WJEC EDUQAS A-LEVEL BIOLOGY · COMPONENT 3

BIOLOGY



EXAM QUESTION PACK

OPTION C: NEUROBIOLOGY AND BEHAVIOUR

SCORE	PERCENTAGE
/116	%

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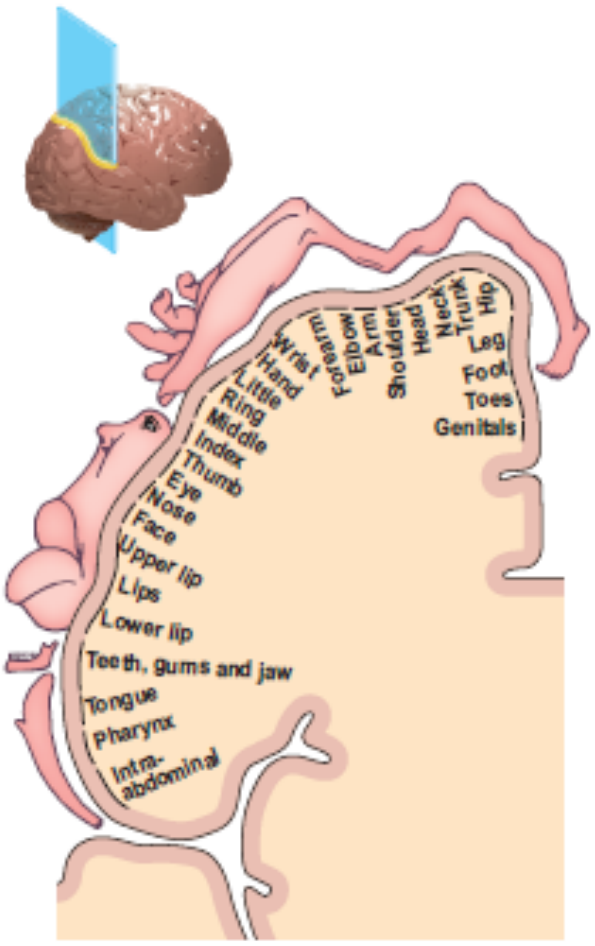
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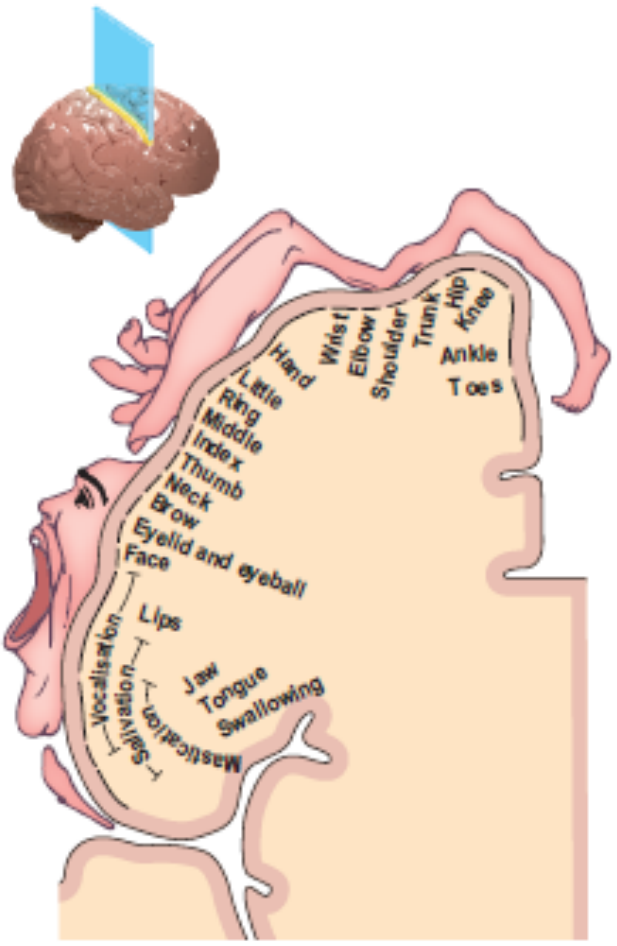
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1. *(a)* The cortical homunculus is a drawing showing the area of cortex devoted to specific regions of the body. It correlates the anatomy of the body with a neurological map. There are two types of cortical homunculus: the sensory homunculus and the motor homunculus.



Sensory cortex in right cerebral hemisphere



Motor cortex in right cerebral hemisphere

With reference to the homunculi shown above, identify what they show and describe and explain the major differences between the two images. [4]

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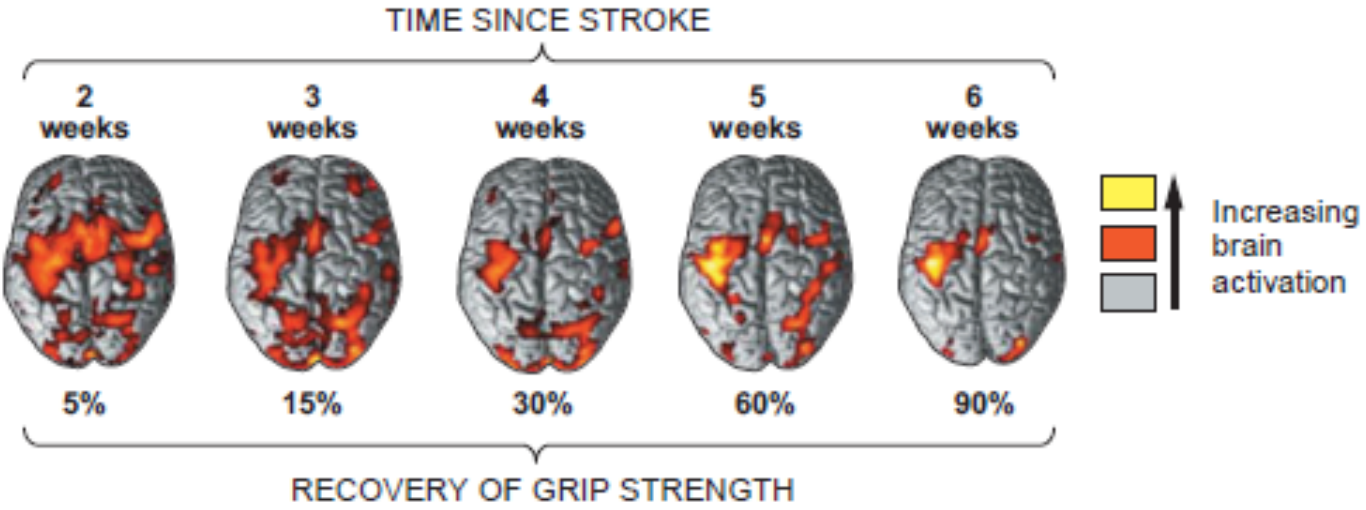
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(b) A stroke is the interruption of blood flow to the brain. It may result in the death of brain cells. Individual patients can recover from strokes over a period of time. The image below shows functional magnetic resonance imaging (fMRI) scans showing the brain during repetitive gripping with the hand. Each brain image represents the activation pattern at different time points over the first six weeks after a stroke for one patient. After 6 weeks, the image is very similar to what is seen during learning of a new complex motor task in the undamaged human brain.



(i) With reference to the image, describe the advantage of fMRI over computerised tomography (CT) and magnetic resonance imaging (MRI) scans. Explain what has happened in the brain in order to recover from the stroke. [3]

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(ii) Some studies suggest that in a healthy person 375 neurones per hour die due to the aging process. In an untreated stroke patient, it is estimated that 1.9 million neurones per minute die. Calculate how many times greater the neurone loss is in a patient who has a stroke that is untreated for 1 hour compared to a healthy person. [2]

Times greater = × .....

(iii) Use the scans opposite to suggest which part of the brain was damaged. Give reasons for your answer. [2]

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(iv) A stroke affecting Wernicke's area has a different affect to a stroke affecting Broca's area. Using your knowledge of these areas of the cerebral cortex describe the effect of each type of stroke. [2]

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(c) Meerkats, *Suricata suricatta*, live in social groups called mobs, of 5-30 individuals. They inhabit open dry land such as the Kalahari desert. Meerkats share parental care responsibilities. Each mob has a dominant alpha male and dominant alpha female. These are usually the only individuals who produce offspring. This social structure is referred to as a dominance hierarchy.



(i) What are the advantages, to the meerkat colony, of this dominance hierarchy? [2]

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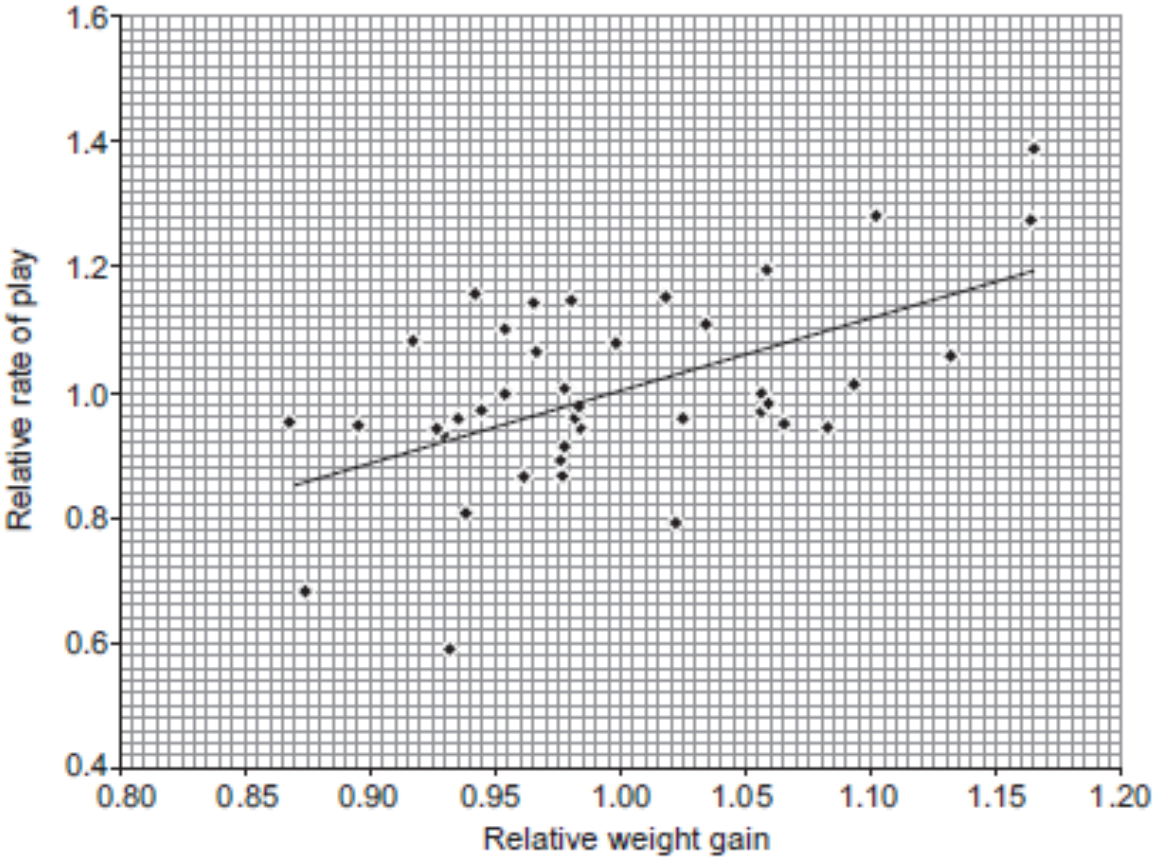
(ii) There is little difference between the size of males and females in meerkats. In other mammals, however, such as African lions, *Panthera leo*, the male is much larger than the female. Explain the reason for the large size of the male lions. [1]

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(d) A study of 39 wild meerkats in South Africa investigated whether engaging in play behaviour was more likely in individuals in a better nutritional state. The meerkats were habituated to close observation and handling, they were individually marked and regularly weighed. The researchers observed play in the early morning. They calculated the mean play rates for the young meerkats and compared the individual play rates to the mean. The results are shown in the scatter graph below.



