



# **KS3 Science**

## **Genetics**

### **Question Paper**

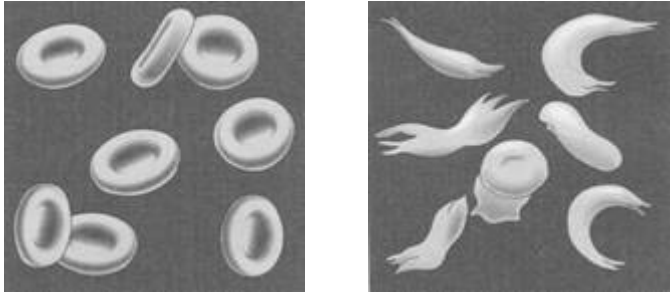
**Time available: 43 minutes**

**Marks available: 47 marks**

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1.

Sickle-cell anaemia is an inherited disease which can be fatal. People with sickle-cell anaemia have sickle-shaped red blood cells.



(a) Sickle-shaped red blood cells can become tangled together. Suggest **one** consequence of this.

.....  
.....

1 mark

(b) Red blood cells contain a chemical called haemoglobin. People with sickle-cell anaemia produce an abnormal form of haemoglobin which crystallises at low oxygen concentrations. Explain why the abnormal haemoglobin is likely to crystallise as the blood flows through the tissues, such as muscle.

.....  
.....

1 mark

(c) Malaria is another disease which can be fatal. The micro-organism which causes malaria spends part of its life cycle inside human red blood cells. The table shows how a person's type of haemoglobin affects their chances of getting malaria.

| Person's type of haemoglobin produced | does the person suffer from sickle-cell anaemia | will the person catch malaria easily? |
|---------------------------------------|---|---------------------------------------|
| normal only                           | no  | yes                                   |
| a mixture of normal and abnormal      | only slightly                                   | no                                    |
| abnormal only                         | yes   | no                                    |

The type of haemoglobin a person makes is an inherited characteristic. In areas where malaria is common, there are more people in each successive generation with a mixture of both normal and abnormal haemoglobin. Explain why.

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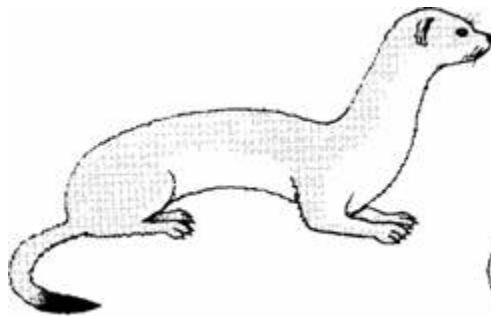
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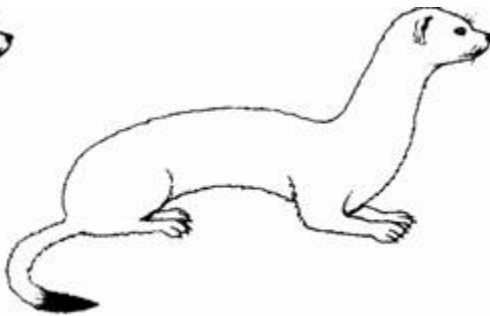
2 marks  
Maximum 4 marks

2.

(a) The drawings below show a stoat in summer and in winter.



stoat in summer



stoat in winter

In winter the ground is often covered by snow or frost. During this part of the year a stoat's fur is white.

Suggest **two** ways its white coat helps a stoat to survive in the winter.

