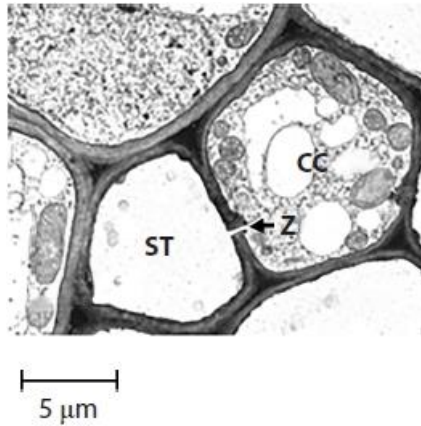


Questions**Q1.**

The electron micrograph shows a cross-section through part of a vascular bundle, containing phloem tissue.



A sieve tube element is labelled 'ST'. A cell called a companion cell is labelled 'CC'.

Calculate the magnification of this image.

(1)

Answer: \times

(Total for question = 1 mark)

Q2.

Mineral ions in the soil affect the growth of the peanut plant, *Arachis hypogaea*.



The effect of mineral ions on the production of fruit by these plants was investigated.

Young peanut plants were grown in soil containing all the mineral ions required.

After one week, 10 of these plants were moved into soil without calcium ions. Another 10 plants were moved into soil without magnesium ions.

Ten plants were left in the original soil.

After leaving the plants to grow, the mean number of flowers per plant and the percentage of these flowers that formed fruit were recorded.

The results are shown in the table.

Soil	Mean number of flowers per plant	Percentage of flowers producing fruit (%)
Containing all minerals	644	9.2
Without calcium ions	392	5.4
Without magnesium ions	583	2.3

(i) Calculate the mean reduction in the number of fruit produced by peanut plants grown in soil without calcium ions.

Give your answer to two decimal places.

(3)

Answer

(ii) Comment on the results of this investigation.

(3)

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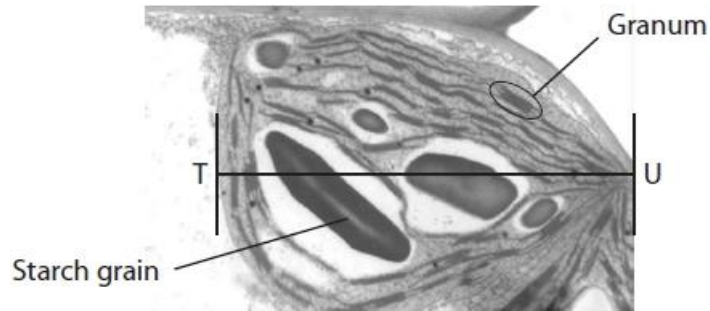
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(Total for question = 6 marks)

Q3.

Photosynthesis is a process that occurs in all green plants.

The electron micrograph shows part of a chloroplast in a plant cell.



- (i) The labelled starch grain in the chloroplast is $2.2\ \mu\text{m}$ long.
Calculate the width of this chloroplast between T and U.

(2)

..... μm

- (ii) Explain the relationship between the structure and functions of a granum in photosynthesis.

(3)

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(Total for question = 5 marks)

Q4.

The concentrations of some inorganic ions were measured in soil and in plants.

The table shows the concentration of nitrate ions in the soil and in different parts of a plant.

Site	Nitrate ion concentration / ppm
leaf	250
leaf stalk	990
stem	1200
root	2100
soil	29

- (i) Calculate the percentage decrease in nitrate ion concentration from the root to the leaf.

(2)

Answer

- (ii) Describe how nitrate ions are transported from the root to the leaves.

(2)

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(Total for question = 4 marks)

Q5.

Plant cell walls contain cellulose. Cellulose molecules are polymers.

(i) Name the monomer that makes up cellulose.

(1)

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(ii) Which of the following correctly describes how these monomers are held together in a cellulose molecule?

(1)

- A** by glycosidic bonds in a branched chain
- B** by glycosidic bonds in an unbranched chain
- C** by hydrogen bonds in a branched chain
- D** by hydrogen bonds in an unbranched chain

(iii) Cellulose molecules are held together in bundles called microfibrils.

These microfibrils are embedded in a matrix containing calcium pectate.
Calcium pectate can be found in the

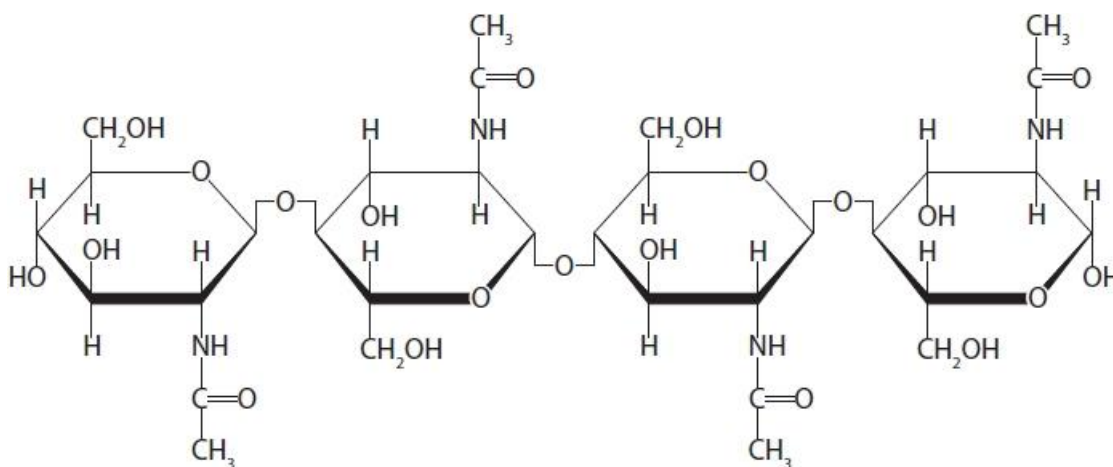
(1)

- A** amyloplast
- B** chloroplast
- C** middle lamella
- D** tonoplast

(Total for question = 3 marks)

Q6.

The diagram shows part of a molecule of chitin, a modified polysaccharide found in fungal cell walls.



Compare and contrast the structure of chitin with that of a cellulose molecule.

(3)

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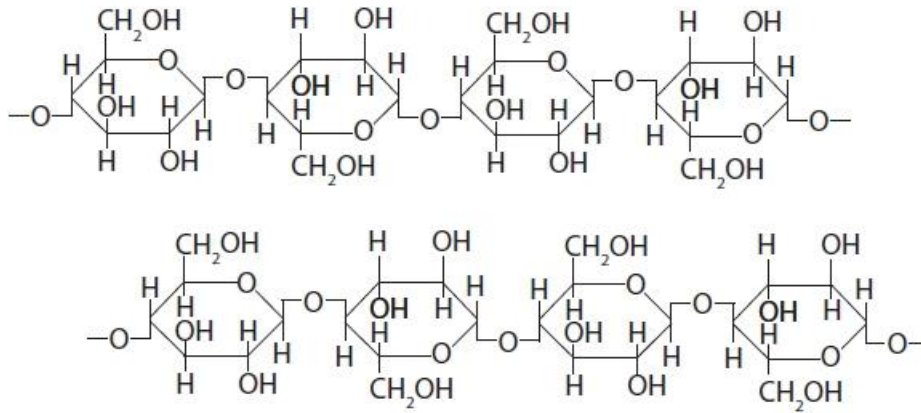
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(Total for question = 3 marks)

Q7.

