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Centre Number

Candidate Number

ADVANCED
General Certificate of Education
2018

Biology

Assessment Unit A2 1
assessing

Physiology and Ecosystems

[AB211]

AB211

THURSDAY 7 JUNE, MORNING

TIME

2 hours.

INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.
You must answer the questions in the spaces provided.
Do not write outside the boxed area on each page or on blank pages.
Complete in black ink only. **Do not write with a gel pen.**
Answer **all nine** questions.

INFORMATION FOR CANDIDATES

The total mark for this paper is 90.
Section A carries 72 marks. Section B carries 18 marks.
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.
You are reminded of the need for good English and clear presentation in your answers.
Use accurate scientific terminology in all answers.
You should spend approximately **25 minutes** on Section B.
You are expected to answer Section B in continuous prose.
Quality of written communication will be assessed in Section B, and awarded a maximum of 2 marks.

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Section A

1 In many plants, flowering is controlled by day length. This is known as photoperiodism.
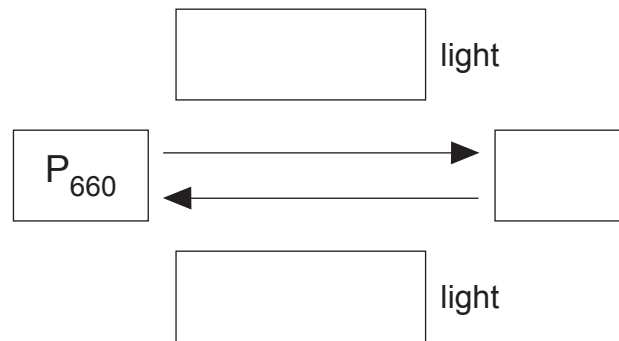
(a) Name the light-sensitive pigment involved in photoperiodism.

_____ [1]

(b) State the location of this light-sensitive pigment in the plant.
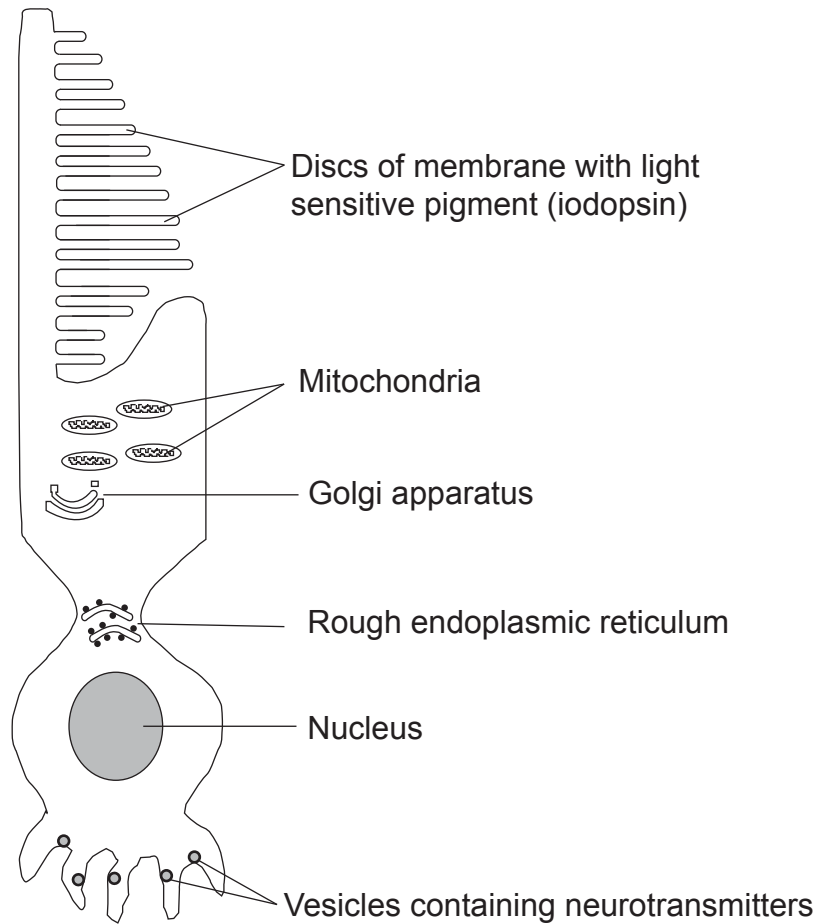
_____ [1]