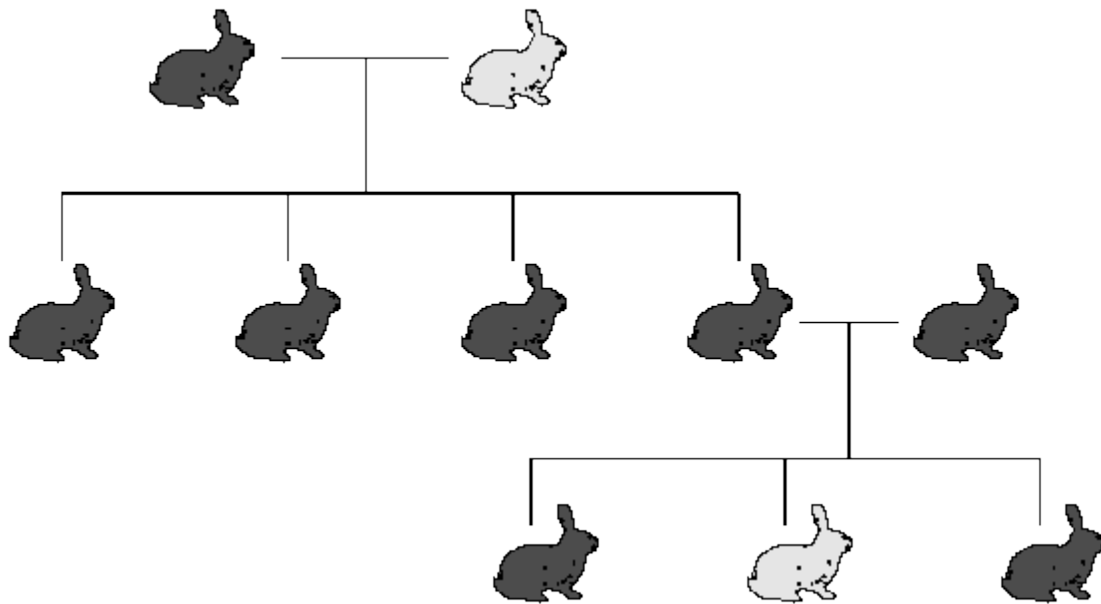
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2 marks

(b) The diagram shows the family tree for a family of rabbits.



Use words from the list below to complete the sentences.

- adapt      cytoplasm      genes      grow      inherit**  
**letters      membrane      mutate      nuclei**

Rabbits have the same fur colour all year round.

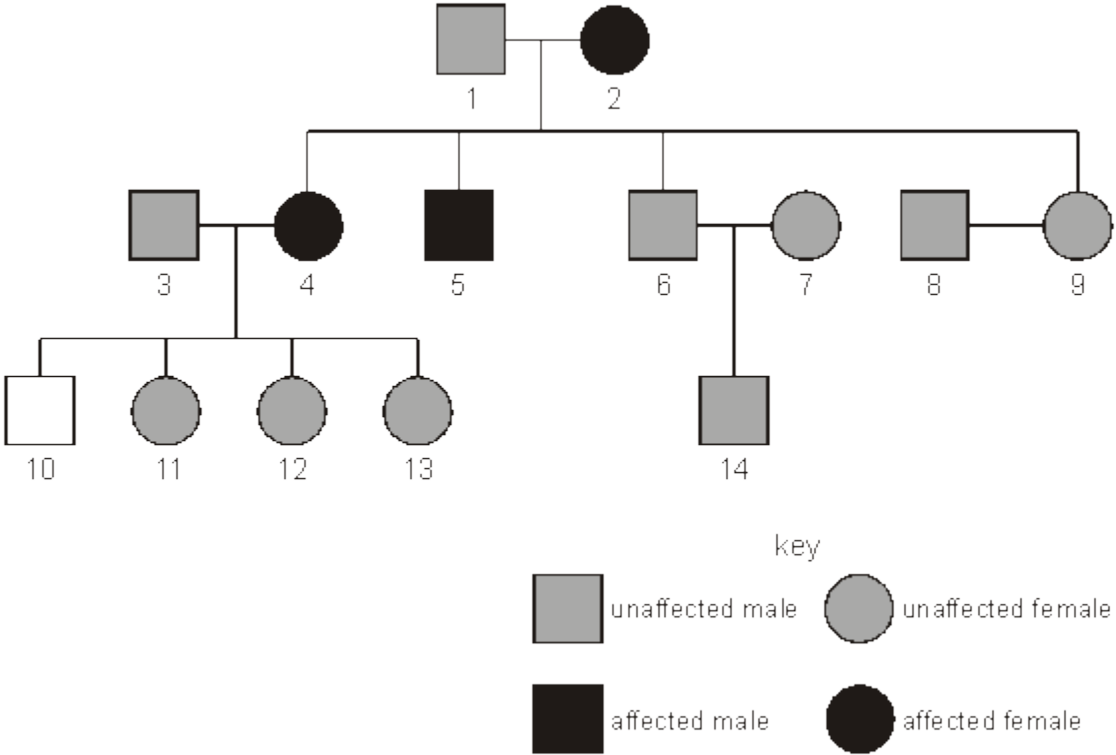
Young rabbits ..... fur colour from their parents.

