AQA GCSE Biology | 8461

SPECIFICATION POINT 4.1.2.1

Chromosomes

Past-paper questions

Tier	**Higher**
Question groups	**56**
Available paper years	**2007–2025**

Using this booklet

1. Answer the questions in order and show your working.
2. Original question numbers and marks are retained.
3. Print at actual size (100%) for measuring questions.
4. Use the companion answer booklet to check your work.

Name: _____ **Date:** _____

Whole questions are retained for context, so some parts assess other specification points. Current and legacy sources are labelled. Continue on extra paper if needed.

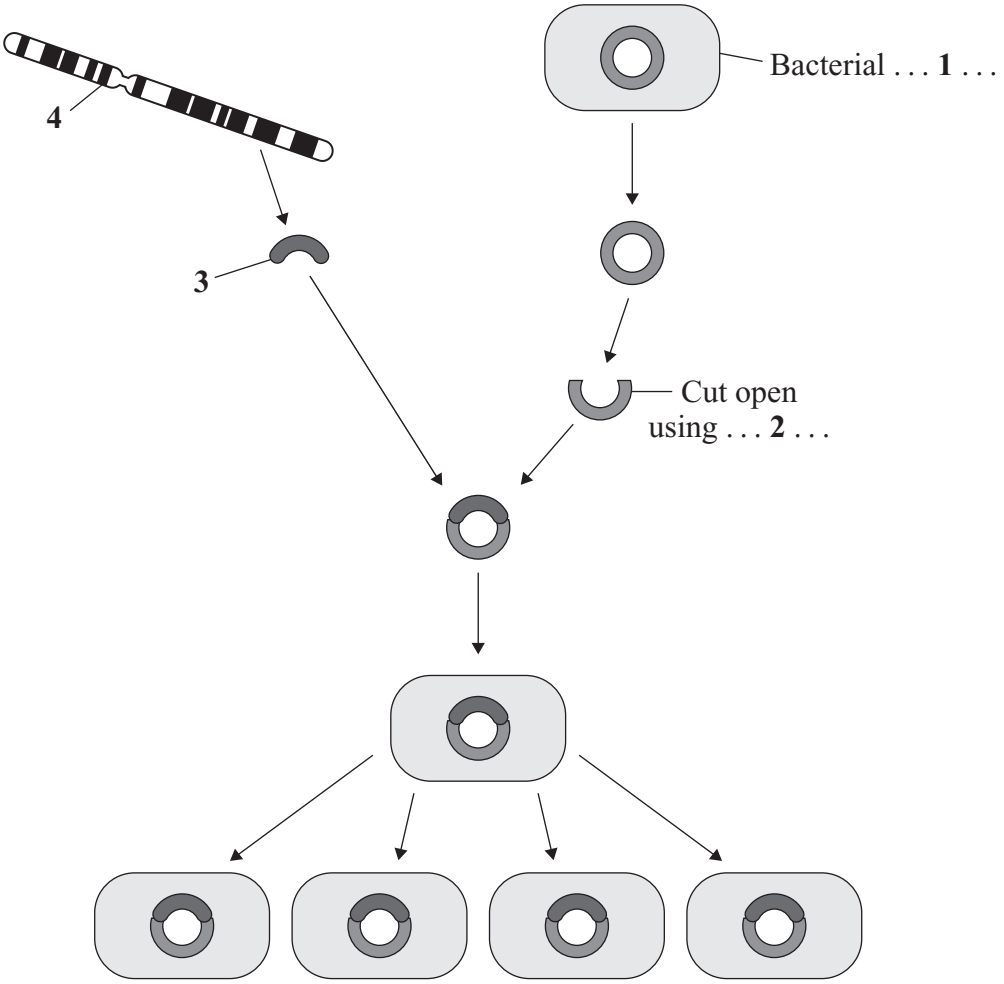
4.1.2.1 Chromosomes

Question 01

March 2007 | BLY1B | Original Q1 | Legacy

QUESTION ONE

The diagram shows some of the steps involved in genetic engineering.



4.1.2.1 Chromosomes

Question 01 · continued

Match words, **A**, **B**, **C** and **D**, with the labels **1–4** on the diagram.

A cell

B chromosome

C enzyme

D gene

4.1.2.1 Chromosomes

Question 02

March 2007 | BLY1B | Original Q6 | Legacy

QUESTION SIX

Read the passage.

GM Plants

There is a lot of concern about genetic engineering and its possible effects on the environment.

The practice of producing genetically modified (GM) food plants by adding genes for different characteristics may be a disaster in the making.

Scientists can add genes such as those for herbicide resistance, insecticide production, vitamin A production and other genes to improve growth, to plants that normally lack these characteristics.

There is evidence that some varieties of butterfly are disappearing, possibly due to eating pollen from GM crops.

There are fears that genes may escape from the organisms in which they were placed by cross-breeding, creating 'superweeds' that cannot be killed easily.

The GM crops may themselves also become weeds and spread rapidly through the environment.

Of further concern is the potential danger to humans of eating GM foods. The genes may react in the body and cause long-term effects which are at present unknown.

6A Which technique is used to produce large numbers of identical genetically modified plants?

1 artificial cross-breeding of plants

2 embryo transplants

3 tissue culture

4 transferring wanted genes to developing plant cells

6B Which genetic modification to plants directly benefits human health?

1 herbicide resistance

2 increased growth

3 insecticide resistance

4 vitamin A production

4.1.2.1 Chromosomes

Question 02 · continued

6C Which concern about GM crops is supported by scientific evidence?

1 Crops will become weeds and spread rapidly through the environment.

2 Herbicides will not be able to kill 'superweeds'.

3 Humans will be harmed by eating GM crops.

4 Some varieties of butterfly will disappear.

6D A scientist wants to find out if a gene for herbicide-resistance can be transferred to weeds from GM crop plants.

How could he investigate this?

1 collect weeds from a number of different environments and study their genes

2 collect weeds from areas where GM crops are grown and spray the weeds with herbicide

3 cross-breed GM herbicide-resistant crop plants with weeds

4 grow the seeds from weeds growing close to GM crops and spray with herbicide

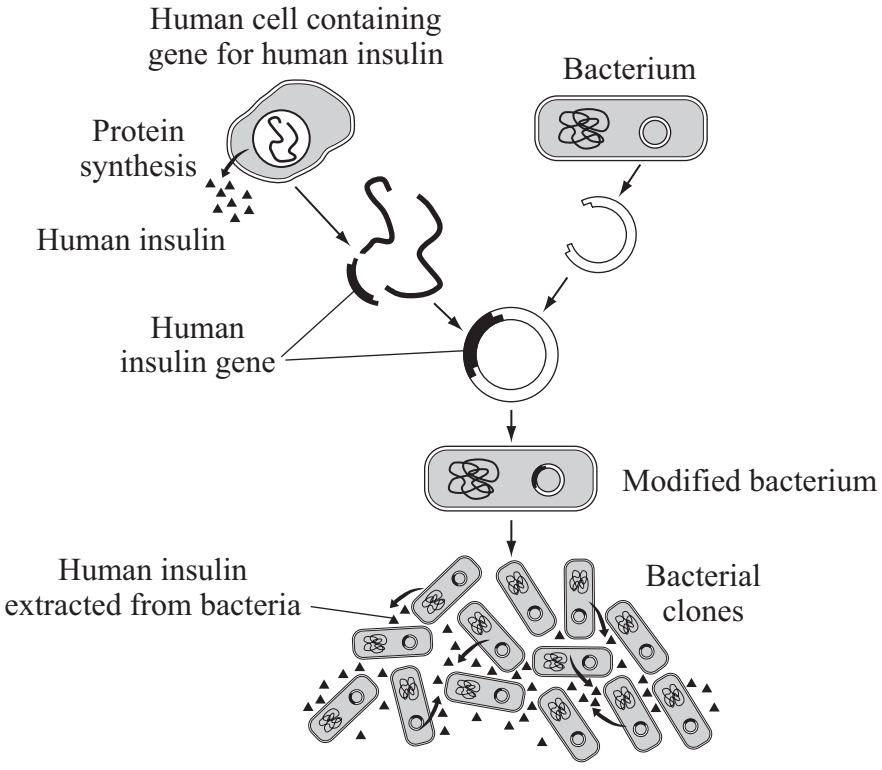
4.1.2.1 Chromosomes

Question 03

June 2007 | BLY1B | Original Q5 | Legacy

QUESTION FIVE

The diagram shows some of the stages involved in the production of the human protein insulin, by a bacterium.



5A The human insulin gene was cut out of a human . . .

1 chromosome.

2 gamete.

3 nucleus.

4 embryo.

5B The removal of the insulin gene from the human cell is carried out by . . .

1 an enzyme.

2 a hormone.

3 a human gene.

4 a bacterium.

4.1.2.1 Chromosomes

5C The advantage of using bacteria rather than mammals to manufacture the insulin is that . . .

1 it needs less research.

2 the bacteria can provide more insulin than a mammal.

3 the bacteria will produce insulin that is less toxic.

4 there are likely to be fewer ethical objections.

5D This method of producing a product using bacteria is an example of . . .

1 sexual reproduction.

2 evolution.

3 genetic engineering.

4 natural selection.

Turn over for the next question

4.1.2.1 Chromosomes

Question 04

June 2007 | BLY1B | Original Q6 | Legacy

QUESTION SIX

Read the passage.

GM Cotton

The bollworm is an insect that attacks cotton plants.

Scientists have developed genetically modified (GM) cotton plants by inserting a gene into the cotton plants.

The gene enables the cotton plants to produce a poison to kill the bollworm and prevent damage to the cotton crop.

Cotton growers do not need to buy as much pesticide to control the bollworm.

GM cotton seeds are more expensive than ordinary cotton seeds.

However, after seven years of growing the GM cotton, growers are now buying and using as much pesticide as farmers growing non-GM cotton.

6A Which of the following is likely to occur as a result of the bollworm being unable to feed on the cotton plants?

1 Other insects may increase in number.

2 Other insects will not be able to feed on the cotton plants.

3 The bollworm will become resistant to the poison produced by the cotton crop.

4 The predators of the bollworm will begin to eat the cotton plants.

6B The gene that was inserted into the cotton plants allowed the plants to . . .

1 produce more cotton.

2 produce a pesticide.

3 resist all insects.

4 resist pesticides.

4.1.2.1 Chromosomes

Question 04 · continued

6C After growing GM cotton for three years, the cotton growers were making 30 % more profit than when they grew the non-GM cotton.

This was a result of . . .

1 not having to buy as much pesticide.

2 having a bigger market for their cotton.

3 paying less for the GM seeds.

4 all insect pests having been destroyed.

6D After growing the GM cotton for seven years, the cotton growers were making less money than they did when growing non-GM cotton.

This was most likely because . . .

1 the bollworm had become resistant to the poison produced by the cotton crop.

2 pesticides could not control the bollworm.

3 the GM cotton seeds had become too expensive to buy.

4 there was no market for the GM cotton.

4.1.2.1 Chromosomes

Question 05

November 2007 | BLY1B | Original Q6 | Legacy

QUESTION SIX

This question is about genetically modified food.

Read the passage.

> In 1996, two supermarkets started to sell genetically modified (GM) tomato puree, a paste made by cooking GM tomatoes.
> It was cheaper than non-GM puree and sold very quickly.
> The GM tomatoes contained a transferred gene which allowed them to keep ripe longer.
> The GM tomatoes were grown in America because the British climate was not suitable.
> Laws prevented uncooked GM tomatoes from being sold in Europe.
> The cans of tomato puree were clearly labelled to show that the GM puree was made from GM tomatoes.
> In 1999, the supermarkets stopped selling the GM tomato puree.

6A Why were the GM tomatoes produced in the first place?

1 to produce cheaper puree

2 to produce tastier puree

3 to produce a bigger crop in America

4 to produce larger tomatoes

6B Which of the following is the most likely reason to explain why people stopped buying the GM tomato puree?

1 concern about the effects on the British economy

2 concern about the effect on the environment of growing GM crops

3 European laws prohibiting the sale of GM tomatoes

4 the tomatoes could not be grown in Britain

4.1.2.1 Chromosomes

Question 05 · continued

6C How are GM tomatoes produced in the first place?

1 producing clones from a mutated plant

2 fusing cells of young tomato plants

3 sexual reproduction of two varieties of tomato plant

4 transferring genes from another species

6D Why were the tins of tomato puree labelled to show that they had been made using GM tomatoes?

1 because the supermarkets were worried about health effects

2 so that the public could choose GM or non-GM puree

3 to inform the public about genetic engineering

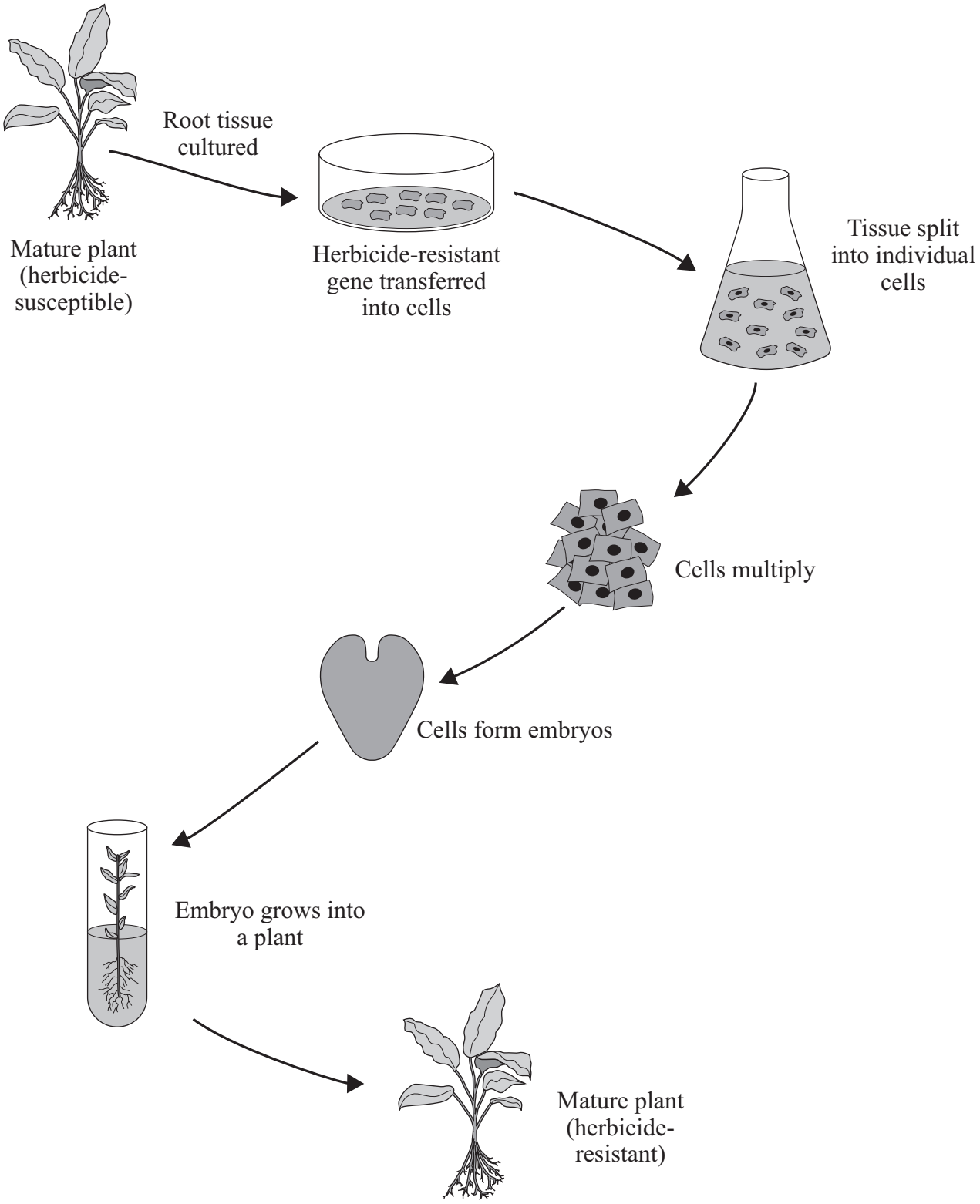
4 to raise public concern over GM crops

4.1.2.1 Chromosomes

Question 06

January 2008 | BLY1H | Original Q8 | Legacy

8 The diagram shows one method of producing herbicide-resistant crop plants.



4.1.2.1 Chromosomes

Question 06 · continued

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(a) (i) The herbicide-resistance gene is obtained from a herbicide-resistant plant.

Which structure in a cell carries the genes?

.....

(1 mark)

(ii) How is the herbicide-resistance gene cut out of this structure?

.....

.....

(1 mark)

(b) Apart from having the herbicide-resistance gene, the herbicide-resistant plants are identical to the herbicide-susceptible plants.

Explain why.

.....

.....

.....

.....

(2 marks)

(c) Suggest **one** advantage to a farmer of growing herbicide-resistant crops.

.....

.....

(1 mark)

(d) Many people are opposed to the growing of herbicide-resistant crops produced in this way.

Suggest **one** reason why.

.....

.....

(1 mark)

6

4.1.2.1 Chromosomes

Question 07

March 2008 | BLY1BP | Original Q4 | Legacy

QUESTION FOUR

Read the passage:

> The *Agrobacterium tumefaciens* bacterium will accept genes from another organism. The bacterium can then transfer those genes from itself into plants. The plant then grows a lump of cells (a gall) that contain the genes from the bacterium. New plants, containing the genes, can be grown from galls. This technique has been used to transfer genes from a firefly into a tobacco plant, which then glows in the dark.

4A The transfer of genes from the firefly into the bacterium is an example of . . .

1 asexual reproduction.

2 cloning.

3 genetic engineering.

4 transplantation.

4B From which structure in the firefly would scientists cut out the gene that causes glowing?

1 gamete

2 chromosome

3 enzyme

4 cell

4C Cells from the tobacco plants containing the new genes would have to be cloned. This cloning would be carried out using . . .

1 embryo transplantation.

2 adult cell cloning.

3 genetic engineering.

4 tissue culture.

4.1.2.1 Chromosomes

4D What was the most likely reason for carrying out this experiment?

1 to make tobacco plants grow taller

2 to remove genes from fireflies

3 to see whether genes could be transferred from animals to plants

4 to grow plants from galls

Turn over for the next question

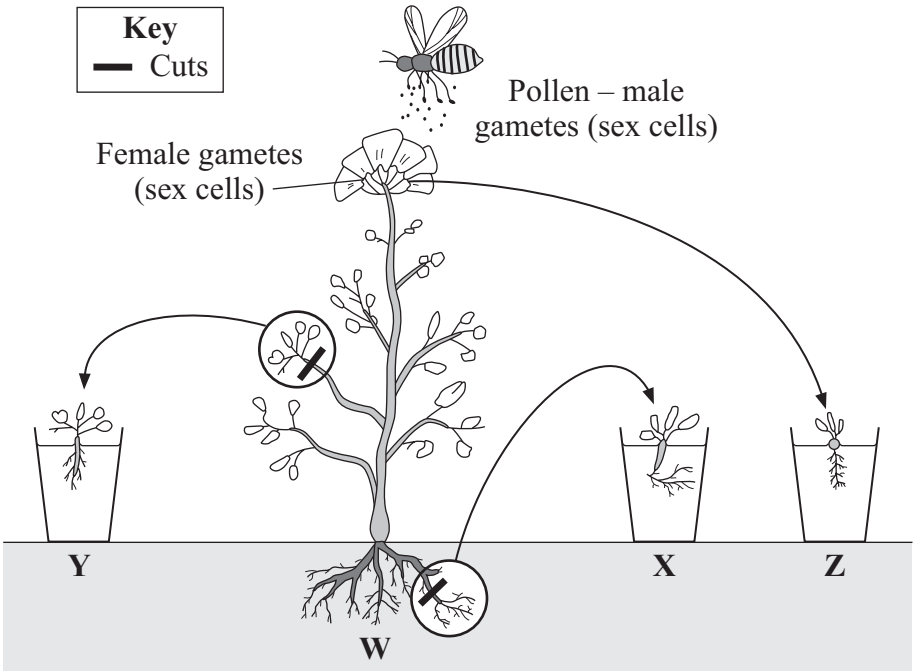
4.1.2.1 Chromosomes

Question 08

March 2008 | BLY1BP | Original Q7 | Legacy

QUESTION SEVEN

New plants may be produced from older adult plants in a variety of ways. Three of these are shown in the diagram.



7A Which process has been used to produce plant **X**?

1 taking cuttings

2 sexual reproduction

3 adult cell cloning

4 embryo transfer

7B Which process has been used to produce plant **Z**?

