SRMJEEE Physics Sample Paper – 1

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 percentage errors in the measurement of the mass and the speed of a body are 2% and 3% respectively. The maximum percentage error in the estimate of its kinetic energy is:

(A) 8%

(B) 10%

(C) 5%

(D) 12%

Q2. Which of the following physical quantities has the same dimensional formula as that of Planck's constant?

(A) Energy

(B) Power

(C) Angular momentum

(D) Linear momentum

Q3. A body of mass 2 kg moving with a velocity of 10 m s^{-1} is brought to rest in 5 s by a constant retarding force. The magnitude of the force is:

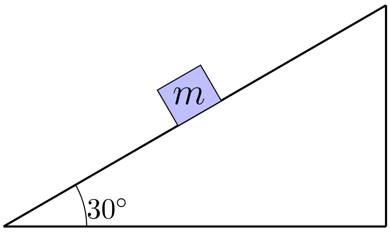
(A) 2 N

(B) 4 N

(C) 10 N

(D) 20 N

Q4. A block of mass m is released from rest on a smooth (frictionless) inclined plane of inclination 30°, as shown. Taking $g = 10$ m s^{-2}, the acceleration of the block down the incline is:



(A) 10 m s^{-2}

(B) 2.5 m s^{-2}

(C) 5 m s^{-2}

(D) 7.5 m s^{-2}

Q5. A ball is thrown vertically upward with an initial speed of 20 m s^{-1}. The time taken by it to reach the highest point is $\left(g = 10 \text{ m s}^{-2}\right)$:

(A) 4 s

(B) 1 s

(C) 0.5 s

(D) 2 s

Q6. A force $\vec{F} = (3\hat{\imath} + 4\hat{\jmath})$ N acts on a body and displaces it by $\vec{d} = (2\hat{\imath} + 3\hat{\jmath})$ m. The work done by the force is:

(A) 12 J

(B) 18 J

(C) 6 J

(D) 24 J

Q7. A body of mass m moving with speed v makes a head-on elastic collision with an identical stationary body. Immediately after the collision, the first body:

(A) comes to rest

(B) continues to move with speed v

(C) moves with speed $v/2$

(D) rebounds with speed v

Q8. The acceleration due to gravity at a height equal to the radius of the Earth (i.e. $h = R$) above the surface is what fraction of its value g on the surface?

(A) $g/2$

(B) g

(C) $g/9$

(D) $g/4$

Q9. The escape velocity from the surface of the Earth is 11.2 km s^{-1}. The escape velocity from the surface of a planet that has the same mean density as the Earth but twice its radius is:

(A) 11.2 km s^{-1}

(B) 22.4 km s^{-1}

(C) 5.6 km s^{-1}

(D) 44.8 km s^{-1}

Q10. A wire of length L and cross-sectional area A elongates by ℓ under a load W. A second wire of the same material, of length $2L$ and area of cross-section $2A$, carries the same load W. Its elongation is:

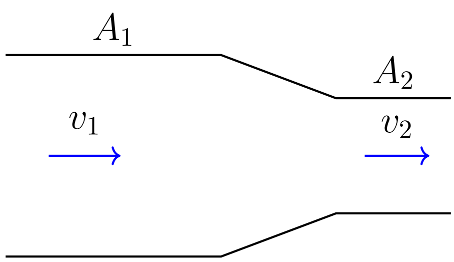
(A) 2ℓ

(B) $\ell/2$

(C) ℓ

(D) 4ℓ

Q11. Water flows steadily through a horizontal pipe whose cross-section narrows from $A_1 = 10$ cm^2 to $A_2 = 5$ cm^2, as shown. If the speed in the wider part is 2 m s^{-1}, the speed of the water in the narrower part is:



(A) 4 m s^{-1}

(B) 2 m s^{-1}

(C) 1 m s^{-1}

(D) 8 m s^{-1}

Q12. Two identical point charges placed a distance r apart repel each other with a force F. If one of the charges is doubled and the separation between them is halved, the new force of repulsion is:

