Please check the examination details below before entering your candidate information

| Candidate surname | Other names |
|---|---|
| | |

**Pearson Edexcel**
**International Advanced Level**

Centre Number | | | | | |

Candidate Number | | | | |

# Thursday 21 January 2021

Morning (Time: 1 hour 30 minutes) | Paper Reference **WBI12/01**

# Biology

## International Advanced Subsidiary
## Unit 2: Cells, Development, Biodiversity and Conservation

**You must have:**
Calculator, HB pencil, 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 your working in calculations and include units where appropriate.**

## 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.*
- In questions marked with an **asterisk** (*), marks will be awarded for your ability to structure your answer logically, showing how the points that you make are related or follow on from each other where appropriate.

## 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.

*Turn over* ▶

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P 6 6 1 5 4 A 0 1 3 2

Pearson

**Answer ALL questions.**

**Write your answers in the spaces provided.**

**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** Brazil is the largest producer of sugarcane.

The photograph shows sugarcane plants growing in Brazil.

(Source: © jeep2499/Shutterstock)

(a) Products from sugarcane, such as starch and cellulose, are used to make bioplastic.

(i) How many of the following statements about **starch** are correct?

- contains α-glucose and β-glucose molecules
- contains amylose and amylopectin
- stored in the tonoplast

**(1)**

☒ **A** none

☒ **B** one

☒ **C** two

☒ **D** three

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(ii) How many of the following statements about a **cellulose** molecule are correct?

- contains α-glucose and β-glucose molecules
- contains 1,4 glycosidic bonds
- forms hydrogen bonds with other cellulose molecules

**(1)**

☒ **A** none

☒ **B** one

☒ **C** two

☒ **D** three

(b) Bioplastic bags made from sugarcane take up to six months to decompose.

Bacteria secrete enzymes onto the bags during the process of decomposition.

(i) Name **two** structures found in bacterial cells that are involved in the synthesis of these enzymes.

**(1)**

1 .....

2 .....

(ii) Decomposition of bioplastic bags occurs faster if there is increased bacterial growth.

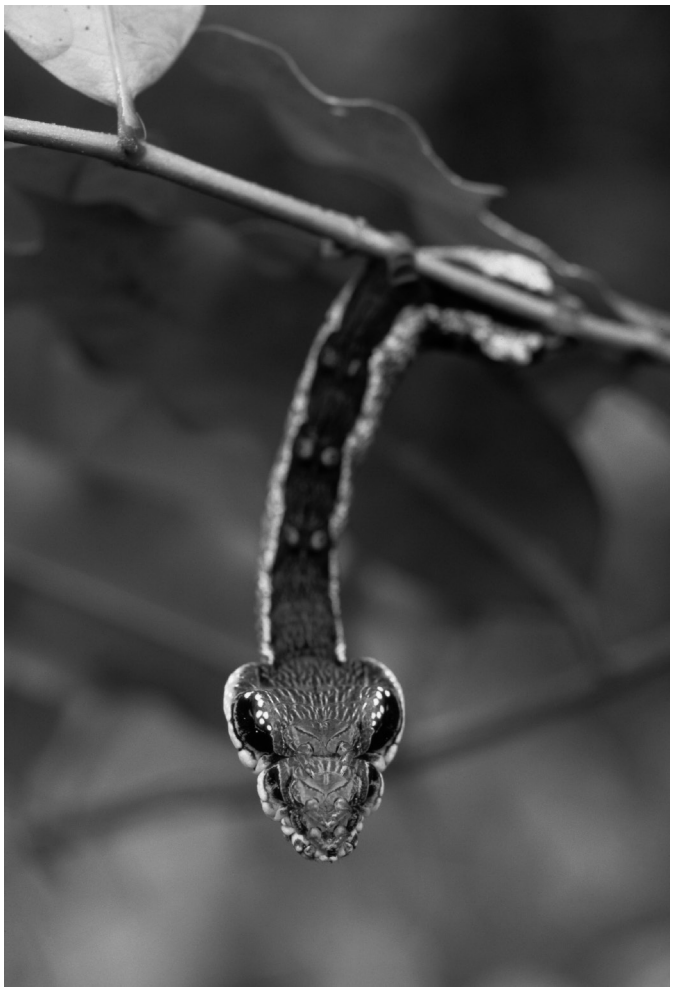
Explain the conditions needed for increased bacterial growth.

