

AIIMS B.Sc Nursing Physics

Sample Paper – 12

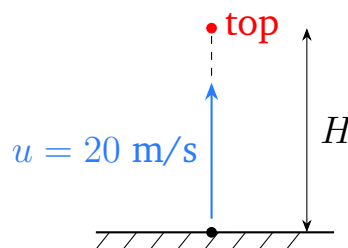
Duration: 36 Minutes

Maximum Marks: 30

Instructions

- This paper contains **30** Multiple Choice Questions (Single Correct Answer), modelled on the Physics section of the **AIIMS B.Sc Nursing (Hons)** entrance.
- Each correct answer carries **+1 mark**. **1/3 mark** is deducted for every incorrect answer. Unattempted questions carry **no penalty**.
- Syllabus level: **Class 11–12 (NCERT) Physics**.
- Only **one** option is correct.
- The actual exam is a **computer-based test**.
- Use of mobile phones, calculators, or other electronic gadgets is strictly prohibited.

Q1. A ball is thrown vertically upward with an initial speed of 20 m/s, as shown. Taking $g = 10 \text{ m/s}^2$, the maximum height it reaches is:



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

Q2. A block of mass 4 kg is placed on a frictionless inclined plane that



makes an angle of 30° with the horizontal. Taking $g = 10 \text{ m/s}^2$, the acceleration of the block down the incline is:

- (A) 5 m/s^2
- (B) 10 m/s^2
- (C) 8.7 m/s^2
- (D) 2.5 m/s^2

Q3. A stone of mass 0.5 kg is dropped from a height of 20 m . Taking $g = 10 \text{ m/s}^2$, its speed just before hitting the ground is:

- (A) 10 m/s
- (B) 40 m/s
- (C) 14.1 m/s
- (D) 20 m/s

Q4. A force of 10 N acts on a body of mass 2 kg for 4 s . If the body starts from rest, the impulse delivered (and final momentum) is:

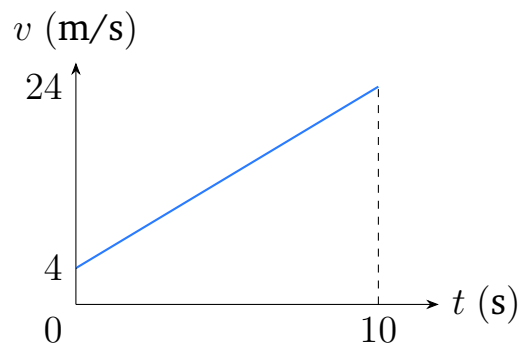
- (A) 20 kg m/s
- (B) 40 kg m/s
- (C) 80 kg m/s
- (D) 10 kg m/s

Q5. The escape velocity from the surface of a planet of mass M and radius R is $v_e = \sqrt{\frac{2GM}{R}}$. If the radius is halved while the mass stays the same, the escape velocity becomes:

- (A) halved
- (B) doubled
- (C) $\sqrt{2}$ times the original
- (D) unchanged

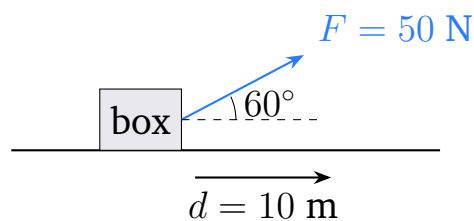


Q6. The velocity-time graph of a car is a straight line as shown. The acceleration of the car is:



- (A) 2 m/s^2
- (B) 4 m/s^2
- (C) 2.4 m/s^2
- (D) 20 m/s^2

Q7. A force of 50 N acting at 60° to the horizontal pulls a box 10 m along the ground, as shown. The work done by the force is:



- (A) 500 J
- (B) 433 J
- (C) 50 J
- (D) 250 J

Q8. A Carnot engine operates between a source at 400 K and a sink at 300 K. Its maximum theoretical efficiency is:

- (A) 75%
- (B) 25%



(C) 33%

(D) 50%

Q9. Water rises to a height of 4 cm in a capillary tube. If a tube of half the radius is used, the height to which water rises becomes:

(A) 2 cm

(B) 4 cm

(C) 8 cm

(D) 16 cm

Q10. The average kinetic energy of a gas molecule depends only on the:

(A) absolute temperature of the gas.

