NEST Physics Sample Paper – 7

Duration: 45 Minutes **Maximum Marks: 60**

Instructions

- This paper contains **20 Multiple Choice Questions (single correct answer)**, modelled on the Physics section of **NEST 2026**.
- Each correct answer carries **+3 marks**. There is a deduction of -1 **mark** for each incorrect answer; **no marks** are deducted for an unattempted question.
- Every question has exactly **four options**, of which only **one** is correct. Choose carefully.
- Personal calculators, log tables, mobile phones, and other electronic gadgets are strictly prohibited in the examination hall.
- A simple on-screen (virtual) calculator is provided in the computer-based test interface and may be used; blank sheets for rough work are supplied at the exam centre.

Q1. The kinetic energy of a body is calculated from $\mathrm{KE} = \frac{1}{2}mv^2$. The mass is measured with a 2% error and the speed with a 3% error. The maximum percentage error in the calculated kinetic energy is

(A) 8%

(B) 5%

(C) 11%

(D) 6.5%

Q2. Two cars start at the same instant from points 400 m apart on a straight road and move directly toward each other. One travels at $15\ \mathrm{m\,s^{-1}}$ and the other at $25\ \mathrm{m\,s^{-1}}$. The time after which they meet is

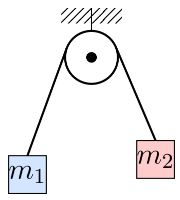
(A) 16 s

(B) 10 s

(C) 20 s

(D) 8 s

Q3. Two masses $m_1 = 3$ kg and $m_2 = 2$ kg hang from the two ends of a light inextensible string passing over a frictionless pulley (Atwood machine), as shown. Take $g = 10\ \mathrm{m\,s^{-2}}$. The acceleration of the masses is



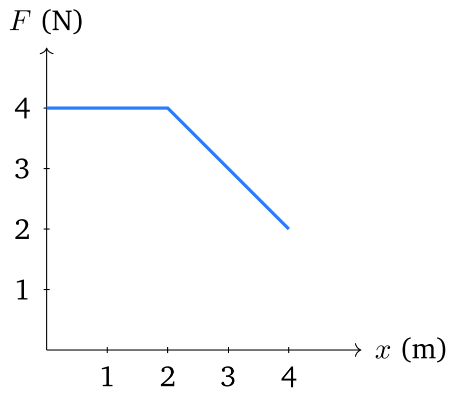
(A) $1\ \mathrm{m\,s^{-2}}$

(B) $4\ \mathrm{m\,s^{-2}}$

(C) $2\ \mathrm{m\,s^{-2}}$

(D) $5\ \mathrm{m\,s^{-2}}$

Q4. A particle moving along the x-axis is acted on by a force F that varies with position x as shown in the graph. The work done by the force as the particle moves from $x = 0$ to $x = 4$ m is



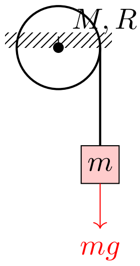
(A) 16 J

(B) 8 J

(C) 12 J

(D) 14 J

Q5. A block of mass $m = 1$ kg hangs from a light string wound around the rim of a uniform disc pulley of mass $M = 2$ kg and radius R, free to rotate about its central axis. Take $g = 10\ \text{m s}^{-2}$. The angular acceleration of the disc when the block is released is



(A) $\frac{5}{R}$ rad s^{-2}

(B) $\frac{10}{R}$ rad s^{-2}

(C) $\frac{5}{2R}$ rad s^{-2}

(D) $\frac{20}{R}$ rad s^{-2}

Q6. A satellite orbits the Earth in a circular path at a height $h = R$ above the surface, where $R = 6.4 \times 10^6$ m is the Earth's radius and surface gravity $g = 10\ \text{m s}^{-2}$. The orbital speed of the satellite is approximately