1 taking cuttings

2 sexual reproduction

3 adult cell cloning

4 embryo transfer

4.1.2.1 Chromosomes

7C Which of these plants will have genes which are all identical to the adult plant (**W**)?

1 **X** and **Y**

2 **X**, **Y** and **Z**

3 **Y** and **Z**

4 **X** and **Z**

7D Producing new plants by the method used to produce plant **Y** is . . .

1 quick and cheap.

2 quick and expensive.

3 slow and expensive.

4 slow and cheap.

Turn over for the next question

4.1.2.1 Chromosomes

Question 09

June 2008 | BLY1BP | Original Q2 | Legacy

QUESTION TWO

This question is about evolution.

Match words, **A**, **B**, **C** and **D**, with the numbers **1–4** in the sentences.

A mutation

B natural selection

C extinction

D variation

Evolution occurs by . . . **1** . . . .

It is a very slow process.

Individual organisms of a particular species have differences in their genes, so may show a wide . . . **2** . . . .

These organisms breed and pass on their genes to the next generation, so passing on their useful characteristics.

More rapid change in a species may result from . . . **3** . . . .

A new disease might cause . . . **4** . . . of the species.

4.1.2.1 Chromosomes

Question 10

June 2008 | BLY1BP | Original Q7 | Legacy

QUESTION SEVEN

Corn borer insects damage corn crops. Genetically modified (GM) corn plants produce a poison which kills the corn borer insects. Experts say that corn borer insects will develop resistance to the poison within 3 to 4 years.

7A The first GM corn plant was produced by inserting genes from bacteria into the cells of an embryo corn plant.

These genes were 'cut out' from the bacteria by using . . .

1 enzymes.

2 gametes.

3 hormones.

4 chromosomes.

7B One advantage of using GM corn plants rather than normal corn plants is that . . .

1 insects will become resistant.

2 biodiversity is reduced.

3 less money is spent on pesticides.

4 all the offspring will be identical.

7C One disadvantage of using GM corn plants is that . . .

1 the corn borer will pass the gene on to other insects.

2 all insects which feed on the corn will become resistant.

3 corn borer predators might become extinct.

4 the corn plants cannot be eaten.

4.1.2.1 Chromosomes

7D Which of the following best describes how the corn borer insects might develop resistance?

1 A mutation in the corn plant allows the corn borer insects to eat the corn and survive to reproduce.

2 An enzyme is produced which breaks down the poison.

3 Resistant corn borer insects only mate with other resistant corn borer insects.

4 Some corn plants become resistant to the predators of the corn borer insect.

Turn over for the next question

4.1.2.1 Chromosomes

Question 11

June 2008 | BLY2H | Original Q4 | Legacy

4 Chromosomes contain molecules of DNA. Genes are small sections of DNA.

4 (a) Each gene contains a code.

What does a cell use this code for?

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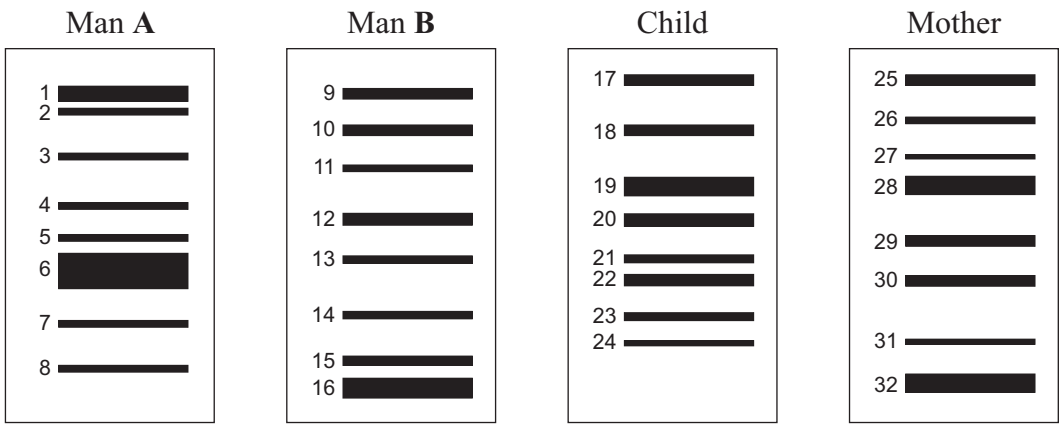
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(2 marks)

4 (b) DNA fingerprints can be used to identify people. One example of the use of DNA fingerprints is to find out which man is the father of a child.

The diagram shows the DNA fingerprints of a child, the child's mother and two men who claim to be the child's father.

The numbers refer to the bars on the DNA fingerprints.



4.1.2.1 Chromosomes

Question 11 · continued

for mark

4 (b) (i) Which man, **A** or **B**, is more likely to be the father of the child?

Use the numbers on the DNA fingerprints to explain your choice.

In your answer you should refer to all four people.

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.....

(3 marks)

4 (b) (ii) Only half the bars of the child's DNA fingerprint match the mother's DNA fingerprint.

Explain why.

.....

.....

.....

.....

.....

(2 marks)

7

4.1.2.1 Chromosomes

Question 12

November 2008 | BLY1BP | Original Q6 | Legacy

QUESTION SIX

Read the passage.

> Trials of genetically-modified (GM) maize crops have been carried out.
> A gene, giving resistance to herbicides, was removed from a bacterium and transferred to maize plants.
>
> The trials involved growing fields of the GM maize next to fields of non-GM maize.
>
> The scientists recorded the number and species of organisms in the fields.
> It was found that in the fields with the GM crops there were fewer species, while in the fields without GM crops the number and species of organisms had increased.

6A The gene giving resistance to herbicides would be removed from bacteria by using . . .

1 small scissors.

2 a chromosome from the bacterium.

3 an enzyme.

4 a nucleus.

6B In the trial, the non-GM maize was used . . .

1 so that the number of organisms could be counted easily.

2 because different species of plants and animals were found in the fields where the two types of maize were grown.

3 to make the results accurate.

4 as a control.

6C Many groups of people are opposed to growing GM crops.

Which of the following is likely to be the main reason for this opposition?

1 GM crops have only been developed for economic reasons.

2 The effect of eating GM crops on human health is not known.

3 There is no evidence that GM crops have better nutritional value.

4 GM crops are resistant to disease.

4.1.2.1 Chromosomes

Question 12 · continued

6D Which process would be used to produce large numbers of the new GM maize plants?

1 sexual reproduction

2 the continued transfer of genes to new maize plants

3 asexual reproduction

4 crossing GM maize with non-GM maize

Turn over for the next question

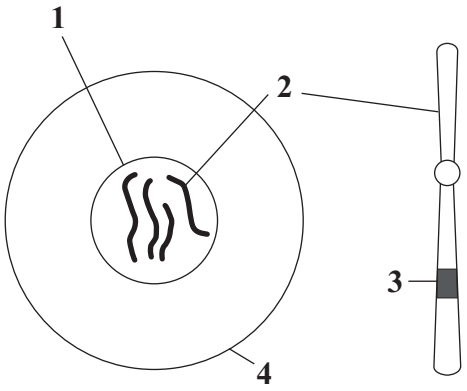
4.1.2.1 Chromosomes

Question 13

March 2009 | BLY1BP | Original Q1 | Legacy

QUESTION ONE

The diagram shows a human egg.



Match structures, **A**, **B**, **C** and **D**, with the labels **1–4** on the diagram.

A cell

B nucleus

C chromosome

D gene

4.1.2.1 Chromosomes

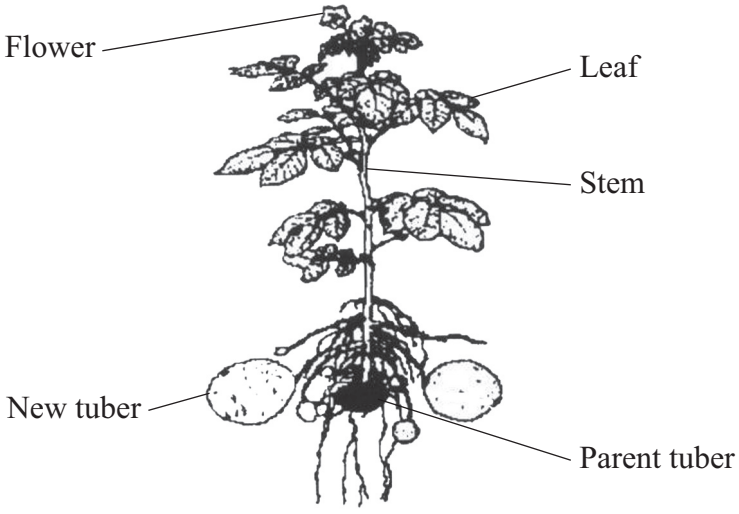
Question 14

March 2009 | BLY1BP | Original Q7 | Legacy

QUESTION SEVEN

There are many varieties of potato plant, producing tubers with different qualities.

Potato plants can reproduce both sexually and asexually.



7A How could new varieties of potato be produced?

1 taking small groups of cells from a new tuber and growing them

2 taking cuttings from the leaf or stem of the plant and growing them

3 allowing gametes from different potato plants to fuse together

4 allowing new tubers to stay in the ground and to grow next year

7B Scientists wish to create a variety of potato which will tolerate drought conditions.
They have identified the gene which gives a cactus species the ability to survive with very little water.

What would be the best way of producing drought-resistant potatoes?

1 breed ordinary potato plants with cactus plants

2 use enzymes to cut out the gene from the cactus and transfer it to potato cells

3 selectively breed cactus plants which, over many generations, are more like potatoes

4 grow potato plants in low water conditions over many generations

4.1.2.1 Chromosomes

Question 14 · continued

7C Some people believe that using genetic engineering to develop potatoes that are tolerant to drought conditions should **not** be allowed.

One reason for this is because . . .

1 the new variety of potato may be susceptible to the same diseases as cactus plants.

2 the cost of the technology required outweighs the possible profits.

3 the native potato may compete with the new variety.

4 there are ethical concerns about interfering with natural processes.

7D Herbicide-resistant potatoes have also been produced.

The advantage of this is that . . .

1 old potato plants can easily be killed to make way for new crops.

2 it is easy to kill insects which might feed on the crop.

3 the growth of wild flowers is encouraged, maintaining biodiversity.

4 competition from other plants can be reduced.

4.1.2.1 Chromosomes

Question 15

March 2009 | BLY1BP | Original Q9 | Legacy

QUESTION NINE

There are several theories for the way in which evolution may have happened.

9A Lamarck's theory of evolution was based on the idea that . . .

1 organisms pass on the advantages that they acquire during their lifetime.

2 organisms acquire genes from their parents which may give them advantages.

3 the characteristics that organisms have are controlled by God.

4 offspring have a mixture of their parents' features.

9B In the 1860s there was much opposition to Darwin's theory of evolution.

Which of the following was **not** a reason for this opposition?

1 The theory conflicted with deeply held religious views.

2 Darwin did **not** have sufficient evidence to support his ideas.

3 Darwin was unable to make his ideas known to other scientists.

4 Nobody knew how inheritance worked.

9C When a new island is formed by volcanic action, the environment continues to undergo rapid change for many years. At first there will be no living things present.

A plant seed may be blown to the island by the wind. When this seed begins to grow, the plant may reproduce asexually.

What is the disadvantage of asexual reproduction to the plant species in this case?

1 Only one individual is needed for reproduction.

2 All the offspring will be genetically identical.

3 New plants will be produced quickly.

4 Dense groups of this species will reduce competition from other species.

4.1.2.1 Chromosomes

Question 15 · continued

March 2009 | BLY1BP | Original Q9 | Legacy

9D Darwin's theory of evolution through natural selection was based on a number of events.

These events are outlined below.

- **P** Those individuals which are most suited to the environment survive.
- **Q** There is an increase in variation between members of the species.
- **R** Genes that improve survival chances are passed on to the next generation.
- **S** Mutation results in new forms of genes.

Which is the correct sequence for these events?

1 **P → R → S → Q**

2 **Q → R → P → S**

3 **S → Q → P → R**

4 **R → S → Q → P**

END OF TEST

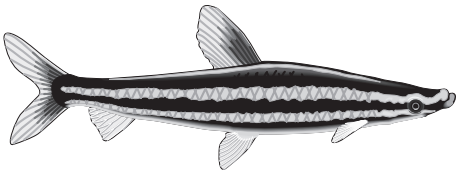
4.1.2.1 Chromosomes

Question 16

June 2009 | BLY1BP | Original Q4 | Legacy

QUESTION FOUR

Zebra fish are small freshwater fish that can tolerate a wide range of environmental conditions. Scientists want to use zebra fish as an indicator species for different types of water pollution.



4A Scientists have extracted 'glow' genes from a jellyfish and transferred them into the eggs of a zebra fish.

What term describes this process?

1 cloning

2 genetic engineering

3 tissue culture

4 embryo transplant

4B Genes from jellyfish are transferred into zebra fish eggs by . . .

1 using a small pair of sharp scissors.

2 using enzymes.

3 mixing the gametes of jellyfish and zebra fish.

4 taking cytoplasm from a jellyfish egg and placing it into a zebra fish egg.

4.1.2.1 Chromosomes

Question 16 · continued

Zebra fish created by this process would glow with different colours, depending on the type of chemical pollution in the water. The table shows how this would work.

Colour	Type of chemical pollution			
	Pesticides	Fertilisers	Acidity	Herbicides
Red	✓			
Green			✓	
Yellow		✓		
Orange				✓

4C Zebra fish would glow green because of . . .

1 an increase in the sulfur dioxide content of the atmosphere.

2 a reduction in the carbon dioxide content of the atmosphere.

3 an increase in the methane content of the atmosphere.

4 an increase in the amount of chemicals used in agriculture.

4D In one river, different zebra fish glow red and orange.

This indicates that the river is polluted by . . .

1 chemicals released from industry.

2 smoke released from power stations.

3 chemicals washed off farmland.

4 sewage leaking from drains.

4.1.2.1 Chromosomes

Question 17

June 2009 | BLY1H | Original Q7 | Legacy

7 Two types of fertility treatment are in-vitro fertilisation (IVF) and in-vitro maturation (IVM).

7 (a) Describe the role of hormones in IVF treatment.

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(3 marks)

(Extra space) .....

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7 (b) Read the passage about fertility treatment.

During normal IVF, a woman undergoes several weeks of hormone injections. The treatment can lead to a condition called ovarian hyperstimulation syndrome resulting in a build-up of fluid in the lungs. Very rarely, it can cause death. The syndrome occurs in about 1 % of standard IVF cycles, but in about 10 % of the IVF cycles of some women. An IVF cycle may cost up to £4300.

In IVM, hormone treatment lasts for less than 7 days. Eggs are then collected from the ovaries while they are still immature. Each egg is then matured in a laboratory for up to 48 hours before being injected with a single sperm. A few days after fertilisation, the embryos are implanted into the mother's womb. The cost of each IVM cycle is £1700.

An IVM expert says: "In IVM treatment there's a small risk of abnormalities in the sex chromosomes and also of birth deformities and cancer in the babies. These risks are not massive but they are greater than in IVF."

4.1.2.1 Chromosomes

Question 17 · continued

for mark

7 (b) Evaluate the use of IVM rather than IVF in treating infertility.

Remember to give a conclusion to your evaluation.

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(4 marks)

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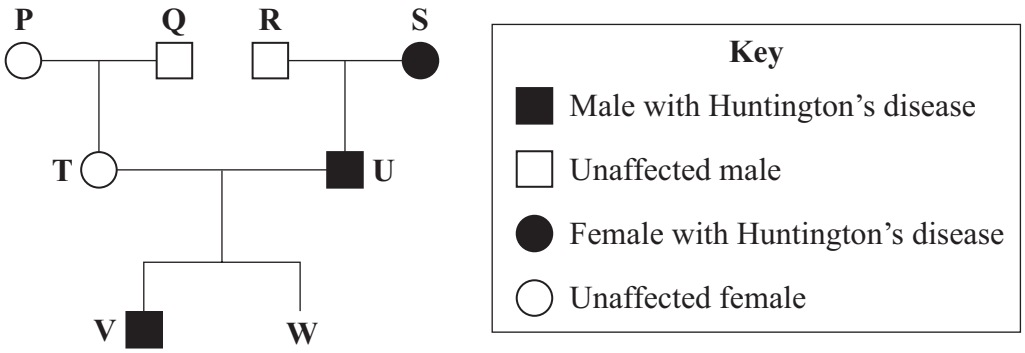
4.1.2.1 Chromosomes

Question 18

June 2009 | BLY2H | Original Q6 | Legacy

6 Huntington's disease is a disorder of the nervous system. It is caused by a dominant allele.

The family tree shows the inheritance of Huntington's disease in one family.



6 (a) **T** and **U** already have a son, **V**, with Huntington's disease. What is the chance that their next child, **W**, will also develop Huntington's disease?

Use a genetic diagram in your answer.

Use the symbols **H** to represent the dominant allele and **h** to represent the recessive allele.

Chance that child **W** will have Huntington's disease = ...

(4 marks)

4.1.2.1 Chromosomes

Question 18 · continued

for mark

6 (b) A doctor advises parents **T** and **U** that embryo **W** should be 'screened'.

6 (b) (i) What is embryo screening?

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.....

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(1 mark)

6 (b) (ii) Some people do not believe that embryos should be screened.

Give **one** reason why.

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(1 mark)

6 (c) Cystic fibrosis is an inherited disorder in which the person's mucus becomes thick.

6 (c) (i) For this gene, one allele in every 30 in the population is the cystic fibrosis allele. However, only one person in every 900 has cystic fibrosis.

Explain why.

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(2 marks)

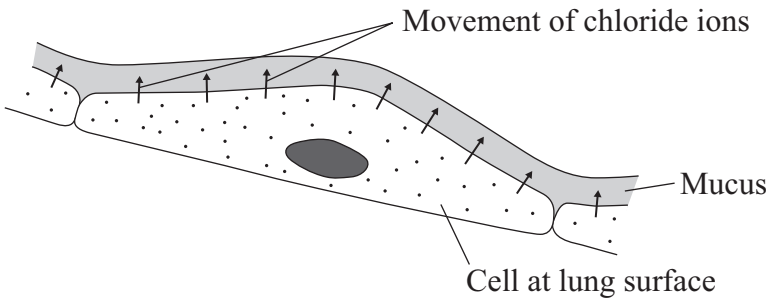
Question 6 continues on the next page

4.1.2.1 Chromosomes

Question 18 · continued

for mark

6 (c) (ii) The diagram shows how, in a healthy person, cells at the lung surface move chloride ions into the mucus surrounding the air passages.



This movement of chloride ions causes water to pass out of the cells into the mucus.

Explain why.

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(3 marks)

6 (c) (iii) Mucus contains protein.

Which parts of the lung cells manufacture the protein in mucus?

.....

(1 mark)

12

4.1.2.1 Chromosomes

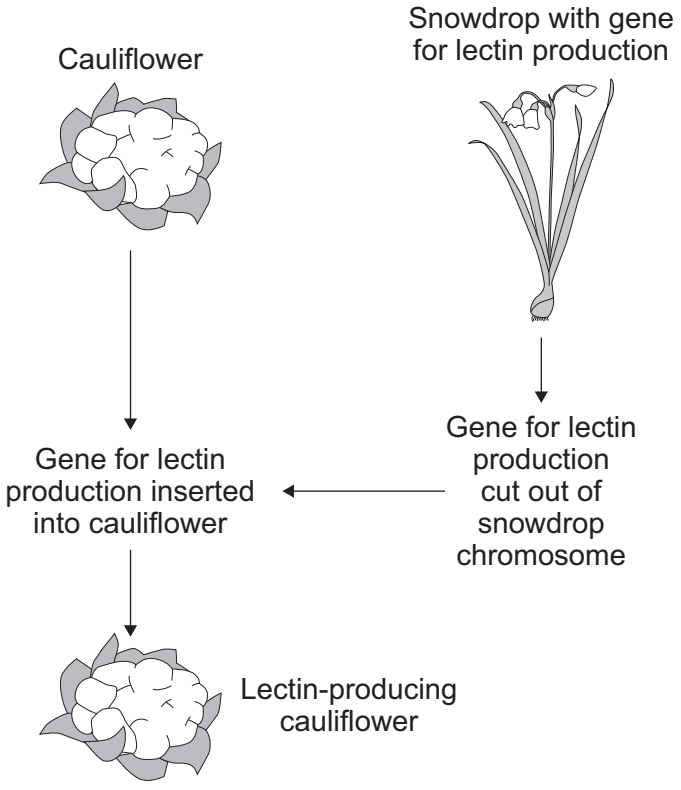
Question 19

June 2010 | BLY1BP | Original Q4 | Legacy

QUESTION FOUR

Up to 40 % of cauliflower crops may be eaten by insects.
Snowdrops can survive attacks by insects because they produce a substance called lectin.
Lectin interferes with the insect's digestive system.

