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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)

Time 1 hour 15 minutes

Paper reference **4BI1/2B**

Biology

UNIT: 4BI1
PAPER: 2B

January 2022

You must have:
Calculator, ruler

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **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.
- Some questions must be answered with a cross in a box ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

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.

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

Making Enough Blood for the World

A blood transfusion is the transfer of blood from a donor into a patient. Blood transfusions are routine medical procedures that save the lives of millions of people every year.



(Source: beerkoff/Shutterstock)

The first successful blood transfusions were performed in the early twentieth century after scientists discovered that there are four main blood groups, A, B, AB and O. The blood groups are due to the presence of proteins, called antigens, on the surface of red blood cells. There are two main protein antigens called A and B. If a patient is given blood with antigens different to their own cells, their immune system will make antibodies against that antigen. The antigens present on the surface of red blood cells for each blood group are shown in the table.

Blood group	Antigens present
A	A
B	B
AB	A and B
O	neither A nor B

Currently, blood transfusions are carried out with blood that has been donated by healthy people. The World Health Organisation calculates that there are 118.5 million blood donations collected globally every year. Of these donations, 40% are collected from a small group of high-income countries. This means that there is a shortage of blood in many countries so the hunt is on to find an alternative.

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Scientists have found a way to make artificial red blood cells. They made spheres of cell membranes filled with haemoglobin. These artificial cells are then suspended in sodium chloride solution. These artificial red blood cells have no proteins on their surface. Another way of making red blood cells is being developed in the United Kingdom. A research team has used stem cells to produce red blood cells with blood group O. The red blood cells produced are then suspended in sodium chloride solution.

Both methods produce large quantities of safe red blood cells. There may be other advantages as well, artificial blood would always have the same concentration of solutes and will not clot when stored. Critics have pointed out that the artificial blood will only transport oxygen and that blood has many more functions.

(a) Name the type of cell that produces antibodies. (Lines 8 and 9)

(1)

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(b) Human blood groups are controlled by three alleles, I^A, I^B and I^O.
The I^A and I^B alleles are codominant and the I^O allele is recessive.

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

(1)

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(ii) Two parents have genotypes of I^AI^O and I^BI^O.

Which of these are all the possible blood groups of their children?

(1)

☒ **A** A and B

☒ **B** A, B and O

☒ **C** AB and O

☒ **D** A, B, AB and O

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(c) Calculate the number of blood donations collected per year from the high-income countries. (Lines 14 and 15)

Give your answer in standard form.

(2)

(d) Some scientists have suggested that spherical artificial red blood cells transport oxygen less efficiently than normal human red blood cells.

Explain why the shape of the artificial red blood cells reduces the efficiency of oxygen transport compared to normal human red blood cells. (Lines 18 and 19)

(3)

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(e) Suggest why artificial blood does not clot when stored. (Lines 26 and 27)

(1)

(f) Explain why the artificial red blood cells are suspended in sodium chloride solution instead of in water. (Line 20)

(2)

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(g) (i) Explain why stem cells can be used to make large quantities of red blood cells. (Lines 22 and 23)

(2)

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(ii) Suggest why the scientists made red blood cells with blood group O. (Lines 22 and 23)

(2)

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(h) Give two substances found in blood plasma that are not present in the artificial blood. (Lines 28 and 29)

(2)

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2 .....

(Total for Question 1 = 17 marks)

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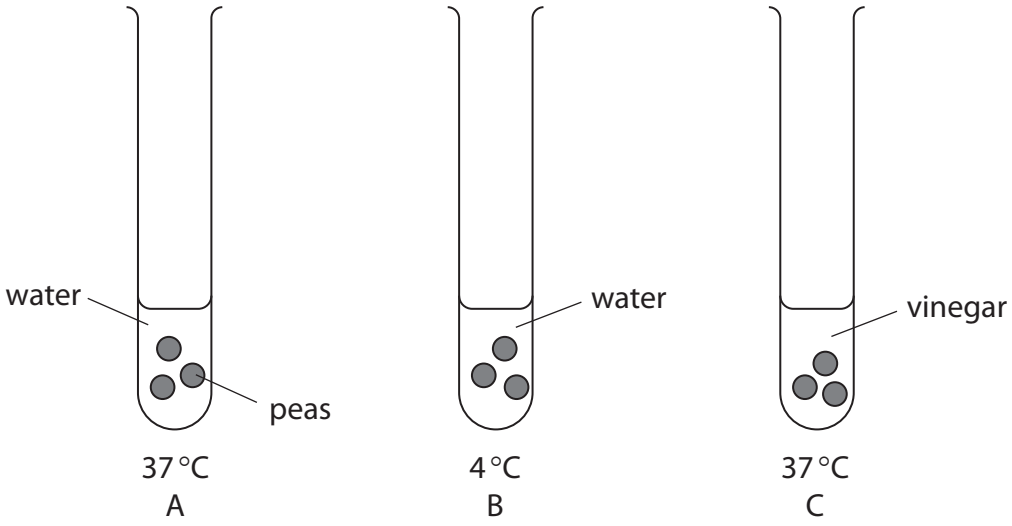
2 Food items can often be spoiled if saprotrophic microorganisms such as mould fungi grow on them.