The cell wall consists of cellulose molecules arranged as microfibrils.
The diagram shows the partial structure of two molecules of cellulose.



(i) Draw **one** link on the diagram that would hold these molecules together in a microfibril.

(1)

(ii) Compare and contrast the structure of cellulose and amylopectin.

(3)

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(Total for question = 4 marks)

Q8.

Plant fibres and oil-based plastics have both been used to make ropes.

Climbing ropes can be made from manila (a plant fibre) or nylon (an oil-based plastic). Various factors affect the tensile strength of these ropes, including diameter and storage conditions.

The table shows the effect of rope diameter on tensile strength.

Diameter of rope / mm	Tensile strength / kN	
	Manila rope	Nylon rope
6	2.4	7.5
8	4.2	12.1
10	5.7	16.3
12	10.6	28.4

It is claimed that the ideal storage conditions for rope are 18 °C and 60% relative humidity.

Devise a valid investigation to determine the effect of storage temperature on the tensile strength of manila rope and nylon rope.

(4)

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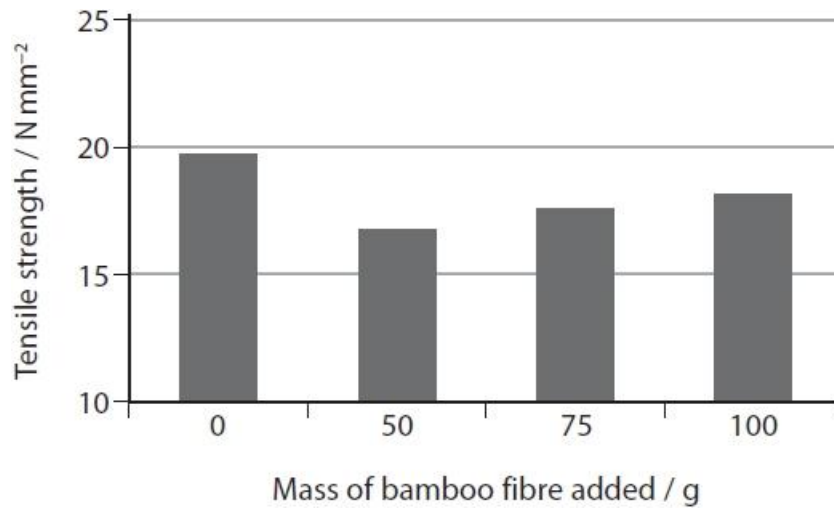
(Total for question = 4 marks)

Q9.

The effect of mixing bamboo fibre with resin was investigated.

The tensile strength of fibres made from a mixture of resin and different masses of bamboo fibre was measured.

The results are shown in the graph.



Describe how the tensile strength of these fibres could have been measured.

(3)

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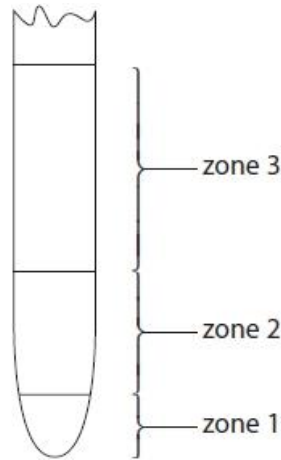
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(Total for question = 3 marks)

Q10.

The diagram shows three different zones found in a plant root.



In zone 2, the plant cells elongate due to a change in their cellulose cell walls.

(i) Cellulose and amylopectin are polymers of hexose sugars.

State one difference between the hexose in cellulose and the hexose in amylopectin.

(1)

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(ii) The cellulose molecules form microfibrils.

Name the bond between adjacent cellulose molecules in a cellulose microfibril.

(1)

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(Total for question = 2 marks)

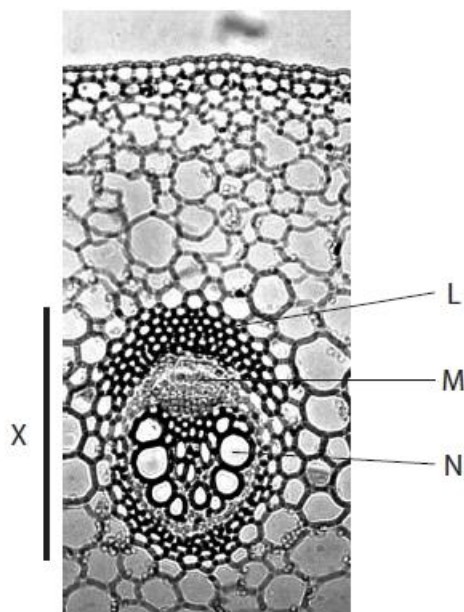
Q11.

Answer the questions with a cross in the boxes you think are correct . If you change your mind about an answer, put a line through the box and then mark your new answer with a cross .

The stems of plants contain tissues involved in transport and in support.

The photograph shows a cross section of part of the stem of a plant.

Fibres can be extracted from stems similar to this one and used instead of fibres produced from oil-based plastics.



John Bebbington FRPS Science and Plants for schools – <https://www.saps.org.uk>

(i) The part of the stem labelled L contains

(1)

- A phloem that transports organic solutes
- B sclerenchyma fibres that provide support
- C sieve tubes that transport water
- D xylem vessels that transport water and mineral ions

(ii) The part of the stem labelled M contains

(1)

- A phloem that transports organic solutes
- B sclerenchyma fibres that transport water
- C sieve tubes that synthesise organic solutes
- D xylem vessels that transport water and mineral ions

(iii) The structure labelled N is a

(1)

- A part of the phloem that transports water
- B sclerenchyma fibre that provides support
- C sieve tube that transports organic solutes
- D xylem vessel that transports water and mineral ions

(iv) The line labelled X on the photograph represents the width of the vascular bundle.

The actual width of the vascular bundle is 320 μm .
Calculate the magnification of the image.

(3)

Answer

(Total for question = 6 marks)

Q12.

Plants can respond to and use light.

The photograph shows a seedling starting to grow from a germinating seed.



(a) Explain why the seedling needs a supply of magnesium ions.

(2)

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(Total for question = 2 marks)

Q13.

A range of minerals is necessary for the formation of healthy plant tissue.

Seedlings of rice plants were grown for two weeks in a complete solution containing all the mineral ions required.

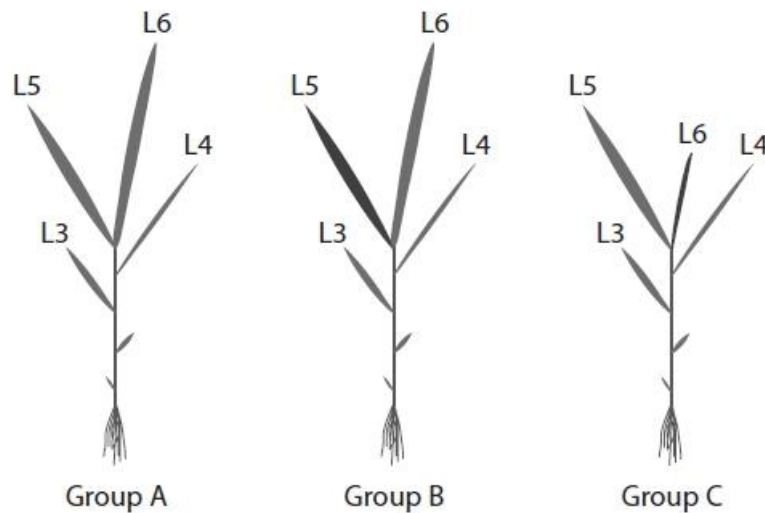
After two weeks, the plants were divided into three groups, A, B and C.

