NEST Physics Sample Paper – 1

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. In an experiment to determine g using a simple pendulum, the length is measured as $L = (1.00 \pm 0.01)$ m and the time period as $T = (2.00 \pm 0.02)$ s. Using $g = \dfrac{4\pi^2 L}{T^2}$, the value of g with its absolute uncertainty is closest to

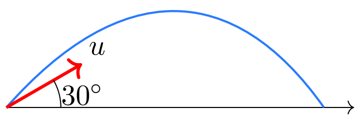
(A) $(9.87 \pm 0.10)\ \mathrm{m\,s^{-2}}$

(B) $(9.87 \pm 0.20)\ \mathrm{m\,s^{-2}}$

(C) $(9.87 \pm 0.30)\ \mathrm{m\,s^{-2}}$

(D) $(9.87 \pm 0.15)\ \mathrm{m\,s^{-2}}$

Q2. A ball is projected from the ground with speed $u = 20\ \mathrm{m\,s^{-1}}$ at 30° above the horizontal (take $g = 10\ \mathrm{m\,s^{-2}}$, neglect air resistance). Its horizontal range is



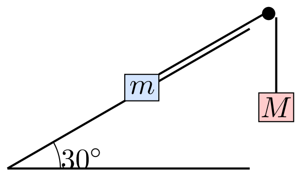
(A) 40 m

(B) $20\sqrt{3}$ m

(C) 20 m

(D) $10\sqrt{3}$ m

Q3. A block of mass $m = 2$ kg rests on a frictionless incline of angle $30°$. It is connected by a light inextensible string over a frictionless pulley to a hanging block of mass $M = 3$ kg, as shown. Take $g = 10$ m s^{-2}. The acceleration of the system is



(A) 4 m s^{-2}

(B) 6 m s^{-2}

(C) 2 m s^{-2}

(D) 5 m s^{-2}

Q4. A pump raises water from a well and ejects it horizontally at the top through a nozzle with speed 4 m s^{-1}. The water is lifted through a vertical height of 10 m and the delivery rate is 2 kg per second. Take $g = 10$ m s^{-2}. The minimum power of the pump is

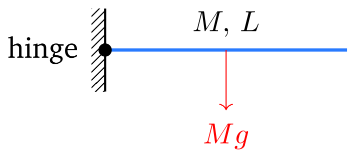
(A) 200 W

(B) 16 W

(C) 232 W

(D) 216 W

Q5. A uniform rod of mass M and length $L = 1.5$ m is hinged at one end and held horizontal, then released from rest. Take $g = 10\ \mathrm{m\,s^{-2}}$. The angular acceleration of the rod immediately after release is



(A) $10\ \mathrm{rad\,s^{-2}}$

(B) $6.7\ \mathrm{rad\,s^{-2}}$

(C) $15\ \mathrm{rad\,s^{-2}}$

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

Q6. A satellite of mass m moves in a circular orbit of radius $r = 2R$ about the Earth, where R is the Earth's radius, M its mass and G the gravitational constant. The total mechanical energy of the satellite is

(A) $-\dfrac{GMm}{2R}$

(B) $-\dfrac{GMm}{4R}$

(C) $-\dfrac{GMm}{8R}$

(D) $-\dfrac{GMm}{R}$

Q7. Water rises in a clean glass capillary tube of internal radius 0.2 mm. Take surface tension of water $T = 0.072\ \mathrm{N\,m^{-1}}$, contact angle 0°, density $\rho = 1000\ \mathrm{kg\,m^{-3}}$ and $g = 10\ \mathrm{m\,s^{-2}}$. The height of capillary rise is approximately

(A) 3.6 cm

(B) 0.72 cm

(C) 7.2 cm

(D) 14.4 cm

Q8. n moles of an ideal *monatomic* gas are heated at constant pressure so that the temperature rises by ΔT. The fraction of the supplied heat that is converted into work done by the gas is

(A) $\frac{2}{5}$

(B) $\frac{3}{5}$

(C) $\frac{2}{3}$

(D) 1

Q9. At the same temperature, the ratio of the root-mean-square speed of hydrogen molecules ($M = 2\ \mathrm{g\,mol^{-1}}$) to that of oxygen molecules ($M = 32\ \mathrm{g\,mol^{-1}}$) is

