

1905/102

APPLIED PHYSICAL SCIENCES, APPLIED BIOLOGICAL
SCIENCES, ANATOMY AND PHYSIOLOGY

March/April 2020

Time: 3 hours



THE KENYA NATIONAL EXAMINATIONS COUNCIL

CRAFT CERTIFICATE IN NUTRITION AND DIETETICS
MODULE I

APPLIED PHYSICAL SCIENCES, APPLIED BIOLOGICAL SCIENCES,
ANATOMY AND PHYSIOLOGY

3 hours

INSTRUCTIONS TO CANDIDATES

You should have the following for this examination:

answer booklet;

non-programmable scientific calculator (battery operated).

This paper consists of TWO sections; A and B.

Answer ALL the questions in section A and any TWO questions from 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 paper consists of 14 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 the questions in this section.

1. Figure 1 is a photomicrograph of spirogyra, an autotrophic organism that inhabits fresh water ponds and ditches.

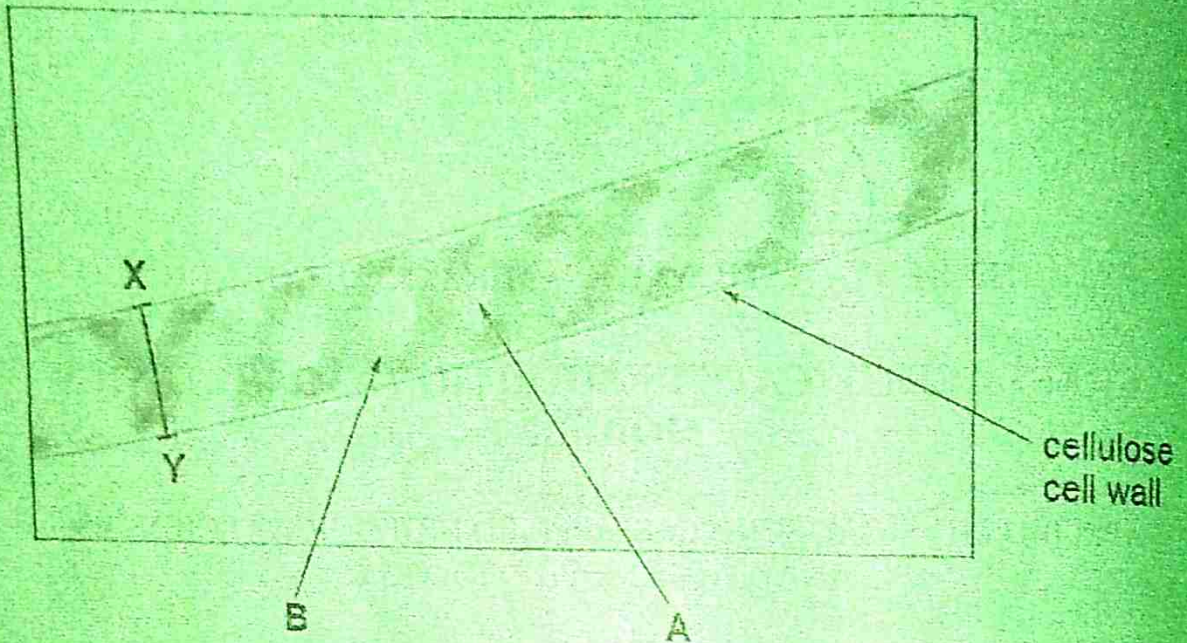


Fig. 1

- (a) Identify the organelles labelled A and B. (2 marks)
- (b) The actual width of the cell between points X-Y was $32.2 \mu\text{m}$. Calculate the magnification that was used to take the photomicrograph. (2 marks)
2. (a) The sex chromosomes in the cells of a mother are XX. The sex chromosomes in the cells of a father are XY. (1 mark)
- (i) Using this information, give the sex chromosomes in the cells of their male foetus. (1 mark)
- (ii) Give the number of chromosomes in a body cell of the male fetus. (1 mark)
- (b) The dominant allele for the ability to smell the scent of a particular flower is represented by A. The recessive allele, which does not allow a person to smell the scent of the flower is represented by a. Using these letters, indicate the: (1 mark)
- (i) possible alleles found in the gametes of a woman who can smell the flower. (1 mark)
- (ii) the genotype of a woman who is unable to smell the flower. (1 mark)

