

Please check the examination details below before entering your candidate information

Candidate surname					Other names				
Centre Number					Candidate Number				

Pearson Edexcel International GCSE (9–1)

Monday 8 June 2026

Morning (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.
- Write your answers neatly and in good English.
- 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 $\boxtimes$. If you change your mind about an answer, put a line through the box $\boxtimes$ and then mark your new answer with a cross $\boxtimes$.

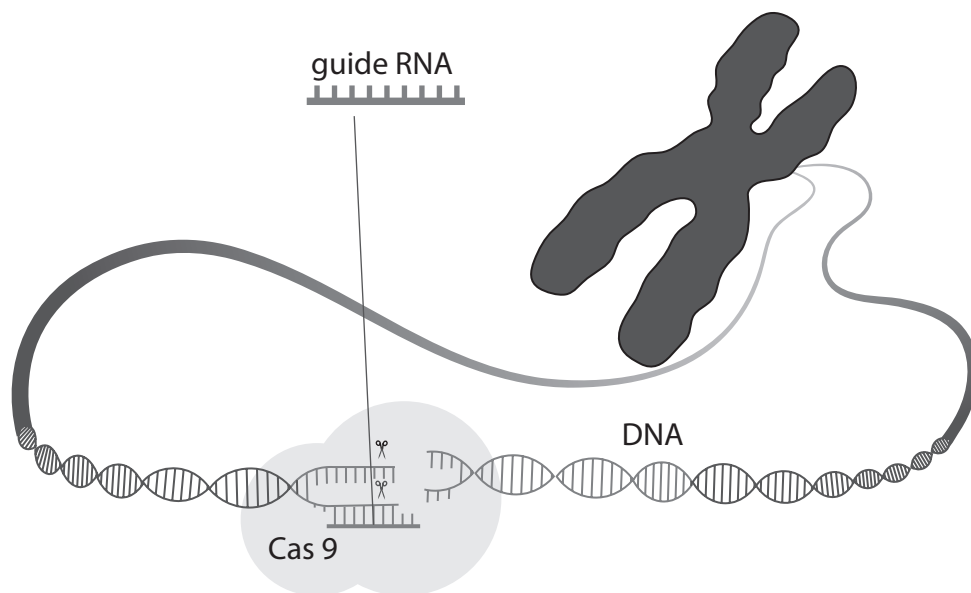
- 1 Read the passage below. Use the information in the passage and your own knowledge to answer the questions that follow.

Gene editing

Gene editing is a new method of genetically modifying organisms. This method involves two important molecules. One molecule is an enzyme called Cas 9, which cuts DNA. The other molecule is a small piece of RNA called guide RNA. This guide RNA is similar to mRNA but is not translated in the cytoplasm. The guide RNA has a sequence of bases complementary to part of the sequence of a gene.

When scientists want to change a gene, they make a piece of guide RNA that is complementary to part of the sequence of the gene to be altered. This guide RNA binds to the gene and separates the two strands of DNA. The enzyme, Cas 9, then cuts the DNA at this point. New, different DNA can then be inserted into the cut piece of DNA. The method has been developed to correct faulty genes, delete genes, and change the function of genes. One problem with gene editing is that occasionally, the guide RNA can cause other parts of the genome to be edited instead of the target area.

The diagram shows how the molecules are used during gene editing.



- 15 Gene editing is being developed to treat a human genetic condition called sickle cell anaemia. Sickle cell anaemia is caused by a faulty allele for haemoglobin. This allele is codominant with the allele for unaffected haemoglobin. People with two copies of the sickle cell allele have full sickle cell anaemia. Their red blood cells have a crescent shape rather than a biconcave disc shape and block small blood vessels. People with full sickle cell anaemia have extreme tiredness, severe pains, and often get infections in body tissues. People who are heterozygous have a mild form of sickle cell anaemia but have natural resistance to malaria. Full sickle cell anaemia is common in human populations who have lived for a long time in



areas where there is a high risk of catching malaria.

- 25 Scientists are investigating if it is possible to edit haemoglobin genes in stem cells taken from people with full sickle cell anaemia. The scientists would edit these stem cells and then place the cells with the corrected haemoglobin genes back into the patient's bone marrow.

- 30 Some people have suggested that in the future, genes could be edited in eggs, sperm, or early embryos, instead of editing the genes in body tissues. However, editing genes in eggs, sperm, and early embryos is not allowed in most countries.