(A) 2

(B) 16

(C) $\frac{1}{4}$

(D) 4

Q10. A block of mass 0.5 kg is attached to a light spring of force constant $200\ \mathrm{N\,m^{-1}}$ on a smooth horizontal surface and set into simple harmonic motion. The time period of oscillation is

(A) $\frac{\pi}{20}$ s

(B) $\frac{\pi}{5}$ s

(C) $\frac{\pi}{10}$ s

(D) $\frac{2\pi}{5}$ s

Q11. A stretched string of length 1.0 m and linear mass density $0.01\ \mathrm{kg\,m^{-1}}$ is held under a tension of 100 N with both ends fixed. The fundamental frequency of transverse vibration of the string is

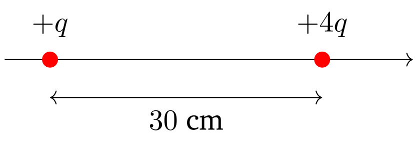
(A) 50 Hz

(B) 100 Hz

(C) 25 Hz

(D) 200 Hz

Q12. Two point charges $+q$ and $+4q$ are fixed on a straight line 30 cm apart, as shown. The point on the line joining them (other than at infinity) where the net electric field is zero lies at



(A) 20 cm from the $+q$ charge

(B) 15 cm from the $+q$ charge

(C) 10 cm from the $+4q$ charge

(D) 10 cm from the $+q$ charge

Q13. A $3\,\mu$F capacitor and a $6\,\mu$F capacitor are connected in series across an ideal 9 V battery. The potential difference across the $3\,\mu$F capacitor is

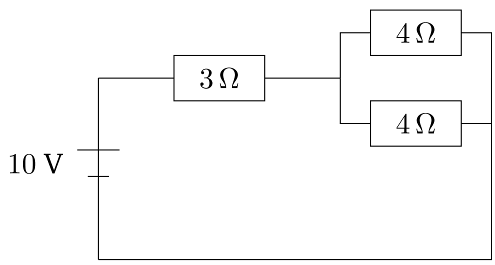
(A) 3 V

(B) 4.5 V

(C) 6 V

(D) 9 V

Q14. In the circuit shown, an ideal battery of emf 10 V drives current through a $3\,\Omega$ resistor in series with two $4\,\Omega$ resistors connected in parallel. The power dissipated in the $3\,\Omega$ resistor is



(A) 4 W

(B) 8 W

(C) 20 W

(D) 12 W

Q15. A flat circular coil of radius 0.1 m has 100 turns and carries a steady current of 2 A. The magnitude of the magnetic field at the centre of the coil is ($\mu_0 = 4\pi \times 10^{-7}\ \mathrm{T\,m\,A^{-1}}$)

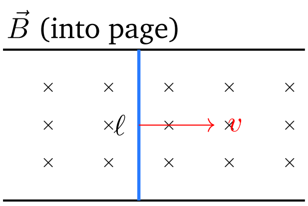
(A) $2\pi \times 10^{-4}$ T

(B) $4\pi \times 10^{-4}$ T

(C) $8\pi \times 10^{-4}$ T

(D) $\pi \times 10^{-4}$ T

Q16. A conducting rod of length $\ell = 0.5$ m slides at constant speed $v = 4\ \mathrm{m\,s^{-1}}$ on two parallel rails, perpendicular to a uniform magnetic field $B = 0.2$ T directed into the page, as shown. The magnitude of the motional emf induced across the rod is



(A) 0.2 V

(B) 0.4 V

(C) 0.8 V

(D) 1.0 V

Q17. A series LCR circuit has $L = 2$ H, $C = 8\,\mu$F and $R = 40\,\Omega$, and is driven by an AC source of rms voltage 200 V. At resonance, the rms current in the circuit is

