2913/106
APPLIED SCIENCE AND
MICROBIOLOGY PRACTICAL
Oct./Nov. 2021
Time: 4 hours

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; **I, II** and **III**.*
*Carry out **ALL** the practical tests and answer **ALL** the questions in the answer booklet provided.*
Materials, tools and equipment for this examination are provided by the training institution.
Candidates should answer the questions in English.

This paper consists of 8 printed pages.

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

1. **You are provided with the following:**

1.) A voltmeter;
2.) Two dry cells and a cell holder;
3.) A switch;
4.) A resistor labelled $R(4\,\Omega)$;
5.) A wire mounted on a millimeter scale labelled **G;**
6.) A micrometer screw gauge (to be shared);
7.) Six connecting wires with six crocodile clips.

Proceed as follows

(a) (i) Record the length, L_0 of the wire labelled **G**. (1 mark)

(ii) Use the micrometer screw gauge provided to measure the diameter of the wire labelled **G** at two different points and determine the average diameter, d. (3 marks)

(iii) Determine the radius of the wire in metres. (1 mark)

(b) Set up the apparatus as shown in Figure 1.

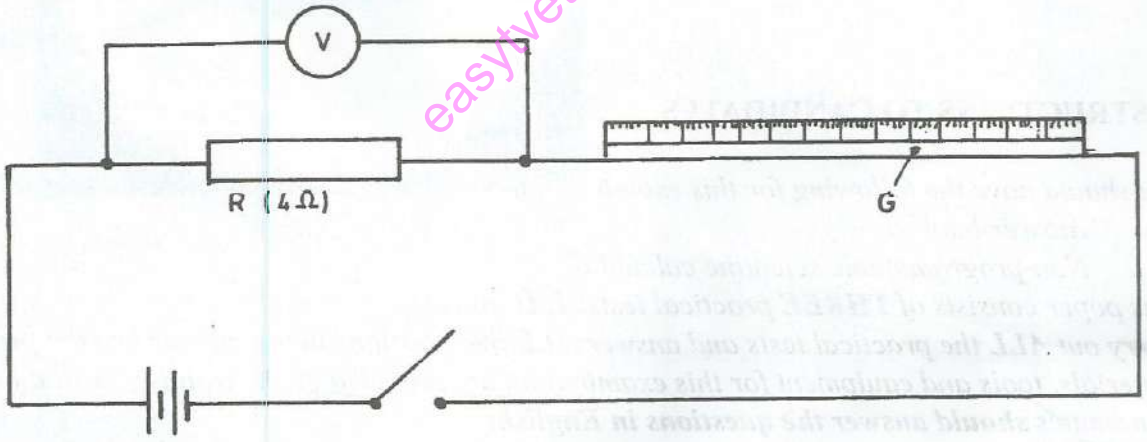


Fig.1

(i) Use the voltmeter provided to measure and record the potential differences V_R across R and the potential differences, V_G across G when the switch is closed, then open the switch. (2 marks)

(ii) Use the value of R indicated and the value of V_R measured and recorded in (i) above to calculate the current I flowing through R when the switch was closed. (2 marks)

(iii) Determine the constant H given that $H = \frac{100\,V_G}{I \times L_0}$. (2 marks)

(c) Connect the voltmeter across R as shown in Figure 2.

