STAREHE BOYS HIGH SCHOOL MOCK 2015

CHEMISTRY PAPER 2

1. Use the table below to answer the questions that follow.
   (The letters are not the actual symbols of the elements)

Element	Atomic number	Melting point (^{0}C)
A	11	97.8
B	13	660
C	14	1410
D	17	-101
E	19	63.7

(a) Write the electronic arrangement for the ions formed by the elements B and D

   B _____   (½ mark)

   D _____   (½ mark)

(b) Select an element which is
   (i) a poor conductor of electricity _____   (½ mark)

   (ii) most reactive metal _____   (½ mark)

(c) Explain briefly how the atomic radii of element B and C compare.   (2 marks)
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(d) Use dots (•) and crosses (x) to represent outermost electrons and show the bonding
   in the compound formed between C and D.   (2 marks)

(e) Explain why the melting point of element B is higher than that of element A.   (2 marks)

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(f) Write an equation for the reaction that takes place between element A and water.   (1 mark)

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(g) Describe how a solid mixture of the sulphate of element E and lead (II) sulphate can be separated into solid samples.   (3 marks)
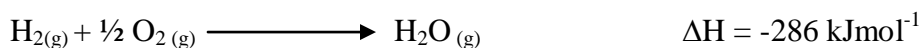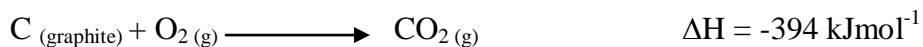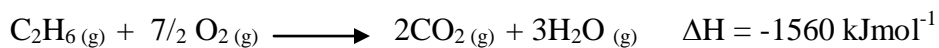
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2.   (a)   (i) State Hess's law.   (1 mark)

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(ii) Use the thermochemical equations given below to calculate the enthalpy of formation of ethane.   (3 marks)

$$C_2H_{6\,(g)} + \frac{7}{2}\,O_{2\,(g)} \longrightarrow 2CO_{2\,(g)} + 3H_2O_{(g)} \qquad \Delta H = -1560 \text{ kJmol}^{-1}$$

$$C_{(graphite)} + O_{2\,(g)} \longrightarrow CO_{2\,(g)} \qquad \Delta H = -394 \text{ kJmol}^{-1}$$

$$H_{2(g)} + \frac{1}{2}\,O_{2\,(g)} \longrightarrow H_2O_{(g)} \qquad \Delta H = -286 \text{ kJmol}^{-1}$$

(b)   The table below gives the volumes of oxygen gas produced at different times when hydrogen peroxide solution decomposed in the presence of a catalyst.

Time in seconds	0	10	20	30	40	50	60
Volume of oxygen (cm^3)	0	66	98	110	119	120	120

(i) Name the catalyst used for this reaction. (1 mark)

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(ii) Write the chemical equation for the decomposition of hydrogen peroxide. (1 mark)

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(iii) On the grid provided, draw the graph of the volume of oxygen gas (vertical axis)
    against time. (3 marks)

(iv) Using the graph, determine the rate of decomposition of hydrogen peroxide between 24th second and 34th second. (2 marks)
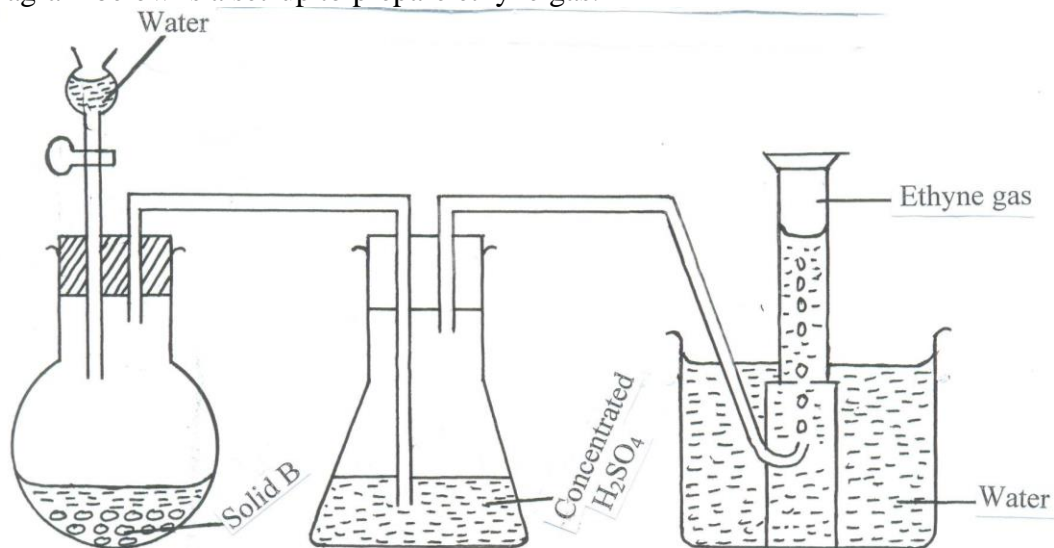
(v) Give a reason why the total volume of oxygen gas produced after 50 seconds remain constant. (1 mark)

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3.   (a) The diagram below is a set-up to prepare ethyne gas.

