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H

Tuesday 14 May 2019 – Afternoon

GCSE (9–1) Biology A (Gateway Science)

J247/03 Paper 3 (Higher Tier)

Time allowed: 1 hour 45 minutes

You must have:
- a ruler (cm/mm)

You may use:
- a scientific or graphical calculator
- an HB pencil

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 may use an HB pencil for graphs and diagrams.
- Answer **all** the questions.
- Where appropriate, your answers should be supported with working. Marks may be given for a correct method even if the answer is incorrect.
- Write your answer to each question in the space provided. If additional space is required, use the lined page(s) at the end of this booklet. The question number(s) must be clearly shown.

INFORMATION
- The total mark for this paper is **90**.
- The marks for each question are shown in brackets **[ ]**.
- Quality of extended response will be assessed in questions marked with an asterisk (*).
- This document consists of **32** pages.

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SECTION A

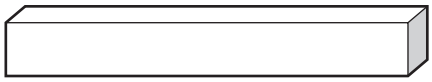
Answer **all** the questions.

You should spend a maximum of 30 minutes on this section.

Write your answer to each question in the box provided.

1 An experiment is carried out to find the concentration of potato tissue.

Four chips are cut from a potato.



At the start, each chip is 50 mm long, 10 mm wide and 10 mm high.

Each chip is put in a different sucrose solution **A**, **B**, **C** and **D**.

The volumes of the chips are calculated after 1 hour.

Sucrose solution	Volume of chip (mm^3)
A	50
B	500
C	5000
D	50 000

Which sucrose solution has the same concentration as the potato tissue?

Your answer ☐ **[1]**

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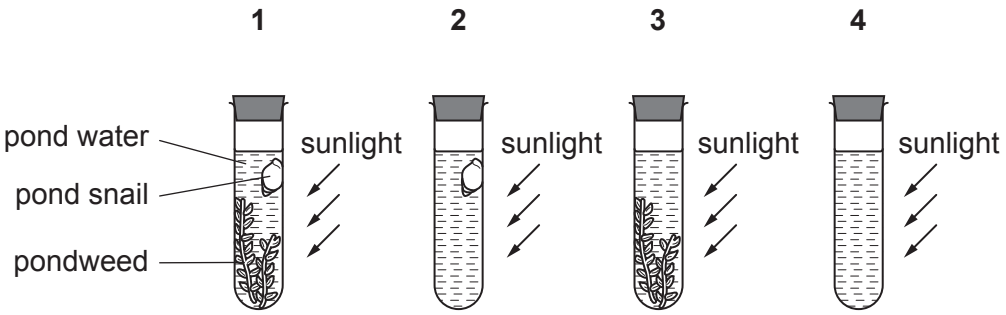
2 Pond snails and pondweed are living in water in sealed test tubes.



Carbon dioxide dissolves in water and forms an acid.

In which test tube would the water become most acidic?

A 1

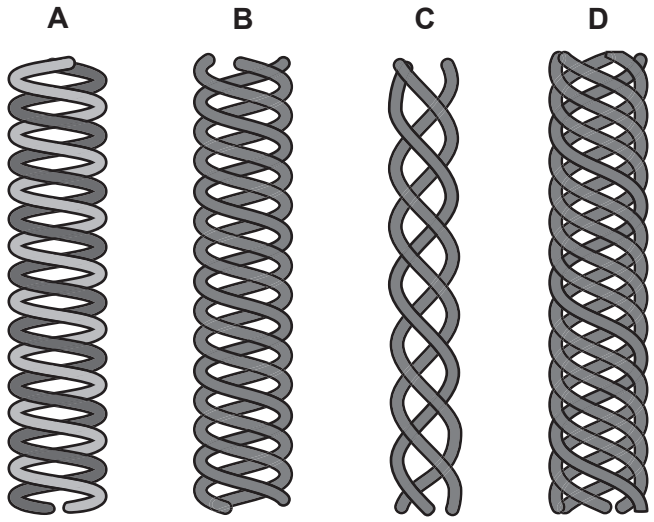
B 2

C 3

D 4

Your answer ☐ **[1]**

3 Which structure most closely resembles DNA?



Your answer ☐ **[1]**

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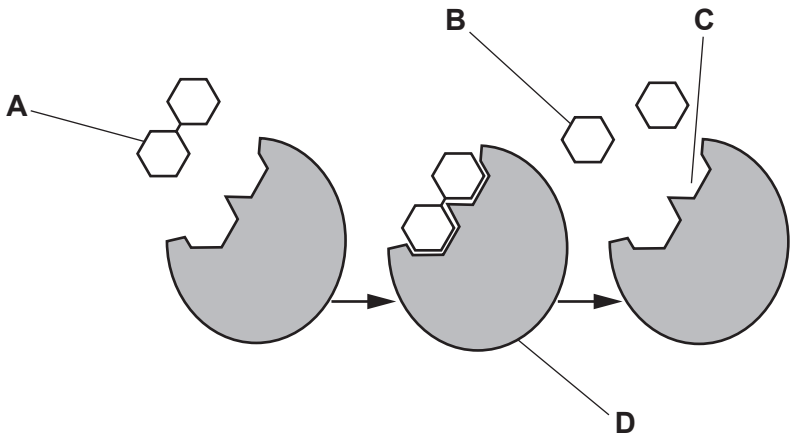
4 Look at the model of enzyme activity.



