National Qualifications 2022

X807/77/02

Biology
Section 1 — Questions

THURSDAY, 19 MAY
1:00 PM – 4:00 PM

Instructions for the completion of Section 1 are given on *page 02* of your question and answer booklet X807/77/01.

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.

SECTION 1 — 20 marks

Attempt ALL questions

1. SDS-PAGE separates proteins by:

A shape

B size

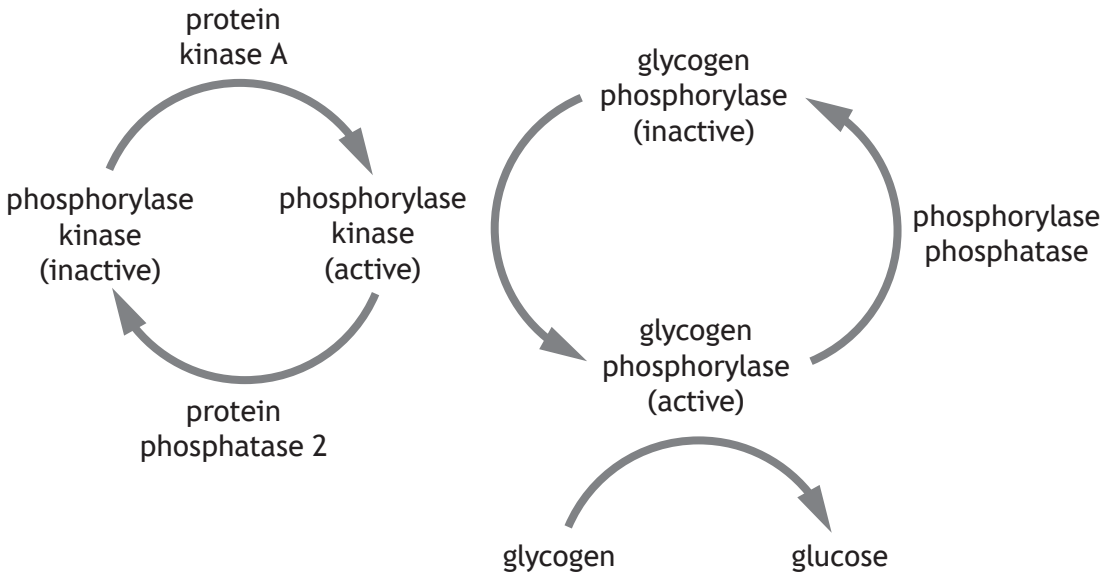
C charge

D isoelectric point.

2. Which row in the table describes functions of compartments involved in the synthesis and transport of proteins?

	Compartment		
	Smooth endoplasmic reticulum	**Rough endoplasmic reticulum**	**Golgi apparatus**
A	post-translational modification	lipid synthesis	protein transport
B	lipid synthesis	protein transport	post-translational modification
C	lipid synthesis	post-translational modification	protein transport
D	post-translational modification	protein transport	lipid synthesis

3. The figure gives information about enzymes involved in glycogen metabolism in humans.



Which row in the table describes events when the enzyme protein kinase A is activated?

	Phosphate group attached to glycogen phosphorylase	**Glycogen converted to glucose**
A	yes	yes
B	yes	no
C	no	no
D	no	yes

[Turn over

4. Which of the following are null hypotheses?

1. Blackbirds show no food preference based on colour.
2. As people age, they do not respond to certain painkillers.
3. As concentration of inhibitor increases, enzyme activity decreases.
4. Increasing light intensity will not affect the rate of germination of cress seeds.

A 1 and 4 only

B 2 and 3 only

C 2 and 4 only

D 1, 2 and 3 only

5. Statins are drugs used to treat people with cardiovascular disease. One large study investigating the effectiveness of a statin drug randomly assigned patients to two groups: one group received the statin; the other group was given a placebo.

One measure of the effectiveness of a treatment is the *relative risk*, which can be calculated using the formula:

$$\text{Relative risk} = \frac{\text{percentage of death in treatment group}}{\text{percentage of death in control group}}$$

After a period of approximately six years, 91% of the patients given the statin and 87% of patients given the placebo survived.

