4.6 Inheritance, Variation and Evolution

Higher

Name: _____

Class: _____

Date: _____

Time: **405 minutes**

Marks: **402 marks**

Comments:

Q1.

Different antibiotics destroy bacteria in different ways.

- Some antibiotics disrupt the bacterial cell membrane.
- Some antibiotics disrupt the bacterial cell wall.

(a) Antibiotics that disrupt the bacterial cell membrane often cause more side effects in humans compared with antibiotics that disrupt bacterial cell walls.

Suggest why.

_____

(1)

(b) Some antibiotics prevent ribosomes functioning.

Suggest how this damages the bacterium.

_____

(1)

(c) Drug manufacturers are spending less on research into new antibiotics.

One reason why is because new antibiotics are rarely prescribed.

Some people think that governments should pay drug manufacturers to develop new antibiotics.

Suggest why.

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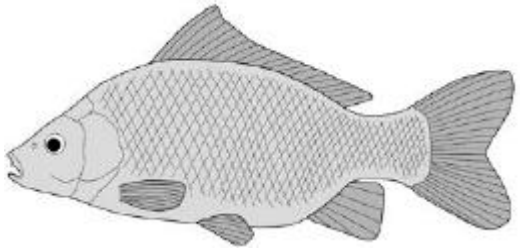
(3)

(Total 5 marks)

Q2.

The figure below shows a carp.



(a) A mutation causes a blue colour in some carp.

What is a mutation?

_____

_____

(1)

(b) Suggest how a mutation could cause a different colour in carp.

_____

_____

(1)

(c) Two alleles control the body colour of carp:

- brown (**B**)
- blue (**b**).

The brown allele is dominant to the blue allele.

Two carp that are heterozygous for colour are crossed and produce 2.6×10^5 offspring.

Approximately how many of the offspring are expected to be blue?

Draw a genetic diagram to explain your answer.

Give your answer in standard form.

Number of offspring expected to be blue = _____

(5)

(d) A scientist wanted to find out whether a brown carp has the genotype **BB** or **Bb**.

Describe what genetic cross a scientist could do to determine this.

_____

_____

_____

_____

_____

_____

(2)
(Total 9 marks)

Q3.

Phenylketonuria (PKU) is an inherited condition. PKU makes people ill.

(a) PKU is caused by a recessive allele.

(i) What is an allele?

_____

_____

(1)

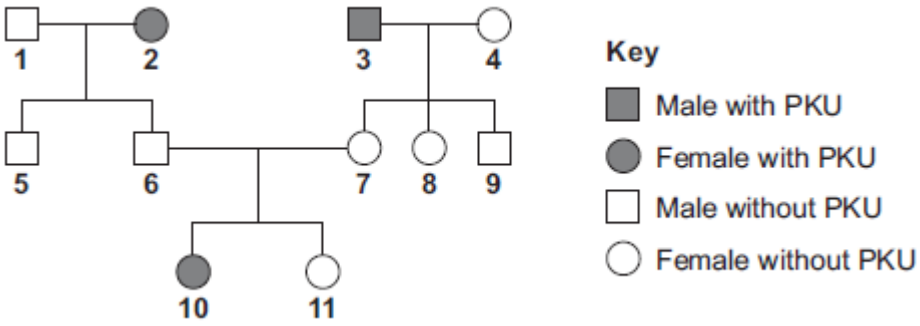
(ii) What is meant by recessive?

_____

_____

(1)

(b) The diagram below shows the inheritance of PKU in one family.



(i) Give **one** piece of evidence from the diagram that PKU is caused by a recessive allele.

_____

_____

(1)

(ii) Persons **6** and **7** are planning to have another child.
Use a genetic diagram to find the probability that the new child will have PKU.

Use the following symbols in your answer:

N = the dominant allele for **not** having PKU

n = the recessive allele for PKU.

Probability = _____

(4)

(c) Persons **6** and **7** wish to avoid having another child with PKU.

A genetic counsellor advises that they could produce several embryos by IVF

treatment.

(i) During IVF treatment, each fertilised egg cell forms an embryo by cell division.

Name this type of cell division.

_____

(1)

(ii) An embryo screening technique could be used to find the genotype of each embryo.

An unaffected embryo could then be placed in person **7**'s uterus.

The screening technique is carried out on a cell from an embryo after just three cell divisions of the fertilised egg.

How many cells will there be in an embryo after the fertilised egg has divided three times? ☐

(1)

(iii) During embryo screening, a technician tests the genetic material of the embryo to find out which alleles are present.

The genetic material is made up of large molecules of a chemical substance.

Name this chemical substance.

_____

(1)

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

(i) Give **one** ethical objection to embryo screening.

_____

(1)

(ii) Give **one** reason in favour of embryo screening.

_____

(1)

(Total 12 marks)

Q4.

A certain allele increases the chance of women developing one type of breast cancer.

A woman has this allele. She wants to be sure that she will not have daughters who also have the allele.

Doctors:

- collect several eggs from her ovaries
- fertilise the eggs with sperm, in dishes.

(a) The doctors expect half the embryos produced to be female.

Explain why.

_____

_____

_____

_____

(2)

(b) The embryos grow to around 100 cells.

Doctors:

- remove one cell from each embryo
- check the cell for the allele.

Complete the sentence.

This process is known as embryo _____ .

(1)

(c) One of the female embryos did not have the allele.
This female embryo was implanted into the woman's uterus.

Evaluate the advantages and disadvantages of the whole procedure.

Use information from all parts of this question and your own knowledge.

Remember to give a conclusion to your evaluation.

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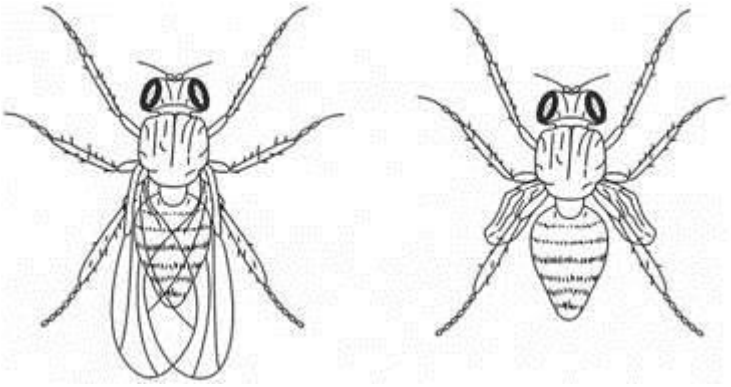
(4)

(Total 7 marks)

Q5.

The fruit fly, *Drosophila,* has either long wings or vestigial wings, as shown in the diagram.



Long-winged fly **Vestigial-winged fly**

The size of the wings is determined by a pair of alleles: **A** and **a**.
Long-winged flies have one of two possible genotypes: **AA** or **Aa**.
Vestigial-winged flies have only one genotype: **aa**.

(a) (i) What is the genotype of a heterozygous fly?

_____

(1)

(ii) Why can vestigial-winged flies only have the genotype **aa**?

_____

(1)

(b) A male and a female long-winged fly were crossed. They produced 96 offspring.
72 of the offspring had long wings and 24 had vestigial wings.
Use a genetic diagram to explain this.

(4)

(Total 6 marks)

Q6.

The black pigment in human skin and eyes is called melanin. Production of melanin is controlled by a single pair of genes. A person who is homozygous for a recessive allele of the gene has no melanin and is said to be albino.

(a) A man is albino. His wife is heterozygous for the melanin-producing allele.

(i) The fertilised egg cell produced by the couple divides to form two cells.

Name the process of cell division involved.

_____

(1)

(ii) How many albino genes would there be in each of these two cells?

_____

Explain you answer.

_____

_____

_____

(3)

(b) (i) Albino people are more likely than people with melanin to suffer mutations that cause cancer in their skin. Suggest why albino people have an increased chance of mutation in their skin cells.

_____

_____

(1)

(ii) Sometimes, mutation in skin cells leads to cancers in other organs, such as the liver.

Explain how.

_____

_____

_____

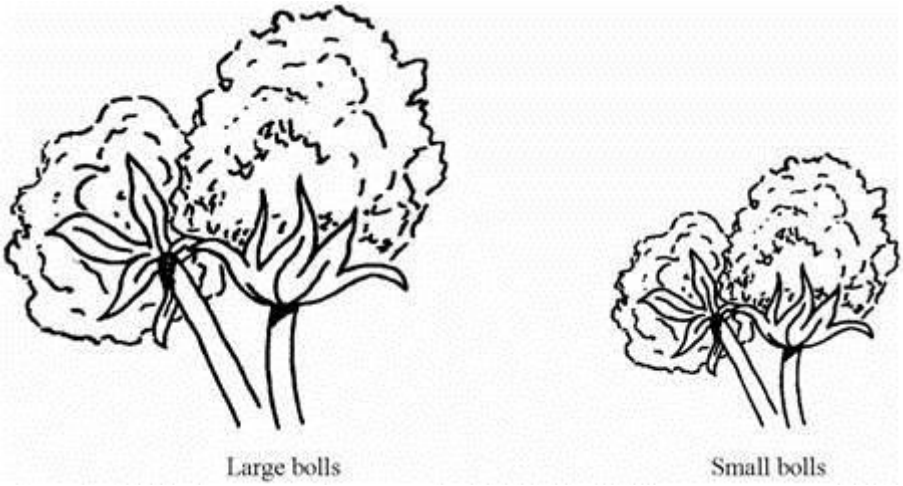
_____

(2)

(Total 7 marks)

Q7.

The drawings show bolls on cotton plants. Cotton thread is made from these bolls.



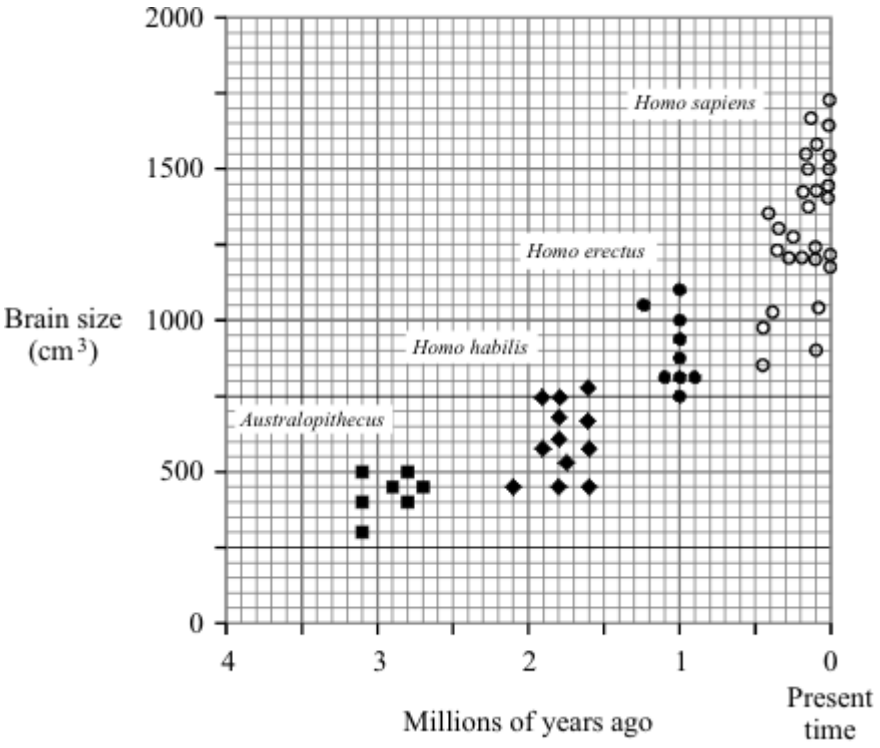
The size of the bolls is controlled by a single gene. This gene has two alleles. The dominant allele **B** is the allele for large bolls. The recessive allele **b** is the allele for small bolls.

Use a genetic diagram to show how two cotton plants with large bolls may produce a cotton plant with small bolls.

(Total 4 marks)

Q8.

Modern humans belong to the species *Homo sapiens*. Many people think that modern humans evolved from more primitive species. Three of these primitive species were *Australopithecus*, *Homo habilis* and *Homo erectus*. These three species are now extinct. The graph shows the brain size of several specimens from each of the species.



(a) Estimate the mean brain size of *Homo habilis*.

_____ cm^3

(1)

(b) Suggest how we know about the brain size of *Australopithecus*.

_____

_____

_____

_____

(2)

(c) Suggest an explanation, in terms of natural selection, for the change in brain size during the evolution of *Homo sapiens*.

_____

_____

_____

_____

_____

(3)

(Total 6 marks)

Q9.

The drawings show two forms of the peppered moth.

Pale form Dark form

In an investigation, pale and dark moths were placed in different positions on trees in two woods. One wood was in an industrial area where the bark was blackened by pollution. The other wood was unpolluted, and the tree bark was covered in pale mosses and lichen. After three days, the surviving moths were counted. The results are shown in the table.

WOOD	POSITION OF MOTH ON TREE	PERCENTAGE OF MOTHS EATEN BY BIRDS	
		PALE	DARK
Polluted	On main trunk	58	40
	Underside of branch	50	28
Unpolluted	On main trunk	32	62
	Underside of branch	26	40

(a) What can you tell from these results about the survival of the two types of moth in polluted and unpolluted woods, and in different positions on the tree?

(3)

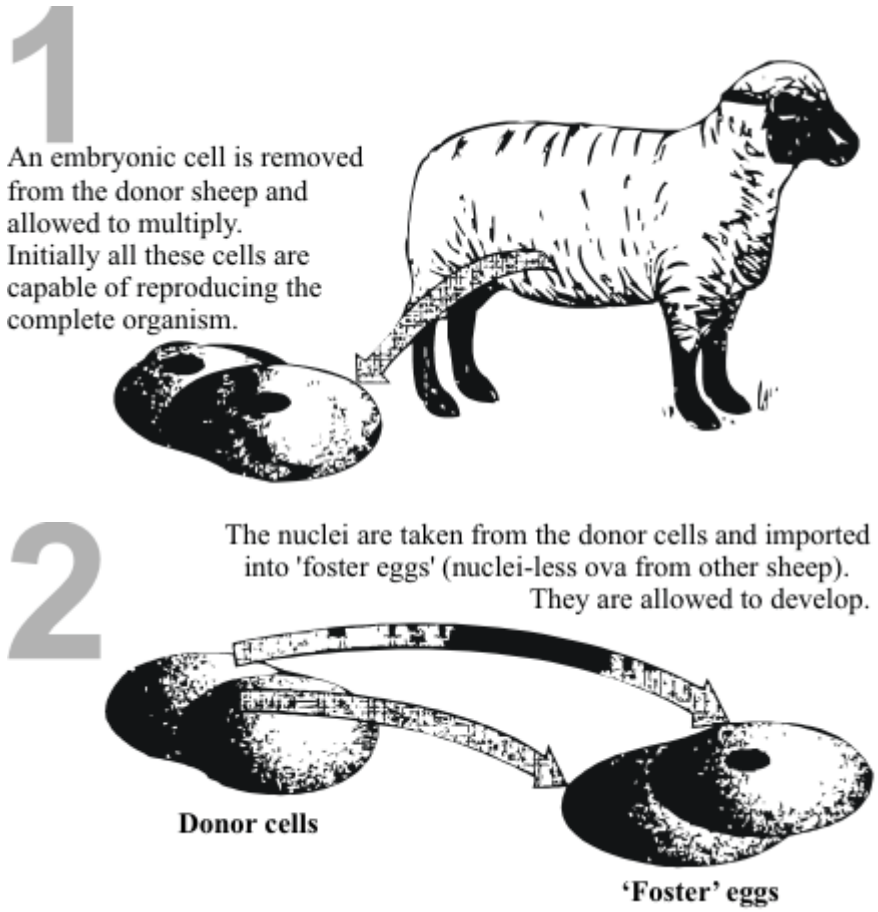
(b) Explain how the results provide evidence for **one** theory of evolution.

(3)

(Total 6 marks)

Q10.

The diagram shows one method of cloning sheep.



(a) Explain why the lambs produced by this technique are identical to each other.

_____

_____

_____

_____

(2)

(b) Explain why the lambs are **not** genetically identical to the sheep which produced the 'foster' eggs.

_____

_____

_____

_____

(2)

(c) Explain the drawback of widespread use of just a few clones of sheep.

_____

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(3)

(Total 7 marks)

Q11.

Wild turkeys have black feathers. Until about 30 years ago turkeys reared for meat also had black feathers like this.

However, a recessive gene which produced entirely white feathers appeared, and turkey farmers changed to breeding white-feathered birds.

Supermarkets preferred white-feathered birds, because small pieces of feather left in the skin after plucking were not visible as dark patches. Customers wanted unblemished oven-ready birds. Now, however, there is a demand again for birds with black feathers which can be marketed as ‘traditional’ farm-produced turkeys.

(a) Feather colour is controlled by one pair of genes.

(i) Suggest suitable symbols for **each** of the two alleles of this pair of genes.

Black feathers _____ White feathers _____

(1)

(ii) What alleles for feather colour would a white turkey have? _____

(1)

(b) Explain carefully why 'traditional' black-feathered turkeys could not be bred from a flock of white-feathered birds.

_____

_____

_____

_____

(2)

(Total 4 marks)

Q12.

