

# Mearns Castle High School

## Higher Chemistry Prelim Examination

Thursday 17<sup>th</sup> February 2005

9.00am – 11.30 am

Name \_\_\_\_\_

Teacher \_\_\_\_\_

### Marks

Section A

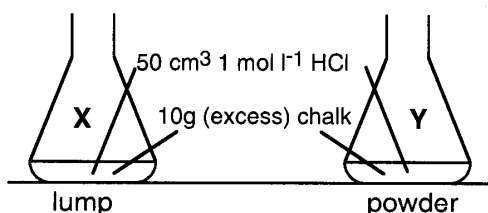
Section B

Total

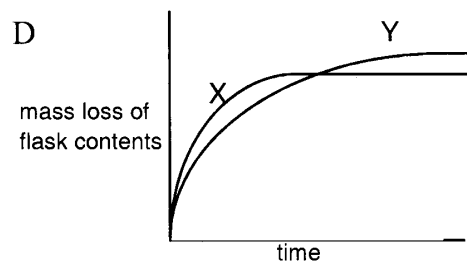
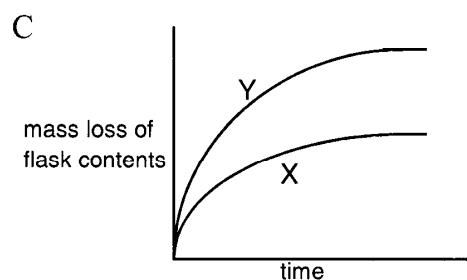
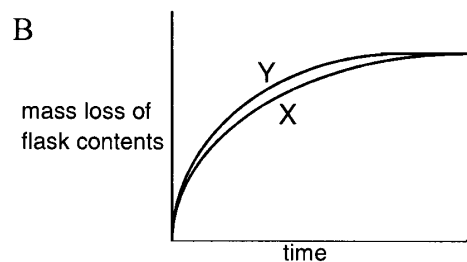
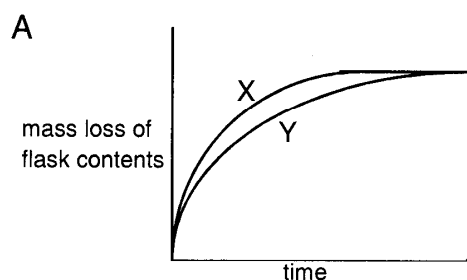
Grade

## Higher Chemistry -Part A

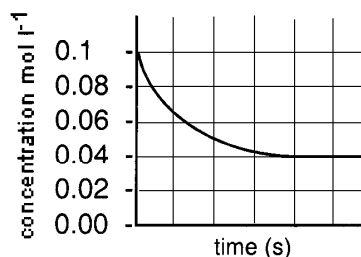
**1.** Consider the experiment illustrated below



Which diagram shows data likely to be obtained from experiments X and Y



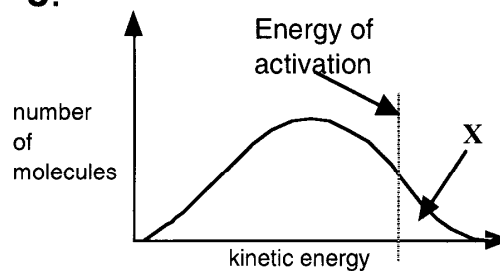
**2.** The graph shows the variation of concentration of a reactant over the 50 seconds taken to complete a reaction



What is the overall rate of the reaction?

- A  $0.0008 \text{ mol l}^{-1}\text{s}^{-1}$
- B  $0.0012 \text{ mol l}^{-1}\text{s}^{-1}$
- C  $0.0020 \text{ mol l}^{-1}\text{s}^{-1}$
- D  $0.0028 \text{ mol l}^{-1}\text{s}^{-1}$

**3.**



In area X:-

- A Molecules always form an activated complex
- B No molecules have the energy to form an activated complex
- C Collisions between molecules are always successful in forming products
- D All molecules have the energy to form an activated complex

Questions 4 and 5 refer to the reaction between zinc and hydrochloric acid solution forming the salt zinc II chloride



4.

What is the mole relationship between the HCl reacting and the hydrogen gas produced?

- A. 1 mol HCl and 1 mol H<sub>2</sub>
- B. 1 mol HCl and 2 mol H<sub>2</sub>
- C. 2 mol HCl and 2 mol H<sub>2</sub>
- D. 2 mol HCl and 1 mol H<sub>2</sub>

5.

