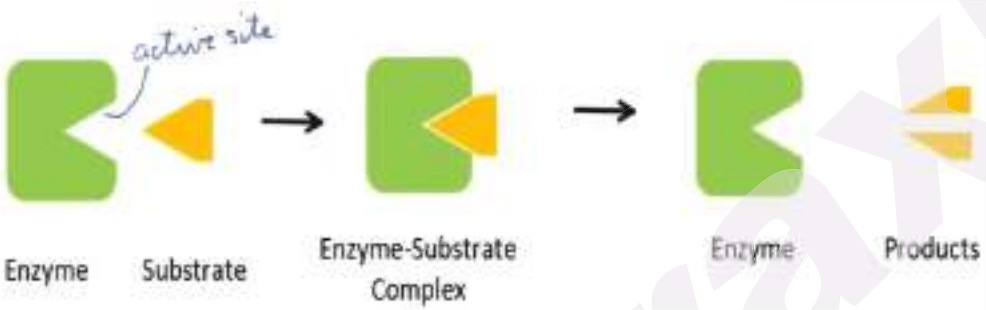
5. Enzymes

(IGCSE Biology Syllabus 2023-2025)

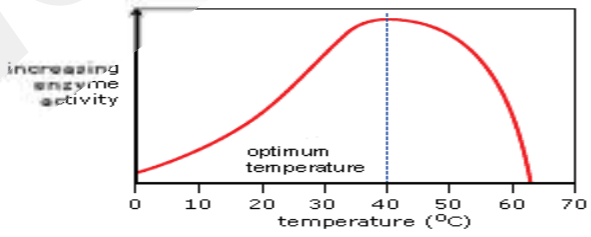
- Catalyst: a substance that speeds up a chemical reaction and is not changed by the reaction
- Enzymes: proteins that function as biological catalysts
- Enzymes lower the amount of energy needed for reaction to take place
- Lock and key theory:



  - Substrate: the molecules before they are made to react
  - Product: the molecules that are made in a reaction
  - Catabolic reaction: molecules are broken down
  - Anabolic reaction: molecules are combined

Effect of Temperature on Enzymes

- Enzymes have an **optimum temperature**: the temperature at which they work best giving the fastest reaction
- When temperature increases, molecules move faster so collide with an enzyme in less time
- Having more energy makes them more likely to bind to active site
- If temperature is too high, enzyme is **denatured** → it loses its shape and will no longer bind with a substrate
- When the temperature is too low, there is not enough kinetic energy for the reaction so it reacts too slowly



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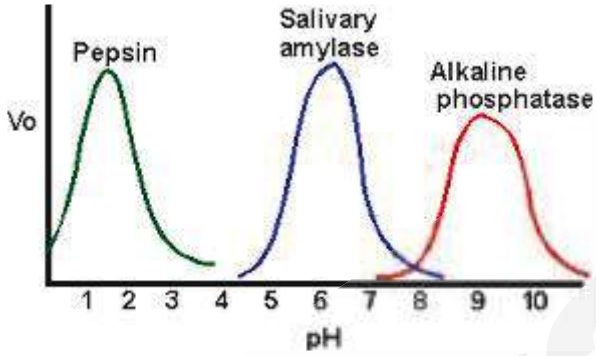
Effect of pH on Enzymes

- Enzymes are sensitive to pH
- Some enzymes work best in an acid, some work best in a neutral condition and others in an alkaline
- Enzymes work best at their optimum pH
- If the pH is changed then the enzyme will denature and will no longer fir with substrate – no reaction takes place



Enzymes and their Uses

- **Seeds to germinate**: the enzyme turn insoluble stored food to soluble
- **Biological washing powders**: enzymes are added to washing powder to help remove stains from clothes
  - Lipase: digest lipids from fatty food and greasy fingerprints
  - Protease: digest proteins from blood stains
- **Food industry**:
  - Isomerase converts glucose to fructose which is sweeter, so less is needed to give a sweet taste
  - Pectinase helps break down cell walls in fruit juice production so it increases yield, lowers viscosity and reduces cloudiness

Enzymes

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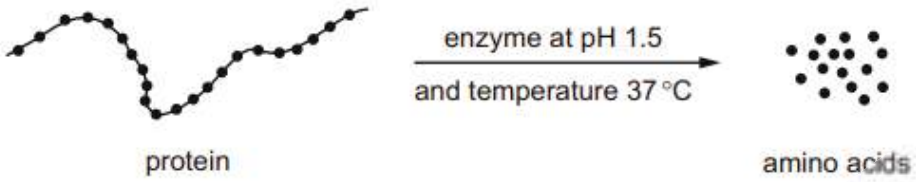
Feb/March 2019 (21)

10 The diagram shows the effect of an enzyme working in the human digestive system.



What would **reduce** the rate of production of amino acids?

