

**P525/2**  
**Chemistry**  
**Paper 2**  
**June / July**  
**2½ hours**

**INTERNAL MOCK EXAMINATIONS 2022**

**Chemistry**

**Paper 2**

**2 hours 30 minutes**

**Instruction To Candidates**

Answer **five** questions including **three** questions from section **A** and any **two** questions from section **B**.

## SECTION A

1. (a) The colligative properties of substances are usually used to determine the relative molecular masses of some compounds.

Explain what is meant by the term colligative property.

(01 mark)

- (b) A solution containing 1.54 g of naphthalene in 18.0 g of camphor has a freezing point of  $148.3^{\circ}\text{C}$ . The melting point of camphor is  $177^{\circ}\text{C}$ , and  $k_f = 42.94^{\circ}\text{C mol}^{-1}\text{kg}^{-1}$

- (i) Determine the molecular mass of naphthalene.

(03 marks)

- (ii) Assuming naphthalene dissociated in camphor, would you expect the experimentally determined molecular mass to be greater or less than the calculated value in (i) above?

Explain your answer.

(04 marks)

- (c) (i) Explain what is meant by the term **Eutectic mixture**.

(02 marks)

- (ii) The naphthalene-biphenyl system forms an eutectic mixture at  $41^{\circ}\text{C}$ . The eutectic has 0.47 mole fraction of naphthalene.

The melting points of various compositions of naphthalene – biphenyl system are given in the table below

Molefraction of naphthalene	0.125	0.275	0.625	0.800
Melting point ( $^{\circ}\text{C}$ )	64.5	56.0	58.0	69

Draw an accurate phase diagram for the naphthalene-biphenyl system and label all the regions of the diagram.

(07 marks)

(The melting point of pure naphthalene is  $80^{\circ}\text{C}$  and that of biphenyl is  $70^{\circ}\text{C}$ )

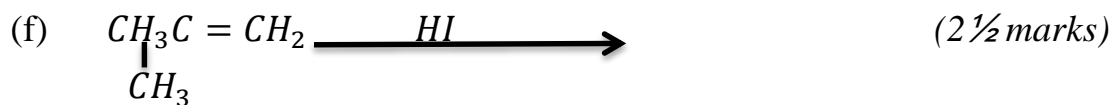
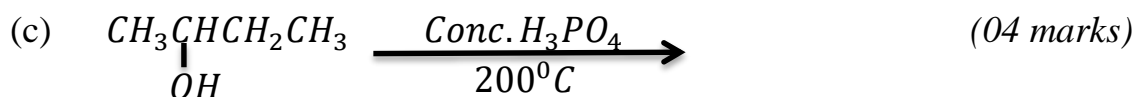
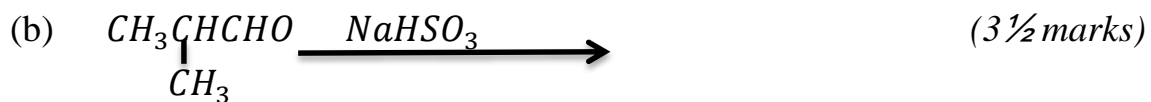
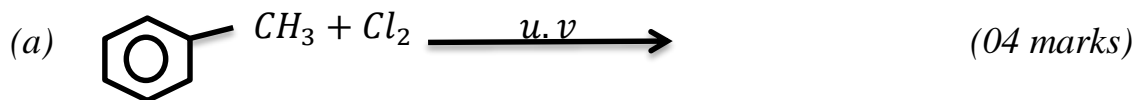
- (iii) Describe what would happen if a mixture containing 0.35 mole fraction biphenyl is cooled from  $70^{\circ}\text{C}$  to  $40^{\circ}\text{C}$

(03 marks)

2. (a) The elements, fluorine, chlorine, bromine and iodine having relative molecular masses 19, 35.5, 80 and 127 respectively belong to group VII of the periodic Table.
- (i) State the physical state in which each of the above given element exists at room temperature. (02 marks)
- (ii) Explain your answer in (a) (i) above. (03 marks)
- (b) Write equations for the ionisation of aqueous hydrogen fluoride in;
- (i) dilute solution.
- (ii) concentrated solution,
- (iii) in which of the solutions above would you expect hydrogen fluoride relatively more acidic? Explain your answer. (03 marks)
- (c) Compare the reaction of fluorine and chlorine with;
- (i) water (03 marks)
- (ii) sodium hydroxide. (03 marks)
- (d) Arrange the following hydrogen halides in order to decreasing acid strength;  $HCl$ ,  $HI$  and  $HBr$ . Explain your answer. (04 marks)
3. Stoichiometric amounts of nitrogen and hydrogen were mixed and heated in a 2-litre vessel at  $450^{\circ}C$ . The vessel was allowed to stand until equilibrium was established. At equilibrium the vessel was found to contain 20% ammonia.
- (a) **Write;**
- (i) Equation for the equilibrium reaction. (01 mark)
- (ii) Expression for the equilibrium constant,  $K_c$ . (01 mark)
- (b) Calculate the value of the equilibrium constant,  $K_c$  in (a) (ii) and state its units. (05 marks)
- (c) Explain the effect of each of the following on the equilibrium above.
- (i) Increasing the temperature of the reaction mixture to  $500^{\circ}C$ . (03 marks)
- (ii) Addition of concentrated hydrochloric acid. (03 marks)
- (iii) Addition of neon gas. (03 marks)
- (iv) Reducing the total pressure of the vessel. (03 marks)

