AME CET Physics

Sample Paper – 2

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 15 V battery with negligible internal resistance is connected to a series combination of a 3 Ω and a 2 Ω resistor. The power dissipated in the 3 Ω resistor is:

(A) 9 W

(B) 27 W

(C) 45 W

(D) 54 W

Q2. A copper wire of length 4 m and cross-sectional area 2×10^{-6} m^2 has a resistivity of 1.7×10^{-8} Ω·m. The resistance of the wire is:

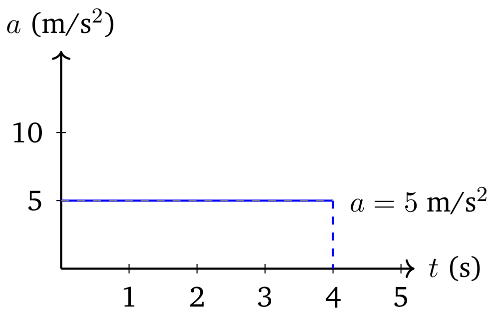
(A) $0.017\ \Omega$

(B) $0.068\ \Omega$

(C) $0.034\ \Omega$

(D) $0.085\ \Omega$

Q3. A particle starts from rest. Its acceleration–time graph is shown below. The velocity of the particle at $t = 4$ s is:



(A) 5 m/s

(B) 10 m/s

(C) 15 m/s

(D) 20 m/s

Q4. A ball is thrown vertically upward from the ground with a speed of 20 m/s. Taking $g = 10$ m/s^2, the maximum height reached by the ball is:

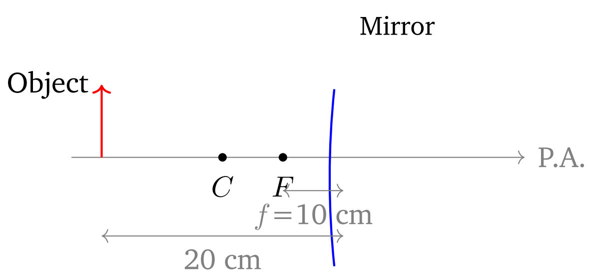
(A) 20 m

(B) 40 m

(C) 10 m

(D) 30 m

Q5. An object is placed 20 cm in front of a concave mirror of focal length 10 cm, as shown. The position of the image (measured from the mirror) is:



(A) 10 cm in front of the mirror

(B) 20 cm behind the mirror

(C) 20 cm in front of the mirror

(D) 40 cm in front of the mirror

Q6. Two thin convex lenses of focal lengths 25 cm and 50 cm are placed in contact coaxially. The power of the combination is:

(A) 1.5 D

(B) 6.0 D

(C) 4.0 D

(D) 2.0 D

Q7. A straight conductor of length 0.4 m moves with a velocity of 5 m/s perpendicular to a uniform magnetic field of 0.5 T. The magnitude of the motional EMF induced in the conductor is:

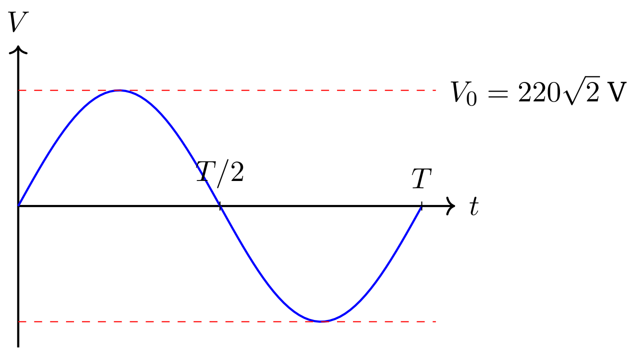
(A) 1.0 V

(B) 0.5 V

(C) 2.0 V

(D) 0.1 V

Q8. An AC voltage source produces the waveform shown below. The root mean square (r.m.s.) voltage of the source is:



(A) 440 V

(B) $110\sqrt{2}$ V

(C) 311 V

(D) 220 V

Q9. Two blocks of masses 5 kg and 3 kg are connected by a light inextensible string passing over a frictionless pulley. The acceleration of the system is: ($g = 10$ m/s^2)

(A) 5.0 m/s^2

(B) 10.0 m/s^2

(C) 2.5 m/s^2

(D) 1.0 m/s^2

Q10. A spring of force constant 200 N/m is compressed by 0.1 m from its natural length. The elastic potential energy stored in the spring is:

(A) 0.5 J

(B) 1.0 J

(C) 2.0 J

(D) 4.0 J

Q11. Two point charges, each of magnitude $4\ \mu$C, are placed 0.4 m apart in vacuum. The magnitude of the electrostatic force between them is: ($k = 9 \times 10^9$ N·m^2/C^2)

(A) 0.36 N

(B) 0.45 N

(C) 1.80 N

(D) 0.90 N

Q12. A circular coil of radius 0.1 m carries a current of 5 A. The magnitude of the magnetic field at the centre of the coil is: ($\mu_0 = 4\pi \times 10^{-7}$ T·m/A)

(A) $\pi \times 10^{-5}$ T

(B) $2\pi \times 10^{-5}$ T

(C) $\pi \times 10^{-6}$ T

(D) $2\pi \times 10^{-6}$ T

Q13. An electron is accelerated from rest through a potential difference of 100 V. The de Broglie wavelength of the electron is approximately: ($m_e = 9.1 \times 10^{-31}$ kg, $h = 6.6 \times 10^{-34}$ J·s, $e = 1.6 \times 10^{-19}$ C)

(A) 0.61 Å

(B) 1.22 Å

(C) 2.44 Å

(D) 0.30 Å

Q14. A radioactive element has a half-life of 20 days. The fraction of the original sample remaining after 60 days is:

(A) $1/4$

(B) $1/2$

(C) $1/8$

(D) $1/16$

Q15. An ideal gas absorbs 500 J of heat and does 200 J of work on its surroundings. The increase in internal energy of the gas is:

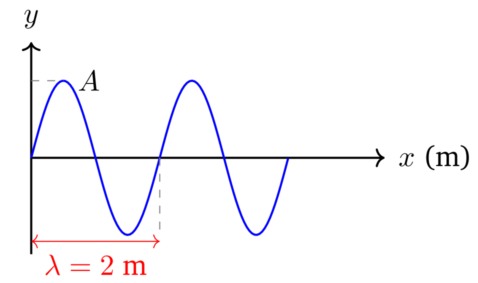
(A) 300 J

(B) 700 J

(C) 500 J

(D) 200 J

Q16. A transverse wave travelling along a string is shown below. The wave has a frequency of 5 Hz. The speed of the wave is:



(A) 2.5 m/s

(B) 5 m/s

(C) 2 m/s

(D) 10 m/s

Q17. A flywheel rotates at 300 revolutions per minute (rpm). The angular velocity of the flywheel in rad/s is:

(A) 300 rad/s

(B) 5π rad/s

(C) 10π rad/s

(D) 600π rad/s

Q18. A Zener diode is primarily used in electronic circuits as:

(A) An amplifier

(B) A voltage regulator

(C) A rectifier

(D) An oscillator

Q19. The excess pressure inside a soap bubble of radius 5 mm is: (surface tension of soap solution $T = 0.04$ N/m)

(A) 32 Pa

(B) 16 Pa

(C) 64 Pa

(D) 8 Pa

Q20. The escape velocity from the surface of the Earth is: ($g = 10$ m/s^2, $R = 6.4 \times 10^6$ m)

(A) 8.0 km/s

(B) 5.66 km/s

(C) 16.0 km/s

(D) 11.3 km/s

Detailed Solutions

Q1.

Solution

Concept — Power in a Resistor: When resistors are connected in series, the same current flows through all. Power dissipated in a resistor is $P = I^2R$.

Step 1 — Find the total resistance:

$$R_{total} = 3 + 2 = 5\ \Omega$$

Step 2 — Find the current using Ohm's law:

$$I = \frac{V}{R_{total}} = \frac{15}{5} = 3\ \text{A}$$

Step 3 — Power dissipated in the 3 Ω resistor:

$$P = I^2R = (3)^2 \times 3 = 9 \times 3 = 27\ \text{W}$$

Why other options are wrong:

- Option A (9 W): Uses $P = I^2R$ with $I = 1$ A (incorrect; current is 3 A, not 1 A).
- Option C (45 W): Uses power in the 5 Ω total combination, not the 3 Ω alone; $P_{total} = I^2 \times 5 = 45$ W.
- Option D (54 W): Uses $P = V^2/R = 225/5\times$ some error — no valid derivation gives 54 W.

