New Specification

Rewarding Learning

ADVANCED
General Certificate of Education
2018

Centre Number

Candidate Number

Biology

Assessment Unit A2 1

assessing

Physiology, Coordination and Control, and Ecosystems

[ABY11]

ABY11

THURSDAY 7 JUNE, MORNING

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.
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 100.
Section A carries 82 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 expected to answer Section B in continuous prose.
Quality of written communication will be assessed in Section B (Question 9).

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Section A

1 In many plants, flowering is controlled by day length. This is known as photoperiodism.

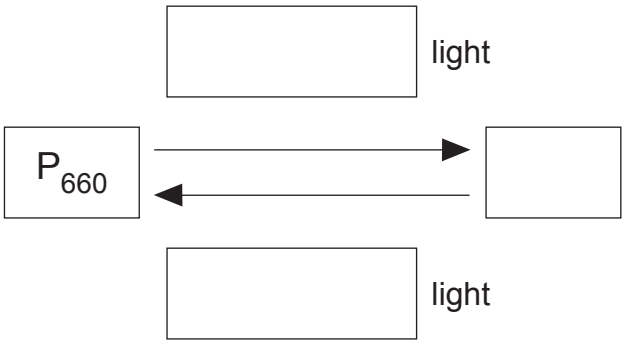
(a) Name the light-sensitive pigment involved in photoperiodism.

_____ [1]

(b) State the location of this light-sensitive pigment in the plant.

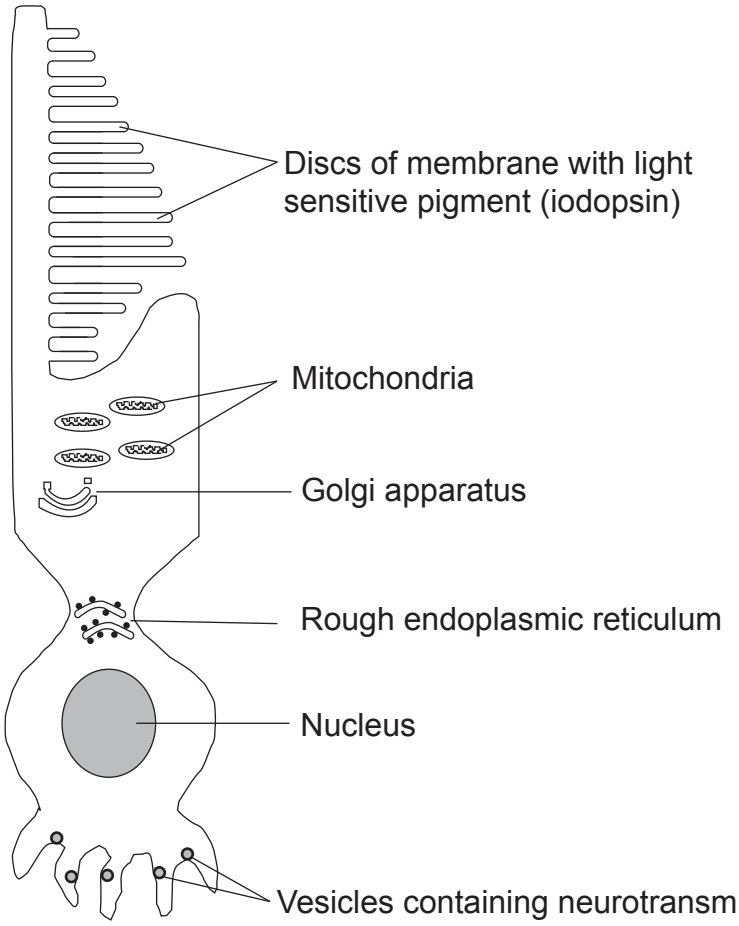
_____ [1]

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



[3]

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



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

1. synthesises protein _____

2. modifies protein _____ [1]

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

_____

_____

_____

_____

_____

_____

_____

_____

_____ [3]

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

(a) Define the term population.

