

SAAT Physics

Sample Paper – 1

Duration: 40 Minutes

Maximum Marks: 40

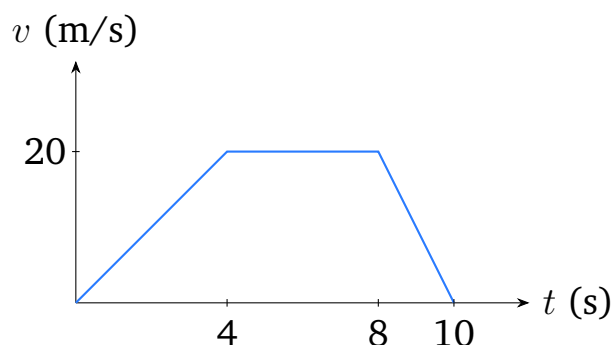
Instructions

- 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. Which one of the following pairs has the **same** dimensional formula?

- (A) Work and Power
- (B) Torque and Work
- (C) Force and Pressure
- (D) Impulse and Force

Q2. The velocity–time graph of a particle moving in a straight line is shown below. The total displacement of the particle in 10 s is

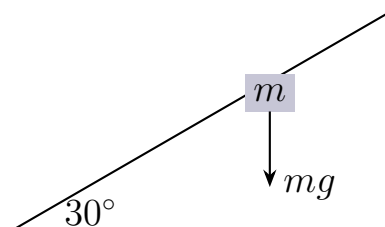


- (A) 120 m
- (B) 100 m
- (C) 140 m
- (D) 160 m

Q3. A ball is thrown vertically upward with a speed of 20 m/s. The maximum height reached by the ball is ($g = 10 \text{ m/s}^2$)

- (A) 20 m
- (B) 40 m
- (C) 10 m
- (D) 25 m

Q4. A block is placed on a smooth (frictionless) inclined plane of inclination 30° as shown. The acceleration of the block down the incline is ($g = 10 \text{ m/s}^2$)



- (A) 10 m/s^2
- (B) 8.66 m/s^2
- (C) 2.5 m/s^2
- (D) 5 m/s^2

Q5. A horizontal force of 10 N is applied to a 2 kg block resting on a rough horizontal surface of coefficient of friction $\mu = 0.2$. The acceleration of the block is ($g = 10 \text{ m/s}^2$)

- (A) 5 m/s^2
- (B) 3 m/s^2



(C) 2 m/s^2

(D) 4 m/s^2

Q6. A force $\vec{F} = (3\hat{i} + 4\hat{j})$ N displaces a body through $\vec{d} = (2\hat{i} + 3\hat{j})$ m. The work done by the force is

(A) 18 J

(B) 12 J

(C) 25 J

(D) 6 J

Q7. A pump lifts 100 kg of water to a height of 10 m in 20 s. The power of the pump is ($g = 10 \text{ m/s}^2$)

(A) 1000 W

(B) 250 W

(C) 500 W

(D) 100 W

Q8. The moment of inertia of a uniform circular disc of mass M and radius R about an axis passing through its centre and perpendicular to its plane is

(A) MR^2

(B) $\frac{1}{4}MR^2$

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

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

Q9. A uniform thin rod of mass M and length L rotates about an axis through one end and perpendicular to its length, as shown. Its moment of inertia about this axis is





- (A) $\frac{1}{12}ML^2$
- (B) $\frac{1}{3}ML^2$
- (C) ML^2
- (D) $\frac{1}{2}ML^2$

Q10. The acceleration due to gravity at a height equal to the radius of the Earth R above the surface, in terms of its surface value g , is

- (A) $g/4$
- (B) $g/2$
- (C) g
- (D) $g/9$

Q11. A wire of length 2 m and cross-sectional area 1 mm^2 stretches by 1 mm when a force of 100 N is applied. The Young's modulus of the wire material is

- (A) $1 \times 10^{11} \text{ N/m}^2$
- (B) $4 \times 10^{11} \text{ N/m}^2$
- (C) $2 \times 10^{11} \text{ N/m}^2$
- (D) $5 \times 10^{10} \text{ N/m}^2$

Q12. A liquid rises to a height of 4 cm in a capillary tube of radius r . In another capillary tube of radius $r/2$ (same liquid), the liquid will rise to a height of

- (A) 2 cm
- (B) 4 cm



- (C) 16 cm
- (D) 8 cm

Q13. A gas absorbs 200 J of heat and does 50 J of work on its surroundings. The change in internal energy of the gas is

- (A) 150 J
- (B) 250 J
- (C) 50 J
- (D) 200 J

Q14. In an adiabatic process, which one of the following quantities is always zero?

