

1 Humans have a nervous system that has a variety of neurones.

(a) The human brain is made up of a number of areas containing many millions of neurones.

Place a cross in the box ☒ that identifies the areas of the brain associated with riding a bicycle uphill.

(i) the decision to ride the bicycle

(1)

- A cerebrum
- B cerebellum
- C hypothalamus
- D medulla

(ii) initiating an increase in sweating during the ride

(1)

- A cerebrum
- B cerebellum
- C hypothalamus
- D medulla

(b) Voltage-gated K^+ and Na^+ channels are involved in the transmission of impulses in sensory and motor neurones.

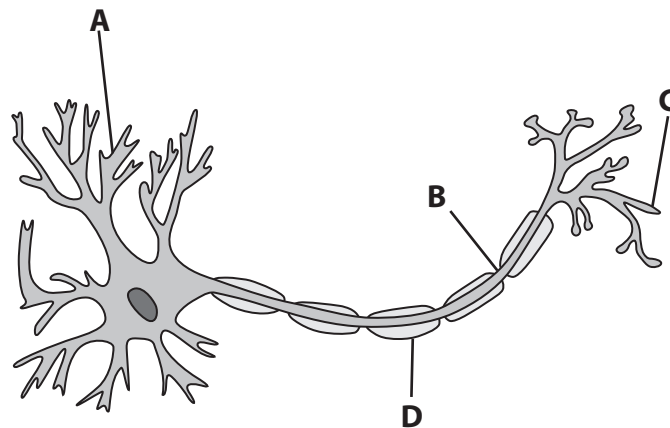
(i) The table below identifies two stages in the transmission of an impulse in a sensory neurone.

Place a tick (✓) in each box that correctly identifies whether the channels are open or closed during these two stages.

(2)

Stage	Voltage-gated K^+ channels open	Voltage-gated K^+ channels closed	Voltage-gated Na^+ channels closed
Depolarisation			
Repolarisation			

(ii) The diagram below shows a myelinated motor neurone.



Place a cross in the box ☒ that labels the site where neurotransmitters bind and initiate depolarisation.

(1)

- A
- B
- C
- D

(iii) Describe the differences in the structure of a myelinated sensory neurone and a myelinated motor neurone.

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(Total for Question 1 = 8 marks)

- 2 An investigation was carried out to study the effect of positive and negative physical and emotional experiences on humans.

The positive physical experience was a warm object placed on the arm of a person for five seconds.

The negative physical experience was a hot object placed on the arm of a person for five seconds.

All other variables were kept constant.

Two groups of people were used in this investigation. In the first group, the warm object was used before the hot object. In the second group, the hot object was used before the warm object.

After each experience, the individuals were asked to rate their feelings using the scoring system below.

Feelings	Score
Very bad	1
Bad	2
Neutral	3
Good	4
Very good	5

- (a) Suggest why one group had the warm object placed on their arm before the hot object and the other group had the hot object placed on their arm first.

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(b) These two groups were then exposed to a positive emotional experience and a negative emotional experience.

The mean results for the investigation are shown in the table below.

Experience	Mean score for feelings and standard deviation	
	Physical	Emotional
Positive	4.5 ± 0.5	4.2 ± 0.4
Negative	1.9 ± 0.6	1.7 ± 0.4

A student concluded that the physical experiences and emotional experiences were similar.

Using information in the table, comment on the validity of this conclusion.

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(c) This investigation then used a scanning technique to study whether the same areas of the brain were involved in both physical experiences and emotional experiences.

(i) Suggest the scanning technique required to study the brain in this investigation. Give reasons for your choice.