Read the extract.

Super-bug may hit the price of coffee

The coffee bean borer, a pest of the coffee crop, can be controlled by the pesticide endosulphan However, strains of the insect that are up to 100 times more resistant to the pesticide have emerged on the South Pacific island of New Caledonia.

For full resistance to be passed on to an offspring two copies of the new resistance allele should be inherited, one from each parent. There is much inbreeding with brother-sister matings happening in every generation, so it takes only a few generations before all the descendants of a single resistant female have inherited two copies of the resistance allele.

If this resistance spreads from New Caledonia, it will mean the loss of a major control method. This will present a serious threat to the international coffee industry.

(a) Suggest how the allele for resistance to endosulfan may have arisen.

_____

_____

(1)

(b) (i) How would you expect the proportion of normal coffee bean borers on New Caledonia to change over the next few years?

_____

(ii) Explain why this change will take place.

_____

_____

_____

_____

_____

_____

(3)

(c) Explain why “it takes only a few generations before all the descendants of a single resistant female have inherited two copies of the resistance allele.” (lines 6-8)

_____

_____

_____

_____

_____

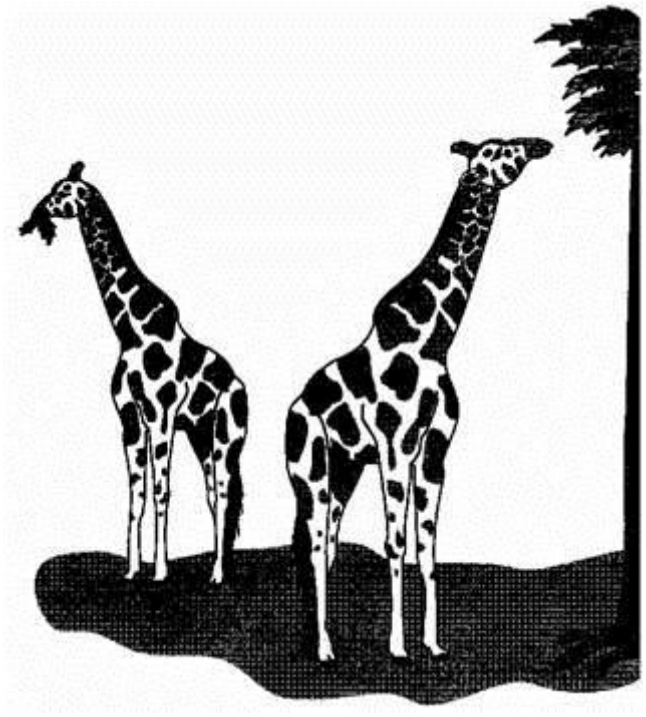
_____

(3)

(Total 7 marks)

Q13.

Giraffes feed on the leaves of trees and other plants in areas of Africa. They are adapted, through evolution, to survive in their environment.



(a) Use the information in the picture to give **one** way in which the giraffe is adapted to its environment.

(1)

(b) Explain how Jean-Baptiste Lamarck (1744–1829) accounted for the evolution of the long neck in giraffes.

(3)

(c) Another scientist, August Weismann (1834 -1914) wanted to check Lamarck's explanation. To do this he cut off the tails of a number of generations of mice and looked at the offspring.

His results did not support Lamarck's theory. Explain why.

(2)

(d) Explain how Charles Darwin (1809–1882) accounted for the evolution of the long neck in giraffes.

(4)

(Total 10 marks)

Q14.

Cotton crops may become infested with weeds. Scientists are developing

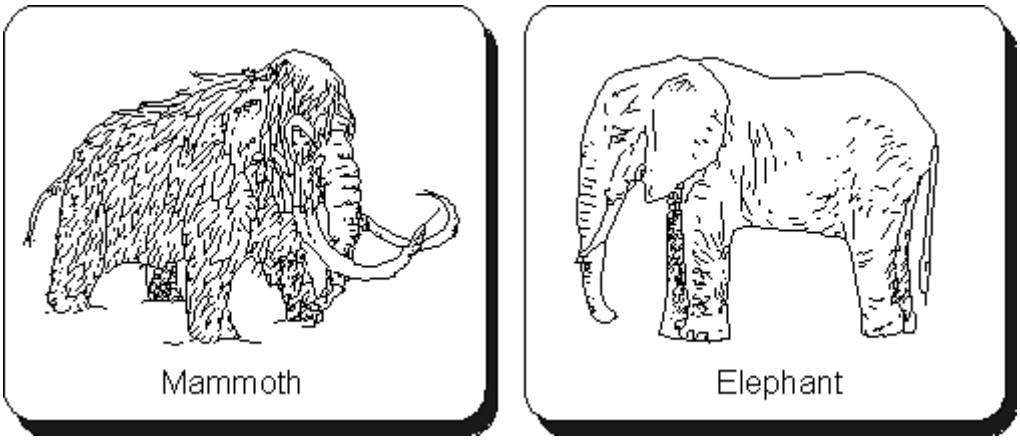
genetically-engineered strains of cotton which resist the action of herbicides. This means that when the crop is sprayed with herbicide, only the weeds are killed. However, there are potential dangers with this procedure. Cotton plants can interbreed with some other species of plants.

Evaluate the possible advantages and disadvantages of developing genetically-engineered herbicide-resistant crops.

(Total 5 marks)

Q15.

The drawings below show a mammoth, an extinct relation of the elephant which lived in arctic regions, and a modern elephant which lives in tropical areas.



The mammoth, which was very hairy, and the elephant, are both thought to have evolved from a scantily haired ancestor. Explain, as fully as you can, how the **mammoth** evolved from the common ancestor.

(Total 5 marks)

Q16.

Meiosis and mitosis are different types of division in human cells. Compare the two processes by referring to where each takes place and the kind of products that are made.

(Total 6 marks)

Q17.

The following passage is adapted from an article by Martin Kelly in The Independent newspaper.

Thanks to the test tube banana

Specially bred resistant varieties may

save African crops from disease

A banana is a fruit, but it has no seeds. And if there are no seeds how do the plants reproduce? At one level the answer is easy; centuries of selective breeding have resulted in varieties with plenty of tasty flesh but few bitter inedible seeds, and propagation is carried out by means of root corms.

Most bananas we eat are thus actually 'clones' of a few successful plants, as is also the case with the potato. Banana clones are genetically identical to their parents, so growers can be completely sure their fruits will be big and tasty.

Genetic variability of these cloned plants is extremely low. Resistance to new diseases, therefore, is almost nil; witness the spread of potato blight through Ireland in the 1840s.

The issue goes well beyond our high streets and supermarkets. The banana has a larger relative called a plantain, which is starchy rather than sweet and is a staple food of more than 60 million Africans. Bananas and plantains are being ravaged by a new fungal

disease called Black Sigatoka. The commercial planters that produce the bananas we buy in supermarkets have little problem here; they can afford to buy chemicals to spray their crops. African subsistence farmers, forced to rely on 'organic' methods can only sit by and watch their plants die.

Several governments have turned to the International Institute for Tropical Agriculture (IATA) for help. IATA is in Africa, but is not of Africa. It is internationally funded with levels of staffing and equipment that enable advanced bio-technological techniques to be used. However, even with genetic engineering, to breed resistant varieties is a long-term project and Black Sigatoka is not going to wait. IATA scientists have had to divide their energies between two approaches: an interim solution and the development of resistant varieties.

The interim solution was easily found in a group of 'cooking bananas' which were resistant to Black Sigatoka disease and which could, to some extent, be substituted for plantain in the diet. These, however, were only found in localised areas and the first problem facing IATA was to obtain enough plants from the few available plants of resistant varieties to supply the needs of the affected farmers.

(a) Explain how selective breeding may have been used to produce bananas with tasty flesh.

(2)

(b) Explain, as fully as you can, why “Genetic variability of these cloned plants is extremely low” compared with natural populations.

(4)

(c) Explain, as fully as you can, how IATA scientists might be able to “obtain enough plants from the few available plants of resistant varieties to supply the needs of affected farmers”.

_____

_____

(3)

(d) Explain, as fully as you can, how IATA scientists may use genetic engineering to produce varieties of banana resistant to Black Sigatoka disease.

_____

_____

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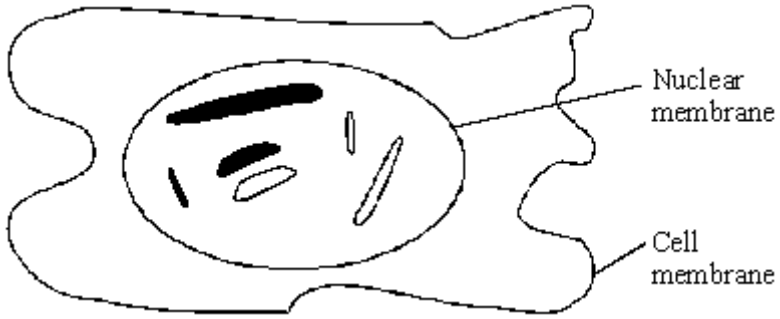
_____

(4)

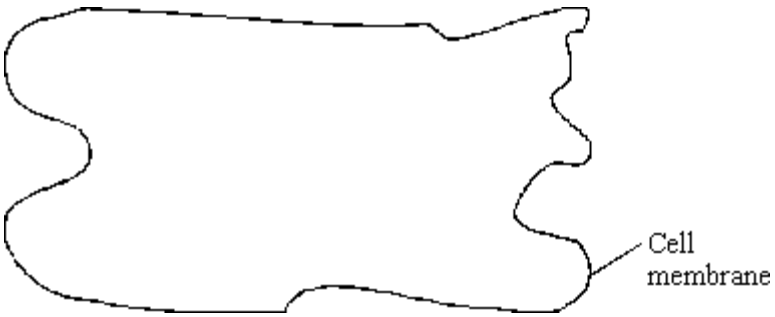
(Total 13 marks)

Q18.

(a) The diagram shows a normal body cell which has six chromosomes.

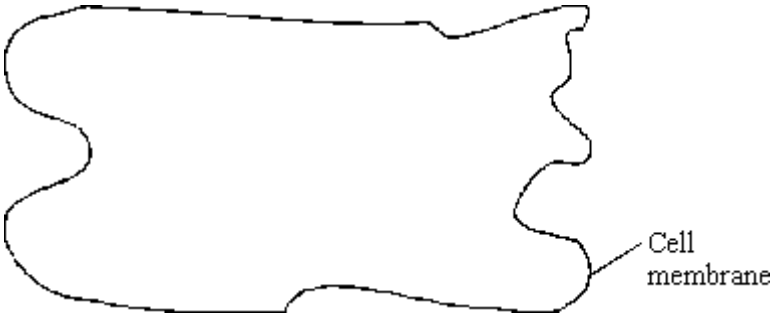


(i) Complete the diagram below to show **one** cell produced from this cell by *mitosis.*



(3)

(ii) Complete the diagram below to show **one** cell produced from the original cell by *meiosis.*



(2)

(b) Thalassaemia is a blood disease. It is determined by a single recessive allele. A person with one recessive allele does **not** get the disease but does act as a carrier. People with this pair of recessive alleles can become ill.

(i) Draw a genetic diagram to show the inheritance of' this disease if both parents are heterozygous.

[Use the symbols T = dominant allele and t = recessive allele]

(3)

(ii) What are the chances of a baby inheriting the disease?

_____

(1)

(iii) What are the chances of a baby being a carrier if both parents are heterozygous?

_____

(1)

(Total 10 marks)

Q19.

Darwin suggested the theory of natural selection.

(a) Explain how natural selection occurs.

_____

_____

_____

_____

(3)

(b) Latitude is a measure of distance from the Earth's equator.

Scientists investigated the effect of latitude on:

- the time taken for new species to evolve
- the number of living species.

The table shows the scientists' results.

Latitude in degrees North of equator	Time taken for new species to evolve in millions of years	Relative number of living species
0 (at the equator)	3–4	100
25	2	80
50	1	30
75 (in the Arctic)	0.5	20

As latitude increases environmental conditions become more severe.

(i) Describe the patterns shown by the data.

(2)

(ii) Suggest explanations for the patterns you have described in part (b)(i).

(2)

(Total 7 marks)

Q20.

(a) Mice with black fur can have the genotype **BB** or **Bb,** whilst mice with brown fur have the genotype **bb**.

(i) Use a genetic diagram to show what fur colours you would predict in the F1 offspring produced by two mice who are both **Bb**.

(3)

(ii) Why might your prediction of fur colour in the F1 generation **not** be proved right?

_____

_____

(1)

(b) Using the example in part (a) to help:

(i) describe the difference between dominant and recessive alleles;

_____

_____

_____

_____

(2)

(ii) describe the difference between alleles and genes;

_____

_____

_____

_____

(2)

(iii) describe the difference between homozygous and heterozygous chromosomes.

_____

_____

_____

_____

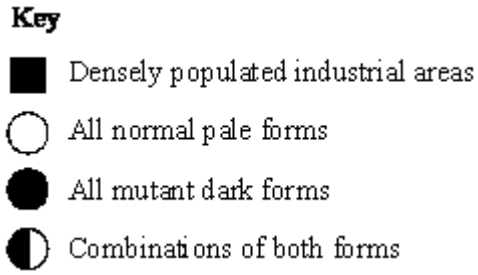
(2)

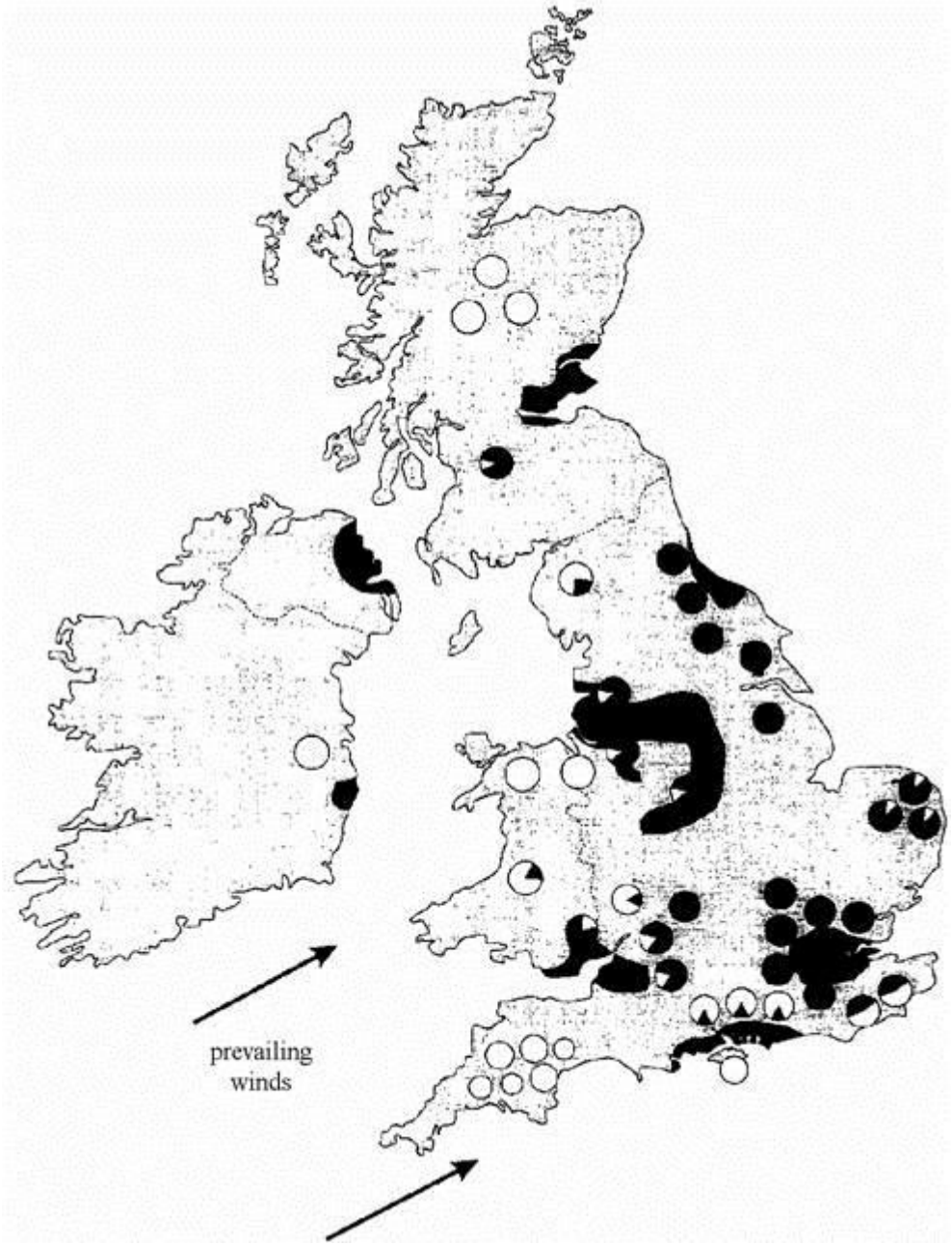
(Total 10 marks)

Q21.

The map shows:

the most densely populated industrial areas;
the frequency of pale and dark forms of the peppered moth;
the direction of the prevailing winds in the British Isles.





Peppered moths usually rest on trees covered with lichen, and they are preyed upon by many birds. In areas of low air pollution the lichen on trees is usually pale in colour. In areas of high air pollution the lichen turns black.

