GCE

Rewarding Learning

# CCEA GCE Specimen Assessment Material for Biology

For first teaching from September 2016
For first award of AS level in Summer 2017
For first award of A level in Summer 2018
Subject Code: 1010

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# Foreword

CCEA has developed new specifications which comply with criteria for GCE qualifications. The specimen assessment materials accompanying new specifications are provided to give centres guidance on the structure and character of the planned assessments in advance of the first assessment. It is intended that the specimen assessment materials contained in this booklet will help teachers and students to understand, as fully as possible, the markers' expectations of candidates' responses to the types of tasks and questions set at GCE level. These specimen assessment materials should be used in conjunction with CCEA's GCE Biology specification.

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# GCE Biology
Specimen Assessment Materials

## Contents

| | |
|---|---|
| Subject Code | 1010 |
| QAN AS | 601/8486/3 |
| QAN A2 | 601/8487/5 |

# SPECIMEN PAPERS

# DIVIDER FRONT

# SPECIMEN PAPERS

# DIVIDER BACK

Rewarding Learning

**ADVANCED SUBSIDIARY (AS)**
**General Certificate of Education**
**2017**

**Centre Number**

| | | | | |
|---|---|---|---|---|
| | | | | |

**Candidate Number**

| | | | |
|---|---|---|---|
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# Biology

## Assessment Unit AS 1

*assessing*

Molecules and Cells

## [CODE]

## SPECIMEN PAPER

**TIME**

1 hour 30 minutes.

**INSTRUCTIONS TO CANDIDATES**

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.
Write your answers in the spaces provided in this question paper.
There is an extra lined page at the end of the paper if required.
Answer **all eight** questions.

**INFORMATION FOR CANDIDATES**

The total mark for this paper is 75.
Section A carries 60 marks. Section B carries 15 marks.
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.
You are expected to answer Section B in continuous prose.
**Quality of written communication** will be assessed in Section B (Question 8).

| For Examiner's use only | |
|---|---|
| **Question Number** | **Marks** |
| 1 | |
| 2 | |
| 3 | |
| 4 | |
| 5 | |
| 6 | |
| 7 | |
| 8 | |
| **Total Marks** | |

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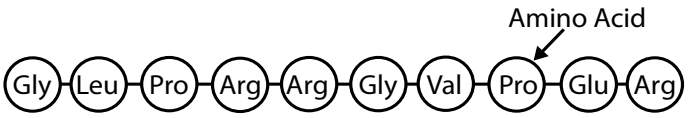
## Section A

| Examiner Only | |
|---|---|
| Marks | Re-mark |
| | |

**1** The diagram below represents the primary structure of a protein.






**(a) (i)** State the name of the bond which joins two amino acids together.

_____ [1]

**(ii)** State the reaction that occurs to form this type of bond.

_____ [1]

**(iii)** Give **one** example of a globular protein.

_____ [1]

**(b) (i)** Give a structural difference between the normal and disease-causing forms of prions.

_____

_____

_____ [1]

**(ii)** State **one** way in which a person can acquire a prion disease.

_____

_____ [1]

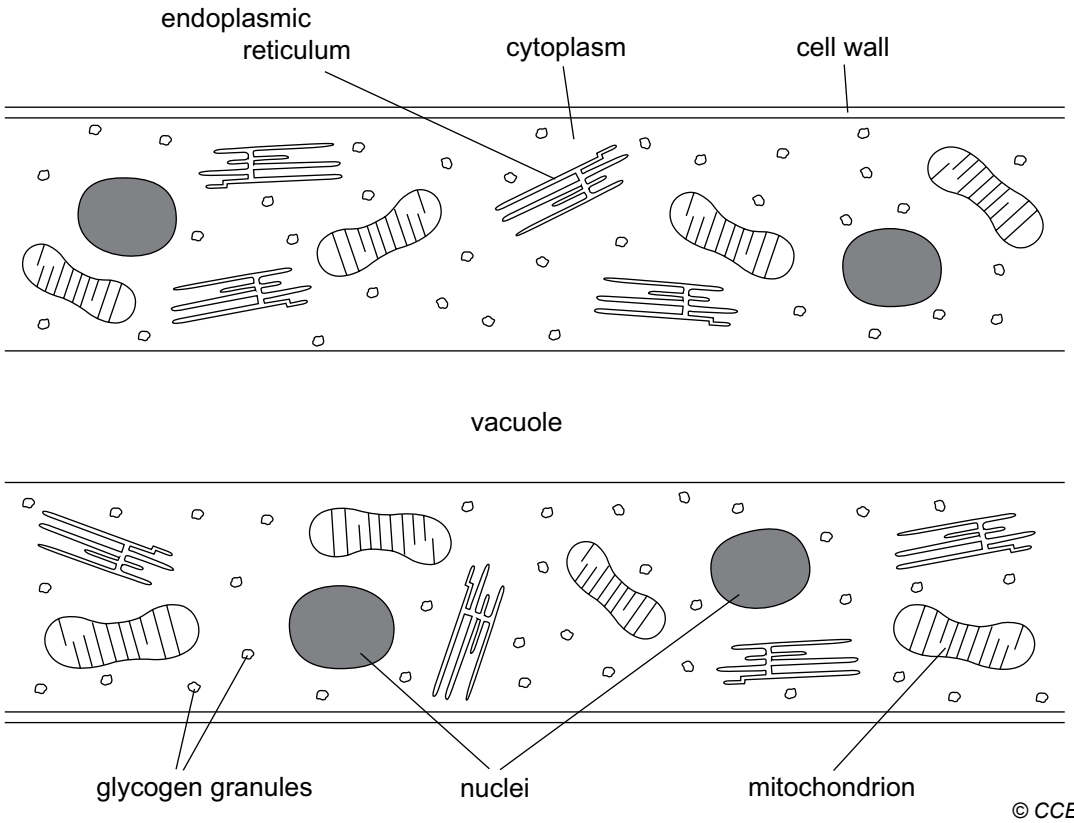
**(c)** Give the colour change which indicates the presence of protein when it is tested with Biuret reagent.

_____

_____ [1]

| Examiner Only | |
|---|---|
| Marks | Re-mark |
| | |

**2** Fungi are composed of eukaryotic cells and the cellular structure of a fungus is represented in the diagram below.






**(a)** Identify which structures labelled in the diagram above are also found:

**(i)** in both plant and animal cells

_____

_____ [1]

**(ii)** in plant cells but not in animal cells

_____

_____ [1]

**(iii)** in animal cells but not in plant cells

_____

_____ [1]

**(b)** Identify **one** cellular feature which is unique to the cells of fungi.

_____ [1]

**(c)** Identify the cell structures by the following descriptions.

**(i)** A network of membrane-bound tubules and cisternae, responsible for synthesis and transport of lipid molecules.

_____ [1]

**(ii)** Finger-like extensions of the cell-surface membrane, which increase the surface area.

_____ [1]

**(iii)** Forms secretory vesicles.

_____ [1]

**(iv)** Allows direct movement of substances between adjacent plant cells.

_____ [1]

| Examiner Only | |
|---|---|
| Marks | Re-mark |
| | |

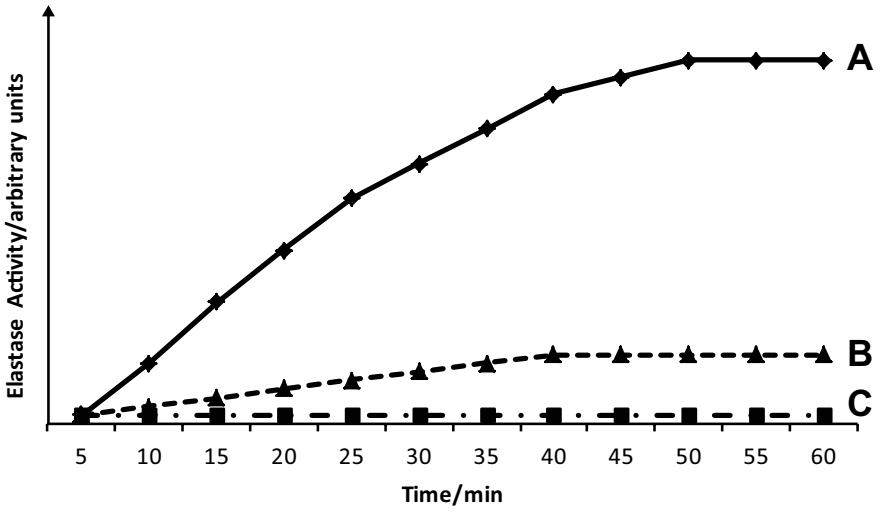
| Examiner Only | |
|---|---|
| Marks | Re-mark |
| | |

**3** Elastin is a fibrous structural protein with elastic properties and gives tissues the ability to stretch and recoil. It is one of the main proteins that make up the alveoli in the lungs. Elastase is an enzyme released from white blood cells during infection or inflammation which breaks down elastin. Individuals with cystic fibrosis can produce large amounts of elastase.

A clinical trial was carried out to test a new inhaled aerosol form of an elastase inhibitor in patients with cystic fibrosis. As part of the trial three samples of mucus were collected from the lungs of 2 different people as listed below:

- a person with cystic fibrosis before taking the inhaled inhibitor (sample A)
- the same person with cystic fibrosis 1 hour after taking the inhaled inhibitor (sample B)
- a person without cystic fibrosis (sample C)

After collection the samples were chilled and an experiment was carried out to investigate the presence of elastase in the mucus. The graph below shows the activity of elastase as time progresses.






**(a)** Describe three trends evident in the graph for each of the samples.

_____

_____

_____

_____

_____

_____ [3]

**(b)** Analyse the data provided and suggest **two** possible explanations for the results shown for sample **B** in relation to **C**.

[2]

**(c)** Using your knowledge of enzymes, explain the results shown in the graph for sample **A**.

[2]

**(d)** Another sample was collected from a different patient who had taken the inhaled inhibitor. Instead of this sample being kept chilled, it was accidently left on the laboratory bench at room temperature for several hours.

State which line on the graph (**A**, **B**, or **C**) would best represent the results that you would expect from an enzyme activity experiment using this sample. Explain your answer.

[3]

| Examiner Only | |
|---|---|
| Marks | Re-mark |
| | |

| Examiner Only | |
|---|---|
| Marks | Re-mark |
| | |

**4** **(a)** Describe concisely the structure and function of a mitochondrion.

[2]

**(b)** In a culture of actively-dividing animal cells, the average cell volume and the average number of mitochondria were measured. The results are shown in the table below.

| Cell volume/μm $^3$ | Number of mitochondria |
|---|---|
| 560 | 65 |
| 650 | 90 |
| 760 | 118 |
| 870 | 141 |
| 920 | 153 |
| 1030 | 146 |
| 1140 | 152 |

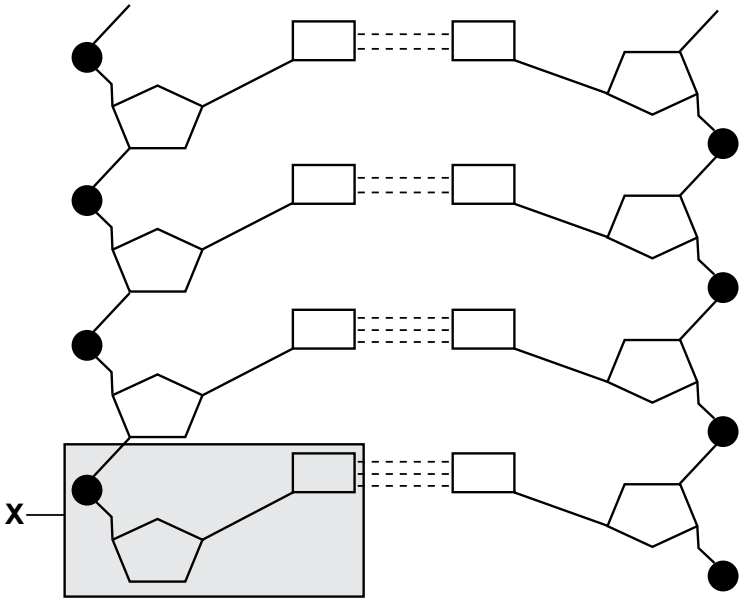
**(i)** Plot the above results, using an appropriate graphical technique. You need to provide a caption.
(Use the graph paper opposite.) [4]

**(ii)** Identify the major trends evident in the results.

[2]

| Examiner Only | |
|---|---|
| Marks | Re-mark |
| | |

**5** **(a)** The diagram below represents the structure of DNA.



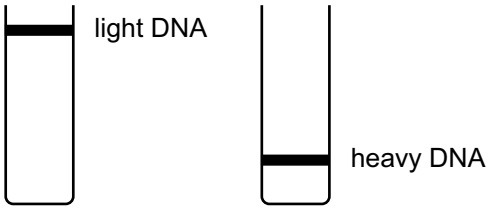

Identify the part of the DNA molecule shown in the box **X**.

_____ [1]

**(b)** In a classic experiment, Matthew Meselson and Frank Stahl grew bacteria in a medium where the nitrogen source contained the 'light' nitrogen isotope, $^{14}N$. The bacteria were then placed in a medium with a nitrogen source containing the 'heavy' nitrogen isotope, $^{15}N$, and allowed to reproduce.

After many generations, all DNA in the bacteria contained this 'heavy' $^{15}N$ isotope. This DNA was termed 'heavy' DNA.

DNA extracted from bacterial cells was centrifuged and observed under ultra-violet light. The DNA appeared as a black band in the centrifuge tube. The band produced by 'heavy' DNA was much lower in the centrifuge tube than that produced by 'light' DNA. They are shown in the diagrams below.





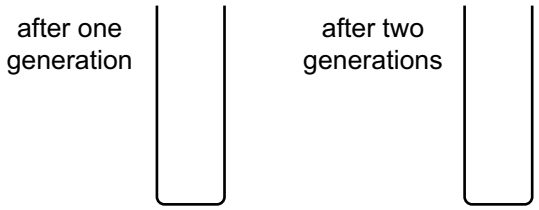

The bacteria containing 'heavy' DNA were then transferred to a medium with a nitrogen source containing the 'light' nitrogen isotope, $^{14}N$, and allowed to reproduce.

After one generation, samples of the bacteria were removed and their DNA was extracted and centrifuged.

This process was repeated after a further generation.

| Examiner Only | |
|---|---|
| Marks | Re-mark |
| | |

**(i)** Complete the diagrams below to show the position of the extracted DNA by **drawing appropriate bands**, in each diagram.






[2]

**(ii)** Explain the result produced after **one generation**.

_____

_____

_____

_____ [2]

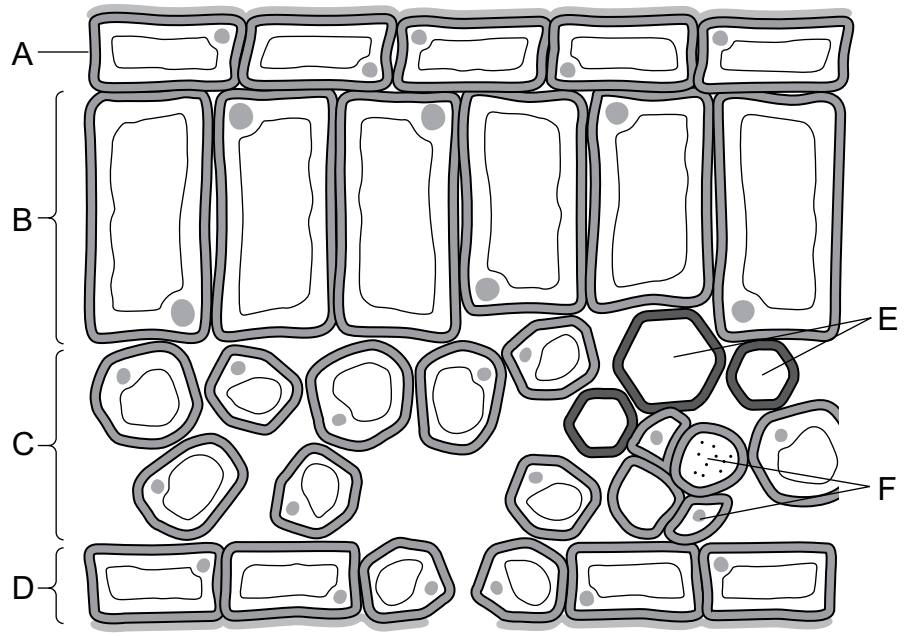
**(c)** In an analysis of the DNA in a cell nucleus, 21% of the bases was found to be guanine.

Calculate the percentage of each of the other bases in the DNA. (Show your working.)

_____ [2]

| Examiner Only | |
|---|---|
| Marks | Re-mark |
| | |

**6** The diagram below shows a transverse section through part of a mesophytic leaf.
Six tissues are labelled **A**–**F**.






**(a) (i)** Using the appropriate letter from the diagram, identify the tissue in which each of the following processes happen:

- maximum absorption of light _____
- diffusion of gases _____
- transport of water _____ [3]

**(ii)** State the role of the cuticle.

_____

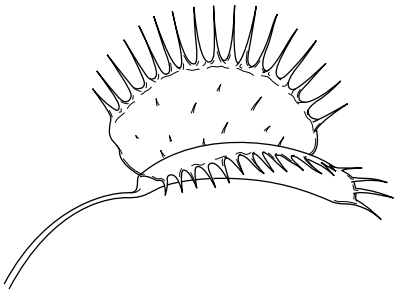
_____ [1]

| Examiner Only | |
|---|---|
| Marks | Re-mark |
| | |

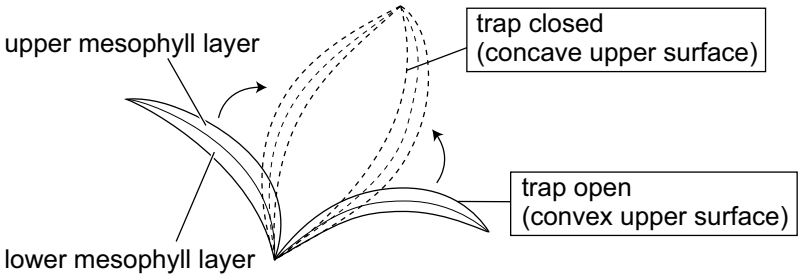
**(b)** The Venus Flytrap plant (*Dionaea muscipula*) has modified leaves which form two plates of a trap. When triggered, small invertebrates are caught and digested. The mechanism of trap closure is caused by osmotic changes and the flow of water between the mesophyll layers within the plates.

A whole view of the plates is shown below, together with a cross-sectional view showing the mesophyll layers.

**whole view**



**cross-sectional view**






The plate consists of two mesophyll layers, the upper and lower mesophyll. The water potentials of the cells of these layers is different and information regarding this is shown in the table below.

| Potential/kPa | Cells of upper mesophyll | Cells of lower mesophyll |
|---|---|---|
| $\psi_{cell}$ | 0 | |
| $\psi_s$ | −250 | −250 |
| $\psi_p$ | | 100 |

**(i)** Calculate the missing values and present these in the empty spaces in the table above. [2]

When the trap is open, water movement between the mesophyll layers is not possible. However, when triggered to close, water will move from one layer to the other.

**(ii)** Determine the direction in which water will flow when the trap is triggered to close. Explain your answer.

_____

_____

_____

_____ [2]

**(iii)** Explain what causes the change in the shape of the plates during closure of the trap.

_____

_____

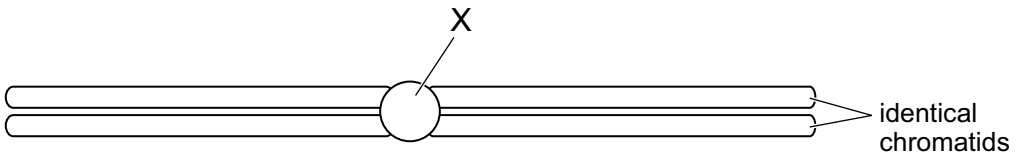
_____

_____ [2]

| Examiner Only | |
|---|---|
| Marks | Re-mark |
| | |

| Examiner Only | |
|---|---|
| Marks | Re-mark |
| | |

**7** **(a)** The diagram below represents a chromosome as it would appear during prophase of mitosis.






**(i)** Name the structure labelled **X**.

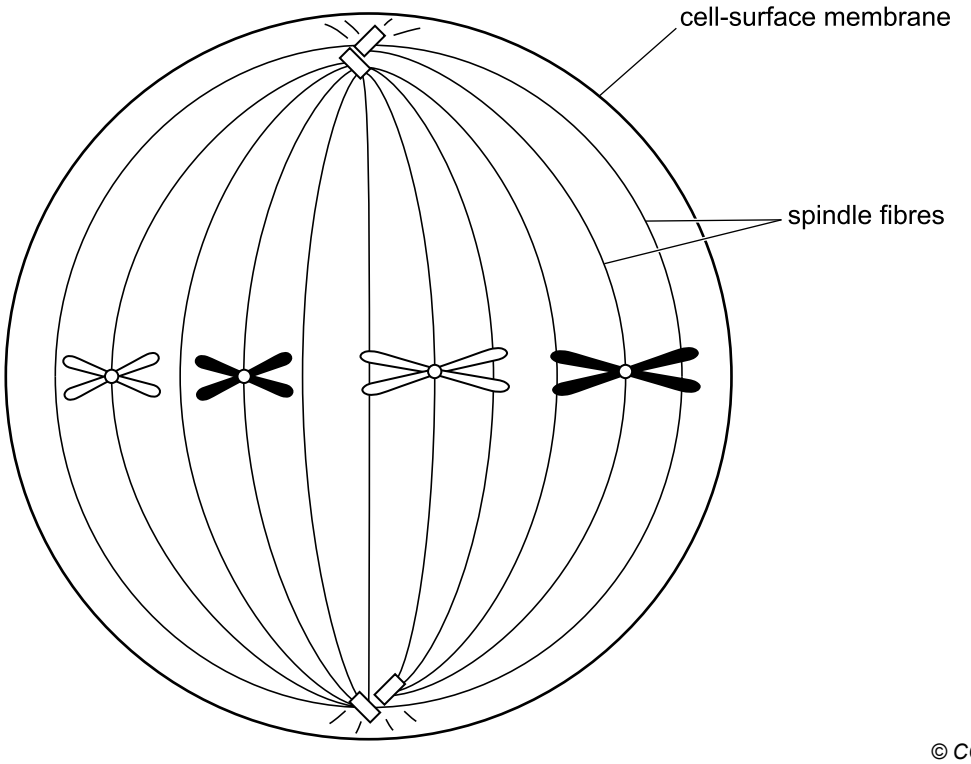
_____ [1]

**(ii)** Identify the specific stage in the cell cycle when DNA replicates to form the two chromatids.

_____

_____ [1]

**(b)** The anti-cancer drug vincristine inhibits the formation of microtubules during the cell cycle. The diagram below shows a cell at a stage of mitosis before the addition of vincristine.






**(i)** Name the stage of mitosis shown in the diagram.

_____ [1]

**(ii)** What effect will the addition of vincristine have on mitosis?

_____

_____

_____

_____ [2]

**(iii)** Explain how mitotic poisons such as vincristine contribute to the treatment of cancer.

_____

_____

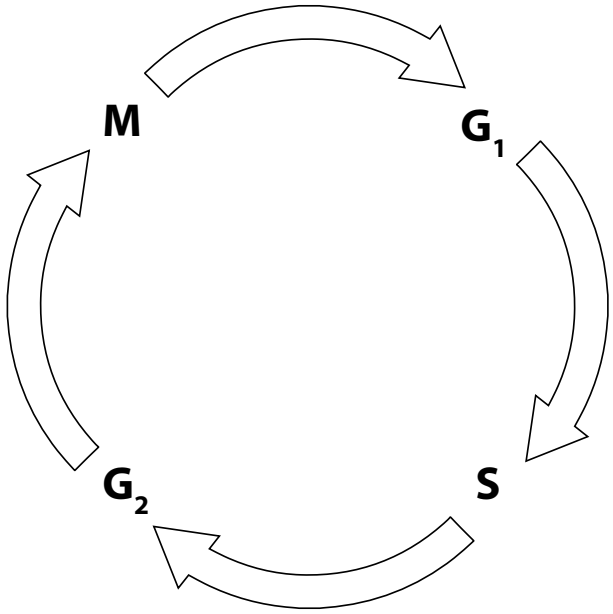
_____

_____ [2]

| Examiner Only | |
|---|---|
| Marks | Re-mark |
| | |

| Examiner Only | |
|---|---|
| Marks | Re-mark |
| | |

**(c)** Stages of the cell cycle are shown in the diagram below.






**(i)** Other than providing a time delay, what is the purpose of the gap phases ($G_1$ and $G_2$)?

_____

_____ [1]

**(ii)** One possible stage is missing from the diagram.

Name and mark this stage with the letter **X** on the diagram. [2]

**(iii)** Mark the diagram with the letter **Y** at the point where cell division takes place. [1]

## Section B

| Examiner Only | |
|---|---|
| Marks | Re-mark |
| | |

**8** The cell membrane consists of a phospholipid bilayer with various proteins embedded in it. This structure enables different substances to travel through the membrane by either simple diffusion, facilitated diffusion or active transport.

**In this question, you will be assessed on your written communication skills, including the use of specialist scientific terms.**

**(a)** Describe the similarities and differences between simple diffusion, facilitated diffusion and active transport.

[6]

**(b)** Large and small molecules, as well as ions, must be able to travel through the cell membrane.

Discuss how the different methods of transport named in part **(a)** are necessary to allow each of these substances to pass through and also how they may allow the membrane to be selective.

[9]

| Examiner Only | |
|---|---|
| Marks | Re-mark |
| | |

**THIS IS THE END OF THE QUESTION PAPER**

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**ADVANCED SUBSIDIARY (AS)**
**General Certificate of Education**
**2017**

**Centre Number**

| | | | | |
|---|---|---|---|---|
| | | | | |

**Candidate Number**

| | | | |
|---|---|---|---|
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# Biology

## Assessment Unit AS 2
*assessing*

## Organisms and Biodiversity

## [CODE]
## SPECIMEN PAPER

**TIME**

1 hour 30 minutes.

**INSTRUCTIONS TO CANDIDATES**

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.
Write your answers in the spaces provided in this question paper.
There is an extra lined page at the end of the paper if required.
Answer **all nine** questions.

