Investigating Brain Function - Questions by Topic

Q1. There are various ways of investigating brain structure and function.

(a) Compare the use of computed tomography (CT) with magnetic resonance imaging (MRI) for studying brain structure.

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(b) Suggest why functional magnetic resonance imaging (fMRI) is considered better than CT for studying brain function.

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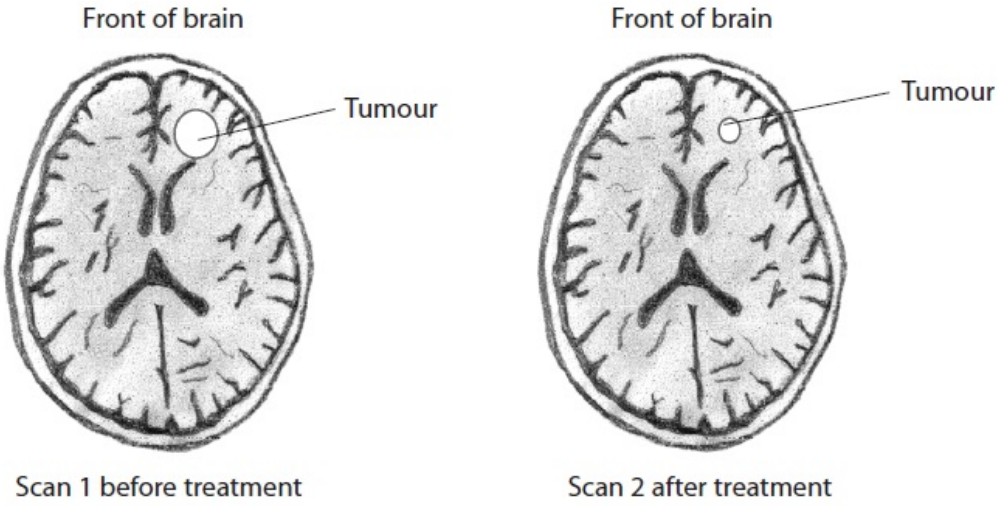
(c) The diagrams below show two MRI scans of the brain of a patient with a tumour. Scan 1 was taken before treatment was carried out, and scan 2 after treatment.



(i) Suggest why the tumour appeared white in the scans.

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(ii) Using the information in the diagrams, describe the effect of the treatment on this tumour.

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(iii) Using the information in the diagrams, suggest **two** brain functions that may have improved after treatment. Give a reason for your answer.

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(Total for Question = 12 marks)

Q2.

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.

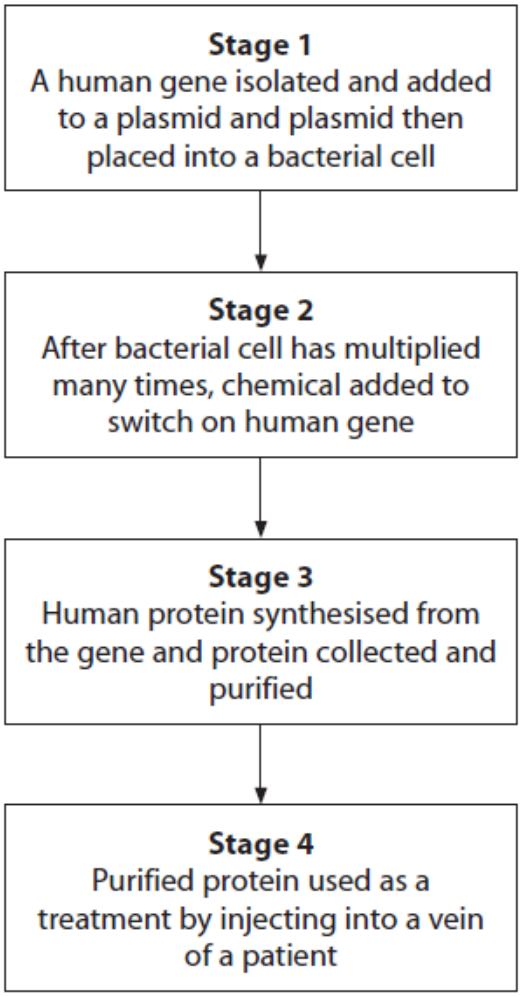
Using the image and your knowledge, complete the table below.

