AH

National Qualifications 2019

X707/77/02

Biology
Section 1 — Questions

TUESDAY, 30 APRIL
1:00 PM – 3:30 PM

Instructions for the completion of Section 1 are given on *page 02* of your question and answer booklet X707/77/01.

Record your answers on the answer grid on *page 03* of your question and answer booklet.

Before leaving the examination room you must give your question and answer booklet to the Invigilator; if you do not, you may lose all the marks for this paper.

SQA
©

SECTION 1 — 25 marks
Attempt ALL questions

1. Primary cell lines have

   A   a limited number of cell divisions and are sourced from tumours

   B   a limited number of cell divisions and are sourced directly from normal animal tissue

   C   an indefinite number of cell divisions and are sourced from tumours

   D   an indefinite number of cell divisions and are sourced directly from normal animal tissue.

2. The proteome is larger than the number of genes in the genome of an organism because

   A   not all genes are expressed as proteins in a particular cell

   B   post translational modifications generate multiple RNAs from a single gene

   C   alternative splicing generates multiple RNAs from a single gene

   D   each mRNA molecule is translated by many ribosomes.

3. A neuron in a squid, running from the brain to the tentacles, is 0·9 m long. A 25 mm length of neuron is depolarised every 0·001 s.

   The time taken for an impulse to travel the length of this neuron is

   A   0·000028 s

   B   0·000036 s

   C   0·028 s

   D   0·036 s

4. The list shows some events that occur in the cell membrane of a neuron during nerve transmission.

   1. Binding of neurotransmitter to neuron
   2. Closure of voltage-gated ion channels
   3. Opening of ligand-gated ion channels
   4. Opening of voltage-gated ion channels

   Which events contribute to the depolarisation of the resting potential of a neuron?

   A   1 and 2 only

   B   2 and 3 only

   C   1, 2 and 3 only

   D   1, 3 and 4 only

5. Which row in the table describes the expected effects of inhibition of the Na/KATPase?

	Intracellular Na ion concentration	Intracellular K ion concentration	Membrane polarity
A	increase	decrease	increase
B	decrease	increase	increase
C	increase	decrease	decrease
D	decrease	increase	decrease

6. A decrease in the activity of glucose symport proteins in the cells lining the small intestine could be caused by an increase in the

   A   glucose concentration inside the small intestine

   B   sodium ion concentration in the cells

   C   ATP concentration in the cells

   D   potassium ion concentration in the cells.

[Turn over

7. The surface area to volume ratio of a cell is an important factor affecting transport into cells.

$$\text{surface area to volume ratio} = \frac{\text{surface area}(\mu m^2)}{\text{volume}(\mu m^3)}$$

The surface area to volume ratio of an *E. coli* cell is 4·5. A eukaryotic cell has a surface area of 1809 μm^2 and a volume of 7235 μm^3.

Compared to *E. coli*, the surface area to volume ratio of the eukaryotic cell is approximately

A   1·1 times larger

B   1·1 times smaller

C   18 times larger

D   18 times smaller.

8. Alpha helices in proteins are stabilised by

A   hydrogen bonds

B   ionic bonds

C   disulphide bridges

D   hydrophobic interactions.

9. Which row in the table describes the effects of an increase in temperature on haemoglobin and oxygen delivery to cells?

	Affinity of haemoglobin for oxygen	Oxygen delivery to tissue
A	increase	increase
B	increase	decrease
C	decrease	increase
D	decrease	decrease

10. The lipid bilayers of cell membranes contain a number of different phospholipids, which are present in different proportions and distributed unevenly across the extracellular and intracellular faces of the bilayer.

Figures 1 and 2 show the proportions and distribution of four phospholipids in the cell membrane of human red blood cells.

**Figure 1** Proportions of four phospholipids in the cell membrane

- PE – phosphatidyl ethanolamine
- PS – phosphatidyl serine
- SP – sphingomyelin
- PC – phosphatidyl choline
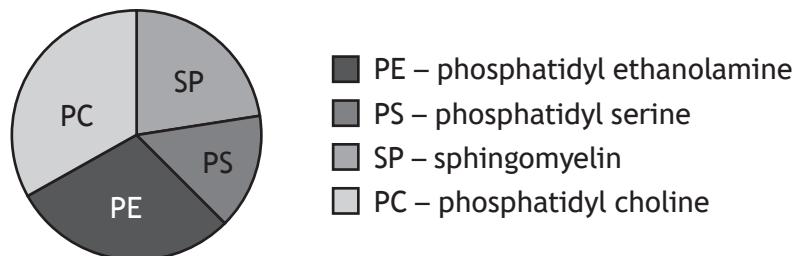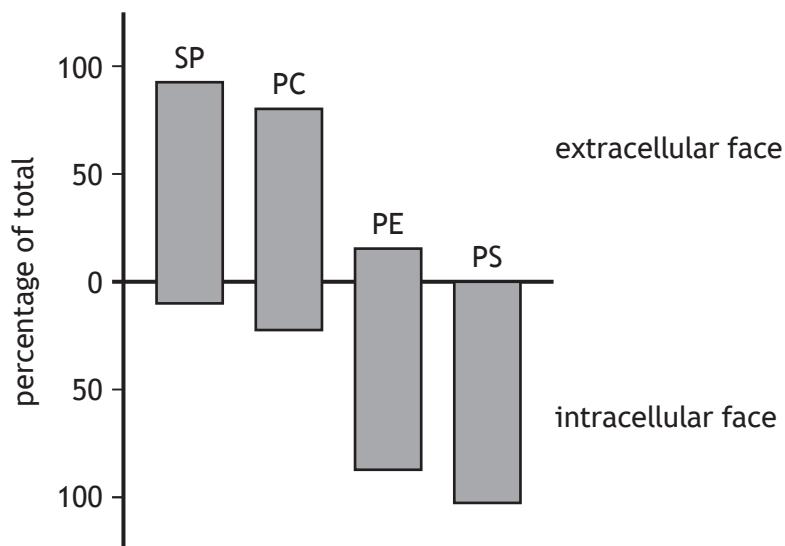
Figure 2 Distribution of the phospholipids in the two faces of the membrane

