PEARSON EDEXCEL IGCSE BIOLOGY · 4BI1

BIOLOGY



EXAM QUESTION PACK

SECTION 3: REPRODUCTION AND INHERITANCE (PACK 2)

SCORE	PERCENTAGE
/198	%

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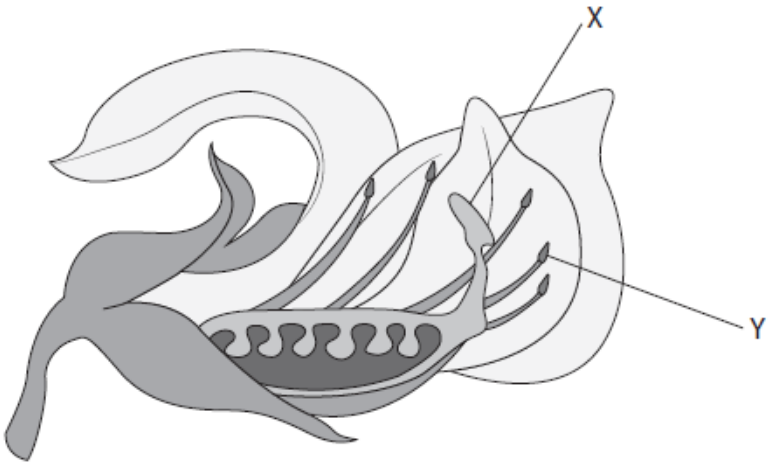
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Q1.

(a) The diagram shows a pea flower with structures labelled X and Y.



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

(2)

X .....

Y .....

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

(3)

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(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

The table shows the scientist's results.

Seeds	Colour of iodine solution	Colour of Benedict's solution
ungerminated	black	blue
germinating	black	red

(i) State which carbohydrates the scientist identified in the ungerminated seeds and the germinating seeds.

(2)

ungerminated seeds

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germinating seeds

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(ii) Explain the difference in the carbohydrate composition of the ungerminated seeds and the germinating seeds.

(3)

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

(2)

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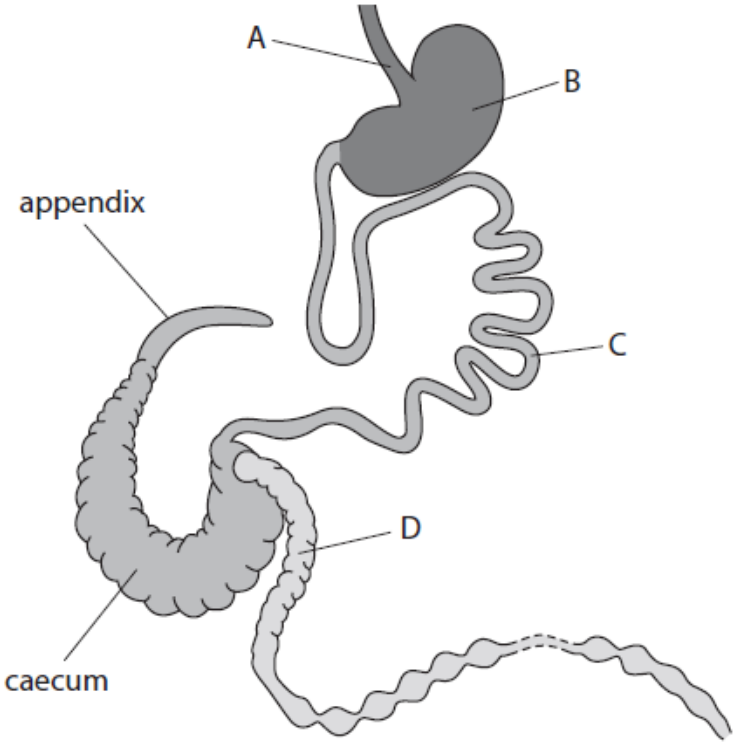
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(Total for question = 12 marks)

Q2.

The diagram shows part of the gut of a rabbit.

The rabbit is a primary consumer and eats mainly grass and other vegetable material.



(a) Name the parts labelled A, B, C and D.

(4)

A .....

B .....

C .....

D .....

(b) The gut of a rabbit has a large caecum and appendix. These contain bacteria that are able to produce the enzyme cellulase.

Explain how these bacteria help the rabbits with their diet of plant material.

(3)

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(c) The human gut has a caecum and appendix but they are much smaller than those in the rabbit.

(i) Suggest why the human gut only has a small caecum and appendix.

(1)

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(ii) In humans the appendix also acts as a store of useful bacteria. Scientists have discovered that patients who have had their appendix removed are more likely to develop infections of the colon.

Explain how having no appendix may increase the likelihood of bacterial infections of the colon.

(2)

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(Total for question = 10 marks)

Q3.

The photograph shows a variety of chicken called a silkie chicken.



(Source: © YVES LANCEAU/NATURE PICTURE LIBRARY/SCIENCE PHOTO LIBRARY)

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)

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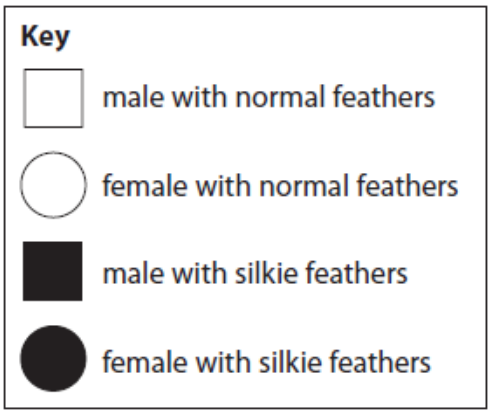
(ii) Give the possible genotypes of a chicken with normal feathers.

