

SAAT Physics

Sample Paper – 3

Duration: 40 Minutes

Maximum Marks: 40

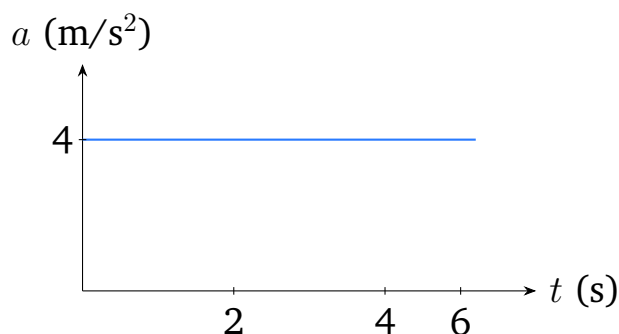
Instructions

- 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. The radius of a sphere is measured as 2.05 cm. The number of significant figures in this measurement is

- (A) 2
- (B) 3
- (C) 4
- (D) 1

Q2. The acceleration–time graph of a particle starting from rest is shown. The velocity of the particle at $t = 6$ s is

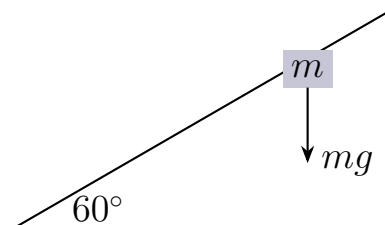


- (A) 24 m/s
- (B) 12 m/s
- (C) 6 m/s
- (D) 48 m/s

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

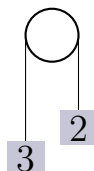
- (A) 90 m
- (B) 45 m
- (C) $45\sqrt{3}$ m
- (D) $30\sqrt{3}$ m

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 ($g = 10 \text{ m/s}^2$)



- (A) 40 N
- (B) 34.6 N
- (C) 30 N
- (D) 20 N

Q5. Two masses 3 kg and 2 kg are connected by a light string over a frictionless pulley, as shown. The acceleration of the system is ($g = 10 \text{ m/s}^2$)



- (A) 2 m/s^2
- (B) 5 m/s^2
- (C) 1 m/s^2
- (D) 4 m/s^2

Q6. A force $\vec{F} = (2\hat{i} + 2\hat{j})$ N acts on a body that is displaced by $\vec{d} = (3\hat{i} - 3\hat{j})$ m. The work done by the force is

- (A) 12 J
- (B) 0 J
- (C) 6 J
- (D) -12 J

Q7. A body of mass 2 kg is dropped from a height of 5 m. Its kinetic energy just before striking the ground is ($g = 10 \text{ m/s}^2$)

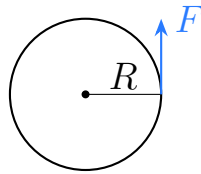
- (A) 50 J
- (B) 25 J
- (C) 100 J
- (D) 200 J

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 tangential force of 20 N is applied at the rim of a wheel of radius 0.5 m, as shown. The torque produced about the centre is





- (A) 10 N m
- (B) 40 N m
- (C) 20 N m
- (D) 5 N m

Q10. The orbital speed of a satellite revolving close to the surface of the Earth is ($R = 6.4 \times 10^6$ m, $g = 10$ m/s²)

- (A) 11.2 km/s
- (B) 8 km/s
- (C) 4 km/s
- (D) 16 km/s

Q11. A steel wire of cross-sectional area 2 mm^2 can support a maximum load of 400 N. The maximum stress the wire can withstand is

- (A) 1×10^8 N/m²
- (B) 4×10^8 N/m²
- (C) 8×10^8 N/m²
- (D) 2×10^8 N/m²

Q12. Water flows through a horizontal pipe whose cross-sectional area decreases from 6 cm^2 to 2 cm^2 . If the speed in the wider section is 3 m/s, the speed in the narrower section is

- (A) 1 m/s
- (B) 6 m/s
- (C) 9 m/s



(D) 3 m/s

Q13. 150 J of work is done *on* a gas while it releases 40 J of heat to the surroundings. The change in internal energy of the gas is

(A) 110 J

(B) 190 J

(C) -110 J

(D) 40 J

Q14. For an ideal gas undergoing an isothermal process, which one of the following quantities is always zero?

