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General Certificate of Education  
 January 2004  
 Advanced Level Examination



**BIOLOGY (SPECIFICATION B) BYB678/B**  
**Unit 6 Section B Applying Biological Principles**  
**Unit 7 Section B Applying Biological Principles**  
**Unit 8 Section B Applying Biological Principles**

Tuesday 27 January 2004 9.00 am to 11.15 am

**In addition to this paper you will require:**

- Section A;
- a ruler with millimetre measurements.

You may use a calculator.

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

Time allowed: The total time for Section A and Section B of this paper is 2 hours 15 minutes.

**Instructions**

- Use blue or black ink or ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** the questions in **Section B** in the spaces provided. All working must be shown.
- **Section A** and **Section B** will be marked by different examiners. You must ensure that any supplementary sheets are fastened to the appropriate question paper answer book.
- Do all rough work in this book. Cross through any work you do not want marked.

**Information**

- The maximum mark for **Section B** is 50.
- Mark allocations are shown in brackets.
- You are reminded that all questions in this **Section B** are synoptic (indicated by the letter **S**). You must use your knowledge of Modules 1-5 when answering this section.
- You are advised to spend 1 hour 15 minutes on **Section B**.
- You are reminded of the need for clear presentation in your answers. All answers should be in good English and should use accurate scientific terminology.

**SECTION B**

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

- S 1** (a) Write a word equation showing how fat is digested by lipase in the intestine.

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(1 mark)

An investigation was carried out on the digestion of fat by lipase. Milk, which contains fat, was used as the substrate. Phenol red solution was used as an indicator. Phenol red solution is yellow below pH 6.8, pink between 6.8 and 8.2 and red above pH 8.2. Sodium carbonate solution is alkaline.

Tubes **A**, **B**, **C** and **D** were set up as shown in **Table 1**. Three drops of phenol red solution were added to each tube.

Tube	Volume / cm <sup>3</sup>				
	Milk	Lipase solution	Sodium carbonate solution	Bile salts solution	Distilled water
<b>A</b>	5	1	1	0	2
<b>B</b>	5	1	1	1	1
<b>C</b>	5	0	1	1	2
<b>D</b>	5	0	1	0	3

**Table 1**

- (b) (i) Explain why sodium carbonate solution was added to each tube.

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.....  
(1 mark)

- (ii) Explain why it was important that different volumes of distilled water were added to tubes **A** and **B**.

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.....  
(1 mark)

- (iii) Explain how tube **C** acted as a control.

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.....  
(1 mark)

- (c) The tubes were kept at 35 °C for 30 minutes.

**Table 2** shows the initial colour of the contents in each tube and the colour after 30 minutes.

<b>Tube</b>	<b>Initial colour</b>	<b>Colour after 30 minutes</b>
<b>A</b>	Red	Pink
<b>B</b>	Red	Yellow
<b>C</b>	Red	Red
<b>D</b>	Red	Red

**Table 2**

Explain the results for

- (i) tube **A**; .....

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*(1 mark)*

- (ii) tube **B**. .....

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*(1 mark)*

- (d) Outline how you would use the same reagents to investigate the effect of concentration of lipase on the breakdown of fats in milk.

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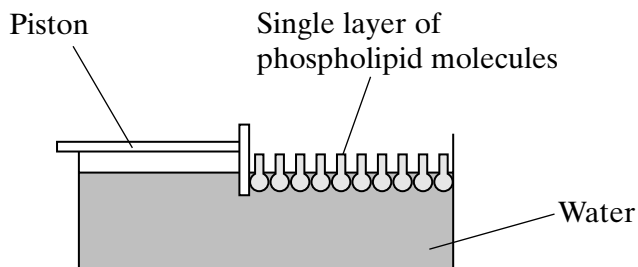
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*(4 marks)*

**Turn over** ▶

**S 2** Gorter and Grendel investigated the structure of the surface membrane of cells. They extracted the phospholipids from the surface membranes of red blood cells in  $1\text{ cm}^3$  of blood and placed them in the apparatus shown in **Figure 1**.



**Figure 1**

The piston was pushed across the surface of the water until the phospholipid molecules were tightly packed into a single layer. The area covered by the phospholipid molecules was measured. This area was compared with the estimated surface area of the red blood cells from which phospholipids were extracted.

Gorter and Grendel obtained the data shown in the table.

Number of red blood cells per $\text{cm}^3$ of blood	$4.74 \times 10^9$
Estimated mean surface area of one red blood cell	$99.4\ \mu\text{m}^2$
Surface area of membrane phospholipids extracted from $1\text{ cm}^3$ of blood	$0.92\ \text{m}^2$

- (a) Explain what these data suggest about the arrangement of phospholipids in the surface membranes of red blood cells. Support your explanation with suitable calculations. Show your working.

