Centre Number						Candidate Number				
Surname										
Other Names										
Candidate Signature										

For Examiner's Use	
Examiner's Initials	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
TOTAL	

General Certificate of Education
Advanced Subsidiary Examination
January 2010

Biology BIOL2

Unit 2 The variety of living organisms

Tuesday 19 January 2010 1.30 pm to 3.15 pm

For this paper you must have:
- a ruler with millimetre measurements.
- a calculator.

Time allowed
- 1 hour 45 minutes

Instructions
- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Answers written in margins or on blank pages will not be marked.
- You may ask for extra paper. Extra paper must be secured to this booklet.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 85.
- You will be marked on your ability to:
  – use good English
  – organise information clearly
  – use scientific terminology accurately.

Answer **all** questions in the spaces provided.

1 (a) Name the process in which cells become adapted for different functions.

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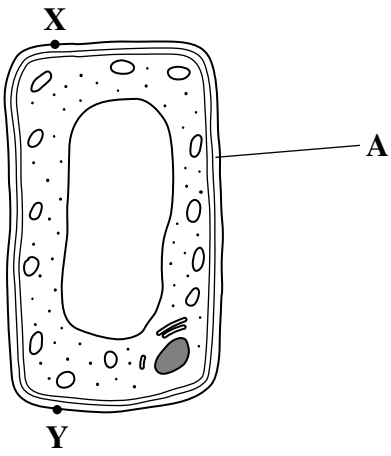
(1 mark)

1 (b) Palisade cells are found in leaves. The diagram shows a palisade cell.



1 (b) (i) Name structure **A**.

.....

(1 mark)

1 (b) (ii) The real length of this cell between **X** and **Y** is 20 micrometres (μm). By how many times has it been magnified? Show your working.

Answer .....

(2 marks)

1 (b) (iii) Explain **one** way in which this cell is adapted for photosynthesis.

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(1 mark)

5

2 In 2002, biologists identified a new group of insects. They called these insects gladiators.

2 (a) (i) *Mantophasma zephyra* is one species of gladiator. Complete the table to show how this species is classified.

Kingdom	Animalia
	Arthropoda
	Insecta
	Notoptera
Family	Mantophasmatodae
Species	

(2 marks)

2 (a) (ii) This system of classification consists of a hierarchy. Explain what is meant by a hierarchy.

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(2 marks)

2 (b) In 2002, very few gladiators were available for identification. Scientists around the world used photographs to establish the relationship of gladiators to other insects. Explain how.

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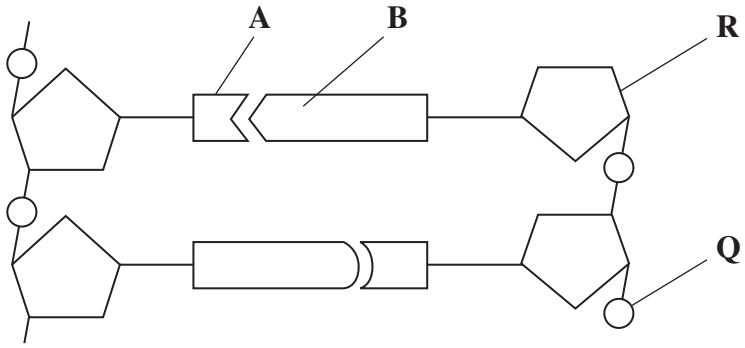
(1 mark)

5

Turn over ▶

3 **Figure 1** shows a short section of a DNA molecule.

Figure 1



3 (a) Name parts **R** and **Q**.

3 (a) (i) **R** .....

3 (a) (ii) **Q** .....

(2 marks)

3 (b) Name the bonds that join **A** and **B**.

.....

(1 mark)

3 (c) Ribonuclease is an enzyme. It is 127 amino acids long.

What is the minimum number of DNA bases needed to code for ribonuclease?

(1 mark)

3 (d) **Figure 2** shows the sequence of DNA bases coding for seven amino acids in the enzyme ribonuclease.

Figure 2

G T T T A C T A C T C T T C T T C T T T A

The number of each type of amino acid coded for by this sequence of DNA bases is shown in the table.

Amino acid	Number present
Arg	3
Met	2
Gln	1
Asn	1

Use the table and **Figure 2** to work out the sequence of amino acids in this part of the enzyme. Write your answer in the boxes below.

Gln						

(1 mark)

3 (e) Explain how a change in a sequence of DNA bases could result in a non-functional enzyme.

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(3 marks)

(Extra space) .....

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8

4 (a) An increase in respiration in the tissues of a mammal affects the oxygen dissociation curve of haemoglobin. Describe and explain how.

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(2 marks)

4 (b) There is less oxygen at high altitudes than at sea level.

4 (b) (i) People living at high altitudes have more red blood cells than people living at sea level. Explain the advantage of this to people living at high altitude.