Final Answer: $P = 27\ \text{W} \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q1

Q2.

Solution

Concept — Resistance from Resistivity: The resistance of a conductor is $R = \frac{\rho L}{A}$, where ρ is resistivity, L is length, and A is cross-sectional area.

Step 1 — Write down the given values:

$$\rho = 1.7 \times 10^{-8}\ \Omega \cdot \text{m}, \quad L = 4\ \text{m}, \quad A = 2 \times 10^{-6}\ \text{m}^2$$

Step 2 — Compute the numerator ρL:

$$\rho L = 1.7 \times 10^{-8} \times 4 = 6.8 \times 10^{-8}\ \Omega \cdot \text{m}^2$$

Step 3 — Divide by area A:

$$R = \frac{6.8 \times 10^{-8}}{2 \times 10^{-6}} = \frac{6.8}{2} \times 10^{-8+6} = 3.4 \times 10^{-2}\ \Omega = 0.034\ \Omega$$

Why other options are wrong:

- Option A (0.017 Ω): Halves the correct answer; arises from using $L = 2$ m instead of 4 m.
- Option B (0.068 Ω): Doubles the correct answer; perhaps from using $A = 1 \times 10^{-6}\ \text{m}^2$.
- Option D (0.085 Ω): Uses $\rho = 1.7 \times 10^{-8}$ but with $L/A = 5 \times 10^6$, which is not the case here.

Final Answer: $R = 0.034\ \Omega \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q2

Q3.

Solution

Concept — Velocity from Acceleration–Time Graph: For a particle starting from rest with constant acceleration a, the velocity at time t is $v = u + at = 0 + at = at$.

Step 1 — Read the constant acceleration from the graph:

$$a = 5\ \text{m/s}^2 \quad (\text{horizontal line at } a = 5 \text{ from } t = 0 \text{ to } t = 4\ \text{s})$$

Step 2 — Initial velocity:

$$u = 0 \quad \text{(starts from rest)}$$

Step 3 — Velocity at $t = 4$ s:

$$v = u + at = 0 + 5 \times 4 = 20 \text{ m/s}$$

Why other options are wrong:

- Option A (5 m/s): This is the value of the acceleration, not the velocity.
- Option B (10 m/s): Uses $v = at$ but with $t = 2$ s instead of 4 s.
- Option C (15 m/s): Uses $v = at$ but with $t = 3$ s instead of 4 s.

Final Answer: $v = 20$ m/s $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q3

Q4.

Solution

Concept — Vertical Throw Upward: At the highest point, velocity is zero. Using $v^2 = u^2 - 2gH$: with $v = 0$, the maximum height is $H = u^2/(2g)$.

Step 1 — Identify given values:

$$u = 20 \text{ m/s}, \quad g = 10 \text{ m/s}^2, \quad v = 0$$

Step 2 — Apply kinematic equation at maximum height:

$$0 = u^2 - 2gH \implies H = \frac{u^2}{2g}$$

Step 3 — Substitute and compute:

$$H = \frac{(20)^2}{2 \times 10} = \frac{400}{20} = 20 \text{ m}$$

Why other options are wrong:

- Option B (40 m): Uses $H = u^2/g$ (omits the factor of 2 in the denominator).
- Option C (10 m): Uses $H = u^2/(4g)$, which applies for $u = 14.1$ m/s, not 20 m/s.

- Option D (30 m): No standard kinematic equation yields 30 m for this problem.

Final Answer: $H = 20$ m $\Rightarrow \boxed{A}$

Answer: (A) Go Back to Q4

Q5.

Solution

Concept — Concave Mirror Formula: $\frac{1}{v} + \frac{1}{u} = \frac{1}{f}$. Using the sign convention (distances measured from the pole, in front is negative): $u = -20$ cm, $f = -10$ cm.

Step 1 — Apply the mirror formula:

$$\frac{1}{v} = \frac{1}{f} - \frac{1}{u} = \frac{1}{-10} - \frac{1}{-20} = -\frac{1}{10} + \frac{1}{20}$$

Step 2 — Find a common denominator:

$$\frac{1}{v} = \frac{-2+1}{20} = -\frac{1}{20}$$

Step 3 — Solve for v:

$$v = -20 \text{ cm}$$

The negative sign means the image is in front of the mirror (real image) at 20 cm.

