1 Sweat glands in the skin release sweat.

(a) Explain how sweat can cool the body down.

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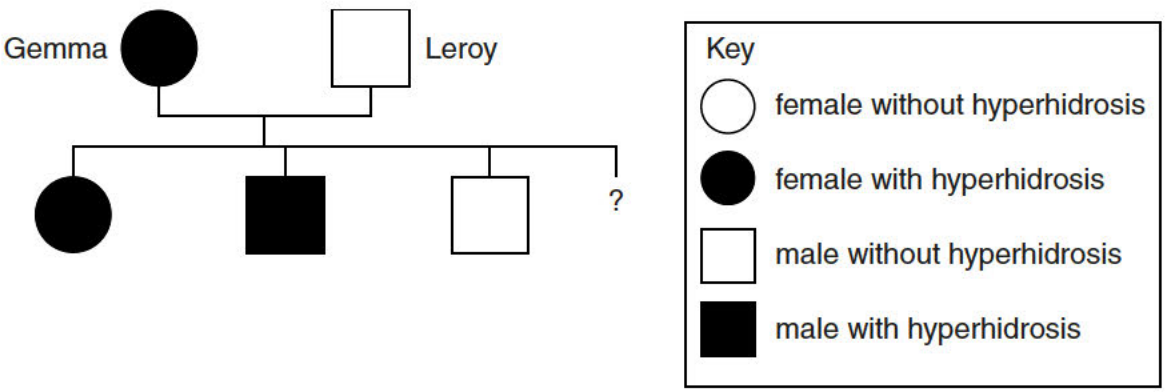
..... **[2]**

(b) Some people sweat too much.

This is called hyperhidrosis.

Scientists have discovered that this is caused by a **dominant** allele.

Look at this family tree.



Gemma and Leroy are expecting a fourth child.

What is the probability that it will have hyperhidrosis?

Explain how you worked out your answer.

probability = ...

explanation .....

.....

.....

..... **[2]**

(c) Gemma's doctor injects her with a drug that makes her sweat less.

(i) Put a tick (✓) in the box that describes what this drug changes.

Gemma's genotype but not her phenotype	☐
Gemma's phenotype and her genotype	☐
neither Gemma's phenotype nor her genotype	☐
Gemma's phenotype but not her genotype	☐

[1]

(ii) The drug contains an antigen made by bacteria.

The drug stops the sweat glands working for about 4 months.

It only works for this long because the antigens are gradually destroyed by Gemma's body.

Explain how Gemma's body destroys antigens.

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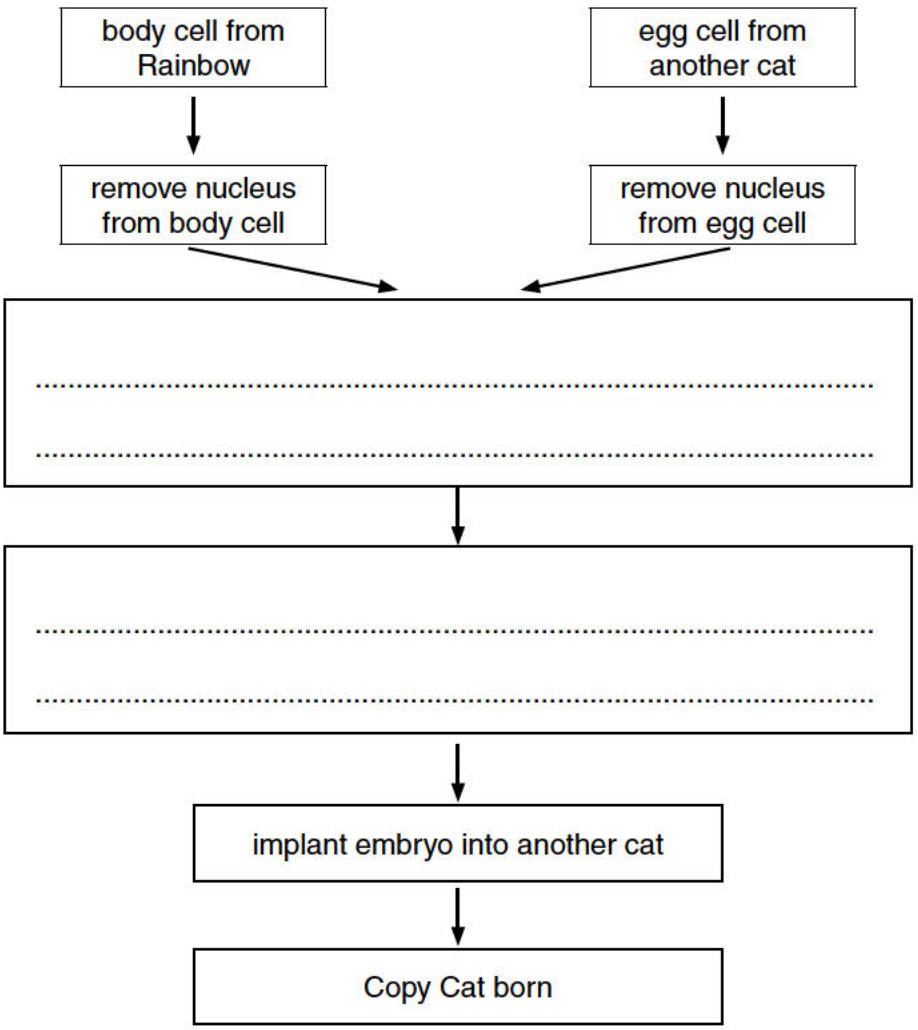
..... **[2]**