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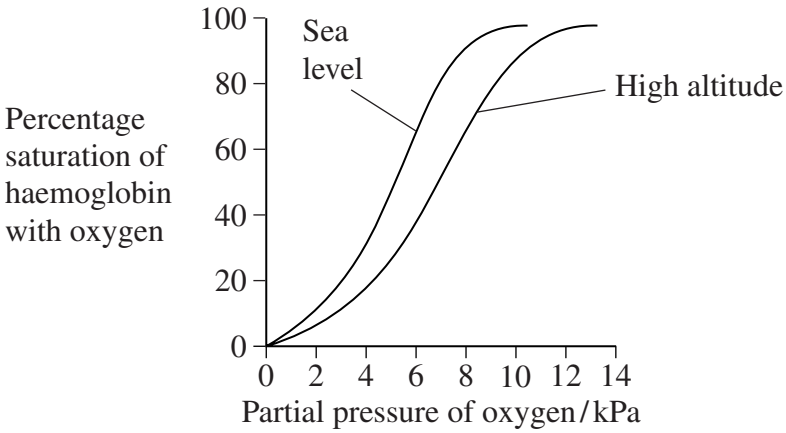
(2 marks)

4 (b) (ii) The graph shows oxygen dissociation curves for people living at high altitude and for people living at sea level.



Explain the advantage to people living at high altitude of having the oxygen dissociation curve shown in the graph.

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(2 marks)

6

5 A student found the number of stomata per cm^2 on the lower surface of a daffodil leaf. He removed a small, thin piece of lower epidermis and mounted it on a microscope slide. He examined the slide using an optical microscope.

5 (a) Explain why it was important that the piece of the epidermis that the student removed was thin.

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(2 marks)

5 (b) Suggest how the student could have used his slide to find the number of stomata per cm^2.

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(3 marks)

(Extra space) .....

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5 (c) The stomata on the leaves of pine trees are found in pits below the leaf surface. Explain how this helps to reduce water loss.

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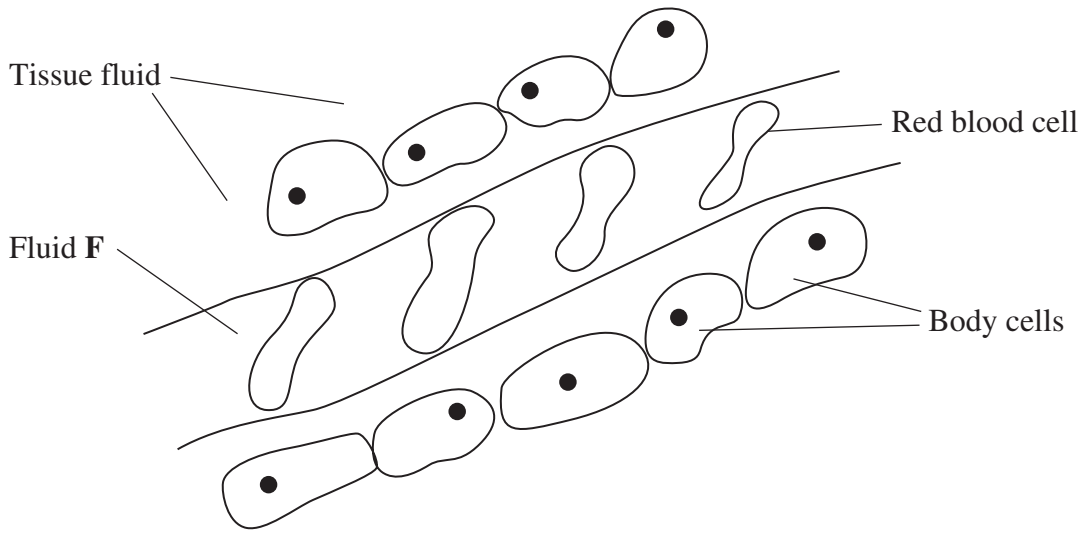
(2 marks)

7

6 The diagram shows tissue fluid and cells surrounding a capillary.



6 (a) Name fluid **F**.

.....

(1 mark)

6 (b) Give **one** way in which fluid **F** is different from tissue fluid.

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(1 mark)

6 (c) (i) The blood pressure is high at the start of the capillary. Explain how the left ventricle causes the blood to be at high pressure.

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(1 mark)

6 (c) (ii) The blood pressure decreases along the length of the capillary. What causes this decrease in pressure?

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(1 mark)

6 (d) In children, some diets may result in a low concentration of protein in fluid **F**. This can cause the accumulation of tissue fluid. Explain the link between a low concentration of protein in fluid **F** and the accumulation of tissue fluid.

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(3 marks)

(Extra space) .....

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7

Turn over for the next question

7 (a) Heath is a community of plants and animals. A student investigated the species diversity of plants in this community. The table shows her results.

Plant species	**Number of plants per m^2**
Heath rush	1
Bilberry	1
Sheep's sorrel	5
Ling	2
Bell heather	1
Heath bedstraw	8
Mat-grass	11

7 (a) (i) The index of diversity can be calculated from the formula

$$d = \frac{N(N-1)}{\sum n(n-1)}$$

where

d = index of diversity
N = total number of organisms of all species
n = total number of organisms of each species.

Use this formula to calculate the index of diversity for the plants on the heath. Show your working.

Answer .....

(2 marks)

7 (a) (ii) Explain why it may be more useful to calculate the index of diversity than to record only the number of species present.

