



Cambridge International A Level

CANDIDATE
NAME

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CENTRE
NUMBER

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BIOLOGY

9700/41

Paper 4 A Level Structured Questions

October/November 2021

2 hours

You must answer on the question paper.

No additional materials are needed.

INSTRUCTIONS

- Section A: answer **all** questions.
- Section B: answer **one** question.
- 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 100.
- The number of marks for each question or part question is shown in brackets [].

This document has **24** pages.

Section A

Answer **all** questions.

- 1 (a) Fig. 1.1 is a diagram of a kidney nephron and some of its blood vessels.

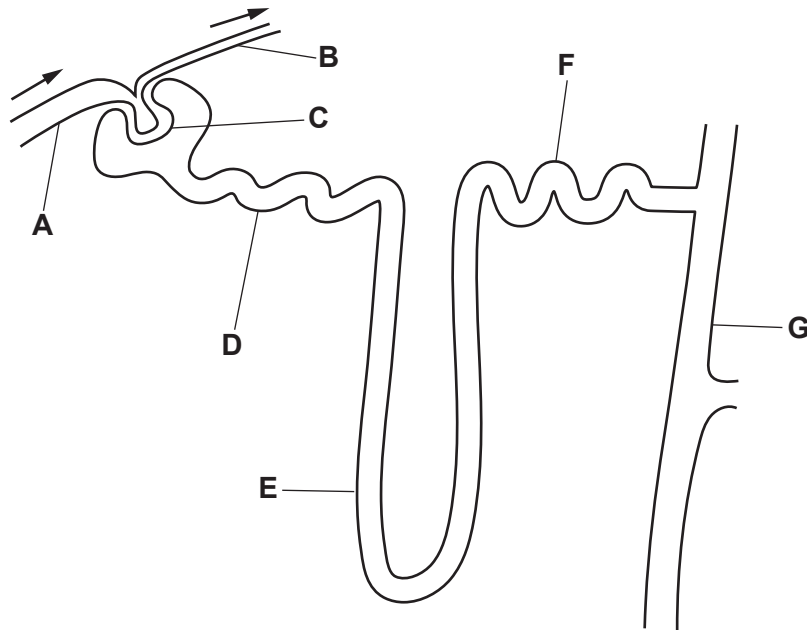


Fig. 1.1

With reference to Fig. 1.1, complete Table 1.1 using the letters **A – G**.

Each letter may be used once, more than once or not at all.

Table 1.1

description	letter
efferent blood vessel
part of nephron containing cells that respond to ADH
part of nephron where podocyte cells are located
part of nephron containing cells that are located in the medulla

[4]

(c) Fig. 1.2 shows the concentrations of ADH in the blood at different percentage changes in water potential of the blood.

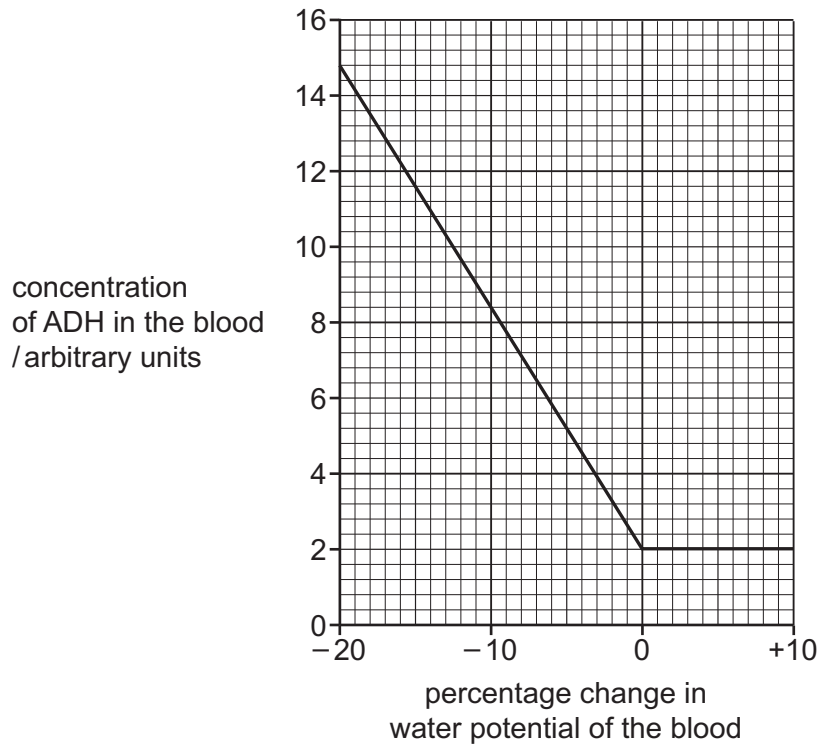


Fig. 1.2

(i) Describe the trend shown in Fig. 1.2.

