

Entrance Test for Ph.D. Programme-2018

Time: 120 Minutes

Max Marks: 100

Discipline: Physical Sciences

Set: A

Test ID: 45

Name:

Father Name:

Roll Number: **Date:**/...../.....

Roll Number in words:

Signature of Candidate:

Signature of Invigilator:

INSTRUCTIONS FOR CANDIDATES

1. Do not open seal before start of Exam.
2. Carefully fill all your details in top portion of this question paper. Don't leave any column blank.
3. Use blue/black ball point pen to fill details on question paper. Write only in capital letters.
4. Carefully fill all your details in top portion of OMR answer sheet. Also put your signatures at bottom portion of OMR.
5. **Use only black ball point pen to fill details & darken circles on OMR sheet. Using pencil is strictly prohibited.**
6. **Carefully fill your Roll No, Test ID, Category, Paper Set and other required details on the OMR sheet.**
7. Question paper consists of two sections. Section-I is of Research Methodology and Section-II is Subject specific. Each section contains 50 multiple choice questions. Total 100 questions of one mark each.
8. **Maximum marks are 100.**
9. **Time allowed is 120 minutes.**
10. **Qualifying marks shall be 50% for General Category and 45% for Reserved Categories.**
11. All questions are compulsory. No negative marking for wrong answers.
12. There are four alternative answers for each question out of which only one is correct.
13. You have to darken the circle of right answer on OMR answer sheet.
14. Questions left blank or attempted with two or more options/answers will not be evaluated.
15. Also read carefully the instructions on OMR answer sheet before attempting the questions.
16. Use of calculator is not allowed.
17. Log tables may be provided for calculation work, if required.
18. OMR sheet should not be folded or crushed. Don't put any stray marks on the sheet.
19. Circles on **OMR sheet** should be darkened completely. Incomplete/half filled circles will not be evaluated.
20. Do not use marker or white fluid on the OMR sheet.
21. **The medium of the examination is English only.**
22. No extra sheet will be provided for the rough work. Use the space inside the question paper pages for rough work.
23. Carrying mobile phones, electronic gadgets, notes or extra papers in examination hall is strictly prohibited.
24. Indulging in any form of unfair means, canvassing, impersonation or misbehaviour with examination staff will result in disqualification of your candidature.

Section-I
Research Methodology

1. Who authored the book "Methods in Social Research"?
 - A) Wilkinson
 - B) C R Kothari
 - C) Kerlinger
 - D) Goode and Halt
2. Social Science deals with
 - A) Objects
 - B) Human beings
 - C) Living things
 - D) Non-living things
3. "The Romance of Research" is authored by
 - A) Redmen and Mory
 - B) P. V. Young
 - C) Robert C. Meir
 - D) Harold Dazier
4. Which of the following is an example of primary data?
 - A) Book
 - B) Journal
 - C) Newspaper
 - D) Census Report
5. ICSSR stands for
 - A) Indian Council for Survey and Research
 - B) Indian Council for Strategic Research
 - C) Indian Council for Social Science Research
 - D) Inter National Council for Social Science Research

6. JRF stands for
 - A) Junior Research Functions
 - B) Junior Research Fellowship
 - C) Junior Fellowship
 - D) None of the above
7. In the formulation of problem, which of the following we need to give?
 - A) Title
 - B) Index
 - C) Bibliography
 - D) Concepts
8. Analogies are sources of
 - A) Data
 - B) Concept
 - C) Research
 - D) Hypothesis
9. When a hypothesis is stated negatively, it is called
 - A) Relational Hypothesis
 - B) Situational Hypothesis
 - C) Null Hypothesis
 - D) Casual Hypothesis
10. In a survey, there is an enumerator and
 - A) Guide
 - B) Respondent
 - C) Supervisor
 - D) Messenger
11. A short summary of Technical Paper is called
 - A) Article
 - B) Research Abstract

- C) Publication
 - D) Guide
12. Ph.D. stands for
- A) Doctor of Philosophy
 - B) Degree in Philosophy
 - C) Doctor of Psychology
 - D) None of the above
13. Failure to acknowledge the borrowed material; is called (Take and use of others as one's own)
- A) Acknowledgement
 - B) Foot Notes
 - C) Index
 - D) Plagiarism
14. Data related to the Human beings are called
- A) Territorial data
 - B) Organisational data
 - C) Peripheral data
 - D) Demographic data
15. Schedule is filled by which of the following?
- A) Respondent
 - B) Enumerator
 - C) Everybody
 - D) None of the above
16. Questions in which only two alternatives are possible are called
- A) Multiple choice questions
 - B) Dichotomous Questions
 - C) Open ended questions
 - D) Structured questions