(a) (i) State a pattern of the distribution of the mutant dark form shown on the map.

_____

_____

(1)

(ii) Suggest a reason for your pattern.

_____

_____

(1)

(b) The dark form of peppered moth developed after a *mutation* in the pale form. What is a *mutation?*

_____

_____

(1)

(c) Using the idea of Natural Selection explain why the dark form of the moth is restricted to the areas shown.

_____

_____

_____

_____

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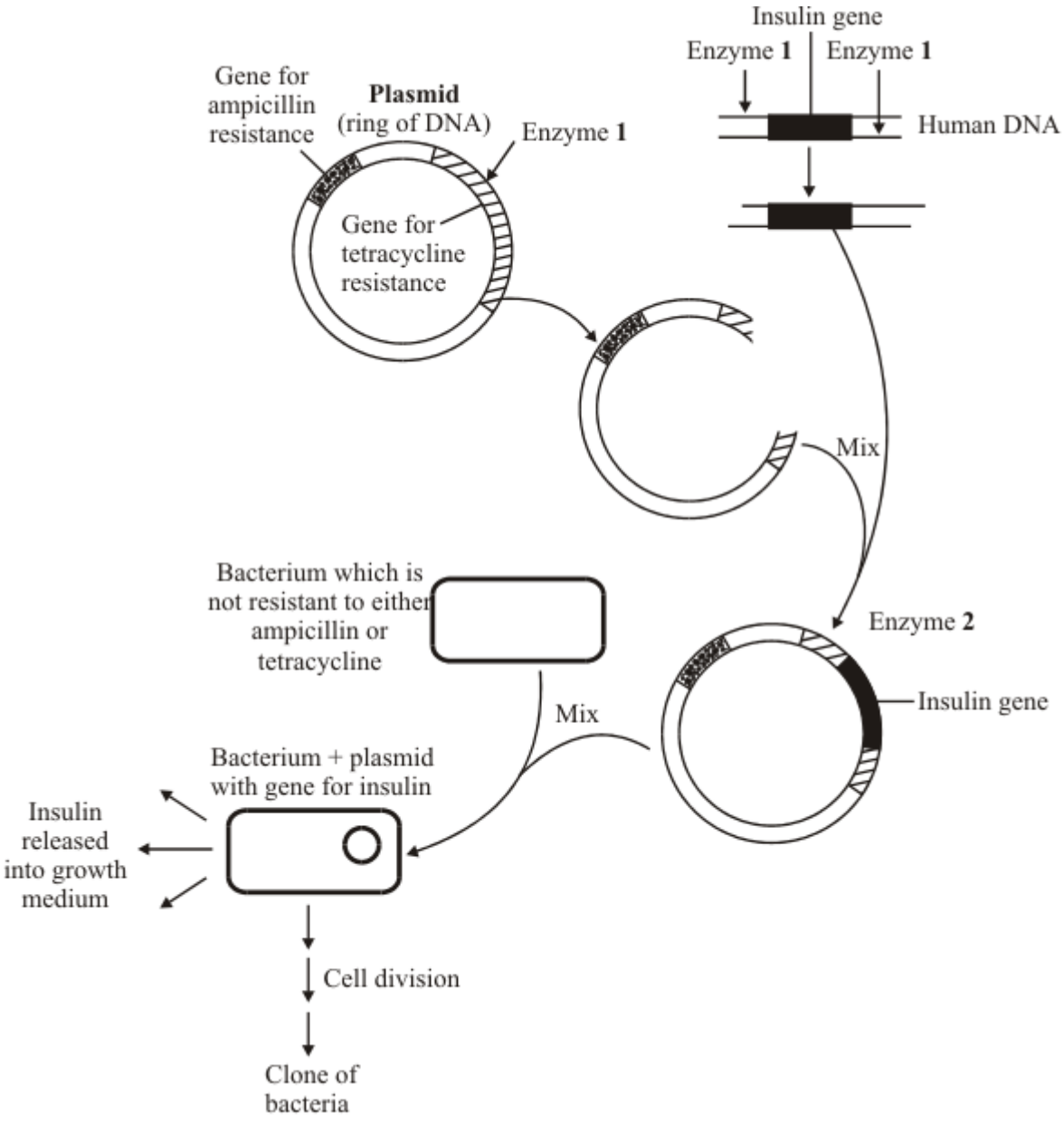
(4)

(Total 7 marks)

Q22.

The diagram shows how genetic engineering can be used to produce human insulin from bacteria. Ampicillin and tetracycline are two types of antibiotic. Study the diagram carefully and answer the questions.



In experiments like these, some bacteria take up the plasmid (ring of DNA) containing the insulin gene. Other bacteria fail to take up a plasmid, or they take up an unmodified plasmid (a ring of DNA which has not been cut open and which does not contain the insulin gene).

(a) Complete the table by putting a tick (✓) in the correct boxes to show which bacteria would be able to multiply in the presence of ampicillin and which bacteria would be able to multiply in the presence of tetracycline.

	Bacterium can multiply in the presence of	
	Ampicillin	**Tetracycline**
Bacterium + plasmid with the insulin gene		
Bacterium without a plasmid		
Bacterium with an unmodified plasmid		

(3)

(b) The bacterium with the plasmid containing the insulin gene multiplies by cell division to form a clone of bacteria.

Will **all** the bacteria in this clone be able to produce insulin? Explain your answer.

_____

_____

_____

_____

_____

_____

(3)

(Total 6 marks)

Q23.

Pathogenic bacteria and viruses may make us feel ill if they enter our bodies.

(a) Why do bacteria and viruses make us feel ill?

Bacteria _____

_____

Viruses _____

_____

(2)

(b) Most drugs that kill bacteria cannot be used to treat viral infections.

Explain why.

_____

_____

_____

_____

_____

_____

(2)

(c) Antibiotic-resistant strains of bacteria are causing problems in most hospitals.

Explain, as fully as you can, why there has been a large increase in the number of antibiotic-resistant strains of bacteria.

_____

_____

_____

_____

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(4)

(Total 8 marks)

Q24.

Diagram **1** shows the nucleus of a cell at the start of meiosis.

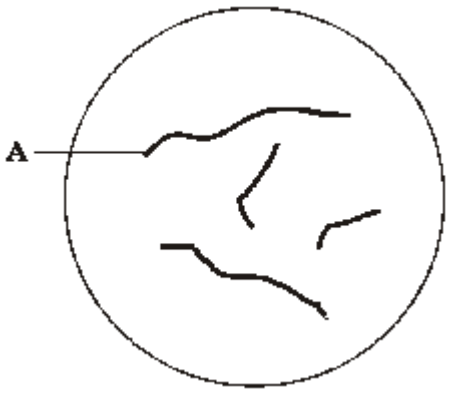


Diagram 1

(a) Name structure **A**. _____

(1)

(b) During meiosis, the nucleus shown in diagram **1** will divide twice to form four nuclei.

Complete diagram **2** to show the appearance of one of these nuclei.

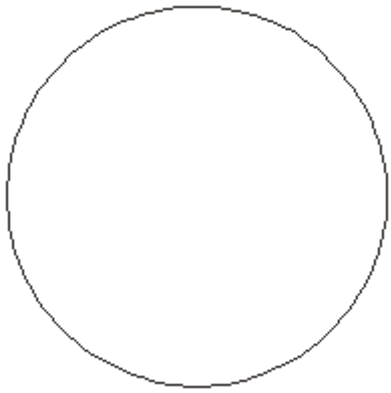


Diagram 2

(2)

(Total 3 marks)

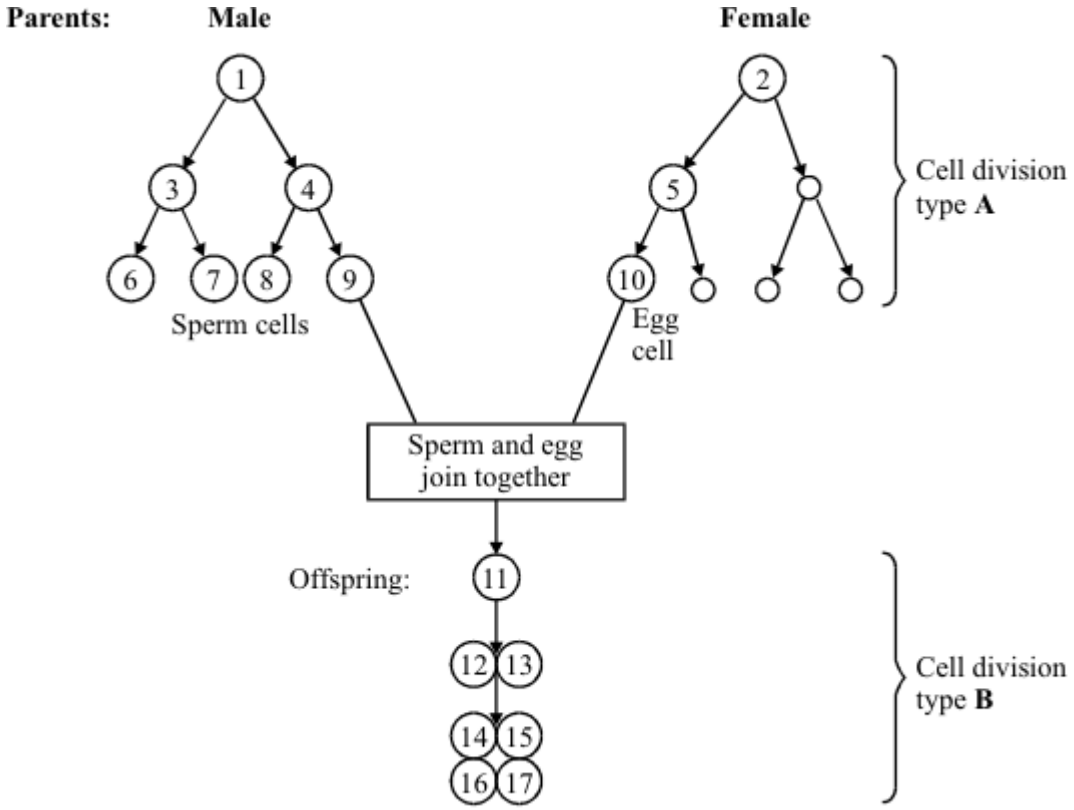
Q25.

The vole is a small, mouse-like animal. Voles found on some cold islands to the north of Scotland are much larger than voles found in warmer areas such as southern France. Explain how natural selection may have caused the northern voles to be larger in size.

(Total 5 marks)

Q26.

The diagram shows two patterns of cell division. Cell division type **A** is used in gamete formation. Cell division type **B** is used in normal growth.



(a) Name the two types of cell division, **A** and **B**, shown in the diagram.

Type **A** _____

Type **B** _____

(2)

(b) Name the process in which an egg and sperm join together.

_____

(1)

(c) Cell **1** contains 46 chromosomes. How many chromosomes will there be in:

(i) cell **10**; _____

(1)

(ii) cell **14**? _____

(1)

(Total 5 marks)

Q27.

(a) What does the theory of evolution state?

_____

_____

_____

_____

(2)

(b) *Daphnia* are microscopic water fleas. Midge larvae prey on *Daphnia*. The midge larvae release a hormone into the water. *Daphnia* respond to these hormones by growing larger protective 'helmet'-like structures

Scientists were surprised to observe that the offspring of *Daphnia* females who had been exposed to these hormones always had larger helmets than offspring whose mothers had never been exposed to the hormones. The offspring with the large helmets went on to produce offspring with large helmets.

Explain why the scientists' observations seem to contradict the theory of natural selection.

_____

_____

_____

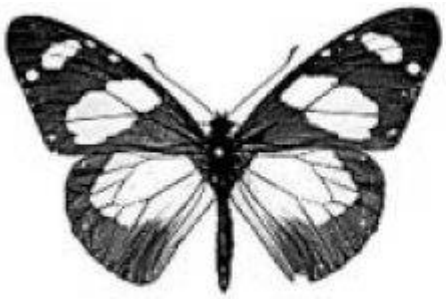
_____

(2)

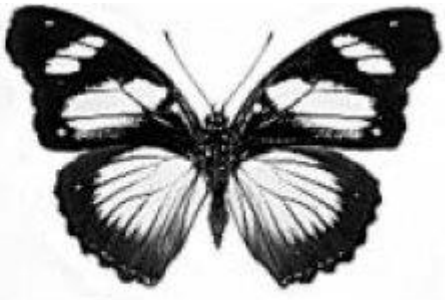
(Total 4 marks)

Q28.

The drawings show two different species of butterfly.



Amauris



Hypolimnas

- Both species can be eaten by most birds.
- *Amauris* has a foul taste which birds do not like, so birds have learned not to prey on it.
- *Hypolimnas* does **not** have a foul taste but most birds do not prey on it.

(a) Suggest why most birds do **not** prey on *Hypolimnas*.

_____

_____

_____

_____

(2)

(b) Suggest an explanation, in terms of natural selection, for the markings on the wings of *Hypolimnas*.

(3)

(Total 5 marks)

Q29.

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

(a) Each gene contains a code.

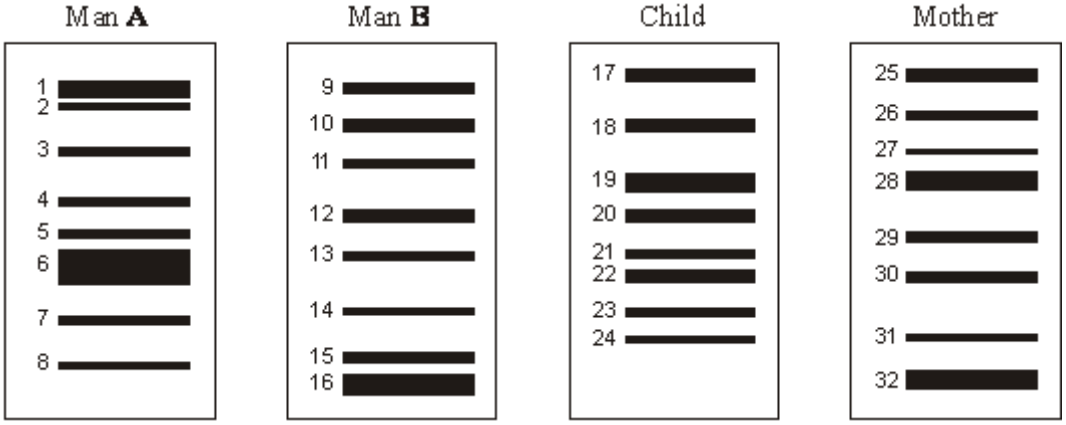
What does a cell use this code for?

(2)

(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.



(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.

_____

_____

_____

_____

_____

_____

_____

(3)

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

Explain why.

_____

_____

_____

_____

_____

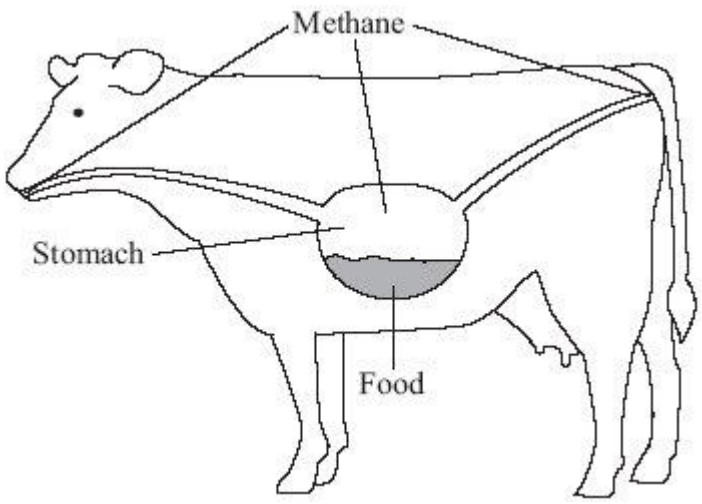
(2)

(Total 7 marks)

Q30.

Scientists are investigating how to reduce methane emissions from cattle.

Most of this methane is emitted by the cows belching.



Scientists have found that less methane is belched if the cows eat high-sugar rye grass.

This rye grass has been produced by genetic engineering.

(i) Suggest how the high-sugar rye grass might have been produced by genetic engineering.

_____

_____

_____

_____

_____

_____

(3)

(ii) Some people might object to the growing of genetically-engineered, high-sugar rye grass for feeding cattle.

Give **two** reasons why.

1. _____

_____

_____

2. _____

_____

_____

(2)

(Total 5 marks)

Q31.

The photograph shows a Crossbill.

A Crossbill feeds by using its bill (beak) to force apart the scales on conifer cones. It then uses its tongue to extract the seeds. If the bill is clipped it grows back again.

Scientists were interested in the evolution of the bill of the Crossbill.

In an investigation, they clipped the bills of several Crossbills so that their bills no longer crossed.

They observed that Crossbills with clipped bills took much longer to get seeds.

Use information from the investigation to suggest an explanation for the evolution of the bill in the Crossbill.

In your explanation, use the ideas of *selection*, *competition* and *mutation*.

(Total 4 marks)

Q32.

The dodo is an extinct bird. The drawing shows an artist's impression of the bird.

