Surname		Other Names	
Centre Number			Candidate Number									
Candidate Signature												

Leave blank

General Certificate of Education
January 2006
Advanced Subsidiary Examination

ASSESSMENT and QUALIFICATIONS ALLIANCE

BIOLOGY/HUMAN BIOLOGY (SPECIFICATION A) BYA1
Unit 1 Molecules, Cells and Systems

Tuesday 10 January 2006 9.00 am to 10.30 am

For this paper you must have:
- a ruler with millimetre measurements

You may use a calculator

Time allowed: 1 hour 30 minutes

Instructions

- Use blue or black ink or ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- Answer the questions in the spaces provided.
- Do all rough work in this book. Cross through any work you do not want marked.

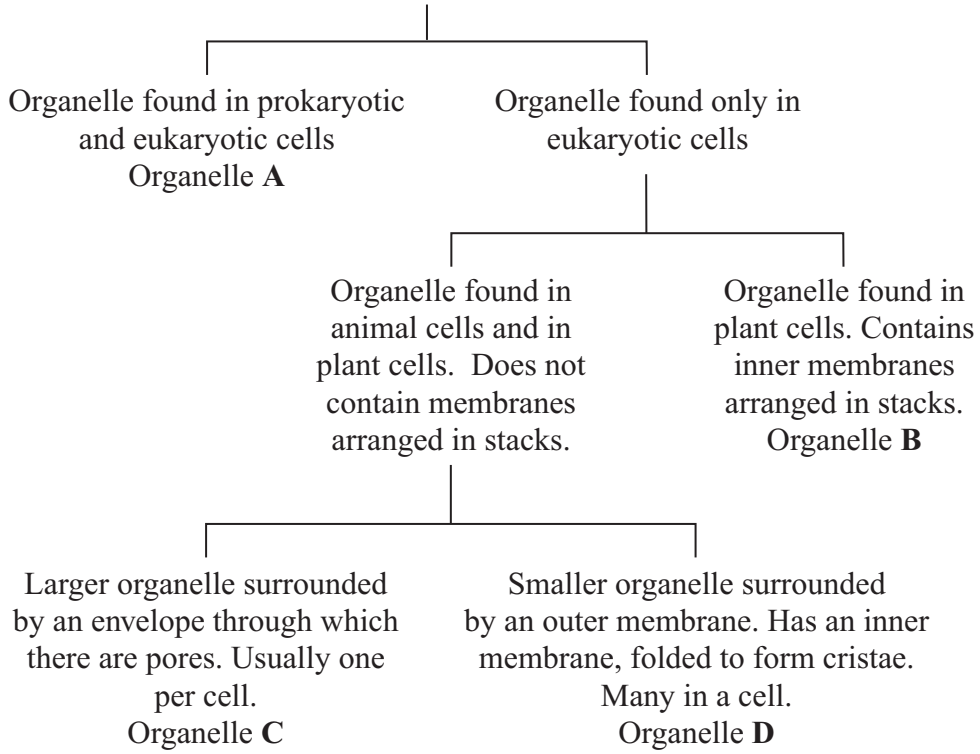
Information

- The maximum mark for this paper is 75.
- The marks for questions are shown in brackets.
- You are reminded of the need for good English and clear presentation in your answers.
- Use accurate scientific terminology in your answers.

For Examiner's Use			
Number	Mark	Number	Mark
1			
2			
3			
4			
5			
6			
7			
8			
Total (Column 1) →			
Total (Column 2) →			
TOTAL			
Examiner's Initials			

Answer **all** questions in the spaces provided.

1 The diagram shows how some organelles may be distinguished from each other.



(a) (i) Name organelle **B**.

.....

(1 mark)

(ii) Describe the function of organelle **B**.

.....

.....

.....

.....

(2 marks)

(b) Which of organelles **A**, **B**, **C** or **D**

(i) is a ribosome;

.....

(1 mark)

(ii) contains most of the DNA found in a plant cell?

.....

(1 mark)

(c) Some liver tissue was ground, filtered and centrifuged to make a suspension of organelle **D**.

(i) Explain why the solution in which the liver tissue was ground should be ice-cold.

.....

.....