(A) Heat absorbed by the gas

(B) Change in internal energy

(C) Work done by the gas

(D) Change in pressure

Q15. At the same temperature, the ratio of the rms speeds of hydrogen ($M = 2$) to oxygen ($M = 32$) molecules is

(A) 1 : 4

(B) 4 : 1

(C) 1 : 16

(D) 16 : 1

Q16. 100 g of water at 80°C is mixed with 300 g of water at 20°C . The final equilibrium temperature of the mixture is

(A) 50°C

(B) 40°C

(C) 30°C

(D) 35°C



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

- (A) 0.05 m/s
- (B) 1 m/s
- (C) 20 m/s
- (D) 0.5 m/s

Q18. A mass of 0.5 kg is attached to a spring of force constant 200 N/m and oscillates, as shown. The time period of oscillation is



- (A) $\frac{\pi}{10}$ s
- (B) $\frac{\pi}{5}$ s
- (C) π s
- (D) $\frac{\pi}{20}$ 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 Hz
- (B) 258 Hz
- (C) 2 Hz
- (D) 4 Hz

Q20. Two point charges of $+3 \mu\text{C}$ and $+4 \mu\text{C}$ are placed 0.3 m apart in vacuum. The magnitude of the force between them is $\left(\frac{1}{4\pi\epsilon_0} = 9 \times 10^9 \text{ N m}^2/\text{C}^2\right)$

- (A) 0.6 N
- (B) 1.08 N
- (C) 1.2 N



(D) 3.6 N

Q21. A uniform electric field exists between two parallel plates 2 cm apart maintained at a potential difference of 200 V. The magnitude of the electric field between the plates is

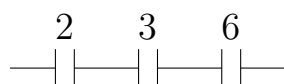
(A) 1×10^4 V/m

(B) 400 V/m

(C) 100 V/m

(D) 4×10^4 V/m

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



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

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

(C) $2 \mu\text{F}$

(D) $3 \mu\text{F}$

Q23. The electrostatic potential energy of a system of two point charges $+2 \mu\text{C}$ and $-3 \mu\text{C}$ separated by 0.6 m is $\left(\frac{1}{4\pi\epsilon_0} = 9 \times 10^9 \text{ N m}^2/\text{C}^2\right)$

(A) -0.045 J

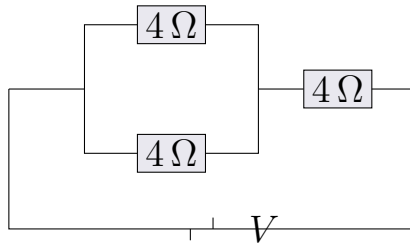
(B) $+0.09$ J

(C) -0.09 J

(D) $+0.045$ J

Q24. Three resistors of 4Ω each are connected, two in parallel and that combination in series with the third, as shown. The equivalent resistance between the terminals is





- (A) $12\ \Omega$
- (B) $4\ \Omega$
- (C) $2\ \Omega$
- (D) $6\ \Omega$

Q25. A cell of emf $6\ \text{V}$ and internal resistance $0.5\ \Omega$ is connected across an external resistance of $2.5\ \Omega$. The terminal voltage of the cell is

- (A) $5\ \text{V}$
- (B) $6\ \text{V}$
- (C) $1\ \text{V}$
- (D) $2\ \text{V}$

Q26. A heater of resistance $20\ \Omega$ carries a current of $5\ \text{A}$ for 2 minutes. The heat produced is

- (A) $30\ \text{kJ}$
- (B) $60\ \text{kJ}$
- (C) $500\ \text{J}$
- (D) $120\ \text{kJ}$

Q27. A wire of length $10\ \text{m}$ and cross-sectional area $2 \times 10^{-6}\ \text{m}^2$ has a resistance of $5\ \Omega$. The resistivity of the material is

- (A) $5 \times 10^{-7}\ \Omega\ \text{m}$
- (B) $2.5 \times 10^{-6}\ \Omega\ \text{m}$
- (C) $1 \times 10^{-6}\ \Omega\ \text{m}$



(D) $1 \times 10^{-7} \Omega \text{ m}$

Q28. A long solenoid has 2000 turns per metre and carries a current of 4 A. The magnetic field inside the solenoid is ($\mu_0 = 4\pi \times 10^{-7} \text{ T m/A}$)

