NAME …………………………………..……… **Adm No.** …………………………………

Date: …………..…...………..   **Candidate's Signature:……………….**

233/2
CHEMISTRY
Theory
PAPER 2
JUNE 2016
TIME: 2 hours

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4MCK JOINT EXAMINATION
FORM 4 EXAMS, JULY 2016
CHEMISTRY Paper 2
2 hours

Instructions to candidates

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1. *Write your name and admission number in the spaces provided above*
2. *Sign and write the date of the examination in the spaces provided above*
3. *Answer all the questions in the spaces provided in the question paper*
4. *Mathematical tables and silent calculators may be used*
5. *All working MUST be clearly shown where necessary*

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For Examiner's use Only

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QUESTIONS	Max. Score	Candidate's Score
1	12	
2	11	
3	12	
4	11	
5	11	
6	9	
7	14	
Total score	80	

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This paper consists of 11 printed pages. Candidates should check to ascertain that all
pages are printed as indicated and that no questions are missing.

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1. The following diagram shows the effects of heat on the physical states of substances
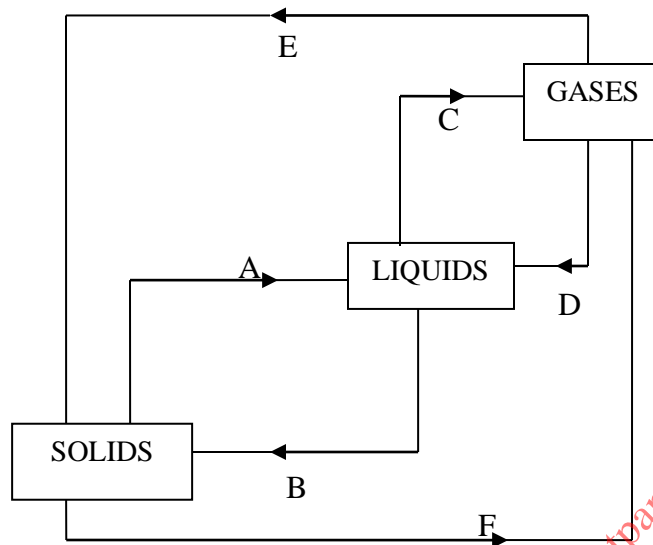
a) Identify the processes represented by the letters A,B,C,D,E, and F.   (3 marks)

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b) Name two substances that undergo the process labeled E and F   (2 marks)

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c) Name a method that can be used to extract the following;
    i)   Common salt from a salt solution.   (1 mark)

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    ii)   Paraffin from crude oil.   (1 mark)

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d) A student separated liquid P (B.P 78°c) and liquid Q (B.P 100°c) using the apparatus shown below.
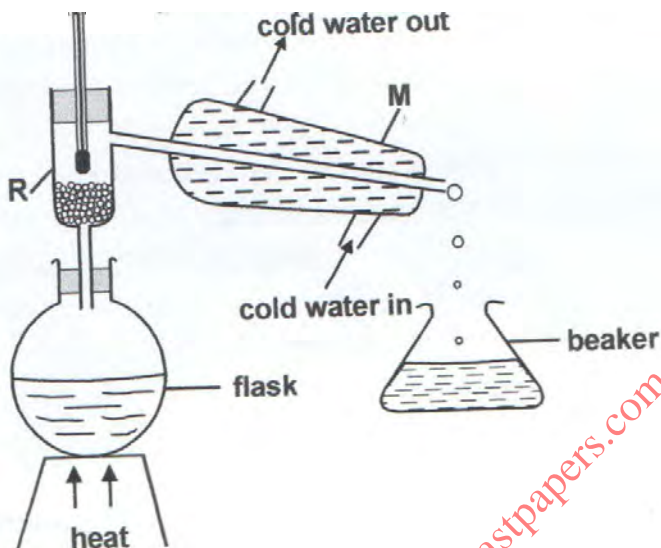
(i) Name the apparatus labeled
   a) M……………………………………………………………………………….(1 mark)

   b) R …………………………………………………………………………….(1 mark)

