

Please check the examination details below before entering your candidate information

Candidate surname

Other names

Centre Number

Candidate Number

Pearson Edexcel International Advanced Level

Friday 19 May 2023

Morning (Time: 1 hour 30 minutes)

Paper
reference

WBI12/01

Biology

International Advanced Subsidiary/Advanced Level

**UNIT 2: Cells, Development, Biodiversity and
Conservation**

You must have:

Scientific calculator, ruler, HB pencil

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 out** 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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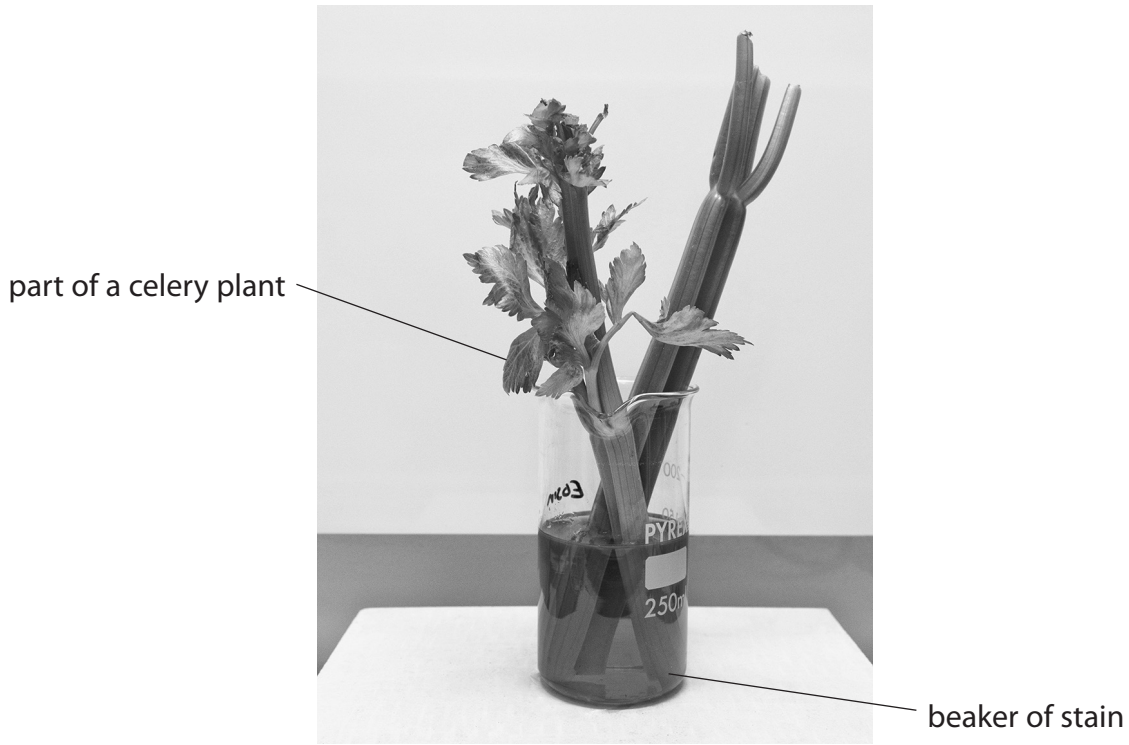
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Answer ALL questions.

Write your answers in the space provided.

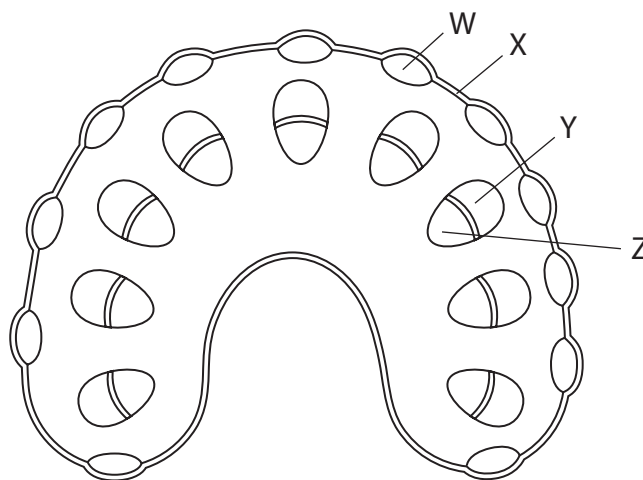
Some questions must be answered with a cross in a box ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

- 1 The photograph shows part of a celery plant which has been placed into a beaker of stain.