What mass of zinc reacts to form 1.0g of hydrogen?

- A. 0.5g
- B. 16.35g
- C. 32.7g
- D. 65.4g

6.

Heterogeneous catalysis depends on reacting molecules:-

- A. bonding moderately strongly to the catalyst
- B. having the required activation energy
- C. being in the same state as the catalyst
- D. having weak intramolecular bonds

7.

When 20cm<sup>3</sup> of 2 mol l<sup>-1</sup> HCl were added to 20cm<sup>3</sup> of 1 mol l<sup>-1</sup> KOH solution, a rise in temperature of 6°C was observed.

If 20cm<sup>3</sup> of 2 mol l<sup>-1</sup> H<sub>2</sub>SO<sub>4</sub> were used instead of the HCl, the temperature rise would be about

- A. 3°C
- B. 6°C
- C. 12°C
- D. Not enough information given

8.

A student carried out an experiment and found that 2.65g of butane burned to give out 6.8kJ of energy.

Calculate the experimental value for the enthalpy of combustion of butane

- A. 112.91kJ mol<sup>-1</sup>
- B. 143.70kJ mol<sup>-1</sup>
- C. 148.83kJ mol<sup>-1</sup>
- D. 184.75kJ mol<sup>-1</sup>

9.

The equation which represents the heat of solution of NaCl crystals is

- A.  $\text{NaCl}_{(s)} + \text{H}_2\text{O}_{(l)} \longrightarrow \text{Na}^+_{(aq)} + \text{Cl}^-_{(aq)}$
  - B.  $\text{NaCl}_{(s)} + \text{H}_2\text{O}_{(l)} \longrightarrow \text{Na}^+_{(g)} + \text{Cl}^-_{(g)}$
  - C.  $\text{NaCl}_{(s)} + \text{H}_2\text{O}_{(l)} \longrightarrow \text{Na}^+_{(l)} + \text{Cl}^-_{(l)}$
  - D.  $\text{NaCl}_{(s)} + \text{H}_2\text{O}_{(l)} \longrightarrow \text{Na}^+_{(s)} + \text{Cl}^-_{(s)}$
-

**10.**

The denaturing of an enzyme involves

- A the neutralisation of the acid groups in the molecule
- B the physical alteration of the molecule
- C the breaking of covalent bonds within the molecule
- D the hydrolysis of the molecule

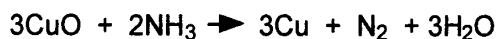
**11.**

Which of the following has the same volume as 14g of nitrogen gas?

(all volumes are measured under the same conditions of temperature and pressure)

- A. 14g of ethane gas
- B. 20g of neon gas
- C. 22g of carbon dioxide gas
- D. 28g of carbon monoxide gas

**12.**



What volume of nitrogen gas, in  $\text{cm}^3$ , would be obtained by reaction between  $100\text{cm}^3$  of ammonia gas and excess copper II oxide?

(all volumes are measured at one atmosphere pressure and room temperature)

- A 50
- B 100
- C 200
- D 400

**13.**

A one carat diamond used in a ring contained approximately  $1 \times 10^{22}$  carbon atoms

The mass of the diamond is:-

- A 0.1g
- B 0.2g
- C 1.0g
- D 1.2g

**14.**

The reaction



is an example of:-

- A Cracking
- B Hydrogenation
- C Addition
- D Reforming

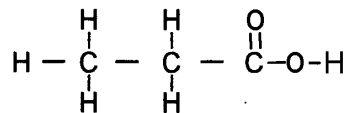
**15.**

Which of the following fuels would not contribute to the 'greenhouse effect' when burned?

- A Petrol
- B Methane
- C Hydrogen
- D Ethanol

**16.**

To which of the following classes does the compound shown belong



- A Alcohols
- B Carboxylic acids
- C Ketones
- D Carbohydrates

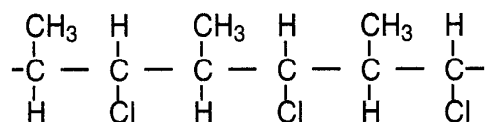


**24.**

A compound S on oxidation, gives a compound T. Reagent T reduces Benedict's solution. Compound S could be

- A Propan-2-one
- B Propan-2-ol
- C Propanal
- D Propan-1-ol

**25.**



Which of the following monomers could polymerise to give the above polymer?