The diagram shows one method of introducing the gene for lectin production into cauliflowers.



4A The gene for lectin production is cut from the snowdrop chromosome using . . .

1 lectin.

2 a herbicide.

3 an enzyme.

4 an electric shock.

4B The technique used to transfer the gene from the snowdrop to the cauliflower is called . . .

1 biodiversity.

2 embryo transplant.

3 cloning.

4 genetic engineering.

4.1.2.1 Chromosomes

Question 19 · continued

4C What is the main benefit to the environment of farmers growing lectin-producing cauliflowers?

1 More snowdrops will survive.

2 Less pesticide will be used.

3 Insects will eat something else.

4 Less fertiliser will be needed.

4D An ethical concern about this technique is that . . .

1 it will make farmers richer.

2 it will increase biodiversity.

3 it is interfering with nature.

4 it is sustainable.

Turn over for the next question

4.1.2.1 Chromosomes

Question 20

June 2010 | BLY1BP | Original Q6 | Legacy

QUESTION SIX

Read the passage about sticklebacks.

> Small fish called sticklebacks originated in the oceans, but began populating freshwater lakes and streams about 20 000 years ago. Sticklebacks that live in freshwater have lost their body 'armour' over the past 20 000 years.
>
> Scientists have identified a mutant gene in sticklebacks that prevents the growth of 'armour'. This mutant gene is very common in freshwater sticklebacks, but is found in only about 1 % of seawater sticklebacks. Sticklebacks with the mutant gene are significantly longer than those without it.
>
> The scientists carried out an investigation in which they moved 200 seawater sticklebacks into freshwater. After a few years the frequency of the mutant gene in the offspring of these fish had increased significantly.

6A The mutant gene that prevents the growth of 'armour' is . . .

1 a strong gene.

2 a weak gene.

3 a changed gene.

4 a stable gene.

6B The change in the frequency of the mutant gene in sticklebacks which live in freshwater is a result of . . .

1 the greenhouse effect.

2 natural selection.

3 new diseases.

4 changes in the composition of freshwater.

4.1.2.1 Chromosomes

Question 20 · continued

6C Because they do not produce ‘armour’, the freshwater sticklebacks can . . .

1 produce more muscles and bones.

2 camouflage themselves.

3 move into deeper water.

4 move back into seawater.

6D The evidence from this investigation . . .

1 proves the theory of evolution.

2 supports the theory of evolution.

3 disproves the theory of evolution.

4 leads to an observation about the theory of evolution.

Turn over for the next question

4.1.2.1 Chromosomes

Question 21

June 2019 | BLY2H | Original Q7 | Legacy

7 The table shows the number of chromosomes found in each body cell of some different organisms.

Animals		Plants	
Species	**Number of chromosomes in each body cell**	**Species**	**Number of chromosomes in each body cell**
Fruit fly	8	Tomato	24
Goat	60	Potato	44
Human	46	Rice	24

7 (a) Nearly every organism on earth has an even number of chromosomes in its body cells.

Suggest why.

.....

.....

(1 mark)

7 (b) Chromosomes contain DNA molecules.

Describe the function of DNA.

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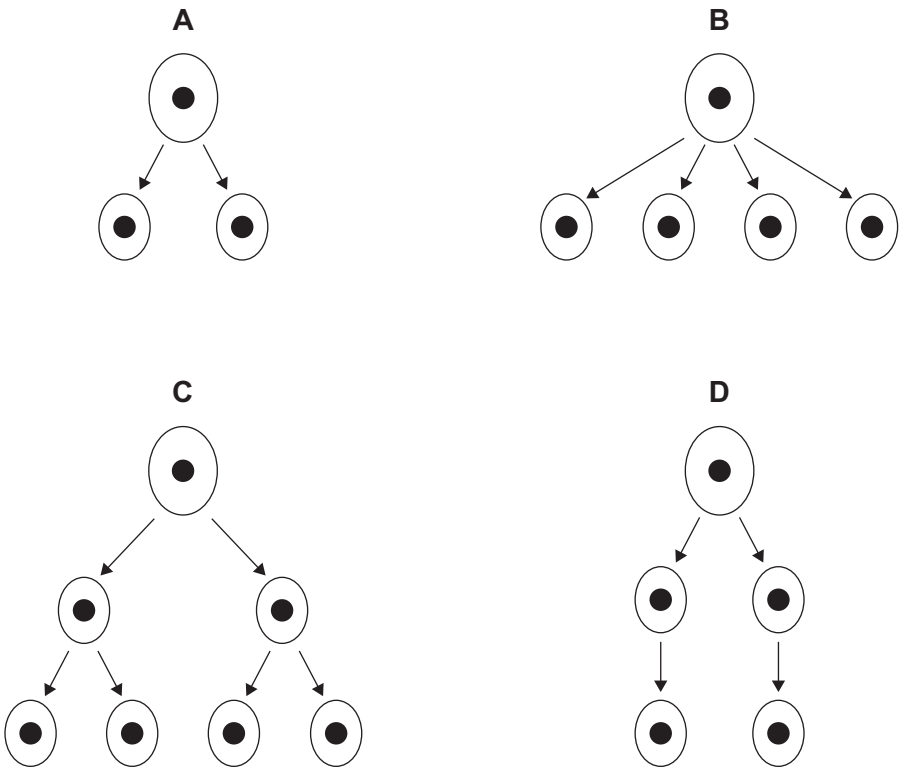
(2 marks)

4.1.2.1 Chromosomes

Question 21 · continued

7 (c) Gametes are made in the testes by meiosis.

7 (c) (i) Look at the diagrams.



Which diagram, **A**, **B**, **C** or **D**, represents how cell division by meiosis produces gametes in the testes? ☐

(1 mark)

7 (c) (ii) How many chromosomes will each goat gamete contain?

.....

(1 mark)

Question 7 continues on the next page

4.1.2.1 Chromosomes

Question 21 · continued

7 (d) Body cells divide by mitosis.

7 (d) (i) Why is the ability of body cells to divide important?

.....

.....

(1 mark)

7 (d) (ii) When a body cell of a potato plant divides, how many chromosomes will each of the new cells contain?

.....

(1 mark)

7

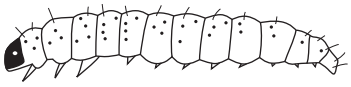
4.1.2.1 Chromosomes

Question 22

March 2011 | BLY1BP | Original Q4 | Legacy

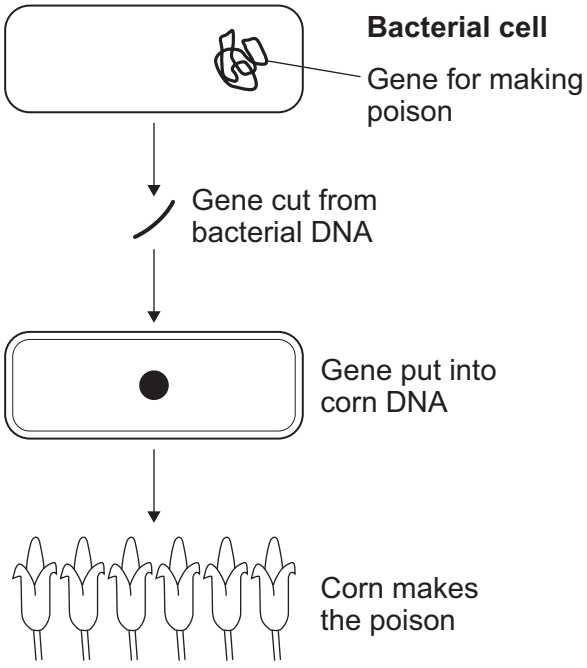
QUESTION FOUR

The drawing shows a European corn borer. European corn borers eat and destroy corn stems.



It is possible to produce corn plants that produce a poison which kills the corn borer if it eats any part of the plant.

The gene for making the poison is cut from the genetic material of a bacterial cell. The gene is then inserted into the cells of a corn plant. The corn plant then produces the poison.



4A Transferring genes from one organism to another is called . . .

1 cloning.

2 evolution.

3 genetic engineering.

4 tissue culture.

4.1.2.1 Chromosomes

Question 22 · continued March 2011 | BLY1BP | Original Q4 | Legacy

4B One economic benefit of producing this type of corn is that . . .

1 more people will want to buy this type of corn.

2 there will be fewer pests.

3 the farmer will need to use less fertiliser.

4 the farmer will produce more corn.

4C An environmental concern about growing this type of corn is that . . .

1 more chemicals will have to be used on the land.

2 it is against some people's religious beliefs.

3 the bacterial gene may get transferred to wild plant species.

4 this type of corn will be much more expensive.

4D Scientists think that this type of corn is not harmful for people to eat.

This is very difficult to prove because . . .

1 people will not volunteer to be part of a trial.

2 the human diet contains a wide variety of foods.

3 scientists are not allowed to carry out experiments on humans.

4 animals that eat this corn appear to be healthy.

4.1.2.1 Chromosomes

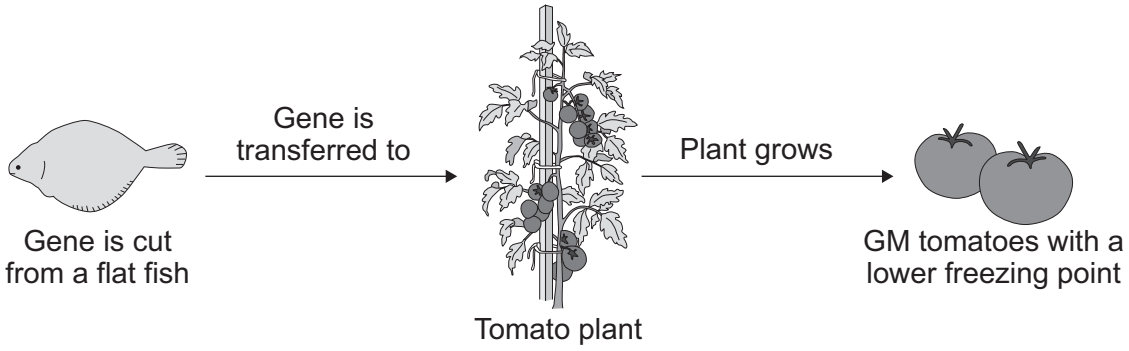
Question 23

June 2011 | BLY1BP | Original Q4 | Legacy

QUESTION FOUR

Scientists have produced genetically modified (GM) tomatoes. The GM tomatoes freeze at a lower temperature than non-GM tomatoes. GM tomatoes are less likely to be damaged in storage.

The diagram shows how the scientists produced the GM tomatoes by genetic engineering.



4A The scientists removed the gene from the flat fish by using . . .

1 hormones.

2 enzymes.

3 very small scissors.

4 a very fine pipette.

4B The scientists wanted to produce large numbers of plants identical to the new tomato plants quickly.

Which would be the best way of doing this?

1 reproducing the new embryo plant sexually

2 splitting embryos from the new tomato plant

3 growing seeds from the new tomato plant

4 culturing groups of cells from the new tomato plant

4.1.2.1 Chromosomes

Question 23 · continued

4C One ethical reason for allowing the GM crops to be grown is that . . .

1 scientists know that there are no health risks from eating GM crops.

2 GM companies will make large profits from the sale of GM plants.

3 the high yield from some GM crops could feed starving people.

4 GM crops are not a risk to the environment.

4D Some people object to GM crops because GM crops . . .

1 could be made resistant to insect attack.

2 could have a longer shelf-life.

3 could be made resistant to weedkillers.

4 could transfer genes to wild plants.

Turn over for the next question

4.1.2.1 Chromosomes

Question 24

November 2011 | BLY1BP | Original Q4 | Legacy

QUESTION FOUR

Scientists use genetic engineering to produce genetically modified (GM) plants.

4A Which row in the table shows the correct order of sizes of structures involved in genetic engineering?

	Largest → Smallest			
1	chromosome →	cell →	gene →	nucleus
2	nucleus →	cell →	chromosome →	gene
3	cell →	gene →	nucleus →	chromosome
4	cell →	nucleus →	chromosome →	gene

Seeds from crops of oil-seed rape are used to produce biofuels.

Farmers spray their fields with herbicide before planting a crop of oil-seed rape.

GM oil-seed rape was developed to be resistant to the herbicide.

4B The GM oil-seed rape has most probably been developed by . . .

1 spraying herbicide on oil-seed rape plants over several generations.

2 taking cuttings from other species that are resistant to herbicides.

3 transferring genes from other species into oil-seed rape plants.

4 producing mutations in non-GM varieties of oil-seed rape.

4C In trials of the GM crop, four field trials were set up.

Which trial will produce the **smallest** yield of oil-seed rape crop?

1 spraying with herbicide before planting non-GM crops

2 spraying with herbicide during growth of a non-GM crop

3 spraying with herbicide before planting a GM crop

4 spraying with herbicide during growth of a GM crop

4.1.2.1 Chromosomes

4D The main concern about planting a GM oil-seed rape crop is that the gene for herbicide resistance might spread to . . .

1 wild plants.

2 other oil-seed rape crops.

3 insects.

4 humans.

Turn over for the next question

4.1.2.1 Chromosomes

Question 25

January 2012 | BL1HP | Original Q5 | Legacy

5 The Blue-moon butterfly lives on a small island called Samoa, in the Pacific Ocean.



In 2006 Blue-moon butterflies almost became extinct.

Wolbachia bacteria killed males before they could hatch from eggs. Only females were resistant to the bacteria.

In 2006 the number of male Blue-moon butterflies had decreased to only 1 per cent of the population. Two years later, the number of males was equal to the number of females.

5 (a) Scientists believe that a change in a gene suddenly occurred to make some males resistant to the bacteria.

What scientific term describes a change in a gene?

.....

(1 mark)

5 (b) The numbers of male Blue-moon butterflies in the population increased quickly after the new form of the gene had appeared.

Suggest why.

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(4 marks)

5

4.1.2.1 Chromosomes

Question 26

June 2012 | BL1HP | Original Q6 | Legacy

6 The picture shows a zebra fish.



Illustration © Emily S. Damstra

Zebra fish are small freshwater fish that usually have black and silver stripes.
Zebra fish can tolerate a wide range of environmental conditions.

6 (a) Scientists have genetically modified zebra fish to act as pollution indicators.
The genetically modified zebra fish have a gene transferred from a jellyfish.
The gene allows the stripes of the zebra fish to change colour.

Describe how the scientists produced the genetically modified zebra fish.

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(3 marks)

6 (b) Some scientists are worried about the production of genetically modified zebra fish.

Suggest reasons why.

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(2 marks)

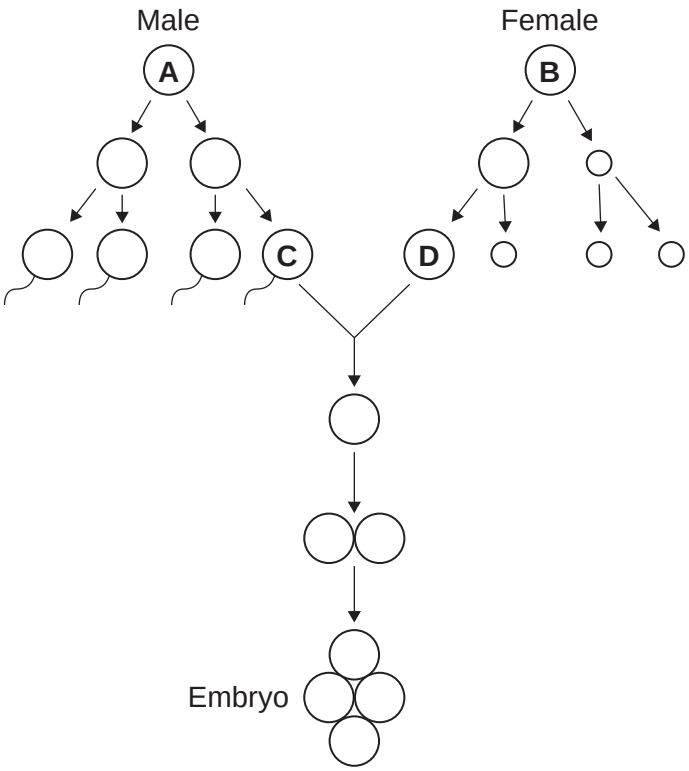
5

4.1.2.1 Chromosomes

Question 27

January 2013 | BL2HP | Original Q4 | Legacy

4 The diagram shows some of the cell divisions that occur during human reproduction.



4 (a) (i) Name the type of cell division that produces cell **D** from cell **B**.

.....

(1 mark)

4 (a) (ii) Which organ in the male body produces cell **C** from cell **A**?

.....

(1 mark)

4 (b) (i) Cells **A** and **B** each contain 46 chromosomes.

How many chromosomes would there be in the nucleus of cell **C**? ☐

(1 mark)

4 (b) (ii) Why is it important that cell **C** has this number of chromosomes?

.....

.....

.....

.....

(2 marks)

5

4.1.2.1 Chromosomes

Question 28

June 2013 | BL2HP | Original Q6 | Legacy

6 A certain gene codes for the production of an enzyme called 'HEXA'.

One human genetic disorder causes damage to nerve cells in the brain.
This disorder is caused by a small change in the DNA of the HEXA gene.
People with this disorder make a changed HEXA enzyme that does not work.

6 (a) Explain how a change in the DNA of the HEXA gene can result in the production of a changed HEXA enzyme that does not work.

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.....

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.....

(3 marks)

6 (b) The gene coding for the HEXA enzyme is found on chromosome number 15.

6 (b) (i) How many chromosomes are there in the nucleus of a human nerve cell? .....

(1 mark)

6 (b) (ii) A boy had the changed HEXA gene on the chromosome number 15 that he inherited from his father.
The changed HEXA gene coded for a HEXA enzyme that does not work.
The boy did **not** develop the genetic disorder.

Explain why the boy did **not** develop the genetic disorder.

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(2 marks)

4.1.2.1 Chromosomes

Question 28 · continued

6 (b) (iii) The boy grew up and got married.

A blood test showed that his wife had also inherited the same changed HEXA gene.

There is a 1 in 4 chance that this couple's first child will have the genetic disorder.

Use a genetic diagram to explain why.

Use the following symbols in your explanation:

H = allele for making the normal HEXA enzyme
h = allele for making a HEXA enzyme that does not work.

(3 marks)

9

4.1.2.1 Chromosomes

Question 29

June 2013 | BL2HP | Original Q8 | Legacy

8 The photographs show the flowers of two closely-related species of plant.

Species A



Species B



The drawings show chromosomes from one cell in the root of each plant during cell division.

Species A



Species B



8 (a) The drawings show that each chromosome has two strands of genetic material.

8 (a) (i) How does a chromosome become two strands?

.....

.....

(1 mark)

4.1.2.1 Chromosomes

Question 29 · continued

8 (a) (ii) Explain why each chromosome must become two strands before the cell divides.

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.....

.....

.....

(2 marks)

8 (b) For sexual reproduction, the plants produce gametes.

8 (b) (i) Name the type of cell division that produces gametes. .....

(1 mark)

8 (b) (ii) How many chromosomes would there be in a gamete from each of these two plant species?

Species A ☐ **Species B** ☐

(1 mark)

8 (b) (iii) It is possible for gametes from **Species A** to combine with gametes from **Species B** to produce healthy offspring plants.

How many chromosomes would there be in each cell of one of the offspring plants?

☐

(1 mark)

Question 8 continues on the next page

4.1.2.1 Chromosomes

Question 29 · continued

8 (c) (i) Look back at the information at the start of the question and the information from part **(b)**.

What evidence from these two pieces of information supports the belief that **Species A** and **Species B** evolved from a common ancestor?

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.....

(2 marks)

8 (c) (ii) For successful gamete production to take place, chromosomes that contain the same genes must pair up.

The drawings showing the chromosomes of **Species A** and of **Species B** are repeated below.

Species A



One chromosome

Species B



One chromosome

The offspring plants cannot reproduce sexually.

Suggest an explanation for this.

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(2 marks)

10

4.1.2.1 Chromosomes

Question 30

June 2014 | BL1HP | Original Q8 | Legacy

8 Read the information.

> Insects can be both useful and harmful to crop plants.
> Insects such as bees pollinate the flowers of some crop plants. Pollination is needed for successful sexual reproduction of crop plants.
> Some insects eat crops and other insects eat the insects that eat crops.
>
> Corn borers are insects that eat maize plants.
> A toxin produced by the bacterium *Bacillus thuringiensis* kills insects.
> Scientists grow *Bacillus thuringiensis* in large containers. The toxin is collected from the containers and is sprayed over maize crops to kill corn borers.
>
> A company has developed genetically modified (GM) maize plants. GM maize plants contain a gene from *Bacillus thuringiensis*. This gene changes the GM maize plants so that they produce the toxin.

