



Our country, our future

525/1

S6 CHEMISTRY

Exam 22

PAPER 1

DURATION: 2 HOUR 45 MINUTES

Instructions to candidates:

1. Answer all questions in section A and six questions in section B
2. All questions are to be answered in the spaces provided

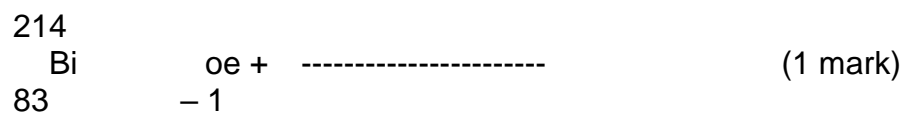
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1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Total

SECTION A (46 MARKS)

Answer all questions in this section

1. (a) Complete the following equation for the decay of bismuth.



- (b) The half life of bismuth is 19.7 minutes. Determine the time taken for 43% by mass of bismuth to decay.

(3 marks)

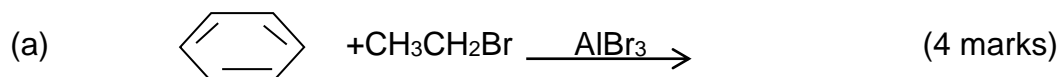
2. Draw the shape and name the structure of each of the following species
(i) H_2O (1 mark)

- (ii) Cl_2O (1 mark)

- (iii) H_3O^+ (1 mark)

- (iv) PCl_5 (1 mark)

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



4. Write an ionic equation for the reaction between sodium hydroxide and



5. 2.910 of a compound Q was dissolved in 160g of ethanol. The boiling point of the solution was 78.97°C while that of pure ethanol was 78.8°C. (K_b for ethanol is 1.15°C for 1 mole in 1000g). Calculate the molecular mass of Q in ethanol

6. (a) A crystalline solid T dissolved in water to give a pink solution. Addition of excess aqueous sodium hydroxide produced a dirty white precipitate which rapidly turned brown on standing. When nitric acid was added to the solution of T followed by sodium bismuthate solution, the solution changed from pink to purple.

(b) Write

- (i) the equation for the reaction that took place when sodium hydroxide was added to the solution. (1 ½ marks)

- (ii) the formula of the species responsible for the purple colour (1 mark)

- (iii) equation for the reaction leading to the formation of the brown solid (1 ½ marks)

7. (a) Define the term 'solubility of a salt'

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- (b) The solubility of calcium phosphate is 0.0011g per 100g of water at 25°C. Calculate the solubility product of calcium phosphate at 25°C (5 marks)

8. Name the reagent that can be used to distinguish between the following pairs of compounds. In each case, state what would be observed if the reagent is treated separately with each pair of compounds

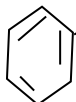
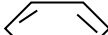
(a) HCOOH and CH_3COOH

Reagent

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Observation

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(b)  OH and  CH_2OH

Reagent:

(1 mark)

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Observation

(2 marks)

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9. 200cm^3 of an aqueous solution containing 40g of x was shaken once with 100cm^3 of ether

(a) Calculate the mass of X extracted by ether. (The distribution coefficient KD, of X between ether and water is 4) (2 marks)

(b) Calculate the mass of X that would be extracted by shaking the solution twice with 50cm^3 of ether. (4 marks)

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SECTION B (54 MARKS)

Attempt only six questions from this section

10. Complete the following reactions and suggest their mechanisms
 (a) $2(\text{CH}_3)_2\text{CO}$ dil. NaOH (3 ½ marks)

Mechanism

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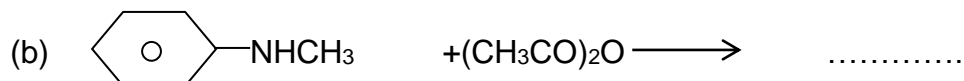
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Mechanism

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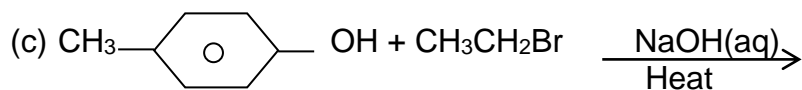
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Mechanism

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(2 ½ marks)

11. (a) A piece of clean magnesium ribbon was added to a solution of iron III chloride solution

(i) State what was observed

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(ii) Explain your observation in a (i) above

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(iii) Write stepwise equations for the reactions that took place (4 marks)

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- (b) State what would be observed if a few drops of iron III chloride was added to the solution of the following:

(i) sodium acetate

(1 mark)

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(ii) phenol

(½ mark)

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12. (a) Write an equation for the

(i) acid dissociation constant, K_a , for ethanoic acid (2 marks)

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(ii) relationship between acid dissociation constant, K_a , and degree of ionisation of an acid (1 mark)

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

(i) The molar conductivity of the ethanoic acid at 20°C (2 marks)

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(ii) The degree of ionisation of the acid at 20°C (1 mark)

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(iii) The pH of the acid

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

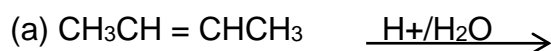
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(1 mark)

13. Complete the following equations and in each case write the accepted mechanism for the reaction



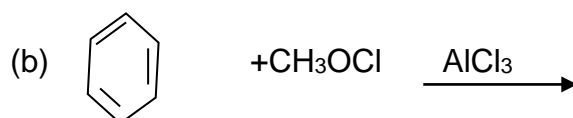
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(3 marks)

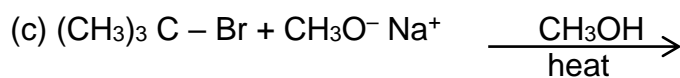
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14. (a) State the oxidation state of chromium in
(i) potassium chromate

(1 mark)

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(ii) potassium dichromate (1 mark)

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(b) Acidified potassium dichromate was reacted with potassium iodide

(i) state what was observed (1 mark)

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(ii) Write the half equations and the overall equation for the reaction (4 marks)

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(c) Potassium chromate solution was added to aqueous lead II nitrate (1 marks)

(i) state what was observed

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(ii) write the ionic equation for the reaction (1 mark)

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15. (a) (i) Write an equation for the solubility of silver sulphate in water

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(ii) Determine the molar concentrations of silver and sulphate ions in a saturated solution of silver sulphate at 25°C. (The K_{sp} of silver sulphate is $1.7 \times 10^{-5} \text{ mol dm}^{-3}$ at 25°C) (3 marks)

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(b) State how the solubility of silver sulphate would be affected if the following substances were added.

(i) Sodium sulphate solution (1 mark)

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(ii) Ammonia solution (1 mark)

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(c) Explain your answer in (b)

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(3 marks)

16. (a) Define the term 'Buffer solution' (2 marks)

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(b) Calculate the mass of sodium ethanoate that should be added to 1 litre of a 0.2M ethanoic acid solution in order to produce a solution of pH = 3.0 (ka for ethanoic acid = 1.8×10^{-5})

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(c) State what would happen to the pH of the solution in (b), if a small amount of the following were added.

(i) sodium hydroxide solution

(ii) hydrochloric acid

(d) State one biological application of a buffer solution (1 mark)

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17. (a) Write equation to show how ethanol can be formed from glucose (4 marks)

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(b) Write equations to show how ethyne can be (4 marks)

(i) prepared from ethanol

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(ii) converted to methylpropyne (1 ½ marks)

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(c) (i) Name one reagent that can be used to confirm the formation of methyl propyne (1 mark)

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(ii) State what would be observed if methyl propyne was reacted with the reagent you have named in C(i) and write equation for the reaction

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(1 ½ marks)