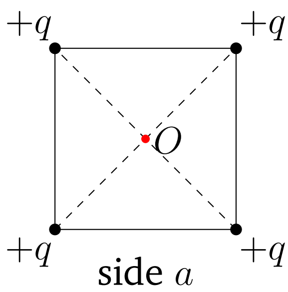
(A) $2F$

(B) $4F$

(C) $16F$

(D) $8F$

Q13. Four equal point charges $+q$ are fixed at the corners of a square of side a, as shown. The electric potential at the centre O of the square is $\left(k = \dfrac{1}{4\pi\varepsilon_0}\right)$:



(A) zero

(B) $\dfrac{4\sqrt{2}\,kq}{a}$

(C) $\dfrac{\sqrt{2}\,kq}{a}$

(D) $\dfrac{kq}{a}$

Q14. A parallel-plate capacitor has a capacitance C with air between its plates. When the space between the plates is completely filled with a dielectric of dielectric constant $K = 4$, its capacitance becomes:

(A) $C/4$

(B) $2C$

(C) $4C$

(D) C

Q15. The work done in moving a charge of 2 C across two points having a potential difference of 5 V is:

(A) 10 J

(B) 2.5 J

(C) 7 J

(D) 0.4 J

Q16. Three resistors of $2\ \Omega$, $3\ \Omega$ and $6\ \Omega$ are connected in parallel. The equivalent resistance of the combination is:

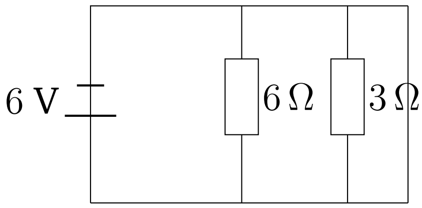
(A) $11\ \Omega$

(B) $3\ \Omega$

(C) $2\ \Omega$

(D) $1\ \Omega$

Q17. In the circuit shown, a $6\ \Omega$ and a $3\ \Omega$ resistor are connected in parallel across an ideal cell of emf 6 V. The current drawn from the cell is:



(A) 1 A

(B) 3 A

(C) 2 A

(D) 6 A

Q18. A uniform wire of resistance R is stretched uniformly so that its length becomes twice the original, the volume remaining constant. The new resistance of the wire is:

(A) $R/2$

(B) $2R$

(C) $4R$

(D) $R/4$

Q19. A charged particle moves with velocity $\vec{v}$ in a region where the uniform magnetic field $\vec{B}$ is parallel to $\vec{v}$. The magnetic force acting on the particle is:

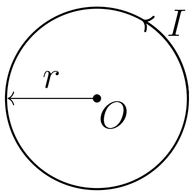
(A) zero

(B) qvB

(C) $qvB/2$

(D) maximum, equal to qvB

Q20. A circular loop of radius $r = 0.1$ m carries a steady current $I = 2$ A, as shown. The magnitude of the magnetic field at the centre O of the loop is $(\mu_0 = 4\pi \times 10^{-7}\text{ T m A}^{-1})$:



(A) $2\pi \times 10^{-6}$ T

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

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

(D) $8\pi \times 10^{-6}$ T

Q21. A long straight wire carries a steady current of 5 A. The magnitude of the magnetic field at a perpendicular distance of 0.1 m from the wire is $(\mu_0 = 4\pi \times 10^{-7}\text{ T m A}^{-1})$:

(A) 5×10^{-6} T

(B) 2×10^{-5} T

(C) 5×10^{-5} T

(D) 1×10^{-5} T

Q22. In a moving-coil galvanometer fitted with a radial magnetic field, the deflection θ of the coil is directly proportional to the current I because:

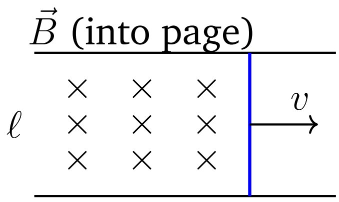
(A) the restoring torque is proportional to I^2

(B) the radial field keeps the plane of the coil always parallel to $\vec{B}$, making the torque proportional to I

(C) the magnetic field varies with θ

(D) the coil has a large number of turns

Q23. A conducting rod of length $\ell = 0.5$ m slides with a constant velocity $v = 4$ m s^{-1} on two parallel rails, perpendicular to a uniform magnetic field $B = 0.2$ T directed into the page, as shown. The emf induced across the rod is:



(A) 0.2 V

(B) 0.8 V

(C) 0.4 V

(D) 1.0 V

Q24. An alternating current has a peak (maximum) value of 10 A. Its root-mean-square (rms) value is approximately:

(A) 7.07 A

(B) 10 A

(C) 14.14 A

(D) 5 A

Q25. Among the following electromagnetic waves, the one with the *shortest* wavelength is:

(A) radio waves

(B) microwaves

(C) X-rays

(D) gamma rays

Q26. A convex lens of focal length 20 cm forms a real image of an object placed at a distance of 30 cm from the lens. The distance of the image from the lens is:

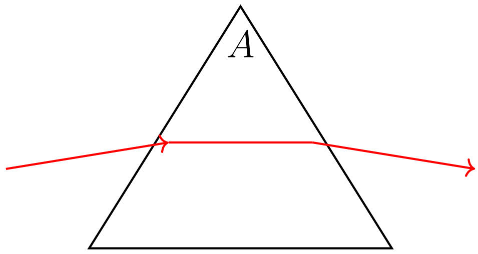
(A) 30 cm

(B) 60 cm

(C) 12 cm

(D) 20 cm

Q27. A ray of light passes symmetrically through an equilateral glass prism ($A = 60^\circ$) at minimum deviation, the ray inside the prism running parallel to the base, as shown. If the refractive index of the glass is $\sqrt{2}$, the angle of minimum deviation δ_m is:



equilateral prism

(A) 60°

(B) 45°

(C) 30°

(D) 15°

Q28. In Young's double-slit experiment the fringe width is β. If the separation between the two slits is doubled while the screen distance and the wavelength are unchanged, the new fringe width becomes:

(A) $\beta/2$

(B) 2β

(C) β

(D) 4β

Q29. Unpolarised light of intensity I_0 is incident on a single ideal polaroid. The intensity of the transmitted light is:

(A) I_0

(B) zero

(C) $I_0/4$

(D) $I_0/2$

Q30. The work function of a metal surface is 2 eV. The threshold wavelength beyond which photoemission does not occur is approximately $(hc = 1240$ eV nm$)$:

(A) 310 nm

(B) 620 nm

(C) 1240 nm

(D) 124 nm

Q31. According to the Bohr model of the hydrogen atom, the radius r_n of the n-th allowed orbit is proportional to:

(A) n

(B) $1/n$

(C) n^2

(D) $1/n^2$

Q32. The half-life of a radioactive sample is 10 years. The fraction of the original nuclei remaining undecayed after 30 years is:

(A) $1/8$

(B) $1/3$

(C) $1/6$

(D) $1/16$

Q33. The binding energy per nucleon is maximum (most stable nucleus) for elements whose mass number is close to:

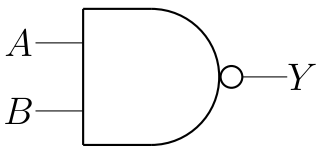
(A) 2

(B) 238

(C) 120

(D) 56

Q34. For the logic gate shown (an AND gate followed by an inverting bubble at its output), the output Y when both inputs are $A = 1$ and $B = 1$ is:



(A) 1

(B) 0

(C) undefined

(D) the same as input A

Q35. When a p–n junction diode is forward biased, the width of the depletion region:

(A) increases

(B) remains unchanged

(C) becomes infinite

(D) decreases

Detailed Solutions

Q1.

Solution

Concept — Combination of errors: For a quantity $Z = x^a y^b$, fractional errors add as $\dfrac{\Delta Z}{Z} = |a|\dfrac{\Delta x}{x} + |b|\dfrac{\Delta y}{y}$.

Step 1 — Write kinetic energy: $K = \frac{1}{2}mv^2$, so $K \propto m^1 v^2$.

Step 2 — Add the percentage errors:

$$\frac{\Delta K}{K} = \frac{\Delta m}{m} + 2\frac{\Delta v}{v} = 2\% + 2(3\%) = 2\% + 6\% = 8\%.$$

Why other options are wrong:

- (B) 10% would arise from adding $2\% + 2 \times 4\%$ (wrong speed error).
- (C) 5% simply adds $2\% + 3\%$, ignoring the square on v.
- (D) 12% doubles both errors.

Final Answer: Maximum error in K is $8\% \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q1

Q2.