Which label represents the active site of an enzyme?

Your answer ☐ **[1]**

5 Which biological molecule is **not** a polymer?

A Amylase

B DNA

C Nucleotide

D Starch

Your answer ☐ **[1]**

6 Which condition can be caused by a lens in the eye that is too thick?

A Long-sightedness

B Colour blindness

C Diabetes

D Short-sightedness

Your answer ☐ **[1]**

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7 The eye switches from focusing on a distant television to focusing on a close up newspaper.

Which change happens to the suspensory ligaments and to the lens during this switch?

	Suspensory ligaments	**Lens**
A	slack to tight	thicker
B	slack to tight	thinner
C	tight to slack	thicker
D	tight to slack	thinner

Your answer ☐ **[1]**

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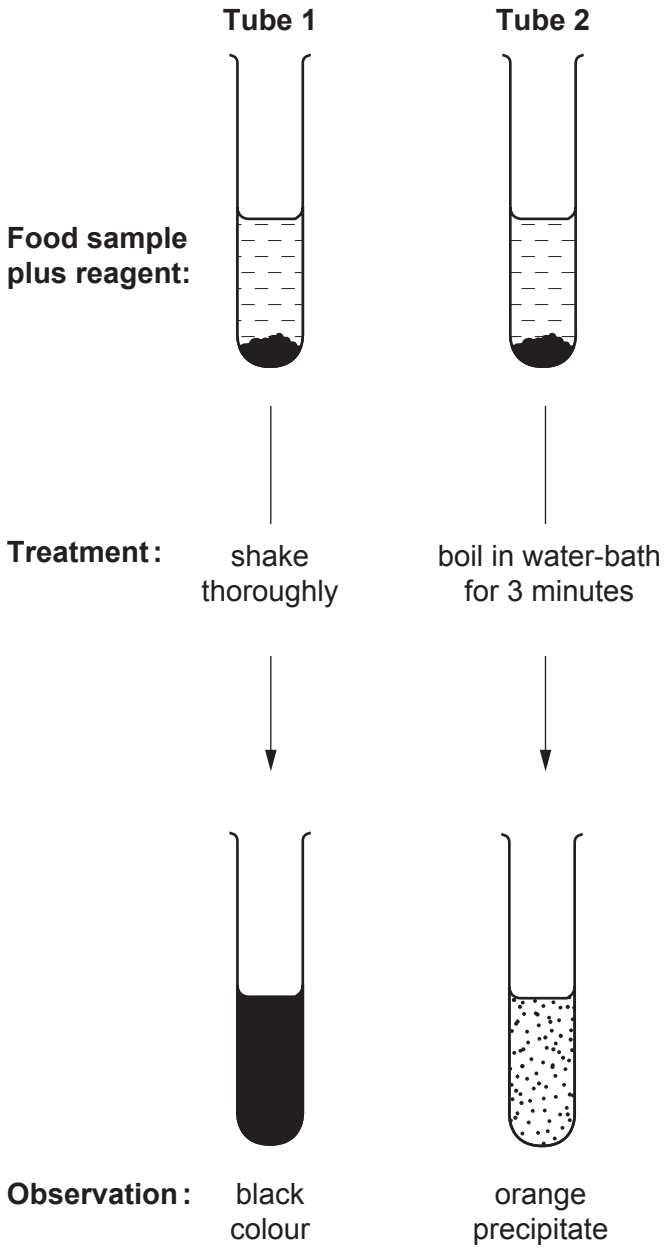
8 The diagram shows positive results in two different food tests.



What do the results show in each tube?

	Tube 1	Tube 2
A	sugar	lipid
B	starch	sugar
C	protein	sugar
D	starch	protein

Your answer ☐ **[1]**

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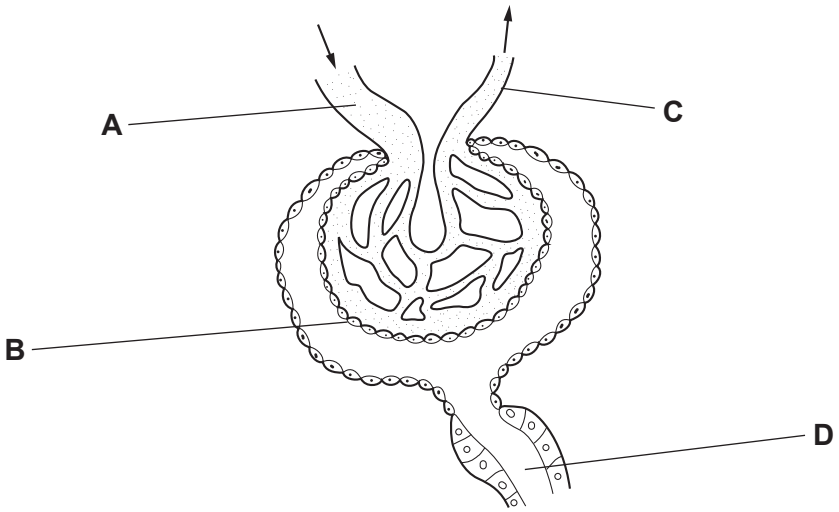
9 The diagram shows part of a kidney tubule (nephron).