(i) Name solid B _____ (1mark)

(ii) Write an equation for the reaction taking place between solid B and water. (1 mark)

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(iii) State the property that makes the gas to be collected by the method shown in the diagram. (1mark)

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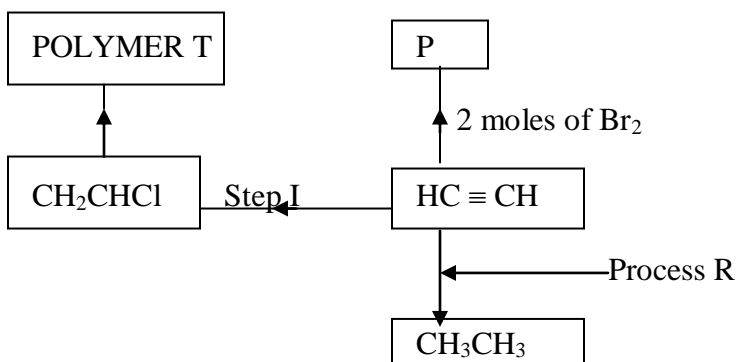
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(iv) State the main commercial use of ethyne. (1 mark)
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(b)   The scheme below represents some reactions of ethyne. Study it and answer the questions that follow.

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(i) Name compound P and draw it's structural formula. (1 mark)
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(ii) Name the reagents used in:

    I) Process R _____ (½ mark)

    II) Step I _____ (½ mark)

(iii) Draw the repeating unit in polymer T. (1 mark)

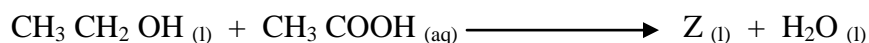(iv) Name polymer T _____ (1 mark)

(v) Give one use of T (1 mark)
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(c)   Ethanol and ethanoic acid react according to the following equation under condition M and process N to form product Z.

$$CH_3 CH_2 OH_{(l)} + CH_3 COOH_{(aq)} \longrightarrow Z_{(l)} + H_2O_{(l)}$$

Name:

(i) Condition M _____   (½ mark)

(ii) Product Z _____   (½ mark)

(iii) Draw the structural formula of product Z.   (1 mark)

(iv) State any 2 differences between the above reaction and that of an hydroxide and an acid. (1 mark)
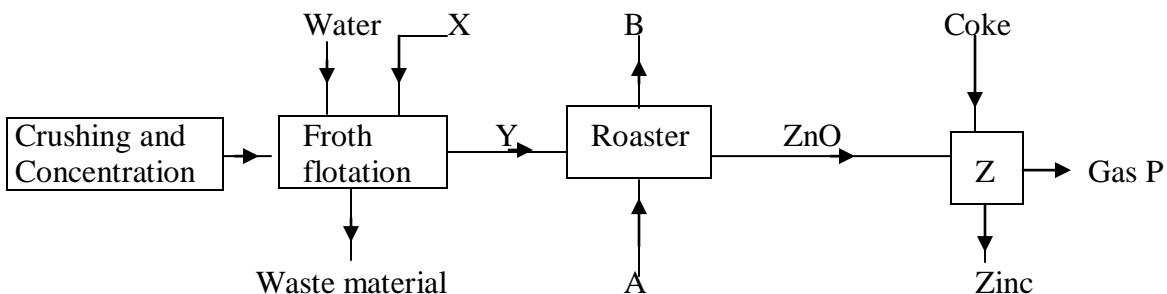_____

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(v) Butane is often used as the main component in domestic gas fuels. Calculate it's heating value (H = 1, C = 12, ΔH^0C (C_4H_{10}) = 2877.0 k Jmol^{-1})   (1 mark)

4. The flow chart below shows the extraction of zinc. Study it and answer the questions that follow.

(a)   (i) Identify substance X _____ (1 mark)

(ii) Give one waste material of the froth flotation process. (1 mark)

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(iii) Identify substances A and B.
     A _____ (½ mark)

     B _____ (½ mark)

(iv) Write equation for the reaction taking place in the roaster. (1 mark)

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(v) Identify gas P and write an equation for it's formation. (1 ½ marks)

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(b) Use the standard electrode potentials given below to answer the questions that follow.