(i) What is the advantage to the study of using meerkats 'habituated' to close observation and handling? [1]

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(ii) What type of correlation is shown between relative weight gain and relative rate of play? [1]

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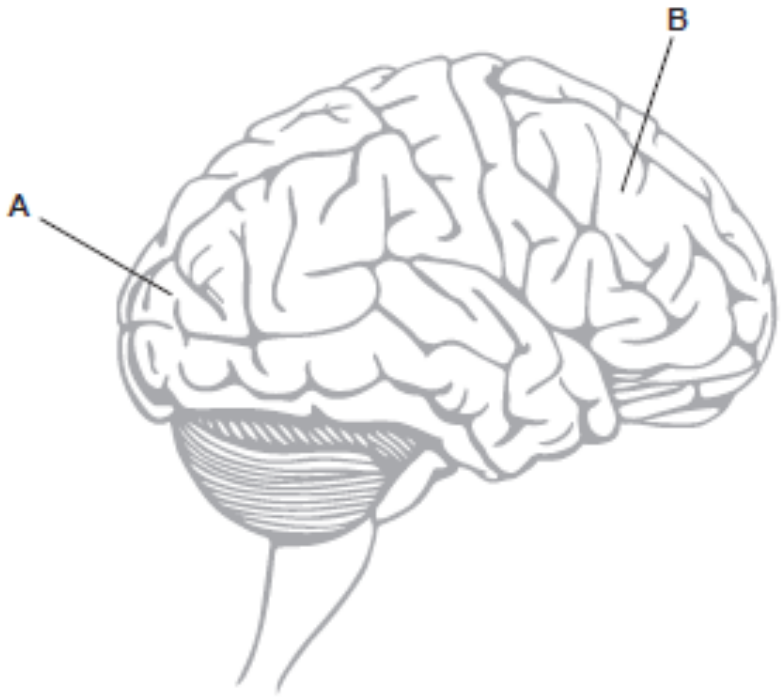
(iii) How could this investigation be improved to give more valid data? [2]

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2. *(a)* The image below shows the divisions of the human cerebral cortex into lobes.



(i) State the name and function of the lobes labelled A and B on the diagram above. [3]

	Name	Function
A		
B		

(ii) The brain can be studied in several ways. Outline the differences in the information provided by electroencephalography (EEG) and computerised tomography (CT). [2]

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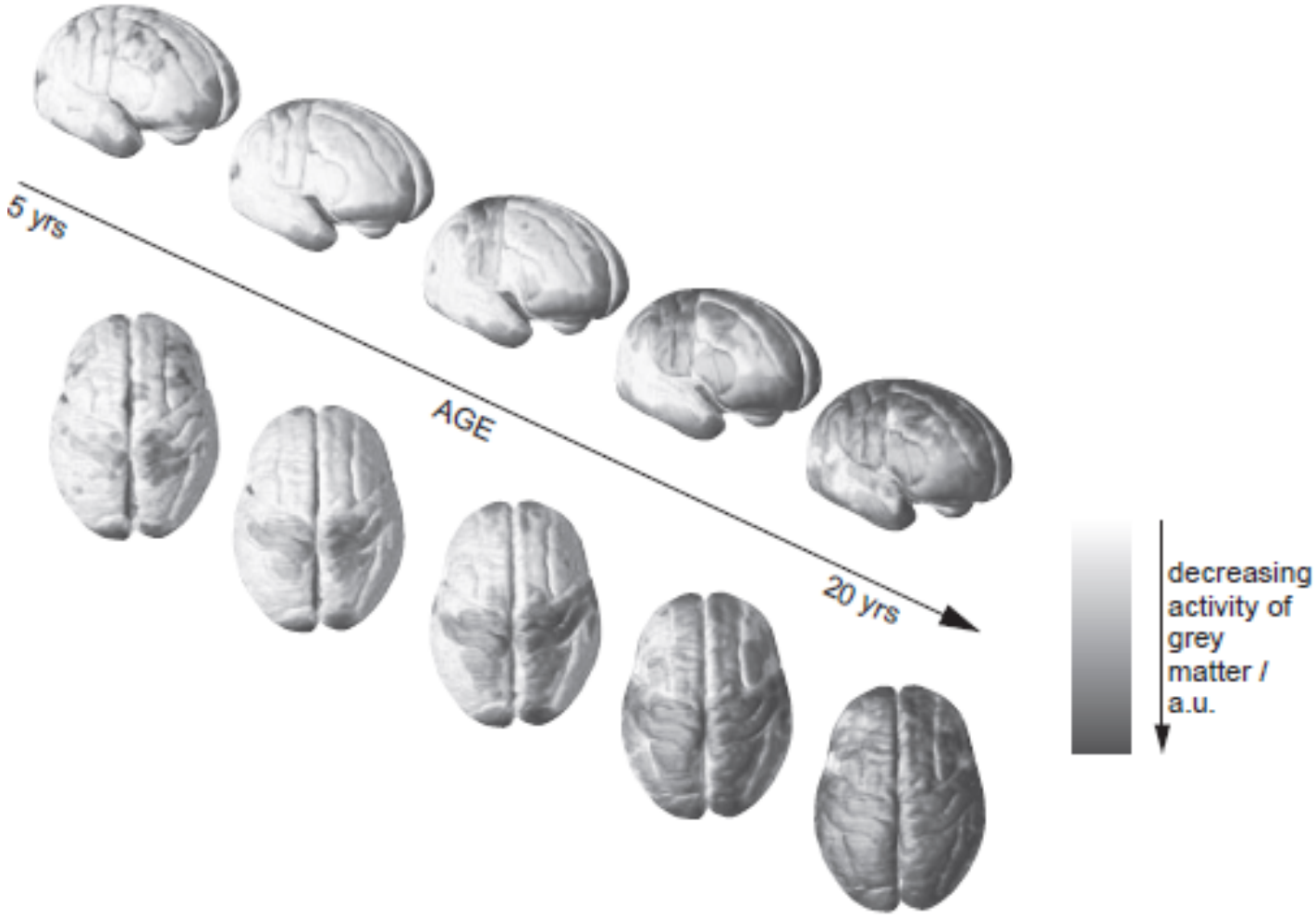
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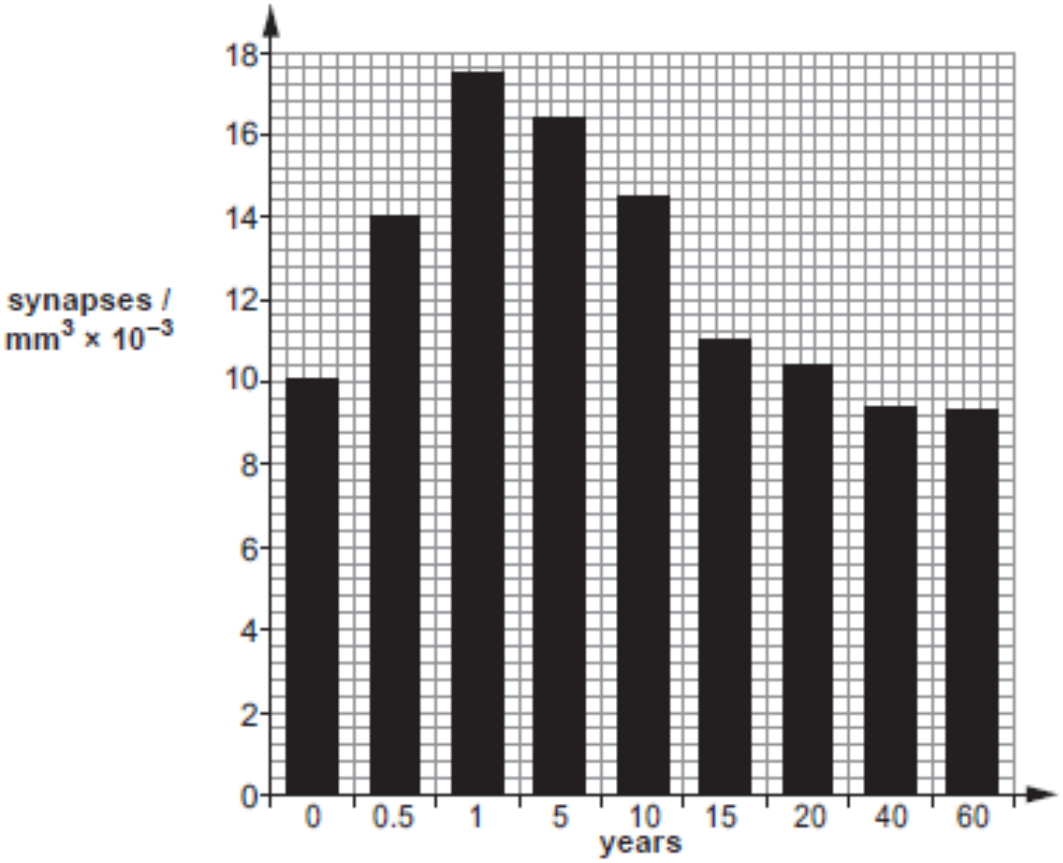
(b) Brain structure changes throughout life with most changes occurring in childhood. During childhood there are critical periods of development where synapses are strengthened in response to environmental stimuli. The critical period for the development of language is between 0-5 years.

Exposure to neglect or psychological trauma during these critical periods in childhood, can change the normal developmental pattern e.g. in 'feral' children.

Brain activity in children was measured using functional magnetic resonance imaging (fMRI) to show the level of activity in the grey matter. The diagram below shows how the level of activity of grey matter in the brain changes with age after this critical period in a person who had not been exposed to neglect or psychological trauma.



The graph shows the number of synapses present in the brain and the changes which normally occur as a child gets older.