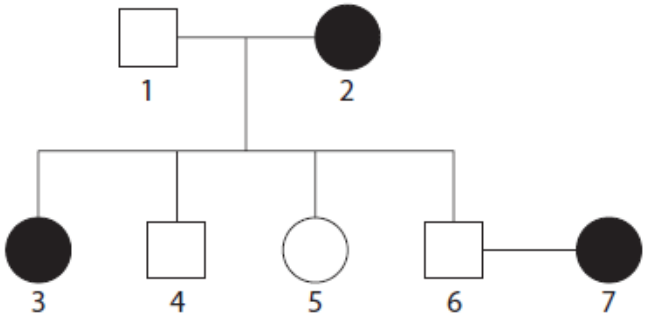
(1)

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

The diagram shows a family pedigree for some chickens.





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

(1)

☒ **A** 0

☒ **B** 3

☒ **C** 4

☒ **D** 5

(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)

probability = ...

(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)

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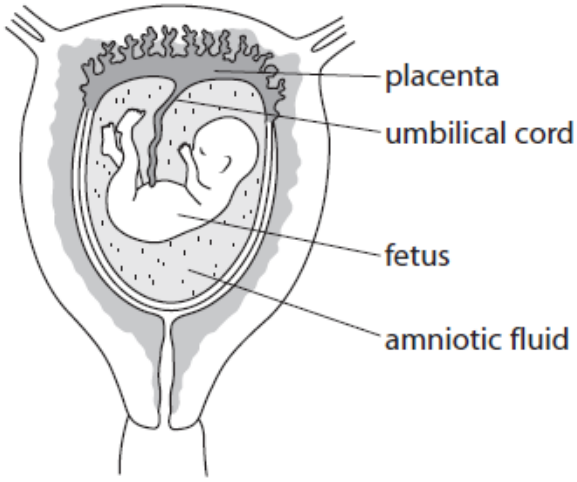
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(Total for question = 10 marks)

Q4.

The diagram shows a fetus in the uterus of a woman.



The umbilical cord transports blood from the placenta to the fetus.

This blood contains molecules from the mother that are needed by the developing fetus.

(a) (i) Explain how some of these molecules allow active transport to occur in cells of the fetus.

(3)

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(ii) Explain how one type of molecule from the mother helps to protect the fetus from infection.

(2)

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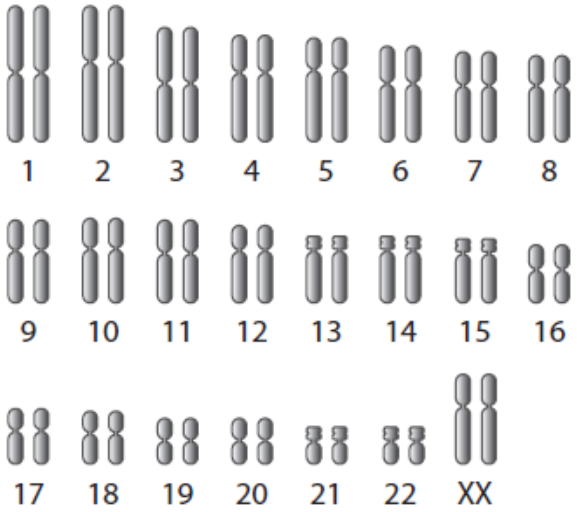
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(b) The amniotic fluid contains cells from the fetus.

It is possible to look at chromosomes in these cells.

A diagram of the chromosomes is called a karyotype.

The diagram shows the karyotype of a fetus cell.



Give two conclusions you can make from this karyotype.

(2)

1 .....

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2 .....

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(c) Doctors recommend that pregnant women obtain more of some dietary components than women who are not pregnant.

The table shows the recommended percentage increase of some dietary components in the diet of a woman who is pregnant compared to a woman who is not pregnant.

Component	Percentage increase of some dietary components in the diet of a woman who is pregnant compared to a woman who is not pregnant (%)
Energy in kJ	10
Calcium in g	71
Iron in mg	50
Protein in g	14
Vitamin D in µg	300

(i) Explain why a woman who is pregnant requires more of each of the dietary components listed in the table.

(4)

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(ii) The actual mass of additional iron needed by the pregnant woman was 9.0 mg per day.

Calculate the actual total mass of iron needed by the pregnant woman.

(3)

mass = ... mg per day

(Total for question = 14 marks)

Q5.

Alkaptonuria is an inherited condition caused by the presence of recessive alleles.

(a) State what is meant by a recessive allele.

(1)

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(b) Alkaptonuria is first diagnosed in children when it is noticed that they produce very dark urine that turns black when exposed to air.

A woman and a man do not have alkaptonuria. They have a child who has the condition.

The woman and the man are expecting a second child.

(i) Draw a genetic diagram to show the genotypes of the woman and the man, the gametes they produce and the possible phenotypes and genotypes of the second child.

(4)

(ii) Calculate the probability that the second child is male and does not have the condition.

(1)

probability = ...

(c) Alkaptonuria is caused by the body being unable to break down the amino acids tyrosine and phenylalanine.

This leads to a build-up of a toxin that causes damage to joints and tendons and can also lead to heart valve damage in later life.

A new drug treatment is being tested that can slow the damage to the joints and tendons.

Scientists selected 40 adults who all had alkaptonuria. They placed each patient into one of two groups. One group was given the drug treatment and the other group acted as a control.

The scientists then compared the symptoms of the patients in each group after three years.

(i) Describe what is meant by the control group.

(1)

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(ii) The table compares the control group with the drug treatment group.

