AME CET Physics

Sample Paper – 12

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. In the network below, a $6\,\Omega$ resistor and a $3\,\Omega$ resistor are connected in parallel, and this combination is connected in series with a $4\,\Omega$ resistor. What is the total equivalent resistance between the terminals?

(A) $4\,\Omega$

(B) $6\,\Omega$

(C) $13\,\Omega$

(D) $2\,\Omega$

Q2. A battery of EMF $\varepsilon = 12\,\text{V}$ has an internal resistance $r = 3\,\Omega$. For maximum power transfer, a load resistance equal to r is connected. What is the maximum power delivered to the load?

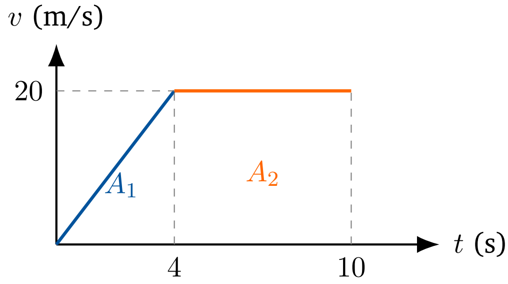
(A) $48\,\text{W}$

(B) $24\,\text{W}$

(C) $12\,\text{W}$

(D) 6 W

Q3. The velocity–time graph of a body is shown below. It accelerates uniformly from rest to $20\,\text{m/s}$ in $4\,\text{s}$, then moves at constant $20\,\text{m/s}$ for the next $6\,\text{s}$. What is the total distance travelled in these $10\,\text{s}$?



(A) $160\,\text{m}$

(B) $200\,\text{m}$

(C) $120\,\text{m}$

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

Q4. A ball is thrown vertically upward with an initial speed $u = 30\,\text{m/s}$. Taking $g = 10\,\text{m/s}^2$, what is the total time of flight (time taken to return to the point of throw)?

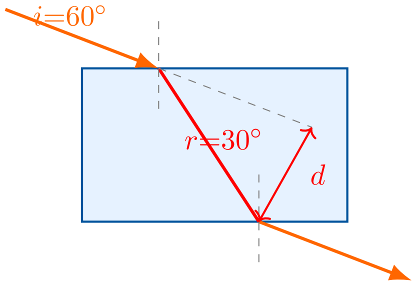
(A) $3\,\text{s}$

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

(C) $1.5\,\text{s}$

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

Q5. A ray of light is incident at $i = 60^\circ$ on a parallel-sided glass slab of thickness $t = 6\sqrt{3}\,\text{cm}$. Inside the slab the ray bends so that the angle of refraction is $r = 30^\circ$. What is the lateral shift d of the emergent ray? (Use $d = \dfrac{t\,\sin(i-r)}{\cos r}$.)



(A) 3 cm

(B) 6 cm

(C) 9 cm

(D) 12 cm

Q6. A coin lies at the bottom of a tank filled with water (refractive index $\mu = 4/3$) to a real depth of 1.2 m. When viewed from directly above, what is the apparent depth of the coin?

(A) 1.6 m

(B) 1.2 m

(C) 0.9 m

(D) 0.6 m

Q7. A long air-cored solenoid of length $l = 0.5$ m has $n = 2000$ turns per metre and cross-sectional area $A = 5 \times 10^{-4}$ m^2. Taking $\mu_0 = 4\pi \times 10^{-7}$ T·m/A, what is the self-inductance of the solenoid? (Use $L = \mu_0 n^2 A l$.)

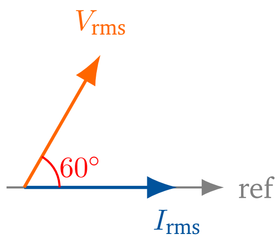
(A) 2.51×10^{-3} H

(B) 5.03×10^{-3} H

(C) 1.26×10^{-4} H

(D) 1.26×10^{-3} H

Q8. In an AC circuit the rms voltage is $V_{rms} = 200$ V and the rms current is $I_{rms} = 5$ A. The phase angle between voltage and current is $\phi = 60°$. What is the average power dissipated? (Use $P = V_{rms} I_{rms} \cos\phi$.)



