Answer **all** the questions.

1 **(a)** Human populations have herded cattle for milk for around 9000 years. Artificial selection over this time has resulted in the modern dairy cow.

(i) State **three** phenotypic traits (characteristics) that have been selected for in dairy cows.

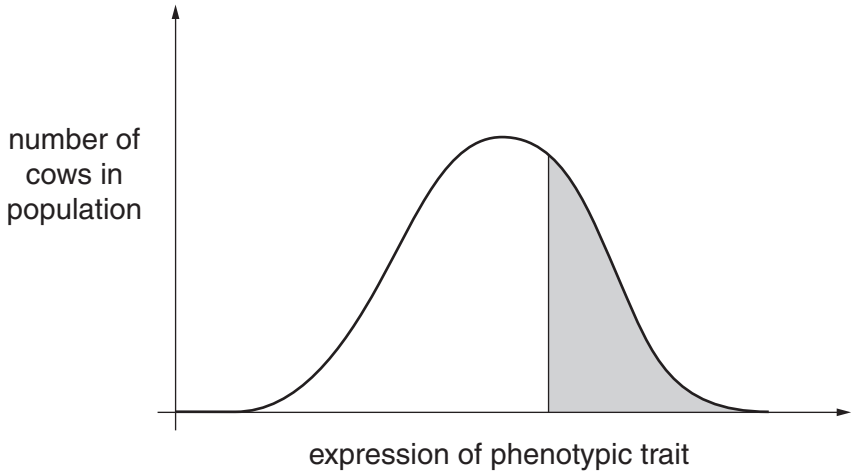
1 .....

2 .....

3 ..... **[3]**

(ii) Fig. 1.1 shows the pattern of variation of a phenotypic trait in a herd of dairy cows. The shaded part of the graph indicates those cows that are chosen to breed.

Draw, **on Fig. 1.1**, a second curve to show the pattern of variation in the next generation.



[2]

Fig. 1.1

(iii) In recent years, artificial selection of dairy cows has been helped by modern reproductive technology.

Name **two** modern techniques or procedures that can be used in the selective breeding of dairy cows.

1 .....

2 ..... **[2]**

(b) Lactase is an enzyme that is necessary to digest lactose sugar in milk.

In some parts of the world, animals are not farmed for milk and no dairy products are eaten. Adult humans that are native to these parts of the world do not produce lactase.

In areas where animals are farmed for milk, native adult humans do produce lactase. In these populations, a new allele has arisen by gene mutation.

(i) State what is meant by gene mutation.

.....

..... **[1]**

(ii) Over time, the frequency of this new allele increased in the gene pool of the human populations whose diet included milk.

Name the process by which this increase occurred.

..... **[1]**

(c) (i) All human babies produce the enzyme lactase. The genetic change that allows adults to produce this enzyme is thought to involve a mutation in a regulatory gene. This mutation causes the structural gene to be expressed in adults.

Distinguish between the terms 'regulatory gene' and 'structural gene'.

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..... **[2]**

(ii) Adult humans who cannot produce the enzyme lactase are described as lactose-intolerant and cannot drink milk without experiencing health problems. However, lactose-intolerant people can safely eat yogurt.

Yogurt is produced from milk that is fermented by bacteria. These bacteria perform anaerobic respiration, using carbohydrate as their respiratory substrate.

Suggest why yogurt is a suitable food for lactose-intolerant people.

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..... **[2]**

(d) The control of the expression of the *lac* operon genes, which allow uptake and digestion of lactose in the bacterium *Escherichia coli*, is well known.

Fig. 1.2 shows the arrangement of the elements of the *lac* operon.

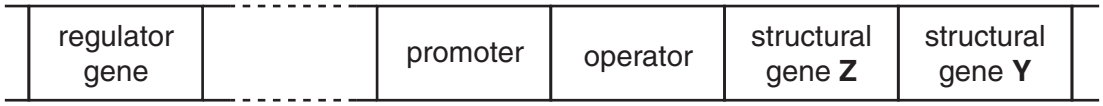

Fig. 1.2

Describe how genes **Z** and **Y** are switched on in bacteria that are moved to a nutrient medium that contains lactose.

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..... **[3]**

[Total: 16]

2 This question is about types of muscle and how the nervous system and hormones control their activity.

(a) There are three types of muscle within the human body. These differ in their cellular structure and in their function.

Complete Table 2.1 to show how each type of muscle **differs from the other two** types.

Table 2.1

	voluntary (skeletal) muscle	involuntary (smooth) muscle	cardiac muscle
cellular structure			
function			

[6]

(b) The human thorax is the area between the base of the neck and the base of the rib cage. All three types of muscle can be found within this area.

For each type of muscle, identify where **in the thorax** this type of muscle may be found.

voluntary .....

involuntary .....

cardiac ..... **[3]**

(c) Fig. 2.1 shows a vertical section through the human brain.

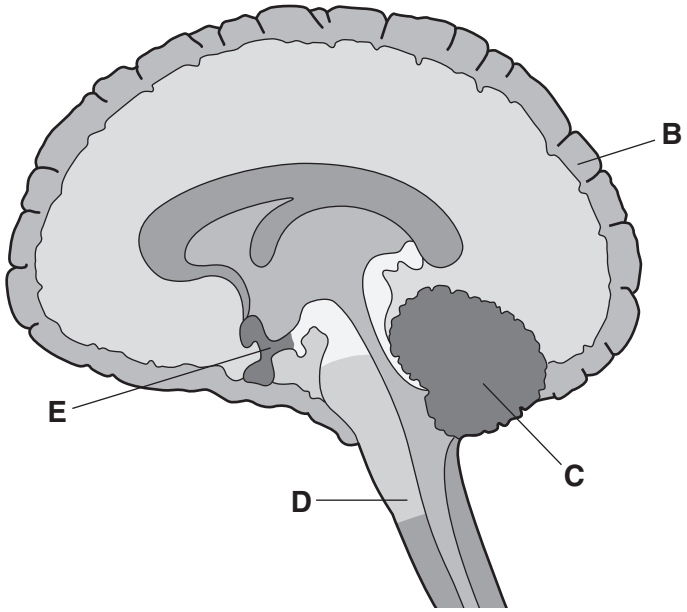

Fig. 2.1

Use Fig. 2.1 to state the letter (**B** to **E**) of the part of the brain that would be involved in the following:

adjusting the rate of contraction of cardiac muscle .....

clapping the hands together .....

automatically correcting balance when riding a bicycle ..... **[3]**

(d) Movement disorders are conditions in which people lose the ability to control their body movements.

Scientists have discovered that inserting electrodes to stimulate parts of the brain can help to cure some movement disorders. This discovery has resulted from experimental work with monkeys, which has made the research controversial.

Suggest why monkeys rather than other laboratory animals, such as rats, were used for this work **and** comment on whether their use in this way is justified or not.

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..... **[3]**

(e) The 'fight or flight' response to threatening environmental stimuli is coordinated by the nervous and endocrine systems.

Describe and explain how the activation of the 'fight or flight' response affects voluntary, involuntary and cardiac muscle.

In your answer, for each type of muscle, you should give a named structure in which it is found and explain how the nervous and endocrine systems affect its response.

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.... **[9]**

[Total: 24]

3 Total plant growth within an ecosystem depends on the light intensity, temperature and the supply of water and inorganic minerals to the ecosystem.

Table 3.1 shows the net primary production by plants in four different ecosystems.

Table 3.1

ecosystem	net primary production ($kJ\,m^{-2}\,year^{-1}$)
temperate grassland	9240
temperate woodland	11340
tropical grassland	13440
tropical rainforest	36160

(a) Discuss possible reasons for the differences in net primary production in these ecosystems.

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..... **[4]**

(b) To calculate the net primary production figures in Table 3.1 in $kJ\,m^{-2}\,year^{-1}$, it is necessary to measure the energy content of the primary producers.

Outline how the energy content, in kJ, of a primary producer such as grass can be measured in the laboratory.

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..... **[2]**

(c) The efficiency with which consumers convert the food they eat into their own biomass is generally low.

Table 3.2 compares the energy egested, absorbed and respired in four types of animal.

Table 3.2

animal	percentage of energy consumed that is:			
	egested	absorbed	respired	converted to biomass
grasshopper, a herbivorous insect	63	37	24	13
perch, a carnivorous fish	17	83	61	
cow, a herbivorous mammal	60	40	39	
bobcat, a carnivorous mammal	17	83	77	6

(i) **Complete Table 3.2** to show the percentage of energy consumed that is converted into biomass in the perch and the cow.

You may use the space below for your working.

[2]

(ii) Describe **and** explain, using the data from Table 3.2, how the trophic level of a **mammal** affects the percentage of its food energy that it is able to convert to biomass.

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..... **[3]**

(iii) Using the data from Table 3.2 and your knowledge of energy flow through food chains, suggest which of these four animals could be farmed to provide the maximum amount of food energy in $kJ\,m^{-2}\,year^{-1}$ for humans.

Explain the reasons for your choice.

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..... **[3]**

[Total: 14]

4 The antibiotic penicillin is produced by batch culture of the fungus *Penicillium chrysogenum*.

(a) Fig. 4.1 shows the concentration of penicillin, lactose and ammonia as well as the fungal biomass over time when penicillin is being produced by batch culture.

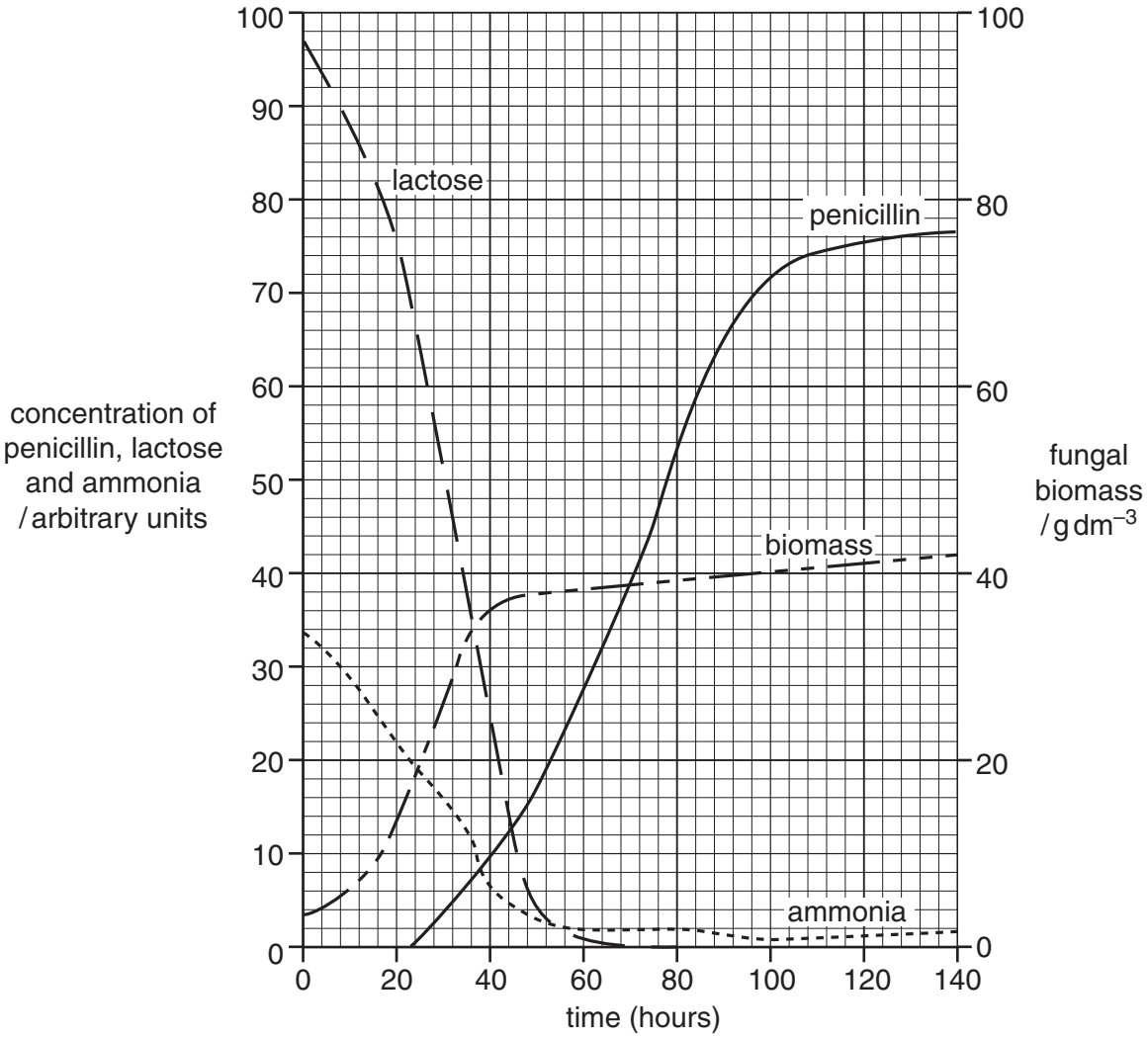

Fig. 4.1

(i) With reference to Fig. 4.1, describe and explain the changes in concentration of lactose **and** ammonia.

description .....

