NEST Physics Sample Paper – 3

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. Three lengths are measured as 12.5 cm, 0.46 cm and 7.234 cm. When these are added, the sum reported to the correct number of significant figures (consistent with the least precise measurement) is

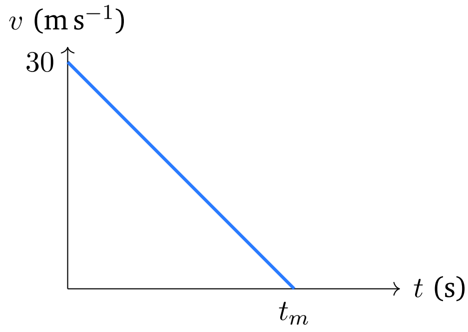
(A) 20.194 cm

(B) 20.2 cm

(C) 20.19 cm

(D) 20 cm

Q2. A ball is thrown vertically upward from the ground with an initial speed of $30\ \mathrm{m\,s^{-1}}$ (take $g = 10\ \mathrm{m\,s^{-2}}$, neglect air resistance). The velocity–time graph for its upward flight is sketched below. The maximum height reached and the time taken to reach it are



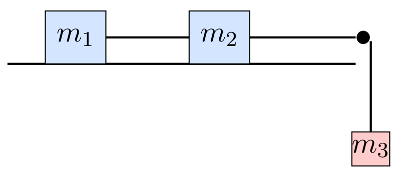
(A) 45 m and 3 s

(B) 90 m and 3 s

(C) 45 m and 6 s

(D) 30 m and 3 s

Q3. Two blocks of masses $m_1 = 4$ kg and $m_2 = 2$ kg lie on a smooth horizontal table, connected by a light string. A second light string runs from m_2 over a frictionless pulley at the table edge to a hanging block of mass $m_3 = 6$ kg, as shown. Take $g = 10\ \mathrm{m\,s^{-2}}$. The acceleration of the system is



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

(B) $6\ \mathrm{m\,s^{-2}}$

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

(D) $10\ \mathrm{m\,s^{-2}}$

Q4. A block is released from rest at the top of a rough incline of length 5 m inclined at 30° to the horizontal. The coefficient of kinetic friction between the block and the incline is $\mu = 0.2$. Take $g = 10\ \mathrm{m\,s^{-2}}$ and $\sqrt{3} \approx 1.73$. Using the work–energy theorem, the speed of the block at the bottom is closest to

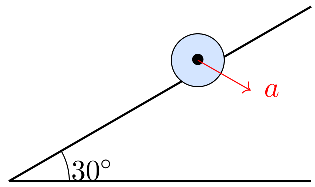
(A) $5.0\ \mathrm{m\,s^{-1}}$

(B) 5.7 m s^{-1}

(C) 7.1 m s^{-1}

(D) 10.0 m s^{-1}

Q5. A uniform solid sphere rolls without slipping down an incline of angle $30°$. Take $g = 10 \text{ m s}^{-2}$. The linear acceleration of the centre of the sphere down the incline is



(A) 5.0 m s^{-2}

(B) 2.5 m s^{-2}

(C) 4.2 m s^{-2}

(D) 3.6 m s^{-2}

Q6. Two satellites orbit the same planet in circular orbits. The radius of the second orbit is 4 times that of the first. By Kepler's third law, the ratio of the orbital period of the second satellite to that of the first is

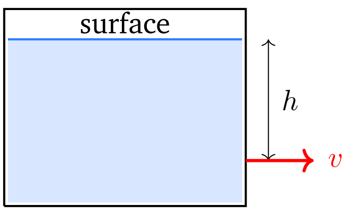
(A) 4

(B) 16

(C) 8

(D) 2

Q7. A large open tank holds water to a height such that a small hole on the side wall is $h = 1.8$ m below the free surface. Take $g = 10 \text{ m s}^{-2}$. By Torricelli's theorem, the speed of efflux of water through the hole is



(A) $6\ \text{m}\,\text{s}^{-1}$

(B) $3.6\ \text{m}\,\text{s}^{-1}$

(C) $18\ \text{m}\,\text{s}^{-1}$

(D) $36\ \text{m}\,\text{s}^{-1}$

Q8. Two moles of an ideal gas expand isothermally and reversibly at temperature 300 K from a volume V to a volume $2V$. Take $R = 8.31\ \text{J}\,\text{mol}^{-1}\text{K}^{-1}$ and $\ln 2 = 0.693$. The work done by the gas is closest to

