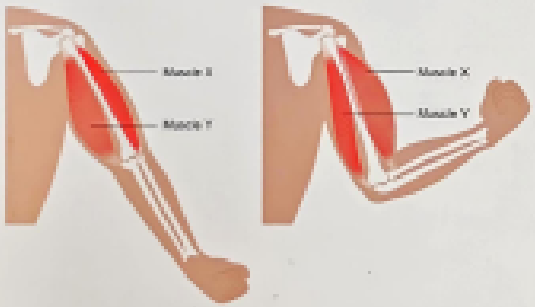
Question 1 (8 marks)

The skeleton consists of bones, joints and cartilage. A diagram of the elbow joint is shown below:



Question 1a (1 mark)

The elbow is an example of a hinge joint. **State** the name of one other hinge joint in the human body.

Question 1b (1 mark)

Select the name of muscle X.

- ○ Bicep
- ○ Deltoid
- ○ Humerus
- ○ Quadricep

Question 1c (2 marks)

The bones provide surfaces to which muscles attach. Bones act as levers, and muscles can only do work by pulling on the bones to which they are attached.

Outline how the two muscles, X and Y, in the diagram above work together to move the arm.

Question 1d (2 marks)

Energy released by cellular respiration is needed for movement. **Outline** one similarity and one difference between aerobic and anaerobic cellular respiration in humans.

Question 1e (2 marks)

Outline the skeleton's functions in the boxes below. The first two boxes have been completed for you.

Function	**Function**
Support and posture	Storage of minerals
How does this happen?	**How does this happen?**
Muscles attached to bones in the legs work together to support the body when standing	*Minerals such as calcium, iron and potassium are stored in bones and released into the blood when needed by the body*

Function

Protection

How does this happen?

Function

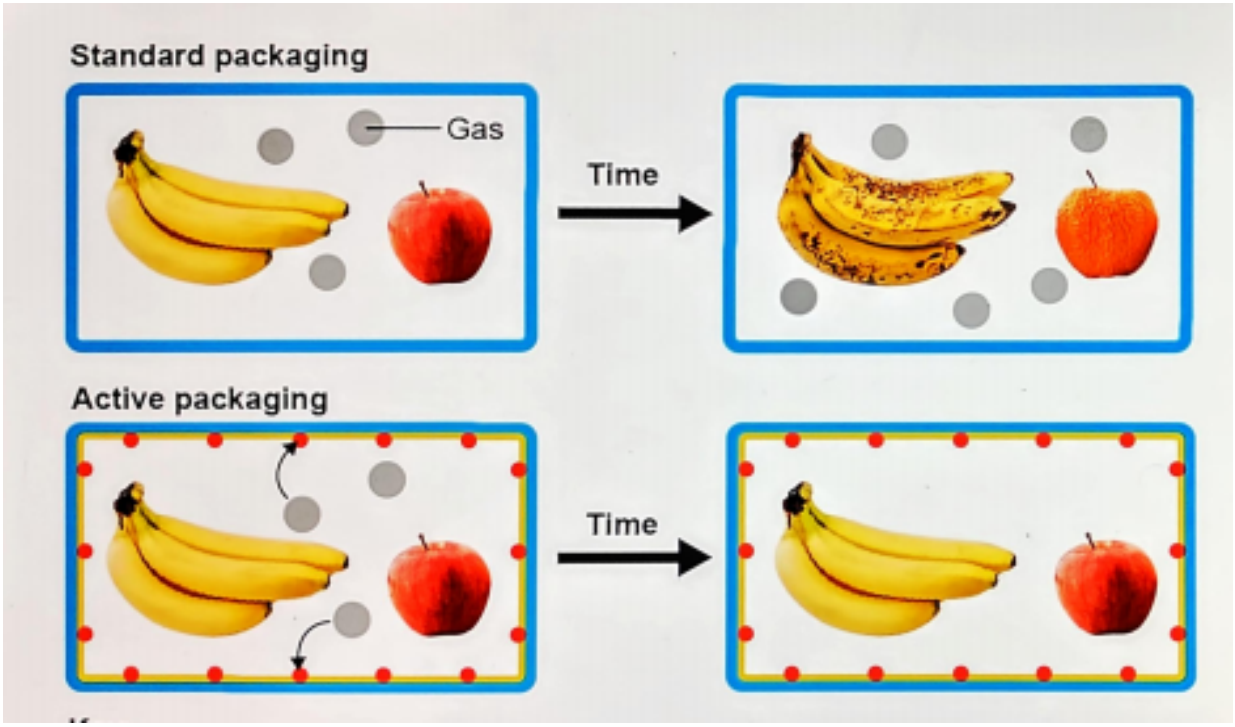
Blood cell production

How does this happen?

