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Centre Number	Candidate Number	Name

CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Advanced Level

BIOLOGY **9700/06**

Paper 6 Options

October/November 2003

1 hour

Additional Materials: Answer Paper.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use a soft pencil for any diagrams, graphs or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Answer the questions set on **one** of the options.

Within your chosen option, Questions 1 and 2 are to be answered in the spaces provided on the question paper. Question 3 is to be answered on the separate answer paper provided.

The answer to Question 3 should be illustrated by large, clearly labelled diagrams, where appropriate.

At the end of the examination,

1. fasten all your work securely together;
2. enter the number of the option you have answered in the grid below.

The number of marks is given in brackets [ ] at the end of each question or part question.

The options are:

1 – Biodiversity (page 2)
2 – Biotechnology (page 10)
3 – Growth, Development and Reproduction (page 14)
4 – Applications of Genetics (page 20)

You are reminded of the need for good English and clear presentation in your answers.

OPTIONS ANSWERED	
FOR EXAMINER'S USE	
1	
2	
3(a)	
3(b)	
TOTAL	

If you have been given a label, look at the details. If any details are incorrect or missing, please fill in your correct details in the space given at the top of this page.

Stick your personal label here, if provided.

This document consists of **21** printed pages and **3** blank pages.

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For Examiner's Use

OPTION 1 – BIODIVERSITY

1 **(a)** Fig. 1.1 is a diagram of a leafy liverwort.

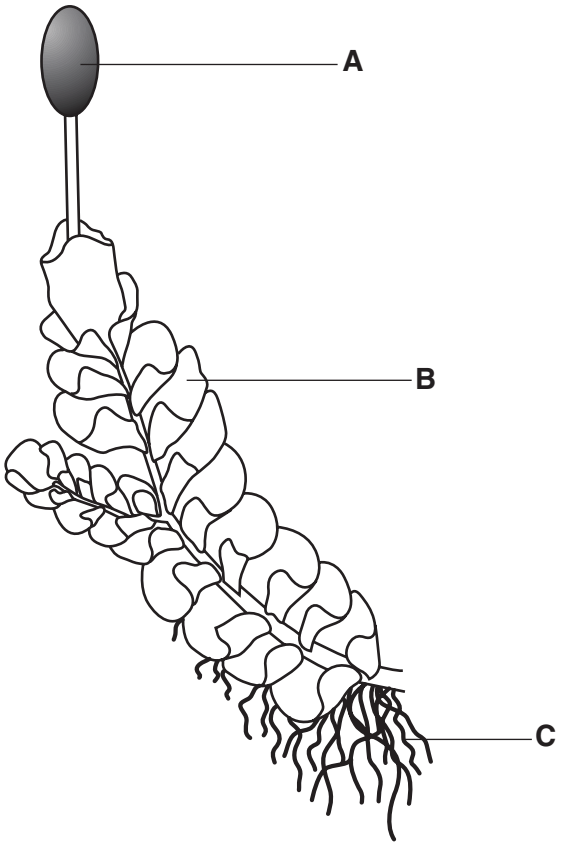


Fig. 1.1

(i) Name the structures **A** to **C**.

A .....

B .....

C ..... [3]

(ii) On Fig. 1.1, draw a label line to a structure which contains

- haploid cells and label it **H**;
- diploid cells and label it **D**.

[2]

(iii) State **one** feature, visible in Fig. 1.1, which is a diagnostic feature of bryophytes.

.....[1]

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QUESTION 1 continues on the next page.

(b) An investigation was carried out into the effect of relative humidity and watering regime on the growth of the woodland bryophytes *Dicranum majus* and *Rhytidiadelphus loreus*.

Pieces of the plants, each with similar shoot densities and overall biomass, were grown in conditions of low (70%) and high (85%) relative humidity. In each humidity,

- one group of plants was watered on alternative days (1W 1D)
- another group was watered for three days and then left dry for three days (3W 3D)
- a third group was watered for six days and then left dry for six days (6W 6D).

These watering regimes were carried out over a period of 120 days, after which the plants were harvested and their mean growth rates calculated. The results are shown in Fig. 1.2.

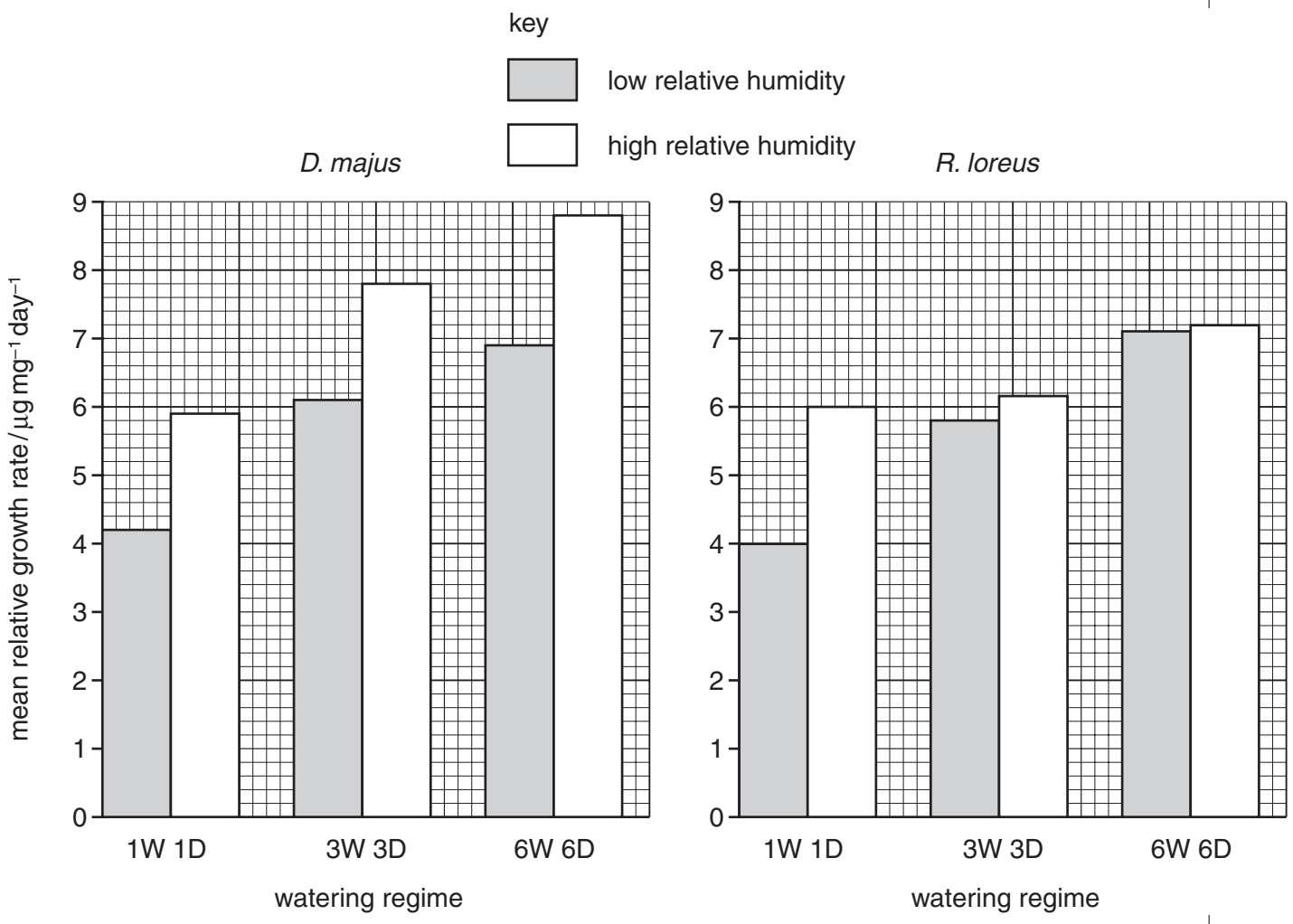


Fig. 1.2

(i) State two factors, other than initial shoot density and biomass, which would need to be kept constant during this experiment.

1. .....

2. ..... [1]

(ii) With reference to Fig. 1.2, describe the conclusions that can be drawn from these results.

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.....[4]

(c) Explain why bryophytes are more sensitive to variations in relative humidity than angiospermophytes.

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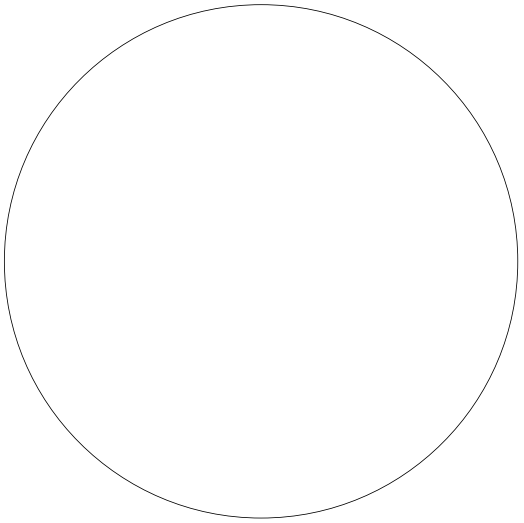
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.....[4]

[Total : 15]

2 **(a)** **(i)** Using the outline below, draw and label a diagram of the unicellular alga *Chlorella*.



[4]

(ii) Indicate the approximate scale of your diagram. [1]

(b) Fig. 2.1 shows the unicellular organism *Vorticella*.

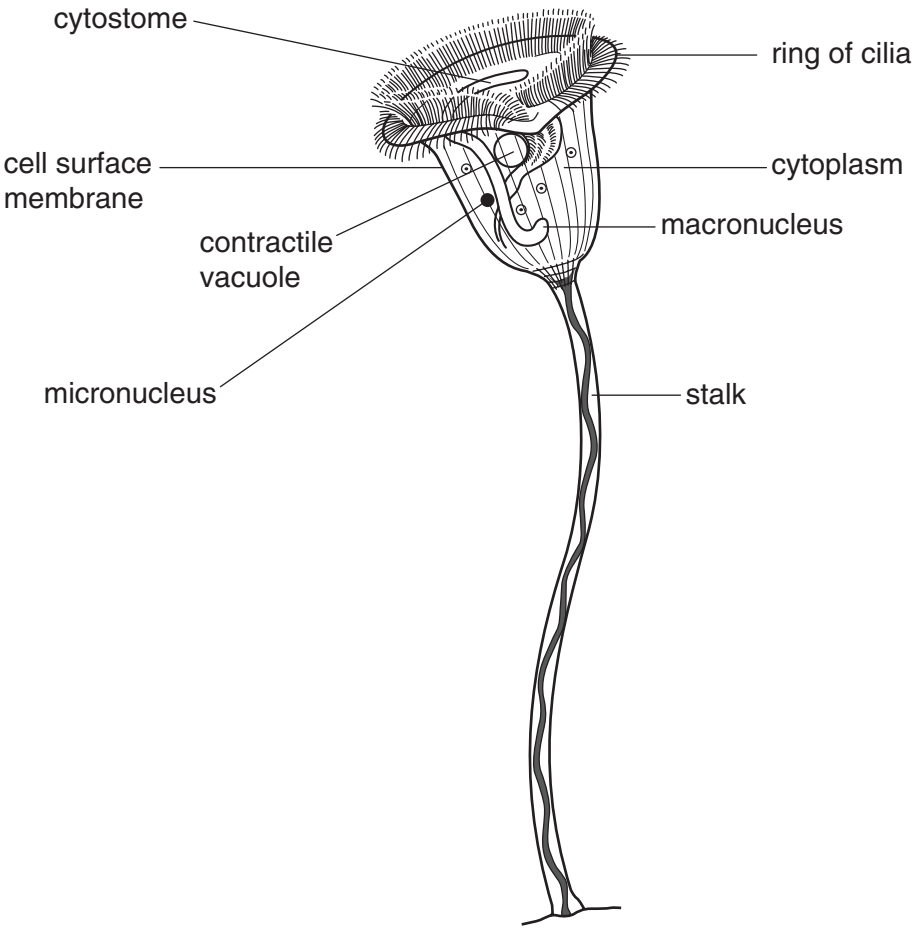


Fig. 2.1

(i) State three ways in which the structure of *Vorticella*, shown in Fig. 2.1, indicates that it should be classified in the same group of unicellular organisms as *Paramecium*.

1. .....

2. .....

3. .....[3]

(ii) The cytoplasm of *Vorticella* often contains living cells of *Chlorella*.

Suggest the nutritional advantages to each organism of this arrangement.

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.....

.....[2]

Fig. 2.2 shows a method of sewage treatment known as an oxidation pond in which algae, such as *Chlorella*, play an important role.

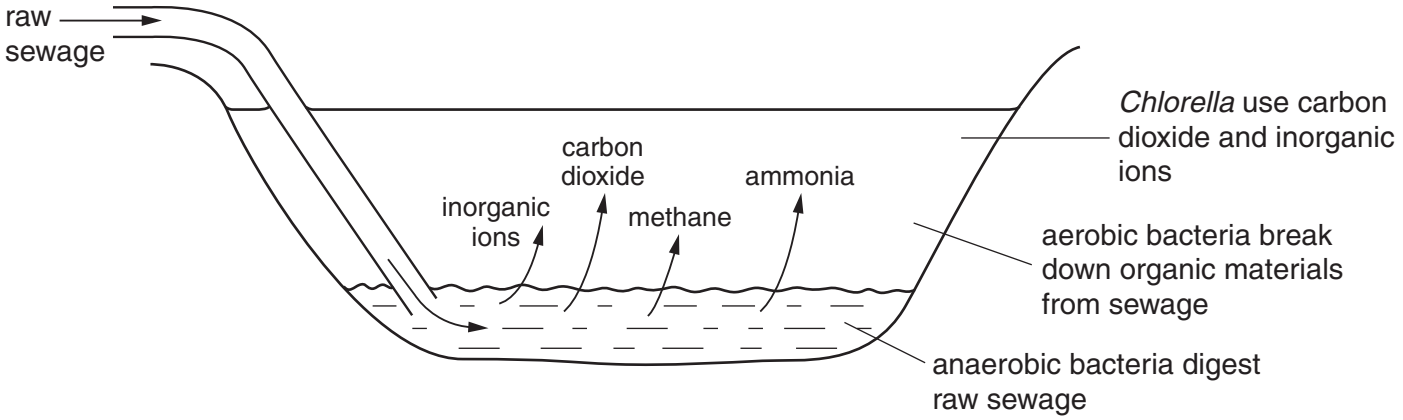


Fig. 2.2

(c) With reference to Fig. 2.2, explain why

(i) the algae grow only in the upper layers of the water;

.....

.....

.....[2]

(ii) their presence allows the growth of populations of aerobic bacteria.

.....

.....[1]

(d) Suggest two uses for the algal biomass that accumulates in the oxidation pond.

1. .....

.....

2. .....

.....[2]

[Total : 15]

3 Either

(a) (i) Describe the special features of tropical rainforests which make their conservation particularly important. [6]

(ii) Explain the reasons for the current rapid loss of tropical rainforests. [6]

(iii) Discuss the **international** measures that can be taken to conserve tropical rainforests. [8]

[Total : 20]

Or

(b) Describe

(i) the structure of a cnidarian; [8]

(ii) how cnidarians feed. [6]

(iii) Discuss the reasons why bony fish possess a specialised gaseous exchange surface, whereas cnidarians do not. [6]

[Total : 20]

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OPTION 2 – BIOTECHNOLOGY begins on the next page.

OPTION 2 – BIOTECHNOLOGY

1 **(a)** Explain the importance of good water management and the effective treatment of sewage.

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.....[3]

(b) The flowchart, Fig. 1.1, summarises a modern sewage treatment process.

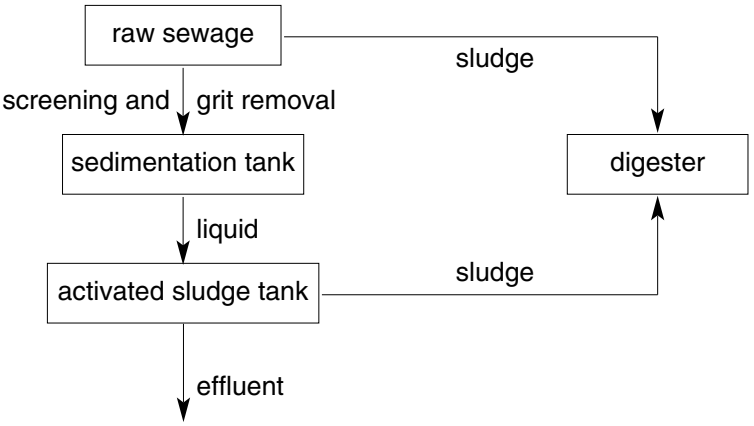


Fig. 1.1

(i) Give one key difference between the processes going on in the activated sludge tank and in the digester.

.....[1]

(ii) Explain the role of microorganisms in the activated sludge tank in preparing the sewage for disposal.

.....

.....

.....

.....[3]

(iii) Outline the role of **named** microorganisms in the production of biogas in a digester.

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.....[3]

Fig. 1.2 shows a method of sewage treatment known as an oxidation pond in which algae, such as *Chlorella*, play an important role.

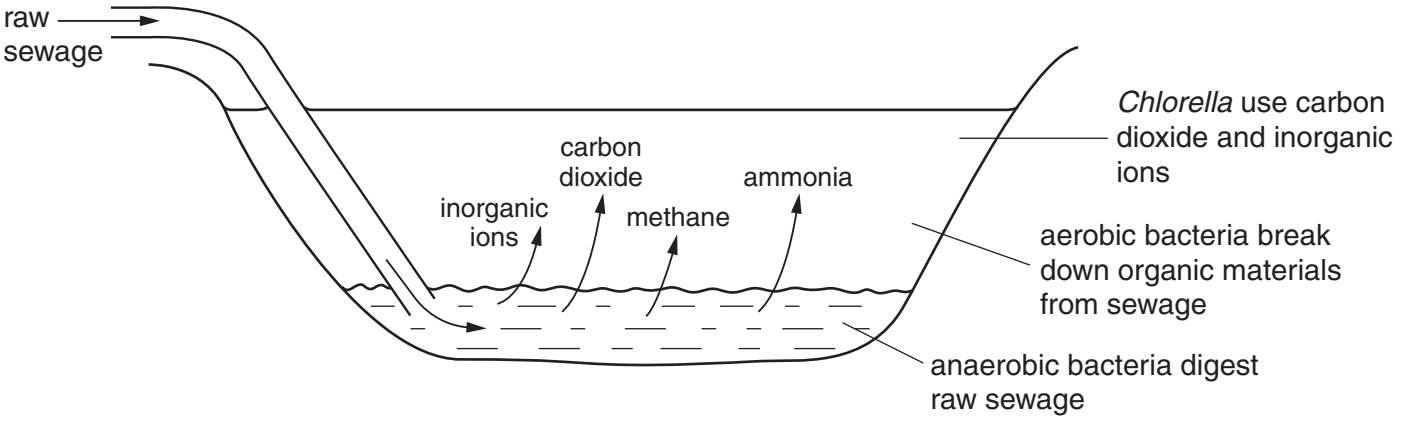


Fig 1.2

(c) With reference to Fig. 1.2, explain why

(i) the algae grow only in the upper layers of the water;

.....

.....

.....[2]

(ii) their presence allows the growth of populations of aerobic bacteria.

.....

.....[1]

(d) Suggest two uses for the algal biomass that accumulates in the oxidation pond.

1. .....

.....

2. .....

.....[2]

[Total : 15]

2 **(a)** Discuss three possible benefits and three possible hazards arising from the use of biotechnology in food production.

benefits

1. .....

.....

2. .....

.....

3. .....

.....[3]

hazards

1. .....

.....

2. .....

.....

3. .....

.....[3]

(b) The Food and Drug Administration in the USA have proposed regulations concerning food developed through biotechnology. The proposed regulations would require food developers to notify the FDA at least 120 days in advance of their intent to market food or animal feed developed through biotechnology.

Suggest why the FDA have proposed these regulations.

.....

.....

.....[2]

(c) Some tortilla chips, a snack food sold in supermarkets and health food stores, were identified on the front of the packet as 'organic'.

Explain what the general public understands by the word *organic*.

.....

.....

.....[2]

(d) Weeds are a serious threat to food crops, such as soya bean. General purpose (broad spectrum) herbicides which would kill the normal soya bean plants can only be used before the crop emerges from the soil. Once the shoots emerge, more selective (narrow spectrum) herbicides, or weedkillers, have to be used. A variety of soya has been genetically modified to produce a protein which enables it to tolerate the general purpose herbicide, glyphosate.

