READ THE FOLLOWING INSTRUCTIONS CAREFULLY.

1. This paper consists of SIX questions in two sections. Answer ALL questions.
2. For Section A, write your answers in the spaces provided in this booklet.
3. For Section B, write your answers in the spaces provided at the end of each question in this booklet.
4. You may use a silent non-programmable calculator.

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO.
1. (a) Figure 1 is a diagram of the structure of part of a mitochondrion as seen in longitudinal section.

![Diagram of a mitochondrion](http://www.hindawi.com/journals/jo/2010/604304/fig1/)

(i) Identify the structures labelled A, B, C and D in Figure 1.

A: 

B: 

C: 

D: [4 marks]

(ii) Using an arrow labelled X, indicate the site of the Krebs cycle on Figure 1. [1 mark]
In an experiment investigating the effects of factors which may limit photosynthesis, some leaves are exposed to two concentrations of atmospheric carbon dioxide. The photosynthetic rates of the leaves are measured at different temperatures. The results of the experiment are shown in Figure 2.

![Graph showing the effect of temperature and carbon dioxide concentration on photosynthetic rate of some leaves.]

Figure 2. Effect of temperature and carbon dioxide concentration on photosynthetic rate of some leaves

http://www.friendsofscience.org/assets/documents/FOS%20Essay/Climate_Change_Science.html

(i) Describe the relationship between leaf temperature and net photosynthetic rate at 1935 ppm CO₂:

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[3 marks]
(ii) With reference to data presented in Figure 2, explain the effect of the increase in CO₂ concentration on the rate of photosynthesis, taking into consideration the temperature of the leaf.

[3 marks]

(iii) Briefly comment on how an understanding of temperature and carbon dioxide, as limiting factors of photosynthesis, may be used by farmers to increase crop yield in greenhouses.

[4 marks]

Total 15 marks
2. (a) The uptake of potassium ions by young cereal roots is measured over time at two temperatures, 0 °C and 25 °C. Potassium cyanide (a respiratory inhibitor) is added after 90 minutes, at both temperatures. The results are shown in Figure 3.

![Graph showing potassium uptake over time at 25 °C and 0 °C]

Figure 3. Absorption of potassium ions by young cereal roots at 0 °C and 25 °C.

http://www.wellcome.ac.uk/en/bia/gallery.htm

State the effect of potassium cyanide on potassium uptake at EACH temperature (0 °C and 25 °C), and give a brief explanation.

0 °C: ________________________________________________________________

______________________________________________________________

25 °C: ______________________________________________________________

______________________________________________________________

[4 marks]
(b) Using a labelled diagram of a transverse section of a root (including a root hair), illustrate THREE pathways by which water moves from soil into root cells. Limit your illustration to a small section of the epidermis and cortex containing 6 – 8 cells.

**Note:** Use a key to distinguish between pathways.
Figure 4 is a simplified diagram of a longitudinal section of a mammalian heart.

![Simplified diagram of a mammalian heart](image)

**Figure 4. Simplified diagram of a longitudinal section of a mammalian heart**

(i) Identify the structures labelled A, B, and C in Figure 4.

A: ____________________________

B: ____________________________

C: ____________________________  [3 marks]

(ii) Explain how arterial pressure is affected if the structure labelled D is defective.

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________  [2 marks]

Total 15 marks
3. (a) Obesity in pre-school children (<5 years of age) has increased over recent decades but trends vary among different regions. Table 1 shows estimates of the percentage of overweight and obesity in pre-school children in different regions for the period 1990–2010.

**TABLE 1: PERCENTAGE OF OVERWEIGHT AND OBESITY IN CHILDREN, 1990–2010**

<table>
<thead>
<tr>
<th></th>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>Africa</td>
<td>4.0</td>
<td>4.7</td>
<td>5.7</td>
<td>6.9</td>
<td>8.5</td>
</tr>
<tr>
<td>Asia</td>
<td>3.2</td>
<td>3.4</td>
<td>3.7</td>
<td>4.2</td>
<td>4.9</td>
</tr>
<tr>
<td>Latin America and the Caribbean</td>
<td>6.8</td>
<td>6.8</td>
<td>6.8</td>
<td>6.9</td>
<td>6.9</td>
</tr>
</tbody>
</table>

(i) On the grid provided below, draw line graphs of the data in Table 1 for Africa and Asia. [5 marks]
(ii) Compare the trend in percentage of overweight and obesity for Africa with that of Latin America and the Caribbean, over the period 1990–2010.

[2 marks]

(iii) Suggest TWO key strategies which may be effective in reducing or preventing obesity in pre-school children.

[2 marks]
(b) Figure 5 shows the steps involved in the phagocytic process in macrophages.

http://textbookofbacteriology.net/inmate_5.html

Figure 5. Phagocytosis of bacteria by a macrophage

(i) On Figure 5, use annotations to describe the steps labelled 1, 2 and 3. [3 marks]

(ii) Outline how a macrophage may act as an antigen-presenting cell. [3 marks]

Total 15 marks
SECTION B

Answer ALL questions.

Write your answers in the spaces provided at the end of each question.

4. (a) Give an analysis of potential energy losses across trophic levels in a food chain. [4 marks]

(b) Comment on the importance of food web complexity in an ecosystem. In your answer, explain what is meant by a food web. [4 marks]

(c) Describe SIX biotic interactions that can occur in an ecosystem. Include a brief explanation of the term ‘biotic interaction’. [7 marks]

Total 15 marks

Write the answer to Question 4 here.
Write the answer to Question 4 here.
Write the answer to Question 4 here.
5. (a) (i) Give a concise explanation of the term ‘translocation’ in plants. [2 marks]

(ii) Apple growers in Japan sometimes make a non-lethal spiral slash around the bark of trees destined for removal after the growing season. This practice makes the apples sweeter.

With reference to the mass flow principle, explain the biological basis of this practice for making the apples sweeter. [Note: details of mass flow hypothesis are NOT required.] [4 marks]

(b) Mammalian neurones in a resting state normally have a membrane potential of approximately –70 millivolts. If the plasma membrane is depolarized an action potential is generated.

(i) Outline the main steps in the depolarization phase of an action potential. [6 marks]

[Note: details of repolarization are NOT required.]

(ii) A common practice in dentistry is the use of local anesthetic injections of Lidocaine to numb a target area. Lidocaine is known to bind to receptor sites of sodium channels.

Suggest, giving a brief explanation, what effect Lidocaine may have on the generation of an action potential. [3 marks]

Total 15 marks

Write the answer to Question 5 here.
Write the answer to Question 5 here.
Write the answer to Question 5 here.
6. (a) Explain the association between excessive dietary fat intake and hypertension. Include in your account a brief explanation of the term ‘hypertension’, and a concise description of plaque formation in arteries. [7 marks]

(b) Distinguish between chronic bronchitis and emphysema, and explain how these chronic obstructive respiratory diseases can develop due to cigarette smoking. [8 marks]

Total 15 marks
Write the answer to Question 6 here.
Write the answer to Question 6 here.

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END OF TEST

IF YOU FINISH BEFORE TIME IS CALLED, CHECK YOUR WORK ON THIS TEST.