

Tuesday 20 June 2017 – Morning

A2 GCE BIOLOGY

F215/01 Control, Genomes and Environment

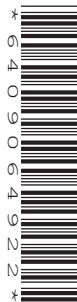
Candidates answer on the Question Paper.

OCR supplied materials:
None

Other materials required:

- Electronic calculator
- Ruler (cm/mm)

Duration: 2 hours



Candidate forename		Candidate surname								
Centre number						Candidate number				

INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Answer **all** the questions.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Write your answer to each question in the space provided. If additional space is required, you should use the lined pages at the end of this booklet. The question number(s) must be clearly shown.
- Do **not** write in the barcodes.

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets [] at the end of each question or part question.
- The total number of marks for this paper is **100**.
-  Where you see this icon you will be awarded marks for the quality of written communication in your answer.
- You may use an electronic calculator.
- You are advised to show all the steps in any calculations.
- This document consists of **24** pages. Any blank pages are indicated.

- Suggest **two** ways in which an ecosystem can change over time.

Describe how you would measure the energy content, in kJ, in the **producer level** of one square metre of grassland.

[5]

(b) The Galapagos fauna includes the Galapagos giant tortoise, *Chelonoidis nigra*. *C.nigra* originally colonised one island in the Galapagos group. Accidentally carried on local currents, the tortoise subsequently colonised new islands as they emerged. Restricted gene flow between isolated islands and differing conditions on them has led to the evolution of various subspecies.

- (i) New species may be formed when parts of a population become isolated by a barrier such as sea channels between islands. What name is given to this type of isolating mechanism?

..... [1]

- (ii) What new sources of evidence, not available to researchers before about 1970, can be used to classify subspecies of the giant tortoise?

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..... [2]

- (iii) Suggest why the different populations of *C.nigra* are classified as subspecies rather than different species.

.....

..... [1]

- (c) The giant tortoise can survive for long periods without food.

Suggest why giant tortoises are able to survive better than mammals for long periods without food.

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..... [2]

- (d) A 200 kg tortoise can eat 35 kg of vegetation biomass **per day**. It is estimated that in one year in the 19th Century, 4000 tortoises were removed from the islands.
- (i) Calculate how much extra biomass would be available for other herbivores on the islands in that **year** as a result of the removal of the tortoises.

Answer = [2]

- (ii) What effect would the removal of the tortoises have on the populations of the other herbivores on the Galapagos islands?

Explain your answer.

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..... [1]

- (e) Capturing or killing Galapagos tortoises for any reason is now illegal.

State an economic **benefit** to the islanders of giant tortoise conservation.

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..... [1]

[Total: 17]

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Question 2 begins on page 6

2 Auxins are a group of plant hormones (plant growth substances).

(a) Name the growth response that makes plants grow towards the source of light.

..... [1]

(b) Fig. 2.1 shows an experiment to investigate the role of auxins in barley seedlings. The investigation was carried out in a laboratory in evenly distributed light.