Half reactions	Electrode potential, E^{θ} (V)
$D^+_{(aq)} + e^- \longrightarrow D_{(s)}$	+ 0.80

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$$E^{2+}_{(aq)} + 2e^- \longrightarrow E_{(s)} \qquad +0.34$$

$$F^{2+}_{(aq)} + 2e^- \longrightarrow F_{(s)} \qquad -0.13$$

$$G^{2+}_{(aq)} + 2e^- \longrightarrow G_{(s)} \qquad -0.76$$

(i) Construct an electrochemical cell that will produce the lowest emf. (3 marks)

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(ii) Calculate the emf of the cell constructed in (i) above. (1 mark)

(iii) From the half reactions listed in the table in (b) above select strongest oxidizing agent. (½ mark)

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5. (a) Fractional distillation of liquid air is mainly used to obtain nitrogen and oxygen.
    (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 the liquid air.
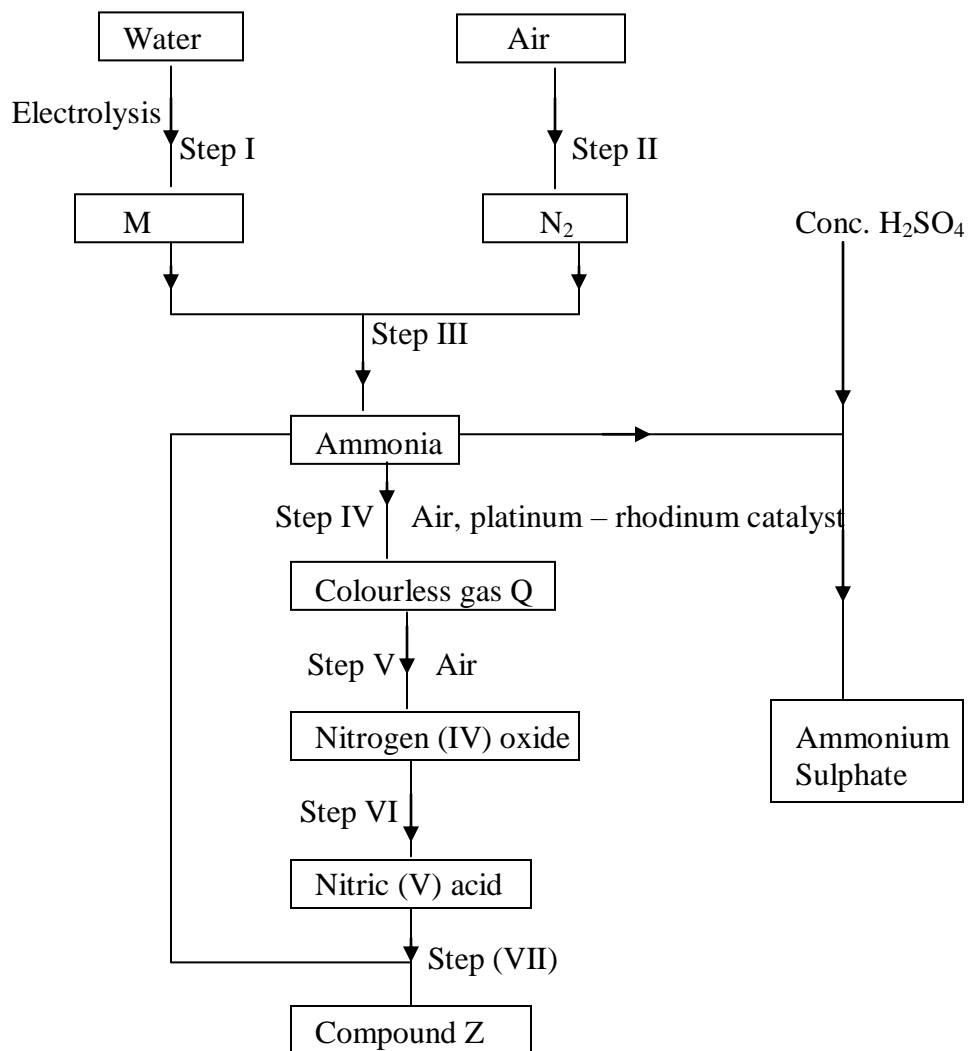   (Boiling points nitrogen = -196^0C, Oxygen = -183^0C) (3 marks)