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..... [2]

(ii) Sometimes a person will have a low concentration of ADH in the blood even though there is a change in the water potential.

Suggest **one** effect on the circulatory system of a low concentration of ADH in the blood.

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..... [1]

[Total: 12]

Turn over for Question 2

(ii) Suggest reasons for the differences shown in Fig. 2.1.

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..... [3]

(b) Rubisco enzymes from cotton and false flax are active at temperatures up to 45 °C and will denature at 45 °C.

Explain how the Calvin cycle is affected when rubisco denatures.

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..... [3]

(c) One goal of genetic engineering is to make crops that are heat tolerant. This means that crops can grow and produce a good yield at high environmental temperatures.

Use the information given in Question 2 to suggest **and** explain a way to improve the tolerance of a crop to high temperatures.

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..... [2]

[Total: 12]

[Turn over

Turn over for Question 4

- 4 (a) In 1984, the geneticist Alec Jeffreys invented a DNA testing technique, known as DNA profiling, that produces a DNA banding pattern on a gel. The DNA banding pattern (profile) is unique to each individual.

DNA profiling can be used in police forensic work to catch criminals.

Since 1987, police in many countries have collected and stored DNA from crime scenes to create DNA profiles, which they try to match with the DNA profiles of criminal suspects.

- (i) DNA at a crime scene may be obtained from hairs and traces of blood, semen and saliva.

Explain why PCR may be needed before DNA from a crime scene can be profiled.

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..... [2]

- (ii) Explain why electrophoresis produces a DNA banding pattern on a gel.

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..... [2]

- (b) GEDmatch is described as ‘an open data personal genomics website’. It can be used by people who want to upload their DNA data to trace their ancestors and other relatives.

In 2018, police in the USA solved a large number of serious crimes. Some of these crimes had been unsolved for over thirty years. The police used GEDmatch to profile DNA taken from crime scenes and to look for matching DNA profiles. In many cases the police found partial matches to the relatives of criminals. This allowed the criminals to be identified and then charged on the basis of a complete DNA profile match.

- (i) Suggest why the police strategy of comparing crime scene DNA with the GEDmatch database was so successful.

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..... [2]

- (ii) Explain why GEDmatch is an example of bioinformatics.

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..... [2]

- (iii) The first successful conviction resulting from the use of GEDmatch by the police was widely reported.

Some journalists and broadcasters thought that the GEDmatch website should not have been used by the police in this way.

In the days following the news, the number of citizens choosing to upload their DNA data to GEDmatch increased from 1500 to 5000 a day.

Comment on the social **and** ethical issues raised by this first successful conviction.

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..... [2]

[Total: 10]

[Turn over

- 5 (a) Gibberellin is a plant growth regulator involved in barley seed germination. Production of gibberellin is stimulated by the uptake of water.

State the location of gibberellin synthesis in a barley seed during germination.

..... [1]

- (b) Barley seeds germinate when placed on blotting (absorbent) paper soaked in water.

The germination of barley seeds placed on blotting paper soaked in solutions of different water potential was investigated.

The success of germination was measured as a germination index for:

- barley seeds placed on blotting paper soaked in water
- barley seeds placed on blotting paper soaked in 5 solutions of different water potential.

The results are shown in Fig. 5.1.

The higher the germination index value, the more successful the germination of the barley seeds.

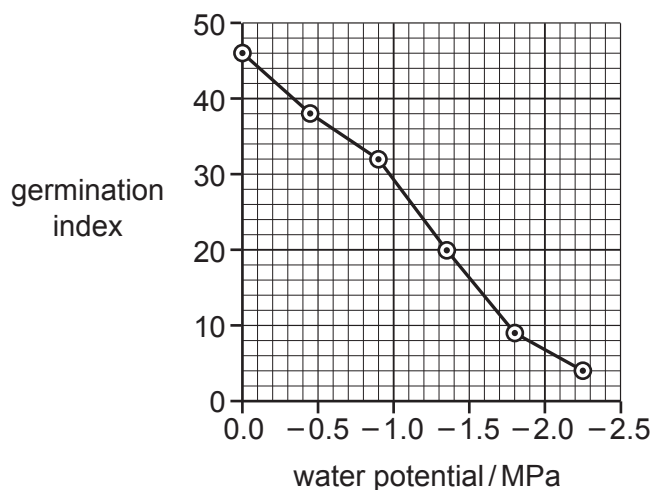


Fig. 5.1

- (i) With reference to Fig. 5.1, describe the relationship between the germination index of barley seeds and water potential.