Explain the benefits to the farmer of growing this variety of soya bean.

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.....

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.....

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.....[5]

[Total : 15]

3 Either

(a) Discuss

(i) the benefits and [6]

(ii) the disadvantages

of donor insemination using sperm from a sperm bank. [6]

(iii) Describe how seeds are stored in seed banks. [8]

[Total : 20]

Or

(b) (i) Explain the techniques used in enzyme immobilisation. [7]

(ii) Discuss the advantages of enzyme immobilisation in the manufacturing industry. [7]

(iii) Describe an experiment to demonstrate the use of immobilised enzymes. [6]

[Total : 20]

[Turn over

OPTION 3 – GROWTH, DEVELOPMENT AND REPRODUCTION

1 **(a)** Fig. 1.1 is a drawing made from a micrograph of a germinating pollen grain.

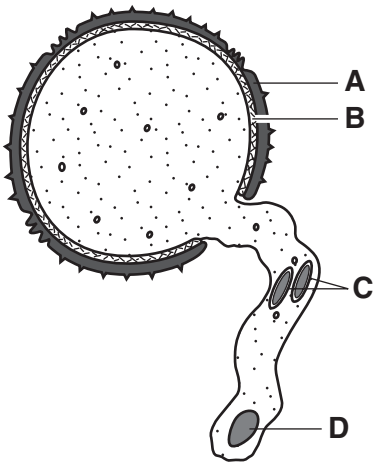


Fig. 1.1

(i) With reference to Fig. 1.1, name **A** to **D**.

A ..... **B** .....

C ..... **D** .....

[2]

(ii) Describe briefly the roles of structures **C** in fertilisation.

.....

.....

.....

.....

.....[4]

(iii) State **one** reason why the pollen grain shown in Fig. 1.1 is likely to be from an insect-pollinated flower.

.....[1]

(b) In Tobacco plants, the penetration of a stigma by a pollen tube is influenced by lipids secreted by the stigma. The secretion consists of a mixture of triglycerides.

Mutant Tobacco plants with a style, but no stigma and hence no secretion, were used in an investigation into the role of the lipids. When pollen and the secretion from normal Tobacco plant stigmas were placed on these stigma-less styles, pollen tubes grew into the style.

Different lipids and lipid derivatives were applied to the stigma-less styles and excess pollen added. The styles were squashed and the number of pollen tubes that had penetrated the style counted.

The results are summarised in Table 1.1.

Table 1.1

substance added to stigma-less style	mean number of pollen tubes penetrating style
secretion from normal Tobacco plant stigma	21
purified mixture of lipids from the normal secretion	25
saturated triglyceride from the normal secretion	1
unsaturated triglycerides from the normal secretion 1 2 3	 15 33 11
saturated fatty acids	0
unsaturated fatty acids	0
glycerol	0

(i) Explain why mutant plants with no stigmas were used in this investigation.

.....

.....[1]

(ii) With reference to Table 1.1, explain why the effects of a purified mixture of lipids from the normal secretion of Tobacco plant stigmas and of fatty acids and glycerol were investigated.

purified mixture of lipids .....

.....

.....

fatty acids and glycerol .....

.....

.....[4]

(iii) State what conclusions may be drawn from the data given in Table 1.1.

.....

.....

.....

.....[3]

[Total : 15]

For Examiner's Use

2 **(a)** Name the precise sites of production in the human male of the following hormones:

(i) follicle stimulating hormone (FSH);

.....

(ii) luteinising hormone (LH) or interstitial cell stimulating hormone (ICSH);

.....

(iii) testosterone.

.....

[3]

(b) Fig. 2.1 shows the concentration of the hormones FSH, LH (ICSH) and testosterone in the blood of a human male at different ages.

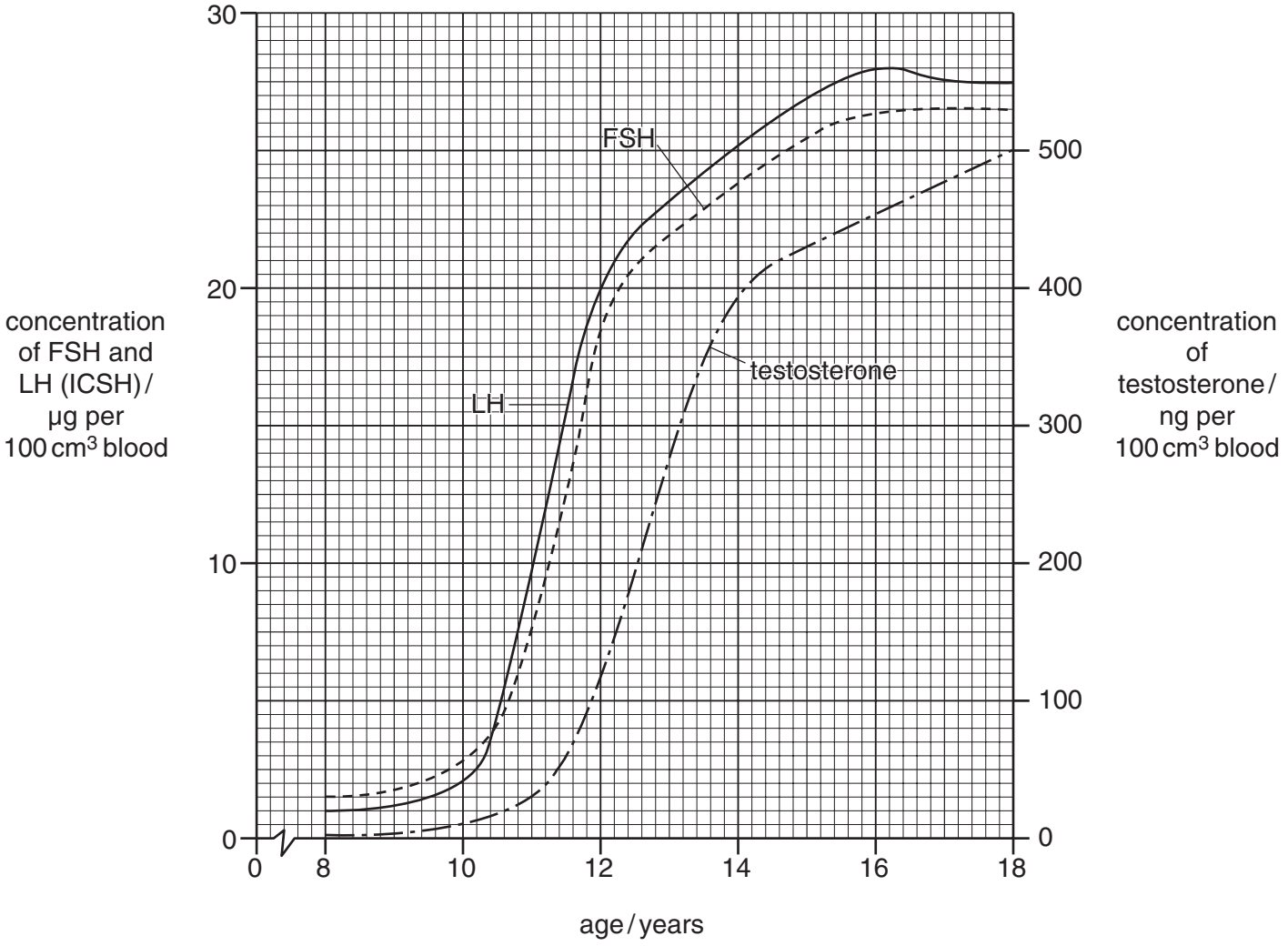


Fig. 2.1

With reference to Fig. 2.1, describe and explain the changes in concentration of:

(i) FSH and LH (ICSH); .....

.....

.....

.....

.....[4]

(ii) testosterone. .....

.....

.....

.....

.....[4]

(c) Table 2.1 shows the mean mass of the human testis at different ages.

Table 2.1

age / years	mean mass of human testis / g
10	2.0
12	3.0
14	8.0
16	18.0
18	28.0

With reference to Table 2.1, calculate, showing your working in each case,

(i) the **absolute** growth rate of the testis between ages 14 and 18 years;

.....

.....

.....[2]

(ii) the **relative** growth rate of the testis between ages 14 and 18 years.

.....

.....