A removing the amino acids as they are formed

B increasing the amount of protein

C raising the temperature to 37.1 °C

D raising the pH to 7.5

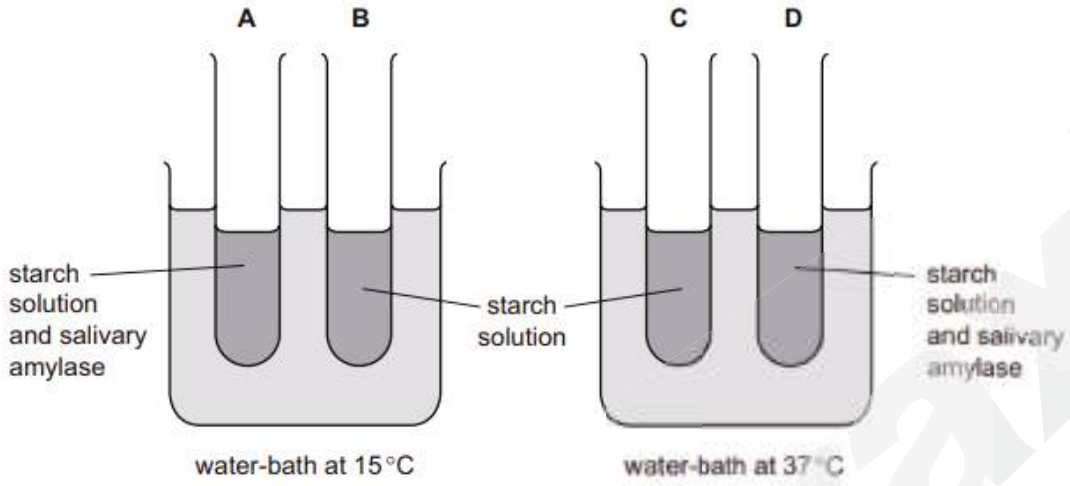
11 The diagrams show molecules involved in the action of a digestive enzyme such as maltase.

Which is the substrate?

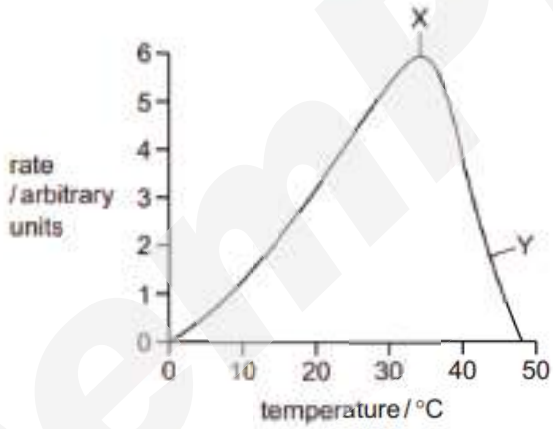
Oct/Nov 2018 (23)

9 The apparatus shown is used for an experiment on starch digestion.

Which test-tube contains the most sugar after 20 minutes?



10 The graph shows how an enzyme-controlled reaction is affected by temperature.



Which statement explains the change in activity between X and Y?

A There are more effective collisions.

B There is a change in the enzyme shape.

C There is more substrate present.

D The kinetic energy of the molecules has increased.

Oct/Nov 2019 (23)

9 Enzyme X digests protein in the stomach.

Four test-tubes were set up, each contained the same amounts of protein and enzyme X. The test-tubes are kept at different levels of pH and temperature, as shown in the table.

In which test-tube will protein digestion be quickest?

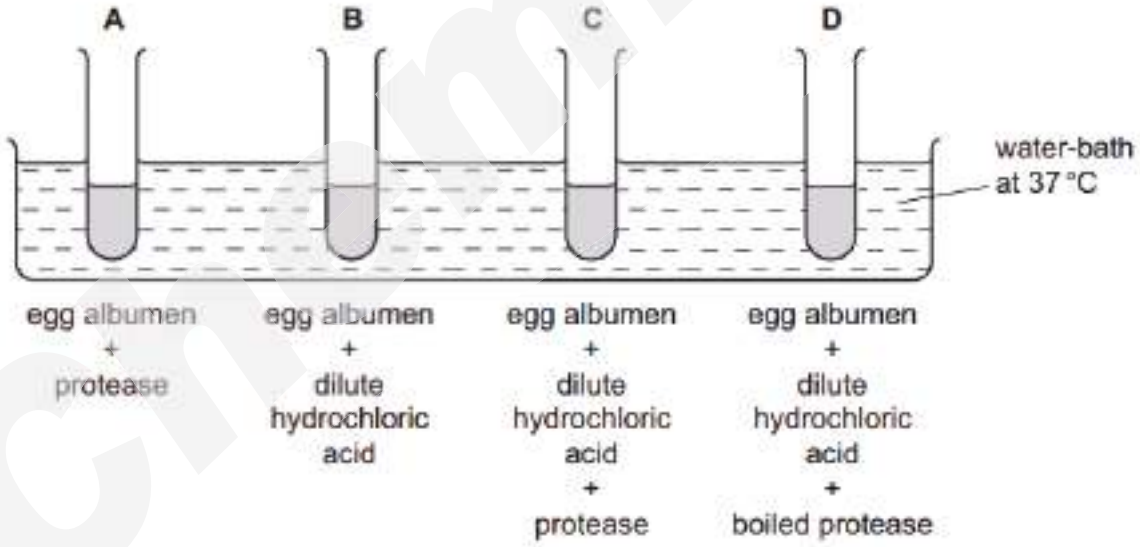
	pH	temperature / °C
A	2	20
B	2	35
C	7	20
D	7	35

Feb/Mar 2020 (22)

10 The diagram shows an experiment on the digestion of the protein in egg albumen by protease.

The protease was taken from a human stomach.

In which test-tube will the protein be digested most quickly?