(B) pressure of the gas.

(C) molar mass of the gas.

(D) volume of the gas.

Q11. A wire of length 2 m and cross-sectional area $1 \times 10^{-6} \text{ m}^2$ stretches by 1 mm under a load of 50 N. Young's modulus of the material is:

(A) $5 \times 10^9 \text{ Pa}$

(B) $2 \times 10^{11} \text{ Pa}$

(C) $5 \times 10^{10} \text{ Pa}$

(D) $1 \times 10^{11} \text{ Pa}$

Q12. A mass attached to a spring oscillates with a certain frequency. If the mass is increased to four times its value, the frequency of oscillation becomes:

(A) four times

(B) twice

(C) half



(D) unchanged

Q13. 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) 4 Hz

(C) 258 Hz

(D) 2 Hz

Q14. A particle in SHM completes 40 oscillations in 20 s. Its frequency is:

(A) 2 Hz

(B) 0.5 Hz

(C) 40 Hz

(D) 20 Hz

Q15. The electric potential at a distance of 0.2 m from a point charge of $4 \mu\text{C}$ in air is (take $\frac{1}{4\pi\epsilon_0} = 9 \times 10^9$ SI units):

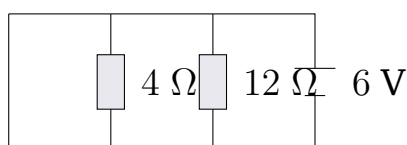
(A) 9×10^4 V

(B) 3.6×10^4 V

(C) 9×10^5 V

(D) 1.8×10^5 V

Q16. In the circuit shown, two resistors are connected in parallel across a 6 V battery of negligible internal resistance. The total current drawn from the battery is:



(A) 1 A



- (B) 2 A
- (C) 0.5 A
- (D) 6 A

Q17. A current of 2 A flows through a conductor for 5 minutes. The amount of charge that passes through it is:

- (A) 10 C
- (B) 120 C
- (C) 600 C
- (D) 50 C

Q18. Two capacitors of $2\ \mu\text{F}$ and $3\ \mu\text{F}$ are connected in series. Their equivalent capacitance is:

- (A) $1.2\ \mu\text{F}$
- (B) $5\ \mu\text{F}$
- (C) $6\ \mu\text{F}$
- (D) $2.5\ \mu\text{F}$

Q19. A potential difference of 10 V is applied across a resistor and a current of 0.5 A flows. The resistance of the resistor is:

- (A) $5\ \Omega$
- (B) $0.05\ \Omega$
- (C) $50\ \Omega$
- (D) $20\ \Omega$

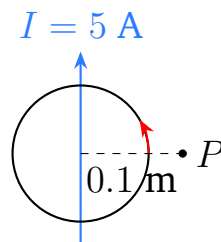
Q20. The capacitance of a parallel-plate capacitor is C . If the distance between the plates is doubled while the area is kept the same, the new capacitance is:

- (A) $2C$



- (B) $\frac{C}{2}$
- (C) $4C$
- (D) C

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



- (A) $5 \times 10^{-6} \text{ T}$
 - (B) $2 \times 10^{-5} \text{ T}$
 - (C) $1 \times 10^{-5} \text{ T}$
 - (D) $1 \times 10^{-6} \text{ T}$
- Q22.** A straight conductor of length 0.5 m carrying a current of 4 A is placed perpendicular to a uniform magnetic field of 0.2 T. The force on the conductor is:
- (A) 4 N
 - (B) 0.8 N
 - (C) 1.6 N
 - (D) 0.4 N
- Q23.** The energy stored in an inductor of inductance 0.5 H carrying a current of 4 A is:
- (A) 8 J
 - (B) 4 J