- The plants in Group A were grown in a complete solution.
- The plants in Group B were grown in a complete solution lacking magnesium ions.
- The plants in Group C were grown in a complete solution lacking calcium ions.

The plants were then grown for nine days. The diagrams show the plants at the end of the growing time.

The labels L3 to L6 on the diagrams refer to the leaves in order of growth.

L6 was the last leaf to grow.



At the end of the growing time, L5 was dead and L6 was yellow in the plants in Group B.

Comment on the effects of deficiencies in magnesium ions and calcium ions on the growth of these rice plants.

(4)

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(Total for question = 4 marks)

Q14.

Mineral ions in the soil affect the growth of the peanut plant, *Arachis hypogaea*.



The effect of mineral ions on the production of fruit by these plants was investigated.

Young peanut plants were grown in soil containing all the mineral ions required.

After one week, 10 of these plants were moved into soil without calcium ions. Another 10 plants were moved into soil without magnesium ions.

Ten plants were left in the original soil.

After leaving the plants to grow, the mean number of flowers per plant and the percentage of these flowers that formed fruit were recorded.

The results are shown in the table.

Soil	Mean number of flowers per plant	Percentage of flowers producing fruit (%)
Containing all minerals	644	9.2
Without calcium ions	392	5.4
Without magnesium ions	583	2.3

Devise an investigation to determine the effect of nitrate ion concentration on the growth of young peanut plants.

(5)

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(Total for question = 5 marks)

Q15.

A range of minerals is necessary for the formation of healthy plant tissue.

'The growth of seedlings is affected by the concentration of magnesium ions whereas germination of seeds is not.'

Devise an investigation to obtain valid evidence to support this statement.

(5)

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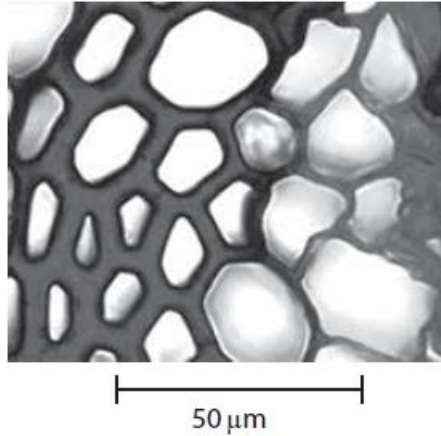
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(Total for question = 5 marks)

Q16.

The image shows a cross section of part of a plant stem examined using a light microscope.



(i) Label a sclerenchyma fibre with the letter **S**.

(1)

(ii) Calculate the magnification of this image.

(3)

Answer

(Total for question = 4 marks)

Q17.

(i) The cell walls in some plant tissues have secondary thickening. This may contain a substance called lignin.

Which of the following properties can lignin give to cell walls in plants?

(1)

- A** flexibility and permeability to water
- B** flexibility and waterproofing
- C** strength and permeability to water
- D** strength and waterproofing

(ii) Name a plant tissue that has lignin in its cell walls.

(1)

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(Total for question = 2 marks)

Q18.

Explain the role of the middle lamella when a plant cell completes mitosis.

(2)

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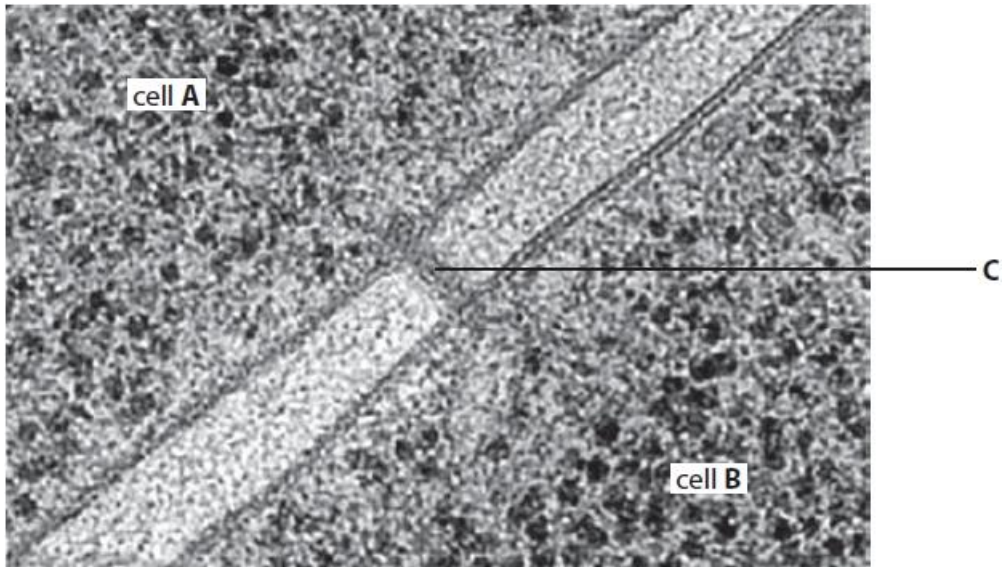
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(Total for question = 2 marks)

Q19.

The electronmicrograph shows the junction between two plant cells, **A** and **B**.



(i) Name the structure labelled **C**. (1)

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(ii) Explain the function of the structure labelled **C**. (2)

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(Total for question = 3 marks)

Q20.

The concentration of magnesium ions in the soil was found to be very low.

Explain the effects of a shortage of magnesium ions on a plant.

(3)

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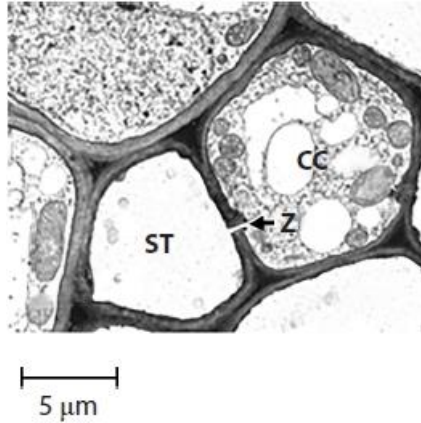
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(Total for question = 3 marks)

Q21.

The electron micrograph shows a cross-section through part of a vascular bundle, containing phloem tissue.



A sieve tube element is labelled '**ST**'. A cell called a companion cell is labelled '**CC**'.

There is no nucleus in a mature sieve tube element.

Give **two** reasons why a sieve tube element does not require rough endoplasmic reticulum and ribosomes.

(2)

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(Total for question = 2 marks)

Q22.

Plant-based products provide a sustainable alternative to oil-based plastics.

A sustainable alternative is a plastic material that contains more than 30% plant-based polymers.

Potato starch is a source of these polymers.

(i) Describe the structure of starch.

(3)

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(ii) Explain why this plastic material is only partially sustainable.

(2)

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(Total for question = 5 marks)

Q23.