- A  $\begin{array}{c} \text{H} & \text{H} & \text{H} \\ | & | & | \\ \text{C} = & \text{C} - & \text{C} - \text{CH}_3 \\ | & & | \\ \text{H} & & \text{Cl} \end{array}$
- B  $\begin{array}{c} \text{H} \\ | \\ \text{CH}_3 - \text{C} = \text{C} - \text{CH}_3 \\ | \\ \text{Cl} \end{array}$
- C  $\begin{array}{c} \text{H} & \text{H} \\ | & | \\ \text{CH}_3 - \text{C} = & \text{C} \\ & | \\ & \text{Cl} \end{array}$
- D  $\begin{array}{c} \text{H} \\ | \\ \text{CH}_3 - \text{C} = \text{C} \\ | & | \\ \text{Cl} & \text{H} \end{array}$

**26.**

Glycerol can be obtained from a fat by:-

- A Electrolysis
- B Condensation
- C Esterification
- D Hydrolysis

Questions 27 and 28 refer to the following:-

- A non-polar covalent bonding
- B polar covalent bonding
- C hydrogen bonding
- D van der Waals' forces

Which of the above is mainly responsible for holding the following pairs together?

- 27.** Two adjacent water molecules in an ice crystal
- 28.** The carbon atom and the chlorine atom in a molecule of tetrachloromethane (CCl<sub>4</sub>)

**29.**

Which of the following exists as diatomic molecules?

- A Helium gas
- B Methane gas
- C Carbon monoxide gas
- D Crystalline sodium chloride

**30.**

Tetrachloromethane, CCl<sub>4</sub>, is considered to be a non-polar substance because

- A The polar bonds are arranged symmetrically
- B The C - Cl bonds are non polar
- C A covalent network structure exists
- D Only linear molecules are polar

**31.**

Which of the following is a non-conductor of electricity, but becomes a good conductor on melting?

- A Solid potassium fluoride
- B Solid argon
- C Solid potassium
- D solid tetrachloromethane

**32.**

Which of the following chlorides is likely to have the most ionic character?

- A HCl
- B CCl<sub>4</sub>
- C LiCl
- D CsCl

**33.**

In which of the following compounds does hydrogen bonding occur?

- A HCl
- B CH<sub>4</sub>
- C C<sub>2</sub>H<sub>5</sub>OH
- D PH<sub>3</sub>

**34.**

Which equation represents the first ionisation energy of chlorine?

- A  $\text{Cl}_{(g)} + e^- \longrightarrow \text{Cl}^-_{(g)}$
- B  $\text{Cl}^-_{(g)} \longrightarrow \text{Cl}_{(g)} + e^-$
- C  $\text{Cl}_{2(g)} + e^- \longrightarrow 2\text{Cl}^-_{(g)}$
- D  $\text{Cl}_{(g)} \longrightarrow \text{Cl}^+_{(g)} + e^-$

**35.**

A metal (melting point 98°C, density 0.97g cm<sup>-3</sup>) was obtained by electrolysis of its molten chloride (melting point 804°C, density 2.2g cm<sup>-3</sup>).

During the electrolysis, in which of the following states would the metal occur?

- A As a solid on the surface of the electrolyte.
- B As a liquid on the surface of the electrolyte
- C As a solid at the bottom of the electrolyte
- D As a liquid at the bottom of the electrolyte

**36.**

Dilute sulphuric acid is dropped onto a mixture of copper and copper carbonate.

Which of the following would be the most likely composition of the gas evolved?

- A Carbon dioxide only
- B Hydrogen only
- C Carbon dioxide and hydrogen
- D Carbon dioxide and sulphur dioxide.

**37.**

In which of the following structures would the nails corrode before the roof itself?