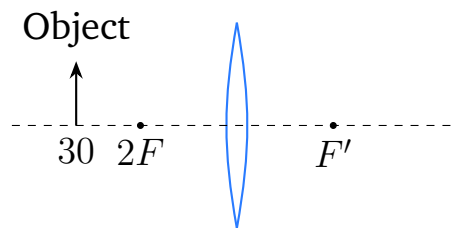


- (C) 2 J
- (D) 1 J

Q24. An inductor of inductance 0.1 H is connected to an AC source of angular frequency 100 rad/s. Its inductive reactance is:

- (A) 10 Ω
- (B) 1000 Ω
- (C) 0.1 Ω
- (D) 1 Ω

Q25. An object is placed 30 cm in front of a convex lens of focal length 15 cm, as shown. The image is formed at a distance of:



- (A) 15 cm
- (B) 45 cm
- (C) 30 cm
- (D) 10 cm

Q26. A convex lens has a focal length of 25 cm. Its power in dioptries is:

- (A) +4 D
- (B) +0.25 D
- (C) -4 D
- (D) +25 D

Q27. In a single-slit diffraction pattern, the first minimum is formed when the path difference between waves from the two edges of the slit equals:



- (A) $\frac{\lambda}{2}$
- (B) λ
- (C) $\frac{\lambda}{4}$
- (D) 2λ

Q28. In the Bohr model of the hydrogen atom, the energy of the electron in the n th orbit 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) -6.8 eV
- (C) -3.4 eV
- (D) -1.5 eV

Q29. The energy equivalent of a mass of 1 atomic mass unit (u) is approximately:

- (A) 511 MeV
- (B) 1.6 MeV
- (C) 13.6 eV
- (D) 931 MeV

Q30. When a pure (intrinsic) semiconductor such as silicon is doped with a pentavalent impurity like phosphorus, the resulting material is:

- (A) an n-type semiconductor with electrons as majority carriers.
- (B) a p-type semiconductor with holes as majority carriers.
- (C) an insulator.
- (D) still an intrinsic semiconductor.



Detailed Solutions

Q1.

Solution

Concept — Maximum height of a vertical throw: At the highest point the velocity is zero, so $v^2 = u^2 - 2gH$ gives $H = \frac{u^2}{2g}$.

Step 1 — Data: $u = 20$ m/s, $g = 10$ m/s².

Step 2 — Substitute:

$$H = \frac{u^2}{2g} = \frac{(20)^2}{2 \times 10} = \frac{400}{20} = 20 \text{ m.}$$

Why other options are wrong:

- 10 m uses g instead of $2g$ wrongly; 40 m doubles the result; 5 m is far too small.

Final Answer: $H = 20$ m \Rightarrow C

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

Q2.

Solution

Concept — Block on a frictionless incline: The acceleration down a smooth incline is $a = g \sin \theta$ (independent of mass).

Step 1 — Data: $\theta = 30^\circ$, $g = 10$ m/s², $\sin 30^\circ = 0.5$.

Step 2 — Substitute:

$$a = g \sin \theta = 10 \times 0.5 = 5 \text{ m/s}^2.$$

Why other options are wrong:

- 10 m/s² would need a vertical drop; 8.7 m/s² uses $\cos 30^\circ$; 2.5 m/s² halves again incorrectly.

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

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



Q3.

Solution

Concept — Energy conservation in free fall: The speed gained after falling height h is $v = \sqrt{2gh}$.

Step 1 — Data: $h = 20$ m, $g = 10$ m/s² (mass does not matter).

Step 2 — Substitute:

$$v = \sqrt{2 \times 10 \times 20} = \sqrt{400} = 20 \text{ m/s.}$$

Why other options are wrong:

- 10 m/s and 14.1 m/s underestimate; 40 m/s forgets the square root.

Final Answer: $v = 20$ m/s \Rightarrow D

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

Q4.

Solution

Concept — Impulse-momentum theorem: Impulse = force \times time = change in momentum, $J = Ft = \Delta p$.

