Part III — CHEMISTRY

(English Version)

Time Allowed : 3 Hours]   [Maximum Marks : 150

Note :   i)   Answer *all* the questions from **Part – I**.

ii)   Answer any *fifteen* questions from **Part– II**.

iii)   Answer any *seven* questions from **Part – III** covering all Sections and choosing at least *two* questions from each Section.

iv)   Question No. **70** is compulsory. Answer any *three* from the remaining questions in **Part – IV**.

v)   Draw diagrams and write equations wherever necessary.

PART – I

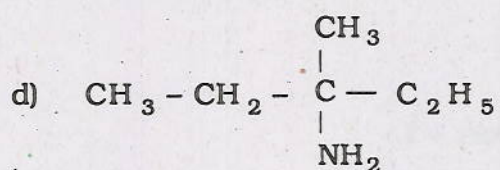*Note :* Answer *all* the questions. $30 \times 1 = 30$

Choose and write the correct answer :

1. When an aqueous solution of benzene diazonium chloride is boiled, the product formed is

   a)   benzyl alcohol

   b)   benzene + N_2

   c)   phenol

   d)   phenyl hydroxylamine.

2. Oxidation of aniline with acidified $K_2Cr_2O_7$ gives

   a)   *p*-benzoquinone   b)   benzoic acid

   c)   benzaldehyde   d)   benzyl alcohol.

[Turn over

3. Which among the following is a tertiary amine ?

   a) $(CH_3)_3 - C - NH_2$

   b) $CH_3 - CH - NH - CH_3$
                   $|$
                  CH_3

   c) $(CH_3)_2 - N - C_2H_5$

                       CH_3
                        $|$
   d) $CH_3 - CH_2 - C - C_2H_5$
                        $|$
                      NH_2
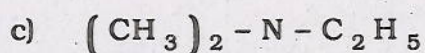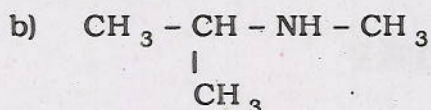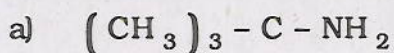
4. The reducing sugar among the following is

   a)   sucrose   b)   cellulose

   c)   glucose   d)   starch.

5. The amino acid without chiral carbon is

   a)   Alanine   b)   Glycine

   c)   Proline   d)   Thyrosine.

6. The active component of dynamite is

   a)   kieselghur   b)   nitroglycerine

   c)   nitrobenzene   d)   trinitrotoluene.

7. Anisole on bromination yields

   a)   *m*-bromoanisole   b)   *o*-bromoanisole

   c)   *o*- & *p*-bromoanisole   d)   benzoic acid.

8. Diethyl ether can be decomposed with

   a)   HI   b) $KMnO_4$

   c)   NaOH   d) H_2O.

9. The compound that does not undergo Cannizzaro reaction is

   a)   formaldehyde   b)   benzaldehyde

   c)   acetaldehyde   d)   trimethyl acetaldehyde.

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10. Which one of the following is least acidic ?

   a) C_2H_5OH b) CH_3COOH

   c) C_6H_5OH d) $ClCH_2COOH$.

11. The excess energy which a molecule possesses to become active is known as

   a)   kinetic energy   b)   potential energy

   c)   activation energy   d)   threshold energy.

12. In the reaction between oxalic acid and potassium permanganate, in the presence of dil. H_2SO_4, ... acts as an autocatalyst.

   a) K_2SO_4 b) $MnSO_4$

   c) MnO_2 d) Mn_2O_3.

13. In the case of physical adsorption, there is desorption when

   a)   temperature increases   b)   temperature decreases

   c)   pressure increases   d)   concentration increases.

14. The blue colour of the sky is due to

   a)   Tyndall effect   b)   Brownian movement

   c)   electrophoresis   d)   electro-osmosis.

15. Faraday's laws of electrolysis are related to

   a)   atomic number of the cation

   b)   atomic number of the anion

   c)   equivalent weight of the electrolyte

   d)   speed of the cation.

