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BIOLOGY

0610/42

Paper 4 Theory (Extended)

May/June 2019

1 hour 15 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your centre number, candidate number and name on all the work you hand in.

Write in dark blue or black pen.

You may use an HB pencil for any diagrams or graphs.

Do not use staples, paper clips, glue or correction fluid.

DO NOT WRITE IN ANY BARCODES.

Answer **all** questions.

Electronic calculators may be used.

You may lose marks if you do not show your working or if you do not use appropriate units.

At the end of the examination, fasten all your work securely together.

The number of marks is given in brackets [] at the end of each question or part question.



This syllabus is regulated for use in England, Wales and Northern Ireland as a Cambridge International Level 1/Level 2 Certificate.

This document consists of **18** printed pages and **2** blank pages.

1 Biotechnology is used in the process of bread-making.

Fig. 1.1 shows some of the steps in making bread.

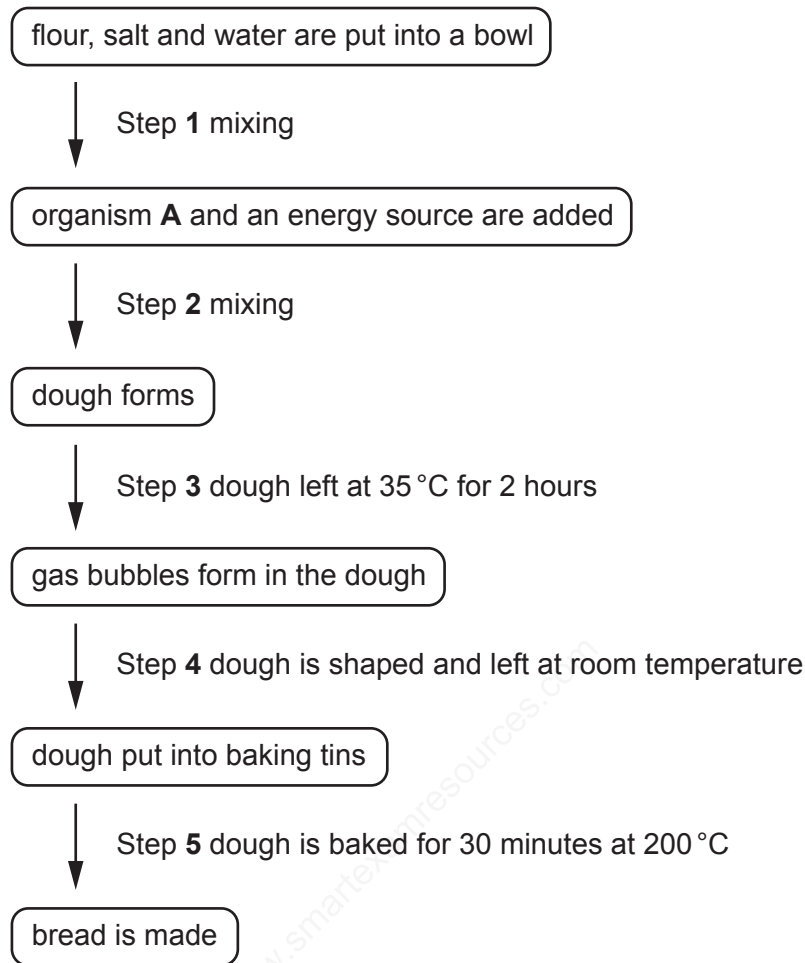


Fig. 1.1

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

Yeast

[1]

(b) (i) State the name of the source of energy used by organism **A**.

Flour

[1]

(ii) State the name of the process that occurs at step **3** that causes gas bubbles to form in the dough.

Respiration

[1]

(iii) State the name of the gas that forms to create the gas bubbles in the dough.

