THE KENYA NATIONAL EXAMINATIONS COUNCIL

DIPLOMA IN APPLIED BIOLOGY
DIPLOMA IN ANALYTICAL CHEMISTRY

MODULE I

MATHEMATICS AND APPLIED SCIENCE

3 hours

INSTRUCTIONS TO CANDIDATES

You should have the following for this examination:
    Answer booklet;
    Non-programmable scientific calculator.
This paper consists of TWO sections; A and B.
Answer ALL questions in BOTH sections A and B.
Each question in section A carries 4 marks while each question in section B carries 20 marks.
Maximum marks for each part of a question are indicated.
Candidates should answer the questions in English.

This paper consists of 12 printed pages.

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

SECTION A (60 marks)

Answer ALL questions in this section.

1. (a)   Solve for $\operatorname{cosec}\theta = 2.4833$ given $0° \le \theta \le 180°$.   (2 marks)

    (b)   Joseph, Odera and Museti agree to pay their hotel bill in the ratio 4:5:6. If the bill amounts to Ksh 6,000, work out the amount of money paid by each.

    (2 marks)

2.   Use the quadratic formular to solve the following equation:

      $$2x^2 - 5x + 2 = 0$$

    (4 marks)

3.   Figure 1 shows a trapezium OABC where $OA = \underset{\sim}{a}$, $OB = \underset{\sim}{b}$ and $CB = 2OA$.
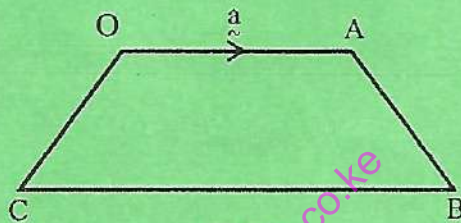

Fig. 1

    Determine:

    (a) $\underset{\sim}{AB}$ (2 marks)

    (b) $\underset{\sim}{CA}$ (2 marks)

4.   Solve the equation

      $$\log(3y + 4) = \log(y - 2) + 3\log 2$$

    (4 marks)

5.   (a)   Determine the value of angle x and y shown in figure 2.   **(2 marks)**
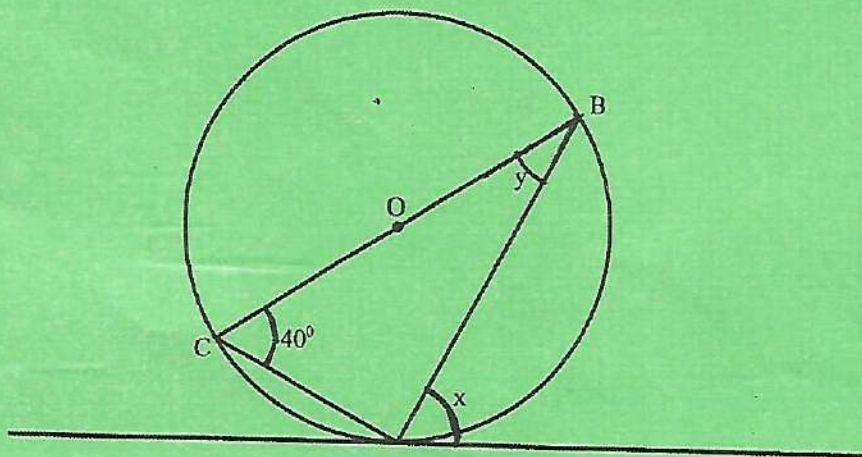

