CAMBRIDGE
OCR

A Level Biology A
H420/01 Biological processes
Sample Question Paper

Date – Morning/Afternoon
Version 3.0

Time allowed: 2 hours 15 minutes

You can use:
- a scientific or graphical calculator
- a ruler (cm/mm)

Please write clearly in black ink. **Do not write in the barcodes.**

Centre number | | | | | | Candidate number | | | | |

First name (s) _____

Last name _____

INSTRUCTIONS
- Use black ink. You can use an HB pencil, but only for graphs and diagrams.
- Answer **all** the questions.
- Where appropriate, your answers should be supported with working. Marks might be given for using a correct method, even if your answer is wrong.
- Write your answer to each question in the space provided. If you need extra space use the lined pages at the end of this booklet. The question numbers must be clearly shown.

INFORMATION
- The total mark for this paper is **100**.
- The marks for each question are shown in brackets **[ ]**.
- Quality of extended response will be assessed in questions marked with an asterisk (*).
- This document has **36** pages.

ADVICE
- Read each question carefully before you start your answer.

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Section A

You should spend a **maximum** of **20 minutes** on this section.

1 Which option is **not** a role of the cytoskeleton?

A Giving mechanical strength to cells

B Movement of chromosomes during mitosis

C Phagocytosis

D Preventing entry of pathogens

Your answer ☐ **[1]**

2 A solution containing an unknown single sugar is tested. The results are shown in the table.

Colour observed after testing	
Benedict's test for reducing sugars	**Benedict's test for non-reducing sugars**
blue	brick red

Identify the unknown sugar.

A Fructose

B Glucose

C Lactose

D Sucrose

Your answer ☐ **[1]**

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3 An anticodon sequence of five tRNA molecules has the following percentage base composition:

Adenine 40: Cytosine 27: Guanine 13: Thymine 0: Uracil 20.

What is the percentage base composition of the template strand of the original DNA molecule?

	Adenine	Cytosine	Guanine	Thymine	Uracil
A	40	27	13	20	0
B	20	13	27	40	0
C	20	13	27	0	40
D	40	27	13	0	20

Your answer ☐ **[1]**

4 Citrate synthase is an example of an enzyme that undergoes end-product inhibition. The enzyme catalyses the conversion of oxaloacetate into citric acid in the Kerbs cycle.

Which row describes citrate synthase?

	Type of respiration involved in	Location of enzyme	Inhibitor
A	aerobic	mitochondria	citric acid
B	aerobic	mitochondria	oxaloacetate
C	anaerobic	cytoplasm	citric acid
D	anaerobic	cytoplasm	oxaloacetate

Your answer ☐ **[1]**

5 Diffusion, osmosis and mass flow are mechanisms used to move water through plants.

Which row identifies the mechanism used to move water into root cells, up the stem in the xylem and out of leaves?

	Into root cells	Up the stem in the xylem	Out of leaves via stomata
A	diffusion	osmosis	diffusion
B	diffusion	osmosis	osmosis
C	osmosis	mass flow	diffusion
D	osmosis	mass flow	osmosis

Your answer ☐ **[1]**

6 Cells require vitamins and minerals in order to function. These vitamins and minerals need to cross the plasma membrane.

Vitamin A is fat soluble and Vitamin C is water soluble.

Which combination of vitamin and mineral enters a cell by facilitated diffusion?

A Vitamin A and calcium atoms

B Vitamin A and calcium ions

C Vitamin C and calcium atoms

D Vitamin C and calcium ions

Your answer ☐ **[1]**

7 Which statement explains the significance of mitosis in the development of whole organisms?

A Budding in yeast is an example of mitosis, producing new multicellular organisms.

B Mitosis can be controlled at certain points in development, which will change body plans.

C Mitosis limits the total number of cells in an organism, which will change its shape.

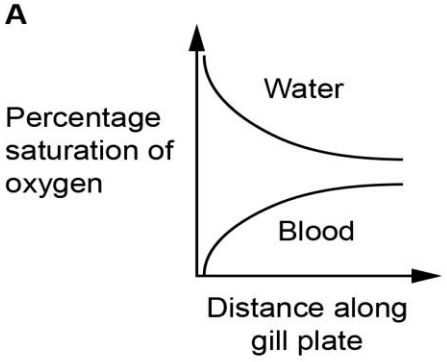
D Sex cells are produced by mitosis, which allows new organisms to be produced.

Your answer ☐ **[1]**

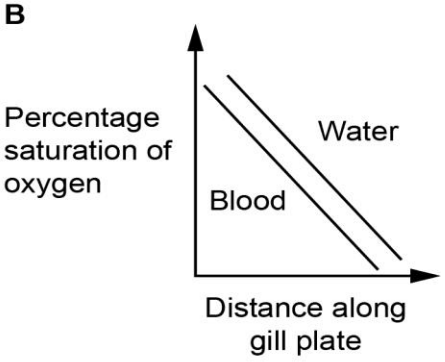
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8 Which graph represents the counter current exchange system in fish gills?

