Please check the examination details below before entering your candidate information

Candidate surname	Other names

Centre Number | Candidate Number

Pearson Edexcel International Advanced Level

Time 1 hour 45 minutes

Paper reference **WBI15/01**

Biology

International Advanced Level
UNIT 5: Respiration, Internal Environment, Coordination and Gene Technology

You must have:
Scientific article (enclosed), scientific calculator, ruler, HB pencil

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.*
- **Show all your working out** in calculations and **include units** where appropriate.

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.*
- In questions marked with an **asterisk** (*), marks will be awarded for your ability to structure your answer logically, showing how the points that you make are related or follow on from each other where appropriate.

Advice

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

Turn over ▶

P71871RA

©2022 Pearson Education Ltd.

B:1/1/1/1/1/

P 7 1 8 7 1 R A 0 1 3 2

Pearson

BLANK PAGE

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

Answer ALL questions.

Write your answers in the spaces provided.

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 Mitochondria supply energy for the processes in cells.

(a) (i) How many of these statements about the inner membrane of a mitochondrion are correct?

(1)

- it is folded (has cristae)
- it is the location of ATP synthase
- it is the site of the electron transfer chain
- it is a site of protein synthesis

☒ **A** 1

☒ **B** 2

☒ **C** 3

☒ **D** 4

(ii) Anaerobic respiration produces lactate as a waste product.

Which is the result of lactate production?

(1)

☒ **A** blood becomes less acidic

☒ **B** muscle becomes less fatigued

☒ **C** pH of the blood increases

☒ **D** muscle becomes more acidic

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

(b) Describe how chemiosmosis is involved in the synthesis of ATP.

(2)

(c) A culture containing respiring cells was supplied with radioactive oxygen molecules.

Which will be the first substance to contain radioactive oxygen atoms?

(1)

- ☒ **A** ATP
- ☒ **B** carbon dioxide
- ☒ **C** reduced NAD
- ☒ **D** water

(Total for Question 1 = 5 marks)

DO NOT WRITE IN THIS AREA DO NOT WRITE IN THIS AREA DO NOT WRITE IN THIS AREA DO NOT WRITE IN THIS AREA DO NOT WRITE IN THIS AREA DO NOT WRITE IN THIS AREA

2 The giraffe is the tallest mammal and has a long neck.

The photograph shows a giraffe.



(Source: © Eugen Haag/Shutterstock)

(a) (i) Which structure joins the bones of the neck together?

(1)

- ☒ **A** actin
- ☒ **B** ligament
- ☒ **C** muscle
- ☒ **D** tendon

(ii) Which structure joins a muscle to a bone?

(1)

- ☒ **A** actin
- ☒ **B** ligament
- ☒ **C** myosin
- ☒ **D** tendon

(iii) Which chemical group contains actin and myosin?

(1)

- ☒ **A** carbohydrates
- ☒ **B** fatty acids
- ☒ **C** nucleic acids
- ☒ **D** proteins

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

(b) Giraffes must bend down to drink water.



(Source: © Wim Hoek/Shutterstock)

(i) Explain how the knee joint can be held steady in this position as the giraffe drinks.

(2)

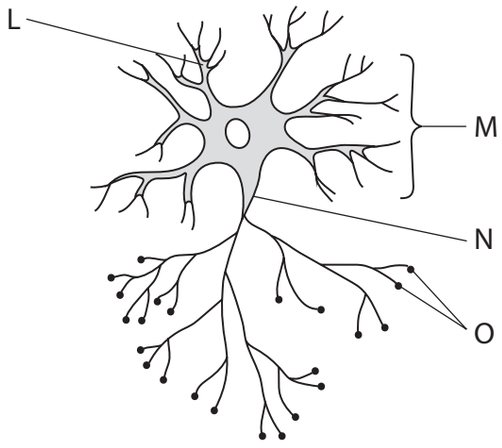
(ii) Describe the role of ATP in the sliding filament theory of muscle contraction.

(3)

(Total for Question 2 = 8 marks)

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

3 The diagram shows a relay neurone.



(a) (i) Complete the table by filling in the names of each labelled part.

(2)

Label	Part
L	
M	
N	
O	

(ii) Lidocaine is a drug that is used as a local anaesthetic.

