AME CET Physics

Sample Paper – 6

Duration: 20 Minutes **Maximum Marks: 80**

Instructions

- This paper contains **20** Multiple Choice Questions (Single Correct Answer), modelled on the Physics section of **AME CET** entrance.
- Each correct answer carries **+4 marks**. Each wrong answer carries -1 **mark**. Unattempted questions carry **0 marks**.
- Only **one** option is correct per question. Choose carefully.
- Syllabus level: **Class 11 and 12 NCERT Physics** (Units & Measurement to Communication Systems).
- Use of mobile phones, calculators, or any electronic gadget is strictly prohibited.

Q1. A resistance wire has resistance $R_0 = 10\,\Omega$ at $0°$C. The temperature coefficient of resistance is $\alpha = 5 \times 10^{-3}\,°\text{C}^{-1}$. What is its resistance at $100°$C?

(A) $10.5\,\Omega$

(B) $15\,\Omega$

(C) $20\,\Omega$

(D) $50\,\Omega$

Q2. A 100 W electric bulb is kept on for 10 hours. What is the electrical energy consumed?

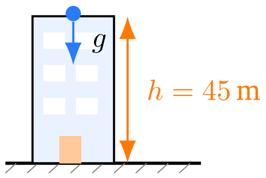
(A) $1000\,\text{J}$

(B) $360\,\text{J}$

(C) $3600\,\text{J}$

(D) $3.6 \times 10^6\,\text{J}$

Q3. A stone is dropped from rest from the top of a building of height $45\,\text{m}$ (see diagram). Taking $g = 10\,\text{m/s}^2$, how long does the stone take to reach the ground?



(A) $3\,\text{s}$

(B) $9\,\text{s}$

(C) $4.5\,\text{s}$

(D) $6\,\text{s}$

Q4. A car moving at $20\,\text{m/s}$ applies brakes and decelerates uniformly at $5\,\text{m/s}^2$. What is the distance covered before it comes to rest?

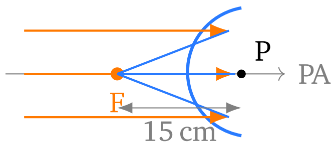
(A) $4\,\text{m}$

(B) $20\,\text{m}$

(C) $40\,\text{m}$

(D) $80\,\text{m}$

Q5. Parallel rays of light are incident on a concave mirror of focal length $f = 15\,\text{cm}$ (see diagram). After reflection, where do the rays converge?



(A) $30\,\text{cm}$ from the pole (centre of curvature)

(B) At the pole of the mirror

(C) At the mirror surface itself

(D) $15\,\text{cm}$ from the pole (focus)

Q6. A biconvex lens has radii of curvature $R_1 = R_2 = 20\,\text{cm}$ and refractive index $n = 1.5$. Using the Lensmaker's equation, what is the focal length of the lens?

(A) $10\,\text{cm}$

(B) $30\,\text{cm}$

(C) $20\,\text{cm}$

(D) $40\,\text{cm}$

Q7. In an AC generator, the maximum EMF is induced when the plane of the rotating coil is:

(A) Parallel to the magnetic field

(B) Perpendicular to the magnetic field

(C) At 45° to the magnetic field

(D) At 30° to the magnetic field

Q8. A capacitor of capacitance $C = 100\,\mu\text{F}$ is connected to an AC source of frequency $f = 50\,\text{Hz}$. What is the capacitive reactance X_C?

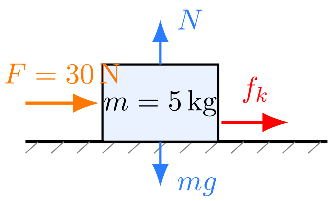
(A) $\dfrac{\pi}{100}\,\Omega$

(B) $\dfrac{100}{\pi}\,\Omega$

(C) $50\pi\,\Omega$

(D) $1000\,\Omega$

Q9. A block of mass $m = 5\,\text{kg}$ is pushed along a horizontal rough surface with a force $F = 30\,\text{N}$ (see diagram). The coefficient of kinetic friction is $\mu_k = 0.4$ and $g = 10\,\text{m/s}^2$. What is the acceleration of the block?



