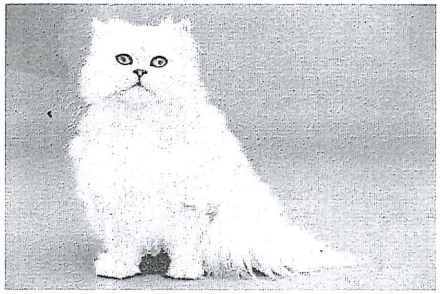
B2.4 Genome, Chromosomes, DNA and Genetics ~ Test Name: _____ Date: _____

Score: 179 __%

1. The length of hair in cats is an inherited characteristic controlled by genes.



© Fuse / Thinkstock

The allele for long hair is dominant to the allele for short hair.
Let H represent the allele for long hair.
Let h represent the allele for short hair.

**(a)** Use a Punnett square to show the possible offspring produced by breeding a heterozygous long haired cat with a short haired cat.

[4]

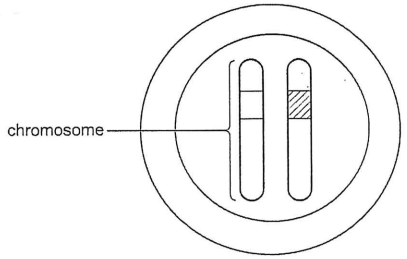
**(b)** Give the phenotypes of the offspring and the ratio of the phenotypes.

Phenotypes _____ and _____

Ratio _____ [2]

| Examiner Only | |
|---|---|
| Marks | Remark |
| | |

2. **(a)** The diagram below shows a cell containing a nucleus with two chromosomes.




© CCEA

**(i)** Name the molecule that makes up chromosomes.

_____ [1]

**(ii)** In the space below, draw the cells and chromosomes that would be produced when this cell divides by **mitosis**.

[3]

| Examiner Only | |
|---|---|
| Marks | Remark |
| | |

**(b)** Genes control characteristics in organisms.

Peas can be smooth or wrinkled.

This characteristic is shown in the photograph below.

smooth wrinkled



Let H represent the allele for smooth peas.

Let h represent the allele for wrinkled peas.

**(i)** Using a Punnett square, show the possible offspring produced when a heterozygous, smooth pea plant is crossed with a wrinkled pea plant.

[4]

**(ii)** Using your Punnett square, give the ratio of smooth pea plants to wrinkled pea plants.

_____ [1]

Examiner Only
Marks | Remark

**(c)** Explain how a test (back) cross could be used to determine the possible genotypes of a smooth pea plant.

_____

_____

_____

_____

_____ [3]

Examiner Only
Marks | Remark

**3.** Cell division takes place by mitosis or meiosis.

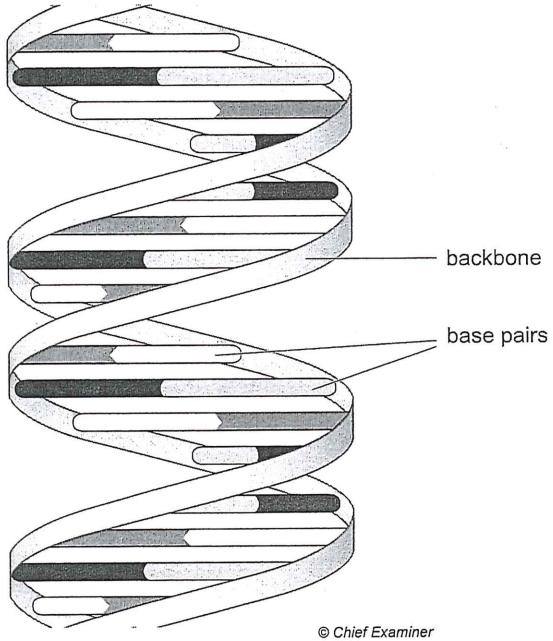
Complete the table by placing a tick (✓) if the feature is correct or an (✗) if the feature is not correct.

| Feature | Type of cell division | |
|---|---|---|
| | Mitosis | Meiosis |
| Exact copy made of cell | | |
| Used to replace damaged cells | | |
| Produces 4 haploid cells | | |

[3]

Examiner Only
Marks | Remark

4. Chromosomes are structures found in the nucleus of a cell.
Chromosomes are made of DNA.
The diagram shows a DNA molecule.






