Surname _____________________________________________
Other Names ___________________________________________
Centre Number _________________________________________
Candidate Number ______________________________________
Candidate Signature ____________________________________

GCSE BIOLOGY

Higher Tier  Paper 2H
8461/2H

Monday 11 June 2018  Morning

Time allowed: 1 hour 45 minutes

For this paper you must have:
• a ruler
• a scientific calculator.

At the top of the page, write your surname and other names, your centre number, your candidate number and add your signature.

[Turn over]
INSTRUCTIONS

• Use black ink or black ball-point pen.
• Answer ALL questions in the spaces provided.
• Do all rough work in this book. Cross through any work you do not want to be marked.
• In all calculations, show clearly how you work out your answer.

INFORMATION

• There are 100 marks available on this paper.
• The marks for questions are shown in brackets.
• You are expected to use a calculator where appropriate.
• You are reminded of the need for good English and clear presentation in your answers.

DO NOT TURN OVER UNTIL TOLD TO DO SO
Many human actions are reflexes.

Which TWO of the following are examples of reflex actions? [2 marks]

Tick TWO boxes.

- Jumping in the air to catch a ball
- Raising a hand to protect the eyes in bright light
- Releasing saliva when food enters the mouth
- Running away from danger
- Withdrawing the hand from a sharp object

FIGURE 1, on page 5, shows how the size of the pupil of the human eye can change by reflex action.
01.2 Name ONE stimulus that would cause the pupil to change in size from A to B, as shown in FIGURE 1. [1 mark]

01.3 Structure Q causes the change in size of the pupil.

Name structure Q. [1 mark]

01.4 Describe how structure Q causes the change in the size of the pupil from A to B. [1 mark]

[Turn over]
FIGURE 2 shows some structures involved in the coordination of a reflex action.

Describe how the structures shown in FIGURE 2 help to coordinate a reflex action. [6 marks]
Many scientists think that global air temperature is related to the concentration of carbon dioxide in the atmosphere.

FIGURE 3 shows changes in global air temperature and changes in the concentration of carbon dioxide in the atmosphere.
Complete TABLE 1.

Use information from FIGURE 3. [2 marks]

Choose answers from the list.

You may use each answer once, more than once or not at all.

constant
decreasing
increasing

TABLE 1

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Trend in carbon dioxide concentration</td>
<td>Increasing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trend in air temperature</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

[Turn over]
Many scientists think that an increase in carbon dioxide concentration in the atmosphere causes an increase in air temperature.

02.2 How would an increase in the concentration of carbon dioxide in the atmosphere cause an increase in air temperature? [1 mark]

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02.3 Evaluate evidence for and against the theory that an increase in the concentration of carbon dioxide in the atmosphere causes an increase in air temperature.

Use data from FIGURE 3 and your own knowledge. [4 marks]

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In each year, the concentration of carbon dioxide in the atmosphere is higher in the winter than in the summer.

Give ONE human activity that could cause the higher concentration of carbon dioxide in the winter. [1 mark]
Give ONE biological process that could cause the lower concentration of carbon dioxide in the summer. [1 mark]

Give TWO possible effects of an increase in global air temperature on living organisms. [2 marks]

1

2
It is important to maintain water balance in the body.

FIGURE 4, below and on page 15, shows how much water a person gained and lost by different methods in one day.

FIGURE 4

Water gained by the body

Volume in cm³

<table>
<thead>
<tr>
<th>Method</th>
<th>Water Gain (cm³)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food</td>
<td>400</td>
</tr>
<tr>
<td>Drink</td>
<td>1500</td>
</tr>
<tr>
<td>Metabolism</td>
<td>300</td>
</tr>
</tbody>
</table>
Water lost from the body

Volume in cm$^3$

<table>
<thead>
<tr>
<th>Method</th>
<th>Volume (cm$^3$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urine</td>
<td>1500</td>
</tr>
<tr>
<td>Faeces</td>
<td>400</td>
</tr>
<tr>
<td>Skin</td>
<td>360</td>
</tr>
<tr>
<td>Breathing</td>
<td>300</td>
</tr>
</tbody>
</table>
When water is balanced, the volume of water taken in by the body is equal to the volume of water lost from the body.

Calculate the volume of water the person lost in one day in faeces.

Use information from FIGURE 4 on pages 14 and 15. [2 marks]

Volume lost in faeces = _____________ cm$^3$
FIGURE 4, on pages 14 and 15, shows that one method of gaining water is by metabolism.

Which metabolic process produces water? [1 mark]

Tick ONE box.

- Breakdown of protein to amino acids
- Changing glycogen into glucose
- Digestion of fat
- Respiration of glucose
The next day, the person ran a 10-kilometre race.

The volume of water lost from the body through the skin and by breathing increased.

Explain why more water was lost through the skin during the race. [2 marks]

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[Turn over]
03.4 Explain why more water was lost by breathing during the race. [3 marks]

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Some students investigated the size of a population of dandelion plants in a field.

FIGURE 5 shows the field.

FIGURE 5

The students:
- placed a 1 m x 1 m square quadrat at 10 random positions in the field
- counted the number of dandelion plants in each quadrat.
TABLE 2 shows the students’ results.

### TABLE 2

<table>
<thead>
<tr>
<th>Quadrat number</th>
<th>Number of dandelion plants</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>2</td>
<td>9</td>
</tr>
<tr>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>6</td>
<td>10</td>
</tr>
<tr>
<td>7</td>
<td>2</td>
</tr>
<tr>
<td>8</td>
<td>1</td>
</tr>
<tr>
<td>9</td>
<td>8</td>
</tr>
<tr>
<td>10</td>
<td>11</td>
</tr>
</tbody>
</table>

Why did the students place the quadrats at random positions? [1 mark]

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[Turn over]
Estimate the total number of dandelion plants in the field.

Calculate your answer using information from FIGURE 5 and TABLE 2.

Give your answer in standard form. [5 marks]

Total number of dandelion plants =
Quadrats 5, 7 and 8 were each placed less than 10 metres from the woodland.

These quadrats contained low numbers of dandelion plants.

The students made the hypothesis:

‘Light intensity affects the number of dandelion plants that grow in an area.’

Plan an investigation to test this hypothesis. [6 marks]

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________________________________________________________________________
Light is an environmental factor that affects the growth of dandelion plants.

Give TWO other environmental factors that affect the growth of dandelion plants. [2 marks]

1

2
Cell division is needed for growth and for reproduction.

TABLE 3 contains three statements about cell division.

Complete TABLE 3. [2 marks]

Tick ONE box for each statement.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Mitosis only</th>
<th>Meiosis only</th>
<th>Both mitosis and meiosis</th>
</tr>
</thead>
<tbody>
<tr>
<td>All cells produced are genetically identical</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In humans, at the end of cell division each cell contains 23 chromosomes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Involves DNA replication</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

[Turn over]
Bluebell plants grow in woodlands in the UK.

- Bluebells can reproduce sexually by producing seeds.
- Bluebells can also reproduce asexually by making new bulbs.

One advantage of asexual reproduction for bluebells is that only ONE parent is needed.

Suggest TWO other advantages of asexual reproduction for bluebells. [2 marks]

1. 
   
2. 
Explain why sexual reproduction is an advantage for bluebells. [4 marks]
Some students investigated geotropism in the roots of bean seedlings.

FIGURE 6 shows the apparatus used.

FIGURE 6

Apparatus A
Stationary

Cork mat
Damp blotting paper

Apparatus B
Rotating slowly

Motor
Pin

Bean seedlings
This is the method used.

1. Measure the length of the root of each of 10 bean seedlings.

2. Pin 5 seedlings to the cork mat in apparatus A.

3. Pin 5 seedlings to the cork mat in apparatus B.

4. Leave A and B in a dark cupboard for 2 days.

5. After the 2 days:
   • make a drawing to show the appearance of each seedling
   • measure the length of the root of each seedling.

0 6. 1 Why did the students surround the seedlings with damp blotting paper? [1 mark]

Tick ONE box.

- To prevent light affecting the direction of root growth
- To prevent photosynthesis taking place in the roots
- To prevent the growth of mould on the roots
- To prevent water affecting the direction of root growth

[Turn over]
Apparatus B is a control.

Apparatus B rotates slowly.

How does apparatus B act as a control? [1 mark]

TABLE 4 shows the students’ results.

TABLE 4

<table>
<thead>
<tr>
<th>Seedling number</th>
<th>Apparatus A</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Apparatus B</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length at start in mm</td>
<td>35</td>
<td>41</td>
<td>32</td>
<td>33</td>
<td>39</td>
<td>30</td>
<td>33</td>
<td>29</td>
<td>28</td>
<td>31</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Length after 2 days in mm</td>
<td>49</td>
<td>57</td>
<td>43</td>
<td>45</td>
<td>54</td>
<td>45</td>
<td>45</td>
<td>44</td>
<td>29</td>
<td>44</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Length change in mm</td>
<td>14</td>
<td>16</td>
<td>11</td>
<td>12</td>
<td>15</td>
<td>15</td>
<td>12</td>
<td>15</td>
<td>1</td>
<td>13</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean length change in mm</td>
<td>14</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>11</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
One student stated:

‘The mean length change for the seedlings in apparatus B is NOT valid.’

Suggest the reason for the student’s statement. [1 mark]


Suggest ONE improvement the students could make to obtain a more valid mean length change for the seedlings in apparatus B. [1 mark]


[Turn over]
FIGURE 7 shows the students’ drawings of two seedlings at the end of the 2 days.

FIGURE 7

Seedling from Apparatus A

Seedling from Apparatus B

A plant hormone is made in the root tip.

The hormone diffuses from the tip into the tissues of the root.

Explain how the hormone causes the appearance of the seedlings in FIGURE 7 to be different.

You should refer to BOTH seedlings in your answer. [3 marks]
In horticulture plant hormones are used for controlling plant growth.

Draw ONE line from each plant hormone to the correct use of that hormone. [3 marks]

<table>
<thead>
<tr>
<th>Plant hormone</th>
<th>Use of hormone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Auxin</td>
<td>To reduce the time taken for tomatoes to ripen</td>
</tr>
<tr>
<td>Ethene</td>
<td>To slow down the growth of plant stems</td>
</tr>
<tr>
<td>Gibberellin</td>
<td>To promote seed germination</td>
</tr>
<tr>
<td></td>
<td>To stimulate root growth in plant cuttings</td>
</tr>
</tbody>
</table>

10
FIGURE 8 shows:
- a food chain for organisms in a river
- the biomass of the organisms at each trophic level.

FIGURE 8

Biomass in g/m²: 840 → 200 → 40 → 10

Draw a pyramid of biomass for the food chain in FIGURE 8 on FIGURE 9.

You should:
- use a suitable scale
- label the x-axis
- label each trophic level.

[4 marks]
Calculate the percentage of the biomass lost between the algae and the large fish.

Give your answer to 2 significant figures. [3 marks]

Percentage loss = _______________
Give ONE way that biomass is lost between trophic levels. [1 mark]
A large amount of untreated sewage entered the river. Many fish died.

Untreated sewage contains organic matter and bacteria.

Explain why many fish died. [5 marks]
Scientists want to breed cows that produce milk with a low concentration of fat.

FIGURE 10 shows information about the milk in one group of cows. The cows were all the same type.

In FIGURE 10 the mean percentage of fat in the milk is equal to the modal value.

Give the mean percentage of fat in the milk of these cows. [1 mark]

Mean percentage = ______________________
FIGURE 10

Number of cows

25
20
15
10
5
0

Percentage fat in milk

2.7 2.8 2.9 3.0 3.1 3.2 3.3 3.4 3.5 3.6 3.7 3.8 3.9 4.0 4.1 4.2 4.3 4.4 4.5 4.6 4.7 4.8

[Turn over]
A student suggested:

‘The percentage of fat in milk is controlled by one dominant allele and one recessive allele.’

How many different phenotypes would this produce? [1 mark]

Tick ONE box.

2 3 22 46

Give the evidence from FIGURE 10 which shows the percentage of fat in the milk is controlled by several genes. [1 mark]

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[Turn over]
One of the genes codes for an enzyme used in fat metabolism.

A mutation in this gene causes a reduction in milk fat.

The mutation changes one amino acid in the enzyme molecule.

Explain how a change in one amino acid in an enzyme molecule could stop the enzyme working. [3 marks]
The scientists found one cow with a mutation.

The cow’s milk contained only 2.9% fat.

FIGURE 11 shows the percentage of fat in the milk of cattle related to the cow with the mutation.

The values for male cattle are the mean values of their female offspring.

FIGURE 11

KEY

● Female with low-fat milk

■ Male whose female offspring have low-fat milk

○ Female with high-fat milk

□ Male whose female offspring have high-fat milk
Animal 8 is homozygous.

The mutation in animal 7 produced a dominant allele for making low-fat milk.

Give evidence from FIGURE 11 that animal 7 is heterozygous. [1 mark]

________________________________________

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________________________________________

Animals 7 and 8 produced 11 offspring. These offspring were produced by in vitro fertilisation (IVF).

The embryos from IVF were transferred into 11 other cows.

Suggest why IVF and embryo transfer were used rather than allowing animals 7 and 8 to mate naturally. [1 mark]

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[Turn over]
Draw a Punnett square diagram to show a cross between animals 7 and 8.

Identify which offspring produce low-fat milk and which offspring produce high-fat milk. [4 marks]

Use the following symbols:
D = dominant allele for making low-fat milk
d = recessive allele for making high-fat milk
The scientists want to produce a type of cattle that makes large volumes of low-fat milk.

The scientists will selectively breed some of the animals shown in FIGURE 11.

Describe how the scientists would do this. [4 marks]
FIGURE 12 shows a ring-tailed lemur.

TABLE 5 shows part of the classification of the ring-tailed lemur.

TABLE 5

<table>
<thead>
<tr>
<th>CLASSIFICATION GROUP</th>
<th>NAME</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kingdom</td>
<td>Animalia</td>
</tr>
<tr>
<td>Phylum</td>
<td>Chordata</td>
</tr>
<tr>
<td></td>
<td>Mammalia</td>
</tr>
<tr>
<td></td>
<td>Primates</td>
</tr>
<tr>
<td></td>
<td>Lemuroidea</td>
</tr>
<tr>
<td>Genus</td>
<td>Lemur</td>
</tr>
<tr>
<td></td>
<td>catta</td>
</tr>
</tbody>
</table>
Complete TABLE 5 to give the names of the missing classification groups. [2 marks]

Give the binomial name of the ring-tailed lemur. Use information from TABLE 5. [1 mark]

Lemurs are only found on the island of Madagascar.

Madagascar is off the coast of Africa.

Scientists think that ancestors of modern lemurs evolved in Africa and reached Madagascar about 50-60 million years ago.

Today there are many species of lemur living on Madagascar.

FIGURE 13, on page 60, shows information about water currents.

FIGURE 14, on page 61, shows the distribution of three species of lemur on Madagascar.

[Turn over]
FIGURE 13

KEY

\[\text{\rightarrow Water currents 50–60 million years ago} \]

\[\text{\rightarrow Water currents today} \]
Suggest how ancestors of modern lemurs reached Madagascar. [1 mark]

__________________________________________________________________________

__________________________________________________________________________

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[Turn over]
Describe how the ancestors of modern lemurs may have evolved into the species shown in FIGURE 14. [5 marks]
There are no questions printed on this page
There are no questions printed on this page

<table>
<thead>
<tr>
<th>Question</th>
<th>Mark</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td></td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
</tr>
</tbody>
</table>

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