SRMJEEE Physics Sample Paper – 5

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. In a simple-pendulum experiment to measure g using $g = \frac{4\pi^2 L}{T^2}$, the length L is measured with 1% error and the time period T with 1.5% error. The maximum percentage error in the value of g obtained is:

(A) 2.5%

(B) 4%

(C) 3%

(D) 5.5%

Q2. In the relation $\left(P + \frac{a}{V^2}\right)$ = constant, where P is pressure and V is volume, the dimensional formula of the constant a is:

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

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

(C) $[\mathrm{ML^{5}T^{-2}}]$

(D) $[ML^{-1}T^{-1}]$

Q3. Two blocks of masses 4 kg and 2 kg are placed in contact on a smooth horizontal surface. A horizontal force $F = 12$ N is applied to the 4 kg block, pushing both blocks together. The magnitude of the contact (mutual) force between the two blocks is:

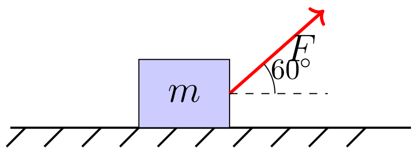
(A) 4 N

(B) 8 N

(C) 12 N

(D) 6 N

Q4. A block of mass $m = 5$ kg rests on a rough horizontal floor. It is pulled by a force $F = 20$ N acting at 60° above the horizontal, as shown. Taking $g = 10$ m s^{-2}, the normal reaction exerted by the floor on the block is:



(A) 50 N

(B) 20 N

(C) 67.3 N

(D) 32.7 N

Q5. A car moving at 20 m s^{-1} is brought to rest by applying brakes that produce a uniform deceleration of 5 m s^{-2}. The distance travelled by the car before it stops is:

(A) 20 m

(B) 80 m

(C) 40 m

(D) 10 m

Q6. A man raises a load of mass 10 kg vertically through a height of 2 m at constant speed. The work done against gravity is $(g = 10 \text{ m s}^{-2})$:

(A) 100 J

(B) 200 J

(C) 20 J

(D) 400 J

Q7. A ball of mass 0.2 kg moving with a speed of 10 m s^{-1} strikes a rigid wall normally and rebounds elastically with the same speed. The magnitude of the impulse imparted to the ball by the wall is:

(A) 1 N s

(B) zero

(C) 2 N s

(D) 4 N s

Q8. A planet has a mass twice that of the Earth and a radius twice that of the Earth. If g is the acceleration due to gravity on the Earth's surface, the acceleration due to gravity on the surface of this planet is:

(A) $g/2$

(B) g

(C) $2g$

(D) $g/4$

Q9. The escape velocity from the surface of a planet of mass M and radius R is given by:

(A) $\sqrt{\dfrac{GM}{R}}$

(B) $\sqrt{\dfrac{GM}{2R}}$

(C) $\sqrt{\dfrac{2GM}{R}}$

(D) $\dfrac{2GM}{R}$

Q10. A liquid of bulk modulus $B = 2 \times 10^9$ Pa is subjected to an increase in pressure of 2×10^6 Pa. The fractional change in its volume $\left(\dfrac{\Delta V}{V}\right)$ is:

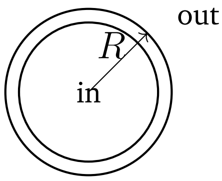
(A) 10^{-2}

(B) 10^{-3}

(C) 10^{-4}

(D) 10^{-6}

Q11. A soap bubble of radius $R = 2$ cm is blown using a soap solution of surface tension $T = 0.03$ N m^{-1}, as shown. The excess pressure inside the bubble (over the outside atmosphere) is:



soap bubble

(A) 1.5 Pa

(B) 3 Pa

(C) 12 Pa

(D) 6 Pa

Q12. For two electrons separated by a distance r, the ratio of the magnitude of the electrostatic force to that of the gravitational force between them is of the order of:

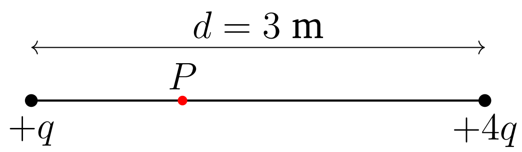
(A) 10^{42}

(B) 10^{20}

(C) 10^{-42}

(D) 1

Q13. Two point charges $+q$ and $+4q$ are placed a distance $d = 3$ m apart, as shown. The point on the line joining them where the net electric field is zero lies at a distance from the charge $+q$ equal to:



(A) 1.5 m

(B) 1 m

(C) 2 m

(D) 0.75 m

Q14. A parallel-plate air capacitor is charged and then *disconnected* from the battery. If the separation between its plates is now doubled, the charge Q on the capacitor:

(A) doubles

(B) halves

(C) remains unchanged

(D) becomes four times

Q15. An electron (charge $e = 1.6 \times 10^{-19}$ C) is accelerated from rest through a potential difference of 200 V. The kinetic energy gained by the electron is:

(A) 3.2×10^{-17} J

(B) 1.6×10^{-19} J

(C) 200 J

(D) 3.2×10^{-19} J

Q16. Two resistors of $4\ \Omega$ and $4\ \Omega$ are connected in parallel, and this combination is connected in series with a third resistor of $3\ \Omega$. The equivalent resistance of the whole network is:

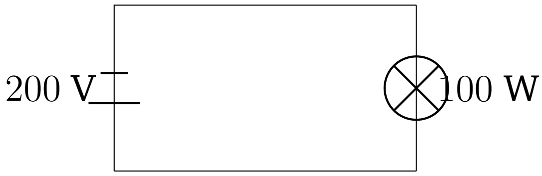
(A) $11\ \Omega$

(B) $2\ \Omega$

(C) $7\ \Omega$

(D) $5\ \Omega$

Q17. An electric bulb is rated "100 W, 200 V" and is connected to a 200 V supply, as shown. The resistance of the filament (at the operating temperature) is:



(A) $200\ \Omega$

(B) $100\ \Omega$

(C) $400\ \Omega$

(D) $2\ \Omega$

Q18. A copper wire has a resistance R. A second copper wire of the *same length* but *twice the cross-sectional area* is taken. Comparing the two wires, which statement is correct?

(A) Both the resistance and the resistivity are halved.

(B) The resistivity is unchanged, but the resistance is halved.

(C) Both the resistance and the resistivity are doubled.

(D) The resistance is unchanged, but the resistivity is halved.

Q19. In a velocity selector, a beam of charged particles passes undeflected through mutually perpendicular electric and magnetic fields $E = 3 \times 10^5$ V m^{-1} and $B = 0.2$ T. The speed of the particles that pass through undeflected is:

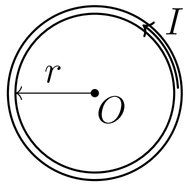
(A) 1.5×10^6 m s^{-1}

(B) 6×10^4 m s^{-1}

(C) 1.5×10^4 m s^{-1}

(D) 6×10^6 m s^{-1}

Q20. A flat circular coil of $N = 100$ turns and radius $r = 0.05$ m carries a current $I = 2$ A, as shown. The magnitude of the magnetic field at the centre O of the coil is $\left(\mu_0 = 4\pi \times 10^{-7}\ \text{T m A}^{-1}\right)$:



N turns

(A) $4\pi \times 10^{-6}$ T

(B) $4\pi \times 10^{-5}$ T

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

(D) $8\pi \times 10^{-4}$ T

Q21. At a tangent galvanometer's location the deflection is 45° when the magnetic field produced by the coil at its centre is $B_{\text{coil}} = 3 \times 10^{-5}$ T. The horizontal component of the Earth's magnetic field B_H at that place is (use $B_{\text{coil}} = B_H \tan\theta$):

(A) 1.5×10^{-5} T

(B) 3×10^{-5} T

(C) 6×10^{-5} T

(D) 4.2×10^{-5} T

Q22. The current sensitivity of a moving-coil galvanometer is defined as the deflection produced per unit current, $\dfrac{\theta}{I} = \dfrac{NAB}{k}$. To *increase* the current sensitivity, one should:

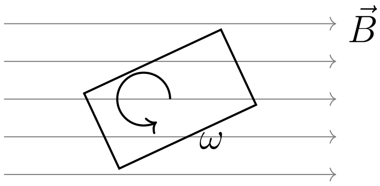
(A) increase the number of turns N of the coil

(B) increase the torsional constant k of the suspension

(C) decrease the area A of the coil

(D) decrease the magnetic field B

Q23. A coil of $N = 200$ turns, each of area $A = 0.05$ m^2, rotates with an angular speed $\omega = 100$ rad s^{-1} in a uniform magnetic field $B = 0.1$ T, as shown. The peak (maximum) value of the induced emf is $(\varepsilon_0 = NBA\omega)$:



rotating coil

(A) 50 V

(B) 200 V

(C) 100 V

(D) 20 V

Q24. In a series AC circuit the rms voltage is 200 V, the rms current is 2 A, and the phase angle between them is $60°$. The average power dissipated in the circuit is $(\cos 60° = 0.5)$:

(A) 400 W

(B) 800 W

(C) 346 W

(D) 200 W

Q25. Which of the following arranges the electromagnetic waves in order of *increasing* frequency?

(A) Infrared $<$ Visible $<$ Ultraviolet $<$ X-rays

(B) X-rays $<$ Ultraviolet $<$ Visible $<$ Infrared

(C) Visible $<$ Infrared $<$ X-rays $<$ Ultraviolet

(D) Ultraviolet $<$ X-rays $<$ Visible $<$ Infrared

Q26. An object is placed 30 cm in front of a concave mirror of focal length 20 cm. The position of the image formed is:

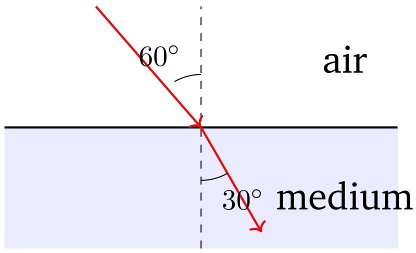
(A) 30 cm in front of the mirror (real)

(B) 60 cm in front of the mirror (real)

