

2914/102
2915/102
MATHEMATICS AND APPLIED SCIENCE
Oct./Nov. 2021
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 9 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 cone has a slant height of 7 cm and a base radius of 3 cm. Calculate its volume. (4 marks)

2. Figure 1 shows a triangle ABC.

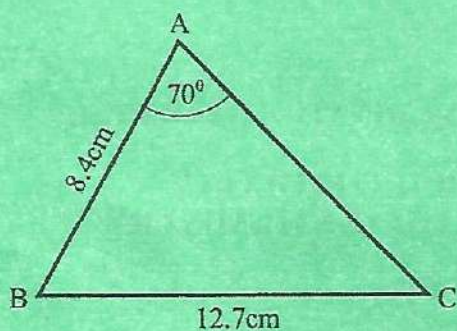


Fig. 1

Determine:

- (a) angle C (3 marks)
- (b) angle B (1 mark)

3. Table I shows scores obtained by students in an oral examination.

Table I

Score (x)	15	16	17	18	19	20
No. of students (y)	4	6	12	10	5	2

Calculate the:

- (a) mode; (1 mark)
- (b) mean. (3 marks)

4. Determine the stationary point in the function $y = x^2 + 2x + 9$ (4 marks)

5. Y is inversely proportional to X^2 . $Y = 32$ when $X = 1$. Write an equation relating Y and X hence determine Y when $X = 4$ (4 marks)

6. (a) Simplify $\frac{P(x-1)}{1-x}$ (1 mark)

- (b) A saleslady is paid a basic salary of Ksh 15,000 per month and a commission of 15% on sales over Ksh 300,000. In a certain month, she made sales worth Ksh 650,000. Determine her total earnings for the month. (3 marks)

7. Solve the simultaneous equations:

$$3x - 5y = 21$$

$$7x - 3y = 23$$

(4 marks)

8. (a) Solve for x in the equation

$$3^{2x+3} = 2187$$

(2 marks)

- (b) The length of a helical spring is 80 cm when a 50 N load is hung on its lower end. The length is 90 cm when the load is changed to 70 N. Determine its spring constant. (2 marks)

9. (a) Figure 2 shows a hydraulic system.

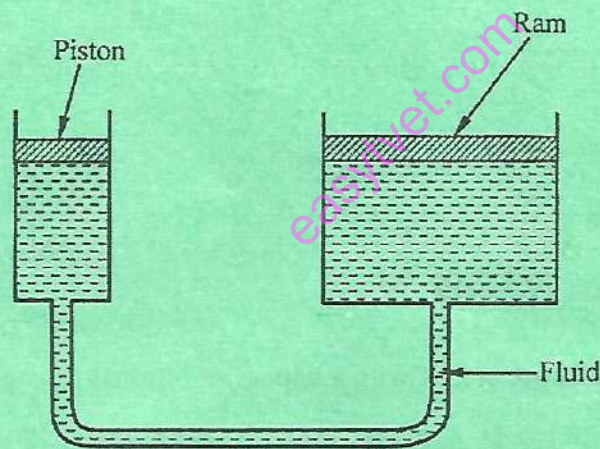


Fig. 2

The cross-sectional areas of the piston and ram are 4 cm^2 and 136 cm^2 respectively. Determine the force produced at the ram when a 100 N force is applied on the piston. (2 marks)

(b) Give any two examples of basic units. (2 marks)

10. (a) State the principle of moments. (1 mark)

(b) Figure 3 shows a pressure valve in a closed position.

