UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Advanced Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

4665788750

BIOLOGY **9700/42**

Paper 4 A2 Structured Questions **May/June 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 **20** printed pages, **2** lined pages and **2** blank pages.

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UNIVERSITY of CAMBRIDGE International Examinations

[Turn over

Section A

Answer **all** the questions.

For Examiner's Use

1 The natterjack toad, *Bufo calamita*, is an endangered amphibian species in the UK. It comes out of hibernation in April and breeds in pools by sand dunes along parts of the UK coast. A young natterjack toad will take about 10 weeks to develop from a fertilised egg. A natterjack toad feeds at night, by running at its prey, mainly insects and worms, on the sand dunes.

Fig. 1.1 shows a natterjack toad.



Fig. 1.1

(a) Suggest what may have caused the natterjack toad to become an endangered species in the UK.

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.....[3]

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(b) Fig. 1.2 shows the number of adult natterjack toads counted from 1989 to 1997 in one area of the UK.

For Examiner's Use

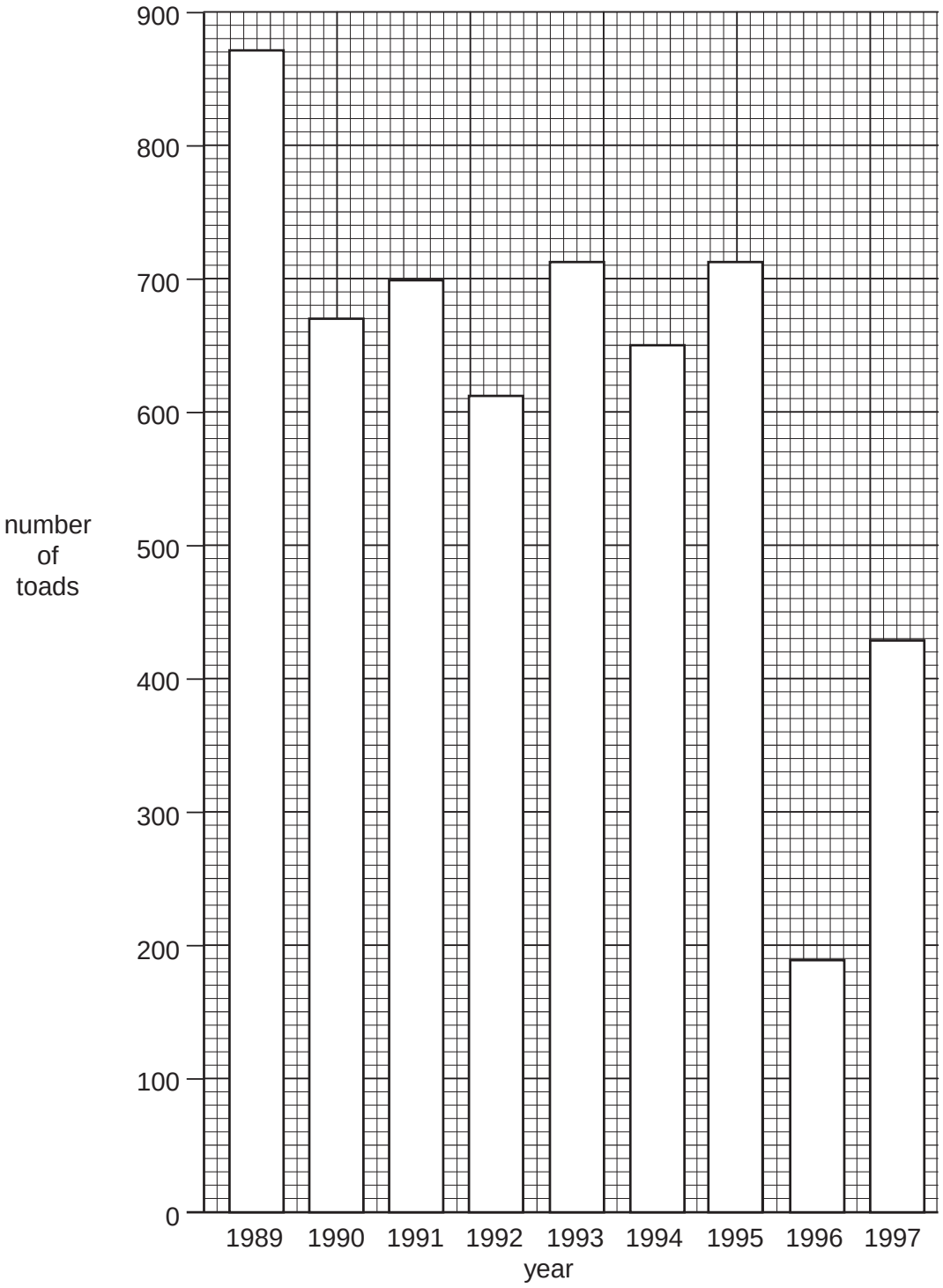


Fig. 1.2

Calculate the mean annual number of adult natterjack toads counted from 1989 to 1997.

Give your answer to the **nearest whole number**.

Show your working.

answer ..... [2]

(c) The natterjack toad is heterotrophic.

For Examiner's Use

(i) Explain what is meant by heterotrophic.

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.....[2]

(ii) Name two kingdoms that are exclusively heterotrophic.

1. .....

2. .....[1]

(d) Each year the International Union for the Conservation of Nature and Natural Resources (IUCN) publishes a list of endangered species called the Red List. The Red List has a very high proportion of vertebrates compared to invertebrates.

Suggest **one** reason **why** the Red List has many more vertebrates than invertebrates.

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.....[1]

[Total: 9]

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Question 2 starts on page 6

2 **(a)** Outline how an enzyme can be immobilised in alginate.

For Examiner's Use

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.....[2]

(b) State two advantages, other than stability, of using an immobilised enzyme in an industrial process compared with the same enzyme that has not been immobilised.

1. .....

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2. .....

.....[2]

(c) Papain is a protease enzyme. Its activity at different temperatures, when immobilised onto an inert support, was compared with its activity in solution.

The results are shown in Fig. 2.1.

