SAAT Physics

Sample Paper – 8

Duration: 40 Minutes **Maximum Marks: 40**

Instructions

- This paper contains **40** Multiple Choice Questions (Single Correct Answer), modelled on the Physics section of the **SAAT** (Siksha 'O' Anusandhan Admission Test).
- Each correct answer carries **+1 mark**. There is **no negative marking** for incorrect or unattempted answers.
- Only **one** option is correct. Attempt every question, since wrong answers are not penalised.
- Use of mobile phones, calculators, or other electronic gadgets is strictly prohibited.

Q1. One joule of energy is equal to how many ergs? (Use $1\ \text{J} = 1\ \text{kg}\,\text{m}^2\text{s}^{-2}$ and $1\ \text{erg} = 1\ \text{g}\,\text{cm}^2\text{s}^{-2}$.)

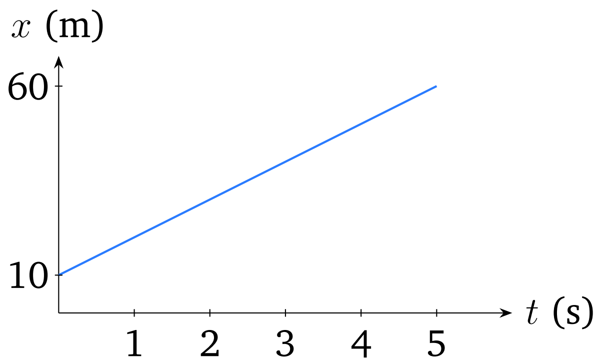
(A) 10^7 erg

(B) 10^5 erg

(C) 10^3 erg

(D) 10^9 erg

Q2. The position–time graph of a particle moving along a straight line is shown. The speed of the particle during the interval is



(A) 12 m/s

(B) 10 m/s

(C) 50 m/s

(D) 5 m/s

Q3. A projectile is launched with a speed of $30\ \mathrm{m/s}$ at an angle of 30° to the horizontal. Its horizontal range is $(g = 10\ \mathrm{m/s^2})$

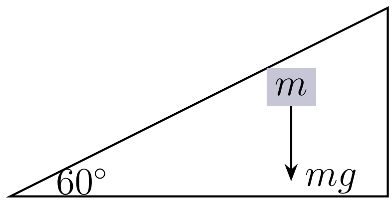
(A) 90 m

(B) 45 m

(C) $45\sqrt{3}$ m

(D) $90\sqrt{3}$ m

Q4. A block of mass 4 kg rests on a smooth inclined plane of inclination 60°, as shown. The normal reaction exerted by the surface on the block is $(g = 10\ \mathrm{m/s^2})$



(A) 40 N

(B) 34.6 N

(C) $34.6\sqrt{3}$ N

(D) 20 N

Q5. A ball of mass 0.2 kg moving at $10\ \mathrm{m/s}$ strikes a wall normally and rebounds with the same speed. The magnitude of the impulse imparted to the ball is

(A) $4\ \mathrm{kg\,m/s}$

(B) $2\ \mathrm{kg\,m/s}$

(C) $1\ \mathrm{kg\,m/s}$

(D) $8\ \mathrm{kg\,m/s}$

Q6. A force $\vec{F} = (5\hat{i} + 12\hat{j})$ N acts on a body that moves through a displacement $\vec{d} = 4\hat{i}$ m. The work done by the force is

(A) 48 J

(B) 20 J

(C) 68 J

(D) 52 J

Q7. A stone of mass 0.5 kg is dropped from a height of 20 m. Just before it hits the ground, its kinetic energy is ($g = 10\ \mathrm{m/s^2}$)

(A) 50 J

(B) 200 J

(C) 100 J

(D) 20 J

Q8. The moment of inertia of a uniform solid sphere of mass M and radius R about an axis passing through its centre is

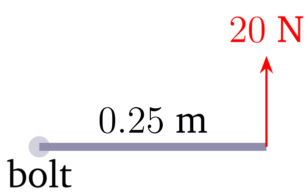
(A) $\frac{1}{2}MR^2$

(B) MR^2

(C) $\frac{2}{3}MR^2$

(D) $\frac{2}{5}MR^2$

Q9. A force of 20 N is applied at the end of a wrench of length 0.25 m, perpendicular to its handle, as shown. The torque produced about the bolt is



(A) 5 N m

(B) 80 N m

(C) 2.5 N m

(D) 10 N m

Q10. The orbital speed of a satellite revolving close to the surface of a planet of radius R and surface gravity g is

(A) $\sqrt{2gR}$

(B) $\sqrt{gR}$

(C) gR

(D) $\sqrt{gR/2}$

Q11. A steel wire of cross-sectional area 2 mm^2 carries a load of 400 N. The tensile stress in the wire is

