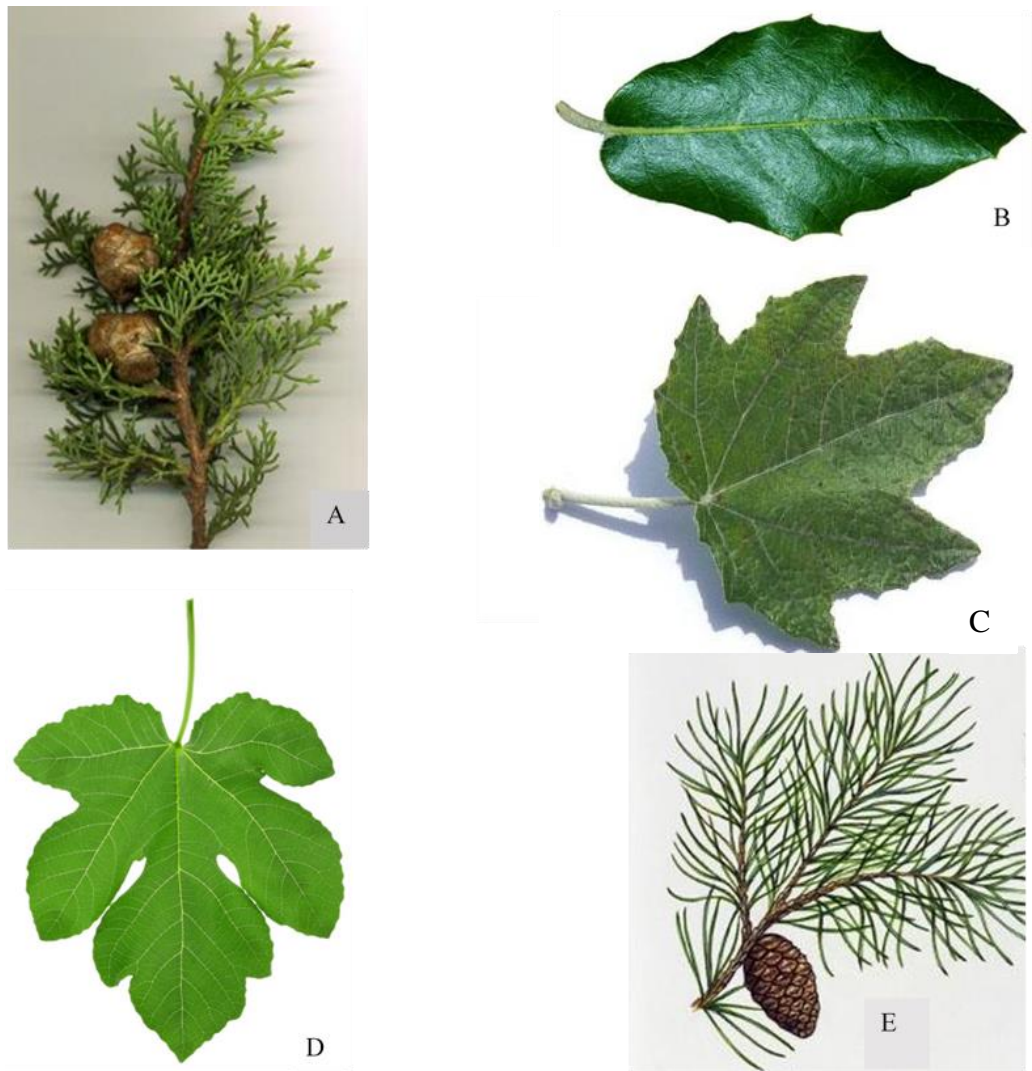


Section A: Answer all questions in this section.

1a. Below is a dichotomous key of leaves from some local trees.



Taken from various sources

Figure 1: Dichotomous Key

1a	Leaves reduced to needles.....	Go to 2
1b	Have broad leaves.....	Go to 3
2a	Have long needles in pair clusters.....	Aleppo Pine
2b	Have short scale like needles.....	Italian Cypress
3a	Leaves are lobed.....	Go to 4
3b	Leaves are not lobed and with rough pointed edges..	Holm Oak
4a	Leaf with deep lobes.....	Fig
4b	Leaf with shallow lobes.....	While Poplar

i) Name the tree represented by the letter: (2)

B _____ E _____

ii) Write the letter of each of the two gymnosperm trees represented above.(1)

- iii) Identify **one** characteristic feature of the trees listed in aii) that made you recognise them as gymnosperms. (1)

- b. The leaves of D are broad and have a network of veins. Explain the importance of these adaptations in photosynthesis. (2)

- c. The underside of the leaves of plant C have small hairs that make them look white. Discuss the role of these hairs and whitish underside. (2)

Total 8 marks

- 2a. The table below shows features of a bacterium and a virus. Complete the table by putting a tick (✓) in the relevant box where a feature is present.

