Question			Answer	Mark	Guidance
1	(a)		*both have* **1** **dendrite**(s) **;** **2** an **axon ;** **3** a **cell body** with a **,** nucleus / named organelle **;** **4** **myelin** sheath / myelinated / (covered with) **Schwann** cell / nodes of Ranvier **;** **5** <u>voltage</u>-gated channels / sodium-potassium (ion) pump **;**	**3 max**	**1** **DO NOT CREDIT** if states that motor neurone has dendrites and a dendron **3** e.g. mitochondria / Golgi / SER / RER **4** **CREDIT** may have / can have
			QWC ;	**1**	Award if **3** of the following terms have been used in a correct context with correct spelling: **dendrite(s)** **axon(s)** **cell body(ies)** **myelin** (or derived term) **schwann** ***Please insert a QWC symbol next to the pencil icon, followed by a tick (✓) if QWC has been awarded or a cross (✗) if QWC has not been awarded.*** ***You should use the green dot to identify the QWC terms that you are crediting.***
1	(b)		**M ;** **B ;** **M ;**	**3**	**Mark the first answer in each box.** If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = **0 marks**

Question			Answer	Mark	Guidance
1	(c)	(i)	**1** evaporation will **,** have a cooling effect / reduce (body) temperature **;** **2** heat **,** taken from / supplied by **,** the body / blood / skin , is **,** needed / used for **,** evaporation **;** **3** *idea that* water has a high latent heat of **,** vaporisation / evaporation **;**	**2 max**	**2** **ACCEPT** evaporation uses latent heat Look for a clear statement that body heat is being ***used*** for evaporation **3** e.g. evaporation of water needs a lot of , energy / heat
1	(c)	(ii)	*idea that* to increase body temperature as it is lower than the 'new' set-point (even though body is hot) **;**	**1**	e.g. as the new 'normal' body temperature is higher, the body is using shivering to raise the temperature of the internal environment.
1	(d)		**1** vasodilation results in more blood nearer to the skin surface **;** **2** *idea that* will lose (even) more heat / further heat loss (from body) / body temperature decreases further **;** **3** (named) organ(s) will not be able to maintain **,** function / metabolism **;**	**2 max**	**1** Vasodilation must be in correct context (arterioles). **DO NOT CREDIT** (large) arteries / capillaries / veins , relaxing / dilating / expanding **DO NOT CREDIT** blood vessels moving closer to the surface **2** just 'the body loses heat' is not enough **3** **ACCEPT** ref to lack of kinetic energy for enzymes **ACCEPT** ref to lack of enzyme activity
			Total	**12**	

Question			Answer	Mark	Guidance
2	(a)	(i)	it converts energy (mechanical) into **,** another / different **,** form of energy (electrical) **;**	1	If type of energy is specified, it must be as indicated in the brackets **ACCEPT** 'converts one form of energy into another' **IGNORE** pressure
2	(a)	(ii)	*idea that deformation of membrane will allow more Na^+ through because* **1** (the increased pressure) causes sodium (ion) channels to open **;** **2** (temporary) gaps / holes / spaces **,** appear **,** between the <u>phospholipids</u> / in the <u>bilayer</u> **;**	1 max	**1** **CREDIT** Na^+ channels **DO NOT CREDIT** Na channels **DO NOT CREDIT** ref to voltage(-gated) channels **2** **IGNORE** weakened **DO NOT CREDIT** '*breaks* in the bilayer' **DO NOT CREDIT** 'pores' for 'gaps' **DO NOT CREDIT** idea of additional **,** channels / carriers **,** inserted
2	(a)	(iii)	if the **,** stimulus is not strong enough / threshold (value) is not reached / depolarisation (of membrane) is insufficient **,** then **,** it / an action potential **,** is not **,** generated / AW **;** **ora**	1	**ACCEPT** 'impulses' for 'action potentials' **DO NOT CREDIT** ref to 'strength' of an action potential **IGNORE** ref to numerical value for threshold potential **IGNORE** ref to 'it' or 'action potential' reaching threshold **DO NOT CREDIT** ref to action potentials of different sizes/values

Question			Answer	Mark	Guidance
2	(a)	(iv)	**1** *idea that* it is represented by the frequency of the action potentials **;** **2** high **,** frequency / rate (of generation) **,** of action potentials shows **,** a strong / an intense **,** stimulus **;** **ora**	2	**Note: max 1 if term 'frequent' or derived term NOT used in answer** **ACCEPT** 'impulses' for 'action potentials' **1** **CREDIT** represented by how **,** frequently / often**,** the action potentials are **,** transmitted / generated **2** **DO NOT CREDIT** ref to speed of **,** action potentials / impulses **Note:** e.g. 'a higher frequency of impulses represents a strong stimulus' **= 2 marks**
2	(b)		*action potentials not generated because* **1** sodium (ion) channels (remain) open / resting potential not re-established **;** **2** *idea of* ions being in the wrong place for correct ion movement (across membrane) **;**	1 max	**IGNORE** lack of (named) neurotransmitter as the Q refers to generation of the action potential in the receptor and not its onward transmission **1** **CREDIT** Na^+ channels **IGNORE** 'voltage-gated' **DO NOT CREDIT** Na channels