(c) Complete the diagram using the most appropriate words or terms.

```
        ┌──────────────┐
        │              │   light
        └──────────────┘

┌────────┐                    ┌──────────┐
│ P_660  │ ─────────────────▶ │          │
│        │ ◀───────────────── │          │
└────────┘                    └──────────┘

        ┌──────────────┐
        │              │   light
        └──────────────┘
```

[3]

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2 A typical cone cell from the retina of a mammalian eye is shown in the diagram below.

Discs of membrane with light sensitive pigment (iodopsin)

Mitochondria

Golgi apparatus

Rough endoplasmic reticulum

Nucleus

Vesicles containing neurotransmitters

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(a) Identify the structure labelled in the diagram which:

1. synthesises protein _____

2. modifies protein _____ [1]

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(b) With reference to the diagram, suggest and explain how the cell is adapted for its function.

_____

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_____ [3]

[Turn over

36AB21105

3 Within an ecosystem, certain populations are r-selected, while others are K-selected.

(a) Define the term population.

_____

_____

_____ [1]

An algal population in a pond is an example of an r-selected population.

(b) On the axes below, sketch an appropriate growth curve for an algal population in a pond from April to December. The population from January to March has been completed for you.

Jan   Feb   Mar   Apr   May   Jun   Jul   Aug   Sept   Oct   Nov   Dec

Time/Month

[1]

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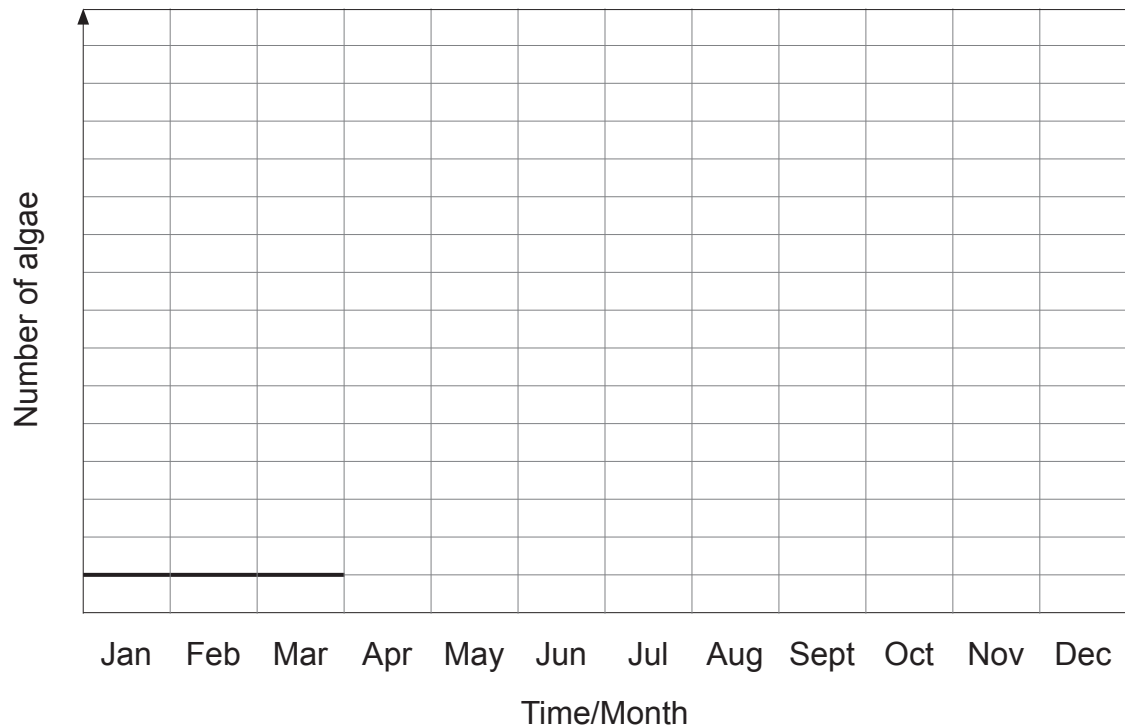
(c) List **three** characteristics of r-selected species.