(A) 1730 J

(B) 3456 J

(C) 4988 J

(D) 6912 J

Q9. According to the kinetic theory of gases, the pressure of an ideal gas is $P = \frac{1}{3}\rho v_{\text{rms}}^2$, where ρ is the density. A gas of density $1.2\ \text{kg}\,\text{m}^{-3}$ exerts a pressure of 1.0×10^5 Pa. The root-mean-square speed of its molecules is closest to

(A) $290\ \text{m}\,\text{s}^{-1}$

(B) $410\ \text{m}\,\text{s}^{-1}$

(C) $250000\ \text{m}\,\text{s}^{-1}$

(D) $500\ \text{m}\,\text{s}^{-1}$

Q10. A particle executes simple harmonic motion of amplitude A. At the instant when its displacement from the mean position is $\frac{A}{2}$, the ratio of its kinetic energy to its potential energy is

(A) 3

(B) $\frac{1}{3}$

(C) 1

(D) 4

Q11. A source emitting sound of frequency 500 Hz moves directly towards a stationary observer at a speed of 30 m s^{-1}. The speed of sound in air is 330 m s^{-1}. The frequency heard by the observer is

(A) 450 Hz

(B) 550 Hz

(C) 530 Hz

(D) 500 Hz

Q12. A short electric dipole has dipole moment $p = 2 \times 10^{-9}$ C m. The magnitude of the electric field at a point 0.2 m from its centre, on the axial line of the dipole, is (take $\frac{1}{4\pi\varepsilon_0} = 9 \times 10^9$ N m^{2}C^{-2})

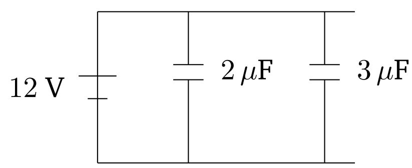
(A) 2250 N C^{-1}

(B) 9000 N C^{-1}

(C) 4500 N C^{-1}

(D) 450 N C^{-1}

Q13. Two capacitors of $2\,\mu$F and $3\,\mu$F are connected in parallel across an ideal 12 V battery, as shown. The charge stored on the $3\,\mu$F capacitor is



(A) $24\,\mu$C

(B) $60\,\mu$C

(C) $14.4\,\mu$C

(D) $36\,\mu$C

Q14. A cell of emf 2.0 V and internal resistance $0.5\,\Omega$ is connected across an external resistance of $3.5\,\Omega$. The terminal voltage of the cell is

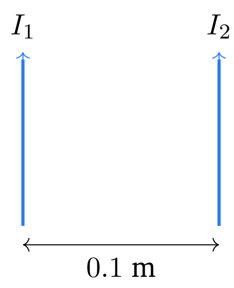
(A) 1.75 V

(B) 2.00 V

(C) 0.25 V

(D) 1.50 V

Q15. Two long straight parallel wires, separated by 0.1 m, carry currents $I_1 = 3$ A and $I_2 = 4$ A in the same direction, as shown. Take $\mu_0 = 4\pi \times 10^{-7}$ T m A^{-1}. The magnitude of the magnetic force per unit length between the wires is



(A) 1.2×10^{-5} N m^{-1}

(B) 2.4×10^{-5} N m^{-1}

(C) 4.8×10^{-5} N m^{-1}

(D) 1.2×10^{-6} N m^{-1}

Q16. The current through an inductor of self-inductance $L = 0.4$ H changes steadily from 2 A to 8 A in 0.1 s. The magnitude of the self-induced emf in the inductor is

(A) 6 V

(B) 12 V

(C) 24 V

(D) 2.4 V

Q17. A resistor of $R = 30\,\Omega$ is connected in series with a capacitor whose reactance is $X_C = 40\,\Omega$, across an AC source. The impedance of the circuit is

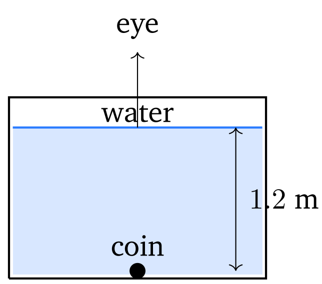
(A) $50\,\Omega$

(B) $70\,\Omega$

(C) $10\,\Omega$

(D) $35\,\Omega$

Q18. A coin lies at the bottom of a tank filled with water to a real depth of 1.2 m. The refractive index of water is $\frac{4}{3}$. When viewed from directly above, the coin appears to be raised. Its apparent depth below the water surface is



