OCR
RECOGNISING ACHIEVEMENT

ADVANCED GCE **2806/01**

BIOLOGY

Unifying Concepts in Biology

WEDNESDAY 30 JANUARY 2008 Afternoon

Time: 1 hour 15 minutes

Candidates answer on the question paper
Additional materials: Electronic calculator
Ruler (cm/mm)

CUP/T38209

Candidate Forename		Candidate Surname	

Centre Number						Candidate Number				

INSTRUCTIONS TO CANDIDATES

- Write your name in capital letters, your Centre Number and Candidate Number in the boxes above.
- Use blue or black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure that you know what you have to do before starting your answer.
- Answer **all** the questions.
- Do **not** write in the bar codes.
- Do **not** write outside the box bordering each page.
- Write your answer to each question in the space provided.

INFORMATION FOR CANDIDATES

- The number of marks for each question is given in brackets [ ] at the end of each question or part question.
- The total number of marks for this paper is **60**.
- You will be awarded marks for the quality of written communication where this is indicated in the question.
- You may use an electronic calculator.
- You are advised to show all the steps in any calculations.

FOR EXAMINER'S USE		
Qu.	**Max.**	**Mark**
1	**13**	
2	**19**	
3	**15**	
4	**13**	
TOTAL	**60**	

This document consists of **15** printed pages and **1** blank page.

[Turn over

Answer **all** the questions.

1 In Britain, the native red squirrel, *Sciurus vulgaris*, has been largely replaced by the grey squirrel, *Sciurus carolinensis*, which was introduced from North America.

Scientists released a population of radio-tagged red squirrels and grey squirrels into three different locations in Britain.

Fig. 1.1 shows data on the percentage of radio-tagged red squirrels and grey squirrels surviving in these locations:

A separate populations of red squirrels and grey squirrels in separate deciduous woodlands;
B separate populations of red squirrels and grey squirrels in separate coniferous woodlands;
C red squirrel and grey squirrel populations sharing the same coniferous woodland habitat.