Information about fur colour is passed on from one generation to the next in the form of ..... in the ..... of an egg and sperm.

3 marks  
Maximum 5 marks

3.

The diagram shows a family tree in which some members of the family had a hereditary disease. The disease is caused by a dominant allele.



(a) In the questions below, use **G** to represent the dominant allele for the disease, and **g** to represent the normal allele.

(i) Give the genotype of the grandmother, person 2.

.....

1 mark

(ii) Explain how you arrived at your answer.

.....  
.....  
.....  
.....

2 marks

(b) (i) Give the genotype of person 5.

.....

1 mark

(ii) Explain how you arrived at your answer.

.....  
.....

1 mark

(c) Person 10 died soon after birth. What is the possibility that he would have developed the disease if he had survived?

.....

1 mark

(d) Harmful alleles like allele **G** arise because of mutation.

(i) Explain what is meant by mutation.

.....  
 .....

1 mark

(ii) State **one** cause of mutation.

.....

1 mark

Maximum 8 marks

**4.**

Human twins may result from:

either the fertilisation of two separate eggs, released together;

or the fertilisation of a single egg which then divides into two cells, each cell developing into a baby.

The table below gives information about three sets of twins.

| sets of twins | name    | blood group | eye colour | mass in kg | sex    |
|---------------|---------|-------------|------------|------------|--------|
| set 1         | Sasha   | A           | brown      | 37         | female |
|               | Ninvata | AB          | brown      | 37         | female |
| set 2         | Lucy    | O           | brown      | 38         | female |
|               | Tom     | O           | brown      | 32         | male   |
| set 3         | Fred    | O           | blue       | 34         | male   |
|               | Jack    | O           | blue       | 36         | male   |

(a) Which **one** of the characteristics below **cannot** be used to decide whether twins have come from a single egg or two eggs?

Tick the correct box.

|             |                          |      |                          |
|-------------|--------------------------|------|--------------------------|
| blood group | <input type="checkbox"/> | mass | <input type="checkbox"/> |
| eye colour  | <input type="checkbox"/> | sex  | <input type="checkbox"/> |

1 mark

- (b) (i) Use the information in the table to suggest which set of twins could have come from a single egg.

.....

1 mark

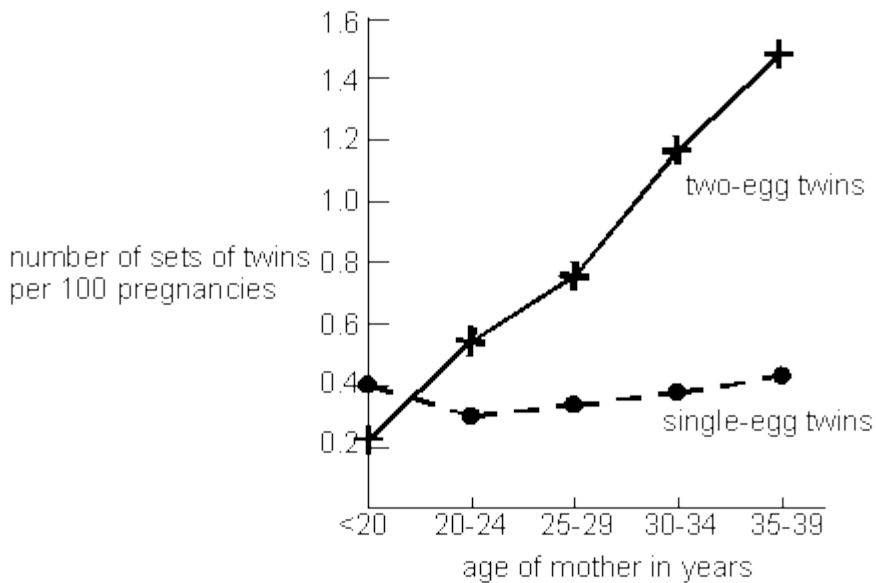
- (ii) Explain why you have suggested this set of twins.

