AME CET Physics

Sample Paper – 9

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. Two cells, each of EMF $\varepsilon = 3\,\text{V}$ and internal resistance $r = 1\,\Omega$, are connected in **parallel** across an external resistance $R = 2\,\Omega$. What is the current through the external resistance?

(A) $0.6\,\text{A}$

(B) $1.5\,\text{A}$

(C) $1.2\,\text{A}$

(D) $3.0\,\text{A}$

Q2. In a metre bridge experiment, the null point is obtained at $l = 40\,\text{cm}$ when a known resistance $R = 20\,\Omega$ is in one gap. What is the unknown resistance S in the other gap?

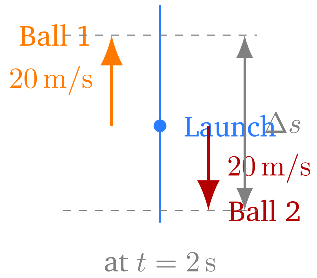
(A) $13.3\,\Omega$

(B) $30\,\Omega$

(C) $20\,\Omega$

(D) $8\,\Omega$

Q3. Two balls are thrown simultaneously from the same point. Ball 1 is projected **upward** at $20\,\text{m/s}$ and ball 2 is projected **downward** at $20\,\text{m/s}$. What is their separation after $t = 2\,\text{s}$? (Take $g = 10\,\text{m/s}^2$.)



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

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

(C) $60\,\text{m}$

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

Q4. Train A moves north at $60\,\text{km/h}$ and Train B moves north at $80\,\text{km/h}$. At $t = 0$, Train B is $5\,\text{km}$ *behind* Train A. How long does Train B take to overtake Train A?

(A) $15\,\text{min}$

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

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

(D) $5\,\text{min}$

Q5. In Young's double-slit experiment, light of wavelength $\lambda_1 = 600\,\text{nm}$ produces a fringe width $\beta_1 = 1.2\,\text{mm}$. The same setup is used with $\lambda_2 = 400\,\text{nm}$. What is the new fringe width β_2?

(A) $1.8\,\text{mm}$

(B) $0.8\,\text{mm}$

(C) $1.0\,\text{mm}$

(D) 2.0 mm

Q6. A convex mirror has focal length $f = +15$ cm. An object is placed at $u = -30$ cm in front of it. Where is the image formed?

(A) 10 cm behind the mirror (virtual)

(B) 30 cm behind the mirror (virtual)

(C) 10 cm in front of the mirror (real)

(D) 15 cm behind the mirror (virtual)

Q7. Two coils have a mutual inductance $M = 0.5$ H. The current in the primary coil changes from 5 A to 1 A in 0.2 s. What is the magnitude of the induced EMF in the secondary coil?

(A) 0.5 V

(B) 2 V

(C) 5 V

(D) 10 V

Q8. In a purely inductive AC circuit, what is the phase relationship between the current and the applied voltage?

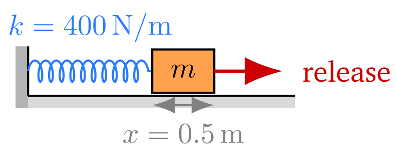
(A) Current leads voltage by $90°$

(B) Current is in phase with voltage

(C) Current lags voltage by $90°$

(D) Current leads voltage by $45°$

Q9. A block of mass $m = 2$ kg rests on a smooth horizontal floor and is connected to a spring of force constant $k = 400$ N/m. The spring is compressed by $x = 0.5$ m and then released. What is the speed of the block when it leaves the spring?



(A) $5\sqrt{2}\,\text{m/s}$

(B) $5\,\text{m/s}$

(C) $10\,\text{m/s}$

(D) $2.5\,\text{m/s}$

Q10. The work done by gravity on a body moving between two fixed points is found to be the same regardless of the path taken. This observation establishes that gravity is:

(A) A force for which both paths are equal in length

(B) A force for which kinetic energy is zero at the end point

(C) A force for which potential energy is zero at the end point

(D) A conservative force

Q11. Three capacitors of capacitance $2\,\mu$F, $3\,\mu$F, and $6\,\mu$F are connected in **parallel** across a $12\,$V supply. What is the total charge stored in the combination?

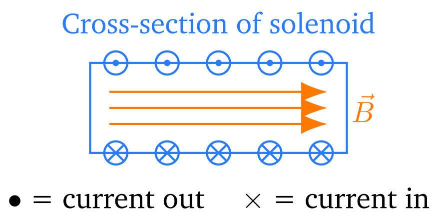
(A) $12\,\mu$C

(B) $132\,\mu$C

(C) $11\,\mu$C

(D) $66\,\mu$C

Q12. A solenoid has $n = 2000$ turns per metre and carries a current $I = 5\,$A. Using $\mu_0 = 4\pi \times 10^{-7}\,$T·m/A, what is the magnetic field inside the solenoid?