Fig. 2

(b)   Three points A(2, 14), B (20, 5) and C (K, 3) lie on the same straight line. Determine the value of K.   **(2 marks)**
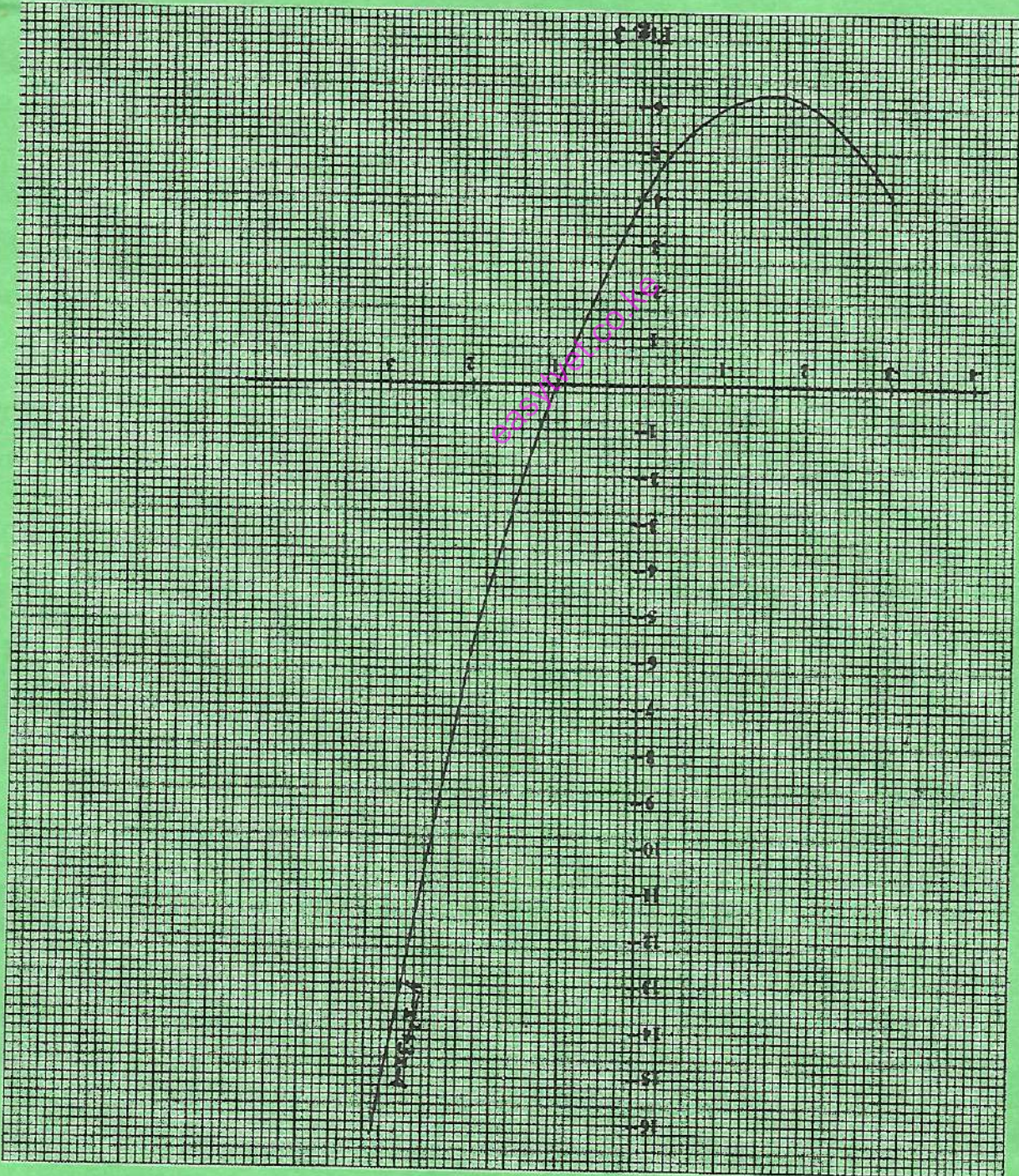
6. Figure 3 shows a graph of $y = x^2 + 3x + 4$.

Fig. 3

Using the graph, solve the following simultaneous equations:

$$y = x^2 + 3x - 4$$
$$y = 2x + 4$$

(4 marks)

7. Determine the median for the grouped data in table I.

Table I

Length (cm)	Number of plants
60-62	6
63-65	18
66-68	42
69-71	27
72-74	8

(4 marks)

8. (a) Integrate with respect to x

$$\int_0^1 \sin x^2 \, dx$$
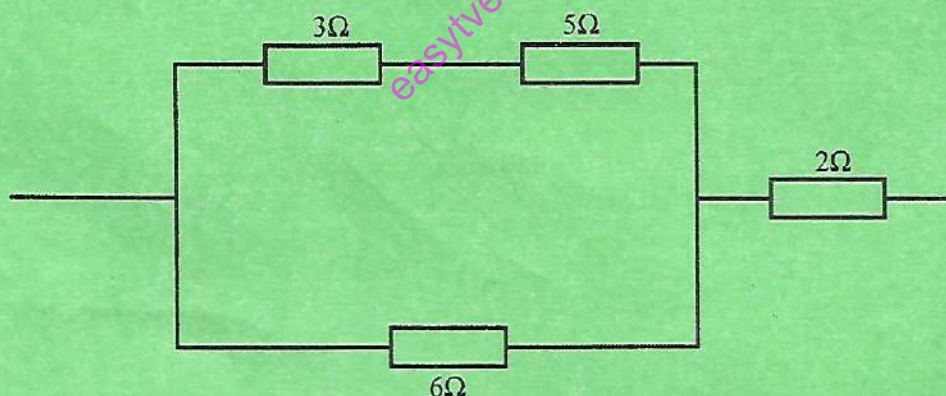
(2 marks)

