SERIES 4 EXAMS
Kenya Certificate of Secondary Education
CHEMISTRY
PAPER 3

MARKING SCHEME

1.

Titration	I	II	III
Final burette reading (cm^3)	30.1	30.1	30.1
Initial burette reading (cm^3)	0.0	0.0	0.0
Volume of solution C1 used (cm^3)	30.1	30.1	30.1

CT – 1
D – 1
A – 1
AV -1
FA – 1
    05

(a)   - Complete table   1 mark
    - Consistent use of decimal   1 mark
    - Penalise fully for mixed decimal
    - Accuracy
        If $\pm$ 0.1 SV   1 mark
            $\pm$ 0.2 SV   ½ mark
    - Principles of averaging

        $\frac{30.1 + 30.1 + 30.1}{3}$ √ ½ mark   = 30.1 cm^3 √ ½

    - Final answer 1 mark
        Rounded to atleast 2 dp
        Penalise fully if rounded to less than 2 dp
    - If average titre within $\pm$ 0.1 of S.V 1 mark

(b)   Number of moles of the acid, C$_1$ that reacted

    Moles of NaOH reacting
        If 1000cm^3 0.2 moles
        25cm^3 ? √ ½ mark

    = $\frac{25}{1000}$ x 0.2 √ ½ mark

            = 0.005 moles
    - Since the acid is dibasic, mole ratio of acid : base
    is 1 : 2 i.e $H_2C_2O_4$. XH_2O : NaOH
            1   : 2   √ ½ mark

Thus 2 moles of NaOH react with one mole of acid

2 moles of NaOH   1 mole of acid $\sqrt{}$ ½ mark

0.005 moles   ?

$$= \quad \frac{0.005 \times 1}{2} \quad \sqrt{} \text{ ½ mark}$$

= 0.0025 moles $\sqrt{}$ ½ mark

(c) Concentration of the acid

If 30.1cm^3 0.0025 moles

1000cm^3 $\sqrt{}$ ½ mark

$$= \quad \frac{1000}{30.1} \times 0.0025 \quad \sqrt{} \text{1 mark}$$

=0.0831 moles / litre $\sqrt{}$ ½ mark

(d) RMM of acid

$$\text{Molarity} \quad = \quad \frac{\text{g/litre}}{\text{RMM}}$$

$$\text{RMM} \quad = \quad \frac{\text{g/litre}}{\text{Molarity}}$$

g/litre

500cm^3 contain 5.04g $\sqrt{}$ ½ mark

1000cm^3 ?

$$= \quad \frac{1000}{500} \times 5.04 \quad \sqrt{} \text{ 1 mark}$$

= 10.08g $\sqrt{}$ ½

Thus RMM = $\frac{10.08}{0.0831}$ $\sqrt{}$ ½ mark

=121.3 $\sqrt{}$ ½ mark

= 121

(d) Value of X

$H_2C_2O_4 . XH_2O = 121$ $\sqrt{}$ ½ mark

90 + 18x = 121

18x = 121 – 90 $\sqrt{}$ 1 mark

x = 1.7

x = 2 $\sqrt{}$ ½ mark

2.   (a)

Total volume of water added to 5g of solid K (cm^3)	10	15	20	25	30	35
Temperature at which crystals appear (^{0}C)	86	67	57	48.5	42	39
Solubility of K in g/100g of water	50	33.3	25	20	16.7	14.3

2

(i)   Complete table (column I)   2 marks
       Incomplete table with 5 readings   2 marks
       Incomplete table with 4 readings   1 mark
       3 and below readings   0 mark

(ii)   Use of decimals   1 mark
       Whole numbers or 1dp (applies to column I)

(iii) Accuracy   ½ mark
       ± 2.0 of S.V   ½ mark
       If otherwise   0 mark

(iv)   Trend ½ mark
       ½ mark for continuous drop in temperature readings in column I, otherwise penalize fully.
       Column II   2 marks
       - ½ mark for each value of solubility correctly calculated

(b)

Graph of solubility of K

Solubility of solid (g/100g of water)

Labelling	½ mark
Scale	½ mark
Plotting	1 mark
Curve	1 mark
	03

Temp (⁰C)

4
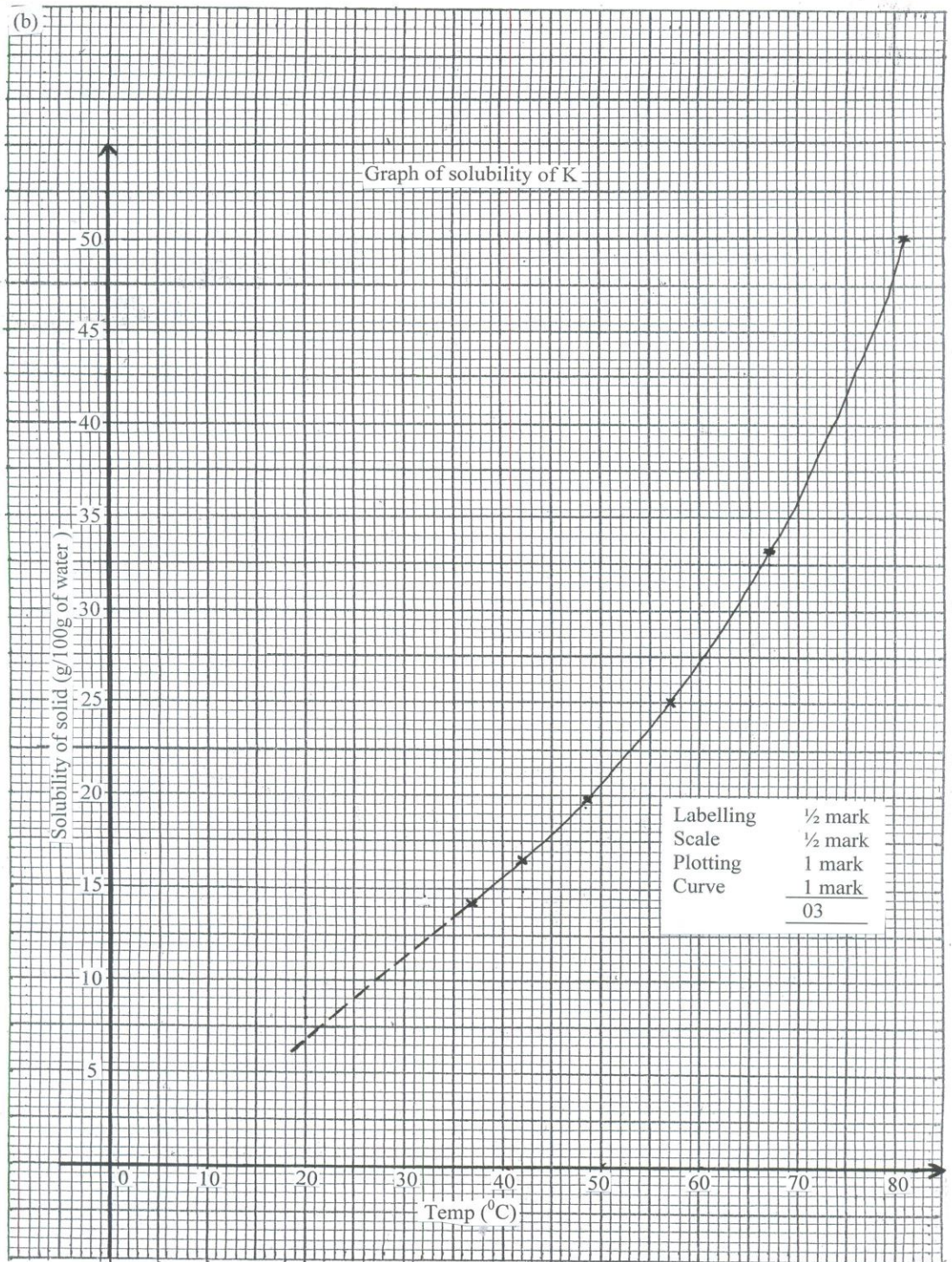
(c)   (i)   Solubility at 25^0C 1 mark
              (Shown in graph) Penalise ½ mark for wrong units
              - From extrapolated graph = 8.5g / 100g pf H_2O

      (ii)   Temperature when solution will contain 22g
              - Penalise ½ mark for wrong units.

(d)   Mass of solid K   (1 mark
       At 52^0C = 21.5 g/100g of H_2O
       At 37^0C = 14.0 g/100g of H_2O
            21.5 – 14.0 = 7.5g

3.

	OBSERVATIONS	INFERENCES
(a)	Blue green flame √ ½	Cu^{2+} present √ ½
b) (i)	White ppt √ ½ soluble in excess √ ½	Zn^{2+}, Pb^{2+}, Al^{3+} present All 3 mentioned 1 mark 2 mentioned - ½ mark Only one – 0 mark
(ii)	White ppt formed √ ½ soluble in excess √ ½	Zn^{2+} present √ ½
(iii)	White ppt formed √ ½ Insoluble on warming √ ½	$SO_4^{\ 2-}$ present √ ½
(iv)	White ppt formed √ ½ insoluble on adding HCl	$SO_4^{\ 2-}$ present √ ½
c)	Effervescence / bubbles formed √ ½	CO^{2-}_3 present √ ½ ($HCO_3^{\ -}$, $SO_3^{\ 2-}$ present
d) (i)	Burns with a yellow sooty flame √ ½	- C = C - , - C C - present √ ½
(ii) I)	Effervescence of a colourless gas √ ½	Acidic substance √ ½ Accept H^+ / H_3O^+ present / RCOOH present
II)	Sweet fruity smell √ ½	R – COOH present √ ½
III)	Purple colour of $KMnO_4$ turns colourless √1	C = C , - C C - , R – OH present √1 Named 3 – 1 mark Named 2 – ½ mark But no mark if R – OH only

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Requirements for candidates.
In addition to the fittings and apparatus that are commonly in a chemistry laboratory, each candidate requires:

1. 50ml burette.
2. 25 ml pipette.
3. 2 conical flasks.
4. Solution C_1 – about 100cm^3.
5. Solution C_2 – about 100cm^3.
6. White tile.
7. Stand and clamp.
8. Solid K – 5g exactly.
9. 10ml measuring cylinder.
10. One 250 ml glass beaker.
11. 2 boiling tubes.
12. Thermometer.
13. Means of heating.
14. Distilled water in a wash bottle.
15. Solid F – About 3g.
16. Solid P – about 3g
17. Metallic spatula.
18. Filter paper.
19. Filter funnel.
20. Stirring rod.
21. 6 test tubes.
22. About 1g sodium hydrogen carbonate.
23. Test tube holder.

ACCESS TO:

- 2M NaOH
- 2M NH_4OH
- 0.25M $Pb(NO_3)_2$
- 0.25M $BaCl_2$
- 2M HCl
- Phenolphthalein indicator.   All supplied with droppers
- Access to conc. H_2SO_4
- Access to acidified $KMnO_4$.
- Access to ethanol

PREPARATION OF SOLUTIONS / SOLIDS

- Solid K

- Solid K – Potassium chlorate (V).

- Solution C_1 is prepared by dissolving 10.08g of oxalic acid in about 500cm^3 and making to one litre.

- Solution C_2 is prepared by dissolving 8g of NaOH pellets in about 500cm^3 of distilled water and making to 1 litre of solution.

- Solid F is a mixture of $CuCO_3$ and $ZnSO_4$ in the ratio 4 : 3 by mass respectively

- Solid P is oxalic acid.