

2006 Senior External Examination



Biological Science

Paper One

Thursday 2 November 2006

9.00 am to 11.40 am

Directions

1. Perusal time: **10 minutes**.
Do not make notes in this paper during perusal time.
2. Working time: **2 hours 30 minutes**.
3. Materials provided:
 - multiple-choice response sheet for Part A.
4. Equipment allowed:
 - 2B pencil (for completing the multiple-choice response sheet)
 - eraser
 - normal writing implements
 - other QSA-approved equipment.
5. This paper contains:
 - formatted pages for responses to Part B
 - planning space on the reverse of this cover and on pages 18–20 for any draft work that is not to be assessed.
6. This paper has **two** parts:
 - Part A: Questions 1–15 Multiple choice
 - Part B: Questions 1–11 Short response.Attempt **all** questions.
7. Clearly cross out any draft work that is not to be assessed.
8. Do not take this paper, used or unused, from the examination room.
Do not tear out any part of this paper. The supervisor will collect this paper when you leave the examination room.

Notes

Suggested time allocation:

Part A: 30 minutes

Part B: 120 minutes.

Assessment:

This paper assesses the following criteria published in the 1999 Senior External Syllabus in Biological Science:

- Knowledge (K)
- Scientific processes (SP).

The criterion assessed by each question is indicated in brackets after each question.

Criterion and standards for assessment are on page 21 of this paper.

Candidate use

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Affix your barcode here

Number of books used

Supervisor use only

Supervisor's initials	
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QSA use only

Examiner number	
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Planning space

Part A

Multiple choice

Suggested time allocation: 30 minutes.

This part has 15 questions of equal value. Attempt all questions.

Each question has four options, **one** of which is correct or is the best option. Respond to each question by selecting one of the four possible options and blackening the appropriate circle on the multiple-choice response sheet provided. Use a 2B pencil to blacken the circles.

No credit for your response will be given if more than one circle is blackened.

Question 1

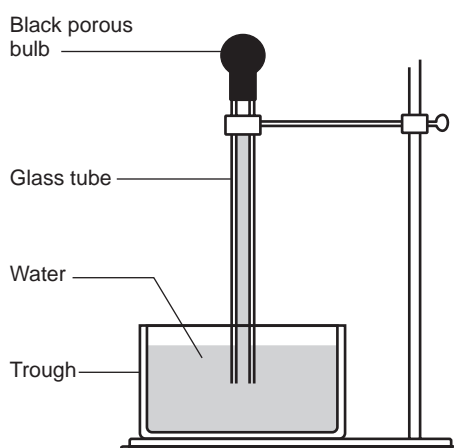
In a greenhouse, young corn plants are grown under optimal conditions of soil, temperature and humidity. Which of the following procedures would probably increase the rate of photosynthesis?

- A increasing the amount of green light available
- B adding very small amounts of sucrose and mineral ions to the soil
- C increasing the oxygen content of the air in the greenhouse by a large amount
- D increasing the carbon dioxide content of the air in the greenhouse by a small amount

(K)

Question 2

The diagram below of a laboratory set-up represents the transportation of water in plants due to transpiration.



Which plant part is represented by the glass tube?



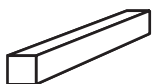
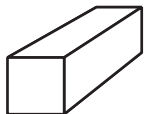
- A xylem
- B phloem
- C cambium
- D epidermis

(K)

Question 3

The following four agar blocks contain an indicator that turns red when placed in alkaline solution, and that turns colourless when placed in acid. Each block was left in alkaline solution overnight. On the following morning each block was placed in a weak acid solution.

Predict which block is the most likely to be the first to turn completely colourless.

	Block	Dimensions (mm)	Total surface area (mm ²)	Total volume (mm ³)
A	1 	10 x 10 x 5	400	500
B	2 	5 x 5 x 5	150	125
C	3 	10 x 2.5 x 2.5	112.5	62.5
D	4 	5 x 10 x 5	250	250

(SP)

Question 4

In mice, the genotype *yy* is grey and *Yy* is yellow. The combination *YY* results in death during the early embryonic stage.

A yellow female mouse is mated with a yellow male. Predict the expected ratio of yellow to grey offspring.