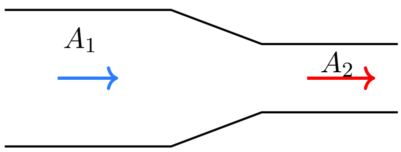
(A) 8.0 km s^{-1}

(B) 5.7 km s^{-1}

(C) 11.2 km s^{-1}

(D) 4.0 km s^{-1}

Q7. Water flows steadily through a horizontal pipe whose cross-sectional area narrows from $A_1 = 8\ \text{cm}^2$ to $A_2 = 2\ \text{cm}^2$, as shown. The speed of water in the wide section is $1\ \text{m s}^{-1}$. The speed of water in the narrow section is



(A) $2\ \mathrm{m\,s^{-1}}$

(B) $0.25\ \mathrm{m\,s^{-1}}$

(C) $4\ \mathrm{m\,s^{-1}}$

(D) $8\ \mathrm{m\,s^{-1}}$

Q8. A refrigerator extracts 200 J of heat from its cold interior in each cycle while the compressor does 50 J of work on the working substance per cycle. The coefficient of performance of the refrigerator is

(A) 4

(B) 5

(C) 0.25

(D) 0.8

Q9. A vessel of volume $V = 2 \times 10^{-3}$ m^3 contains an ideal gas at pressure $P = 8.28 \times 10^3$ Pa and temperature $T = 300$ K. Take $k_B = 1.38 \times 10^{-23}$ $\mathrm{J\,K^{-1}}$. The number of gas molecules in the vessel is approximately

(A) 2×10^{21}

(B) 1×10^{22}

(C) 8×10^{22}

(D) 4×10^{21}

Q10. A particle executes simple harmonic motion of amplitude $A = 0.05$ m with angular frequency $\omega = 20$ $\mathrm{rad\,s^{-1}}$. The maximum speed and maximum acceleration of the particle are respectively

(A) $1\ \mathrm{m\,s^{-1}}$ and $10\ \mathrm{m\,s^{-2}}$

(B) $0.5\ \mathrm{m\,s^{-1}}$ and $20\ \mathrm{m\,s^{-2}}$

(C) $1\ \mathrm{m\,s^{-1}}$ and $20\ \mathrm{m\,s^{-2}}$

(D) $2\ \mathrm{m\,s^{-1}}$ and $40\ \mathrm{m\,s^{-2}}$

Q11. An open organ pipe of length 0.5 m is sounded. Taking the speed of sound in air as $340\ \mathrm{m\,s^{-1}}$, the fundamental frequency of the pipe is

(A) 340 Hz

(B) 170 Hz

(C) 680 Hz

(D) 255 Hz

Q12. A point charge $q = 2 \times 10^{-6}$ C is placed in vacuum. Taking $\dfrac{1}{4\pi\varepsilon_0} = 9 \times 10^9$ $\mathrm{N\,m^2\,C^{-2}}$, the magnitude of the electric field at a point 0.3 m from the charge is

(A) $6 \times 10^4\ \mathrm{N\,C^{-1}}$

(B) $2 \times 10^5\ \mathrm{N\,C^{-1}}$

(C) $6 \times 10^5\ \mathrm{N\,C^{-1}}$

(D) $1.8 \times 10^5\ \mathrm{N\,C^{-1}}$

Q13. A $2\,\mu$F capacitor charged to 100 V is connected in parallel (positive plate to positive plate) with an uncharged $3\,\mu$F capacitor. The common potential of the combination after connection is

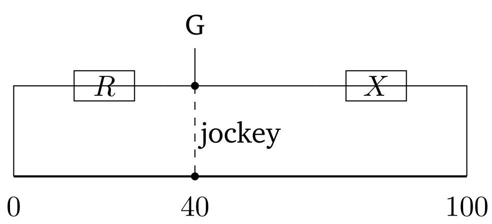
(A) 60 V

(B) 50 V

(C) 40 V

(D) 100 V

Q14. In a meter bridge experiment, a known resistance $R = 20\,\Omega$ is placed in the left gap and an unknown resistance X in the right gap. The balance point (null point) is found at a length of 40 cm from the left end of the 100 cm wire, as shown. The value of X is