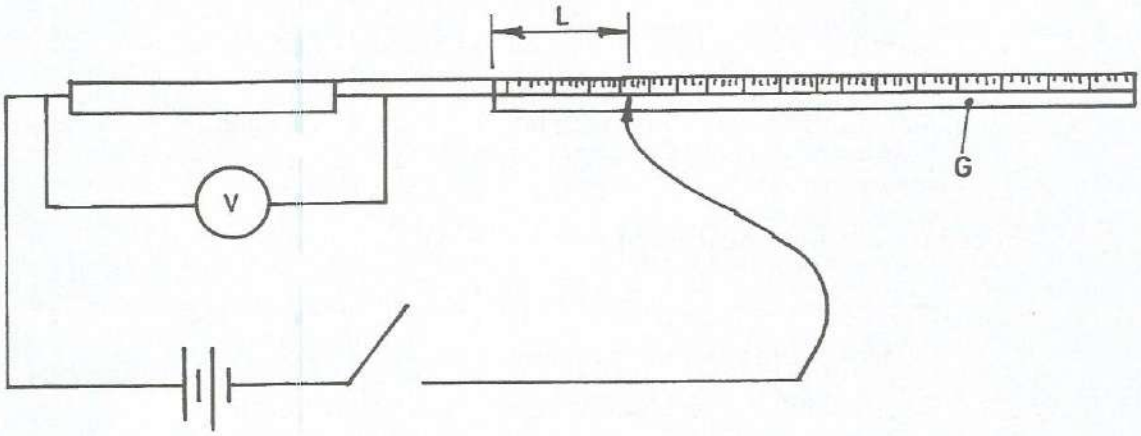


Fig. 2

Adjust the position of one crocodile clip on the wire **G** to a point such that the length, L of the wire in the circuit is 5 cm. Close the switch then read and record in table I the value of potential difference across R. Open the switch.

(d) Repeat the procedure in (c) above for other values of l shown in table 1 below. (8 marks)

Table I

Distance l, (cm)	0	5	10	20	30	40	60	70
p.d, V_R across R (V)	0	2.	0.9.	0.7.	0.5	0.4	0.3	0.2.

(c) (i) Plot a graph of, V_R, (V)against l (cm). (9 marks)

(ii) From the graph, determine l_1, the value of l when $V_R = \frac{V_0}{2}$ where V_O is the potential difference when $l = 0$. (2 marks)

(f) Determine the constant D for the wire given that $D = \frac{R}{l_1} \times \frac{300}{V_0}$. (2 marks)

(g) Determine the constant P given that $P = \frac{\pi r^2}{2}(D + H)$ where r is the radius of the wire in metres. (2 marks)

2. (a) **You are provided with the following:**

1.) Sodium hydroxide pellets;
2.) Phenolphthalein indicator;
3.) Citric acid solution, $C_3H_50(COOH)_3$, 192.12 g/mol;
4.) Potassium acid phthalate $KHC_8H_4O_4$, 204.228 g/mol;
5.) Metallic compounds labelled **P, Q, R** and **S** in a 50 ml beaker.

(b) **You are required to:**

1.) Identify the metallic ions present in the metallic compound solutions using flame test;
2.) Prepare a 0.1 M sodium hydroxide solution;
3.) Standardize the solution with potassium acid phthalate;
4.) Determine the molarity of the citric acid solution.

(c) **Procedure for identification of metallic ions.** (8 marks)

(i) Clean the wire loop provided by dipping it into concentrated hydrochloric acid and then hold it in a hot Bunsen burner.

(ii) Repeat until the wire loop produces no colour in flame.

(iii) When the wire is clean, moisten it again in the concentrated hydrochloric acid and then deep it into a beaker containing metallic compound solution labelled **P** and record your observation.

(iv) Repeat procedure (iii) above for samples **Q, R** and **S**.

(v) Record your observation and inferences in table format.

(d) **Procedure for preparation and standardization of 0.1 M sodium hydroxide solution.**

(i) Calculate the mass of sodium hydroxide required to prepare $250\,cm^3$ of 0.1 M sodium hydroxide solution. (2 marks)

(ii) Weigh the mass of sodium hydroxide calculated in d (i) above.

(iii) Record the exact mass of sodium hydroxide weighed in d (ii) above. (1 mark)

(iv) Transfer the sodium hydroxide weighed into a $250\,cm^3$ beaker, add $100\,cm^3$ of CO_2 free water, stir with a glass rod until the sodium hydroxide is completely dissolved.

(v) Quantitatively, transfer the solution into a $250\,cm^3$ volumetric flask and top up to the mark with CO_2 free water. Stopper the flask.

(vi) Accurately weigh 0.8 g of potassium acid phthalate into each of the three Erlenmeyer flasks.