Why other options are wrong:

- Option A (10 cm in front): Gives the focal length, not the image distance.
- Option B (20 cm behind): $v > 0$ would indicate a virtual image; here $v < 0$ (real image in front).
- Option D (40 cm in front): Would require the object at the focus, but $u = -20$ cm, not -10 cm.

Final Answer: Image is 20 cm in front of the mirror $\Rightarrow \boxed{C}$

Answer: (C) Go Back to Q5

Q6.

Solution

Concept — Power of Lens Combination: When two thin lenses are placed in contact, the equivalent power is $P = P_1 + P_2$, where power P (in dioptres) equals $1/f$ with f in metres.

Step 1 — Convert focal lengths to metres:

$$f_1 = 25 \text{ cm} = 0.25 \text{ m}, \quad f_2 = 50 \text{ cm} = 0.50 \text{ m}$$

Step 2 — Find individual powers:

$$P_1 = \frac{1}{0.25} = 4 \text{ D}, \quad P_2 = \frac{1}{0.50} = 2 \text{ D}$$

Step 3 — Add the powers:

$$P = P_1 + P_2 = 4 + 2 = 6 \text{ D}$$

Why other options are wrong:

- Option A (1.5 D): Computes $1/(f_1 + f_2)$, which is not the formula for combined power.
- Option C (4.0 D): Uses only P_1 (ignores the second lens).
- Option D (2.0 D): Uses only P_2 (ignores the first lens).

Final Answer: $P = 6.0 \text{ D} \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q6

Q7.

Solution

Concept — Motional EMF: When a conductor of length L moves with velocity v perpendicular to a magnetic field B, the motional EMF is $\varepsilon = BLv$.

Step 1 — Identify given values:

$$B = 0.5 \text{ T}, \quad L = 0.4 \text{ m}, \quad v = 5 \text{ m/s}, \quad \theta = 90^\circ$$

Step 2 — Apply the formula ($\theta = 90°$, so $\sin\theta = 1$):

$$\varepsilon = BLv\sin\theta = 0.5 \times 0.4 \times 5 \times 1$$

Step 3 — Compute:

$$\varepsilon = 0.5 \times 2.0 = 1.0 \text{ V}$$

Why other options are wrong:

- Option B (0.5 V): Uses $L = 0.2$ m or $v = 2.5$ m/s; both are incorrect substitutions.
- Option C (2.0 V): Doubles the correct answer; perhaps multiplied by 2 erroneously.
- Option D (0.1 V): Uses $\varepsilon = BL$ without multiplying by v.

Final Answer: $\varepsilon = 1.0 \text{ V} \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q7

Q8.

Solution

Concept — RMS Voltage of AC: The r.m.s. voltage is related to the peak voltage by $V_{rms} = V_0/\sqrt{2}$.

Step 1 — Identify the peak voltage from the graph:

$$V_0 = 220\sqrt{2} \text{ V}$$

Step 2 — Apply the r.m.s. formula:

$$V_{rms} = \frac{V_0}{\sqrt{2}} = \frac{220\sqrt{2}}{\sqrt{2}}$$

Step 3 — Simplify:

$$V_{rms} = 220 \text{ V}$$

Why other options are wrong:

- Option A (440 V): Uses $V_{rms} = 2V_0/\sqrt{2} = \sqrt{2}\,V_0$, which is incorrect.
- Option B ($110\sqrt{2}$ V): Divides the peak by 2 instead of $\sqrt{2}$.

- Option C (311 V): This is approximately the peak voltage $220\sqrt{2} \approx 311$ V — confused with V_{rms}.

Final Answer: $V_{rms} = 220$ V $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q8

Q9.