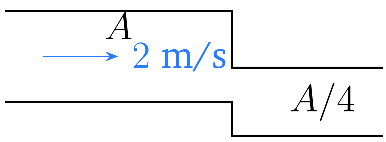
(A) $1 \times 10^8 \text{ N/m}^2$

(B) $4 \times 10^8 \text{ N/m}^2$

(C) $2 \times 10^8 \text{ N/m}^2$

(D) $8 \times 10^8 \text{ N/m}^2$

Q12. Water flows steadily through a horizontal pipe whose cross-section narrows from A to $A/4$, as shown. If the speed in the wide part is 2 m/s, the speed in the narrow part is



(A) 2 m/s

(B) 4 m/s

(C) 16 m/s

(D) 8 m/s

Q13. A gas absorbs 500 J of heat, and its internal energy increases by 300 J. The work done by the gas on its surroundings is

(A) 800 J

(B) 200 J

(C) 300 J

(D) 500 J

Q14. One mole of an ideal gas expands isothermally and reversibly at temperature T from volume V to $2V$. The work done by the gas is

(A) RT

(B) zero

(C) $RT \ln 2$

(D) $2RT$

Q15. The density of a gas is $1.5\ \mathrm{kg/m^3}$ and the root-mean-square speed of its molecules is $400\ \mathrm{m/s}$. The pressure exerted by the gas, using $P = \frac{1}{3}\rho c^2$, is

(A) 8×10^4 Pa

(B) 2.4×10^5 Pa

(C) 1.2×10^5 Pa

(D) 4×10^4 Pa

Q16. According to Newton's law of cooling, the rate of loss of heat of a body is directly proportional to

(A) the fourth power of its absolute temperature

(B) its own absolute temperature only

(C) the square of the temperature difference

(D) the temperature difference between the body and its surroundings

Q17. A particle executes SHM described by $x = 0.05\sin(20\,t)$ (SI units). The maximum speed of the particle is

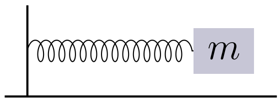
(A) 0.05 m/s

(B) 1 m/s

(C) 20 m/s

(D) 2 m/s

Q18. A block of mass 2 kg attached to a spring of force constant 200 N/m executes SHM on a frictionless surface, as shown. The time period of oscillation is



(A) $\frac{2\pi}{10}$ s

(B) $\frac{\pi}{10}$ s

(C) 2π s

(D) $\frac{\pi}{5}$ s

Q19. Two tuning forks of frequencies 256 Hz and 260 Hz are sounded together. The number of beats heard per second is

(A) 516

(B) 2

(C) 4

(D) 8

Q20. Two point charges of $+3\ \mu C$ and $+2\ \mu C$ are placed 0.3 m apart in vacuum. The electrostatic force between them is $\left(\frac{1}{4\pi\varepsilon_0} = 9 \times 10^9\ \mathrm{N\,m^2/C^2}\right)$

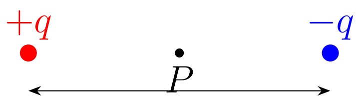
(A) 1.2 N

(B) 0.18 N

(C) 0.06 N

(D) 0.6 N

Q21. Two equal and opposite point charges $+q$ and $-q$ are separated by a small distance. At the midpoint between them, the resultant electric field due to the two charges points



(A) from $-q$ towards $+q$ and equals zero

(B) from $+q$ towards $-q$

(C) from $-q$ towards $+q$

(D) zero, since the two contributions cancel

Q22. Three capacitors of $2\ \mu\text{F}$, $3\ \mu\text{F}$ and $6\ \mu\text{F}$ are connected in series. The equivalent capacitance of the combination is

(A) $1\ \mu\text{F}$

(B) $11\ \mu\text{F}$

(C) $0.5\ \mu\text{F}$

(D) $3.7\ \mu\text{F}$

Q23. The electrostatic potential energy of a system of two point charges $+5\ \mu\text{C}$ and $-2\ \mu\text{C}$ placed 0.1 m apart is $\left(\dfrac{1}{4\pi\varepsilon_0} = 9 \times 10^9\ \text{N m}^2/\text{C}^2\right)$

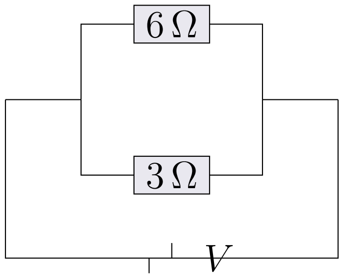
(A) $+0.9$ J

(B) -0.45 J

(C) -0.9 J

(D) $+0.45$ J

Q24. In the network shown, two resistors of $6\ \Omega$ and $3\ \Omega$ are connected in parallel across a battery of emf V. The equivalent resistance of the combination is