- (A) Work done by the gas
- (B) Heat exchanged with the surroundings
- (C) Change in internal energy
- (D) Change in temperature

Q15. The root-mean-square speed of the molecules of an ideal gas at absolute temperature T is v . If the temperature is raised to $4T$, the rms speed becomes

- (A) v
- (B) $4v$
- (C) $2v$
- (D) $v/2$

Q16. A Carnot engine operates between a source at 600 K and a sink at 300 K. Its efficiency is

- (A) 100%
- (B) 25%



(C) 75%

(D) 50%

Q17. A particle executes simple harmonic motion of amplitude A . At a displacement of $A/2$ from the mean position, the fraction of the total energy that is kinetic is

(A) $3/4$

(B) $1/4$

(C) $1/2$

(D) 1

Q18. A simple pendulum has a time period T . If its length is increased to four times the original length, the new time period will be

(A) T

(B) $2T$

(C) $4T$

(D) $T/2$

Q19. A transverse wave is described by $y = 0.02 \sin(300t - 1.5x)$, where all quantities are in SI units. The speed of the wave is

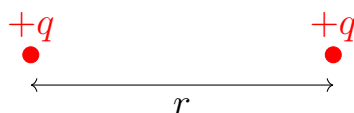
(A) 300 m/s

(B) 150 m/s

(C) 100 m/s

(D) 200 m/s

Q20. Two equal point charges $+q$ each are separated by a distance r and experience a force F , as shown. If the separation is doubled to $2r$, the new force between them is



- (A) F
- (B) $2F$
- (C) $F/4$
- (D) $4F$

Q21. The magnitude of the electric field at a distance of 0.1 m from a point charge of $2 \mu\text{C}$ is $\left(\frac{1}{4\pi\epsilon_0} = 9 \times 10^9 \text{ N m}^2/\text{C}^2\right)$

- (A) $1.8 \times 10^6 \text{ N/C}$
- (B) $9 \times 10^5 \text{ N/C}$
- (C) $3.6 \times 10^6 \text{ N/C}$
- (D) $1.8 \times 10^5 \text{ N/C}$

Q22. A parallel-plate capacitor has capacitance C . If the separation between the plates is halved (with the area unchanged), the new capacitance becomes

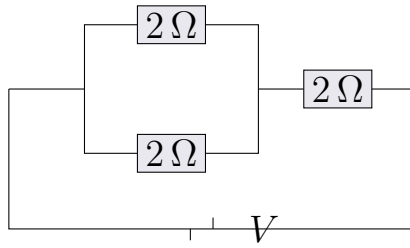
- (A) $C/2$
- (B) $2C$
- (C) C
- (D) $4C$

Q23. The electric potential at a distance of 0.2 m from a point charge of $4 \mu\text{C}$ is $\left(\frac{1}{4\pi\epsilon_0} = 9 \times 10^9 \text{ N m}^2/\text{C}^2\right)$

- (A) $9 \times 10^4 \text{ V}$
- (B) $3.6 \times 10^5 \text{ V}$
- (C) $1.8 \times 10^5 \text{ V}$
- (D) $1.8 \times 10^6 \text{ V}$

Q24. In the circuit shown, each resistor has a resistance of 2Ω . The equivalent resistance between the battery terminals is





- (A) $6\ \Omega$
- (B) $2\ \Omega$
- (C) $1.5\ \Omega$
- (D) $3\ \Omega$

Q25. A cell of emf $12\ \text{V}$ and internal resistance $1\ \Omega$ is connected to an external resistance of $5\ \Omega$. The current drawn from the cell is

- (A) $1\ \text{A}$
- (B) $2\ \text{A}$
- (C) $2.4\ \text{A}$
- (D) $12\ \text{A}$

Q26. An electric bulb is rated $60\ \text{W}$ at $120\ \text{V}$. The resistance of its filament is