1. _____

_____

2. _____

_____

3. _____

_____ [3]

36AB21107

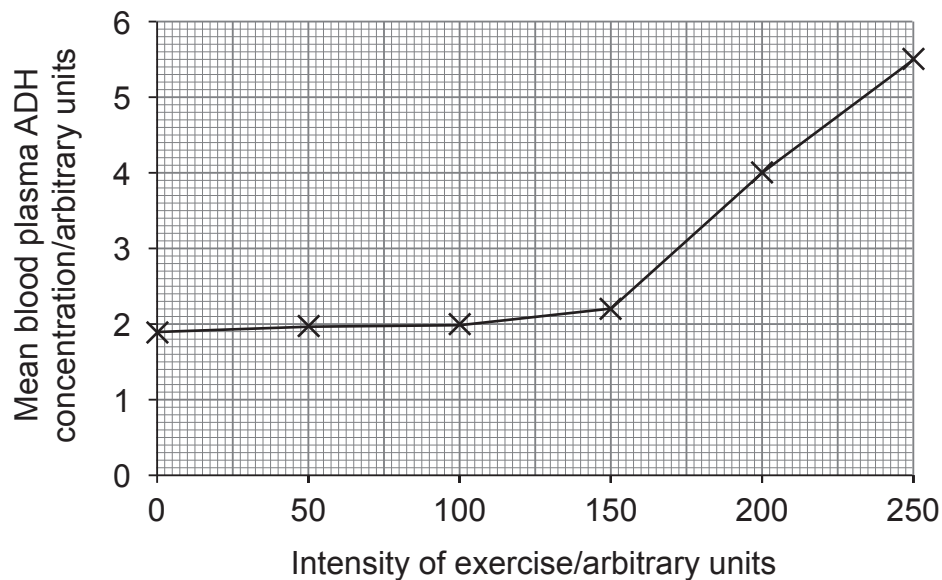**4** Antidiuretic hormone (ADH) has a role in osmoregulation of the blood.

(a) (i) State the precise location of osmoreceptor cells in the brain.

_____ [1]

(ii) State precisely where ADH is released into the blood stream.

_____ [1]

The effect of intensity of exercise on the concentration of ADH in blood plasma was investigated in a group of students. They carried out exercises of different intensities for the same length of time, and the ADH concentration in each student was measured one hour after the exercise. The results of the investigation are summarised in the graph below.

(b) (i) Identify one **other** controlled variable appropriate for this investigation.

_____

_____ [1]

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(ii) Describe and explain the trend shown and the consequence of this on kidney function.

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_____ [4]

36AB21109

5 The energy flow through a cow is summarised in the diagram below.
All values are given in kJ year $^{-1}$.

Respiration (**R**)
34.68×10^6

Consumed (**C**)
91.78×10^6

Production (**P**)

