

Biology
UNIT: 4BI1
Science (Double Award) 4SD0
PAPER: 1BR

Total Marks

Time: 2 hours

In the boxes below, write your name, centre number and candidate number.

Surname					
Other names					
Centre Number					
Candidate Number					

YOU MUST HAVE

Calculator, ruler

YOU WILL BE GIVEN

Diagram Booklet

INSTRUCTIONS

Answer ALL questions.

Answer the questions in the spaces provided in this Question Paper or in the separate Diagram Booklet – 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 110.

The marks for EACH question are shown in brackets – use this as a guide as to how much time to spend on each question.

There may be spare copies of some diagrams.

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.

Answer ALL questions.

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 ☒.

- 1 Look at the diagram for Question 1 in the Diagram Booklet. It shows a root cell from a plant with structures labelled W, X, Y and Z.**

- (a) (i) Which structure is the nucleus?
(1 mark)**

☐ **A W**

☐ **B X**

☐ **C Y**

☐ **D Z**

(continued on the next page)

1 continued.

(ii) Which structure is NOT found in human white blood cells?

(1 mark)

☐

A W

☐

B X

☐

C Y

☐

D Z

(iii) Which molecule is the storage carbohydrate in the root cell?

(1 mark)

☐

A glucose

☐

B glycerol

☐

C glycogen

☐

D starch

(continued on the next page)

Turn over

1 continued.

(b) The actual width of the cell from P to Q is $125\mu\text{m}$.

**Determine the magnification of the diagram.
(3 marks)**

[1 mm = $1000\mu\text{m}$]

magnification = _____

(Total for Question 1 = 6 marks)

2 Yeast cells can be genetically modified to produce the proteins found on the outside of viruses.

(a) (i) Yeast is a single-celled organism.

A yeast cell has a nucleus, and the cell wall is made of chitin.

Which group of organisms does yeast belong to?

(1 mark)

- ☐ **A animals**
- ☐ **B fungi**
- ☐ **C plants**
- ☐ **D protoctists**

(ii) Give a reason why viruses are not considered to be living organisms.

(1 mark)

(continued on the next page)

2 continued.

(continued on the next page)

2 continued.

- (b) A species of yeast is genetically modified to produce a protein found on the outside of a hepatitis B virus.**

This protein is used to make vaccines to prevent people being infected with hepatitis B.

The gene for this protein is inserted into a plasmid.

This plasmid is then used to modify the yeast cells.

Give the roles of two named enzymes used to produce plasmids containing the gene for the hepatitis B protein.

(2 marks)

(continued on the next page)

2 continued.

(continued on the next page)

2 continued.

(c) Look at the diagram for Question 2(c) in the Diagram Booklet. It shows an industrial fermenter that can be used to grow large quantities of genetically modified yeast.

**(i) Explain the function of the temperature monitor and cooling jacket.
(3 marks)**

(continued on the next page)

Turn over

2 continued.

**(ii) Explain why air is needed in the fermenter.
(2 marks)**

**(iii) Explain why the air is filtered before going
into the fermenter.
(2 marks)**

(continued on the next page)

Turn over

2 continued.

(Total for Question 2 = 11 marks)

- 3 Look at the diagram for Question 3 in the Diagram Booklet. It shows part of a food web from an ecosystem in a region of North America.**

**(a) (i) Which of these organisms in the food web is a primary consumer?
(1 mark)**

☐ **A beaver**

☐ **B coyote**

☐ **C grass**

☐ **D wolf**

**(ii) State what is meant by the term ECOSYSTEM.
(1 mark)**

(continued on the next page)

3 continued.

(b) Wolves were hunted in this region of North America until they became extinct in 1926.

The extinction of wolves damaged the ecosystem in these ways.

- the population of mice, hawks and beavers decreased**
- the population of producer species decreased**

Beavers are important in this ecosystem because they cut down old trees and create shelters that other organisms nest in.

**Discuss why the extinction of wolves damaged the ecosystem.
(4 marks)**

(continued on the next page)

Turn over

3 continued.

This image shows a blank sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

(continued on the next page)

Turn over

3 continued.

(c) In 1995, 14 wolves were reintroduced to this region.

Look at the diagram for Question 3(c) in the Diagram Booklet. It shows the change in wolf population from 1996 to 2016.

**(i) Calculate the percentage change in the wolf population between 1996 and 2004.
(2 marks)**

percentage change = _____ %

(continued on the next page)

Turn over

3 continued.

- (ii) Suggest why the wolf population changed between 2004 and 2012.
(2 marks)**

(continued on the next page)

3 continued.

- (iii) The reintroduction of wolves caused changes in the populations of some plant species.**

**Describe how the population size of a plant species in the region could be determined.
(3 marks)**

(continued on the next page)

Turn over

3 continued.