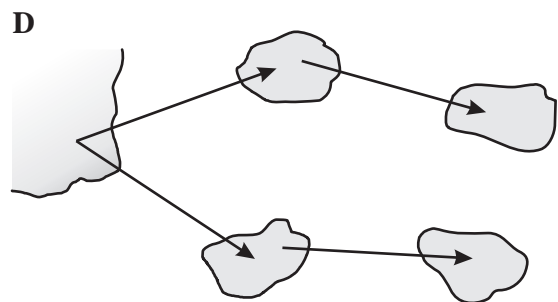
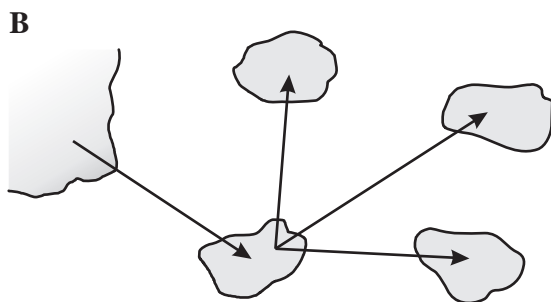
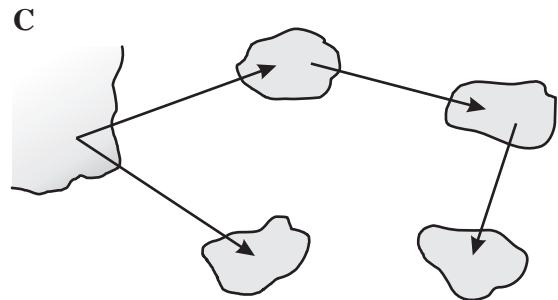
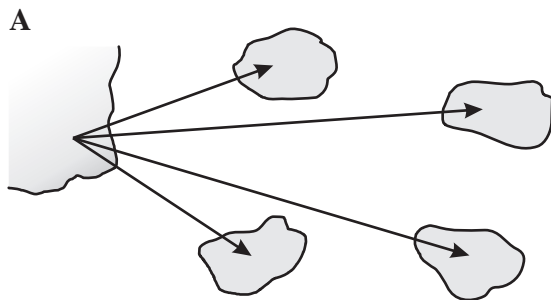
- A** 1:1
- B** 1:3
- C** 2:1
- D** 3:1

(K)

Question 5

The diagram below shows dispersal patterns of five closely related species of birds on a mainland and four adjacent islands.

Identify, on the basis of beak shape, which dispersal pattern is the most likely to have occurred.



(SP)

Question 6

The table below gives the gestation time (the amount of time that offspring are carried in the mother) and the average number of offspring for a variety of mammals.

Species	Common name	Average gestation (days)	Average number of offspring
<i>Rattus norvegicus</i>	Black rat	21	12
<i>Felis catus</i>	Cat	63	6
<i>Canis familiaris</i>	Dog	63	6
<i>Homo sapiens</i>	Human	278	1
<i>Equus caballus</i>	Horse	336	1
<i>Elephas maximus</i>	Indian elephant	624	1

A reasonable generalisation from this table is that the larger the mammal

- A the shorter the gestation and the larger the number of offspring.
- B the shorter the gestation and the smaller the number of offspring.
- C the longer the gestation and the larger the number of offspring.
- D the longer the gestation and the smaller the number of offspring.

(SP)

Question 7

Which of the following includes abiotic components?

- A community
- B ecosystem
- C food web
- D population

(K)

Question 8

As part of an ecological study, the biomass of organisms in a community was estimated.

Organism	Biomass (kg)
R	50
S	10
T	250
U	200
V	3000
W	75

From this data one probable food chain would be:

A S → W → U → V

B T → V → R → S

C U → T → W → R

D V → T → W → S

(K)

Question 9

A biological science student was given a number of identified and labelled echinoderms which she used to construct the following key.

1a	Star-shaped.....	2
1b	Not star-shaped.....	6
2a	Arms touching each other near body	3
2b	Arms completely separate at body	5
3a	Five arms	4
3b	More than five arms	<i>Crossaster papposus</i>
4a	Arm length about half total radius of the animal	<i>Asterina gibbosa</i>
4b	Arm length much more than half of the total radius of the animal	<i>Asterias rubens</i>
5a	Five arms	<i>Ophiothrix fragilis</i>
5b	More than five arms	<i>Ophiothrix muttans</i>
6a	Body spherical or heart-shaped, covered in spines	7
6b	Body cylindrical shaped, without spines.....	<i>Cucumaria normani</i>
7a	Body heart-shaped, with weak spines.....	<i>Spatangus purpureus</i>
7b	Body spherical, with long spines	<i>Echinus esculentus</i>