8 (a) Describe how scientists can transfer the gene from *Bacillus thuringiensis* to maize plants.

[3 marks]

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4.1.2.1 Chromosomes

Question 30 · continued

8 (b) Would you advise farmers to grow GM maize plants?

Justify your answer by giving advantages and disadvantages of growing GM maize plants.

Use the information from the box and your own knowledge to help you.

[4 marks]

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7

4.1.2.1 Chromosomes

Question 31

June 2015 | BL1HP | Original Q8 | Legacy

8 As embryos develop, some genes in cells are turned off and some genes are turned on. This allows cells to become specialised for particular functions.

Usually, after cells have become specialised, they cannot change again into different types of cells.

8 (a) What is a gene?

[2 marks]

.....

.....

.....

.....

8 (b) Scientists have developed a way to change specialised cells back into embryo-like cells by a method called iPS.

Read the information in the box.

> Cells made using iPS can be changed into different types of cells.
>
> Scientists plan to take skin cells from an endangered species of monkey called a drill and change these cells into iPS cells. These iPS cells can then be changed into egg cells or sperm cells.
>
> After fertilisation, the embryo can be inserted into the womb of a female of a non-endangered species called a mandrill. The mandrill is closely related to the drill.

Describe similarities and differences between the iPS method and adult cell cloning.

[4 marks]

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4.1.2.1 Chromosomes

Question 31 · continued

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8 (c) Suggest **one** advantage of trying to preserve endangered species such as the drill.

[1 mark]

.....

.....

7

Turn over for the next question

4.1.2.1 Chromosomes

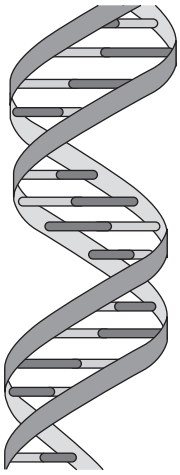
Question 32

June 2015 | BL2HP | Original Q3 | Legacy

3 DNA is the genetic material of human cells.

Figure 4 shows the structure of part of a DNA molecule.

Figure 4



3 (a) (i) Describe where DNA is found in a human cell.

[2 marks]

.....

.....

.....

3 (a) (ii) When a cell divides by mitosis the new cells are genetically identical.

What causes the cells to be genetically identical?

[1 mark]

.....

.....

3 (b) Many genes have different forms called alleles.

3 (b) (i) A person has polydactyly (extra fingers or toes). Polydactyly is caused by a dominant allele.
What is the smallest number of copies of the dominant allele for polydactyly that could be found in a body cell of this person?

[1 mark]

.....

3 (b) (ii) Another person has cystic fibrosis. Cystic fibrosis (CF) is caused by a recessive allele.
How many copies of the recessive CF allele are there in a body cell of this person?

[1 mark]

.....

4.1.2.1 Chromosomes

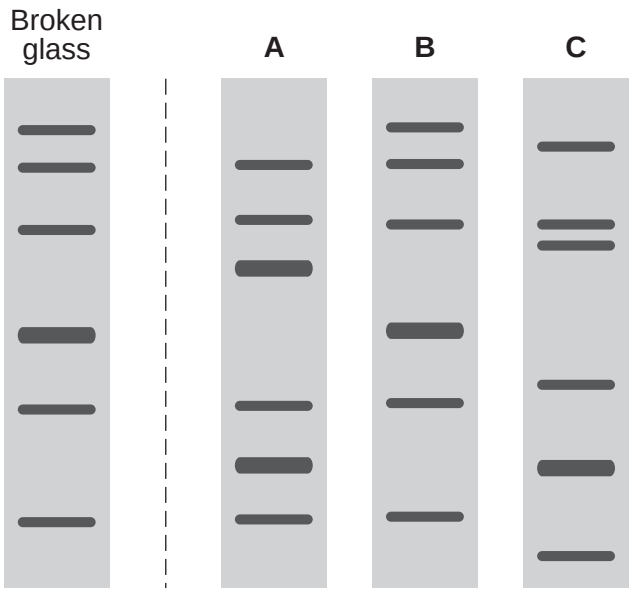
Question 32 · continued

3 (c) A burglar broke into a house. The burglar cut his hand on some broken glass. Scientists extracted DNA from the blood on the broken glass.

The scientists analysed the DNA from the glass and DNA from three suspects, **A**, **B** and **C**. The scientists used a method called DNA fingerprinting.

Figure 5 shows the scientists' results.

Figure 5



Which suspect, **A**, **B** or **C**, is most likely to have been the burglar?

[1 mark]

Tick (✓) **one** box.

A ☐

B ☐

C ☐

6

4.1.2.1 Chromosomes

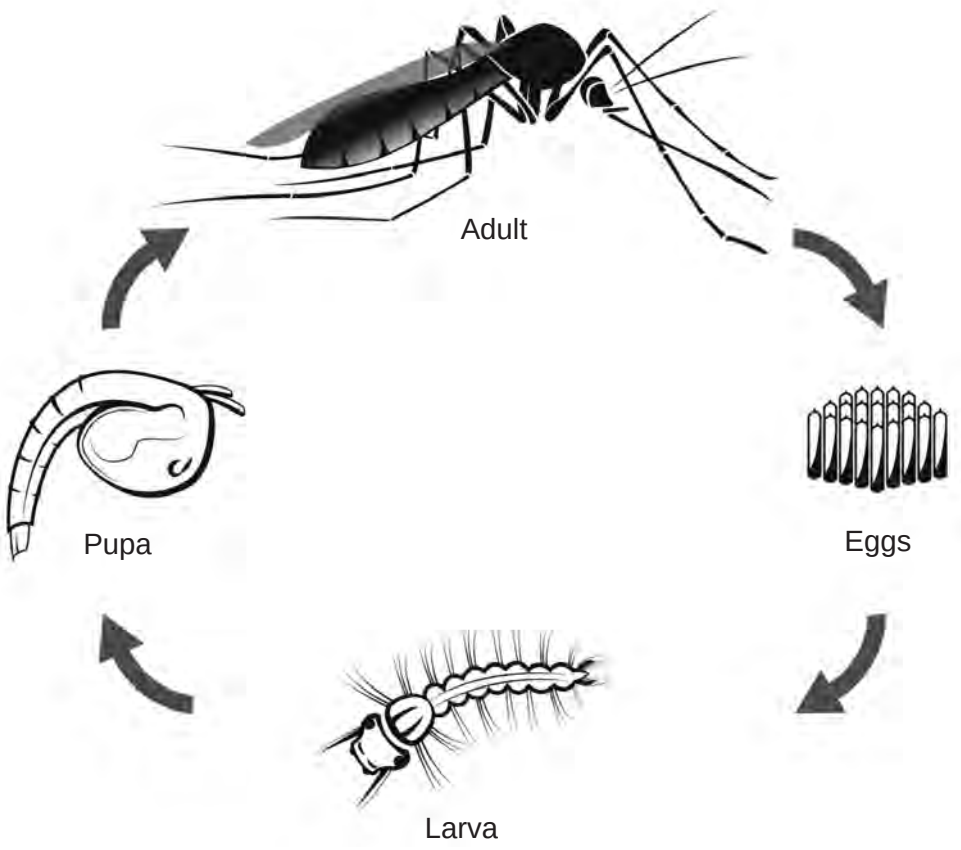
Question 33

June 2016 | BL1HP | Original Q6 | Legacy

6 Malaria is a disease caused by a microorganism carried by mosquitoes.
The microorganism is transferred to humans when adult female mosquitoes feed on human blood.

Figure 5 shows the life cycle of a mosquito.

Figure 5



The World Health Organisation estimates that 3×10^8 people are infected with malaria every year.

Scientists estimate that malaria kills 2×10^6 people every year.

The people who are infected with malaria but do not die, may be seriously ill and need health care for the rest of their lives.

6 (a) Based on the estimated figures, what percentage of people infected with malaria die from the disease?

[2 marks]

4.1.2.1 Chromosomes

Question 33 · continued

6 (b) An internet article states:

1 Mosquito larvae are at the start of the food chain for some fish.
2 Adult mosquitoes provide food for bats and birds.
3 Mosquitoes are also important in plant reproduction because they feed from flowers of crop plants.

6 (b) (i) The first sentence in the article is **not** correct.

Explain why.

[2 marks]

6 (b) (ii) A company plans to produce genetically modified (GM) adult male mosquitoes. The GM mosquitoes will carry a gene from bacteria. The gene causes the death of offspring before they become adults.

Male mosquitoes do **not** feed on blood.
Scientists are considering releasing millions of adult male GM mosquitoes into the wild.

Do you think scientists should release millions of male GM mosquitoes into the wild?

In your answer you should give advantages and disadvantages of releasing GM mosquitoes into the wild.

[4 marks]

Question 6 continues on the next page

4.1.2.1 Chromosomes

Question 33 · continued

6 (b) (iii) Describe the process for creating a GM mosquito.

[3 marks]

11

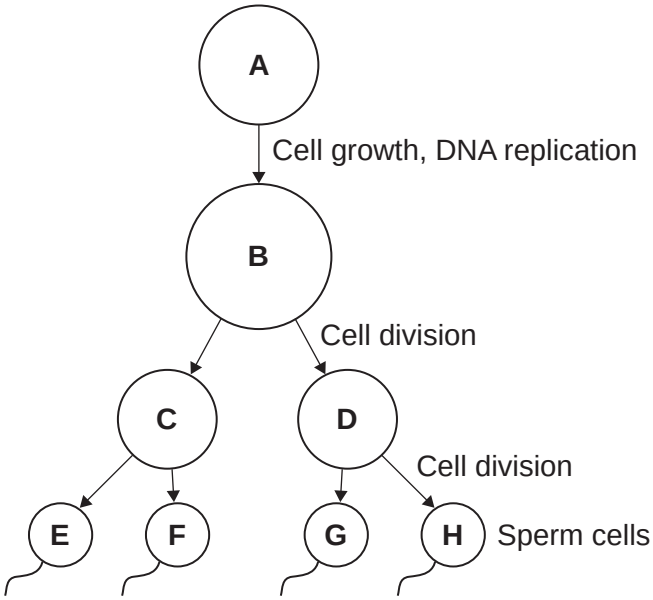
4.1.2.1 Chromosomes

Question 34

June 2016 | BL2HP | Original Q5 | Legacy

5 **Figure 4** shows the production of human sperm cells.

Figure 4



5 (a) Name the organ where the processes shown in **Figure 4** take place.

[1 mark]

_____

5 (b) (i) Not every cell in **Figure 4** contains the same amount of DNA.

Cell **A** contains 6.6 picograms of DNA (1 picogram = 10^{-12} grams).

How much DNA is there in each of the following cells?

[2 marks]

Cell **B** _____ picograms

Cell **C** _____ picograms

Cell **E** _____ picograms

5 (b) (ii) How much DNA would there be in a fertilised egg cell?

[1 mark]

_____ picograms

5 (b) (iii) A fertilised egg cell divides many times to form an embryo.

Name this type of cell division.

[1 mark]

_____

4.1.2.1 Chromosomes

Question 34 · continued

5 (c) After a baby is born, stem cells may be collected from the umbilical cord. These can be frozen and stored for possible use in the future.

5 (c) (i) What are stem cells?

[2 marks]

5 (c) (ii) Suggest why it is ethically more acceptable to take stem cells from an umbilical cord instead of using stem cells from a 4-day-old embryo produced by In Vitro Fertilisation (IVF).

[1 mark]

5 (c) (iii) Stem cells taken from a child's umbilical cord could be used to treat a condition later in that child's life.

Give **one** advantage of using the child's own umbilical cord stem cells instead of using stem cells donated from another person.

[1 mark]

5 (c) (iv) Why would it **not** be possible to treat a genetic disorder in a child using his own umbilical cord stem cells?

[1 mark]

10

4.1.2.1 Chromosomes

Question 35

June 2017 | BL1HP | Original Q7 | Legacy

7 Reproduction may be sexual or asexual.

7 (a) Describe **one** advantage to a species of sexual reproduction rather than asexual reproduction.

[1 mark]

_____

_____

7 (b) Mitochondria contain genes. The genes control some of the reactions in respiration.

In a person with mitochondrial disease, genes in the mitochondria are faulty. The person may have muscle weakness, blindness and heart failure.

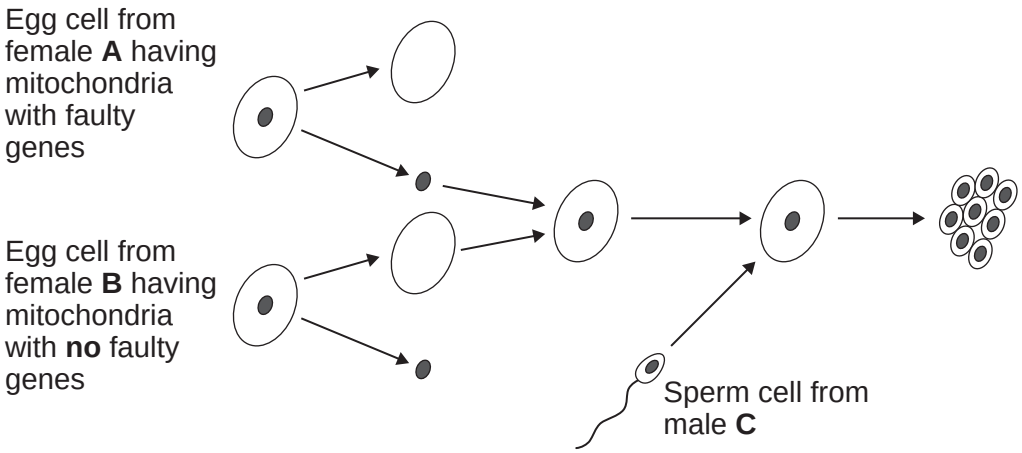
In human reproduction, an embryo will have mitochondria from the cytoplasm of the mother's egg cell.

Scientists have developed a way of solving the problem of a child inheriting mitochondrial disease.

Figure 6 shows the process.

The cells involved come from three different people, **A**, **B** and **C**.

Figure 6



4.1.2.1 Chromosomes

Question 35 · continued

7 (b) (i) Describe the process shown in **Figure 6**.

Use your knowledge of sexual reproduction and adult cell cloning.

[4 marks]

7 (b) (ii) Explain why the embryo formed from the process shown in **Figure 6** will **not** have mitochondrial disease.

[2 marks]

7 (b) (iii) Suggest **one** ethical objection to this process being used for reproduction in humans.

[1 mark]

8

4.1.2.1 Chromosomes

Question 36

June 2017 | BL2HP | Original Q6 | Legacy

6 Alkaptonuria (AKU) is a rare, inherited condition. A person with AKU produces brownish-black urine. Further health problems develop later in life.

6 (a) The allele that causes AKU is on chromosome number 3.
The allele is recessive.

6 (a) (i) How many chromosomes are there in most human cells?

[1 mark]

_____

6 (a) (ii) What are alleles?

[1 mark]

_____

_____

6 (a) (iii) What does recessive mean?

[1 mark]

_____

_____

Question 6 continues on the next page

4.1.2.1 Chromosomes

Question 36 · continued

6 (b) Two parents, who do **not** have AKU, have a child with AKU.

These two parents are heterozygous.

6 (b) (i) What does heterozygous mean?

[1 mark]

_____

_____

6 (b) (ii) Draw a genetic diagram to find the probability that the parents' next child will have AKU.

[4 marks]

You should identify in your diagram any children with AKU.

Use the following symbols: **N** = allele for **not** having AKU (non-AKU)
n = allele for AKU

Probability of having a child with AKU = _____

4.1.2.1 Chromosomes

Question 36 · continued

6 (c) The parents do not want to have another child with AKU.

A genetic counsellor tells the parents that this would be possible if they use IVF followed by embryo screening.

The procedure is:

1. several eggs from the woman are fertilised in a glass dish using sperm cells from the man (IVF)
2. each fertilised egg divides to form an embryo
3. at the 16-cell stage, one cell is removed from each embryo and the cell's DNA is tested (embryo screening)
4. one embryo, which does not have the recessive allele for AKU, is placed in the woman's uterus to develop into a baby
5. some of the other embryos may be frozen and stored.

In **Steps 2** and **3**, a 16-cell embryo is produced by cell division of the original fertilised egg cell.

6 (c) (i) Name the type of cell division in **Step 2**.

[1 mark]

_____

6 (c) (ii) How many cell divisions are needed to make 16 cells from one cell?

[1 mark]

_____

6 (d) Some people have ethical objections to embryo screening.

6 (d) (i) Suggest **one** ethical objection to embryo screening.

[1 mark]

_____

_____

6 (d) (ii) Suggest **one** reason in favour of embryo screening.

[1 mark]

_____

_____

12

4.1.2.1 Chromosomes

Question 37

June 2018 | 8461/1H | Original Q6

0 6 Cystic fibrosis (CF) is a genetic disorder caused by a change in a gene.

0 6 . 1 What molecule are genes made of?

[1 mark]

0 6 . 2 CF affects the cell membranes of cells in the lungs and digestive system.

What is the function of the cell membrane?

[1 mark]

0 6 . 3 In a person with CF, cells lining the lungs and digestive system create too much mucus.

The mucus can:

- block the duct leading from the pancreas to the small intestine
- block the tubes leading to the alveoli in the lungs.

Explain why children with CF grow more slowly than children without CF.

[6 marks]

4.1.2.1 Chromosomes

Question 37 · continued

Table 6 shows information about people in the UK in 2015.

Table 6

	Median age in years
People with CF	19
Whole population	40

0 6 . 4 Describe how the median age of a group of people can be determined.

[2 marks]

0 6 . 5 Suggest **one** reason why the median age for people with CF is lower than the median age for the whole population.

[1 mark]

Question 37 · continued

0 6 . 6 People with a lung function below 30% may need a lung transplant.

Table 7 gives information about people with CF in 2015.

Table 7

Lung Function (%)	Percentage of people with CF
>75	22
51 – 75	72
30 – 50	4
<30	2

In 2015, the total number of people with CF in the UK was 10 800.

Calculate how many people with CF in the UK in 2015 would **not** need a lung transplant.

[2 marks]

Number of people = _____

4.1.2.1 Chromosomes

Question 37 · continued

0 6 . 7 Lung transplants from donors have risks. One risk is organ rejection.

Scientists are researching how to solve the problem of organ rejection and hope to use stem cells to create healthy lungs.

The healthy lungs can then be transplanted into CF patients without the risk of organ rejection.

Describe how scientists may use stem cells to create healthy lungs that are **not** rejected by the CF patient.

[4 marks]

0 6 . 8 Some people disagree with the use of stem cells because of the risk of cancer.

Give **one** other reason why some people disagree with the use of stem cells to create new organs for transplants.

[1 mark]

18

4.1.2.1 Chromosomes

Question 38

0 5 Cell division is needed for growth and for reproduction.

0 5 . 1 **Table 3** contains three statements about cell division.

Complete **Table 3**.

[2 marks]

Tick **one** box for each statement.

Table 3

Statement	Statement is true for		
	Mitosis only	**Meiosis only**	**Both mitosis and meiosis**
All cells produced are genetically identical			
In humans, at the end of cell division each cell contains 23 chromosomes			
Involves DNA replication			

4.1.2.1 Chromosomes

Question 38 · continued

Bluebell plants grow in woodlands in the UK.

- Bluebells can reproduce sexually by producing seeds.
- Bluebells can also reproduce asexually by making new bulbs.

0 5 . 2 One advantage of asexual reproduction for bluebells is that only **one** parent is needed.

Suggest **two** other advantages of asexual reproduction for bluebells.

[2 marks]

1

2

0 5 . 3 Explain why sexual reproduction is an advantage for bluebells.

