Centre No.						Paper Reference							Surname	Initial(s)
Candidate No.						6	1	0	4	/	0	1	Signature	

Paper Reference(s)

6104/01

Edexcel GCE

Biology

Biology (Human)

Advanced

Unit 4A Core and Option

Microbiology and Biotechnology

Tuesday 20 June 2006 – Morning

Time: 1 hour 30 minutes

Examiner's use only

Team Leader's use only

Question Number	Leave Blank
1	
2	
3	
4	
5	
Paper 11 Total	
6	
7	
8	
9	
Paper 12 Total	
Total	

Materials required for examination

Ruler

Items included with question papers

Nil

Instructions to Candidates

In the boxes above, write your centre number, candidate number, your surname, initial(s) and signature.
The paper reference is shown above. Check that you have the correct question paper.
Answer ALL questions in the spaces provided in this booklet.
Show all the steps in any calculations and state the units. Calculators may be used.
Include diagrams in your answers where these are helpful.

Information for Candidates

The marks for the individual questions and parts of questions are shown in round brackets: e.g. (**2**).
The total mark for this question paper is 70.

Advice to Candidates

You will be assessed on your ability to organise and present information, ideas, descriptions and arguments clearly and logically, taking into account your use of grammar, punctuation and spelling.

Printer's Log. No.
N22193A
W850/R6104/57570 7/7/7/7/2/7300

N 2 2 1 9 3 A 0 1 2 0

Turn over

edexcel

BLANK PAGE

Leave blank

Answer ALL questions in the spaces provided.

1. Phytochromes are pigments found in plants. One form of phytochrome is known as P_{FR} (or P_{730}).

(a) Name **one** place in a plant where P_{FR} is found.

.....

(1)

(b) State the effect that the following conditions have on P_{FR}.

Darkness .....

.....

.....

Exposure to far red light .....

.....

.....

(2)

(c) Describe how the effects of exposure of P_{FR} to darkness could be reversed.

.....

.....

.....

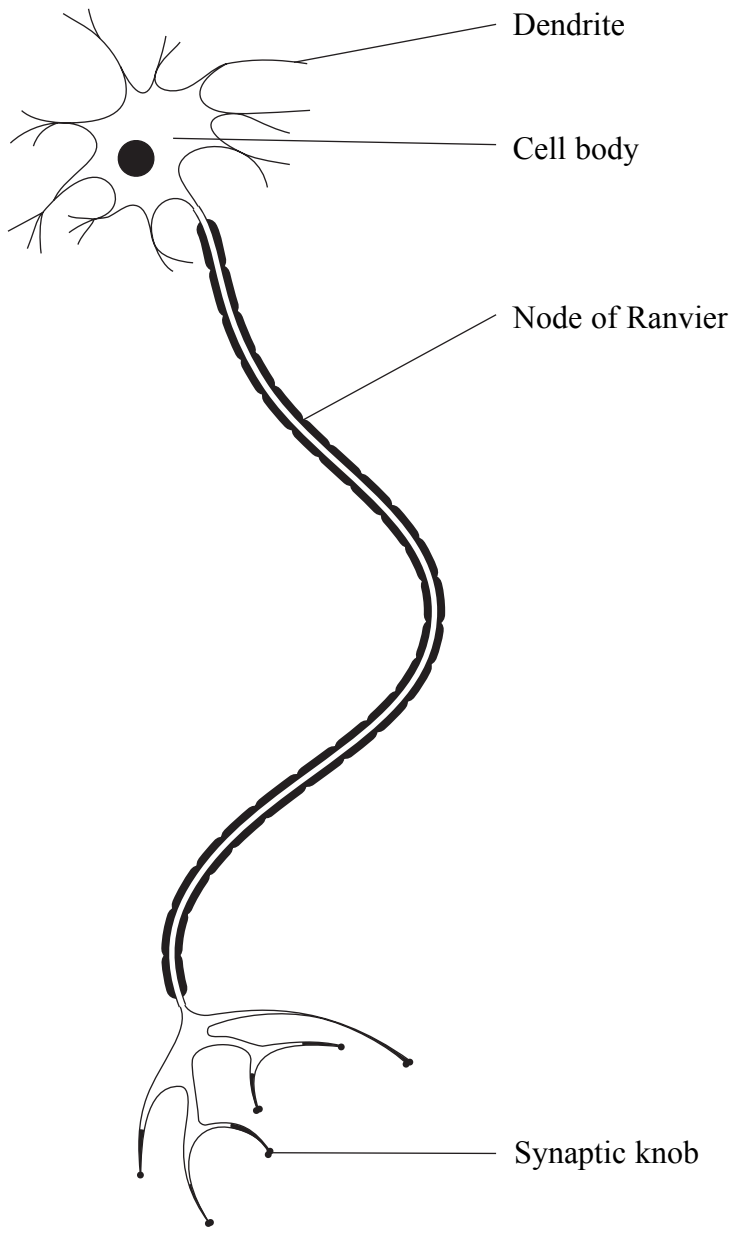
(1)