**INFORMATION FOR CANDIDATES**

The total mark for this paper is 75.
Section A carries 60 marks. Section B carries 15 marks.
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.
You are expected to answer Section B in continuous prose.
**Quality of written communication** will be assessed in Section B (Question 9).

| For Examiner's use only | |
|---|---|
| **Question Number** | **Marks** |
| 1 | |
| 2 | |
| 3 | |
| 4 | |
| 5 | |
| 6 | |
| 7 | |
| 8 | |
| 9 | |
| **Total Marks** | |

## Section A

| Examiner Only | |
|---|---|
| Marks | Re-mark |
| | |

**1** Stomata are found on both the upper and lower surfaces of a leaf. A student took four counts of stomata on both surfaces of a leaf. The results are shown in the table below.

| | Number of stomata/cm$^2$ | |
|---|---|---|
| | Upper epidermis | Lower epidermis |
| Replicates | 136 | 67 |
| | 146 | 81 |
| | 132 | 90 |
| | 154 | 58 |
| Mean count | 142 | 74 |



**(a)** Comment on the variation shown within the replicates and the reliability of the measurements.

_____

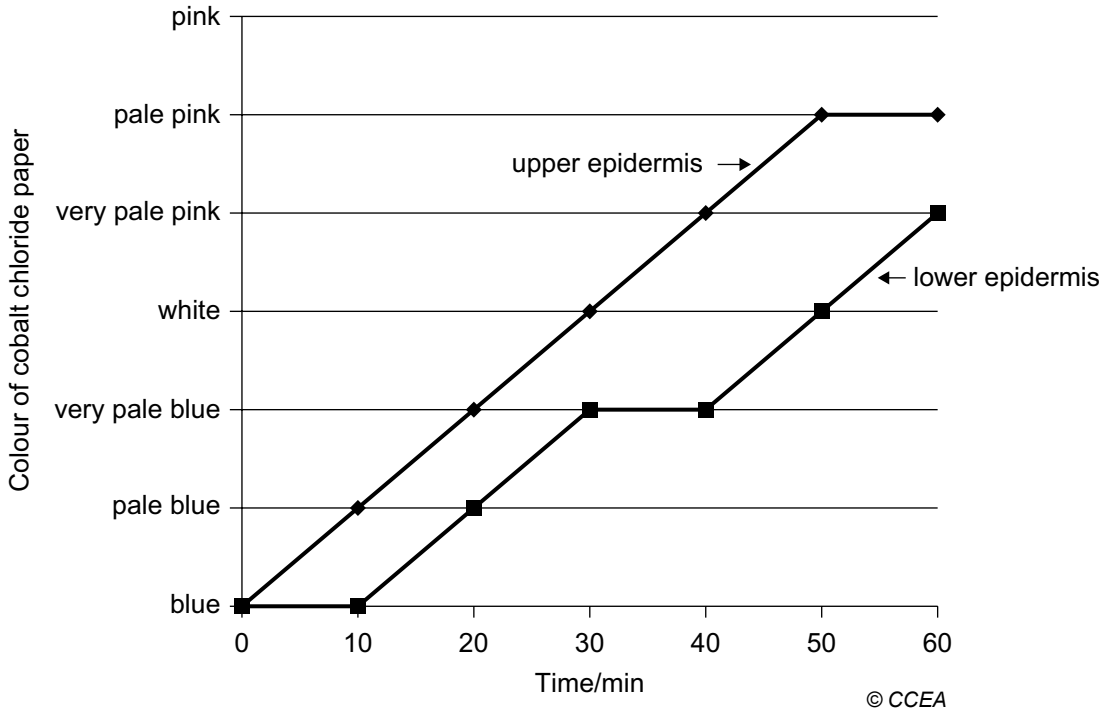
_____

_____

_____ [2]

| Examiner Only | |
|---|---|
| Marks | Re-mark |
| | |

**(b)** An estimate was made of the amount of transpiration from both surfaces of a daffodil leaf. This was carried out by sticking small pieces of dry cobalt chloride paper on the upper and lower epidermis. The cobalt chloride paper changes from blue to pink as it absorbs water. The results are shown in the graph below.




Using the information provided, explain the colour changes shown.

[3]

| Examiner Only | |
|---|---|
| Marks | Re-mark |
| | |

**2** In Northern Ireland, farmers have been encouraged to use agricultural practices that promote biodiversity. One example is hedgerow conservation.

**(a)** Give **three** ways in which hedgerow conservation encourages biodiversity.

1 _____

_____

_____

2 _____

_____

_____

3 _____

_____

_____ [3]

**(b)** State **three** potential disadvantages of hedgerows.

1 _____

_____

2 _____

_____

3 _____

_____ [3]

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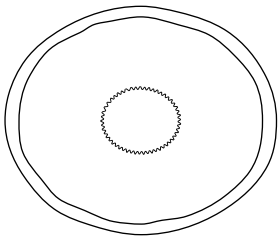
**(Questions continue overleaf)**

**3** The diagram below represents a transverse section through a blood vessel.





**(a)** Give **two** pieces of evidence visible in the diagram which suggest that this is an artery.

1 _____

2 _____ [2]

**(b)** Outline the role of smooth muscle in an artery.

_____

_____

_____

_____ [2]

**(c)** Fick's Law states a relationship between three factors.

These include:
- concentration gradient
- diffusion distance

State the third factor that would influence the rate of diffusion in Fick's Law.

_____

_____ [1]

| Examiner Only | |
|---|---|
| Marks | Re-mark |
| | |

**(d)** Chronic bronchitis and emphysema are common long-term lung diseases that cause difficulty in breathing.

**(i)** Suggest why sufferers of emphysema have difficulty breathing.

_____

_____

_____

_____ [2]

**(ii)** One of the effects of long term smoking is bronchitis.

Explain how long term smoking causes bronchitis.

_____

_____

_____

_____ [2]

**(e)** Recent studies by a team from the University of California have found that compounds in cocoa found in chocolate could help prevent blood clots and so lower the risk of heart disease and heart attacks.

Using your knowledge of blood clotting, suggest **two** ways in which these cocoa compounds may prevent the formation of blood clots.

1 _____

_____

2 _____

_____ [2]

| Examiner Only | |
|---|---|
| Marks | Re-mark |
| | |

**(f)** Minoxidil is a drug which relaxes the smooth muscle in blood vessels, causing them to dilate.

Suggest why the chances of heart disease are reduced in patients taking this drug.

_____

_____

_____

_____ [2]

| Examiner Only | |
|---|---|
| Marks | Re-mark |
| | |

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**(Questions continue overleaf)**

| Examiner Only | |
|---|---|
| Marks | Re-mark |
| | |

**4** Xylem and phloem contain a variety of cell types.

**(a) (i)** Describe the distribution of xylem and phloem tissues in the stem of a flowering plant.

_____

_____

_____

_____ [2]

**(ii)** Phloem sieve tubes are the main cell type in phloem tissue.

State **two** major features of phloem sieve tubes.

1 _____

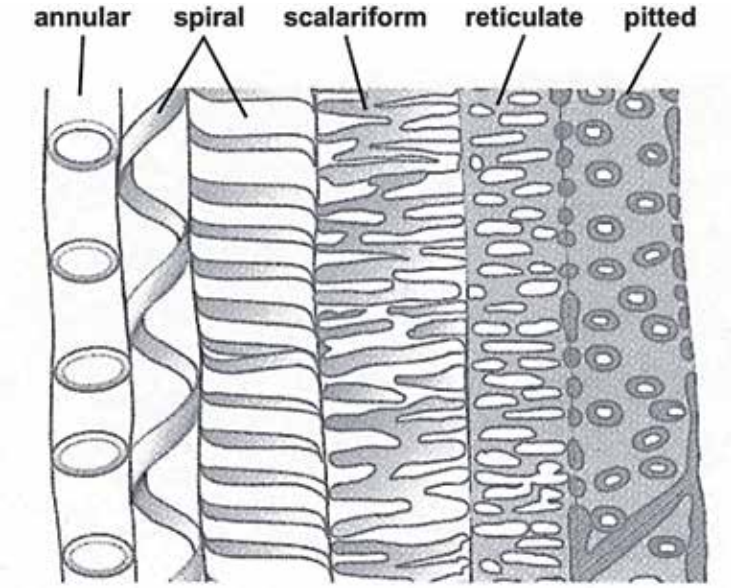
_____

2 _____

_____ [2]

| Examiner Only | |
|---|---|
| Marks | Re-mark |
| | |

**(b)** The diagram below shows different forms of lignification patterns in xylem vessels.






**(i)** Explain why the added strength which lignin provides in the xylem vessels is necessary for their functioning.

_____

_____

_____

_____ [2]

**(ii)** Suggest why the xylem vessels in young stems have rings or spirals of lignin whereas older stems will have scalariform or reticulate walls, as shown in the diagram above.

_____

_____

_____

_____ [2]

| Examiner Only | |
|---|---|
| Marks | Re-mark |
| | |

**5** **(a)** The red squirrel (*Sciurus vulgaris*), which is native to Ireland, is related to chipmunks, marmots and prairie dogs and is included in a taxonomic group called the Sciuridae. All Sciuridae belong to a group of mammals called the Rodentia.

Using this information, complete the following table concerning the taxonomy of the red squirrel.

| Kingdom | Animalia |
|---|---|
| | Chordata |
| Class | |
| Order | |
| Family | |
| Genus | |
| Species | |

[3]

**(b)** There are an estimated 40,000 red squirrels throughout Ireland. However the range of this native species is rapidly decreasing as grey squirrels (*Sciurus carolinensis*) spread and outcompete reds. Grey squirrels were introduced from North America. Some information about both red and grey squirrels is given in the table below.

| Feature | Red squirrel | Grey squirrel |
|---|---|---|
| Body length | 20–22 cm | 25–27 cm |
| Body mass | 275–305 g | 540–660 g |
| Body shape | Slender | Stocky |
| Habitat | Mainly coniferous forest | Broadleaf forest |
| Diet | Seeds, nuts, buds and berries | Same as red, plus acorns (particularly big seeds); can eat seeds that are not fully ripe |
| Feeding area | Mainly in the tree canopy | Mainly on the ground |
| Breeding | 2–3 litters per year with 3–4 kittens per litter | 3–4 litters per year with 5–6 kittens per litter |

**(i)** Using the information in the table, suggest **four** ways in which the grey squirrels are able to outcompete the red squirrels.

| Examiner Only | |
|---|---|
| Marks | Re-mark |
| | |

1 _____

_____

_____

2 _____

_____

_____

3 _____

_____

_____

4 _____

_____

_____ [4]

**(ii)** Analysing the information provided, suggest **one** other way in which forestry management could encourage the spread of red squirrels.

_____

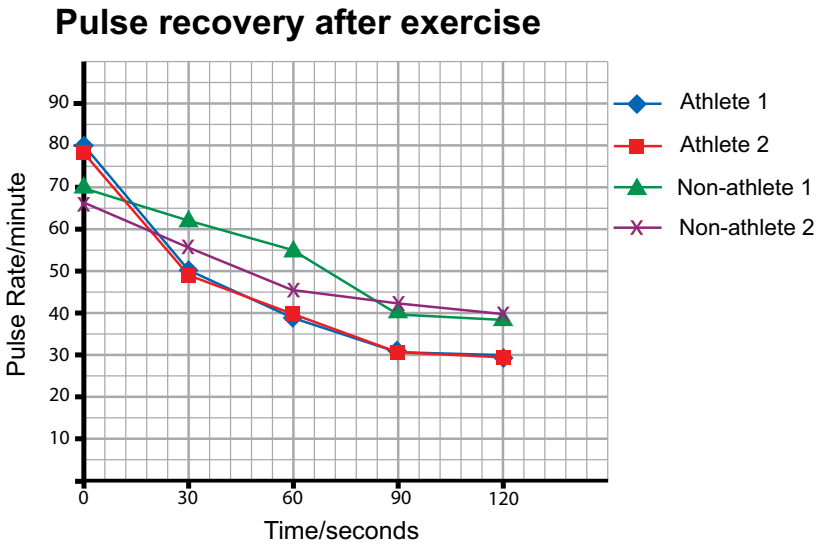
_____ [1]

| Examiner Only | |
|---|---|
| Marks | Re-mark |
| | |

**6** An investigation was carried out to determine the recovery of students of different athletic ability after a period of strenuous exercise. Four students, two athletic and two non-athletic, each ran 200 metres. Their pulses were counted immediately after the exercise.

Pulses were then recorded for each consecutive 30 second period for a total of two minutes (so that for each student there are four recordings after the exercise was complete).

The pulses recorded are shown in the graph below:






**(a)** Using the information provided, suggest **one** reason for each of the following statements:

**(i)** The athletes had the higher pulse rates immediately after the exercise.

_____

_____

**(ii)** The largest decrease in pulse was within the first 30 seconds for the athletes.

_____

_____

**(iii)** The athletes had the lower pulse rates after 90 seconds.

_____

_____

**(iv)** It would be more appropriate to compare percentage fall in pulse rates over the recovery period.

_____

_____ [4]

**(b)** Exercise places an increased demand on the cardiovascular system.

List **three** important functions performed by the cardiovascular system during exercise.

1 _____

2 _____

3 _____ [3]

**(c)** During exercise when a tissue's metabolic rate increases, the pH of the tissue will decrease.

Explain how a decrease in pH is brought about in respiring tissue.

_____

_____

_____

_____ [2]

| Examiner Only | |
|---|---|
| Marks | Re-mark |
| | |

| Examiner Only | |
|---|---|
| Marks | Re-mark |
| | |

**7** The holm oak (*Quercus ilex*) is a tree of Mediterranean origin which was introduced into Ireland during the 16th century.

**(a)** The leaf of the holm oak possesses a thick waxy cuticle.

Explain how this suggests that the tree evolved in a warm, dry climate.

_____

_____

_____

_____ [2]

Only two species of insect feed on the leaves of holm oak and both of these are moth larvae. The table below shows data for the abundance of these moth larvae in a group of holm oaks.

| Insect feeding on holm oak | Number of individuals |
|---|---|
| Holm oak leaf-mining moth (*Phyllonorycter messaniella*) larvae | 526 |
| Lacky moth (*Malacosoma neustrium*) larvae | 371 |



**(b)** Simpson's index is used as a measure of biodiversity. The value for Simpson's index (D) for holm oak can be calculated using the formula below;

$$D = \frac{\Sigma n_i (n_i - 1)}{N(N-1)}$$



Where $n_i$ = the total number of organisms of each individual species; and
N = the total number of organisms of all species.

Using this formula a value of 0.51 was calculated for D.

Predict how values for Simpson's index for these moth larvae might have changed since initiatives to conserve habitats and promote biodiversity were introduced. Explain your answer.

_____

_____

_____

| Examiner Only | |
|---|---|
| Marks | Re-mark |
| | |

[3]

| Examiner Only | |
|---|---|
| Marks | Re-mark |
| | |

**8** An investigation was carried out to show how light intensity affects the rate of carbon dioxide uptake in two different plant species. The results are shown in the table below.

| Light intensity/ $Wm^{-2}$ | Rate of carbon dioxide uptake/ arbitrary units | |
|---|---|---|
| | Species A | Species B |
| 0 | −2.0 | −2.0 |
| 20 | 1.6 | −0.3 |
| 40 | 3.3 | 1.4 |
| 120 | 4.8 | 8.2 |
| 160 | 5.1 | 9.3 |
| 240 | 5.1 | 9.3 |



**(a)** For each plant species, there is a particular light intensity value which results in no net exchange of carbon dioxide.

State the term used to describe this value.

_____ [1]

**(b)** In its natural habitat, plant species **A** can be found growing under dense tree cover, but plant species **B** is confined to bright forest clearings.

Analyse the information provided and explain how plant species **A** is adapted for growing in shady conditions.

_____

_____

_____

_____ [2]

**(c)** Apart from having a thicker cuticle, suggest **three** ways in which a xerophyte may differ structurally to plant species **A** and **B**.

_____

_____

_____

_____ [3]

## Section B

| Examiner Only | |
|---|---|
| Marks | Re-mark |
| | |

**9** Describe and explain the sequence of events, following the return of blood to the heart from the lungs, which lead to the creation of high pressure in the aorta.

Your answer should include both the stimulation of heart muscle and the changes that take place within the chambers of the heart. [15]

**In this question, you will be assessed on your written communication skills, including the use of specialist scientific terms.**

| Examiner Only | |
|---|---|
| Marks | Re-mark |
| | |

| Examiner Only | |
|---|---|
| Marks | Re-mark |
| | |

[15]

## *Extra lined page*

| Examiner Only | |
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| Marks | Re-mark |
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**General Certificate of Education**
**2017**

**Centre Number**

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**Candidate Number**

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# Biology

## Assessment Unit AS 3

*assessing*

Practical Skills in AS Biology

## [CODE]
## SPECIMEN PAPER

**TIME**

1 hour.

**INSTRUCTIONS TO CANDIDATES**

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.
Write your answers in the spaces provided in this question paper.
You are provided with **Photograph 3.5** for use with **Question 5** in this paper. Do not write your answers on this photograph.
Answer **all eight** questions.

**INFORMATION FOR CANDIDATES**

The total mark for this paper is 50.
Figures in brackets down the right hand side of pages indicate the marks awarded to each question or part question.

| For Examiner's use only | |
|---|---|
| **Question Number** | **Marks** |
| 1 | |
| 2 | |
| 3 | |
| 4 | |
| 5 | |
| 6 | |
| 7 | |
| 8 | |
| **Total Marks** | |

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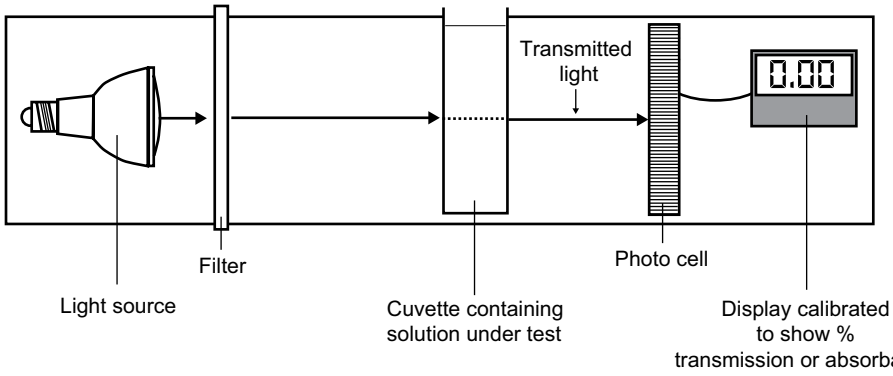
## Section A

| Examiner Only | |
|---|---|
| Marks | Re-mark |
| | |

**1** The diagram below represents a colorimeter.






**(a)** Name **one** type of investigation in which it is appropriate to use a colorimeter.

_____

_____ [1]

**(b)** **(i)** In the context of a colorimeter, explain what is meant by % transmission.

_____

_____ [1]

**(ii)** Explain the function of the colorimeter filter.

_____

_____

_____

_____ [2]

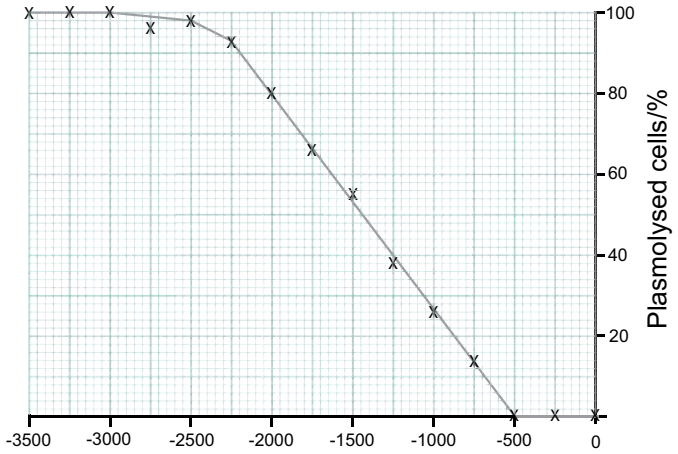
**(iii)** Apart from using the correct filter, give **one** other procedure that would lead to more accurate readings of % transmission of light.

_____

_____ [1]

| Examiner Only | |
|---|---|
| Marks | Re-mark |
| | |

**2** The average solute potential of onion cells at incipient plasmolysis can be calculated by placing strips of onion epidermis in a range of sucrose solutions. The percentage of cells plasmolysed in each solution was calculated. The graph below shows the relationship between the percentage of cells plasmolysed and the solute potential of the sucrose solution.






**(a)** Suggest why, in this graph, it is appropriate to draw a best fit line (between –500 and –2250 kPa) rather than draw short straight lines between each point.

_____

_____ [1]

**(b)** Using the graph, identify the average solute potential of these onion cells at incipient plasmolysis.

_____ kPa [1]

**(c)** State why it is necessary to hydrate the slide containing the cells with sucrose solution rather than water.

_____

_____ [1]

| Examiner Only | |
|---|---|
| Marks | Re-mark |
| | |

**3** Paper chromatography can be used to identify the amino acids present in a protein.

| Examiner Only | |
|---|---|
| Marks | Re-mark |
| | |

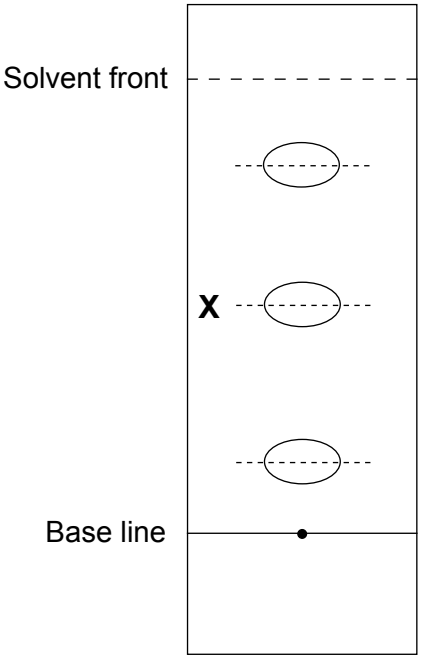
**(a)** Given a concentrated solution of amino acids produced by the hydrolysis of a protein, outline the procedure used for preparing and running a chromatogram to investigate the amino acids present. (Do not describe how to develop or analyse the chromatogram.)

[4]

| Examiner Only | |
|---|---|
| Marks | Re-mark |
| | |

**(b)** A diagrammatic representation of a developed chromatogram is shown below. For the sake of clarity only 3 spots are shown. The dotted line through each spot indicates its mid-point, which is used to measure the distance it has travelled.

| Amino acid | $R_f$ value |
|---|---|
| alanine | 0.38 |
| arginine | 0.20 |
| asparagine | 0.50 |
| glutamic acid | 0.30 |
| leucine | 0.73 |
| lysine | 0.14 |
| valine | 0.61 |






Using the table of $R_f$ values shown above, identify amino acid **X** on the chromatogram. (Show your working.)

Amino acid **X** _____ [2]

| Examiner Only | |
|---|---|
| Marks | Re-mark |
| | |

**4** A bog in Co. Down was sampled to measure its biodiversity. In this bog, the percentage cover of plant species was estimated in 10 randomly placed quadrats. The results are summarised in the table below.

| Plant species | Total % cover of each species in 10 quadrats ($n_i$) | $n_i(n_i–1)$ |
|---|---|---|
| Bog moss | 990 | 979 110 |
| Bog cotton | 445 | 197 580 |
| Ling heather | 220 | 48 180 |
| Cross-leaved heather | 330 | 108 570 |
| Cranberry | 240 | 57 360 |
| Lichen | 45 | 1 980 |
| Bog asphodel | 235 | 54 990 |
| | **N = 2505** | **$\sum n_i(n_i – 1)$ = 1 447 770** |



**(a)** Calculate the value for Simpson's index (D) for this bog.

The formula for calculating D is presented as:

$$D = \frac{\Sigma n_i(n_i\text{-}1)}{N(N\text{-}1)}$$



Where $n_i$ = the total % cover of each individual species; and
N = the total % cover of organisms of all species.
(Show your working.)

Answer _____ [2]

**(b)** Apart from using more quadrats, suggest **one** way in which the investigation could be extended to increase reliability.

_____

_____

_____ [1]

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**(Questions continue overleaf)**

| Examiner Only | |
|---|---|
| Marks | Re-mark |
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**5** **(a)** **Photograph 3.5** is an electron micrograph of a plant cell, with some parts of surrounding cells also visible. Some structures in the photograph have already been labelled.

**(i)** Identify the structures labelled **A** to **C**.

**A** _____

**B** _____

**C** _____ [3]

**(ii)** The magnification of this photograph is ×7500.

Calculate the width of the cell in μm along the line **X-X**.
(Show your working.)

Answer _____ μm [3]

**(b)** Cell length can also be calculated using a graticule and a stage micrometer.

Describe how you would use these to calculate accurately the average length of onion epidermal cells. (You do not need to describe how to prepare the onion epidermal cell slides.)

