Entrance Test for Enrollment in Ph.D. Programme
July 2017

Time: 120 Mins. **Max. Marks: 120**

Stream : **Applied Sciences** Discipline : **Physics** Set : **A** Test ID : **51**

Name :

Father's Name :

Roll Number : | | | | | | | | | | ***Date :*** | | | | | | | | |

Roll Number in words :

Signature of Candidate :

Signature of Invigilator :

IMPORTANT INSTRUCTIONS

- Do not Open seal before start of Exam.
- Fill all the information in various columns in capital letters, with blue/black ball point pen.
- Use of calculators is not allowed.
- All questions are compulsory. No negative marking for wrong answers.
- Each question has only right answer.
- Questions attempted with two or more options/answers will not be evaluated.
- Kindly bring any one of the original photo-identity proofs at the time of entrance test, like Voter ID Card, Driving License, PAN Card or Passport along with **ADMIT CARD.**
- Study the instructions carefully before the start of examination.
- The time duration for the test will be 120 minutes.
- You must report at examination centre 30 minutes prior to examination.
- Test will comprise of two sections. The Section-I will comprise of Research Methodology and section-II will be Subject specific. Each Section will comprise of 60 questions carrying each making total paper of 120 marks.
- **It will be compulsory for the candidate to secure minimum passing marks in each section (which amounts to be 50% i.e. 30 marks for the general category and 45% i.e. 27 for reserved categories in each section)**. The passing marks will be 50% of the total i.e. 60 marks for general category and 45% for reserved categories i.e. 54 marks.
- The questions paper will comprise of Multiple Choice Questions.
- Each question will have only one right answer.
- Blank, Cutting, Erasing, Half filling or Question attempted with two or more answers will not be evaluated
- There is no negative marking for wrong answers.
- OMR sheet should not be folded or crushed.
- Use only **BLACK BALL POINT PEN** to fill the ovals.
- Use of pencil is strictly prohibited.
- Ovals on **OMR sheet** should be darkened completely and properly filled.
- Cutting and erasing on **OMR sheet** is not allowed.
- Do not use any stray marks on the **OMR sheet**.
- Do not use marker or white fluid to hide the marks.
- Fill **ROLL NUMBER** and **TEST ID** carefully on the **OMR sheet.**
- Use of calculator is not allowed.
- Log tables may be provided for calculation work, if required.
- The medium of the examination is English only.
- No sheet will be provided for the rough work. Reverse side of the question paper can only be used for rough work.
- **Carrying mobile phones, electronic gadgets, notes or extra papers in examination hall is not allowed.**

Research Methodology
Section –I

1. Which of the following is the best way to test a hypothesis according to the hypothetico-deductive method?
    a. By finding evidence which supports the hypothesis.
    b. By repeating a study looking for consistency in outcomes.
    c. By rejecting the hypothesis.
    d. By looking for instances where the hypothesis fails.
2. Which of the following are the most similar?
    a. Ordinal, interval and ratio data
    b. Nominal, ratio, and interval data
    c. Nominal and ratio data
    d. Nominal, ordinal and ratio data
3. What sort of variable is dress size?
    a. Ordinal
    b. Ratio
    c. Nominal
    d. Dependent
4. What is deemed a good measure of the quality of a journal?
    a. The intake factor.
    b. The impact factor.
    c. The OPAC factor.
    d. The influence factor.
5. Variables in a cross-sectional design are:
    a. nominal data.
    b. a mixture of both score and nominal data.
    c. frequencies.
    d. score data
6. Studies which measure the same variables in the same cases over time are called:
    a. lagged.
    b. panel.
    c. cross-lagged.
    d. synchronous.
7. Response rate refers to:
    a. how confident you want to be about your results.
    b. how variable participants' responses are.
    c. the proportion of people who take part in a study.
    d. how big a population is.
8. The difference between the mean of a researcher's sample and the mean of the population of the sample is known as the:
    a. sampling error.
    b. significance level.
    c. confidence interval.
    d. standard deviation.
9. The purpose of research is:
    a. to extend the conceptual understanding of a topic.
    b. that the empirical work should be testing a theory.

c. primarily to get more data.
d. to produce work of publishable quality.