[Total: 7]

2 The following article appeared in a newspaper.

> In 2001, scientists in Texas cloned a pet cat, Rainbow, producing a kitten they called Copy Cat.
>
> Copy Cat was the only surviving animal of 87 embryos that were created using the same cloning technique that had been used to produce Dolly the sheep.

(a) Complete the flow chart to show how Copy Cat was produced.



[2]

(b) The scientists could **not just** use a body cell from Rainbow and make that grow into an embryo.

Why can a body cell **not** grow into an embryo?

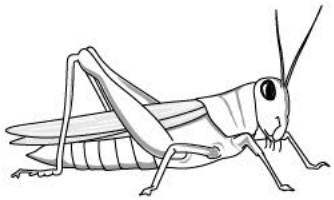
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..... **[1]**

[Total: 3]

3 Female mammals have two X chromosomes (XX), and males have an X and a Y chromosome (XY).

This is **not** the same in all animals.



grasshopper

In grasshoppers, females have two X chromosomes (XX) but males just have one X chromosome and no Y chromosome.

This is written as XO. (O means no chromosome.)

(a) Complete the genetic diagram to show the genotypes and phenotypes of the offspring of a pair of grasshoppers.

One box has been done for you.

		Male grasshopper	
		X	O
Female grasshopper	X	XX female	....
	X	....	....

[2]

(b) Female grasshoppers have 24 chromosomes in each body cell.

(i) How many chromosomes are in a **male** grasshopper body cell? ..... **[1]**

(ii) How many chromosomes are in grasshopper sperm cells? ..... **[1]**

[Total: 4]

4 Look at the picture of Asad.



He is five years old and lives in Africa.

Asad suffers from marasmus, a disorder caused by starvation.

His muscles have wasted.

This is because his muscle protein is being used as an energy source due to the lack of food.

(a) (i) What molecules are proteins made of?

..... **[1]**

(ii) The estimated average daily requirement (EAR) for protein can be calculated using this formula.

$$\text{EAR in g} = 0.6 \times \text{body mass in kg}$$

Asad has a body mass of 12.0 kg.

Use the formula to calculate Asad's EAR for protein.

Asad's EAR = ... g **[1]**

(iii) The usual EAR for protein for a five year old boy is 11 grams a day.

The usual EAR for protein for a fifteen year old boy is 34 grams a day.

Explain why the EARs are not the same.

.....

.....

..... [2]

(b) Beta thalassaemia is caused by a recessive allele.

Asad's sister has beta thalassaemia but Asad does not.

His parents do not have beta thalassaemia.

Asad's mother is pregnant.

