

INSTRUCTIONS AND INFORMATION

1. Write your examination number and centre number in the appropriate spaces on the ANSWER BOOK.
2. Answer ALL the questions.
3. This question paper consists of TWO sections:
SECTION A (25)
SECTION B (125)
4. Answer SECTIONS A and B in the ANSWER BOOK.
5. Non-programmable calculators may be used.
6. Appropriate mathematical instruments may be used.
7. Number the answers correctly according to the numbering system used in this question paper.
8. Data sheets and a periodic table are attached for your use.
9. Give brief motivations, discussions, et cetera where required.

SECTION A

Answer this section on the attached ANSWER SHEET.

QUESTION 1: ONE-WORD ITEMS

Give ONE word/term for each of the following descriptions. Write only the word/term next to the question number (1.1 – 1.5) on the attached ANSWER SHEET.

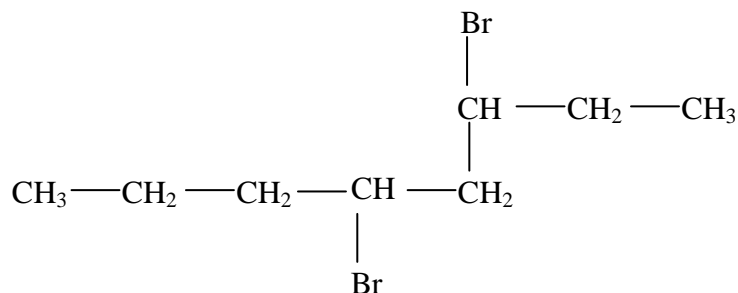
- 1.1 The name of the process used in industry to manufacture nitric acid. (1)
- 1.2 The reactant which undergoes an increase in oxidation number during a chemical reaction. (1)
- 1.3 The stage in a reversible reaction when the rate of the forward reaction equals the rate of the reverse reaction. (1)
- 1.4 During a chemical reaction this energy is reduced by using a catalyst. (1)
- 1.5 The type of elimination reaction during which a halide is removed from a haloalkane. (1)

[5]

QUESTION 2 : MULTIPLE-CHOICE QUESTIONS

Four options are provided as possible answers to the following questions. Each question has only ONE correct answer. Choose the answer and make a cross (X) in the block (A – D) next to the question number (2.1 – 2.10) on the attached ANSWER SHEET.

2.1 The condensed structural formula of an organic compound is shown below:



Which ONE of the following is the correct IUPAC name of this compound?

- A 3,5-dibromooctane
- B 4-bromo-5-bromo-5-propylpentane
- C 4,6-dibromooctane
- D 2-bromo-1-bromo-1-propylpentane (2)

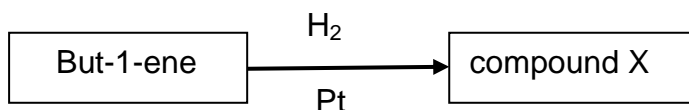
2.2 Which ONE of the following reaction types can be used to prepare ethene from octane?

- A Addition
- B Cracking
- C Hydrogenation
- D Substitution (2)

2.3 Which ONE of the following pairs of reactants can be used to prepare the ester ethyl pentanoate in the laboratory ?

- A Ethanol and pentanol
- B Ethanoic acid and pentanol
- C Ethanol and pentanoic acid
- D Ethanal and pentanoic acid (2)

2.4 In the flow diagram below

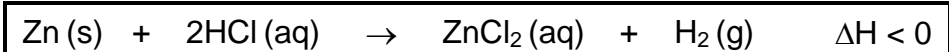


The IUPAC name for compound X is :

- A but-1-yne
- B butan-1-ol
- C butan-2-ol
- D butane

(2)

2.5 Two learners, A and B, prepared hydrogen gas in the laboratory by adding hydrochloric acid to an excess of zinc. The equation for the reaction is:



Each learner was given the same mass of Zn and the same volume of HCl. Their results were tabulated as follows:

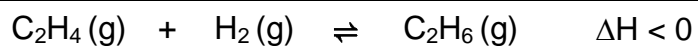
Time (minutes)	Learner A Volume of H ₂ (cm ³)	Learner B Volume of H ₂ (cm ³)
1	10	20
2	20	25
3	25	30
4	25	30

The reasons for the different volumes that A and B obtained are:

- A B used a catalyst and a higher concentration of HCl than A.
- B B used a catalyst and a higher temperature than A.
- C B used a catalyst and powdered zinc.
- D B used powdered zinc and a higher temperature than A.