- A Zinc roof with iron nails
- B Iron roof with copper nails
- C Copper roof with iron nails
- D Zinc roof with copper nails

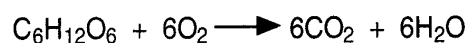
**38.**

An element conducts electricity. When it is burned in oxygen and the product is added to water the resulting solution has a pH greater than 7 the element could be

- A Carbon
- B Sodium
- C Sulphur
- D Aluminium

**39.**

The reaction



is an example of

- A Photosynthesis
- B Hydrolysis
- C Combustion
- D Hydration

**40.**

When a Group 1 metal atom X reacts to become an ion  $\text{X}^+$

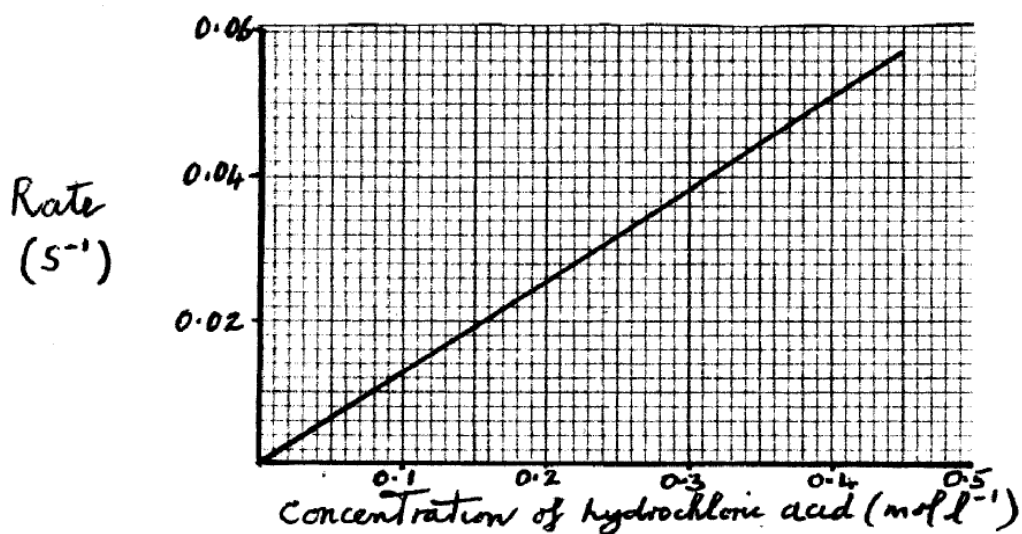
- A The diameter of the particle increases
- B The positive charge of the nucleus increases
- C The atomic number of X decreases
- D The number of occupied electron shells decreases by 1



## Higher Chemistry – Part B

1.

A pupil investigated the effect of acid concentration on the rate of a reaction between magnesium ribbon and excess hydrochloric acid. The pupil recorded, for different concentrations of hydrochloric acid, the time taken for all the magnesium added to react completely. After converting the times recorded to a rate measurement, the following graph was drawn by the pupil.



(a) Name two variables that the pupil must control for a fair experiment.

(2)

(b) Explain how a recorded time was changed into a rate measurement.

(1)

(c) Calculate the reaction time when  $0.25 \text{ mol l}^{-1}$  hydrochloric acid was used.

(1)

[4]

2.

Under the correct conditions, benzene can be converted to cyclohexane by an addition reaction with hydrogen.

(a) Write a balanced equation for this reaction.

(1)

(b) Calculate the volume of hydrogen required to convert 1kg of benzene into cyclohexane. (take the molar volume of hydrogen to be  $24 \text{ l mol}^{-1}$ )

(2)

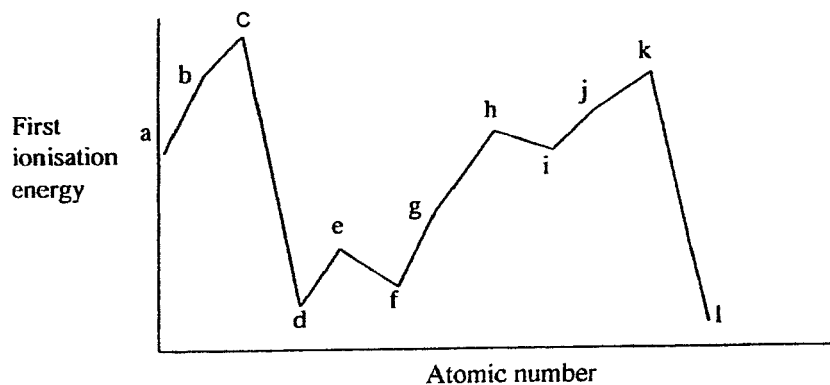
(c) Benzene hexachloride is an important insecticide. Draw the full structural formula of a molecule of benzene hexachloride.

(1)

**[4]**

3.