	Bacterium	Virus
Genetic Material		
Cell wall		
Capsomeres		
Cytoplasm		

(2)

- b. Protists, fungi, animals and plants are all eukaryotes.
i) Name **one** organelle present in eukaryotic cells. (1)

- ii) Both fungi and plant cells have a cell wall surrounding the cell. Distinguish between the cell walls of fungi and plants. (1)

- iii) Some single cell protists have permanent structures that allow them to move about in their habitat. Name this structure. (1)

Total 5 marks

3. A student investigated the breakdown of starch by an enzyme produced by the human digestive system.

a. i) Name the human enzyme that breaks down starch. (1)

ii) Give the product of this reaction. (1)

b. The student added the enzyme to a starch solution and measured the concentration of the disaccharide produced in the reaction mixture every 5 minutes.

Below are the results obtained and processed in the form of a graph.

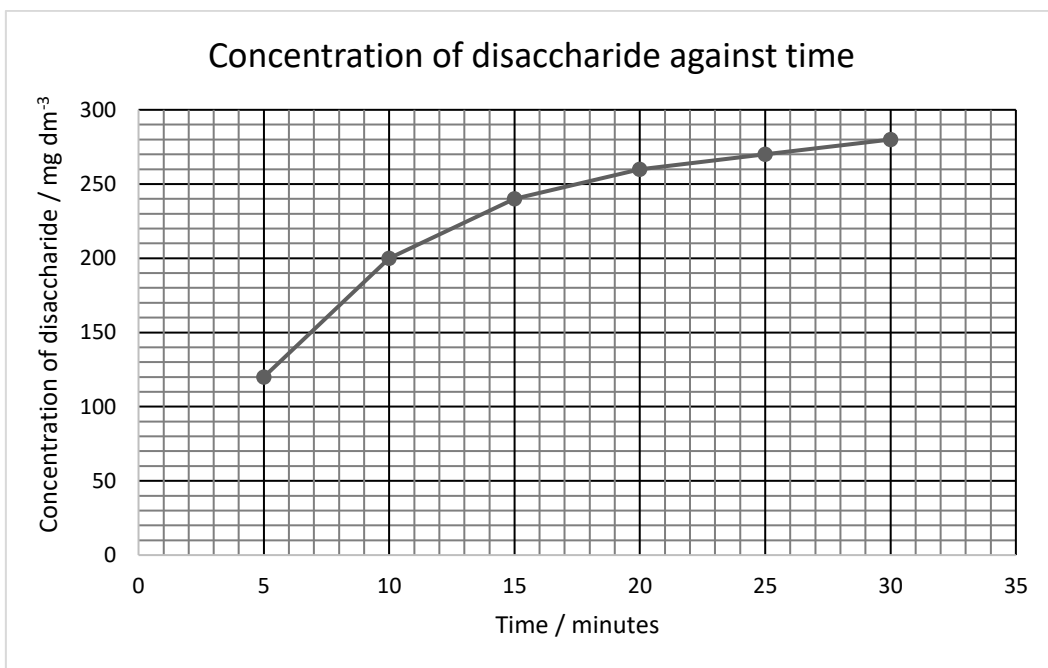


Figure 2: Graph of disaccharide concentration against time

i) Explain the results shown in the graph. (2)