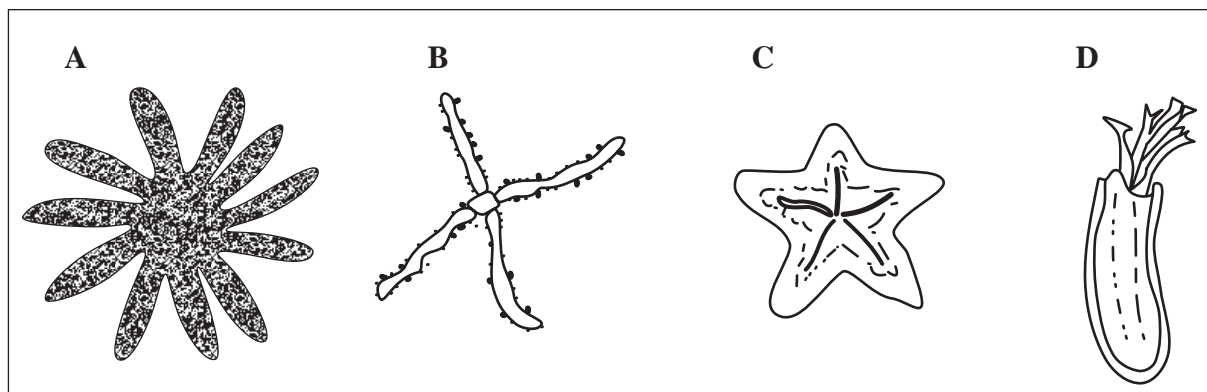
The first word of a scientific name gives the genus of the animal. The number of genera (plural of genus) used to construct the key was

- A one.
- B six.
- C seven.
- D eight.

(SP)

Question 10

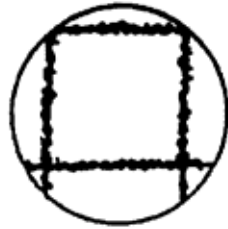
Using the information in the key in Question 9 above, state which of the following drawings could be *Cucumaria normani*.



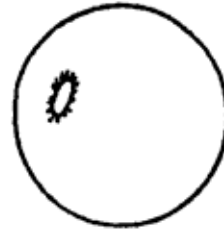
(SP)

Question 11

A student viewed some millimetre graph paper under the low power objective (x10) of her microscope to get an idea of the scale used. The eyepiece of the microscope magnified x10 as well. She then viewed some pond water using the same objective lens (x10) and observed the organism shown below.



millimetre graph paper



organism from pond water sample

The diameter of the field of view using low power is closest to

- A 2 mm.
- B 1.5 mm.
- C 1 mm.
- D 0.5 mm.

(SP)

Question 12

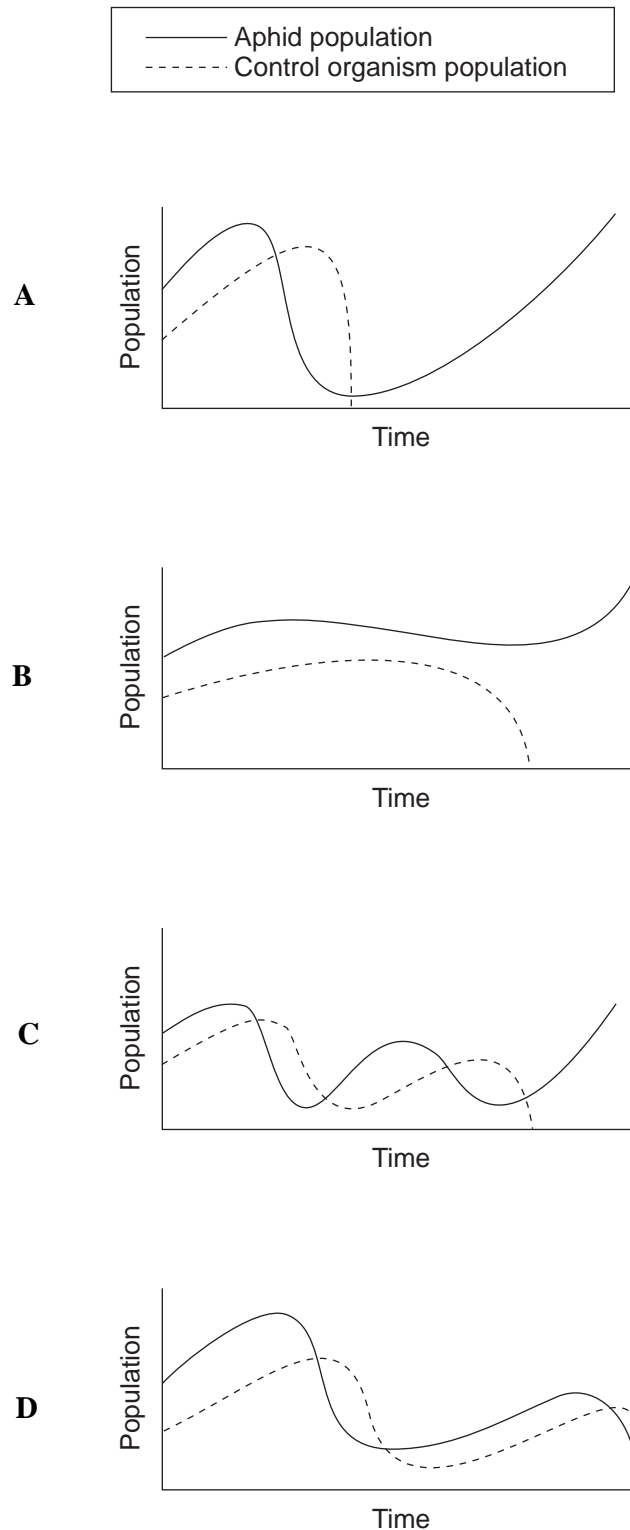
Use the information in Question 11 to respond to this question. The length of the organism seen under low power is closest to