The graph below represents the first ionisation energies of consecutive elements in part of the Periodic Table.



(a) Define the term first ionisation energy.

(1)

(b) Identify the letters that correspond to noble gases.

(1)

(c) State the **general** trend in first ionisation energies going across a period as shown by the graph.

(1)

(d) Explain the reason for this trend.

(2)

[5]

4.

The enthalpy of solution of sodium bromide is  $+10\text{kJ mol}^{-1}$ .

- (a) Calculate the energy change in making 1 litre of a  $2\text{ mol l}^{-1}$  solution from the solid compound.

(1)

- (b) Use your answer above to calculate the **change** in the temperature of the water during the making of this solution.

(2)

[3]

5.

The Earth's atmosphere contains 0.93% argon.

Calculate the number of argon atoms present in 5 litres of air.

(Take the molar volume of argon to be 24 litres)

(2)

[2]

## 6.

Esters can be produced in the laboratory by reacting an alkanolic acid with an alkanol in the presence of a suitable catalyst.

(a) Draw a **labelled diagram** of the apparatus used to carry out this experiment.

(2)

(b) Name the catalyst used.

(1)

(c) What type of reaction is involved in the production of the ester?

(1)

(d) Why is the mixture heated by hot water rather than directly with the Bunsen burner?

(1)

(e) (i) Name the ester whose structural formula is  $\text{HCOOCH}_2\text{CH}_3$

(1)

(ii) Draw the full structural formulae of the alkanol and the alkanolic acid used to produce this ester.

(2)

[8]

**7.**

The boiling point of an organic compound is greatly influenced by the kind of bonding present.

<b>compound</b>	<b>boiling point °C</b>
methylpropane	-12
propan-2-ol	82

Explain the difference in boiling points between the two compounds in terms of the **intermolecular** attractions.

(3)  
[3]

## 8.

At room temperature, a lump of white phosphorus reacts with air forming phosphorus(V) oxide



(a) Use this information to calculate the enthalpy of combustion of phosphorus

(1)

(b) State the effect of using powdered phosphorus in place of lump phosphorus on:-

(a) the rate of the reaction

(1)

(b) the enthalpy change for the reaction

(1)

[3]

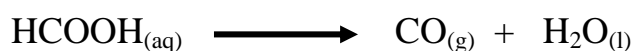
9.

Methanoic acid, HCOOH, can break down to carbon monoxide and water by two different reactions, **A** and **B**.

**Reaction A (catalysed)**



**Reaction B (uncatalysed)**



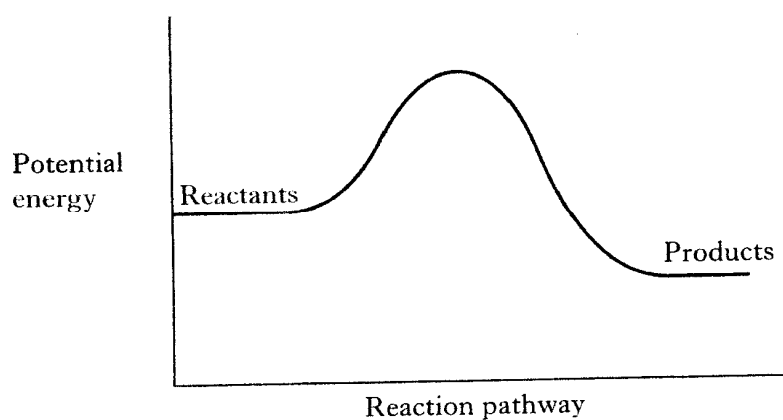
- (a) (i) What is the evidence in the equation for **reaction A** that the  $\text{H}^+_{(\text{aq})}$  ion acts as a catalyst?

(1)

- (ii) Explain whether **reaction A** is an example of a heterogeneous or homogeneous catalysis.

(1)

- (b) The energy diagram for the **catalysed** reaction is:



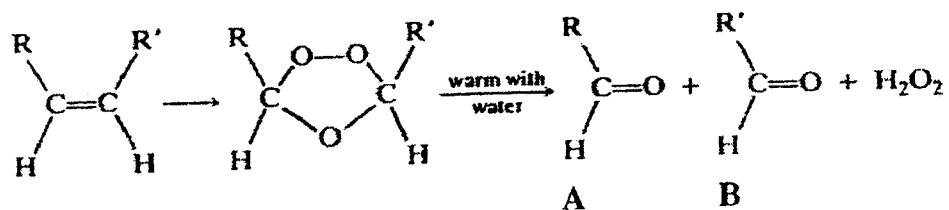
Draw a line on the diagram to show the reaction pathway for the **uncatalysed** reaction

(1)  
[3]



## 10.

Ozone reacts with alkenes as shown below.