Solution

Concept — Atwood Machine: For two masses $m_1 > m_2$ connected over a frictionless pulley, the net downward force on the system is $(m_1 - m_2)g$ and the total mass is $(m_1 + m_2)$. By Newton's second law:

$$a = \frac{(m_1 - m_2)\,g}{m_1 + m_2}$$

Step 1 — Identify the masses:

$$m_1 = 5 \text{ kg}, \quad m_2 = 3 \text{ kg}, \quad g = 10 \text{ m/s}^2$$

Step 2 — Compute numerator and denominator:

$$(m_1 - m_2)g = (5 - 3) \times 10 = 2 \times 10 = 20 \text{ N}$$

$$m_1 + m_2 = 5 + 3 = 8 \text{ kg}$$

Step 3 — Find acceleration:

$$a = \frac{20}{8} = 2.5 \text{ m/s}^2$$

Why other options are wrong:

- Option A (5.0 m/s^2): Uses only the difference in masses without dividing by the total mass.
- Option B (10.0 m/s^2): This is g itself — treats only the heavier mass as the system.
- Option D (1.0 m/s^2): Divides $(m_1 - m_2)g$ by $m_1 \times m_2 = 15$, which is incorrect.

Final Answer: $a = 2.5$ m/s^2 $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q9

Q10.

Solution

Concept — Elastic Potential Energy of a Spring: The energy stored in a spring compressed or stretched by x from its natural length is $E = \frac{1}{2}kx^2$.

Step 1 — Identify given values:

$$k = 200 \text{ N/m}, \quad x = 0.1 \text{ m}$$

Step 2 — Apply the formula:

$$E = \frac{1}{2}kx^2 = \frac{1}{2} \times 200 \times (0.1)^2$$

Step 3 — Compute:

$$E = \frac{1}{2} \times 200 \times 0.01 = \frac{1}{2} \times 2 = 1.0 \text{ J}$$

Why other options are wrong:

- Option A (0.5 J): Omits the spring constant; uses $E = \frac{1}{2}x^2 = 0.005$ — then scaled by wrong factor.
- Option C (2.0 J): Omits the $\frac{1}{2}$ factor; uses $E = kx^2 = 200 \times 0.01 = 2$ J.
- Option D (4.0 J): Uses $E = kx^2$ with $x = 0.2$ m; both errors combined.

Final Answer: $E = 1.0 \text{ J} \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q10

Q11.

Solution

Concept — Coulomb's Law: $F = k\frac{q_1 q_2}{r^2}$, where $k = 9 \times 10^9$ N·m²/C².

Step 1 — Identify given values:

$$q_1 = q_2 = 4\ \mu\text{C} = 4 \times 10^{-6} \text{ C}, \quad r = 0.4 \text{ m}$$

Step 2 — Compute $q_1 q_2$:

$$q_1 q_2 = (4 \times 10^{-6})^2 = 16 \times 10^{-12} \text{ C}^2$$

Step 3 — Apply Coulomb's law:

$$F = 9 \times 10^9 \times \frac{16 \times 10^{-12}}{(0.4)^2} = 9 \times 10^9 \times \frac{16 \times 10^{-12}}{0.16}$$

Step 4 — Simplify:

$$F = 9 \times 10^9 \times 100 \times 10^{-12} = 9 \times 10^9 \times 10^{-10} = 0.9 \text{ N}$$

Why other options are wrong:

- Option A (0.36 N): Uses $r^2 = 0.16 \times \frac{16}{9}$; an arithmetic error in k.
- Option B (0.45 N): Halves the correct answer; may have used only one charge squared.
- Option C (1.80 N): Doubles the correct answer; perhaps used $r = 0.2$ m instead of 0.4 m.

Final Answer: $F = 0.9 \text{ N} \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q11

Q12.

Solution

Concept — Magnetic Field at the Centre of a Circular Loop: $B = \dfrac{\mu_0 I}{2r}$, where r is the radius of the loop.

Step 1 — Identify given values:

$$\mu_0 = 4\pi \times 10^{-7} \text{ T·m/A}, \quad I = 5 \text{ A}, \quad r = 0.1 \text{ m}$$

Step 2 — Apply the formula:

$$B = \frac{\mu_0 I}{2r} = \frac{4\pi \times 10^{-7} \times 5}{2 \times 0.1}$$

Step 3 — Simplify numerator and denominator:

$$B = \frac{20\pi \times 10^{-7}}{0.2} = 100\pi \times 10^{-7} = \pi \times 10^{-5} \text{ T}$$

Why other options are wrong:

- Option B ($2\pi \times 10^{-5}$ T): Doubles the correct value; arises from using $r = 0.05$ m.
- Option C ($\pi \times 10^{-6}$ T): Off by a factor of 10; arises from a powers-of-ten error.
- Option D ($2\pi \times 10^{-6}$ T): Off by a factor of 20; combines both above errors.

