SRMJEEE Physics Sample Paper – 2

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 density of a cube is found from its mass and the length of its edge. If the percentage error in the mass is 2% and that in each edge length is 1%, the maximum percentage error in the measured density is:

(A) 3%

(B) 7%

(C) 5%

(D) 9%

Q2. The coefficient of viscosity η appears in the relation $F = \eta A \frac{dv}{dx}$. Its dimensional formula is:

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

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

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

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

Q3. Two blocks of masses 3 kg and 2 kg hang from the two ends of a light inextensible string passing over a frictionless pulley. Taking $g = 10$ m s^{-2}, the tension in the string is:

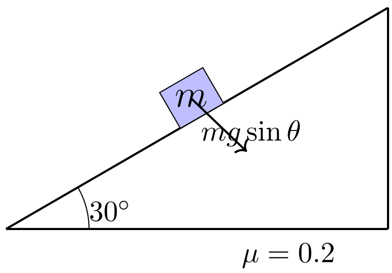
(A) 30 N

(B) 20 N

(C) 50 N

(D) 24 N

Q4. A block of mass $m = 2$ kg rests on a rough inclined plane of inclination 30° with coefficient of friction $\mu = 0.2$, as shown. Taking $g = 10$ m s^{-2}, the net acceleration of the block down the incline is:



(A) 5 m s^{-2}

(B) 3.27 m s^{-2}

(C) 1.73 m s^{-2}

(D) 6.73 m s^{-2}

Q5. A projectile is launched with a speed of 20 m s^{-1} at an angle of 30° above the horizontal. Taking $g = 10$ m s^{-2}, the maximum height it reaches is:

(A) 5 m

(B) 10 m

(C) 20 m

(D) 2.5 m

Q6. A constant horizontal force of 10 N acts on a body initially at rest on a frictionless surface, moving it through a distance of 4 m. The kinetic energy gained by the body is:

(A) 2.5 J

(B) 14 J

(C) 40 J

(D) 20 J

Q7. A body of mass 4 kg moving at $6\ \text{m s}^{-1}$ collides head-on with a stationary body of mass 2 kg and the two stick together. Their common velocity after the collision is:

(A) $6\ \text{m s}^{-1}$

(B) $2\ \text{m s}^{-1}$

(C) $3\ \text{m s}^{-1}$

(D) $4\ \text{m s}^{-1}$

Q8. The acceleration due to gravity at a depth $d = R/2$ below the surface of the Earth (radius R) is what fraction of its surface value g? (Assume uniform density.)

(A) $g/2$

(B) $g/4$

(C) g

(D) $3g/4$

Q9. The orbital speed of a satellite revolving in a circular orbit very close to the Earth's surface is $\left(g = 10\ \text{m s}^{-2},\ R = 6.4 \times 10^{6}\ \text{m}\right)$:

(A) $11.2\ \text{km s}^{-1}$

(B) $8\ \text{km s}^{-1}$

(C) $6.4\ \text{km s}^{-1}$

(D) $4\ \text{km s}^{-1}$

Q10. A stretched wire experiences a tensile stress of 2×10^8 N m^{-2} and undergoes a longitudinal strain of 1×10^{-3}. The Young's modulus of the material of the wire is:

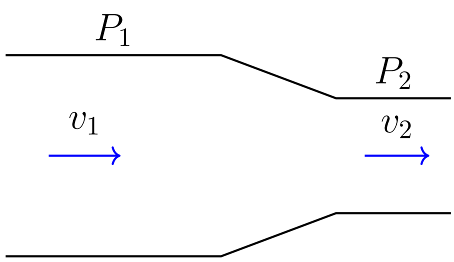
(A) 2×10^5 N m^{-2}

(B) 2×10^8 N m^{-2}

(C) 2×10^{11} N m^{-2}

(D) 5×10^{10} N m^{-2}

Q11. Water ($\rho = 1000$ kg m^{-3}) flows steadily through the horizontal constricted pipe shown. The speed in the wide section is $v_1 = 1$ m s^{-1} and in the throat is $v_2 = 3$ m s^{-1}. The pressure drop $(P_1 - P_2)$ from the wide section to the throat is:



(A) 2000 Pa

(B) 1000 Pa

(C) 8000 Pa

(D) 4000 Pa

Q12. Two point charges separated by a fixed distance experience a force F when placed in vacuum. When the same charges, at the same separation, are immersed in a medium of dielectric constant $K = 4$, the force between them becomes:

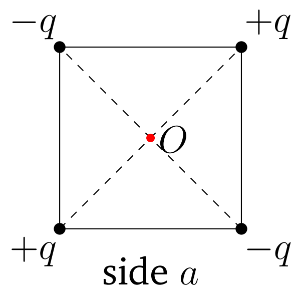
(A) $F/4$

(B) $4F$

(C) $F/2$

(D) $16F$

Q13. Four point charges of equal magnitude q are placed at the corners of a square of side a with alternating signs ($+q$, $-q$, $+q$, $-q$ going around), as shown. The net electric *potential* at the centre O of the square is:



(A) zero

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

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

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

Q14. Two capacitors of 6 μF and 3 μF are connected in series. The equivalent capacitance of the combination is:

(A) 9 μF

(B) 2 μF

(C) 4.5 μF

(D) 18 μF

Q15. A capacitor of capacitance 4 μF is charged to a potential difference of 100 V. The energy stored in the capacitor is:

(A) 0.04 J

(B) 0.4 J

(C) 0.02 J

(D) 2×10^{-4} J

Q16. A $4\ \Omega$ resistor is connected in series with a parallel combination of two $6\ \Omega$ resistors. The equivalent resistance between the terminals of the network is:

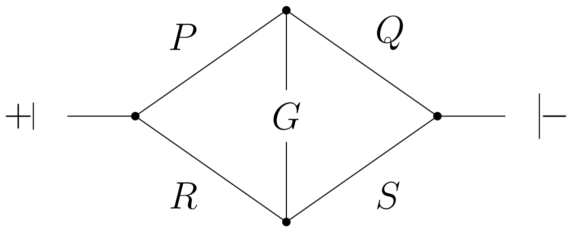
(A) $10\ \Omega$

(B) $16\ \Omega$

(C) $3\ \Omega$

(D) $7\ \Omega$

Q17. The Wheatstone bridge shown is balanced, so that no current flows through the galvanometer G. With $P = 2\ \Omega$, $Q = 4\ \Omega$ and $R = 3\ \Omega$, the unknown resistance S is:



(A) $1.5\ \Omega$

(B) $4\ \Omega$

(C) $6\ \Omega$

(D) $2\ \Omega$

Q18. A current I flows through a conductor of cross-sectional area A in which the free-electron number density is n. Using $I = neAv_d$, the drift speed v_d of the electrons is:

(A) $\dfrac{I}{neA}$

(B) $\dfrac{neA}{I}$

(C) $\dfrac{nIA}{e}$

(D) $neAI$

Q19. A charged particle of mass m and charge q enters a uniform magnetic field B with speed v perpendicular to the field. The radius of its circular path is:

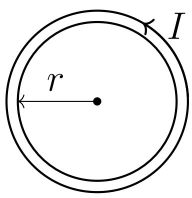
(A) $\frac{qB}{mv}$

(B) $\frac{mv}{qB}$

(C) $\frac{mvB}{q}$

(D) $\frac{qvB}{m}$

Q20. A flat circular coil of $N = 50$ turns and radius $r = 0.04$ m carries a current $I = 2$ A, as shown. The magnitude of the magnetic moment of the coil is:



$N = 50$ turns

(A) 0.16 A m^2

(B) 0.80 A m^2

(C) 0.25 A m^2

(D) 0.50 A m^2

Q21. Two long parallel wires are 0.2 m apart and carry equal currents of 5 A in the *same* direction. The magnitude of the net magnetic field at the midpoint between them is $(\mu_0 = 4\pi \times 10^{-7}$ T m A$^{-1})$:

(A) zero

(B) 2×10^{-5} T

(C) 1×10^{-5} T

(D) 4×10^{-5} T

Q22. A galvanometer of resistance $G = 100\ \Omega$ gives full-scale deflection for a current of 1 mA. To convert it into an ammeter reading up to 1 A, the shunt resistance required (in parallel) is approximately:

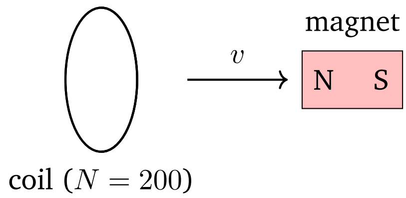
(A) $100\ \Omega$

(B) $1\ \Omega$

(C) $0.1\ \Omega$

(D) $10\ \Omega$

Q23. A coil of $N = 200$ turns encloses an area through which the magnetic flux changes uniformly from 0.04 Wb to 0.01 Wb in 0.1 s, as a magnet is withdrawn, as shown. The magnitude of the emf induced in the coil is:



(A) 30 V

(B) 60 V

(C) 6 V

(D) 0.6 V

Q24. A capacitor of capacitance $C = \dfrac{1}{2\pi}$ mF is connected to an AC source of frequency 50 Hz. The capacitive reactance of the capacitor is:

(A) $50\ \Omega$

(B) $100\ \Omega$

(C) $5\ \Omega$

(D) $10\ \Omega$

Q25. In a plane electromagnetic wave travelling in vacuum, the peak value of the magnetic field is $B_0 = 2 \times 10^{-8}$ T. The peak value of the electric field is $\left(c = 3 \times 10^8 \text{ m s}^{-1}\right)$:

(A) 1.5 V m^{-1}

(B) 0.67 V m^{-1}

(C) 6 V m^{-1}

(D) 12 V m^{-1}

Q26. An object is placed 30 cm in front of a concave mirror of focal length 20 cm. The magnification produced by the mirror is:

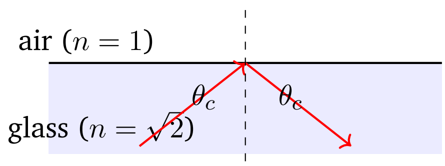
(A) -2

(B) $+2$

(C) -0.5

(D) -1

Q27. Light travelling inside a medium of refractive index $n = \sqrt{2}$ meets the boundary with air $(n = 1)$ and undergoes total internal reflection when the angle of incidence exceeds the critical angle, as shown. The critical angle for this medium is:



(A) $30°$

(B) $60°$

(C) $45°$

(D) $90°$

Q28. In a two-source interference experiment with monochromatic light of wavelength λ, a point on the screen will be *dark* (destructive interference) when the path difference between the two waves equals:

(A) $n\lambda$

(B) $2n\lambda$

(C) $n\lambda/2$

(D) $(2n+1)\lambda/2$

Q29. Plane-polarised light of intensity I_0 is incident on a polaroid whose transmission axis makes an angle of 60° with the plane of polarisation of the light. The intensity of the transmitted light is:

(A) I_0

(B) $\frac{3I_0}{4}$

(C) $\frac{I_0}{4}$

(D) $\frac{I_0}{2}$

Q30. Light of energy 5 eV per photon falls on a metal of work function 2 eV. The maximum kinetic energy of the emitted photoelectrons is:

(A) 3 eV

(B) 7 eV

(C) 2.5 eV

(D) 10 eV

Q31. In the Bohr model of the hydrogen atom, the energy of an electron in the n-th level is $E_n = -\frac{13.6}{n^2}$ eV. The energy of the electron in the second orbit ($n = 2$) is:

(A) -13.6 eV

(B) -3.4 eV

(C) -1.51 eV

(D) -6.8 eV

Q32. A radioactive sample contains $N = 2 \times 10^{20}$ nuclei of a species whose decay constant is $\lambda = 5 \times 10^{-8}$ s^{-1}. The activity ($A = \lambda N$) of the sample is:

(A) 1×10^{12} Bq

(B) 4×10^{27} Bq

(C) 1×10^{13} Bq

(D) 2.5×10^{12} Bq

Q33. The mass defect of a certain nucleus is $\Delta m = 0.10$ u. Using 1 u $\equiv$ 931 MeV, the binding energy of the nucleus is approximately:

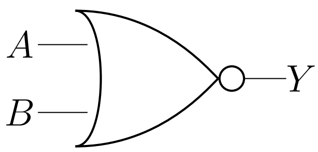
(A) 9.31 MeV

(B) 931 MeV

(C) 0.931 MeV

(D) 93.1 MeV

Q34. For the logic gate shown (an OR gate with an inverting bubble at its output, i.e. a NOR gate), the output Y when both inputs are $A = 0$ and $B = 0$ is:



(A) 1

(B) 0

(C) undefined

(D) the same as input B

Q35. In a full-wave rectifier fed by an AC input, the output across the load during *both* halves of the input cycle is:

(A) zero throughout the negative half-cycle

(B) a unidirectional (one-direction) current for both half-cycles

(C) alternating, exactly like the input

(D) present only during the positive half-cycle

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 density in terms of measurables: $\rho = \dfrac{m}{L^3}$, so $\rho \propto m^1 L^{-3}$.

Step 2 — Add the percentage errors:

$$\frac{\Delta \rho}{\rho} = \frac{\Delta m}{m} + 3\frac{\Delta L}{L} = 2\% + 3(1\%) = 2\% + 3\% = 5\%.$$

Why other options are wrong:

- (A) 3% uses the edge error only once instead of three times (forgetting L^3).
- (B) 7% doubles the mass error term.
- (D) 9% multiplies the mass error by 3 as well.

Final Answer: Maximum error in ρ is $5\% \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q1

Q2.

Solution

Concept — Dimensions of viscosity: From $F = \eta A \dfrac{dv}{dx}$, solve $\eta = \dfrac{F}{A\,(dv/dx)}$.

Step 1 — Dimensions of each factor: $[F] = [\mathrm{MLT^{-2}}]$, $[A] = [\mathrm{L^2}]$, $\left[\dfrac{dv}{dx}\right] = \dfrac{[\mathrm{LT^{-1}}]}{[\mathrm{L}]} = [\mathrm{T^{-1}}]$.

Step 2 — Combine:

$$[\eta] = \frac{[\mathrm{MLT^{-2}}]}{[\mathrm{L^2}][\mathrm{T^{-1}}]} = [\mathrm{ML^{-1}T^{-1}}].$$

Why other options are wrong:

- (A) $[\mathrm{ML^{-1}T^{-2}}]$ is the dimension of pressure or stress, not viscosity.
- (C) $[\mathrm{MLT^{-1}}]$ is linear momentum; (D) $[\mathrm{ML^2T^{-1}}]$ is angular momentum.