(a) Which functional group is common to both compounds A and B?

(1)

(b) Name and draw the full structural formula of the alkene which would produce, on reaction with ozone, butan-2-one only

(2)

(c) The Earth's atmosphere contains a layer of ozone.  
This layer is being depleted by the presence of halogenated hydrocarbons.  
Why does this depletion pose a health risk?

(1)

[4]

11.

A student added 3.81g of copper metal to 40 cm<sup>3</sup> of 2 mol l<sup>-1</sup> silver I nitrate solution.

The equation for the reaction is



- (a) Show by calculation which reactant was in excess  
**(show your working clearly)**

(2)

- (b) Calculate the mass of silver produced

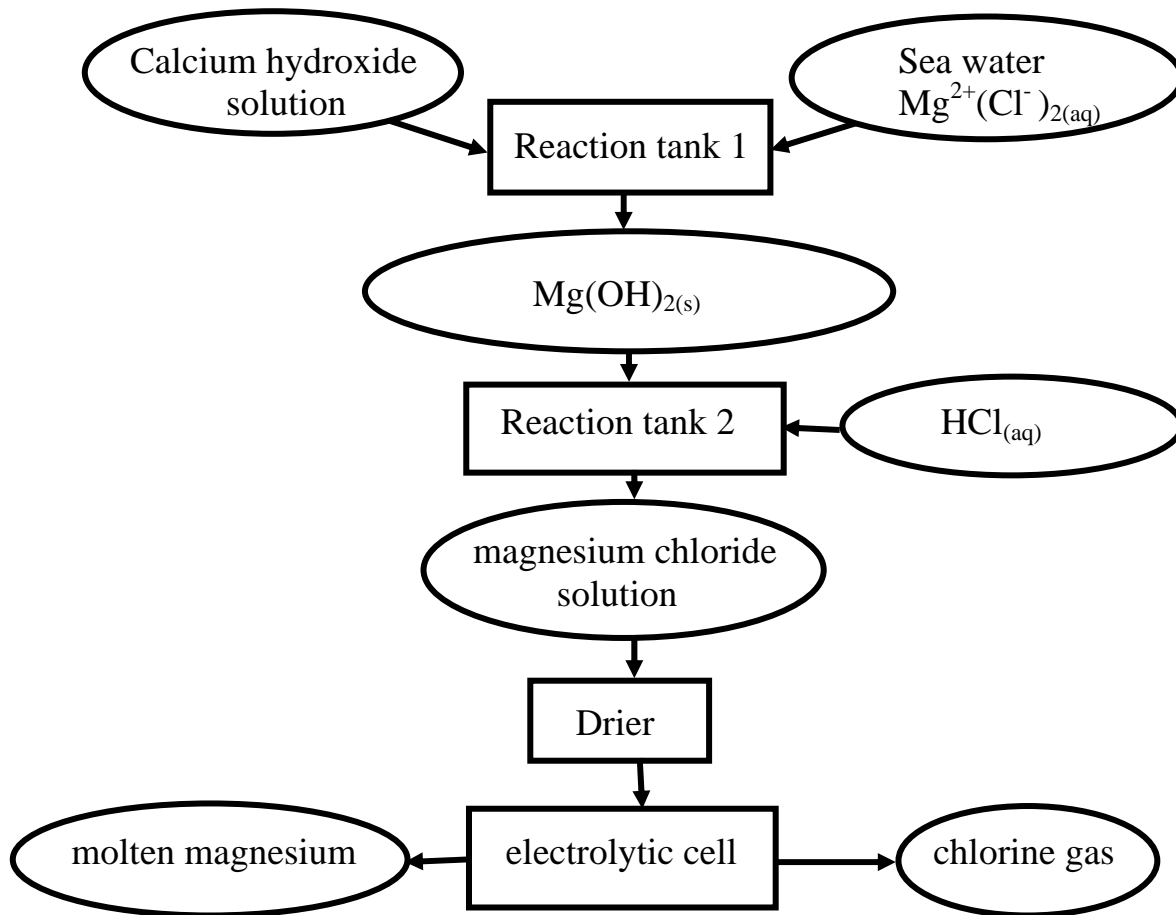
(1)

- (c) State why the reaction produced a blue coloured solution

(1)  
[4]

12.