Which structure is the proximal convoluted tubule?

Your answer ☐ **[1]**

10 Aerobic respiration occurs all the time in plant cells but photosynthesis only occurs in daylight.

Why is more energy released by a plant cell during the night?

A Photosynthesis is endothermic taking in energy and aerobic respiration is exothermic.

B Photosynthesis is exothermic taking in energy and aerobic respiration is endothermic.

C Aerobic respiration is exothermic taking in energy and photosynthesis is endothermic.

D Aerobic respiration is endothermic taking in energy and photosynthesis is exothermic.

Your answer ☐ **[1]**

11 A cell structure measures 1 micrometre in diameter.

What is the diameter of the cell structure in metres?

A 1×10^{-3} metres

B 1×10^{-6} metres

C 1×10^{-9} metres

D 1×10^{-12} metres

Your answer ☐ **[1]**

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12 A human cell has 10 000 mitochondria and a yeast cell has 10.

By how many orders of magnitude are there more mitochondria in a human cell than in a yeast cell?

A 2

B 3

C 10

D 1000

Your answer ☐ **[1]**

13 Urine produced after vigorous exercise is often much darker in colour than urine produced when at rest.

Which reason explains why urine becomes darker in colour?

A Increased sweating and decreased urea production.

B Decreased ADH production and increased urea production.

C Increased sweating and increased ADH production.

D Increased ADH production and decreased urea production.

Your answer ☐ **[1]**

14 Why are plant hormones used to cause parthenocarpic fruit development?

A To delay dormancy

B To selectively kill weeds

C To produce seedless fruit

D To shed leaves

Your answer ☐ **[1]**

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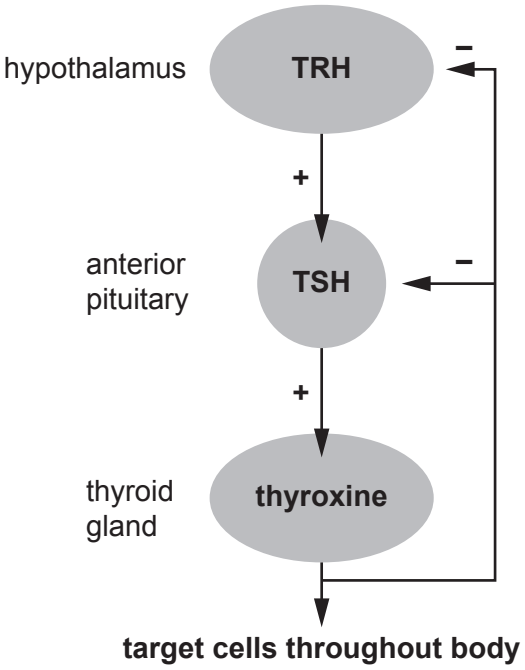
15 Thyroxine is a hormone controlled by negative feedback.



There is an **increase** in the metabolic rate of the body until the cells of the body have the required amount of energy.

Once the cells of the body have the required amount of energy what will happen to the levels of the three hormones in the blood?

A all three will increase

B all three will decrease

C TRH and TSH will increase and thyroxine will decrease

D TRH and TSH will decrease and thyroxine will increase

Your answer ☐ **[1]**

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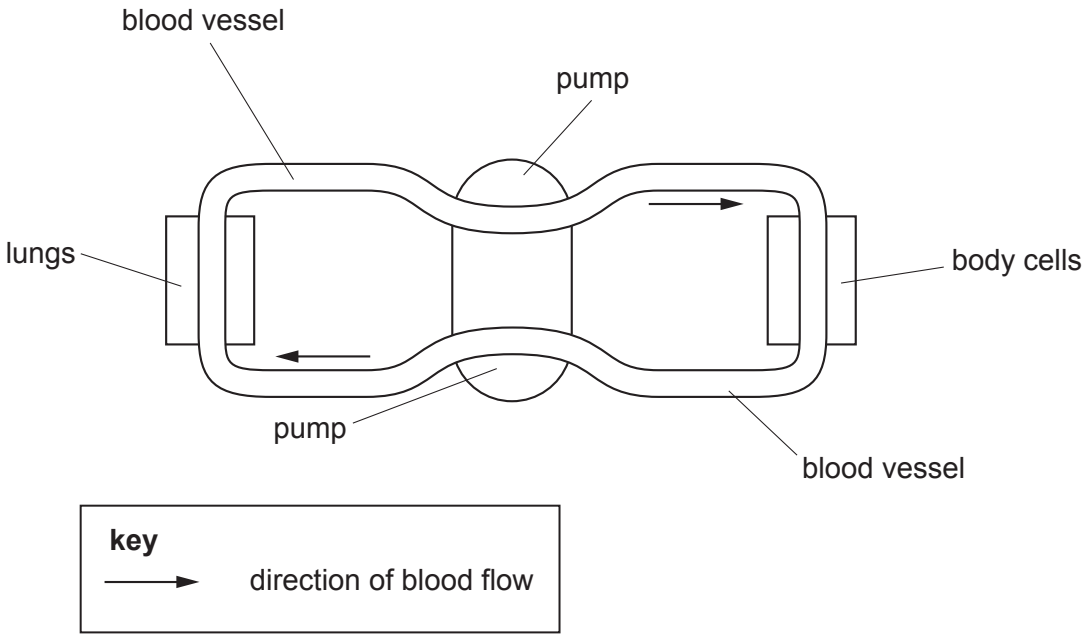
SECTION B

