Please check the examination details below before entering your candidate information

Candidate surname	Other names

Centre Number | Candidate Number

Pearson Edexcel International Advanced Level

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.*
- Questions labelled with an **asterisk** (*) are ones where the quality of your written communication will be assessed
  – *you should take particular care on these questions with your spelling, punctuation and grammar, as well as the clarity of expression.*

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 ▶

P69499A

©2022 Pearson Education Ltd.

L:1/1/1/1/1/1/1/1/

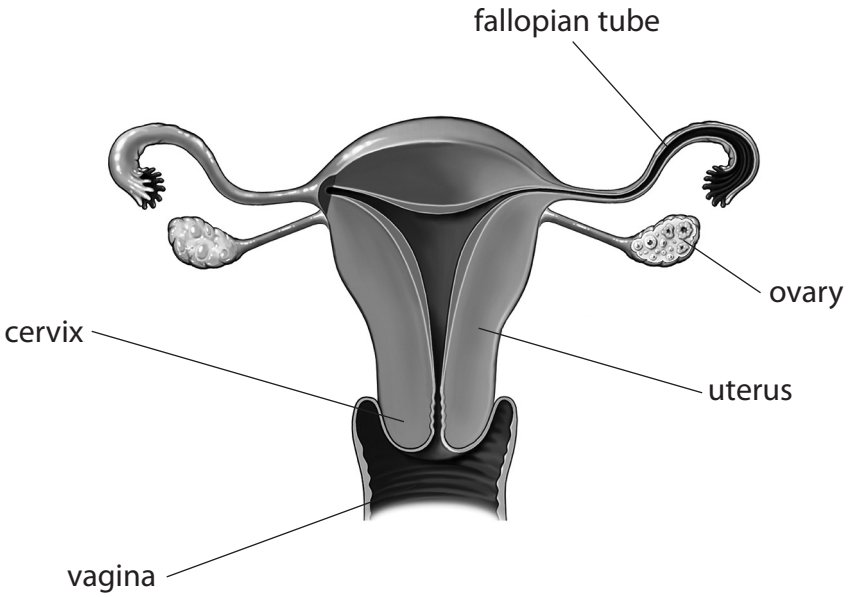
P 6 9 4 9 9 A 0 1 3 2

Pearson

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 diagram shows an organ system of a human female.



(Source: © Nucleus Medical Media Inc / Alamy Stock Photo)

(a) State what is meant by the term **organ system**.

(1)

(b) Gametes are produced in one of the tissues in the ovary.

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

(1)

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

(ii) Gametes are specialised for their functions.

Complete the table to show the correct statement for each structure found in gametes.

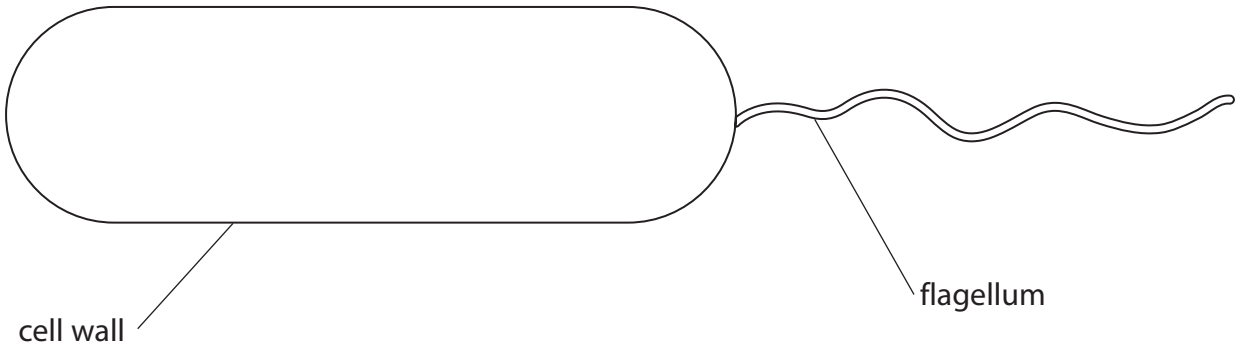
(4)

Structure	Propels male gamete towards female gamete	Modified by the action of cortical granules	Produces ATP by respiration	Contains linear DNA
flagellum	☒ **A**	☒ **B**	☒ **C**	☒ **D**
mitochondria	☒ **A**	☒ **B**	☒ **C**	☒ **D**
nucleus	☒ **A**	☒ **B**	☒ **C**	☒ **D**
zona pellucida	☒ **A**	☒ **B**	☒ **C**	☒ **D**

(Total for Question 1 = 6 marks)

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

2 The diagram shows part of a prokaryotic cell, as drawn by a student.



(a) Draw **and** label a capsule and two pili on the diagram.