(Source: © Sara Sadler/Alamy Stock Photo)

A student made a drawing of a cross-section of the bottom of the stem of the celery plant before it was placed into the beaker of stain.



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(a) One hour after being placed into the beaker of stain, the student observed a cross-section from half way up the celery stem.

(i) Which of the following would be a different colour due to the presence of the stain?

(1)

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

(ii) Explain why, after one hour, this part of the stem would be a different colour.

(2)

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(b) Cells in the leaf contain organelles that store molecules of starch.

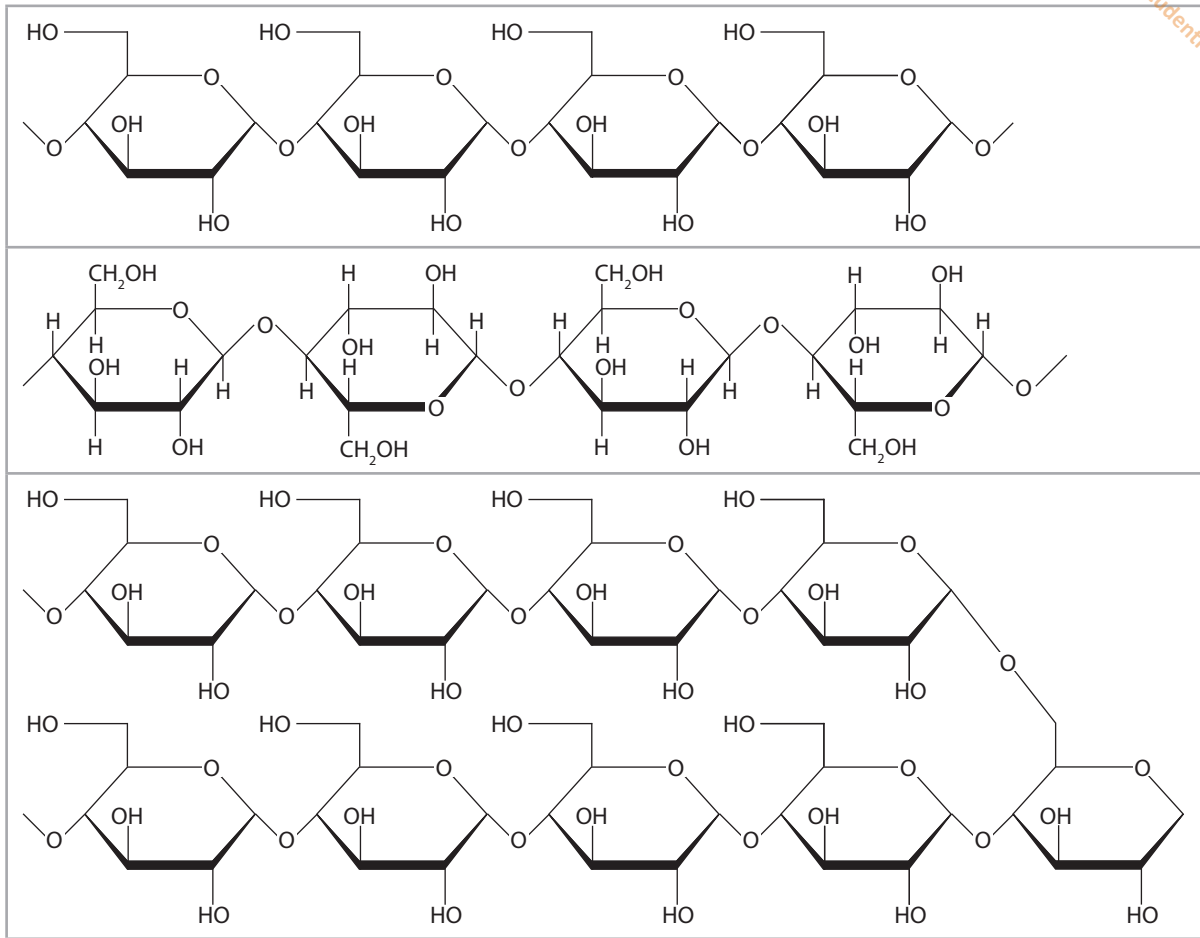
(i) Name **one** organelle in a leaf cell that stores starch.