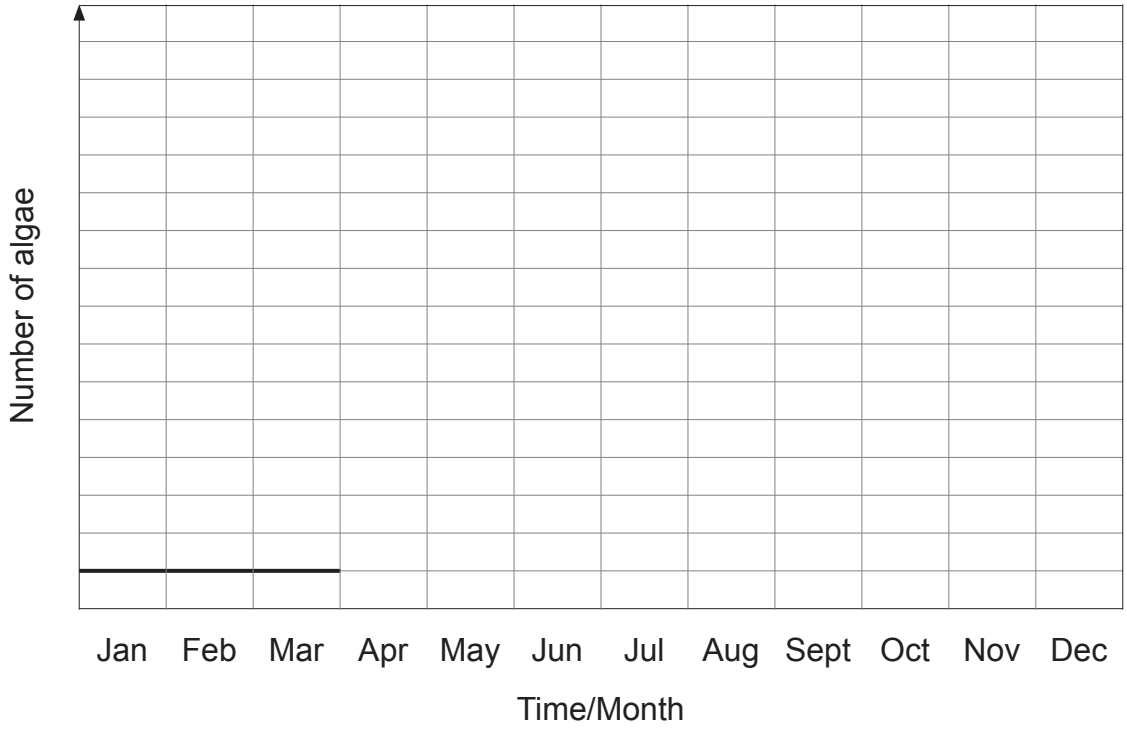
_____

_____

_____ [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.



[1]

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

1. _____

_____

2. _____

_____

3. _____

_____ [3]

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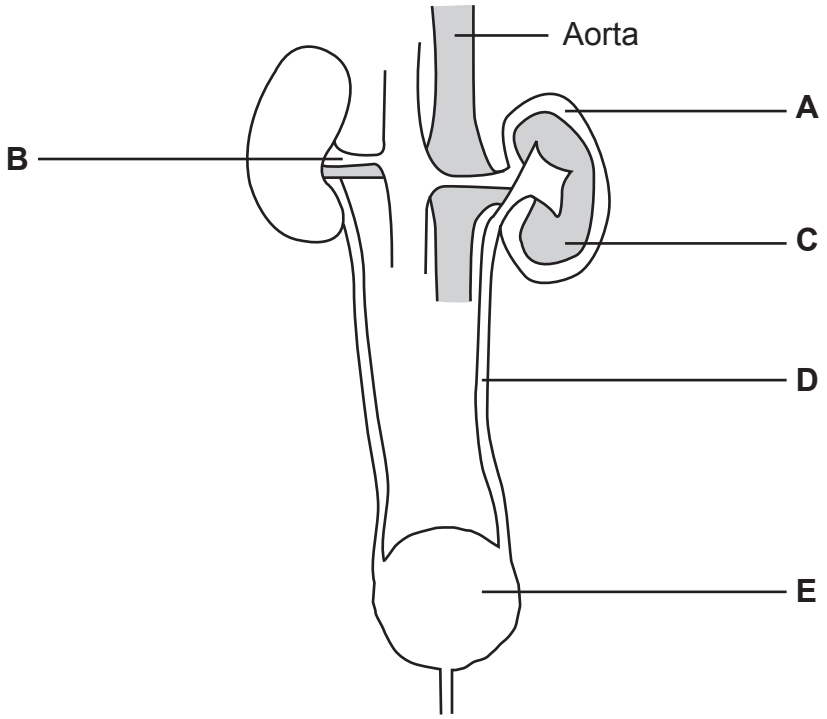
4 The human urinary system is shown in the diagram below. One of the kidneys shown is dissected.