10. Which of the following is the first step in starting the research process?
    a. Searching sources of information to locate problem.
    b. Survey of related literature
    c. Identification of problem
    d. Searching for solutions to the problem
11. Questionnaire is a
    a. Research method
    b. Measurement technique
    c. Tool for data collection
    d. Data analysis technique
12. Which of the following is not covered under Intellectual Property Rights ?
    a. Copyrights
    b. Patents
    c. Trade Marks
    d. Thesaurus
13. Field study is related to
    a. real life situations
    b. experimental situations
    c. laboratory situations
    d. none of the above
14. Which of the following is a non-probability sample ?
    a. Quota sample
    b. Simple random sample
    c. Purposive sample
    d. (a) and (c) both
15. Formulation of hypothesis may not be necessary in
    a. survey studies
    b. fact finding (historical) studies
    c. normative studies
    d. experimental studies
16. All are causes of non sampling errors except
    a. faulty tools of measurement
    b. inadequate sample
    c. non response
    d. defect in data collection
17. The review of the related study is important while undertaking a research because
    a. it avoids repetition or duplication
    b. it helps in understanding the gaps
    c. it helps the researcher not to draw illogical conclusions
    d. all of above
18. Of all of the steps in the research process, the one that typically takes the most time is
    a. selecting a research method.
    b. developing a hypothesis.
    c. data collection.
    d. formulating the problem.
19. A mean, median and mode are all examples of _____

a. measures of correlation
b. measures of enumeration
c. measures of coefficients
d. measures of central tendency

20. Research carried out to portray accurately the characteristics of a particular individual, situation or a group are termed as
    a. Exploratory
    b. Descriptive
    c. Diagnostic
    d. None of these
21. A _____ is conducted to detect weaknesses in research instrument's design
    a. Pilot study
    b. Questionnaire
    c. Interview
    d. Sampling
22. One of the important characteristics of a good research is that the purpose of the research is
    a. Clearly defined
    b. Vaguely defined
    c. Not defined
    d. All of the above
23. In order to deliver a good research, a researcher should confine the conclusions to those justified by
    a. The Data
    b. The Perception of Researcher
    c. The Intuition
    d. The Guide
24. The research plan should include
    a. Research objective
    b. Research Methods
    c. Sampling Plan
    d. All of these
25. Which of the following are excellent sources for research topics?
    a. Theory
    b. Personal experience
    c. Replication of prior research
    d. All of the above
26. A review of the literature should enable an investigator to do which of the following?
    a. Ascertain what is already known about a topic.
    b. Identify methodological strategies for designing the study.
    c. Provide the insight necessary to develop a logical framework into which the topic fits.
    d. All of the above.
27. The Internet has become an accepted source of information for educational research. Which of the following is NOT an indicator of the quality of information found on the Internet?
    a. The number of "hits" for the site
    b. The honesty with which information is reported and presented
    c. The authenticity of the information
    d. The lack of bias
28. A literature review should be characterized by all of the following EXCEPT
    a. summarize and report each article.

b. use important topics as the organizing structure of the review.
c. analyze all articles for similarities and differences related to major topics.
d. discuss implications relative to the research problem.

29. Which of the following is the BEST hypothesis?
    a. Students taking formative quizzes will perform better on chapter exams than students not taking these quizzes.
    b. Taller students will have higher test scores than shorter students.
    c. Students taught in a cooperative group setting should do better than students in a traditional class.
    d. Students using laptops will do well.
30. Which of the following statistics is most closely related to the standard error of the mean?
    a. Mean
    b. Standard deviation
    c. Z score
    d. Correlation
31. A significant result of a chi square test of significance would suggest the researcher should
    a. accept the null hypothesis.
    b. reject the null hypothesis.
    c. reject the alternative hypothesis.
    d. replicate the study.
32. Ram has set a very conservative alpha level of .001 for his analysis. He is likely concerned about a
    a. Type I error.
    b. Type II error.
    c. standard error.
    d. test of significance.
33. Mr. Sham has identified two groups of students to participate in his study examining the effectiveness of using algebra tiles. One group will use these manipulatives while a second group will receive a traditional lecture approach. Which test should be used to test the differences between the mean scores for the two classes?
    a. t test for dependent samples
    b. t test for independent samples
    c. Chi square
    d. Scheffé post hoc comparison
34. Which of the following is a common post hoc test?
    a. Scheffé
    b. Tukey HSD
    c. Duncan's Multiple Range Test
    d. All of the above
35. Ms. Rani is making decisions to accept students into her college based on a prediction of a student's future performance derived from his or her high school GPA, ACT score, and college placement test score. Which statistical procedure did she use to develop this predictive process?
    a. ANOVA
    b. ANCOVA
    c. Multiple regression
    d. Chi square
36. Which section of a research report sets the stage for the report and indicates where in the report each component, tables, and figures can be found?
    a. Preliminary pages
    b. Table of contents

