GCSE Biology

Variation and Evolution

Question Paper

Time available: 65 minutes
Marks available: 55 marks

www.accesstuition.com

1.

Our understanding of genetics and inheritance has improved due to the work of many scientists.

(a) Draw **one** line from each scientist to the description of their significant work.

Scientist	Description of significant work
Charles Darwin	Carried out breeding experiments on pea plants.
Alfred Russel Wallance	Wrote 'On the origin of species'.
Gregor Mendel	Worked on plant defence systems.
	Worked on warning colouration in animals.

(3)

(b) In the mid-20th century the structure of DNA was discovered.

What is a section of DNA which codes for one specific protein called?

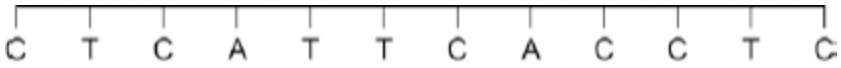
_____

(1)

(c) **Figure 1** shows one strand of DNA.

The strand has a sequence of bases (A, C, G and T).

Figure 1



How many amino acids does the strand of DNA in **Figure 1** code for?

Tick **one** box.

2 ☐

3 ☐

4 ☐

6 ☐

(1)

(d) Mutations of DNA cause some inherited disorders.

One inherited disorder is cystic fibrosis (CF).

A recessive allele causes CF.

Complete the genetic diagram in **Figure 2**.

- Identify any children with CF.
- Give the probability of any children having CF.

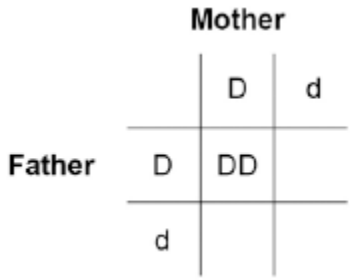
Each parent does not have CF.

The following symbols have been used:

D = dominant allele for **not** having CF

d = recessive allele for having CF

Figure 2



Probability of a child with CF = _____

(3)

(e) What is the genotype of the mother shown in **Figure 2**?

Tick **one** box.

Heterozygous ☐

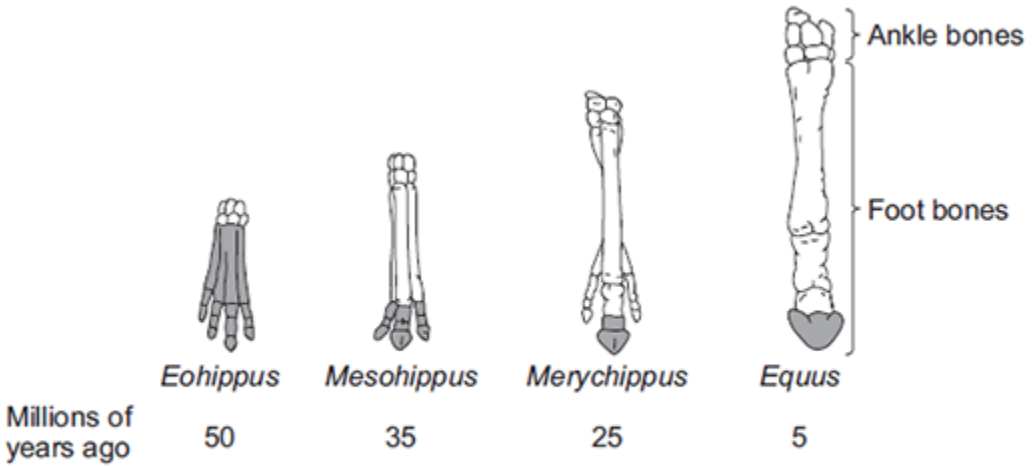
Homozygous dominant ☐

Homozygous recessive ☐

(1)

(Total 9 marks)

2. The diagram below shows changes in the foot bones of four ancestors of modern horses over the past 50 million years.



Key: The shaded bones are the bones which touched the ground.

(a) Describe **two** changes to the bones in the feet of horses that have taken place over the past 50 million years.

_____

_____

_____

_____

(2)

(b) *Eohippus* lived in swampy areas with soft mud.

Since this time the ground in the habitat has become drier and harder.

All of the horse ancestors were preyed upon by other animals.

(i) Explain **one** advantage to *Eohippus* of the arrangement of bones in its feet.

_____

_____

_____

_____

(2)

(ii) The changes in the arrangement of the foot bones of horses support Darwin's theory of evolution by natural selection.

Explain how the arrangement of the foot bones of *Eohippus* could have evolved into the arrangement of the foot bones of *Equus.*

(4)

(Total 8 marks)

3. **Figure 1** is a map showing a group of islands in the Pacific Ocean, near the coast of California, USA.

Figure 1

A species of fox, called the Island Fox, lives on each of the six islands shown in **Figure 1**.

Figure 2 shows an Island Fox.

