OCR
RECOGNISING ACHIEVEMENT

OXFORD CAMBRIDGE AND RSA EXAMINATIONS
Advanced GCE

BIOLOGY 2804

Central Concepts

Tuesday **21 JUNE 2005** 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	13	
2	13	
3	15	
4	14	
5	12	
6	14	
7	9	
TOTAL	90	

This question paper consists of 17 printed pages and 3 blank pages.

For Examiner's Use

Answer **all** the questions.

1 Fig. 1.1 is a diagram of a section through a mitochondrion.

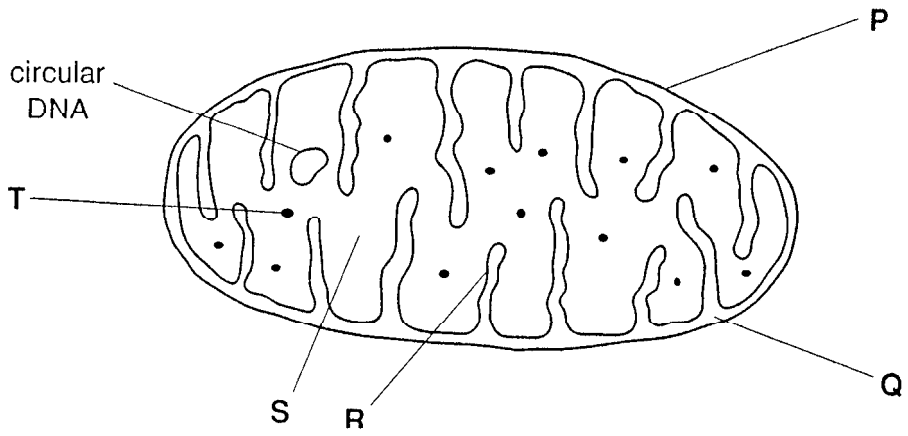

Fig. 1.1

(a) In each case, state the letter which indicates the site of:

the Krebs cycle .....

oxidative phosphorylation .....

decarboxylation ..... [3]

(b) Suggest **one** function of the loop of DNA shown in Fig. 1.1.

.....

.....

.....[1]

Fig. 1.2 is a diagrammatic representation of a section through the inner mitochondrial membrane showing the processes leading to ATP formation.

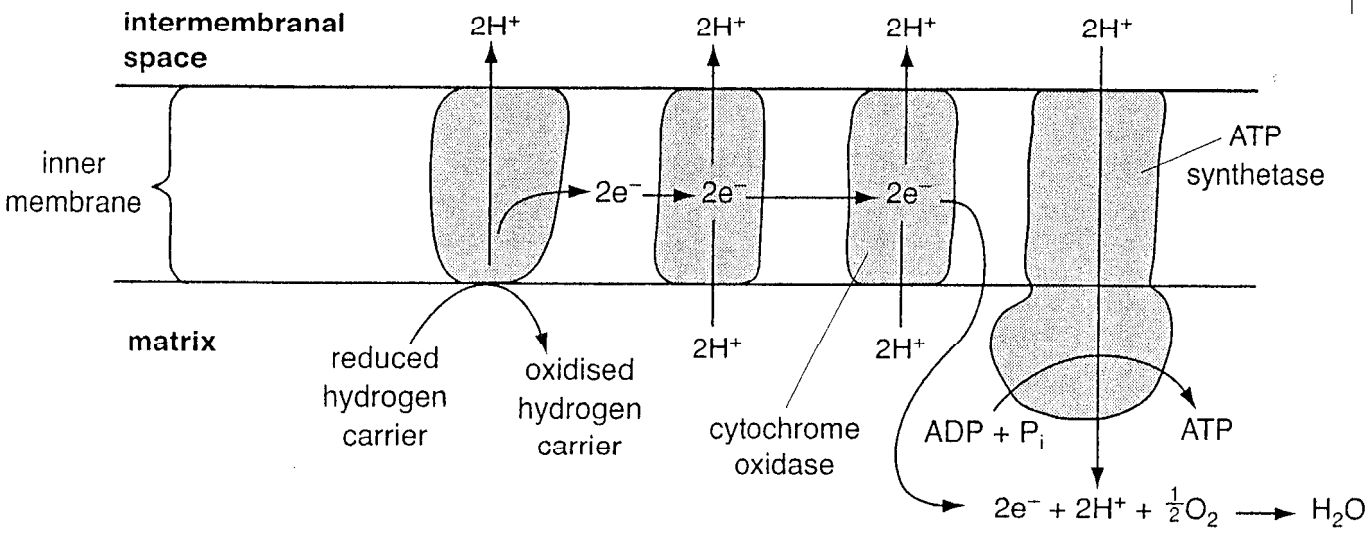

Fig. 1.2

(c) Name a hydrogen carrier that links the Krebs cycle to the electron transport chain.