It shows the numbers starting and completing the trial and those showing harmful effects.

It also compares improvements in two symptoms of alkaptonuria.

	Control group	Drug group
number of patients starting trial	20	20
number of patients completing trial	17	16
number of patients showing adverse effects	0	2
number of patients that died	0	1
decrease in time taken to stand up and walk 3 m in seconds	0.54	1.33
increase in distance in metres walked in 6 minutes	6.7	51.5

Evaluate whether the new drug should be recommended as an effective treatment for alkaptonuria.

(5)

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(d) Other scientists have suggested that eating fewer proteins that contain tyrosine and phenylalanine would reduce the symptoms of alkaptonuria.

Suggest why eating fewer of these proteins may be difficult.

(2)

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(Total for question = 14 marks)

Q6.

Fur colour in rats is controlled by a gene with two alleles.

One allele codes for black fur colour. The other allele codes for agouti fur colour.

Several female rats with agouti coloured fur are mated with several male rats with black coloured fur.

All of the offspring have agouti coloured fur.

(a) (i) Explain which allele is dominant.

(2)

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(ii) A male and female rat from these offspring are then mated together in a second cross.

Some of the offspring of this second cross have agouti coloured fur and some have black coloured fur.

Draw a genetic diagram to show this second cross. Include the genotypes of the parents, the gametes they produce, and the genotypes and the phenotypes of the offspring.

(4)

(iii) Calculate the probability of any one offspring from this second cross being male with agouti coloured fur.

(2)

probability = ...

(b) Scientists observed that genes that control fur colour in rats can affect rat behaviour, such as how tame they are.

Other genes that control the size of the adrenal glands and the production of neurotransmitters also affect rat behaviour.

Scientists also noticed that coat colour is associated with differences in anatomy and physiology, such as the size of the adrenal glands and the production of neurotransmitters.

(i) State the name of the type of genetic control where many genes control one phenotype.

(1)

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(ii) Explain why the size of the adrenal glands and the production of neurotransmitters would affect rat behaviour.

(3)

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(c) Some rats with white fur also have pink eyes.

These rats have pink eyes because they do not have pigment in their irises.

This means that their irises let light pass through, unlike the coloured irises found in other rats.

Explain how this difference in the iris affects vision in the rats with pink eyes.

(3)

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(Total for question = 15 marks)

Q7.

Fur colour in mice is controlled by a single gene that has two alleles.

Mice can have grey fur or white fur.

In a first cross, a female white mouse is mated with a male grey mouse.

They have eight offspring, each with grey fur.

(a) Which allele is dominant?

(1)

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(b) One of the female offspring from this first cross is mated with a male white mouse in a second cross.

(i) Draw a genetic diagram to show the genotypes of the parents, the gametes they produce and the expected genotypes and phenotypes of the offspring from this second cross.

(4)

(ii) This second cross produces six offspring.

Four are male and two are female.

Give a reason why the ratio of male to female mice in the offspring is not 1 : 1

(1)

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.....

(iii) The parents of the second cross mate again and produce another set of offspring.

Calculate the probability that one of these offspring will be male and have white fur.

(2)

probability = ...

(c) Scientists have found that mice with white fur may be more likely to develop some bacterial infections.

The mouse immune system is similar to the human immune system.

Describe how the immune system of a mouse responds when exposed to a bacterial infection.

(3)

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(Total for question = 11 marks)

Q8.

The photograph shows an insect-pollinated plant called a stock.



(a) Give two features of insect-pollinated flowers.

(2)

1 .....

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2 .....

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(b) There are two types of stock plant. One type has single flowers and the other type has double flowers.

The double flower is caused by a recessive allele (d) and has no stamens.

Gardeners often grow plants that have double flowers because they are larger and last longer than single flowers.

Plants with double flowers cannot reproduce. Plants with double flowers are usually produced by self-pollinating a plant with single flowers that carries the recessive allele.

(i) Explain why plants with double flowers cannot reproduce on their own.

(2)

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(ii) A plant with single flowers that carries the recessive allele is self-pollinated.

Draw a genetic diagram to show the parent genotypes, the gametes produced, and the genotypes and phenotypes of the offspring.

(4)

(iii) This self-pollinated plant with single flowers produces 600 seeds.

Calculate the expected number of plants with double flowers that will grow from these seeds.

(2)

expected number = ...

(Total for question = 10 marks)

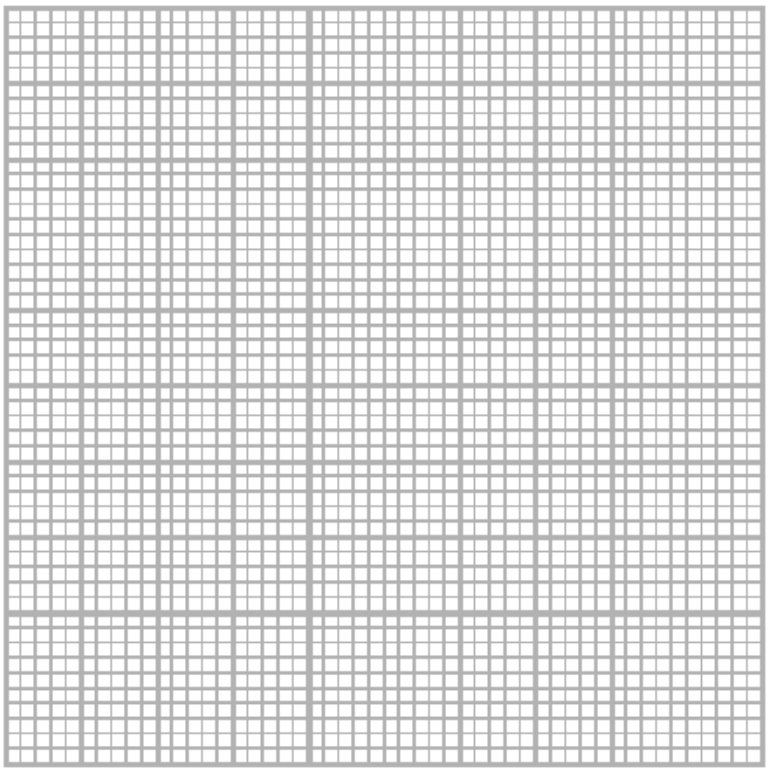
Q9.