Carbon dioxide

[1]

- (c) Explain the reasons for the different temperatures used in step 3 and step 5.

step 3

- 35 °C - A lower temperature: provides an optimum temperature for to allow the dough to rise

step 5

- 200 °C - At higher temperature the organism's enzymes get denatured. It allows to cook the dough and at the same time allows the ethanol to evaporate
- [2]

- (d) State the name of **two** products of biotechnology, other than bread, that make use of microorganisms.

1 Biofuels

2 Wine

[2]

[Total: 8]

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2 The concentration of atmospheric carbon dioxide has increased considerably in recent years.

(a) Describe the possible causes of increased atmospheric carbon dioxide.

The following are the possible causes of increased atmospheric carbon dioxide:

- burning of fuels
- deforestation
- increased human population
-

..... [3]

(b) Soybean plants, *Glycine max*, were grown in two separate plots.

Each plot used a carbon dioxide enrichment system to control the atmospheric carbon dioxide concentration.

The atmospheric carbon dioxide concentrations in the two plots were kept at:

- 370 ppm, which is similar to the current atmospheric carbon dioxide concentration
- 550 ppm, which is a possible future atmospheric carbon dioxide concentration.

When the soybean plants were fully grown, scientists calculated the average rates of photosynthesis at regular intervals from 04:00 to 22:00 for both plots.

The results are shown in Fig. 2.1.

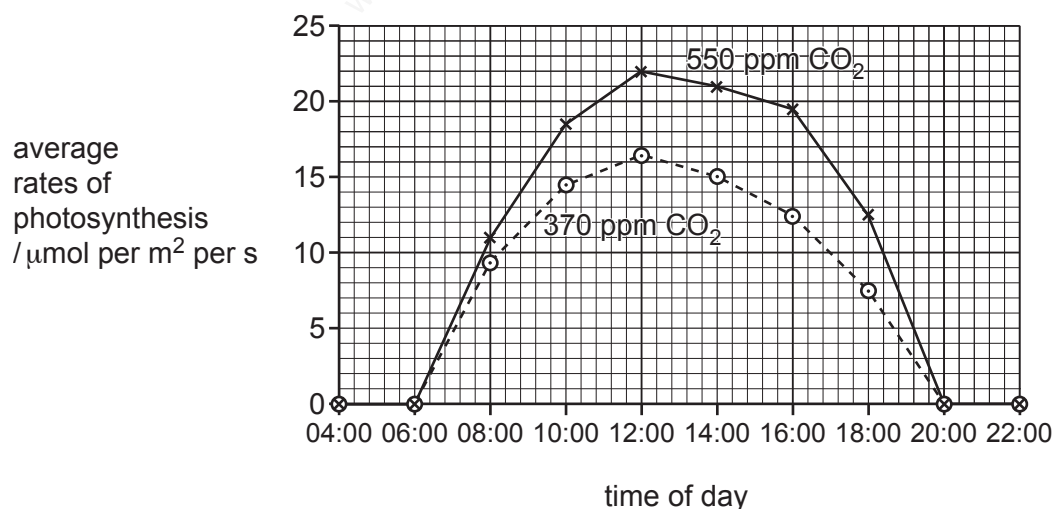


Fig. 2.1

Describe **and** explain the effect of carbon dioxide concentration on the average rates of photosynthesis of the soybean plants from 04:00 to 22:00.

Use the data from Fig. 2.1 in your answer.

- The rate of photosynthesis peaks at, 12:00
- Photosynthesis starts at, 06:00 and stops at, 20:00
- The rate of photosynthesis at 550 (ppm) is greater than at 370 (ppm)
- Both plots follow the same trend
- There is maximum light at 12:00 until 6:00 . The light intensity as a limiting factor because light is required for photosynthesis
- The CO_2 as a limiting factor .At high atmospheric CO_2 , the concentration gradient to air is steeper, hence diffusion is faster. The effect of CO_2 concentration is most at high light intensities
- The temperature is also a limiting factor . A higher temperature causes an increased rate of photosynthesis.

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..... [6]

(c) The scientists also made observations of the leaf structure of the soybean plants.

Epidermis and mesophyll tissues are adapted for photosynthesis.