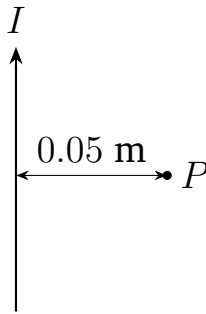
- (A) $240\ \Omega$
- (B) $120\ \Omega$
- (C) $60\ \Omega$
- (D) $480\ \Omega$

Q27. A steady current of $2\ \text{A}$ flows through a conductor. The total charge passing through any cross-section of the conductor in $10\ \text{s}$ is

- (A) $2\ \text{C}$
- (B) $0.2\ \text{C}$
- (C) $10\ \text{C}$
- (D) $20\ \text{C}$



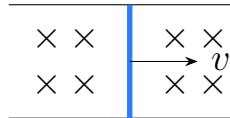
- Q28.** A long straight wire carries a current of 10 A. The magnetic field at a point P located 0.05 m from the wire is ($\mu_0 = 4\pi \times 10^{-7} \text{ T m/A}$)



- (A) $1 \times 10^{-5} \text{ T}$
(B) $2 \times 10^{-5} \text{ T}$
(C) $4 \times 10^{-5} \text{ T}$
(D) $8 \times 10^{-5} \text{ T}$
- Q29.** A charge of $1.6 \times 10^{-19} \text{ C}$ moves with a speed of 10^6 m/s perpendicular to a uniform magnetic field of 0.5 T. The magnitude of the magnetic force on the charge is
- (A) $8 \times 10^{-14} \text{ N}$
(B) $1.6 \times 10^{-13} \text{ N}$
(C) $4 \times 10^{-14} \text{ N}$
(D) $1.6 \times 10^{-14} \text{ N}$
- Q30.** The magnetic field at the centre of a circular coil of 100 turns and radius 0.1 m carrying a current of 2 A is ($\mu_0 = 4\pi \times 10^{-7} \text{ T m/A}$)
- (A) $6.28 \times 10^{-4} \text{ T}$
(B) $1.26 \times 10^{-3} \text{ T}$
(C) $2.51 \times 10^{-3} \text{ T}$
(D) $1.26 \times 10^{-4} \text{ T}$
- Q31.** A conducting rod of length 0.2 m moves with a velocity of 10 m/s on a pair of horizontal rails in a uniform magnetic field of 0.5 T directed into the page, as shown. The emf induced across the rod is



B (into page)



- (A) 0.5 V
- (B) 2 V
- (C) 1 V
- (D) 0.1 V

Q32. An alternating current has a peak value of 10 A. Its root-mean-square (rms) value is

- (A) 10 A
- (B) 5 A
- (C) 14.1 A
- (D) 7.07 A

Q33. The speed of electromagnetic waves in free space (vacuum) is

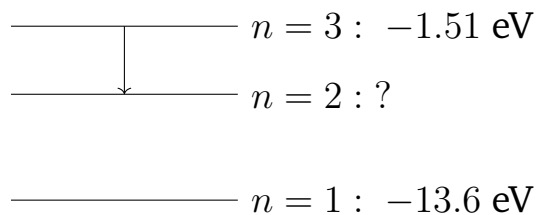
- (A) 3×10^8 m/s
- (B) 3×10^6 m/s
- (C) 1.5×10^8 m/s
- (D) 3×10^{10} m/s

Q34. The process of superimposing a low-frequency message signal onto a high-frequency carrier wave is called

- (A) Demodulation
- (B) Modulation
- (C) Amplification
- (D) Rectification



- Q35.** Light of photon energy 5 eV falls on a metal surface whose work function is 2 eV. The maximum kinetic energy of the emitted photoelectrons is
- (A) 7 eV
(B) 2 eV
(C) 3 eV
(D) 5 eV
- Q36.** The de Broglie wavelength associated with a moving particle is inversely proportional to its
- (A) charge
(B) energy
(C) mass only
(D) momentum
- Q37.** The energy of the electron in the ground state ($n = 1$) of a hydrogen atom is -13.6 eV. The energy of the level $n = 2$, shown in the diagram, is



- (A) -3.4 eV
(B) -13.6 eV
(C) -1.51 eV
(D) -0.85 eV
- Q38.** A radioactive sample has a half-life of 10 years. The fraction of the original sample remaining un-decayed after 30 years is
- (A) $1/2$

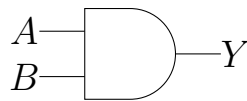


- (B) $1/8$
- (C) $1/4$
- (D) $1/16$

Q39. When a $p-n$ junction diode is forward biased, the width of the depletion region

- (A) increases
- (B) becomes infinite
- (C) decreases
- (D) remains unchanged

Q40. The logic gate whose output Y is 1 only when both inputs A and B are 1, represented by $Y = A \cdot B$, is



- (A) OR gate
- (B) NOT gate
- (C) NOR gate
- (D) AND gate



Detailed Solutions

Q1.

