Test Booklet Series

A

Test Booklet
(Chmistry)

Test Booklet No.

Name of Applicant ..... Answer Sheet No. .....

Applicant ID/Roll No. : ..... Signature of Applicant : .....

Date of Examination : ..... Signature of the Invigilator(s)

Time of Examination : ..... 1. .....

2. .....

Duration : 2 Hour] **[Maximum Marks : 100**

IMPORTANT INSTRUCTIONS

(i) The question paper is in the form of Test-Booklet containing **100 (Hundred)** questions. All questions are compulsory. Each question carries four answers marked (A), (B), (C) and (D), out of which only one is correct. Choose the correct option or the most appropriate option.

(ii) On receipt of the Test-Booklet (Question Paper), the candidate should immediately check it and ensure that it contains all the pages, i.e., **100** questions. Discrepancy, if any, should be reported by the candidate to the invigilator immediately after receiving the Test-Booklet.

(iii) A separate Answer-Sheet is provided with the Test-Booklet/Question Paper. On this sheet there are **100** rows containing four circles each. One row pertains to one question.

(iv) The candidate should write his/her Application ID/Roll number at the places provided on the cover page of the Test-Booklet/Question Paper and on the Answer-Sheet and NOWHERE ELSE.

(v) No second Test-Booklet/Question Paper and Answer-Sheet will be given to a candidate. The candidates are advised to be careful in handling it and writing the answer on the Answer-Sheet.

(vi) For every correct answer of the question **One (1) mark will be awarded**.

(vii) Marking shall be done only on the basis of answers responded on the Answer-Sheet.

(viii) To mark the answer on the Answer-Sheet, candidate should darken the appropriate circle in the row of each question with Blue or Black pen.

(ix) For each question only **one** circle should be **darkened** as a mark of the answer adopted by the candidate. If more than one circle for the question are found darkened or with one black circle any other circle carries any mark, the answer will be treated as incorrect.

(x) The candidates should not remove any paper from the Test-Booklet/Question Paper. Attempting to remove any paper shall be liable to be punished for use of unfair means.

(xi) Rough work may be done on the blank space provided in the Test-Booklet/Question Paper only.

(xii) *Mobile phones (even in Switch-off mode) and such other communication/programmable devices are not allowed inside the examination hall.*

(xiii) No candidate shall be permitted to leave the examination hall before the expiry of the time.

DO NOT OPEN THIS QUESTION BOOKLET UNTIL ASKED TO DO SO.

PART–A

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

2. The conceptual framework in which research is conducted is called a
   (A) Synopsis of research
   (B) Research design
   (C) Research hypothesis
   (D) Research paradigm

3. What are the main characteristics of Scientific Research?
   (A) Empirical
   (B) Theoretical
   (C) Experimental
   (D) All the above

4. Which research design will be most appropriate to study the relationship between the level of aspirations and achievement of rural children?
   (A) Experimental Research Design
   (B) Ex Post Facto Research Design
   (C) Historical Research Design
   (D) Survey Research Design

5. The principles of fundamental research are used in:
   (A) action research
   (B) applied research
   (C) philosophical research
   (D) historical research

6. A shift in attitude in respondents between two points during data collection is called
   (A) Reactive effect
   (B) Maturation effect
   (C) Regression effect
   (D) Conditioning effect

7. Ethical Norms in research do not involve guideline for:
   (A) Thesis Format
   (B) Copyright
   (C) Patenting Policy
   (D) Data sharing Policy

8. The primary objective of an experimental research design is to:
   (A) Explore an unknown topic.
   (B) Establish cause-and-effect relationships.
   (C) Describe a population or situation.
   (D) Examine the relationship between variables without manipulation.