_____

_____

_____

_____

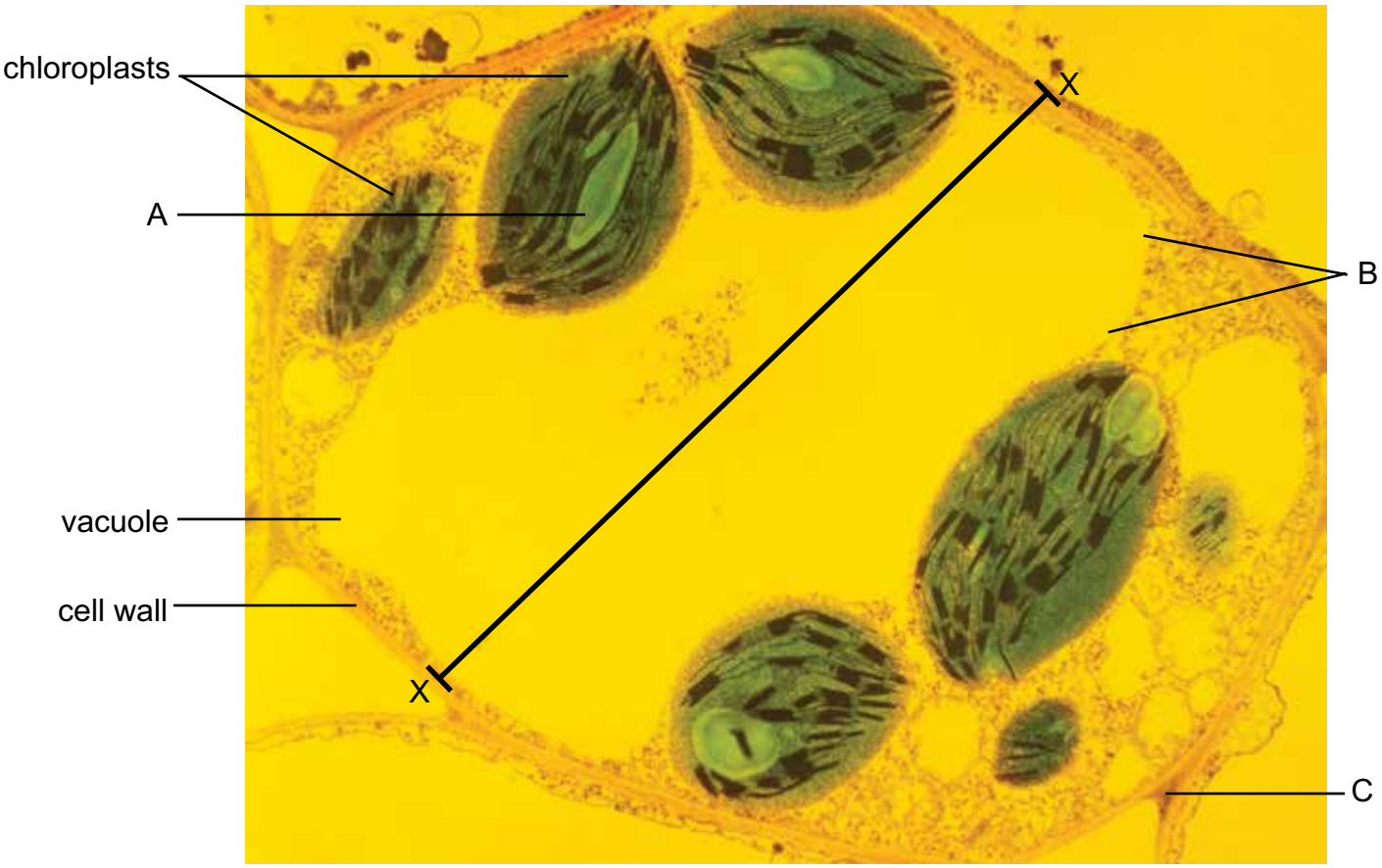
_____

_____

_____

_____ [4]

**Photograph 3.5**
**(for use with Question 5)**

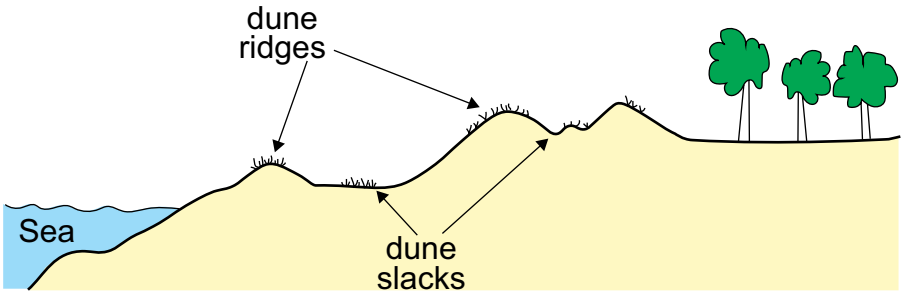





Magnification ×7500

| Examiner Only | |
|---|---|
| Marks | Re-mark |
| | |

**6** A sand dune system consists of a series of dune ridges, separated by dune slacks, as shown in the diagram below.






A group of students compared the distribution of plants on a dune ridge with that in a dune slack. They used a random sampling method to investigate the plants found on a dune ridge and in the dune slack behind it.

**(a)** Describe a random sampling method which the students could use to investigate the relative abundance of the different plant species present.

[4]

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**(Questions continue overleaf)**

| Examiner Only | |
|---|---|
| Marks | Re-mark |
| | |

In addition to sampling the plants growing in the dune system, the students also measured some abiotic factors in the two areas. These included soil moisture and wind speed.

In order to measure the soil moisture, five cores of soil were removed from each area being investigated. Each sample was weighed in the laboratory and then heated in a microwave oven for 10 minutes. It was then reweighed and placed in the microwave for a further 5 minutes. This process of heating and reweighing was repeated until no further change in mass was observed.

**(b)** Suggest the reason for this repeated heating and reweighing.

_____

_____ [1]

Some of the results of the investigation are shown in the table below.

| **Species** | **Abundance** | |
|---|---|---|
| | **Dune ridge** | **Dune slack** |
| Marram grass | 112 | 4 |
| Fescue grass | 36 | 25 |
| Portland spurge | 20 | 0 |
| Catsear | 13 | 27 |
| Thyme | 0 | 34 |
| Mosses | 0 | 164 |



**(c)** Plot the above results, using an appropriate graphical technique.
You should include a caption on your graph.
(Use the graph paper opposite.) [4]

**7** The table below shows the number of cells observed at different stages by three students who were examining broad bean root tips for mitosis.

| Stage / Student | Interphase | Prophase | Metaphase | Anaphase | Telophase |
|---|---|---|---|---|---|
| A | 61 | 11 | 2 | 0 | 6 |
| B | 48 | 10 | 3 | 2 | 8 |
| C | 71 | 15 | 3 | 2 | 11 |



**(a)** Analyse the data in the table and account for the pattern shown.

[4]

**(b)** A fourth student failed to find any stages of mitosis in his root tips.

Suggest **one** reason why.

[1]

| Examiner Only | |
|---|---|
| Marks | Re-mark |
| | |

| Examiner Only | |
|---|---|
| Marks | Re-mark |
| | |

**8** An experiment was carried out to investigate the effect of cyanide poison on cell organelles extracted from a sample of liver tissue.

Organelles can be separated from the rest of the cell contents using a centrifuge.

**(a)** **Circle** the name of the organelle fraction which would require the slowest spinning speed in order to separate it from the rest of the cell contents.

**mitochondria** **ribosomes** **nuclei** [1]

**(b)** A fraction of mitochondria was obtained and placed in a buffer which was isotonic to the liver tissue (i.e. with the same water potential as the liver tissue.)

**(i)** Explain fully the purpose of the isotonic buffer.

_____

_____

_____

_____ [2]

Two test tubes (**A** and **B**) were then prepared as follows:

- 2 $cm^3$ of mitochondria in buffer solution was added to each tube
- 1 $cm^3$ of cyanide solution was added to tube **A**
- 1 $cm^3$ of the isotonic buffer was added to tube **B**

The concentration of oxygen in each tube was then investigated using an oxygen probe. Readings were taken from each tube initially and then every minute for 10 minutes. Oxygen concentration was measured in micromoles (μM).

In tube **A**, the concentration of oxygen initially was 520. Subsequent readings were 511, 505, 500, 497, 495 and then five readings of 493.

In tube **B**, the concentration of oxygen initially was 505. Subsequent readings were 475, 444, 415, 386, 355, 324, 304, 297, 292 and 290.

**(ii)** Construct a table of these results in the space below.

Your table should have a caption and should include appropriate column headings, units and all the data.

[4]

| Examiner Only | |
|---|---|
| Marks | Re-mark |
| | |

**(iii)** Describe the results of the experiment.

_____

_____

_____

_____ [2]

| Examiner Only | |
|---|---|
| Marks | Re-mark |
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**THIS IS THE END OF THE QUESTION PAPER**

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**2018**

Centre Number

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Candidate Number

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# Biology

## Assessment Unit A2 1
*assessing*

## Physiology, Coordination and Control, and Ecosystems

## [CODE]

## SPECIMEN PAPER

**TIME**

2 hours 15 minutes.

**INSTRUCTIONS TO CANDIDATES**

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.
Write your answers in the spaces provided in this question paper.
There is an extra lined page at the end of the paper if required.
Answer **all ten** questions

**INFORMATION FOR CANDIDATES**

The total mark for this paper is 100.
Section A carries 82 marks. Section B carries 18 marks.
Figures in brackets down the right hand side of pages indicate the marks awarded to each question or part question.
You are expected to answer Section B in continuous prose.
**Quality of written communication** will be assessed in Section B (Question 10).

| For Examiner's use only | |
|---|---|
| **Question Number** | **Marks** |
| 1 | |
| 2 | |
| 3 | |
| 4 | |
| 5 | |
| 6 | |
| 7 | |
| 8 | |
| 9 | |
| 10 | |
| **Total Marks** | |

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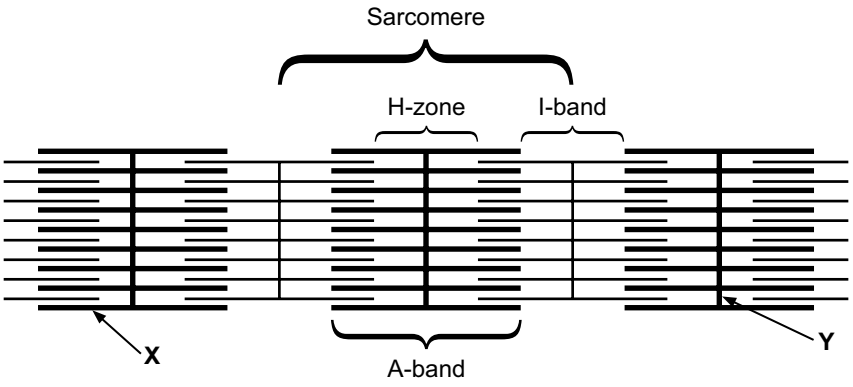
## Section A

| Examiner Only | |
|---|---|
| Marks | Re-mark |
| | |

**1** The diagram below represents a section through a myofibril in a skeletal muscle.





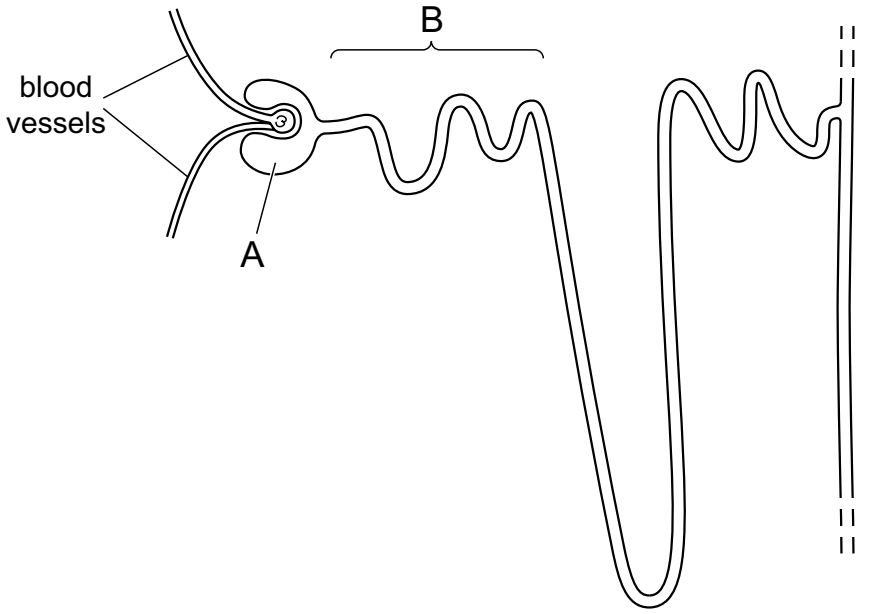

Identify the structures labelled **X** and **Y**.

**X** _____

**Y** _____ [2]

| Examiner Only | |
|---|---|
| Marks | Re-mark |

**2** The diagram below shows part of a mammalian nephron from a small mammal that lives in a **rainforest**.






**(a)** Identify the parts labelled **A** and **B**.

**A** _____

**B** _____ [2]

**(b)** The table below shows changes in the relative concentration of solutes in the filtrate from this mammal, as it passes through the loop of Henlé.

| **Position of filtrate in loop of Henlé** | **Relative concentration of solutes/arbitrary units** |
|---|---|
| Top of descending limb | 250 |
| Bottom of descending limb | 900 |
| Apex of loop | 1150 |
| Bottom of ascending limb | |
| Top of ascending limb | |

**(i)** Using your knowledge and understanding of the loop of Henlé, **complete the table above** by suggesting values for the concentration of solutes in the ascending limb. [2]

**(ii)** Explain how, in the descending limb, the relative concentration of solutes changes from 250 to 900 arbitrary units.

[3]

**(c)** In mammals, there is a strong positive correlation between the length of the loop of Henlé and the degree of aridity (dryness) of the environment that a mammal, such as the desert rat, inhabits.

Explain this relationship and suggest how the relative concentration of solutes at the apex of the loop of Henlé, would compare to the figure in the table for the rainforest mammal.

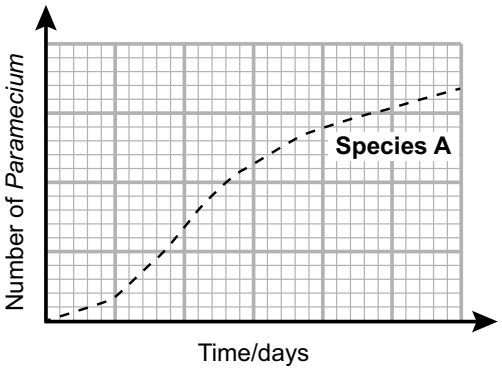
[3]

| Examiner Only | |
|---|---|
| Marks | Re-mark |
| | |

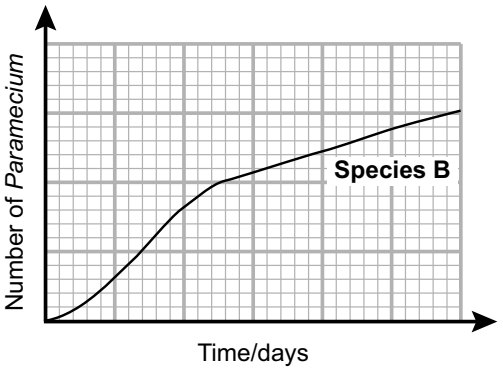
| Examiner Only | |
|---|---|
| Marks | Re-mark |
| | |

**3** *Paramecium* are mobile protoctistans. The graphs below show the population growth curves of two species (**A** and **B**) of *Paramecium* when cultured together in separate beakers (**Graphs 1** and **2**) and when cultured together in the same beaker (**Graph 3**). Each beaker contained a rich supply of bacteria, the preferred food source of both species.

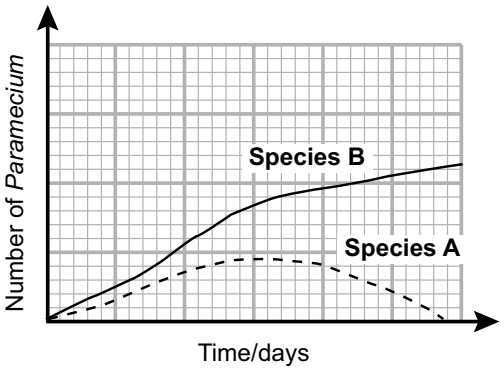
**Graph 1**




**Graph 2**




**Graph 3**



**(a)** Evaluate the information provided and describe and give a possible explanation for the population growth curves of the two species when cultured together (**Graph 3**).

[3]

**(b)** Protoctistan numbers can be estimated using a haemocytometer.

Suggest **one** reason why it might be difficult to estimate *Paramecium* numbers accurately using this technique.

[1]

| Examiner Only | |
|---|---|
| Marks | Re-mark |
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| Examiner Only | |
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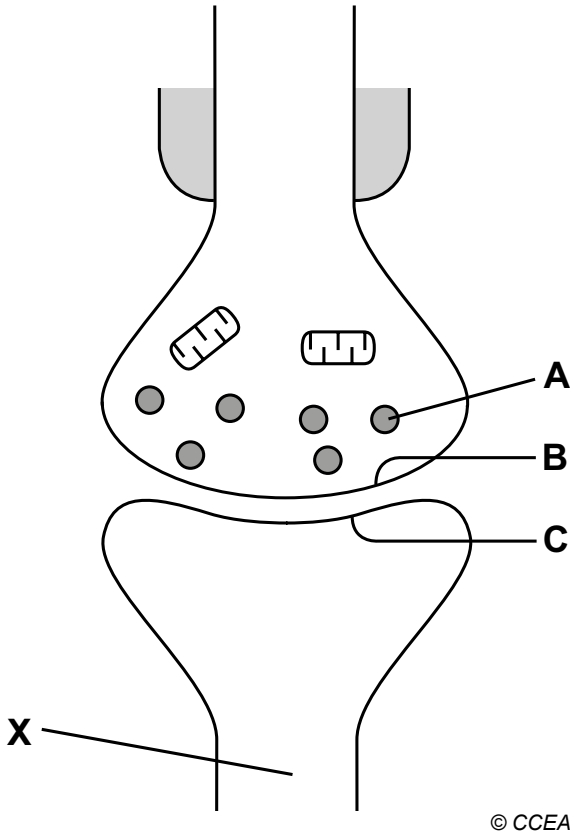
| Marks | Re-mark |
| | |

**4 (a) (i)** The diagram below shows two adjacent neurones at a synapse, as seen using an electron microscope.






Three important features of the synapse are labelled **A**, **B** and **C**.

The table below lists four statements describing functions of certain features of a synapse.

| Number | Statement |
|---|---|
| **1** | stores acetylcholine |
| **2** | location of acetylcholine receptor sites |
| **3** | provides energy for the re-synthesis of acetylcholine |
| **4** | location of exocytosis of acetylcholine |

Complete the table below by matching the labelled feature with the number of the most appropriate statement.

| Feature | Statement number |
|---|---|
| **A** | |
| **B** | |
| **C** | |

[3]

**(ii)** State why transmission between neurones is unidirectional.

_____

_____

_____ [1]

**(b) (i)** The axon of the post-synaptic neurone labelled **X** is unmyelinated.

Explain how this would affect the transmission speed in this neurone **and** name **one** other feature of axons that also influences transmission speed.

_____

_____

_____

_____

_____

_____

_____

_____

_____ [3]

**(ii)** One of the components of myelin is a glycolipid called galactocerebroside.

Given this information, name an organelle that would be expected to be abundant in a Schwann cell and explain your choice.

_____

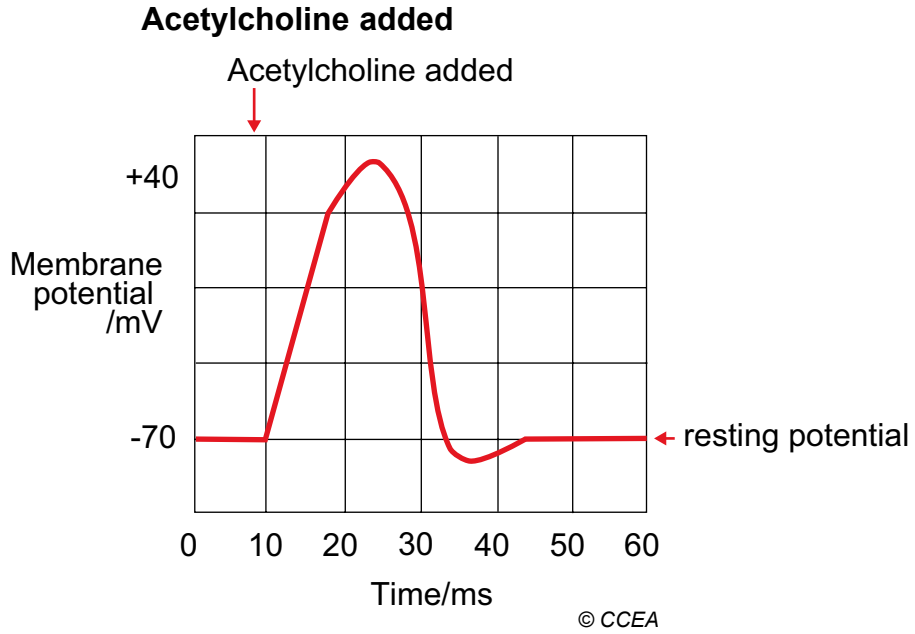
_____

_____

_____ [2]

| Examiner Only | |
|---|---|
| Marks | Re-mark |
| | |

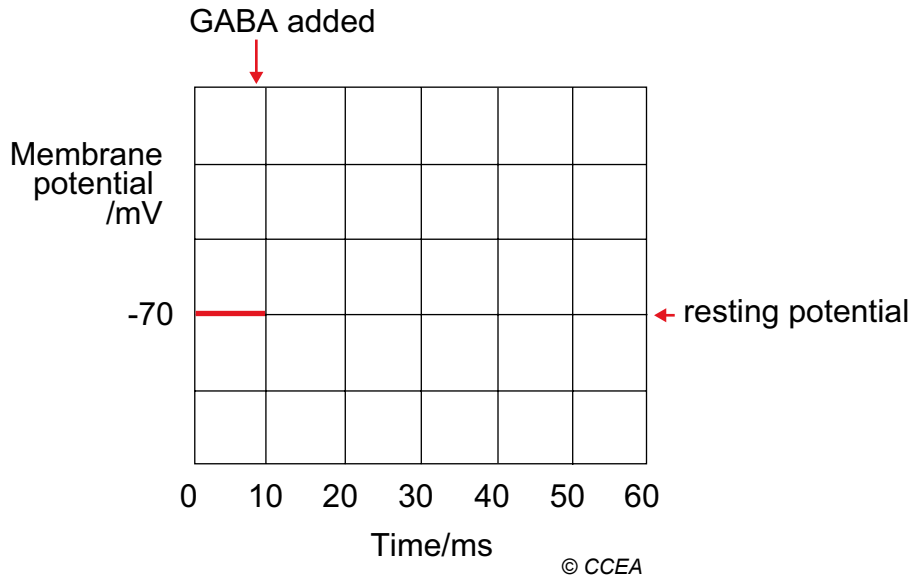
The graph below shows the effect of acetylcholine on a post-synaptic membrane.





**(c)** Gamma-aminobutyric acid (GABA) is a neurotransmitter released at inhibitory synapses in the brain.

**Complete the graph** below to show the effect of GABA on post synaptic membrane potential at an inhibitory synapse.





[2]

| Examiner Only | |
|---|---|
| Marks | Re-mark |
| | |

**(d)** Analyse the information provided **and** explain the effect of GABA on synaptic transmission.

[3]

| Examiner Only | |
|---|---|
| Marks | Re-mark |
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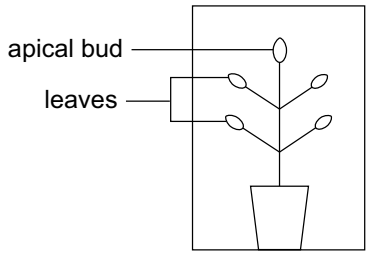
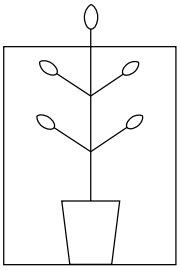
| Examiner Only | |
|---|---|
| Marks | Re-mark |
| | |

**5** The importance of the photoperiod in the control of flowering has been known since the early 1900s and phytochrome, the plant pigment responsible, was eventually discovered in 1960.

Experiments were designed to investigate whether it is the leaves or the apical bud which are sensitive to the photoperiod. In each experiment, the entire plant or a portion of the plant was placed in a light-proof box which allowed the period of light and darkness to be controlled. The plants used were short-day plants.

The experiments are shown in the diagram together with the results obtained.

| **Experiment one** | **Experiment two** |
|---|---|
| • Entire plant receives a short-day light treatment within the box<br>  <br> | • Leaves receive a short-day light treatment within the box<br>• Apical bud receives a long-day light treatment outside the box<br>  |
| **Result:** plant flowers | **Result:** plant flowers |



**(a) (i)** Analyse the information provided to explain how the results of **Experiment 2** suggest that the photoperiod is perceived by the leaves and not the apical bud.

[3]

**(ii)** What is the purpose of **Experiment 1** in this investigation?

_____

_____

_____ [1]

The results suggest that a chemical messenger is involved in flowering. This is supported by the fact that plants, given light treatments to inhibit their flowering, can be caused to flower by grafting or attaching leaves from plants that are already flowering.

**(b)** How do such grafting experiments suggest that a chemical messenger is involved?

_____

_____

_____

_____

_____

_____ [2]

**(c)** Most flowering plants are classified as short-day plants or long-day plants. Flowering can be seen in a variety of species from early spring to late summer.

Suggest why it is an advantage that different plants flower at different times of the year.

_____

_____

_____

_____

_____

_____ [2]

| Examiner Only | |
|---|---|
| Marks | Re-mark |
| | |

**(d) (i)** Other flowering plants are classified as day-neutral plants.

What does this suggest about their control of flowering?

_____

_____

_____ [1]

**(ii)** Suggest how flowering is controlled in these day-neutral plants.

_____

_____

_____ [1]

| Examiner Only | |
|---|---|
| Marks | Re-mark |
| | |

| Examiner Only | |
|---|---|
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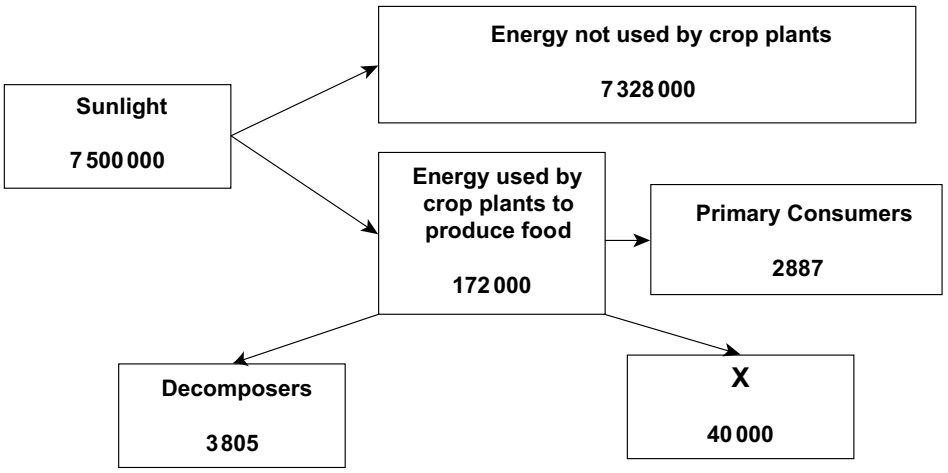
| | |

**6** The diagram below shows the transfer of energy in an agricultural ecosystem prior to harvesting. The figures are in $kJm^{-2}\ year^{-1}$.






