OCR
RECOGNISING ACHIEVEMENT

ADVANCED GCE **2804**

BIOLOGY

Central Concepts

FRIDAY 13 JUNE 2008 Afternoon

Time: 1 hour 30 minutes

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

CUP/T42416

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.
- 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 **90**.
- 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	**18**	
2	**18**	
3	**16**	
4	**14**	
5	**12**	
6	**12**	
TOTAL	**90**	

This document consists of **17** printed pages and **3** blank pages.

[Turn over

Answer **all** the questions.

1 **(a)** Fig. 1.1 is a high power electronmicrograph of some mitochondria.

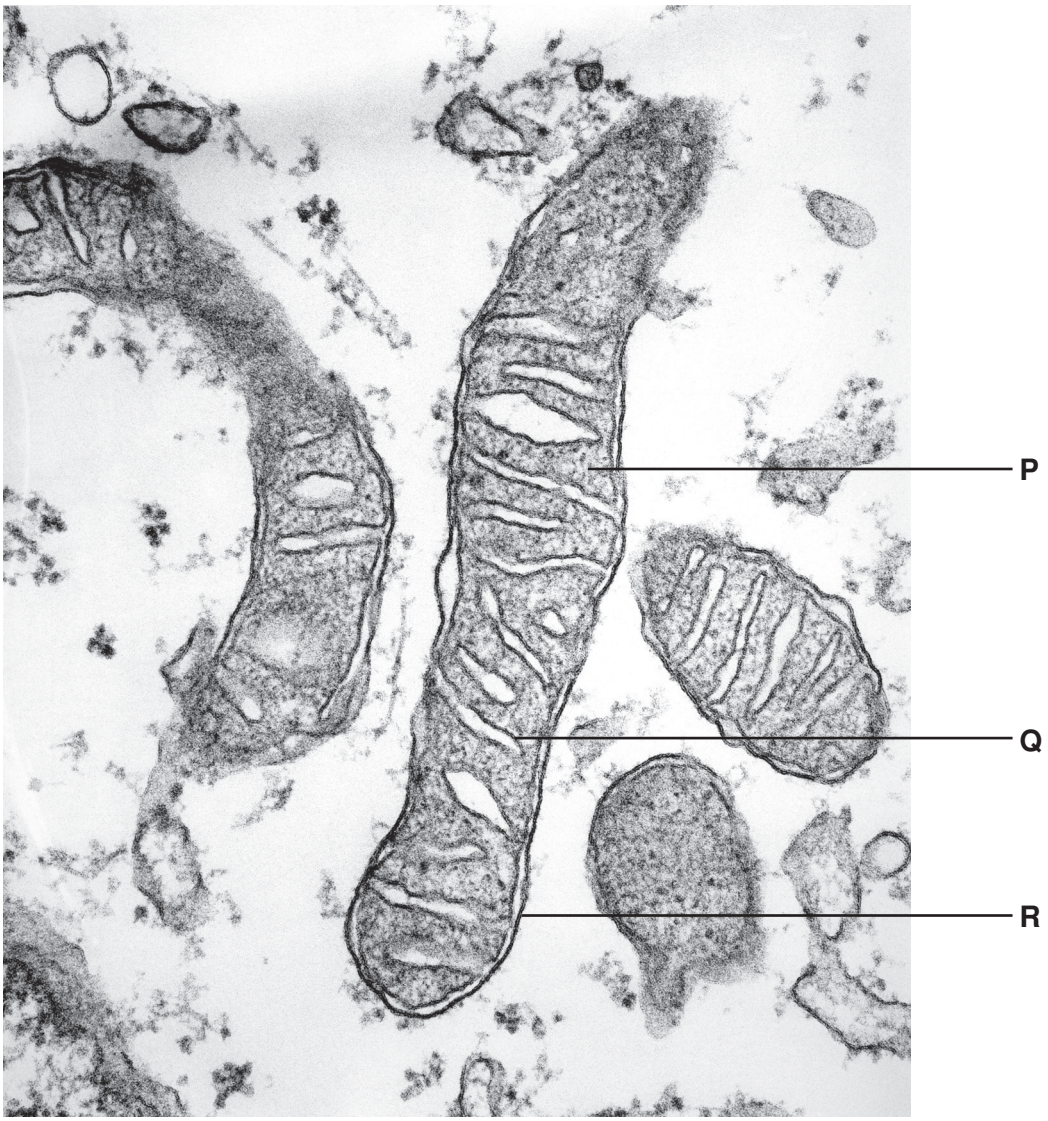

Fig. 1.1

Identify **P**, **Q** and **R**.

P .....

Q .....

R ..... [3]

(b) Mitochondria are variable in shape and size. They may be spiral, spherical, elongated, cup-shaped and even branched. Their length varies from 1.5 to 10.0 µm and their width from 0.25 to 1.00 µm. However, their diameter does not exceed 1.0 µm.

(i) Suggest why the diameter of mitochondria must not exceed 1.0 µm when the length and shape is so variable.

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..... [1]

(ii) Explain why structure **Q** on Fig. 1.1 is so highly folded.

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..... [2]

(c) During respiration, exchange of materials takes place between the cytoplasm and mitochondria.

Complete the table below listing **three** chemical substances that enter mitochondria from the cytoplasm during respiration and **three** that leave mitochondria during respiration.

	Chemical substance that **enters** mitochondria from cytoplasm	Chemical substance that **leaves** mitochondria and enters cytoplasm
1	.....	.....
2	.....	.....
3	.....	.....

[6]

(d) Fatty acids are important energy sources contributing at least half the normal energy requirements of cardiac muscle, the liver and kidneys.

Explain why fatty acids release more energy per gram than carbohydrates.

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..... [2]

(e) Tripalmitin is a triglyceride. The chemical equation for the aerobic respiration of tripalmitin is:

$$2\ C_{51}H_{98}O_6 + 145\ O_2 \longrightarrow 102\ CO_2 + 98\ H_2O$$

(i) Calculate the RQ value for tripalmitin. Show your working.

Answer = ... [2]

(ii) Explain why the usual RQ value for respiration in humans is between 0.7 and 1.0.

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..... [2]

[Total: 18]

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2 **(a)** Fig. 2.1 shows eight stages of **meiosis** in a plant cell.

