1904/106
SCIENCE LABORATORY TECHNIQUES I: PRACTICAL
June/July 2018
Time: 4 hours

THE KENYA NATIONAL EXAMINATIONS COUNCIL

# CRAFT CERTIFICATE IN SCIENCE LABORATORY TECHNOLOGY

## MODULE I

SCIENCE LABORATORY TECHNIQUES I: PRACTICAL

4 hours

**INSTRUCTIONS TO CANDIDATES**

*You should have the following for this examination:*
*Answer booklet;*
*Scientific calculator (battery operated).*
*Answer **ALL** questions.*
*Maximum marks for each part of the question are indicated.*
***Candidates should answer the questions in English.***

**This paper consists of 7 printed pages.**

**Candidates should check the question paper to ascertain that all the pages are printed as indicated and that no questions are missing.**



**Turn over**

1. (a) You are provided with:

- 150 $cm^3$ of 0.1 M HCl
- 250 $cm^3$ of a solution of an impure mixture of $NaHCO_3$ and $Na_2CO_3$.
- Methyl orange indicator.
- Phenolphthalein indicator.
- 25 $cm^3$ pipette
- Burette (0 - 50 $cm^3$).
- Other common apparatus found in a chemistry laboratory.

(b) You are required to determine the concentration of each salt in the sample, in ppm.

(c) **Part I: Proceed as follows.**

(i) Fill the burrette with the 0.1M HCl solution.

(ii) Pipette 25 $cm^3$ of the sample solution into a clean conical flask and add 4 drops of phenolphthalein indicator.

(iii) Titrate the sample with the acid until a permanent colour change occurs.

(iv) Repeat the experiment three more times and tabulate your results as shown in table I.

Table 1

| | Trial | | |
|---|---|---|---|
| | 1st | 2nd | 3rd |
| Final burette reading in $cm^3$ | 31.0 | 32.0 | 34.0 |
| Initial burette reading in $cm^3$ | 0.0 | 0.0 | 0.0 |
| Titre volume in $cm^3$ | 31.0 | 32.0 | 34.0 |

(5 marks)

Average titre volume = _____ $cm^3$ 32.3
Let this titre volume be $V_1$.

(d) Given that the reaction that takes place during this titration is

$$H^+_{(aq)} + CO_3^{2-}{}_{(aq)} \longrightarrow HCO_{3(aq)}^- \text{-------(1)}$$

H=1
C=12
O=16*3=48 =61

Calculate:

(i) moles of acid used (2 marks)

(ii) moles of $Na_2CO_3$ used (2 marks)

(iii) moles of $Na_2CO_3$ in the whole solution. (2 marks)

(iv) mass of $Na_2CO_3$ in the sample.
(Na = 23, C = 12, O = 16) (2 marks)

(v) the concentration of Na2CO3 in the 3.5 g sample in ppm. (2 marks)

(e) **Part II: Proceed as follows:**

(i) Fill the burette with 0.1M HCl solution.

(ii) Pipette 25 $cm^3$ of the sample solution into a clean conical flask and add 4 drops of methyl orange indicator.

(iii) Titrate the sample with the acid until a permanent colour change occurs.

(iv) Repeat the experiment three more times and tabulate your results as shown in Table II.

Table II

| | Trial | | |
|---|---|---|---|
| | 1st | 2nd | 3rd |
| Final burette reading in $cm^3$ | | | |
| Initial burette reading in $cm^3$ | | | |
| Titre volume in $cm^3$ | | | |

(5 marks)

Average titre volume = _____ $cm^3$
Let this titre volume be $V_2$.

(f) Given that the reactions that take place during this titration are:

$2H^+_{(aq)} + CO_3^{2-}{}_{(aq)} \longrightarrow H_2O_{(l)} + CO_{2(g)}$ —— (2)

$H^+_{(aq)} + HCO_3^-{}_{(aq)} \longrightarrow H_2O_{(l)} + CO_{2(g)}$ —— (3)

Calculate:

(i) titre volume for reaction (2) (2 marks)

(ii) titre volume for reaction (3) (2 marks)

(iii) moles of acid used in reaction (3) (1 mark)

(iv) moles of $NaHCO_3$ used during titration. (2 marks)

(v) moles of $NaHCO_3$ in the whole solution. (2 marks)

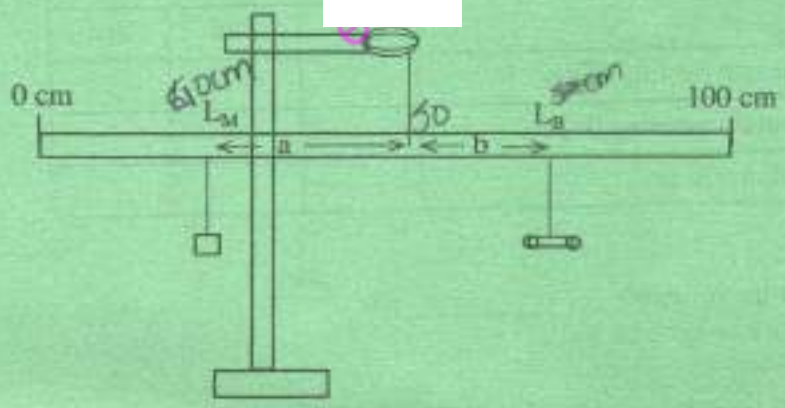
(vi) mass of $NaHCO_3$ in the sample. (2 marks)
(Na = 23, H = 1, C = 12, O = 16)

(vii) the percentage of $NaHCO_3$ (w/w) in the sample of mass 3.5 g. (2 marks)

2. You are provided with the following:

- 1 wooden metre rule
- 100 g mass with a hook
- 2 dry cells (1.5 V each)
- 2 metre ordinary sewing thread
- 1 resort stand and clamp

(a) Set up the apparatus as shown in the figure below



(b) (i) Balance the metre rule using the sewing thread and note the graduation mark M (cm) on the scale.

(ii) Attach the 100 g mass at graduation mark $L_M$ (40 cm) and identify the graduation mark $L_B$ on the other side of M where the batteries balance the metre rule.

(iii) Record both $L_M$ and $L_B$ in table III.

(iv) Change position $L_M$ of 100 grams to 35 cm, 30 cm, 25 cm and 20 cm mark. For each position determine the corresponding position $L_B$ of the battery necessary to balance the metre rule.

(v) Record values of $L_M$ and $L_B$ for each position in table III.

Graduation mark M = 50cm (1 mark)

Table III

| Location of 100 g mass ($L_M$) | Distance from pivot $a = M - L_M$ | Location of battery ($L_B$) | Distance from pivot $b = L_B - M$ |
|---|---|---|---|
| 40 | | | |
| 35 | | | |
| 30 | | | |
| 25 | | | |
| 20 | | | |
| | (5 marks) | (5 marks) | (5 marks) |

(c) (i) Fill column $a = M - L_M$ and $b = L_B - M$ in the table.

(ii) Plot a graph of a against b. (7 marks)

(iii) Calculate the gradient of the graph. (3 marks)

(iv) Determine the value of $M_b$ from the equation

$$\text{Gradient} = \frac{M_b}{0.100 \times 9.8}$$ (2 marks)

(v) State the physical quantity represented by $M_b$. (1 mark)

(vi) State the principle applied by using the equation from (iv) above. (1 mark)

(vii) State the advantage of using gradient instead of individual data of a/b in (iv) above. (1 mark)

(viii) State **three** possible sources of error in this experiment. (3 marks)

3. You are provided with:

- Two leaves W and X.
- Light microscope.
- Clear varnish.
- 4 glass slides labelled $X_1$, $X_2$, $W_1$, $W_2$.
- Graph paper.
- Ruler.
- Scalpel blade

(a) Proceed as follows:

(i) Apply the clear varnish on the upper surface of leaf W and X.

(ii) Let the varnish dry for 5 minutes.

(iii) Peel off the dry layer of varnish from each leaf using a scalpel blade.

(iv) Place the layer from leaf W on the glass slide marked $W_1$ and the layer from leaf X on the glass slide marked $X_1$.

(v) Observe each slide in turn using the light microscope.

(vi) Count and record the number of stomata within the field of view in table IV.

Table IV

| | Leaf W | Leaf X |
|---|---|---|
| Number of stomata on upper leaf surface | | |

(2 marks)

(b) (i) Repeat the experiment in (a) above but this time apply the varnish on the lower leaf surface.

(ii) Place the dry varnish layer from leaf W and X on slide $W_2$ and $X_2$ respectively.

(iii) Record the number of stomata in table V.

Table V

| | Leaf W | Leaf X |
|---|---|---|
| Number of stomata on lower leaf surface | | |

(2 marks)

(c) (i) Using a ruler obtain the diameter of the Field of View (FOV) of your microscope.
Diameter _____ (cm or mm) (1 mark)

(ii) Calculate the area of field of view. (Show your working) (3 marks)

(d) Trace leaf outlines of the two leaves, W and X on a graph paper, and estimate the area of:

(i) Leaf W (2 marks)
(ii) Leaf X (2 marks)

(e) From the results obtained in (c) and (d) above, estimate the total number of stomata on the upper and lower surfaces of leaf W and leaf X. Show your working.

Table VI

| | Surface of Leaf W | | Surface of Leaf X | |
|---|---|---|---|---|
| | Upper | Lower | Upper | Lower |
| Total number of stomata | | | | |

(8 marks)

(f) Explain your observation for leaf W. (4 marks)

(g) Comment on the number of stomata on the lower surfaces of the two leaves. (4 marks)

(h) Give **two** roles of these stomata in plants. (1 mark)

(i) State **two** adaptations of the stomata to their functions in plants. (4 marks)

Are closely spaw to allow more stomata to photosynthesis

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