8. Transport in Plants

(IGCSE Biology Syllabus 2023-2025)

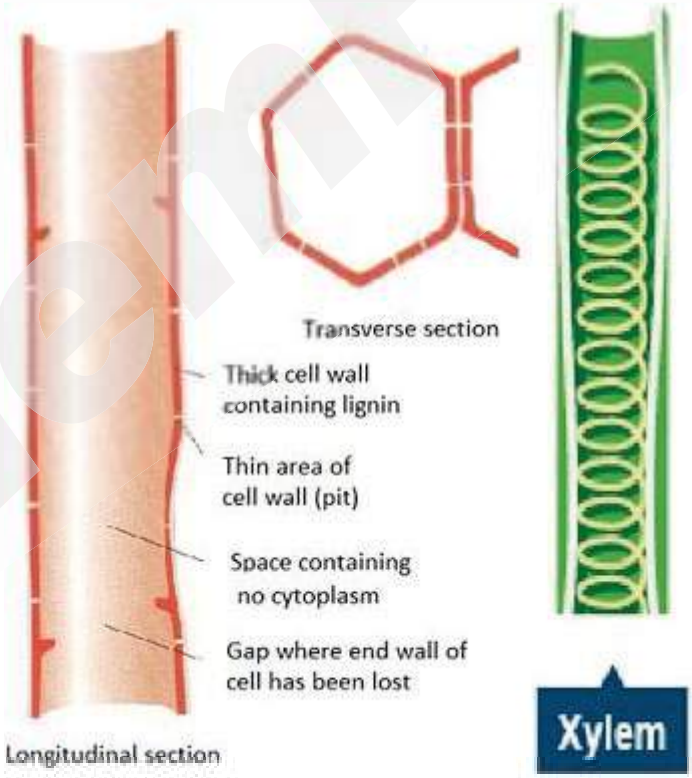
8.1 Xylem and Phloem

Plants have transport systems to move food, water and minerals around. These systems use continuous tubes called xylem and phloem

- **Xylem vessels** carry **water** and minerals from the **roots** to the leaves + **supporting** the stem and strengthening it
- **Phloem** tubes carry **sugar** & other organic **nutrients** made by plant from the **leaves** to the rest of the plant

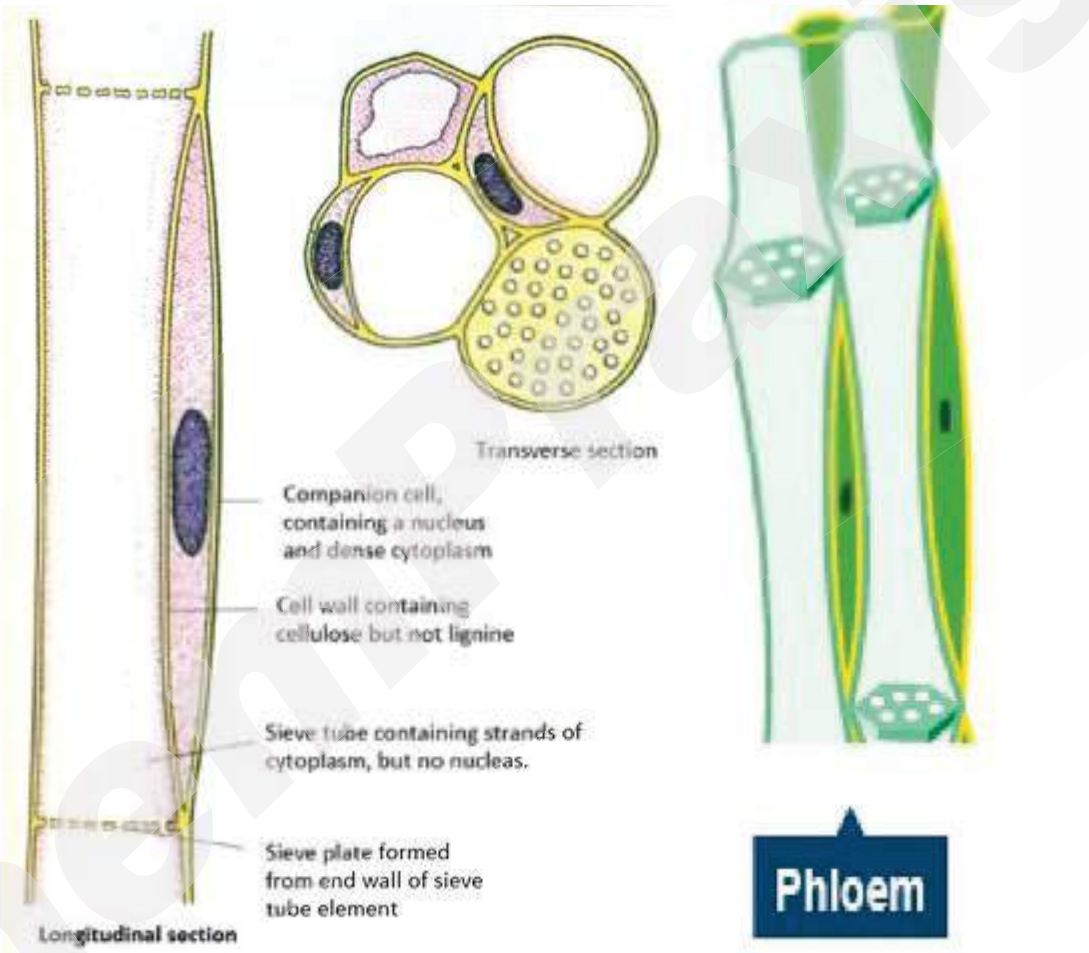
Structure of Xylem Tissue

i. Dead cells
ii. Thick, strengthened cellulose cell wall
iii. Hollow lumen
iv. End walls of the cells have disappeared – long and open tube
v. Contains holes (pits)



