Name: Marking Scheme ..... Class: ..... Adm.No. .....

School: ..... Index No. .....

Date: .....

Sign: .....

233/2
CHEMISTRY
Paper 2
JULY 2019
Time: 2 hours

MOKASA II JOINT EXAMINATION

Kenya Certificate to Secondary Education

CHEMISTRY PAPER 2

TIME: 2 HOURS

INSTRUCTIONS TO CANDIDATES

- *Write your name, admission number, date and school in the spaces provided.*
- *Answer **all** the questions in the spaces provided.*
- *All working **must** be clearly shown where necessary.*
- *Scientific calculators may be used.*

FOR EXAMINERS' USE ONLY

Question	Maximum Score	Student's Score
1	12	
2	10	
3	10	
4	11	
5	10	
6	9	
7	7	
8	11	

1. Study the table below and answer the questions that follow.

Element	Atomic number	Relative atomic mass	Melting point (°C)
Aluminium	13	37.0	
Calcium	20	40.0	850
Carbon	6 ½	12.0	3730
Hydrogen	1 ½	1.0	-259
Magnesium	12	24.3	650
Neon	10	20 ½	-249
Phosphorus	15	31.0	44.2 (white)
Phosphorus	15	31	590 (red)
Sodium	11 ½	23	

(a) Complete the table by filling in the missing atomic numbers and atomic mass. **(2 marks)**

(b) Write the electron arrangement for the following ions. **(2 marks)**

Ca^+ ..... 2.8.1 ✓1 .....

P^{3-} ..... 2.8 ✓1 .....

(c) What is the melting point of hydrogen in Kelvin? **(1 mark)**

..... −259 + 273 = 14K ✓1 .....

(d) Which of the allotropes of phosphorous has a higher density? Explain. **(2 marks)**

..... Red. ✓1 Has higher melting point. ✓1 .....

.....

(e) The mass numbers of three isotopes of magnesium are 24, 25 and 26. What is the mass number of the abundant isotope of magnesium? Explain. **(2 marks)**

..... Mg-24. The mass is nearest .....

..... the R.A.M. .....

(f) Give the formula of the compound formed between calcium and carbon. **(1 mark)**

..... CaC_2 // Ca_2C .....

.....

(g) Explain the difference in the melting points of magnesium and sodium. **(2 marks)**

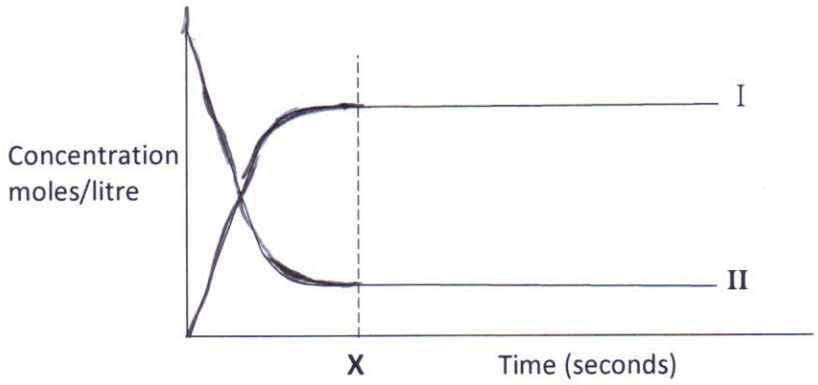
..... Magnessium has higher mpt, than Sodium ✓1 .....

Mg has stronger metallic bonds in giant metallic structure due to more delocalized electrons ✓1

2. Hydrogen gas can be obtained by reacting carbon (II) oxide and steam as shown below.

$$CO_{(g)} + H_2O_{(g)} \rightleftharpoons CO_{2(g)} + H_{2(g)} \quad \Delta H = +Ve$$

The curve below was obtained during the process.



(a) Which curve represents the change in the concentration of hydrogen, give a reason. **(2 marks)**

I, The Concentration is increasing with increase in time ✓1 ✓1

(b) Give a reason for the shapes of curve at point **X**. **(1 mark)**

Point of equilibrium.