(2)

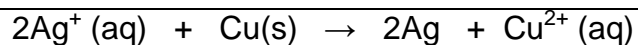
2.6 Consider the following equilibrium reaction:



For this reaction, the K_C value was found to be 2×10^{-2} at a certain temperature. To change the K_C value to 6×10^{-3} ...

- A the temperature has to be decreased.
- B the temperature has to be increased.
- C the pressure has to be increased.
- D a catalyst has to be added. (2)

2.7 Consider the reaction represented by the following equation :



Which ONE of the following represents the oxidising agent in the above reaction ?

- A Cu
- B Ag
- C Ag^+
- D Cu^{2+} (2)

2.8 Consider the following statements:

- I The anode of a galvanic cell is positive.
- II Oxidation takes place at the negative electrode of an electrolytic cell.
- III Electroplating of metals occurs at the cathode.

Which statement(s) is/are correct?

- A Only I
- B II and III
- C I, II and III
- D Only III (2)

2.9 Nitrogen, phosphorus and potassium are ingredients in fertilisers. They are essential nutrients for plant growth and have the following functions:

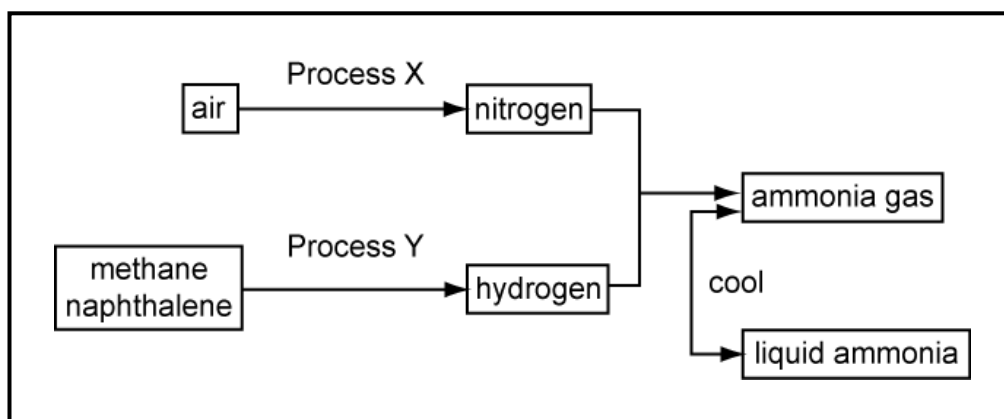
- * Nitrogen – for rapid growth and green leaves
- * Phosphorus – for strong roots, fruit and flower development
- * Potassium – protects against cold and dry weather

Your lawn has a well developed root system. You need a fertiliser that will provide nutrients for rapid growth and green leaves, and to protect the lawn during extreme dry conditions. Which ONE of the following fertiliser mixtures will you use on your lawn?

- A 8 : 1 : 5 B 1 : 1 : 5 C 2 : 5 : 1 D 7 : 1 : 1

(2)

2.10 Consider the flow diagram below which illustrates large quantities of nitrogen and hydrogen being used for the production of ammonia.



The industrial processes marked X and Y are:

	Process X	Process Y
A	Fractional distillation	Haber process
B	Cracking	Cracking
C	Haber process	Cracking
D	Fractional distillation	Cracking

(2)

[20]

SECTION B

INSTRUCTIONS

1. Answer this section in the ANSWER BOOK.
2. The formulae and substitutions must be shown in ALL calculations.
3. Round off your answers to TWO decimal places.

