

2914/102
2915/102
MATHEMATICS AND APPLIED SCIENCE
June/July 2020
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 the questions in BOTH section A and section B in the answer booklet provided.

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 11 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. Simplify $\frac{2}{7}$ of $(1\frac{10}{11} - \frac{9}{11}) \div 1\frac{7}{11}$. (4 marks)
2. Table I indicates the number of students taking various subjects in an institution.

Table I

Subject	Number of students
Sciences	20
Business Studies	40
Computer Applications	30
Electronics	60

Draw a pie chart to represent this information. (4 marks)

3. (a) Convert 50,000 India rupees into Kenya shillings given the exchange rate as 100 India rupees is equivalent to 162.50 Kenya shillings. (2 marks)
- (b) A trader sells a TV set for Ksh 15,400 and thereby makes a profit of 25% on the cost price. Find the cost price of the TV set. (2 marks)
4. (a) Calculate the surface area of a sphere with a radius of 8 cm. (2 marks)
- (b) Calculate the length of the arc of a circle centre O, radius 8 cm which subtends an angle of 30° at the centre. (2 marks)

5. Determine the value of x and y if $(xy) \begin{pmatrix} 2 & 3 \\ 1 & 2 \end{pmatrix} = (3 \ 5)$ (4 marks)

6. (a) Given that $a = \begin{pmatrix} 3 \\ 2 \end{pmatrix}$, $b = \begin{pmatrix} -1 \\ 4 \end{pmatrix}$ and $c = \begin{pmatrix} 5 \\ 3 \end{pmatrix}$, work out:
- (i) $a + b$ $\begin{pmatrix} 3 \\ 2 \end{pmatrix} + \begin{pmatrix} -1 \\ 4 \end{pmatrix} = \begin{pmatrix} 2 \\ 6 \end{pmatrix}$ (2 marks)
- (ii) $|c|$ $\sqrt{5+3} = 2.8$ (2 marks)
- (b) Simplify $(\frac{16}{81})^{\frac{3}{4}}$ (2 marks)

7. (a) Expand $(1+x)^3$ (2 marks)
- (b) Evaluate $(1.001)^3$ to 6 decimal places. (2 marks)

8. (a) Find the sum of the first seven terms of the following geometric progression $2 + 6 + 18 + \dots$ (2 marks)

AP. GP. $GP = a(r^{n-1})$

$\begin{matrix} \text{deter } (2 \times 2) - (3 \times 1) \\ 4 - 3 = 1 \\ 3 \begin{bmatrix} 2 & 3 \\ 1 & 2 \end{bmatrix} \begin{matrix} x \\ y \end{matrix} \\ 3 \begin{bmatrix} 2 & 3 \\ 1 & 2 \end{bmatrix} \begin{matrix} x \\ y \end{matrix} \\ \begin{matrix} 3 \times 2 + 3 \times 3 \\ 3 \times 1 + 3 \times 2 \end{matrix} \begin{matrix} x \\ y \end{matrix} \\ \begin{matrix} 6 + 9 \\ 3 + 6 \end{matrix} \begin{matrix} x \\ y \end{matrix} \\ \begin{matrix} 15 \\ 9 \end{matrix} \begin{matrix} x \\ y \end{matrix} \\ \begin{matrix} 15 = x \\ 9 = y \end{matrix} \end{matrix}$

- (b) Sketch the magnetic field of a current flowing downwards through a copper wire. (2 marks)

9. Figure 1 shows a stress-strain graph of a material.

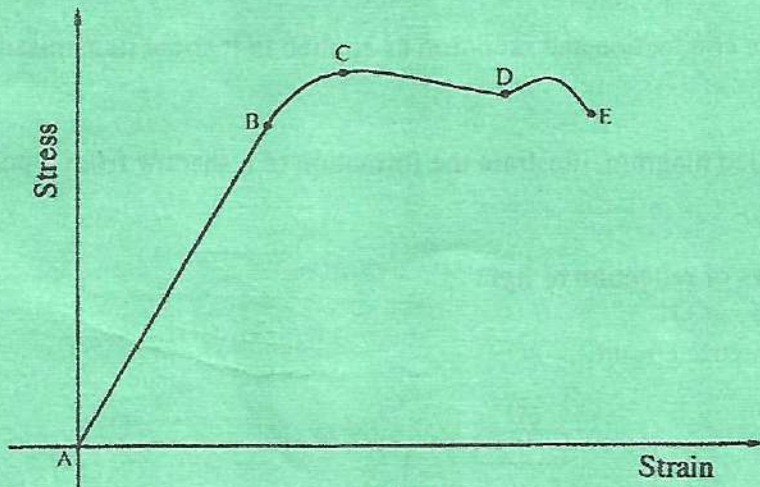


Fig. 1

Using points A, B, C, D and E on the graph, identify:

- (a) (i) elastic limit point; B
(ii) yield point; C

(2 marks)

- (b) (i) elastic region;
(ii) plastic region.