Solution

Concept — Dimensions of Planck's constant: From $E = h\nu$, $h = E/\nu$ has dimensions $\dfrac{[\text{ML}^2\text{T}^{-2}]}{[\text{T}^{-1}]} = [\text{ML}^2\text{T}^{-1}]$.

Step 1 — Compare with the options: Angular momentum $L = mvr$ has dimensions $[\text{M}][\text{LT}^{-1}][\text{L}] = [\text{ML}^2\text{T}^{-1}]$, identical to h.

Step 2 — Eliminate the rest: Energy $[\text{ML}^2\text{T}^{-2}]$, power $[\text{ML}^2\text{T}^{-3}]$, linear momentum $[\text{MLT}^{-1}]$ — none match.

Final Answer: h has the dimensions of angular momentum $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q2

Q3.

Solution

Concept — Newton's second law: $F = ma = m\frac{v-u}{t}$.

Step 1 — Substitute values: $u = 10$ m s^{-1}, $v = 0$, $t = 5$ s, $m = 2$ kg.

$$a = \frac{0-10}{5} = -2 \text{ m s}^{-2}.$$

Step 2 — Magnitude of force: $|F| = 2 \times 2 = 4$ N.

Why other options are wrong:

- (A) 2 N uses the acceleration as the force, forgetting the mass.
- (C),(D) come from dividing or multiplying by the wrong time/mass.

Final Answer: $|F| = 4$ N $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q3

Q4.

Solution

Concept — Motion on a smooth incline: The only force along a frictionless incline is the component of gravity $mg\sin\theta$, so $a = g\sin\theta$ (independent of mass).

Step 1 — Substitute: $a = g\sin 30° = 10 \times \frac{1}{2} = 5$ m s^{-2}.

Step 2 — Note the independence from m: Since $ma = mg\sin\theta$, the mass cancels, so the answer holds for any block.

Why other options are wrong:

- (A) 10 m s^{-2} is free-fall g, valid only for a vertical drop ($\theta = 90°$).
- (B) 2.5 would need $\sin\theta = 0.25$; (D) 7.5 has no basis here.

Final Answer: $a = 5$ m s^{-2} $\Rightarrow$ $\boxed{\text{C}}$

Answer: (C) Go Back to Q4

Q5.

Solution

Concept — Vertical motion under gravity: At the highest point the velocity is zero; $v = u - gt$.

Step 1 — Set $v = 0$: $0 = 20 - 10\,t \Rightarrow t = \dfrac{20}{10} = 2$ s.

Why other options are wrong:

- (A) 4 s is the total time of flight (up + down), not the time to the top.
- (B),(C) use the wrong relation between u and g.

Final Answer: Time to reach the top $= 2$ s $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q5

Q6.

Solution

Concept — Work as a dot product: $W = \vec{F} \cdot \vec{d} = F_x d_x + F_y d_y$.

Step 1 — Compute: $W = (3)(2) + (4)(3) = 6 + 12 = 18$ J.

Why other options are wrong:

- (A) 12 takes only the y-term; (C) 6 only the x-term.
- (D) 24 comes from multiplying the magnitudes $|\vec{F}| = 5$ and $|\vec{d}| \approx 3.6$ without the angle.

Final Answer: $W = 18$ J $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q6

Q7.

Solution

Concept — Elastic collision between equal masses: In a one-dimensional elastic collision of equal masses, the two bodies simply *exchange velocities*.

Step 1 — Apply the exchange rule: The moving body (v) and the stationary body (0) swap: the first becomes 0, the second becomes v.

Step 2 — Verify with conservation laws: Momentum: $mv = m(0) + m(v)$ ✓. Kinetic energy: $\frac{1}{2}mv^2 = \frac{1}{2}mv^2$ ✓.

Why other options are wrong:

- (B),(C) violate momentum/energy conservation for equal masses.
- (D) rebounding with v would need a much heavier, near-fixed target.

Final Answer: The first body comes to rest $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q7

Q8.

Solution

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

Step 1 — Put $h = R$: $g' = g\left(\dfrac{R}{2R}\right)^2 = g\left(\frac{1}{2}\right)^2 = \dfrac{g}{4}$.

Why other options are wrong:

- (A) $g/2$ ignores the square in the inverse-square law.
- (C) $g/9$ corresponds to $h = 2R$ (total distance $3R$).

