

**ADVANCED GCE
HUMAN BIOLOGY**

Energy, Control and Reproduction
WEDNESDAY 24 JANUARY 2007

2866

Morning

Time: 1 hour 30 minutes

Additional materials:
Electronic calculator
Ruler (cm/mm)



Candidate
Name

Centre
Number

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Candidate
Number

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INSTRUCTIONS TO CANDIDATES

- Write your name, Centre Number and Candidate Number in the boxes above.
- Answer **all** the questions.
- Use blue or black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure you know what you have to do before starting your answer.
- Do **not** write in the bar code.
- Do **not** write outside the box bordering each page.
- **WRITE YOUR ANSWER TO EACH QUESTION IN THE SPACE PROVIDED. ANSWERS WRITTEN ELSEWHERE WILL NOT BE MARKED.**

INFORMATION FOR CANDIDATES

- The number of marks for each question 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

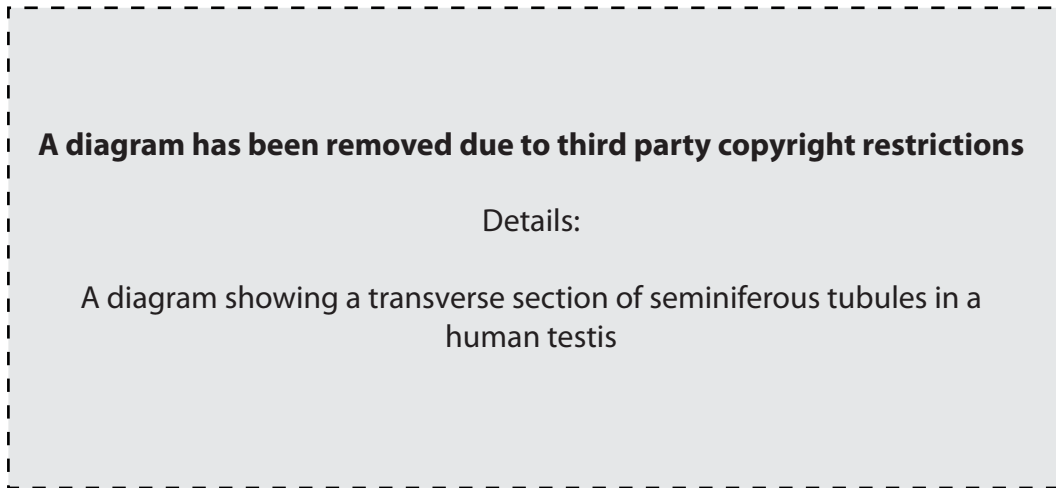
Qu.	Max.	Mark
1	18	
2	16	
3	12	
4	12	
5	15	
6	17	
TOTAL	90	

This document consists of **16** printed pages.

Answer all the questions.

- 1 Microscopic examination of the testes shows some of the processes involved in reproduction.

Fig. 1.1 shows a transverse section of seminiferous tubules in a human testis.



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Fig. 1.1

- (a) (i) Name the structures labelled A and B.

A

B [2]

- (ii) State the function of the Leydig cells.

..... [1]

(b) The following statements refer to the passage of sperm from their site of production in the testis as they move towards the oviduct.

Using the letters, **P** to **U**, place the statements in the correct order.

- P** sperm enter the cervix
- Q** sperm enter the vas deferens
- R** sperm enter the vagina
- S** sperm enter the epididymis
- T** sperm enter the uterus
- U** sperm enter the urethra

.....,,,,, [3]

(c) The fluid secreted by the prostate gland and seminal vesicles has the same water potential as the cytoplasm of the sperm cells.

Explain why this is necessary.

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.....[3]

(d) Sperm are produced by meiosis. During prophase I of meiosis, crossing over may occur.

Crossing over may result in different combinations of alleles on the chromatids of homologous chromosomes.

(i) Explain the meaning of the terms *gene* and *allele*.

gene
.....
allele
.....[4]

(ii) Explain the importance of crossing over in the production of sperm cells.

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.....[2]

(iii) Describe how independent assortment during metaphase I of meiosis, may lead to different combinations of alleles in a zygote following fertilisation.

You may use labelled diagrams if it helps with your answer.