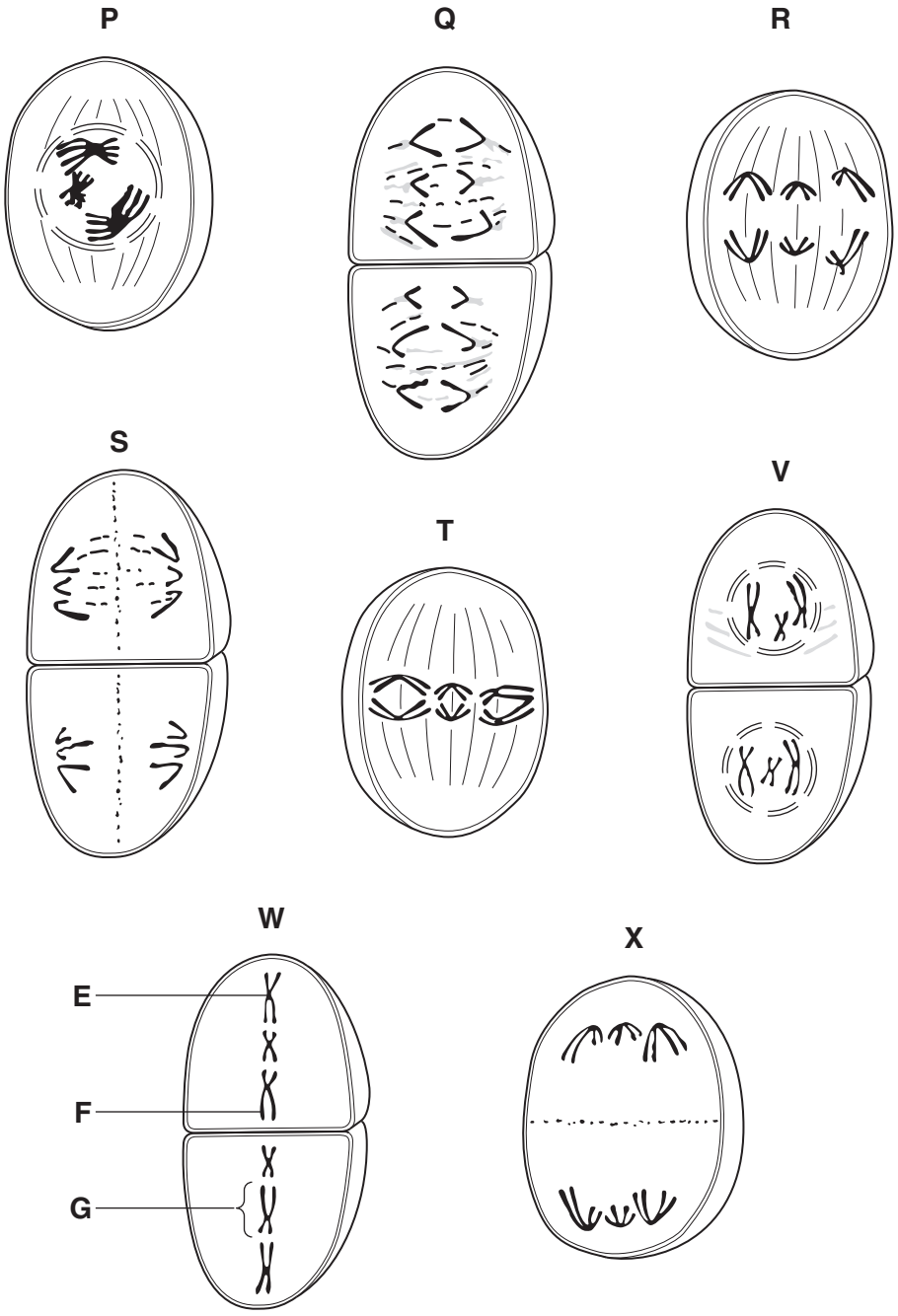

Fig. 2.1

(i) Complete the table below by writing the letter from Fig. 2.1 which matches the name of the stage of meiosis.

The first one has been done for you.

name of stage of meiosis	letter of diagram from Fig. 2.1
prophase 1	**P**
metaphase 1	……
anaphase 1	……
prophase 2	……
metaphase 2	……
telophase 2	……

[5]

(ii) Identify the structures labelled **E**, **F** and **G** in stage **W** of Fig. 2.1.

E .....

F .....

G ..... [3]

(iii) State **one** difference between meiosis in plant and animal cells.

..... [1]

(iv) State the **haploid** number of the plant species from which the cells shown in Fig. 2.1 have been taken.

..... [1]

(b) In this question, one mark is available for the quality of use and organisation of scientific terms.

Explain how meiosis and fertilisation in sexual reproduction lead to variation within a population.

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Quality of Written Communication [1]

[Total: 18]

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3 **(a)** Fig. 3.1 is a summary of the light independent reactions of photosynthesis (Calvin cycle).