(A) $6\,\text{m/s}^2$

(B) $4\,\text{m/s}^2$

(C) $2\,\text{m/s}^2$

(D) $0.4\,\text{m/s}^2$

Q10. A ball of mass $m_1 = 0.5\,\text{kg}$ moving at $4\,\text{m/s}$ collides and sticks to a stationary ball of mass $m_2 = 1.5\,\text{kg}$ (perfectly inelastic collision). What is their common velocity after the collision?

(A) $1\,\text{m/s}$

(B) $2\,\text{m/s}$

(C) $4\,\text{m/s}$

(D) $0.5\,\text{m/s}$

Q11. Two parallel plates are connected to a voltage of $V = 100\,\text{V}$ and separated by a distance $d = 0.01\,\text{m}$. What is the magnitude of the uniform electric field between the plates?

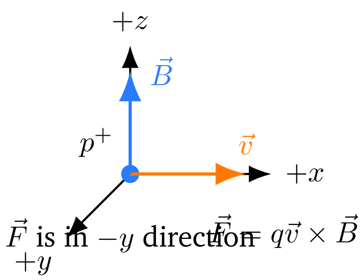
(A) $1\,\text{V/m}$

(B) $100\,\text{V/m}$

(C) $10^5\,\text{V/m}$

(D) $10^4\,\text{V/m}$

Q12. A proton moves with velocity $\vec{v}$ in the $+x$ direction and enters a magnetic field $\vec{B}$ directed in the $+z$ direction (see diagram). What is the direction of the magnetic force on the proton?



(A) $+x$ direction

(B) $-y$ direction

(C) $+y$ direction

(D) $+z$ direction

Q13. X-rays are produced by an X-ray tube operating at a potential difference of $25\,000$ V. Given $h = 6.6\times10^{-34}$ J·s, $c = 3\times10^{8}$ m/s, and $e = 1.6\times10^{-19}$ C, what is the minimum wavelength of the X-rays produced?

(A) $5\,\text{Å}$

(B) $50\,\text{Å}$

(C) $0.5\,\text{Å}$

(D) $5 \times 10^{-12}\,\text{m}$

Q14. Radon-222 ($^{222}_{86}$Rn) undergoes alpha (α) decay. What is the daughter nucleus produced?

(A) $^{218}_{84}$Po

(B) $^{222}_{87}$Fr

(C) $^{226}_{88}$Ra

(D) $^{218}_{83}$Bi

Q15. Which of the following statements correctly describes an adiabatic process?

(A) Temperature remains constant throughout the process

(B) Pressure remains constant throughout the process

(C) Volume remains constant throughout the process

(D) No heat is exchanged between the system and its surroundings

Q16. A particle executing simple harmonic motion has amplitude $A = 0.2\,\text{m}$ and angular frequency $\omega = 4\pi$ rad/s. What is its maximum speed?

(A) $0.8\,\text{m/s}$

(B) $0.8\pi\,\text{m/s}$

(C) $4\pi\,\text{m/s}$

(D) $2\pi\,\text{m/s}$

Q17. A flywheel has moment of inertia $I = 0.5\,\text{kg}\cdot\text{m}^2$. A net torque of $\tau = 2\,\text{N}\cdot\text{m}$ is applied to it. What is the angular acceleration of the flywheel?

(A) $1\,\text{rad/s}^2$

(B) $0.25\,\text{rad/s}^2$

(C) $2\,\text{rad/s}^2$

(D) $4\,\text{rad/s}^2$

Q18. A full-wave rectifier is connected to an AC supply of frequency $f = 50\,\text{Hz}$. What is the frequency of the rectified output?

(A) $25\,\text{Hz}$

(B) $50\,\text{Hz}$

(C) $100\,\text{Hz}$

(D) $150\,\text{Hz}$

Q19. Water rises in a capillary tube of radius $r = 0.5\,\text{mm} = 5 \times 10^{-4}\,\text{m}$. Given surface tension $T = 0.073\,\text{N/m}$, density of water $\rho = 1000\,\text{kg/m}^3$, and $g = 10\,\text{m/s}^2$, what is the height of water rise (contact angle $\theta \approx 0$)?

(A) $2.9\,\text{cm}$

(B) $5.8\,\text{cm}$

(C) $1.46\,\text{cm}$

(D) $14.6\,\text{cm}$

Q20. A satellite of mass $m = 200\,\text{kg}$ is lifted from Earth's surface to a height $h = R_E$ (equal to Earth's radius $R_E = 6.4 \times 10^6\,\text{m}$). Taking $g = 10\,\text{m/s}^2$, the minimum work done against gravity is $W = \frac{mgR_E}{2}$. What is this work?