(A) $\pi \times 10^{-3}\,$T

(B) $2\pi \times 10^{-3}\,$T

(C) $4\pi \times 10^{-3}\,\text{T}$

(D) $8\pi \times 10^{-3}\,\text{T}$

Q13. A photon has wavelength $\lambda = 500\,\text{nm}$. Given Planck's constant $h = 6.6 \times 10^{-34}\,\text{J·s}$, what is the momentum of the photon?

(A) $1.32 \times 10^{-27}\,\text{kg·m/s}$

(B) $6.6 \times 10^{-27}\,\text{kg·m/s}$

(C) $3.3 \times 10^{-27}\,\text{kg·m/s}$

(D) $2.64 \times 10^{-27}\,\text{kg·m/s}$

Q14. What is the average number of neutrons released per fission of a $^{235}_{92}\text{U}$ nucleus?

(A) 1

(B) 5

(C) 10

(D) 2.5

Q15. A gas at 27°C is cooled at constant pressure until its volume becomes half the original. What is the final temperature of the gas?

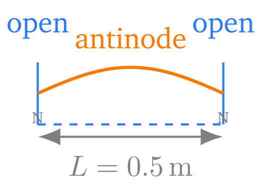
(A) 13.5°C

(B) −27°C

(C) −123°C

(D) 0°C

Q16. An open organ pipe has length $L = 0.5\,\text{m}$. Given the speed of sound $v = 340\,\text{m/s}$, what is the fundamental frequency of the pipe?



fundamental mode ($\lambda/2 = L$)

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

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

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

(D) $85\,\text{Hz}$

Q17. A body of moment of inertia $I = 2\,\text{kg·m}^2$ starts from rest and a constant torque $\tau = 5\,\text{N·m}$ is applied for $t = 4\,\text{s}$. What is the angular velocity at the end of $4\,\text{s}$?

(A) $5\,\text{rad/s}$

(B) $2.5\,\text{rad/s}$

(C) $20\,\text{rad/s}$

(D) $10\,\text{rad/s}$

Q18. Which logic gate produces an output of 1 *only* when **all** its inputs are 1?

(A) OR gate

(B) NOT gate

(C) AND gate

(D) NAND gate

Q19. Pipe A has radius r and pipe B has radius $2r$, both of length L. Under the same pressure difference and using the same fluid, what is the ratio of the volume flow rate through pipe A to that through pipe B?

(A) $1/4$

(B) $1/16$

(C) $1/2$

(D) 4

Q20. What is the time period of a geostationary satellite orbiting Earth?

(A) $24\,\text{hours}$

(B) 12 hours

(C) 1 hour

(D) 365 days

Detailed Solutions

Q1.

Solution

Concept — Cells in Parallel: For n identical cells in parallel, equivalent EMF $= \varepsilon$, equivalent internal resistance $r_{\text{eq}} = r/n$.

Step 1 — Equivalent internal resistance (2 cells):

$$r_{\text{eq}} = \frac{r}{2} = \frac{1}{2} = 0.5\,\Omega$$

Step 2 — Total circuit resistance:

$$R_{\text{total}} = r_{\text{eq}} + R = 0.5 + 2 = 2.5\,\Omega$$

Step 3 — Current through external resistance:

$$I = \frac{\varepsilon}{R_{\text{total}}} = \frac{3}{2.5} = \frac{30}{25} = 1.2\,\text{A}$$

Why other options are wrong:

- Option A (0.6 A): uses $r_{\text{eq}} = 2r = 2\,\Omega$ (series rule, not parallel).
- Option B (1.5 A): ignores internal resistance entirely ($I = \varepsilon/R$).
- Option D (3.0 A): uses wrong external resistance value.

Final Answer: $I = 1.2\,\text{A} \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q1

Q2.

Solution

Concept — Metre Bridge (Wheatstone Principle): At null point: $R/S = l/(100 - l)$.

Step 1 — Remaining length:

$$100 - l = 100 - 40 = 60\,\text{cm}$$

Step 2 — Unknown resistance:

$$S = R \times \frac{100 - l}{l} = 20 \times \frac{60}{40} = 20 \times 1.5 = 30\,\Omega$$

Why other options are wrong:

- Option A (13.3 Ω): inverts ratio, uses $20 \times 40/60$.
- Option C (20 Ω): assumes null point at 50 cm.
- Option D (8 Ω): uses $S = 20 \times 40/100$.

