UGANDA NATIONAL EXAMINATIONS BOARD

Uganda Advanced Certificate of Education

P525/2 CHEMISTRY

SCORING GUIDE

FOR THE SAMPLE PAPER

Turn Over

Item 1.

To attain the highest level of achievement, a *candidate is expected to;*

- *develop clear logical and well sequenced plan using appropriate preliminary tests, specific tests and confirmatory tests for inorganic or organic substances.*
- *perform tests accurately, and record observations accurately for preliminary tests, specific tests and confirmatory tests.*
- *use observations made to make logical deductions for preliminary test, specific tests and confirmatory tests.*
- *give a recommendation based on conclusion.*

Possible response

TESTS	OBSERVATIONS	DEDUCTIONS
a) A small amount of **Q** was burnt on spatula end.	Colourless liquid burnt with a yellow non-sooty flame	**Q** is an aliphatic organic compound of low carbon content.
b) To 1cm3 of **Q** in a test tube was added 2 cm^3 of distilled water. The mixture was shaken and solution tested with blue and red litmus paper.	**Q** was completely miscible with water. The solution had no effect on both blue and red litmus paper.	Polar organic compound of low molecular mass. Neutral compound like alcohol, carbonyl compound present.
c) To 1 cm^3 of **Q** in a test tube was added Brady's reagent.	No observable change.	Carbonyl compound absent.
d) To 1 cm^3 **Q** in a test tube, 3 drops of acidified potassium dichromate(vi) sodium was added and mixture warmed (heated)	Orange solution turned green.	Primary alcohol or secondary alcohol present.
e) To 1 cm^3 of **Q** in a test tube was added 1cm3 of ethanoic acid and then 3 drops of concentrated sulphuric acid and mixture heated and then poured in water in a beaker.	A sweet fruity smell.	Ester formed so **Q** is a primary alcohol or a secondary alcohol.
f) To 1 cm^3 of **Q** in test tube was added 3 drops of acidified potassium dichromate(vi) solution and the mixture heated. The mixture was cooled and then	Orange solution formed green then. No reddish brown ppt was formed	Secondary alcohol oxidized to ketone.

Fehling's reagent added and heated.	with Fehling's reagent.	
g) To 1 cm^3 of **Q** was added to Lucas reagent.	A cloudy solution formed after 8 minutes.	Secondary alcohol present.
h) To 1 cm^3 of **Q** in a test tube, 3cm^3 of iodine solution was added followed by little sodium hydroxide solution.	Yellow precipitate formed	Secondary alcohol of the form CH_3CHR present.

Conclusion; **Q** is an aliphatic secondary alcohol of the form CH_3CHR.

Recommendations

Q can be used to make perfumes since it is a low molecular mass aliphatic alcohol.

Q can be used to make sanitizers since it is polar and soluble of low molecular mass.

Q can be used to make nail vanish remover since it has a hydro-carbon group that can dissolve non-polar compounds.

ITEM 2

Planning for the experiment

To attain the highest level of achievement, a *candidate is expected to present;*

- *an aim that should have the; nature of the experiment (the relationship between variables), the purpose of the experiment derived from the challenge in the scenario.*
- *all variables (independent, dependent and controlled).*
- *a correct hypothesis (prediction on the interaction of independent and dependent variables of the experiment with a reason for the prediction)*

Possible responses

Aim; An investigation to determine enthalpy of formation of magnesium oxide by measuring temperatures at specific time intervals when a fixed volume of hydrochloric acid separately reacts with a fixed mass of solid **X** and **Y** so as to determine the suitability of magnesium oxide as an alternative binder to Portland cement.

Hypothesis; The enthalpy of formation of magnesium oxide obtained by measuring temperatures at specific time intervals when a fixed volume of hydrochloric acid separately reacts with a fixed mass of solid **X** and **Y** is lower than that of Portland cement.

Variables

Independent variables; Type of solid (**X** or **Y**) and time.

Dependent variables; Temperature of solution for **X** and **Y**.

Controlled variables; Volume of hydrochloric acid used was 60 cm^3.

The mass of solid **X** and **Y** were fixed at 1.2 g and 2.0 g respectively.

Time intervals used was 30 seconds.

Methodology of the experiment.

To attain the highest level of achievement, a *candidate is expected to;have a procedure with; all the relevant steps logical presented and coherent to the scenario, well used apparatus, appropriate quantities of variable used, mitigated risks.*

Procedure;

i) 1.2g of solid **X** (magnesium metal) was weighed using a weighing balance.
ii) 60.0 cm^3 of FA1 (hydrochloric acid) was measured using a measuring cylinder and transferred into a plastic beaker.
iii) The initial temperature of the acid was measured using a thermometer and recorded.
iv) Solid **X** was added to acid in the plastic beaker and a stop clock started immediately.
v) The temperature of the mixture was noted and recorded after every 30 seconds for three minutes.
vi) Procedure (i) to (v) were repeated using 2.0g of **Y** (magnesium oxide) instead of **X**.
vii) The results were tabulated.

