

F-1

ENTRANCE EXAMINATION, 2026
QUESTION PAPER BOOKLET

Ph.D. (PHYSICS)

Marks: 70

Time: 2.00 hrs.

Hall Ticket No.:

I. Please enter your Hall Ticket Number on Page 1 of this question paper and on the OMR sheet without fail.

II. Read carefully the following instructions:

1. This Question paper has two parts: PART - A and PART - B.
2. PART-A consists of 20 objective type questions related to Research Methodology.
3. PART-B consists of 20 objective type questions related to Physics.
4. Each question carries 1.75 marks. There is no negative marking
5. Answers are to be marked on the OMR answer sheet following the instructions provided there upon. An example is shown below

100. ☐ A ☐ B ☐ C ☒

6. Only Scientific Calculators are permitted. Mobile phone based calculators are not permitted. Logarithmic tables are not allowed.
7. Hand over the OMR sheet at the end of the examination.
8. No additional sheets will be provided. Rough work can be done in the question paper itself in the space provided at the end of the booklet.

This book contains 18 pages

III. Values of physical constants:

$$c = 3 \times 10^8 \text{ m/s}; h = 6.63 \times 10^{-34} \text{ J.s}; k_B = 1.38 \times 10^{-23} \text{ J/K}$$

$$e = 1.6 \times 10^{-19} \text{ C}; \mu_0 = 4\pi \times 10^{-7} \text{ Henry/m}; \epsilon_0 = 8.85 \times 10^{-12} \text{ Farad/m}$$

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Blank sheets are provided for rough work at the end of this booklet

Part A

1. The correct statement in the following is

[A] $|\sin \theta \cos \theta| \leq |\sin \theta| + |\cos \theta|$

[B] $|\sin \theta \cos \theta| \geq |\sin \theta| + |\cos \theta|$

[C] $|\sin \theta + \cos \theta| \leq 1$

[D] $|\sin \theta - \cos \theta| \leq 1$

2. The value of the continued fraction $\sqrt{3} + \frac{1.5}{\sqrt{3} + \frac{1.5}{\sqrt{3} + \dots}}$ is

[A] $\frac{\sqrt{3} + 1.5}{2}$

[B] $\sqrt{3} + 0.75$

[C] $\frac{\sqrt{3} + 3}{2}$

[D] $\sqrt{3} + 1.5$

3. Two random numbers x_1, x_2 are drawn from a probability distribution $p(x) = e^{-x}$ for $x > 0$, $p(x) = 0$ for $x < 0$. The probability distribution $P(y)$ for $y = x_1 + x_2$ is

[A] ye^{-y}

[B] $2e^{-y}$

[C] e^{-y}

[D] $2ye^{-y}$

4. In a certain population, 10% of the population has diabetes, 30% of the population is obese, and 7% of the population has both diabetes and obesity. The probability of a randomly chosen individual has one of the conditions is

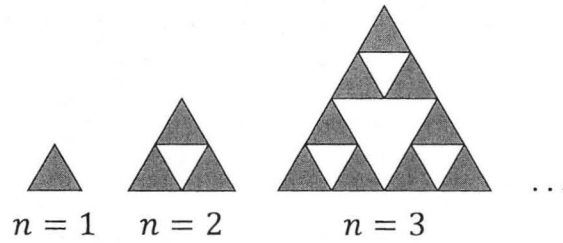
[A] 40%

[B] 47%

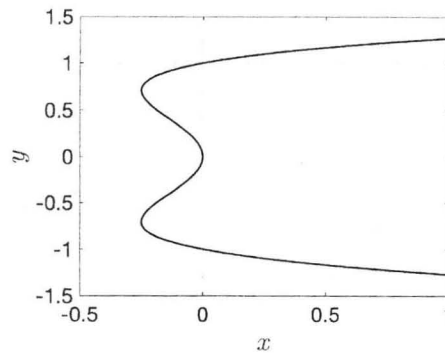
[C] 29%

[D] 33%

5. Consider an iteration as shown in the figure for $n = 1, 2, 3$. As $n \rightarrow \infty$, the fraction of the unshaded area is