9. The research that aims at immediate application is:
   (A) Action Research
   (B) Empirical Research
   (C) Conceptual Research
   (D) Fundamental Research

10. A null hypothesis is
   (A) when there is no difference between the variables
   (B) the same as research hypothesis
   (C) subjective in nature
   (D) when there is difference between the variables

11. When the researcher rejects a true null hypothesis a ---------- error occurs.
   (A) Type I
   (B) Type A
   (C) Type II
   (D) Type B

12. The researcher is usually interested in supporting ..... when he or she is engaging in hypothesis testing:
   (A) The alternative Hypothesis
   (B) The null Hypothesis
   (C) Both alternative and null Hypothesis
   (D) Neither the alternative or null Hypothesis

13. A research design is often described as the "blueprint" for a research project. This emphasizes its role in:
   (A) Collecting data
   (B) Analysing data
   (C) Providing a strategy and framework for the study
   (D) Presenting findings

14. What is a cross-sectional research design?
(A) A design in which a data is collected at one point of time.
(B) A design in which data is collected over a period of time.
(C) A design in which data is collected from a representative sample of the population.
(D) A design in which data is collected from a non-representative sample of the population.

15. Match the measurement scale to the given variables:

Scale of measurement	**Variable**
(a) Nominal	(i) Height of student
(b) Ordinal	(ii) Time of day
(c) Interval	(iii) Caste
(d) Ratio	(iv) Rank of Army Personnel

Choose the correct answer from the options given below:
(A) (a) – (i), (b) – (ii), (c) – (iii), (d) – (iv)
(B) (a) – (ii), (b) – (iii), (c) – (iv), (d) – (i)
(C) (a) – (iii), (b) – (iv), (c) – (ii), (d) – (i)
(D) (a) – (iv), (b) – (i), (c) – (ii), (d) – (iii)

16. Which is the simplest form of Measurement?
(A) Ordinal (B) Nominal
(C) Ratio (D) Interval

17. The data is obtained through a survey conducted is called:
(A) Primary data (B) Secondary data
(C) Continuous data (D) Qualitative data

18. A survey in which the information is collected from each and every individual of the population is known as:
(A) Sample survey (B) Pilot survey
(C) Biased survey (D) Census survey

19. Interview is an example of which data?
(A) Primary data (B) Secondary data
(C) Both (A) and (B) (D) None of the above

20. What is the process of organizing raw data into rows and columns for systematic analysis called?
(A) Compilation
(B) Presentation
(C) Tabulation
(D) Classification

21. The graphical representation of a frequency distribution is called
(A) Bar chart
(B) Line chart
(C) Histogram
(D) Pie char

22. Identify the correct sequence of research steps:
(A) Selection of topic, review of literature, data collection, interpretation of findings
(B) Review of literature, selection of topic, data collection, and interpretation of findings
(C) Selection of topic, data collection, review of literature, interpretation of findings
(D) Selection of topic, review of literature, interpretation of findings, data collection

23. When a research problem is related to heterogeneous population, the most suitable sampling method is:
(A) Cluster Sampling
(B) Stratified Sampling
(C) Convenient Sampling
(D) Lottery Method

24. A researcher wants to study the long-term effects of a new teaching method on student performance over several years. Which research design would be most appropriate?
(A) Cross-sectional design
(B) Case study design
(C) Longitudinal design
(D) Survey design

25. From the list given below identify those which are called non-probability sampling procedures:
(i) Simple random sampling
(ii) Dimensional sampling
(iii) Snowball sampling
(iv) Cluster sampling
(v) Quota sampling
(vi) Stratified sampling
Choose the correct option
(A) (i), (ii) and (iii)
(B) (ii), (iv) and (v)
(C) (i), (iii) and (v)
(D) (ii). (iii) and (v)

26. Among the following types of sampling techniques, which one is also known as 'Judgmental' sampling?

(A) Quota sampling
(B) Convenience Sampling
(C) Cluster Sampling
(D) Purposive Sampling

27. The primary objective of an experimental research design is to:

(A) Explore an unknown topic.
(B) Establish cause-and-effect relationships.
(C) Describe a population or situation.
(D) Examine the relationship between variables without manipulation.

28. "Students from the pure mathematics background can crack a bank recruitment test"—Which type of hypothesis is this?

(A) Relational Hypothesis
(B) Descriptive hypothesis
(C) Two tailed Hypothesis
(D) Null Hypothesis

29. Parametric tests make assumptions on:

(A) The population size
(B) The underlying distribution
(C) The sample size
(D) The mean sample

30. If the researcher has a nominal data, which non parametric test will he/she can use:

(A) T-test
(B) Z-test
(C) Chi square test
(D) All the above

31. If a researcher needs to verify whether there is a significant difference between the means of two groups to test a hypothesis, which statistical method would he/she employ?