The dodo lived on a small island in the middle of the Indian Ocean. Its ancestors were pigeon-like birds which flew to the island millions of years ago. There were no predators on the island. There was a lot of fruit on the ground. This fruit became the main diet of the birds. Gradually, the birds became much heavier, lost their ability to fly and evolved into the dodo.

(a) Suggest an explanation for the evolution of the pigeon-like ancestor into the flightless dodo.

_____

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(b) The dodo became extinct about 80 years after Dutch sailors first discovered the island in the eighteenth century.

Scientists are uncertain about the reasons for the dodo's extinction.

Suggest an explanation for this uncertainty.

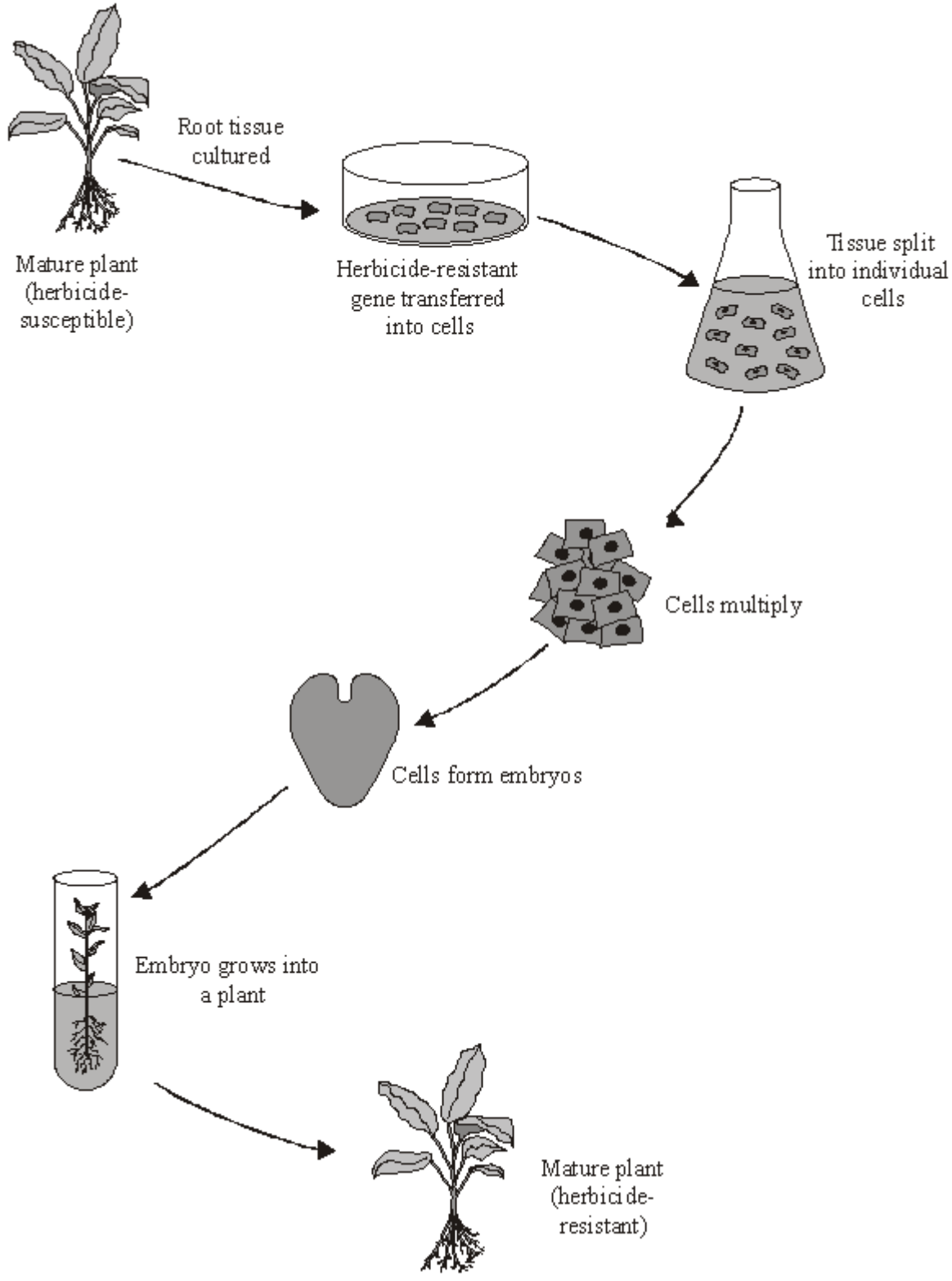
_____

(1)

(Total 5 marks)

Q33.

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



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

Which structure in a cell carries the genes?

_____

(1)

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

_____

_____

(1)

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

Explain why.

_____

_____

_____

_____

(2)

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

_____

_____

(1)

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

Suggest **one** reason why.

_____

_____

(1)

(Total 6 marks)

Q34.

Soay sheep live wild on an island off the north coast of Scotland. No people live on the island.

By Owen Jones = Jonesor [CC-BY-SA-2.5], via Wikimedia Commons

Over the last 25 years, the average height and mass of the wild Soay sheep have decreased.

The scientists think that climate change might have affected the size of the sheep.

Suggest an explanation for the evolution of the wild Soay sheep over the last 25 years.

(Total 4 marks)

Q35.

The photograph shows a snake eating a toad.

Cane toads were first introduced into Australia in 1935. The toads contain toxins and most species of Australian snake die after eating the toad.

The cane toad toxin does not affect all snakes the same way. Longer snakes are less affected by toad toxin.

Scientists investigated how red-bellied black snakes had changed in the 70 years since cane toads were introduced into their area. They found that red-bellied black snakes had become longer by around 3 – 5 %.

Suggest an explanation for the change in the body length of the red-bellied black snakes since the introduction of the cane toads.

_____

_____

_____

_____

(Total 4 marks)

Q36.

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

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

Suggest why.

_____

_____

(1)

(b) Chromosomes contain DNA molecules.

Describe the function of DNA.

_____

_____

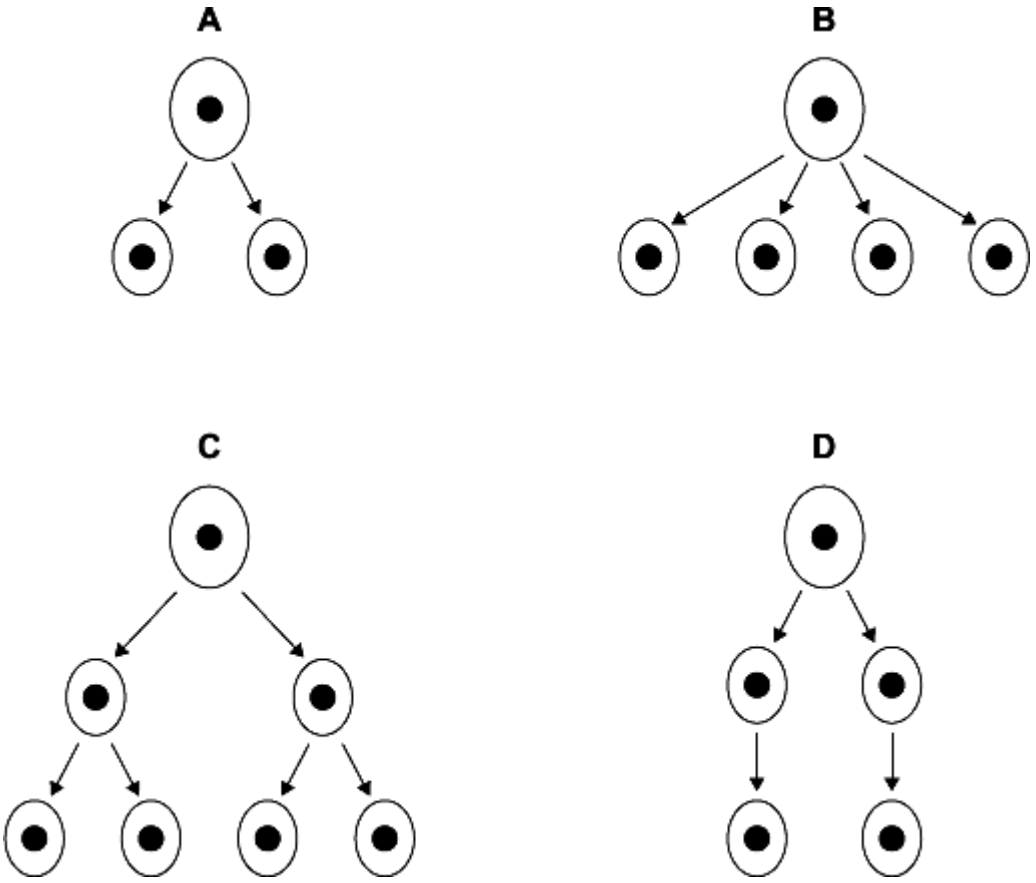
_____

_____

(2)

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

(i) Look at the diagrams.



Which diagram, **A**, **B**, **C** or **D**, represents how cell division by meiosis produces

gametes in the testes? ☐

(1)

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

_____

(1)

(d) Body cells divide by mitosis.

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

_____

_____

(1)

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

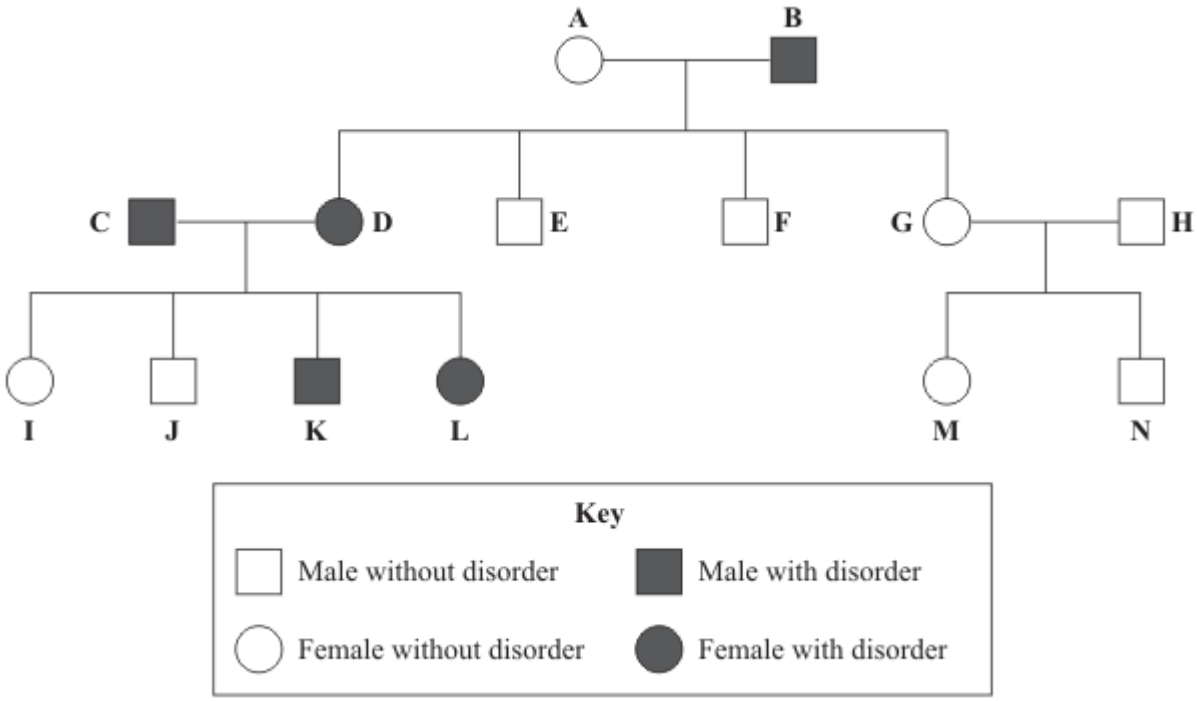
_____

(1)

(Total 7 marks)

Q37.

The diagram shows a family tree in which some individuals have an inherited disorder, which may cause serious long-term health problems.



(a) What proportion of the children of **A** and **B** have the disorder?

_____

(1)

(b) Explain the evidence from the diagram which shows that the allele for the disorder is dominant.

Use the appropriate letters to identify individuals in your answer.

You may use genetic diagrams in your explanation. There is space for you to draw a genetic diagram at the top of the facing page.

_____

_____

_____

_____

_____

_____

(3)

(c) (i) What is meant by 'embryo screening'?

_____

_____

(1)

(ii) A doctor suggests that couple **C** and **D** should have their embryos screened

but that couple **G** and **H** do **not** need this procedure.

Explain the reasons for the doctor's suggestions.

(3)

(Total 8 marks)

Q38.

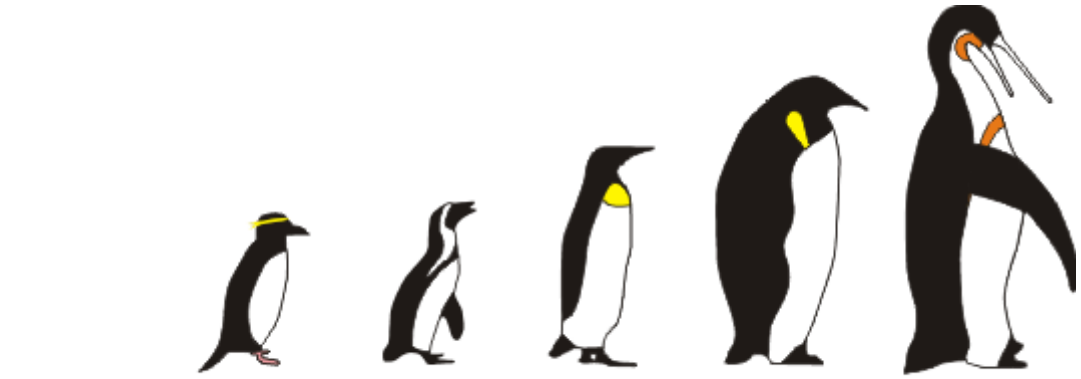
(a) Explain, as fully as you can, how natural selection leads to evolution.

(3)

(b) Most penguins live in cold climates. The modern penguin best adapted for cold conditions is the emperor penguin.

Scientists have found fossils of a 'giant' penguin which they have called *Icadyptes*.

The diagram shows how the size of modern penguins compares with *Icadyptes*.



The scientists were surprised to discover that *Icadyptes* lived in warm seas at a time when the Earth's climate was much warmer than it is now.

Explain why the scientists were surprised that *Icadyptes* lived in warm seas.

(2)

(Total 5 marks)

Q39.

Cystic fibrosis and Huntington's disease are inherited disorders.

(a) Someone can be a carrier of cystic fibrosis.

Explain how.

You may include a genetic diagram in your answer.

(2)

(b) Why does only one parent need to have the Huntington's disease allele for a child to inherit Huntington's disease?

_____

_____

(1)

(Total 3 marks)

Q40.

(a) Mr and Mrs Smith both have a history of cystic fibrosis in their families.
Neither of them has cystic fibrosis.
Mr and Mrs Smith are concerned that they may have a child with cystic fibrosis.

Use a genetic diagram to show how they could have a child with cystic fibrosis.

Use the symbol **A** for the dominant allele and the symbol **a** for the recessive allele.

(3)

(b) Mr and Mrs Smith decided to visit a genetic counsellor who discusses embryo screening.

Read the information which they received from the counsellor.

- Under an anaesthetic five eggs will be removed from Mrs Smith's ovary.
- The eggs will be fertilised in a dish using Mr Smith's sperm cells.
- The embryos will be grown in the dish until each embryo

has about thirty cells.

- One cell will be removed from each embryo and tested for cystic fibrosis.
- A suitable embryo will be placed into Mrs. Smith's uterus and she may become pregnant.
- Any unsuitable embryos will be killed.

(i) Suggest why it is helpful to take five eggs from the ovary, rather than just one.

_____

_____

(1)

(ii) Evaluate the use of embryo screening in this case.