The relative risk for those given the statin is:

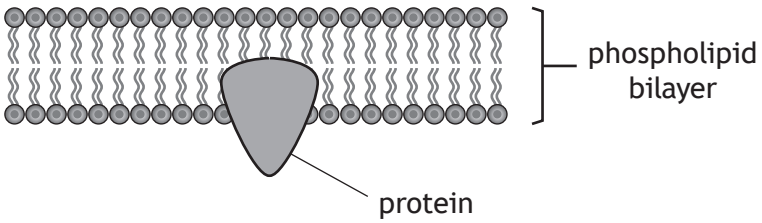
A 0.69

B 0.96

C 1.05

D 1.44

6. The diagram shows a protein molecule and the cell membrane.



Which row in the table identifies features of this protein?

	Protein type		Nature of R groups on protein surface	
	Integral	**Peripheral**	**Hydrophobic**	**Hydrophilic**
A	✓		✓	
B		✓	✓	✓
C	✓		✓	✓
D		✓		✓

7. The response to an increase in insulin concentration in the blood involves the following events.

1. Recruitment of GLUT 4 to the cell membrane.
2. A phosphorylation cascade inside the cell.
3. Insulin receptor changes conformation.
4. Phosphorylation of the insulin receptor.
5. Binding of insulin to its receptor.

The correct sequence of these events is:

A 5, 4, 3, 1, 2

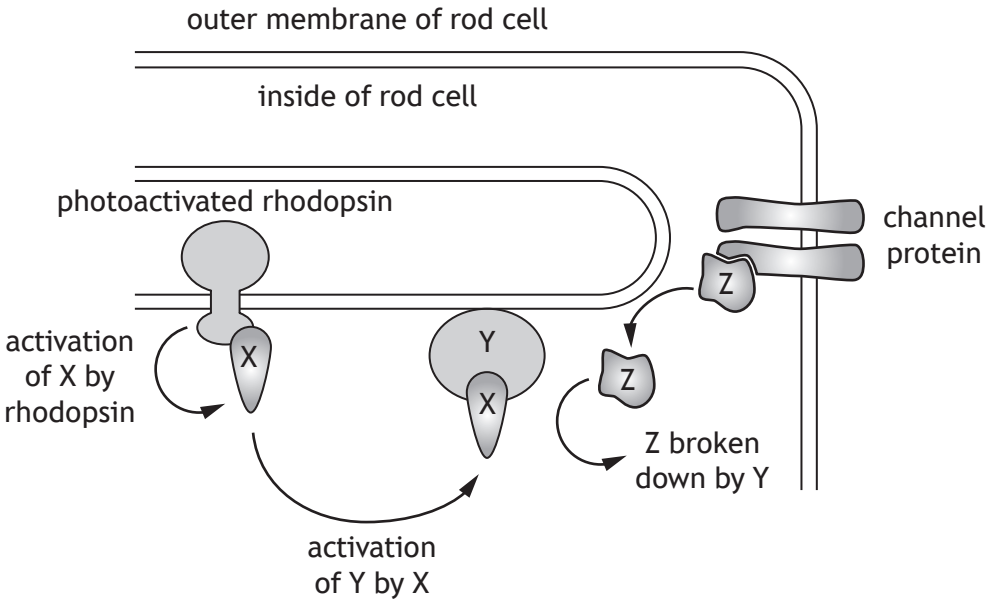
B 2, 4, 3, 5, 1

C 5, 3, 4, 2, 1

D 5, 3, 1, 2, 4

[Turn over

8. The diagram shows events in the response to light in the rod cells of animals.

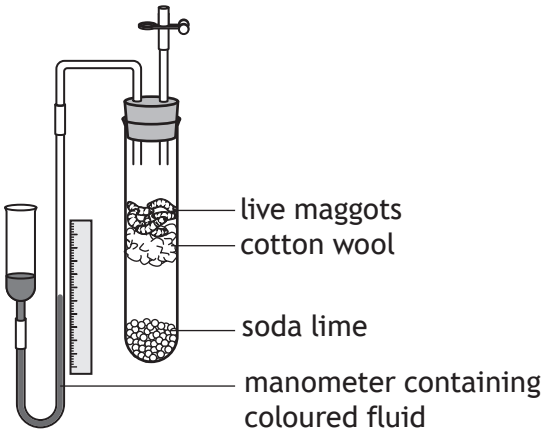


When a photon of light hits a molecule of rhodopsin it activates molecule X, which disassociates from rhodopsin and activates another molecule, Y. Activated Y breaks down molecule Z, which in turn affects the function of a channel protein.