(C) 12 cm behind the mirror (virtual)

(D) 20 cm in front of the mirror (real)

Q27. A ray of light travelling in air strikes the flat surface of a transparent medium at an angle of incidence $60°$ and is refracted at an angle of $30°$, as shown. The refractive index of the medium is:



(A) $\dfrac{1}{\sqrt{3}}$

(B) $\sqrt{2}$

(C) $\sqrt{3}$

(D) 2

Q28. Two coherent light beams of amplitudes in the ratio $3 : 1$ interfere. The ratio of the maximum to the minimum intensity, $\dfrac{I_{\max}}{I_{\min}}$, in the resulting pattern is:

(A) $3 : 1$

(B) $9 : 1$

(C) $2 : 1$

(D) $4:1$

Q29. Unpolarised light of intensity I_0 passes through three ideal polaroids placed one after another. The transmission axis of the second polaroid is at 45° to that of the first, and the third is at 90° to the first (i.e. 45° to the second). The intensity of light emerging from the third polaroid is:

(A) $I_0/8$

(B) $I_0/4$

(C) zero

(D) $I_0/2$

Q30. In the photoelectric effect, if the intensity of the incident light is increased while its frequency is kept fixed (above the threshold), then:

(A) the maximum kinetic energy of the emitted electrons increases.

(B) the photoelectric current increases, but the maximum kinetic energy of the electrons stays the same.

(C) both the current and the maximum kinetic energy increase.

(D) neither the current nor the maximum kinetic energy changes.

Q31. The energy of the electron in the ground state ($n = 1$) of the hydrogen atom is -13.6 eV. The energy required to ionize a hydrogen atom from its ground state is:

(A) 3.4 eV

(B) 27.2 eV

(C) 10.2 eV

(D) 13.6 eV

Q32. A radioactive sample has a half-life of 5730 years. After 11460 years, the fraction of the original number of nuclei that remains undecayed is:

(A) $1/2$

(B) $1/3$

(C) $1/4$

(D) $1/8$

Q33. Which of the following statements about nuclear fission and fusion is correct?

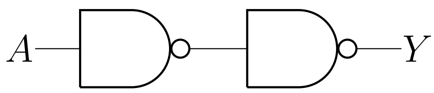
(A) Both fission of a heavy nucleus and fusion of light nuclei release energy because the products have a greater binding energy per nucleon than the reactants.

(B) Fission releases energy but fusion always absorbs energy.

(C) Energy is released only when the products have a smaller binding energy per nucleon.

(D) Fusion of light nuclei absorbs energy because light nuclei are already very stable.

Q34. Two NAND gates are connected as shown: the two inputs of the first NAND gate are tied together to a single input A, and its output feeds both inputs of a second NAND gate, whose output is Y. The gate realised between A and Y is:



(A) an AND gate giving $Y = A$ always equal to 1

(B) a NAND gate

(C) an OR gate

(D) a NOT gate followed by a NOT gate, so that $Y = A$ (a buffer)

Q35. Regarding the energy band gap E_g between the valence band and the conduction band, the correct ordering for a conductor, a semiconductor and an insulator is:

(A) insulator < semiconductor < conductor

(B) conductor $<$ semiconductor $<$ insulator

(C) semiconductor $<$ insulator $<$ conductor

(D) all three have the same band gap

Detailed Solutions

Q1.

Solution

Concept — Combination of errors: For $g = \frac{4\pi^2 L}{T^2}$, the fractional errors add as $\frac{\Delta g}{g} = \frac{\Delta L}{L} + 2\frac{\Delta T}{T}$, since T appears squared.

Step 1 — Insert the percentage errors: $\frac{\Delta L}{L} = 1\%$ and $\frac{\Delta T}{T} = 1.5\%$.

Step 2 — Add (with the factor 2 on T):

$$\frac{\Delta g}{g} = 1\% + 2(1.5\%) = 1\% + 3\% = 4\%.$$

Why other options are wrong:

- (A) 2.5% adds $1\% + 1.5\%$, forgetting the square on T.
- (C) 3% keeps only the time-error term.
- (D) 5.5% wrongly squares L as well.

Final Answer: Maximum error in g is $4\% \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q1

Q2.

Solution

Concept — Dimensional homogeneity: In $\left(P + \frac{a}{V^2}\right)$, the term $\frac{a}{V^2}$ must have the same dimensions as pressure P. Hence $[a] = [P][V^2]$.

Step 1 — Dimensions of the building blocks: $[P] = [\text{ML}^{-1}\text{T}^{-2}]$ and $[V] = [\text{L}^3]$, so $[V^2] = [\text{L}^6]$.

Step 2 — Multiply:

$$[a] = [\text{ML}^{-1}\text{T}^{-2}]\,[\text{L}^6] = [\text{ML}^5\text{T}^{-2}].$$

Why other options are wrong:

- (A) is just the dimension of pressure P, i.e. a/V^2 not a.
- (B) $[\text{ML}^2\text{T}^{-2}]$ is energy; (D) is not dimensionally consistent here.

Final Answer: $[a] = [\text{ML}^5\text{T}^{-2}] \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q2

Q3.