c. Main body
d. Appendices

37. In which section is the researcher allowed greater flexibility to express opinions, discuss implications for educational practice, and suggest additional research?
    a. Review of the literature
    b. Significance of the study
    c. Results
    d. Discussion
38. An unhypothesized result represents a(n)
    a. accepted null hypothesis.
    b. rejected null hypothesis.
    c. unintended result that appeared in the study.
    d. statistical error.
39. The purpose of random sampling is to ensure
    a. a sufficient sample size.
    b. a clearly defined target population.
    c. representativeness of the sample.
    d. representation of specific subgroups in the population.
40. Which of the following is NOT a random sampling technique?
    a. Purposive sampling
    b. Stratified sampling
    c. Cluster sampling
    d. Systematic sampling
41. The logic of purposive sampling is
    a. that a random sample can generalize to a population.
    b. that a few information-rich participants studied in depth yield many insights about a topic.
    c. to include all participants, even though they are not all relevant to the problem.
    d. to use participants because the researcher has access to them.
42. Which of the following is a characteristic of a standardized test?
    a. The administration of the test is controlled carefully to ensure that all examinees experience the same conditions.
    b. The test is developed by experts to ensure it is technically sound.
    c. The scores are interpreted in standard ways.
    d. All of the above.
43. Which of the following is a characteristic of qualitative research?
    a. It relies on disciplined inquiry.
    b. It uses random sampling techniques.
    c. It uses a static, fixed research design.
    d. It is deductive in orientation
44. Memo writing helps accomplish all of the following EXCEPT
    a. identify topics or issues for further exploration.
    b. select appropriate participants.
    c. identify areas that could provide focus for the formal data analysis.
    d. provide opportunities to reflect on methodology.
45. Which of the following represents excellent advice for conducting an interview?
    a. Listen more and talk less.
    b. Don't interrupt.
    c. Don't be judgmental about the interviewee's beliefs or views.

d. All of the above.

46. Which of the following types of items is likely to result in the most objective score?
    a. Open-ended
    b. Short answer
    c. Multiple choice
    d. Essay
47. Measures of variability indicate
    a. the average score.
    b. the central tendency of scores.
    c. the extent to which scores differ from one another.
    d. the relationships between variables.
48. Approximately what percentage of scores in a normal distribution fall between +1 and -1 standard deviations?
    a. 50
    b. 68
    c. 75
    d. 99
49. Mr. Ram has ranked the students in his class on the basis of their math scores. He wants to compare these ranks with the ranks of the same students in Ms.Rani's English class. Which correlation coefficient is appropriate for Mr. Ram to use?
    a. Pearson r
    b. Spearman rho
    c. Mean
    d. Quartile deviation
50. Primary data which is gathered by observing relevant actions and people is called
    a. experimental research
    b. ethnographic research
    c. observational research
    d. survey research
51. Idea generation by two or more people thinking as freely as possible is formally known as:
    a. brainstorming.
    b. the learning curve.
    c. forced relationships.
    d. clap-trapping.
52. Which ONE of these is an example of processed data?
    a. Number of visitors to a store.
    b. Tables from surveys.
    c. Customer comments.
    d. CCTV recordings of shopper visits.
53. Which ONE is an advantage of secondary data?
    a. May be outdated.
    b. May not be accurate.
    c. Expensive.
    d. Already exist.
54. With efficient IPR system, India becomes prosperous in terms of "Knowledge Economy", which is a boon towards the goal of VISION-____?
    a. 2020
    b. 2030

c. 2040
d. 2050

55. The copyrights does not include rights in form of
    a. news-paper items,
    b. land ownership
    c. story books,
    d. poetry books,
56. In India, Patent rights are governed by
    a. Patent Act, 1970
    b. Patent Act, 1980
    c. Patent Act, 1990
    d. Patent Act, 1950
57. A mark shall not be registered as a trade mark if
    a. It is of such nature as to deceive the public or cause confusion:
    b. It contains or comprises of any matter likely to hurt the religious susceptibilities of any class or section of the citizens of India;
    c. It comprises or contains scandalous or obscene matter
    d. All of these
58. Computer programmes are protected under the
    a. Copyright Act
    b. Trademark Act
    c. Patent Act
    d. All of these
59. The general rule is that copyright lasts for
    a. 45 Years
    b. 50 Years
    c. 55 Years
    d. 60 Years
60. The existing legislation on industrial designs in India is contained in the New
    a. Designs Act, 2000
    b. Designs Act, 2009
    c. Designs Act, 1995
    d. Designs Act, 2015