Lidocaine works by

(1)

☒ **A** blocking the binding of acetylcholine to its receptor

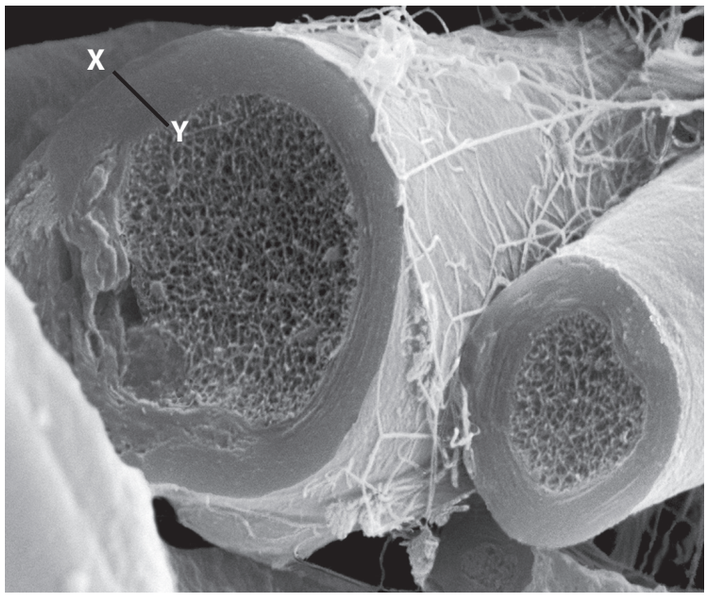
☒ **B** blocking the release of acetylcholine

☒ **C** inhibiting potassium ion channels

☒ **D** inhibiting sodium ion channels

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

(b) The photograph shows a nerve with an outer layer of connective tissue.



(Source: © Science Photo Library/Alamy Stock Photo)

Magnification × 3300

(i) State the type of microscope used to produce this image.

(1)

.....

.....

(ii) Calculate the thickness of the connective tissue layer between the points X and Y.

Give your answer in micrometres (μm).

(2)

Answer ..... μm

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

(iii) The nerve shown in the photograph contains many myelinated neurones.

Explain why a myelinated neurone conducts an impulse faster than a non-myelinated neurone of the same diameter.

(3)

(Total for Question 3 = 9 marks)

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

4 Animal species have different resting heart rates.

(a) The table shows the resting heart rate and mean life expectancy for some animal species.

Animal species	Resting heart rate / bpm	Mean life expectancy / years	Mean mass / kg	Mean resting metabolic rate / $dm^3\ O_2\ hr^{-1}$
elephant	30	80	5780	1400
horse	38	30	500	910
human	72	78	110	360
rabbit	205	12	7	48
rat	420	1.8	2	10.8
humming bird	1260	7	0.02	0.012

(i) Describe the relationships between resting heart rate and the data shown in the table.

(2)

.....

.....

.....

.....

.....

.....

(ii) Calculate the volume of oxygen used each hour by a resting elephant with a mass of 4500 kg.

Give your answer in standard form.

(3)

Answer .....

DO NOT WRITE IN THIS AREA DO NOT WRITE IN THIS AREA DO NOT WRITE IN THIS AREA DO NOT WRITE IN THIS AREA DO NOT WRITE IN THIS AREA DO NOT WRITE IN THIS AREA

(b) The photograph shows a cheetah.



(Source: © Stu Porter/Shutterstock)

The heart rate for a cheetah increases from 120 bpm to 250 bpm during a chase. It can reach speeds of 100 km hr^{-1}

(i) Explain how the heart rate of a cheetah can be increased during a chase.

(4)

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

(ii) Suggest why a cheetah can maintain this heart rate and speed for only a short period of time.

(2)

.....

.....

.....

.....