[4 marks]

8

4.1.2.1 Chromosomes

Question 39

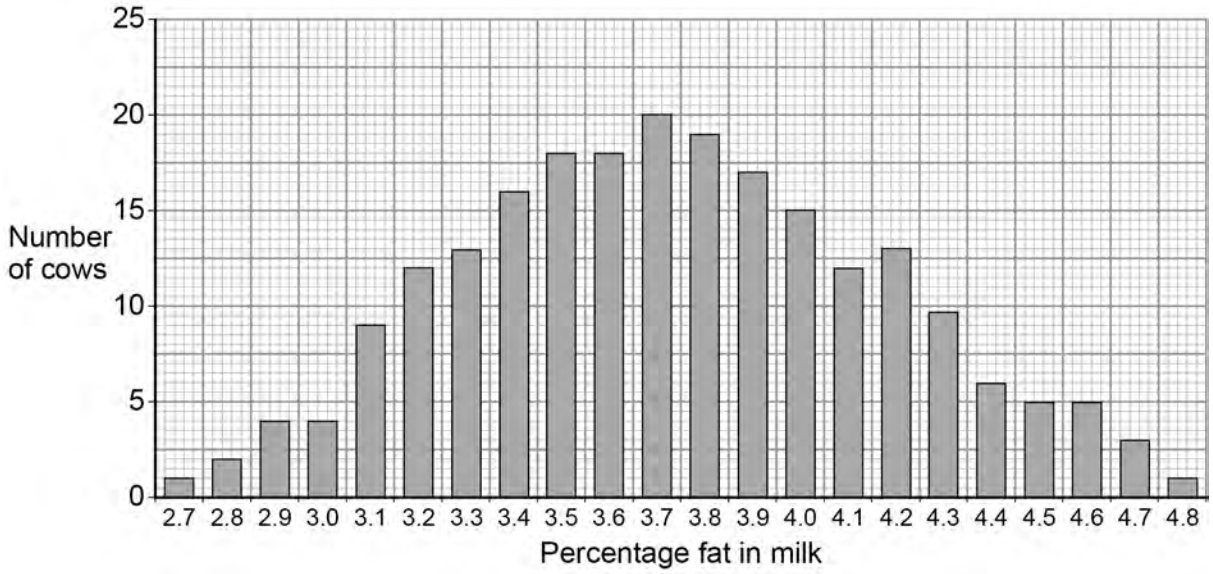
June 2018 | 8461/2H | Original Q8

0 8 Scientists want to breed cows that produce milk with a low concentration of fat.

Figure 10 shows information about the milk in one group of cows.

The cows were all the same type.

Figure 10



0 8 . 1 In **Figure 10** the mean percentage of fat in the milk is equal to the modal value.

Give the mean percentage of fat in the milk of these cows.

[1 mark]

Mean percentage = _____

0 8 . 2 A student suggested:

'The percentage of fat in milk is controlled by one dominant allele and one recessive allele.'

How many different phenotypes would this produce?

[1 mark]

Tick **one** box.

2		3		22		46	

4.1.2.1 Chromosomes

Question 39 · continued

0 8 . 3 Give the evidence from **Figure 10** which shows the percentage of fat in the milk is controlled by several genes.

[1 mark]

0 8 . 4 One of the genes codes for an enzyme used in fat metabolism.

A mutation in this gene causes a reduction in milk fat.

The mutation changes one amino acid in the enzyme molecule.

Explain how a change in one amino acid in an enzyme molecule could stop the enzyme working.

[3 marks]

Question 8 continues on the next page

4.1.2.1 Chromosomes

Question 39 · continued

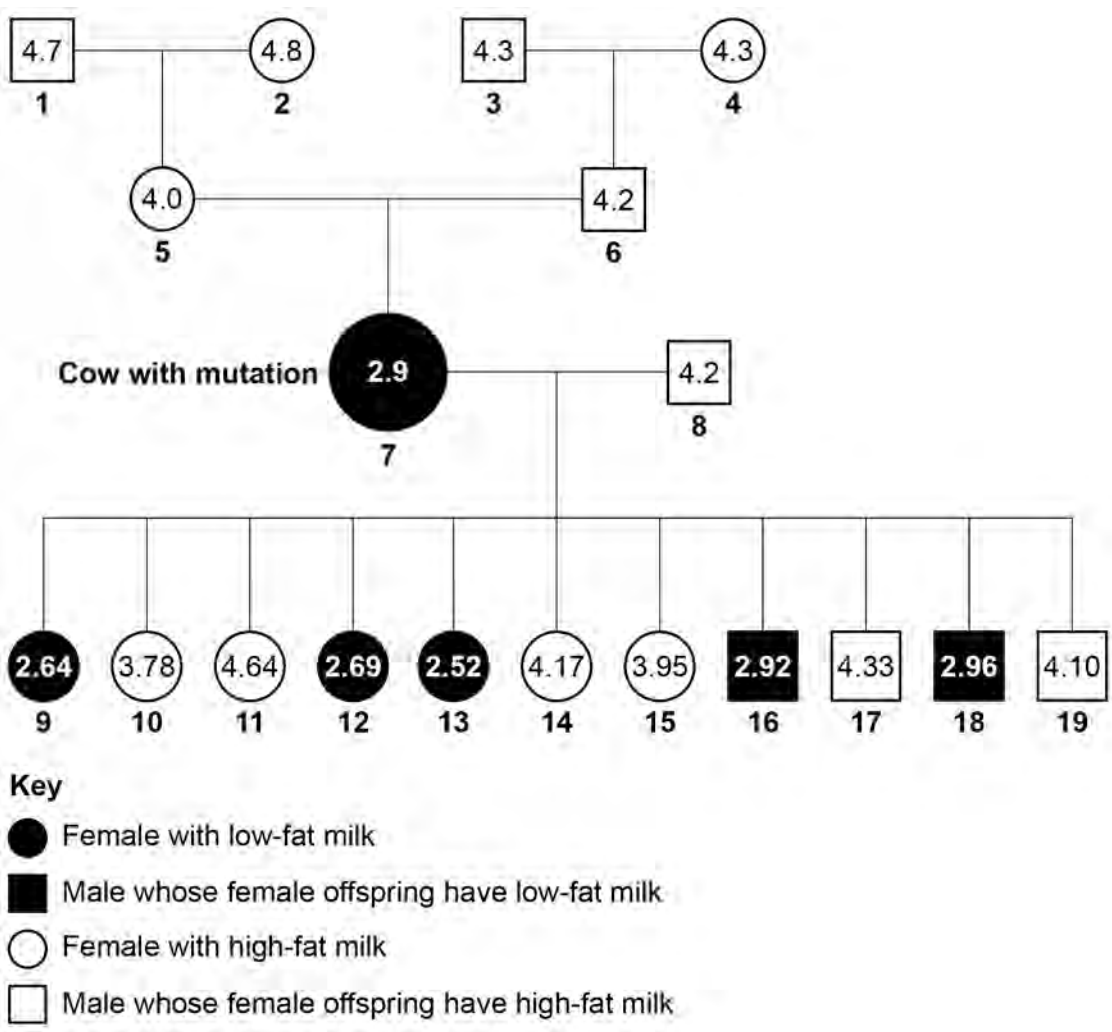
The scientists found one cow with a mutation.

The cow's milk contained only 2.9% fat.

Figure 11 shows the percentage of fat in the milk of cattle related to the cow with the mutation.

The values for male cattle are the mean values of their female offspring.

Figure 11



4.1.2.1 Chromosomes

Question 39 · continued

0 8 . 5 Animal **8** is homozygous.

The mutation in animal **7** produced a dominant allele for making low-fat milk.

Give evidence from **Figure 11** that animal **7** is heterozygous.

[1 mark]

0 8 . 6 Animals **7** and **8** produced 11 offspring. These offspring were produced by in vitro fertilisation (IVF).

The embryos from IVF were transferred into 11 other cows.

Suggest why IVF and embryo transfer were used rather than allowing animals **7** and **8** to mate naturally.

[1 mark]

0 8 . 7 Draw a Punnett square diagram to show a cross between animals **7** and **8**.

Identify which offspring produce low-fat milk and which offspring produce high-fat milk.

[4 marks]

Use the following symbols:

D = dominant allele for making low-fat milk

d = recessive allele for making high-fat milk

4.1.2.1 Chromosomes

Question 39 · continued

0 8 . 8 The scientists want to produce a type of cattle that makes large volumes of low-fat milk.

The scientists will selectively breed some of the animals shown in **Figure 11**.

Describe how the scientists would do this.

[4 marks]

16

4.1.2.1 Chromosomes

Question 40

0 8 Pancreatic cancer develops when a malignant tumour grows inside the pancreas.

0 8 . 1 The pancreas produces digestive enzymes.

What is an enzyme?

[2 marks]

0 8 . 2 Carbohydrase is an enzyme produced by the pancreas.

Name **two** other organs in the digestive system that produce carbohydrase.

[2 marks]

1 _____

2 _____

0 8 . 3 One symptom of pancreatic cancer is weight loss.

Explain how pancreatic cancer may cause a person to lose weight.

Do **not** refer to hormones in your answer.

[4 marks]

4.1.2.1 Chromosomes

Question 40 · continued

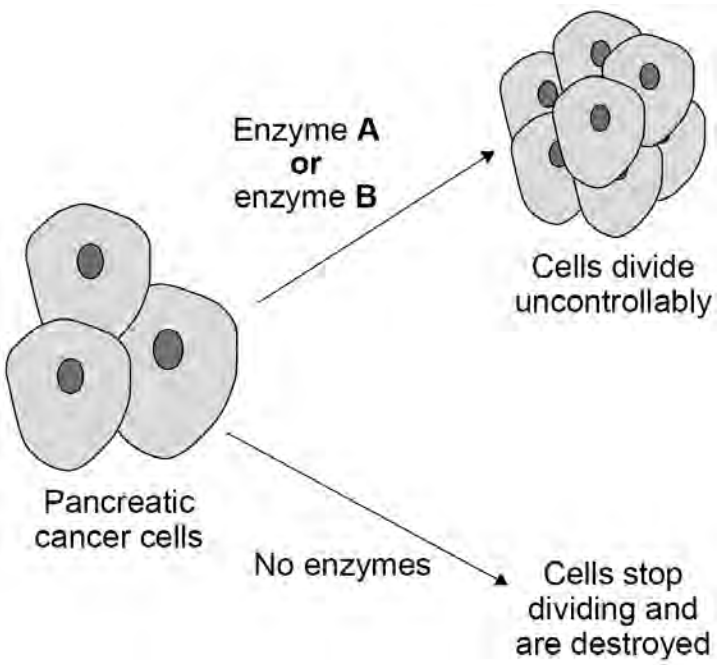
Enzyme **A** and enzyme **B** are involved in controlling cell division in pancreatic cancer cells.

Most cancer cells produce both enzyme **A** and enzyme **B**.

Some people have a gene mutation that stops cancer cells producing enzyme **B**.

Figure 9 shows how cell division is controlled in pancreatic cancer cells.

Figure 9



4.1.2.1 Chromosomes

Question 40 · continued

Scientists have developed a drug that inhibits enzyme **A**.

The drug is given to pancreatic cancer patients who have the gene mutation that stops cancer cells producing enzyme **B**.

The drug only targets cancer cells.

0 8 . 4 Explain why the drug can be used to treat pancreatic cancer in patients with the gene mutation.

Use information from **Figure 9**.

[3 marks]

0 8 . 5 Explain why the drug could **not** be used to treat pancreatic cancer in a patient that produces both enzyme **A** and enzyme **B**.

[2 marks]

Question 8 continues on the next page

4.1.2.1 Chromosomes

Question 40 · continued

0 8 . 6 The drug was trialled before it was licensed for use.

To improve validity of the results in the trial:

- some patients were given a placebo
- a double-blind trial was used.

Give reasons why a placebo and a double-blind trial were used.

[2 marks]

A placebo _____

_____

_____

A double-blind trial _____

_____

_____

0 8 . 7 One stage in a drug trial is to test the drug on healthy volunteers.

What is the next stage in the drug trial?

[1 mark]

Tick (✓) **one** box.

Testing on all patients with the disease ☐

Testing on human tissue ☐

Testing on live animals ☐

Testing on volunteers with the disease ☐

4.1.2.1 Chromosomes

Question 40 · continued

0 8 . 8 A monoclonal antibody has been produced to treat pancreatic cancer.

Explain how the monoclonal antibody works to treat pancreatic cancer.

[3 marks]

19

4.1.2.1 Chromosomes

Question 41

June 2019 | 8461/2H | Original Q7

0 7 Ragwort is a weed that grows on farmland.

Ragwort is poisonous to horses.

0 7 . 1 Plan an investigation to estimate the size of a population of ragwort growing in a rectangular field on a farm.

[4 marks]

Question 7 continues on the next page

4.1.2.1 Chromosomes

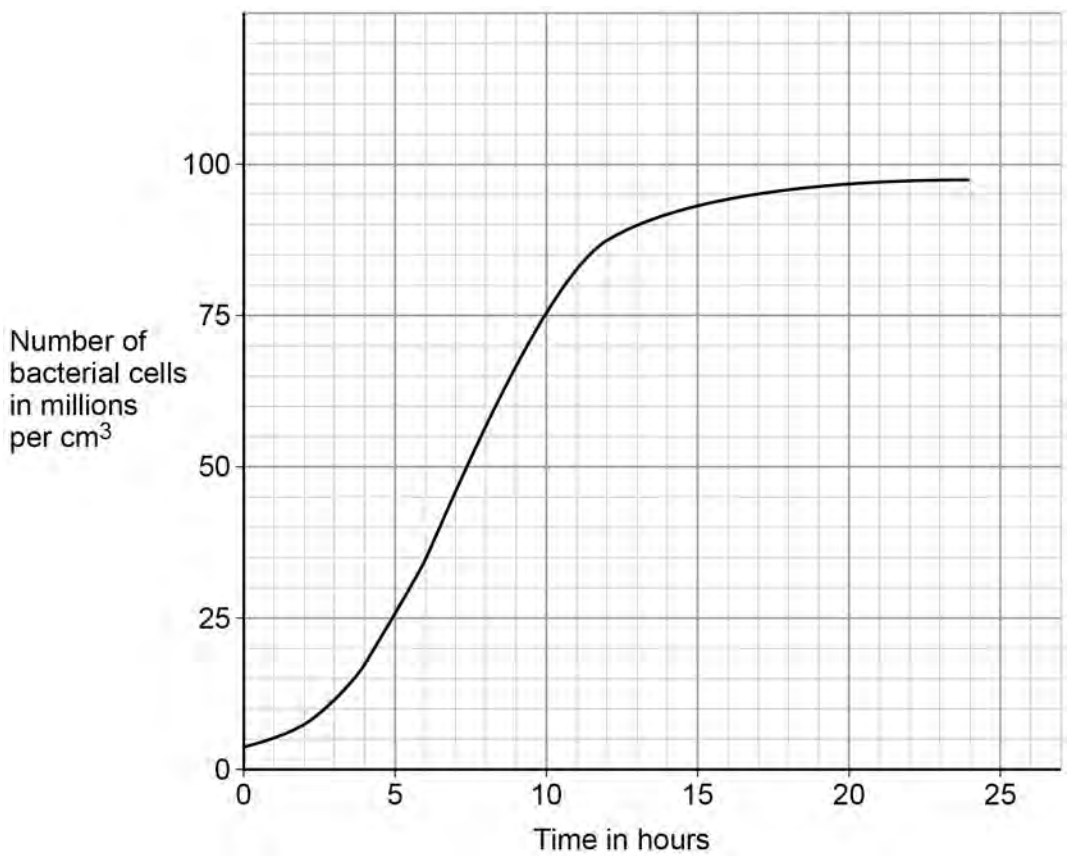
Question 41 · continued

The herbicide glyphosate will kill ragwort and other weeds.

Scientists use bacteria for the genetic engineering of crop plants to make the crops resistant to glyphosate.

Figure 8 shows the growth of a culture of the bacteria in a solution of nutrients at 25 °C

Figure 8



0 7 . 2 Why did the rate of reproduction increase between 2 hours and 7 hours?

[1 mark]

4.1.2.1 Chromosomes

Question 41 · continued

0 7 . 3 After 12 hours, the rate of reproduction decreased.

Suggest **three** ways the scientists could maintain a high rate of reproduction in the bacterial culture.

[3 marks]

1 _____

_____

2 _____

_____

3 _____

_____

0 7 . 4 The rate of reproduction of the bacteria is fastest at 7 hours.

How many times faster is the rate of reproduction at 7 hours than the rate at 12 hours?

[4 marks]

_____

_____

_____

_____

_____

_____

_____

_____

Rate at 7 hours is _____ times faster.

Question 7 continues on the next page

4.1.2.1 Chromosomes

Question 41 · continued

0 7 . 5 Scientists transferred a gene for resistance to the herbicide glyphosate into the bacteria.

The genetically-modified (GM) bacteria can then transfer the glyphosate-resistance gene to a crop plant.

Explain the advantage of making crop plants resistant to glyphosate.

[3 marks]

15

4.1.2.1 Chromosomes

Question 42

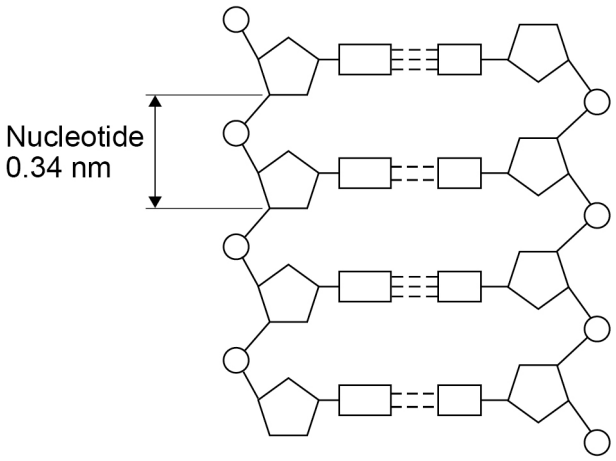
0 4 DNA is a polymer of nucleotides.

0 4 . 1 Why is DNA described as a polymer?

[1 mark]

Figure 5 shows part of a DNA molecule.

Figure 5



0 4 . 2 Describe the structure of a nucleotide.

[4 marks]

4.1.2.1 Chromosomes

Question 42 · continued

0 4 . 3 The length of a DNA double helix increases by 0.34 nm for every pair of nucleotides.

The total number of nucleotides in a human body cell is 1.2×10^{10}.

Calculate the total length of double helix in a human body cell.

Give your answer in metres. Use information from **Figure 5**.

[5 marks]

Total length = _____ m

0 4 . 4 Some parts of DNA do **not** code for proteins.

Describe how non-coding parts of DNA can affect the expression of genes.

[1 mark]

11

4.1.2.1 Chromosomes

Question 43

November 2020 | 8461/2H | Original Q5

0 5 There are two types of cell division: mitosis and meiosis.

0 5 . 1 Describe **three** differences between the processes of mitosis and meiosis.

[3 marks]

1 _____

_____

_____

2 _____

_____

_____

3 _____

_____

_____

0 5 . 2 Describe **one** similarity between the processes of mitosis and meiosis.

[1 mark]

_____

_____

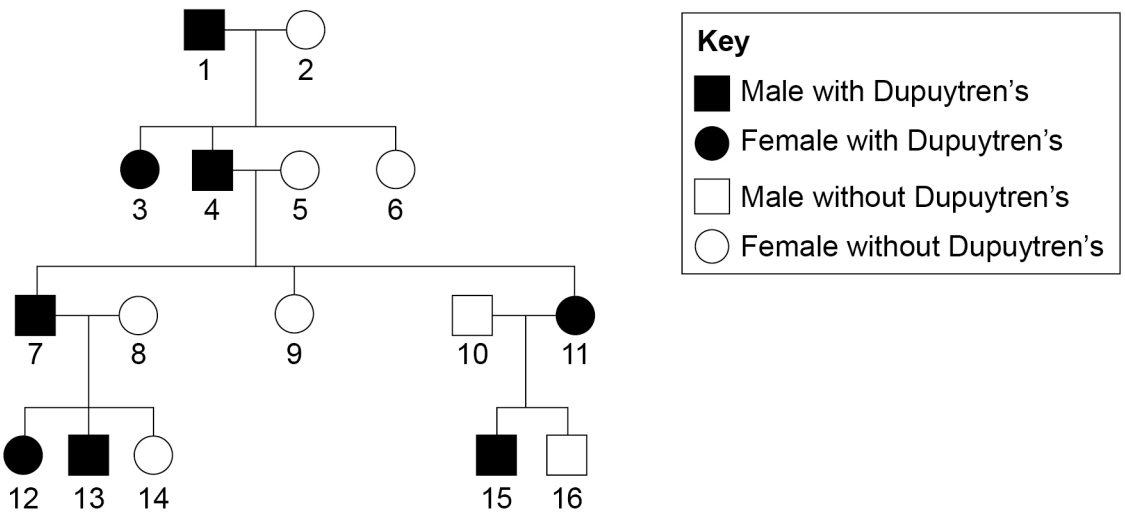
Question 5 continues on the next page

Question 43 · continued

Dupuytren's is a disorder that affects the hands.

Figure 6 shows the inheritance of Dupuytren's in one family.

Figure 6



Dupuytren's is caused by a dominant allele in this family.

D = dominant allele

d = recessive allele

0 5 . 3 Give the genotype of person **1**.

Explain your answer.

[2 marks]

Genotype _____

4.1.2.1 Chromosomes

Question 43 · continued

0 5 . 4 Person **7** and person **8** in **Figure 6** are expecting a fourth child.

What is the probability of the child having Dupuytren's?

