

PGIMER BSc Nursing Physics

Sample Paper – 8

Duration: 23 Minutes

Maximum Marks: 25

Instructions

- This paper contains **25** Multiple Choice Questions (Single Correct Answer), modelled on the Physics portion of the **PGIMER BSc Nursing** entrance exam.
- Each correct answer carries **+1 mark**. **0.25 mark** is deducted for every incorrect answer. Unattempted questions carry **0 marks**.
- Only **one** option is correct. Choose carefully.
- Syllabus level: **Class 11 and 12 (NCERT) Physics**.
- The exam is conducted as a computer-based test. Personal calculators, mobile phones, log tables, and other electronic gadgets are strictly prohibited.

Q1. Surface tension is defined as force per unit length acting along the surface of a liquid. The dimensional formula of surface tension is:

- (A) $[MLT^{-2}]$
(B) $[ML^{-1}T^{-2}]$
(C) $[MT^{-2}]$
(D) $[ML^{-2}T^{-1}]$

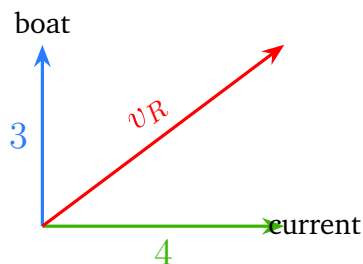
Q2. A body is dropped from rest from a height of 80 m. Taking $g = 10 \text{ m s}^{-2}$ and neglecting air resistance, the time taken to reach the ground (use $h = \frac{1}{2}gt^2$) is:

- (A) 4 s
(B) 2 s
(C) 8 s

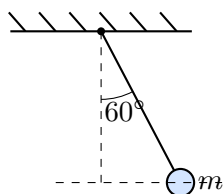


(D) 16 s

- Q3.** A boat heads straight across a river with a speed of 3 m s^{-1} relative to the water, while the river current flows at 4 m s^{-1} perpendicular to the boat's heading, as shown. The magnitude of the resultant velocity of the boat is:



- (A) 7 m s^{-1}
(B) 1 m s^{-1}
(C) 5 m s^{-1}
(D) 12 m s^{-1}
- Q4.** A car of mass 1000 kg moves at a constant speed of 10 m s^{-1} along a circular road of radius 50 m . The centripetal force acting on the car (use $F = \frac{mv^2}{r}$) is:
- (A) 500 N
(B) 1000 N
(C) 4000 N
(D) 2000 N
- Q5.** A mass of 2 kg is whirled in a horizontal circle at the end of a light string that makes an angle of 60° with the vertical (a conical pendulum), as shown. Taking $g = 10 \text{ m s}^{-2}$ and $\cos 60^\circ = 0.5$, the tension in the string is:



- (A) 20 N
- (B) 10 N
- (C) 40 N
- (D) 80 N

Q6. A block of mass 10 kg is pushed slowly up a frictionless incline of length 5 m inclined at 30° to the horizontal. Taking $g = 10 \text{ m s}^{-2}$ and $\sin 30^\circ = 0.5$, the work done against gravity (use $W = mgh$) is:

- (A) 250 J
- (B) 500 J
- (C) 125 J
- (D) 50 J

Q7. A rigid body of mass 2 kg has a moment of inertia of 8 kg m^2 about a given axis. Its radius of gyration about that axis (use $k = \sqrt{I/M}$) is:

- (A) 4 m
- (B) 8 m
- (C) 2 m
- (D) 16 m

Q8. The gravitational field intensity at the surface of the Earth (mass $M = 6 \times 10^{24} \text{ kg}$, radius $R = 6.4 \times 10^6 \text{ m}$, $G = 6.67 \times 10^{-11} \text{ N m}^2 \text{ kg}^{-2}$), found from $E = \frac{GM}{R^2}$, is approximately:

- (A) 9.8 N kg^{-1}
- (B) 4.9 N kg^{-1}
- (C) 19.6 N kg^{-1}
- (D) 6.67 N kg^{-1}

Q9. A liquid of bulk modulus $2 \times 10^9 \text{ Pa}$ is subjected to an additional pressure of $2 \times 10^6 \text{ Pa}$. The fractional change in its volume $\left(\frac{\Delta V}{V} = \frac{P}{B}\right)$ is:



- (A) 0.01
- (B) 0.1
- (C) 0.0001
- (D) 0.001

Q10. For one mole of an ideal gas the molar specific heat at constant volume is $C_v = 20.8 \text{ J mol}^{-1}\text{K}^{-1}$. Taking the universal gas constant $R = 8.31 \text{ J mol}^{-1}\text{K}^{-1}$, the molar specific heat at constant pressure ($C_p = C_v + R$) is:

- (A) $12.5 \text{ J mol}^{-1}\text{K}^{-1}$
- (B) $20.8 \text{ J mol}^{-1}\text{K}^{-1}$
- (C) $8.31 \text{ J mol}^{-1}\text{K}^{-1}$
- (D) $29.1 \text{ J mol}^{-1}\text{K}^{-1}$

Q11. Hydrogen gas (molar mass 2 g mol^{-1}) and oxygen gas (molar mass 32 g mol^{-1}) are kept at the same temperature. The ratio of the rms speed of hydrogen molecules to that of oxygen molecules $\left(v_{\text{rms}} \propto \frac{1}{\sqrt{M}}\right)$ is:

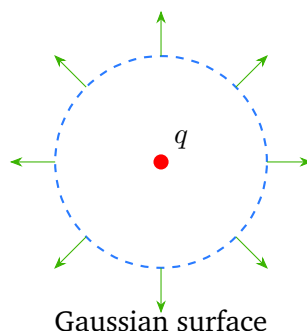
- (A) $\frac{1}{4}$
- (B) 4
- (C) 16
- (D) $\frac{1}{16}$

Q12. A stretched string of length 0.5 m has a linear mass density of 0.01 kg m^{-1} and is held under a tension of 100 N. Its fundamental frequency $\left(f = \frac{1}{2L} \sqrt{\frac{T}{\mu}}\right)$ is:

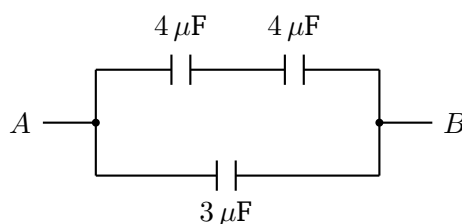
- (A) 50 Hz
- (B) 200 Hz
- (C) 100 Hz
- (D) 25 Hz



- Q13.** A point charge of $8.85 \mu\text{C}$ is enclosed by a closed surface, as shown. Taking $\epsilon_0 = 8.85 \times 10^{-12} \text{ C}^2 \text{ N}^{-1} \text{ m}^{-2}$, the total electric flux through the surface $\left(\Phi = \frac{q}{\epsilon_0} \right)$ is:



- (A) $8.85 \times 10^6 \text{ N m}^2 \text{ C}^{-1}$
 (B) $8.85 \times 10^{-6} \text{ N m}^2 \text{ C}^{-1}$
 (C) $2 \times 10^6 \text{ N m}^2 \text{ C}^{-1}$
 (D) $1 \times 10^6 \text{ N m}^2 \text{ C}^{-1}$
- Q14.** In the network shown, two capacitors of $4 \mu\text{F}$ each are connected in series, and this combination is connected in parallel with a third capacitor of $3 \mu\text{F}$. The equivalent capacitance between the terminals is:



- (A) $11 \mu\text{F}$
 (B) $2 \mu\text{F}$
 (C) $4 \mu\text{F}$
 (D) $5 \mu\text{F}$
- Q15.** A galvanometer of resistance 99Ω gives full-scale deflection for a current of 0.1 A . To convert it into an ammeter that reads up to 10 A , the value of the shunt resistance $\left(S = \frac{G i_g}{I - i_g} \right)$ required is:

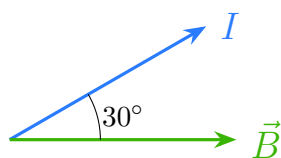


- (A) 1Ω
- (B) 9.9Ω
- (C) 0.1Ω
- (D) 99Ω

Q16. A current of 10 A flows uniformly through a conductor of cross-sectional area $2 \times 10^{-6} \text{ m}^2$. The current density $\left(J = \frac{I}{A} \right)$ in the conductor is:

- (A) $2 \times 10^6 \text{ A m}^{-2}$
- (B) $5 \times 10^6 \text{ A m}^{-2}$
- (C) $10 \times 10^6 \text{ A m}^{-2}$
- (D) $0.5 \times 10^6 \text{ A m}^{-2}$

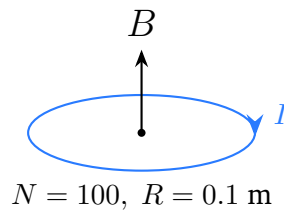
Q17. A straight wire of length 1 m carrying a current of 2 A is placed in a uniform magnetic field of 0.5 T such that the wire makes an angle of 30° with the field, as shown. The force on the wire ($F = BIL \sin \theta$) is:



- (A) 0.5 N
- (B) 1.0 N
- (C) 0.25 N
- (D) 2.0 N

Q18. A circular coil of 100 turns and radius 0.1 m carries a current of 2 A, as shown. Taking $\mu_0 = 4\pi \times 10^{-7} \text{ T m A}^{-1}$, the magnetic field at the centre of the coil $\left(B = \frac{\mu_0 NI}{2R} \right)$ is:



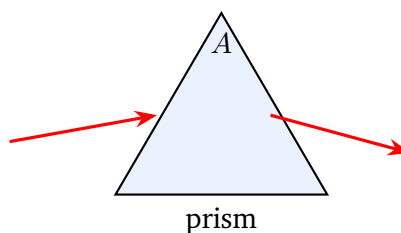


- (A) $1.26 \times 10^{-3} \text{ T}$
- (B) $6.28 \times 10^{-4} \text{ T}$
- (C) $2.51 \times 10^{-3} \text{ T}$
- (D) $4\pi \times 10^{-3} \text{ T}$

Q19. An inductor of inductance 0.5 H is connected to an AC source of rms voltage 10 V and angular frequency 100 rad s^{-1} . The rms current through the inductor $\left(X_L = \omega L, I = \frac{V}{X_L} \right)$ is:

- (A) 0.5 A
- (B) 0.2 A
- (C) 2 A
- (D) 0.1 A

Q20. A thin prism of refracting angle 8° is made of glass of refractive index 1.5. The angle of deviation produced by the prism $(\delta = (n - 1)A)$ is:



- (A) 8°
- (B) 4°
- (C) 12°
- (D) 2°



- Q21.** Light of wavelength 600 nm in vacuum enters a medium of refractive index 1.5. The wavelength of the light inside the medium $\left(\lambda_m = \frac{\lambda}{n}\right)$ is:
- (A) 600 nm
(B) 900 nm
(C) 300 nm
(D) 400 nm
- Q22.** An electron is accelerated from rest through a potential difference of 100 V. Its de Broglie wavelength $\left(\lambda = \frac{12.27}{\sqrt{V}} \text{ \AA}\right)$ is:
- (A) 12.27 Å
(B) 0.123 Å
(C) 122.7 Å
(D) 1.23 Å
- Q23.** In a hydrogen atom an electron makes a transition from the level $n = 3$ to the level $n = 2$. Using $E_n = -\frac{13.6}{n^2}$ eV, the energy of the emitted photon is:
- (A) 3.4 eV
(B) 13.6 eV
(C) 1.89 eV
(D) 10.2 eV
- Q24.** In a nuclear reaction the total mass of the products is less than that of the reactants by 0.02 u (mass defect). The energy released in the reaction (using 1 u = 931.5 MeV) is:
- (A) 9.315 MeV
(B) 18.63 MeV
(C) 931.5 MeV



(D) 1.863 MeV

Q25. A certain solid has a forbidden energy gap of about 1 eV between its valence band and conduction band. On the basis of band theory, the solid is best classified as a:

(A) Conductor

(B) Semiconductor

(C) Insulator

(D) Superconductor



Detailed Solutions

Q1.

Solution

Concept — Dimensions from a definition: Surface tension S is force acting per unit length along a liquid surface, so $S = \frac{F}{L}$.

Step 1 — Write the defining relation:

$$S = \frac{\text{force}}{\text{length}} = \frac{F}{L}.$$

Step 2 — Substitute the dimensions: Force: $[F] = [MLT^{-2}]$.

Length: $[L] = [L]$.

Step 3 — Divide:

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

Why other options are wrong:

- Option A $[MLT^{-2}]$: this is the dimension of force itself.
- Option B $[ML^{-1}T^{-2}]$: this is the dimension of pressure or stress.
- Option D $[ML^{-2}T^{-1}]$: incorrect powers of length and time.

Final Answer: The dimensional formula of surface tension is $[MT^{-2}] \Rightarrow \boxed{\text{C}}$

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

Q2.

Solution

Concept — Free fall from rest: A body dropped from rest falls a distance $h = \frac{1}{2}gt^2$ in time t .

Step 1 — List the known values: Height $h = 80$ m.

Acceleration $g = 10 \text{ m s}^{-2}$.

Initial speed = 0.

Step 2 — Rearrange for time:

$$h = \frac{1}{2}gt^2.$$



$$t^2 = \frac{2h}{g}$$

Step 3 — Substitute the numbers:

$$t^2 = \frac{2 \times 80}{10} = \frac{160}{10} = 16 \text{ s}^2.$$

Step 4 — Take the square root:

$$t = \sqrt{16} = 4 \text{ s}.$$

Why other options are wrong:

- Option B (2 s): forgets the factor of 2 in $2h/g$.
- Option C (8 s): uses $t = 2h/g$ without the square root.
- Option D (16 s): quotes t^2 instead of t .