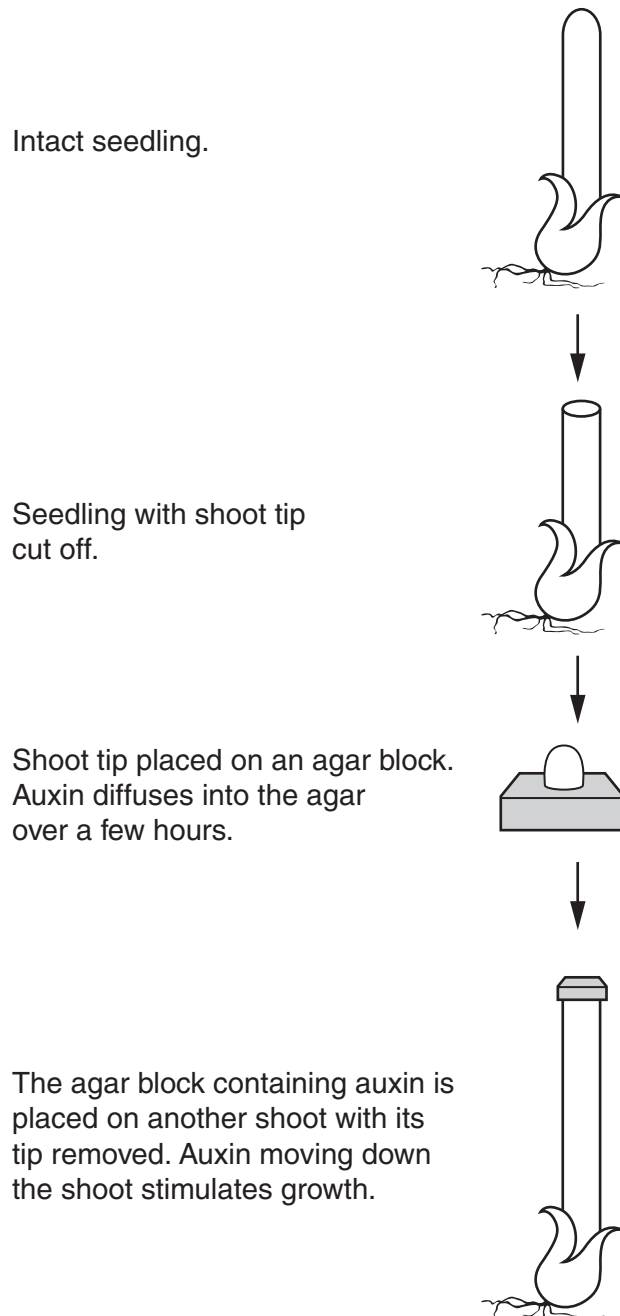


Fig. 2.1

- (i) Suggest **two** different controls that could be used in this investigation **and** explain the purpose of each control.

Control 1

.....

Explanation

.....

Control 2.....

.....

Explanation

.....

[4]

- (ii) State **two** variables, other than light, that should be kept constant during the investigation.

1

2

[2]

- (c) Two plant-technology graduates set up in business to produce scented oils from lavender, an aromatic plant.

Stressing the lavender plants by keeping them in harsh conditions increases the yield of oil. One **abiotic** condition that the graduates found effective was altering the direction and wavelength of light. They discovered, however, that this treatment tended to damage the plants by causing leaf abscission.

- (i) Complete the table below to show the change, if any, in the levels of plant hormones that result in abscission.

Plant hormone	Change in level (e.g. increases, decreases or stays the same)
Auxin	
Ethene	

[1]

- (ii) Suggest one **biotic** condition that might cause stress without damaging the plant by increasing leaf abscission.

..... [1]

(d) The graduates used the following procedures to create a population of high-yielding clones of lavender plants:

- genetic modification of a sample of cells from the lavender plants
 - production of clones by tissue culture.
- (i) The gene to be inserted into the sample cell codes for a polypeptide that improves plant yield. This gene consists of a section of **DNA** with a total of 52 230 bases.

How many amino acids make up this polypeptide? Show your working.

Answer = [2]

(ii) The statements in Table 2.1 may apply to mRNA, rRNA and tRNA.

Complete the table by inserting a tick [✓] to indicate the **type or types** of RNA that correspond to each statement.

Statement	mRNA	rRNA	tRNA
Binds to an amino acid by condensation			
Carries a DNA transcript from the nucleus to the cytoplasm			
Found in the nucleus			
Present in the ribosome			
Structural element of an organelle			

Table 2.1

[5]



In your answer, you should clearly link the roles of named plant hormones to the steps involved in plant tissue-culture production.

[5]

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Turn over

- 3 (a)** Animal behaviour is controlled by the brain and may be innate or learned. Behaviour can be modified by exposure to different environmental conditions.

In Africa, the lion population is under threat.

- The lions' natural habitat is changing as land is used increasingly for cattle farming.
- The increase in cattle farming drives away the lions' natural prey.
- Lions that remain in their habitats then prey on cattle.
- Farmers poison or shoot lions that kill the cattle, thus threatening the survival of the remaining lion population.

Research was carried out on the behaviour of lions that were known to prey on cattle. The lions were fed with beef that had been treated with a chemical that caused stomach upset. After a few meals of this treated beef, the lions refused to eat beef offered to them, even beef that had not been treated.

Discuss why this might be considered to be an example of classical conditioning or operant conditioning rather than habituation.

[5]

- (b) The sport of boxing and certain martial arts involve blows to the head. Repeated blows to the head can cause injury to the brain, particularly the cerebrum.

- (i) Which of the following **two** functions might be impaired by injury to the cerebrum?

Insert a tick [✓] in the table to indicate the **two** functions.