- A 4 mm.
- B 1 mm.
- C $\frac{1}{4}$ mm.
- D $\frac{1}{10}$ mm.

(SP)

Question 13

An aphid is a small insect that sucks sugars from plant stems. The graphs below show the effectiveness of four different biological control organisms (A, B, C and D) on a species of aphid. The organisms were released during the first summer of a number of years. Study the graphs, then select the control organism (A, B, C or D) that would be most suitable to control the pest.



(SP)

Question 14

Read the following facts about reproduction:

- It takes about 60 hours for a sperm to meet and fertilise an egg.
- An average sperm count of at least 40 million is needed for successful fertilisation.
- The average lifespan of a sperm is about 72 hours.

Look at the sperm counts and “lifespans” for the sperm of four men. The results show the sperm count over time.

Male	Initial count	Fraction of original sperm left				
		After 20 hours	After 40 hours	After 60 hours	After 80 hours	After 100 hours
John	190 million	9/10	1/4	1/10	1/50	1/100
Jack	60 million	9/10	4/5	3/4	2/5	1/5
Paul	90 million	7/10	3/5	1/3	1/4	1/5
Con	120 million	4/5	3/5	1/4	1/5	1/20

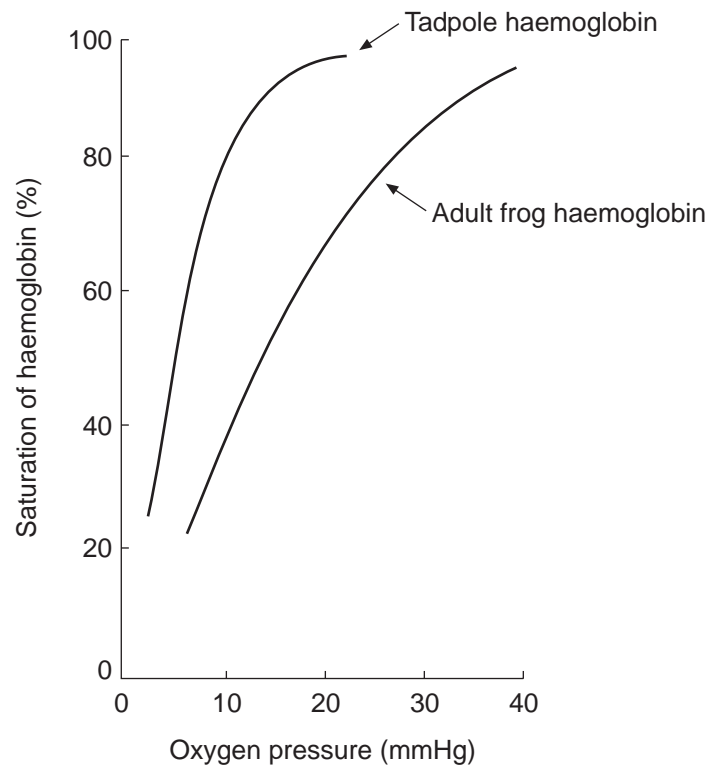
Which male has sperm that can fertilise a female egg?

- A** John
- B** Jack
- C** Paul
- D** Con

(SP)

Question 15

The percentage of haemoglobin that combines with oxygen at different oxygen pressures was determined for adult frogs and their tadpoles. The results are shown in the graph below.



Which of the following is a reasonable conclusion that can be made from the graph?

- A** When compared with adult frog haemoglobin, tadpole haemoglobin has a lesser ability to combine with oxygen at an oxygen pressure of 15 mmHg.
- B** Adult frog haemoglobin requires a lower oxygen pressure to become fully saturated than tadpole haemoglobin does.
- C** Tadpoles are better adapted than frogs for life in areas of low oxygen concentration.
- D** Tadpole blood contains less haemoglobin per unit volume than adult frog blood.

(SP)

Part B

Short response

Suggested time allocation: 120 minutes

This part has 11 questions of equal value. Attempt all questions.