(2)

(b) The effect of concentrations of sodium chloride solution on the growth of bacteria was investigated.

The same number of *L. piscium* bacteria were added to test tubes containing different concentrations of sodium chloride solution.

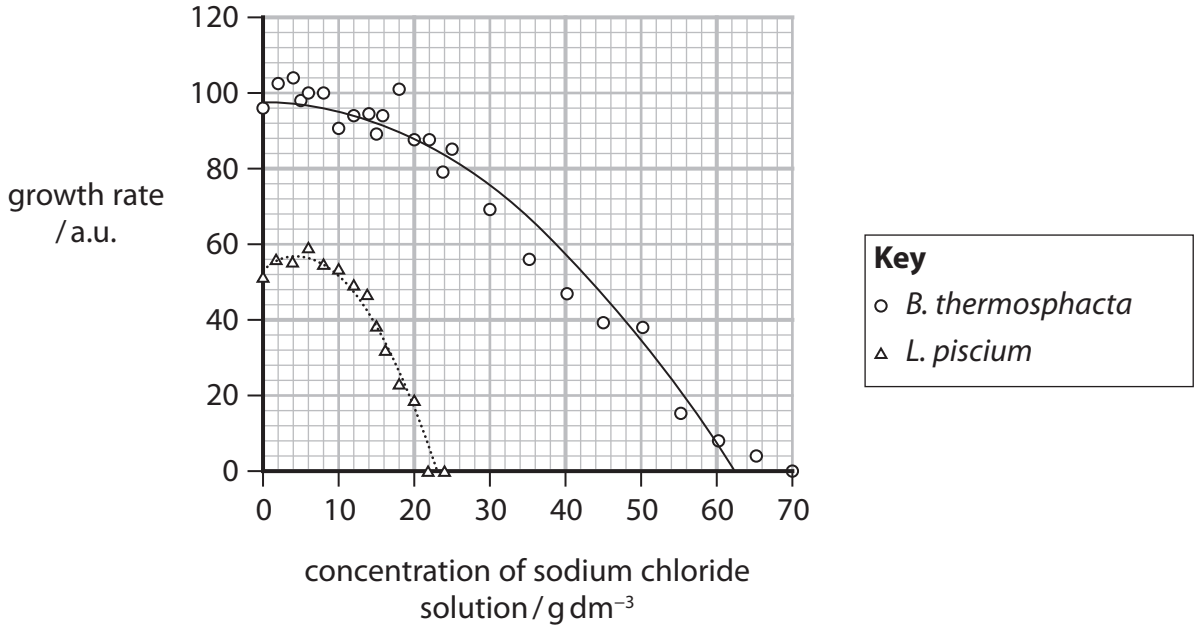
The volume of sodium chloride solution was the same in each test tube.

The growth rates of the bacteria were recorded after a set period of time.

The investigation was repeated with *B. thermosphacta* bacteria.

The graph shows the results of this investigation.

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA



Comment on the results of this investigation.

(4)

(Total for Question 2 = 6 marks)

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

3 The use of plant products can contribute to sustainability.

(a) Fruits from calabash plants are used to make bowls.

The photograph shows a bowl made from a Nigerian calabash fruit.



(Source: © Irene Abdou / Alamy Stock Photo)

(i) A spherical calabash fruit was cut in half to make two bowls.

Each bowl had a radius of 25 cm.

Calculate the volume of one bowl to the nearest whole number.

Use the formula: volume of a sphere = $\frac{4}{3}\pi r^3$

(2)

Answer ..... cm^3

(ii) Explain why bowls made from calabash fruits are a sustainable resource.

(2)

.....

.....

.....