The data in the table shows how the mean maximum lung volume changes with age for males and females.

Age / years	Mean maximum lung volume / dm^3	
	males	females
7	2.10	2.05
16	4.50	3.70
25	5.20	3.80
50	4.80	3.40
70	3.90	2.80

(a) (i) Plot a bar graph to show this data.

(5)



(ii) Calculate the increase in mean maximum lung volume for males between the ages of 7 and 25.

(1)

increase = ... dm^3

(iii) Explain why the mean maximum lung volume for males and females is similar at age 7 but is different at age 25.

(3)

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(b) The data shows the mean maximum lung volume at each age.

(i) Which of the following would improve the reliability of these mean values?

(1)

☒ **A** using a larger range of ages

☒ **B** measuring more people at each age

☒ **C** measuring lung volume in cm^3

☒ **D** measuring lung volumes in other mammals

(ii) Variation in maximum lung volume exists between males at each age.

Suggest **two** factors that could cause this variation.

(2)

1 .....

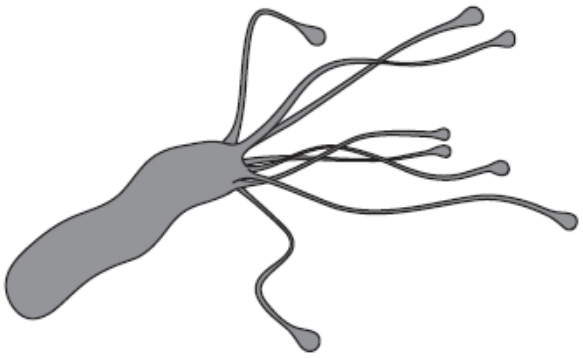
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(Total for question = 12 marks)

Q10.

The bacterium *H. pylori* causes stomach ulcers.

(a) The diagram shows this bacterium.



(i) Which of these is found in this bacterium?

(1)

☒ **A** cellulose

☒ **B** chitin

☒ **C** cytoplasm

☒ **D** nucleus

(ii) The bacterium has evolved to release an enzyme called urease.

The action of the bacterium neutralises the acid in the stomach.

What is the pH changed to?

(1)

☒ **A** 1

☒ **B** 2

☒ **C** 7

☒ **D** 12

(iii) Use the theory of evolution by natural selection to explain how *H. pylori* bacteria could have evolved to produce urease.

(4)

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(b) Probiotics are live microorganisms that can have health benefits when consumed.

Scientists investigate the ability of probiotics and cranberry juice to reduce the growth of *H. pylori*.

The scientists give various treatments to a group of people who have *H. pylori*.

The treatments are given daily for three weeks.

The scientists measure the mean percentage reduction of *H. pylori* for each treatment.

The table shows the scientists' results.

Treatment	Mean percentage (%) reduction in *H. pylori*
probiotics	14.9
cranberry juice	16.9
probiotics and cranberry juice	22.9
control	1.5

Give two conclusions from these results.

(2)

1 .....

2 .....

(Total for question = 8 marks)

Q11.

(a) The table gives some examples of biological processes.

Complete the table by giving the name of each process.

The first one has been done for you.

(3)

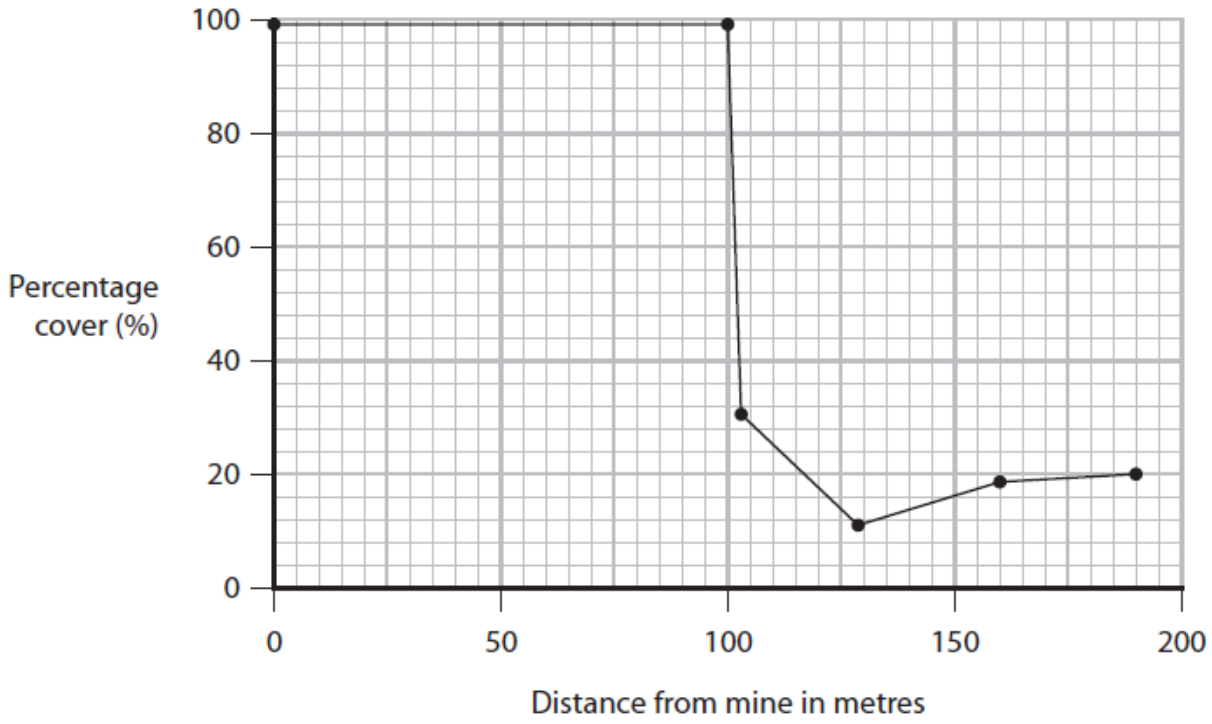
Example of process	Name of process
plants with a short growing season survive drought	natural selection
growth of algae in rivers polluted by fertiliser	
pollen transferred from one plant to another by an insect	
absorption of nitrate ions from soil using ATP	