Final Answer: $g' = g/4 \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q8

Q9.

Solution

Concept — Escape velocity in terms of density: $v_e = \sqrt{\dfrac{2GM}{R}}$ with $M = \frac{4}{3}\pi R^3\rho$, giving $v_e = R\sqrt{\dfrac{8\pi G\rho}{3}}$. For fixed density, $v_e \propto R$.

Step 1 — Scale the radius: Doubling R (same ρ) doubles v_e.

$$v_e' = 2 \times 11.2 = 22.4 \text{ km s}^{-1}.$$

Why other options are wrong:

- (A) treats v_e as unchanged; (C) halves it.
- (D) 44.8 would require $v_e \propto R^2$.

Final Answer: $v_e' = 22.4 \text{ km s}^{-1} \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q9

Q10.

Solution

Concept — Elongation of a wire: $\Delta\ell = \frac{WL}{AY}$, where Y is Young's modulus (a material constant).

Step 1 — For the first wire: $\ell = \frac{WL}{AY}$.

Step 2 — For the second wire ($2L$, $2A$, same W, same material):

$$\Delta\ell' = \frac{W(2L)}{(2A)Y} = \frac{WL}{AY} = \ell.$$

The doubling of length and area cancel.

Why other options are wrong:

- (A) 2ℓ accounts for the length but not the area.
- (B) $\ell/2$ accounts for the area but not the length.

Final Answer: Elongation $= \ell \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q10

Q11.

Solution

Concept — Equation of continuity: For an incompressible fluid, $A_1 v_1 = A_2 v_2$.

Step 1 — Solve for v_2:

$$v_2 = \frac{A_1 v_1}{A_2} = \frac{10 \times 2}{5} = 4 \text{ m s}^{-1}.$$

Step 2 — Physical check: A narrower cross-section (A halved) must speed the flow up (doubled), consistent with $4 > 2$.

Why other options are wrong:

- (B) 2 assumes the speed is unchanged.
- (C),(D) invert the area ratio.

Final Answer: $v_2 = 4 \text{ m s}^{-1} \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q11

Q12.

Solution

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

Step 1 — Original force: $F = \dfrac{kq \cdot q}{r^2} = \dfrac{kq^2}{r^2}$.

Step 2 — Apply the changes ($q \to 2q$, $r \to r/2$):

$$F' = \frac{k(2q)(q)}{(r/2)^2} = \frac{2kq^2}{r^2/4} = \frac{8kq^2}{r^2} = 8F.$$

Why other options are wrong:

- (A) $2F$ accounts only for the charge change.
- (B) $4F$ accounts only for the distance change.
- (C) $16F$ doubles both charges instead of one.

Final Answer: $F' = 8F \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q12

Q13.

Solution

Concept — Potential is a scalar: Potentials from several charges *add algebraically*, with no cancellation by direction (unlike the field).

Step 1 — Distance from centre to a corner: half the diagonal,

$$d = \frac{\text{diagonal}}{2} = \frac{a\sqrt{2}}{2} = \frac{a}{\sqrt{2}}.$$

Step 2 — Add the four potentials:

$$V = 4 \cdot \frac{kq}{d} = 4 \cdot \frac{kq}{a/\sqrt{2}} = \frac{4\sqrt{2}\,kq}{a}.$$

Why other options are wrong:

- (A) "zero" confuses this with the electric *field* at the centre, which does vanish by symmetry — but the potential does not.

- (C),(D) drop the factor of 4 or the $\sqrt{2}$.

Final Answer: $V = \dfrac{4\sqrt{2}\,kq}{a} \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q13

Q14.

Solution

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

Step 1 — Substitute: $C' = 4C$.

Why other options are wrong:

- (A) $C/4$ would mean the dielectric *reduces* capacitance — it does the opposite.
- (B) $2C$ uses $K = 2$; (D) C ignores the dielectric.

Final Answer: $C' = 4C \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q14

Q15.

Solution

Concept — Work and potential difference: $W = qV$.

Step 1 — Substitute: $W = 2\text{ C} \times 5\text{ V} = 10\text{ J}$.

Why other options are wrong:

- (B) 2.5 divides instead of multiplying.
- (D) 0.4 inverts the relation.