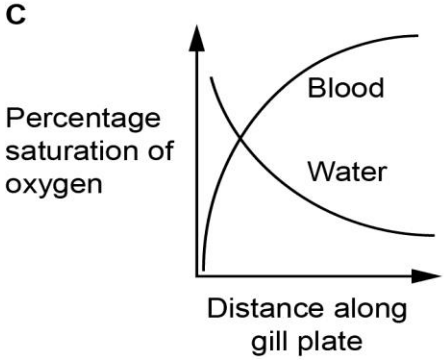
A



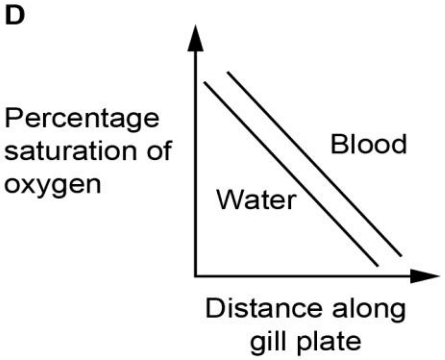
B



C



D



Your answer ☐ **[1]**

9 Blood vessels are adapted for their function.

Which of the following statements are true?

1. The walls of arteries near the heart contain a lot of elastic fibres so that they can stretch and recoil to maintain blood pressure.

2. The walls of the venules contain little muscle.

3. The walls of arteries contain a lot of muscle fibres to contract and generate pressure in the blood.

A 1, 2 and 3

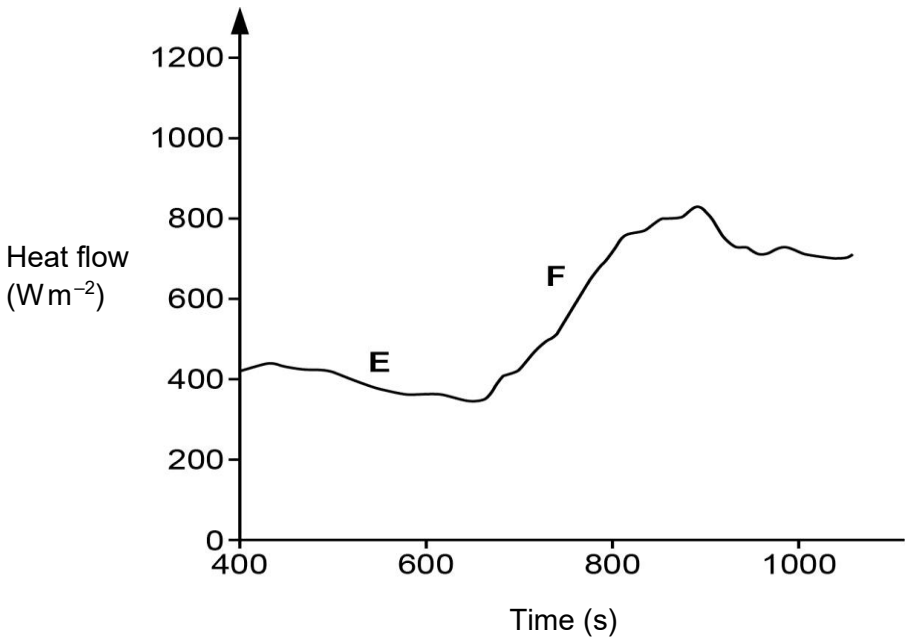
B Only 1 and 2

C Only 2 and 3

D Only 1

Your answer ☐ **[1]**

10 The graph shows the heat flow through the skin of an athlete during vigorous exercise.



Blood flow can be directed to the parts of the body that have the greatest demands.

What is happening to the blood flow at stages **E** and **F**?

	Stage E	**Stage F**
A	Blood directed towards the skin to remove heat from the body	Blood directed away from skin to avoid excess heat loss
B	Blood directed away from skin and towards the muscles to supply more oxygen for respiration	Blood directed towards skin to remove heat from the body
C	Blood directed away from skin to avoid excess heat loss	Blood directed towards skin to gain heat from the environment
D	Blood directed away from skin and towards the muscles to supply more oxygen for respiration	Blood directed towards skin to gain heat from the environment

Your answer ☐ **[1]**

11 Which option is a medical intervention used to regulate high blood glucose levels in diabetic patients?

A Injection of glycogen

B Injection of glucagon

C Injection of insulin

D Injection of pancreatic beta cells

Your answer ☐ **[1]**

12 The kidneys of a healthy individual filter 178 $dm^3 day^{-1}$ of fluid from the glomeruli into the renal capsules. However, only 1.5 $dm^3 day^{-1}$ of urine is produced.

Which option shows the percentage of the filtrate that is reabsorbed back into the blood?

A 0.8

B 11.8

C 99.2

D 176.5

Your answer ☐ **[1]**

13 Which row describes the process that happens during repolarisation of a neurone during an action potential?

	Sodium channels	**Potassium channels**	**Membrane potential**
A	closed	open	decreasing
B	closed	open	increasing
C	open	closed	decreasing
D	open	closed	increasing

Your answer ☐ **[1]**

14 Animals receive different stimuli from their environment. Their synapses can manage multiple stimuli, often resulting in one response such as a muscle twitching.

What is this action of the synapse an example of?

A All or nothing response

B Cell signalling

C Spatial summation

D Temporal summation

Your answer ☐ **[1]**

15 Plant membranes are made of phospholipid bilayers.

Which of the following statements are true?