**(a) (i)** Calculate the percentage of sunlight trapped as GPP. (Show your working.)

_____ % [2]

**(ii)** State **two** reasons why the energy transfer from sunlight to the producers (crop plants) is so low.

**1** _____

_____

_____

**2** _____

_____

_____ [2]

**(iii)** Suggest what process **X** represents.

_____ [1]

**(b)** Suggest why the values obtained in the diagram may have been difficult to collect.

_____

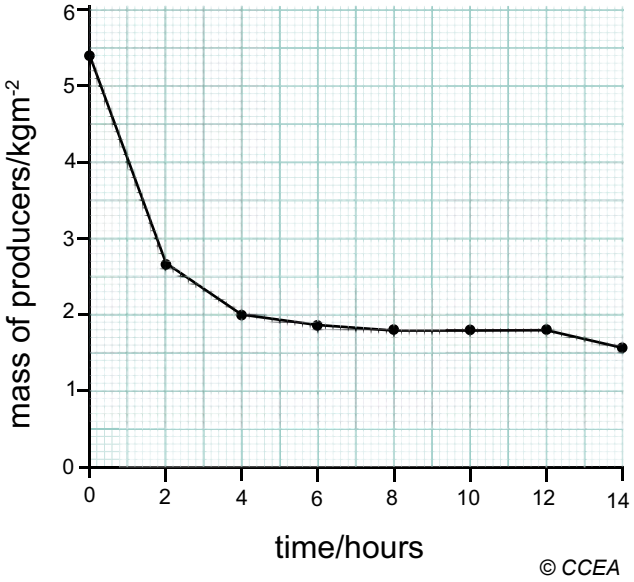
_____

_____ [1]

| Examiner Only | |
|---|---|
| Marks | Re-mark |
| | |

| Examiner Only | |
|---|---|
| Marks | Re-mark |
| | |

**(c)** The biomass of the organisms at each trophic level was also recorded. To obtain the data for the producers, all the crop plants in one square metre were collected and dried in an oven at 65°C for 12 hours. The results are shown in the graph below.






**(i)** Use the graph to determine the dry mass of the crop plants in one square metre.

_____

_____ [1]

**(ii)** Use your value obtained in **(c) (i)** to calculate the percentage decrease in mass from the original (fresh) mass.
(Show your working.)

_____ [2]

**(d)** Suggest an explanation for the further decrease in mass at 14 hours.

_____

_____

_____

_____

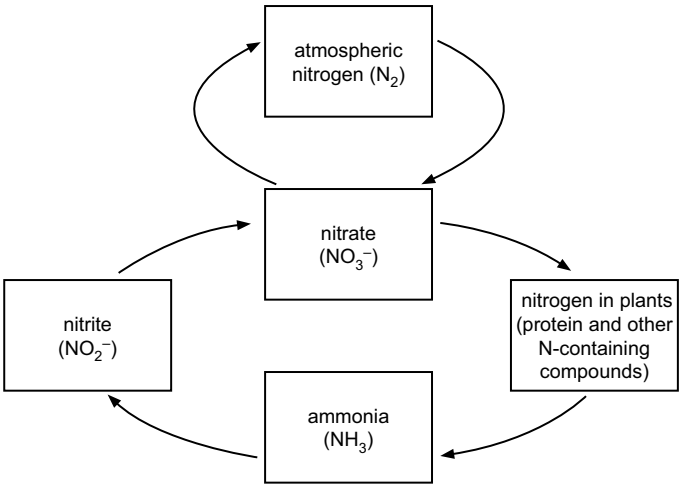
_____

_____ [2]

| Examiner Only | |
|---|---|
| Marks | Re-mark |
| | |

**7** A simplified nitrogen cycle is represented by the diagram below.

| Examiner Only | |
|---|---|
| Marks | Re-mark |
| | |






**(a)** How does the diagram show that the process of nitrification involves oxidation?

_____

_____

_____ [1]

**(b)** Pea plants are able to fix nitrogen using nitrogen-fixing bacteria. These bacteria are found in nodules, which are small oval swellings in the roots. The bacteria have a mutualistic association with the pea plant.

To determine if a relationship exists between soil nitrogen concentration and root nodule size in peas, the following investigation was carried out.

- The nitrogen content of the soil at the base of the stem of 10 pea plants was determined
- The pea plants were carefully excavated and the length of 10 randomly selected root nodules from each plant was measured
- A mean value for nodule length in each plant was calculated

The table below shows the results obtained.

| Plant | Soil nitrogen content/% | Mean nodule length/mm |
|---|---|---|
| 1 | 0.17 | 3.2 |
| 2 | 0.36 | 0.8 |
| 3 | 0.24 | 2.4 |
| 4 | 0.29 | 1.6 |
| 5 | 0.14 | 3.8 |
| 6 | 0.20 | 2.8 |
| 7 | 0.37 | 1.0 |
| 8 | 0.09 | 4.1 |
| 9 | 0.11 | 3.6 |
| 10 | 0.33 | 1.2 |



**(i)** Analyse the data in the table and state the relationship between soil nitrogen content and mean nodule length.

Suggest a possible explanation for the relationship.

_____

_____

_____

_____

_____

_____ [3]

| Examiner Only | |
|---|---|
| Marks | Re-mark |
| | |

**(ii)** State **two** factors (variables) that should have been considered in the investigation design to ensure that valid results were obtained.

**1** _____

_____

**2** _____

_____ [2]

| Examiner Only | |
|---|---|
| Marks | Re-mark |
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| Examiner Only | |
|---|---|
| Marks | Re-mark |
| | |

**8** The human body has different lines of defence against bacteria and viruses. These range from natural barriers preventing their entry to specific reactions once entry is gained.

**(a) (i)** State how tears act as a barrier to entry.

_____

_____

_____ [1]

**(ii)** Antibodies are produced which specifically react with the type of bacterium or virus which has entered the body. Antibodies are made of protein.

Using your understanding of protein structure, explain why protein is suitable for this role.

_____

_____

_____

_____

_____

_____

_____

_____

_____ [3]

**(b) (i)** Antibiotic resistance in bacteria is increasing as some populations of bacteria are able to survive after exposure to antibiotics. It is rapidly becoming a major public health concern of the 21st century as very few new antibiotics have been developed in recent years.

Suggest **one** consequence to human health of antibiotic resistance.

_____

_____

_____ [1]

Antibiotics have several modes of action including:

1. **Inhibiting cell wall synthesis**
2. **Inhibiting cell membrane function**
3. **Inhibiting protein synthesis by locking onto ribosomes**

**(ii)** Suggest why mode of action **1** above is described as a broad-spectrum treatment.

_____

_____

_____ [1]

**(iii)** Protein synthesis is a feature of prokaryotic and eukaryotic cells.

Suggest an explanation why mode of action **3** above is safe to use in humans.

_____

_____

_____

_____

_____

_____ [2]

| Examiner Only | |
|---|---|
| Marks | Re-mark |
| | |

**(c)** The search for new antibiotics has led researchers to investigate previously undiscovered soil microorganisms that possess anti-microbial properties.

Suggest the benefit to soil microorganisms in possessing antimicrobial properties.

_____

_____

_____

_____

_____

_____ [2]

**(d)** Drug discovery and development is an expensive business. It can cost up to £15 billion to get a drug compound from discovery in a laboratory to being used by patients.

Using the information provided suggest why pharmaceutical companies may not be keen to invest money into the development of new antibiotics.

_____

_____

_____

_____

_____

_____ [2]

| Examiner Only | |
|---|---|
| Marks | Re-mark |
| | |

| Examiner Only | |
|---|---|
| Marks | Re-mark |
| | |

**9** The distribution of plants in sand dunes typically reflects a pattern of succession. The young unstable dunes closest to the sea are dominated by marram grass, a species particularly effective at growing in sand. Its roots bind the sand together and provide stability.

The dune slacks (hollows) behind the young dunes have a very shallow soil. Although little marram grass grows here, the slacks are species-rich with 'ground-hugging' plant species such as thyme and birdsfoot trefoil. These species are highly adapted to thrive in the nutrient-poor shallow soils that are frequently battered by onshore winds.

Further inland, as the dunes become older and more stable, the marram grass is gradually replaced by small shrubs (mainly heather) and even further inland by the larger bracken and gorse. In these older dunes the ground layer is dominated by moss species.

**(a) (i)** Although sand dunes typically receive high levels of rainfall, marram grass is a xerophyte.

Suggest why marram grass requires xerophytic adaptations in this environment.

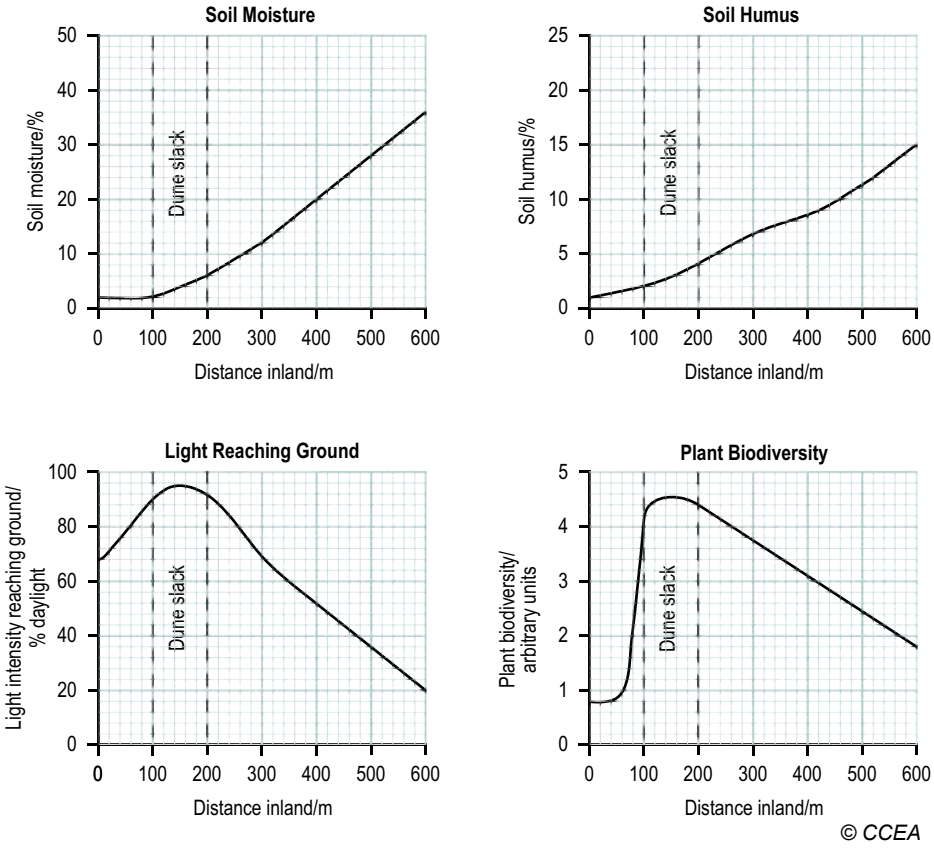
_____

_____ [1]

**(ii)** Name **one** xerophytic adaptation that marram grass would be expected to possess.

_____ [1]

**(b)** In an ecological investigation of a sand dune system the following data was obtained.






**(i)** Analyse all the information provided and explain the change in plant biodiversity across the sand dune system.

[5]

| Examiner Only | |
|---|---|
| Marks | Re-mark |
| | |

**(ii)** When carrying out this investigation, it was important that the data was gathered within a reasonably short time frame (i.e. a few hours).

Analyse the information provided to suggest **two** reasons for this.

**1** _____

_____

**2** _____

_____ [2]

Abandoned quarries are also common settings for observing succession. The gorse shrub is an early coloniser in quarry successions. It is able to grow in the very thin soils that develop in rock crevices, often becoming the dominant species at a relatively early stage.

**(c)** Gorse is a species that is able to fix nitrogen.

Using this information, explain its dominant position in the early stages of succession in quarries.

_____

_____

_____

_____ [2]

**(d)** **(i)** State why both a sand dune and a quarry succession can be regarded as a primary succession.

_____

_____

_____ [1]

**(ii)** Identify a major difference between a sand dune succession and a quarry succession. (Your answer does not need to refer to the different type of substrate or the different species present).

_____

_____

_____ [1]

| Examiner Only | |
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## Section B

| Examiner Only | |
|---|---|
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| | |

**10** The mammalian eye is highly adaptable: capable of accommodating images of objects which are close-up or far away; providing detailed colour images during daytime when the light intensity is high; and yet able to perceive images when the light intensity is low. Some species of nocturnal mammals have eyes that are highly specialised to function only in the very low light intensities during the night.

**In this question, you will be assessed on your written communication skills, including the use of specialist scientific terms.**

**(a)** Describe and explain how the typical mammalian eye provides a detailed colour image of close-up objects in high light intensities.

| Examiner Only | |
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[12]

**(b)** Explain how the eye is adapted to provide vision in low light intensities, and suggest how the eyes of nocturnal mammals are specialised.

[6]

| Examiner Only | |
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*Extra lined page*

| Examiner Only | |
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**THIS IS THE END OF THE QUESTION PAPER**

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**General Certificate of Education**
**2018**

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# Biology

## Assessment Unit A2 2

*assessing*

Biochemistry, Genetics and Evolutionary Trends

## [CODE]

## SPECIMEN PAPER

**TIME**

2 hours 15 minutes.

**INSTRUCTIONS TO CANDIDATES**

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.
Write your answers in the spaces provided in this question paper.
There is an extra lined page at the end of the paper if required.
Answer **all ten** questions.

**INFORMATION FOR CANDIDATES**

The total mark for this paper is 100.
Section A carries 82 marks. Section B carries 18 marks.
Figures in brackets down the right hand side of pages indicate the marks awarded to each question or part question.
You are expected to answer Section B in continuous prose.
**Quality of written communication** will be assessed in Section B (Question 10).
**Statistics sheets are provided for use with this paper.**

| For Examiner's use only | |
|---|---|
| **Question Number** | **Marks** |
| 1 | |
| 2 | |
| 3 | |
| 4 | |
| 5 | |
| 6 | |
| 7 | |
| 8 | |
| 9 | |
| 10 | |
| **Total Marks** | |

## Section A

| Examiner Only | |
|---|---|
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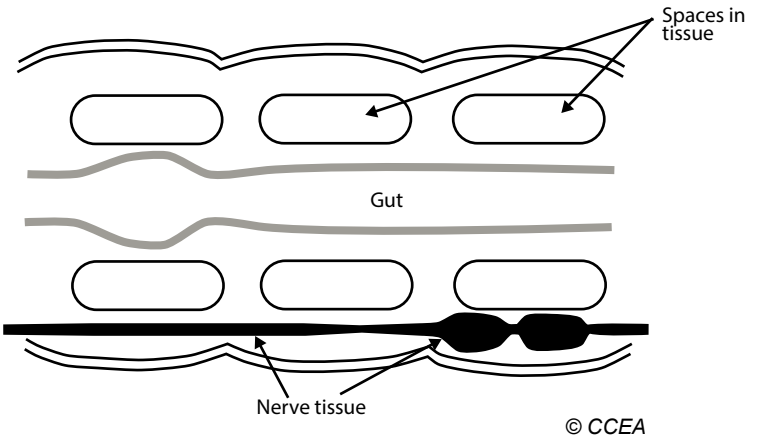
| | |

**1** **(a)** The diagram below represents a section through an annelid.






**(i)** Describe **one** piece of evidence from the diagram which shows that annelids are metamerically segmented.

_____

_____ [1]

**(ii)** Annelids are described as being bilaterally symmetrical.

Explain what is meant by 'bilateral symmetry' **and** suggest why it is not evident in the diagram.

_____

_____

_____

_____

_____

_____ [2]

**(b)** State the types of skeletal support found in the phylum Annelida and the phylum Chordata.

Annelida _____

_____

Chordata _____

_____ [2]

| Examiner Only | |
|---|---|
| Marks | Re-mark |
| | |

| Examiner Only | |
|---|---|
| Marks | Re-mark |
| | |

**2** Pharmacogenetics involves tailoring prescribed medicines to an individual, based on their genotype. The genotype can affect how medicines such as the painkiller codeine are metabolised by the body.

Codeine is referred to as a 'prodrug', meaning it is not active until metabolised into a compound called morphine in the body. In high concentrations, morphine can be toxic or even fatal. With regard to codeine metabolism, individuals can be classified according to their genotype as poor metabolisers, normal metabolisers or ultra-rapid metabolisers.

Analyse the information provided and explain the most likely outcome for the patient if individuals with the following genotypes were treated with the normal adult dosage of 40mg.

**(a)** an ultra-rapid metaboliser

_____

_____

_____ [2]

**(b)** a poor metaboliser

_____

_____

_____ [2]

| Examiner Only | |
|---|---|
| Marks | Re-mark |
| | |

**3** In woodlands, mosses can often be found growing on the bark of tree trunks. After investigating the distribution of moss around the tree trunks, a group of students observed that the moss was more abundant on the side facing north than on the side facing south. It was thought that this distribution pattern was related to the damper microclimate found on the north-facing side of trees.

**(a)** Give **two** structural features of moss plants which cause them to be confined to damp habitats.

1 _____

_____

2 _____

_____ [2]

**(b)** Ferns are also found in woodland, but they grow much larger than mosses. This is in part due to the increased support which their structure allows.

Describe how support is achieved and maintained in ferns.

_____

_____

_____

_____

_____

_____ [3]

**(c)** Flowering plants have several structural features in common with ferns, but their distribution is less dependent on water availability than that of ferns.

Describe fully **one** feature of flowering plants which result in their reduced dependence on water compared to ferns.

_____

_____

_____

_____ [2]

| Examiner Only | |
|---|---|
| Marks | Re-mark |
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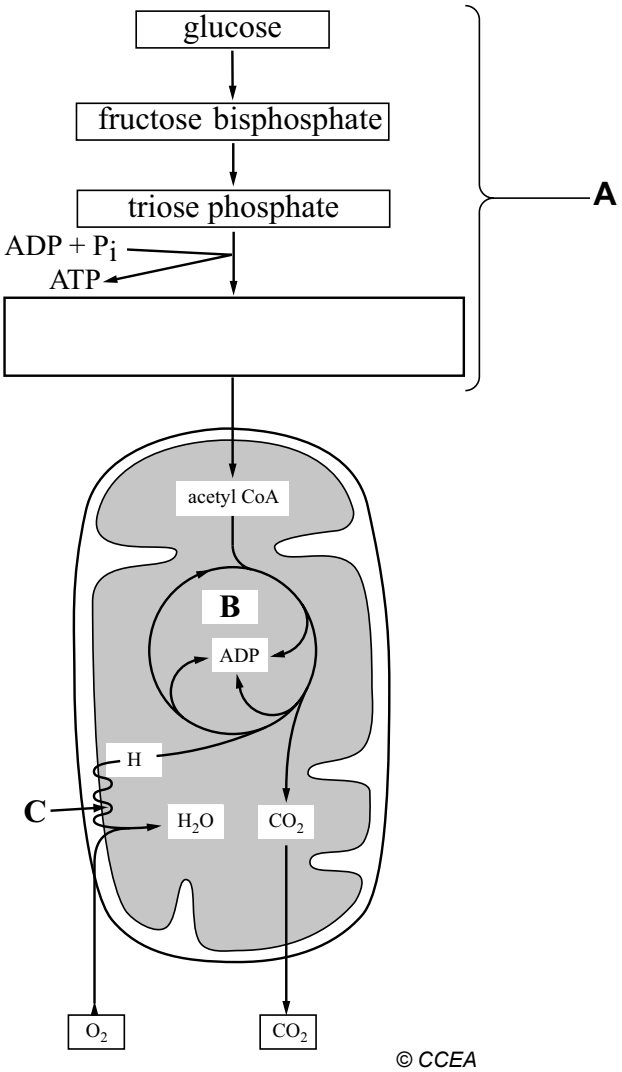
**4** The diagram below summarises the various stages involved in the respiration of a glucose molecule.






**(a) (i)** **Complete the diagram** by writing the name of the missing compound in the empty box. [1]

**(ii)** State the location in the cell of process **A**.

_____ [1]

**(iii)** Name the stages of respiration which take place at location **B** and location **C**.

location **B** _____

location **C** _____ [2]

| Examiner Only | |
|---|---|
| Marks | Re-mark |
| | |

**(b)** Other respiratory substrates, for example, fatty acids as a component of fats, may be broken down to yield energy.

Describe the respiration of fatty acids.

[2]

In an experiment using a respirometer to investigate respiration in woodlice and in soaked peas, a student obtained the following results:

| Organism | Volume of carbon dioxide produced/ $mm^3$ | Volume of oxygen used/ $mm^3$ | RQ |
|---|---|---|---|
| woodlice | 3.7 | 5.3 | |
| soaked peas | 2.4 | 2.2 | |

**(c) (i)** **Complete the final column** in the table by calculating the RQ values for woodlice and soaked peas. [2]

**(ii)** What conclusion would you draw about the respiratory substrate of the woodlouse?

[1]

Through some research, the student discovered that woodlice give off ammonia as a waste gas.

**(iii)** What effect, if any, would you expect this to have on the validity of the experiment? Explain your answer.

[2]

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**(Questions continue on next page)**

| Examiner Only | |
|---|---|
| Marks | Re-mark |
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**5** The enzyme ribulose bisphosphate carboxylase (rubisco) catalyses the reaction between ribulose bisphosphate (RuBP) and carbon dioxide.

Genetically altered plants can be produced which synthesise less rubisco enzyme. These are called 'reduced rubisco plants'. They grow slowly and are small.

**(a) (i)** Name the first stable product of the reaction between ribulose bisphosphate and carbon dioxide.

_____ [1]

**(ii)** Explain why the 'reduced rubisco plants' are slow growing and stunted.

_____

_____

_____

_____

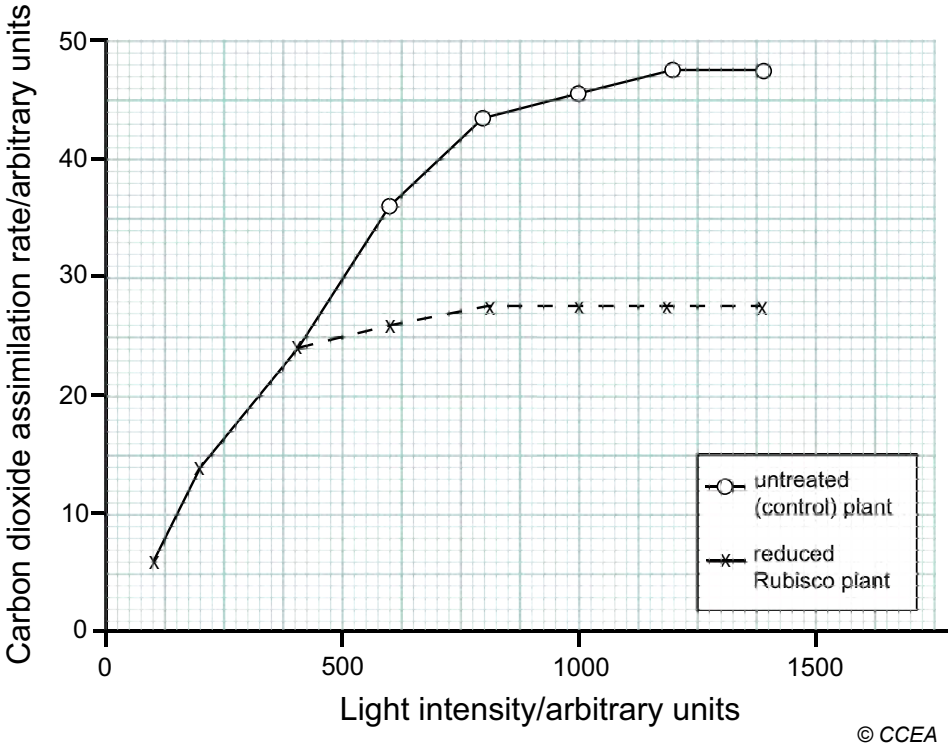
_____

_____ [2]

| Examiner Only | |
|---|---|
| Marks | Re-mark |
| | |

**(b)** Leaves from a 'reduced rubisco plant' and an untreated (control) plant were used in a series of experiments. The graph below shows the rate of carbon dioxide assimilation by each type of leaf at different light intensities.

A temperature of 25°C and a high concentration of $CO_2$ were maintained at all light intensities.






**(i)** Describe and explain the assimilation rates of both plants in low light intensities.

Description _____

_____ [1]

Explanation _____

_____

_____

_____ [2]

**(ii)** Explain the different assimilation rates of the plants in high light intensities.

_____

_____

_____

_____

_____

_____ [2]

**(c)** A second experiment was designed to measure the rate of carbon dioxide assimilation for each type of plant at varying carbon dioxide concentrations.

In this experiment, it would be necessary to maintain a temperature of 25°C and a high light intensity.

**(i)** Explain why it would be necessary to maintain a relatively high temperature of 25°C in these experiments.

_____

_____

_____

_____ [2]

**(ii)** Predict the result of this second experiment for both the 'reduced rubisco plant' and the untreated (control) plant.

_____

_____

_____

_____ [2]

**(iii)** Give **one** reason to support your prediction.

_____

_____ [1]

| Examiner Only | |
|---|---|
| Marks | Re-mark |
| | |

| Examiner Only | |
|---|---|
| Marks | Re-mark |
| | |

**6** A ‘saddle’ pattern of the wool of a sheep is due to a recessive allele at a single gene locus. In a flock of sheep, 800 lambs were produced of which 4% showed the ‘saddle’ pattern. The ‘saddle’ pattern within the population of lambs is considered to be in Hardy–Weinberg equlibrium.

**(a)** Calculate the relative frequency of the ‘saddle’ allele and the ‘non-saddle’ allele in the population of lambs.
(Show your working.)

Relative frequency of ‘saddle’ allele _____

Relative frequency of ‘non-saddle’ allele _____ [2]

**(b)** Calculate the relative frequency of lambs which might be expected to be homozygous ‘non-saddle’ and heterozygous ‘non-saddle’.
(Show your working.)

Relative frequency of homozygous ‘non-saddle’ lambs _____

Relative frequency of heterozygous ‘non-saddle’ lambs _____ [2]

**(c)** Calculate how many of the 800 lambs would be expected to be heterozygous for the ‘non-saddle’ pattern condition.
(Show your working.)

Number of lambs heterozygous for the ‘non-saddle’ condition _____ [1]

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**7** Labrador retrievers are dogs with black, brown or yellow coats. The coat colour is controlled by two independently-inherited genes which are not sex-linked.

The alleles of a pigment gene at the **B/b** locus determine the amount of black pigment produced. The presence of a **B** allele results in a black coat. A brown coat is produced by the **bb** genotype.

A second gene at the **E/e** locus influences the expression of the alleles at the **B/b** locus. The presence of the **E** allele allows the allele at the **B/b** locus to be expressed. A yellow coat is always produced if the genotype is **ee**, no matter which alleles are present at the **B/b** locus.

**(a) (i)** State the genotype of a pure breeding brown Labrador.

_____ [1]

**(ii)** State the genetic term which describes the relationship between the **B/b** and **E/e** loci.

_____ [1]

**(b)** Two black Labradors known to be heterozygous for both genes (**BbEe**) were crossed.

Determine the expected proportions of the offspring produced with respect to both genotypes and phenotypes. Show your working in a genetic diagram in the space below.