(b) Describe photoelectric emission. (2 marks)

9. (a) An electric kettle rated 240 V, 13 Amps, heats water for 15 minutes. Calculate the amount of heat dissipated by the heater. (2 marks)

(b) Determine the overall resistance in figure 4. (2 marks)

Fig. 4

10. (a) Illustrate the decay curve of a radioactive substance. (2 marks)

(b) A spherical ball is placed between two vertical plane mirror which are at an angle of 60° to each other. Determine the number of images formed. (2 marks)

11. (a) Explain the term 'real image' as used in lenses. (1 mark)

    (b) (i) Using a diagram, show the defect myopia in the human eye. (2 marks)

        (ii) State how the defect in (i) is corrected. (1 mark)

12. (a) Derive the SI unit of acceleration. (2 marks)

    (b) State **two** examples that show the existence of surface tension in liquids. (2 marks)

13. (a) Sketch the set-up of a fluid flow venturimeter. (2 marks)

    (b) State **two** quantities measured from the venturimeter. (2 marks)

14. (a) Using a diagram, explain thermal convection. (3 marks)

    (b) Describe a black body as used in thermal radiation. (1 mark)

15. Two vertical insulated copper wires are placed close to each other. Large currents flow through the wires but in opposite directions. Using diagrams, explain the observations made. (4 marks)

SECTION B (40 marks)

Answer ALL questions in this section.

16. (a) Figure 5 shows the pathway of fat in part of the alimentary canal.
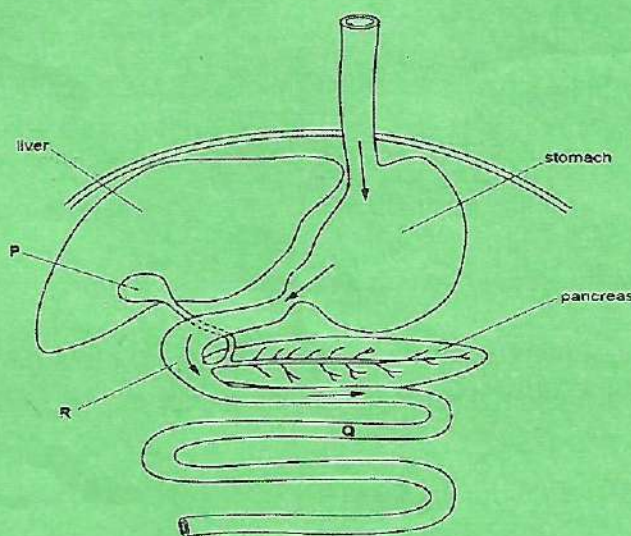
Fig. 5

Name the:

(i)   enzyme secreted by the pancreas that digests fats;   (1 mark)

(ii)   **two** products of chemical digestion of fats;   (2 marks)

(iii)   liquid that is produced by the liver and stored by organ P;   (1 mark)

(iv)   organ P.   (1 mark)

(b)   Figure 6 shows the structure of a mature grape flower.

Fig. 6

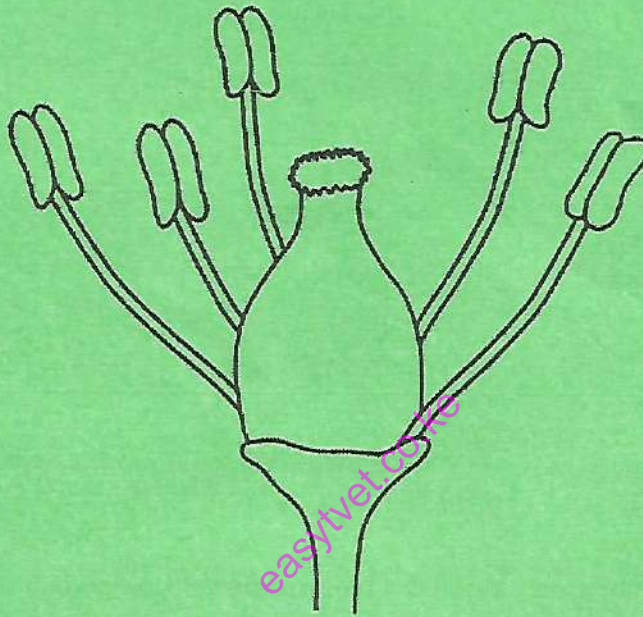(i)   Name **three** parts normally found in other flowers that are not present in
        figure 6.   (3 marks)