16. The number of close neighbours in a body centred cubic lattice of identical sphere is

   a)   6   b)   4

   c)   12   d)   8.

17. All the naturally occurring processes proceed spontaneously in a direction which leads to

   a)   decrease of entropy   b)   increase in enthalpy

   c)   increase in free energy   d)   decrease of free energy.

A   [Turn over

18. The percentage efficiency of a heat engine that operates between $127°C$ and $27°C$ is

    a)   20%   b)   50%

    c)   100%   d)   25%.

19. For the homogeneous gas reaction at 600 K

    $$4\, NH_3\,(g) + 5\, O_2\,(g) \rightleftharpoons 4\, NO\,(g) + 6\, H_2O\,(g)$$

    the equilibrium constant K_c has the unit

    a) $\left(\text{mol dm}^{-3}\right)^{-1}$ b) $\left(\text{mol dm}^{-3}\right)$

    c) $\left(\text{mol dm}^{-3}\right)^{10}$ d) $\left(\text{mol dm}^{-3}\right)^{-9}$.

20. If the equilibrium constant of the reaction $2\,A \rightleftharpoons B$ is K_1 and the equilibrium constant of the reaction $B \rightleftharpoons 2\,A$ is K_2, then

    a) $K_1 = \dfrac{1}{K_2}$ b) $K_1 = 2\,K_2$

    c) $K_1 = \dfrac{1}{K_2^2}$ d) $K_2 = \left(K_1\right)^2$.

21. Which of the following ions will give colourless aqueous solution ?

    a) Ni^{2+} b) Cu^{+}

    c) Cu^{2+} d) Fe^{2+}.

22. Maximum oxidation state exhibited by lanthanides is

    a)   + 1   b)   + 2

    c)   + 3   d)   + 4.

23. Which of the following is a radioactive lanthanide ?

    a)   Pu   b)   Ac

    c)   Th   d)   Pr.

24. Which one of the following is a cationic complex ?

    a) $K_4\left[Fe\,(CN)_6\right]$ b) $\left[Cu\,(NH_3)_4\right]Cl_2$

    c) $K_3\left[Cr\,(C_2O_4)_3\right]$ d) $K_3\left[Fe\,(CN)_6\right]$.

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25. Which one of the following particles is used to bombard $_{13}Al^{27}$ to give $_{15}P^{30}$ and a neutron ?

   a) α-particle   b) Proton

   c) Neutron   d) Deuteron.

26. The intramolecular hydrogen bonding is present in

   a) o-nitrophenol   b) m-nitrophenol

   c) p-nitrophenol   d) p-aminophenol.

27. The hybridisation in SO_4^{2-} ion is

   a) sp^3 b) sp^3d^2

   c) sp^3d d) sp^3d^3.

28. The electron affinity of an atom is

   a) directly proportional to its size   b) inversely proportional to its size

   c) independent of its size   d) none of these.

29. An element which was burnt in limited supply of air to give oxide A, which on treatment with water gives an acid B. Acid B on heating gives acid C which gives yellow precipitate with $AgNO_3$ solution. Compound A is

   a) SO_2 b) NO_2

   c) P_2O_3 d) SO_3.

30. A metal which precipitates gold from its aurocyanide complex is

   a) Cr   b) Ag

   c) Pt   d) Zn.

PART – II

   Note : i)   Answer any *fifteen* questions.

          ii) Each answer should be in one or two sentences.   15 × 3 = 45

31. Define hybridisation.

32. Ionisation energy of Neon is greater than that of Fluorine. Give reason.

33. Prove that P_2O_5 is a powerful dehydrating agent.

A   [Turn over

34. What is inert pair effect ?

35. Why do d-block elements exhibit variable oxidation states ?

36. Explain Chromyl chloride test with equation.

37. How many α and β particles will be emitted by an element $_{84}A^{218}$ in changing to a stable isotope of $_{82}B^{206}$?

38. Sketch the following lattices :

     a)   Simple cubic

     b)   Face-centred cubic

     c)   Body centred cubic.

39. Calculate the entropy change involved in the conversion of 1 mole of ice at 0°C and 1 atm to liquid at 0°C and 1 atm. The enthalpy of fusion per mole of ice is $6008 \ J \ mol^{-1}$.

