Guidelines for PhD Admission Test at Centre for High Energy Physics

Test for PhD admission will have two parts; Part A and Part B
(Both Parts will be MCQ based)

Part A: This part will be GRE/HAT general type. It is mandatory to score 60% marks in this part.
Part B: This part will contain MCQs from the Physics related subjects, etc.
Note: It is mandatory to score 60% in cumulative in the admission test.

The questions related to the following concepts will be part of the test.

- English/Verbal Reasoning, Analytical Reasoning and Quantitative Reasoning
- Mathematics (Quantitative skills, Vectors, Calculus, Complex Analysis, Fourier and Taylor Series, Tensor and Fourier Analysis, Green function, etc.)
- Quantum Mechanics
- Computational skills (understanding simple programs and algorithms)
- Electromagnetism (Law of electrostatics and magneto statics, and Maxwell's equations etc.)
- Classical Mechanics (including the Lagrangian and Hamiltonian formulations)
- Special Relativity
- Atomic and Nuclear Physics
- Group Theory
- Relativistic Quantum Mechanics
- Statistical Physics
- Verbal reasoning (English)
- Analytical reasoning (Logical thinking)

The candidates may consult the following books:

1. Any Books related to preparation of GRE/HAT general, such as "GAT General" Dogar Publishers or other books of the similar standard and contents.
2. "Calculus and Analytic Geometry" by G.B. Thomas and R.L. Finney,
3. "Mathematical Methods for Physicists", G. Arfken,
4. "Physics", by Halliday, Resnick and Krane,
5. "Perspectives of Modern Physics", by A. Beiser,
6. "Quantum Mechanics" by Zettili
7. "Mathematica for Scientists and Engineers" by Thomas B. Bahder
8. "Classical Electrodynamics" by Griffith or Ritz
9. "Classical Mechanics" by T.L. Chow,
10. "Statistical physics" by F. Reif
11. "Nuclear Physics" by Berchem or Williams
12. "Group Theory for High Energy Physicists" By Mohammad Saleem, Muhammad Rafique
13. "Relativistic Quantum Mechanics. Wave Equations" By Walter Greiner

Sample Paper for the Admission Test of PhD, 2023

Centre for High Energy Physics, University of the Punjab, Lahore, Pakistan.

Choose the correct one amongst the choices given against each question.

Part A:

Sample Questions of Verbal Reasoning

1. Identify the synonym of curious
   A. Disinterested
   B. Inquisitive
   C. Unconcerned
   D. Ordinary

2. We went to the _____ to see how coins are made.
   A. Tannery
   B. Mint
   C. Arsenal
   D. Winery

3. Identify the antonym of persistence:
   A. Incompetence
   B. Inconsistency
   C. Inequality
   D. Irrelevance

Sample Question of Analytical Reasoning

4. Mrs. Green wishes to renovate her cottage. She hires the services of a plumber, a carpenter, a painter, an electrician, and an interior decorator. The renovation is to be completed in a period of one working week i.e. Monday to Friday. Every worker will be taking one complete day to do his job. Mrs. Green will allow just one person to work per day.
   The painter can do his work only after the plumber and the carpenter have completed their jobs.
   The interior decorator has to complete his job before that of the electrician.
   The carpenter cannot work on Monday or Tuesday.

   Which arrangement among the following is possible?
   A. The electrician will work on Tuesday and the interior decorator on Friday.
   B. The painter will work on Wednesday and the plumber on Thursday.
   C. The carpenter will work on Tuesday and the painter on Friday.
   D. The carpenter will work on Wednesday and the plumber on Thursday

Sample Questions of Quantitative Reasoning

5. A person invests $18,000 at 4% simple annual interest. How much interest has been

earned after four months?

A. $60

B. $180

C. $240

D. $360

6. The ages of Sohail, Afzal, and Bilal are 17, 16, and 12 respectively. If the age of Aslam is also included the average of the ages is increased by 5. What is the age of Aslam?

A. 32

B. 33

C. 34

D. 35

Part B:

1. Eigenvectors of a Hermitian operator belonging to different eigenvalues are
   α) not possible   β) scalar multiple of each other
   γ) complex conjugate of each other   δ) orthogonal.

2. What is the speed of a cubical box so that its contracted volume is half of its value when at rest?
   α) 0.866c   β) 0.5c   γ) 0.999c   δ) 0.233c η) 0.144c

3. What is the standard deviation in decay rate of an unstable nucleus if its average rate is $64\ s^{-1}$?
   α) $4\ s^{-1}\ s$ β) $6\ s^{-1}$ γ) $8\ s^{-1}$ δ) $10\ s^{-1}$ η) $6.4\ s^{-1}$

4. Consider a solenoid with R<<L. The magnetic field at the center of the solenoid is B_0. A second solenoid is constructed that has twice the radius, twice the length, and carries twice the current as the original solenoid, but has the same number of turns per meter. The magnetic field at the center of second solenoid is
   α) $B_0/2$ β) B_0 γ) $2B_0$ δ) $4\ B_0$

5. Let $Z_0 = \dfrac{1}{2}i$ lies inside a simple closed path C. Then $\oint \dfrac{z^3-6}{2z-i}$ is equal to
   α) $\dfrac{\pi}{8} - 6\pi i$ β) $\dfrac{1}{8} - 6i$ γ) $\dfrac{1}{8} - 6\pi i$ δ) $\dfrac{\pi}{8} - 6i$

6. Let $A = \begin{bmatrix} -5 & 2 \\ 2 & -2 \end{bmatrix}$, then eigensystem of the matrix A is
   α) $\begin{bmatrix} 1 \\ 2 \end{bmatrix}, \begin{bmatrix} 1 \\ -2 \end{bmatrix}, 0, -1, 3$ β) $\begin{bmatrix} 1 \\ 2 \end{bmatrix}, \begin{bmatrix} 2 \\ -1 \end{bmatrix}, 0, -1, -6$ γ) $\begin{bmatrix} 1 \\ 2 \end{bmatrix}, \begin{bmatrix} 2 \\ -1 \end{bmatrix}, 0, 1, -6$ δ) $\begin{bmatrix} 1 \\ 2 \end{bmatrix}, \begin{bmatrix} 1 \\ -2 \end{bmatrix}, -1, 3$

7. At the end of the following assignments: x = 2; y = 3; x = y + x; y = y − x; x = y^2, the values of x and y are
   α) 2, 3   β) 3, 2   γ) 4, -2   δ) 4, 3

8. Consider a rigid body moving freely in space, then which statement is true for the number of degree of freedom and for the number of constraint equations
   α) No. of Degree of freedom is 3 and No. of constraint equations is 3
   β) No. of Degree of freedom is 6 and No. of constraint equations is 2
   γ) No. of Degree of freedom is 6 and No. of constraint equations is 3
   δ) No. of Degree of freedom is 3 and No. of constraint equations is 6