Section - II Physics

61. If A and B are idempotent matrices, then A+B will be idempotent if

a. AB=0
a. b.BA=0
b. AB=BA=0
c. None of these

62. The matrix $\begin{bmatrix} 0 & -4 & 1 \\ 4 & 0 & -5 \\ -1 & 5 & 0 \end{bmatrix}$ is

a. Orthogonal
b. Idempotent
c. Skew symmetric
d. Symmetric

63. Which of the following is false?

a. A symmetric matrix is one for which the transpose of the matrix is the same as the original matrix.
b. Diagonal elements of an antisymmetric matrix are all zeros.
c. An anti symmetric matrix is one for which the transpose of the matrix is the negative of the original matrix.
d. The inverse of a matrix and inverse of its transpose are the same.

64. The value of $\int_c \frac{zdz}{\sin z}$ where C: |z|=4 is

a. 2πi
b. b.-2πi
c. 0
d. d.-4πi

65. Find the analytic function f(z)=u+iv, if $v = e^{-y}sinx$

a. e^{iz}
b. e^{-iz}
c. ln z
d. none of these

66. What is the coefficient of the term z^4 in the Taylor series expansion of $\frac{\sin z}{e^{-z}}$ about the origin?

a. $\frac{1}{4}$
b. $-\frac{1}{4}$
c. $\frac{1}{6}$
d. $-\frac{1}{6}$

67. The wave particle duality is evident in

a. the photograph effect
b. the Maxwell's equations

c. the faraday effect
d. the compton effect

68. If an observable has no explicit time dependence and it commutes with the Hamiltonian, then it is a quantum mechanical

a. dynamical variable
b. constant of the stagnation
c. universal constant
d. constant of the motion.

69. Which of the following is true?

a. Newton's second law can be obtained from Schrodinger's equation.
b. Schrodinger's equation can be obtained from Newton's second law.
c. both (a) and (b) are correct.
d. none of above.

70. For an atom placed in external magnetic field, the most dominant interaction is

a. Hartee interaction
b. Coulombic interation
c. spin-orbit interation
d. Zeeman splitting

71. An electron cannot have the quantum numbers n, l m_l as

a. 6, 1, 0
b. 3, 2, 3
c. 3, 2, -2
d. 1, 0, 0

72. In Rutherford scattering cross section, differential cross section is proportional to [e=charge]

a. e
b. e^2
a. $c.e^3$
c. e^4

73. On the annihilation of particle and its anti-particle, the energy released is E, mass of each particle is

a. $\frac{E}{c^2}$
b. $\frac{E}{2c^2}$
c. $\frac{E}{C}$
d. $\frac{E}{2C}$

74. Possible longitudinal normal modes of the linear symmetric triatomic molecule is/are

a. One

b. Two
c. Three
d. Four

75. A gamma ray of energy 2.2MeV produces an electron positron pair. Then the energy imparted to each of the charge particles is nearly

a. 1.1 MeV
b. 0.51 MeV
c. 0.59 MeV
d. 1.18 MeV

76. When electromagnetic waves are propagated in waveguide

a. they travel along the broader walls of the guide
b. they are reflected from the wall but, do not travel along them
c. they travel through the dielectric without touching the walls
d. they travel along all four walls of the waveguide

77. The dominant mode in a rectangular wave guide is TE_0, because, this mode has

a. no attenuation
b. no cut off
c. no magnetic field component
d. the highest cutoff wavelength

78. The amplifier band width is defined as difference between two frequencies at which the power is

a. ¼ of midfrequency power
b. 33% of midfrequency power
c. half of midfrequency power
d. 67% of midfrequency power

79. Only one IC is active at a time to avoid a bus conflict caused by two ICs writing different data to the same bus, is ensured by

a. control bus
b. control instructions
c. address decoder
d. CPU

80. In a cubic crystal, the planes (001) and (010) are

a. parallel to each other
b. perpendicular to each other
c. at 45o to each other
d. none of above

81. The width of the super conducting energy gap

a. increases with increase of temperature

b. decreases with increase of temperature
c. may increase or decrease with increase of temperature
d. does not change with temperature

82. A crystal shows piezoelectricity only if

a. it possesses a center of inversion symmetry
b. it does not possess a center of inversion symmetry
c. it possesses a diad rotational symmetry axis
d. it does not possess a diad rotational symmetry axis

