Investigating Brain Function - Mark Scheme

Q1.

Question Number	Answer	Additional guidance	Mark
(a)	1. idea of comparative image clarity ; 2. CT therefore can only identify {larger / main} structures / MRI can identify smaller structures / eq ; 3. Reference to tissue identified / eq ; 4. MRI uses {radio waves / magnetic field}, CT uses X-rays / eq ; 5. Idea of both give {2D / 3D} images ; 6. limitation of MRI or CT ; 7. idea of images for both are at one point in time ; 8. ref to comparative cost of use ;	ACCEPT 1 - image resolution {higher in MRI / lower in CT} / MRI offers more detail ACCEPT 6 – MRI-noisy, need to keep still, not so good for people with metal implants, pacemakers CT ref to safety aspects of X-rays ACCEPT 8 - MRI more expensive than CT	**(3)**

Question Number	Answer	Additional guidance	Mark
(b)	1. view brain activity directly / eq ; 2. idea of see brain activity over a period of time ; 3. safer as does not use X rays ; 4. no need to use special dyes ;	ACCEPT 1 – MRI identifies active areas by greater blood flow, greater oxygen uptake, presence of more oxyhaemoglobin in these areas ACCEPT 2 – see in real time, quotes figures such as fMRI takes up to 4 images a second or moving image, CT is still image	**(2)**

Question Number	Answer	Additional guidance	Mark
(c)(i)	1. idea that tumour tissue differs from brain tissue ; 2. detail of effect on scan e.g. {energy source / magnetic field / radio waves / eq} {absorbed / blocked / eq}} ; 3. Ref to difference in blood supply ;	ACCEPT 1 - ref to relative densities, tumour growing / dividing / mutated cells	**(2)**

Question Number	Answer	Additional guidance	Mark
(c)(ii)	1. Idea that (treatment) has been partially successful ; 2. tumour reduced / eq ; 3. reduction qualified e.g. in contact with less brain tissue or size reduction quoted ;	ACCEPT 3 - affecting less brain tissue Halved in size	**(2)**

Question Number	Answer	Additional guidance	Mark
(c)(iii)	1&2. two appropriate functions given e.g. think, learn, show emotions, memory, personality, reasoning, eq ; ; 3. Because tumour is situated in the frontal lobe / cerebral hemispheres / cerebrum ;	ACCEPT 1&2 – decision making, problem solving, planning, intelligence, controls voluntary behaviour, forming associations (combining information from rest of cortex) ACCEPT 3 – frontal cortex	**(3)**

Q2.

Question Number	Answer	Additional Guidance	Mark
(a)	**Labelled structure** / **Name of structure** / **One function** A / Medulla (oblongata) ; / Controls {breathing / heart / eq} ; C ; / Cerebral hemisphere/ cerebrum / frontal cortex ; / Feel emotions	ACCEPT for function of A: involuntary muscles or named e.g. swallowing, vomiting, sneezing ACCEPT for cerebrum: frontal lobe / prefrontal / cerebral cortex	**(4)**

Question Number	Answer	Additional Guidance	Mark
(b)(i)	1. idea that cuts at a specific sequence of bases ; 2. idea of (generates) sticky ends ; 3. so easier to join together / eq ;	3. ACCEPT to produce {same / complementary / eq} sticky ends (in plasmid and (human) gene)	**(2)**

Question Number	Answer	Additional Guidance	Mark
(b)(ii)	1. the chemical could be a {transcription factor / hormone} ; 2. idea of interaction at (bacterial) cell (surface) membrane ; 3. idea of transcription factor being activated ; (e.g. transcription initiation complex formed, binds to transcription factor) or counters inhibitor ; 4. reference to promoter region ; 5. idea of transcription occurs e.g. RNA polymerase binds, mRNA produced ;	2. ACCEPT binds to cell surface membrane / passes through	(3)

Question Number	Answer	Additional Guidance	Mark
(b)(iii)	(ribosome has) larger and smaller subunit / (ribosomal) protein and rRNA ;	ACCEPT ref to 2 subunits	(1)

Question Number	Answer	Additional Guidance	Mark
(b)(iv)	1. larger lumen so easier to put into blood / eq ; 2. {less muscle / thinner wall} so easier to penetrate / eq ; 3. (blood) pressure less so less damage to vein / eq ; 4. idea that vein is easier to find;	ACCEPT converse when appropriate 3. ACCEPT (blood) pressure less so less blood loss 4. ACCEPT vein nearer the skin surface	(2)

Q3.

Question Number	Answer	Mark
(a)	<table><tr><th>Labelled structure</th><th>Name of structure</th><th>One function</th></tr><tr><td>A</td><td>cerebellum ;</td><td>coordinates movement / balance / posture / fine motor control ;</td></tr><tr><td>D ;</td><td>hypothalamus ;</td><td>Thermoregulation</td></tr></table>	(4)

Question Number	Answer	Additional guidance	Mark
(b)	1. heat (energy) from blood in capillaries / eq ; 2. absorbed by sweat ; 3. used to break H bonds in water ; 4. reference to latent heat ; 5. (so) water evaporates ; 6. taking heat from the body / eq ;		(3)

Q4.

