K.C.S.E CHEMISTRY PAPER 233/2 2004

1. a) The table below shows some properties of chlorine, bromine and iodine.

Element	Formula	Colour and state at room temperature	Solubility in water
Chlorine	Cl_2	(i)	Soluble
Bromine	Br_2	Brown liquid	(ii) .....
Iodine	I_2	(iii)	Slightly soluble

Complete the table by giving the missing information in (i), (ii) and (iii) (3 marks)

b) Chlorine gas is prepared by reacting concentrated hydrochloric acid with manganese (IV) oxide.

i) Write the equation for the reaction between concentrated hydrochloric acid and manganese (IV) oxide (1 mark)

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ii) What is the role of manganese (IV) oxide in this reaction (1 mark)

c) i) Iron (II) Chloride reacts with chlorine gas to form substance E.
Identify substance E (1 mark)

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ii) During the reaction in c (i) 6.30g of iron (II) chloride were converted to 8.06g of substance E. Calculate the volume of chlorine gas used.
(Cl = 35.5, Molar gas volume at room temperature = 24000cm^3, Fe = 56) (3 marks)

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d) Draw and name the structure of the compound formed when excess chlorine gas is reacted with ethene gas. (2 marks)
Structure

Name

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e) Give one industrial use of chlorine (1 mark)

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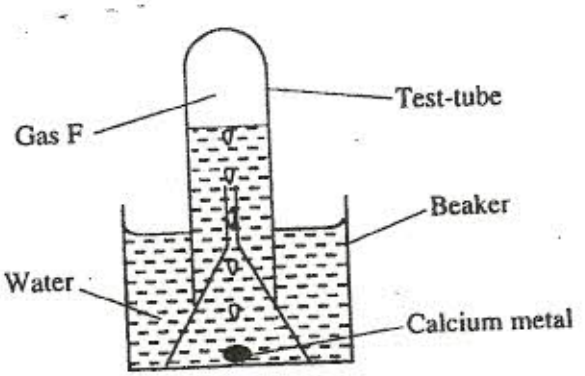
2. a) The set-up below was used to collect gas F, produced by the reaction between water and calcium metal.



i) Name gas F (1 mark)

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ii) At the end of the experiment, the solution in the beaker was found to be a weak base. Explain why the solution is a weak base. (2 marks)

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(iii) Give one laboratory use of the solution formed in the beaker (1 mark)

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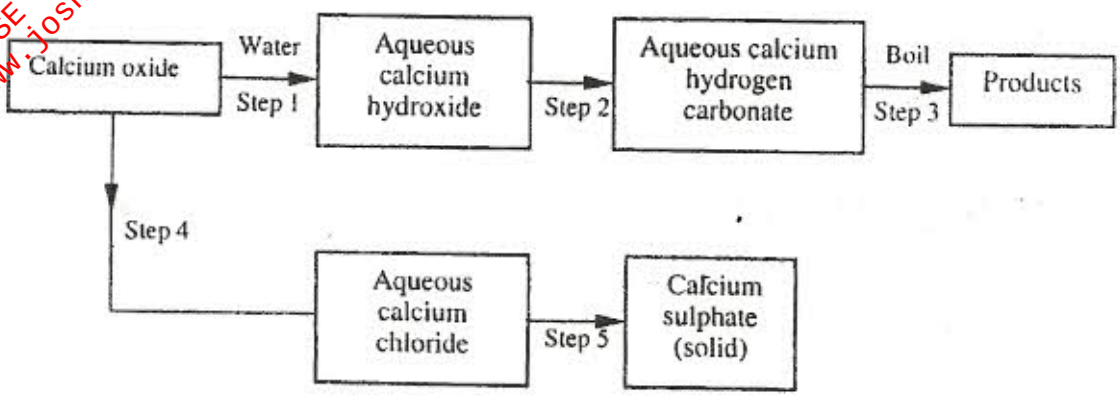
b) The scheme below shows some reactions starting with calcium oxide. Study it and answer the questions that follow



i) Name the reagents used in steps 2 and 4 (2 marks)

Step 2 .....