(c) State and explain the effect on equilibrium when concentrated potassium hydroxide solution is added on equilibrium above. **(2 marks)**

✓1 Equilibrium Shift to the right. KOH reacts with CO_2 reducing the concentration hence forward reaction is favoured. ✓1

(d) Explain the effects of increasing temperature of the system above on the yields of hydrogen. **(2 marks)**

Yields increases ✓1 forward reaction is endothermic hence it's favoured by increase in temperature ✓1 ✓1

(e) The table below shows the volume of oxygen produced with increase in time during a reaction of 2g Manganese (IV) oxide and 50cm³ hydrogen peroxide at 25⁰C.

Time sec.	0	10	20	30	40	50	60	70	80
Volume (O_2) cm³	0	60	90	105	112	116	120	120	120

(i) Calculate the rate of reaction between 20th and 40th second. **(1 mark)**

$\frac{112-90}{40-20} = \frac{22}{20}$ $1.1\ cm^3/sec$

penalize ½ for wrong units if given.

(ii) Explain why volume of O_2 produced does not exceed 120cm³. **(1 mark)**

All the H_2O_2 had decomposed ✓1

(iii) Explain the effect of using 4g of manganese (IV) oxide on total volume of oxygen produced. **(1 mark)**

The volume remains the same. MnO_2 is a catalyst it does not affect the product.

3. Use the table below to answer the questions that follow.

Substance	Formula
A	$CH_3(CH_2)_2OH$
B	C_2H_5COOH
C	CH_3CHCH_2
D	$CH_3CH_2CH_3$
E	CH_3CCH

(a) Explain how one would differentiate between substance **D** and **E** in the laboratory. **(2 marks)** ✓1

Bubble the gases separately in bromine water

E decolorizes Tellow bromine water while does not decolorize ✓1

Accept any other e.g. $KMnO_4$ or use of burning

(b) Write an equation to show the reaction that will take place when substance **A** is heated in presence of concentrated sulphuric VI acid at temperature of 170^{0}C. **(1 mark)**

$CH_3CH_2CH_2OH \xrightarrow[170^\circ C]{H_2SO_4(l)} CH_3CHCH_2 + H_2O$

(Ignore omission of states)

(c) What is the name of the process involved when substance **D** reacts with chlorine? Give the condition required for the process.

Process - Substitution **(1 mark)**

Condition - Presence of U.V. Light. **(1 mark)**

(d) Select **two** substances from the table that could be reacted to form a pleasant smelling substance.

(i) Substances - A and B. ✓1 **(1 mark)**

(ii) Conditions - few drops of Conc. H_2SO_4 ✓½
Warming ✓½ **(1 mark)**

(e) Substance **C** is subjected to high temperatures and pressure to form a solid substance.

(i) Name the solid substance formed. **(1 mark)**

Polypropene

(ii) Explain the effect of using the substance formed above for a long time. **(2 marks)**

It pollutes the environment ✓1 since it is non-biodegradable.

4. The standard electrode potentials of metals **J**, **K**, **L** and **M** are as shown below. Use it to answer the questions. (The letters are not the actual chemical symbols).

$J^{2+}_{(aq)} + 2e \longrightarrow J_{(s)} \quad -0.13V$

$K^{2+}_{(aq)} + 2e \longrightarrow K_{(s)} \quad -0.77V$

$L^{3+}_{(aq)} + 3e \longrightarrow L \quad -1.66V$

$M^{2+}_{(aq)} + 2e \longrightarrow M \quad -2.37V$

(i) Select **two** metals whose half cells will yield the highest e.m.f. when connected. **(1 mark)**