**(3)**

**(Total for Question 1 = 6 marks)**

**2** The photograph shows the caterpillar of a moth from Costa Rica.

The caterpillar looks like a pit viper snake. It will try to strike potential predators.



(Source: © Avalon/Photoshot License / Alamy Stock Photo)

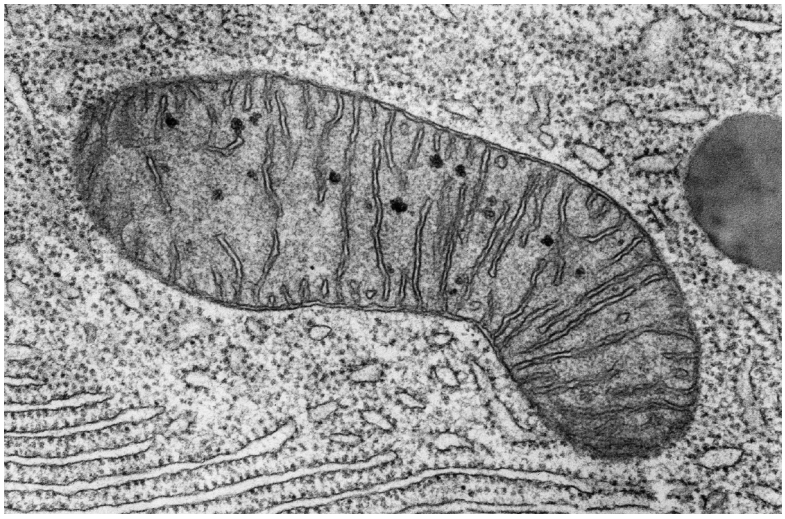
(a) This caterpillar is adapted to its niche.

Complete the table to show the type of adaptations shown by this caterpillar.

**(2)**

| Feature | Type of adaptation |
|---|---|
| looks like a pit viper snake | ..... |
| tries to strike potential predators | ..... |

(b) The photograph shows an organelle that can be found in caterpillar cells, as seen using a microscope.



(Source: © Science History Images / Alamy Stock Photo)

Magnification × 72 500

(i) State the type of microscope used to view this organelle.

**(1)**

(ii) Describe the function of this organelle.

**(3)**

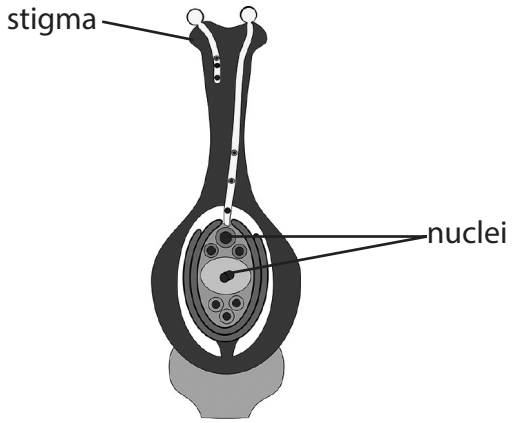
(c) Rough endoplasmic reticulum is another organelle found in caterpillar cells.

Draw a labelled diagram of rough endoplasmic reticulum.

**(3)**

**(Total for Question 2 = 9 marks)**

**3** The diagram shows the nuclei in an ovule of a flowering plant.




(Source: © Kazakova Maryia/Shutterstock)

(a) Double fertilisation takes place in the ovules.

Describe the events that occur from the time a pollen grain lands on the stigma to the production of a triploid endosperm nucleus and a zygote.