Svalbard Global Seed Vault (SGSV) is a seed bank. It keeps seeds from almost 4000 species of plants, focussing on food crops such as wheat, rice and maize.

Many seeds in SGSV store food in the form of starch.

(i) Why does the food store in seeds contain starch rather than cellulose?

(1)

- A** starch can be stored for longer because it has 1–4 bonds
- B** starch has more mineral ions than cellulose
- C** starch is branched and supplies energy more quickly than cellulose
- D** starch is more compact than cellulose because it has 1–6 bonds

(ii) Explain why starch must be broken down before it can be used by the cells of the growing plant.

(2)

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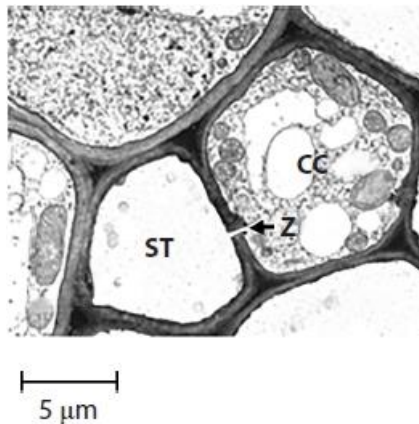
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(Total for question = 3 marks)

Q24.

The electron micrograph shows a cross-section through part of a vascular bundle, containing phloem tissue.



A sieve tube element is labelled '**ST**'. A cell called a companion cell is labelled '**CC**'.

Companion cells are found next to sieve tube elements.

(i) Describe the structure labelled **Z** that connects the cytoplasm of the companion cell to the sieve tube element.

(2)

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(ii) The electron micrograph shows a difference in the number of mitochondria in the sieve tube element and in the companion cell.

Explain the difference in the number of mitochondria.

(3)

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(Total for question = 5 marks)

Q25.

Plant fibres and oil-based plastics have both been used to make ropes.

Ropes used in climbing need to have high tensile strength.

State what is meant by the term **tensile strength**.

(1)

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(Total for question = 1 mark)

Q26.

Plant-based products provide a sustainable alternative to oil-based plastics.

The tensile strength of plant fibres can be tested using different methods.

One method is to attach both ends of a fibre to clamps horizontally and hang increasing numbers of masses until the fibre breaks.

A second method is to attach one end of a fibre to a clamp and the other to a forcemeter, pulling on the forcemeter until the fibre breaks.

Explain which method will give more accurate results.

(2)

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(Total for question = 2 marks)

Q27.

Textiles are often made from plant fibres. The use of plant fibres is more sustainable than the use of synthetic fibres made from fossil fuels.

The tensile strength of plant fibres from different plant species can be measured.

(i) Which of the following are variables that would need to be controlled when testing the tensile strength of these fibres?

(1)

- A** humidity and light intensity
- B** light intensity and temperature
- C** temperature and humidity
- D** temperature and pH

(ii) Describe how the tensile strength of these fibres can be measured.

(3)

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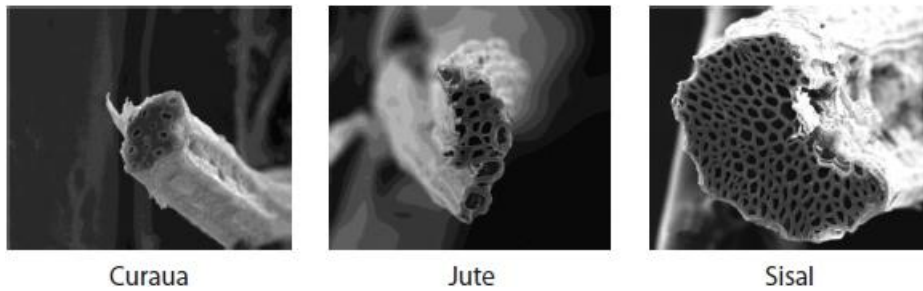
(Total for question = 4 marks)

Q28.

Textiles are often made from plant fibres. The use of plant fibres is more sustainable than the use of synthetic fibres made from fossil fuels.

Fibres of curaua, jute and sisal were examined using an electron microscope.

These electron micrographs were examined and the physical features of the fibres were measured.



Type of fibre	Cell wall thickness / μm	Diameter of lumen / μm	Mean tensile strength / MPa
Curaua	3.5	4.0	543
Jute	2.5	6.7	249
Sisal	2.6	8.2	484

Analyse these data to evaluate the relationship between the structure of these plant fibres and their tensile strength.

(4)

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(Total for question = 4 marks)

Q29.

Some plant cells contain the polymer starch.

Explain how the structure and properties of starch are related to its function as a storage molecule.

(3)

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(Total for question = 3 marks)

Q30.

Plant fibres and oil-based plastics have both been used to make ropes.

Tissues that contain lignin provide strength to plant fibres.

Describe the positions in the stem of those tissues that contain lignin.

(2)

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(Total for question = 2 marks)

Q31.

The fibres from different species of plants have different properties.
Therefore, plant fibres can be used in the manufacture of a variety of materials.

Describe the importance of magnesium ions in the production of plant fibres.

(2)

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(Total for question = 2 marks)

Q32.

Kapok (*Ceiba pentandra*) is a tree.

Kapok produces seed pods containing waxy fibres made of cellulose covered in lignin.

These fibres are used as fillings for cushions.

(i) Describe the arrangement of glucose monomers in a cellulose molecule.

(2)

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(ii) Devise a method to find the relationship between the actual diameter and the tensile strength of kapok fibres.

(6)

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(Total for question = 8 marks)

Q33.

Starch contains two different molecules, amylose and amylopectin. The percentage of each molecule found in starch varies depending on its source.

The effect of amylose content on the hydrolysis of starch from different sources by enzymes was investigated.

Source of starch	Amylose content (%)	Percentage of starch hydrolysed after 4 hours (%)
Cassava	20.0	51.9
Peruvian carrot	18.7	54.2
Potato	28.9	39.6
Yellow maize	35.8	37.5

(i) Calculate the ratio of amylose to amylopectin in cassava. Give your answer in simplest form.

(1)

Answer

(ii) Explain the relationship between the composition of the starch and the rate of hydrolysis by enzymes.

(4)

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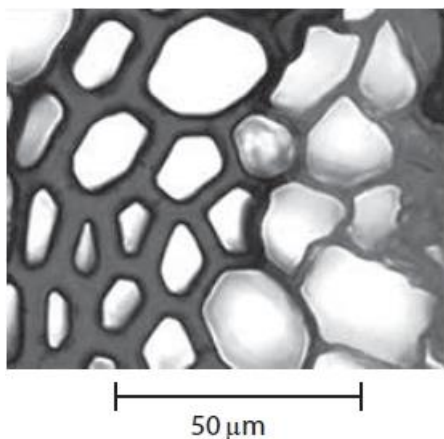
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(Total for question = 5 marks)

Q34.

The image shows a cross section of part of a plant stem examined using a light microscope.



(i) A nucleus will be found in a

(1)

- A companion cell
- B sclerenchyma fibre
- C sieve tube
- D xylem vessel

(ii) Xylem and sclerenchyma fibres both

(1)

- A provide support
- B transport glucose
- C transport hormones
- D transport mineral ions

(iii) The cell wall forms a greater percentage of the total mass of the sclerenchyma fibre than of a phloem sieve tube.