(A) $9\ \Omega$

(B) $4.5\ \Omega$

(C) $3\ \Omega$

(D) $2\ \Omega$

Q25. A cell of emf 6 V and internal resistance $0.5\ \Omega$ delivers a current of 4 A to an external circuit. The terminal voltage of the cell is

(A) 4 V

(B) 2 V

(C) 6 V

(D) 8 V

Q26. A heater draws a current of 5 A from a 220 V supply for 10 minutes. The electrical energy consumed is

(A) 1100 J

(B) 6.6×10^5 J

(C) 1.1×10^4 J

(D) 1.1×10^3 J

Q27. A wire of resistivity $1.8 \times 10^{-8}\ \Omega\,\text{m}$, length 20 m and cross-sectional area $2 \times 10^{-6}\ \text{m}^2$ has a resistance of

(A) $0.36\ \Omega$

(B) $1.8\ \Omega$

(C) $0.18\ \Omega$

(D) $3.6\ \Omega$

Q28. A long solenoid has 500 turns per metre and carries a current of 4 A. The magnetic field inside the solenoid is $(\mu_0 = 4\pi \times 10^{-7}\ \mathrm{T\,m/A})$

(A) 1.0×10^{-3} T

(B) 6.28×10^{-4} T

(C) 1.26×10^{-3} T

(D) 2.51×10^{-3} T

Q29. A straight conductor of length 0.5 m carrying a current of 4 A is placed perpendicular to a uniform magnetic field of 0.3 T. The force on the conductor is

(A) 0.6 N

(B) 1.2 N

(C) 0.3 N

(D) 2.4 N

Q30. A circular coil of 50 turns and radius 0.04 m carries a current of 2 A. Its magnetic dipole moment is

(A) $0.5\ \mathrm{A\,m^2}$

(B) $0.503\ \mathrm{A\,m^2}$

(C) $0.25\ \mathrm{A\,m^2}$

(D) $5.03\ \mathrm{A\,m^2}$

Q31. The magnetic flux through a coil of 200 turns changes uniformly from 0.04 Wb to 0.02 Wb in 0.1 s. The magnitude of the induced emf is

(A) 4 V

(B) 0.2 V

(C) 80 V

(D) 40 V

Q32. The capacitive reactance of a 50 μF capacitor connected to an AC source of angular frequency 1000 rad/s is

(A) 50 Ω

(B) 5 Ω

(C) 20 Ω

(D) 200 Ω

Q33. The concept introduced by Maxwell to make Ampere's circuital law consistent for a charging capacitor is the

(A) displacement current

(B) conduction current

(C) eddy current

(D) magnetising current

Q34. A transmitting antenna is mounted at a height of 80 m. Taking the radius of the Earth as 6.4×10^6 m, the maximum line-of-sight distance to the horizon, $d = \sqrt{2Rh}$, is approximately

(A) 64 km

(B) 32 km

(C) 16 km

(D) 48 km

Q35. The maximum kinetic energy of photoelectrons emitted from a metal surface is 1.5 eV. The stopping potential required to stop these electrons is

(A) 3.0 V

(B) 0.75 V

(C) 1.5 V

(D) 1.5×10^{-19} V

Q36. The momentum of a particle whose de Broglie wavelength is 5×10^{-11} m is $(h = 6.6 \times 10^{-34}\ \mathrm{J\,s})$

(A) $3.3 \times 10^{-24}\ \mathrm{kg\,m/s}$

(B) $6.6 \times 10^{-23}\ \mathrm{kg\,m/s}$

(C) $1.32 \times 10^{-22}\ \mathrm{kg\,m/s}$

(D) $1.32 \times 10^{-23}\ \mathrm{kg\,m/s}$

Q37. In the Bohr model of the hydrogen atom, the radius of the first orbit is 0.53 Å. The radius of the third orbit ($n = 3$) is

(A) 1.59 Å

(B) 4.77 Å

(C) 0.53 Å

(D) 1.06 Å

Q38. The mass defect of a certain nucleus is 0.05 u. The binding energy of the nucleus is (take $1\ \mathrm{u} = 931\ \mathrm{MeV}/c^2$)

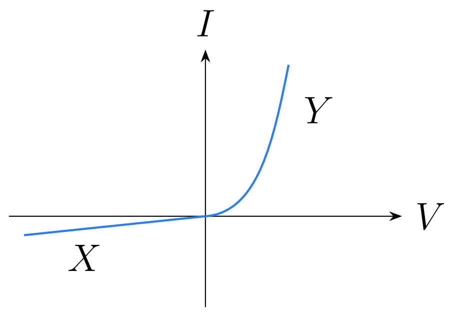
(A) 46.55 MeV

(B) 9.31 MeV

(C) 93.1 MeV

(D) 4.655 MeV

Q39. The current–voltage (I–V) characteristic of a p–n junction diode is shown below. The portion of the curve marked X corresponds to



(A) forward bias with a large current

(B) the breakdown region of forward bias

(C) zero applied voltage

(D) reverse bias with a small saturation current

Q40. The truth table of a two-input logic gate is given below. The gate is

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

(A) AND

(B) NAND

(C) OR

(D) NOR

Detailed Solutions

Q1.