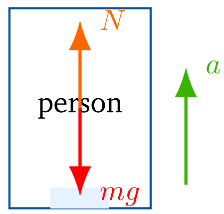
(A) 500 W

(B) 1000 W

(C) 866 W

(D) 250 W

Q9. A person of mass $m = 60\,\text{kg}$ stands on a weighing scale inside a lift that accelerates **upward** at $a = 2\,\text{m/s}^2$. Taking $g = 10\,\text{m/s}^2$, what is the apparent weight (normal reaction) recorded by the scale?



(A) 600 N

(B) 720 N

(C) 480 N

(D) 120 N

Q10. A truck moves at a constant speed of 15 m/s along a level road against a total resistive force of 1200 N. What is the instantaneous power delivered by the engine? (Use $P = Fv$.)

(A) 80 W

(B) 1215 W

(C) 9000 W

(D) 18000 W

Q11. A parallel-plate capacitor has plate area $A = 2 \times 10^{-2}\,\text{m}^2$ and plate separation $d = 1\,\text{mm}$, with air (vacuum) between the plates. Taking $\varepsilon_0 = 8.85 \times 10^{-12}\,\text{F/m}$, what is its capacitance? (Use $C = \varepsilon_0 A/d$.)

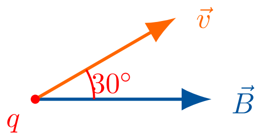
(A) $1.77 \times 10^{-10}\,\text{F}$

(B) $1.77 \times 10^{-13}\,\text{F}$

(C) $8.85 \times 10^{-12}\,\text{F}$

(D) $1.77 \times 10^{-7}\,\text{F}$

Q12. A charge $q = 2 \times 10^{-3}\,\text{C}$ moves with speed $v = 4 \times 10^{4}\,\text{m/s}$, making an angle $\theta = 30^\circ$ with a uniform magnetic field $B = 0.5\,\text{T}$. What is the magnitude of the magnetic force on the charge? (Use $F = qvB\sin\theta$.)



(A) $80\,\text{N}$

(B) $69.3\,\text{N}$

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

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

Q13. A proton (mass $m = 1.6\times10^{-27}\,\text{kg}$, charge $q = 1.6\times10^{-19}\,\text{C}$) is accelerated from rest through a potential difference $V = 200\,\text{V}$. Taking $h = 6.6 \times 10^{-34}\,\text{J·s}$, what is its de Broglie wavelength? (Use $\lambda = h/\sqrt{2mqV}$.)

(A) $1.0 \times 10^{-11}\,\text{m}$

(B) $2.06 \times 10^{-12}\,\text{m}$

(C) $2.06 \times 10^{-10}\,\text{m}$

(D) $6.6 \times 10^{-13}\,\text{m}$

Q14. A radioactive sample initially contains $N_0 = 6.4 \times 10^{20}$ nuclei. The half-life of the substance is 5 years. How many nuclei remain undecayed after 20 years?

(A) 1.6×10^{20}

(B) 3.2×10^{20}

(C) 8.0×10^{19}

(D) 4.0×10^{19}

Q15. A fixed mass of gas at constant temperature occupies a volume $V_1 = 4\,\text{L}$ at pressure $P_1 = 3 \times 10^5\,\text{Pa}$. The pressure is increased isothermally to $P_2 = 6 \times 10^5\,\text{Pa}$. What is the new volume V_2? (Use Boyle's law $P_1V_1 = P_2V_2$.)

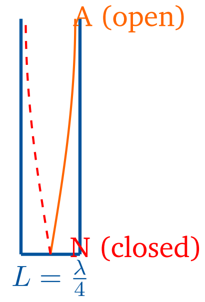
(A) $8\,\text{L}$

(B) $4\,\text{L}$

(C) $2\,\text{L}$

(D) $1\,\text{L}$

Q16. A pipe closed at one end has length $L = 0.25\,\text{m}$. The speed of sound in air is $v = 340\,\text{m/s}$. What is the fundamental frequency of the air column? (Use $f = v/4L$.)