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(2 marks)

7 (b) The demand for increased food production has led to areas of heath being used to grow wheat. Explain the effect of this on

7 (b) (i) the species diversity of plants

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(2 marks)

7 (b) (ii) the species diversity of animals.

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(2 marks)

8

Turn over ▶

8 (a) Gas exchange in fish takes place in gills. Explain how **two** features of gills allow efficient gas exchange.

1 .....

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2 .....

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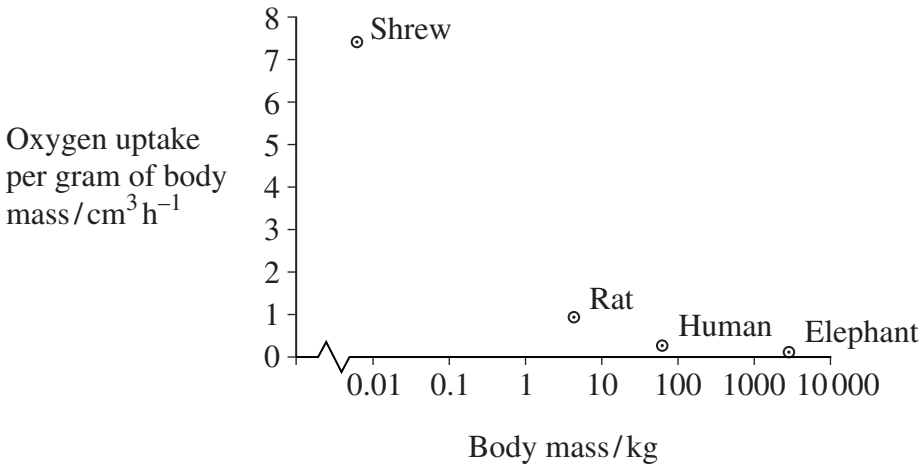
(2 marks)

8 (b) A zoologist investigated the relationship between body mass and rate of oxygen uptake in four species of mammal. The results are shown in the graph.



8 (b) (i) The scale for plotting body mass is a logarithmic scale. Explain why a logarithmic scale was used to plot body mass.

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(1 mark)

8 (b) (ii) Describe the relationship between body mass and oxygen uptake.

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(1 mark)

8 (b) (iii) The zoologist measured oxygen uptake per gram of body mass. Explain why he measured oxygen uptake per gram of body mass.

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(2 marks)

8 (b) (iv) Heat from respiration helps mammals to maintain a constant body temperature. Use this information to explain the relationship between body mass and oxygen uptake shown in the graph.

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(3 marks)

(Extra space) .....

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9

9 Taxol is a drug used to treat cancer. Research scientists investigated the effect of injecting taxol on the growth of tumours in mice. Some of the results are shown in **Figure 3**.

Figure 3

Number of days of treatment	Mean volume of tumour / mm^3	
	Control group	Group injected with taxol in saline
1	1	1
10	7	2
20	21	11
30	43	20
40	114	48
50	372	87

9 (a) Suggest how the scientists should have treated the control group.

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(2 marks)

9 (b) Suggest and explain **two** factors which should be considered when deciding the number of mice to be used in this investigation.

1 .....

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2 .....

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(2 marks)

9 (c) The scientists measured the volume of the tumours. Explain the advantage of using volume rather than length to measure the growth of tumours.

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(1 mark)

9 (d) The scientists concluded that taxol was effective in reducing the growth rate of the tumours over the 50 days of treatment. Use suitable calculations to support this conclusion.

(2 marks)

9 (e) In cells, taxol disrupts spindle activity. Use this information to explain the results in the group that has been treated with taxol.

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(3 marks)

(Extra space) .....

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Question 9 continues on the next page

9 (f) The research scientists then investigated the effect of a drug called OGF on the growth of tumours in mice. OGF and taxol were injected into different mice as separate treatments or as a combined treatment. **Figure 4** and **Figure 5** show the results from this second investigation.