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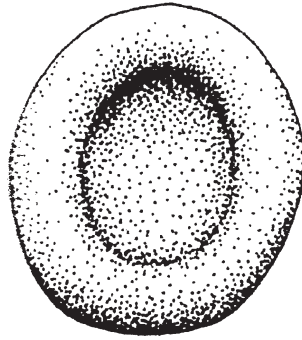
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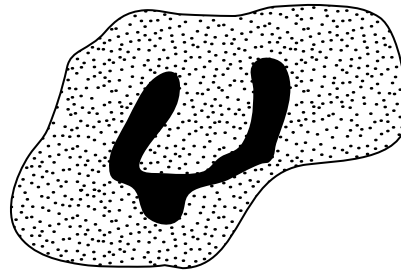
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(3 marks)

(b) **Figure 2** shows a red blood cell and a white blood cell.



Red blood cell



White blood cell

**Figure 2**

Explain why red blood cells were used in this investigation rather than white blood cells.

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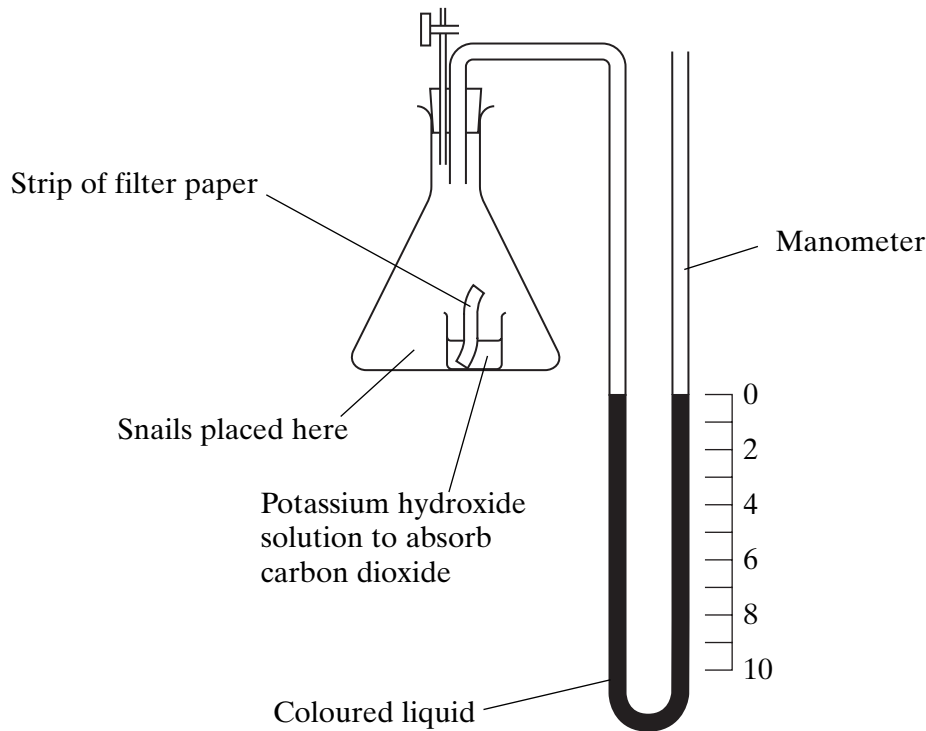
(2 marks)

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**TURN OVER FOR THE NEXT QUESTION**

**Turn over** ▶

- S 3** The diagram shows apparatus used to measure the oxygen uptake of snails that live on the seashore. The apparatus was kept at a constant temperature.



- (a) (i) Explain the purpose of the strip of filter paper in the potassium hydroxide solution.

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 .....

(1 mark)

- (ii) The level of liquid in the right-hand side of the manometer went down during the experiment. Explain why.

.....  
 .....

(2 marks)

- (iii) What measurements are needed to calculate the rate of oxygen uptake by the snails in  $\text{mm}^3 \text{g}^{-1} \text{h}^{-1}$ ?

.....  
 .....

(3 marks)

- (b) Two experiments were carried out using the apparatus shown in the diagram.
- 1 The oxygen uptake of batches of 10 seashore snails kept in moist air was measured at temperatures between 5 °C and 35 °C.
  - 2 Experiment 1 was repeated but with batches of 10 seashore snails covered by aerated seawater.

The experiments were repeated several times and means and standard deviations calculated. The results are shown in the table. The values given are means plus or minus one standard deviation.

Temperature / °C	Oxygen uptake of snails kept in moist air / $\text{mm}^3 \text{g}^{-1} \text{h}^{-1}$	Oxygen uptake of snails kept in seawater / $\text{mm}^3 \text{g}^{-1} \text{h}^{-1}$
5	$35 \pm 2$	$28 \pm 8$
10	$34 \pm 6$	$32 \pm 3$
15	$36 \pm 3$	$35 \pm 3$
20	$86 \pm 8$	$52 \pm 10$
25	$141 \pm 13$	$96 \pm 15$
30	$132 \pm 14$	$108 \pm 9$
35	$120 \pm 16$	$79 \pm 21$

- (i) Describe **one** similarity and **one** difference between the pattern of mean oxygen uptake of the snails kept in moist air and those covered by seawater.

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(2 marks)

- (ii) Explain why valid conclusions cannot be drawn about the trends in oxygen uptake at temperatures of 25 °C and above.

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(2 marks)

Turn over ►