3. Figure 2 shows blood returning to the heart at low pressure through a vein in a leg.

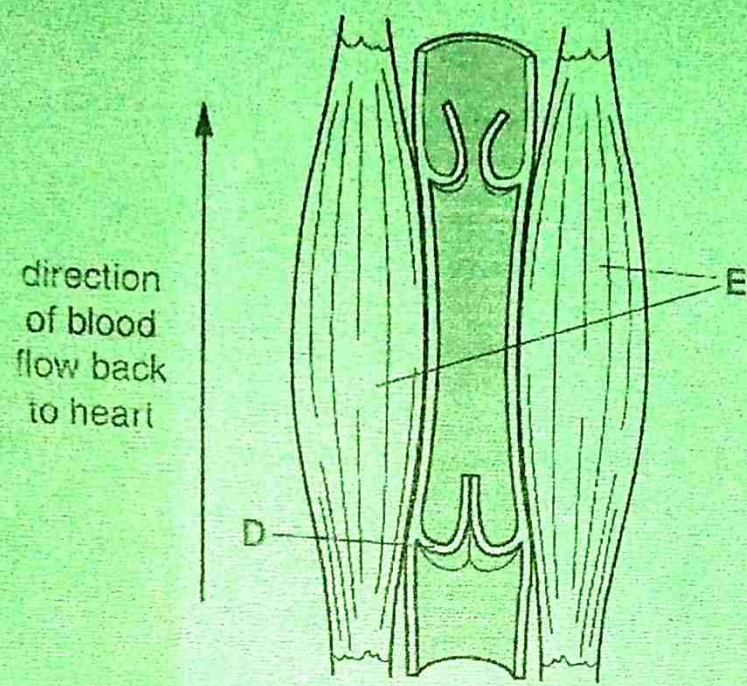


Fig. 2

- (a) Name the part labelled D. (1 mark)
- (b) Explain how the parts labelled D and E function to enable blood to return to the heart. (3 marks)

4. (a) Photosynthesis takes place in the leaves of a plant. Complete the equation below for photosynthesis using words



(b) Figure 3 shows one leaf taken from the plant and the appearance of part of the lower side of leaf when viewed using a microscope.

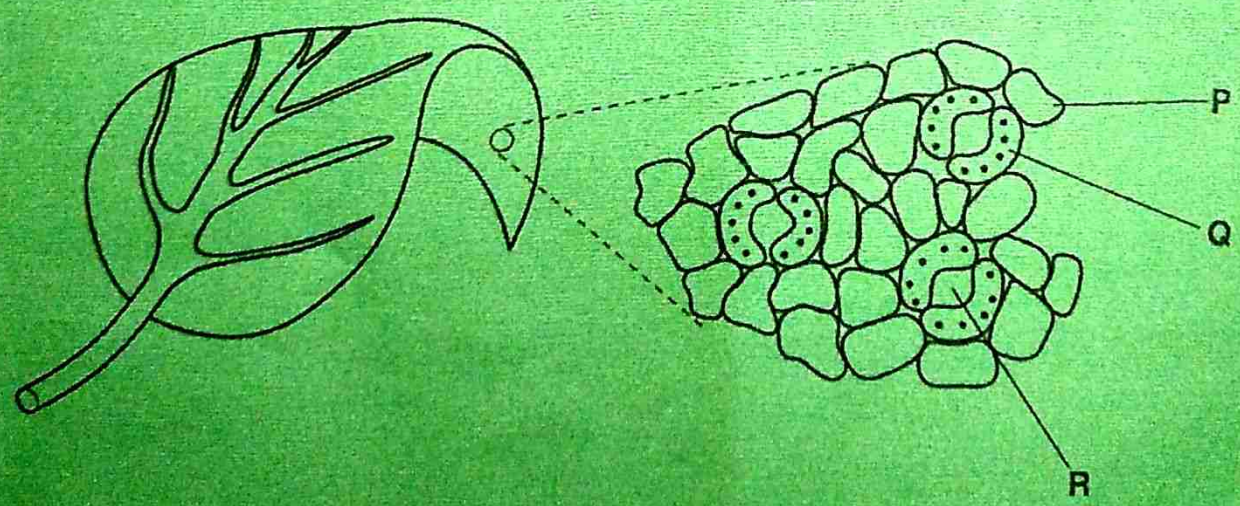


Fig. 3

Name the parts labelled P, Q and R. (3 marks)