(A) $13.3\,\Omega$

(B) $50\,\Omega$

(C) $80\,\Omega$

(D) $30\,\Omega$

Q15. A flat rectangular coil of 50 turns, each of area 4×10^{-3} m^2, carries a current of 2 A. It is placed in a uniform magnetic field of 0.5 T such that the plane of the coil is parallel to the field. The torque experienced by the coil is

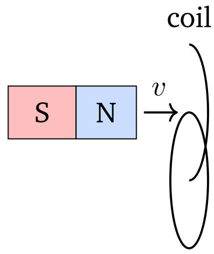
(A) 0.1 N m

(B) 0.2 N m

(C) 0.4 N m

(D) 0.05 N m

Q16. The north pole of a bar magnet is moved toward a circular coil along its axis, as shown (viewed from the magnet side facing the coil). According to Lenz's law, the induced current in the coil, as seen by the approaching magnet, flows



(A) clockwise, so that the near face becomes a south pole

(B) anticlockwise, so that the near face becomes a north pole

(C) clockwise, so that the near face becomes a north pole

(D) there is no induced current because the magnet is permanent

Q17. An alternating current has a peak value $I_0 = 4$ A and flows through a pure resistor $R = 10\,\Omega$. The rms current and the average power dissipated in the resistor are respectively

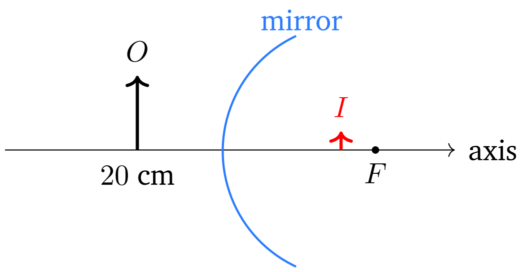
(A) 4 A and 160 W

(B) $2\sqrt{2}$ A and 160 W

(C) $2\sqrt{2}$ A and 80 W

(D) 4 A and 80 W

Q18. An object is placed 20 cm in front of a convex mirror of focal length 15 cm, as shown. The image formed is



(A) virtual, erect and diminished, at about 8.6 cm behind the mirror

(B) real, inverted and diminished, at 60 cm in front of the mirror

(C) virtual, erect and magnified, at 60 cm behind the mirror

(D) real, inverted and the same size, at 20 cm in front of the mirror

Q19. In a Young's double-slit experiment, the amplitudes of the waves arriving at a point from the two slits are in the ratio $2 : 1$. The ratio of the maximum intensity to the minimum intensity in the interference pattern is

(A) $4 : 1$

(B) $9 : 1$

(C) $3 : 1$

(D) $2 : 1$

Q20. Light of frequency 1.0×10^{15} Hz is incident on a metal whose threshold frequency is 6.0×10^{14} Hz. Take Planck's constant $h = 6.6 \times 10^{-34}$ J s. The maximum kinetic energy of the emitted photoelectrons is

(A) 6.6×10^{-19} J

(B) 3.96×10^{-19} J

(C) 1.056×10^{-18} J

(D) 2.64×10^{-19} J

Detailed Solutions

Q1.

Solution

Concept — Propagation of errors in a power law: For $\text{KE} = \frac{1}{2}mv^2$, fractional errors add, and the exponent of each quantity multiplies its fractional error. The speed appears squared, so its error counts *twice*.

Step 1 — Write the error relation: $\frac{\Delta(\text{KE})}{\text{KE}} = \frac{\Delta m}{m} + 2\frac{\Delta v}{v}$ (the constant $\frac{1}{2}$ contributes no error).

Step 2 — Substitute percentages: $= 2\% + 2(3\%) = 2\% + 6\% = 8\%$.

Why other options are wrong:

- (B) 5% simply adds $2\% + 3\%$ and forgets the factor 2 on v.
- (C) 11% wrongly doubles the mass error too ($2 \times 2\% + 2 \times 3\%$ would be 10%; 11% is an arithmetic slip).
- (D) 6.5% averages the contributions instead of adding them.