(A) 3.2×10^9 J

(B) 6.4×10^9 J

(C) 1.28×10^{10} J

(D) 1.6×10^{10} J

Detailed Solutions

Q1.

Solution

Concept — Temperature Coefficient of Resistance: Resistance varies with temperature as $R_T = R_0(1 + \alpha\,\Delta T)$.

Step 1 — Temperature change:

$$\Delta T = 100 - 0 = 100°\text{C}$$

Step 2 — Substitute into the formula:

$$R_{100} = R_0\,(1 + \alpha\,\Delta T) = 10\,(1 + 5 \times 10^{-3} \times 100)$$

Step 3 — Simplify the bracket:

$$1 + 5 \times 10^{-3} \times 100 = 1 + 0.5 = 1.5$$

Step 4 — Final resistance:

$$R_{100} = 10 \times 1.5 = 15\,\Omega$$

Why other options are wrong:

- Option A ($10.5\,\Omega$): uses $\Delta T = 10°$C instead of $100°$C.
- Option C ($20\,\Omega$): doubles R_0 (uses $\alpha\Delta T = 1$ erroneously).
- Option D ($50\,\Omega$): misapplies α as a multiplier giving $R_0 \times \alpha \times 100/2$.

Final Answer: $R_{100} = 15\,\Omega \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q1

Q2.

Solution

Concept — Electrical Energy: Energy $=$ Power $\times$ Time. Time must be converted to seconds.

Step 1 — Convert time to seconds:

$$t = 10\,\text{h} \times 3600\,\text{s/h} = 36\,000\,\text{s}$$

Step 2 — Calculate energy in joules:

$$E = P \times t = 100\,\text{W} \times 36\,000\,\text{s} = 3\,600\,000\,\text{J}$$

Step 3 — Express in scientific notation:

$$E = 3.6 \times 10^6\,\text{J}$$

Why other options are wrong:

- Option A $(1000\,\text{J})$: uses $t = 10\,\text{s}$ (not converted to seconds properly).
- Option B $(360\,\text{J})$: uses $t = 3.6\,\text{s}$.
- Option C $(3600\,\text{J})$: uses $t = 36\,\text{s}$ (forgot to multiply hours by 1000).

Final Answer: $E = 3.6 \times 10^6\,\text{J} \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q2

Q3.

Solution

Concept — Free Fall: For a body dropped from rest: $h = \frac{1}{2} g\,t^2$.

Step 1 — Rearrange for time t:

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

Step 2 — Substitute values:

$$t = \sqrt{\frac{2 \times 45}{10}} = \sqrt{\frac{90}{10}} = \sqrt{9}$$

Step 3 — Evaluate:

$$t = \sqrt{9} = 3\,\text{s}$$

Why other options are wrong:

- Option B ($9\,\text{s}$): uses $t = h/g$ without the factor of 2.
- Option C ($4.5\,\text{s}$): uses $t = h/(g/2)$ without taking the square root.
- Option D ($6\,\text{s}$): uses $t = \sqrt{2h}$ without dividing by g.

Final Answer: $t = 3\,\text{s} \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q3

Q4.

Solution

Concept — Braking Distance: Use the kinematic equation $v^2 = u^2 - 2as$. For stopping, $v = 0$.

Step 1 — Set $v = 0$ and solve for s:

$$0 = u^2 - 2as \implies s = \frac{u^2}{2a}$$

Step 2 — Substitute values:

$$s = \frac{(20)^2}{2 \times 5} = \frac{400}{10}$$

Step 3 — Evaluate:

$$s = 40\,\text{m}$$

Why other options are wrong:

- Option A ($4\,\text{m}$): uses $s = u/a$ with extra division by 5.
- Option B ($20\,\text{m}$): uses $s = u^2/a$ without the factor of 2 in the denominator.
- Option D ($80\,\text{m}$): uses $s = u^2/a$ or doubles the correct answer.

Final Answer: $s = 40\,\text{m} \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q4

Q5.

Solution

Concept — Concave Mirror, Parallel Rays: Rays parallel to the principal axis, after reflection from a concave mirror, converge at the principal focus F at distance f in front of the pole.