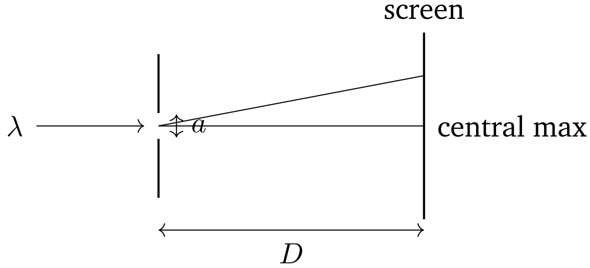
(A) 1.6 m

(B) 1.2 m

(C) 0.4 m

(D) 0.9 m

Q19. In a single-slit diffraction experiment, light of wavelength 600 nm passes through a slit of width 0.1 mm. The screen is at a distance 1.5 m from the slit. The distance of the first minimum from the central maximum on the screen is



(A) 4.5 mm

(B) 9.0 mm

(C) 18 mm

(D) 4.5 cm

Q20. The mass defect of a helium-4 ($^4_2$He) nucleus is 0.0304 u. Taking 1 u $= 931$ MeV/c^2, the binding energy per nucleon of the helium-4 nucleus is closest to

(A) 28.3 MeV

(B) 14.2 MeV

(C) 7.1 MeV

(D) 3.5 MeV

Detailed Solutions

Q1.

Solution

Concept — Significant figures in addition: When adding measurements, the result is rounded to the same number of *decimal places* as the term with the fewest decimal places.

Step 1 — Raw sum: $12.5 + 0.46 + 7.234 = 20.194$ cm.

Step 2 — Identify least precise term: 12.5 cm has only one decimal place, so the answer must be reported to one decimal place.

Step 3 — Round: $20.194 \to 20.2$ cm.

Why other options are wrong:

- (A) 20.194 keeps all digits, ignoring the precision limit.
- (C) 20.19 rounds to two decimal places (matches 0.46, not the least precise term).
- (D) 20 over-rounds; one decimal place is permitted.

Final Answer: 20.2 cm $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q1

Q2.

Solution

Concept — Vertical motion under gravity: At maximum height the velocity is zero. Use $v = u - gt$ for the time and $v^2 = u^2 - 2gh$ for the height.

Step 1 — Time to top: $0 = u - gt_m \Rightarrow t_m = \dfrac{u}{g} = \dfrac{30}{10} = 3$ s.

Step 2 — Maximum height: $H = \dfrac{u^2}{2g} = \dfrac{(30)^2}{2(10)} = \dfrac{900}{20} = 45$ m.

Why other options are wrong:

- (B) 90 m uses $H = u^2/g$ (forgets the factor 2).
- (C) 6 s is the total flight time (up and down), not the time to the top.
- (D) 30 m mixes up speed and height numerically.

Final Answer: $H = 45$ m at $t_m = 3$ s $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q2

Q3.

Solution

Concept — Connected bodies: Treat all three masses as one system. The only driving force is the weight of the hanging block; the table is smooth, so the blocks on it contribute only inertia.

Step 1 — Driving force: $m_3 g = 6(10) = 60$ N.

Step 2 — Total mass: $m_1 + m_2 + m_3 = 4 + 2 + 6 = 12$ kg.

Step 3 — Acceleration:

$$a = \frac{m_3 g}{m_1 + m_2 + m_3} = \frac{60}{12} = 5\ \mathrm{m\,s^{-2}}.$$

Why other options are wrong:

- (A) $4\ \mathrm{m\,s^{-2}}$ omits one of the table masses from the total.
- (B) $6\ \mathrm{m\,s^{-2}}$ divides by 10 kg (drops a mass).
- (D) $10\ \mathrm{m\,s^{-2}}$ is free fall, ignoring the inertia of the table blocks.

Final Answer: $a = 5\ \mathrm{m\,s^{-2}} \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q3

Q4.

