THE KENYA NATIONAL EXAMINATIONS COUNCIL

DIPLOMA IN FOOD SCIENCE AND PROCESSING TECHNOLOGY

MODULE I

APPLIED SCIENCE AND MICROBIOLOGY PRACTICAL

4 hours

INSTRUCTIONS TO CANDIDATES

You should have the following for this examination:
Answer booklet;
Non-programmable scientific calculator.
*This paper consists of **THREE** practical tests.*
*Carry out **ALL** practical tests and answer **ALL** the questions in the answer booklet provided.*
Candidates should answer the questions in English.

This paper consists of 5 printed pages.

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

1. You are provided with the following:

- 500 mL glass beaker;
- Clamp plus stand;
- Distilled water;
- 200 g salt;
- Clear plastic ruler;
- Digital weighing scale;
- Ordinary pins.

You are required to determine the refractive index of:

(i) distilled water;
(ii) salt solutions of 4%, 8% and 16% w/w basis.

A Procedure

1. Pour distilled water in a glass beaker up to the 500 mL mark. Measure the height of the water in the beaker and record it as 'Y' cm in table I. – 8 5
2. Place an object pin at the bottom of the beaker with water. Fix the other pin (search pin) on a clamp as shown in diagram 1. Move the search pin up and down adjacent to the beaker until there is no parallax between the search pin and the image of the object pin at the bottom of the beaker. Note the position and measure its distance from the surface of the water. Record this distance as distance 'X' cm in table I.
3. Calculate the amount of salt in grams required to make the 4%, 8% and 16% salt solutions in table I. (4 marks)
4. Add the of amount salt in the water in the beaker to make 4% salt solution. Record distance 'X' and 'Y' for the solution. Repeat the procedure for 8% and 16% solutions. Record the respective distances 'X' and 'Y' in table I. (12 marks)

Diagram 1

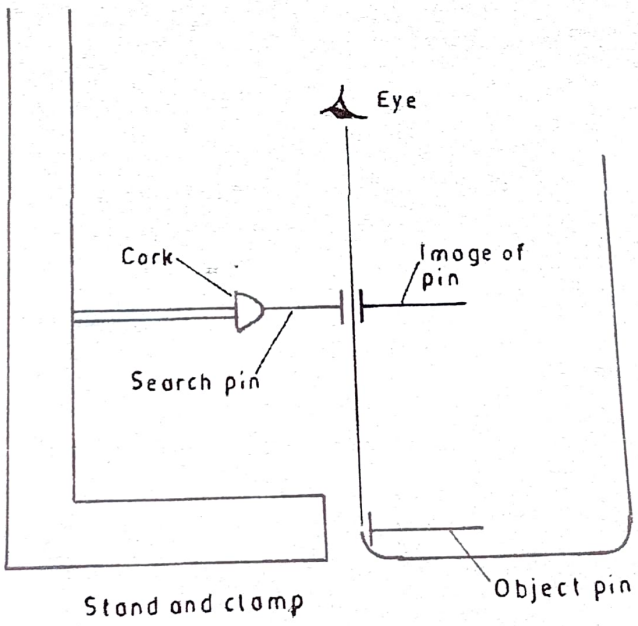

Table I

Experiment	% salt added in water	Amount of salt(g) added	Height of water Column (Y cm)	Height of water Column (X cm)
1	0	0	8.5	8.5
2	4	4	9.	8.2
3	8	8	9.2	8
4	16	16	9.4	7.6

B Exercise

(a) Calculate the refractive index for each of the four experiments in table I. (9 marks)

(b) From the refractive indices obtained in (a), explain the relationship between the refractive index and salt concentration. (3 marks)

(c) Calculate the percentage change in volume of salt solution during the four experiments. (3 marks)

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

2. You are provided with the following:

- 0.5 M copper (ii) sulphate solution labelled **A**;
- Metal **B** powder labelled solid $\mathbf{B_1}$;
- Iron powder labelled solid $\mathbf{B_2}$;
- 0.02 M acidified potassium manganate (vii) solution labelled **C**.

