BSc Degree Examinations 2018-9

Department:
BIOLOGY

Title of Exam:
Food and Fuel

Time Allowed:
1 Hour and 30 Minutes

Marking Scheme:
Total marks available for this paper: 60
The marks available for each question are indicated on the paper.

Instructions:
Answer all questions in the spaces provided on the examination paper. This is an open book exam, and you are allowed to view notes you have brought in to the exam. These should be in the form of a notebook or ring binder containing your own notes (hand-written and/or typed), print outs of lecture slides and any other printouts of electronic material (including scientific papers relevant to the module. You are not permitted to bring in electronic equipment.

For marker use only: Office use only:

<table>
<thead>
<tr>
<th>1</th>
<th>2</th>
<th>3</th>
<th>Total as %</th>
</tr>
</thead>
</table>

DO NOT WRITE ON THIS BOOKLET BEFORE THE EXAM BEGINS
DO NOT TURN OVER THIS PAGE UNTIL INSTRUCTED TO DO SO BY AN INVIGILATOR

Page 1 of 7
Answer all questions. Each question is worth 20 marks.

1. Increases in crop yields are needed to feed a future population. Metabolic modelling of the Calvin-Benson-Bassham cycle has identified that increases in the enzyme activities of nuclear encoded sedoheptulose-1,7-bisphosphatase (SBPase) and fructose-1,6-bisphosphate aldolase (FBPA) would result in increased carbon fixation and yields. You lead a research team and want to make a large impact on global food production. What crop would you initially engineer and why? (2 marks). Outline a plant engineering strategy to increase SBPase and FBPA expression. Diagrams can be used and multiple strategies may be discussed and compared. (18 marks) (20 Marks)
The space above the line should be sufficient for your answer.
2. A farmer would like to start growing and selling organic potatoes on a 5 hectares field which has a history of potato cultivation. Records show that for last year’s poorly yielding potato crop, no fertiliser was applied. Using a soil corer, single soil samples 15cm deep were recently taken from four random positions in the field and sent to a laboratory for analysis. The results of the analysis are presented below. Evaluate the sampling method and indicate what useful information is missing from these analyses? (5 marks). From the available soil analyses and field history, indicate any deficiencies or other potential problems with the soil (3 marks). Outline agronomic techniques which can be employed to try to solve these issues without relying on synthetic fertilisers, pesticides, or GMO technology (12 marks).

Soil textural class: Sandy loam

<table>
<thead>
<tr>
<th>Sample</th>
<th>Extractable phosphate (mg/L soil)</th>
<th>Organic matter</th>
<th>pH</th>
<th>Other notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>18</td>
<td>1.5%</td>
<td>6.3</td>
<td>High numbers of <em>G. pallida</em> (potato cyst nematode) eggs detected</td>
</tr>
<tr>
<td>2</td>
<td>32</td>
<td>7%</td>
<td>6.4</td>
<td>none</td>
</tr>
<tr>
<td>3</td>
<td>20</td>
<td>1.3%</td>
<td>6.8</td>
<td><em>G. Pallida</em> detected</td>
</tr>
<tr>
<td>4</td>
<td>25</td>
<td>0.8%</td>
<td>6.5</td>
<td>none</td>
</tr>
</tbody>
</table>
3. Deficiency in dietary folic acid has been identified as an important issue, particularly for women in pregnancy. Bacteria synthesise folic acid for their own requirements from GTP via a six-step metabolic pathway. A research project is aiming to address folic acid deficiency exploiting bacterial folic acid biosynthesis genes, for use as a food supplement. Discuss strategies that could be used, and some of the potential challenges that might arise.

(20 marks)
The space above the line should be sufficient for your answer.