WJEC (Eduqas) Biology A-level Option 3.C: Neurobiology and Behaviour

Questions by Topic - Mark Scheme

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**

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><th></th><th>Sympathetic</th><th>Parasympathetic</th></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**