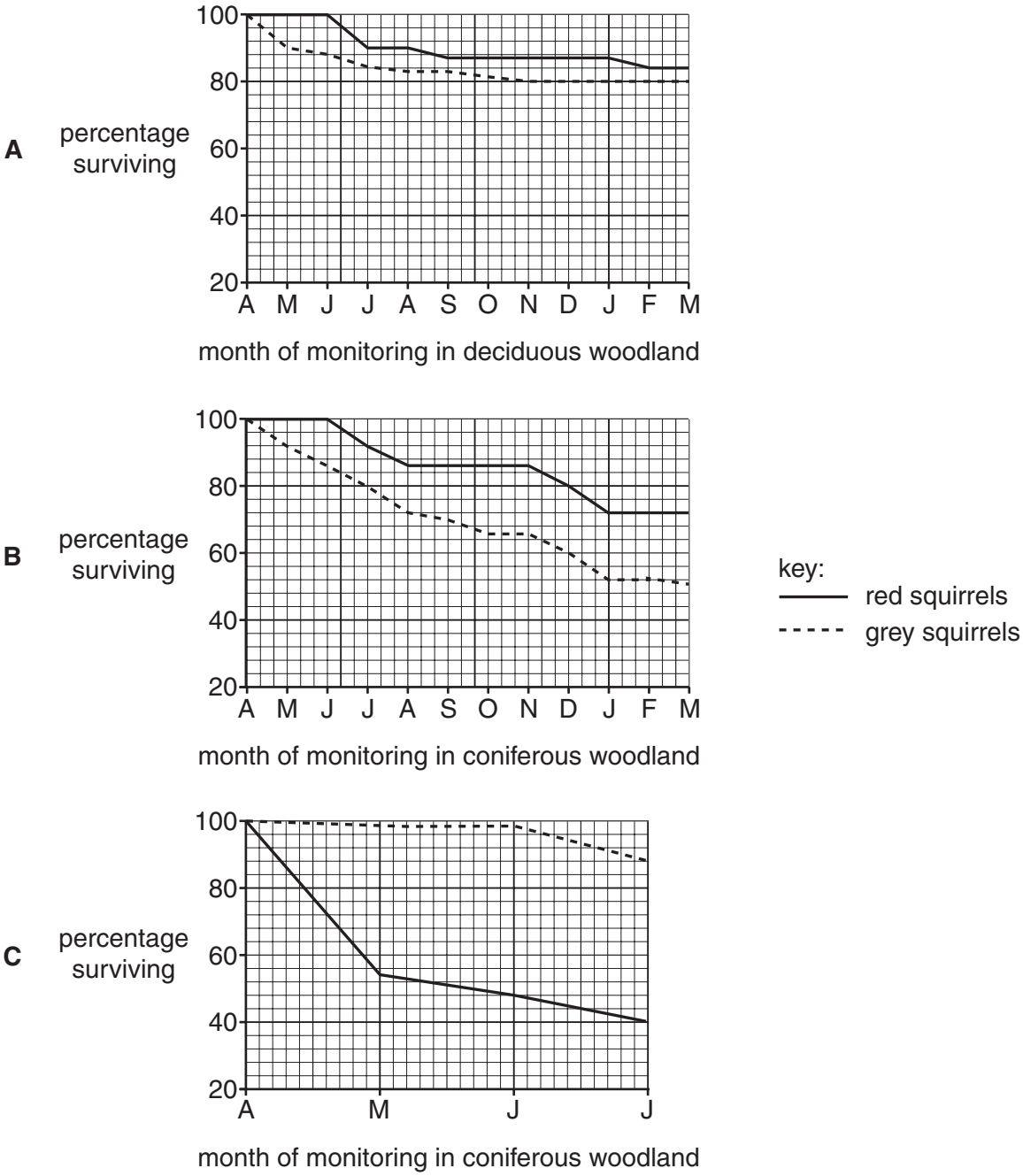

Fig. 1.1

(a) Explain why both types of squirrel have the word *Sciurus* in their Latin name.

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(b) Using Fig. 1.1, explain whether the data supports the hypothesis that there is competition between red squirrels and grey squirrels.

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(c) Coniferous woodlands frequently contain only one tree species, such as pine. Deciduous woodlands contain a mixture of tree species, such as oak, beech, sycamore and hazel. Fig. 1.1 shows that when the red squirrels and grey squirrels are in separate populations, the survival rate of both species is higher in deciduous woodlands than in coniferous woodlands.

Suggest **two** reasons for the improved survival rate in deciduous woodlands.

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(d) Acorns are the favoured food of grey squirrels. Acorns contain a high level of chemicals called tannins. Tannins cause protein molecules to precipitate and therefore affect the digestive process in animals. Young mammals of species that do not usually eat a tannin-rich diet fail to gain weight if fed food containing tannin.

Suggest **and** explain how tannins prevent weight gain in a young mammal.

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(e) In species that regularly eat tannin-containing foods, the saliva contains special proteins called salivary proline-rich proteins (PRPs). Different species produce different forms of PRPs that are specific to the kinds of tannin in their normal plant food.

(i) PRPs are made in salivary gland cells and are processed by the addition of sugar and phosphate groups before they are released.

Suggest where in the cell this processing is likely to take place.

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(ii) Grey squirrels are better at digesting acorns than red squirrels.

Suggest **two** differences in the PRP content of the saliva of the two species.

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[Total: 13]

2 Asthma is a chronic disease where the lungs are sensitive to certain environmental triggers that can cause acute asthma attacks. During an attack, smooth muscle in the lungs contracts, reducing the diameter of the airways.

(a) Name the airways that will constrict during an asthma attack.

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(b) The difficulty in breathing that occurs during an asthma attack can be relieved by **inhaling** a drug called salbutamol.

Suggest why salbutamol is best administered by inhalation rather than in tablet form.

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(c) The salbutamol molecule is the same shape as one of the body's neurotransmitters, noradrenaline. The action of noradrenaline on the lungs is to cause the airways to widen.

Suggest how salbutamol causes the airways to widen.

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(d) A drug that mimics the effects of noradrenaline on the heart is called a β-agonist. A drug that has the opposite effect to noradrenaline is called a β-blocker.