(A) $2\pi \times 10^{-3} \text{ T}$

(B) $16\pi \times 10^{-3} \text{ T}$

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

(D) $8\pi \times 10^{-3} \text{ T}$

Q29. A straight conductor of length 0.25 m carrying a current of 8 A is placed perpendicular to a uniform magnetic field of 0.4 T. The force on the conductor is

(A) 0.8 N

(B) 1.6 N

(C) 0.4 N

(D) 3.2 N

Q30. A circular coil of 50 turns and area $4 \times 10^{-3} \text{ m}^2$ carries a current of 2 A. When placed with its plane parallel to a uniform magnetic field of 0.5 T, the torque on the coil is

(A) 0.1 N m

(B) 0.2 N m

(C) 0.4 N m

(D) 0.05 N m

Q31. The magnetic flux through a coil of 200 turns changes from 0.04 Wb to 0.01 Wb in 0.1 s. The magnitude of the induced emf is

(A) 30 V

(B) 6 V



- (C) 60 V
- (D) 0.3 V

Q32. A capacitor of $50 \mu\text{F}$ is connected to an AC source of angular frequency 1000 rad/s . The capacitive reactance is

- (A) 50Ω
- (B) 5Ω
- (C) 200Ω
- (D) 20Ω

Q33. In a plane electromagnetic wave travelling through vacuum, the directions of the electric field \vec{E} , the magnetic field \vec{B} and the direction of propagation are

- (A) all parallel to one another
- (B) mutually perpendicular to one another
- (C) \vec{E} parallel to \vec{B} but perpendicular to propagation
- (D) randomly oriented

Q34. A high-frequency carrier wave is required for the transmission of a message signal mainly because it

- (A) increases the loudness of the signal
- (B) removes noise from the signal
- (C) allows a practical antenna size and long-range transmission
- (D) lowers the energy needed for transmission

Q35. Light of frequency 10^{15} Hz falls on a metal of work function 2 eV . The maximum kinetic energy of the emitted photoelectrons is ($h = 6.6 \times 10^{-34} \text{ Js}$, $1 \text{ eV} = 1.6 \times 10^{-19} \text{ J}$)

- (A) 2.1 eV



- (B) 4.1 eV
- (C) 6.6 eV
- (D) 0.5 eV

Q36. The de Broglie wavelength of an electron accelerated through a potential difference of 100 V is approximately

- (A) 12.27 Å
- (B) 0.123 Å
- (C) 1.0 Å
- (D) 1.227 Å

Q37. In the Bohr model of the hydrogen atom, the radius of the n th orbit is proportional to

- (A) n
- (B) n^2
- (C) $1/n^2$
- (D) $1/n$

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

- (A) 46.55 MeV
- (B) 9.31 MeV
- (C) 93.1 MeV
- (D) 18.62 MeV

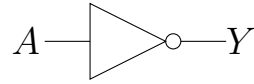
Q39. A Zener diode, when operated in the reverse breakdown region, is most commonly used as a

- (A) rectifier
- (B) amplifier



- (C) voltage regulator
- (D) oscillator

Q40. The logic gate that has a single input and whose output is the complement of the input ($Y = \bar{A}$) is the gate shown below.



- (A) AND gate
- (B) OR gate
- (C) NAND gate
- (D) NOT gate



Detailed Solutions

Q1.

Solution

Concept — Significant figures: All non-zero digits are significant, and zeros between non-zero digits are also significant.

Step 1 — Read the digits: 2.05 has the digits 2, 0 and 5.

Step 2 — Count: The zero lies between two non-zero digits, so it counts. There are 3 significant figures.

Why other options are wrong: 2 wrongly drops the sandwiched zero; 4 and 1 miscount the digits present.

Final Answer: 3 significant figures \Rightarrow

Answer: (B) [Go Back to Q1](#)

Q2.

Solution

Concept — Area under an $a-t$ graph: The change in velocity equals the area under the acceleration–time graph.

Step 1 — Constant acceleration: $a = 4 \text{ m/s}^2$ for 6 s.

Step 2 — Velocity: Starting from rest, $v = u + at = 0 + 4 \times 6 = 24 \text{ m/s}$ (area = 4×6).

Why other options are wrong: 12 uses $t = 3$; 6 confuses a with v ; 48 doubles the time.