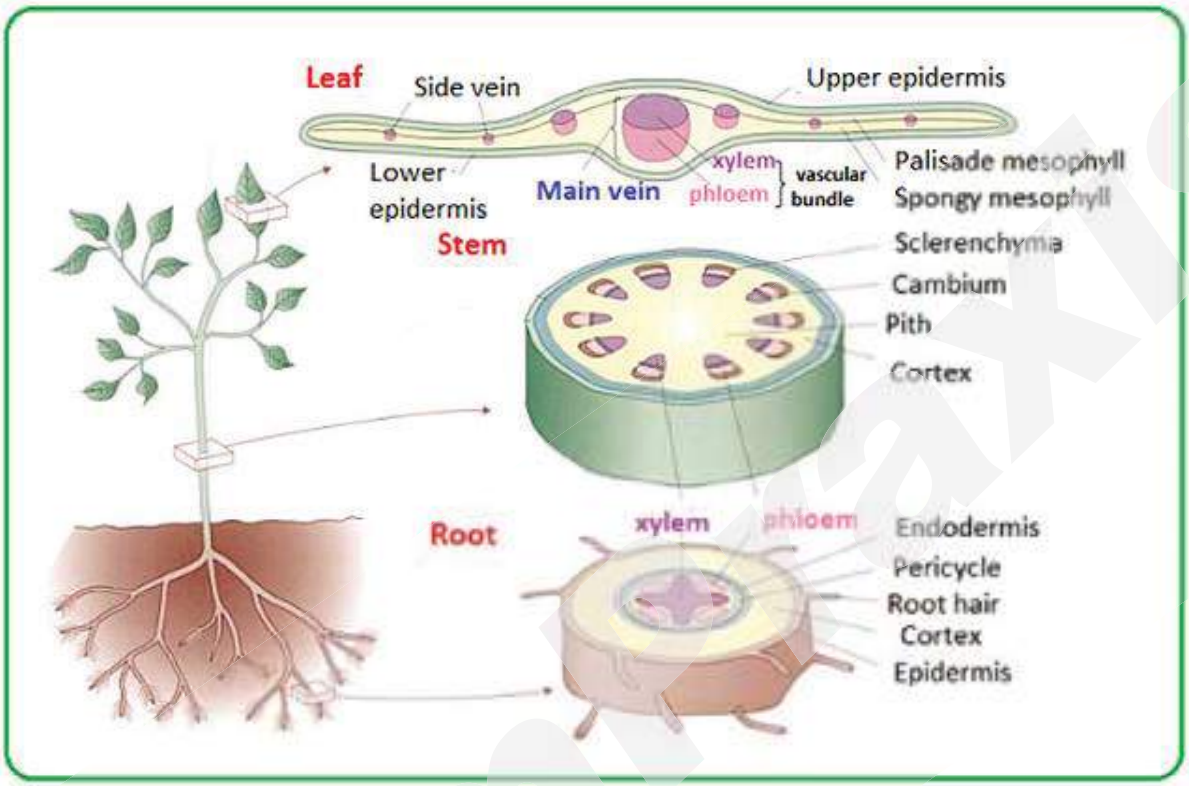
Structure of the Phloem Tissue

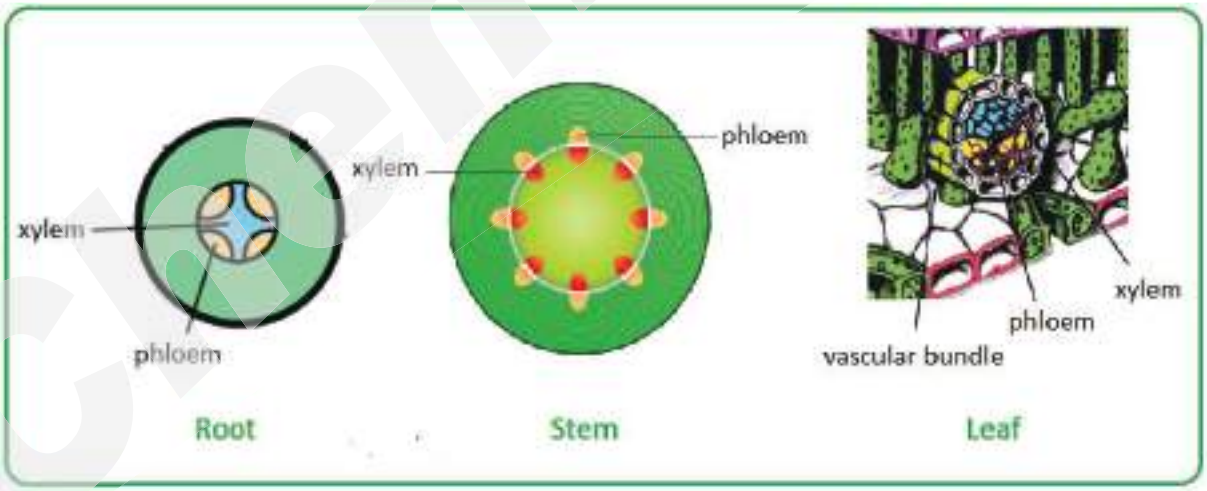
i. Long, narrow tube
ii. Perforated sieve plates
iii. Made of columns of living cells, which contains a cytoplasm but no nucleus
iv. Its activities control by a companion cell next to it which has a nucleus (***but companion cell have no function in translocation)



