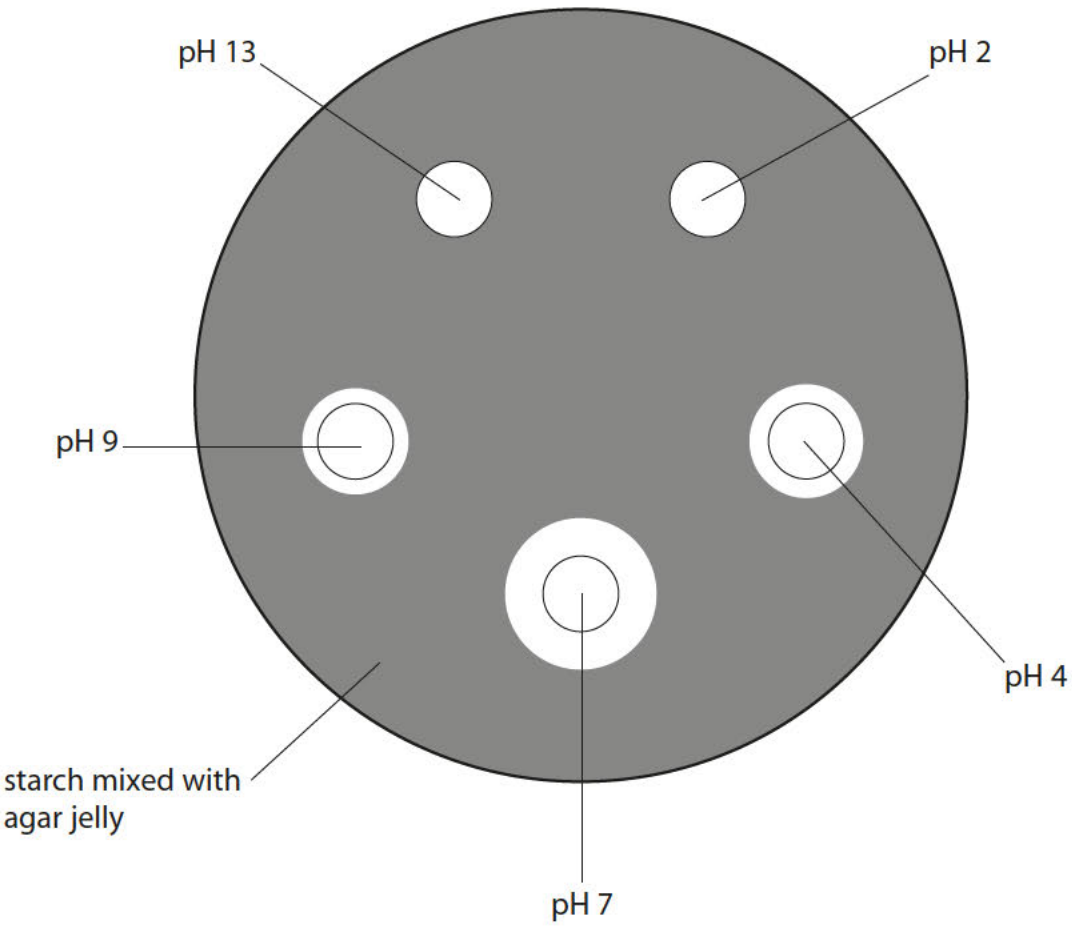
1 A student is given a Petri dish containing starch mixed with agar jelly.

The student makes five wells each of diameter 10 mm in the agar. She fills the wells with solutions of amylase, each with a different pH.

After 24 hours she pours iodine solution on to the agar jelly.

The iodine solution turns the starch in the agar jelly a dark blue colour.

The diagram shows the appearance of the Petri dish.



(a) The student measures the clear area around each well using a ruler.

Two have been done for you. Complete the remainder of the table.

(1)

pH of amylase solution	Diameter in mm
2	
4	15
7	
9	
13	10

(b) (i) Explain why there is a clear zone around some of the wells containing amylase.

(2)

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(ii) Explain why the clear zones have a range of different diameters. The diameters of the wells do not change during the experiment.

(2)

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(c) Name the independent variable in this investigation.

(1)

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(d) (i) The student keeps the Petri dish at 20 °C to control the temperature in order to make a valid comparison between each pH.

Name three other variables that the student needs to control.

(3)

1 .....