Functions impaired by injury	Insert a tick [✓]
Coordination of antagonistic muscles	
Memory	
Regulation of heartbeat	
Speech	
Temperature regulation	

[2]

- (ii) The central nervous system is composed of nerve cells which form 'grey matter' and 'white matter'.

In the peripheral nervous system in mammals, the nerve cells form 'white matter'.

Name the structural feature that makes nerve cells appear white **and** explain the role of this feature in the transmission of action potentials.

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..... [3]

(c) In boxing or martial arts, a person needs to be able to bend and straighten the arm at the elbow repeatedly.

(i) Name the **two** muscles involved in bending and straightening the arm and describe how they achieve this.

.....

.....

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.....

..... [2]

(ii) When training or fighting, these actions may be repeated forcefully over many seconds. Such effort needs a continuous supply of ATP.

How is ATP regenerated from ADP in muscles **other than from respiration**?

.....

.....

..... [1]

(d) The following steps, **A** to **H**, take place during muscle contraction. The steps are not in the correct order.

- A** ADP (+P_i) detaches from myosin
- B** ATP hydrolysed to ADP (+P_i)
- C** Myosin head changes shape
- D** Myosin head attaches to actin at binding site
- E** Energy is released
- F** ATP binds to myosin head
- G** Myosin head detaches from actin
- H** Actin pulled past myosin

Place the steps, **A** to **H**, in the correct order.

..... [4]

[Total: 17]

- 4 The rabbit, *Oryctolagus cuniculus*, was introduced into Australia from Europe and released into the wild in the middle of the 19th Century. Rabbits can breed throughout the year and one pair of rabbits can produce between 30 and 40 offspring a year.

By the 1950s the rabbit population of Australia had increased to approximately 500 million.

- (a) Rabbits graze on vegetation and burrow into the ground to make the warrens in which they live in large groups.

Suggest two **different** ways an increase in the rabbit population may threaten the survival of native plants and animals.

1

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2

.....

[2]

Question 4(b) begins on page 14

(b) Fig. 4.1 shows the population of *O.cuniculus* in Australia between 1950 and 2000.

Three attempts have been made to control this population:

- In 1950, the rabbits were exposed to a strain of the myxoma virus (causing myxomatosis, a disease that is fatal in most cases).
- From 1970 to 1990, further myxoma viral strains were introduced annually after releasing rabbit fleas into the habitats.
- In 1995, the rabbits were exposed to the Rabbit Haemorrhagic Disease (RHD) virus, which is also fatal in most cases.

