OCR

RECOGNISING ACHIEVEMENT

OXFORD CAMBRIDGE AND RSA EXAMINATIONS

Advanced GCE

BIOLOGY 2806/01

Unifying Concepts in Biology

Monday **16 JUNE 2003** Morning 1 hour 15 minutes

Candidates answer on the question paper.
Additional materials:
Electronic calculator

Candidate Name	Centre Number	Candidate Number

TIME 1 hour 15 minutes

INSTRUCTIONS TO CANDIDATES

- Write your name in the space above.
- Write your Centre number and Candidate number in the boxes above.
- Answer **all** the questions.
- Write your answers, in blue or black ink, in the spaces on the question paper.
- Read each question carefully before starting your answer.

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets [ ] at the end of each question or part question.
- 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	9	
2	9	
3	13	
4	10	
5	10	
6	9	
TOTAL	60	

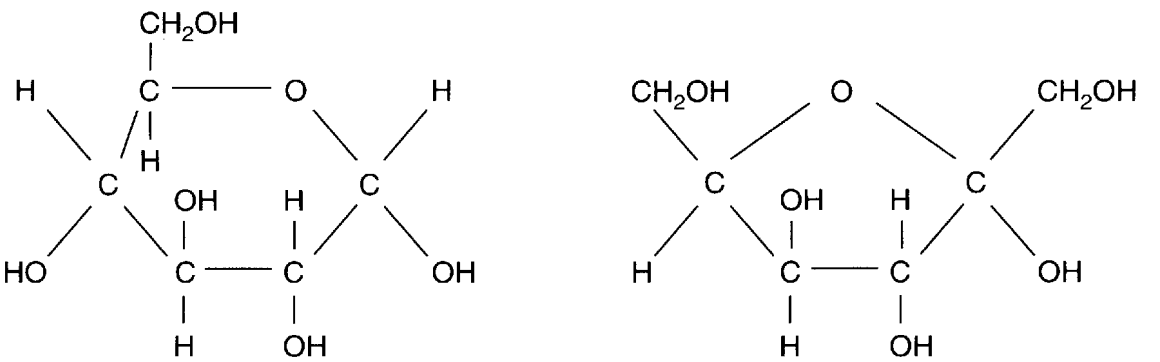
This question paper consists of 14 printed pages and 2 blank pages.

MML 3539 6/02 S38476/6

Registered Charity Number: 1066969
[Turn over

Answer **all** the questions.

1 Inulin is a polysaccharide which is stored by plants of the genus *Dahlia*. It is made up of several fructose units linked by glycosidic bonds. The structures of fructose and glucose are shown in Fig. 1.1.



glucose fructose

Fig. 1.1

(a) Mammals cannot digest inulin but are able to digest both starch and glycogen.

Explain why an enzyme that catalyses the hydrolysis of glycogen is unlikely to hydrolyse inulin.

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(b) Inulin has been used to investigate kidney function because it is inert (unreactive), and because inulin molecules are small enough to be filtered in the glomeruli. A standard dose of inulin solution is injected into a vein and the concentration of inulin in the urine is then monitored. The results of such experiments on two people, **A** and **B**, are shown in Fig. 1.2.

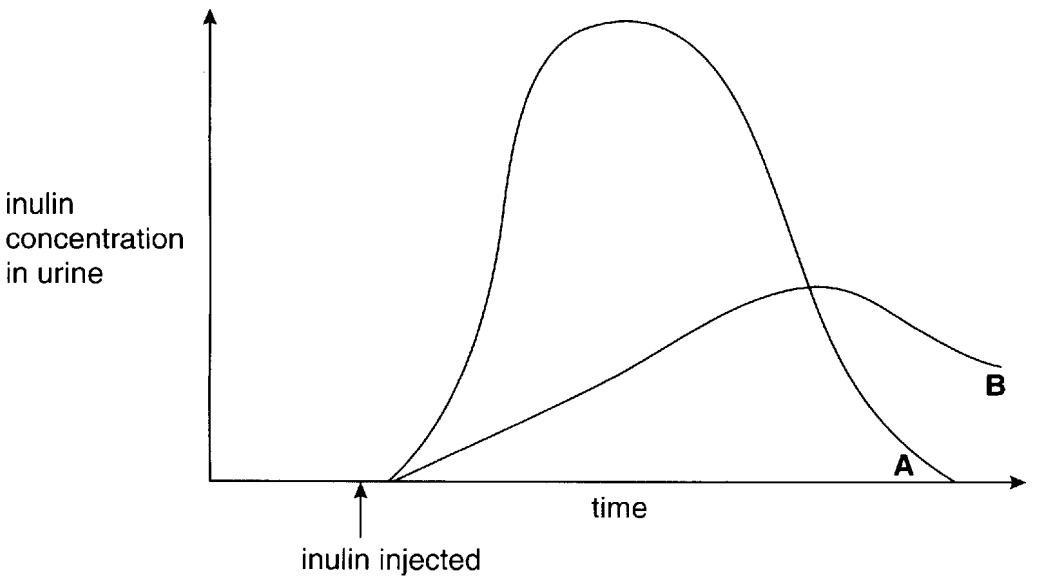

Fig. 1.2

(i) Describe the difference in response of **A** and **B** to the standard dose of inulin.

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(ii) **B** has very low blood pressure. Explain how this may account for the difference between the results for **A** and **B** in Fig. 1.2.

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(c) Explain why a chemically inert molecule is used to study glomerular filtration.

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[Total: 9]

2 During a walk along a country road in northern England, a biologist observed a fairly steep bank beside the road, as shown in Fig. 2.1.

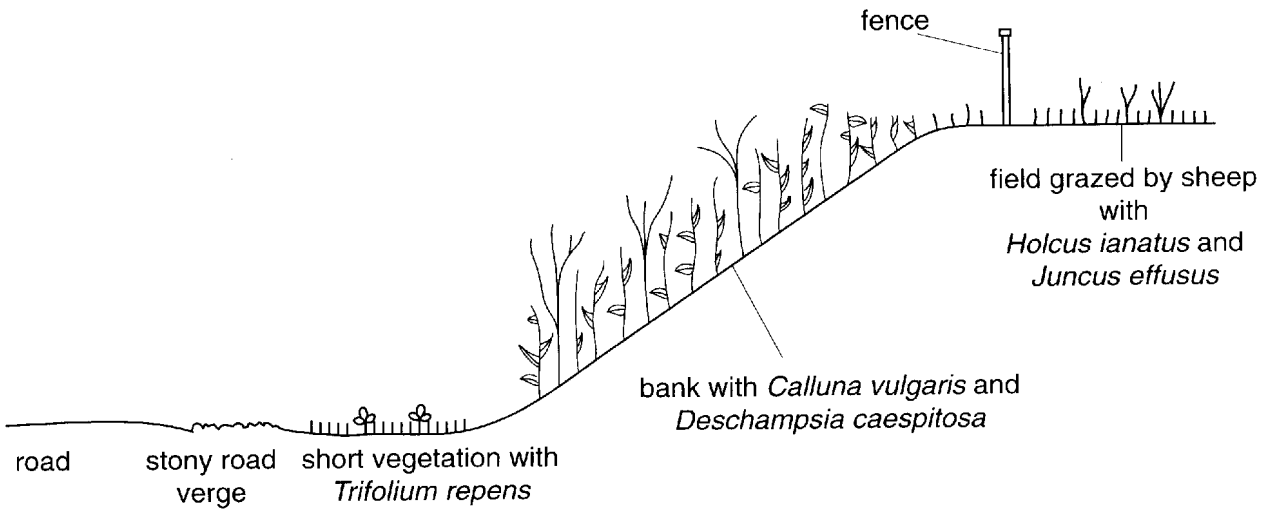

Fig. 2.1

The bank was covered by a fairly dense growth of heather, *Calluna vulgaris*, and a grass species called *Deschampsia caespitosa*. Between the bank and the road surface was an area of short vegetation with several species including white clover, *Trifolium repens*, which is a leguminous plant. At the top of the bank was a fence, on both sides of which was a dense growth of a grass called *Holcus ianatus*, together with a rush called *Juncus effusus*.

(a) Describe briefly how you would carry out a survey to obtain data in order to extend this brief description of the site.

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(b) Describe **one** aspect of the ecological niche occupied by clovers, such as *Trifolium repens*, in plant communities.

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(c) Use the site description provided and Fig. 2.1 to suggest ecological factors that might confine *Calluna vulgaris* to the bank and prevent it from colonising the other habitats observed.