**(a)** What term describes the shape of the DNA molecule?

_____ [1]

**(b)** Name the **two** chemicals that make up the backbone of DNA.

1. _____

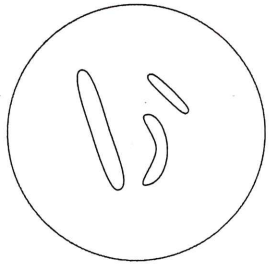
2. _____ [2]

**(c)** A DNA molecule has four different bases.
Give the **two** base pairs in a DNA molecule.

1. _____ and _____

2. _____ and _____ [2]

5. **(a)** The diagram shows the nucleus of a cell that has been produced by meiosis.
It contains three chromosomes.



In the space draw the nucleus of this cell **before** it divided by meiosis.

[2]

**(b)** **(i)** Name **one** part of the human body where meiosis takes place.

_____ [1]

**(ii)** How many haploid cells are produced from one cell during meiosis?

_____ [1]

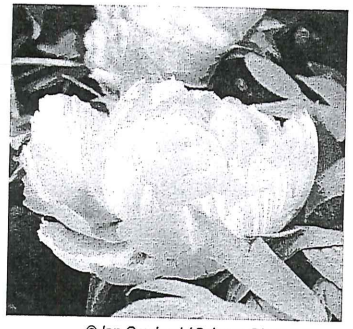
**(iii)** Human eggs and sperm each contain 23 chromosomes.
Explain the significance of this during fertilisation in terms of chromosome numbers.

_____

_____

_____ [1]

6. Peony plants have plain red or red striped flowers.
The photograph shows a red striped peony flower.



© Ian Gowland / Science Photo Library

In peony flowers the allele **R** for plain red colour is dominant.
The allele **r** for red striped flowers is recessive.

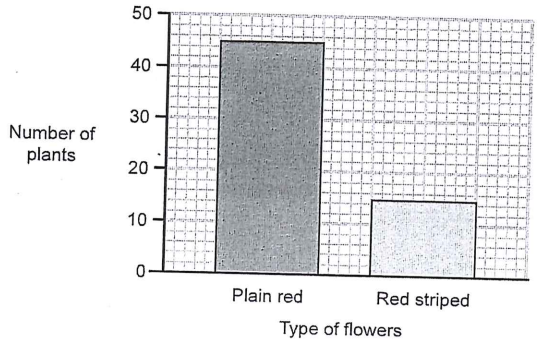
**(a)** A peony plant, homozygous for plain red flowers, is crossed with a heterozygous peony plant.
Draw a Punnett square to show the genotypes of the flowers that would be produced from this cross.

[4]

**(b)** A breeder has a peony plant with plain red flowers.
She is unsure of its genotype.
Draw Punnett squares to show how she could use a test (back) cross to find out the genotype of this plant.

[4]

**(c)** Seeds were collected from another peony plant.
When plants were grown from these seeds the types of flowers produced were counted.
The bar graph shows the results.




**(i)** Use the graph to give the ratio of plain red flowers to red striped flowers produced from these seeds.

_____ to _____ [1]

**(ii)** Use the graph to give the type of variation shown by these flowers.

_____ [1]

**(iii)** Name a human characteristic that shows this type of variation.

_____ [1]

7.

**(a)** A protein, produced by genetically engineered bacteria, is used to treat diabetes. Name this protein.

_____ [1]

**(b)** A different protein, called chymosin, is used to make cheese from milk.
For many years it was obtained from the stomachs of calves.
It is now produced using genetically engineered bacteria.

**(i)** Draw a **labelled** diagram in Box 1 to show the chymosin gene in a calf's DNA. [2]

**(ii)** Draw a **labelled** diagram in Box 2 to show a bacterial plasmid after the chymosin gene has been inserted into it. [2]

Box 1

Box 2

**(iii)** The genetically engineered bacteria are placed in a fermenter.
What do these bacteria do to produce large amounts of chymosin?

_____ [1]

**(iv)** Name the type of molecule used by the bacteria to build up the chymosin protein.

_____ [1]

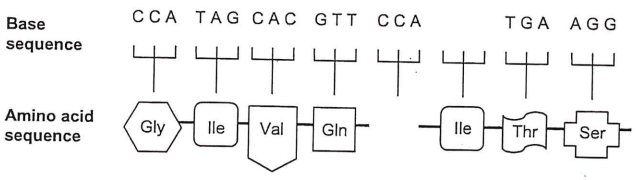
**(v)** Genetically engineered bacteria produce large amounts of chymosin.
Suggest **one other** advantage of producing chymosin using genetic engineering.

_____

_____ [1]

8.

**(a)** The diagram below shows part of the base sequence of DNA which is used to code for specific amino acids. The amino acids join to make a protein molecule such as insulin.




**(i)** Complete the diagram by:

- adding the missing three bases in the base sequence.
- drawing the missing amino acid in the amino acid sequence. [2]

**(ii)** Insulin is a protein made up of 51 amino acids.

How many bases are needed to code for this protein?