.....

.....

.....

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

(b) Fibres from the stems of the calabash plants have many uses. Some of these fibres are formed from phloem, sclerenchyma and xylem.

(i) How many of the following statements about sclerenchyma fibres are correct?

- they provide support to the plant
- they are used to translocate organic solutes
- they are used to transport water and mineral ions

(1)

☒ **A** none

☒ **B** one

☒ **C** two

☒ **D** three

(ii) Compare and contrast the structures of phloem sieve tubes and xylem vessels.

(4)

(Total for Question 3 = 9 marks)

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

4 There are 11 species of muntjac in Asia.

One of these is the Indian muntjac.

The photograph shows an Indian muntjac.



(Source: © blickwinkel / Alamy Stock Photo)

(a) The female Indian muntjac body cells have three pairs of chromosomes.

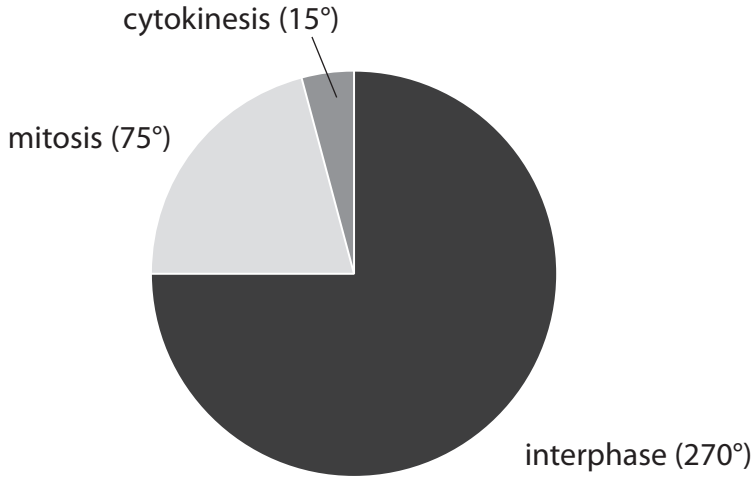
(i) Dividing cells can be taken from the body of a female Indian muntjac.

Draw one of these body cells showing the arrangement of chromosomes in the anaphase stage of mitosis.

(2)

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

(ii) The diagram shows the relative proportions of time that a cell spends in each part of the cell cycle.



The cell was in interphase for nine hours.

The cell was in anaphase for 20 minutes.

Calculate the angle that would represent anaphase plotted on this pie chart.

(2)

Answer ..... °

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

(b) The diagram shows one of the chromosomes in an Indian muntjac cell.



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

(1)

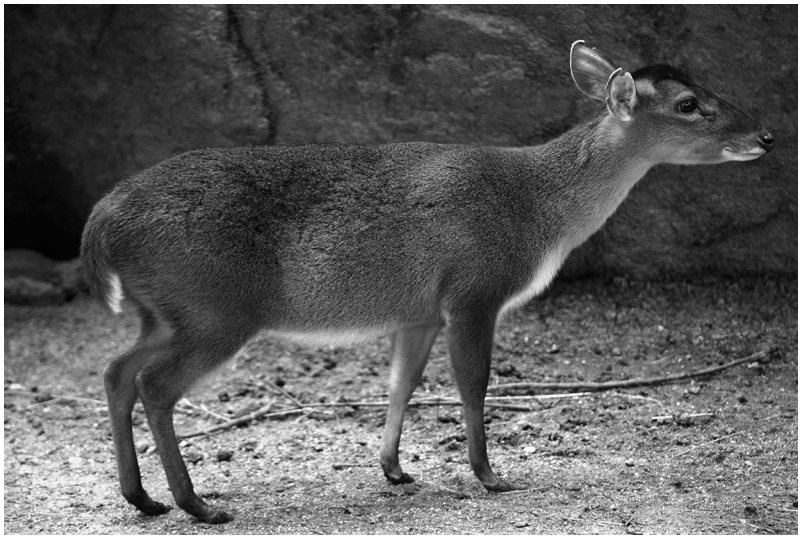
(ii) Explain how the chromosomes of an Indian muntjac egg cell could differ from those in a body cell.