Solution

Concept — Two blocks pushed together: Treat the system as one body to get the common acceleration, then isolate the rear block to find the contact force.

Step 1 — Common acceleration: Total mass $= 4 + 2 = 6$ kg,

$$a = \frac{F}{m_{\text{total}}} = \frac{12}{6} = 2\text{ m s}^{-2}.$$

Step 2 — Force on the 2 kg block: The only horizontal force on it is the contact force N from the 4 kg block:

$$N = m_2\, a = 2 \times 2 = 4\text{ N}.$$

Why other options are wrong:

- (B) 8 N uses the 4 kg mass instead of 2 kg.
- (C) 12 N is the applied force F itself; (D) 6 N has no basis.

Final Answer: Contact force $= 4$ N $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q3

Q4.

Solution

Concept — Normal reaction with an angled pull: The upward vertical component of the pull $F\sin\theta$ reduces the normal reaction. Balancing the vertical forces, $N = mg - F\sin\theta$.

Step 1 — Weight and vertical pull component: $mg = 5 \times 10 = 50$ N; $F\sin 60^\circ = 20 \times \dfrac{\sqrt{3}}{2} = 10\sqrt{3} \approx 17.3$ N.

Step 2 — Vertical balance:

$$N = mg - F\sin 60^\circ = 50 - 17.3 = 32.7\text{ N}.$$

Why other options are wrong:

- (A) 50 N ignores the lifting effect of the pull.
- (C) 67.3 N *adds* $F \sin 60°$, as for a downward push.
- (B) 20 N is just F.

Final Answer: $N \approx 32.7 \text{ N} \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q4

Q5.

Solution

Concept — Kinematics with uniform deceleration: Use $v^2 = u^2 - 2as$ with the final speed $v = 0$.

Step 1 — Substitute: $u = 20 \text{ m s}^{-1}$, $a = 5 \text{ m s}^{-2}$,

$$0 = (20)^2 - 2(5)s \Rightarrow s = \frac{400}{10} = 40 \text{ m}.$$

Why other options are wrong:

- (A) 20 m uses u instead of u^2.
- (B) 80 m drops the factor 2 in $2as$; (D) 10 m is off by a factor of 4.

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

Answer: (C) Go Back to Q5

Q6.

Solution

Concept — Work against gravity: Raising a mass at constant speed, the work done against gravity equals the gain in gravitational potential energy, $W = mgh$.

Step 1 — Substitute: $m = 10$ kg, $g = 10 \text{ m s}^{-2}$, $h = 2$ m,

$$W = 10 \times 10 \times 2 = 200 \text{ J}.$$

Why other options are wrong:

- (A) 100 J drops a factor (e.g. $h = 1$ m).
- (C) 20 J forgets g; (D) 400 J doubles the height.

Final Answer: $W = 200 \text{ J} \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q6

Q7.

Solution

Concept — Impulse–momentum theorem: Impulse equals the change in momentum, $J = \Delta p = p_f - p_i$. For an elastic rebound the speed is unchanged but the direction reverses.

Step 1 — Take the incoming direction as positive: $p_i = mv = 0.2 \times 10 = +2$ N s; after rebound $p_f = -mv = -2$ N s.

Step 2 — Magnitude of impulse:

$$|J| = |p_f - p_i| = |-2 - 2| = 4 \text{ N s}.$$

Why other options are wrong:

- (C) 2 N s forgets that the momentum reverses (it uses mv, not $2mv$).
- (B) zero would apply only if the ball stuck and kept moving the same way (it does not).
- (A) 1 N s halves the result.

Final Answer: $|J| = 4$ N s $\Rightarrow$ D

Answer: (D) Go Back to Q7

Q8.

Solution

Concept — Surface gravity: $g = \dfrac{GM}{R^2}$, so $g \propto \dfrac{M}{R^2}$.

Step 1 — Scale mass and radius: $M \to 2M$ and $R \to 2R$,

$$g_{\text{planet}} = \frac{G(2M)}{(2R)^2} = \frac{2GM}{4R^2} = \frac{1}{2} \cdot \frac{GM}{R^2} = \frac{g}{2}.$$

Why other options are wrong:

- (B) g would need M and R^2 to scale equally; here R^2 grows fourfold.
- (C) $2g$ ignores the radius; (D) $g/4$ ignores the doubled mass.

Final Answer: $g_{\text{planet}} = g/2 \Rightarrow$ A

Answer: (A) Go Back to Q8

Q9.

Solution

Concept — Escape velocity: The escape speed is found by setting kinetic energy equal to the magnitude of gravitational potential energy: $\frac{1}{2}mv_e^2 = \frac{GMm}{R}$.

Step 1 — Solve for v_e:

$$v_e = \sqrt{\frac{2GM}{R}}.$$

Why other options are wrong:

- (A) $\sqrt{GM/R}$ is the orbital (circular) speed, missing the factor 2.
- (B) halves under the root incorrectly; (D) has wrong dimensions (no square root).

Final Answer: $v_e = \sqrt{\frac{2GM}{R}} \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q9

Q10.