.....

.....

1 mark

- (c) The graph shows the number of sets of single-egg and two-egg twins born to mothers of different ages.



Two hormones, produced by the pituitary gland, cause eggs to develop in the ovary.

Which statement could explain the results shown on the graph?

Tick the correct box.

As women get older, their ovaries do not respond to either of the hormones.

As women get older, they are less likely to give birth to single-egg twins.

As women get older, they produce more of each hormone.

As women get older, their ovaries release two eggs every month.

1 mark

(d) There are two types of cell division, meiosis and mitosis.

(i) Why are eggs and sperms produced by **meiosis**?

.....  
.....

1 mark

(ii) Why does a fertilised egg divide by **mitosis**?

.....  
.....

1 mark

Maximum 6 marks

**5.**

Burmese cats always have dark brown fur. Siamese cats always have pale brown fur. This is because they are both homozygous for coat colour. Coat colour is controlled by a pair of alleles.

(a) If **S** represents the allele for Siamese and **B** represents the allele for Burmese, which pair of alleles for coat colour is present in:

Siamese cats? .....

Burmese cats? .....

1 mark

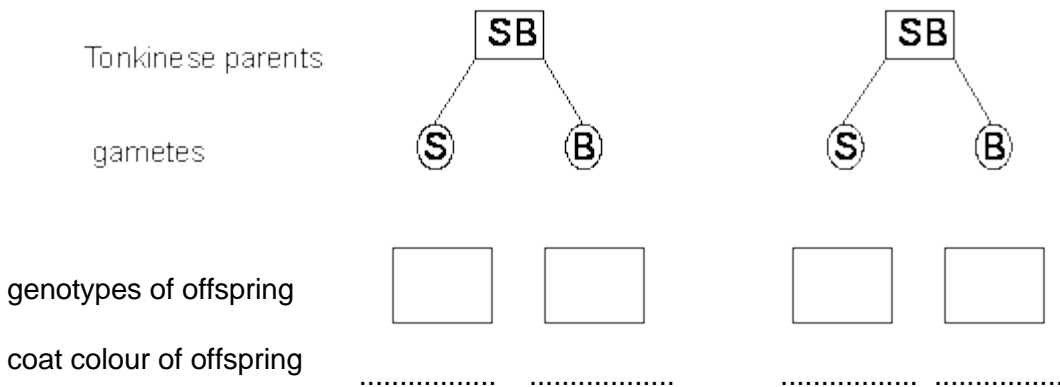
When a Siamese cat is crossed with a Burmese cat, the kittens are called Tonkinese. They have a mid-brown coat colour in between the colours of the parents.

(b) Complete the diagram to show how two Tonkinese cat can produce a litter containing kittens with all three different coat colours.

(i) Draw **two** lines from each gamete to the boxes to represent fertilisation.

1 mark

(ii) In each blank box, write the genotype of the offspring, and on the line below each box write the coat colour of the offspring.



1 mark



(c) Explain why neither of the alleles for coat colour can be described as dominant.

.....  
.....

1 mark

(d) There are two forms of cell division: mitosis and meiosis. The table below contains statements about cell division.

For each statement, place **one** tick in the appropriate row.

| statement   | mitosis only | meiosis only | both mitosis and meiosis |
|---|--------------|--------------|--------------------------|
| occurs only in reproductive organs                        |              |              |                          |
| replaces worn out body cells                              |              |              |                          |
| DNA or genetic information is copied before cell division |              |              |                          |
| number of chromosomes in a cell is halved                 |              |              |                          |

4 marks  
Maximum 8 marks

**6.** Plants can be grown from cuttings or from seeds.

(a) The production of plants from cuttings is an example of asexual reproduction. Pelargoniums ('geraniums') produced from cuttings have the same leaf pattern and flower colour as the parent plant from which they were taken.

(i) Name the type of cell division which takes place during the growth of plants from cuttings.

.....

1 mark

(ii) Why are all the plants grown from these cuttings identical?

.....  
.....