Which of the following explains this difference?

(1)

- A phloem sieve tubes do not contain organelles
- B phloem sieve tubes have thinner, lignified walls
- C sclerenchyma fibres contain organelles
- D sclerenchyma fibres have thickened, lignified cell walls

(Total for question = 3 marks)

Q35.

Answer the questions with a cross in the boxes you think are correct . If you change your mind about an answer, put a line through the box and then mark your new answer with a cross .

Starch is an important component of the human diet.

The main sources of starch are plants such as maize and potatoes.

(i) Starch is composed of amylose and amylopectin.

Which of the following terms is the correct description of amylose?

(1)

- A disaccharide
- B monosaccharide
- C polysaccharide
- D trisaccharide

(ii) Starch can be broken down by a

(1)

- A condensation reaction involving ester bonds
- B condensation reaction involving glycosidic bonds
- C hydrolysis reaction involving ester bonds
- D hydrolysis reaction involving glycosidic bonds

(iii) Give **one** structural difference between amylose and amylopectin.

(1)

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(Total for question = 3 marks)

Q36.

Explain how the structures of amylopectin and glycogen make them suitable for storing energy.

(3)

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(Total for question = 3 marks)**Q37.**

Glycogen and starch can be hydrolysed by enzymes.

Which row shows the correct features of the structure of glycogen?

(1)

<input type="checkbox"/> A	1,4-glycosidic bonds only	branched
<input type="checkbox"/> B	1,6-glycosidic bonds only	unbranched
<input type="checkbox"/> C	1,4-glycosidic bonds and 1,6-glycosidic bonds	branched
<input type="checkbox"/> D	1,4-glycosidic bonds and 1,6-glycosidic bonds	unbranched

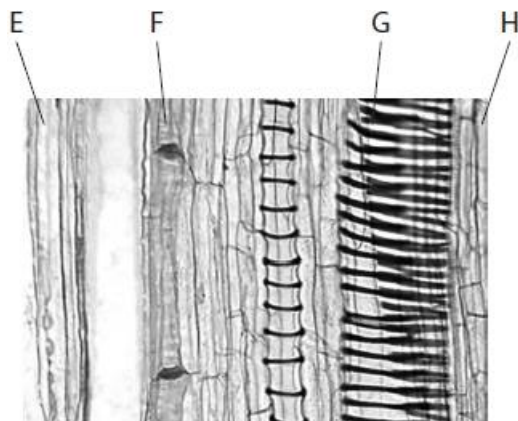
(Total for question = 1 mark)

Q38.

Answer the questions with a cross in the boxes you think are correct . If you change your mind about an answer, put a line through the box and then mark your new answer with a cross .

The stems of plants contain tissues involved in transport and in support.

The photograph shows a longitudinal section through one plant stem.



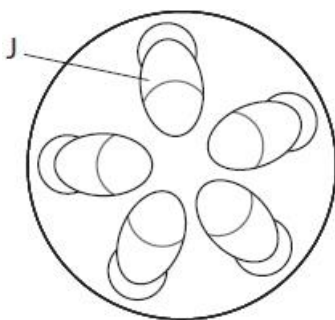
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(i) Which labelled structure in the photograph contains lignin?

(1)

- A E
 B F
 C G
 D H

(ii) The diagram shows a transverse section through a plant stem.



Which of the labelled structures in the photograph is located in the area labelled J in the diagram?

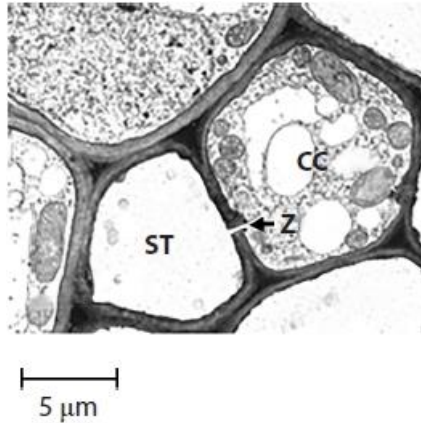
(1)

- A E
 B F
 C G
 D H

(Total for question = 2 marks)

Q39.

The electron micrograph shows a cross-section through part of a vascular bundle, containing phloem tissue.



A sieve tube element is labelled '**ST**'. A cell called a companion cell is labelled '**CC**'.

The wall of the sieve tube element contains

- A** cellulose, lamellae and lignin
- B** cellulose, lignin and pectin
- C** hemicellulose, microfibrils and pectin
- D** hemicellulose, peptidoglycan and pectin

(1)

(Total for question = 1 mark)

Mark Scheme

Q1.

Question Number	Answer	Additional Guidance	Mark
	<ul style="list-style-type: none"> correct calculation of magnification (1) 	<u>Example of calculation</u> 14mm = 14000µm 14000 ÷ 5 = 2800 x 2800	(1)

Q2.

Question Number	Answer	Additional Guidance	Mark
(i)	<ul style="list-style-type: none"> mean number of fruit for plants grown in soil with all minerals (1) mean number of fruit for plants grown in soil without calcium ions (1) difference between these values calculated (1) 	<u>Example of calculation:</u> $(644 \times 9.2) \div 100 = 59.248 / 59.25$ $(392 \times 5.4) \div 100 = 21.168 / 21.17$ $59.25 - 21.17 = 38.08$ Correct answer with no working gains full marks	(3)

Question Number	Answer	Additional Guidance	Mark
(ii)	An answer which makes reference to the following: <ul style="list-style-type: none"> deficiency in both ions reduces flowering and fruit formation (1) flower number reduced more by a deficiency in calcium than a deficiency in magnesium (1) fruit production reduced more by a deficiency in magnesium than a deficiency in calcium (1) 	ALLOW calcium deficiency has most effect on flower number ALLOW magnesium deficiency has most effect on fruit production	(3)

Q3.

Question Number	Answer	Additional Guidance	Mark
(i)	<ul style="list-style-type: none"> correct measurements from the photograph (1) correct answer 	<u>Example of calculation</u> Starch grain 27mm and width of chloroplast 60mm $27000 \div 22 = 12\ 273$ $60000 \div 12\ 273 = 4.889\ (\mu\text{m})$ ALLOW 4.9 / 4.89 / 4.8 recurring (μm) (ALLOW one mark for correct calculation from different measurements)	(2)

Question Number	Answer	Additional Guidance	Mark
(ii)	An explanation that makes reference to three of the following: <ul style="list-style-type: none"> (granum) is formed from many layers of thylakoid membranes to increase surface area (for absorbing light) thylakoid membranes contain chlorophyll to absorb light electron carrier molecules in thylakoid membrane involved in ATP production 	ALLOW stacks of thylakoids provide a large surface area ALLOW photosystems / photosynthetic pigments in place of chlorophyll ALLOW for light dependent reaction in place of absorb light ALLOW ATP synthase / photophosphorylation	(3)

Q4.

Question Number	Answer	Additional Guidance	Mark
(i)	<ul style="list-style-type: none"> correct calculation of the difference in concentration (1) correct calculation of the percentage (1) 	<u>Example of calculation</u> $2100 - 250 = 1850$ $1850 \div 2100 \times 100 = 88\%$ ALLOW 88.1% / 88.10% Answer should be given to no more than 2dp Correct answer with no working gains full marks	(2)

Question Number	Answer	Additional Guidance	Mark
(ii)	A description that makes reference to the following points: <ul style="list-style-type: none"> through the xylem (vessels) (1) in { water / solution } (1) 	NOT phloem ALLOW via transpiration stream IGNORE ref to active transport	(2)

Q5.