Answer **all** the questions.

16 Look at the diagram. It represents the human circulatory system.



(a) Describe how the diagram shows that humans have a double circulatory system.

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

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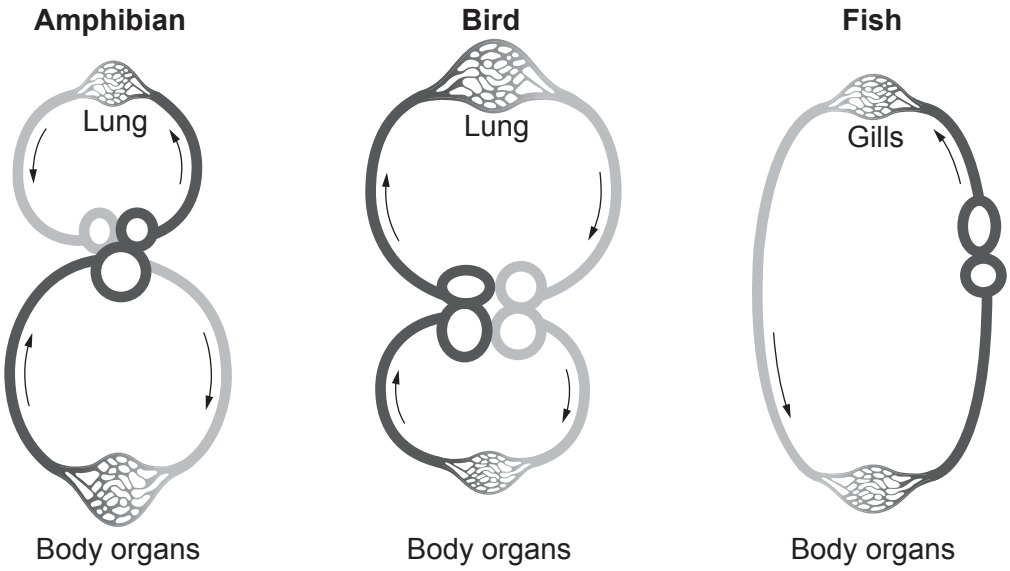
(b) Look at the diagrams of the circulation systems in an amphibian, bird and fish.



Which of these has a circulatory system most similar to humans?

Tick (✓) **one** box.

Amphibian ☐

Bird ☐

Fish ☐

Explain your choice.

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

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(c) Scientists investigate how exercise affects blood flow to different organs in the body.

This is their method.

- Ask a healthy person to sit in a room at 20 °C
- Measure the blood flow to different organs in the person's body
- Repeat this with the person exercising at a constant speed on a treadmill in the same room.

The table shows the scientists' results.

Organ	**Rate of blood flow (ml per minute)**	
	Sitting	**Doing exercise**
Brain	750	750
Heart muscle	250	1000
Muscles	1200	22 000
Skin	500	600
Other organs	3100	650
Total	**5800**	**25 000**

(i) By how many times has the **total** blood flow increased by doing exercise?

Give your answer to the **nearest whole number**.

Number of times the total blood flow has increased = ... **[2]**

(ii) The table shows that blood flow to other organs has decreased by nearly 5 times when a person is **doing exercise**.

The blood flow to the muscles has increased by more than eighteen times.

Explain these changes to blood flow rate.

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

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17 Yeast cells can respire anaerobically.

(a) Complete the word equation for **anaerobic** respiration in yeast.

glucose ⟶ ..... + ... **[1]**

(b) Write down **two** ways in which anaerobic respiration in yeast cells is different from anaerobic respiration in human muscle cells.

1 .....

.....

2 .....

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

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(c) Date fruits contain three different sugars, fructose, glucose and sucrose.

Different strains of yeast can ferment different sugars to produce a fermented product.

