Cambridge Assessment International Education

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CANDIDATE NAME									
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BIOLOGY **0610/43**

Paper 4 Theory (Extended) **May/June 2022**

1 hour 15 minutes

You must answer on the question paper.

No additional materials are needed.

INSTRUCTIONS

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.

INFORMATION

- The total mark for this paper is 80.
- The number of marks for each question or part question is shown in brackets [ ].

This document has **24** pages. Any blank pages are indicated.

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1 Penicillin is produced by biotechnology industries.

(a) (i) State the name of the type of pathogen penicillin is used to treat.

View solution

..... [1]

(ii) State the name of the group of medicinal drugs that includes penicillin.

View solution

..... [1]

(b) Fig. 1.1 is a flow diagram of some of the steps in the production of penicillin.

View solution

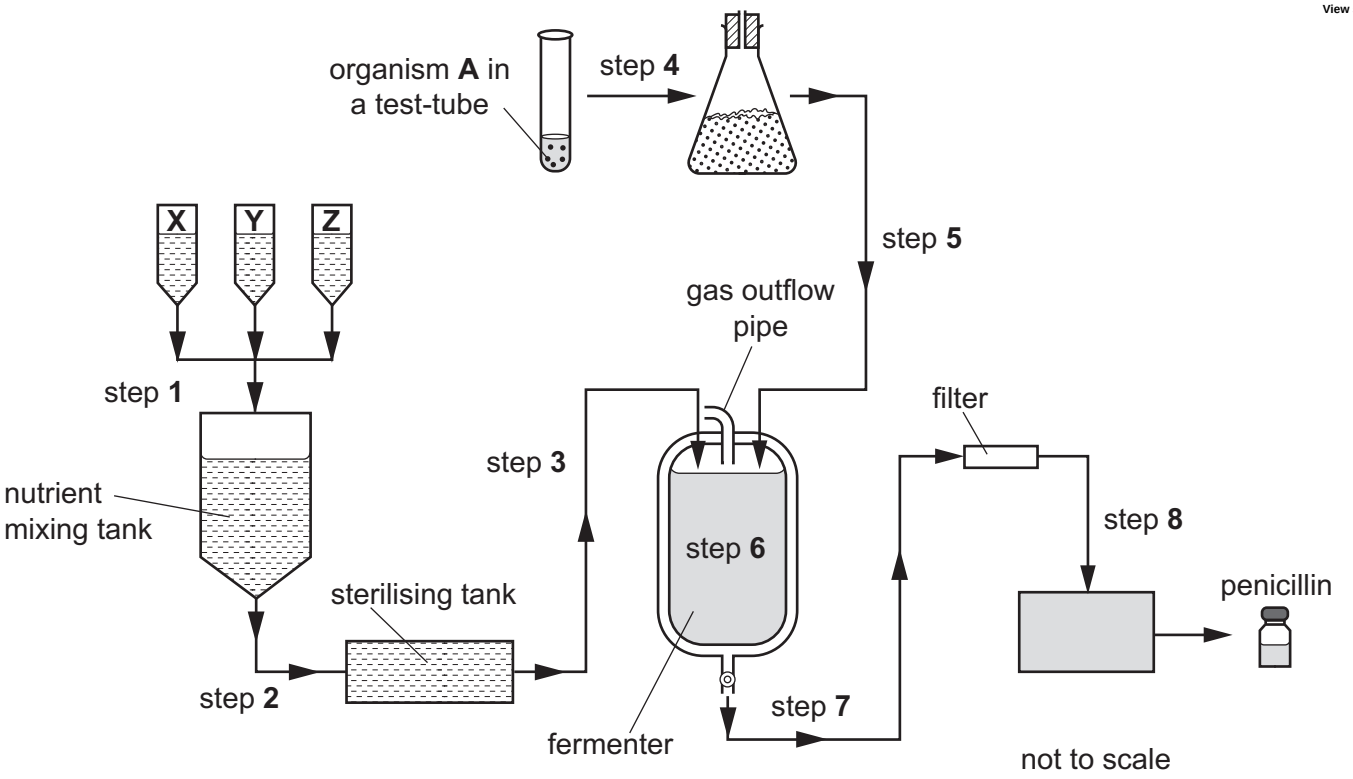

Fig. 1.1

(i) Organism **A** belongs to the fungus kingdom.