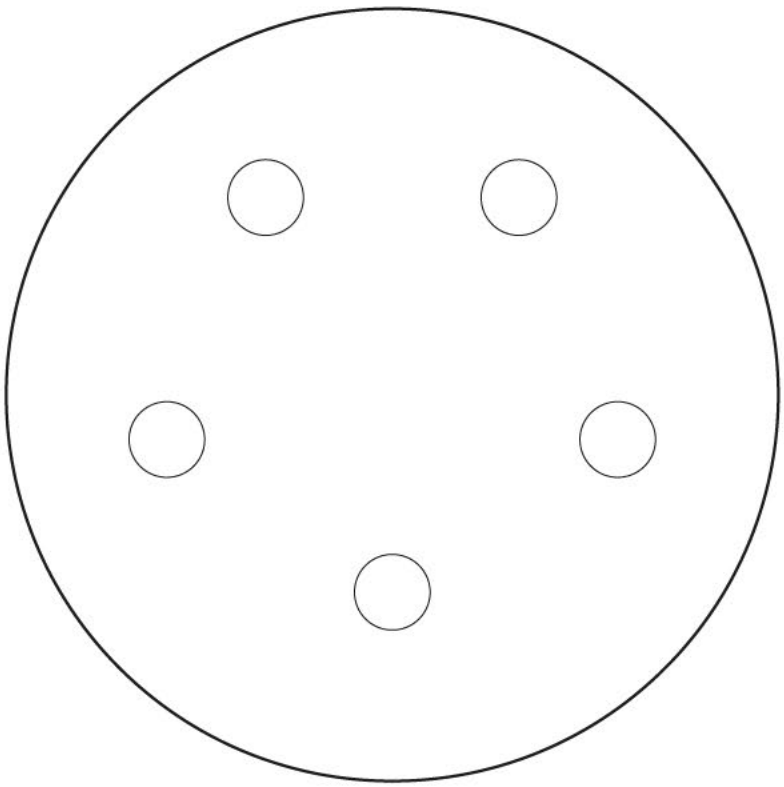
2 .....

3 .....

(ii) The student repeats the experiment, keeping the Petri dish at 37 °C on this occasion.

On the diagram, draw the results you would expect to see.

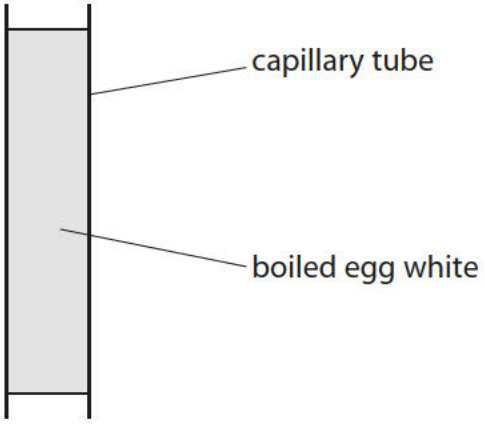
(2)



(Total for Question = 11 marks)

2 A student wants to investigate the effect of secretions (juice) from the pancreas on the digestion of protein.

The white of an egg is put into fifteen 50 mm long capillary tubes. The tubes are placed in boiling water for 10 minutes until the egg white becomes solid. The diagram shows one of the tubes filled with solid egg white.



The fifteen tubes are put into three groups of five.

- five tubes are placed in a beaker of distilled water
- five tubes are placed into a beaker of juice from the pancreas
- five tubes are placed into a beaker of juice from the pancreas that has been boiled

After three hours the length of the boiled egg white in each tube is measured in mm. The results are shown in the table.

Length of boiled egg white after three hours in mm		
Distilled water	**Juice from the pancreas**	**Boiled juice from the pancreas**
50	14	50
50	12	50
50	13	50
50	14	50
50	14	50

(a) (i) Give the dependent variable in this experiment.

(1)

(ii) Give two reasons why the results obtained by the student are reliable.

(2)

1 .....

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2 .....

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(iii) Suggest how the student can obtain precise measurements of length.

(1)

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(b) (i) Explain the difference in the results obtained in distilled water compared to juice from the pancreas.

(2)

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(ii) Explain the difference in the results obtained in pancreas juice compared to boiled juice from the pancreas.

(2)

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(c) Suggest how you could modify this investigation to find out the effect of pH on protein digestion by pancreas juice.