Final Answer: $v = 24 \text{ m/s} \Rightarrow$

Answer: (A) [Go Back to Q2](#)

Q3.

Solution

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

Step 1 — Substitute: $R = \frac{(30)^2 \sin 60^\circ}{10} = \frac{900 \times (\sqrt{3}/2)}{10}$.



Step 2 — Compute: $R = 90 \times \frac{\sqrt{3}}{2} = 45\sqrt{3} \text{ m.}$

Why other options are wrong: 90 uses $\sin 2\theta = 1$; 45 drops the $\sqrt{3}$; $30\sqrt{3}$ mis-evaluates u^2/g .

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

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: $N = 4 \times 10 \times \cos 60^\circ = 40 \times 0.5$.

Step 2 — Compute: $N = 20 \text{ N.}$

Why other options are wrong: 40 ignores the angle; 34.6 uses $\cos 30^\circ$; 30 has no consistent basis.

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

Answer: (D) [Go Back to Q4](#)

Q5.

Solution

Concept — Atwood machine: For two masses over a frictionless pulley, $a = \frac{(m_1 - m_2)g}{m_1 + m_2}$.

Step 1 — Substitute: $a = \frac{(3 - 2) \times 10}{3 + 2} = \frac{10}{5}$.

Step 2 — Compute: $a = 2 \text{ m/s}^2$.

Why other options are wrong: 5 uses $g/2$; 1 and 4 use wrong mass combinations.

Final Answer: $a = 2 \text{ m/s}^2 \Rightarrow \boxed{\text{A}}$

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: $W = (2)(3) + (2)(-3) = 6 - 6$.

Step 2 — Add: $W = 0$ J (force is perpendicular to displacement).

Why other options are wrong: 12 and -12 keep only one term with the wrong sign; 6 drops the second term.

Final Answer: $W = 0$ J \Rightarrow **B**

Answer: (B) [Go Back to Q6](#)

Q7.

Solution

Concept — Energy conservation: A freely falling body converts potential energy into kinetic energy, so $KE = mgh$.

Step 1 — Substitute: $KE = 2 \times 10 \times 5$.

Step 2 — Compute: $KE = 100$ J.

Why other options are wrong: 50 drops the mass; 25 halves wrongly; 200 doubles the height.

Final Answer: $KE = 100$ J \Rightarrow **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 over the solid sphere gives $\frac{2}{5}MR^2$.

Why other options are wrong: $\frac{1}{2}MR^2$ is a disc/cylinder; MR^2 is a ring; $\frac{2}{3}MR^2$ is a hollow sphere.

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

Answer: (D) [Go Back to Q8](#)



Q9.

Solution

Concept — Torque: $\tau = F \times R$ for a force applied tangentially at the rim.

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

Step 2 — Compute: $\tau = 10 \text{ N m}$.

Why other options are wrong: 40 uses $R = 2$; 20 ignores the radius; 5 halves the answer.

Final Answer: $\tau = 10 \text{ N m} \Rightarrow \boxed{\text{A}}$

Answer: (A) [Go Back to Q9](#)

Q10.

Solution

Concept — Orbital speed near the surface: $v_o = \sqrt{gR}$.

Step 1 — Substitute: $v_o = \sqrt{10 \times 6.4 \times 10^6} = \sqrt{6.4 \times 10^7}$.

Step 2 — Compute: $v_o = 8 \times 10^3 \text{ m/s} = 8 \text{ km/s}$.

Why other options are wrong: 11.2 km/s is the escape speed; 4 and 16 km/s come from a wrong factor.

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

Answer: (B) [Go Back to Q10](#)

Q11.

Solution

Concept — Stress: $\text{Stress} = \frac{\text{Force}}{\text{Area}}$.

Step 1 — Substitute SI values: $A = 2 \text{ mm}^2 = 2 \times 10^{-6} \text{ m}^2$, $F = 400 \text{ N}$.

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

Why other options are wrong: 1×10^8 uses a wrong area; 4×10^8 and 8×10^8 misplace the factor of two/ten.

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

Answer: (D) [Go Back to Q11](#)



Q12.

Solution

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

Step 1 — Solve for v_2 : $v_2 = \frac{A_1v_1}{A_2} = \frac{6 \times 3}{2}$.

Step 2 — Compute: $v_2 = 9$ m/s.