Suggest why a person who is prescribed β-blocker medicines to slow down their heart beat should **not** also take salbutamol.

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(e) The majority of people who have asthma can prevent attacks by taking a second inhaled medicine called beclometasone. This drug acts like the hormone cortisone, which has anti-inflammatory effects. The drug prevents the airways from becoming inflamed and sensitive to the triggers which can cause contraction of smooth muscle. Inflammation involves a molecule called prostaglandin.

Fig. 2.1 shows stages in the biochemical pathway that produces prostaglandin.

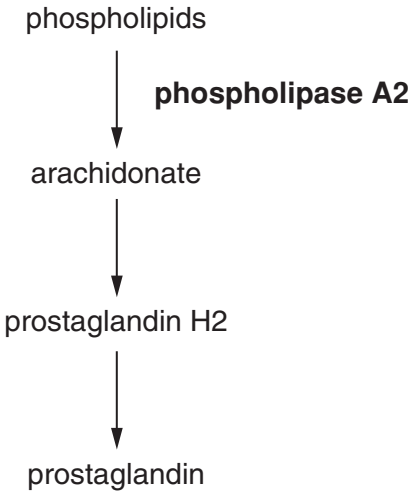

Fig. 2.1

- Beclometasone inhibits phospholipase A2.
- Phospholipase A2 breaks an ester bond in a phospholipid molecule to form arachidonate.

Explain why phospholipase A2 is likely to be a protein molecule.

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(f) In this question, one mark is available for the quality of spelling, punctuation and grammar.

Describe how you would carry out laboratory tests to determine whether beclometasone is a **competitive or non-competitive** inhibitor of phospholipase A2.

Assume you have access to known concentrations of beclometasone, phospholipase A2 and phospholipid, and a way of measuring the production of arachidonate.

You may sketch graphs to show your expected results.

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Quality of Written Communication [1]

[Total: 19]

3 The Venus fly trap, *Dionaea muscipula*, is a carnivorous plant that is found in waterlogged soil in parts of North America. This plant is able to trap and digest insects. The trap consists of a specialised leaf with two lobes which stand up above the central midrib region. The midrib acts as a hinge. The lobes have sensitive hairs that cause a change in electrical potential when touched.

The plant is shown in Fig. 3.1.