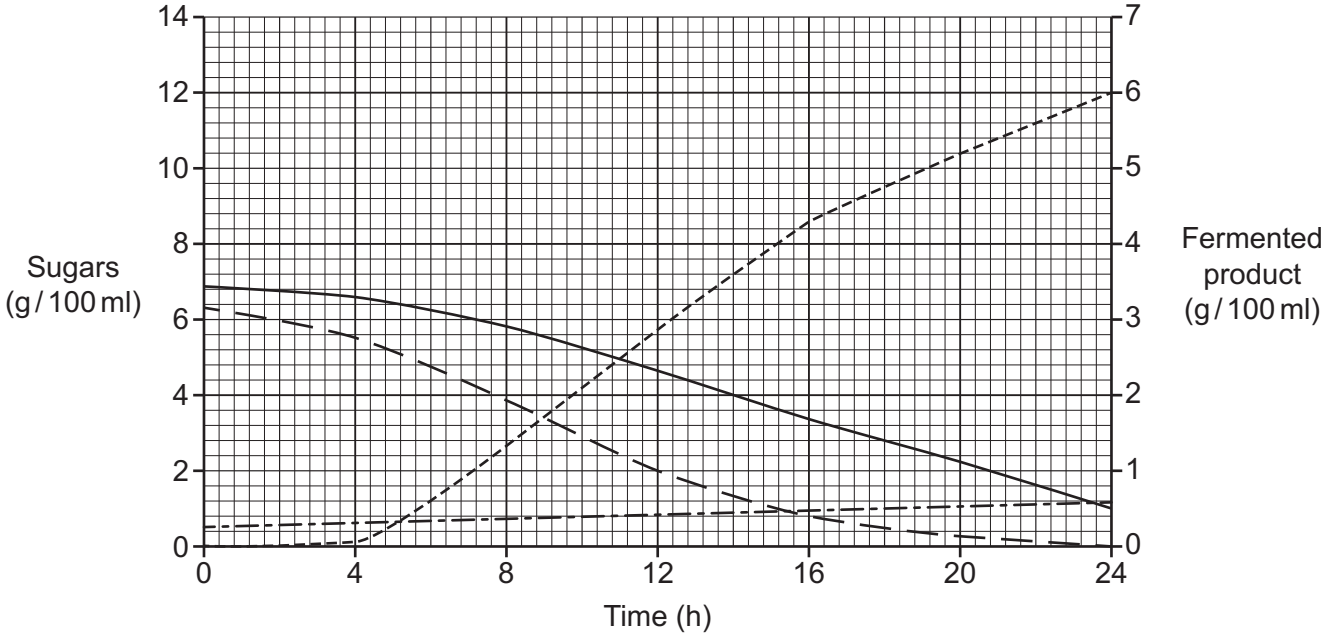
Scientists investigate how two different strains of yeast, **A** and **B**, ferment sugars inside date fruits.

Look at their results.

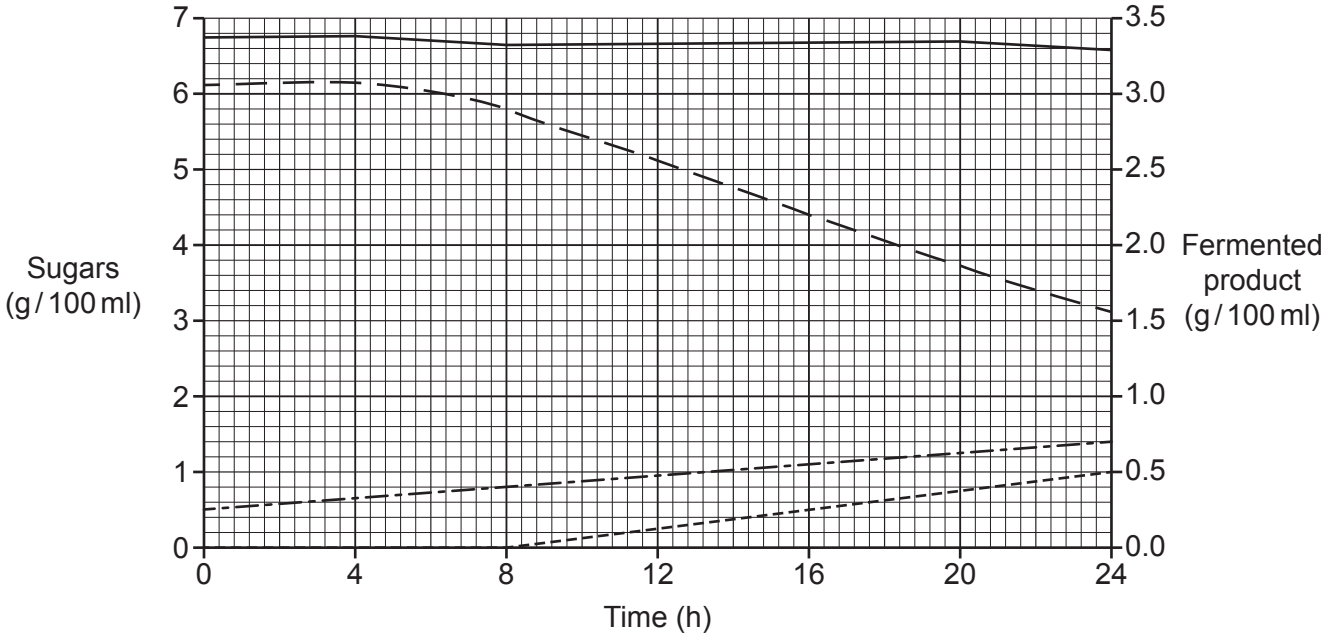
Key

——— fructose — — glucose - - — - - sucrose - - - - - - fermented product

Yeast A



Yeast B



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(i) Which sugar is **not** fermented by either strain of yeast?