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(a) Identify **A–E**

A _____

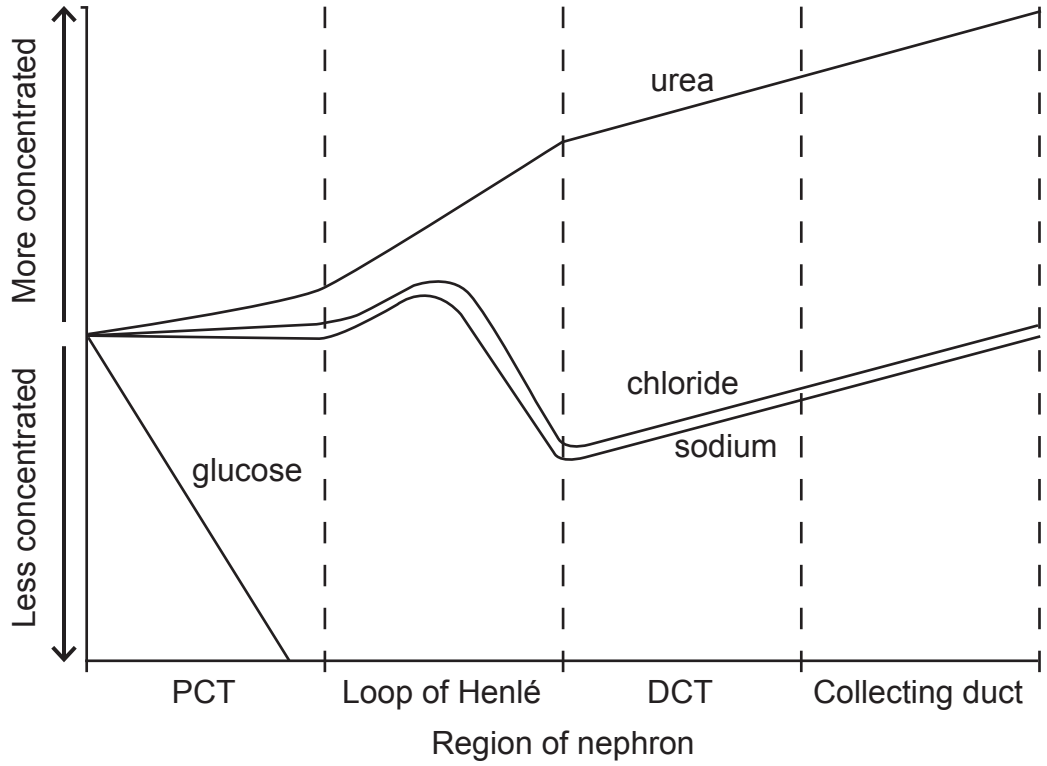
B _____

C _____

D _____

E _____ [3]

(b) The concentrations of four substances in different regions of the nephron were measured. Their concentration compared to that in the glomerular filtrate was then calculated. The results are shown in the graph below.



(i) Describe and explain the trend shown for glucose in the proximal convoluted tubule (PCT).

_____

_____

_____

_____

_____ [2]

(ii) Explain the changes in the concentrations of ions (sodium and chloride) along the loop of Henlé.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____ [4]