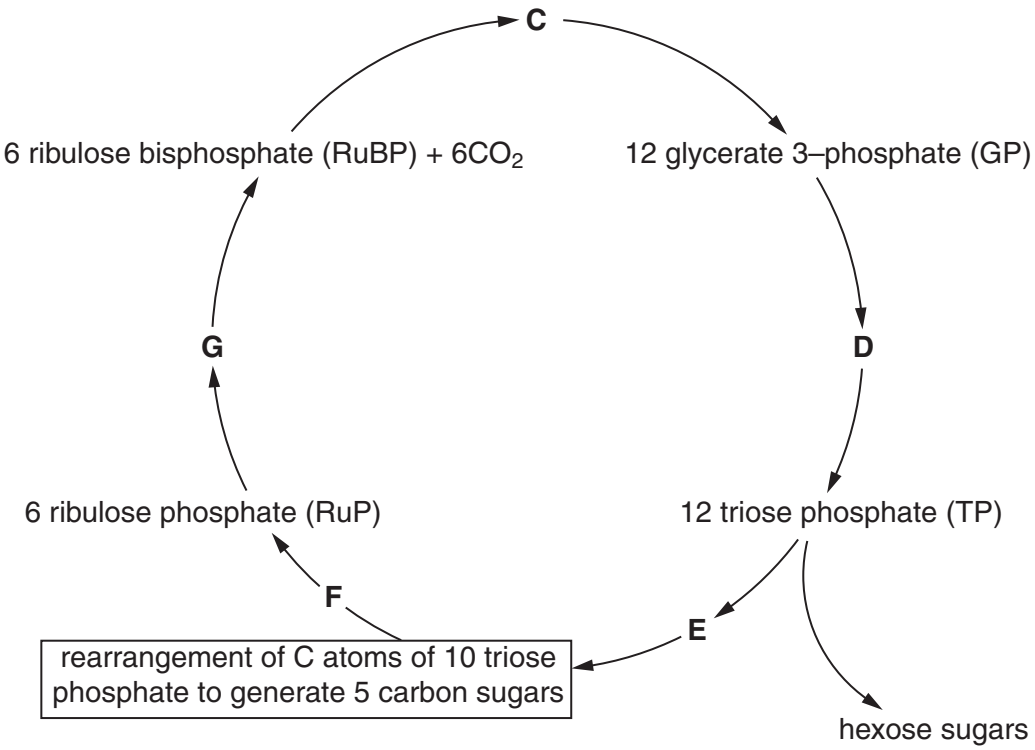

Fig. 3.1

(i) Name the two products of the **light dependent** stage of photosynthesis that are required in the Calvin cycle.

1 .....

2 ..... [2]

(ii) Using Fig. 3.1, state the **letters of the two steps** where chemicals named in section **(a)(i)** are required.

1 .....

2 ..... [2]

(iii) State **two** possible fates of the hexose sugars shown in Fig. 3.1.

1 .....

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2 .....

..... [2]

(iv) State where in the chloroplast the **light independent** stage of photosynthesis takes place.

..... [1]

(v) Describe **and** explain what will happen to the concentrations of ribulose bisphosphate (RuBP) and glycerate 3-phosphate (GP) if carbon dioxide concentrations fall.

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..... [2]

(b) The rate of photosynthesis is limited by environmental factors.

List **three** environmental limiting factors of photosynthesis.

1 .....

2 .....

3 ..... [3]

(c) The rate of carbon dioxide uptake was determined for a maize plant during a warm sunny day. Readings were taken at two-hourly intervals. The results are shown in Table 3.1.

Table 3.1

time of day	carbon dioxide uptake / $cm^3\ m^{-2}\ h^{-1}$
07.00	1.2
09.00	3.8
11.00	2.5
13.00	1.8
15.00	1.2
17.00	2.2

With reference to limiting factors, suggest an explanation for the decrease in carbon dioxide uptake between 9.00 and 15.00.

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..... [4]

[Total: 16]

4 **(a)** The coordinated activity of an organism relies upon a continuous input of information from the internal and external environments. Information is in the form of stimuli which are detected by receptors. One such receptor is called a Pacinian corpuscle which is found in the skin.

Fig. 4.1 shows the electrical activity recorded by two microelectrodes inserted into:

- the axon within the Pacinian corpuscle
- the axon of the sensory neurone leaving the corpuscle.