State **two** main features of fungal cells that are used to distinguish them from the cells of prokaryotes.

1 .....

2 .....

[2]

(ii) State the genus name of organism **A** in Fig. 1.1.

..... [1]

(iii) Penicillin is produced in the fermenter shown in Fig. 1.1. A variety of nutrients, **X**, **Y** and **Z**, are mixed together and added to the fermenter in step **1**.

List **two** nutrients that need to be added to a fermenter to produce penicillin.

1 .....

2 .....
[2]

(iv) Explain why the nutrients are sterilised (step **2**) before they are added to the fermenter (step **3**).

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..... [1]

(v) Explain why the fermenter has a gas outflow pipe.

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..... [2]

(vi) Using the information in Fig. 1.1, outline the events occurring from step **4** to step **8** during the production of penicillin.

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..... [4]

[Total: 14]

2 Red blood cells contain the protein haemoglobin.

(a) **(i)** State the names of the **four** chemical elements that are found in all proteins.

View solution

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..... [2]

(ii) State the role of haemoglobin.

View solution

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..... [1]

(b) Fig. 2.1 shows a photomicrograph of some red blood cells from a person with sickle cell anaemia.

Abnormal red blood cells occur because of a mutation in the gene for haemoglobin.

View solution

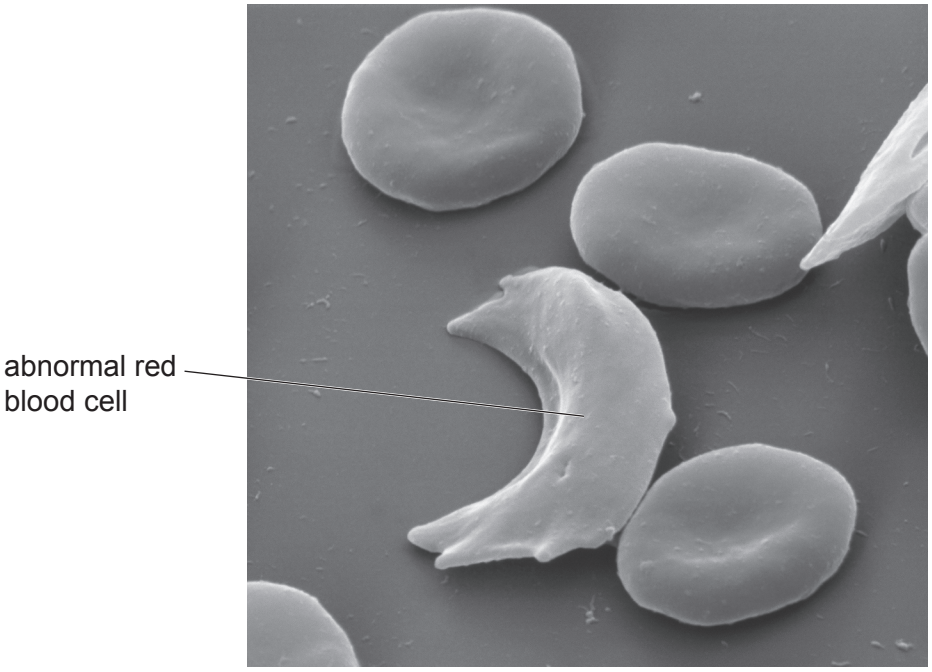

Fig. 2.1

Suggest how the shape of the abnormal red blood cell shown in Fig. 2.1 will affect blood flow.

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..... [2]

(c) The allele for the normal form of haemoglobin is $\mathbf{Hb^A}$.

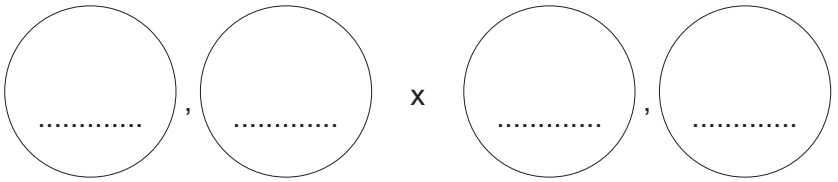
The allele for the abnormal form of haemoglobin is $\mathbf{Hb^S}$.

