CHEMISTRY IS NOT A MYSTERY

2021
CHEMISTRY
ZOOM SEMINAR FOUR
CHEMISTRY (P525/2)

MEETING ID: 6463129614
PASSCODE: HELP
SCHEDULED FOR Sat 24th OCT 2021

Questions;

1. (a) State **Raoult's law** and the conditions under which the law holds. *(03 marks)*

(b) Benzene and methylbenzene form a liquid mixture that is ideal. A liquid mixture of the two compounds was made by adding 23.4g of benzene to 46g of methylbenzene at 25℃. The vapour pressures of benzene and methylbenzene are $203Nm^{-2}$ and $76Nm^{-2}$ respectively at 25℃. Calculate the:

(i) vapour pressure of the mixture. *(04 marks)*

(ii) composition of each component in the vapour. *(03 marks)*

(c) Explain why the mixture of benzene and methylbenzene is ideal. *(04 marks)*

(d) (i) Sketch a boiling point-composition diagram for the mixture of benzene and methylbenzene. (Boiling points of benzene and methylbenzene are 80℃ and 111℃ respectively)

(ii) Using the diagram, describe what will happen when a liquid mixture containing 50% of each component is distilled. *(05 marks)*

(e) State **one** similarity between an azeotropic mixture and a compound. *(01 mark)*

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2. (a)(i) State the **two** oxidation states exhibited by group IV elements. *(01 mark)*

(ii) Describe how group IV elements react with chlorine. *(05 marks)*

(iii)Solid lead(II) chloride can be prepared in the laboratory by heating lead(II) oxide with dilute hydrochloric acid and the mixture allowed to cool but the same compound cannot be prepared using concentrated hydrochloric acid . *(04 marks)*

(b) The melting points of group IV elements of the periodic table are shown in the table below.

Element	C	Si	Ge	Sn	Pb
Atomic number	6	14	32	50	82
Melting point(℃)	3550	1410	937	232	327

(i) Define the term **melting point**. *(01 mark)*

(ii) Plot a graph of melting point against atomic number. *(04 marks)*

(iii) Explain the shape of the graph. *(05 marks)*

(iv)

3. (a) Define the term **ebullioscopic constant** of a liquid. *(01 mark)*

(b) Describe an experiment that can be carried out to determine the relative molecular mass of phosphorus in carbon disulphide by elevation of boiling point method. *(08 marks)*
(Your answer should include a diagram of apparatus that can be used and the treatment of the results).

(c) Explain why the method you have described in (b) is not suitable for the determination of the relative molecular mass of;

(i) phosphorus(V) chloride in water. *(02 marks)*

(ii) polystyrene in benzene. *(2 ½ marks)*

(d) 2.0 g of phosphorus raises the boiling point of 37.4 g of carbon disulphide by 1.003℃, whereas 4.65 g of sulphur rises the boiling point of 100 g of carbon disulphide by 0.42℃. Calculate the;

(i) boiling point constant of carbon disulphide.
(Molar mass of sulphur=256). *(2 ½ marks)*

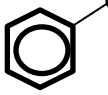
(ii) molar mass of phosphorus in carbon disulphide. *(2½ marks)*

(e) Determine the molecular formula of phosphorus. (P = 31)
(1 ½ marks)

4. Complete the following equations and write the accepted mechanism for each of the reactions.

(a) $CH_3CH_2C \equiv CNa + CH_3Br \xrightarrow{Liq.NH_3}$ *(02 marks)*

(b)  $+ CH_3COBr \xrightarrow{FeCl_3}$ *(04 marks)*

(c)  $\xrightarrow[heat]{NaOH(aq)}$ *(02 marks)*

(d) $CH_3CH_2OH + Conc.H_2SO_4 \xrightarrow{140\ ^\circ C}$ *(04 marks)*

(e)  $+ CH_3CH_2Cl \xrightarrow{KOH(aq)}$ *(04 marks)*

5. (a) Ethanoic acid is a weak acid.

(i) What is meant by the term **weak acid**? *(01 mark)*

(ii) Calculate the pH of 0.25M ethanoic acid. (pK_a of ethanoic acid is 4.76 at 25°C) *(3 ½ marks)*

(b) Calculate the pH of the resultant solution when 25 cm^3 of 0.1M sodium ethanoate was added to 75cm^3 of 0.25M ethanoic acid. *(04 marks)*

(c) The table below shows pH values for the titration of sodium hydroxide solution against 25.0cm^3 of 0.1M ethanoic acid.

Volume of sodium hydroxide added(cm^3)	0	4.0	6.0	8.0	10.0	12.0	14.0	14.6	14.8	15.0	15.2	15.4	16.0
pH	2.8	3.8	4.2	4.6	5.1	5.5	6.2	6.8	7.6	9.0	9.8	10.5	11.4

(i) Plot a graph of pH against volume of sodium hydroxide added. *(04 marks)*

(ii) From the graph, determine the volume of sodium hydroxide needed to neutralise the acid. *(01 mark)*

(iii) Calculate the molar concentration of sodium hydroxide solution. *(3 ½ marks)*

(iv) Determine the ratio of $[CH_3COO^-]:[CH_3COOH]$ when $5\,cm^3$ of sodium hydroxide solution has been added to $25\,cm^3$ of ethanoic acid. *(03 marks)*

6. (a) A compound ***Q*, $C_7H_{14}O_2$** reacted with sulphuric acid on heating to form compounds ***W*, $C_4H_{10}O$** and **$C_3H_6O_2$**. ***W*** reacted with sodium with effervescence but had no effect on litmus paper.

(i) Write the names and structural formulae of all the possible isomers of ***W***. *(04 marks)*

(ii) Name a reagent that can be used to distinguish between the isomers in (i) and state what would be observed if the isomers are reacted with the reagent. *(04 marks)*

(b) ***W*** reacted with acidified dichromate solution to give ***R***, which formed a **yellow solid** when reacted with alkaline iodine solution;

(i) Identify ***W***, ***R*** and the **yellow solid**. *(03 marks)*

(ii) Name the reagent that can be used to identify the functional group in ***R*** and state the observation made when the reagent is treated with ***R***. *(02 marks)*

(c) Write equations and indicate a mechanism for the reaction between ***W*** and;

(i) concentrated orthophosphoric acid *(04 marks)*

(ii) ethanoyl chloride *(03 marks)*

7. Explain the following observations;
   (a) When ammonia solution is added to a solution of magnesium sulphate a white precipitate is formed, but when it is added in the presence of ammonium sulphate no precipitate is formed. *(05 marks)*
   (b) Carbon dioxide is a gas at room temperature whereas silicon (IV)oxide is a solid with a very high melting point. *(04 marks)*
   (c) Anhydrous copper(II) sulphate dissolves in water exothermically while copper(II) sulphatepentahydrate dissolves exothermically. *(04 marks)*
   (d) Phenol is a stronger acid than cyclohexanol *(03 marks)*
   (e) When sodium carbonate solution was added to a solution of aluminium chloride, a white precipitate was formed and a colourless gas evolved. *(04 marks)*

8. (a) Briefly describe how chlorine is manufactured on a large scale. *(05 marks)*
   (b) Describe how fluorine and chlorine react with : *(08 marks)*
      (i) water
      (ii) sodium hydroxide
   (c) Explain each of the following observations.
      (i) Aluminium fluoride has a higher melting point than aluminium chloride. *(03 marks)*
      (ii) Hydrofluoric acid is a weaker acid than hydrochloric acid. *(04 marks)*

END