Figure 2

© GaryKavanagh/iStock

The foxes on each island are slightly different from those on the other islands.

The Island Foxes are similar to another species of fox, called the Grey Fox.

The Grey Fox lives in mainland California.

(a) Suggest how scientists could prove that the six types of Island Fox belong to the same species.

(2)

(b) Scientists believe that ancestors of the modern Island Fox first colonised what is now Santa Cruz Island during the last Ice Age, approximately 16 000 years ago. At that time, lowered sea levels made the three northernmost islands into a single island and the distance between this island and the mainland was reduced to about 8 km.

(i) How could the Island Fox have developed into a completely different species from the mainland Grey Fox?

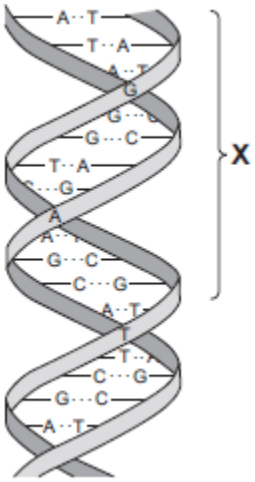
(5)

(ii) Suggest why the Island Foxes have developed into different varieties of the same species instead of six different species.

(1)

(Total 8 marks)

4. The diagram shows part of a DNA molecule.



(a) (i) In which part of an animal cell is DNA found?

_____

(1)

(ii) Complete the following sentence.

The letters **A**, **C**, **G** and **T** in the diagram represent four different compounds

called _____ .

(1)

(iii) One strand of the DNA, in the section labelled **X**, contains the following sequence of these compounds:

T A T G G G T C T T C G

How many amino acids would this section of the DNA code for? ☐

(1)

(iv) The section of DNA described in part **(a) (iii)** is a small part of a gene.

The sequence of compounds **A**, **C**, **G** and **T** in the gene is important.

Explain why.

_____

_____

_____

_____

(2)

(b) *Read the following information about genetic engineering.*

The caterpillar of the European Corn Borer moth feeds on the fruits of maize (sweet corn). There is a chemical called Bt-toxin which is poisonous to the corn borer caterpillar but not to humans.

Scientists carried out the following steps.

1. The Scientists made a bacterial plasmid to which they added two genes:
   - **Bt** gene, which coded for production of the Bt-toxin
   - **kan^r** gene, which coded for resistance to an antibiotic called kanamycin.

2. They used this plasmid to produce genetically modified bacteria which could invade plant cells.

3. They mixed these genetically modified bacteria with pieces cut from maize leaves.

4. They placed the pieces of maize leaf on agar jelly in a Petri dish. The agar jelly contained the antibiotic, kanamycin. The kanamycin killed most of the pieces of maize leaf, but a few survived.

5. They took some cells from the surviving pieces of maize leaf and grew them in tissue culture.

The result was maize plants that now contained the **Bt** gene, as well as the **kan^r** gene, in all of their cells.

(i) What is a **plasmid** (Step 1)?

_____

_____

_____

_____

(2)

(ii) Why did the scientists add **kanamycin** to the agar jelly (Step 4)?

_____

_____

_____

_____

(2)

(iii) The scientists grew each Bt-maize plant from a single cell which contained the **Bt** gene.

Explain why **all** the cells in the Bt-maize plant contained the **Bt** gene.

_____

_____

_____

_____

(2)

(iv) Kanamycin is an antibiotic.

Some scientists are concerned that the gene for kanamycin resistance has been put into maize.

Suggest why.

_____

_____

_____

_____

_____

_____

(2)

(Total 13 marks)

5. Kangaroos have brown coats. The two parent kangaroos in the photograph produced a baby kangaroo with a white coat.

Photographs supplied by iStockphoto/Thinktsock

(a) Use words from the box to complete the sentences.

asexual	**characteristic**	**chromosome**
mutation	**nucleus**	**sexual**

The baby kangaroo was produced by _____ reproduction.

The coat colour of the adult kangaroo is a _____

The different coat colour of the baby kangaroo is the result of a

_____ of a gene.

The gene is found on a thread-like structure called a _____

(4)

(b) Some animals similar to kangaroos are endangered species.

Cloning is one way of making sure that endangered species do not die out.
The flowchart below shows one way of cloning an animal.

The four statements needed to complete the flowchart are numbered **1**, **2**, **3** and **4**.

Complete the flow chart by writing the **number** of the correct statement in the empty box.