5. Figure 4 represents part of a human digestive system.

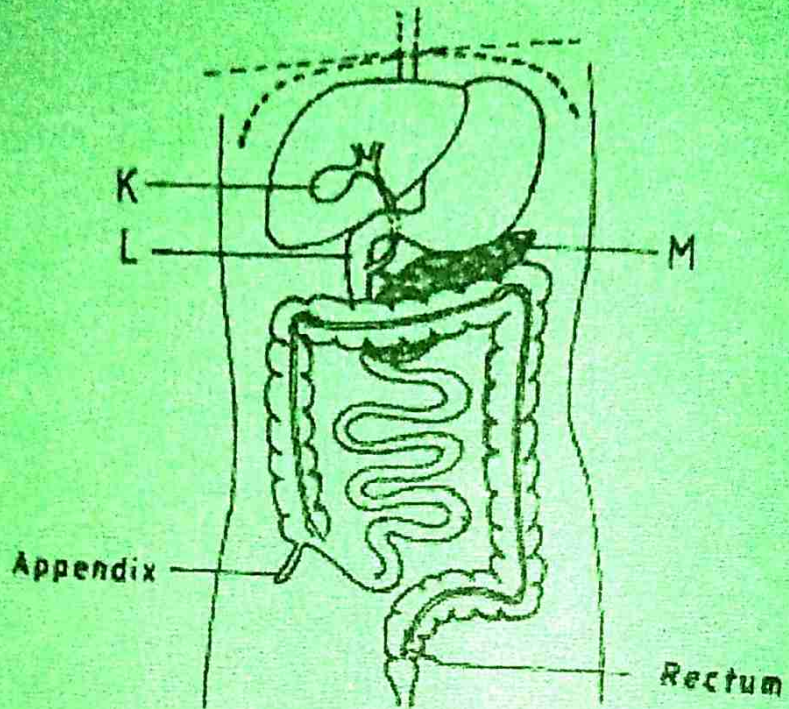


Fig. 4

- (a) Name the organs labelled L and M. (2m)
- (b) (i) Identify the substance produced by the organ labelled K. (1m)
- (ii) State the function of the substance identified in b(i). (1m)
6. (a) Define homeostasis. (1m)
- (b) State **three** homeostasis roles of the human skin. (3m)
7. Explain the likely impact on the composition of urine in case of the following: (2m)
- (a) vigorous physical exercises. (2m)
- (b) taking a meal rich in protein. (2m)

8. (a) Figure 5 illustrates a blood capillary surrounding a structure for gaseous exchange in human beings.

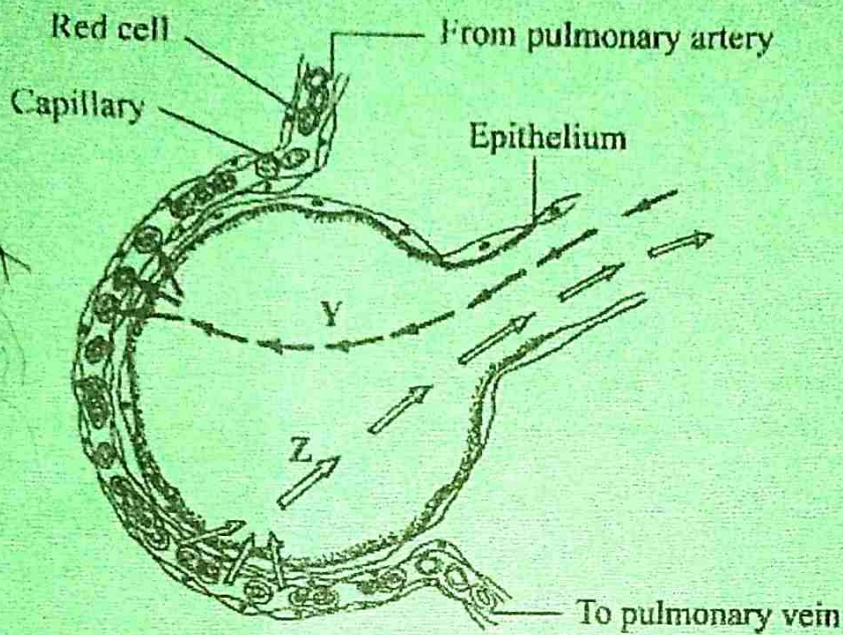


Fig. 5

- (i) Identify the gaseous exchange structure. (1 mark)
- (ii) Identify the gases labelled Y and Z. (2 marks)
- (b) Define a synapse. (1 mark)

Table 1 gives information about dry air from two different places. One is in town, and the other is in the country side.

Table 1

| Gas present | Town % | Country side % |
|-----------------|--------|----------------|
| Argon | 1.00 | 1.00 |
| Nitrogen | 78.00 | 78.00 |
| Oxygen | 20.80 | 20.96 |
| Carbon dioxide | 0.05 | 0.04 |
| Carbon monoxide | 0.10 | 0 |
| Nitrogen oxides | 0.05 | 0 |
| Total | 100.0 | 100.0 |

- (a) Work out the percentage of carbon dioxide in the town. (2 marks)
- (b) The carbon dioxide concentration is higher in the town. Give reason (s) for this occurrence. (2 marks)