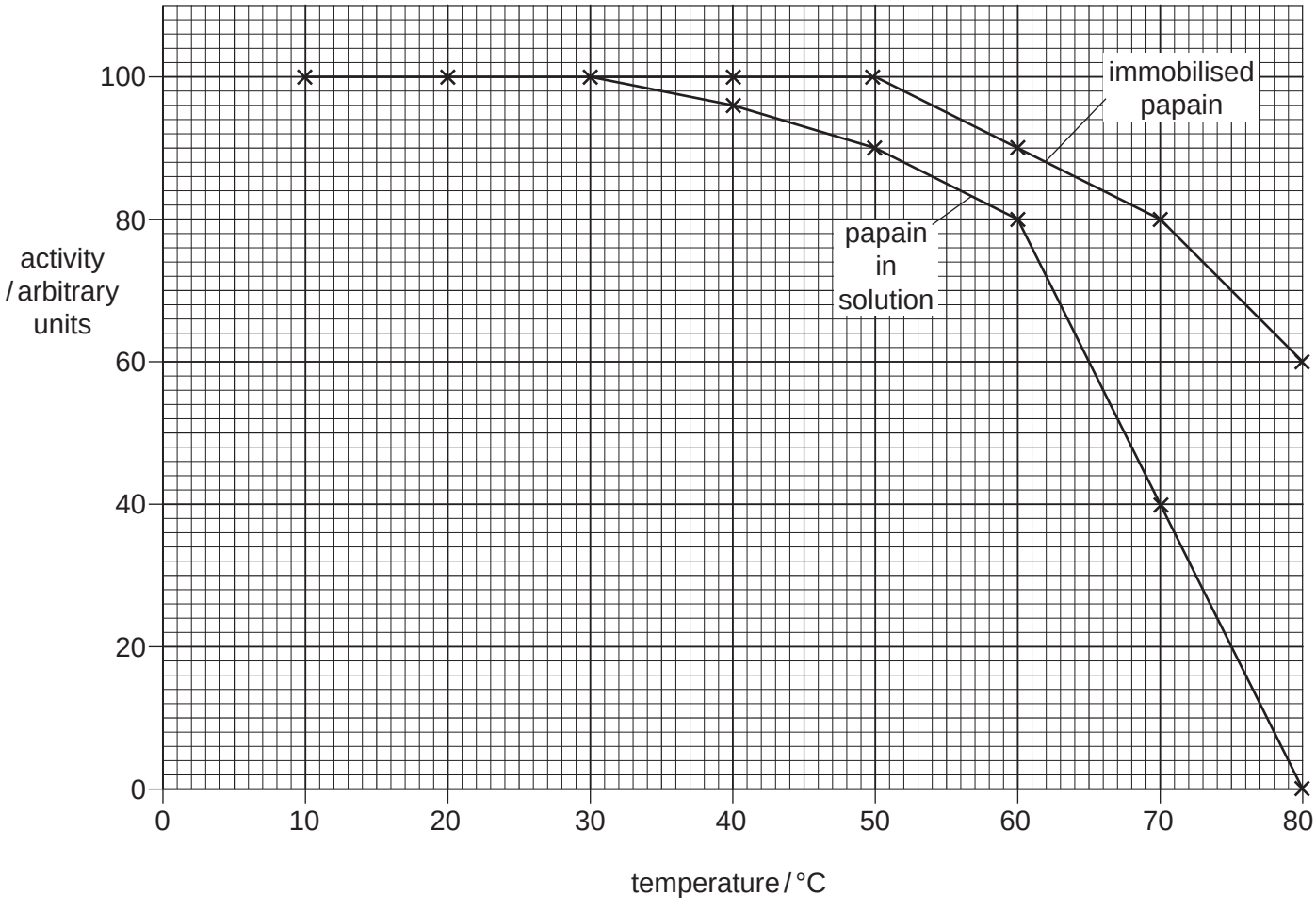


Fig. 2.1

With reference to Fig. 2.1, describe **and** explain the differences in activity of immobilised papain and papain in solution.

For Examiner's Use

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[Total: 8]

For Examiner's Use

3 **(a)** Fig. 3.1 shows a drawing of a section through an ovarian follicle.

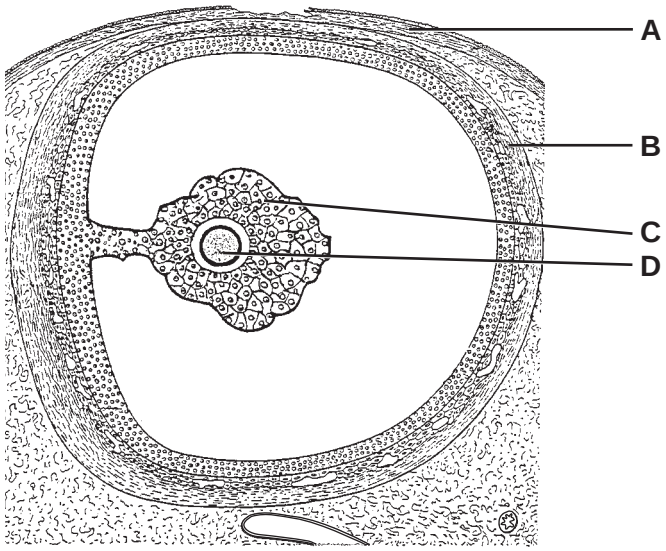


Fig. 3.1

State the names of the parts labelled **A**-**D** in Fig. 3.1.

A .....

B .....

C .....

D ..... [4]

(b) Outline the biological basis of the effect of the oestrogen/progesterone contraceptive pill.

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..... [4]

(c) The zona pellucida of an oocyte is made up of ZP proteins. ZP3, which does not occur anywhere else in the body, has a complex tertiary structure and acts as a receptor for sperm during fertilisation.

For Examiner's Use

A new method of contraception, which does not involve the use of hormones, is in the early stages of development. It involves blocking the expression of the gene coding for ZP3.

(i) Explain how blocking the expression of the gene coding for ZP3 acts as a contraceptive.

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.....[3]

(ii) Explain why it is desirable to devise a method of contraception that does not involve oestrogen and progesterone.

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.....[2]

(iii) Explain why it is important, when blocking the expression of the gene coding for ZP3, that ZP3 is only found in the zona pellucida.

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.....[2]

[Total: 15]

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4 Maize, *Zea mays*, is a major cereal food crop. Unlike most crop plants, maize seed is produced by hybridisation between two different inbred parental strains.

(a) (i) Explain why this is done.

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.....[3]

(ii) Suggest **one** disadvantage of producing seed in this way.

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.....[1]

(b) In the light-independent stage of photosynthesis, the enzyme rubisco catalyses the combination of carbon dioxide with ribulose bisphosphate, RuBP. When the carbon dioxide concentration within the leaf is very low, rubisco tends to combine oxygen, rather than carbon dioxide, with RuBP. This process is called photorespiration. It reduces carbon dioxide assimilation and therefore reduces crop yields.

Photorespiration is most likely to happen in hot, dry conditions.

(i) Suggest **why** photorespiration is most likely to take place in hot, dry conditions.

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.....[3]

(ii) Explain how the leaf anatomy of a maize plant reduces photorespiration, even in hot, dry conditions.

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.....[4]

(c) It is expected that the carbon dioxide concentration in the atmosphere will increase in the future, which would be expected to increase rates of photosynthesis in many crop plants.

Investigations were carried out into the effect of increased carbon dioxide concentration on the rate of photosynthesis in maize.

- Maize plants were grown in open-air trials, in the same field and were exposed to the same changes in the weather.
- 50% of the plants were exposed to a normal carbon dioxide concentration.
- 50% of the plants were exposed to an increased carbon dioxide concentration.
- The rate of photosynthesis was measured as the net assimilation rate of carbon dioxide.
- Measurements were made at three-hourly intervals between 0700 hours and 1900 hours on three different days.

The results are shown in Fig. 4.1.

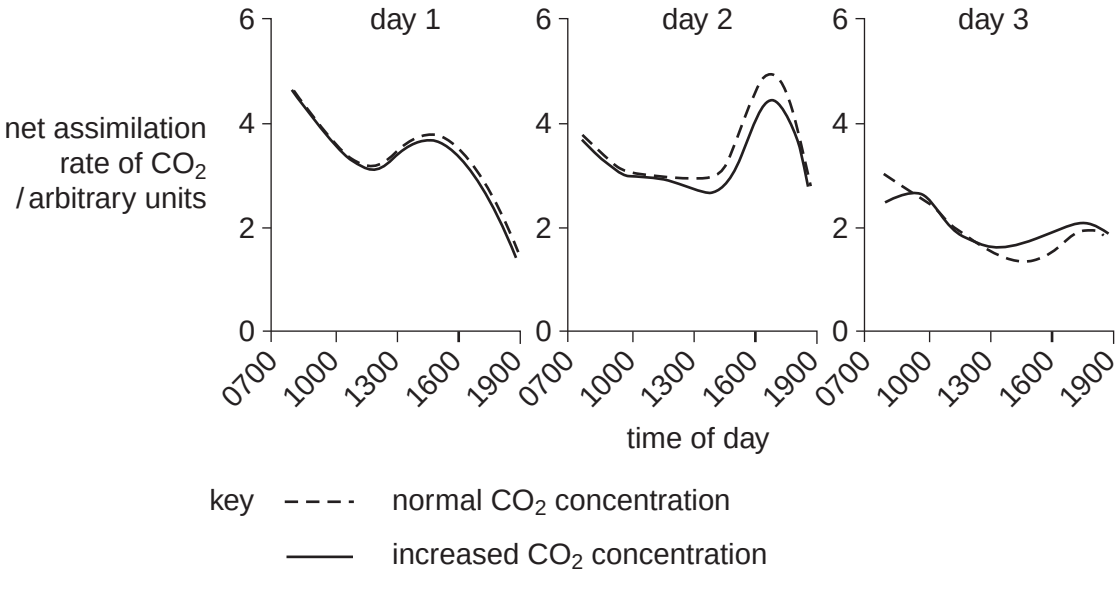


Fig. 4.1

For Examiner's Use

(i) Suggest an explanation for the lack of effect of carbon dioxide concentration on the rate of photosynthesis in maize plants, shown by these results.

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.....[2]

(ii) Suggest **one** explanation for the changes in the rate of photosynthesis between 0700 hours and 1900 hours on day 1.

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.....[2]

[Total: 15]

For Examiner's Use

5 In the USA, about 35% of all maize that is grown has been genetically modified to produce a toxin, called Bt toxin, derived from the bacterium *Bacillus thuringiensis.* The genetically modified plants are known as Bt maize.

(a) Explain the advantages of growing Bt maize.

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..... [2]

(b) An investigation was carried out into the potential effects of dead leaves from Bt maize on organisms living in streams that flow through areas where the maize is grown.

The researchers conducted a laboratory-based experiment in which larvae of one species of aquatic caddis fly, *Lepidostoma liba*, were fed on non-Bt maize leaves, or on leaves from Bt maize. The growth rates of the larvae were measured.

The results are summarised in Fig. 5.1.

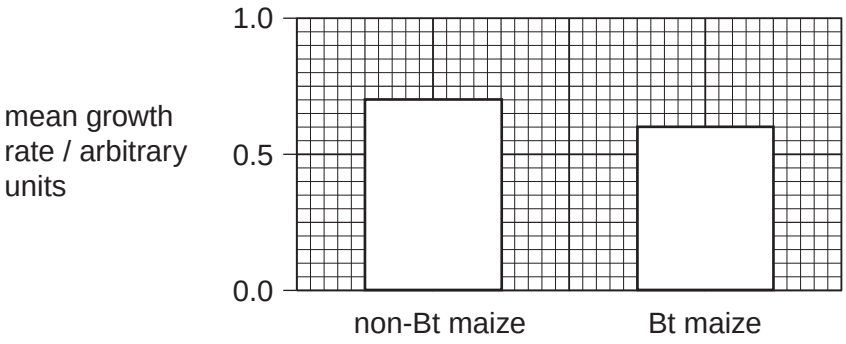


Fig. 5.1

Describe the effect of eating leaves from Bt maize on the growth rate of *L. liba* larvae.

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..... [2]

For Examiner's Use

(c) In a second laboratory-based experiment, three groups of larvae of a different species of caddis fly, *Helicopsyche borealis*, were fed on pollen containing:

A no Bt toxin

B Bt toxin at concentrations found in streams in maize-growing areas

C Bt toxin at concentrations twice as high as found in those streams.

The researchers measured the mortality rates of the caddis fly larvae.

Their results are summarised in Table 5.1.

Table 5.1

groups compared	**difference in mortality rate**
groups **A** and **B**	no significant difference
groups **A** and **C**	significantly greater mortality in **C** than in **A**

The researchers were careful to state that their results showed the '**potential** ecological effects' on the caddis fly larvae of growing Bt maize.

Suggest **two** reasons why 'potential ecological effects' is a suitable description of any conclusions that could be drawn from the results of this experiment.

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.....[2]

(d) When the results of the experiments described in **(b)** and **(c)** were published, many other scientists criticised the research very strongly.

Suggest why some scientists might wish to suppress results such as these, even if there is no fault with the investigation itself.

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.....[1]

[Total: 7]

6 The Krebs cycle occurs in the matrix of the mitochondrion.

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Fig. 6.1 outlines the steps of the Krebs cycle.