Final Answer: Time to reach the ground = 4 s \Rightarrow A

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

Q3.

Solution

Concept — Resultant of two perpendicular velocities: When two velocities act at right angles, their resultant magnitude is $v_R = \sqrt{v_1^2 + v_2^2}$.

Step 1 — Identify the two components: Boat across the river: $v_1 = 3 \text{ m s}^{-1}$.

River current: $v_2 = 4 \text{ m s}^{-1}$ (perpendicular to the boat heading).

Step 2 — Apply the Pythagorean rule:

$$v_R = \sqrt{v_1^2 + v_2^2} = \sqrt{3^2 + 4^2}.$$

Step 3 — Simplify:

$$v_R = \sqrt{9 + 16} = \sqrt{25} = 5 \text{ m s}^{-1}.$$

Why other options are wrong:

- Option A (7 m s^{-1}): simply adds the two speeds, valid only if they were parallel.
- Option B (1 m s^{-1}): subtracts the speeds, valid only if they were anti-parallel.



- Option D (12 m s^{-1}): multiplies the two speeds.

Final Answer: Resultant velocity = $5 \text{ m s}^{-1} \Rightarrow$

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

Q4.

Solution

Concept — Centripetal force: A body moving in a circle of radius r at speed v needs a centre-directed force $F = \frac{mv^2}{r}$.

Step 1 — List the values: Mass $m = 1000 \text{ kg}$.

Speed $v = 10 \text{ m s}^{-1}$, so $v^2 = 100 \text{ m}^2\text{s}^{-2}$.

Radius $r = 50 \text{ m}$.

Step 2 — Substitute into the formula:

$$F = \frac{mv^2}{r} = \frac{1000 \times 100}{50}$$

Step 3 — Simplify:

$$F = \frac{100000}{50} = 2000 \text{ N.}$$

Why other options are wrong:

- Option A (500 N): uses v instead of v^2 .
- Option B (1000 N): doubles the radius by mistake.
- Option C (4000 N): halves the radius by mistake.

Final Answer: Centripetal force = $2000 \text{ N} \Rightarrow$

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



Q5.

Solution

Concept — Conical pendulum: For a mass whirled in a horizontal circle on a string at angle θ to the vertical, the vertical component of the tension balances the weight: $T \cos \theta = mg$.

Step 1 — Write the vertical balance:

$$T \cos \theta = mg.$$

Step 2 — Solve for tension:

$$T = \frac{mg}{\cos \theta}.$$

Step 3 — Substitute the values ($m = 2 \text{ kg}$, $g = 10$, $\cos 60^\circ = 0.5$):

$$T = \frac{2 \times 10}{0.5} = \frac{20}{0.5}.$$

Step 4 — Simplify:

$$T = 40 \text{ N}.$$

Why other options are wrong:

- Option A (20 N): equals mg , ignoring the $\cos \theta$ factor.
- Option B (10 N): uses only half the weight.
- Option D (80 N): divides by 0.25 instead of 0.5.

Final Answer: Tension in the string = 40 N \Rightarrow **C**

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

Q6.

Solution

Concept — Work against gravity: Lifting a body through a vertical height h requires work $W = mgh$, independent of the path taken.

Step 1 — Find the vertical height gained: The block moves 5 m along the incline at 30° :

$$h = L \sin \theta = 5 \times 0.5 = 2.5 \text{ m}.$$



Step 2 — Apply the work formula:

$$W = mgh = 10 \times 10 \times 2.5.$$

Step 3 — Simplify:

$$W = 100 \times 2.5 = 250 \text{ J}.$$

Why other options are wrong:

- Option B (500 J): uses the full incline length 5 m as the height.
- Option C (125 J): halves the correct value.
- Option D (50 J): omits g in the calculation.

Final Answer: Work done against gravity = 250 J \Rightarrow **A**

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

Q7.

Solution

Concept — Radius of gyration: The radius of gyration k is defined through $I = Mk^2$, so $k = \sqrt{\frac{I}{M}}$.

Step 1 — List the values: Moment of inertia $I = 8 \text{ kg m}^2$.

Mass $M = 2 \text{ kg}$.

Step 2 — Substitute into the formula:

$$k = \sqrt{\frac{I}{M}} = \sqrt{\frac{8}{2}}.$$

Step 3 — Simplify:

$$k = \sqrt{4} = 2 \text{ m}.$$

Why other options are wrong:

- Option A (4 m): quotes I/M without the square root.
- Option B (8 m): quotes I itself.
- Option D (16 m): uses $I \times M$ instead of I/M .

