

Write your name here

Surname

Other names

**Pearson Edexcel**  
**International**  
**Advanced Level**

Centre Number

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Candidate Number

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# Biology

**Advanced**

**Unit 4: The Natural Environment and Species Survival**

Friday 10 January 2014 – Afternoon

**Time: 1 hour 30 minutes**

Paper Reference

**WBI04/01**

**You do not need any other materials.**

Total Marks

## Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided  
– *there may be more space than you need.*

## Information

- The total mark for this paper is 90.
- The marks for **each** question are shown in brackets  
– *use this as a guide as to how much time to spend on each question.*
- Questions labelled with an **asterisk** (\*) are ones where the quality of your written communication will be assessed  
– *you should take particular care with your spelling, punctuation and grammar, as well as the clarity of expression, on these questions.*
- Candidates may use a calculator.

## Advice

- Read each question carefully before you start to answer it.
- Keep an eye on the time.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ►

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**PEARSON**

**Answer ALL questions.**

**Some questions must be answered with a cross in a box ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.**

**1** When a pathogen infects a person for the first time, an immune response takes place. The appropriate T helper cell is activated and a clone from this cell is produced.

(a) (i) Name the type of division that occurs when the T helper cell is cloned. (1)

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(ii) Suggest how a microscope slide could be prepared to observe cell division in T helper cells. (3)

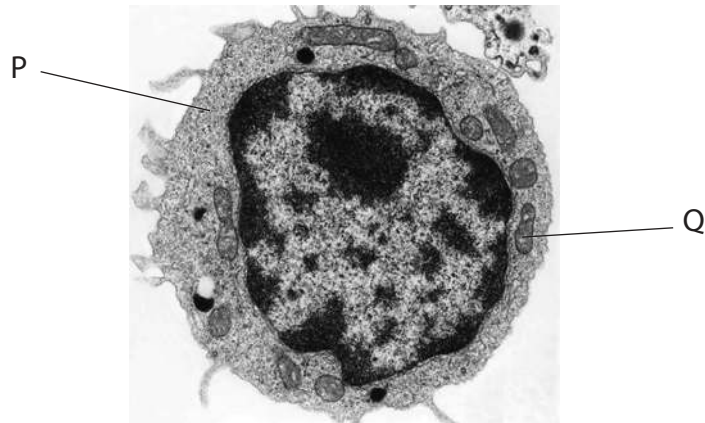
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(b) Describe the role of T helper cells in the immune response. (3)

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(c) The electron micrograph below shows a T helper cell. Some structures of this cell have been labelled.



Magnification  $\times 6000$

Place a cross  in the box to identify each of the labelled structures.

(i) Structure P

(1)

- A** cytoplasm
- B** lysosome
- C** nucleolus
- D** vacuole

(ii) Structure Q

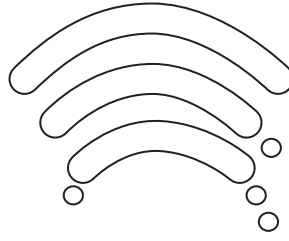
(1)

- A** endoplasmic reticulum
- B** lysosome
- C** mitochondrion
- D** nucleus



P 4 2 9 1 8 A 0 3 2 8

(d) The diagram below shows an organelle found in T helper cells.



(i) Name this organelle.

(1)

(ii) Describe the role of this organelle in T helper cells.

(3)

(Total for Question 1 = 13 marks)



2 Some diseases are caused by viruses infecting cells.

(a) The table below shows some features of cells and viruses.

For each feature, place **one** cross in the appropriate box, in each row, to show whether it is found in all viruses, some viruses or is not found in viruses.

(3)

Feature	All viruses	Some viruses	Not found in viruses
Cytoplasm	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
DNA	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Protein coat (capsid)	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>