Solution

Concept — Work–energy theorem on a rough incline: Net work = gain in kinetic energy. Gravity does positive work $mg\sin\theta\, L$; friction does negative work $\mu mg\cos\theta\, L$.

Step 1 — Net work per unit mass: $a_{\text{eff}}\, L = gL(\sin\theta - \mu\cos\theta)$, and $\frac{1}{2}v^2 = gL(\sin\theta - \mu\cos\theta)$.

Step 2 — Substitute: $\sin 30^\circ = 0.5$, $\cos 30^\circ = \frac{\sqrt{3}}{2} \approx 0.865$.

$$v^2 = 2gL(\sin\theta - \mu\cos\theta) = 2(10)(5)\big(0.5 - 0.2(0.865)\big) = 100(0.5 - 0.173) = 100(0.327) = 32.7.$$

Step 3 — Speed: $v = \sqrt{32.7} \approx 5.7\ \mathrm{m\,s^{-1}}$.

Why other options are wrong:

- (A) $5.0\ \mathrm{m\,s^{-1}}$ rounds away the friction correction carelessly.
- (C) $7.1\ \mathrm{m\,s^{-1}}$ ignores friction entirely ($v = \sqrt{2gL\sin\theta} = \sqrt{50}$).
- (D) $10.0\ \mathrm{m\,s^{-1}}$ uses the full $2gL$ as if free-falling the length.

Final Answer: $v \approx 5.7\ \mathrm{m\,s^{-1}} \Rightarrow \boxed{\mathrm{B}}$

Answer: (B) Go Back to Q4

Q5.

Solution

Concept — Rolling without slipping: For a body of moment of inertia $I = \beta MR^2$ rolling down an incline, $a = \dfrac{g\sin\theta}{1+\beta}$. For a solid sphere $\beta = \frac{2}{5}$.

Step 1 — Insert the sphere factor:

$$a = \frac{g\sin\theta}{1+\frac{2}{5}} = \frac{g\sin\theta}{\frac{7}{5}} = \frac{5}{7}\,g\sin\theta.$$

Step 2 — Substitute: $a = \dfrac{5}{7}(10)(0.5) = \dfrac{25}{7} \approx 3.57 \approx 3.6\ \mathrm{m\,s^{-2}}$.

Why other options are wrong:

- (A) $5.0\ \mathrm{m\,s^{-2}}$ is the frictionless sliding value $g\sin\theta$ (no rolling factor).
- (B) $2.5\ \mathrm{m\,s^{-2}}$ halves the sliding value, with no basis.
- (C) $4.2\ \mathrm{m\,s^{-2}}$ uses $\beta = \frac{1}{2}$ (a disc/cylinder gives $\frac{2}{3}g\sin\theta$).

Final Answer: $a = \dfrac{5}{7}g\sin\theta \approx 3.6\ \mathrm{m\,s^{-2}} \Rightarrow \boxed{\mathrm{D}}$

Answer: (D) Go Back to Q5

Q6.

Solution

Concept — Kepler's third law: For circular orbits about the same body, $T^2 \propto r^3$, so $\dfrac{T_2}{T_1} = \left(\dfrac{r_2}{r_1}\right)^{3/2}$.

Step 1 — Apply with $r_2/r_1 = 4$:

$$\frac{T_2}{T_1} = 4^{3/2} = \left(4^{1/2}\right)^3 = 2^3 = 8.$$

Why other options are wrong:

- (A) 4 assumes $T \propto r$ (linear, wrong).
- (B) 16 uses $T \propto r^2$.
- (D) 2 takes $T \propto \sqrt{r}$, the inverse of the correct power.

Final Answer: $\frac{T_2}{T_1} = 8 \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q6

Q7.

Solution

Concept — Torricelli's theorem: The efflux speed from a hole at depth h below the free surface of an open tank is $v = \sqrt{2gh}$ (Bernoulli applied between surface and hole).

Step 1 — Substitute: $v = \sqrt{2(10)(1.8)} = \sqrt{36} = 6\ \text{m}\,\text{s}^{-1}$.

Why other options are wrong:

- (B) $3.6\ \text{m}\,\text{s}^{-1}$ uses $v = gh/\ldots$, a dimensionally wrong shortcut.
- (C) $18\ \text{m}\,\text{s}^{-1}$ uses $v = 2gh$ without the square root.
- (D) $36\ \text{m}\,\text{s}^{-1}$ reports v^2 as the speed.