- (a) (i) Cas 9 is an enzyme that cuts DNA (lines 2 to 3).

Which of these enzymes also cuts DNA?

(1)

- ☐ **A** ligase
- ☐ **B** lipase
- ☐ **C** maltase
- ☐ **D** restriction

- (ii) One strand of a gene contains 750 nucleotides.

When all the nucleotides on both strands of the gene are combined, there is a total of 1500 nucleotides.

30% of these 1500 nucleotides are adenine (A).

Using your knowledge of base pairing, calculate the number of guanine (G) nucleotides in this gene.

(2)

number =



- (b) Guide RNA is similar to mRNA but is not translated in the cytoplasm (lines 3 to 4).

Describe how a polypeptide is produced when mRNA is translated.

(3)

- (c) Suggest why guide RNA can cause other areas of the genome to be edited (lines 11 to 13).

(1)

- (d) (i) State what is meant by the term **codominant allele** (lines 16 to 17).

(1)

- (ii) Explain why people with sickle cell anaemia have extreme tiredness and infections in their body tissues (lines 18 to 21).

(3)



- (iii) Explain why the sickle cell anaemia allele is common in areas of the world where there is a high risk of catching malaria (lines 22 to 24).

Refer to the process of natural selection in your answer.

(3)

- (e) Explain why scientists are planning to use stem cells rather than body cells to treat sickle cell anaemia (lines 25 to 28).

(2)

- (f) Suggest one reason why modifying sperm, eggs and early embryos is not allowed in most countries (lines 30 to 31).

(1)

(Total for Question 1 = 17 marks)



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2 The photograph shows an area of deforestation.



(Source: © 53/SPL)

(a) Explain why deforestation increases leaching of minerals into rivers.

(2)

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(b) Deforestation can negatively affect ecological communities and biodiversity.

(i) State what is meant by the term **ecological community**.

(1)

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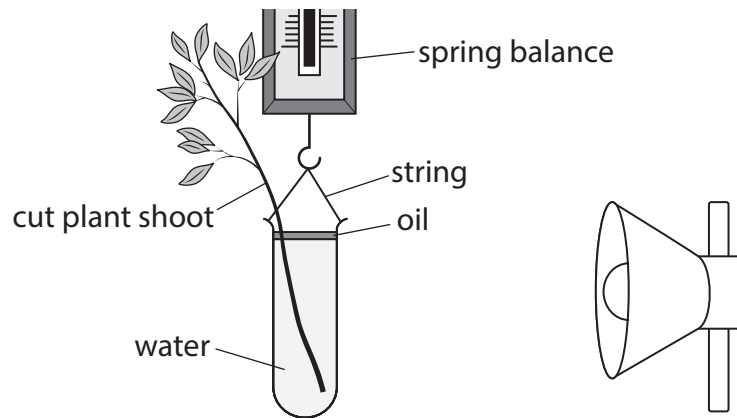


(4)

(Total for Question 2 = 7 marks)



- 3 A student uses this apparatus to investigate the effect of light intensity on water loss from a plant shoot.



This is the student's method.

- pour 50 cm^3 of water into a test tube
- place a cut plant shoot into the water
- pour a layer of oil onto the surface of the water
- hang the apparatus from a spring balance
- place the lamp near the test tube and provide high light intensity for 12 hours followed by low light intensity for 12 hours
- record the mass of the apparatus after every 4 hours
- after 24 hours, measure the volume of water remaining in the test tube

(a) (i) State the reason for using the oil.

(1)

(ii) State two abiotic variables that the student should control.

(2)

1

2



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

Time in hours	Light intensity	Mass of apparatus in g
0	high	120
4	high	112
8	high	104
12	high	96
16	low	94
20	low	93
24	low	93

- (i) Calculate the rate of change of mass of the apparatus, in g per minute, from 0 hours to 4 hours.

Give your answer to two significant figures.

(3)

rate = g per minute

- (ii) Explain the results shown in the table.

(3)

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(iii) After 24 hours, the volume of water in the test tube is 20 cm^3 .

This volume of water has a mass of 20 g.

Explain why the change in mass of the apparatus is different from the change in volume of water in the test tube.

(2)

(Total for Question 3 = 11 marks)

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4 Animals and plants are eukaryotic organisms that release excretory products.