.....[2]

[Total : 15]

3 Either

(a) (i) Describe asexual reproduction in a **named** prokaryote. [7]

(ii) Describe **one** technique for measuring growth of a **named** microorganism. [7]

(iii) Discuss the problems of measurement arising in the use of the technique described in **(ii)**. [6]

[Total : 20]

Or

(b) (i) Describe an investigation to identify the major factors affecting seed germination. [7]

(ii) Describe the reasons for seed dormancy. [7]

(iii) Discuss the advantages to plants of seed dormancy. [6]

[Total : 20]

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OPTION 4 – APPLICATIONS OF GENETICS begins on the next page.

OPTION 4 – APPLICATIONS OF GENETICS

1 The Mauritius pink pigeon is an endangered species. The wild population was reduced to sixteen in 1993. In the 1970s, eleven birds, whose relationships were unknown, were taken from the wild population to establish captive breeding programmes in Mauritius and in the UK.

(a) The captive population in the UK began to show harmful effects of inbreeding.

Describe the harmful effects of inbreeding.

.....

.....

.....

.....[3]

(b) The relationships of the captive birds were determined by genetic fingerprinting.

Outline how genetic fingerprinting is carried out.

.....

.....

.....

.....

.....[4]

(c) Explain how genetic fingerprinting can be used to keep inbreeding of the captive populations of the Mauritius pink pigeon to a minimum in future.

.....

.....

.....

.....[3]

(d) The aims of selective breeding and of maintaining a captive population of an endangered species are very different.

Explain

(i) why selective breeding is carried out;

.....

.....

.....[2]

(ii) in what ways maintaining a captive population of an endangered species differs from selective breeding.

.....

.....

.....

.....[3]

[Total : 15]

[Turn over

2 When Lima bean leaves are attacked by spider mites the leaves emit volatile chemicals which switch on genes giving resistance to the herbivores. The volatile chemicals affect both the plant that is under attack and neighbouring plants.

(a) (i) State an advantage of switching on resistance genes only when needed.

.....

.....

.....[2]

(ii) Explain briefly how the spider mite population may overcome the herbivore resistance of the Lima bean leaves.

.....

.....

.....

.....

.....[4]

In an investigation, two Lima bean leaves, each infested with 100 spider mites were placed in sealed containers with uninfested leaves. The spider mites were not able to move on to the uninfested leaves, but any volatile chemicals given off by the infested 'emitter' leaves could reach the uninfested 'receiver' leaves.

Controls were set up in which two uninfested leaves (control 1) or two artificially wounded leaves (control 2) were used as 'emitter' leaves. Both 'emitter' and 'receiver' leaves were tested for activity of six resistance genes.

The results of the investigation are shown in Table 2.1.

Table 2.1

Key: ✓ = gene activity X = no gene activity

	experiment		control 1		control 2	
	emitter leaves	receiver leaves	emitter leaves	receiver leaves	emitter leaves	receiver leaves
resistance gene	leaves infested by spider mites	uninfested leaves	uninfested leaves	uninfested leaves	artificially wounded leaves	uninfested leaves
1	✓	✓	X	X	✓	✓
2	✓	✓	X	X	✓	X
3	✓	X	X	X	X	X
4	✓	✓	X	X	✓	X
5	✓	✓	X	X	✓	X
6	✓	✓	X	X	X	X

(b) Suggest how the leaves could be tested for gene activity.

.....

.....

.....[2]

(c) With reference to Table 2.1, describe the effect of

(i) spider mite infestation;

.....

.....

.....[2]

(ii) artificially wounding leaves.

.....

.....

.....[2]

(d) Explain whether it would be advantageous or disadvantageous for the Lima bean to have its six resistance genes on the same chromosome.

.....

.....

.....

.....[3]

[Total : 15]

3 Either

(a) (i) Describe, with examples, how the alleles at one gene locus may interact with each other. [6]

(ii) Describe Huntington's disease (HD) in humans and explain how it is inherited. [8]

(iii) Discuss the advantages and disadvantages of genetic screening for HD. [6]

[Total : 20]

Or

(b) (i) Describe, using examples, the difference between continuous and discontinuous variation of the phenotype. [8]

(ii) Explain the genetic basis of continuous and discontinuous variation. [6]

(iii) Describe **two** examples of the effect of the environment on the phenotype. [6]

[Total : 20]

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