J and M ✓1

(ii) Write the cell diagram for the cell formed in (i) above. **(1 mark)**

$M_{(s)} | M^{2+}_{(aq)} // J^{2+}_{(aq)} | J_{(s)}$

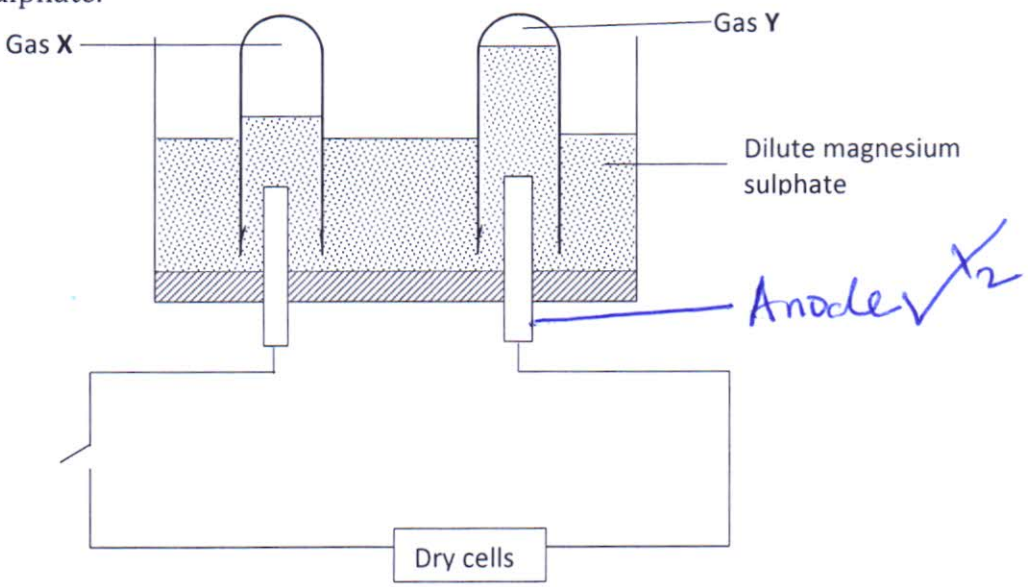
(iii) Calculate the initial e.m.f of the cell formed. **(1 mark)**

Emf = Ered − Eoxi.
= −0.13 − −2.37V ✓½
= + 2.24V ✓½

(iv) State **one** use of salt bridge in electrochemical cells. **(1 mark)**

- Completes the circuit
- Maintain charge balance / Replace the discharged ions.

(v) The set-up below shows electrolysis of dilute solution of magnesium sulphate.



(i) Identify the gases **X** and **Y**. **(1 mark)**

X - Hydrogen ✓½

Y - Oxygen ✓½

(ii) On the diagram, label the electrode that is the anode. **(½ mark)**

(iii) A current of 1.5A was passed through the solution for 50 minutes. Calculate the volume of the gas produced at the cathode. (M.G.V. r.t.p. = 24000cm³, IF = 96500c). **(3 marks)**

$Q = It = 1.5 \times 50 \times 60$ ✓½

$= 4500C$ ✓½

$2H^+_{(aq)} + 2e^- \longrightarrow H_{2(g)}$ ✓½

$96500 \times 2 \longrightarrow 24000cm^3$

$4500C \quad X$?

$\frac{4500 \times 24000}{193,000}$ ✓1

$= 559.5855cm^3$. ✓½

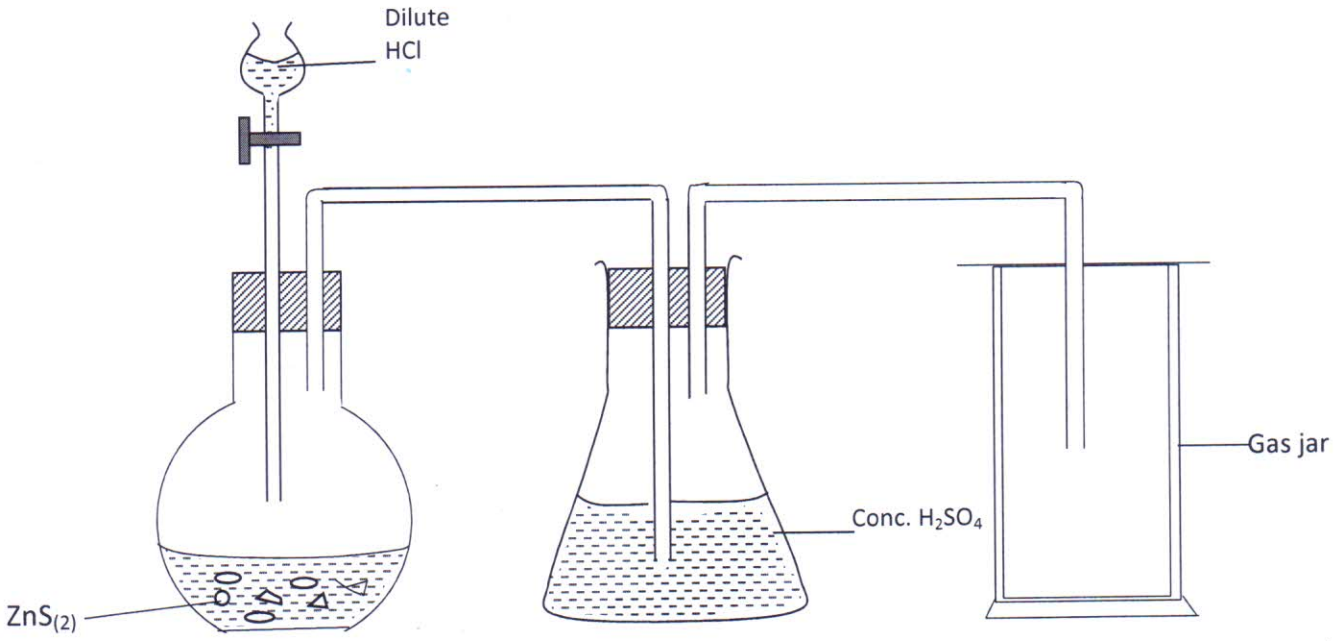
(iv) State the effect of electrolysis of magnesium sulphate on the concentration of the electrolyte. **(½ mark)**