Q1

(Total 4 marks)

Leave blank

2. The diagram below shows one type of mammalian neurone.



(a) (i) Name the type and state the role of the neurone shown in the diagram.

Type: .....

Role: .....

.....

.....

(2)

(ii) Draw an arrow on the diagram to show the direction in which an impulse would travel.

(1)

Leave blank

(b) State precisely where in the central nervous system the cell body of this type of neurone is found and explain the importance of the dendrites.

.....

.....

.....

.....

.....

.....

(2)

(c) Describe the node of Ranvier and explain its importance in the neurone.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(3) **Q2**

(Total 8 marks)

Leave blank

3. In non-diabetic individuals, the pancreas secretes hormones which maintain the blood glucose concentration within narrow limits.

The table below shows the changes in blood glucose concentrations of non-diabetic and diabetic men over a sixty-minute period, after eating a glucose-rich meal.

Time after meal / min	Mean blood glucose concentration / mmol dm^{-3}	
	Non-diabetic men	Diabetic men
0	5.5	11.9
30	7.3	16.4
60	4.9	17.7

(a) Compare the changes in mean blood glucose concentrations of the non-diabetic and the diabetic men over the sixty-minute period.

.....

.....

.....

.....

.....

.....

.....

.....

.....

(3)

(b) (i) One possible cause of diabetes is insufficient insulin production.
What evidence is there in the table to support this idea?

.....

.....

.....

.....

.....

.....

(2)

Leave blank

(ii) Suggest why it is important for the blood glucose concentration to be maintained within narrow limits.

.....

.....

.....

.....

.....

.....

.....

(2)

(c) After a further sixty minutes, without any additional glucose intake, the mean blood glucose concentration of the non-diabetic men was 5.5 mmol dm^{-3}.

Explain how this change in concentration occurred.

.....

.....

.....

.....

.....

.....

.....

.....

.....

(3)

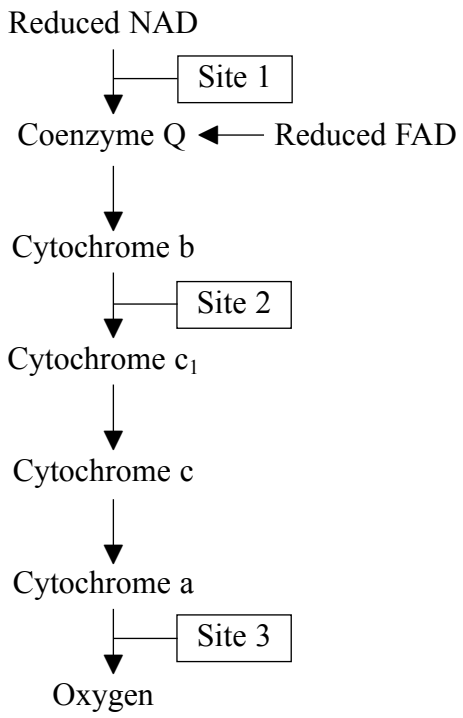
Q3

(Total 10 marks)

Leave blank

4. In oxidative phosphorylation, ATP is formed when electrons pass down the electron transport chain from one component to the next. ATP is synthesised at three sites.

