Name: ……………………………………………………Adm No: ……………………… Class: ………..

Candidate’s Signature: …………………………………Date: ……………………………………………..

**233/2**

**CHEMISTRY**

**PAPER**

**THEORY**

**SEPTEMBER 2022**

**2 HOURS**

**SUNRISE 2 EXAMINATIONS 2022**

**Kenya Certificate of Secondary Education**

**FORM 4**

**CHEMISTRY**

**PAPER 2**

**2 HOURS**

**INSTRUCTIONS TO CANDIDATES**

1. Write your name and index number in the spaces above.
2. Sign and write the date of examination in the spaces provided above.
3. Answer all questions in the spaces provided.
4. KNEC Mathematical tables and silent non-programmable electronic calculators may be used.
5. All working MUST be clearly shown where necessary.

**FOR EXAMINER’S USE ONLY**

|  |  |  |
| --- | --- | --- |
| **QUESTION** | **Maximum Score** | **Candidate’s Score** |
| 1 | 12 |  |
| 2 | 12 |  |
| 3 | 13 |  |
| 4 | 10 |  |
| 5 | 10 |  |
| 6 | 10 |  |
| 7 | 13 |  |
| **Total Score** | **80** |  |

***This paper consists of 12 printed pages***

***Turn Over***

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 (0C) |
| A | 11 | 97.8 |
| B | 13 | 660 |
| C | 14 | 1410 |
| D | 17 | -101 |
| E | 19 | 63.7 |

1. 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 )

………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………

(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)

………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………

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

………………………………………………………………………………………………………………

(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 )

C2H6 (g) + 7/2 O2 (g)  2CO2 (g) + 3H2O (g)  ΔH = -1560 kJmol-1

C (graphite) + O2 (g)  CO2 (g)  ΔH = -394 kJmol-1

H2(g) + ½ O2 (g)  H2O (g)  ΔH = -286 kJmol-1

………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………………

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(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 (cm3) | 0 | 66 | 98 | 110 | 119 | 120 | 120 |

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

…………………………………………………………………………………………………….

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

…………………………………………………………………………………………………….

(iii) On the grid provided, draw the graph of the volume of oxygen gas ( vertical axis )

against time (horizontal axis). (3 marks)



(iv) Using the graph, determine the rate of decomposition of hydrogen peroxide 24th second and 34th second. (2 marks)

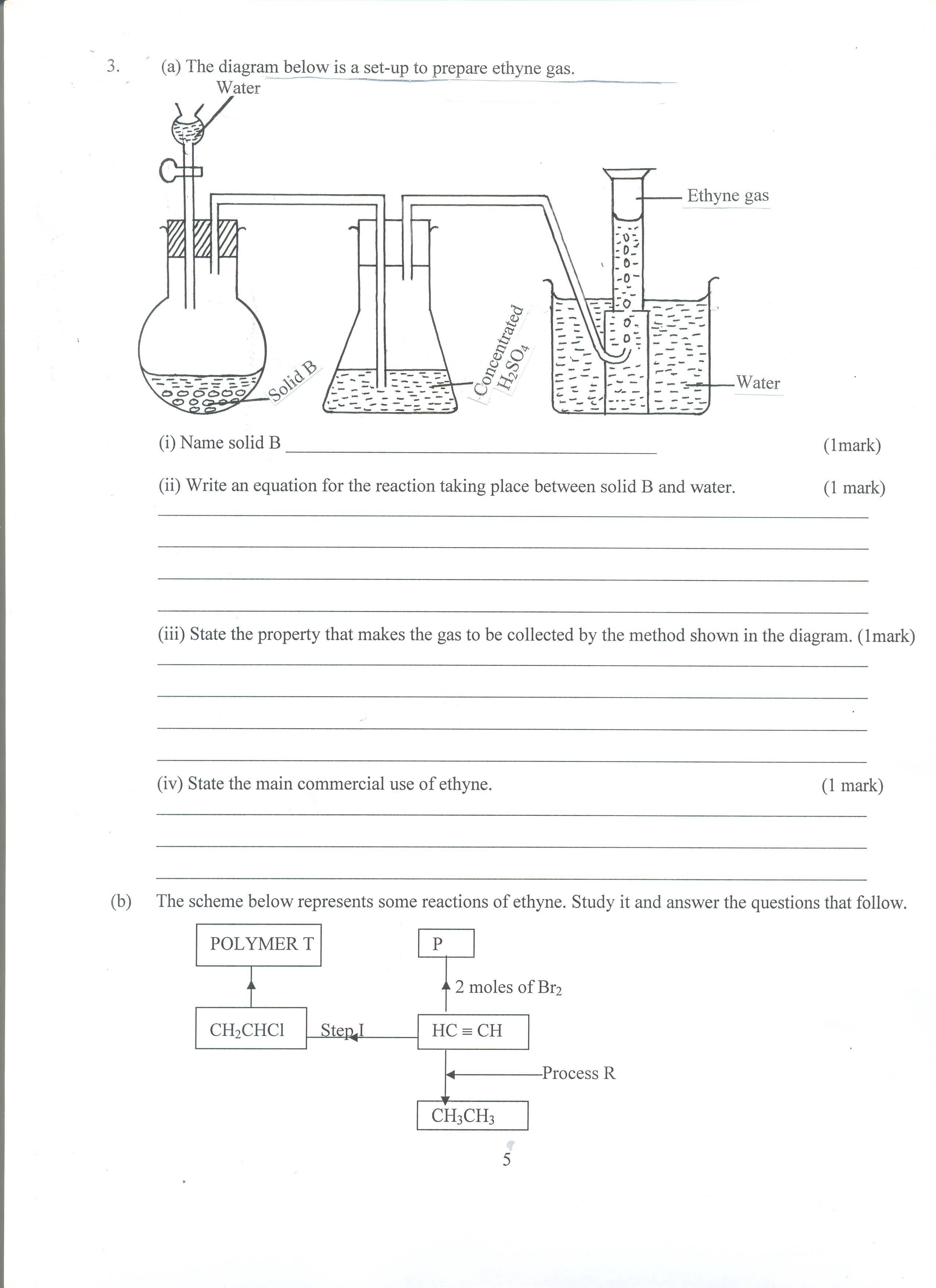
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(v) Give a reason why the total volume of oxygen gas produced after 50 seconds