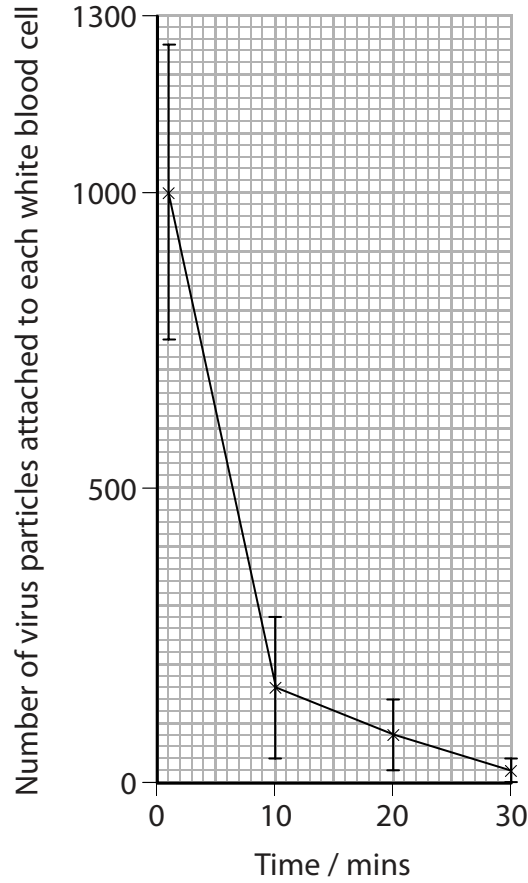
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(b) An investigation was carried out to study phagocytosis of virus particles by human white blood cells.

When the virus particles were added, they attached to the membranes of the white blood cells. The number of virus particles attached to each white blood cell was recorded for 30 minutes.

After 30 minutes, virus particles were observed in vesicles inside the white blood cells.

The graph below shows the results of this investigation.



(i) Comment on the reliability of these results.

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(ii) Use the fluid mosaic model of cell membranes to explain the results of this investigation.

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(c) Antibiotics cannot be used to treat infections caused by viruses.

Hospitals have a code of practice to prevent and control the spread of infections caused by viruses.

(i) Suggest why antibiotics cannot be used to treat infections caused by viruses.

(1)

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(ii) State **two** ways that hospitals can reduce the spread of infections caused by viruses.

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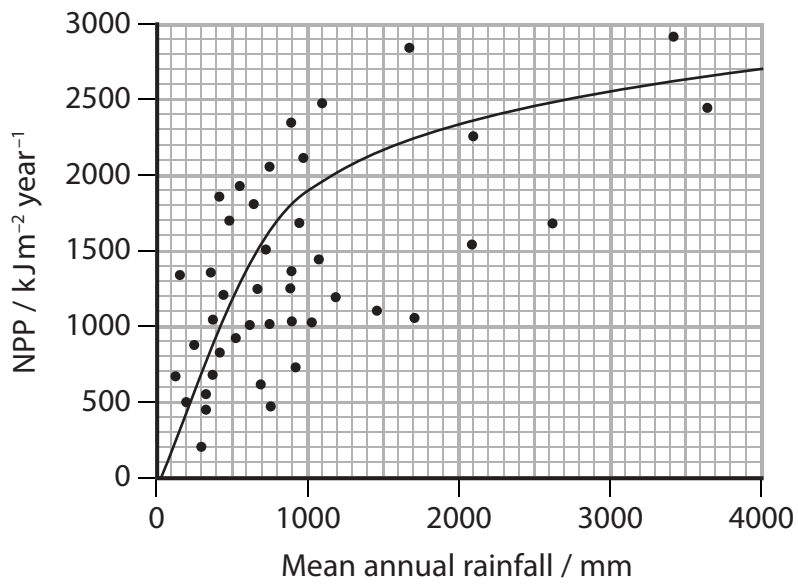
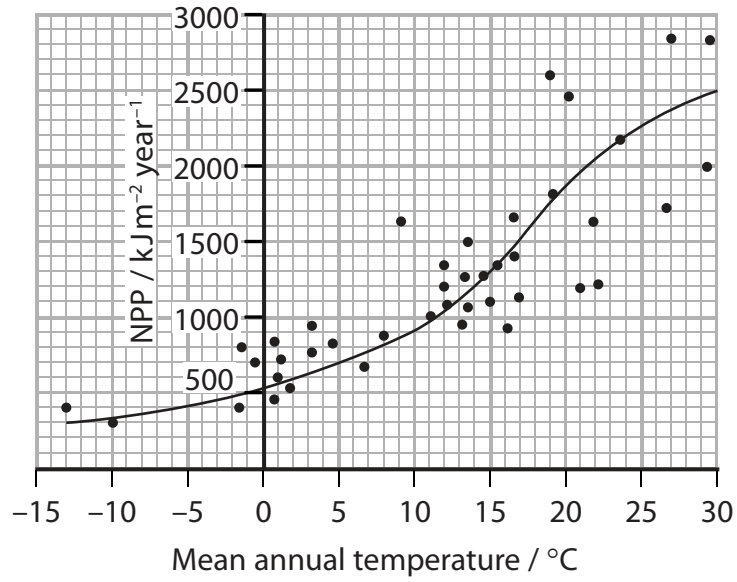
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(Total for Question 2 = 12 marks)



- 3 (a) The net primary productivity (NPP) of an ecosystem is affected by temperature and rainfall.