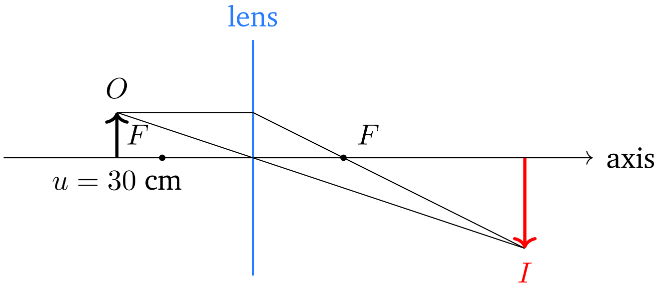
(A) 2.5 A

(B) 10 A

(C) 5 A

(D) 4 A

Q18. An object is placed 30 cm in front of a thin convex lens of focal length 20 cm. The image formed is



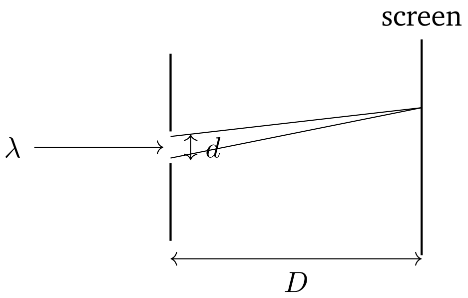
(A) real, inverted and at 60 cm from the lens

(B) virtual, erect and at 60 cm from the lens

(C) real, inverted and at 12 cm from the lens

(D) real, inverted and at 30 cm from the lens

Q19. In a Young's double-slit experiment, the slit separation is $d = 1$ mm and the screen is at a distance $D = 1$ m from the slits. Monochromatic light of wavelength $\lambda = 600$ nm is used. The fringe width (spacing between adjacent bright fringes) on the screen is



(A) 0.3 mm

(B) 0.6 mm

(C) 1.2 mm

(D) 6 mm

Q20. Light of wavelength 400 nm is incident on a metal surface of work function 2.0 eV. Take $hc = 1240$ eV·nm. The stopping potential for the emitted photoelectrons is

(A) 3.1 V

(B) 0.9 V

(C) 2.0 V

(D) 1.1 V

Detailed Solutions

Q1.

Solution

Concept — Propagation of errors: For a product/quotient $g = 4\pi^2 L T^{-2}$, fractional errors add, with each exponent acting as a multiplier on that term.

Step 1 — Central value: $g = \frac{4\pi^2(1.00)}{(2.00)^2} = \frac{4\pi^2}{4} = \pi^2 \approx 9.87\ \mathrm{m\,s^{-2}}$.

Step 2 — Fractional error: $\frac{\Delta g}{g} = \frac{\Delta L}{L} + 2\frac{\Delta T}{T} = \frac{0.01}{1.00} + 2 \cdot \frac{0.02}{2.00} = 0.01 + 0.02 = 0.03$ (i.e. 3%).

Step 3 — Absolute error: $\Delta g = 0.03 \times 9.87 \approx 0.30\ \mathrm{m\,s^{-2}}$.

Why other options are wrong:

- (A) 0.10 counts only the length error and forgets the factor of 2 on T.
- (B) 0.20 uses $2\times$(length error) only.
- (D) 0.15 mistakenly halves the time-error contribution.

Final Answer: $g = (9.87 \pm 0.30)\ \mathrm{m\,s^{-2}} \Rightarrow \boxed{\text{C}}$

Answer: (C) **Go Back to Q1**

Q2.

Solution

Concept — Projectile range: For a projectile launched with speed u at angle θ, the horizontal range is $R = \frac{u^2 \sin 2\theta}{g}$.

Step 1 — Substitute: $u = 20\ \mathrm{m\,s^{-1}}$, $\theta = 30^\circ$, so $2\theta = 60^\circ$ and $\sin 60^\circ = \frac{\sqrt{3}}{2}$.

Step 2 — Compute: $R = \frac{(20)^2 \cdot \frac{\sqrt{3}}{2}}{10} = \frac{400}{10} \cdot \frac{\sqrt{3}}{2} = 40 \cdot \frac{\sqrt{3}}{2} = 20\sqrt{3} \approx 34.6$ m.

Why other options are wrong:

- (A) 40 m uses $\sin 2\theta = 1$ (the 45° value).
- (C) 20 m drops the $\sin 60^\circ$ factor.
- (D) $10\sqrt{3}$ m mistakenly uses $\sin\theta$ instead of $\sin 2\theta$.

Final Answer: $R = 20\sqrt{3}$ m $\Rightarrow \boxed{\text{B}}$

Answer: (B) **Go Back to Q2**

Q3.

