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# Pearson Edexcel International GCSE (9–1)

## Friday 9 June 2023

Afternoon (Time: 1 hour 15 minutes)

Paper reference **4BI1/2B**

# Biology

**UNIT: 4BI1**

**PAPER: 2B**

**You must have:**
Calculator, ruler

Total Marks

## Instructions

- Use **black** ink or ball-point pen.
- If pencil is used for diagrams/sketches/graphs it must be dark (HB or B).
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided
  – *there may be more space than you need.*
- Show all the steps in any calculations and state the units.

## Information

- The total mark for this paper is 70.
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question.*

## Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

*Turn over* ▶

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**Answer ALL questions**

**Some questions must be answered with a cross in a box ☒. If you change your mind t an answer, put a line through the box ☒ and then mark your new answer with a cross ◺**

**1** Read the passage below. Use the information in the passage and your own knowledge to answer the questions that follow.

**When the Oceans Glow**

In some areas of the world the oceans around the coast sometimes glow with a blue light. The photograph shows an area of coast that is glowing. This blue light is produced by the presence of thousands of microscopic, living organisms called dinoflagellates. These dinoflagellates are protoctists. The production of light by living organisms is called bioluminescence, a process that has evolved many times in different species of organism.



(Source: © AMIRREZA KAMKAR/SCIENCE PHOTO LIBRARY)

To generate light, dinoflagellates use special proteins and the ATP produced within their cells. Many species of dinoflagellate contain chlorophyll and are able to photosynthesize. The appearance of glowing dinoflagellates in the sea used to be a rare event but this now occurs much more frequently. Many of the events occur in the sea around river estuaries and scientists think that intensive farming and deforestation could be to blame. Due to overpopulation of dinoflagellates in these areas, other species of animal are often harmed. After a series of glowing events, large numbers of dinoflagellates die causing oxygen levels in the water to decrease.

People have often wondered why dinoflagellates glow. They only glow in areas where the water moves around, such as when waves hit a beach. Scientists now think that the production of light is a type of warning to stop predators eating the dinoflagellates. If an animal eats dinoflagellates, the dinoflagellates in the area glow making the animal obvious to its own predators. To test this, scientists placed dinoflagellates into a tank along with 15 copepods, which are predators of dinoflagellates. When the dinoflagellates glowed, the copepods ate 1200 dinoflagellates in two hours. When the dinoflagellates did not glow, the copepods ate 2100 dinoflagellates in two hours.

Some scientists think that we could make use of the dinoflagellates to provide sustainable street lighting. Tanks of dinoflagellates could be placed on top of lamp posts. The dinoflagellates would photosynthesise during the day when it is light. A stirrer powered by a small battery would then move them at night so that they would glow. These sustainable lamps could be carbon neutral and help to reduce pollution.

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(a) Which of these processes produces ATP? (line 6)

- ☒ **A** active transport
- ☒ **B** diffusion
- ☒ **C** respiration
- ☒ **D** transpiration

(b) (i) Explain why intensive farming and deforestation would cause an increase in populations of dinoflagellates. (lines 9 to 11)

**(3)**

(ii) Explain why oxygen levels decrease after a series of glowing events. (lines 10 to 13)

**(2)**

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(c) Which type of bacteria converts ammonia into nitrates?

- ☒ **A** decomposer
- ☒ **B** denitrifying
- ☒ **C** nitrifying
- ☒ **D** nitrogen fixing

(d) (i) Each of the 15 copepods ate glowing dinoflagellates at a mean rate of 40 dinoflagellates per hour.

Calculate the mean rate at which each copepod ate dinoflagellates that were not glowing. (lines 18 to 21)

**(2)**

mean rate = ..... dinoflagellates per hour

(ii) Explain how natural selection could have resulted in the evolution of dinoflagellates that glow. (lines 15 to 18)

**(4)**

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(e) Explain why using dinoflagellates for street lighting would help to reduce pollution. (lines 22 to 26)

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**(Total for Question 1 = 16 marks)**