(a) (i) Which feature is common to all eukaryotic organisms?

(1)

- ☐ **A** they are multicellular organisms
- ☐ **B** they have nuclei in their cells
- ☐ **C** they have chloroplasts in their cells
- ☐ **D** they have a protein coat around their cells

(ii) Which molecule is an excretory product of animals and plants?

(1)

- ☐ **A** carbon dioxide
- ☐ **B** nitrate
- ☐ **C** oxygen
- ☐ **D** urea

(b) The kidney is an excretory organ.

(i) In which region of the nephron is glucose reabsorbed?

(1)

- ☐ **A** Bowman's capsule
- ☐ **B** collecting duct
- ☐ **C** loop of Henle
- ☐ **D** proximal convoluted tubule

(ii) The concentrations of oxygen, carbon dioxide and urea are different in the blood in the renal artery compared with the blood in the renal vein.

Which of these substances have a higher concentration in the blood in the renal artery compared with the blood in the renal vein?

(1)

- ☐ **A** carbon dioxide and urea
- ☐ **B** carbon dioxide only
- ☐ **C** oxygen only
- ☐ **D** oxygen and urea



- (iii) Some people have a condition which means they are unable to release enough ADH into their blood.

Explain what happens to the volume of urine produced by people with this condition.

(3)

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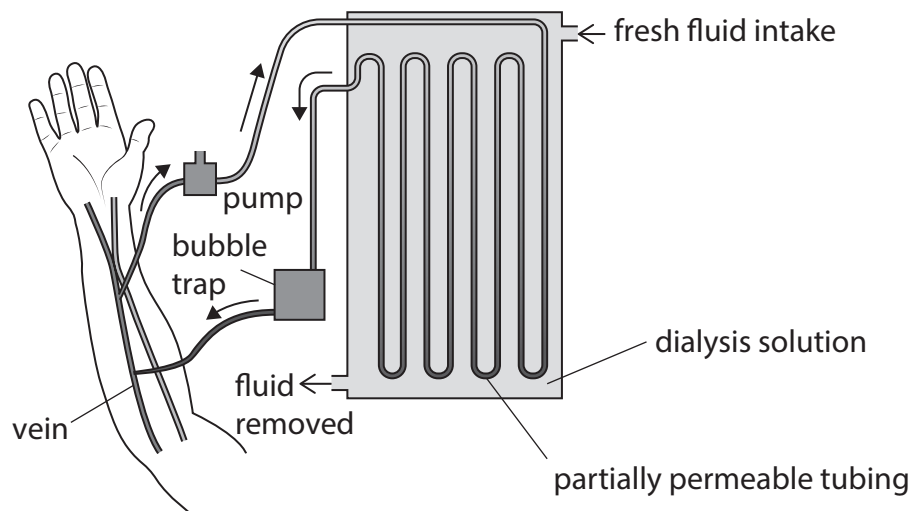
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- (c) Some people with kidney disease have excess substances removed from their blood by kidney dialysis.

During dialysis, blood is passed through partially permeable tubing that is placed in dialysis solution.

The diagram shows the process of kidney dialysis.



The table shows the concentrations of some substances in

- the blood plasma of a patient without kidney disease
- the blood plasma of a patient with kidney disease before dialysis
- fresh dialysis solution

Substance	Concentration in g per dm ³		
	blood plasma of patient without kidney disease	blood plasma of patient with kidney disease before dialysis	fresh dialysis solution
sodium chloride	2.0	2.4	2.0
glucose	0.1	0.1	0.3
urea	1.6	12.0	0.0
protein	4.0	4.0	0.0



Using information from the diagram and the table, discuss how dialysis removes urea, excess salt and excess water from the blood of patients with kidney disease.