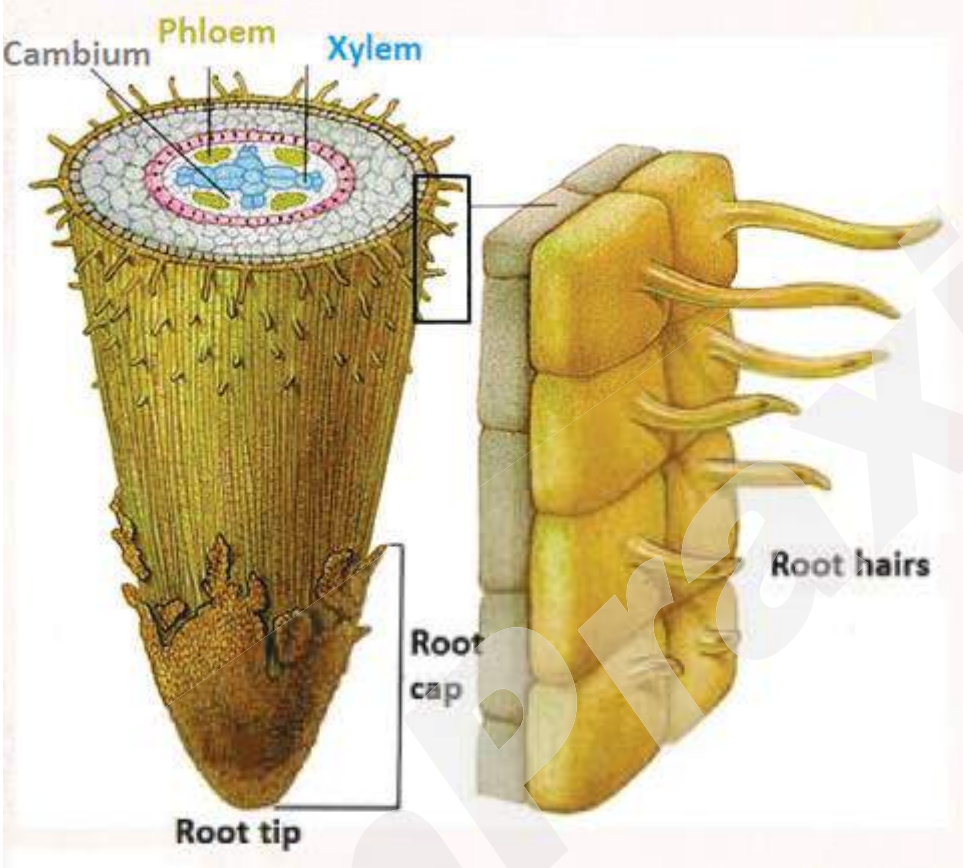
Distribution of Xylem and Phloem in roots, stems and leaves

- In the **roots,** xylem and phloem are in the **centre** to withstand stretching forces.
- In the **stems**, they are arranged in bundles near the **edge** to resist compression and bending forces.
- They are grouped together into **veins** and **vascular bundles** as they pass through **leaves**.





8.2 Water Uptake



Plants take in **water** from the soil, through their **root hairs:**

- At the very tip is a **root cap**. This is a layer of cells which protects the root as it grows through the soil.
- The rest of the root is covered by a layer of cells called the **epidermis**.
- The **root hairs** are a little way up from the root tip. Each root hair is a **long epidermal cell**. Root hairs do not live for very long. As the root grows, they are replaced by new ones.

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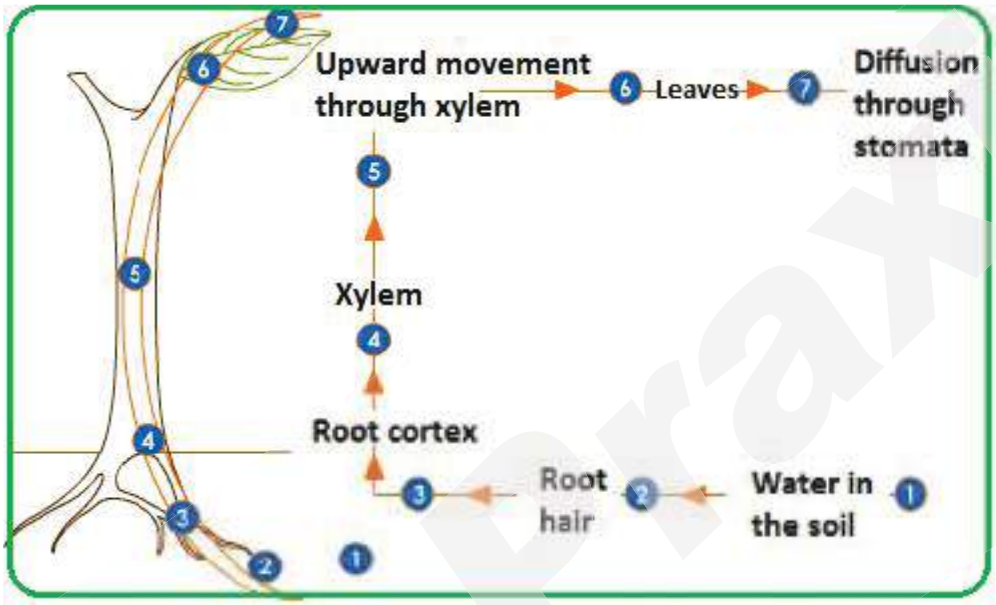
Functions of root hair cell

- **Increase** the external **surface area** of the root for **absorption** of **water** and mineral ions (the hair increases the surface area of the cell to make it more efficient in absorbing materials).
- Provide **anchorage** for the plant.

8.3 Transpiration



- Water enters **root hair** cells by **osmosis**. This happens when the water potential in the **soil** surrounding the root is higher than in the cell à water diffuses from the soil into the root hair, **down** its **concentration gradient.**
- As the water enters the cell, its water potential becomes higher than in the cell next to it, e.g. in the **cortex**. So water moves, by **osmosis**, into the next cell. Some of water may also just **seep** through the spaces between the cells, or through the cell walls, never actually entering a cell.

Oct/Nov 2018 (42)

3 **(a)** Fig. 3.1 is a photomicrograph of some xylem vessels.