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

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    ┌──────────┐              ┌──────────┐
    │  Water   │              │   Air    │
    └────┬─────┘              └────┬─────┘
 Electrolysis│                     │
         │ Step I                  │ Step II
         ▼                         ▼
    ┌──────────┐              ┌──────────┐        Conc. H₂SO₄
    │    M     │              │   N₂     │
    └────┬─────┘              └────┬─────┘             │
         │                         │                   │
         └──────────┬──────────────┘                   │
                Step III                                │
                    ▼                                   │
              ┌──────────┐                              │
       ┌─────►│ Ammonia  │────────────►────────────┐    │
       │      └────┬─────┘                          ▼    ▼
       │     Step IV │ Air, platinum – rhodinum catalyst
       │           ▼
       │   ┌─────────────────┐
       │   │ Colourless gas Q │
       │   └────┬─────────────┘
       │    Step V ▼  Air
       │           ▼                         ┌──────────────┐
       │   ┌──────────────────┐              │  Ammonium    │
       │   │ Nitrogen (IV) oxide │            │  Sulphate    │
       │   └────┬─────────────┘              └──────────────┘
       │   Step VI │
       │           ▼
       │   ┌──────────────┐
       │   │ Nitric (V) acid │
       │   └────┬─────────┘
       │        ▼ Step (VII)
       └────────┤
                ▼
         ┌──────────────┐
         │  Compound Z  │
         └──────────────┘
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(i) Name substance M _____ (1 mark)

(ii) Identify gas Q _____ (1 mark)

(iii) State one use of compound Z (1 mark)

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(iv) A fertilizer manufacturing industry uses $1400dm^3$ of ammonia gas per hour to produce ammonium sulphate. Calculate the amount of ammonium sulphate produced in kg for one day if the factory operates for 18 hours.
   (N = 14, H = 1, S = 32, O = 16, 1 mole of gas = $24dm^3$) (3 marks)

6.   The chart below represents the main steps in the large-scale manufacture of sodium carbonate.

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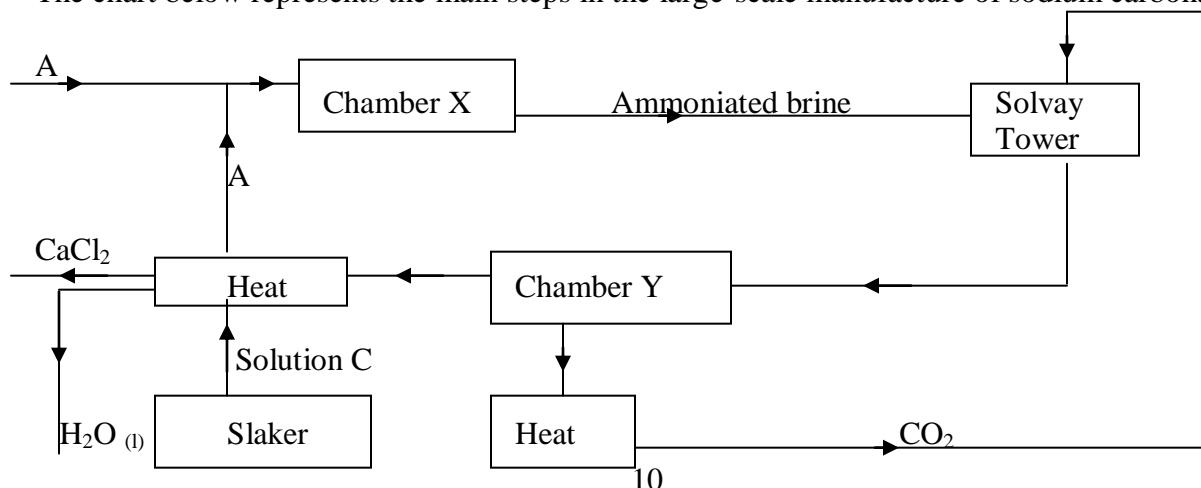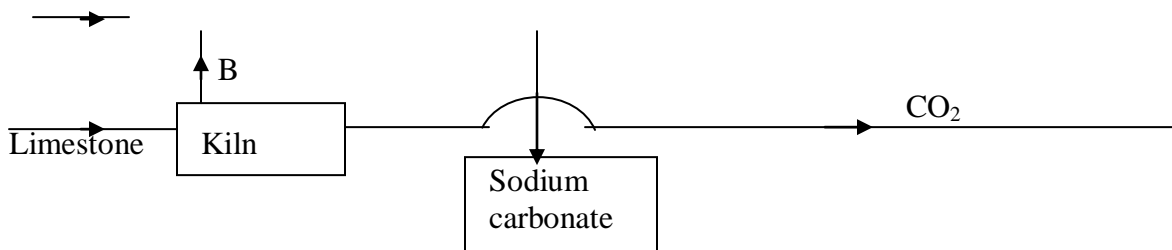
(a) Name substances A and B.