The key can be used to identify each of the phospholipids.
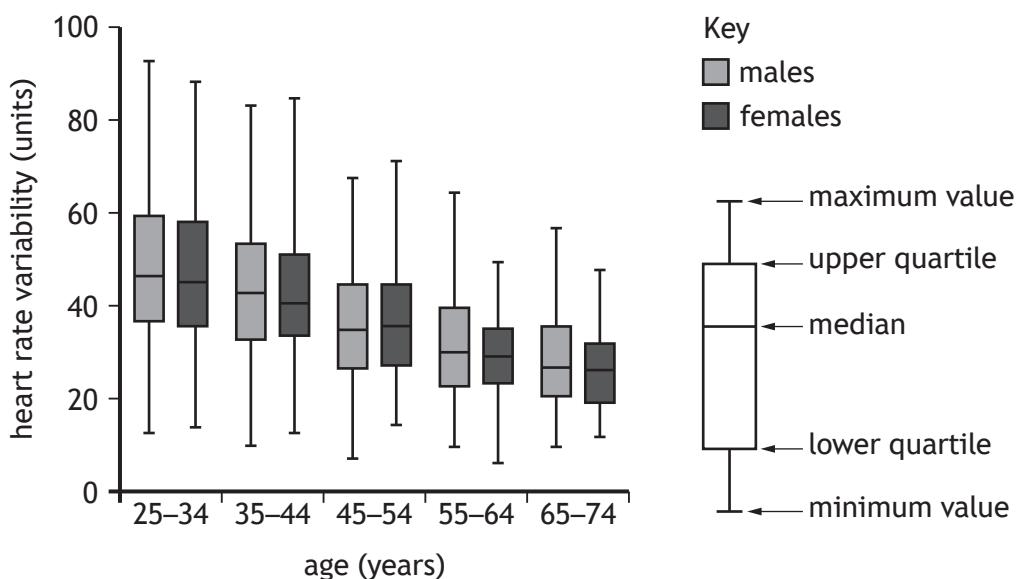
| 1 | more than 25 % of total lipid | go to 2 |
	less than 25 % of total lipid	go to 3
2	found mainly on the extracellular face	A
	found mainly on the intracellular face	B
3	found mainly on the extracellular face	C
	found mainly on the intracellular face	D

Which letter represents sphingomyelin?

[Turn over

Questions 11 and 12 refer to the following information.

Short-term variations in the time interval between heart beats is termed *heart rate variability* (HRV). HRV is one measure that can be used to assess health. The box plots give information from one study about the influence of age and gender on HRV.

11. From the data shown, which of the statements about HRV is correct?

    A   There is a trend towards lower HRV in females

    B   The greatest error in measurements is for ages 25–34

    C   The mean HRV for females aged 35–44 is lower than 40 units

    D   Gender-related differences in median values are greater than age-related differences

12. Which row in the table describes features of this study?

	Design of experiment	Type of data collected
A	simple	ranked
B	simple	continuous
C	multifactorial	ranked
D	multifactorial	continuous

13. There are approximately 40 species of birds of paradise in New Guinea, on islands nearby, and in areas of mainland Australia. They are thought to have evolved from a crow-like common ancestor that lived 20 million years ago.

The list describes processes that are likely to have contributed to the evolution of the different species.

X   The food availability on a certain part of one island favoured the survival of male and female individuals with slender curved bills.

Y   On one island with abundant food choices, females choose mates whose head feathers have elongated plumes.

Z   Some males and females of a species of crow-like mainland bird were blown by a freak storm to some of the islands.

Which row in the table matches processes of evolution with descriptions from the list?

	Processes of evolution		
	Genetic drift	**Selection**	
		Natural	**Sexual**
A	X	Z	Y
B	Z	X	Y
C	Z	Y	X
D	Y	X	Z

14. Which row in the table indicates factors that can all lead to a high rate of evolution?

	Factor		
	Selection pressure	**Generation time**	**Gene transfer**
A	high	long	asexual reproduction
B	low	short	horizontal
C	low	long	horizontal
D	high	short	sexual reproduction

[Turn over

15. Which of the following adaptations can be explained using the Red Queen hypothesis?

1. Acceleration of cheetahs is related to the speed of the antelope they prey on
2. Migration of insectivorous birds is influenced by the availability of insects
3. Resistance of insect larvae to parasitic wasp infection is a response to these wasps
4. Ornamental head plumes of some male birds are attractive to females

A   1 and 2 only

B   1 and 3 only

C   2 and 3 only

D   3 and 4 only

16. A student used a colorimetric assay to measure the activity of an enzyme in bananas. An extract was prepared from one banana and used five times to measure the enzyme activity. Three absorbance readings were taken for each of the five assays.

The data collected are shown in the table.

Assay	Absorbance reading at 540 nm		
	1	2	3
1	0·55	0·56	0·55
2	0·49	0·48	0·50
3	0·56	0·57	0·57
4	0·62	0·63	0·62
5	0·58	0·58	0·59

The student evaluated the data to be reliable and accurate.

The student's evaluation of the data is

A   correct because the data are reliable and accurate

B   incorrect because the data are accurate but not reliable

C   incorrect because the data are reliable but not necessarily accurate

D   incorrect because the data are not reliable and not necessarily accurate.

17. Biological fieldwork can sometimes be more dangerous than laboratory work.

Which of the following would **not** generally be involved in a risk assessment for carrying out fieldwork safely?

