Digital Teachers

Our country, our future

S6 CHEMISTRY

Exam 20

PAPER 1

DURATION: 2 HOUR 45 MINUTES

INSTRUCTIONS TO CANDIDATES

Answer all questions in section A and six questions in section B.
All questions must be answered in the space provided
The periodic table , with relative atomic masses, is supplied at the end of the paper
Mathematical tables (3 figure tables) are adequate or non-programmable scientific electronic calculators may be used.
Illustrate your answers with equations where applicable

For Examiners' use only

For examiner's use only																	Total
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	

SECTION A: (46 MARKS)
Answer all questions in this section

1. (a) (i) Define the term "Osmotic pressure

    (ii) State 4 conditions solutions should have in order to obey the laws of osmotic pressure

(b) The Osmotic pressure of an aqueous solution containing 3.22g of a polymer Q per 100 cm^3 of a solution is 5.637 x 10^{-2} Pa. Determine the molecular mass of Q

2. (a) Explain what is meant by "half life" of a radioactive substance.

(b) Complete the following equation for the decay of bismuth

$$^{214}_{83}Bi \quad ^{0}_{-1}e + \ldots\ldots$$
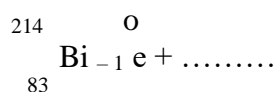
(c) The half life of bismuth is 19.7 minutes. Determine the percentage by mass of bismuth which will be remaining after 16.0 minutes of decay of bismuth

3. Show how the following conversions could be carried out
(a) CH_3CO_2H from methanol

(b) From CH^{2}OH
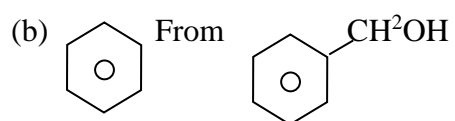
4. State what is observed and write an equation(s) when the following compounds are reacted
   (a) Aqueous potassium dichromate (VI) with hydrogen sulphide

   (b) When lead (iv) oxide is heated with sulphurdioxide

   (c) Aqueous copper (II) nitrate with potassium iodide

5. (a) Define
   (i)   enthalpy of hydration

   (ii)   enthalpy of solution

   (b) The enthalpies of solution and lattice energies of salts AX and BX are given in the table below.

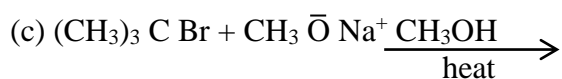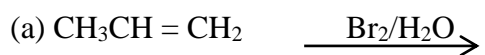 | Salt | Enthalpy of solution/Kjmol^{-1} | Lattice energy/ Kjmol^{-1} |
   |------|-----------------------------------|------------------------------|
   | AX | +20 | -880 |
   | BX | -10 | -790 |

   Calculate the enthalphy of hydration of each salt
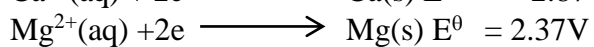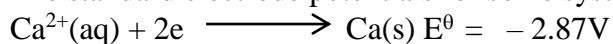
   AX

   BX

(ii) State the salt which has a larger value of hydration energy

6. Complete the following equations and write the IUPAC name of the major organic product

(a) $CH_3CH = CH_2$ $\xrightarrow{\quad Br_2/H_2O \quad}$

(b) $C_6H_5NH_2$ $\xrightarrow[\text{dil HCl } 0°C]{\quad NaNO_2 \quad}$

(c) $(CH_3)_3 C Br + CH_3 \bar{O} Na^+$ $\xrightarrow[\text{heat}]{\quad CH_3OH \quad}$

7. The standard electrode potentials for some systems are given below

$Ca^{2+}(aq) + 2e \xrightarrow{\quad} Ca(s)$ $E^{\theta} = -2.87V$

$Mg^{2+}(aq) + 2e \xrightarrow{\quad} Mg(s)$ $E^{\theta} = 2.37V$

(a) Write the convention for the cell

(b) Write the equation for the overall reaction

(c) (i) calculate the cell voltage

(ii) What conclusion can you draw from the e.m.f value in c (i) above

8. (a) (i) Define the term "complex ion"

(ii) Explain why transition metals form many complexes

(b) (i) Write the structural formulae of the isomers of chromium (III) chloride $CrCl.6H_2O$

(ii) State one way of distinguishing the isomers

9. (a) (i) Explain what is meant by boiling point elevation constant

(ii) 2.8g of cadmium iodide CdI_2 was dissolved in 20g of water. Calculate the boiling point of an aqueous solution of cadmiumiodide at normal pressure.

