UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Advanced Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

BIOLOGY **9700/43**

Paper 4 A2 Structured Questions **October/November 2011**

2 hours

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name in the spaces provided at the top of this page.
Write in dark blue or black ink.
Do not use staples, paper clips, highlighters, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Section A
Answer **all** questions.

Section B
Answer **one** question
Circle the number of the Section B question you have answered in the grid below.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

For Examiner's Use	
Section A	
1	
2	
3	
4	
5	
6	
7	
8	
9	
Section B	
10 or 11	
Total	

This document consists of **21** printed pages, **2** lined pages and **1** blank page.

Section A

Answer **all** the questions.

For Examiner's Use

1 The Bengal Tiger, *Panthera tigris tigris*, is an endangered mammalian species of Southern Asia. It lives mostly in a forest habitat.

Fig. 1.1 shows a Bengal Tiger.

Fig. 1.1

(a) Table 1.1 shows the relationship between available forest habitat and Bengal Tiger numbers between 1970 and 2010.

Table 1.1

year	forest habitat remaining compared to 1970 (%)	Bengal Tiger numbers
1970	100	37 000
1980	79	27 000
1990	42	12 000
2000	26	3 600
2010	18	1 400

Calculate the percentage decrease in the number of Bengal Tigers between 1970 and 2010.
Give your answer to the **nearest whole number**.

For Examiner's Use

answer ..... % [2]

(b) Suggest methods to conserve the Bengal Tiger.

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(c) The Bengal Tiger belongs to the kingdom Animalia. State **two** differences between members of the kingdom Animalia and the kingdom Plantae.

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[Total: 8]

[Turn over

For Examiner's Use

2 **(a)** In the small intestine, the enzyme lactase hydrolyses the disaccharide lactose into the monosaccharides glucose and galactose. A deficiency of lactase can lead to a condition known as lactose intolerance. The lactose passes undigested into the large intestine resulting in diarrhoea. Some babies are born with congenital lactase deficiency, which is an inherited condition, and require lactose-free milk from birth.

Suggest how two parents, who can digest lactose, can have a child with congenital lactase deficiency.

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(b) The enzyme lactase can be produced by biotechnology and then used to produce lactose-free dairy products. Lactase is frequently used immobilised in alginate beads.

Fig. 2.1 shows a comparison between the activity of lactase free in solution and lactase immobilised in alginate beads, over a range of temperatures. Equal concentrations of free lactase and immobilised lactase were used.