(3)

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

(c) Chinese muntjac cells contain 23 pairs of chromosomes.

The photograph shows a Chinese muntjac.



(Source: © Design Pics Inc / Alamy Stock Photo)

The Chinese muntjac looks similar to the Indian muntjac. However, if they breed together, they produce offspring that are infertile.

Suggest why the offspring would be infertile.

(2)

.....

.....

.....

.....

.....

.....

(Total for Question 4 = 10 marks)

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

5 The Hawaiian islands have 18 species of honeycreeper birds.

The Hawaii amakihi honeycreeper and the Hawaii palila honeycreeper are two species found on these islands.

(a) The table gives information about these two species of honeycreeper.

Information	Hawaii amakihi honeycreeper	Hawaii palila honeycreeper
Photograph	 (Source: © NPS Photo/Alamy Stock Photo)	 (Source: © Minden Pictures/Alamy Stock Photo)
Habitat	lowland and mountainous forest and shrubland	mountainous forest
Number of Hawaiian islands with a population	3	1
Estimated population size	$<10\,000$	<1000
Food source	nectar, tree sap, spiders and insects	seeds and berries

(i) The Hawaii palila honeycreeper is found only in the mountainous forest on one island.

Which of the following is the term used to describe this distribution?

(1)

☒ **A** diversity

☒ **B** endemic

☒ **C** polygenic

☒ **D** specific

(ii) In 2003, it was estimated that there were 7100 Hawaii palila honeycreeper birds on this island. In 2020, it was estimated that there were 950 of these birds.

Calculate the percentage change in the estimated populations of these birds.

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

(2)

Answer ..... %

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

*(b) It is suggested that both of these Hawaiian honeycreeper species evolved from the same common ancestor.

Explain how these two species of honeycreeper could have evolved from the same common ancestor.

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

(6)

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

(c) Explain how scientists could determine which of the 17 other species of honeycreeper on these islands is the most closely related to the Hawaii palila honeycreeper species.

(2)

.....

.....

.....

.....

.....

.....

(Total for Question 5 = 11 marks)

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

6 Fertilisation in mammals, such as the African northern white rhino, results in the fusion of gamete nuclei.

The photograph shows the last two remaining northern white rhinos.

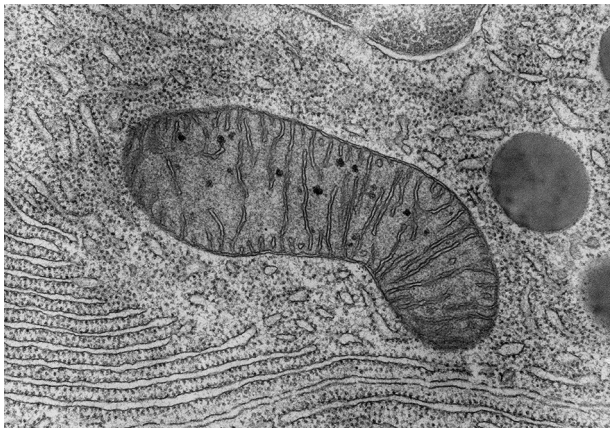
Both of these rhinos are female.

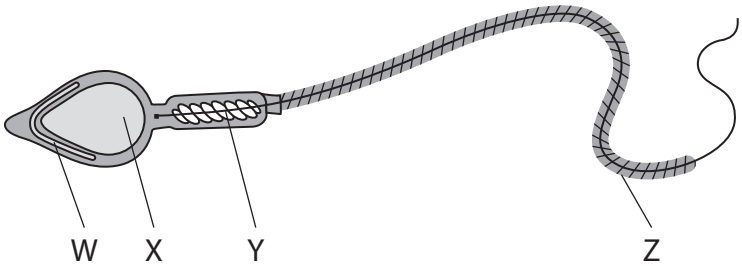


(Source: © Xinhua/Alamy Stock Photo)

Sperm and tissue samples were taken from the last few male northern white rhinos before they died. The sperm samples were frozen.

(a) The photograph shows an organelle taken from a sperm cell, as seen using an electron microscope. The diagram shows a sperm cell.





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

In which part of this sperm cell would this organelle be found?