Final Answer: $S = 30\,\Omega \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q2

Q3.

Solution

Concept — Separation Between Two Balls: Both balls experience gravity equally. Relative displacement $= (u_1 - u_2)\,t$ (gravity cancels).

Step 1 — Position of Ball 1 (upward, $u_1 = +20$ m/s):

$$s_1 = u_1 t - \tfrac{1}{2} g t^2 = 20 \times 2 - 5 \times 4 = 40 - 20 = 20\,\text{m}$$

Step 2 — Position of Ball 2 (downward, $u_2 = -20$ m/s):

$$s_2 = (-20) \times 2 - \tfrac{1}{2} \times 10 \times 4 = -40 - 20 = -60\,\text{m}$$

Step 3 — Separation:

$$\Delta s = s_1 - s_2 = 20 - (-60) = 80\,\text{m}$$

Elegant check: $\Delta s = (u_1 - u_2)\,t = (20 - (-20)) \times 2 = 40 \times 2 = 80\,\text{m}$.

Why other options are wrong:

- Option A (20 m): only s_1.
- Option B (40 m): only the velocity term, ignores gravity.
- Option C (60 m): $|s_2|$ alone.

Final Answer: Separation $= 80\,\text{m} \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q3

Q4.

Solution

Concept — Relative Speed Catch-up: $t = \text{gap}/v_{\text{rel}}$.

Step 1 — Relative speed of B w.r.t. A:

$$v_{\text{rel}} = 80 - 60 = 20\,\text{km/h}$$

Step 2 — Time to close 5 km gap:

$$t = \frac{5}{20} = 0.25\,\text{h}$$

Step 3 — Convert to minutes:

$$t = 0.25 \times 60 = 15\,\text{min}$$

Why other options are wrong:

- Option B (30 min): uses $v_{\text{rel}} = 10$ km/h.
- Option C (12 min): uses $v_{\text{rel}} = 25$ km/h.
- Option D (5 min): uses speed of A alone.

Final Answer: $t = 15\,\text{min} \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q4

Q5.

Solution

Concept — YDSE Fringe Width: $\beta = \lambda D/d$, so $\beta \propto \lambda$ for fixed D, d.

Step 1 — Proportionality:

$$\frac{\beta_2}{\beta_1} = \frac{\lambda_2}{\lambda_1} = \frac{400}{600} = \frac{2}{3}$$

Step 2 — New fringe width:

$$\beta_2 = 1.2 \times \frac{2}{3} = \frac{2.4}{3} = 0.8\,\text{mm}$$

Why other options are wrong:

- Option A (1.8 mm): inverts the ratio (λ_1/λ_2).
- Option C (1.0 mm): arithmetic mean of the two wavelengths.
- Option D (2.0 mm): doubles β_1 without basis.

Final Answer: $\beta_2 = 0.8\,\text{mm} \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q5

Q6.

Solution

Concept — Convex Mirror Formula: $1/v + 1/u = 1/f$ with $f = +15$ cm (behind mirror), $u = -30$ cm.

Step 1:

$$\frac{1}{v} = \frac{1}{f} - \frac{1}{u} = \frac{1}{15} - \frac{1}{-30} = \frac{1}{15} + \frac{1}{30} = \frac{2}{30} + \frac{1}{30} = \frac{3}{30} = \frac{1}{10}$$

Step 2 — Image distance:

$$v = +10\,\text{cm (behind mirror, virtual)}$$

Why other options are wrong:

- Option B (30 cm): sets $u \to \infty$.
- Option C (10 cm in front): convex mirror cannot form real images.
- Option D (15 cm): $v = f$ only when object is at infinity.

Final Answer: $v = 10\,\text{cm}$ behind mirror $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q6

Q7.

Solution

Concept — Mutual Inductance: $|\varepsilon| = M\,|\Delta I/\Delta t|$.

Step 1 — Rate of change:

$$\left|\frac{\Delta I}{\Delta t}\right| = \frac{|5-1|}{0.2} = \frac{4}{0.2} = 20\,\text{A/s}$$

Step 2 — Induced EMF:

$$|\varepsilon| = 0.5 \times 20 = 10\,\text{V}$$

Why other options are wrong:

- Option A (0.5 V): uses $M \times \Delta I$ only, ignores Δt.
- Option B (2 V): uses $M \times \Delta I = 0.5 \times 4$.
- Option C (5 V): uses half the correct $\Delta I/\Delta t$.

Final Answer: $|\varepsilon| = 10\,\text{V} \Rightarrow \boxed{\text{D}}$

Answer: (D) **Go Back to Q7**

Q8.