Solution

Concept — Bulk modulus: $B = -\frac{\Delta P}{\Delta V/V}$, so the fractional volume change is $\frac{\Delta V}{V} = \frac{\Delta P}{B}$ (in magnitude).

Step 1 — Substitute:

$$\frac{\Delta V}{V} = \frac{\Delta P}{B} = \frac{2 \times 10^6}{2 \times 10^9} = 10^{-3}.$$

Why other options are wrong:

- (A) 10^{-2} and (C) 10^{-4} misplace a power of ten.
- (D) 10^{-6} squares the pressure ratio.

Final Answer: $\frac{\Delta V}{V} = 10^{-3} \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q10

Q11.

Solution

Concept — Excess pressure in a soap bubble: A soap bubble has *two* liquid surfaces, so the excess pressure is $\Delta P = \frac{4T}{R}$ (a single drop would give $2T/R$).

Step 1 — Convert units: $R = 2$ cm $= 0.02$ m, $T = 0.03$ N m^{-1}.

Step 2 — Substitute:

$$\Delta P = \frac{4T}{R} = \frac{4 \times 0.03}{0.02} = \frac{0.12}{0.02} = 6 \text{ Pa}.$$

Why other options are wrong:

- (B) 3 Pa uses $2T/R$ (a single-surface drop, not a bubble).
- (A) 1.5 Pa uses T/R; (C) 12 Pa forgets to convert cm to m correctly.

Final Answer: $\Delta P = 6$ Pa $\Rightarrow \boxed{\text{D}}$

Answer: (D) **Go Back to Q11**

Q12.

Solution

Concept — Ratio of electric to gravitational force: Both forces vary as $1/r^2$, so the r-dependence cancels:

$$\frac{F_e}{F_g} = \frac{ke^2}{Gm_e^2}.$$

Step 1 — Insert known constants: $k = 9 \times 10^9$, $e = 1.6 \times 10^{-19}$ C, $G = 6.67 \times 10^{-11}$, $m_e = 9.1 \times 10^{-31}$ kg.

Step 2 — Estimate the order:

$$\frac{F_e}{F_g} = \frac{(9 \times 10^9)(1.6 \times 10^{-19})^2}{(6.67 \times 10^{-11})(9.1 \times 10^{-31})^2} \approx 4 \times 10^{42}.$$

Why other options are wrong:

- (C) 10^{-42} is the inverse ratio F_g/F_e.
- (B) 10^{20} and (D) 1 are far too small — gravity between electrons is utterly negligible.

Final Answer: $F_e/F_g \sim 10^{42} \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q12

Q13.

Solution

Concept — Null point between two like charges: The net field is zero at the point where the two field magnitudes are equal. For like charges this point lies *between* them, closer to the smaller charge.

Step 1 — Set the fields equal: Let the null point be a distance x from $+q$ and $(d - x)$ from $+4q$:

$$\frac{kq}{x^2} = \frac{k(4q)}{(d-x)^2} \Rightarrow \frac{(d-x)^2}{x^2} = 4 \Rightarrow \frac{d-x}{x} = 2.$$

Step 2 — Solve for x: $d - x = 2x \Rightarrow d = 3x \Rightarrow x = \frac{d}{3} = \frac{3}{3} = 1$ m.

Why other options are wrong:

- (A) 1.5 m is the midpoint, wrong for unequal charges.
- (C) 2 m is the distance from $+4q$ (i.e. $d - x$), not from $+q$.
- (D) 0.75 m uses the wrong square-root direction.

Final Answer: $x = 1$ m from $+q \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q13

Q14.

Solution

Concept — Isolated charged capacitor: Once the battery is *disconnected*, the charge Q has nowhere to go, so it is conserved regardless of how the plate separation changes. (The capacitance $C = \varepsilon_0 A/d$ and the voltage do change, but not Q.)

Step 1 — Apply charge conservation: With the plates isolated, Q stays exactly the same when d is doubled.

Step 2 — What does change: C halves ($C \propto 1/d$), and since $Q = CV$ is fixed, V doubles.

Why other options are wrong:

- (A),(B),(D) describe how C or V change, but the *charge* on an isolated capacitor cannot change.

Final Answer: Q remains unchanged $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q14

Q15.

Solution

Concept — Energy gained by an accelerated charge: The work done by the field equals the kinetic energy gained, $\Delta K = qV$.

Step 1 — Substitute: $q = 1.6 \times 10^{-19}$ C, $V = 200$ V,

$$\Delta K = (1.6 \times 10^{-19})(200) = 3.2 \times 10^{-17} \text{ J}.$$

Step 2 — In electron-volts: $\Delta K = 200$ eV, consistent with 1 eV $= 1.6 \times 10^{-19}$ J.

Why other options are wrong:

- (B) 1.6×10^{-19} J uses $V = 1$ V.
- (C) 200 J confuses eV with joules; (D) misplaces a power of ten.

Final Answer: $\Delta K = 3.2 \times 10^{-17}$ J $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q15

Q16.

Solution

Concept — Series and parallel combination: First reduce the parallel pair, then add the series resistor.