(Total for Question 3 = 13 marks)

- 4 (a) Look at the diagram for Question 4(a) in the Diagram Booklet. It shows part of a human thorax with structures labelled R and S.**

**(i) What is the name of structure R?
(1 mark)**

- ☐ **A bronchiole**
- ☐ **B bronchus**
- ☐ **C oesophagus**
- ☐ **D trachea**

**(ii) Explain how changes in structure S enable a person to breathe in.
(3 marks)**

(continued on the next page)

Turn over

4 continued.

(continued on the next page)

4 continued.

(b) A scientist uses this method to investigate the effect of exercise on the ventilation rate of a person.

Step 1: rest for 10 minutes

Step 2: measure the volume of air in each breath

Step 3: measure the breathing rate

Step 4: ride a bicycle at 15 kilometres per hour for 10 minutes

Step 5: measure the volume of air in each breath

Step 6: measure the breathing rate

The scientist repeats Step 4, Step 5 and Step 6 at increasing cycling speeds.

Look at the table for Question 4(b) in the Diagram Booklet. It shows some of the results.

(continued on the next page)

4 continued.

- (i) State the independent variable in the investigation.
(1 mark)**

(continued on the next page)

4 continued.

- (ii) At a cycling speed of 35 km per hour the person has a breathing rate of 25 breaths per minute.**

They also have a ventilation rate of 65 dm^3 per minute.

Calculate the volume of air, in cm^3 , in each breath.

(2 marks)

$[1 \text{ dm}^3 = 1000 \text{ cm}^3]$

volume = _____ cm^3

(continued on the next page)

Turn over

4 continued.

(iii) Comment on the effect of increasing cycling speed on ventilation rate.

**Refer to the data in the table in your answer.
(4 marks)**

(continued on the next page)

Turn over

4 continued.

**(iv) State how the scientist could make the investigation more reliable.
(1 mark)**

(Total for Question 4 = 12 marks)

- 5 This question is about a variety of chicken called a silkie chicken.**

Silkie chickens have feathers that have a fluffy appearance.

Feather structure is controlled by a single gene.

The allele for producing silkie feathers (f) is recessive to the allele for producing normal feathers (F).

- (a) (i) State what is meant by the term GENE.
(1 mark)**

- (ii) Give the possible genotypes of a chicken with normal feathers.
(1 mark)**

(continued on the next page)

5 continued.

(b) A scientist investigates the inheritance of feather types in chickens.

Look at the diagram for Question 5(b) in the Diagram Booklet. It shows a family pedigree for some chickens.

**(i) How many chickens in the family pedigree are heterozygous?
(1 mark)**

☐ **A 0**

☐ **B 3**

☐ **C 4**

☐ **D 5**

(continued on the next page)

5 continued.

- (ii) Use a genetic diagram to determine the probability of one of the offspring of individual 6 and individual 7 being a chicken with silkie feathers.
(4 marks)**

probability = _____

(continued on the next page)

Turn over

5 continued.

(iii) The scientist observes that the chickens have either normal feathers or silkie feathers.

However, the chickens have a wide range of different heights.

**Explain why there is a wider range of variation in height than in feather type.
(3 marks)**

(Total for Question 5 = 10 marks)

Turn over

6 (a) Look at the diagram for Question 6(a)(i) in the Diagram Booklet. It shows the human alimentary canal with structures labelled X, Y and Z.

**(i) Which of these structures produce amylase?
(1 mark)**

☐ **A X only**

☐ **B X and Y**

☐ **C X and Z**

☐ **D Y and Z**

(ii) Look at Table 1 for Question 6(a)(ii) in the Diagram Booklet. It gives the names of some enzymes, the molecules they digest, and the products formed.

**Complete Table 1 by giving the missing information.
(3 marks)**

(continued on the next page)

6 continued.

(b) Look at Table 2 for Question 6(b) in the Diagram Booklet. It shows the recommended daily amounts (RDA) of some dietary components for a person.

Table 2 also shows the actual amounts of these dietary components in a person's diet in one day.

(continued on the next page)

6 continued.

- (i) One 100 g serving of lentils provides 25 g of protein.**

Calculate the mass of lentils that contains 46 g of protein.

(2 marks)

mass of lentils = _____ g

(continued on the next page)

Turn over

6 continued.

- (ii) Discuss the possible long-term effects of this person eating the same diet every day.
(5 marks)**

(continued on the next page)

Turn over

6 continued.

(continued on the next page)

6 continued.

- (iii) Suggest two reasons why the RDA for energy may not be the actual amount required by this person.
(2 marks)**

1 _____

2 _____

(Total for Question 6 = 13 marks)

7 The skin is an organ involved in temperature regulation.

**(a) State why the skin is described as an organ.
(1 mark)**

(b) Look at the diagram for Question 7(b) in the Diagram Booklet. It shows a section of human skin.