(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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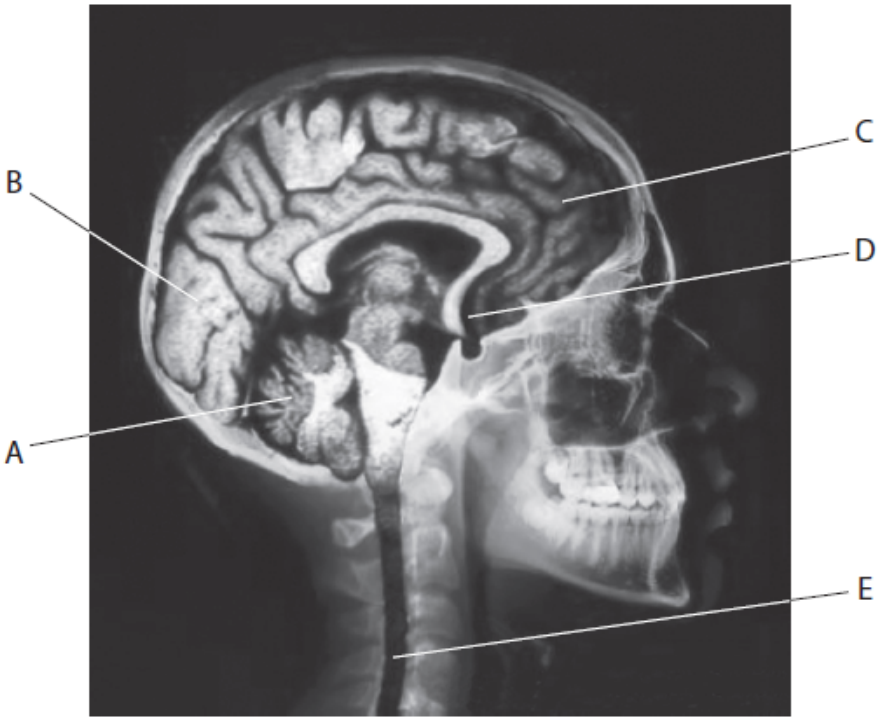
(Total for question = 12 marks)

Q3.

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 C



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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(c) The photograph below shows a California sea lion (*Zalophus californianus*), a large marine mammal.

Magnification × 0.005

Domoic acid is a neurotoxin, produced by algae, that harms the brains of these mammals. This neurotoxin damages brain cells that release a neurotransmitter called glutamate.

(i) Describe how a neurotransmitter, such as glutamate, is released from a brain cell.

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

Suggest how MRI can provide this evidence.

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(Total for question = 13 marks)

Q4.

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

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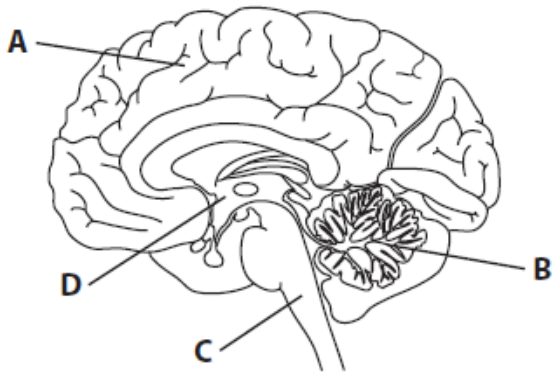
(ii) It was found that an area of the brain called the insula was involved in both physical experiences and emotional experiences. The insula is found just above the hypothalamus.

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

(1)



☒ **A**

☒ **B**

☒ **C**

☒ **D**

Q5.

Scientists have investigated the influence of both nature and nurture on brain development. They used several pairs of identical twins and several pairs of non-identical twins.

(a) In one investigation, each twin was shown a number of human faces and then asked to identify them amongst a group of unfamiliar faces.

The agreement in face identification between each pair of twins was recorded.

The results were used to calculate the mean percentage agreement in face identification for the two types of twin. This is shown in the table below.

Mean percentage agreement in face identification (%)	
identical twins	non-identical twins
70	29

(i) From these results, the scientists concluded that face identification has a genetic component.

Explain how these results support this conclusion.

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(ii) This investigation was repeated using written words rather than faces. The mean percentage agreement in word identification for the two types of twin suggested that this involved an environmental component.

Suggest how the results of this investigation might differ from the results shown in the table.

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(b) Functional magnetic resonance imaging (fMRI) was used in another investigation. Brain activity was recorded whilst carrying out face identification.

Suggest why fMRI was used in this investigation.

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(Total for question = 9 marks)

Q6.

An investigation was carried out to study the effect of light on the mammalian retina.

Part of the retina of a young rat was removed and kept in the dark for two hours. This allowed the pigment in the rod cells to recover from bleaching caused by exposure to light.

Suggest **two** reasons why some people might have objections to the use of rats in this investigation.

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Q7.

The response of an animal to a stimulus can change if the stimulus is repeated.

The photograph shows the head and part of the body of a marine worm that lives in a chalky tube.

© Johner Images / Alamy

The worm moves its head out of the tube to feed. The worm will withdraw into its tube if it senses danger and any change in length of the worm can be measured.

An investigation was carried out to study the response of ten worms to a moving shadow and to touch. Five of the worms were kept in their tubes and the other five were removed from their tubes. A shadow was moved over the worms and the decrease in length of each worm was recorded.

The investigation was repeated with another 10 worms but the stimulus used was touch instead of a moving shadow.

The results are shown in the table below.

Worms	Mean decrease in length / cm	
	Moving shadow	Touch
In tube	1.08	2.03
Not in tube	0.01	1.53

(a) Calculate the percentage difference in the response of the worms to tou

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Answer .....

(b) Analyse the data to explain the difference in the withdrawal response of the worms to the different stimuli.

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(c) When the touch stimulus is applied several times to the worms, they learn to reduce the withdrawal response.

(i) Give **two** advantages for worms with this type of learning behaviour.

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(ii) Explain how repeated touch stimulation reduces the withdrawal response.

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(Total for question = 12 marks)