Remember to give a conclusion as part of your evaluation.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

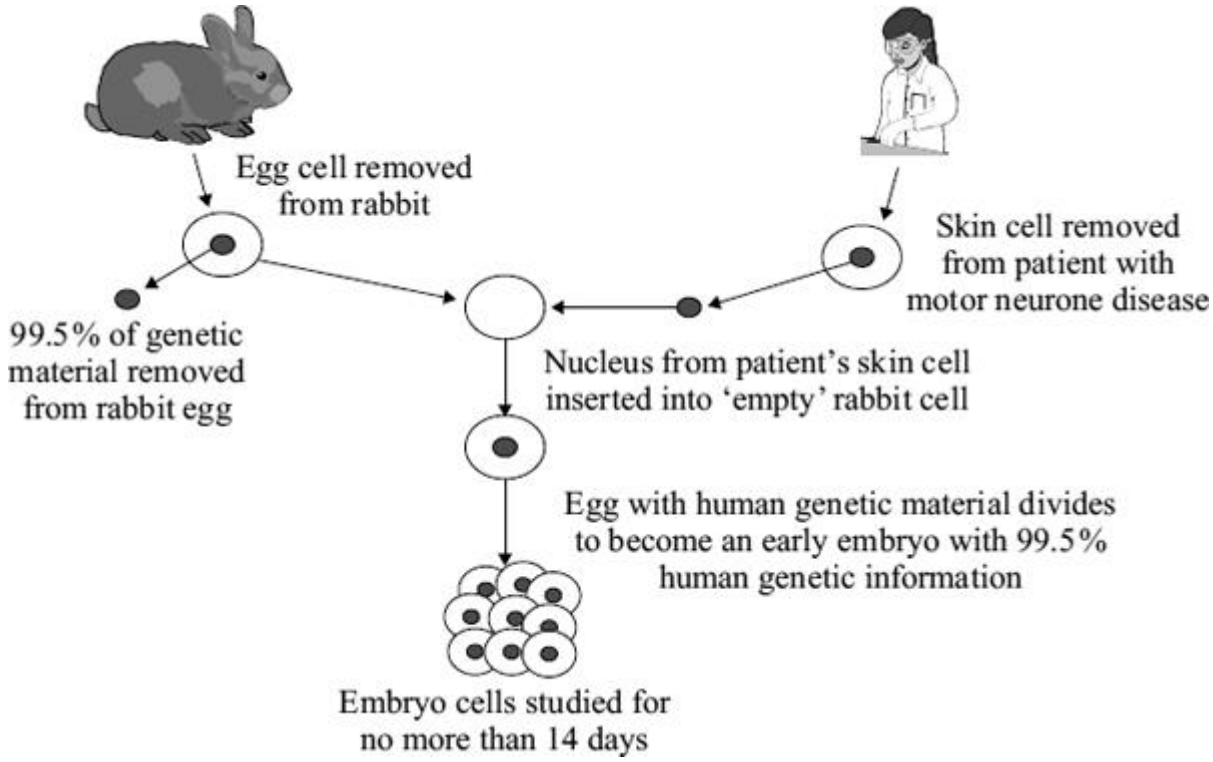
(4)

(Total 8 marks)

Q41.

Scientists in Korea have discovered a method of producing rabbit–human embryos.Rabbit–human embryos could provide cells for research into human diseases such as motor neurone disease. Rabbits produce large numbers of eggs. Rabbit–human embryos could overcome a shortage of human embryo cells for research.

The diagram shows how rabbit–human embryos are produced.



(a) Which structures in the nucleus contain 99.5% of a cell's genetic information?

_____

(1)

(b) Use the above information and your own knowledge and understanding to evaluate how the production of rabbit–human embryos may help research into human diseases.

Remember to give a conclusion as part of your evaluation.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(Total 5 marks)

Q42.

In the 18th century a binomial system of grouping similar organisms was developed.

Before the binomial system was developed the common briar rose had the following names:

- *Rosa sylvestris inodora seu canina*
- *Rosa sylvestris alba cum rubore folio glabro*.

In the binomial system, the same rose is called *Rosa canina*.

(a) One advantage of the binomial system is that the name is shorter than the names used before this system.

Suggest **two other** advantages of the binomial system.

1. _____

_____

2. _____

_____

(2)

(b) Classification systems have changed in the last 50 years.

Give **one** reason why we now have more information to classify organisms.

_____

_____

(1)

(c) 'Archaea' is one of the groups in the three-domain system of classification.

Give **two** features of the domain Archaea.

1. _____

_____

2. _____

_____

(2)

(Total 5 marks)

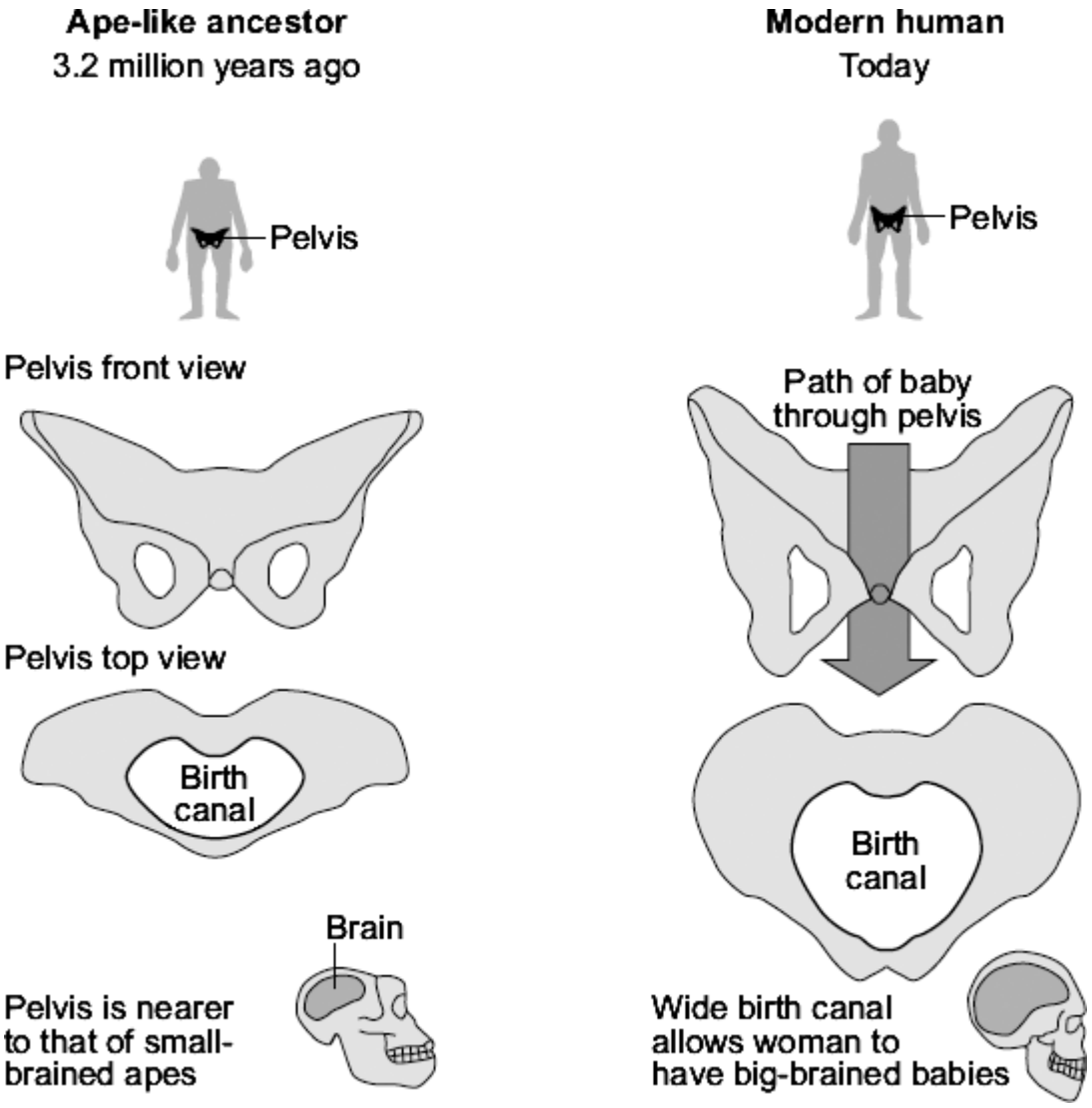
Q43.

Humans have evolved from ape-like ancestors by natural selection.

The drawing shows the pelvis of an ape-like ancestor and a modern human.

The skull and brain of the new born baby are also shown to the same scale.

Modern humans are much more intelligent than their ape-like ancestors.



Suggest an explanation for the evolution of the size and shape of the pelvis of modern humans.

Use information from the drawing to help you.

(Total 4 marks)

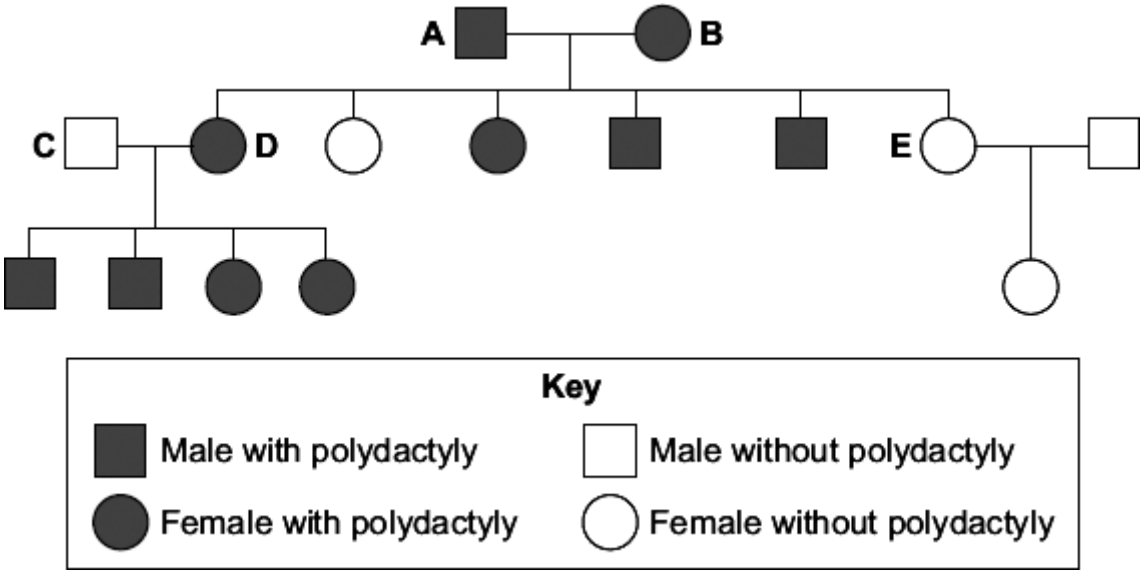
Q44.

Cats normally have four toes on each back paw.

The picture shows the back paw of a cat with an inherited condition called polydactyly.

By Onyxrain (Own work) [Public domain], via Wikimedia Commons

The family tree shows the inheritance of polydactyly in three generations of cats.



(a) What combination of alleles did the original parents, **A** and **B**, have?

Explain how you work out your answer.

You may use a genetic diagram in your answer.

Use the symbol **H** to represent the dominant allele.

Use the symbol **h** to represent the recessive allele.

A = _____ **B =** _____

(4)

(b) (i) Give **two** possible combinations of alleles for cat **D**.

1. _____ 2. _____

(1)

(ii) You cannot be sure which one of these two is the correct combination of alleles for cat **D**.

Why?

_____

_____

_____

(1)

(Total 6 marks)

Q45.

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.

(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.

_____

_____

_____

_____

_____

_____

_____

(3)

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

Suggest reasons why.

(2)

(Total 5 marks)

Q46.

Many strains of bacteria have developed resistance to antibiotics.

The table shows the number of people infected with a resistant strain of one species of bacterium in the UK.

Year	2004	2005	2006	2007	2008
Number of people infected with the resistant strain	3499	3553	3767	3809	4131

(a) Calculate the percentage increase in the number of people infected with the resistant strain between 2004 and 2008.

Show clearly how you work out your answer.

Percentage increase = _____

(2)

(b) Explain, in terms of natural selection, why the number of people infected with the resistant strain of the bacterium is increasing.

(3)

(Total 5 marks)

Q47.

People with cystic fibrosis make large amounts of thick, sticky mucus in their lungs. Cystic fibrosis is caused by the inheritance of recessive alleles.

(a) What do each of the following mean?

(i) Alleles

_____

_____

(1)

(ii) Recessive

_____

_____

(1)

(b) Mr and Mrs Brown have a child with cystic fibrosis. They hope to have another child. They want to know the probability that their next child will have cystic fibrosis. They visit a genetic counsellor who explains, "You are both heterozygous for cystic fibrosis. There is a 1 in 4 (25%) chance that your next child will have cystic fibrosis."

Use the following symbols in answering the questions.

N = allele for being unaffected by cystic fibrosis
n = allele for cystic fibrosis

(i) Mr and Mrs Brown both have the same genotype.

What is their genotype? _____

(1)

(ii) There is a 1 in 4 chance that Mr and Mrs Brown's next child will have cystic fibrosis.
Use a genetic diagram to explain why.

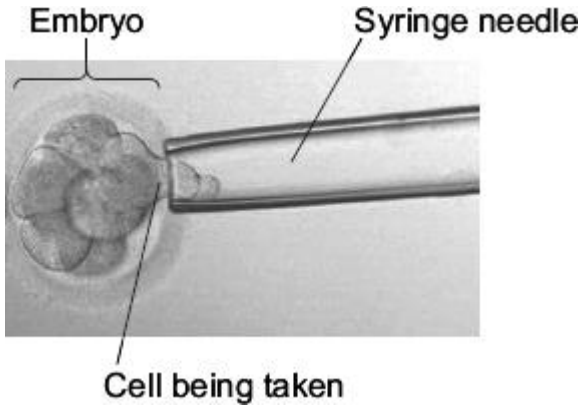
(3)

(c) Mr and Mrs Brown do **not** want to have another child with cystic fibrosis. The genetic counsellor explains two different methods for finding out whether an embryo has cystic fibrosis. The methods are:

- pre-implantation genetic diagnosis (**PGD**)
- chorionic villus sampling (**CVS**).

In **PGD**, eggs are fertilised in dishes and allowed to grow into embryos. A cell is

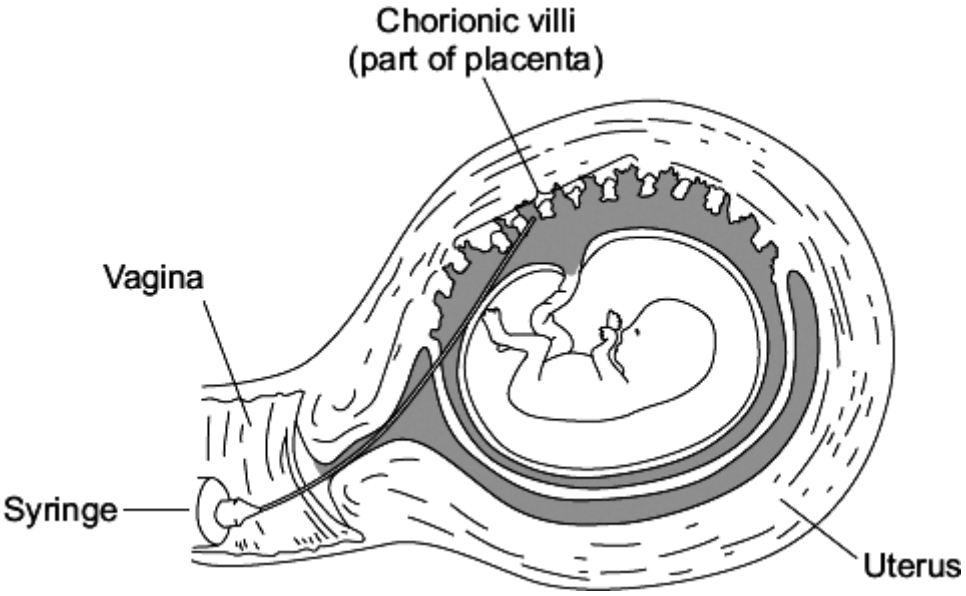
taken from each embryo when the embryo is 3 days old. The photograph shows how the cell is taken.



Photograph:© Pascal Goetgheluck/
Science Photo Library

The DNA in the cell can then be tested. The possibility of a false positive result is about 1 in 6. An unaffected embryo can then be placed in the woman's uterus. The procedure costs about £6000.

CVS can only be done after 9 weeks of pregnancy. A tiny piece of the placenta is taken out using a tube attached to a syringe. This is grown in tissue culture for about 7 days. The diagram below shows how **CVS** is done.



The DNA in the cells can then be tested. About 2 in every 100 women have a miscarriage because of **CVS**. The possibility of a false positive result is about 1%. The procedure costs about £600. Following a positive result, the parents must then decide whether to terminate the pregnancy.

The genetic counsellor thinks that **PGD** is a better method than **CVS** for detecting cystic fibrosis in an embryo.

Evaluate this opinion.

_____

_____

_____

(4)

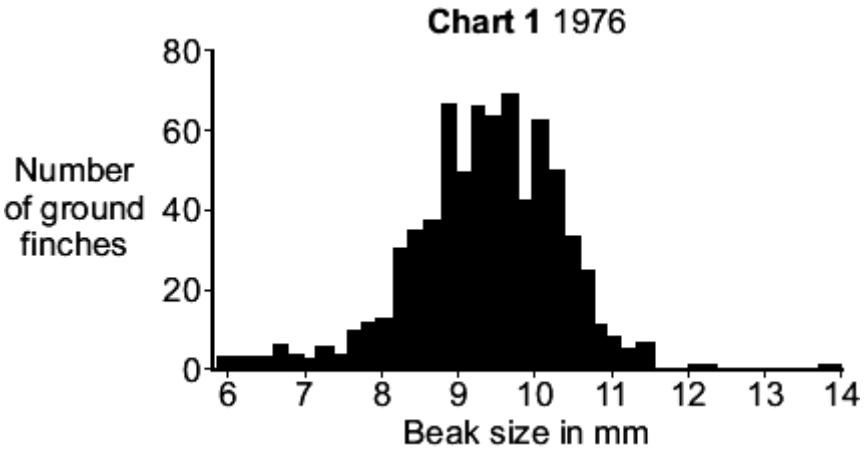
(Total 10 marks)

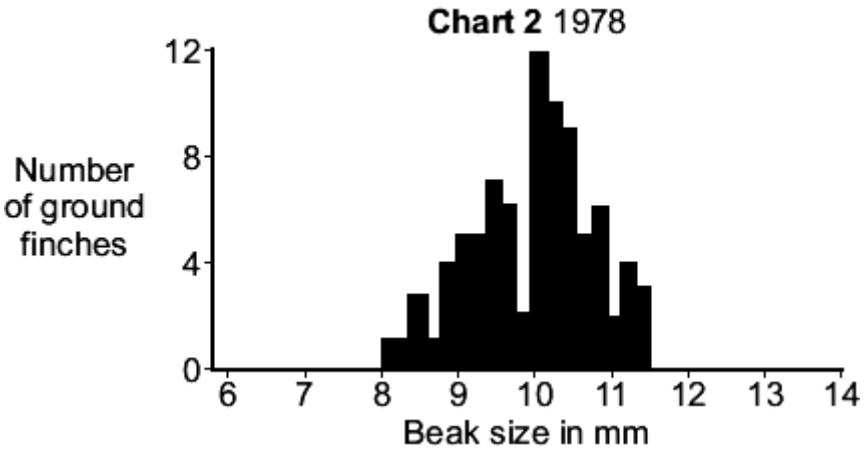
Q48.