.....[1]

(d) Explain how oxidative phosphorylation results in the production of ATP.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....[5]

(e) The poison cyanide binds with cytochrome oxidase, one of the electron carriers. When this happens, the flow of electrons stops.

Suggest how ingestion of cyanide by humans leads to death by muscle failure.

.....

.....

.....

.....

.....

.....[3]

[Total: 13]

2 There are several different pigments involved in the light-dependent reactions of photosynthesis in flowering plants.

(a) Name **two** photosynthetic pigments found in flowering plants.

1 .....

2 .....[2]

The pigments are arranged in photosystems that absorb light. There are two photosystems: photosystem I and photosystem II.

(b) State:

(i) the precise site where the photosystems are located in chloroplasts;

.....[1]

(ii) **one** way in which photosystem I differs from photosystem II.

.....[1]

Fig. 2.1 is a diagram that shows the relationship between the light-dependent reactions of photosynthesis and the Calvin cycle in a chloroplast.

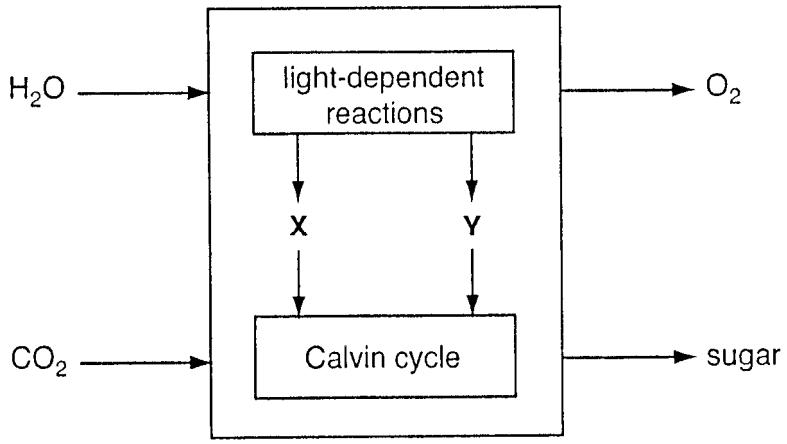

Fig. 2.1

(c) Name the substances **X** and **Y** shown in Fig. 2.1.

X .....

Y .....[1]

For Examiner's Use

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

In the palisade cells of a leaf, the fixation of carbon dioxide occurs in the Calvin cycle.

Describe the main features of this cycle. **No credit will be given for a flow diagram of the cycle.**

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....[7]

Quality of Written Communication

[Total: 13]

3 In guinea pigs, the genes for coat texture and coat colour are found on separate chromosomes. The allele for rough coat is dominant to the allele for smooth coat. The allele for black coat is dominant to the allele for white coat.

A black guinea pig with a rough coat was crossed with a white guinea pig with a rough coat. The cross was repeated on a number of occasions and the phenotypes of the offspring were as follows:

28 rough and black coats

31 rough and white coats

11 smooth and black coats

10 smooth and white coats

(a) Complete the genetic diagram to explain this cross.

Use the following symbols to represent the alleles:

R = rough r = smooth
B = black b = white

Parental phenotypes:	rough and black coat	×	rough and white coat
Parental genotypes:	.....		.....
Gametes:	.....		.....

Offspring genotypes: .....

Offspring phenotypes: .....

Expected phenotypic ratio: .....[5]

(b) A gene controlling coat colour in cats is **sex linked**. The two alleles of this gene are black and orange. When both the black and orange alleles are present, the coat colour produced is called tortoiseshell.

(i) Define the following terms.

gene .....

.....

.....

.....[2]

allele .....

.....[1]

(ii) Explain why there are no male tortoiseshell cats.

.....

.....

.....

.....[2]

(c) The bacterium *Escherichia coli* uses glucose as a respiratory substrate. In the absence of glucose, *E. coli* can use lactose.

Explain how lactose induces the enzyme system involved in its uptake and metabolism.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....[5]

[Total

For Examiner's Use

4 (a) Explain the term *endocrine gland.*

.....

.....

.....[2]

(b) Fig. 4.1 is a flow diagram of the role of the pancreas in controlling blood glucose concentrations. Study the diagram and answer the questions below.