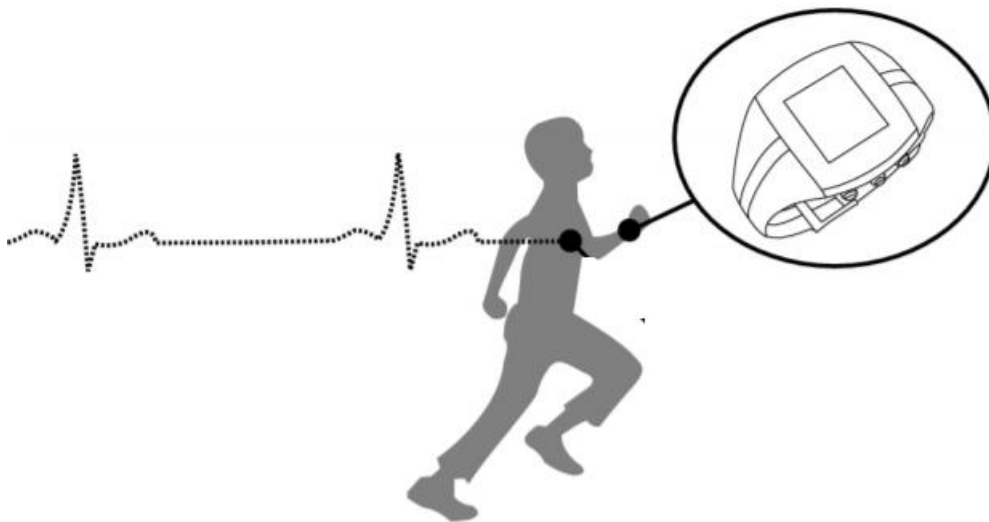
ii) Using your biological knowledge, justify the trend shown by the graph. (3)

iii) State the independent variable of this investigation. (1)

c. The product of the breakdown of starch is a reducing sugar. Describe a chemical test used to test for a reducing sugar. (2)

Total 10 marks

4. Wrist heart rate monitors are fitness trackers that sense the pulse rate in real time. They are used to gather heart rate data during several forms of physical exercise.



https://www.polar.com/sites/default/files/b2b/pe/lessons_for_life_e-version.pdf

Figure 3: Heartbeat and heart rate monitors

a. Describe how the heart rate changes from a person being at rest to exercising for half an hour. (2)

b. Athletes train to improve the efficiency of delivering oxygen to the muscles.
i) Describe **two** adaptations of red blood cells for the transport of oxygen. (2)

- ii) Before competitions, athletes train at high altitudes where the oxygen concentration in air is less than that at sea level. Explain the benefit of training at high altitudes. (3)

- c. The human circulatory system is a double system. Explain. (2)

Total 9 marks

5. The global COVID-19 cities lockdown affected the environment both positively and negatively.

- a. Describe the positive impact on the environment of the following:

- i) Beaches, both the seawater and the surrounding land are cleaner. (2)

- ii) There was a decrease in noise pollution. (1)

- b. Describe the negative impact on the environment of the following:

- i) The overall household waste increased. (2)

- ii) Certain cities stopped waste recycling. (2)

Total 7 marks

6. In a research study on the effect of soil pH on the common ragweed plant, the following results were obtained.

Soil pH	Effect on plant	
	% Germination	No. of inflorescence (flowers on a plant)
5	58	7
6	50	12
7	55	0

Results taken from <https://www.frontiersin.org/articles/10.3389/fpls.2018.01335/full>

- a. Other data on % germination shows that at pH 3 and pH 9 the % germination was 15% and 18% respectively. Explain why different pH levels affect germination. (2)

- b. Soil pH is known to affect plant growth as it influences the uptake of nutrients such as nitrates and magnesium. Explain how these two nutrients support plant growth. (2)

Nitrates _____

Magnesium _____

- c. There are separate male and female flowers on a ragweed plant. Name the reproductive organs present on a male flower and on a female flower. (2)

Male flower _____ Female flower _____

- d. Ragweed pollen causes respiratory allergies such as hay fever. A plant may produce millions of pollen grains in one season. These pollen grains are transported by wind.

- i) Mention **one** characteristic of pollen that is dispersed by wind. (1)

- ii) Suggest what can be done to reduce the amount of pollen produced by this plant. (1)

Total 8 marks

7a. Describe the daughter cells (products) of the process of mitosis. (1)

b. Give **one** reason why gametes are produced by the process of meiosis. (2)

c. Incontinentia pigmenti is a rare X-linked disorder that stops the production of a protein in skin cells resulting in blisters and warts from infancy. The mutated allele is dominant. The mutated allele causes lethality in boys i.e. the boy foetus dies before it is born.
The mother of a family had three pregnancies of which a girl and a boy were born. The girl has incontinentia pigmenti, the son is normal. The third pregnancy resulted in the birth of a dead boy. Only one parent has incontinentia pigmenti. Determine the genotype of the parents showing with a genetic diagram the reasons behind the genotypes given. (5)

Total 8 marks

Section B: Answer any three questions from this section on the foolscaps provided.
Graph paper is needed for Question 1.