Final Answer: $B = \pi \times 10^{-5}$ T $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q12

Q13.

Solution

Concept — de Broglie Wavelength: $\lambda = \frac{h}{p} = \frac{h}{\sqrt{2mK}}$, where $K = eV$ is the kinetic energy gained by the electron.

Step 1 — Find the kinetic energy:

$$K = eV = 1.6 \times 10^{-19} \times 100 = 1.6 \times 10^{-17} \text{ J}$$

Step 2 — Find the momentum:

$$p = \sqrt{2mK} = \sqrt{2 \times 9.1 \times 10^{-31} \times 1.6 \times 10^{-17}}$$

$$= \sqrt{2.912 \times 10^{-47}} = \sqrt{29.12 \times 10^{-48}} \approx 5.40 \times 10^{-24} \text{ kg·m/s}$$

Step 3 — Find the de Broglie wavelength:

$$\lambda = \frac{h}{p} = \frac{6.6 \times 10^{-34}}{5.40 \times 10^{-24}} \approx 1.22 \times 10^{-10} \text{ m} = 1.22 \text{ Å}$$

Why other options are wrong:

- Option A (0.61 Å): Halves the correct answer; uses $V = 400$ V or doubles m.
- Option C (2.44 Å): Doubles the correct answer; uses $V = 25$ V instead of 100 V.
- Option D (0.30 Å): Corresponds to $V \approx 1600$ V, not 100 V.

Final Answer: $\lambda \approx 1.22$ Å$\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q13

Q14.

Solution

Concept — Radioactive Decay and Half-Life: After n half-lives, the remaining fraction is $(1/2)^n$, where $n = t/T_{1/2}$.

Step 1 — Find the number of half-lives:

$$n = \frac{t}{T_{1/2}} = \frac{60 \text{ days}}{20 \text{ days}} = 3$$

Step 2 — Compute the remaining fraction:

$$\frac{N}{N_0} = \left(\frac{1}{2}\right)^3 = \frac{1}{8}$$

Why other options are wrong:

- Option A $(1/4)$: Corresponds to $n = 2$ half-lives (40 days), not 60 days.
- Option B $(1/2)$: Corresponds to $n = 1$ half-life (20 days), not 60 days.
- Option D $(1/16)$: Corresponds to $n = 4$ half-lives (80 days), not 60 days.

Final Answer: Remaining fraction $= 1/8 \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q14

Q15.

Solution

Concept — First Law of Thermodynamics: $\Delta U = Q - W$, where Q is the heat absorbed by the system and W is the work done *by* the system on the surroundings.

Step 1 — Identify given values:

$$Q = +500 \text{ J (absorbed)}, \quad W = +200 \text{ J (done by gas)}$$

Step 2 — Apply the first law:

$$\Delta U = Q - W = 500 - 200 = 300 \text{ J}$$

Why other options are wrong:

- Option B (700 J): Uses $\Delta U = Q + W$ — adds instead of subtracts.

- Option C (500 J): Takes $\Delta U = Q$, ignoring the work done.
- Option D (200 J): Takes $\Delta U = W$, ignoring the heat absorbed.

Final Answer: $\Delta U = 300$ J $\Rightarrow \boxed{A}$

Answer: (A) Go Back to Q15

Q16.

Solution

Concept — Wave Speed: The speed of a wave is related to its frequency and wavelength by $v = f\lambda$.

Step 1 — Read wavelength from the graph:

$$\lambda = 2 \text{ m}$$

Step 2 — Given frequency:

$$f = 5 \text{ Hz}$$

Step 3 — Compute wave speed:

$$v = f\lambda = 5 \times 2 = 10 \text{ m/s}$$

Why other options are wrong:

- Option A (2.5 m/s): Divides f by λ instead of multiplying: $5/2 = 2.5$.
- Option B (5 m/s): Uses only the frequency value, ignoring the wavelength.
- Option C (2 m/s): Uses only the wavelength value, ignoring the frequency.

Final Answer: $v = 10$ m/s $\Rightarrow \boxed{D}$

Answer: (D) Go Back to Q16

Q17.

Solution

Concept — Conversion of rpm to rad/s: One revolution $= 2\pi$ radians; one minute $= 60$ seconds. So $\omega = N \times \frac{2\pi}{60}$ rad/s.