17. Assigning numerals or other symbols to the categories or response is called
- A) Editing
 - B) Coding
 - C) Transcription
 - D) Tabulation
18. Tippet table refers to
- A) Table of random digits
 - B) Table used in sampling methods
 - C) Table used in statistical investigations
 - D) All of the above
19. Research and development become the index of development of country. Which of the following reasons are true with regards to the statement?
- A) Because R&D reflect the true economic and social conditions prevailing in a country.
 - B) Because R&D targets the human development.
 - C) Because R&D can improve the standard of living of the people in a country.
 - D) All of the above.
20. The word "Anusandhan" implies
- A) Attaining an aim
 - B) Goal orientation
 - C) Following an aim
 - D) Praying to achieve an aim
21. A Researcher wants to study the relationship of family size to income. He classifies his population into different income slabs and then takes a random sample from each slab in order. Which technique of sampling is he working with?
- A) Cluster sampling
 - B) Random sampling

C) Stratified Random sampling

D) Systematic sampling

For Q. 22-23. The following table gives the sales of batteries manufactured by a company over the years.

Number of different batteries sold (in thousands)

Year	Types of Batteries					
	4AH	7AH	32AH	35AH	55AH	Total
1992	75	144	114	102	108	543
1993	90	126	102	84	126	528
1994	96	114	75	105	135	525
1995	105	90	150	90	75	510
1996	90	75	135	75	90	465
1997	105	60	165	45	120	495
1998	115	85	160	100	145	605

22. What was the approximate percentage increase in the sales of 55AH batteries in 1998 compared to that in 1992?

A) 28%

B) 31%

C) 33%

D) 34%

23. The percentage of 4AH batteries sold to the total number of batteries sold was maximum in the year?

A) 1994

B) 1995

C) 1996

- D) 1997
24. Look the series: 22, 21, 23, 22, 24, 23,
- A) 22
 - B) 24
 - C) 25
 - D) 26
25. Which word does not belong to others?
- A) Dodge
 - B) Flee
 - C) Duck
 - D) Avoid
26. Which of the following is not an essential element of report writing?
- A) Research Methodology
 - B) Reference
 - C) Conclusion
 - D) None of the above
27. Which of the following is non-probability sampling?
- A) Snowball
 - B) Random
 - C) Cluster
 - D) Stratified
28. In group interview, there are
- A) One interviewer and one interviewee
 - B) More than one interviewer and one interviewee
 - C) One interviewer and more than one interviewee
 - D) More than one interviewer and more than one interviewee
29. Uniting various qualitative methods with quantitative methods can be called as
- A) Coalesce

B) Triangulation

C) Bipartite

D) Impassive

30. Books and records are the primary sources of data in:

A) clinical research

B) historical research

C) laboratory research

D) participatory research

31. The important pre-requisites of a researcher in sciences, social sciences and humanities are

A) laboratory skills, records, supervisor, topic

B) Supervisor, topic, critical analysis, patience

C) archives, supervisor, topic, flexibility in thinking

D) topic, supervisor, good temperament, pre-conceived notions

32. A college wants to give training in use of Statistical Package for Social Sciences (SPSS) to researchers. For this the college should organize

A) Lecture

B) Seminar

C) Workshop

D) Conference

33. Which One of the following is not a quality of researcher?

A) Keeness in enquiry

B) He must be of alert mind

C) His assertion to outstrip the evidence

D) Unison with that of which he is in search

34. Null means?

A) One

B) Two

- C) Zero
- D) None of the above

35. The depth of any research can be judged by:

- A) title of the research
- B) duration of the research
- C) objectives of the research
- D) total expenditure on the research

36. Fundamental research reflects the ability to:

- A) Expound new principles
- B) Synthesize new ideals
- C) Evaluate the existing material concerning research
- D) Study the existing literature regarding various topics

37. A ratio represents the relation between

- A) Part and Part
- B) Part and Whole
- C) Whole and Whole
- D) All of the above

38. Circle graphs are used to show:

- A) How one part is related to other parts?
- B) How various sections share in the whole?
- C) How one whole is related to other whole?
- D) How various parts are related to the whole?

39. Field-work based research is classified as:

- A) Historical
- B) Empirical
- C) Biographical
- D) Experimental

40. Statistical measure based upon the entire population is called parameter while measure based upon a sample is known as:
- A) Inference
 - B) Statistics
 - C) Sample parameter
 - D) None of these
41. The importance of the correlation co-efficient lies in the fact that:
- A) It is one of the most valid measure of statistics.
 - B) It is a non-parametric method of statistical analysis.
 - C) There is a linear relationship between the correlated variables.
 - D) It allows one to determine the degree or strength of the association between two variables.
42. Which one of the following is the most comprehensive source of population data?
- A) Census
 - B) National Sample Surveys
 - C) Demographic Health Surveys
 - D) National Family Health Surveys
43. Which correlation co-efficient best explains the relationship between creativity and intelligence?
- A) 0.3
 - B) 0.5
 - C) 0.6
 - D) 1.0
44. Normal Probability Curve should be
- A) Zero skewed
 - B) Positively skewed
 - C) Negatively skewed
 - D) Leptokurtic skewed

45. A doctor studies the relative effectiveness of two drugs of dengue fever. His research would be classified as
- A) Case Study
 - B) Ethnography
 - C) Descriptive Survey
 - D) Experimental Research
46. Newton gave three basic laws of motion. This research is categorized as
- A) Sample Survey
 - B) Applied Research
 - C) Descriptive Research
 - D) Fundamental Research
47. When two or more successive footnotes refer to the same work which one of the following expressions is used?
- A) et.al
 - B) op.cit
 - C) loc.cit
 - D) ibid
48. Nine year olds are taller than seven year olds. This is an example of a reference drawn from
- A) Vertical study
 - B) Time series study
 - C) Experimental study
 - D) Cross-sectional study
49. Which one of the following belongs to the category of good 'research ethics'?
- A) Publishing the same paper in two research journals without telling the editors
 - B) Trimming outliers from a data set without discussing your reasons in a research paper

- C) Conducting a review of the literature that acknowledges the contributions of other people in the relevant field or relevant prior work
 - D) Including a colleague as an author on a research paper in return for a favor even though the colleague did not make a serious contribution to the paper
50. Which of the following are the basic rules of APA style of referencing format?
- A) Alphabetically index reference list
 - B) Invert authors' names (last name first)
 - C) Italicize titles of longer works such as books and journals
 - D) All of the above

Section-B
Physical Sciences

51. The eigen values of the given matrix $A = \begin{bmatrix} 3 & 1 & 4 \\ 0 & 2 & 6 \\ 0 & 0 & 5 \end{bmatrix}$ are
- (a) 0,1,2
 - (b) 2,3,5
 - (c) 2,3,6
 - (d) 3,5,7
52. If $P_n(x)$ is a Legendre polynomial, then $P_2(x)$ is given by
- (a) x^2
 - (b) $3x - 1$
 - (c) $(3x^2 - 1)/2$
 - (d) $x^2 - 1$
53. The solution of Laplace equation in spherical polar coordinates when it is axially symmetric about Z-axis involves
- (a) associated Legendre's function
 - (b) Legendre's polynomial
 - (c) Bessel's function
 - (d) trigonometric function
54. The value of $\int_2^6 x^3 dx$ by Simpson's rule is
- (a) 56
 - (b) 60
 - (c) 80
 - (d) none of these
55. In $SU(2)$, the generators are
- (a) traceless Hermitian matrices
 - (b) not traceless matrices
 - (c) may or may not be trace Hermitian matrices
 - (d) all of the above
56. A force which appears in the non-inertial frame but is zero in the inertial frame, is called
- (a) real force
 - (b) gravitational force
 - (c) fictitious force
 - (d) conservative force

57. The operator which represents the two variables should commute if the Poisson bracket of two variables have value
- 1
 - 0
 - $i\hbar$
 - $-i\hbar$
58. On the annihilation of a particle and its anti-particle, the energy released is E , mass of each particle is
- E/c^2
 - $E/2c^2$
 - E/c
 - $E/2c$
59. A particle of mass m_1 moving with a velocity u_1 , is elastically scattered from another particle of mass m_2 at rest. After collision, the two particles move in opposite direction with the same speed. The relation between two masses is
- $m_2 = m_1$
 - $m_2 = 2m_1$
 - $m_2 = 3m_1$
 - $2m_2 = m_1$
60. The polar coordinates of a point are $(r, \theta, \phi) = (8, 30^\circ, 45^\circ)$. The corresponding Cartesian coordinates of the same point will be
- $(2\sqrt{2}, 2\sqrt{2}, 4\sqrt{3})$
 - $(3\sqrt{2}, 2\sqrt{2}, 4\sqrt{3})$
 - $(2\sqrt{2}, 3\sqrt{2}, 4\sqrt{3})$
 - $(2\sqrt{2}, 2\sqrt{2}, 3\sqrt{2})$
61. The differential form of Gauss's law in CGS system is
- $\vec{\nabla} \cdot \vec{E} = \rho/\epsilon_0$
 - $\epsilon_0 \operatorname{div} \vec{E} = \rho$
 - $\vec{\nabla} \cdot \vec{E} = 4\pi\rho$
 - $\operatorname{div} \vec{E} = 4\pi\sigma$
62. The path of a charged particle in crossed electric and magnetic fields is
- circular
 - parabolic

- (c) hyperbolic
(d) cycloid
63. Maxwell's electromagnetic equations are valid under all conditions except one and that is
- they do not apply to non-isotropic media
 - they do not apply to non-homogeneous media
 - they do not apply to the media which move w.r.t. system of coordinates
 - they do not apply to non-linear media
64. The electromagnetic theory suggests that the electric vector in the wave suffers a sudden phase change of π on reflection from the plane reflecting surface but the magnetic vector suffers
- No phase change
 - A phase change of $\pi/2$
 - A phase change of π
 - A phase change of 2π
65. A transmission line whose characteristic impedance is a pure resistance
- must be a lossless line
 - must be a distortionless line
 - may not be a lossless line
 - may not be a distortionless line
66. A wave function which is a sum of two functions of opposite parities, is
- acceptable
 - unacceptable
 - may or may not be accepted
 - none of these
67. The mutual potential energy V of two particles is given by $V = a/r^2 - b/r$, where $a > 0$, $b > 0$ and r is their mutual separation. For what value of r , the two particles are in static equilibrium?
- b
 - a
 - b/a
 - $2a/b$
68. Born approximation is valid only when
- total wave function is different from incident wave function
 - total wave function is not generally different from the incident wave function
 - Always applicable
 - none of the above

69. According to Dirac's theory
- angular momentum is a constant of motion
 - angular momentum may or may not be a constant of motion
 - angular momentum is not a constant of motion
 - all above are incorrect
70. The Schrodinger time independent equation can be written as
- $H \Psi = E \Psi$
 - $H \Psi = (E - V) \Psi$
 - $H \Psi = (E + V) \Psi$
 - $H \Psi + E \Psi = 0$
71. For a thermodynamic system, Helmholtz free energy is a function of
- S, V
 - V, T
 - T, P
 - S, P

Symbols have their usual meanings

72. The Planck's radiation law and Rayleigh – Jeans law become identical if
- wavelength becomes very low
 - temperature becomes very low
 - temperature becomes very high
 - wavelength becomes very high
73. For an adiabatic expansion of a gas, the value of $\frac{dp}{p}$ will be
- $\frac{dV}{V}$
 - $\frac{V}{dV}$
 - $-\gamma \frac{dV}{V}$
 - $\gamma \frac{V}{p}$
74. Internal energy of an ideal gas varies with volume as $U = \alpha V^\beta$. The work done by the gas as its internal energy increases by ΔU is
- $\Delta U(\gamma + 1)/\beta$
 - $\Delta U(\gamma - 1)/(\beta + 1)$
 - $\Delta U(\gamma - 1)/(\beta - 1)$
 - $\Delta U(\gamma - 1)/\beta$

Here γ is adiabatic exponent and α, β are constants

75. In a grandcanonical ensemble, the comprising systems are capable of exchanging
- (a) only energy
 - (b) only constituent particles
 - (c) both energy and constituent particles
 - (d) none of the above
76. A filter stops frequencies within a specified band and passes those above and below the limit of this band, is called
- (a) band elimination filter
 - (b) high pass filter
 - (c) band pass filter
 - (d) low pass filter
77. The main function of coupling capacitor in an RC coupled common emitter amplifier is to
- (a) increase the input impedance
 - (b) increase the output impedance
 - (c) increase the gain of the amplifier
 - (d) DC isolation
78. A silicon diode is in series with a $1.0 \text{ k}\Omega$ resistor and a 5 V battery. If the anode is connected to the positive battery terminal, the cathode voltage with respect to the negative battery terminal is
- (a) 5.7 V
 - (b) 4.3 V
 - (c) 0.7 V
 - (d) 5.0 V
79. When an input electrical signal $A = 10100$ is applied to a NOT gate, its output signal will be
- (a) 01011
 - (b) 10101
 - (c) 10100
 - (d) 00101
80. An 8-bit digital data 10101100 is fed to an ADC. The reference voltage is $+10 \text{ V}$. In this case, the analog output voltage will be
- (a) 5.54 V
 - (b) 5.70 V
 - (c) 6.74 V
 - (d) 7.72 V