Alternative Procedure;

i) 1.2 g of solid **X** (magnesium metal) was weighed using a weighing balance.
ii) 60.0 cm^3 of FA1 (hydrochloric acid) was measured using a measuring cylinder and transferred into a plastic beaker.
iii) The initial temperature of the acid was measured using a thermometer three consecutive times after every 30 seconds for one minute then solid X was added and the recording of the temperature continued for another three minutes.
iv) Procedure (i) to (iii) was repeated by using 2.0 g of solid **Y** (magnesium oxide) instead of **X**.
v) The results were tabulated.

Mitigated risks.

The reaction gives off hydrogen gas which when inhaled can cause respiratory complications. This can be avoided by wearing a face mask to prevent inhalation of the gas.

Injuries and cuts from broken glass equipment. This can be mitigated by wearing closed shoes, gloves to prevent contact of the body with broken glass.

Data presentation

To attain the highest level of achievement, a *candidate is expected to; to present complete data sets required, data must be accurate (presented with correct decimal places within accuracy range), data presented in appropriate formats, variables in the table must be with correct units.*

Volume of FA1 used = 60.0 cm^3

Mass of solid **X** + container (g)	101.2
Mass of container only (g)	100.0
Mass of **X** weighed (g)	1.2

Mass of solid **Y** + container (g)	102.0
Mass of container only (g)	100.0
Mass of **Y** weighed (g)	2.0

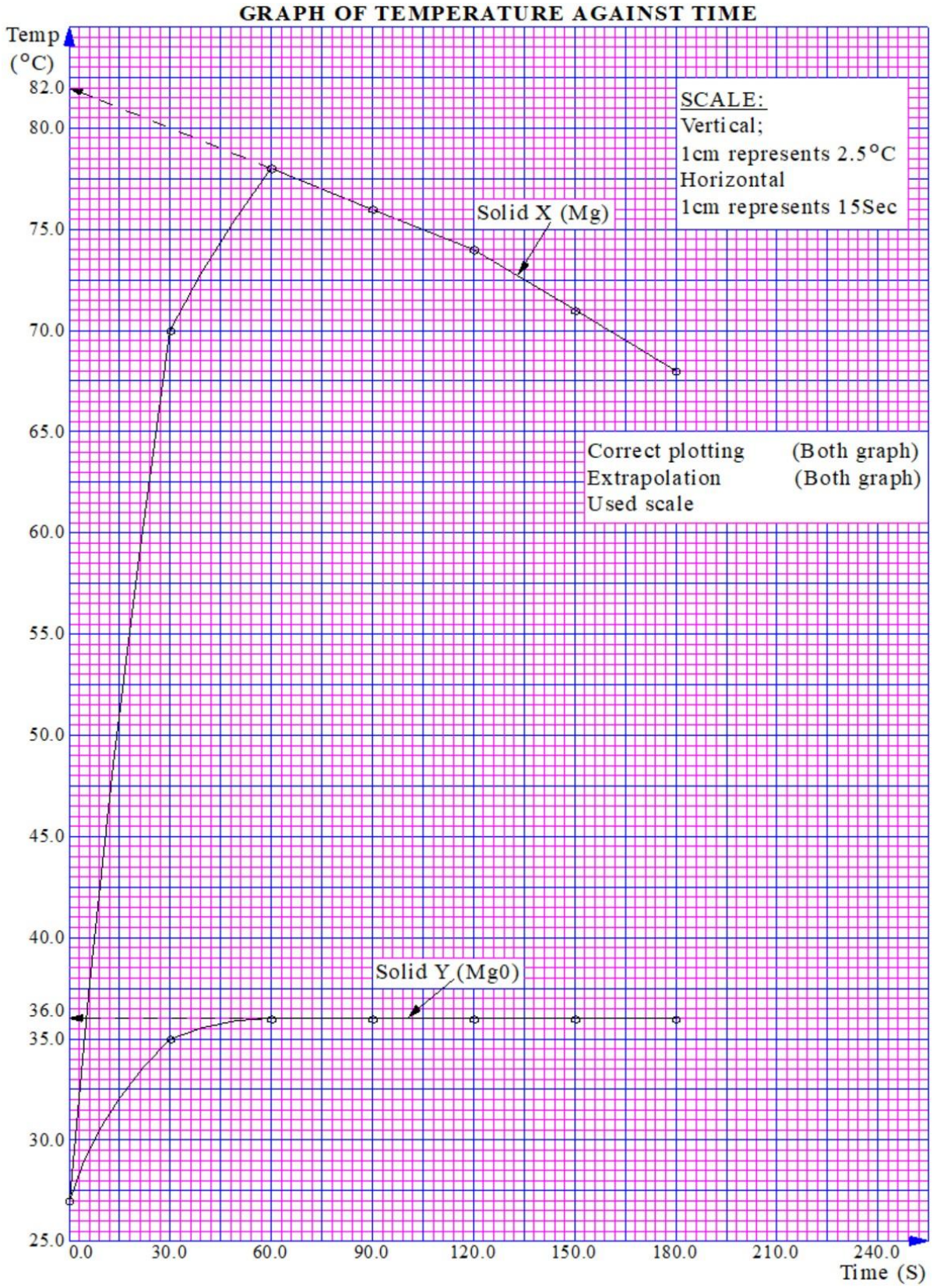
Time (s)	0.0	30.0	60.0	90.0	120.0	150.0	180.0
Temperature of **X** + HCl (^{0}C)	27.0	70.0	78.0	76.0	74.0	71.0	68.0
Temperature of **Y** + HCl (^{0}C)	27.0	35.0	36.0	36.0	36.0	36.0	36.0