You should:

- draw a Punnett square diagram
- identify which offspring have Dupuytren's

[5 marks]

Probability = _____

0 5 . 5 Explain how **Figure 6** shows the allele for Dupuytren's is **not** on the Y chromosome.

[2 marks]

_____

_____

_____

_____

13

4.1.2.1 Chromosomes

Question 44

November 2021 | 8461/2H | Original Q1

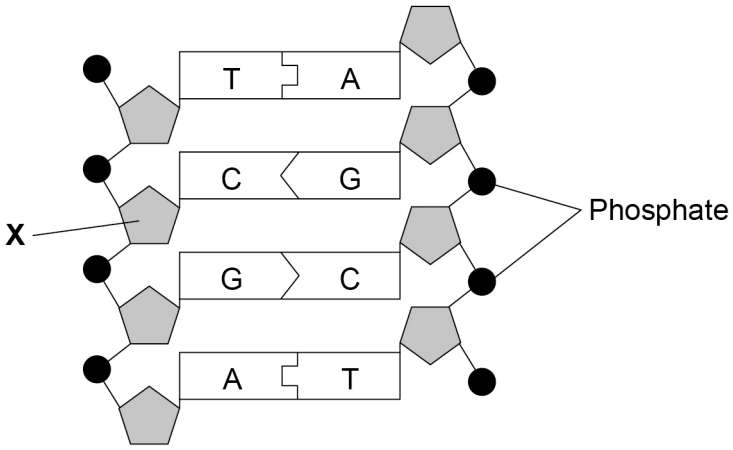
0 1 The nucleus of a cell contains DNA.

0 1 . 1 Name the structures inside the cell nucleus that contain DNA.

[1 mark]

Figure 1 shows part of a DNA molecule.

Figure 1



0 1 . 2 Name the part of the DNA molecule labelled **X**.

[1 mark]

0 1 . 3 What type of substances are labelled **A**, **C**, **G** and **T** in **Figure 1**?

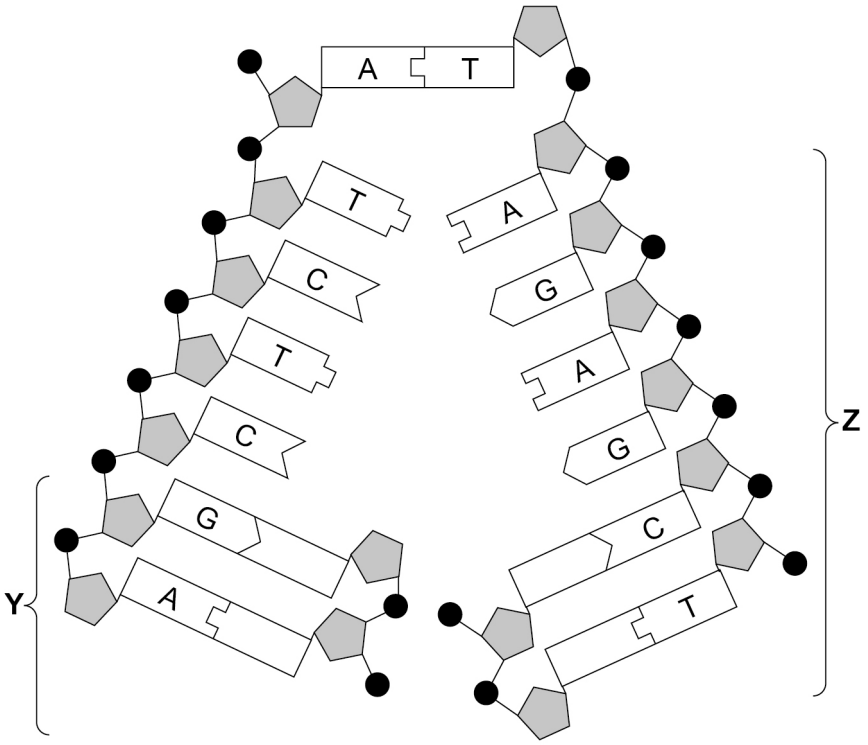
[1 mark]

4.1.2.1 Chromosomes

Question 44 · continued

Figure 2 shows another section of a DNA molecule.

Figure 2



0 1 . 4 Four of the substances you named in Question **01.3** are **not** labelled in part **Y** of **Figure 2**.

Label each of these substances with the correct letter, **A**, **C**, **G** or **T**.

Use information from other parts of **Figure 2** to help you.

[1 mark]

0 1 . 5 What is happening to the DNA in part **Z** of **Figure 2**?

[1 mark]

Tick (✓) **one** box.

- Differentiation ☐
- Evolution ☐
- Fertilisation ☐
- Replication ☐

4.1.2.1 Chromosomes

Question 44 · continued

0 1 . 6 A gene is a length of DNA.

What type of substance does a gene code for?

[1 mark]

0 1 . 7 Most human body cells contain 6×10^{-12} grams of DNA.

What mass of DNA will a human sperm cell contain?

[1 mark]

Tick (✓) **one** box.

- 6×10^{-6} grams ☐
- 6×10^{-12} grams ☐
- 3×10^{-6} grams ☐
- 3×10^{-12} grams ☐

0 1 . 8 What is the name of the type of cell division that produces sperm cells?

[1 mark]

Tick (✓) **one** box.

- Binary fission ☐
- Differentiation ☐
- Meiosis ☐
- Mitosis ☐

8

4.1.2.1 Chromosomes

Question 45

November 2021 | 8461/2H | Original Q8

0 8 Sickle cell anaemia is an inherited condition that affects red blood cells.

Sickle cell anaemia is caused by a mutation in the gene for haemoglobin. Haemoglobin is the red pigment found in red blood cells.

A person who is homozygous for the normal haemoglobin allele (H^A) produces normal red blood cells.

A person who is homozygous for the mutated allele (H^S):

- produces red blood cells with abnormal haemoglobin
- has red blood cells that can form an altered shape
- has sickle cell anaemia and becomes ill.

A person who is heterozygous:

- has both normal and abnormal haemoglobin in the red blood cells
- has sickle cell trait
- is generally healthy but can become ill in certain circumstances.

0 8 . 1 Give the reason why a mutation in the gene coding for haemoglobin could be harmful.

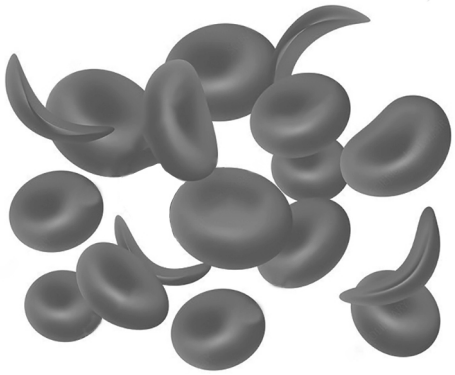
[1 mark]

4.1.2.1 Chromosomes

Question 45 · continued

0 8 . 2 **Figure 13** shows some red blood cells from the blood of a person with sickle cell trait.

Figure 13



Calculate the proportion of cells in **Figure 13** that have an altered shape.

[2 marks]

Proportion = _____

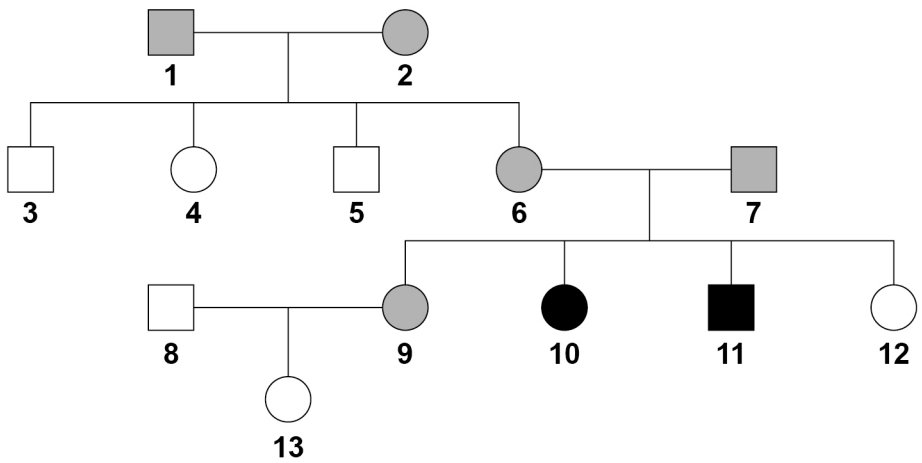
Question 8 continues on the next page

4.1.2.1 Chromosomes

Question 45 · continued

Figure 14 shows the inheritance of sickle cell anaemia in one family.

Figure 14



Key

- Unaffected male
- Unaffected female
- Male with sickle cell anaemia
- Female with sickle cell anaemia
- Male with sickle cell trait
- Female with sickle cell trait

4.1.2.1 Chromosomes

Question 45 · continued

0 8 . 3 Persons **8** and **9** in **Figure 14** are expecting a second child.

Determine the probability that the child will be a girl with sickle cell trait.

You should:

- draw a Punnett square diagram
- identify the phenotype of each offspring genotype
- use the symbols:

  H^A = normal haemoglobin allele

  H^S = mutated haemoglobin allele.

[5 marks]

Probability of a girl with sickle cell trait = _____

Question 8 continues on the next page

4.1.2.1 Chromosomes

Question 45 · continued

0 8 . 4 Without medical treatment, people with sickle cell anaemia are frequently ill and have a reduced life expectancy.

The malarial parasite cannot live in the red blood cells of a person who has the $\mathbf{H^S}$ allele.

A scientist stated:

'It is an advantage for people to have the $\mathbf{H^S}$ allele in countries where malaria occurs.'

Evaluate the scientist's statement.

[3 marks]

11

4.1.2.1 Chromosomes

Question 46

0 9 The Galapagos Islands are located in the Pacific Ocean.

Several species of birds called finches live on the Galapagos Islands.

These finches are very similar to each other.

Figure 15 shows two modern species of Galapagos finch and their classification.

Figure 15

Medium ground finch



Small ground finch



Classification group	**Medium ground finch**	**Small ground finch**
Kingdom	*Animalia*	*Animalia*
	Chordata	*Chordata*
Class	*Aves*	*Aves*
	Passeriformes	*Passeriformes*
	Thraupidae	*Thraupidae*
Genus	*Geospiza*	*Geospiza*
	fortis	*fuliginosa*

4.1.2.1 Chromosomes

Question 46 · continued

0 9 . 1 Complete **Figure 15** to give the names of the missing classification groups.

[2 marks]

0 9 . 2 Give the binomial name of the medium ground finch.

Use information from **Figure 15**.

[1 mark]

Question 9 continues on the next page

Question 46 · continued

In each species of finch, there is a variation in beak depth.

Figure 16 shows how beak depth is measured.

Figure 16

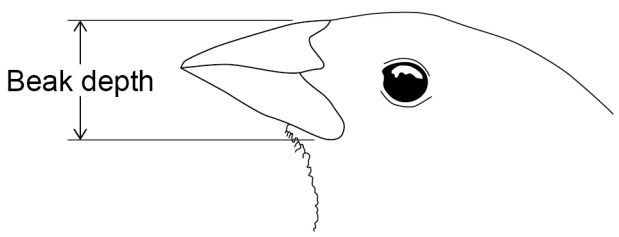
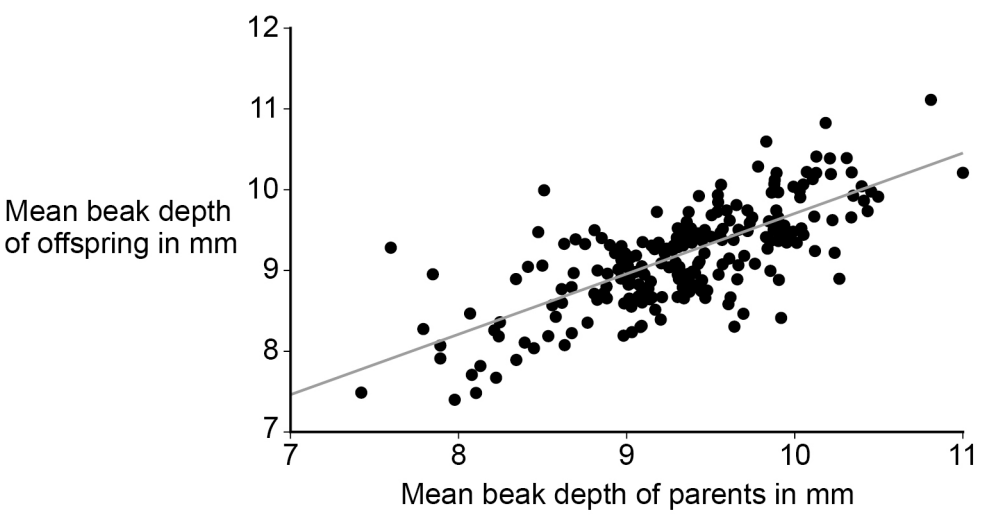


Figure 17 shows the relationship between the beak depth of parent birds and the beak depth of their offspring.

Figure 17



0 9 . 3 Give evidence from **Figure 17** that beak depth is an inherited characteristic.

[1 mark]

4.1.2.1 Chromosomes

Question 46 · continued

0 9 . 4 Scientists suggested that more than one gene controls beak depth.

Give evidence from **Figure 17** to support the scientists' suggestion.

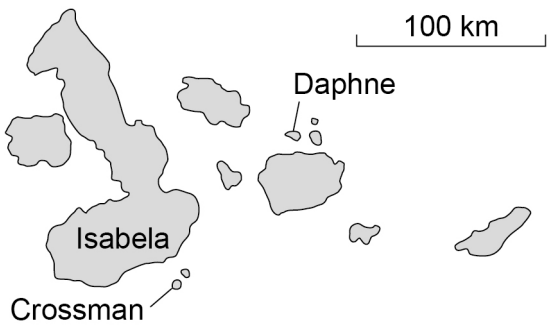
[1 mark]

Question 9 continues on the next page

Question 46 · continued

Figure 18 is a map of the Galapagos Islands.

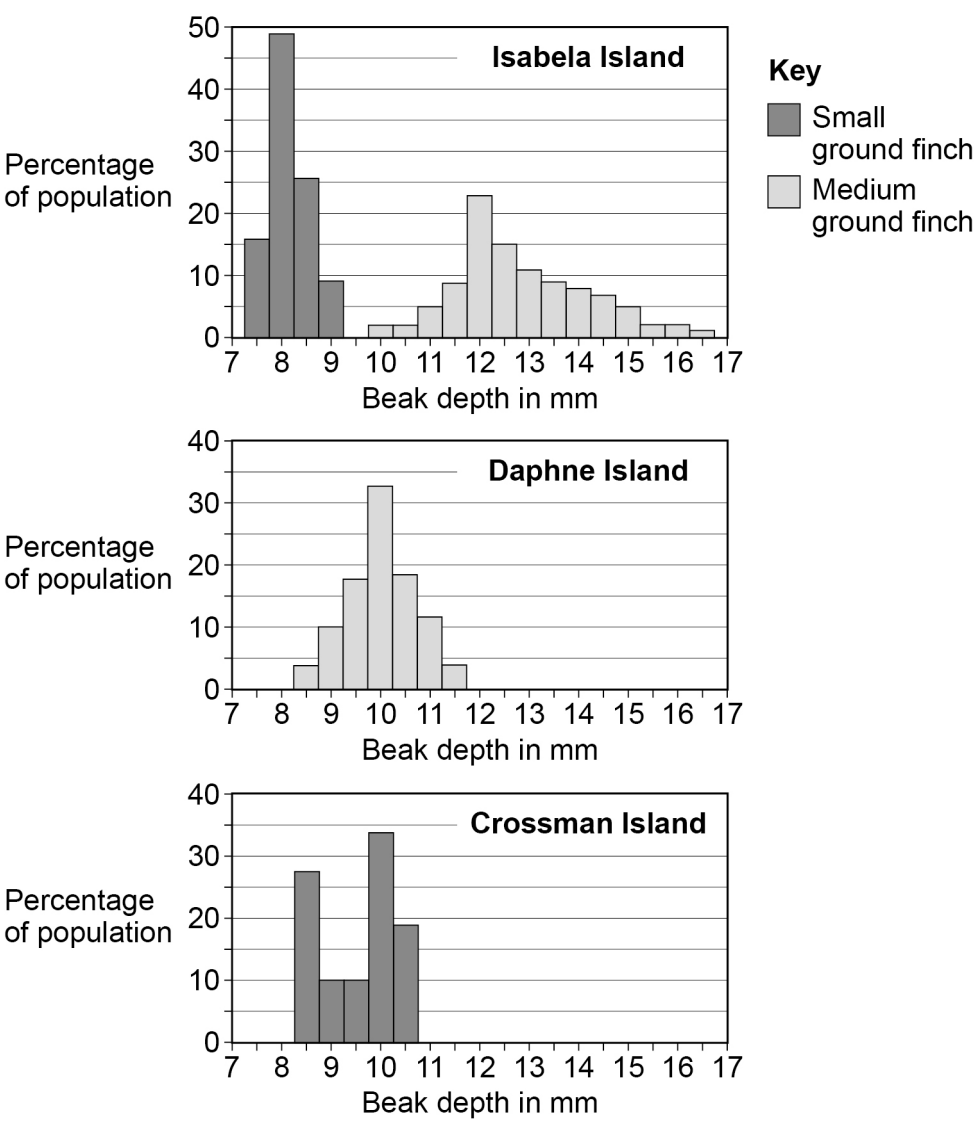
Figure 18



On Isabela Island, the medium ground finch **and** the small ground finch are found.
On Daphne Island, only the medium ground finch is found.
On Crossman Island, only the small ground finch is found.

Figure 19 shows how the beak depth of each species varies on each island.

Figure 19



4.1.2.1 Chromosomes

Question 46 · continued

The medium ground finch and the small ground finch both feed on seeds.

The size of seeds eaten by each bird depends on the depth of the bird's beak.

0 9 . 5 The range of beak depth of **medium ground finches** on Isabela Island is different from the range on Daphne Island.

Explain what might have caused this difference.

[6 marks]

Question 9 continues on the next page

4.1.2.1 Chromosomes

Question 46 · continued

0 9 . 6 **Figure 19** shows:

- the **two** species of finch live on Isabela Island
- only **one** of the species lives on Daphne Island
- only **one** of the species lives on Crossman Island.

Suggest why both species of finch are able to live on Isabela Island.

[2 marks]

13

4.1.2.1 Chromosomes

Question 47

June 2022 | 8461/2H | Original Q1

0 1 There are two types of reproduction:

- sexual reproduction
- asexual reproduction.

0 1 . 1 Complete **Table 1** to compare sexual reproduction with asexual reproduction.

Write a tick (✓) in the box if the statement is true.

The first row has been completed for you.

[2 marks]

Table 1

	Sexual reproduction	Asexual reproduction
Cell division occurs	✓	✓
Fertilisation occurs		
Genes are passed on from parent to offspring		
Offspring are genetically identical to each other		

0 1 . 2 Gametes are formed in sexual reproduction.

Name the male gamete formed in flowering plants.

[1 mark]

_____

Question 1 continues on the next page

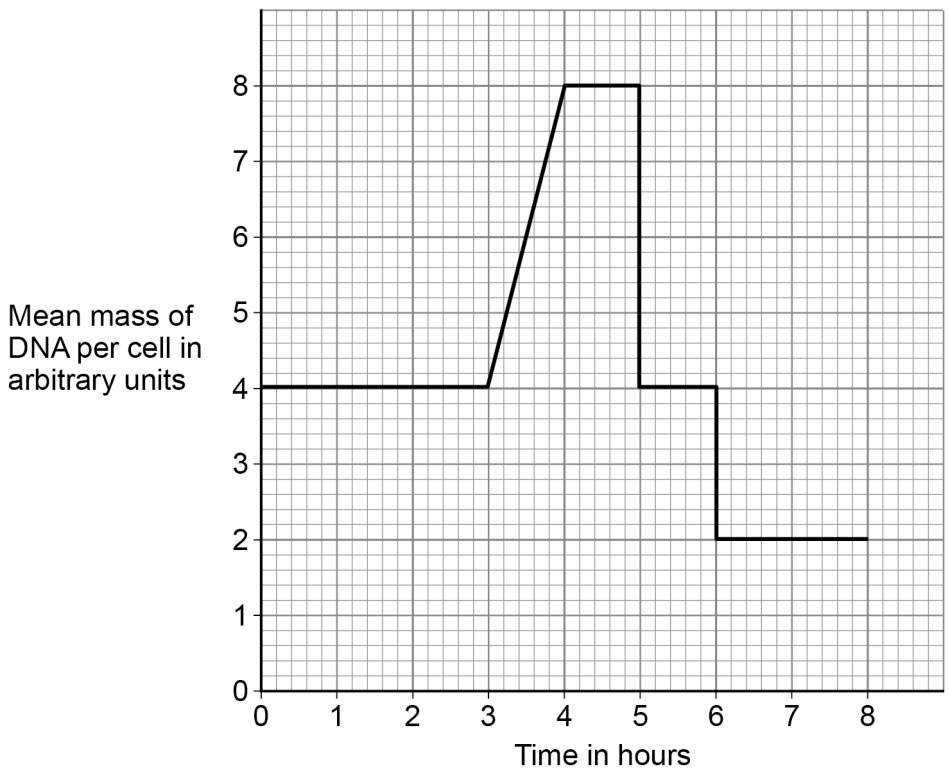
4.1.2.1 Chromosomes

Question 47 · continued

Cell division by meiosis forms gametes.