Step 1 — Parallel pair ($4\ \Omega \parallel 4\ \Omega$):

$$R_p = \frac{4 \times 4}{4+4} = \frac{16}{8} = 2\ \Omega.$$

Step 2 — Add the series $3\ \Omega$:

$$R_{\text{eq}} = R_p + 3 = 2 + 3 = 5\ \Omega.$$

Why other options are wrong:

- (A) $11\ \Omega$ adds all three in series.
- (B) $2\ \Omega$ stops at the parallel pair; (C) $7\ \Omega$ adds the series resistor twice.

Final Answer: $R_{\text{eq}} = 5\ \Omega \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q16

Q17.

Solution

Concept — Resistance from power rating: For a device rated P at voltage V, $P = \dfrac{V^2}{R}$, hence $R = \dfrac{V^2}{P}$.

Step 1 — Substitute: $V = 200$ V, $P = 100$ W,

$$R = \frac{(200)^2}{100} = \frac{40000}{100} = 400\ \Omega.$$

Why other options are wrong:

- (A) $200\ \Omega$ uses V/P instead of V^2/P.
- (B) $100\ \Omega$ uses the power as resistance; (D) $2\ \Omega$ uses P/V.

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

Answer: (C) Go Back to Q17

Q18.

Solution

Concept — Resistivity is a material property: ρ depends only on the material (and temperature), *not* on the wire's shape. The resistance $R = \dfrac{\rho L}{A}$ does depend on geometry.

Step 1 — Same material: Both wires are copper, so ρ is identical for both.

Step 2 — Effect of doubling the area (same length):

$$R' = \frac{\rho L}{2A} = \frac{1}{2} \cdot \frac{\rho L}{A} = \frac{R}{2}.$$

The resistance halves while the resistivity stays the same.

Why other options are wrong:

- (A),(C),(D) all claim the resistivity changes — it does not, because ρ is geometry-independent.

Final Answer: Resistivity unchanged, resistance halved $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q18

Q19.

Solution

Concept — Velocity selector: A particle passes undeflected when the electric force balances the magnetic force, $qE = qvB$, giving $v = \dfrac{E}{B}$ (independent of charge and mass).

Step 1 — Substitute:

$$v = \frac{E}{B} = \frac{3 \times 10^5}{0.2} = 1.5 \times 10^6 \text{ m s}^{-1}.$$

Why other options are wrong:

- (B),(C) misplace powers of ten.
- (D) 6×10^6 multiplies by B instead of dividing.

Final Answer: $v = 1.5 \times 10^6$ m s^{-1} $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q19

Q20.

Solution

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

Step 1 — Substitute the values:

$$B = \frac{(4\pi \times 10^{-7})(100)(2)}{2(0.05)} = \frac{8\pi \times 10^{-5}}{0.1} = 8\pi \times 10^{-4} \text{ T}.$$

Step 2 — Numerical size: $8\pi \times 10^{-4} \approx 2.5 \times 10^{-3}$ T.

Why other options are wrong:

- (A) $4\pi \times 10^{-6}$ is the single-turn result ($N = 1$), a factor of 100 too small.
- (B) $4\pi \times 10^{-5}$ uses $N = 10$; (C) $2\pi \times 10^{-4}$ uses $\mu_0 N I/(4r)$ (an axial-point formula).

Final Answer: $B = 8\pi \times 10^{-4}\ \text{T} \approx 2.5 \times 10^{-3}\ \text{T} \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q20

Q21.

Solution

Concept — Tangent law: At equilibrium the coil field and the horizontal Earth field combine so that $B_{\text{coil}} = B_H \tan\theta$, hence $B_H = \dfrac{B_{\text{coil}}}{\tan\theta}$.

Step 1 — Use $\theta = 45°$: $\tan 45° = 1$, so

$$B_H = \frac{B_{\text{coil}}}{\tan 45°} = \frac{3 \times 10^{-5}}{1} = 3 \times 10^{-5}\ \text{T}.$$

Step 2 — Interpretation: At a $45°$ deflection the coil field exactly equals the horizontal Earth field — a hallmark of the tangent galvanometer's most sensitive setting.

Why other options are wrong:

- (A) 1.5×10^{-5} halves the field for no reason.
- (C) 6×10^{-5} doubles it; (D) 4.2×10^{-5} multiplies by $\sqrt{2}$ for no valid reason.

Final Answer: $B_H = 3 \times 10^{-5}\ \text{T} \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q21

Q22.

Solution

Concept — Current sensitivity: $\dfrac{\theta}{I} = \dfrac{NAB}{k}$. It rises when the numerator (N, A, B) increases or the denominator (k) decreases.

Step 1 — Pick the change that raises NAB/k: Increasing the number of turns N directly increases the sensitivity.

Why other options are wrong:

- (B) increasing k *lowers* the sensitivity.
- (C) decreasing A and (D) decreasing B both *reduce* NAB/k.

Final Answer: Increase $N \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q22

Q23.

Solution

Concept — Peak emf of an AC generator: A coil of N turns, area A, rotating at angular speed ω in a field B produces $\varepsilon = NBA\omega \sin \omega t$, with peak value $\varepsilon_0 = NBA\omega$.