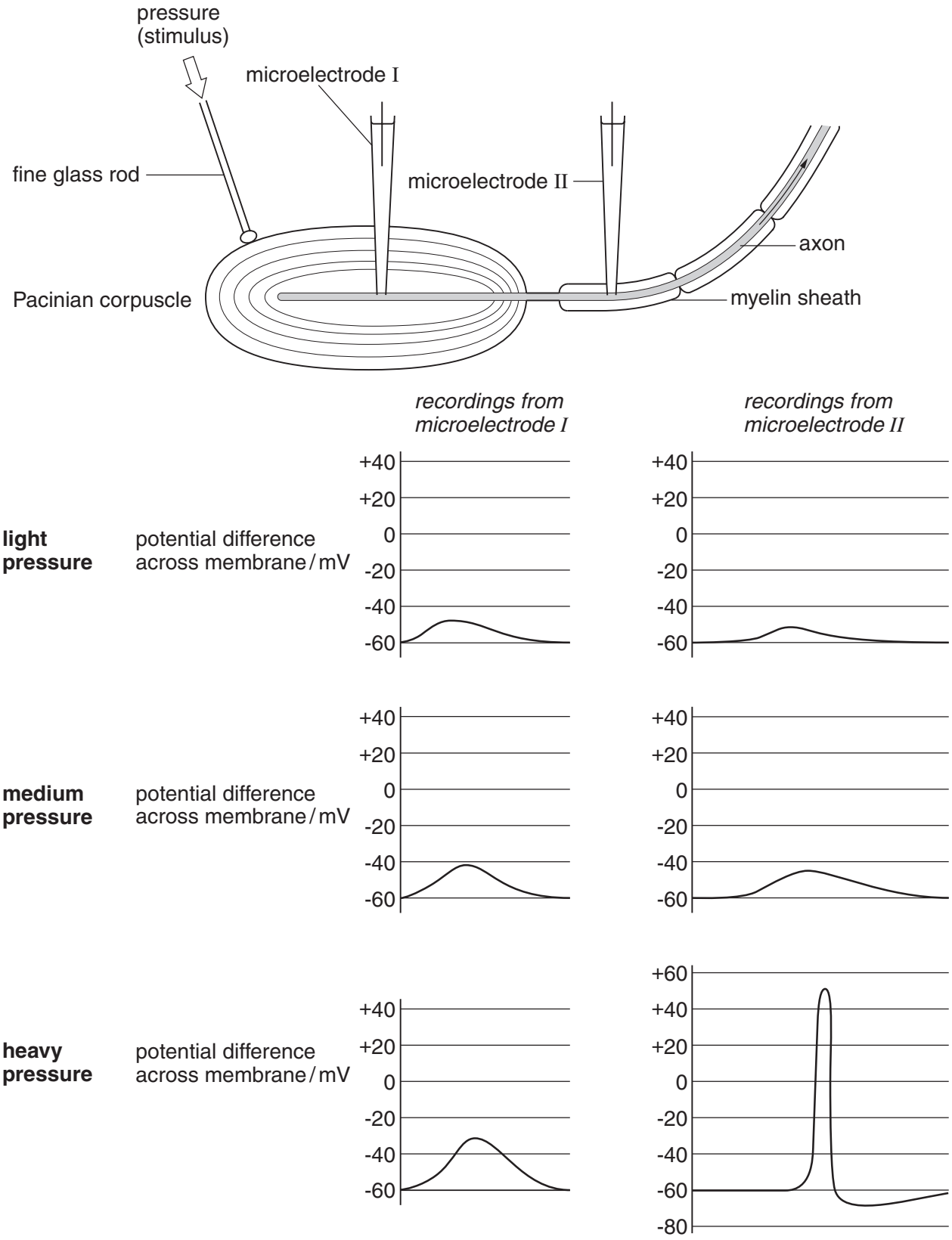

Fig. 4.1

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

Using the information in Fig. 4.1, describe **and** explain the changes in electrical activity both in the receptor and in the sensory neurone as increasing pressure is applied to the Pacinian corpuscle.