Step 1 — Write the conversion:

$$\omega = 300 \times \frac{2\pi}{60} \text{ rad/s}$$

Step 2 — Simplify:

$$\omega = \frac{300 \times 2\pi}{60} = \frac{600\pi}{60} = 10\pi \text{ rad/s}$$

Why other options are wrong:

- Option A (300 rad/s): Confuses rpm directly with rad/s — omits the $2\pi/60$ factor.
- Option B (5π rad/s): Uses $N/(2\pi) \times (2\pi/60) = N/60$, an incorrect formula giving 5 rad/s.
- Option D (600π rad/s): Multiplies by 2π but forgets to divide by 60.

Final Answer: $\omega = 10\pi$ rad/s $\Rightarrow$ $\boxed{\text{C}}$

Answer: (C) Go Back to Q17

Q18.

Solution

Concept — Zener Diode: A Zener diode is a specially designed p-n junction that operates in the reverse breakdown region at a precise voltage (the Zener voltage), maintaining a nearly constant output voltage despite variations in input voltage or load current.

Step 1 — Recall the operating principle: In the reverse-biased breakdown region, the Zener diode maintains a constant voltage V_Z across its terminals regardless of the current (within limits).

Step 2 — Identify the application: This property of maintaining a fixed reference voltage makes the Zener diode ideal as a **voltage regulator** in power supplies and reference circuits.

Why other options are wrong:

- Option A (Amplifier): Amplifiers use transistors (BJT or MOSFET); a Zener diode does not provide gain.
- Option C (Rectifier): Rectifiers use ordinary diodes in forward bias; a Zener operates in reverse breakdown.
- Option D (Oscillator): Oscillators require active gain elements; Zener diodes have no oscillating mechanism.

Final Answer: Zener diode $\rightarrow$ voltage regulator $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q18

Q19.

Solution

Concept — Excess Pressure in a Soap Bubble: A soap bubble has two surfaces (inner and outer), so the excess pressure inside is $\Delta P = \dfrac{4T}{r}$, where T is the surface tension and r is the radius.

Step 1 — Identify given values:

$$T = 0.04 \text{ N/m}, \quad r = 5 \text{ mm} = 5 \times 10^{-3} \text{ m}$$

Step 2 — Apply the formula:

$$\Delta P = \frac{4T}{r} = \frac{4 \times 0.04}{5 \times 10^{-3}}$$

Step 3 — Compute:

$$\Delta P = \frac{0.16}{5 \times 10^{-3}} = \frac{0.16}{0.005} = 32 \text{ Pa}$$

Why other options are wrong:

- Option B (16 Pa): Uses $\Delta P = 2T/r$ (formula for a spherical liquid drop, not a soap bubble — factor of 2 missing).
- Option C (64 Pa): Uses $r = 2.5$ mm or doubles the surface tension in error.
- Option D (8 Pa): Uses $\Delta P = T/r$ (omits both the factor of 4 and the two-surface correction).

Final Answer: $\Delta P = 32 \text{ Pa} \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q19

Q20.

Solution

Concept — Escape Velocity: The minimum speed needed to escape Earth's gravitational pull is $v_e = \sqrt{2gR}$, where g is surface gravity and R is Earth's radius.

Step 1 — Identify given values:

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

Step 2 — Apply the formula:

$$v_e = \sqrt{2gR} = \sqrt{2 \times 10 \times 6.4 \times 10^6} = \sqrt{1.28 \times 10^8}$$

Step 3 — Simplify:

$$v_e = \sqrt{128 \times 10^6} = 8\sqrt{2} \times 10^3 \approx 8 \times 1.414 \times 10^3 = 11.31 \times 10^3 \text{ m/s} \approx 11.3 \text{ km/s}$$

Why other options are wrong:

- Option A (8.0 km/s): The first cosmic velocity (orbital speed at Earth's surface), $v_1 = \sqrt{gR}$; escape velocity is $\sqrt{2}$ times larger.
- Option B (5.66 km/s): Orbital velocity at height $h = R$ (Paper 1, Q20); not escape velocity.
- Option C (16.0 km/s): Corresponds to $g = 20$ m/s^2, which is not the given value.

Final Answer: $v_e \approx 11.3$ km/s $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q20

Answer Key

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