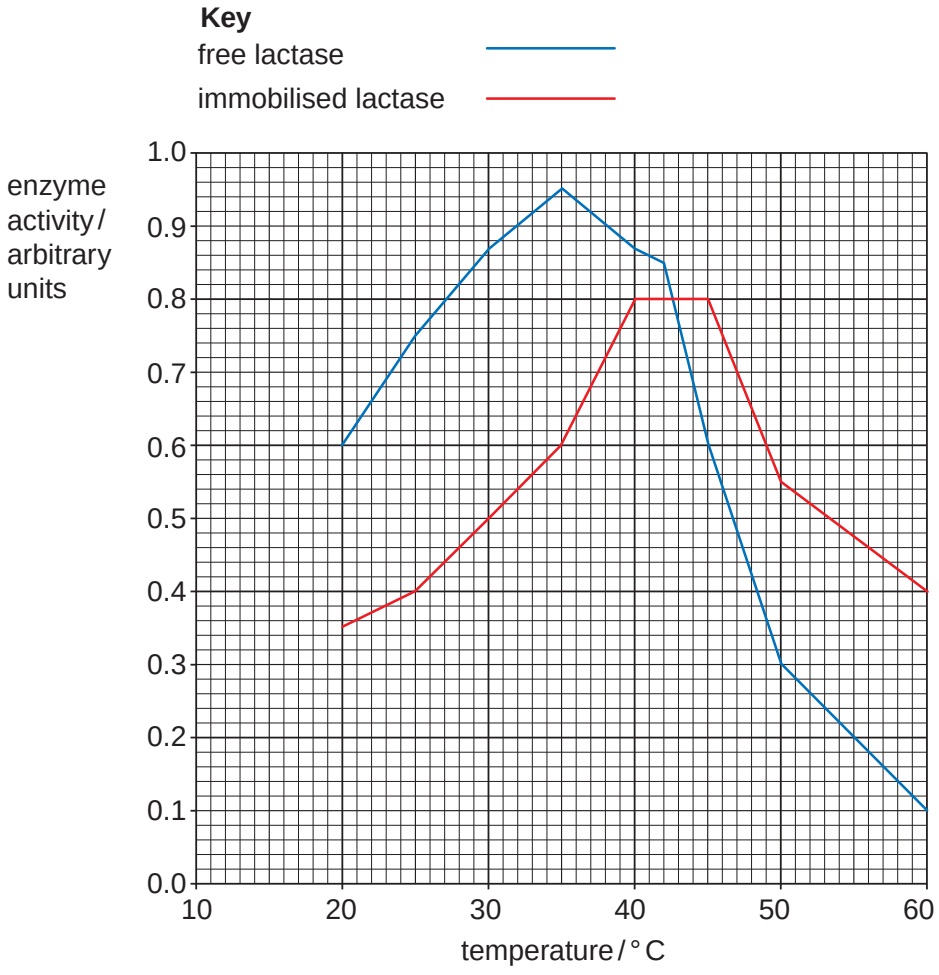

Fig. 2.1

With reference to Fig. 2.1:

For Examiner's Use

(i) describe the effect of immobilisation on the activity of lactase

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(ii) suggest explanations for the differences between the activity of immobilised lactase and free lactase up to 40 °C.

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(c) State the advantages of using immobilised enzymes instead of free enzymes.

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[Total: 10]

3 **(a)** Spermatogenesis, the production of male gametes, occurs in the testes of a human male from the age of puberty.

For Examiner's Use

Fig. 3.1 outlines the sequence of events that occur during oogenesis.

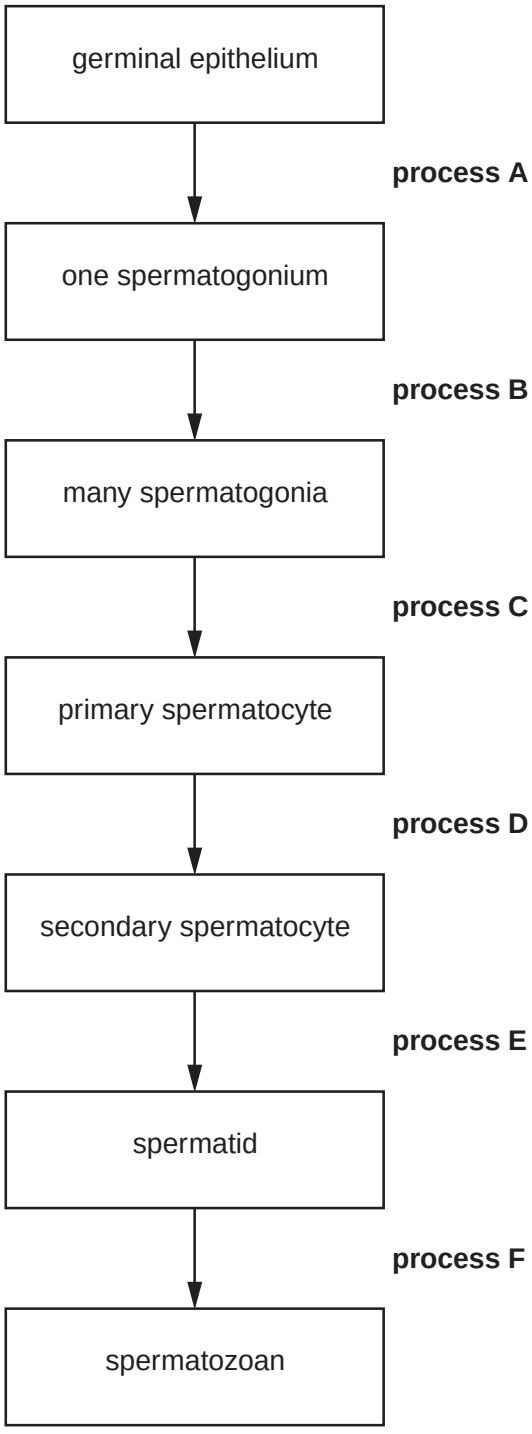

Fig. 3.1

With reference to Fig. 3.1, state what is happening to cells during:

For Examiner's Use

(i) process B

.....[1]

(ii) process D

.....[1]

(iii) process F.