83. The quasicrystals are characterized to be

a. hard and brittle, having high electrical, thermal resistivity and low surface energy
b. hard and brittle, having low electrical, thermal resistivity and low surface energy
c. soft, having high electrical, thermal resistivity and high surface energy
d. soft, having low electrical, thermal resistivity and high surface energy

84. Electronic contribution to the specific heat of a metal at low temperature is

a. An exponential function of T
b. A linear function of T
c. Zero
d. None of these

85. Point defects in crystals cannot be produced by

a. Elastic deformation
b. quenching from high temperatures
c. Plastic deformation
d. irradiation with x-rays

86. Dulong and Petit's law obeys at room temperature for many metals while it fails for light elements because

a. The debye's temperature of these elements is very high
b. The debye's temperature of these elements is very low
c. their Debye's temperature is about 300K
d. none of these

87. The Bragg's angle for first order reflection from (111) planes in a crystal is 30 when X rays of wavelength 1.75Å are used, the interatomic spacing

a. 3.31 Å
b. 3.03 Å
c. 3.33 Å
d. 3.13 Å

88. The potential energy between a pair of atoms is $U = -\frac{\alpha}{r^6} + \frac{\beta}{r^{12}}$. The equilibrium interatomic separation will be

a. $\frac{2\beta}{\alpha}$
b. $\frac{\beta}{\alpha}$

c. $(\frac{2\beta}{\alpha})^{1/6}$
d. $\frac{-2\beta}{\alpha}$

89. Isotope effect is represented as

a. $T_c \propto Q_D$
b. $T_c \propto {Q_D}^2$
c. $T_c \propto {Q_D}^{-2}$
d. $T_c \propto {Q_D}^{-1}$

90. if the nuclear radius of ^{27}Al is 3.6 Fermi, the approximate nuclear radius of ^{64}Cu in Fermi is

a. 4.8
a. 3.6
b. 2.4
c. 1.2

91. Energy released in the fission of a single $^{235}U_{92}$ nucleus is 200MeV. The fission rate of a $^{235}U_{92}$ filled reactor operating at a power level of 5W is

a. $1.56 \times 10^{-10}\ s^{-1}$
b. $1.56 \times 10^{-11}\ s^{-1}$
c. $1.56 \times 10^{-16}\ s^{-1}$
d. $1.56 \times 10^{-17}\ s^{-1}$

92. The isotope $^{14}_{6}C$ has a half life of 5,730 years. Starting with a sample of 1,000 C-14 nuclei, the number of nuclei that will still be undecayed in 25,000 years is

a. 58
b. 49
c. 86
d. 124

93. In the nuclear interaction, between two protons, the mediating paricle is

a. a photon
b. a neutral pion
c. W+ boson
d. W- boson

94. The packing fraction is zero for

a. $_6C^{12}$
b. $_8O^{16}$
c. $_2He^4$
d. $_7N^{14}$

95. According to liquid drop model the surface correction term is proportional to

a. A
b. $A^{1/3}$

c. $A^{2/3}$
d. $A^{-2/3}$

96. Atom with nuclear spin equal to ½ cannot have

a. Electric quadrupole moment
b. Fine structure
c. magnetic interactions
d. dipole interaction between atoms

97. When a gamma ray is scattered by an electron at rest, it is observed that

a. The wavelength of scattered rays is less than original rays
b. The wavelength of scattered rays is greater than original rays
c. The wavelength of scattered rays cannot be smaller than the de-Broglie wavelength
d. The wavelength of scattered rays is greater than original and depends on the angle of scattering

98. Strongly interacting bosons are

a. Leptons
b. Mesons
c. Bosons
d. Photons

99. Two nuclei have their mass numbers in the ratio 1:3. The ratio of their nuclear densities would be

a. 1:3
b. 3:1
c. 1:1
d. either of (a) and (b)

100. The expression for the conserved angular momentum in a central force problem is,

a. $L = mr^2 \dot{\square}$
b. $L = \frac{m}{r^2 \dot{\square}}$
c. $L = mr \dot{\square}$
d. $L = 2mr^2 \dot{\square}$

101. Hamilton's principle is an example of a

a. consevation law
b. continuity equation
c. variational principle
d. both (b) and (c)

102. The Gibbs function for a system is given as G = H – TS, where H is enthalpy. T is temperature and S is the entropy of the system. In the case of a reversible, isothermal, isobaric process

a. G = constant

b. G > 0 and changes with T
c. G < 0 and changes with S
d. G changes with both T and S