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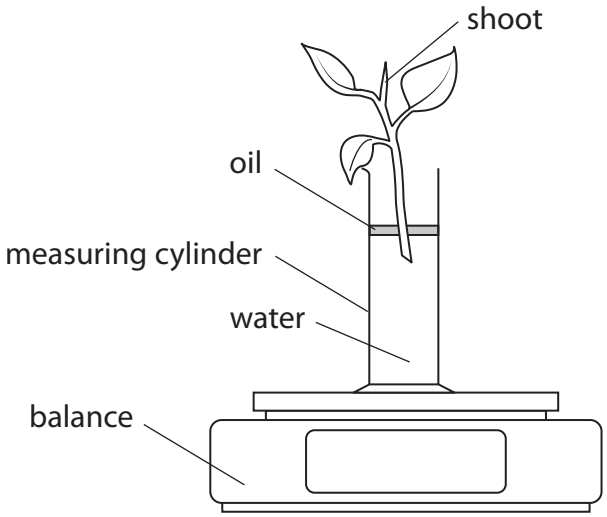
**2** A student uses this method to investigate water uptake and water loss by a plant shoot.

- pour 100 $cm^3$ of water into a measuring cylinder
- place a plant shoot into the measuring cylinder
- cover the surface of the water with oil
- place the measuring cylinder and plant shoot on a balance and record the total mass
- shine light on the plant shoot using a lamp
- record the volume of the water in the measuring cylinder after four days, and after eight days
- record the total mass of the measuring cylinder and plant shoot after four days, and after eight days

The diagram shows the student's apparatus.




(a) State the reason for using the oil.

**(1)**

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(b) The table shows the student's results.

| | Volume of water in measuring cylinder in $cm^3$ | Total mass of measuring cylinder and plant shoot in g |
|---|---|---|
| **start (day 1)** | 100 | 175 |
| **day 4** | 75 | 165 |
| **day 8** | 65 | 155 |

(i) The volume of water taken up by the plant shoot is equal to the change in volume of water in the measuring cylinder. This is called the water uptake.

Calculate, in $cm^3$ per day, the mean rate of water uptake by the plant shoot during the eight days.

**(2)**

mean rate = ..... $cm^3$ per day

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(ii) Comment on the changes in total mass of the measuring cylinder and plant shoot, compared with the changes in volume of water in the measuring cylinder.

[1 $cm^3$ of water has a mass of 1 g]

**(4)**

(c) Explain why the rate of water loss would be different if a working fan is placed in front of the plant shoot.

**(3)**

**(Total for Question 2 = 10 marks)**

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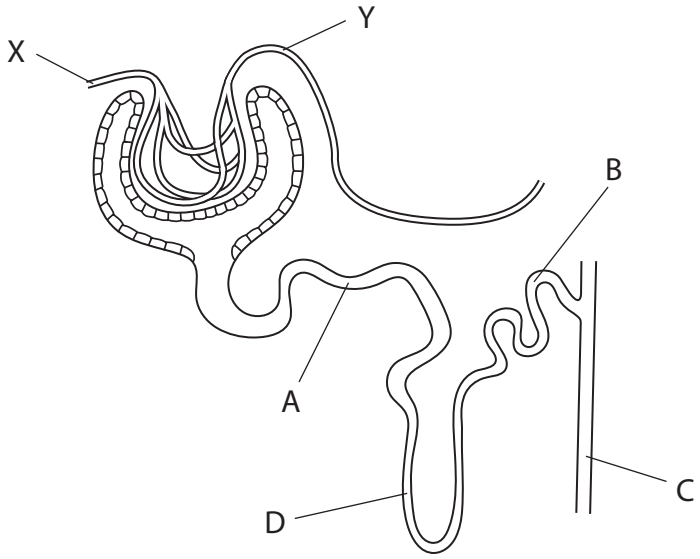
**3** The diagram shows part of a human nephron.




(a) Which structure is the proximal convoluted tubule?

**(1)**

- ☒ **A**
- ☒ **B**
- ☒ **C**
- ☒ **D**

(b) The hollow space inside a blood vessel is called the lumen.

(i) The blood vessel labelled X has a lumen with a radius of 100 μm.

Use this formula to calculate the cross-sectional area, in $mm^2$, of the lumen of this blood vessel.

$$\text{area of circle} = \pi \times (\text{radius})^2$$

[$\pi = 3.14$]

[1 mm = 1000 μm]

**(2)**

cross-sectional area = ..... $mm^2$

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(ii) The lumen of blood vessel X is wider than the lumen of blood vessel Y.

Explain why this difference in the width of the lumen of the two blood vessels is important for kidney function.