Why other options are wrong: 1 inverts the ratio; 6 uses a factor of two; 3 assumes no change in speed.

Final Answer: $v_2 = 9$ m/s \Rightarrow **C**

Answer: (C) [Go Back to Q12](#)

Q13.

Solution

Concept — First law of thermodynamics: $\Delta U = Q - W$, where W is work done by the gas and Q is heat added to it.

Step 1 — Assign signs: Heat released $\Rightarrow Q = -40$ J. Work done on the gas $\Rightarrow W = -150$ J.

Step 2 — Compute: $\Delta U = (-40) - (-150) = 110$ J.

Why other options are wrong: 190 adds the magnitudes; -110 flips the sign; 40 uses only the heat term.

Final Answer: $\Delta U = 110$ J \Rightarrow **A**

Answer: (A) [Go Back to Q13](#)

Q14.

Solution

Concept — Isothermal process: Temperature is constant, and for an ideal gas internal energy depends only on temperature, so $\Delta U = 0$.

Step 1 — Apply the first law: With $\Delta U = 0$, $Q = W$, so heat and work are both non-zero and equal.

Why other options are wrong: Heat absorbed, work done and pressure all change in an isothermal expansion; only the internal energy stays constant.

Final Answer: $\Delta U = 0 \Rightarrow$ **B**



Answer: (B) [Go Back to Q14](#)

Q15.

Solution

Concept — RMS speed and molar mass: $v_{rms} = \sqrt{\frac{3RT}{M}}$, so at the same T ,
 $v_{rms} \propto \frac{1}{\sqrt{M}}$.

Step 1 — Take the ratio: $\frac{v_{H_2}}{v_{O_2}} = \sqrt{\frac{M_{O_2}}{M_{H_2}}} = \sqrt{\frac{32}{2}} = \sqrt{16}$.

Step 2 — Simplify: $\frac{v_{H_2}}{v_{O_2}} = 4 \Rightarrow 4 : 1$.

Why other options are wrong: 1 : 4 inverts the ratio; 1 : 16 and 16 : 1 forget the square root.

Final Answer: Ratio = 4 : 1 \Rightarrow C

Answer: (C) [Go Back to Q15](#)

Q16.

Solution

Concept — Calorimetry: Heat lost by hot water = heat gained by cold water;
 $m_1c(T_1 - T) = m_2c(T - T_2)$.

Step 1 — Write the balance: $100(80 - T) = 300(T - 20)$.

Step 2 — Solve: $8000 - 100T = 300T - 6000 \Rightarrow 14000 = 400T \Rightarrow T = 35^\circ\text{C}$.

Why other options are wrong: 50 is the simple average; 40 and 30 ignore the unequal masses.

Final Answer: $T = 35^\circ\text{C} \Rightarrow$ 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 — Identify: $A = 0.05 \text{ m}$, $\omega = 20 \text{ rad/s}$.



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

Why other options are wrong: 0.05 and 20 quote A or ω alone; 0.5 uses half of ω .

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

Answer: (B) [Go Back to Q17](#)

Q18.

Solution

Concept — Spring-mass oscillator: $T = 2\pi\sqrt{\frac{m}{k}}$.

Step 1 — Substitute: $T = 2\pi\sqrt{\frac{0.5}{200}} = 2\pi\sqrt{2.5 \times 10^{-3}}$.

Step 2 — Compute: $\sqrt{2.5 \times 10^{-3}} = 0.05$, so $T = 2\pi(0.05) = 0.1\pi = \frac{\pi}{10} \text{ s}$.

Why other options are wrong: $\pi/5$ doubles the answer; π and $\pi/20$ misplace the factor.

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

Answer: (A) [Go Back to Q18](#)

Q19.

Solution

Concept — Beats: The beat frequency equals the difference of the two source frequencies, $f_b = |f_1 - f_2|$.

Step 1 — Substitute: $f_b = |260 - 256|$.

Step 2 — Compute: $f_b = 4 \text{ Hz}$.

Why other options are wrong: 516 adds the frequencies; 258 averages them; 2 halves the difference.

Final Answer: $f_b = 4 \text{ Hz} \Rightarrow \boxed{\text{D}}$

Answer: (D) [Go Back to Q19](#)



Q20.

Solution

Concept — Coulomb's law: $F = \frac{1}{4\pi\epsilon_0} \frac{q_1 q_2}{r^2}$.