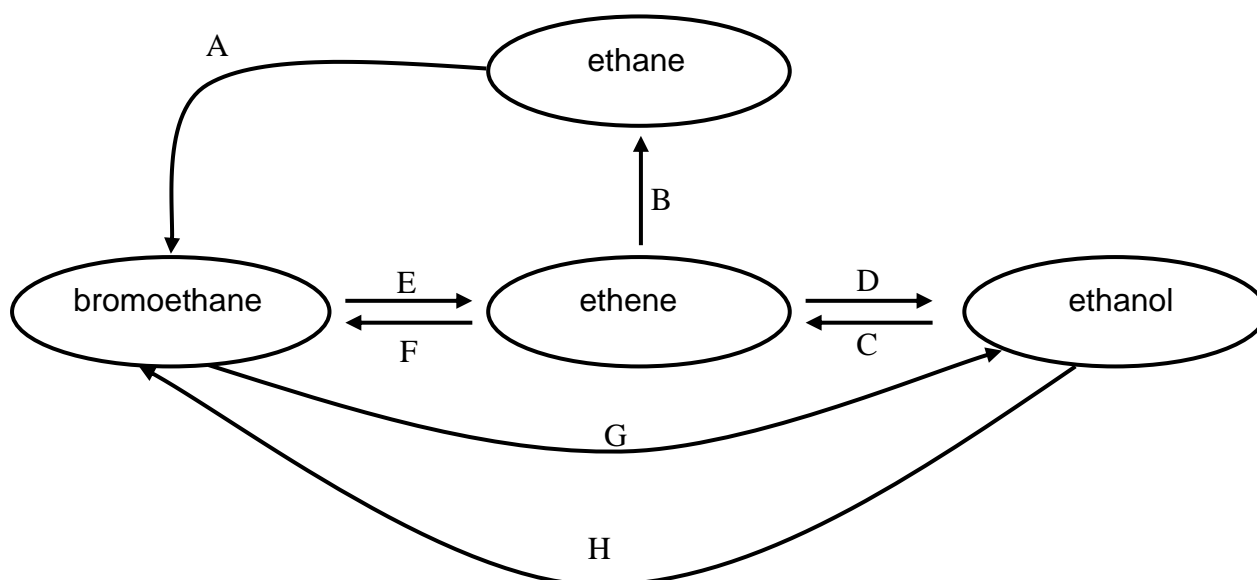
QUESTION 3

Ethene is a gaseous hormone associated with the ripening of fruit. It also contributes to the ageing and distortion of plants. In industry, the artificial ripening of fruit takes place when ethene is passed over the fruit in large rooms. After a while the ripening fruit releases its own ethene.

- 3.1 Write down the structural formula of ethene. (2)
- 3.2 Why is it not advisable to place a banana that has been artificially ripened alongside a cabbage and lettuce? (2)

In industry ethene is also used to synthesise a variety of organic compounds.

The flow diagram below illustrates some of the many reactions ethene undergoes.



- 3.3 Write down the general formula for the homologous series to which ethane belongs. (1)

- 3.4 Name the type of reaction represented by each of the letters A , B , D and H. (4)
- 3.5 Use structural formulae to write down a balanced equation for reaction B. (3)
- 3.6 Apart from ethane , which other reactant is needed for reaction F ? Write down the FORMULA only (2)
- 3.7 Both reactions E and G occur in the presence of a base. Reaction E is an elimination reaction and reaction G is a substitution reaction.
- 3.7.1 How is the base in reaction E different from the base in reaction G ? (2)
- 3.7.1 Name the type of elimination reaction represented by E. (1)

[17]

QUESTION 4

The first six members of the alkanes occur as gases and liquids at normal temperatures. Alkanes are currently our most important fuels, but the use of alcohols as renewable energy source is becoming more and more important. Alcohols are liquids that might be a solution to the energy crisis.

- 4.1 Which chemical property of alkanes and alcohols make them suitable to be used as fuels? (2)
- 4.2 The table shows the boiling points of the first six alkanes and the first six alcohols.

Alkane	Boiling point (°C)	Alcohol	Boiling point (°C)
methane	- 164	methanol	65
ethane	- 89	ethanol	79
propane	- 42	1-propanol	97
butane	- 0,5	1-butanol	117
pentane	36	1-pentanol	138
hexane	69	1-hexanol	156

Draw a graph of boiling points versus number of carbon atoms for the first six ALCOHOLS. Choose 50 °C and 1 carbon atom as origin and use an appropriate scale. Plot the points and draw the best curve through the points.