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

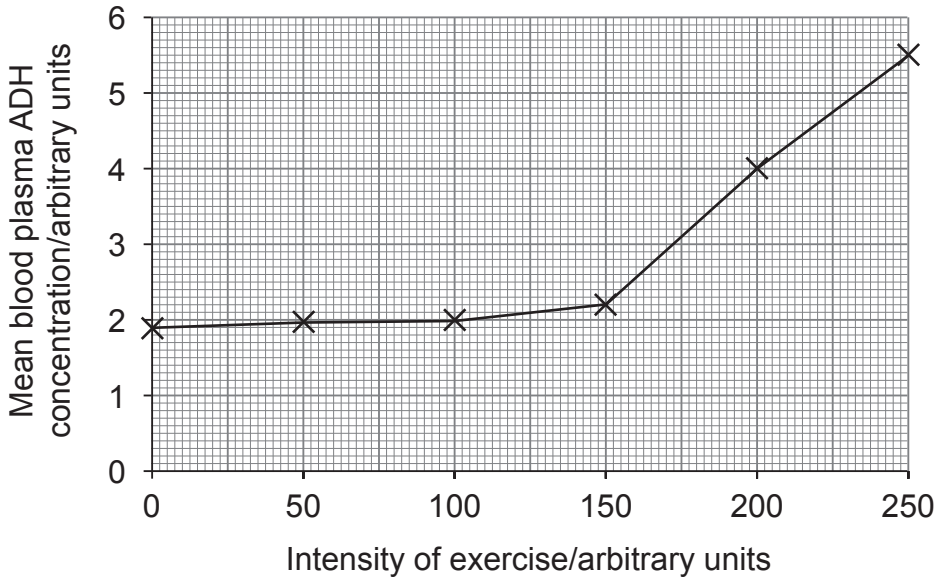
(c) **(i)** State the precise location of osmoreceptor cells in the brain.

_____ [1]

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

_____ [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.



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

_____

_____ [1]

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

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

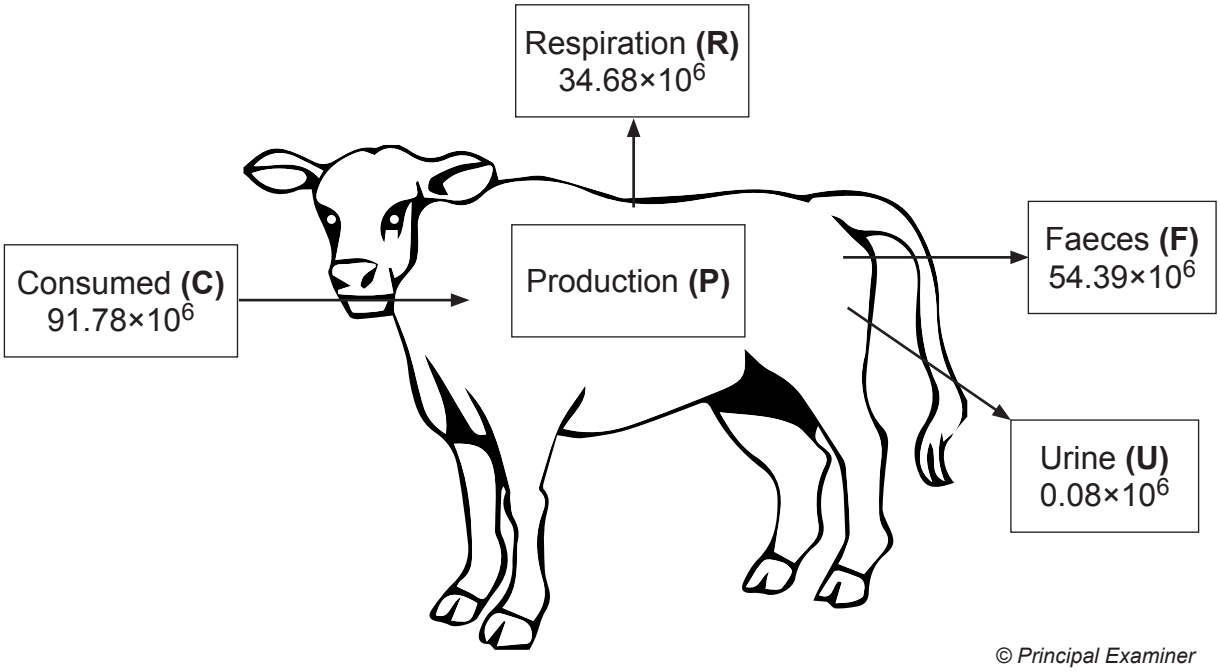
_____

_____

_____

_____ [4]

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



(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]

(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

(b) In an investigation, the same type of crop was grown in two adjoining fields, **A** and **B**. Each field was subdivided 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]

(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]