The order of some components in the electron transport chain and the three sites of ATP synthesis are shown in the diagram below.



(a) The oxidation of one molecule of reduced NAD ($NADH + H^+$) yields three molecules of ATP.

Using the information given in the diagram above and your knowledge of mitochondria and oxidative phosphorylation, explain how the three molecules of ATP are made.

.....

.....

.....

.....

.....

.....

.....

.....

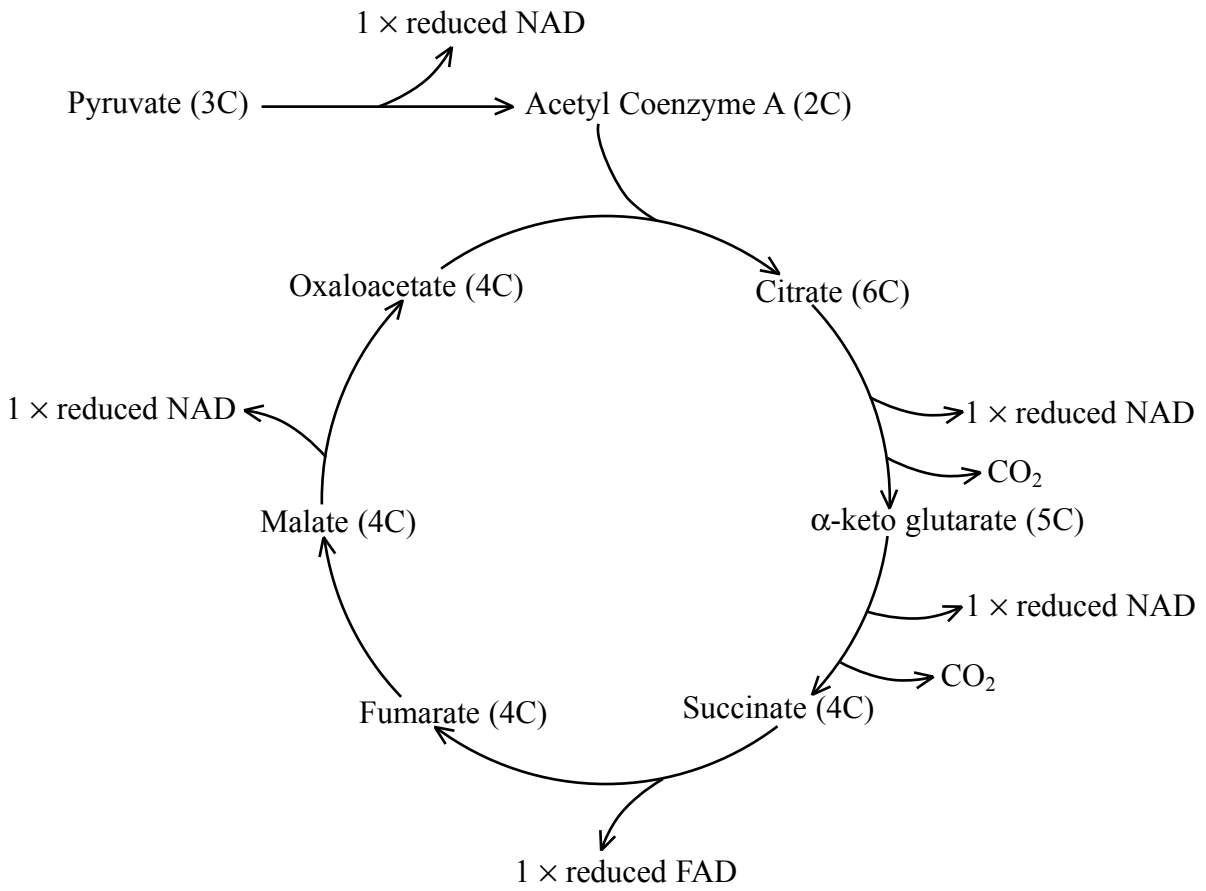
.....