(6)

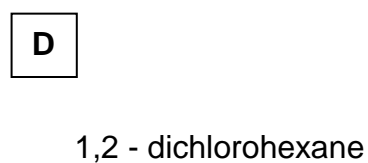
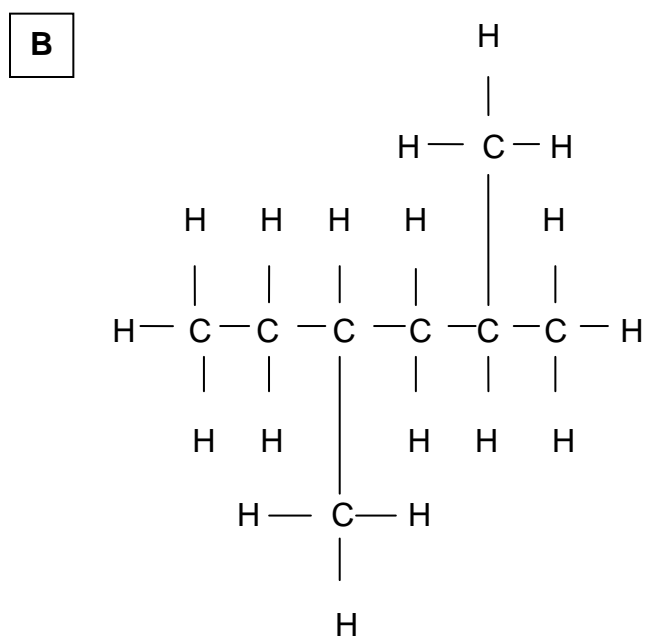
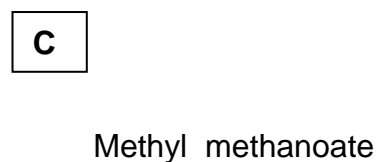
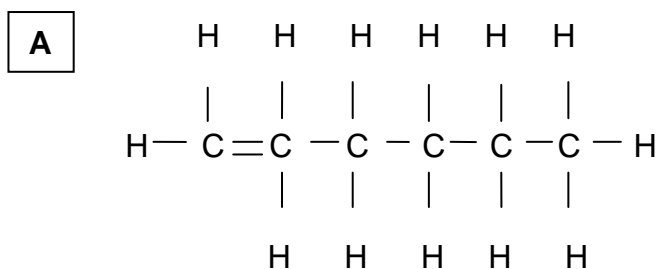
4.3 What trend in boiling point can be observed from the graph ? (2)

4.4 People are always cautioned to keep liquids such as petrol (a mixture of alkanes) out of reach of children. Use the boiling points of alkanes and justify this precaution (2)

[12]

QUESTION 5

The chemical properties of organic compounds are determined by their functional groups. The letters **A** to **E** below represent six organic compounds.



- 5.1 Write down the LETTER that represents the following :
- 5.1.1 An alkene (1)
- 5.1.2 A haloalkane (1)
- 5.1.3 A carboxylic acid (1)
- 5.1.4 ester (1)
- 5.2 Write down the IUPAC name of the following :
- 5.2.1 Compound **A** (1)
- 5.2.2 Compound **B** (1)
- 5.2.3 Compound **E** (1)
- 5.3 Draw neat structural formula for each of the compounds below :
- 5.3.1 Compound **C** (2)
- 5.3.2 Compound **D** (2)
- 5.3.3 Compound **E** (2)
- 5.4 Compound **A** reacts with a certain gas to form the product compound **D**.
- 5.4.1 Give the name of the gas. (1)
- 5.4.2 Name the type of reaction that takes place in 5.4.1. (1)

[15]

QUESTION 6

An Al/Al^{3+} and a Ag^+/Ag half-cell is used to construct a galvanic cell. A reading is noted on the voltmeter

- 6.1 State the energy conversion that occurs in this cell. (2)
- 6.2 Is Ag the anode or the cathode? (1)
- 6.3 Write down the standard conditions for this cell. (2)
- 6.4 Write down a balanced equation for the overall reaction. (3)