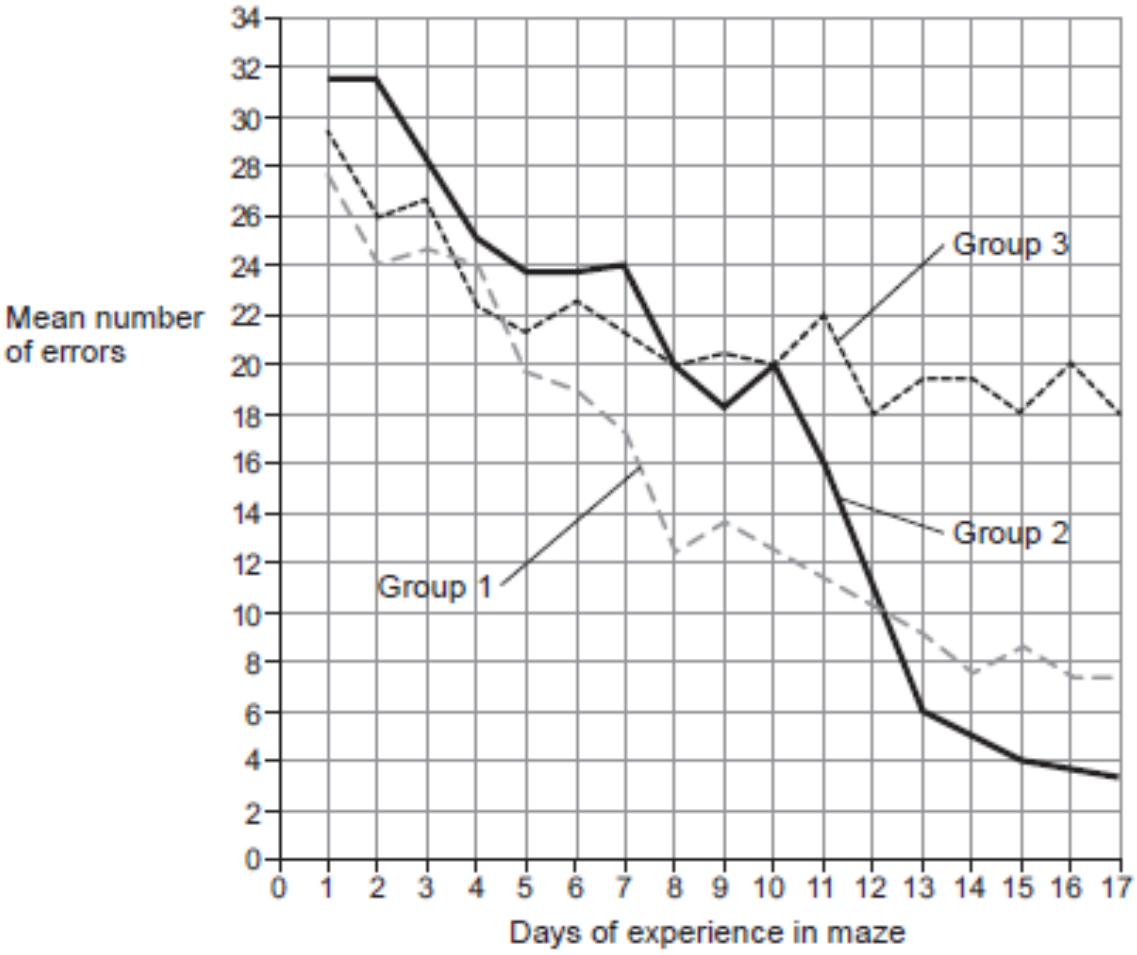
(i) Suggest why children who are not exposed to language during the critical period are likely to never develop speech. [4]

(ii) Suggest how the fMRI images and graph would differ for a feral child. [1]

(iii) State **one** factor which could be involved in causing this effect in feral children or those exposed to psychological trauma at an early age. [1]

(c) In 1930, Tolman and Honzik investigated learning in rats. Thirty female rats were placed in three groups and the number of errors they made when going through the maze was recorded.

Group 1 – Rewarded every time they completed the maze
Group 2 – Placed in the maze every day and only rewarded from day 10 onwards
Group 3 – Never rewarded



(i) Which area of the brain is involved in learning? [1]

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(ii) Use the information provided to conclude the learning patterns exhibited by each group of rats. Explain your conclusions. [4]

Group 1 .....

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Group 2 .....

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Group 3 .....

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(iii) Calculate the percentage change in the number of errors for group 2 between day 10 and day 13. [2]

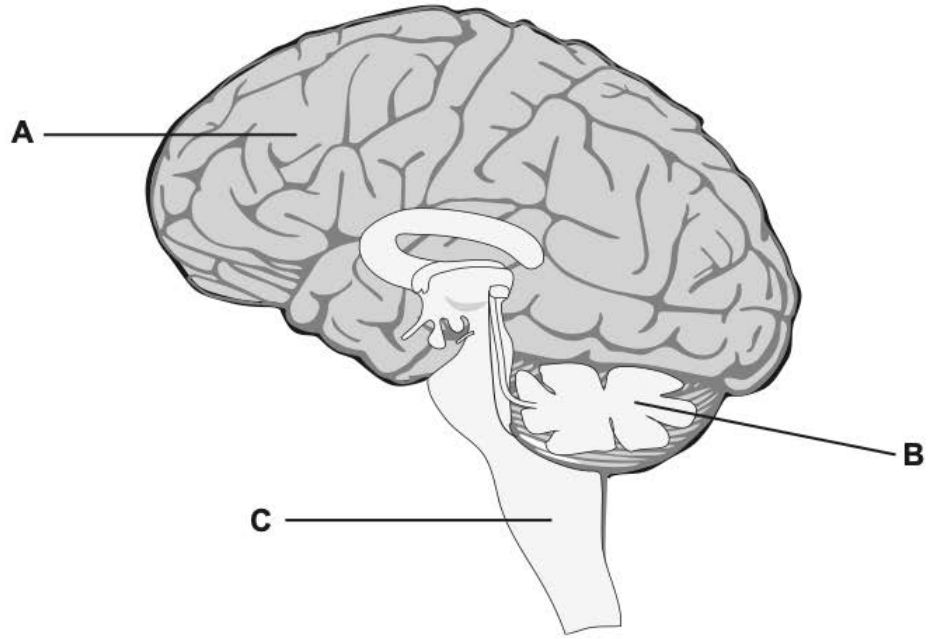
Percentage change = ... %

(iv) State two factors which should have been controlled in this investigation. [2]

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3. The diagram below shows a section through the human brain.



(a) Identify **A**, **B** and **C** on the diagram above. [1]

A .....

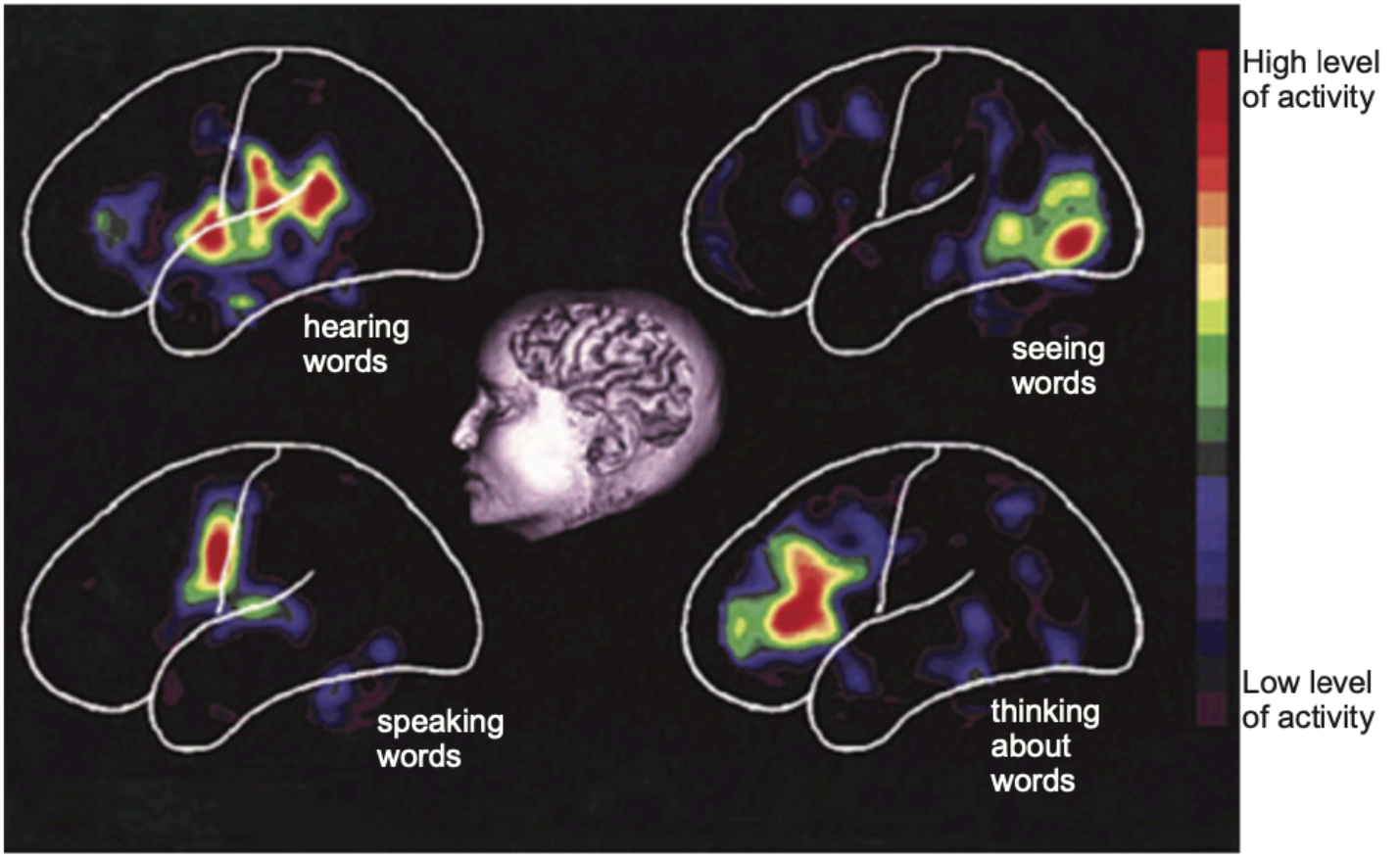
B .....

C .....

(b) It is estimated that there are 125 000 deaf adults in the UK who use British Sign Language (BSL). The language involves movement of the hands, body, face and head. Some people are born deaf and others become deaf during their lives. There are many causes of deafness, including damage to the auditory nerve between the ear and the brain.

Positron emission tomography (PET) can be used to generate images of the brain using radioactive tracers which have a short half-life. There is a PET scanner at Cardiff University.

The image below shows the results of a PET scan when a hearing patient was given tasks associated with language.



(i) Explain why a PET scan would be suitable for investigating activity levels within the brain whereas an MRI scan would not. [2]

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(ii) With reference to the image of the PET scan and your knowledge of brain regions involved in language, suggest and explain how the PET scan of a deaf person, actively using BSL, would compare to that of a hearing person. [5]

(iii) Suggest **two** medical details that would be needed when interpreting PET scans from patients with hearing problems. [2]

(iv) Explain why PET scans of adults with total hearing loss have revealed activation of regions of the cortex related to hearing. [3]

(c) The three-spined stickleback, *Gasterosteus aculeatus*, is common to lakes and rivers in Wales. The male stickleback has a red belly during the breeding season and behaves aggressively when defending its territory.

