CHEMISTRY IS NOT A MYSTERY

2021 **MEETING ID: 6463129614**

CHEMISTRY

ZOOM SEMINAR THREE **PASSCODE: HELP**

CHEMISTRY (P525/2)

Questions;

1. (a) Define the following terms;

   (i) **Colligative property** *(01 mark)*

   (ii) **Freezing point constant** *(01 mark)*

   (b) (i) Describe how the molecular mass of a substance can be determined using freezing point depression method**.**

   (Diagram not required) *(07 marks)*

   (ii) Explain why the method you have described in (a)(i) is not suitable for determining the molecular mass of a polymer. *(02 marks)*

   (c) The table below shows the freezing point of various concentrations of a non-volatile solute ***Z*** in water at 760mmHg.

Concentration (gdm^{-3})	0	30	60	90	120	150
Freezing point (^0C)	0	-0.16	-0.32	-0.49	-0.65	-0.81

   (i) Plot a graph of freezing point depression against concentration. *(06 marks)*

   (ii) Use the graph you have drawn to determine the molecular mass of ***Z***. *(03 marks)*

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2. (a) $1.781g$ of a bromoalkane, ***D***, was heated with excess sodium hydroxide solution. The resulting mixture was cooled and acidified with dilute nitric acid and the solution diluted to $100cm^3$. $10.0cm^3$ of this solution required 13.0cm^3 0f 0.1M silver nitrate solution for complete precipitation of bromide ions as silver bromide.
   (i) Calculate formula mass of ***D*** *(03 marks)*
   (ii) Deduce the molecular formula of ***D*** *(02 marks)*
   (iii) Write the structural formulae and names of all possible isomers of ***D*** *(03 marks)*

   (b) When ***D*** was reacted with sodium hydroxide, compound ***E*** was formed. ***E*** formed two layers within 10 minutes when shaken with a mixture of concentrated hydrochloric acid and anhydrous zinc chloride.
   (i) Identify ***D*** *(01 mark)*
   (ii) Write the equation and state the conditions for the reaction between ***D*** and sodium hydroxide. *(02 marks)*

   (c) ***E*** can be oxidized by chromium trioxide in the presence of concentrated sulphuric acid to give compound ***G***, which reacts with iodine in the presence of sodium hydroxide solution. State what would be observed and write the equation for the:
   (i) oxidation of ***E*** *(02 marks)*
   (ii) reaction between ***G*** and iodine in the presence of sodium hydroxide. *(03 marks)*

   (d) One of the isomers of ***D*** undergoes a unimolecular reaction when treated with aqueous sodium hydroxide.
   (i) Name the isomer *(01 mark)*
   (ii) Write an equation for the reaction in (d) and outline a mechanism for the reaction. *(03 marks)*

3. (a) Write the name and the formula of the chief ore from which aluminum is extracted. *(02 marks)*

(b) Describe how;

(i) the ore in (a) above is purified. *(05 marks)*

(ii) aluminium is obtained from the purified ore in (b)(i) above.

(Your answer should include equations) *(03 marks)*

(b) Write equations and state the conditions under which aluminium reacts with.

(i) air *(2 ½ marks)*

(ii) sodium hydroxide *(2 ½ marks)*

(iii) hydrochloric acid *(2 ½ marks)*

(c) Explain why aluminium utensils should not be washed using soap solutions. *(2 ½ marks)*

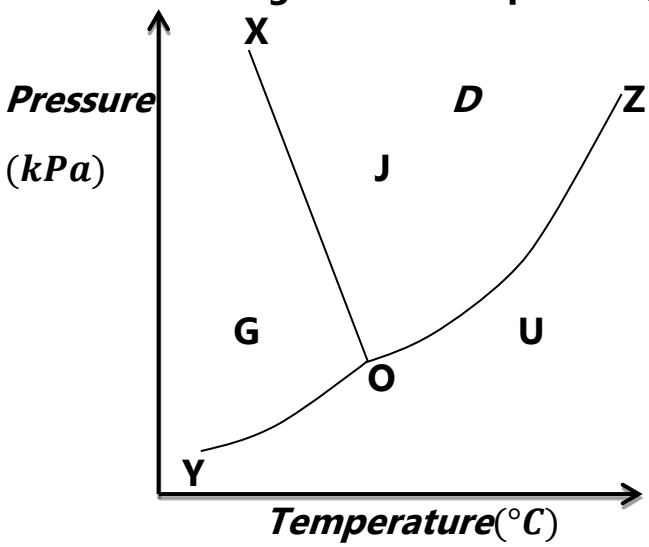
4. (a) Distinguish between each of the following terms as used component systems;

