

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

Friday 12 June 2009 – Afternoon

Time: 1 hour 30 minutes

Examiner's use only

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Team Leader's use only

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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 NINE 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.

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Answer ALL questions in the spaces provided.

1. Rhodopsin is the light-sensitive pigment contained in rod cells.

The diagram below shows a rod cell from the retina of a mammal.



(a) Use the letter **R** to label on the diagram where rhodopsin is found in the rod cell. **(1)**

(b) When a person enters a dimly-lit room, after being in bright sunlight, objects in the room only gradually become more visible. Give an explanation for this.

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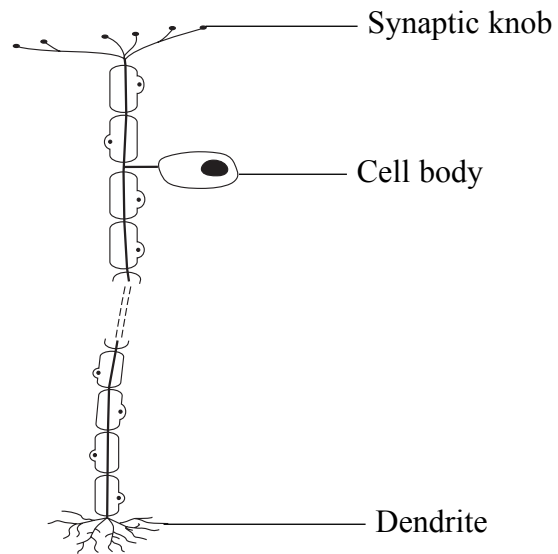
(3)

Q1

(Total 4 marks)



2. (a) The diagram below shows one type of mammalian neurone.



(i) Name the type of neurone shown in this diagram.

..... (1)

(ii) Describe the function of this type of neurone.

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..... (2)

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

..... (1)

(b) Explain what is meant by the term **action potential**.

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..... (2)

(Total 6 marks)

Q2



3. (a) The photograph below shows a mitochondrion as seen using an electron microscope.



PR. G Gimenez Martin/Science Photo Library
Magnification $\times 20\,000$

(i) Name the parts labelled **B** and **C**.

B

C

(2)

(ii) Give the **letter** that represents the location of the electron transport chain.

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(1)



(b) Antimycin A is an inhibitor of the electron transport chain. It binds to one of the electron carriers in the chain. An experiment was carried out to investigate the effect of Antimycin A on the respiration of yeast cells.

Yeast cells were mixed with a buffer solution containing ADP, phosphate ions and glucose to form a suspension. This suspension was then placed in a waterbath at 30 °C and incubated for 30 minutes. During this time, the oxygen content of the suspension was measured.

The experiment was then repeated with Antimycin A added to the suspension 5 minutes after the start of the incubation.

The results are shown in the table below.

Time of incubation / mins	Oxygen content of suspension / arbitrary units	
	Without Antimycin A	With Antimycin A added 5 minutes after the start of incubation
0	6.4	6.4
5	3.7	3.7
10	2.4	3.7
15	1.6	3.7
20	0.9	3.7
25	0.5	3.7
30	0.5	3.7

(i) Suggest why the oxygen content of the suspension of cells without Antimycin A did not reach zero.

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(2)



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(ii) Explain why the oxygen concentration of the suspension did not decrease after Antimycin A was added.

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(2)

(iii) Suggest what effect the addition of Antimycin A will have on the production of ATP.

Give an explanation for your answer.

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(3)

(Total 10 marks)

Q3



4. (a) An investigation was carried out to study the effect of the age of a person on the ability to control blood glucose concentration.

A group of non-diabetic men of different ages fasted (did not eat) for 12 hours and then their blood glucose concentration was measured. Each man then drank the same volume of a solution containing a high concentration of glucose.

The blood glucose concentration of each man was measured 30 minutes after drinking the solution. This allows time for all of the glucose to be absorbed into the bloodstream. The blood glucose concentration was measured again 120 minutes after drinking the solution.

The results are shown in the table below.

Age / years	Blood glucose concentration / mmol dm ⁻³		
	After fasting, before drinking glucose solution	30 minutes after drinking glucose solution	120 minutes after drinking glucose solution
30	5.3	8.8	6.1
40	5.5	8.9	6.5
50	5.4	8.8	6.7
60	5.6	9.0	7.6
70	5.7	8.9	8.1
80	5.7	8.8	8.2

- (i) The blood glucose concentration at 120 minutes is lower than at 30 minutes after drinking the glucose solution.

Using information from the table, describe the effect of age on the rate at which blood glucose concentration falls.

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(3)



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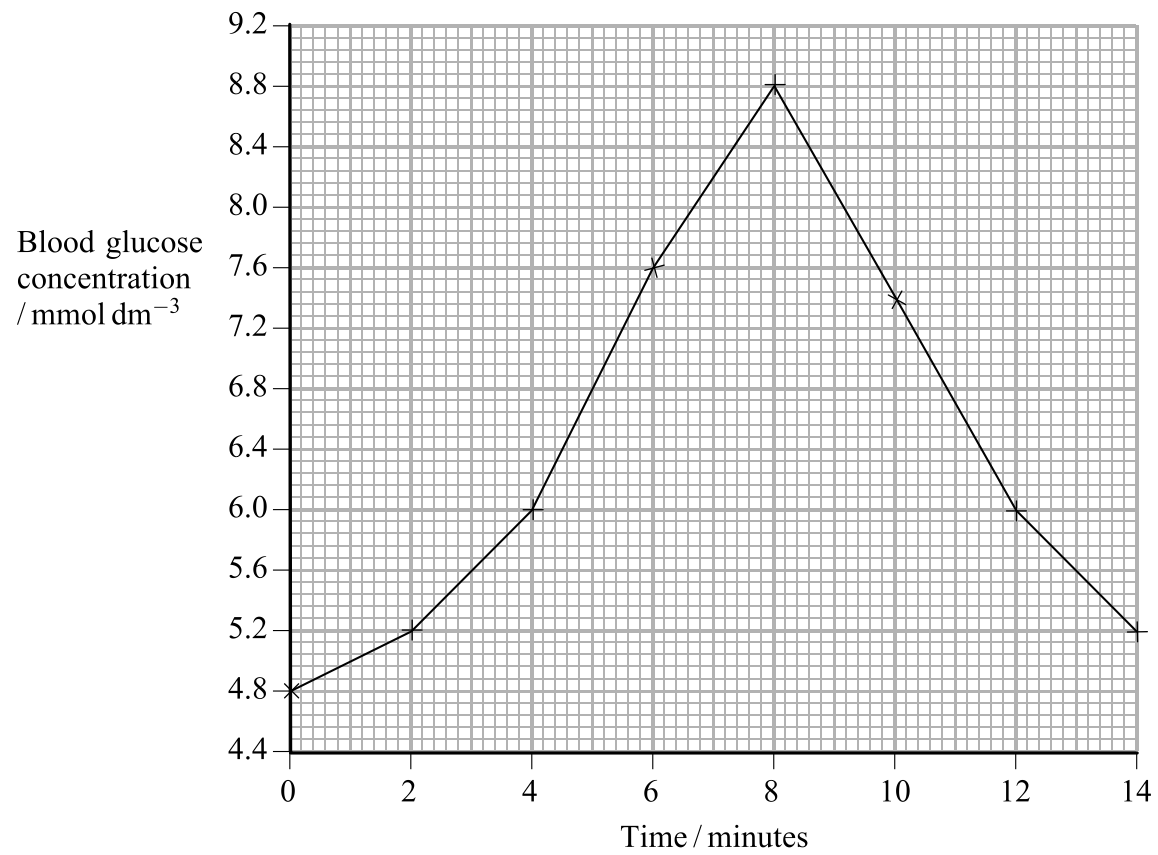
(ii) Suggest **one** explanation for the effect of age on the ability to control blood glucose concentration.

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(1)

(b) In a separate investigation, a man fasted for three hours and was then given an injection of glucagon. His blood glucose concentration was measured at two minute intervals after the injection.

The results are shown in the graph below.



Leave
blank

- (i) Calculate the percentage increase in blood glucose concentration between 0 and 8 minutes after the injection of glucagon. Show your working.

Answer%
(3)

- (ii) Explain how glucagon causes an increase in blood glucose concentration.

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(3)

- (iii) Name **one** other hormone that causes an increase in blood glucose concentration.

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(1)

(Total 11 marks)

Q4

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Option A: Microbiology and Biotechnology

6. The table below refers to some of the stages involved in Gram staining and the appearance of Gram negative and Gram positive bacteria after each stage. Complete the table by writing the most appropriate word or words in the empty boxes.