(2)

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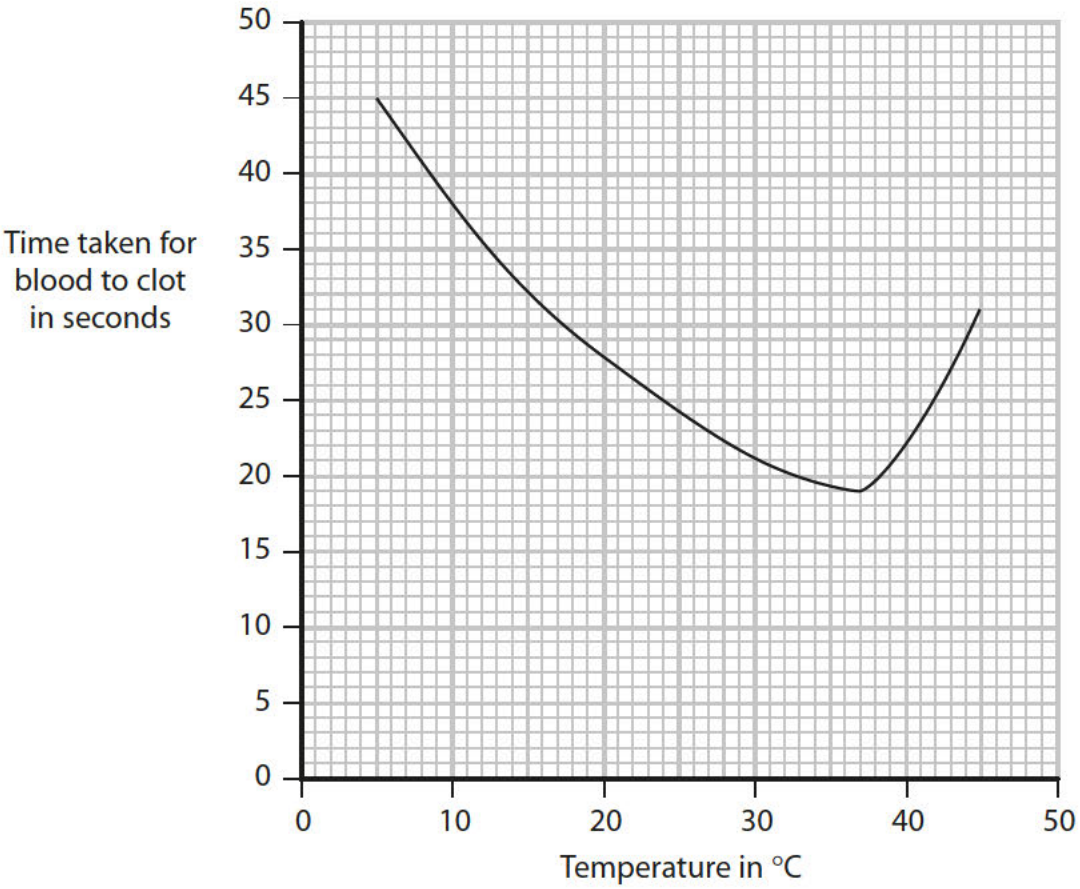
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(Total for Question = 10 marks)

3 The graph shows the time taken for samples of blood to clot at different temperatures.



(a) When blood clots, an enzyme converts a soluble plasma protein into an insoluble plasma protein.

Use the information in the graph to suggest the optimum temperature for this enzyme.

(1)

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(b) Explain why blood takes longer to clot at 20 °C than it does at 30 °C.

(2)

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(c) Use your knowledge of enzymes to explain why blood is slow to clot at 45 °C.

(2)

(d) The coronary artery supplies blood to heart muscle cells. A heart attack may occur if the coronary artery is blocked by a blood clot.

Suggest what happens in heart muscle cells when the coronary artery is blocked.

(4)

(Total for Question = 9 marks)

4 Read the passage below. Use the information in the passage and your own knowledge to answer the questions that follow.

COPD: chronic obstructive pulmonary disorder

Chronic obstructive pulmonary disorder (COPD) is the term used to describe several lung diseases including bronchitis and emphysema. People with COPD have trouble breathing because they have damaged their lungs, usually because of smoking. Eighty per cent of people who develop COPD are, or have been, smokers.

However, breathing in dust or fumes may also cause COPD. There is also a small genetic risk linked to COPD called alpha-1-antitrypsin deficiency. Alpha-1-antitrypsin is a molecule that protects your lungs from being digested by a protease enzyme released by white blood cells in the lungs. People who have an alpha-1-antitrypsin deficiency usually develop COPD at a younger age.