Use the information in the diagram to support your answer.

**(5)**

(b) The photograph shows flowers from a silver trumpet tree in Thailand.

(Source: © Picture/Shutterstock)

Flowering plants such as the silver trumpet tree contain several ovules.

Explain how the silver trumpet tree produces seeds that are genetically different from each other.

**(4)**

**(Total for Question 3 = 9 marks)**

**4** The photograph shows a species of harvest mouse native to countries in Asia.

(Source: © Mark Bridger/Shutterstock)

(a) The body of this species of harvest mouse is 55 mm to 75 mm long and its tail is 50 mm to 75 mm long.

The body of the Indian flat-haired mouse is 10 cm to 12 cm long and its tail is 7 cm to 8 cm long.

Calculate the percentage difference in **minimum** total length of the Indian flat-haired mouse compared with the **minimum** total length of the harvest mouse.

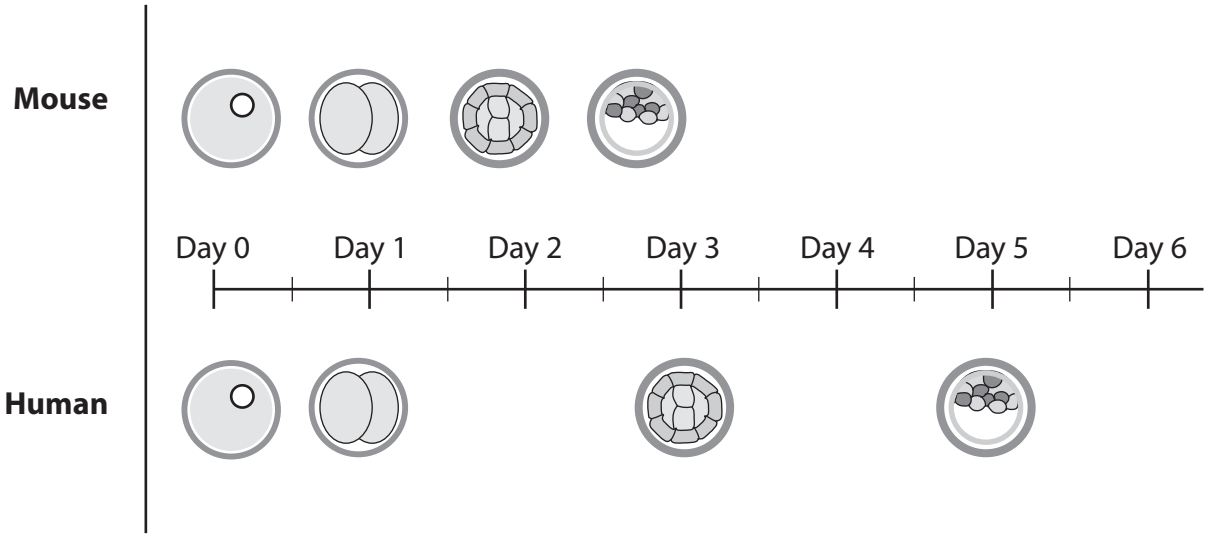
Give your answer to **two** significant figures.

**(2)**

Answer ..... %

(b) The diagram shows the timeline for the structures formed after fertilisation in a mouse and in a human.

A fertilised egg cell is called a zygote.




(i) As mouse egg cells develop they accumulate small spherical lipid droplets.

These lipid droplets have a mean radius of 88 μm.

The volume of a sphere (V) is calculated using the formula

$$V = \frac{4}{3}\pi r^3$$

Which of the following gives the mean volume of a lipid droplet in **mm$^3$** ?

**(1)**

☒ **A** $2.85 \times 10^{-6}$

☒ **B** $2.85 \times 10^{-3}$

☒ **C** $2.85 \times 10^{3}$

☒ **D** $2.85 \times 10^{6}$

(ii) Draw a circle around the part of the diagram that is a mouse morula. Label the circle 'morula'.