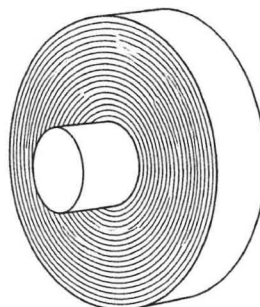


- [A] $1/3$
 [B] 1
 [C] $1/2$
 [D] 0
6. The curve shown is represented by the equation



- [A] $y = x^2 + x^4$
 [B] $y = -x^2 + x^4$
 [C] $x = y^2 + y^4$
 [D] $x = -y^2 + y^4$
7. Consider the solution $x(t)$ of the differential equation $\frac{d^2x}{dt^2} + 100x = 0$, with initial conditions $x(t=0) = 0$, $\frac{dx}{dt}\bigg|_{t=0} = 1$. Then, $10x^2 + \frac{1}{10}\left(\frac{dx}{dt}\right)^2$ is equal to
- [A] 0.1
 [B] 10
 [C] 0.01
 [D] 100

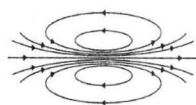
8. A thin tape of thickness 1 mm is tightly wound, as shown, over itself many turns around a rigid cylindrical core of radius 20 mm. If the total length of the tape is 100π meters, the number of turns is approximately



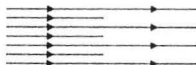
- [A] 300
 [B] 500
 [C] 5000
 [D] 3000
9. If $\log_x\left(\frac{a+5}{a}\right) = -\frac{1}{3}$, the value of x is
- [A] $3\log_{10}\left(\frac{a+5}{a}\right)$
 [B] $\left(\frac{a+5}{a}\right)^3$
 [C] $3\log_{10}\left(\frac{a}{a+5}\right)$
 [D] $\left(\frac{a}{a+5}\right)^3$
10. Consider a function $f(x) = e^{ikx}$, where $k = k_1 + ik_2$, with $k_1 > 0$ and $k_2 > 0$. In the limit of $x \rightarrow \infty$, $|f(x)|$ approaches
- [A] 1
 [B] π
 [C] ∞
 [D] 0

11. A sample of a radioactive isotope has an initial activity of 800 counts per minute. After three hours, the activity falls to 200 counts per minute. The half-life of the isotope is
- [A] 1.5 hours
 [B] 2.0 hours
 [C] 3.0 hours
 [D] 4.0 hours
12. The electrostatic field lines in a region cannot be represented by

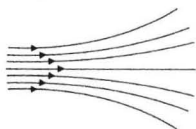
[A]



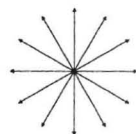
[B]



[C]



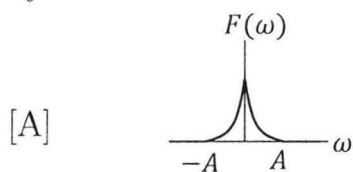
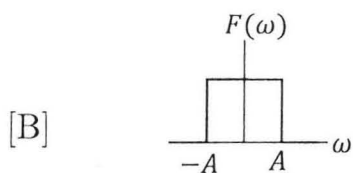
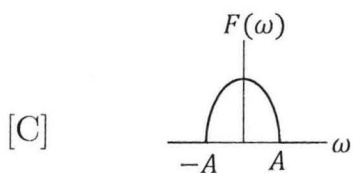
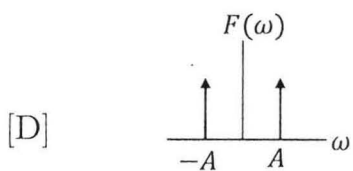
[D]



13. Let a surface be defined by a constant value of a scalar field $\phi(\vec{r}) = 0$, and $\hat{n} = \frac{\vec{\nabla}\phi}{|\vec{\nabla}\phi|}$ be the unit vector normal to the surface at a point P where $\vec{\nabla}\phi \neq 0$. The tangential component of a vector $\vec{L}$ at P is
- [A] $(\vec{L} \cdot \hat{n})\hat{n}$
 [B] $\vec{L} - (\vec{L} \cdot \hat{n})\hat{n}$
 [C] $(\vec{L} \cdot \vec{\nabla}\phi)\hat{n}$
 [D] $(\vec{L} \cdot \hat{n})\hat{n}$