(ii)   Suggest the type of pollination found in this grape prant. Give **two**
        reasons.   (3 marks)
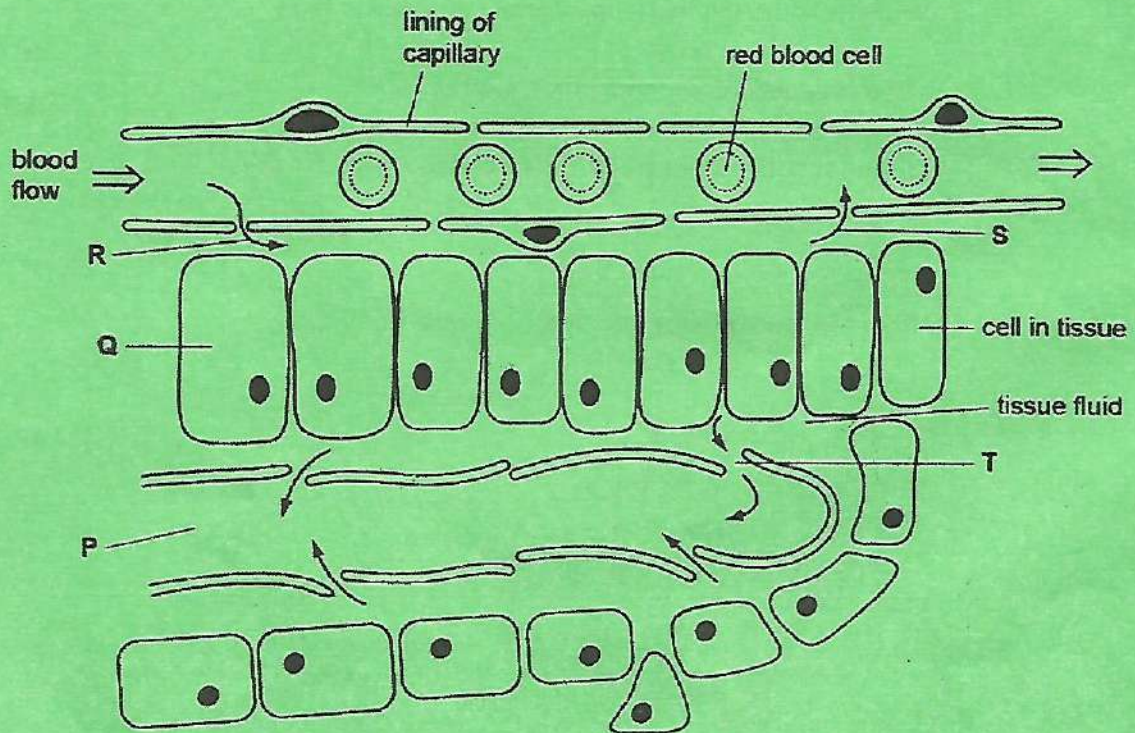
(c)   Figure 7 shows a capillary inside a tissue.

Fig. 7

(i)   State how oxygen passes from the capillary into cell Q and describe the function of oxygen in this cell.   (2 marks)

(ii)   Name **four** substances required by cells other than oxygen that pass from the blood to the tissue fluid at R.   (4 marks)

(iii) List any **three** substances produced by cells that pass from the tissue fluid to the blood at S.   (3 marks)

17.   (a)   When magnesium is burned in air, it reacts with oxygen to form magnesium oxide.

A class of students investigated the relationship between the mass of magnesium burned in air and the mass of magnesium oxide formed.
Each student was given a different mass of clean magnesium to burn. Two students used the following method.

-   weigh a crucible and lid.

-   place the magnesium ribbon in the crucible, replace the lid and reweigh.