Figure 4

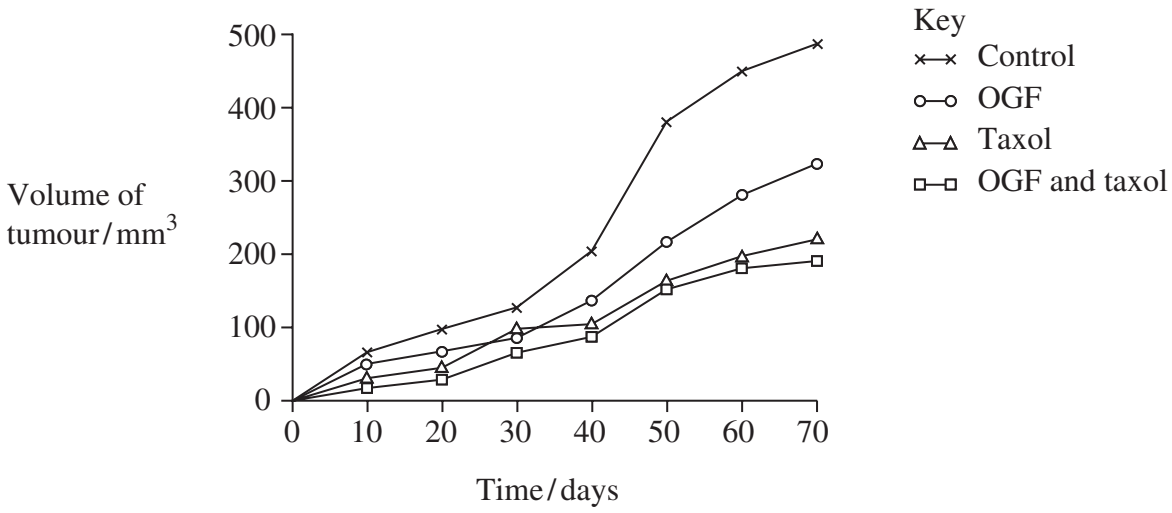

Figure 5

Treatment	**Mean volume of tumour following 70 days treatment / mm^3 (± standard deviation)**
OGF	322 (± 28.3)
Taxol	207 (± 22.5)
OGF and taxol	190 (± 25.7)
Control	488 (± 32.4)

9 (f) (i) What information does standard deviation give about the volume of the tumours in this investigation?

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(1 mark)

9 (f) (ii) Use **Figure 4** and **Figure 5** to evaluate the effectiveness of the two drugs when they are used separately and as a combined treatment.

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(4 marks)

(Extra space) .....

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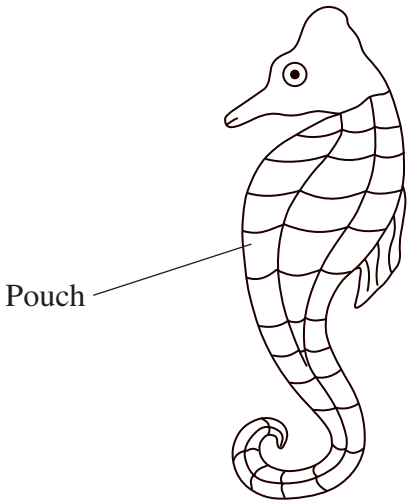
15

10 The diagram shows a seahorse. A seahorse is a fish. Mating in seahorses begins with courtship behaviour. After this, the female transfers her unfertilised eggs to the male's pouch.
Most male fish fertilise eggs that have been released into the sea. However, a male seahorse fertilises the eggs while they are inside his pouch. The fertilised eggs stay in the pouch where they develop into young seahorses.



10 (a) Give **two** ways in which courtship behaviour increases the probability of successful mating.

1 .....

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2 .....

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(2 marks)

10 (b) Give **one** way in which reproduction in seahorses increases the probability of

10 (b) (i) fertilisation

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(1 mark)

10 (b) (ii) survival of young seahorses.

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(1 mark)

Scientists investigated the effect of total body length on the selection of a mate in one Australian species of seahorse. The scientists used head length as a measure of total body length.

10 (c) (i) Use the diagram to suggest why the scientists measured head length rather than total body length.

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(1 mark)

10 (c) (ii) Suggest why the scientists were able to use head length as a measure of total body length.

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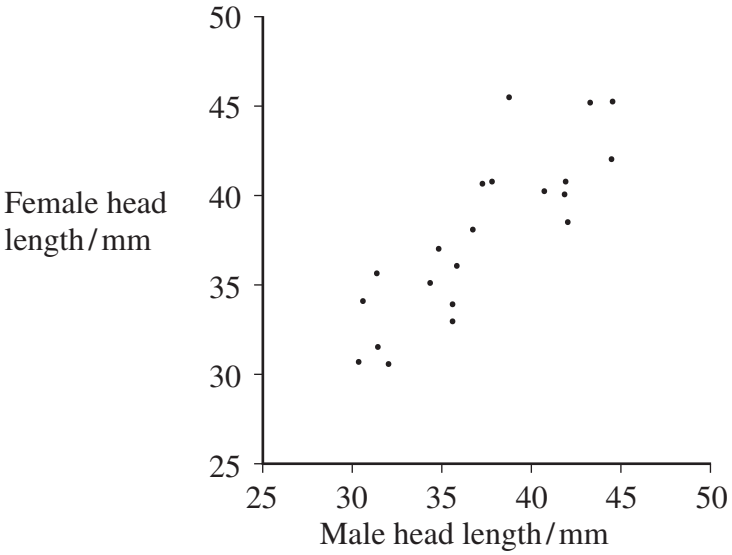
(1 mark)

The scientists measured the head lengths of the female and male of a number of pairs. The results are shown in the graph.



10 (d) The scientists concluded that total body length affects the selection of a mate. Explain how the results support this conclusion.

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(1 mark)

Question 9 continues on the next page

10 (e) A female with a head length of 50 mm selected a mate. Explain how you could use the graph to predict the total head length of the mate selected.

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(2 marks)

10 (f) Scientists studied two species of North American seahorse. They thought that these two species are closely related. Describe how comparisons of biological molecules in these two species could be used to find out if they are closely related.

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(6 marks)

(Extra space) .....

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END OF QUESTIONS

15

Write your name here

Surname	Other names

Edexcel GCE

Centre Number	Candidate Number

Biology

Advanced Subsidiary

Unit Test 2: Development, Plants & the Environment

Wednesday 14 January 2009 – Afternoon
Time: 1 hour 15 minutes

Paper Reference
6BI02/01

You do not need any other materials.