Solution

Concept — Dimensional formula: Quantities with the same dimensions can be added or equated. Torque = force \times perpendicular distance, and work = force \times displacement.

Step 1 — Torque: $[\tau] = [\text{Force}][\text{Length}] = (MLT^{-2})(L) = ML^2T^{-2}$.

Step 2 — Work: $[W] = [\text{Force}][\text{Length}] = ML^2T^{-2}$. They match.

Why other options are wrong:

- Work ML^2T^{-2} vs Power ML^2T^{-3} : differ by a factor of time.
- Force MLT^{-2} vs Pressure $ML^{-1}T^{-2}$: differ.
- Impulse MLT^{-1} vs Force MLT^{-2} : differ.

Final Answer: Torque and Work share $ML^2T^{-2} \Rightarrow$ B

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

Q2.

Solution

Concept — Area under a $v-t$ graph: The displacement equals the area between the velocity–time curve and the time axis.

Step 1 — Split the graph: A triangle from 0 to 4 s, a rectangle from 4 to 8 s, and a triangle from 8 to 10 s, with peak velocity 20 m/s.

Step 2 — Add the areas: $\frac{1}{2}(4)(20) + (4)(20) + \frac{1}{2}(2)(20) = 40 + 80 + 20 = 140$ m.

Why other options are wrong: 120, 100, and 160 m come from omitting one of the three regions or mis-reading the peak velocity.

Final Answer: Displacement = 140 m \Rightarrow C

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



Q3.

Solution

Concept — Vertical motion under gravity: At maximum height the velocity becomes zero, so $v^2 = u^2 - 2gh$ with $v = 0$.

Step 1 — Apply the equation: $0 = u^2 - 2gh \Rightarrow h = \frac{u^2}{2g}$.

Step 2 — Substitute: $h = \frac{(20)^2}{2(10)} = \frac{400}{20} = 20$ m.

Why other options are wrong: 40 m uses $g = 5$; 10 m halves the result wrongly; 25 m has no consistent basis.

Final Answer: $h = 20$ m \Rightarrow A

Answer: (A) [Go Back to Q3](#)

Q4.

Solution

Concept — Block on a smooth incline: The only force along the incline is the component of gravity, giving $a = g \sin \theta$.

Step 1 — Resolve gravity: Along the incline, $a = g \sin 30^\circ$.

Step 2 — Substitute: $a = 10 \times 0.5 = 5$ m/s².

Why other options are wrong: 10 is free fall (vertical); 8.66 uses $\cos 30^\circ$; 2.5 halves the answer incorrectly.

Final Answer: $a = 5$ m/s² \Rightarrow D

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

Q5.

Solution

Concept — Friction on a horizontal surface: The net force is the applied force minus kinetic friction $f = \mu mg$.

Step 1 — Friction force: $f = \mu mg = 0.2 \times 2 \times 10 = 4$ N.

Step 2 — Newton's second law: $a = \frac{F - f}{m} = \frac{10 - 4}{2} = 3$ m/s².

Why other options are wrong: 5 ignores friction; 4 and 2 use wrong net force.

Final Answer: $a = 3$ m/s² \Rightarrow B



Answer: (B) [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: $W = (3)(2) + (4)(3) = 6 + 12$.

Step 2 — Add: $W = 18 \text{ J}$.

Why other options are wrong: 12 and 6 keep only one term; 25 wrongly uses magnitudes (5×5).

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

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

Q7.

Solution

Concept — Power as work per unit time: $P = \frac{W}{t} = \frac{mgh}{t}$ for lifting against gravity.

Step 1 — Work done: $W = mgh = 100 \times 10 \times 10 = 10000 \text{ J}$.

Step 2 — Power: $P = \frac{10000}{20} = 500 \text{ W}$.