(A) $1360\,\text{Hz}$

(B) $170\,\text{Hz}$

(C) $680\,\text{Hz}$

(D) $340\,\text{Hz}$

Q17. A uniform disc of mass $M = 4\,\text{kg}$ and radius $R = 0.5\,\text{m}$ is free to rotate about its central axis. What torque is required to give it an angular acceleration of $\alpha = 6\,\text{rad/s}^2$? (For a disc $I = \frac{1}{2}MR^2$.)

(A) $6\,\text{N}\cdot\text{m}$

(B) $3\,\text{N}\cdot\text{m}$

(C) $12\,\text{N}\cdot\text{m}$

(D) $1.5\,\text{N}\cdot\text{m}$

Q18. In a common-emitter transistor configuration, the collector current is $I_C = 4.95\,\text{mA}$ and the base current is $I_B = 50\,\mu\text{A}$. What is the current gain β? (Use $\beta = I_C/I_B$.)

(A) 0.99

(B) 50

(C) 99

(D) 100

Q19. A stretched wire has a tensile stress of 2×10^8 Pa and a strain of 1×10^{-3}. What is the elastic potential energy stored per unit volume of the wire? (Use $u = \frac{1}{2}\times$ stress $\times$ strain.)

(A) $1\times10^5\,\text{J/m}^3$

(B) $2\times10^5\,\text{J/m}^3$

(C) $1\times10^8\,\text{J/m}^3$

(D) $2\times10^8\,\text{J/m}^3$

Q20. For a satellite in a low circular orbit close to a planet's surface, the orbital velocity is $v_{\text{orb}} = 8\,\text{km/s}$. The escape velocity from the same surface is $v_{\text{esc}} = \sqrt{2}\,v_{\text{orb}}$. What is the escape velocity (rounded), and what is the ratio $v_{\text{esc}}/v_{\text{orb}}$?

(A) $8\,\text{km/s},\ \text{ratio} = 1$

(B) $16\,\text{km/s},\ \text{ratio} = 2$

(C) $11.3\,\text{km/s},\ \text{ratio} = \sqrt{2}$

(D) $5.7\,\text{km/s},\ \text{ratio} = 1/\sqrt{2}$

Detailed Solutions

Q1.

Solution

Concept — Mixed Network: First reduce the parallel pair, then add the series resistor.

Step 1 — Parallel combination of $6\,\Omega$ and $3\,\Omega$:

$$\frac{1}{R_p} = \frac{1}{6} + \frac{1}{3} = \frac{1}{6} + \frac{2}{6} = \frac{3}{6} = \frac{1}{2}$$

Step 2 — Invert:

$$R_p = 2\,\Omega$$

Step 3 — Add the series $4\,\Omega$:

$$R_{\text{total}} = R_p + 4 = 2 + 4 = 6\,\Omega$$

Why other options are wrong:

- Option A ($4\,\Omega$): counts only the series resistor.
- Option C ($13\,\Omega$): adds all three in series ($6 + 3 + 4$).
- Option D ($2\,\Omega$): gives only the parallel part, ignoring the series $4\,\Omega$.

Final Answer: $R_{\text{total}} = 6\,\Omega \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q1

Q2.

Solution

Concept — Maximum Power Transfer: Power is maximum when load $R = r$. Then $P_{\max} = \dfrac{\varepsilon^2}{4r}$.

Step 1 — Current at $R = r$:

$$I = \frac{\varepsilon}{R + r} = \frac{12}{3 + 3} = \frac{12}{6} = 2\,\text{A}$$

Step 2 — Power in the load:

$$P_{\max} = I^2 R = (2)^2 \times 3 = 4 \times 3 = 12\,\text{W}$$

Step 3 — Check with formula:

$$P_{\max} = \frac{\varepsilon^2}{4r} = \frac{144}{12} = 12\,\text{W}$$

Why other options are wrong:

- Option A (48 W): uses $\varepsilon^2/r = 144/3$ (no factor 4).
- Option B (24 W): uses $\varepsilon^2/(2r)$.
- Option D (6 W): halves the correct result.