Respond to the questions in the spaces provided.

Question 1

Explain the importance of making sure that all the possible influencing variables in an experiment (except the one being manipulated) are controlled and kept at a constant level across all treatments.

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(SP)

Question 2

Explain the difference between heterozygous and homozygous.

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(K)

Question 3

The drawing below shows the chromosomes in the nucleus of a skin cell of a mammal.



Determine the haploid number of chromosomes for this species.

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(K)

Question 4

In a biological science examination paper one candidate wrote:

“In droughts, grass was scarce and some animals stretched their necks to feed from the leaves of trees. These animals survived and their young had long necks. In this way giraffes evolved long necks.”

Refer to the above statement and suggest a more accurate explanation in terms of the principle of evolution by natural selection.

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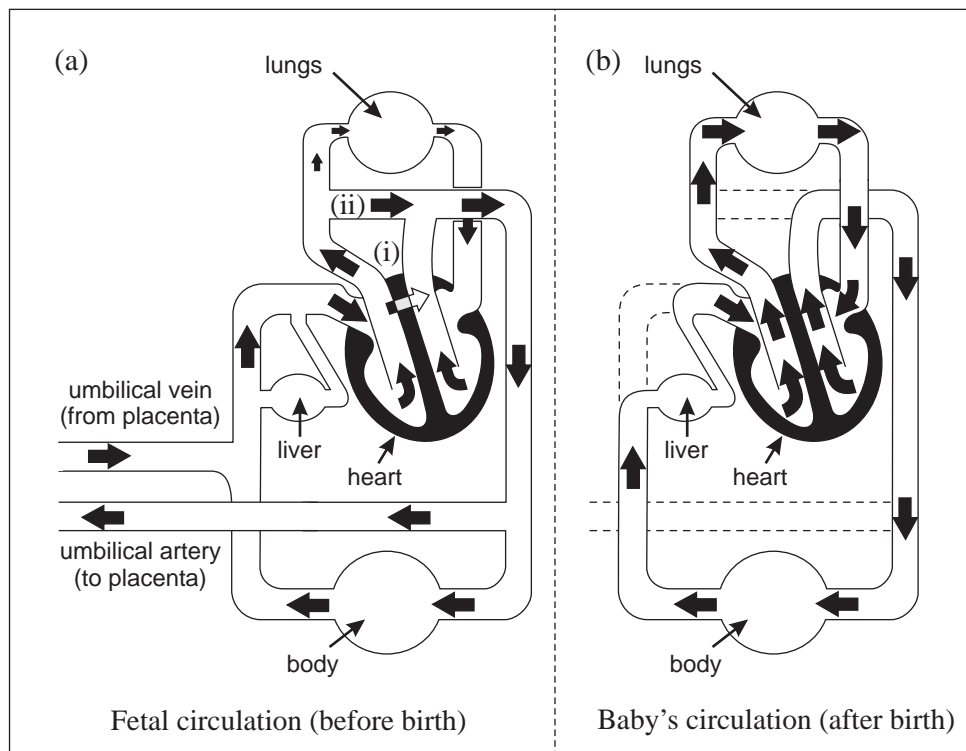
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(SP)

Question 5

The diagrams below show the circulatory systems of a human fetus and a human baby. The major differences between the two systems are:

- fetal lungs are non-functional before birth
- in fetus systems about 60% of the blood that enters the right atrium passes through the *foramen ovale* – indicated on the diagram at (i) – to the left of the atrium
- most of the remaining 40% passes via the *ductus arteriosus* – indicated on the diagram at (ii) – into the body circulation.



Describe the disadvantages that these bypasses would present for the baby after birth if they remained unchanged.