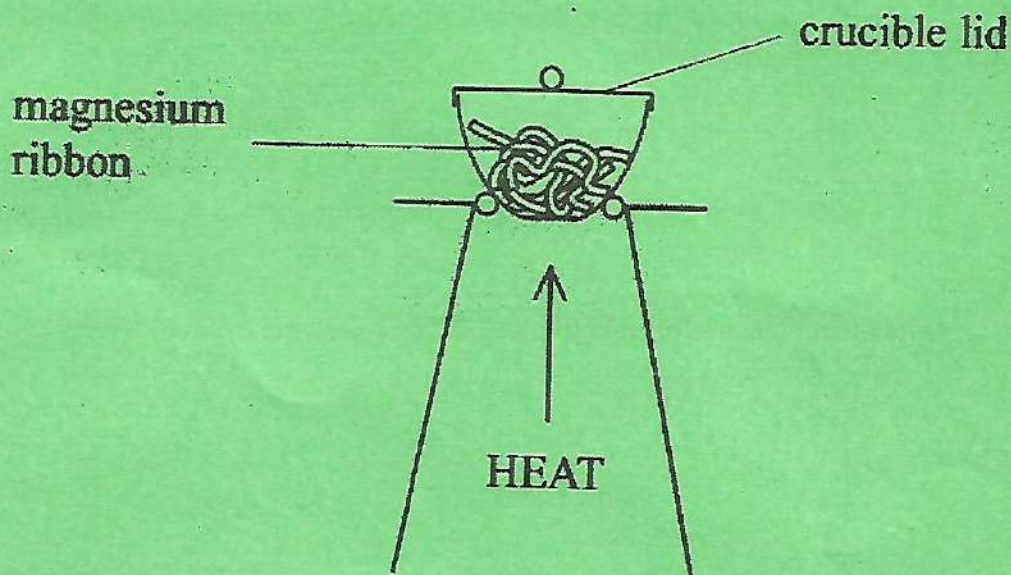-   heat the crucible as shown in figure 8 until the magnesium burns.

Fig. 8

- Lift the lid from time to time until there is no sign of further reaction.
- Allow the crucible and lid to cool and reweigh.
- Repeat the heating, cooling and reweighing until two consecutive masses are the same.

(i) (I) Write a balanced reaction for burning magnesium. **(2 marks)**

(II) State why it is necessary to lift the lid from time to time while heating. **(1 mark)**

(III) Give reason why it is necessary to repeat the heating until two consecutive masses are the same. **(1 mark)**

(IV) Show how the mass of magnesium oxide formed can be calculated from the readings obtained. **(2 marks)**

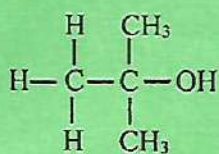(ii) The results of each experiment are given in table II.

Table II

Mass of magnesium (g)	Mass of magnesium oxide (g)
0.24	0.40
0.26	0.64
0.42	0.70
0.62	1.04
0.70	1.20
0.80	1.33

(I)   Plot a graph of magnesium oxide (y-axis) against the mass of magnesium.   (6 marks)

(II)   Identity any anomalous result.   (1 mark)

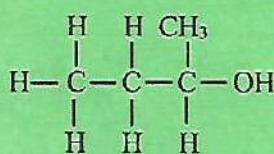(III)   Find the mass of magnesium oxide formed when 0.48 g of magnesium is burned.   (1 mark)

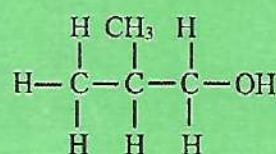(b)   Write the molecular formula for each of the following cycloalkanes:

(i)   (1 mark)

(ii)   (1 mark)

(iii)   (1 mark)

(c)   Consider the following structurally isomeric alcohols labelled W, X and Z. The alcohols belong to different classes as primary, secondary or tertiary.

$$
\begin{array}{ccc}
\begin{array}{c}
\quad H \quad CH_3 \\
\quad | \qquad | \\
H - C - C - OH \\
\quad | \qquad | \\
\quad H \quad CH_3 \\
\\
W
\end{array}
&
\begin{array}{c}
\quad H \quad H \quad CH_3 \\
\quad | \quad\; | \qquad | \\
H - C - C - C - OH \\
\quad | \quad\; | \qquad | \\
\quad H \quad H \quad H \\
\\
X
\end{array}
&
\begin{array}{c}
\quad H \quad CH_3 \quad H \\
\quad | \qquad | \quad\; | \\
H - C - C - C - OH \\
\quad | \qquad | \quad\; | \\
\quad H \quad H \quad\; H \\
\\
Z
\end{array}
\end{array}
$$

(i)   Identify the class of alcohols represented by W and X.   (2 marks)

(ii)   Identify the alcohol which on oxidation will produce an aldehyde.   (1 mark)