Why other options are wrong: 1000 uses $t = 10$; 250 uses $t = 40$; 100 drops a factor of g .

Final Answer: $P = 500 \text{ W} \Rightarrow$ C

Answer: (C) [Go Back to Q7](#)

Q8.

Solution

Concept — Moment of inertia of a disc: For a uniform disc about its central perpendicular axis, $I = \frac{1}{2}MR^2$.

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

Why other options are wrong: MR^2 is a ring/hoop; $\frac{2}{5}MR^2$ is a solid sphere; $\frac{1}{4}MR^2$ is a disc about a diameter.



Final Answer: $I = \frac{1}{2}MR^2 \Rightarrow \boxed{\text{D}}$

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

Q9.

Solution

Concept — Moment of inertia of a rod: About an axis through one end, perpendicular to its length, $I = \frac{1}{3}ML^2$.

Step 1 — Centre value: About the centre, $I_c = \frac{1}{12}ML^2$.

Step 2 — Parallel-axis theorem: $I = I_c + M\left(\frac{L}{2}\right)^2 = \frac{1}{12}ML^2 + \frac{1}{4}ML^2 = \frac{1}{3}ML^2$.

Why other options are wrong: $\frac{1}{12}ML^2$ is about the centre; ML^2 and $\frac{1}{2}ML^2$ have no basis here.

Final Answer: $I = \frac{1}{3}ML^2 \Rightarrow \boxed{\text{B}}$

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

Q10.

Solution

Concept — Variation of g with height: $g' = \frac{g}{(1 + h/R)^2}$.

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

Why other options are wrong: $g/2$ ignores the square; $g/9$ uses $h = 2R$; g ignores height altogether.

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

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

Q11.

Solution

Concept — Young's modulus: $Y = \frac{F/A}{\Delta L/L} = \frac{FL}{A\Delta L}$.

Step 1 — Substitute SI values: $F = 100 \text{ N}$, $A = 10^{-6} \text{ m}^2$, $L = 2 \text{ m}$, $\Delta L = 10^{-3} \text{ m}$.

Step 2 — Compute: $Y = \frac{100 \times 2}{10^{-6} \times 10^{-3}} = \frac{200}{10^{-9}} = 2 \times 10^{11} \text{ N/m}^2$.

Why other options are wrong: 1×10^{11} and 5×10^{10} drop the length factor; 4×10^{11}



doubles incorrectly.

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

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

Q12.

Solution

Concept — Capillary rise: $h = \frac{2T \cos \theta}{r \rho g}$, so $h \propto \frac{1}{r}$ for the same liquid.

Step 1 — Inverse relation: Halving the radius doubles the rise.

Step 2 — Compute: $h' = 2 \times 4 = 8 \text{ cm}$.

Why other options are wrong: 2 cm halves instead of doubling; 16 cm uses $1/r^2$; 4 cm assumes no change.

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

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: $\Delta U = Q - W$.

Step 2 — Substitute: $\Delta U = 200 - 50 = 150 \text{ J}$.

Why other options are wrong: 250 adds instead of subtracting; 50 and 200 confuse the work and heat terms.

Final Answer: $\Delta U = 150 \text{ J} \Rightarrow \boxed{\text{A}}$

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

Q14.

Solution

Concept — Adiabatic process: By definition no heat is exchanged with the surroundings, so $Q = 0$.

Step 1 — Apply the first law: With $Q = 0$, $\Delta U = -W$, so internal energy and temperature still change.



Why other options are wrong: Work, internal energy, and temperature all change in an adiabatic process; only the heat exchanged is zero.

Final Answer: Heat exchanged is zero \Rightarrow **B**

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

Q15.

Solution

Concept — RMS speed of gas: $v_{rms} = \sqrt{\frac{3RT}{M}}$, so $v_{rms} \propto \sqrt{T}$.

Step 1 — Temperature ratio: Raising T to $4T$ multiplies the speed by $\sqrt{4} = 2$.

Step 2 — New speed: $v' = 2v$.

Why other options are wrong: $4v$ uses a linear (not square-root) dependence; v and $v/2$ ignore or invert it.

Final Answer: $v' = 2v \Rightarrow$ **C**

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

Q16.

