Candidates are advised to use the first 15 minutes for reading through this paper carefully.

READ THE FOLLOWING INSTRUCTIONS CAREFULLY.

 Candidates must attempt ALL questions in this paper.

 Answers are to be written in the spaces provided in this answer booklet.

 EACH question is worth 10 marks.

 The use of silent non-programmable calculators is allowed.
Name the MAJOR pigment and ONE accessory pigment used by plants in photosynthesis.

State the wavelengths of light absorbed by Photosystems I and II.

(i) Photosystem I:

(ii) Photosystem II:

[1 mark]

(c) Figure 1 shows how electrons are transported through Photosystem I and Photosystem II in the light-dependent stage of photosynthesis.

Figure 1. Light-dependent stages of photosynthesis
With reference to Figure 1, answer questions (i) to (v).

Identify the photosystems labelled at Boxes 1 and 2.

Photosystem at Box 1:

Photosystem at Box 2:

[ 1 mark ]

(ii) Briefly explain

a) TWO events caused by incident light at Reaction Centre 1

Event 1:

Event 2:

[ 1 mark ]

b) why electrons enter Box 1.

[ 1 mark ]

(iii) State TWO events which occur between Boxes 3 and 4.

Event 1:

Event 2:

[ 2 marks]

(iv) State TWO events which occur between Boxes 4 and 5.

Event 1:

Event 2:

[ 1 mark ]
Identify the substances in Boxes 6, 7 and 8.

Box 6

Box 7

Box 8 [ 1 mark ]

(d) Each thylakoid has a flattened disc-like shape, and is composed of a thylakoid membrane enclosing an oval thylakoid space.

Which substance, e⁻ or H⁺, is stored in the thylakoid space? [ 1 mark ]

Total 10 marks
NOTHING HAS BEEN OMITTED.
The graphs in Figure 2 below show the rate of respiration and the rate of growth of cells in a culture medium as well as the changes in oxygen concentration and pH that take place in the culture medium.

![Graph showing respiration rate and growth rate of cell suspension](image1)

![Graph showing changes in pH and oxygen concentration](image2)

**Figure 2. Changes during growth of cell suspension**


Examine the graphs in Figure 2 and answer the following questions.

(a) Determine the maximum respiration rate of the cell suspension.
Determine the concentration of oxygen in the cell suspension medium on the day of maximum respiration.

[1 mark]

Deduce what type of respiration is being carried out on Day 3 and Day 28. Give ONE reason for your answer.

Day 3: ________________________________

Day 28: ________________________________

[1 mark]

Reason: ________________________________

[1 mark]

Suggest why the pH of the cell suspension medium changes over the period of the experiment.

[2 marks]

Determine the increase in the mass per cm$^3$ of cells in the cell suspension medium between Day 0 (start of the experiment) and Day 28.

[1 mark]

Explain why the number of cells present in the medium does NOT continue to increase indefinitely.

[1 mark]

Write a balanced equation for the fermentation of glucose to ethanol and state ONE use of this process.

Equation: ________________________________

[1 mark]

Use of the process: ________________________________

[1 mark]

Total 10 marks
3. Figure 3 is a diagram of the nitrogen cycle.

![Diagram of the nitrogen cycle]

**(ii)** Label (3) in Figure 3 represents a mutualistic relationship. Define the term 'mutualism'.

---

**Figure 2. The nitrogen cycle**

(a) (i) Identify the stages or organisms represented by the numbers 1 – 6 in Figure 3.

1. 

2. 

3. 

4. 

5. 

6. 

[ 3 marks]

(ii) Label (3) in Figure 3 represents a mutualistic relationship. Define the term 'mutualism'.

---

[ 1 mark ]
Logging of trees for timber in tropical forests has ecological consequences for the ecosystem.

Briefly describe TWO prominent biological effects of logging.

Effect 1: 

Effect 2: 

[ 2 marks]  

(b) State TWO benefits that bacteria derive from being part of the nitrogen cycle.

Benefit 1: 

Benefit 2: 

[ 2 marks]  

(c) Giving ONE example, suggest the effect that flooding of farm fields would have on the nitrogen cycle.

[ 1 mark ]  

(d) Although nitrogen is cycled, some of the stages of the cycle contain greater reserves of the element. State, with support, which is the LARGEST reserve.

[ 1 mark ]  

Total 10 marks
NOTHING HAS BEEN OMITTED.
On the micrograph of EACH organ, label ONLY the **phloem**. [2 marks]

Identify EACH plant organ in Figure 4.1. [2 marks]

**Figure 4.1. Transverse sections of two plant organs**

The leaf of the broad bean *Vicia faba*, is exposed to radioactive carbon dioxide for 35 minutes. Both transverse and longitudinal sections are made of the leaf to display the vascular bundles. The sections are placed in contact with an autoradiographic film, which shows up radioactivity as dark grains on the film. The film is left in contact with the sections for 32 days and then developed.