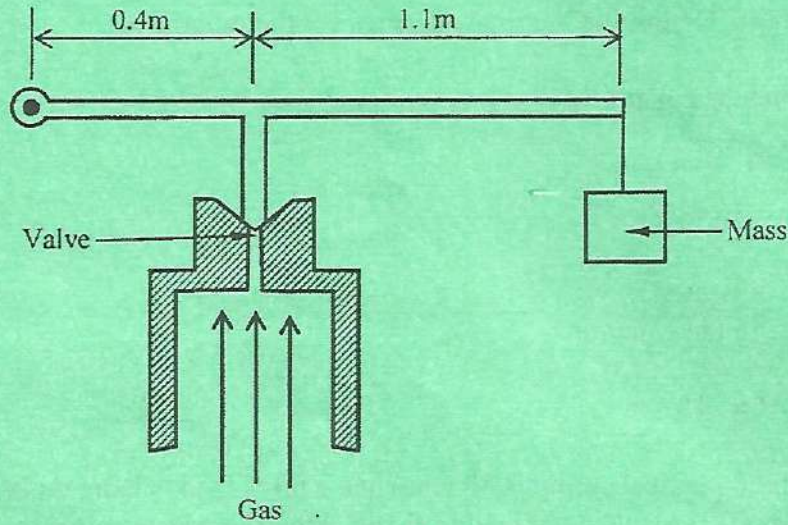


Fig. 3

If the force acting on the valve due to the pressurized gas is 1.8 kN. Calculate the mass required to keep the valve closed. ($g = 10 \text{ N/kg}$) (3 marks)

11. An object is placed 15 cm in front of a concave mirror of focal length 10 cm. Calculate the:

- (a) position of the image; (1 mark)
- (b) magnification of the image produced. (3 marks)

12. (a) State Ohm's law. (1 mark)

(b) Figure 4 shows an electric circuit with a battery of internal resistance 3Ω .

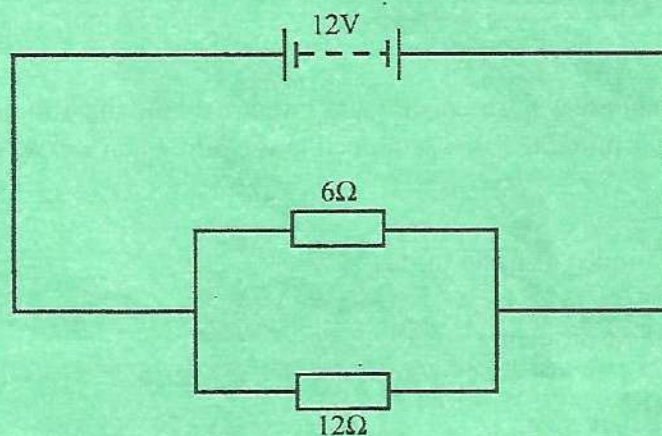


Fig. 4

Determine the current flowing in the circuit. (3 marks)

13. (a) State Lenz's law. (1 mark)
- (b) Explain Eddy currents. (3 marks)
14. (a) State **two** uses of a cathode ray oscilloscope. (2 marks)
- (b) State any **two** properties of X-rays. (2 marks)
15. Two balls of mass 20 g and 30 g move linearly in opposite directions at speeds of 7 m/s and 4 m/s respectively. They collide and move together after impact.
- (a) Calculate the initial total momentum of the two balls. (2 marks)
- (b) If there is no loss of momentum during impact, determine the final speed. (2 marks)

SECTION B (40 marks)

Answer **ALL** questions in this section.

16. (a) Figure 5 shows a food web from an African ecosystem.