(b) Zinc is poisonous to many plants and can affect natural selection.

A scientist investigates the ability of one grass species to survive at different distances from a zinc mine.

The scientist uses a sampling method to measure the percentage cover of this grass species at different distances from the zinc mine.

The graph shows the scientist's results.



(i) The zinc concentration in soil is higher near the zinc mine than it is further from the zinc mine.

Explain how natural selection could be responsible for the results shown in the graph between 0 and 100 metres.

(4)

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(ii) Describe a method the scientist could use to compare the population size of the grass species at 50 metres and 100 metres from the mine.

(4)

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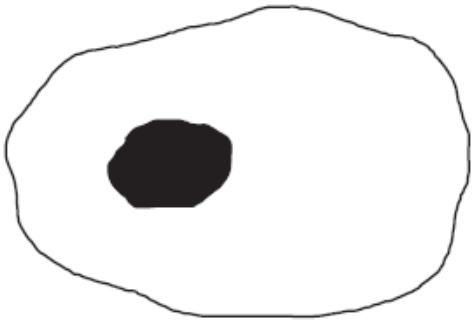
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(Total for question = 11 marks)

Q12.

(a) A student uses a light microscope to look at a human cheek cell.

The student makes this drawing of the cell.



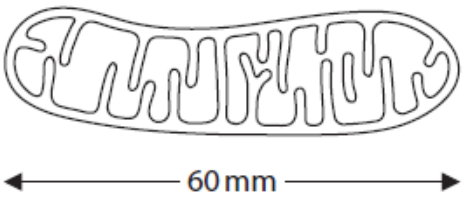
Name the organelle shown in the drawing.

(1)

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(b) Mitochondria are organelles that are too small to be seen using a light microscope.

The drawing shows a mitochondrion that has been magnified.



The actual length of this mitochondrion is 6 µm.

[1 µm = 0.001 mm]

Calculate the magnification of this drawing.

(2)

magnification = ...

(c) The table gives information about mitochondria in different human cells.

Cell	Mean number of mitochondria per cell	Mean volume of cell in µm³	Mean number of mitochondria per µm³
heart muscle	5000	15000	
sperm	75	30	2.50
egg	600000	4000000	0.15

(i) What is the mean number of mitochondria per μm^3 in a heart muscle cell?

(1)

☒ **A** 0.33

☒ **B** 3

☒ **C** 10 000

☒ **D** 75 000 000

(ii) Comment on the differences in the data for the sperm and for the egg.

(3)

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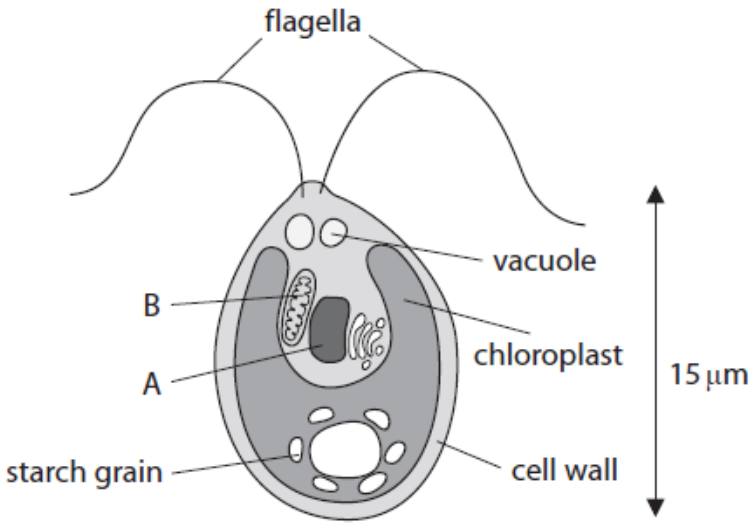
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(Total for question = 7 marks)

Q13.

The diagram shows *Chlamydomonas*, a single-celled protoctist that is found in water.



(a) Name the structures labelled A and B.

(2)

A .....

B .....

(b) (i) *Chlamydomonas* has some structures that are normally found in plant cells, but not found in animal cells.

Name two of these structures.

(2)

1 .....

2 .....

(ii) State why *Chlamydomonas* is not classified as a plant.

(1)

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(c) Explain how *Chlamydomonas* obtains energy.

(2)

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(d) *Chlamydomonas* has flagella.