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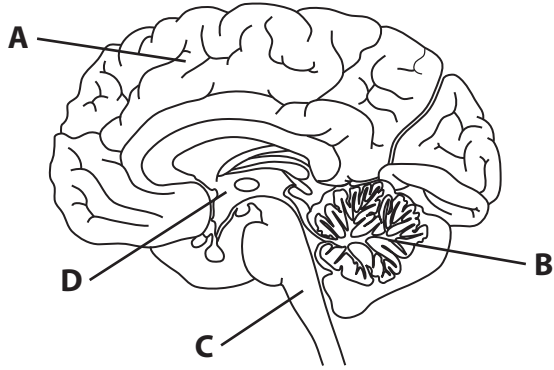
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(ii) It was found that an area of the brain called the insula was involved in both physical experiences and emotional experiences. The insula is found just above the hypothalamus.

Using the diagram below, place a cross in the box that identifies the area of the insula.

(1)



- A
- B
- C
- D

- 3 The central nervous system (CNS) is made up of the brain and the spinal cord.
- (a) The image below of a human head and neck shows part of the CNS.



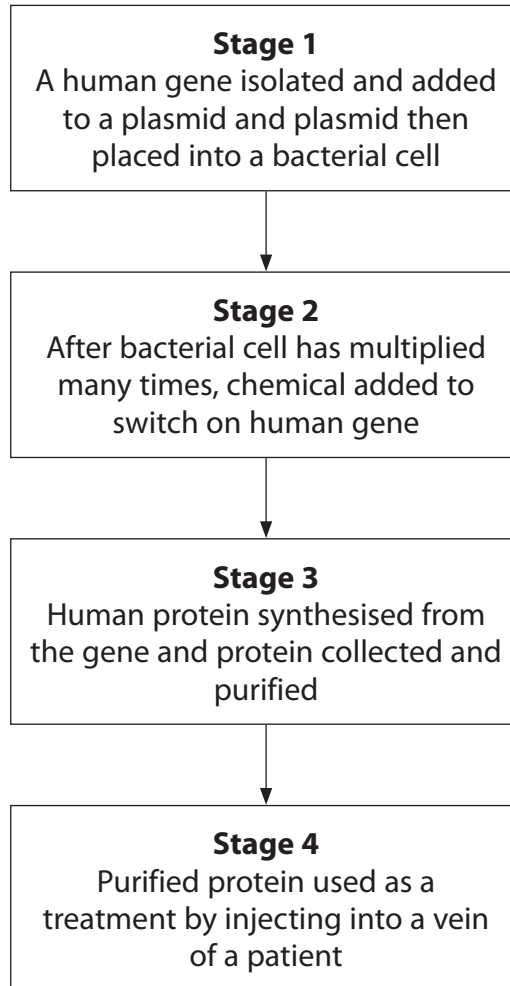
Using the image and your knowledge, complete the table below.

(4)

Labelled structure	Name of structure	One function
A		
		Feel emotions

(b) Some of the drugs used to treat human disorders are proteins. Some of these proteins can be synthesised by genetically modified bacteria.

The diagram below shows some stages in the production of one of these drugs.



(i) A restriction enzyme is used in Stage 1.

Explain why only one restriction enzyme is used in stage 1.

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(ii) Suggest how the addition of a chemical causes the human gene to be switched on in stage 2.

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(iii) Describe the structure of an organelle found in a bacterial cell that is involved in synthesising human protein in stage 3.

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(iv) Suggest **two** advantages of injecting the protein into a vein rather than an artery in stage 4.

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(Total for Question 3 = 12 marks)

4 The central nervous system (CNS) is made up of the brain and the spinal cord.

(a) The image below of a human head and neck shows part of the CNS.



Using the image and your knowledge, complete the table below.

(4)

Labelled structure	Name of structure	One function
A		
		Thermoregulation

(b) The structure involved in thermoregulation may cause sweat glands to release more sweat.

Explain how increased sweating is involved in the regulation of body temperature.

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- (ii) Scientists have used magnetic resonance imaging (MRI) to provide evidence that domoic acid may damage the brains of California sea lions.

Suggest how MRI can provide this evidence.

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(Total for Question 4 = 13 marks)