(a) Describe how a saprotrophic fungus such as mould obtains its food.

(3)

(b) A student uses this method to investigate ways of preventing peas from being spoiled.

- place three peas in each of three test tubes as shown in the diagram
- cover the peas in test tube A with water and keep at 37 °C
- cover the peas in test tube B with water and keep at 4 °C
- cover the peas in test tube C with vinegar, which is a weak acid, and keep at 37 °C
- leave the peas for 24 hours



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The student observes the level of cloudiness of the solution to determine how spoiled the peas have become.
The level of cloudiness can be used as a measure of fungal growth.

The table shows the student's results.

Test tube	Conditions peas are kept in	Level of cloudiness
A	water at 37 °C	very cloudy
B	water at 4 °C	slightly cloudy
C	vinegar at 37 °C	no cloudiness

(i) Suggest a problem with using the level of cloudiness of the solution to determine how spoiled the peas have become.

(1)

(ii) Explain the appearance of the peas in water at 4 °C.

(2)

(iii) Explain the appearance of the peas in vinegar at 37 °C.

(2)

(Total for Question 2 = 8 marks)

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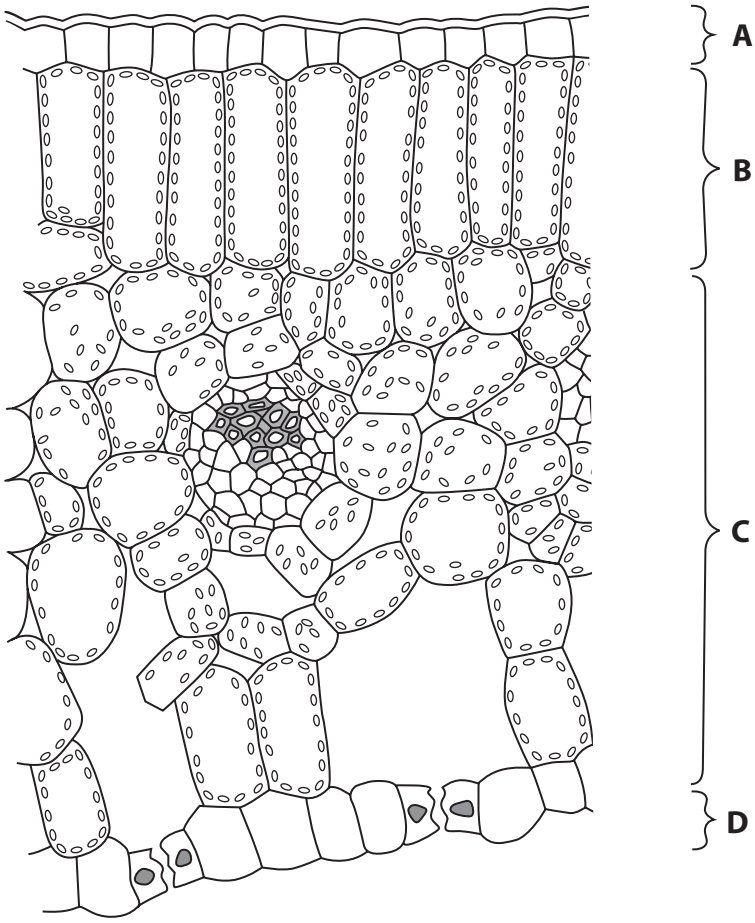
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3 The diagram shows a cross-section through a leaf.



(a) (i) Which layer contains palisade mesophyll cells?

(1)

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

(ii) Which set of environmental conditions would produce the fastest rate of transpiration from this leaf?

(1)

	Humidity	Temperature
☒ **A**	High	High
☒ **B**	High	Low
☒ **C**	Low	High
☒ **D**	Low	Low

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(b) Scientists investigate the effect of changing carbon dioxide concentration on the density of stomata of wheat plants.

They grow wheat plants from seed in different concentrations of carbon dioxide.

After three weeks, they take a leaf from each plant and calculate the mean density of stomata.

(i) State the independent variable in this investigation.

(1)

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(ii) Give two abiotic variables that the scientists could control.

(2)

1 .....

2 .....