(2 marks)

10. (a) State Bernoulli's principle. (1 mark)

- (b) Figure 2 shows a tank containing two immiscible liquids A and B of density 760 kg/m^3 and 840 kg/m^3 respectively. Calculate the pressure at the bottom of tank given that $g = 10 \text{ N/kg}$. (3 marks)

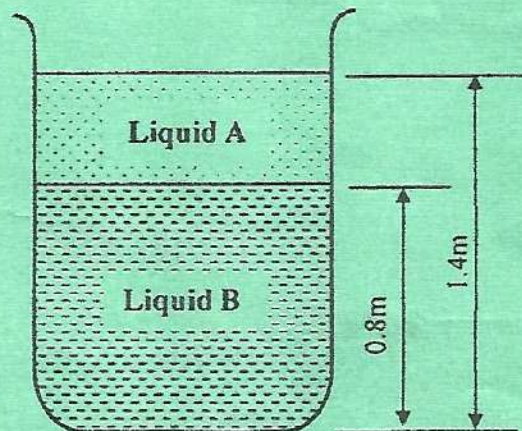


Fig. 2

11. (a) State **two** factors that affect equilibrium of a static body. (2 marks)
- (b) Define momentum and state its SI unit. (2 marks)
12. Differentiate between conduction and radiation as applied in thermal transmission. (4 marks)
13. (a) Using a labelled diagram, illustrate the formation of a shadow from a point source of light. (2 marks)
- (b) State **two** laws of reflection of light. (2 marks)
14. Figure 3 shows an electric circuit.

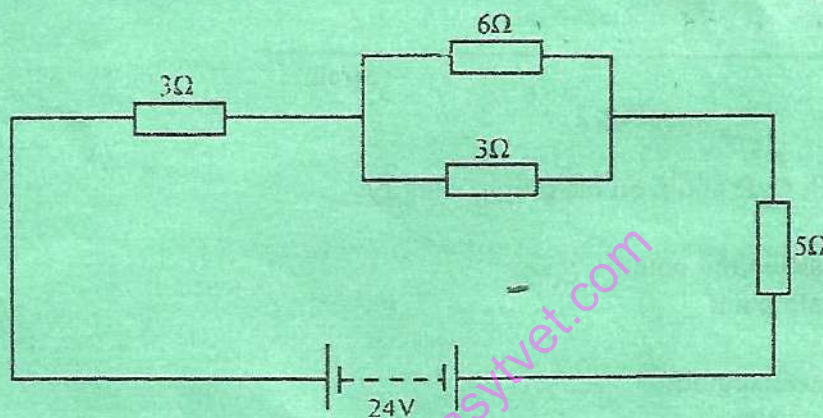


Fig. 3

Calculate the current flowing in the circuit. (4 marks)

15. Figure 4 shows a coil XY connected to a galvanometer. A bar magnet is moved towards and away from the coil as shown.

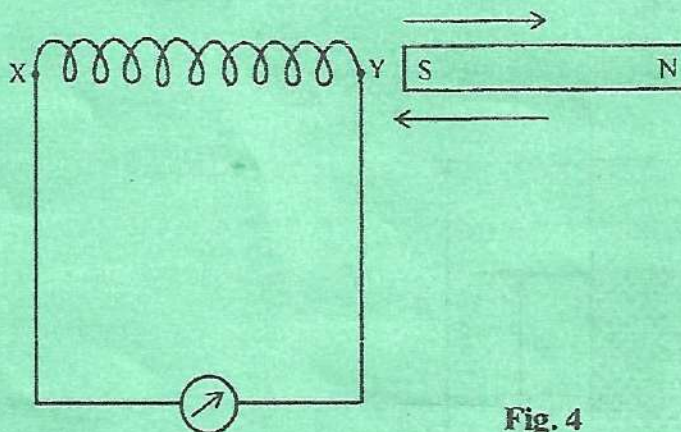


Fig. 4

- (a) Outline the observations made. (2 marks)
- (b) State **two** ways of increasing the effect observed in (a). (2 marks)

SECTION B (40 marks)

Answer ALL questions in this section.