Stage of Gram staining	Appearance of Gram negative bacteria	Appearance of Gram positive bacteria
Cells heat fixed onto slide	Colourless	Colourless
Slide flooded with crystal violet		
Slide flooded with Gram's iodine		
Slide rinsed with alcohol or acetone		
Slide counterstained with safranin / carbol fuchsin		

(Total 4 marks)

Q6



7. The bacterium *Mycobacterium tuberculosis* causes a disease called tuberculosis (TB). TB can be a disease of the lung (pulmonary TB) or other parts of the body (non-pulmonary TB). In some cases, this can cause death.

(a) Explain how this bacterium causes TB.

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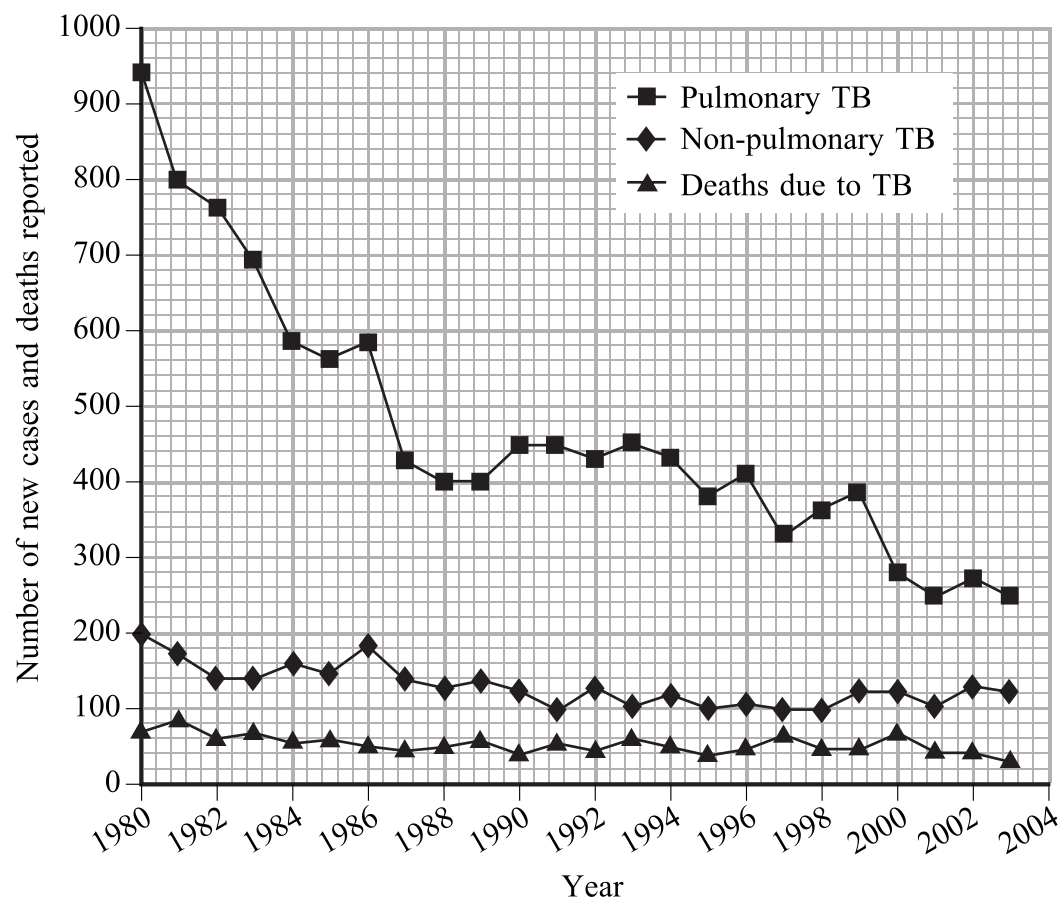
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(2)

(b) The graph below shows the number of new cases of TB and the number of deaths from TB reported each year in Scotland, between 1980 and 2004.



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(i) Describe how the number of new cases of pulmonary TB changed between 1980 and 2004.

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(2)

(ii) Suggest reasons why the number of deaths from TB remained fairly constant between 1980 and 2004.