.....

(4)

Leave blank

(b) The diagram below shows some of the stages that occur in the Krebs cycle.



Using the information given in both diagrams, explain why the oxidation of one molecule of succinate to oxaloacetate yields only five molecules of ATP.

.....

.....

.....

.....

.....

.....

(3)

(c) State where in the cell the following processes take place.

Glycolysis .....

Conversion of pyruvate to acetyl coenzyme A .....

Krebs cycle .....

(3)

Q4

(Total 10 marks)

Leave blank

5. Give an account of the structure of the kidney.

Leave blank

Q5

(Total 8 marks)

Leave blank

BLANK PAGE

Leave blank

Option A: Microbiology and biotechnology

6. (a) Distinguish between an endotoxin and an exotoxin.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(3)

(b) Compare the structure of the λ (lambda) phage with the structure of the human immunodeficiency virus (HIV).

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(3) **Q6**

(Total 6 marks)

Leave blank

7. Production of penicillin is by batch fermentation. The diagram below summarises the main steps involved in the production of penicillin.

Step 1: *Penicillium* added to culture fluid in a fermenter

↓

Step 2: Aerobic fermentation

↓

Step 3: Separation into two fractions:
Fraction 1 *Penicillium*
Fraction 2 Culture fluid

↓

Step 4: Extraction of penicillin

(a) Name the group of microorganisms to which *Penicillium* belongs.

.....

(1)

(b) (i) Explain what is meant by the term **batch fermentation**.

.....

.....

.....

.....

(2)

(ii) Explain why batch fermentation is used in the production of penicillin.

.....

.....

.....

.....

(2)

Leave blank

(c) State which of the two fractions, separated in Step 3, is used in Step 4. Give a reason for your answer.

.....

.....

.....

.....

.....

.....

(2) **Q7**

(Total 7 marks)

Leave blank

8. An experiment was carried out to investigate the effect of pH on the growth of two species of bacteria: *Lactobacillus bulgaricus* and *Escherichia coli*.

Liquid media ranging between pH 4 and pH 9 were prepared. Suspensions containing 6×10^6 viable bacterial cells per cm^3 of each of the bacterial species were made. A 2 cm^3 sample of the *E. coli* suspension was added to 20 cm^3 of each of the liquid media. This was repeated for *L. bulgaricus*.

All the liquid cultures were then incubated at 35 °C for eight hours. At the end of this incubation period, the number of viable bacterial cells in each of the liquid cultures was determined.

The results are shown in the table below.

pH of liquid culture	Number of viable bacterial cells $\times 10^5$ per cm^3	
	E. coli	*L. bulgaricus*
4	0	5
5	0	800
6	5	2600
7	300	400
8	3100	0
9	0	0

(a) Calculate the number of viable *E. coli* cells in 1 cm^3 of the liquid culture at the start of the incubation period. Show your working.

Answer ..... cells per cm^3

(3)

Leave blank

(b) (i) Compare the effect of pH on the survival and growth of these two species of bacteria.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(3)

(ii) Suggest an explanation for the different effects of pH on these two species of bacteria.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(3) **Q8**

(Total 9 marks)

Leave blank

9. An experiment was carried out to study the growth of bacteria in a medium containing glucose as a carbon source.

A liquid culture of bacteria was set up and incubated at 25 °C for 24 hours. The glucose concentration at the start was 0.05 mol dm^{-3}. Samples were removed every 2 hours for 24 hours and the number of viable cells determined.