Step 1 — Identify nature of rays: Parallel rays come from a very distant object ($u \to \infty$).

Step 2 — Apply mirror formula with $u \to \infty$:

$$\frac{1}{v} + \frac{1}{u} = \frac{1}{f} \implies \frac{1}{v} + 0 = \frac{1}{f} \implies v = f = 15\,\text{cm}$$

Step 3 — Location of convergence:

Rays converge at the focus, 15 cm from the pole.

Why other options are wrong:

- Option A (30 cm = centre of curvature): rays from C converge back at C, not parallel rays.
- Option B (pole): physically impossible; reflected rays cannot converge at the reflecting surface.
- Option C (mirror surface): also physically impossible.

Final Answer: Focus, 15 cm from the pole $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q5

Q6.

Solution

Concept — Lensmaker's Equation:

$$\frac{1}{f} = (n-1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

For a biconvex lens with both surfaces convex: $R_1 = +20\,\text{cm}$, $R_2 = -20\,\text{cm}$.

Step 1 — Substitute sign-convention values:

$$\frac{1}{f} = (1.5-1)\left(\frac{1}{20} - \frac{1}{-20}\right) = 0.5\left(\frac{1}{20} + \frac{1}{20}\right)$$

Step 2 — Simplify:

$$\frac{1}{f} = 0.5 \times \frac{2}{20} = 0.5 \times \frac{1}{10} = \frac{1}{20}$$

Step 3 — Invert to find f:

$$f = 20\,\text{cm}$$

Why other options are wrong:

- Option A ($10\,\text{cm}$): drops the factor $(n-1) = 0.5$.
- Option B ($30\,\text{cm}$): uses incorrect radius values.
- Option D ($40\,\text{cm}$): uses only one surface in the formula.

Final Answer: $f = 20\,\text{cm} \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q6

Q7.

Solution

Concept — AC Generator Maximum EMF: $\varepsilon = NBA\omega\sin(\omega t)$. EMF is maximum when $|\sin(\omega t)| = 1$.

Step 1 — Flux through the coil: $\Phi = NBA\cos\theta$, where θ is the angle between the *normal* to the coil and $\vec{B}$.

Step 2 — Rate of change (EMF):

$$\varepsilon = -\frac{d\Phi}{dt} = NBA\omega\sin(\omega t)$$

EMF is maximum when $\sin(\omega t) = 1$, i.e., when the *normal* to the coil is perpendicular to $\vec{B}$ (which means the *plane* of the coil is *parallel* to $\vec{B}$).

Step 3 — Conclusion:

$$\varepsilon_{\max} = NBA\omega \implies \text{plane of coil is parallel to } \vec{B}$$

Why other options are wrong:

- Option B (perpendicular): flux is maximum but its rate of change is zero, so EMF $= 0$.
- Option C ($45°$): gives $\varepsilon = \varepsilon_{\max}/\sqrt{2}$, not maximum.
- Option D ($30°$): gives $\varepsilon = \varepsilon_{\max}/2$, not maximum.

Final Answer: Plane parallel to magnetic field $\Rightarrow \boxed{A}$

Answer: (A) Go Back to Q7

Q8.

Solution

Concept — Capacitive Reactance: $X_C = \dfrac{1}{2\pi f C}$.

Step 1 — Substitute values:

$$X_C = \frac{1}{2\pi \times 50 \times 100 \times 10^{-6}}$$

Step 2 — Evaluate denominator:

$$2\pi \times 50 \times 100 \times 10^{-6} = 2\pi \times 5 \times 10^{-3} = 10^{-2}\pi$$

Step 3 — Evaluate X_C:

$$X_C = \frac{1}{10^{-2}\pi} = \frac{100}{\pi}\,\Omega \approx 31.8\,\Omega$$

Why other options are wrong:

- Option A $(\pi/100\,\Omega)$: is the reciprocal of the correct answer.
- Option C $(50\pi\,\Omega)$: omits C from the denominator.
- Option D $(1000\,\Omega)$: uses an incorrect formula.

Final Answer: $X_C = 100/\pi\,\Omega \Rightarrow \boxed{B}$

Answer: (B) Go Back to Q8

Q9.