Suggest a function of these flagella.

(1)

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(e) The magnification of the cell in the diagram is calculated using this formula.

$$\text{magnification} = \frac{\text{length of cell in diagram}}{\text{actual length of cell}}$$

The actual length of the cell is 15 µm.

Calculate the magnification of the diagram.

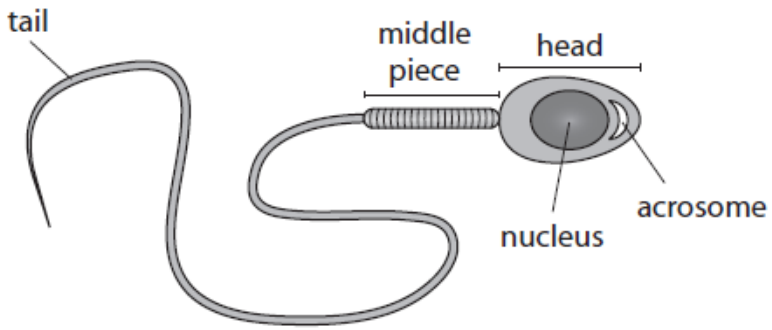
(2)

magnification = ...

(Total for question = 10 marks)

Q14.

The diagram shows a human sperm cell.



(a) What is the maximum number of X chromosomes found in the nucleus of a sperm cell?

(1)

☒ **A** 0

☒ **B** 1

☒ **C** 2

☒ **D** 23

(b) The middle piece of the sperm cell contains mitochondria.

Explain the function of these mitochondria.

(2)

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(c) The acrosome contains digestive enzymes.

Suggest the function of the acrosome.

(2)

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(d) Describe the route taken by a sperm cell from when it enters the woman's body to the site of fertilisation of the egg.

(2)

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(Total for question = 7 marks)

Q15.

There is a relationship between the colour of a flower and pollination by insects.

Design an investigation to find out if the colour of a flower affects how attractive it is to pollinators.

Include experimental details in your answer and write in full sentences.

(6)

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(Total for question = 6 marks)

Q16.

The passage describes reproduction in flowering plants.

Complete the passage by writing a suitable word in each blank space.

(8)

Flowers are organs that allow plants to carry out
..... reproduction.

The male gamete is contained within the
..... grains. These grains

are released from the ..... , which is found on top of the filament.

These grains need to land on the ..... , the female part of the flower.

Grains can be transferred by wind or by animals. These animals are often insects such as

..... or butterflies. The petals of insect-pollinated plants are often

..... and brightly coloured. After pollination, the grains

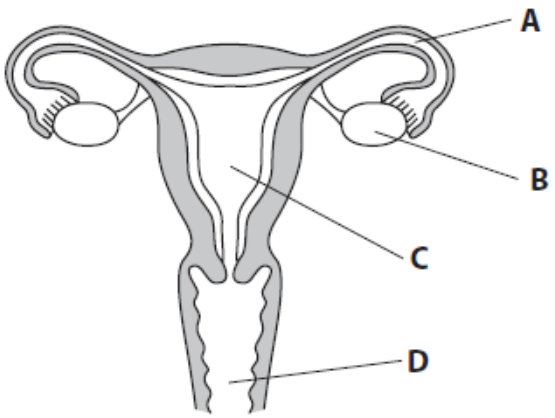
germinate and a tube grows down the
..... to reach the ovary.

In the ovary, the gametes fuse. This process is known as
..... .

(Total for question = 8 marks)

Q17.

The diagram shows the human female reproductive system.



(a) (i) Which label shows where ovulation occurs?

(1)

☒ **A**

☒ **B**

☒ **C**

☒ **D**

(ii) Which label shows where fertilisation usually occurs?

(1)