6.5 Calculate the **EMF** of this cell under standard conditions. (4)

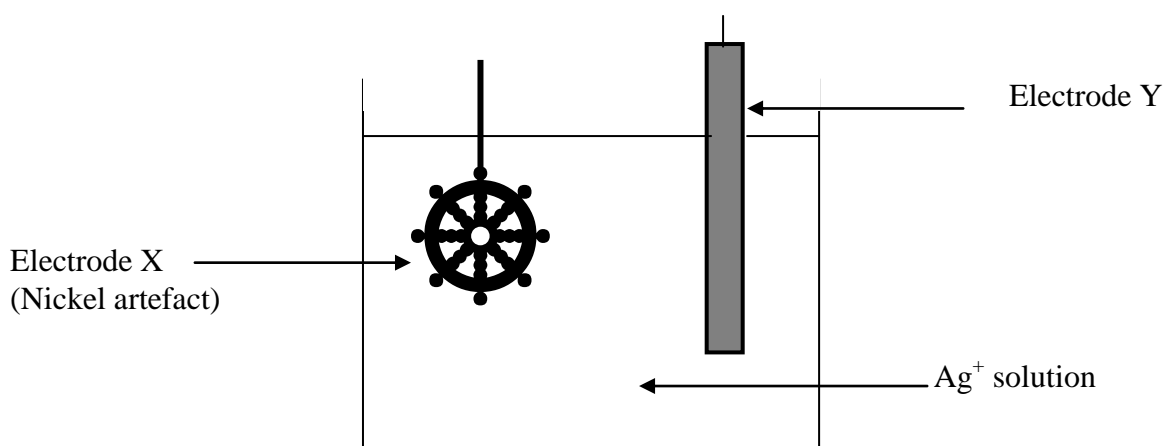
6.6 In which direction will electrons flow in the external circuit ? Write only “from Al to Ag” or “from Ag to Al”. (1)

[13]

QUESTION 7

An attractive silver appearance can be created by electroplating artefacts made from cheaper metals, such as nickel, with silver.

The simplified diagram below represents an arrangement that can be used to electroplate a nickel artefact with silver.



7.1 Which electrode (cathode/anode) will the nickel artefact represent? (1)

7.2 Name the metal represented by electrode Y. (1)

7.3 Write down the half-reaction responsible for the change that occurs at the surface of electrode Y. (2)

7.4 Write down the half-reaction responsible for the change that occurs at the surface of the artefact. (2)

7.5 Give a reason why the concentration of the electrolyte remains constant during electroplating. (2)

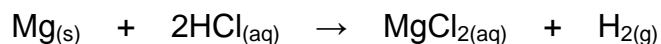
7.6 In industry some plastic articles are sometimes electroplated. Explain why plastic must be coated with graphite before electroplating. (2)

7.7 Give a reason why, from a business point of view, it is not advisable to plate platinum with silver. (1)

[11]

QUESTION 8

A piece of magnesium ribbon is put in a conical flask and reacts with hydrochloric acid. The balanced chemical reaction is given below :

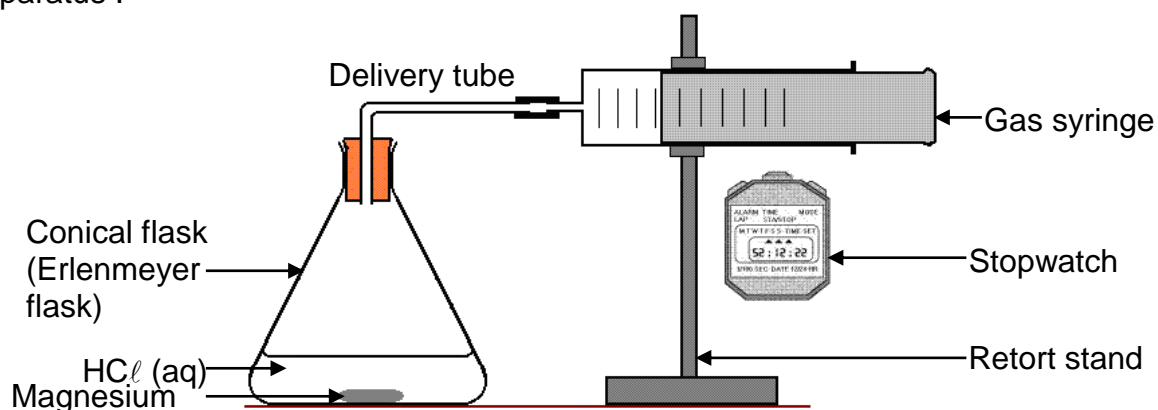


A group of learners use two samples of magnesium to investigate **one of the factors that influences the reaction rate**. The one sample is magnesium ribbon while the other sample is magnesium powder. They follow the method and use the apparatus given below, to conduct the investigation.

Method:

1. Place a piece of magnesium ribbon in a conical flask and add 20cm^3 $\text{HCl}_{(aq)}$.
2. Simultaneously start the stopwatch and close flask with rubber stopper that is at the end of the delivery tube attached to the gas syringe.
3. Measure the volume of H_2 gas formed in intervals of 30 seconds.
4. Repeat 1 to 3 above, but use magnesium powder.