(vii) Record the weight of each of the potassium acid phthalate weighed. (1 mark)

(ix) Add three drops of phenolphthalein indicator in each flask and titrate against a white background with the sodium hydroxide solution to a faint pink colour that persists for 15 seconds after swirling and record the value of each titre. Calculate the mean of the three titrations. (6 marks)

(x) Calculate the molarity of sodium hydroxide solution. (2 marks)

(e) **Procedure for determination of the molarity of the citric acid solution.**

(i) Pipette $50\,cm^3$ of citric acid solution provided into a $250\,cm^3$ clean Erlenmeyer flask.

(ii) Add three drops of phenolphthalein indicator.

(iii) Titrate with sodium hydroxide solution to a faint pink colour and record the titre value. Repeat two more times and record the mean titre. (9 marks)

(iv) Write an equation for the reaction taking place during the titration. (1 mark)

(v) Calculate the:

(I) moles of sodium hydroxide used; (1 mark)
(II) moles of citric acid reacting with sodium hydroxide solution; (1 mark)
(III) molarity of the citric acid solution. (1 mark)

Using the pictures of animals shown in Figure 3, complete the construction of the dichotomous key by writing the answers for the blank spaces. (13 marks)

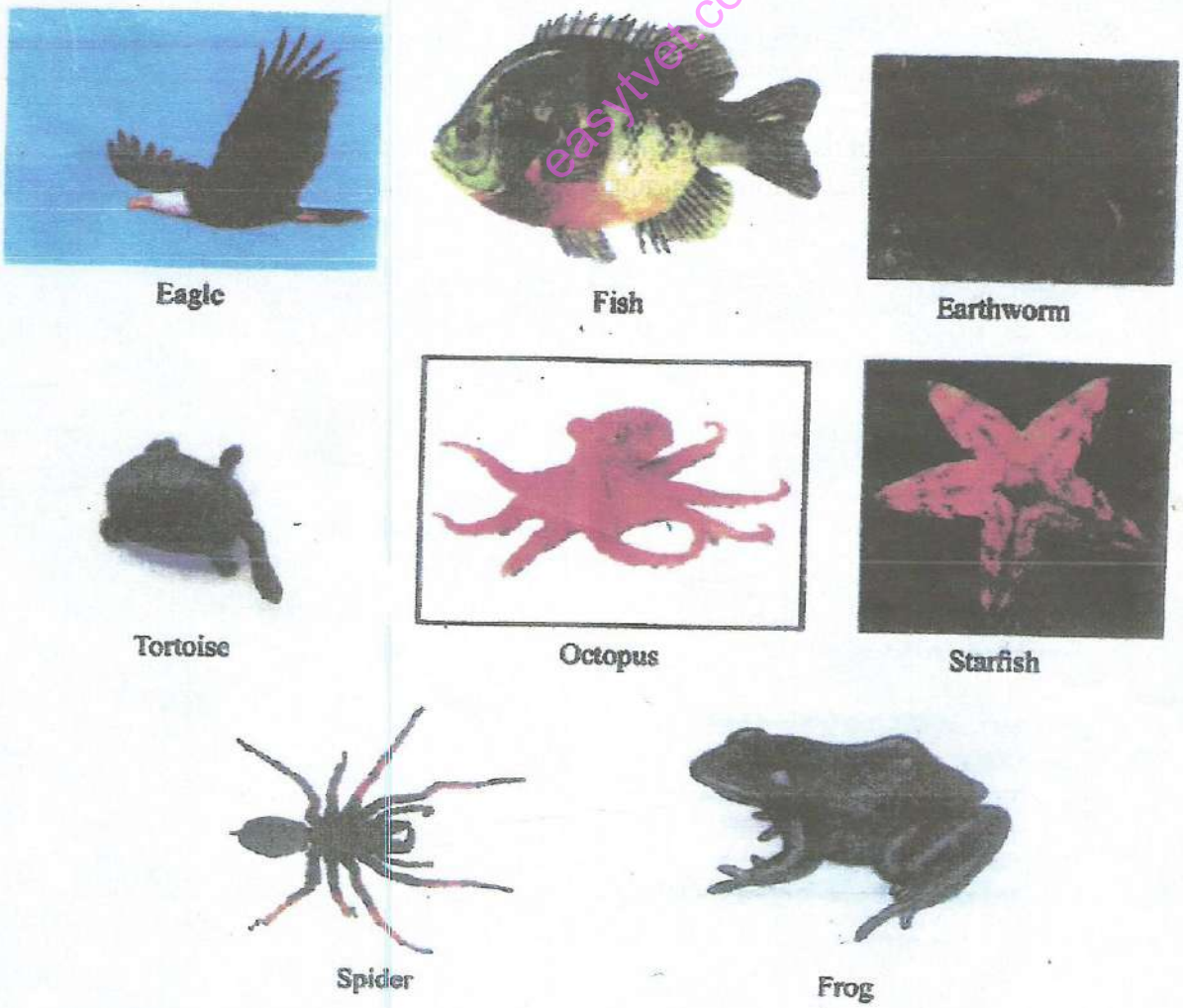


Figure 3

1. (a) Animals with a backbone ..... go to 2.
(b) Animals without a backbone ..... _____?

2. (a) Animals with wings ..... Eagle ?
(b) Animals without wings ..... _____? 3

3. (a) Animals which live in water all the time ..... _____?
(b) Animals which live in water sometimes ..... _____?

4. (a) Animals with scales ..... _____?
(b) Animals without scales ..... _____?

5. (a) Animals with legs ..... _____?
(b) Animals without legs ..... _____ go to 7

6. (a) Animals with six legs ..... _____ Butterfly
(b) Animals with eight legs ..... _____?

7. (a) Animals with a shell ..... _____ snail
(b) Animals without a shell ..... _____?

8. (a) Animals with a jelly-like body ..... _____?
(b) Animals without a jelly-like body ..... _____?

9. (a) Animals with segmented body ..... _____?
(b) Animals without segmented body ..... _____?

(b) Figure 4 shows a photograph of a fish. Examine it and answer the questions that follow.

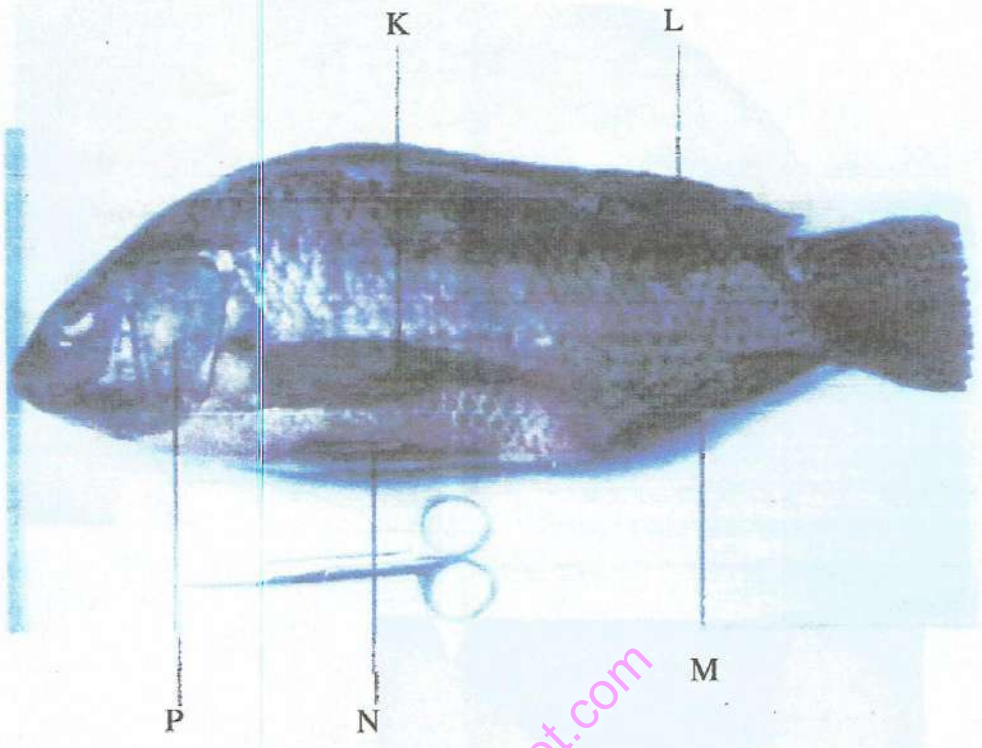


Figure 4

(i) Name the parts labelled **K, L, M** and **N**. (4 marks)