1. ATP synthase embedded in thylakoid membranes maintains chemiosmotic gradients.

2. Phospholipid bilayers within the chloroplast are impermeable to protons.

3. Thylakoid membranes contain electron transport chain proteins.

A 1, 2 and 3

B Only 1 and 2

C Only 2 and 3

D Only 1

Your answer ☐ **[1]**

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Section B

16

(a) The electrical activity of the heart can be monitored using an electrocardiogram (ECG).

Figure 16.1 shows the ECG pattern for a single normal heartbeat.

Figure 16.1

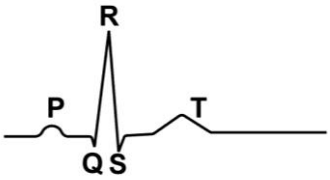


Figure 16.2 shows an ECG trace for a person with normal heart rhythm and **Figure 16.3** shows an ECG trace for a person with tachycardia.

Figure 16.2

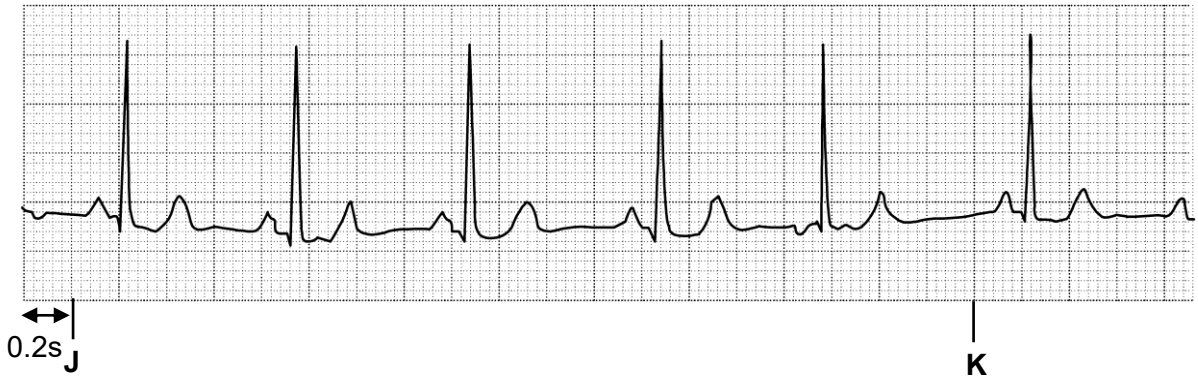
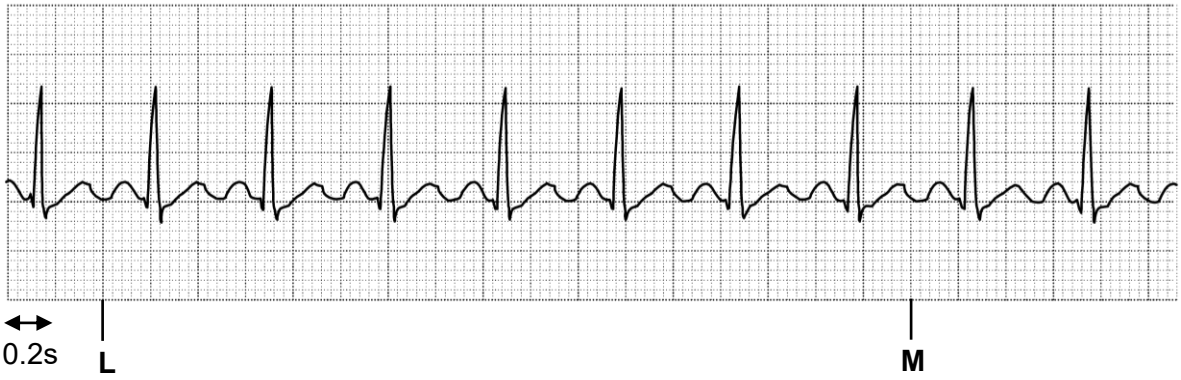


Figure 16.3



(i) Calculate the percentage increase in heart rate for the person with tachycardia compared to a normal heart rhythm.

Use the data between points **J** and **K** on **Figure 16.2** and points **L** and **M** on **Figure 16.3**.

Give your answer to the nearest whole number.

Percentage increase = ... % **[4]**

(ii) The most obvious feature of tachycardia is an increased heart rate.

Using **Figure 16.1**, **Figure 16.2** and **Figure 16.3**, describe the **other** key features of tachycardia.

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…… **[2]**

(b) **Figure 16.4** is an ECG trace of a person with an abnormal heart rhythm.

Figure 16.4



Using **Figure 16.4**, describe the actions of the heart that create this rhythm.