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.*

Information

- The total mark for this paper is 80.
- The marks for **each** question are shown in brackets
  – *use this as a guide as to how much time to spend on each question.*
- You will be assessed on your ability to organise and present information, ideas, descriptions and arguments clearly and logically, including your use of grammar, punctuation and spelling.
- Candidates may use a calculator.

Advice

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

Turn over ▶

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N 3 4 4 0 9 A 0 1 2 0

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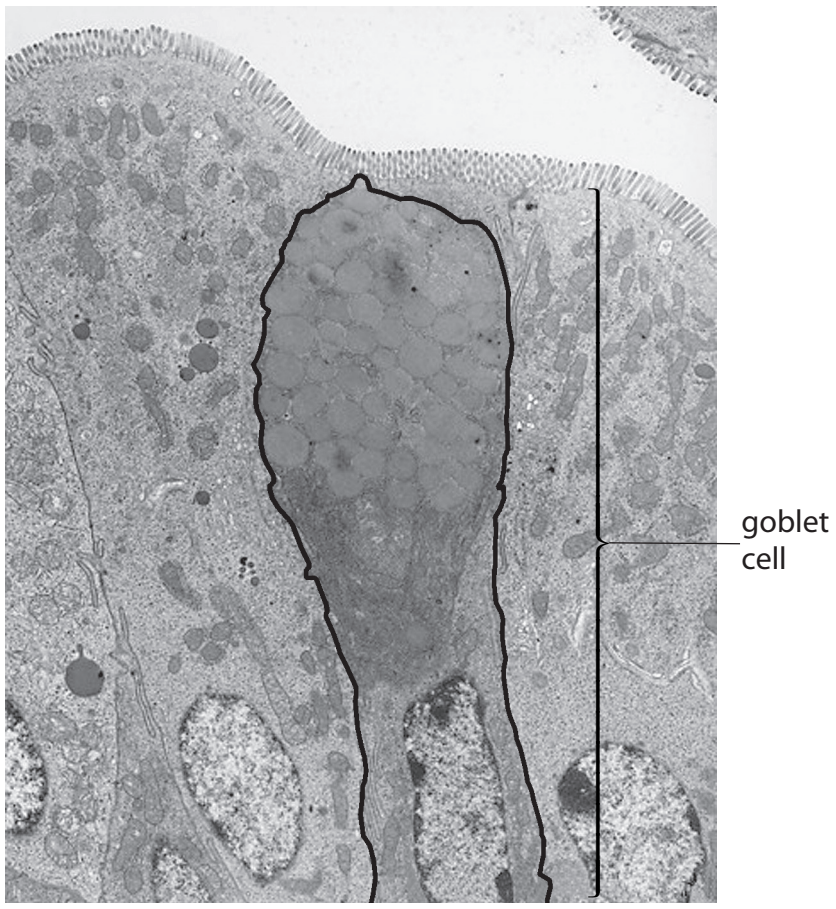
Answer ALL questions.

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 The photograph below shows some human epithelial tissue, as seen using an electron microscope. The tissue includes a goblet cell which contains a large number of Golgi apparatus.



magnification ×5000

(a) Explain the meaning of the term **tissue**.

(2)

1

2

3

(b) The Golgi apparatus of a goblet cell is involved in receiving protein, modifying it and then packaging the modified protein into vesicles.

(i) In the space below, draw a diagram of a Golgi apparatus. Add an arrow to your drawing to show the direction of movement of the protein material as it moves through the Golgi apparatus.

(3)

(ii) Proteins in a cell can be made radioactive by supplying the cell with radioactive amino acids. The movement of the radioactive protein within the cell can be traced over time.

In an investigation, it was found that the quantity of radioactivity in the protein that entered the Golgi apparatus was less than that supplied to the cell.

Suggest **three** reasons for this difference.

(3)

1 .....

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2 .....

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3 .....

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(Total for Question 1 = 8 marks)

2 In a study of plant structure, a leaf cell and a cell from a root tip were observed.

(a) Name **one** structure that may be found in a leaf cell that identifies it as **both** a eukaryotic cell **and** a plant cell.

(1)

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(b) The cell from the root tip was observed to be undergoing anaphase of mitosis.

(i) Describe **anaphase** of mitosis.

(3)

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(ii) During anaphase, the cell from the root tip did not have a nucleus but was still considered to be eukaryotic. Suggest **two** reasons why this cell was still considered to be eukaryotic.

(2)

1 .....

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2 .....

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(c) The table below shows the number of cells at each stage of the cell cycle in one sample of tissue taken from the growing region of a plant root.

Stage of the cell cycle	Number of cells in each stage	Percentage of cells in each stage (%)
Interphase	47	78.3
Prophase	3	5.0
Metaphase		3.3
Anaphase	1	1.7
Telophase	3	5.0
Cytokinesis		6.7
TOTAL	**60**	**100**

(i) Complete the table by calculating the number of cells undergoing metaphase and cytokinesis. Give your answer to the nearest whole number.

(2)

(ii) Using the table above, suggest which stage of the cell cycle takes the longest. Give a reason for your answer.

(2)

(iii) Suggest **one** reason why your answer to (c)(ii) may be unreliable.