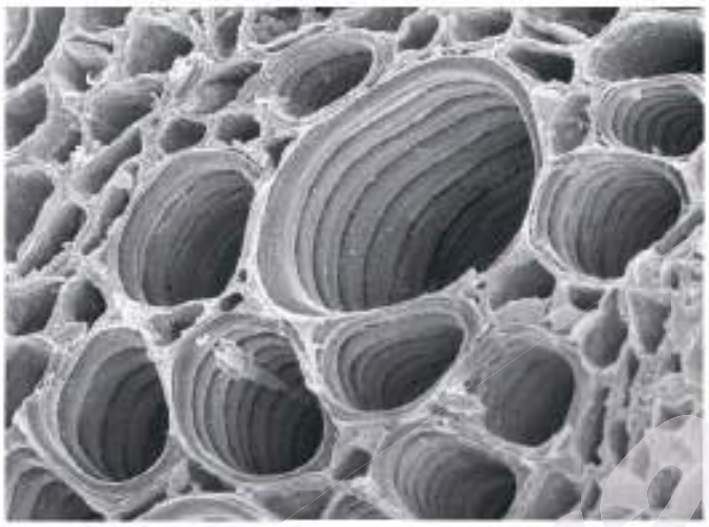


Fig. 3.1

(i) State **one** structural feature of xylem vessels and explain how this is related to the function of water transport.

feature .....

.....

explanation .....

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[2]

(ii) Explain the mechanism that is responsible for the movement of water in xylem vessels.

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..... [4]

(iii) State **one** role of xylem vessels **other** than transport.

..... [1]

(b) The rate of transpiration is affected by several factors including the temperature and the humidity of the air.

State **and** explain the effect of an increase in temperature on the rate of transpiration.

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..... [3]

[Total: 10]

May/June 2018 (42)

3 Aphids are insects that feed on the phloem sap in plants.

Fig. 3.1 shows a diagram of an aphid with its mouth parts inserted into the stem of a plant.

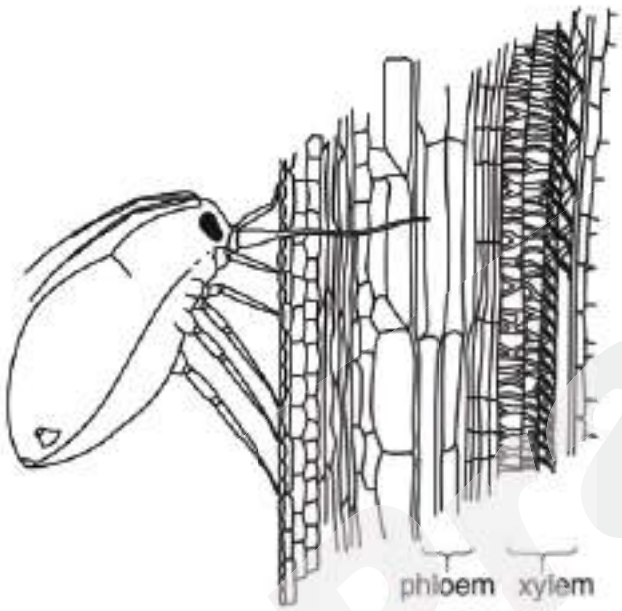


Fig. 3.1

(a) The mouth parts of the aphid reach the phloem tissue of the stem.

(i) State the name of the foods the aphid could suck out of the phloem tissue.

1 .....

2 .....

[2]

9. Transport in Animals

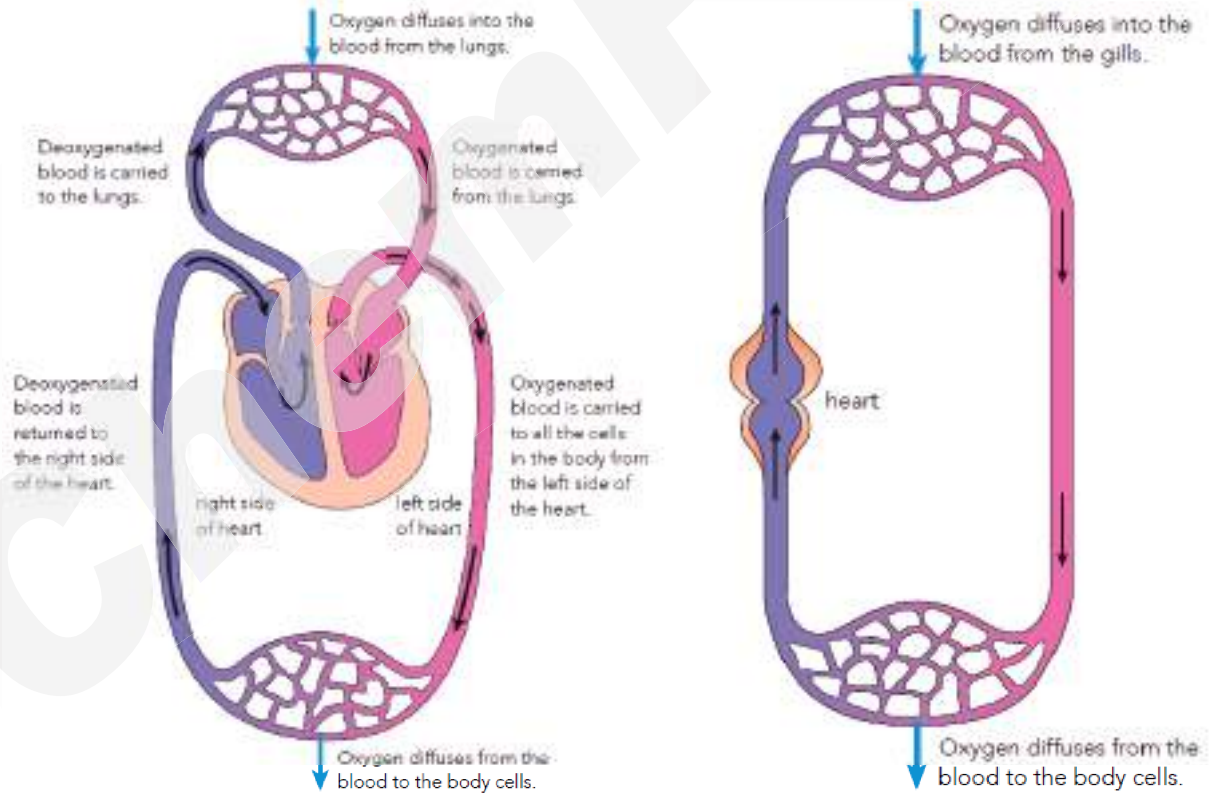
(IGCSE Biology Syllabus 2023-2025)