You are requires to determine the:

(i) enthalpy change for the displacement reaction between metal **B** and copper (ii) sulphate;

(ii) Mass of iron that reacts with copper (ii) sulphate in the displacement reaction.

A Procedure I

(a) (i) Using a pipette, place 25.0 cm^3 of solution **A** into a 100 cm^3 plastic beaker. Allow to stand for 1 minute and then measure the temperature of the solution. Record your reading in table II as the initial temperature.
Add all of solid $\mathbf{B_1}$ to the solution. Stir mixture carefully with a thermometer and measure the highest temperature reached. This will take approximately 5 minutes. Record the reading in table II as maximum temperature reached. and calculate the change in temperature. (3 marks)

Table II

Maximum Temperature reached (°C)	28
Initial temperature (°C)	20
Change on temperature, ΔT_1 (°C)	8

(ii) Calculate the:

(I) number of moles of copper (ii) sulphate used. (1 mark)

(II) enthalpy change for the reaction of solid $\mathbf{B_1}$ (metal **B**) with one mole of copper (ii) sulphate, assuming that the specific heat capacity for the mixture = $4.2\,Jg^{-1}K^{-1}$ and density = $1.0\,g\,cm^{-3}$. (2 marks)

(b) Repeat procedure I (a) (i) with all solid $\mathbf{B_2}$ (*iron powder*) in place of solid $\mathbf{B_1}$. The maximum temperature is reached in about 8 minutes. Record the temperature readings in table III and calculate the change in temperature. Retain the mixture for procedure II. (3 marks)

(c) Compare the changes in temperature ΔT_1 and ΔT_2 and comment on the differences. (3 marks)

Table III

Maximum Temperature reached (°C)	20
Initial temperature (°C)	20
Change on temperature, ΔT_2 (°C)	0

B Procedure II

(a) Fill the burette with solution **C**.

(b) Filter the mixture obtained in procedure I(b) into a 250 cm^3 volumetric flask. Wash the residue with distilled water and add into the flask. Add more distilled water to make up to the mark. Label this solution $\mathbf{B_2}$.

(c) Using a pipette, place 25 cm^3 of solution $\mathbf{B_2}$ into a 250 cm^3 conical flask. Titrate solution $\mathbf{B_2}$ with solution **C** until a permanent pink colour appears. Record the readings on table IV. (9 marks)

(d) **Table IV**

	I	II	III
Final burette reading	11.0	11.0	10.9
Initial burette reading	0.0	0.0	0.0
Volume of solution **C** used (cm^3)	11.0	11.0	10.9

(e) Calculate the average volume of solution C used. (2 marks)

(f) The reaction equation between Manganet (viii) and Iron II ions is

$$MnO_4^-{}_{(aq)} + 5Fe^{2+}{}_{(aq)} + 8H^+{}_{(aq)} \longrightarrow Mn^{2+}{}_{(aq)} + 5Fe^{3+}{}_{(aq)} + 4H_2O_{(aq)}.$$

Calculate the number of moles of:

(i) Potassium Manganet (vii) used (2 marks)
(ii) Iron (ii) ions in 25 cm^3 solution B_2. (3 marks)
(iii) Iron that reacts with copper (ii) sulphate. (2 marks)
(iv) Determine the mass of iron that reacted (RAM of Fe = 55.8). (3 marks)

3. (a) You are provided with the following:

- Microorganism labelled **X** growing on nutrient agar;
- 1 microscope slide;
- 1 wire loop;
- Bunsen burner;
- Distilled water in a wash bottle;
- Carbolfuchsin solution;
- Staining tray;
- Immersion oil;
- Microscope with 10X, 40X, 100X objectives
- A dropper;
- Blotting paper;
- Lens paper.

(i) Make a smear of the micro-organism provided using simple staining technique
Outline the procedure followed. (10 marks)
(ii) Explain the principles of the simple staining procedure. (7 marks)
(iii) Describe the appearance of microorganisms. (3 marks)

(b) (i) Identify the equipment labelled 'Y' stating its functions. (2 marks)
(ii) Outline the procedure for operating the equipment 'Y'. (8 marks)
(iii) State safety precautions observed while operating equipment 'Y'. (3 marks)

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