2025- Revision

Advanced Level Chemistry – Model Paper - 10

Time – 1 hour

(01) a) Answer the following questions using the species given in the list.

$SbCl_3$, CrO_3, $S_2O_3^{2-}$, Cu, P

i) Which gives SO_2 gas with conc. H_2SO_4 upon boiling? ……

ii) Which results a clear chemical transformation with water? ……...

iii) Which produces a gaseous product with conc. NaOH upon heating? ……....

iv) Which produces a yellow colour turbidity and a colourless gas with dil. HNO_3? ……

v) Which produces a yellow-coloured solution when dissolved in dil. NaOH?

……

b) Classify the following species by considering their physical properties.

Graphite, $Ag_{(s)}$, $NaF_{(s)}$, $CO_{2(s)}$, $SiO_{2(s)}$

i) Which has the highest thermal and electrical conductivity? …….

ii) Which sublimates easily? …….

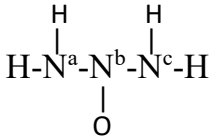
iii)Which one has a higher melting point, and very poor electric conductivity?

…….....

iv) Which can conduct electricity in molten state but cannot do so in the solid state? ……

v) Which one has a two-dimensional giant lattice and conduct electricity? ……

c) Skeleton of $N_3H_4O^+$ is given below.



i) Draw the most acceptable Lewis structure and two other resonance structures for the above ion.

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ii) Label the structures above as 1,2 and 3 and arrange them in the increasing order of stability.

iii) Explain your answer in part (ii).

iv) Complete the following table considering the structure drawn in part (i).

Atom	Valency	Oxidation No.	Electron pair geometry around the atom	Hybridization
N_a				
N_b				
N_c				
O				

(02) a) Choose the suitable species for the statement from the given list.

Ag_2O, NO_2, K_2O, PbO, $BaCl_2$, $Na_2S_2O_3$, $K_3[Fe(CN)_6]_{(aq)}$, $K_4[Fe(CN)_6]_{(aq)}$

i) Which gives a blue colour solution with $FeCl_2$? ……

ii) Which slowly gives a turbidity with H_2SO_4 ? ……

iii) Which can dimerise at high pressure? ……

iv) Which gives off O_2 during heating? ……

v) Which contains unpaired electrons? ……

b) Elements **L** and **M** are located in two consecutive periods. They produce the oxides L_2O_5 and M_2O_5. The chlorides resulting from their maximum oxidation states are LCl_3 and MCl_5, respectively.

i) Identify **L** and **M**.

ii) Write the balanced chemical equations using the correct chemical symbols for the reactions between the following chemicals and water.

L_2O_5, M_2O_5, LCl_3, MCl_5

c) **X** and **Y** are two elements with atomic numbers less than 18. At room temperature, **X** readily reacts with water and forms **Z** gas and **A** solution. **Y** cannot react with water. However, it reacts with solution **A** to form **Z** gas and **B** solution.

i) Identify **X**, **Y** and **Z**.

ii) What results may you expect to see if you add dil. HCl to the above solutions in excess?

iii) Write the balanced equation for the reaction between **A** and **Y** using the actual chemical symbols.

d) i) Write the chemical formula and oxidation numbers of four chlorine oxides that results from four different oxidation states.

ii) Write the names of four different oxo acids of chlorine.

iv) Write laboratory synthesize methods of two oxo acids you stated above.

v) Write two laboratory methods to produce Cl_2 gas.

(03) a) One of the key ingredients in bleaching powder is chlorate (I) ions. 2.5 g of bleaching powder were dissolved in 100 cm^3 of distilled water to prepare a solution. To the 25 cm^3 of the above solution, 10 cm^3 of 0.1 mol dm^{-3} KI solution and 10 cm^3 of H_2SO_4 acid were added. ClO^- oxidizes I^- to produce I_2. Resulted I_2 was titrated with 0.01 mol dm^{-3} $Na_2S_2O_3$ solution. The end point was attained at 24 cm^3. (Na = 23, S =32, O = 16, Cl = 35.5, I = 127)

i) Write the balanced equation for the reaction between I_2 and $Na_2S_2O_3$.

ii) Write the balanced equation for the reaction between ClO^- and I^-.

iii) Calculate the molar ratio of used $S_2O_3^{2-}$ to chlorate (I) ions during the titration.

iv) Calculate the chlorate (I) ion content in bleaching powder.

v) Calculate the mass percentage of chlorate (I) in bleaching powder.

b) Using the terms provided for an ideal gas system, write expressions for the following parameters using only the given symbols.