.....[1]

(b) Female gametes develop inside follicles.

Fig. 3.2 shows a section through a mature (Graafian) follicle in a human ovary.

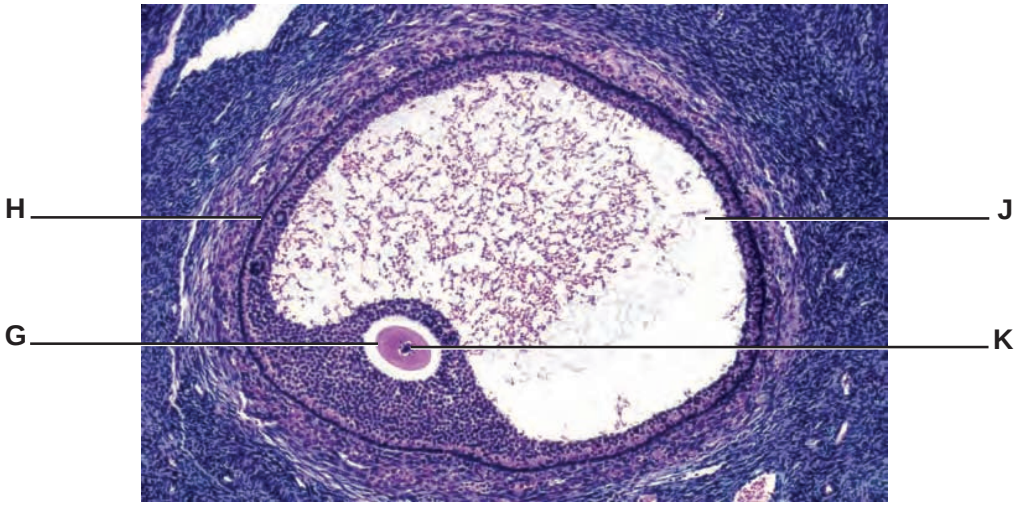

Fig. 3.2

Table 3.1 below lists a number of statements about the mature follicle. Each statement refers to one of the letters **G**, **H**, **J** and **K** shown in Fig. 3.2.

Complete the table using the letters **G**, **H**, **J** and **K**.

Table 3.1

statement	letter
contains protective fluid	
produces oestrogen	
has glycoprotein receptors	
contains 23 chromosomes	

[4]

(c) A man and a woman may be described as infertile if they have failed to conceive a child after 12 months of trying. They may opt for in-vitro fertilisation (IVF) if the woman is producing some normal eggs.

For Examiner's Use

Outline the technique of IVF.

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(d) Not all pregnancies due to IVF treatment result in live births. In the USA in 2008 the figures were:

- 85% of these pregnancies result in live births for women under 35 years old
- 66% of these pregnancies result in live births for women between 38–40 years old.

Suggest reasons for the difference in percentage for the two groups of women.

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[Total: 14]

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Question 4 starts on page 10

[Turn over

4 **(a)** Fig. 4.1 shows the male and female flowers of maize.

For Examiner's Use

Fig. 4.1

(i) With reference to Fig. 4.1 suggest how the flowering habit of maize encourages wind pollination.

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(ii) In a maize plant, the anthers normally ripen and release pollen before the stigmas are mature and ready to receive pollen. This encourages cross-pollination.

Explain **two** potential advantages of cross-pollination to a plant species.

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(b) The conditions in which wheat and maize are grown affect their ability to photosynthesise.

For Examiner's Use

Fig. 4.2 compares the rate of photosynthesis of wheat and maize at different temperatures.