10. Figure 6 shows the apparatus used for the electrolysis of some molten compounds.

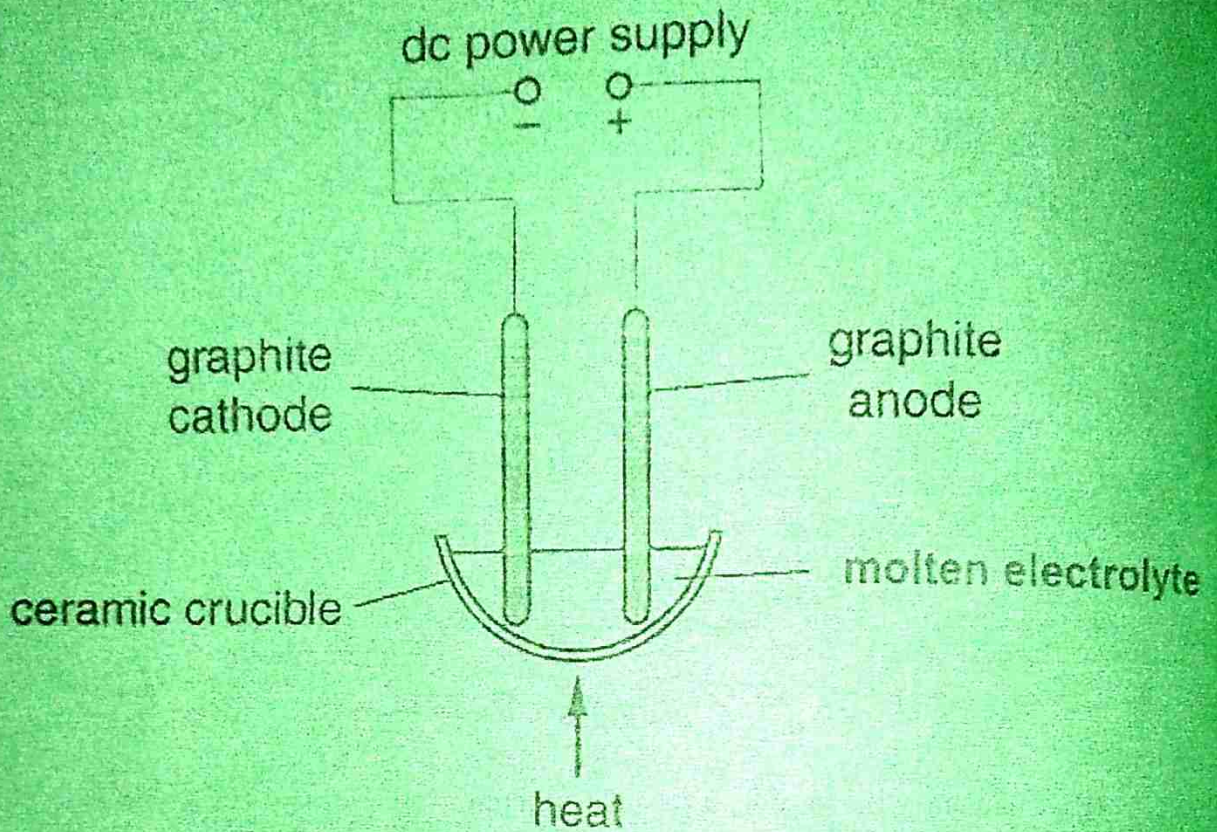


Fig. 6

Table 2 shows what is produced at each electrode during the electrolysis of molten compounds.

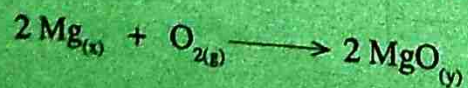
Table 2

| Molten electrolyte | Product at cathode | Product at anode |
|--------------------|--------------------|------------------|
| Sodium chloride | - | - |
| Lead bromide | - | - |

Identify the products at both the cathode and the anode for each of the molten electrolytes.

(4 marks)

11. Magnesium burns in oxygen to make magnesium oxide according to the following equation.



(a) Identify the state symbols represented by X and Y in the equation.

(2 marks)

(b) Indicate which element is oxidized and which element is reduced.

(2 marks)

Handwritten notes and a table at the bottom right corner of the page. The table has columns for '20', '25', and '30' and rows for '10', '15', and '20'. There are also some scribbles and the number '02' written nearby.

12. Methane burns in oxygen as per the following

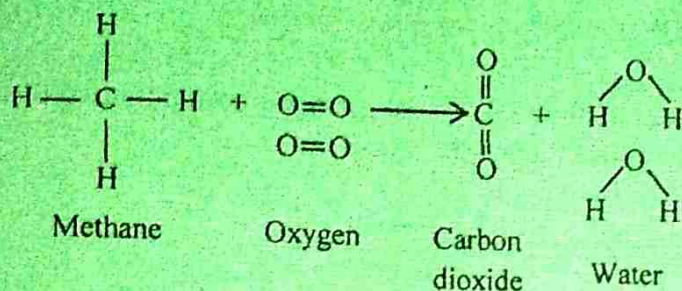


Table 3 shows the bond energies of the bonds involved.

