OCR
RECOGNISING ACHIEVEMENT

OXFORD CAMBRIDGE AND RSA EXAMINATIONS
Advanced GCE

BIOLOGY 2804

Central Concepts

Tuesday **24 JANUARY 2006** Morning 1 hour 30 minutes

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

Candidate Name	Centre Number	Candidate Number

TIME 1 hour 30 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 provided 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	12	
2	18	
3	17	
4	15	
5	14	
6	14	
TOTAL	90	

This question paper consists of 19 printed pages and 1 blank page.

Registered Charity Number: 1066969
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For Examiner's Use

Answer **all** the questions.

1 Fig. 1.1 is an electronmicrograph of a chloroplast.

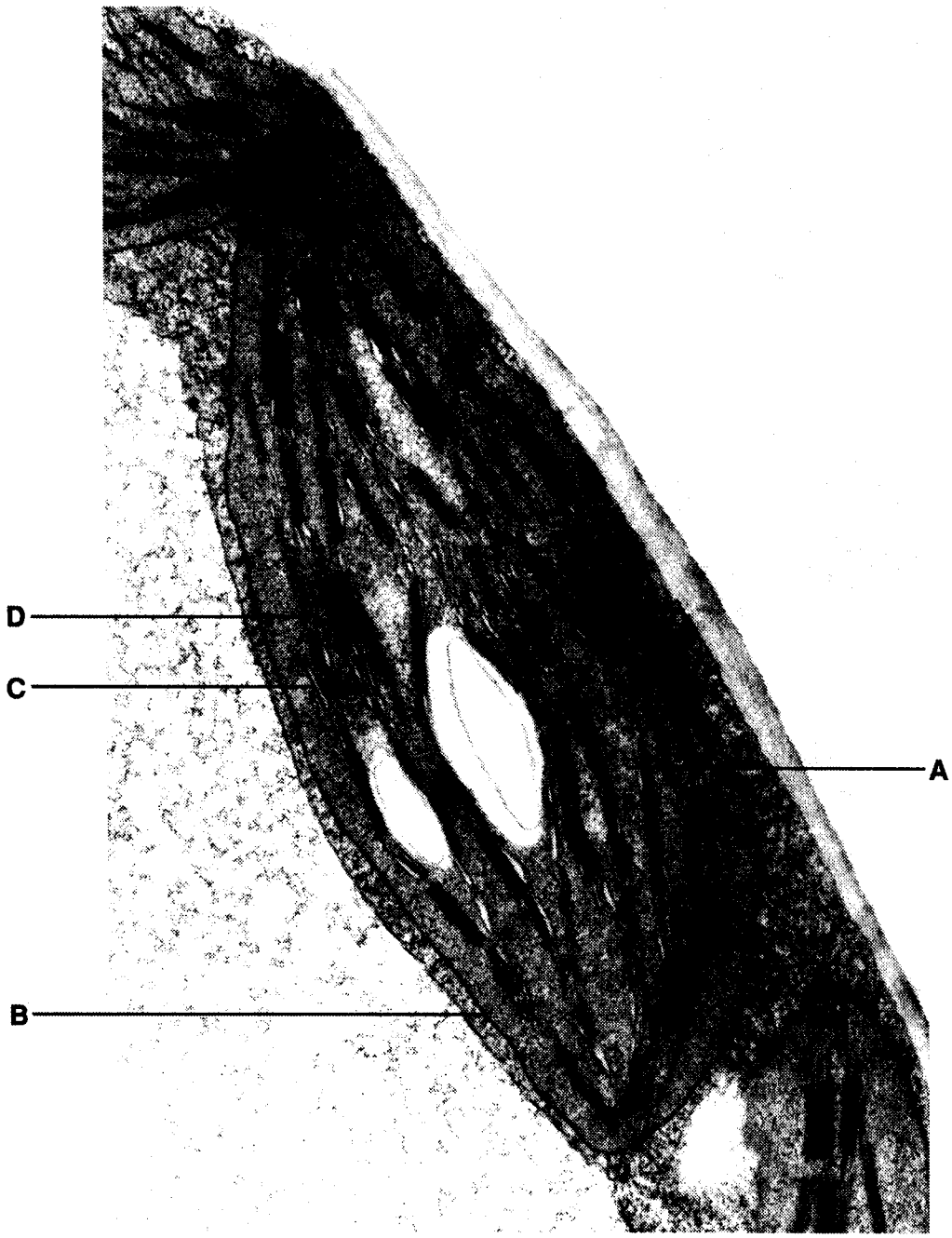


Fig. 1.1

(a) Identify the structures labelled **A** to **D**.