6 MRSA is a strain of the bacterium *Staphylococcus aureus* and is resistant to the antibiotic methicillin.

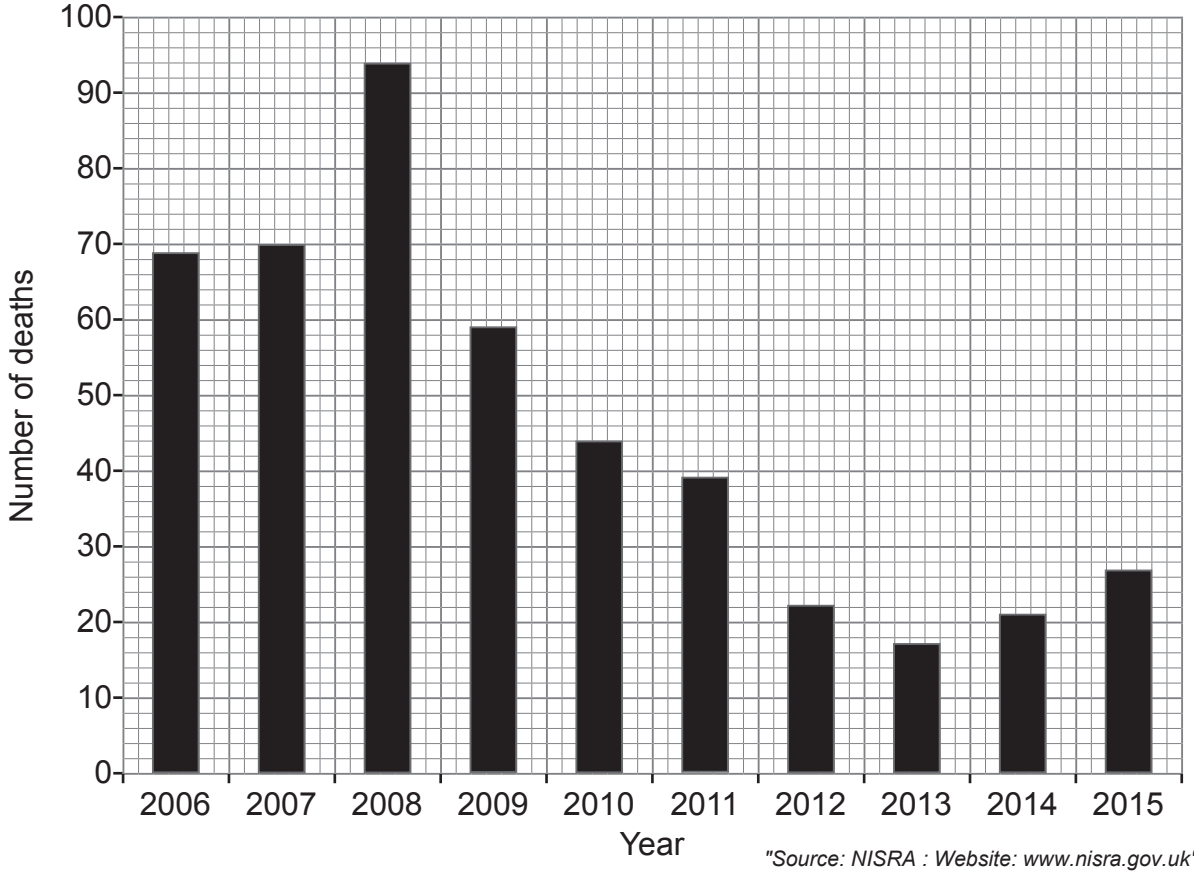
(a) **(i)** State the kingdom to which bacteria belong.

_____ [1]

(ii) Genes for antibiotic resistance are commonly found within structures outside the main bacterial chromosome. Name these structures.

_____ [1]

The number of deaths involving MRSA in Northern Ireland during the period 2006 to 2015 is shown in the graph below.



"Source: NISRA : Website: www.nisra.gov.uk"
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(b) Describe and suggest reasons for the trends shown from 2008 to 2015.