(1)

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(ii) How many of the following show the structure of part of a starch molecule?



(1)

- A none
- B one
- C two
- D three

(iii) Give **one** role of starch molecules in a leaf cell.

(1)

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(c) Transparent plastic film can be made from oil-based plastics or from starch.

The photograph shows transparent bio-plastic film, made from starch.

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transparent
bio-plastic film

(Source: © Roman/Alamy Stock Photo)

Give **one** reason why the use of starch-based transparent bio-plastic film is more sustainable than the use of oil-based plastics.

(1)

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(Total for Question 1 = 7 marks)

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2 Eye colour in humans is an example of polygenic inheritance.

Two of the genes giving rise to this characteristic are found on chromosome 15.

(a) There is more than one version of each of the genes involved.

Which term is used for different versions of a gene?

(1)

- A allele
- B locus
- C phenotype
- D polygenic

(b) Inheritance of different versions of these two genes shows genetic linkage.

Explain how the phenotypes of an individual can show genetic linkage in the inheritance of two genes.

(2)

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(c) One gene can give rise to more than one type of protein through post-transcriptional changes to the mRNA.

One of these changes is the removal of introns.

Explain how different proteins can be synthesised from this mRNA that has had introns removed.

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(Total for Question 2 = 6 marks)

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3 The photograph shows a caterpillar and fluid inside a pitcher plant found on the island of Madagascar.

The fluid contains extracellular enzymes which are digesting the caterpillar.



(Source: © Martin Lindsay/Alamy Stock Photo)

(a) Describe the role of the Golgi apparatus in the formation of these extracellular enzymes.

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(b) The digested insects are a source of nitrogen for the pitcher plant.

Give **two** ways in which this source of nitrogen is used by the pitcher plants.

(2)

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(c) Bacterial cells have also been found in the fluid in pitcher plants.

(i) Which **three** structures are found in both plant cells and bacterial cells?

(1)

- A** cell membrane, cellulose cell wall and DNA
- B** cell membrane, DNA and pili
- C** cell wall, DNA and capsule
- D** cell wall, DNA and ribosome

(ii) The fluid of the pitcher plant contains water and molecules from digested organisms, which bacterial cells need for growth.

Explain **two** other conditions needed for optimum bacterial growth in the fluid of the pitcher plant.

(2)

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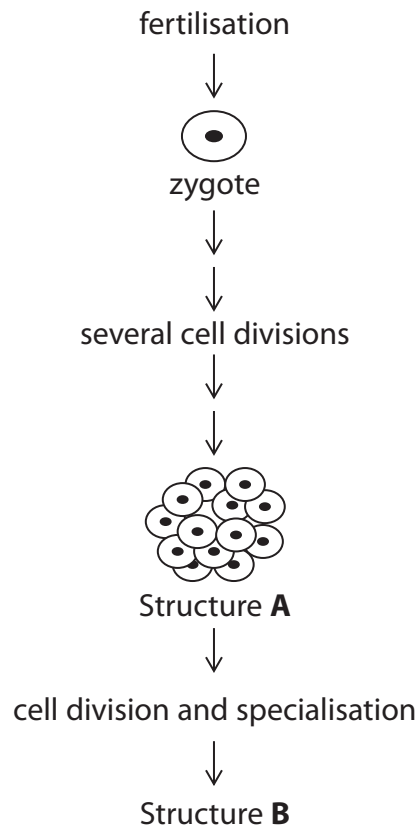
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(Total for Question 3 = 7 marks)



4 The diagram shows some processes that occur after the fertilisation of an egg cell.



(a) Structure B is a blastocyst.

Describe the structure of a blastocyst.

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(b) Structure **A** contained 60 cells.

The mitotic index of cells from structure **A** was calculated as 15%.

Calculate the number of cells in structure **A** which were in mitosis.

(1)

Answer

(c) Structure **B** contains pluripotent stem cells.

Histone modification and DNA methylation are processes that occur when totipotent stem cells develop into pluripotent stem cells.

Explain how these two processes alter the activation of genes in the cells.

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(Total for Question 4 = 8 marks)



5 The photograph shows a humphead cichlid fish found only in Lake Tanganyika in Africa.



(Source: © Martin Lindsay/Alamy Stock Photo)

A behavioural adaptation shown by the female humphead cichlid is that fertilised egg cells are kept in her mouth until they hatch.

(a) (i) Which of the following is a term used to describe the fact that this fish is found only in Lake Tanganyika?

(1)

- A diversity
- B endemic
- C homozygous
- D specific

(ii) Suggest why the female humphead cichlids have this behavioural adaptation.

Give a reason for your answer.

(2)

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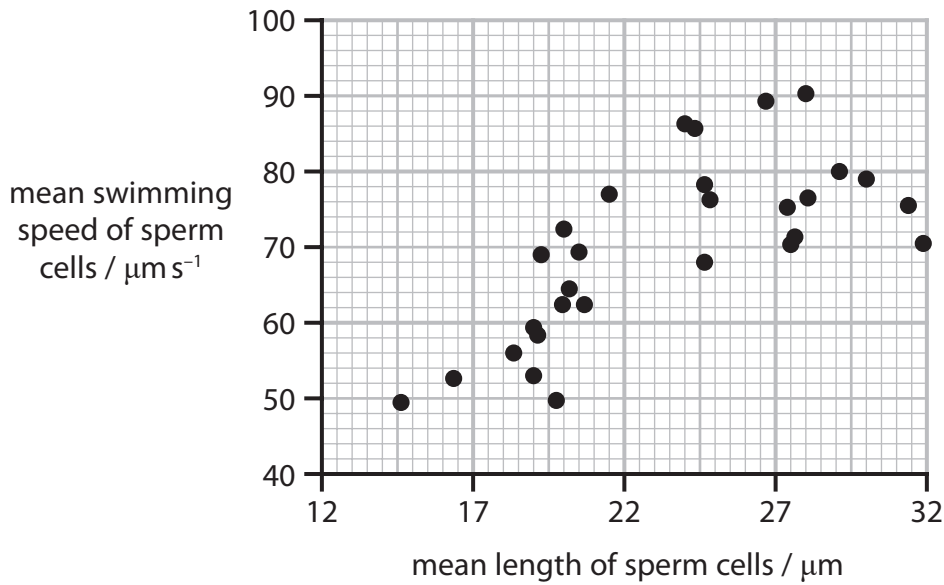
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(b) The relationship between the length and swimming speed of the sperm cells of 30 cichlid species was investigated.

The graph shows the results of this investigation.



(i) State the relationship between the mean length and swimming speed of the sperm cells of these cichlid species.

(1)

(ii) A scientist wanted to assess the strength of the relationship between these two variables.

Which statistical test should be used to assess the strength of the relationship between these two variables?

(1)

- A chi-squared test
- B correlation coefficient
- C index of diversity
- D Student's t-test

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(iii) Suggest **one** advantage for a male cichlid of producing sperm cells with a faster swimming speed.

(1)

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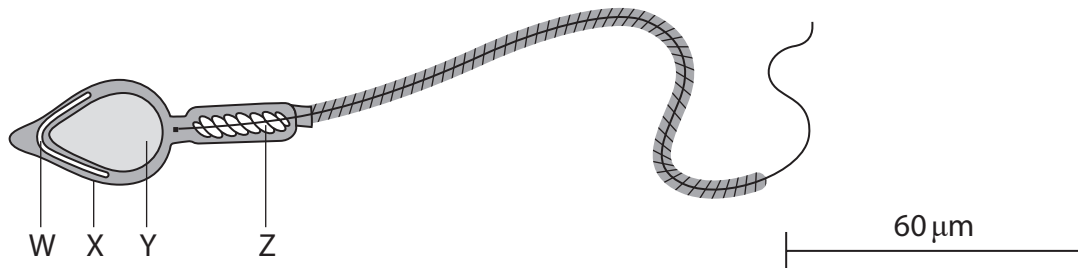
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(c) A sperm cell contains an acrosome, a specialised lysosome.

The diagram shows a sperm cell.



(i) Which labelled structure is an acrosome?

(1)

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

(ii) Calculate the magnification of the sperm cell shown in the diagram.

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

(2)

Answer



(iii) Compare and contrast the structure and function of lysosomes and acrosomes.

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(3)

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(Total for Question 5 = 12 marks)



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6 Meiosis results in genetic variation in gametes.

(a) (i) Explain how meiosis causes this genetic variation.

(3)

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(ii) Give **two** differences in the arrangement of the DNA in a cell at the beginning of interphase and at the end of prophase I.

(2)

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(b) The DNA content of two cells was compared.

Cell A was undergoing mitosis. The mass of DNA in the cell in prophase was 12 pg.

Cell B was undergoing meiosis. The mass of DNA in the cell in prophase I was 12 pg.

What would be the mass of DNA in each daughter cell produced at the end of mitosis and at the end of meiosis?

(1)

	Mass of DNA in a daughter cell produced from cell A at the end of mitosis / pg	Mass of DNA in a daughter cell produced from cell B at the end of meiosis / pg
<input type="checkbox"/> A	3	6
<input type="checkbox"/> B	6	3
<input type="checkbox"/> C	6	12
<input type="checkbox"/> D	12	6

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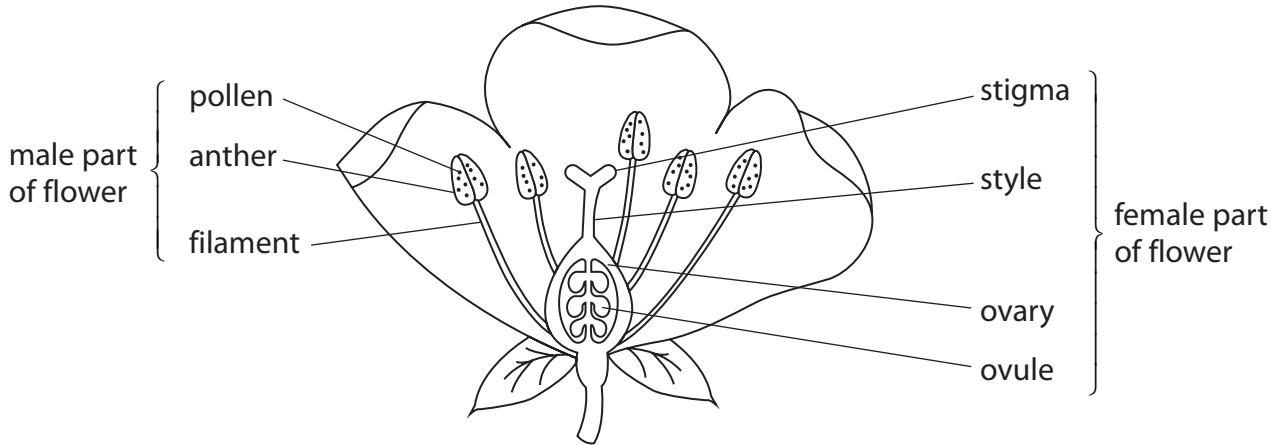


*(c) Plants can produce seeds from either cross-fertilisation or self-fertilisation.

Self-fertilisation occurs when male nuclei from a flower fertilises an egg cell in a flower on the same plant.

Cross-fertilisation occurs when male nuclei from a flower on one plant fertilises an egg cell in a flower on a different plant of the same species.

The image shows the female and male parts of a flower.



Some plants have developed strategies to prevent self-fertilisation.

- Date palm plants have only male flowers or only female flowers.
- Some orchids release chemicals that prevent the germination of pollen produced by flowers of the same plant.

Some plants have developed strategies to produce seeds if cross-fertilisation has not occurred.

- The fireweed plant species from North America will self-fertilise if cross-fertilisation has not occurred.
- Unfertilised egg cells of a dandelion plant will develop into a seed.



Discuss the advantages and disadvantages of the strategies shown by these plants.

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(Total for Question 6 = 12 marks)



7 The photograph shows a corpse lily flower (*Rafflesia hasseltii*).



(Source: © paul kennedy/Alamy Stock Photo)

The corpse lily plant is found in the rainforests of Sumatra.

The flowers can be 100 cm in diameter and are the largest flowers found on Earth.

(a) The smallest flower on Earth is produced by *Wolffia globosa*.

The flower of *W. globosa* measures $50\ \mu\text{m}$ in diameter.

Which is the ratio for the diameters of the flowers of *R. hasseltii* to *W. globosa*?

(1)

- A 20:1
- B 200:1
- C 2000:1
- D 20 000:1



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(b) The corpse lily plant is unusual because none of its cells contains chloroplasts.

Most of the corpse lily plant grows inside the tissues of a rainforest vine plant, including inside the tissues involved in the translocation of organic solutes.