Complete Table 2.1 by stating **two** structural features of each of these tissues **and** explain how each feature is an adaptation for photosynthesis.

Table 2.1

tissue	feature	how the feature is an adaptation for photosynthesis
epidermis	1 Transparent	Allows light to pass through
	2 Thin	So that more light can pass through
mesophyll	1 has many chloroplasts	To trap light energy
	2 has air spaces	for movement of gases within leaf

[4]

(d) When the scientists were working in the plot with a carbon dioxide concentration of 550 ppm, their breathing rates were higher than when they worked in the other plot.

Suggest why their breathing rates were higher.

More carbon dioxide in the blood results in a low blood-pH. This high carbon dioxide is detected by the brain. This increases the impulses to the muscles used in breathing that perform processes to lower the blood pH. This is called as homeostasis, that tries to maintain a carbon dioxide level of the blood to normal.

.....
..... [2]

[Total: 15]

- 3 Very small pieces of plastic, called microplastics, are found in many products such as soaps and toothpaste.

Fig. 3.1 shows toothpaste that contains microplastics.



Fig. 3.1

- (a) (i) It is estimated that microplastics make up 5% of the mass of some toothpastes.

Each person uses approximately 2 g of toothpaste a day.

There were estimated to be 1.2×10^9 people using toothpaste that contained microplastics in some countries in 2013.

Calculate the mass of microplastics contained in the toothpaste used on one day in 2013 for these countries.

Show your working and state appropriate units with your answer.

Amount of micro plastic present in 2g of toothpaste $(2 \times 0.05) = 0.1\text{g}$
 In one day , the total mass of micro-plastic consumed by 1.2×10^9
 people $= 0.1 \times 1.2 \times 10^9 = 1.2 \times 10^8\text{g}$

$$1.2 \times 10^8 \text{ g}$$

.....
[3]

- (ii) State **one** recommendation, other than regular brushing, for the proper care of teeth.

Avoid too much sugar in the diet

..... [1]

(b) Lugworms live in sand on coastal beaches and are eaten by wading birds. Lugworms feed on diatoms. Diatoms are photosynthetic protists that require ammonium ions as a source of nitrogen. Beach sand contains ammonium ions.

(i) Construct a food chain for these marine organisms.

diatom → lugworm → wading bird ;

[2]

(ii) There is some evidence that microplastics affect ammonium ions. Affected ammonium ions cannot be used by diatoms. A group of researchers thought that this could affect lugworms living in sand polluted by microplastics.

The researchers collected 30 healthy lugworms, all with the same initial mass.

They divided them into three groups, **A**, **B** and **C**. Each group contained 10 lugworms.

Each group of lugworms was placed in a bucket containing the same mass of beach sand and ammonium ions and:

- A** biodegradable microplastics
- B** non-biodegradable microplastics
- C** no microplastics.

The measurements that were recorded at the **end** of the investigation are shown in Table 3.1.

Table 3.1

variable measured	group		
	A	B	C
ammonium ion concentration in the bucket/ $\mu\text{mol per dm}^3$	19.3	47.0	27.4
average respiration rate of lugworms /mg oxygen per hour per g mass	5.2	9.6	5.1
volume of lugworm faeces / cm^3	60.0	25.0	40.0
average lugworm mass/g	9.1	7.0	9.1

Describe **and** explain why the researchers concluded that non-biodegradable microplastics are the most harmful to lugworms.

Use the information in Table 3.1 in your answer.

Less ammonium ions are absorbed as they cannot be consumed by diatoms. This results in the slower growth of lugworms. Hence there are less diatoms available for lugworms. This results in a higher respiration rates of lugworms as they need to release more energy for finding food. As less food is available for lugworms, they show less growth. The digestion of lugworms is also affected.

.....
.....
.....
.....
..... [4]

(c) Ammonium ions are an important part of the nitrogen cycle. They can be converted into nitrate ions, which are used by plants and protists such as diatoms.