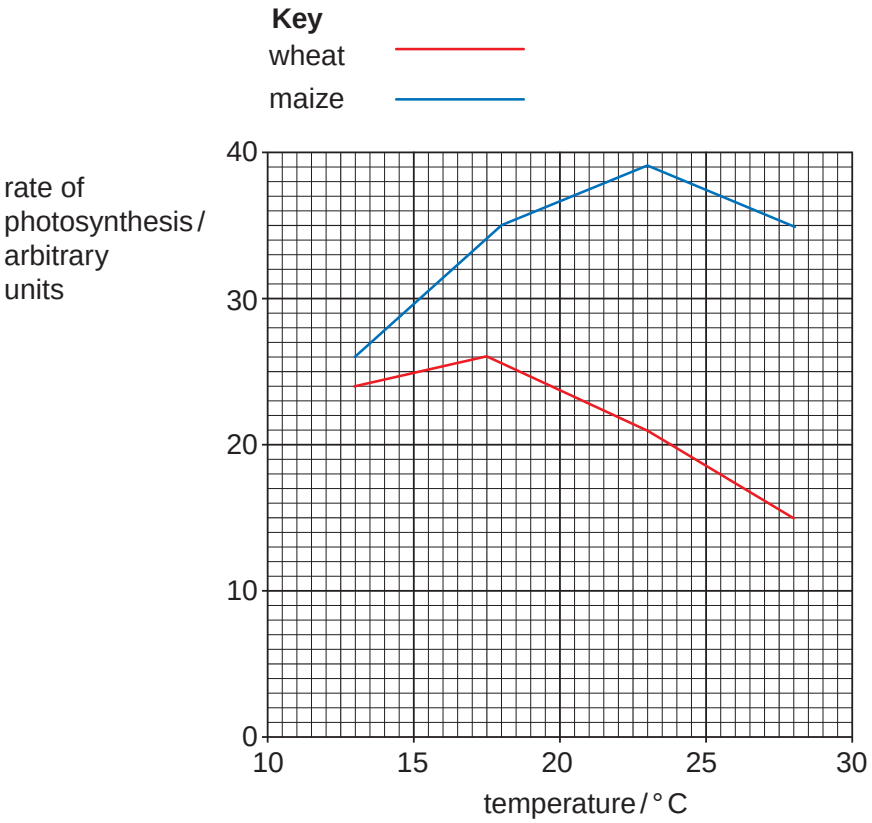

Fig. 4.2

With reference to Fig. 4.2:

(i) **compare** the effect of temperature on the rates of photosynthesis of wheat and maize

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(ii) explain the difference between the rates of photosynthesis of wheat and maize at **28 °C**.

For Examiner's Use

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(c) Cereal grains are a major component of the human diet.

Table 4.1 shows some of the nutrient contents of 100 g samples of grains of wheat, white rice and maize.

Table 4.1

	wheat	**white rice**	**maize**
protein / g	12.3	7.5	8.9
fat / g	2.0	2.8	4.7
carbohydrate / g	75.0	77.0	74.0
fibre / g	2.3	0.9	2.0
calcium / mg	34.0	28.0	7.0
iron / mg	5.4	1.6	2.7
sodium / mg	2.0	6.0	35.0

(i) With reference to Table 4.1 suggest reasons for the difference in protein content between wheat and white rice.

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(ii) State, giving a reason, which type of grain would be beneficial for a person with anaemia.

For Examiner's Use

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[Total: 14]

5 **(a)** The steps involved in a method of production of human insulin by gene technology are listed in Table 5.1.
The steps are **not** listed in the correct order.

For Examiner's Use

Table 5.1

step	description
A	DNA coding for human insulin inserted into cut plasmid vector
B	genetically modified bacteria identified
C	mRNA for human insulin isolated in β cells
D	plasmid vector inserted into bacterium
E	genetically modified bacteria cloned
F	DNA for human insulin cloned
G	human insulin harvested
H	cDNA coding for human insulin synthesised

(i) Complete Table 5.2 to show the steps in the correct order.

Two of the steps have been done for you.