View solution

Draw a genetic diagram to determine the probability of two heterozygous parents having a child who does **not** have the $\mathbf{Hb^S}$ allele.

parental phenotypes ..... x .....

parental genotypes ..... x .....

gametes  ..... , ... x ..... , ...

offspring genotypes .....

probability of offspring **not** having the $\mathbf{Hb^S}$ allele .....

[5]

(d) Fig. 2.2 and Fig. 2.3 are maps showing some of the different regions in a country. Scientists studied the distribution of the **Hb^S** allele in the country.

View solution

Fig. 2.2 shows the estimated frequency of the allele within the population.

Fig. 2.3 shows the estimated number of babies born with sickle cell anaemia in each region.

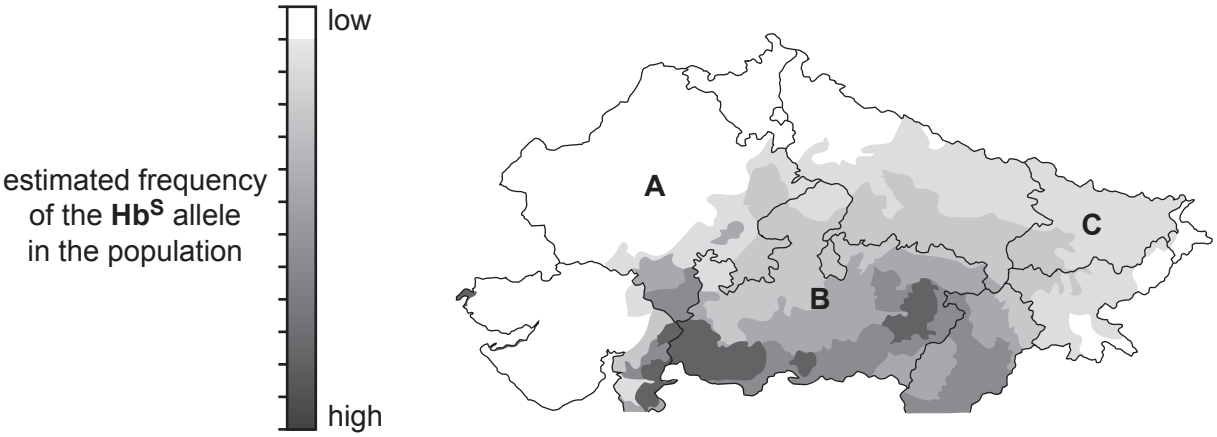


Fig. 2.2

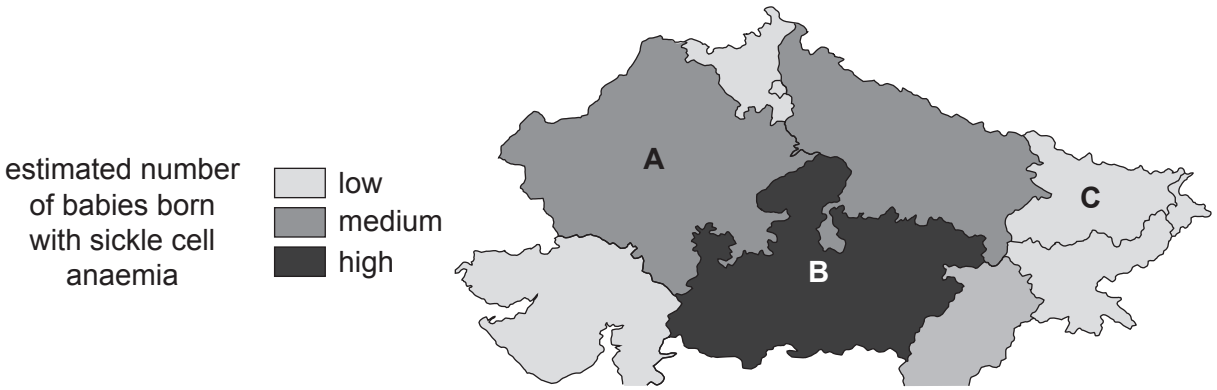


Fig. 2.3

The scientists made a statement:

'There is a relationship between the frequency of the Hb^S allele and the number of babies born with sickle cell anaemia in regions **A**, **B** and **C**.'

(i) Using the information in Fig. 2.2 and Fig. 2.3, discuss the evidence for and against this statement for regions **A**, **B** and **C only**.