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Quality of Written Communication [1]

(b) A new painkiller that is much more effective than morphine became available in the United Kingdom in 2006. It was extracted from the venom of the Magician's Cone Snail, *Conus magus*.

C. magus is a native of coral reefs in the Pacific Ocean. It injects the venom into fish, which are paralysed and swallowed whole. Scientists have discovered that the venom blocks calcium channels at synapses between neurones.

Explain how the blocking of calcium channels can result in both reduction of pain in humans **and** paralysis in fish.

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..... [5]

[Total: 14]

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5 (a) Scientists have been studying finches on an island in the Galapagos for over thirty years.

Before 1982, the only type of ground finch living on the island was the medium ground finch, *Geospiza fortis*.

In 1982, the large ground finch, *Geospiza magnirostris* settled on the island. The large ground finch is almost twice the size of the medium ground finch.

The key food for both species is the large seed from the plant *Tribulus cistoides*. Both species use their beaks to crack open the seeds.

During the period of the study there have been two major droughts in 1977 and 2003. Some of the observations made by the scientists are listed below:

- The drought in 1977 wiped out mainly plant species producing small seeds, leaving *Tribulus cistoides* plants that produced large seeds with hard coats.
- Following the 1977 drought, the population of the medium ground finch was greatly reduced and the average beak size had increased in both length and depth by approximately 4%.
- The 2003 drought greatly reduced seed production by all plants including *Tribulus cistoides.*

Measurements were made of the beak mean lengths and mean break depths of the medium ground finch population in both 2002 and 2005. These are shown in Table 5.1.

Table 5.1

	2002	2005	% decrease
mean beak length / mm	11.2	10.6	.....
mean beak depth / mm	9.4	8.6	.....

(i) Calculate the percentage decreases in the mean length and mean depth of the beaks of the medium ground finch population between 2002 and 2005.

Write your answers in Table 5.1.

Space for working

[3]

(ii) State the two main selection pressures acting on the medium ground finch population following the 2003 drought.

1 .....

2 ..... [2]

(iii) State how selection pressure on the medium ground finch population was different following the 1977 drought.

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..... [1]

(iv) Explain the mechanism that has produced this change in mean beak size in the medium ground finch population between 2002 and 2005.

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..... [5]

(b) An A-level student reading the data in Table 5.1 commented that stabilising selection was taking place in the medium ground finch population.

State whether you agree or disagree with this statement giving a reason for your answer.

decision .....

reason .....

..... [1]

[Total: 12]

6 **(a)** Isle Royale is a small island in the middle of Lake Superior located between the USA and Canada. The most abundant large herbivore on the island is the moose. The most abundant large predator is the wolf. Studies have shown that moose make up over 90% of the wolf diet.

Fig. 6.1 shows the changes in the moose and wolf populations between 1955 and 2005.