Question Number	Answer	Additional Guidance	Mark
(i)	Beta-glucose	Allow b glucose / β glucose	(1)

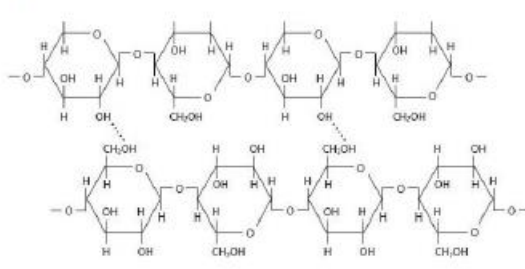
Question Number	Answer	Mark
(ii)	The only correct answer is B – by glycosidic bonds in an unbranched chain <i>A is not correct because a cellulose molecule is not branched</i> <i>C is not correct because a cellulose molecule is not branched</i> <i>D is not correct because the monomers in a cellulose molecule are not held together by hydrogen bonds</i>	(1)

Question Number	Answer	Mark
(iii)	The only correct answer is C – middle lamella <i>A is not correct because there is no calcium pectate in the amyloplast</i> <i>B is not correct because there is no calcium pectate in the chloroplast</i> <i>D is not correct because there is no calcium pectate in the tonoplast</i>	(1)

Q6.

Question Number	Answer	Additional guidance	Mark
	<p>An answer that makes reference to three of the following:</p> <p><u>Similarities</u></p> <ul style="list-style-type: none"> both have glycosidic bonds (1) description of every other monomer being inverted (1) <p><u>Differences</u></p> <ul style="list-style-type: none"> (the monomers of) chitin have eight carbon atoms whereas in cellulose there are six carbon atoms (1) chitin { has an additional side chain / contains nitrogen but cellulose does not } (1) 	<p>IGNORE 1,4 and 1,6</p> <p>ALLOW every other glucose</p> <p>ALLOW only chitin contains nitrogen / chitin has an amide group</p>	(3)

Q7.

Question Number	Answer	Additional Guidance	Mark
(i)	<ul style="list-style-type: none"> a link between the O of an OH group with H on an adjacent molecule (1) 	<p>e.g.</p> 	(1)

Question Number	Answer	Additional Guidance	Mark
(ii)	<p>An answer which makes reference to the following:</p> <p>Similarities:</p> <ul style="list-style-type: none"> both are {polysaccharides / polymers of glucose} (1) both contain (1,4) glycosidic bonds (1) <p>Differences:</p> <ul style="list-style-type: none"> cellulose contains { β /beta } glucose whereas amylopectin contains { α / alpha } glucose (1) cellulose { is not branched / does not contain 1-6 glycosidic bonds } (1) 	<p>ALLOW alternate monomers are inverted in cellulose</p> <p>ALLOW converse for amylopectin</p>	(3)

Q8.

Question Number	Answer	Additional Guidance	Mark
	<p>An answer that makes reference to four of the following:</p> <ul style="list-style-type: none"> pieces of rope of same length and {width / diameter } (1) (stored at) a range of temperatures above and below 18°C (1) humidity at 60% / ropes stored for same period of time (1) {masses / force / weights} applied until rope breaks (1) calculate change in tensile strength (1) 		(4)

Q9.

Question Number	Answer	Additional Guidance	Mark
	<p>An answer that makes reference to three of the following:</p> <ul style="list-style-type: none"> • add {50g / 75g / 100g} bamboo fibre to (the same mass of) resin (1) • tensile strength tested by {adding masses / applying force} until the fibre breaks (1) • calculate tensile strength by dividing force by cross-sectional area (1) • relevant variable controlled (1) 	e.g. temperature, humidity, age of bamboo fibre, length of fibre	(3)

Q10.

Question Number	Answer	Additional Guidance	Mark
(i)	<ul style="list-style-type: none"> • amylopectin contains alpha glucose and cellulose contains beta glucose (1) 	ALLOW { α / a } glucose and { β / b } glucose OR H and OH have been reversed on carbon 1	(1)

Question Number	Answer	Additional Guidance	Mark
(ii)	<ul style="list-style-type: none"> • hydrogen / H (bond) 		(1)

Q11.

Question Number	Answer	Mark
(i)	<p>The only correct answer is B - sclerenchyma fibres provide support</p> <p><i>A is not correct because it is not phloem</i></p> <p><i>B is not correct because it is not sieve tubes</i></p> <p><i>D is not correct because it is not xylem</i></p>	(1)

Question Number	Answer	Mark
(ii)	<p>The only correct answer is A - phloem that transports organic solutes</p> <p><i>B is not correct because sclerenchyma does not transport water</i></p> <p><i>C is not correct because sieve tubes do not synthesise organic solutes</i></p> <p><i>D is not correct because it is not xylem</i></p>	(1)

Question Number	Answer	Mark
(iii)	<p>The only correct answer is D - xylem vessel that transports water and mineral ions</p> <p><i>A is not correct because it is not phloem</i></p> <p><i>B is not correct because it is not a sclerenchyma fibre</i></p> <p><i>C is not correct because it is not a sieve tube</i></p>	(1)

Question Number	Answer	Additional guidance	Mark
(iv)	<p>An answer that makes reference to the following</p> <ul style="list-style-type: none"> length of line correctly measured (1) correct conversion to μm (1) image size divided by actual size to give magnification (1) 	<p>Example of calculation</p> <p>36mm ALLOW 37mm</p> <p>36000 ALLOW 37000</p> <p>36000/320 = 112.5 OR 37000/320 = 115.6</p> <p>Correct answer without working gains full marks</p>	(3)

Q12.

Question number	Answer	Additional guidance	Mark
	<p>An explanation that makes reference to the following:</p> <ul style="list-style-type: none"> magnesium is needed to make chlorophyll (1) because chlorophyll is required for photosynthesis (1) because shoots need (chlorophyll) to carry out photosynthesis to grow (1) 	<p>ALLOW required to replace organic molecules stored in seed that have been used up</p>	<p>Choose an item.</p> <p>(2)</p>

Q13.

Question Number	Answer	Additional guidance	Mark
	<p>An answer that makes reference to four of the following:</p> <ul style="list-style-type: none"> the effect of magnesium deficiency is shown earlier than the effect of calcium (1) because the first leaf to die is leaf five in Group B plants (1) plants continue to grow in solution lacking magnesium (1) plants stop growing in solution lacking in calcium (1) without calcium for the middle lamella new leaves cannot grow fully (1) 	ALLOW leaves are stunted	(4)


Q14.

Question Number	Answer	Additional Guidance	Mark
	<p>An answer which makes reference to five of the following:</p> <ul style="list-style-type: none"> use of plants that are { clones / same variety / same age } (1) a range of (at least) five different nitrate concentrations (1) description of how an abiotic variable will be controlled (1) grown for a set period of time (1) relevant measure of growth (1) repeats (at each nitrate concentration) to calculate mean values (1) 	<p>e.g. suitable method for controlling temperature or light described or pH of soil or presence of all other mineral ions in soil or volume of water provided e.g. height or mass</p>	(5)

Q15.

