

SECTION A

Attempt *three* questions from this section

1. (a) Define the terms:

(i) Conductivity.

(01 mark)

(ii) Molar conductivity.

(01 mark)

(b) The table below shows the molar conductivities of an aqueous solution of sodium hydroxide.

Concentration (mol dm^{-3})	0.01	0.04	0.09	0.16	0.25	0.36
Molar conductivity ($\text{Scm}^2\text{mol}^{-1}$)	238	231	224	217	210	203

(i) Plot a graph of molar conductivity against square root of concentration.

(04 marks)

(ii) Use the graph to determine the molar conductivity of sodium hydroxide at infinite dilution.

(01 mark)

(iii) Explain the shape of the graph.

(03 marks)

(c)(i) Draw a sketch graph to show the change in the conductivity when 25cm^3 of 0.1M methanoic acid is titrated against 0.1M ammonia solution.

(1½ marks)

(ii) Explain the shape of the graph.

(3½ marks)

(d) The conductivity of a saturated solution of silver phosphate at 25°C is $2.661 \times 10^{-6} \text{ Scm}^{-1}$ and that of pure water is $1.519 \times 10^{-6} \text{ Scm}^{-1}$. If the molar ionic conductivities of silver ions and phosphate ions at infinite dilution at 25°C are 61.9 and $240 \text{ Scm}^2\text{mol}^{-1}$ respectively. Calculate the:

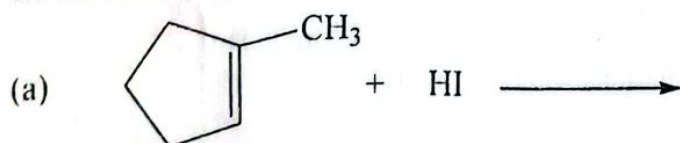
(i) solubility of silver phosphate in moles dm^{-3} at 25°C .

(2½ marks)

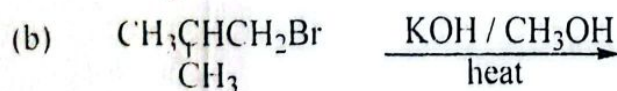
(ii) solubility product of silver phosphate at 25°C and state its units.

(2½ marks)

2. Complete the following equations and in each case outline a suitable mechanism for the reaction.



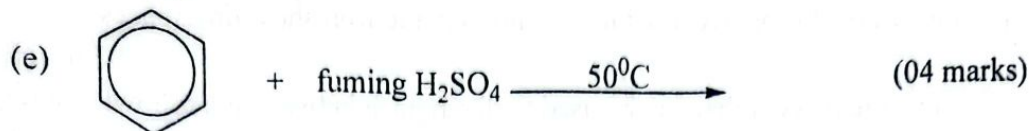
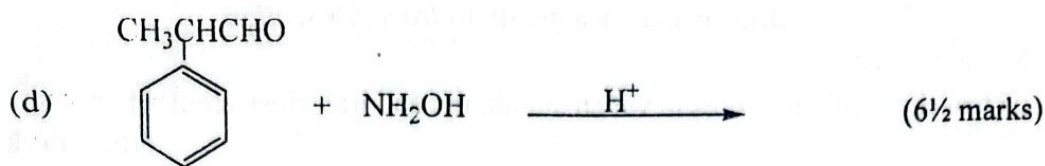
(2½ marks)



(03 marks)



(04 marks)



3. (a) Write the outer most electronic structure of group(VII) elements. (01 mark)

(b) Describe the reactions of:

(i) Fluorine and chlorine with sodium hydroxide. (07 marks)

(ii) Chlorine with turpentine. (1½ marks)

(iii) The hydrides of chlorine and bromine with sulphuric acid. (04 marks)

(iv) Glass with hydrofluoric acid. (2½ marks)

(c) Concentrated hydrochloric acid was added to lead(II) ethanoate solution drop-wise until in excess. State what was observed and write equation for the reaction that took place. (04 marks)

4. A Compound Y contains carbon, hydrogen and nitrogen only. On complete combustion, 2.325g of Y yielded 6.6g of carbon dioxide and 295.4cm³ of nitrogen gas measured at 15°C and at 760mmHg. Y burns with a sooty flame.