There are about 65 million people in the UK and 835 000 are known to have COPD. There are thought to be another 2 million who have COPD but have not been diagnosed because they have not asked for medical help. They seem content to put up with what they call smoker's cough. Sadly, there are about 25 000 deaths a year in the UK because of COPD.

The symptoms of COPD do not usually show until after the age of 35. They include breathlessness when exercising, persistent coughing of mucus and frequent chest infections, particularly in winter. The walls of the airways get thicker in response to inflammation, more mucus is made and the air sacs are damaged. Although any damage that has already happened to the lungs cannot be reversed, it is possible to prevent COPD from getting worse by making lifestyle changes.

Chest infections are common and can be caused by bacteria or viruses. People with COPD are advised to have two vaccinations. A yearly 'flu jab' each autumn protects against possible influenza and any chest infection that may develop due to this. Vaccination against *Pneumococcus*, a bacterium that can cause serious chest infections, involves a one-off injection.

Treatment for COPD usually involves relieving the symptoms, such as using an inhaler to make breathing easier. Other treatments such as steroids, antibiotics, breathing oxygen from a cylinder, and inhaling mucolytic (mucus-thinning) medicines are sometimes prescribed in more severe cases, or during a worsening of symptoms.

(a) COPD includes diseases such as emphysema (line 2).

Give two causes of emphysema.

(2)

1 .....

2 .....

(b) The white blood cells in the lungs release protease (a protein digesting enzyme) (line 9).

Suggest the function of this enzyme in the white blood cells in the lungs.

(2)

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(c) Calculate the number of people who may have COPD that are smokers (lines 4 and 5 and lines 11 and 12).

Show your working.

(2)

Answer .....

(d) (i) Name the air sacs in the lungs responsible for gas exchange (line 19).

(1)

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(ii) Suggest how damage to the air sacs can cause the symptom of breathlessness when exercising (line 17).

(2)

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(e) Explain how the vaccination against *Pneumococcus* provides protection from further infection (lines 24 to 27).

(2)

(f) (i) Suggest how mucolytic medicines help to treat the symptoms of COPD (lines 30 and 31).

(2)

(ii) Breathing in oxygen from a cylinder changes the concentration of oxygen in the air sacs.

How does the change in oxygen concentration help to reduce the symptoms of COPD?

(2)

(Total for Question = 15 marks)

5 Nitrogen is an essential element for plant growth. Most plants can only use nitrogen in the form of nitrate ions. Only legumes that have bacteria living in their root nodules can use nitrogen from the air.

(a) (i) Explain how nitrate ions help plants to grow.

(1)

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(ii) Name the type of bacteria that live in the root nodules of legumes.

(1)

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(b) Many animals excrete urine that contains urea. Some soil microorganisms use the enzyme urease to change urea to ammonium ions and carbon dioxide.

Describe how ammonium ions can be converted to nitrate ions in the soil.

(2)

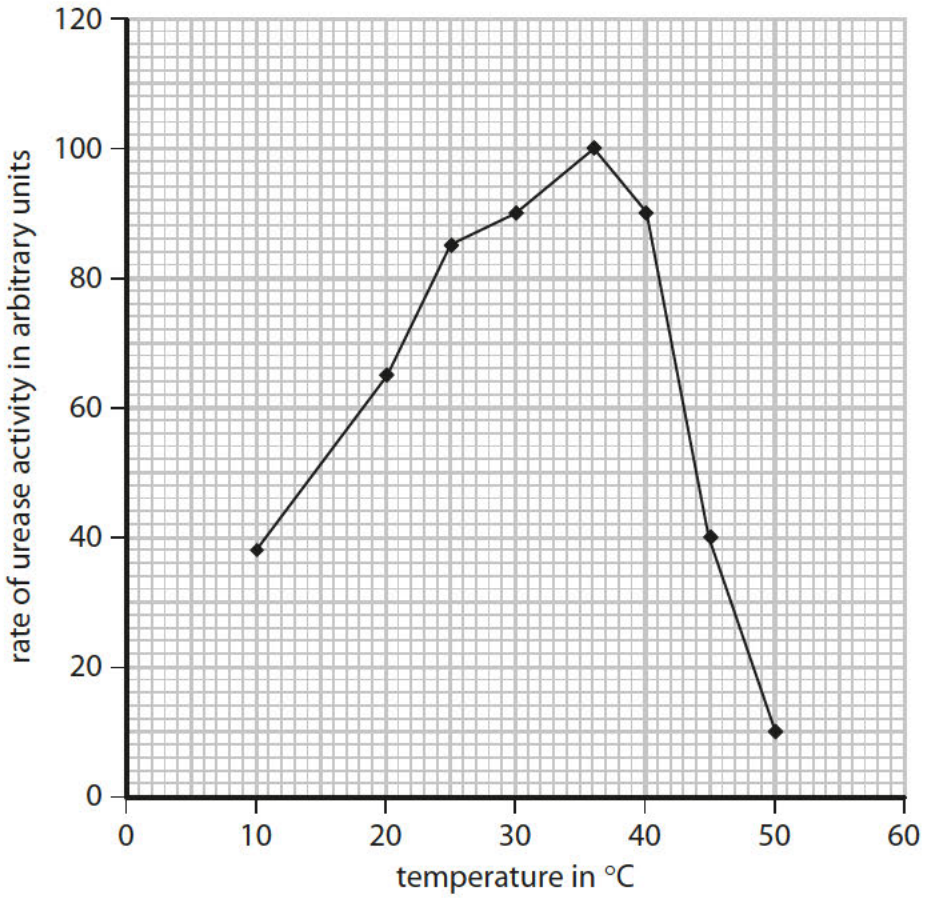
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(c) The graph shows the effect of different temperatures on the rate of urease activity.