Faeces (**F**)
54.39×10^6

Urine (**U**)
0.08×10^6

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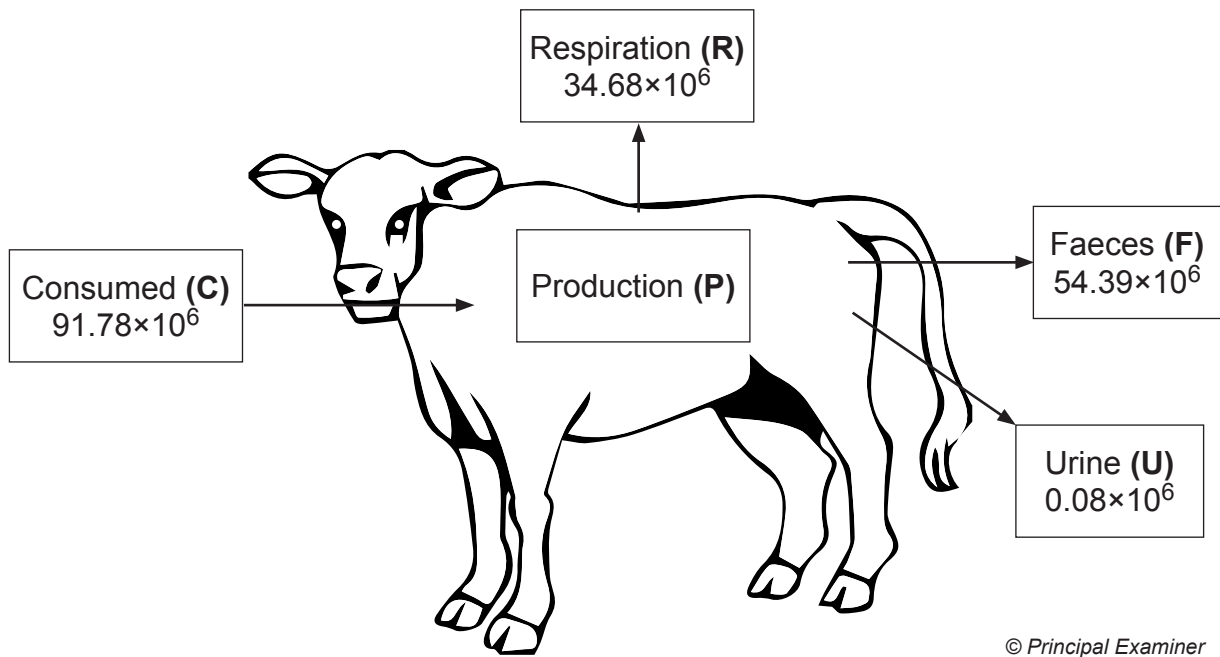
(a) (i) Using the letters shown (**C**, **F**, **R** and **U**) write a formula which will allow
production (**P**) to be calculated.

P = _____ [1]

(ii) Calculate the value for production (**P**).

_____ $\times 10^6$ kJ year $^{-1}$ [1]

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(iii) The productivity of grass is $22\,275$ kJ m^{-2} year^{-1}. A different cow feeding on 9500 m^2 of grassland has a production of 1.6×10^6 kJ year^{-1}.

Calculate the percentage of the energy in the grass that is used in production in this cow.
(Show your working.)

_____% [2]

[Turn over

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(b) In an investigation, the same type of crop was grown in two adjoining fields, **A** and **B**.
Each field was sub-divided into six plots of one hectare (ha) each. A different mass of fertiliser was added to each plot.

After six weeks, samples of crop plants from each plot were collected and their mass in kilograms (kg) was measured. The results are shown in the table below.

Plot	Mass of fertiliser added to plot/kg ha^{-1}	Mass of crop/kg m^{-2}	
		Field A	**Field B**
1	0	14.2	6.2
2	10	16.6	9.7
3	20	17.3	13.1
4	30	17.5	16.2
5	40	17.5	17.1
6	50	17.5	17.1

(i) Explain the change in the mass of crop produced in field **B** when the mass of fertiliser added increased from 0 to 20 kg ha^{-1}.

_____

_____

_____

_____ [2]

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(ii) During the previous year, field **A** had been used for grazing cattle. Field **B** had been used to grow the same type of crop in each year. The table shows that when no fertiliser was added, the mass of crop from field **A** was higher than from field **B**. Suggest an explanation for this difference.

_____

_____

_____

_____

_____

_____ [2]

(iii) State **one** advantage and **one** disadvantage of using artificial (inorganic) fertiliser on a field.

Advantage: _____

_____

Disadvantage: _____

_____ [2]

[Turn over

6 Coppicing is a technique used in the maintenance of woodlands. It involves cutting down some trees to leave stumps. New shoots then grow from the stumps. After a number of years, these trees can be coppiced again.