Step 4 .....

ii) Write an equation for the reaction in step 3 (1 mark)

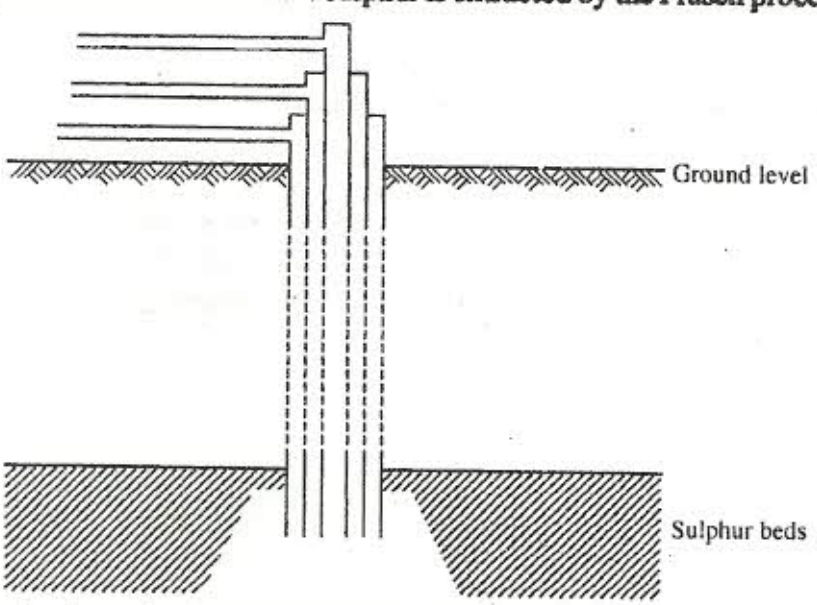
_____

iii) Describe how a solid sample of anhydrous calcium sulphate is obtained in step 5 (3 marks)

_____

_____

3. a) The diagram below illustrates how sulphur is extracted by the Frasch process



Label the pipe through which superheated water is pumped in (1 mark)

_____ _____

b) The equation below shows the oxidation of sulphur dioxide to sulphur trioxide in the contact process

$$2SO_{2(g)} + O_{2(g)} \rightleftharpoons 2SO_{3(g)} \quad ;\Delta H = -196kJ$$

i) Name one catalyst for this reaction (1 mark)

ii) State and explain the effect on the yield of sulphur trioxide when:

I the temperature is increased (2 marks)

II the amount of oxygen is increased (2 marks)

iii) Describe how sulphur trioxide is converted to sulphuric acid in the contact process (2 marks)

c) State two disadvantages of having sulphur dioxide in the environment (2 marks)

d) Ammonium sulphate is a fertilizer produced by passing ammonia gas into concentrated sulphuric acid

(i) Write the equation for the reaction (1 mark)