The behaviour of 12 male sticklebacks was investigated during the breeding season. Each male stickleback was exposed to model sticklebacks with red or silver bellies and the number of times each model was bitten was recorded.



Male and female sticklebacks during the breeding season, in Llyn Frongoch, Ceredigion

(i) State **one** advantage to male sticklebacks of defending their territory. [1]

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The table below shows the results of the investigation.

Model colour	Mean number of bites
red belly	119.8
silver belly	60.4

(ii) State what is meant by a **sign stimulus** and based on this information, identify what it would be for the stickleback. Explain your answer. [3]

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Model colour	Mean number of bites	$\sum(x-\bar{x})^2$	Standard Deviation
red belly	119.8	524.7	6.9
silver belly	60.4	343.3	.....

(iii) **Complete** the table above by calculating the standard deviation for the silver belly stickleback using the formula below: [2]

$$\textit{Standard Deviation} = \sqrt{\frac{\sum(x-\bar{x})^2}{N-1}}$$

where:

$\bar{x}$ = mean
$\sum$ = sum of
N = number of samples

(iv) The standard deviation for both models was high. Explain how this could affect your confidence in the conclusion. [1]

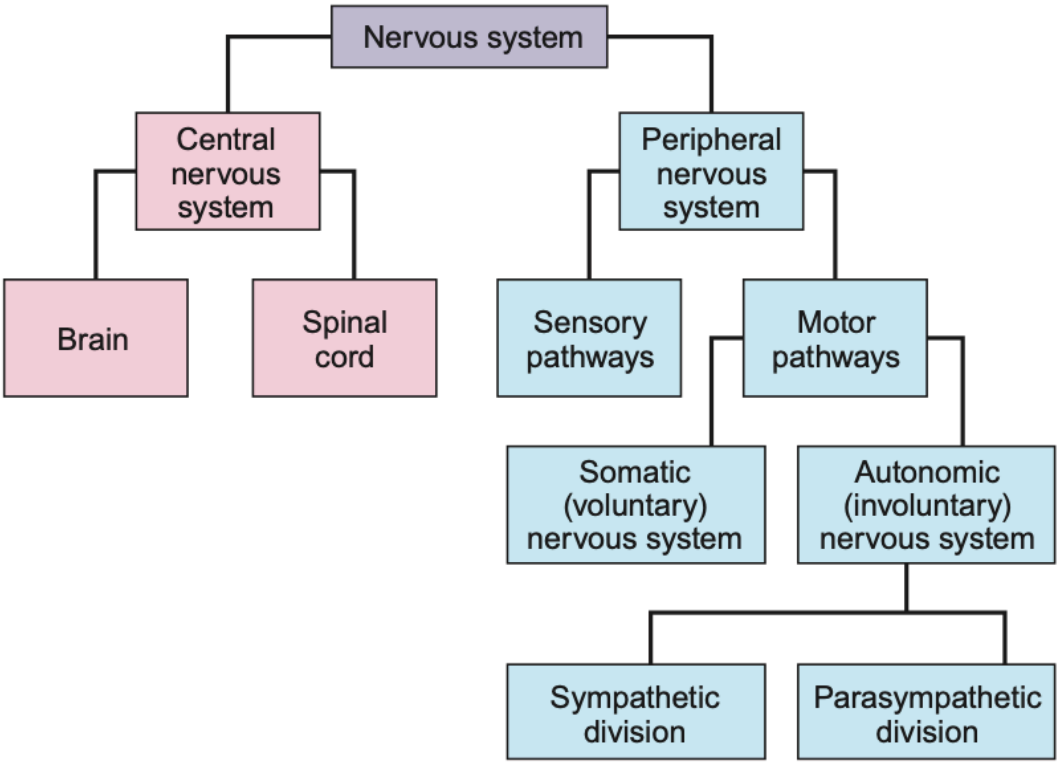
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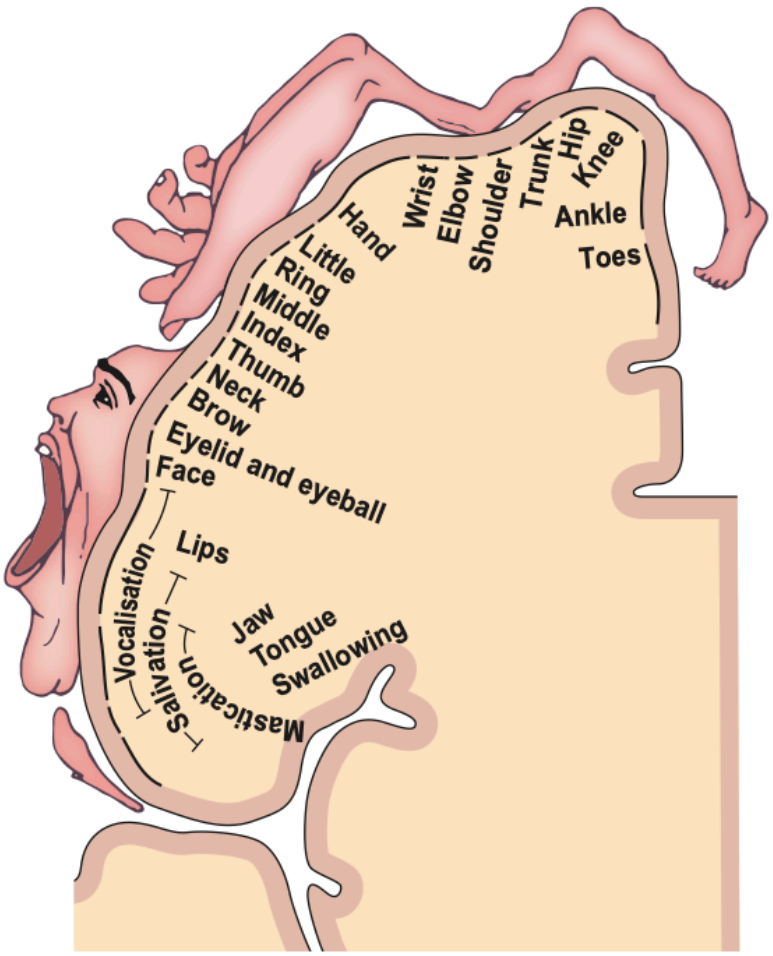
(a) The diagram below shows the organisation of the human nervous system.



(i) Complete the table below to show the differences between the divisions of the autonomic nervous system. [3]

	Sympathetic	Parasympathetic
Neurotransmitter		
General effect		
Effect on heart rate		

The somatic nervous system is involved in controlling voluntary movements via motor neurones, and sensory information via sensory neurones. This links to the motor and sensory cortex of the cerebrum of the brain. The diagram below shows a motor homunculus.



(ii) Explain what the motor homunculus represents. [1]

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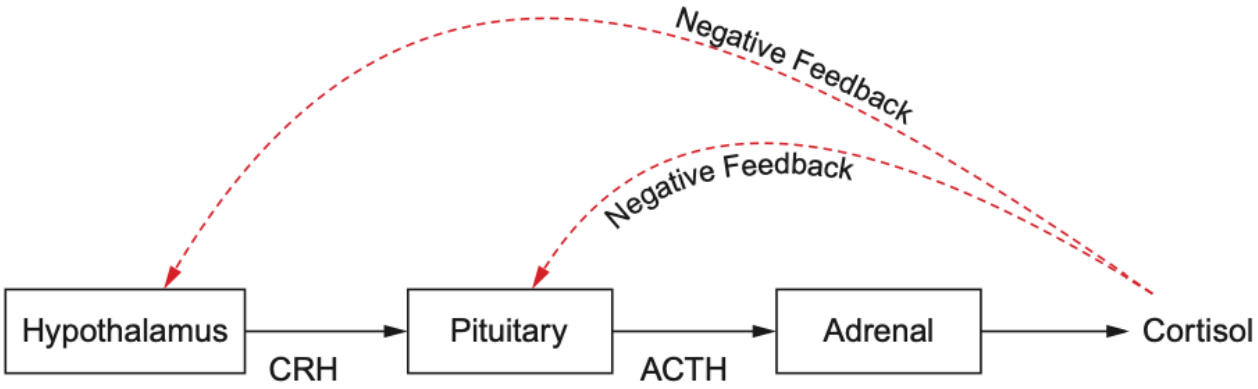
(iii) Suggest why the sensory homunculus would differ from the motor homunculus. [1]

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(b) The hypothalamus is the link between the nervous system and the endocrine system, and is found in the brain. It is closely associated with the pituitary gland.

Cortisol is a hormone produced by the adrenal glands and is involved in the body's response to stress. The normal release of cortisol is controlled by the hypothalamus as shown in the diagram below.



High levels of cortisol could be a cause of mental illness. Cushing's disease can be caused by a tumour on the pituitary gland, which causes an abnormally high level of ACTH to be released.

(i) Using the information above, and your own knowledge, suggest why mental illness has been linked with Cushing's disease. [3]

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(ii) The gene for cortisol is expressed in the cells of the adrenal gland.
Suggest how the expression of this gene could be affected in children who have experienced trauma. [2]

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(c) Behaviour describes many actions by living organisms in relation to other organisms or the environment they inhabit. Behaviours can be highly complex or seem quite simple.

Ants are social insects which live in large colonies.

(i) State the advantages to the ants of living in a colony. [2]

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(ii) Suggest how ants may communicate with each other. [1]

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Sexual selection has played a role in the evolution of courtship behaviours in vertebrates. Male elephant seals fight with other males for breeding rights, often with fatal consequences.

The photograph below shows two male elephant seals fighting.



(iii) State the type of sexual selection displayed by the male elephant seals. Explain the consequence of this type of selection. [2]

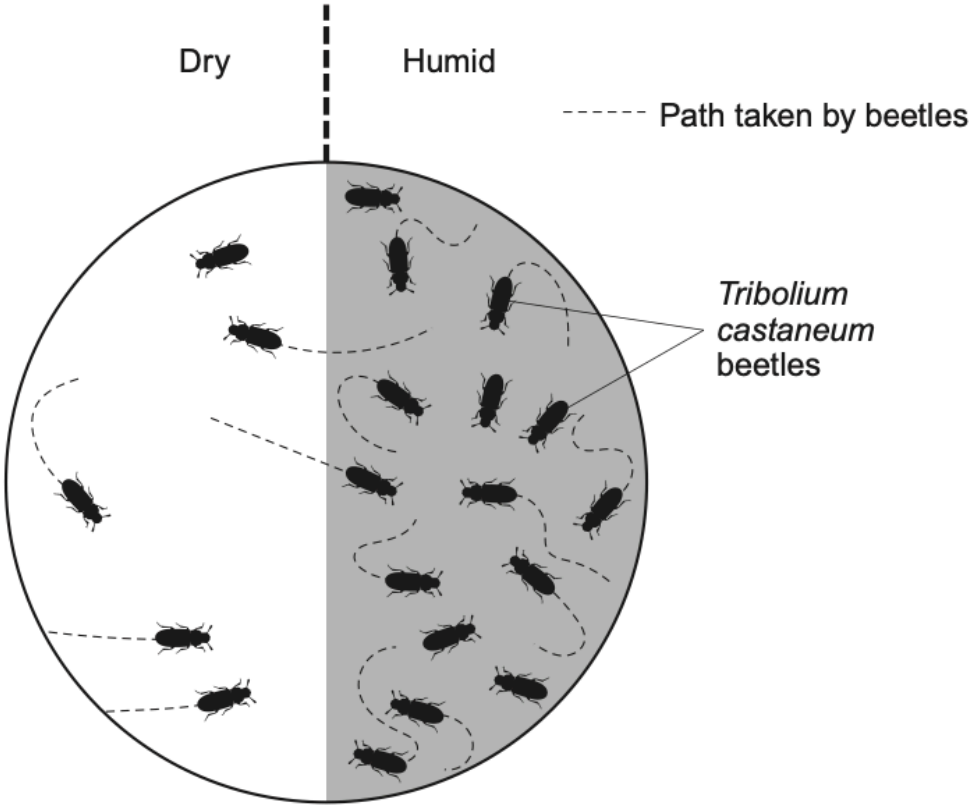
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(iv) Students carried out the following experiment to investigate behaviour in insects. Twenty *Tribolium castaneum* beetles were placed in a Petri dish which had dry and humid areas. The number of beetles found in each area was recorded every 30 seconds for 3 minutes.



State the type of innate behaviour exhibited by the beetles in response to the environment they are placed in. [1]

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(v) The null hypothesis for this experiment was that there was no significant difference between the observed and expected number of *Tribolium* beetles found in the dry and humid areas. A Chi-squared test was then performed on the data to test the null hypothesis.

Degree of freedom	p = 0.1	p = 0.05	p = 0.02	p = 0.01
1	2.705	3.841	5.024	6.635
2	4.605	5.991	7.378	9.210
3	6.251	7.815	9.348	11.345
4	7.779	9.488	11.143	13.277
5	9.236	11.070	12.832	15.086

The calculated value of Chi-squared for these data was 5.00 with one degree of freedom. Use this information to reach a conclusion for this experiment at a suitable level of significance. [4]

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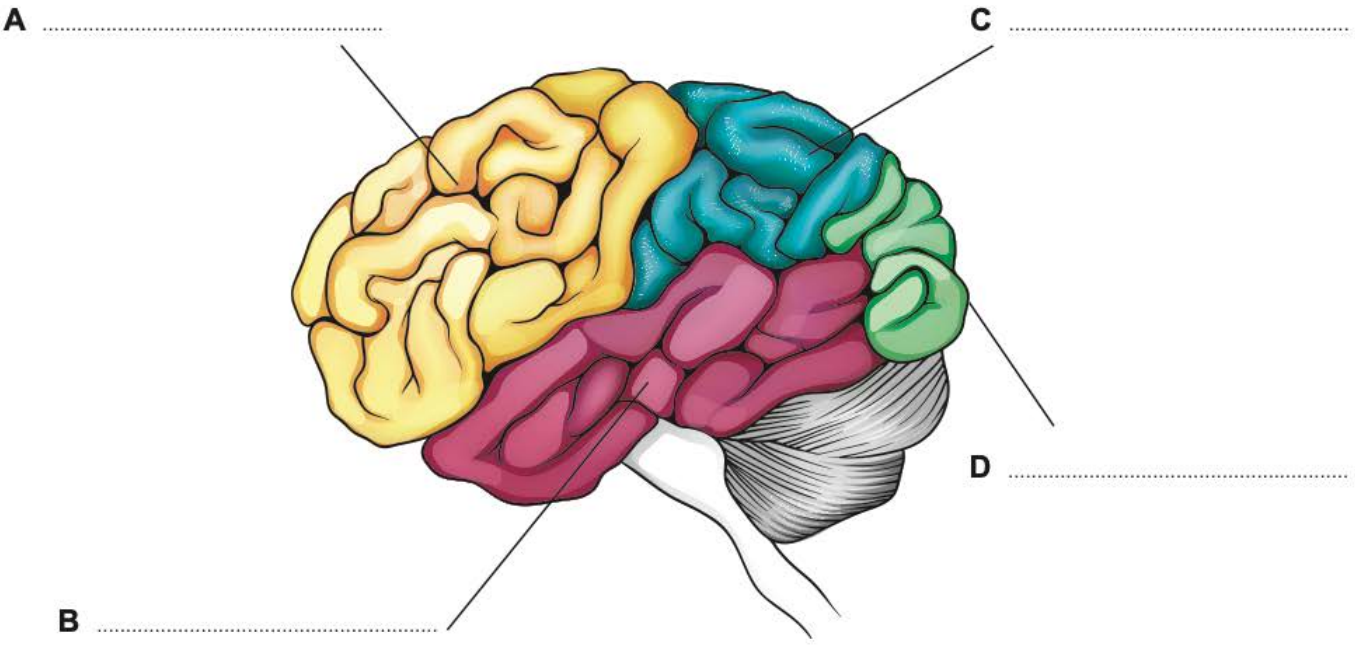
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5.

(a) Figure 10.1 shows the lobes of the cerebral hemispheres of the human brain.

Figure 10.1



(i) **Label the lobes A-D of the cerebral cortex** shown in figure 10.1. [2]

(ii) In humans the cortex is greatly folded and contains around 1.6×10^{10} neurones. Figure 10.2 shows the values for some other mammals.

Figure 10.2

Mammal	Number of cortical neurones
mouse	4×10^{6}
dog	1.6×10^{9}
long-finned pilot whale	3.72×10^{10}

The human has ten times more cortical neurones than the dog. Calculate how many times more cortical neurones are present in the human compared to the mouse. [1]

Answer = ...

(iii) State the conclusion you could make about the cognitive function of a long-finned pilot whale when compared to the other mammals. [2]

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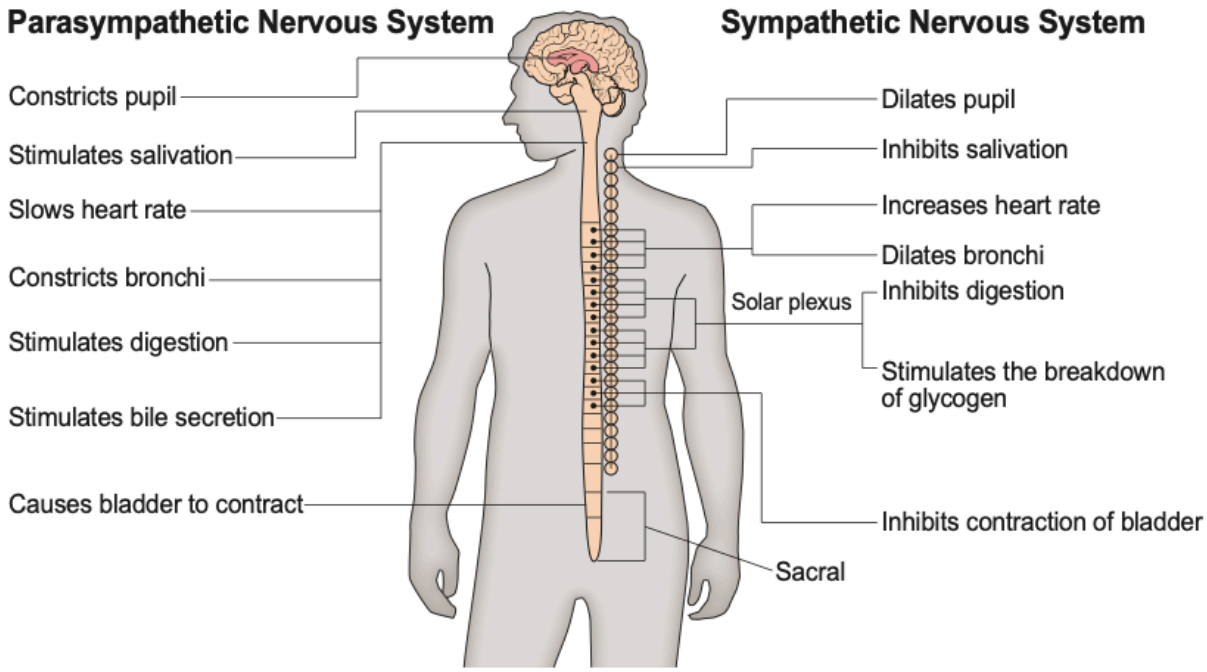
(iv) Damage to the cerebral cortex, through either injury or disease, produces different symptoms according to which lobe of the cerebral cortex is affected. Consider the case studies below and complete figure 10.3: [2]

Figure 10.3

Description of damage	Symptoms	Lobe of cerebral cortex affected
A steel bar went through the head of the patient in an accident in the 19th century.	Personality affected so he was rude to friends and lost all inhibitions, exhibiting very aggressive behaviour.	.....
Road traffic accident, the patient suffered head trauma.	Inability to distinguish colours and reported hallucinations.	.....
Injury sustained falling from mountain bike and banging his head against a tree.	The patient could not remember his children's names and forgot how to read a map.	.....

(b) Figure 10.4 shows the autonomic nervous system.

Figure 10.4



(i) Identify the neurotransmitters involved in the following divisions of the autonomic nervous system. [1]

parasympathetic .....

sympathetic .....

(ii) Using figure 10.4, describe and explain how the sympathetic nervous system helps an individual during a fight or flight response. [2]

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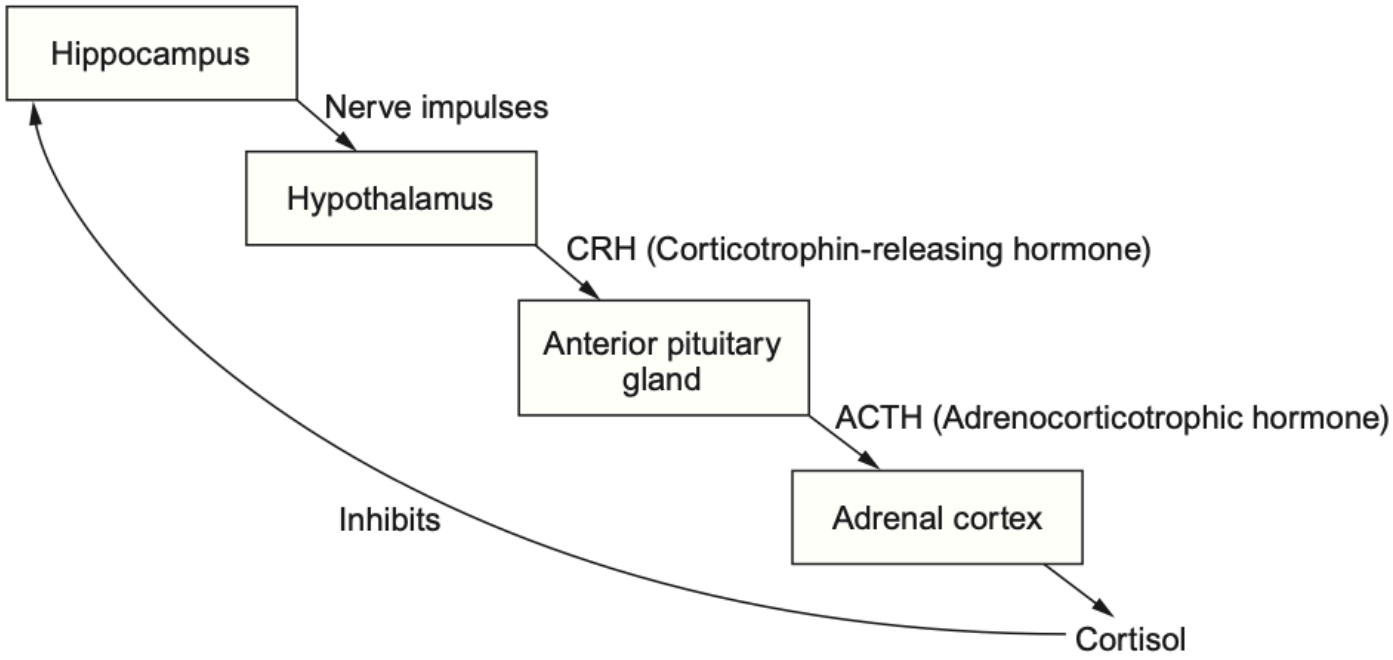
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(c) The hypothalamus releases a hormone, which leads to the production of cortisol as shown in figure 10.5:

Figure 10.5



(i) Using the diagram and your own knowledge, explain the role of the brain in preventing the individual becoming overstressed. [2]

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(ii) The blood cortisol levels of an individual who had suffered a traumatic childhood would be expected to be higher than normal. Explain why such individuals may be pre-disposed to mental illnesses throughout their lives. [1]

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(d) Bees show a variety of behaviour patterns which are innate and instinctive. On returning to their colonies, worker honeybees perform a dance to communicate to other bees the direction and distance of a food source.

(i) Explain why this social behaviour benefits the colony. [1]

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Karl von Frisch discovered much of what we know today about honeybee communication. He studied thousands of bees and collected data from more than one hive.

(ii) Identify the main risk associated with the study and how the risk could be minimised. [1]

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He observed that when food is more than 70 m away from the hive they perform a "waggle dance" in the hive. As shown in figure 10.6.

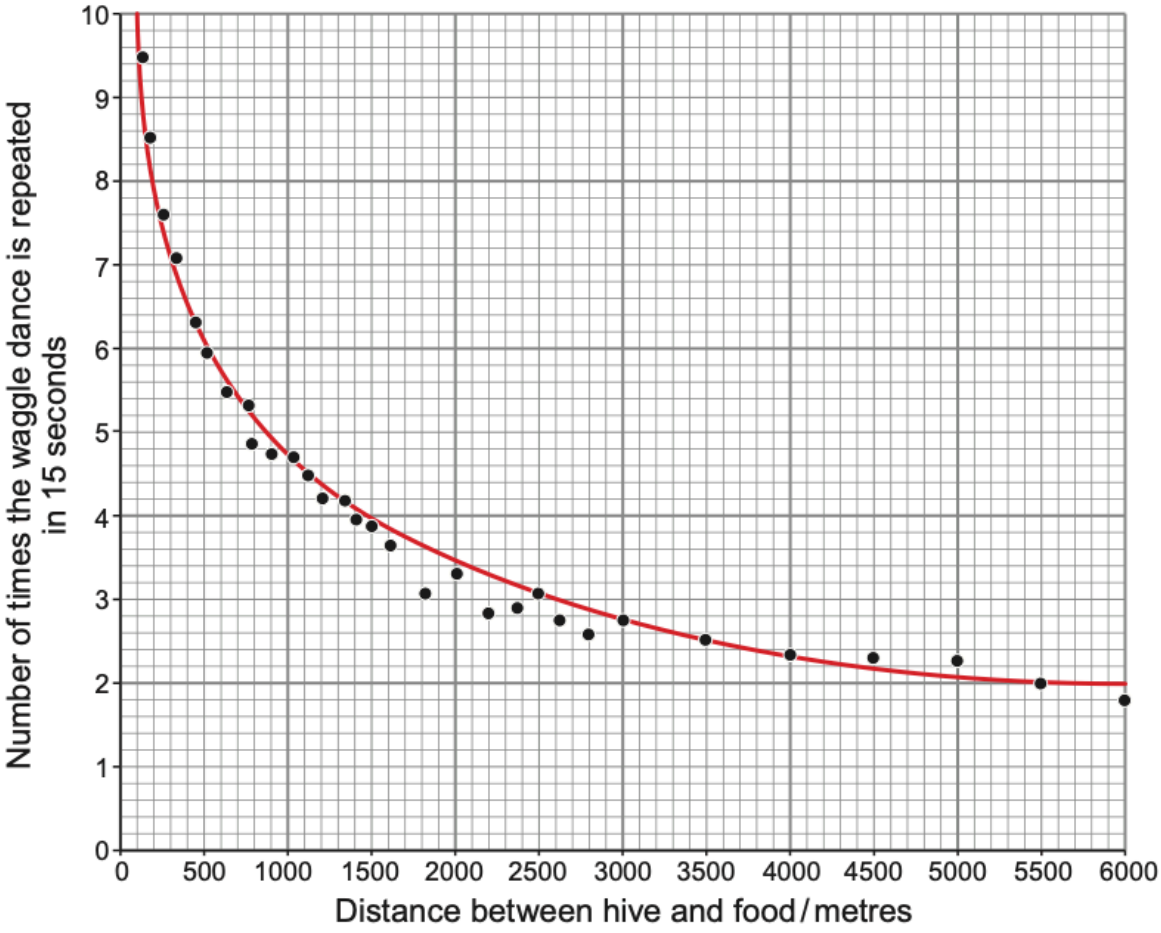
Figure 10.6



waggle dance
(food more than 70 m away)

The number of times the waggle dance is repeated in a unit of time depends on the distance between the hive and the food. This is shown in figure 10.7.

Figure 10.7



(iii) I. Using the graph, complete the table below by calculating the difference in the number of times the waggle dance is repeated in 15 seconds between 100 and 500 m. [1]

Distance between hive and food / m	Difference in number of times the waggle dance is repeated in 15 seconds
100-500	.....
3000-3500	0.2

II. Use the values from the table to conclude what happens to the accuracy of the waggle dance for finding food as the distance of the food from the hive increases. [1]

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(iv) There were two factors which were important in terms of making a valid conclusion.

1. Karl von Frisch studied thousands of bees and collected data from more than one hive.
2. His study has also been repeated by other scientists many times.

Explain why these **two** factors were important in terms of making a valid conclusion. [2]

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(e) Different groups of chimpanzees obtain food in a variety of ways. One group of chimpanzees was observed trapping colobus monkeys in order to eat them. Other groups use tools to get food; the way they do this varies from group to group. This is an example of social learning.
Explain the advantages of social learning to the different groups of chimpanzees. [1]

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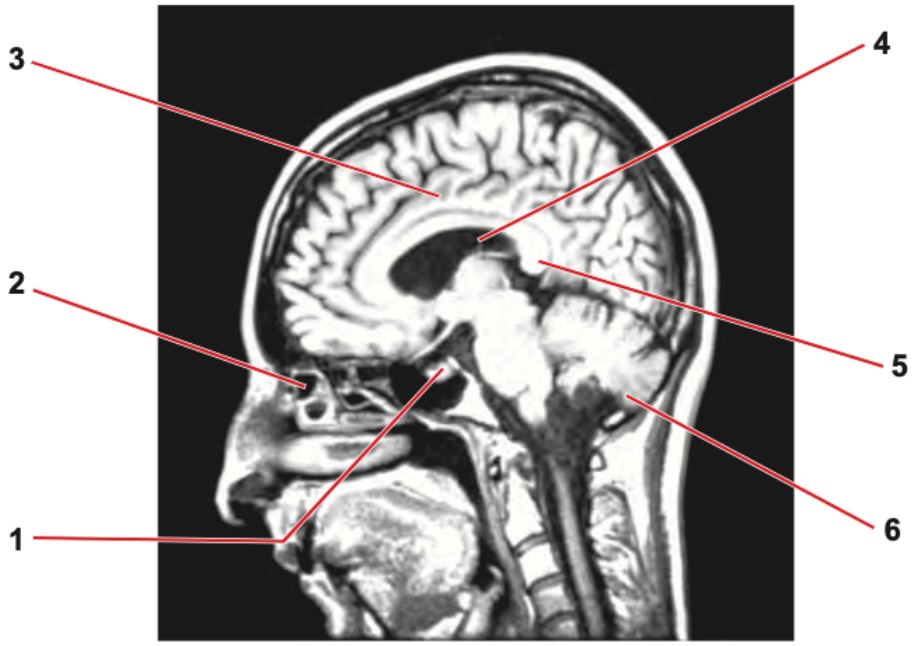
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6.

Scientists carried out research into possible changes that occur in the brains of taxi drivers, as a result of learning. To qualify as a London taxi driver, they have to learn every street name, landmark and direction of traffic flow. MRI images can be analysed to measure the volume of specific brain structures.

(a) (i) The following image depicts an MRI scan of a human brain. Which number **(1-6)** shows the hippocampus? [1]

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(ii) Suggest why the scientist studied the hippocampus region of the brain. Give reasons for your answer. [2]

