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Please check the examination details below before entering your candidate information

Candidate surname	Other names

Pearson Edexcel International GCSE (9–1)

Centre Number | Candidate Number

Wednesday 13 January 2021

Morning (Time: 1 hour 15 minutes) | Paper Reference **4BI1/2BR**

Biology

Unit: 4BI1

Paper: 2BR

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.

Haemolytic disease

Haemolysis is the term used to describe the bursting of red blood cells. Haemolytic disease occurs when the red blood cells burst in the body of a foetus in a pregnant woman. The bursting of the red blood cells affects the development of the foetus into a baby.

The red blood cells burst when certain antibodies from the mother pass across the placenta. The antibodies attach to protein molecules called antigens. These antigens are on the surface of the foetal red blood cells. The protein antigen is called the rhesus factor and is made using the genetic code found on the dominant allele, D, during the production of red blood cells in bone marrow.

Homozygous dominant and heterozygous individuals have cells with the antigen. These individuals have the rhesus positive blood group. Homozygous recessive individuals have cells that do not have the antigen. These individuals have the rhesus negative blood group.

During the birth of a rhesus positive baby, some red blood cells may leak into the circulatory system of the mother. This happens as the placenta pulls away from the wall of the uterus. A rhesus negative mother will make antibodies that destroy rhesus positive red blood cells. This is not a problem for the child that has just been born. However, if the mother becomes pregnant again with another rhesus positive foetus, the antibodies will harm the foetus.

Haemolytic disease can be avoided by treating a rhesus negative woman at risk of having a second rhesus positive child. This treatment involves the mother having an injection during and after pregnancy. The injection destroys rhesus positive cells in the mother's blood before the cells can cause an immune response.

If the foetus is rhesus positive, the pregnancy is carefully monitored for signs of haemolytic disease. Monitoring includes regular ultrasound scans of the foetus and measuring the amount of antibody in the mother's blood. A change in the concentration of the antibody in the mother's blood, due to her secondary immune response, can lead to dangerous haemolysis. If a foetal blood test confirms a low number of red blood cells, a blood transfusion can be done *in utero* to replace the burst foetal red blood cells.

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(a) Explain why bursting of red blood cells affects the development of a foetus (lines 3 and 4).

(2)

(b) The dominant allele codes for the production of the protein that will act as an antigen.

Describe how the dominant allele leads to the production of RNA during protein synthesis (lines 7 to 9).

(3)

(c) Give the reason why proteins cannot be made by red blood cells (lines 7 to 9).

(1)

(d) Give one piece of evidence from the passage that shows that antibodies are smaller than red blood cells.

(1)

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(e) (i) A mother who is homozygous recessive for the rhesus factor has a child with a father who is heterozygous.

Give the genotypes of the mother, the father, their gametes and the possible genotypes of the child.

(3)

(ii) Give the probability that the child will be rhesus positive.

(1)

(f) Explain why the concentration of the rhesus antibody in the mother's blood rises quickly to harmful levels if she has a second child who is Rhesus positive (lines 16 to 19).

(3)

(g) Suggest what is meant by the term *in utero* (line 30).

(1)

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(h) A foetus with haemolytic disease can be given a blood transfusion.

Suggest the blood group of the source of the cells used for this transfusion (lines 29 and 30).

(1)

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(Total for Question 1 = 16 marks)

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2 A student investigates the rate of evaporation from a clay pot and the rate of transpiration by a plant. The clay pot is porous and has small holes that allow water to evaporate.

The student keeps the clay pot and the plant in the same conditions next to a closed window. He measures the rates at different times of the day.

The table shows the student's results.

Time of day	Rate of evaporation from clay pot in cm^3 per hour	Rate of transpiration from a plant in cm^3 per hour
02 00 to 03 00	0.8	14
06 00 to 07 00	3.9	93
14 00 to 15 00	9.5	198
22 00 to 23 00	3.4	19

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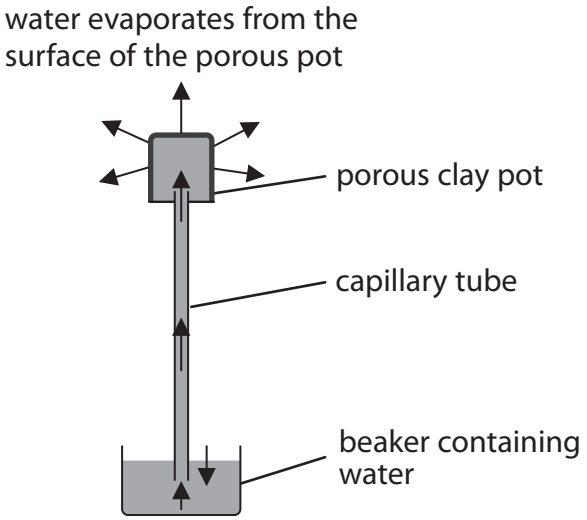
(a) The student uses this apparatus to measure the rate of evaporation from the clay pot.