A .....

B .....

C .....

D .....[4]

(b) Name the part of the chloroplast where photophosphorylation takes place.

.....[1]

There is a flow of electrons during photophosphorylation. This flow is either cyclic or non-cyclic.

(c) State the **three** end products of **non-cyclic** photophosphorylation.

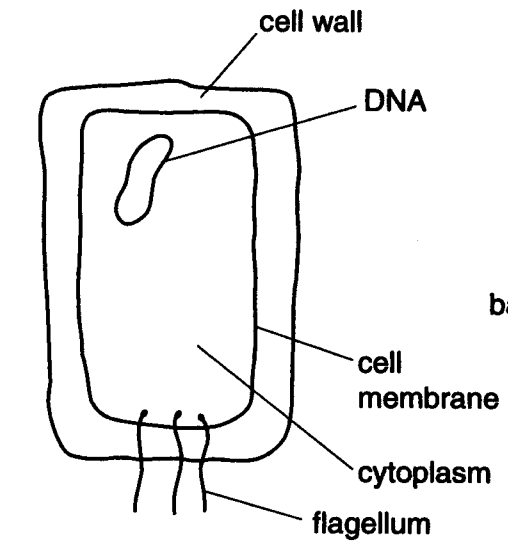
1 .....

2 .....

3 .....[3]

[Turn over

(d) Some bacteria can survive in anaerobic conditions by utilising light energy to drive the production of ATP in the cell membrane. In such conditions, *Halobacterium salinarium* makes the protein bacteriorhodopsin. When this protein absorbs light, protons (H^+) are pumped outwards across the cell membrane. This is shown in Fig. 1.2.



Halobacterium salinarium (general structure)

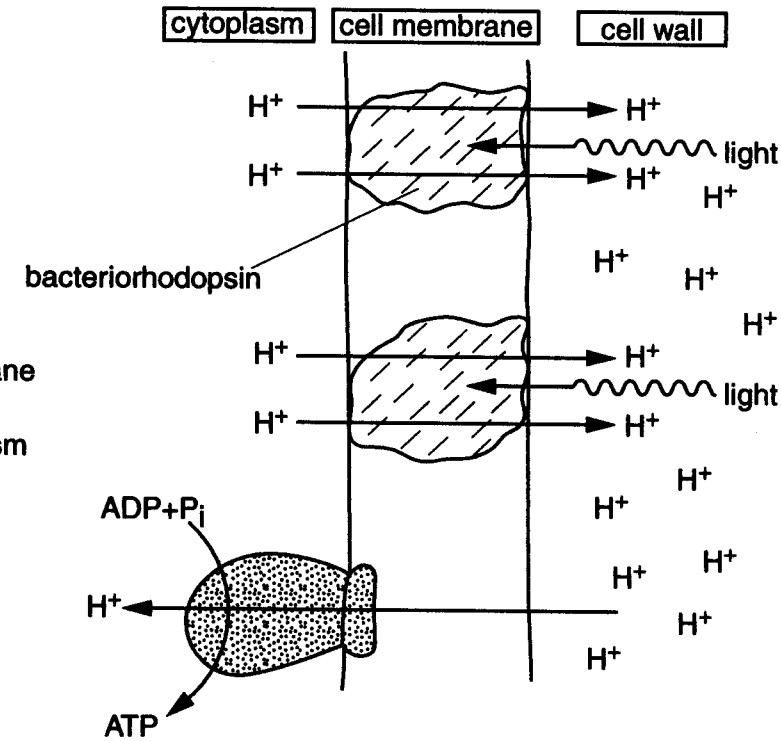


Fig. 1.2

Using the information in Fig. 1.2 together with your knowledge of photophosphorylation and oxidative phosphorylation, explain how *H. salinarium* makes ATP in anaerobic conditions.

