

MID TERM THREE EXAMINATIONS

S.5 CHEMISTRY PAPER TWO

TIME ALLOWED: 2 ½ HOURS

INSTRUCTIONS

- Attempt **all** questions.
- Each question must start on a fresh page.

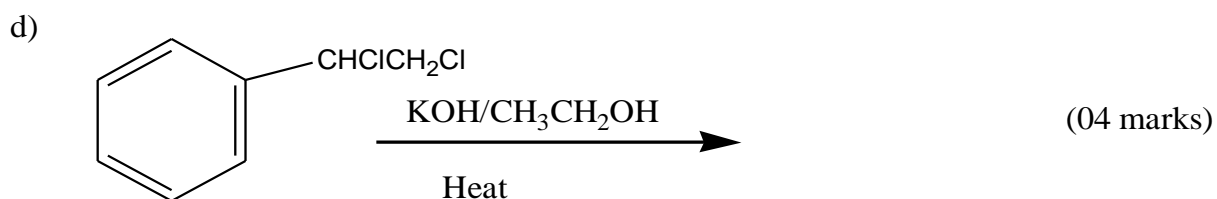
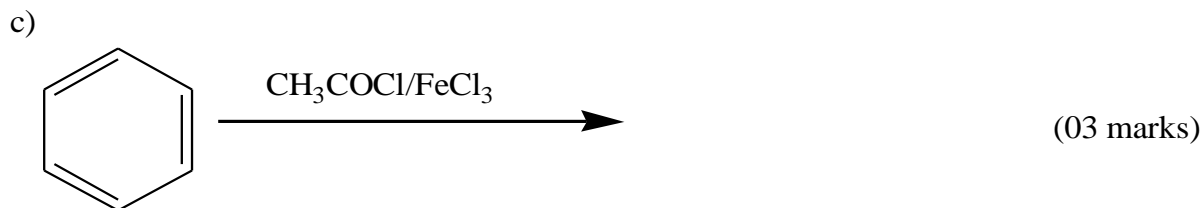
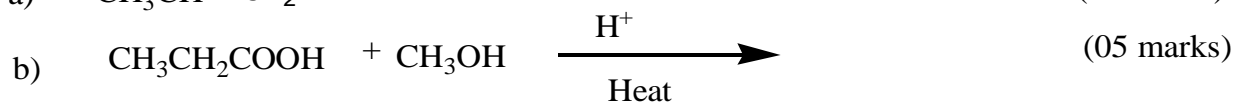
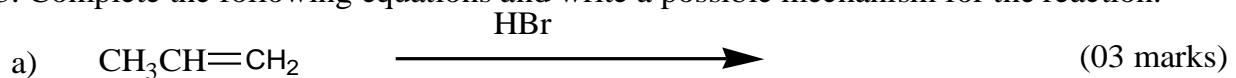
SECTION A

1. Beryllium and Aluminium show diagonal relationship.
 - a) Explain what is meant by the term diagonal relationship. **(02 marks)**
 - b) Apart from aluminium and beryllium; identify 2 other pairs of elements that show diagonal relationship. **(02 marks)**
 - c) Identify 3 reasons why elements show such a relationship. **(03 marks)**
 - d) Elements aluminium, silicon and chlorine are period 3 elements. Describe the reactions of the elements with;
 - i) Sodium hydroxide. **(06 marks)**
 - ii) Water. **(02 marks)**
 - iii) Nitric acid. **(05 marks)**
2. Magnesium chloride is one of the commonest salts of magnesium in nature. The following thermochemical data was recorded about the salt.

| Reaction | Energy (kJmol ⁻¹) |
|---|-------------------------------|
| Atomization of magnesium | +148 |
| First ionization energy of magnesium | +737 |
| Second ionization energy of magnesium | +1450 |
| Bond dissociation of chlorine | +242 |
| First electron affinity of chlorine | -349 |
| Enthalpy of formation of magnesium chloride | -641.8 |