16. (a) Figure 5 shows some structures in the human breathing system.

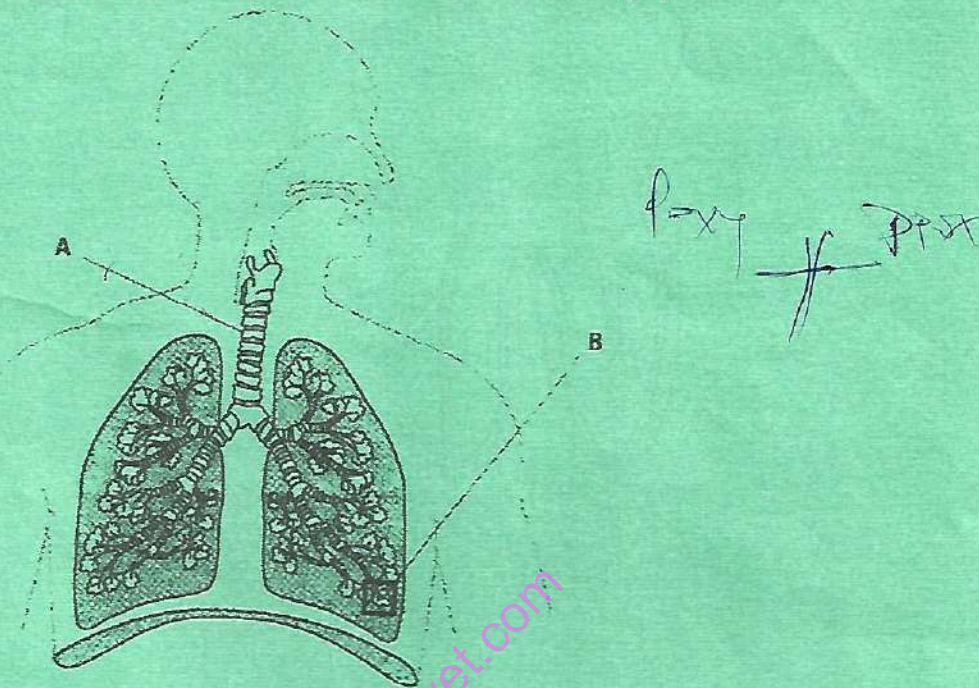


Fig. 5

- (i) Name the parts labelled A and B; - Alveolus (2 marks)
- (ii) Table II shows the amount of two gases, X and Y in blood entering and leaving the lungs during the process of gas exchange.

Table II

Gas	Amount of gas in cm^3 per 100 cm^3 of blood entering lungs	Amount of gas in cm^3 per 100 cm^3 of blood leaving lungs
X	10.6	19.0
Y	58.0	50.0

O_2 , CO_2

- (I) identify gases X and Y; - O_2 (2 marks)
- (II) determine the amount of gas X that enters 100 cm^3 of blood before the blood leaves the lungs. (1 mark)

$$\frac{10 \times 6}{100}$$

- (b) Red pandas (*Ailurus fulgens*) and humans have a similar arrangement of teeth. Figure 6a shows a section through one tooth of a red panda while figure 6b shows the side view of the lower jaw of a red panda.

