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

### READ THE FOLLOWING INSTRUCTIONS CAREFULLY.

1. This paper consists of NINE questions.

2. Section A consists of THREE questions. Candidates must attempt ALL questions in this section and should spend no more than 30 minutes on this section. Answers to this section MUST be written in this question paper.

3. Section B consists of SIX questions. Candidates must attempt THREE questions in this section, ONE question from EACH module. Answers to this section MUST be written in the separate answer booklet provided.

4. The use of silent non-programmable calculators is allowed.
You must attempt ALL THREE questions in this section. You should NOT spend more than 30 minutes on this section.

1. Table 1 shows the results of food tests conducted on three solutions.

<table>
<thead>
<tr>
<th>Test Tubes</th>
<th>Biuret Reagent</th>
<th>Benedict’s Solution</th>
<th>Iodine in Potassium Iodide</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>Blue</td>
<td>Brick-red</td>
<td>Brown</td>
</tr>
<tr>
<td>Y</td>
<td>Purple</td>
<td>Blue</td>
<td>Blue-black</td>
</tr>
<tr>
<td>Z</td>
<td>Purple</td>
<td>Brick-red</td>
<td>Brown</td>
</tr>
</tbody>
</table>

**TABLE 1: FOOD TESTS RESULTS FOR SOLUTIONS X, Y AND Z**

(a) (i) What conclusions can you draw about the contents of the solutions?

X: __________________________________________________________________________

Y: __________________________________________________________________________ [3 marks]

(ii) Briefly explain the colour change recorded for Solution X when treated with Benedict’s solution.

______________________________________________________________________________

______________________________________________________________________________

______________________________________________________________________________

______________________________________________________________________________ [2 marks]
(b) Suggest how you would determine the concentration of the substance in Solution X if given additional samples.

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

[ 4 marks]

(b) How would you determine the presence of lipid in a liquid foodstuff, using a test-tube based method?

__________________________________________________________________________

__________________________________________________________________________

__________________________________________________________________________

[ 1 mark ]

Total 10 marks
2. Figure 1 shows a stained slide preparation of root tips undergoing mitosis.

http://www.visualsunlimited.com/images/watermarked307/30712.jpg

(a) In the spaces provided make representative drawings of the cells and nuclear contents showing the stages labelled in Figure 1 as A and B. Drawings should be at X3. Identify the stages drawn.

A Identity ________________________________

B Identity ________________________________

[ 6 marks]
(b) State the procedures involved in making a slide preparation of an onion root tip to examine mitosis.


[ 2 marks]

(c) State FOUR locations (other than the root tip) where mitosis occurs in plants.


[ 2 marks]

Total 10 marks
3. (a) Figure 2 represents categories 1 - 5 of the five-kingdom system of classification of living organisms proposed by Margulis and Schwartz.

Figure 2

Complete Table 2 below to show which number on Figure 2 matches EACH kingdom indicated.

<table>
<thead>
<tr>
<th>Kingdom</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i) Plants</td>
<td></td>
</tr>
<tr>
<td>(ii) Fungi</td>
<td></td>
</tr>
<tr>
<td>(iii) Protoctists</td>
<td></td>
</tr>
<tr>
<td>(iv) Animals</td>
<td></td>
</tr>
<tr>
<td>(v) Prokaryotes</td>
<td></td>
</tr>
</tbody>
</table>

[2 marks]
(b) Certain features are used to distinguish organisms into kingdoms. For EACH kingdom, state the features used to discriminate between them.

(i) Prokaryotes from the other four kingdoms

Feature

(ii) Animals from plants

Feature 1

Feature 2

(iii) Fungi from plants

Feature 1

Feature 2

(iv) Protoctists from the animal, plant and fungus kingdoms.

Feature

[ 3 marks]
In Figure 3, electron micrographs 1 - 5 show cells of the immune system. In order to assist in identifying them, create a set of paired dichotomous keys.

Figure 3
Adapted from I Roitt, Essential Immunology, Blackwell Scientific Publications 1997, pp 132, 134, 155, 156.
Use the space below to create the dichotomous keys.