Tick (✓) **one** box.

Fructose ☐

Glucose ☐

Sucrose ☐

[1]

(ii) After 24 hours, how many times higher is the fermented product yield of yeast **A** compared to yeast **B**?

Number of times higher = ... **[2]**

(iii) Which sugar would increase fermentation the **most** if added to either yeast **A** or yeast **B**?

Tick (✓) **one** box.

Fructose ☐

Glucose ☐

Sucrose ☐

[1]

(iv) Fermented dates are used to supply both fructose and fermented product.

Explain why it would be best to use yeast **B** to ferment dates to supply both fructose and fermented product.

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

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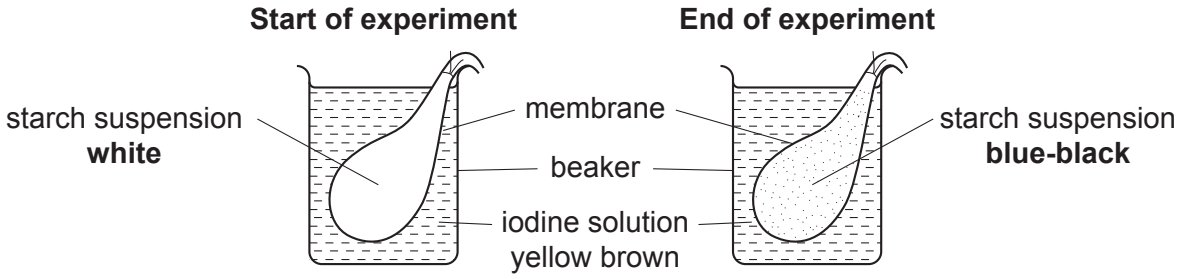
18 (a) An experiment is set up to investigate how substances move into and out of cells.

Look at the results.



Explain the results of this experiment.
Use ideas about molecules in your answer.

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

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***(b)** Sodium ions help regulate the balance of water between the blood and body cells.

In some people the level of sodium ions in the blood can become very low. This can alter the balance of water between the blood and body cells. Doctors can prescribe drugs for patients who have this condition.

Explain how low sodium ion levels in the blood will affect the cells of the body and suggest why drugs that block the action of ADH can treat this condition.

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..... **[6]**

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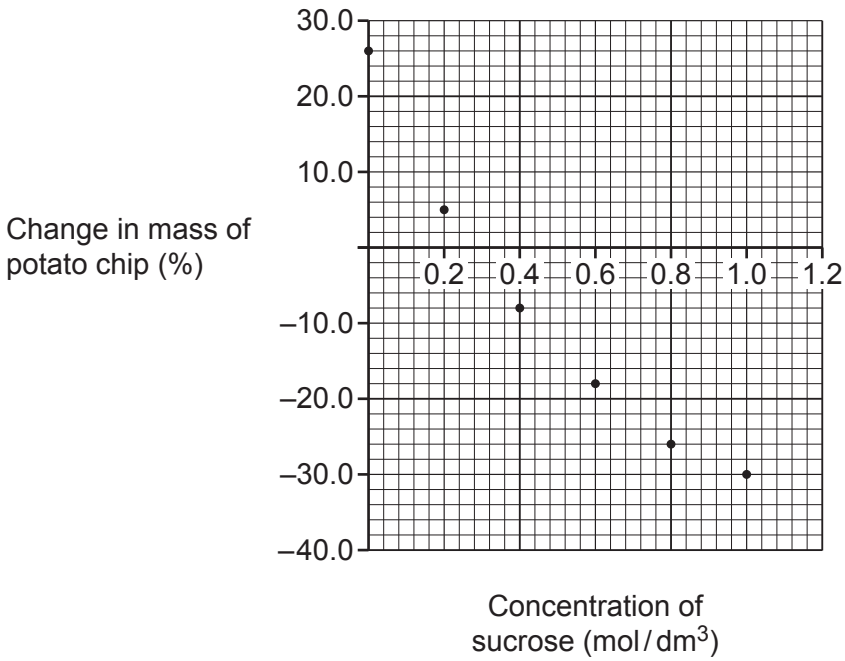
(c) Plant cells are also affected by osmotic conditions.

Look at the graph. It shows the percentage change in mass of potato chips in different concentrations of sucrose.



(i) Draw a curve of best-fit on the graph. **[1]**

(ii) Use the graph to estimate the concentration of sucrose that has the same water potential as the potato cells.