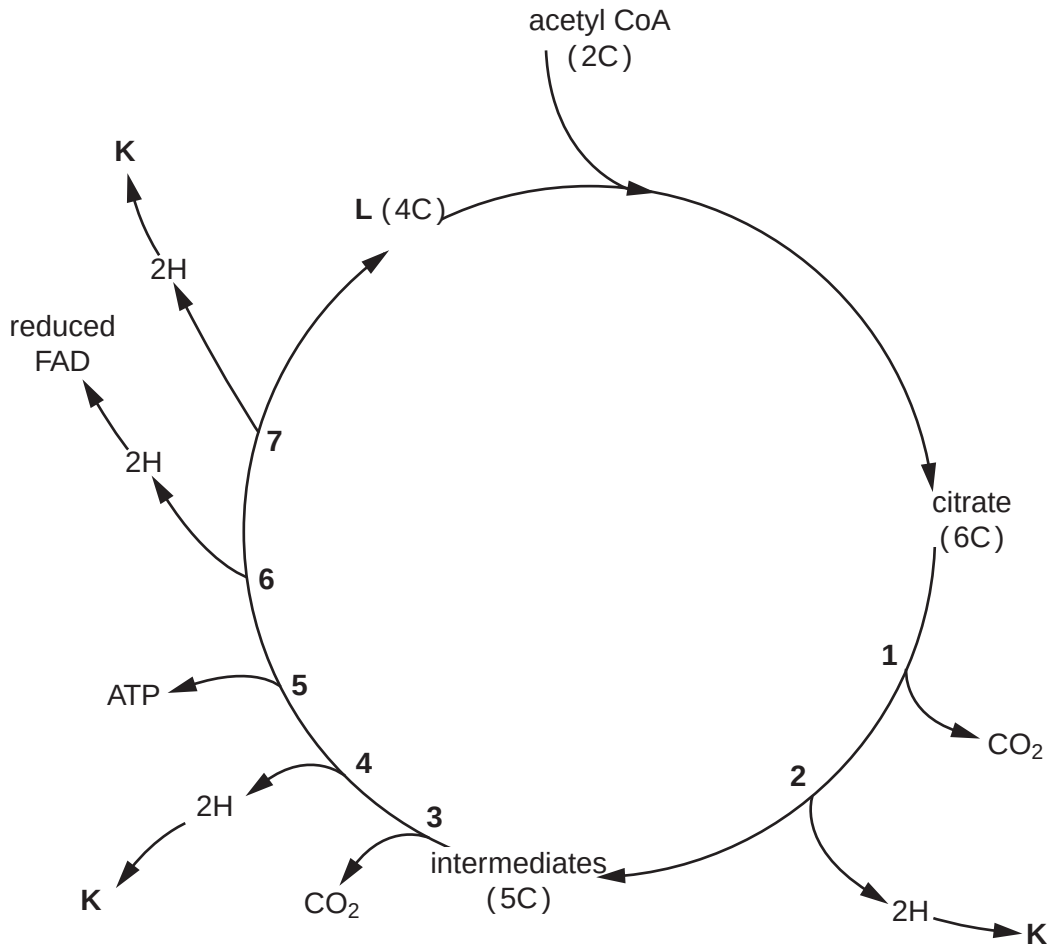


Fig. 6.1

(a) With reference to Fig. 6.1 name the process occurring at:

(i) **1** and **3** ..... [1]

(ii) **2**, **4**, **6** and **7** ..... [1]

(iii) **5** ..... [1]

(b) Name the compounds **K** and **L**.

K .....

L ..... [2]

(c) Most of the hydrogen atoms that are released by the Krebs cycle will take part in oxidative phosphorylation on the cristae of the mitochondria.

For Examiner's Use

Outline the process of oxidative phosphorylation.

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.....[5]

[Total: 10]

7 Meiosis is a type of nuclear division, which produces gametes for sexual reproduction.

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(a) Fig. 7.1 shows diagrams of the stages of meiosis, **A** to **J**, but they are not in the correct order.