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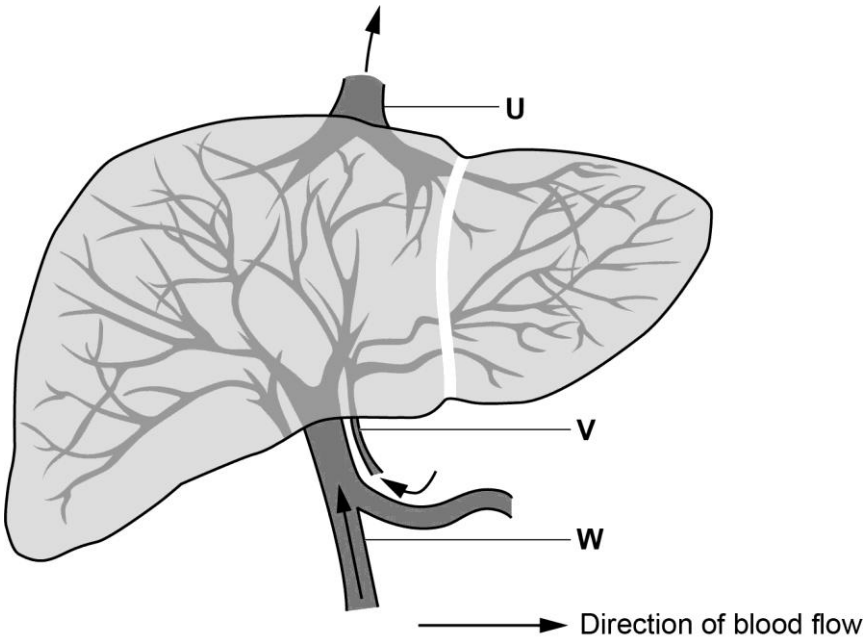
…… **[3]**

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17

(a) This is a diagram of the external view of a mammalian liver.



Identify the blood vessels labelled **U**, **V** and **W**.

U .....

V .....

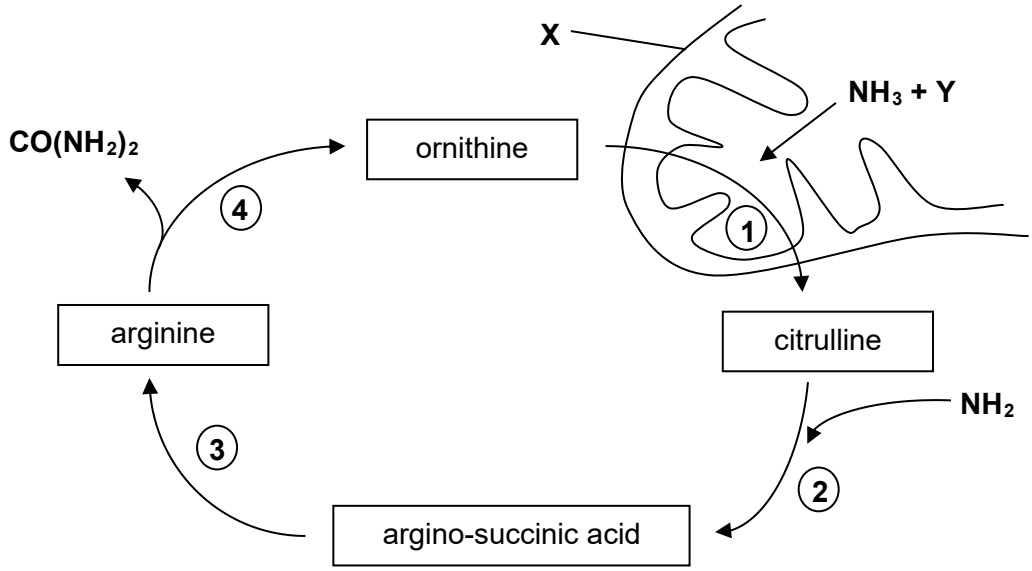
W .....

[3]

(b) One of the main functions of liver cells is conversion of ammonia to urea.

The formation of urea occurs rapidly via a series of water-soluble nitrogen-containing intermediate molecules in the ornithine cycle.

This is an outline of the ornithine cycle.



(i) Step **1** of the cycle takes place in the organelle represented by **X**.

Identify organelle **X**.

…… **[1]**

(ii) During the cycle, ornithine moves into organelle **X** and citrulline moves out of organelle **X**.

Suggest **one** method by which these molecules move into and out of organelle **X** during the cycle.

Give reasons for your choice.

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…… **[2]**

(iii) State how the ammonia that is used in step **1** has been formed.

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…… **[1]**

(iv) Identify the compound labelled **Y**.

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(c) Liver cells have a high metabolic rate. Hydrogen peroxide is a metabolic product produced in large quantities in liver cells. It needs to be removed in order to prevent serious damage to the liver cells.

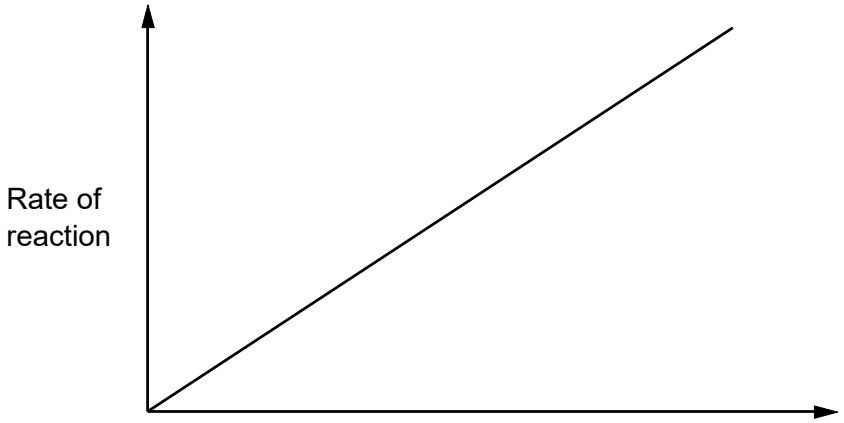
Hydrogen peroxide is detoxified by the enzyme catalase in this reaction:

$2\,H_2O_2 \longrightarrow 2\,H_2O + O_2$

Catalase has a very high turnover rate. A single catalase molecule can catalyse the breakdown of approximately 6 million hydrogen peroxide molecules every minute. Catalase is found in peroxisomes inside the liver cells. Peroxisomes are organelles surrounded by a single membrane.

Scientists investigate the activity of catalase using chopped liver tissue and dilute hydrogen peroxide. When chopped liver is added to the hydrogen peroxide bubbles of oxygen are produced.

The graph shows the effect of increasing enzyme concentration on the rate of the reaction.



(i) Identify **two** variables that need to be controlled in this investigation.

1 ……

2 ……...

[1]

(ii) Describe how you could control **one** of the variables that you identified in part **(i)**.

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…….. **[1]**

(iii)* Explain why **and** how catalase activity is regulated inside the liver cells.

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Extra answer space if required.

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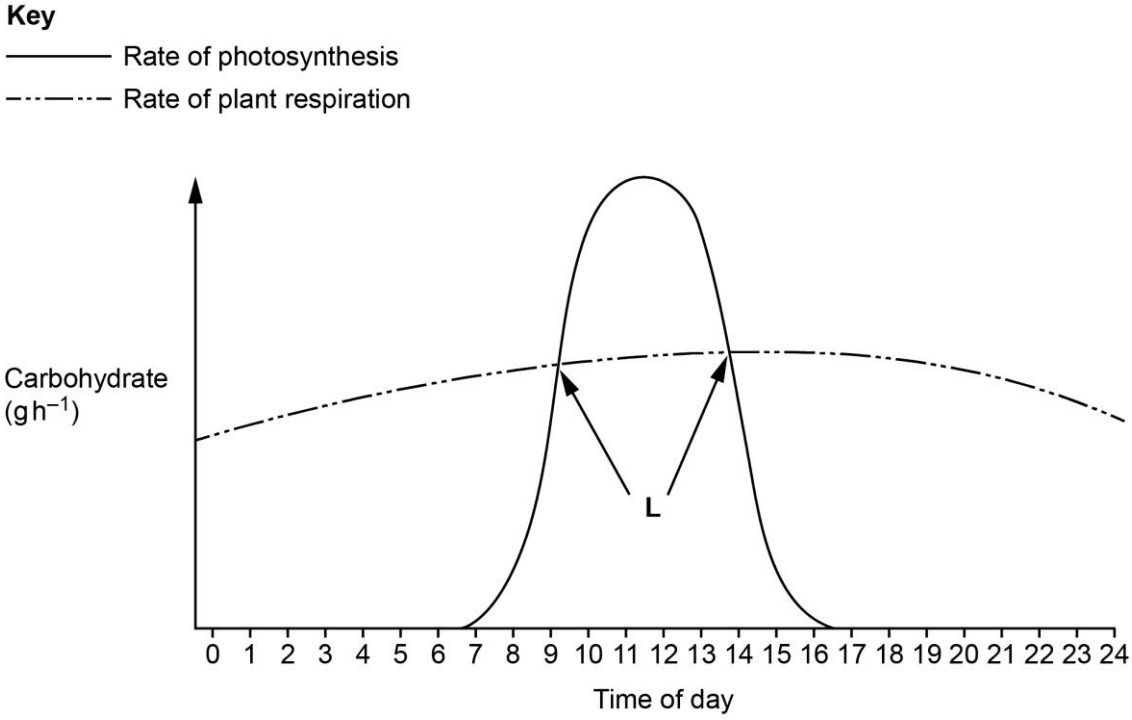
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18

(a) Plants photosynthesise and respire.

The graph shows the rate of production of carbohydrate in photosynthesis and the rate of use of carbohydrate by respiration.



(i) Explain the shape of the curve for the rate of photosynthesis.

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…… **[2]**

(ii) Explain the shape of the curve for the rate of plant respiration.

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…… **[2]**

(iii) Identify what is happening at the points indicated by the letter **L**.

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…… **[1]**

(b) Plants grow successfully in temperatures that are suited to their metabolism. Some plants are adapted for growth in cool climates while others can grow well in warm climates.

Plants also vary in their photosynthetic metabolism. Many plants produce a 3-carbon compound as the first product of carbon fixation and so are referred to as C3 plants. Another group of plants produces a 4-carbon compound as the first product and so are referred to as C4 plants.

C3 plants include barley, lentil, rice, soya, sunflower and wheat.
C4 plants include maize, millet, sorghum and sugar cane.

The graph shows the assimilation of carbon dioxide by four different crops at different temperatures.

