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 to answer items.

DO NOT TURN THIS PAGE UNTIL YOU ARE TOLD TO DO SO.
SECTION A

Answer ALL questions.

Write your answers in the spaces provided in this booklet.

1. (a) Water is a molecule that is important to life due to the variety of its properties. Table 1 is an incomplete table showing the link between some properties of water and examples of its importance to life.

Complete Table 1 by writing the missing information in the spaces provided.

**TABLE 1: PROPERTIES OF WATER AND ITS IMPORTANCE TO LIFE**

<table>
<thead>
<tr>
<th>Properties of Water</th>
<th>Examples of Water’s Importance to Life</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Helps leaves to pull water upwards from the roots.</td>
</tr>
<tr>
<td>Solubility</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Helps to stabilize the temperature of organisms and the environment.</td>
</tr>
</tbody>
</table>

[3 marks]

(b) Table 2 summarizes data on changes in water potential over an 18-hour period, beginning at 0400 hours, in the leaves of a shrub that grows in dry conditions. Note that 0400 hours is the same as 4:00 a.m.

**TABLE 2: WATER POTENTIAL OVER AN 18-HOUR PERIOD**

<table>
<thead>
<tr>
<th>Time of day (hours)</th>
<th>Water Potential (MPa)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0400</td>
<td>-1.2</td>
</tr>
<tr>
<td>0600</td>
<td>-1.8</td>
</tr>
<tr>
<td>0800</td>
<td>-3.0</td>
</tr>
<tr>
<td>1200</td>
<td>-2.8</td>
</tr>
<tr>
<td>1600</td>
<td>-2.6</td>
</tr>
<tr>
<td>1800</td>
<td>-3.0</td>
</tr>
<tr>
<td>2000</td>
<td>-1.9</td>
</tr>
<tr>
<td>2200</td>
<td>-1.3</td>
</tr>
</tbody>
</table>

(i) On the grid provided on page 3, plot the data in Table 2 as a line graph. [5 marks]
Question 1 (b) (i)

Water potential (MPa)
(ii) Account for the shape of the graph. Include in your account a brief description of the shape of the graph.

[3 marks]

(c) Figure 1 is a diagram of the structure of a generalized triglyceride.

![Diagram of triglyceride structure](image)

**Figure 1. Structure of a generalized triglyceride**

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

A

B

[2 marks]

(ii) Label an ester linkage in the triglyceride shown in Figure 1.

[1 mark]

(iii) State ONE feature of the triglyceride molecule that enables it to function as a better energy store than carbohydrates.

[1 mark]

Total 15 marks
NOTHING HAS BEEN OMITTED.
2. Figure 2 summarizes the main steps in the replication of DNA in eukaryotes.

DNA replication
A DNA molecule produces two identical copies of itself.

Figure 2. Steps in the replication of DNA in eukaryotes
(a) (i) Give a concise description of the events occurring at the steps labelled 1, 2 and 3 in Figure 2.

Step 1

Step 2

Step 3

[6 marks]

(ii) DNA replication is regarded as being semi-conservative. Comment on the significance of this method of replication.

[2 marks]
Figure 3 shows the distribution of beak depth of medium ground finches on Daphne Major, a small island in the Galapagos. Initial measurements of all birds on the island were taken in 1976. In 1978, following a period of severe drought on the island in the previous year, the beak depth of the surviving population was recorded. The illustrations at the bottom of the graphs show the beak depths of the initial and surviving populations.

Figure 3. Beak depth of medium ground finches on Daphne Major before (1976) and after (1978) a drought period

Source: http://www.bio.miami.edu/~cmallery/150/unity/sf38x1b.jpg

(i) With reference to average beak depth (indicated by the broken line in Figure 3) and nature of the frequency distributions of the two populations, determine what effect the drought had on the finch populations. Quote values where appropriate.
(ii) With the aid of a simple diagram, comment on the type of selection illustrated by the data shown in Figure 3.

Diagram:

Comment: 

[2 marks]

Total 15 marks
3. (a) Figure 4 is an incomplete diagrammatic representation of the stages in the development of an embryo sac.

![Diagram of stages in embryo sac development]

**Figure 4. Stages in the development of an embryo sac**

(i) Complete Figure 4 to show the missing stages in the boxes labelled A and B.  
[2 marks]

(ii) Use an arrow labelled C to indicate on Figure 4 where meiosis occurs during the development of the embryo sac.  
[1 mark]
(iii) Use an arrow labelled D to indicate the location of the female gamete on Figure 4.

[1 mark]

(iv) Angiosperms and mammals both produce haploid gametes. Comment on TWO OTHER ways in which sexual reproduction in angiosperms and mammals may be similar.

[4 marks]

(b) Figure 5 is a diagrammatic representation of a section of the placenta of a mammal.

![Diagram of placenta](http://www.natracare.com/images/help_for_schools/illustrations/placenta.gif)

Figure 5. Section of the placenta of a mammal

(i) Identify the structures labelled A, B, C, D, and E in Figure 5.

A

B

C

D

E

[5 marks]
(ii) Comment on the MAIN function of the structure labelled E.

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[2 marks]

Total 15 marks

SECTION B

Answer ALL questions.

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

4. (a)  
   (i) Describe THREE structures which are common to a mitochondrion and a chloroplast.  
       [6 marks]
   (ii) Discuss how a mitochondrion differs from a chloroplast with respect to their MAIN  
        function in a cell.  
        [4 marks]
   (b) Explain, using the dicotyledonous root as an example, the difference between a ‘tissue’ and an  
       ‘organ’.  
       [5 marks]

Total 15 marks

Write the answer to Question 4 here.

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GO ON TO THE NEXT PAGE
Write the answer to Question 4 here.
Write the answer to Question 4 here.
5. (a) (i) Distinguish between the terms ‘gene mutation’ and ‘chromosome mutation’. [4 marks]

(ii) Using sickle-cell anaemia as the example, explain the sequence of changes triggered by the gene mutation that leads to the cells becoming sickle shaped. [5 marks]

(b) (i) Outline the procedure of somatic gene therapy, giving FOUR key steps. [4 marks]

(ii) With reference to cystic fibrosis, comment on ONE difficulty in using gene therapy to treat diseases. [2 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)  (i)  Distinguish between 'binary fission' and 'budding'.  [4 marks]

(ii) Discuss ONE advantage and ONE disadvantage of asexual reproduction.  [4 marks]

(b)  (i) Outline the sequence of events that leads from germination of a pollen grain to double fertilization in flowering plants.  [5 marks]

(ii) Briefly comment on the significance of double fertilization in the life cycle of a flowering plant.  [2 marks]

Total 15 marks

Write the answer to Question 6 here.
Write the answer to Question 6 here.
Write the answer to Question 6 here.

END OF TEST

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