Final Answer: Maximum error $= 8\% \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q1

Q2.

Solution

Concept — Relative velocity (approaching objects): When two bodies move directly toward each other, the gap closes at the rate equal to the *sum* of their speeds.

Step 1 — Closing speed: $v_{\text{rel}} = 15 + 25 = 40\ \text{m s}^{-1}$.

Step 2 — Time to meet: $t = \frac{\text{separation}}{v_{\text{rel}}} = \frac{400}{40} = 10\ \text{s}$.

Why other options are wrong:

- (A) 16 s uses only the faster car's speed ($400/25$).
- (C) 20 s uses the difference of speeds ($25 - 15 = 10$) instead of the sum.
- (D) 8 s would need a closing speed of $50\ \text{m s}^{-1}$.

Final Answer: $t = 10$ s $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q2

Q3.

Solution

Concept — Atwood machine: For two masses over a frictionless pulley, the heavier mass falls and the system accelerates with $a = \dfrac{(m_1 - m_2)g}{m_1 + m_2}$.

Step 1 — Substitute: $m_1 = 3$ kg, $m_2 = 2$ kg, $g = 10\ \text{m s}^{-2}$.

$$a = \frac{(3-2)(10)}{3+2} = \frac{10}{5} = 2\ \text{m s}^{-2}.$$

Step 2 — (Tension, for completeness): $T = m_2(g + a) = 2(10 + 2) = 24$ N $= m_1(g - a) = 3(8) = 24$ N. ✓

Why other options are wrong:

- (A) 1 uses $(m_1 - m_2)g/(2(m_1 + m_2))$, an extra factor of 2.
- (B) 4 divides the net force by the mass *difference* instead of the sum.
- (D) 5 uses $g(m_1 - m_2)/m_2$, dividing by one mass only.

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

Answer: (C) Go Back to Q3

Q4.

Solution

Concept — Work as area under the F–x graph: The work done by a variable force equals the area enclosed between the F–x curve and the x-axis over the given interval.

Step 1 — Region 0 to 2 m (rectangle): $F = 4$ N is constant, so area $= 4 \times 2 = 8$ J.

Step 2 — Region 2 to 4 m (trapezium): F falls linearly from 4 N to 2 N over a width of 2 m, so area $= \frac{1}{2}(4 + 2)(2) = 6$ J.

Step 3 — Total work: $W = 8 + 6 = 14$ J.

Why other options are wrong:

- (A) 16 J treats the whole interval as a rectangle at $F = 4$ N.
- (B) 8 J counts only the flat first section.
- (C) 12 J uses the average force 3 N over 4 m but mis-weights the segments.

Final Answer: $W = 14$ J $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q4

Q5.

Solution

Concept — Disc pulley with a hanging mass: The string tension provides torque $\tau = TR = I\alpha$ on the disc ($I = \frac{1}{2}MR^2$), while the block obeys $mg - T = ma$ with $a = \alpha R$.

Step 1 — Equations: Block: $mg - T = m(\alpha R)$. Disc: $TR = \frac{1}{2}MR^2\alpha \Rightarrow T = \frac{1}{2}MR\alpha$.

Step 2 — Eliminate T: $mg - \frac{1}{2}MR\alpha = mR\alpha \Rightarrow mg = \left(m + \frac{M}{2}\right) R\alpha$.

Step 3 — Solve for α:

$$\alpha = \frac{mg}{\left(m + \frac{M}{2}\right) R} = \frac{(1)(10)}{(1+1)R} = \frac{10}{2R} = \frac{5}{R} \text{ rad s}^{-2}.$$

Why other options are wrong:

- (B) $10/R$ ignores the disc's inertia ($\alpha = g/R$).
- (C) $5/(2R)$ uses $I = MR^2$ (a ring) and mis-combines terms.
- (D) $20/R$ drops the factor $\frac{1}{2}$ and the block mass.