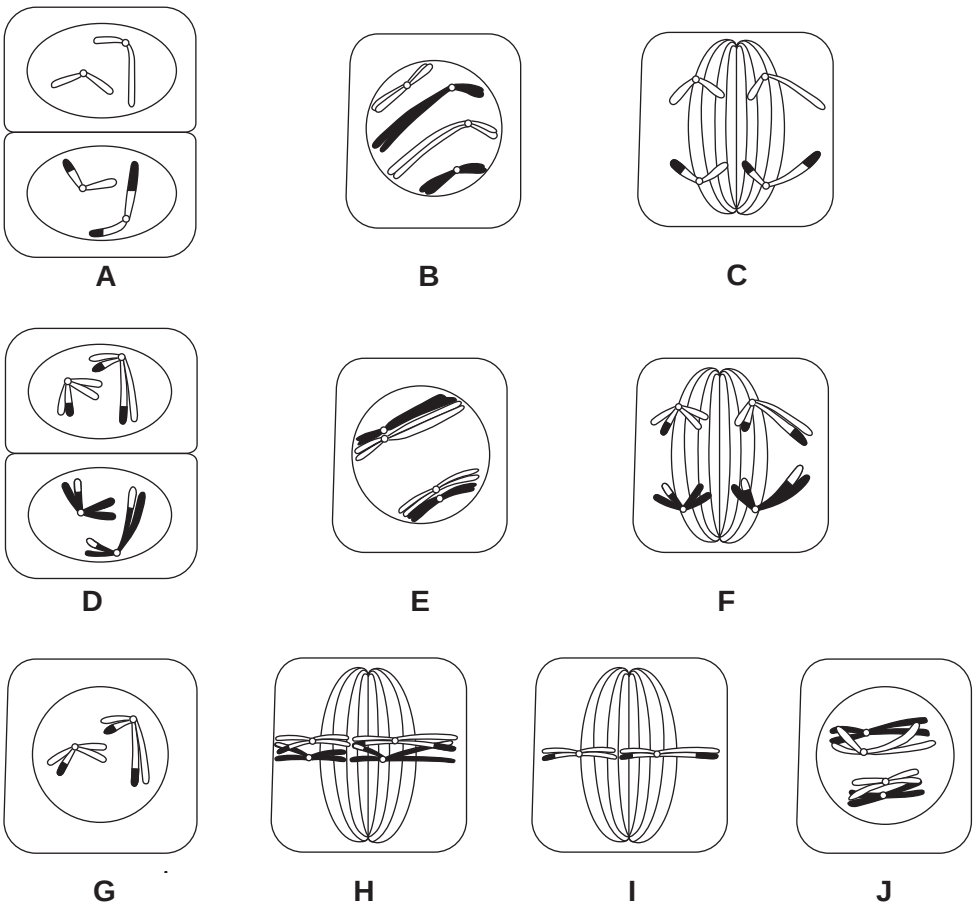


Fig. 7.1

Complete the table below by writing the stages of meiosis in the correct order.

Some of the stages have already been written in the table.

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nuclear division	letter of stage
meiosis I	**B**
	D
meiosis II	

[4]

(b) Explain how meiosis can result in genetic variation amongst offspring.

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.....[5]

[Total: 9]

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

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Some of the words have been omitted.

Write the most appropriate term in each space.

Individuals in a population have great ..... potential and yet the numbers in a population remain roughly ..... . This is because many die due to environmental factors and therefore do not reproduce. There is ..... amongst members of a population and those with the features best adapted to the environment survive. They reproduce and pass on their ..... to their offspring. This may lead to a change in the ..... pool of the population and over time may lead to evolutionary change.

[5]

[Total: 5]

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9 Huntington's Disease (HD) is a severe neurological disorder in which symptoms usually appear after the person has reached sexual maturity. Symptoms include memory loss and changes in personality and mood.

HD is caused by a gene mutation on chromosome 4 in which the triplet code CAG is repeated many times. The resulting allele is dominant.

(a) Explain what is meant by the terms gene mutation and triplet code.

gene mutation .....

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.....

triplet code .....

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..... [4]

(b) A couple wish to start a family. The man does not have HD but the woman does have the disease. The woman's father does not have the disease.

Complete the genetic diagram below to show the probability of the couple's first child having HD.

key
Huntington allele = T
normal allele = t

parental phenotypes	man without HD	woman with HD
parental genotypes	.....	.....
gametes	.....	.....
offspring genotypes	.....	
offspring phenotypes	.....	

probability of first child having HD ..... [3]

[Total: 7]

Section B

Answer **one** question.

For Examiner's Use

10 **(a)** Describe the photoactivation of chlorophyll **and** its role in **cyclic** photophosphorylation. [8]

(b) Explain briefly how reduced NADP is formed in the light-dependent stage and how it is used in the light-independent stage. [7]

[Total: 15]

11 **(a)** Describe the role of abscisic acid (ABA) in the closure of a stoma. [8]

(b) Describe the role of gibberellins in the germination of barley seeds. [7]

[Total: 15]

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