What is the probability of this child having beta thalassaemia?

Draw a genetic diagram to explain your answer.

(Use T for the dominant allele and t for the recessive allele.)

probability of this child having beta thalassaemia ..... [3]

[Total: 7]

5 The picture shows Dolly the sheep.



Dolly grew from an embryo implanted into a surrogate mother sheep.

(a) As the embryo grew, its cells divided.

Write down the name of this type of cell division.

..... [1]

(b) Describe the cloning technique that scientists used to produce the embryo that grew into Dolly.

The quality of written communication will be assessed in your answer to this question.

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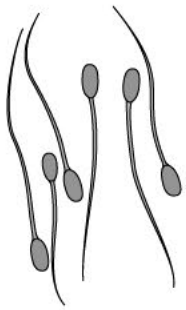
..... [6]

[Total: 7]

6 Look at the picture of bull sperm cells.

Bull sperm cells contain a different number of chromosomes to the number in body cells.

Bull **skin** cells contain 60 chromosomes.



(a) What is the **haploid** number of chromosomes for a bull?

.....

[1]

(b) The Holstein breed of cattle has been bred especially for milk production.

Many Holstein cattle frequently suffer lameness and diarrhoea.

This is because of the way they are bred.

Explain why the method of breeding can increase the risk of lameness and diarrhoea.

.....

.....

.....

.....

..... **[3]**

(c) Cattle can also be cloned for increased milk production.

(i) Cloning animals is more difficult than cloning plants.

Explain why.

.....

..... [1]

(ii) Cloning is possible because of pioneering scientific research.

Scientists now understand a lot about how cells are controlled.

This is due to work done by several scientists.

Read the following information about some scientific work.

> Watson and Crick worked at Cambridge University. Together they were studying the structure of deoxyribonucleic acid (DNA), the molecule that contains the hereditary information for cells.
>
> At the same time, Maurice Wilkins and Rosalind Franklin were using X-ray diffraction to study DNA at King's College London. Watson and Crick used information from the X-ray studies to further their research and in April 1953 published the structure of DNA.
>
> Watson, Crick and Wilkins received the Nobel Prize for Medicine in 1962. Rosalind Franklin had died in 1958 and, despite her key experimental work, received no prize. The Nobel Prize is not awarded to someone after they have died.

Explain the advantages of using teams of scientists to investigate scientific problems.

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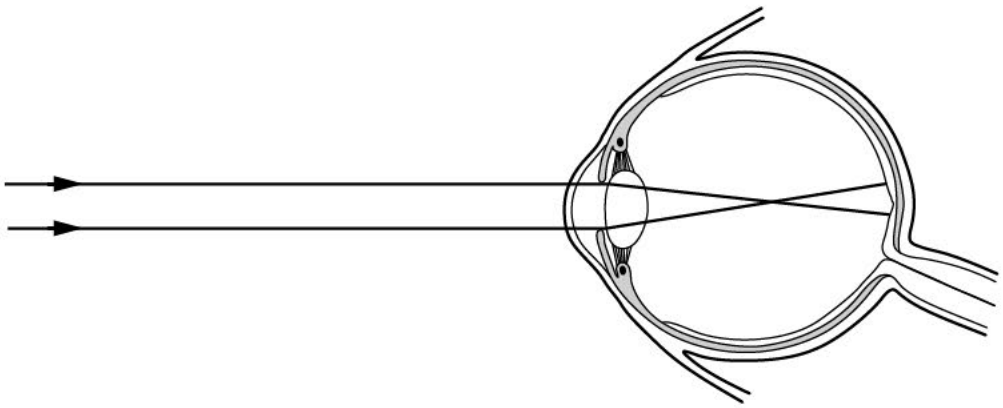
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..... [3]

[Total: 8]

7 **(a** The diagram shows an eye of a short-sighted person looking at a distant object.



(i) Explain how the lens being the wrong shape can cause **short**-sight.

.....

.....

..... **[2]**

(ii) Short-sight can be corrected by wearing glasses.

Write down the type of lens used in these glasses.

..... **[1]**

(b) Scientists have found a rare genetic disorder that can cause short-sight.