Final Answer: $P_{\max} = 12$ W $\Rightarrow$ $\boxed{\text{C}}$

Answer: (C) Go Back to Q2

Q3.

Solution

Concept — Distance from a v–t Graph: Total distance = area under the graph = triangle (acceleration phase) + rectangle (constant phase).

Step 1 — Area of the triangle (0 to 4 s):

$$A_1 = \frac{1}{2} \times \text{base} \times \text{height} = \frac{1}{2} \times 4 \times 20 = 40\,\text{m}$$

Step 2 — Area of the rectangle (4 s to 10 s):

$$A_2 = \text{base} \times \text{height} = 6 \times 20 = 120\,\text{m}$$

Step 3 — Total distance:

$$s = A_1 + A_2 = 40 + 120 = 160\,\text{m}$$

Why other options are wrong:

- Option B (200 m): treats the whole 10 s at constant 20 m/s.
- Option C (120 m): counts only the constant-velocity part.
- Option D (40 m): counts only the acceleration triangle.

Final Answer: $s = 160$ m $\Rightarrow$ $\boxed{\text{A}}$

Answer: (A) Go Back to Q3

Q4.

Solution

Concept — Time of Flight (Vertical Throw): The time to rise equals the time to fall, so total $T = 2u/g$.

Step 1 — Time to reach the top:

$$t_{\text{up}} = \frac{u}{g} = \frac{30}{10} = 3\,\text{s}$$

Step 2 — Total time of flight:

$$T = 2\,t_{\text{up}} = 2 \times 3 = 6\,\text{s}$$

Why other options are wrong:

- Option A (3 s): only the upward time, not the round trip.
- Option B (9 s): uses $T = 3u/g$.
- Option C (1.5 s): uses $T = u/(2g)$.

Final Answer: $T = 6$ s $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q4

Q5.

Solution

Concept — Lateral Shift in a Slab: $d = \dfrac{t\,\sin(i - r)}{\cos r}$.

Step 1 — Angle difference:

$$i - r = 60^\circ - 30^\circ = 30^\circ, \quad \sin 30^\circ = \frac{1}{2}$$

Step 2 — $\cos r$:

$$\cos 30^\circ = \frac{\sqrt{3}}{2}$$

Step 3 — Substitute ($t = 6\sqrt{3}$ cm):

$$d = \frac{6\sqrt{3} \times \frac{1}{2}}{\frac{\sqrt{3}}{2}} = \frac{3\sqrt{3}}{\frac{\sqrt{3}}{2}} = 3\sqrt{3} \times \frac{2}{\sqrt{3}} = 6\,\text{cm}$$

Why other options are wrong:

- Option A (3 cm): forgets to divide by $\cos r$.
- Option C (9 cm): uses $\sin(i+r)$ instead of $\sin(i-r)$.
- Option D (12 cm): doubles the correct shift.

Final Answer: $d = 6\text{ cm} \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q5

Q6.

Solution

Concept — Apparent Depth: apparent depth $= \dfrac{\text{real depth}}{\mu}$.

Step 1 — Substitute:

$$d_{\text{app}} = \frac{1.2}{4/3} = 1.2 \times \frac{3}{4}$$

Step 2 — Evaluate:

$$d_{\text{app}} = \frac{3.6}{4} = 0.9\,\text{m}$$

Why other options are wrong:

- Option A (1.6 m): multiplies by μ instead of dividing.
- Option B (1.2 m): leaves depth unchanged ($\mu = 1$).
- Option D (0.6 m): uses $\mu = 2$.

Final Answer: $d_{\text{app}} = 0.9\text{ m} \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q6

Q7.

Solution

Concept — Solenoid Self-Inductance: $L = \mu_0 n^2 A l$.