Question Number	Answer	Additional guidance	Mark
	<p>An answer that makes reference to the following:</p> <ul style="list-style-type: none"> • range of magnesium ion concentrations (1) • measurement of germination rate (1) • use of seedlings germinated in solutions containing all mineral ions (1) • measurement of seedling growth (1) • environmental variables controlled {temperature / humidity} (1) 		(5)

Q16.

Question Number	Answer	Additional Guidance	Mark
(i)	<ul style="list-style-type: none"> • sclerenchyma correctly labelled (1) 	<p>Any identification within shown region</p> 	(1)

Question Number	Answer	Additional Guidance	Mark
(ii)	<ul style="list-style-type: none"> • correct measurement of scale bar (1) • conversion to micrometres (1) • division of image length by actual length to give magnification (1) 	<p><u>Example of calculation:</u></p> <p>35mm or 3.5cm</p> <p>35000 (or measured value multiplied by relevant figure if value incorrect)</p> <p>$(35000) \div 50$ = (x) 700</p> <p>Correct answer with no working gains full marks</p>	(3)

Q17.

Question Number	Answer	Mark
(i)	<p>The only correct answer is D - strength and waterproofing</p> <p><i>A is not correct because lignin is not permeable to water</i></p> <p><i>B is not correct because lignin does not provide flexibility</i></p> <p><i>C is not correct because lignin is not permeable to water</i></p>	(1)

Question Number	Answer	Additional Guidance	Mark
(ii)	<p>An answer that makes reference to the following:</p> <ul style="list-style-type: none"> xylem / sclerenchyma (1) 	<p>DO NOT ALLOW mark if phloem is mentioned.</p> <p>IGNORE vessels etc</p>	(1)

Q18.

Question Number	Answer	Additional guidance	Mark
3(c)	<p>An explanation that makes reference to the following</p> <ul style="list-style-type: none"> produced between (adjacent) new cells (in cell plate) (1) because the middle lamella holds cell walls together (1) 		(2)

Q19.

Question Number	Answer	Additional Guidance	Mark
(i)	plasmodesma (1)	ALLOW plasmodesmata	(1)
Question Number	Answer	Additional Guidance	Mark
(ii)	An explanation which makes reference to the following: <ul style="list-style-type: none"> cytoplasmic connection (between cells) (1) which allows { transport / communication } (between cells) (1) 	ALLOW cytoplasm continuous between the cells ALLOW exchange of materials between cells	(2)

Q20.

Question Number	Answer	Additional Guidance	Mark
	An explanation that makes reference to the following points: <ul style="list-style-type: none"> (a shortage of magnesium ions) limits the production of chlorophyll (1) lack of { glucose / carbohydrate / cellulose } due to less photosynthesis (1) (therefore) plant leaves may be yellow / plants may be small (1) 	ALLOW a named carbohydrate / sugar ALLOW slow growth, stunted growth, pale leaves, leaves not green IGNORE wilting	(3)

Q21.

Question Number	Answer	Additional Guidance	Mark
	An answer that makes reference to the following: <ul style="list-style-type: none"> there will be no { transcription / mRNA } (therefore ribosomes not required for translation) (1) no proteins will be synthesised to be processed in endoplasmic reticulum (1) 	ALLOW proteins are provided by/from the companion cell	(2)

Q22.

Question Number	Answer	Additional guidance	Mark
(i)	<p>A description that makes reference to three of the following:</p> <ul style="list-style-type: none"> starch is a polysaccharide made from alpha glucose (1) monomers in the chains are joined by 1,4 glycosidic links (1) starch contains {unbranched chains / amylose} and {branched chains / amylopectin} (1) branches are joined to chains by 1,6 glycosidic links (1) 	ALLOW branches involve 1,6 glycosidic links	(3)

Question Number	Answer	Additional guidance	Mark
(ii)	<p>An explanation that makes reference to the following:</p> <ul style="list-style-type: none"> because starch comes from plants that can be regrown (1) however not 100% starch so some oil-based products needed (1) 		(2)

Q23.

Question Number	Answer	Mark
(i)	C starch is branched and supplies energy more quickly than cellulose	(1)

Question Number	Answer	Additional Guidance	Mark
(ii)	<p>An explanation making reference to the following:</p> <ul style="list-style-type: none"> to produce {glucose / maltose } (1) which is { soluble / transported / enters cells easily / used in respiration } (1) 	<p>NOT beta-glucose</p> <p>ALLOW converse for starch</p> <p>IGNORE ref to size of molecules</p>	(2)

Q24.

Question Number	Answer	Additional Guidance	Mark
(i)	<p>A description making reference to the following:</p> <ul style="list-style-type: none"> a pit (in the cell wall) / plasmodesma (1) the cell wall has only one layer / only primary cell wall present / a strand of cytoplasm (1) 	<p>ALLOW plasmodesmata ALLOW a narrow channel through the cell wall</p> <p>description must match structure named</p>	(2)

Question Number	Answer	Additional Guidance	Mark
(ii)	<p>An explanation making reference to three of the following:</p> <ul style="list-style-type: none"> (the micrograph shows that) the CC has many mitochondria whereas the ST has { few / none } (1) the role of the ST is to provide a channel, so cellular contents are kept to a minimum (1) the ST has { limited / no } ability to carry out (aerobic) respiration (1) { ATP / energy } is supplied to the ST from the CC (1) 	<p>ALLOW CC has more mitochondria / ST has fewer mitochondria</p> <p>ALLOW CC is able to respire more</p> <p>ALLOW use of { ATP / energy } for active transport for phloem loading / described</p>	(3)

Q25.

Question Number	Answer	Additional Guidance	Mark
	<p>An answer that makes reference to the following:</p> <ul style="list-style-type: none"> the (pulling) force the fibre can withstand before breaking <p>(1)</p>	<p>ALLOW mass or weight instead of force</p>	(1)

Q26.

Question Number	Answer	Additional guidance	Mark
	<p>An explanation that makes reference to the following:</p> <ul style="list-style-type: none"> the second method will be more accurate (because the exact value will be shown on the forcemeter) (1) the first method is less accurate because the true value will be between two masses (1) 		(2)

Q27.

Question Number	Answer	Mark
(i)	<p>The only correct answer is C – temperature and humidity</p> <p><i>A is not correct because light intensity would not affect tensile strength when testing fibres</i></p> <p><i>B is not correct because light intensity would not affect tensile strength when testing fibres</i></p> <p><i>D is not correct because pH would not affect tensile strength when testing fibres</i></p>	(1)

Question Number	Answer	Additional Guidance	Mark
(ii)	<p>A description that makes reference to the following:</p> <ul style="list-style-type: none"> tensile strength calculated as a factor of force divided by cross sectional area of fibre (1) <p>And any two of the following:</p> <ul style="list-style-type: none"> addition of {force / weight / mass} to a fibre (1) measurement of {force / weight /mass} required to break fibre (1) calculation of cross-sectional area (1) 	<p>ALLOW last before breaking or the value at which the fibre breaks.</p>	(3)

Q28.