81. A resistance is measured by passing a current through it and measuring the resulting voltage drop. If the voltmeter and ammeter have uncertainties of 3% and 4% respectively, then the uncertainty in the value of resistance is
- (a) 7.0%
 - (b) 3.5%
 - (c) 5.0%
 - (d) 12.0%
82. Keeping all the parameters same if the standard deviation is doubled, variance would be
- (a) halved
 - (b) doubled
 - (c) quadrupled
 - (d) no effect
83. In which of the following detectors p-n junction diode is used?
- (a) Proportional counter
 - (b) GM counter
 - (c) Scintillation counter
 - (d) surface barrier detector
84. In an amplitude modulated system, if the total power is 600 W and the power in carrier is 400 W, then the modulation index is
- (a) 0.5
 - (b) 0.75
 - (c) 0.9
 - (d) 1
85. The appropriate detector for the detection of fast (MeV) neutrons is
- (a) GM counter
 - (b) BF_3 proportional counter
 - (c) plastic scintillator
 - (d) semiconductor detector
86. Assuming that the LS coupling scheme is valid, the number of permitted transitions from $^3\text{p}_{1/2}$ to $^2\text{s}_{1/2}$ due to a weak magnetic field is
- (a) 2
 - (b) 4
 - (c) 6
 - (d) 10

87. X-rays and gamma-rays of same energies may be distinguished by their
- (a) velocities
 - (b) intensities
 - (c) frequencies
 - (d) method of production
88. The number of hyperfine components observed in the electronic transition ${}^2p_{1/2} \rightarrow {}^2s_{1/2}$ of an atom with nuclear spin $1/2$ is
- (a) 3
 - (b) 4
 - (c) 5
 - (d) 6
89. A hydrogen atom is placed in a magnetic field of 3 T. The energy difference between the $m_l = -1$ and $m_l = +1$ components in the 2p state is
- (a) 1.01×10^{-4} eV
 - (b) 1.01×10^{-2} eV
 - (c) 2.35×10^{-3} eV
 - (d) 3.48×10^{-4} eV
90. In He-Ne laser the most favourable ratio of helium to neon for satisfactory laser action is
- (a) 1 : 4
 - (b) 4 : 1
 - (c) 1 : 7
 - (d) 7 : 1
91. Electron spin resonance is a phenomenon exhibited by paramagnetic substances due to their
- (a) paired electrons
 - (b) unpaired electrons
 - (c) K-shell electrons
 - (d) all protons in nucleus
92. Consider X-ray diffraction from a crystal with a face centered cubic (fcc) lattice. The lattice plane for which there is no diffraction peak is
- (a) (2, 1, 2)
 - (b) (1, 1, 1)
 - (c) (2, 0, 0)
 - (d) (3, 1, 1)

93. At low temperature (T), the mean free path and collision time of an electron in a metal are proportional to
- T^{-1}
 - T^{-2}
 - T^{-3}
 - does not depend upon T
94. Meissner effect implies that in superconducting state, a material has a magnetic susceptibility equal to
- $\chi = 0$
 - $\chi = -1$
 - $\chi = 1$
 - $\chi = \text{infinite}$
95. A sample of silicon of thickness $200 \mu\text{m}$ is doped with 10^{23} phosphorous atoms per m^3 . If the sample is kept in a magnetic field of 0.2 Wb/m^2 and a current of 1 mA is passed through the sample, the Hall voltage produced is
- $62.5 \mu\text{V}$
 - $-6.25 \mu\text{V}$
 - $+6.25 \mu\text{V}$
 - $-62.5 \mu\text{V}$
96. According to Fermi theory of beta –decay, the number of final states of electrons corresponding to momentum between p and $p + dp$ is
- independent of p
 - proportional to pdp
 - proportional to p^2dp
 - proportional to p^3dp
97. The name of the process in which an excited nucleus decays without emitting alpha particle or beta particle or gamma-rays, is
- Photo electric effect
 - Compton effect
 - Pair production
 - Internal conversion
98. On the basis of Nuclear Shell Model the ground state spin of ^{33}S nucleus is
- $5/2$
 - $3/2$
 - $1/2$

(d) Zero

99. The reaction $e^+ + e^- \rightarrow \mu^+ + \pi^-$ is forbidden because of

- (a) law of baryon number conservation
- (b) law of momentum energy conservation
- (c) law of muon number conservation
- (d) none of the above

100. Elementary particles whose mass is more than that of nucleons are called

- (a) mesons
- (b) leptons
- (c) baryons
- (d) muons