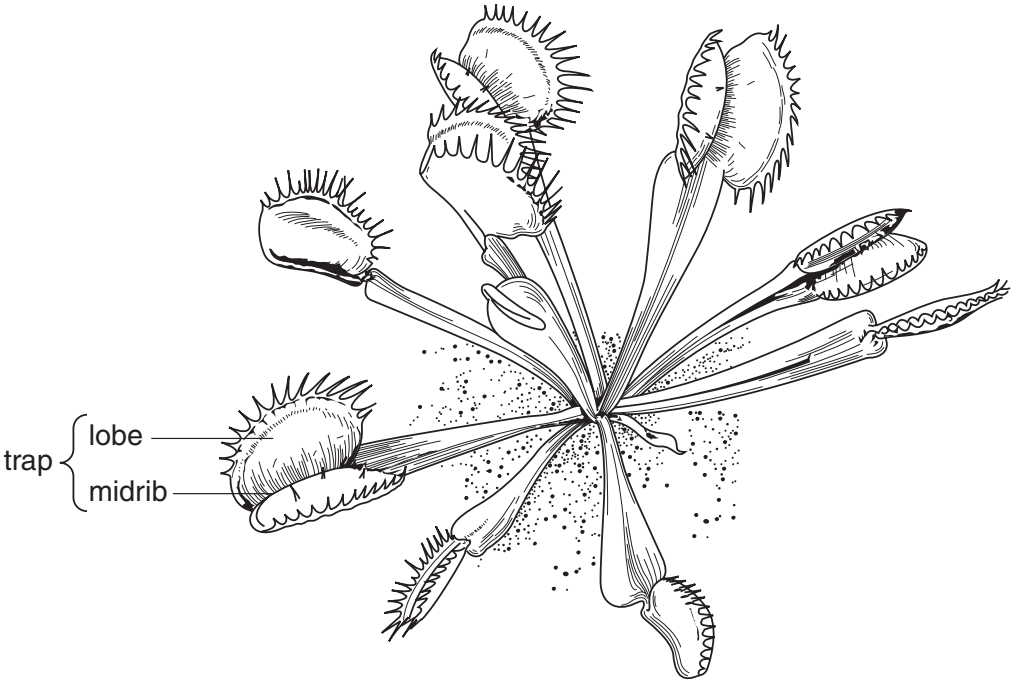

Fig. 3.1

(a) (i) The inner side of the lobes of the trap are coloured red. The rest of the aerial parts of the plant are green.

Explain why most of the plant is green in colour.

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(ii) Insects are readily attracted to land on the lobes of the Venus fly trap.

Suggest **two** ways in which the plant may be adapted to ensure that insects land on the lobes.

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(b) Fig. 3.2 is a flow diagram outlining the events that are thought to take place, to enable the trap to close, when an insect lands and triggers the sensitive hairs. This sequence of events takes place in less than a second. The plant then secretes a protease enzyme which kills and digests the insect.

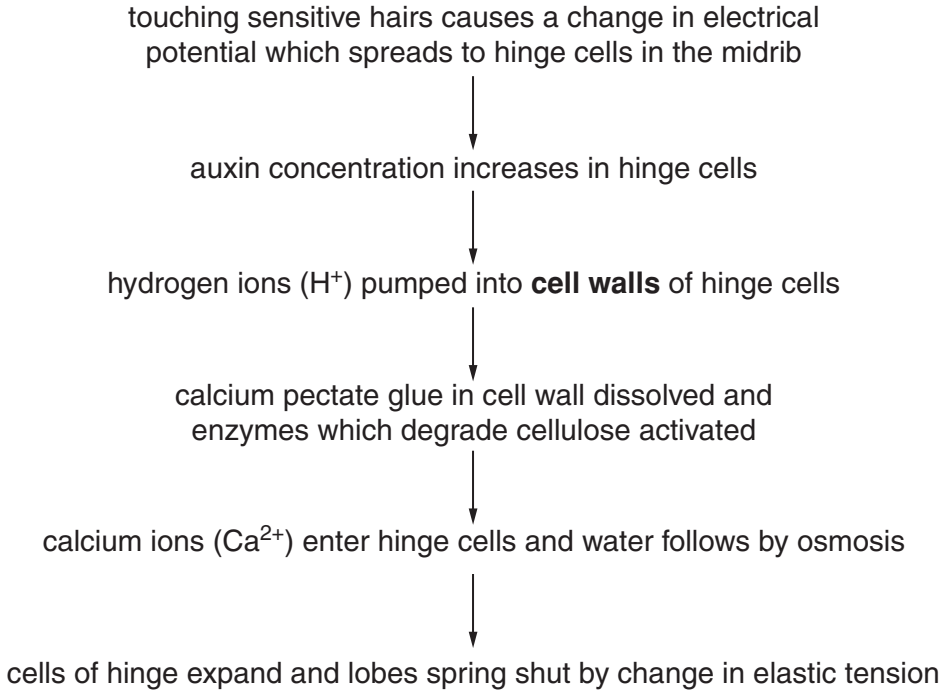

Fig. 3.2

(i) Explain how changes in electrical potential occur across a cell membrane.

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(ii) Calcium ions enter the hinge cells.

Use Fig. 3.2 to state the source of these ions.

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(iii) Explain why water then enters the hinge cells.

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(c) (i) The Venus fly trap and other carnivorous plants all grow in habitats with waterlogged, anaerobic soil. These conditions affect the activities of bacteria important in the nitrogen cycle. Aerobic decomposers are unable to function, while anaerobic denitrifying bacteria thrive.

Use this information to state how the concentration of nitrate ions in waterlogged soil differs from that in a well-drained soil.

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(ii) Suggest how trapping and digesting insects benefits carnivorous plants growing in this type of habitat.