Question 2 (8 marks)

Scientists are looking for ways to keep food fresh for longer. Active packaging changes the conditions inside the packaging to extend the time food stays in good condition and is safe to eat.

As bananas ripen, they produce a gas that speeds up the ripening process. The image below shows how active packaging can absorb and remove this gas.



Key:

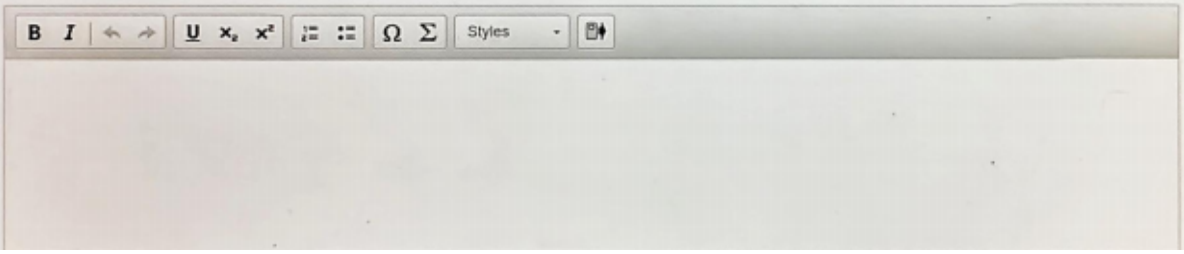
- Gas absorber
- Coating to prevent growth of microbes

Question 2a (2 marks)

Suggest two benefits of using active packaging when transporting fruit.

Question 2b (3 marks)

Other active packaging solutions work by keeping temperature constant. **Describe** why many foods are stored between 3°C and 5°C.



Question 2c (3 marks)

Before active packaging was developed, people used other methods to keep food fresh for longer. Historically, salt was put on meat to kill bacteria and prevent them from multiplying. The microscope images below show bacteria on fresh and salted meat.

Fresh meat

Salted meat

Describe why bacteria on salted meat have changed their form and no longer have a smooth surface.

Question 3 (10 marks)

Lactose is the major energy source for infants and young mammals. Lactose is found in milk and is broken down by an enzyme called lactase.

Question 3a (2 marks)

Outline the importance of enzymes in the body.

B I U Styles

Question 3b (1 mark)

An organism that is able to produce lactase is said to be lactose tolerant. A copy of the dominant allele, T, must be inherited. The recessive allele has the symbol t.

State whether each genotype below is lactose tolerant or not by completing the table.

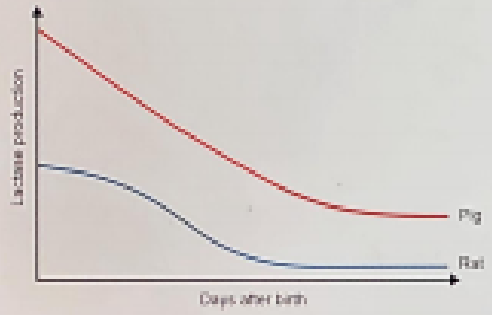
Genotype	Lactose tolerant
TT	
Tt	Yes / No
tt	

Question 3c (1 mark)

State the meaning of the term *phenotype*.

Question 3d (4 marks)

The amount of milk consumed by young mammals is usually related to the amount of lactase they produce. The graph below shows how lactase production in pigs and rats changes as these animals become older.



Using scientific knowledge, **identify** and **justify** one similarity and one difference in lactase production after birth in pigs and rats.

Similarity and justification

Question 3e (1 mark)

Lactase production in humans often begins to decrease from around age two. However, lactose tolerant individuals continue to produce large quantities of lactase as adults. The infographic below gives some data about lactose tolerance around the world.

This media is interactive

Hover over each of the highlighted countries for more information.

©

Using the data in the infographic, **state** the relationship between lactose tolerance and milk consumption.

Question 3f (1 mark)

Suggest why scientists should be cautious when drawing conclusions about this data.

Question 4 (16 marks)

The agave plant can be processed to produce fibres that can be used in the textile industry. The plant fibres can be removed by hand or using a machine. Once the plant fibres have been removed, they can be tested to measure how easily they stretch or break.

©

After processing, the conditions under which the plant fibres are stored can be varied to alter their properties.

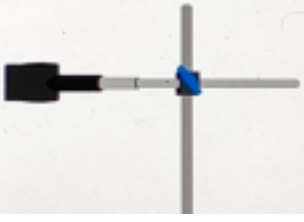
After processing, the conditions under which the plant fibres are stored can be varied to alter their properties.