_____

_____

_____

_____

_____

_____

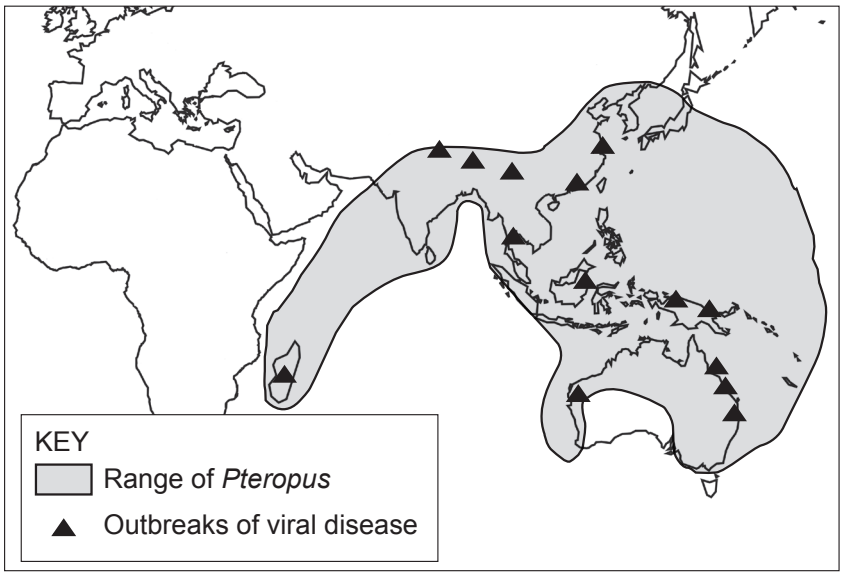
_____

_____ [3]

[Turn over

(c) Some human diseases are caused by viruses that were originally found in other mammals, e.g. bats. These mammals can be referred to as 'reservoirs' for the virus concerned.

The map below shows both the locations of recent outbreaks of human diseases known to be caused by a number of these viruses and the distribution range of bats of the genus *Pteropus*.



Nipah Virus Distribution Map © Centers for Disease Control and Prevention

(i) Using the map, suggest why *Pteropus* bats may have been identified as reservoirs for these viruses.

_____

_____

_____ [1]

(ii) Suggest **two** reasons why viruses which are carried by bats may pass relatively easily to human populations.

1. _____

_____

2. _____

_____ [2]

Once a virus is transmitted to humans, it may mutate so that it can spread more easily to other humans. This could potentially cause a pandemic.

(d) **(i)** Define the term 'pandemic'.

_____

_____

_____

_____ [2]

(ii) The viruses referred to in part **(c)** are retroviruses. State the type of genetic material contained within retroviruses and explain the significance of the enzyme reverse transcriptase in retroviruses.

Genetic material _____ [1]

Significance of enzyme _____

_____

_____

_____ [2]

(iii) State how an inhibitor of reverse transcriptase might help to prevent a pandemic.

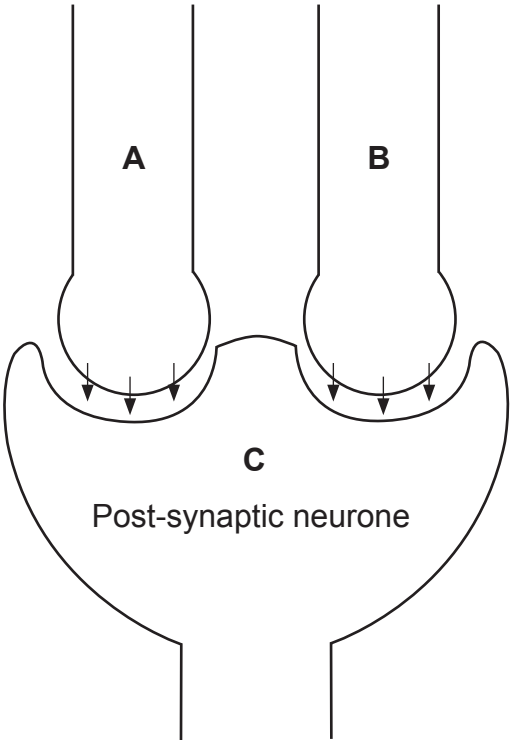
_____

_____

_____ [1]

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]

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

_____

_____

_____

_____

_____

_____ [2]

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

_____

_____

_____

_____

_____

_____ [2]

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.