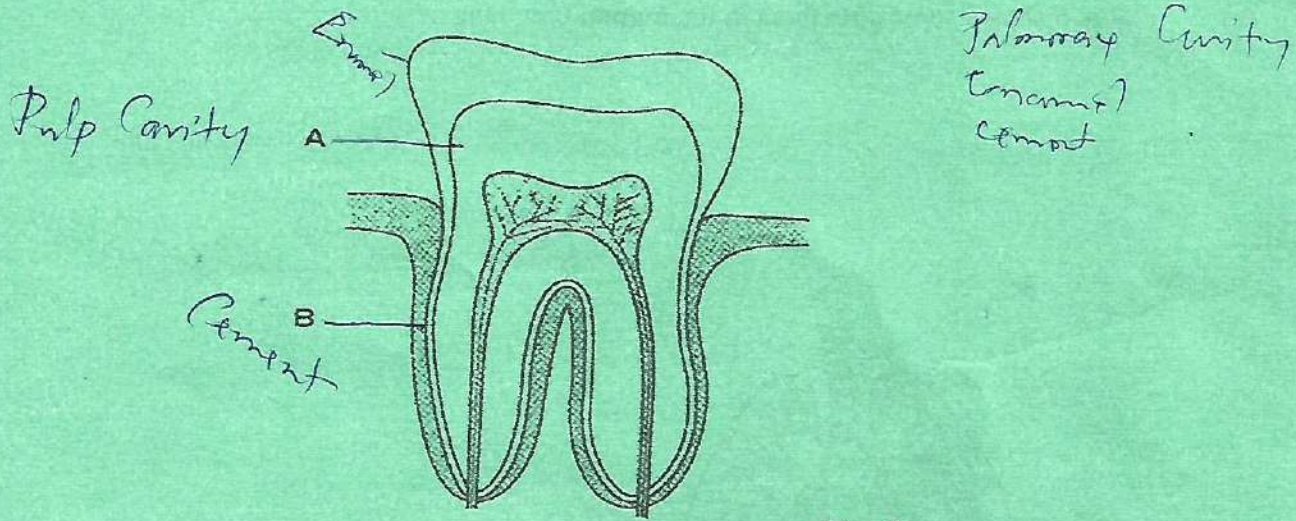


Fig. 6a

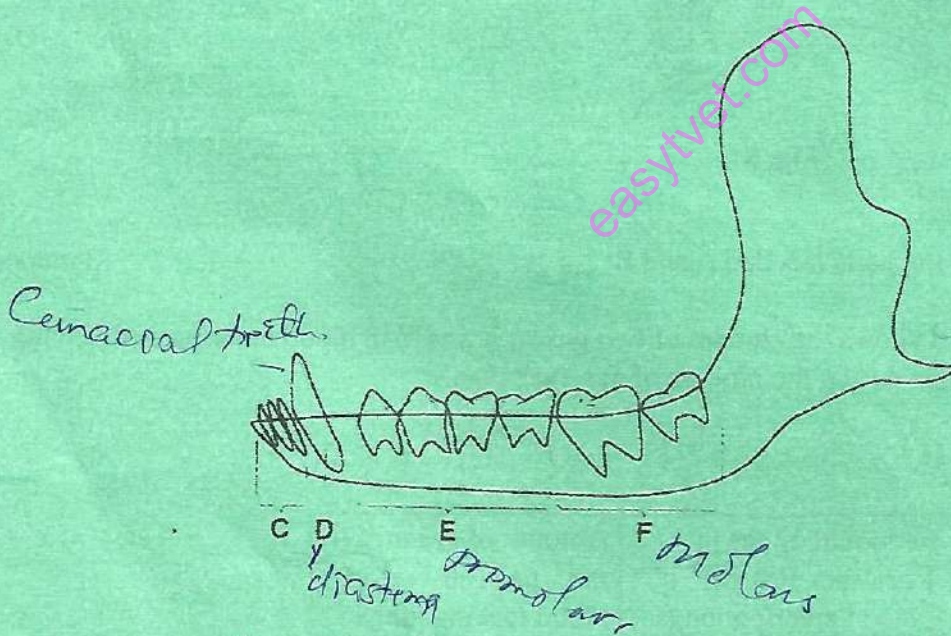


Fig. 6b

- (i) Name the structures labelled A, B, C, D, E and F. (6 marks)
- (ii) Food that sticks to the tooth can cause decay of the tooth. Explain. (2 marks)
- (iii) Name the two parts of teeth that are affected in (ii). (1 mark)

teeth has bacteria that release chemical causing decay

- roof of teeth
- grip. of teeth
(enamel)

(c) Figure 7a is a branching key used to identify different species of bacteria.

