

ENTRANCE TEST FOR Ph.D. PROGRAMME, 2023

CHEMISTRY

Time : Three Hours

Maximum : 100 Marks

Part A

*Answer all questions.**Each question carries 1 mark.*

Choose the correct answer from the choices given :

1. What is the half-life of a radioactive substance, if 87.5% of any given amount of the substance disintegrates in 40 minutes ?
[A] 26 min 40 sec. [B] 13 hrs 20 min.
[C] 13 sec. [D] 13 min. 20 sec.
2. Lithium metal crystallizes in a body centered cubic crystal. If the length of the unit cell of lithium is 351 pm, the atomic radius of lithium will be
[A] 151.8 pm. [B] 75.5 pm.
[C] 300.5 pm. [D] 240.8 pm.
3. The gas constant 'R' is :
[A] Work done per molecule.
[B] Work done per mole.
[C] Work done per degree per mole.
[D] Work done per degree molecule.
4. The temperature at which real gases obey the ideal gas laws over a wide range of pressure is called :
[A] Critical temperature. [B] Boyle temperature.
[C] Inversion temperature. [D] Reduced temperature.
5. The relationship which describes the variation of vapour pressure with temperature is called :
[A] Hess' law. [B] Arrhenius equation.
[C] Kirchhoff s law. [D] Claussius - Clapeyron equation.

Turn over

6. For a reversible reaction, if concentration of the reactant is doubled, the equilibrium constant will be
- [A] The same. [B] One-fourth.
[C] Doubled. [D] Halved.
7. The degree of ionization of an electrolyte does not depend on the :
- [A] Size of the solvent molecule. [B] Temperature.
[C] Concentration of solution. [D] Nature of the solute and solvent.
8. When an acid or alkali is mixed with buffer solution, then pH of buffer solution
- [A] Increases. [B] Changes slightly.
[C] Does not change. [D] Decreases.
9. Which of the will give effective reduction of 3-hexyne to trans-3-hexene ?
- [A] DIBAL. [B] Na/liq. NH_3 .
[C] Fe/NaCl. [D] H_2 /Lindlar's catalyst.
10. According to the law of Mass action, the rate of a chemical reaction is proportional to the :
- [A] Molar concentration of the reactants
[B] Molar concentration of the products.
[C] Concentration of the reactants .
[D] Concentration of the products.
11. Heat of neutralization of an acid by a base is highest when :
- [A] Both the acid and base are weak.
[B] Both the acid and base are strong.
[C] The acid is strong and the base is weak.
[D] The base is strong and the acid is weak.
12. When a lead storage battery is discharged :
- [A] Pb is formed. [B] SO_2 is evolved.
[C] PbSO_4 is consumed. [D] H_2SO_4 is consumed

13. For which of the following molecules would you expect the infrared active fundamentals to be Raman inactive and vice versa ?
- [A] NO_2 . [B] Fluorobenzene.
[C] Benzene. [D] Fluoroethane.
14. Chemical shifts originate from :
- [A] Magnetic momentum. [B] Free induction decay.
[C] Electron shielding. [D] Scalar coupling.
15. In which of the following methods are liquid samples injected into the column in gas chromatography ?
- [A] Rotary sample valve. [B] Micro-syringe.
[C] Solid injection syringes. [D] Gas tight syringe.
16. Which of the following reagents would distinguish cis-cyclopentane-1,2-diol from its trans-isomer ?
- [A] Acetone. [B] Ozone.
[C] MnO_2 . [D] $\text{Al}[(i\text{-C}_3\text{H}_7\text{O})_3]$.
17. Which Intermediate is formed in Wolff's reaction ?
- [A] Ketene. [B] Carbanion.
[C] Carbene. [D] Carbocation.
18. What is the main difference between Hofmann and Curtius rearrangement ?
- [A] Products are different. [B] Isomers.
[C] Reactants are different. [D] Intermediate formed is different
19. The frequency of vibration of a bond is a function of which factor ?
- [A] Force constant of the bond.
[B] Masses of the atoms involved in bonding.
[C] Force constant of the bond and Masses of the atoms.
[D] Bond order.