Question Number	Answer	Additional Guidance	Mark
	<p>An answer that makes reference to the following:</p> <ul style="list-style-type: none"> • (positive) correlation between cell wall thickness and tensile strength (1) • due to presence of lignin (1) • no correlation between lumen diameter and tensile strength (1) • curaua fibres strongest as they had the thickest cell walls (1) 	<p>ALLOW lumen diameter has {little / no effect} on tensile strength</p> <p>ALLOW converse statements, e.g. jute has thinnest cell wall and is the weakest fibre</p>	(1)

Q29.

Question Number	Answer	Additional Guidance	Mark
	<p>An explanation that makes reference to three the following:</p> <ul style="list-style-type: none"> • contains glucose needed for {respiration/energy} (1) • insoluble so { has no osmotic effect / remains in the cell } (1) • amylose is coiled making starch compact (so more can be stored) (1) • amylopectin {is branched/contains 1-6 glycosidic bonds} so is rapidly hydrolysed (1) 	<p>ALLOW description of osmotic effect eg. water moving into cell</p> <p>ALLOW broken down</p>	(3)

Q30.

Question Number	Answer	Additional Guidance	Mark
	<p>An answer that makes reference the following:</p> <ul style="list-style-type: none"> • sclerenchyma (fibres) on the outer side of the {vascular bundle / phloem} (1) • xylem (vessels) on the {inner side / inside} of the vascular bundle (1) 	<p>ALLOW correctly labelled diagram</p> <p>ALLOW sclerenchyma outside vascular bundle</p> <p>ALLOW xylem in the vascular bundle</p>	(2)

Q31.

Question Number	Answer	Additional guidance	Mark
	<p>A description that makes reference to two of the following:</p> <ul style="list-style-type: none"> • magnesium is essential to produce chlorophyll • chlorophyll is necessary to produce glucose during photosynthesis • glucose needed to produce cellulose for the cell walls 		(2)

Q32.

Question Number	Answer	Additional guidance	Mark
(i)	<p>An answer that makes reference to the following:</p> <ul style="list-style-type: none"> • monomers are connected by 1-4 glycosidic links (1) • alternate monomers are inverted (1) 	<p>ALLOW answers in the form of a diagram</p>	(2)

Question Number	Answer	Additional guidance	Mark
(ii)	<p>An answer that makes reference to six of the following:</p> <ul style="list-style-type: none"> • extraction of individual fibres from seed pod/isolation of single fibre (1) • diameter of fibre measured { using callipers / microscopy } (1) • control of relevant named variable (1) • clamping fibres and hanging masses from the fibre (1) • adding increased mass at regular intervals until fibre breaks (1) • repeat to find a mean at each diameter (1) • divide the force by the cross-sectional area (1) 	<p>E.g. fibre length, humidity, temperature</p> <p>ALLOW determine mass required to break the fibre</p>	(6)

Q33.

Question Number	Answer	Additional Guidance	Mark
(i)	<ul style="list-style-type: none"> • correct answer (1) 	<p><u>Example of calculation</u> $100 - 20 = 80$ $20 : 80 = 1 : 4$</p> <p>1 : 4 Do not allow any reference to percentages</p>	(1)

Question Number	Answer	Additional Guidance	Mark
(ii)	<p>An explanation that makes reference to four of the following:</p> <ul style="list-style-type: none"> • as amylose content increases the percentage of starch hydrolysed decreases (1) • the less amylose present the greater the proportion of amylopectin (1) • amylose is unbranched / amylopectin is branched (1) • amylopectin contains (1,4 and) 1,6-glycosidic bonds (1) • { branches / a greater number of terminal ends } increases the rate of hydrolysis (1) 	<p>Allow converse</p> <p>Allow converse</p>	(4)

Q34.

Question Number	Answer	Mark
(i)	<p>A - companion cell</p> <p><i>The only correct answer is A</i></p> <p><i>B is not correct because sclerenchyma fibres do not contain nuclei</i></p> <p><i>C is not correct because sieve tubes do not contain nuclei</i></p> <p><i>D is not correct because xylem vessels do not contain nuclei</i></p>	(1)

Question Number	Answer	Mark
(ii)	<p>A - provide support</p> <p><i>The only correct answer is A</i></p> <p><i>B is not correct because neither xylem nor sclerenchyma transport glucose</i></p> <p><i>C is not correct because neither xylem nor sclerenchyma transport hormones</i></p> <p><i>D is not correct because sclerenchyma does not transport mineral ions</i></p>	(1)

Question Number	Answer	Mark
(iii)	<p>D - sclerenchyma fibres have thickened, lignified cell walls</p> <p><i>The only correct answer is D</i></p> <p><i>A is not correct because phloem sieve tubes having no organelles does not explain a greater percentage of the total mass of the sclerenchyma</i></p> <p><i>B is not correct because phloem sieve tubes do not have lignified walls</i></p> <p><i>C is not correct because sclerenchyma fibres do not contain organelles</i></p>	(1)

Q35.

Question Number	Answer	Mark
(i)	<p>The only correct answer is C polysaccharide</p> <p><i>A is incorrect because amylose is not a disaccharide</i></p> <p><i>B is incorrect because amylose is not a monosaccharide</i></p> <p><i>D is incorrect because amylose is not a trisaccharide</i></p>	(1)

Question Number	Answer	Mark
(ii)	<p>The only correct answer is D hydrolysis reaction involving glycosidic bonds</p> <p><i>A is incorrect because starch does not contain ester bonds</i></p> <p><i>B is incorrect because starch does not contain ester bonds</i></p> <p><i>C is incorrect because condensation reactions join molecules together</i></p>	(1)

Question Number	Answer	Additional Guidance	Mark
(iii)	<p>An answer that makes reference to the following:</p> <ul style="list-style-type: none"> amylose is {unbranched / has only 1,4 glycosidic bonds} <p>OR</p> <ul style="list-style-type: none"> amylopectin {is branched / has (1,4 and) 1,6 glycosidic bonds} 	IGNORE coiled	(1)

Q36.

Question Number	Answer	Additional Guidance	Mark
	<p>An explanation that makes reference to three of the following:</p> <ul style="list-style-type: none"> • branched therefore can be rapidly hydrolysed (to release glucose) (1) • compact so more (energy / glucose) can be stored (1) • insoluble therefore does not affect osmosis (1) • molecules too large to diffuse across cell surface membrane (1) 	<p>ALLOW branched therefore can be broken down quicker ignore easily</p> <p>ALLOW 'does not take up much space'</p> <p>ALLOW insoluble therefore does not affect water potential of cell</p> <p>ALLOW large molecules therefore remain in cells</p>	(3)

Q37.

Question Number	Answer	Additional Guidance	Mark
	C - 1,4-glycosidic bonds and 1,6-glycosidic bonds and branched		(1)

Q38.

Question Number	Answer	Mark
(i)	<p>The only correct answer is C G (which is the xylem)</p> <p><i>A is not correct because E does not contain lignin</i></p> <p><i>B is not correct because F, which is phloem, does not contain lignin</i></p> <p><i>D is not correct because H is not xylem</i></p>	(1)

Question Number	Answer	Mark
(ii)	<p>The only correct answer is B F (this is phloem)</p> <p><i>A is not correct because E is not phloem</i></p> <p><i>C is not correct because G is not phloem</i></p> <p><i>D is not correct because H is not phloem</i></p>	(1)

Q39.

Question Number	Answer	Mark
	C hemicellulose, microfibrils and pectin	(1)