Solution

Concept — Carnot efficiency: $\eta = 1 - \frac{T_{sink}}{T_{source}}$ with temperatures in kelvin.

Step 1 — Substitute: $\eta = 1 - \frac{300}{600} = 1 - 0.5 = 0.5$.

Step 2 — As a percentage: $\eta = 50\%$.

Why other options are wrong: 100% violates the second law; 25% and 75% use wrong temperature ratios.

Final Answer: $\eta = 50\% \Rightarrow$ **D**

Answer: (D) [Go Back to Q16](#)



Q17.

Solution

Concept — Energy in SHM: Total energy $E = \frac{1}{2}kA^2$; potential energy at displacement x is $\frac{1}{2}kx^2$.

Step 1 — Kinetic fraction: $\frac{KE}{E} = 1 - \frac{x^2}{A^2}$.

Step 2 — Put $x = A/2$: $\frac{KE}{E} = 1 - \frac{1}{4} = \frac{3}{4}$.

Why other options are wrong: $1/4$ is the potential fraction; $1/2$ holds only at $x = A/\sqrt{2}$; 1 is true only at the mean position.

Final Answer: Kinetic fraction = $3/4 \Rightarrow$ A

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

Q18.

Solution

Concept — Simple pendulum: $T = 2\pi\sqrt{\frac{L}{g}}$, so $T \propto \sqrt{L}$.

Step 1 — Length ratio: Making L four times larger multiplies the period by $\sqrt{4} = 2$.

Step 2 — New period: $T' = 2T$.

Why other options are wrong: $4T$ assumes $T \propto L$; T and $T/2$ ignore or invert the relation.

Final Answer: $T' = 2T \Rightarrow$ B

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

Q19.

Solution

Concept — Wave speed from its equation: For $y = A \sin(\omega t - kx)$, the speed is $v = \frac{\omega}{k}$.

Step 1 — Identify: $\omega = 300$ rad/s, $k = 1.5$ rad/m.

Step 2 — Compute: $v = \frac{300}{1.5} = 200$ m/s.

Why other options are wrong: 300 and 150 confuse ω or k with the speed; 100 uses a wrong ratio.



Final Answer: $v = 200 \text{ m/s} \Rightarrow \boxed{\text{D}}$

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

Q20.

Solution

Concept — Coulomb's inverse-square law: $F = \frac{1}{4\pi\epsilon_0} \frac{q^2}{r^2}$, so $F \propto \frac{1}{r^2}$.

Step 1 — Double the separation: $r \rightarrow 2r$ multiplies r^2 by 4.

Step 2 — New force: $F' = \frac{F}{4}$.

Why other options are wrong: $2F$ and $4F$ would mean force increases; F ignores the dependence on distance.

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

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

Q21.

Solution

Concept — Field of a point charge: $E = \frac{1}{4\pi\epsilon_0} \frac{Q}{r^2}$.

Step 1 — Substitute: $E = \frac{9 \times 10^9 \times 2 \times 10^{-6}}{(0.1)^2}$.

Step 2 — Compute: $E = \frac{1.8 \times 10^4}{0.01} = 1.8 \times 10^6 \text{ N/C}$.

Why other options are wrong: 9×10^5 and 1.8×10^5 mis-handle the $r^2 = 0.01$ factor; 3.6×10^6 doubles incorrectly.

Final Answer: $E = 1.8 \times 10^6 \text{ N/C} \Rightarrow \boxed{\text{A}}$

Answer: (A) [Go Back to Q21](#)

Q22.

Solution

Concept — Parallel-plate capacitor: $C = \frac{\epsilon_0 A}{d}$, so $C \propto \frac{1}{d}$.

Step 1 — Halve the separation: $d \rightarrow d/2$ doubles the capacitance.

Step 2 — New value: $C' = 2C$.



Why other options are wrong: $C/2$ inverts the relation; $4C$ uses $1/d^2$; C ignores the change.

Final Answer: $C' = 2C \Rightarrow$ **B**

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

Q23.

Solution

Concept — Potential of a point charge: $V = \frac{1}{4\pi\epsilon_0} \frac{Q}{r}$.

Step 1 — Substitute: $V = \frac{9 \times 10^9 \times 4 \times 10^{-6}}{0.2}$.

Step 2 — Compute: $V = \frac{3.6 \times 10^4}{0.2} = 1.8 \times 10^5 \text{ V}$.