Solution

Concept — Connected bodies (Newton's second law): Treat the two masses as one system; the net driving force is the weight of the hanging block minus the gravity component of the incline block.

Step 1 — Net force: Hanging block pulls with $Mg = 3(10) = 30$ N. The incline component opposing motion is $mg \sin 30° = 2(10)(0.5) = 10$ N.

Step 2 — Acceleration:

$$a = \frac{Mg - mg\sin 30°}{M + m} = \frac{30 - 10}{3 + 2} = \frac{20}{5} = 4 \text{ m s}^{-2}.$$

(For completeness, the string tension is $T = M(g - a) = 3(6) = 18$ N.)

Why other options are wrong:

- (B) 6 uses $M + m = ...$ or omits the incline term incorrectly.
- (C) 2 divides the net force by 10 (sum of weights) rather than total mass.
- (D) 5 ignores the opposing $mg \sin 30°$ term $(30/(M + m))$.

Final Answer: $a = 4 \text{ m s}^{-2} \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q3

Q4.

Solution

Concept — Power as rate of energy delivery: The pump supplies both potential energy (to lift) and kinetic energy (to eject) per unit time.

Step 1 — Energy per unit mass: Each kilogram gains $gh + \frac{1}{2}v^2 = (10)(10) + \frac{1}{2}(4)^2 = 100 + 8 = 108$ J.

Step 2 — Multiply by mass rate: $P = \dot{m}\left(gh + \frac{1}{2}v^2\right) = 2 \times 108 = 216$ W.

Why other options are wrong:

- (A) 200 W keeps only the lifting (PE) term.
- (B) 16 W keeps only the kinetic term.
- (C) 232 W double-counts by adding $\frac{1}{2}v^2$ twice.

Final Answer: $P = 216 \text{ W} \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q4

Q5.

Solution

Concept — Rotation about a fixed axis: The torque of gravity about the hinge equals $I\alpha$, with gravity acting at the rod's centre of mass.

Step 1 — Torque: About the hinge, $\tau = Mg \cdot \frac{L}{2}$.

Step 2 — Moment of inertia: For a rod hinged at one end, $I = \frac{ML^2}{3}$.

Step 3 — Angular acceleration:

$$\alpha = \frac{\tau}{I} = \frac{MgL/2}{ML^2/3} = \frac{3g}{2L} = \frac{3(10)}{2(1.5)} = \frac{30}{3} = 10\ \text{rad s}^{-2}.$$

Why other options are wrong:

- (B) 6.7 uses $I = ML^2/2$ (a disc, not a rod).
- (C) 15 uses g/L without the geometric factor $3/2$.
- (D) 5 treats the rod as a point mass at its end ($I = ML^2$).

Final Answer: $\alpha = \frac{3g}{2L} = 10\ \text{rad s}^{-2} \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q5

Q6.

Solution

Concept — Energy of a circular orbit: For a bound circular orbit, $KE = \frac{GMm}{2r}$ and $PE = -\frac{GMm}{r}$, so the total energy is $E = -\frac{GMm}{2r}$.

Step 1 — Substitute $r = 2R$:

$$E = -\frac{GMm}{2r} = -\frac{GMm}{2(2R)} = -\frac{GMm}{4R}.$$

Why other options are wrong:

- (A) $-\frac{GMm}{2R}$ forgets to substitute $r = 2R$ (uses $r = R$).
- (C) $-\frac{GMm}{8R}$ uses $E = -\frac{GMm}{4r}$ by mistake.
- (D) $-\frac{GMm}{R}$ is the potential energy at $r = R$, not the orbital total energy.

Final Answer: $E = -\dfrac{GMm}{4R} \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q6

Q7.

Solution

Concept — Capillary rise: A liquid that wets the tube rises to height $h = \dfrac{2T\cos\theta}{\rho g r}$.

Step 1 — Substitute ($\theta = 0°$, so $\cos\theta = 1$):

$$h = \frac{2(0.072)}{(1000)(10)(0.2\times10^{-3})} = \frac{0.144}{2.0} = 0.072 \text{ m}.$$

Step 2 — Convert: 0.072 m $= 7.2$ cm.