(1 mark)

(ii) The ground liver was centrifuged at low speed. The pellet that formed at the bottom of the centrifuge tube was thrown away and the supernatant centrifuged again at higher speed. Explain why it was necessary to first centrifuge the ground liver at low speed in order to obtain a suspension of organelle **D**.

.....

.....

.....

.....

(2 marks)

8

2 Uric acid is produced in the body. One of the reactions involved in the production of uric acid is catalysed by xanthine oxidase.

$$\text{xanthine} \xrightarrow{\text{xanthine oxidase}} \text{uric acid}$$

(a) A sample of xanthine oxidase was tested by mixing with biuret reagent. Describe and explain the result of this test.

.....

.....

.....

.....

(2 marks)

(b) Explain why xanthine oxidase is able to catalyse this reaction but it is not able to catalyse other reactions.

.....

.....

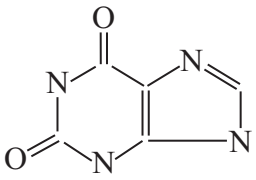
.....

.....

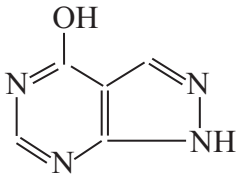
(2 marks)

(c) Gout is a painful condition caused by uric acid crystals in the joints. It is often treated with a drug that inhibits xanthine oxidase. The diagram shows a molecule of xanthine and a molecule of this drug.

Xanthine



Drug used to treat gout



Use the diagram to explain why this drug is effective in the treatment of gout.

.....

.....

.....

.....

.....

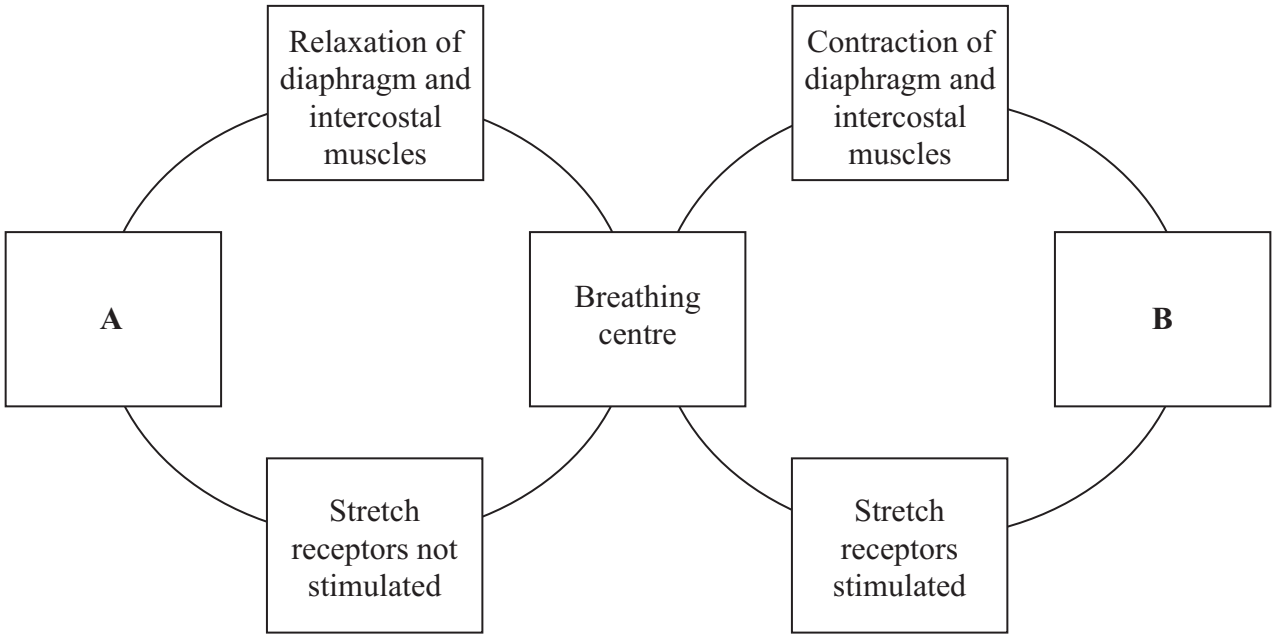
.....