**(2)**

(c) Protein is often found in the urine of people who have high blood pressure.

Describe how urine could be tested for protein.

**(2)**

**(Total for Question 3 = 7 marks)**

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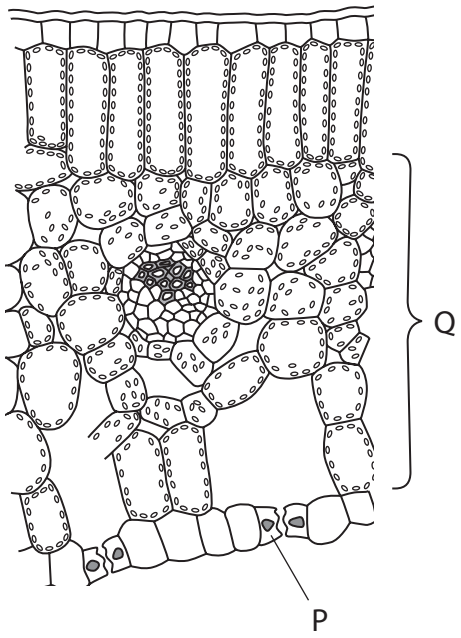
**4** (a) The diagram shows a cross-section through part of a plant leaf.




(i) What is the name of the cell labelled P?

**(1)**

- ☒ **A** cuticle
- ☒ **B** guard
- ☒ **C** palisade
- ☒ **D** stoma

(ii) Explain how part Q is adapted for photosynthesis in the leaf.

**(3)**

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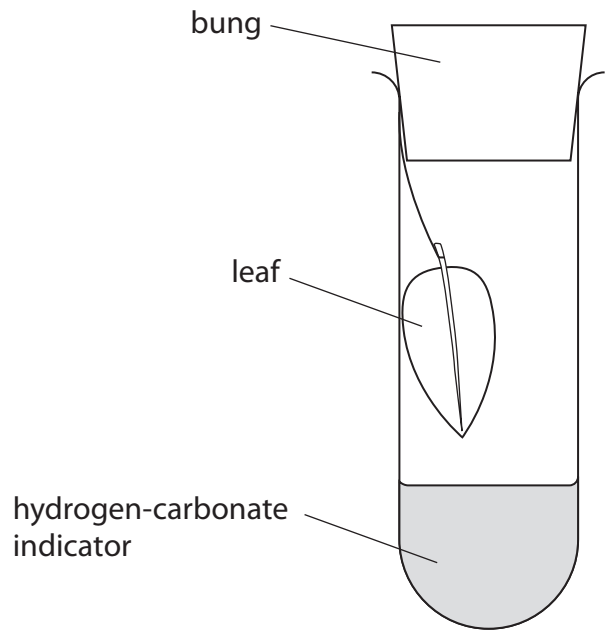
(b) A student uses this method to investigate the effect of temperature on the rat gas exchange in leaves.

- pour 10 $cm^3$ of hydrogen-carbonate indicator into each of six test tubes
- hang a leaf in five of the test tubes
- place a bung in each test tube
- place the five tubes with leaves into separate water baths at temperatures of 15 °C, 20 °C, 25 °C, 30 °C, 35 °C, and 40 °C
- place the tube with no leaf in a water bath at 25 °C
- place all tubes in bright sunlight
- record the time taken for each of the hydrogen-carbonate indicator solutions to change from orange to red

The student repeats the experiment two more times.

The diagram shows one of the tubes with a leaf.




(i) State the independent variable.

**(1)**

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(ii) The species and size of leaf were the same in each tube.

Give a reason for controlling one other named factor.

**(2)**

factor

.....

reason

.....

.....

(iii) State the function of the tube with no leaf.

**(1)**

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(c) The table shows the student's results.

| Temperature in °C | Time taken for indicator in tubes with leaves to change from orange to red in minutes | | | |
|---|---|---|---|---|
| | 1 | 2 | 3 | mean |
| 15 | 50 | 40 | 40 | 43 |
| 20 | 35 | 40 | 35 | 37 |
| 25 | 25 | 30 | 25 | |
| 30 | 10 | 10 | 15 | 12 |
| 35 | 15 | 10 | 10 | 12 |

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(i) Calculate the mean time taken for the indicator to change from orange to r at 25 °C.