Solution

Concept — Unit conversion of energy: Convert each SI base unit to CGS: $1\ \text{kg} = 10^3\ \text{g}$ and $1\ \text{m} = 10^2\ \text{cm}$.

Step 1 — Write the dimensions: $1\ \text{J} = 1\ \text{kg}\,\text{m}^2\text{s}^{-2} = (10^3\ \text{g})(10^2\ \text{cm})^2(\text{s})^{-2}$.

Step 2 — Collect powers of ten: $= 10^3 \times 10^4\ \text{g}\,\text{cm}^2\text{s}^{-2} = 10^7\ \text{erg}$.

Why other options are wrong: 10^5 forgets to square the length factor; 10^3 keeps only the mass factor; 10^9 over-counts the powers.

Final Answer: $1\ \text{J} = 10^7\ \text{erg} \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q1

Q2.

Solution

Concept — Slope of an x–t graph: For uniform motion the speed equals the slope, $v = \dfrac{\Delta x}{\Delta t}$.

Step 1 — Read endpoints: Position goes from 10 m at $t = 0$ to 60 m at $t = 5$ s.

Step 2 — Compute slope: $v = \dfrac{60-10}{5-0} = \dfrac{50}{5} = 10\ \text{m/s}$.

Why other options are wrong: 50 uses Δx alone; 5 inverts the ratio; 12 uses a wrong intercept.

Final Answer: $v = 10\ \text{m/s} \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q2

Q3.

Solution

Concept — Projectile range: $R = \dfrac{u^2 \sin 2\theta}{g}$.

Step 1 — Evaluate $\sin 2\theta$: $2\theta = 60^\circ$, so $\sin 60^\circ = \dfrac{\sqrt{3}}{2}$.

Step 2 — Substitute: $R = \dfrac{(30)^2(\sqrt{3}/2)}{10} = \dfrac{900 \times 0.866}{10} = 45\sqrt{3}\ \text{m} \approx 77.9\ \text{m}$.

Why other options are wrong: 90 uses $\sin 2\theta = 1$ (a $45°$ launch); 45 drops the $\sqrt{3}$; $90\sqrt{3}$ doubles the result.

Final Answer: $R = 45\sqrt{3}$ m $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q3

Q4.

Solution

Concept — Block on a smooth incline: The normal reaction balances the perpendicular component of gravity, $N = mg\cos\theta$.

Step 1 — Substitute: $N = 4 \times 10 \times \cos 60° = 40 \times 0.5$.

Step 2 — Compute: $N = 20$ N.

Why other options are wrong: 40 N ignores the cosine; 34.6 N uses $\cos 30°$; the $\sqrt{3}$ option mixes the components.

Final Answer: $N = 20$ N $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q4

Q5.

Solution

Concept — Impulse equals change in momentum: $J = \Delta p = m(v_f - v_i)$, taking direction into account.

Step 1 — Assign signs: Incoming $+10$ m/s, rebound -10 m/s, so $\Delta v = -10 - 10 = -20$ m/s.

Step 2 — Compute magnitude: $|J| = 0.2 \times 20 = 4$ kg m/s.

Why other options are wrong: 2 uses only one speed (no rebound); 1 halves it; 8 doubles the mass.

Final Answer: $|J| = 4$ kg m/s $\Rightarrow \boxed{\text{A}}$

Answer: (A) 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 — Multiply components: $W = (5)(4) + (12)(0)$.

Step 2 — Add: $W = 20 + 0 = 20$ J.

Why other options are wrong: 48 pairs the 12 with the 4; 52 adds the magnitude of $\vec{F}$; 68 sums all products without regard to direction.

Final Answer: $W = 20 \text{ J} \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q6

Q7.

Solution

Concept — Energy conservation in free fall: The kinetic energy just before impact equals the lost potential energy, $KE = mgh$.

Step 1 — Substitute: $KE = 0.5 \times 10 \times 20$.

Step 2 — Compute: $KE = 100$ J.

Why other options are wrong: 50 drops the height factor; 200 omits the mass; 20 keeps only gh.

Final Answer: $KE = 100 \text{ J} \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q7

Q8.