Step 1 — Square the turn density:

$$n^2 = (2000)^2 = 4 \times 10^6\,\text{m}^{-2}$$

Step 2 — Multiply $\mu_0 n^2$:

$$\mu_0 n^2 = 4\pi \times 10^{-7} \times 4 \times 10^6 = 16\pi \times 10^{-1} = 1.6\pi$$

Step 3 — Multiply by A and l:

$$L = 1.6\pi \times (5 \times 10^{-4}) \times 0.5 = 1.6\pi \times 2.5 \times 10^{-4}$$

Step 4 — Evaluate:

$$L = 4\pi \times 10^{-4} = 12.566 \times 10^{-4} = 1.26 \times 10^{-3}\,\text{H}$$

Why other options are wrong:

- Option A (2.51×10^{-3} H): uses $l = 1$ m.
- Option B (5.03×10^{-3} H): omits the factor $l = 0.5$ (and area scaling).
- Option C (1.26×10^{-4} H): uses n instead of n^2 scaling error.

Final Answer: $L = 1.26 \times 10^{-3}$ H $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q7

Q8.

Solution

Concept — Average AC Power: $P = V_{\text{rms}} I_{\text{rms}} \cos\phi$.

Step 1 — Apparent power:

$$V_{\text{rms}} I_{\text{rms}} = 200 \times 5 = 1000\,\text{VA}$$

Step 2 — Power factor:

$$\cos 60^\circ = 0.5$$

Step 3 — Average power:

$$P = 1000 \times 0.5 = 500\,\text{W}$$

Why other options are wrong:

- Option B (1000 W): forgets the power factor ($\cos\phi = 1$).

- Option C (866 W): uses $\cos 30^\circ = 0.866$.
- Option D (250 W): uses $\cos\phi = 0.25$.

Final Answer: $P = 500 \text{ W} \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q8

Q9.

Solution

Concept — Apparent Weight in a Lift: For upward acceleration, $N = m(g + a)$.

Step 1 — Effective acceleration:

$$g + a = 10 + 2 = 12\,\text{m/s}^2$$

Step 2 — Normal reaction:

$$N = m(g + a) = 60 \times 12 = 720\,\text{N}$$

Why other options are wrong:

- Option A (600 N): the true weight mg (lift not accelerating).
- Option C (480 N): uses $m(g - a)$ for downward acceleration.
- Option D (120 N): computes only ma.

Final Answer: $N = 720 \text{ N} \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q9

Q10.

Solution

Concept — Instantaneous Power: At constant speed the engine force equals the resistive force, so $P = Fv$.

Step 1 — Identify quantities:

$$F = 1200\,\text{N}, \quad v = 15\,\text{m/s}$$

Step 2 — Multiply:

$$P = Fv = 1200 \times 15 = 18000\,\text{W} = 18\,\text{kW}$$

Why other options are wrong:

- Option A (80 W): divides F by v instead of multiplying.
- Option B (1215 W): adds $F + v$.
- Option C (9000 W): uses $v = 7.5$ m/s.

Final Answer: $P = 18000$ W $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q10

Q11.

Solution

Concept — Parallel-Plate Capacitance: $C = \dfrac{\varepsilon_0 A}{d}$.

Step 1 — Convert separation:

$$d = 1\,\text{mm} = 1 \times 10^{-3}\,\text{m}$$

Step 2 — Numerator $\varepsilon_0 A$:

$$\varepsilon_0 A = 8.85 \times 10^{-12} \times 2 \times 10^{-2} = 1.77 \times 10^{-13}$$

Step 3 — Divide by d:

$$C = \frac{1.77 \times 10^{-13}}{1 \times 10^{-3}} = 1.77 \times 10^{-10}\,\text{F}$$

Why other options are wrong:

- Option B (1.77×10^{-13} F): is $\varepsilon_0 A$ before dividing by d.
- Option C (8.85×10^{-12} F): uses $A = 1$, $d = 1$.
- Option D (1.77×10^{-7} F): uses $d = 10^{-6}$ m.

Final Answer: $C = 1.77 \times 10^{-10}$ F $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q11

Q12.

Solution

Concept — Force on a Moving Charge: $F = qvB\sin\theta$.