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[Total: 15]

4 **(a)** Fig. 4.1 shows the structure of the brown seaweed, *Fucus vesiculosus*. It grows on rocky seashores and is exposed for part of the day when the tide goes out. A layer of slimy mucilage prevents it drying out. Its brown colour is due to the presence of the photosynthetic pigment fucoxanthin, which it has in addition to chlorophyll. The tips of the fronds contain structures called conceptacles that are important in sexual reproduction.

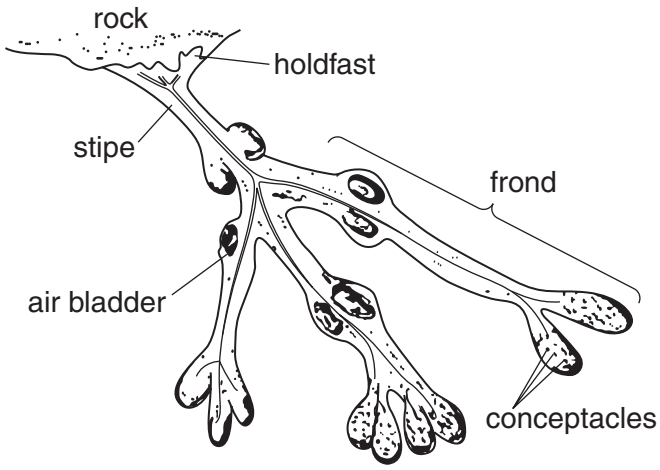

Fig. 4.1

Use Fig. 4.1 and the information given to describe and explain **two** ways in which *F. vesiculosus* is adapted to photosynthesise in shallow water.

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(b) Fig. 4.2 shows vertical sections through the male and female reproductive structures of *F. vesiculosus*.

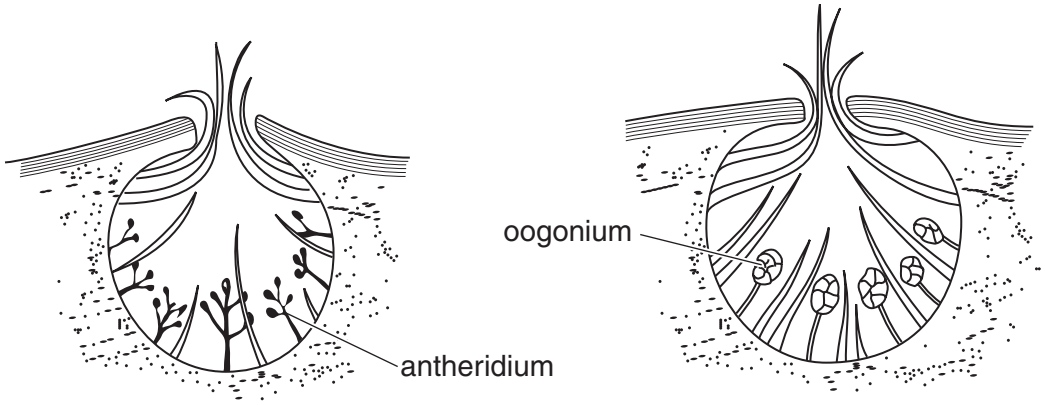

Fig. 4.2

In the oogonium, meiosis in one cell is followed by one mitosis which produces eight haploid egg cells.

In the antheridium, meiosis in one cell is followed by four mitotic divisions which produce a number of sperm cells.

Calculate how many sperm cells are produced from one cell in an antheridium. Show your working.

Answer = …… [2]

(c) *F. vesiculosus* releases its gametes into the open sea. The egg cells sink to the bottom. The sperm cells swim and are attracted to the eggs by a chemical substance. One sperm enters and fertilises the egg to form a zygote.

Fig. 4.3 shows the life cycle of *F. vesiculosus*.

(i) Complete the life cycle of *F. vesiculosus* by writing the words **haploid** or **diploid** in the spaces provided in Fig. 4.3. [3]

(ii) State the type of nuclear division that occurs at **X**.