(ii) State one function of the glass bead in apparatus labeled R   (1 mark)
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(iii) What is the reading on the thermometer when the first few drops of the distillate appeared in the beaker.   (1 mark)
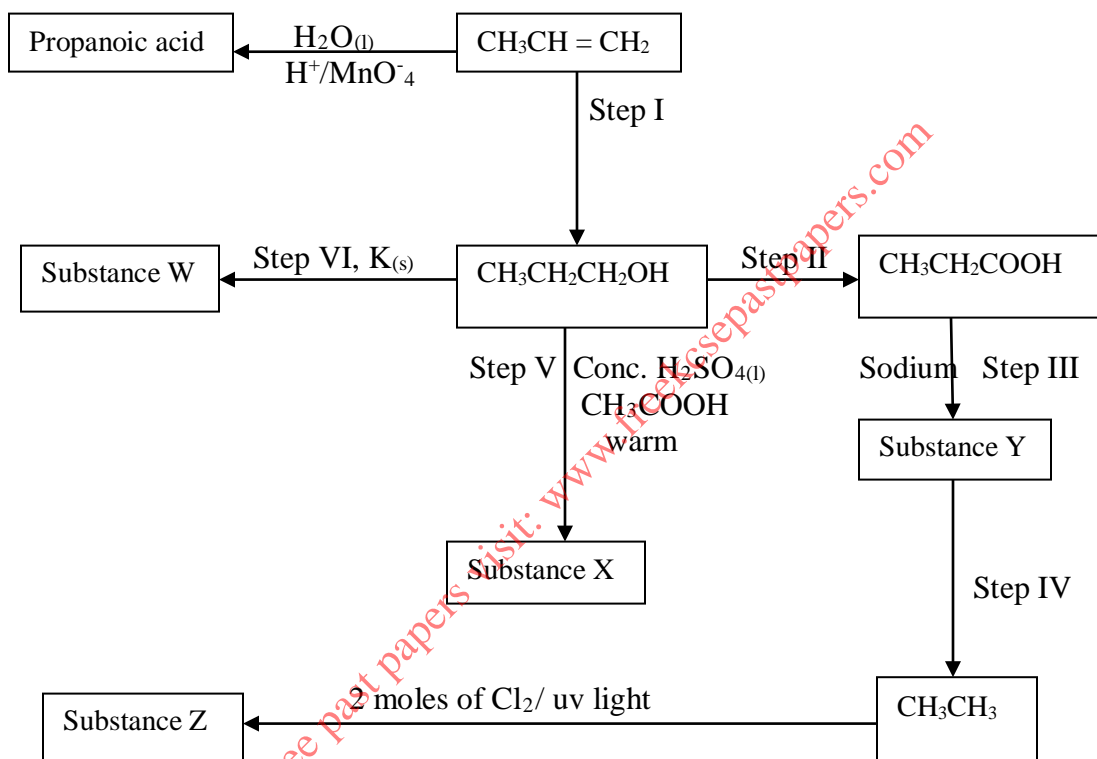………………………………………………………………………………………………………
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(iv) Which of the liquids remains in the flask.   (1 mark)

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2. Study the reactions below for some organic chemistry reactions and answer the questions that follow

Propanoic acid	$\xleftarrow{\begin{array}{c}H_2O_{(l)}\\ \hline H^+/MnO^-_4\end{array}}$	$CH_3CH = CH_2$

$\downarrow$ Step I

Substance W $\xleftarrow{\text{Step VI, } K_{(s)}}$ $CH_3CH_2CH_2OH$ $\xrightarrow{\text{Step II}}$ CH_3CH_2COOH

Step V | Conc. $H_2SO_{4(l)}$
CH_3COOH
warm

Sodium   Step III

$\downarrow$ Substance X

Substance Y

Step IV

Substance Z $\xleftarrow{\text{2 moles of } Cl_2/ \text{ uv light}}$ CH_3CH_3

(a) Name the type of reactions in step I, II, III, and V. (2 marks)

