2 0 1 9

CHEMISTRY

(Theory)

Full Marks : 70

Time : 3 hours

General Instructions :

  (i) Write all answers in the Answer Script.

 (ii) Attempt all parts of a question together in one place.

(iii) All questions are compulsory.

(iv) Marks for each question are indicated against it.

 (v) Question No. **1** of Part—I is of Multiple-choice Type, each of ½ mark. Choose and write the correct answer in the Answer Script from the four options given.

 (vi) Question Nos. **2** to **9** of Part—II are very Short-answer Type Questions of 1 mark each. Answer these either in *one* word or in *one* sentence each.

(vii) Question Nos. **10** to **17** of Part—III are Short-answer Type–I Questions of 2 marks each. Answer these in about *20–30* words each.

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(2)

(viii) Question Nos. **18** to **26** of Part—IV are Short-answer Type–II Questions of 3 marks each. Answer these in about *40–50* words each.

(ix) Question Nos. **27** to **29** of Part—V are Long-answer Type Questions of 5 marks each. Answer these in about *70–80* words each.

(x) Use of non-programmable ordinary Scientific Calculators and Log Tables is allowed.

(xi) Mobile phones and Pagers are not allowed inside the Examination Hall.

PART—I

1. Choose and write the correct answers for the following in the Answer Script :   ½×8=4

   (a) In which pair is the most efficient packing present?

   (i) hcp and bcc

   (ii) bcc and ccp

   (iii) hcp and ccp

   (iv) bcc and simple cubic

   (b) The fraction of the total volume occupied by the atoms present in a simple cubic is

   (i) $\dfrac{\pi}{4}$

   (ii) $\dfrac{\pi}{6}$

   (iii) $\dfrac{\pi}{3\sqrt{2}}$

   (iv) $\dfrac{\pi}{4\sqrt{2}}$

(c) Increasing the temperature of an aqueous solution will cause

   (i)   decrease in molality

   (ii)   decrease in molarity

   (iii)   decrease in mole fraction

   (iv)   decrease in mass percent

(d) Colligative properties are those properties which depend on

   (i)   shapes of the particles

   (ii)   nature of the particles only

   (iii)   nature of the solvent only

   (iv)   number of particles only

(e) The most suitable reagent for the conversion of $R—CH_2—OH \rightarrow RCHO$ is

   (i) $KMnO_4$

   (ii) $K_2Cr_2O_7$

   (iii) $LiAlH_4$

   (iv)   PCC

(f) The strongest acid among the following compounds is

   (i)   *o*-nitrophenol

   (ii)   *p*-chlorophenol

   (iii)   *m*-nitrophenol

   (iv)   *p*-nitrophenol

(4)

(g) Which of the following acids is a vitamin?
 (i) Aspartic acid
 (ii) Adipic acid
 (iii) Ascorbic acid
 (iv) Saccharic acid

(h) The reason for the double helical structure of DNA is due to the presence of
 (i) van der Waals' forces
 (ii) dipole-dipole interactions
 (iii) hydrogen bonding
 (iv) London forces

PART—II

2. What is Kraft temperature?   1

3. What are ambidentate ligands?   1

4. Arrange the following in order of decreasing S_N1 reactivity :   1

$(CH_3)_3CCl$, CH_3Cl, $(CH_3)_2CHCl$, CH_3CH_2Cl

5. Write the IUPAC name of

   1
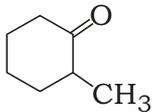
6. Identify the products A and B formed in the following reaction :   ½+½=1

$CH_3—CH_2—CH=CH—CH_3 + HCl \longrightarrow A + B$

(**5**)

7. Give one reaction that can be used as a test for primary amines.   1

8. Identify *A* and *B* in the following reaction :   ½+½=1
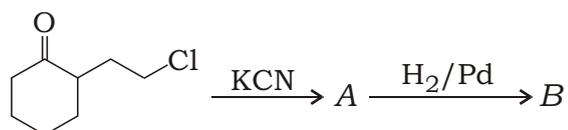
9. How does antiferromagnetism differ from ferromagnetism in terms of magnetic domains?   1

PART—III

10. An element has bcc structure with cell edge of 288 pm. The density of the element is $7 \cdot 2 \ g \ cm^{-3}$. How many atoms are present in 208 g of the element?   2

11.   *Either*

    (a) What will happen to the boiling point of a solution on mixing two miscible liquids showing negative deviation from Raoult's law?   1

    (b) Give two conditions necessary for a solution to be ideal.   1

             Or

    (c) Derive a relation between relative lowering of vapour pressure and mole fraction of the solute.   2

