

2914/102
2915/102
MATHEMATICS AND APPLIED SCIENCE
Oct./Nov. 2022
Time: 3 hours



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 section A and section 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 question 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.

SECTION A (60 marks)

Answer ALL questions in this section.

- Given that $a = 3$, $b = 5$ and $c = -\frac{1}{2}$, evaluate $\frac{b^3 - 4a}{c}$. (2 marks)
 - Using logarithms to base 10, determine the value of $\log_3 58.47$. (2 marks)
- The frustum in figure 1 is formed from a cone of slant height 52 cm.

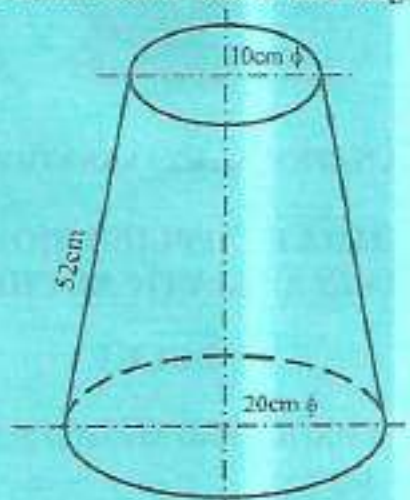


Fig. 1

- Calculate the area of the curved surface of the frustum. (4 marks)
- The length of a flower garden is 2 m less than twice its width. The area of the garden is 60 m^2 . Calculate its length. (4 marks)
 - The first term of an arithmetic sequence is -7 and the common difference is 3. Determine the sum of the first 50 terms of the sequence. (2 marks)
 - Simplify the following by writing in the form of $\log x$
$$\frac{1}{2} \log 64 + 2 \log 3 - \log 12$$
 (2 marks)
 - The number of people who attended an agricultural show in one day was 510 men, 1080 women and children. when the information is represented on a pie-chart the combined angle for men and children is 216° . Determine the angle that would represent the children. (4 marks)

6. (a) Given the two matrices $A = \begin{pmatrix} 2 & 4 \\ 3 & 6 \end{pmatrix}$ and $B = \begin{pmatrix} 11 & 3 \\ 4 & 1 \end{pmatrix}$ determine $2BA$. (2 marks)
- (b) Given that $F = \frac{h}{d} \sqrt{n^2 - k}$ evaluate without using a calculator the value of F when $h=1.5$, $d=2.25$, $n=25$ and $k=544$. (2 marks)
7. A tourist converted 5820 US dollars into Kenya shillings at a rate of Ksh 102.10 per dollar. While in Kenya he spent Ksh 450,000 and converted the balance into dollars at the rate of Ksh 103.00 per dollar. Calculate the remaining amount of money to the nearest dollar. (4 marks)
8. (a) Evaluate $\int (2x + 3x^3) dx$ (2 marks)
- (b) A helical spring extends by an average length of 20 cm under a 50 N load. Determine the spring constant of the spring in N/m. (2 marks)
9. (a) State the Newton's law of cooling. (2 marks)
- (b) Sketch a graph of temperature ($^{\circ}\text{C}$) against time (minutes) for a hot body cooling to room temperature (T). (2 marks)
10. (a) Write the Bernoulli's equation for a fluid undergoing streamline flow. (1 mark)
- (b) An oil pipeline has a varying diameter. At a certain point its diameter is 30 cm and the velocity of oil is 50 m/s. Calculate its velocity at the point where diameter is 60 cm. (3 marks)
11. (a) Define the term 'half-life' of a radioactive material. (1 mark)
- (b) 150 Coulombs of charge flows through a certain point in a circuit for 2 minutes. Calculate the current flowing in the circuit. (3 marks)
12. (a) Sketch the magnetic field around a bar magnet. (2 marks)
- (b) Define magnetic flux and give its formula. (2 marks)
13. (a) Give the SI units of the following:
- (i) specific heat capacity;
- (ii) thermal resistance. (2 marks)
- (b) Determine the momentum of a 4.5 tonne lorry travelling at 80 km/hr on a highway. (2 marks)

14. An object placed 10 cm in front of a converging lens, forms an image 6 cm behind the lens. Determine the power of the lens. (4 marks)
15. Figure 2 gives information about two forces acting on a body, Z.

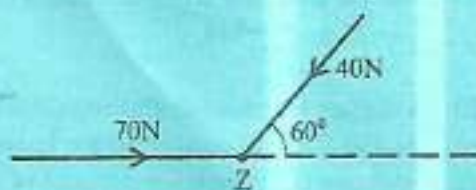


Fig. 2

Determine the magnitude and the direction of a third force required to keep the system at equilibrium. (4 marks)

SECTION B (40 marks)

Answer *ALL* questions in this section.

16. (a) Figure 3 shows the positions of eight elements in the modern periodic table.

Group	1	2								3	4	5	6	7	0
	Li											N			
										Al					
	K					Fe		Cu				As		Br	

Fig. 3

Identify the symbol's that represent:

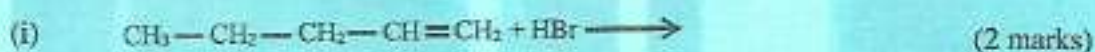
- (i) two metals that react vigorously with water. (2 marks)
- (ii) two elements with five electrons in the outer shells of their atoms. (2 marks)
- (iii) two elements whose atomic structure has only two energy levels. (2 marks)

- (b) For the following redox reaction:



Identify the:

- (i) substance oxidized; (1 mark)
- (ii) substance reduced; (1 mark)
- (iii) oxidizing agent; (1 mark)
- (iv) reducing agent. (1 mark)
- (c) Using Markonikov's rule, predict the IUPAC name and structure of the predominant product in each of the following addition reactions:



- (d) A student investigated the reaction of copper carbonate with dilute sulphuric acid as shown in figure 4.