(a) (i) Name one method which could have been used to determine the number of viable cells in this experiment.

.....

.....

(1)

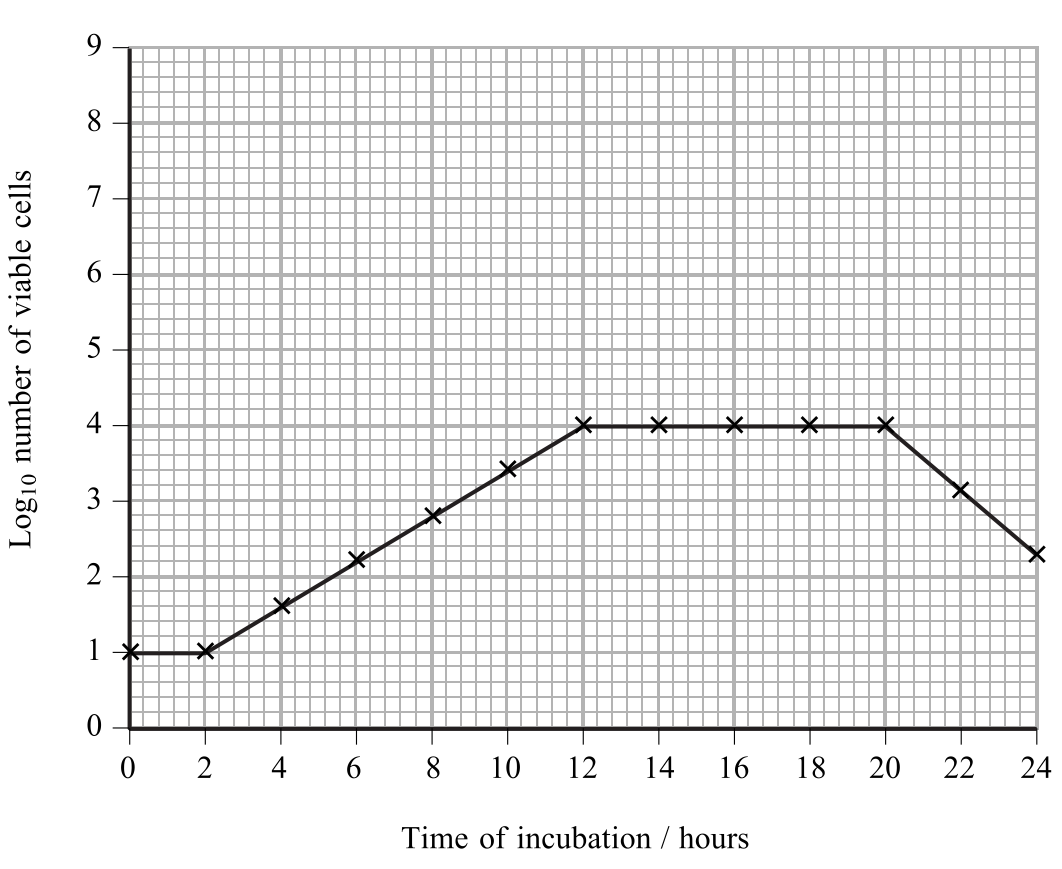
(ii) State one precaution that must be taken to ensure an accurate count is made.

.....

.....

(1)

The results of the experiment are presented in the graph below.



Leave blank

In a second experiment, another culture was set up in the same way. After 12 hours some sucrose was added to the culture to give a sucrose concentration of 0.05 mol dm^{-3}.

Samples were removed every 2 hours for the next 10 hours and the number of viable cells determined.

(b) (i) On the graph draw a line to show how the number of viable cells may have changed from 12 to 24 hours.

(3)

(ii) Give an explanation for the shape of the curve you have drawn.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(3) Q9

(Total 8 marks)

TOTAL FOR PAPER: 70 MARKS

END

BLANK PAGE