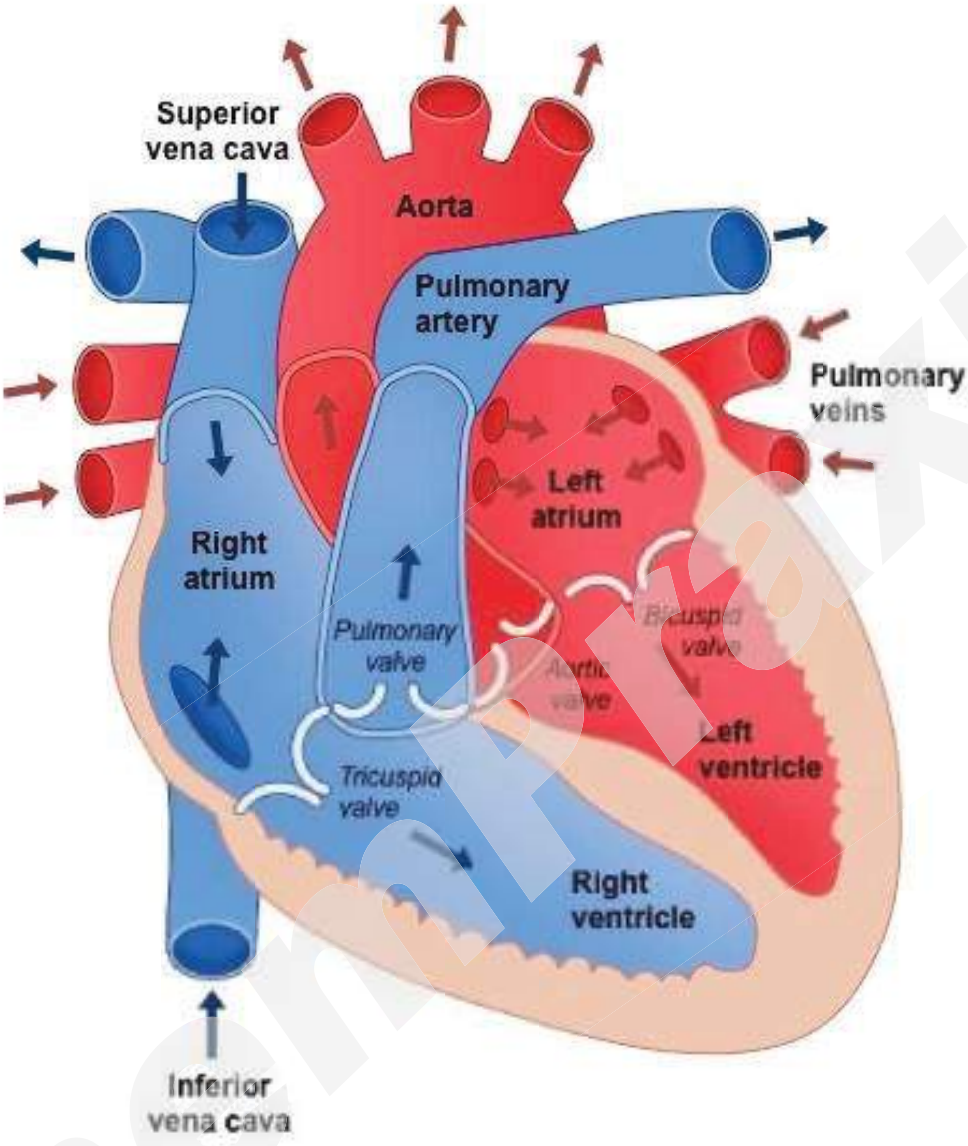
9.1 Transport System

- **Circulatory system**: system of blood vessels (veins, capillaries, arteries) with a pump (heart) and valves (in heart and veins) to ensure one-way flow of blood
- **Double circulation system**:
  - Four heart chambers
  - Blood passes through heart twice
  - Blood is oxygenated in lungs, to heart, to body then back to heart
  - Advantage: delivers greater blood flow rate to tissues around the body as the heart pumps the oxygenated blood from the lungs