Concentration increases

(v) Give any **one** application of electrolysis. **(1 mark)**

Electroplating // Extraction of metal // Purification of metals

5. (a) The following set-up was used by a Form 3 student to prepare and collect dry hydrogen sulphide gas. **(3 marks)**



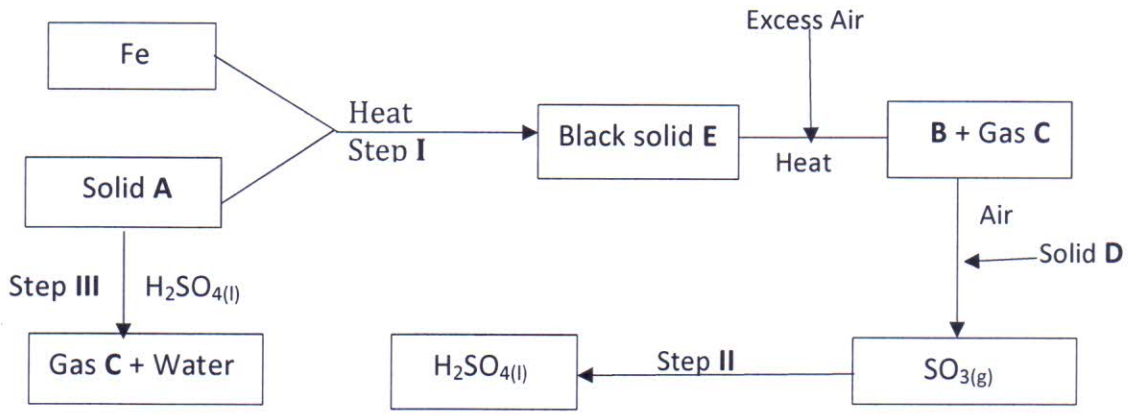
(i) At the end of the experiment, the student realized that no gas was collected. Give a reason. **(1 mark)**

H_2S Produced reacted with Conc. Sulphuric (VI) ✓1
acid. (to form Sulphur & water)

(ii) Write an equation for the reaction when excess hydrogen sulphide gas is passed through sodium hydroxide solution. **(1 mark)**

$2NaOH_{(s)} + H_2S_{(g)} \longrightarrow Na_2S_{(s)} + 2H_2O_{(l)}$

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



(i) Name; **(3 marks)**

I. Solid **A** ..... Sulphur .....

II. Solid **D** ..... Vanadium (V) oxide .....

III. Substance **B** ..... Iron (III) oxide .....

(ii) Write equations for the two consecutive reactions that must take place in step **II** before sulphuric (VI) acid is formed. **(2 marks)**

Penalize for wrong states

$SO_{3(g)} + H_2SO_{4(l)} \longrightarrow H_2S_2O_{7(l)}$ ✓1

$H_2S_2O_{7(l)} + H_2O_{(l)} \longrightarrow 2H_2SO_{4(l)}$ ✓1

(iii) State the property of solid A that enables it to react with H_2SO_4 in step **III**. **(1 mark)**