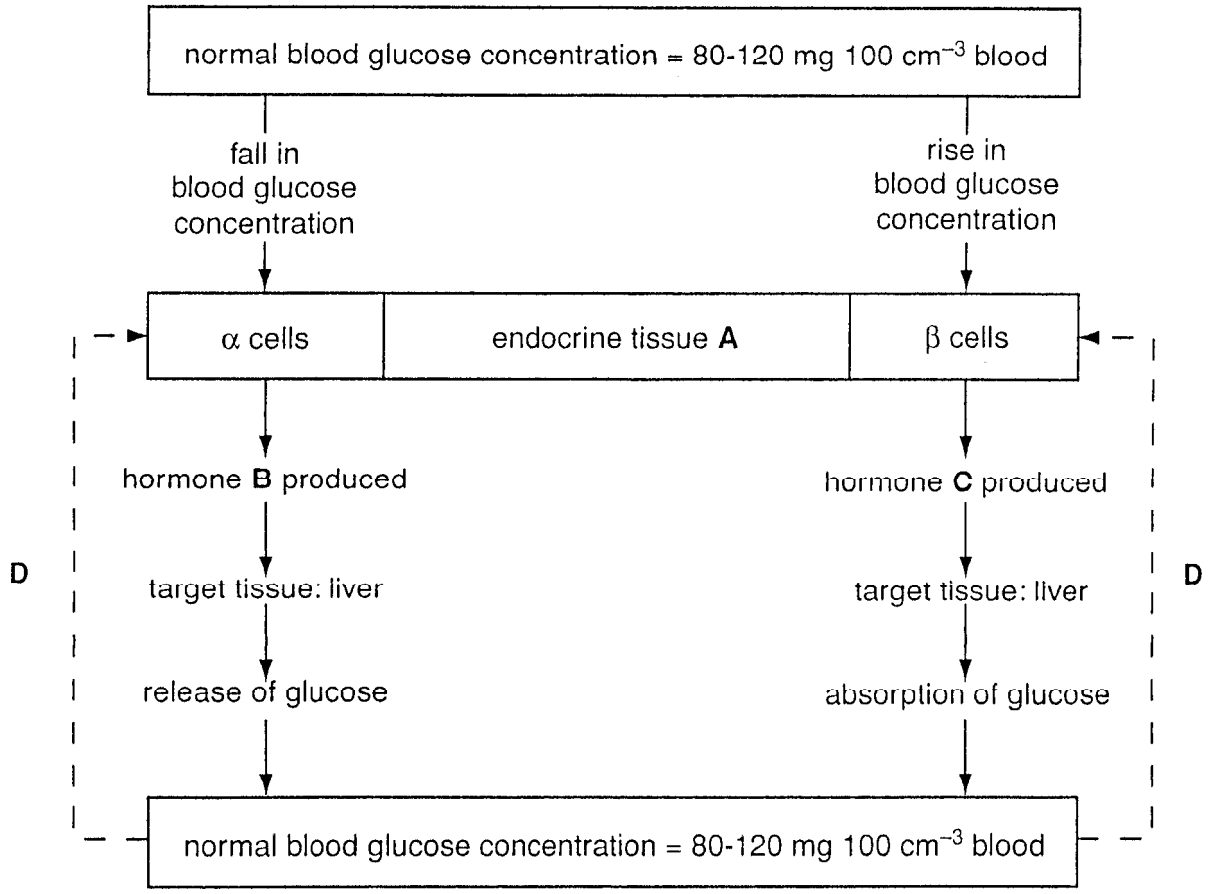

Fig. 4.1

(i) Name the endocrine tissue labelled **A**. .....[1]

(ii) Name the hormone, **B**, produced by the α cells. .....[1]

(iii) Name the hormone, **C**, produced by the β cells. .....[1]

(iv) Name the process represented by the dotted lines labelled **D**.

.....[1]

(v) Describe how hormone **B** brings about a rise in blood glucose concentration when it reaches the liver.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....[5]

(c) Untreated diabetes is a condition that can lead to blood glucose concentrations often rising above 120 mg 100 cm^{-3} of blood. Genetic engineering has been used to improve the treatment of diabetes.

Explain the advantages of using genetic engineering in the treatment of diabetics.

.....

.....

.....

.....

.....

.....[3]

[Total: 14]

5 Resistance to the poison warfarin is now extremely common in rats. Warfarin inhibits an enzyme in the liver that is necessary for the recycling of vitamin K. This vitamin is involved in the production of substances required for blood clotting. There are two alleles of the gene that codes for this enzyme. Resistant rats have the allele $\mathbf{R^R}$; rats susceptible to warfarin have the genotype $\mathbf{R^S R^S}$.

- Rats susceptible to warfarin die of internal bleeding.
- Homozygous resistant rats do not suffer from internal bleeding if their diet provides more than 70 μg of vitamin K per kg body mass per day.
- Heterozygous rats are resistant to warfarin if their diet provides about 10 μg of vitamin K per kg body mass per day.