Ecologists investigated the effect of coppicing on the growth of wild daffodils in a woodland in County Armagh. Some areas of the woodland were coppiced and some were not. The graph shows results from this investigation.
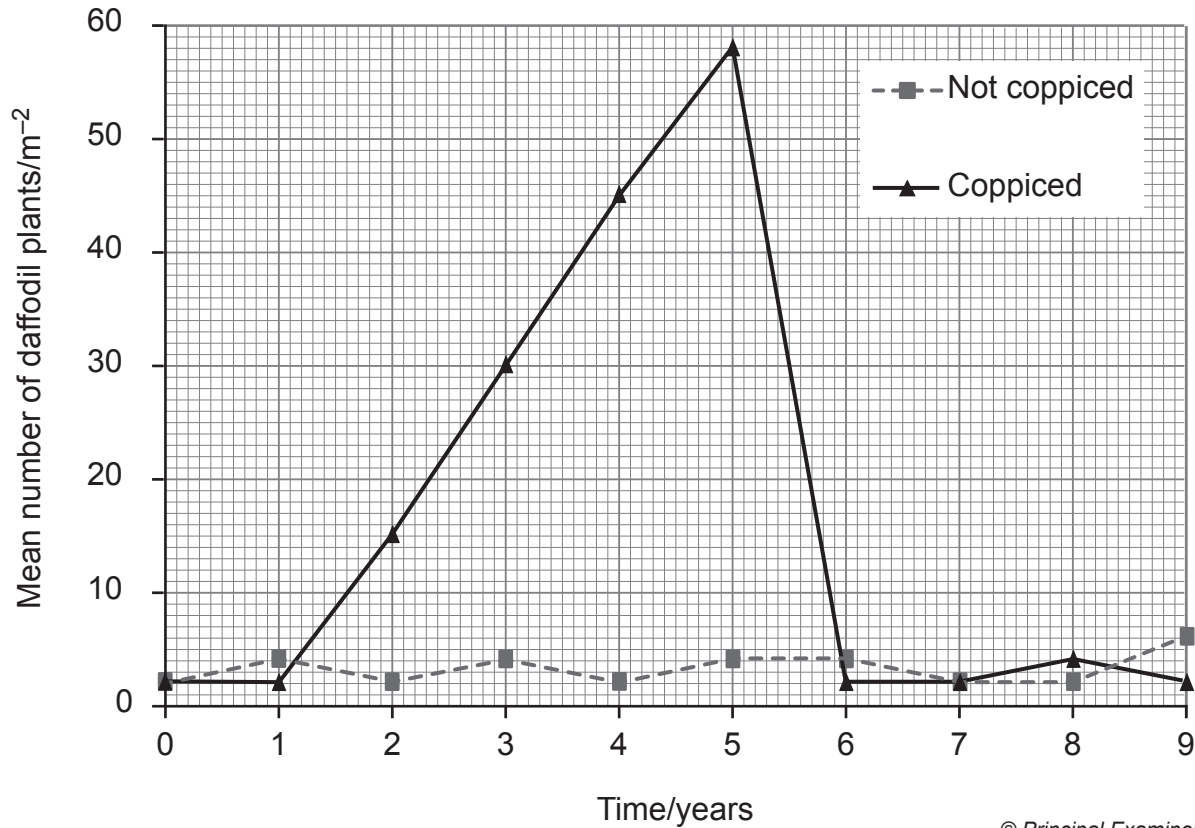
© Principal Examiner

(a) (i) A suitable method for sampling the woodland involves using quadrats. Describe how you would place the quadrats randomly to ensure the results obtained are not biased.

_____

_____

_____

_____

_____

_____ [2]

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(ii) Explain fully why it is important to carry out many replicates when collecting the data.

_____

_____

_____

_____

_____

_____ [2]

(b) (i) Many visitors come to the woodland every year to see the daffodils and other wildflowers. Explain how the information in the graph could help the owners to manage the woodland so there are many daffodils in flower every year.