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 [2]

(ii) Suggest explanations for the relationship shown in Fig. 5.1.

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..... [3]

(c) During barley seed germination, gibberellin stimulates the synthesis of enzymes.

State the name of one of these enzymes **and** the precise location of its synthesis.

enzyme

location

[2]

(d) Some plants are grown commercially for their flowers. Many of these plants are varieties that have short stems.

Two factors that affect the height of stems are:

- gibberellin
- the *Le/le* gene.

The *Le/le* gene has two alleles, *Le* and *le*.

(i) Suggest an advantage of growing a short-stemmed variety of a flowering plant.

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..... [1]

(ii) Explain how the *Le/le* gene and gibberellin are involved in affecting the height of plant stems.

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..... [3]

[Total: 12]

6 Fig. 6.1 outlines the first three stages of respiration in aerobic conditions.

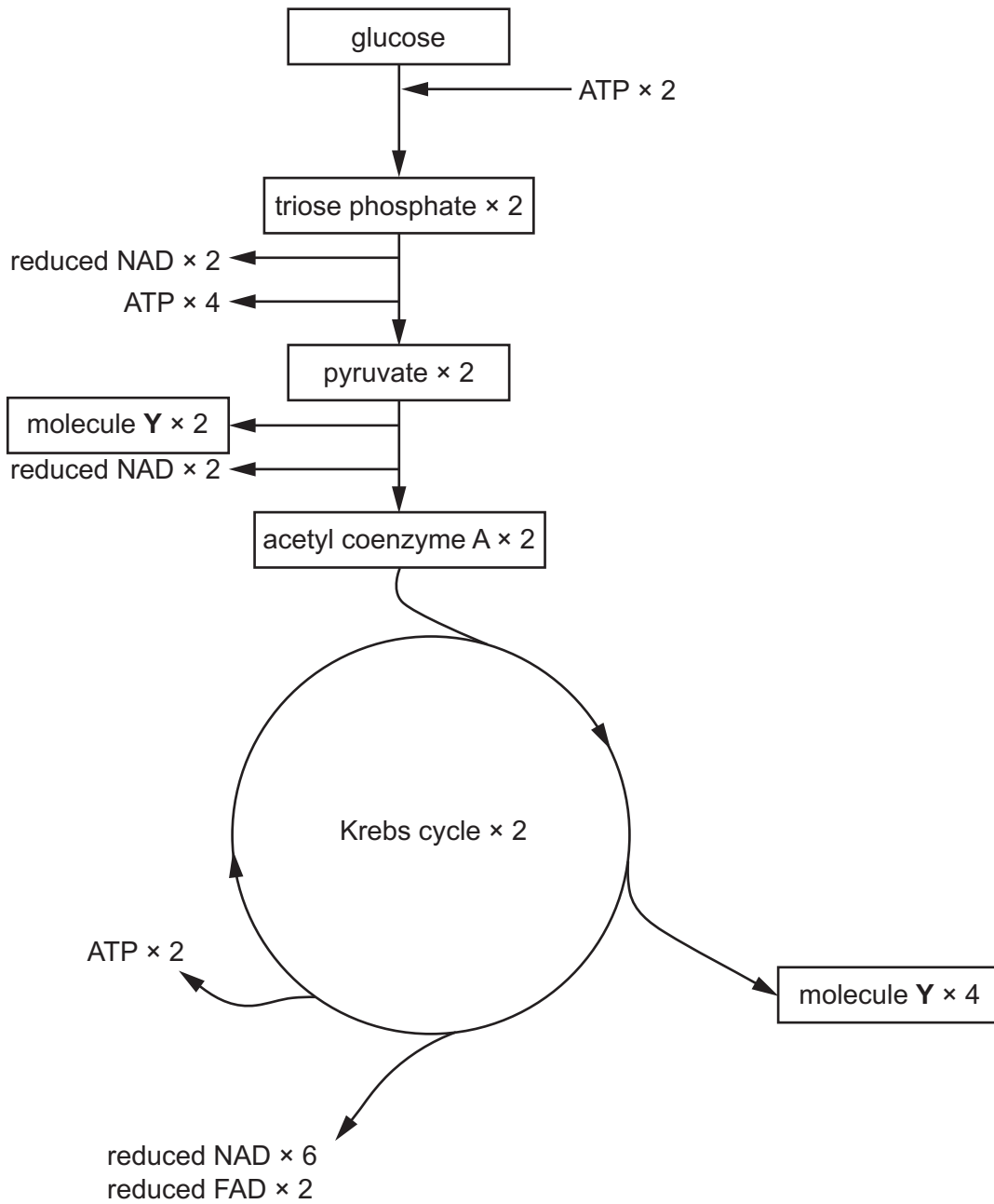


Fig. 6.1

(a) Name molecule Y in Fig. 6.1.

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(b) Explain how Fig. 6.1 shows that glycolysis involves oxidation.

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 [1]

- (c) At one time it was thought that the oxidative phosphorylation of:
- one molecule of reduced NAD results in the synthesis of 3 ATP molecules
 - one molecule of reduced FAD results in the synthesis of 2 ATP molecules.