(1)

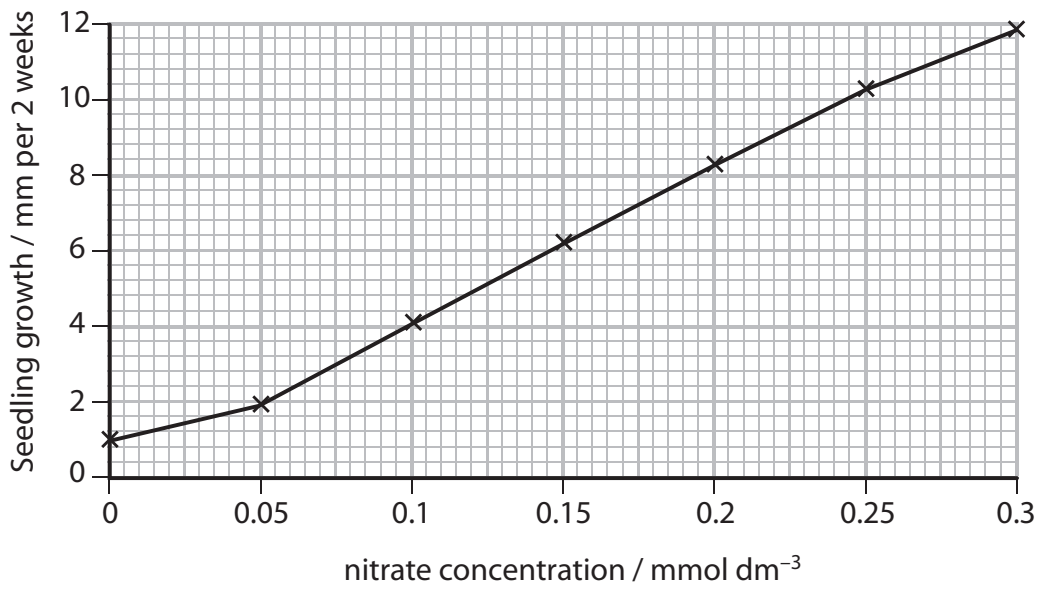
(Total for Question 2 = 11 marks)

3 A student investigated the effect of nitrate ion concentration on the growth of wheat seedlings.

She took seven wheat seedlings and measured the length from the shoot tip to the root tip of each seedling. She placed each seedling in a different test tube so that its roots were in a mineral ion solution. Each tube contained a mineral ion solution with a different concentration of nitrate ions.

She left the seedlings on a window sill for two weeks and then measured the new length between the shoot tip and the root tip of each seedling. She then calculated the difference between the final length and initial length of each wheat seedling.

The results are shown in the graph below.



(a) After her investigation, she said "I conclude that nitrates are needed for seedling growth and the higher the nitrate concentration the greater the growth."

(i) Give **one** piece of evidence from the graph that supports her conclusion.

(1)

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(ii) Give **one** piece of evidence from the graph that does not support her conclusion

(1)

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1

2

3

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(iii) State the nitrate ion concentration of the solution that acted as the control.

(1)

..... mmol dm^{-3}

(iv) Explain why it is better to use the difference in length as the measure of seedling growth rather than just the final length.

(1)

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(v) Suggest why calculating the difference between final mass and initial mass of each seedling may be an even better indicator of growth than measuring length.

(1)

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(vi) Suggest **three** variables that the student would need to keep constant to ensure the reliability of her data.

(3)

1 .....

2 .....

3 .....

(b) The student repeated the investigation using another wheat seedling. However, she replaced the mineral ion solution with soil from her garden. After two weeks the wheat seedlings had grown. She found the total increase in length to be 5.2 mm.

Use the graph to estimate the nitrate ion concentration of her soil.

(2)

Answer .....

(c) Inorganic ions are used by plants to make molecules. The table below refers to two inorganic ions, the molecules made and the main role of these molecules in a plant. Complete the table by writing the most appropriate word or words in each of the empty boxes.

(2)

Inorganic ion	Molecule made	Main role of the molecule in a plant
Nitrate		Plant growth
Calcium	Calcium pectate (pectin)	

(Total for Question 3 = 12 marks)