The graphs below show the relationship between NPP and these two environmental factors.



- (i) Explain the meaning of the term **net primary productivity (NPP)**.

(2)

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(ii) Using the information in the graphs, describe and explain the relationship between NPP and each of these two environmental factors.

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(iii) Describe the appearance of a graph showing the relationship between gross primary productivity (GPP) and rainfall, in ecosystems. Give a reason for your answer.

(3)

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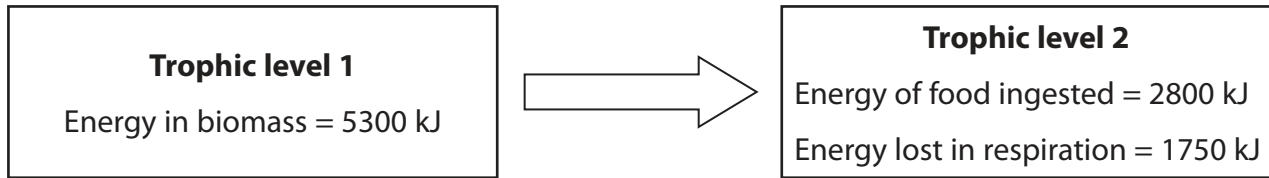
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(b) The diagram below shows the energy content of two trophic levels.



Calculate the percentage of energy transferred from trophic level 1 to trophic level 2.

(2)

Answer = ..... %

**(Total for Question 3 = 12 marks)**



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4 Lipase is an enzyme that breaks down triglycerides into their component molecules.

An investigation was carried out to compare the effect of temperature on the activity of lipase R and lipase S. These lipases were obtained from two different types of bacteria.

The results are shown in the table below.

Temperature / °C	Activity of lipase R / arbitrary units	Activity of lipase S / arbitrary units
30	25	10
40	43	22
50	58	28
60	80	38
70	70	59
80	52	65

(a) Name the **two** products from the complete breakdown of triglycerides by lipase. (1)

(b) Describe and explain the effect of temperature on the activity of lipase R. (5)

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(c) In this investigation the pH was controlled. Further experiments were carried out to find the optimum temperature for the activity of lipase S.

(i) Place a cross  in the box next to the correct term that completes the following sentence.

(1)

The pH was controlled to make this investigation

- A** accurate
- B** precise
- C** reliable
- D** valid

(ii) Place a cross  in the box next to the temperatures that should be used in further experiments.

(1)

- A** 30°C to 80°C
- B** 60°C to 80°C
- C** 70°C to 80°C
- D** 70°C to 100°C

**(Total for Question 4 = 8 marks)**



5 Oak trees may be found growing in gardens and woods.

During sexual reproduction in oak trees, pollen is transferred between the flowers. The flowers then produce nuts called acorns. An acorn contains the embryo plant, as well as a store of starch.

The photograph below shows oak leaves and acorns.



(a) (i) Describe how the pollen is involved in the production of the embryo plant.

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(ii) Explain why starch is a suitable molecule to be stored in the acorn.

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(b) Some oak trees lose their leaves each year. The leaves remain on the ground because they take a long time to decompose.

The leaves contain high levels of tannins that are poisonous to many animals and microorganisms.

Explain why oak tree leaves take a long time to decompose.

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**(Total for Question 5 = 12 marks)**