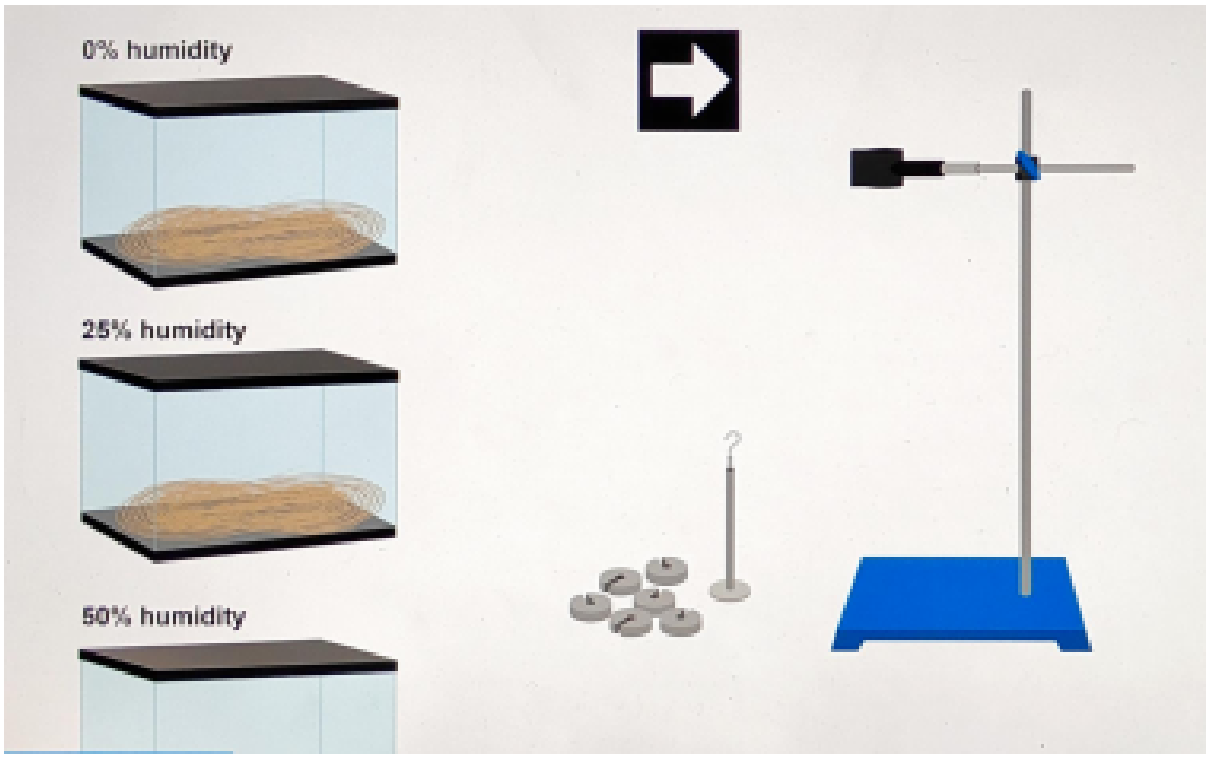
Some students wanted to study the effects of humidity on the strength of plant fibres. They set up a preliminary investigation to test their method. The equipment below can be used to test how easily the plant fibres break.

This media is interactive

Click on the arrows to move through the experiment.

0% humidity





Question 4a (1 mark)

Formulate a research question for this investigation.

Question 4b (2 marks)

Identify the independent and dependent variables in this investigation.

Question 4c (2 marks)

Suggest two control variables that should be used in this investigation.

Question 4d (1 mark)

State why control variables are important in an investigation.

Question 4e (2 marks)

The students' results are presented in the table below:

Humidity / %	Mass needed to break the plant fibre / g
0	30
25	40
50	40

The students did not collect sufficient data to draw a conclusion. **Suggest** and **justify** how the experiment could be improved to collect sufficient data.

Question 4f (4 marks)

Another group of students (Group 2) followed a similar method but used 2.5g masses instead of 10g masses. Their data has been added to the table below:

Humidity / %	Mass needed to break the plant fibre / g	
	Group 1	Group 2
0	30	27.5
25	40	32.5
50	40	37.5

Present the data for both groups in a graph.

Question 4g (2 marks)

State the patterns shown in each group's data.

Group 1

Group 2

Question 4h (2 marks)

The two groups of students compared their data. One group claimed that the different data were due to the plant fibres having different strengths. The other group argued that the different data were due to the different masses used by each group.