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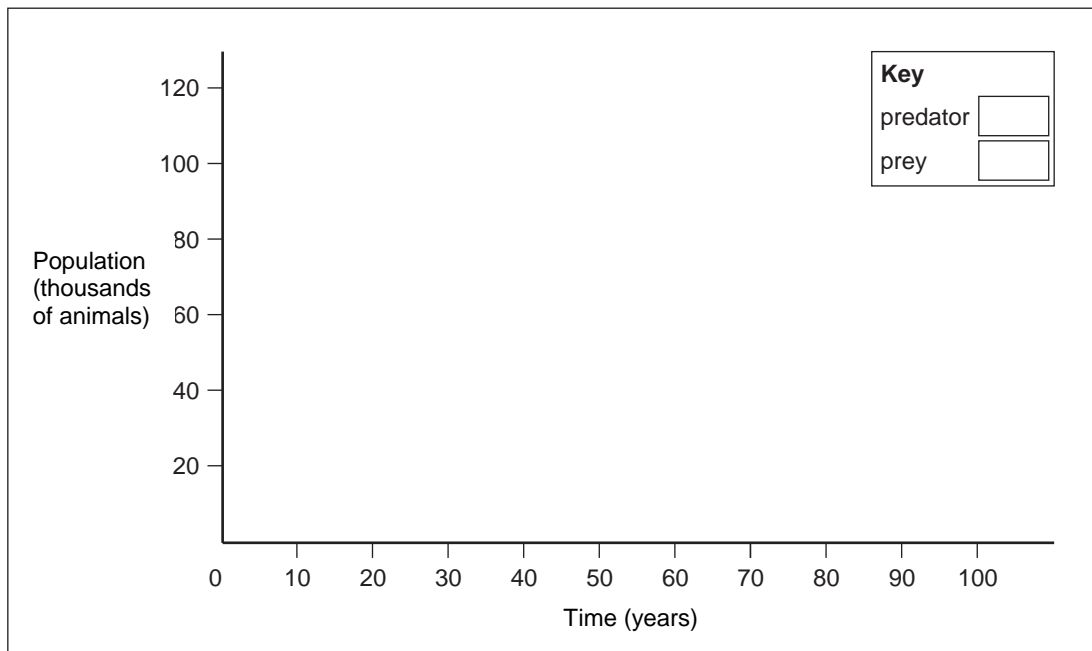
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(SP)

Question 6

In the space below sketch a graph that depicts population fluctuations of both organisms that would be predicted in a typical predator–prey relationship.

Hint: complete the key.



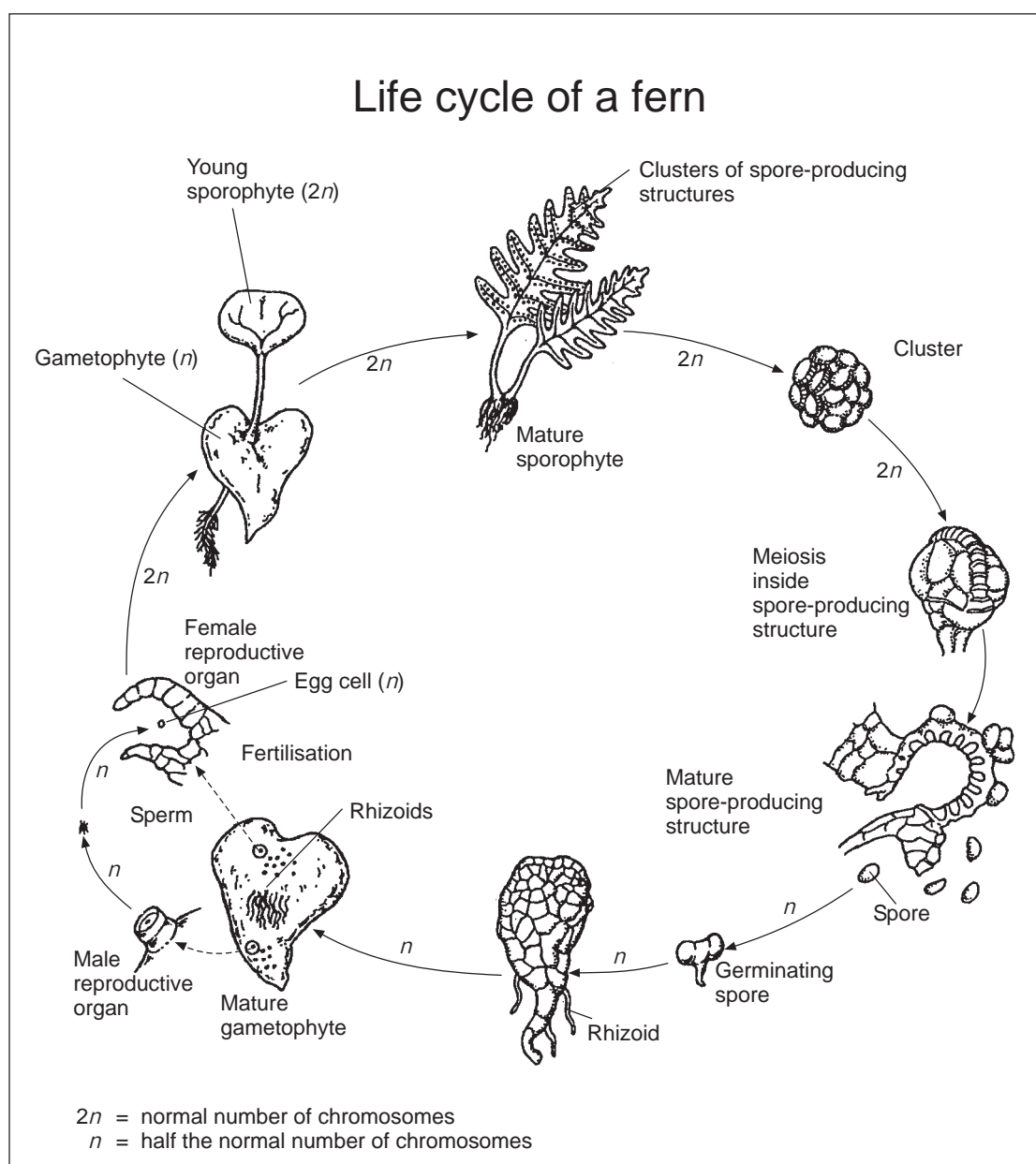
(SP)