_____

_____

_____

_____

_____

_____ [2]

[Turn over

36AB21115

Coppicing can result in areas with increased biodiversity in the woodland.

(ii) Explain how coppicing would encourage greater biodiversity in the woodland.

_____

_____

_____

_____

_____

_____ [2]

Wood mice (*Apodemus sylvaticus*) were present in the woodland. To estimate the size of the wood mouse population, a mark/recapture technique was used.

An initial sample of 25 mice was taken, marked and released. The recapture sample contained 18 mice, 3 of which were marked.

(c) (i) Calculate the estimated wood mouse population size in the woodland. (Show your working.)

_____ [2]

(ii) State **three** assumptions that are made when estimating the size of the wood mouse population using a mark/recapture technique.

1. _____

_____

2. _____

_____

3. _____

_____ [3]

[Turn over

11431

36AB21117

7 Synapses allow coordination and integration in the nervous system. The diagram below shows how two neurones, **A** and **B**, synapse with a third neurone, **C**.

Neurone **A** releases the neurotransmitter acetylcholine and is excitatory. Neurone **B** releases a different neurotransmitter called GABA (gamma-aminobutyric acid) and is inhibitory. Neurone **C** is the post-synaptic neurone. Binding of GABA results in the movement of negative ions into the post-synaptic neurone.
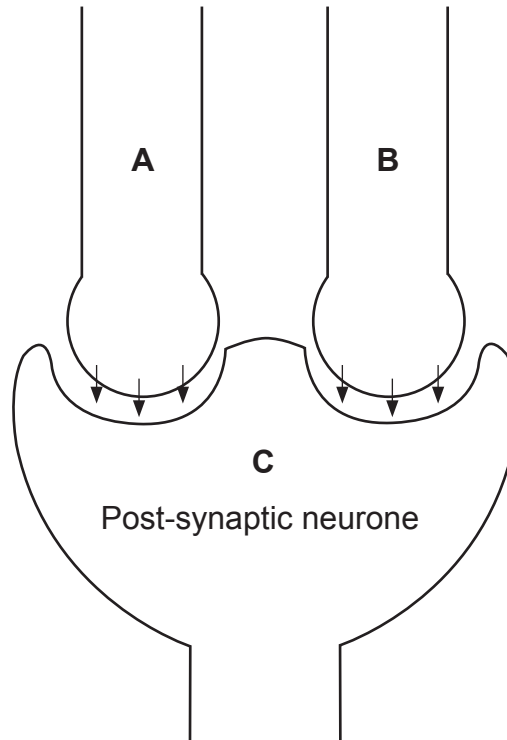
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(a) (i) Explain how the release of acetylcholine from neurone **A** causes an excitatory post-synaptic potential (EPSP) in the post-synaptic neurone **C**.

_____

_____

_____

_____

_____

_____ [2]

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(ii) Suggest why the arrival of an impulse in neurone **B** reduces the possibility of an EPSP forming in the post-synaptic neurone.

_____

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_____

_____

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_____ [2]

(iii) The enzyme acetylcholinesterase acts in the synaptic cleft. Explain the role of this enzyme.

_____

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_____

_____ [2]

36AB21119

DFP is a pesticide which interacts with the active site of acetylcholinesterase. It is a neurotoxin, causing paralysis and resulting in the death of an insect pest.

(b) (i) Suggest how DFP affects the post-synaptic neurone of an insect.

_____

_____

_____

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_____ [2]

DFP has been useful in controlling insect pest populations in the past. However, some populations now appear to have become resistant to DFP.

(ii) Explain how a population may become resistant to a pesticide such as DFP.

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_____ [2]

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36AB21121

8 Young rabbits often die of a disease called rabbit haemorrhagic disease (RHD), caused by a virus. To learn more about this disease, young mice were used as models. Scientists investigated the survival rates of young mice following infection with the virus at different ages. The results are shown in the graph below.

(a) (i) Given that young mice feed on milk produced by their mother, suggest a possible explanation for the high survival rates of mice infected during the three weeks following birth.