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

Answer: (A) Go Back to Q15

Q16.

Solution

Concept — Resistors in parallel: $\frac{1}{R_p} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3}$.

Step 1 — Add the reciprocals (LCD $= 6$):

$$\frac{1}{R_p} = \frac{1}{2} + \frac{1}{3} + \frac{1}{6} = \frac{3+2+1}{6} = \frac{6}{6} = 1.$$

Step 2 — Invert: $R_p = 1\ \Omega$.

Why other options are wrong:

- (A) $11\ \Omega$ is the *series* sum.
- (B),(C) are intermediate values, not the final parallel resistance.

Final Answer: $R_p = 1\ \Omega \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q16

Q17.

Solution

Concept — Parallel resistors across a cell: First reduce the parallel pair, then apply Ohm's law $I = V/R$.

Step 1 — Equivalent resistance:

$$R_p = \frac{6 \times 3}{6+3} = \frac{18}{9} = 2\ \Omega.$$

Step 2 — Total current from the cell:

$$I = \frac{V}{R_p} = \frac{6}{2} = 3\ \text{A}.$$

Why other options are wrong:

- (A) 1 A uses the series resistance $9\ \Omega$ wrongly ($6/9$ rounded).
- (C) 2 A is the current through the $3\ \Omega$ branch alone; (D) 6 A uses $R = 1\ \Omega$.

Final Answer: $I = 3\ \text{A} \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q17

Q18.

Solution

Concept — Resistance of a stretched wire (constant volume): $R = \dfrac{\rho L}{A}$ and $A = \dfrac{V}{L}$, so $R = \dfrac{\rho L^2}{V} \propto L^2$.

Step 1 — Double the length: $R' \propto (2L)^2 = 4L^2$, hence $R' = 4R$.

Step 2 — Cross-check with the area: Constant volume means the area halves; $R = \rho L/A$ then gives $\dfrac{\rho(2L)}{A/2} = 4\dfrac{\rho L}{A} = 4R$ ✓.

Why other options are wrong:

- (B) $2R$ accounts only for the length, not the thinning.
- (A),(D) reduce the resistance, which stretching never does.

Final Answer: $R' = 4R \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q18

Q19.

Solution

Concept — Magnetic Lorentz force: $\vec{F} = q\,\vec{v} \times \vec{B}$, magnitude $F = qvB\sin\theta$.

Step 1 — Velocity parallel to field: $\theta = 0^\circ \Rightarrow \sin\theta = 0$, so $F = 0$.

Step 2 — Interpretation: A charge moving along $\vec{B}$ feels no magnetic force and travels in a straight line; maximum force (qvB) occurs only when $\vec{v} \perp \vec{B}$.

Why other options are wrong:

- (B),(D) qvB is the *maximum*, for the perpendicular case.
- (C) $qvB/2$ would need $\theta = 30^\circ$.

Final Answer: Force $= 0 \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q19

Q20.

Solution

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

Step 1 — Substitute the values:

$$B = \frac{(4\pi \times 10^{-7})(2)}{2(0.1)} = \frac{8\pi \times 10^{-7}}{0.2} = 4\pi \times 10^{-6}\ \text{T}.$$

Step 2 — Numerical size: $4\pi \times 10^{-6} \approx 1.26 \times 10^{-5}$ T.

Why other options are wrong:

- (A),(B) drop a factor of 2 or use $\mu_0 I/4r$ (a point on the axis, not the centre).
- (D) $8\pi \times 10^{-6}$ forgets the 2 in the denominator.

Final Answer: $B = 4\pi \times 10^{-6}$ T $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q20

Q21.

Solution

Concept — Field of a long straight wire: $B = \frac{\mu_0 I}{2\pi r}$.

Step 1 — Substitute:

$$B = \frac{(4\pi \times 10^{-7})(5)}{2\pi(0.1)} = \frac{(2 \times 10^{-7})(5)}{0.1} = \frac{10^{-6}}{0.1} = 1 \times 10^{-5}\ \text{T}.$$

Why other options are wrong:

- (B) 2×10^{-5} uses the loop formula $\mu_0 I/2r$ instead of $\mu_0 I/2\pi r$.
- (A),(C) misplace a power of ten.