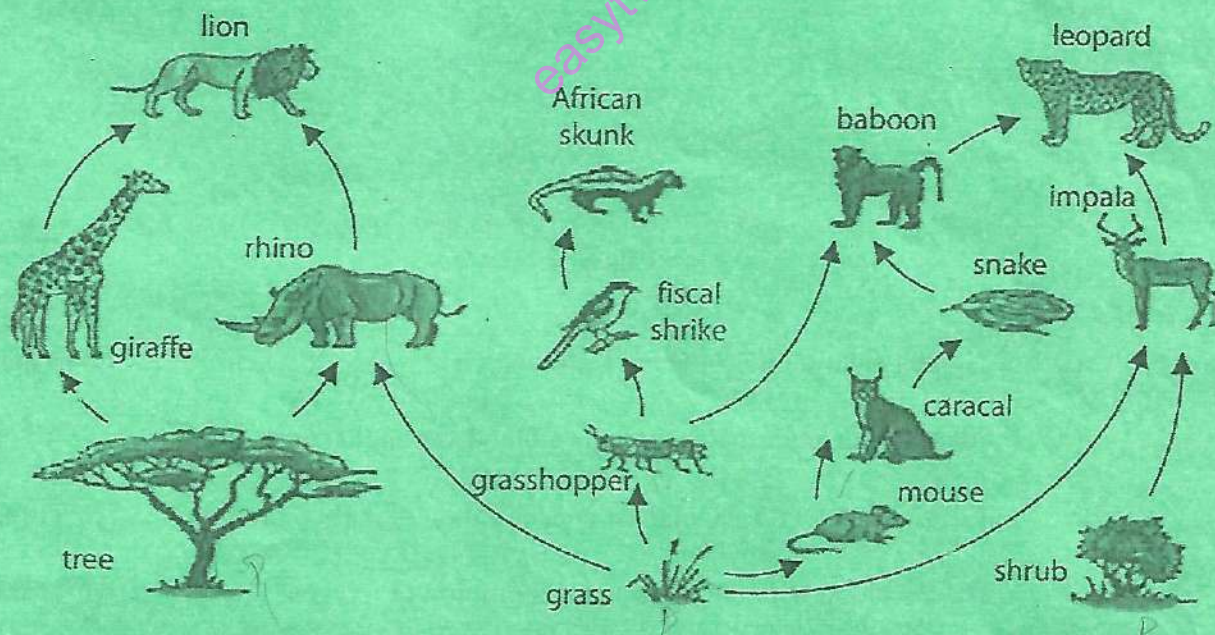


Fig. 5

- (i) Define the term 'ecosystem'. (1 mark)
- (ii) Identify **three** producers in the food web. (3 marks)

- (iii) Give the trophic level of the lion in this food web. (1 mark)
- (iv) Name one organism that occurs at two different trophic levels in this food web. (1 mark)
- (v) Write the food chain from this food web that contains four different organisms including baboon. (1 mark)
- (vi) Differentiate between a food chain and a food web. (4 marks)

(b) Figure 6 shows a vertical section through a human heart and the major blood vessels

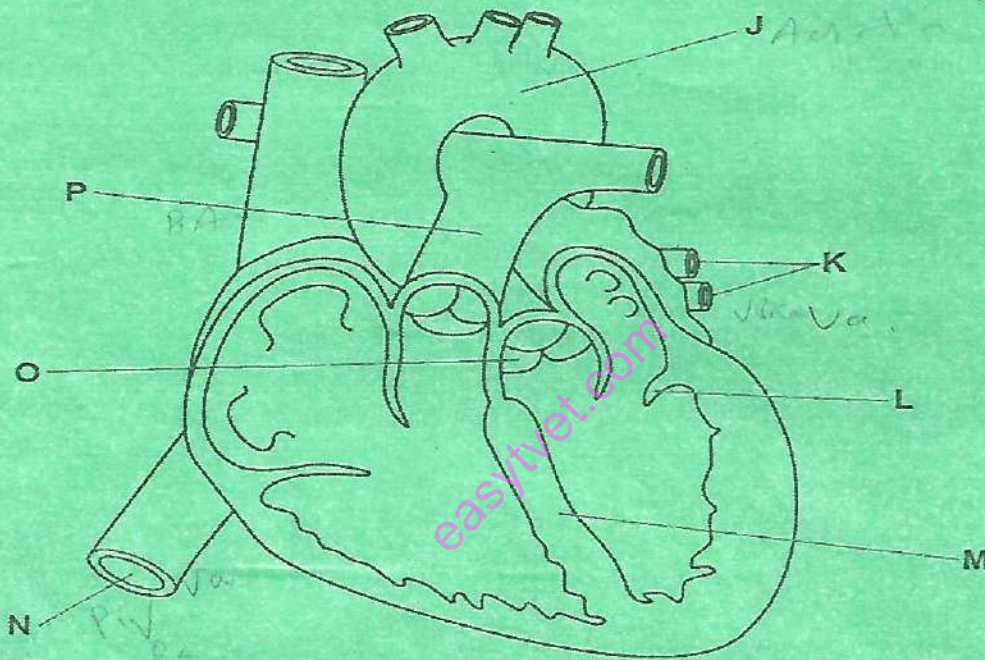


Fig. 6

- (i) Name the structures labelled L, M and O. (3 marks)
 - (ii) Identify the letter that represents a blood vessel that has:
 - N I. blood with the highest concentration of carbon dioxide; *K* (1 mark)
 - J II. blood with the highest concentration of oxygen; *N* (1 mark)
 - K III. the highest pressure. *Aorta* (1 mark)
- (c) COVID-19 is considered a deadly pandemic.
- (i) Give the full meaning of COVID. (1 mark)