**(i) Explain how the skin capillaries regulate body temperature when the body temperature increases.
(3 marks)**

(continued on the next page)

7 continued.

(continued on the next page)

7 continued.

- (ii) Some people have suggested that drinking warm drinks may cool the body because it increases the rate of sweat production.**

Design an investigation to determine whether drinking warm drinks increases the rate of sweat production.

**Include experimental details in your answer and write in full sentences.
(6 marks)**

(continued on the next page)

Turn over

7 continued.

This image shows a blank sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.

(continued on the next page)

Turn over

7 continued.

(Total for Question 7 = 10 marks)

8 A student uses this method to investigate the effect of fertiliser on the growth of plant seedlings.

- **set up two trays with an equal mass of compost in each tray**
- **plant 100 seeds, equally spaced, in each tray**
- **place the trays under the same lamp until the seeds start to germinate**
- **water each tray every day with the same volume of water**
- **add fertiliser to one of the trays every day**
- **remove five seedlings from each tray every four days for a period of 20 days**
- **dry these seedlings in an oven and find their mass**

Look at the table for Question 8 in the Diagram Booklet. It shows the student's results.

(continued on the next page)

8 continued.

- (a) (i) Give two abiotic variables that the student controls.
(2 marks)**

1 _____

2 _____

- (ii) The student dries the seedlings in an oven to find their dry mass.**

**Suggest why it is important to use dry mass in this investigation.
(2 marks)**

(continued on the next page)

Turn over

8 continued.

(continued on the next page)

8 continued.

- (b) (i) Look at the grid for Question 8(b)(i) in the Diagram Booklet. Plot a line graph to show the dry mass of seedlings without fertiliser and the dry mass of seedlings with fertiliser, from day 4 to day 20.**

Use a ruler to join your points with straight lines.

(5 marks)

- (ii) The fertiliser contains magnesium ions and nitrate ions.**

Explain the effect of these two ions on the growth of the seedlings.

(4 marks)

(continued on the next page)

Turn over

8 continued.

(Total for Question 8 = 13 marks)

9 (a) Look at the diagram for Question 9(a) in the Diagram Booklet. It shows a pea flower with structures labelled X and Y.

**(i) Give the names of structures X and Y.
(2 marks)**

X _____

Y _____

**(ii) Explain how two structures, present in the diagram, show how the flower is pollinated.
(3 marks)**

(continued on the next page)

9 continued.

(continued on the next page)

9 continued.

(b) A scientist uses this method to compare the carbohydrates present in ungerminated and germinating pea seeds.

- carry out an iodine test and a Benedict's test on ungerminated seeds**
- soak another set of seeds in water and allow them to germinate in unsealed jars**
- after three days, carry out an iodine test and a Benedict's test on the germinating seeds**

Look at the table for Question 9(b) in the Diagram Booklet. It shows the scientist's results.

(continued on the next page)

9 continued.

- (i) State which carbohydrates the scientist identified in the ungerminated seeds and the germinating seeds.
(2 marks)**

ungerminated seeds

germinating seeds

- (ii) Explain the difference in the carbohydrate composition of the ungerminated seeds and the germinating seeds.
(3 marks)**

(continued on the next page)

Turn over

9 continued.

**(iii) Explain why the jars used in the investigation
are not sealed.
(2 marks)**

(Total for Question 9 = 12 marks)

Turn over

10 Red blood cells and white blood cells are two components of blood.

(a) Look at the diagram for Question 10(a) in the Diagram Booklet. It shows some red blood cells from a fish.

Human red blood cells have a biconcave shape. Fish red blood cells have a more rounded, sphere-like shape.

(i) Give a difference, other than shape, between the structure of fish red blood cells and human red blood cells.

(1 mark)

(continued on the next page)

10 continued.

- (ii) Explain why fish red blood cells transport oxygen less efficiently than human red blood cells.
(2 marks)**

(continued on the next page)

10 continued.

- (b) Llamas are large mammals that have evolved to live at high altitude where there is less oxygen in the atmosphere.**

The red blood cells of llamas can absorb more oxygen than the red blood cells of animals that live at low altitude.

**Explain how llamas have evolved by natural selection to live at high altitude.
(4 marks)**

(continued on the next page)

Turn over

10 continued.

(c) Phagocytes are white blood cells that are transported in the blood.

Describe the role of phagocytes in the body.
(3 marks)

(continued on the next page)

Turn over

10 continued.

(Total for Question 10 = 10 marks)

TOTAL FOR PAPER = 110 MARKS

END OF PAPER