

JEE MAIN Physics Sample Paper 05

Total Questions: 25 | **Duration:** 1 Hour

Marking Scheme: Correct (+4) | Incorrect MCQ (-1) | Incorrect NVT (0)

Section A: Multiple Choice Questions (1-20)

1. Ratio of de-Broglie wavelengths $\lambda_\alpha : \lambda_p : \lambda_e$ for same KE:

- | | |
|---|---|
| A. (A) $\lambda_e > \lambda_p > \lambda_\alpha$ | B. (B) $\lambda_\alpha > \lambda_p > \lambda_e$ |
| C. (C) All equal | D. (D) $\lambda_p > \lambda_\alpha$ |

2. Velocity of wave $y = 0.05 \sin(8x - 4t)$:

- | | |
|----------------|----------------|
| A. (A) 0.5 m/s | B. (B) 2.0 m/s |
| C. (C) 8.0 m/s | D. (D) 4.0 m/s |

3. Tension in string for masses 4kg and 1kg on double incline $60^\circ/30^\circ$:

- | | |
|----------------------------|----------------------------|
| A. (A) $4(\sqrt{3} + 1)$ N | B. (B) $4(\sqrt{3} - 1)$ N |
| C. (C) $2\sqrt{3}$ N | D. (D) 10 N |

4. Frequency of second line of Paschen if first line is 720nm:

- | | |
|---------------|---------------|
| A. (A) 480 nm | B. (B) 540 nm |
| C. (C) 600 nm | D. (D) 640 nm |

5. Induced EMF in rotating rod length L at ω in perpendicular B:

- | | |
|-------------------------|----------------------|
| A. (A) $0.5B\omega L^2$ | B. (B) $B\omega L^2$ |
| C. (C) $2B\omega L^2$ | D. (D) Zero |

6. Phase difference for two SHM waves of 8cm amplitude and 8cm resultant:

- | | |
|--------------------|-------------------|
| A. (A) 120° | B. (B) 60° |
| C. (C) 90° | D. (D) 0° |
-

7. Acceleration of electron in circular orbit is v^2/r . Also derived as:

- | | |
|-----------------------------|----------------------------|
| A. (A) $h^2/4\pi^2 m^2 r^3$ | B. (B) $h^2/\pi^2 m^2 r^3$ |
| C. (C) v^2/r | D. (D) Both A and C |
-

8. Potential energy of dipole in 1000 V/m field at 45° ($P = 10^{-29}$):

- | | |
|---------------------------------------|--|
| A. (A) $-7 \times 10^{-27} \text{ J}$ | B. (B) $-10 \times 10^{-29} \text{ J}$ |
| C. (C) $20 \times 10^{-18} \text{ J}$ | D. (D) Zero |
-

9. Combined capacitance in series C_{eq} for $K=5$ system:

- | | |
|----------------------------|-----------------------------|
| A. (A) $5/3\epsilon_0 A/d$ | B. (B) $10/3\epsilon_0 A/d$ |
| C. (C) $24/3...$ | D. (D) $3/4...$ |
-

10. Weight at altitude 3200km if surface weight is 18N ($R = 6400\text{km}$):

- | | |
|------------|--------------|
| A. (A) 9 N | B. (B) 4.5 N |
| C. (C) 8 N | D. (D) 2 N |
-

11. Ratio of magnetic field at center vs axis at distance r for loop radius r :

- | | |
|------------------------|------------------------|
| A. (A) $2\sqrt{2} : 1$ | B. (B) $3\sqrt{2} : 2$ |
| C. (C) $1 : 2$ | D. (D) $1 : \sqrt{2}$ |
-

12. Damped oscillations energy decay time to drop half:

- | | |
|--------------|-------------|
| A. (A) 7 s | B. (B) 14 s |
| C. (C) 3.5 s | D. (D) 10 s |
-

13. The truth table 1,0,0,0 corresponds to which logic gate?

- | | |
|------------|-------------|
| A. (A) NOR | B. (B) NAND |
| C. (C) OR | D. (D) AND |
-

14. Due to inert pair effect, stability of +1 state in Group 13:

- | | |
|-----------------------------|-----------------------------|
| A. (A) Increases down group | B. (B) Decreases down group |
| C. (C) Constant | D. (D) All same |
-

15. Magnetic dipole moment $\mu \propto n^x$. Find x:

- | | |
|----------------|----------------|
| A. (A) $x = 1$ | B. (B) $x = 2$ |
| C. (C) $x = 0$ | D. (D) $x = 3$ |
-