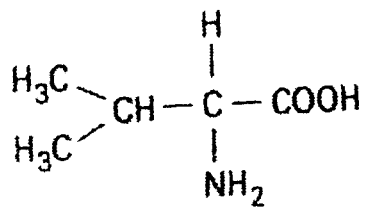
Sea water is an important source of magnesium. Part of the Dow process for producing magnesium from sea water is shown in the following flow diagram.



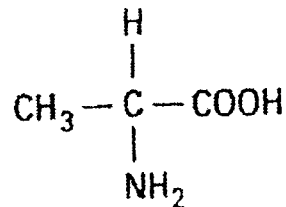
- (a) Write a balanced chemical equation for the reaction occurring in reaction tank 1. (1)
- (b) Which type of reaction occurs in reaction tank 2? (1)
- (c) Write an equation for the reduction reaction in the electrolytic cell. (1)
- (d) Suggest how the chlorine gas produced can be used to make the Dow process more efficient. (1)
- (e) Explain why Mg<sup>3+</sup><sub>(aq)</sub> are not found in sea water (1)

[5]

13.



VALINE



ALANINE

The above are molecules of amino acids.

- (a) Draw the full structural formula of the dipeptide molecule formed from these molecules.

(1)

- (b) What type of reaction takes place between amino acids?

(1)

- (c) Valine is an **essential amino acid**. Explain this term

(1)

[3]

## 14.

Vinegar is a dilute solution of ethanoic acid. Its concentration can be determined by titration against standard sodium hydroxide solution using the following method.

Dilute vinegar as follows. Pipette 10ml of vinegar into 250ml standard flask, top up to the mark with deionised water, stopper and mix.

Titrate 25ml portions of this solution against  $0.02 \text{ mol l}^{-1}$  sodium hydroxide solution until two concordant results are obtained

The following results were obtained for a bottle of commercially produced vinegar.

Titre	initial burette reading	final burette reading	alkali added (ml)
rough	0.0	25.2	25.2
first titration	0.0	23.6	23.6
second titration	0.0	47.1	23.5

(a) What volume of sodium hydroxide should be used in subsequent calculations?

(1)

(b) Calculate the concentration (in  $\text{mol l}^{-1}$ ) of the **diluted** vinegar. (vinegar and sodium hydroxide react in a 1mol : 1 mol ratio).

(1)

(c) Calculate the concentration in  $\text{g l}^{-1}$  of the **commercial** vinegar.

(2)

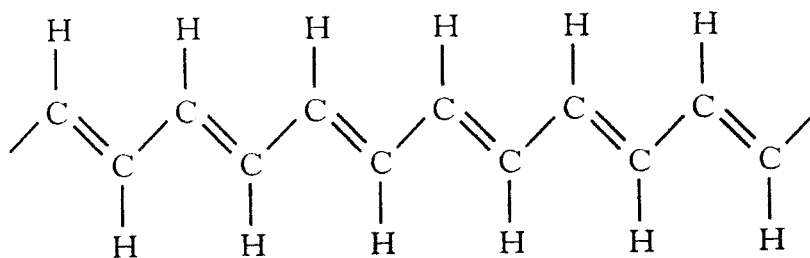
(d) Glass is produced from silicon dioxide. Explain why it is important to thoroughly rinse the burette with water after use in the titration.

(1)

[5]

**15.**

Part of a polymer structure is shown below.



(a) Draw the structure for the monomer from which it is made.

(1)

(b) This polymer can be treated to make a polymer that conducts electricity. Why does it conduct electricity?

(1)

[2]

## 16.

Addition of hydrogen chloride to an alkene can give two products.

Markovnikoff observed that the hydrogen of the hydrogen chloride mainly attaches to the carbon atom of the double bond which already has the most hydrogens directly attached to it.

(a) Draw the full structural formula for the major product formed when hydrogen chloride reacts with but-1-ene.

(b) Why is it not necessary to consider Markovnikoff's rule when hydrogen chloride reacts with but-2-ene?

(1)

(1)

[2]

**End of paper**