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(b) Write a structural formula and give the name of the product X in step V. (2 marks)

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(c) Name the products W and Z. (2 marks)

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(d) Write the observations which would be made in step V. (1 mark)

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(e) Write the chemical equations for each of the reactions in step (III) and (IV) (2 marks)

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(f) State two uses of ethanoic acid. (2 marks)

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3. (a) Fractional distillation of a liquid air usually produces nitrogen and oxygen as the major products.
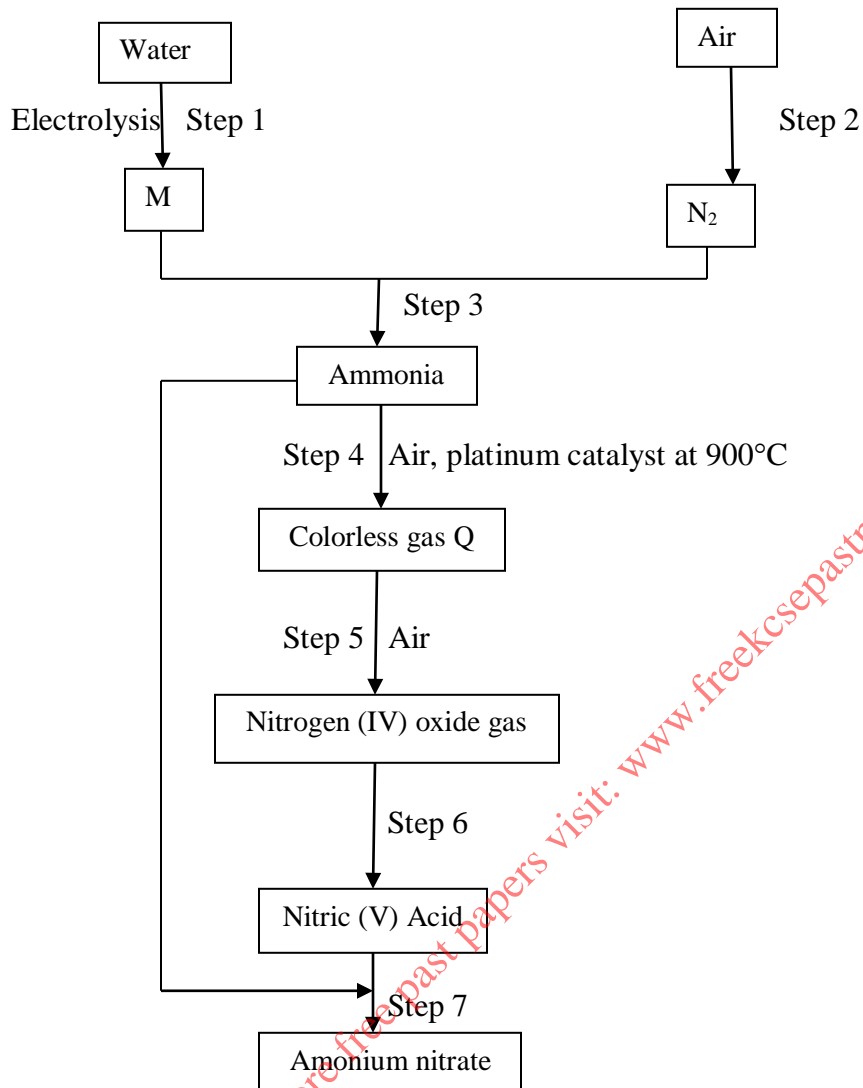(i) Name one substance that is used to remove carbon (IV) oxide from the air before it is changed into liquid. (1 mark)

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(ii) Describe how nitrogen gas is obtained from liquid air. (Boiling point nitrogen = -196°C, Oxygen = -180°C) (3 marks)

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(b) Study the chart below and answer the questions that follow