[5 marks]

Total 10 marks
SECTION B

You must answer THREE questions in this section. Answer ONE question EACH from Modules 1, 2 and 3. You MUST write your answers in the separate answer booklet provided.

MODULE 1

Answer EITHER Question 4 OR Question 5.

4. (a) Explain what is meant by the term ‘tertiary structure of a protein’. [2 marks]

(b) (i) Draw a large labelled diagram to illustrate the structure of the haemoglobin molecule.

(ii) State the main function of haemoglobin and explain how the structure is related to the function given. [8 marks]

(c) Discuss the factors which affect enzyme activity. [10 marks]

Total 20 marks

5. (a) Describe the structure of the membrane of a typical cell, and identify its component parts and their biochemical nature. [6 marks]

(b) The role of the membrane is to control the movement of substances. Clarify how this is done for EACH of the following:

(i) Entry of useful minerals, such as potassium [2 marks]

(ii) Absorption of large molecules by endocytosis [2 marks]

(iii) Entry of non-ionic molecules such as sucrose [2 marks]

(iv) Prevention of entry of toxic molecules such as copper or lead [2 marks]

(c) When strips of potato tissue are immersed in distilled water for two hours, they increase in length and become turgid. Relate this outcome to the exact causes and processes occurring in the cells of the tissue. [6 marks]

Total 20 marks
6. (a) (i) Describe the structure of the DNA molecule. [10 marks]

(ii) Outline how the structure of RNA differs from that of DNA. [10 marks]

(b) Discuss how changes in the nucleotide sequence of DNA can result in changes in the structure and functioning of erythrocytes in sickle cell anaemia. [10 marks]

Total 20 marks

7. (a) (i) Give a detailed, labelled drawing of a section of the placenta to show the relative positions of the umbilical cord and blood vessels, the villi, uterine wall, maternal blood spaces and maternal blood vessels (inclusion of embryo not required). [10 marks]

(ii) In the umbilical cord use arrows to show the direction of blood flow and indicate which blood is oxygenated or deoxygenated. [10 marks]

(b) Discuss EACH of the following:

(i) The function of the amnion

(ii) The effects of the foetus on the mother

(iii) The lifestyle requirements of the mother for healthy foetal development [10 marks]

Total 20 marks
Figure 4 is a pedigree chart showing the inheritance of haemophilia in several of the Royal families of Europe.

Key:
- O Normal female
- □ Normal male
- @ Known female carrier
- ▉ Haemophiliac male

(a) (i) Explain the nature of inheritance of the allele for haemophilia.

(ii) Explain why none of Queen Victoria’s female offsprings were haemophiliacs.

(iii) Draw a genetic diagram to show the inheritance of the haemophilia allele in the children of Leopold Duke of Albany.

(iv) Explain the inheritance of the human ABO blood group. [14 marks]

(b) In a cross between two types of pea plants, one heterozygous for the round yellow seed condition, and the other, pure-breeding with wrinkled green seeds, the following offsprings were recorded:

- Round yellow peas — 108
- Round green peas — 102
- Wrinkled yellow peas — 105
- Wrinkled green peas — 101

Clarify the sequential steps to be taken when using the Chi-squared test to determine the significance of the results.

The formula for conducting a Chi-squared test is

\[ X^2 = \sum \frac{(O - E)^2}{E} \]. [6 marks]

Total 20 marks
9. (a) (i) Define the term 'environment', and explain the influence of ONE physical factor and ONE biotic factor, on the environment.

(ii) Define the term 'evolution', and explain the difference between the terms 'allopatric' and 'sympatric'. [6 marks]

(b) Give FOUR reasons for the importance of maintaining biodiversity on earth. [4 marks]

(c) Discuss EACH of the following terms:

(i) Stabilizing selection

(ii) Directional selection

Include in your answer the effects of environmental pressure on ONE named example in each case to illustrate the operation of these two methods of natural selection. [8 marks]

(d) "Disruptive selection is closely associated with speciation." Comment on this statement. [2 marks]

Total 20 marks

END OF TEST

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