remain constant. (1 mark)

………………………………………………………………………………………………………………………………………………………………………………………………

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



(i) Name solid B ……………………………………………………. (1 mark)

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

………………………………………………………………………………………………………….

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

(1 mark ………………………………………………………………………………………………………………………………………………………………………………………………………………………………

(iv) State the main commercial use of ethyne. (1 mark)

………………………………………………………………………………………………………………………………………………………………………………………………………………………………

(b) The scheme below represents some reactions of ethyne. Study it and answer the questions that follow.

POLYMER T P

2 moles of Br2

CH2CHCl Step I HC ≡ CH

Process R

CH3CH3

(i) Name compound P and draw it’s structural formula. (1 mark)

(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)

………………………………………………………………………………………………………………………………………………………………………………………………………………………………

(c ) Ethanol and ethanoic acid react according to the following equation under condition M

and process N to form product Z.

CH3 CH2 OH (l) + CH3 COOH (aq) Z (l) + H2O (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 1 difference between the above reaction and that of an hydroxide and an acid.

(1 mark)

………………………………………………………………………………………………………………………………………………………………………………………………………………………………

(v) Butane is often used as the main component in domestic gas fuels. Calculate it’s

heating value ( H = 1, C = 12, ΔHθC (C4H10) = 2877.0 k Jmol-1 ) (1 mark)

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

Water X B Coke

Crushing and Froth Y Roaster ZnO

Concentration flotation Z Gas P

Waste material A Zinc

(a) (i) Identify substance X ……………………………………………………. (1 mark)

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

………………………………………………………………………………………………………

(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)

………………………………………………………………………………………………………

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

………………………………………………………………………………………………………………………………………………………………………………………………………………

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

Half reactions Electrode potential, Eθ (V)

D+ (aq) + e- D (s) + 0.80

E2+ (aq) + 2e- E (s) + 0.34

F 2+ (aq) + 2e- F (s) -0.13

G 2+ (aq) + 2e- G (s) -0.76

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

(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)

………………………………………………………………………………………………………………

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)

…………………………………………………………………………………………………………….

(ii) Describe how nitrogen gas is obtained from the liquid air.

(Boiling points nitrogen = -1960C, Oxygen = -1830C ) (3 marks)

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

Water Air

Electrolysis

Step I Step II

M N2 Conc. H2SO4

Step III

Ammonia

Step IV Air, platinum – rhodinum catalyst

Colourless gas Q

Step V Air

Nitrogen (IV) oxide Ammonium

Sulphate

Step VI

Nitric (V) acid

Step (VII)

Compound Z

(i) Name substance M ………………………………………………………………. (1 mark)

(ii) Identify gas Q …………………………………………………………………… (1 mark)

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

………………………………………………………………………………………………………………

(iv) A fertilizer manufacturing industry uses 1400dm3 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 = 24dm3 ) (3 marks)

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

A

Chamber X Ammoniated brine Solvay

Tower

A

CaCl2

Heat Chamber Y

Solution C

H2O (l)  Slaker Heat CO2

B

CO2

Limestone Kiln

Sodium

carbonate

(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)

………………………………………………………………………………………………………………

(c ) A stream of cold water is made to circulate around chamber X. What does this

suggest about the reaction taking place. (1 mark)

………………………………………………………………………………………………………………

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

………………………………………………………………………………………………………………

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

………………………………………………………………………………………………………………………………………………………………………………………………………………………………

(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 some time.