Give your answer to two significant figures.

**(2)**

mean time = ..... minutes

(ii) Explain the effect of increasing the temperature on the mean time taken for the indicator to change from orange to red.

**(3)**

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(d) In another experiment, the student places a test tube containing a leaf and hydrogen-carbonate indicator in a 25 °C water bath.

The student then places all this apparatus in the dark for one hour.

Explain why the indicator solution changes from orange to yellow.

**(2)**

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**(Total for Question 4 = 15 marks)**

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**5** Hormones control the menstrual cycle.

(a) (i) Name the gland that produces FSH.

**(1)**

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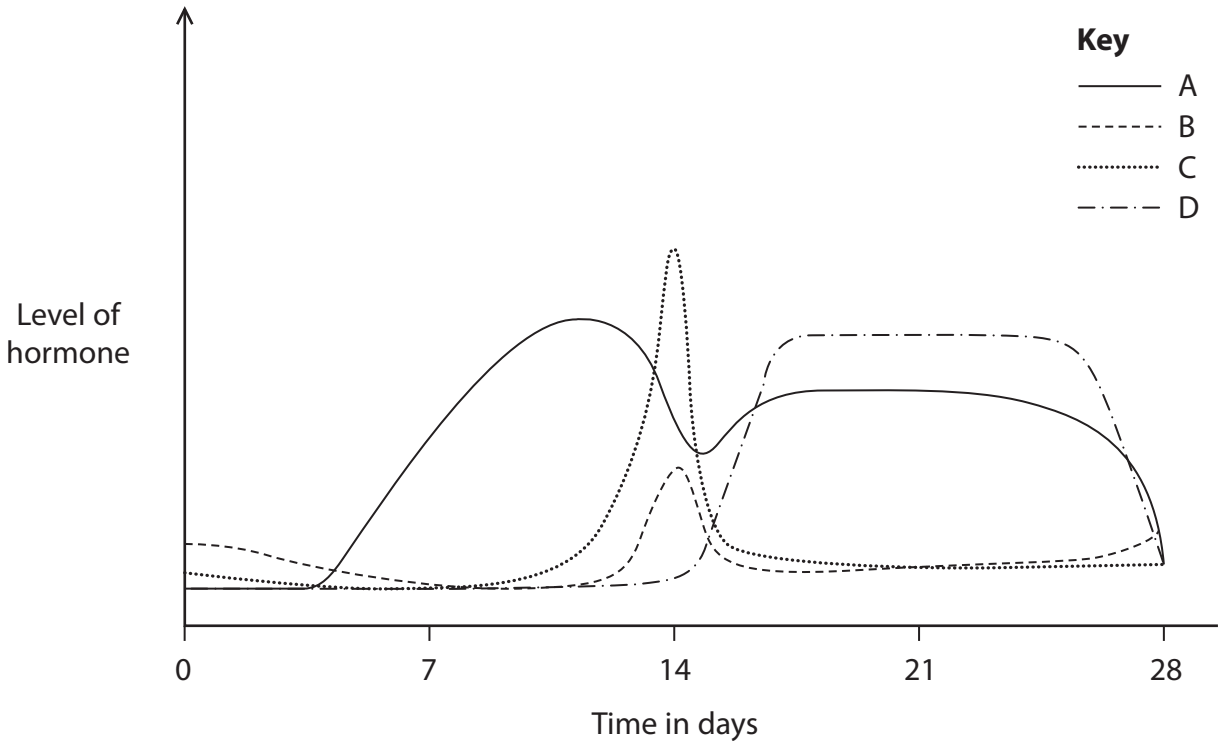
(ii) The diagram shows the changes in four hormones during the human menstrual cycle.




Which line represents the hormone progesterone?

**(1)**

- ☒ **A**
- ☒ **B**
- ☒ **C**
- ☒ **D**

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(iii) Describe the roles of FSH and LH in the menstrual cycle.

FSH

LH

(b) Reproductive hormones can be used as contraceptives to prevent pregnancy.

The table gives information about three different methods of hormonal contraception.

| Method | Description | Percentage effectiveness in preventing pregnancy (%) |
|---|---|---|
| oral tablets | • tablets taken every day at same time | 91 to 99 |
| injection | • injection into muscle by medical professional<br>• injection is repeated every 12 weeks | 94 to 99 |
| implant | • plastic rod containing hormones is surgically placed under skin of upper arm<br>• can last for up to three years and then needs replacing | 94 to 99 |

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Discuss the advantages and disadvantages of the three methods of contracept shown in the table.