Final Answer: $B = 1 \times 10^{-5}$ T $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q21

Q22.

Solution

Concept — Working of a moving-coil galvanometer: A *radial* field makes the plane of the coil always contain $\vec{B}$, so the deflecting torque is $\tau = NIAB$ for every position. At equilibrium it balances the spring torque $k\theta$.

Step 1 — Balance the torques: $NIAB = k\theta \Rightarrow \theta = \frac{NAB}{k} I$, i.e. $\theta \propto I$ (a linear, uniform scale).

Why other options are wrong:

- (A) the restoring torque is $\propto \theta$, not I^2.
- (C) in a radial field B at the coil is constant, not θ-dependent.
- (D) more turns raise the sensitivity but do not explain linearity.

Final Answer: Radial field $\Rightarrow \theta \propto I \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q22

Q23.

Solution

Concept — Motional emf: A rod of length ℓ moving with speed v perpendicular to a field B develops $\varepsilon = B\ell v$.

Step 1 — Substitute:

$$\varepsilon = B\ell v = 0.2 \times 0.5 \times 4 = 0.4 \text{ V}.$$

Why other options are wrong:

- (A) 0.2 drops the factor of v or ℓ.
- (B) 0.8 uses $\ell = 1$ m; (D) 1.0 uses $B = 0.5$ T.

Final Answer: $\varepsilon = 0.4 \text{ V} \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q23

Q24.

Solution

Concept — RMS value of a sinusoidal current: $I_{\text{rms}} = \dfrac{I_0}{\sqrt{2}}$.

Step 1 — Substitute: $I_{\text{rms}} = \dfrac{10}{\sqrt{2}} = \dfrac{10}{1.414} \approx 7.07$ A.

Why other options are wrong:

- (B) 10 is the peak value itself.
- (C) 14.14 multiplies by $\sqrt{2}$ instead of dividing.
- (D) 5 is the average over a half-cycle is $2I_0/\pi \approx 6.37$, not 5.

Final Answer: $I_{\text{rms}} \approx 7.07 \text{ A} \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q24

Q25.

Solution

Concept — Electromagnetic spectrum: In order of increasing frequency (decreasing wavelength): radio $<$ microwave $<$ infrared $<$ visible $<$ ultraviolet $<$ X-ray $<$ gamma ray.

Step 1 — Identify the extreme: Gamma rays have the highest frequency and therefore the *shortest* wavelength ($\lesssim 10^{-12}$ m).

Why other options are wrong:

- (A) radio waves have the *longest* wavelength.
- (C) X-rays are short but still longer than gamma rays.

Final Answer: Gamma rays $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q25

Q26.

Solution

Concept — Thin-lens formula: $\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$ (sign convention: real object $u = -30$ cm, convex lens $f = +20$ cm).

Step 1 — Solve for v:

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

Step 2 — Image distance: $v = +60$ cm (real, on the far side).

Why other options are wrong:

- (A) 30 just repeats the object distance.
- (C) 12 comes from adding the reciprocals; (D) 20 is the focal length.

Final Answer: $v = 60$ cm $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q26

Q27.

Solution

Concept — Prism at minimum deviation: $n = \frac{\sin\left(\frac{A+\delta_m}{2}\right)}{\sin\left(\frac{A}{2}\right)}$.

Step 1 — Insert $A = 60°$, $n = \sqrt{2}$:

$$\sin\left(\frac{60° + \delta_m}{2}\right) = \sqrt{2}\,\sin 30° = \sqrt{2} \times \tfrac{1}{2} = \tfrac{1}{\sqrt{2}} = \sin 45°.$$

Step 2 — Solve: $\frac{60° + \delta_m}{2} = 45° \Rightarrow 60° + \delta_m = 90° \Rightarrow \delta_m = 30°$.

Why other options are wrong:

- (A),(B) do not satisfy the prism formula for $n = \sqrt{2}$.
- (D) 15° would give $n = \sin 37.5°/\sin 30° \approx 1.22$, not $\sqrt{2}$.

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

Answer: (C) Go Back to Q27

Q28.

Solution

Concept — Fringe width in YDSE: $\beta = \dfrac{\lambda D}{d}$, so $\beta \propto \dfrac{1}{d}$.