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..... [5]

(ii) Suggest how the scientists would identify the presence of the Hb^S allele in tissue samples.

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..... [1]

View solution

(e) Mutations are always inherited in single-celled organisms that reproduce asexually but are **not always** inherited in organisms that reproduce sexually.

View solution

Explain why.

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..... [4]

[Total: 20]

3 Acid rain has destroyed many forests including the forest shown in Fig. 3.1.



Fig. 3.1

(a) Describe how acid rain destroys forests.

View solution

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..... [3]

(b) Explain the negative consequences to the environment of destroying forests.

View solution

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..... [4]

(c) Acid rain can also damage aquatic organisms such as the amphibian shown in Fig. 3.2.

View solution



Fig. 3.2

Suggest why amphibians are vulnerable to pollutants such as acid rain.

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..... [2]

(d) Many countries have strict laws to prevent acid rain.

View solution

Describe how countries have reduced acid rain.

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..... [3]

[Total: 12]

4 **(a)** Fig. 4.1 is a diagram of the alimentary canal.

View solution

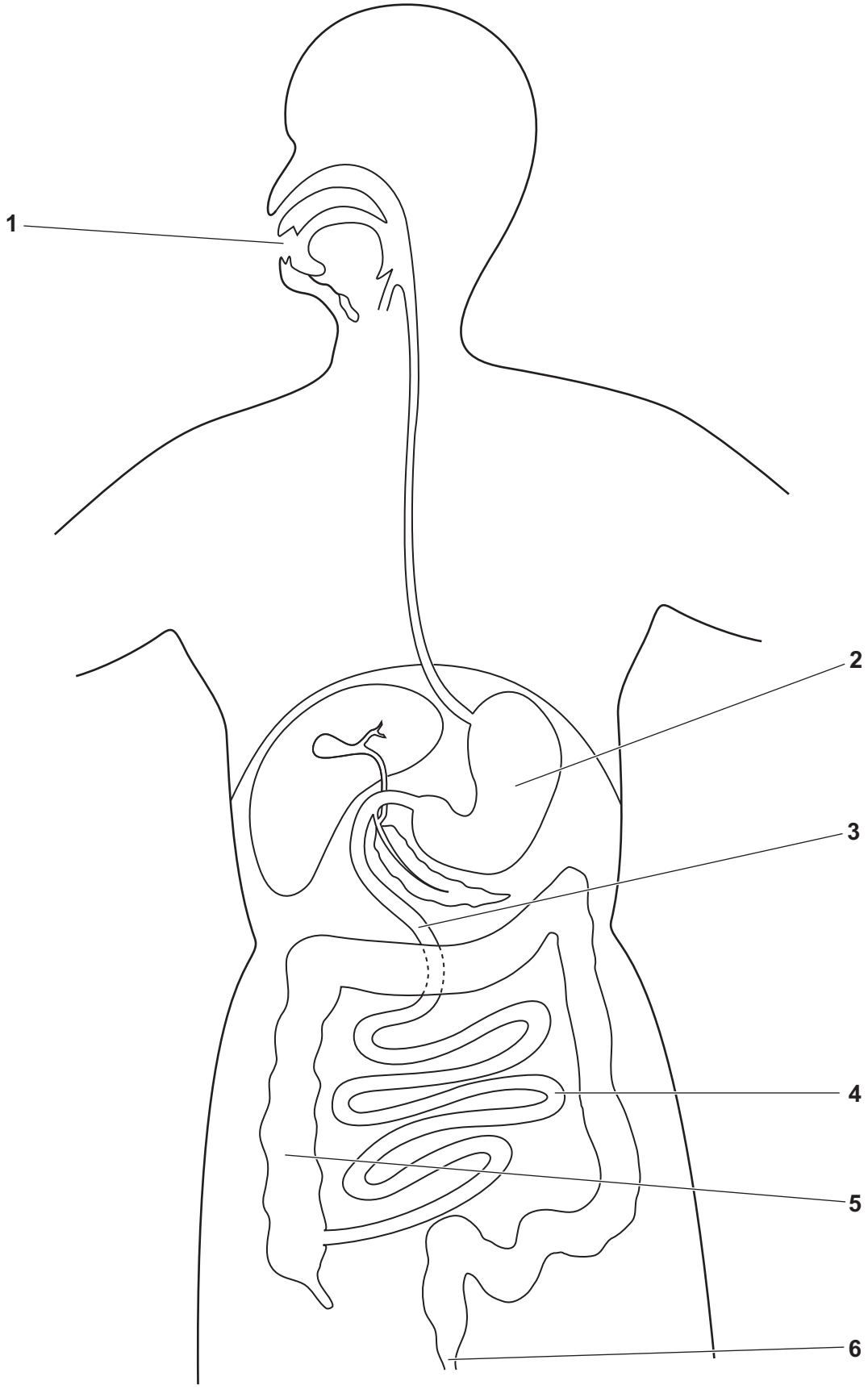

Fig. 4.1

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Complete Table 4.1 by stating:

- the names of the organs from Fig. 4.1
- the letters of **all** the processes shown in the key that occur in each organ.

Key:
A – absorption
C – chemical digestion
E – egestion
I – ingestion
M – mechanical digestion

Table 4.1

number from Fig. 4.1	name of the organ	letter or letters of all the processes that occur in the organ
1		
2		
3		
4		
5		
6		

[6]

(b) Fig. 4.2 is a diagram of a villus. The arrow indicates the direction of blood flow.

View solution

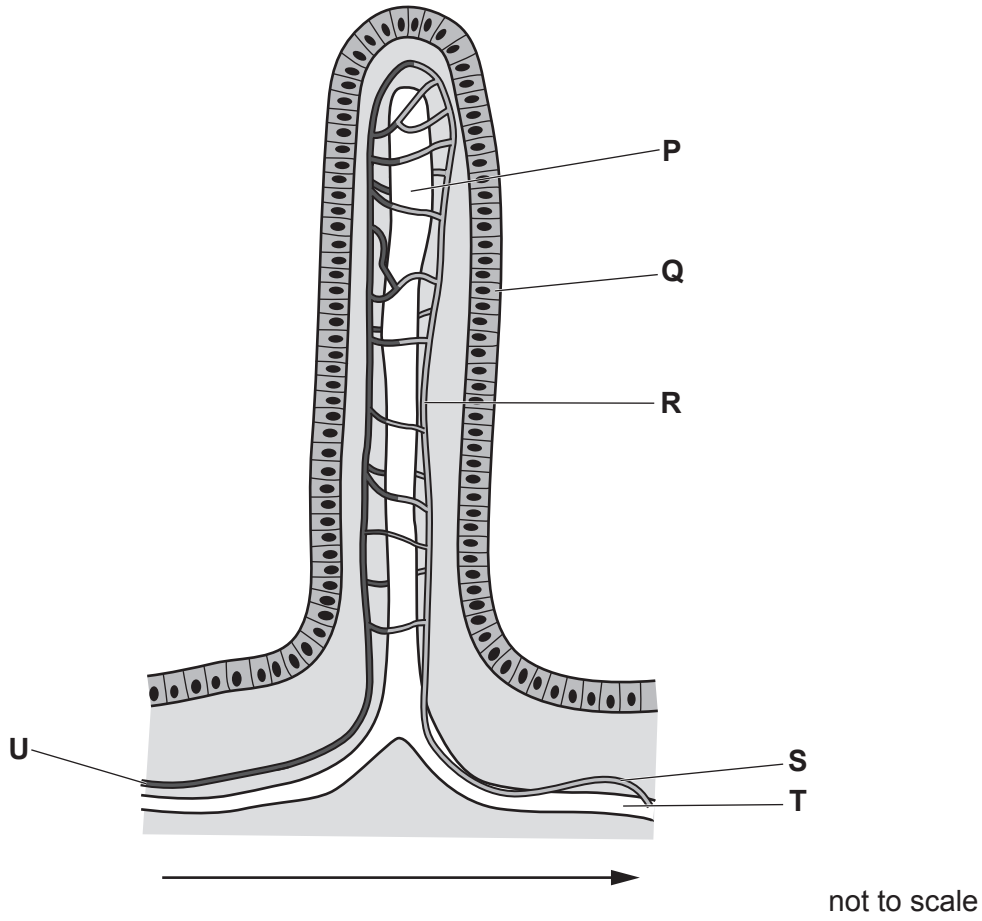

Fig. 4.2

Describe the structure of a villus **and** its role in the alimentary canal.

Use the letters in Fig. 4.2 to support your answer.