Final Answer: Radius of gyration = 2 m \Rightarrow **C**

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



Q8.

Solution

Concept — Gravitational field of the Earth: The gravitational field intensity (force per unit mass) at the surface is $E = \frac{GM}{R^2}$.

Step 1 — List the values: $G = 6.67 \times 10^{-11} \text{ N m}^2\text{kg}^{-2}$.

$M = 6 \times 10^{24} \text{ kg}$.

$R = 6.4 \times 10^6 \text{ m}$, so $R^2 = 4.096 \times 10^{13} \text{ m}^2$.

Step 2 — Compute the numerator:

$$GM = 6.67 \times 10^{-11} \times 6 \times 10^{24} = 4.0 \times 10^{14}.$$

Step 3 — Divide by R^2 :

$$E = \frac{4.0 \times 10^{14}}{4.096 \times 10^{13}} \approx 9.8 \text{ N kg}^{-1}.$$

Why other options are wrong:

- Option B (4.9): divides the correct value by 2.
- Option C (19.6): doubles the correct value.
- Option D (6.67): quotes G rather than the field.

Final Answer: Gravitational field intensity $\approx 9.8 \text{ N kg}^{-1} \Rightarrow \boxed{\text{A}}$

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

Q9.

Solution

Concept — Bulk modulus: The bulk modulus relates pressure to fractional volume change by $B = \frac{P}{\Delta V/V}$, so $\frac{\Delta V}{V} = \frac{P}{B}$.

Step 1 — List the values: Applied pressure $P = 2 \times 10^6 \text{ Pa}$.

Bulk modulus $B = 2 \times 10^9 \text{ Pa}$.

Step 2 — Substitute into the formula:

$$\frac{\Delta V}{V} = \frac{P}{B} = \frac{2 \times 10^6}{2 \times 10^9}.$$



Step 3 — Simplify the powers of ten:

$$\frac{\Delta V}{V} = 1 \times 10^{6-9} = 1 \times 10^{-3} = 0.001.$$

Why other options are wrong:

- Option A (0.01): a power-of-ten error.
- Option B (0.1): a larger power-of-ten error.
- Option C (0.0001): divides by an extra factor of ten.

Final Answer: Fractional change in volume = 0.001 \Rightarrow D

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

Q10.

Solution

Concept — Mayer's relation: For an ideal gas the molar specific heats are related by $C_p - C_v = R$, so $C_p = C_v + R$.

Step 1 — List the values: $C_v = 20.8 \text{ J mol}^{-1}\text{K}^{-1}$.

$$R = 8.31 \text{ J mol}^{-1}\text{K}^{-1}.$$

Step 2 — Apply the relation:

$$C_p = C_v + R = 20.8 + 8.31.$$

Step 3 — Add:

$$C_p = 29.11 \approx 29.1 \text{ J mol}^{-1}\text{K}^{-1}.$$

Why other options are wrong:

- Option A (12.5): equals $C_v - R$ instead of $C_v + R$.
- Option B (20.8): quotes C_v unchanged.
- Option C (8.31): quotes R itself.

Final Answer: $C_p \approx 29.1 \text{ J mol}^{-1}\text{K}^{-1} \Rightarrow$ D

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



Q11.

Solution**Concept — RMS speed and molar mass:** At a fixed temperature the rms speedis $v_{\text{rms}} = \sqrt{\frac{3RT}{M}}$, so $v_{\text{rms}} \propto \frac{1}{\sqrt{M}}$.**Step 1 — Write the ratio:**

$$\frac{v_{\text{H}_2}}{v_{\text{O}_2}} = \sqrt{\frac{M_{\text{O}_2}}{M_{\text{H}_2}}}$$

Step 2 — Substitute the molar masses:

$$\frac{v_{\text{H}_2}}{v_{\text{O}_2}} = \sqrt{\frac{32}{2}} = \sqrt{16}$$

Step 3 — Simplify:

$$\frac{v_{\text{H}_2}}{v_{\text{O}_2}} = 4$$

Why other options are wrong:

- Option A ($\frac{1}{4}$): inverts the ratio of molar masses.
- Option C (16): forgets to take the square root.
- Option D ($\frac{1}{16}$): inverts and omits the square root.

Final Answer: The ratio of rms speeds is 4 \Rightarrow **B****Answer: (B)** [Go Back to Q11](#)

Q12.

Solution**Concept — Fundamental frequency of a string:** A stretched string of length L , tension T and linear mass density μ vibrates at fundamental frequency $f = \frac{1}{2L} \sqrt{\frac{T}{\mu}}$.**Step 1 — List the values:** $L = 0.5$ m. $T = 100$ N. $\mu = 0.01$ kg m⁻¹.