Step 1 — Product qvB:

$$qvB = (2 \times 10^{-3})(4 \times 10^{4})(0.5)$$

Step 2 — Evaluate the product:

$$qvB = 2 \times 10^{-3} \times 4 \times 10^{4} = 80; \quad 80 \times 0.5 = 40$$

Step 3 — Apply $\sin\theta$ ($\sin 30° = 0.5$):

$$F = 40 \times 0.5 = 20\,\text{N}$$

Why other options are wrong:

- Option A (80 N): forgets both B and $\sin\theta$ factors partially.
- Option B (69.3 N): uses $\sin 60°$ on $qvB = 80$.
- Option D (40 N): omits the $\sin 30°$ factor.

Final Answer: $F = 20$ N $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q12

Q13.

Solution

Concept — de Broglie Wavelength (Accelerated Charge): $\lambda = \dfrac{h}{\sqrt{2mqV}}$.

Step 1 — Compute $2mqV$:

$$2mqV = 2 \times 1.6 \times 10^{-27} \times 1.6 \times 10^{-19} \times 200$$

Step 2 — Multiply step by step:

$$2 \times 1.6 \times 10^{-27} = 3.2 \times 10^{-27}$$

$$3.2 \times 10^{-27} \times 1.6 \times 10^{-19} = 5.12 \times 10^{-46}$$

$$5.12 \times 10^{-46} \times 200 = 1.024 \times 10^{-43}$$

Step 3 — Square root (momentum p):

$$p = \sqrt{1.024 \times 10^{-43}} = 3.2 \times 10^{-22}\,\text{kg} \cdot \text{m/s}$$

Step 4 — Wavelength:

$$\lambda = \frac{6.6 \times 10^{-34}}{3.2 \times 10^{-22}} = 2.06 \times 10^{-12}\,\text{m}$$

Why other options are wrong:

- Option A (1.0×10^{-11} m): drops the factor 2 inside the root.
- Option C (2.06×10^{-10} m): exponent error (off by 10^2).
- Option D (6.6×10^{-13} m): divides h by 10^{-21} wrongly.

Final Answer: $\lambda = 2.06 \times 10^{-12}$ m $\Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q13

Q14.

Solution

Concept — Radioactive Decay: $N = N_0 \left(\frac{1}{2}\right)^n$, where n = number of half-lives.

Step 1 — Number of half-lives:

$$n = \frac{\text{total time}}{\text{half-life}} = \frac{20}{5} = 4$$

Step 2 — Decay fraction:

$$\left(\frac{1}{2}\right)^4 = \frac{1}{16}$$

Step 3 — Remaining nuclei:

$$N = \frac{6.4 \times 10^{20}}{16} = 0.4 \times 10^{20} = 4.0 \times 10^{19}$$

Why other options are wrong:

- Option A (1.6×10^{20}): uses $n = 2$ (divides by 4).
- Option B (3.2×10^{20}): uses $n = 1$ (one half-life).

- Option C (8.0×10^{19}): uses $n = 3$ (divides by 8).

Final Answer: $N = 4.0 \times 10^{19} \Rightarrow \boxed{D}$

Answer: (D) Go Back to Q14

Q15.

Solution

Concept — Boyle's Law (Isothermal): At constant T, $P_1V_1 = P_2V_2$.

Step 1 — Rearrange for V_2:

$$V_2 = \frac{P_1V_1}{P_2}$$

Step 2 — Substitute:

$$V_2 = \frac{(3 \times 10^5)(4)}{6 \times 10^5}$$

Step 3 — Evaluate:

$$V_2 = \frac{12 \times 10^5}{6 \times 10^5} = 2\,\text{L}$$

Why other options are wrong:

- Option A (8 L): multiplies by the pressure ratio instead of dividing.
- Option B (4 L): leaves the volume unchanged.
- Option D (1 L): uses a pressure ratio of 4.

Final Answer: $V_2 = 2\,\text{L} \Rightarrow \boxed{C}$

Answer: (C) Go Back to Q15

Q16.

Solution

Concept — Closed Organ Pipe: A pipe closed at one end has a node at the closed end and an antinode at the open end; the fundamental satisfies $L = \lambda/4$, so $f = \dfrac{v}{4L}$.