Step 1 — Substitute: $F = \frac{9 \times 10^9 \times 3 \times 10^{-6} \times 4 \times 10^{-6}}{(0.3)^2}$.

Step 2 — Compute: $F = \frac{9 \times 10^9 \times 12 \times 10^{-12}}{0.09} = \frac{0.108}{0.09} = 1.2 \text{ N}$.

Why other options are wrong: 0.6 uses $r = 0.6$; 1.08 drops the r^2 ; 3.6 mis-handles the powers of ten.

Final Answer: $F = 1.2 \text{ N} \Rightarrow \boxed{\text{C}}$

Answer: (C) [Go Back to Q20](#)

Q21.

Solution

Concept — Field between parallel plates: $E = \frac{V}{d}$ for a uniform field.

Step 1 — Substitute: $d = 2 \text{ cm} = 0.02 \text{ m}$, $V = 200 \text{ V}$.

Step 2 — Compute: $E = \frac{200}{0.02} = 1 \times 10^4 \text{ V/m}$.

Why other options are wrong: 400 and 100 use d in centimetres or a wrong divisor; 4×10^4 misplaces a power of ten.

Final Answer: $E = 1 \times 10^4 \text{ V/m} \Rightarrow \boxed{\text{A}}$

Answer: (A) [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 adds them as in parallel; 2 and 3 keep only one capacitor.

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



Answer: (B) [Go Back to Q22](#)

Q23.

Solution

Concept — Potential energy of two charges: $U = \frac{1}{4\pi\epsilon_0} \frac{q_1q_2}{r}$, taking the signs of the charges.

Step 1 — Substitute: $U = \frac{9 \times 10^9 \times (2 \times 10^{-6})(-3 \times 10^{-6})}{0.6}$.

Step 2 — Compute: $U = \frac{9 \times 10^9 \times (-6 \times 10^{-12})}{0.6} = \frac{-0.054}{0.6} = -0.09 \text{ J}$.

Why other options are wrong: -0.045 uses $r = 1.2$; the positive options ignore the opposite signs of the charges.

Final Answer: $U = -0.09 \text{ J} \Rightarrow \boxed{\text{C}}$

Answer: (C) [Go Back to Q23](#)

Q24.

Solution

Concept — Series and parallel resistors: Two equal resistors in parallel give half their value; resistors in series add.

Step 1 — Parallel pair: $\frac{1}{R_p} = \frac{1}{4} + \frac{1}{4} \Rightarrow R_p = 2 \Omega$.

Step 2 — Add the series resistor: $R_{eq} = R_p + 4 = 2 + 4 = 6 \Omega$.

Why other options are wrong: 12 adds all three in series; 4 keeps only one; 2 stops at the parallel pair.

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

Answer: (D) [Go Back to Q24](#)

Q25.

Solution

Concept — Terminal voltage: $V = \epsilon - Ir$, with $I = \frac{\epsilon}{R + r}$.

Step 1 — Current: $I = \frac{6}{2.5 + 0.5} = \frac{6}{3} = 2 \text{ A}$.

Step 2 — Terminal voltage: $V = 6 - 2 \times 0.5 = 6 - 1 = 5 \text{ V}$ (equivalently



$$V = IR = 2 \times 2.5).$$

Why other options are wrong: 6 ignores internal resistance; 1 is the drop across r ; 2 confuses V with I .

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

Answer: (A) [Go Back to Q25](#)

Q26.

Solution

Concept — Joule heating: $H = I^2Rt$.

Step 1 — Substitute: $H = (5)^2 \times 20 \times 120$ (with $t = 2 \times 60 = 120 \text{ s}$).

Step 2 — Compute: $H = 25 \times 20 \times 120 = 60000 \text{ J} = 60 \text{ kJ}$.

Why other options are wrong: 30 kJ uses $t = 60 \text{ s}$; 500 J drops the time; 120 kJ doubles incorrectly.

Final Answer: $H = 60 \text{ kJ} \Rightarrow \boxed{\text{B}}$

Answer: (B) [Go Back to Q26](#)

Q27.

Solution

Concept — Resistivity: $R = \frac{\rho L}{A} \Rightarrow \rho = \frac{RA}{L}$.