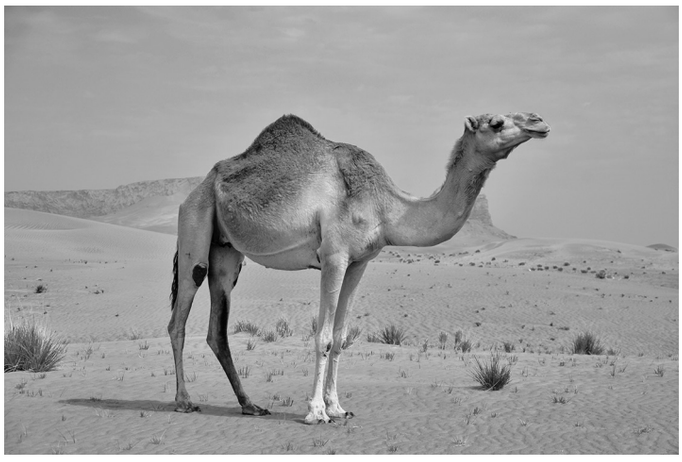
.....

.....

(Total for Question 4 = 11 marks)

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

5 The photograph shows a camel.



(Source: © Shengyong Li/Shutterstock)

Camels are an important livestock species. They are adapted to living in hot, dry environments.

(a) How many of the following adaptations enable a camel to reduce its water loss?

- production of very concentrated urine
- high glomerular filtration rate
- long loop of Henle
- reduced release of ADH

(1)

☒ **A** 0

☒ **B** 1

☒ **C** 2

☒ **D** 3

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

(b) The table shows the water use of five species of animal.

Species	Water use / $cm^3\ kg^{-1}\ day^{-1}$	Mean mass / kg
buffalo	150	697
camel	57	850
goat	136	80
sheep	95	110
zebu	120	195

(i) Calculate the difference in the volume of water use in a day by a buffalo and a camel.

Give your answer in dm^3 to two significant figures.

(2)

Answer ..... dm^3

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

(ii) Suggest two reasons why there is no correlation between water use and mean mass for the species given in the table.

(2)

.....

.....

.....

.....

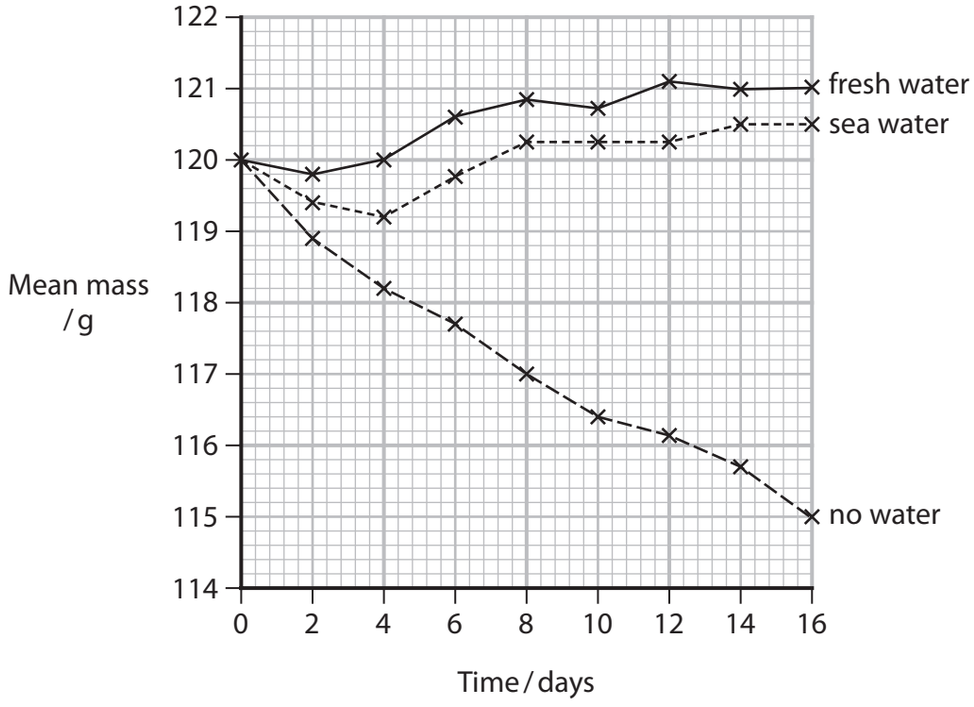
.....

.....

(c) The kangaroo rat is another animal that lives in a hot, dry environment.

In an investigation, kangaroo rats were given either fresh water, sea water or no water.