Question 7

Different organisms have different life cycles with respect to the points at which meiosis and fertilisation occur. Two different models are described in the table below.

Model A	Meiosis and fertilisation occur at separate times and the organism has a distinct haploid and diploid stage.
Model B	Meiosis is followed almost immediately by fertilisation and most of the life cycle of the organism is diploid.

With reference to the life cycle of a fern represented in the diagram below, which of these two models matches best?



(SP)

Question 8

State one requirement for a respiratory surface to be efficient in the role of gas exchange.

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(K)

Question 9

Using an Australian example, state one possible negative effect that the introduction of a new species may have on the local environment.

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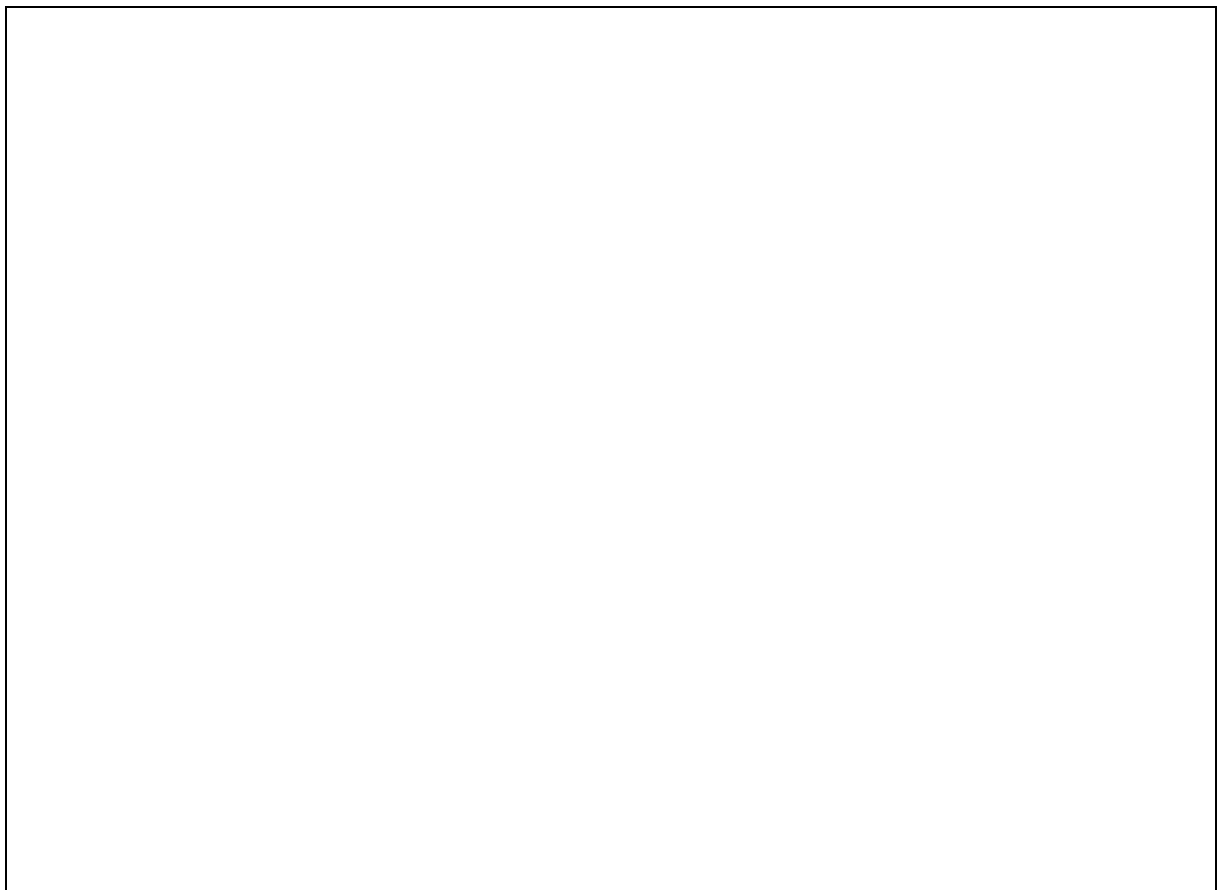
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(K)