1 mark

(b) Pelargoniums grown from seeds, which are produced by sexual reproduction, often have different leaf patterns and flower colours from their parent plants.

(i) Name the type of cell division which occurs only during sexual reproduction.

.....

1 mark

(ii) Why are pelargoniums grown from seeds often different from each other and from the parent plants?

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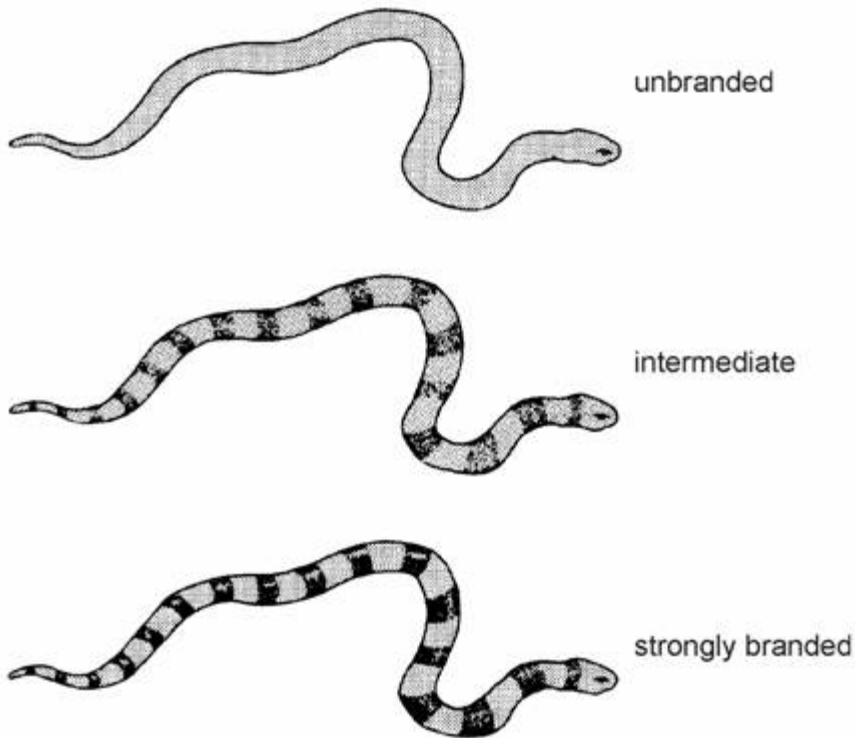
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1 mark  
Maximum 4 marks

7.

The water snake *Natrix sipedon* lives on small islands in Lake Erie in North America and on the nearby mainland.

The colour pattern on the body of the snakes is inherited. There are three body patterns.



A survey of the snakes on the islands gave the following results:

| <b>body pattern</b> | <b>percentage of newly hatched snakes</b> | <b>percentage of adult snakes</b> |
|---------------------|---|-----------------------------------|
| unbanded            | 8   | 37                                |
| intermediate        | 74  | 58                                |
| strongly banded     | 18  | 5                                 |

(a) (i) Which body pattern seems to improve the chances of survival to adulthood?

.....

1 mark

(ii) Explain how camouflage helps snakes to survive.

.....

.....

1 mark

There is much more vegetation on the mainland than on the islands.  
Most of the snakes on the mainland are strongly banded.

Snakes from the mainland interbreed with snakes on the islands.

(b) (i) Suggest how the proportions of strongly banded and unbanded snakes on the islands would change over a number of years if this interbreeding stopped.

.....

.....

1 mark

(ii) Explain your answer with reference to the genes for body pattern.

.....