1. A group of students investigated the effect of light intensity on the rate of photosynthesis. The students set up a pondweed in a test tube filled with water and moved a lamp at regular distances. For each distance, the number of gas bubbles produced in 2 minutes was recorded. Below are the results obtained.

Distance from lamp (cm)	10	20	30	40	50
No. of gas bubbles in 2 minutes	78	32	12	6	6

- Draw a graph of number of gas bubbles against distance from lamp. This graph is a curve. (6)
- Describe the trend observed. (2)
- Give a reason for this observed trend in the graph. (2)
- State the gas produced from photosynthesis. (1)
- Name **one** chemical (reactant) needed for the process of photosynthesis to occur. (1)
- From the graph, find the distance from the lamp when light is a limiting factor. (1)
 - Temperature is another limiting factor. Explain how the rate of photosynthesis changes with increasing temperature. (2)

Total 15 marks

2. The nervous system is a complex network of nerves and cells that carry messages to and from the brain and spinal cord to various parts of the body.

- Describe the 'messages' that are carried by nerve cells (neurones). (1)
- Draw a labelled diagram of either a motor neurone or a sensory neurone. (3)
- The spinal cord is also part of the central nervous system. Draw a diagram to show the path taken by these 'messages' as they travel along a reflex arc in the spinal cord. Show the direction of the messages in your diagram. (5)
- Hormones also help in coordination. Define the term hormones. (2)
- Glucose regulation is an example of hormonal coordination. Two hormones help to keep the concentration of glucose in blood constant.
 - Name **one** of these two hormones. (1)
 - Describe the function of the hormone named in ei). (1)
 - Regulation occurs through a feedback mechanism. Explain. (2)

Total 15 marks

3. In an article on 'Antifungal symbiotic peptides in legume', the researchers wrote the following:

Statement 1	The fungus <i>Botrytis cinerea</i> causing gray mould disease is a major problem for farmers growing strawberries, grapes, raspberries, tomatoes and lettuce. To mitigate the problem, they often resort to applying chemical fungicides which can lose their effectiveness over time.
Statement 2	Scientists at the Pacific Northwest National Laboratory have identified a sub class of peptides in the nodules of the legume, <i>Medicago truncatula</i> that proved effective in inhibiting growth of the fungus causing gray mould.

Taken from <https://www.sciencedaily.com/releases/2020/07/200720103320.htm>

- a.
- i) Give the species name of the fungus. (1)
 - ii) Draw and label the structure of a mould fungus. (3)
 - iii) Chemical fungicides may be more harmful than beneficial. Explain. (2)
 - iv) Grapes, raspberries and tomatoes are fruits containing seeds. Describe the structure of a seed. (2)
- b.
- i) Name the single units that form peptides. (1)
 - ii) List the elements that make up peptides. (1)
 - iii) Leguminous plants have single-celled prokaryotic organisms living in their root nodules. Name the kingdom of these organisms. (1)
 - iv) These organisms form an association with the plant harbouring them. What is this relationship called? (1)
 - v) Describe this association of the legume with the organisms. (3)

Total 15 marks

4. The production of vinegar using fruit scraps such as apple is a double fermentation process.

- a. What is fermentation? (2)
- b. This process first involves yeast for alcohol fermentation and then acetobacteria for acetic acid (vinegar) fermentation. Identify **two** structural similarities between yeast and bacteria. (2)
- c. Alcohol fermentation is used to produce bread, wines and beers.
- i) This process is an anaerobic process. Explain. (1)
 - ii) Name the substrate found in food scraps that is converted to alcohol. (1)
 - iii) One by-product of the second fermentation is cellulose that floats to the surface of the fermenting liquid. Describe a cellulose molecule. (2)
- d. Alcohol can be used as a biofuel instead of fossil fuels. This is considered more environmentally friendly. Explain. (2)
- e. Apple flowers are insect pollinated and once fertilisation occurs, the apple fruit develops.
- i) State **one** characteristic of flowers that are insect pollinated. (1)
 - ii) Distinguish between pollination and fertilisation. (2)
 - iii) In which specific part of the flower does fertilisation occur? (1)
 - iv) The apple flower has five petals and five sepals. Is this plant a monocot or a dicot? (1)

Total 15 marks

5. Distinguish between the following terms:

- a. Phototropism and geotropism. (4)
- b. Insects and arachnids. (2)
- c. Eutrophication and bioaccumulation. (5)
- d. Community and population. (4)

Total 15 marks