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explanation .....

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..... **[4]**

(ii) A student incorrectly suggested that penicillin might be produced by continuous culture fermentation instead of by batch culture.

Suggest how the curves for lactose, ammonia and biomass on Fig. 4.1 might differ in continuous culture.

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..... **[2]**

(iii) A second student said that continuous culture would not be suitable, as penicillin is a secondary metabolite.

What evidence is there in Fig. 4.1 that penicillin is a secondary metabolite?

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..... **[2]**

(b) (i) Explain the importance of maintaining aseptic conditions in manufacturing penicillin by fermentation.

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..... **[3]**

(ii) State **three** physical or chemical factors within the fermenter, other than nutrient levels, that need to be monitored and controlled.

For each factor, explain **why** it must be controlled.

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..... **[3]**

[Total: 14]

5 This question is about genetic engineering and the techniques used for making multiple copies of genes (gene cloning).

(a) Genetic engineering uses the following:

A an enzyme that synthesises new DNA
B an enzyme that cuts DNA at specific sequences
C an enzyme that reseals cut ends of DNA
D small circular pieces of DNA found in bacteria; these pieces of DNA have antibiotic resistance genes
E an enzyme found in some viruses with an RNA genome; this enzyme converts RNA into DNA.

Name **A** to **E**.

A .....

B .....

C .....

D .....

E ..... **[5]**

(b) Genes are cloned for a number of reasons. For example,

- one group of research scientists at a hospital wanted to sequence a disease-causing mutation to learn more about a human disease; these scientists started their research using white blood cells;

- another group of scientists at a biotechnology company wanted to clone the insulin gene in order to manufacture its protein product to treat diabetes; these scientists started their research using cells from the pancreas.

Suggest **and** explain the biological reasons why the two groups each started with a different cell.

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..... **[4]**

(c) A gene can be cloned *in vitro* (in a test-tube) by the polymerase chain reaction (PCR). Alternatively, a gene can be cloned *in vivo* (in living cells) by introducing the gene into bacterial host cells.

Table 5.1 identifies some of the key steps in each process.

Table 5.1

in vitro gene cloning (PCR)	*in vivo* gene cloning
At 95 °C, DNA extracted from a cell separates into two strands.	A library of gene fragments is produced and introduced into host bacteria.
At 50 °C, specially-made primer sequences attach to the ends of the desired gene only.	Bacteria are screened for antibiotic resistance to identify those with recombinant DNA.
At 72 °C complementary copies of both DNA strands are made.	A gene probe is used to select the bacterial colony containing the desired gene.
The cycle of temperature changes is repeated and more copies of the gene are made.	This colony is grown on in nutrient broth and the DNA is then purified.

Compare the two processes of gene cloning by explaining the advantages of each.

In your answer you should ensure that clear comparisons between the two processes are made and explained.

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[Total: 17]

6 **(a)** State the term used to describe:

(i) a directional growth response of a plant

..... **[1]**

(ii) a signalling molecule that enables **plants** to respond to environmental change

..... **[1]**

(iii) plants that lose their leaves seasonally

..... **[1]**

(iv) the process of managing an ecosystem sustainably to protect biodiversity

..... **[1]**

(v) organisms that return inorganic minerals from the bodies of dead organisms to the abiotic environment

..... **[1]**

(vi) the conversion of nitrogen gas to ammonium compounds in the soil.

..... **[1]**

(b) Describe briefly **one** example of each of the following types of **animal** behaviour:

(i) habituation

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..... **[3]**

(ii) operant conditioning

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..... **[3]**

(iii) social behaviour in primates and its importance.

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..... **[3]**

[Total: 15]

END OF QUESTION PAPER

Answer **all** the questions.

1 Fig. 1.1 shows a metabolic pathway involving the amino acid, phenylalanine. One of the products of this pathway is melanin, the pigment that gives a brown colour to hair, skin and the iris of the eyes. This metabolic pathway also produces thyroid hormones.

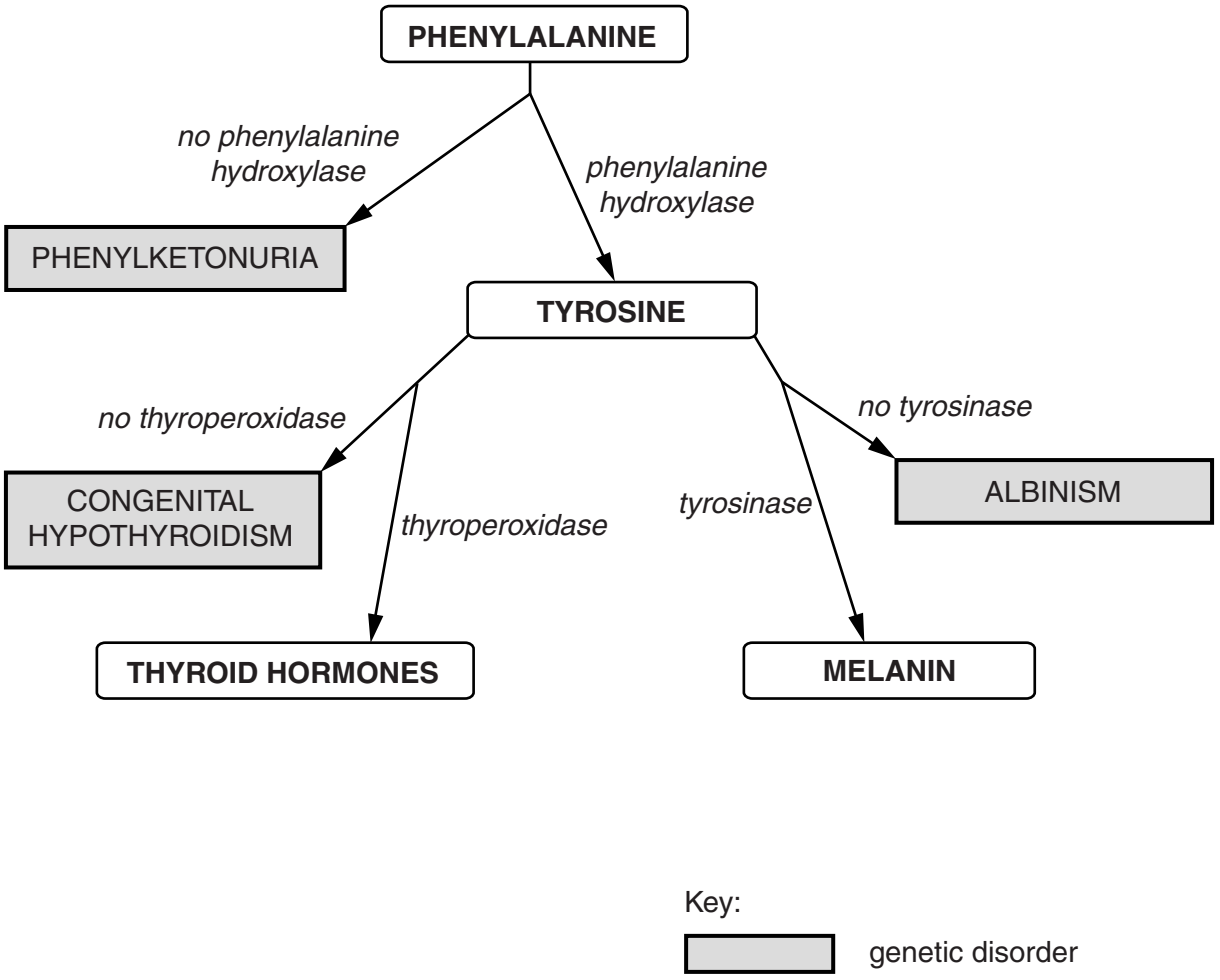

Fig. 1.1

(a) Use Fig. 1.1 to name:

(i) the **enzyme** that catalyses the last step in melanin production

..... **[1]**

(ii) the **genetic disorder** resulting from the absence of the enzyme at the start of the metabolic pathway for melanin production.

..... **[1]**

(b) Phenylalanine and tyrosine are both amino acids.

Explain why phenylalanine and tyrosine are classified as amino acids.

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..... **[2]**

(c) One effect of thyroid hormones is to increase the activity of mitochondria within cells. Suggest how the metabolism of a person with the condition congenital hypothyroidism might differ from that of a person who does not have this condition.

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..... **[3]**

(d) Albinism is a genetic disorder in which a person lacks melanin pigment in their skin, hair and the iris of their eyes. A person with this disorder is called an albino. The genotype of an albino has two copies of a recessive allele of the gene for an enzyme involved in melanin production.

(i) State the term used to describe a genotype that has two copies of the same allele at a particular gene locus.

..... **[1]**

(ii) Explain what is meant by the following terms:

genotype .....

.....

.....

allele .....

.....

..... **[4]**

(e) The Hardy-Weinberg principle can be used to predict the expected frequencies of albino and non-albino alleles in a population. However, this principle can only be applied to populations which fulfil all of the following criteria:

- sexually reproducing organisms
- diploid organisms
- large populations
- randomly-mating populations.

The tiger, an endangered species of mammal, is undergoing a worldwide captive breeding programme in zoos.

Suggest why the Hardy-Weinberg principle cannot be used to predict the expected frequencies of albino and non-albino alleles in the worldwide zoo population of tigers.

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..... **[2]**

(f) A change in allele frequencies in a population is described as an evolutionary change.

List **two** factors that might cause allele frequencies to change from generation to generation in a population that meets the Hardy-Weinberg criteria.

.....

..... **[2]**

[Total: 16]

2 Animals respond to frightening or stressful stimuli in their environment.

This question is about the 'fight or flight' response in mammals.

Fig. 2.1 (**on the insert**) shows a husky dog in a calm state.

Fig. 2.2 (**on the insert**) shows a different husky displaying external signs of the 'fight or flight' response.

(a) Describe **three** features in the external appearance of the husky in Fig. 2.2 that are due to the 'fight or flight' response.

1 .....

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2 .....

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3 .....

..... **[3]**

(b) The 'fight or flight' response is brought about by the hormone adrenaline and the autonomic nervous system working together. As well as causing external differences in appearance, the 'fight or flight' response causes numerous changes in the functioning of the internal organs.

Complete Table 2.1 to describe how **two** internal organs would function differently in a calm mammal compared to a frightened mammal.

Table 2.1

internal organ	calm mammal	frightened mammal

[6]

(c) The differences you described in part **(b)** are coordinated by the **autonomic** nervous system. The autonomic nervous system has two divisions, each of which uses a different neurotransmitter to bring about effects in the internal organs.

In the table below, state which division of the autonomic nervous system will be active in each case, and name the **neurotransmitter** that will be secreted by neurones into the organs.

	calm mammal	frightened mammal
division of the autonomic nervous system activated		
name of neurotransmitter secreted by neurones		

[4]

(d) State precisely where in the body adrenaline is produced.

..... **[2]**

(e) The adrenaline molecule is not lipid-soluble, therefore it cannot pass directly through the cell surface membrane. In order to bring about changes inside the cell, adrenaline relies on a second messenger system.

(i) Describe the events that occur after adrenaline reaches the cell surface membrane that then result in changes in metabolism inside the cell cytoplasm.

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..... **[4]**

(ii) The second messenger system is a multi-step mechanism. It enables large changes in cell metabolism to occur rapidly, although only relatively small numbers of adrenaline molecules are involved.

Suggest how having a number of steps in the signalling pathway enables a small number of adrenaline molecules to rapidly cause large effects.

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..... **[2]**

[Total: 21]

3 **(a)** Organisms do not live in isolation, but interact with other organisms and with their physical environment.

State the word used to describe:

(i) the study of the interactions between organisms and their environment

..... **[1]**

(ii) the physical (non-living) factors in the environment

..... **[1]**

(iii) a physical area that includes all the organisms present **and** their interactions with each other **and** with the physical environment.

..... **[1]**

(b) State and describe **two types** of ecological interaction that can occur between different species in a habitat.

As part of each description, you should **name** the two species involved in your chosen example.

1 .....

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2 .....

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..... **[6]**

(c) Plants are able to respond to changes in their environment.

(i) Describe **two** ways in which hormones may alter a plant's growth in response to overcrowding by other plants.

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..... **[4]**

(ii) Suggest how hormones alter a plant's growth if the top of the plant shoot is eaten by an animal.

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..... **[3]**

(d) The distribution and abundance of plants in a habitat can show how a physical factor varies across the habitat.

Describe how you would measure the distribution and abundance of plants over a distance of 100 metres.

In your answer you should make clear the sequence of procedures you would follow.

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..... **[6]**

[Total: 22]

4 **(a)** Genetic modification of organisms uses a "toolkit" that includes:

- enzymes that cut DNA
- enzymes that join sections of DNA together
- vectors that introduce DNA into new host cells.

Some of the enzymes and vectors that are important in genetic modification are given an identifying letter in Table 4.1.

Table 4.1

	enzymes
A	reverse transcriptase
B	DNA polymerase
C	DNA ligase
D	restriction endonuclease
E	RNA polymerase

	vectors
J	plasmid
K	virus
L	*Agrobacterium tumefaciens*
M	BAC
N	bacteriophage

Select **one** correct letter from Table 4.1 to fit each of the following statements.

An enzyme that cuts DNA .....

An enzyme that joins sections of DNA together .....

A vector to introduce foreign DNA into bacteria .....

A vector to introduce foreign DNA into plant cells .....

A vector to introduce foreign DNA into animal cells ..... **[5]**

(b) Discuss the **potential benefits** to mankind and the **ethical concerns** raised by the following examples of genetically modified organisms:

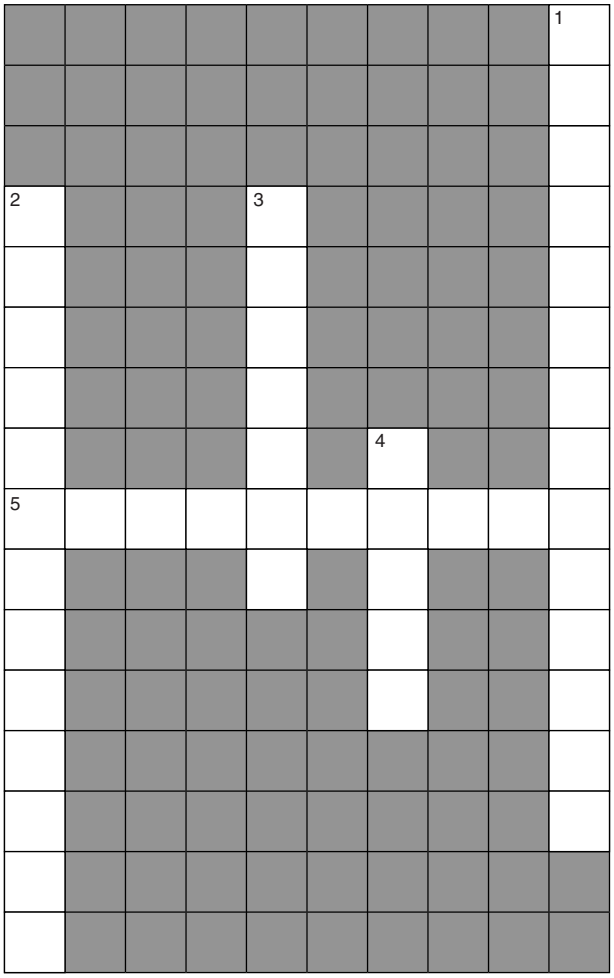
- rice modified for increased vitamin A content ('Golden Rice™')
- humans having somatic gene therapy treatment for a genetic disease.

In your answer you should give a balanced account of the benefits and concerns for each example of genetic modification.

..... **[9]**

[Total: 14]

5 Fig. 5.1 is a crossword that should contain five words relating to the use of microorganisms by humans.



[5]

Fig. 5.1

Use the clues below to write the five appropriate words in the correct spaces on Fig. 5.1.

ACROSS

5 Microbial culture method in which nutrients are added and the product harvested throughout the fermentation process.

DOWN

1 Technique that makes enzymes more thermostable and allows them to be re-used.

2 The industrial use of living organisms to produce food, drugs or other products.

3 Sterile technique that prevents the growth of undesirable microorganisms.

4 Kingdom of eukaryotic microorganisms with cell walls made of chitin.

[Total: 5]

6 A long-term breeding experiment to investigate the **genetic** basis of tame (friendly) behaviour was carried out in a population of silver foxes. The foxes were bred each year and the resulting young foxes assessed each month between the ages of 1 and 8 months to see how tame they were.

Table 6.1 shows how the foxes were put into categories according to their tameness.

Table 6.1

tameness class	description of behaviour towards humans
3	Not tame – these foxes run away from humans or bite when handled.
2	Neutral – these foxes allow handling by humans but show no emotionally friendly response.
1	Tame – these foxes are friendly to humans. They wag their tails and whine for attention.
elite	Very tame – these foxes are eager for human contact. They whimper to attract attention and sniff and lick humans.

The tamest 5% of the male foxes and the tamest 20% of the female foxes in each generation were used for breeding to produce the next generation. This was repeated for over forty generations.

(a) (i) State the name given to the process in which only a certain percentage of adult foxes were chosen by humans to breed in each generation.

..... **[1]**

(ii) Suggest why 20% of the female foxes were used for breeding but only 5% of the male foxes.

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..... **[2]**

(b) Table 6.2 shows the number of foxes in the elite tameness class during the long-term experiment.

Table 6.2

number of generations	foxes in elite class (%)
10	18
20	35
35	75

Discuss what the results shown in Table 6.2 suggest about the **causes of the variation** in tameness behaviour in silver foxes.

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..... **[3]**

(c) As tameness increased in the silver fox population over the years, it was noticed that other phenotypic traits also became more common.

Table 6.3 compares the frequency of these traits in a control group of silver foxes that had not been used in this long-term breeding experiment and in the tame population of foxes.

Table 6.3

phenotypic trait	animals showing trait (per 100 000)		percentage increase in trait
	control population	tame population	
white patch of fur on head	710	12 400	1 646
floppy ears	170	230	35
short tail	2	140	6 900
curly tail	830	9 400	1 033

Students were asked to suggest a variety of genetic hypotheses to explain why these traits become more common in tame foxes. Their suggestions were:

linkage **epistasis** **inbreeding** **genetic drift**

Select **one** hypothesis from the list and explain how it could account for the data in Table 6.3.

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..... **[2]**

(d) Similar changes in tameness, colour and body shape are believed to have occurred in the 11 000 year period during which the grey wolf species, *Canis lupus*, evolved into the domesticated dog species, *Canis familiaris*.

Suggest how different types of isolating mechanism allowed dogs to evolve separately to wolves.

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..... **[3]**

(e) Interbreeding between members of the wolf species and some dogs has been reported. However, there are some large breeds of dogs that cannot breed successfully with small dog breeds.

Use this information and your own knowledge to explain the problems of classifying wolves and different dog breeds according to:

- the biological species concept
  and
- the phylogenetic species concept.

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..... **[4]**

[Total:15]

7 Homeobox genes show astonishing similarity across widely different species of animal, from fruit flies, which are insects, to mice and humans, which are mammals. The sequences of these genes have remained relatively unchanged throughout evolutionary history and the same genes control embryonic development in flies and mammals.

(a) State what is meant by a homeobox gene.

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..... **[2]**

(b) Homeobox genes show 'astonishing similarity across widely different species of animal'.

Explain why there has been very little change by mutation in these genes.

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..... **[2]**

(c) Frogs reproduce by laying eggs in water. Each egg develops into a tadpole, which has external gills to extract oxygen from the water, and a tail to help it swim. The tadpole gradually changes into an adult frog as it grows. During this time its gills and tail disappear.

List **two** cellular processes that must occur during the development of a tadpole into a frog.

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..... **[2]**

(d) Name another kingdom of organisms, other than animals, that have similar homeotic genes.

..... **[1]**

[Total: 7]

END OF QUESTION PAPER

Fig. 2.1

Fig. 2.2

Answer **all** the questions.

1 Fig. 1.1 is a flow diagram showing the main stages involved in making cheese. The starting material is milk, which contains the protein, casein.

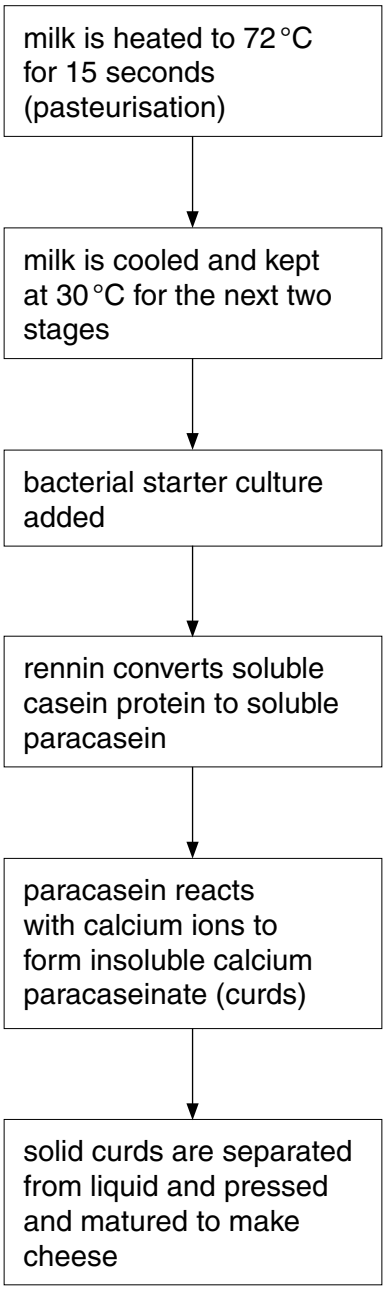

Fig. 1.1

(a) (i) Explain why making cheese can be described as a biotechnological process.

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(ii) Suggest **two** benefits of the pasteurisation stage.

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..... **[2]**

(b) (i) Rennin is a protein that can be obtained from the stomach lining of calves. It is used in the cheese-making process in the ratio one part rennin to 10 000 parts milk.

Suggest what type of protein rennin is **and** explain how a very small quantity of rennin is able to convert a large quantity of milk.

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..... **[3]**

(ii) Rennin could, in theory, be immobilised for use in cheese-making.

List **two** potential advantages of this.

1 .....

2 ..... **[2]**

(c) Rennin can now be made by genetically modified microorganisms.

Outline the process by which bacteria can be genetically modified to produce rennin.

In your answer, you should make clear how the steps in the process are sequenced.

[8]

[Total: 17]

2 Four different eye pigments in the fruit fly, *Drosophila melanogaster,* are made from the amino acid tryptophan. A simplified metabolic pathway of pigment production is shown in Fig. 2.1.

Three different gene loci control the pathway. Each locus has two alleles. These alleles are **V** or **v**, **C** or **c** and **B** or **b**, as shown in Fig. 2.1.

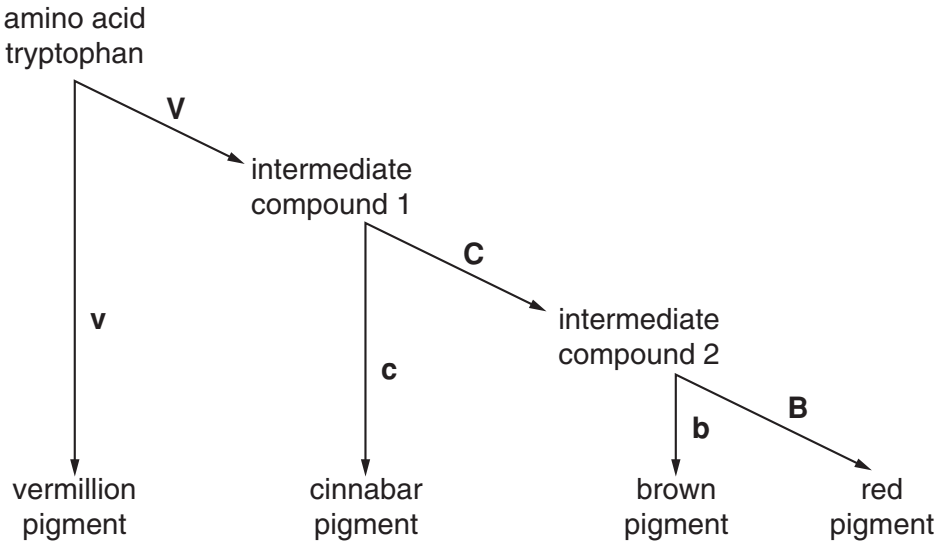

Fig. 2.1

(a) (i) Using the information in Fig. 2.1, deduce the phenotypes of flies with the following genotypes:

genotype	*phenotype*
VvCcBb	.....
vvCCBB	.....
VvccBB	..... **[3]**

(ii) State the term that is applied to this type of gene interaction.

..... **[1]**

(iii) Explain how the products **coded for** by the genes interact to give the different pigments.

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..... **[3]**

(b) A mutation in another gene at another locus in *Drosophila* gives rise to white-eyed flies. The red eye allele of this gene (**R**) is known to be dominant to the white eye allele (**r**).

A student crossed a red-eyed fly with a white-eyed fly, expecting to get an F1 generation of red-eyed flies. In fact, the results were as shown in Table 2.1.

Table 2.1

phenotype of fly	number of offspring
red-eyed female	27
red-eyed male	0
white-eyed female	0
white-eyed male	23

(i) The student first suggested that the reason for there being red-eyed and white-eyed flies in the offspring was that the red-eyed parent was heterozygous.

Explain why this **cannot** be the correct explanation for the results shown in Table 2.1.

.....

.....

.....

..... **[2]**

(ii) In *Drosophila*, the males are the heterogametic sex, possessing two different sex chromosomes, X and Y.

Draw a genetic diagram to show how the results shown in Table 2.1 could have been produced.

Parental genotypes …… ……

Gametes …… ……

F_1 genotypes …… ……

[3]

(iii) The chi-squared (χ^2) test can be used to analyse the results in Table 2.1.

The expected ratio of red-eyed females to white-eyed males is 1:1.

Use Table 2.2 to calculate a value for chi-squared (χ^2).

$$\chi^2 = \Sigma \frac{(O - E)^2}{E} \qquad df = n - 1$$

Key to symbols:

Σ = 'sum of …'
df = degrees of freedom
n = number of classes
O = observed value
E = expected value

Table 2.2

phenotype of fly	O	E	O – E	$(O - E)^2$	$\frac{(O - E)^2}{E}$
red-eyed female					
white-eyed male					

χ^2 = ...

Use your calculated value of χ^2 and the table of probabilities shown in Table 2.3 to test the significance of the difference between the observed and expected results.

State your conclusion in the space below.

Table 2.3

degrees of freedom	probability, p			
	0.90	0.50	0.10	0.05
1	0.02	0.45	2.71	3.84
2	0.21	1.39	4.61	5.99

Conclusion .....

.....

.....

..... **[4]**

[Total: 16]

3 **(a)** The fruit fly, *Drosophila melanogaster*, the zebra fish, *Danio rerio*, and the mouse, *Mus musculus*, have all been used by scientists to find out more about how genes control development in all animals, including humans. They are described as 'model organisms'.

(i) Suggest why information gained from studying such model organisms can be applied to humans.

.....

.....

.....

..... **[2]**

(ii) Suggest **two** characteristics that researchers should look for when choosing an organism for research into how genes control development.

1 .....

2 ..... **[2]**

(b) Fig. 3.1 and Fig. 3.2, **on the insert**, show the heads of two *Drosophila* fruit flies.

Fig. 3.1 shows a normal wild type fly.
Fig. 3.2 shows a mutant fly.

(i) Name the type of microscope used to take the two pictures.

..... **[2]**

(ii) State one significant difference between the two heads.

.....

..... **[1]**

(iii) Name the type of gene which, if mutated, gives rise to dramatic changes in body plan.

..... **[1]**

(c) Describe how the information coded on genes is used to synthesise polypeptides **and** how these polypeptides control the physical development of an organism.

In your answer, you should consider both the synthesis of polypeptides and their roles.

.... **[8]**

[Total: 16]

Turn over

4 Fig. 4.1 shows a junction between two neurones where the neurotransmitter is dopamine. Fig. 4.2 shows a neuromuscular junction.

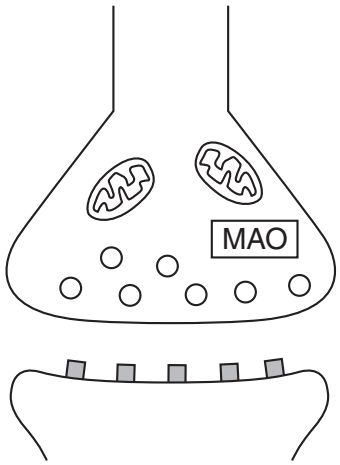

Fig. 4.1

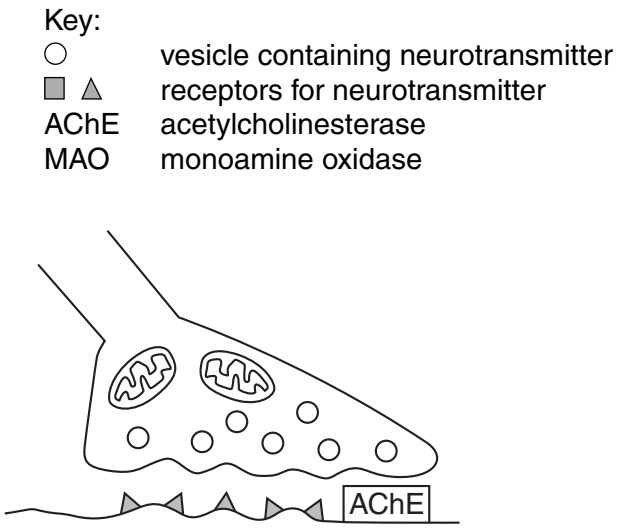

Fig. 4.2

(a) Complete Table 4.1 below to compare the structure and function of the dopamine synapse and the neuromuscular junction.

Table 4.1

	similarity	difference
structure		
function		

[4]

(b) The sequence of events at a dopamine synapse is given below:

- dopamine molecules bind to the protein receptors on the postsynaptic membrane and trigger a response
- dopamine leaves the receptors and moves back into the presynaptic neurone
- some dopamine is repackaged into vesicles
- some dopamine is broken down by the enzyme monoamine oxidase (MAO).

Table 4.2 summarises the action of some drugs that affect dopamine synapses.

Table 4.2

drug	action at synapse
phenothiazine	binds to and blocks dopamine receptors
phenelzine	acts as an inhibitor of MAO
amphetamine	binds to and activates the dopamine receptor and causes release of stored dopamine from vesicles

(i) Use the information in Table 4.2 to suggest which drug molecule could have a shape that **differs** from that of the dopamine molecule. Give a reason for your answer.

.....

.....

..... **[2]**

(ii) Schizophrenia is a condition in which there is a higher than usual level of dopamine in certain areas of the brain.

Suggest why phenothiazine is used to treat schizophrenia.

.....

.....

..... **[2]**

(c) DRD4 is a dopamine receptor in humans. The DRD4 receptor gene has a large number of alleles, of which a single individual can only have two.

(i) Explain why one individual can only have two of the different alleles of the DRD4 gene.

.....

.....

..... **[2]**

(ii) Name a technique that would reveal differences in the lengths of the different forms of the DRD4 receptor gene.

..... **[1]**

(d) Three alleles of DRD4 have the following alterations:

- a single base-pair substitution
- a 21 base-pair deletion
- a 13 base-pair deletion.

Suggest which of the three mutations will have the most serious consequences for the structure of the protein receptor. Give a reason for your choice.

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.....

..... **[3]**

(e) One allele of DRD4 has been found more frequently amongst individuals whose personality is described as 'novelty-seeking' and whose behaviour tends to be exploratory and impulsive.

Suggest how this particular allele of the DRD4 receptor could have become common in the human population.

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..... **[4]**

[Total: 18]

5 Sarawak is an area of tropical rainforest in south-east Asia. Logging has been allowed in 60% of the forest.

A study was carried out into the effects of logging on the diversity of mammal species living in the forest. An area of rainforest was sampled before logging, immediately after logging and then again two years and four years after logging.

Before logging began, there were 29 mammal species and four years after logging there were 26 mammal species.

Table 5.1 shows the population densities of six groups of mammals before and after logging. Where numbers were too small to measure the density, the species was recorded as "present".

Table 5.1

mammal	mean number of animals per km^2			
	before logging	immediately after logging	two years after logging	four years after logging
marbled cat	present	0	0	0
oriental small-clawed otter	present	0	0	0
giant squirrel	5	1	4	1
small squirrel	16	24	104	19
tree shrew	10	5	10	38
barking deer	3	1	10	present

(a) Marbled cats and otters are carnivores, while squirrels, shrews and deer are herbivores.

Use the information provided to choose the best word(s) or terms to complete the following passage.

The rainforest …… is a dynamic set of interactions between populations of organisms and the abiotic environment. Energy flows from …… , such as trees, to …… consumers, such as squirrels, and on to consumers such as cats and otters at higher …… . The activities of decomposers contribute to the energy lost from the …… component of the rainforest but decomposers allow …… to be recycled. **[6]**

(b) (i) Table 5.1 shows that the number of small squirrels increases initially, but then decreases.

Explain, using your knowledge of factors affecting population growth, why the small squirrel population in this rainforest does **not** increase in size indefinitely.

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..... **[4]**

(ii) Describe, using the information provided, how species richness **and** species evenness change in the rainforest by comparing the situation before logging and four years after logging.

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..... **[2]**

(c) (i) Suggest why marbled cats and oriental small-clawed otters became extinct in this area but other mammals did not.

.....

..... **[1]**

(ii) Outline **three** reasons for conserving biological resources, such as the rainforest in Sarawak.

1 .....

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2 .....

.....

3 .....

..... **[3]**

(d) Timber is produced sustainably in the United Kingdom.

Describe **and** explain the benefits of **two** management practices used in sustainable timber production in a temperate country.

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..... **[4]**

[Total: 20]

6 **(a)** Plant responses to environmental changes are co-ordinated by plant growth substances (plant hormones).

Explain why plants need to be able to respond to their environment.

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..... **[2]**

(b) The following investigation was carried out into the effects of plant growth substances on germination:

- a large number of lettuce seeds was divided into eight equal batches
- each batch of seeds was placed on moist filter paper in a Petri dish and given a different treatment.

The different treatments are shown in Table 6.1. Each tick represents one of the eight batches of seeds.

Table 6.1

	treatment	concentration of gibberellin (mol dm^{-3})			
		0.00	0.05	0.50	5.00
A	water	✓	✓	✓	✓
B	abscisic acid	✓	✓	✓	✓

The batches of seeds were left to germinate at 25 °C in identical conditions and the percentage germination was calculated.

Fig. 6.1 shows the results of this investigation.

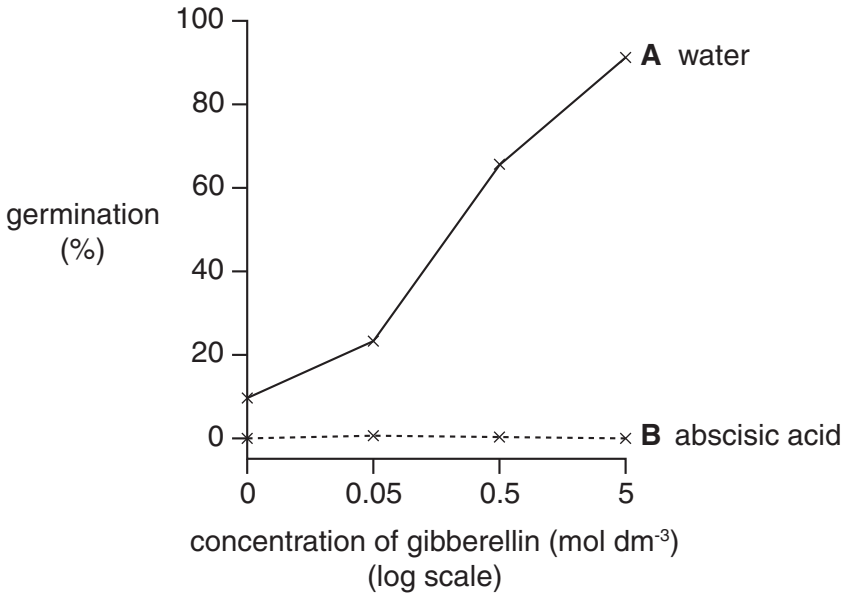

Fig. 6.1

(i) Describe, with reference to Fig. 6.1, the effects of the plant growth substances on the germination of lettuce seeds.

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..... **[4]**

(ii) Explain why all the lettuce seeds were kept at 25 °C.

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..... **[2]**

(iii) State **three** variables, **other than temperature**, that needed to be controlled in the investigation.

1 .....

2 .....

3 ..... **[3]**

(c) State **two** commercial uses of plant growth substances.

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..... **[2]**

[Total: 13]

END OF QUESTION PAPER

insert for mock papers 3

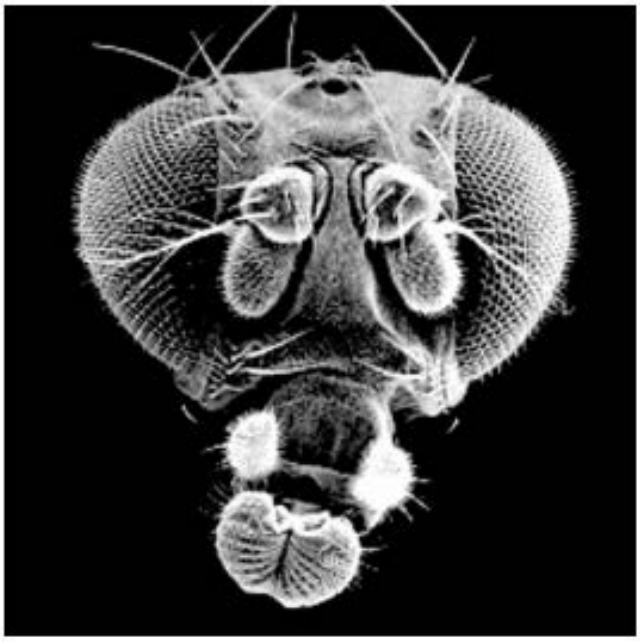

Fig. 3.1

Fig. 3.2

Answer **all** the questions.

1 Knowledge of the nitrogen cycle can be used to make decisions about management of farmland. A farmer uses her grass meadow to raise sheep. In a separate field she grows cabbages.

(a) Fig. 1.1 shows part of the nitrogen cycle. The four boxes on the bottom line of the diagram refer to substances in the soil.

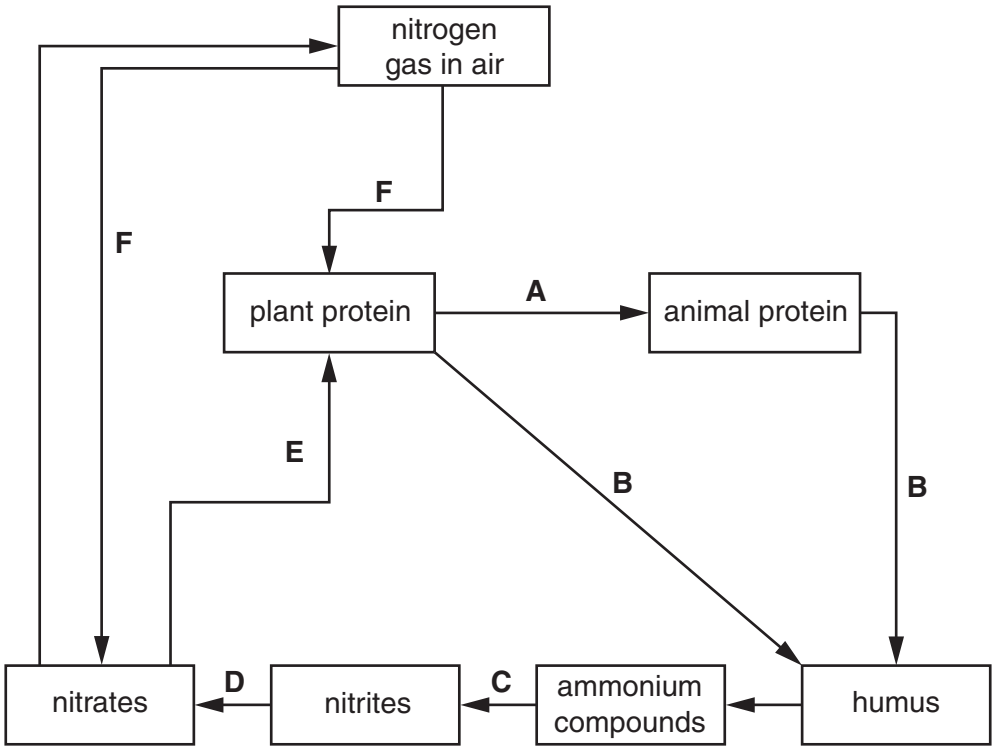

Fig. 1.1

(i) Briefly describe the steps that must occur for plant protein to be converted to animal protein in the farmer's sheep, as shown by arrow **A** on Fig. 1.1.

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..... **[3]**

(ii) List the processes which contribute to **B** in the meadow where sheep are raised.

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..... **[2]**

(iii) Name the bacteria that carry out processes **C** and **D, and** explain the significance of these bacteria for the growth of plants.

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..... **[3]**

(iv) Use the letters on Fig. 1.1 to explain why the soil nitrate concentration will decrease in the cabbage field if it is used to grow repeated crops of cabbages year after year.

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..... **[3]**

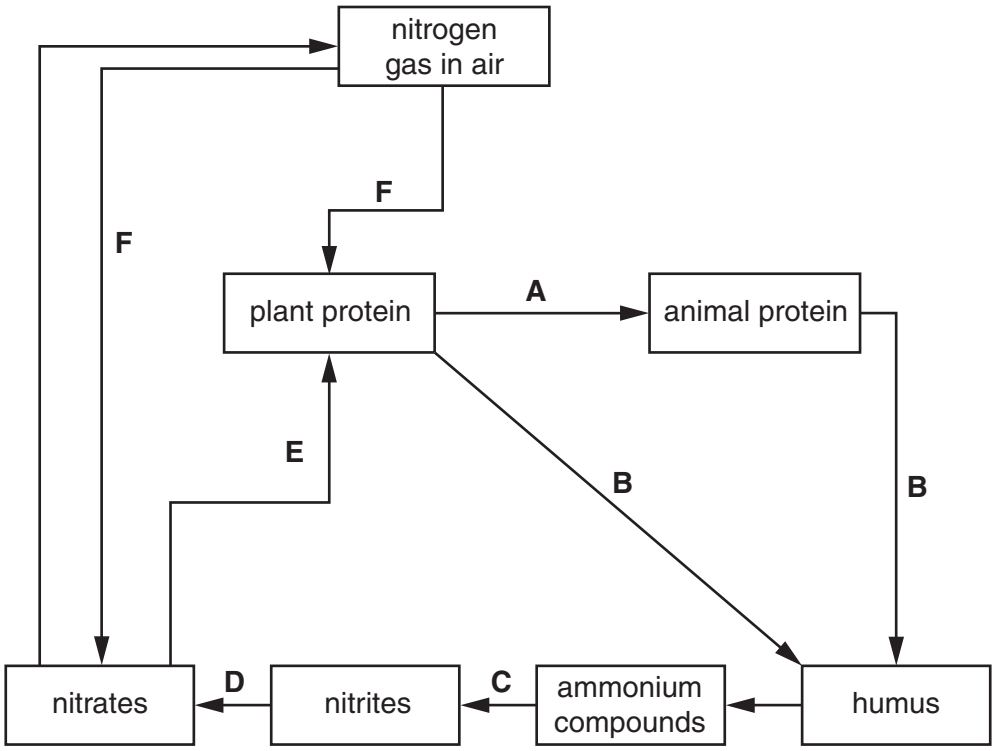

Fig. 1.1

(v) The farmer does not wish to use inorganic fertiliser to replace the nitrate in the soil of the cabbage field. She wishes to make use of process **F**.

Suggest a crop she could plant that would allow process **F** to occur **and** explain how this would add nitrate to the soil.

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..... **[3]**

(b) The sheep on this farm belong to a rare breed called Greyface Dartmoor. The Rare Breeds Survival Trust (RBST) gives advice on looking after these sheep and keep records to monitor the breeding of these sheep, in order to maintain a healthy population.

Why is the continued existence of rare breeds of farm animals desirable?

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..... **[2]**

(c) North Ronaldsay sheep are listed as 'endangered' by the Rare Breeds Survival Trust. These sheep were raised on a small Scottish Island where they were kept along the seashore for most of the year. The sheep developed an unusual metabolism that allowed them to survive by eating seaweed. They are, however, susceptible to copper poisoning when fed on grass.

(i) State the **two** essential steps that must have occurred for a breed to develop a distinctive metabolism, such as the ability to eat mainly seaweed.

.....

..... **[2]**

(ii) Suggest what particular problems make the North Ronaldsay breed one of the most endangered sheep breeds in the United Kingdom.

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..... **[2]**

[Total: 20]

2 Animals behave in ways that enhance their survival and reproductive capacity. This behaviour may be innate or learned.

(a) Describe what is meant by:

(i) innate behaviour

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..... **[2]**

(ii) learned behaviour.

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..... **[2]**

(b) Describe the advantages to animals of innate **and** learned behaviour, with reference to specific examples of each type of behaviour.

Your answer should include both types of behaviour and make clear the advantages to the animals of your chosen examples.

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.... [11]

[Total: 15]

Turn over

3 Molecular evidence has shown that all specimens of the English Elm tree, *Ulmus procera*, form a genetically isolated clone. English Elms developed from a variety of elm brought to Britain from Rome in the first century A.D.

Although English Elm trees make pollen, they rarely produce seeds. Instead they spread by developing structures known as suckers from their roots. Each sucker can grow into a new tree.

This tendency of elms to create suckers has been exploited by humans, who have separated the suckers, with roots attached, and used them to plant hedges and establish new woodlands.

(a) (i) Suggest a technique that could be used to provide **molecular** evidence that all English Elm trees form a clone.

..... **[1]**

(ii) State why the English Elm clone is genetically isolated from other varieties of elm.

.....

..... **[1]**

(iii) State the name given to the process in which plants reproduce asexually by means such as suckers.

..... **[1]**

(b) In 1967, a new, virulent strain of an elm disease fungus arrived in Great Britain on imported timber. Beetles that lived under the bark of elm trees spread the fungus.

The saws used to cut down dead branches were not sterilised after use. When the saws were used to prune healthy trees, these trees became infected. Approximately 25 million elm trees, most of the English Elm population, died within a few years of the arrival of this fungus.

Explain why there was such a rapid loss of elm trees in Britain as a result of this elm disease.

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..... **[4]**

(c) Elm trees respond to fungal infection by plugging their xylem vessels. The leaves on the upper branches of the tree then turn yellow and die. When most of the branches have lost their leaves and died, the roots are weakened and may also die.

(i) Explain why the plugging of xylem vessels will result in the leaves of the upper branches turning yellow.

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..... **[2]**

(ii) Explain why the loss of leaves from the tree may result in the death of the tree's roots.

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..... **[2]**

(d) Many ornamental plants for gardens can be cloned by tissue culture.

Describe the process of cloning plants by tissue culture.

In your answer you should make clear the order in which the steps of the process occur.

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..... **[7]**

(e) List **two** advantages and **two** disadvantages of cloning plants by tissue culture.

advantage 1 .....

.....

advantage 2 .....

.....

disadvantage 1 .....

.....

disadvantage 2 .....

..... **[4]**

[Total: 22]

4 Wading birds (waders) are birds that feed in shallow water. Table 4.1 shows changes in the population size of four species of wader in two areas of the Western Isles off the coast of Scotland.

- Area 1 is an area that has remained free of hedgehogs.
- Area 2 is an area where four hedgehogs were introduced from the mainland in 1974. Since then, they have established a large population.

Hedgehogs eat the eggs of ground-nesting birds like waders.

Table 4.1

	number of breeding pairs of wader birds			
	area 1 (hedgehogs absent)		area 2 (hedgehogs present)	
year / species of wader	1983	2000	1983	2000
lapwing	1104	1364	1869	1287
redshank	486	733	1288	760
dunlin	803	558	2016	884
snipe	172	154	655	280

(a) (i) Calculate the percentage decrease in the number of breeding pairs of **snipe** in **area 2** between 1983 and 2000.

Show your working.

Answer = ... % **[2]**

(ii) Use the data in Table 4.1 to describe **and** explain the effect of the introduction of hedgehogs on the number of breeding pairs of waders in **area 2**.

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..... **[6]**

(iii) Suggest **two** factors that might have allowed a large population of hedgehogs to increase from just four individuals in **area 2**.

Explain how each factor has led to an increase in the hedgehog population.

1 .....

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.....

.....

2 .....

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.....

..... **[4]**

(b) Three suggested methods to reduce the effect of hedgehogs on the numbers of waders in area 2 were considered. These were:

- trapping and moving hedgehogs to the mainland
- trapping hedgehogs and keeping them in captivity indefinitely
- trapping of hedgehogs followed by humane killing.

The third method was judged to be the most effective and likely to succeed in reducing hedgehog numbers.

Comment on the ethical issues involved in making this decision.

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..... **[3]**

[Total: 15]

5 Fig. 5.1 is a circular representation of the genetic code.

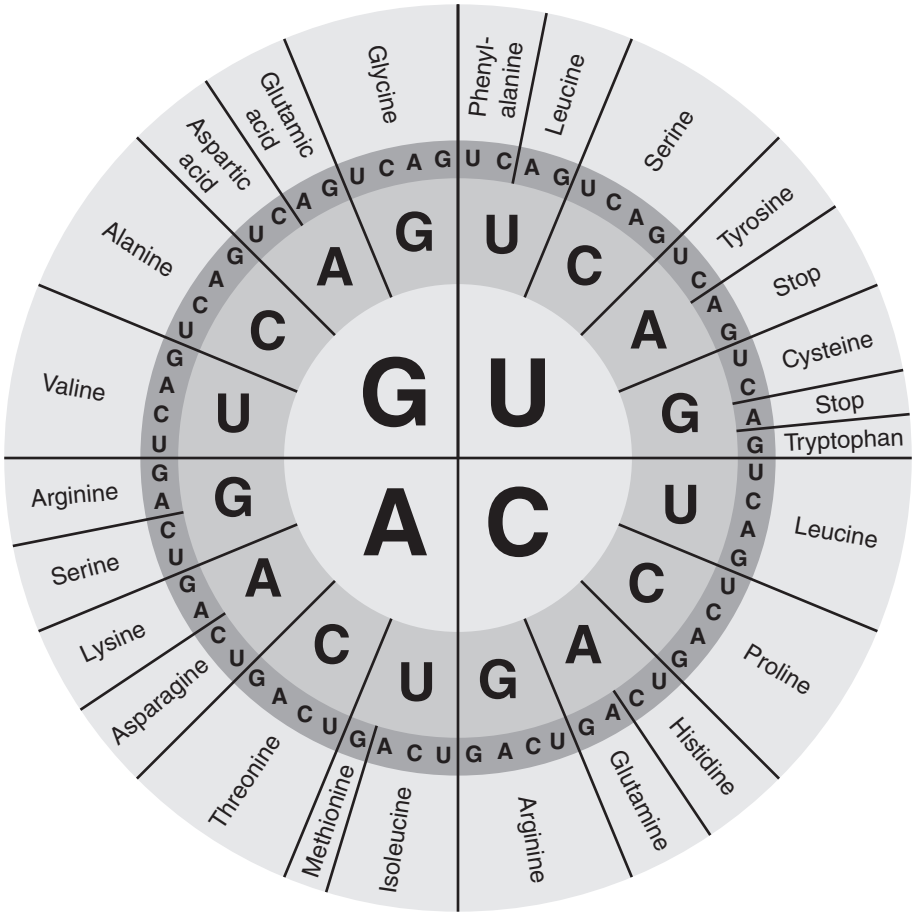

Fig. 5.1

(a) **Fig. 5.2** shows a sequence of bases coding for a sequence of amino acids. The name of the third amino acid in the sequence has been filled in.

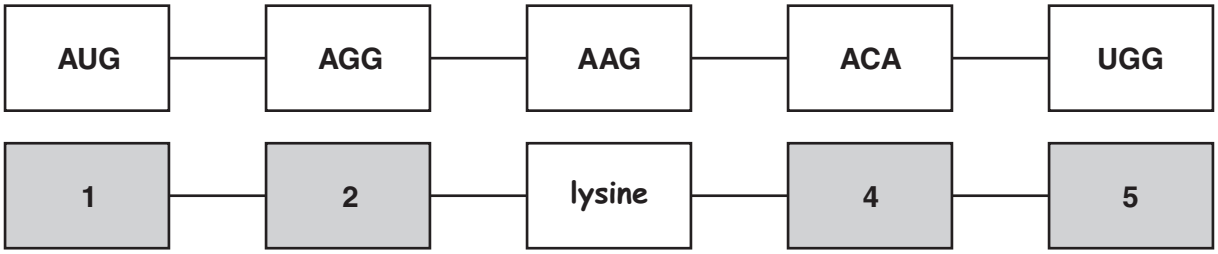

Fig. 5.2

Identify the remaining amino acids in the sequence.

1 .....

2 .....

3 lysine

4 .....

5 ..... **[2]**

(b) State the name of the stage of protein synthesis represented in Fig.5.2 **and** name the organelle in the cell where this takes place.

.....

..... **[2]**

(c) Identify the type of nucleic acid that holds the sequence of bases shown in Fig. 5.2.

..... **[2]**

(d) Using the information in **Fig. 5.1**, list the **three** triplet codons that would cause termination of a polypeptide chain (stop codons) **and** explain why these codons have this effect.

.....

.....

.....

.....

..... **[2]**

(e) What name would be given to a mutation that resulted in a change of the codon **UUU** to **UUC**?

..... **[1]**

[Total: 9]

6 Describe the differences between:

(a) somatic cell gene therapy and germ line cell gene therapy

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..... **[2]**

(b) the central nervous system and the peripheral nervous system

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..... **[4]**

(c) prophase 1 of meiosis and prophase 2 of meiosis.

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..... **[2]**

[Total: 8]

7 Two-spot ladybirds, *Adalia bipunctata*, show a colour polymorphism. They are normally red with two black spots. However, melanic individuals occur which are black with two red spots.

A student investigated the proportion of these colour forms in the ladybird population along a transect going up a hill near his school.

(a) (i) Suggest a suitable technique by which the student might have collected his samples of ladybirds along this transect.

.....

.....

..... **[1]**

(ii) The student's teacher suggested he should make several transects up the hill rather than just one transect.

Explain why this is good experimental design.

.....

.....

..... **[1]**

(b) The student's results are shown in Table 7.1.

Table 7.1

height above sea level (m)	total number of red form of ladybird	total number of black form of ladybird
100	93	7
200	78	13
300	71	16
400	54	14

(i) Suggest a method of processing this data to make comparisons between the frequency of the red form and black form of ladybird at the different altitudes more valid.

Explain why your method is an improvement.

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..... **[2]**

(ii) Evaluate whether the student was correct to conclude as follows:

"My data showed a positive correlation between increasing altitude and the frequency of the black form of the ladybird. I therefore concluded that high altitude causes the black form to survive better."

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..... **[3]**

(c) The black, melanic, form of the ladybird is caused by an allele (**B**) that is dominant.

The red form of the ladybird is therefore homozygous recessive at this locus (**bb**).

(i) State what is meant by the term *recessive*.

.....

.....

..... **[1]**

(ii) The data in Table 7.1 give the total number of the red form of ladybird found as 296, and the total number of the black form of ladybird as 50.

The Hardy-Weinberg principle states that:

$$p + q = 1$$

$$p^2 + 2pq + q^2 = 1$$

Use the Hardy-Weinberg principle and the figures given above to calculate the frequency of the dominant allele, p, and the recessive allele, q, in the two-spot ladybird population.

Show each step in your working. **Give your answers to 2 decimal places**.

p = ...

q = ... **[3]**

[Total: 11]

END OF QUESTION PAPER

mock papers 5

1 The process of photosynthesis has two main stages. The first of these involves the light-dependent reactions.

(a) The statements below describe important parts of the light-dependent reactions of photosynthesis. Place a cross ☒ in the box next to the term that completes each statement correctly.

(i) When light is absorbed by chlorophyll, it excites

(1)

☒ **A** electrons

☒ **B** neutrons

☒ **C** photons

☒ **D** protons

(ii) Oxygen is produced when water molecules are split in the process of

(1)

☒ **A** analysis

☒ **B** autolysis

☒ **C** hydrolysis

☒ **D** photolysis

(iii) The products of the light-dependent reactions that are used in the light-independent reactions are reduced NADP and

(1)

☒ **A** ATP

☒ **B** GALP

☒ **C** DNA

☒ **D** RuBP

(b) Describe the structures in a chloroplast that are involved in the light-dependent reactions of photosynthesis.

(3)

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.....

(c) In an investigation, wheat plants were grown using artificial lighting. Three different types of lighting were used. When the wheat plants were mature, the total biomass of the plants and the mass of the grain (seeds) they produced were measured for each type of lighting.

The table below shows the results of this investigation.

Type of lighting	**Total biomass / kg**	**Mass of grain / kg**	**Grain yield as a percentage of total biomass (%)**
Low pressure sodium lamps	171	61.7	36.1
High pressure sodium lamps	159	58.8	37.0
Metal halide lamps	162	62.4	

(i) Calculate the grain yield, as a percentage of total biomass, for the wheat grown under metal halide lamps. Show your working.

(2)

Answer ..... %

(ii) With reference to the data in the table, suggest the conclusions the investigators may have made about the effect of using different types of lighting on grain yield.

(3)

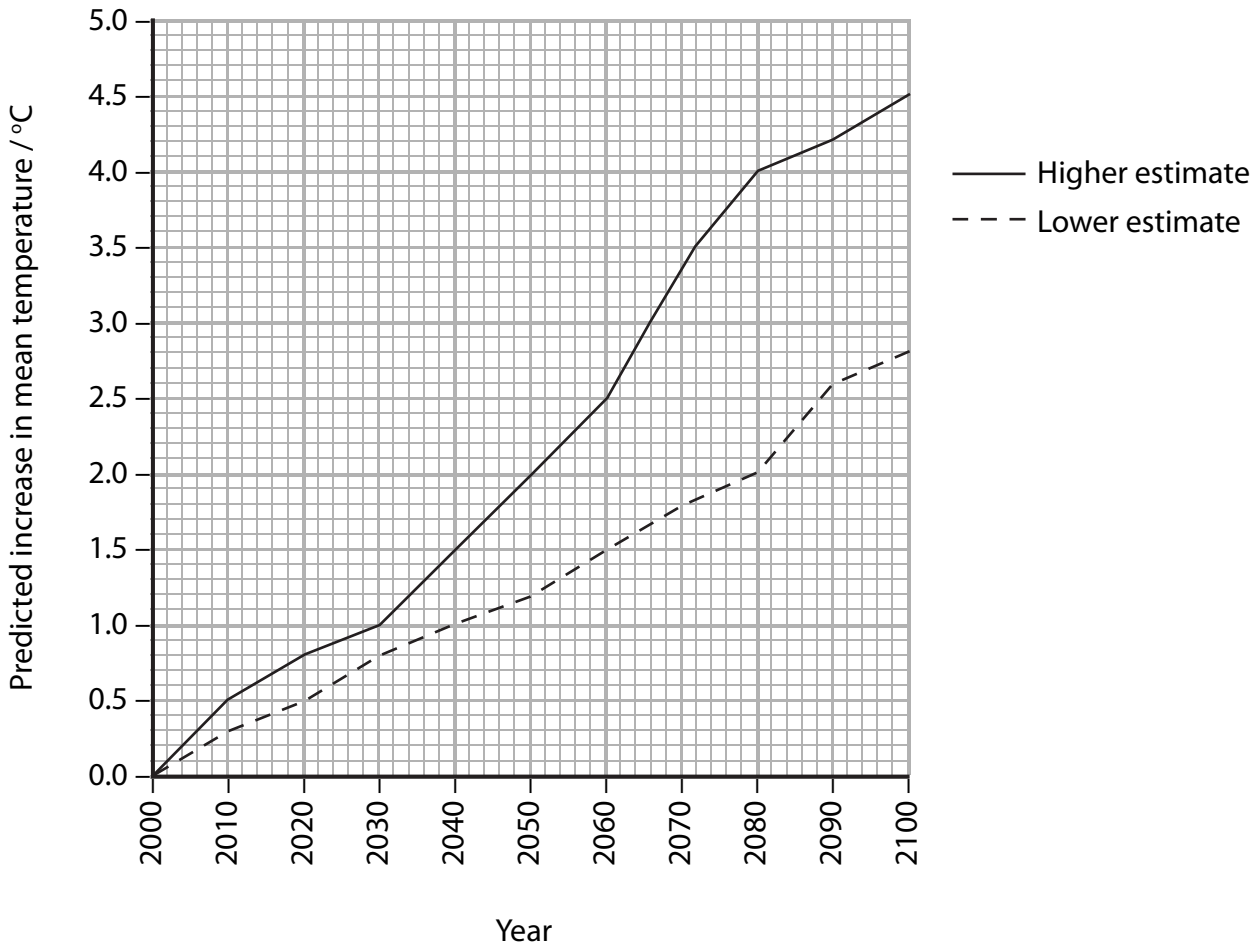
(iii) Suggest **two** advantages of growing crops of wheat in glasshouses with artificial lighting rather than growing them in open fields.

(2)

(Total for Question 1 = 13 marks)

Turn over ▶

2 The mean global temperature is expected to increase as a result of climate change. The graph below shows the predicted changes in mean temperature in New Zealand, during the 21st century. A higher and lower estimate of these changes have been made.



(a) (i) Explain how increases in carbon dioxide and methane, released into the atmosphere, may be contributing towards the estimated changes in mean temperature shown in the graph.

(3)

(ii) Suggest why a higher estimate and a lower estimate were made.

(1)

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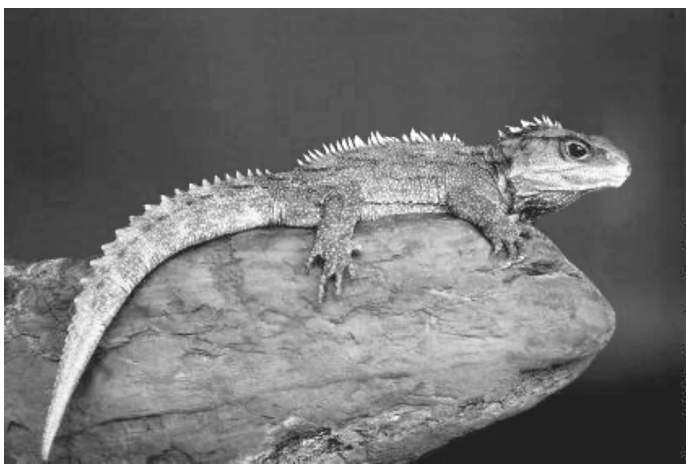
(b) Tuataras are reptiles found only on a group of small islands off the coast of mainland New Zealand. Adult tuataras grow to approximately 65 cm in length. They feed on small mammals, bird chicks and invertebrates such as insects and worms.



Tuataras build nests in which their eggs are laid. The gender (sex) of the tuatara, that hatches from an egg, is determined by the incubation temperature in the nest. A temperature of 22 °C or above will mean that a male tuatara will hatch. Female tuataras only hatch from eggs incubated below 22 °C.

During the breeding season in 2000, the temperature of the nests ranged between 18 °C and 24 °C.

Turn over ▶

(i) Suggest how the changes in the mean temperature, shown in the graph on page 6, might affect the tuataras on the islands off the coast of New Zealand.

(4)

(ii) Suggest how other animal populations on these islands might be affected by changes in the tuatara population.

(2)

(Total for Question 2 = 10 marks)

3 The distribution and abundance of an organism within its habitat can be influenced by both abiotic and biotic factors.

(a) Explain the difference between **abiotic** and **biotic** factors.

(1)

(b) Periwinkles are similar to snails and are one of the common invertebrates found on many seashores around Britain. A study of the distribution of two species of periwinkle, *Littorina littorea* and *Littorina obtusata*, was carried out.

Areas of a sloping seashore were selected at different heights above sea level. Within each of these areas, the mean density (individuals per m^2) of each of the periwinkle species was recorded.

(i) Place a cross ☒ in the box next to the name of the most suitable piece of apparatus for obtaining the data for the density of the periwinkles.

(1)

☒ **A** quadrant

☒ **B** quadrat

☒ **C** quadrille

☒ **D** quartile

*(ii) Explain how this piece of apparatus would be used to obtain the mean density of the two species of periwinkle in each area.

(3)

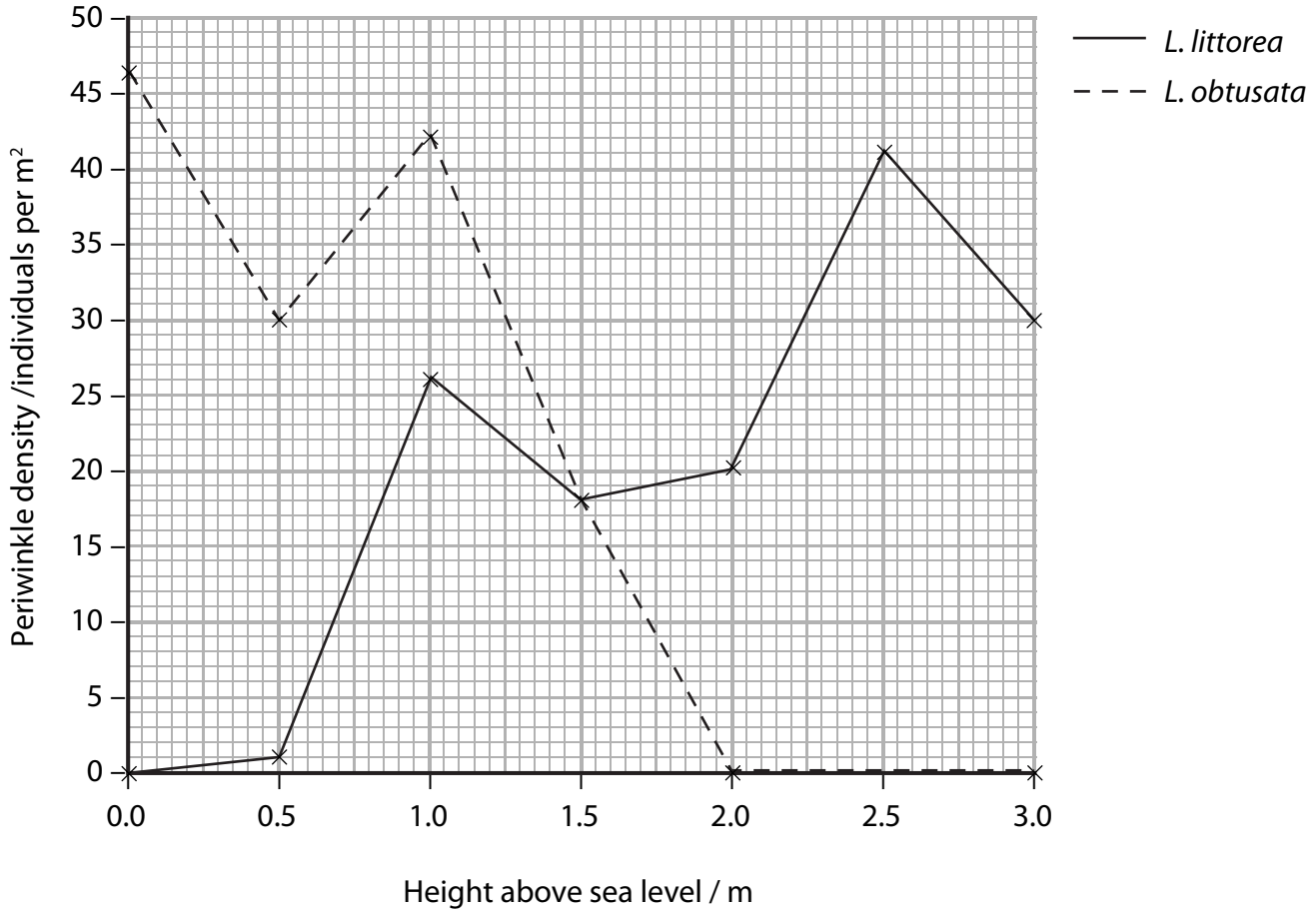
(iii) Suggest **one** abiotic factor and **one** biotic factor that may influence the distribution of the periwinkles on the seashore.

(2)

Abiotic .....

Biotic .....

(iv) The results of this study into periwinkle density are shown in the graph below.



The three statements below show the conclusions recorded by different students following the seashore study of periwinkles.
Place a cross ☒ in the box next to one statement that could form a valid conclusion using the information shown in the graph opposite.

(1)

☒ **A** All periwinkles are affected by the height above sea level

☒ **B** The height above sea level influences the distribution of different species of periwinkle

☒ **C** Neither of the species of periwinkle is affected by the height above sea level

(v) With reference to the data in the graph, discuss the validity of statements **A**, **B** and **C**.

(4)

(Total for Question 3 = 12 marks)

4 The bases in a gene code for the synthesis of a protein. Gene mutations can influence the metabolism of an organism.

(a) (i) The diagram below shows the bases on the template strand of DNA in the part of a gene that codes for a short sequence of amino acids in an enzyme.

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

Each of the following statements is about this sequence of bases. For each statement, place a cross ☒ in the appropriate box to show whether it is true or false.

(3)

Statement	True	False
This sequence of bases could be used as a template during translation	☒	☒
A strand of mRNA could be synthesised using this sequence	☒	☒
This sequence codes for 7 amino acids during protein synthesis	☒	☒

(ii) Name and describe the structures where the polypeptide chain of this enzyme would be synthesised.