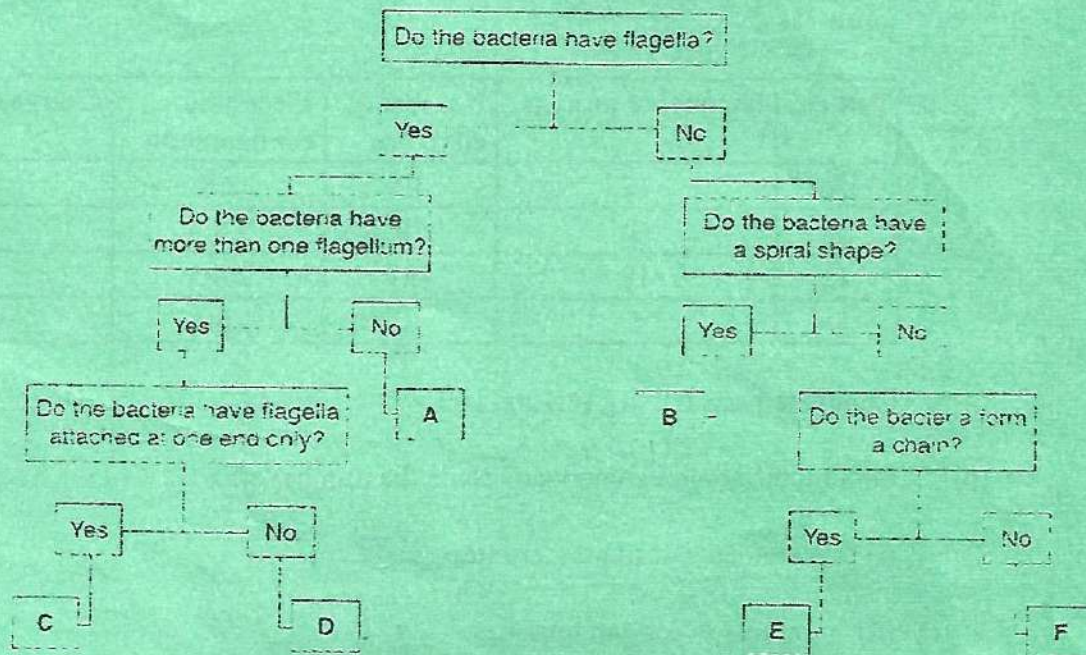


Fig. 7a

Figure 7b shows six different species of bacteria.

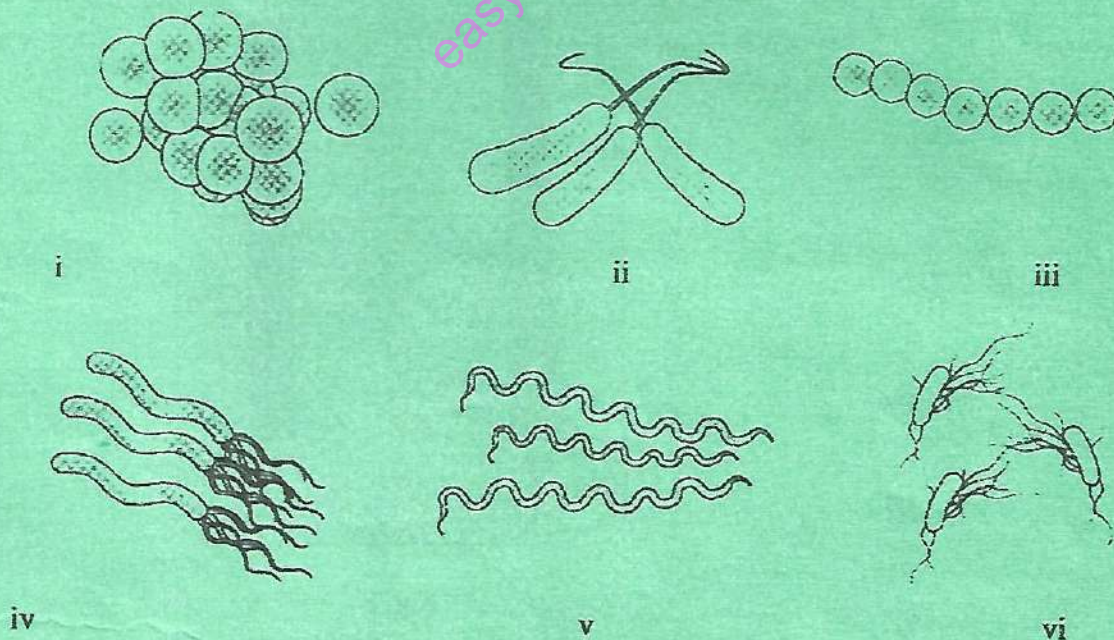


Fig. 7b

Use the branching key to identify the letter representing each of the different species of bacteria labelled i, ii, iii, iv, v and vi. (6 marks)

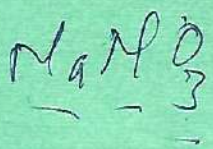
17. (a) Table III shows information about particles A, B, C and D.