**(1)**

(iii) Describe the events that occur after a sperm cell enters an egg cell, until a zygote is formed.

**(3)**

(c) Analysis of some mouse egg cells showed that the lipid droplets were located within 10 nm of mitochondria.

Suggest why mitochondria were located within 10 nm of the lipid droplets.

**(3)**

**(Total for Question 4 = 10 marks)**

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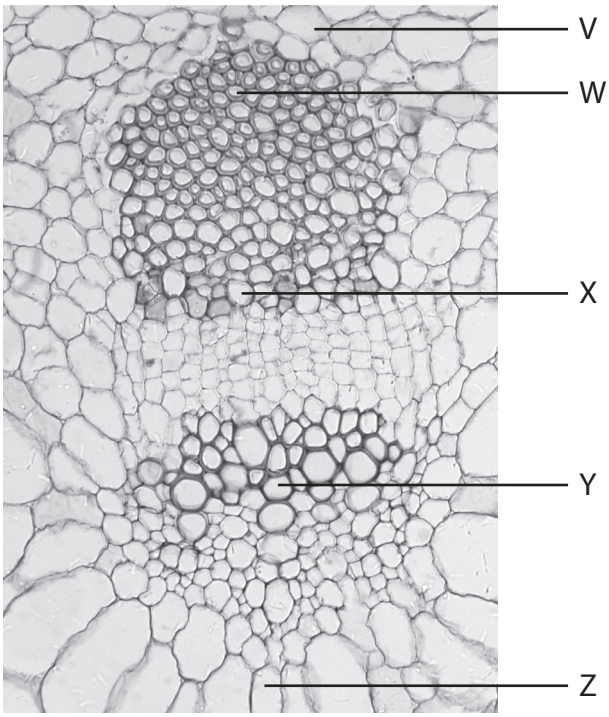
**5** The stem of a plant contains structures involved in transporting substances and supporting the plant.

The photograph shows a section through part of the stem of a plant, as seen using a light microscope.




(Source: © Choksawatdikorn/Shutterstock)

(a) (i) Which of the labelled structures is sclerenchyma?

**(1)**

☒ **A** W

☒ **B** X

☒ **C** Y

☒ **D** Z

(ii) Which of the labelled structures is involved in transporting substances both up and down the plant stem?

**(1)**

- ☒ **A** W
- ☒ **B** X
- ☒ **C** Y
- ☒ **D** Z

(iii) Which of the labelled structures is involved in transporting calcium ions from the stem to the leaves?

**(1)**

- ☒ **A** V
- ☒ **B** W
- ☒ **C** X
- ☒ **D** Y

(iv) Which of the following may have secondary thickening in the cell walls?

**(1)**

- ☒ **A** phloem sieve tubes only
- ☒ **B** phloem sieve tubes and sclerenchyma fibres
- ☒ **C** xylem vessels only
- ☒ **D** xylem vessels and sclerenchyma fibres

(b) Plants require inorganic ions for growth.

The photograph shows a leaf with magnesium ion deficiency.

(Source: © Nigel Cattlin / Science Source / Science Photo Library)

In an investigation, groups of plants were watered with the same volume of a nutrient solution.

The solution contained all the required inorganic ions, but with different concentrations of magnesium ions.

The table shows the results of this investigation.

| Concentration of magnesium ions in nutrient solution / mmol $dm^{-3}$ | Mean dry mass of root / g | Mean dry mass of shoot / g | Mean total dry mass / g |
|---|---|---|---|
| 0.01 | 2.38 ± 0.15 | 15.56 ± 1.22 | 17.94 ± 1.38 |
| 0.10 | 5.42 ± 0.43 | 33.36 ± 1.21 | 38.78 ± 1.63 |
| 0.40 | 7.08 ± 0.50 | 46.06 ± 0.59 | 53.14 ± 0.50 |

(i) Explain the importance of magnesium ions to plants.