(i) Explain the change in rate of urease activity from 10 °C to 36 °C.

(2)

(ii) Explain the change in rate of urease activity from 36 °C to 50 °C.

(3)

(Total for Question = 9 marks)

6 Read the passage below. Use the information in the passage and your own knowledge to answer the questions that follow.

Meat-eating plants



Venus flytraps carry out the process of photosynthesis. The glucose produced is used as a source of energy. In addition to synthesising glucose, plants also need to make amino acids, vitamins and other components to survive. To do this, plants need to absorb minerals.

In the bogs where Venus flytraps live the mineral content of the soil is low so minerals are scarce. Most plants cannot survive in this environment because they cannot make enough of the building blocks necessary for growth. The Venus flytrap has evolved the ability to grow well in this habitat by finding alternate means of getting minerals. Insects provide a good source of the minerals missing from the soil, and they contain additional carbohydrates.

Carnivorous plants attract and capture insects, discriminate between food and non-food, and digest the insects. They do this using mechanical and chemical processes. Plants lack the muscles and tendons to eat, chew and swallow food. The Venus flytrap completes the entire process using specialised leaves that carry out the role of the mouth and the intestines.

Most plants have some mechanism to attract insects. The Venus flytrap does this by secreting sweet nectar from the leaves of the trap. When an insect lands or crawls on the trap, it is likely to touch one of six, short, stiff hairs on the trap's surface. These are trigger hairs, and they serve as a motion detector for the plant. If two of these hairs are brushed in quick succession, or one hair is touched twice, the leaves close on the insect.

The mechanism of trap closure is not clearly understood but it involves changes in the concentration of solution in the cells. The cells expand as water enters causing the trap to close. Once the trap fully closes, the leaves form a seal so that digestive fluid and insects are kept inside the trap and bacteria and fungi cannot get in.

To make sure that the insects are kept in the trap, the edges of the leaves have projections that fit together when the leaves shut. These projections look like teeth but they are only used to keep the trap shut.

The leaf trap now serves as a digestive organ to dissolve the soft tissues and cell membranes of the food. It produces acid and enzymes. The insect body is broken down over a period of 5 to 10 days and the products of digestion are absorbed.

(a) Name the process that the plant uses to release energy from glucose (lines 1 and 2).

(1)

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(b) Carnivorous plants attract insects for food.

Give a reason why other plants need to attract insects (line 11).

(1)

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(c) The Venus flytrap can be placed at two different trophic levels.

Name these levels.

(2)

1 .....

2 .....

(d) The trap only closes 'If two of these hairs are brushed in quick succession, or one hair is touched twice' (lines 20 and 21).

Suggest why this is an advantage to the plant.

(2)

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(e) Explain how changes in the concentration of solution in the cells can lead to water entering the cells (lines 23 and 24).

(2)

(f) Suggest two reasons why the traps need to prevent the entry of bacteria or fungi (line 26).

(2)

1

2

(g) (i) The trap lacks teeth that function as they do in animals.

Explain how this may affect the rate at which the insect is digested.

(2)

(ii) Name one enzyme that may be present in the digestive fluid produced within the trap (line 25).

(1)

(h) Explain two factors that could affect the length of time taken to digest an insect once it has been caught in a trap.

(4)

1 .....

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2 .....

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(Total for Question = 17 marks)