Model Question Paper

M.Sc. Chemistry
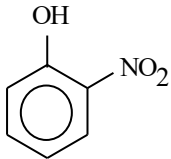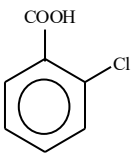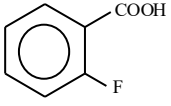
Max. Marks: 75   **Time: 2 hours**
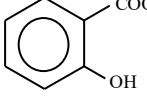
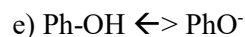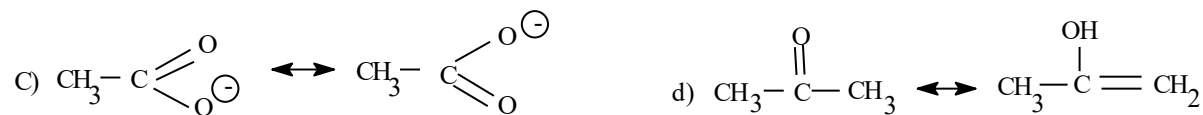### SAMPLE QUESTIONS

<div style="text-align:center">

SECTION-A

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Answer the following questions. Each question carries ONE mark: *(25 x 1 = 25 marks)*

1. Humphries series in the H-spectrum arises when electrons jump from higher energy level to

   a) n = 2   b) n = 6   c) n = 4   d) n = 5   e) n = 6

2. The ionic species of highest bond order is

   a) O_2^+ b) O_2 c) O_2^- d) O_2^{2-} e) O_2^{3-}

3. Which of the following salts in water forms acidic solution?

   a) NH_4Br b) Na_2CO_3 c) KI   d) K_3PO_4 e)K_2CO_3

4. The most suitable indicator for the titration of 0.2M CH3COOH ($K_a = 1.8 \times 10^5$) with 0.2 M NaOH would be

   a) methyl orange   b) thymol blue   c) methyl red   d) bromophenol blue   e) Phenol red

5. Strongest intramolecular 'H' bonding is found in

   e) P-Nitrophenol

6. Which of the following mixed systems does not function as a buffer solution?

   a) Equal volumes of 0.5 M CH3COOH(aq) and 0.3M NaOH(aq).
   b) Equal volumes of 0.1 M C_6H_5COOH(aq) and 0.1M C_6H_5COONa(aq).
   c) Equal volumes of 0.1 M HNO_2(aq) and 0.1M $NaNO_2$(aq).
   d) Equal volumes of 0.1 M NH_3(aq) and 0.1M HCl(aq).
   e) Equal volumes of 0.2 M NH_3(aq) and 0.2M HCl(aq).

7. The ionic strength of the solution containing 0.02M $CuSO_4$ (aq) and 0.01M $CaCl_2$ (aq) is

   a) 0.03   b) 0.11   c) 0.015   d) 0.06   e) 0.08

8. Which of the following sets is NOT a pair of resonance structures?

a) $CH_3 - CH = \overset{\oplus}{\underset{\cdot\cdot}{O}} - H \leftrightarrow CH_3 - \overset{\oplus}{CH} - \overset{\cdot\cdot}{\underset{\cdot\cdot}{O}} - H$ b) $\overset{\oplus}{CH_2} - CH = CH_2 \leftrightarrow CH_2 = CH - \overset{\oplus}{CH_2}$

C) $CH_3 - C\overset{O}{\underset{O^{\ominus}}{\diagup\!\!\!\diagdown}} \leftrightarrow CH_3 - C\overset{O^{\ominus}}{\underset{O}{\diagup\!\!\!\diagdown}}$ d) $CH_3 - \overset{O}{\overset{||}{C}} - CH_3 \leftrightarrow CH_3 - \overset{OH}{\overset{|}{C}} = CH_2$

e) Ph-OH ⟷ PhO⁻

9. The activity of A in a mixture is 0.13 at the molefraction, $x = 0.2$. The activity coefficient of A will be

a) 0.026   b) 0.65   c) 1.54   d) 0.13   e) 0.04

10. Calculate the ratio of molarities of CO_3^{2-}/HCO_3^- required to achieve buffering at pH = 9.25. The pKa_2 of H_2CO_3 is 10.25.

a) 1.0   b) 0.1   c) 10   d) 0.5   e) 0.6

11. The compound which <u>cannot</u> be employed as a primary standard in titrimetry is

a) CH_3COOH b) $\overset{COOH}{\underset{COOH}{|}}$ c) Na_2CO_3 d) $K_2Cr_2O_7$

e) Propionic acid

12. When 50 mL of 0.1M HCOOH(aq) is added to 50 mL of 0.1M NH₃(aq), the pH of the resulting solution would be $\left[\begin{array}{l} HCOOH, Ka = 1.77 \; x \; 10^{-4} \\ NH_3, K_b = 1.81 \; x \; 10^{-5} \end{array}\right]$

a) 7.0   b) 6.5   c) 7.5   d) 3.8   e) 4.0

13. An example of a Redox Indicator is

a) Thymolphthalein   b) Phenolphthalein   c) Feroin   d) Methyl Red   e) Methylene blue