Final Answer: $[\eta] = [\mathrm{ML^{-1}T^{-1}}] \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q2

Q3.

Solution

Concept — Atwood machine: For two masses over a frictionless pulley, $a = \dfrac{(m_1 - m_2)g}{m_1 + m_2}$ and the string tension is $T = \dfrac{2m_1 m_2\, g}{m_1 + m_2}$.

Step 1 — Identify the masses: $m_1 = 3$ kg, $m_2 = 2$ kg, $g = 10$ m s^{-2}.

Step 2 — Compute the tension:

$$T = \frac{2(3)(2)(10)}{3+2} = \frac{120}{5} = 24\text{ N}.$$

Why other options are wrong:

- (A) 30 N is the weight of the heavier block ($m_1 g$), valid only if it were static.
- (B) 20 N is the weight of the lighter block; (C) 50 N adds the two weights.

Final Answer: $T = 24\text{ N} \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q3

Q4.

Solution

Concept — Motion down a rough incline: The driving force is $mg\sin\theta$ and the opposing kinetic friction is $\mu mg\cos\theta$, giving $a = g(\sin\theta - \mu\cos\theta)$.

Step 1 — Insert the values: $\theta = 30°$, $\mu = 0.2$, $g = 10$.

$$a = 10\big(\sin 30° - 0.2\cos 30°\big) = 10\big(0.5 - 0.2 \times 0.866\big).$$

Step 2 — Evaluate:

$$a = 10(0.5 - 0.1732) = 10(0.3268) \approx 3.27\text{ m s}^{-2}.$$

Why other options are wrong:

- (A) 5 m s^{-2} is the frictionless value ($g\sin\theta$), ignoring μ.
- (C) 1.73 is just $g\mu\cos\theta$ (the friction term alone); (D) 6.73 wrongly adds friction.

Final Answer: $a \approx 3.27\ \text{m s}^{-2} \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q4

Q5.

Solution

Concept — Maximum height of a projectile: $H = \dfrac{u^2 \sin^2\theta}{2g}$.

Step 1 — Substitute: $u = 20\ \text{m s}^{-1}$, $\theta = 30°$, $\sin 30° = 0.5$.

$$H = \frac{(20)^2(0.5)^2}{2(10)} = \frac{400 \times 0.25}{20} = \frac{100}{20} = 5\ \text{m}.$$

Why other options are wrong:

- (B) 10 m forgets to square $\sin\theta$.
- (C) 20 m uses $\theta = 90°$ (vertical throw); (D) 2.5 halves the result.

Final Answer: $H = 5\ \text{m} \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q5

Q6.

Solution

Concept — Work-energy theorem: The change in kinetic energy equals the net work done: $\Delta K = W = Fd$ (force along displacement).

Step 1 — Substitute: $F = 10$ N, $d = 4$ m.

$$\Delta K = Fd = 10 \times 4 = 40\ \text{J}.$$

Step 2 — Interpretation: Since the surface is frictionless and the body starts from rest, all the work becomes kinetic energy.

Why other options are wrong:

- (A) 2.5 J divides instead of multiplying.
- (B) 14 J adds F and d; (D) 20 J uses $d = 2$ m.

Final Answer: $\Delta K = 40\ \text{J} \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q6

Q7.

Solution

Concept — Perfectly inelastic collision: The bodies stick together; momentum is conserved, so $m_1u_1 = (m_1 + m_2)v$.

Step 1 — Conserve momentum:

$$(4)(6) + (2)(0) = (4 + 2)v \Rightarrow 24 = 6v.$$

Step 2 — Solve: $v = \frac{24}{6} = 4\ \text{m s}^{-1}$.

Why other options are wrong:

- (A) $6\ \text{m s}^{-1}$ ignores the added mass.
- (B) 2 and (C) 3 come from dividing 24 by the wrong total mass.

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

Answer: (D) Go Back to Q7

Q8.

Solution

Concept — Variation of g with depth: For a uniform Earth, $g_d = g\left(1 - \frac{d}{R}\right)$.

Step 1 — Put $d = R/2$:

$$g_d = g\left(1 - \frac{R/2}{R}\right) = g\left(1 - \frac{1}{2}\right) = \frac{g}{2}.$$

Why other options are wrong:

- (B) $g/4$ wrongly uses the height (inverse-square) formula for depth.
- (C) g ignores the depth altogether; (D) $3g/4$ uses $d = R/4$.

Final Answer: $g_d = g/2 \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q8

Q9.

Solution

Concept — Orbital speed near the surface: For an orbit close to the surface, $v_o = \sqrt{gR}$.

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

$$v_o = \sqrt{(10)(6.4 \times 10^6)} = \sqrt{6.4 \times 10^7} = 8 \times 10^3\ \text{m s}^{-1}.$$

Step 2 — Convert: $v_o = 8\ \text{km s}^{-1}$.