(i) State the name of the molecules that are converted into ammonium ions in the nitrogen cycle.

Protein
..... [1]

(ii) State the name of the process of converting ammonium ions into nitrate ions.

Nitrification
..... [1]

(iii) Explain the effects of nitrate ion deficiency on plant growth.

The plants absorb nitrogen as nitrate ions, as they are needed to make amino acids, to make DNA. As protein is needed for growth and cell repair, their deficiency hinders these processes.

.....
.....
.....
..... [3]

(d) Non-biodegradable plastics are also harmful to terrestrial ecosystems.

Discuss the effects of non-biodegradable plastics on terrestrial ecosystems.

- The following are the effects of non-bio degradable plastics on terrestrial ecosystems:
They cause visual pollution
- They block the digestive systems of animals
- The toxins accumulate in the organism or are passed down a food chain
- They cause habitat destruction e.g. plastic covers the habitats
- Plastic blocks light / water for photosynthesis for the land plants.
- Plastic block the roots and prevent root-growth
- Plastic remains in the ecosystem for a very long time

..... [5]

[Total: 20]

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4 Neurones are part of the nervous system. Neurones are connected to each other by synapses.

(a) (i) Describe how the structure of a neurone is related to its function.

The following is the structure of the neurons related to their function:

- They are long, to transmit impulse over long distance
- They have mitochondria to release energy for transmission of impulse
- They have vesicles to, carry neurotransmitters into synapse
- Neurotransmitters are released, to allow connection to other neurones or across a synapse ;
- They have receptors to allow unidirectional transmission

..... [3]

(ii) The nervous system is made up of the central nervous system and the peripheral nervous system.

State the names of the organs that make up the central nervous system.

brain and spinal cord

..... [1]

(b) Reflex actions allow the body to respond rapidly to changes in the external environment.

(i) Outline the pathway in a reflex arc in response to shining a bright light into the eye.

The stimulus (light) is detected by the retina . The (electrical) impulse travel in the order mentioned below

sensory neurone → relay neurone → motor neurone ;

In doing so, they cross the synapses between neurones. The effector

(circular) muscles in the iris contract in response to the stimulus received.

.....
.....
..... [3]

(ii) Doctors sometimes check the reflexes of people who are unconscious.

Suggest why reflexes occur in people who are unconscious.

Because the involuntary neurons still function

..... [1]

(c) Fig. 4.1 is a diagram of a synapse and parts of two neurones.

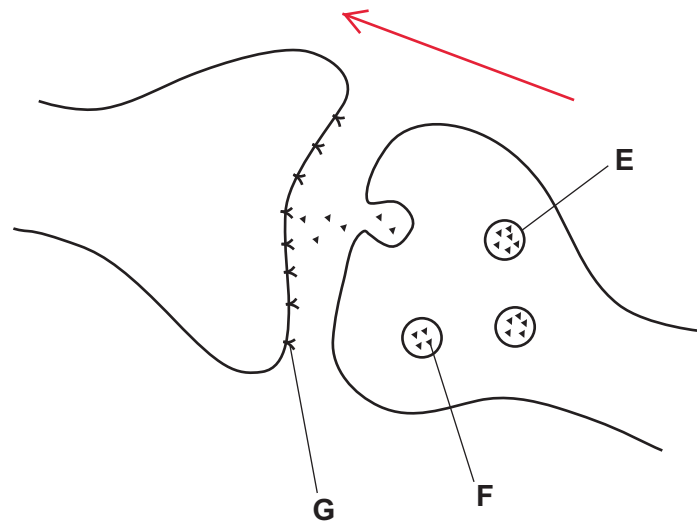


Fig. 4.1

(i) State the names of the labelled parts in Fig. 4.1.

E vesicle ;

F neurotransmitter ;

G neurotransmitter-receptor molecule

[3]

(ii) Draw an arrow on Fig. 4.1 to show the direction in which the signal travels across the synapse. [1]

[Total: 12]

5 (a) The testes are part of the endocrine system because they produce hormones.