(1)

☒ **A** W

☒ **B** X

☒ **C** Y

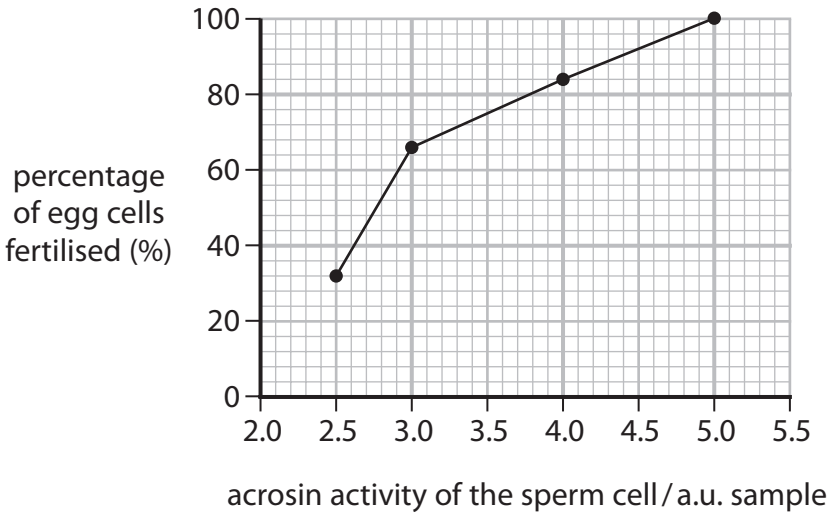
☒ **D** Z

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

(b) Sperm cells contain a digestive enzyme called acrosin.

The effect of acrosin activity of samples of sperm cells on the percentage of egg cells fertilised was investigated.

The graph shows the results of this investigation.



(i) Describe the role of **one** organelle involved in the production of this enzyme.

(2)

Organelle

.....

Role

.....

.....

.....

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

(ii) The investigation used 2500 egg cells for each sample of sperm cells.

Calculate the number of egg cells that would have been fertilised by sperm cells with 2.5 a.u. acrosin activity.

(1)

Answer .....

(iii) Explain why a higher activity of the digestive enzyme acrosin resulted in a higher percentage of egg cells being fertilised.

(4)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

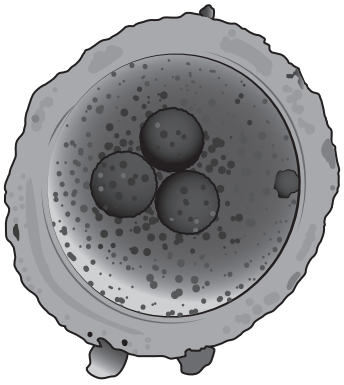
.....

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

(c) In vitro fertilisation (IVF) has been used to fertilise northern white rhino egg cells using the frozen sperm samples.

The zona pellucida of some egg cells were damaged when they were removed from the ovaries of the females.

The drawing shows a fertilised egg cell with three nuclei.



magnification ×200

(i) State how to calculate the actual size of this egg cell.

(1)

.....

.....

(ii) Suggest why this fertilised egg cell has three nuclei.

(3)

.....

.....

.....

.....

.....

.....

.....

.....

.....

(Total for Question 6 = 12 marks)

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

BLANK PAGE

7 Sweet pea plants were originally found in Sicily and southern Italy.

They are used to investigate genetic inheritance and linkage.

The photograph shows a flowering sweet pea plant.



(Source: © Tim Gainey/Alamy Stock Photo)

Sweet pea plant flowers can be different colours and have a variety of pollen grain shapes.

(a) (i) How many of the following statements about a pollen grain are correct?

- contains a tube nucleus and a generative nucleus
- the generative nucleus divides by mitosis to form two female gametes
- can produce diploid gametes

(1)

☒ **A** none

☒ **B** one

☒ **C** two

☒ **D** three

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

(ii) The table gives information about the surface area and volume of round and long pollen grains.

Pollen grain shape	Surface area	Volume / μm^3	Surface area to volume ratio
round	5.03	33.5	0.150
long		25.8	0.160

Calculate the difference in surface area between round and long pollen grains.

Give your answer in standard form with appropriate units.

(2)

Answer .....

(b) Plants that grow from a sweet pea seed contain stem cells.