Final Answer: $\alpha = \dfrac{5}{R} \text{ rad s}^{-2} \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q5

Q6.

Solution

Concept — Orbital speed: For a circular orbit of radius r, $v_{\text{orb}} = \sqrt{\frac{GM}{r}}$. Using $GM = gR^2$, $v_{\text{orb}} = \sqrt{\frac{gR^2}{r}}$.

Step 1 — Orbital radius: At height $h = R$, the orbit radius is $r = R + h = 2R = 1.28 \times 10^7$ m.

Step 2 — Compute:

$$v_{\text{orb}} = \sqrt{\frac{gR^2}{2R}} = \sqrt{\frac{gR}{2}} = \sqrt{\frac{(10)(6.4 \times 10^6)}{2}} = \sqrt{3.2 \times 10^7}.$$

$\sqrt{3.2 \times 10^7} = \sqrt{32 \times 10^6} = 5.66 \times 10^3\ \mathrm{m\,s^{-1}} \approx 5.7\ \mathrm{km\,s^{-1}}$.

Why other options are wrong:

- (A) $8.0\ \mathrm{km\,s^{-1}}$ uses $r = R$ (low orbit), $\sqrt{gR}$.
- (C) $11.2\ \mathrm{km\,s^{-1}}$ is the escape speed from the surface.
- (D) $4.0\ \mathrm{km\,s^{-1}}$ uses $r = 4R$ in the denominator.

Final Answer: $v_{\text{orb}} \approx 5.7\ \mathrm{km\,s^{-1}} \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q6

Q7.

Solution

Concept — Equation of continuity: For an incompressible fluid in steady flow, $A_1v_1 = A_2v_2$; a narrower section means faster flow.

Step 1 — Apply continuity: $v_2 = \dfrac{A_1v_1}{A_2} = \dfrac{(8)(1)}{2} = 4\ \mathrm{m\,s^{-1}}$ (the $\mathrm{cm^2}$ units cancel, so no conversion is needed for the ratio).

Step 2 — (Bernoulli check): Since the pipe is horizontal, the faster, narrow section has *lower* pressure, consistent with energy conservation.

Why other options are wrong:

- (A) $2\ \mathrm{m\,s^{-1}}$ uses an area ratio of 2 instead of 4.
- (B) $0.25\ \mathrm{m\,s^{-1}}$ inverts the ratio (assumes the narrow section is slower).
- (D) $8\ \mathrm{m\,s^{-1}}$ multiplies by A_1 without dividing by A_2 correctly.

Final Answer: $v_2 = 4\ \mathrm{m\,s^{-1}} \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q7

Q8.

Solution

Concept — Coefficient of performance (refrigerator): The COP is the heat extracted from the cold reservoir per unit work input, $\text{COP} = \dfrac{Q_C}{W}$.

Step 1 — Identify quantities: $Q_C = 200$ J (heat removed from inside), $W = 50$ J (work by compressor).

Step 2 — Compute: $\text{COP} = \dfrac{Q_C}{W} = \dfrac{200}{50} = 4$.

Why other options are wrong:

- (B) 5 uses $Q_H/W = (Q_C + W)/W = 250/50$, which is the heat-pump COP, not the refrigerator's.
- (C) 0.25 inverts the ratio (W/Q_C).
- (D) 0.8 uses $W/Q_H = 50/250$.

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

Answer: (A) Go Back to Q8

Q9.

Solution

Concept — Ideal gas in terms of molecule number: $PV = Nk_BT$, where N is the number of molecules and k_B is Boltzmann's constant.

Step 1 — Rearrange: $N = \dfrac{PV}{k_BT}$.

Step 2 — Substitute:

$$N = \frac{(8.28 \times 10^3)(2 \times 10^{-3})}{(1.38 \times 10^{-23})(300)} = \frac{16.56}{4.14 \times 10^{-21}} = 4 \times 10^{21}.$$

Why other options are wrong:

- (A) 2×10^{21} forgets the factor $V = 2 \times 10^{-3}$ (uses $V = 10^{-3}$).
- (B) 1×10^{22} drops a power of ten in k_BT.
- (C) 8×10^{22} misplaces the volume exponent.