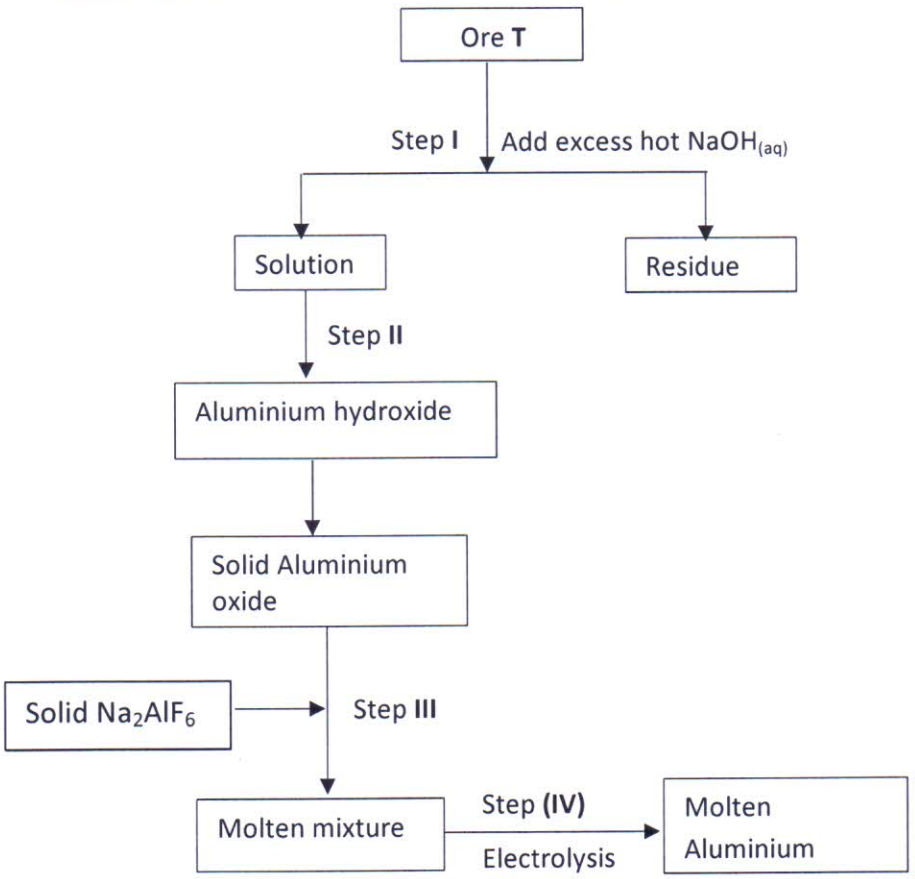
Reducing Property

(iv) State any **two** uses of sulphuric (VI) acid. **(2 marks)**

Manufacture of fertilizers ✓1 / Manufacture of detergents
Processing of metal ores // manufacture of plastics

Accept any other (2) for (2 marks)

6. I. Study the flow chart below and answer questions that follow.



(a) Name ore **T**. **(1 mark)**

Bauxite ✓1 reject formular.

(b) Explain why the ore is dissolved in excess $NaOH_{(aq)}$. **(1 mark)**

To enable removal of Iron(III) oxide & Silicon(IV) oxide impurities.

(c) Name compound present in:- **(1 mark)**

(i) Solution Sodium aluminate / Sodium silicate ✓½

(ii) Residue Iron (III) oxide ✓½

(d) Name the process that takes place in step **II**. **(½ mark)**

Seeding / precipitation by use of CO_2. ✓½

(e) Why are sodium and fluoride ions not discharged in step **IV**? **(½ mark)**

Are higher in electrochemical series than Al^{3+} and O^{2-} ions respectively.