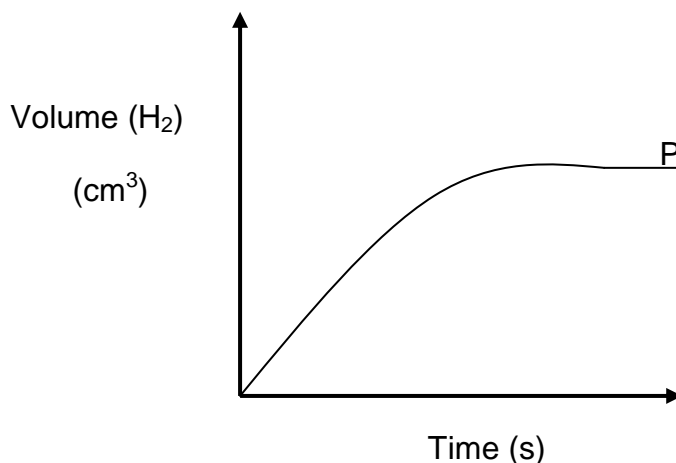
Apparatus :



- 8.1 Define the term reaction rate. (2)
- 8.2 Write down an investigative question for this investigation. (2)
- 8.3 State THREE variables that must be controlled during this investigation. (3)

8.4 Apart from the apparatus illustrated on the sketch , the learners need at least ONE other pieces of apparatus to conduct the investigation. Write down the NAME of the one piece of apparatus , as well as the purpose in your ANSWER BOOK. (2)

8.5 Consider the sketch graph below for the reaction of hydrochloric acid with the magnesium ribbon.



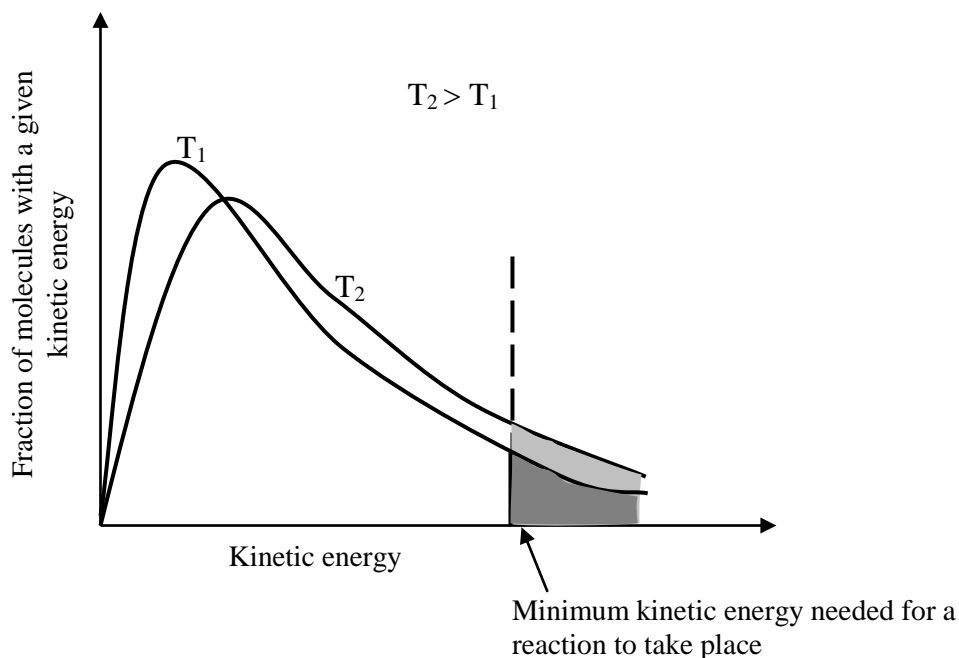
Redraw the above sketch graph in your ANSWER BOOK. On the same set of axes , sketch the curve Q that was obtained for the reaction of the magnesium powder with hydrochloric acid. Clearly label the curves P and Q on the re-drawn sketch graph.

(3)

[12]

QUESTION 9

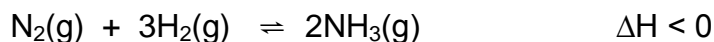
In general a teaspoonful of sugar dissolves much quicker in hot water than in the same amount of cold water. Use the graph below and your knowledge of the collision theory to explain this observation.