(i) Write down the chemical equation of the reaction that takes place. (1 mark)

………………………………………………………………………………………………………………

(ii) State the property of concentrated sulphuric (VI) acid investigated in (i) above. (1 mark)

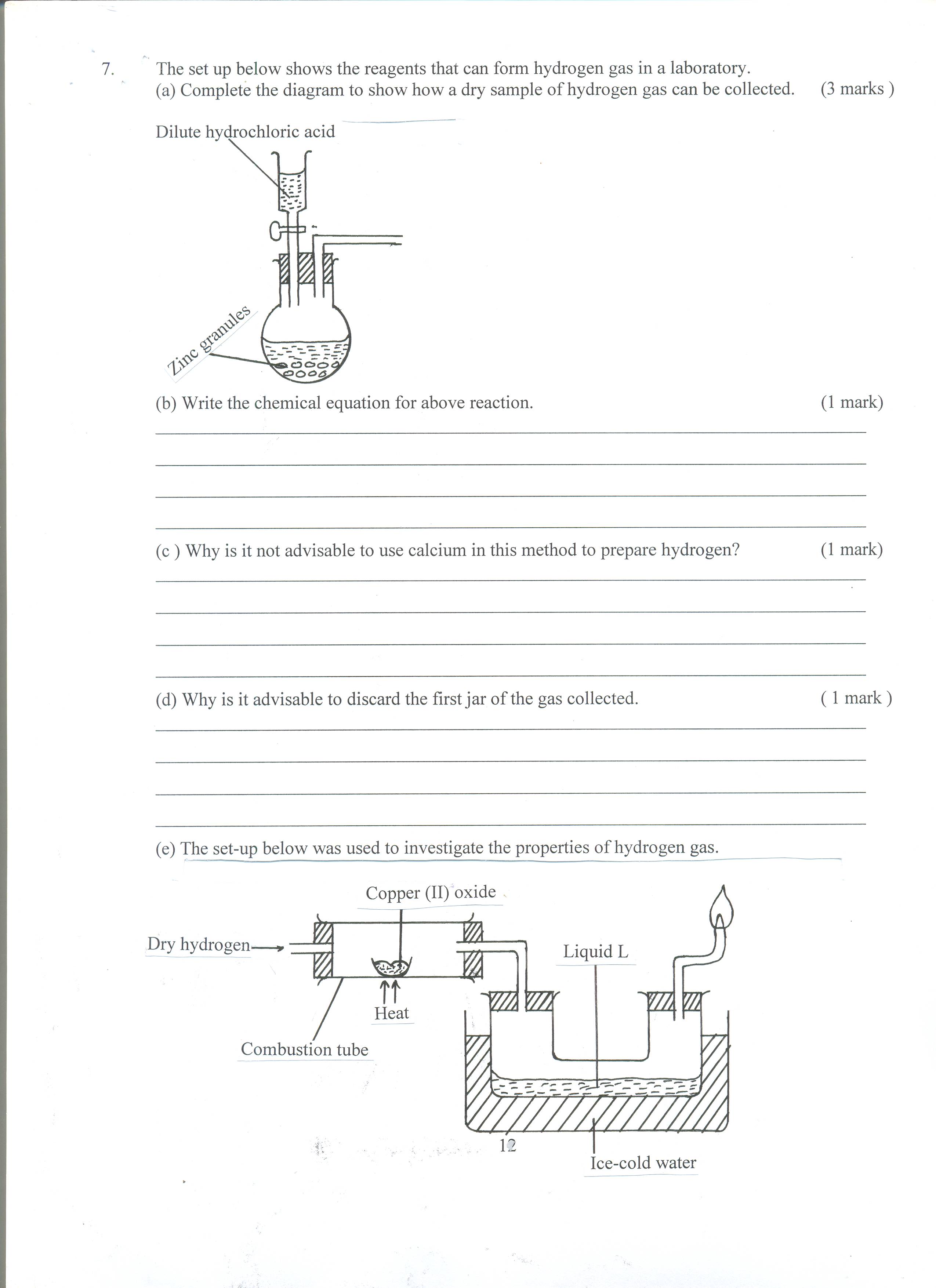
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(g) Mention any 2 uses of sodium carbonate. (1 mark)

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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)

(b) Write the chemical equation for above reaction. (1 mark)

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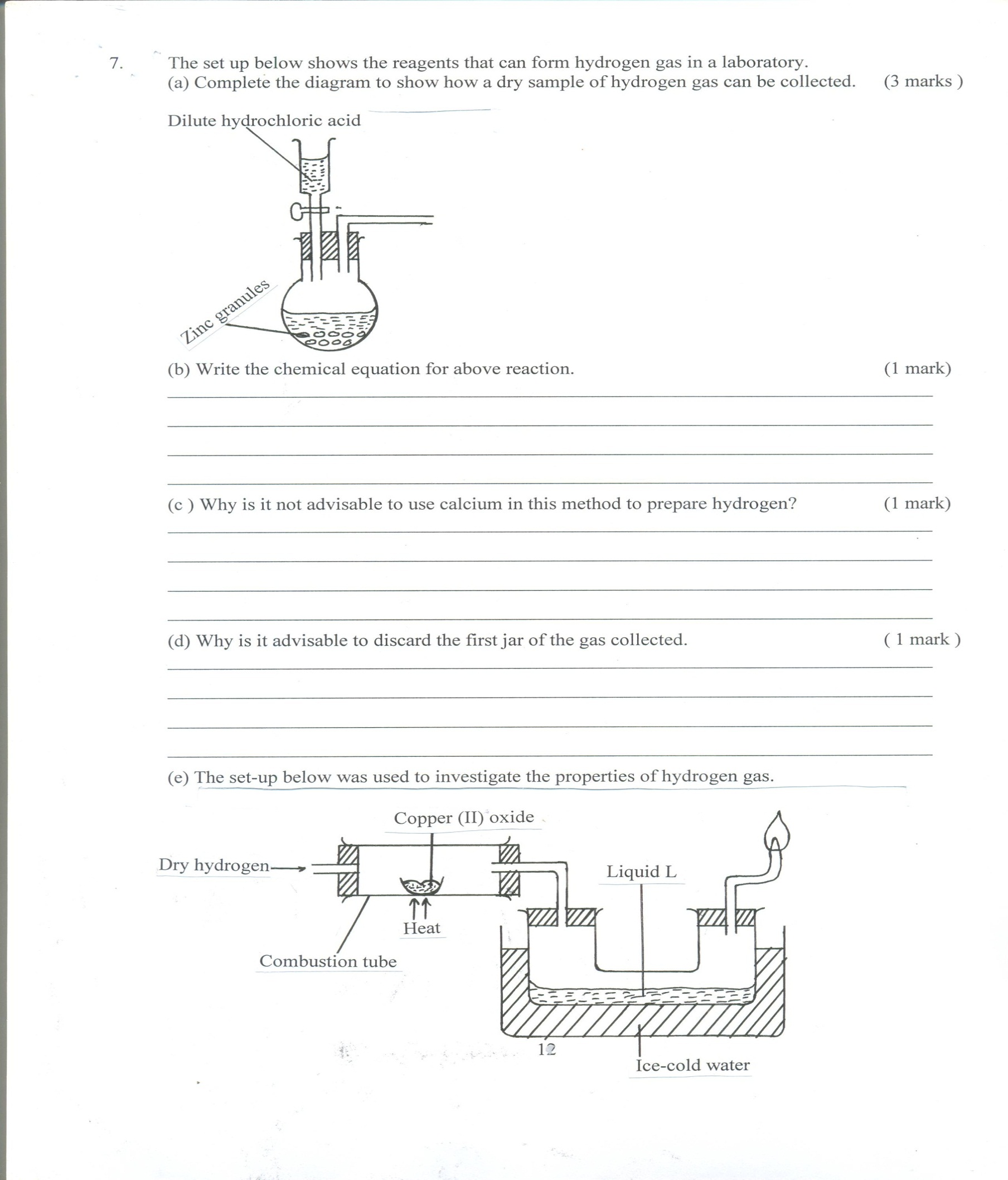
(c ) Why is it not advisable to use calcium in this method to prepare hydrogen? (1 mark)

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(d) Why is it advisable to discard the first jar of the gas collected? (1 mark)

………………………………………………………………………………………………………………………………………………………………………………………………………………………………

(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)

………………………………………………………………………………………………………………………………………………………………………………………………………………………………

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

………………………………………………………………………………………………………………

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

………………………………………………………………………………………………………………

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

………………………………………………………………………………………………………………………………………………………………………………………………………………………………

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

hydrogenation? (1 mark)

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

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