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**(Total for Question 5 = 11 marks)**

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**6** The photograph shows a plant called a snapdragon.



(Source: © BRIAN GADSBY/SCIENCE PHOTO LIBRARY)

Selective breeding has been used to produce snapdragons with brightly coloured flowers.

(a) (i) Describe how selective breeding can produce snapdragon plants with brightly coloured flowers.

**(2)**

(ii) Micropropagation is often used to make copies of a snapdragon plant.

Describe the process of micropropagation.

**(3)**

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(b) Scientists investigate the effect of exposing snapdragon explants to increasing amounts of ionising radiation.

This is the scientists' method.

- take a snapdragon plant and use micropropagation to produce many explants
- expose groups of explants to different amounts of ionising radiation
- grow the explants into plants and record the number of differences in their phenotypes compared with the original plant
- take samples of each of the plants and measure the number of differences in DNA nucleotides of each plant compared with the original plant

(i) Give the reason why micropropagation is used to produce the plants to be tested.

**(1)**

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(ii) What term is given to all the DNA in an organism?

**(1)**

☒ **A** gene

☒ **B** genome

☒ **C** genotype

☒ **D** nucleoid

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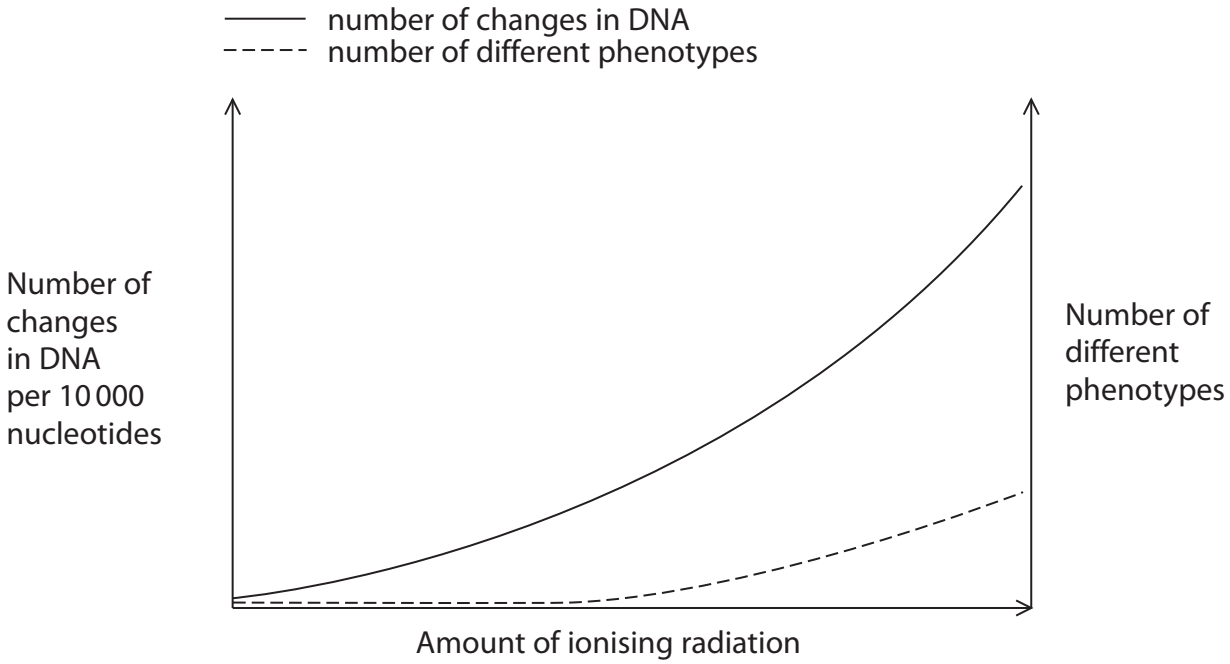
(iii) The graph shows the scientists' results.




Discuss the effects that increasing the amount of ionising radiation has on the snapdragons.

**(4)**

**(Total for Question 6 = 11 marks)**

**TOTAL FOR PAPER = 70 MARKS**

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