[5]

| Examiner Only | |
|---|---|
| Marks | Re-mark |
| | |

| Examiner Only | |
|---|---|
| Marks | Re-mark |
| | |

**(c)** A litter of pups, which resulted from a cross between a yellow male Labrador and a black female, consisted of 7 yellow and 3 black pups.

**(i)** With respect to the alleles at the **E/e** locus only, state the genotypes for the male and female parents.

Give **one** reason to account for each of your answers.

- yellow male genotype _____

  reason _____

  _____

  _____

- black female genotype _____

  reason _____

  _____

  _____ [4]

**(ii)** Suggest an explanation for the lack of brown pups in the litter.

_____

_____

_____

_____

_____

_____ [2]

| Examiner Only | |
|---|---|
| Marks | Re-mark |
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**8** The genetic code is carried in the chromosomal DNA in the nucleus of eukaryotic cells. Genes code for proteins and it is the 'proteome' or protein profile of a cell which determines its characteristics. Protein synthesis takes place on the rough endoplasmic reticulum and in other cellular membrane systems.

**(a)** Name and describe the process whereby the code contained in a length of DNA is converted into a code in messenger RNA.

Name of process _____ [1]

Description_____

_____

_____

_____

_____

_____

_____

_____

_____ [3]

While all cells in an organism such as a human contain the full genome (i.e. all the genes of the organism), the proteome varies from one cell type to another. This is because, in each cell type, some genes are 'switched on' and other genes are 'switched off'.

**(b)** Give **one** example of a DNA modification which acts to 'switch off' a gene.

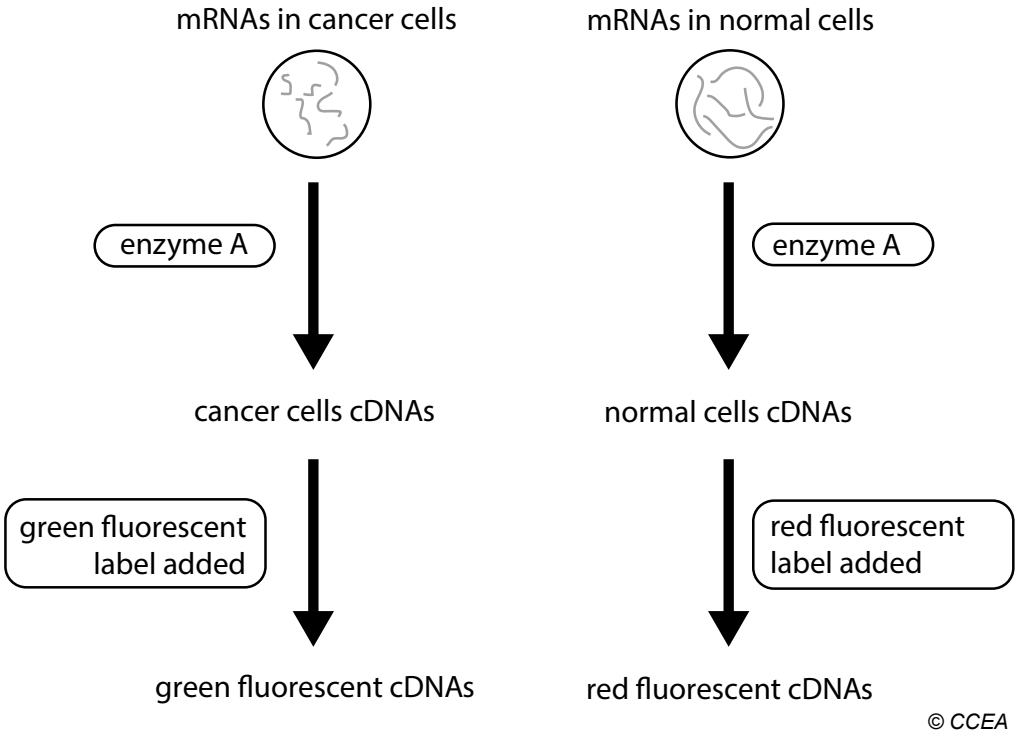
_____

_____ [1]

| Examiner Only | |
|---|---|
| Marks | Re-mark |
| | |

**(c)** The proteome of cancer cells differs from that of normal cells. This property of cancer cells can be used to investigate the genetics of the cancer using microarray technology. The results of this may inform decisions about potential treatments.

One type of microarray technology allows an investigation of gene expression in both cancer cells and normal cells. The first steps in this process are summarised in the diagram below.






**(i)** Identify enzyme **A**.

_____ [1]

The fluorescently-labelled cDNA molecules are then applied to a microarray slide.
The slide has thousands of small spots on it, each of which contains many copies of a different DNA probe. In this case, each probe corresponds to a different human gene. The chip can be 'read' to indicate which genes are expressed in each cell type.

**(ii)** What is a DNA probe?

_____

_____

_____

_____

_____ [2]

**(iii)** With reference only to DNA molecules, describe the sequence of events which would result in a spot being detected as red when the slide is examined after application of the cDNAs.

_____

_____

_____

_____

_____

_____ [2]

In cancer cells, some genes are 'up-regulated' (i.e. expressed more in cancer cells than in normal cells) while others are 'down-regulated'.

**(iv)** Analyse the information provided and identify the colour of the fluorescent label on a spot which indicates an 'up-regulated' gene.

_____ [1]

The strength of the signal detected on each spot may provide some information about how much of a particular protein is being produced in a cell.

**(v)** Using the information in this question and your knowledge, explain the link between the strength of the signal and the amount of a particular protein produced in the cell.

_____

_____

_____

_____

_____

_____ [2]

| Examiner Only | |
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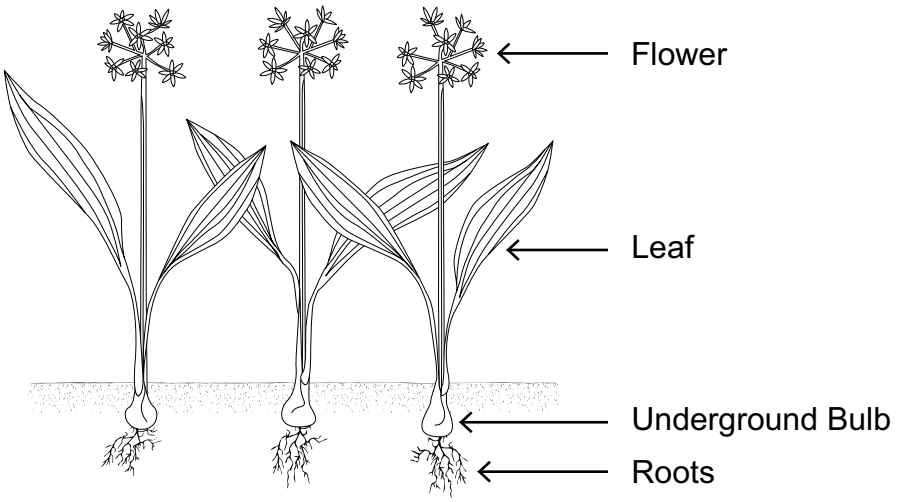
**9** *Allium ursinum* (wild garlic) is a common plant found throughout damper areas of the British Isles.

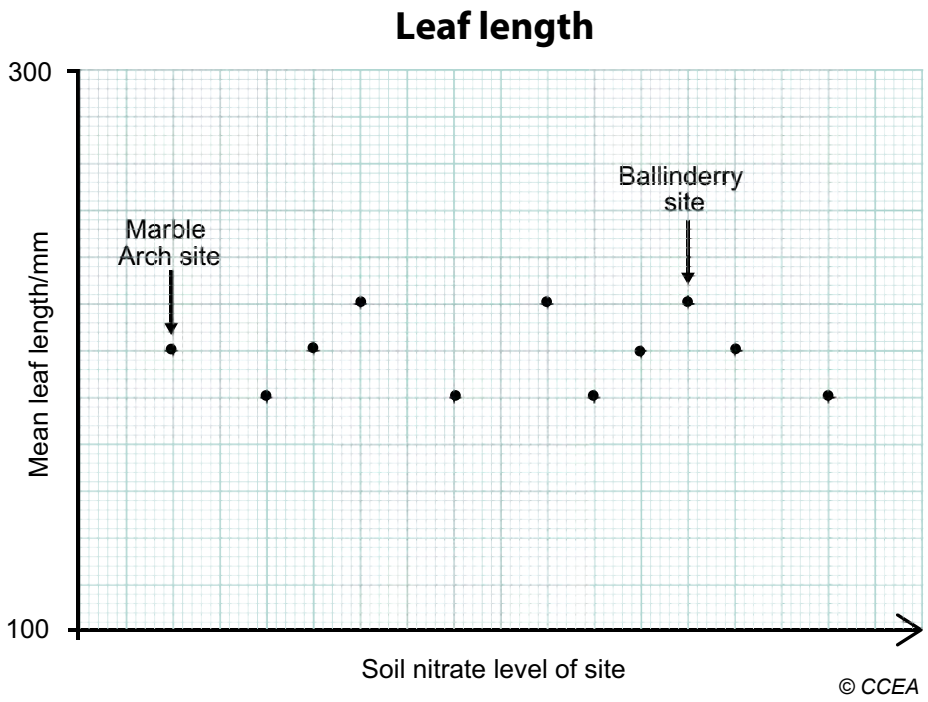


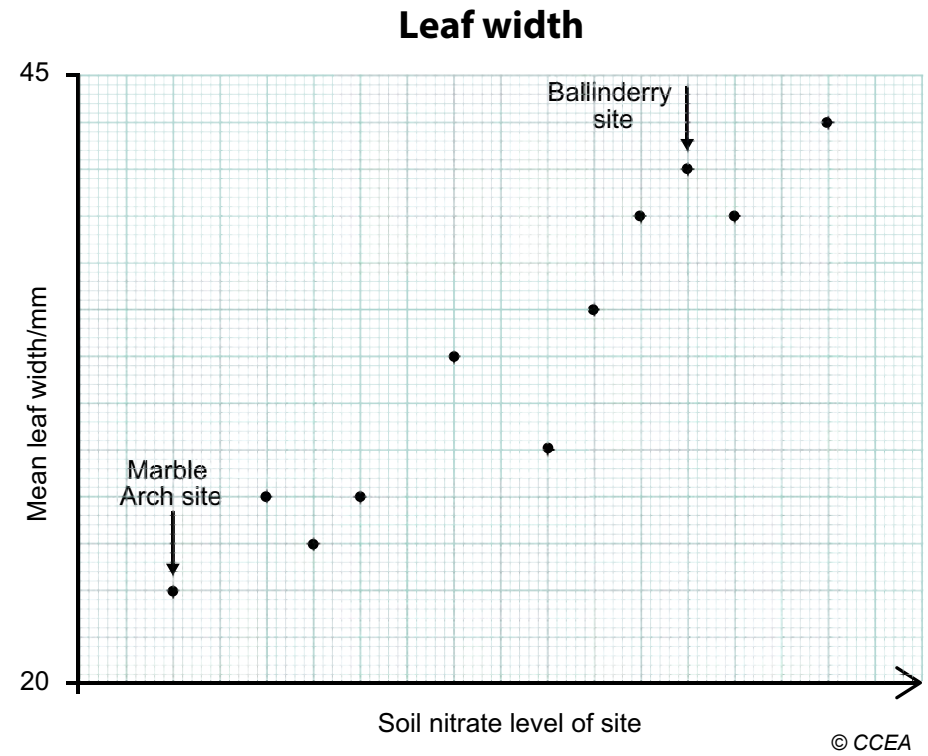



**(a)** An investigation was carried out to determine if leaf size in wild garlic was associated with soil nitrate levels. Measurements were taken of the length and width of leaves at various sites in Northern Ireland along with soil nitrate levels. Fifty leaves were measured at each site and the mean values calculated.

The scatter diagrams overleaf show the results. (Two of the sites investigated, Ballinderry and Marble Arch, are identified on the graphs – these relate to sub-part **(ii)** of the question.)

| Examiner Only | |
|---|---|
| Marks | Re-mark |
| | |


Leaf length
300
100
Mean leaf length/mm
Marble Arch site
Ballinderry site
Soil nitrate level of site
© CCEA


Leaf width
45
20
Mean leaf width/mm
Marble Arch site
Ballinderry site
Soil nitrate level of site
© CCEA

**(i)** Describe the trend shown by each of the scatter diagrams on the page opposite.

_____

_____

_____

_____

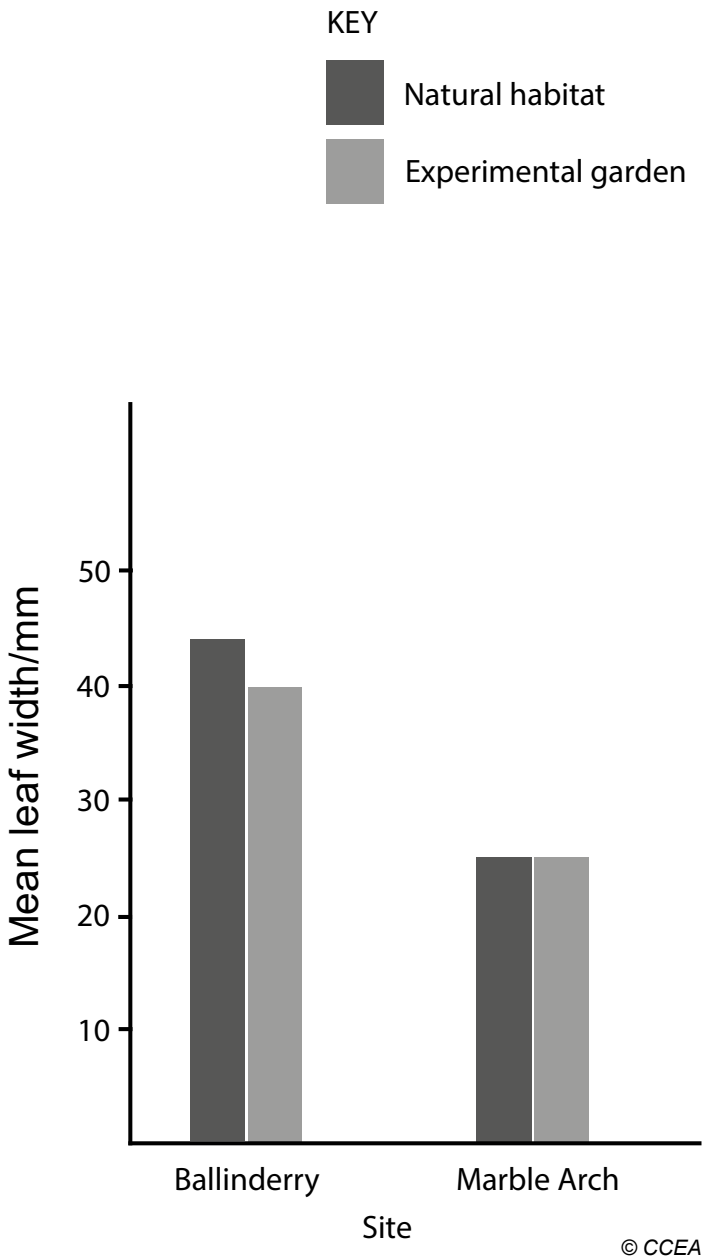
_____

_____ [2]

| Examiner Only | |
|---|---|
| Marks | Re-mark |
| | |

There is an obvious difference in the mean leaf width of the plants in Ballinderry and Marble Arch. An experiment was devised to investigate the relative contributions of the genotype and the environment in determining this difference. Seeds from wild garlic plants in Ballinderry and Marble Arch were collected and planted in an experimental garden, where soil nitrate levels were controlled and kept constant.

After a number of years, when the plants in the experimental garden had reached maturity, 50 leaves from each site of origin were sampled and their width measured. The graph below shows these results along with the results of mean leaf width in the natural habitats.






| Examiner Only | |
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| Marks | Re-mark |
| | |

**(ii)** Analyse the information provided **and** explain the evidence that suggests that the difference in leaf width between the two sites is genetic rather than purely environments.

[2]

**(b)** Asexual reproduction in wild garlic occurs via bulb formation while sexual reproduction produces seeds. The seeds are heavy and are rarely dispersed more than a few centimetres away from the parent plant. The result is that populations of wild garlic are effectively isolated. However, DNA analysis shows that the wild garlic populations in the Ballinderry and Marble Arch sites have evolved from the same ancestral population.

**(i)** Explain how evolutionary change has contributed to the differences in leaf width between the sites.

[5]

| Examiner Only | |
|---|---|
| Marks | Re-mark |
| | |

**(ii)** It is possible that the wild garlic in the two sites has evolved into different species.

Suggest how you could investigate whether this has happened or not.

_____

_____

_____

_____

_____

_____ [2]

| Examiner Only | |
|---|---|
| Marks | Re-mark |
| | |

## Section B

| Examiner Only | |
|---|---|
| Marks | Re-mark |
| | |

**10** ATP is synthesised in both respiration and photosynthesis.

**In this question, you will be assessed on your written communication skills, including the use of specialist science terms.**

**(a)** Describe the synthesis of ATP in respiration.

[6]

**(b)** Discuss the similarities and differences in ATP production between the two processes.

| Examiner Only | |
|---|---|
| Marks | Re-mark |
| | |

| Examiner Only | |
|---|---|
| Marks | Re-mark |
| | |

[12]

*Extra lined page*

| Examiner Only | |
|---|---|
| Marks | Re-mark |
| | |

**THIS IS THE END OF THE QUESTION PAPER**

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**General Certificate of Education**
**2018**

**Centre Number**

| | | | | |
|---|---|---|---|---|
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**Candidate Number**

| | | | |
|---|---|---|---|
| | | | |

# Biology

## Assessment Unit A2 3
*assessing*

## Practical Skills in Biology

## [CODE]
## SPECIMEN

**TIME**

1 hour 15 minutes.

**INSTRUCTIONS TO CANDIDATES**

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.
Write your answers in the spaces provided in this question paper.
Answer **all ten** questions.
You are provided with **Photograph 3.5** for use with **Question 5** in this paper.
Do not write your answers on this photograph.

**INFORMATION FOR CANDIDATES**

The total mark for this paper is 60.
Figures in brackets printed down the right hand side of pages indicate the marks awarded to each question or part question.
Skills used in researching information will be assessed in **Question 10**.
**Statistics sheets are provided for use with this paper.**

| For Examiner's use only | |
|---|---|
| **Question Number** | **Marks** |
| 1 | |
| 2 | |
| 3 | |
| 4 | |
| 5 | |
| 6 | |
| 7 | |
| 8 | |
| 9 | |
| 10 | |
| **Total Marks** | |

| Examiner Only | |
|---|---|
| Marks | Re-mark |
| | |

**1** **(a)** Plant pigments can be separated and identified using paper chromatography. After loading a chromatogram using concentrated spots of pigment from homogenised nettle leaves, it is then set up to run.

After the stage outlined above, describe how you would continue the experiment to calculate the $R_f$ values of the photosynthetic pigments.

[5]

**(b)** Apart from inaccuracy, suggest **two** reasons why different groups of students may get slightly different $R_f$ values when carrying out this experiment.

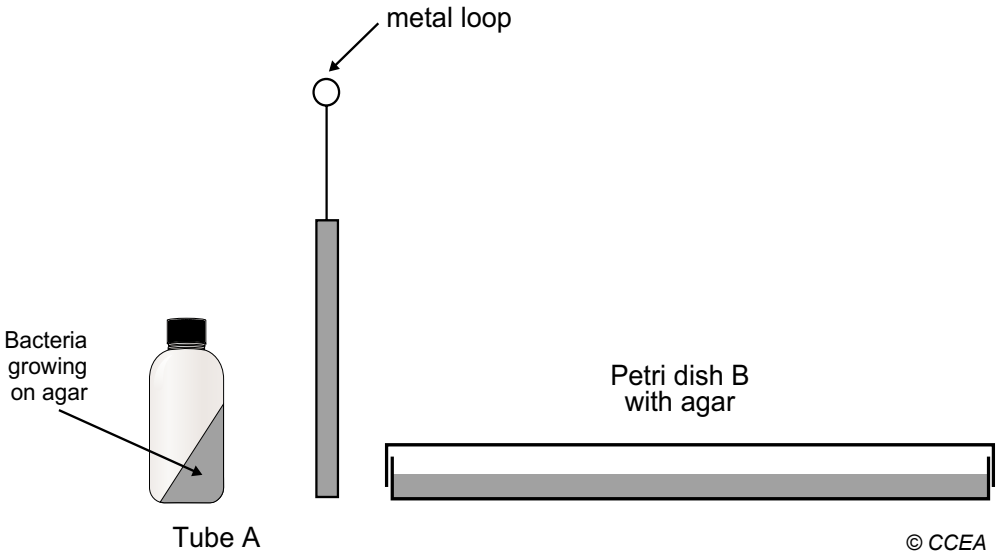
1

2

[2]

| Examiner Only | |
|---|---|
| Marks | Re-mark |
| | |

**2** **(a)** The following apparatus can be used when culturing microorganisms.




**(i)** Describe how you would transfer bacteria from tube **A** to Petri dish **B** so that contamination is avoided.

[4]

| Examiner Only | |
|---|---|
| Marks | Re-mark |
| | |

**(ii)** After the bacteria had been transferred, the Petri dish was incubated at 25°C.

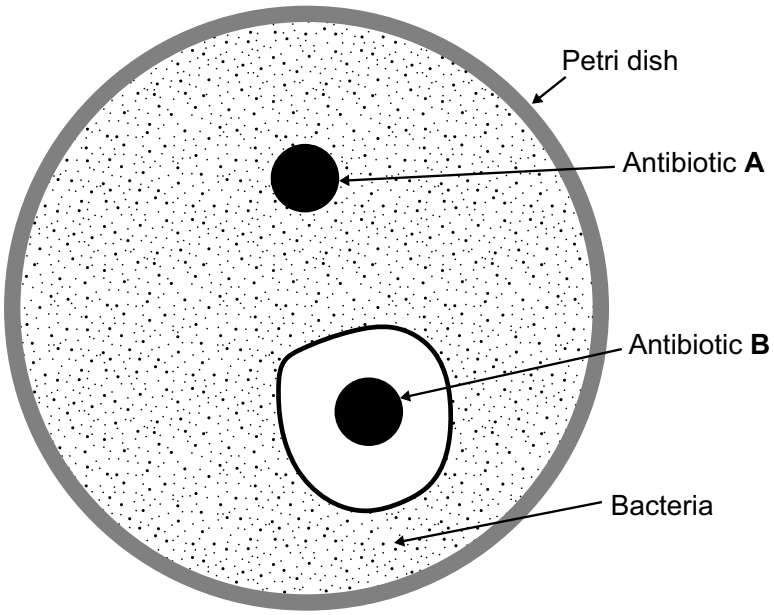
Why was it not incubated at a higher temperature?

_____

_____

_____ [1]

**(b)** Two antibiotics, **A** and **B**, were added to a Petri dish containing a strain of *E. coli* bacteria. The dish was then incubated at 25°C for five days.






**(i)** Comment on the results shown.

_____

_____

_____

_____

_____

_____ [3]

**(ii)** Apart from using replicates, suggest **one** way you could extend the investigation to give more detailed information about the effects of the antibiotics on the strain of *E. coli* used.

_____

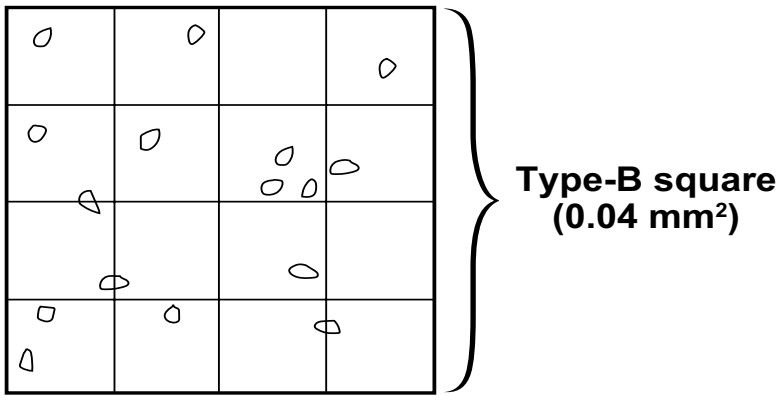
_____ [1]

| Examiner Only | |
|---|---|
| Marks | Re-mark |
| | |

| Examiner Only | |
|---|---|
| Marks | Re-mark |
| | |

**3** **(a)** In a class experiment investigating the population growth of yeast, yeast was grown in a conical flask containing glucose. The culture was sampled at intervals and the number of yeast cells estimated using a haemocytometer.

The diagram below represents the results obtained by a student from one type-B square. The distance between the surface of these type-B squares and the overlying coverslip is 0.1 mm.






**(i)** Using the information provided, calculate the number of yeast cells per $mm^3$. (Show your working.)

Answer _____ cells $mm^{-3}$ [2]

Other students also took samples from the conical flask at the same time. The table below shows the values calculated by three students.

| Student | Number of yeast cells /$mm^{-3}$ |
|---|---|
| A | 4900 |
| B | 2800 |
| C | 3300 |

**(ii)** Apart from inaccurate counting of yeast cells, suggest **two** reasons that could account for the large variation among the results obtained.

1 _____

_____

2 _____

_____ [2]

The students found that the number of yeast cells sampled did **not** fall as expected nearing the end of the investigation, but remained relatively constant over a long period of time.

**(iii)** Suggest a reason for this observation.

_____

_____ [1]

**(b)** In investigations of this nature, it is possible that there could be too many cells to clearly see the grid lines on the haemocytometer.

How could you ensure that the number of cells can be accurately estimated?

_____

_____

_____

_____

_____

_____ [2]

| Examiner Only | |
|---|---|
| Marks | Re-mark |
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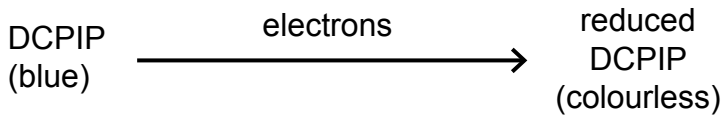
| Examiner Only | |
|---|---|
| Marks | Re-mark |
| | |

**4** The redox indicator DCPIP is blue when oxidised but colourless when reduced.




In an experiment investigating the light-dependent stage of photosynthesis, a suspension of chloroplasts was prepared by grinding fresh leaves in a buffer solution and then separating the chloroplasts from the leaf debris by centrifugation.