The graph shows the mean body mass of kangaroo rats which were fed on a diet of soya beans over a 16-day period.



DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

Determine the effect of the type of water given on the mean mass of the kangaroo rats in this investigation.

Use the information in the graph to support your answer.

(3)

(d) The kangaroo rat's kidneys play an important role in the process of conserving water.

Explain how the nephrons (kidney tubules) in the kidneys of the kangaroo rat are able to produce very concentrated urine.

(2)

(Total for Question 5 = 10 marks)

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

6 Plants respond to external stimuli.

(a) Phytochrome molecules are found in plants.

Phytochrome exists in two forms, Pr (P_{660}) and Pfr (P_{730}).

Which row shows the action of these two forms of phytochrome?

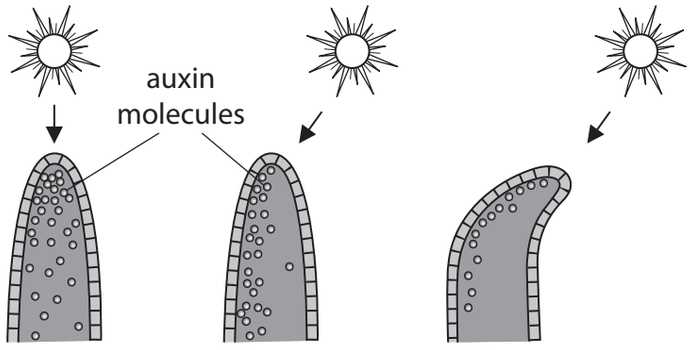
(1)

		Absorbs far red light	Breaks down in the dark
☒	**A**	Pfr	Pfr
☒	**B**	Pfr	Pr
☒	**C**	Pr	Pfr
☒	**D**	Pr	Pr

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

(b) Auxins (IAA) are plant growth substances.

The diagram shows auxin molecules producing a phototropic response in a shoot.



Explain the role of auxins in this phototropic response.

Use the information in the diagram to support your answer.

(3)

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

(c) Seeds contain starch. This starch is used to supply energy when the seed germinates.

Gibberellins are a group of naturally occurring plant growth substances.

Gibberellins regulate starch hydrolysis in the seed.

Explain how gibberellins can produce this effect on the seed.

(4)

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

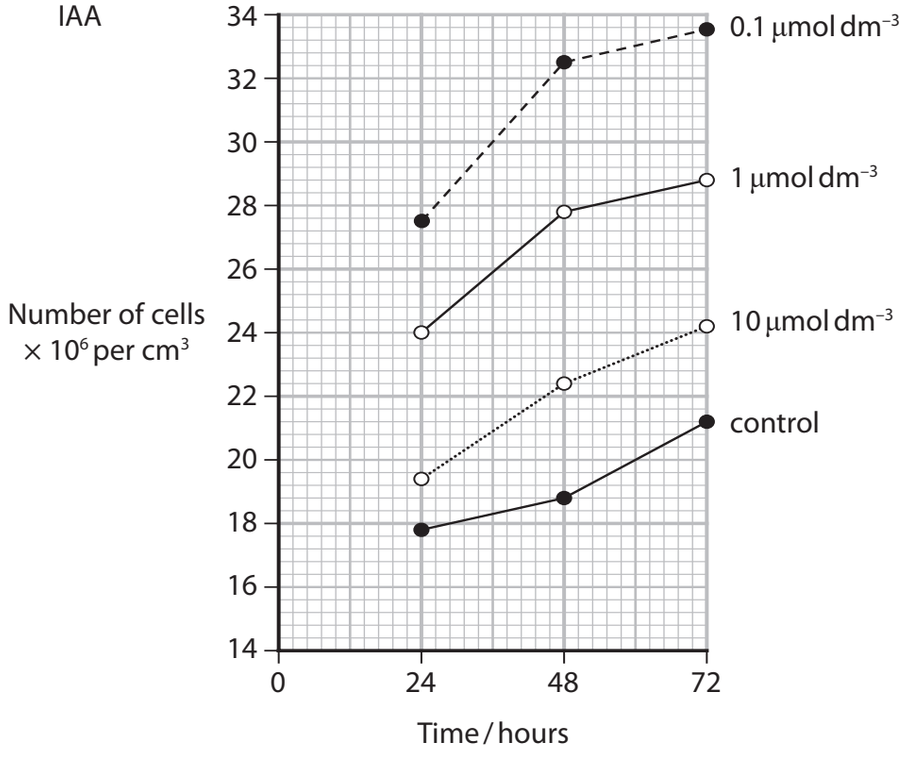
(d) Indole acetic acid (IAA) is a natural plant auxin. 1-Naphthaleneacetic acid (NAA) is a synthetic auxin.