12. The boiling point of benzene is 353·23 K. When 1·80 g of a nonvolatile solute was dissolved in 90 g of benzene, the boiling point is raised to 354·11 K. Calculate the molar mass of the solute. (K_b for benzene is 2·53 K kg mol^{-1})   2

13. *(a)* When does the average rate of a reaction become equal to instantaneous rate?   1

(b) Write any one condition under which a bimolecular reaction may be kinetically of first order.   1

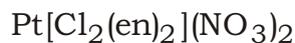**14.** *(a)* Calculate the magnetic moment of a divalent ion in aqueous solution if its atomic number is 25.   1

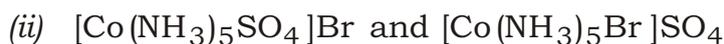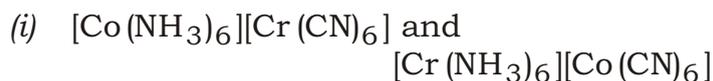*(b)* Predict which of the following will be coloured in aqueous solution :   1

$$Sc^{3+}, \ Fe^{3+}, \ Ti^{4+}, \ V^{3+}$$
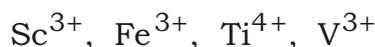
(Atomic nos. of Sc, Fe, Ti and V are 21, 26, 22 and 23 respectively)

15.   *Either*

(a) Write the IUPAC name of the following complex :   1

$$Pt[Cl_2(en)_2](NO_3)_2$$

(b) Name the type of isomerism exhibited by the following pairs of complexes :   ½×2=1

(i) $[Co(NH_3)_6][Cr(CN)_6]$ and $[Cr(NH_3)_6][Co(CN)_6]$
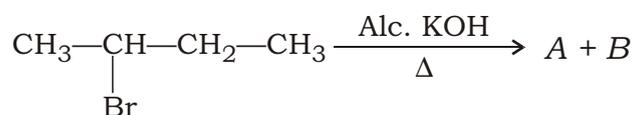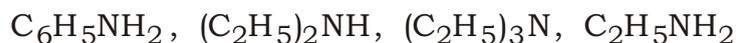
(ii) $[Co(NH_3)_5SO_4]Br$ and $[Co(NH_3)_5Br]SO_4$

Or

(c) Is the complex $[Ni(CO)_4]$ a low-spin or a high-spin complex? Explain on the basis of VBT.　2

16. Write the products of the following reaction. Which one is the major product and why?　2

$$CH_3—\underset{\underset{Br}{|}}{CH}—CH_2—CH_3 \xrightarrow[\Delta]{Alc.\ KOH} A + B$$

17. *(a)* Arrange the following substances in increasing order of their basic strength in water :　1

$C_6H_5NH_2$, $(C_2H_5)_2NH$, $(C_2H_5)_3N$, $C_2H_5NH_2$

(b) Out of ethylamine and ethyl alcohol, which has higher boiling point and why?　1

PART—IV

18. *Either*

(a) Half-life period of a reaction increases with increase in initial concentration. Predict the order of the reaction.　1

(b) Decomposition of a compound follows first-order kinetics. If it takes 15 minutes for 20% of original substance to decay, calculate—

　(i) rate constant;

　(ii) the time at which 10% of the reactant remains undecayed.　1+1=2

Or

(c) Define activation energy.   1

(d) The rate of a particular reaction doubles when temperature changes from 27 °C to 37 °C. Calculate the value of activation energy. $(R = 8\cdot314 \text{ J K}^{-1} \text{ mol}^{-1})$ 2

19. (a) Distinguish between Physical adsorption and Chemical adsorption.   1

(b) What do you mean by selectivity of a catalyst?   1

(c) State Hardy-Schulze rule.   1

20.   *Either*

(a) What are the two requirements for vapour phase refining? Write the chemical reactions which occur during Mond's process for the refining of nickel.   3

Or

(b) What is the role of cryolite in the metallurgy of aluminium?   1

(c) Name the depressant used for the separation of ZnS ore from PbS ore during froth floatation process.   1

(d) How would you convert pig iron into cast iron?   1

(**9**)

21. Give reason for the following :   1+2=3

    (a) O_3 acts as a powerful oxidizing agent.
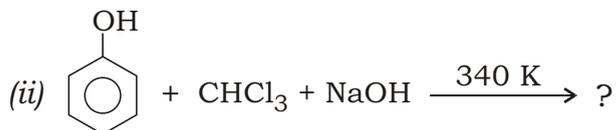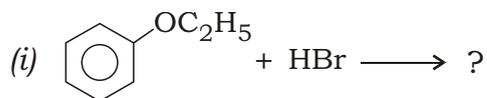
    (b) O_2 is a gas but sulphur is a solid.