14. The hybridisation involved in t he formation of $I_3^{\ominus}$

a) dsp^2 b) sp^3 c) sp^3d d) d^2sp^3 e) sp^2

15. The dipole moment of HF bond is 1.91 D and the bond length is 92 pm. The percentage ionic character of the bond will be

a) 12   b) 43   c) 17   d) 46   e) 20

16. Among the following compounds identify a thermochromic compound.

a) S_4N_4 b) I_2 c) $Na_2S_2O_3$ d) NH4 Cl   e) NaCl

17. Which one of the following ions is a pseudohalide ion?

   a) Br^- b) CN^- c) ICl_2^- d) S^{2-} e) O_2^-

18. The following compound under anhydrous conditions is covalent in nature.

   a) $AlCl_3$ b) $PbCl2$ c) $BiCl3$ d) $TlCl$ e) $NaBr$

19. The expansion work done when 36 g of water is electrolyzed under constant pressure at 25 ^0C is

   a) $-10kJ$ b) $-5kJ$ c) $-2.5kJ$ d) $-7.4kJ$ e) $-8.4kJ$

20. Among the following identify a covalent like carbide

   a) CaC_2 b) SiC c) Be_2C d) Al_4C_3 e) SrC_2

21. Which one of the following pentahalides is not known?

   a) PCl_5 b) $SbCl5$ c) $NCl5$ d) $PBr5$ e) PF_5

22. The oxoacid of sulphur which behaves as a reducing agent is

   a) Sulphuric acid   b) Caro's acid   c) Mashall's acid   d) Thiosulphuric acid
   e) Oleum

23. Kolbe– Schmitt reaction is the reaction between

   a) phenol and formaldehyde in presence of alkali   b) phenol and carbon dioxide in presence of alkali
   c) phenol and chloroform in presence of alkali   d) phenol and carbon tetrachloride in presence of alkali
   e) None of the above

24. Which one of the following solutions satisfies Raoult's law?

   a) chloroform and acetone   b) carbon disulphide and acetone
   c) benzene and toluene   d) cyclohexane and benzene
   e) benzene and water

25. The molar enthalpy of vaporization of benzene at its boiling point (353.25 K) is 30.8 $kJmol^{-1}$. The molar internal energy change is

   a) $+25.8kJmol^{-1}$ b) $+27.9kJmol^{-1}$ c) $+35.8kJmol^{-1}$ d) $-25.8kJmol^{-1}$ e) $-45.8kJmol^{-1}$

(6 x 5 = 30 marks)

Answer any six questions. Each question carries FIVE marks:

1. An organic compound CH_4O(A) on oxidation with CrO_3 in pyridine gives(B), but oxidation of (A)with H_2CrO_4 gives (C). (B) on treatment with NaOH followed by acidification gives (A) and (C). Identify the compounds (A), (B) and (C).

2. Distinguish between inter and intramolecular–H–bonding. Why is ortho-nitrophenol steam volatile and para-nitrophenol is <u>NOT</u> ?

3. Use Carnot cycle to prove that $qh/q_c = -T_h/T_c$

4. Sketch and explain the pH curve for the titration of CH3COOH   with NaOH giving appropriate expression for pH   at various stages of titration.

5. Give the salient features of SN^2 and SN^1 reactions with suitable examples.

6. How does HSAB concept explain the stability and formation of a compound ? Give reason(s) for the existence of (Ca^{2+}, Mg^{2+}) ions as carbonates in nature and (Hg^{2+}, Cu^+) as sulphides .

7. Write a general expression for Debye–Huckel–Onsager equation. Based on this, account for the variation of

molar conductivity with concentration for an aqueous solution of NaCl.

8. How is the series of aldoses ascended and descended? Explain with suitable examples.

(20 marks)

Answer any one question. Each question carries TWENTY marks :

9. a) Write a general expression for Debye–Huckel–Onsager equation. Based on this, account for the variation of molar conductivity with concentration for an aqueous solution of NaCl.
   b) Explain mutarotation. Propose a mechanism. What does this convey about the structure of sugars? Explain with an example.
   c) What is disintegration series? Mention the different types of disintegration series.
   d) Draw the MO energy diagram for $NO^{\oplus}$.   Calculate bond order and predict its magnetic behaviour.

4x5=20 marks

(OR)

10. a) What is Fajan's rule ? Why is the melting point and electrical conductivity in the Molten state of NaCl greater than that of $AlCl_3$.

b) Differentiate between chemisorption and physisorption

c) What is selective precipitation? Explain in detail as to how selective precipitation of the ions from solution containing $Cu2^+$, Al^{3+} and Z_n^{2+} ions is achieved.

d) Predict the product(s) obtained when following dicarboxylic acids are subjected to thermal treatment:

i) Oxalic acid ii) Malonic acid iii) Succinic acid iv) Adipic acid v) Pimelic acid.

4x5=20 marks

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