A   Identify hazards

B   Specify control measures

C   Assess safety training records of participants

D   Consider hazard severity and likelihood of occurring

**18.** Some populations of a species may evolve to become more r-selected or K-selected depending on the nature of the habitat they occupy.
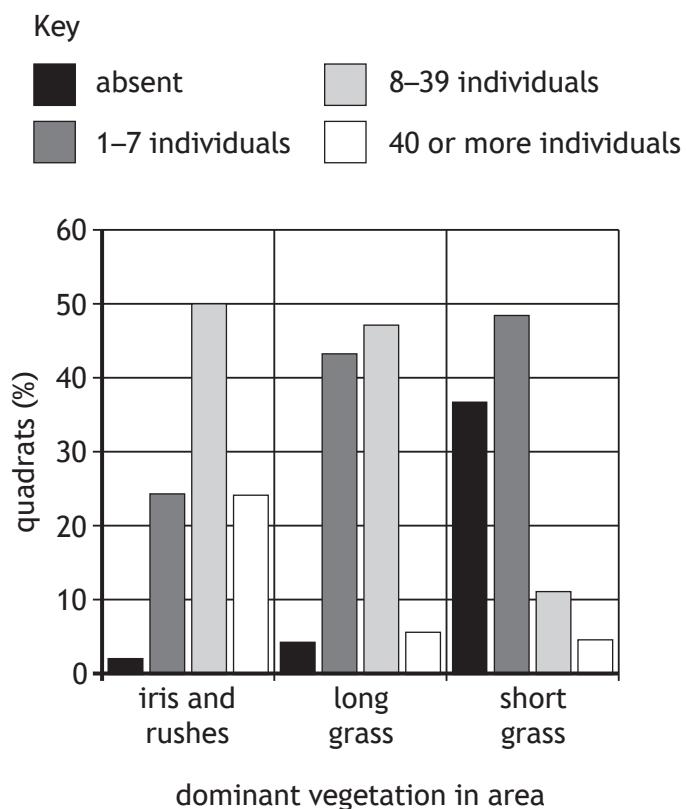
Which row in the table shows changes in the factors likely to be associated with a population becoming more K-selected?

	Environmental stability	Number of offspring
A	increase	decrease
B	increase	increase
C	decrease	increase
D	decrease	decrease

[Turn over

19. The population of the snail *Vertigo antivertigo* was investigated at a small site in Wales. Equal numbers of quadrat samples were taken in three areas with different dominant vegetation and the number of individual snails in each was recorded.

The results are shown in the chart.

Key

■ absent   ▨ 8–39 individuals

▨ 1–7 individuals   □ 40 or more individuals

dominant vegetation in area

The information in the chart indicates that this species of snail prefers

A   short grass to long grass

B   irises and rushes to long grass

C   long grass to irises and rushes

D   short grass to irises and rushes.

20. Biological fieldwork often requires the estimation of population size for a prey species. One method used is mark and recapture. If the method of marking reduced the camouflage coloration of this species, what effect would this be likely to have on the population estimate obtained?

A   Recapture numbers would be increased and population size would be overestimated

B   Recapture numbers would be increased and population size would be underestimated

C   Recapture numbers would be decreased and population size would be overestimated

D   Recapture numbers would be decreased and population size would be underestimated

21. In three-spined stickleback fish, males have a distinctive red underside in the breeding season, which is not present in females. Territorial males were presented with model fish, some of which had their undersides painted red and some of which were left unpainted. Males showed an automatic attack response to only the red-painted models.

This attack response behaviour is triggered by

A   sexual dimorphism

B   sexual selection

C   an honest signal

D   a sign stimulus.

22. The list shows three events in meiosis I.
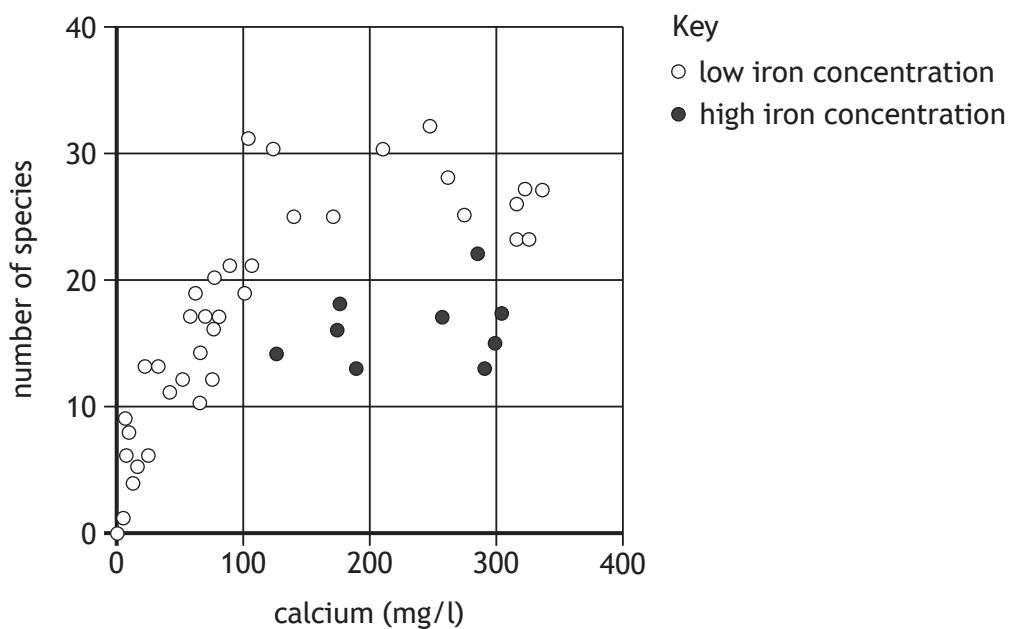
Q   Independent assortment

R   Recombination of alleles of linked genes

S   Pairing of homologous chromosomes

The order in which these events occur is

A   S – R – Q

B   S – Q – R

C   Q – R – S

D   Q – S – R.

[Turn over

23. The graph shows species richness of mollusc populations in areas of fenland. The number of species of mollusc was recorded in several areas as well as the calcium concentration in the fenland water. At each site the concentration of iron was also measured.

Key
○ low iron concentration
● high iron concentration

Which of the following generalisations can be drawn from the graph?
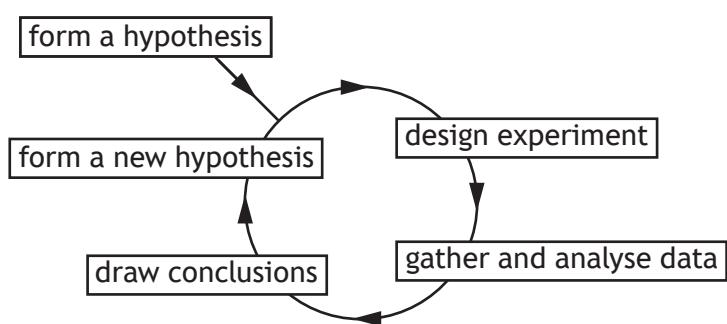
A   An increase in calcium from 100 to 400 mg/l increases the species richness

