

Booklet Serial No.

Signature Invigilator

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PhD Physics
Entrance Test May 2026
Question Paper cum Answer Script

Hall Ticket No.

OMR Serial No.

Time: 2hrs

Maximum Marks: 70

INSTRUCTIONS FOR CANDIDATES

1. Candidate should write their Hall Ticket number and OMR number on the space provided above. Candidate should not write their Hall Ticket and OMR number at any other place.
2. This question booklet contains (28) pages. The Candidate should check the booklet before taking the Test. In case of any discrepancy, a new booklet may be provided by the Invigilator.
3. The question booklet consists of Part A and Part B. Part A contains 50 multiple-choice questions, each with four options. The candidate must select the correct answer and mark the corresponding circle on the OMR sheet using a blue or black ballpoint pen. Each question carries one mark. No marks will be awarded if the correct answer is not properly marked against the corresponding question number in the OMR sheet. Further, if more than one option is marked for any question, no marks will be awarded for that question.
4. Part B consists of four descriptive questions, each carrying 5 marks. The answers must be written only in the 8-page answer booklet provided. No additional answer booklet will be issued.
5. There are no Negative marks.
6. At the end of Entrance Test, candidates are allowed to take their question booklet and handover the OMR Sheet and answer booklet to the Invigilator.

Part A**Section 1 – Research Methodology**

1. In order to pursue the research, which of the following is priorly required
 - (A) Developing a research design
 - (B) Formulating a research question
 - (C) Deciding about the data analysis procedure
 - (D) Formulating a research hypothesis

2. How to judge the depth of any research
 - (A) By research title
 - (B) By research duration
 - (C) By research objectives
 - (D) By total expenditure on research

3. Which of the following is not the method of Research?
 - (A) Survey
 - (B) Historical
 - (C) Observation
 - (D) Philosophical

4. Research is
 - (A) Searching again and again
 - (B) Finding solution to any problem
 - (C) Working in a scientific way to search for truth of any problem
 - (D) None of the above

5. In the process of conducting research ‘Formulation of Hypothesis’ is followed by
 - (A) Statement of Objectives
 - (B) Analysis of Data
 - (C) Collection of Data
 - (D) Selection of Research Tools

6. The main objective ofstudies is to acquire knowledge.
- (A) Exploratory (B) Descriptive
(C) Diagnostic (D) Descriptive and Diagnostic
7. Concepts are of Research.
- (A) Guide (B) Tools
(C) Methods (D) Variables
8. Survey is a Study
- (A) Descriptive (B) Fact finding
(C) Analytical (D) Systematic
9. What are the core elements of a Research Process?
- (A) Introduction; Data Collection; Data Analysis; Conclusions and Recommendations
(B) Executive Summary; Literature Review; Data Gathered; Conclusions; Bibliography
(C) Research Plan; Research Data; Analysis; References
(D) Introduction; Literature Review; Research Methodology; Results; Discussions and Conclusions
10. Identifying causes of a problem and possible solution to a problem is
- (A) Field Study (B) Pilot study
(C) Action study (D) Diagnostic study
11. Questionnaire is filled by
- (A) Respondent (B) Everybody
(C) Enumerator (D) None of the above

12. Final stage in the Research Process is
- (A) Problem formulation (B) Data collection
(C) Data Analysis (D) Report Writing
13. A comprehensive full Report of the research process is called
- (A) Thesis (B) Summary Report
(C) Abstract (D) Article
14. Which of the following is not one of the seven major parts to the research report?
- (A) Results (B) Abstract
(C) Method (D) Footnotes
15. What are the main purposes of data analysis?
- (A) Description
(B) Explanation and prediction
(C) Generating empirical relationships
(D) Construction of Measurement Scale
16. Which type of research is also called as decisional research?
- (A) Action research (B) Pure research
(C) Applied research (D) Explanatory research
17. Which of the following is not a data collection method?
- (A) Observation (B) Schedules
(C) Interview (D) Research question