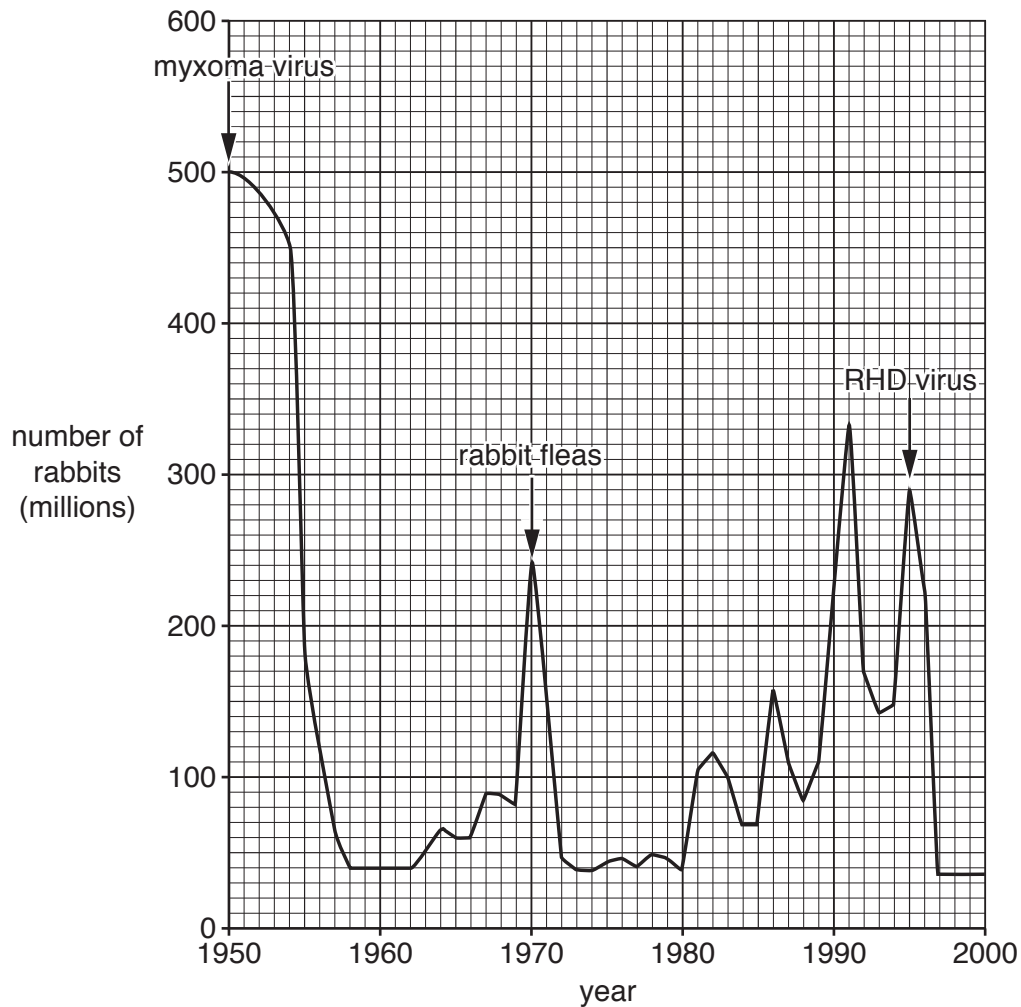


Fig. 4.1

- (i) The methods used to control the population of *O.cuniculus* in Australia are biological methods of control.

Suggest why these are biological methods of control.

.....

.....

..... [1]

- (ii) Using the data in Fig. 4.1, calculate the percentage decrease in the *O.cuniculus* population following exposure to the myxoma virus.

Show your working. Give your answer to the nearest whole number.

Answer = [2]

- (iii) Suggest why the myxoma virus can spread so quickly within the rabbit population.

.....

 [1]

- (iv) Selection pressures result in evolution.

Give **two** reasons why the *O.cuniculus* population **increased** between 1960 and 1970 even though these rabbits had been exposed to a strain of the myxoma virus.

1

 2
 [2]

- (v) Rabbit fleas are not pathogenic.

Suggest why the annual release of rabbit fleas into the habitats resulted in a decrease in rabbit numbers.

.....

 [1]

- (vi) As the rabbit population increases, non-native predators such as foxes are attracted to the area.

The rabbit and fox population in one region of Australia is shown in Fig. 4.2.

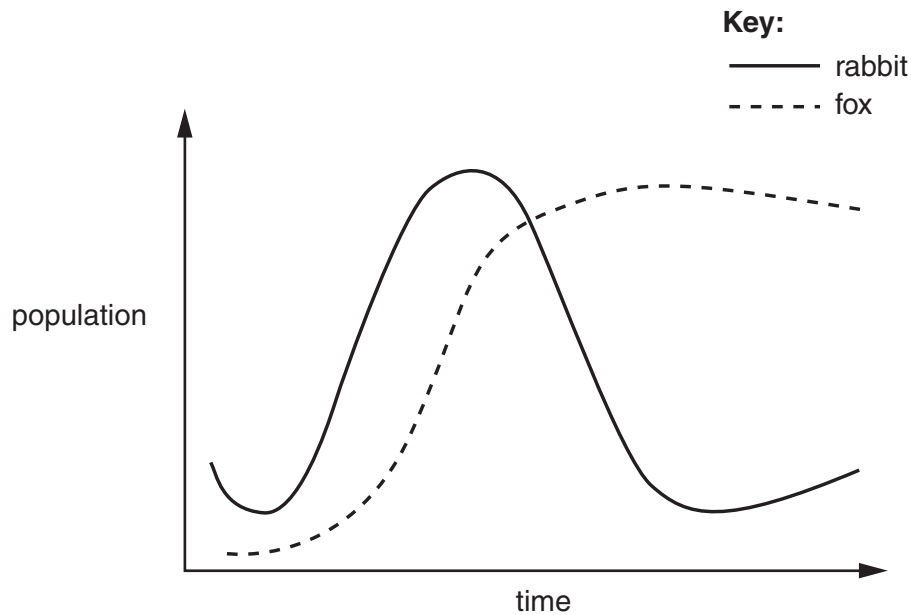


Fig. 4.2

Suggest why the population of the non-native predators, such as foxes, does **not** follow the expected predator-prey pattern.