Describe how a stem cell in a plant can become a sclerenchyma cell.

(4)

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

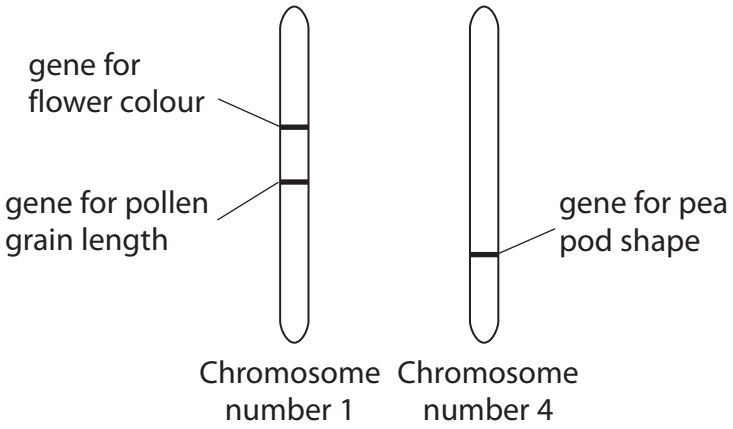
.....

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

(c) Sweet pea plants were used in an investigation into the inheritance of flower colour, pollen grain length and pea pod shape.

Each of these traits is controlled by a single gene. Sweet peas have seven pairs of chromosomes.

The arrangement of these three genes on sweet pea chromosomes is shown in the diagram.



Comment on the role of meiosis in the inheritance of these traits.

(4)

(Total for Question 7 = 11 marks)

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

BLANK PAGE

8 Elk are one of the largest species of deer. The photograph shows three elk grazing in Yellowstone National Park.

They prefer to feed on young tree shoots, such as aspen and cottonwoods, rather than grass.



(Source: ©Westend61 GmbH/Alamy Stock Photo)

(a) Wolves were introduced into Yellowstone National Park in 1995.

Wolves are predators of elk.

Before the introduction of wolves, elk grazed undisturbed, eating all the young tree shoots in the forest and riverside habitats.

The table shows how the percentage of young shoots eaten by the elk changed after the introduction of wolves.

Year	Percentage of young tree shoots eaten by elk (%)	
	Forest habitat	Riverside habitat
1996	100	100
1998	100	100
2000	100	92
2002	90	81
2004	86	45
2006	63	11
2010	19	2

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

Explain why the percentage of young tree shoots eaten by the elk changed after the introduction of wolves.

(3)

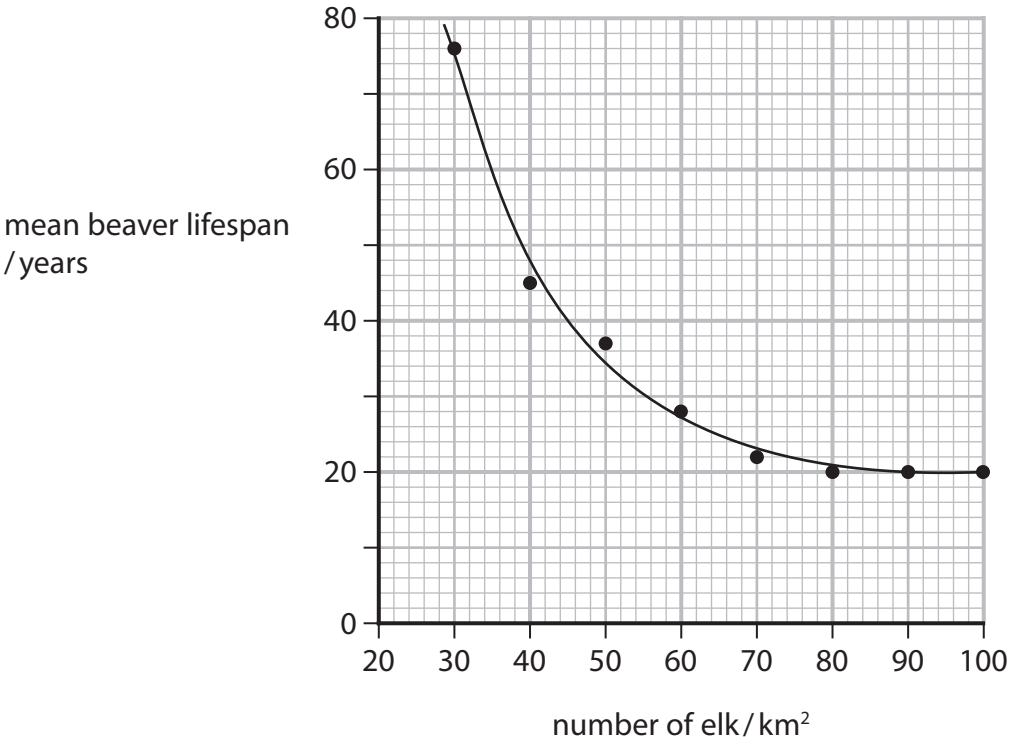
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