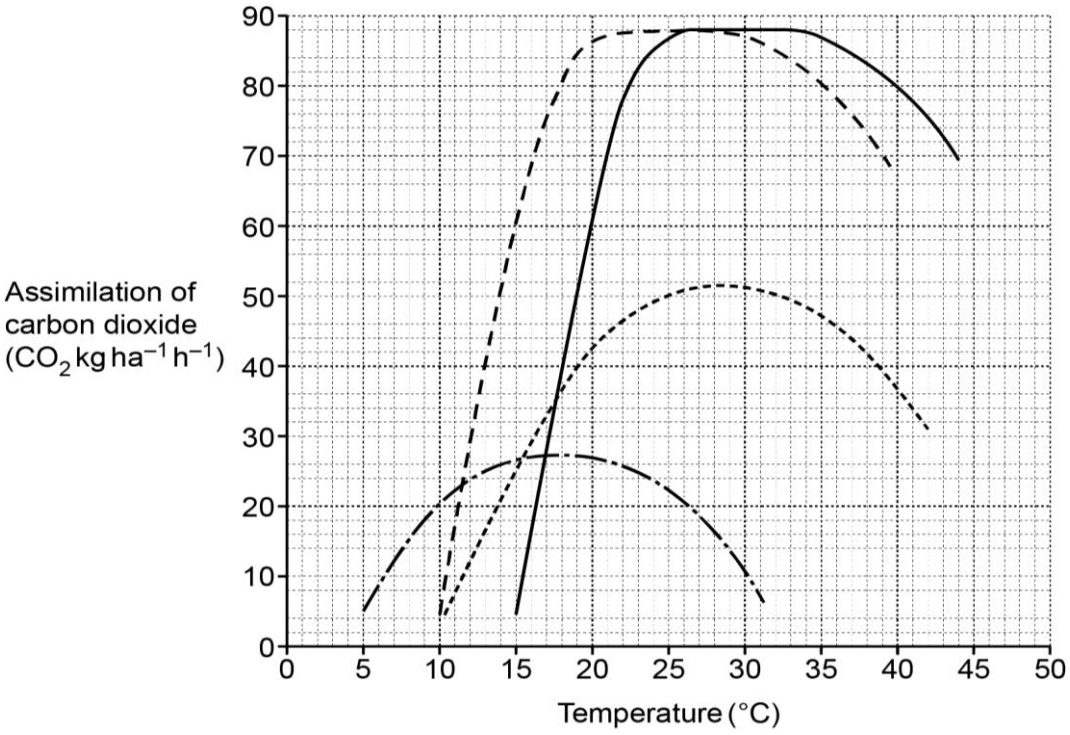
Key

C4 crop 1 = - - - - -

C4 crop 2 = ————

C3 crop 2 = ·····

C3 crop 1 = –·—·–



(i) Using the graph, describe the general relationship between increasing temperature and the assimilation of carbon dioxide.

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…… **[2]**

(ii) Calculate the values for the mean assimilation of carbon dioxide by C3 plants and C4 plants at 20°C.

C3 plants mean = ... $CO_2 kg ha^{-1} h^{-1}$

C4 plants mean = ... $CO_2 kg ha^{-1} h^{-1}$

[2]

(iii) Suggest **one** conclusion that could be drawn from the mean values you calculated in part **(ii)**.

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..... **[1]**

(iv) Suggest which curve on the graph corresponds to each of the following crops:

Sugar cane, which grows in warm climates.

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Barley, which grows in cool climates.

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[2]

(c) Temperature has an important role in plant photosynthesis.

Temperature stress is concerning to plant scientists because of climate change.

High temperature (HT) stress is defined as the rise in temperature that is enough to cause irreversible damage to plant growth and development.

The stress effects of temperature have been recorded in various plants and are outlined in the table.

Temperature	Effect
Moderate HT stress	Heat-induced deactivation of RuBisCO No change in chlorophyll fluorescence in photosystem 2 Reduction in stomatal opening
Severe HT stress	Decrease in chlorophyll content Changes in the ultrastructure of the chloroplast

(i) Suggest the impact of moderate HT stress on the process of photosynthesis.

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(ii) Suggest **two** ways in which the ultrastructure of the chloroplast is changed in high temperatures.

For each suggestion, explain the effect that it will have on photosynthesis.

Suggestion ……

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Explanation ……..

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Suggestion ……

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Explanation ……..

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[4]

19 Assimilates are transported throughout the plant by translocation in phloem.

(a) Phloem sap mainly consists of carbohydrate in the form of sucrose, but also contains other solutes.

(i) Suggest why it is beneficial to the plant for the carbohydrate to be transferred throughout the plant in the form of sucrose rather than as an alternative carbohydrate.

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…….. **[2]**

(ii) State **one** similarity **and one** difference between transport of substances in phloem and xylem.

Similarity …...…….

…….

Difference ……

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[2]

(b) Assimilates are loaded into the phloem at the source and then transported to the sink.

(i) Explain how some parts of the plant can act as both a source and a sink.