(A) Chi-square test
(B) Correlation coefficient
(C) Sign-test
(D) Student's t-test

32. Chi-square is used to analyse:
(A) Scores
(B) Ranks
(C) Frequencies
(D) None of these

33. On which of the following does the critical value for a chi-square statistic rely?
(A) The degrees of freedom
(B) The sum of the frequencies
(C) The row totals
(D) The number of variables

34. Calculated value of chi-square is always.....
(A) Positive
(B) Negative
(C) Zero
(D) None of these

35. Which of the following best describes the purpose of using ANOVA in research?
(A) ANOVA is used to compare the means of two groups.
(B) ANOVA is use to compare the means of more than two groups.
(C) ANOVA is used to determine the correlation between two variables.
(D) ANOVA is used to determine the interaction effect between dependent variables.

36. What do ANOVA calculate?
(A) T-Ratio
(B) Chi-square
(C) Z-Ratio
(D) F-Ratio

37. What is the primary goal of factor analysis?
(A) To predict a dependent variable from multiple independent variables.
(B) To reduce a large number of variables into a smaller set of underlying factors.
(C) To determine the causal relationship between variables.
(D) To calculate the correlation between two variables.

38. Which assumption is required for factor analysis?
(A) Extreme collinearity exists among variables.
(B) Variables have a skewed distribution.
(C) A linear relationship exists among variables.
(D) There are many outliers in the data.

39. When using Principal Component Analysis (a common method for factor analysis), what does the first principal component capture?
(A) The minimum variance.
(B) The mean deviation.
(C) The maximum variance.
(D) The average variance.

40. Which statistical measure is used to assess the sampling adequacy for conducting factor analysis?
(A) Kaiser-Meyer-Olkin (KMO) measure.
(B) Bartlett's test of sphericity.
(C) Eigenvalue.
(D) All of the above.

41. The process by which we estimate the value of dependent variable on the basis of one or more independent variable is called:
(A) Correlation
(B) Regression
(C) Residual
(D) Slope

42. The major characteristic of correlation analysis is to seek out
(A) Differences among variables
(B) Variations among variables
(C) Association among variables
(D) Regression among variables

43. A correlation coefficient (r) of –1.0 indicates a:
(A) Perfect positive correlation
(B) Weak positive correlation
(C) No correlation
(D) Perfect negative correlation

44. The statistical tool that studies the degree of association between two variables is called:
(A) Regression
(B) Standard error
(C) Index numbers
(D) Correlation

45. Which type of correlation analysis is appropriate for examining the relationship between variables with non-linear relationships?
(A) Pearson's correlation
(B) Spearman's rank correlation
(C) Both Pearson's and Spearman's
(D) Neither Pearson's nor Spearman's

46. What is the primary goal of cluster analysis?
    (A) Classifying data into predefined groups.
    (B) Predicting a continuous value.
    (C) Grouping similar data points together based on their characteristics.
    (D) Reducing the number of variables in a dataset.

47. The primary purpose of conjoint analysis is to:
    (A) Identify which customer segments are most profitable.
    (B) Determine the price elasticity of demand for an existing product.
    (C) Quantify the value that consumers place on different features of a product or service.
    (D) Predict sales volume for a new product with absolute certainty.

48. The most common type of conjoint analysis, which presents respondents with sets of product profiles and asks them to choose the one they prefer most, is known as:
    (A) Adaptive Conjoint Analysis (ACA).
    (B) Choice-Based Conjoint (CBC).
    (C) Full-Profile Conjoint Analysis.
    (D) Self-Explicated Conjoint Analysis.

49. Which statement is an accurate representation of a "trade-off" in conjoint analysis?
    (A) A decision to buy a product from one brand over another.
    (B) A decision to delay a purchase until a later date.
    (C) A customer choosing a larger screen over longer battery life for a phone.
    (D) A customer buying a product with all the most desired features.

50. What is the primary purpose of discriminant analysis?
    (A) To determine the effect of independent variables on a continuous dependent variable.
    (B) To identify the underlying structure or dimensions within a set of variables.
    (C) To classify cases into two or more distinct, pre-defined groups based on a set of predictor variables.
    (D) To cluster data points into a specific number of groups based on their similarities.