(f) Write the equation for reaction in step **IV**. **(1 mark)**

(1) $Al^{3+}_{(l)} + 3e^- \longrightarrow Al_{(s)}$ Penalize fully for wrong states on Al^{3+}/O^{2-}

(1) $2O^{2-}_{(l)} \longrightarrow O_{2(g)} + 4e^-$

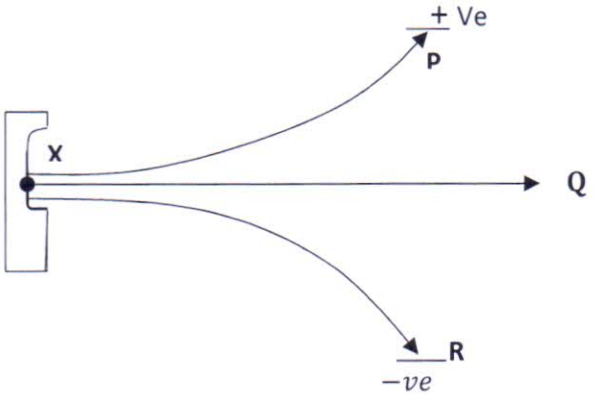
(g) Why should the anode be replaced from time to time? **(1 mark)**

It reacts with O_2 at high temperatures hence wearing off.

(h) State any **two** uses of aluminium. **(1 mark)**

Making utensils . Aircraft parts. ; electrical cables

II. The figure below shows the behavior of emissions by radioactive isotope X. Use it to answer questions that follow.



(a) Explain why isotope **X** emits radiation. **(½ mark)**

It has unstable nucleus. n/p ratio > 1

(b) Name radiations **P**, **Q** and **R**. **(1 ½ marks)**

P Beta. ✓½

Q Gamma ✓½

R Alpha. ✓½

7. (a) State Hess's law. **(1 mark)**

Energy in converting reactants to product is the same regardless of the route a chemical change takes.

(b) Calculate the enthalpy of formation of ethane given that the molar enthalpies of combustion of carbon, hydrogen and ethane are -394kJ, -286kJ and -1560kJ respectively. **(3 marks)**

$C_{(s)} + O_2 \longrightarrow CO_{2(g)}, \quad \Delta H = -394\ kJ/mole$

$H_2 + \frac{1}{2}O_2 \longrightarrow H_2O_{(l)}, \quad \Delta H = -286\ kJ/mole$

$C_2H_6 + \frac{7}{2}O_2 \longrightarrow 2CO_2 + 3H_2O \quad \Delta H = -1560\ kJ/mole$

$2C_{(s)} + 3H_{2(g)} \xrightarrow{\Delta H_3} C_2H_{6(g)}$

$2CO_2 + 3H_2O \xrightarrow{\Delta H_1, \Delta H_2} 2C_{(s)} + 3H_{2(g)} + 2O_2 + 3O_2$

$2CO_2 + 3H_2O \xrightarrow{\Delta H_4} C_2H_6 + \frac{7}{2}O_2$

Correct energy cycle (mark) ✓1

$-788 - 1158 + 1560$

$\Delta H_3 = 2\Delta H_1 + 3\Delta H_2 - \Delta H_4$

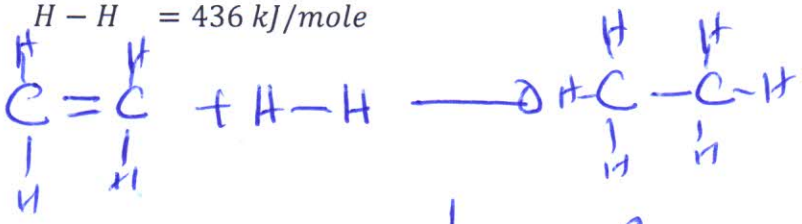
$= 2 \times (-394) + 3 \times -286 - (-1560)$

$= -386\ kJ/mole$ ✓1

(c) Calculate the enthalpy change for the relation.

$C_2H_{4(g)} + H_{2(g)} \longrightarrow C_2H_{6(g)}$, *Given;* **(3 marks)**

$C - C = 347\ kJ/mole$
$C = C = 612\ kJ/mole$
$C - H = 413\ kJ/mole$
$H - H = 436\ kJ/mole$



Bond broken.