4

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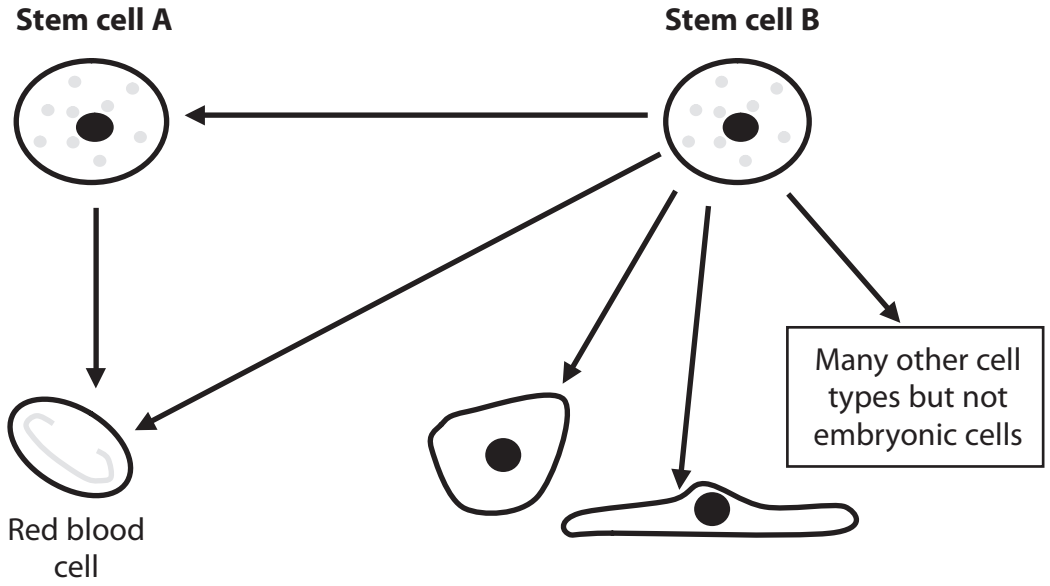
4 (a) The diagram below shows two different stem cells and the differentiated cells that they can form.



(i) Use the diagram to explain why stem cell B is described as **pluripotent**.

(2)

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(ii) Suggest **one** site where stem cell A may be found in an **adult** human.

(1)

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(iii) All the differentiated cells derived from stem cell B have the same genotype but have very different structures and functions. This is due to differential gene expression.

Explain how **differential gene expression** can enable cells which have the same genetic material to have very different structures and functions.

(3)

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(b) Three examples of how temperature affects organisms are given below. If the example is due to differential gene expression, place a cross (☒) in the box to the right of that example.

(1)

Examples	
The rate of protein synthesis within a plant is temperature dependent.	☒
The gender of turtles is determined by the temperature of the ground in which the eggs are laid.	☒
Asexual reproduction is more rapid in bacteria if the temperature is higher.	☒

(Total for Question 4 = 7 marks)

5

A

B

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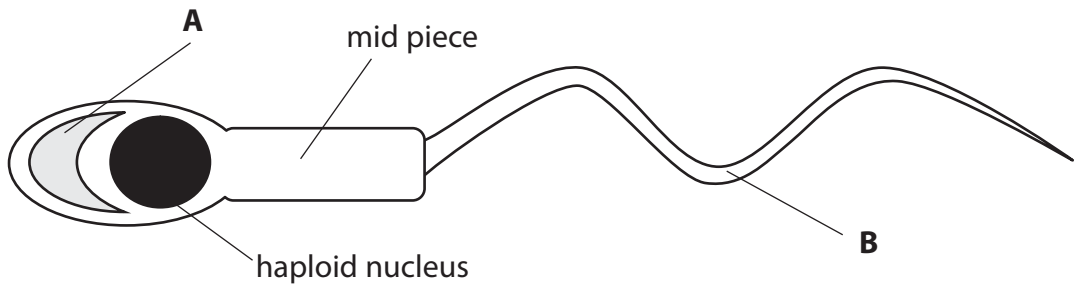
5 Fertilisation involves the fusion of haploid nuclei.

(a) The diagram below shows a human sperm cell.



(i) Name the structures labelled **A** and **B**.

(2)

A .....

B .....

(ii) Explain why it is important that the sperm has a nucleus that is haploid.

(2)

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(iii) Describe the changes in the female gamete from the point when a sperm releases its digestive enzymes to the point when the two nuclei fuse.

(3)

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(b) An investigation into the effect of temperature on pollen tube growth was carried out. Two different varieties of cotton pollen grain were used, variety A and variety B.

Twenty newly-germinated cotton pollen grains of variety A were placed on growth medium in a Petri dish and incubated in the dark for 24 hours at 15 °C. After this time, the length of each pollen tube was measured and the mean calculated. This was repeated at 5 different temperatures.

The investigation was then repeated using variety B. The results are shown in the table below.

Incubation temperature / °C	**Mean length of pollen tube after 24 hours incubation / mm**	
	variety A	**variety B**
15	0.18	0.19
20	0.35	0.48
25	0.53	0.83
30	0.60	0.90
35	0.57	0.60
40	0.10	0.10

(i) Describe the effect of temperature on the mean length of pollen tubes for variety A.

(2)

(ii) Compare the effect of temperature on the mean length of pollen tubes in variety A with variety B, between 15 °C and 30 °C.

(2)

(iii) Suggest an explanation for the change in the mean length of pollen tubes when the temperature increased from 35 °C to 40 °C.