Step 1 — Substitute: $\rho = \frac{5 \times 2 \times 10^{-6}}{10}$.

Step 2 — Compute: $\rho = \frac{10^{-5}}{10} = 1 \times 10^{-6} \Omega \text{ m}$.

Why other options are wrong: 5×10^{-7} halves the area factor; 2.5×10^{-6} and 1×10^{-7} misplace a power of ten.

Final Answer: $\rho = 1 \times 10^{-6} \Omega \text{ m} \Rightarrow \boxed{\text{C}}$

Answer: (C) [Go Back to Q27](#)



Q28.

Solution

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

Step 1 — Substitute: $B = (4\pi \times 10^{-7})(2000)(4)$.

Step 2 — Compute: $B = 4\pi \times 10^{-7} \times 8000 = 32\pi \times 10^{-4} \times 10^{-7}$. Simplify:
 $= 4\pi \times 8000 \times 10^{-7} = 32000\pi \times 10^{-7} = 32\pi \times 10^{-4}/10 = 8\pi \times 10^{-3}$ T.

Why other options are wrong: $2\pi \times 10^{-3}$ and $4\pi \times 10^{-3}$ drop a factor; $16\pi \times 10^{-3}$ doubles the current.

Final Answer: $B = 8\pi \times 10^{-3}$ T \Rightarrow **D**

Answer: (D) [Go Back to Q28](#)

Q29.

Solution

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

Step 1 — Substitute: $F = 0.4 \times 8 \times 0.25$.

Step 2 — Compute: $F = 0.8$ N.

Why other options are wrong: 1.6 doubles the length; 0.4 drops a factor; 3.2 uses $L = 1$.

Final Answer: $F = 0.8$ N \Rightarrow **A**

Answer: (A) [Go Back to Q29](#)

Q30.

Solution

Concept — Torque on a current loop: $\tau = NIAB \sin \theta$. When the plane is parallel to B , the normal is perpendicular to B , so $\theta = 90^\circ$ and $\sin \theta = 1$.

Step 1 — Substitute: $\tau = 50 \times 2 \times 4 \times 10^{-3} \times 0.5$.

Step 2 — Compute: $\tau = 50 \times 2 \times 0.5 \times 4 \times 10^{-3} = 50 \times 4 \times 10^{-3} = 0.2$ N m.

Why other options are wrong: 0.1 uses $\sin \theta$ for a wrong orientation; 0.4 doubles; 0.05 drops a factor.

Final Answer: $\tau = 0.2$ N m \Rightarrow **B**



Answer: (B) [Go Back to Q30](#)

Q31.

Solution

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

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

Step 2 — Compute: $|\varepsilon| = 200 \times \frac{0.03}{0.1} = 200 \times 0.3 = 60$ V.

Why other options are wrong: 30 uses $\Delta\phi/0.2$; 6 drops the turns factor; 0.3 ignores N .

Final Answer: $|\varepsilon| = 60$ V \Rightarrow **C**

Answer: (C) [Go Back to Q31](#)

Q32.

Solution

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

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

Step 2 — Compute: $X_C = \frac{1}{0.05} = 20$ Ω .

Why other options are wrong: 50 and 5 mis-handle the powers of ten; 200 uses a wrong frequency.

Final Answer: $X_C = 20$ $\Omega \Rightarrow$ **D**

Answer: (D) [Go Back to Q32](#)

Q33.

Solution

Concept — Structure of an EM wave: In a plane electromagnetic wave, \vec{E} , \vec{B} and the propagation direction \hat{k} are mutually perpendicular, with \hat{k} along $\vec{E} \times \vec{B}$.

Step 1 — Apply the rule: $\vec{E} \perp \vec{B}$, and both are perpendicular to the direction of travel.

Why other options are wrong: The fields are neither parallel to each other nor



to the propagation direction, and they are not randomly oriented.

Final Answer: They are mutually perpendicular \Rightarrow B

Answer: (B) [Go Back to Q33](#)

Q34.

Solution

Concept — Need for a high-frequency carrier: The size of an efficient transmitting antenna is comparable to the signal wavelength ($\sim \lambda/4$). A high-frequency carrier has a short wavelength, giving a practical antenna size and enabling long-range transmission.

Step 1 — Reasoning: Audio (low) frequencies would need impractically long antennas (kilometres), so the message is loaded onto a high-frequency carrier.