Final Answer: $N \approx 4 \times 10^{21}$ molecules $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q9

Q10.

Solution

Concept — SHM maxima: In SHM, the maximum speed is $v_{\text{max}} = \omega A$ and the maximum acceleration is $a_{\text{max}} = \omega^2 A$.

Step 1 — Maximum speed: $v_{\text{max}} = \omega A = (20)(0.05) = 1\ \text{m s}^{-1}$.

Step 2 — Maximum acceleration: $a_{\text{max}} = \omega^2 A = (20)^2(0.05) = (400)(0.05) = 20\ \text{m s}^{-2}$.

Why other options are wrong:

- (A) $10\ \mathrm{m\,s^{-2}}$ uses $a_{\max} = \omega A^2$ or halves ω^2.
- (B) $0.5\ \mathrm{m\,s^{-1}}$ uses $v_{\max} = \frac{1}{2}\omega A$.
- (D) $2\ \mathrm{m\,s^{-1}}$, $40\ \mathrm{m\,s^{-2}}$ doubles both results.

Final Answer: $v_{\max} = 1\ \mathrm{m\,s^{-1}}$, $a_{\max} = 20\ \mathrm{m\,s^{-2}} \Rightarrow \boxed{\mathrm{C}}$

Answer: (C) Go Back to Q10

Q11.

Solution

Concept — Open organ pipe: An open pipe has antinodes at both ends; its fundamental frequency is $f_1 = \dfrac{v}{2L}$, and all harmonics $(f_1, 2f_1, 3f_1, \dots)$ are present.

Step 1 — Substitute: $v = 340\ \mathrm{m\,s^{-1}}$, $L = 0.5$ m.

$$f_1 = \frac{v}{2L} = \frac{340}{2(0.5)} = \frac{340}{1} = 340\ \text{Hz}.$$

Why other options are wrong:

- (B) 170 Hz uses $f = v/(4L)$, the *closed*-pipe fundamental.
- (C) 680 Hz uses $f = v/L$ (omits the factor 2).
- (D) 255 Hz has no consistent basis (mixes constants).

Final Answer: $f_1 = 340\ \text{Hz} \Rightarrow \boxed{\mathrm{A}}$

Answer: (A) Go Back to Q11

Q12.

Solution

Concept — Field of a point charge: The electric field magnitude at distance r from a point charge q is $E = \dfrac{1}{4\pi\varepsilon_0}\dfrac{q}{r^2} = \dfrac{kq}{r^2}$.

Step 1 — Substitute: $k = 9 \times 10^9$, $q = 2 \times 10^{-6}$ C, $r = 0.3$ m so $r^2 = 0.09\ \mathrm{m}^2$.

$$E = \frac{(9 \times 10^9)(2 \times 10^{-6})}{0.09} = \frac{1.8 \times 10^4}{0.09}.$$

Step 2 — Compute: $E = 2 \times 10^5\ \mathrm{N\,C^{-1}}$.

Why other options are wrong:

- (A) 6×10^4 uses r instead of r^2 in the denominator.
- (C) 6×10^5 uses $r^2 = 0.03$ (a mis-square of 0.3).
- (D) 1.8×10^5 forgets to divide by r^2 (divides by 1).

Final Answer: $E = 2 \times 10^5\ \mathrm{N\,C^{-1}} \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q12

Q13.

Solution

Concept — Charge sharing / common potential: When two capacitors are joined, charge redistributes until both reach a common potential $V = \dfrac{\text{total charge}}{\text{total capacitance}}$.

Step 1 — Initial charge: On the $2\,\mu$F: $Q_1 = C_1V_1 = (2\,\mu\text{F})(100\,\text{V}) = 200\,\mu$C. The $3\,\mu$F is uncharged ($Q_2 = 0$).

