Digital Teachers

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525/1

S6 CHEMISTRY

Exam 21

PAPER 1

DURATION: 2 HOUR 45 MINUTES

Instructions

Answer all questions in section A and six questions in section B.

All questions must be answered in the spaces provided.

Illustrate your answers with equations where applicable.

The periodic table is provided.

SECTION. A(46 MARKS)
Answer all questions from this section

1.a) i) State the conditions for steam distillation. (1 ½ marks)

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ii) State one advantage of steam distillation over fractional distillation. (1 mark)

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b) Substance A distills with steam at 98.3^OC under pressure of 753mmHg. Calculate the percentage by mass of A in the distillate. (The vapour pressure of water at 98.3^OC is 715mmHg; A =128) (03 marks)

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2.a) Write the electronic configuration of copper. (01 mark)

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b) State two properties of copper as a transition element. (04 marks)

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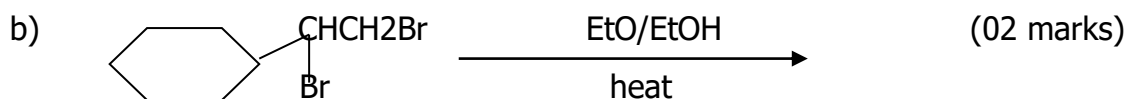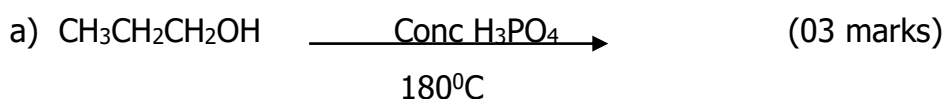c) Hydrated copper (ii) sulphate was dissolved in water. Write equation (s) for the reaction (s) that took place. (03 marks)

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3. Complete the following equations and in each case write a mechanism for the reaction.

a) $CH_3CH_2CH_2OH$ $\xrightarrow[\text{180}^0\text{C}]{\text{Conc } H_3PO_4}$ (03 marks)

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b) CHCH2Br   Br $\xrightarrow[\text{heat}]{\text{EtO/EtOH}}$ (02 marks)

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4.a) Define the term "partial pressure" (1 mark)

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b) The vapour pressures of pure chloroform and carbon tetrachloride are 199.1 and 114.5mmHg respectively at 25°C.

(Assume that a mixture of the two liquids behave as an ideal gas and that it contains 0.96 mole of each pure liquid).

   i)   The partial pressure of each component in the mixture. (2 ½ marks)

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ii)   The total pressure. (1 mark)

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c) Calculate the percentage of carbon tetrachloride in the vapour in equilibrium with the liquid mixture. (1 mark)

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   5.Lithium is in group 1 and magnesium is in group II of the periodic table but the two elements show some common chemical properties.

a) State the name given to this type of relationship. (1 mark)

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b) Give four examples of the properties in which the two elements show similarities. (4 marks)

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c) Name two other pairs of elements that show similar type of relation as lithium and magnesium. (1 mark)

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6. Complete the following equations and write the IUPAC name of the main organic production each case.

a) $CH_3CH_2CO_2H$ $\qquad$ + PCl_5 $\underrightarrow{\hspace{1cm} heat \hspace{1cm}}$ $\qquad$ (1 ½ marks)

b) $HC = CH$ $\underrightarrow{\hspace{0.5cm} Ag(NH_3)_2^+ (aq) \hspace{0.5cm}}$ (1 ½ marks)

7. The ionic radii of Na^+, Mg^{2+} and Al^{3+} are 0.095, 0.065 and 0.050 respectively.

a) Calculate the charge/ radius ratio per

i) Na^+ (01 mark)

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ii) Mg^{2+} (01 mark)

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iii) Al^{3+} (01 mark)

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b) Which of the ions has

i) The least polanising power? (½ marks)

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iii)   The greatest polarizing power. (½ marks)

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c) Give reasons for your answers in c) i) and ii) above. (02 marks)

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8.a) State Graham's law. (01 mark)

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b) A certain volume of oxygen diffused through a porous membrane in 120s. under the same conditions the same volume of a gas. X diffuses in 112s. calculate the relative molecular mass of X. (3 ½ marks)

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9. The   empirical formula of a fluoride of sulphur, Y 1 is SF_4 . 0.1g of Y occupied $22.10cm^3$ when vapourised at 20^0C and 766mmHg.

a) Determine the molecular formula of Y. (3 ½ marks)

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b) Draw the structure of Y and name the shape (1 ½ marks)

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SECTION. B (54 MARKS)

Attempt six questions from this section

10. Write equations to show how the following compounds can be synthesized.

a) $CH_3CH_2CH_2COOH$ from $CH_3CH=CH_2$.   (3 marks)

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b) C_6H_6 from CH_3CH_3.   (3 marks)

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c) $CH_3CH_2CH_2OH$ to CH_3CHCH_3 (3 marks)

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11. State what would be observed and write equation for the reaction that would take place when

a) Copper is added to a solution of concentrated nitric acid. (2 ½ marks)

Equation

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Observation

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b) Potassium iodide   is added to acidified solution of hydrogen peroxide. (02 marks)

Equation.