Solution

Concept — Purely Inductive AC Circuit: $V = L\,dI/dt$. Integrating: $I \propto \sin(\omega t - \pi/2)$. Current *lags* voltage by 90°.

Step 1: Applied voltage: $V = V_0 \sin(\omega t)$.

Step 2: Integrating $dI/dt = V_0 \sin(\omega t)/L$:

$$I = -\frac{V_0}{\omega L}\cos(\omega t) = \frac{V_0}{\omega L}\sin\left(\omega t - \frac{\pi}{2}\right)$$

Step 3: Phase of I is $-\pi/2$ relative to $V \Rightarrow$ current **lags** voltage by 90°.

Mnemonic: ELI the ICE man — in an inductor (L), E leads I.

Why other options are wrong:

- Option A (leads 90°): applies to capacitor (ICE), not inductor.
- Option B (in phase): resistive circuit only.
- Option D (leads 45°): RL circuit with $R = X_L$.

Final Answer: Current lags voltage by $90^\circ \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q8

Q9.

Solution

Concept — Spring-Block Energy: $\frac{1}{2}kx^2 = \frac{1}{2}mv^2 \Rightarrow v = x\sqrt{k/m}$.

Step 1:

$$\frac{k}{m} = \frac{400}{2} = 200\,\text{s}^{-2}$$

Step 2:

$$v^2 = x^2 \cdot \frac{k}{m} = (0.5)^2 \times 200 = 0.25 \times 200 = 50$$

Step 3:

$$v = \sqrt{50} = 5\sqrt{2}\,\text{m/s}$$

Why other options are wrong:

- Option B (5 m/s): evaluates $\sqrt{25}$ instead of $\sqrt{50}$.
- Option C (10 m/s): uses $v = kx^2/m$.
- Option D (2.5 m/s): dimensional error.

Final Answer: $v = 5\sqrt{2}\,\text{m/s} \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q9

Q10.

Solution

Concept — Conservative Force: A force is conservative if the work done between two points is path-independent.

Step 1: Path-independence of work is the defining property of a conservative force.

Step 2: Since gravity's work is path-independent, gravity is a conservative force.

Consequence: Potential energy $U = mgh$ can be defined; $W = -\Delta U$.

Why other options are wrong:

- Option A: path-independence $\neq$ equal path lengths.

- Option B: KE at endpoint depends on net work, not gravity's nature alone.
- Option C: PE at endpoint depends on reference level.

Final Answer: Gravity is a conservative force $\Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q10

Q11.

Solution

Concept — Capacitors in Parallel: $C_{\text{eq}} = C_1 + C_2 + C_3$; $Q = C_{\text{eq}}V$.

Step 1:

$$C_{\text{eq}} = 2 + 3 + 6 = 11\,\mu\text{F}$$

Step 2:

$$Q = 11 \times 12 = 132\,\mu\text{C}$$

Why other options are wrong:

- Option A (12 μC): $Q = C_1 \times V$ only.
- Option C (11 μC): gives C_{eq} without multiplying by V.
- Option D (66 μC): divides the answer by 2.

Final Answer: $Q = 132\,\mu\text{C} \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q11

Q12.

Solution

Concept — Solenoid Field: $B = \mu_0 n I$.

Step 1:

$$B = 4\pi \times 10^{-7} \times 2000 \times 5 = 4\pi \times 10^{-7} \times 10^4 = 4\pi \times 10^{-3}\,\text{T}$$

Why other options are wrong:

- Option A ($\pi \times 10^{-3}$): uses $nI = 500$.
- Option B ($2\pi \times 10^{-3}$): uses $n = 1000$.
- Option D ($8\pi \times 10^{-3}$): uses $I = 10$ A.

Final Answer: $B = 4\pi \times 10^{-3}\,\text{T} \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q12

Q13.

Solution

Concept — Photon Momentum: $p = h/\lambda$.

Step 1: $\lambda = 500\,\text{nm} = 5 \times 10^{-7}$ m.

Step 2:

$$p = \frac{6.6 \times 10^{-34}}{5 \times 10^{-7}} = \frac{6.6}{5} \times 10^{-34+7} = 1.32 \times 10^{-27}\,\text{kg·m/s}$$

Why other options are wrong:

- Option B: uses $\lambda = 10^{-7}$ m (forgets factor 5).
- Option C: halves the answer.
- Option D: doubles the answer.

Final Answer: $p = 1.32 \times 10^{-27}\,\text{kg·m/s} \Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q13

Q14.

Solution

Concept — U-235 Fission Neutron Yield: Experimental average $\bar{\nu} \approx 2.5$ prompt neutrons per fission.