(i) State the name of the hormone released from the testes.

testosterone
 [1]

(ii) The testes are also part of the reproductive system. This means that the testes are part of two organ systems.

Complete Fig. 5.1 by stating **two** other organs that also belong to **two** organ systems.

One has been completed for you.

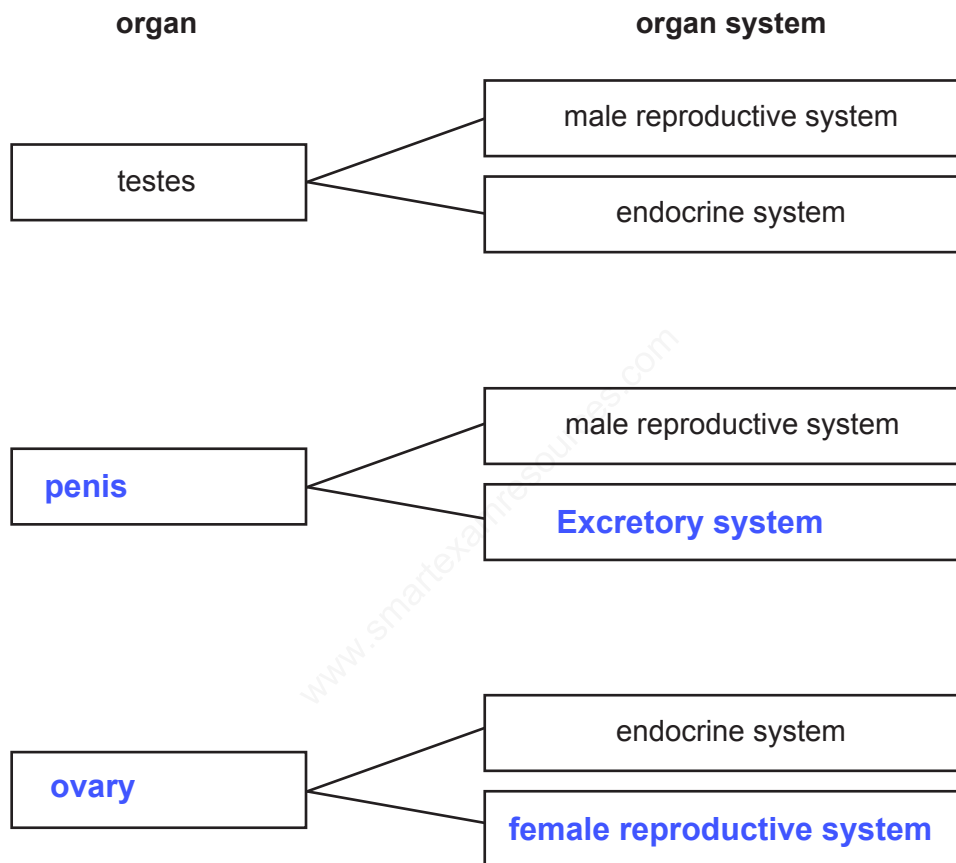


Fig. 5.1

[4]

Fig. 5.2 is a photomicrograph of part of a mammalian testis.