Step 1 — Data: $F = 10$ N, $t = 4$ s.

Step 2 — Substitute:

$$J = Ft = 10 \times 4 = 40 \text{ kg m/s.}$$

Since the body starts from rest, its final momentum is also 40 kg m/s.

Why other options are wrong:

- 20 kg m/s and 10 kg m/s use wrong factors; 80 kg m/s doubles the impulse.

Final Answer: $J = 40$ kg m/s \Rightarrow B

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



Q5.

Solution

Concept — Escape velocity: $v_e = \sqrt{\frac{2GM}{R}} \propto \frac{1}{\sqrt{R}}$ for fixed M .

Step 1 — Halve the radius: If $R \rightarrow \frac{R}{2}$, then $v_e \rightarrow \sqrt{\frac{2GM}{R/2}} = \sqrt{2} \times \sqrt{\frac{2GM}{R}}$.

Step 2 — Conclusion: The escape velocity becomes $\sqrt{2}$ times the original.

Why other options are wrong:

- It is not halved, doubled, or unchanged; the dependence is on $1/\sqrt{R}$.

Final Answer: $v_e \rightarrow \sqrt{2}v_e \Rightarrow$

Answer: (C) [Go Back to Q5](#)

Q6.

Solution

Concept — Acceleration from a v - t graph: The acceleration equals the slope of the line, $a = \frac{\Delta v}{\Delta t}$.

Step 1 — Read the graph: The velocity rises from 4 m/s at $t = 0$ to 24 m/s at $t = 10$ s.

Step 2 — Slope:

$$a = \frac{24 - 4}{10 - 0} = \frac{20}{10} = 2 \text{ m/s}^2.$$

Why other options are wrong:

- 4 m/s^2 and 2.4 m/s^2 misread the values; 20 m/s^2 forgets to divide by time.

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

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



Q7.

Solution

Concept — Work by a force at an angle: $W = F d \cos \theta$.

Step 1 — Data: $F = 50 \text{ N}$, $d = 10 \text{ m}$, $\theta = 60^\circ$, $\cos 60^\circ = 0.5$.

Step 2 — Substitute:

$$W = 50 \times 10 \times 0.5 = 250 \text{ J.}$$

Why other options are wrong:

- 500 J ignores the angle; 433 J uses $\cos 30^\circ$; 50 J drops the distance.

Final Answer: $W = 250 \text{ J} \Rightarrow$ D

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

Q8.

Solution

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

Step 1 — Data: $T_{\text{source}} = 400 \text{ K}$, $T_{\text{sink}} = 300 \text{ K}$.

Step 2 — Substitute:

$$\eta = 1 - \frac{300}{400} = 1 - 0.75 = 0.25 = 25\%.$$

Why other options are wrong:

- 75% uses the ratio directly; 33% and 50% use wrong temperatures.

Final Answer: $\eta = 25\% \Rightarrow$ B

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



Q9.

Solution

Concept — Capillary rise: The height of rise is $h = \frac{2T \cos \theta}{r \rho g} \propto \frac{1}{r}$.

Step 1 — Halve the radius: If $r \rightarrow \frac{r}{2}$, then $h \rightarrow \frac{1}{r/2} = 2 \times \frac{1}{r}$, so the height doubles.

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

Why other options are wrong:

- 2 cm halves instead of doubling; 4 cm keeps it the same; 16 cm quadruples it.

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

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

Q10.

Solution

Concept — Average kinetic energy of a gas molecule: $\overline{KE} = \frac{3}{2}k_B T$, which depends only on the absolute temperature.

Explanation: The mean translational kinetic energy per molecule is $\frac{3}{2}k_B T$. It does not depend on pressure, volume, or the type of gas; only on T .

Why other options are wrong:

- Pressure, molar mass and volume do not appear in $\frac{3}{2}k_B T$.

Final Answer: Depends only on absolute temperature $\Rightarrow \boxed{\text{A}}$

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 — Data: $F = 50 \text{ N}$, $L = 2 \text{ m}$, $A = 1 \times 10^{-6} \text{ m}^2$, $\Delta L = 1 \times 10^{-3} \text{ m}$.