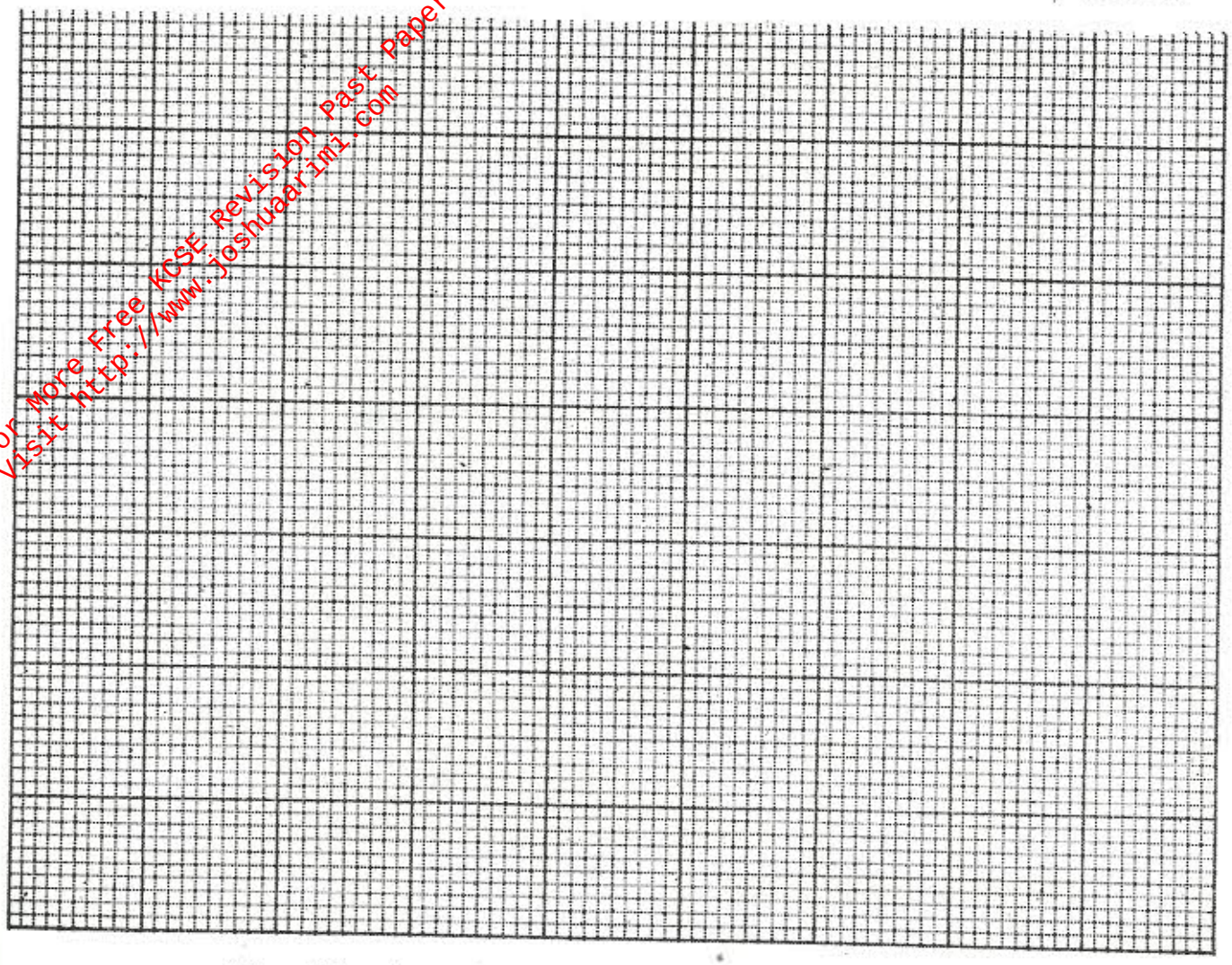
(ii) Calculate the mass in kg of sulphuric acid required to produce 25kg of the fertilizer (S = 32.0; O = 16.0; N= 14.0 H = 1.0) (3 marks)

4. a) At 25°C, 50g of potassium nitrate were added to 100g of water to make a saturated solution. What is meant by a saturated solution? (1 mark)

b) The table below gives the solubilities of potassium nitrate at different temperatures

Temperatures (°C)	12	20	28	36	44	52
Solubility g/100 g water	22	31	42	55	70	90

(i) Plot a graph of the solubility of potassium nitrate (vertical axis) against temperature. (3 marks)



(ii) Using the graph

I determine the solubility of potassium nitrate at 15°C. (1 mark)

.....

II determine the mass of potassium nitrate that remained undissolved given that 80 g of potassium nitrate were added to 100 cm^3 of water and warmed to 40°C. (2 marks)

.....

.....

(c) Determine the molar concentration of potassium nitrate at 15°C.
(Assume there is no change in density of water at this temperature).
(K = 39.0; N = 14.0; 0 = 16.0). (3 marks)