Solution

Concept — Newton's Second Law with Kinetic Friction:

Step 1 — Normal force (horizontal surface):

$$N = mg = 5 \times 10 = 50\,\text{N}$$

Step 2 — Kinetic friction force:

$$f_k = \mu_k N = 0.4 \times 50 = 20\,\text{N}$$

Step 3 — Net horizontal force:

$$F_{\text{net}} = F - f_k = 30 - 20 = 10\,\text{N}$$

Step 4 — Apply Newton's second law:

$$a = \frac{F_{\text{net}}}{m} = \frac{10}{5} = 2\,\text{m/s}^2$$

Why other options are wrong:

- Option A ($6\,\text{m/s}^2$): ignores friction entirely ($a = F/m$).
- Option B ($4\,\text{m/s}^2$): uses $\mu_k = 0.2$ or incorrect normal force.
- Option D ($0.4\,\text{m/s}^2$): divides only friction force by m.

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

Answer: (C) Go Back to Q9

Q10.

Solution

Concept — Perfectly Inelastic Collision: Conservation of linear momentum: $m_1 u_1 = (m_1 + m_2)\, v$.

Step 1 — Initial momentum:

$$p_i = m_1 u_1 = 0.5 \times 4 = 2\,\text{kg·m/s}$$

Step 2 — Total mass after collision:

$$M = m_1 + m_2 = 0.5 + 1.5 = 2\,\text{kg}$$

Step 3 — Common velocity:

$$v = \frac{p_i}{M} = \frac{2}{2} = 1\,\text{m/s}$$

Why other options are wrong:

- Option B ($2\,\text{m/s}$): divides momentum by m_1 alone (ignores m_2).
- Option C ($4\,\text{m/s}$): is the initial velocity of m_1 before collision.
- Option D ($0.5\,\text{m/s}$): incorrectly halves the numerator.

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

Answer: (A) Go Back to Q10

Q11.

Solution

Concept — Electric Field Between Parallel Plates: For uniform field, $E = V/d$.

Step 1 — Substitute values:

$$E = \frac{V}{d} = \frac{100}{0.01}$$

Step 2 — Evaluate:

$$E = 100 \times 100 = 10\,000\,\text{V/m}$$

Step 3 — Scientific notation:

$$E = 10^4\,\text{V/m}$$

Why other options are wrong:

- Option A ($1\,\text{V/m}$): uses $E = V \times d$ (wrong formula).
- Option B ($100\,\text{V/m}$): uses $d = 1\,\text{m}$.
- Option C ($10^5\,\text{V/m}$): uses $d = 0.001\,\text{m}$.

Final Answer: $E = 10^4\,\text{V/m} \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q11

Q12.

Solution

Concept — Lorentz Force on a Moving Charge: $\vec{F} = q\,\vec{v} \times \vec{B}$.

Step 1 — Given vectors: $\vec{v} = v\,\hat{x}$, $\vec{B} = B\,\hat{z}$, $q = +e > 0$.

Step 2 — Compute cross product $\hat{x} \times \hat{z}$:

$$\hat{x} \times \hat{z} = -(\hat{z} \times \hat{x}) = -\hat{y}$$

(Using cyclic identity: $\hat{z} \times \hat{x} = \hat{y}$.)

Step 3 — Force direction:

$$\vec{F} = qvB(\hat{x} \times \hat{z}) = qvB(-\hat{y})$$

Since $q > 0$, $\vec{F}$ is in the $-y$ direction.

Why other options are wrong:

- Option A $(+x)$: force cannot be parallel to velocity in a magnetic field.
- Option C $(+y)$: sign error in the cross product.
- Option D $(+z)$: force cannot be along $\vec{B}$ (since $\vec{v} \times \vec{B} \perp \vec{B}$).

Final Answer: $\vec{F}$ is in the $-y$ direction $\Rightarrow \boxed{\text{B}}$

Answer: (B) **Go Back to Q12**

Q13.