Final Answer: $v = 6\ \text{m}\,\text{s}^{-1} \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q7

Q8.

Solution

Concept — Isothermal work: For an isothermal reversible expansion of an ideal gas, $W = nRT \ln\frac{V_2}{V_1}$.

Step 1 — Substitute: $n = 2$, $R = 8.31$, $T = 300$, $V_2/V_1 = 2$.

$$W = 2(8.31)(300)\ln 2 = 4986 \times 0.693.$$

Step 2 — Compute: $W \approx 4986 \times 0.693 \approx 3456$ J.

Why other options are wrong:

- (A) 1730 J uses $n = 1$ instead of 2.
- (C) 4988 J forgets the $\ln 2$ factor (nRT alone).
- (D) 6912 J doubles the correct work (uses $\ln 4$ or a factor-2 slip).

Final Answer: $W \approx 3456$ J $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q8

Q9.

Solution

Concept — Pressure from kinetic theory: $P = \frac{1}{3}\rho\, v_{\text{rms}}^2$, so $v_{\text{rms}} = \sqrt{\frac{3P}{\rho}}$.

Step 1 — Substitute:

$$v_{\text{rms}} = \sqrt{\frac{3(1.0 \times 10^5)}{1.2}} = \sqrt{\frac{3 \times 10^5}{1.2}} = \sqrt{2.5 \times 10^5}.$$

Step 2 — Compute: $\sqrt{2.5 \times 10^5} = \sqrt{250000} = 500\ \text{m s}^{-1}$.

Why other options are wrong:

- (A) $290\ \text{m s}^{-1}$ drops the factor of 3 ($\sqrt{P/\rho}$).
- (B) $410\ \text{m s}^{-1}$ uses a factor of 2 instead of 3.
- (C) $250000\ \text{m s}^{-1}$ reports v_{rms}^2 as the speed (no square root).

Final Answer: $v_{\text{rms}} = 500\ \text{m s}^{-1} \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q9

Q10.

Solution

Concept — Energy in SHM: Total energy $E = \frac{1}{2}kA^2$. At displacement x, $PE = \frac{1}{2}kx^2$ and $KE = E - PE = \frac{1}{2}k(A^2 - x^2)$.

Step 1 — Form the ratio:

$$\frac{KE}{PE} = \frac{A^2 - x^2}{x^2}.$$

Step 2 — Substitute $x = \frac{A}{2}$:

$$\frac{KE}{PE} = \frac{A^2 - \frac{A^2}{4}}{\frac{A^2}{4}} = \frac{\frac{3}{4}A^2}{\frac{1}{4}A^2} = 3.$$

Why other options are wrong:

- (B) $\frac{1}{3}$ inverts the ratio (PE/KE).
- (C) 1 would hold at $x = A/\sqrt{2}$, not $x = A/2$.
- (D) 4 uses A^2/x^2 and forgets to subtract x^2.

Final Answer: $\dfrac{KE}{PE} = 3 \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q10

Q11.

Solution

Concept — Doppler effect (approaching source): For a source moving towards a stationary observer, the heard frequency is $f' = f\,\dfrac{v}{v - v_s}$, which is higher than f.

Step 1 — Substitute: $f = 500$ Hz, $v = 330$ m s^{-1}, $v_s = 30$ m s^{-1}.

$$f' = 500 \times \frac{330}{330 - 30} = 500 \times \frac{330}{300}.$$

Step 2 — Compute: $f' = 500 \times 1.1 = 550$ Hz.

Why other options are wrong:

- (A) 450 Hz uses $v + v_s$ in the denominator (receding case).
- (C) 530 Hz mishandles the arithmetic of the ratio.
- (D) 500 Hz ignores the motion altogether.

Final Answer: $f' = 550$ Hz $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q11

Q12.

Solution

Concept — Axial field of a short dipole: On the axis, $E_{\text{axial}} = \dfrac{1}{4\pi\varepsilon_0}\dfrac{2p}{r^3}$.