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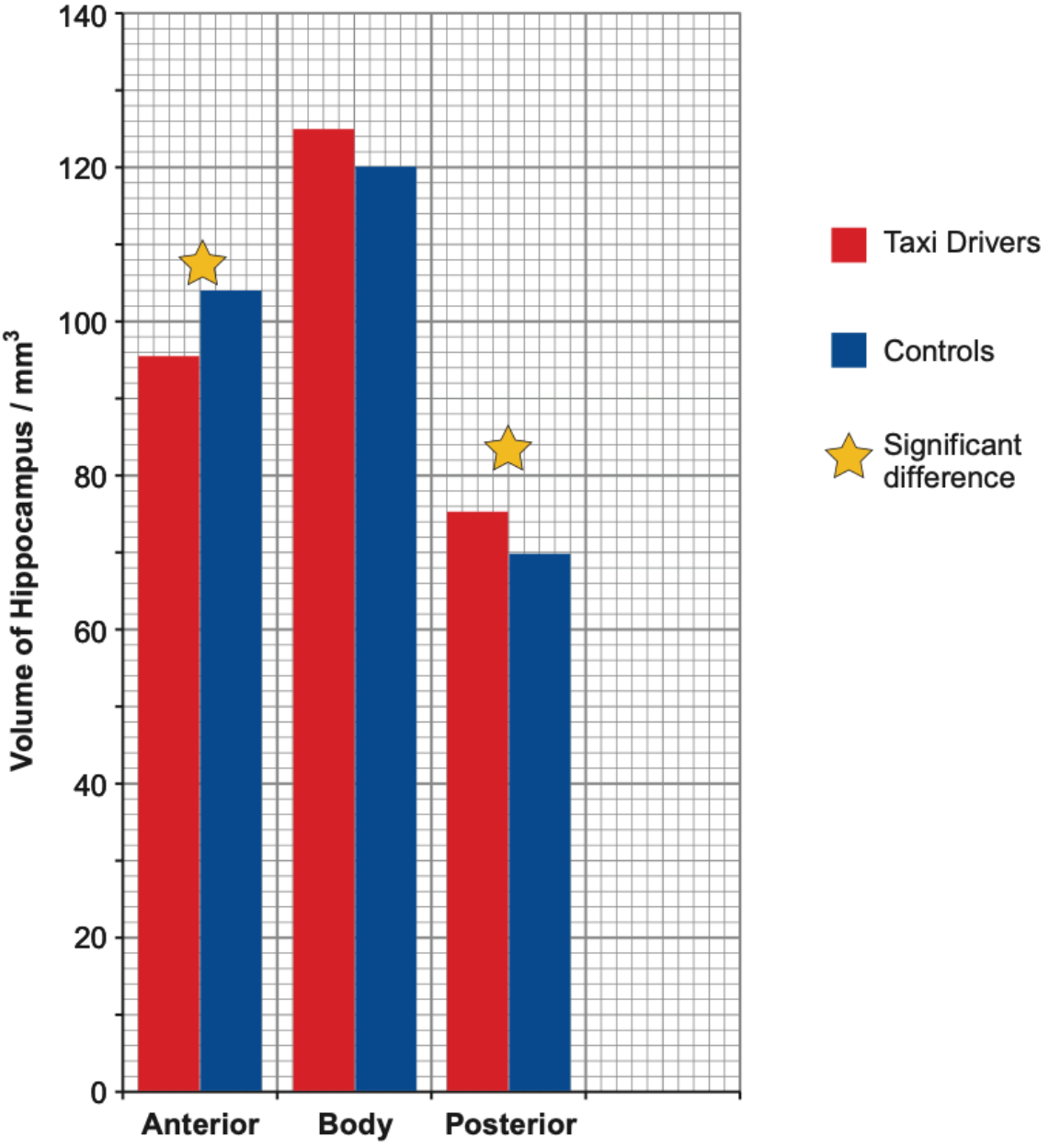
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(iii) The independent variable in this research was being a male taxi driver. The dependent variable was the volume of the hippocampus as seen using MRI. Male non-taxi drivers were used as controls in this study. Suggest **two** *other* factors regarding these individuals that should be controlled. [1]

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(b) The MRI scanned the anterior, body (middle) and the posterior regions of the hippocampus. The results from the research are shown below.



(i) The scientist's hypothesis stated, "the regions of hippocampi in London taxi drivers will be structurally different to the hippocampi in non-taxi drivers".
Using the results given, can the hypothesis be accepted? Justify your conclusion.
[4]

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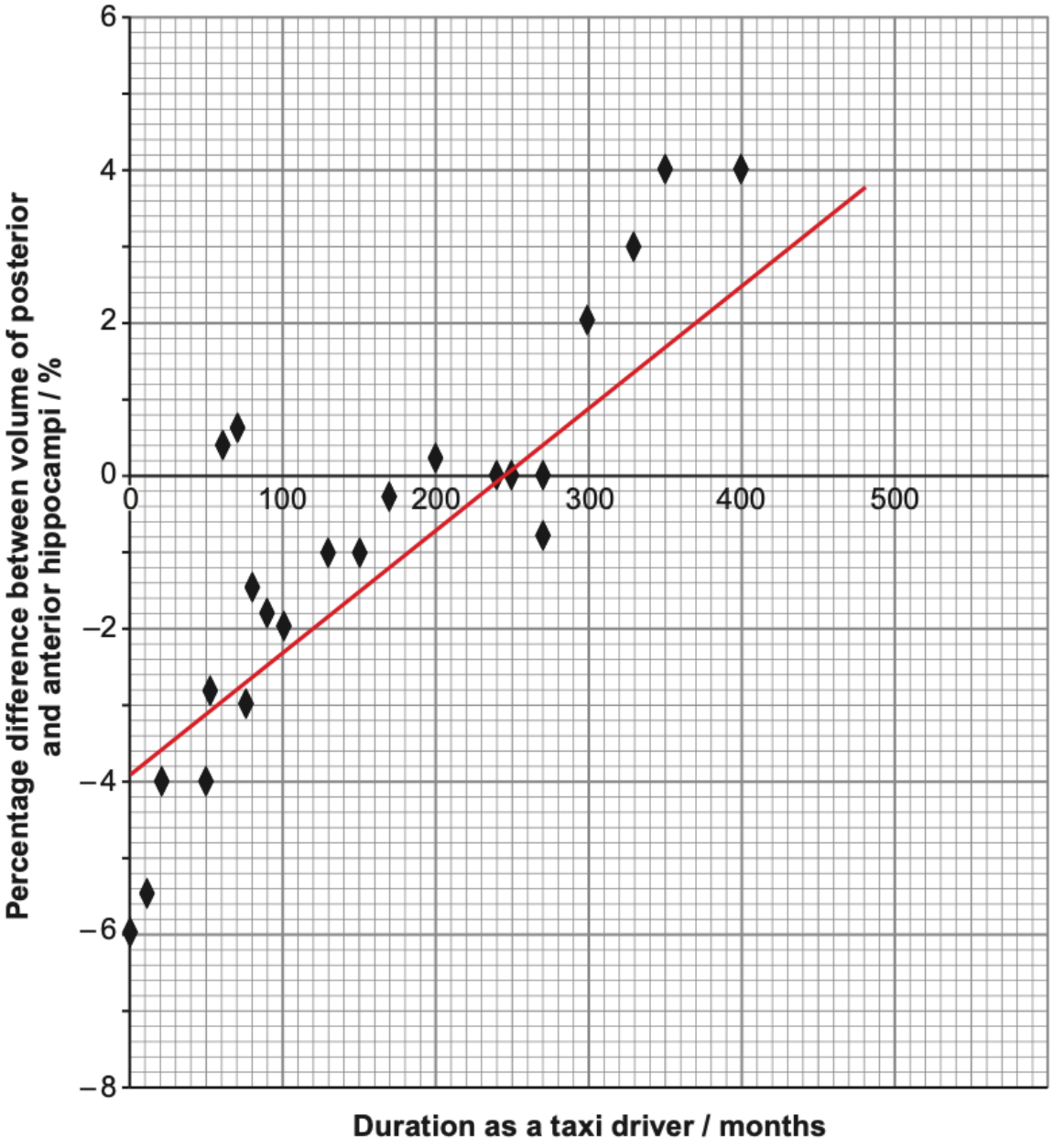
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The percentage differences between the volumes of the posterior and anterior hippocampi were plotted against the duration of time spent as a taxi driver.



(ii) The line shown on the graph is a correlation line. Using the trend shown and your knowledge of brain structure and neuroplasticity, what conclusions can be drawn? [4]

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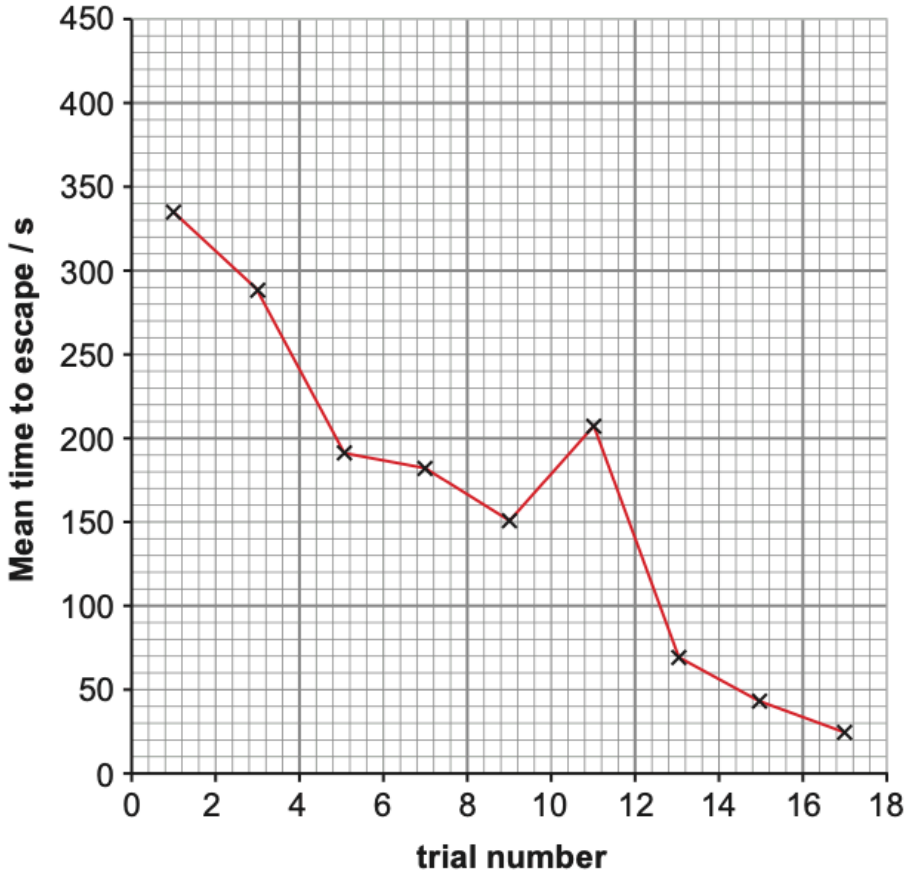
(iii) A further investigation is to be carried out to look at changes in brain activity during a map reading exercise whilst driving the taxi. Suggest a brain imaging technique that could be used and explain why it would be more suitable than MRI. [2]

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(c) In order to better understand learning in animals, researchers presented spotted hyenas *(Crocuta crocuta)* with a problem-solving task. Hyenas were placed in a puzzle box and were encouraged to escape to reach food placed outside. Researchers timed how long it took the hyenas to escape. The experiment was repeated several times.



(i) Calculate the percentage change in mean time to escape between the start and end of the trials. [2]

percentage change in mean time = ...

(ii) State and explain the type of behaviour exhibited by the hyenas. [2]

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(iii) Explain why the time taken to escape from the box decreases. [1]

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(iv) Suggest how the experiment could be modified to improve the reliability of the conclusion. [1]

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1.