Table 5.2

correct order	letter of step
1	**C**
2	
3	
4	
5	**D**
6	
7	
8	

[4]

(ii) Name the enzymes responsible for the following steps:

step A .....

step H ..... [2]

(b) Explain **two** advantages of treating diabetes with human insulin produced by gene technology rather than using insulin from animals.

For Examiner's Use

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[Total: 8]

[Turn over

6 **(a)** Fig. 6.1 outlines anaerobic respiration in yeast cells.

For Examiner's Use

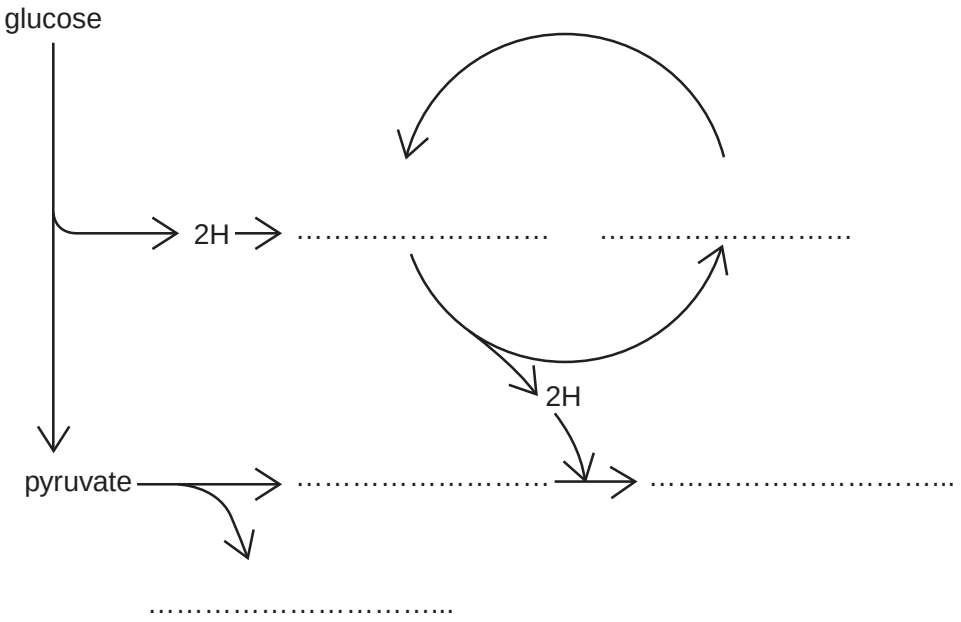

Fig. 6.1

Complete Fig. 6.1 by writing in the missing compounds. [5]

(b) Describe how anaerobic respiration in mammalian cells differs from anaerobic respiration in yeast cells.

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(c) Explain why anaerobic respiration results in a small yield of ATP compared with aerobic respiration.

For Examiner's Use

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[Total: 11]

[Turn over

7 **(a)** Table 7.1 shows the effect of several events on the blood concentration of glucose, insulin and glucagon in a healthy person.

For Examiner's Use

Complete the table using the words **increase**, **decrease** or **no effect**.

The first row has been done for you.

Table 7.1

	initial effect of event on blood concentration of		
event	**glucose**	**insulin**	**glucagon**
meal containing sucrose	increase	increase	decrease
meal containing only protein			
fasting			
exercising			
meal containing starch			

[4]

(b) The concentration of glucose in the blood is controlled by the hormones insulin and glucagon.

Describe the part played by **glucagon** in the control of glucose in the blood.

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..... [3]

[Total: 7]

8 The following passage is a summary of the main principles of artificial selection.

Some of the words have been omitted.

Write the most appropriate term in each space.

For Examiner's Use

When humans purposefully apply selection ..... to members of a population, the process is known as artificial selection. For example, people have tried to 'improve' their cattle for thousands of years. It is desirable for a dairy farmer to have cows with a high milk yield. The farmer will select cows with high milk yields and mate them with bulls whose ..... have high milk yields. Some of the ..... conferring high milk yield are passed onto their female offspring who are then chosen for breeding. This will continue for many ..... . Artificial selection can have disadvantages such as ..... depression which can lead to infertility. [5]

[Total: 5]

For Examiner's Use

9 **(a)** When a part of the body is damaged or injured, action potentials are sent to the areas of the brain responsible for the perception of pain.