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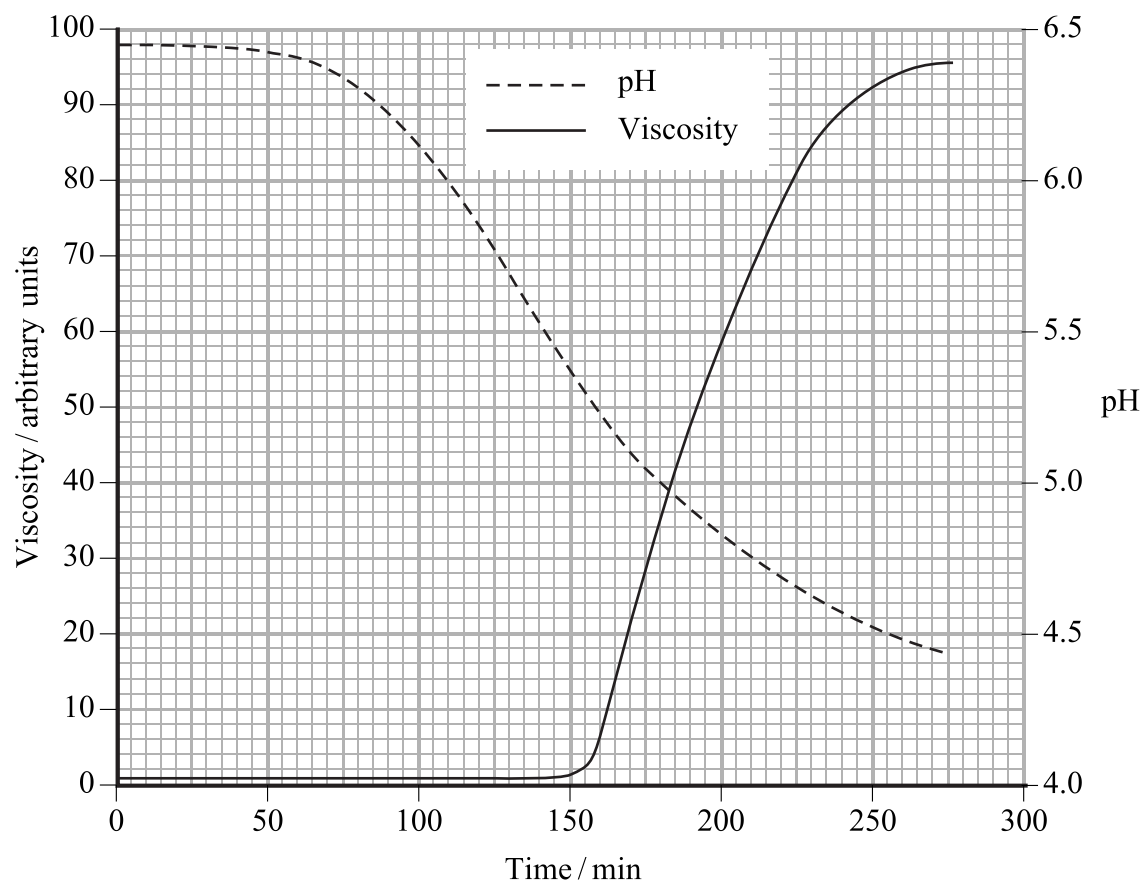
(Total 6 marks)

Q7



8. Microorganisms are involved in the production of yoghurt and antibiotics.

(a) The graph below shows the changes in viscosity (thickness) and pH that occur during yoghurt production.



(i) Describe how the changes in pH affect the viscosity of the yoghurt.

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(2)



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(ii) Give an explanation for the viscosity changes during yoghurt production.

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(3)

(b) Describe the use of a fermenter (bioreactor) in the production of the antibiotic penicillin.

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(4)

Q8

(Total 9 marks)



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9. An investigation was carried out to examine diauxic growth as shown by the bacterium *Pseudomonas denitrificans*. The bacterium was cultured in a fermenter (bioreactor), in anaerobic conditions. The turbidity of the bacterial culture was measured every hour using a colorimeter.

The results are shown in the table below.

Time / hours	Turbidity / arbitrary units
0	0.07
1	0.07
2	0.08
3	0.09
4	0.09
5	0.10
6	0.11
7	0.12
8	0.13
9	0.14
10	0.14

- (a) State how turbidity is measured by a colorimeter.

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(1)

- (b) Calculate the percentage increase in turbidity during the first 3 hours.

Answer%
(2)



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(c) Describe and explain the changes in turbidity.

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(4)

(d) Dilution plating could be used to assess the number of living cells of *Pseudomonas denitrificans* in this culture.

Describe how dilution plating could be used to monitor the growth of this culture.

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(4)

Q9

(Total 11 marks)

TOTAL FOR PAPER: 70 MARKS

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