Solution

Concept — Minimum Wavelength of X-rays (Duane–Hunt Limit):

$$\lambda_{\text{min}} = \frac{hc}{eV}$$

Step 1 — Numerator hc:

$$hc = 6.6 \times 10^{-34} \times 3 \times 10^{8} = 19.8 \times 10^{-26}\ \text{J·m}$$

Step 2 — Denominator eV:

$$eV = 1.6 \times 10^{-19} \times 25\,000 = 1.6 \times 10^{-19} \times 2.5 \times 10^{4} = 4.0 \times 10^{-15}\ \text{J}$$

Step 3 — Divide:

$$\lambda_{\min} = \frac{19.8 \times 10^{-26}}{4.0 \times 10^{-15}} = 4.95 \times 10^{-11}\,\text{m}$$

Step 4 — Convert to Å ($1\,\text{Å} = 10^{-10}$ m):

$$\lambda_{\min} = \frac{4.95 \times 10^{-11}}{10^{-10}}\,\text{Å} \approx 0.495\,\text{Å} \approx 0.5\,\text{Å}$$

Why other options are wrong:

- Option A ($5\,\text{Å}$): ten times too large.
- Option B ($50\,\text{Å}$): hundred times too large.
- Option D ($5 \times 10^{-12}\,\text{m} = 0.05\,\text{Å}$): ten times too small.

Final Answer: $\lambda_{\min} \approx 0.5\,\text{Å} \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q13

Q14.

Solution

Concept — Alpha Decay: In α decay, the parent emits ${}^{4}_{2}\text{He}$. Mass number decreases by 4, atomic number by 2.

Step 1 — Decay equation for ${}^{222}_{86}$Rn:

$${}^{222}_{86}\text{Rn} \longrightarrow {}^{A-4}_{Z-2}Y + {}^{4}_{2}\text{He}$$

Step 2 — Calculate daughter's mass and atomic numbers:

$$A_{\text{daughter}} = 222 - 4 = 218$$

$$Z_{\text{daughter}} = 86 - 2 = 84$$

Step 3 — Identify element with $Z = 84$: Polonium (Po).

$$\text{Daughter nucleus} = {}^{218}_{84}\text{Po}$$

Why other options are wrong:

- Option B (${}^{222}_{87}$Fr): mass unchanged, Z increases by 1 — that is β^- decay, not

α.

- Option C ($^{226}_{88}$Ra): is the *parent* of ^{222}Rn, not its daughter.
- Option D ($^{218}_{83}$Bi): uses $Z - 3$ instead of $Z - 2$.

Final Answer: $^{218}_{84}\text{Po} \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q14

Q15.

Solution

Concept — Adiabatic Process: An adiabatic process is one in which the system exchanges *no heat* with its surroundings, i.e., $Q = 0$.

Step 1 — First law of thermodynamics:

$$\Delta U = Q - W$$

Step 2 — For an adiabatic process, $Q = 0$:

$$\Delta U = -W$$

Internal energy changes at the expense of work done (or vice versa), but temperature, pressure, and volume can all change.

Step 3 — Conclusion:

$$\boxed{Q = 0 \text{ (no heat exchanged)}}$$

Why other options are wrong:

- Option A (temperature constant): describes an *isothermal* process ($\Delta T = 0$).
- Option B (pressure constant): describes an *isobaric* process ($\Delta P = 0$).
- Option C (volume constant): describes an *isochoric* process ($\Delta V = 0$).

Final Answer: No heat exchanged ($Q = 0$) $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q15

Q16.

Solution

Concept — SHM Maximum Speed: Speed is maximum at the equilibrium position: $v_{max} = A\omega$.

Step 1 — Identify given values:

$$A = 0.2\,\text{m}, \quad \omega = 4\pi\,\text{rad/s}$$

Step 2 — Substitute into the formula:

$$v_{max} = A\omega = 0.2 \times 4\pi$$

Step 3 — Multiply:

$$v_{max} = 0.8\pi\,\text{m/s} \approx 2.51\,\text{m/s}$$

Why other options are wrong:

- Option A ($0.8\,\text{m/s}$): omits π from ω (uses $\omega = 4$).
- Option C ($4\pi\,\text{m/s}$): forgets to multiply by A (uses $A = 1\,\text{m}$).
- Option D ($2\pi\,\text{m/s}$): uses $A = 0.5\,\text{m}$.

Final Answer: $v_{max} = 0.8\pi\,\text{m/s} \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q16

Q17.

Solution

Concept — Rotational Newton's Second Law: $\tau = I\alpha$, so $\alpha = \tau/I$.

