233/2 MS
CHEMISTRY
Paper 2
MARKING SCHEME

THE KENYA NATIONAL EXAMINATIONS COUNCIL
Kenya Certificate of Secondary Education

CHEMISTRY

Paper 2

MARKING SCHEME
(CONFIDENTIAL)

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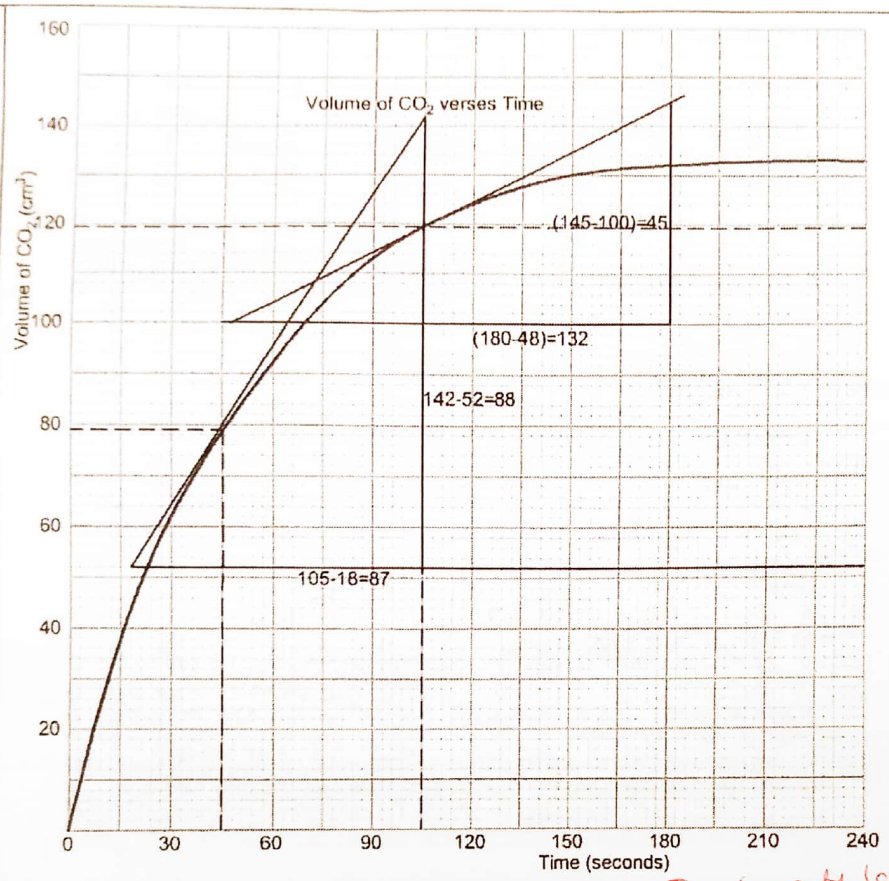
This marking scheme consists of 10 printed pages.

1. (a)	(i) Compound **A** - changes from a crystalline solid to a powder (1) because it loses its water of crystallization (1).	2 marks
	(ii) Compound **B** - changes from a crystalline solid to a solution (1) because it absorbs water vapour from the atmosphere to an extend of forming a solution / it absorbs water vapour until it dissolves forming a colourless solution (1)	2 marks
b)	$MgSO_4 \bullet XH_2O$ Mass of anhydrous $MgSO_4$ = 26.82 – 25.62 g = 1.20 g Mass of water = (28.08 – 26.82)g = 1.26 g **(½ mark for both masses)** **OR** Mass of hydrated sample = (28.08 - 25.62)g = 2.46 g Mass of anhydrous salt = 26.82 – 25.62 = 1.20 Mass of water = (2.46 – 1.20) = 1.26 g RFM of $MgSO_4$ = 24 + 32 + 64 = 120 RFM of H_2O = 18 **(½ mark for both RFMs)**	½ mark ½ mark

		$MgSO_4$	H_2O
	Mass (g)	1.20	1.26
	No. of moles	$\frac{1.20}{120} = 0.01$	$\frac{1.26}{18} = 0.07$ ($^1/_2$)
	Ratio of moles	$\frac{0.01}{0.01}$	$\frac{0.07}{0.01}$ ($^1/_2$)
		1	7
	Formula of hydrated salt is $MgSO_4 \cdot 7H_2O$ (1)		1 mark
(c)	(i) Hydrogen gas (1)		4 marks
	(ii) $[Zn(OH)_4]^{2-}$ (1)		
	(iii) Zinc / Zn (1)		
	Copper / Cu (1)		**11 marks**
2 (a)	Sulphur is obtained from underground sulphur deposits where it is mined using Frasch process where three concentric pipes are drilled into the sulphur deposits ($^1/_2$). Superheated water is pumped through the outer pipe to melt the sulphur deposits ($^1/_2$). Hot compressed air is used forced through the inner pipe which pushes the molten sulphur through the middle pipe to the surface (1).		2 marks
(b)	Air is cheap source of oxygen gas (1)		1 mark
(c)	(i) **M** - concentrated sulphuric(VI) acid (1)		2 marks
	(ii) **N** – water (1)		