**(2)**

(ii) Comment on the results of this investigation.

Use the information in the table to support your answer.

**(4)**

**(Total for Question 5 = 10 marks)**

**6** The phenotype of an organism is the result of interactions between the genotype and the environment.

Phenotypes can show continuous or discontinuous variation in a population.

(a) Sketch a graph to show the distribution for a phenotype showing continuous variation in a population.

**(2)**

(b) The presence or absence of teeth in chickens is one example of a discontinuous phenotype.

Chicken genomes contain the genes for tooth production, but chickens do not normally develop teeth.

These genes are switched off as the embryo develops.

Explain how a mutation could cause the development of teeth in a chicken embryo.

**(4)**

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(c) The photograph shows two Himalayan goats.

(Source: © Rainer Pauschert / Alamy Stock Photo)

The fur colour of a goat depends on its genotype.

Gene B controls fur colour in these goats.

The allele for brown fur is dominant to the allele for white fur in goats.

The allele **B** codes for brown fur and the allele **b** codes for white fur.

In one population, there were 470 brown goats and 140 white goats.

Calculate the frequency of the allele **B** in this population, using the equation

$$p^2 + 2pq + q^2 = 1$$

Give your answer to **two** decimal places.

**(3)**

Answer .....

**(Total for Question 6 = 9 marks)**

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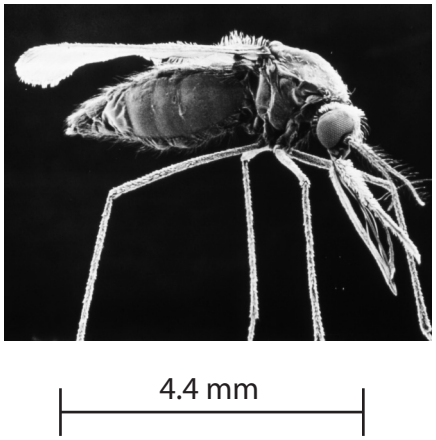
**7** Female mosquitoes feed on the blood of other animals to promote the development of their eggs. During this process, infected mosquitoes can transmit the *Plasmodium* parasite.

The *Plasmodium* parasite causes the disease malaria.

The photograph shows a female *Anopheles* mosquito.




(Source: © Dr Tony Brain / Science Photo Library)

(a) Calculate the magnification of the *Anopheles* mosquito in this photograph.

Give your answer to one decimal place.

**(1)**

Answer .....

(b) In 2017, an estimated 219 million people in 87 countries had malaria, and 435 000 of these people died.

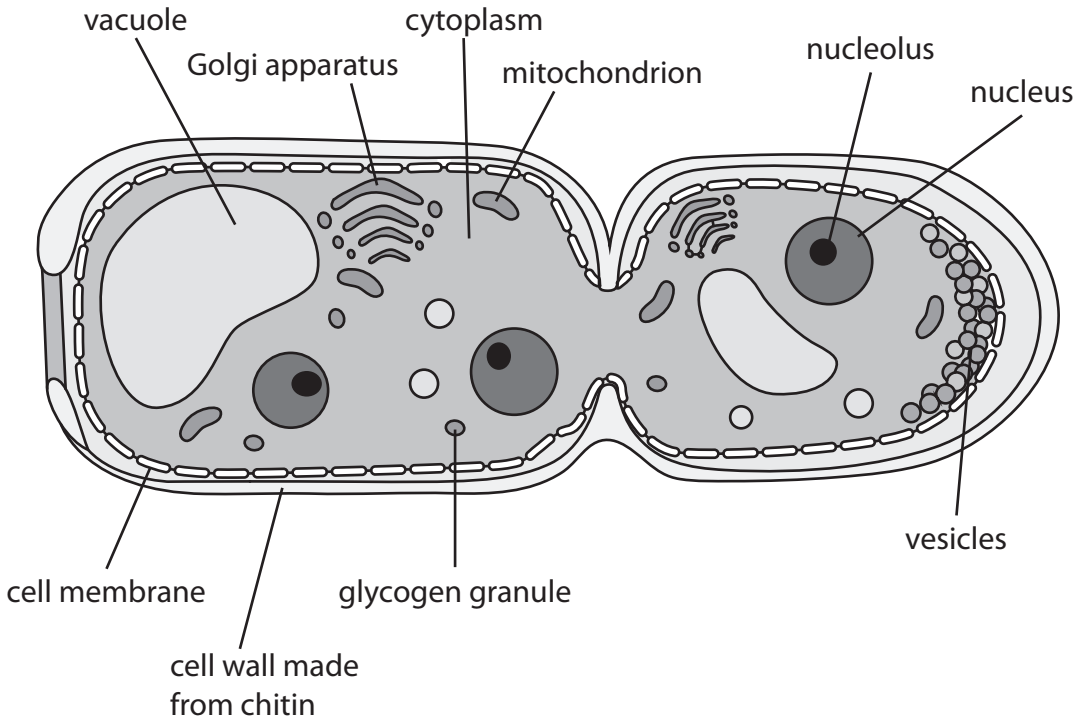
Which of the following shows the percentage of infected people who died?