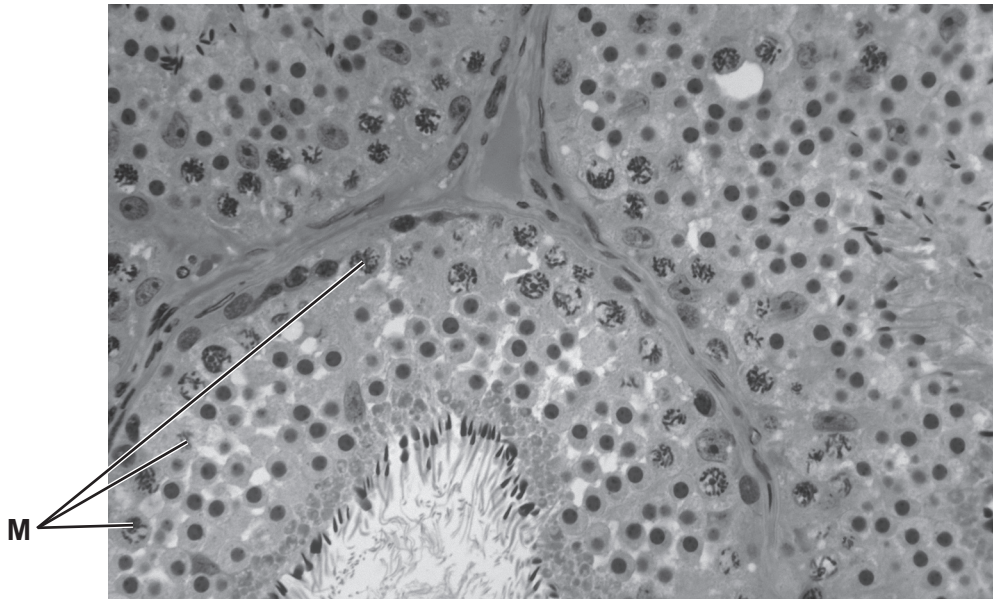


Fig. 5.2

(b) The cells labelled **M** in Fig. 5.2 are undergoing meiosis.

Explain why meiosis is necessary in the testes.

Mitosis is necessary in testes to produce gametes for sexual reproduction ;. It is to produce haploid cells ,so that when fertilisation occurs the number of chromosomes return to the, same (diploid)number . This creates genetic variation.

..... [3]

(c) Fig. 5.3 is a photomicrograph of a section through a sperm.



Fig. 5.3

Table 5.1 shows information about the sperm shown in Fig. 5.3.

Complete Table 5.1.

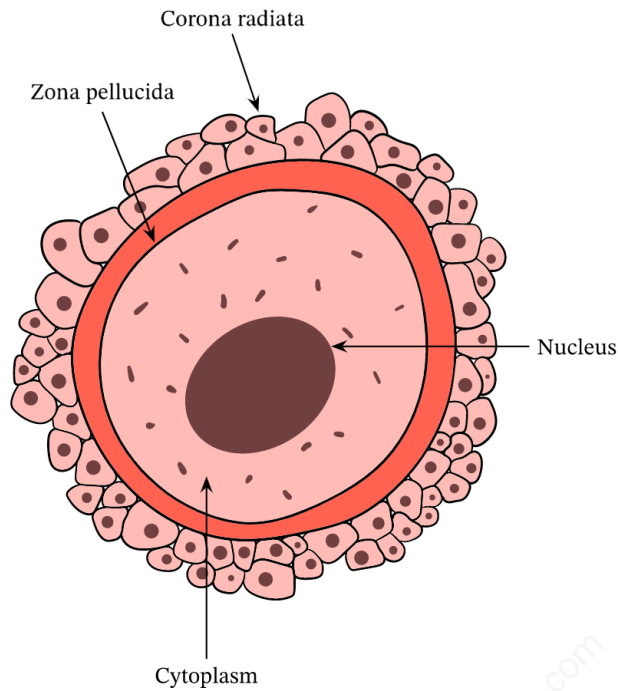
Table 5.1

letter on Fig. 5.3	name of the structure	function
P	acrosome	contain enzymes to digest jelly coat
Q	haploid nucleus	Contains half number chromosomes
R	mitochondrion	releases energy
S	flagellum	swimming

[4]

(d) Draw and label **one** human egg cell.

Include at least one labelled feature that is not found in a sperm cell.



[3]

(e) Describe what happens to a fertilised egg cell before implantation in the uterus.

The jelly coat of the fertilized egg hardens. This fertilised egg is called as a zygote .The zygote changes to an embryo through mitosis and moves down the oviduct

..... [3]

[Total: 18]

- 6 Fig. 6.1 shows some of the many different varieties of potato, *Solanum tuberosum*, that are cultivated across the world for food.