_____

_____

_____

_____

_____

_____ [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.

_____

_____

_____

_____

_____

_____ [2]

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(Questions continue overleaf)

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]

11581

(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.

_____

_____

_____

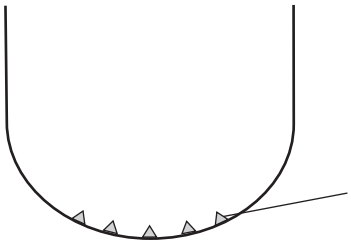
_____

_____

_____ [2]

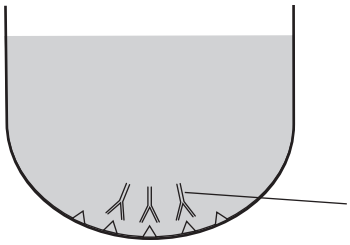
A test for RHD virus in rabbits detects the presence of RHD antibodies in the blood serum of infected rabbits. The technique is summarised below.

Step 1



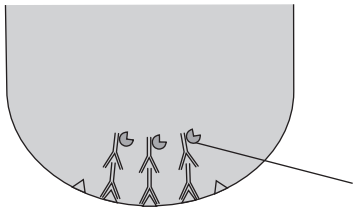
Antigens are attached to the wall of a well (a small chamber)

Step 2



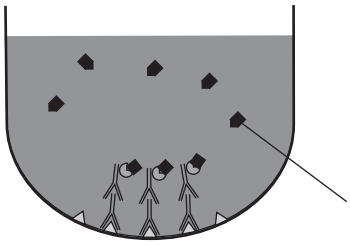
Serum from a rabbit is added. If the serum contains RHD antibodies these will bind to the antigens

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

Step 4



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

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(c) (i) Define the term antigen.

_____

_____ [1]

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

_____

_____

_____

_____

_____

_____

_____

_____ [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.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____ [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.

_____

_____

_____

_____

_____ [2]

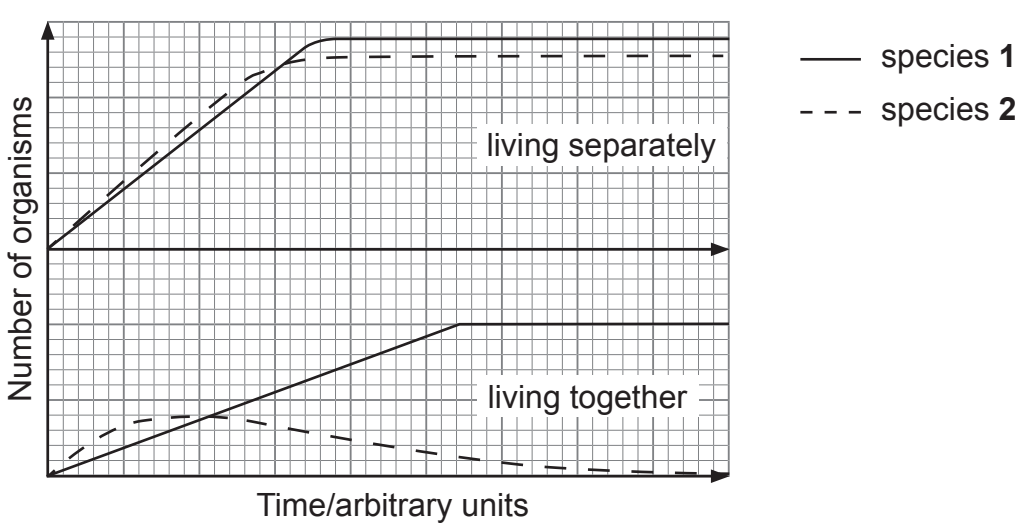
Section B

Quality of written communication is assessed in this section.