Why other options are wrong:

- (A) 3.6 cm drops the factor 2 in the numerator.
- (B) 0.72 cm is a decimal-place slip.
- (D) 14.4 cm uses radius $= 0.1$ mm (or mistakes diameter for radius).

Final Answer: $h \approx 7.2$ cm $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q7

Q8.

Solution

Concept — First law at constant pressure: For an ideal gas $W = nR\Delta T$ (isobaric) and $Q = nC_P\Delta T$. For a monatomic gas $C_P = \frac{5}{2}R$.

Step 1 — Work and heat: $W = nR\Delta T$ and $Q = n\left(\frac{5}{2}R\right)\Delta T$.

Step 2 — Fraction:

$$\frac{W}{Q} = \frac{nR\Delta T}{n\left(\frac{5}{2}R\right)\Delta T} = \frac{2}{5}.$$

Why other options are wrong:

- (B) $\frac{3}{5}$ is the fraction going to internal energy ($\Delta U/Q$).
- (C) $\frac{2}{3}$ uses $C_P = \frac{3}{2}R$ (the C_V value).
- (D) 1 would require an isothermal process ($Q = W$).

Final Answer: $\dfrac{W}{Q} = \dfrac{2}{5} \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q8

Q9.

Solution

Concept — RMS speed: $v_{\text{rms}} = \sqrt{\dfrac{3RT}{M}}$, so at a fixed temperature $v_{\text{rms}} \propto \dfrac{1}{\sqrt{M}}$.

Step 1 — Ratio:

$$\frac{v_{H_2}}{v_{O_2}} = \sqrt{\frac{M_{O_2}}{M_{H_2}}} = \sqrt{\frac{32}{2}} = \sqrt{16} = 4.$$

Why other options are wrong:

- (A) 2 takes $\sqrt{M_{O_2}/M_{H_2}}$ without squaring inside, i.e. $\sqrt{4}$ from a wrong mass ratio.
- (B) 16 forgets the square root (M ratio itself).
- (C) $\frac{1}{4}$ inverts the ratio (heavier gas would then be faster — wrong).

Final Answer: $\dfrac{v_{H_2}}{v_{O_2}} = 4 \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q9

Q10.

Solution

Concept — SHM of a spring–mass system: Angular frequency $\omega = \sqrt{k/m}$ and period $T = \dfrac{2\pi}{\omega}$.

Step 1 — Angular frequency: $\omega = \sqrt{\dfrac{200}{0.5}} = \sqrt{400} = 20\ \text{rad s}^{-1}$.

Step 2 — Period: $T = \dfrac{2\pi}{20} = \dfrac{\pi}{10} \approx 0.314$ s.

Why other options are wrong:

- (A) $\pi/20$ comes from forgetting the factor of 2π (uses π/ω).
- (B) $\pi/5$ doubles the correct period.
- (D) $2\pi/5$ uses $\omega = 5\ \text{rad s}^{-1}$ (k/m not square-rooted correctly).

Final Answer: $T = \dfrac{\pi}{10}\ \text{s} \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q10

Q11.

Solution

Concept — Vibrating string: Wave speed $v = \sqrt{T/\mu}$; the fundamental frequency of a string fixed at both ends is $f_1 = \dfrac{v}{2L}$.

Step 1 — Wave speed: $v = \sqrt{\dfrac{100}{0.01}} = \sqrt{10000} = 100\ \mathrm{m\,s^{-1}}$.

Step 2 — Fundamental: $f_1 = \dfrac{v}{2L} = \dfrac{100}{2(1.0)} = 50$ Hz.

Why other options are wrong:

- (B) 100 Hz uses $f = v/L$ (an open-pipe type relation).
- (C) 25 Hz halves the fundamental.
- (D) 200 Hz mistakes v itself for the frequency.

Final Answer: $f_1 = 50$ Hz $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q11

Q12.

Solution

Concept — Null point of two like charges: Between two positive charges the fields oppose; the zero lies nearer the *smaller* charge.