B   High iron concentration leads to the highest species richness

C   When both calcium and iron concentrations are high the species richness is highest

D   An increase in calcium up to 150 mg/l increases species richness

24. New patterns of resistance in *Plasmodium* have increased the challenge experienced in the treatment of malaria.

Which of the following strategies is **least** likely to reduce the challenges in the treatment and control of malaria?
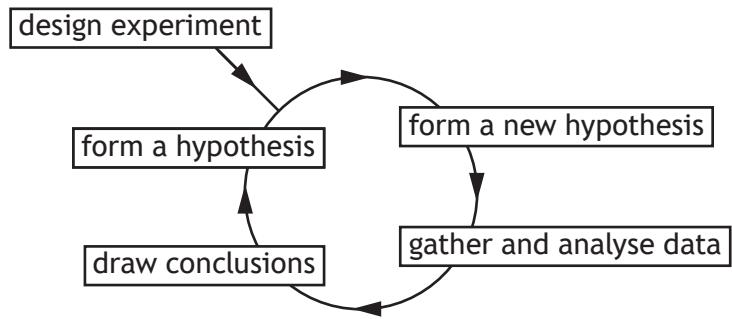
A   Improved sanitation

B   Development of new culture methods for *Plasmodium*

C   Coordinated vector control

D   Building of new low-density housing in malarial areas

25. Which diagram shows the sequence of events in the scientific cycle?

A

form a hypothesis → design experiment → gather and analyse data → draw conclusions → form a new hypothesis

B

design experiment → form a hypothesis → form a new hypothesis → gather and analyse data → draw conclusions

C

form a hypothesis → design experiment → draw conclusions → gather and analyse data → form a new hypothesis

D

design experiment → form a new hypothesis → gather and analyse data → form a hypothesis → draw conclusions

[END OF SECTION 1. NOW ATTEMPT THE QUESTIONS IN SECTION 2 OF YOUR QUESTION AND ANSWER BOOKLET.]

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National Qualifications 2019

Mark

X707/77/01

Biology
Section 1 — Answer grid and Section 2

TUESDAY, 30 APRIL
1:00 PM – 3:30 PM

Fill in these boxes and read what is printed below.

Full name of centre

Town

Forename(s)

Surname

Number of seat

Date of birth

Day   Month   Year   Scottish candidate number

Total marks — 90

SECTION 1 —25 marks

Attempt ALL questions.

Instructions for the completion of Section 1 are given on *page 02*.

SECTION 2 — 65 marks

Attempt ALL questions.

A supplementary sheet for question 1 is enclosed inside the front cover of this question paper.

Write your answers clearly in the spaces provided in this booklet. Additional space for answers and rough work is provided at the end of this booklet. If you use this space you must clearly identify the question number you are attempting. Any rough work must be written in this booklet. Score through your rough work when you have written your final copy.

Use **blue** or **black** ink.

Before leaving the examination room you must give this booklet to the Invigilator; if you do not, you may lose all the marks for this paper.

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SECTION 1 — 25 marks

The questions for Section 1 are contained in the question paper X707/77/02.

Read these and record your answers on the answer grid on *page 03* opposite.

Use **blue** or **black** ink. Do NOT use gel pens or pencil.

1. The answer to each question is **either** A, B, C or D. Decide what your answer is, then fill in the appropriate bubble (see sample question below).

2. There is **only one correct** answer to each question.

3. Any rough working should be done on the additional space for answers and rough work at the end of this booklet.

Sample question

The thigh bone is called the

     A   humerus

     B   femur

     C   tibia

     D   fibula.

The correct answer is **B** — femur. The answer **B** bubble has been clearly filled in (see below).

A	B	C	D
○	●	○	○

Changing an answer

If you decide to change your answer, cancel your first answer by putting a cross through it (see below) and fill in the answer you want. The answer below has been changed to **D**.

A	B	C	D
○	✗	○	●

If you then decide to change back to an answer you have already scored out, put a tick (✓) to the **right** of the answer you want, as shown below:

A	B	C	D		A	B	C	D
○	✗✓	○	✗	or	○	✗✓	○	○

OBJ25AD1

	A	B	C	D
1	○	○	○	○
2	○	○	○	○
3	○	○	○	○
4	○	○	○	○
5	○	○	○	○
6	○	○	○	○
7	○	○	○	○
8	○	○	○	○
9	○	○	○	○
10	○	○	○	○
11	○	○	○	○
12	○	○	○	○
13	○	○	○	○
14	○	○	○	○
15	○	○	○	○
16	○	○	○	○
17	○	○	○	○
18	○	○	○	○
19	○	○	○	○
20	○	○	○	○
21	○	○	○	○
22	○	○	○	○
23	○	○	○	○
24	○	○	○	○
25	○	○	○	○

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SECTION 2 — 65 marks

Attempt ALL questions

Question 10 contains a choice

1. **Read through the supplementary sheet for question 1 before attempting this question.**

   (a) **Refer to Figure 2.**

   Within a species there is usually a positive correlation between size and age, where larger organisms are older.

   Use **Figure 2** to explain if the data support this for veined squid.   **1**

   _____

   _____

   _____

   (b) The researchers used evidence published by other scientists to support their work on ageing squid.

   Give the term used to describe published summaries of current knowledge and recent findings in a particular field.   **1**

   _____

   (c)   (i) Explain why many marine organisms use external fertilisation.   **1**

   _____

   _____

   (ii) Give one cost of this type of fertilisation.   **1**

   _____

1. **(continued)**

(d) **Refer to Figure 3.**

(i) Explain how **Figure 3a** suggests that larger males may have a reproductive advantage. **1**

_____

_____

(ii) Does the data in **Figure 3b** also support this conclusion? **1**

Justify your answer.

_____

_____

(e) **Refer to Figure 4.**

(i) Identify the month that would have the highest breeding activity. **1**

_____

(ii) Squid eggs can take 30 days to hatch.

Explain how the data for April support this finding. **1**

_____

_____

_____

(iii) The squid take over a month to mature from stage 2 to stage 3.