Using Fig. 6.1, a theoretical value for the net number of ATP molecules that are synthesised for each molecule of glucose can be calculated.

Modern research has shown that the actual net number of ATP molecules synthesised for each glucose molecule respired is much lower than this theoretical value.

- (i) Using Fig. 6.1, calculate the theoretical value for the net number of ATP molecules that are synthesised for each molecule of glucose respired in **all** phosphorylation reactions.

Show your working.

answer = [2]

- (ii) Suggest **two** reasons why the actual net number of ATP molecules synthesised is less than the theoretical number.

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..... [2]

- (d) Outline the roles of NAD and FAD in aerobic respiration.

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..... [3]

8 California salamanders are terrestrial amphibians.

An original population of California salamanders occupied an area of forest in northern California. Approximately 10 million years ago, two separate populations, **A** and **B**, started to migrate from the original population.

- Population **A** travelled along the coast of California, to the west of the Great Central Valley.
- Population **B** travelled east of the Great Central Valley.

The two populations now live close to each other in southern California.

Fig. 8.1 outlines the migratory routes of populations **A** and **B**.

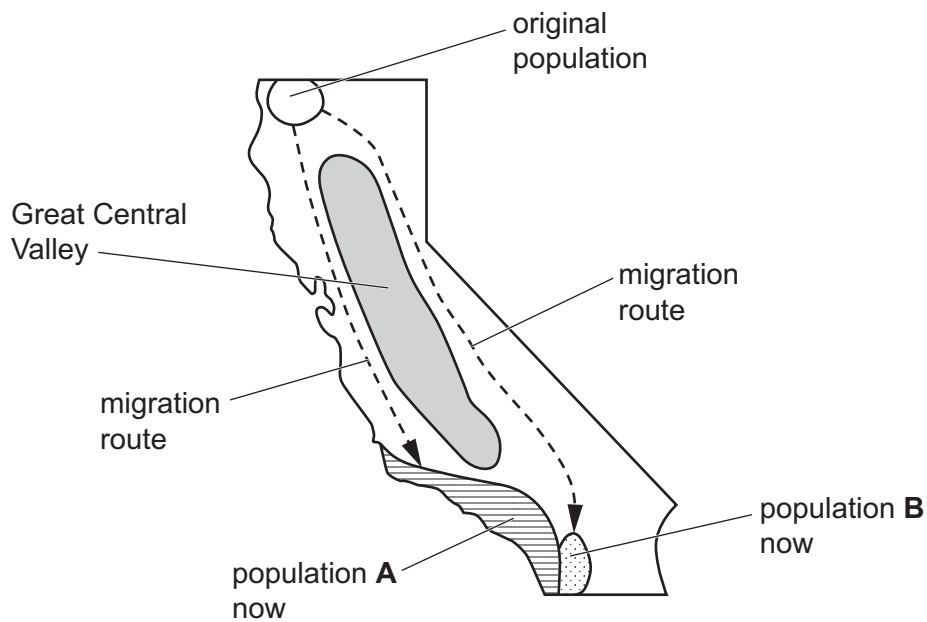


Fig. 8.1