Figure 1 shows the mean mass of DNA per cell before, during and after meiosis.

Figure 1



Use information from **Figure 1** to answer questions **01.3** to **01.6**.

0 1 . 3 When is the DNA in the chromosomes being copied?

[1 mark]

Tick (✓) **one** box.

Between 0 and 3 hours ☐

Between 3 and 4 hours ☐

Between 4 and 5 hours ☐

Between 5 and 6 hours ☐

4.1.2.1 Chromosomes

Question 47 · continued

0 1 . 4 Cells divide twice during meiosis.

Which **two** times in **Figure 1** show one cell dividing into two cells?

[2 marks]

Tick (✓) **two** boxes.

- 3 hours ☐
- 4 hours ☐
- 5 hours ☐
- 6 hours ☐
- 8 hours ☐

0 1 . 5 What is the mean mass of DNA in arbitrary units in a sperm cell?

[1 mark]

Tick (✓) **one** box.

2 ☐ 4 ☐ 8 ☐ 16 ☐

0 1 . 6 What is the mean mass of DNA in arbitrary units in each cell in an embryo?

[1 mark]

Tick (✓) **one** box.

2 ☐ 4 ☐ 8 ☐ 16 ☐

8

4.1.2.1 Chromosomes

Question 48

June 2023 | 8461/2H | Original Q3

0 3 Reproduction can produce offspring which are:

- genetically different

  or

- genetically identical.

Farmers grow tomato plants in greenhouses.

The tomatoes are sold in supermarkets.

0 3 . 1 Suggest **one** advantage of growing tomato plants that are genetically different.

[1 mark]

0 3 . 2 Suggest **one** advantage of growing tomato plants that are genetically identical.

[1 mark]

0 3 . 3 Scientists can grow genetically identical tomato plants using tissue culture.

What is tissue culture?

[1 mark]

0 3 . 4 Genetically identical tomato plants growing in the same garden do **not** all grow to the same height.

Give **one** reason why.

[1 mark]

4.1.2.1 Chromosomes

Question 48 · continued

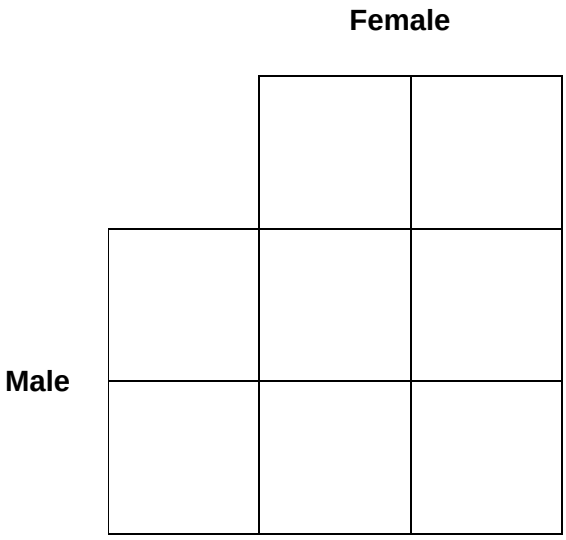
The sex of dogs is determined by **X** and **Y** chromosomes in the same way as in humans.

0 3 . 5 Complete the Punnett square diagram in **Figure 4** to show the inheritance of sex in dogs.

Use the symbols **X** and **Y**.

[3 marks]

Figure 4



0 3 . 6 A female dog gave birth to six offspring.

Why would you expect there to be three male offspring and three female offspring?

Use your answer to Question **03.5**.

[1 mark]

Question 3 continues on the next page

Question 48 · continued

Farmers keep chickens for:

- meat production
- egg production.

Some varieties of chicken grow more quickly and are more suitable for meat production.

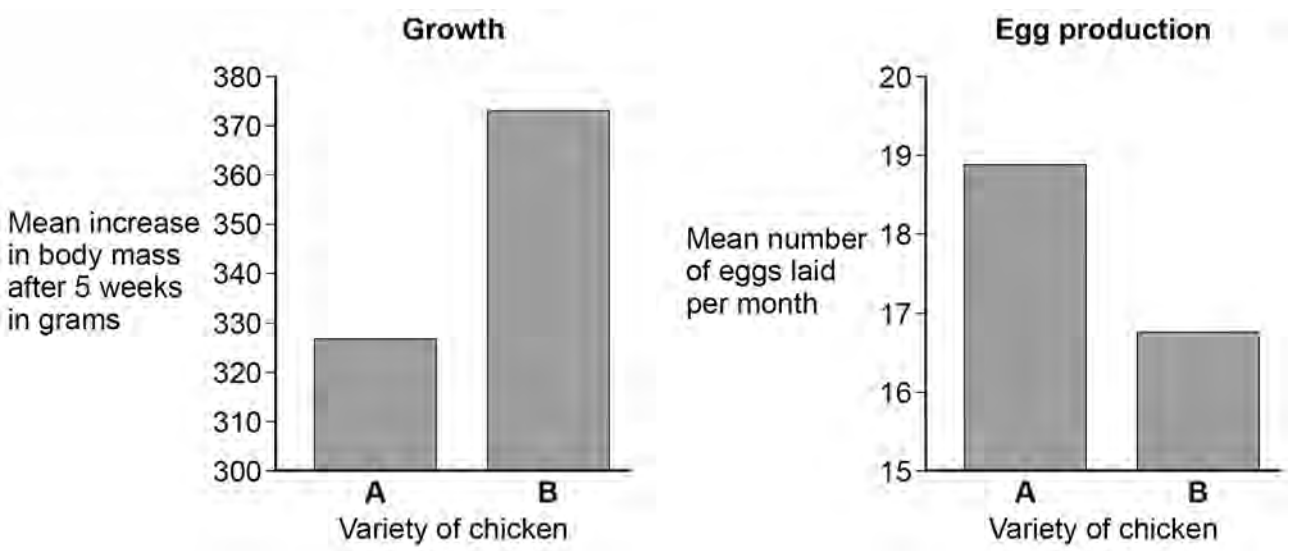
Other varieties of chicken produce more eggs.

A farmer keeps two varieties of chicken, **A** and **B**.

The farmer investigated the growth rates and egg-production rates of both varieties.

Figure 5 shows the results.

Figure 5



0 3 . 7 Suggest **two** control variables the farmer should have used in this investigation.

[2 marks]

1 _____

_____

2 _____

_____

4.1.2.1 Chromosomes

Question 48 · continued

0 3 . 8 **Figure 5** shows mean values from 500 chickens of each variety.

Give the reason the farmer used a large number of chickens.

[1 mark]

0 3 . 9 The farmer wants to produce a new variety of chicken that is good for **both** meat production **and** egg production.

Describe how selective breeding of chicken varieties **A** and **B** can produce the new variety of chicken.

[4 marks]

15

4.1.2.1 Chromosomes

Question 49

June 2023 | 8461/2H | Original Q7

0 7

Hormones are important for regulating the menstrual cycle.

During the menstrual cycle, eggs mature inside follicles in the ovaries.

A 27-year-old woman was infertile.

A doctor tested a sample of the woman's blood.

The test did **not** detect any follicle stimulating hormone (FSH) in the woman's blood.

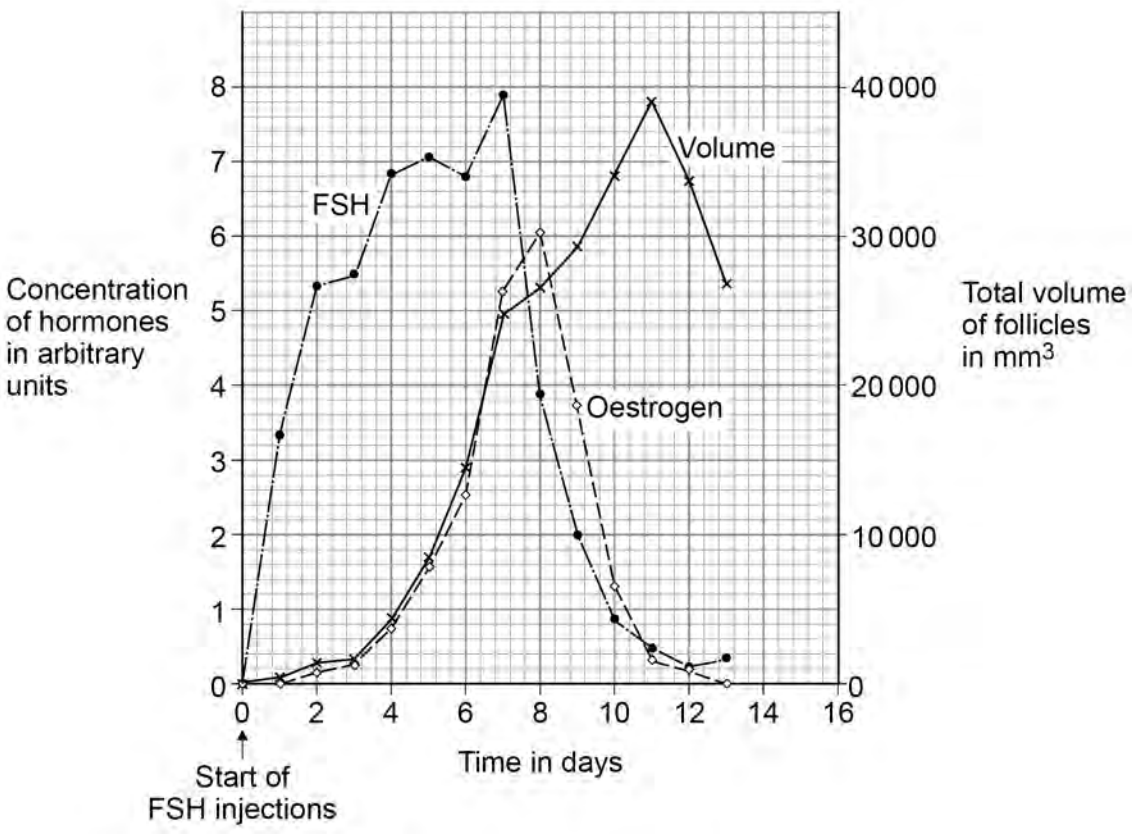
The doctor gave the woman daily injections of FSH for 7 days.

The doctor measured:

- the concentration of FSH in the woman's blood
- the concentration of oestrogen in the woman's blood
- the volumes of developing follicles in the ovaries.

Figure 12 shows the results.

Figure 12



4.1.2.1 Chromosomes

Question 49 · continued

0 7 . 1 Give evidence from **Figure 12** that the follicles in the ovaries release oestrogen.

[1 mark]

0 7 . 2 Injection of FSH caused the development of a number of follicles.

The mean diameter of the follicles on day 11 was 22 millimetres.

Calculate the number of follicles in the woman's ovaries on day 11.

Assume each follicle is a sphere.

Volume of a sphere = $\frac{4}{3}\pi r^3$

r = radius
π = 3.14

Give your answer to the nearest whole number.

[5 marks]

Number of follicles (to the nearest whole number) = _____

Question 7 continues on the next page

4.1.2.1 Chromosomes

Question 49 · continued

0 7 . 3 Before treatment with FSH, the woman had underdeveloped breasts.

Explain why the lack of FSH in the woman's blood caused underdeveloped breasts.

[2 marks]

0 7 . 4 Usually males and females both produce FSH.

The woman had inherited a faulty gene for FSH production from each of her parents.

The woman's parents both produce FSH.

Show how the **woman's parents** could have a child that does **not** produce FSH.

You should:

- draw a Punnett square diagram
- identify the phenotype of each offspring genotype
- use the symbols below:

  H = allele for making FSH

  h = allele for **not** making FSH

[3 marks]

4.1.2.1 Chromosomes

Question 49 · continued

0 7 . 5 The woman continues to have injections of FSH.

The woman has a child with a man who is heterozygous for the FSH gene.

Explain why the probability that the child will be able to produce FSH is 0.5.

[3 marks]

14

Turn over for the next question

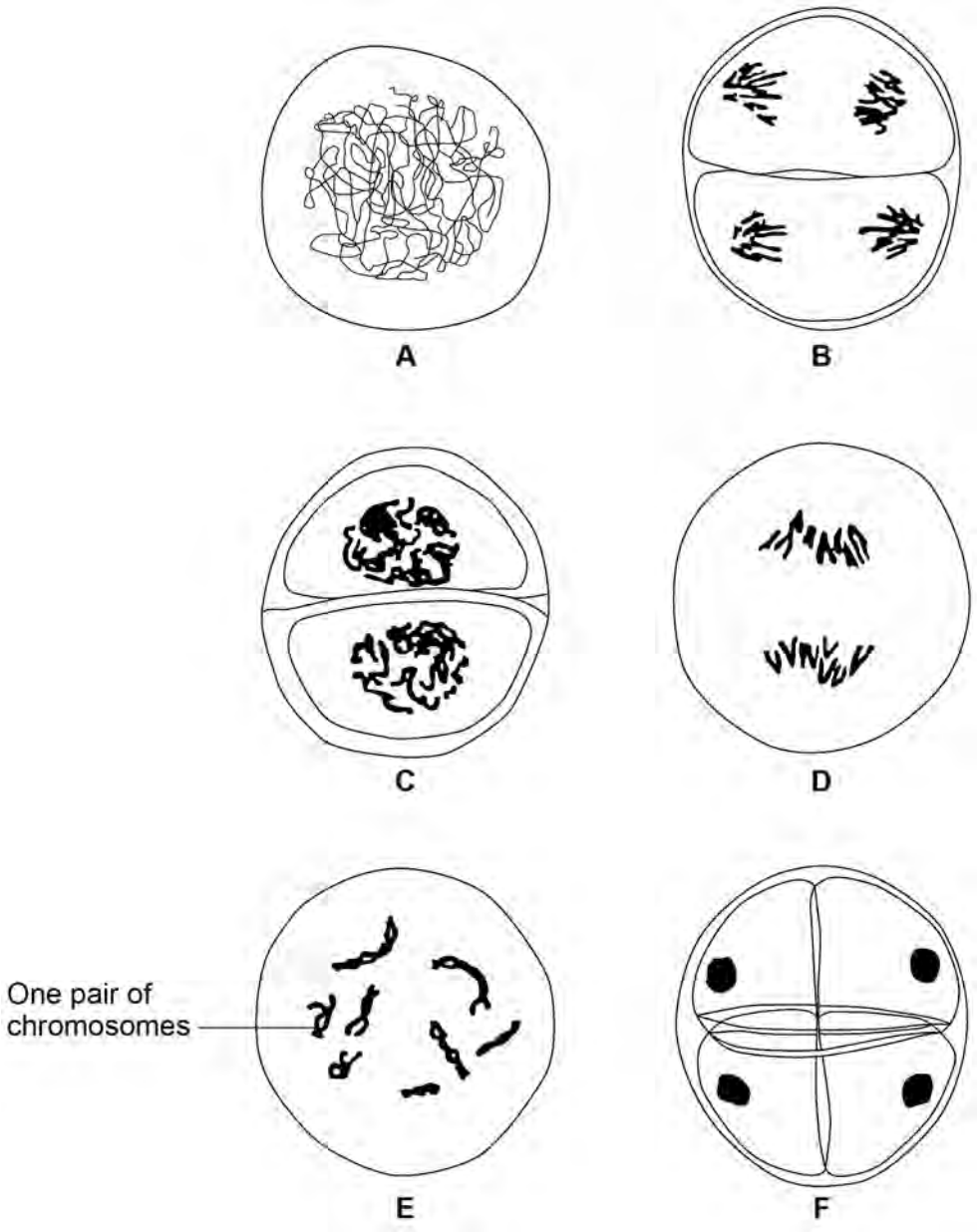
4.1.2.1 Chromosomes

Question 50

June 2023 | 8461/2H | Original Q8

0 8 **Figure 13** shows six stages in the process of meiosis.

Figure 13



0 8 . 1 In **Figure 13**, **A** is the first stage and **F** is the final stage.

Stages **B** to **E** are **not** in the correct order.

Give the correct order of stages **A** to **F**.

[1 mark]

A → _____ → _____ → _____ → _____ → **F**

4.1.2.1 Chromosomes

Question 50 · continued

At the end of meiosis the number of chromosomes is different from the number of chromosomes at the start of meiosis.

0 8 . 2 Give the number of chromosomes in **one** cell in **Figure 13**:

- at the start of meiosis
- at the end of meiosis.

[2 marks]

Start _____

End _____

0 8 . 3 Explain why the change in the number of chromosomes is important.

[3 marks]

0 8 . 4 Meiosis produces cells that are genetically different.

Describe how meiosis produces cells that are genetically different.

[2 marks]

Question 8 continues on the next page

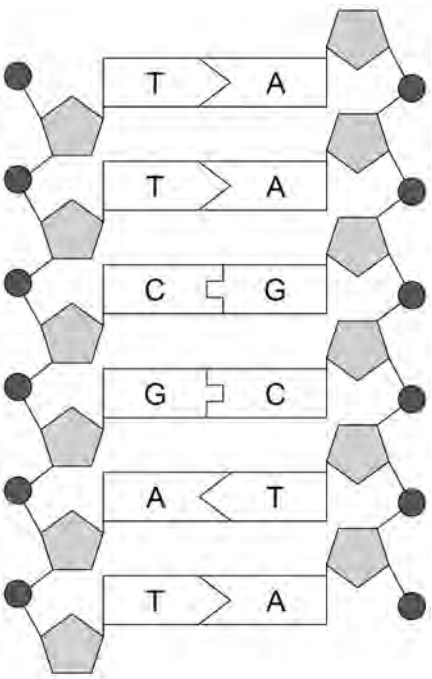
4.1.2.1 Chromosomes

Question 50 · continued

Chromosomes contain DNA.

Figure 14 shows part of a DNA molecule.

Figure 14



0 8 . 5 What type of substances are labelled **A**, **C**, **G** and **T** in **Figure 14**?

[1 mark]

0 8 . 6 DNA is made of nucleotides.

How many nucleotides are shown in **Figure 14**?

[1 mark]

10

4.1.2.1 Chromosomes

Question 51

June 2024 | 8461/1H | Original Q2

0 2 Cystic fibrosis (CF) is an inherited disorder caused by a faulty gene.

0 2 . 1 Where in a cell would the CF gene be found?

[1 mark]

4.1.2.1 Chromosomes

Question 51 · continued

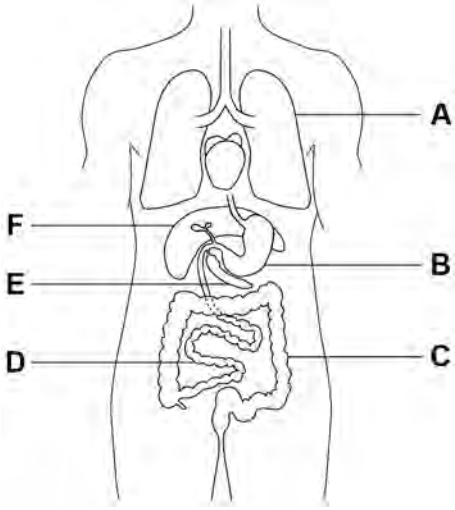
CF affects many organs in the body.

The main organs affected are:

- the lungs
- the pancreas
- the small intestine.

0 2 . 2 **Figure 2** shows organs of the human body.

Figure 2



Which letters in **Figure 2** show the lungs, the pancreas and the small intestine?

[1 mark]

Tick (✓) **one** box.

A, **D** and **E** ☐

A, **E** and **F** ☐

B, **C** and **D** ☐

B, **C** and **F** ☐

Question 2 continues on the next page

4.1.2.1 Chromosomes

Question 51 · continued

0 2 . 3 The pancreas produces several digestive enzymes.

CF reduces the amount of each enzyme that reaches the small intestine.

Explain why a person with CF has:

- difficulty digesting food
- difficulty gaining body mass.

[6 marks]

4.1.2.1 Chromosomes

Question 51 · continued

0 2 . 4 Gas exchange happens in the alveoli in the lungs.