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[Total: 9]

3 Read the passage and answer the questions which follow.

Chaperone proteins.

Cells make many thousands of protein molecules. During protein synthesis, amino acids are joined by peptide bonds into chains of increasing length which are finally released, for example into the rough endoplasmic reticulum. Protein function depends on the precise shape that the newly synthesised polypeptides adopt. The tertiary structure of globular proteins depends on the way they are folded. Even small changes to shape can alter or destroy the complex functions shown by enzymes, antibodies and transport proteins.

Incorrectly folded proteins can be extremely stable, so they cannot be broken down. This may result in cell death. Such changes are associated with both CJD and Alzheimer's disease.

When some new polypeptides are synthesised, the R groups (side chains) of the amino acids must be prevented from forming bonds with the wrong molecular partners. When such a polypeptide arrives in a location, such as the Golgi apparatus, it can establish its final shape. Recently discovered proteins, called chaperone proteins, bind reversibly to new polypeptides and shield them from other molecules until the new polypeptides are able to fold correctly.

(a) Name the organelle that synthesises polypeptides.

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(b) Explain why

'Even small changes to shape can alter or destroy the complex functions shown by enzymes, antibodies and transport proteins'.

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(c) **(i)** Describe how protein may be broken down in cells.

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(ii) Suggest why incorrectly folded protein may be more difficult to break down.

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(d) State **one** example of a type of bond that may form between amino acid R groups (side chains) to establish protein tertiary structure.

..... [1]

(e) Newly formed polypeptides, together with their chaperones, must be moved from the site of synthesis to a location in the cell where they adopt their final shape.

Suggest why this movement is unlikely to be by diffusion.

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..... [2]

[Total: 13]

4 Roots absorb ions selectively from the soil. If the concentration of an ion in the soil is high, it may be absorbed in unusually large amounts, interfering with biochemical functions and producing symptoms of toxicity. Different species of plant vary greatly in the range of concentrations of specific ions which they will tolerate.

(a) State **two** mechanisms by which ions may be taken in by plant cells.

1 .....

2 ..... [2]

(b) Suggest a mechanism by which increased concentrations of an ion within cells may result in toxicity.

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Saline soils, with high concentrations of sodium ions, are a major problem in many parts of the world. Most crop species are unable to tolerate high concentrations of sodium ions.

In an investigation of the effects of soil salinity on tomato plants, two species, the edible tomato, *Lycopersicum esculentum*, and a wild species of tomato that is salt tolerant, *L. cheesmanii*, were compared. Fig. 4.1 shows some of the results of this investigation.

Soil salinity was simulated by adding sodium chloride to the standard nutrient solution in which the plants were grown. The accumulation of sodium ions in the leaves of the two species was measured.