Explain how the structure of a sensory neurone can enable the action potentials to reach the brain very quickly.

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(b) The pain associated with osteoarthritis can be relieved using transcutaneous electrical nerve stimulation (TENS). It uses electrical impulses to stimulate the nerve endings at, or near, the site of the pain. Self-adhesive electrodes are stuck on the skin and attached to a small, portable power unit.

Fig. 9.1 shows a TENS machine in use.

Fig. 9.1

It is thought that TENS triggers the release of natural painkillers called endorphins, which are similar in shape to painkilling drugs such as morphine.

Fig. 9.2 shows synapses in a pain pathway from a damaged joint to the brain.

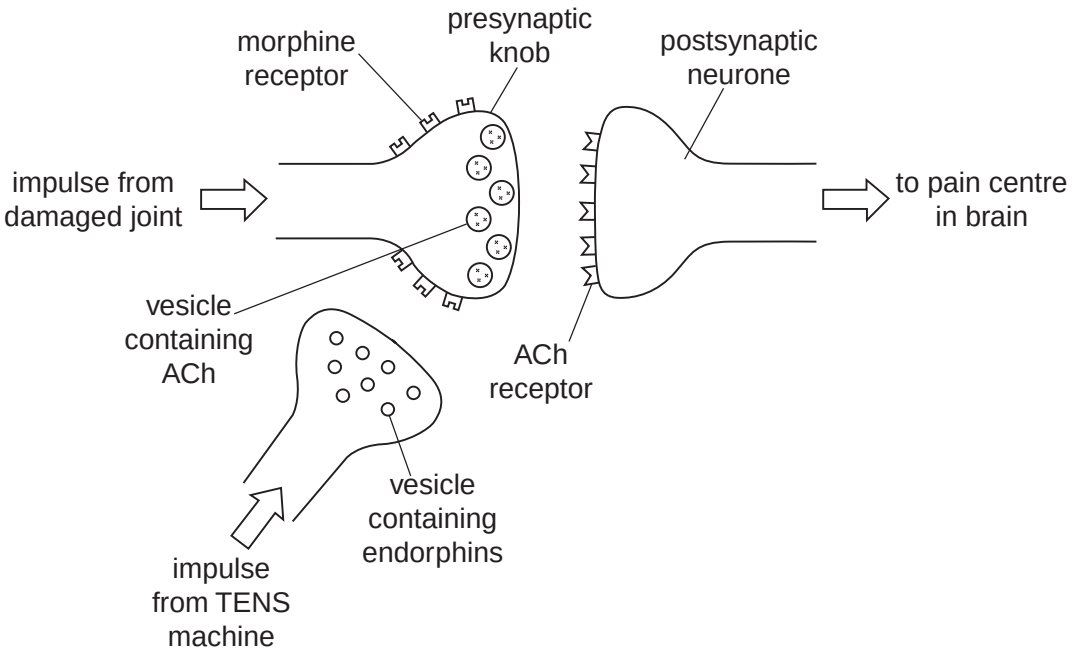

Fig. 9.2

(i) Suggest how endorphins may act to reduce pain.

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(ii) Suggest advantages of using TENS for pain relief instead of more conventional treatment.

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[Total: 8]

Section B

For Examiner's Use

Answer **one** question.

10 **(a)** Explain how the palisade mesophyll cells of a leaf are adapted for photosynthesis. [7]

(b) Describe the structure of photosystems **and** explain how a photosystem functions in ***cyclic*** photophosphorylation. [8]

[Total: 15]

11 **(a)** Explain how changes in the nucleotide sequence of DNA may affect the amino acid sequence in a protein. [8]

(b) Explain how the allele for haemophilia may be passed from a man to his grandchildren. You may use genetic diagrams to support your answer. [7]

[Total: 15]

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For Examiner's Use

For Examiner's Use