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   ┌─────────┐                    ┌───────┐
   │  Water  │                    │  Air  │
   └─────────┘                    └───────┘
        │                             │
 Electrolysis  Step 1          Step 2 │
        ↓                             ↓
     ┌─────┐                      ┌──────┐
     │  M  │                      │  N₂  │
     └─────┘                      └──────┘
        │                             │
        └──────────────┬──────────────┘
                       │  Step 3
                       ↓
               ┌──────────────┐
               │   Ammonia    │
               └──────────────┘
                       │
              Step 4   │  Air, platinum catalyst at 900°C
                       ↓
               ┌────────────────┐
               │ Colorless gas Q│
               └────────────────┘
                       │
              Step 5   │  Air
                       ↓
             ┌─────────────────────┐
             │ Nitrogen (IV) oxide gas │
             └─────────────────────┘
                       │
              Step 6   │
                       ↓
               ┌──────────────┐
               │ Nitric (V) Acid │
               └──────────────┘
                       │
                    Step 7
                       ↓
             ┌──────────────────┐
             │ Amonium nitrate  │
             └──────────────────┘
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(i)   Name element M   (1 mark)

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(ii)   Why is it necessary to use excess air in step 4?   (1 mark)

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(iii)   Identify gas Q.   (1 mark)

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(iv)   Write an equation for the reaction in step 7.   (1 mark)

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(v)   Give one use of ammonium nitrate.   (1 mark)

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(c) State and explain the observation that would be made if a sample of sulphur is heated with concentrated nitric (V) acid.   (3 marks)

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4. Study the information in the table below and answer the questions that follow. (The letters are not the actual symbols of the element).

Element	Electronic configuration	Ionisation KJmol^{-1}
J	2.1	519
K	2.8.1	494
L	2.8.8.1	418

(a) (i) What is the general name of elements J,K and L   (1 mark)

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(ii) What is ionisation energy?   (1 mark)

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(iii)   Explain why element L has lowest ionization.   (1 mark)

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(iv) When a piece of element K was placed on water, it melts a hissing sound was produced as it moves on the surface of the water. Explain these observation.

(2 marks)

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(v) Write an equation for the reaction between element L and water.   (1 mark)

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(b) One method of preparing salt is called neutralization.
   (i) What is neutralization reaction?   (1 mark)

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(ii) Describe how you would prepare crystal of sodium nitrate starting with $200cm^3$ of 2M sodium hydroxide.   (3 marks)

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(iii) Write an equation for the reaction that takes place when a sample of sodium nitrate is heated.   (1 mark)

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5. a) Use the standard electrode potential for elements A, B,C, D, and F given below to answer the questions that follow. The letters do not represent the actual symbols of the elements.

Reaction	E^θ**(volts)**
$A^{2+}_{(aq)} + 2e^- \rightleftharpoons A_{(s)}$	-2·90
$B^{2+}_{(aq)} + e^- \rightleftharpoons B(s)$	-2·38
$2C^+_{(aq)} + 2e^- \rightleftharpoons C_2(g)$	0·00

$$D^{2+}_{(aq)} + 2e^- \rightleftharpoons D(s) \qquad\qquad +0.34$$

$$\tfrac{1}{2}F_{2(aq)} + e \rightleftharpoons F^-(aq) \qquad\qquad +2.87$$
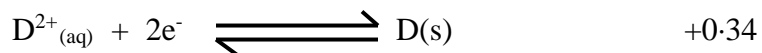
(i) Which one is likely to be hydrogen? Give a reason for your answer.   (2 marks)

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(ii) What is the E^θ value of the strongest reducing agent?   (1 mark)

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(iii) Draw a labeled diagram of the electrochemical cell that would be obtained when half cells of element B and D are combined.   (3 marks)

(b) During the electrolysis of aqueous copper(II) sulphate using copper electrodes, a current of 0.2 amperes was passed through the cell for 5 hours.