Figure 4.2 shows longitudinal and transverse sections of the vascular bundle.

![Transverse section](image1)

![Longitudinal section](image2)

*Figure 4.2. Sections of vascular bundles of *Vicia faba*

(i) Identify the groups of plant cells in Figure 4.2 that appear dark.  

[ 1 mark ]

(ii) Explain why ONLY these cells appear dark.  

[ 2 marks ]

(iii) Calculate the width of the cell labelled A in the longitudinal section in Figure 4.2.  

[ 1 mark ]

(c) Briefly state the pressure flow hypothesis.  

[ 2 marks ]

Total 10 marks
Figure 5.1 shows the relationship between the proximal convoluted tubules and a peritubular capillary, in longitudinal section.

Figure 5.1. Proximal convoluted tubule and peritubular capillary
State FOUR substances, other than water and mineral ions, present in the tubule lumen in Figure 5.1 which will be absorbed by the tubule cells.

Substance 1: ________________________________
Substance 2: ________________________________
Substance 3: ________________________________
Substance 4: ________________________________  [2 marks]

(ii) Describe THREE processes used to transport named substances from the tubule lumen mentioned in (a) (i) into the tubule cells.

Process 1: __________________________________________
Process 2: __________________________________________
Process 3: __________________________________________  [3 marks]

(iii) Give TWO reasons why substances which accumulate at the intercellular space between the tubule and capillary move into the capillary and do NOT return to the tubule lumen.

____________________________________________________
____________________________________________________
____________________________________________________
____________________________________________________  [2 marks]
(b) Figure 5.2 below represents the loop of Henle.

(i) Based on your knowledge of kidney structure, sketch transverse sections of the tube at areas T1 and T2 to show the differences between their cellular structure. (Make EACH drawing X5 the diameter of the tube).

Transverse Section T1

Transverse Section T2

Figure 5.2. Loop of Henle

(ii) Suggest the functional reason for the differences between T1 and T2.

[ 2 marks]
6. (a) State what actions of the heart are controlled by the

(i) sino-atrial node (SAN)

(ii) atrio-ventricular node (AVN)

(iii) Purkinje tissue.

(b) Give brief explanatory answers to the following:

(i) Why is there a 0.15 second delay between the effect of the SAN and the AVN?

(ii) What is the benefit of stimulating the contraction of the ventricles to begin at their base, further away from the AVN, and not their apex next to the AVN?
Two campers are awakened from rest when a jaguar looks into their tent. Frightened, the campers jump up and rush off. Their pumping leg muscles squeeze blood up the veins, back to the heart, and reserve blood from the spleen enters the circulation. Diaphragm muscles increase the breathing movements.

Complete Table 1 to identify the structures associated with this response, and the body’s actions.

**TABLE 1: STRUCTURES, LOCATIONS OR EFFECT OF BODY’S RESPONSES**

<table>
<thead>
<tr>
<th>ACTION IN BODY</th>
<th>ANSWER</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i) Location of structures which <strong>respond</strong> to the stimulus of increased blood flow in the cardiac area</td>
<td></td>
</tr>
<tr>
<td>(ii) Type of nerve which <strong>carries</strong> stimulus to the brain.</td>
<td></td>
</tr>
<tr>
<td>(iii) Name of area of brain which <strong>responds</strong> to stimulus and generates a reaction.</td>
<td></td>
</tr>
<tr>
<td>(iv) Type of nerve which <strong>transmits</strong> the stimulus back to the heart.</td>
<td></td>
</tr>
<tr>
<td>(v) Location in heart which <strong>receives</strong> the stimulus.</td>
<td></td>
</tr>
<tr>
<td>(vi) <strong>Effect</strong> of stimulus on cardiac output.</td>
<td></td>
</tr>
</tbody>
</table>

[ 3 marks]
(d) Non-nervous control of the heart may be affected by several factors. For each of the following stimuli, state its effect on the heart rate.

(i) Low pH

(ii) Low body temperature

[2 marks]

Total 10 marks
7. In 1999 – 2000, a British crime survey analysed alcohol-related crimes in relation to acts of violence performed against strangers (persons unknown to the perpetrators) or acquaintances (family or friends).