Table III

Particle	Number of protons	Number of electrons	Electronic configuration	Charge on particle
A	12	10	2:8	2+
B	(i)	18	2:8:8	1-
C	18	(ii)	2:8:8	0
D	8	10	(iii)	(iv)

Complete parts (i), (ii), (iii) and (iv). (4 marks)

(b) Sodium nitrate is a compound. State the number of:



(i) elements in sodium nitrate; (3) (1 mark)

(ii) atoms in sodium nitrate. (13) (1 mark)

(c) Figure 8 shows the movement of the ions Na^+ and Cl^- during the electrolysis of molten sodium chloride.

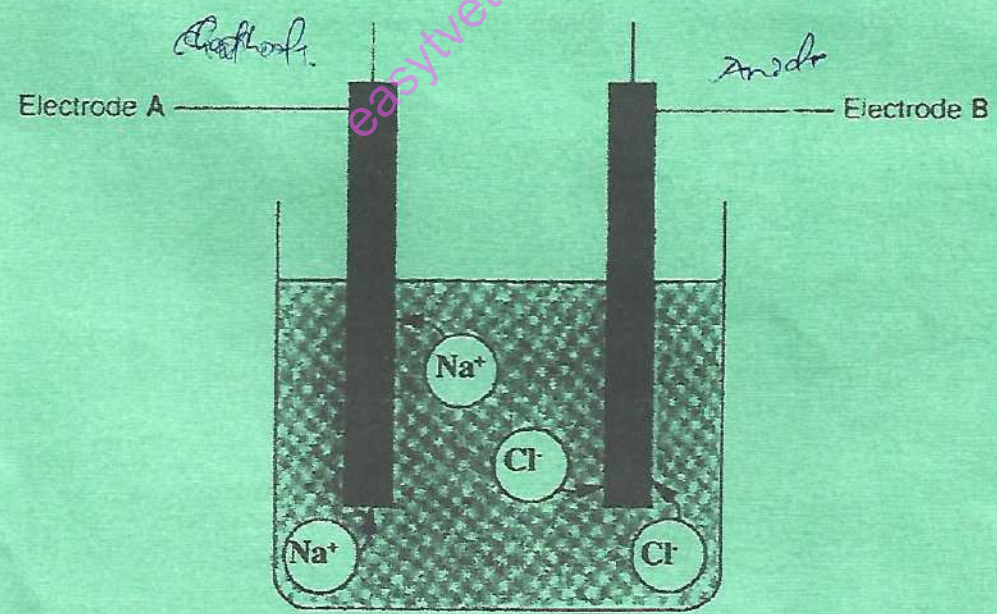
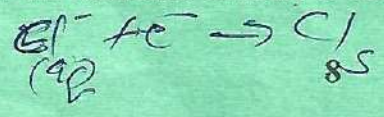


Fig. 8

(i) Identify the positive electrode. Give a reason. B - attract Cl^- ions (2 marks)

(ii) Name the ion which is attracted to the cathode. Na^+ (1 mark)

(iii) Write the molecular formula of the substance formed at the anode. (1 mark)



- (d) Concentrated ammonia solution gives off ammonia gas. Concentrated hydrochloric acid gives off hydrogen chloride gas. Ammonia, NH_3 and hydrogen chloride, HCl are both colourless gases. Ammonia reacts with hydrogen chloride to make the white solid ammonium chloride. The apparatus is set up as shown in figure 9.

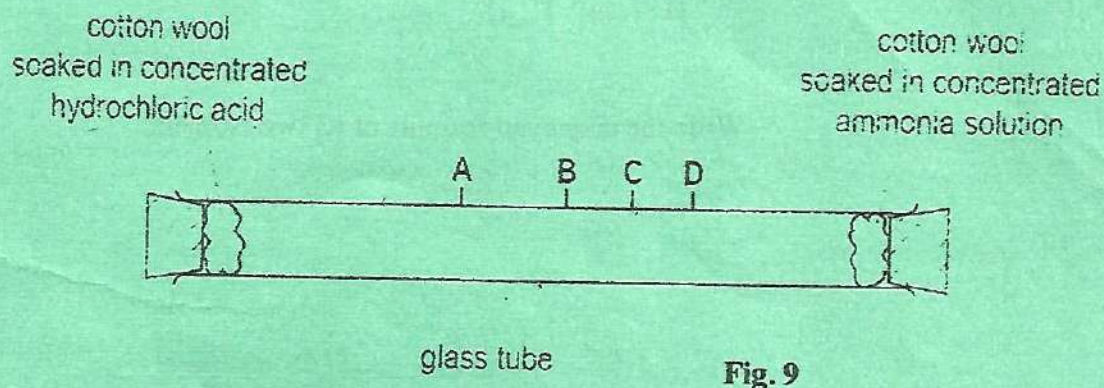


Fig. 9

After ten minutes, a white solid forms in the tube where the gases meet.