40. Dissociation of PCl_5 decreases in the presence of increase in Cl_2. Why ?

41. Define order of a reaction.

42. Write the Arrhenius equation and explain the terms.

43. What is peptisation ? Give an example.

44. State Ostwald's dilution law.

45. Give the conditions required for a compound to exhibit optical isomerism.

46. How is Terylene prepared from glycol ?

47. How is phenol identified ?

48. How is acetophenone prepared by Friedel-Crafts reaction ?

49. Mention the uses of oxalic acid.

50. An aromatic primary amine A with molecular formula C_6H_7N undergoes diazotisation to give B. B when treated with hypophosphorous acid gives C. Identify A, B and C.

51. How is nylon-66 prepared ? Give its use.

PART – III

Note : Answer any *seven* questions choosing at least *two* questions from each Section. $7 \times 5 = 35$

SECTION – A

52. The uncertainty in the position of a moving bullet of mass 10 g is 10^{-5} m. Calculate the uncertainty in its velocity.

53. How is Cr_2O_3 reduced to chromium by aluminothermic process ?

54. Bring out the consequences of lanthanide contraction.

55. In what way does $\left[FeF_6\right]^{4-}$ differ from $\left[Fe(CN)_6\right]^{4-}$?

SECTION – B

56. What are the characteristics of entropy ?

57. Apply Le Chatelier's principle for the manufacture of SO_3 by contact process and find the conditions for getting maximum yield of SO_3.

58. Compound *A* reacts by first order kinetics. At 25°C, the rate constant of the reaction is $0.45 \ sec^{-1}$. What is the half-life period of *A* at 25°C ? What is the time required to have 12.5% unreacted *A* for first order reaction ?

59. Derive Nernst equation.

SECTION – C

60. Give any two methods of preparation of anisole.

61. Explain 'Popott's rule' with an example.

62. Explain the mechanism of Kolbe's reaction.

63. Explain briefly on the characteristics of rocket propellants.

PART – IV

Note : Question No. **70** is compulsory and answer any *three* from the remaining questions. $4 \times 10 = 40$

64. a) Explain the various factors that affect electron affinity.

    b) Write any five points about the anomalous nature of fluorine.

A   [Turn over

65. a) What are the postulates of valence bond theory ?

    b) Distinguish chemical reactions from nuclear reactions.

66. a) Explain Schottky defect and Frenkel defect.

    b) Write briefly the 'adsorption theory of catalysis'.

67. a) Explain quinonoid theory of indicators.

    b) Write notes on IUPAC conventions of representation of a cell.

68. a) Write in detail about optical isomerism in tartaric acid.

    b) How are the following conversions carried out ?

    i) Salicylic acid → asprin

    ii) Methyl acetate → ethyl acetate

    iii) Lactic acid → pyruvic acid.

69. a) Explain Gabriel's phthalimide synthesis and mustard oil reaction.

    b) Elucidate the structure of glucose.

70. a) Two isomers (A) and (B) have the same molecular formula $C_4H_{10}O$. (A) when heated with copper at 573 K gives an alkene (C) of molecular formula C_4H_8. (B) on heating with copper at 573 K gives (D) of molecular formula C_4H_8O which does not reduce Tollen's reagent but answers iodoform test. Identify (A), (B), (C) and (D) and explain the reactions.

    b) Silver reacts with dil. HNO_3 to give compound (A), which on heating at 723 K gives compound (B). (B) on heating gives compound (C). Compound (A) reacts with KBr and gives (D) which is highly useful in photography. Identify (A), (B), (C) and (D). Explain the reactions.

OR

    c) An aromatic compound (A) with molecular formula C_7H_6O has the smell of bitter almonds. (A) reacts with Cl_2 in the absence of catalyst to give (B) and in the presence of catalyst compound (A) reacts with chlorine to give (C). Identify (A), (B) and (C). Explain the reactions.

    d) 0·1978 g of copper is deposited by a current of 0·2 ampere in 50 minutes. What is the electrochemical equivalent of copper ?

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