Suggest a reason for the unexpected decrease in the proportions of squid at stage 2 caught in May. **1**

_____

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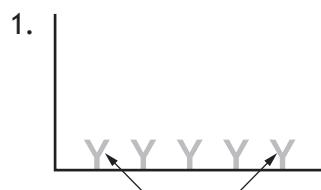
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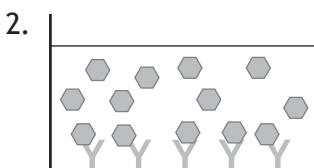
2. *Fasciolosis* is a disease of cattle caused by the flatworm *Fasciola hepatica* (*F. hepatica*).
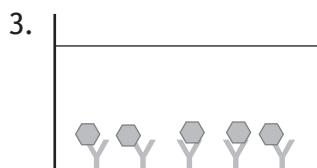
F. hepatica antigens are found both in the blood and the milk of infected cattle and their presence is the basis of an enzyme-linked immunoassay used to identify infected animals. A positive assay is described in the figure.

1.
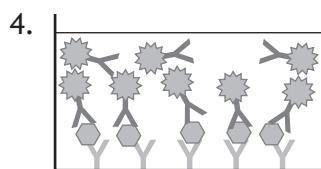
monoclonal antibodies specific to *F. hepatica* are bound to the assay plate

2.
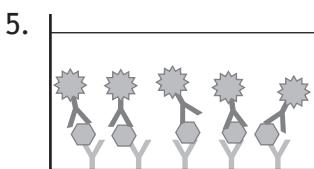
an infected milk sample is added to the plate

3.

the plate is washed with a buffer

4.
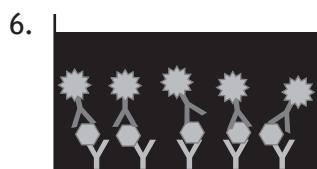
a second monoclonal antibody, specific to *F. hepatica* and linked to an enzyme, is added

5.

the plate is washed with a buffer

6.

the colourless enzyme substrate is added and is converted to a coloured product

(a)　(i)　The antibody added at step four is a monoclonal antibody.

State the meaning of the term monoclonal. **1**

_____

_____

(ii)　Monoclonal antibodies can be produced in a laboratory using hybridomas that are prepared by fusing together B lymphocytes and myeloma cells.

Name the chemical used to fuse these two cell types together. **1**

_____

2. (continued)

(b) If the procedure was not carried out correctly a positive result could occur in the absence of *F. hepatica* antigens; a *false positive* result.

Suggest a possible cause for this false positive result.

1

_____

_____

_____

(c) A pH buffer was used in all reagents and wash solutions.

Explain why it is important to control pH in immunoassays.

2

_____

_____

_____

_____

(d) Infection with *F. hepatica* in cattle results in weight loss and a reduction in milk yield.

Suggest a reason for the reduced milk yield in infected cattle.

1

_____

_____

[Turn over

3. Photoreceptor system proteins are found across the three domains.

(a) (i) Name the light sensitive molecule in animals that combines with the protein opsin to form photoreceptors of the eye. **1**

_____

(ii) Rod cells contain rhodopsin.
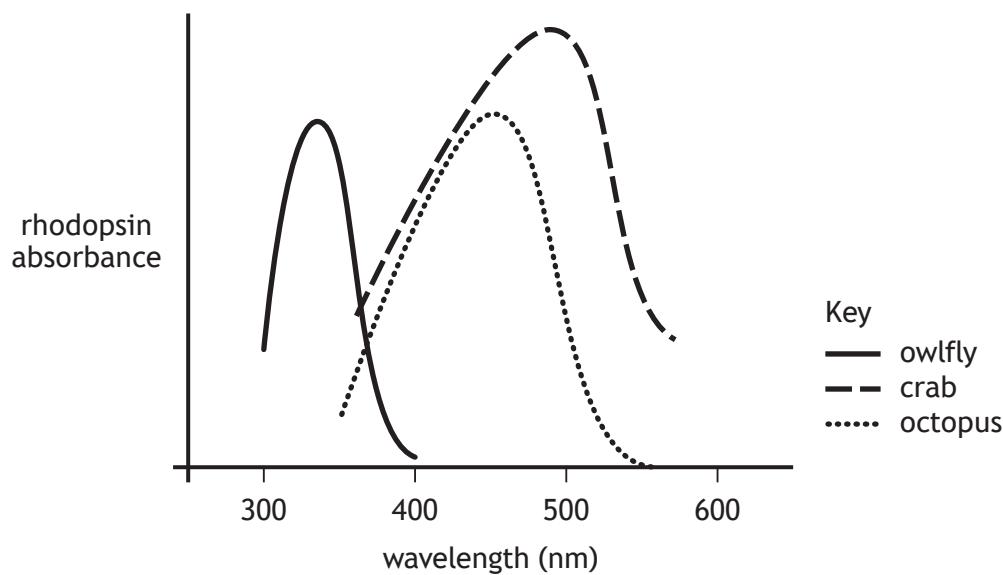
Explain why these cells can function in low light intensity. **1**

_____

_____

(iii) Describe the role of bacteriorhodopsin in archaea. **2**

_____

_____

_____

Figure 1 shows the absorption spectra of rhodopsin in a variety of organisms.

Figure 1

(b) Owlflies have rhodopsin that is sensitive to light of 345 nm (UV).

Suggest how the photoreceptor proteins of owlflies differ from those of crabs. **1**