(ii) Name the body organ which is majorly affected by COVID-19. (1 mark)

(iii) Name the main ingredient in the hand sanitizer disinfectant as recommended by World Health Organization (WHO). (1 mark)

17. (a) Use the periodic table provided to identify each of the following elements by name:

(i) halogen in period 2;

(ii) alkali metal in period 3;

(iii) noble gas in period 4;

(iv) alkaline earth metal in period 5.

(4 marks)

(b) The following are some methods that can be used in separation of mixtures.

Crystallization, solvent extraction, evaporation, filtration, paper chromatography, simple distillation and fractional distillation

Select the most suitable method for each of the following:

(i) removing sand from a mixture of sand and water;

(ii) obtaining pure water from a mixture of sand and water;

(iii) extracting essential oils from eucalyptus leaves;

(iv) separating the coloured dyes in a sample of green ink.

(4 marks)

(c) Tungsten is a useful metal. One method of extracting tungsten involves heating a tungsten compound (WO_3) with hydrogen.

(i) Give the chemical name of WO_3 (1 mark)

(ii) Balance the following equation:



(1 mark)

(iii) State a reason why the reaction in (ii) would be described as reduction.

(1 mark)

- (iv) Scheelite is an ore of tungsten. The main compound in scheelite has the following percentage composition by mass:

Ca = 13.9%, W = 63.9%, O = 22.2%

Calculate the empirical formula of this compound.

(Ca = 40; W = 184; O = 16)

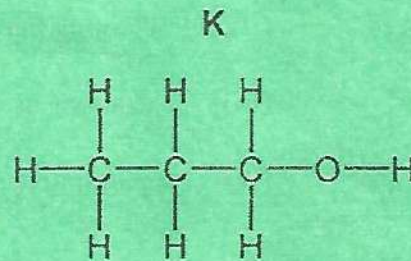
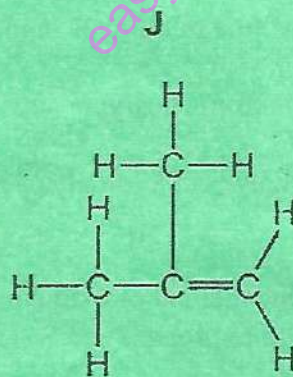
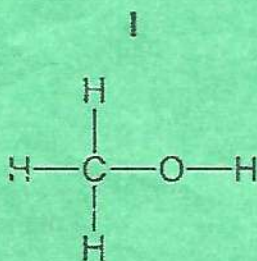
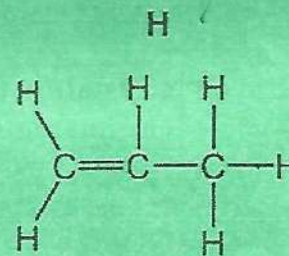
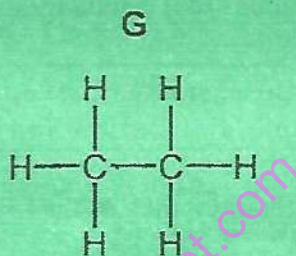
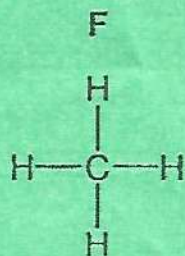
(3 marks)

- (d) Alkanes, alkenes and alcohols are three different homologous series of compounds.

- (i) Define the term 'homologous series'.

(2 marks)

- (ii) The structures of some alkanes, alkenes and alcohols are shown below:



- I. Giving reasons for the response, identify the letters of any **two** compounds that are saturated hydrocarbons.

(2 marks)

- II. Identify **two** compounds that are alkenes.

(2 marks)