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.....[4]

[Total: 12]

For Examiner's Use

2 The tiger, *Panthera tigris,* is the largest and most distinctive cat in the world.

(a) Complete the following table to show the classification of the tiger.

kingdom	.....
.....	chordata
.....	mammalia
order	carnivora
family	felidae
genus	.....
.....	*Panthera tigris*

[5]

Tigers are further classified into a number of sub-species (races) based on marked phenotypic differences, such as body size and colour. Fig. 2.1 shows the distribution of the different sub-species 100 years ago and in 2004. The names of the sub-species are shown on the map.

Key:

100 years ago 2004

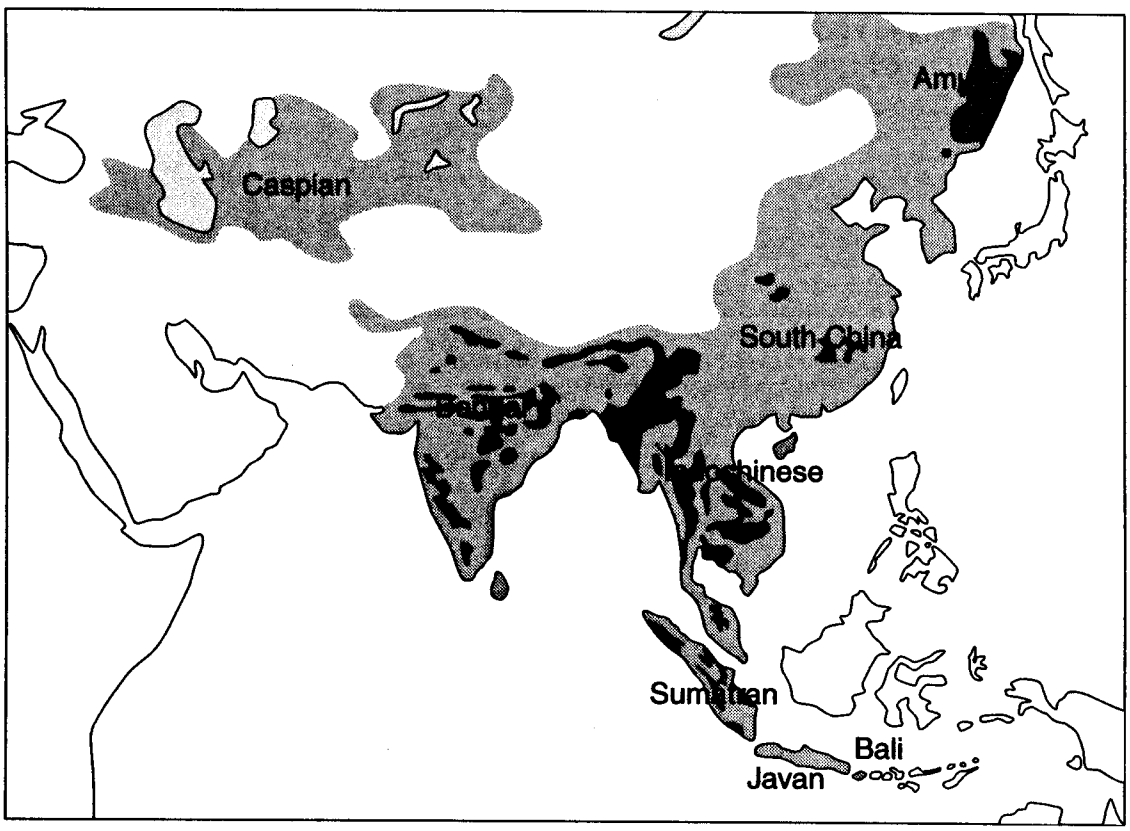

Fig. 2.1

(b) (i) Describe the changes shown in Fig. 2.1.

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.....[2]

(ii) Explain how the distinct phenotypic differences between the sub-species may have arisen.

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.....[4]

(iii) Suggest why these populations of tigers are classified as different sub-species rather than as different species.

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.....[2]

[Turn over

Tigers prey mainly upon large mammals. One of the threats to the survival of the tiger is a reduction in numbers of prey. Fig. 2.2 shows the relationship between the numbers of two cat species, **A** and **B**, and the prey biomass.