Why other options are wrong: 3.6×10^5 drops the 0.2 in the denominator; 9×10^4 and 1.8×10^6 mis-place the power of ten.

Final Answer: $V = 1.8 \times 10^5 \text{ V} \Rightarrow$ **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: $\frac{1}{R_p} = \frac{1}{2} + \frac{1}{2} \Rightarrow R_p = 1 \Omega$.

Step 2 — Add the series resistor: $R_{eq} = R_p + 2 = 1 + 2 = 3 \Omega$.

Why other options are wrong: 6 adds all three in series; 2 keeps only one; 1.5 stops at the parallel pair plus a wrong step.

Final Answer: $R_{eq} = 3 \Omega \Rightarrow$ **D**

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



Q25.

Solution

Concept — Current in a circuit with internal resistance: $I = \frac{\varepsilon}{R + r}$.

Step 1 — Total resistance: $R + r = 5 + 1 = 6 \Omega$.

Step 2 — Compute: $I = \frac{12}{6} = 2 \text{ A}$.

Why other options are wrong: 12 A ignores resistance; 2.4 A drops the internal resistance; 1 A doubles the total resistance.

Final Answer: $I = 2 \text{ A} \Rightarrow \boxed{\text{B}}$

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

Q26.

Solution

Concept — Power rating of a bulb: $P = \frac{V^2}{R} \Rightarrow R = \frac{V^2}{P}$.

Step 1 — Substitute: $R = \frac{(120)^2}{60} = \frac{14400}{60}$.

Step 2 — Compute: $R = 240 \Omega$.

Why other options are wrong: 120 and 60 use V or P directly; 480 doubles the answer.

Final Answer: $R = 240 \Omega \Rightarrow \boxed{\text{A}}$

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

Q27.

Solution

Concept — Charge from steady current: $q = It$.

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

Step 2 — Compute: $q = 20 \text{ C}$.

Why other options are wrong: 2 and 10 use only one factor; 0.2 divides instead of multiplying.

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

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



Q28.

Solution

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

Step 1 — Substitute: $B = \frac{(4\pi \times 10^{-7})(10)}{2\pi(0.05)}$.

Step 2 — Simplify: $B = \frac{2 \times 10^{-7} \times 10}{0.05} = \frac{2 \times 10^{-6}}{0.05} = 4 \times 10^{-5} \text{ T}$.

Why other options are wrong: 1×10^{-5} and 2×10^{-5} mis-handle the $2\pi r$ factor; 8×10^{-5} doubles it.

Final Answer: $B = 4 \times 10^{-5} \text{ T} \Rightarrow \boxed{\text{C}}$

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

Q29.

Solution

Concept — Magnetic force on a moving charge: $F = qvB \sin \theta$, with $\theta = 90^\circ$.

Step 1 — Substitute: $F = (1.6 \times 10^{-19})(10^6)(0.5)$.

Step 2 — Compute: $F = 0.8 \times 10^{-13} = 8 \times 10^{-14} \text{ N}$.

Why other options are wrong: 1.6×10^{-13} omits the 0.5; 4×10^{-14} and 1.6×10^{-14} mis-handle the powers of ten.

Final Answer: $F = 8 \times 10^{-14} \text{ N} \Rightarrow \boxed{\text{A}}$

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

Q30.

Solution

Concept — Field at the centre of a coil: $B = \frac{\mu_0 NI}{2R}$.

Step 1 — Substitute: $B = \frac{(4\pi \times 10^{-7})(100)(2)}{2(0.1)}$.

Step 2 — Compute: $B = \frac{(4\pi \times 10^{-7})(200)}{0.2} = (4\pi \times 10^{-7})(1000) = 4\pi \times 10^{-4} \approx 1.26 \times 10^{-3} \text{ T}$.

Why other options are wrong: 6.28×10^{-4} uses $\mu_0 NI/4R$; 2.51×10^{-3} doubles; 1.26×10^{-4} drops a power of ten.



Final Answer: $B \approx 1.26 \times 10^{-3} \text{ T} \Rightarrow \boxed{\text{B}}$

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

Q31.

Solution

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

Step 1 — Substitute: $\varepsilon = (0.5)(0.2)(10)$.

Step 2 — Compute: $\varepsilon = 1 \text{ V}$.