(3 marks)

7

Turn over for the next question

3 The diagram shows the way in which breathing is controlled.



(a) (i) Box **B** describes what happens to the lungs. What should be written in box **B**?

.....

.....

(1 mark)

(ii) Mark the diagram with an **X** to show a line which represents a stage in which nerve impulses travel to the breathing centre.

(1 mark)

(b) Use Fick's law to explain how breathing results in efficient uptake of oxygen from the lungs.

.....

.....

.....

.....

(2 marks)

(c) Explain **two** ways in which changes in the contraction of the diaphragm muscle affect pulmonary ventilation.

1 .....

.....

.....

.....

2 .....

.....

.....

.....

(4 marks)

8

Turn over for the next question

4 (a) A plant cell was observed with an optical microscope. Describe how the length of the cell could be estimated.

.....

.....

.....

.....

(2 marks)

(b) The water potential of a plant cell is –400 kPa. The cell is put in a solution with a water potential of –650 kPa. Describe and explain what will happen to the cell.

.....

.....

.....

.....

.....

.....

(3 marks)

(c) A group of students investigated the effect of sucrose concentration on the change in length of cylinders of tissue cut from a young carrot. They measured the initial lengths of the carrot cylinders, then placed one in each of a number of sucrose solutions. After 18 hours, they removed the carrot cylinders and measured their final lengths. Some of the results are shown in the table.

Concentration of sucrose / mol dm^{-3}	**Percentage decrease in length of carrot cylinder**
0.4	4.2
0.5	8.7
0.6	13.0
0.7	16.8
0.8	18.1
0.9	18.1
1.0	18.1

(i) The carrot cylinders were left for 18 hours in the sucrose solutions. Explain why they were left for a long time.

.....

.....

(1 mark)

(ii) Explain how you would use a graph to predict the concentration of sucrose that would result in no change in length of the carrot cylinders.

.....

.....

.....

.....

(2 marks)

(iii) Young carrots store sugars in their tissues but, in older carrots, some of this is converted to starch. How would using cylinders of tissue from older carrots affect the results obtained for a sucrose solution of 0.6 mol dm^{-3}? Give a reason for your answer.

.....

.....

.....

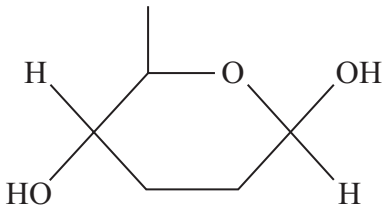
.....

(2 marks)

10

Turn over for the next question

5 (a) The diagram shows a molecule of β-glucose.



(i) Describe how this molecule differs from a molecule of α-glucose.

.....

.....

(1 mark)

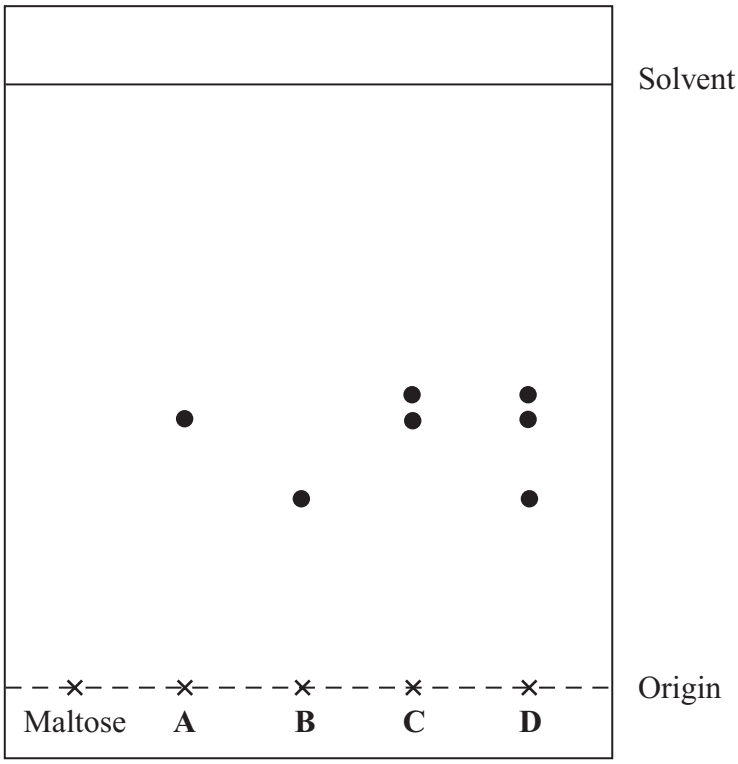
(ii) Draw a diagram in the space below to show how two β-glucose molecules join by condensation.