Which row in the table identifies molecules X, Y and Z?

	Molecule X	**Molecule Y**	**Molecule Z**
A	cGMP	transducin	PDE
B	transducin	PDE	cGMP
C	PDE	transducin	cGMP
D	transducin	cGMP	PDE

9. A respirometer was used to measure the rate of respiration in maggots as shown in the diagram. The soda lime was present to absorb the carbon dioxide produced by the maggots during respiration. The manometer was used to measure the decrease in gas volume over a fixed time period.



It was found that the decrease in gas volume, and hence the oxygen consumed, in the respirometer was 0.24 cm^3 per gram of maggots.

The experiment was repeated with identical conditions except that the soda lime was replaced with an equal volume of plastic beads, allowing the measurement of the net change in both carbon dioxide and oxygen. The net change in volume in this experiment was found to be a decrease of 0.07 cm^3 per gram of maggots.

The respiratory quotient is calculated using the equation:

$$\text{Respiratory quotient} = \frac{\text{volume of carbon dioxide produced}}{\text{volume of oxygen consumed}}$$

Calculate the respiratory quotient for the maggots in this experiment.

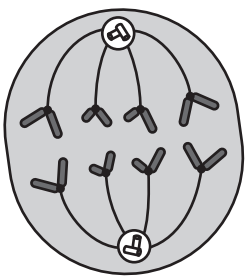
A 0.29

B 0.71

C 1.41

D 3.43

10. The diagram represents a cell in which stage of mitosis?



A Metaphase

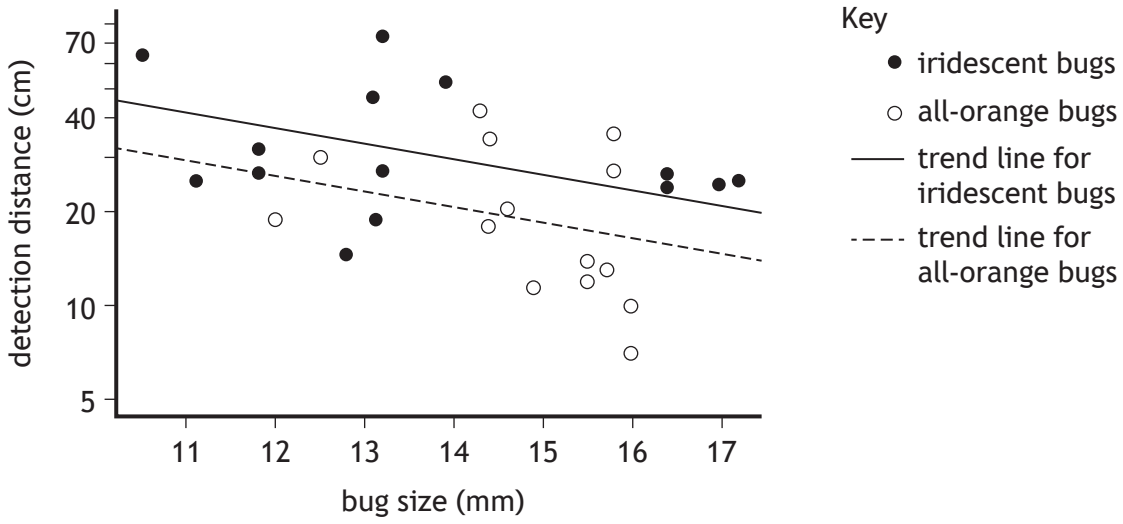
B Prophase

C Telophase

D Anaphase

11. The cotton harlequin bug has highly variable coloration; individuals may be all-orange or have blue-green iridescent patches of variable size. The bright orange colour induces avoidance behaviour in birds but not in arthropod predators such as the praying mantis. The praying mantis lacks a red photoreceptor and has difficulty distinguishing the all-orange bugs from a green background.

The graph shows results from an experiment that was carried out to compare the ability of praying mantises to detect all-orange and iridescent bugs of different sizes from different distances.



The following conclusions were drawn:

1. Both colour and size of bugs affect detection distance.
2. Iridescent bugs are mostly larger than all-orange bugs.
3. The negative correlation between bug size and detection distance shows that smaller bugs were detected from further away.