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..... [1]

- (c) In order to determine whether a rabbit had been infected with the myxoma virus, blood tests can be carried out. Three different types of procedure can be used.

- (i) Small fragments of the virus may be found in the blood. Some of these fragments can be amplified, using enzymes such as Taq polymerase, increasing the amount so that there is sufficient to test for their presence.

Name the constituent of the myxoma virus that can be amplified in this way **and** the procedure that is used to carry out the amplification.

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..... [2]

- (ii) The presence of the myxoma virus in the blood can also be detected using a procedure known as ELISA. The procedure is outlined in Fig. 4.3 below.

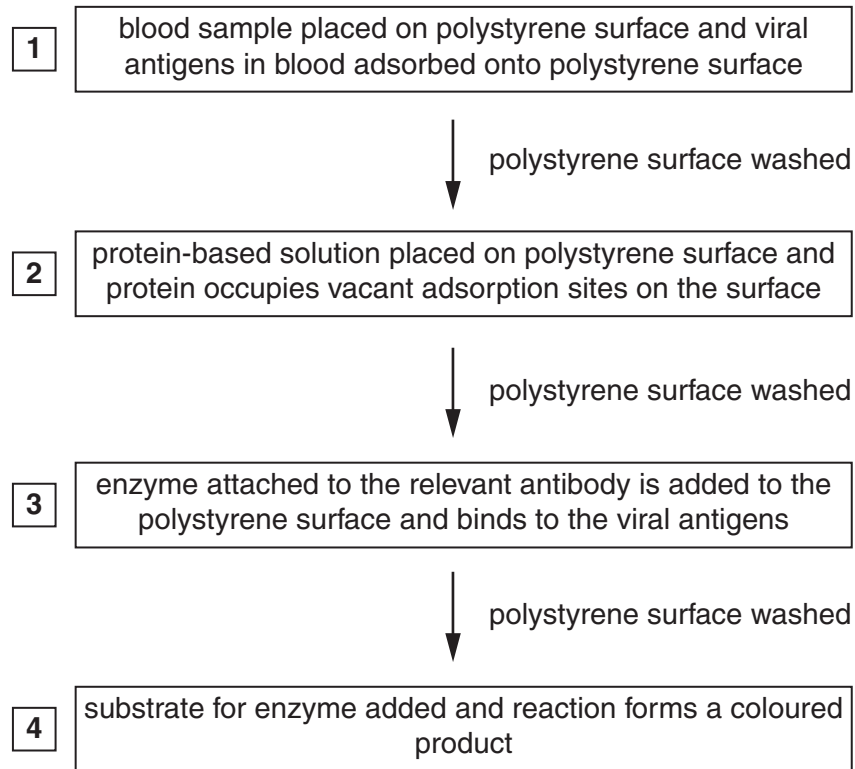


Fig. 4.3

Identify **two** of the stages **1** to **4** in the procedure where complementary shapes are important.

Stage Stage [2]

- (iii) The immunological response of the rabbit can also indicate whether it has been exposed to the myxoma virus.

Which type of blood proteins would be identified by a blood test if an immunological response has occurred?

..... [1]

[Total: 15]

- 5 (a) A rare form of diabetes, Maternally Inherited Diabetes and Deafness (MIDD), affects approximately 1% of people with diabetes.
- During fertilisation the nuclear DNA of the sperm cell (spermatozoon) **only**, enters the egg cell (ovum).
 - MIDD is not caused by a mutation of a gene in nuclear DNA, but by a mutation of a gene in mitochondrial DNA known as A3242G.
 - The expression of the mutation is dominant.

Fig. 5.1 shows the pattern of inheritance of the A3242G gene.

Key:

 affected individual
 unaffected individual



Fig. 5.1

- (i) Analyse the information given and explain the pattern of inheritance of the A3242G gene shown in Fig. 5.1.

..... [3]

- (ii) How does the pattern of inheritance shown in Fig. 5.1(a) and Fig. 5.1(b) differ from sex-linked inheritance of a **recessive allele** carried on the X chromosome?

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..... [3]

- (iii) The mutated gene is known as A3242G.

The convention for naming mutated forms of a gene is to show:

- correct nucleotide
- nucleotide position in the gene
- incorrect nucleotide.

Use this information to describe the change in the DNA caused by this mutation.

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..... [2]

- (iv) Different individuals with the mutated gene are affected to different degrees.

