X/25

MASAKA DIOCESAN EXAMINATIONS BOARD

Uganda Advanced Certificate of Education
JOINT MOCK EXAMINATIONS 2026

P525/2 CHEMISTRY

DRAFT MARKING SCHEME

1	QP_1	03
	QM_1	03
	QD_1	03
	QA_1	03
	QG_1	02
2	PA_2	03
	SA_2	03
	CA_2	03
	CR_2	02
Total		25

ITEM ONE

Aim	To determine the percentage purity of Solid J (citric acid) by measuring the volume of standardized sulphuric acid required to neutralize a fixed volume of diluted solution of J and excess sodium hydroxide in order to ascertain its suitability in preserving local fruit juices.
Hypothesis	The percentage purity of Solid J (citric acid) will be between 99.0-99.9% when obtained by measuring the volume of standardized sulphuric acid required to neutralize a volume of diluted solution of J and excess sodium hydroxide.
Variables; $4A+3V+3H=QP_1(3)$ $4A+3V=QP_1(2)$ $3V=QP_1(1)$	Independent; Volume of diluted solution containing excess sodium hydroxide used.
	Dependent; The volume of standardized sulphuric acid (FA1) required to neutralize the excess sodium hydroxide.
	Controlled; Volume of diluted solution was kept constant by pipetting 25.0 cm^3 for each titration.
Procedure and materials; (with SPr)	• The burette was rinsed and filled with FA1 and the initial burette reading was recorded. • 25.0cm^3 of FA2 was pipetted using a pipette into a clean conical flask. • 2 drops of phenolphthalein indicator were added using a dropper and the solution titrated with FA1 from the burette slowly while swirling until the end point was reached. • The final burette reading was recorded. • The titration was repeated two more times to obtain consistent results. • The results were recorded in the **table 1** below. • Exactly 1.20 g of solid J was weighed using a weighing scale and transferred into a clean beaker.

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	• Exactly 50.0 cm^3 of FA3 were measured using a measuring cylinder and added to the beaker containing J. The mixture was stirred and allowed to react completely/until solid J completely dissolved. • The resultant solution was transferred to a 250 cm^3 volumetric flask. • The conical flask was rinsed with distilled water and the washings added to the volumetric flask. • The solution was made up to 250 cm^3 with distilled water and mixed well and labelled FA4. • 25.0cm^3 of the FA4 was pipetted into a clean conical flask and 2 drops of phenolphthalein indicator were added. • The burette was refilled with FA1. • The pipetted solution was then titrated with FA1 until the solution turned colourless. • The titration was repeated two more times to obtain consistent titres. • The results were recorded in the table 2 below.
Risks and mitigations	Sulphuric acid is corrosive if spilled on the skin. This was mitigated by wearing gloves to prevent direct contact of the skin with acid spills. Breakage of burette, pipette or conical flasks could cause cuts. This was mitigated by wearing gloves to avoid direct contact of body parts with broken glass.
Presentation of data	TABLE 1 Volume of pipette used= 25.0 cm^3

Experiment number	1	2	3
Final burette reading(cm^3)	11.50	21.40	21.50
Initial burette reading(cm^3)	0.00	10.00	10.00
Volume of FA1 used(cm^3)	11.50	11.40	11.50

TABLE 2

Volume of pipette used= 25.0 cm^3

Experiment number	1	2	3
Final burette reading(cm^3)	14.30	28.60	24.30
Initial burette reading(cm^3)	0.00	14.30	10.00
Volume of FA1 used(cm^3)	14.30	14.30	14.30

Data analysis and interpretation	Moles of ***NaOH*** used (in 25.0 cm^3 of solution FA2): $1000\ cm^3 of\ solution\ contain\ 0.10\cancel{125}\ moles$ $25.0\ cm^3\ of\ solution\ contain\ \left(\frac{25.0 \times 0.10\cancel{125}}{1000}\right) = 0.00253125\ moles$ $H_2SO_4(aq) + 2NaOH(aq) \rightarrow Na_2SO_4(aq) + 2H_2O(l)$ 2 moles of $NaOH$ react with 1 mole of H_2SO_4 Moles of H_2SO_4 that reacted $= \frac{1}{2} \times 0.00253125 = 0.001265625$

Average volume of acid used $= \frac{11.50+11.50}{2} = 11.50cm^3$

$11.50cm^3\ of\ FA1\ contain$ 0.001265625 moles of acid

$1000\ cm^3\ of\ solution\ contain\ \left(\frac{1000\times0.001265625}{11.50}\right)$moles of acid

$Concentration\ of\ the\ acid = 0.11M$

The concentration of the sulphuric acid is **0.11 moles per litre**

Average volume of acid used to react with excess NaOH in FA4 $= \frac{14.30+14.30}{2} = 14.30cm^3$

$1000cm^3\ of$ FA1 $contain$ 0.11 moles of acid

$14.30\ cm^3\ of\ solution\ contain\ \left(\frac{14.30\times0.11}{1000}\right)$moles of acid

$= 0.001573\ moles$

Moles of excess $\boldsymbol{NaOH}$ in 25 cm³of FA4

1 mole of $H_2SO_4\ reacts\ with$ 2 moles of $NaOH$

Moles of $NaOH$ that reacted = 2× 0.001573 =0.003146

$\therefore 25cm^3\ of\ FA4\ contain$ 0.003146moles of $NaOH$

Moles of excess $\boldsymbol{NaOH}$ in 250 cm³of FA4

$25\ cm^3\ of\ FA4\ contain$ 0.003146 moles

$250\ cm^3\ of\ solution\ contain\ \left(\frac{250\times0.003146}{25}\right)$moles of NaOH

$=0.03146\ moles$

Original moles of $\boldsymbol{NaOH}$ added to J

$1000\ cm^3\ of\ FA3\ contain$ 1.0 moles

$50\ cm^3\ of\ solution\ contain\ \left(\frac{50\times1.0}{1000}\right)$moles of NaOH

$=0.05\ moles$

Moles of $\boldsymbol{NaOH}$ that reacted with $\boldsymbol{J}$

$= 0.05 - 0.03146 = 0.01854\ moles$

Moles of $\boldsymbol{J}$ that reacted with $\boldsymbol{NaOH}$

3 moles of $NaOH\ react\ with$ 1 mole of J

Moles of J that reacted = $\frac{1}{3}$× 0.01854= 0.00618

Mass of pure $\boldsymbol{J}$ that reacted

Molar mass of J $(C_6H_8O_7)=(6\times12)+8+(7\times16) = 192g/mol$

1 mole of J weighs 192g

0.00618 moles weigh $0.00618\times192 = 1.18656g$

Percentage purity of $\boldsymbol{J}$

	$\left(\frac{1.18656}{1.20}\right) \times 100 = 98.9\%$ Dq The percentage purity of Solid J is approximately 98.9% hence out of the stated acceptable range of 99.0% - 99.9%, Dc
Conclusion and recommendation	Solid J does not meet the required standard because its purity is slightly below the minimum acceptable value. C **Recommendation** The juice vendor should reject or return this batch of citric acid to the supplier because its purity is below the required range. R

C + R = Q, (2)
C = Q, (1)

ITEM TWO

	TEST	OBSERVATION	DEDUCTION
1	A spatula endful of **X** was burnt Pp	Blue non sooty flame Op	Aliphatic compound of low carbon content Df
2	Two spatula endfuls of **X** were shaken with 6cm^3 of water. Pr	**X** dissolved to form a colorless solution Op	Polar aliphatic compound of low molecular mass Dp
3	The resultant solution from (2) was tested with litmus and divided into six portions. Pp	Blue litmus paper turned red Op	Acidic compound present Dp
4	To the first portion was added Brady's reagent Ps	No observable change Os	Carbonyl compound absent Ds
5	To the second portion was added acidified potassium dichromate and mixture warmed Ps	No observable change Os	Reducing agent absent (methanoic acid, primary or secondary alcohol absent) Ds
6	To the third portion was added alkaline potassium permanganate solution/ bromine water Ps	No observable change Os	Unsaturated Carbon to carbon bond absent Ds
7	To the fourth portion was added sodium carbonate/sodium hydrogencarbonate Pc	Bubbles of a colourless gas Oc	Carboxylic acid/carboxyl group present Dc

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	solution/magnesium powder or ribbon		
8	To the fifth portion was an equal volume of ethanol and 5 drops of concentrated sulphuric acid and mixture heated. The contents of the test tube were poured in a beaker of cold water	A sweet fruity smell O_c	Carboxylic acid/carboxyl group confirmed D_c
9	To the sixth portion was added sodium hydroxide solution and the mixture heated and allowed to cool. Then dilute nitric acid was added followed by a few drops silver nitrate solution P_c	White precipitate was formed O_c	Carbon to chlorine bond confirmed D_c

Conclusion; X is a **low molecular mass aliphatic carboxylic acid with a carbon to chlorine bond** C C C

Or X is an **low molecular mass aliphatic alkylchloride/chloroalkane with a carboxyl group**.

The highly polar carboxylic acids makes the pesticide highly soluble in water for spraying and the carbon to chlorine bond is highly susceptible to nucleophilic substitution, producing intermediates in pesticide manufacture. R

Recommendation; **The consignment of Sample X is highly suitable for use and should be approved for immediate pesticide production.**

$All\ (3P_p + 3P_s + 2P_c) = PA_2\ (3)$

$All\ (3P_p + 3P_s) = PA_2\ (2)$

$All\ 3P_p = PA_2\ (1)$

$All\ (3O_p + 3O_s + 2O_c) = SA_2\ (3)$

$All\ (3O_p + 3O_s) = SA_2\ (2)$

$All\ 3O_p = SA_2\ (1)$

$All\ (3D_p + 3D_s + 2D_c) = CA_2\ (3)$

$All\ (3D_p + 3D_s) = CA_2\ (2)$

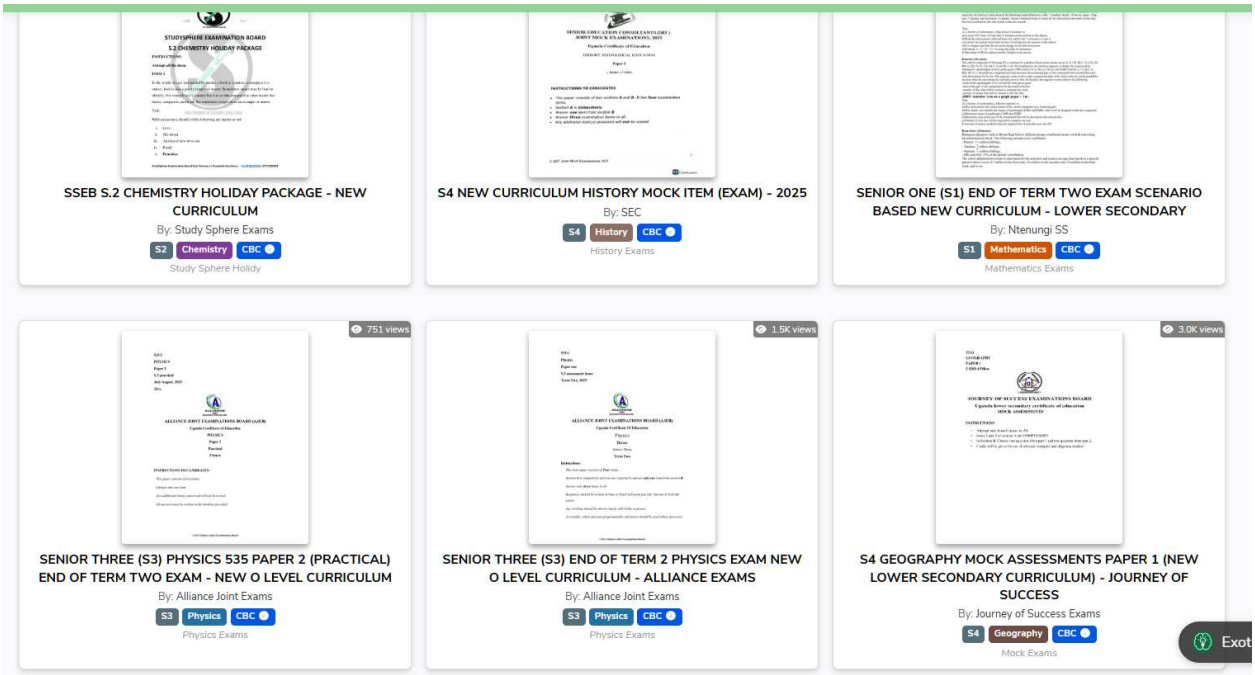
$All\ 3D_p = CA_2\ (1)$

$3C + R = CR_2\ (2)$

$3C = CR_2\ (1)$

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