103. Using uncertainty principle, the minimum energy that an electron in hydrogen atom (radius=5.3× 〖10〗 ^(-11)m) can have is

a. 5.1 eV
b. 10. 5 eV
c. 13.6 eV
d. 3.4 eV

104. Which of the following sets of operators form a commuting set for an electron

a. H, J^2 and J_z^2
b. H, J^2 and J_z
c. H, J and J_z^2
d. H, J and J_z

105. In the Standard Model, neutrino

a. has very small mass
b. participates in strong interactions
c. is spin 0 particle
d. exists only in left handed helicity state

106. The characteristic of a good conductor is

a. $\frac{\sigma}{\omega\epsilon} \gg 1$
b. $\frac{\sigma}{\omega\epsilon} \ll 1$
c. $\frac{\omega}{\sigma\epsilon} \gg 1$
d. $\frac{\omega}{\sigma\epsilon} \ll 1$

107. The Doppler broadening of spectral lines is

a. proportional to square root of the temperature
b. proportional to the frequency
c. inversely proportional to square root of atomic weight
d. proportional to atomic number

108. Maxwell's equation $\oint B.ds = 0$ implies that

a. total magnetic flux crossing any closed surface is zero
b. magnetic flux lines occur in closed loops
c. there are no magnetic monopoles

d. all of above

109. Dislocations in a crystal are responsible for

a. the colour of the crystal

b. mechanical strength of a crystal

c. high conductivity of a crystal

d. elasticity of a crystal

100. The Hall coefficient for a semiconductor increases with

a. an increase in the applied current and magnetic field

b. decrease in the applied current and magnetic field

c. decrease in the charge carrier concentration

d. increase in the width of the crystal

111. The mean square displacement of a particle undergoing Brownian motion at a temperature T is proportinal to

a. $\frac{1}{T}$

b. $\frac{1}{\sqrt{T}}$

c. $\sqrt{T}$

d. T

112. Magnetostriction is a property by which a ferromagnetic substance, when placed in magnetic field shows

a. an increase in length in the direction of magnetic field

b. an increase in length in the direction opposite to the magnetic field

c. increase in temperature

d. decrease in temperature

113. If n is an exact number and $Q = x^n$, then uncertainty in Q is given as

a. $\frac{\delta Q}{|Q|} = |n|\frac{\delta x}{|x|}$

b. $\frac{\delta Q}{|Q|} = \frac{(\delta x)^n}{|x|}$

c. $\frac{\delta Q}{|Q|} = \frac{\delta x}{n|x|}$

d. $\frac{\delta Q}{|Q|} = \frac{\delta x}{|x|}$

114. The Fermi – Dirac distribution function is given as

a. $f(E) = \dfrac{1}{e^{(E-E_F)/kT} + 1}$

b. $f(E) = \dfrac{1}{Ae^{E_F/kT} - 1}$

c. $f(E) = \dfrac{1}{e^{(E-E_F)/kT} - 1}$

d. $f(E) = \dfrac{1}{Ae^{E_F/kT} + 1}$

115. The parity operator Π is defined as

a. $\Pi\,\psi(x) = \overline{\psi(x)}$

b. $\Pi\,\psi(x) = \psi(x)^{\dagger}$

c. $\Pi\,\psi(x) = \psi(-x)$

d. $\Pi\,\psi(x) = \overline{\psi(-x)}$

116. Scleronomous constraints have:

a. explicit time dependence

b. no explicit time dependence

c. no time dependence at all

d. may or may not have a time dependence

117. Canonical transformations can often be conveniently found or verified by using

a. rotational matrix

b. generating function

c. degeneration function

d. separation tensor

118. In an extrinsic semiconductor, the conduction process becomes intrinsic, when

a. Temperature is low

b. Temperature is high

c. $T \to 0K$

d. The conduction process never becomes intrinsic.

119. If G is a group of even order, then

a. $a^2=e$ for all $a \in G$

b. $a^2=e$ for at least one $a \in G$

c. $a^2=a$ for all $a \in G$

d. none of above

120. The number of different combinations of n different things, k at a time, without repetitions, is

a. $\dfrac{n!}{k!\,(n-k)!}$

b. $\dfrac{n!}{k!\,(n+k)!}$

c. $\dfrac{n!}{(n-k)!}$

d. $\dfrac{n!\;k!}{(n+k)!}$

Space for Rough Work

Space for Rough Work