_____
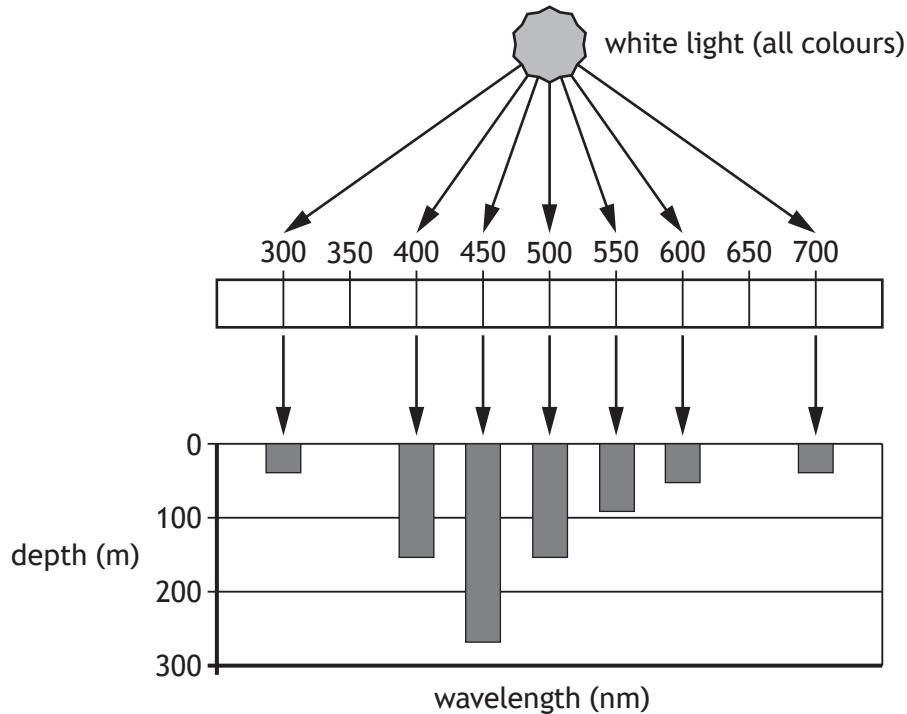
3. **(continued)**

Figure 2 shows the depth of penetration in water of the wavelengths in daylight.

Figure 2

white light (all colours)

300 350 400 450 500 550 600 650 700

depth (m)

0
100
200
300

wavelength (nm)

(c) Crab species tend to live in shallower coastal waters, whereas octopus species can live in open seas.

Explain how the data from **Figures 1 and 2** support this statement.   **2**

_____

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_____

[Turn over
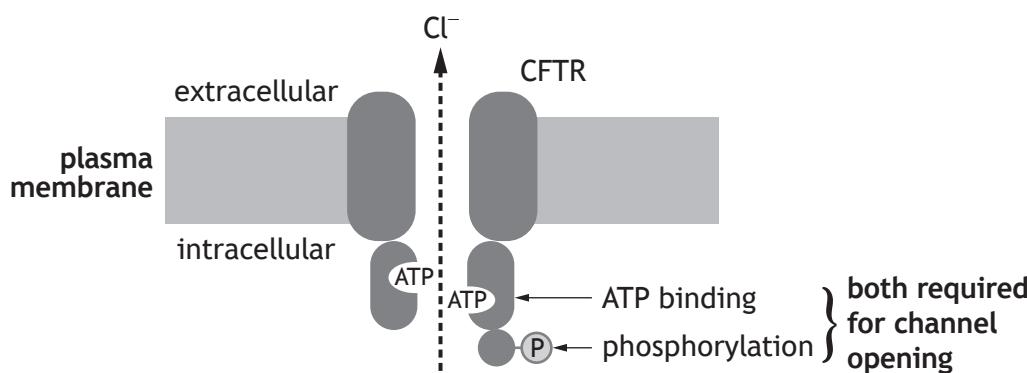
4. The *CFTR* gene encodes a large transmembrane protein (CFTR) with a symmetrical structure. This is composed of two transmembrane regions and two ATP-binding regions.

(a) Name the class of R-groups that predominate in the transmembrane regions of proteins. **1**

_____

(b) The protein CFTR is involved in the regulation of water content of extracellular mucus in the lungs and digestive system.

The figure represents the action of CFTR. It regulates the passage of chloride ions (Cl^-) across membranes of epithelial (lining) cells. In order for this ion channel to open, the protein must bind two ATP molecules, as well as a phosphate group. The increased concentration of Cl^- outside the cell draws water out of the epithelial cells into the mucus, maintaining its fluidity.

(i) What name is given to a molecule that binds to a protein? **1**

_____

(ii) Suggest how the binding of ATP results in the opening of the chloride ion channel. **1**

_____

_____

4. **(continued)**

(c) Cholera is a disease caused by the bacterium *Vibrio cholerae*. It causes severe watery diarrhoea, which can lead to dehydration and even death. The bacterium produces *cholera toxin* which interferes with the control of the CFTR protein channel by constantly activating a kinase enzyme.

(i) Describe the reaction catalysed by a kinase enzyme. **1**

_____

_____

(ii) Explain how the production of cholera toxin by *Vibrio cholerae* can lead to more water being drawn out of the epithelial cells. **2**

_____

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[Turn over

5. It is thought that the level of fruit and vegetable consumption could influence the risk of some diseases in humans. One large study has examined the relationship between the level of fruit and vegetable consumption and the risk of mortality. This was a *meta-analysis*, which is a type of observational study that combines and summarises data from several previous similar studies.

(a) Meta-analyses provide good evidence and are widely used in epidemiological studies.

State what is meant by the term 'epidemiology'. **1**

_____

_____

A search of previously published research papers was used to identify studies for inclusion in the meta-analysis. However, not all possible studies were included. In most of the studies used, fruit and vegetable consumption was assessed using questionnaires.

(b) Suggest why the use of questionnaires to collect information about fruit and vegetable consumption may have led to some errors in the data. **1**

_____

_____

(c) One possible criticism of meta-analyses is that the people carrying them out select the previous studies to include, which could result in selection bias.

(i) Suggest **one** reason why an individual study might be considered invalid and therefore excluded from the meta-analysis. **1**

_____

_____

(ii) State the effect that selection bias would have on the sample obtained. **1**