(5)

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(Total for Question 4 = 12 marks)

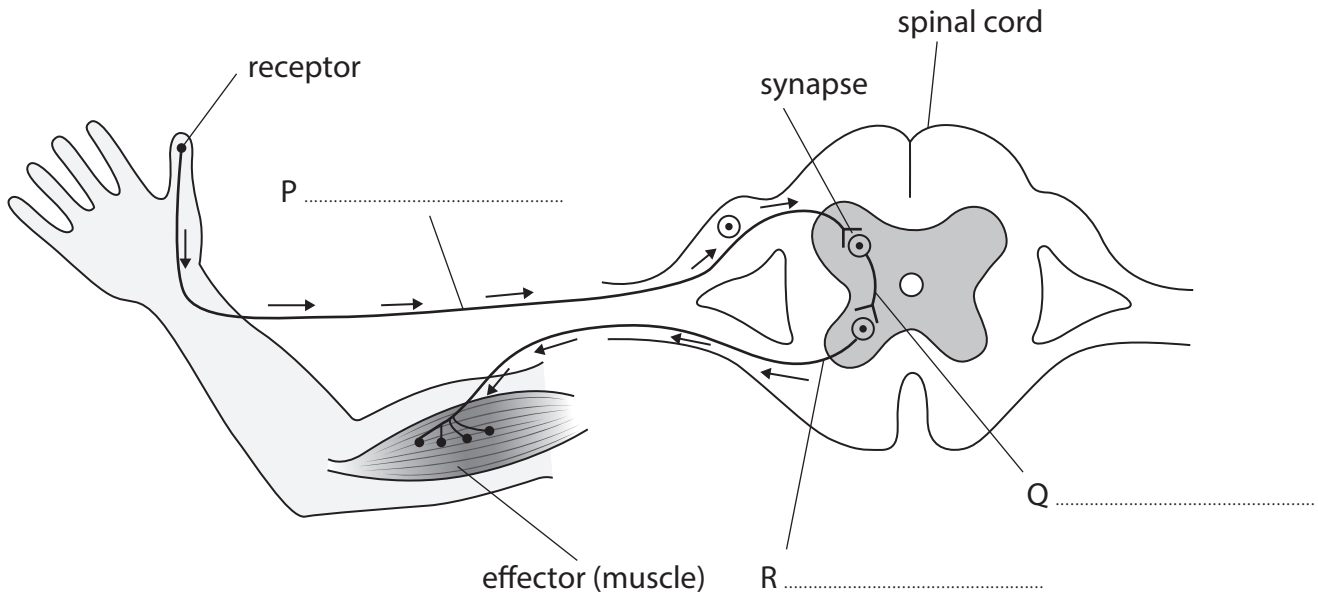


5 Reflexes are rapid responses to stimuli.

(a) The diagram shows a reflex arc.

Add the names of neurones P, Q and R to the diagram of the reflex arc.

(2)



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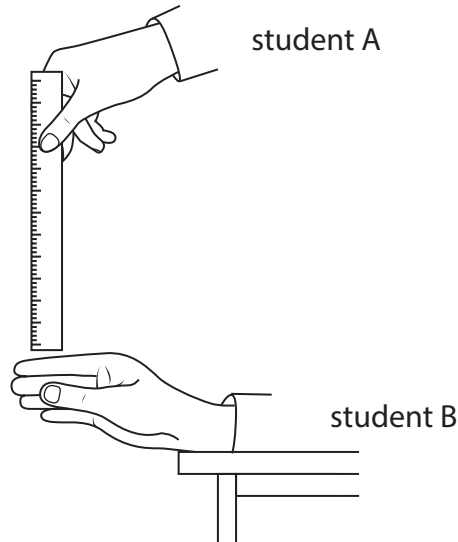
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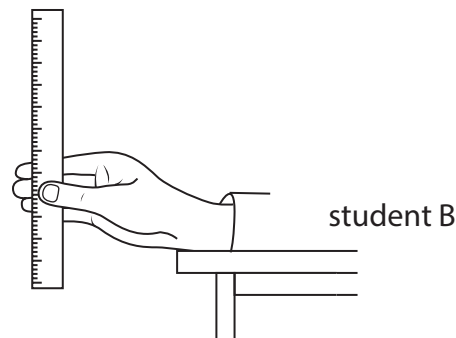
- (b) Two students, A and B, compare the speed of a reflex using sight as a stimulus compared with using touch as a stimulus.

This is the students' method.

- student A holds a ruler between the thumb and first finger of student B



- student A drops the ruler
- student B catches the ruler as soon as they see it move



- student A records the distance the ruler falls
- student B then closes their eyes
- student A holds the ruler so it is touching the first finger of student B
- student A drops the ruler and student B catches the ruler as soon as they feel it move
- student A records the distance the ruler falls

The students repeat the method seven more times.

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Table 1 shows their results.