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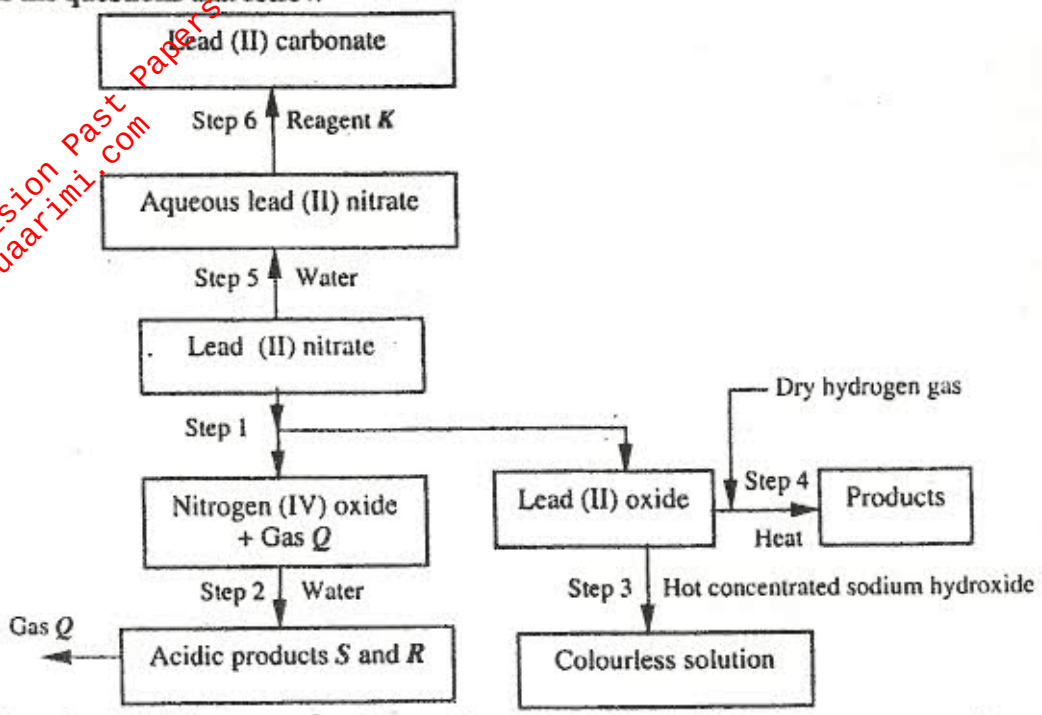
5. a) The flow chart below shows some reactions starting with lead (II) nitrate. Study it and answer the questions that follow



(i) State the condition necessary in step 1 (1 mark)

_____

(ii) Identify: (3 marks)

I reagent K _____

II Gas Q _____

III acidic products S and R

S _____

R _____

(iii) Write:

I the formula of the complex ion formed in step 3 (1 mark)

II the equation of the reaction in step 4 (1 mark)

b) The use of materials made of lead in roofing and in water pipes is being discouraged. State

(i) two reasons why these materials have been used in the past (2 marks)

_____

_____

(ii) one reason why their use is being discouraged (1 mark)

_____

c) i) The reaction between lead (II) nitrate and concentrated sulphuric acid starts but stops immediately. Explain (2 marks)

_____

ii) Name one suitable reagent that can be reacted with concentrated sulphuric acid to produce nitric acid (1 mark)

_____

6. a) Crude oil is a source of many compounds that contain carbon and hydrogen only.
   i) Name the process used to separate the components of crude oil (1 mark)