Step 1 — Substitute: $p = 2 \times 10^{-9}$ C m, $r = 0.2$ m, so $r^3 = 8 \times 10^{-3}$ m^3.

$$E = 9 \times 10^9 \times \frac{2(2 \times 10^{-9})}{8 \times 10^{-3}} = 9 \times 10^9 \times \frac{4 \times 10^{-9}}{8 \times 10^{-3}}.$$

Step 2 — Compute: $\dfrac{4 \times 10^{-9}}{8 \times 10^{-3}} = 0.5 \times 10^{-6}$, so $E = 9 \times 10^9 \times 0.5 \times 10^{-6} = 4500$ N C^{-1}.

Why other options are wrong:

- (A) 2250 N C^{-1} drops the factor of 2 for the axial field (uses the equatorial form).
- (B) 9000 N C^{-1} double-counts the factor of 2.
- (D) 450 N C^{-1} is a power-of-ten slip in r^3.

Final Answer: $E = 4500$ N C^{-1} $\Rightarrow$ $\boxed{\text{C}}$

Answer: (C) Go Back to Q12

Q13.

Solution

Concept — Capacitors in parallel: Parallel capacitors share the *same voltage* (the full battery voltage here); the charge on each is $Q = CV$.

Step 1 — Voltage across each: Both see $V = 12$ V.

Step 2 — Charge on the 3 μF: $Q = CV = (3\,\mu\text{F})(12\,\text{V}) = 36\,\mu\text{C}$.

Step 3 — Check: The $2\,\mu$F holds $24\,\mu$C; the equivalent $5\,\mu$F holds $60\,\mu\text{C} = 24 + 36$. ✓

Why other options are wrong:

- (A) $24\,\mu$C is the charge on the $2\,\mu$F capacitor.
- (B) $60\,\mu$C is the total charge drawn from the battery.
- (C) $14.4\,\mu$C treats the capacitors as if in series (sharing equal charge).

Final Answer: $Q_{3\mu F} = 36\,\mu\text{C} \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q13

Q14.

Solution

Concept — Cell with internal resistance: The current is $I = \frac{\varepsilon}{R+r}$; the terminal voltage is $V = \varepsilon - Ir = IR$.

Step 1 — Current: $I = \frac{2.0}{3.5+0.5} = \frac{2.0}{4.0} = 0.5$ A.

Step 2 — Terminal voltage: $V = IR = 0.5 \times 3.5 = 1.75$ V. (Check: $\varepsilon - Ir = 2.0 - 0.5(0.5) = 1.75$ V. ✓)

Why other options are wrong:

- (B) 2.00 V is the emf, valid only for zero current (open circuit).
- (C) 0.25 V is the internal voltage drop Ir, not the terminal voltage.
- (D) 1.50 V uses a wrong current or drops the wrong resistance.

Final Answer: $V = 1.75$ V $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q14

Q15.

Solution

Concept — Force between parallel currents: Two long parallel wires a distance d apart exert a force per unit length $\frac{F}{\ell} = \frac{\mu_0 I_1 I_2}{2\pi d}$ (attractive for currents in the same direction).

Step 1 — Substitute: $I_1 = 3$ A, $I_2 = 4$ A, $d = 0.1$ m.

$$\frac{F}{\ell} = \frac{(4\pi \times 10^{-7})(3)(4)}{2\pi(0.1)} = \frac{(4\pi \times 10^{-7})(12)}{0.2\pi}.$$

Step 2 — Simplify: Cancel π: $\frac{4 \times 10^{-7} \times 12}{0.2} = \frac{48 \times 10^{-7}}{0.2} = 240 \times 10^{-7} = 2.4 \times 10^{-5}\ \mathrm{N\,m^{-1}}$.

Why other options are wrong:

- (A) $1.2 \times 10^{-5}\ \mathrm{N\,m^{-1}}$ halves the result (drops a factor of 2).
- (C) $4.8 \times 10^{-5}\ \mathrm{N\,m^{-1}}$ doubles it (forgets the 2π, keeps only π).
- (D) $1.2 \times 10^{-6}\ \mathrm{N\,m^{-1}}$ is a power-of-ten slip.

Final Answer: $\dfrac{F}{\ell} = 2.4 \times 10^{-5}\ \mathrm{N\,m^{-1}} \Rightarrow \boxed{\mathrm{B}}$

Answer: (B) Go Back to Q15

Q16.

Solution

Concept — Self-induced emf: An inductor opposes changes in current with $\varepsilon = -L\dfrac{dI}{dt}$; the magnitude is $|\varepsilon| = L\dfrac{\Delta I}{\Delta t}$.