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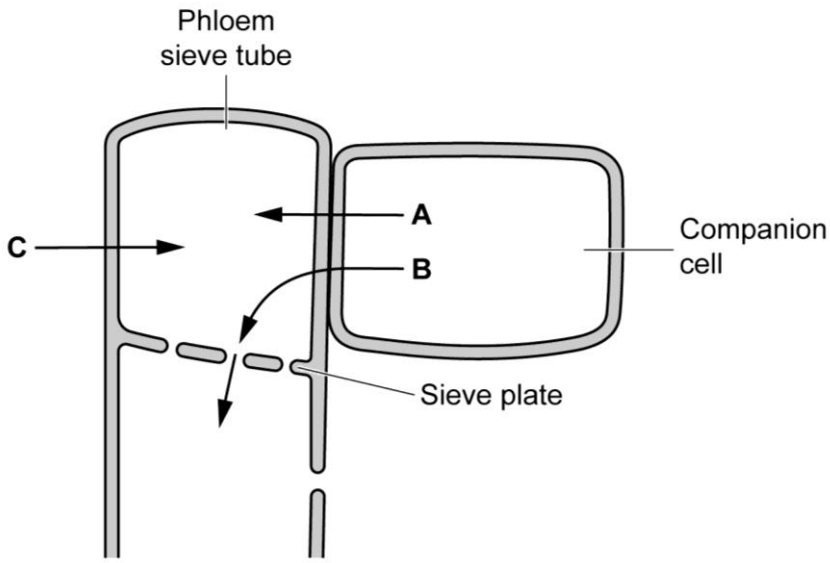
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(ii)* The diagram represents the loading of sucrose into the phloem at a source.



Explain the process of the loading of sucrose into the phloem and its movement in the phloem.

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……**[6]**

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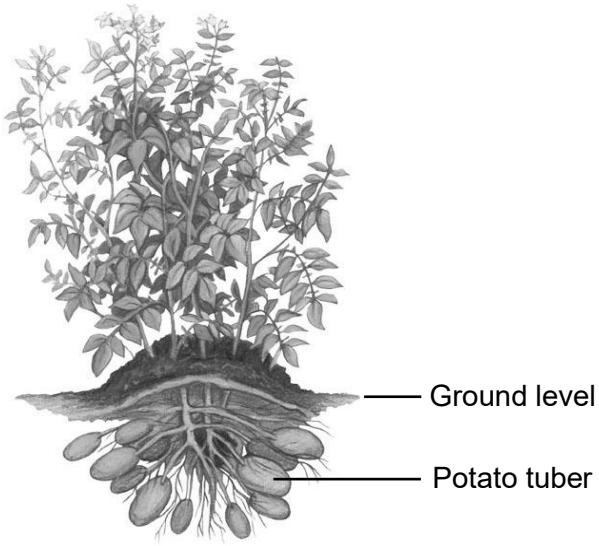
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(c) This is an image of a potato plant.



Potatoes are tubers. Tubers are underground storage organs.

Actively growing tissues have a high demand for carbohydrates. Phloem sap is directed to these tissues and sucrose is unloaded in large amounts.

Scientists modified potato plants by inserting a gene for invertase into their DNA so that the gene would be expressed in the tubers.

Invertase is responsible for catalysing the hydrolysis of the disaccharide sucrose.

The scientists investigated the properties of the modified and non-modified plants.

The results are shown in the table.

	Mean number of tubers (per plant)	**Mean mass of one tuber (g)**	**Mean sucrose concentration (mg g^{-1} tuber)**	**Mean glucose concentration (mg g^{-1} tuber)**	**Invertase activity (arbitrary units)**
Modified	2.2	49.7	1.4	36.3 ± 3.5	62.1
Non-modified	5.3	16.8	13.7	1.9 ± 0.3	1.1

(i) Name the bond that is hydrolysed by invertase.

…… **[1]**

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(ii) The potato tubers contain monosaccharides.

Compare the concentration of monosaccharides in the modified tubers with those that were not modified.

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…… **[2]**

(iii) In the modified plants, the unloading of sucrose is increased in the tubers compared with those that were not modified.

The transport of sucrose to the tubers is also increased in the modified plants.

Using the data and the information given, explain a possible mechanism that causes the increased unloading **and** the transport of sucrose in the modified plants.

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…… **[4]**

(iv) The trial experiment compared the properties of modified potato plants with those that were not modified.

Analyse the data and draw conclusions about the yield from the tubers of modified plants compared with those tubers from plants which have not been modified.