(i) Explain the changes in the rate of evaporation from the clay pot.

(2)

(ii) Suggest how the student could measure the rate of evaporation from the clay pot.

(3)

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(b) (i) Explain one factor that affects transpiration from the plant that does not affect evaporation from the clay pot.

(2)

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(ii) Draw a labelled diagram of the apparatus the student could use to determine the rate of transpiration by a plant.

(4)

(Total for Question 2 = 11 marks)

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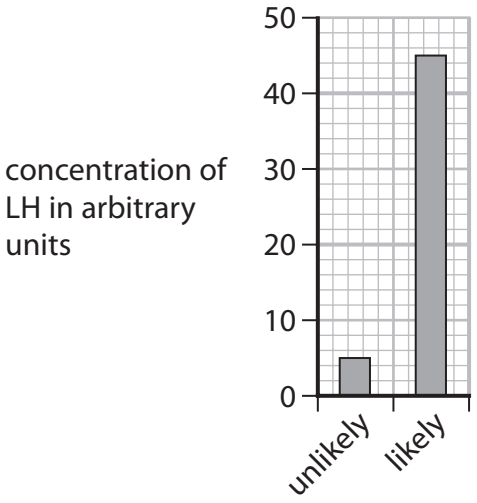
3 The hormones FSH and LH are involved in the regulation of the menstrual cycle.

(a) Which row gives the correct source for each hormone?

(1)

		Source of FSH	Source of LH
☒	**A**	ovary	pituitary
☒	**B**	ovary	ovary
☒	**C**	pituitary	pituitary
☒	**D**	pituitary	ovary

(b) The graph shows the concentration of LH in the blood of a woman when she is unlikely to become pregnant and when she is likely to become pregnant.



Calculate the percentage increase in concentration of LH in the blood from when the woman is unlikely to become pregnant to when the woman is likely to become pregnant.

(2)

percentage increase = ... %

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(c) Describe the roles of the hormones FSH and LH.

(4)

FSH.....

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LH.....

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(Total for Question 3 = 7 marks)

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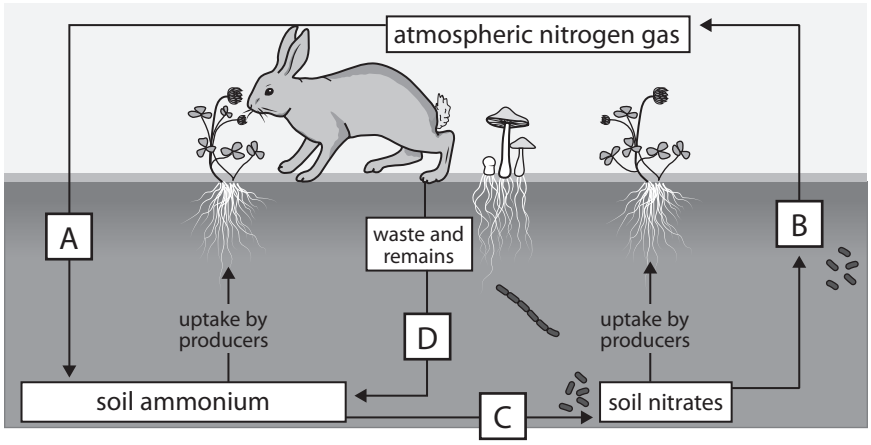
4 (a) The diagram shows the nitrogen cycle with four processes labelled A, B, C and D.



(Source: https://www.shutterstock.com/image-vector/diagram-nitrogen-cycle-process-by-which-1400843660)

(i) Which process is nitrogen fixation?

(1)

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

(ii) Which process is decomposition?

(1)

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

(iii) Which process is nitrification?

(1)

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

(iv) Name a type of organism that carries out process C.

(1)

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(b) A student does an investigation to determine if nitrate ions are required for plant growth.

He uses this method.

Step 1 Use a measuring cylinder to add 10 cm^3 of the control solution containing all the minerals a plant requires to a test tube

Step 2 Cover the top of the tube with foil

Step 3 Make a small hole in the foil

Step 4 Push the root of a germinated bean seedling through the hole so it is in the solution

Step 5 Rinse the measuring cylinder with distilled water

Step 6 Repeat Steps 1 to 4 using a test solution containing all the mineral a plant requires apart from nitrate ions

Step 7 Wrap both tubes in black paper

Step 8 Place both tubes in a test tube rack in bright sunlight

(i) Explain why the control solution contains all the mineral ions the plant requires but the test solution contains all the mineral ions the plant requires except nitrate.