Step 2 — Common potential:

$$V = \frac{Q_1 + Q_2}{C_1 + C_2} = \frac{200\,\mu\text{C}}{(2+3)\,\mu\text{F}} = \frac{200}{5} = 40\ \text{V}.$$

Why other options are wrong:

- (A) 60 V uses $C_1 + C_2$ wrongly (e.g. divides by 3.33).
- (B) 50 V averages the two voltages (100 and 0), ignoring unequal capacitances.
- (D) 100 V assumes no redistribution occurs.

Final Answer: $V = 40\ \text{V} \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q13

Q14.

Solution

Concept — Meter bridge balance: At the null point, the bridge is balanced: $\frac{R}{X} = \frac{\ell}{100-\ell}$, where ℓ is the balance length from the end on the R side.

Step 1 — Write the balance condition: With R in the left gap and balance length $\ell = 40$ cm,

$$\frac{R}{X} = \frac{\ell}{100-\ell} = \frac{40}{60} = \frac{2}{3}.$$

Step 2 — Solve for X: $X = R \cdot \frac{100-\ell}{\ell} = 20 \cdot \frac{60}{40} = 20 \cdot 1.5 = 30\,\Omega.$

Why other options are wrong:

- (A) $13.3\,\Omega$ inverts the ratio ($R \cdot \ell/(100-\ell)$).
- (B) $50\,\Omega$ adds rather than scales.
- (C) $80\,\Omega$ uses $(100-\ell)/\ell$ on the wrong quantity (factor 4).

Final Answer: $X = 30\,\Omega \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q14

Q15.

Solution

Concept — Torque on a current loop: $\tau = NBIA\sin\theta$, where θ is the angle between the magnetic moment (normal to the coil) and $\vec{B}$. When the coil *plane* is parallel to $\vec{B}$, the normal is perpendicular to $\vec{B}$, so $\theta = 90°$ and torque is maximum.

Step 1 — Set $\sin\theta = 1$: $\tau = NBIA$.

Step 2 — Substitute: $\tau = (50)(0.5)(2)(4 \times 10^{-3}) = (50)(0.5)(2)(0.004)$.

$$\tau = 50 \times 0.5 \times 2 \times 0.004 = 0.2\ \text{N m}.$$

Why other options are wrong:

- (A) 0.1 N m drops a factor (uses $\sin\theta = \frac{1}{2}$ or omits a 2).
- (C) 0.4 N m doubles the area or current.
- (D) 0.05 N m uses one quarter of the correct product.

Final Answer: $\tau = 0.2\ \text{N m} \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q15

Q16.

Solution

Concept — Lenz's law: The induced current opposes the change in flux. As a north pole approaches, the coil's near face must become a *north* pole to repel the magnet and oppose the increasing flux.

Step 1 — Determine the induced polarity: Approaching N pole $\Rightarrow$ near face becomes N (repulsion opposes the approach).

Step 2 — Determine the current sense: For the face toward the magnet to act as a north pole, the current (as seen by the approaching magnet) must flow *anticlockwise* (right-hand rule: anticlockwise current as viewed produces field out of that face, i.e. a north pole facing the viewer).

Why other options are wrong:

- (A) A south near-face would attract the magnet, aiding the change — violates Lenz's law.
- (C) A north near-face is correct, but a clockwise current (as seen by the magnet) produces a south pole, contradicting itself.
- (D) Induced current does arise; only relative motion (changing flux) matters, not whether the magnet is permanent.

Final Answer: Anticlockwise; near face becomes north $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q16

Q17.

Solution

Concept — RMS current and average power: For a sinusoidal current, $I_{\text{rms}} = \dfrac{I_0}{\sqrt{2}}$, and the average power in a resistor is $P_{\text{avg}} = I_{\text{rms}}^2 R$.

Step 1 — RMS current: $I_{\text{rms}} = \dfrac{4}{\sqrt{2}} = 2\sqrt{2} \approx 2.83$ A.