Which of the conclusions are consistent with the data shown?

A 1 and 2 only

B 1 and 3 only

C 2 and 3 only

D 1, 2 and 3

12. Which row in the table shows a model organism correctly classified?

	Model organism	**Taxonomic group**
A	*Caenorhabditis elegans*	Bacteria
B	*Escherichia coli*	Nematoda
C	*Arabidopsis thaliana*	Chordata
D	*Drosophila melanogaster*	Arthropoda

13. Which of the following descriptions of animal behaviour is anthropomorphic?

A Woodlice consistently prefer damp environments.

B Rats may be very cautious about eating new foods presented to them.

C Lekking behaviour in a male black grouse encourages females to mate.

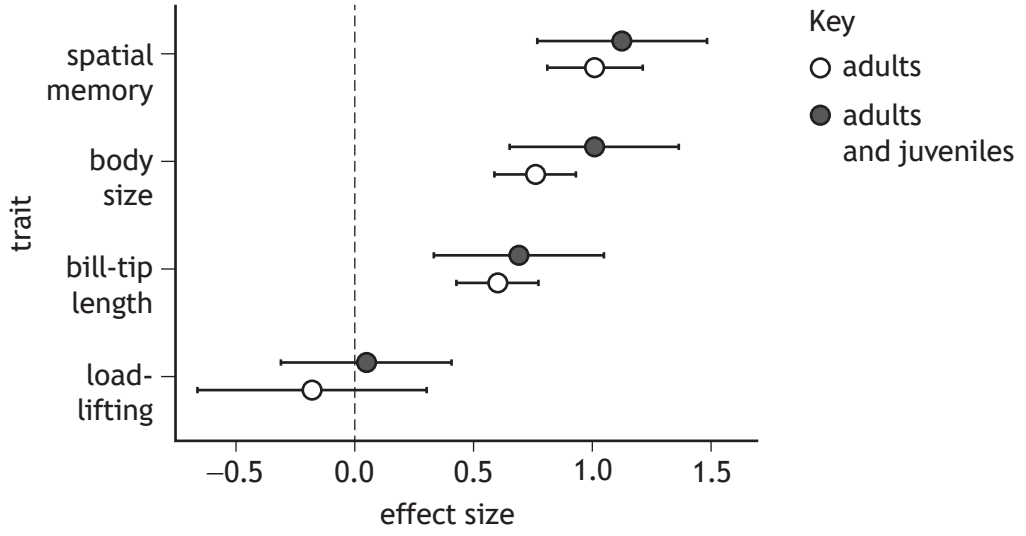
D A greedy herring gull was recently observed swallowing a whole blackbird.

[Turn over

14. Male long-billed hermit hummingbirds (*Phaethornis longirostris*) defend a territory (favoured perch). At the same time, they have to forage successfully for nectar-producing flowers over great distances. The ability to recall rewarding locations efficiently (spatial memory) allows more time to be spent defending the territory.

An experiment was carried out to compare the importance of this spatial memory to the importance of three physical phenotypic traits: body size, bill-tip length and load-lifting ability. The importance of each trait was represented by an 'effect size'. The larger the effect size the greater the effect on its ability to defend a territory.

The figure shows the effect size for all four traits.



Which of the following conclusions can be drawn from the data?

A There is no difference between adults and juveniles.

B The ability to recall the position of nectar-producing flowers increases the ability to defend a territory.

C No conclusion can be drawn as none of the differences in the data are significant.

D Adults always have a smaller territory.

15. Four students carried out an experiment to measure the glucose concentration of a carton of fruit juice. Each student measured the values four times.

The table shows the readings obtained.

Student	Concentrations of glucose measured (mg/100 ml)				Mean (mg/100 ml)
1	10	16	8	18	13
2	15	13	12	15	14
3	17	10	12	17	14
4	10	9	10	10	10

The actual concentration of glucose in the fruit juice was 12 mg/100 ml.

Which statement best describes the data set?