Describe **three** features of the alveoli that help maximise gas exchange.

[3 marks]

1 _____

_____

2 _____

_____

3 _____

_____

0 2 . 5 CF reduces the amount of oxygen that can enter the blood from the alveoli.

Explain how a reduced amount of oxygen entering the blood will affect the human body.

[3 marks]

_____

_____

_____

_____

_____

_____

14

4.1.2.1 Chromosomes

Question 52

June 2024 | 8461/1H | Original Q8

0 8 Cancer is caused by changes in cells that result in uncontrolled cell division.

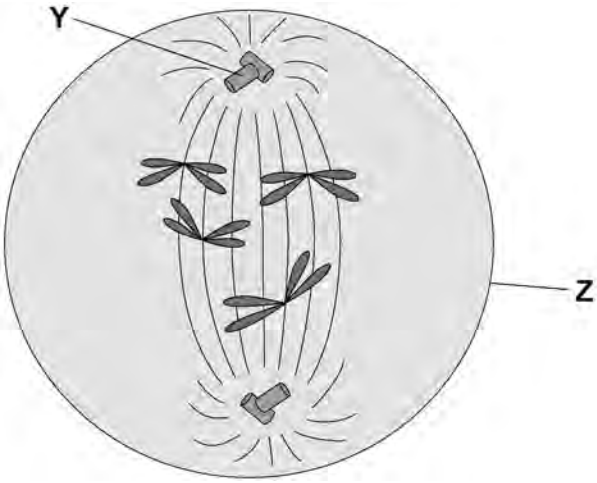
0 8 . 1 Before a cell begins to divide, its DNA replicates to form two copies of each chromosome.

Describe **one other** change that occurs in a cell **before** the cell begins to divide.

[1 mark]

Figure 8 shows a cell during one of the stages of cell division.

Figure 8



0 8 . 2 Name structure **Z** in **Figure 8**.

[1 mark]

4.1.2.1 Chromosomes

Question 52 · continued

0 8 . 3 Structure **Y** in **Figure 8** is a cylinder.

For structure **Y**:

- real volume = 24 500 000 nm^3
- real radius = 125 nm.

The length of a cylinder is calculated using the equation:

$$\text{length} = \frac{\text{volume}}{\pi \times \text{radius}^2}$$

The length of the image of structure **Y** in **Figure 8** is 4 mm.

Calculate the magnification of structure **Y** in **Figure 8**.

Use $\pi = 3.14$

[6 marks]

Magnification = ×

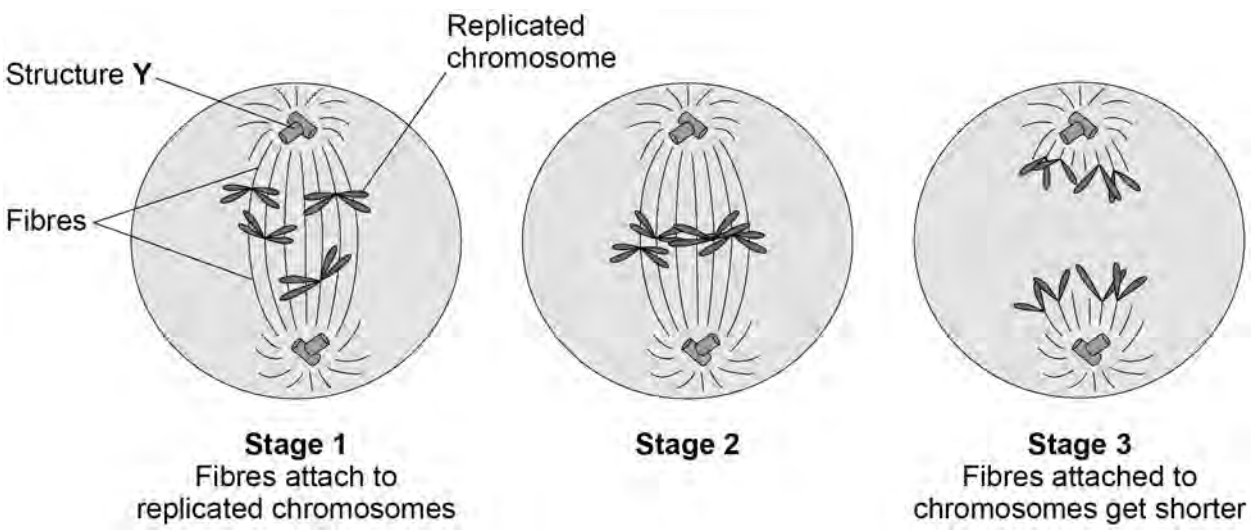
Question 8 continues on the next page

4.1.2.1 Chromosomes

Question 52 · continued

Figure 9 shows some of the stages of cell division.

Figure 9



Some cancer drugs prevent cell division.

Drug **X** prevents the fibres from attaching to the replicated chromosomes in **stage 1**.

0 8 . 4 Explain why a cell **cannot** complete division when affected by drug **X**.

[2 marks]

4.1.2.1 Chromosomes

Question 52 · continued

0 8 . 5 Give the reason why a drug that stops cell division helps to treat cancer.

[1 mark]

0 8 . 6 New cancer drugs are tested in clinical trials.

Preclinical testing happens before clinical trials.

What is involved in preclinical testing of drugs?

[1 mark]

Tick (✓) **one** box.

- Testing the drugs for side effects ☐
- Testing the drugs on live tissues in a laboratory ☐
- Testing the drugs to find the optimum dose ☐
- Testing the drugs with chemicals in a laboratory ☐

12

4.1.2.1 Chromosomes

Question 53

0 6 Some human disorders are inherited.

Polydactyly is an inherited disorder.

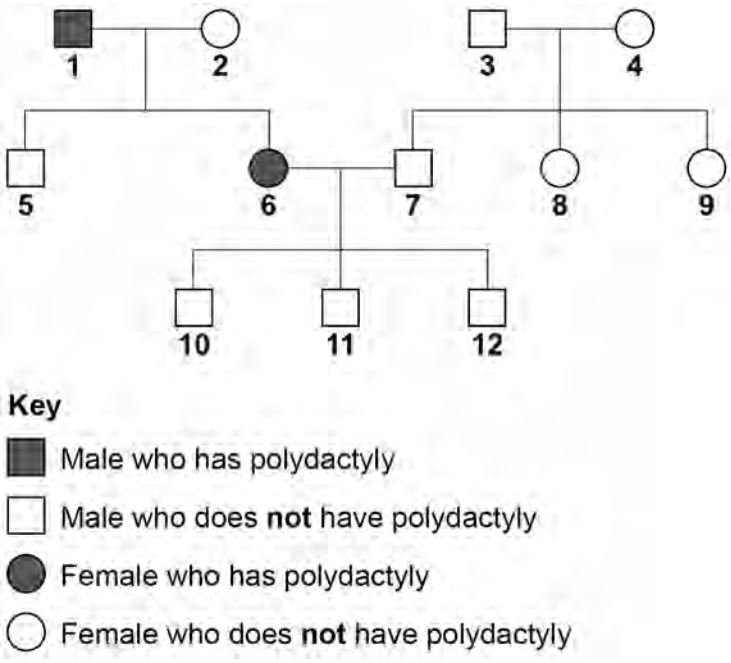
- A person with polydactyly has extra fingers or toes.
- Polydactyly is caused by a dominant allele.

0 6 . 1 What is a dominant allele?

[1 mark]

Figure 10 shows the inheritance of polydactyly in one family.

Figure 10



4.1.2.1 Chromosomes

Question 53 · continued

In questions **06.2** and **06.3**, use the following symbols:

D = allele for having polydactyly

d = allele for **not** having polydactyly.

0 6 . 2 Person **1** is heterozygous.

Explain how **Figure 10** shows that person **1** is heterozygous.

[2 marks]

0 6 . 3 Persons **6** and **7** are expecting a fourth child.

A doctor states that the probability of having a child with polydactyly is 0.5

Explain how the doctor determined this probability.

[4 marks]

You should:

- draw a Punnett square diagram
- give the genotype of person **6** and the genotype of person **7**
- identify **all** the offspring that will have polydactyly.

Question 6 continues on the next page

4.1.2.1 Chromosomes

Question 53 · continued

0 6 . 4 Cystic fibrosis (CF) is another inherited disorder caused by a mutation.

The mutation occurs in a gene called CFTR.

For the CFTR gene, one **allele** in every 50 in the UK population is the cystic fibrosis allele.

Explain why only one person in 2500 in the UK population has cystic fibrosis.

[4 marks]

11

4.1.2.1 Chromosomes

Question 54

June 2025 | 8461/2H | Original Q4

0 4 Human growth hormone (hGH) is made by the pituitary gland.

0 4 . 1 Name **one other** hormone made by the pituitary gland.

[1 mark]

0 4 . 2 hGH is a protein.

A child with a deficiency of hGH can be given injections of hGH.

What would happen to the hGH if it was given as a tablet that was swallowed?

[1 mark]

Question 4 continues on the next page

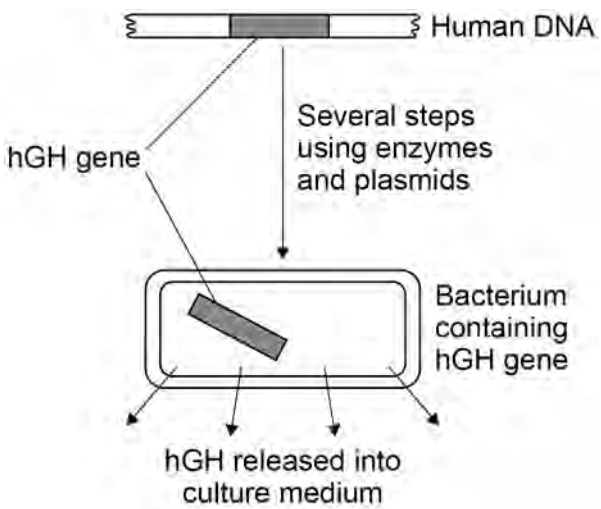
4.1.2.1 Chromosomes

Question 54 · continued

Scientists can use genetic engineering to make hGH.

Figure 4 shows a summary of the process.

Figure 4



0 4 . 3 Describe how scientists can transfer the gene for hGH from human cells to bacterial cells.

Use information from **Figure 4**.

[4 marks]

Extra space

4.1.2.1 Chromosomes

Question 54 · continued

0 4 . 4 Growth hormone (GH) can be extracted from the urine of farm animals.

It is better to use hGH made by genetic engineering than to use GH from the urine of farm animals.

Suggest **two** reasons why.

Do **not** refer to ethical reasons or religious beliefs in your answer

[2 marks]

1 _____

_____

2 _____

_____

8

Turn over for the next question

4.1.2.1 Chromosomes

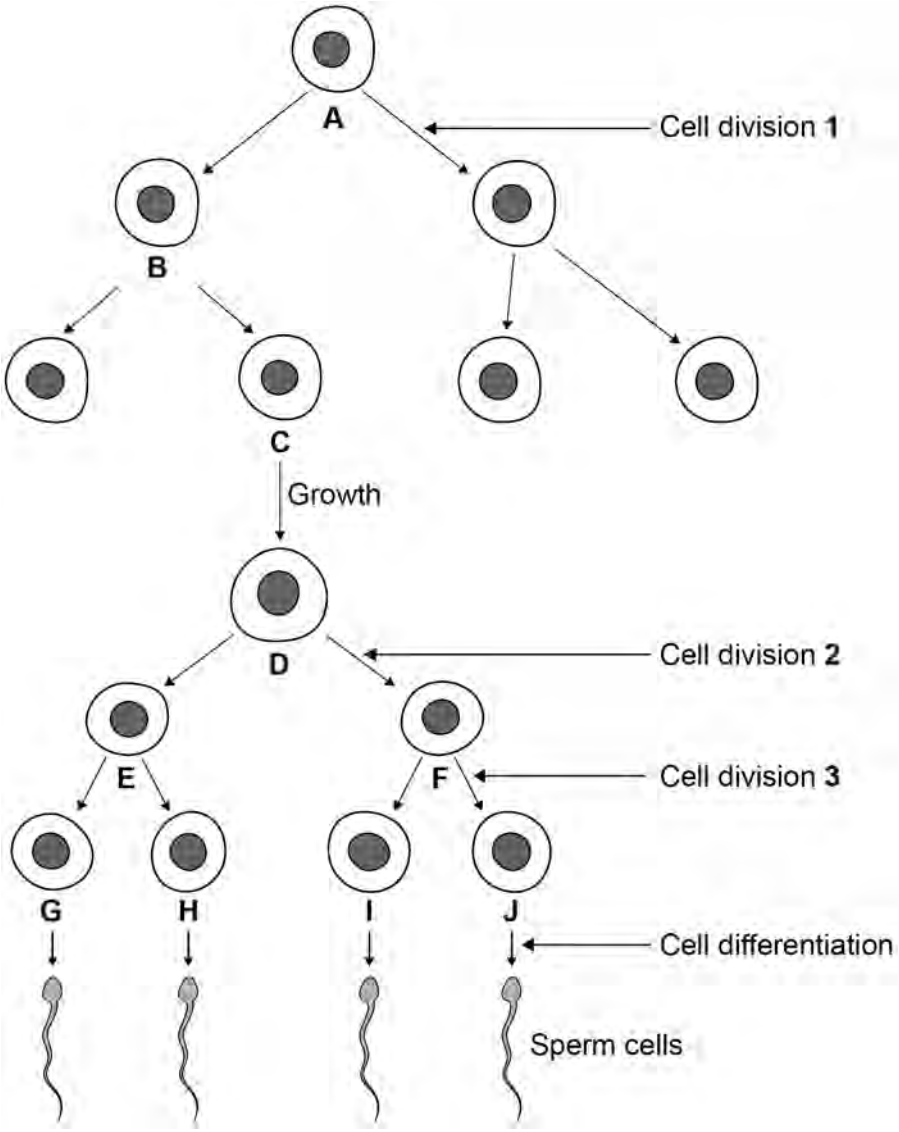
Question 55

June 2025 | 8461/2H | Original Q6

0 6 New cells are produced by cell division.

Figure 5 shows sperm formation in a human.

Figure 5



4.1.2.1 Chromosomes

Question 55 · continued

0 6 . 1 Which cell division in **Figure 5** represents mitosis?

[1 mark]

Tick (✓) **one** box.

Cell division **1** ☐

Cell division **2** ☐

Cell division **3** ☐

0 6 . 2 Which two cells in **Figure 5** are genetically identical?

[1 mark]

Tick (✓) **one** box.

A and **C** ☐ **B** and **I** ☐ **F** and **J** ☐ **G** and **H** ☐

0 6 . 3 How many chromosomes are there in cell **J** in **Figure 5**?

[1 mark]

0 6 . 4 How many of the cells **C**, **D**, **E**, **F**, **G**, **H**, **I** and **J** contain a Y chromosome?

Use **Figure 5**.

[1 mark]

Question 6 continues on the next page

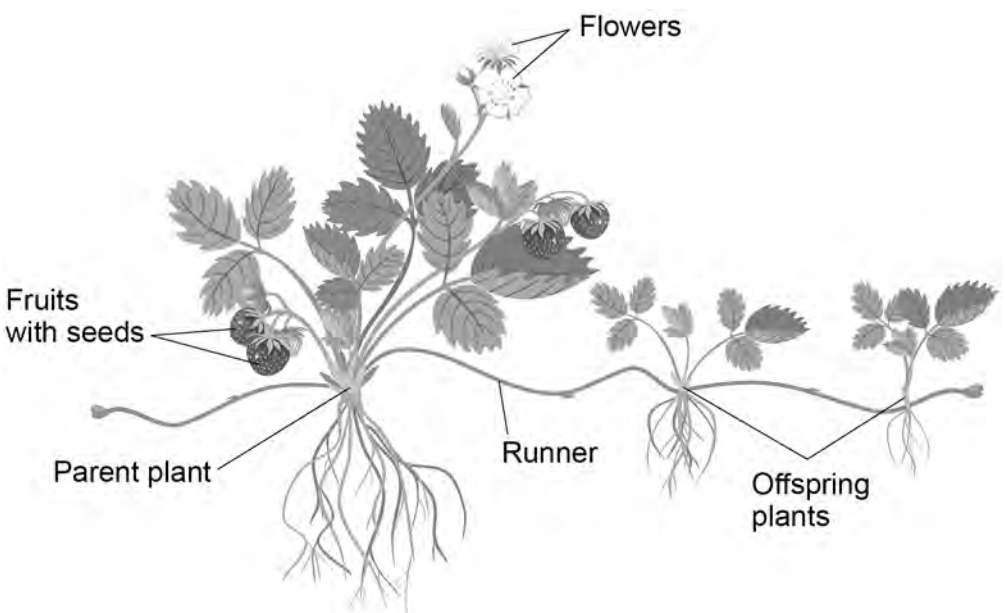
Question 55 · continued

Strawberry plants can reproduce both sexually and asexually.

Figure 6 shows a strawberry plant reproducing:

- sexually using flowers, fruits and seeds
- asexually using horizontal stems called runners.

Figure 6



0 6 . 5 Explain why the offspring produced using runners are genetically identical.

[2 marks]

4.1.2.1 Chromosomes

Question 55 · continued

0 6 . 6 Explain why the offspring produced using flowers, fruits and seeds are **not** genetically identical.

[2 marks]

0 6 . 7 Describe **two** advantages of **asexual** reproduction for the survival of strawberry plants.

[2 marks]

1

2

0 6 . 8 Describe **two** advantages of **sexual** reproduction for the survival of strawberry plants.

[2 marks]

1

2

12

4.1.2.1 Chromosomes

Question 56

0 8 Some people keep rabbits as pets.

Figure 8 shows two types of rabbit.

Figure 8



Himalayan rabbit
has black patches



White rabbit
has no black patches

The Himalayan fur pattern is controlled by a dominant allele.

A heterozygous male Himalayan rabbit was crossed many times with each of two female Himalayan rabbits, **A** and **B**.

The results of the two types of cross were different.

- Crosses with female **A**: **all** of the 210 offspring were Himalayan rabbits.
- Crosses with female **B**: **some** of the 240 offspring were Himalayan rabbits and **some** were white rabbits.

In Questions **08.1** and **08.2**, use the following symbols to represent alleles:

H = dominant allele for Himalayan fur

h = recessive allele for white fur.

0 8 . 1 What is the genotype of female Himalayan rabbit **A**?

Give the reason for your answer.

[2 marks]

Genotype _____

Reason _____

_____

4.1.2.1 Chromosomes

Question 56 · continued

0 8 . 2 Determine the probability that one of the offspring from a cross with female Himalayan rabbit **B** will be white.

You should:

- draw a Punnett square diagram
- use the symbols **H** and **h**
- identify the phenotype of each offspring genotype.

[4 marks]

Probability of offspring being white = _____

Question 8 continues on the next page

4.1.2.1 Chromosomes

Question 56 · continued

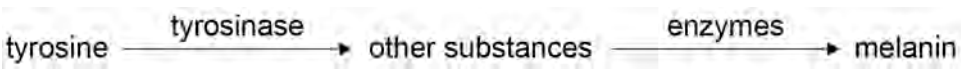
Adult Himalayan rabbits have:

- white fur over most of the body
- black fur on the nose, ears and feet.

The black colour is caused by production of a substance called melanin.

Figure 9 shows how melanin is made from another substance called tyrosine.

Figure 9



0 8 . 3 White rabbits have one base change in the gene that codes for the enzyme tyrosinase.

Explain how a change of one base in the DNA of the gene coding for tyrosinase could stop the tyrosinase working.

[4 marks]

4.1.2.1 Chromosomes

Question 56 · continued

For the first four weeks of life, Himalayan rabbits produce white fur over the whole body.

The black areas of fur start to develop after four weeks.

In the first four weeks, young rabbits stay in the nest with their mother.

A rabbit's body temperature is 39 °C.

The tyrosinase in Himalayan rabbits is:

- most active between 15 °C and 25 °C
- **not** active above 35 °C.

0 8 . 4 The fur on the nose, ears and feet of Himalayan rabbits is white for the first four weeks of life.

Explain what causes the fur to be white in the first four weeks of life.

[2 marks]

0 8 . 5 From the age of four weeks, young rabbits move from the nest to the outside environment.

Explain why a Himalayan rabbit develops black nose, ears and feet from the age of four weeks.

[3 marks]

4.1.2.1 Chromosomes

Question 56 · continued

0 8 . 6 Melanin is also produced in human skin.

Melanin absorbs ultraviolet (UV) radiation from sunlight and prevents the radiation reaching deep into the skin.

UV radiation is a type of ionising radiation.

Explain the advantage of producing melanin in human skin when exposed to bright sunlight.

[2 marks]

17