$612 + 1652 + 436 = 2700$ ✓1

Bond formed

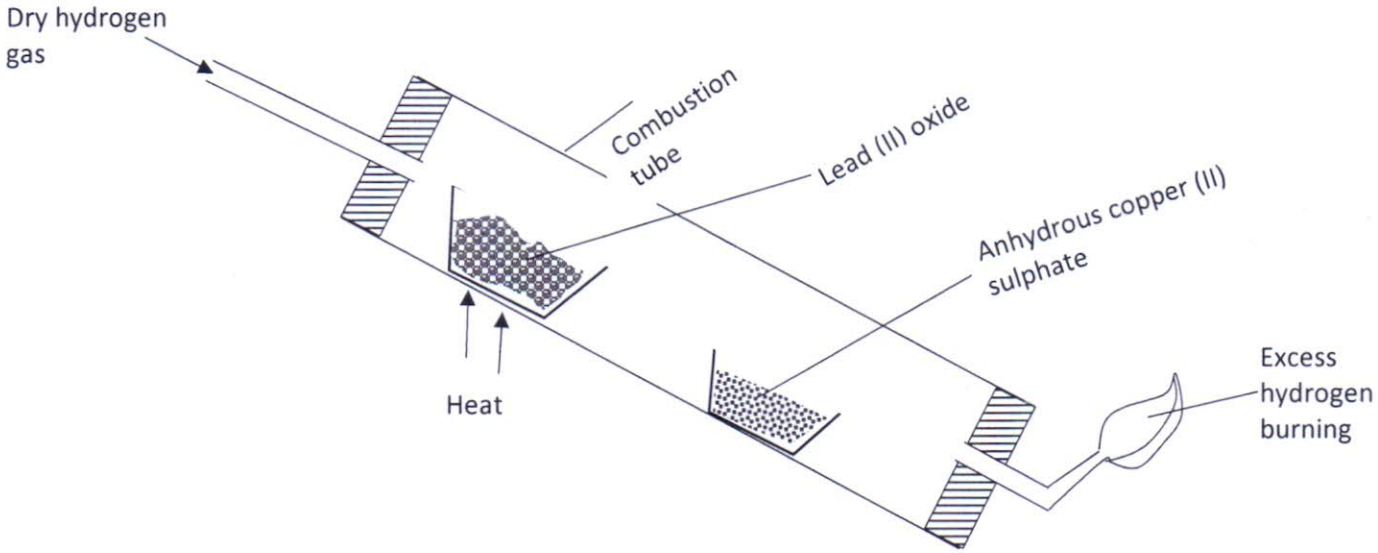
$347 + 2478 = 2825$ ✓1

$2700 - 2825$ ✓½

$-125\ kJ/mole$ ✓½

Penalize ½ for wrong units & sign.

8. The experiment below was used to investigate the effect of dry hydrogen gas on hot Lead (II) oxide. Use it to answer the questions that follow.



(a) (i) What was observed in the combustion tube at the end of the experiment? **(1 mark)**

• grey solid is formed ✓1

(ii) Why should the tube be slanting? **(1 mark)**

To prevent water from flowing back which will break the combustion tube

(iii) State any **two** precautions to be observed when doing this experiment. **(2 marks)**

a. Excess hydrogen should be burnt at jet.

b. Hydrogen gas should flow through the apparatus when lead formed is cooling

(b) (i) If 2.07g of lead (II) oxide was reduced by certain amount of hydrogen gas during experiment. Calculate the mass of hydrogen gas that reduced 2.07g of lead (II) oxide. (Pb = 207, O = 32, H = 1)

(3 marks)

$PbO_{(s)} + H_{2(g)} \longrightarrow Pb_{(s)} + H_2O_{(l)}$ ✓1

moles of PbO

$= \frac{2.07}{223}$

$= 0.009283$ ✓½ moles

from reacting ratio 1 : 1 ✓½

moles of H_2 0.009282

Mass of H_2 ✓½

$= 0.009282 \times 2$

$= 0.018566\text{g}$ ✓½

(accept answers to 4 decimal places).

(ii) Calculate the mass of the residue in the combustion tube.

(2 marks)

moles of Pb : PbO

1 : 1 ✓1

moles of Pb = 0.009283

mass = 0.009283×207 ✓½

$= 1.9216\text{g}$ ✓½

(iii) Calculate the volume of hydrogen gas used at r.t.p. (MGV = 24L)

(2 marks)

1 mole is 24000 cm^3

moles H_2 : PbO

1 : 1 ✓1

moles 0.009283

Volume 0.009283×24000 ✓½

$= 222.792\text{cm}^3$ ✓½