(iii) To calculate the mean density of stomata, leaf sections are viewed with a microscope.

The number of stomata within six circular areas of the leaf are counted.

The results for one leaf are shown in the table.

Leaf area number	Per number of stomata
1	68
2	72
3	66
4	75
5	76
6	63

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The radius of each circular area is 0.40 mm.

area of circle = πr^2

[$\pi = 3.14$]

Calculate the mean density of stomata on the leaf surface.

(3)

mean density = ... stomata per mm^2

(iv) The investigation shows that in increased carbon dioxide concentrations there is a lower mean density of stomata.

The scientist concludes that in hot dry areas, with increased carbon dioxide concentrations, it would be an advantage for wheat to have a lower mean density of stomata.

Discuss the scientist's conclusion.

(4)

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(Total for Question 3 = 12 marks)

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4 Fish farming is often used to produce protein rich food.

(a) Selective breeding is often used to produce fish that grow rapidly and do not waste much food.

Explain how selective breeding can be used to produce fish that grow rapidly.

(2)

(b) Fish farming systems can often release ammonia into the water. The ammonia is converted into nitrates.

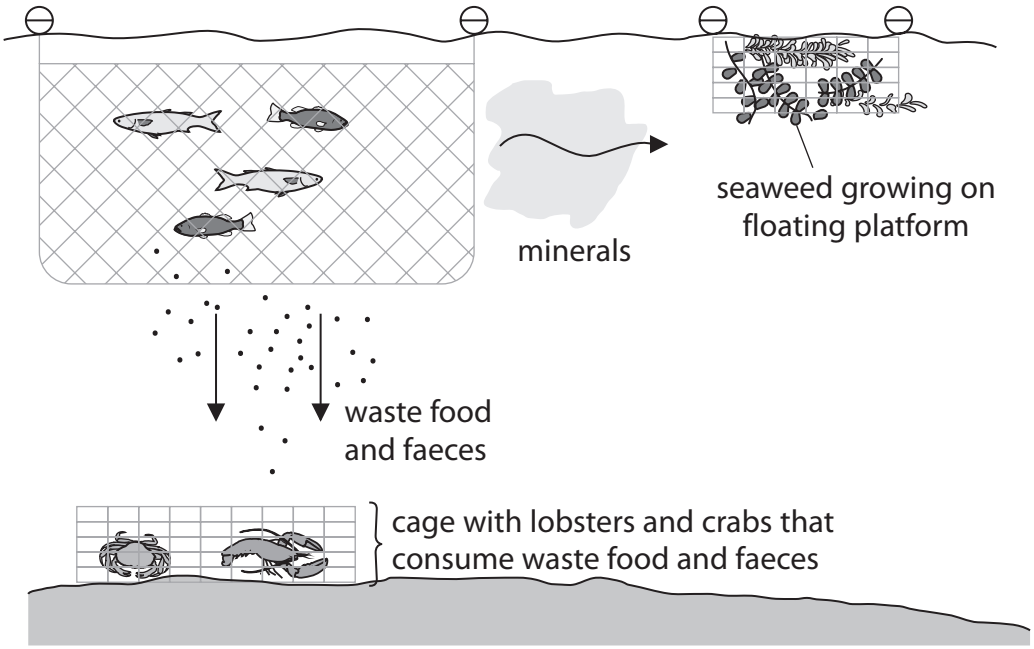
Describe how ammonia is converted into nitrates.

(2)

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(c) Multi-trophic level aquaculture is a method of fish farming that has been developed to reduce environmental pollution and increase profits.

The diagram shows a multi-trophic level aquaculture system.



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Explain how the multi-trophic level aquaculture system reduces environmental pollution, and increases the profits of fish farming.

Use information from the diagram and your own knowledge to support your answer.

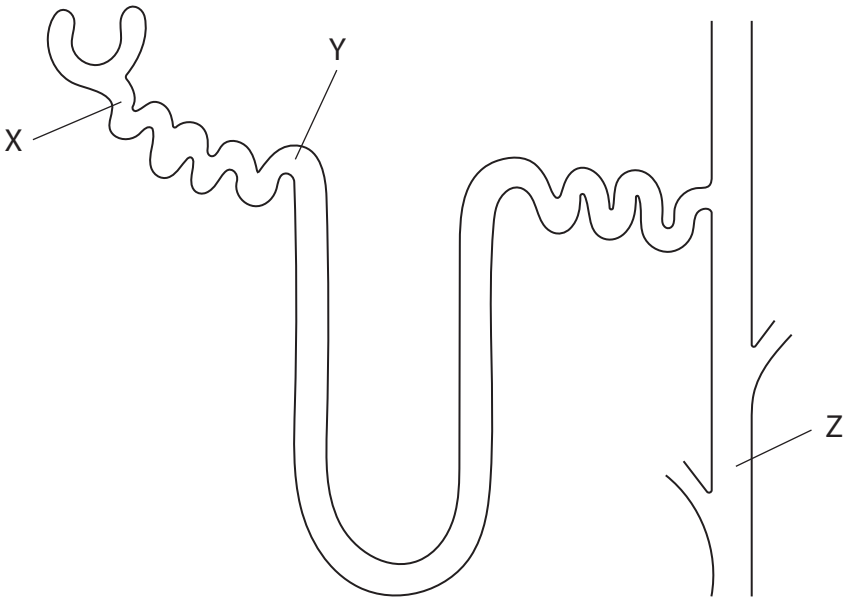
(5)