Volume = **B** dm^3 Pressure = **γ** N m^{-2} Mass of a molecule = **a** g

Number of molecules = **x** Root mean squre velocity of gaseous molecules = **v** m s^{-1}

Relative molecular mass = **A** g mol^{-1}

i) Density of the gas ii) Number of moles

iii) Pressure of the system (γ) iv) Volume of the system (B)

c) A reaction taking place at 298 K is as follows:

$$CO_{(g)} + 3H_{2(g)} \longrightarrow CH_{4(g)} + H_2O_{(l)}$$

Consider the following thermodynamic data.

	Standard formation enthalpy (kJ mol^{-1})	**Standard entropy (J mol^{-1} K^{-1})**
$CH_{4(g)}$	-751	186
$H_2O_{(l)}$	-286	70
$CO_{(l)}$	-111	198
$H_{2(g)}$	0	131

i) Calculate the standard enthalpy change of the above reaction.

ii) Calculate the standard entropy change of the above reaction.

iii) Using a calculation, determine whether this reaction is spontaneous or not at 298 K.

iv) Determine the minimum temperature that should exist for this reaction to take place.

(04) a) A salt mixture is composed of 75% (w/w) K_2SO_4 and 25% (w/w) sulphate of another Metal (MSO_4). 1.0 g of this mixture was dissolved in water, and excess $BaCl_2$ was added to precipitate $BaSO_4$. The dry weight of the $BaSO_4$ precipitate is 1.495 g. Calculate the molar mass of the MSO_4 salt.

(Ba = 137, K = 39, S = 32, O = 16)

b) 30 cm^3 of a solution of $K_xH_y(C_2O_4)_2.nH_2O$ with a density of 9.15 g dm^{-3} was allowed to react with 27 cm^3 of 0.12 mol dm^{-3} NaOH solution. It also reacts with a 36.00 cm^3 solution of 0.024 mol dm^{-3} $KMnO_4$.

(K =39, H=1, C=12, O=16)

i) Calculate the H^+ ion concentration in 30 cm^3 of oxalate solution.

ii) Calculate the number of moles of $C_2O_4^{2-}$ in 30 cm^3 of the solution.

iii) Calculate the $H^+ : C_2O_4^{2-}$ molar ratio in the mixture.

iv) Calculate the values of x, y, and n.

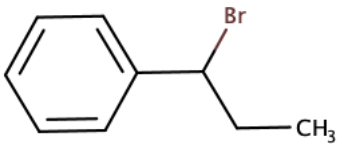
v) Write the chemical formulae of the salt.

05. 1. How would you synthesize the following compounds using 1-butyne as the only source of carbon, along with the inorganic compounds you need.

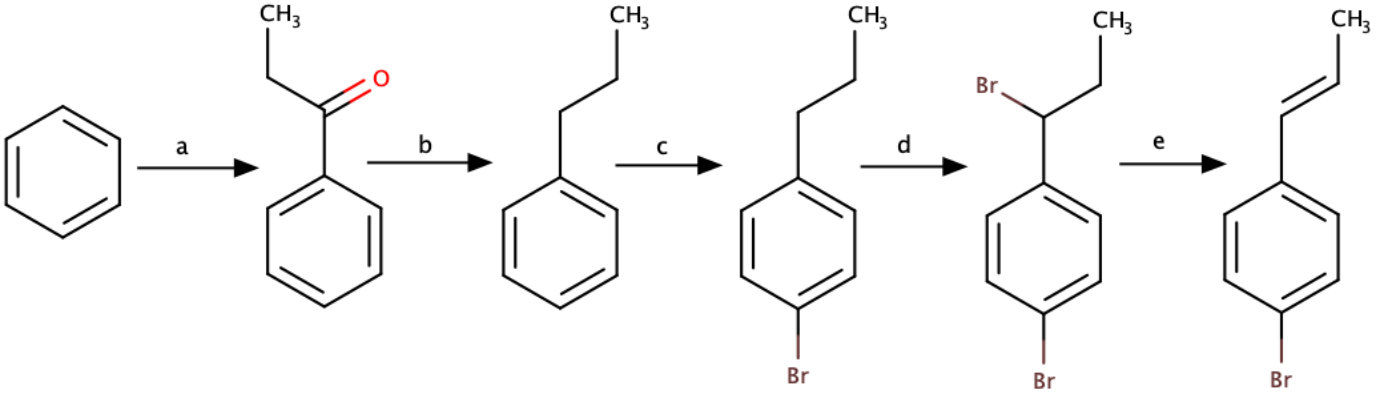
a. 1,1,2,2-tetrachlorobutane b. 3-hexene

2. Write the mechanism for the formation of Phenylacetone from benzene and acetyl chloride in the presence of anhydrous $AlCl_3$.

3. Addition of HBr to 1-phenylpropene yields the following compound drawn below as the major product. Draw a mechanism for the reaction and explain the reason for the formation of only this compound.