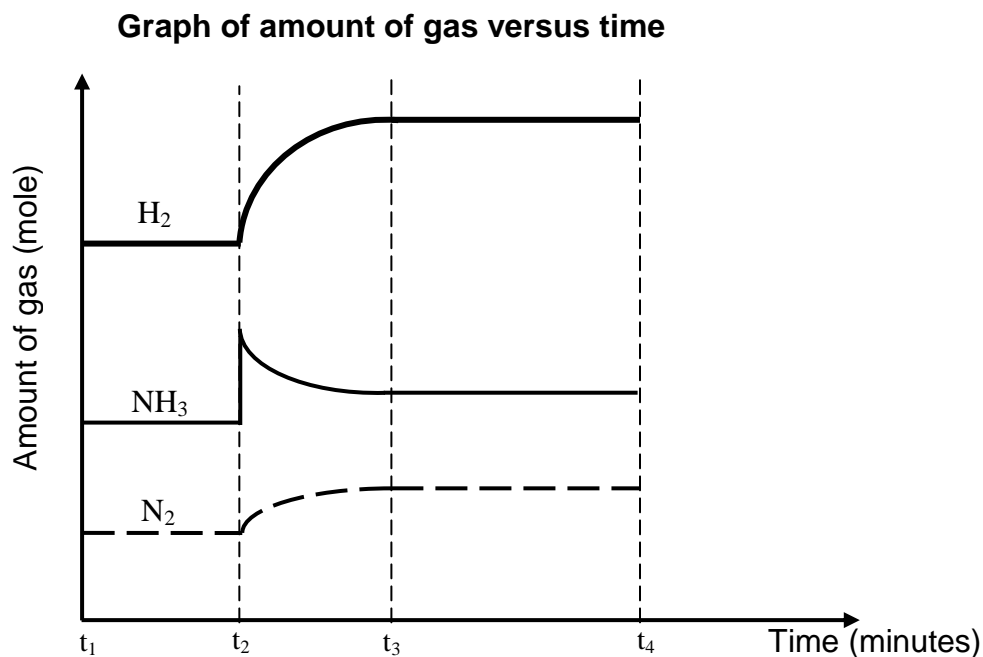
[5]

QUESTION 10

The following equation represents a reversible reaction that has reached equilibrium at 470 °C in a closed container:



A change was then made to the NH_3 in the equilibrium mixture at t_2 . A graph showing the effect of this change is drawn below. (The graph is not drawn to scale.)



- 10.1 What is the meaning of the horizontal lines between t_1 and t_2 ? (1)
- 10.2 State the change that was made to the NH_3 in the mixture at time t_2 (1)
- 10.3 Explain how the change mentioned in QUESTION 10.2, affected the concentration of H_2 and N_2 gases as shown in the graph (2)
- 1,5 mol of $\text{N}_2(\text{g})$ and 2 mol $\text{H}_2(\text{g})$ were injected into a $0,5 \text{ dm}^3$ closed reaction vessel and allowed to reach equilibrium at 470 °C. When equilibrium was reached it was found that 1 mol of $\text{NH}_3(\text{g})$ was present.
- 10.4 Calculate the equilibrium constant (K_C) at 470 °C. Show ALL your calculations. (9)
- 10.5 The temperature is now increased to 800 °C.
- 10.5.1 How will the value of K_C be affected if the temperature is increased to 800 °C? Write down only INCREASES or DECREASES or REMAINS THE SAME. (1)