PART–B
(Chmistry)

51. Entropy is ..... property.
    (A) Intensive (B) Extensive
    (C) Chemical (D) None

52. First law of thermodynamics is related to
    (A) Energy conservation (B) Entropy conservation
    (C) Enthalpy conservation (D) None

53. A plane cuts on crystallographic axis at 1, 2 unit distances along x, y and parallel to z axis directions. The Miller indices for the plane will be
    (A) (111) (B) (123)
    (C) (210) (D) (012)

54. The correct expression for Bragg's equation is
    (A) $2d \cos \theta = n\lambda$ (B) $2d \sin \theta = n\lambda$
    (C) $d \sin \theta = n\lambda$ (D) $2d \tan \theta = n\lambda$

55. The half-life of a first-order reaction is 10 minutes. How much time is required for 87.5% completion?
    (A) 20 minutes (B) 30 minutes
    (C) 40 minutes (D) 50 minutes

56. The half-life of a reaction is independent of the initial concentration for:
    (A) Zero-order reaction (B) First-order reaction
    (C) Second-order reaction (D) Both (A) and (B)

57. Activation energy of a chemical reaction can be determined by _____.
    (A) determining the rate constant at standard temperature.
    (B) determining the rate constants at two temperatures.
    (C) determining the probability of collision.
    (D) using catalyst.

58. The incorrect criteria for predicting feasibility/spontaneity of a process is?

(A) $(dS)_{U,V} \geq 0$ (B) $(dU)_{S,V} \leq 0$

(C) $(dH)_{S,P} \leq 0$ (D) $(dA)_{T,V} \geq 0$

59. For a particle in a one dimensional box having length 'a', which of the following statements is wrong?

(A) The separation between energy levels increases with 'n'

(B) The separations between energy levels decrease as the size of the box 'a' increases.

(C) If the box becomes very large, quantization of energy disappears.

(D) If he walls of the box are removed, the energy of the free particle still remains quantized.

60. The eigen value for the function Ψ = cos (ax) cos (by) cos (cz) for Laplacian operator is

(A) $(a^2 + b^2 + c^2)$ (B) $-(a^2 + b^2 + c^2)$

(C) $(a_2 - b_2 + c^2)$ (D) Zero

61. The possible term symbols for excited Na atom with electronic configuration $[1S^2\ 2S^2\ 2P^6\ 3P^1]$ is/are

(A) $^2P_{3/2}$, $^2P_{1/2}$ (B) $^2S_{3/2}$, $^2D_{1/2}$

(C) $^2P_{3/2}$, $^2S_{1/2}$ (D) None

62. Infrared (IR) spectroscopy is used for determining certain aspects of the structure of organic compounds. Which of the following statement(s) is correct?

(A) IR radiation induces electronic transitions

(B) IR peak intensities are related to molecular mass

(C) Most organic functional groups absorb in a characteristic region of the IR spectrum

(D) Each element absorbs at a characteristic wavelength

63. Which of the following statement is incorrect regarding Tetramethylsilane (TMS)?

(A) TMS is the accepted internal standard for calibrating chemical shift for ^{1}H NMR

(B) TMS is soluble in water

(C) All the twelve hydrogen atoms in a tetramethylsilane molecule are equivalent

(D) ^{1}H NMR spectrum of TMS consists of a singlet and the chemical shift of this singlet is assigned as $\delta = 0$, and all other chemical shifts are determined relative to it

64. If a radioactive element having half-life of 30 min is undergoing beta decay, the fraction of radioactive element remains undecayed after 90 min will be:

(A) 1/2 (B) 1/8

(C) 1/4 (D) 1/16

65. During radioactivity decay, $^{234}_{90}Th$ decays finally to $^{206}_{82}Pb$. The number of α and β particles emitted in this process are?