5. Identify the reagents represented by the letters a-e in the following scheme.



Answer the following MCQs

1. Which of the following molecule pair has a zero-dipole moment?
   1) NH_3/SO_2 2) CCl_4/CO_2 3) ICl_3/BCl_3 4) BH_3/F_2O 5) $CHCl_3/NH_3$

2. When element X reacts with concentrated HNO_3 acid, XO_2, NO_2, and water are formed. What is the number of moles of HNO_3 reacting with 1 mol of X in this reaction?
   1) 1 2) 2 3) 3 4) 4 5) 5

3. As for the Fe and Fe^{2+} variants with nucleon values of 56, they
   1) Two different nuclides.
   2) Species with the same number of valence electrons.
   3) Species with different number of neutrons.
   4) act as reducing agents.
   5) Showing similar chemical properties since they are varieties of the same element.

4. Which of the following standard enthalpy changes cannot be specifically expressed as exothermic/endothermic?
    1) Hydration
    2) Sublimation
    3) Neutralization
    4) Enthalpy of solution
    5) Enthalpy of ionization

5. If propene reacts with HBr with BrCl are separately through a similar mechanism, the possible results are respectively,
    1) $CH_3CHBrCH_3$ and $CH_3CHBrCH_2Cl$ 2) $CH_3CHClCH_2Br$ and $CH_3CHBrCH_3$
    3) $CH_3CH_2CH_2Br$ and $CH_3CHClCH_2Br$ 4) $CH_3CHBrCH_3$ and $CH_3CHClCH_2Br$
    5) $CH_3CHBrCH_2Cl$ and $CH_3CH_2CH_2Br$

6. Which of the following statement is true?
    1) $SrCO_3$ decomposes at a higher temperature than $CaCO_3$.
    2) All the nitrates formed by the group I elements undergo thermal decomposition to give O_2.
    3) All the carbonates in group I except Li_2CO_3 undergo thermal decomposition.
    4) The polarizing power of the cations formed by the group II elements increases down the group, and so does thermal stability of their carbonates.
    5) All of the group I nitrates decompose to give NO_2.

7. Consider the following chemical reactions.

$$4y_{(g)} \rightarrow y_{4(g)};\ -200\ kJ\ mol^{-1}$$
$$y_{(l)} \rightarrow y_{(g)};\ +40\ kJ\ mol^{-1}$$
$$y_{4(l)} \rightarrow y_{4(g)};\ +84\ kJ\ mol^{-1}$$

The enthalpy change of the following reaction is,

$$4y_{(l)} \rightarrow y_{4(l)}$$

1) 224 kJ mol^{-1} 2) -156 kJ mol^{-1} 3) 156 kJ mol^{-1} 4) -244 kJ mol^{-1} 5) -124 kJ mol^{-1}

8. Which of the following gives a colour closest to the colour obtained when more concentrated HCl is added to a concentrated $CoCl_2$ solution?
    1) Adding more concentrated HCl to a solution of $NiCl_2$.
    2) Adding more NH_4OH to a solution of $CuSO_4$.
    3) Adding more concentrated HCl to a solution of $FeCl_3$.
    4) Adding more NH_4OH to a solution of Cr^{3+}.
    5) Adding more concentrated HCl to a solution of $CuSO_4$.

9. What is the correct chemical formula of **pentaamminechloridocobalt(III) nitrate**?
    1) $[Co(NH_3)_5Cl]NO_3$ 2) $[Co(NH_3)_5Cl](NO_3)_2$ 3) $[CoCl(NH_3)_5]NO_3$
    4) $[CoCl(NH_3)_5](NO_3)_2$ 5) $Co(NH_3)_5Cl(NO_3)$

10. A solution of 100 cm^3 was made by dissolving 3.15 g of a hydrous compound of $Ba(OH)_2.x(H_2O)$ in water. The volume of 0.1 mol dm^{-3} HCl consumed in titrating 10 cm^3 of this solution is 20 cm^3. What is the value of x? (Ba = 137, O = 16, H = 1)
    1) 2 2) 4 3) 6 4) 8 5)10

11. A solution called **S** is made by mixing 50 cm^3 of 0.020 mol dm^{-3} $Al(NO_2)_3$ solution with 50 cm^3 of 0.030 mol dm^{-3} $Mg(NO_3)_2$ solution. If the density of that solution is 1 g cm^{-3}, what is the composition by mass of N in the solution in ppm (mg/ kg) ? (Mg = 24, Al = 27, N = 14, O = 16)
    1) 840 2) 168 3) 800 4) 84 5) 1680

12. Which one of the following statements is not true about hybridisation?
    1) Hybrid orbitals formed from a given hybridisation have the same shape.
    2) Hybrid orbitals may form π bonds.
    3) The angle between sp^2 hybrid orbitals is 120°.
    4) All carbon atoms in hydrocarbons are hybridised.
    5) Hybrid orbitals formed from a given hybridisation have the same energy.