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..... [6]

[Total: 12]

5 Glasshouses are designed to maximise crop plant yield.

(a) (i) Explain why carbon dioxide enrichment is used in many glasshouses to increase crop plant yield.

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..... [3]

(ii) Suggest how the carbon dioxide concentration in a glasshouse can be enriched.

View solution

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..... [1]

(iii) Outline how carbon dioxide in a glasshouse moves into leaves.

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.....

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.....

..... [2]

(b) Additional lighting is often installed in glasshouses in countries with temperate climates.

Table 5.1 summarises some of the factors that are considered by plant growers when choosing the type of lamps to install in a glasshouse.

View solution

Table 5.1

type of lamp	electrical energy used by the lamp / J per s	light intensity output / arbitrary units	notes
sodium	1041	1767	• releases lots of heat • best when used in addition to sunlight
LED	423	378	• releases very little heat • can be used as an alternative to sunlight
metal halide	651	817	• releases some heat • can be used as an alternative to sunlight
fluorescent	394	374	• releases some heat • best when used in addition to sunlight

(i) Calculate the percentage increase in the energy used by the metal halide lamp compared to the energy used by the fluorescent lamp.

Give your answer to **two** significant figures.

Space for working.

..... %
[2]

(ii) State which type of lamp has the highest light intensity output per unit of electrical energy used.

..... [1]

View solution

(iii) Some types of lamp release a lot of heat.

View solution

Explain the possible effects of excessive heat on the plants in a glasshouse.

.....

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..... [3]

[Total: 12]

6 **(a)** Fig. 6.1 shows a photograph of fruit attached to the branch of an orange tree, *Citrus sinensis*.

View solution



Fig. 6.1

State **one** reason why orange trees are classified as dicotyledonous plants.

.....

.....

..... [1]

(b) Biotechnologists use enzymes to extract juice from fruit such as oranges.

View solution

Define the term enzyme.

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..... [2]

(c) Fig. 6.2 shows the results of leaving pieces of orange fruit in an enzyme solution for different lengths of time.

View solution

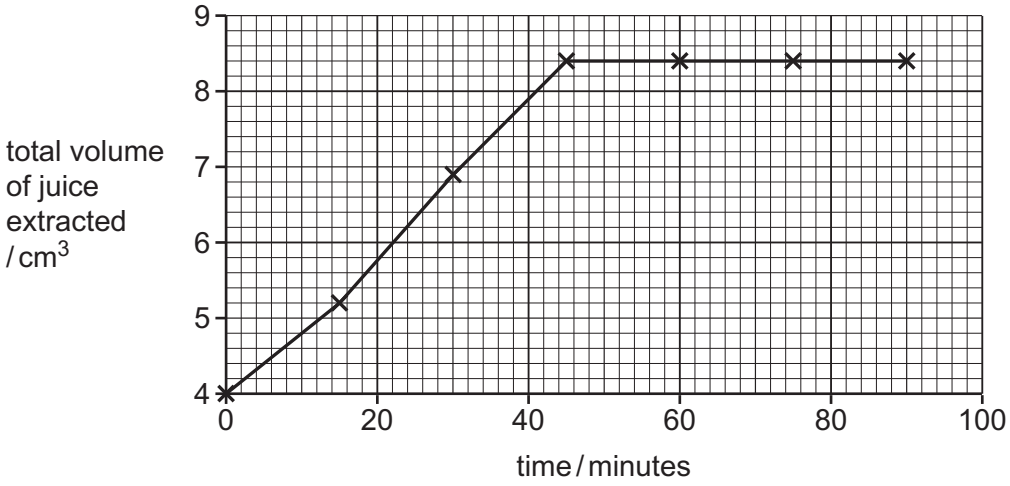

Fig. 6.2

(i) State the name of the enzyme used to extract juice from fruit.

..... [1]

(ii) Using the information in Fig. 6.2, state the optimum length of time for efficient extraction of juice from oranges.

..... [1]

(iii) State the name of the vitamin found in high concentrations in citrus fruit such as oranges.

..... [1]

(d) The genes in some plants have been changed to increase the concentration of vitamins that these plants produce.

View solution

(i) State the name of the process of changing the genes of a plant.

..... [1]

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(ii) Discuss the possible disadvantages of people changing the genes in a plant.

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..... [3]

[Total: 10]

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