(2)

(ii) State the purpose of Step 5.

(1)

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(iii) Explain the purpose of Step 7.

(2)

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(iv) Explain the measurements that the student could make to determine if nitrate ions are required for plant growth.

(2)

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(Total for Question 4 = 11 marks)

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5 Many mammals have been cloned since Dolly the sheep was produced by cloning in 1996.

(a) It took 277 attempts at cloning to produce one sheep.

Calculate how many attempts would have been needed to produce 50 cloned sheep in 1996.

Assume the same number of attempts are needed to produce each sheep as were needed to produce Dolly.

(1)

number of attempts = ...

(b) Describe the stages used to clone a male dog.

(5)

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(c) Pet owners can now pay scientists to use cells from their pet to produce a clone.

The process costs $50 000 for a dog and $25 000 for a cat.

Cloning is not always successful and as with Dolly, many attempts may need to be made to produce one clone.

Many scientists disagree with this use of cloning.

Comment on whether cloning of pets is a good idea.

Use the information in this question and your own knowledge to support your answer.

(4)

(Total for Question 5 = 10 marks)

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6 Pyramids of biomass and energy transfer are ways of representing what happens in an ecosystem.

(a) Diagram 1 shows pyramids of biomass for a crop field ecosystem and for a coral reef ecosystem.

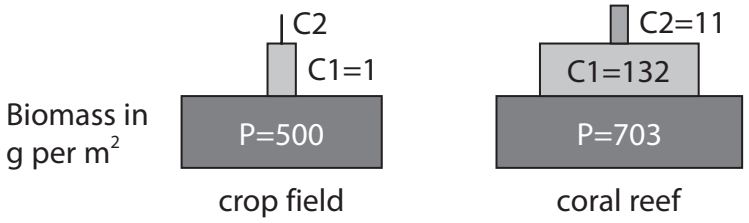

Diagram 1

(i) Use data from Diagram 1 to calculate the efficiency of the transfer of biomass from producers (P) to primary consumers (C1) in the coral reef.

(1)

producer to primary consumer = ... %

(ii) The efficiency of the transfer of biomass from primary consumers (C1) to secondary consumers (C2) in the crop field is 1%.

Calculate the biomass of the secondary consumers in the crop field in g per m^2.

(1)

biomass = ... g per m^2

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(iii) Suggest why the biomass transfer is different in the coral reef compared to the crop field.

(1)

(b) Diagram 2 shows pyramids of biomass for an ocean and a lake.

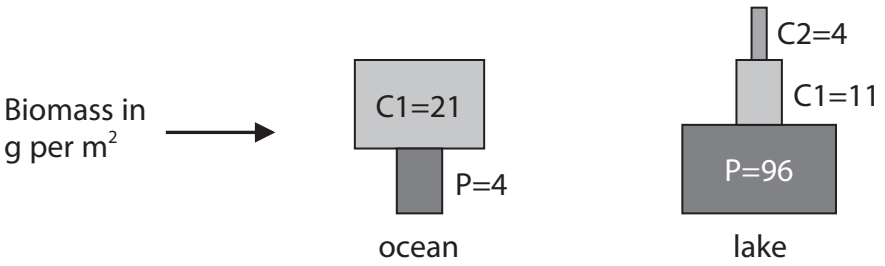

Diagram 2

Explain the shape of the pyramid of biomass for the ocean.

(2)

(c) Suggest how scientists could estimate the energy of the producers in 1 m^2 of the crop field.

(2)

(Total for Question 6 = 7 marks)

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7 The human kidney is an organ that is able to process excretory products from human metabolism.

(a) Concentration of urine is calculated using this formula.

$$\text{concentration in milliosmoles per dm}^3 = \frac{\text{amount of waste in milliosmoles}}{\text{volume in dm}^3}$$

The amount of waste the kidneys produce per day is 600 milliosmoles.

The maximum concentration that the human kidneys can produce is 1400 milliosmoles per dm^3.

Calculate the minimum volume of urine that must be produced each day.

Give your answer in cm^3.

(2)

minimum volume = ... cm^3

(b) Name another organ that carries out excretion in the human body.

(1)

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(c) Explain the role of the nephron in osmoregulation.

(5)

(Total for Question 7 = 8 marks)

TOTAL FOR PAPER = 70 MARKS

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