The Galapagos Islands are in the Pacific Ocean, 1400 km from South America.
A type of bird called a ground finch lives on the islands.
The picture shows a ground finch.

By Charlesjsharp (Own work) [CC-BY-SA-3.0], via Wikimedia Commons

The size of the seeds the ground finch can eat depends upon the size of the beak.
To eat large seeds, a large beak is needed.
The bar charts show the sizes of the beaks of ground finches on **one** island, in 1976 and in 1978.





(a) The population of the ground finches and their beak sizes changed between 1976 and 1978.

Describe these changes.

_____

_____

_____

_____

_____

_____

(3)

(b) In 1977 there was very little rain on the island. The lack of rain affected the seeds that the finches ate.
The table shows how the seeds were affected.

Year	Mean number of seeds per m^2	Mean mass of each seed in mg
1976	8.5	3.5
1978	2.8	4.2

Suggest an explanation for the changes in beak sizes between 1976 and 1978.

(4)

(Total 7 marks)

Q49.

(a) Animal breeders use sexual reproduction to produce new strains of animals.

How does sexual reproduction produce variation?

(2)

(b) A salmon is a type of fish.

Scientists have created a GM (genetically modified) 'super' salmon.

The scientists transferred a gene from a fish called a pout into a salmon. The gene increases the secretion of growth hormone in the salmon. The GM salmon grows much faster than an ordinary salmon, reaching market size up to one year earlier. Many more GM salmon will be grown in fish farms.

(i) Describe how a gene can be transferred from a pout into a salmon.

(3)

(ii) The government might not allow the production of GM salmon.

Suggest **one** reason why.

_____

_____

(1)

(Total 6 marks)

Q50.

People may be immunised against diseases using vaccines.

(a) (i) Which part of the vaccine stimulates the body's defence system?

_____

_____

_____

_____

(2)

(ii) A person has been vaccinated against measles. The person comes in contact with the measles pathogen. The person does **not** catch measles.

Explain why.

_____

_____

_____

_____

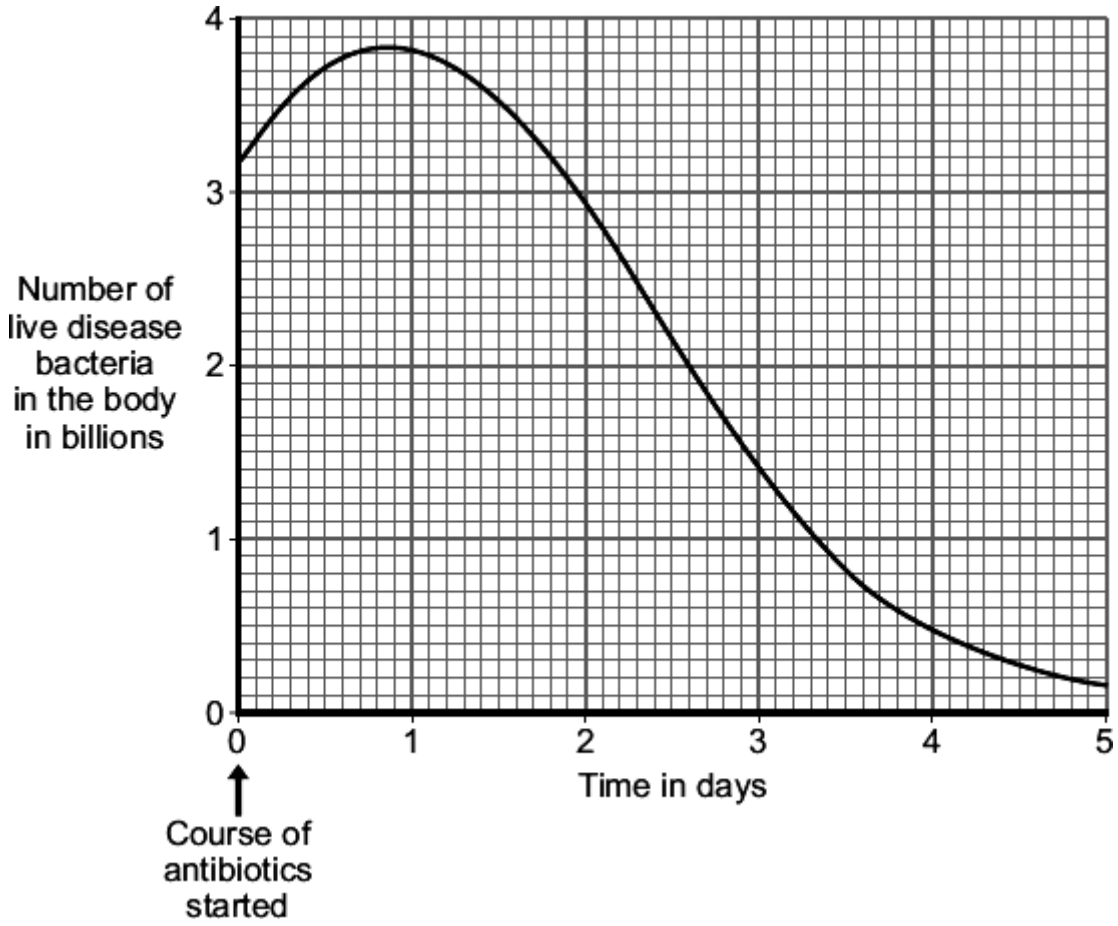
_____

_____

(3)

(b) A man catches a disease. The man has **not** been immunised against this disease. A doctor gives the man a course of antibiotics.

The graph shows how the number of live disease bacteria in the body changes when the man is taking the antibiotics.



(i) Four days after starting the course of antibiotics the man feels well again.
It is important that the man does **not** stop taking the antibiotics.

Explain why.

Use information from the graph.

_____

_____

_____

_____

(2)

(ii) Occasionally a new, resistant strain of a pathogen appears.

The new strain may spread rapidly.

Explain why.

_____

_____

_____

_____

_____

(3)

(Total 10 marks)

Q51.

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

By Emoke Dénes [CC-BY-SA-2.5], via Wikimedia Commons

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.

(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)

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

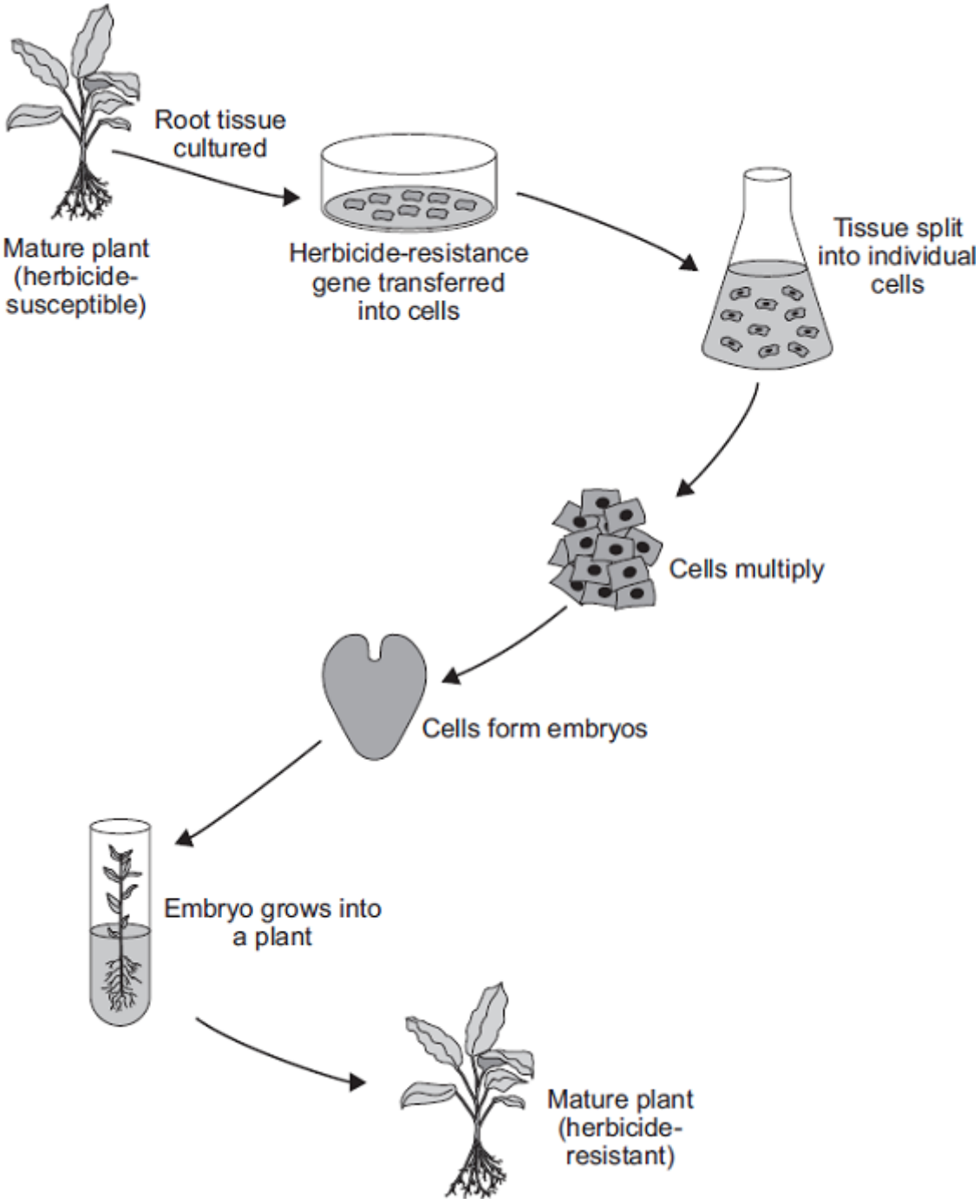
Suggest why.

(4)

(Total 5 marks)

Q52.

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



(a) The herbicide-resistance gene is cut out of a chromosome of a herbicide-resistant plant.

How is the herbicide-resistance gene cut out of the chromosome?

_____

_____

(1)

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

Explain why.

_____

_____

_____

_____

(2)

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

_____

_____

(1)

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

Suggest **one** reason why.

_____

_____

(1)

(Total 5 marks)

Q53.

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

Species A Species B

Images: © iStock/Thinkstock

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

Species A **Species B**

One chromosome **One chromosome**

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

(i) How does a chromosome become two strands?

_____

_____

(1)

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

_____

_____

_____

_____

(2)

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

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

(1)

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

Species A ☐ **Species B** ☐

(1)

(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)

(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?

_____

_____

_____

_____

(2)

(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 Species B

The offspring plants cannot reproduce sexually.

Suggest an explanation for this.

_____

_____

_____

_____

_____

_____

(2)

(Total 10 marks)

Q54.

(a) Mr and Mrs Smith both have a history of cystic fibrosis in their families.
Neither of them has cystic fibrosis.
Mr and Mrs Smith are concerned that they may have a child with cystic fibrosis.

Use a genetic diagram to show how they could have a child with cystic fibrosis.

Use the symbol **A** for the dominant allele and the symbol **a** for the recessive allele.

(3)

(b) Mr and Mrs Smith decided to visit a genetic counsellor who discussed embryo screening.

Read the information which they received from the genetic counsellor.

- Five eggs will be removed from Mrs Smith's ovary while she is under an anaesthetic.
- The eggs will be fertilised in a dish using Mr Smith's sperm cells.
- The embryos will be grown in the dish until each embryo has about thirty cells.
- One cell will be removed from each embryo and tested for cystic fibrosis.
- A suitable embryo will be placed into Mrs Smith's uterus and she may become pregnant.
- Any unsuitable embryos will be destroyed.

(i) Suggest why it is helpful to take five eggs from the ovary and not just one egg.

_____

_____

(1)

(ii) Evaluate the use of embryo screening in this case.

Remember to give a conclusion to your evaluation.

_____

_____

_____

_____

_____

_____

_____

_____

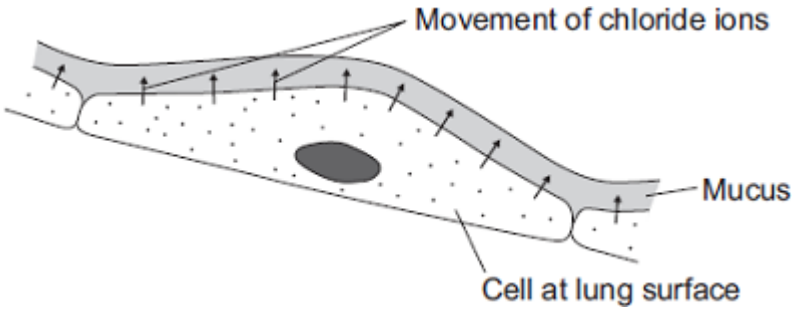
_____

_____

(4)

(c) In someone who has cystic fibrosis the person's mucus becomes thick.

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



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

Explain why.

_____

_____

_____

_____

_____

_____

_____

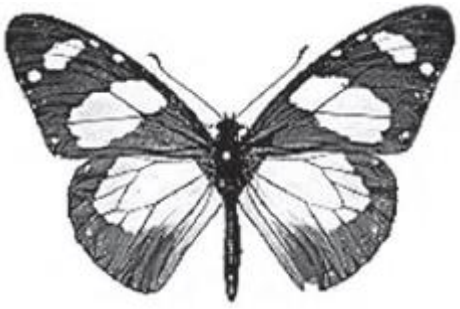
_____

(3)

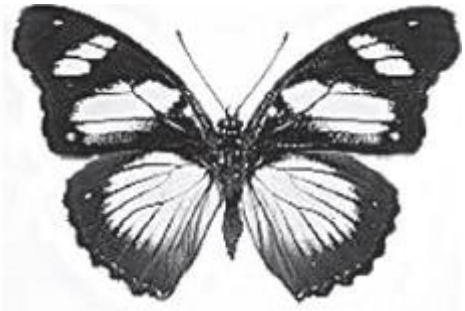
(Total 11 marks)

Q55.

The drawings show two different species of butterfly.



Amauris



Hypolimnas

- Both species can be eaten by most birds.

- *Amauris* has an unpleasant taste which birds do **not** like, so birds have learned **not** to prey on it.
- *Hypolimnas* does **not** have an unpleasant taste but most birds do **not** prey on it.

(a) Suggest why most birds do **not** prey on *Hypolimnas*.

_____

_____

_____

_____

(2)

(b) Suggest an explanation, in terms of natural selection, for the markings on the wings of *Hypolimnas*.

_____

_____

_____

_____

_____

_____

(3)

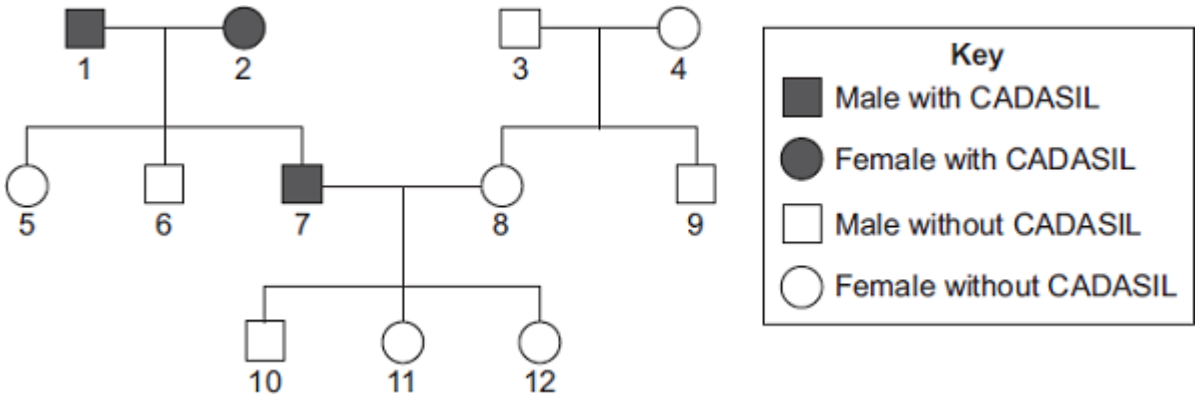
(Total 5 marks)

Q56.