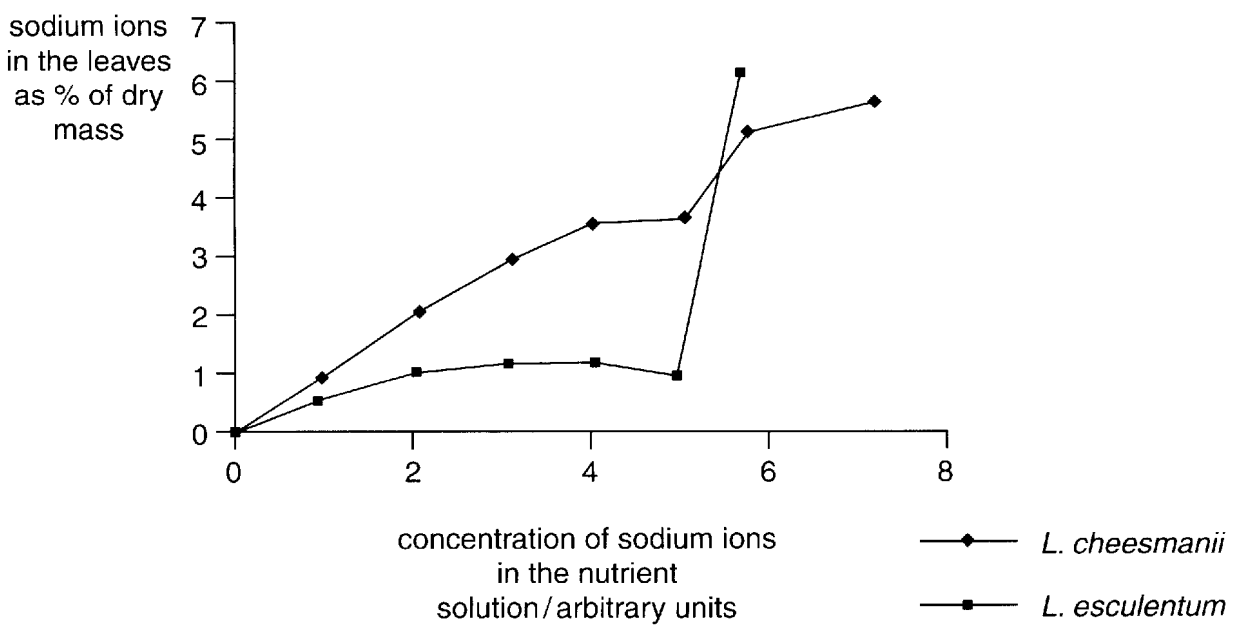

Fig. 4.1

(c) Describe the relationship between the sodium ion concentration of the nutrient solution and the accumulation of sodium ions in the leaves of *L. cheesmanii* as shown in Fig. 4.1.

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(d) When *L. cheesmanii* grows in saline soils, it stores excess sodium ions in the cell vacuoles. When *L. esculentum* grows in saline soils, it is unable to do this and actively pumps excess sodium ions from the root cells into the soil.

(i) Suggest why plants which actively pump sodium ions into the soil do not grow well in saline soils.

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(ii) State **one** function of the solution found in the vacuoles of root cells, other than to store excess ions.

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(iii) Suggest why excess sodium ions are less toxic to the plant if they accumulate in the vacuole rather than in the cytoplasm.

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[Total: 10]

5 **(a)** Bronchi have walls that contain mucus-secreting glands and smooth muscle cells. During exercise, the lumen of the bronchi enlarge. This is known as bronchial dilation.

Explain why bronchial dilation is beneficial during exercise.

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..... [1]

(b) Increasingly large numbers of people suffer from asthma. This is often triggered by exercise, especially during cold weather. During an asthma attack, a person takes longer to exhale than normal after maximal inhalation - the air flows out of the lungs more slowly.

Suggest **two** changes in the bronchi that might result in a temporary slowing of the movement of air during breathing.

1 .....

2 ..... [2]

(c) In this question, one mark is available for the quality of written communication.

Blood vessels, like bronchi, are tubes.

Outline the changes that take place in the blood vessels during exercise.

No credit will be given for answers that refer to the action of the heart.

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Quality of Written Communication [1]

[Total: 10]

6 Pea plants have outgrowths from the stem, at the base of each leaf, called bracts. Normally each leaf has one or more pairs of leaflets and ends in tendrils. Tendrils allow the plant to cling to other plants or to non-living supports.

Leaves from four varieties of peas are shown in Fig. 6.1.