**(a)** Suggest the advantage of using isolated chloroplasts rather than ground-up leaf tissue.

_____

_____ [1]

The isolated chloroplasts were treated as outlined in the table below. The results of the investigation are also included in the table.

| Tube | Treatment | Colour | |
|---|---|---|---|
| | | At start | After 30 minutes |
| **A** | water + DCPIP in bright light | blue | blue |
| **B** | chloroplast suspension + DCPIP in bright light | blue/green | green |
| **C** | chloroplast suspension + DCPIP in darkness | blue/green | blue/green |

**(b)** Using the results for all three tubes, explain fully the result for **Tube B**.

| Examiner Only | |
|---|---|
| Marks | Re-mark |
| | |

[3]

| Examiner Only | |
|---|---|
| Marks | Re-mark |
| | |

**5** **(a)** **Photograph 3.5** is an electron micrograph of the junction between two neurones in the brain.

**(i)** Identify the structures labelled **A** and **B**.

**A** _____

**B** _____ [2]

**(ii)** **X** and **Y** are separate neurones. Neurones are highly specialised, elongated cells with long axons.

Suggest why the axons are not visible in the electron micrograph.

_____

_____ [1]

**(b)** The preparation of brain tissue that provided the specimen used in the photograph had been treated to aid interpretation of the structures present when viewed using a transmission electron microscope.

**(i)** Suggest **one** way in which the preparation had been treated.

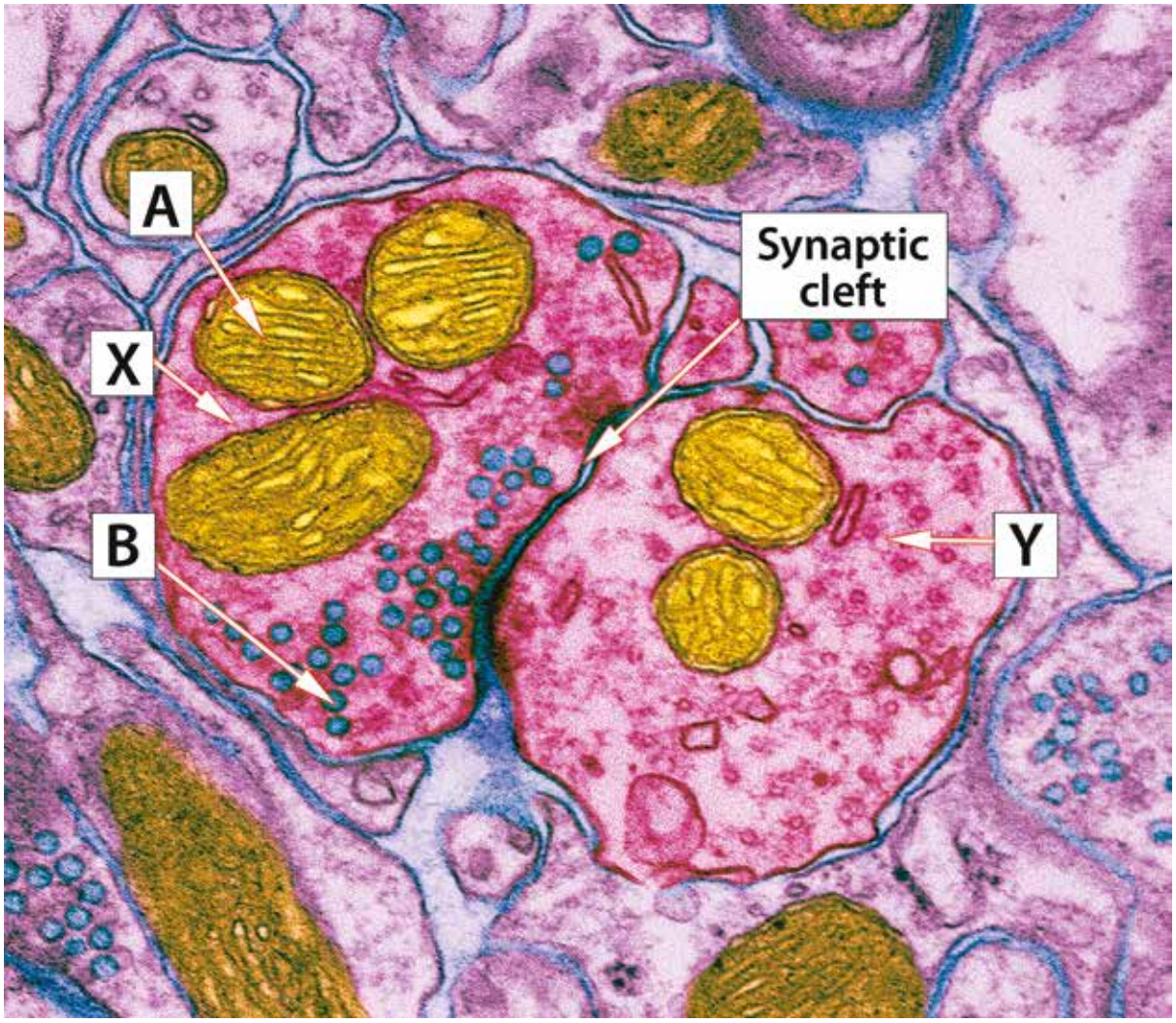
_____ [1]

**(ii)** State **one** piece of evidence which shows that the photograph was taken using an electron microscope (as opposed to a light microscope).

_____

_____ [1]

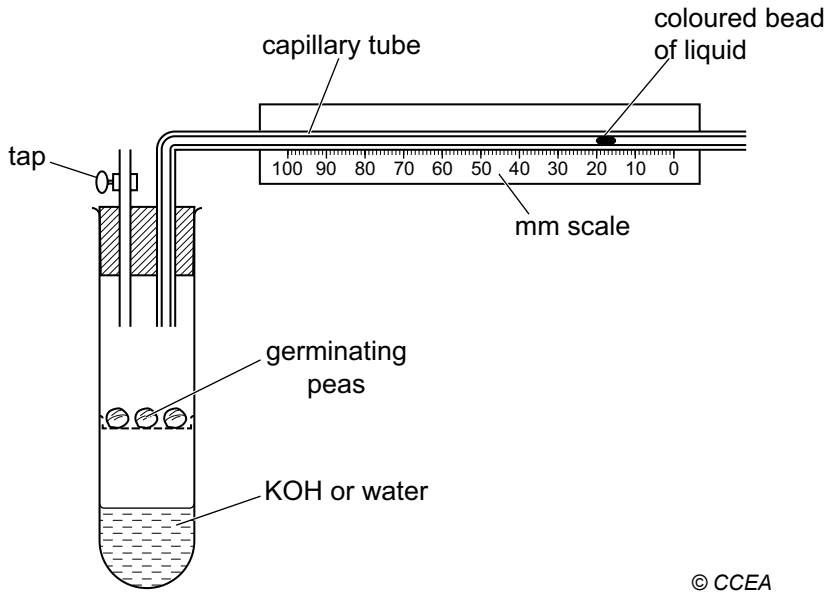
**Photograph 3.5**
**(for use with Question 5)**



| Examiner Only | |
|---|---|
| Marks | Re-mark |
| | |

**6** Anaerobic respiration in muscle tissue does not produce carbon dioxide as a waste product. However, anaerobic respiration in fungi and plants produces carbon dioxide.

The diagram below shows one type of simple respirometer.






Devise a plan for an investigation using the respirometer to determine if a sample of germinating peas is respiring anaerobically.

Your plan should outline the experimental set up, the control of variables, the collection of data and how you could determine if anaerobic respiration is taking place.
(You do not need to give a detailed procedure for the investigation.)

[5]

**7** The photograph below shows lichen growing on a tree.

*Photograph: Dr James Napier*

Describe how you could compare the amounts of lichen growing on beech and oak trees growing in a woodland. Your answer should describe how you could control, or limit, the effect of variables.

[4]

| Examiner Only | |
|---|---|
| Marks | Re-mark |
| | |

| Examiner Only | |
|---|---|
| Marks | Re-mark |
| | |

**8** **(a)** Longitudinal sections of the epidermis of grass leaves can be prepared by using a safety razor blade to scrape away all the other layers until only the epidermis remains.

When carrying out this procedure it is important to hold the razor blade vertically (perpendicular to the plane of the grass) and gently sweep the blade along the long axis of the grass several times. During this process the grass leaf should be on a microscope slide.

**(i)** Suggest why it is important to have the grass well irrigated with water as the above procedure takes place.

_____

_____ [1]

**(ii)** After the epidermal layer has been isolated, suggest why it is beneficial to add a drop of iodine to the slide before observing the specimen.

_____

_____ [1]

**(b)** Following the preparation as described above, and adding a cover slip, it is possible to view the grass epidermis under a microscope.

**(i)** When one student viewed her preparation she observed that the grass section in part of the slide contained green cells, and the cells in this region were difficult to distinguish. Whereas in other parts of the slide the cells were mainly colourless, and it was much easier to identify individual cells.

Explain this observation.

_____

_____

_____

_____

_____

_____ [2]

**(ii)** The student noted that all the stomata in the epidermis appeared closed. Suggest why?

_____

_____ [1]

**(iii)** Name the apparatus that would be additionally required, should the student wish to measure the average length of the epidermal cells.

_____

_____ [1]

| Examiner Only | |
|---|---|
| Marks | Re-mark |
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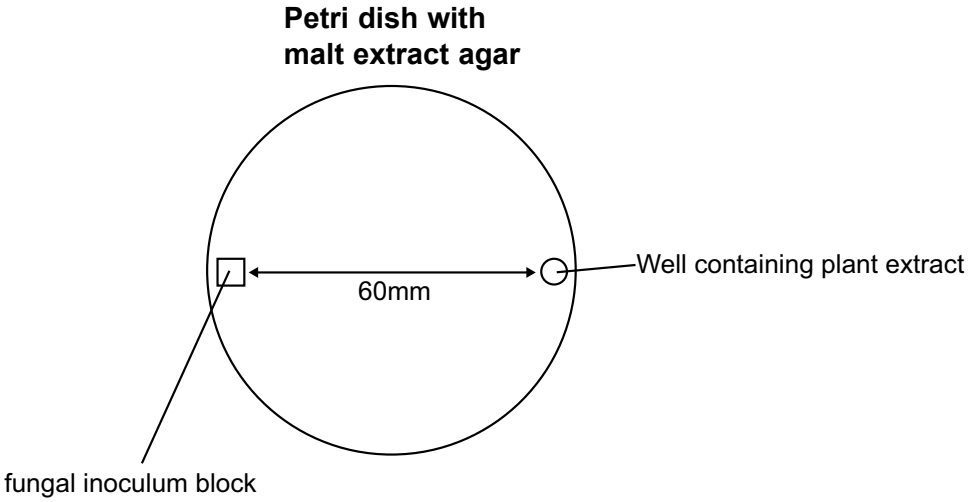
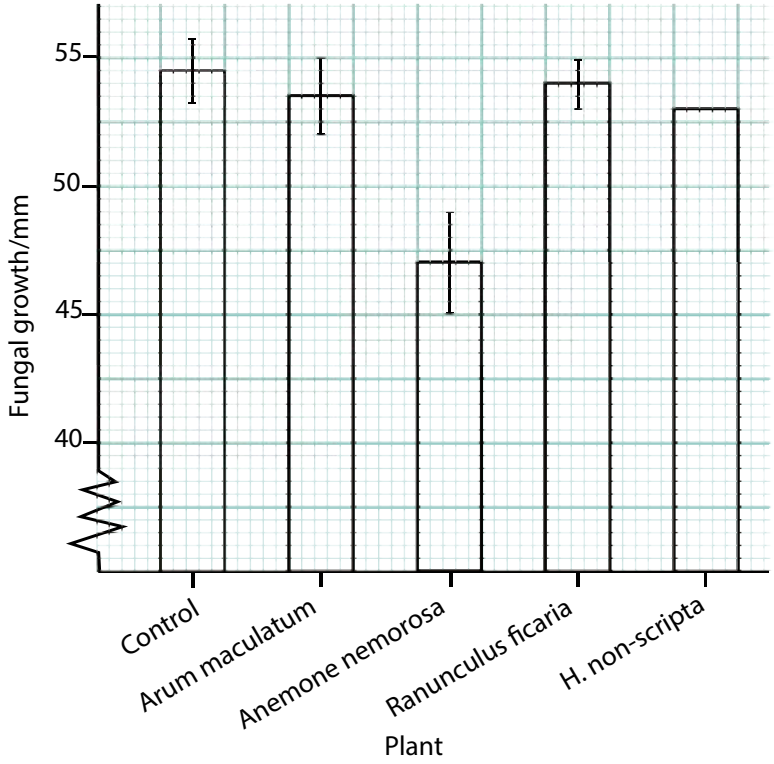
**9** Many plant species possess natural fungicides that help protect against infection. An investigation was set up to compare the anti-fungal properties of four species: *Hyacinthoides non-scripta* (bluebell), *Ranunculus ficaria* (lesser celandine), *Arum maculatum* (cuckoo pint), and *Anemone nemorosa* (wood anemone). Petri dishes, containing malt agar, were prepared. Each dish was inoculated with the fungus *Pythium debaryanum* opposite an extract of one of the plant species as shown below.






The plant extracts were prepared by grinding 5 g of fresh plant tissue in 2 $cm^3$ of cooled boiled water. Ten replica plates were produced for each plant species and the plates were incubated at 25°C. Following inoculation of the test plates, fungal growth was measured and recorded every 24 hours. Fungal growth was taken as the distance from the edge of the inoculum block to the colony edge, measured as the extent of growth out from the inoculum block towards the plant extract well opposite.

The bar chart above shows the mean fungal growth after 4 days for extracts of plant species and also for a control. 95% confidence limits are also shown except for *H. non-scripta.*

**(a)** Suggest a suitable control for this investigation.

_____

_____ [1]

**(b)** The mean growth value for bluebell (*H. non-scripta*) after four days was 53 mm and the standard deviation (error) of the mean was 0.442.

**(i)** Using the information provided and your statistics sheets, calculate the 95% confidence limits for *H. non-scripta*. (Show your working).

upper limit _____

lower limit _____ [3]

**(ii)** Complete the graph provided by adding the 95% confidence limits for *H. non-scripta*. [1]

**(iii)** The null hypothesis for this investigation stated that there was no significant difference between the effects of each of the plant extracts on the growth of the fungus. Based on the information provided, state and justify your decision about the null hypothesis.

_____

_____

_____

_____

_____

_____ [2]

| Examiner Only | |
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| Marks | Re-mark |
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**10** Read the following three extracts (**A, B,** and **C**) about gene technology and answer the questions which follow.

| Examiner Only | |
|---|---|
| Marks | Re-mark |
| | |

**A** 'The genetics revolution is ongoing, and there may indeed be no stopping it now.'
'The forces of natural selection are about to be replaced by the forces of human selection.'

*Steven Potter, Designer Genes – A New Era in the Evolution of Man, Random House, 2010*

**B** 'A domain once governed by fate has now become an arena of choice.'
'The advent of genetic testing creates a burden of decision that did not exist before.'

*2007, The Case Against Perfection, Belknap Press of Harvard University Press, Michael J. Sandel,*

**C** 'It is traditional to draw a distinction between repairing or curing dysfunction on the one hand and enhancing function on the other.'

*Enhancing Evolution – The Ethical Case for Making Better People, 2007, Princetown University Press, John Harris,*

**(a) (i)** Suggest what is meant by the terms 'curing dysfunction' and 'enhancing function.' (extract **C**):

- curing dysfunction _____

_____

_____

- enhancing function _____

_____

_____ [2]

**(ii)** What is the main ethical concern raised in the extracts?

_____

_____

_____ [1]

**(b)** Write a bibliography for the three extracts.

_____

_____

_____

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[3]

**THIS IS THE END OF THE QUESTION PAPER**

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# Biology

Statistical Formulae and Tables

# Statistics Sheets
# For use with Units A2 2 and A2 3

**Statistical Formulae and Tables**

## 1 Definition of Symbols

$n$ = sample size

$\bar{x}$ = sample mean

$\hat{\sigma}$ = estimate of the standard deviation

These parameters are obtained using a calculator with statistical functions, remembering to use the function for $\hat{\sigma}$ – which may be designated a different symbol on the calculator – with ($n$ – 1) denominator.

## 2 Practical Formulae

### 2.1 *Estimation of the standard deviation (error) of the mean* ($\hat{\sigma}_{\bar{x}}$)

$$\hat{\sigma}_{\bar{x}} = \sqrt{\frac{\hat{\sigma}^2}{n}}$$

### 2.2 *Confidence limits for population mean*

$$\bar{x} \pm t\sqrt{\frac{\hat{\sigma}^2}{n}}$$

which can be rewritten, in terms of $\hat{\sigma}_{\bar{x}}$, as

$$\bar{x} \pm t(\hat{\sigma}_{\bar{x}})$$

where $t$ is taken from $t$ tables for the appropriate probability and $n$ – 1 degrees of freedom.

## 3 Tests of significance

### 3.1 *Student's t test*

Different samples are denoted by subscripts; thus, for example, $\bar{x}_1$ and $\bar{x}_2$ are the sample means of sample 1 and sample 2 respectively.

The following formula for $t$ is that to be used:

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{\hat{\sigma}_1^{\,2}}{n_1} + \frac{\hat{\sigma}_2^{\,2}}{n_2}}}$$

which can be rewritten, in terms of $\hat{\sigma}_{\bar{x}}$, as

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\hat{\sigma}_{\bar{x}_1}^{\,2} + \hat{\sigma}_{\bar{x}_2}^{\,2}}}$$

with $n_1 + n_2 - 2$ degrees of freedom.

### 3.2 *Chi squared test*

Using the symbols $O$ = observed frequency, $E$ = expected frequency and $\Sigma$ = the sum of

$$\chi^2 = \sum \frac{(O-E)^2}{E}$$

with $n - 1$ degrees of freedom (where $n$ is the number of categories).

**Table 1** Student's $t$ values

| d.f. | $p = 0.1$ | 0.05 | 0.02 | 0.01 | 0.002 | 0.001 |
|---|---|---|---|---|---|---|
| **1** | 6.314 | 12.706 | 31.821 | 63.657 | 318.31 | 636.62 |
| **2** | 2.920 | 4.303 | 6.965 | 9.925 | 22.327 | 31.598 |
| **3** | 2.353 | 3.182 | 4.541 | 5.841 | 10.214 | 12.924 |
| **4** | 2.132 | 2.776 | 3.747 | 4.604 | 7.173 | 8.610 |
| **5** | 2.015 | 2.571 | 3.365 | 4.032 | 5.893 | 6.869 |
| **6** | 1.943 | 2.447 | 3.143 | 3.707 | 5.208 | 5.959 |
| **7** | 1.895 | 2.365 | 2.998 | 3.499 | 4.785 | 5.408 |
| **8** | 1.860 | 2.306 | 2.896 | 3.355 | 4.501 | 5.041 |
| **9** | 1.833 | 2.262 | 2.821 | 3.250 | 4.297 | 4.781 |
| **10** | 1.812 | 2.228 | 2.764 | 3.169 | 4.144 | 4.587 |
| **11** | 1.796 | 2.201 | 2.718 | 3.106 | 4.025 | 4.437 |
| **12** | 1.782 | 2.179 | 2.681 | 3.055 | 3.930 | 4.318 |
| **13** | 1.771 | 2.160 | 2.650 | 3.012 | 3.852 | 4.221 |
| **14** | 1.761 | 2.145 | 2.624 | 2.977 | 3.787 | 4.140 |
| **15** | 1.753 | 2.131 | 2.602 | 2.947 | 3.733 | 4.073 |
| **16** | 1.746 | 2.120 | 2.583 | 2.921 | 3.686 | 4.015 |
| **17** | 1.740 | 2.110 | 2.567 | 2.898 | 3.646 | 3.965 |
| **18** | 1.734 | 2.101 | 2.552 | 2.878 | 3.610 | 3.922 |
| **19** | 1.729 | 2.093 | 2.539 | 2.861 | 3.579 | 3.883 |
| **20** | 1.725 | 2.086 | 2.528 | 2.845 | 3.552 | 3.850 |
| **21** | 1.721 | 2.080 | 2.518 | 2.831 | 3.527 | 3.819 |
| **22** | 1.717 | 2.074 | 2.508 | 2.819 | 3.505 | 3.792 |
| **23** | 1.714 | 2.069 | 2.500 | 2.807 | 3.485 | 3.767 |
| **24** | 1.711 | 2.064 | 2.492 | 2.797 | 3.467 | 3.745 |
| **25** | 1.708 | 2.060 | 2.485 | 2.787 | 3.450 | 3.725 |
| **26** | 1.706 | 2.056 | 2.479 | 2.779 | 3.435 | 3.707 |
| **27** | 1.703 | 2.052 | 2.473 | 2.771 | 3.421 | 3.690 |
| **28** | 1.701 | 2.048 | 2.467 | 2.763 | 3.408 | 3.674 |
| **29** | 1.699 | 2.045 | 2.462 | 2.756 | 3.396 | 3.659 |
| **30** | 1.697 | 2.042 | 2.457 | 2.750 | 3.385 | 3.646 |
| **40** | 1.684 | 2.021 | 2.423 | 2.704 | 3.307 | 3.551 |
| **60** | 1.671 | 2.000 | 2.390 | 2.660 | 3.232 | 3.460 |
| **120** | 1.658 | 1.980 | 2.358 | 2.617 | 3.160 | 3.373 |
| **∞** | 1.645 | 1.960 | 2.326 | 2.576 | 3.090 | 3.291 |

*Reproduced from R E Parker: Introductory Statistics for Biology second edition Studies in Biology No 43 by permission of Edward Arnold (Publishers) Ltd*

**Table 2** $\chi^2$ values

| d.f. | $p = 0.900$ | 0.500 | 0.100 | 0.050 | 0.010 | 0.001 |
|---|---|---|---|---|---|---|
| **1** | 0.016 | 0.455 | 2.71 | 3.84 | 6.63 | 10.83 |
| **2** | 0.211 | 1.39 | 4.61 | 5.99 | 9.21 | 13.82 |
| **3** | 0.584 | 2.37 | 6.25 | 7.81 | 11.34 | 16.27 |
| **4** | 1.06 | 3.36 | 7.78 | 9.49 | 13.28 | 18.47 |
| **5** | 1.61 | 4.35 | 9.24 | 11.07 | 15.09 | 20.52 |
| **6** | 2.20 | 5.35 | 10.64 | 12.59 | 16.81 | 22.46 |
| **7** | 2.83 | 6.35 | 12.02 | 14.07 | 18.48 | 24.32 |
| **8** | 3.49 | 7.34 | 13.36 | 15.51 | 20.09 | 26.13 |
| **9** | 4.17 | 8.34 | 14.68 | 16.92 | 21.67 | 27.88 |
| **10** | 4.87 | 9.34 | 15.99 | 18.31 | 23.21 | 29.59 |
| **11** | 5.58 | 10.34 | 17.28 | 19.68 | 24.73 | 31.26 |
| **12** | 6.30 | 11.34 | 18.55 | 21.03 | 26.22 | 32.91 |
| **13** | 7.04 | 12.34 | 19.81 | 22.36 | 27.69 | 34.53 |
| **14** | 7.79 | 13.34 | 21.06 | 23.68 | 29.14 | 36.12 |
| **15** | 8.55 | 14.34 | 22.31 | 25.00 | 30.58 | 37.70 |
| **16** | 9.31 | 15.34 | 23.54 | 26.30 | 32.00 | 39.25 |
| **17** | 10.09 | 16.34 | 24.77 | 27.59 | 33.41 | 40.79 |
| **18** | 10.86 | 17.34 | 25.99 | 28.87 | 34.81 | 42.31 |
| **19** | 11.65 | 18.34 | 27.20 | 30.14 | 36.19 | 43.82 |
| **20** | 12.44 | 19.34 | 28.41 | 31.41 | 37.57 | 45.32 |
| **21** | 13.24 | 20.34 | 29.62 | 32.67 | 38.93 | 46.80 |
| **22** | 14.04 | 21.34 | 30.81 | 33.92 | 40.29 | 48.27 |
| **23** | 14.85 | 22.34 | 32.01 | 35.17 | 41.64 | 49.73 |
| **24** | 15.66 | 23.34 | 33.20 | 36.42 | 42.98 | 51.18 |
| **25** | 16.47 | 24.34 | 34.38 | 37.65 | 44.31 | 52.62 |
| **26** | 17.29 | 25.34 | 33.56 | 38.89 | 45.64 | 54.05 |
| **27** | 18.11 | 26.34 | 36.74 | 40.11 | 46.96 | 55.48 |
| **28** | 18.94 | 27.34 | 37.92 | 41.34 | 48.28 | 56.89 |
| **29** | 19.77 | 28.34 | 39.09 | 42.56 | 49.59 | 58.30 |
| **30** | 20.60 | 29.34 | 40.26 | 43.77 | 50.89 | 59.70 |
| **40** | 29.05 | 39.34 | 51.81 | 55.76 | 63.69 | 73.40 |
| **50** | 37.69 | 49.33 | 63.17 | 67.50 | 76.15 | 86.66 |
| **60** | 46.46 | 59.33 | 74.40 | 79.08 | 88.38 | 99.61 |
| **70** | 55.33 | 69.33 | 85.53 | 90.53 | 100.43 | 112.32 |
| **80** | 64.28 | 79.33 | 96.58 | 101.88 | 112.33 | 124.84 |
| **90** | 73.29 | 89.33 | 107.57 | 113.15 | 124.12 | 137.21 |
| **100** | 82.36 | 99.33 | 118.50 | 123.34 | 135.81 | 149.45 |

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# MARK SCHEME

# DIVIDER FRONT

# MARK SCHEME

# DIVIDER BACK

Rewarding Learning

General Certificate of Education

# Biology

# GENERAL MARKING INSTRUCTIONS

**General Marking Instructions**

***Introduction***

The main purpose of the mark scheme is to ensure that examinations are marked accurately, consistently and fairly. The mark scheme provides examiners with an indication of the nature and range of candidates' responses likely to be worthy of credit. It also sets out the criteria which they should apply in allocating marks to candidates' responses.

***Assessment objectives***

Below are the assessment objectives for Biology.

Candidates should be able to demonstrate:

**AO1** Knowledge and understanding of scientific ideas, processes, techniques and procedures.

**AO2** Apply knowledge and understanding of scientific ideas, processes, techniques and procedures:

- in a theoretical context
- in a practical context
- when handling qualitative data
- when handling quantitative data.

**AO3** Analyse, interpret and evaluate scientific information, ideas and evidence, including in relation to issues, to:

- make judgements and reach conclusions
- develop and refine practical design and procedures.

***Quality of candidates' responses***

In marking the examination papers, examiners should be looking for a quality of response reflecting the level of maturity which may reasonably be expected of a 17 or 18-year-old which is the age at which the majority of candidates sit their GCE examinations.