The effects of these two auxins on the growth of *Chlorella* was investigated.

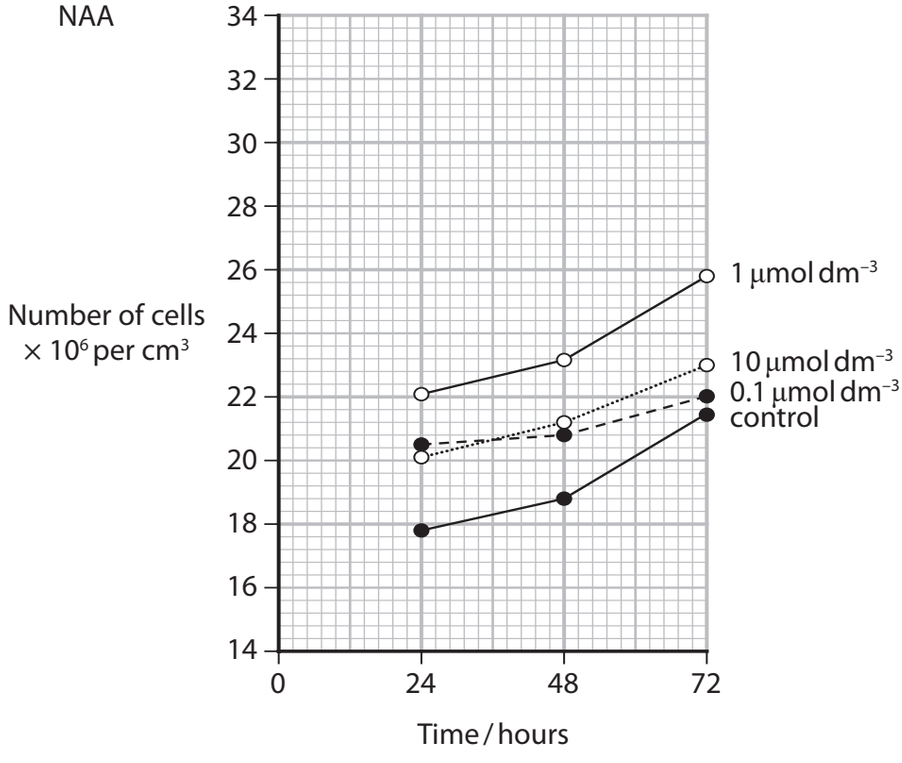
Chlorella is a single-celled photosynthetic organism.

The graphs show the effect of different concentrations of the auxins on the growth of *Chlorella*.

IAA



NAA



DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

Comment on the effect of these auxins on the growth of *Chlorella*.

(4)

(Total for Question 6 = 12 marks)

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

7 Animals and plants can be genetically modified.

(a) Recombinant human erythropoietin (rHE) is a protein drug that can be given to patients with low haemoglobin concentrations.

(i) Sheep have been genetically modified to produce rHE in their milk.

Explain how a sheep could be genetically modified to produce rHE in its milk.

(4)

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

(ii) In a clinical study, 4382 patients were treated with rHE. They showed a mean increase in blood haemoglobin from 80 g dm^{-3} to 142 g dm^{-3}.

Calculate the percentage increase in the mean blood haemoglobin concentration as a result of rHE treatment.

(1)

Answer ..... %

(iii) Some patients receiving rHE develop anti-rHE antibodies.

Describe how these antibodies may be produced.

(4)

.....

.....

.....

.....

.....

.....

.....

.....