Fig. 6.1

All varieties of *S. tuberosum* are classified as the same species.

- (a) Define the term *species*.

Species is a group of organisms that can reproduce to produce fertile offspring.

.....
..... [2]

(b) Fig. 6.2 shows a method of reproduction that some potato farmers use to produce more potato plants.

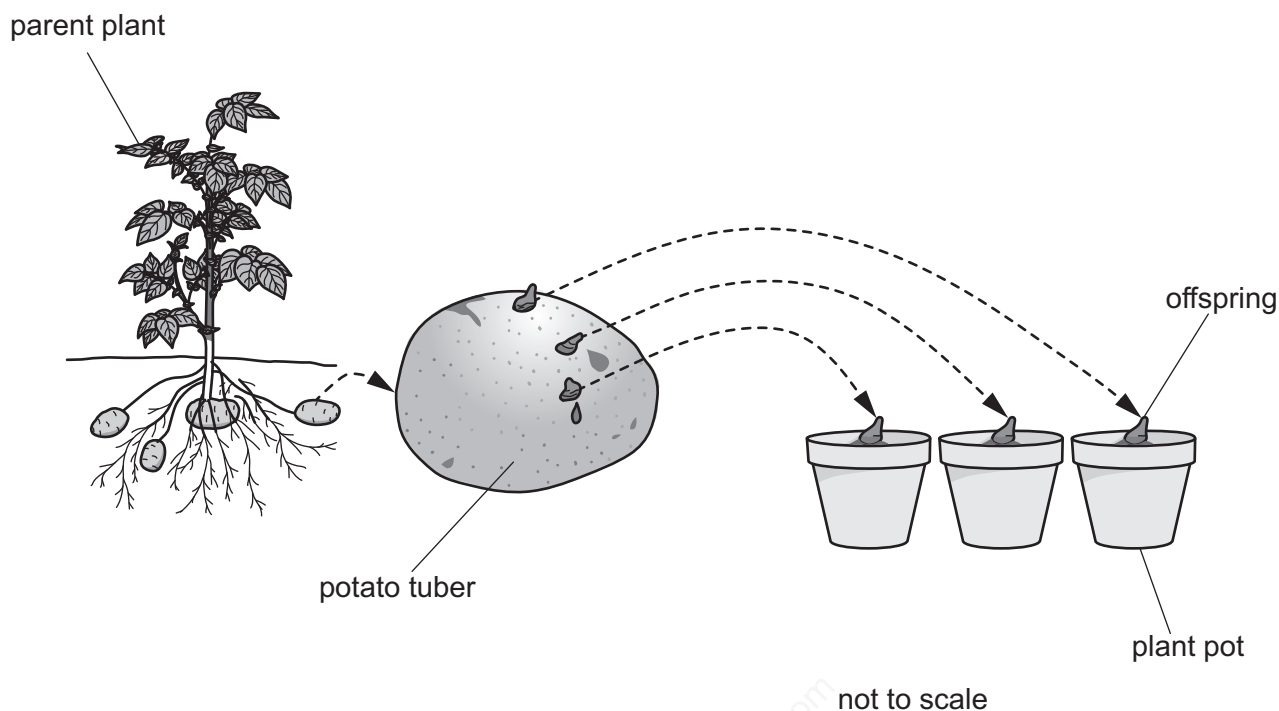


Fig. 6.2

Describe the advantages of the type of reproduction shown in Fig. 6.2 in crop production.

The following are the advantages of the reproduction shown above:

- The off springs are genetically
- The method produces quick offspring
- Reproduction is possible even if variety is sterile
- No pollinators are required

..... [3]

(c) Potato tubers store starch.

Explain why plants store starch.

Plants store starch as an energy (as a source or as a sink).
 Plants also use starch as a reserve of energy when they cannot photosynthesise or when they are in a state of dormancy or when they no leaves or when they are in the dark.

..... [2]

[Total: 7]

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