(A) 7α and 6β (B) 6α and 7β

(C) 3α and 2β (D) 2α and 4β

66. Claisen rearrangement is

(A) 1,3-Sigmatropic reaction (B) 3,3-Sigmatropic reaction

(C) 1,5-Sigmatropic reaction (D) 1,7-Sigmatropic reaction

67. Diel's Alder reaction is

(A) [2+2]-Cycloaddition reaction (B) [4+2]-Cycloaddition reaction

(C) [4+4]-Cycloaddition reaction (D) [6+2]-Cycloaddition reaction

68. In Pinacol Pinacolone Rearrangement Process, the reaction intermediate is

(A) Carbanion (B) Carbene

(C) Carbocation (D) Nitrene

69. Which one of the following complex is the most stable?

(A) $[AlBr_6]^{3-}$ (B) $[AlI_6]^{3-}$

(C) $[AlF_6]^{3-}$ (D) $[AlC_{l6}]^{3-}$

70. How many five-membered rings are there in fullerenes (C_{60})?

(A) 34 (B) 15

(C) 12 (D) 10

71. Which one of the following complexes can exhibit geometrical isomerism?

(A) $[Pt(NH_3)_2Cl_2]$ (B) $[Zn(NH_3)_2Cl_2]$

(C) $[Cu(NH_3)_4]^{2+}$ (D) $[Co(NH_3)_5Cl]^{2+}$

72. Which one of the following is not a property or parameter of electromagnetic radiation?

(A) Wavelength (B) Voltage

(C) Wave number (D) Amplitude

73. Which of the following is false about the wavelengths of electromagnetic radiation?

(A) Radiation with short wavelengths have high energies

(B) Energy does not depend on wavelength

(C) Radiation with long wavelengths have low energies

(D) Energy depends on wavelength

74. NMR signal is generated due to absorption of –

(A) Infrared radiation (B) Microwave radiation

(C) Radio waves (D) UV radiation

75. Which of the following spectroscopic technique is / are correctly matched with the radiations used for their study?

(i) Vibrational Spectroscopy – IR waves

(ii) Electron Spectroscopy – Gamma rays

(iii) NMR Spectroscopy – Radio waves

(A) Only (i) and (ii) (B) Only (i) and (iii)

(C) Only (ii) and (iii) (D) All of the above

76. What catalyst is commonly used for the hydrogenation of alkenes?
(A) HCl
(B) NaOH
(C) Pt or Pd
(D) H_2O

77. Which compound is formed when HBr is added to propene ($CH_3CH = CH_2$)?
(A) $CH_3CH_2CH_2Br$
(B) $CH_3CHBrCH_3$
(C) $CH_2BrCH_2CH_3$
(D) $CH_2CH = CHBr$

78. Which of the following is an example of anti-Markovnikov addition?
(A) HCl addition to ethane
(B) HBr addition to propene with peroxide
(C) Br_2 addition to ethane
(D) Water addition to 2-butene

79. What is the molecular geometry of SF_4?
(A) Trigonal planar
(B) Trigonal pyramidal
(C) See-saw
(D) Tetrahedral

80. Which of the following compound has a pentagonal bipyramidal shape of geometry?
(A) IF_7
(B) TeF_6
(C) PF_5
(D) None of the above

81. Which of the following are the principle laws of photochemistry?
(A) Grothus-Draper and Stark-Einstein law
(B) Raoult's and Dalton's law
(C) Raoult's and Henry's law
(D) Lambert's and Beer's law

82. Reactivity order of Pyrrole, Furan and Thiophene towards Electrophilic substitution
(A) Pyrrole > Furan > Thiophene
(B) Thiophene > Pyrrole > Furan
(C) Pyrrole > Thiophene > Furan
(D) Furan > Thiophene > Pyrrole

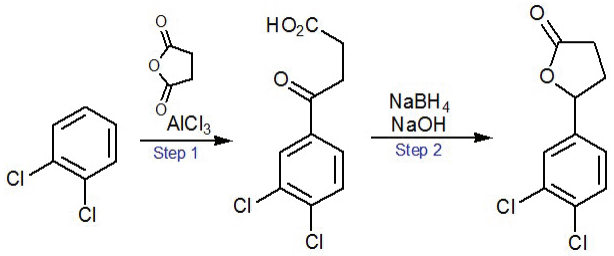
83. The correct order of aromaticity for Pyrrole, Furan and Thiophene is
(A) Thiophene > Pyrrole > Furan
(B) Thiophene > Furan > Pyrrole
(C) Furan > Thiophene > Pyrrole
(D) Pyrrole > Furan > Thiophene

84. A hydroxyacid HO–$(CH_2)_5$–COOH is polymerized and it is found that the product has a number average molar mass of 20,000 g mol^{-1}. What is the extent of the reaction?