Step 1 — Rate of change: $\dfrac{\Delta I}{\Delta t} = \dfrac{8-2}{0.1} = \dfrac{6}{0.1} = 60\ \mathrm{A\,s^{-1}}$.

Step 2 — emf: $|\varepsilon| = L\dfrac{\Delta I}{\Delta t} = 0.4 \times 60 = 24$ V.

Why other options are wrong:

- (A) 6 V uses ΔI alone without dividing by Δt then mis-scaling.
- (B) 12 V uses $\Delta I/\Delta t = 30$ (e.g. $\Delta I = 3$).
- (D) 2.4 V is a power-of-ten slip ($\Delta t = 1$ s).

Final Answer: $|\varepsilon| = 24$ V $\Rightarrow \boxed{\mathrm{C}}$

Answer: (C) Go Back to Q16

Q17.

Solution

Concept — Series RC impedance: For a resistor and capacitor in series, $Z = \sqrt{R^2 + X_C^2}$.

Step 1 — Substitute: $R = 30\,\Omega$, $X_C = 40\,\Omega$.

$$Z = \sqrt{30^2 + 40^2} = \sqrt{900 + 1600} = \sqrt{2500}.$$

Step 2 — Compute: $Z = 50\,\Omega$.

Why other options are wrong:

- (B) $70\,\Omega$ adds R and X_C directly (treats them as in phase).
- (C) $10\,\Omega$ subtracts them ($X_C - R$).
- (D) $35\,\Omega$ averages the two values.

Final Answer: $Z = 50\,\Omega \Rightarrow \boxed{\mathrm{A}}$

Answer: (A) Go Back to Q17

Q18.

Solution

Concept — Apparent depth: For near-normal viewing, apparent depth $= \dfrac{\text{real depth}}{n}$, where n is the refractive index of the medium.

Step 1 — Substitute: real depth $= 1.2$ m, $n = \frac{4}{3}$.

$$\text{apparent depth} = \frac{1.2}{4/3} = 1.2 \times \frac{3}{4} = 0.9 \text{ m}.$$

Why other options are wrong:

- (A) 1.6 m multiplies by n instead of dividing (would deepen the coin).
- (B) 1.2 m ignores refraction.
- (C) 0.4 m divides by 3 instead of by $4/3$.

Final Answer: apparent depth $= 0.9$ m $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q18

Q19.

Solution

Concept — Single-slit diffraction: The first minimum satisfies $a \sin\theta = \lambda$. For small angles, the distance on the screen is $y_1 = \dfrac{\lambda D}{a}$.

Step 1 — Substitute (SI units): $\lambda = 600 \times 10^{-9}$ m, $D = 1.5$ m, $a = 0.1 \times 10^{-3}$ m $= 1 \times 10^{-4}$ m.

$$y_1 = \frac{(600 \times 10^{-9})(1.5)}{1 \times 10^{-4}} = \frac{9 \times 10^{-7}}{1 \times 10^{-4}} = 9 \times 10^{-3} \text{ m}.$$

Step 2 — Convert: 9×10^{-3} m $= 9.0$ mm.

Why other options are wrong:

- (A) 4.5 mm uses $a = 0.2$ mm or halves y_1.
- (C) 18 mm doubles the result (e.g. uses $a = 0.05$ mm).
- (D) 4.5 cm is a power-of-ten slip in the slit width.

Final Answer: $y_1 = 9.0$ mm $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q19

Q20.

Solution

Concept — Binding energy and mass defect: The total binding energy is $BE = \Delta m\, c^2 = \Delta m \times 931$ MeV (with Δm in u). Divide by the nucleon number A for the per-nucleon value.

Step 1 — Total binding energy: $BE = 0.0304 \times 931 \approx 28.3$ MeV.

Step 2 — Per nucleon ($A = 4$): $\dfrac{BE}{A} = \dfrac{28.3}{4} \approx 7.1$ MeV.

Why other options are wrong:

- (A) 28.3 MeV is the *total* binding energy, not per nucleon.
- (B) 14.2 MeV divides by 2 (the proton number) instead of $A = 4$.
- (D) 3.5 MeV divides by 8 by mistake.

Final Answer: $\dfrac{BE}{A} \approx 7.1 \text{ MeV} \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q20

Answer Key

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