**TABLE 2: INCIDENCE RATE OF CRIME AGAINST STRANGERS AND ACQUAINTANCES BY AGE AND GENDER OF THE ASSAULTER**

<table>
<thead>
<tr>
<th>Gender</th>
<th>Age</th>
<th>Strangers (per 10 000 adults)</th>
<th>Acquaintances (per 10 000 adults)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>16 – 19</td>
<td>749</td>
<td>559</td>
</tr>
<tr>
<td></td>
<td>20 – 24</td>
<td>569</td>
<td>426</td>
</tr>
<tr>
<td></td>
<td>25 – 29</td>
<td>339</td>
<td>277</td>
</tr>
<tr>
<td></td>
<td>30 – 34</td>
<td>326</td>
<td>148</td>
</tr>
<tr>
<td></td>
<td>35 – 39</td>
<td>101</td>
<td>64</td>
</tr>
<tr>
<td></td>
<td>40 – 45</td>
<td>94</td>
<td>61</td>
</tr>
<tr>
<td></td>
<td>45+</td>
<td>66</td>
<td>46</td>
</tr>
<tr>
<td>Female</td>
<td>16 – 19</td>
<td>157</td>
<td>338</td>
</tr>
<tr>
<td></td>
<td>20 – 24</td>
<td>122</td>
<td>88</td>
</tr>
<tr>
<td></td>
<td>25 – 29</td>
<td>70</td>
<td>96</td>
</tr>
<tr>
<td></td>
<td>30 – 34</td>
<td>54</td>
<td>68</td>
</tr>
<tr>
<td></td>
<td>35 – 39</td>
<td>15</td>
<td>56</td>
</tr>
<tr>
<td></td>
<td>40 – 45</td>
<td>20</td>
<td>68</td>
</tr>
<tr>
<td></td>
<td>45+</td>
<td>5</td>
<td>36</td>
</tr>
</tbody>
</table>


(a) (i) Using references to the data in Table 2, comment on the aggressiveness, under the influence of alcohol, of

a) drinkers in relation to their age

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

[2 marks]
b) Males and females in relation to their choice of victim.

(ii) Give ONE possible behavioural reason for your answer in (a) (i) b).

[ 1 mark ]
Figure 6 below shows the incidence rates of alcohol-related assaults on strangers, acquaintances and total assaults in 1999 by unit consumption.

(i) On the histogram in Figure 6, write in the missing data above the columns which represent the totals. [1 mark]

(ii) With reference to the data in Figure 6, comment on the relationship between alcohol consumption in units per day and total assault rate.

(c) What is the accepted 'safe limit' of alcohol consumption in units per day for the average person? [1 mark]
8. Cigarette smoking can cause the healthy coronary artery, cross-section shown in Figure 7.1.A, to become the unhealthy artery, cross section shown in Figure 7.1.B.

![Figure 7.1.A](image1)


![Figure 7.1.B](image2)

Chemistry in Britain. Royal Society of Chemistry. Thomas Graham House, Vol 38, #9, p. 35.

(a) (i) Name the disease that is characterized by the state of the coronary artery in Figure 7.1.B.

(ii) Briefly outline FOUR symptoms that a smoker with the coronary artery shown in Figure 7.1.B is LIKELY to experience.

(iii) Estimate the percentage obstruction occurring in the lumen of the coronary artery in Figure 7.1.B.
Name TWO components of cigarette smoke and describe ONE effect of EACH component on the body.

Component 1: ____________________________
Effect: ____________________________

Component 2: ____________________________
Effect: ____________________________

[2 marks]

Figure 7.2 below shows age standardized mortality rates from coronary heart disease (CHD) in men and women under 75 years of age in 1998.

Figure 7.2. Age standardised mortality rates from CHD, men and women aged under 75, in 1998


Using Figure 7.2, determine the number of male and female deaths per 100,000 population, that occurred in the USA and Japan in 1998.

USA: Female ____________________________ Male ____________________________

Japan: Female ____________________________ Male ____________________________

[2 marks]
(d) Japanese diet consists mainly of fresh fruit, vegetables, rice, fish and soybean curd. The American diet consists mainly of beef, pork, chicken, rice, potatoes, carbonated and alcoholic beverages.

Suggest how these differences in diet contribute to the CHD levels in EACH country.

[ 2 marks]

Total 10 marks
9. (a) State FOUR methods that can be used to control mosquitoes.

(b) An increase in the number of cases of mosquito-borne diseases is closely correlated with increases in rainfall.

Suggest why these trends are normally correlated.

(c) On the island of Trinidad the mosquito, *Anopheles albimanus*, breeds in swamps. *Anopheles bellator*, another species of mosquito found in Trinidad, breeds in water trapped between the overlapping leaf bases of bromeliads growing on the trunks of trees of the rain forests.

In the 1940's officials in Trinidad sprayed with insecticide and drained numerous marshes and swamps. However, the incidence of malaria remained unchanged.

Suggest why this campaign failed to reduce the incidence of malaria in Trinidad.
(d) For EITHER dengue OR malaria

(i) name the specific causative agent

[1 mark]

(ii) briefly describe FOUR typical symptoms of the disease

[2 marks]

(iii) use your knowledge of the habits of the mosquito that transmits the disease to suggest the part of the day when an individual is MOST likely to be bitten by the disease-transmitting mosquito.

[1 mark]

(e) State TWO precautions that may be taken to reduce the chance of being bitten by a mosquito which is a vector for EITHER dengue OR malaria.

[1 mark]

Total 10 marks

END OF TEST

The Council has made every effort to trace copyright holders. However, if any have been inadvertently overlooked, or any material has been incorrectly acknowledged, CXC will be pleased to correct this at the earliest opportunity.