22. *(a)* Write the reaction of $KMnO_4$ with Fe(II) ions in acidic medium.   1

    (b) Define lanthanoid contraction. Write two consequences of lanthanoid contraction.   1+1=2

23. *(a)* How would you convert propene to propan-1-ol?   1

    (b) Complete the following reactions :   1×2=2

        (i)   ⬡—OC_2H_5 + HBr ⟶ ?

        (ii)   ⬡—OH + $CHCl_3$ + NaOH $\xrightarrow{340\ K}$?

24.   *Either*

    (a) Name the vitamins whose deficiency is responsible for—

        (i)   night blindness;

        (ii)   poor coagulation of blood.   ½+½=1

    (b) What are essential and nonessential amino acids? Give one example of each type.   1+1=2

Or

(c) What is the difference between amylose and amylopectin?   1

(d) What is a glycosidic linkage?   1

(e) Name the base that is found in RNA only.   1

25. (a) What is a biodegradable polymer?   1

    (b) Classify the following into addition and condensation polymers :   2

       Terylene, Bakelite, Polyvinyl chloride, Polythene

26. (a) What are tranquilizers?   1

    (b) What are broad-spectrum antibiotics?   1

   (c) Name a substance that can be used as an antiseptic as well as disinfectant.   1

PART—V

27.   *Either*

    (a) Why does the conductivity of a solution decrease with dilution?   1

    (b) Write two conditions necessary for the corrosion to occur.   1

(c) State Kohlrausch's law. Calculate the molar conductivity of an aqueous solution at infinite dilution for $BaCl_2$, when ionic conductances of Ba^{2+} and Cl^- ions are 127·30 S cm^2 mol^{-1} and 76·34 S cm^2 mol^{-1} respectively.   1+2=3

Or

(d) What are fuel cells?   1

(e) Write all reactions taking place during recharging of lead storage cell.   2

(f) Calculate the standard Gibbs' energy change for the reaction

$$Zn\,(s) + Cu^{2+}(aq) \rightarrow Zn^{2+}(aq) + Cu\,(s)$$
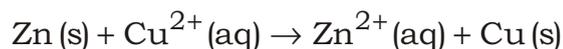
(Given, $E^{\circ}_{Zn^{2+}/Zn} = -0.76$ V, $E^{\circ}_{Cu^{2+}/Cu} = +0.34$ V)   2

28.   *Either*

(a) How does ammonia react with a solution of Cu^{2+} ions?   1

(b) Draw the structure of cyclometaphosphoric acid.   1

(c) Write the principle and conditions involved giving stepwise reaction for the manufacture of H_2SO_4 by contact process.   3
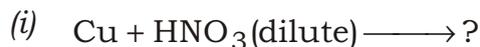
Or

(d) HCl reacts with powdered Fe to give $FeCl_2$ and not $FeCl_3$. Why?   1

(e) When NaBr is heated with conc. H_2SO_4, Br_2 is produced. But when NaCl is heated with conc. H_2SO_4, HCl is produced. Explain with chemical equations. 2
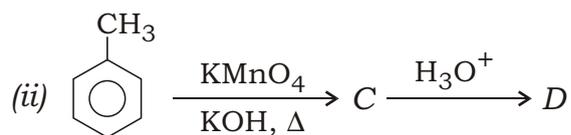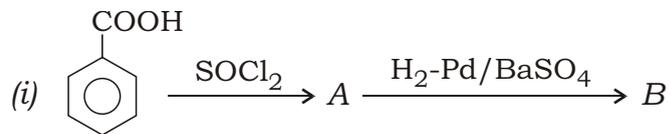
(f) Complete the following reactions : 1×2=2

   (i) $Cu + HNO_3 (dilute) \longrightarrow ?$

   (ii) $XeF_4 + O_2F_2 \longrightarrow ?$

29. (a) Arrange the following in increasing order of acidic strength : 1

   $ClCH_2COOH$, CF_3COOH, HCOOH, CCl_3COOH

(b) Identify the products A, B, C and D in the given reactions : 1×2=2

   (i) $\underset{\bigcirc}{COOH} \xrightarrow{SOCl_2} A \xrightarrow{H_2\text{-}Pd/BaSO_4} B$

   (ii) $\underset{\bigcirc}{CH_3} \xrightarrow[KOH, \Delta]{KMnO_4} C \xrightarrow{H_3O^+} D$

(c) How will you bring about the following conversions? 1×2=2

   (i) Ethyl cyanide to 1-phenyl propanone

   (ii) Ethanal to 2-aminoethanoic acid

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