Suggest why.

.....

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..... [1]

- (b) In 1982, genetically engineered insulin, misleadingly named 'human' insulin, was the first genetically engineered drug to be marketed.

In 1996, the first rapid-acting insulin analogue was introduced. Insulin analogues are made by a further genetic modification of 'human' insulin. This insulin analogue is no longer identical to the human insulin molecule produced by the body.

Both types of insulin are produced inside bacterial cells of *Escherichia coli*.

- (i) How will the structure of the analogue insulin differ from that of 'human' insulin?

.....

 [1]

- (ii) Plasmids are used to introduce the gene into the bacterium. Plasmids have features that make them useful for this technique.

Complete the table below to indicate how each feature is important in genetic engineering.

Plasmid feature	Importance
Small size	
Plasmid passes to both daughter cells in binary fission	
Contains at least one active promoter	
Can be cut by different enzymes in different places	

[4]

[Total: 14]

Compare and contrast the processes of continuous culture and batch culture.



In your answer, you should describe the similarities and differences between the two processes.

..... [5]

(b) Nitrates, phosphates and sulfates are added to the culture in a fermenter. These salts are required by the microorganisms for the formation of biological molecules such as polymers.

Describe which salts are required for the formation of named types of biological polymers in the microorganisms.

..... [2]

7 (a) There are two types of nuclear division.

(i) Fig. 7.1 is a diagram that represents a diploid cell at the beginning of nuclear division.

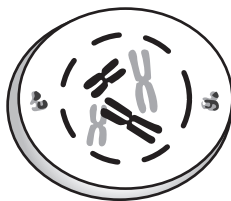


Fig. 7.1

Describe the events that have taken place for the chromosomes to have the appearance shown in Fig. 7.1.

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..... [2]

Fig. 7.2 and Fig. 7.3 are diagrams that represent some of the stages of the two types of nuclear division. The stages are indicated by numbers 1 to 6.

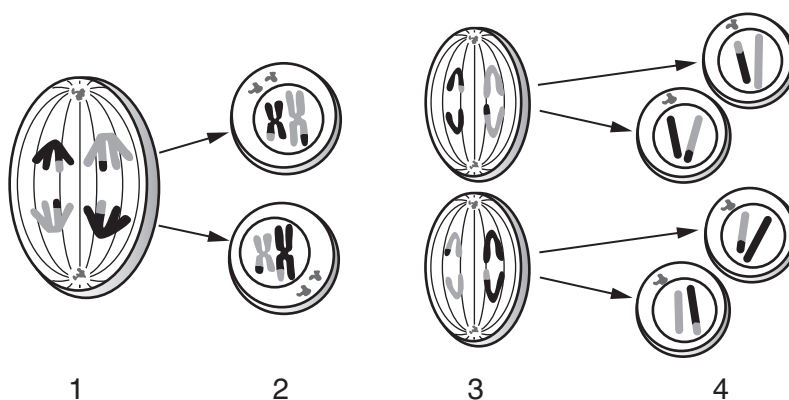


Fig. 7.2

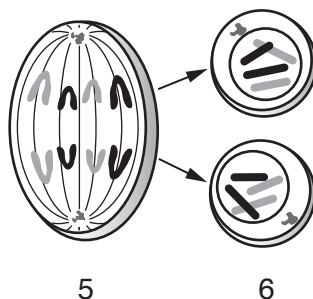


Fig. 7.3

- (ii) Identify the following stages by using the appropriate number or numbers **1** to **6** from Fig. 7.2 and Fig. 7.3.

The stage in Fig. 7.2 that corresponds to stage **5** in Fig. 7.3.

.....

The stages in Fig. 7.2 and Fig. 7.3 in which the spindle fibres are shortening.

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[3]

- (iii) Stage **4** results in cells that show variation.

How could the cells in stage **6** show variation?

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..... [1]

- (b) There are a number of misconceptions about cloning.

Explain why the following statements are **incorrect**.

- (i) Cloning is always an artificial process.

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..... [1]

- (ii) Cloned individuals are 'carbon copies' of each other.

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..... [2]

[Total: 9]

END OF QUESTION PAPER

This image shows a blank sheet of white paper designed for writing. It features a series of evenly spaced horizontal blue lines across its entire width. A single vertical red line runs down the left side, creating a narrow margin. The paper is otherwise completely empty, with no text or markings.

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