Step 2 — Evaluate the square root:

$$\sqrt{\frac{T}{\mu}} = \sqrt{\frac{100}{0.01}} = \sqrt{10000} = 100 \text{ m s}^{-1}.$$

Step 3 — Divide by $2L$:

$$f = \frac{1}{2 \times 0.5} \times 100 = \frac{100}{1} = 100 \text{ Hz}.$$

Why other options are wrong:

- Option A (50 Hz): uses L instead of $2L$ wrongly halved.
- Option B (200 Hz): drops the factor $2L$.
- Option D (25 Hz): squares the length factor.

Final Answer: Fundamental frequency = 100 Hz \Rightarrow **C**

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

Q13.

Solution

Concept — Gauss's law: The total electric flux through any closed surface equals the enclosed charge divided by the permittivity of free space, $\Phi = \frac{q}{\epsilon_0}$.

Step 1 — List the values: Enclosed charge $q = 8.85 \mu\text{C} = 8.85 \times 10^{-6} \text{ C}$.

$$\epsilon_0 = 8.85 \times 10^{-12} \text{ C}^2\text{N}^{-1}\text{m}^{-2}.$$

Step 2 — Substitute into Gauss's law:

$$\Phi = \frac{q}{\epsilon_0} = \frac{8.85 \times 10^{-6}}{8.85 \times 10^{-12}}.$$

Step 3 — Simplify:

$$\Phi = 1 \times 10^{-6-(-12)} = 1 \times 10^6 \text{ N m}^2 \text{ C}^{-1}.$$

Why other options are wrong:

- Option A (8.85×10^6): forgets to cancel the 8.85 factor.
- Option B (8.85×10^{-6}): quotes the charge value instead of the flux.
- Option C (2×10^6): arithmetic error.



Final Answer: Total electric flux = $1 \times 10^6 \text{ N m}^2 \text{ C}^{-1} \Rightarrow \boxed{\text{D}}$

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

Q14.

Solution

Concept — Combining capacitors: Capacitors in series combine as $\frac{1}{C_s} = \frac{1}{C_1} + \frac{1}{C_2}$; capacitors in parallel simply add.

Step 1 — Combine the two series $4 \mu\text{F}$ capacitors:

$$\frac{1}{C_s} = \frac{1}{4} + \frac{1}{4} = \frac{2}{4} = \frac{1}{2}.$$

$$C_s = 2 \mu\text{F}.$$

Step 2 — Add the parallel $3 \mu\text{F}$ capacitor:

$$C_{\text{eq}} = C_s + 3 = 2 + 3.$$

Step 3 — Simplify:

$$C_{\text{eq}} = 5 \mu\text{F}.$$

Why other options are wrong:

- Option A ($11 \mu\text{F}$): adds all three capacitors as if in parallel.
- Option B ($2 \mu\text{F}$): stops after the series step.
- Option C ($4 \mu\text{F}$): uses only one of the capacitors.

Final Answer: Equivalent capacitance = $5 \mu\text{F} \Rightarrow \boxed{\text{D}}$

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



Q15.

Solution

Concept — Converting a galvanometer into an ammeter: A low shunt resistance S is placed in parallel with the galvanometer so that most of the current bypasses it. The required shunt is $S = \frac{G i_g}{I - i_g}$.

Step 1 — List the values: Galvanometer resistance $G = 99 \Omega$.

Full-scale current $i_g = 0.1 \text{ A}$.

Maximum current to be read $I = 10 \text{ A}$.

Step 2 — Find the denominator:

$$I - i_g = 10 - 0.1 = 9.9 \text{ A.}$$

Step 3 — Substitute into the formula:

$$S = \frac{G i_g}{I - i_g} = \frac{99 \times 0.1}{9.9}.$$

Step 4 — Simplify:

$$S = \frac{9.9}{9.9} = 1 \Omega.$$

Why other options are wrong:

- Option B (9.9Ω): forgets the i_g factor in the numerator.
- Option C (0.1Ω): uses I instead of $(I - i_g)$ and mis-scales.
- Option D (99Ω): quotes the galvanometer resistance itself.

Final Answer: Shunt resistance = $1 \Omega \Rightarrow \boxed{\text{A}}$

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

Q16.

Solution

Concept — Current density: Current density is the current flowing per unit cross-sectional area, $J = \frac{I}{A}$.

Step 1 — List the values: Current $I = 10 \text{ A}$.

Cross-sectional area $A = 2 \times 10^{-6} \text{ m}^2$.