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Observation

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c) sodium sulphite is added to a solution of acidified potassium dichromate (VI)

Equation

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Observation

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d) aqueous iron (ii) sulphate is added to acidified potassium manganate (VII) solution.

(2 marks)

Equation

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Observation

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12. A compound P contains 52.2% of carbon, 13% of hydrogen the rest being oxygen

a) Determine the empirical formula of P

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b) When vaporized 0.1g of P occupied 78.8cm^3 at 150^{0}C and a pressure of 740mmHg

i) Calculate the formula mass of P (2 ½ marks)

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ii) Determine the molecular formula of P. (1 ½ marks)

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iii) Write the structural formula of all the possible isomers of P. (1 mark)

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c) P does not react with sodium metal. Identify P. (0 ½ marks)

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d) Write an equation to show how P can be prepared from methanol. (1 ½ marks)

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13. Name the reagent (s) that can be used to distinguish between the following pairs of compounds and state what is observed in each case.

a) CH_3CH_2OH and $CH_3\overset{\displaystyle OH}{\underset{\displaystyle |}{C}}HCH_3$ (3 marks)

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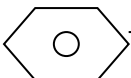
b) $CH = CCH_3$ and $CH_3C= CCH_3$ (3 marks)

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c) CH_3CH_2Cl and Cl (3 marks)

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14.a) State what is meant by the term order of a reaction. (2 marks)

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b) Methly ethanoate is hydrolysed by water in the presence of an acid according to the following equation;

$$CH_3CO_2CH_3 + H_2O \xrightarrow{\quad H^+ \quad} CH_3CO_2H + CH_3OH$$
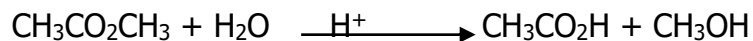
i) State the molecularity of the reaction. (1 mark)

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ii) Determine the order of the reaction. (Assume that the acid takes part in the reaction.

(01 mark)

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iv)   State the conditions under which the reaction can be overall first order. (02 marks)

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c) The table below shows some kinetic data for the following reaction: $3A + B \longrightarrow 2P$.

Experiment	Initial conc'n of A (Moldm^{-3})	Initial conc'n of B (Moldm^{-3})	Initial rate (moldm^{-3}s^{-1})
1	0.20	0.20	1.2 x 10^{-8}
2	0.20	0.60	1.2 x 10^{-8}
3	0.40	0.60	4.8 x 10^{-8}

i) Write the overall rate equation. (1 ½ marks)

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ii) Calculate the rate constant and give its units. (1 ½ marks)

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15.a) State Raoult's law (2 marks)

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b) The boiling point composition diagram of a mixture of water and substance X which is miscible with water is given below.

Composition of X (percentage)

i)   State how the mixture deviates from Raoult's law . (1 mark)

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Explain how pure X can be obtained from a mixture containing 50% of water. (4 marks)

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ii)   What name is given to the mixture containing 36% of X? (1 mark)

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iii)   Name one substance that would behave in a different way from X. (1 mark)

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16. 0.9875g of an impure potassium manganate (vii) was dissolved in water to make 250cm^3 of solution. When 20.0cm^3 of this solution was acidified with dilute sulphuric acid, warmed and titrated against sodium ethanediate (oxalate) solution, made by dissolving 1.675g of anhydrous sodium ethanediate to make 250cm3 of solution, 24.40cm^3 of the sodium ethanediate solution was used.

($Na_2C_2O_4$ = 134 and $KMnO_4$ = 158)

a) Write an ionic equation for the reaction between sodium ethanedioate and potassium manganate (vii) (2 marks)

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b) Determine the molar concentration of manganate vii) ions. (3 ½ marks)

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c) Calculate the percentage purity of potassium manganate (vii) (2 ½ marks)

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d) Name one compound which is a common impurity in potassium manganate. (1 mark)
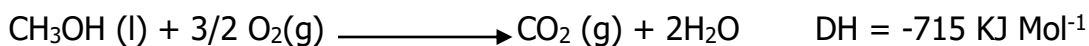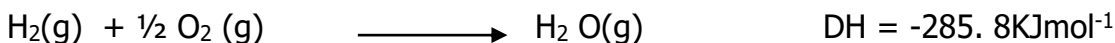
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17.a) State Hess's law of constant heat summation (2 marks)

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b) i) Use the data below to calculate the enthalpy change for the reaction

$CO(g)$ + $2H_2(g)$ ⟶ $CH_3OH(l)$ at 298K

Data;

$CO(g) + ½ O_2(g)$ ⟶ $CO_2(g)$ DH = -283KJmol^{-1}

$H_2(g) + ½ O_2(g)$ ⟶ $H_2O(g)$ DH = -285. 8KJmol^{-1}

$CH_3OH(l) + 3/2 O_2(g)$ ⟶ $CO_2(g) + 2H_2O$ DH = -715 KJ Mol^{-1}

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i) Name the type of reaction in b) i) above. (1 mark)

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