***Flexibility in marking***

Mark schemes are not intended to be totally prescriptive. No mark scheme can cover all the responses which candidates may produce. In the event of unanticipated answers, examiners are expected to use their professional judgement to assess the validity of answers. If an answer is particularly problematic, then examiners should seek the guidance of the Supervising Examiner.

***Positive marking***

Examiners are encouraged to be positive in their marking, giving appropriate credit for what candidates know, understand and can do rather than penalising candidates for errors or omissions. Examiners should make use of the whole of the available mark range for any particular question and be prepared to award full marks for a response which is as good as might reasonably be expected of a 17 or 18-year-old GCE candidate.

***Awarding zero marks***

Marks should only be awarded for valid responses and no marks should be awarded for an answer which is completely incorrect or inappropriate.

***Marking Calculations***
In marking answers involving calculations, examiners should apply the 'own figure rule' so that candidates are not penalised more than once for a computational error. To avoid a candidate being penalised, marks can be awarded where correct conclusions or inferences are made from their incorrect calculations.

***Types of mark schemes***
Mark schemes for tasks or questions which require candidates to respond in extended written form are marked on the basis of levels of response which take account of the quality of written communication.

Other questions which require only short answers are marked on a point for point basis with marks awarded for each valid piece of information provided.

***Levels of response***
In deciding which level of response to award, examiners should look for the 'best fit' bearing in mind that weakness in one area may be compensated for by strength in another. In deciding which mark within a particular level to award to any response, examiners are expected to use their professional judgement.

The following guidance is provided to assist examiners.

- ***Threshold performance:*** Response which just merits inclusion in the level and should be awarded a mark at or near the bottom of the range.
- ***Intermediate performance:*** Response which clearly merits inclusion in the level and should be awarded a mark at or near the middle of the range.
- ***High performance:*** Response which fully satisfies the level description and should be awarded a mark at or near the top of the range.

***Quality of written communication***
Quality of written communication is taken into account in assessing candidates' responses to all tasks and questions that require them to respond in extended written form. These tasks and questions are marked on the basis of levels of response. The description for each level of response includes reference to the quality of written communication.

For conciseness, quality of written communication is distinguished within levels of response as follows:

Level 1: Quality of written communication is basic.
Level 2: Quality of written communication is good.
Level 3: Quality of written communication is excellent.

In interpreting these level descriptions, examiners should refer to the more detailed guidance provided below:

**Level 1 (Basic):** The candidate makes only a limited selection and use of an appropriate form and style of writing. The organisation of material may lack clarity and coherence. There is little use of specialist vocabulary. Presentation, spelling, punctuation and grammar may be such that intended meaning is not clear.

**Level 2 (Good):** The candidate makes a reasonable selection and use of an appropriate form and style of writing. Relevant material is organised with some clarity and coherence. There is some use of appropriate specialist vocabulary. Presentation, spelling, punctuation and grammar are sufficiently competent to make meaning clear.

**Level 3 (Excellent):** The candidate successfully selects and uses the most appropriate form and style of writing. Relevant material is organised with a high degree of clarity and coherence. There is widespread and accurate use of appropriate specialist vocabulary. Presentation, spelling, punctuation and grammar are of a sufficiently high standard to make meaning clear.

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**2017**

# Biology

Assessment Unit AS 1

*assessing*

Molecules and Cells

**[CODE]**

**SPECIMEN**

# MARK SCHEME

/ denotes alternative points
; denotes separate points

AVAILABLE MARKS

## Section A

**1 (a) (i)** Peptide bond [1]

**(ii)** Condensation [1]

**(iii)** Enzymes/other appropriate response [1]

**(b) (i)** The secondary structure of the disease-causing form is composed of beta sheets/normal form is composed of helices [1]

**(ii)** Eating food rich in prions/spontaneous formation of disease version/inheritance of mutation in gene that codes for the disease version [1]

**(c)** Changes from blue to purple [1] 6

**2 (a) (i)** In both: cytoplasm, mitochondria, endoplasmic reticulum, nucleus (any **three**) [1]

**(ii)** in plant only: vacuole and cell wall (both needed) [1]

**(iii)** in animal only: glycogen granules [1]

**(b)** The cell wall is made from chitin/the cell is multinucleated (lacks dividing membranes)/cells contained within hyphae [1]

**(c) (i)** Smooth endoplasmic reticulum/smooth ER [1]
**(ii)** microvilli [1]
**(iii)** Golgi apparatus [1]
**(iv)** Plasmodesmata [1] 8

| | | | AVAILABLE MARKS |
|---|---|---|---|
| **3** | **(a)** | Any **three** from:<br>• sample A – increase in elastase activity over time until 50 minutes when it reaches a plateau<br>• sample B – increase in elastase activity over time until 40 minutes when it reaches a plateau<br>• elastase activity for sample B is less than that for sample A but greater than sample C<br>• sample C – no increase in elastase activity over time/no elastase present/small residual amount of elastase present [3] | |
| | **(b)** | Not enough inhaled inhibitor was taken/dosage too low;<br>not all of the inhaled inhibitor reached the lung. [2] | |
| | **(c)** | Any **two** from:<br>• high concentration of elastase in sample/mucus<br>• substrate is specific for the active site of elastase/enzyme<br>• forms enzyme-substrate complexes/formation of product over time<br>• activity levels off as substrate used up [2] | |
| | **(d)** | Line C<br>enzyme would be damaged;<br>no/less activity would be detected in assay. [3] | 10 |
| **4** | **(a)** | Mitochondria are bounded by an envelope in which the inner membrane is folded/forms cristae;<br>their function is to generate ATP/aerobic respiration. [2] | |
| | **(b)** | **(i)** Caption;<br>scaling of the graph (using the graph paper to maximal effect);<br>labels and units of measurement shown;<br>points accurately plotted. [4] | |
| | | **(ii)** Larger cells (up to a certain size) possess a greater number of mitochondria;<br>over a certain size the number of mitochondria remains steady/fluctuates. [2] | 8 |

AVAILABLE MARKS

**5** **(a)** Nucleotide
(accept deoxyribose nucleotide, but **not** ribonucleotide) [1]

**(b)** **(i)** One intermediate band after one generation;
two bands, one light and one intermediate after two generations.
[2]

**(ii)** Semi-conservative replication of the DNA/each (heavy) strand acts as a template;
produces DNA with one heavy chain and one light chain.
(allow by means of a diagram) [2]

**(c)** Cytosine = guanine = 21%;
Adenine and thymine both = (100 – 42) ÷ 2 = 29%.
[2] 7

**6** **(a)** **(i)** B;
C (accept D);
E. [3]

**(ii)** To reduce/minimise water loss by evaporation/transpiration [1]

**(b)** **(i)**

| Potential/kPa | Cells of upper mesophyll | Cells of lower mesophyll |
|---|---|---|
| $\psi_{cell}$ | | -150 |
| $\psi_s$ | | |
| $\psi_p$ | 250 | |

[2]

**(ii)** Water will flow from upper mesophyll cells to lower mesophyll cells;
since osmosis takes place from higher to lower water potential.
(Must make reference to water potential, not concentration) [2]

**(iii)** The cells of the lower mesophyll become more turgid;
lower mesophyll increases in size (and becomes more convex).
[2] 10

| | | | | | AVAILABLE MARKS |
|---|---|---|---|---|---|
| 7 | **(a)** | **(i)** | Centromere/kinetochore | [1] | |
| | | **(ii)** | S/synthesis phase (of interphase) | [1] | |
| | **(b)** | **(i)** | Metaphase | [1] | |
| | | **(ii)** | Prevent the production of spindle fibres/microtubules; prevent the separation of chromatids to opposite sides of cell/ prevent anaphase. | [2] | |
| | | **(iii)** | Stops mitosis continuing after metaphase/prevents anaphase; tumour cells don't continue to divide/undergo mitosis. | [2] | |
| | **(c)** | **(i)** | Allows the cell to monitor the internal/external environments/ ensure cell is ready to enter S and M phases | [1] | |
| | | **(ii)** | $G_0$; letter X positioned between $G_1$ and S. | [2] | |
| | | **(iii)** | Diagram marked with letter Y at M; | [1] | 11 |
| | | | **Section A** | | **60** |

## Section B

AVAILABLE MARKS

**8 (a) Indicative Content:**

- both simple and facilitated diffusion are passive/require no energy
- and movement is down the concentration gradient
- simple diffusion is possible between the phospholipid molecules
- while facilitated diffusion requires transmembrane proteins
- active transport carries substances against the concentration gradient which requires ATP for energy
- active transport also requires specific carriers
- the carriers undergo a change of shape to move the substance across the membrane
- use of protein carriers in active transport and facilitated diffusion confers selectivity

**Band 3 Mark [5]–[6]**

Candidates use the most appropriate specialist terms to fully describe the similarities and differences between simple diffusion, facilitated diffusion and active transport using a minimum of six points of indicative content. Spelling, punctuation and grammar is excellent and the form and style are of a high standard.

**Band 2 Mark [3]–[4]**

Candidates sometimes use appropriate specialist terms to describe the similarities and differences between simple diffusion, facilitated diffusion and active transport using a minimum of four points of indicative content. Spelling, punctuation and grammar, and the form and style are of a good standard.

**Band 1 Mark [1]–[2]**

Candidates partially describe the similarities and differences between simple diffusion, facilitated diffusion and active transport. Spelling, punctuation and grammar, and the form and style is of a basic standard.

6

**(b) Indicative Content:**

- some molecules are hydrophobic/non polar/very small (e.g. oxygen and carbon dioxide)
- and so can pass directly between the phospholipid molecules in the bilayer
- ions are polar/charged/hydrophilic
- and therefore cannot pass between the phospholipid molecules
- therefore they need hydrophilic pores/channel proteins through which to pass
- transport through bilayer/pore/channel is non-selective/but channel selective if gated
- larger polar molecules (such as glucose) depend on protein carriers in the membrane
- which have specific receptor sites [not active sites]
- that are complementary to the molecule being carried
- these carriers are therefore selective in what they can carry
- also the relative abundance of different carriers will influence the relative amount of different substances able to cross the membrane

**Band 3 Mark [7]–[9]**

Candidates use the most appropriate specialist terms to fully discuss how the different methods of transport describe in (a) are necessary to allow large and small molecules, as well as ions pass through the cell membrane using a minimum of nine points of indicative content. Spelling, punctuation and grammar, and the form and style are of a high standard.

**Band 2 Mark [4]–[6]**

Candidates sometimes use appropriate specialist terms to discuss how the different methods of transport described in (a) are necessary to allow large and small molecules, as well as ions pass through the cell membrane using a minimum of five points of indicative content. Spelling, punctuation and grammar, and the form and style are of a good standard.

**Band 1 Mark [1]–[3]**

Candidates partially explain how the different methods of transport described in (a) are necessary to allow large and small molecules, as well as ions pass through the cell membrane. Spelling, punctuation and grammar, and the form and style is of a basic standard.

| AVAILABLE MARKS |
|---|
| 9 |
| **15** |
| **75** |

**Section B**

**Total**

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# Biology

## Assessment Unit AS 2

*assessing*

Organisms and Biodiversity

**[CODE]**

**SPECIMEN**

# MARK SCHEME

/ denotes alternative points
; denotes separate points

AVAILABLE MARKS

## Section A

**1** **(a)** The counts for the upper epidermis are not that variable (relatively close)/for the lower epidermis the counts are variable (not just quoting range) the less variable the counts the more reliable the results (allow converse)/for lower epidermis reliability (of the mean) could be increased by further replication [2]

**(b)** Any **three** from:
- the colour changes as water is lost from the leaf (stomata/colour changes are more rapid on the upper surface)
- transpiration/water loss is occurring from both surfaces
- transpiration more rapid from the upper surface (allow converse)
- as there are more stomata on the upper surface (allow converse)

[3] 5

**2** **(a)** Any **three** from:
- plants in the hedge provide food and shelter
- nesting sites
- offering more ecological niches/creates habitats
- they allow a means of dispersal and migration to other habitats/ act as wildlife corridors
- hedges reduce soil erosion
- associated predator strips may be used as pest control
- other appropriate response [3]

**(b)** Any **three** from:
- restrict high intensity farming
- increases pests and weeds
- are costly and time consuming to maintain
- take up valuable space for crops
- limit the size of machinery that can be used
- shade crops close to them, reducing growth capacity
- other appropriate response [3] 6

AVAILABLE MARKS

**3** **(a)** Any **two** from:
- lumen relatively small
- vessel wall/middle layer relatively thick
- lumen lining 'crinkled'
- overall rounded shape [2]

**(b)** Smooth muscle allows for vasodilation/vasoconstriction of an artery; provides control of blood distribution [2]

**(c)** Surface area [1]

**(d)** **(i)** Any **two** from:
- alveoli gradually destroyed so reducing surface area for gaseous exchange
- loss of elasticity in alveolar walls
- alveoli stay inflated on expiring
- difficulty exhaling [2]

**(ii)** Any **two** from:
- cilia damage
- build-up of mucus
- narrowing of bronchi/bronchioles
- inhaling/exhaling delivers less air (to alveoli) so affecting concentration gradient [2]

**(e)** Any **two** from:
- inhibits the production of thromboplastin
- prevents conversion of prothrombin to thrombin
- removes calcium from plasma
- inhibits action of clotting factors
- stops conversion of fibrinogen to fibrin
- other appropriate response [2]

**(f)** Lumen of blood vessels increase in size; allows for greater delivery of oxygen/metabolites. [2]

13

AVAILABLE MARKS

**4 (a) (i)** Both tissues are found within (a ring of) vascular bundles
xylem on the inside; phloem on the outside (of each bundle) [2]

**(ii)** Any **two** from:
- the tube cells are joined end to end/forming continuous structures through the plant
- their end walls are perforated/forming sieve plates
- associated with companion cells
- there is a little cytoplasm (metabolically active tissue)/few organelles/no nucleus
- plasmodesmata link the tube cells with the companion cells
- microtubules pass through pores in the sieve plate/between sieve tubes
- thick secondary cell walls remain unlignified [2]

**(b) (i)** Any **two** from:
- the strengthened walls will not collapse
- under tension/negative pressure (as water is pulled up the stem by transpiration)
- lignified xylem provides support for the whole plant

(*Not just strength/support)* [2]

**(ii)** Any **two** from:
- it requires time for the vessels to become fully lignified
- rings and spirals allow for stretching/elongation
- in young stems which are still growing
- the larger older vessels must be able to withstand greater tension
- older stems provide more support for branches/leaves/ inflorescence [2] 8

**5 (a)**

| Kingdom | Animalia |
|---|---|
| Phylum | |
| | Mammalia |
| | Rodentia |
| | Sciuridae |
| | Sciurus |
| | vulgaris |

all rows correct [3]
five rows correct [2]
three or four rows correct [1] [3]

**(b) (i)** Any **four** from:
- more litters per year/bigger litters (means population increases more readily)
- stocky body shape allows them to survive the winter better/ they have a smaller surface area for heat loss
- stocky shape/higher body mass means they have more stored fat/more food reserves/able to survive food shortage

| | | | | AVAILABLE MARKS |
|---|---|---|---|---|
| | | | • being bigger they may be more able to fight for food (where they are in direct competition)<br>• they can eat seeds that are not fully ripe thus leaving less for the red squirrels/thus they have a longer feeding season<br>• they can also eat acorns, which are big seeds (better food source)/a more varied diet<br>• other appropriate suggestion (e.g. able to fight predators due to size/fight for nesting sites) [4] | |
| | **(ii)** | | Planting more coniferous forest/planting more of the species which favour the red squirrels/other appropriate suggestion. [1] | 8 |
| **6** | **(a)** | **(i)** | They ran faster/were more active during the running/more muscle mass | |
| | | **(ii)** | The athletes recover faster/fitter | |
| | | **(iii)** | The athletes had the lower resting pulse rate/their larger hearts pump out more blood with each pulse/heart more efficient/non-athletes have yet to recover | |
| | | **(iv)** | The initial pulse rates are different [4] | |
| | **(b)** | | Any **three** from:<br>• delivers oxygen to working muscles<br>• oxygenates blood by returning it to the lungs<br>• transports heat (a by-product of activity) from the core to the skin<br>• delivers nutrients and fuel to active tissues [3] | |
| | **(c)** | | Carbon dioxide levels will be increased;<br>combines with water in blood to form a weak acid [2] | 9 |
| **7** | **(a)** | | Presence of xerophytic adaptation as water availability limited;<br>the waxy cuticle reduces transpiration/reduces evaporation/prevents water loss [2] | |
| | **(b)** | | After changes, the index would be lower;<br>indicating an increase in biodiversity;<br>reference to specific initiative to conserve habitats/increase biodiversity [3] | 5 |
| **8** | **(a)** | | Compensation point [1] | |
| | **(b)** | | Species A has a low compensation point;<br>therefore photosynthesis exceeds respiration at low light intensities [2] | |
| | **(c)** | | Any **three** from:<br>• leaf curvature<br>• reduced surface area<br>• hairs<br>• sunken stoma<br>• succulent tissue<br>• deep roots<br>• spines [3] | 6 |
| | | | **Section A** | **60** |

## Section B

AVAILABLE MARKS

**9 Indicative content:**

- impulse originates from the sino-atrial node (SAN)/pacemaker
- wave of excitation reaches left atrium
- atrial systole occurs causing increasing pressure
- blood is pushed into left ventricle via the bicuspid valve
- ventricular pressure rises due to infilling of blood
- left ventricle not stimulated by an impulse direct from the atrium
- results in a time delay to allow complete atrial emptying
- wave of excitation reaches atrio-ventricular node (AVN)
- spreads down the bundle of His into Purkinje fibres
- ventricular systole occurs from the apex of the heart
- ventricular pressure exceeds atrial pressure so bicuspid valve closes
- ventricular pressure exceeds aortic pressure so semi-lunar valve opens
- blood flows into aorta causing an increase in pressure
- semi-lunar valves close as aortic pressure now exceeds ventricular pressure

**Band 3 Mark [11]–[15]**

Candidates use the most appropriate specialist terms to fully describe and explain the sequence of events which lead to the creation of high pressure in the aorta using a minimum of nine points of indicative content. Spelling, punctuation and grammar and the form and style are of a high standard.

**Band 2 Mark [6]–[10]**

Candidates sometimes use appropriate specialist terms to describe and explain the sequence of events which lead to the creation of high pressure in the aorta using a minimum of five points of indicative content. Spelling, punctuation and grammar, and the form and style are of a good standard.

**Band 1 Mark [1]–[5]**

Candidates partially describe and/or explain the sequence of events which lead to the creation of high pressure in the aorta. Spelling, punctuation and grammar, and the form and style is of a basic standard.

15

| | |
|---|---|
| **Section B** | **15** |
| **Total** | **75** |

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# Biology

Assessment Unit AS 3
*assessing*
Practical Skills in AS Biology

**[CODE]**

**SPECIMEN**

# MARK SCHEME

/ denotes alternative points
; denotes separate points

AVAILABLE MARKS

## Section A

**1** **(a)** Enzyme reaction, e.g. effect of amylase on starch/other appropriate response, e.g. population growth of microorganisms/membrane permeability of beetroot [1]

**(b)** **(i)** The percentage of light passing through the test solution/cuvette compared with the control [1]

**(ii)** To provide maximum range of colorimeter readings;
as the investigation progresses, e.g. between full amount of starch present and when no starch present [2]

**(iii)** Clean cuvette/handle on sides not used in light transmission/reset between readings/other appropriate response [1] 5

**2** **(a)** Many plotted points taken into account/trend is clear [1]

**(b)** –1450 kPa [1]

**(c)** To ensure no further osmotic change/same osmotic effect as immersing solution [1] 3

**3** **(a)** Any **four** from:

- add solvent to the chromatography vessel and allow it to saturate the atmosphere
- draw a base line in pencil towards the bottom of the chromatography paper
- add a spot of the amino acid solution to the base line, allow it to dry and re-apply the solution to make a concentrated spot
- lower the paper into the vessel, ensuring the base line is above the level of the solvent
- allow sufficient time for the solvent to rise up the paper but not reach the top/ensure chromatography paper does not touch side of vessel
- remove the paper and mark the solvent front
- handle the paper using gloves/tongs/avoid touching the paper/ touching only sides or top [4]

**(b)** Distance moved by spot 3 cm, distance moved by solvent 6 cm;
Rf value 3 ÷ 6 = 0.5 **[consequential to answer above]** so X corresponds to asparagine **[consequential to Rf value calculated]** [2] 6

| | | | AVAILABLE MARKS |
|---|---|---|---|
| **4** | **(a)** | 1447770 ÷ (2505 × 2504);<br>0.23<br>Correct answer gets 2 marks [2] | |
| | **(b)** | Repeat at different times of year/other appropriate response [1] | 3 |
| **5** | **(a)** | **(i)** **A**: starch grain<br>**B**: tonoplast<br>**C**: middle lamella [3] | |
| | | **(ii)** Magnified length = 115 mm;<br>= 115 000 µm;<br>115 000 ÷ 7500 = 15.33 µm; [3] | |
| | **(b)** | Any **four** from:<br>• calibrate graticule using stage micrometer<br>• value of each graticule 'unit' calculated as 'X' micrometres (at both low and high power)<br>• remove stage micrometer and place slide containing onion cells on microscope<br>• using graticule calculate the length of a number of onion epidermal cells<br>• use high power (if possible) for greater accuracy [4] | 10 |
| **6** | **(a)** | Place two measuring tapes at right angles to mark out sample area/place one tape parallel to shoreline and place several tapes perpendicular to this tape/other appropriate method of determining sampling positions;<br>use random numbers to determine co-ordinates/position for sampling;<br>use quadrat and estimate % cover (of each species)/use sampling pin and record species present/other suitable method;<br>sample many points to improve reliability (*insist on link between repetition and reliability*) [4] | |
| | **(b)** | To ensure all of the water has evaporated/to determine dry mass [1] | |
| | **(c)** | Bar chart used, with bars for different species not touching;<br>appropriate title (reference to (plant) species, sand dunes, two areas);<br>scale selected to make best use of grid (must cover at least half of the grid in both dimensions) and axis labels appropriate;<br>data accurately plotted, with key/label for each area [4] | 9 |
| **7** | **(a)** | Any **four** from:<br>• most cells in interphase<br>• minority of cells in mitosis<br>• as mitosis is only a short part of overall cell cycle<br>• as interphase lasts longer than mitosis<br>• during mitosis most cells in prophase/fewest in anaphase<br>• prophase takes longest time during mitosis/anaphase is shortest time [4] | |
| | **(b)** | Looking at wrong part of root tip/other appropriate response [1] | 5 |

| | | AVAILABLE MARKS |
|---|---|---|
| **8** | **(a)** Nuclei [1] | |
| | **(b)** **(i)** The buffer resists changes in pH;<br>and prevents loss/gain of water by the organelles [2] | |
| | **(ii)** Caption refers to oxygen concentration, mitochondria and cyanide present/absent (and time);<br>data organised in columns/rows;<br>appropriate column headings (cyanide present/absent must be clear, not just 'tube **A**/tube **B**');<br>units included (min and μM) [4] | |
| | **(iii)** Any **two** from:<br>• in both tubes oxygen concentration falls over time<br>• the oxygen concentration falls much faster when mitochondria are not treated with cyanide (in tube B)<br>• with cyanide present (tube A), oxygen concentration in the suspension stops decreasing (after 6 minutes)/with cyanide absent, oxygen concentration continues to decrease [2] | 9 |
| | **Total** | **50** |

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**2018**

# Biology

## Assessment Unit A2 1

Physiology, Coordination and Control, and Ecosystems

## [CODE]

## SPECIMEN

# MARK SCHEME

/ denotes alternative points
; denotes separate points

AVAILABLE MARKS

## Section A

**1** X – myosin
Y – M-line [2] 2

**2** **(a)** A – Bowman's capsule
B – proximal convoluted tubule [2]

**(b)** **(i)** Bottom of ascending limb: less than 900 but greater than 250;
top of ascending limb: less than 250 [2]

**(ii)** Descending limb permeable to water loss/impermeable to ion (solute) loss;
water exits descending limb into salty medulla (more negative water potential);
by osmosis (increasing the concentration of solutes as the filtrate flows along) [3]

**(c)** Longer loop of Henlé produces a more concentrated filtrate at the apex of the loop/solute concentration in the table would be higher;

and any **two** from:
- more ions exit the ascending limb and create a medulla with a lower water potential
- more water is subsequently reabsorbed from the collecting duct
- small quantity of hypertonic urine is produced [3] 10

**3** **(a)** Numbers of species B continue to increase over time but species A increases initially then dies out (goes back into decline);

and any **two** from:
- neither species does as well as when cultured separately
- species A dies out due to competition for food
- consequence of competitive exclusion (or explained) [3]

**(b)** Paramecium are mobile/can move across the haemocytometer [1] 4

AVAILABLE MARKS

**4 (a) (i)**

| Feature | Statement number |
|---|---|
| A | 1 |
| B | 4 |
| C | 2 |

[3]

**(ii)** Synaptic knob only at one end of neurone/transmitter substance on one side of synapse only/receptors on one side only/location of receptors [1]

**(b) (i)** Transmission speed would be slower;
action potential event must travel along the entire length of the axon/no saltatory conduction;
axon diameter/temperature [3]

**(ii)** Golgi;
addition of carbohydrate/polysaccharide to lipid/delivery of glycolipid to plasma membrane

**Or**

SER (smooth endoplasmic reticulum);
Involved in lipid transport and synthesis [2]

**(c)** Line drawn has a membrane potential more negative than –70 mV;
line returns to –70mV [2]

**(d)** The post-synaptic membrane is hyperpolarised/membrane potential becomes more negative;
making depolarisation of post-synaptic neurone less likely;
making an action potential in PSN less likely to occur [3] 14

**5 (a) (i)** Leaves receive a short-day treatment;
the plant responds by flowering;
apical bud receives a long-day treatment which does not influence/ inhibit flowering [3]

**(ii)** To confirm that the plant is a short-day plant/to confirm that short-day treatment stimulates flowering in this plant/allows for comparison (with experiment two); *not just control* [1]

**(b)** Grafted leaves contain/produce the chemical messenger/introduce the chemical messenger into the recipient plant;
which stimulates flowering/overcomes the effect of the inhibitory light treatment

