

1 Neurones are cells involved in coordination and control within an animal.

(a) The table below shows the concentration of sodium ions and potassium ions in the cytoplasm of a neurone and in the fluid outside the neurone.

Ion	Concentration of ion / mmol dm^{-3}	
	Cytoplasm	Fluid outside the neurone
Sodium	15	150
Potassium	150	5

(i) Using the information in the table, comment on the concentration gradients of these ions.

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(ii) During an action potential the distribution of sodium and potassium ions changes.

Explain how proteins in the cell surface membrane of this neurone enable the concentrations of these ions to **return** to those shown in the table.

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(b) Describe how the arrival of a nerve impulse at a synapse causes the release of neurotransmitters.

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(Total for Question 1 = 9 marks)

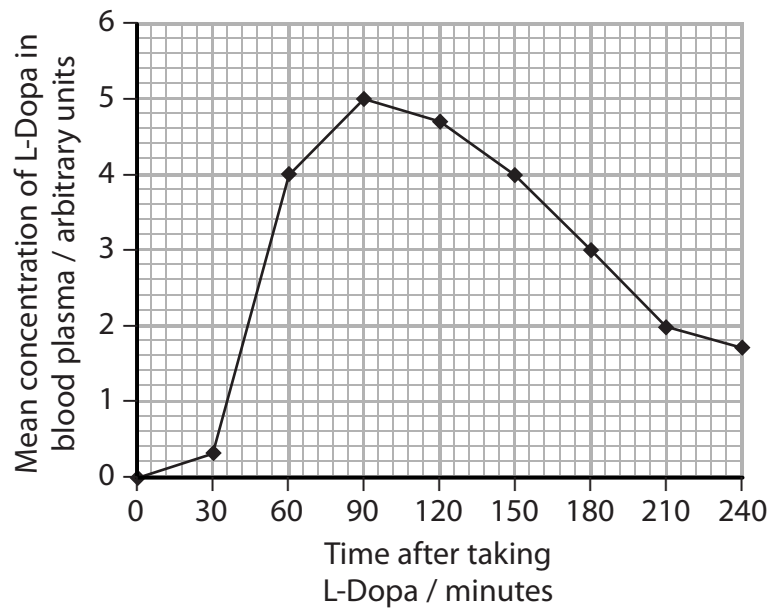
2 Humans and sea anemones have nervous systems with synapses.

(a) L-Dopa is a drug used to treat people with Parkinson's disease.

An investigation was carried out to study the uptake of L-Dopa from the gut into the blood plasma of people with Parkinson's disease.

A number of people with Parkinson's disease were each given a tablet containing 200 mg of L-Dopa. The concentration of L-Dopa in the blood plasma of each person was then recorded over a period of four hours.

The mean results are shown in the graph below.



(i) Using the information in the graph, calculate the mean rate of uptake of L-Dopa from 0 to 90 minutes.

Show your working.

(2)

(ii) Suggest an explanation for the decrease in the mean concentration of L-Dopa in the blood plasma after 90 minutes.

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3 The scientific article you have studied is adapted from the book called The Immortal Life of Henrietta Lacks by Rebecca Skloot. Published by Pan Books in 2011.

(a) Explain what is meant by the term **mitosis** (paragraph 7).

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(b) The genome makes sure that cells 'do their jobs, whether that's controlling your heartbeat or helping your brain understand the words on this page' (paragraph 10).

Describe how cells in the sino-atrial node (SAN) are involved in controlling heart rate.

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(c) Henrietta's cells have 'been used to study lactose digestion' (paragraph 16).

Suggest how her cells may have digested lactose.

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(d) 'Like guinea pigs and mice, Henrietta's cells have become the standard laboratory workhorse' (paragraph 16).

Suggest **two** reasons why it is preferable to use Henrietta's cells in medical research, rather than using guinea pigs and mice.

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**(e)* 'By the end of 1951, the world was in the midst of the biggest polio epidemic in history' (paragraph 19). This was caused by poliovirus which can lead to paralysis (paragraph 20).

The virus infects motor neurones which can stop skeletal muscles from working.

Suggest how an infection of motor neurones by the virus can stop the transmission of nerve impulses and lead to muscle paralysis.

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(f) Poliovirus, like Human Immunodeficiency Virus, is a retrovirus. Poliovirus was able to infect HeLa cells (paragraph 25).

Give **three** similarities between the structure of the genetic material in poliovirus and the genetic material in HeLa cells.

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- (g) Scientists had studied genes by breeding plants 'then breeding their offspring to see how genetic traits are passed from one generation to the next' (paragraph 33).

When this was done using a smooth pea and a wrinkled pea, it was found that in the F₂ generation (second generation of offspring), 75% were smooth.

In the space below, draw genetic diagrams to describe and explain the genotypes of the parents and their offspring in the previous **two** generations.

(4)

(h) Explain what is meant by the term **human genome map** (paragraph 37).

(2)

(i) Suggest how the 'p53 tumor suppressor gene' (paragraph 43) could stop a potential tumour cell forming.

(2)

(j) Using paragraph 46, suggest what the 'specific DNA sequence from a blood cell' coded for.

(2)

(k) A human telomere (paragraph 60) contains 10 000 nucleotides. Using information from paragraph 58, state the number of telomere nucleotides lost per cell division.

(1)

Answer nucleotides

(Total for Question 3 = 30 marks)
