m.

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

Answer: (B) Go Back to Q26

Q27.

Solution

Concept — Apparent depth: For an object viewed normally from above, apparent depth $= \dfrac{\text{real depth}}{n}$.

Step 1 — Substitute: $d_{\text{app}} = \dfrac{8}{4/3} = 8 \times \dfrac{3}{4} = 6$ cm.

Step 2 — Interpretation: The coin appears raised by $8 - 6 = 2$ cm because of refraction at the water surface.

Why other options are wrong:

- (A) 10.7 cm multiplies by n instead of dividing.
- (B) 8 cm ignores refraction; (D) 4 cm uses $n = 2$.

Final Answer: Apparent depth $= 6$ cm $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q27

Q28.

Solution

Concept — Fringe width vs wavelength: $\beta = \dfrac{\lambda D}{d}$, so with the geometry fixed $\beta \propto \lambda$.

Step 1 — Take the ratio: $\dfrac{\beta'}{\beta} = \dfrac{\lambda'}{\lambda} = \dfrac{450}{600} = 0.75$.

Step 2 — Result: $\beta' = 0.75\,\beta$ (the fringes get narrower as the wavelength decreases).

Why other options are wrong:

- (B) $1.33\,\beta$ inverts the ratio ($600/450$).
- (C) β ignores the wavelength change; (D) $0.50\,\beta$ uses the wrong ratio.

Final Answer: $\beta' = 0.75\,\beta \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q28

Q29.

Solution

Concept — Brewster's law: The reflected light is completely plane-polarised when $\tan\theta_B = n$.

Step 1 — Substitute: $\tan\theta_B = \sqrt{3} \Rightarrow \theta_B = 60°$.

Step 2 — Consistency: At this angle the reflected and refracted rays are perpendicular, the signature of Brewster's condition.

Why other options are wrong:

- (A) $30°$ gives $\tan 30° = 1/\sqrt{3}$, the wrong index.
- (B) $45°$ gives $n = 1$; (C) $90°$ is grazing incidence, not Brewster's angle.

Final Answer: $\theta_B = 60° \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q29

Q30.

Solution

Concept — de Broglie wavelength at fixed kinetic energy: $\lambda = \frac{h}{p} = \frac{h}{\sqrt{2mE}}$, so for equal E, $\lambda \propto \frac{1}{\sqrt{m}}$.

Step 1 — Compare the masses: The electron is far lighter than the proton ($m_e \ll m_p$), so $\frac{1}{\sqrt{m_e}} > \frac{1}{\sqrt{m_p}}$.

Step 2 — Conclusion: The lighter electron has the *longer* wavelength: $\lambda_e > \lambda_p$.

Why other options are wrong:

- (A) equal wavelengths would need equal masses.
- (B) $\lambda_e < \lambda_p$ reverses the mass dependence; (D) the ratio is $\sqrt{m_p/m_e} \approx 43$, not 2.

Final Answer: $\lambda_e > \lambda_p \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q30

Q31.

Solution

Concept — Series limit of the Balmer series: $\frac{1}{\lambda} = R\left(\frac{1}{2^2} - \frac{1}{n^2}\right)$; the shortest wavelength is the limit $n \to \infty$, giving $\frac{1}{\lambda} = \frac{R}{4}$.

Step 1 — Compute: $\frac{1}{\lambda} = \frac{1.097 \times 10^7}{4} = 2.74 \times 10^6\ \text{m}^{-1}$.

Step 2 — Invert: $\lambda = \frac{1}{2.74 \times 10^6} \approx 3.65 \times 10^{-7}\ \text{m} = 365\ \text{nm}$.

Why other options are wrong:

- (A) 912 nm is the Lyman-style limit divided wrongly (uses R not $R/4$ inversely).
- (C) 656 nm is the H_α line ($3 \to 2$), not the limit; (D) 122 nm belongs to the Lyman series.

Final Answer: $\lambda \approx 365\ \text{nm} \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q31

Q32.

Solution

Concept — Mean life and half-life: $\tau = \frac{1}{\lambda}$ and $T_{1/2} = \frac{\ln 2}{\lambda} = 0.693\,\tau$.

Step 1 — Rearrange: $\tau = \frac{T_{1/2}}{0.693} = 1.44\,T_{1/2}$.

Step 2 — Note: The mean life is always *longer* than the half-life, since $1.44 > 1$.

Why other options are wrong:

- (A) $\tau = T_{1/2}$ confuses the two; (B) $\tau = 0.693\,T_{1/2}$ inverts the relation.
- (C) $\tau = 2\,T_{1/2}$ uses the wrong factor.

Final Answer: $\tau = 1.44\,T_{1/2} \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q32

Q33.

Solution

Concept — Q-value from mass defect: The energy released equals the mass defect times c^2: $Q = \Delta m \times 931.5$ MeV (with Δm in atomic mass units).

Step 1 — Substitute: $Q = 0.005 \times 931.5 = 4.66$ MeV.

Step 2 — Sign: Since the reactants are heavier, energy is released (exothermic), so $Q > 0$.

Why other options are wrong:

- (B) 0.93 MeV uses $\Delta m = 0.001$ u; (C) 9.32 MeV uses $\Delta m = 0.01$ u.
- (D) 46.6 MeV misplaces a power of ten.

Final Answer: $Q \approx 4.66$ MeV $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q33

Q34.

Solution

Concept — Identifying a gate from its truth table: A gate whose output is 1 *only* when all inputs are 1 (and 0 otherwise) is the AND gate, $Y = A \cdot B$.

Step 1 — Read the table: $Y = 1$ at $(A, B) = (1, 1)$ and $Y = 0$ for $(0, 0)$, $(0, 1)$ and (the omitted) $(1, 0)$ — exactly the AND pattern.

Step 2 — Verify the logic: $0 \cdot 0 = 0$, $0 \cdot 1 = 0$, $1 \cdot 0 = 0$, $1 \cdot 1 = 1$ ✓.

Why other options are wrong:

- (A) an OR gate gives 1 when *either* input is 1, so $(0, 1)$ would give 1.
- (C) NOT is a single-input gate; (D) a NOR gate gives 1 only when both inputs are 0.

Final Answer: The gate is an AND gate $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q34

Q35.

Solution

Concept — Zener diode as a voltage regulator: A Zener diode operated in its *reverse breakdown* region maintains a nearly constant voltage across itself. It is connected *in parallel* with the load (across the output) so that the load voltage is clamped to the Zener voltage.

Step 1 — Bias direction: The Zener must be *reverse biased* to work in the breakdown region; a series resistor limits the current.

Step 2 — Connection: Placed *in parallel* with the load, it absorbs current variations and keeps $V_{\text{load}} = V_Z$ constant.

Why other options are wrong:

- (A),(B) forward bias would not give the stable breakdown voltage.
- (D) a series Zener cannot clamp the load voltage as a shunt regulator does.

Final Answer: Reverse biased, in parallel with the load $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q35

Answer Key

Q	Ans	Q	Ans	Q	Ans	Q	Ans	Q	Ans
1	B	2	A	3	D	4	C	5	A
6	C	7	B	8	D	9	B	10	C
11	A	12	D	13	B	14	C	15	A
16	D	17	A	18	C	19	B	20	D
21	A	22	B	23	C	24	D	25	A
26	B	27	C	28	A	29	D	30	C
31	B	32	D	33	A	34	B	35	C