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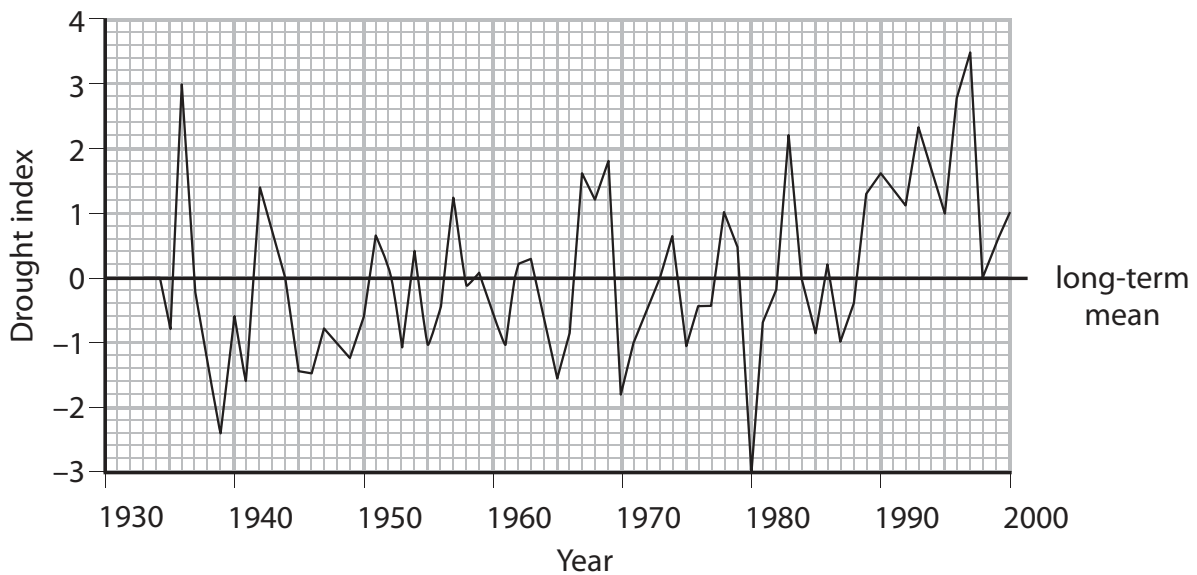
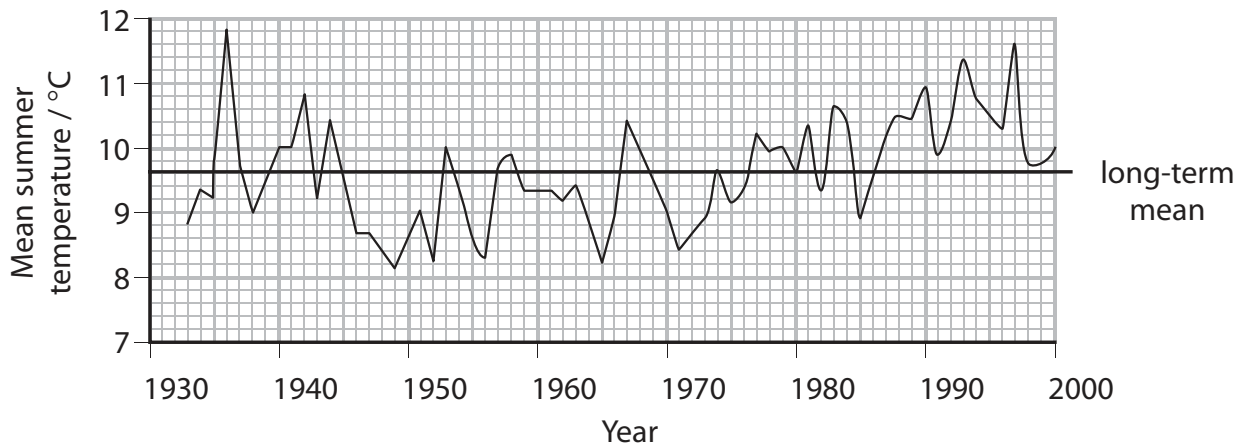
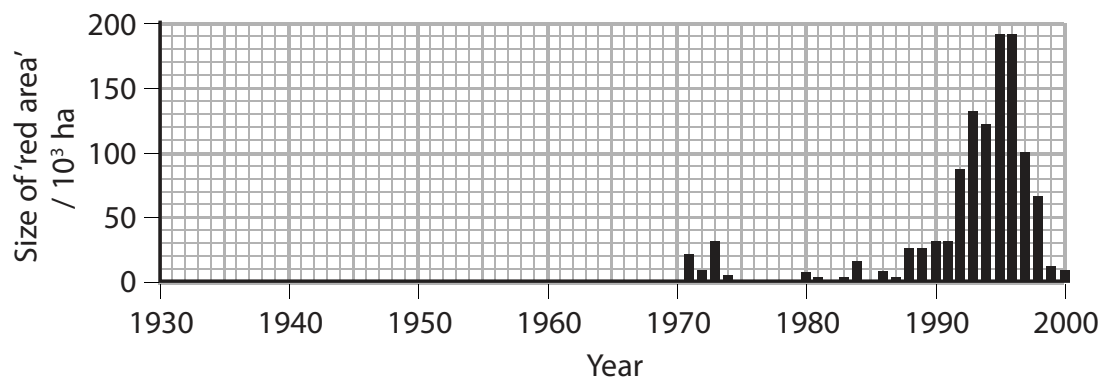
- 6 The spruce bark beetle feeds on and breeds in spruce trees. If a large number of beetles are on a spruce tree, the tree will die. These dead trees will appear red when viewed from the air.