Why other options are wrong: Carrier frequency does not change loudness, remove noise, or by itself lower the transmission energy.

Final Answer: It allows a practical antenna size and long-range transmission \Rightarrow C

Answer: (C) [Go Back to Q34](#)

Q35.

Solution

Concept — Photoelectric equation: $KE_{max} = h\nu - \phi$.

Step 1 — Photon energy: $E = h\nu = 6.6 \times 10^{-34} \times 10^{15} = 6.6 \times 10^{-19} \text{ J} = \frac{6.6 \times 10^{-19}}{1.6 \times 10^{-19}} \text{ eV} \approx 4.1 \text{ eV}$.

Step 2 — Subtract work function: $KE_{max} = 4.1 - 2 = 2.1 \text{ eV}$.

Why other options are wrong: 4.1 is the photon energy itself; 6.6 misuses h ; 0.5 uses a wrong work function.

Final Answer: $KE_{max} = 2.1 \text{ eV} \Rightarrow$ A

Answer: (A) [Go Back to Q35](#)



Q36.

Solution

Concept — de Broglie wavelength of an accelerated electron: $\lambda = \frac{12.27}{\sqrt{V}} \text{ \AA}$.

Step 1 — Substitute: $\lambda = \frac{12.27}{\sqrt{100}} = \frac{12.27}{10}$.

Step 2 — Compute: $\lambda \approx 1.227 \text{ \AA}$.

Why other options are wrong: 12.27 uses $V = 1$; 0.123 uses $V = 10^4$; 1.0 rounds incorrectly.

Final Answer: $\lambda \approx 1.227 \text{ \AA} \Rightarrow$ **D**

Answer: (D) [Go Back to Q36](#)

Q37.

Solution

Concept — Bohr orbit radius: $r_n = \frac{n^2 h^2 \epsilon_0}{\pi m e^2}$, so $r_n \propto n^2$.

Step 1 — Read the dependence: The radius grows as the square of the principal quantum number.

Why other options are wrong: n describes the velocity-independent linear case (it is not); $1/n^2$ and $1/n$ describe energy and angular-momentum-type scalings, not the radius.

Final Answer: $r_n \propto n^2 \Rightarrow$ **B**

Answer: (B) [Go Back to Q37](#)

Q38.

Solution

Concept — Mass–energy equivalence: Binding energy = $\Delta m \times 931 \text{ MeV}$ per atomic mass unit.

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

Step 2 — Compute: $BE = 46.55 \text{ MeV}$.

Why other options are wrong: 9.31 and 93.1 misplace a power of ten; 18.62 uses a wrong mass defect.

Final Answer: $BE = 46.55 \text{ MeV} \Rightarrow$ **A**



Answer: (A) [Go Back to Q38](#)

Q39.

Solution

Concept — Zener diode: In its reverse breakdown region a Zener diode maintains a nearly constant voltage across itself even as current varies, which makes it act as a voltage regulator.

Step 1 — Mechanism: Beyond the breakdown voltage the diode holds the output steady, clamping the voltage.

Why other options are wrong: Rectification, amplification and oscillation are functions of ordinary diodes, transistors or LC circuits, not a Zener used in breakdown.

Final Answer: It acts as a voltage regulator \Rightarrow

Answer: (C) [Go Back to Q39](#)

Q40.

Solution

Concept — Logic gates: A NOT gate (inverter) has a single input and gives the complemented output $Y = \overline{A}$; the small bubble at the apex of the triangle denotes inversion.

Step 1 — Match the symbol: A triangle with a bubble and one input is the standard NOT-gate symbol.

Why other options are wrong: AND and OR have two inputs and no inversion bubble; a NAND has two inputs with a bubble.

Final Answer: The gate is a NOT gate \Rightarrow

Answer: (D) [Go Back to Q40](#)



Answer Key

Q	Ans	Q	Ans	Q	Ans	Q	Ans	Q	Ans
1	B	2	A	3	C	4	D	5	A
6	B	7	C	8	D	9	A	10	B
11	D	12	C	13	A	14	B	15	C
16	D	17	B	18	A	19	D	20	C
21	A	22	B	23	C	24	D	25	A
26	B	27	C	28	D	29	A	30	B
31	C	32	D	33	B	34	C	35	A
36	D	37	B	38	A	39	C	40	D