Step 1 — Substitute: $N = 200$, $B = 0.1$ T, $A = 0.05$ m^2, $\omega = 100$ rad s^{-1},

$$\varepsilon_0 = 200 \times 0.1 \times 0.05 \times 100 = 100 \text{ V}.$$

Why other options are wrong:

- (A) 50 V drops a factor of 2; (B) 200 V doubles the result.
- (D) 20 V omits ω partially.

Final Answer: $\varepsilon_0 = 100 \text{ V} \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q23

Q24.

Solution

Concept — Average power in AC: $P_{\text{avg}} = V_{\text{rms}} I_{\text{rms}} \cos\phi$, where $\cos\phi$ is the power factor.

Step 1 — Substitute: $V_{\text{rms}} = 200$ V, $I_{\text{rms}} = 2$ A, $\cos 60^\circ = 0.5$,

$$P_{\text{avg}} = 200 \times 2 \times 0.5 = 200 \text{ W}.$$

Why other options are wrong:

- (A) 400 W is the apparent power $V_{\text{rms}} I_{\text{rms}}$, ignoring the power factor.
- (B) 800 W doubles that; (C) 346 W uses $\cos 30^\circ$ instead of $\cos 60^\circ$.

Final Answer: $P_{\text{avg}} = 200 \text{ W} \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q24

Q25.

Solution

Concept — Electromagnetic spectrum: Frequency increases (wavelength decreases) in the order: radio $<$ microwave $<$ infrared $<$ visible $<$ ultraviolet $<$ X-rays $<$ gamma rays.

Step 1 — Read off the listed waves: Infrared $<$ Visible $<$ Ultraviolet $<$ X-rays is the correct increasing-frequency sequence.

Why other options are wrong:

- (B) is the exact reverse (decreasing frequency).
- (C),(D) jumble the order (e.g. they place infrared or X-rays in the wrong slot).

Final Answer: Infrared $<$ Visible $<$ UV $<$ X-rays $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q25

Q26.

Solution

Concept — Mirror formula: $\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$. For a concave mirror $f = -20$ cm and a real object $u = -30$ cm (sign convention: distances in front of the mirror are negative).

Step 1 — Solve for v:

$$\frac{1}{v} = \frac{1}{f} - \frac{1}{u} = \frac{1}{-20} - \frac{1}{-30} = -\frac{1}{20} + \frac{1}{30} = \frac{-3+2}{60} = -\frac{1}{60}.$$

Step 2 — Image distance: $v = -60$ cm — the negative sign means the image is 60 cm in *front* of the mirror, hence real (and inverted).

Why other options are wrong:

- (A) 30 cm just repeats the object distance.
- (C) a virtual image behind the mirror needs an object inside the focus; (D) 20 cm is the focal length.

Final Answer: Image 60 cm in front, real $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q26

Q27.

Solution

Concept — Snell's law: $n_1 \sin\theta_1 = n_2 \sin\theta_2$. With air ($n_1 = 1$), $n = \dfrac{\sin\theta_i}{\sin\theta_r}$.

Step 1 — Substitute the angles: $\theta_i = 60^\circ$, $\theta_r = 30^\circ$,

$$n = \frac{\sin 60^\circ}{\sin 30^\circ} = \frac{\sqrt{3}/2}{1/2} = \sqrt{3}.$$

Why other options are wrong:

- (A) $1/\sqrt{3}$ inverts the ratio (refraction the wrong way).
- (B) $\sqrt{2}$ would need $\theta_r = 45^\circ$; (D) 2 has no basis here.

Final Answer: $n = \sqrt{3} \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q27

Q28.

Solution

Concept — Interference intensity from amplitudes: $I \propto A^2$, and

$$\frac{I_{\text{max}}}{I_{\text{min}}} = \left(\frac{A_1 + A_2}{A_1 - A_2}\right)^2.$$

Step 1 — Insert the amplitude ratio $A_1 : A_2 = 3 : 1$:

$$\frac{I_{\text{max}}}{I_{\text{min}}} = \left(\frac{3+1}{3-1}\right)^2 = \left(\frac{4}{2}\right)^2 = 4.$$

So $I_{\text{max}} : I_{\text{min}} = 4 : 1$.

Why other options are wrong:

- (A) $3 : 1$ is the amplitude ratio, not the intensity ratio.
- (B) $9 : 1$ is the *intensity* ratio of the individual beams, not $I_{\text{max}} : I_{\text{min}}$.
- (C) $2 : 1$ forgets to square the $(A_1 + A_2)/(A_1 - A_2)$ ratio.

Final Answer: $I_{\text{max}} : I_{\text{min}} = 4 : 1 \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q28

Q29.

Solution

Concept — Malus's law in sequence: The first polaroid passes $\frac{1}{2}I_0$ of the unpolarised light; each subsequent polaroid applies $I\cos^2\theta$ for the angle between successive axes.

Step 1 — After the first polaroid: $I_1 = \dfrac{I_0}{2}$.