_____

_____ [1]

(ii) Suggest a reason why mice were used as disease models for this investigation.

_____

_____

_____ [1]

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36AB21122

(b) The virus can enter the cells in the respiratory and digestive tracts, using a molecule found in the plasma (cell surface) membrane of these cells. The virus binds to this molecule and then enters the host cell. Production of this molecule increases with age.

Most damage associated with RHD occurs to the cells of the liver. Liver cells do not have this molecule on their plasma membrane.

Using the information provided:

(i) Suggest **another** possible reason for the high survival rate of mice infected during the three weeks following birth.

_____

_____

_____

_____

_____ [2]

(ii) Explain why there is thought to be more than one mechanism by which the virus can enter a cell.

_____

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[Turn over

A test for RHD virus in rabbits detects the presence of RHD antibodies in the blood serum of infected rabbits. The technique is summarised below.
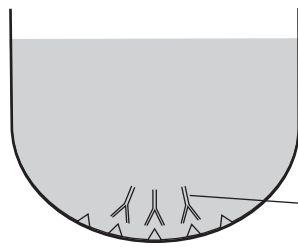
Step 1
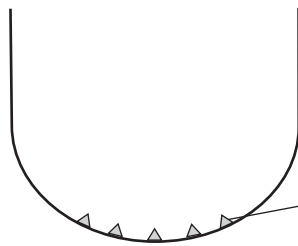
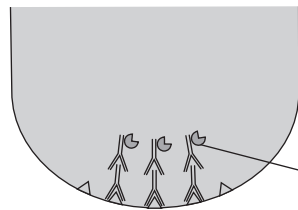Antigens are attached to the wall of a well (a small chamber)

antigen

Step 2

Serum from a rabbit is added. If the serum contains RHD antibodies these will bind to the antigens
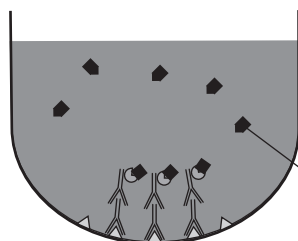
antibody

Step 3

A second antibody (with attached enzyme) is added and binds to the original RHD antibodies. The enzyme is only activated if the second antibodies are attached to RHD antibodies

antibody with attached enzyme

Step 4

A substrate is added which binds to activated enzymes and a coloured product is released

substrate

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(c) (i) Define the term antigen.

_____

_____ [1]

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(ii) Describe and explain the result you would expect if the rabbit was **not** infected by the RHD virus.

_____

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_____ [3]

It is sometimes necessary to carry out a dilution of the serum sample using a buffer.

(iii) Calculate the volume of undiluted serum in µl (1000 µl = 1 ml), which must be added to a buffer to give 10 ml of solution at a final dilution of 1/500. (Show your working.)

_____ µl [2]

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(iv) Describe an immune response that may occur in rabbits infected with RHD virus.

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_____ [4]

In some countries rabbit farming is an important activity, providing a source of meat and fur products.

(d) Suggest and explain a possible way to protect rabbits from this potentially fatal disease.