(i) Write an ionic equation for the reaction that took place at the anode.   (1 mark)

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(ii) State the observation which would be made at the anode.   (1 mark)

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(iii) Determine the mass of the copper which would be deposited at the cathode (Cu 63·5)
(3 marks)

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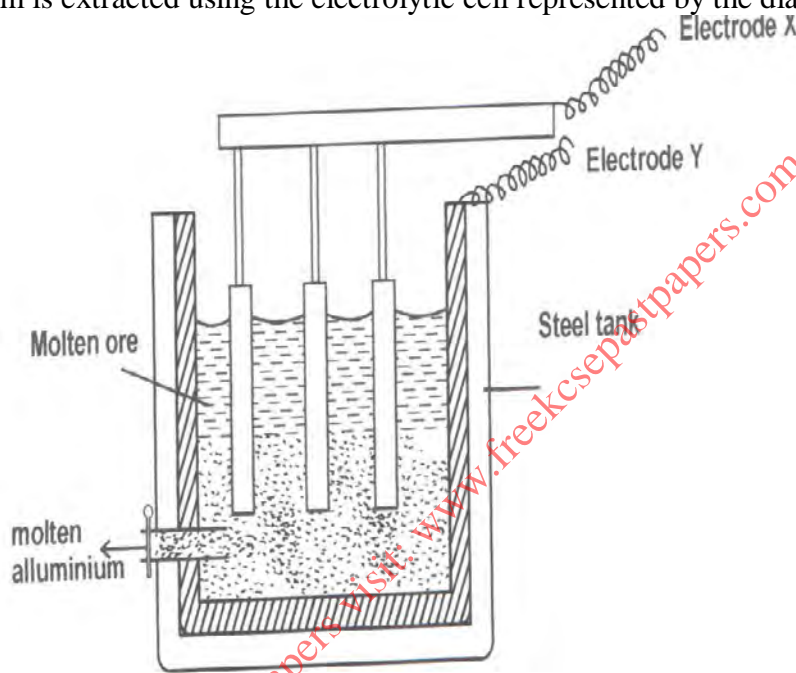………

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6. Aluminium is extracted using the electrolytic cell represented by the diagram below.

a) Why is aluminium extracted by electrolytic method. (1 mark)

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b) Name the electrodes labeled X and Y (1 mark)

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c) The chief core from which aluminum is extracted is bauxite.
   (i) Name two main impurities present in bauxite. (2 marks)

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(ii) Aluminum oxide is the main component in bauxite with a melting point of 2015°C but electrolysis of molten aluminium oxide is carried out at 800°C. Explain how this is achieved. (2 marks)

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d) Write the equations for the reaction taking place at the node. (1 mark)

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e) One of the electrodes is replaced periodically. Which one and why? (1 mark)

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f) Duralumin (an alloy of copper, aluminum, and magnesium) is preferred to pure aluminum in the construction of airplane. Give one property of duralumin that is considered. (1 mark)

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7. a) (i) What Is the meaning of the term enthalpy of combustion? (1 mark)

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(ii) The enthalpies of formation of carbon (IV) oxide, water and ethane are indicated below.

$\Delta H_f(CO_2) = -393 \cdot 0 kJmol^{-1}$

$\Delta H_f(H_2 0) = -286 \cdot 0 kJmol^{-1}$

$\Delta H_f(C_2 H_4) = +228 \cdot 0 kJmol^{-1}$

I. Draw the energy cycle diagram that links the enthalpies of formations of carbon (IV) oxide, water and ethene and the enthalpy of combustion of ethene. (3 marks)

II.   Determine the enthalpy of combustion of ethene.   (2 marks)

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(c) In an experiment, the temperature of $50cm^3$ of water was measured at 30 seconds interval. At 1½ minute potassium nitrate were added to the solution and continued to measure the temperature in the same time intervals. The results were recorded in the table below.