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[3]

[Total: 18]

2 Respiration is the process that releases energy from respiratory substrates in the form of ATP. This makes the energy available to do work. Different respiratory substrates yield different quantities of energy. The value of the respiratory quotient (RQ) indicates which substrates are being respired.

(a) State what is meant by the term *respiratory quotient (RQ)*.

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.....[2]

(b) One way of calculating the RQ involves using a Douglas bag.

- The volume of expired air in a given period of time is measured.
- The concentrations of oxygen and carbon dioxide in the expired air are measured.
- The procedure is repeated a number of times.

(i) State a suitable instrument for measuring the oxygen or carbon dioxide concentrations in the expired air.

.....
.....[1]

(ii) Explain why the procedure is repeated a number of times.

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.....[2]

(iii) State what additional data would be required in order to calculate the RQ using the procedure outlined above.

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.....[1]

(c) Table 2.1 shows the RQ values obtained when different substrates are respired aerobically.

Table 2.1

respiratory substrate	RQ values
carbohydrate (glucose)	1.0
fat (lipid)	0.7
protein	0.9

(i) The RQ of an athlete **at rest** was measured as 0.85. What does this value suggest about the substrates being respired?

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[2]

(ii) The same athlete then sprinted for 100m. This intense activity used anaerobic respiration.

Describe **and** explain what would happen to the athlete's RQ value.

describe

.....

explain

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.....[3]

(d) Different respiratory substrates have different energy values. Carbohydrates and proteins both release about 17 kJg^{-1} , whereas fat releases about 39 kJg^{-1} .

(i) Explain why the energy value for a gram of fat is much higher than that of a gram of carbohydrate or protein.

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.....[2]

(ii) During intense activity muscle protein may be respired in muscle.

Describe what must happen to muscle proteins before they can enter the respiratory pathway.

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.....[3]

[Total: 16]

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.....[8]

Quality of Written Communication [1]

(b) In 2004 the legal classification of cannabis was changed from a class B to a class C drug.

This means that the law now regards cannabis as less dangerous.

Discuss the **social** and **ethical** issues that may arise from this change in the law.

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.....[3]

[Total: 12]

4 Humans eat a varied diet and are part of many food chains. Every time a human eats a piece of steak they are part of a food chain similar to the one shown in Fig. 4.1.



Fig. 4.1

(a) Energy from the sun enters the food chain by photosynthesis.

(i) Suggest why the rate of photosynthesis may be higher in tropical climates than in temperate climates.

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.....[2]

(ii) Explain the importance of producers, such as grass, in making energy available to consumers.

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.....[2]

(b) Of the energy contained in the grass tissues, 2700 kJ is eaten by the cattle and of this, 135 kJ is available to humans to eat as meat.

(i) Calculate the percentage efficiency of the energy transfer from cattle to humans. Show your working.

Answer =% [2]

(ii) Explain why only a small percentage of the energy eaten by the cattle is available to humans.

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(c) It is argued by some people that a diet based only on plants provides a more energy efficient way of feeding our rapidly growing world population.

Discuss this idea.

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.....[3]

[Total: 12]

5 The nervous system enables humans to be aware of and to respond to their environment. It is therefore important that it functions properly.

Fig. 5.1 is a flow diagram which shows how the nervous system is organised.

(a) (i) Write the names of the missing sections of the nervous system in the blank boxes on Fig. 5.1. [2]