18. Review of literature means?
- (A) Documentation of referenced material
 - (B) Overview of the previously published works on specific topic
 - (C) Formation of a theoretical framework
 - (D) Elucidating and testing hypothesis
19. is a strategy for addressing research issues in partnership with local people.
- (A) Action research
 - (B) Pure research
 - (C) Applied research
 - (D) Evaluation Research
20. Which of the following is not a feature of Correlational survey?
- (A) A focus on naturally occurring patterns
 - (B) Identifying causality
 - (C) The measurement of specific variables
 - (D) The use of statistics to clarify patterns of relationships
21. Which of the following stage is known as 'blueprint' of a research?
- (A) Development of Working Hypothesis
 - (B) Research design
 - (C) Formulating the Research Problem
 - (D) Execution of the Project
22. The research is mainly focusing testing theories and hypothesis rather than its practical applicability. It is known as?
- (A) Applied research
 - (B) Pure research
 - (C) Action research
 - (D) Participatory research

23. It is defined as the systematic collection of numerical data and application of statistical, mathematical, or computational approaches to investigate phenomena, it is known as?
- (A) Experimental research (B) Qualitative research
(C) Quantitative research (D) Applied research
24. Pure research is also known as?
- (A) Fundamental research (B) Exploratory research
(C) Action research (D) Explanatory research
25. Which of the following is not a method of data collection is not used in the case study?
- (A) Correlational method
(B) Interviews and surveys
(C) Participant and non-participant observations
(D) Secondary data

Section 2 – Physics

Note: Values of Physical Constants:

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

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

26. A motorist travels in a straight line with a velocity v for a distance d , followed by a distance $2d$ with a velocity $2v$. the average velocity is:
- (A) v (B) $v/2$
(C) $3v/2$ (D) $3v/4$
27. Consider a curve defined by $y=f(x)$. If the slope of the tangent at x is proportional to x , then the curve is:
- (A) a circle (B) an ellipse
(C) a straight line (D) a parabola

28. The Fourier transform of a Gaussian function is:
- (A) a Gaussian (B) a Lorentzian
(C) an exponential function (D) a Sine function
29. The radial size of the nucleus is proportional to $A^{1/3}$, where A is the mass number. In the liquid drop model of the nucleus, the surface energy term contributing to the binding energy is proportional to:
- (A) A (B) $A^{1/2}$
(C) $A^{1/3}$ (D) $A^{2/3}$
30. The Miller indices of a plane, that intercepts the crystal axes at $3a$, $b/2$ and $3c$ respectively are:
- (A) (161) (B) (611)
(C) (116) (D) (323)
31. For a particle in one-dimensional box with periodic boundary conditions, we have:
- (A) A doubly-degenerate ground state and non-degenerate excited state.
(B) A non-degenerate ground state and doubly-degenerate excited state.
(C) Doubly-degenerate ground and excited states.
(D) Non-degenerate ground and excited states.
32. A LASER with a wavelength of 532 nm is passing through water of refractive index 1.34. the minimum angle of incidence, for which the light is totally reflected from the interface with air is:
- (A) 30.22° (B) 45.22°
(C) 42.22° (D) 48.22°

33. The Degeneracy of a three-dimensional harmonic oscillator energy level of energy $\frac{9}{2}\hbar\omega$ is:
- (A) 3 (B) 8
(C) 4 (D) 10
34. The correct ordering of the numerical methods, according to their rate of convergence, from the lowest to the highest speed is:
- (A) Bisection, Newton-Raphson and Secant
(B) Bisection, Secant and Newton-Raphson
(C) Newton-Raphson, Bisection and Secant
(D) Secant, Newton-Raphson and Bisection
35. The interplanar spacing for a BCC (Body Centered Cubic) crystal corresponding to (100) planes is d_{100} and for (111) planes is d_{111} . The ratio $d_{100} : d_{111}$ is:
- (A) $1 : \frac{1}{\sqrt{3}}$ (B) $1 : 3$
(C) $1 : \frac{2}{\sqrt{3}}$ (D) $2 : \frac{1}{\sqrt{3}}$
36. The number of vibrational modes of CO_2 and SO_2 molecules, respectively are:
- (A) 4, 3 (B) 4, 4
(C) 3, 4 (D) 3, 3
37. Given that the mass of the Deuteron is $m_D = 1875.61 \text{ MeV}$ and the masses of the proton and the neutron are $m_p = 938.28 \text{ MeV}$ and $m_n = 939.57 \text{ MeV}$. The Binding energy of the deuteron is ($C = 1$)
- (A) 2.24 MeV (B) 937.33 MeV
(C) 936.04 MeV (D) 1.29 MeV

38. Consider a planet in an elliptic orbit around the SUN with energy E , the angular momentum $\vec{L}$, the momentum $\vec{P}$. Then

- (A) $\vec{L}$ and E are conserved and $\vec{P}$ is not conserved.
 (B) $\vec{L}$ and $\vec{P}$ are conserved and E not conserved.
 (C) $\vec{P}$ and E are conserved and $\vec{L}$ is not conserved.
 (D) $\vec{P}$, $\vec{L}$ and E conserved.