- (i) Write a balanced chemical equation for the reaction. (2 marks)

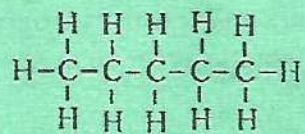
$$NH_3 + HCl \rightarrow NH_4Cl(s)$$
- (ii) Name the process by which ammonia and hydrogen chloride gases move in the tube. (1 mark)
diffusion
- (iii) Identify, with reason, the point where the white solid forms. (2 marks)
A - NH_3 diffuse 2 times faster than HCl
- (e) A trainer explained the different types of formulae used in organic chemistry using ethene as an example as shown:

Description	Formula
General	C_nH_{2n}
Empirical	(CH_2)
Molecular	C_2H_4
Structural	$CH_2=CH_2$
Displayed	$\begin{array}{c} H & & H \\ & \backslash & / \\ & C = C \\ & / & \backslash \\ H & & H \end{array}$

Using this description, write the:

- (i) empirical formula of methane; (1 mark)
- (ii) molecular formula of ethane; (1 mark)
- (iii) structural formula of propane. (1 mark)

(iv) The displayed formula of pentane is:



Write the displayed formula of its two isomers.

(2 marks)

easyvet.com

PERIODIC TABLE OF ELEMENTS

1 2

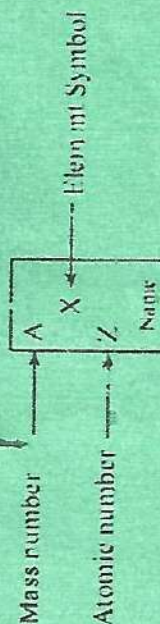
Group

3 4 5 6 7 0

1 H Hydrogen

³ Li Lithium	⁴ Be Beryllium											² He Helium					
¹¹ Na Sodium	¹² Mg Magnesium											⁹ F Fluorine	¹⁰ Ne Neon				
¹⁹ K Potassium	²⁰ Ca Calcium	²¹ Sc Scandium	²² Ti Titanium	²³ V Vanadium	²⁴ Cr Chromium	²⁵ Mn Manganese	²⁶ Fe Iron	²⁷ Co Cobalt	²⁸ Ni Nickel	²⁹ Cu Copper	³⁰ Zn Zinc	³¹ Ga Gallium	³² Ge Germanium	³³ As Arsenic	³⁴ Se Selenium	³⁵ Br Bromine	³⁶ Kr Krypton
³⁷ Rb Rubidium	³⁸ Sr Strontium	³⁹ Y Yttrium	⁴⁰ Zr Zirconium	⁴¹ Nb Niobium	⁴² Mo Molybdenum	⁴³ Tc Technetium	⁴⁴ Ru Ruthenium	⁴⁵ Rh Rhodium	⁴⁶ Pd Palladium	⁴⁷ Ag Silver	⁴⁸ Cd Cadmium	⁴⁹ In Indium	⁵⁰ Sn Tin	⁵¹ Sb Antimony	⁵² Te Tellurium	⁵³ I Iodine	⁵⁴ Xe Xenon
⁵⁵ Cs Caesium	⁵⁶ Ba Barium	⁵⁷ La Lanthanum	⁵⁸ Hf Hafnium	⁵⁹ Ta Tantalum	⁶⁰ W Tungsten	⁶¹ Re Rhenium	⁶² Os Osmium	⁶³ Ir Iridium	⁶⁴ Pt Platinum	⁶⁵ Au Gold	⁶⁶ Hg Mercury	⁶⁷ Tl Thallium	⁶⁸ Pb Lead	⁶⁹ Bi Bismuth	⁷⁰ Po Polonium	⁷¹ At Astatine	⁷² Rn Radon
⁸⁷ Fr Francium	⁸⁸ Ra Radium	⁸⁹ Ac Actinium															

Key:



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