Table 3

| Bond | Bond energy (KJ/mol) |
|-------|----------------------|
| C - H | 435 |
| O = O | 498 |
| C = O | 805 |
| O - H | 464 |

- (a) Name the type of energy change that happens when bonds break. (1 mark)
- (b) Calculate the energy change for this reaction. (3 marks)
3. (a) A sinusoidal current has a root mean square (rms) value of 12 A. Calculate its maximum value. (2 marks)
- (b) Name a device that allows flow of:
- (i) direct current and oppose alternating current. (1 mark)
- (ii) alternating current and oppose direct current. (1 mark)
4. Determine the fraction of a radioactive element that decays in 3 years if its half-life is 1 year. (4 marks)
5. An object 2 cm high is placed 20 cm in front of a concave mirror of focal length 25 cm. Determine:
- (i) image position. (2 marks)
- (ii) magnification. (2 marks)

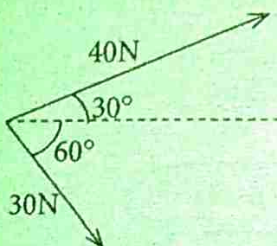
SECTION B (40 marks)

Answer any TWO questions from this section.

16. (a) A uniform beam has length 10 m and mass 50 kg. It is supported by two pistons as shown. Determine the force at the support R_1 and R_2 . (4 marks)



(b)



- (i) Determine the net resultant of horizontal component of forces.
 (ii) Determine the acceleration of 20 kg object subjected to both forces assuming friction force is negligible. (7 marks)

(c) Describe the working principle of an electric bell (include a diagram). (9 marks)

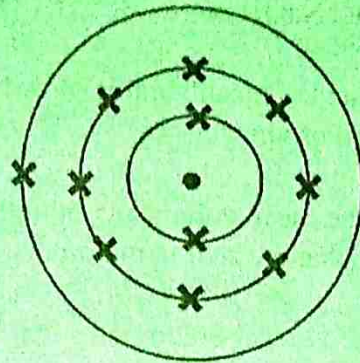
17. (a) (i) Table 4 shows information about atoms of some elements.

Table 4

| Element | Symbol | Number of Protons | Number of Neutrons | Number of Electrons |
|-----------|-------------------------|-------------------|--------------------|---------------------|
| Beryllium | ${}^4_2\text{Be}$ | 4 | 5 | 4 |
| Fluorine | ${}^{19}_9\text{F}$ | 9 | III | IV |
| Calcium | I | 20 | 20 | V |
| Argon | ${}^{40}_{18}\text{Ar}$ | II | 22 | 18 |

Identify I, II, III, IV and V. (5 marks)

- (ii) The diagram below shows the electronic structure of an element in the periodic table.



Using X to represent an electron, draw a similar diagram to show the electronic structure of the element which lies immediately:

- (I) below this element in the periodic table. (1 mark)
- (II) to the right of this element in the periodic table. (1 mark)

- (b) A food scientist was asked to check the quality of a bottle of vinegar. Vinegar contains ethanoic acid, CH_3COOH . The apparatus shown in figure 7 was used to find the concentration of ethanoic acid in vinegar.

Dilute sodium hydroxide of concentration 0.90 mol dm^{-3} was added a little at a time to 25.0 cm^3 of vinegar until the indicator changed colour. The procedure was carried out three times.

| | Run 1 | Run 2 | Run 3 |
|--|-------|-------|-------|
| Volume of sodium hydroxide added (cm^3) | 24.1 | 23.9 | 24.0 |

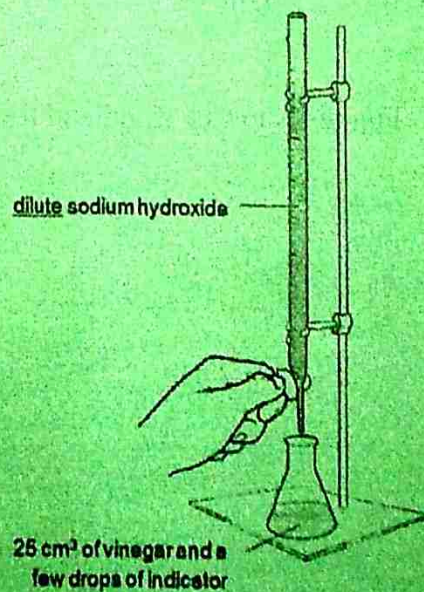
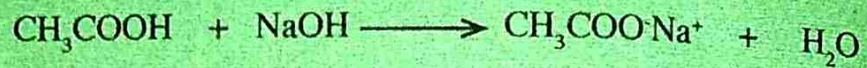


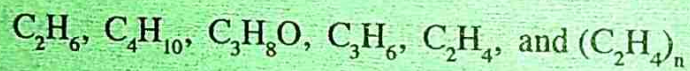
Fig. 7

- (i) Ethanoic acid reacts with sodium hydroxide solution according to the following equation:



- (I) Calculate the mean volume of sodium hydroxide needed to neutralize 25.0 cm³ of vinegar. (1 mark)
- (II) Using the mean volume of sodium hydroxide, calculate the concentration of the ethanoic acid in mol dm⁻³. (3 marks)
- (ii) The label on the vinegar bottle states that it contains a minimum of 5g of ethanoic acid in 100 cm³ vinegar.
- (I) Calculate the relative molecular mass M_r of ethanoic acid. (2 marks)
- (II) Show whether the information on the label is correct. (4 marks)

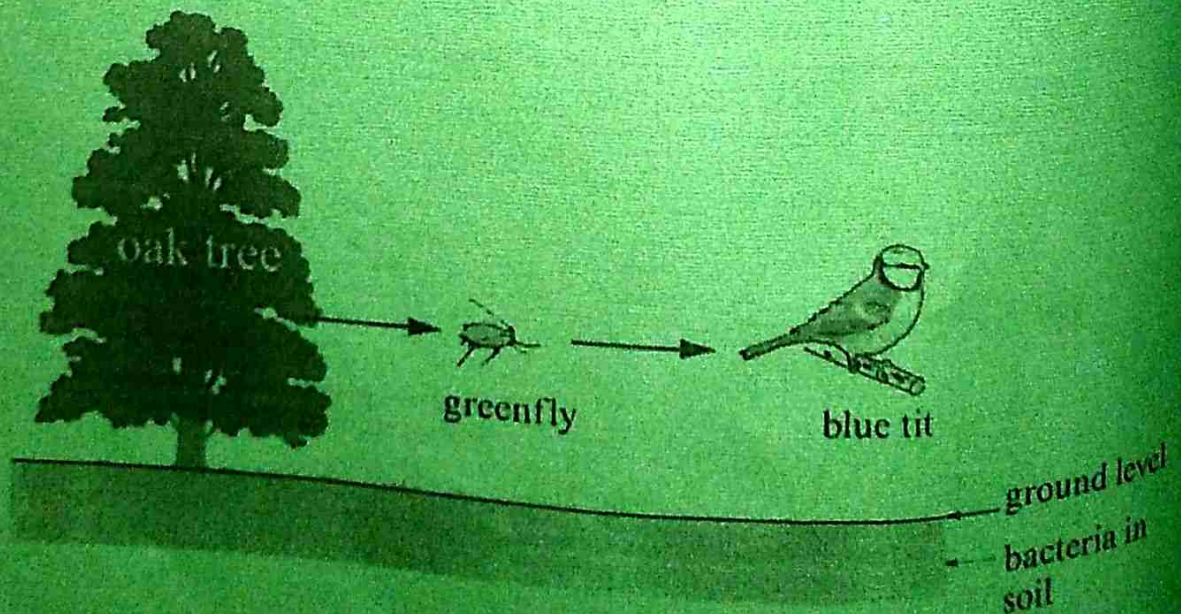
- (c) The formula of some organic compounds are listed as follows:



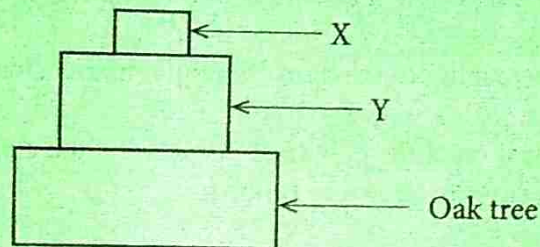
Identify the compound(s) which represent:

- (i) alkenes;
(ii) alcohols;
(iii) polymers. (3 marks)

- 18 (a) Figure 8 shows a woodland food chain.



- (i) (I) What is the source of energy for the food chain? (1 mark)
- (II) Name the herbivore in this food chain. (1 mark)
- (ii) Using this food chain, complete the labels X and Y on the pyramid of biomass below: (2 marks)



- (iii) The organisms in the food chain belong to different groups. Each group has an identifying feature. Use the information in table 5 to place each organism in its correct group. Use a tick (✓) in the correct group. (3 marks)

Table 5

| Organism Feature | | Group | | | |
|------------------|--------------------|-------|------------|--------------|---------------|
| | | Plant | Vertebrate | Invertebrate | micro organic |
| Oak tree | has flowers | ✓ | | | |
| Greenfly | has no backbone | | | | |
| Blue tit | has backbone | | | | |
| Bacteria | brings about decay | | | | |

- (b) A grey bodied fruit fly was mated with a black bodied fruit fly. All the F₁ offsprings were grey bodied.

Using the letters A and a, to represent the alleles for the two different body colours, complete the punnett square below to show the offsprings produced from the mating between the grey-bodied and black bodied fruit flies.