Concentration = ... mol/dm^3 **[1]**

(iii) In a different experiment a sucrose concentration of 0.0 mol/dm^3 increases the mass of a carrot chip by 30%.

The carrot chip shows a 10% decrease in mass compared with its original mass for every 0.2 mol/dm^3 increase in sucrose concentration.

Calculate the x-axis intercept for the carrot chip.

x-axis intercept = ... mol/dm^3 of sucrose **[1]**

(d) Osmotic conditions can increase the size of plant tissue but stem cells are responsible for growth of new cells.

What name is given to plant tissue that contains stem cells?

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

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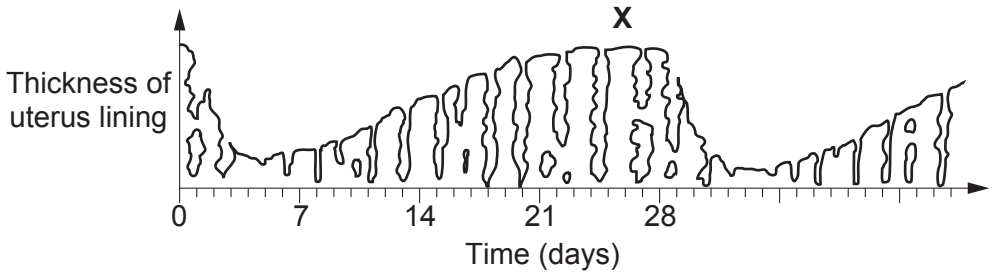
19 **(a)** Look at the diagram. It shows changes to the uterus lining during the menstrual cycle.



(i) Which hormone would peak at point **X**?

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

(ii) Name **two** hormones that peak immediately before ovulation.

1 .....

2 .....

[1]

(b) Explain how hormones can be used by women for contraception.

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

(c) Which hormone works with insulin to control blood sugar levels in the body?

Tick (✓) **one** box.

Gibberellin ☐

Glucagon ☐

Glucose ☐

Glycogen ☐

[1]

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(d) A glucose tolerance test can help identify diabetes.

The graphs show a glucose tolerance test in three people, **A**, **B** and **C**.

One person is healthy, and two people have different types of diabetes.

Key
——— Glucose
– – – – Insulin

'The Child with a Metabolic Condition', Chapter 31, www.nursekey.com, Nurse Key. Item removed due to third party copyright restrictions. Link to material: https://nursekey.com/wp-content/uploads/2016/08/F000310f031-003-9781437708240.jpg

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(i) Which person has **type 2** diabetes?

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

(ii) Explain the reasons for your choice in part **(d)(i)**.

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

(e) Scientists are using human embryonic stem cells to grow cells to treat type 1 diabetes.

Explain why scientists use embryonic rather than adult stem cells.

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

(f) Plant development is also controlled by hormones.

Describe **one** effect of gibberellins and **one** effect of ethene on plant development.

gibberellins .....

.....

ethene .....

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

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20 A scientist clones a cauliflower plant.

He uses small pieces of the cauliflower plant called explants.

This is the method the scientist uses to get the explants:

- Place the equipment in a beaker of bleach and swab the bench with 70% alcohol.
- Collect a small piece of cauliflower and place on a white tile.
- Using a scalpel cut the piece of cauliflower lengthways into small 3–5 mm pieces called explants.
- Measure the mass of the explants.

(a) What equipment should be used to measure the mass of the explants to 1 hundredth of a gram?

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

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(b) The scientist prepares the explants for cloning on an agar jelly plate.

He does this by placing the explants on the agar.

To grow the explants into cauliflower plants, the scientist places the agar jelly plate in a warm room near to a window.

(i) Before they form new plant structures, the explants must take in sugars from the agar jelly.

Explain why explants cannot make their own sugars.

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

(ii) The experiment could be improved by placing the agar jelly plate with explants into a heated cabinet containing light bulbs.

Describe how this cabinet could be further improved to maximise the growth and development of the explants.

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

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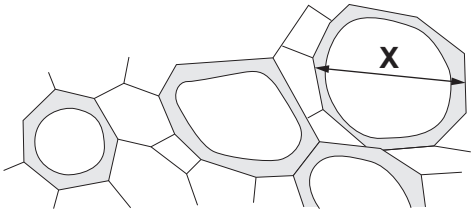
(c) The scientist observes some of the tissues of the growing explants using a light microscope.

The diagram shows some of the plant cells.



The diameter of **X** has been magnified 500×.

What is the actual diameter of **X**?

Give your answer in **standard form**.

Diameter = ... mm **[2]**

(d) Transmission **electron** microscopes (TEM) work by passing a beam of electrons through a very thin slice of an object.

Suggest **one** advantage and **one** disadvantage of using TEM rather than a light microscope to look at cells.

advantage .....

.....

disadvantage .....

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

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21 **(a)** Investigating brain function may involve the following techniques:

- External recording of the brain using EEG.
- Scanning techniques such as CAT and MRI.
- Case studies of humans with accidental damage.
- Deliberate damage in animal experimentation.