Solution

Concept — Moment of inertia of a solid sphere: About a diameter through its centre, $I = \frac{2}{5}MR^2$.

Step 1 — Standard result: Integrating $r^2\,dm$ over the solid sphere gives $\frac{2}{5}MR^2$.

Why other options are wrong: $\frac{1}{2}MR^2$ is a disc/solid cylinder; MR^2 is a hoop; $\frac{2}{3}MR^2$ is a thin spherical shell.

Final Answer: $I = \frac{2}{5}MR^2 \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q8

Q9.

Solution

Concept — Torque: For a force applied perpendicular to a lever arm, $\tau = F\,r$.

Step 1 — Substitute: $\tau = 20 \times 0.25$.

Step 2 — Compute: $\tau = 5$ N m.

Why other options are wrong: 80 divides by the length instead of multiplying; 2.5 halves it; 10 uses a wrong arm.

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

Answer: (A) Go Back to Q9

Q10.

Solution

Concept — Orbital speed near a surface: The gravitational force supplies the centripetal force, $\frac{mv^2}{R} = mg$, so $v = \sqrt{gR}$.

Step 1 — Equate forces: $v^2 = gR$.

Step 2 — Take the root: $v = \sqrt{gR}$.

Why other options are wrong: $\sqrt{2gR}$ is the escape speed; gR has the wrong dimensions; $\sqrt{gR/2}$ uses a stray factor.

Final Answer: $v = \sqrt{gR} \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q10

Q11.

Solution

Concept — Tensile stress: Stress $= \frac{F}{A}$.

Step 1 — Convert the area: $A = 2\ \text{mm}^2 = 2 \times 10^{-6}\ \text{m}^2$.

Step 2 — Compute: Stress $= \frac{400}{2 \times 10^{-6}} = 2 \times 10^8\ \text{N/m}^2$.

Why other options are wrong: 4×10^8 forgets to halve for the $2\ \text{mm}^2$ area; 1×10^8 and 8×10^8 mis-handle the conversion.

Final Answer: Stress $= 2 \times 10^8\ \text{N/m}^2 \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q11

Q12.

Solution

Concept — Equation of continuity: For an incompressible fluid, $A_1v_1 = A_2v_2$.

Step 1 — Set up the ratio: $v_2 = v_1\frac{A_1}{A_2} = v_1\frac{A}{A/4} = 4v_1$.

Step 2 — Substitute: $v_2 = 4 \times 2 = 8$ m/s.

Why other options are wrong: 2 assumes no change; 4 uses a factor of 2; 16 squares the area ratio.

Final Answer: $v_2 = 8$ m/s $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q12

Q13.

Solution

Concept — First law of thermodynamics: $Q = \Delta U + W$, where W is the work done *by* the gas.

Step 1 — Rearrange: $W = Q - \Delta U$.

Step 2 — Substitute: $W = 500 - 300 = 200$ J.

Why other options are wrong: 800 adds the terms; 300 and 500 confuse ΔU and Q with the work.

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

Answer: (B) Go Back to Q13

Q14.

Solution

Concept — Isothermal work: For an ideal gas at constant temperature, $W = nRT\ln\frac{V_2}{V_1}$.

Step 1 — Substitute $n = 1$, $V_2 = 2V$, $V_1 = V$: $W = RT\ln\frac{2V}{V}$.

Step 2 — Simplify: $W = RT\ln 2$.

Why other options are wrong: "zero" applies to an isochoric step, not expansion; RT and $2RT$ drop the logarithm.

Final Answer: $W = RT\ln 2 \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q14

Q15.

Solution

Concept — Pressure of a gas: $P = \frac{1}{3}\rho c^2$, where c is the rms speed.

Step 1 — Substitute: $P = \frac{1}{3}(1.5)(400)^2$.

Step 2 — Compute: $P = \frac{1}{3}(1.5)(1.6 \times 10^5) = 0.5 \times 1.6 \times 10^5 = 8 \times 10^4$ Pa.

Why other options are wrong: 2.4×10^5 omits the factor $\frac{1}{3}$; 1.2×10^5 and 4×10^4 mis-handle the arithmetic.

Final Answer: $P = 8 \times 10^4$ Pa $\Rightarrow \boxed{A}$

Answer: (A) Go Back to Q15

Q16.

Solution

Concept — Newton's law of cooling: For a small temperature excess, $\frac{dQ}{dt} \propto (T - T_0)$, the difference between the body and its surroundings.

Step 1 — State the law: The rate of heat loss is proportional to the temperature difference, not to any single absolute temperature.

Why other options are wrong: The fourth-power dependence is Stefan's law; the bare absolute temperature and the squared difference are not Newton's law.