14. On tossing a coin, the probability of getting a head or a tail is equal. If the coin is tossed 5 times, the probability of getting heads at least three times is
- [A] $3/10$
 - [B] $1/2$
 - [C] $1/3$
 - [D] $3/5$
15. A physical quantity is measured multiple times using an instrument that has a systematic error. The mean of a large number of measurements is reported. The correct statement is
- [A] the mean value converges to the true value
 - [B] the standard deviation goes to zero, eliminating all errors
 - [C] the mean value can differ from the true value
 - [D] the systematic error cancels out
16. A locker in a bank is secured by a 3-digit numeric code. A person has forgotten the code and tries all possible combinations. If each operation takes 3 seconds, the maximum time taken to open the locker is
- [A] 30 minutes
 - [B] 100 minutes
 - [C] 50 minutes
 - [D] 200 minutes
17. Consider a straight line described by $y = x + c$, where c is a real number. The values of c for which the straight line meets the curve described by $x^2 + y^2 = 1$ at a single point is
- [A] $0, \sqrt{2}$
 - [B] $\pm\sqrt{2}$
 - [C] $0, -\sqrt{2}$
 - [D] ± 1

18. A monochromatic light passes from a rarer medium to a denser medium. Then,
- [A] its frequency changes but the wavelength remains the same
 - [B] its wavelength changes but the frequency remains the same
 - [C] both the frequency and the wavelength change
 - [D] both the frequency and the wavelength remain the same
19. The number of integers between 100 and 1000 with only even digits is
- [A] 64
 - [B] 80
 - [C] 100
 - [D] 125
20. The Fourier transform of $f(t) = \cos At$ can be schematically represented by



Part B

21. A particle of mass m is moving under the influence of a one-dimensional potential given by $V(x) = -\frac{a}{2}x^2 + \frac{b}{4}x^4$, where $a > 0$ and $b > 0$. Then, the position of the stable equilibrium and the frequency of the small oscillations near the equilibrium, are respectively

[A] $\pm\sqrt{\frac{a}{b}}, \sqrt{\frac{2a}{m}}$

[B] $0, \sqrt{\frac{2a}{m}}$

[C] $0, \sqrt{\frac{a}{m}}$

[D] $\pm\sqrt{\frac{a}{b}}, \sqrt{\frac{a}{m}}$

22. The value of the contour integral $\int_C \frac{\sin(\pi z^2) + \cos(\pi z^2)}{(z-1)(z-2)} dz$, where the contour C is the circle with $|z-i|=3$, is

[A] 0

[B] $2\pi i$

[C] $-2\pi i$

[D] $4\pi i$

23. Consider two coaxial conducting cylindrical surfaces, with their radii 1 cm and 9 cm, respectively. The inner conductor is maintained at a potential 10 V and the outer conductor is grounded. The values of the potential at the radial distances 0.5 cm and 3 cm, are respectively

[A] 10 V, 2.5 V

[B] 0, 2.5 V

[C] 10 V, 5 V

[D] 0, 5 V

24. Using the spherical polar coordinates, the Hamiltonian of a particle moving in a potential $V(r)$ is given by $H = \frac{1}{2m}(p_r^2 + \frac{p_\theta^2}{r^2} + \frac{p_\phi^2}{r^2 \sin^2 \theta}) + V(r)$. Here, the momenta p_r , p_θ , and p_ϕ are conjugate to r , θ , and ϕ , respectively. For $K = p_\theta^2 + \frac{p_\phi^2}{\sin^2 \theta}$, the Poisson bracket $\{H, K\}$ is
- [A] $1/2$
 - [B] 2
 - [C] 0
 - [D] 1
25. An ideal gas consisting of N atoms is initially at equilibrium with volume V and internal energy U . The gas undergoes a quasi-static process in which its volume is increased to $4V$, keeping the number of particles and the internal energy unchanged. The change in the entropy is
- [A] $Nk_B \log 2$
 - [B] $2Nk_B \log 2$
 - [C] $4Nk_B \log 2$
 - [D] $3Nk_B \log 2$
26. The general solution of the differential equation $y''' - 3y'' + 3y' - y = 0$, where $y' = dy/dx$, is
- [A] $y = Ae^x + Bxe^x + Ce^{-x}$
 - [B] $y = Ae^x + Bx^2e^x + Ce^{-x}$
 - [C] $y = Ae^x + Bxe^x + Cx^2e^x$
 - [D] $y = Axe^x + Bx^2e^x + Cx^3e^x$