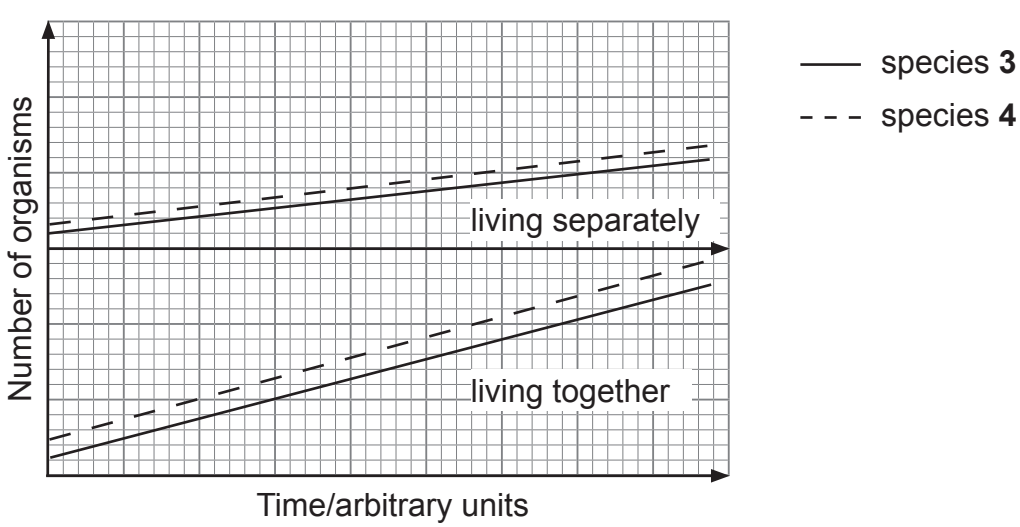
9 The interactions of some populations are shown in graphs **A**, **B** and **C**.

Graphs **A** and **B** summarise the results of two separate investigations into the growth of populations of four different species, **1**, **2**, **3** and **4**.

A



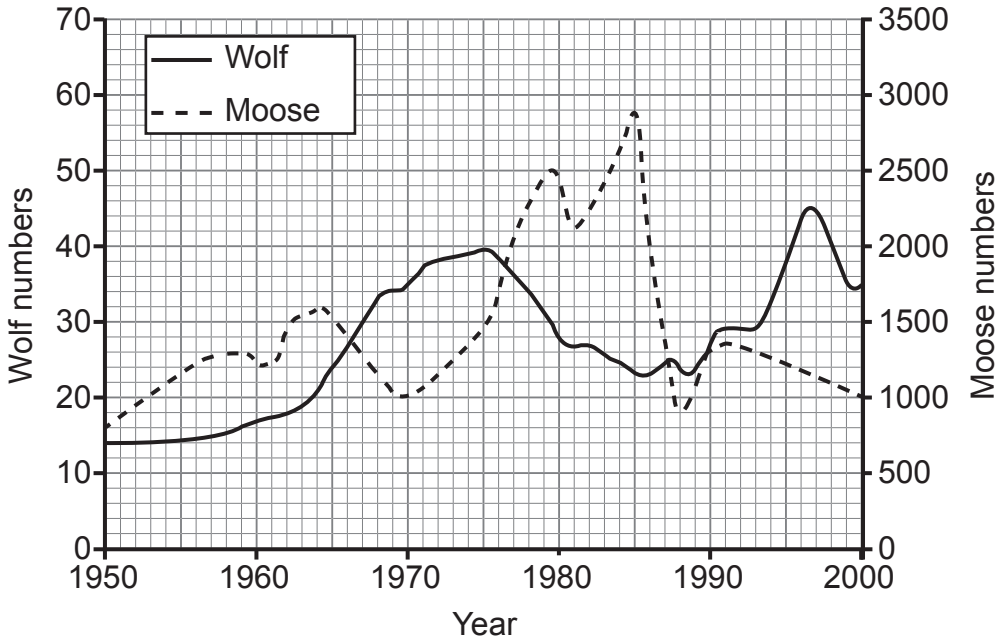
B



(a) Identify the population interactions shown in graph **A** and graph **B**. Explain reasons for your choices. [9]

Graph **C** shows a predator–prey interaction.

C



© Wolves & Moose of Isle Royale

(b) Comment on the predator–prey interaction shown and contrast this type of interaction with grazing and with parasitism. [9]

_____

(a) Identify the population interactions shown in graph **A** and graph **B.** Explain reasons for your choices.

Graph **A** _____

_____

_____

_____

_____

_____

_____

[Turn over

Graph **B**

[Turn over

(b) Comment on the predator–prey interaction shown and contrast this type of interaction with grazing and with parasitism.

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Question Number	Marks
1	
2	
3	
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9	
Total Marks	

Examiner Number

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