Final Answer: Proportional to the temperature difference $\Rightarrow \boxed{D}$

Answer: (D) Go Back to Q16

Q17.

Solution

Concept — Maximum speed in SHM: For $x = A\sin(\omega t)$, the maximum speed is $v_{max} = A\omega$.

Step 1 — Read A and ω: $A = 0.05$ m, $\omega = 20$ rad/s.

Step 2 — Compute: $v_{max} = 0.05 \times 20 = 1$ m/s.

Why other options are wrong: 0.05 and 20 quote A or ω alone; 2 uses a wrong product.

Final Answer: $v_{max} = 1$ m/s $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q17

Q18.

Solution

Concept — Time period of a spring–mass system: $T = 2\pi\sqrt{\dfrac{m}{k}}$.

Step 1 — Substitute: $T = 2\pi\sqrt{\dfrac{2}{200}} = 2\pi\sqrt{0.01}$.

Step 2 — Compute: $T = 2\pi(0.1) = \dfrac{2\pi}{10}$ s.

Why other options are wrong: $\dfrac{\pi}{10}$ drops a factor of 2; 2π ignores the ratio; $\dfrac{\pi}{5}$ mis-roots the fraction.

Final Answer: $T = \dfrac{2\pi}{10}$ s $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q18

Q19.

Solution

Concept — Beat frequency: The number of beats per second equals the difference of the two frequencies, $f_{beat} = |f_1 - f_2|$.

Step 1 — Subtract: $f_{beat} = |260 - 256|$.

Step 2 — Compute: $f_{beat} = 4$ Hz.

Why other options are wrong: 516 adds the frequencies; 2 halves the difference; 8 doubles it.

Final Answer: 4 beats per second $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q19

Q20.

Solution

Concept — Coulomb's law: $F = \frac{1}{4\pi\varepsilon_0}\frac{q_1 q_2}{r^2}$.

Step 1 — Substitute: $F = \frac{9\times10^9\times(3\times10^{-6})(2\times10^{-6})}{(0.3)^2}$.

Step 2 — Compute: $F = \frac{9\times10^9\times6\times10^{-12}}{0.09} = \frac{5.4\times10^{-2}}{0.09} = 0.6\text{ N}$.

Why other options are wrong: 1.2 N drops the r^2; 0.18 N uses $r = 1$; 0.06 N misplaces a power of ten.

Final Answer: $F = 0.6\text{ N} \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q20

Q21.

Solution

Concept — Field of two opposite charges: The field of a positive charge points away from it; that of a negative charge points towards it. At the midpoint both contributions point the same way.

Step 1 — Direction from $+q$: Points away from $+q$, i.e. towards $-q$.

Step 2 — Direction from $-q$: Points towards $-q$, the same direction. The fields add, giving a net field from $+q$ towards $-q$.

Why other options are wrong: The fields do not cancel (a common trap); they reinforce, so the answer is neither zero nor reversed.

Final Answer: Net field from $+q$ towards $-q \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q21

Q22.

Solution

Concept — Capacitors in series: $\frac{1}{C_{eq}} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}$.

Step 1 — Add reciprocals: $\frac{1}{C_{eq}} = \frac{1}{2} + \frac{1}{3} + \frac{1}{6} = \frac{3+2+1}{6} = 1$.

Step 2 — Invert: $C_{eq} = 1\ \mu\text{F}$.

Why other options are wrong: $11\ \mu$F adds the values (a parallel rule); 0.5 and

3.7 μF mis-add the reciprocals.

Final Answer: $C_{eq} = 1\ \mu\text{F} \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q22

Q23.

Solution

Concept — Potential energy of two charges: $U = \dfrac{1}{4\pi\varepsilon_0}\dfrac{q_1 q_2}{r}$, keeping the signs of the charges.

Step 1 — Substitute: $U = \dfrac{9\times10^9\times(5\times10^{-6})(-2\times10^{-6})}{0.1}$.

Step 2 — Compute: $U = \dfrac{9\times10^9\times(-1\times10^{-11})}{0.1} = \dfrac{-9\times10^{-2}}{0.1} = -0.9$ J.

Why other options are wrong: $+0.9$ ignores the sign; ±0.45 misplaces the distance factor.

Final Answer: $U = -0.9\ \text{J} \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q23

Q24.

Solution

Concept — Resistors in parallel: $\dfrac{1}{R_{eq}} = \dfrac{1}{R_1} + \dfrac{1}{R_2}$.

Step 1 — Add reciprocals: $\dfrac{1}{R_{eq}} = \dfrac{1}{6} + \dfrac{1}{3} = \dfrac{1+2}{6} = \dfrac{1}{2}$.

Step 2 — Invert: $R_{eq} = 2\ \Omega$.