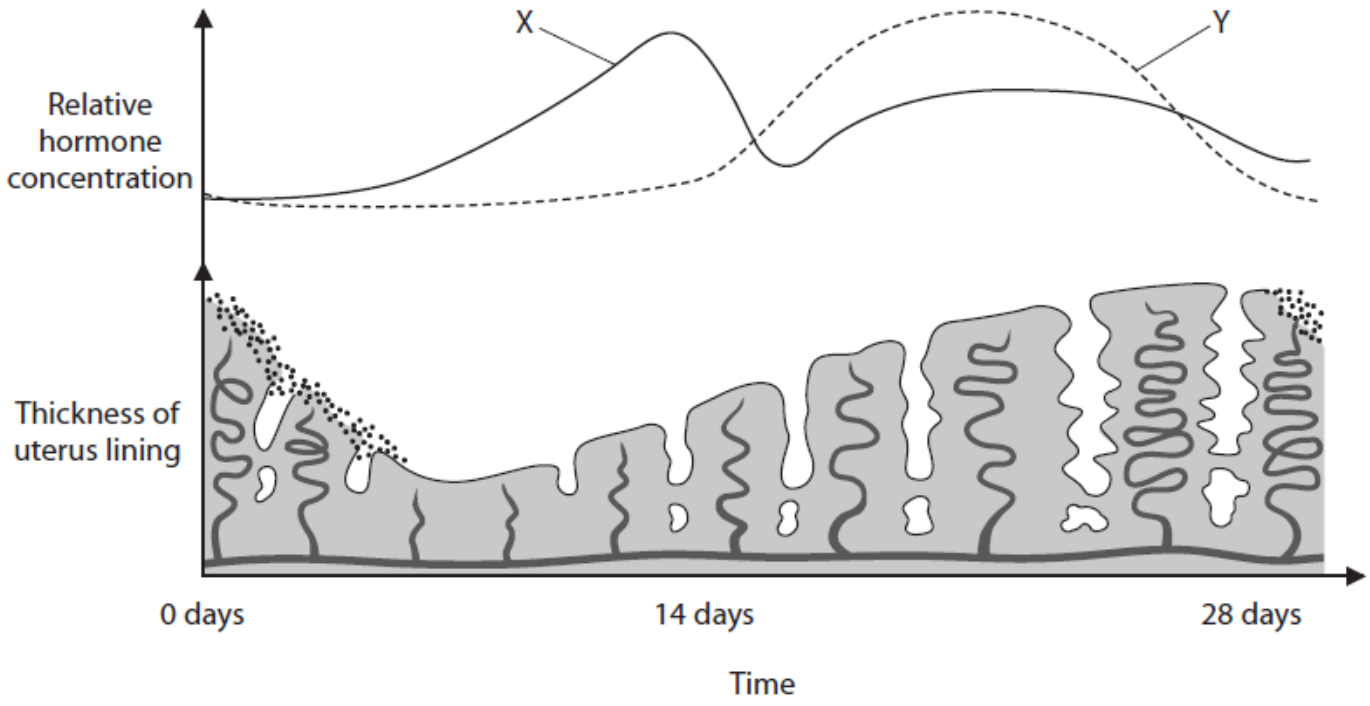
☒ **A**

☒ **B**

☒ **C**

☒ **D**

(b) The diagram shows the changes in thickness of the uterus lining and levels of two hormones produced by the ovary during a menstrual cycle.



(i) Hormones X and Y are produced by the ovaries.

Name X and Y.

(2)

X .....

Y .....

(ii) Explain the function of hormone X during the menstrual cycle.

(2)

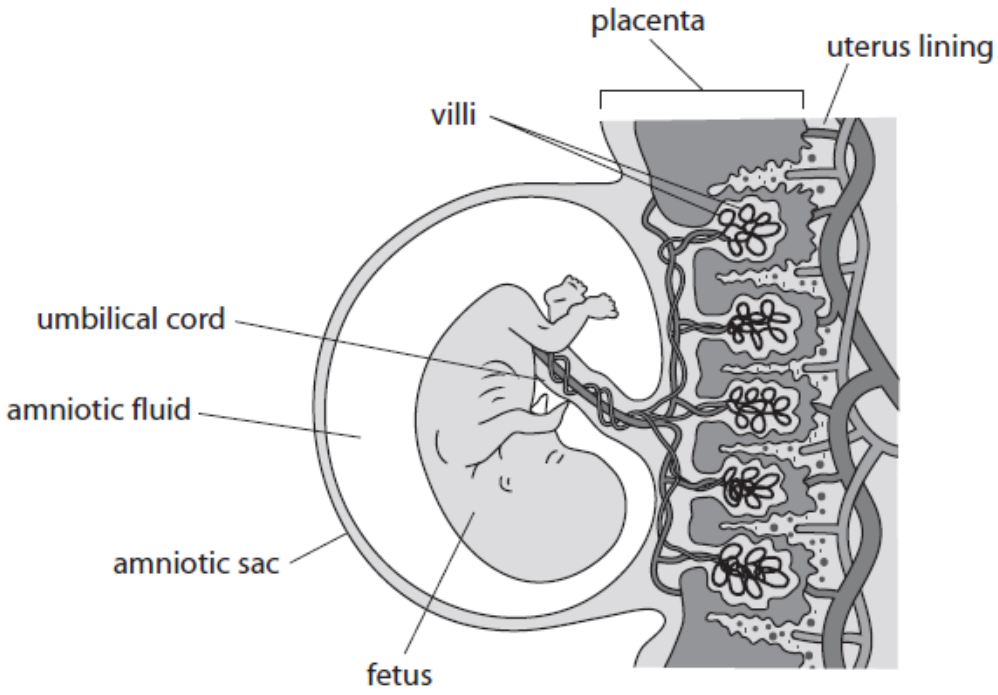
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(c) The diagram shows a human fetus developing in the uterus.



Explain how the structure of the placenta enables the efficient exchange of substances between the fetus and the mother.

(3)

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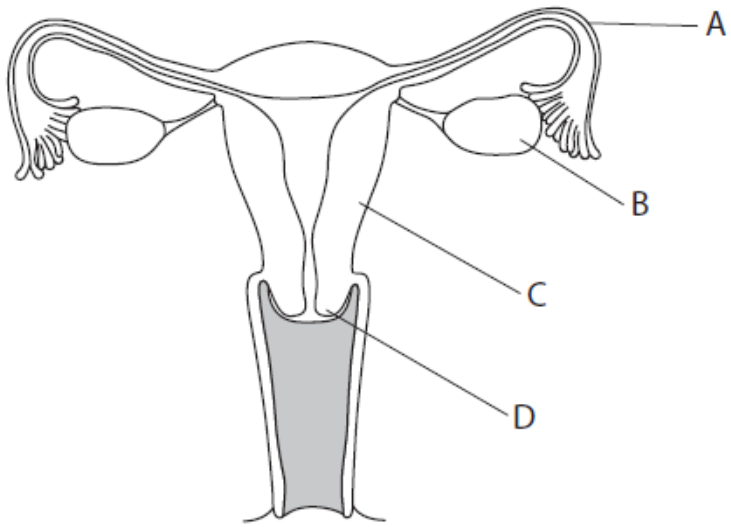
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(Total for question = 9 marks)

Q18.

The diagram shows the female reproductive system.



(a) (i) Give the letter that shows where oestrogen is produced.

(1)

.....

(ii) Give one role of oestrogen.

(1)

.....

(b) When an egg is released it can be fertilised by a sperm.