Why other options are wrong:

- (A) 11.2 km s^{-1} is the escape velocity $\sqrt{2gR}$, larger by $\sqrt{2}$.
- (C) 6.4 and (D) 4 misuse the numbers under the root.

Final Answer: $v_o = 8\ \text{km s}^{-1} \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q9

Q10.

Solution

Concept — Young's modulus: $Y = \dfrac{\text{stress}}{\text{strain}}$.

Step 1 — Substitute:

$$Y = \frac{2 \times 10^8}{1 \times 10^{-3}} = 2 \times 10^{11}\ \text{N m}^{-2}.$$

Why other options are wrong:

- (A) 2×10^5 multiplies instead of dividing by the strain.
- (B) 2×10^8 just repeats the stress (strain treated as 1).
- (D) 5×10^{10} has the wrong arithmetic.

Final Answer: $Y = 2 \times 10^{11}\ \text{N m}^{-2} \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q10

Q11.

Solution

Concept — Bernoulli's equation (horizontal pipe): With no height change, $P_1 + \frac{1}{2}\rho v_1^2 = P_2 + \frac{1}{2}\rho v_2^2$, so $P_1 - P_2 = \frac{1}{2}\rho(v_2^2 - v_1^2)$.

Step 1 — Substitute: $\rho = 1000$, $v_1 = 1$, $v_2 = 3$.

$$P_1 - P_2 = \tfrac{1}{2}(1000)(3^2 - 1^2) = \tfrac{1}{2}(1000)(9 - 1).$$

Step 2 — Evaluate:

$$P_1 - P_2 = \tfrac{1}{2}(1000)(8) = 4000 \text{ Pa}.$$

Why other options are wrong:

- (A) 2000 uses $(v_2 - v_1)^2$ instead of $v_2^2 - v_1^2$.
- (B) 1000 drops the factor $\frac{1}{2} \times 8$; (C) 8000 forgets the $\frac{1}{2}$.

Final Answer: $P_1 - P_2 = 4000$ Pa $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q11

Q12.

Solution

Concept — Coulomb force in a medium: A dielectric medium of constant K reduces the force by a factor K: $F_{\text{medium}} = \dfrac{F_{\text{vacuum}}}{K}$.

Step 1 — Substitute $K = 4$:

$$F' = \frac{F}{4}.$$

Step 2 — Reasoning: The medium partially screens the charges, weakening their mutual force; it can never strengthen it.

Why other options are wrong:

- (B) $4F$ would mean the medium *increases* the force, the opposite of screening.
- (C) $F/2$ uses $K = 2$; (D) $16F$ squares the factor and inverts the effect.

Final Answer: $F' = F/4 \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q12

Q13.

Solution

Concept — Potential is a scalar: All four charges lie at the *same* distance from the centre, so their potentials add algebraically.

Step 1 — Distance from centre to each corner: half the diagonal, $d = \frac{a}{\sqrt{2}}$ (the same for all four).

Step 2 — Add with signs: Two charges are $+q$ and two are $-q$, all at distance d:

$$V = \frac{k(+q)}{d} + \frac{k(-q)}{d} + \frac{k(+q)}{d} + \frac{k(-q)}{d} = 0.$$

Why other options are wrong:

- (B),(C),(D) would hold only if all four charges had the same sign; here the equal positive and negative contributions cancel exactly.
- Note the electric *field* at O is *not* zero, but the question asks for the potential.

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

Answer: (A) Go Back to Q13

Q14.

Solution

Concept — Capacitors in series: $\frac{1}{C_s} = \frac{1}{C_1} + \frac{1}{C_2}$.

Step 1 — Add the reciprocals:

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

Step 2 — Invert: $C_s = 2\ \mu\text{F}$.

Why other options are wrong:

- (A) $9\ \mu$F is the *parallel* sum; (D) $18\ \mu$F is the product alone.
- (C) $4.5\ \mu$F wrongly averages the two values.

Final Answer: $C_s = 2\ \mu\text{F} \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q14

Q15.

Solution

Concept — Energy stored in a capacitor: $U = \frac{1}{2}CV^2$.

Step 1 — Substitute: $C = 4 \times 10^{-6}$ F, $V = 100$ V.

$$U = \tfrac{1}{2}(4 \times 10^{-6})(100)^2 = \tfrac{1}{2}(4 \times 10^{-6})(10^4).$$

Step 2 — Evaluate:

$$U = \tfrac{1}{2}(4 \times 10^{-2}) = 2 \times 10^{-2} = 0.02 \text{ J}.$$

Why other options are wrong:

- (A) 0.04 J forgets the factor $\frac{1}{2}$.
- (B) 0.4 J misplaces a power of ten; (D) 2×10^{-4} drops V^2.

Final Answer: $U = 0.02$ J $\Rightarrow \boxed{\text{C}}$

Answer: (C) **Go Back to Q15**

Q16.