Alaska has experienced recent changes in the number of spruce bark beetles. It is thought that the number of beetles is affected by climate change.

Each year, the extent of damage to the woodland was estimated by measuring the size of the 'red area' from aerial photographs.

The drought index of the woodland was also determined. A high drought index indicates warm, dry conditions and a low drought index indicates cool, moist conditions.

The graphs below show the changes in 'red area', mean summer temperature and drought index in Alaskan woodland, from 1930 to 2000.



(a) Describe the changes in the size of the 'red area' from 1970 to 2000.

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(b) Suggest why there is no data for the size of the 'red area' before 1970.

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(c) Suggest why the number of spruce bark beetles is affected by temperature.

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(d) Using the information in the graphs, describe the evidence for climate change being responsible for the size of the 'red area'.

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(e) Explain why a valid conclusion cannot be made about the effect of climate change on the size of the 'red area'.

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**(Total for Question 6 = 12 marks)**



7 A pathologist can use a number of methods to estimate the time of death of a body found at a crime scene.

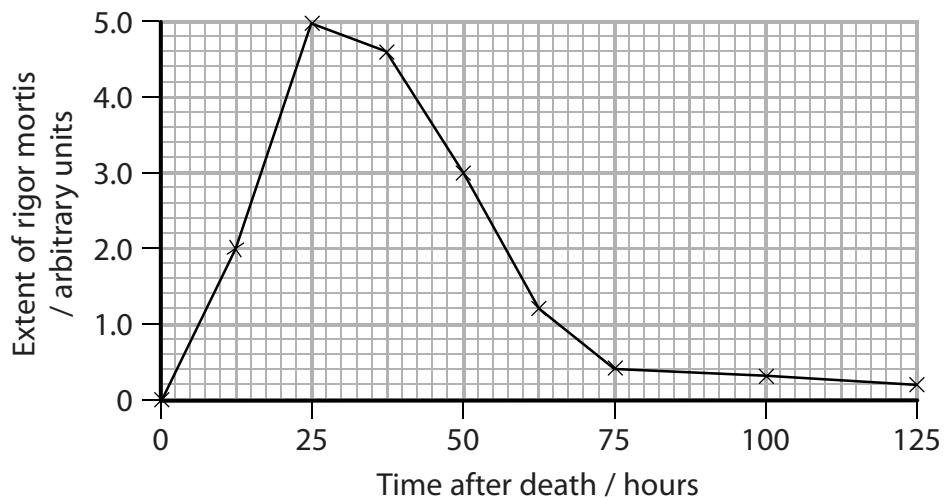
The extent of rigor mortis is one method that the pathologist can use to estimate the time of death.

(a) Place a cross ☒ in the box next to the correct description of rigor mortis.

(1)

- A bloating of the abdomen
- B paling of the skin
- C settling of the blood
- D stiffening of the muscles

(b) The graph below shows how the extent of rigor mortis changes with time after death.



(i) The pathologist assessed the extent of rigor mortis of the body as 2.0 arbitrary units. He used the information in the graph to estimate how long the body had been dead.

Calculate the difference between his lower and upper estimates.

(2)

Answer = ..... hours



P 4 2 9 1 8 A 0 2 1 2 8

(ii) Explain how the pathologist could use the core temperature of the body and the ambient temperature to make this estimate more accurate.

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(iii) State **one** other factor that could affect the pathologist's estimate. Explain how this factor could affect the estimate.

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\***(c)** Forensic entomologists use information on insect life cycles to estimate the time of death. The hister beetle is an insect that may be found on a body.

The life cycle of this beetle consists of five stages:

- egg
- first instar larva
- second instar larva
- pupa
- adult beetle.

The time taken for each of these stages depends on temperature.

Describe an investigation that could be carried out to study the effect of temperature on each of these stages.

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**(Total for Question 7 = 12 marks)**



8 One gene can give rise to more than one protein.

(a) Explain the importance of the sequence of bases in a gene.

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\***(b)** The cochlea in a chicken’s inner ear is lined with hair cells that can detect different frequencies of sound. The frequency detected depends on the type of BK channel protein present in the cell membrane.

One report suggests that there are 48 different BK channel proteins in these hair cells.

The *cSlo* gene codes for all of these BK channel proteins.

Explain how one *cSlo* gene can give rise to different BK channel proteins in these hair cells.

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**(Total for Question 8 = 9 marks)**

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**TOTAL FOR PAPER = 90 MARKS**





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