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
1	(a)			Sensory homunculus shows relative sensitivity of different parts of the body **and** Motor homunculus shows the motor control of different parts of the body. (1) Any three (x1) from Area for hand is greater in the motor cortex – fine motor control (1) Area for face is greater in motor cortex – because of the fine motor control needed for {facial expressions/ chewing/swallowing/ vocalisation (1) Area devoted to tongue/lips/genitals greater in sensory cortex – due to large number of sensory receptors (1) No area in motor cortex for teeth, gums, genitals – No motor control of teeth, gums, genitals (1)	1	1 1 1		4		
	(b)	(i)		fMRI provides information on brain function + whereas MRI/CT scan provide images which show structure (1) Any two (x1) from • Neuroplasticity (1) • Undamaged axons grow new nerve endings to connect damaged neurons (1) • Recovery of function is associated with less (area of) brain activity, due to increasingly efficient neural circuitry (1)	1 1	1		3		
		(ii)		304 000 times greater = 2 marks If incorrect award 1 mark for 1 900 000 x 60 114 000 000		2		2	2	
		(iii)		Left motor {cortex/ area} (1) increasing brain activation seen on left side of cerebrum (1)			2	2		
		(iv)		Stroke in Broca's area – patient cannot produce speech (1) Stroke in Wernicke's area – patient does not understand speech (1)	1 1			2		
	(c)	(i)		Reduces aggression (1) Dominant males and females have {stronger/fitter} offspring, improving the survival/ advantageous alleles passed (1)		1 1		2		
		(ii)		Males fight for sexual access to females/ Sexual selection has favoured evolution of larger males.	1			1		
	(d)	(i)		They are used to being handled and show natural behaviour			1	1		
		(ii)		Positive (correlation)		1		1		1
		(iii)		Repeat investigation with more individuals/ with a different mob (1) Use data from individuals of the same age/same gender (1)			1 1	2		2
				Question 1 total	**6**	**9**	**5**	**20**	**2**	**3**

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2.

Question Option C				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
2	(a)		(i)	A Occipital lobe + B Frontal lobe (1) A Vision (1) B reasoning/planning/speech/movement/emotions/problem solving (1)	3			3		
			(ii)	EEG – measures {electrical/functional} activity of the brain (1) CT – gives brain images(1)	2			2		
	(b)		(i)	(During the critical period/between 0-5) synapses are formed and strengthened (1) If {Speech/Language} areas of the brain are not stimulated (1) There is more pruning of unused synapses (1) After critical period – brain is 'hard wired' and more difficult/impossible to form new synapses for language (1)		4		4		
			(ii)	{Less grey matter activity /darker scan } **and** fewer synapses			1	1		1
			(iii)	Any 1 from: high Cortisol levels (1) Epigenetic changes to the brain in the critical period/increased methylation(1) Maternal influence during pregnancy (1) e.g. stress/alcohol/smoking		1		1		
	(c)		(i)	Hippocampus/temporal lobe	1			1		
			(ii)	Group 1 is rewarded every time – operant conditioning, there is a steady decrease in errors (1) Group 2, is latent learning until day 10 (1) and then operant conditioning because reward given(1) Group 3 latent learning only no reward given (1)			4	4		
			(iii)	(-)70 % = 2 marks $\frac{20-6}{20} \times 100$ = 1 mark		2		2	2	
			(iv)	**Any two (x1) from:** Age/gender of rat (1) length of time left in the maze (1) mass of rat (1) same maze (1) same reward (1)		2		2		2
				Question 2 Option C total	**6**	**9**	**5**	**20**	**2**	**3**

3.

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
3	*(a)*			All three for 1 mark A - Cerebral cortex / cerebrum / frontal lobe B - Cerebellum C - Medulla oblongata	1			1		
	(b)	(i)		MRI scan shows {structural anatomy of the brain/pictures which are static} **and** PET scans shows areas of the brain which are functioning at a particular time (1) MRI wouldn't show active areas of the brain, as language is an active process (1)	2			2		
		(ii)		Any 5 x (1) from: A. {Broca's area is the same in both / same colour on scan} as both produce language (1) B. Increased use of motor cortex in BSL / more activity in that area in scan (1) C. because BSL involves more movement than speech alone (1) D. Increased {use/ activity} of the occipital lobe for {vision in BSL / visual stimuli} (1) E. Decreased use of the auditory cortex in BSL/ less activity in that area(1) F. as no link to sound and ear/ no sound detected (1)		2	3	5		
		(iii)		Any 2 x (1) from: Age when became deaf (1) Reason for deafness/ or description of (1) Level of deafness (1)		2		2		2
		(iv)		Deaf people may exhibit neuroplasticity /'brain has adapted to form new connections as there is no auditory stimuli being received (1) Auditory cortex involved in interpretation of BSL (as near to Wernicke's area) (1) New connections/different connections to hearing between auditory cortex and {Broca's / Wernicke's} area (1)	1		2	3		
	(c)	(i)		Building a nest / to attract a mate/increase reproductive success / protect offspring/eggs / reduce competition with other males for mating (1)	1			1		
		(ii)		sign stimulus - a stimulus which elicits/causes a FAP (fixed action pattern) in the sticklebacks/ produced by one individual, causes a response in a second individual (1) Red belly triggers the aggressive behaviour/ attack/ bite (1) Data reference twice as many bites seen when red bellied model used/ more aggression seen when red bellied model used (1)	1	2		3		
		(iii)		5.6 = 2 marks 5.59 = 1 mark $\sqrt{\frac{343.3}{11}} = 1$ mark		2		2	2	
		(iv)		Reduce confidence in conclusion as SDs overlap (1)		1		1		1
				Question 3 total	**6**	**9**	**5**	**20**	**2**	**3**

4.

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
4	(a)	(i)		<table><tr><td></td><td>Sympathetic</td><td>Parasympathetic</td></tr><tr><td>Neurotransmitter</td><td>Noradrenaline NOT adrenaline</td><td>Acetylcholine (1)</td></tr><tr><td>General effect</td><td>Excitatory/ stimulatory;</td><td>Inhibitory (1)</td></tr><tr><td>Effect on heart rate</td><td>Increases</td><td>Decreases; (1)</td></tr></table> **1 mark for each row**	3			3		
		(ii)		The larger the area on the motor cortex + increased movement {complexity/ increased fine movements} NOT number of motor neurones	1			1		
		(iii)		Increased sensory cortex to areas more receptive to stimuli / or example increased sensory cortex for genitals/ hand/ tongue etc (1)		1		1		
	(b)	(i)		Cortisol levels raised (1) Cortisol levels raised all the time (1) Negative Feedback loop {not working/ overridden/ faulty} (1)		2	1	3		
		(ii)		Epigenetic factors (1) Increased gene expression leading to increased cortisol levels (1)		2		2		
	(c)	(i)		Division of labour/ separate working groups/ different groups for different jobs/ 2 examples from: care of offspring/ looking for food/ reproduction/ defence of the colony (1) Increased efficiency (1)		2		2		
		(ii)		Pheromones/visual cues / touch/ movement		1		1		
		(iii)		Intra-sexual (selection)(1) Males more aggressive / increases sexual dimorphism / weaker males die off / strong males {survive/ reproduction}/ passing on of advantageous alleles (1)	1	1		2		
		(iv)		Kinesis Accept: orthokinesis / klinokinesis	1			1		
		(v)		• Critical value of Chi-squared = 3.841 (1) • Calculated Chi-squared of 5.00 {> critical value/ to the right of the critical value} (1) • Reject {the null hypothesis/ H_0}(1) • there is less than a 0.05 probability the results are due to chance/ Significant difference between {the dry and humid environments/ O and E} (1)			4	4	2	3
				Question 4 total	**6**	**9**	**5**	**20**	**2**	**2**

5.

Question				Marking details	Marks available					
					AO1	AO2	AO3	Total	Maths	Prac
5	*(a)*	(i)		A Frontal lobe B Temporal lobe C Parietal lobe D Occipital lobe 4 correct – 2 marks 2/3 correct – 1 mark 0/1 correct – 0 marks	2			2		
		(ii)		Mouse – 4000 times		1		1	1	
		(iii)		The long finned pilot whale has many more cortical neurones, (1) and so is likely to have a complex language / process sensory input. (1)		1	1	2		
		(iv)		Frontal lobe Occipital lobe Temporal lobe 3 correct – 2 marks 2 correct – 1 mark 0/1 correct – 0 marks		2		2		
	(b)	(i)		**Both for 1 mark** Acetylcholine Noradrenaline	1			1		
		(ii)		Increases heart rate/ ventilation/ blood pressure. (1) This ensures that muscles are supplied with blood to enable the response/ diversion of blood from {gut/skin} to muscles/ more oxygen delivered to muscles. (1)	1	1		2		
	(c)	(i)		Cortisol binds to glucocorticoid receptors in the hippocampus. (1) The hippocampus sends nerve impulses to the hypothalamus, inhibiting it/ owtte (1)	1	1		2		
		(ii)		Negative feedback doesn't work, (This increases vulnerability to mental illness.)	1			1		
	(d)	(i)		They will be more efficient at finding food.			1	1		
		(ii)		Main risk: bee stings – minimise by wearing protective clothing/ any sensible suggestion. (1)		1				1
		(iii)	I	10.0 – 6.0 = 4.0 turns (1) Accept 3 - 4		1		1	1	
			II	Accuracy decreases with distance because there is less difference in turns as the distance is further away. (1)			1	1		
		(iv)		Many bees from different hives increases reliability/ repeatability of data (1) Other studies getting similar data./ peer review/ reproducibility (1) Penalise "accuracy" once only.			2	2		2
	(e)			allows them to {adapt to/ access available food} in different environments they are in/ owtte		1		1		
				Question 5 total	6	9	5	20	2	**3**

6.

Question				Marking details	Marks Available					
					AO1	AO2	AO3	Total	Maths	Prac
6	(a)	(i)		Label 1	1			1		
		(ii)		It is involved in learning/ consolidate memories/ spatial memory/ spatial awareness/ navigation(1) permanent memory storage(1) short term to long term memory = 2 marks	2			2		
		(iii)		**Any 2 for 1 mark from:** age/ health/ driving experience / OWTTE			1	1		1
	(b)	(i)		• Yes(1) • posterior hippocampus - significantly {greater volume/ larger}in taxi drivers / ORA(1) • anterior hippocampus was significantly {smaller/ lower volume} in taxi drivers / ORA(1) • hippocampus body - no significant difference between the two groups (1)		3	1	4		
		(ii)		Positive correlation/ as time increases percentage difference increases(1) neuro plasticity: change in structure of brain / new neurones/ new neural pathways/new (neural) connections/ new synapses/ synaptic pruning (in response to change) (1) ACC ref to strengthening / reinforcing / weakening neural pathways redistribution of neurones from anterior to posterior (1) (1) redistribution of neurones from anterior to posterior (1) (indicates) map / street name memory stored in posterior hippocampus (1)		2	2	4		2
		(iii)		Electroencephalography /EEG (1) portable (whereas as MRI isn't)/ Owtte (1)	1	1		2		
	(c)	(i)		335-25/335 x100 / 25-335/335 x 100 (1) 92.5%/ 93% / -92.5% / -93% (2)		2		2	2	
		(ii)		Operant conditioning (1) hyenas rewarded with food/ learning associated with a {reward/ reinforcement/ food} (1)	2			2		
		(iii)		(In successive trials the hyena would) learn that escaping would have favourable consequences /{learn/ remember} the route/ learn how to escape/ positive reinforcement		1		1		
		(iv)		Increase sample size/ use more or different hyenas/ do more trials/ compare against a control/ group description of control (1) NOT different animals / species of hyena / different puzzle box			1	1	1	
				Question 6 total	**6**	**9**	**5**	**20**	**2**	**3**