(i) **phase** and **component** *(02 marks)*

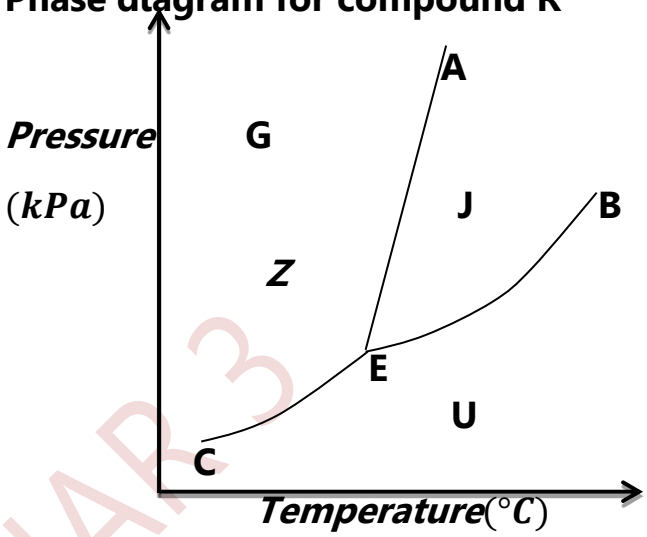
(ii) **triple point** and **critical point** *(02 marks)*

(b) The figures below show phase diagram for two different compounds that form a one- component system. Use them to answer the questions that follow.

Phase diagram for compound Q



Phase diagram for compound R



(i) Identify the compounds ***Q*** and ***R.*** *(01 mark)*

(ii) Name the phases ***G***, ***J*** and ***U***. *(1 ½ marks)*

(iii) Name the curves ***OZ*** and ***EB***. *(01 mark)*

(c) Compare the slanting directions of curves ***OX*** and ***EA*** and give reasons for the observed difference. *(03 marks)*

(d) State and explain the changes that would take place if;

(i) gaseous ***R*** is cooled to point ***Z*** at a constant pressure. *(04 marks)*

(ii) the pressure of liquid ***Q*** is increased to point ***D*** at constant temperature. *(02 marks)*

(e) ***Q*** is a liquid at room temperature and standard pressure whereas ***R*** is a gas under the same conditions. Explain this observation. *(3 ½ marks)*

5. Carbon, silicon, germanium, tin and lead are elements in group IV of the Periodic Table.

(a) Compare the reactions of carbon, silicon and lead with;

(i) Sulphur *(6 ½ marks)*

(ii) Hydrofluoric acid *(03 marks)*

(b) The elements can form chlorides in both the +2 and +4 oxidation state.

(i) Write the formulae of the chloride formed by each of the elements in the +2 oxidation state. *(1 ½ marks)*

(ii) Draw the structure and name the shape of the chloride of tin written in (b)(ii) above. Explain why the chloride adopts the shape you have named. *(04 marks)*

(c) Compare the differences in solubility of the chlorides of tin and lead as shown in b(i) above in ;

(i) water *(02 marks)*

(ii) concentrated hydrochloric acid. *(03 marks)*

6. (a) For each of the following pairs of compounds, name **one** reagent that can be used to distinguish between each of the following pairs of compounds.

Your answer should include relevant observations and equation(s) for the reactions.

(i) $CH_3CH_2CH_2OH$ and $(CH_3)_3COH$ *(05 marks)*

(ii)  *(04 marks)*

(iii)  and CH_3CH_2Cl *(04 marks)*

(iv) $CH_3C \equiv CCH_3$ and $CH_3CH_2C \equiv CH$ *(04 marks)*

(b) Briefly explain the observation in (a)(iii) above. *(03 marks)*

7. (a) Ammonia is a weak base.
   (i) What is meant by the term a **weak base**? *(01 mark)*
   (ii) Write the equation for the ionization of ammonia inwater.(*01 mark)*
   (iii) Write an expression for the base ionization constant for ammonia.
   (b) Calculate the pH of:
      (i) a 0.02M ammonia solution *(2 ½ marks)*
      (ii) a solution made by mixing 35cm^3 of 0.02M ammonia solution and 15cm^3 of 0.02M ammonium chloride solution.
      ($K_w = 1.0 \times 10^{-14} mol^2 l^{-2}$, $pK_b\ for\ ammonia = 4.74$) *(3 ½ marks)*
   (c) Explain the difference in your answers in (b)(i) and (ii) above. *(04 marks)*
   (d) (i) Sketch a graph of pH against volume of hydrochloric acid when ammonia solution is being titrated with hydrochloric acid. *(02 marks)*
   (ii) Explain the shape of the graph in (d)(i) above. *(05 marks)*
8. Explain each of these observations. Include equations in your answers where necessary.
   (a) The boiling points of pentane and 2, 2-dimethylpropane are 36^{0}C and 10^{0}C respectively, yet the two compounds have the same molecular masses. *(04 marks)*
   (b) Magnesium ion reacts with hydrogen sulphide in alkaline medium to form a precipitate, whereas it does not form a precipitate in acidic medium. *(04 marks)*
   (c) Phosphorous burns spontaneously in air whereas nitrogen is inert at the same temperature yet both elements are in the same group in the period table. *(03 marks)*
   (d) Aluminium chloride sublimes on heating but sodium chloride does not. *(03 marks)*
   (e) Ammonium chloride solution gives effervescence with magnesium ribbon, whereas sodium ethanoate solution gives a blue precipitate with aqueous copper (II) chloride solution. *(06 marks)*