Why other options are wrong: 9 adds them in series; 4.5 averages them; 3 keeps only one branch.

Final Answer: $R_{eq} = 2\ \Omega \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q24

Q25.

Solution

Concept — Terminal voltage: $V = \varepsilon - Ir$, the emf minus the drop across the internal resistance.

Step 1 — Internal drop: $Ir = 4 \times 0.5 = 2$ V.

Step 2 — Subtract: $V = 6 - 2 = 4$ V.

Why other options are wrong: 6 ignores the internal drop; 2 gives only the drop; 8 adds instead of subtracting.

Final Answer: $V = 4$ V $\Rightarrow \boxed{A}$

Answer: (A) Go Back to Q25

Q26.

Solution

Concept — Electrical energy: $E = VIt$, with time in seconds.

Step 1 — Convert time: $t = 10$ min $= 600$ s.

Step 2 — Compute: $E = 220 \times 5 \times 600 = 6.6 \times 10^5$ J.

Why other options are wrong: 1100 J uses $t = 1$ s; 1.1×10^4 and 1.1×10^3 mis-handle the time conversion.

Final Answer: $E = 6.6 \times 10^5$ J $\Rightarrow \boxed{B}$

Answer: (B) Go Back to Q26

Q27.

Solution

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

Step 1 — Substitute: $R = \dfrac{(1.8 \times 10^{-8})(20)}{2 \times 10^{-6}}$.

Step 2 — Compute: $R = \dfrac{3.6 \times 10^{-7}}{2 \times 10^{-6}} = 0.18\ \Omega$.

Why other options are wrong: 0.36 forgets to divide by the area factor; 1.8 and 3.6 misplace powers of ten.

Final Answer: $R = 0.18\ \Omega \Rightarrow \boxed{C}$

Answer: (C) Go Back to Q27

Q28.

Solution

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

Step 1 — Substitute: $B = (4\pi \times 10^{-7})(500)(4)$.

Step 2 — Compute: $B = (4\pi \times 10^{-7})(2000) = 8\pi \times 10^{-4} \approx 2.51 \times 10^{-3}$ T.

Why other options are wrong: 1.26×10^{-3} uses half the turns; 6.28×10^{-4} and 1.0×10^{-3} drop a factor.

Final Answer: $B \approx 2.51 \times 10^{-3}$ T $\Rightarrow$ D

Answer: (D) Go Back to Q28

Q29.

Solution

Concept — Force on a current-carrying conductor: $F = BIL\sin\theta$, with $\theta = 90°$.

Step 1 — Substitute: $F = (0.3)(4)(0.5)$.

Step 2 — Compute: $F = 0.6$ N.

Why other options are wrong: 1.2 omits the length; 0.3 drops the current factor; 2.4 multiplies incorrectly.

Final Answer: $F = 0.6$ N $\Rightarrow$ A

Answer: (A) Go Back to Q29

Q30.

Solution

Concept — Magnetic moment of a coil: $m = NIA = NI\pi r^2$.

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

Step 2 — Compute: $m = 50 \times 2 \times 5.03 \times 10^{-3} \approx 0.503$ A m^2.

Why other options are wrong: 0.5 uses $\pi \approx 3$ crudely off; 0.25 omits a factor of 2; 5.03 misplaces a power of ten.

Final Answer: $m \approx 0.503$ A m^2 $\Rightarrow$ B

Answer: (B) Go Back to Q30

Q31.

Solution

Concept — Faraday's law: $|\varepsilon| = N\dfrac{|\Delta\phi|}{\Delta t}$.

Step 1 — Change in flux: $|\Delta\phi| = 0.04 - 0.02 = 0.02$ Wb.

Step 2 — Compute: $|\varepsilon| = 200 \times \dfrac{0.02}{0.1} = 200 \times 0.2 = 40$ V.

Why other options are wrong: 4 drops the turns; 0.2 omits N entirely; 80 doubles the flux change.

Final Answer: $|\varepsilon| = 40$ V $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q31

Q32.

Solution

Concept — Capacitive reactance: $X_C = \dfrac{1}{\omega C}$.

Step 1 — Substitute: $X_C = \dfrac{1}{(1000)(50 \times 10^{-6})}$.

Step 2 — Compute: $X_C = \dfrac{1}{0.05} = 20\ \Omega$.

Why other options are wrong: 50 and 5 mis-handle the product ωC; 200 misplaces a power of ten.

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

Answer: (C) Go Back to Q32

Q33.

Solution

Concept — Displacement current: Maxwell noted that a changing electric field between capacitor plates acts like a current, $I_d = \varepsilon_0 \dfrac{d\phi_E}{dt}$, restoring continuity in Ampere's law.

Step 1 — Identify the term: The extra source of magnetic field where no charge flows is the displacement current.