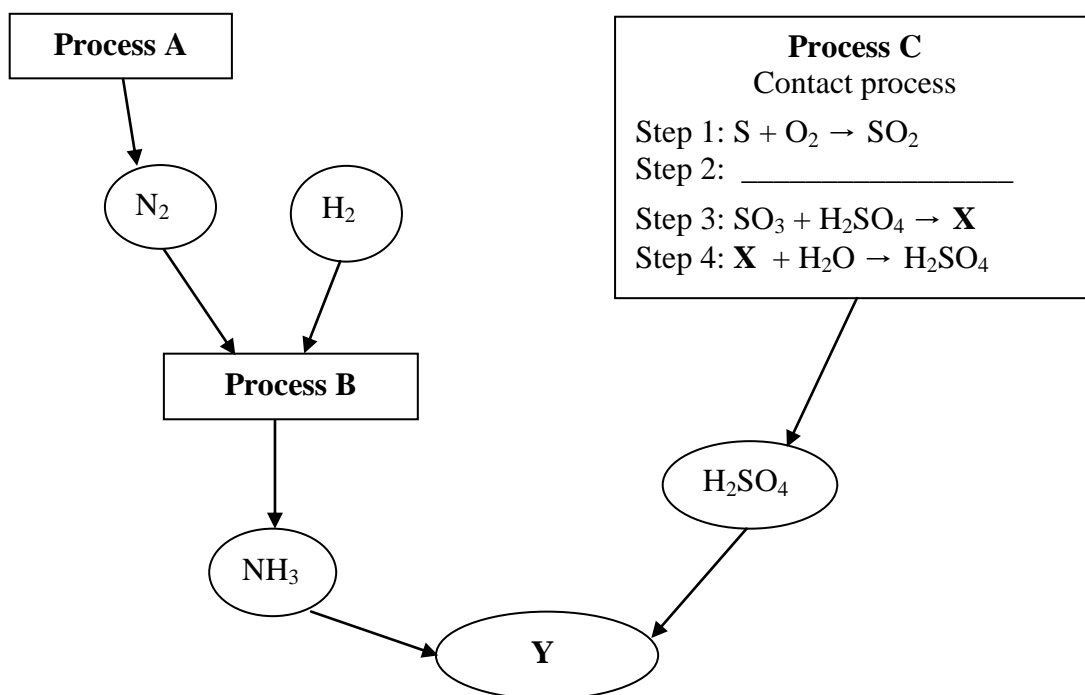
10.5.2 Explain your answer to QUESTION 10.5.1

(2)

[16]

QUESTION 11

About one third of the protein consumed by humans comes from fertilisers. The flow diagram below shows three industrial processes, A, B and C, that result in the production of fertilisers.



11.1 Write down the name of the Process A. (1)

11.2 Write down the balanced equation for the reaction which takes place in process B. (3)

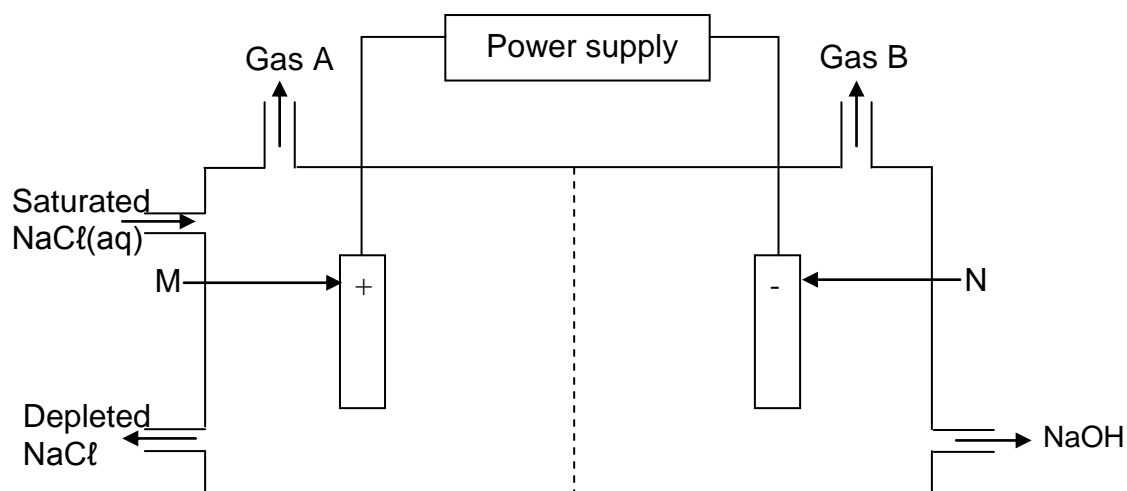
11.3 Write down the balanced equation for step 2 of Process C. (3)

11.4 Write down the FORMULA and the NAME of product X in step 3 of Process C. (2)

11.5 Write the FORMULA and the NAME of the fertiliser represented by Y. (3)

[12]

QUESTION 12



- 12.1 Give TWO reasons why the membrane cell is the preferred cell for the preparation of NaOH . (2)
- 12.2 Name the metal represented by electrode M. (2)
- 12.3 Write down the equation of the half – reaction taking place at electrode M. (2)
- 12.4 Write down the name of gas A and state ONE of its uses. (2)
- 12.5 Is electrode N the anode or the cathode ? (1)
- 12.6 Write down the half – reaction taking place at electrode N. (2)
- 12.7 Write down the name of gas B. (1)

[12]