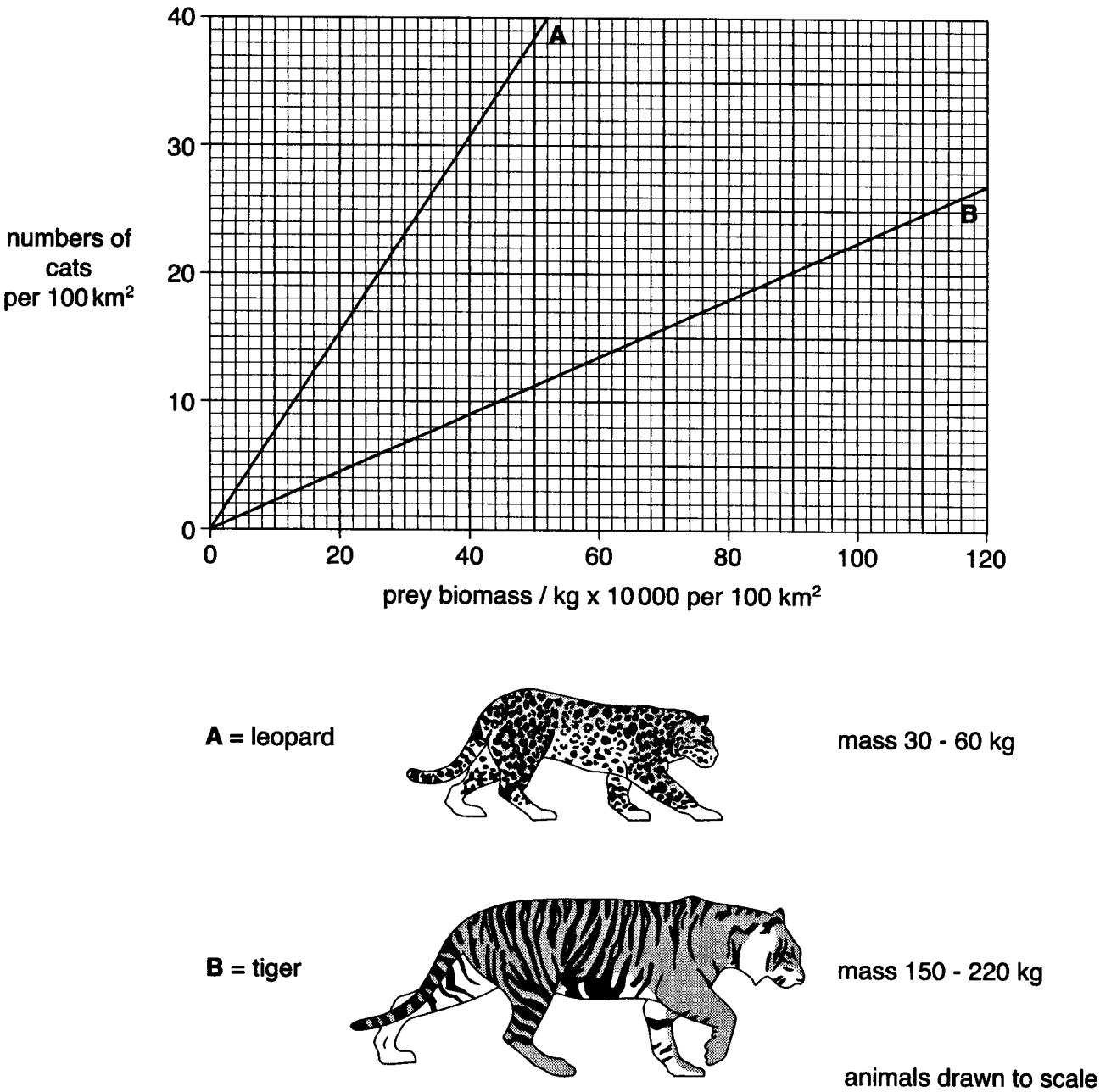

Fig. 2.2

(c) Use Fig. 2.2 to determine the number of **(i)** leopards and **(ii)** tigers per 100 km² that can be expected to be supported by a biomass of 300 000 kg of prey per 100 km².

(i) leopards ..... per 100 km²

(ii) tigers ..... per 100 km² [2]

(d) These two species are geographically isolated and therefore do not compete for prey.