Solution

Concept — Mixed network: First combine the parallel pair, then add the series resistor.

Step 1 — Parallel pair of two $6\ \Omega$:

$$R_p = \frac{6 \times 6}{6 + 6} = \frac{36}{12} = 3\ \Omega.$$

Step 2 — Add the series $4\ \Omega$:

$$R_{\text{eq}} = 4 + 3 = 7\ \Omega.$$

Why other options are wrong:

- (A) $10\ \Omega$ treats the two $6\ \Omega$ wrongly (e.g. as $4 + 6$).
- (B) $16\ \Omega$ adds all three in series; (C) $3\ \Omega$ is only the parallel part.

Final Answer: $R_{\text{eq}} = 7\ \Omega \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q16

Q17.

Solution

Concept — Balanced Wheatstone bridge: At balance the galvanometer current is zero and $\frac{P}{Q} = \frac{R}{S}$.

Step 1 — Rearrange for S:

$$S = \frac{Q\,R}{P}.$$

Step 2 — Substitute $P = 2$, $Q = 4$, $R = 3$:

$$S = \frac{4 \times 3}{2} = \frac{12}{2} = 6\ \Omega.$$

Why other options are wrong:

- (A) $1.5\ \Omega$ inverts the ratio (PR/Q).
- (B) $4\ \Omega$ and (D) $2\ \Omega$ ignore one of the resistances in the balance condition.

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

Answer: (C) Go Back to Q17

Q18.

Solution

Concept — Microscopic form of current: The current is $I = neAv_d$, where n is the free-electron density, e the electronic charge, A the area and v_d the drift speed.

Step 1 — Solve for the drift speed:

$$v_d = \frac{I}{neA}.$$

Step 2 — Sanity check: A larger current means a faster drift, while a thicker wire (larger A) or denser electrons (larger n) means a slower drift — exactly what $v_d = I/(neA)$ shows.

Why other options are wrong:

- (B),(D) invert or multiply the relation incorrectly.
- (C) nIA/e does not even have the dimensions of speed.

Final Answer: $v_d = \dfrac{I}{neA} \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q18

Q19.

Solution

Concept — Charged particle in a magnetic field: The magnetic force qvB supplies the centripetal force $\dfrac{mv^2}{r}$.

Step 1 — Equate the forces:

$$qvB = \frac{mv^2}{r}.$$

Step 2 — Solve for the radius:

$$r = \frac{mv}{qB}.$$

Why other options are wrong:

- (A) qB/mv is the reciprocal of the correct expression.
- (C),(D) misplace B in the numerator and have the wrong dimensions for a radius.

Final Answer: $r = \dfrac{mv}{qB} \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q19

Q20.

Solution

Concept — Magnetic moment of a coil: For N turns each of area A carrying current I, the magnetic moment is $m = NIA$, with $A = \pi r^2$.

Step 1 — Find the area: $A = \pi r^2 = \pi(0.04)^2 = \pi(1.6 \times 10^{-3}) \approx 5.03 \times 10^{-3}$ m^2.

Step 2 — Multiply:

$$m = NIA = 50 \times 2 \times 5.03 \times 10^{-3} \approx 0.50 \text{ A m}^2.$$

Why other options are wrong:

- (A) 0.16 drops the factor π (uses r^2 instead of πr^2).
- (B) 0.80 uses $A = r^2 \times \pi$ but with wrong N; (C) 0.25 halves the result.

Final Answer: $m \approx 0.50\ \text{A m}^2 \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q20

Q21.

Solution

Concept — Field between parallel currents: Each wire produces $B = \dfrac{\mu_0 I}{2\pi r}$ at the midpoint. For currents in the *same* direction, the two fields at the midpoint point in opposite directions and cancel.

Step 1 — Magnitude from each wire: At the midpoint, distance $r = 0.1$ m,

$$B_1 = B_2 = \frac{(4\pi \times 10^{-7})(5)}{2\pi(0.1)} = 1 \times 10^{-5}\ \text{T}.$$

Step 2 — Add as vectors: Same-direction currents give opposing fields between the wires, so $B_{\text{net}} = B_1 - B_2 = 0$.

Why other options are wrong:

- (B),(C) would be the result if the fields added (they do for *opposite* currents).
- (D) 4×10^{-5} has no basis here.

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

Answer: (A) Go Back to Q21

Q22.

Solution

Concept — Shunt for an ammeter: A low resistance S is placed in parallel so that the galvanometer carries only I_g and the remaining current $(I - I_g)$ flows through S: $I_g G = (I - I_g) S$.

Step 1 — Rearrange: $S = \dfrac{I_g G}{I - I_g}$.