(a) A population of rats was studied in an area where warfarin was used. The dietary intake of the rats was about 15 μg of vitamin K per kg body mass per day.

Complete the table below to indicate whether rats of the three genotypes have a **high** or a **low** chance of surviving to maturity in this population. Explain each of your answers.

genotype	chance of surviving to maturity	explanation
$\mathbf{R^R R^R}$		
$\mathbf{R^R R^S}$		
$\mathbf{R^S R^S}$		

[3]

(b) **(i)** State how the allele for warfarin resistance originated.

.....[1]

(ii) Explain how the allele spread through the population.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....[5]

(c) State why this is an example of **natural** selection.

.....

.....[1]

(d) Explain what is likely to happen to the frequencies of the two alleles (R^R and R^S) within the rat population over a period of time if warfarin use is discontinued.

.....

.....

.....

.....[2]

[Total: 12]

6 Table 6.1 shows how the speed of nerve impulse conduction varies with the diameter of myelinated and non-myelinated axons in different organisms.

Table 6.1

organism	type of axon	axon diameter / μm	speed of impulse / m s^{-1}
crab	non-myelinated	30	5
squid	non-myelinated	500	25
cat	myelinated	20	100
frog	myelinated	16	32

(a) Describe the trends shown in Table 6.1.

.....

.....

.....

.....[2]

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

Explain how nerve impulses are transmitted along axons accounting for the differences shown in Table 6.1.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....[7]

Quality of Written Communication [1]

(c) Explain the term *refractory period* **and** outline its importance in nerve impulse conduction.

.....

.....

.....

.....

.....

.....

.....[4]

[Tot

7 Fig. 7.1 shows a typical bacterial growth curve for a closed system, such as a test tube or conical flask.

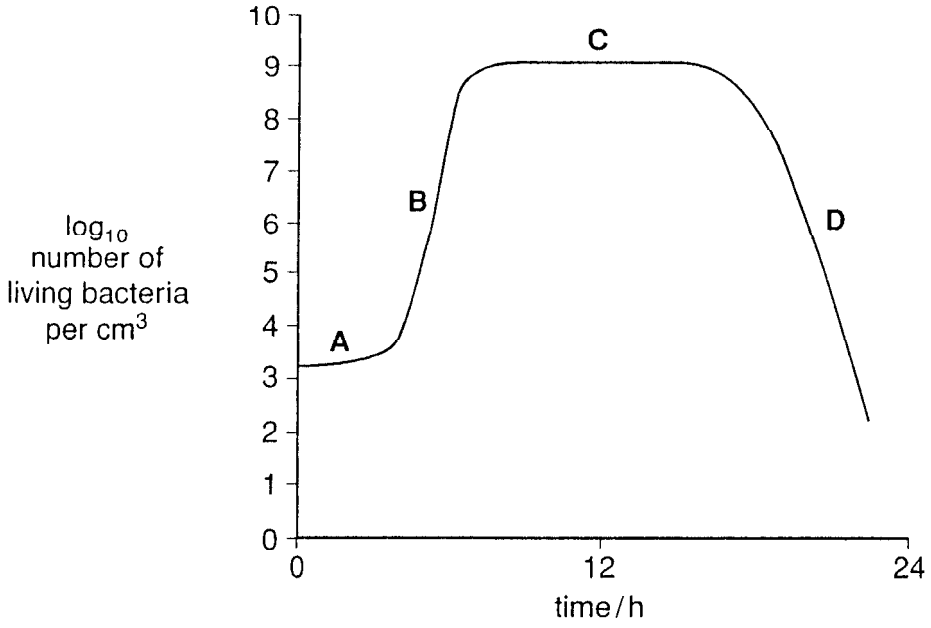

Fig. 7.1

(a) Complete the table below by writing the appropriate letter from Fig. 7.1 in the spaces provided.

description of stage	letter
cells divide at a constant rate depending upon the composition of the growth medium and the conditions of the incubation	
some cells are dividing and an equal number are dying	
number of living cells is decreasing	
time required for synthesis of inducible enzymes and factors involved in cell division	

[4]

(b) Generation time **(G)** is defined as the length of time **(t)** from one generation to the next.

The mean generation time is calculated using the following formula:

$G = \frac{t}{n}$ where **t** = time and **n** = number of generations

(i) The bacterium *Streptococcus lactis* has been shown to divide 55 times during 24 hours.

Calculate the mean generation time of this bacterium in minutes. Show your working.

Generation time = ... minutes [2]

(ii) The generation time for *Escherichia coli* in a laboratory can be 20 minutes, but in the intestinal tract it can be as much as 24 hours. Suggest **three** reasons for this difference.

1 .....

.....

2 .....

.....

3 .....

.....[3]

[Total: 9]

END OF QUESTION PAPER