27. In a cylindrical region of space of radius 10 cm, with the cylindrical axis being the z -direction, a time-dependent magnetic field is present given by $\vec{B}(t) = \hat{z}B_0t/t_0$, where B_0 and t_0 do not depend on the time t . A circular loop of radius 2 cm lies in the xy -plane with its center on the cylindrical axis. For $B_0 = 1$ Tesla, $t_0 = 10^{-3}$ sec, the induced electric field in the loop is
- [A] 1 V/m
 - [B] 5 V/m
 - [C] 10 V/m
 - [D] 20 V/m
28. A stationary-state wave function for a particle moving in a one-dimensional potential is given by $\psi(x) = Ae^{-Bx^2}$, where A and B are constants. For $B = 1$, the classical turning points for the state are
- [A] $\pm\sqrt{1/2}$
 - [B] ± 1
 - [C] $\pm\sqrt{3/2}$
 - [D] $\pm\sqrt{2}$
29. Consider a two-state system with the Hamiltonian given by $H = e_0(|1\rangle\langle 1| + |2\rangle\langle 2|) + t(|1\rangle\langle 2| + |2\rangle\langle 1|)$, where e_0 is the energy of the unhybridised states $|1\rangle$ and $|2\rangle$, and t the hybridisation amplitude. The energy eigenvalues are
- [A] $e_0 \pm t$
 - [B] $t \pm e_0$
 - [C] $\pm\sqrt{e_0^2 + t^2}$
 - [D] $\pm t$

30. Consider the Boolean expressions:

(i) $ABC + A\bar{B}C + AB\bar{C} = AC + AB\bar{C}$

(ii) $AB + A\bar{B} = \bar{A}B$

(iii) $A(\bar{A} + B) = \bar{A}B$

(iv) $(\overline{A + AB}) + (\overline{B + AB}) = A\bar{B} + \bar{A}B.$

The correct Boolean expressions are

[A] (i) and (iv)

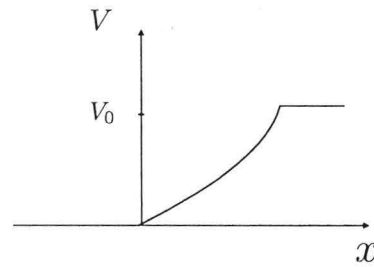
[B] (i) only

[C] (i) and (ii)

[D] (i) and (iii)

31. Consider a particle moving in a one-dimensional potential shown below.

The energy spectrum of the particle for energy $E < V_0$ is



[A] non degenerate and discrete

[B] non degenerate and continuous

[C] two-fold degenerate and discrete

[D] two-fold degenerate and continuous

32. Consider N non interacting spins, each taking two values $S_i = \pm 1$, in a magnetic field B at a temperature T . The Hamiltonian is given by $H = -B\mu_B \sum_{i=1}^N S_i$, where μ_B is the Bohr magneton. For $\mu_B B \ll k_B T$, the magnetisation is