Suggest **one** explanation for the difference between the figures you have given in **(c)**.

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.....[1]

(e) Other factors could be limiting the size of the tiger populations.

State **two** of these factors.

1 .....

2 .....[2]

[Total: 18]

3 Fig. 3.1 shows several stages in the life cycle of the water flea, *Daphnia*.

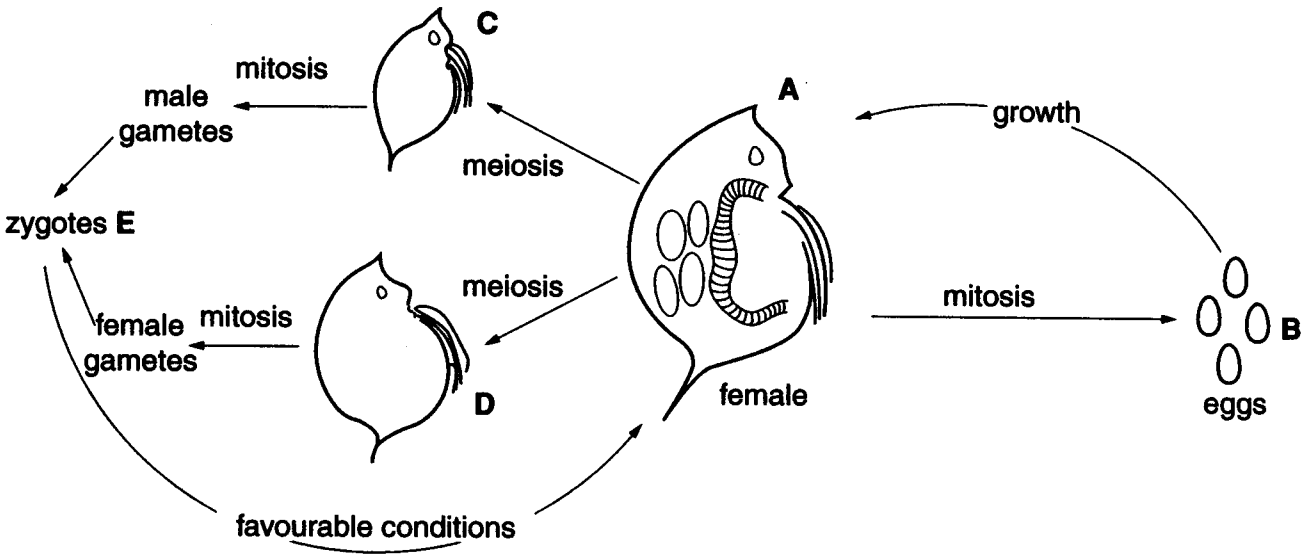

Fig. 3.1

- In favourable conditions, all the individuals in a population are females, **A**.
- These females produce eggs, **B**, by **mitosis** which develop into further females.
- In unfavourable conditions, eggs are produced by **meiosis** and develop without fertilisation into either males, **C**, or females, **D**.
- Gametes are produced by **mitosis** from **C** and **D**.
- The resultant zygotes, **E**, develop a protective case which enables them to survive unfavourable conditions.
- When favourable conditions return, these zygotes develop into young females.

(a) (i) State which of the stages, **A** to **E**, contain individuals with the diploid number of chromosomes.

.....[1]

(ii) Explain why the females in stage **A** show greater variation than the females in stage **D**.

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.....[2]

(iii) Explain why gametes are produced by mitosis from males **C** and females **D**.

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.....[2]

For Examiner's Use

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

Describe the behaviour of chromosomes during **meiosis** which results in genetic variation among *Daphnia* populations.

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Quality of Written Communication [1]

(c) The human ABO blood groups are A, B, AB and O. They are determined by a single gene with multiple alleles. I^A and I^B alleles are codominant, but both these alleles are dominant to the I^O allele.

In a maternity ward, the identities of four babies became accidentally mixed up. The ABO blood groups of the babies were discovered to be O, A, B and AB. The ABO blood groups of the four sets of parents were determined and are shown in the table below.