Why other options are wrong: 0.5 and 0.1 drop a factor; 2 doubles the length wrongly.

Final Answer: $\varepsilon = 1 \text{ V} \Rightarrow \boxed{\text{C}}$

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

Q32.

Solution

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

Step 1 — Substitute: $I_{rms} = \frac{10}{\sqrt{2}} = \frac{10}{1.414}$.

Step 2 — Compute: $I_{rms} \approx 7.07 \text{ A}$.

Why other options are wrong: 10 is the peak; 5 halves it; 14.1 multiplies by $\sqrt{2}$ instead of dividing.

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

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

Q33.

Solution

Concept — Speed of light: All electromagnetic waves travel in vacuum at $c = \frac{1}{\sqrt{\mu_0 \varepsilon_0}} = 3 \times 10^8 \text{ m/s}$.

Step 1 — Standard value: $c \approx 3 \times 10^8 \text{ m/s}$, independent of frequency.



Why other options are wrong: 3×10^6 and 3×10^{10} are off by powers of ten; 1.5×10^8 is the speed only in a medium of refractive index 2.

Final Answer: $c = 3 \times 10^8$ m/s \Rightarrow A

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

Q34.

Solution

Concept — Modulation: Modulation is the process of impressing a low-frequency message signal onto a high-frequency carrier for transmission.

Step 1 — Match the definition: Superimposing the message on the carrier is exactly modulation.

Why other options are wrong: Demodulation recovers the message at the receiver; amplification raises signal strength; rectification converts AC to DC.

Final Answer: The process is modulation \Rightarrow B

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

Q35.

Solution

Concept — Einstein's photoelectric equation: $KE_{max} = E_{photon} - \phi$, where ϕ is the work function.

Step 1 — Substitute: $KE_{max} = 5 - 2$.

Step 2 — Compute: $KE_{max} = 3$ eV.

Why other options are wrong: 7 adds the two; 5 ignores the work function; 2 gives only the work function.

Final Answer: $KE_{max} = 3$ eV \Rightarrow C

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



Q36.

Solution

Concept — de Broglie wavelength: $\lambda = \frac{h}{p}$, so λ is inversely proportional to momentum.

Step 1 — Read the relation: A larger momentum gives a shorter wavelength.

Why other options are wrong: Wavelength does not depend on charge; it depends on momentum, which combines mass and velocity, not mass or energy alone in this direct inverse form.

Final Answer: $\lambda \propto 1/p$ (momentum) \Rightarrow **D**

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

Q37.

Solution

Concept — Energy levels of hydrogen: $E_n = \frac{-13.6}{n^2}$ eV.

Step 1 — Put $n = 2$: $E_2 = \frac{-13.6}{4}$.

Step 2 — Compute: $E_2 = -3.4$ eV.

Why other options are wrong: -13.6 eV is $n = 1$; -1.51 eV is $n = 3$; -0.85 eV is $n = 4$.

Final Answer: $E_2 = -3.4$ eV \Rightarrow **A**

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

Q38.

Solution

Concept — Radioactive decay by half-lives: Remaining fraction = $(\frac{1}{2})^n$, where n is the number of half-lives elapsed.

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

Step 2 — Compute: Fraction = $(\frac{1}{2})^3 = \frac{1}{8}$.

Why other options are wrong: $1/2$ is after one half-life; $1/4$ after two; $1/16$ after four.

Final Answer: Fraction remaining = $1/8 \Rightarrow$ **B**



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

Q39.

Solution

Concept — Biased p - n junction: Forward bias lowers the potential barrier, so the depletion region narrows.

Step 1 — Effect of forward bias: The external field opposes the built-in field, reducing the depletion width and allowing current to flow.

Why other options are wrong: The width increases under reverse bias, not forward; it never becomes infinite, and it does change.

Final Answer: The depletion region decreases \Rightarrow C

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

Q40.

Solution

Concept — Logic gates: The AND gate gives output 1 only when *all* its inputs are 1, with $Y = A \cdot B$.

Step 1 — Match the rule: “Output 1 only when both inputs are 1” is the AND truth table.

Why other options are wrong: OR gives 1 if any input is 1; NOT inverts a single input; NOR is the complement of OR.

Final Answer: The gate is an AND gate \Rightarrow D

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



Answer Key

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