Question 10

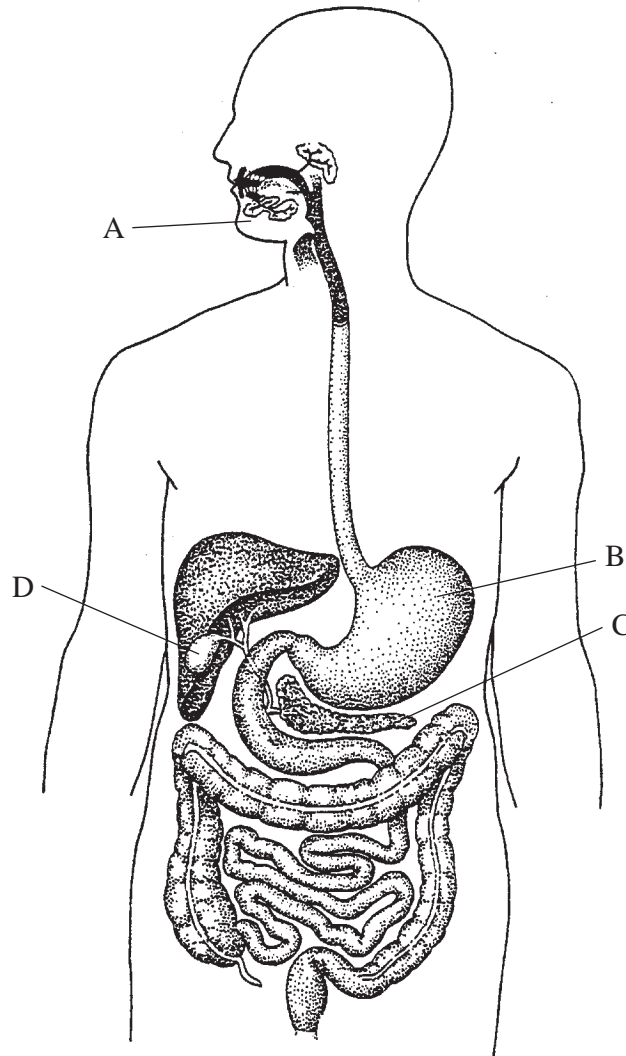
In the space below draw one or more diagrams that explain the difference between the terms *osmosis* and *diffusion*.



(SP)

Question 11

Below is a diagram of the human digestive system. Choose ONE of the organs labelled A, B, C or D and outline its main function including any secretions that it may produce.



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(K)

Planning space

Planning space

Planning space

Standards associated with exit levels of achievement

	Very High Achievement	High Achievement	Sound Achievement	Limited Achievement	Very Limited Achievement
Knowledge of subject matter	A very high ability to recall and apply biological knowledge in simple situations.	A high ability to recall and apply biological knowledge in simple situations.	A satisfactory ability to recall and apply biological knowledge in simple situations.	Little ability to recall and apply biological knowledge in simple situations.	Very little ability to recall and apply biological knowledge in simple situations.
Scientific processes	A very high ability to succeed in simple scientific process tasks related to biological science — collecting and organising data, processing information, making simple judgments, communicating information in various contexts, devising and designing simple single-step investigations.	A high ability to succeed in simple scientific process tasks related to biological science — collecting and organising data, processing information, making simple judgments, communicating information in various contexts, devising and designing simple, single-step investigations.	A satisfactory ability to succeed in simple scientific process tasks related to biological science — collecting and organising data, processing information, making simple judgments, communicating information in various contexts, devising and designing simple, single-step investigations.	Little ability to succeed in simple scientific process tasks related to biological science.	Very little ability to succeed in simple scientific process tasks.

Acknowledgments

The Australian Council for Educational Research Limited for text and a graphic from *Australian Biology Test Item Bank Years 11 and 12 Volume II: Year 12* edited by David W. Brown and Jeffrey J. Sewell, 1984.

The Regents of the University of Colorado, the University of Lancaster, and John Murray (Publishers) Ltd for text and a graphic from *Resource Book of Test Items in Biology* by Elizabeth Perrott, David Hughes-Evans and Ian Campbell, published by John Murray (Publishers) Ltd, London, 1979.

Coghill Publishing, E.E. Clements, and the Victorian Institute of Secondary Education (now Victorian Curriculum and Assessment Authority), Melbourne, for text and a graphic from *HSC Biology: Exam Questions by topics* prepared by E.E. Clements, published by Coghill Publishing, Melbourne, 1985.

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