(b) The photograph shows a beaver.



(Source: © Ian MacNicol/Getty Images)

The graph shows the mean beaver lifespan in areas with different numbers of elk per km^2.



DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

Describe the relationship shown in the graph.

(3)

(c) Scientists investigated the effect of the introduction of wolves on the biodiversity of Yellowstone National Park.

(i) Suggest what information the scientists would need to collect in order to calculate species richness in a habitat in Yellowstone National Park.

(2)

(ii) Write a formula that could be used to determine the biodiversity of a habitat in Yellowstone National Park.

(1)

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

*(d) Beavers and elk eat the shoots of young trees.

Beavers use older trees to build dams in the rivers, which create new habitats, such as ponds.

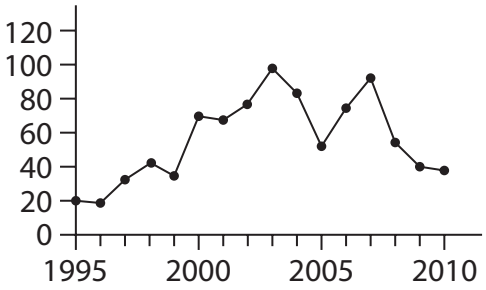
Beavers live in colonies of up to 8 individuals.

After the introduction of the wolves, scientists recorded the number of wolves, elk and beaver colonies for 15 years.

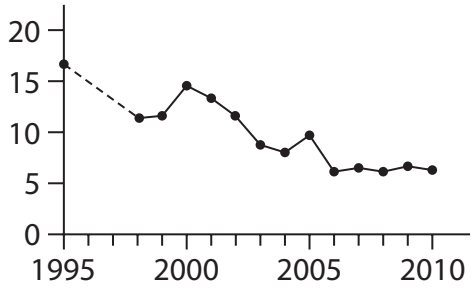
They also recorded the number of young cottonwood shoots that were taller than 5 cm.

The graphs show the data collected by these scientists.

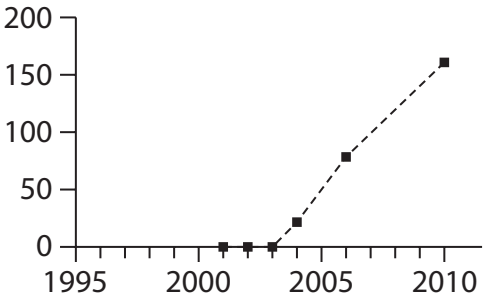
number of wolves



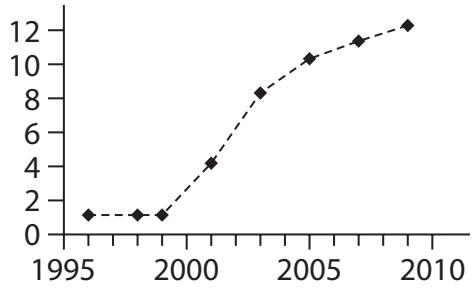
number of elk $\times 10^3$



number of cottonwood shoots



number of beaver colonies



DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

Discuss the effect of the introduction of wolves on the biodiversity of Yellowstone National Park.

Use all the information in the question to support your answer.

(6)

(Total for Question 8 = 15 marks)

TOTAL FOR PAPER = 80 MARKS

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

BLANK PAGE

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

BLANK PAGE

BLANK PAGE

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA