

# X007/701

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NATIONAL  
QUALIFICATIONS  
2007

MONDAY, 21 MAY  
1.00 PM – 3.30 PM

BIOLOGY  
ADVANCED HIGHER

**SECTION A—Questions 1–25 (25 marks)**

Instructions for completion of Section A are given on *Page two*.

**SECTIONS B AND C**

The answer to each question should be written in ink in the answer book provided. Any additional paper (if used) should be placed inside the front cover of the answer book.

Rough work should be scored through.

**Section B (55 marks)**

All questions should be attempted. Candidates should note that Question 8 contains a choice.

Question 1 is on Pages 8, 9 and 10. Questions 2, 3 and 4 are on Page 11. Pages 10 and 11 are fold-out pages.

**Section C (20 marks)**

Candidates should attempt the questions in **one** unit, **either** Biotechnology **or** Animal Behaviour **or** Physiology, Health and Exercise.



### Read carefully

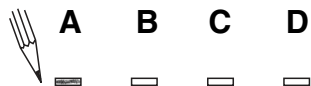
- 1 Check that the answer sheet provided is for **Biology Advanced Higher (Section A)**.
- 2 For this section of the examination you must use an **HB pencil** and, where necessary, an eraser.
- 3 Check that the answer sheet you have been given has **your name, date of birth, SCN** (Scottish Candidate Number) and **Centre Name** printed on it.  
Do not change any of these details.
- 4 If any of this information is wrong, tell the Invigilator immediately.
- 5 If this information is correct, **print** your name and seat number in the boxes provided.
- 6 The answer to each question is **either** A, B, C or D. Decide what your answer is, then, using your pencil, put a horizontal line in the space provided (see sample question below).
- 7 There is **only one correct** answer to each question.
- 8 Any rough working should be done on the question paper or the rough working sheet, **not** on your answer sheet.
- 9 At the end of the exam, put the **answer sheet for Section A inside the front cover of the answer book**.

### Sample Question

Which of the following molecules contains six carbon atoms?

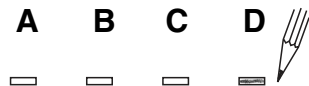
- A Glucose
- B Pyruvic acid
- C Ribulose biphosphate
- D Acetyl coenzyme A

The correct answer is **A**—Glucose. The answer **A** has been clearly marked in **pencil** with a horizontal line (see below).



### Changing an answer

If you decide to change your answer, carefully erase your first answer and using your pencil, fill in the answer you want. The answer below has been changed to **D**.



SECTION A

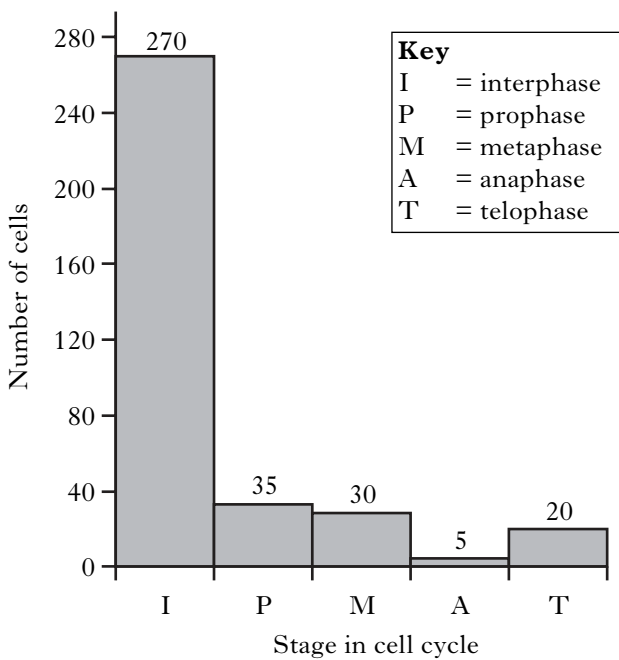
All questions in this section should be attempted.

Answers should be given on the separate answer sheet provided.

1. What name is given to the cytoplasmic connections that link adjacent plant cells?

- A Microvilli
- B Microfilaments
- C Plasmodesmata
- D Middle lamellae

2. The figure below shows the number of cells in a tissue sample at various stages of the cell cycle.



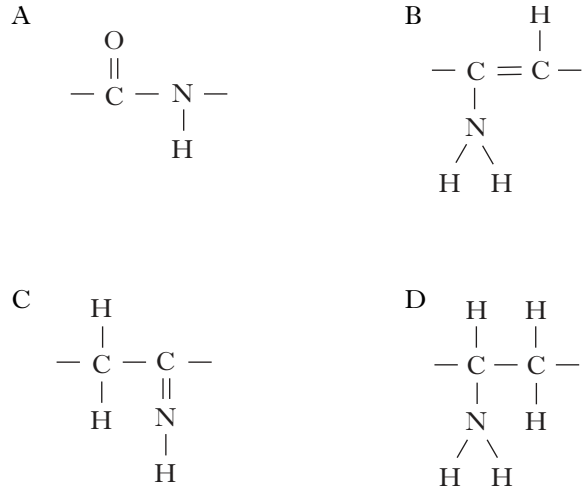
The mitotic index for this sample is

- A 3
- B 4
- C 25
- D 33.

3. Which line in the table correctly describes the chemical reaction in which a fatty acid is joined to a glycerol?

	Type of reaction	Type of bond formed
A	hydrolysis	ester
B	condensation	glycosidic
C	hydrolysis	glycosidic
D	condensation	ester

4. Which of the following diagrams illustrates a peptide bond?



5. The proportion of sugars produced in the breakdown of starch can be measured by the dextrose equivalent (DE). The DE can be calculated as follows:

$$\text{DE} = 100 \times \frac{\text{number of glycosidic bonds broken}}{\text{number of glycosidic bonds originally present}}$$

What is the approximate DE when an amylose molecule is completely digested to maltose?

- A 0.5
- B 1.0
- C 50
- D 100

6. Which of the following describes the structure of cytosine?

- A A purine base with a single-ring structure
- B A purine base with a double-ring structure
- C A pyrimidine base with a single-ring structure
- D A pyrimidine base with a double-ring structure

[Turn over

7. A diploid cell contains  $6 \times 10^9$  base pairs of genetic code. Only 4% of this codes for protein.

How many anticodons does this represent?

- A  $2.4 \times 10^7$
- B  $8 \times 10^7$
- C  $2.4 \times 10^8$
- D  $8 \times 10^8$

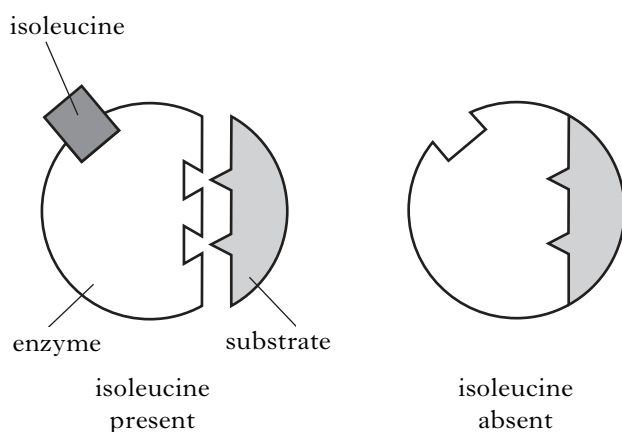
8. To which group of signalling molecules does testosterone belong?

- A Extracellular hydrophobic
- B Extracellular hydrophilic
- C Peptide hormone
- D Neurotransmitter

9. Enzymes that catalyse the hydrolysis of phosphodiester bonds in genetic material are called

- A kinases
- B ligases
- C ATPases
- D nucleases.

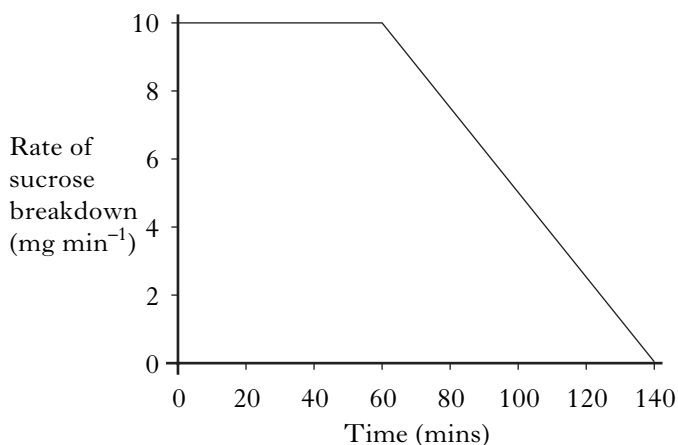
10. The diagram below shows the effect of isoleucine on the enzyme threonine deaminase.



In high concentrations, isoleucine acts as

- A an allosteric inhibitor
- B an allosteric activator
- C a competitive inhibitor
- D a positive modulator.

11. The graph shows the results of an investigation using the enzyme invertase that breaks down sucrose into glucose and fructose. 1 g of sucrose was dissolved in  $100 \text{ cm}^3$  water and  $2 \text{ cm}^3$  of a 1% invertase solution was added.



Which of the following conclusions can be drawn from this information?

- A At 70 minutes exactly half the substrate remains.
- B Between 0 and 60 minutes the concentration of the substrate remains constant.
- C At 140 minutes the enzyme is no longer active.
- D Between 60 and 140 minutes the concentration of the substrate is the limiting factor.

12. The following stages are used to introduce a “foreign” gene into a tomato plant.

- W Descendent plant cells receive copies of foreign gene.
- X Foreign gene inserted into plasmid.
- Y Altered plasmid introduced into cultured plant cells.
- Z Plasmid isolated from *Agrobacterium tumefaciens*.

These stages would occur in the order

- A Y, W, X, Z
- B Z, X, Y, W
- C X, Z, W, Y
- D Z, Y, X, W.

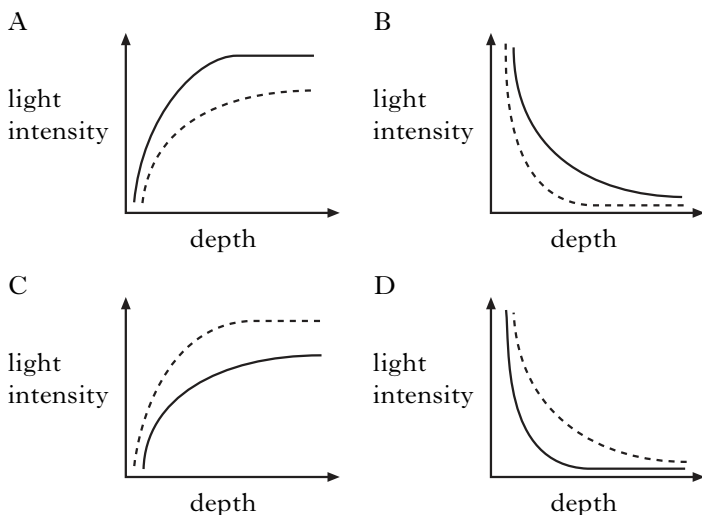
13. Which of the following processes only takes place in autotrophs?
- A Assimilation  
 B Decomposition  
 C Photosynthesis  
 D Respiration
14. The number of trophic levels in a food chain is limited because at each level the
- A amount of energy decreases  
 B number of organisms decreases  
 C biomass decreases  
 D productivity decreases.

15. In aquatic ecosystems the amount of sunlight absorbed by water increases with depth.
- Absorption by seawater is greater than absorption by fresh water.

Which of the following graphs represents the relationship between depth and light intensity in fresh water and seawater?

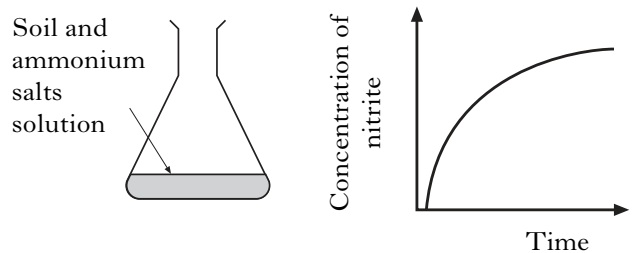
**Key**

— fresh water  
 - - - - seawater



16. In the nitrogen cycle, which of the following bacteria utilises nitrogenase?
- A *Rhizobium*  
 B *Nitrosomonas*  
 C *Nitrobacter*  
 D *Pseudomonas*

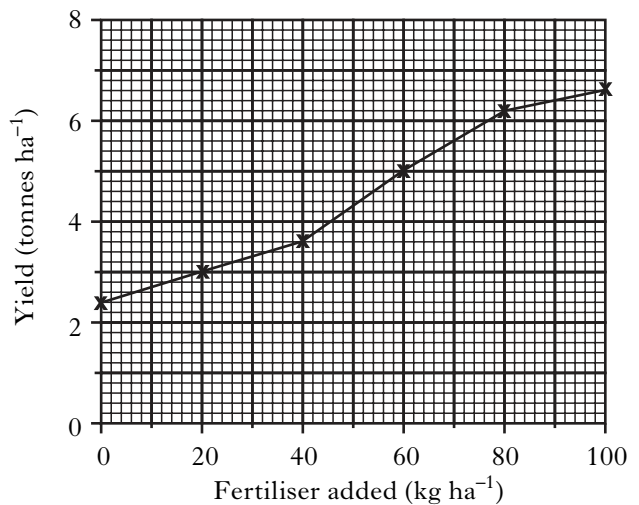
17. A flask was set up to demonstrate the activity of some of the micro-organisms involved in the nitrogen cycle. The concentration of nitrite in the solution was measured over several weeks and the results are shown in the graph.



Which process has been shown to be taking place in the flask?

- A Ammonification  
 B Nitrification  
 C Nitrogen fixation  
 D Denitrification

18. The graph shows the effect of adding different amounts of fertiliser on the yield of a crop plant.



The percentage increase in yield obtained when the fertiliser is increased from 40 to 80 kg ha<sup>-1</sup> is

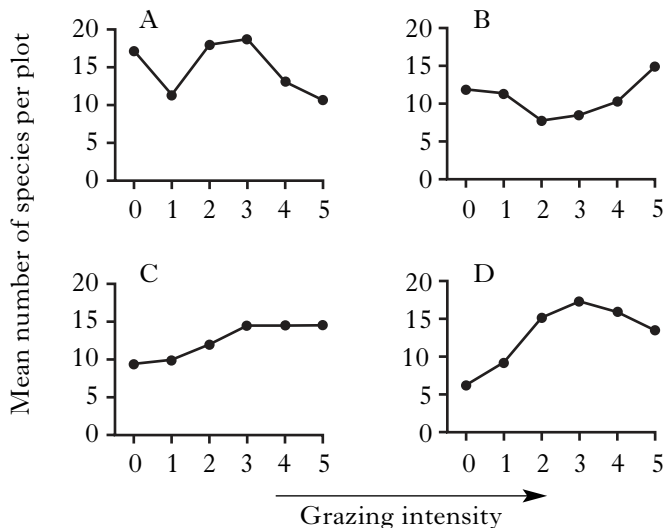
- A 26  
 B 40  
 C 58  
 D 72.

[Turn over

19. Which of the following is an example of *exploitation* competition?

- A Red grouse, through aggressive behaviour, establish a territory which provides food and cover.
- B A population of moose living on an island share a limited supply of food.
- C Dandelions have evolved a flat rosette leaf arrangement which maximises their supply of light.
- D Encrusting sponges use poisonous chemicals to overcome other sponge species as they expand to fill open space on rock surfaces.

20. Which of the graphs best represents the relationship between the intensity of rabbit grazing and the diversity of plant species in a series of grassland plots?



21. The piping plover (*Charadrius melodus*) often nests within colonies of the common tern (*Sterna hirundo*). The breeding success of the plover is greater when nesting takes place within a tern colony. The breeding success of terns is very similar in colonies with and without plovers. This suggests that the relationship between the two species is

- A commensalism
- B mutualism
- C parasitism
- D competitive.

22. The table shows some of the characteristics of a number of agricultural fertilisers.

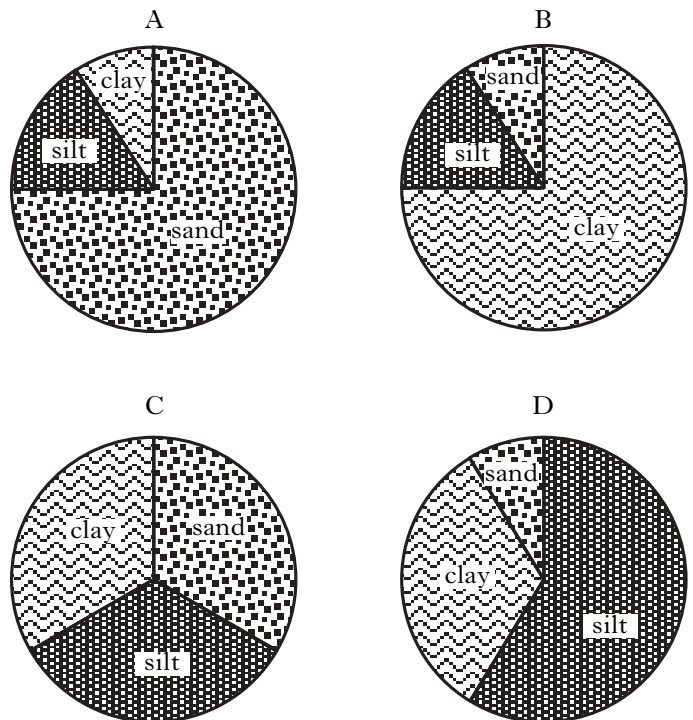
Characteristic	Fertiliser			
	A	B	C	D
Phosphate concentration	high	high	low	high
Nitrate concentration	high	low	high	high
Nutrient release rate	slow	slow	fast	fast

Which of these fertilisers would be most likely to cause eutrophication in an aquatic ecosystem?

23. Soils are mixtures of rock particles of different sizes called clay, silt and sand. The table shows the composition of a number of different soil types.

Soil type	Particle size (%)		
	Clay	Silt	Sand
sandy clay loam	20 – 30	0 – 30	50 – 80
clay loam	20 – 35	20 – 60	20 – 50
sandy silt loam	0 – 20	40 – 80	20 – 50
silty clay loam	20 – 35	45 – 80	0 – 20

Which of the following represents a clay loam?



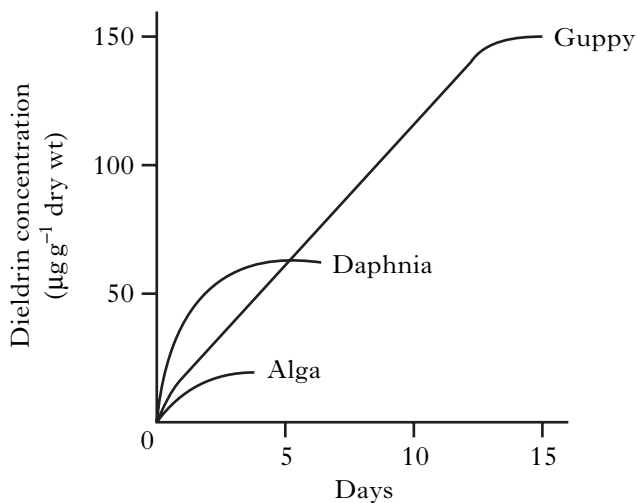
24. The following gases can all be atmospheric pollutants.

- 1 Carbon dioxide
- 2 Methane
- 3 Nitrous oxide
- 4 Sulphur dioxide

Those that contribute to the formation of acid rain are

- A 1, 2, 3 and 4
- B 1, 3 and 4 only
- C 1, 2 and 4 only
- D 3 and 4 only.

25. The figure shows the concentration of dieldrin (a pesticide) in an alga, the water flea *Daphnia* and a small fish known as a guppy. The species were immersed separately in a solution of dieldrin. The *Daphnia* were not fed during the test; the fish were fed on uncontaminated *Daphnia*.



The results in the graph are a consequence of

- A biological magnification
- B bioaccumulation
- C biotransformation
- D biodegradation.

[END OF SECTION A]

**Candidates are reminded that the answer sheet MUST be returned INSIDE the front cover of the answer book.**

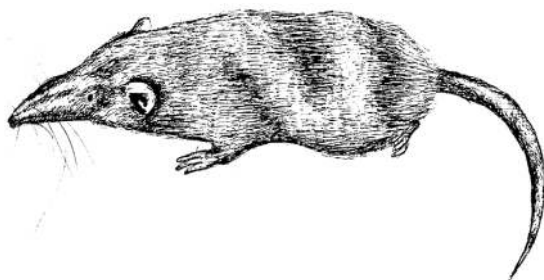
**[Turn over for Section B on Page eight**

## SECTION B

**All questions in this section should be attempted.  
All answers must be written clearly and legibly in ink.**

1. The Asian musk shrew (*Suncus murinus*), an efficient and rapid coloniser originating in India, has reached the island of Mauritius. The shrew is frequently transported unknowingly in ships' cargoes and personal baggage. It is responsible for a number of damaging ecological effects and is fast becoming a pest species of global proportions, especially in small island ecosystems.

**Figure 1: The Asian musk shrew (*Suncus murinus*)**



One conservation programme to eradicate the shrew has been attempted on Ile aux Aigrettes, a small island nature reserve off the coast of Mauritius. In the programme, “live” traps were used with a trap-door mechanism closing behind any animal entering. Traps were checked daily and any shrews caught were killed; other species were released unharmed.

The locations for traps were marked out on a grid to give 1650 potential trapping points covering the whole island. Trapping started in August 1999 at the western end of the island. At intervals of 6 to 15 days, traps were moved progressively across the island until all points had been covered. Five more trapping “sweeps” were carried out to give six in total. Trapping results are shown in Table 1; these are reported as *trap nights*, values obtained by multiplying the number of traps used by the number of nights the sweeps lasted.

The shrew’s breeding period lasts from November to March. Pregnant females were only found in traps from late November to January.

Each location was classified according to the four main vegetation types found on the island. The percentage cover of vegetation types is shown in Table 2. Observed and expected capture data in these four vegetation types are shown in Figure 2.

**Table 1: Capture rates of shrews during each trapping sweep**

<i>Sweep number</i>	<i>Dates (1999–2000)</i>	<i>Number of trap nights</i>	<i>Capture rate (Number of shrews per 10 000 trap nights)</i>
1	Early August	12 804	589
2	Late August	16 569	15
3	Early September	10 080	2
4	Late September	9 669	2
5	October–November	22 751	11
6	December–January	24 740	15



**Question 1 (continued)**

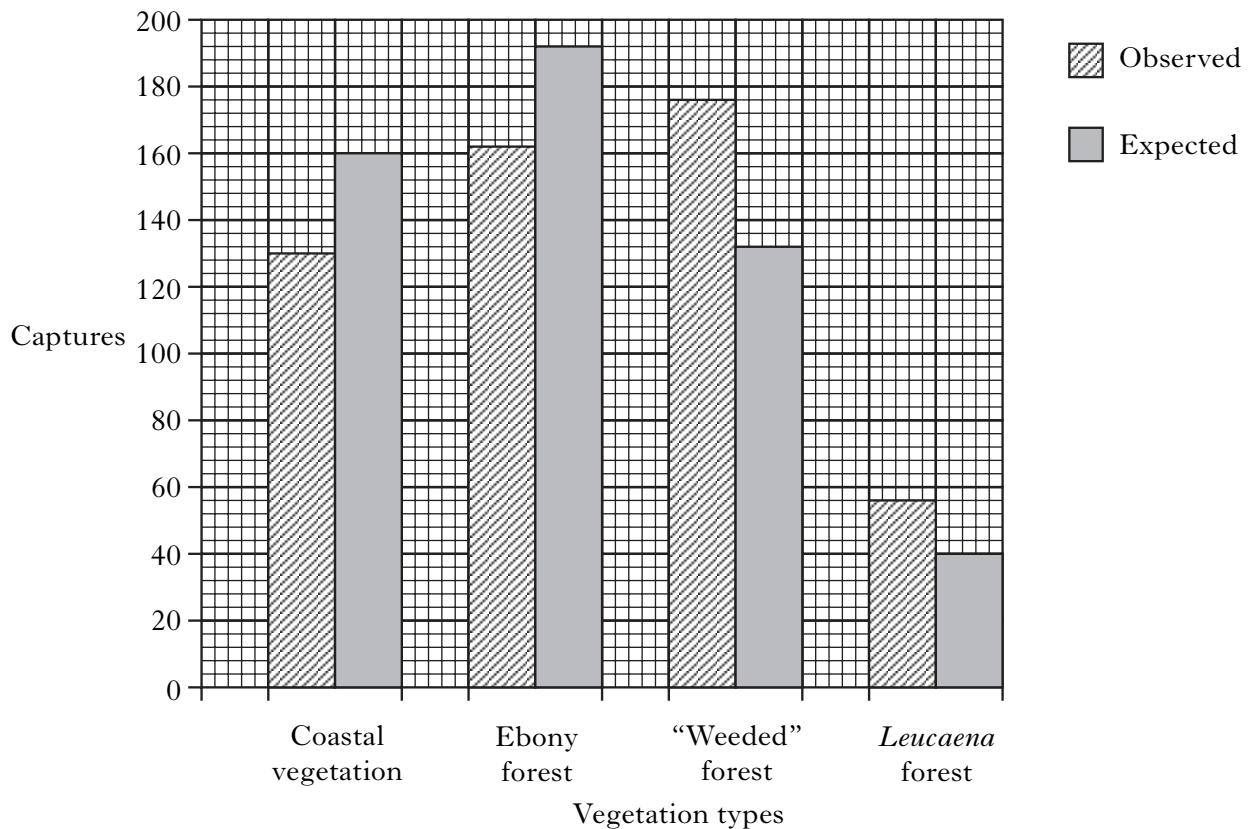
**Table 2: Vegetation types on Ile aux Aigrettes**

<i>Vegetation type</i>	<i>Description</i>	<i>Cover (%)</i>
Coastal	Native, dense scrub. No forest	31
Ebony forest	Native tree species	37
“Weeded” forest	Invasive plants removed with native species being replanted	25
<i>Leucaena</i> forest	Monoculture of an introduced species	7

**Figure 2: Observed and expected captures in each vegetation type**

The expected capture values assume that shrews are uniformly spread across the island and are not affected by vegetation type.

Total number in this capture sample is 524.



**[Question 1 continues on Page ten**

**Question 1 (continued)**

- (a) (i) What term is used to describe foreign, introduced species such as the Asian musk shrew? **1**
- (ii) State **one** possible “damaging ecological effect” of such a species. **1**
- (b) Refer to the data in Table 1.
- (i) Explain why capture rates are presented as “number of shrews per 10 000 trap nights”. **1**
- (ii) Initially the conservation team believed the eradication programme was successful. However, by the end, they had to conclude that it had failed.  
Use the data to show why they changed their minds. **2**
- (c) The conservation team concluded that it was important to trap when the shrews were not breeding. How is this conclusion justified by the information given? **1**
- (d) Refer to the data in Table 2 and Figure 2.
- (i) The expected capture values are based on the assumption that the shrews are spread uniformly across the island.  
Using ebony forest as an example, show how the expected capture values were calculated. **2**
- (ii) In which vegetation type is shrew density at its highest? **1**
- (iii) What evidence is there that human activity affects shrew distribution? **1**
- (e) Pesticides were considered as a means of eradicating the shrews.  
Describe **one** feature of an ecologically “desirable” pesticide. **1**
- (f) The term “commensal” has been used by the conservation team to describe the shrew’s relationship with humans. What is meant by the term commensal? **1**
- (g) Suggest a control measure that could be introduced, in addition to the eradication programme, to help eliminate the Asian musk shrew. **1**
- (13)**

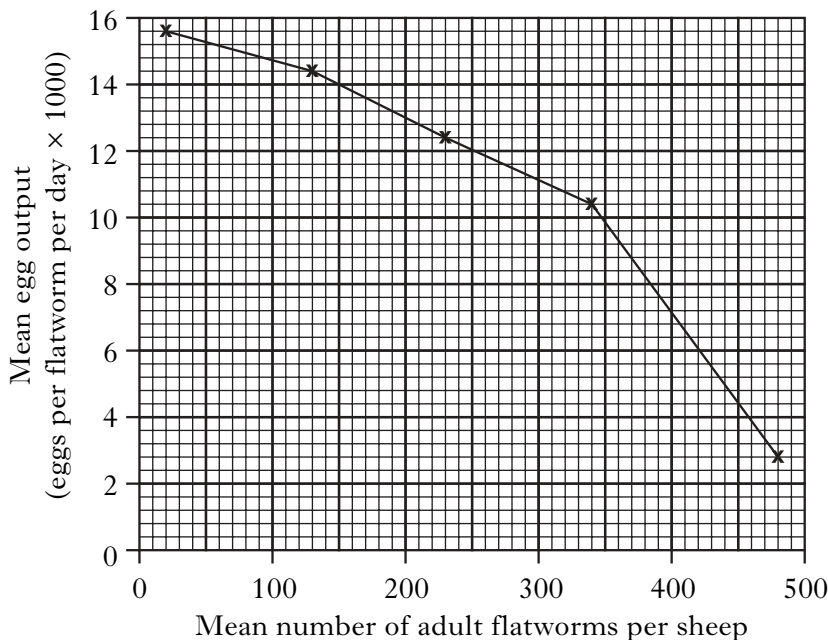
**[Questions 2, 3 and 4 are on fold-out Page eleven**

2. In an investigation into decomposition, discs of oak leaves were enclosed in nylon mesh bags with either large (7 mm) or small (1 mm) mesh size. The bags were then buried in garden soil. The 1 mm mesh excluded larger soil invertebrates such as earthworms and millipedes. The leaf discs were weighed at the start and thereafter at yearly intervals.

Mesh size (mm)	Percentage of leaf disc mass remaining		
	November 2004	November 2005	November 2006
1	100	38	30
7	100	15	8

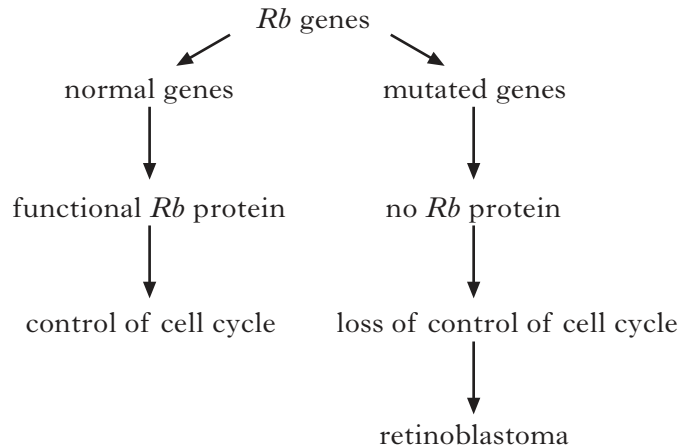
- (a) What term is used to describe invertebrates that feed on dead organic material? 1
- (b) Explain why the leaf disc mass decreased faster in 7 mm bags than in 1 mm bags. 2
- (c) State **one** final product of the processes taking place inside the nylon bags. 1
- (d) A predictable sequence of changes in community structure occurs in the bags as the organic material disappears. What term is used to describe this sequence? 1
- (5)**
3. Discuss the responses of regulators to variations in the external environment. (5)

4. The liver fluke *Fasciola hepatica* is a parasitic flatworm. The figure shows the relationship between the mean daily egg output per adult worm and the mean number of worms present in its sheep host.



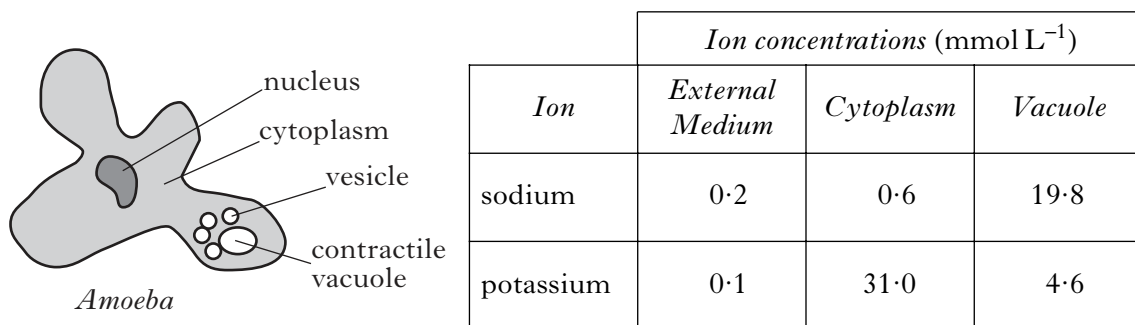
- (a) Explain how the decreasing rate of egg production shows a density-dependent effect. 1
- (b) The flatworm uses a snail species as a secondary host.  
Describe the role of the snail in the life cycle of the liver fluke. 1
- (c) Explain how the health of a sheep may affect the outcome of a fluke infestation. 1
- (d) Describe **one** measure that can be used to prevent infestation of a host by a parasite. 1
- (4)**

5. *Retinoblastoma* is a rare cancer that develops in the eyes of children. Mutation in both copies of the retinoblastoma (*Rb*) gene results in proliferation of cells that would normally form retinal tissue. The protein arising from the *Rb* gene is abundant in the nucleus of all normal mammalian cells where it has an important role in the cell cycle.



When phosphorylated, the *Rb* protein binds to gene regulatory proteins and prevents them from activating cell proliferation. When unphosphorylated, it cannot bind to the gene regulatory proteins.

- (a) Explain why kinase enzyme activity might restrict cell division when functional *Rb* protein is abundant. 2
- (b) Explain how the information provided indicates that the *Rb* gene is **not** a proto-oncogene. 1
- (3)**
6. *Amoeba* is a unicellular organism found in fresh water. It uses a contractile vacuole to eliminate water entering by osmosis. The data below show the concentrations of sodium ions ( $\text{Na}^+$ ) and potassium ions ( $\text{K}^+$ ) in the external medium, cytoplasm and contractile vacuole of *Amoeba* in culture.



- (a) Give **two** characteristics that would distinguish prokaryotic organisms from an *Amoeba*. 1
- (b) Show as a whole number ratio the relative concentrations of sodium ions in the external medium, cytoplasm and vacuole. 1
- (c) It is thought that the contractile vacuole is formed from smaller vesicles containing fluid isotonic with the cytoplasm. Ion concentrations are then changed as a result of ion pump activity.

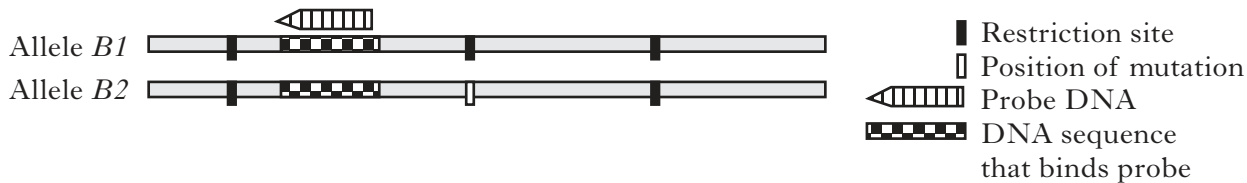
Explain how the data could support the hypothesis that a sodium-potassium pump may be working across the vacuole membrane but not across the plasma membrane. 3

**(5)**

7. Figure 1 below shows the two alleles, *B1* and *B2*, for a gene. Within *B1* there are sites where a restriction enzyme can cut; in *B2*, the allele has a mutation at one of the restriction sites, which prevents a cut.

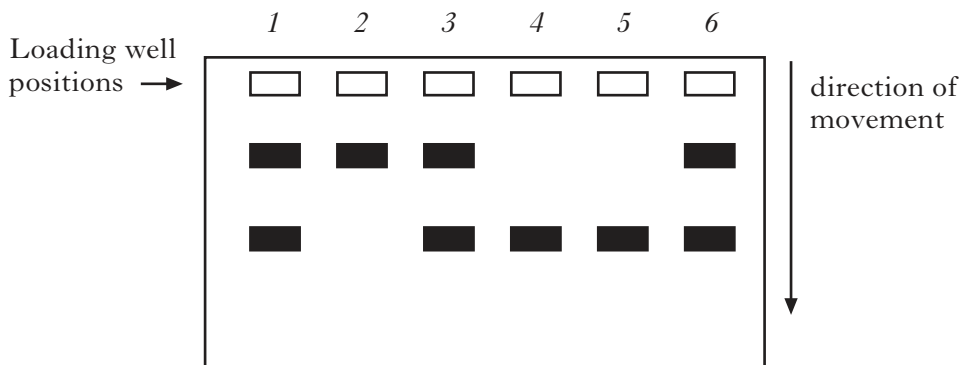
A probe complementary to a short portion of the DNA can bind at the position shown in Figure 1.

**Figure 1**



Samples of DNA from a family of two parents and their four children were digested with the same restriction enzyme. The fragments were separated by electrophoresis and tested with the probe. The results for family members are identified with the numbers 1 to 6, as shown in Figure 2.

**Figure 2**



- (a) Why is DNA able to move in the electrophoresis gel? 1
  - (b) Explain how the results show that individuals 1, 3 and 6 have the genotype *B1B2*. 2
  - (c) What is the genotype of individual 2? 1
  - (d) Identify **two** individuals who could be the parents in this family. 1
- (5)**

[Turn over

	<i>Marks</i>
<b>8. Answer either A or B.</b>	
<b>A. Describe the growth of cells under the following headings:</b>	
(i) control mechanisms of the cell cycle;	<b>6</b>
(ii) culturing of mammalian cells.	<b>9</b>
<b>OR</b>	<b>(15)</b>
<b>B. Give an account of cell membranes under the following headings:</b>	
(i) the structure of phospholipids;	<b>6</b>
(ii) the composition of the plasma membrane;	<b>3</b>
(iii) functions of membrane proteins.	<b>6</b>
	<b>(15)</b>

*[END OF SECTION B]*

### SECTION C

Candidates should attempt questions on **one** unit, **either** **Biotechnology** or **Animal Behaviour** or **Physiology, Health and Exercise**.

The questions on **Animal Behaviour** can be found on pages 18–21.

The questions on **Physiology, Health and Exercise** can be found on pages 22–24.

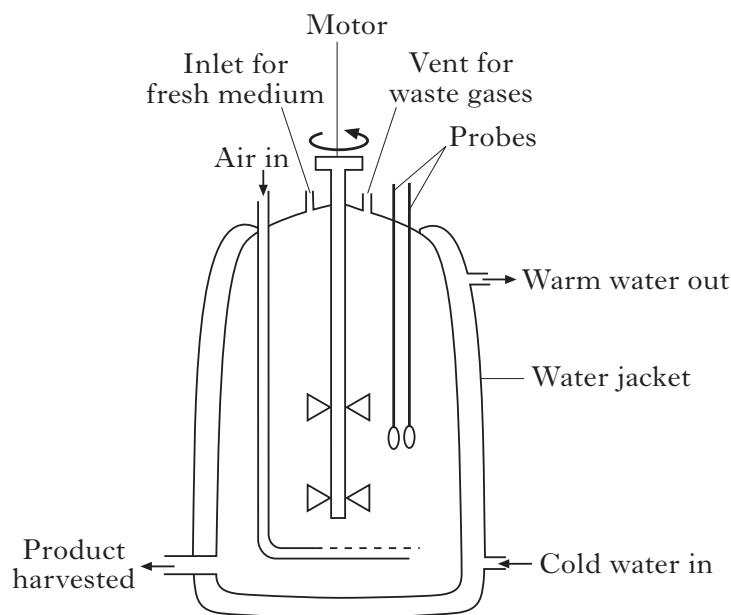
All answers must be written clearly and legibly in ink.

Labelled diagrams may be used where appropriate.

Marks

#### Biotechnology

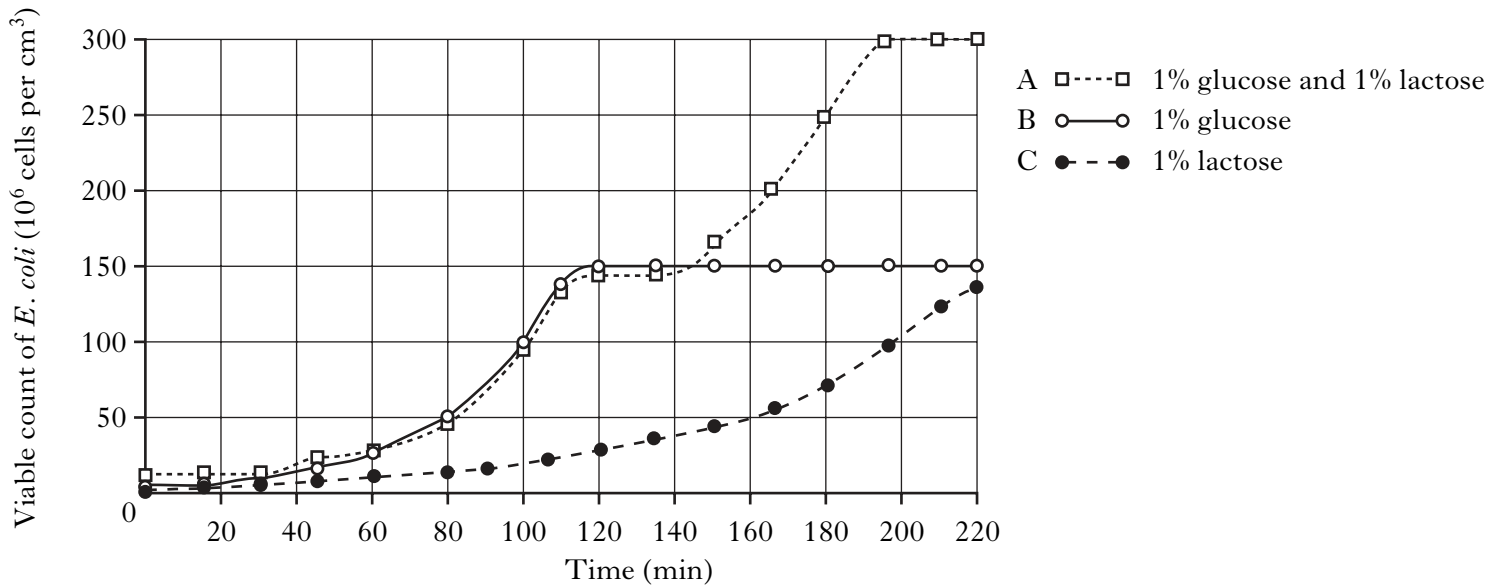
1. The diagram shows a fermenter used to grow large numbers of micro-organisms for enzyme production. To achieve rapid growth, particular conditions are needed.



- (a) Give **one** precaution that needs to be taken to prevent contamination by other micro-organisms during enzyme production. 1
- (b) Explain the purpose of the water jacket in this fermenter. 1
- (c) Name an enzyme produced commercially from:
- (i) a naturally occurring micro-organism;
  - (ii) a genetically modified micro-organism. 2
- (4)**
2. Antibiotics are produced commercially in large-scale industrial fermenters. Give an account of how a pure antibiotic product could be recovered at the end of the fermentation. (5)

[Turn over

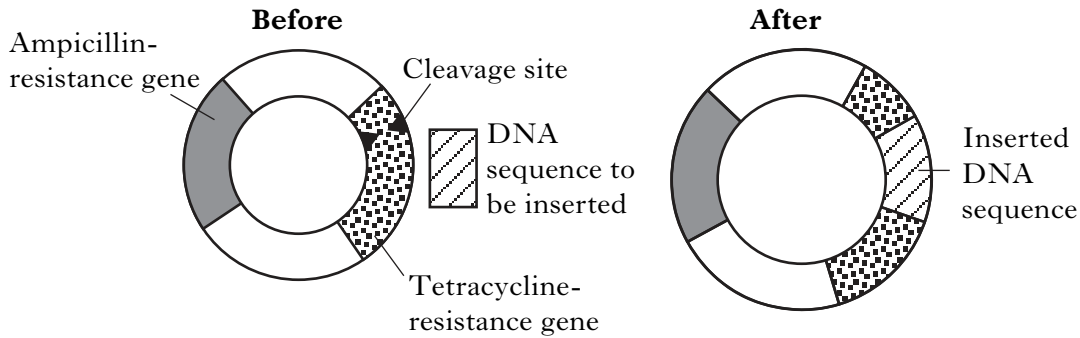
3. An investigation was carried out to determine how different energy sources affect the growth of *E. coli*. The figure shows viable counts of cells grown in three separate fermenters (A, B and C); each fermenter had a different energy source.



- (a) What is the difference between a total count and a viable count? 1
- (b) Use data from the figure to describe how the growth of *E. coli* in 1% glucose is different from that in 1% lactose. 2
- (c) (i) The following equation is used to calculate the growth rate constant,  $k$ , of a bacterial population.
- $$k = \frac{\ln 2}{g}$$
- where  $\ln 2 = 0.693$  and  $g$  is the time in hours for the population to double.
- Calculate the growth rate constant for fermenter B between 80 and 100 minutes. 1
- (ii) How could calculation of growth rate constants be used to determine when culture conditions are no longer optimal? 1
- (d) The diauxic growth demonstrated by *E. coli* in fermenter A is dependent on the synthesis of  $\beta$ -galactosidase. Briefly describe the role of CAP in stimulating the synthesis of this enzyme. 2
- (7)**



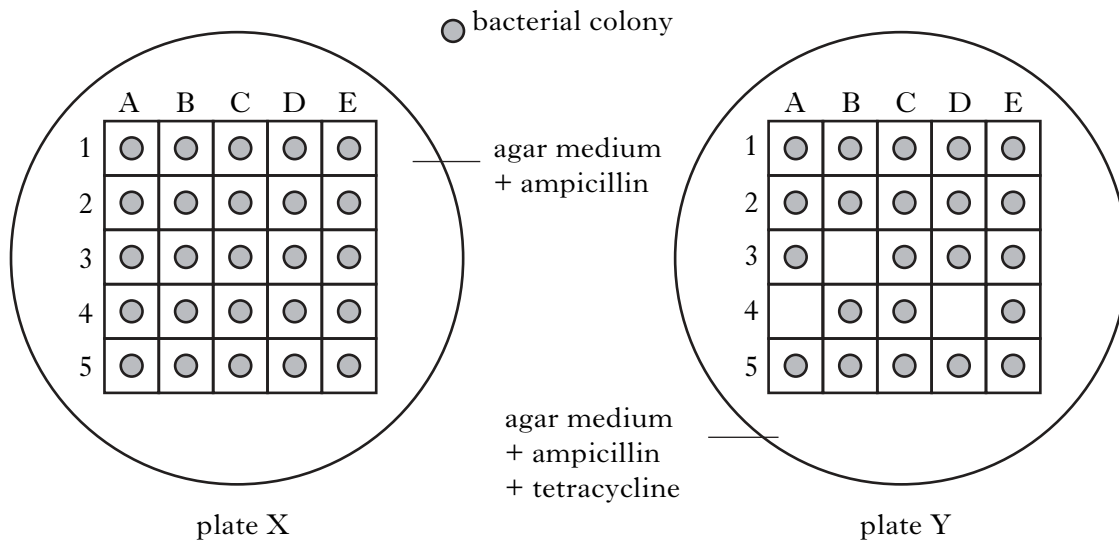
4. Genetic manipulation of bacteria can be achieved by the introduction of plasmids containing DNA sequences from other organisms. The diagram shows a plasmid containing resistance genes for the antibiotics ampicillin and tetracycline, before and after the insertion of a DNA sequence.



There are two possible problems with this approach:

- (i) only some of the plasmids take up the DNA sequence;
- (ii) only a small percentage of bacterial cells take up a plasmid of any kind.

Bacteria containing plasmids with the desirable DNA sequence can be selected by culturing them on media containing antibiotics. The same colonies are plated in the same grid positions on the two plates shown below.



- (a) What is the effect of inserting the DNA sequence into the tetracycline-resistance gene? 1
- (b) Explain why the colonies A4, B3 and D4 from plate Y would be selected for further analysis. 2
- (c) Give an example of an agricultural use of this technique. 1

(4)  
(20)

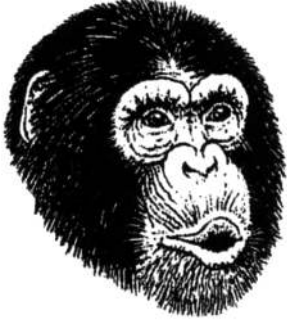
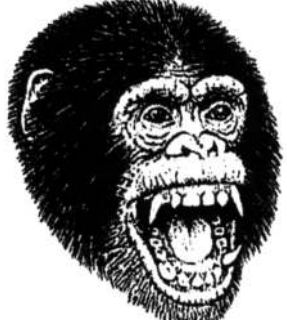

[End of Biotechnology questions. Animal Behaviour questions start on Page 18]

**SECTION C (continued)**

Marks

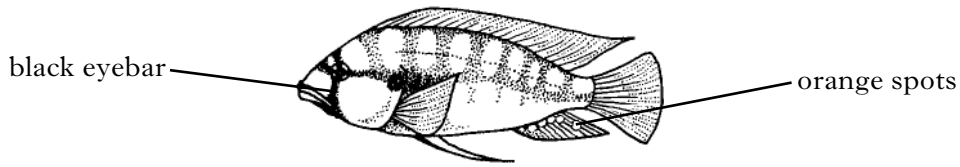
*Animal Behaviour*

1. Chimpanzees (*Pan troglodytes*) are social primates. The table shows a list of facial expressions that are used in group interactions.

<i>Facial expression</i>	<i>Interaction</i>
Pout 	Begging for food
Full open grin 	Displaying fear or excitement
Fear grin 	Approaching a higher-ranking chimpanzee

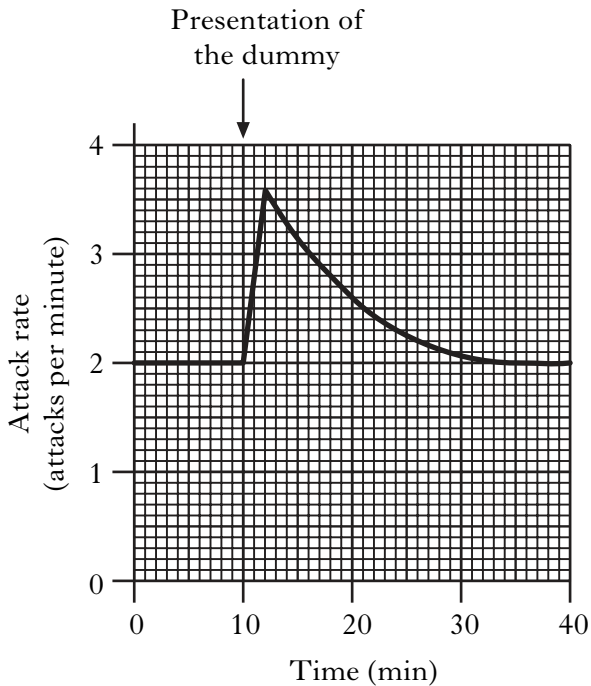
- (a) What term is used to describe a list of this type? 1
- (b) Using an example from the table, explain the meaning of the term *anthropomorphism*. 1
- (c) Other than the use of facial expressions, name a behaviour in primates that is used to strengthen social bonds between the individuals in a group. 1
- (3)**

2. Some males of the cichlid species *Astatotilapia burtoni* are territorial and vigorously defend their territory by fighting. Territorial males have brightly coloured bodies, a black eyebar and orange spots on their anal fin. Non-territorial males and females lack any of these bright or contrasting colours or patterns. The eggs of the females are very similar in appearance to the orange spots on the anal fins of territorial males.

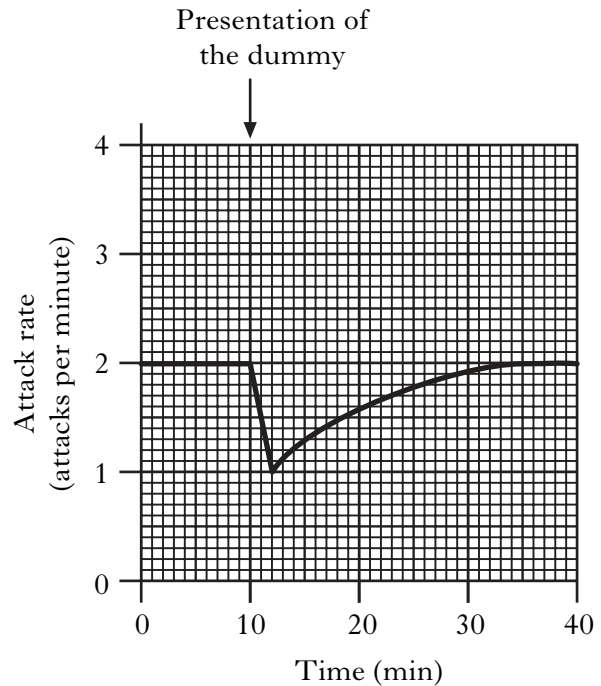


Figures 1 and 2 below show the rate of attack response of territorial males to two different dummy fish.

**Figure 1**  
**Dummy: eyebar present; orange spots absent**



**Figure 2**  
**Dummy: eyebar absent; orange spots present**



- (a) Using data from Figures 1 and 2, compare the responses to the two dummies in relation to frequency of attacks. 2
- (b) Suggest an explanation for the response shown in Figure 2. 1
- (c) What benefit do successful males gain through fighting? 1
- (d) To what extent does *A. burtoni* show sexual dimorphism? 1

[Turn over

- (e) The table below summarises data from experiments investigating the development of the attack response of *A. burtoni*.

<i>Rearing conditions</i>	<i>Stimuli provoking attack response</i>
Reared alone	Black eyebar model Male of own species
Reared by own species	Black eyebar model Male of own species
Reared by foster species	Black eyebar model Male of own species Male of foster species

What two pieces of evidence indicate that the development of attack response behaviour in *A. burtoni* depends on the interaction between genetic and environmental influences?

2  
(7)

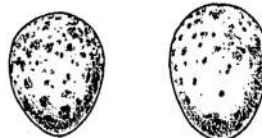
3. The cuckoo (*Cuculus canorus*) is a *brood parasite* of some species of small birds that nest in Scotland.

- (a) What is the ultimate cause of nest-building behaviour in birds? 1
- (b) The female cuckoo lays an egg in the host nest. Typical eggs of hosts and cuckoos are shown below.

*Host species*

*Host species egg*    *Cuckoo egg*

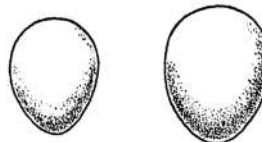
Species 1



Species 2

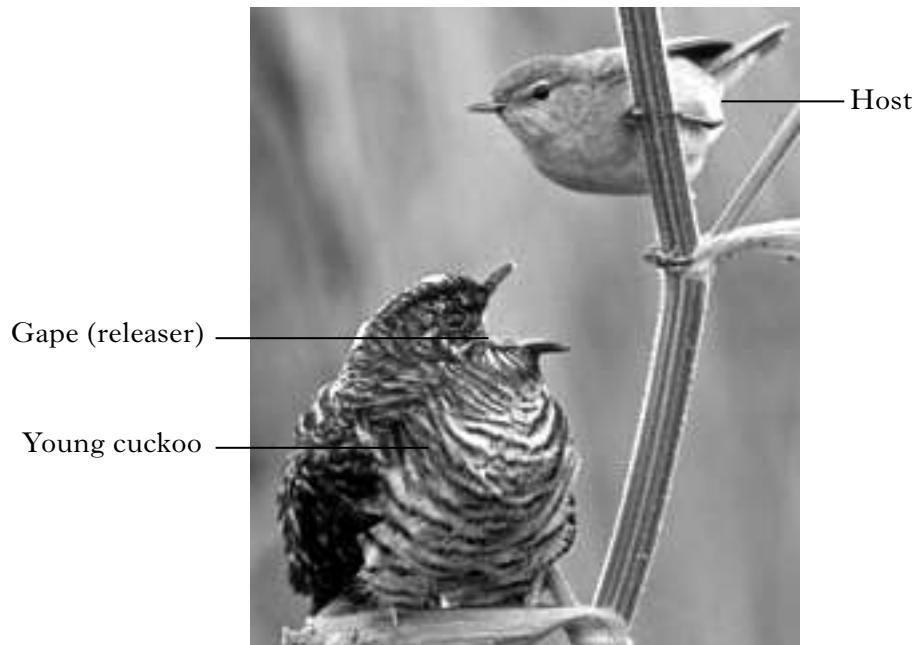


Species 3



What term could be used to describe the close match in appearance between the cuckoo eggs and the host species' eggs? 1

(c) The figure shows the feeding behaviour of a young cuckoo.



The hatchling cuckoo bears little resemblance to the host's hatchlings.

What compels the host to feed the young cuckoo?

1

(d) Explain why the relationship between the host and the cuckoo is **not** an example of reciprocal altruism.

2

(5)

4. Imprinting is a feature of bird behaviour.

Discuss the process of imprinting.

(5)

(20)

[End of *Animal Behaviour* questions. *Physiology, Health and Exercise* questions start on Page 22]

[Turn over

## SECTION C (continued)

Marks

## Physiology, Health and Exercise

1. Two patients were tested for diabetes in hospital. After fasting, their blood glucose was measured at 09:00 hours. They were given a glucose drink and their blood glucose was monitored over the following 3 hours (Glucose Tolerance Test). The test results are shown below.

City General Hospital <u>OUTPATIENTS DEPARTMENT</u>	
Name	<i>Patient A</i>
<u>Glucose Tolerance Test</u>	
<i>Blood Glucose Concentration</i>	
Time	(mmol/L)
09:00	4.4
09:30	6.8
10:00	6.1
10:30	5.4
11:00	5.3
11:30	4.9
12:00	4.5

City General Hospital <u>OUTPATIENTS DEPARTMENT</u>	
Name	<i>Patient B</i>
<u>Glucose Tolerance Test</u>	
<i>Blood Glucose Concentration</i>	
Time	(mmol/L)
09:00	7.8
09:30	11.7
10:00	13.9
10:30	15.0
11:00	16.1
11:30	15.5
12:00	15.5

- (a) Give **two** pieces of evidence from the test results that could be used to identify the diabetic patient. 2
- (b) What is the role of glucagon in the control of blood glucose concentration? 1
- (c) (i) State the major risk factor in the onset of non insulin-dependent diabetes mellitus (NIDDM). 1
- (ii) Give **two** ways by which regular exercise can help in the control of NIDDM. 2

**(6)**

2. Basal metabolic rate (BMR) can be calculated using the following equations:

<u>Males</u>	
Age 10–17 years:	$\text{BMR(MJ/day)} = 0.074 \times \text{body mass (kg)} + 2.754$
Age 18–29 years:	$\text{BMR(MJ/day)} = 0.063 \times \text{body mass (kg)} + 2.896$
<u>Females</u>	
Age 10–17 years:	$\text{BMR(MJ/day)} = 0.056 \times \text{body mass (kg)} + 2.898$
Age 18–29 years:	$\text{BMR(MJ/day)} = 0.062 \times \text{body mass (kg)} + 2.036$

- (a) Calculate the basal metabolic rate for a 26 year old woman with a mass of 75 kg. 1
  - (b) Energy expenditure can be determined by measuring the oxygen uptake from breathed air. Explain why this procedure is referred to as indirect calorimetry. 1
  - (c) Explain how different factors affect BMR. 5
- (7)**

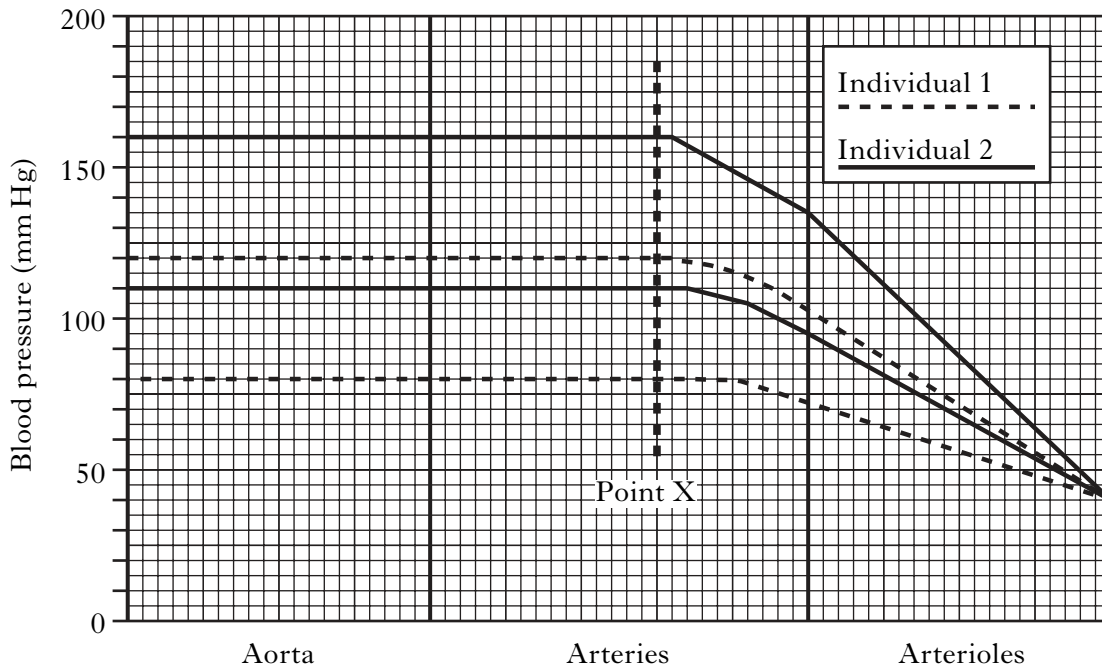
3. The table shows data from maximal testing of an individual, before and after a period of endurance training. The data can be used to calculate  $\text{VO}_{2 \text{ max}}$ .

<i>Measurement</i>	<i>Before training</i>	<i>After training</i>
Left ventricular mass (g)	210	300
Maximum stroke volume (ml)	120	180
Maximum heart rate (beats/min)	175	195
Maximum oxygen uptake (L/min)	3.1	4.6
Body mass (kg)	60	60

- (a) Which measurements from the table would be used to calculate:
    - (i)  $\text{VO}_{2 \text{ max}}$  1
    - (ii) cardiac output? 1
  - (b) What evidence from the table indicates that this individual has developed cardiac hypertrophy? 1
  - (c) Describe how  $\text{VO}_{2 \text{ max}}$  is determined using sub-maximal testing. 1
- (4)**

**[Turn over for Question 4 on Page twenty four**

4. The force exerted by the blood against the walls of blood vessels is known as blood pressure. The figure shows changes in arterial blood pressure of a 20 year old female and a 45 year old male.



A medical examination showed that the 45 year old had hypertension.

- (a) State **two** modifiable conditions that can influence the development of hypertension. 2
- (b) What is the diastolic blood pressure of the 45 year old man at point X on the graph? 1

(3)  
(20)

[END OF QUESTION PAPER]



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