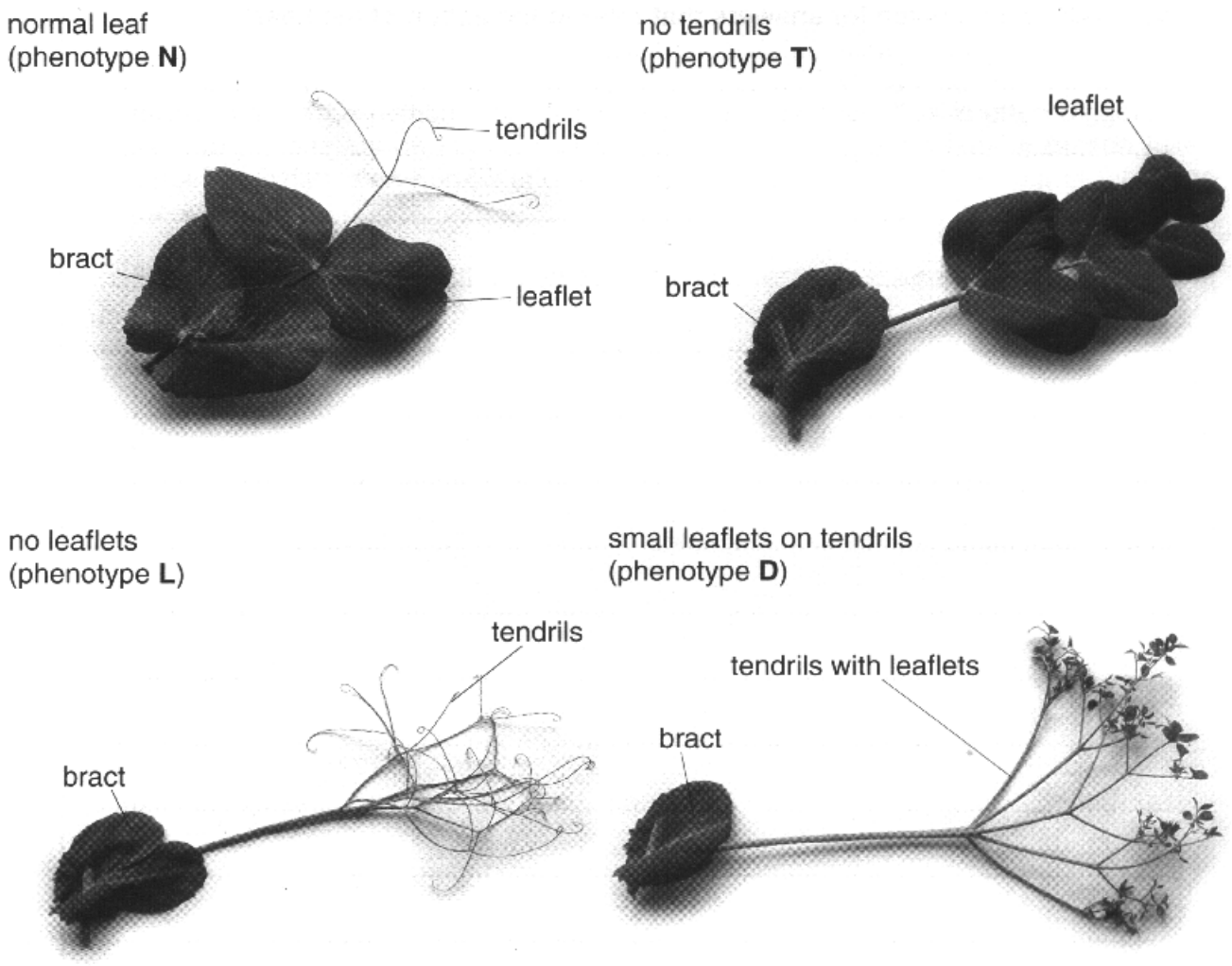

Fig. 6.1

(a) Using Fig. 6.1, explain why a plant with phenotype **L** might be expected to produce fewer peas than a plant with phenotype either **N** or **T**.

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These phenotypes are controlled by two genes, each with two alleles. The way in which this happens is shown in Table 6.1.

Table 6.1

	dominant allele		recessive allele	
	symbol	phenotype that results	symbol	phenotype that results
gene 1	A	tendrils at the tip of the leaf, pairs of leaflets behind the tip	a	the tendrils replaced by leaflets
gene 2	B	tendrils at the tip of the leaf, pairs of leaflets behind the tip	b	the leaflets replaced by tendrils

A leaf without tendrils is shown in Fig. 6.1 as phenotype **T**.

A leaf in which the leaflets are replaced by tendrils is shown in Fig. 6.1 as phenotype **L**.

If a plant with phenotype **T** is crossed with a plant with phenotype **L** and both these parent plants are homozygous, the F_1 offspring all have normal leaves, phenotype **N**.

When these F_1 plants self-pollinate, the resulting F_2 offspring include plants with phenotypes **N**, **L** and **T** but there are also F_2 offspring with a new phenotype **D**. These have small leaflets at the ends of each tendril.

In a large population of F_2 plants, about one in sixteen have the new phenotype **D**.

(b) Suggest **one** possible genotype for each of the phenotypes

N .....

T .....

L .....

D ..... [4]

(c) Peas are grown commercially in an open field without any sticks or other physical supports. The seeds are sown at a fairly high density and the crop is harvested by a mechanical harvester that strips the pods from the plants. Leaves are a nuisance during this process because they tend to be harvested with the pea pods.

Many commercial varieties are dwarf plants in which the leaflets are replaced by tendrils, phenotype **L** in Fig. 6.1.

Explain the practical advantages of this combination of characteristics.

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[Total: 9]