[A] $\frac{N\mu_B^2 B}{k_B T}$

[B] $N\mu_B$

[C] $\frac{N\mu_B^2 B}{2k_B T} e^{-\mu_B B/k_B T}$

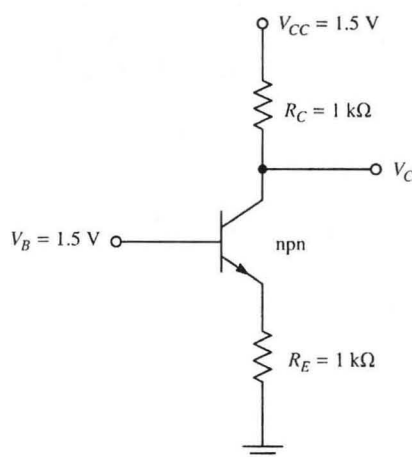
[D] $N\mu_B e^{-\mu_B B/k_B T}$

33. The xy -plane forms the interface between two linear homogeneous dielectric media. The relative permittivities are $\epsilon_r = 4$ for $z > 0$, and $\epsilon_r = 2$ for $z < 0$. The electric field in the region $z > 0$ is given by $\vec{E} = (4\hat{i} - 2\hat{j} + 5\hat{k})$ V/m. The electric field in the region $z < 0$ is
- [A] $(8\hat{i} - 4\hat{j} + 6\hat{k})$ V/m
 - [B] $(4\hat{i} - 2\hat{j} + 8\hat{k})$ V/m
 - [C] $(8\hat{i} - 4\hat{j} - 6\hat{k})$ V/m
 - [D] $(4\hat{i} - 2\hat{j} + 10\hat{k})$ V/m
34. The decay rates for $\mu^- \rightarrow e^- \bar{\nu}_e \nu_\mu$ and $\tau^- \rightarrow e^- \bar{\nu}_e \nu_\tau$ are related by $\Gamma_\mu = 7.5 \times 10^{-7} \Gamma_\tau$. The mean life of μ^- is 2.2×10^{-6} seconds and the branching ratio of μ^- decay is 100%. If the branching ratio of τ^- decay is 17.85%, the estimated mean life of τ^- is
- [A] 0.1×10^{-13} seconds
 - [B] 2.9×10^{-13} seconds
 - [C] 2.2×10^{-6} seconds
 - [D] 1.6×10^{-6} seconds
35. Following Bloch's theorem in the band theory of solids, the wave function of an electron moving in a periodic potential can be expressed as
- [A] a plane wave independent of the potential
 - [B] a product of a plane wave and a periodic function
 - [C] a product of a gaussian function and a periodic function
 - [D] a constant function

36. Two rockets are sent from earth in opposite directions each with a speed of $0.5c$ relative to earth. One rocket transmits an electromagnetic signal at a frequency 12 GHz. The frequency of the receiver on the other rocket, that must be tuned to detect the signal, is

[A] 12 GHz
 [B] 4 GHz
 [C] 8 GHz
 [D] 6 GHz

37. The region of operation of the silicon transistor shown in the circuit is



[A] cut-off
 [B] active
 [C] saturation
 [D] breakdown

38. The Q value for the alpha decay $^{230}\text{Th}_{90} \rightarrow ^{226}\text{Ra}_{88} + \alpha$ (ground state decay) is 4.77 MeV. Taking the mass numbers as the approximate masses, the kinetic energies of the alpha particle and the daughter nucleus, respectively, are approximately

[A] 3.15 MeV, 1.62 MeV
 [B] 4.69 MeV, 0.08 MeV
 [C] 5.12 MeV, 0.21 MeV
 [D] 2.25 MeV, 0.15 MeV

39. Two plane waves with the electric fields $\vec{E}_1 = E_0 \hat{e}_1 e^{i[k_0(x+y+z)-\omega t]}$, $\vec{E}_2 = E_0 \hat{e}_2 e^{i[k_0(x-y-z)-\omega t]}$, where $\hat{e}_1, \hat{e}_2$ are unit vectors and E_0 a constant. The visibility $\frac{I_{\max} - I_{\min}}{I_{\max} + I_{\min}}$ of the resulting interference pattern is

[A] $|\hat{e}_1 \cdot \hat{e}_2|$

[B] $|\hat{e}_1 + \hat{e}_2|$

[C] $\frac{1 - |\hat{e}_1 \cdot \hat{e}_2|}{1 + |\hat{e}_1 \cdot \hat{e}_2|}$

[D] $\frac{1}{1 + |\hat{e}_1 \cdot \hat{e}_2|}$

40. The electronic configuration of Pr is $[\text{Xe}] 4f^3 6s^2$. The magnetic moment of Pr^{3+} ion in the ground state is (in units of Bohr magneton)

[A] 4.47

[B] 6.12

[C] 8.00

[D] 3.58

F-1

Rough Work

Rough Work

Rough Work

PHYSICS

Final Key

16-6-2026

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

Question Number	Answer
21	A ✓
22	D ✓
23	C ✓
24	C ✓
25	B ✓
26	C ✓
27	C ✓
28	A ✓
29	A ✓
30	A ✓
31	B ✓
32	A ✓
33	D ✓
34	B ✓
35	B ✓
36	B ✓
37	C ✓
38	B ✓
39	A ✓
40	D ✓

UNIVERSITY OF HYDERABAD

ENTRANCE EXAMINATIONS - 2026

PHD ADMISSIONS - JULY SESSION

PHYSICS.

V. N. Srinivasulu Reddy 09/06/26