CADASIL is an inherited disorder caused by a dominant allele.

CADASIL leads to weakening of blood vessels in the brain.

The diagram shows the inheritance of CADASIL in one family.



(a) CADASIL is caused by a *dominant allele*.

(i) What is a *dominant allele*?

_____

_____

(1)

(ii) What is the evidence in the diagram that CADASIL is caused by a dominant allele?

_____

_____

(1)

(iii) Person **7** has CADASIL.

Is person **7** homozygous or heterozygous for the CADASIL allele?

Give evidence for your answer from the diagram.

_____

_____

(1)

(b) Persons **7** and **8** are planning to have another baby.
Use a genetic diagram to find the probability that the new baby will develop into a person with CADASIL.

Use the following symbols to represent alleles.

D = allele for CADASIL
d = allele for not having CADASIL

Probability = _____

(4)

(c) Scientists are trying to develop a treatment for CADASIL using stem cells.

Specially treated stem cells would be injected into the damaged part of the brain.

(i) Why do the scientists use stem cells?

_____

_____

_____

_____

(2)

(ii) Embryonic stem cells can be obtained by removing a few cells from a human

embryo. In 2006, scientists in Japan discovered how to change adult skin cells into stem cells. Suggest **one** advantage of using stem cells from adult skin cells.

_____

_____

(1)

(Total 10 marks)

Q57.

Humans can use different methods to produce animals and plants with desired characteristics.

The figure below shows some different breeds of horse.

(a) All breeds of horse are of the same species.

Suggest what you could do to show this.

_____

_____

_____

_____

(2)

(b) Horse racing is an ancient sport.

Selective breeding has been used for centuries to produce racehorses.

Describe the steps involved in selective breeding to produce a racehorse.

(3)

(c) Another way of producing organisms with desired characteristics is genetic engineering.

Bt cotton is a variety of cotton that has been genetically engineered to produce a poison.

The poison kills several different species of insect that feed on cotton plants.

The poison is naturally produced by a soil bacterium called *Bacillus thuringiensis*.

Describe how cotton plants can be genetically engineered to produce the Bt poison.

(3)

(d) Describe the advantages and disadvantages of growing Bt cotton.

(4)

(Total 12 marks)

Q58.

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.

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

(3)

(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)

(Total 7 marks)

Q59.

Huntington's disease is an inherited disorder that affects the nervous system.

It is caused by a dominant allele.

A man is heterozygous for Huntington's disease.

His partner is healthy and does not have the allele that causes Huntington's disease.

(a) What are the genotypes of the man and the woman?

Use:

- **H** for the allele that causes Huntington's disease
- **h** for the healthy allele.

Man's genotype _____

Woman's genotype _____

(1)

(b) The couple want to have a child.

Use a Punnett square to determine the probability of the child having Huntington's disease.

Circle the genotypes of any children that will have Huntington's disease.

Probability of child having Huntington's disease = _____

(4)

(c) The couple visit a genetic counsellor, who gives them the following options.

1. Adopt a child.
2. Gamete donation – uses sperm from another man to fertilise the woman's eggs by in vitro fertilisation (IVF).
3. Conceive naturally.

4. Use pre-implantation genetic diagnosis (PGD).

- Many embryos are produced by IVF using gametes from the man and woman.
- Embryos are tested for Huntington's disease and a healthy embryo is implanted into the woman's uterus.
- The risk of implanting an embryo with the allele for Huntington's disease is 0.2%.
- Costs the NHS about £11 000.

5. Conceive naturally and use prenatal diagnosis (PND) once the woman becomes pregnant.

- A sample of the placenta is taken at 10 weeks of pregnancy or a sample of fluid is taken from around the developing baby at 16 weeks of pregnancy.
- The sample is tested for the Huntington's allele.
- A 0.5–1.0% risk of miscarriage.
- About 1% of samples collected are unsuitable for testing.
- Costs the NHS about £600.

The couple decide they want to have a healthy baby that is their own biological offspring.

Evaluate the options.

Suggest which option would be best for the couple.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

(6)

(Total 11 marks)

Q60.

(a) Evidence about extinct species of animals and plants comes from fossils.

Below is a photograph of a fossil of a bird-like animal called *Archaeopteryx.* *Archaeopteryx* lived about 150 million years ago.

(i) Suggest how the fossil of *Archaeopteryx* was formed.

_____

_____

_____

_____

(2)

(ii) Scientists have found other fossils of the ancestors of modern birds, but the fossil record is very incomplete.

Suggest **two** reasons why there are gaps in the fossil record.

1. _____

_____

2. _____

_____

(2)

(b) There are many different species of bird on the Earth today.

Describe how these different species may have evolved from an ancestor such as *Archaeopteryx*.

_____

_____

_____

_____

(4)
(Total 8 marks)

Mark schemes

Q1.

(a) human cells have cell membrane
or
human cells have no cell wall

1

(b) can no longer synthesise proteins

1

(c) antibiotics are being developed at a slower rate than emergence of new resistant strains

1

resistant strains mean we cannot treat (common) infections

1

reduce (future) cost of antibiotic resistant infections

1

[5]

Q2.

(a) a change in the DNA / gene

1

(b) produces a different protein / enzyme that is responsible for colour

1

(c) parents genotype both Bb
allow correctly derived gametes

1

offspring genotypes correctly derived

1

bb identified as blue
allow ring around bb only

1

65 000
allow ecf or 260 000 × 0.25

1

6.5×10^4

1

(d) cross with **bb** / blue carp
*allow annotated Punnett square diagram(s) of cross with **bb** carp*

1

if any offspring are blue, the parent was **Bb** / heterozygous
allow converse

1

*allow cross with known **Bb** carp*
*if any offspring are blue, other parent was **Bb** / heterozygous*

[9]

Q3.

(a) (i) one form of a / one gene

*do **not** allow 'a type of gene'*

allow a mutation of a gene

1

(ii) not expressed if dominant / other allele is present / if heterozygous

or

only expressed if dominant allele not present / or no other allele present

allow need two copies to be expressed / not expressed if only one copy / only expressed if homozygous

1

(b) (i) two parents without PKU produce a child with PKU / **6** and **7** → **10**

allow 'it skips a generation'

1

(ii) genetic diagram including:

accept alternative symbols if defined

Parental gametes:

6: **N** and **n**
and 7: **N** and **n**

1

derivation of offspring genotypes:

NN Nn Nn nn

allow genotypes correctly derived from student's parental gametes

1

identification: **NN** and **Nn** as non-PKU

OR nn as PKU

allow correct identification of student's offspring genotypes

1

correct probability only: 0.25 / ¼ / 1 in 4 / 25% / 1 : 3

*do **not** allow 3 : 1 / 1 : 4*

*do **not** allow if extra incorrect probabilities given*

1

(c) (i) mitosis

correct spelling only

1

(ii) 8

1

(iii) DNA

allow deoxyribonucleic acid

*do **not** allow RNA / ribonucleic acid*

1

(d) (i) may lead to damage to embryo / may destroy embryos / embryo cannot give consent

allow avoid abortion

allow emotive terms – eg murder religious argument must be qualified

allow ref to miscarriage

allow idea of avoiding prejudice against disabled people

allow idea of not producing designer babies

1

(ii) any **one** from:

- prevent having child with the disorder / prevent future suffering / reduce incidence of the disease

  ignore ref to having a healthy child

  ignore ref to selection of gender
- embryo cells could be used in stem cell treatment

  allow ref to long term cost of treating a child (with a disorder)

  allow ref to time for parents to become prepared

1

[12]

Q4.

(a) half / 50% sperm have X (chromosome)
or
half / 50% sperm have Y (chromosome)

penalise incorrect use of gene / allele once only

1

all eggs have X (chromosome)

*annotated genetic diagram could gain **2 marks***

1

(b) screening

ignore selection

1

(c) any **three** from:

*max **2** if only advantages **or** only disadvantages discussed*

advantages:(**max 2**)

- (girl / children / women) don't / less likely to get / inherit (breast) cancer / this / the disease

  *do **not** accept reference to allele alone for this point*
- future generations get less cancer **or** less likely to have the allele
- less expensive (for NHS) than treating cancer

disadvantages:(**max 2**)

- (wrong / immoral to) reject / kill embryos

  ignore wrong / immoral / religious argument unqualified

- possible harm to embryo (that is implanted) / miscarriage
  ignore reference to termination

- possible harm to mother (due to operational procedure)
  allow reference to needing hormone treatment

3

argued conclusion
  *must refer to **both** advantages and disadvantages and must be at end of answer*

1

[7]

Q5.

(a) (i) **Aa** or aA

1

(ii) allele / gene for vestigial wings / **a** is recessive
or vestigial is recessive **or A** is dominant **or**
A would override the effect of **a or A** present gives long wings

1

(b) parental genotypes correct – both **Aa**
  NB can pick up chain of logic at any point correctly derived from candidate's previous point

1

gametes correctly derived from **P** genotypes

1

offspring genotypes correctly derived from gametes

1

3:1 ratio recognised
  wrong cross and not 3:1 ratio = max 2

1

[6]

Q6.

(a) (i) mitosis
  for 1 mark

1

(ii) 1
fertilised egg cell has 1 albino gene from father splits to produce identical cells / produced by mitosis
  each for 1 mark

3

(b) (i) less protection from UV light / UV radiation
  for 1 mark

1

(ii) ideas of uncontrolled multiplication of mutated cells reject fast /
rapid cell division cells invade of other parts / cells transported in blood
  each for 1 mark

2

[7]

Q7.

parental genotypes both correct – both Bb
gamete genotypes all correct B and b B and b
genotype of bb offspring correctly related to gametes
bb offspring identified as small bolls

for 1 mark each

[4]

Q8.

(a) 550 – 650

for one mark

1

(b) skulls
preserved as fossils / measure skull volume

for 1 mark each

2

(c) range of brain size / bigger brains arose by mutation
more with large brains more likely to survive
because more intelligent / survival advantage described
their genes passed to next generation / offspring inherited large brains

any three for 1 mark each

3

[6]

Q9.

(a) greater proportion of dark moths survive in polluted woods
Greater proportion of pale moths survive in unpolluted woods
% survival on underside of branch is greater in both situations

each for 1 mark

3

(b) *ideas that (please indicate in body of answer by √1, √2, √3)*
1. different sorts of moths / pale and dark moths
2. ideal of differential survival in different habitats
3. this is evidence for natural selection / survival of the fittest
or idea that feature likely to be passed on

each for 1 mark

3

[6]

Q10.

(a) contain the same genes, because they are formed by division
of identical nucleus

for 1 mark each

2

(b) genes located in nucleus, nucleus comes from donor cells

for 1 mark each

2

(c) number of alleles in population reduced, therefore less chance of successfully breeding, to cope with changed conditions

for 1 mark each

3

[7]

Q11.

(a) (i) e.g. B and b

for 1 mark

1

(ii) e.g. bb

for 1 mark

1

(b) no black genes in flock
all double recessive

for 1 mark each

2

[4]

Q12.

(a) mutation

for 1 mark

1

(b) fall,
idea that resistant beetles more likely to survive to breed,
∴ their offspring more likely to appear in the next generation

for 1 mark each

3

(c) inbreeding between resistant brothers and sister,
will produce some individuals with 2 copies of the resistance allele,
if 2 of these individuals breed all their offspring will be resistant

for 1 mark each

3

[7]

Q13.

(a) long neck or legs

1

(b) change in environment **or** reaching for food **or** stretching led to **more use** of neck (and legs) [1]

use led to **increased** size **or** characteristic acquired during lifetime [1]

this characteristic was passed to offspring [1]

3

(c) phenotypic changes do not affect genotype **or** genes [1]

acquired characteristics are not passed to offspring **or** the offspring were bom with tails **or** inheritance has to be genetic [1]

2

(d) **one** mark awarded for each of the following general points:

variation exists in all populations **or**
mutation occurred [1]

or if written specific to giraffes:

*all giraffes are different **or** reference to short necked giraffes[1]*

4

some individuals will have an advantage in certain areas **or** will be better adapted **or** there is survival of fittest [1]

*taller giraffes **or** those with longer necks will have an advantage in being able to reach high vegetation **or** there is survival of fittest [1]*

advantaged individuals breed more **or**
are more successful [1]

*these giraffes will breed more **or** will be more successful [1]*

the genes **or** units of heredity **or** DNA
of these individuals are passed on [1] (look for idea of genetic information being passed on)

*the genes **or** units of heredity **or** DNA of these giraffes are passed on [1]*

[10]

Q14.

advantages 2 of:
kills weeds but not cotton
higher yields of cotton
increased profits

any 2 for 1 mark each

2

disadvantages 2 of:
reduced genetic variability in ecosystem
other species of plants may become resistant to herbicide
possible devastating effect on future crop growth
effects on ecosystem on spread of herbicide resistant plants

2

any 2 for 1 mark each

evaluation anywhere = 1

for 1 mark

1

[5]

Q15.

natural variation in amount of body hair;
in cold environment, (having genes) which produce long hair is an advantage;
because hair insulates; OWTTE
such animals more likely to survive;

and pass these genes onto succeeding generations

each for 1 mark

[5]

Q16.

one mark for each of the following comparisons to a maximum of **6**

*candidates **must** make a clear comparison*

meiosis	**mitosis**
sexual	asexual
gametes	growth
ovary **or** testes **or** gonads	all other cells
half number of chromsomes	same number of chromosomes
haploid **or** 23 chromosomes	diploid **or** 46 chromosomes
reassortment **or** variation possible **or** not identical	no reassortment **or** no variation **or** identical
4 cells produced	2 cells produced
2 divisions	1 division

[6]

Q17.

(a) select for breeding;
the plants with the sweetest taste

each for 1 mark

2

(b) natural population has a wide range of variations;
because it has a large number of alleles;
selective breeding reduces the number of alleles;
cloning perpetuates this reduced number of alleles

each for 1 mark

4

(c) 3 of:
reference to cuttings;
reference to tissue culture;
reference to hormones;
cloning

each for 1 mark

3

(d) 4 of:

cut genes for disease resistance;
from chromosomes of 'cooking banana';
introduce into chromosomes of 'ordinary banana';
tissue culture to produce disease resistant plants/clone;
enzymes cut chromosomes

each for 1 mark

4

[13]

Q18.

(a) (i)

if two nuclei drawn then maximum two marks

1

6 chromosomes

1

same 3 homologous pairs

1

nuclear membrane drawn

1

(ii) 3 chromosomes

1

1 from each homologous pair

1

(b) (i)

parent line must be separate

heterozygous parents Tt × Tt

*maximum of **2** marks if parental genotype is wrong*

gametes correct T t T t

1

genotypes TT Tt Tt tt

1

(ii) correct analysis of chance i.e. 1 in 4
or 25%

1

(iii) 50% **or** 1 in 2

1

[10]

Q19.

(a) variation (between organisms within species)

allow described example

*allow mutation – but **not** if caused by change in conditions*

1

those most suited / fittest survive

1

genes / alleles passed on (to offspring / next generation)

allow mutation passed on

1

(b) (i) any **two** from:

allow converse

- increase in latitude reduces number of (living) species

  ignore references to severity of conditions

- increase in latitude reduces time for evolution (of new species)

- the less the time to evolve the fewer the number of (living) species

2

(ii) any **two** from:

*do **not** accept intention or need to evolve*

- (increase in latitude reduces number of (living) species because) less food / habitats / more competition <u>at high latitude</u>

  allow only extremophiles / well-adapted species can survive

- (increase in latitude reduces time for evolution (of new species) because) severe conditions act more quickly / to a greater extent on the weakest

- (the less the time to evolve the fewer the number of (living) species because) species that evolve slowly don't survive

2

[7]

Q20.

(a) (i) gametes i.e. B b and B b

1

correct combination of genotypes i.e. BB, Bb, Bb, bb

1

correct analysis of phenotypes i.e. 3 black fur 1 with brown fur

1

(ii) award one mark for the recognition that it is down to chance (which two gametes fuse) and not simply 'because it's a prediction'

*do **not** accept mutation*

1

(b) (i) **B** is dominant/ an allele is dominant if it is expressed in the heterozygous phenotype

candidates are likely to use a variety of ways of expressing their ideas

1

b is recessive/ a recessive allele is not expressed in the presence of its contrasting allele

*do **not** accept powerful*
*do **not** accept stronger*

1

(ii) alleles are different forms of a gene controlling a characteristic and occupying the same site on homologous chromosomes (e.g. B or b)

1

genes are the units of DNA/sites on chromosomes carrying the information that determines characteristics (e.g. bB)

1

(c) homozygous: BB / bb / possessing a pair of identical alleles for a character/true breeding

give credit to an explanation using a diagram

1

heterozygous: Bb / carrying a pair of contrasting/different alleles for a characteristic

*do **not** accept references to xx, xy*
*do **not** accept gene by itself*

1

[10]

Q21.