Turn over

20. When the rate of the reaction is equal to the reaction constant, the reaction is having :
- [A] Third order. [B] First order.
[C] Second order. [D] Zero order.
21. The benzylic acid rearrangement reaction of a cyclic diketone leads to _____.
- [A] Ring contraction. [B] Ring fusion.
[C] Isomers. [D] Ring expansion.
22. The catalyst used in Cannizzarro reaction is _____.
- [A] conc. HCl. [B] NaOH.
[C] dil. HCl. [D] CN^- .
23. In _____ reaction an amide is converted to a primary amine.
- [A] Hoffmann bromamide. [B] Schmidt.
[C] Curtius. [D] Lossen.
24. Bromination of acetanilide is carried out using _____.
- [A] HBr. [B] Bromine in CS_2 .
[C] bromine in acetic acid. [D] NBS.
25. In bromometric method for the estimation of phenol _____ reagent is used.
- [A] KBr/KOH. [B] KBr/KI.
[C] KBrO_3/KBr . [D] KBrO_3/KI .
26. The indicator used in the estimation of glucose is _____.
- [A] Methylene blue. [B] Methyl orange.
[C] Bromophenol blue. [D] Methyl red.
27. What is the catalyst for the Michael addition reaction ?
- [A] Aluminium isopropoxide. [B] Aluminium chloride.
[C] Aluminium hydroxide. [D] Aluminium oxide.
28. To which of the following does guanine form hydrogen bonds in DNA ?
- [A] Adenine. [B] Guanine.
[C] Cytosine. [D] Thymine.

29. Reduction of Aldehydes to hydrocarbon takes place in the presence of which of the following ?
- [A] Zn amalgam and HCl. [B] Anhydrous AlCl_3 .
[C] Ni/Pt. [D] Pd/ BaSO_4 .
30. In the synthesis of pyridine by Chichibabin synthesis, synthesis of acrolein is done which method?
- [A] Dieckmann condensation. [B] Aldol condensation.
[C] Knoevenagel Condensation. [D] Claisen condensation.
31. In mass spectrometer, the ions are sorted out in which of the following ways ?
- [A] By accelerating them through electric field.
[B] By accelerating them through magnetic field.
[C] By applying a high voltage.
[D] By accelerating them through electric and magnetic field.
32. The Williamson synthesis involves _____.
- [A] A nucleophilic addition. [B] $\text{S}_{\text{N}}2$ displacement an.
[C] $\text{S}_{\text{N}}1$ displacement. [D] Electrophilic substitution.
33. The unimolecular elimination involves formation of a _____.
- [A] Biradical. [B] Free radical.
[C] Carbocation. [D] Carbanion.
34. According to Wade's rule, $[\text{C}_2\text{B}_{10}\text{H}_{12}]$ adopts which type of structure ?
- [A] Closo structure. [B] Nido structure.
[C] Archano structure. [D] Hypo structure.
35. Fe is made passive by concentrated _____ acid
- [A] Sulfuric. [B] Nitric.
[C] Hydrochloric. [D] Phosphoric.
36. The polymer used in bullet proof glass is _____.
- [A] Polyurethane. [B] poly methyl methacrylate.
[C] Poly styrene. [D] PTFE.