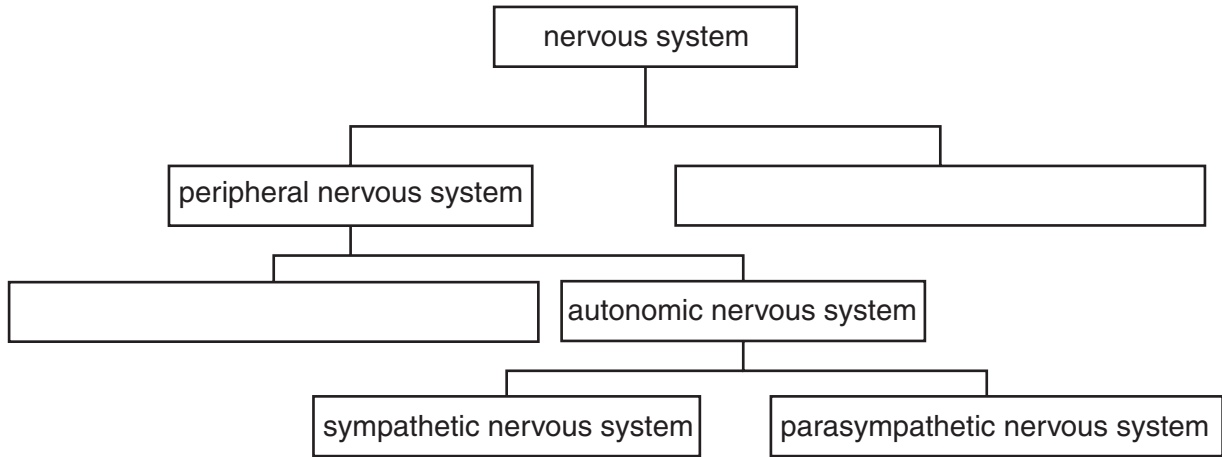


Fig. 5.1

(ii) State the name of the part of the nervous system **shown in Fig. 5.1** that directly controls the pupil reflex.

.....[1]

(b) (i) Infection by the rubella virus during pregnancy may cause a baby to be born with cataracts (clouding of the lens in the eye).

Suggest an explanation for the fact that cataracts are more likely to be present if the baby was exposed to the virus during the first three months of the pregnancy.

.....

[2]

(ii) Describe **and** explain the effect of the cataracts on the baby's ability to see.

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[2]

6 Fig. 6.1 shows an electron micrograph of a transverse section through the axon of a myelinated neurone.

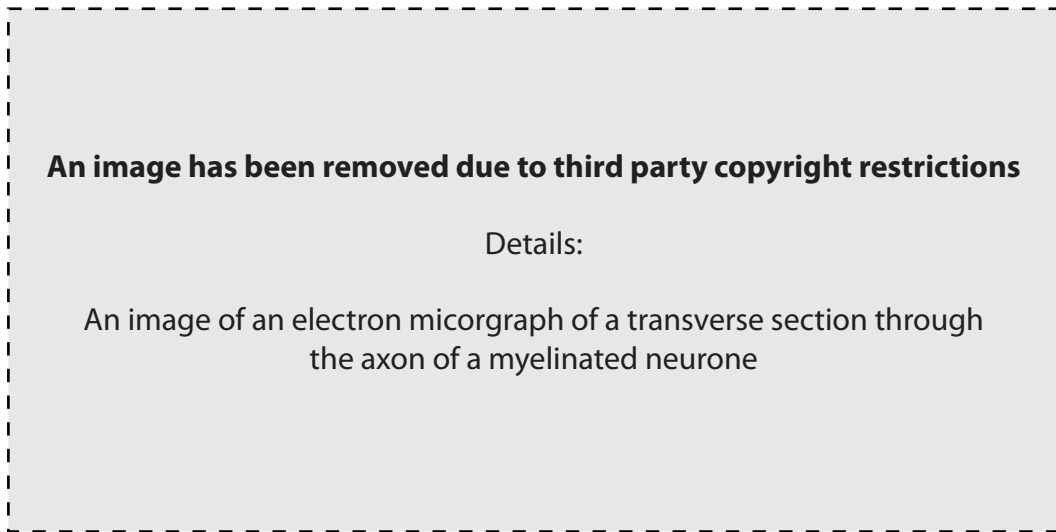


Image by Dr. Anthony M. Heape

Fig. 6.1

(a) (i) Name structures X and Y.

X

Y[2]

(ii) Calculate the magnification of the photograph.
Show your working.

Answer = [2]

(b) The cell membranes of Schwann cells contain myelin, a lipid containing a high proportion of saturated fatty acids.

(i) Apart from their role in the transmission of action potentials, state three other functions of cell membranes in general.

1

2

3[3]

- (ii) Saturated fatty acids are necessary for myelin formation. However, an excess of saturated fatty acids may harm the body.

Explain why.

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.....[3]

- (c) (i) The myelin sheath speeds up the transmission of the action potential along the axon.

Explain how the myelin sheath speeds up transmission of the action potential.

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- (ii) Suggest the likely effects of diseases of the nervous system in which the myelin sheath breaks down.

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.....[2]

[Total: 17]

END OF QUESTION PAPER

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