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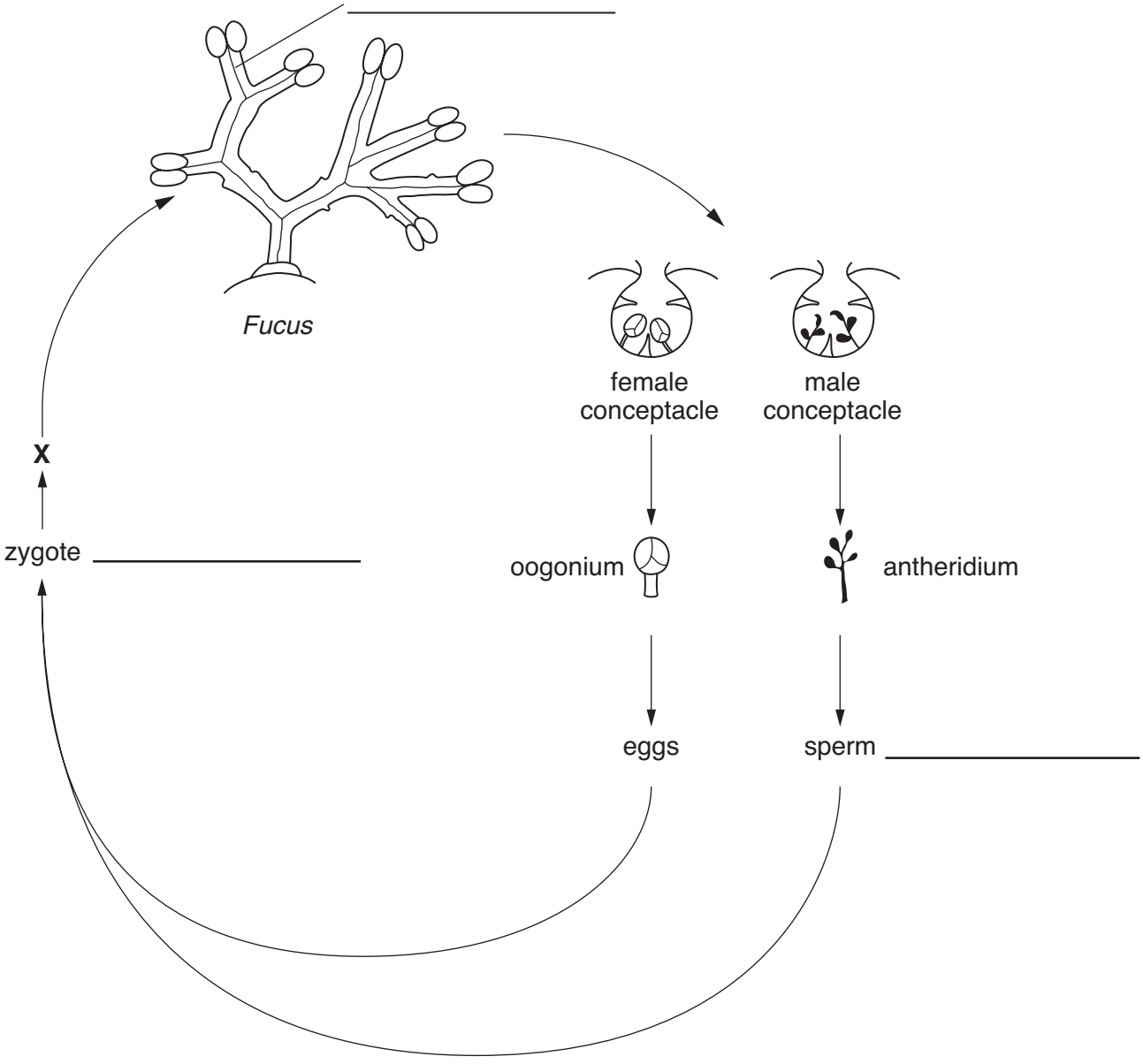

Fig. 4.3

(d) Three species of *Fucus* are common on British shores. Their distribution on a smoothly sloping beach is in zones, with *Fucus spiralis* at the top of the beach, *Fucus vesiculosus* in the middle zone and *Fucus serratus* in the lowest zone.

Describe how you would conduct an ecological investigation to collect data to show this distribution.

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[Total: 13]

END OF QUESTION PAPER

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