A Accurate, but not precise

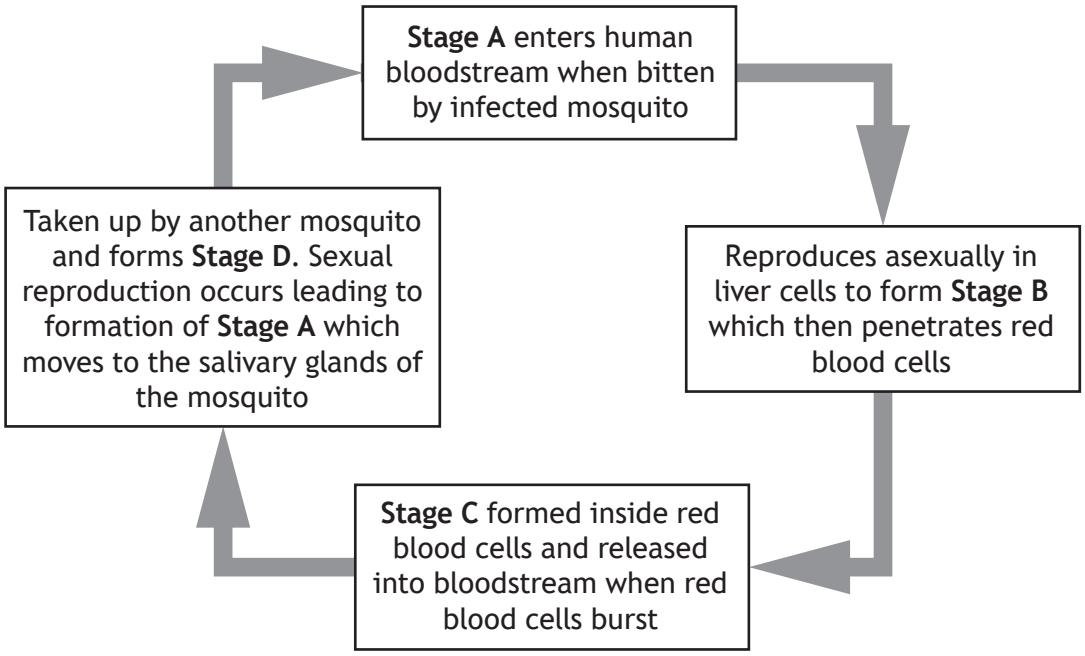
B Precise, but not accurate

C Accurate and precise

D Neither accurate or precise

16. The figure shows some of the stages in the life cycle of the malarial parasite, *Plasmodium*.

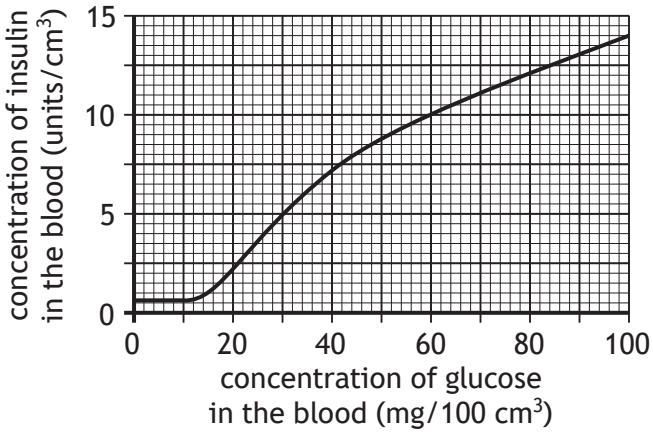
Which of the four stages described is a gametocyte?



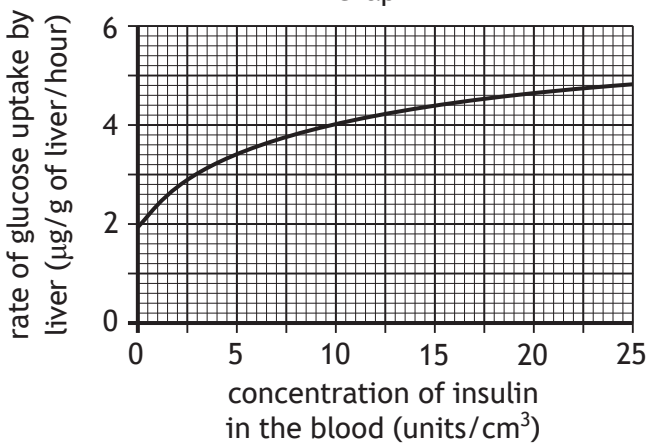
[Turn over

17. Graphs 1 and 2 show how the rate of glucose uptake by the liver is affected by the concentrations of glucose and insulin in the blood.