Step 1 — Double the slit separation: $d \to 2d \Rightarrow \beta' = \dfrac{\lambda D}{2d} = \dfrac{\beta}{2}$.

Why other options are wrong:

- (B) 2β would require *halving* d.
- (C),(D) ignore the inverse dependence on d.

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

Answer: (A) Go Back to Q28

Q29.

Solution

Concept — Unpolarised light through a polaroid: A polaroid transmits exactly half the intensity of incident unpolarised light, because the average of $\cos^2\theta$ over all angles is $\frac{1}{2}$.

Step 1 — Apply: $I = \dfrac{I_0}{2}$.

Why other options are wrong:

- (A) I_0 ignores the polariser's filtering.
- (B) zero would need crossed polaroids; (C) $I_0/4$ applies to a *second* polaroid at $60°$, not the first.

Final Answer: $I = I_0/2 \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q29

Q30.

Solution

Concept — Threshold wavelength: The work function relates to the threshold wavelength by $\phi = \frac{hc}{\lambda_0}$, so $\lambda_0 = \frac{hc}{\phi}$.

Step 1 — Substitute ($hc = 1240$ eV nm, $\phi = 2$ eV):

$$\lambda_0 = \frac{1240}{2} = 620 \text{ nm}.$$

Why other options are wrong:

- (A) 310 uses $\phi = 4$ eV; (C) 1240 uses $\phi = 1$ eV.
- (D) 124 misplaces a power of ten.

Final Answer: $\lambda_0 = 620$ nm $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q30

Q31.

Solution

Concept — Bohr orbit radius: $r_n = \frac{n^2 h^2 \varepsilon_0}{\pi m e^2}$, i.e. $r_n \propto n^2$.

Step 1 — Read off the dependence: The radius grows as the *square* of the principal quantum number; for hydrogen $r_n = 0.529\, n^2$ Å.

Why other options are wrong:

- (A) n is the dependence of orbital *angular momentum*, not radius.
- (B),(D) the radius increases with n, so it cannot fall as $1/n$ or $1/n^2$.

Final Answer: $r_n \propto n^2 \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q31

Q32.

Solution

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

Step 1 — Number of half-lives: $n = \dfrac{30}{10} = 3.$

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

Why other options are wrong:

- (B) $1/3$ wrongly treats decay as linear in time.
- (D) $1/16$ corresponds to 4 half-lives (40 years).

Final Answer: Fraction left $= 1/8 \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q32

Q33.

Solution

Concept — Binding-energy-per-nucleon curve: The curve rises sharply for light nuclei, peaks near $A \approx 56$ (iron, ≈ 8.8 MeV/nucleon), then falls slowly for heavy nuclei.

Step 1 — Locate the peak: Maximum stability occurs around mass number 56.

Why other options are wrong:

- (A) $A = 2$ (deuterium) has very low binding energy per nucleon.
- (B) 238 (uranium) lies on the falling tail; (C) 120 is past the peak.

Final Answer: Most stable near $A = 56 \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q33

Q34.

Solution

Concept — AND gate with an output bubble = NAND gate: A NAND output is the inverse of AND: $Y = \overline{A \cdot B}$.

Step 1 — Evaluate the AND: $A \cdot B = 1 \cdot 1 = 1$.

Step 2 — Invert it: $Y = \overline{1} = 0$. (A NAND gate gives 0 only when both inputs are 1.)

Why other options are wrong:

- (A) 1 would be the plain AND output, ignoring the inverting bubble.
- (C),(D) a logic gate gives a definite 0 or 1, fixed by the inputs.

Final Answer: $Y = 0 \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q34

Q35.

Solution

Concept — Biasing a p–n junction: Forward bias applies the external field opposite to the built-in (barrier) field, pushing majority carriers toward the junction.

Step 1 — Effect on the depletion layer: The incoming carriers neutralise some of the immobile ions, so the depletion region *narrows* and the barrier potential falls — allowing a large forward current.

Step 2 — Contrast with reverse bias: Reverse bias would *widen* the depletion region and raise the barrier.

Why other options are wrong:

- (A) increasing the width is what reverse bias does.
- (B),(C) the width definitely changes and stays finite under forward bias.

Final Answer: The depletion width decreases $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q35

Answer Key

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