It is called nanophthalmos.

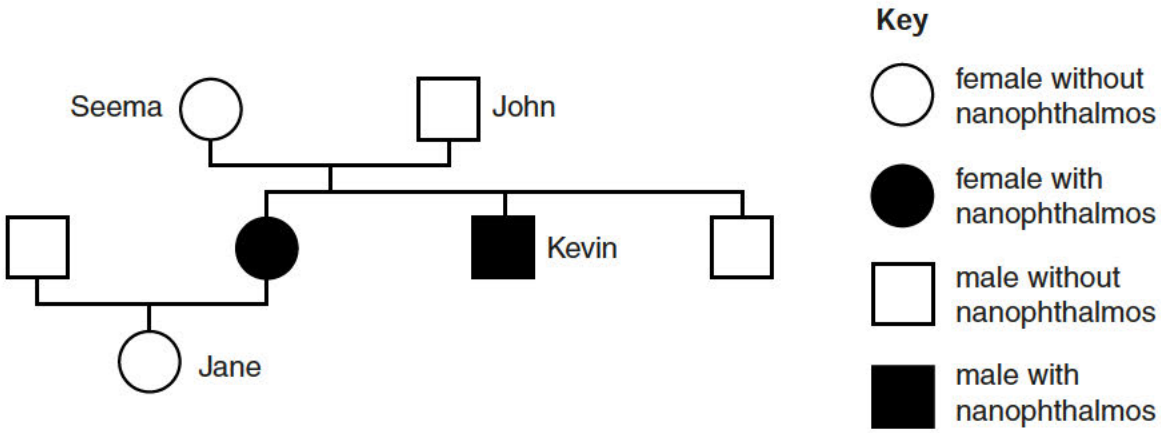
This is caused by a recessive allele.

(i) What is an allele?

.....

..... **[1]**

(ii) Look at this part of a family tree showing some people with nanophthalmos.



Nanophthalmos is caused by a recessive allele.

How can you tell this from this family tree?

.....

.....

..... **[2]**

(iii) Jane is a carrier of nanophthalmos.

Jane marries Simon who has nanophthalmos.

What is the probability of their first child having the disorder?

You must draw a genetic diagram to work out your answer.

(Use **N** for the allele for normal vision and **n** for the allele for nanophthalmos.)

probability = ... % **[3]**

[Total: 9]

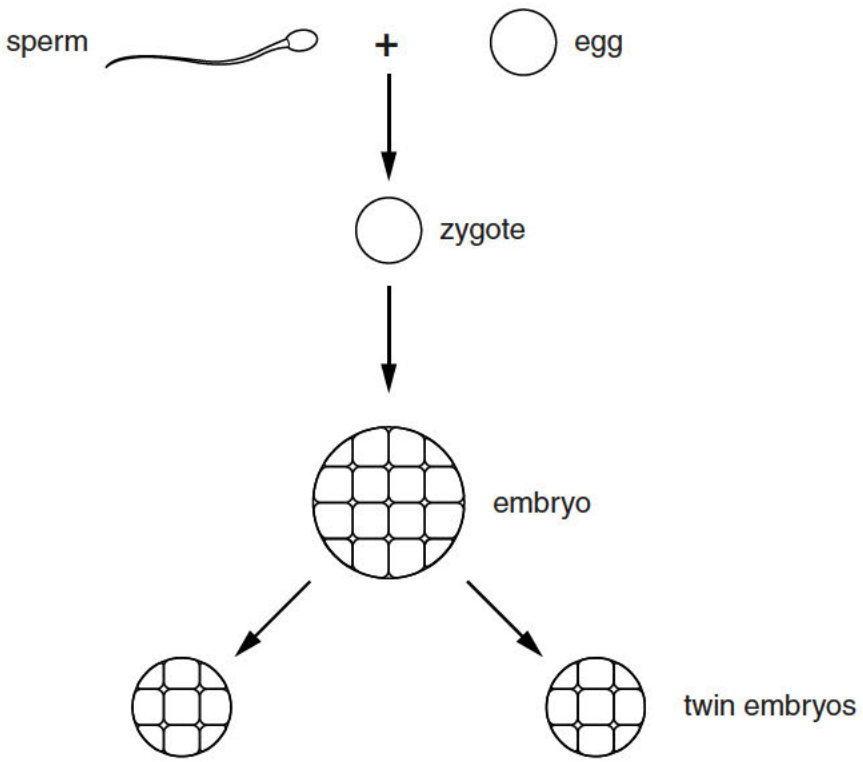
8 Amy and Sarah are identical twins.