Step 2 — Substitute:

$$Y = \frac{50 \times 2}{(1 \times 10^{-6})(1 \times 10^{-3})} = \frac{100}{1 \times 10^{-9}} = 1 \times 10^{11} \text{ Pa.}$$

Why other options are wrong:

- $5 \times 10^9 \text{ Pa}$ and $5 \times 10^{10} \text{ Pa}$ misplace a power of ten in the arithmetic.

Final Answer: $Y = 1 \times 10^{11} \text{ Pa} \Rightarrow \boxed{\text{D}}$

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

Q12.

Solution

Concept — Spring-mass frequency: $f = \frac{1}{2\pi} \sqrt{\frac{k}{m}} \propto \frac{1}{\sqrt{m}}$.

Step 1 — Increase the mass: If $m \rightarrow 4m$, then $f \rightarrow \frac{1}{\sqrt{4m}} = \frac{1}{2\sqrt{m}}$, which is half the original frequency.

Step 2 — Conclusion: The frequency becomes **half**.

Why other options are wrong:

- Increasing mass cannot increase the frequency, so “four times” and “twice” are wrong; it does change, so it is not unchanged.

Final Answer: Frequency becomes half $\Rightarrow \boxed{\text{C}}$

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



Q13.

Solution

Concept — Beats: The number of beats per second equals the difference of the two frequencies, $f_b = |f_1 - f_2|$.

Step 1 — Data: $f_1 = 260$ Hz, $f_2 = 256$ Hz.

Step 2 — Subtract:

$$f_b = 260 - 256 = 4 \text{ Hz.}$$

Why other options are wrong:

- 516 Hz adds the frequencies; 258 Hz averages them; 2 Hz halves the difference.

Final Answer: $f_b = 4$ Hz \Rightarrow B

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

Q14.

Solution

Concept — Frequency: Frequency is the number of oscillations per second, $f = \frac{N}{t}$.

Step 1 — Data: $N = 40$ oscillations, $t = 20$ s.

Step 2 — Substitute:

$$f = \frac{40}{20} = 2 \text{ Hz.}$$

Why other options are wrong:

- 0.5 Hz inverts the ratio; 40 Hz and 20 Hz just repeat the given numbers.

Final Answer: $f = 2$ Hz \Rightarrow A

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



Q15.

Solution

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

Step 1 — Data: $q = 4 \times 10^{-6}$ C, $r = 0.2$ m.

Step 2 — Substitute:

$$V = 9 \times 10^9 \times \frac{4 \times 10^{-6}}{0.2} = 9 \times 10^9 \times 2 \times 10^{-5}.$$

Step 3 — Compute:

$$V = 1.8 \times 10^5 \text{ V.}$$

Why other options are wrong:

- 9×10^4 , 3.6×10^4 and 9×10^5 V misuse the distance or charge.

Final Answer: $V = 1.8 \times 10^5$ V \Rightarrow **D**

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

Q16.

Solution

Concept — Parallel resistors with a cell: First find R_{eq} from $\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2}$,

then $I = \frac{V}{R_{eq}}$.

Step 1 — Equivalent resistance:

$$\frac{1}{R_{eq}} = \frac{1}{4} + \frac{1}{12} = \frac{3}{12} + \frac{1}{12} = \frac{4}{12} = \frac{1}{3} \Rightarrow R_{eq} = 3 \Omega.$$

Step 2 — Total current:

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

Why other options are wrong:

- 1 A uses a series resistance; 0.5 A adds the resistances; 6 A uses $R = 1 \Omega$.

Final Answer: $I = 2$ A \Rightarrow **B**



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

Q17.

Solution

Concept — Charge, current and time: $Q = It$, with time in seconds.

Step 1 — Convert time: 5 minutes = $5 \times 60 = 300$ s.