_____

_____
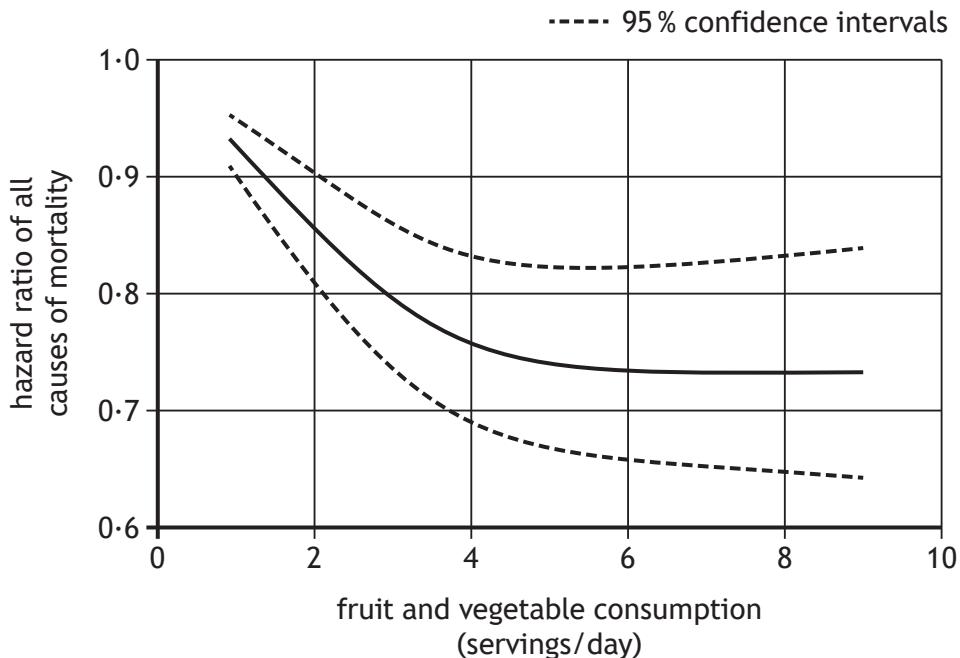
5. (continued)

The results from this meta-analysis are shown in the graph. The risk of mortality was expressed as a hazard ratio, with a hazard ratio of 1·0 indicating no effect on the risk of mortality.

(d) The graph shows the 95 % confidence intervals for the data.

The confidence interval for six servings per day is wider than that for two servings.

What does this indicate about these two sets of data? **1**

_____

_____

(e) This study is consistent with the hypothesis that higher fruit and vegetable consumption is associated with a reduced risk of mortality over time.

Explain why this observational study can only suggest a possible link between fruit and vegetable consumption and mortality risk over time. **1**

_____

_____

_____

6. Behaviour is an animal's response to internal and external stimuli.

Discuss how animal behaviour can be measured and recorded. **4**

_____

_____

_____

_____

_____

_____

_____

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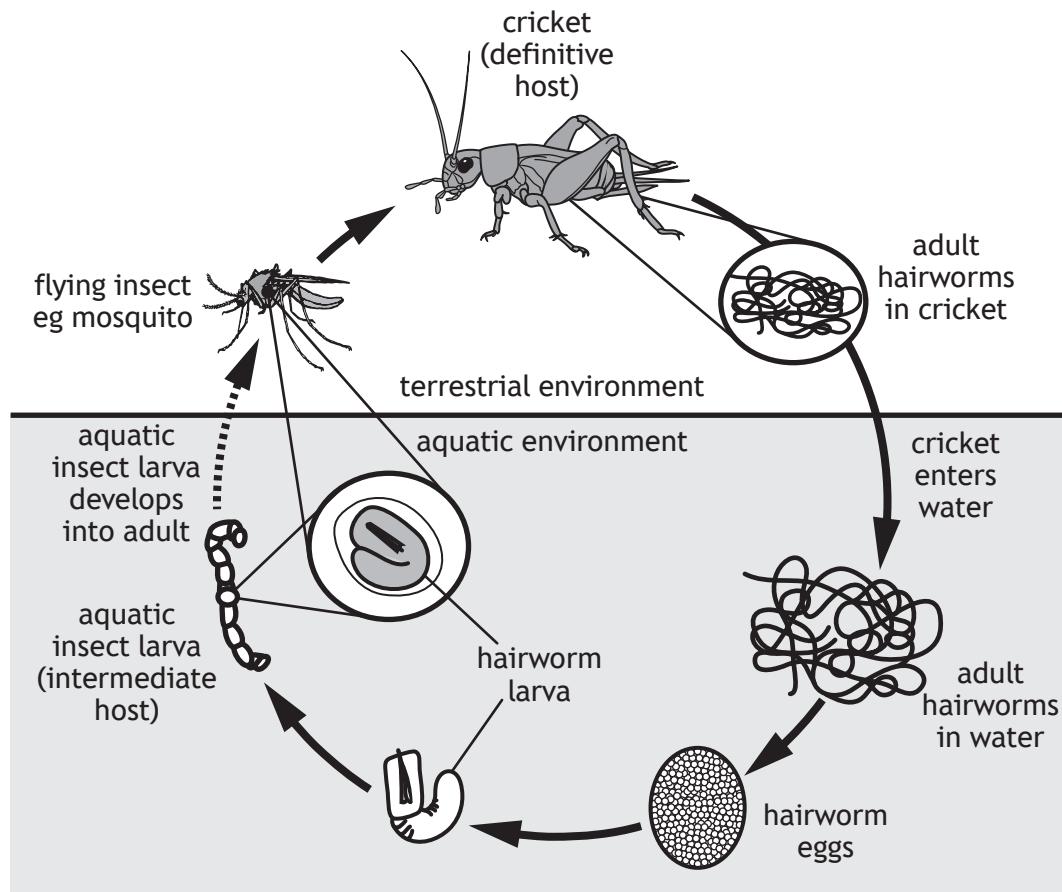
7. The figure shows the life cycle of the parasitic hairworm, *Paragordius varius*, found in lakes throughout North and South America.

cricket (definitive host)

flying insect eg mosquito

adult hairworms in cricket

terrestrial environment

aquatic environment

aquatic insect larva develops into adult

cricket enters water

aquatic insect larva (intermediate host)

hairworm larva

adult hairworms in water

hairworm eggs

(a) Hairworm eggs develop into larvae that hatch and move slowly through water at the bottom of the lake, where they may be ingested by aquatic insect larvae. The insects act as intermediate hosts, transporting the parasites into the terrestrial environment when the aquatic insect larvae become flying adults. If the flying insects are eaten by crickets, the parasite larvae penetrate the gut of the cricket to enter the body cavity.

(i) Explain why the hairworm and the cricket can be described as symbionts.

1

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(ii) Explain why the cricket, and not the aquatic insect larva, is the definitive host.

1

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7. (continued)

(b) In the presence of water, the hairworm exits the cricket's body and commences the next stage of its life-cycle. Researchers have shown that the hairworm adults produce 'mind-controlling' chemicals, which cause their normally terrestrial cricket hosts to jump into bodies of water.

(i) Suggest how this modification of host behaviour benefits the parasite.