- (d) State **two** practical applications of chemical equilibrium other than the haber process. (01 mark)

4. Complete the following organic reactions, and in each case outline a mechanism.



## SECTION B

5. (a) (i) Write the electronic configuration of chromium ( $Cr = 24$ ).  
( $\frac{1}{2}$  marks)
- (ii) State the oxidation states of chromium.  
(01 mark)
- (b) Explain why chromium has a high melting point.  
(02 marks)
- (c) Describe the reactions of chromium with
- (i) water.  
(02 marks)
- (ii) sulphuric acid.  
(04 marks)
- (d) Explain the reactions that take place when the following solutions are added to an aqueous solution of potassium chromium (III) sulphate
- (i) sodium carbonate.  
(04 marks)
- (ii) sodium hydroxide until in excess.  
(04 marks)
- (e) Hydrogen peroxide was added to the solution formed in (c) (ii) above.
- (i) State what was observed.  
(01 mark)
- (ii) Write equation for the reaction that takes place.  
(1  $\frac{1}{2}$  marks)
6. (a) Name reagent(s) that can be used to distinguish between the following pairs of compounds. In each case state what would be observed when the reagent named is reacted with each member of the pair.
- (i)  $CH_3CH(OH)-C_6H_5$  and  $C_6H_5-CH_2CH_2OH$ .  
(03 marks)
- (ii)  $CH_3CH_2CH(CH_3)CH_2NH_2$  and  $(CH_3)_2NCH_2CH_3$ .  
(03 marks)
- (b) Using equations show how the following conversions can be brought about.
- (i) Phenylethene from ethanoic acid.  
(04 marks)
- (ii) 1-bromopropane from 2-bromo propane.  
(03 marks)
- (iii)  $CH_3CH(OH)CH_2Cl$  from  $CH_3CH(OH)CH_3$ .  
(03 marks)
- (iv)  $CH_3CH_2CH_2COOH$  from  $CH_3CH_2CH_2OH$ .  
(03 marks)
- (v)  $CH_3CH_2OCH_3$  from  $CH_3CH_2OH$ .  
(02 marks)

7. (a) Write;
- equation for the ionisation of propanoic acid. (1½ marks)
  - the expression for the ionisation constant,  $k_a$  for propanoic acid. (01 mark)
- (b) Calculate the pH of a solution made by mixing  $15\text{cm}^3$  of  $0.01\text{M}$  propanoic acid solution with  $25\text{cm}^3$  of  $0.1\text{M}$  sodium propanoate solution. (04 marks)
- ( $K_a = 1.32 \times 10^{-5} \text{ mol}^2 \text{ dm}^{-6}$  at  $25^\circ\text{C}$ ).
- (c) The table below shows that the variation of pH during the titration of  $25\text{cm}^3$  of  $0.01\text{M}$  ethylamine solution with hydrochloric acid.

Volume of $\text{HCl}$ added ( $\text{cm}^3$ )	0	2.0	4.0	6.0	8.0	10.0	12.0	14.0	16.0
pH of the solution	11.5	11.35	10.94	10.60	10.21	9.35	3.0	2.64	2.5

- Plot a graph of pH against volume of hydrochloric acid added. (04 marks)
  - Explain the shape of the graph. (4½ marks)
- (d) (i) Use the graph to determine the pH at the end point. (01 mark)
- Calculate the molarity of hydrochloric acid used. (2½ marks)
  - Determine the base dissociation constant  $k_b$ , of ethylamine. (1½ marks)
8. (a) What is meant by the term **ore**? (01 mark)
- (b) Briefly describe how the following ores can be purified
- Zinc blende. (04 marks)
  - Bauxite. (06 marks)
- (c) Write the following equation(s) to show how aluminium metal can be extracted from the purified ore in (b) (ii) above. (1½ marks)
- (d) Describe how;
- aluminium reacts with sulphuric acid and sodium hydroxide solution. (05 marks)
  - Zinc oxide reacts with sodium hydroxide solution. (2½ marks)

**END**