Time (Min)	0·0	½	1·0	1½	2·0	2½	3·0	3½	4·0
Temperature °C	26·0	26·0	26·0	x	24·5	24·5	26·0	26·0	26·0

(i)   On the grid provided, plot a graph of temperature (vertical axis) against time in minutes.   (3 marks)
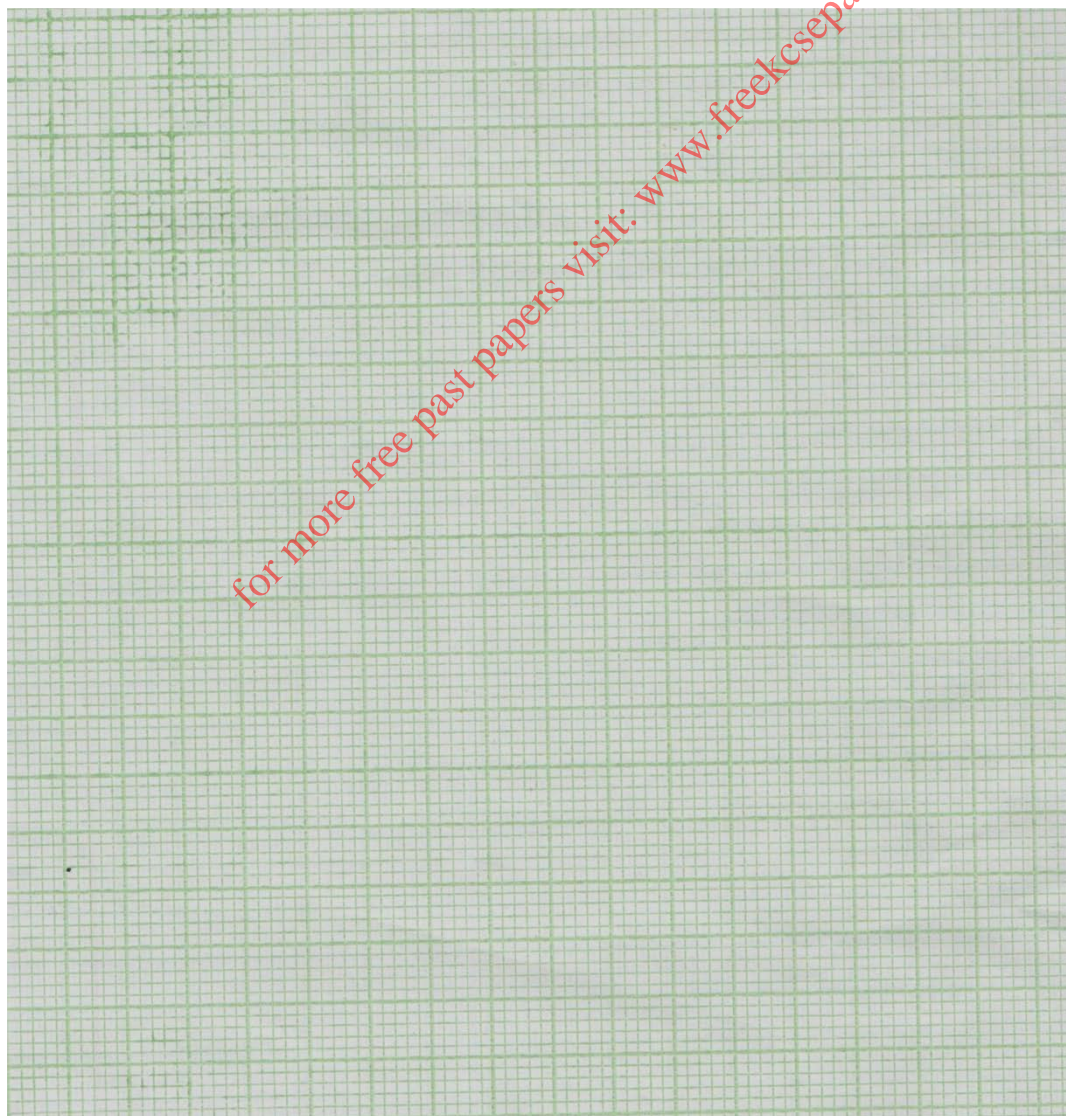
(ii)   Using your graph, determine the
   I.   Highest temperature change.   (1 mark)

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   II.   Find the heat change   (2 marks)
        (Specific heat capacity is $4 \cdot 2$kj kg^{-1}k^{-1} and density of solution in $1 \cdot 0$g/cm^3)

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   III.   Find the molar heat of solution of potassium nitrate.   (2 marks)

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