Why other options are wrong: Conduction current is the flow of charge; eddy currents are induced loops in conductors; magnetising current relates to inductors, not this correction.

Final Answer: The displacement current $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q33

Q34.

Solution

Concept — Line-of-sight range: The horizon distance for an antenna of height h is $d = \sqrt{2Rh}$.

Step 1 — Substitute: $d = \sqrt{2 \times 6.4 \times 10^6 \times 80}$.

Step 2 — Compute: $d = \sqrt{1.024 \times 10^9} \approx 3.2 \times 10^4$ m $= 32$ km.

Why other options are wrong: 64 km drops the square root of 2 wrongly; 16 and 48 km use a wrong height or radius.

Final Answer: $d \approx 32$ km $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q34

Q35.

Solution

Concept — Stopping potential: The stopping potential V_0 satisfies $eV_0 = KE_{max}$, so $V_0 = KE_{max}/e$.

Step 1 — Use eV units: With KE_{max} expressed in electron-volts, V_0 in volts equals the same number.

Step 2 — Read off: $KE_{max} = 1.5$ eV $\Rightarrow V_0 = 1.5$ V.

Why other options are wrong: 3.0 doubles the value; 0.75 halves it; 1.5×10^{-19} confuses joules with the volt reading.

Final Answer: $V_0 = 1.5$ V $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q35

Q36.

Solution

Concept — de Broglie relation: $\lambda = \frac{h}{p}$, so $p = \frac{h}{\lambda}$.

Step 1 — Substitute: $p = \frac{6.6 \times 10^{-34}}{5 \times 10^{-11}}$.

Step 2 — Compute: $p = 1.32 \times 10^{-23}$ kg m/s.

Why other options are wrong: 3.3×10^{-24} and 1.32×10^{-22} misplace a power of ten; 6.6×10^{-23} drops the wavelength.

Final Answer: $p = 1.32 \times 10^{-23}$ kg m/s $\Rightarrow \boxed{D}$

Answer: (D) Go Back to Q36

Q37.

Solution

Concept — Bohr orbit radius: $r_n = n^2 r_1$, since $r_n \propto n^2$.

Step 1 — Put $n = 3$: $r_3 = 3^2 \times 0.53 = 9 \times 0.53$.

Step 2 — Compute: $r_3 = 4.77$ Å.

Why other options are wrong: 1.59 Å uses n instead of n^2; 1.06 Å uses $n = 2$ partly; 0.53 Å ignores the orbit number.

Final Answer: $r_3 = 4.77$ Å $\Rightarrow \boxed{B}$

Answer: (B) Go Back to Q37

Q38.

Solution

Concept — Mass–energy equivalence: Binding energy = $(\Delta m) \times 931$ MeV when Δm is in atomic mass units.

Step 1 — Substitute: $E = 0.05 \times 931$.

Step 2 — Compute: $E = 46.55$ MeV.

Why other options are wrong: 9.31 and 4.655 MeV misplace the decimal; 93.1 MeV doubles the mass defect.

Final Answer: $E = 46.55$ MeV $\Rightarrow \boxed{A}$

Answer: (A) Go Back to Q38

Q39.

Solution

Concept — Diode I–V characteristic: In the first quadrant the diode conducts heavily (forward bias); in the third quadrant the current is a tiny, nearly constant reverse saturation current.

Step 1 — Locate X: The branch X lies for negative V with a very small negative current that barely changes.

Step 2 — Interpret: This is the reverse-bias region with its small saturation current.

Why other options are wrong: The large-current branch Y is forward bias; "zero voltage" is just the origin; breakdown would show a sudden steep reverse current, not the flat part shown.

Final Answer: Reverse bias with a small saturation current $\Rightarrow \boxed{D}$

Answer: (D) Go Back to Q39

Q40.

Solution

Concept — Reading a truth table: Match the output column to the standard gate definitions.

Step 1 — Inspect the table: $Y = 0$ only when both inputs are 0; $Y = 1$ whenever at least one input is 1.

Step 2 — Identify: This is exactly the OR gate, $Y = A + B$.

Why other options are wrong: AND gives 1 only when both inputs are 1; NAND and NOR give 1 for the all-zero input, which contradicts the table.

Final Answer: The gate is an OR gate $\Rightarrow \boxed{C}$

Answer: (C) Go Back to Q40

Answer Key

Q	Ans	Q	Ans	Q	Ans	Q	Ans	Q	Ans
1	A	2	B	3	C	4	D	5	A
6	B	7	C	8	D	9	A	10	B
11	C	12	D	13	B	14	C	15	A
16	D	17	B	18	A	19	C	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	B	35	C
36	D	37	B	38	A	39	D	40	C