**Or**

Chemical messengers are diffusible/transferable;
so move from the leaf to the flowering buds/other parts of the plant [2]

| | | | AVAILABLE MARKS |
|---|---|---|---|
| | **(c)** | Any **two** from:<br>• increased chance of being pollinated by insects/less competition for pollinators<br>• increased chance of seed dispersal<br>• allow ground plants to flower before leaf canopy closes<br>• other appropriate response [2] | |
| | **(d)** **(i)** | Flowering is not promoted/inhibited by level of $P_{730}$ ($P_{FR}$) (in the leaves)/flowering is controlled by another mechanism (other than light regime) [1] | |
| | **(ii)** | External temperature/light intensity/flowering occurs when maturity is reached/other appropriate response [1] | 10 |
| **6** | **(a)** **(i)** | 172 000/7500 000;<br>0.023 × 100 = 2.29/2.3% [2]<br>[**correct answer is worth 2 marks**] | |
| | **(ii)** | Any **two** from:<br>• light absorbed by clouds/atmosphere/reflected back into space<br>• light energy reflected from leaves<br>• light energy used in evaporating water<br>• light energy missing chloroplasts/passing through leaf/not hitting leaves<br>• wavelengths that cannot be used<br>• inefficiency of photosynthetic (photochemical/biochemical) process [2] | |
| | **(iii)** | Respiration [1] | |
| | **(b)** | Data needs to be collected throughout the year/over a time period/ other appropriate response [1] | |
| | **(c)** **(i)** | 1.8 kg $m^{-2}$ [1] | |
| | **(ii)** | (5.4 – 1.8) = 3.6/5.4 x 100;<br>66.7 % [**consequential to answer above**] [2]<br>(*Do not accept rounding to 67%)* | |
| | **(d)** | Combustion/thermal decomposition;<br>of organic/carbon containing compounds [2] | 11 |

| | | | | AVAILABLE MARKS |
|---|---|---|---|---|
| 7 | **(a)** | The increasing levels of oxygen/loss of hydrogen ions in the compounds nitrite and nitrate (compared to ammonia) [1] | | |
| | **(b)** | **(i)** As soil nitrogen increases mean nodule length decreases (or converse);<br>larger nodules suggest increasing ability to fix nitrogen (or converse);<br>in nitrogen-rich soils large root nodules are less advantageous/ have less of an advantage as nitrogen levels less likely to be limiting (or converse) [3] | | |
| | | **(ii)** Any **two** from:<br>• plants samples from a range of areas/fields (where soil nitrogen content would be expected to be different)<br>• the nodules were measured in the same plane/consistency in nodule measurement<br>• nodules were randomly selected/selected using objective sampling (e.g. the 10 nodules closest to the base of the root were sampled)<br>• soil collected for nitrogen testing obtained from same proximity to pea root<br>• stored for same length of time/stored in same conditions (e.g. storage in plastic bags will encourage denitrification therefore reducing nitrogen content)<br>• other appropriate response [2] | | 6 |
| 8 | **(a)** | **(i)** Contains lysozyme enzyme (to break down microbes) [1] | | |
| | | **(ii)** Protein has tertiary/globular structure/3D structure;<br>variety of shapes/a specific shape;<br>which is complementary to shape of antigen [3]<br>[*insist on complementary not same*] | | |
| | **(b)** | **(i)** Death from routine infections/complications following surgery/ complications after childbirth/other appropriate response. [1] | | |
| | | **(ii)** Attacks/destroys all prokaryotic/bacterial cells [1] | | |
| | | **(iii)** Bacterial ribosomes are different size/smaller subunits than human (eukaryotic) ribosomes;<br>antibiotic (molecule) and human ribosome are not complementary to each other<br>[*do not accept same shape*] [2] | | |
| | **(c)** | Competition between microorganisms/other appropriate response;<br>presence of antimicrobal properties makes these microorganisms better adapted/other appropriate response [2] | | |
| | **(d)** | Any **two** from:<br>• bacteria may become resistant in short period of time<br>• company may not make any/enough profit<br>• drugs are too specific/few patients/narrow-spectrum<br>• other appropriate response [2] | | 12 |

AVAILABLE MARKS

**9** **(a)** **(i)** Sand is unable to retain moisture/exposed to high winds/other appropriate response [1]

**(ii)** Long roots/curved leaves/reduced surface area of leaves/fewer stomata/sunken stomata/leaf hairs/thick waxy cuticle/other appropriate response [1]

**(b)** **(i)** Low biodiversity in young dunes/near sea, increases to maximum in dune slack and falls further inland;
**and**
any **four** from:

- in young dunes soil moisture/humus levels too low to support most plants (will only support specialist plants, e.g. marram)
- in dune slack high light levels and rising soil moisture/humus levels will support greater variety of plant species
- in dune slacks little marram grass to provide shade/most plants are ground-hugging
- some plants may be nitrogen-fixing (in nutrient-poor soil)
- the older more stable dunes allows the establishment of shrubs (plants with longer life cycles/K-strategists)
- (due to) high humus/high moisture levels
- the shrubs/species in older dunes (heather, bracken, gorse) reduce light levels reaching the ground
- reducing biodiversity in ground layer/only allowing mosses to grow in ground layer
- other appropriate response [5]

**(ii)** Any **two** from:

- angle of sun will change (affecting amount of light reaching ground layer)/light levels change during the day
- rain may increase soil moisture levels/sun may reduce soil mosture
- other appropriate response, e.g. grazing effects [2]

**(c)** Fixing nitrogen can compensate for poor soil development;
allows the development of N-containing compounds (protein, nucleic acids, ATP). [2]

**(d)** **(i)** Both develop on bare rock/land that has not been colonised before [1]

**(ii)** All stages of sand dune succession are evident at one time/is spatial/quarry succession is temporal/at any one time only one stage/sere is evident/quarry succession is faster/less gradation of environmental factors in a quarry/other appropriate response [1]

13

**Section A** **82**

## Section B

AVAILABLE MARKS

**10 (a) Indicative content:**

- the cornea and the lens are both involved in the convergence of light/combine to focus light onto the retina
- the lens is responsible for accommodation/fine control of light rays
- for a close up object the ciliary muscles contract reducing tension in the suspensory ligaments
- allowing the lens to become thicker
- causing the greater convergence/refraction/shorter focal length required
- in high light intensities the circular muscles in the iris contract (radial muscles relax) to reduce the diameter of the pupil
- reducing the amount of light entering the eye
- protecting the retina from damage
- the choroid layer prevents internal reflection (which would distort vision)
- cones contain the photosensitive pigments that function in high light intensities
- each cone synapses with individual bipolar neurones/cones show no convergence
- giving greater visual acuity/greater resolution
- there are three types of cone thereby providing colour vision
- each type has a different type of iodopsin sensitive to red, green or blue light
- colour vision depends on the degree of stimulation of each type of cone
- the presence of two eyes provides binocular vision/gives stereoscopic vision/good depth perception

**Band 3 Mark [9]–[12]**

Candidates use the most appropriate specialist terms to fully describe and explain how the typical mammalian eye provides a detailed colour image of close-up objects in high light intensities using a minimum of twelve points of indicative content. Spelling, punctuation and grammar, and the form and style are of a high standard.

**Band 2 Mark [5]–[8]**

Candidates sometimes use appropriate specialist terms to describe and explain how the typical mammalian eye provides a detailed colour image of close-up objects in high light intensities using a minimum of seven points of indicative content. Spelling, punctuation and grammar, and the form and style are of a good standard.

**Band 1 Mark [1]–[4]**

Candidates partially describe and/or explain how the typical mammalian eye provides a detailed colour image of close-up objects in high light intensities. Spelling, punctuation and grammar, and the form and style is of a basic standard.

12

**(b) Indicative content:**

- rods contain the photosensitive pigment rhodopsin which is broken down/bleached in low light intensities
- several rods synapse with one bipolar neurone/rods exhibit retinal convergence
- allowing summation of (generator) potentials (transmitter substances) to produce an impulse in the bipolar neurone/allows threshold to be reached
- providing greater sensitivity
- pupil is dilated/large to allow as much light as possible to stimulate the retina (enter eye)
- pupil dilation is due to contraction of radial muscle in the iris
- large eyes/pupils
- to maximise the amount of light reaching the retinal/ photosensitive cells
- mainly rods present/no cones
- other appropriate response (e.g. layer at back of eye to reflect light back through retina)

**Band 3 Mark [5]–[6]**

Candidates use the most appropriate specialist terms to fully explain how the eye is adapted to provide vision in low light intensities and they suggest how the eyes of nocturnal mammals are specialised using a minimum of seven points of indicative content. Spelling, punctuation and grammar, and the form and style are of a high standard.

**Band 2 Mark [3]–[4]**

Candidates sometimes use appropriate specialist terms to explain how the eye is adapted to provide vision in low light intensities and they suggest how the eyes of nocturnal mammals are specialised using a minimum of four points of indicative content. Spelling, punctuation and grammar, and the form and style are of a good standard.

**Band 1 Mark [1]–[2]**

Candidates partially explain how the eye is adapted to provide vision in low light intensities and/or they suggest how the eyes of nocturnal mammals are specialised. Spelling, punctuation and grammar, and the form and style is of a basic standard.

| AVAILABLE MARKS |
|---|
| 6 |
| **18** |
| **100** |

**Section B**

**Total**

Rewarding Learning

**ADVANCED**

**General Certificate of Education**

**2018**

# Biology

## Assessment Unit A2 2

*assessing*

Biochemistry, Genetics and Evolutionary Trends

**[CODE]**

**SPECIMEN**

# MARK SCHEME

/ denotes alternative points
; denotes separate points

AVAILABLE MARKS

## Section A

**1 (a) (i)** Tissue spaces segmented/external segmentation constricted at intervals [1]

**(ii)** Bilateral symmetry is the situation in which one side of the animal is the mirror image of the other side;
diagram is of a longitudinal section/not of transverse section [2]

**(b)** Annelids have a hydrostatic skeleton (fluid-filled tissue spaces);
Chordates have an internal spinal column (of calcified bone) [2] 5

**2 (a)** The patient may overdose/suffer unpleasant side effects/die;
since a large amount of morphine is produced/the blood concentration of morphine becomes dangerously high [2]

**(b)** The patient may get little or no pain relief;
since morphine is produced in small amounts/the blood concentration of morphine does not reach high enough levels to be effective [2] 4

**3 (a)** Any **two** from:
- lack of a cuticle
- rhizoids which do not absorb water
- lack of vascular tissue
- lack of stomata [2]

**(b)** Support achieved by turgor/turgor by explanation;
maintained by control of stomata/cuticle;
and strengthened/woody vascular tissue [3]

**(c)** Seeds are dispersed rather than spores;
seeds are resistant to desiccation

**or**

features enabling adaptation to terrestrial habitats are more highly evolved in flowering plants;
e.g. xerophytic adaptations

**or**

other appropriate description;
with appropriate explanation [2] 7

| | | | | AVAILABLE MARKS |
|---|---|---|---|---|
| **4** | **(a)** | **(i)** | Pyruvate [1] | |
| | | **(ii)** | Cytoplasm [1] | |
| | | **(iii)** | **B**: Krebs cycle<br><br>**C**: Electron transport chain/oxidative phosphorylation [2] | |
| | **(b)** | | Any **two** from:<br>• fatty acids are broken down into 2C lengths<br>• each 2C length forms a molecule of acetyl-CoA<br>• enters Krebs cycle/respires aerobically [2] | |
| | **(c)** | **(i)** | RQ = volume of $CO_2$ produced/volume of $O_2$ used (evidence of correct formula used);<br>woodlice RQ 0.7, soaked peas RQ 1.1 (1.09)<br>**[correct answers for 2 marks]** [2] | |
| | | **(ii)** | The woodlouse is respiring fat/fatty acids [1] | |
| | | **(iii)** | Validity is reduced/negatively affected;<br>since the volume of gas produced may include ammonia, in addition to $CO_2$/an overestimate of $CO_2$ production is made [2] | 11 |
| **5** | **(a)** | **(i)** | Glycerate phosphate/GP [1] | |
| | | **(ii)** | Less carbon dioxide is fixed;<br>less carbohydrate is produced (meeting demands of respiration with little excess)/reduced net production [2] | |
| | **(b)** | **(i)** | Both assimilation rates similar;<br>and any **two** from:<br>• light limiting<br>• RuBP slowly regenerated/GP to TP light limited/lack of ATP/NADPH<br>• higher levels of rubisco in the control plant are of no advantage in these lower light intensities/lack of rubisco has no effect [3] | |
| | | **(ii)** | The reduced rubisco plant has limited amounts of enzyme/ rubisco is the limiting factor/smaller leaves can utilise less light/ take in less carbon dioxide due to reduced stomata;<br>RuBP is rapidly produced at higher light intensities resulting in the higher rate of carbon dioxide assimilation in the control plant [2] | |

AVAILABLE MARKS

**(c) (i)** Any **two** from:
- enzymes are temperature sensitive
- temperature is another independent variable which must be controlled/ensuring a valid experiment design/fair test/ controlled variable
- 25ºC is a near optimal temperature
- high temperature to ensure temperature is not limiting [2]

**(ii)** Any **two** from:
- increased $CO_2$ concentration increases assimilation by both plant types
- at low $CO_2$ concentrations the assimilation of $CO_2$ is the same for both plants
- Reduced rubisco plant will have a lower $CO_2$ assimilation (at higher $CO_2$ concentrations)/or converse [2]

**(iii)** The lack of available enzyme (active sites) is limiting at the higher $CO_2$ levels/smaller leaves with fewer stomata reduce the utilisation of the $CO_2$ [1] 13

**6 (a)** $q^2$ = 4% = 0.04; q=0.2, p=0.8 (**consequential to value for $q^2$ above**) [2]

**(b)** 0.64; 0.32;
(**both consequential to values of p and q above**) [2]

**(c)** 256 (**consequential to value for 2pq**) [1] 5

**7 (a) (i)** bbEE [1]

**(ii)** Epistasis [1]

**(b)** Gamete types shown;
Punnett square to show possible fertilisations;
genotypes correctly shown;
phenotypes correctly shown;
phenotypic ratio correctly shown/9 black, 4 yellow, 3 brown

**BbEe X BbEe**

| **Gametes** | **BE** | **Be** | **bE** | **be** |
|---|---|---|---|---|
| **BE** | **BBEE black** | **BBEe black** | **BbEE black** | **BbEe black** |
| **Be** | **BBEe black** | **BBee yellow** | **BbEE black** | **Bbee yellow** |
| **bE** | **BbEE black** | **BbEe black** | **bbEE brown** | **bbEe brown** |
| **be** | **BbEe black** | **Bbee yellow** | **bbEe brown** | **bbee yellow** |

[5]

| | | | AVAILABLE MARKS |
|---|---|---|---|
| **(c)** | **(i)** | Yellow male genotype ee; prevents the black or brown expression;<br>Black female genotype Ee; heterozygous as there are yellow pups there must have been ova carrying the e allele [4] | |
| | **(ii)** | Any **two** from:<br>• to produce brown pups both parents would need to be heterozygous<br>• if both parents heterozygous there is a low probability of brown pups, not achieved in a small sample/small sample size so brown was not produced<br>• no brown pups if one parent is BB (irrespective of other parent)<br>• so all pups inherit a B allele (and so black) [2] | 13 |
| **8** | **(a)** | Transcription;<br>Any **three** from:<br>• hydrogen bonds between base pairs in DNA are broken<br>• complementary ribonucleotides pair with exposed bases on DNA<br>• base pairing rule, including U on RNA pairing with T on DNA<br>• RNA polymerase catalyses the formation of bonds between adjacent ribonucleotides<br>• only exons sequences appear in the final mRNA molecule [4] | |
| | **(b)** | Methylation/histone modification [1] | |
| | **(c)** | **(i)** Reverse transcriptase [1] | |
| | | **(ii)** A single stranded length of DNA;<br>of known base sequence [2] | |
| | | **(iii)** A cDNA from a normal cell;<br>hybridises to a complementary probe in the spot [2] | |
| | | **(iv)** Green [1] | |
| | | **(v)** A stronger signal indicates more molecules of cDNA have bound to probe;<br>resulting from a large number of mRNA molecules initially in the cell [2] | 13 |

| | | | | AVAILABLE MARKS |
|---|---|---|---|---|
| 9 | (a) | (i) | No correlation between mean leaf length and soil nitrate level;<br>positive correlation between mean leaf width and soil nitrate level [2] | |
| | | (ii) | Leaf width was different in the experimental garden where nitrate levels were the same;<br>experimental garden values mirror natural habitat where nitrate levels were different [2] | |
| | (b) | (i) | Any **five** from:<br>• Ballinderry and Marble Arch populations geographically isolated/populations restricted to damper sites/allopatric speciation may take place<br>• aided by poor seed dispersal<br>• little gene flow between populations<br>• leaf width has strong genetic component/gene (for leaf width) passed on<br>• (ancestral) population was genetically viable<br>• new allelles introduced by mutation<br>• differential/directional selection operate/allele frequency changes<br>• narrow leaf width favoured where the are low soil nitrate levels (as in Marble Arch)<br>• wide leaf favoured where there are high soil nitrate levels (as in Ballinderry) [5] | |
| | | (ii) | Plants from two sites crossed;<br>if fertile offspring produced still same species/if not possibly different species [2] | 11 |
| | | | **Section A** | **82** |

## Section B

AVAILABLE MARKS

**10 (a) Indicative content:**

- in glycolysis, 4 ATP are produced directly/there is a net yield of 2 ATP
- in the Krebs cycle, 1 ATP is produced directly/in substrate phosphorylation
- dehydrogenation in glycolysis/Krebs cycle
- results in the production of NADH and $FADH_2$/reduced NAD and FAD
- which carry the hydrogens to the ETC
- where they pass down a series of carriers at progressively lower energy levels
- the hydrogens subsequently split into $H^+$ ions (protons) and electrons
- the electrons pass along the cytochromes
- (at certain stages sufficient) energy is released to create an ATP molecule
- NADH yields 3 ATPs while $FADH_2$ only yields 2 ATPs

**Band 3 Mark [5]–[6]**

Candidates use the most appropriate specialist terms to fully describe the synthesis of ATP in respiration using a minimum of seven points of indicative content. Spelling, punctuation and grammar, and the form and style are of a high standard.

**Band 2 Mark [3]–[4]**

Candidates sometimes use the appropriate specialist terms to describe the synthesis of ATP in respiration using a minimum of four points of indicative content. Spelling, punctuation and grammar, and the form and style are of a good standard.

**Band 1 Mark [1]–[2]**

Candidates partially describe the synthesis of ATP in respiration. Spelling, punctuation and grammar, and the form and style is of a basic standard.

6

**(b) Indicative content:**

Similarities

- both processes involve an ETC (containing cytochromes)/use of electrons
- which are arranged in sequence in a (intracellular) membrane/carriers at progressively lower energy levels
- carriers are successively oxidised and reduced/involve redox reactions
- phosphorylation is associated with electron transfer

Differences

- membranes are thylakoids (in chloroplasts) for photosynthesis and the cristae (of mitochondria) for respiration [both needed]
- in respiration the starting point is the delivery of hydrogen atoms to the ETC/chemical energy of glucose
- so that ATP production is described as oxidative phosphorylation
- in photosynthesis the starting point involves light energy
- hence ATP production is described as photophosphorylation
- different hydrogen carriers used/NADP in photophosphorylation, while NAD and FAD in respiration
- terminal electron acceptors different/terminal acceptor is $O_2$ in respiration, NADP in photosynthesis

**Band 3 Mark [9]–[12]**

Candidates use the most appropriate specialist terms to fully discuss the similarities and differences between photosynthesis and respiration using a minimum of eight points of indicative content. Spelling, punctuation and grammar, and the form and style are of a high standard.

**Band 2 Mark [5]–[8]**

Candidates sometimes use appropriate specialist terms to discuss the similarities and differences between photosynthesis and respiration using a minimum of four points of indicative content. Spelling, punctuation and grammar, and the form and style are of a good standard.

**Band 1 Mark [1]–[4]**

Candidates partially discuss the similarities and/or differences between photosynthesis and respiration. Spelling, punctuation and grammar, and the form and style is of a basic standard.

| AVAILABLE MARKS |
|---|
| 12 |
| **18** |
| **100** |

**Section B**

**Total**

Rewarding Learning

**ADVANCED**

**General Certificate of Education**

**2018**

# Biology

Assessment Unit A2 3

*assessing*

Practical Skills in Biology

**[CODE]**

**SPECIMEN**

# MARK SCHEME

/ denotes alternative points
; denotes separate points

AVAILABLE MARKS

**1** **(a)** Any **five** from:
- stop chromatogram run before solvent reaches top
- draw line marking solvent front (before solvent is dry)
- calculate value from baseline to solvent front (Y)
- use mid-line or front of each pigment (for consistency)
- measure from baseline to each pigment (X) and from baseline to the solvent front (Y)
- Rf value is X/Y [5]

**(b)** Any **two** from:
- solvent front not accurately marked
- difficulties in identifying centre/leading edge of pigment position
- different chromatography paper
- (slightly) different solvent strengths
- other appropriate response [2] 7

**2** **(a)** **(i)** Any **four** from:
- sterilise loop/use sterilised disposable loop
- open culture bottle (tube A) and hold at angle/keep lid off bench
- use loop to scrape bacteria from surface of slope in culture bottle
- once loop removed, replace lip of culture bottle immediately/flame lid
- partially open Petri dish and spread bacteria over agar
- replace lid immediately and tape closed
- sterilise loop (again) or safe disposal [4]

**(ii)** To avoid culturing pathogens (that thrive in higher temperatures) [1]

**(b)** **(i)** Antibiotic B kills bacteria in area surrounding it;
antibiotic A has no effect;
*E. Coli*/bacteria is resistant to A [3]

**(ii)** Carry out investigation at different temperatures/use different strengths of antibiotic/other appropriate response [1] 9

AVAILABLE MARKS

**3** **(a)** **(i)** Volume = (0.04 × 0.1) = 0.004 $mm^3$;
16 ÷ 0.004/16 × 250 = 4000 cells $mm^{-3}$ [2]

**(ii)** Any **two** from:
- flask not mixed before sampling
- samples not obtained from the same depth
- clumping of cells
- haemocytometer grid not totally filled/overfilled [2]

**(iii)** Dead yeast cells were counted/other appropriate suggestion [1]

**(b)** (Serial) dilution (or explained);
when calculating numbers need to multiply by dilution factor [2] 7

**4** **(a)** Maximise quantity of electrons produced/chloroplasts are the organelles of the light-dependent stage which generates electrons/ homogenised tissue will also contain mitochondria which will produce hydrogen (from dehydrogenase activity in respiration) [1]

**(b)** Chloroplasts contain photosystems/photosynthetic pigments;
which absorb light and become excited;
so that electrons are emitted (from primary pigments) to reduce the DCPIP

**Or**

The result in Tube A (when compared to Tube B) indicates that reduction of DCPIP requires the presence of chloroplasts/chlorophyll;
the result in Tube C (when compared to Tube B) indicates that reduction of DCPIP only occurs (with chloroplasts) in the light;
reduction of DCPIP occurs in Tube B as light causes the emission of electrons from the pigment molecules/chlorophyll/photosystems in the chloroplasts [3] 4

**5** **(a)** **(i)** A – mitochondrion
B – synaptic vesicle [2]

**(ii)** Consequence of the angle of sectioning/axons in different plane/section only through synapse [*do not allow axons in TS*] [1]

**(b)** **(i)** Stained/*very* thin section produced/other appropriate response [1]

**(ii)** Detail of ultrastructure shown or by example, e.g. synaptic vesicles, mitochondrial cristae [1] 5

| | | AVAILABLE MARKS |
|---|---|---|
| **6** | Any **five** from:<br>• respirometer used separately with KOH and without KOH/with water<br>• cover with foil to prevent photosynthesis/carry out in darkness<br>• use a water bath to keep respirometer at same temperature<br>• use same peas as different peas have different metabolic rates/ masses/stages of germination<br>• measure the movement of the coloured bead per unit time<br>• with KOH, oxygen uptake indicated by the bead moving in<br>• with water, the bead moving out indicates that more carbon dioxide is produced than oxygen used/no bead movement indicates $CO_2$ production = $O_2$ uptake/bead moving inwards indicates $O_2$ uptake exceeds $CO_2$ production<br>• anaerobic respiration identified by greater $CO_2$ production than $O_2$ uptake/bead moving away from respirometer/RQ value greater than 1 [5] | 5 |
| **7** | Any **four** from:<br>• modified quadrat (e.g. 10 cm × 10 cm)<br>• select number of trees to be sampled (e.g. 20 of each species)<br>• select number of quadrats to be used per tree<br>• control area/part of tree to be sampled (e.g. ground – 2 metre height)<br>• explanation of how random sampling achieved<br>• use % cover (or density if justified) [4] | 4 |
| **8 (a) (i)** | Prevent tearing/reduce friction/to trap section/keep cells in cut section moist [1] | |
| **(ii)** | Increase contrast between different structures/some structures, e.g. nucleus will be seen more clearly [1] | |
| **(b) (i)** | Any **two** from:<br>• grass was unevenly sectioned<br>• green cells were palisade/spongy mesophyll cells present (as this part was too thick)<br>• colourless when only upper epidermis (as few chloroplasts present) [2] | |
| **(ii)** | Closed due to water stress [1] | |
| **(iii)** | Stage micrometer and graticule [1] | 6 |
| **9 (a)** | Petri dish with well containing (cooled boiled) water [1] | |
| **(b) (i)** | Tabulated t value, at p = 0.05 and d.f. = 9, is 2.262;<br>95% confidence limits = 53 (mean) ±2.262 × 0.442 (0.99/1) **[consequential to t-value used]**;<br>upper limit = 54 and lower limit = 52 **[consequent to value above]**; [3] | |
| **(ii)** | 95% limits added accurately **[consequent to (i)]** [1] | |

| | | | | AVAILABLE MARKS |
|---|---|---|---|---|
| | | **(iii)** | Null hypothesis rejected;<br>*A. nemorosa* significantly different from other plant extracts/95% confidence limits of *A. nemorosa* do not overlap with other plant extracts<br>**[consequent to values calculated in (i) and/or displayed in (ii)]** [2] | 7 |
| **10** | **(a)** | **(i)** | Curing dysfunction – curing genetic disease/conditions;<br>Enhancing function – making improvements above and beyond what is normal/'designer babies' [2] | |
| | | **(ii)** | That medicine will go beyond the curing of genetic disease/conditions and influence characteristics in otherwise normal children, e.g. intelligence [1] | |
| | **(b)** | | Any appropriate format/style that is consistent in all three references [3 marks]; one mistake [2 marks] and two mistakes [1 mark]<br>e.g.<br>Harris J. Enhancing Evolution – The Ethical Case for Making Better People, Princetown University Press, 2007.<br>Potter, S. Designer Genes – A New Era in the Evolution of Man, Random House, 2010.<br>Sandel M.J. The Case Against Perfection, Belknap Press of Harvard University Press, 2007. [3] | 6 |
| | | | **Total** | **60** |

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