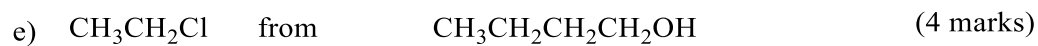
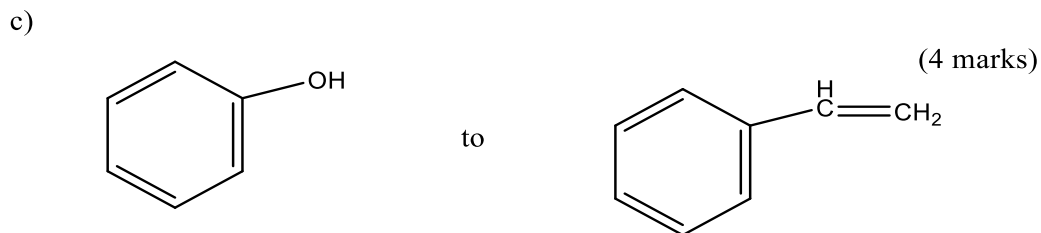
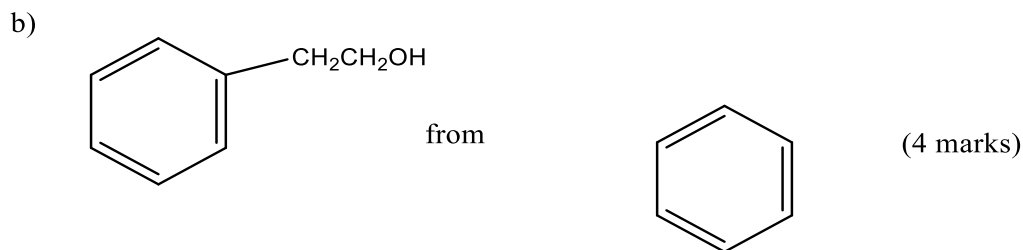
- a) Define the term enthalpy of formation. **(01 mark)**
- b) Draw an energy level diagram for formation of magnesium chloride. Use it to determine the lattice energy for the reaction. **(07 marks)**
- c) The hydration energies magnesium and chloride ions are -1920kJmol⁻¹ and -364kJmol⁻¹ respectively. Calculate the enthalpy of solution of magnesium chloride. **(03 marks)**
- d) Describe an experiment that can be used to determine enthalpy of combustion of methanol. **(06 marks)**
- e) Explain why magnesium sulphate is more soluble than barium sulphate and both are group (II) sulphates. **(03 marks)**

3. Complete the following equations and write a possible mechanism for the reaction.



4.

Using equations show how the following synthesis reactions can be effected. indicate reagents and conditions necessary for the reactions to occur.



5. (a).(i) Explain the term colligative property. **(01 mark)**
(ii) State four colligative properties of a solution. **(02 marks)**
- b) . (i) Describe how the molecular mass of a substance can be determined by elevation of boiling point method. **(06 marks)**
(ii) State four limitations of the method. **(02 marks)**
- c) Calculate the **boiling point** of an aqueous solution of urea, $[\text{CO}(\text{NH}_2)_2]$ of concentration **12g/dm^3** at a pressure of **101.3kPa** . **(03 marks)**
[Assume that the volume of the solute is negligible compared to that of the solution. The boiling point elevation constant for water = **$0.52^\circ\text{C/mol/kg}$**]
- d) The **table** below shows the freezing points of various solutions of cane sugar in solvent, **X**.

| | | | | | | | |
|-------------------------------------|------|------|------|------|------|------|------|
| Mass of cane sugar in 1,000g of X | 26 | 42 | 66 | 78 | 118 | 148 | 173 |
| Freezing point ($^\circ\text{C}$) | 5.11 | 4.87 | 4.51 | 4.33 | 3.73 | 3.28 | 2.90 |

- i) Plot a graph of freezing point against mass of cane sugar. **(03 marks)**
ii) Use the graph to determine freezing point of solvent, X and freezing point constant if the relative molecular mass of cane sugar is **342**. **(03 marks)**

END