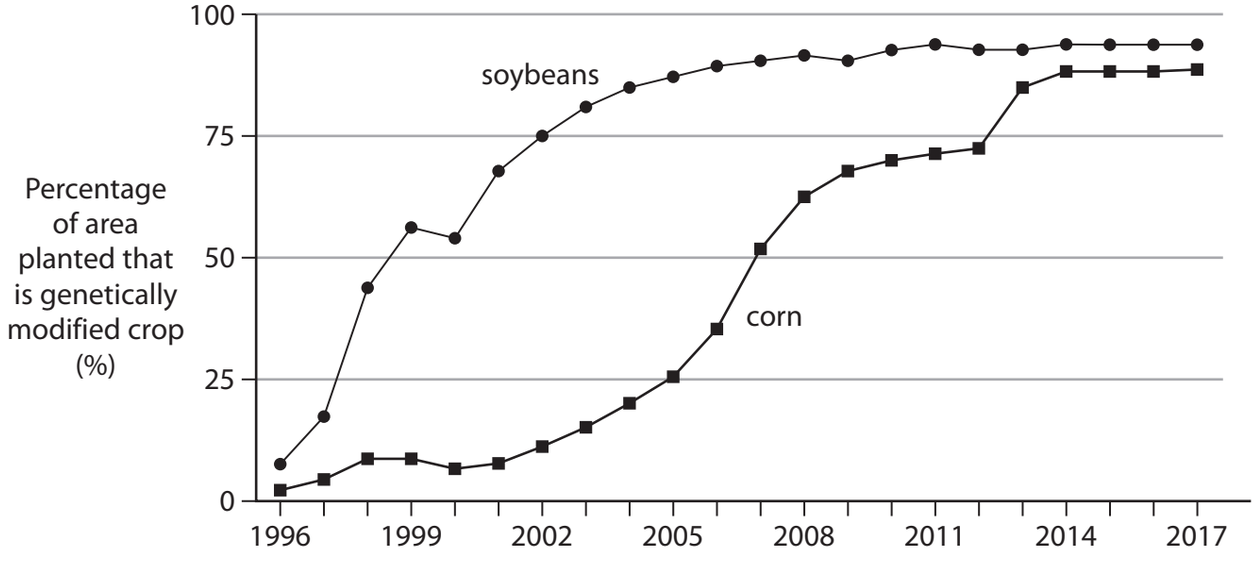
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

(b) Advances in genetic engineering have allowed for precise control of the genetic changes introduced into plants.

The table describes some examples of the use of genetic modification in plants.

Trait	Plant	Details
herbicide tolerance	soybean	glycophosphate herbicide tolerance using a gene from the bacterium *A. tumefaciens*
insect resistance	corn	resistance to European corn borer using a gene from *B. thuringiensis*

The graph shows the increase in the use of genetically modified crops in the United States from 1996 to 2017.



DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

Discuss the risks and benefits of genetic modification in valuable agricultural plants.

Use all the data and your own knowledge to support your answer.

(6)

(Total for Question 7 = 15 marks)

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

8 The scientific document you have studied is adapted from an article *'How we perceive the world' by Julius D. and Patapoutian A.* in 2021.

Use the information from the scientific document and your own knowledge to answer the following questions.

(a) Describe how light is detected by the rod cells in the eye (paragraph 1).

(4)

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

(b) Suggest how the genes expressed in a sensory neurone could be identified (paragraph 4).

(3)

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

(c) Explain how capsaicin could activate nerve cells causing a pain sensation (paragraph 4).

(3)

(d) Explain how changes in ion channel protein can result in nerve impulses in the nervous system (paragraph 5).

(3)

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

(e) Explain how mechanical stimuli, e.g. pressure, are converted into electrical signals in cells (paragraphs 5 and 7).

(3)

(f) Explain what is meant by the phrase 'Based on its similarity to Piezo 1, a second ion channel was found (Piezo 2)' (paragraph 7 and Figure 3).

(2)

(g) Suggest the role of TRPV1 in maintaining core body temperature (paragraph 9).

(2)

(Total for Question 8 = 20 marks)

TOTAL FOR PAPER = 90 MARKS

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

BLANK PAGE

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA
DO NOT WRITE IN THIS AREA

BLANK PAGE

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

DO NOT WRITE IN THIS AREA

BLANK PAGE