(Total for Question 4 = 9 marks)

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5 The diagram shows a nephron from a kidney with three different areas, X, Y and Z.



The table gives the concentration of glucose and urea at X, Y and Z.

Area of nephron	Concentration of glucose in mg per 100 cm^3	Concentration of urea in mg per 100 cm^3
X	90	32
Y	0	440
Z	0	1700

(a) Explain the difference in concentration of glucose between X and Y.

(3)

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(b) (i) Calculate how many times more concentrated the urea is in area Z compared to area Y.

Give your answer to two significant figures.

(2)

answer = ...

(ii) Explain the difference in urea concentration in the filtrate found in Y and Z.

(2)

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(c) High blood pressure during pregnancy can result in the production of urine that contains protein.

(i) Describe how a sample of urine could be tested to see if it contains protein.

(2)

(ii) Protein is not normally found in urine.

Suggest why high blood pressure could cause protein to be present in urine.

(2)

(Total for Question 5 = 11 marks)

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6 (a) The diagram shows one strand of DNA from a section of a gene.

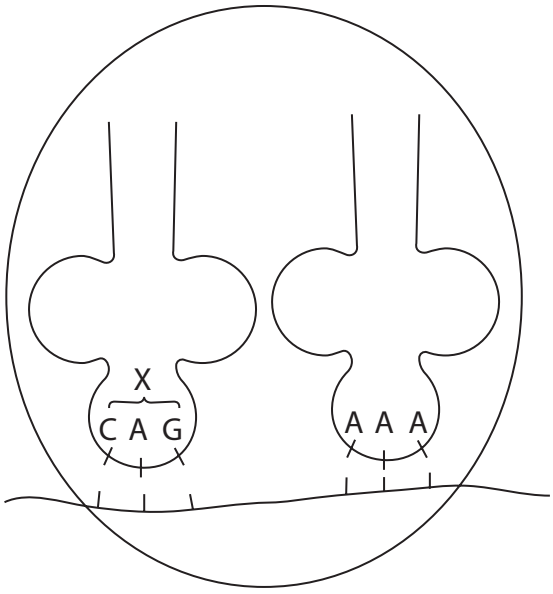
ATTCCGAGT

What would be the complementary sequence of bases on the messenger RNA produced from this strand of DNA?

(1)

- ☒ **A** TAAGGCTCA
- ☒ **B** ATTCCGAGT
- ☒ **C** UAAGGCUCA
- ☒ **D** AUUCCGAGU

(b) The diagram shows a stage during protein synthesis.



Which row gives the correct names for the stage of protein synthesis shown and the sequence of bases labelled X?

(1)

	Stage of protein synthesis	X
☒ **A**	transcription	anticodon
☒ **B**	transcription	codon
☒ **C**	translation	anticodon
☒ **D**	translation	codon

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(c) Explain how a mutation in a gene can affect the phenotype of an organism.

(3)

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(d) In an accident at a nuclear power station, radioactive material was released into the surrounding areas of land.

Scientists investigated the impact of this on a species of butterfly.



(Source: septembersun.123rf.com/PAL)

Samples of adult butterflies were collected from an area near the power station two months after the release of the radioactive material.

The percentages of butterflies with abnormalities were calculated.

The butterflies were then mated in the laboratory and the percentage of offspring with abnormalities calculated.

The experiment was repeated with butterflies collected from the same area, 10 months after the release of the radioactive material.

(i) Describe how the scientists could have sampled the population of butterflies in the area.

(3)

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(ii) The results of the investigation are shown in the table.

Butterfly generation	Percentage of butterflies with abnormalities	
	two months after the accident	ten months after the accident
adult	12.4	28.1
offspring	18.3	60.2

The scientists concluded that the increased level of radioactivity has led to an increased rate of mutation of DNA.

Discuss the scientists' conclusion referring to data from the table to support your answer.

(5)

(Total for Question 6 = 13 marks)

TOTAL FOR PAPER = 70 MARKS

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