(i) Name the cell produced when an egg is fertilised.

(1)

.....

(ii) A sperm travels a distance of 14 cm to fertilise an egg.

This sperm travels at a speed of 3.0 mm per minute.

Calculate the time taken for this sperm to travel to the egg.

Give your answer in minutes.

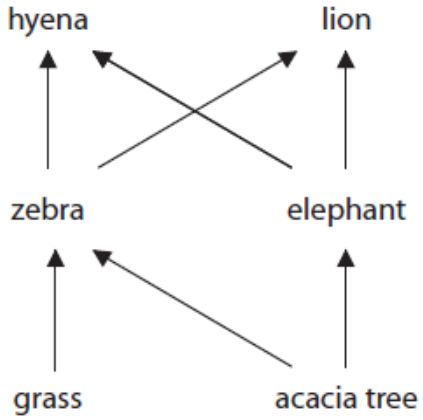
(2)

time = ... minutes

(Total for question = 5 marks)

Q19.

The diagram shows a food web for a region in Africa.



(a) Use information from the food web to complete the table.

The first one has been done for you.

(3)

number of plants	2
number of primary consumers	
number of carnivores	
number of food chains	

(b) The flowers of the acacia tree produce nectar.

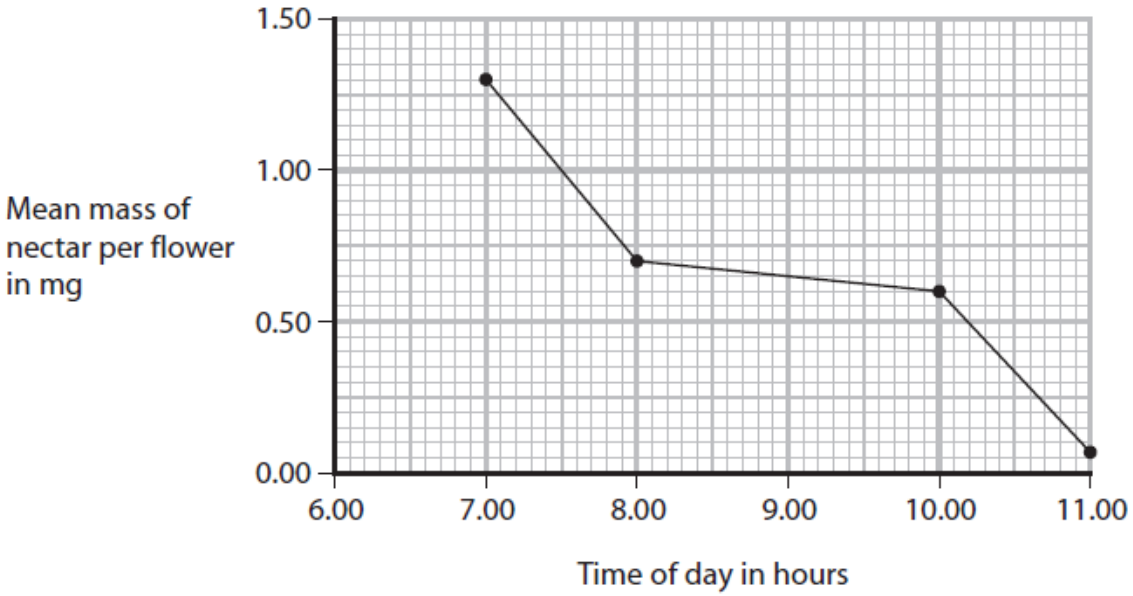
Give two other features you would expect to find in an acacia flower.

(2)

1 .....

2 .....

(c) The graph shows the decrease in the mean mass of nectar in flowers during one morning.



(i) Use the graph to calculate the greatest rate of decrease in the mean mass of nectar.

(2)

greatest rate = ... mg per hour

(ii) Give a reason why the mass of nectar decreases during the morning.

(1)

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(d) Acacia flowers produce a chemical that repels ants.

Suggest two advantages for the acacia plant of producing this chemical.

(2)

1 .....

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2 .....

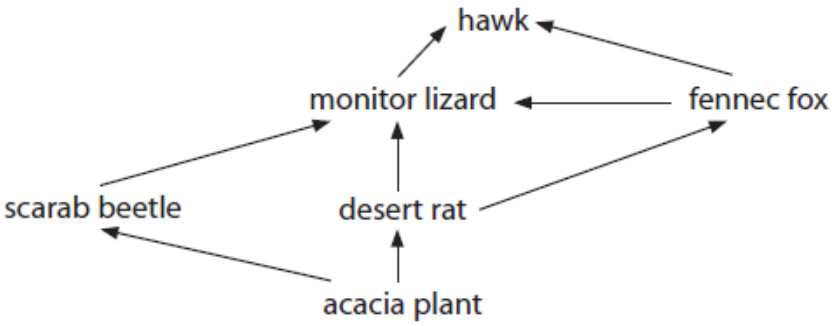
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(Total for question = 10 marks)

Q20.

The diagram shows part of a food web for a desert community.



(a) (i) How many organisms in this food web are secondary consumers?

(1)

☒ **A** 2

☒ **B** 3

☒ **C** 4

☒ **D** 5

(ii) Draw the longest food chain in this food web.

(1)

(iii) Explain why most of the energy in the producers is **not** transferred to the hawk.

(3)

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(b) The photograph shows a fennec fox.



(Source: anolis01.123rf.com/PAL)

Fennec foxes live in the Sahara Desert, which is very hot. They have very large ears and a thin body.

Explain how the body shape of the fennec fox has evolved by natural selection.

(4)

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(Total for question = 9 marks)