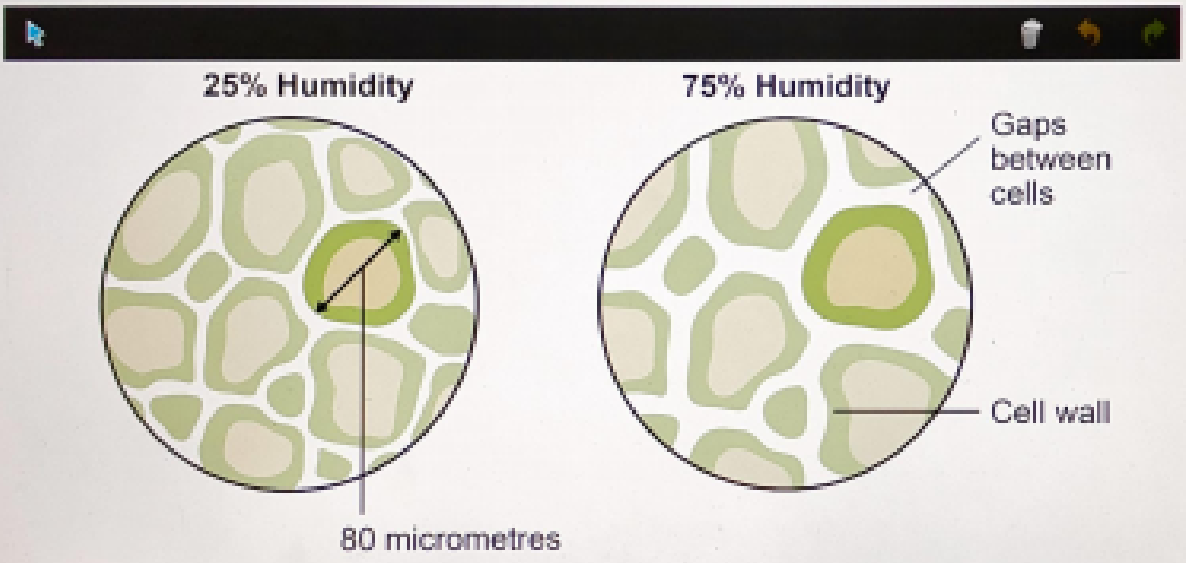
Suggest one reason to support the claim made by **each** group.

Different strengths

Different masses

Question 5 (10 marks)

The students used microscopes with the same magnification to look at the cells in plant fibres after changing the humidity from 25% to 75%. The diagrams below show what they saw.



Draggable item:

Question 5a (1 mark)

Measure the diameter of the highlighted cell at 75% humidity.

Question 5b (3 marks)

Calculate the percentage increase in diameter for the highlighted cell from 25% to 75% humidity. You should give your answer to the nearest 1%.

Question 5c (4 marks)

The diagrams above show changes in the plant fibres when the humidity changes. Use the diagrams to **explain** how the movement of water causes the plant fibres to increase in size as humidity increases.

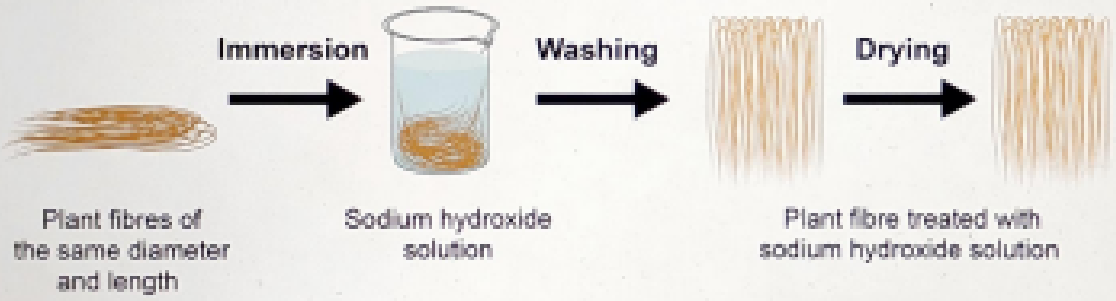
Question 5d (2 marks)

A student wanted to extend their knowledge of the effect of humidity on the structure of the plant fibres and cell diameter. **Suggest** different measurements the student could take and **justify** how these measurements would benefit the investigation.

Question 6 (7 marks)

Plant fibres can also be treated with sodium hydroxide solution to change their properties.

The flow chart below briefly outlines the process used by a group of students to treat their plant fibres.



Question 6a (1 mark)

State one control variable shown in the flow chart.

Question 6b (1 mark)

The students discussed whether the flow chart was an appropriate way to present a scientific method.

One student suggested that the length of time the fibres are immersed in the sodium hydroxide solution should be included. **Suggest** why this would improve the method.

Question 6c (3 marks)

The students planned to investigate the effect of sodium hydroxide on the properties of the plant fibres. They planned to measure how long the plant fibres would become before breaking.

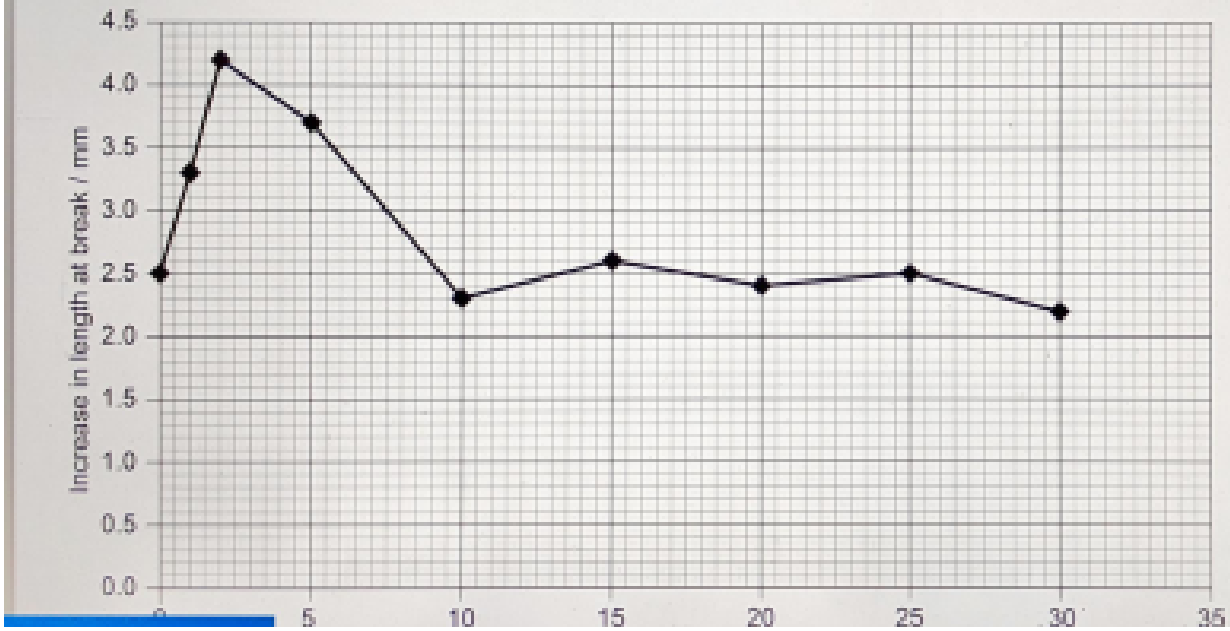
Before making their measurements, the students suggested the following hypothesis:

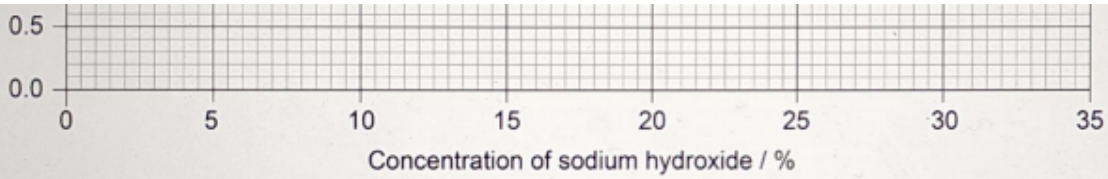
> As the concentration of alkali changes, the fibres will stretch more.

Suggest how the students could improve the hypothesis to make it testable.

Question 6d (2 marks)

The students presented their results in the graph below:





Use data from the graph to **discuss** whether the students' results support the hypothesis in part (c).

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Question 7 (15 marks)

Plant fibres can be combined with other fibres to change their properties. The percentage of plant fibres in a rope can be changed to vary the stretching characteristics. You are provided with standard laboratory equipment and a range of different ropes containing between 0% and 20% plant fibres.

Design an experiment to investigate how the percentage of plant fibres in a rope affects the length it will stretch to when a fixed mass is attached. In your answer, you should include:

- a research question
- the independent, dependent and two control variables
- equipment you will use
- details of how to manipulate, measure or control the variables
- details of the method to collect sufficient data
- how you will make your method safe.

B I U x_2 x^2 Ω Σ Styles

Question 8 (13 marks)

One of the United Nations (UN) sustainable development goals is that cities should be inclusive, safe, resilient and sustainable. In response to migration to large cities, planners must consider the social, economic and environmental impact of urbanization. The video below shows some impacts of urbanization.

For most of history, human populations have lived in rural settings. Over the past few centuries, urbanization has occurred. Urbanization is a trend where people migrate from rural to urban areas. Since 2007, around half of the world's population live in urban areas. Cities have greater access to goods and services and bring many benefits for society.

Urban development, however, has had serious environmental consequences.

Just 3% of the Earth's land is occupied by cities, but these are responsible for 60–80% of global energy consumption and 75% of carbon emissions.

Urbanization also has a negative effect on biodiversity. Land is cleared to build more housing, which permanently destroys natural habitats and reduces opportunities for people to connect with nature.

Cities have their own microclimate. The Sun's heat and light hit urban and rural areas in the same way, but the built environment of a city absorbs and retains more heat than surfaces in surrounding rural areas. This is known as the "heat island effect".

Cities use significant amounts of resources, produce large quantities of waste and cause air and water pollution. To become more sustainable, cities must plan to address these issues.

Question 8a (1 mark)

Plants have a cooling effect when water evaporates from their leaves. **Select** the name of this process.

- ○ osmosis
- ○ photosynthesis
- ○ respiration
- ○ transpiration

Question 8b (4 marks)

A consequence of urbanization is lower biodiversity.

Explain how a reduction in the population of pollinators, such as bees, will further reduce biodiversity.

Question 8c (8 marks)

There are a number of actions needed for existing cities to become more sustainable. Some actions can be taken by an individual, some are needed at governmental level. **Explain** how an existing city can become more sustainable. In your answer, you should include:

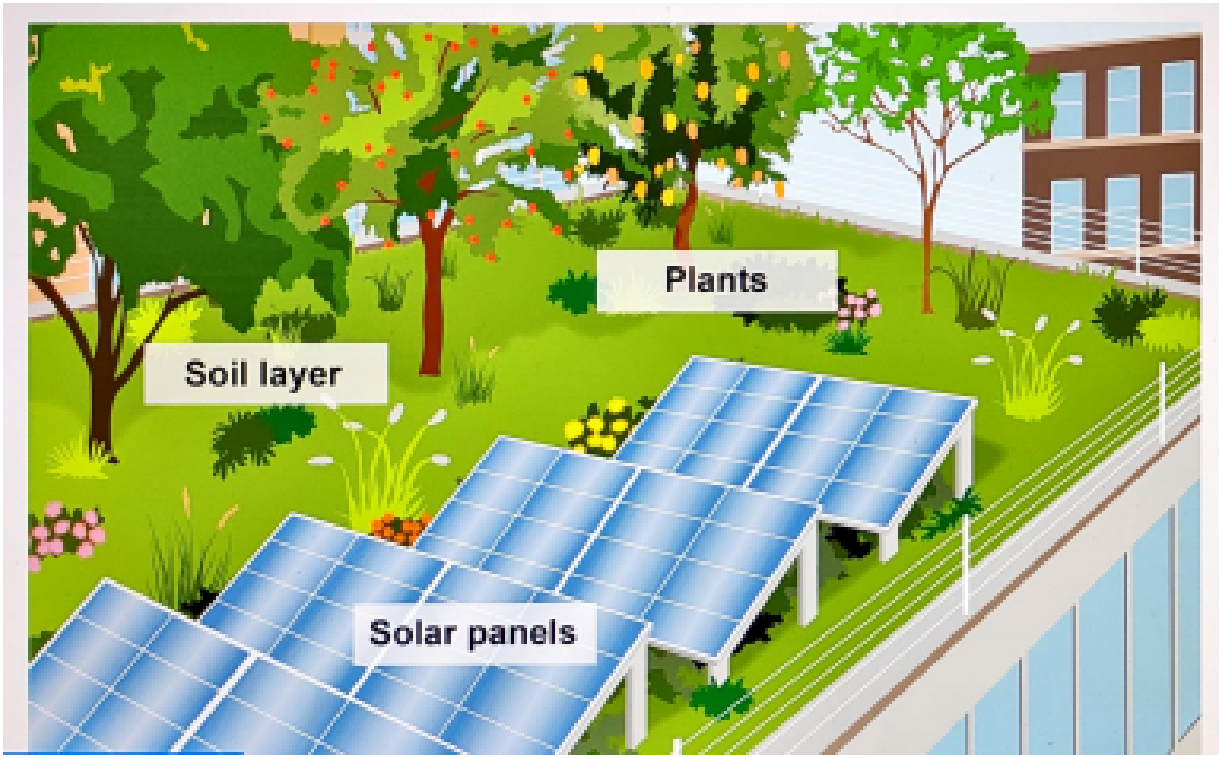
- a justification of one action an individual can take
- a justification of one action a government can take
- a statement of why each action might be difficult to implement
- a conclusion.

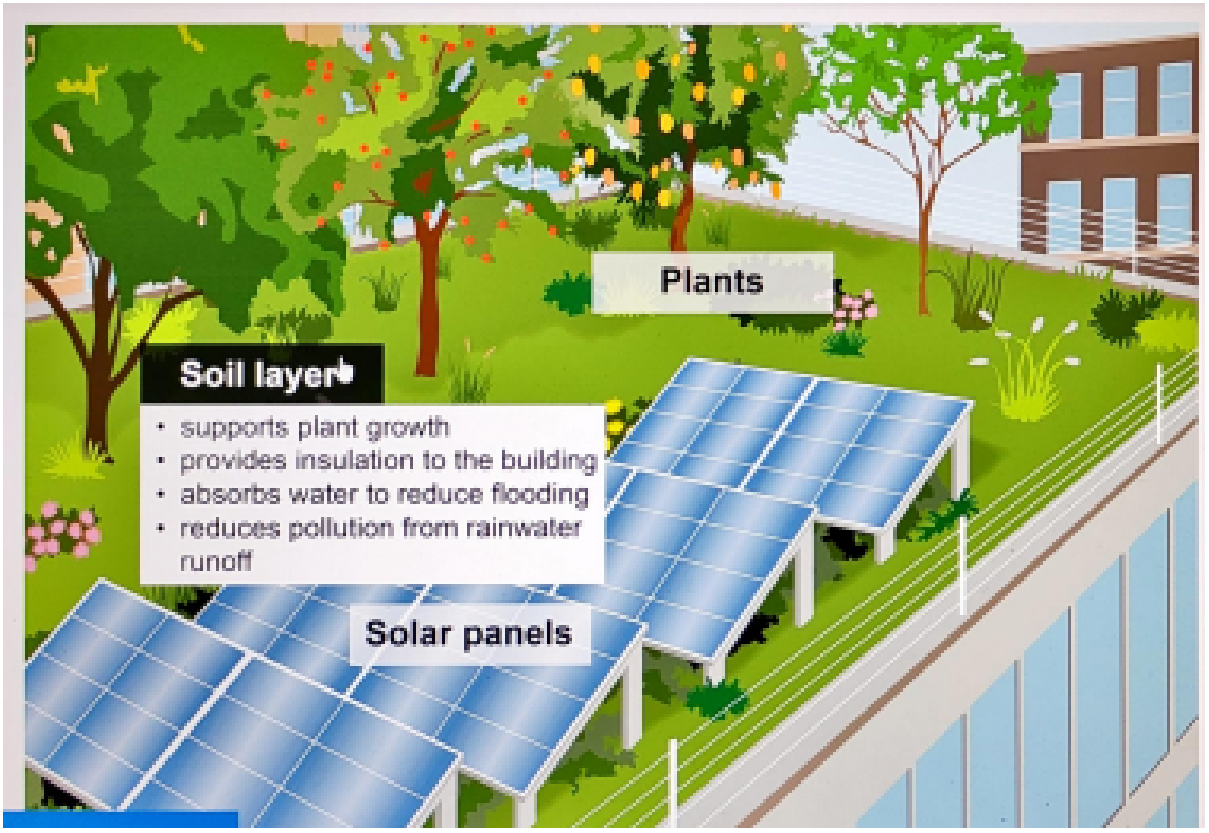
Question 9 (13 marks)

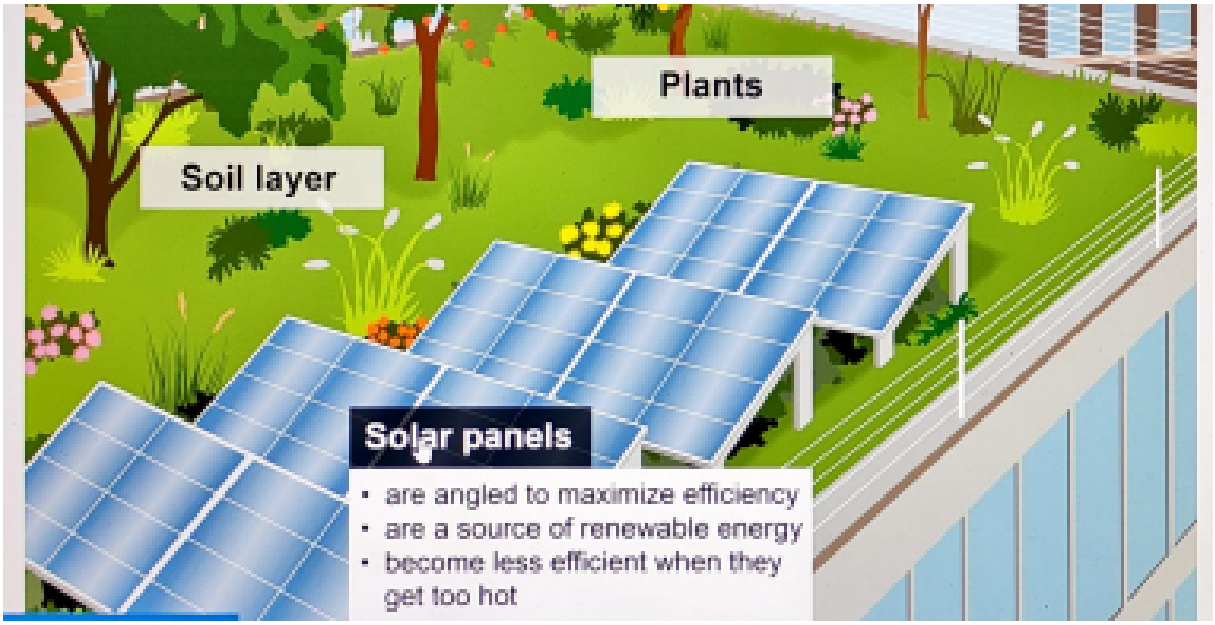
Cities can enhance biodiversity by creating additional green spaces. Urban green spaces can reduce flooding, reduce air pollution and remove carbon dioxide from the air. Green spaces also contribute to the wellbeing of people. Green roofs are a type of green space found in some cities. This type of roof is made by adding a layer of soil to a rooftop and then planting it with vegetation. Green roofs are heavy and expensive to construct and so are not appropriate for all buildings.

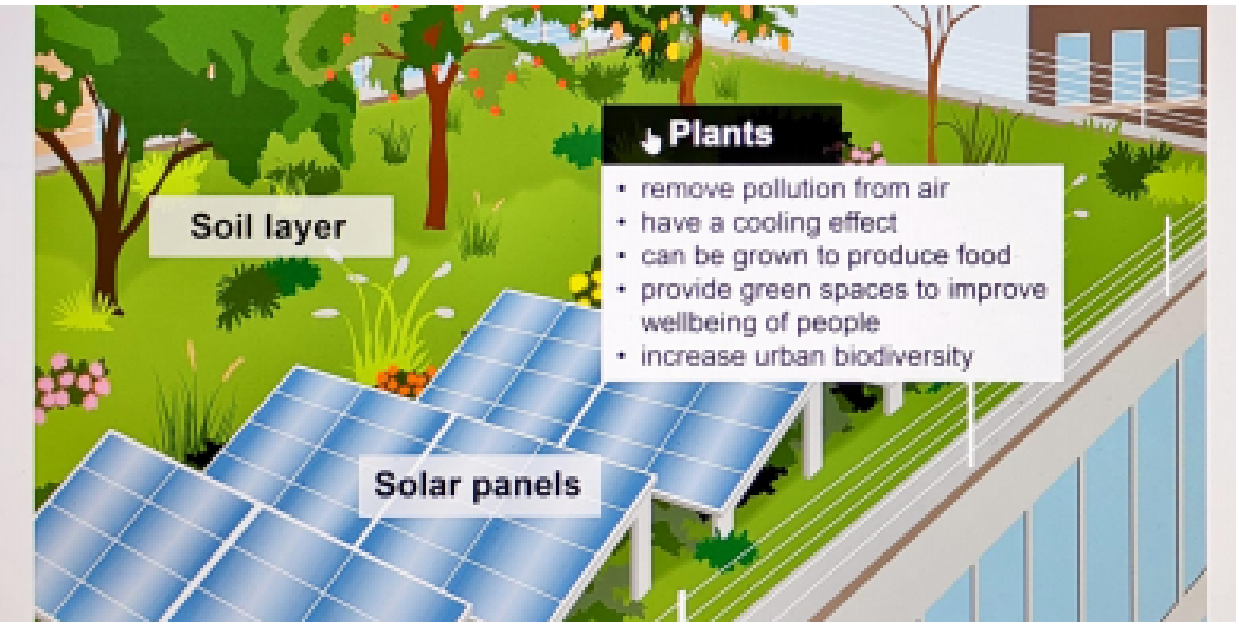
Solar panels are a sustainable source of energy. They convert the Sun's energy into electrical energy. Solar panels can be placed on rooftops or can be incorporated into roof tiles. If the solar panels get too hot, however, their efficiency decreases. Solar panels use rare elements and are expensive to produce; however, over time they can produce savings and decrease the reliance on fossil fuels.

More recently, scientists have investigated the potential benefits of combining both green roofs and solar panels to create a new technology called biosolar roofs.




Plants
Soil layer
• supports plant growth
• provides insulation to the building
• absorbs water to reduce flooding
• reduces pollution from rainwater runoff
Solar panels


Plants
Soil layer
Solar panels
• are angled to maximize efficiency
• are a source of renewable energy
• become less efficient when they get too hot



Using information from this task and your wider MYP studies, **discuss** and **evaluate** the use of biosolar technology to improve the sustainability of urban areas. In your answer, you should include:

- environmental impacts of green roofs and solar panels
- economic impacts of green roofs and solar panels
- **additional** benefits when green roofs and solar panels are combined in biosolar technology
- one factor to consider when deciding where to place biosolar technology
- a concluding statement.