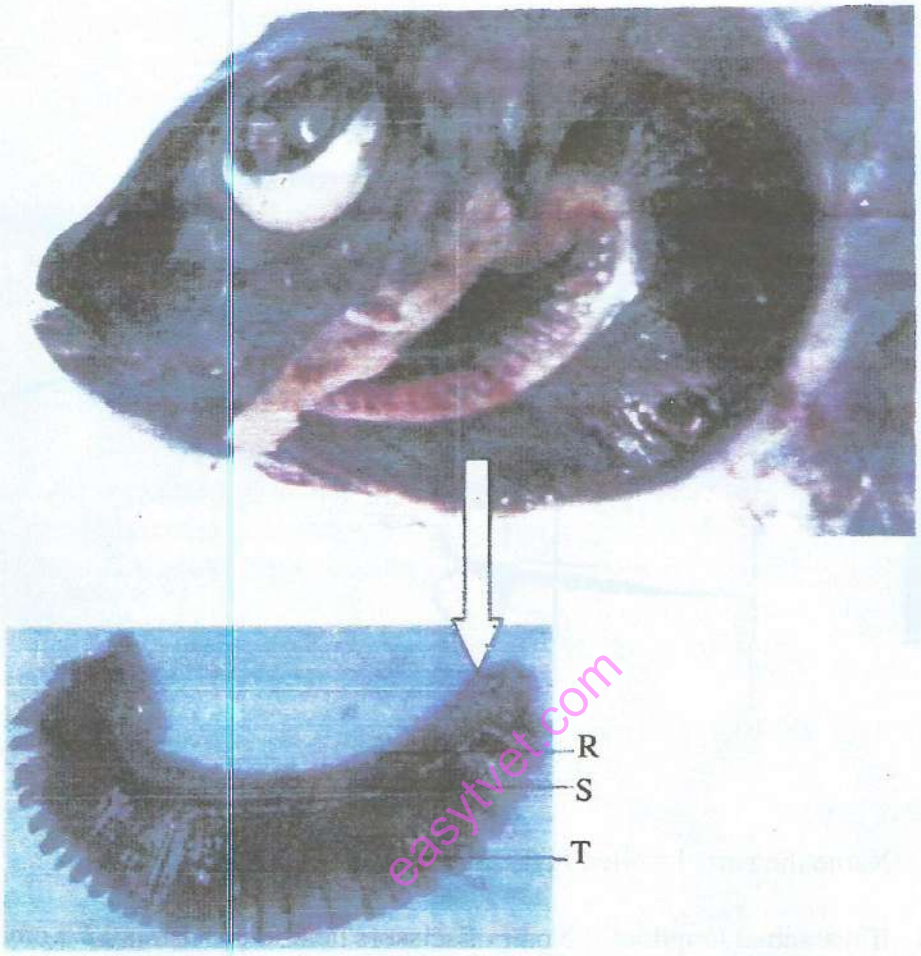
(ii) If the actual length of the pair of scissors next to the fish is 12.5 cm, calculate the actual length of this fish. (3 marks)

(iii) Name the fins that prevent the following movement of fish during swimming:

(I) yawing; (1 mark)
(II) pitching. (2 marks)

(iv) State **four** characteristics of organisms that belong to the same class as fish. (4 marks)

(c) Figure 5 shows a photograph of fish with structures visible after removing the part labelled **P** in Figure 4. The insert shows a magnified view of one of the structures.



(i) Name the parts labelled **R**, **S** and **T**. (3 marks)

(ii) Explain how each of the parts named in c (i) above is adapted to its functions. (3 marks)

THIS IS THE LAST PRINTED PAGE.