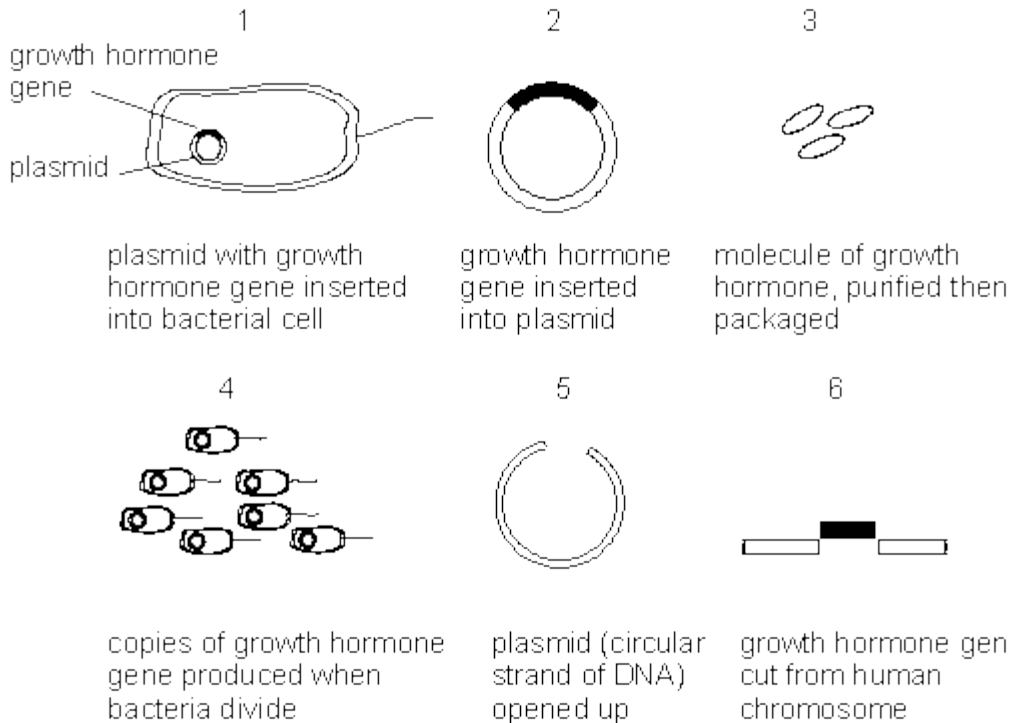
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2 marks  
Maximum 5 marks

8.

Genetic engineering can be used to prepare human growth hormone using bacteria. The diagrams represent six stages in the process. They are not in the order, and they are not drawn to scale.



(a) Put the stages shown in the diagrams above in the correct order. Two stages have already been put in for you.

|   |  |  |  |  |   |
|---|--|--|--|--|---|
| 6 |  |  |  |  | 3 |
|---|--|--|--|--|---|

1 mark

(b) Give **two** reasons why these bacteria are used in this process.

1. ....  
.....

1 mark

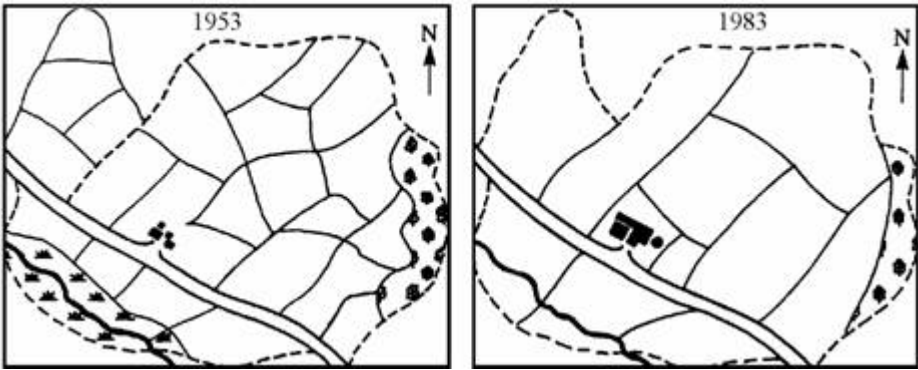
2. ....  
.....

1 mark

Maximum 3 marks

9.

The drawings show changes to a farm between 1953 and 1983.



**Key**

|           |       |
|-----------|-------|
| Hedges    | —     |
| Boundary  | - - - |
| River     | —     |
| Buildings | ■ ■   |
| Trees     | ⊕ ⊕   |
| Marsh     | ⊕ ⊕ ⊕ |

The fields on the farm are separated by hedges.

(i) Give **two** major changes which were made to the land on this farm between 1953 and 1983.

1 .....

2 .....

(2)

(ii) How would these changes affect the number of wild animals which live on the farmland?

.....

Explain your answer.

.....

.....

(2)

(Total 4 marks)