JEE MAIN Physics Sample Paper 02

Subject: Physics
Structure: 20 MCQs + 5 Numerical Type Questions
Marking Scheme: Correct (+4) | Incorrect MCQ (-1) | Incorrect NVT (0)

Section A: Multiple Choice Questions (1-20)

1. Range of $f(x) = (x^2 - 4)/(x^2 + 4)$:

A. [-1, 1)
B. (-1, 1]
C. [-1, 1]
D. (-1, 1)

2. Number of radial nodes in 4d orbital:

A. 0
B. 1
C. 2
D. 3

3. High spin d^6 configuration CFSE:

A. -0.4Δo
B. -0.6Δo
C. -2.4Δo
D. Zero

4. Zener diode voltage beyond knee point:

A. Increases
B. Decreases
C. Remains constant
D. Zero

5. Non-reducing sugar is:

A. Glucose
B. Sucrose
C. Maltose
D. Lactose

6. Center of mass of rod with density $\rho = \rho_0(1 - x^2/L^2)$:

A. L/2
B. 3L/8

C. 5L/8

D. L/4

7. Induced EMF of rod length L rotating at ω in field B:

A. $B\omega L^2$

B. $0.5B\omega L^2$

C. $2B\omega L^2$

D. Zero

8. Probability of exactly one of A or B if P(A) = 0.4, P(B) = 0.6:

A. 0.2

B. 0.4

C. 0.52

D. 0.6

9. Common chord length of circles $x^2 + y^2 = 4$ and $(x - 1)^2 + y^2 = 1$:

A. $\sqrt{3}$

B. $\sqrt{2}$

C. 2

D. 1

10. Mech energy ratio for satellites mass 4:3 in orbits 3r, 4r:

A. 16:9

B. 9:16

C. 1:1

D. 4:3

11. Work bringing +q from side a to a/2 in equilateral triangle:

A. $3q^2/2\pi\epsilon_0 a$

B. $3q^2/4\pi\epsilon_0 a$

C. $q^2/4\pi\epsilon_0 a$

D. Zero

12. Photon from 3E → E is λ. From 5E/3 → E it is:

A. 3λ

B. 1.5λ

C. 2λ

D. 3λ/5

13. Conductivity ratio of material σ_1 to σ_2. Resistance R:

A. $\ell/\pi r^2(\sigma_1+\sigma_2)$

B. $3\ell/\pi r^2(\sigma_1+\sigma_2)$

C. $3\ell/\pi r^2(\sigma_1+2\sigma_2)$

D. $\ell/2\pi r^2\sigma$

14. Radius of curvature at θ/2 for projectile angle θ:

A. $u^2\cos^2\theta/g\cos^3(\theta/2)$

B. $u^2\cos^2\theta/g$

C. u^2/g

D. Zero

15. Stability order of Oxygen species:

A. $O_2^+ > O_2 > O_2^-$

B. $O_2 > O_2^+ > O_2^-$

C. $O_2^- > O_2 > O_2^+$

D. All same

16. Minimum force to move up vs prevent slip. If $F_1 = 3F_2$, μ_s:

A. $\frac{1}{2}\tan\theta$

B. $\frac{1}{3}\tan\theta$

C. $2\tan\theta$

D. $\tan\theta$

17. Average velocity for 120° arc constant speed π:

A. $1.5\sqrt{3}$

B. $\sqrt{3}$

C. $2\sqrt{3}$

D. π

18. Root ratio for roots in GP (2s - q) : q:

A. $(r^2 - p^2) : p^2$

B. $p^2 : r^2$

C. 1:1

D. r : p

19. Fundamental frequency of open pipe is f_0. One end closed:

A. $f_0/2$

B. $2f_0$

C. f_0

D. $1.5f_0$

20. Distance of COM from end A of 1D rod:

A. 3L/8

B. L/2

C. L/4

D. 2L/3

Section B: Numerical Value Questions (21-25)

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

22. Distance (cm) where KE = 3PE if amplitude is 10cm: _____

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

24. Max water mass (g) from 12g mixture (2:1 ratio): _____

25. Activation energy (kJ/mol) for 4x rate inc (293-313K): _____

ANSWER KEY & DETAILED EXPLANATION

1. [A] y ranges from -1 to 1 based on x^2 values.

2. [B] Nodes = n - l - 1 = 4 - 2 - 1 = 1.

3. [A] CFSE for d^6 high spin is -0.4Δo.

4. [C] Zener diode maintains constant voltage.

5. [B] Sucrose is a non-reducing sugar.

6. [C] Integration of density function gives center of mass at 5L/8.

7. [B] $\varepsilon = \frac{1}{2}B\omega L^2$ for a rotating rod.

8. [C] $P(A)+P(B)-2P(A\cap B) = 0.52$.

9. [A] Chord length = $2 * \sqrt{(7/4)} = \sqrt{3}$.

10. [B] ME ratio based on orbit and mass is 9:16.

11. [A] Work = $3q^2/2\pi\epsilon_0 a$.

12. [C] Transition energy difference leads to 3λ.

13. [B] Resistance integration gives $R = 3\ell/\pi r^2(\sigma_1+\sigma_2)$.

14. [A] Substituting kinematics at angle $\theta/2$ gives option A.

15. [A] Order based on bond order: $O_2^+(2.5) > O_2(2.0) > O_2^-(1.5)$.

16. [A] Ratio 3 leads to $\mu = \frac{1}{2}\tan\theta$.

17. [A] Same as Q6 Paper 1: $1.5\sqrt{3}$.

18. [A] Roots in GP result in the ratio $(r^2-p^2):p^2$.

19. [A] Fundamental $f' = f_0/2$.

20. [A] Distance from end A is 3L/8.

21. [60] 3 half-lives: 3 * 20 = 60 mins.

22. [5] x = A/2 = 5 cm.

23. [191] Rev/min calculation yields ~191.

24. [6] 2:1 ratio of 12g gives 6g water.

25. [52.9] Solving ln(4) gives 52.9 kJ/mol.