A _____ (1 mark)

B _____ (1 mark)

(b) Write down the chemical equation leading to formation of C. (1 mark)

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(c) A stream of cold water is made to circulate around chamber X. What does this
suggest about the reaction taking place. (1 mark)

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(d) Name the process that takes place in chamber Y. (1 mark)

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(e) State any 2 by-products recycled in the process. (2 marks)

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(f) In an experiment, wood charcoal was mixed with concentrated sulphuric (VI) acid in
a test-tube. The mixture was then placed over a Bunsen-burner flame for sometime.
(i) Write down the chemical equation of the reaction that takes place. (1 mark)

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       (ii) State the property of concentrated sulphuric (VI) acid investigated in (i) above. (1 mark)
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(g) Mention any 2 uses of sodium carbonate.   (1 mark)
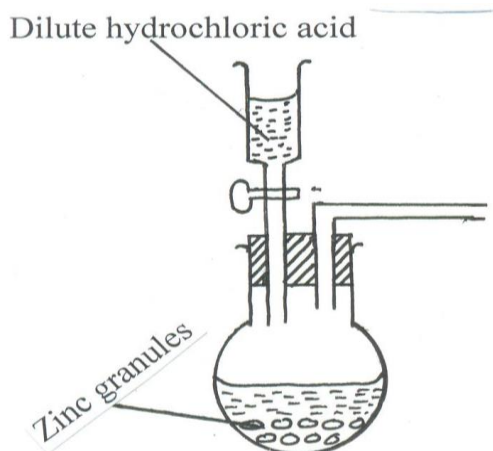_____

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7.   The set up below shows the reagents that can form hydrogen gas in a laboratory.
     (a) Complete the diagram to show how a dry sample of hydrogen gas can be collected.   (3 marks)

Dilute hydrochloric acid

Zinc granules

(b) Write the chemical equation for above reaction.   (1 mark)
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(c) Why is it not advisable to use calcium in this method to prepare hydrogen?   (1 mark)
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(d) Why is it advisable to discard the first jar of the gas collected. (1 mark)

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(e) The set-up below was used to investigate the properties of hydrogen gas.
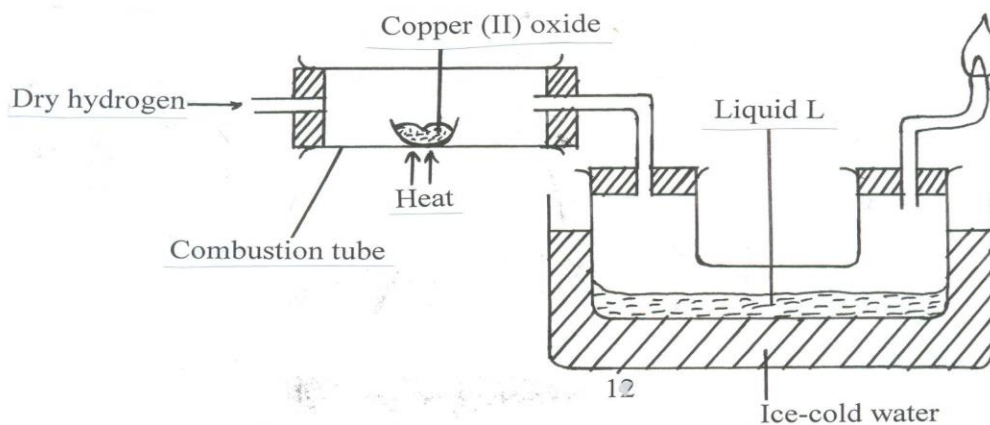
(i) State the observation made in the combustion tube. (1 mark)

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(ii) Write down the equation leading to formation of liquid L. (1 mark)

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(iii) What property of hydrogen is being investigated. (1 mark)

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(iv) Why is potassium oxide not used to investigate this property of hydrogen gas.   (1 mark)

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(v) Hydrogen gas is used in hydrogenation of oils. What do you understand by the term
   hydrogenation?   (1 mark)

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(vi) Give any 2 other industrial uses of hydrogen gas.   (2 marks)

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