(1)

(Total for Question 5 = 12 marks)

6 Humans have found that plants are a valuable source of cellulose, starch and fibres.

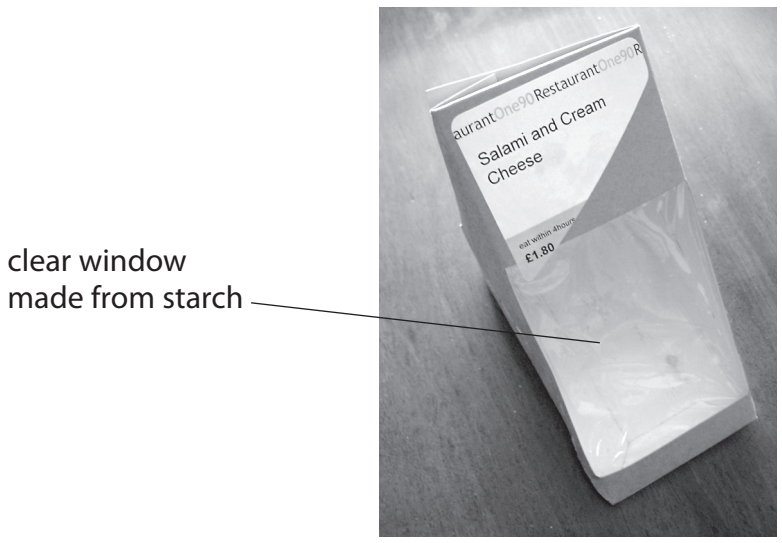
(a) The table below lists some statements about polysaccharides.

Indicate whether each statement is true or false by placing a cross (☒) in the appropriate box.

(5)

Statements	True	False
Polymer of glucose	☒	☒
Molecule contains α and β glucose	☒	☒
Glycosidic bonds present	☒	☒
Molecule may have side branches	☒	☒
Molecule can form hydrogen bonds with adjacent molecules	☒	☒

(b) The clear window in this sandwich packaging is made from starch rather than plastic.



Suggest how this use of starch, rather than plastic, may contribute to **sustainability**.

(2)

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(c) Plant stems contain xylem vessels and sclerenchyma fibres.

Give **one** similarity and **one** difference between xylem vessels and sclerenchyma fibres.

(2)

Similarity .....

.....

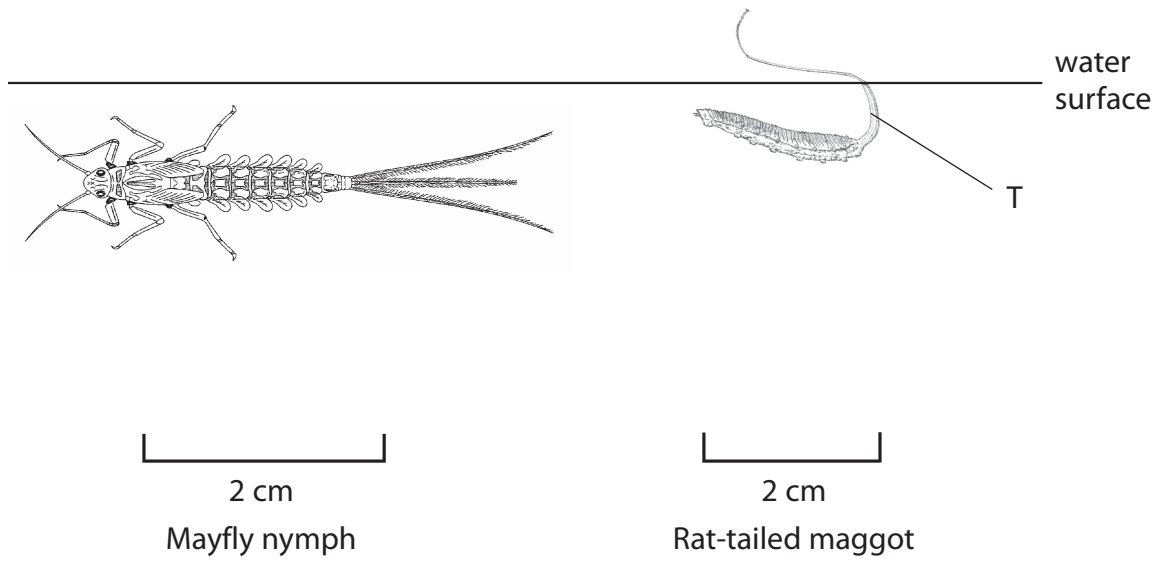
Difference .....

.....

(Total for Question 6 = 9 marks)

7 The process of natural selection can lead to the adaptation of organisms to their environment as well as to evolution.

(a) The diagram below shows two species of invertebrates found in freshwater.



(i) Suggest **two** features of the mayfly nymph, shown in the diagram above, that makes it well-adapted to survival in fast-flowing streams. Explain how each feature helps it to survive.

(4)

1 .....

.....

.....

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2 .....

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.....

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(ii) The rat-tailed maggot lives in water which has a low concentration of dissolved oxygen. Suggest how the structure labelled T helps it to survive in this environment.

(2)

(b) Adaptation can occur within the same species. Leopards and panthers are members of the same species found in Africa. Leopards have spotted fur and hunt in open grasslands, whilst panthers have black fur and hunt in forests.

Suggest how natural selection has led to the evolution of these two different forms of the same species.

(4)

(Total for Question 7 = 10 marks)

8 Classification of organisms is important when trying to assess biodiversity.

(a) All organisms can be classified into one of three domains.

Name the **three** domains of organisms.

(3)

1 .....

2 .....

3 .....

(b) (i) Explain what is meant by the term **species**.

(2)

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(ii) Explain the meaning of the term **genetic diversity** within a species.

(2)

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(iii) Describe how zoos maintain the genetic diversity of endangered species.

(4)

(Total for Question 8 = 11 marks)

TOTAL FOR THE PAPER = 80 MARKS

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