Step 2 — After the second (at $45°$ to the first):

$$I_2 = I_1\cos^2 45° = \frac{I_0}{2}\cdot\frac{1}{2} = \frac{I_0}{4}.$$

Step 3 — After the third (at $45°$ to the second):

$$I_3 = I_2\cos^2 45° = \frac{I_0}{4}\cdot\frac{1}{2} = \frac{I_0}{8}.$$

Why other options are wrong:

- (C) zero is what two *crossed* polaroids alone give; the $45°$ middle one lets light through.
- (B) $I_0/4$ stops after two polaroids; (D) $I_0/2$ after one.

Final Answer: $I_3 = I_0/8 \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q29

Q30.

Solution

Concept — Photoelectric effect: The maximum kinetic energy depends only on the *frequency* ($K_{\max} = h\nu - \phi$), while the photocurrent (number of electrons per second) depends on the *intensity* (number of photons per second).

Step 1 — Increase intensity at fixed frequency: More photons strike per second, so more electrons are ejected $\Rightarrow$ the photocurrent rises.

Step 2 — Effect on $K_{\max}$: Each photon still carries the same energy $h\nu$, so $K_{\max} = h\nu - \phi$ is unchanged.

Why other options are wrong:

- (A),(C) wrongly tie $K_{\max}$ to intensity.
- (D) ignores that more photons mean more emitted electrons.

Final Answer: Current up, K_{max} unchanged $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q30

Q31.

Solution

Concept — Ionization energy: Ionization removes the electron from $n = 1$ to $n = \infty$. The energy needed equals the magnitude of the ground-state energy: $E_{\text{ion}} = 0 - E_1 = +13.6$ eV.

Step 1 — Compute: $E_1 = -13.6$ eV, $E_\infty = 0$, so

$$E_{\text{ion}} = E_\infty - E_1 = 0 - (-13.6) = 13.6 \text{ eV}.$$

Why other options are wrong:

- (A) 3.4 eV is the binding energy of the $n = 2$ level.
- (C) 10.2 eV is the $n = 1 \to 2$ excitation energy; (B) 27.2 eV is twice the value.

Final Answer: $E_{\text{ion}} = 13.6$ eV $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q31

Q32.

Solution

Concept — Radioactive decay law: After $n = t/T_{1/2}$ half-lives, the remaining fraction is $\left(\frac{1}{2}\right)^n$.

Step 1 — Number of half-lives: $n = \dfrac{11460}{5730} = 2.$

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

Why other options are wrong:

- (A) $1/2$ is after one half-life; (D) $1/8$ after three.
- (B) $1/3$ treats decay as if linear in time.

Final Answer: Fraction left $= 1/4 \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q32

Q33.

Solution

Concept — Energy release and binding energy per nucleon: A nuclear reaction releases energy when the *products* are more tightly bound (higher binding energy per nucleon) than the reactants. Splitting very heavy nuclei (fission) and combining very light nuclei (fusion) both move toward the peak near $A \approx 56$.

Step 1 — Fission: A heavy nucleus ($A \sim 240$) splits into medium nuclei with higher binding energy per nucleon $\Rightarrow$ energy released.

Step 2 — Fusion: Light nuclei ($A \sim 2$–4) merge into a more tightly bound nucleus $\Rightarrow$ energy released.

Why other options are wrong:

- (B),(D) wrongly claim fusion absorbs energy — stellar fusion releases enormous energy.
- (C) reverses the binding-energy condition.

Final Answer: Both release energy by raising binding energy per nucleon $\Rightarrow \boxed{A}$

Answer: (A) Go Back to Q33

Q34.

Solution

Concept — NAND as a universal gate: A NAND gate with both inputs tied together acts as a NOT gate, since $\overline{A \cdot A} = \overline{A}$. Two such NOT operations in series cancel.

Step 1 — First NAND (inputs both A): $X = \overline{A \cdot A} = \overline{A}$ — this is a NOT gate.

Step 2 — Second NAND (inputs both X): $Y = \overline{X \cdot X} = \overline{X} = \overline{\overline{A}} = A$.

Step 3 — Result: Two inverters in series give back the input, i.e. a buffer, $Y = A$.

Why other options are wrong:

- (A) wrongly fixes $Y = 1$; the output follows A.
- (B) a single NAND is needed for NAND; (C) an OR needs a different NAND arrangement (inputs inverted first).

Final Answer: Two NANDs in series give $Y = A$ (a buffer) $\Rightarrow \boxed{D}$

Answer: (D) Go Back to Q34

Q35.

Solution

Concept — Energy band gap: The band gap E_g is the energy separation between the valence and conduction bands, and it controls how easily electrons reach the conduction band.

Step 1 — Conductor: The valence and conduction bands overlap, so $E_g \approx 0$.

Step 2 — Semiconductor: A small gap ($E_g \sim 1$ eV, e.g. silicon 1.1 eV) allows some thermal excitation.

Step 3 — Insulator: A large gap ($E_g \gtrsim 5$ eV) blocks conduction. Hence conductor $<$ semiconductor $<$ insulator.

Why other options are wrong:

- (A) reverses the order.
- (C) misplaces the semiconductor below the insulator-vs-conductor ranking; (D) is false — the gaps differ markedly.

Final Answer: conductor $<$ semiconductor $<$ insulator $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q35

Answer Key

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