Step 1 — Example reaction:

$${}^{235}_{92}\text{U} + {}^{1}_{0}n \longrightarrow {}^{141}_{56}\text{Ba} + {}^{92}_{36}\text{Kr} + 3\,{}^{1}_{0}n$$

Step 2: Averaging over all fission channels: $\bar{\nu} \approx 2.5$.

Why other options are wrong:

- Option A (1): measured average is higher; 1 is threshold for criticality.
- Option B (5): overestimate.
- Option C (10): far too high.

Final Answer: $\bar{\nu} \approx 2.5 \Rightarrow \boxed{\text{D}}$

Answer: (D) Go Back to Q14

Q15.

Solution

Concept — Charles' Law: $V_1/T_1 = V_2/T_2$ (temperatures in Kelvin).

Step 1: $T_1 = 27 + 273 = 300\,\text{K}$.

Step 2:

$$T_2 = T_1 \times \frac{V_2}{V_1} = 300 \times \frac{1}{2} = 150\,\text{K}$$

Step 3 — Convert to Celsius:

$$T_2 = 150 - 273 = -123°\text{C}$$

Why other options are wrong:

- Option A ($13.5°$C): halves Celsius directly, forgets Kelvin conversion.
- Option B ($-27°$C): halves Celsius temperature.
- Option D ($0°$C): no physical basis.

Final Answer: $T_2 = -123°\text{C} \Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q15

Q16.

Solution

Concept — Open Organ Pipe Fundamental: $L = \lambda/2 \Rightarrow f_0 = v/(2L)$.

Step 1:

$$f_0 = \frac{340}{2 \times 0.5} = \frac{340}{1.0} = 340\,\text{Hz}$$

Why other options are wrong:

- Option A (170 Hz): uses $f = v/(4L)$ (closed pipe formula).
- Option C (680 Hz): second harmonic of open pipe.
- Option D (85 Hz): uses $f = v/(8L)$.

Final Answer: $f_0 = 340\,\text{Hz} \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q16

Q17.

Solution

Concept — Rotational Kinematics: $\alpha = \tau/I$; $\omega = \omega_0 + \alpha t$.

Step 1 — Angular acceleration:

$$\alpha = \frac{\tau}{I} = \frac{5}{2} = 2.5\,\text{rad/s}^2$$

Step 2 — Angular velocity at $t = 4$ s:

$$\omega = 0 + 2.5 \times 4 = 10\,\text{rad/s}$$

Why other options are wrong:

- Option A (5 rad/s): uses $\omega = \tau/I$ without $\times t$.
- Option B (2.5 rad/s): gives α only.
- Option C (20 rad/s): wrong denominator in α.

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

Answer: (D) Go Back to Q17

Q18.

Solution

Concept — AND Gate: $Y = A \cdot B$; output is 1 only when ALL inputs are 1.

Truth table excerpt:

A	B	AND
0	0	0
0	1	0
1	0	0
1	1	**1**

Why other options are wrong:

- Option A (OR): output is 1 when ANY input is 1.
- Option B (NOT): single-input inverter.
- Option D (NAND): complement of AND; output is 0 when all inputs are 1.

Final Answer: AND gate $\Rightarrow \boxed{\text{C}}$

Answer: (C) Go Back to Q18

Q19.

Solution

Concept — Poiseuille's Law: $Q = \pi \Delta P r^4/(8\eta L)$, so $Q \propto r^4$.

Step 1:

$$\frac{Q_A}{Q_B} = \left(\frac{r_A}{r_B}\right)^4 = \left(\frac{r}{2r}\right)^4 = \left(\frac{1}{2}\right)^4 = \frac{1}{16}$$

Why other options are wrong:

- Option A (1/4): uses $Q \propto r^2$.
- Option C (1/2): uses $Q \propto r$.
- Option D (4): inverts the ratio.

Final Answer: $Q_A/Q_B = 1/16 \Rightarrow \boxed{\text{B}}$

Answer: (B) Go Back to Q19

Q20.

Solution

Concept — Geostationary Satellite: Appears stationary over Earth; orbital period equals Earth's rotation period.

Step 1: Earth's rotational period $= 24$ hours.

Step 2: Geostationary satellite period $= 24$ hours (same direction as Earth rotation, equatorial plane).

Why other options are wrong:

- Option B (12 h): GPS satellite (MEO).
- Option C (1 h): LEO approximate (ISS $\approx$ 90 min).
- Option D (365 days): Earth's period around the Sun.

Final Answer: $T = 24$ hours $\Rightarrow \boxed{\text{A}}$

Answer: (A) Go Back to Q20

Answer Key

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