Step 1 — Denominator:

$$4L = 4 \times 0.25 = 1\,\text{m}$$

Step 2 — Frequency:

$$f = \frac{v}{4L} = \frac{340}{1} = 340\,\text{Hz}$$

Why other options are wrong:

- Option A (1360 Hz): uses $f = v/L$ (no factor 4).
- Option B (170 Hz): uses $f = v/(8L)$.
- Option C (680 Hz): uses $f = v/(2L)$ (open-pipe formula).

Final Answer: $f = 340$ Hz $\Rightarrow$ $\boxed{\text{D}}$

Answer: (D) Go Back to Q16

Q17.

Solution

Concept — Torque and Angular Acceleration: $\tau = I\alpha$, with $I = \frac{1}{2}MR^2$ for a disc.

Step 1 — Moment of inertia:

$$I = \frac{1}{2}MR^2 = \frac{1}{2} \times 4 \times (0.5)^2 = \frac{1}{2} \times 4 \times 0.25 = 0.5\,\text{kg}\cdot\text{m}^2$$

Step 2 — Torque:

$$\tau = I\alpha = 0.5 \times 6 = 3\,\text{N}\cdot\text{m}$$

Why other options are wrong:

- Option A (6 N·m): uses $I = MR^2$ wrongly without the $\frac{1}{2}$ (giving 1×6 via $R^2 = 0.25$ doubled).
- Option C (12 N·m): uses $I = MR^2$ with full factor and α.
- Option D (1.5 N·m): uses $I = \frac{1}{4}MR^2$.

Final Answer: $\tau = 3$ N·m $\Rightarrow$ $\boxed{\text{B}}$

Answer: (B) Go Back to Q17

Q18.

Solution

Concept — Transistor Current Gain: $\beta = \dfrac{I_C}{I_B}$.

Step 1 — Convert to common units:

$$I_C = 4.95\,\text{mA} = 4950\,\mu\text{A}, \quad I_B = 50\,\mu\text{A}$$

Step 2 — Divide:

$$\beta = \frac{4950}{50} = 99$$

Why other options are wrong:

- Option A (0.99): this is $\alpha = I_C/I_E$, not β.
- Option B (50): divides by $100\,\mu$A instead of $50\,\mu$A.
- Option D (100): rounds incorrectly (uses $I_C = 5$ mA).

Final Answer: $\beta = 99 \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q18

Q19.

Solution

Concept — Elastic Energy Density: $u = \frac{1}{2} \times$ stress $\times$ strain.

Step 1 — Product of stress and strain:

$$\text{stress} \times \text{strain} = (2 \times 10^8)(1 \times 10^{-3}) = 2 \times 10^5$$

Step 2 — Apply the factor $\frac{1}{2}$:

$$u = \frac{1}{2} \times 2 \times 10^5 = 1 \times 10^5\ \text{J/m}^3$$

Why other options are wrong:

- Option B (2×10^5 J/m^3): omits the factor $\frac{1}{2}$.
- Option C (1×10^8 J/m^3): uses stress alone without strain.
- Option D (2×10^8 J/m^3): equals the stress value, ignoring strain and $\frac{1}{2}$.

Final Answer: $u = 1 \times 10^5$ J/m^3 $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q19

Q20.

Solution

Concept — Escape vs Orbital Velocity: $v_{\text{esc}} = \sqrt{2}\, v_{\text{orb}}$, so the ratio is $\sqrt{2}$.

Step 1 — Apply the relation:

$$v_{\text{esc}} = \sqrt{2}\, v_{\text{orb}} = 1.414 \times 8$$

Step 2 — Evaluate:

$$v_{\text{esc}} = 11.31 \approx 11.3\,\text{km/s}$$

Step 3 — Ratio:

$$\frac{v_{\text{esc}}}{v_{\text{orb}}} = \frac{11.3}{8} = \sqrt{2} \approx 1.414$$

Why other options are wrong:

- Option A (ratio 1): assumes the two speeds are equal.
- Option B (16 km/s, ratio 2): uses a factor 2 instead of $\sqrt{2}$.
- Option D (5.7 km/s): divides by $\sqrt{2}$ instead of multiplying.

Final Answer: $v_{\text{esc}} = 11.3$ km/s, ratio $= \sqrt{2} \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q20

Answer Key

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