Step 1 — Set fields equal: Let the point be at distance x from $+q$ (so $30 - x$ from $+4q$):

$$\frac{kq}{x^2} = \frac{k(4q)}{(30-x)^2} \quad \Rightarrow \quad (30-x)^2 = 4x^2.$$

Step 2 — Solve: $30 - x = 2x \Rightarrow 3x = 30 \Rightarrow x = 10$ cm. So the field is zero 10 cm from $+q$ (and 20 cm from $+4q$), lying between the charges.

Why other options are wrong:

- (A) 20 cm from $+q$ is the distance from the larger charge.
- (B) 15 cm is the midpoint, where the fields do *not* cancel.
- (C) "10 cm from $+4q$" places it nearer the larger charge — wrong side.

Final Answer: 10 cm from the $+q$ charge $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q12

Q13.

Solution

Concept — Capacitors in series: Series capacitors carry the *same* charge Q; the equivalent capacitance is $\frac{1}{C_{eq}} = \frac{1}{C_1} + \frac{1}{C_2}$.

Step 1 — Equivalent capacitance: $C_{eq} = \frac{C_1 C_2}{C_1 + C_2} = \frac{3 \times 6}{3+6} = 2\,\mu\text{F}$.

Step 2 — Common charge: $Q = C_{eq}V = 2\,\mu\text{F} \times 9\,\text{V} = 18\,\mu\text{C}$.

Step 3 — Voltage across the $3\,\mu$F: $V_3 = \frac{Q}{C_1} = \frac{18\,\mu\text{C}}{3\,\mu\text{F}} = 6\,\text{V}$. (Check: $V_6 = 18/6 = 3$ V, and $6 + 3 = 9$ V. ✓)

Why other options are wrong:

- (A) 3 V is the voltage across the $6\,\mu$F capacitor.
- (B) 4.5 V wrongly splits 9 V equally (valid only for equal capacitors).
- (D) 9 V puts the full battery voltage across one capacitor.

Final Answer: $V_3 = 6\text{ V} \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q13

Q14.

Solution

Concept — Series–parallel networks: Combine the parallel pair, add the series resistor, find the battery current, then $P = I^2R$ for the target resistor.

Step 1 — Equivalent resistance: Two $4\,\Omega$ in parallel give $\frac{4 \times 4}{4+4} = 2\,\Omega$. Total $R_{eq} = 3 + 2 = 5\,\Omega$.

Step 2 — Battery (and $3\,\Omega$) current: $I = \frac{10}{5} = 2$ A. This full current passes through the series $3\,\Omega$ resistor.

Step 3 — Power: $P_{3\Omega} = I^2R = (2)^2(3) = 12$ W.

Why other options are wrong:

- (A) 4 W uses a per-branch current (1 A) through $4\,\Omega$.
- (B) 8 W uses the parallel ($2\,\Omega$) value instead of $3\,\Omega$.

- (C) 20 W is the *total* power delivered by the battery ($\varepsilon I = 10 \times 2$).

Final Answer: $P_{3\Omega} = 12$ W $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q14

Q15.

Solution

Concept — Field at the centre of a coil: For a circular coil of N turns, radius R, carrying current I, the field at the centre is $B = \dfrac{\mu_0 N I}{2R}$.

Step 1 — Substitute:

$$B = \frac{(4\pi \times 10^{-7})(100)(2)}{2(0.1)} = \frac{(4\pi \times 10^{-7})(200)}{0.2}.$$

Step 2 — Simplify: $\dfrac{200}{0.2} = 1000$, so $B = (4\pi \times 10^{-7})(1000) = 4\pi \times 10^{-4}$ T $\approx 1.26 \times 10^{-3}$ T.

Why other options are wrong:

- (A) $2\pi \times 10^{-4}$ T mishandles the factor $2R$ in the denominator.
- (C) $8\pi \times 10^{-4}$ T forgets the 2 in the denominator.
- (D) $\pi \times 10^{-4}$ T divides by N instead of multiplying.

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

Answer: (B) Go Back to Q15

Q16.

Solution

Concept — Motional emf: A rod of length ℓ moving with speed v perpendicular to a field B develops an emf $\varepsilon = B\,\ell\,v$ (the rod sweeps area at rate ℓv, so $\varepsilon = B\,\dfrac{dA}{dt}$).

Step 1 — Substitute: $\varepsilon = B\,\ell\,v = (0.2)(0.5)(4)$.

Step 2 — Compute: $\varepsilon = 0.4$ V.