(4 marks)

F₁

| Gametes | A | a |
|---------|----|----|
| A | AA | Aa |
| a | Aa | aa |

- (ii) Construct another punnet square to show the offsprings produced when two of the F_1 offsprings are selfed. (2 marks)
- (iii) Determine the ratio of the different phenotypes in the F_2 offsprings. (1 mark)
- (iv) Name the 19th Century scientist whose work on the garden pea plants led to the understanding of the mechanism of inheritance. (1 mark)
- (c) (i) State the meaning of the term "binomial nomenclature". (1 mark)
- (ii) A classification of the cow (*Bos taurus*) and the classification of the horse (*Equus ferus*) are shown as follows:

| | | | |
|------------|---------------|--------------|-----------|
| Cow | | Horse | |
| Kingdom | - I | Kingdom | - animal |
| Phylum | - vertebrates | Phylum | - II |
| Class | - mammals | Class | - mammals |
| Genus | - Bos | Genus | - III |
| Species | - taurus | Species | - IV |

Identify I, II, III, and IV.

(4 marks)

- 19 (a) Table 6 lists some human conditions and their causes to show a possible cause of each condition.
- (i) Copy and complete the table by placing a tick (\checkmark) in each row to show a possible cause of each condition. The first row has been completed. (3 marks)

Table 6

| | Cause | | | |
|---------------------|----------|----------------|-----------------------|---------------------|
| | Bacteria | Excess alcohol | Excess energy in food | Excess salt in food |
| High blood pressure | | | | |
| Infection | | | | \checkmark |
| Drug dependence | | | | |
| Obesity | | | | |

(ii) Which of the above conditions may be treated by:

(I) antibiotics.

(1 mark)

(II) reduced fat in the diet.

(1 mark)

(b) The level of glucose in a person's blood was measured every 3 minutes for three and a half hours. During this time the person was given a drink containing glucose. The results are shown in table 7.

Table 7

| Time (min) | Glucose level mg/ml |
|------------|---------------------|
| 0 | 26 |
| 30 | W |
| 60 | X |
| 90 | 74 |
| 120 | 90 |
| 150 | 65 |
| 180 | 43 |
| 210 | 28 |

(i) Use the graph in figure 9 to complete table 7 by replacing X and W with the correct values.