Only the corpse lily flower can be seen growing outside of the vine.

The corpse lily plant obtains organic solutes such as sucrose from one of the tissues in the vine plant.

(i) State what is meant by the term **tissue**. (1)

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(ii) Suggest how the corpse lily plant obtains organic solutes, such as sucrose, from one of the tissues in the vine plant. (3)

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(c) The wound healing properties of an extract made from corpse lily plants were investigated.

Treatments were tested on four groups of six rats with identical skin wounds.

The treatments were applied to the wounds twice a day.

The time taken for the wounds to heal was recorded.

The table shows the treatment applied to each group and the results of this investigation.

Rat group	Treatment	Mean healing time / days	Standard deviation
1	gel + no extract	21.67	± 0.48
2	gel + 5% extract	15.83	± 0.33
3	gel + 10% extract	14.67	± 0.56
4	gel + current wound treatment	12.33	± 0.31

(i) Explain the purpose of the gel used in these treatments.

(3)

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(ii) Comment on the results of this investigation.

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(Total for Question 7 = 12 marks)



8 Snow leopards (*Panthera uncia*) live in mountainous regions in Asia.

The photograph shows a snow leopard on a snow-covered mountain.



(Source: © Natural Visions/Alamy Stock Photo)

(a) Give **one** reason for a named anatomical adaptation of this snow leopard that enables it to occupy its niche.

Use the information in the photograph to support your answer.

(1)

Adaptation

Reason

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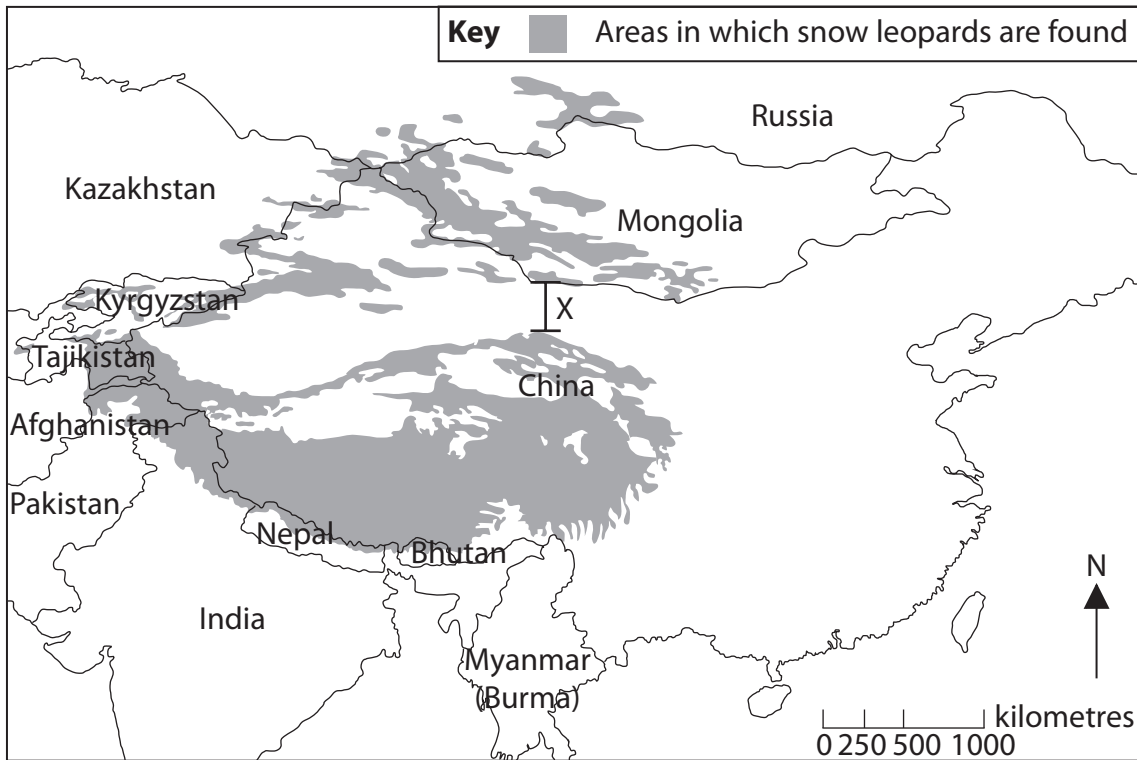
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(b) Snow leopards are found in several areas in Asia.