(b) state four assumptions made in the calculation in (a)

SECTION b (54 MARKS)
Answer only six questions in this section

10. Complete the following equations and in each case write the mechanism for the reaction
    (a) CH3CH2I + KOH (aq)

    (b) CH3CHO + NH2OH   H+(aq)

    (c) ⬡ +CH₃COCl   AlCl₃
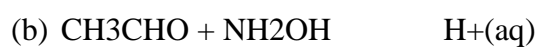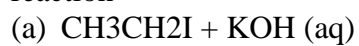
11. Explain why
    (a) The melting point of calcium oxide is much higher than that of calciumoxide

    (b) When solid lead (IV) oxide is added to water, white fumes are observed and a brown precipitate is formed

(c) An aqueous iron (III) chloride solution has a pH < 7

12. (a) State
      (i)   the distribution (partition) law

      (ii)   the conditions under which the distribution law is valid

(b) $1.00dm^3$ of aqueous solution contains 5.00g of butanoic acid . Calculate the mass of butanoic acid extracted when the solution was shaken
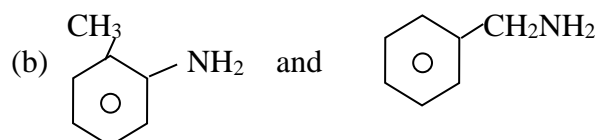(The distribution coefficient of acid between solvent Q and water is 4)
      (i)   with $50.0cm^3$ of solvent Q

      (ii)   twice with $25.0cm^3$ of solvent Q

13. Name one reagent that can be used to distinguish between each of the following pairs of compounds and state what would be observed in each case if the reagent is reacted with the compounds

(a) C_6H_5COOH and C_6H_5OH

(b)

CH₃ structure: methylbenzene with NH₂ substituent

CH_2NH_2 structure: benzene ring with CH_2NH_2 substituent

(c) CH_3OH and CH_3CH_2OH

14. (a) (i) Write an expression for the acid dissociation constant Ka, for ethanoic acid

(ii) Relationship between acid dissociation, Ka, and the degree of ionisation of an acid α

(b) The electrolytic conductivity of a $1.6 \times 10^{-2} M CH_3COOH$ at 20^oC is 1.96×10^{-2} Sm and its molar conductivity at infinite dilution is 3.5×10^{-2} Sm^2 mol^{-1}

Calculate

      (i)   the molar conductivity of ethanoic acid at 20^oC

      (ii)   the degree of ionisation of the acid at 20^oC

      (iii)   the pH of the acid

(c) Besides concentration, state one other factor that can affect the pH of the acid

15. (a) Write the structural formulae and names of all possible isomers of an organic compound having the molecular formula C_3H_8O

(b) When one of the isomers p in (a) above was reacted with acidified potassium dichromate compound Q was formed. Q reacted with phosphorousj pentachloride to form compound R and hydrogen chloride gas
Identify
P
Q
R

(c) Write equation and indicate a mechanism for the reaction between P and concentrated sulphuric acid

16. (a) Write an equation for the hydrolysis of sodium ethanoate in water
    (b) Write an expression for the hydrolysis costant K_h of sodium ethanate
    (c) Calculate
        (i)   the value of K_h for sodium ethanoate and indicate its units
        (Ka for $CH_3 COOH$ is 1.8×10^{-5}, $Kw = 1 \times 10^{-14}$)

        (ii)   The pH of a 0.1M sodium ethanoate solution

    (d) State what would be the effect on pH of the solution in (c) (ii) if Icm^3 of 0.IM ethanoic acid was added to it

17. (a) In volumetric estimation of reducing agents, potassium dichromate (VI) is preferred to potassium manganate (VII) as an oxidant.

(b) 3.8 of solder containing tin was dissolved in excess hydrochloric acid. The solution was made up to $250cm^3$. $250cm^3$ of this solution required $23.5cm^3$ of a 0.01M potassiumdichromate (VI) solution for complete reaction

    (i)   write the half equation for potassium dichromate (VI) acting as an oxidising agent in acid medium

    (ii)   calculate the number of moles of potassium dichromate (VI) used

    (iii)   Calculate the number of moles of tin in the $250cm^3$ of solution

    (iv)   Determine the percentage, by mass, of tin in the solder

18.