Step 2 — Average power: $P_{\text{avg}} = I_{\text{rms}}^2 R = (2\sqrt{2})^2(10) = (8)(10) = 80$ W. (Equivalently $P = \frac{1}{2} I_0^2 R = \frac{1}{2}(16)(10) = 80$ W.)

Why other options are wrong:

- (A) 4 A, 160 W uses peak current as rms and $P = I_0^2 R$.
- (B) $2\sqrt{2}$ A is correct, but 160 W comes from $I_0^2 R$ rather than $I_{\text{rms}}^2 R$.

- (D) 4 A treats peak as rms (power coincidentally right form but wrong current).

Final Answer: $I_{\text{rms}} = 2\sqrt{2}$ A, $P_{\text{avg}} = 80$ W $\Rightarrow$ $\boxed{\text{C}}$

Answer: (C) **Go Back to Q17**

Q18.

Solution

Concept — Convex mirror: A convex mirror always forms a virtual, erect, diminished image behind the mirror, for any real object. Use $\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$ with $f > 0$ (convex).

Step 1 — Apply mirror formula: $u = -20$ cm, $f = +15$ cm.

$$\frac{1}{v} = \frac{1}{f} - \frac{1}{u} = \frac{1}{15} - \frac{1}{-20} = \frac{1}{15} + \frac{1}{20} = \frac{4+3}{60} = \frac{7}{60}.$$

So $v = \frac{60}{7} \approx +8.6$ cm (positive $\Rightarrow$ behind the mirror, virtual).

Step 2 — Magnification: $m = -\frac{v}{u} = -\frac{8.6}{-20} = +0.43$: erect ($m > 0$) and diminished ($|m| < 1$).

Why other options are wrong:

- (B) Convex mirrors never form real, inverted images for real objects.
- (C) The image is diminished, not magnified.
- (D) Same-size image at 20 cm is impossible for a convex mirror.

Final Answer: Virtual, erect, diminished, about 8.6 cm behind $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) **Go Back to Q18**

Q19.

Solution

Concept — Intensity from amplitudes: Intensity $\propto$ amplitude^2. In interference, $I_{\text{max}} \propto (a_1 + a_2)^2$ and $I_{\text{min}} \propto (a_1 - a_2)^2$.

Step 1 — Form the ratio: With $a_1 : a_2 = 2 : 1$,

$$\frac{I_{\text{max}}}{I_{\text{min}}} = \left(\frac{a_1 + a_2}{a_1 - a_2}\right)^2 = \left(\frac{2+1}{2-1}\right)^2 = \left(\frac{3}{1}\right)^2 = 9.$$

Step 2 — State result: $I_{\text{max}} : I_{\text{min}} = 9 : 1$.

Why other options are wrong:

- (A) $4 : 1$ is the intensity ratio $I_1 : I_2 = a_1^2 : a_2^2$, not max:min.
- (C) $3 : 1$ uses amplitudes without squaring.
- (D) $2 : 1$ is just the amplitude ratio.

Final Answer: $I_{\text{max}} : I_{\text{min}} = 9 : 1 \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q19

Q20.

Solution

Concept — Einstein's photoelectric equation: The maximum kinetic energy is $K_{\text{max}} = h(\nu - \nu_0)$, where ν_0 is the threshold frequency and $h\nu_0 = \phi$ (the work function).

Step 1 — Frequency difference: $\nu - \nu_0 = 1.0 \times 10^{15} - 6.0 \times 10^{14} = 4.0 \times 10^{14}$ Hz.

Step 2 — Compute:

$$K_{\text{max}} = h(\nu - \nu_0) = (6.6 \times 10^{-34})(4.0 \times 10^{14}) = 2.64 \times 10^{-19} \text{ J}.$$

Why other options are wrong:

- (A) 6.6×10^{-19} J uses the incident photon energy $h\nu$ alone.
- (B) 3.96×10^{-19} J is the work function $h\nu_0$.
- (C) 1.056×10^{-18} J adds ν and ν_0 instead of subtracting.

Final Answer: $K_{\text{max}} = 2.64 \times 10^{-19} \text{ J} \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q20

Answer Key

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