(d)	(i) Impurities in the gas poisons the catalyst (1) (ii) I. High temperatures increase the rate of the reaction as the particles gain kinetic energy resulting to frequent fruitful collisions (1). II. Can be recycled to preheat SO_2 and O_2 gases (1).	1 mark 2 marks
(e)	The formation of SO_3 in chamber 3 occurs when SO_2 and O_2 come into contact with each other on the surface of the catalyst (1).	1 mark
(f)	(i) - Metallic structures near the plant are rusted (corroded) (1); - Vegetation near the plant changes from green to yellow or dries up (ii) Passing the gaseous emissions through alkaline or basic substances such as calcium hydroxide/scrubbing the gas (1).	2 marks **11 marks**
3 (a)	- Colliding particles may not possess /have the necessary kinetic energy (1). - Particles may not collide in the right (correct) orientation **(Any one correct)**	1 mark
(b)	(i) Increase in surface area of solid reactants increases the rate of reaction (½) because more particles are exposed to the reaction to the other reactant hence the smaller the size of the particles, the faster the rate of the reaction (1).	1 mark
	(ii) Increase in pressure brings the molecules of gaseous reactants closer to each other (½); this increases number of collisions hence increase in rate of the reaction (½).	1 mark

(c)(i)

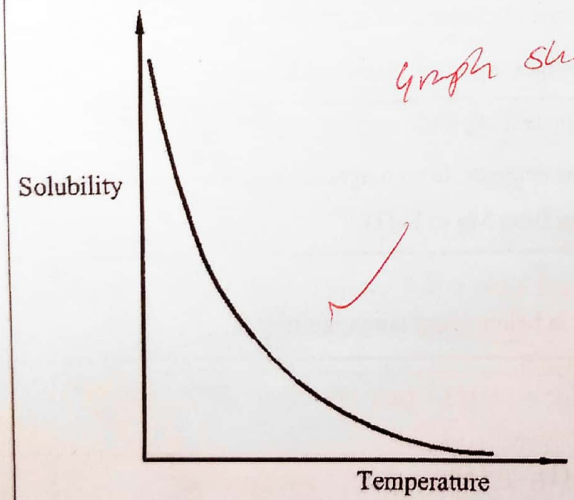


3 marks

- Uniform scale.
- Name the scale.
- correctly labelled.

✗ Inverted axes - award a maximum of 2 mks

(ii)	I. Rate at 45th second $\text{Rate} = \frac{\text{Change in Y- axis}}{\text{Change in X- axis}}$ $= \frac{140-52}{105-18} = \frac{88}{87}$ (½) $= 1.011\ \text{cm}^3/\text{sec}$ (½) II. Rate at 105th second $\text{Rate} = \frac{145-100}{180-48}$ (½) $= \frac{45}{132}$ $= 0.341\text{cm}^3/\text{sec}$ (½)	1mark 1 mark
(iii)	At 105th second the concentration of acid and mass of marble chips is less than at 45th second causing reduction in rate of the reaction (½). At 45th second, the rate is high since concentration of reagents available is high hence the faster the reaction (½).	1 mark
(iv)	1 mole = 24,000 cm^3 maximum volume of gas produced = 133 cm^3 Moles of gas produced $= \frac{133}{24000} = 5.54 \times 10^{-3}$ moles of CO_2 (½) Moles of CO_2 = Moles of $CaCO_3 = 5.54 \times 10^{-3}$ (½) RFM of $CaCO_3 = 40 + 12 + (3\times16) = 100$ g 1 mole = 100 g $5.54 \times 10^{-3} = ?$ $= \frac{5.54 \times 10^{-3}}{1} \times 100$ (½) 0.554 g of marble chips (½)	2 marks **11 marks**