(i) Understanding of brain function has increased in recent years. However, there are still problems that scientists face that are preventing a complete understanding.

Evaluate the reasons why understanding has increased but also why problems still exist.

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

(ii) When scientists complete their research they usually publish it in journals or online.

Give **two** reasons why scientists publish their results.

1 .....

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2 .....

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[2]

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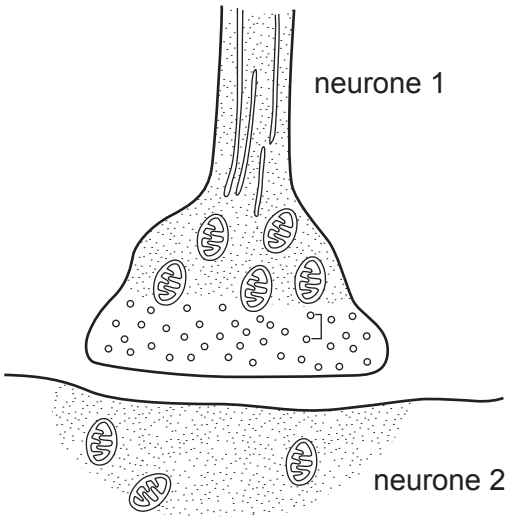
(b) Alzheimer's disease involves damage to nerve transmission.

Symptoms include difficulties in judging distance, concentrating and making decisions.

The diagram shows a synapse between two neurones in the brain.



Acetylcholine is a neurotransmitter in the brain. It diffuses across the 32 nanometre synaptic gap.

In a brain from a person with Alzheimer's disease, the time for acetylcholine to diffuse between neurones is 6.4×10^{-7} s.

1 metre = 10^9 nanometres

(i) Calculate the speed of diffusion in a person with Alzheimer's disease.

Use this formula: speed = distance ÷ time

Give your answer in metres per second.

Speed of diffusion = ... metres per second **[3]**

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(ii) In the brain of a healthy person the speed of diffusion is 0.2 metres per second.

How does the result obtained in part **(i)** account for the symptoms of Alzheimer's disease?

.....

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

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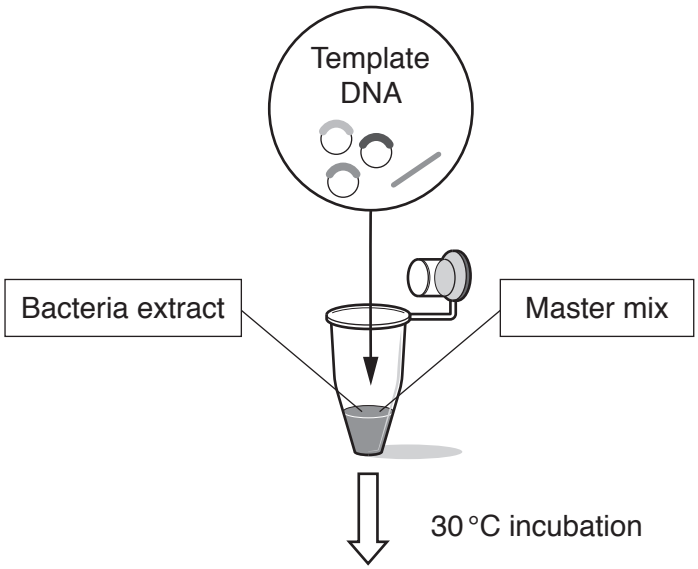
22 Scientists can make the proteins they need outside of living cells (*in vitro*).

To do this they use cell free protein synthesis kits.

The kit includes three different parts:

- A template DNA molecule
- An extract from bacteria containing mRNA and tRNA nucleotides
- A master mix containing amino acids, energy sources, enzymes and ribosomes.

To make a protein the three different parts are mixed together and incubated for 3 hours at 30 °C.



(a) **(i)** Describe the role of the DNA template and mRNA nucleotides in the production of the protein.

.....

.....

.....

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

(ii) Describe the role of the tRNA nucleotides and ribosomes in the production of the protein.

.....

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

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(b) Thirty years ago, identifying a person from their DNA required a large sample of DNA.

Polymerase chain reaction (PCR) is a technique developed in 1983.

PCR allows a single copy or segments of DNA to quickly make multiple copies of a DNA sequence.

(i) Many crimes committed over 30 years ago can now be solved using PCR.

Explain why.

.....

.....

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

(ii) Which part of the cell cycle takes place in PCR?

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

(c) **(i)** DNA databases involve storing a person's individual DNA profile. The DNA profile identifies DNA sequences present in an individual.

DNA databases are used by many different organisations.

Solving crimes is one use of a DNA database.

Suggest **other** reasons why organisations might need a DNA database.

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

(ii) Write down **one** reason why people might **not** want to be included on a DNA database.

.....

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

END OF QUESTION PAPER

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ADDITIONAL ANSWER SPACE

If additional space is required, you should use the following lined page(s). The question number(s) must be clearly shown in the margin(s).

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