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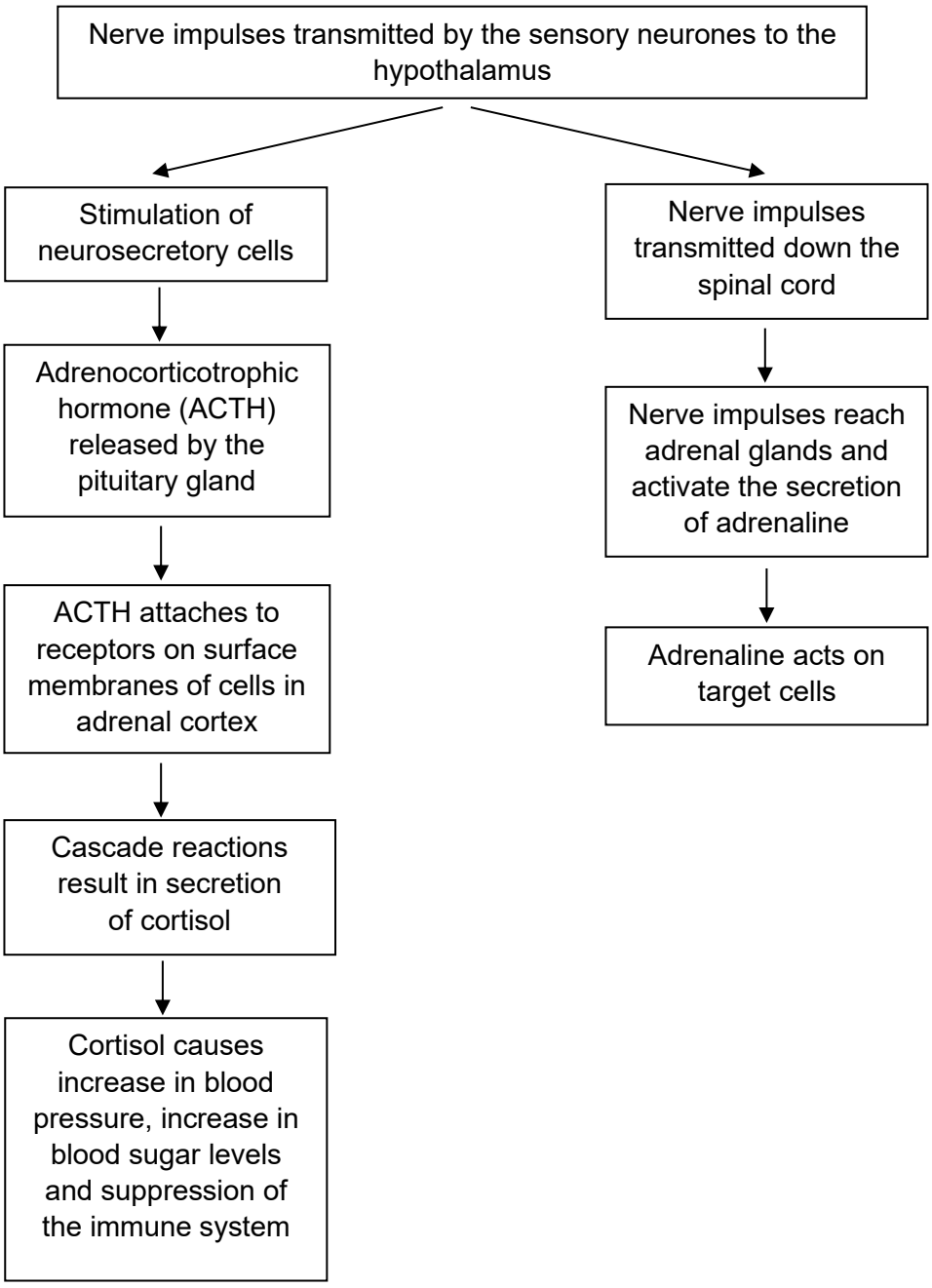
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…… **[3]**

20

(a) The flow diagram shows the sequence of events in the body once a threat is detected. The response is often described as the 'fight or flight' response as it prepares the body to respond physically to a threat.



(i) Identify **two** signalling molecules named in the diagram.

1 ……

2 ……

[1]

(ii) Adrenaline acts on different cell types and produces different responses.

Complete the table by stating the effects of stimulating each target cell.

Target cell	Response	Role in the 'fight or flight' response
Smooth muscle in bronchioles		
Sino-atrial node		
Liver cell		

[6]

(iii) Describe the sequence of actions that occur in the target liver cells once adenylyl cyclase is activated.

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…… **[2]**

(iv) The response described in the flow diagram also occurs when a person is subjected to stress. However, the body does not need to respond physically to the stimulus.

Suggest the long term adverse effects on body function of continued exposure to stress.

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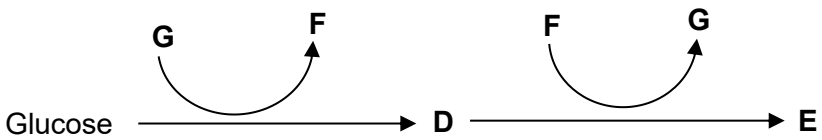
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…….. **[2]**

(b) Muscle cells require a supply of oxygen for respiration. If not enough oxygen is available, the cells respire anaerobically.

The diagram shows the process of anaerobic respiration in muscle cells.



(i) Identify the compounds labelled **D** and **E**.

D ……

E ……

[2]

(ii) Identify the role of compound **D** in anaerobic respiration.

……

…….. **[1]**

(iii) Explain why it is important that compound **G** is formed during the reaction in which compound **D** is converted into compound **E** in anaerobic respiration.

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……. **[2]**

(iv) Compound **E** is toxic and is removed from muscle cells. It is transported to an organ in the body.

Name the organ compound **E** is transported to **and** state how compound **E** reaches that organ.

……

…….. **[1]**

(c) Athletic sprinters require large amounts of energy in short periods of time. Many elite sprinters can run 100 m races in under 10 s.

Under normal conditions, exercise requires an increased rate of breathing. It has been observed that some of the best sprinters only take one breath at the start of the race and do not inhale again until the end of the race.

Suggest how these sprinters can release so much energy without needing to carry out aerobic respiration.

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…… **[2]**

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