_____ [1]

**(iii)** Explain what would happen if the first base (C) in the base sequence above was removed.

_____

_____

_____ [2]

| Examiner Only | |
|---|---|
| Marks | Remark |
| | |

(b) Bacteria can be genetically engineered to make human insulin to treat people with diabetes.

| Examiner Only | |
|---|---|
| Marks | Remark |
| | |

(i) Draw a genetically engineered bacterium which contains a gene for human insulin.

Label the human insulin gene and the plasmid.

[3]

(ii) The genetically engineered bacterium is placed in a fermenter with optimum conditions.

What happens next so that large quantities of human insulin can be produced?

_____ [1]

(iii) Until scientists developed the process of producing insulin by genetic engineering, it was obtained from cows and pigs.

State **two** advantages of producing human insulin by genetic engineering.

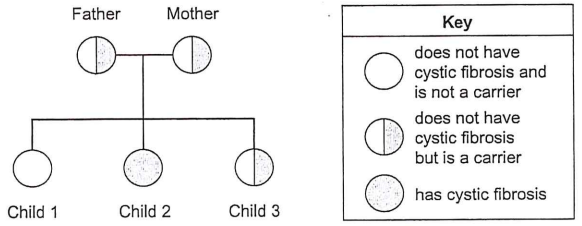
_____

_____

_____ [2]

(c) Cystic fibrosis is an inherited condition. The diagram below shows how two parents who are carriers can have a child with cystic fibrosis.

A carrier is a person who has an allele for a condition but does not have the condition.




(i) Using the diagram and your knowledge, explain how two parents who are carriers can have a child with cystic fibrosis.

_____

_____

_____

_____ [2]

(ii) Anne and Niall have a child with cystic fibrosis.

Anne is pregnant with a second baby and has asked her doctor for information on genetic screening.

Suggest two ethical issues associated with genetic screening during pregnancy.

1. _____

2. _____ [2]

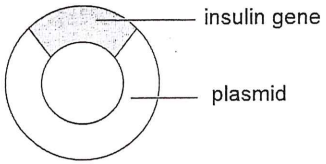
(iii) Cystic fibrosis is caused by a change in the genes.

Name one genetic condition that is caused by a change in the **number of chromosomes**.

_____ [1]

| Examiner Only | |
|---|---|
| Marks | Remark |
| | |

9. Insulin is a hormone which can be made using genetic engineering.
Bacteria are used in this process.
The diagram shows a stage in the production of human insulin by genetic engineering.




(a) Describe **three** stages required to produce the plasmid shown in the diagram.

[3]

(b) The plasmid containing the insulin gene is placed back into a bacterium.
Explain how this genetically engineered bacterium can be used to produce large quantities of insulin in a short period of time.

[1]

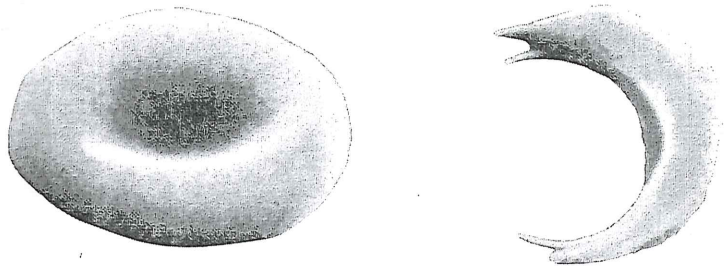
(c) State **two other** advantages of producing human insulin by this method.

[2]

(d) Name the condition that insulin is used to treat.

[1]

10. Sickle cell anaemia is a recessive inherited condition which affects red blood cells.
The photograph shows a normal red blood cell and a sickle-shaped red blood cell.





People who are homozygous recessive for the condition suffer from sickle cell anaemia.
People who are heterozygous for the condition are carriers for sickle cell anaemia.

Let b represent the allele for sickle cell anaemia.

(a) Draw a Punnett square to show how two parents who do **not** suffer from sickle cell anaemia could have a child who does suffer from sickle cell anaemia.

[4]

(b) The National Health Service (NHS) offers screening to some parents during pregnancy so they can find out if they are carriers for sickle cell anaemia. This will inform them if they are at risk of having a baby with sickle cell anaemia.

The mother is screened first. The father is only screened if the mother is a carrier.

(i) Explain why it is **only necessary** to screen the father if the mother is a carrier for sickle cell anaemia.

[1]

(ii) Suggest the benefit **to the NHS** of only screening the father if the mother is a carrier for sickle cell anaemia.

[1]