(2 marks)

(b) The table gives some information about four sugars.

Sugar	Chemical formula	Type of sugar
Glucose	$C_6H_{12}O_6$	Monosaccharide
Fructose	$C_6H_{12}O_6$	Monosaccharide
Sucrose	$C_{12}H_{22}O_{11}$	Disaccharide formed by condensation of glucose and fructose
Maltose	$C_{12}H_{22}O_{11}$	Disaccharide formed by condensation of glucose

The diagram shows a chromatogram of some individual sugars and mixtures of sugars.



(i) The R_f value of maltose is 0.25. Mark on the diagram the position of the spot representing maltose. *(1 mark)*

(ii) Which of **A**, **B**, **C** or **D** represents the complete hydrolysis of sucrose?

.....

(1 mark)

(iii) The spots from mixture **D** were very close together. What could you do to a chromatogram of mixture **D** to separate the spots further?

.....

.....

.....

.....

(2 marks)

7

There are no questions printed on this page

6 Seals are mammals. They spend much of the time in water but have lungs and breathe air. When a seal is resting at the surface of the water, the blood flow to each gram of swimming muscles is 0.21 cm^3 per minute. When it is swimming under water, the blood flow to different organs changes. The flow to the swimming muscles is then 0.05 cm^3 per gram per minute.

(a) Describe the part played by arterioles in redistributing blood to different organs.

.....

.....

.....

.....

(2 marks)

(b) (i) Describe how the change in blood flow to the muscles of a seal differs from the change in blood flow to human muscles as activity increases.

.....

.....

(1 mark)

(ii) Suggest the advantage to the seal of the change in blood flow to the muscles.

.....

.....

.....

.....

(2 marks)

5

Turn over for the next question

7 Read the following passage.

During the course of a day, we come into contact with many poisonous substances. These include industrial and household chemicals. The skin acts as a barrier and prevents many of these substances entering and harming the body.

The skin is one of the largest organs in the body. It is composed of several layers of tissue. The outer layer consists of dead cells packed with keratins. Keratins are a group of proteins that differ from each other in their primary structure. Each keratin molecule consists of several polypeptide chains, each individual chain wound into a spiral or helix. The polypeptide chains include many sulphur-containing amino acids and these help to give the keratin molecules their characteristic strength.

Use information from the passage and your own knowledge to answer the questions.

(a) What is the evidence from the passage that

(i) the skin is an organ;

.....

.....

(1 mark)

(ii) keratin molecules have a quaternary structure?

.....

.....

(1 mark)

(b) Explain how sulphur-containing amino acids help to give keratin molecules their characteristic strength (lines 8–9).

.....

.....

.....

.....

(2 marks)

(c) Explain why differences in primary structure result in keratins with different properties (line 6).

.....

.....

.....

.....

(2 marks)

(d) The skin prevents poisonous substances entering and harming the body (line 3). Explain why these substances are unable to pass through the outer layer of skin cells by active transport.

.....

.....

.....

.....

.....

.....

(3 marks)

(e) Skin cells may be studied with a transmission electron microscope or an optical microscope. Explain the advantages and limitations of using a transmission electron microscope to study cells.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

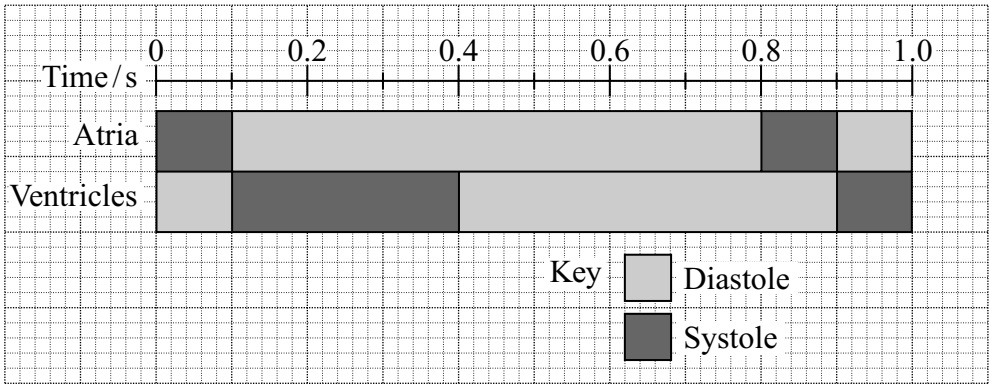
.....