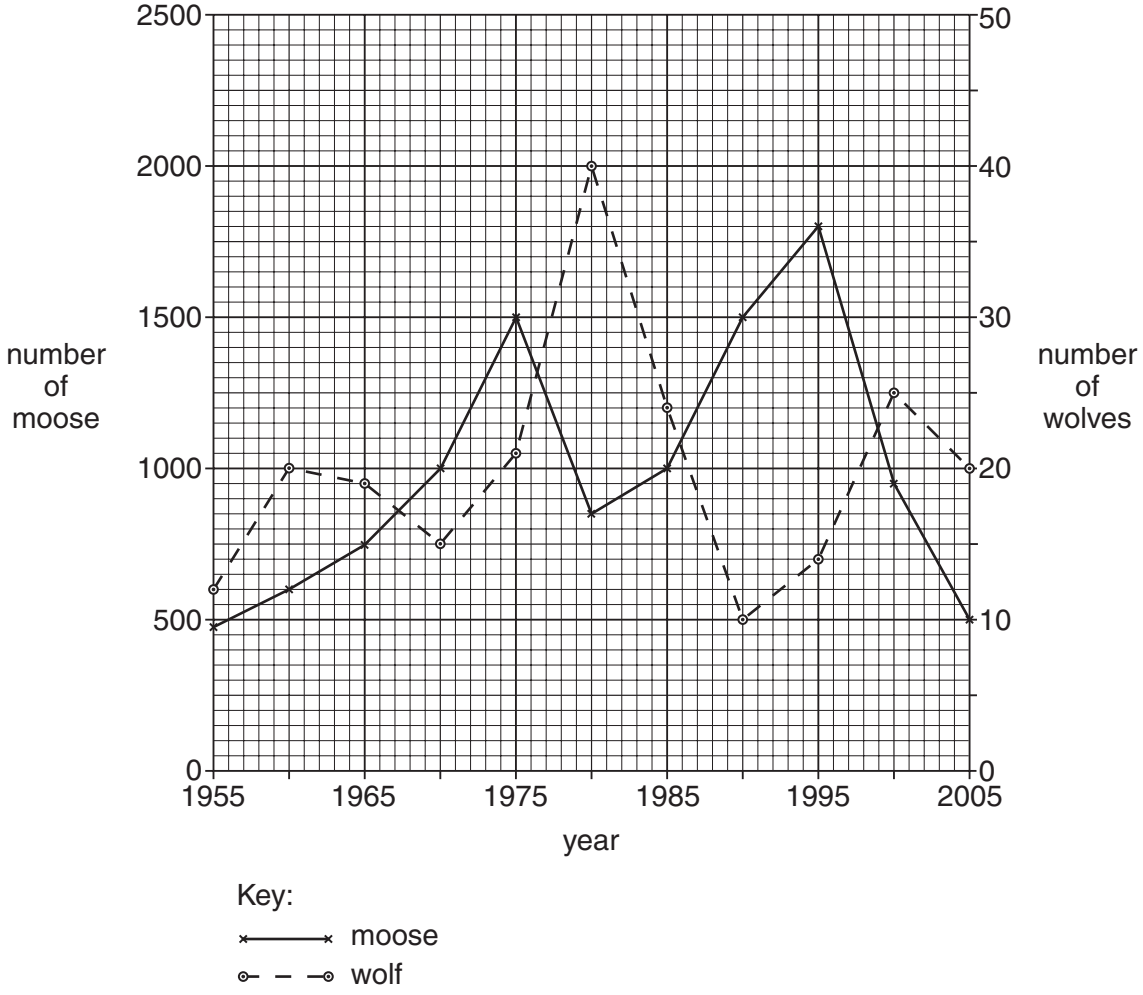

Fig. 6.1

(i) With reference to Fig. 6.1, name the relationship shown between the two species.

..... [1]

(ii) Describe **and** explain the changes in the two populations between 1970 and 1985.

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(b) During the past two decades, biologists have been concerned that the wolf population of Isle Royale might become extinct. Numbers have reached as low as ten in some years. With the population at such low levels, genetic weaknesses can result from inbreeding. Inbreeding is the result of mating between closely related individuals.

Explain why inbreeding can lead to genetic weakness in the population.

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..... [2]

(c) Scientists noted that the wolf population often increases after a mild winter followed by a hot summer. In these conditions, the moose suffer from heavy winter tick (parasite) infestation and the heat of the summer also makes it difficult for them to put on sufficient fat reserves.

(i) Suggest why a hot summer makes it difficult for moose to develop fat reserves.

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(ii) Explain why the wolf population increases following conditions when the moose are unable to lay down fat reserves and suffer heavy tick infestation.

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[Total: 12]

END OF QUESTION PAPER