Why other options are wrong:

- (A) 0.2 V drops the length factor $\ell = 0.5$ m (uses Bv only, then halves).
- (C) 0.8 V uses $\ell = 1$ m.

- (D) 1.0 V multiplies the numbers without the $B = 0.2$ factor handled correctly.

Final Answer: $\varepsilon = 0.4$ V $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q16

Q17.

Solution

Concept — Series LCR at resonance: At resonance $X_L = X_C$, so the impedance is minimum and equal to R; the current is then $I = \frac{V}{R}$.

Step 1 — Verify resonance condition (optional): $\omega_0 = \frac{1}{\sqrt{LC}} = \frac{1}{\sqrt{(2)(8 \times 10^{-6})}} = 250 \text{ rad s}^{-1}$; at this ω, $Z = R$.

Step 2 — Current: $I_{\text{rms}} = \frac{V_{\text{rms}}}{R} = \frac{200}{40} = 5$ A.

Why other options are wrong:

- (A) 2.5 A uses $Z = 80\,\Omega$ (an off-resonance impedance).
- (B) 10 A uses $R = 20\,\Omega$.
- (D) 4 A uses $R = 50\,\Omega$.

Final Answer: $I_{\text{rms}} = 5$ A $\Rightarrow$ $\boxed{\text{C}}$

Answer: (C) Go Back to Q17

Q18.

Solution

Concept — Thin lens formula: $\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$ with sign convention; magnification $m = \frac{v}{u}$.

Step 1 — Apply formula: $u = -30$ cm, $f = +20$ cm.

$$\frac{1}{v} = \frac{1}{f} + \frac{1}{u} = \frac{1}{20} - \frac{1}{30} = \frac{3-2}{60} = \frac{1}{60} \Rightarrow v = +60 \text{ cm}.$$

Step 2 — Nature of image: $v > 0$ means a real image on the far side. $m = \frac{v}{u} =$

$\frac{60}{-30} = -2$: inverted and magnified two-fold. The object lies between F and $2F$, consistent with a real, magnified, inverted image beyond $2F$.

Why other options are wrong:

- (B) A convex lens with a real object here cannot give a virtual erect image (that needs the object inside F).
- (C) 12 cm comes from a sign error ($\frac{1}{v} = \frac{1}{20} + \frac{1}{30}$).
- (D) 30 cm would require $u = \infty$, incompatible with the data.

Final Answer: Real, inverted, 60 cm from the lens $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q18

Q19.

Solution

Concept — Young's double slit: Adjacent bright fringes are separated by the fringe width $\beta = \frac{\lambda D}{d}$.

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

$$\beta = \frac{(600 \times 10^{-9})(1)}{1 \times 10^{-3}} = 6 \times 10^{-4} \text{ m}.$$

Step 2 — Convert: 6×10^{-4} m $= 0.6$ mm.

Why other options are wrong:

- (A) 0.3 mm halves β (e.g. uses $d = 2$ mm).
- (C) 1.2 mm uses $d = 0.5$ mm.
- (D) 6 mm is a power-of-ten slip (λ taken as 6000 nm).

Final Answer: $\beta = 0.6$ mm $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q19

Q20.

Solution

Concept — Photoelectric effect: The maximum kinetic energy is $K_{\text{max}} = \dfrac{hc}{\lambda} - \phi$, and the stopping potential satisfies $eV_0 = K_{\text{max}}$.

Step 1 — Photon energy: $E = \dfrac{hc}{\lambda} = \dfrac{1240}{400} = 3.1$ eV.

Step 2 — Maximum KE: $K_{\text{max}} = 3.1 - 2.0 = 1.1$ eV.

Step 3 — Stopping potential: $V_0 = \dfrac{K_{\text{max}}}{e} = 1.1$ V (since K_{max} is expressed in eV).

Why other options are wrong:

- (A) 3.1 V uses the photon energy and ignores the work function.
- (B) 0.9 V mis-subtracts (e.g. $\phi - ...$).
- (C) 2.0 V is just the work function in volts.

Final Answer: $V_0 = 1.1 \text{ V} \Rightarrow \boxed{\text{D}}$

Answer: (D) **Go Back to Q20**

Answer Key

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