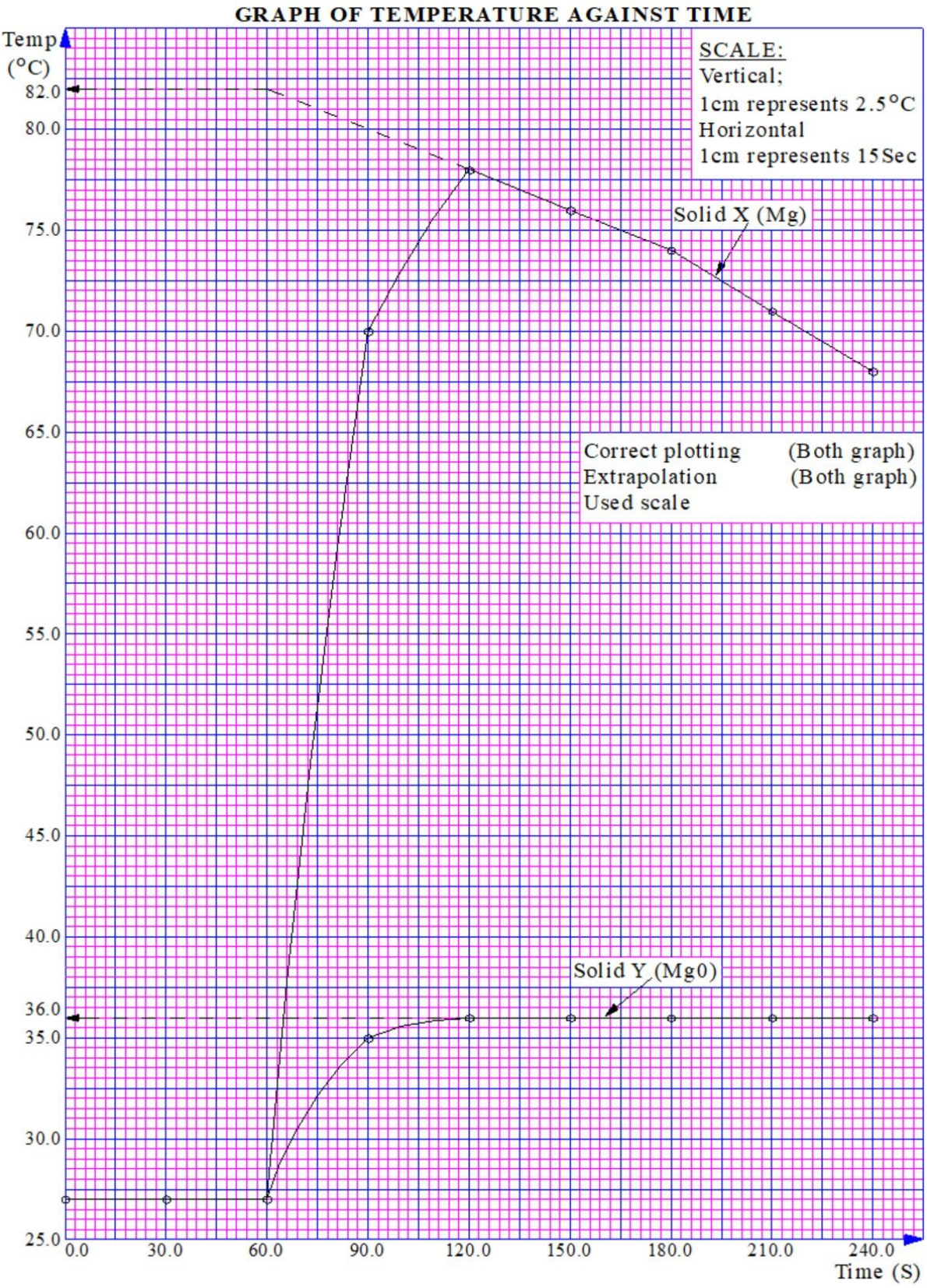
Alternative

Time (s)	0.0	30.0	60.0	90.0	120.0	150.0	180.0	210.0	240.0
Temperature of **X** + HCl (^{0}C)	27.0	27.0	27.0	70.0	78.0	76.0	74.0	71.0	68.0
Temperature of **Y** + HCl (^{0}C)	27.0	27.0	27.0	35.0	36.0	36.0	36.0	36.0	36.0

Data interpretation

To attain the highest level of achievement, a *candidate is expected to; identify trends and relationships, apply scientific principles to give logical interpretation of data.*


GRAPH OF TEMPERATURE AGAINST TIME
Temp (°C)
82.0
80.0
75.0
70.0
65.0
60.0
55.0
50.0
45.0
40.0
36.0
35.0
30.0
25.0
0.0
30.0
60.0
90.0
120.0
150.0
180.0
210.0
240.0
Time (S)
SCALE:
Vertical;
1cm represents 2.5°C
Horizontal
1cm represents 15Sec
Solid X (Mg)
Solid Y (Mg0)
Correct plotting (Both graph)
Extrapolation (Both graph)
Used scale



Determination of the enthalpy for the reaction;

$Mg_{(s)} + 2HCl_{(aq)} \longrightarrow MgCl_{2(aq)} + H_{2(g)}$

Heat change; MCΔT

ΔT (82.0 – 27.0) = 55.0 ^{0}C

Mass of solution; (density X volume)

(1.0 x 60) = 60.0 g

C = 4.2

Heat change; (60 x 4.2 x 55.0) = 13860 J

Moles of solid **X** used; (1.2/24) = 0.05 moles

0.05 moles of solid **X** liberated 13860 J

1 mole of solid **X** liberated $\frac{(13860 \times 1)}{0.05}$

277200 Jmol^{-1}

277.2 kJmol^{-1}

The enthalpy of the reaction between solid **X** and hydrochloric acid is -277.2kJmol^{-1}.

Determination of enthalpy of reaction for;

$MgO_{(s)} + 2HCl_{(aq)} \longrightarrow MgCl_{2(aq)} + H_2O_{(l)}$