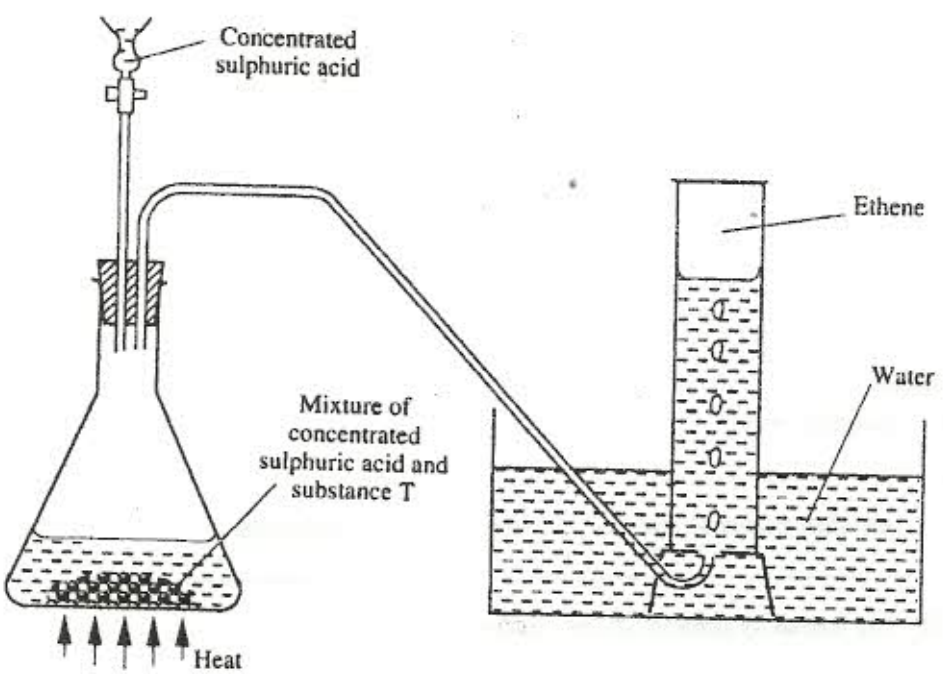
   ii) On what two physical properties of the above components does the separation depend? (2 marks)

   b) Under certain conditions, hexane can be converted to two products.
   The formula of one of the products is C_3H_8
   i) Write the formula of the other product (1 mark)

   ii) Describe a simple chemical reaction to show the difference between the two products formed in (b) above. (2 marks)

   c) Ethyne, C_2H_2 is another compound found in crude oil. One mole of ethyne was reacted with one mole of hydrogen chloride gas and a product P_1 was formed. P_1 was then reacted with excess hydrogen gas to form P_2.
   Draw the structure of P_1 and P_2.
   P_1 (1 mark)
   P_2 (1 mark)

   d) The set-up below was used to prepare and collect ethene gas. Study it and answer the questions that follow



   (i) Name substance T. (1 mark)

   (ii) Give the property of ethene that allows is to be collected as shown in the set-up (1 mark)

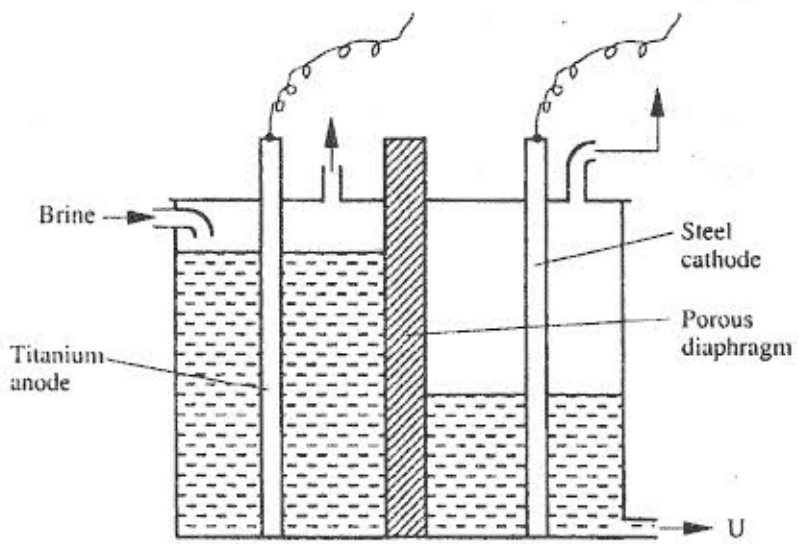
e) One of the reactions undergone by ethene is addition polymerisation. Give the name of the polymer and one disadvantage of the polymer it forms (2 marks)

Name of polymer

Disadvantage of polymer

7. a) Brine usually contains soluble calcium and magnesium salts. Explain how sodium carbonate is used to purify brine (2 marks)

b) The diagram below represents a diaphgram cell used to elecrolyse pure brine



(i) Write the equations for the reactions that take at:

I cathode (1 mark)

II anode (1mark)

(ii) Name:

I product at U (1 mark)

II another material that can be used instead of Titanium (1 mark)

III the impurity present in the product at U

(iii) State two functions of the diaphragm (2 marks)

c) Give one industrial use of the product at U (1 mark)