Complete the table to match each baby to its parents by indicating:

- the parental genotypes, using the symbols I^A, I^B and I^O;
- the blood group of the baby which belongs to each set of parents.

parental blood groups	parental genotypes	baby blood group
O and O		
AB and O		
A and O		
AB and A		

[4]

[Total: 17]

For Examiner's Use

4 **(a)** Define the term *excretion.*

.....

.....[2]

(b) Name **two** groups of macromolecules that are broken down to form nitrogenous excretory products in mammals.

1 .....

2 .....[2]

Table 4.1 shows the amount of different substances excreted by a volunteer during two 24 hour periods. During the first 24 hour period the volunteer was fed a protein-deficient diet; during the second 24 hour period the volunteer was fed a protein-rich diet. All other variables were kept constant.

Table 4.1

substance excreted	protein-deficient diet	protein-rich diet
urea / g	2.20	14.70
uric acid / g	0.09	0.18
ammonium ions / g	0.04	0.49
creatinine / g	0.60	0.58

(c) **(i)** Calculate the percentage increase in urea excreted when the volunteer switched from a protein-deficient to a protein-rich diet. Show your working.

Answer = ...% [2]

(ii) Explain why more urea is produced when eating a protein-rich diet.

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.....[2]

[Turn over

(d) Explain why the main nitrogenous excretory product of humans is urea rather than ammonia.

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.....[2]

(e) Table 4.2 shows the concentrations of glucose and urea in the renal artery and renal vein.

Table 4.2

	concentration / mg 100 cm^{-3} plasma	
	renal artery	renal vein
glucose	90	80
urea	30	16

Both substances are present in lower concentration in the renal vein than in the renal artery. However, urea appears in the urine of a healthy individual but glucose does not.

Explain why this is so.

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.....[5]

[Total: 15]

For Examiner's Use

5 In both plants and animals, chemical messengers help to transfer information from one part of the organism to another to achieve coordination.

(a) The table below lists some of these chemicals together with their functions.

Complete the table.

name of chemical messenger	function
.....	controls water permeability of collecting ducts in kidney
insulin	.....
glucagon	.....
.....	stimulates stomatal closure during water stress
.....	controls apical dominance

[5]

[Turn over

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

Mammals also rely on nerves to transfer information in the form of electrical impulses.

Using the information shown in Fig. 5.1, outline how impulses are transmitted from receptor to effector.