16. Work done by force $F = i + 3t^2j$ from 0 to 2s:

- | | |
|-------------|-------------|
| A. (A) 46 J | B. (B) 30 J |
| C. (C) 17 J | D. (D) 10 J |
-

17. Entropy change in isothermal expansion of ideal gas:

- | | |
|-----------------|-----------------|
| A. (A) Positive | B. (B) Negative |
| C. (C) Zero | D. (D) Infinite |
-

18. Speed of particle in horizontal circle $r = L/\sqrt{2}$ suspended by L:

- | | |
|--------------------|---------------------|
| A. (A) $\sqrt{rg}$ | B. (B) $\sqrt{2}rg$ |
| C. (C) rg | D. (D) Zero |
-

19. Max Range is 100m. Max height for vertical throw:

- | | |
|--------------|--------------|
| A. (A) 50 m | B. (B) 25 m |
| C. (C) 100 m | D. (D) 200 m |
-

20. Symmetric resistor bridge network, current division ratio:

A. (A) 1:4

B. (B) 4:1

C. (C) 1:1

D. (D) 2:3

Section B: Numerical Value Questions (21-25)

21. Time (min) for 80% to 10% activity drop (half-life 20m): _____

22. Distance (cm) where KE = 3PE in SHM (Amplitude 10cm): _____

23. Rev/min 'K' for stone (100g, 2m, 80N max): _____

24. Equilibrium power in potential formula 'a' is 1/6. Value of a: _____

25. Power Factor factor x in x/10 for LCR circuit ($\cos\phi=0.8$): _____

Answer Key & Detailed Explanation

1. [A] $\lambda = h/\sqrt{(2mK)}$. Since $m_e < m_p < m_\alpha$, $\lambda_e > \lambda_p > \lambda_\alpha$.

2. [A] Wave velocity $v = \omega/k = 4/8 = 0.5$ m/s.

3. [B] Applying Newton's law: Tension $T = 4(\sqrt{3} - 1)$ N.

4. [B] Using Rydberg formula for Paschen series: second line gives 540 nm.

5. [A] Standard EMF formula for rotating rod: $\varepsilon = \frac{1}{2}B\omega L^2 = 0.5B\omega L^2$.

6. [A] For resultant 8 from two waves of 8: $8^2 = 8^2 + 8^2 + 2(8^2)\cos\Phi \rightarrow \Phi = 120^\circ$.

7. [D] Acceleration v^2/r is equivalent to $\frac{h^2}{4\pi^2 m^2 r^3}$ in Bohr model. Both A and C are correct.

8. [B] $U = -pE \cos 45^\circ$. Calculation yields approximately -10×10^{-29} J.

9. [B] Combined capacitance $C_{eq} = \frac{10}{3} \varepsilon_0 A/d$ for $K=5$ system.

10. [C] $g_h = g(R/(R+h))^2$. For $h=R/2$, $g_h = 4/9$ g. Weight = $18 \times 4/9 = 8$ N.

11. [A] $B_{center} = \mu_0 I / 2r$. $B_{axis} = \mu_0 I r^2 / 2(r^2 + x^2)^{3/2}$. For $x=r$, ratio is $2\sqrt{2} : 1$.

12. [A] Damped oscillations decay: $t = (m/b)\ln 2$. Calculation yields ~ 7 s.

13. [A] Truth table 1,0,0,0 corresponds to NOR gate logic.

14. [A] Inert pair effect increases stability of +1 oxidation state down Group 13.

15. [A] $\mu \propto L$. Since $L = nh/2\pi$, $\mu \propto n^1$, so $x = 1$.

16. [A] $W = \int \mathbf{F} \cdot d\mathbf{r}$. Integrating $x=t$ and $y=t^3$ gives approx 46 J.

17. [A] Isothermal expansion: Q absorbed at constant T. $\Delta S = Q/T > 0$ (Positive).

18. [A] In horizontal circle $r=L/\sqrt{2}$, force balance yields $v = \sqrt{rg}$.

19. [A] Max Range = $u^2/g = 100$. Max height $H = u^2/2g = 50$ m.

20. [C] symmetric resistor bridge current division ratio is 1:1.

21. [60] 80% to 10% is 3 half-lives. $3 \times 20 = 60$ mins.

22. [5] $KE=3PE \rightarrow A^2-x^2 = 3x^2 \rightarrow x = A/2 = 10/2 = 5$ cm.

23. [191] $F = m\omega^2 r \rightarrow 80 = 0.1 \cdot \omega^2 \cdot 2 \rightarrow \omega=20$. RPM = $20 \cdot 60 / 2\pi \approx 191$.

24. [0.167] $1/6 \approx 0.167$.

25. [8] $\cos\phi = 0.8$. If $\cos\phi = x/10$, then $x = 8$.