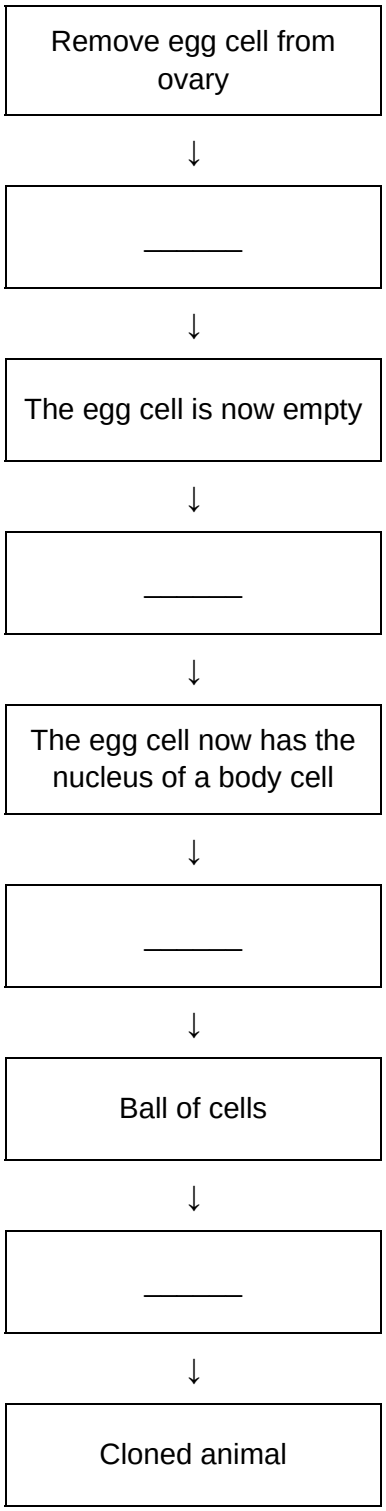
Each number should be used **once** only.

1 Give a small electric shock

2 Transfer nucleus from body cell

3 Remove nucleus from egg cell

4 Insert embryo into womb of female

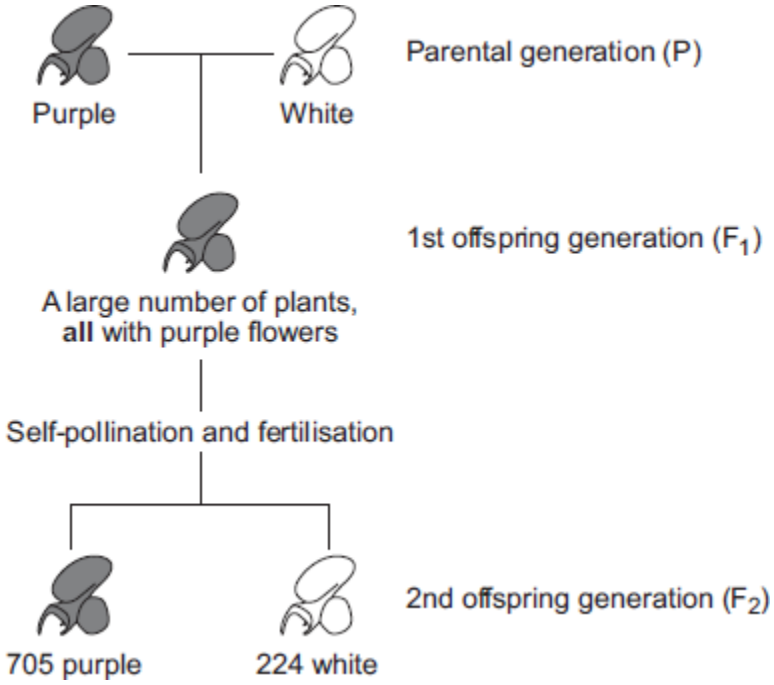


(3)

(Total 7 marks)

6. In 1866, Gregor Mendel published the results of his investigations into inheritance in garden pea plants.

The diagram below shows the results Mendel obtained in one investigation with purple-flowered and white-flowered pea plants.



(a) (i) Calculate the ratio of purple-flowered plants to white-flowered plants in the F_2 generation.

Ratio of purple : white = _____

(1)

(ii) There was a total of 929 plants in the F_2 generation.

Mendel thought that the production of a large number of offspring plants improved the investigation.

Explain why.

_____

_____

_____

_____

(2)

(b) (i) Some of the plants in the diagram are homozygous for flower colour and some are heterozygous.

Complete the table to show whether each of the plants is homozygous or heterozygous. For each plant, tick (✓) **one** box.

	Homozygous	**Heterozygous**
Purple-flowered plant in the P generation		
White-flowered plant in the P generation		
Purple-flowered plant in the F_1 generation		

(2)

(ii) Draw a genetic diagram to show how self-pollination of the F_1 purple-flowered plants produced mainly purple-flowered offspring in the F_2 generation together with some white-flowered offspring.

Use the following symbols:

N = allele for purple flower colour
n = allele for white flower colour

(3)

(c) When Mendel published his work on genetics, other scientists at the time did not realise how important it was.

Suggest **two** reasons why.

1. _____

_____

2. _____

_____

(2)

(Total 10 marks)