Ruler drop number	Distance ruler falls in cm	
	sight as stimulus	touch as stimulus
1	5	14
2	7	14
3	9	12
4	5	15
5	9	15
6	7	20
7	8	18
8	9	18
mean	7.4	
median	7.5	

Table 1

- (i) Determine the mean distance and the median distance that the ruler falls when touch is the stimulus.

(2)

mean = cm

median = cm

- (ii) Use this formula to calculate the mean time taken, in seconds, to catch the ruler when sight is the stimulus.

Give your answer to two decimal places.

(1)

$$\text{mean time taken} = \sqrt{\frac{2 \times \text{mean distance ruler fell}}{980}}$$

time taken = s



- (iii) Table 2 shows the distances that impulses travel along all the neurones in both reflex arcs, from receptor to effector.

Stimulus	Distance impulse travels along all neurones in cm
sight	105
touch	250

Table 2

The students conclude that reflex arcs and impulses are faster for sight than for touch.

Comment on the students' conclusion.

(3)

- (iv) Explain if the students' results are reliable.

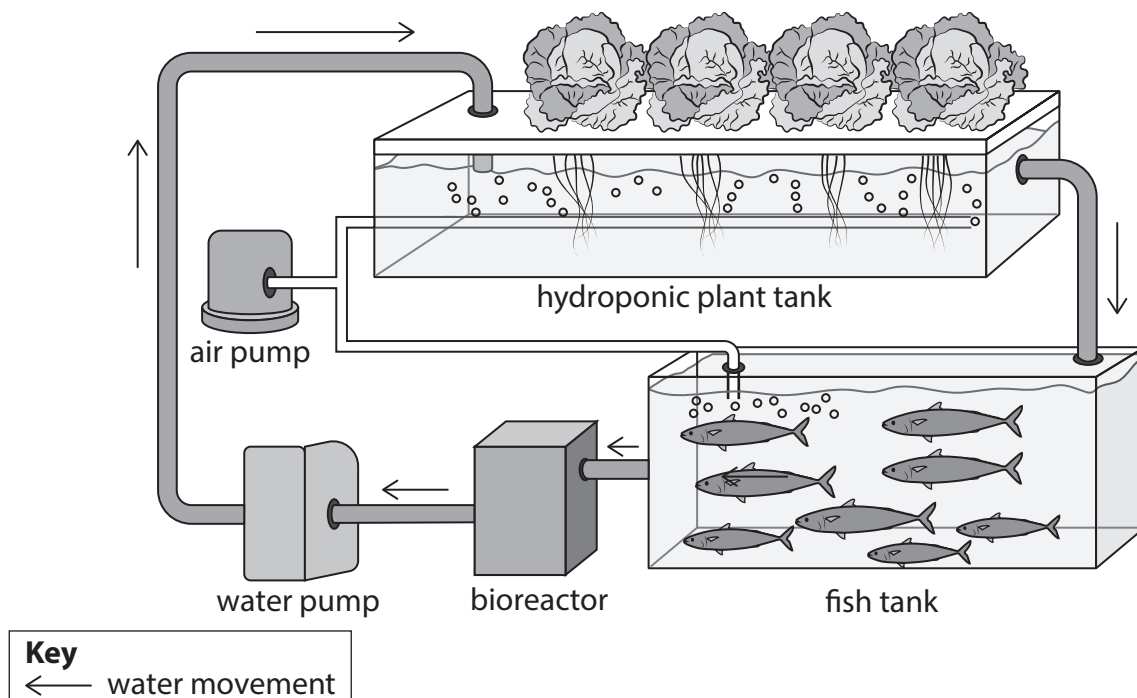
(2)

(Total for Question 5 = 10 marks)



- 6 The diagram shows an integrated aquaculture system that is used to produce fish and crop plants for human consumption in indoor glasshouses.

The fish are fed with protein pellets produced from plants.



- (a) (i) State the trophic level that the fish occupy in this food chain.

(1)

- (ii) The bioreactor in this system contains bacteria.

Water contaminated with food and faeces from the fish tank is used to make fertiliser in the bioreactor. This fertiliser is then pumped into the hydroponic plant tank.

One of the minerals in the fertiliser is nitrate.

Describe how bacteria produce nitrate from proteins in the faeces and waste food.

(3)



(iii) Explain why plants need nitrates for growth.

(2)

(iv) Explain why air is bubbled into the water that the plants are grown in.

(2)

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