Their development began when an egg cell and sperm cell joined to form a zygote.

The zygote developed into an embryo made of many cells.

After about a week the embryo split into the two twin embryos.

The two embryos grew to become Amy and Sarah.



(a) Put **one** tick (✓) in **each** row of the table to show which cells are haploid and which are diploid.

	Haploid	**Diploid**
egg cell		
sperm cell		
zygote		
cells in embryo		
cells in twin embryos		

[2]

(b) What type of cell division happens to the zygote to form the embryo?

.....

[1]

(c) As an embryo grows into a foetus (developing baby), one of the first organ systems that develops is the blood circulatory system.

(i) A human foetus has a double circulatory system.

Describe one advantage of a double circulatory system compared with a single circulatory system.

.....

..... [1]

(ii) The haemoglobin of a human foetus more readily combines with oxygen than the mother's haemoglobin combines with oxygen.

Suggest why this is important.

.....

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..... [2]

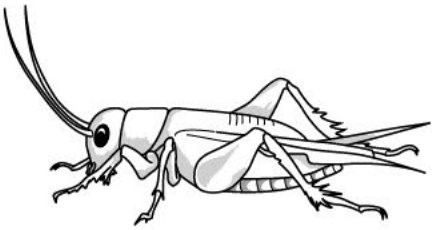
(iii) During growth, the foetus uses oxygen to produce ATP.

Why does the foetus need ATP?

..... [1]

[Total: 7]

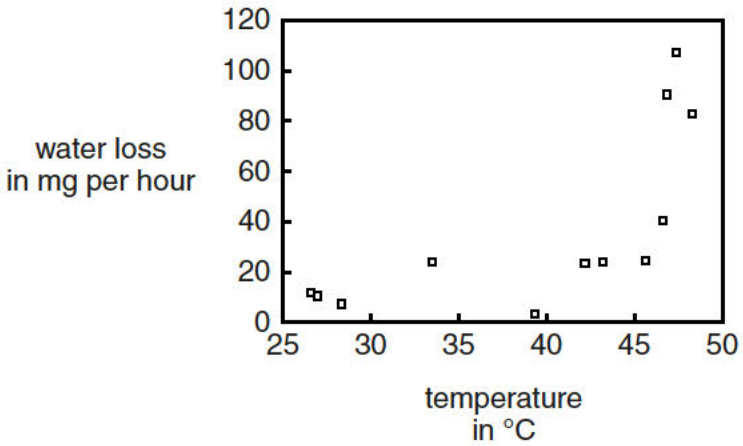
9 Crickets are small arthropods that look like grasshoppers.



One type of cricket lives on the island of Kauai in Hawaii.

It is adapted to live in hot conditions.

(a) The graph shows the loss of water from crickets at different temperatures.



Use the graph to explain how crickets survive in hot conditions.

.....

..... **[1]**

(b) The crickets make a noise or 'sing' by rubbing their wings together.

This attracts a mate.

Unfortunately, the noise also attracts a type of fly.

The fly lays eggs on the cricket.

The eggs hatch and maggots burrow into the cricket and feed on it, eventually killing it.

(i) What word is used to describe the maggots in this feeding relationship?

Choose your answer from this list.

competitor **tner** **y**

answer ..... **[1]**

(ii) Scientists found that some crickets on the island had a gene that made them silent.

The scientists found that after a few years most crickets on the island were silent.

However, there are still a small number of crickets that sing.

Use natural selection to explain why most of the crickets are now silent and why scientists think that this could lead to the formation of a new species.



The quality of written communication will be assessed in your answer to this question.

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..... [6]

[Total: 8]