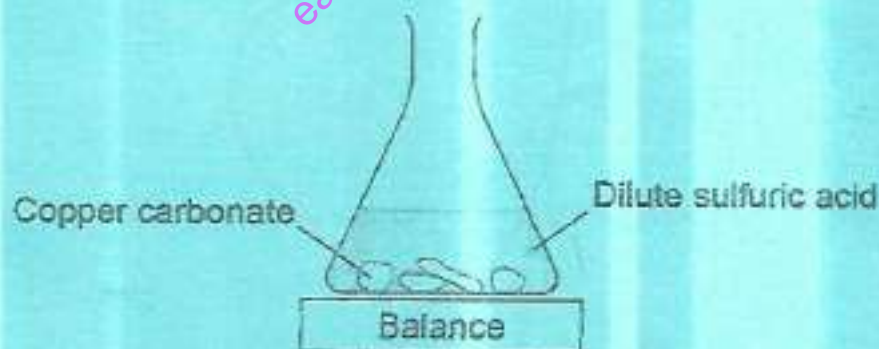


Fig. 4

- (i) Write the chemical formula of the three expected products of this reaction. (3 marks)
- (ii) State the reason why the balance reading decreased during the reaction. (1 mark)

17. (a) Figure 5(a) shows a photograph of two cells as seen under a light microscope and figure 5(b) is an incomplete drawing representing one of the cells.

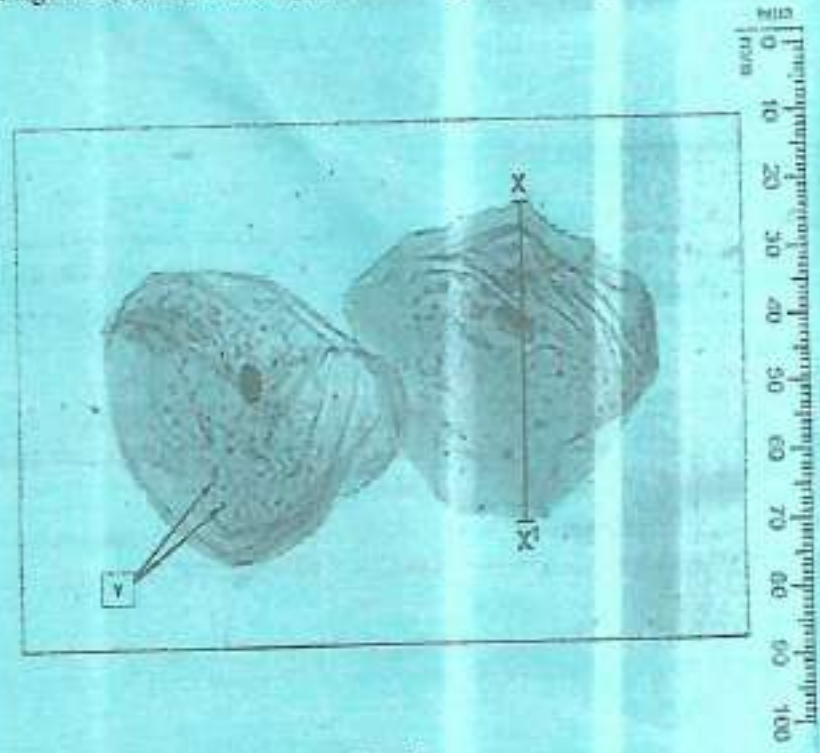


Fig. 5a

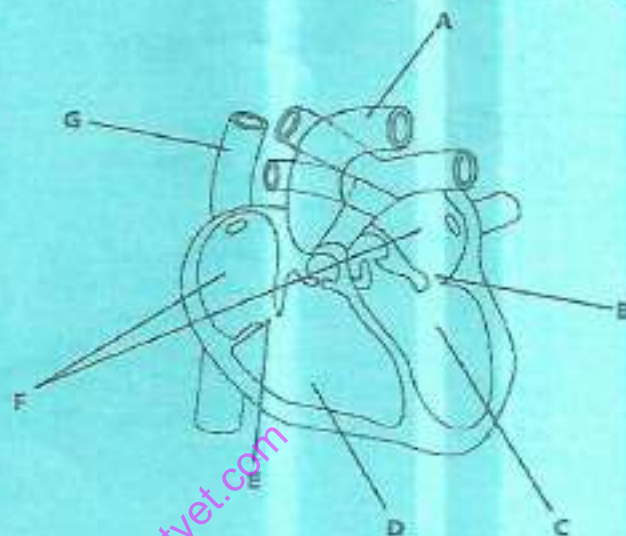


Fig. 5b

- (i) Copy the drawing of figure 5b and on it:
 - I. label the cytoplasm and the cell membrane; (2 marks)
 - II. add and label the nucleus. (1 mark)
- (ii) Name the structures labelled Y which carry out respiration. (1 mark)

- (iii) Explain why the photographed cells are not plant cells. (3 marks)
- (iv) The actual length of the cell along X-X' is 0.02 mm. Determine the magnification of the photograph. (3 marks)
- (v) The cells in the photograph have been stained.
- I. Describe how to stain a cell in the laboratory. (2 marks)
 - II. State the purpose of staining cells in the laboratory. (1 mark)

(b) Figure 6 shows a section of the human heart as positioned in the body.



- (i) Name the structures labelled A, B, C, D, E and F. (6 marks)
- (ii) Identify the letter that points to a blood vessel that carries deoxygenated blood with a high level of carbon dioxide. (1 mark)

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