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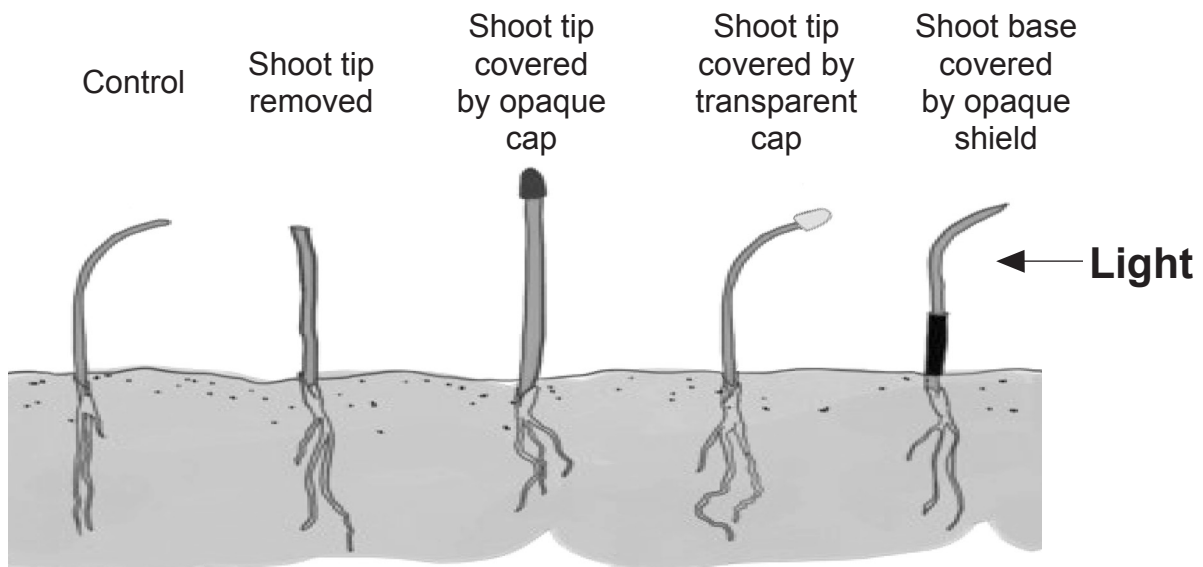
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Section B

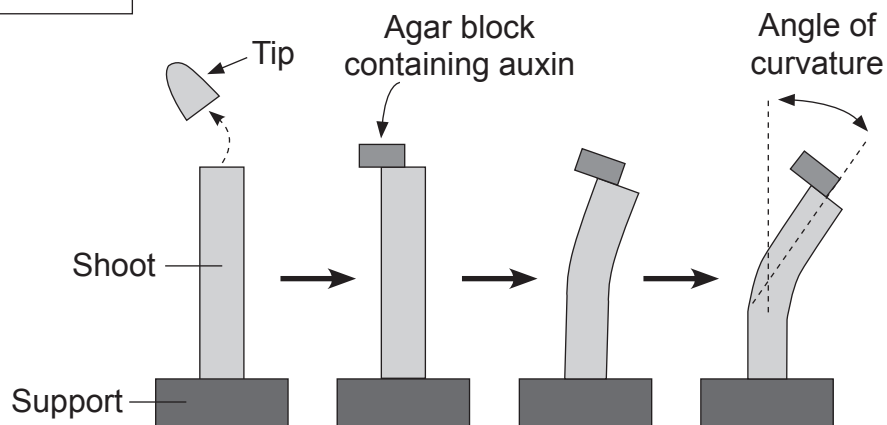*Quality of written communication is awarded a maximum of 2 marks in this section.*

9 In plants, phototropism is a growth response to light. Early studies of phototropism were carried out by Darwin and others. The experimental work and observations of Darwin are summarised in diagram **A** below.

A Darwin

Control | Shoot tip removed | Shoot tip covered by opaque cap | Shoot tip covered by transparent cap | Shoot base covered by opaque shield

Light

Subsequent work carried out by Went is summarised in diagram **B** below.

B Went

Tip

Agar block containing auxin

Angle of curvature

Shoot

Support

This experiment was carried out in darkness

© Biology for CCEA A2 Level by James Napier. (ISBN: 978-1780730103) Published by Colourpoint Books, 2013

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(a) Describe and explain the results obtained by Darwin and their significance to our understanding of phototropism. [9]

(b) Went investigated the effect of auxin concentration on the angle of curvature of the shoot. With a supply of fresh shoot tips, suggest how he could have obtained agar blocks containing different concentrations of auxin. Suggest **two** controlled variables in his investigation. [7]

Quality of written communication [2]

_____

(a) Describe and explain the results obtained by Darwin and their significance to our understanding of phototropism.

_____

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(b) Went investigated the effect of auxin concentration on the angle of curvature of the shoot. With a supply of fresh shoot tips, suggest how he could have obtained agar blocks containing different concentrations of auxin. Suggest **two** controlled variables in his investigation.

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