39. Consider the ground state for a free particle state (FP), a particle moving in a harmonic potential in one dimension (HO) and an electron in a hydrogen atom (HA). The ground state energies in the three cases are ordered in an ascending form as:

- (A) FP, HO, HA (B) HA, HO, FP
 (C) HO, HA, FP (D) HA, FP, HO

40. Using the Karnaugh map shown, the reduced Boolean algebraic expression is:

RS PQ	00	01	11	10
00	1	1	0	0
01	0	0	0	0
11	1	0	0	0
10	1	1	0	0

- (A) $\bar{Q} \bar{R} + \bar{P} \bar{R} \bar{S}$ (B) $Q R + P \bar{R} \bar{S}$
 (C) $\bar{Q} R + P \bar{R} S$ (D) $\bar{Q} \bar{R} + P \bar{R} \bar{S}$

41. Coaxial superposition of right – handed and left – handed circular polarized waves of equal amplitudes, with an initial phase difference of δ , is

- (A) Linearly polarized with $\vec{E}$ at an angle $\delta / 2$ with x-axis
 (B) Linearly polarized with $\vec{E}$ at an angle δ with x-axis
 (C) Right – handed elliptically polarized
 (D) Left – handed elliptically polarized

42. Consider a three level system which has a ground state energy $-\Delta$, and the two excited states with same energy Δ . If this system is in equilibrium with a reservoir at temperature Δ/K_B , the probability of finding the system in ground state is:
- (A) $1/3$ (B) $1/2$
 (C) $\frac{e^2}{(2 + e^2)}$ (D) $\frac{e^2}{(1 + e^2)}$
43. The measured values of quantities x , y and z respectively are 1, 2 and 3. If the measured errors are respectively 0.01, 0.02 and 0.01 then the fractional error in the function $2x^2y + 5z/y$ is approximately:
- (A) 2% (B) 4%
 (C) 1% (D) 3%
44. The $2P \rightarrow 1S$ transition in the Hydrogen atom corresponds to an angular frequency $\omega = 1.5 \times 10^{16}$ Hz. If the lifetime of the $2P$ state for spontaneous emission is 1.6×10^{-9} s, assuming refractive index $n = 1$ then the Einstein A_{21} , coefficient is:
- (A) $6.25 \times 10^8/\text{s}$ (B) $2.40 \times 10^7/\text{s}$
 (C) $0.94 \times 10^{25}/\text{s}$ (D) $1.01 \times 10^{-25}/\text{s}$
45. Consider the phonon spectra of a two-dimensional lattice with three atoms per unit cell. The number of acoustic and optical phonon branches respectively are:
- (A) 2 and 3 (B) 2 and 4
 (C) 4 and 2 (D) 3 and 2
46. The Binary equivalent of $(8.2)_{10}$ is
- (A) 1001.0011 (B) 1000.0011
 (C) 1000.0110 (D) 0111.0110

47. Alpha decay is an example of
- (A) Nuclear fission (B) Barrier Generation
(C) Coulomb repulsion (D) Nuclear Ionization
48. A hollow metallic waveguide can support:
- (A) TE, TM and TEM waves (B) Either TE or TM waves
(C) Both TE and TM waves (D) Only TE waves
49. To use a transistor as an amplifier:
- (A) Emitter – base junction should be forward-biased and the collector-base junction reverse-biased.
(B) Both junctions should be forward biased.
(C) Both junctions should be reserve biased.
(D) None of the above
50. Beta decay of nucleus is an example of which force:
- (A) Weak nuclear force (B) Strong nuclear force
(C) Nuclear fission (D) Nuclear fusion

Part B (Descriptive Questions)

Answer all four questions

20 Marks

Research Methodology

1. Describe the various steps involved in a research process.
2. Distinguish between Pure and Applied research.

Physics

3. Differentiate between Classical Mechanics and Quantum Mechanics.
4. Write a note on Special Semiconductor Diodes.

Rough Work

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