(a) Calculate the empirical formula of Y. (5½ marks)

(b) When compound was steam distilled at 97°C and 755mmHg, the distillate contained 45.49 % by mass of Y. (The saturated vapour pressure of water at this temperature 650mmHg). Determine the molecular formula of Y. (3½ marks)

(c) Write the structural formula and name of Y. (01 mark)

(d) When Y treated with a mixture of concentrated hydrochloric acid and sodium nitrite solution under ice cold conditions, compound Z was formed. State what would be observed and write equation for the reaction when:

(i) An alkaline solution of naphthalene-2-ol was added to Z. (02 marks)

(ii) A few drops of bromine water were added to Y. (02 marks)

(e) Without using equations show how:

(i) Y is prepared from benzene. (03 marks)

(ii) Z can be converted to benzoic acid. (03 marks)

SECTION B

Attempt only two questions from this section

5. (a) Discuss:

(i) two chemical properties in which aluminium and iron show similarities.

(05 marks)

(ii) one chemical property in which aluminium and iron show differences.

(03 marks)

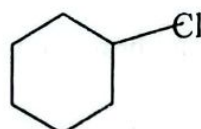
(b) Name one reagent that can be used to distinguish between the following pairs of chemical species. In each case state what would be observed when the named reagent is treated separately with the chemical species and write the equation for the reaction that takes place.

(i) Methanol and ethanol.

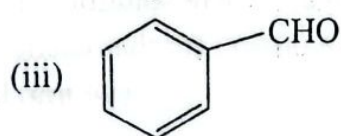
(04 marks)



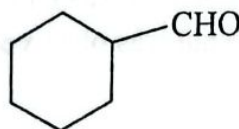
and



(04 marks)



and



(04 marks)

6. (a) State what is meant by the term:

(i) Activated complex.

(01 mark)

(ii) Molecularity of a reaction.

(01 mark)

(iii) Order of a reaction.

(01 mark)

(b) Compound P undergoes a reaction to compound Q. The course of the reaction can be followed by adding excess potassium iodide solution to a fixed volume of the reactant. P reacts with potassium iodide to form iodine which can be titrated with a standard solution of sodium thiosulphate. The volume of sodium thiosulphate solution is a measure of the concentration of P remaining at a certain time, t. The table below shows the volume of sodium thiosulphate ($V \text{ cm}^3$) required at various time (minutes).

Time, t (minutes)	0	60	120	180	240	300
Volume (cm^3)	24.7	17.8	12.9	9.5	6.75	4.25

Plot a graph of volume against time.

(04 marks)

(c) From the graph in (b) above, deduce the time taken for P to be reduced to a:

- (i) half the original value. (01 mark)
- (ii) quarter of the original value. (01 mark)
- (d) (i) What conclusions can be drawn from your answers in (c) above? (03 marks)
- (ii) Write the rate equation for the reaction in (b) above. (01 mark)
- (iii) Determine the rate constant for the reaction in (b) above. (02 marks)
- (e) Explain the effect of the following on the rate of the reaction.
- (i) Temperature. (2½ marks)
- (ii) Catalyst. (2½ marks)

7.(a) Describe the process by which sodium hydroxide is prepared on an industrial scale. *(A diagram is required)* (07 marks)

(b) Soap can be prepared from sodium hydroxide and another raw material obtained from sunflower seeds.

- (i) State three ways by which the raw material can be obtained from sunflower seeds which is a natural source. (1½ marks)
- (ii) Describe how soap can be prepared from the raw materials. (4½ marks)
- (iii) State one advantage and one disadvantage of using soap. (02 marks)
- (iv) Briefly explain the cleansing action of soap. (2½ marks)
- (v) Explain why an aqueous solution of soap has a pH greater than 7. (2½ marks)

8. Explain the following observations

- (a) When potassium iodide solution was added to copper(II) sulphate solution white precipitate and brown solution were formed. (04 marks)
- (b) Ethanoic acid has a lower ionisation constant than methanoic acid. (04 marks)
- (c) When concentrated ammonia solution was added to cobalt(II) chloride solution, blue precipitate was formed which dissolved in excess ammonia solution to form a pale brown solution. (05 marks)
- (d) Both 0.1M aqueous urea solution and 0.05M aqueous potassium chloride solution have the same boiling point at 760mmHg pressure. (03 marks)
- (e) When a clean piece of magnesium ribbon was added to an aqueous solution of aluminium nitrate there is effervescence of a colourless gas and white precipitate was formed. (04 marks)

END