(2)

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(b) *Chlamydomonas* is a single-celled photosynthetic organism that lives in well-illuminated ponds. In populations of *Chlamydomonas*, a gene mutation occasionally occurs. This mutation enables *Chlamydomonas* to take in organic compounds produced by other organisms and use them as a source of energy.

(i) Explain what is meant by the term **gene mutation**.

(2)

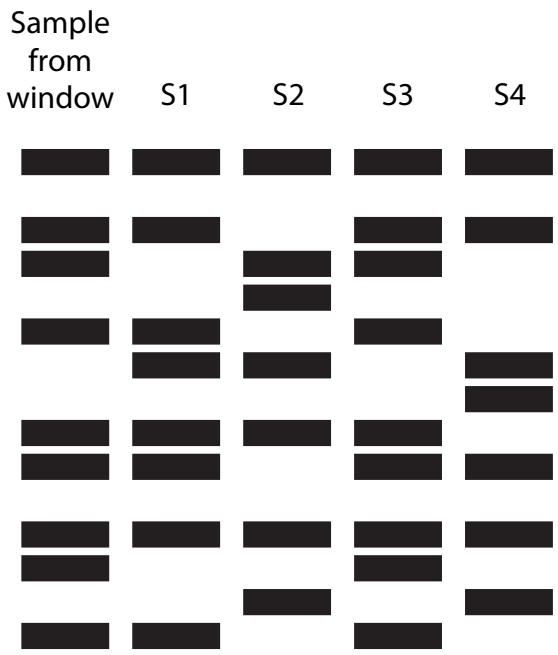
(ii) A population of *Chlamydomonas* was found in a pond in the centre of a developing forest of fast-growing trees. Suggest how the allele frequency for this mutation could change as the forest develops. Give reasons for your answer.

(4)

(Total for Question 4 = 11 marks)

Turn over ▶

5 Following a burglary, a DNA profile was created using a small sample of blood left behind on a broken window pane. This DNA profile was then compared with DNA profiles from four suspects, S1, S2, S3 and S4. These DNA profiles are shown in the diagram below.



(a) (i) Place a cross ☒ in the box next to the name of the enzyme used in the process used to amplify the DNA in the small sample of blood taken from the crime scene.

(1)

☒ **A** endonuclease

☒ **B** invertase

☒ **C** polymerase

☒ **D** transcriptase

(ii) Place a cross ☒ in the box next to the name of the process that could be used to separate DNA fragments to create the profiles shown in the diagram above.

(1)

☒ **A** amniocentesis

☒ **B** electrophoresis

☒ **C** endocytosis

☒ **D** chromatography

(iii) Suggest which of the suspects is most likely to have left the blood sample on the broken window pane. With reference to the theory used in DNA profiling, explain how you came to this conclusion.

(5)

Suspect .....

Explanation .....

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Turn over ▶

(b) Explain why evidence from DNA profiles may not be absolutely conclusive.

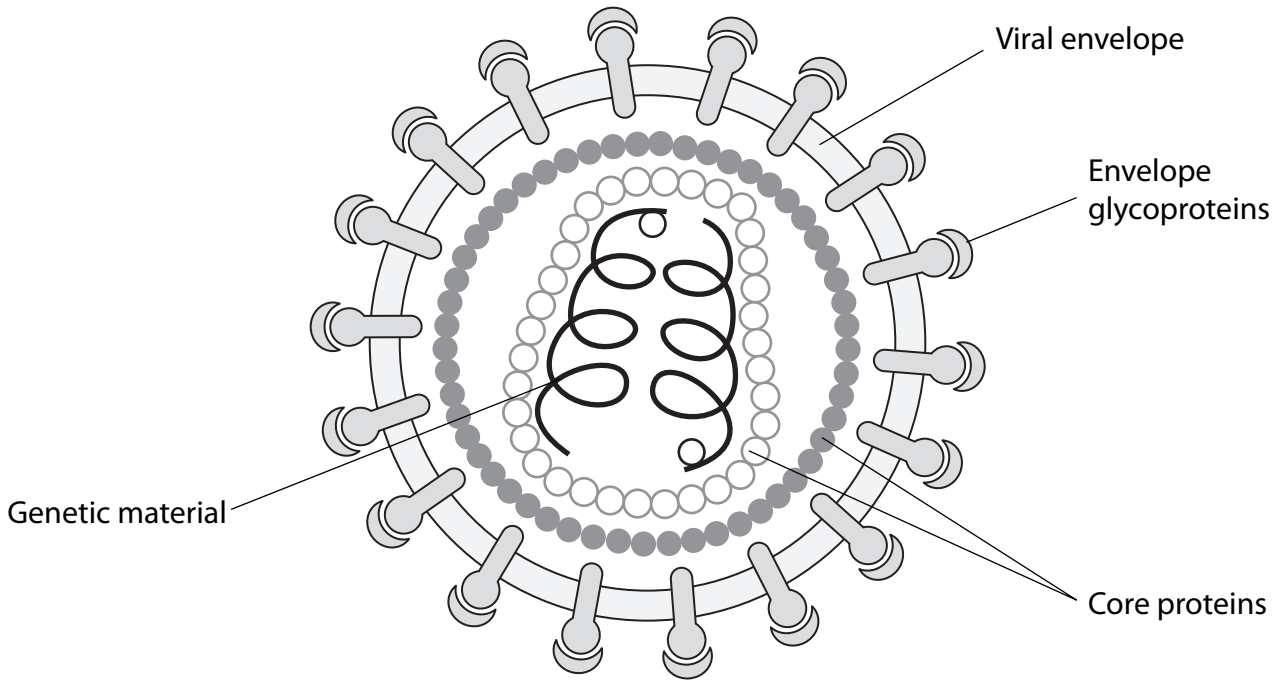
(2)

(c) Suggest how DNA profiling could be useful to scientists who examine fossils of animals and plants.

(2)

(Total for Question 5 = 11 marks)

6 The diagram below shows the structure of Human Immunodeficiency Virus (HIV).



(a) State how the genetic material in HIV differs from the genetic material in the bacterium *Mycobacterium tuberculosis* that causes TB.

(2)

Turn over ▶

(b) One of the ways in which HIV may enter the blood is through the use of infected needles. Explain why unbroken skin is an effective barrier against HIV infection.

(2)

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(c) The table below shows the changes in the number of CD4 T-lymphocytes in the blood of a person infected with HIV, during the first 10 weeks after infection.

Time after infection / weeks	CD4 T-lymphocyte count / cells per mm^3 of blood
0	1050
1	980
2	810
3	600
4	520
5	490
6	480
7	500
8	530
9	580
10	600

(i) Describe the change in numbers of CD4 T-lymphocytes during the first 6 weeks after infection with HIV.

(2)

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*(ii) Explain the change in numbers of CD4 T-lymphocytes during the first 6 weeks after infection with HIV.

(5)

(iii) Suggest **one** effect that this change would have on one other component of the infected person's blood.

(1)

(Total for Question 6 = 12 marks)

Turn over ▶

7 Cow pats, formed from the faeces dropped by cattle, are a familiar sight in any field where cattle have been grazing. Apart from water, a cow pat consists of a mixture of organic compounds left over from the digestive processes in the cow.

Cellulose and plant fibres are efficiently digested in cattle. Therefore, the texture of a cow pat is relatively soft in comparison to the faeces of some other herbivores.

(a) (i) Place a cross ☒ in the **two** boxes next to the types of bond that would need to be broken during the digestion of cellulose in cattle.

(2)

ester ☒

hydrogen ☒

glycosidic ☒

peptide ☒

(ii) Name **two** types of plant fibre that may be present in the material eaten by cattle.

(2)

1 .....

2 .....

(b) The first stage in the decomposition of a cow pat is known as putrefaction. Explain how carbon dioxide and ammonia are formed during this stage of decomposition.

(4)

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(c) The table below shows the mean time taken for a cow pat to decompose, at different times of the year, in a field in southern Britain.

Season	Decomposition time for cow pat / days
Early spring	140
Late spring	125
Early summer	110
Late summer	90
Early autumn	120
Late autumn	150

With reference to the data in the table, suggest why the time taken for a cow pat to decompose changes at different times of the year.

(3)

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(Total for Question 7 = 11 marks)

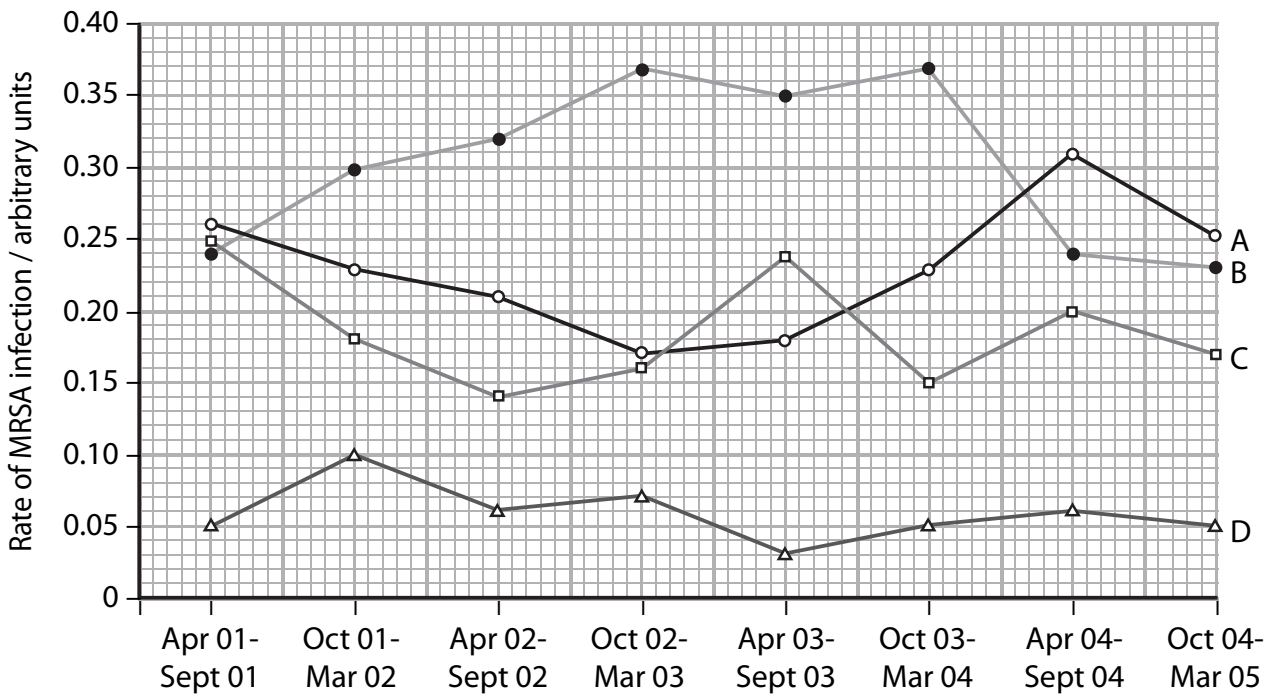
Turn over ▶

8 Blood infection caused by the bacterium, methicillin-resistant *Staphylococcus aureus* (MRSA), has become a major concern in hospitals. This infection can be difficult to treat due to increasing resistance of MRSA to bacteriostatic and bactericidal antibiotics.

(a) Explain what is meant by the terms **bacteriostatic antibiotic** and **bactericidal antibiotic**.

(3)

(b) The graph below shows the occurrence of MRSA infection in four hospitals, A, B, C, and D for the period from April 2001 to March 2005. The rate of MRSA infection in each hospital during each six-month period was recorded.



Compare the rates of MRSA infection in hospital A with those in hospital B.

(3)

Turn over ▶

(c) MRSA is present on the skin of approximately 1 in 3 of all patients entering hospitals for treatment.

(i) Describe the most significant difference between the rate of MRSA infection in hospital D compared with those of the other three hospitals.

(1)

(ii) Suggest why the rate of MRSA infection in hospital D differs from the rates in the other hospitals.

(3)

(Total for Question 8 = 10 marks)

TOTAL FOR PAPER = 90 MARKS