Heat change; MCΔT

ΔT; (36.0 – 27.0) = 9.0 ^{0}C

Mass of solution; (1 x 60) = 60 g

Heat change = (60 x 4.2 x 9.0); 2263 J

Number of moles of Y; (2.0/40.0) = 0.05 moles

0.05moles of Y liberated 2268J of heat

1 mole of Y liberated $\frac{(2268 \times 1)}{0.05}$ J

= 45360 Jmol^{-1}

= 45.36 kJmol^{-1}

The enthalpy of the reaction between solid Y and hydrochloric acid is -45.36KJmol^{-1}.

Enthalpy of formation of MgO.

$Mg_{(s)} + ½O_{2(g)} \longrightarrow MgO_{(s)}$

$Mg_{(s)} + 2HCl_{(aq)} \longrightarrow MgCl_{2(aq)} + H_{2(g)}$ -277.2 kJmol^{-1} ……(i)

$MgO_{(s)} + 2HCl_{(aq)} \longrightarrow MgCl_{2(aq)} + H_2O_{(g)}$ -45.36 kJmol^{-1} ……...(ii)

$H_{2(g)} + ½O_{(g)} \longrightarrow H_2O_{(l)}$ -285.8 kJmol^{-1} ……(iii)

Applying Hess's law;

Equation (i) + Reversed equation (ii) + Equation (iii)

-277.2 + 45.36 + (-285.8)

= -518 kJmol^{-1}

The enthalpy of formation of magnesium oxide is -518 kJmol^{-1} and exothermic.

Conclusion and recommendation

To attain the highest level of achievement, a *candidate is expected to;*
to give a recommendation (linked to the challenge in the scenario)and based on conclusion (conclusion should be linked to the hypothesis).

Conclusion;
The enthalpy of formation of magnesium oxide is -518 $kJmol^{-1}$ which is less negative than that of Portland cement (-3000 $kJmol^{-1}$). Therefore, magnesium oxide is less stable than Portland cement.
Recommendation;
Magnesium oxide is not a suitable alternative to Portland cement as a binder.