Step 2 — Substitute into the formula:

$$J = \frac{I}{A} = \frac{10}{2 \times 10^{-6}}.$$

Step 3 — Simplify:

$$J = 5 \times 10^6 \text{ A m}^{-2}.$$

Why other options are wrong:

- Option A (2×10^6): uses the area value in the numerator.
- Option C (10×10^6): forgets to divide by 2.
- Option D (0.5×10^6): inverts the ratio.

Final Answer: Current density = $5 \times 10^6 \text{ A m}^{-2} \Rightarrow$ B

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

Q17.

Solution

Concept — Force on a current-carrying wire: A wire of length L carrying current I in a field B , making angle θ with the field, feels a force $F = BIL \sin \theta$.

Step 1 — List the values: $B = 0.5 \text{ T}$, $I = 2 \text{ A}$, $L = 1 \text{ m}$, $\theta = 30^\circ$.

Step 2 — Note the sine of the angle:

$$\sin 30^\circ = 0.5.$$

Step 3 — Substitute into the formula:

$$F = BIL \sin \theta = 0.5 \times 2 \times 1 \times 0.5.$$

Step 4 — Simplify:

$$F = 0.5 \times 2 \times 0.5 = 0.5 \text{ N}.$$

Why other options are wrong:

- Option B (1.0 N): takes $\sin 30^\circ = 1$ (treats the wire as perpendicular).
- Option C (0.25 N): squares the sine factor.
- Option D (2.0 N): drops both the field and the sine factor.



Final Answer: Force on the wire = 0.5 N \Rightarrow **A**

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

Q18.

Solution

Concept — Field at the centre of a circular coil: A coil of N turns and radius R carrying current I produces a field $B = \frac{\mu_0 NI}{2R}$ at its centre.

Step 1 — List the values: $N = 100$, $I = 2$ A, $R = 0.1$ m, $\mu_0 = 4\pi \times 10^{-7}$ T m A⁻¹.

Step 2 — Substitute into the formula:

$$B = \frac{\mu_0 NI}{2R} = \frac{(4\pi \times 10^{-7}) \times 100 \times 2}{2 \times 0.1}$$

Step 3 — Simplify the numbers:

$$B = \frac{(4\pi \times 10^{-7}) \times 200}{0.2} = (4\pi \times 10^{-7}) \times 1000.$$

$$B = 4\pi \times 10^{-4} \text{ T.}$$

Step 4 — Put in $\pi \approx 3.14$:

$$B = 4 \times 3.14 \times 10^{-4} = 12.56 \times 10^{-4} = 1.26 \times 10^{-3} \text{ T.}$$

Why other options are wrong:

- Option B (6.28×10^{-4}): halves the correct value.
- Option C (2.51×10^{-3}): doubles the correct value.
- Option D ($4\pi \times 10^{-3}$): a power-of-ten error.

Final Answer: Field at the centre $\approx 1.26 \times 10^{-3}$ T \Rightarrow **A**

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



Q19.

Solution

Concept — Inductive reactance: An inductor opposes alternating current through its reactance $X_L = \omega L$; the rms current is $I = \frac{V}{X_L}$.

Step 1 — Find the inductive reactance:

$$X_L = \omega L = 100 \times 0.5 = 50 \Omega.$$

Step 2 — Apply Ohm's law for AC:

$$I = \frac{V}{X_L} = \frac{10}{50}.$$

Step 3 — Simplify:

$$I = 0.2 \text{ A}.$$

Why other options are wrong:

- Option A (0.5 A): uses $X_L = 20 \Omega$ by mistake.
- Option C (2 A): ignores the factor L in the reactance.
- Option D (0.1 A): doubles the reactance.

Final Answer: RMS current through the inductor = 0.2 A \Rightarrow **B**

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

Q20.

Solution

Concept — Deviation by a thin prism: For a thin prism of refracting angle A and refractive index n , the angle of deviation is $\delta = (n - 1)A$.

Step 1 — List the values: Refracting angle $A = 8^\circ$.

Refractive index $n = 1.5$.

Step 2 — Substitute into the formula:

$$\delta = (n - 1)A = (1.5 - 1) \times 8.$$

Step 3 — Simplify:

$$\delta = 0.5 \times 8 = 4^\circ.$$



Why other options are wrong:

- Option A (8°): quotes the refracting angle itself.
- Option C (12°): uses $(n + 1)$ instead of $(n - 1)$.
- Option D (2°): uses $(n - 1) = 0.25$ by mistake.

Final Answer: Angle of deviation = $4^\circ \Rightarrow$ **B**

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

Q21.

Solution

Concept — Wavelength in a medium: When light enters a denser medium its frequency stays the same but its speed and wavelength reduce by the factor n , so

$$\lambda_m = \frac{\lambda}{n}.$$

Step 1 — List the values: Wavelength in vacuum $\lambda = 600$ nm.