Step 2 — Substitute $I_g = 10^{-3}$ A, $G = 100\ \Omega$, $I = 1$ A:

$$S = \frac{(10^{-3})(100)}{1 - 10^{-3}} = \frac{0.1}{0.999} \approx 0.1\ \Omega.$$

Why other options are wrong:

- (A) $100\ \Omega$ is the galvanometer resistance itself, far too large for a shunt.
- (B) $1\ \Omega$ and (D) $10\ \Omega$ would let too much current through the galvanometer.

Final Answer: $S \approx 0.1\ \Omega \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q22

Q23.

Solution

Concept — Faraday's law: The magnitude of the induced emf is $\varepsilon = N\dfrac{|\Delta\phi|}{\Delta t}$.

Step 1 — Change in flux: $|\Delta\phi| = |0.01 - 0.04| = 0.03$ Wb.

Step 2 — Apply Faraday's law:

$$\varepsilon = N\frac{|\Delta\phi|}{\Delta t} = 200 \times \frac{0.03}{0.1} = 200 \times 0.3 = 60\ \text{V}.$$

Why other options are wrong:

- (A) 30 V uses $N = 100$ or halves the flux change.
- (C) 6 V and (D) 0.6 V misplace a power of ten in Δt.

Final Answer: $\varepsilon = 60\ \text{V} \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q23

Q24.

Solution

Concept — Capacitive reactance: $X_C = \dfrac{1}{2\pi f C}$.

Step 1 — Identify C: $C = \dfrac{1}{2\pi}\ \text{mF} = \dfrac{1}{2\pi} \times 10^{-3}\ \text{F}$.

Step 2 — Substitute $f = 50$ Hz:

$$X_C = \frac{1}{2\pi(50)\left(\frac{1}{2\pi} \times 10^{-3}\right)} = \frac{1}{50 \times 10^{-3}} = \frac{1}{0.05} = 20\ \Omega.$$

Why other options are wrong:

- (A) $50\ \Omega$ and (B) $100\ \Omega$ leave a stray 2π uncancelled.
- (C) $5\ \Omega$ misplaces a power of ten.

Final Answer: $X_C = 20\ \Omega \Rightarrow \boxed{D}$

Answer: (D) Go Back to Q24

Q25.

Solution

Concept — E and B amplitudes in an EM wave: In vacuum the peak fields obey $E_0 = c\,B_0$.

Step 1 — Substitute: $B_0 = 2 \times 10^{-8}$ T, $c = 3 \times 10^8$ m s^{-1}.

$$E_0 = cB_0 = (3 \times 10^8)(2 \times 10^{-8}).$$

Step 2 — Evaluate:

$$E_0 = 6 \times 10^0 = 6 \text{ V m}^{-1}.$$

Why other options are wrong:

- (A) 1.5 and (B) 0.67 divide by c instead of multiplying.
- (D) 12 V m^{-1} doubles the correct value.

Final Answer: $E_0 = 6$ V m^{-1} $\Rightarrow \boxed{C}$

Answer: (C) Go Back to Q25

Q26.

Solution

Concept — Concave mirror: Use $\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$ (with $u = -30$, $f = -20$, mirror convention), then $m = -\frac{v}{u}$.

Step 1 — Find v:

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

so $v = -60$ cm.

Step 2 — Magnification:

$$m = -\frac{v}{u} = -\frac{(-60)}{(-30)} = -2.$$

Why other options are wrong:

- (B) $+2$ drops the negative sign (the image is inverted, so $m < 0$).
- (C) -0.5 inverts the ratio; (D) -1 would need $u = v$.

Final Answer: $m = -2 \Rightarrow \boxed{A}$

Answer: (A) Go Back to Q26

Q27.

Solution

Concept — Critical angle: At the critical angle, $\sin\theta_c = \frac{1}{n}$ (light going from a denser medium n into air).

Step 1 — Substitute $n = \sqrt{2}$:

$$\sin\theta_c = \frac{1}{\sqrt{2}}.$$

Step 2 — Solve: $\theta_c = \sin^{-1}\left(\frac{1}{\sqrt{2}}\right) = 45°$.

Why other options are wrong:

- (A) $30°$ corresponds to $\sin\theta_c = 0.5$, i.e. $n = 2$.
- (B) $60°$ gives $n = 2/\sqrt{3}$; (D) $90°$ would mean no total internal reflection at all.

Final Answer: $\theta_c = 45° \Rightarrow \boxed{C}$

Answer: (C) Go Back to Q27

Q28.

Solution

Concept — Interference conditions: Constructive (bright) interference needs a path difference of $n\lambda$; destructive (dark) interference needs an *odd* multiple of half-wavelengths, $(2n+1)\frac{\lambda}{2}$.

Step 1 — Pick the dark condition: For a dark fringe the two waves arrive out of phase, requiring path difference $= (2n+1)\frac{\lambda}{2}$, with $n = 0, 1, 2, \ldots$

Why other options are wrong:

- (A) $n\lambda$ and (B) $2n\lambda$ are the *bright*-fringe (constructive) conditions.

- (C) $n\lambda/2$ includes even multiples too, which give bright fringes.