Step 1 — Identify given values:

$$I = 0.5\,\text{kg·m}^2, \quad \tau = 2\,\text{N·m}$$

Step 2 — Substitute:

$$\alpha = \frac{\tau}{I} = \frac{2}{0.5}$$

Step 3 — Evaluate:

$$\alpha = 4\,\text{rad/s}^2$$

Why other options are wrong:

- Option A ($1\,\text{rad/s}^2$): uses $\alpha = \tau \times I = 2 \times 0.5 = 1$ (inverted formula).
- Option B ($0.25\,\text{rad/s}^2$): inverts both τ and I ($0.5/2$).
- Option C ($2\,\text{rad/s}^2$): uses $I = 1\,\text{kg·m}^2$ instead of 0.5.

Final Answer: $\alpha = 4\,\text{rad/s}^2 \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q17

Q18.

Solution

Concept — Full-Wave Rectifier Output Frequency: A full-wave rectifier converts both positive and negative half-cycles; the output pulsates twice per input cycle.

Step 1 — Input period:

$$T_{\text{in}} = \frac{1}{f_{\text{in}}} = \frac{1}{50} = 0.02\,\text{s}$$

Step 2 — Output period (half of input period):

$$T_{\text{out}} = \frac{T_{\text{in}}}{2} = \frac{0.02}{2} = 0.01\,\text{s}$$

Step 3 — Output frequency:

$$f_{\text{out}} = \frac{1}{T_{\text{out}}} = \frac{1}{0.01} = 100\,\text{Hz}$$

Why other options are wrong:

- Option A ($25\,\text{Hz}$): would be half the input frequency — no standard rectifier does this.
- Option B ($50\,\text{Hz}$): is the output frequency of a *half-wave* rectifier (only one half-cycle per input cycle).
- Option D ($150\,\text{Hz}$): has no physical basis for a standard full-wave rectifier.

Final Answer: $f_{\text{out}} = 100\,\text{Hz} \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q18

Q19.

Solution

Concept — Capillary Rise (Jurin's Law): $h = \dfrac{2T\cos\theta}{\rho g r}$.

Step 1 — With contact angle $\theta = 0$, $\cos\theta = 1$:

$$h = \frac{2T}{\rho g r}$$

Step 2 — Substitute values:

$$h = \frac{2 \times 0.073}{1000 \times 10 \times 5 \times 10^{-4}}$$

Step 3 — Numerator:

$$2 \times 0.073 = 0.146$$

Step 4 — Denominator:

$$1000 \times 10 \times 5 \times 10^{-4} = 10\,000 \times 5 \times 10^{-4} = 5$$

Step 5 — Divide:

$$h = \frac{0.146}{5} = 0.0292\,\text{m} = 2.92\,\text{cm} \approx 2.9\,\text{cm}$$

Why other options are wrong:

- Option B (5.8 cm): uses $r = 0.25$ mm (half the given radius).
- Option C (1.46 cm): uses $r = 1$ mm (double the given radius).
- Option D (14.6 cm): uses $r = 0.1$ mm.

Final Answer: $h \approx 2.9\,\text{cm} \Rightarrow \boxed{A}$

Answer: (A) **Go Back to Q19**

Q20.

Solution

Concept — Work to Lift Satellite to Height $h = R_E$: Using gravitational potential energy (not mgh approximation):

$$W = \frac{mgR_E\,h}{R_E + h}$$

With $h = R_E$: $W = \frac{mgR_E}{2}$.

Step 1 — Identify values:

$$m = 200\,\text{kg}, \quad g = 10\,\text{m/s}^2, \quad R_E = 6.4 \times 10^6\,\text{m}$$

Step 2 — Compute numerator mgR_E:

$$mgR_E = 200 \times 10 \times 6.4 \times 10^6 = 2000 \times 6.4 \times 10^6 = 12.8 \times 10^9\,\text{J}$$

Step 3 — Divide by 2:

$$W = \frac{12.8 \times 10^9}{2} = 6.4 \times 10^9\,\text{J}$$

Why other options are wrong:

- Option A (3.2×10^9 J): uses $h = R_E/2$ (not the height given).
- Option C (1.28×10^{10} J): uses $W = mgR_E$ without the factor of $\frac{1}{2}$.
- Option D (1.6×10^{10} J): doubles mgR_E erroneously.

Final Answer: $W = 6.4 \times 10^9\,\text{J} \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q20

Answer Key

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