The map shows the areas where snow leopards can be found.



Describe how the biodiversity of habitats in these areas could be compared.

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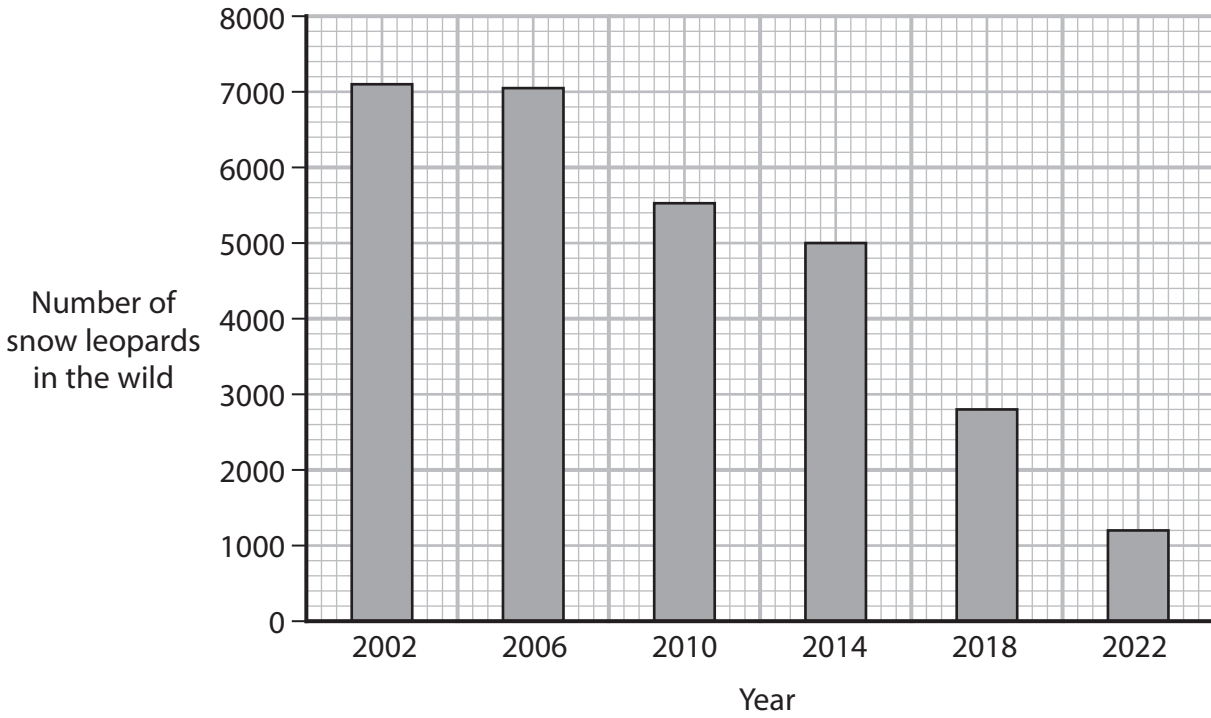
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(c) The graph shows the numbers of snow leopards in the wild since 2002.



(i) Calculate the percentage decrease in snow leopards from 2002 to 2022.

Give your answer to one decimal place.

(2)

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(ii) Suggest **one** reason for this decrease in the number of snow leopards.

(1)

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(d) Populations of snow leopards, living in different areas of Asia, sometimes develop different characteristics. These populations are called subspecies.

Individuals from different subspecies are able to produce fertile offspring.

Some scientists have proposed that there are three subspecies of snow leopard.

The table shows the names and locations of the snow leopard range for the three subspecies.

Subspecies	Location of snow leopard range
<i>P. uncia irbis</i>	Northern
<i>P. uncia uncia</i>	Western
<i>P. uncia uncioides</i>	Central

(i) The northern and central locations are separated by a desert region.

The width of the region is shown by the line labelled X on the map.

Calculate the width of this desert region using the scale shown on the map.

Give your answer in standard form.

(2)

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*(ii) Explain how these subspecies of snow leopard could form.
Use the information in the question to support your answer.

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(6)

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(iii) Give a reason as to why these different populations are described as subspecies and not different species of snow leopard.

(1)

(Total for Question 8 = 16 marks)

TOTAL FOR PAPER = 80 MARKS



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