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School: SUNSHINE SCHOOL Adm no:.....Class:.....

Candidate's Signature:..... Date: .....

233/3
CHEMISTRY PRACTICAL
Paper 3
KASSU JUNE 2022
TIME: *2 ¼* HOURS

KASSU JET – JUNE 2022

Kenya Certificate of Secondary Education (K.C.S.E)
233/3
Chemistry Practical
Paper 3
2 ¼ **Hours**

INSTRUCTIONS TO CANDIDATES:

- Answer all the questions in the spaces provided in the question paper.
- You are **NOT** allowed to start working within the first 15 minutes of the 2 ¼ hours allowed for this paper. This time is to enable you read the question paper and make sure you have all the chemicals and apparatus that you may need.
- All working **MUST** be clearly shown.
- Mathematical tables and silent scientific calculators may be used.
- Candidates should check to ascertain that all papers are printed as indicated and that no questions are Missing

For Examiner's Use Only:

Question	Maximum score	Candidate's score	Examiner's initials
1	14		
2	10		
3	10		
4	06		
Total score	40		

Mr Wamalwa Sunshine 0724-917412

1. You are provided with:
   - Solution A_1, potassium iodate solution 0.05M
   - Solution A_2, acidified sodium hydrogen sulphite solution
   - Solution A_3 starch indicator
   - Distilled water in a wash bottle.
   - Stop watch / stop clock

You are required to find out the effect of concentration of potassium iodate A_1 on the rate of reaction with acidified sodium hydrogen sulphite A_2.

Note: the end point of reaction of potassium iodate with acidified sodium hydrogen sulphite is indicated in the formation of a blue coloured complex using starch indicator.

Procedure 1:

(a) Using a 10 cm^3 measuring cylinder to pour 5 cm3 of aqueous sodium hydrogen sulphite into the conical flask.
(b) Use another 10 cm_3 of measuring cylinder to pour 5 cm^3 of starch solution into the same conical flask.
(c) Using a burette pour 15 cm^3 of distilled water into the same beaker.
(d) Using a burette pour 20 cm^3 of aqueous potassium iodide into the beaker and immediately start the stop watch.
(e) Swirl the mixture in the conical / flask and continue to swirl until a sudden blue colour change is seen.
(f) Stop the stop-watch and record time taken seconds for the sudden blue colour change to appear.
(g) Rinse the beaker with water.

Experiment 2:

(h) Repeat procedure 1 using 17 cm^3 of distilled water and 18 cm^3 of aqueous potassium iodate.
(i) Repeat procedure 1 using 21 cm^3 of distilled water and 14cm^3 of aqueous potassium iodate.
(j) Repeat experiment 1 using 23 cm^3 of distilled water and 12 cm^3 of aqueous potassium iodate.
(k) Repeat experiment 1 using 25 cm^3 of distilled water and 10 cm^3 of aqueous potassium iodate.

✓ C.T – All data for all 5 expmts complete (2mks)
✓ – All times in seconds and as whole number only (1mk)
✓ – Times increase from left to right (1mk)

(a) Complete the table below.

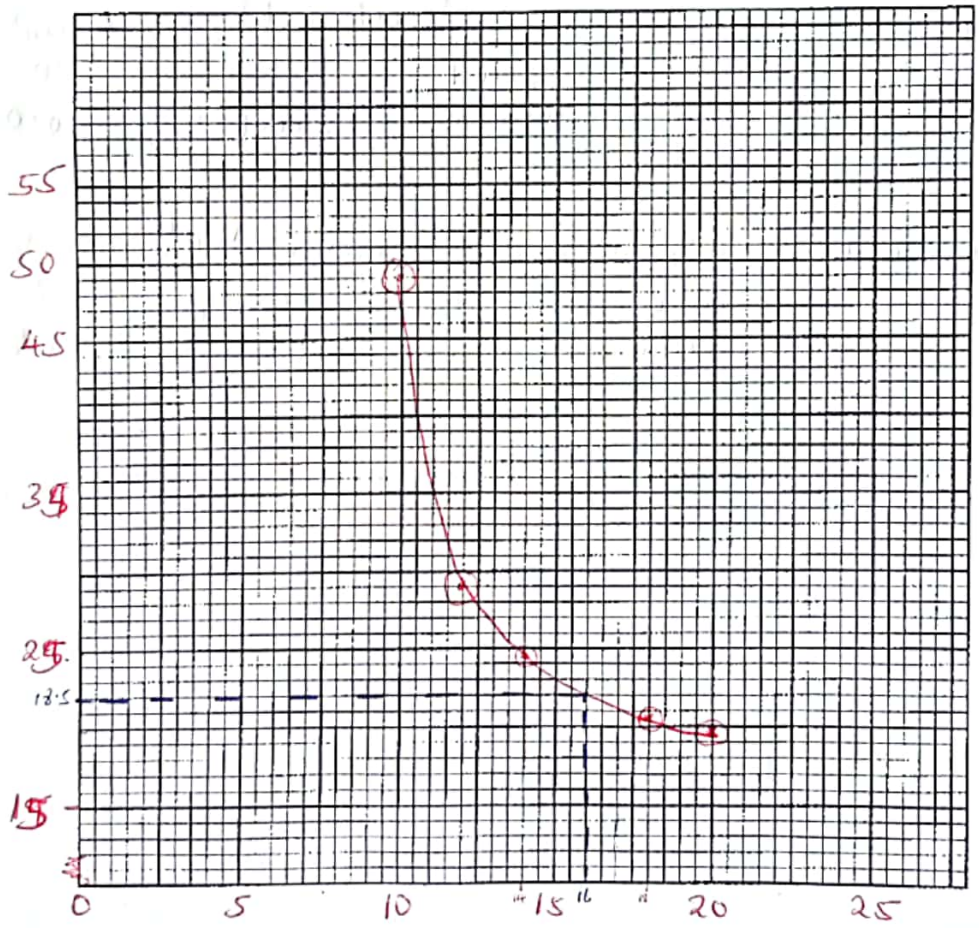
Table I

Experiment	1	2	3	4	5
Volume of Sodium hydrogen sulphate ($NaHSO_3$) used	5	5	5	5	5
Volume of distilled water used (cm^3)	15	17	21	23	25
Volume of potassium iodate (KIO_3 (aq) used in cm^3	20	18	14	12	10
Time taken to change colours (secs)	196	205	246	238	490

(4 marks)

(b) On the grid below plot a graph of time taken (secs) for the colour change (vertical axis) against volume of aqueous potassium iodate used (cm^3).

(3 marks)



Time taken for change of colour in seconds x10

✓ Appropriate vertical scale, highest point should be over half-way up the y-scale ✓ (1mk)
Scale (1mk)
Plotting (1mk)
✓ All 5 points plotted correctly ✓ (1mk)
Curve (1mk)
✓ Suitable best fit curve drawn (Smooth single curve only) ✓ (1mk)

(c) (i) From your graph determine the time taken for the blue colour to appear if 16 cm^3 of aqueous potassium iodate was used. (Show clearly on the graph how you worked out your answer). (1 mark)

$18.5 \times 10^1 = 185$ seconds ✓1 Time correct for their working

(ii) Calculate the volume of distilled water required if 16 cm^3 of aqueous potassium iodate was used. (1 mark)

$35 - 16 = 19\ cm^3$ ✓1

(d) On the graph sketch the graph that could be expected if the above experiment's were done at a higher temperature. Explain. (1 mark)

Increase in temperature ✓½ leads to increase in rate of reaction or less time taken to react.

- line is below plotted line and does not meet/touch the plotted line ✓½

(e) Calculate the concentration of potassium iodate solution in moles per litre in the final reaction mixture in the experiment 1. (2 marks)

0.05 mole of KIO_3 — 1000 cm^3
x — 20 cm^3

$x = \frac{0.05 \times 20}{1000}$ ✓1
$= 0.001$ moles

0.001 moles KIO_3 — 45 cm^3
x — 1000

$x = \frac{0.001 \times 1000}{45} = 0.02222\ M$ ✓1

(f) How does the concentration of potassium iodate solution A_1, affect its rate of reaction with acidified sodium hydrogen sulphate A_2? Explain your answer. (2 marks)

Increase in concentration leads to increase in the rate of reaction hence less time to react. The more the concentration (moles) number of particles leads to more collisions hence more reacting hence less time taken to react.

2. **You are provided with:**
   - Solution B, which is 0.05M acidified potassium manganite (VII) solution ($KMnO_4$).
   - Solution C, containing 5.0g/l of a dibasic acid, $H_2A.2H_2O$

You are required to:
- Determine the concentration of dibasic acid H_2X, solution c and then the formula mass of X.

Procedure II

1. Fill the burette with solution B.
2. Using a clean pipette, place 25 cm^3 of solution C into a clean conical flask. Heat this solution to about 70^0c.
3. Titrate using solution B until a permanent pink colour just appears. Shake thoroughly during titration.
4. Record the reading in table I below.
5. Repeat the titration one more time to complete the table below.

$C_2O_4^{2-}$

6 ✓
24
28

(a) Complete the table I below.

Table I

	I	II
Final burette reading (cm^3)	8.0	8.0
Initial burette reading (cm^3)	0.0	0.0
Volume of solution b used cm	8.0	8.0

cT
d.p
Ae

(3 marks)

(b) Determine the average volume of solution B used. (1 mark)

$\frac{8.0+8.0}{2} = \frac{16.0}{2} = 8.0\ cm^3 \pm 0.2$

(c) Calculate:

(i) The number of moles of manganite (VII) ions in the average volume of solution B used above. (1 mark)

0.05 moles ——— 1000 cm^3
x ——— 8 cm

$x = \frac{0.05 \times 8}{1000} = 0.0004$ moles ✓1

(ii) Given that 2 moles of manganite (VII) ions react with 5 moles of dibasic acid $H_2X.2H_2O$. Calculate the number of moles of the diabasic acid $H_2X.2H_2O$ in the 25 cm^5 of solution C. (2 marks)

$MnO_4^- : H^+$
2 : 5 ✓1
0.0004 : x

$x = \frac{0.0004 \times 5}{2}$
$= 0.001$ moles ✓1

(iii) The concentration of solution C in moles per litre. (1 mark)

0.001 moles of C ——— 25 cm^3
x ——— 1000 cm^3

$x = \frac{0.001 \times 1000}{25}$
$= 0.04M$ ✓

(iv) Calculate the formula mass of X in the diabasic acid $H_2A.2H_2O$ (H = 1, O = 16) (2 marks)

$H_2C_2O_4 \cdot 2H_2O$
88

$\text{Molarity} = \frac{g/L}{R.Fm}$

$0.04 = \frac{5g/L}{x}$ ✓1

$x = 5 \div 0.04 = 125$

$H_2A \cdot 2H_2O = 125$

$2 + x + 2(18) = 125$

$x = 125 - 36 - 2$
$= 87$ ✓1

5

$AlCl_3$ (aq)

3. You are provided with solution Q. Carry out the tests below. Write your observations and inferences in the spaces provided.

Place about 2 cm^3 of the solution in five separate test-tube.

(a) To the first portion, add aqueous sodium hydroxide drop wise until in excess.

Observations	Inferences
White precipitate ½ Soluble in excess ½ (1 mark)	Zn^{2+}, Al^{3+}, Pb^{2+} ions present (1 mark)

(b) To the second portion, add aqueous ammonia dropwise until in excess.

Observations	Inferences
White precipitate ½ Insoluble in excess ½ (1 mark)	Al^{3+}, Pb^{2+} ions present (1 mark)

(c) To the third portion, add 3 drops of dilute hydrochloric acid.

Observations	Inferences
NO white precipitate ½ NO effervescence ½ (1 mark)	Al^{3+} present, Pb^{2+} absent ½ (Any one) SO_3^{2-}, CO_3^{2-}, HCO_3^- absent ½ Any two (1 mark)

(d) To the fourth portion, add 3 drops of barium nitrate solution.

Observations	Inferences
NO white precipitate (1 mark)	SO_4^{2-} absent (1 mark)

(e) To the last portion, add 3 drops of lead (II) nitrate solution then warm the mixture.

Observations	Inferences
White precipitate that dissolves on warming ✓1 (1 mark)	Cl^- present ✓1 (1 mark)

4. You are provided with solid **R**. Carry out the tests below. Write your observations and inferences in the spaces provided. - maleic acid

i). Place one third of solid R on a metallic spatula. Burn it in non-luminoius flame of the Bunsen burner.

Observations ✓1	Inference ✓1
Burns with a yellow sooty flame. (½ mark)	$\dot{C}=\dot{C}$, $-C\equiv C-$ present (½ mark)

ii). Place the remaining solid in a test-tube. Add about 6 cm^3 of distilled water and shake the mixture well. Retain the solution for the next procedure.

Observations	Inferences ✓½
Dissolves to form a colourless solution ✓½ homogenous mixture (½ mark)	Polar compound (½ mark)

(I) In another 2 cm^3, add 2 drops of acidified potassium manganite (VII).

Observations	Inferences
Acidified potassium manganate (VII) changes colour from purple to ✓1 colourless (1 mark)	$\dot{C}=\dot{C}$, $-C\equiv C$, R-OH present ✓1 (1 mark)

Any two ✓½

(II) To about 1cm^3, add 3 drops of acidified potassium dichromate (VI) and warm.

Observations	Inferences
yellow Acidified potassium dichromate (VI) ~~changes colour from~~ remains yellow ✓½ (½ mark)	R-OH absent ✓½ (½ mark)

(III) To about 2 cm^3 of the solution, add 1g of solid D; sodium hydrogen carbonate.

Observations	Inferences
~~Effervesce~~ and bubbles of a colourless gas given out ✓½ (½ mark)	H^+, H_3O^+, $R-\overset{O}{\overset{\|\|}{C}}-O-H$ ✓½ present (½ mark)