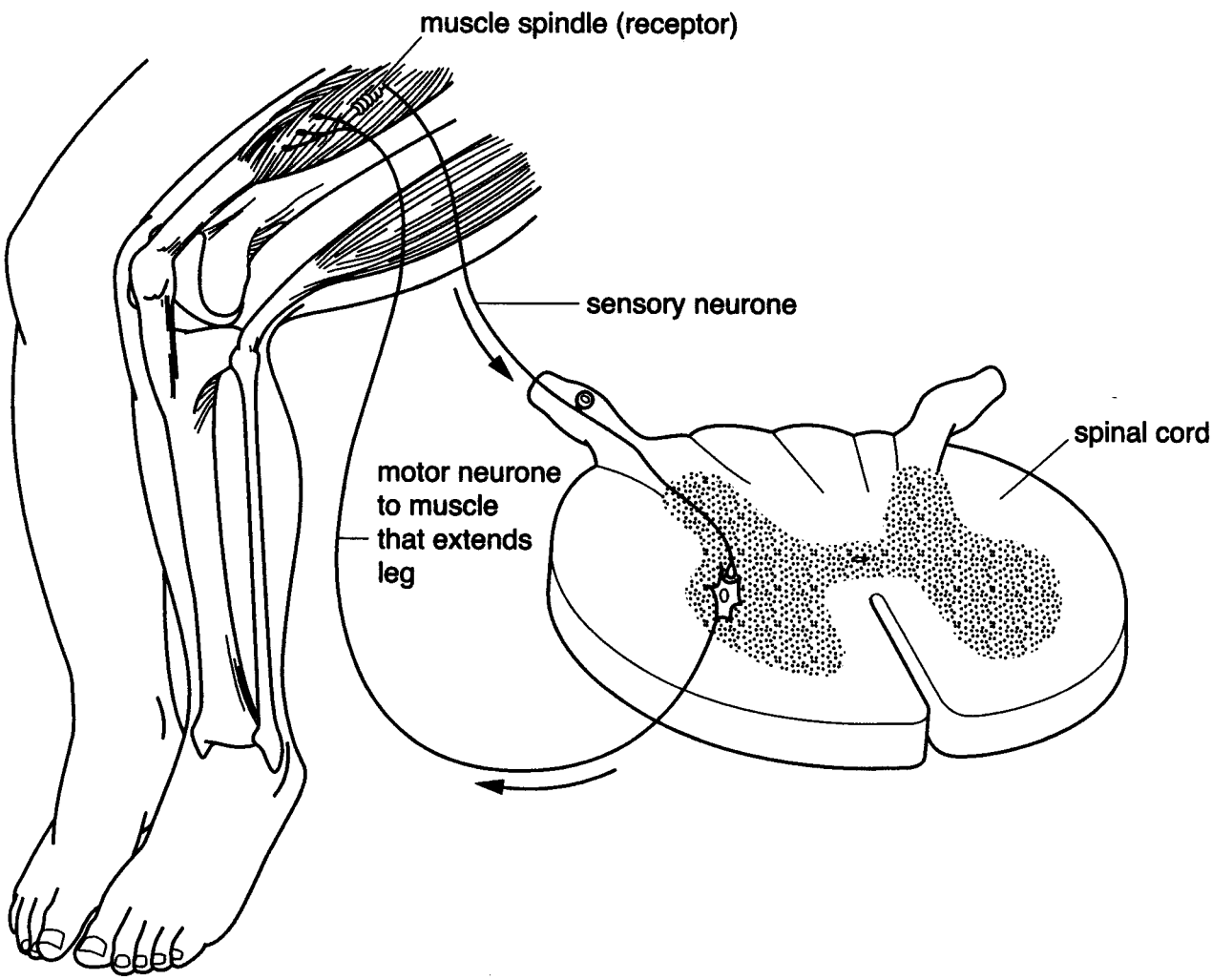

Fig. 5.1

For Examiner's Use

....[8]

Quality of Written Communication [1]

[Total: 14]

6 Fig. 6.1 is an outline of the glycolytic pathway.

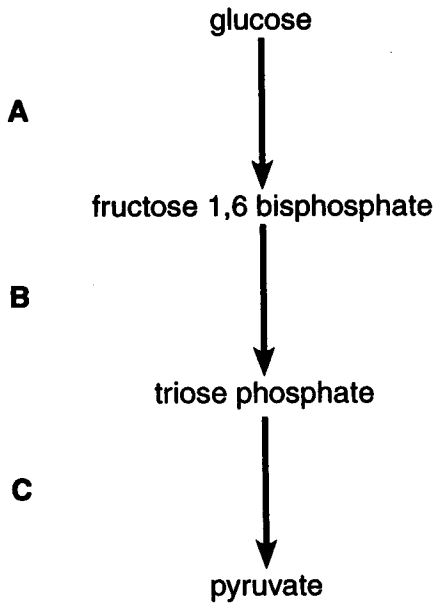

Fig. 6.1

(a) With reference to Fig. 6.1, state the letter, **A**, **B** or **C**, in the glycolytic pathway where the following processes occur.

phosphorylation using ATP .....

dehydrogenation .....

formation of ATP .....

splitting of a hexose ..... [4]

(b) State where glycolysis occurs in a cell.

.....[1]

(c) State the **net gain** in ATP molecules when **one** molecule of glucose is broken down to pyruvate in glycolysis.

.....[1]

(d) Describe what would happen to the pyruvate molecules formed under **anaerobic** conditions in mammalian muscle tissue.

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.....[3]

(e) Explain why, under **aerobic** conditions, lipids have a greater energy value per unit mass than carbohydrates or proteins.

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.....[2]

(f) Many chemicals will 'uncouple' oxidation from phosphorylation. In this situation, the energy released by oxidation of food materials is converted into heat instead of being used to form ATP. One such compound is dinitrophenol, which was used in munition factories for the manufacture of explosives during the First World War. People working in these factories were exposed to high levels of dinitrophenol.

Suggest **and** explain why people working in munitions factories during the First World War became very thin regardless of how much they ate.

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.....[3]

[Total: 14]

END OF QUESTION PAPER