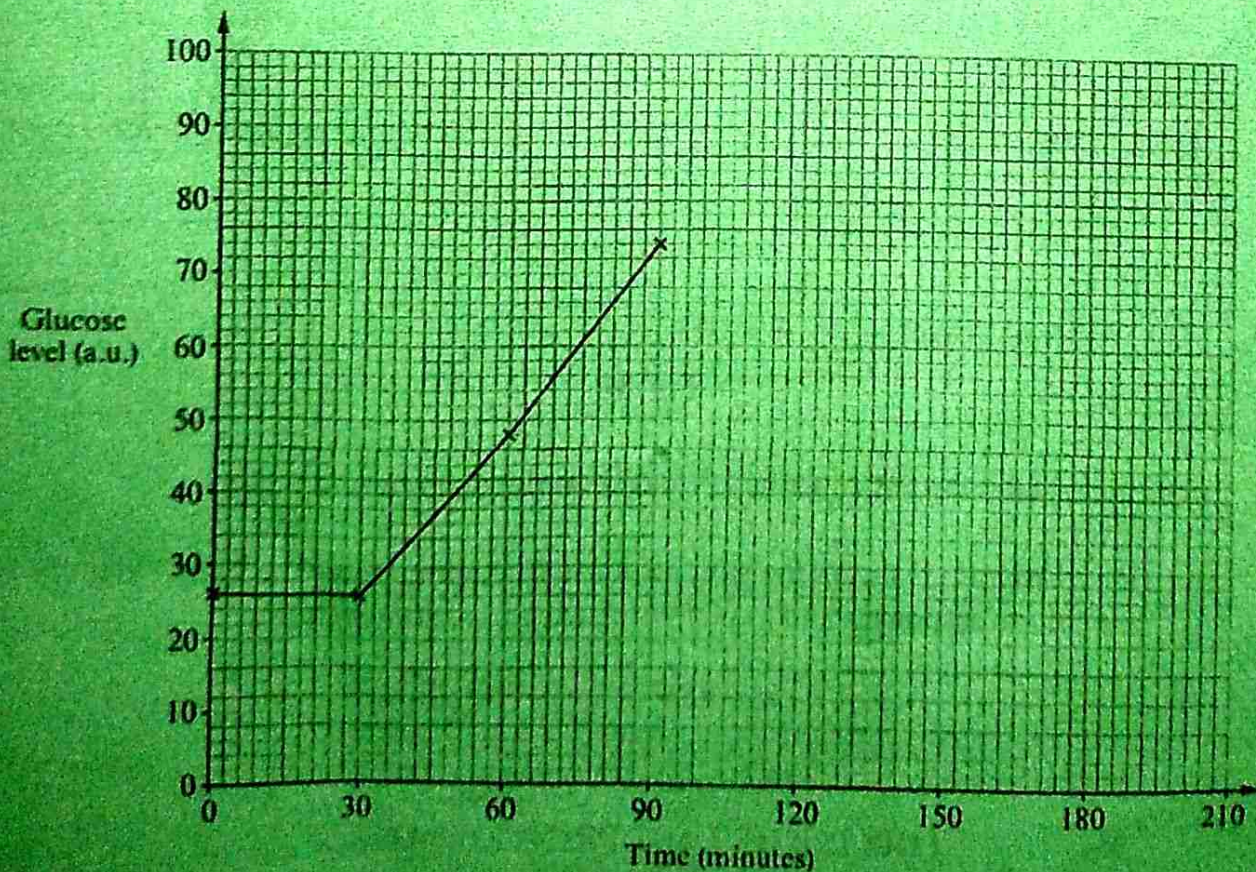


Fig. 9

- (ii) Complete the graph by plotting the results from 90 to 210 minutes and join the plots with a ruler. (4 marks)
- (iii) From the graph;
- (I) Determine the time the person took the glucose drink. (1 mark)
 - (II) State how the level of glucose changed between 60 and 150 minutes. (2 marks)
- (iv) Name the hormone that controls the level of glucose in blood. (1 mark)
- (v) Some people have a medical condition where they do not produce enough of the hormone named in (iv) above. Give the name of the condition. (1 mark)
- (c) Figure 10 shows the skin under two different environment conditions.

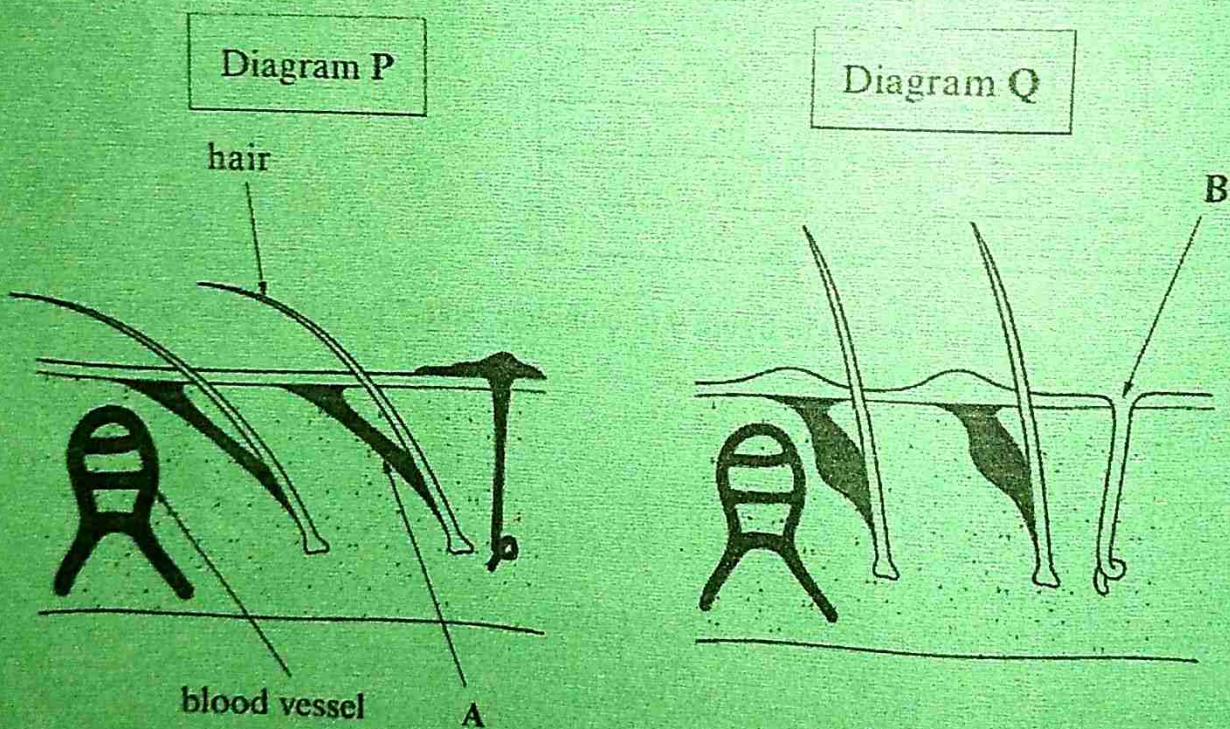


Fig. 10

- (i) Name the parts labelled A and B on the diagrams. (2 marks)
- (ii) Diagram P shows the skin response in cooling down the body. Identify two of these responses and explain how each cools the body. (4 marks)

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