Graph 1



Graph 2



The **mass** of glucose taken up in 30 minutes by a 1.4 kg liver when the concentration of glucose in the blood is 60 mg/100 cm^3 is:

A 2 µg

B 4 µg

C 2800 µg

D 5600 µg.

18. The table shows information concerning some characteristics of three species of MacArthur's warblers, which are closely related species of insectivorous songbirds living in spruce forests in north-eastern USA.

	Species of MacArthur's warblers		
	Setophaga fusca	***Setophaga coronata***	***Setophaga castanea***
Foraging zone	treetops	trunk area of trees	middle interior portions of trees
Nesting sites	high in trees near tips of branches	horizontal branches in trees up to 15 m	lower portions of spruce and fir trees
Food sources	insect larvae, spiders and spruce budworm	insects, insect larvae and spruce budworm	insects, spiders and spruce budworm
Nesting period	May–July	May–July	May–July

The strongest evidence of resource partitioning between these three species comes from the analysis of their:

A foraging zone and nesting period

B nesting sites and food sources

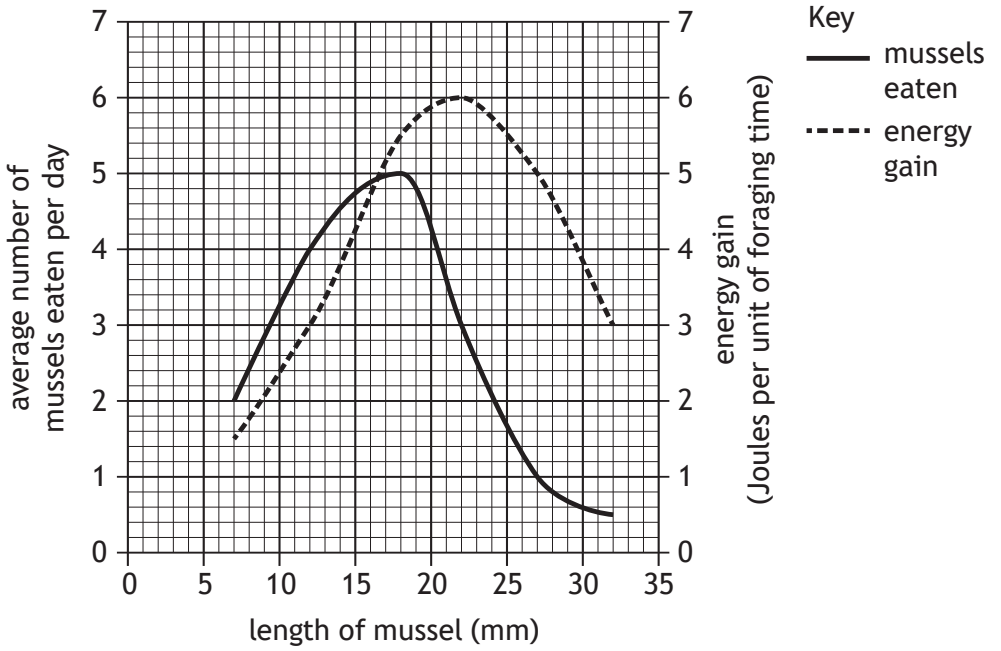
C nesting period and food sources

D foraging zone and nesting sites.

[Turn over

19. During an investigation into foraging behaviour, a student studied prey selection by shore crabs feeding on mussels. The student observed the crabs feeding and measured the length of each mussel predated on by the crabs over several days. The results were compared with another study where the energy expended by a crab to open a mussel of a specific size was compared to the energy content of the mussel to allow the energy gained per unit of foraging time to be calculated.

The results are shown in the graph.



What conclusion can be drawn from the results?

A Shore crabs don't select prey on the basis of size.

B As prey size increases, foraging becomes less efficient.

C As prey size increases, foraging becomes more efficient.

D Shore crabs tend to select prey sizes that make foraging more efficient.

20. Which of the following characteristics is most likely to be found in an r-selected species?

A Produce a large number of small offspring

B Most offspring reach adulthood

C Have a longer generation time

D High level of parental care

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

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