Step 2 — Substitute:

$$Q = It = 2 \times 300 = 600 \text{ C.}$$

Why other options are wrong:

- 10 C and 50 C forget to convert minutes to seconds; 120 C uses only 60 s.

Final Answer: $Q = 600 \text{ C} \Rightarrow \boxed{\text{C}}$

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

Q18.

Solution

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

Step 1 — Substitute:

$$\frac{1}{C_{eq}} = \frac{1}{2} + \frac{1}{3} = \frac{3}{6} + \frac{2}{6} = \frac{5}{6}$$

Step 2 — Invert: $C_{eq} = \frac{6}{5} = 1.2 \mu\text{F}$.

Why other options are wrong:

- $5 \mu\text{F}$ adds them (parallel rule); $6 \mu\text{F}$ multiplies them; $2.5 \mu\text{F}$ averages them.

Final Answer: $C_{eq} = 1.2 \mu\text{F} \Rightarrow \boxed{\text{A}}$

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



Q19.

Solution

Concept — Ohm's law: $R = \frac{V}{I}$.

Step 1 — Data: $V = 10 \text{ V}$, $I = 0.5 \text{ A}$.

Step 2 — Substitute:

$$R = \frac{10}{0.5} = 20 \Omega.$$

Why other options are wrong:

- 5Ω multiplies instead of dividing; 0.05Ω inverts the ratio; " 50Ω " is a miscalculation.

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

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

Q20.

Solution

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

Step 1 — Double the separation: If $d \rightarrow 2d$, then $C \rightarrow \frac{\epsilon_0 A}{2d} = \frac{C}{2}$.

Step 2 — Conclusion: The capacitance becomes **half**.

Why other options are wrong:

- $2C$ and $4C$ would need a smaller separation; the capacitance must change, so it is not C .

Final Answer: New capacitance = $\frac{C}{2} \Rightarrow$ **B**

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



Q21.

Solution

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

Step 1 — Data: $I = 5 \text{ A}$, $r = 0.1 \text{ m}$, $\mu_0 = 4\pi \times 10^{-7}$.

Step 2 — Substitute:

$$B = \frac{(4\pi \times 10^{-7})(5)}{2\pi \times 0.1} = \frac{4\pi \times 10^{-7} \times 5}{0.2\pi}$$

Step 3 — Simplify:

$$B = \frac{4 \times 5 \times 10^{-7}}{0.2 \times 2} = \frac{20 \times 10^{-7}}{0.2} \cdot \frac{1}{2} \cdot 2 = 10^{-5} \text{ T.}$$

More directly, $B = \frac{2 \times 10^{-7} \times I}{r} = \frac{2 \times 10^{-7} \times 5}{0.1} = 1 \times 10^{-5} \text{ T.}$

Why other options are wrong:

- 5×10^{-6} , 2×10^{-5} and $1 \times 10^{-6} \text{ T}$ misplace a power of ten or the factor of 2.

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

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

Q22.

Solution

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

Step 1 — Data: $B = 0.2 \text{ T}$, $I = 4 \text{ A}$, $L = 0.5 \text{ m}$.

Step 2 — Substitute:

$$F = BIL = 0.2 \times 4 \times 0.5 = 0.4 \text{ N.}$$

Why other options are wrong:

- 4 N , 0.8 N and 1.6 N drop or double one of the three factors.

Final Answer: $F = 0.4 \text{ N} \Rightarrow \boxed{\text{D}}$

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



Q23.

Solution**Concept — Energy stored in an inductor:** $U = \frac{1}{2}LI^2$.**Step 1 — Data:** $L = 0.5 \text{ H}$, $I = 4 \text{ A}$.**Step 2 — Substitute:**

$$U = \frac{1}{2}(0.5)(4)^2 = \frac{1}{2}(0.5)(16) = 4 \text{ J}.$$

Why other options are wrong:

- 8 J forgets the factor $\frac{1}{2}$; 2 J and 1 J misuse the current.

Final Answer: $U = 4 \text{ J} \Rightarrow$ B Answer: (B) [Go Back to Q23](#)

Q24.