**(1)**

- ☒ **A** 0.02%
- ☒ **B** 0.20%
- ☒ **C** 99.80%
- ☒ **D** 99.98%

(c) The fungus *Metarhizium pingshaense* infects *Anopheles* mosquitoes.

A student drew a labelled diagram of a fungal cell that was dividing.




(i) State the function of a nucleolus.

**(1)**

.....

.....

.....

(ii) Give **three** differences in ultrastructure between this cell and a cell taken from the root of a plant.

**(3)**

1 .....

.....

.....

2 .....

.....

.....

3 .....

.....

.....

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*(d) Insecticides are chemicals used to kill insects.

*Anopheles* mosquitoes have developed resistance to the insecticides currently used.

*Metarhizium pingshaense* is a fungus that infects *Anopheles* mosquitoes.

Scientists in West Africa have genetically engineered (GE) this fungus using a gene from a spider.

When the GE fungus infects an *Anopheles* mosquito this gene becomes activated. A toxin is released, which kills the mosquito.

In an investigation, four huts each containing a group of 500 breeding pairs of mosquitoes were used.

Three different treatments used to kill mosquitoes were compared with a control group.

The walls and ceiling of the huts were sprayed with the treatment.

(Source: © Ivan Vdovin / Alamy Stock Photo)

The table shows the number of adult mosquitoes in the first two generations of offspring from each hut after spraying.

| Treatment | Number of adult mosquitoes in each generation | |
|---|---|---|
| | First | Second |
| Control (no treatment) | 921 | 1396 |
| Insecticide | 919 | 1353 |
| Normal fungus | 436 | 455 |
| GE fungus | 399 | 13 |

Evaluate these three treatments.

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

**(6)**

**(Total for Question 7 = 12 marks)**

**8** Sehuencas water frogs are endemic to Bolivia.

It was once believed that this frog was extinct in the wild.

This was due to human activity and a disease caused by a fungus.

(a) Suggest how human activity could cause the extinction of the Sehuencas water frog in the wild.

**(3)**

(b) In 2008, there was only one Sehuencas water frog in captivity.

In 2018, five Sehuencas water frogs were discovered in a Bolivian mountain forest. Three of these frogs were male.

Scientists suggested that these five frogs were resistant to the fungal disease.

Explain how resistance to this fungus could develop in a population of Sehuencas water frogs.

**(4)**

(c) One way of studying the genetic diversity within a species is to calculate the heterozygosity index.

Describe how the scientists could calculate the heterozygosity index for a population of Sehuencas water frogs.

**(2)**

*(d) Describe the role of zoos in the conservation of endangered Sehuencas water frogs.

**(6)**

**(Total for Question 8 = 15 marks)**

**TOTAL FOR PAPER = 80 MARKS**

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