Refractive index $n = 1.5$.

Step 2 — Substitute into the formula:

$$\lambda_m = \frac{\lambda}{n} = \frac{600}{1.5}.$$

Step 3 — Simplify:

$$\lambda_m = 400 \text{ nm}.$$

Why other options are wrong:

- Option A (600 nm): assumes the wavelength is unchanged.
- Option B (900 nm): multiplies by n instead of dividing.
- Option C (300 nm): divides by 2 instead of 1.5.

Final Answer: Wavelength in the medium = 400 nm \Rightarrow **D**

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



Q22.

Solution

Concept — de Broglie wavelength of an electron: An electron accelerated through a potential difference V has wavelength $\lambda = \frac{12.27}{\sqrt{V}} \text{ \AA}$ (with V in volts).

Step 1 — List the value: Accelerating potential $V = 100 \text{ V}$.

Step 2 — Take the square root of V :

$$\sqrt{V} = \sqrt{100} = 10.$$

Step 3 — Substitute into the formula:

$$\lambda = \frac{12.27}{10} = 1.227 \approx 1.23 \text{ \AA}.$$

Why other options are wrong:

- Option A (12.27 Å): forgets to divide by \sqrt{V} .
- Option B (0.123 Å): uses V instead of \sqrt{V} .
- Option C (122.7 Å): multiplies by \sqrt{V} instead of dividing.

Final Answer: de Broglie wavelength $\approx 1.23 \text{ \AA} \Rightarrow \boxed{\text{D}}$

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

Q23.

Solution

Concept — Photon energy in a transition: The energy of the photon emitted when an electron falls from level n_i to n_f is $E = E_{n_i} - E_{n_f}$, with $E_n = -\frac{13.6}{n^2} \text{ eV}$.

Step 1 — Write the photon energy:

$$E = 13.6 \left(\frac{1}{n_f^2} - \frac{1}{n_i^2} \right) = 13.6 \left(\frac{1}{2^2} - \frac{1}{3^2} \right).$$

Step 2 — Evaluate the bracket:

$$\frac{1}{4} - \frac{1}{9} = \frac{9 - 4}{36} = \frac{5}{36}.$$



Step 3 — Multiply by 13.6:

$$E = 13.6 \times \frac{5}{36} = \frac{68}{36} = 1.89 \text{ eV.}$$

Why other options are wrong:

- Option A (3.4 eV): equals $|E_2|$, not the transition energy.
- Option B (13.6 eV): equals the ionisation energy from $n = 1$.
- Option D (10.2 eV): is the energy of the $n = 2 \rightarrow n = 1$ transition.

Final Answer: Energy of the emitted photon = 1.89 eV \Rightarrow **C**

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

Q24.

Solution

Concept — Mass–energy equivalence: The energy released in a nuclear reaction equals the mass defect Δm times c^2 ; in convenient units $E = \Delta m \times 931.5 \text{ MeV}$ when Δm is in atomic mass units.

Step 1 — List the value: Mass defect $\Delta m = 0.02 \text{ u}$.

Step 2 — Apply the conversion:

$$E = \Delta m \times 931.5 = 0.02 \times 931.5.$$

Step 3 — Simplify:

$$E = 18.63 \text{ MeV.}$$

Why other options are wrong:

- Option A (9.315 MeV): uses $\Delta m = 0.01 \text{ u}$.
- Option C (931.5 MeV): uses $\Delta m = 1 \text{ u}$.
- Option D (1.863 MeV): uses $\Delta m = 0.002 \text{ u}$.

Final Answer: Energy released = 18.63 MeV \Rightarrow **B**

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



Q25.

Solution

Concept — Classification by band gap: Solids are classified by the size of the forbidden energy gap E_g between the valence band and the conduction band: conductors have overlapping bands ($E_g \approx 0$), semiconductors have a small gap (about 1 eV), and insulators have a large gap (several eV).

Step 1 — Compare the given gap with the typical ranges: A gap of about 1 eV is small but not zero, so a few electrons can be thermally excited into the conduction band.

Step 2 — Match to the correct category: This intermediate gap of roughly 1 eV is the defining feature of a semiconductor (for example, silicon has $E_g \approx 1.1$ eV).

Why other options are wrong:

- Option A (Conductor): conductors have no forbidden gap; the bands overlap.
- Option C (Insulator): insulators have a large gap of several electron-volts.
- Option D (Superconductor): superconductivity is a low-temperature resistance phenomenon, not a band-gap classification.

Final Answer: A solid with a gap of about 1 eV is a semiconductor \Rightarrow **B**

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



Answer Key

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