.....

(6 marks)

15

8 Relaxation of heart muscle is called diastole. Contraction is called systole. The diagram shows the periods of diastole and systole when the heart is beating.



(a) At what time is the volume of blood in the ventricle at a maximum?

.....

(1 mark)

(b) Calculate the heart rate in beats per minute. Show your working.

Heart rate = ... beats per minute

(2 marks)

(c) The valves between the atria and the ventricles are closed between 0.1 s and 0.4 s.

(i) Explain how pressure causes these valves to be shut.

.....

.....

(1 mark)

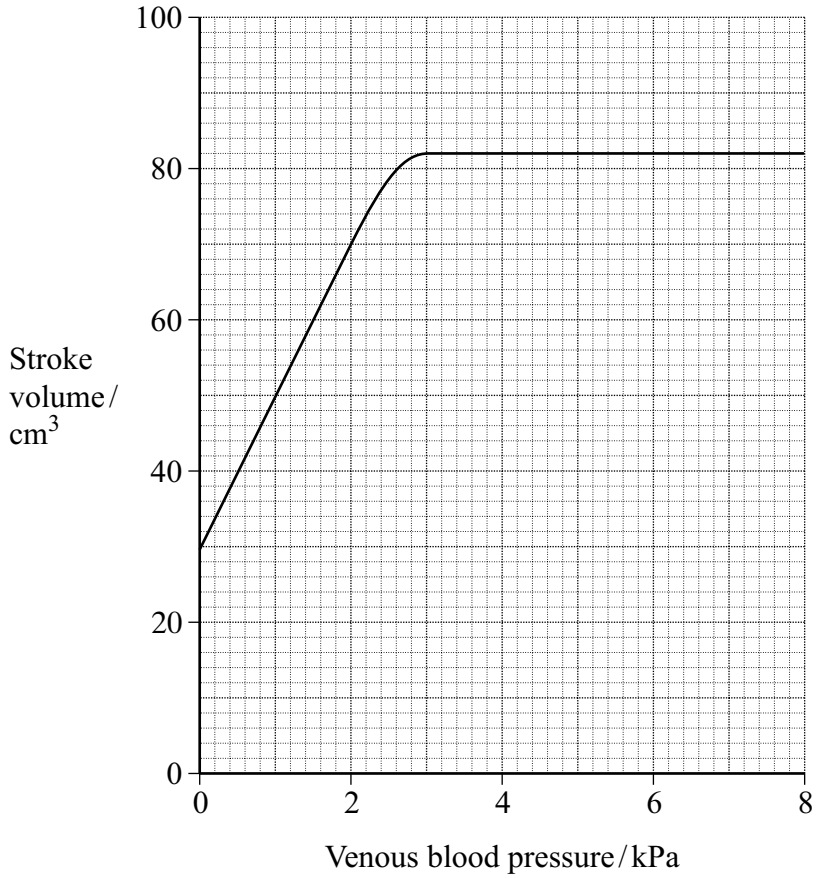
(ii) Explain how closure of these valves is essential to the functioning of the heart.

.....

.....

(1 mark)

The graph shows the effect of the pressure of blood in the veins on the stroke volume of the heart.



(d) Describe how venous blood pressure affects stroke volume.

.....

.....

.....

.....

(2 marks)

(e) At a venous pressure of 2 kPa, the cardiac output is 5600 cm^3 per minute. Calculate the number of times the ventricle contracts in one minute. Show your working.

Answer ..... *(2 marks)*

Question 8 continues on the next page

(f) Explain how blood in a vein in the leg is returned to the heart.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

(6 marks)

15

END OF QUESTIONS

There are no questions printed on this page

There are no questions printed on this page