Final Answer: Dark fringe at path difference $(2n+1)\lambda/2 \Rightarrow \boxed{D}$

Answer: (D) Go Back to Q28

Q29.

Solution

Concept — Malus's law: For polarised light passing through a polaroid at angle θ, $I = I_0 \cos^2\theta$.

Step 1 — Substitute $\theta = 60°$: $\cos 60° = \frac{1}{2}$, so $\cos^2 60° = \frac{1}{4}$.

$$I = I_0\left(\tfrac{1}{2}\right)^2 = \frac{I_0}{4}.$$

Why other options are wrong:

- (A) I_0 would need $\theta = 0°$.
- (B) $3I_0/4$ uses $\sin^2 60°$ instead of $\cos^2 60°$; (D) $I_0/2$ is the result for *unpolarised* light, not for $\theta = 60°$.

Final Answer: $I = I_0/4 \Rightarrow \boxed{C}$

Answer: (C) Go Back to Q29

Q30.

Solution

Concept — Einstein's photoelectric equation: $K_{\max} = h\nu - \phi = E_{\text{photon}} - \phi$.

Step 1 — Substitute: $E_{\text{photon}} = 5$ eV, $\phi = 2$ eV.

$$K_{\max} = 5 - 2 = 3 \text{ eV}.$$

Why other options are wrong:

- (B) 7 eV adds the work function instead of subtracting it.
- (C) 2.5 eV halves the photon energy; (D) 10 eV multiplies the energies.

Final Answer: $K_{\max} = 3 \text{ eV} \Rightarrow \boxed{A}$

Answer: (A) Go Back to Q30

Q31.

Solution

Concept — Bohr energy levels: $E_n = -\frac{13.6}{n^2}$ eV.

Step 1 — Substitute $n = 2$**:**

$$E_2 = -\frac{13.6}{2^2} = -\frac{13.6}{4} = -3.4 \text{ eV}.$$

Why other options are wrong:

- (A) -13.6 eV is the ground state ($n = 1$).
- (C) -1.51 eV is the $n = 3$ level; (D) -6.8 eV divides by 2 instead of 2^2.

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

Answer: (B) Go Back to Q31

Q32.

Solution

Concept — Activity of a radioactive sample: The activity is $A = \lambda N$, the number of disintegrations per second.

Step 1 — Substitute: $\lambda = 5 \times 10^{-8}$ s^{-1}, $N = 2 \times 10^{20}$.

$$A = (5 \times 10^{-8})(2 \times 10^{20}).$$

Step 2 — Evaluate:

$$A = 10 \times 10^{12} = 1 \times 10^{13} \text{ Bq}.$$

Why other options are wrong:

- (A) 1×10^{12} misadds the exponents.
- (B) 4×10^{27} multiplies N by N; (D) 2.5×10^{12} divides instead of multiplying.

Final Answer: $A = 1 \times 10^{13}$ Bq $\Rightarrow$ $\boxed{\text{C}}$

Answer: (C) Go Back to Q32

Q33.

Solution

Concept — Mass-energy equivalence: The binding energy equals the mass defect times 931 MeV/u: $E_b = \Delta m \times 931$ MeV.

Step 1 — Substitute: $\Delta m = 0.10$ u.

$$E_b = 0.10 \times 931 = 93.1 \text{ MeV}.$$

Why other options are wrong:

- (A) 9.31 MeV uses $\Delta m = 0.01$ u (a power-of-ten slip).
- (B) 931 MeV uses $\Delta m = 1$ u; (C) 0.931 MeV uses $\Delta m = 0.001$ u.

Final Answer: $E_b = 93.1$ MeV $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q33

Q34.

Solution

Concept — NOR gate: A NOR gate is an OR gate followed by an inverting bubble: $Y = \overline{A + B}$. Its output is 1 *only* when both inputs are 0.

Step 1 — Evaluate the OR: $A + B = 0 + 0 = 0$.

Step 2 — Invert it: $Y = \overline{0} = 1$.

Why other options are wrong:

- (B) 0 would be the OR output without the inverting bubble.
- (C),(D) a logic gate gives a fixed 0 or 1 determined entirely by the inputs.

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

Answer: (A) Go Back to Q34

Q35.

Solution

Concept — Full-wave rectifier: A full-wave rectifier conducts during *both* halves of the AC input, redirecting the reversed (negative) half so that the current through the load always flows in the same direction.

Step 1 — Positive half-cycle: One pair of diodes conducts and current passes through the load in the forward direction.

Step 2 — Negative half-cycle: The other pair conducts, but the load current still flows the *same* way — giving a pulsating but unidirectional output.

Why other options are wrong:

- (A),(D) describe a *half-wave* rectifier, which blocks one half-cycle.
- (C) the output is rectified (one direction), not alternating like the input.

Final Answer: Unidirectional current for both half-cycles $\Rightarrow \boxed{B}$

Answer: (B) Go Back to Q35

Answer Key

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