9.2 The Heart

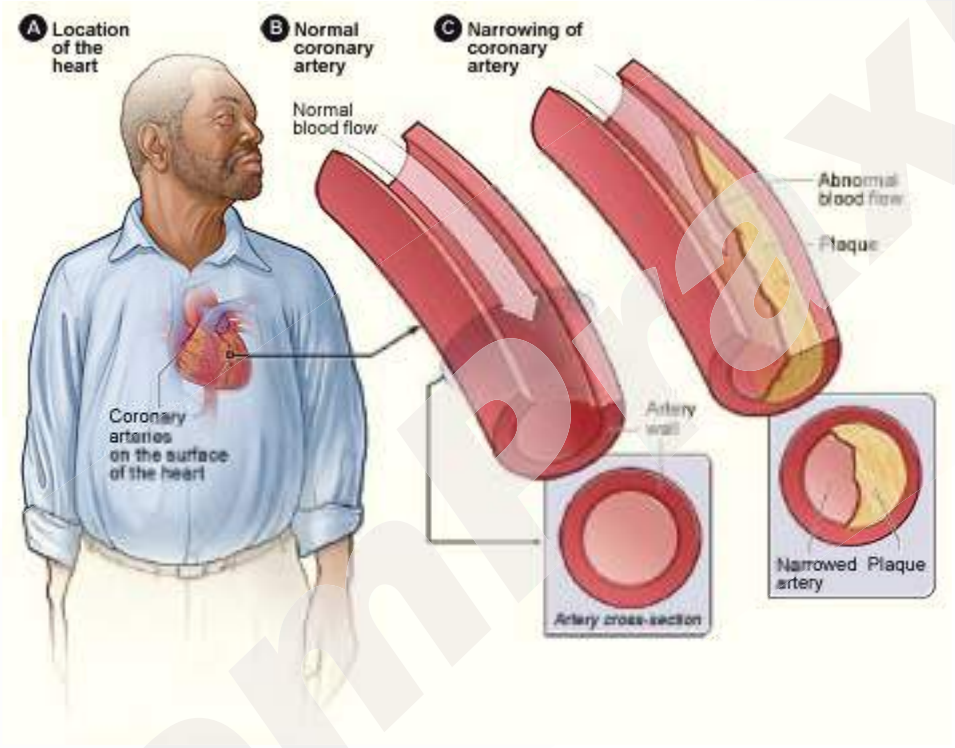
- Single circulation system
  - Two heart chambers
  - Blood passes through heart once
  - Blood travels much more slowly to a fish's body organs than it does in a mammal




Superior vena cava
Aorta
Pulmonary artery
Pulmonary veins
Left atrium
Right atrium
Pulmonary valve
Tricuspid valve
Left ventricle
Right ventricle
Inferior vena cava

Coronary Heart Disease

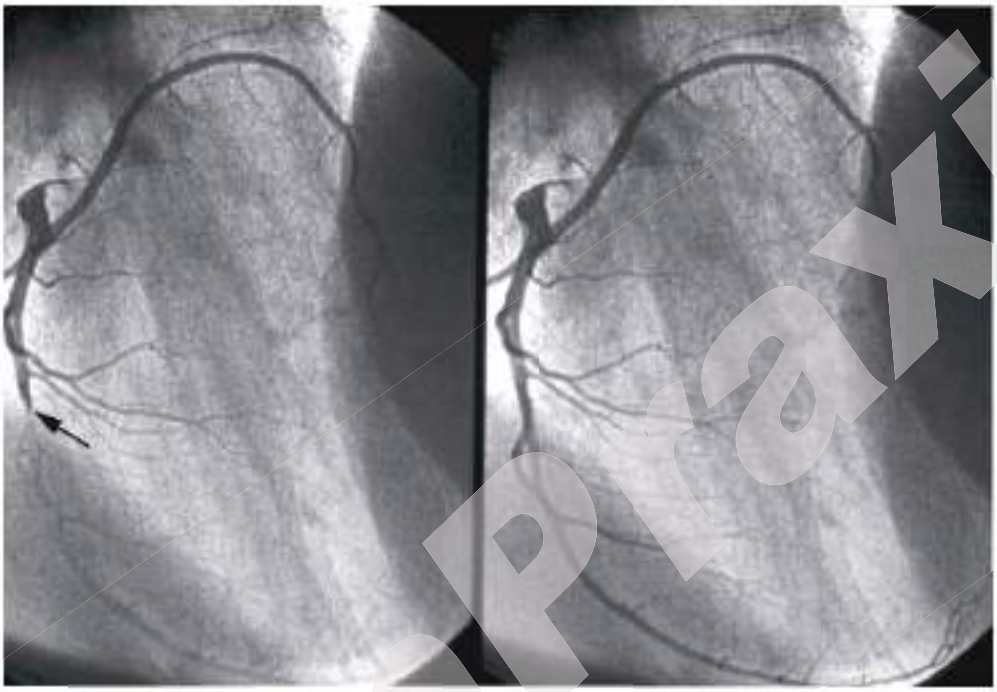
- Coronary artery becomes blocked, interrupting the supply of blood to the heart muscle
- The heart muscle cells are deprived of oxygen and glucose, and poisonous wastes such as lactic acid build up
- Part of the heart muscle stops contracting, causing a heart attack
- Caused by stress, smoking, poor diet, poor lifestyle and genetically
- Can be prevented by not smoking, avoiding fatty food and exercising regularly
- Treated by aspirin and surgery (stents, angioplasty and by-pass)



Past Year Topical Questions

Oct/Nov 2019 (41)

5 Fig. 5.1 shows an angiogram of a heart before and after treatment for coronary heart disease (CHD). An angiogram is an image of the blood flow through the blood vessels of the heart.



before treatment after treatment

Fig. 5.1

(a) The arrow on Fig. 5.1 shows the position of a blockage in a blood vessel.

(i) State the name of the blocked blood vessel.

..... [1]

(ii) The blockage is caused by a blood clot.

Describe how a blood clot forms.

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..... [3]

(iii) State the name of a drug that can be used to treat coronary heart disease.

..... [1]