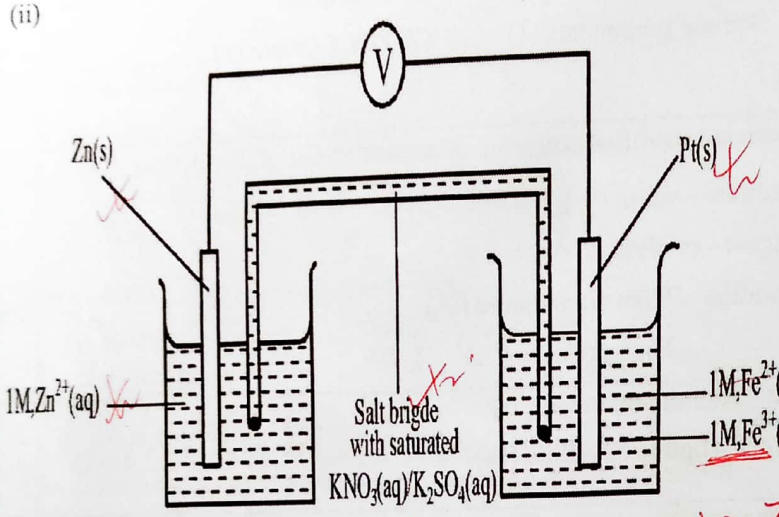
4 (a)	Sea water is trapped in a pan, allowed to undergo solar evaporation until solid crystallises out (1), liquor is allowed to drain out (1) and solid left is washed and dried (1).	3 marks
(b)	RFM of NaCl = 23 + 35.5 = 58.5 (½) 100g water = 100 cm^3 water 36.2 g NaCl in 100 cm^3 = 362 g (½) NaCl in 1000 cm^3 ∴ Concentration = $\frac{g/l}{RFM}$ = $\frac{362}{58.5}$ (½) = 6.2 mol^{-1} (½)	2 marks
(c) (i)	Ammonia gas is bubbled/passed through inverted funnel dipped in water in a beaker (1). This is to prevent suck back (½). Ammonia being highly soluble dissolves n the water forming aqueous ammonia (½).	2 marks
(ii)		1 mark
(iii)	Solubility decreases with increase in temperature because the gaseous particles gain energy and escape from the solution (1).	1 mark

(d)	As water passes through rocks containing minerals of magnesium and calcium such as magnesium carbonate and calcium carbonate (1) magnesium and calcium salts slowly dissolve into the water (1).	2 marks **11 marks**
5(a)	(i) I. metal - Cs ($^1/_2$) II. non-metal - F ($^1/_2$)	1 mark
	(ii) He	1 mark
(iii)	I. Fractional distillation of liquid air (1). II. Uses of argon - Used to provide inert atmosphere in fluorescent lamps/bulbs (1) - Used in radioactive dating.	1mark 1 mark
iv	I. The metallic bonding in lithium is stronger than that in potassium hence more energy required to break the metallic bonds in lithium the potassium during melting (1). II. Chlorine and iodine exists as diatomic molecules, mass of I_2 is higher than that of Cl_2 and iodine molecules are bigger than for chlorine. Van der Waals forces are stronger in iodine than in chlorine (1).	1 mark 1 mark
v	Mg^{2+}, Na^+, O^{2-}, N^{3-} → increasing ionic size (1) Reason: number of protons decrease from magnesium to nitrogen hence nuclear attraction decreases from Mg to N (1).	2 marks
(b) (i)	Substance K ($^1/_2$). Its boiling point of - 60°C is below room temperature ($^1/_2$).	1 mark
(ii)	I. H - Ions (1). II. J - electrons (1).	2 marks
iii	I. H - electrostatic forces (1). II. K - weak Van der Waals forces (1).	2 marks **13 marks**
6	(i) **Name** **Formula**	

(a)	**X** - Magnesium propoxide (1) $(CH_3CH_2CH_2O)_2Mg$ (1) (ii) **Name** **Formula** **Y** - Sodium propanoate (1) CH_3CH_2COONa (1)	2 marks 2 marks
(b)	(i) Reagents - acidified potassium manganate(VII)/ $K_2Cr_2O_7$ ($^1/_2$) Condition - warm ($^1/_2$) (ii) Reagent - ~~catalyst~~ Condition - High temperature ($^1/_2$) - High pressure ($^1/_2$)	2 marks
(c)	Reagent - Aluminium oxide ($^1/_2$) Condition - High temperature ($^1/_2$)	1 mark
(d)	(i) dehydration/ elimination (1) (ii) addition polymerization (1)	2 marks
(e)	(i) $CH_3CHCH_2 + Br_2 \rightarrow CH_3CHBrCH_2Br$ (1) (ii) Bromine is decolourised (1)	2 marks **11 marks**
7 (a)	$HCl_3(aq) + 5HCl(aq) \rightarrow 3Cl_2(g) + 3H_2O(l)$ Oxidation No. of chlorine +5 -1 0 (1) Chlorine in HCl_3 is reduced from +5 to 0 while chlorine in HCl is oxidized from -1 to 0 (1)	2 marks
(b)	(i) I. $PbO_2(s) + 2SO_4^{2-}(aq) + 4H^+(aq) + Pb(s) \rightarrow 2PbSO_4(s) + 2H_2O(l)$ (1) II.	2 marks

E^0 of the cell = +1.69 - (-0.36) (1)
= +2.05V

(ii)



3 marks

(iii) Purple/pink acidified potassium manganate(VII)/ $KMnO_4$ is decolourised (1). MnO_4^- is reduced to Mn^{2+} (½) while H_2O_2 is oxidised to O_2 (½). E^0 of the reaction is (1.51 – 0.68) = +0.83V (1).

3 marks

(iv) Zinc is more reactive than iron so when coated iron is exposed zinc, it reacts (corrodes) leaving iron intact (1). On the other hand, Iron is more reactive than copper, hence it will react (corrode) leaving copper intact (1).

2 marks

12 marks