(a) (i) dark form lives in the industrialised/ densely populated areas
or
dark form lives to the East/downwind/North East of industrialised are

1

(ii) more pollution/discolouration in those areas
or
pollution blown by prevailing winds

1

(b) a **change** to the genetic material/DNA/chromosomes/genes in an organism

*do **not** accept fault. error*

1

(c) <u>survival in polluted areas:</u>

one mark for each mark point to a maximum of 4

(pollution) lichen/trees/buildings become(s) blackened

credit an answer given in terms of survival in polluted areas or non-survival in other areas

(camouflage) black formed camouflaged / more difficult to see

(predation) not preyed upon eaten by thrushes

(survival) survive to breed

<u>or non survival</u>

(no pollution) lichen/trees/buildings remain(s)pale/non-blackened

(no camouflage) black formed not camouflaged / easier to see

(predation) preyed upon/eaten by thrushes

(survival) do not survive to breed

4

[7]

Q22.

(a)

Ampicillin	Tetracycline
✓	–
–	–
✓	✓

*accept blank **or** cross **or** –*

*1 st: mark by rows to maximum **3** marks*

*2 nd: if no marks by rows, mark by columns to maximum **1** mark*

*table completely blank = **0** marks*

3

(b) 1st: Yes (no mark)

*if 'no' - read on for logical argument e.g. loss of plasmid **or** gene mutation*

2nd: all formed from same original cell

must be <u>one</u> cell i.e. bacterium

1

by asexual reproduction / no fusion / not sexual

allow reference to 'mitosis'

1

offspring cells are genetically identical **or**
all have a copy of the insulin gene / of the plasmid

1

[6]

Q23.

(a) (bacteria) produce toxins / poisons

1

(viruses) damage / kills cells **or** toxins released from cell

1

(b) any **two** from:

- viruses live inside cells
- viruses inaccessible to drug
- drug would damage body cells / tissue

2

(c) any **four** from:

- overuse of antibiotics
- bacteria mutate

*do **not** allow antibiotic causes mutation*

- antibiotics kill non-resistant strains **or** idea of selection
- reduced competition
- resistant bacteria reproduce

4

[8]

Q24.

(a) chromosome

accept chromosomes

1

(b) drawing shows:

1

just 2 chromosomes

one long + one short

1

[3]

Q25.

any **five** from:

- genetic variation exists in a population **or**
  variation caused by mutation / change in gene / in DNA
- larger voles have smaller $\frac{\text{S.A.}}{\text{Vol.}}$
  or have more fat

  'they' accept as larger voles
- larger voles lose less heat / are better insulated **or** more energy stored
- larger voles survive
- larger voles breed
- larger voles pass on (beneficial) gene / allele / mutation / DNA

  ignore characteristic

[5]

Q26.

(a) A = meiosis

accept 'mieosis'

*do **not** accept 'miosis'*

1

B = mitosis

*do **not** accept 'meitosis' etc*

1

(b) fertilisation allow conception

1

(c) (i) 23

1

(ii) 46

1

[5]

Q27.

(a) present day organisms have evolved from simpler organisms

ignore answers in terms of natural selection

1

over long periods of time
or
millions / billions of years

1

(b) (natural selection operates on successful)
characteristics produced by chance / (random) mutation

1

in this experiment caused by hormones / environment

*allow this example indicates inheritance of acquired characteristics for **2** marks*

*allow this is Lamarckism only for **1** mark*

1

[4]

Q28.

(a) wing pattern similar to *Amauris*

1

birds assume it will have foul taste

1

(b) mutation / variation produced wing pattern similar to *Amauris*

*do **not** accept breeds with Amauris*

*do **not** accept idea of intentional adaptation*

1

these butterflies survived

1

breed / genes passed to next generation

1

[5]

Q29.

(a) any **two** from:

- to combine / use amino acids

  *do **not** allow to make amino acids*

- in specific / particular / correct / right order

- to manufacture protein / enzymes / hormones

  allow examples of proteins / enzymes / hormones

2

(b) (i) (man) B

*no mark for this **but** max **2** marks if A given*

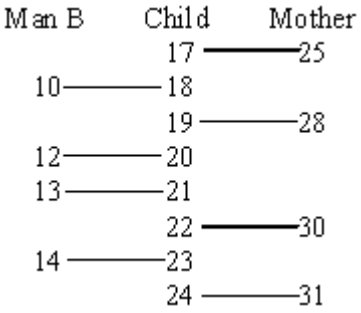
any **three** from:

- child gets DNA / bars / lines from mother and father / parents

  ignore genes / chromosomes

- (child has) mother's 25 / 28 / 30 / 31
  or child gets 17 / 19 / 22 / 24 from mother

- (child has) man B's 10 / 12 / 13 / 14
  or child gets 18 / 20 / 21 / 23 from B



contradictions disqualify 2nd and / or 3rd marking points

ignore genes / chromosomes

- no bars / DNA / lines from man A correspond to child

3

(ii) any **two** from:

- gametes / eggs / sperm
- contain only half of (mother's / father's) DNA / chromosomes / genes / genetic information
- due to meiosis

2

[7]

Q30.

(i) any **three** from:

ignore references to other methods eg tissue culture and embryo transplantation

- remove gene
- use of enzymes
- from plant with high sugar production

allow from bacteria

- insert gene into rye grass

3

(ii) any **two** from eg

- concern about effect on (health) of cow
- concern about effects on human (health)
- concern about food chain effects **or** effects on ecosystem
- effect on gene pool

*ignore not natural **or** cost*
ignore ethical / religious arguments
if no other marks awarded
'we don't know the long term effects' = 1 mark

2

[5]

Q31.

any **four** from:

*max **two** marks for a Lamarck explanation*

- mutation produced a bird whose bill was crossed
  *do **not** allow birds decide to mutate*
- birds compete for <u>food</u> / <u>seeds</u>
- mutant crossbill able to obtain food faster / easier / more successfully
- selected for **or** more likely to survive
- reproduce / mate / breed / produce offspring

[4]

Q32.

(a) any **four** from:

- mutation / variation
- produces smaller wings / fatter body
  must be linked to mutation / variation
- wings no longer an advantage since no predators
  allow wings / flight not needed as no predators
- wings no longer an advantage since food on ground
  allow wings / flight not needed as food on ground
- fatter body can store more energy when fruit scarce
- successful birds breed / pass on genes

4

(b) any **one** from:

- evidence has all gone
- no scientists on island at time to record evidence

- no records (from sailors)

1

[5]

Q33.

(a) (i) chromosomes

allow DNA

ignore nucleus

1

(ii) enzymes

1

(b) asexual reproduction / no gametes / no fusion / only one parent

ignore clones

1

cells all contain same genetic information / same genes (as parent) / same DNA

1

(c) can spray crop with herbicide – only weeds killed

crop survives herbicide insufficient

1

(d) any **one** from:

- fears / lack of knowledge about effects of GM food on health

  allow 'think that GM food is bad for health'

  *ignore not natural **or** against religion*

- crop plants may pass on gene to wild plants

- encourages use of herbicides

1

[6]

Q34.

mutation **or** variation **or** range of sizes

*do **not** accept deliberate mutation **or** factor caused mutation*

1

warm(er) / dry(er) now

allow global warming

1

if warmer more smaller lambs / sheep survive winter

award 'survival' point only if linked to warmer / dryer conditions

1

or if warmer sheep do not need fat / wool / fur to keep warm
or if warmer smaller sheep can lose heat more readily / do not overheat / keep cool (so survive)

*do **not** accept smaller sheep retain more heat*

or if warmer smaller sheep have larger SA / V ratio (so survive)

*do **not** accept smaller sheep have smaller SA / V ratio*

or if dryer smaller lambs / sheep need less grass (to survive)

ignore small sheep feed easier on grass

small sheep breed / pass genes / mutations / characteristics to next generation

*do **not** accept if Lamarckian*

ignore competition / predation / human influence

1

[4]

Q35.

any **four** from

- mutation

  *do **not** accept 'had to mutate / decided to mutate'*

- produces longer snake **or** there is variation in snake length

  *do **not** accept 'had to adapt and became longer'*

- longer snake less susceptible to toxin **or** longer snake survives
- survivors reproduce
- gene passed to next generation

  allow characteristic passed to next generation

[4]

Q36.

(a) any **one** from

- chromosomes in pairs
- inherited one of each pair from each parent
- one of each pair in egg **and** one of each pair in sperm
- so sex cells / gametes can have half the number

  allow need to pair during cell division / meiosis

1

(b) any **two** from:

- <u>code</u>
- combination / sequence of amino acids
- forming specific / particular proteins / examples

  *If **no other mark** gained allow reference to controlling characteristics / appearance for **1** mark*

2

(c) (i) C

1

(ii) 30

1

(d) (i) for growth / repair / replacement / asexual reproduction

*do **not** accept incorrect qualification, eg growth of cells **or** repair of cells*

they equals cells therefore do not accept they grow etc

1

(ii) 44 **or** 22 pairs

1

[7]

Q37.

(a) 1 in 4 / 1/4 / 1: 3 / 25% / 0.25

*do **not** accept 3:1 / 1:4 / 2:6*

1

(b) **either** from C **and** D

accept synonyms for dominant / recessive eg Normal / faulty

accept genetic diagram if clearly referring to correct individuals or genotypes on family tree

allow 'gene' for 'allele'

any **three** from:

- C **and** D have disorder

  *ignore **'C & D are carriers'***

- I/J don't have disorder

- C **and** D have dominant **and** recessive alleles

- recessive alleles from C **and** D passed to I/J **or** I/J have two recessive alleles

  *NB if allele was recessive then all offspring of C **and** D would have the disorder = **3** marks*

or from A **and** B

assume response refers to A + B unless contradicted

- A is homozygous recessive / rr, **and** B is heterozygous / Rr can be shown in words or symbols

  allow any symbol

- offspring can be rr **or** Rr described

  allow without key

3

(c) (i) (embryos) checked for inherited / genetic disorders / conditions

accept diseases for disorders

1

(ii) any **three** from:

- C/D have disorder / have dominant allele

  accept disease / condition

accept 'gene' for 'allele'
ignore reference to 'carriers'

- chance of embryo / foetus / child having disorder **or** may pass on alleles for disorder to their offspring
- C/D might want to decide on termination **or** prepare for child with disorder
- G **and** H don.t have disorder / both homozygous recessive / have no dominant alleles (for this disorder)
- so offspring (of G **and** H) cannot / don.t have disorder

3

[8]

Q38.

(a) variation / mutation

1

individuals with characteristics most suited to environment survive

allow survival of the fittest

1

genes passed to next generation **or** these individuals reproduce

1

(b) any **two** from:

- similar in size to Emperor penguin **or** bigger than all penguins
- large size is adaptation to cold climate
- since less heat loss per unit of body volume **or** smaller surface area / volume ratio

2

[5]

Q39.

(a) cystic fibrosis (allele / gene) recessive

allow an annotated genetic diagram

1

carrier has <u>only</u> one cystic fibrosis allele / gene

accept carrier is heterozygous
accept any symbol with key or
accept conventional use of symbols
penalise use of chromosome once only

1

(b) any **one** from:

- Huntington's (allele / gene) dominant
- (to have Huntington's) need only one Huntington's allele / gene

1

[3]

Q40.

(a) both parents **Aa**

accept other upper and lower case letters without key or symbols with a key

allow shown as gametes in punnet square

1

aa in offspring correctly derived from parents /
aa correctly derived from the parents given

ignore other offspring / gametes for this mark parents do not have to be correct

1

offspring **aa** identified as having cystic fibrosis

*may be the only offspring shown **or** circled / highlighted / described*

1

(b) (i) any **one** from:

accept converse if clear eg if you (only) took one it might have cystic fibrosis / might not be fertilised

- sure / greater chance of healthy / non-cystic fibrosis egg / embryo /child

  accept some may have the allele

  reference to suitable embryo is insufficient

- greater chance of fertilisation

1

(ii) ***to gain 3 marks both advantages <u>and</u> disadvantages must be given***

advantages
any **two** from

ignore references to abortion unless qualified by later screening

- greater / certain chance of having child / embryo without cystic fibrosis / healthy
- child with cystic fibrosis difficult / expensive to bring up
- cystic fibrosis (gene / allele) not passed on through generations

disadvantages
any **two** from:

- operation dangers eg infection

  ignore risk unqualified

- ethical or religious issues linked to killing embryos

  accept wrong / cruel to kill embryos accept right to life

- (high) cost

- possible damage to embryo (during testing for cystic fibrosis / during operation)

3

plus

conclusion

a statement that implies a valued, qualified judgement

eg it is right because the risk of infection is small

or
eg it is wrong because embryos are killed

Note: *the conclusion mark cannot be given unless a reasonable attempt to give both an advantage and a disadvantage has (already) been made*

do ***not*** *award the mark if the conclusion only states that advantages outweigh disadvantages*

1

[8]

Q41.

(a) chromosomes

ignore gene / DNA

1

(b) *to obtain* ***3*** *marks candidates must give* ***one****reasonable pro* ***and one*** *reasonable con*

pros eg

any **two** from:

- overcomes shortage of human eggs / rabbits produce lots of eggs

  ignore all embryos identical

- ethical / religious issues with using human embryos
- reduces tests on (adult) humans
- may provide cure for / cause of disease
- embryo not allowed to develop beyond 14 days
- no harm to rabbit
- 99.5 % human genetic information so very similar to human or will react in the same way

max 2

cons eg

any **two** from:

- ethical / religious objections to mixture of human and rabbit genes
- ethical issues with experimenting with rabbits

  allow some people object to using rabbits / cruel to rabbits

- ethical / religious objections to killing embryos
- 0.5% of rabbit genetic information might affect results
- 14 days too short a time to get results

max 2

plus

conclusion eg

- possibility of cure does / does not outweigh ethical / religious objections

  Note: *the conclusion mark cannot be given unless both an advantage and a disadvantage have (already) been given*

- cure does not justify mixing human and animal genes / killing embryos

  *do **not** award the mark if the conclusion only states that advantages outweigh disadvantages*

1

[5]

Q42.

(a) same name to everyone

1

(genus) part gives information on ancestry

1

(b) any **one** from:

- DNA / RNA analysis
- improvements to (electron) microscopes
- improved understanding of biochemical processes
- evidence of internal structures being more developed

1

(c) primitive bacteria / prokaryotes

1

(often) from extreme environments / extremophiles

1

[5]

Q43.

a mutation occurs **or** variation in size / shape of pelvis

allow idea that walking upright needs larger pelvis to bear weight

1

large / wide birth canal / pelvis allowed passage of wide skull / brain

*do **not** allow pelvis became larger to enable birth of larger-skulled babies*

1

link between brain size and intelligence

1

those with larger pelvis / brain more likely to survive / reproduce

1

[4]

Q44.

(a) **A** = Hh **B** = Hh

may not be in answer space

accept heterozygous or description

1

(allele for) polydactyly is dominant **or** polydactyly is H,

for marking points 1, 2 and 3 accept evidence in clearly labelled / annotated genetic diagram

1

cats with polydactyly have H

accept if polydactyly was recessive all offspring would have polydactyly

1

E or (some) offspring of **A** and **B**, does not have polydactyly,
so **A** and **B** must both have h

1

(b) (i) HH **and** Hh **or**
homozygous dominant **and** heterozygous

both required, in either order

allow description

1

(ii) any **one** from:

accept annotated genetic diagram to explain answer

- polydactyly is dominant
- parents are both Hh
- if D is Hh all offspring could inherit H

1

[6]

Q45.

(a) (jellyfish) gene(s) cut out

1

ref to enzymes (at any stage)

1

(gene) transferred to zebra fish at early stage of development / embryo / egg

ignore removal of zebra fish genes

1

(b) any **two** from:

ignore unethical / religious / unnatural

- could transfer gene to other (fish) species
- effects on food chains

accept effects on other species / humans who eat them

- effects on zebra fish themselves, eg may out compete non GM zebra fish

2

[5]

Q46.

(a) 18.06 / 18 / 18.1

*correct answer gains **2** marks*
if answer incorrect evidence of
(4131 - 3499) ÷ 3499 × 100
***or** 632 ÷ 3499 × 100*
***or** ((4131 ÷ 3499) × 100) - 100*
***or** 0.18*
*gains **1** mark*

2

(b) antibiotics kill non-resistant strain
or resistant strain bacteria survive

accept resistant strain the successful competitor
*do **not** accept intentional adaptation*
ignore strongest / fittest survive
ignore mutation
ignore people do not finish antibiotic course

1

resistant strain bacteria reproduce
or resistant strain bacteria pass on genes

1

population of resistant strain increases **or** proportion of resistant bacteria increases

allow high numbers of resistant bacteria

or
people more <u>likely</u> to be infected by resistant strain (than non-resistant strain)

1

[5]

Q47.

(a) (i) (alternative) forms / types of <u>a</u> / the same gene

1

(ii) only expressed if 2 copies inherited
or not expressed if other allele present

allow over ruled / over powered by the other allele

1

(b) (i) **Nn**

ignore heterozygous

1

(ii) genetic diagram including:

accept alternative symbols, if defined

gametes: **N** and **n** from <u>both</u> parents

accept alternative symbols if correct for answer to (b)(i)

1

correct derivation of offspring genotypes:
NN Nn Nn nn

allow if correct for candidate's parental genotypes / gametes

1

identification of **nn** as having cystic fibrosis

1

(c) **Argued evaluation**

any **four** from:

- PGD <u>higher</u> financial cost
  accept CVS <u>only</u> costs £600
- PGD occurs before pregnancy / implantation
  accept detected at <u>earlier</u> stage so less unethical / less trauma
- PGD does not involve abortion so less trauma / less pain / ethical