Turn over

37. According to IUPAC nomenclature sodium nitroprusside dihydrate is named as :
- [A] Sodium pentacyanonitrosylferrate(II).
 - [B] Sodium nitroferricyanide.
 - [C] Sodium nitroferrocyanide.
 - [D] Sodium pentacyanonitrosylferrate(III).
38. In photosynthesis, the predominant metal present in the reaction centre of photosystem II is :
- [A] Mn.
 - [B] Cu.
 - [C] Fe.
 - [D] Zn.
39. Pernicious anaemia is one of the obvious symptoms of _____ deficiency.
- [A] Nickel.
 - [B] Magnesium.
 - [C] Cobalt.
 - [D] Calcium.
40. In metal carbonyl the M - C bond is :
- [A] Ionic.
 - [B] Covalent.
 - [C] Covalent with ionic character.
 - [D] Co-ordinate covalent.
41. The blue colour obtained in the Lassaigne's test is due to the formation of
- [A] $\text{Fe}_4[\text{Fe}(\text{CN})_6]_3$.
 - [B] $\text{Na}[\text{Fe}(\text{CN})_6]$.
 - [C] $\text{Fe}_4[\text{Fe}(\text{CN})_6]_4$.
 - [D] $\text{Fe}_3[\text{Fe}(\text{CN})_6]$.
42. The existence of two different coloured complexes with the composition of $[\text{Co}(\text{NH}_3)_4\text{Cl}_2]^+$ is due to _____ isomerism.
- [A] Co-ordination.
 - [B] Geometrical.
 - [C] Ionization.
 - [D] Linkage.
43. If bond order increases, then :
- [A] Energy and bond length increases.
 - [B] Energy and bond length decreases.
 - [C] Energy decreases and bond length increases.
 - [D] Energy increases and bond length decreases.

44. Two ice cubes are pressed over each other until they unite to form one block. Which one of the following force dominate for holding them together ?
- [A] Dipole - dipole. [B] Van der Walls force.
[C] Ionic interactions. [D] Hydrogen bonding.
45. The bond dissociation energy is the amount of energy required to break a bond :
- [A] So as to produce the more stable pair of ions.
[B] Heterolytically.
[C] Homolytically.
[D] Via hydrogenation.
46. In neutron activation analysis the radiation commonly detected is :
- [A] Gamma rays. [B] beta rays.
[C] Alpha rays. [D] X-rays.
47. In "Research", 'R' means :
- [A] Role. [B] Retain.
[C] Real. [D] Round.
48. A hypothesis is a :
- [A] Tentative statement whose validity is still to be tested.
[B] Supposition which is based on the past experiences.
[C] Statement of fact.
[D] Methodology of work to be done.
49. The main purpose of research in education is to :
- [A] Increase individual's market value of jobs.
[B] Increase the social prestige of an individual.
[C] Help the individual to become an eminent educationist.
[D] Help in individual's personal growth.

Turn over

50. Synopsis of a research project is _____.

- [A] The blue print of research.
- [B] A plan of the research.
- [C] The summary of the findings of the research.
- [D] The extracts from the research observations.

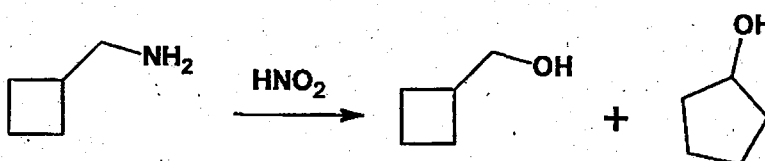
(50 × 1 = 50 marks)

Part B

Answer any ten questions.

Each question carries 5 marks.

51. Explain the basic differences between nuclear fission and nuclear fusion.
52. Discuss the temperature dependence of free energy.
53. Discuss the harmonic oscillator model for a diatomic molecule.
54. Explain the applications of e.m.f. measurements.
55. Explain the mechanism of the following conversion :



56. Explain the Hapto nomenclature of organometallic compounds
57. Briefly explain the various criteria for aromaticity
58. An aromatic compound exhibited peaks in UV (256 nm), IR (3530, 3030, 1540, 1500, 1470, 1220, 800 cm⁻¹), ¹H-NMR (9.2 (s), 8.2 (d) and 7.6(d) ppm in the ratio 1 : 2 : 2), ¹³C-NMR (126, 132, 140 and 162 ppm in the ratio 2 : 2 : 1 : 1) Its Mass spectral degradation is 186, 169, 152, 93, 76, 34, 17. Elucidate the structure of the compound.

59. Discuss the statistical formulation of third law of thermodynamics.
60. Explain the mechanism of ion transport across membranes.
61. What is the observational method of research ?
62. Distinguish between confounding variable and extraneous variable.
63. What is randomization in research methodology ?
64. What is a directional hypothesis and when would it be used ?

(10 × 5 = 50 marks)