Question Number	Answer	Additional guidance	Mark
(c)(i)	1. reference to arrival of { impulse / action potential / eq } ; 2. calcium ion {channels / eq } open in { pre-synaptic membrane / brain cell membrane / eq } ; 3. calcium ions enter (brain cell) through {diffusion / down concentration gradient } ; 4. causes (glutamate-rich) vesicles to {move towards / fuse with} pre-synaptic membrane / eq ; 5. {neurotransmitter / glutamate} release through exocytosis ;		(4)
Question Number	**Answer**	**Additional guidance**	**Mark**
(c)(ii)	1. idea that the damaged areas can be identified on MRI scan ;		
	2. idea that these damaged areas are known to be areas associated with the release of glutamate ; 3. comparison with and without domoic acid ;	3. ACCEPT in terms of comparison of brain regions or sea lions	(2)

Question Number	Answer	Additional Guidance	Mark
(i)	1. fMRI ; and any two from: 2. (fMRI) operates in real time / eq ; 3. as experience will be short lived / eq ; 4. Active areas will {light up / be coloured / eq} (on the image) / eq ; 5. high resolution (as areas involved may be small) / eq ; 6. Safer / eq ;	**2 ACCEPT** live images, 4 images per second **4. ACCEPT** idea of active areas require more oxygen/ oxygenated blood 5 **ACCEPT** more pixels, image is more detailed **6. ACCEPT** ref. to not using X rays, etc	**(3)**

Question Number	Answer	Mark
(ii)	D ;	**(1)**

Q5.

Question Number	Answer	Additional Guidance	Mark
(a)(i)	1. identical twins (agreement) is greater / eq ; 2. credit correct manipulation of the data e. g. {41% more / 2.4x as much / 141% higher / eq} agreement than non-identical twins ; 3. idea that alleles are involved ; 4. idea that non-identical have genetic differences ; 5. idea that because less than 100% then some other factor is involved ;	ACCEPT converse where appropriate 2. ACCEPT 41% difference 3. ACCEPT gene alternatives 4. ACCEPT identical twins are genetically the same	**(4)**

Question Number	Answer	Additional Guidance	Mark
(a)(ii)	idea that there is less of a gap between the results ;	ACCEPT expressed as numbers, results similar (to each other), identical twin result is lower, non-identical twin result is higher	**(1)**

Question Number	Answer	Additional Guidance	Mark
(b)	1. idea that active areas have more {oxygen / oxygenated blood} ; 2. active areas involved in face recognition will be identified / eq ; 3. idea of level of brain activity between identical twins and non identical twins is compared ; 4. to offer supportive evidence / improve validity of study ; 5. idea that fMRI shows brain activity in real time ; 6. idea of high resolution ; 7. comment on safety / eq ;	3. ACCEPT idea of {areas more active / more oxygenated blood flowing to areas} in identical twins compared with non-identical twins 3. ACCEPT idea of {more / eq} areas showing activity in common in identical twins than non-identical 7. ACCEPT fMRI does not use X rays	(4)

Q6.

Question Number	Answer	Additional Guidance	Mark
	1. idea of rats have rights; 2. rats made {blind/ eq } ; 3. 15 samples may not be sufficient for a reliable investigation / eq ; 4. idea that rat retina may not behave like human retina (so investigation has no (potential) medical application) ;	1. **ACCEPT** lack of consent given 2. **ACCEPT** harmed, causes pain, requires killing rats 4. **ACCEPT** tissue culture available	(2)

Q7.

Question Number	Acceptable Answer	Additional Guidance	Mark
(a)	• 2.03 – 1.53 = 0.5 ÷ 2.03 x 100 (1) • = 24.63% (1)		**(2)**

Question Number	Acceptable Answer	Additional Guidance	Mark
(b)	An explanation that makes reference to three of the following: • moving shadow and touch are perceived as presence of {danger / predator} (1) • response to touch is greater than to shadow because touch perceived as {more dangerous/ closeness of predator} (1) • response in tube is greater than response out of tube because tube provides physical surface to assist {contraction/ withdrawal} (1) • worm has receptors and those for light generate less response than those for touch (1) • when out of tube, a shadow stimulus affects all of a worm but a touch stimulus affects part of a worm (1)		**(3)**

Question Number	Acceptable Answer	Additional Guidance	Mark
(c)(i)	An answer that makes reference to the following: • prevents wasting energy (1) • allows maximum feeding effort (1)		**(2)**

Question Number	Acceptable Answer	Additional Guidance	Mark
(c)(ii)	An explanation that makes reference to the following: • there is less response because there is less depolarisation of the post–synaptic membrane (1) • because there are fewer calcium ions entering the pre synaptic membrane so fewer vesicles fuse with the presynaptic cell membrane (1) • so less neurotransmitter diffuses across the synaptic cleft (1) • therefore less binding to the receptors on the post– synaptic membrane so fewer sodium channels open (1) • resulting in no {action potential / impulse} in the post– synaptic neurone leading to no withdrawal response (1)	Allow description of sodium ion movement	**(5)**