(A) 0.814 (B) 0.854

(C) 0.920 (D) 0.993

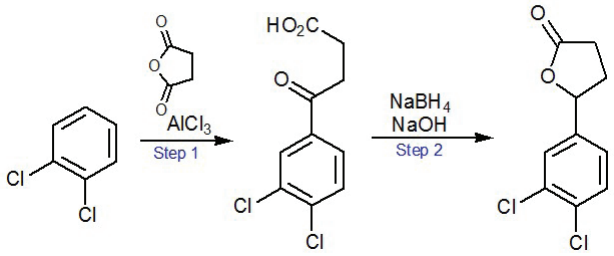
85. What sort of selectivity is observed in step 1 of the following synthesis?



(A) Chemoselectivity (B) Regioselectivity

(C) Stereospecificity (D) Enantioselectivity

86. What sort of selectivity is observed in step 2 of the following synthesis?



(A) Chemoselectivity (B) Stereospecificity

(C) Enantioselectivity (D) Regioselectivity

87. The correct order of C = O stretching frequency in IR spectrum for the following compounds is

(A) A > C > B (B) B > C > A

(C) C > B > A (D) B > A > C

88. The selection rule of the translational energy levels in the Raman spectrum is ΔJ is equal to

(A) $\Delta J = \pm 1$ (B) $\Delta J = \pm 2$

(C) $\Delta J = +1$ (D) $\Delta J = +2$

89. In the rotational Raman spectrum of a linear triatomic molecule, the energy difference between the second Stokes and the second anti-Stokes lines is: Let B denote the rotational constant of the molecule.

(A) 12B (B) 20B

(C) 24B (D) 8B

90. Which of the following species will be deflected to the greatest extent in mass spectrometer?

(A) $^{37}Na^{+}$ (B) $^{35}Na^{+}$

(C) ^{37}Na (D) $^{35}Na^{2+}$

91. In photosynthesis, energy from light reaction to dark reaction is transferred in the form of

(A) Chlorophyll (B) ATP

(C) ADP (D) RuDP

92. Which element is located at the center of the porphyrin ring in chlorophyll?

(A) Magnesium (B) Manganese

(C) Potassium (D) Calcium

93. Which of the following is the most sensitive in electroanalytical methods?

(A) Potentiometry (B) Polarography

(C) Coulometry (D) Conductomretry

94. According to the first law of electrolysis, the mass of a substance liberated at the electrodes during electrolysis is directly proportional to?

(A) Temperature of the electrolyte

(B) Quantity of electrical charge (Q) passed through the electrolyte

(C) Volume of the electrolyte

(D) Pressure of the electrolyte

95. What type of microscope is commonly used in educational settings and laboratories, which uses visible light to illuminate the specimen?

(A) Electron microscope
(B) Optical microscope
(C) Scanning probe microscope
(D) X-ray microscope

96. What type of microscope is used to obtain high-resolution images of the surface of a specimen by scanning it with a focused beam of electrons?

(A) Electron microscope
(B) Optical microscope
(C) X-ray microscope
(D) Scanning probe microscope

97. The vibrational frequency of a homonuclear diatomic molecule is v. The temperature at which the population of the first excited state will be half that of the ground state is given by

(A) $T = hv.ln2/kB$
(B) $T = hv/(ln2.kB)$
(C) $T = ln2/(hv.kB)$
(D) $T = hv.log2/k$

98. Six distinguishable particles are distributed over 3 non-degenerate levels, of energies 0, ε and 2ε. The most probable value for the total energy is

(A) 5ε
(B) 7ε
(C) 8ε
(D) 6ε

99. Which metal ion is commonly found in the active site of the enzyme carbonic anhydrase?

(A) Iron (Fe)
(B) Copper (Cu)
(C) Zinc (Zn)
(D) Magnesium (Mg)

100. Which metalloenzyme is responsible for the breakdown of hydrogen peroxide into water and oxygen?

(A) Catalase
(B) Peroxidase
(C) Supeoxide Dismuase
(D) None of the above

ROUGH WORK

ROUGH WORK