Solution**Concept — Inductive reactance:** $X_L = \omega L$.**Step 1 — Data:** $\omega = 100 \text{ rad/s}$, $L = 0.1 \text{ H}$.**Step 2 — Substitute:**

$$X_L = \omega L = 100 \times 0.1 = 10 \Omega.$$

Why other options are wrong:

- 1000Ω multiplies wrongly; 0.1Ω and 1Ω drop a factor.

Final Answer: $X_L = 10 \Omega \Rightarrow$ A Answer: (A) [Go Back to Q24](#)

Q25.

Solution

Concept — Lens formula: $\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$, with $u = -30$ cm and $f = +15$ cm for a convex lens.

Step 1 — Substitute:

$$\frac{1}{v} = \frac{1}{f} + \frac{1}{u} = \frac{1}{15} + \frac{1}{-30} = \frac{1}{15} - \frac{1}{30}$$

Step 2 — Common denominator:

$$\frac{1}{v} = \frac{2}{30} - \frac{1}{30} = \frac{1}{30}$$

Step 3 — Image distance: $v = +30$ cm, so a real image forms 30 cm on the other side of the lens.

Why other options are wrong:

- 15 cm, 45 cm and 10 cm come from sign or arithmetic errors in the lens formula.

Final Answer: $v = 30$ cm \Rightarrow C

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

Q26.

Solution

Concept — Power of a lens: $P = \frac{1}{f(\text{in metres})}$, measured in dioptres (D).

Step 1 — Convert focal length: $f = 25$ cm = 0.25 m.

Step 2 — Substitute:

$$P = \frac{1}{0.25} = +4 \text{ D.}$$

A convex lens has positive power.

Why other options are wrong:

- +0.25 D forgets to convert to metres; -4 D would be a concave lens; $+25$ D uses centimetres.

Final Answer: $P = +4$ D \Rightarrow A



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

Q27.

Solution

Concept — Single-slit diffraction: The first minimum occurs when the path difference between the waves from the two edges of the slit equals one full wavelength, $a \sin \theta = \lambda$.

Explanation: For the slit of width a , the condition for the first dark fringe is $a \sin \theta = \lambda$. So the path difference between the edges is exactly λ .

Why other options are wrong:

- $\lambda/2$ and $\lambda/4$ correspond to other parts of the pattern, not the first minimum; 2λ gives the second minimum.

Final Answer: Path difference = $\lambda \Rightarrow$ **B**

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

Q28.

Solution

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

Step 1 — Put $n = 2$:

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

Why other options are wrong:

- -13.6 eV is for $n = 1$; -6.8 eV divides by 2 not 4; -1.5 eV is for $n = 3$.

Final Answer: $E_2 = -3.4 \text{ eV} \Rightarrow$ **C**

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



Q29.

Solution

Concept — Mass-energy equivalence: The energy equivalent of 1 u is a standard result, $1 \text{ u} \equiv 931 \text{ MeV}$.

Explanation: Using $E = mc^2$ with $1 \text{ u} = 1.66 \times 10^{-27} \text{ kg}$ gives about $1.49 \times 10^{-10} \text{ J}$, which equals 931 MeV.

Why other options are wrong:

- 511 MeV (really 0.511 MeV) is the electron rest energy; 1.6 MeV and 13.6 eV are far too small.

Final Answer: $1 \text{ u} \equiv 931 \text{ MeV} \Rightarrow$ D

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

Q30.

Solution

Concept — Doping of semiconductors: A pentavalent impurity (5 valence electrons) donates an extra electron, producing an n-type semiconductor.

Explanation: Phosphorus has five valence electrons; four form bonds with silicon and the fifth is free to conduct. The free electrons are the majority carriers, so the material is **n-type**.

Why other options are wrong:

- A trivalent impurity would give p-type; doping increases conductivity, so it is not an insulator and no longer intrinsic.

Final Answer: n-type with electrons as majority carriers \Rightarrow A

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



Answer Key

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