1

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(ii) Give another example of a host behaviour that can be altered as part of the extended phenotype of a parasite.

1

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_____

(c) Adult hairworms are free-living in aquatic environments where they mate. Males die almost immediately after mating so only mate once. Females die shortly after laying eggs fertilised by a single male.

State the term used to describe this type of reproductive strategy.

1

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(d) Hairworms are closely related to members of the phylum Nematoda.

Name the phylum to which both their hosts belong.

1

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[Turn over

8. The 1918 'Spanish flu' pandemic was caused by the influenza virus and is thought to have killed approximately 50 million people.

(a) (i) Humans have many defences that prevent viruses from entering the body including physical barriers and chemical secretions.

Name one of the non-specific immune responses that may result if the virus is able to bypass these defences.   **1**

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(ii) Annual flu vaccinations are designed to give immunity to some strains of influenza for vulnerable individuals. The vaccines typically contain inactivated virus particles that have been purified to leave only two of the proteins that are found on the surface of the virus coat.

Suggest why a new flu vaccine needs to be developed annually.   **2**

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8. (continued)

(b) Scientists have predicted that another flu pandemic is highly likely in the future. They are particularly concerned that this might arise from the *H5N1* strain of influenza virus, which is common in wild bird species, and is able to pass from birds to humans.

(i) What term is used to describe the level of harm caused to the host species by a virus? **1**

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(ii) The *case fatality rate* (CFR) is the proportion of infected individuals who die as a result of a disease. Spanish flu had an estimated CFR of 2·5 % but the *H5N1* flu strain has a CFR of 55 %.

If Spanish flu had been caused by the *H5N1* strain, and it had infected a similar number of people, what would have been the resulting number of deaths? **1**

Space for calculation

[Turn over

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9. The sandperch, *Parapercis cylindrica*, is a fish that lives on the sea floor. Each female defends a territory in which it feeds and reproduces. Dependent on the population density of the species, a single male may defend a group of up to 10 neighbouring females.

(a) All sandperch begin life as hermaphrodites and mature into females.

What is meant by the term hermaphrodite? **1**

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_____

(b) There is a strict size-based dominance hierarchy in the social groups; the mean size of males is greater than that of females.

State the term used to describe this difference in mean size. **1**

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(c) If the male dies, the largest female will undergo a period of growth and will then change sex.

State one **other** cause of sex change in organisms. **1**

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(d) A study was conducted to measure the growth of female fish undergoing sex-change. Social groups were created in a laboratory by placing groups of similar sized fish in tanks with identical environmental conditions.

Two treatments were set up, each with 10 groups.

- Treatment 1 with 2 females and 1 male in each group
- Treatment 2 with 4 females and 1 male in each group

On day 5, the male was removed from half of each of the treatment groups to create experimental groups. On day 35 the sex and growth of each fish was determined. The structure of the groups is shown in the table.
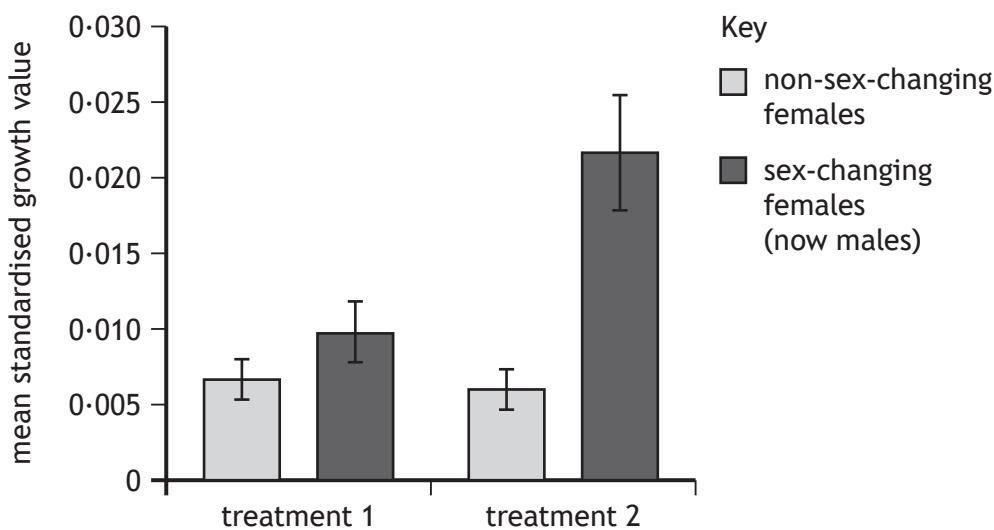
		Treatment 1 (10 groups)		Treatment 2 (10 groups)	
		Control (5 groups)	Experimental (5 groups)	Control (5 groups)	Experimental (5 groups)
Group structure	Day 1	2 females 1 male	2 females 1 male	4 females 1 male	4 females 1 male
	Day 5	2 females 1 male	2 females	4 females 1 male	4 females
	Day 35	2 females 1 male	1 female 1 male	4 females 1 male	3 females 1 male

9. (d) (continued)

At day 35 the growth of fish in each experimental group was compared to its control group. This was used to calculate a standardised value that took into account growth in the control group. The figure shows the mean standardised growth values for the experimental groups in treatments 1 and 2. Error bars represent standard error of the mean.

(i) Suggest why it was necessary to have separate control groups for treatments 1 and 2.

1

(ii) Give one conclusion that could be drawn about the effect of treatment 2 on the growth of sex-changing females compared to treatment 1.

1

(iii) Suggest an advantage of greater size in sex-changed females.

1

10. Answer **either A or B** in the space below and on *page 25*.

    A   Discuss signalling between cells under the following headings.

        (i) Hydrophilic signalling molecules and signal transduction   **6**

        (ii) Insulin signalling and diabetes   **4**

    OR

    B   Discuss control of the cell cycle under the following headings.

        (i) Phases of the cell cycle and the importance of cell cycle checkpoints   **6**

        (ii) The role of cyclins and cyclin-dependent kinases   **4**

SPACE FOR ANSWER FOR QUESTION 10

[END OF QUESTION PAPER]

ADDITIONAL SPACE FOR ANSWERS AND ROUGH WORK

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ADDITIONAL SPACE FOR ANSWERS AND ROUGH WORK

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