Question			Answer	Mark	Guidance
2	(c)			3 max	**ACCEPT** 'action potentials' for 'impulses' **IGNORE** 'messages' and 'signals' throughout
			1 allows **,** neurones to communicate / cell signalling **;**		**1** e.g. ● passes impulse on to next neurone ● passes neurotransmitter on to next neurone
			2 ensure transmission (between neurones) in one direction (only) **;**		**2** **Must be transmission *between* neurones** **IGNORE** description unless for clarification
			3 allows **,** convergence / impulses from more than one neurone to be passed to a single neurone **;**		**3** **IGNORE** 'summation' **ACCEPT** 'neurotranmsitter' instead of 'impulse'
			4 allows **,** divergence / impulses from a single neurone to be passed to more than one neurone **;**		**4** **ACCEPT** 'neurotranmsitter' instead of 'impulse'
			5 idea that filters (out) **,** 'background' / low level **,** stimuli **or** ensures that only stimulation that is strong enough will be passed on **;**		
			6 prevents fatigue / prevents over-stimulation **;**		
			7 allows many low level stimuli to be amplified **;**		**7** **IGNORE** 'summation'
			8 *idea that* presence of inhibitory and stimulatory synapses allows impulses to follow specific path **;**		
			9 permits **,** memory / learning / decision making **;**		
					Note: **'**impulses from more than one neurone can pass to a single neurone' = **2 marks** (mps 1 & 3) **Note:** **'**impulses from a single neurone can pass to many neurones' = **2 marks** (mps 1 & 4)
			Total	**9**	

Question			Answer	Mark	Guidance
3	(a)	(i)	acetylcholine **;**	1	**Mark the first answer.** If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = **0 marks** **CREDIT** other correct examples e.g. dopamine / noradrenaline / norepinephrine **ACCEPT** ACh
3	(a)	(ii)	***either*** post-synaptic membrane **;** (TRPA1) prevents attachment of (named) neurotransmitter to its receptor **;** ***or*** pre-synaptic membrane / (pre)synaptic knob / axon terminal / bouton / synaptic bulb **;** (TRPA1) prevents **,** release of (named) neurotransmitter / influx of calcium ions **;**	2	**Explanation must match correct location for 2 marks.** **If no location stated then explanation can be awarded independently for 1 mark.** **Incorrect location = 0 marks.** **IGNORE** 'interferes' (as in Q) **IGNORE** ref to dendrites / cell bodies /neurone(s) / synapse(s) **CREDIT** causes hyperpolarisation **DO NOT CREDIT** idea that TRPA1 is a free protein that will enter the ACh receptor and block it (rather like a competitive inhibitor occupying the active site of an enzyme) **ACCEPT** Ca^{2+}

Question			Answer	Mark	Guidance
3	(b)	(i)	**A** sinusoid **;** **B** (branch of) bile duct **;** **C** (branch of) hepatic portal <u>vein</u> **;** **D** (branch of) hepatic artery / arteriole **;** **E** (branch of) hepatic / central **,** <u>vein</u> **;**	5	**Mark the first answer on each prompt line.** If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = **0 marks** **B** **DO NOT CREDIT** canaliculus **C** **IGNORE** inter lobular **but** **DO NOT CREDIT** intra lobular **D** **IGNORE** inter lobular **but** **DO NOT CREDIT** intra lobular **E** **IGNORE** intra lobular **but** **DO NOT CREDIT** inter lobular
3	(b)	(ii)	**1** because there is not enough <u>glutathione</u> / <u>glutathione</u> has run out **;** **2** enzyme catalysing glutathione reaction is **,** working at V_{max} / inhibited / in short supply **;** **3** the NAPQI cannot **,** cross the cell (surface) membrane / leave the cell / leave (named) organelle **;**	1 max	**2** **DO NOT CREDIT** in context of P450 system **3** **IGNORE** ref to excretion
3	(b)	(iii)	hepatocytes **<u>and</u>** <u>mitosis</u> / <u>mitotic</u> (division) **;**	1	**CREDIT** (liver) stem cells / hepatic cells **IGNORE** liver cells unqualified **DO NOT CREDIT** Kupffer cells **ONLY CREDIT** correct spelling for mitosis / mitotic
			Total	**10**	

Question			Answer	Marks	Guidance
4	(a)	(i)	**A** cytoplasm **;** **B** cell surface (plasma) membrane / neurone / neurilemma / axon / dendron **;** **C** nucleus (of Schwann cell) **;**	3	**Mark the first answer on each prompt line.** If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = **0 marks** **A** **ACCEPT** cytosol **IGNORE** myelin **B** **IGNORE** nerve **DO NOT CREDIT** cell body
4	(a)	(ii)	node(s) of Ranvier **;**	1	**Mark the first answer.** If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = **0 marks**
4	(b)		*in myelinated neurones* **1** conduction faster in myelinated neurone **; ora** **2** depolarisation / action potential **,** can **only** occur where (voltage-gated / $Na^{(+)}$) channels present **;** **3** *idea that* myelinated neurones have long(er) sections with no, (voltage-gated / $Na^{(+)}$) channels present **;** **4** ion **,** movement / transfer **,** can **only** take place at the gaps / nodes **; ora** **5** longer local circuits / fewer local circuits **;** **6** saltatory conduction / action potential jumps from node to node **; ora**	4	**1** must be a comparative statement and not from figs alone **2** **IGNORE** ref to nodes of Ranvier (as they should be using information in Q) **3** e.g. (only) 0.2% of the myelinated neurone has voltage-gated Na channels **ACCEPT** channels are further apart in myelinated **4** This is a general mark for Na+ or K^+ movement, regardless of direction **5** **ACCEPT** 'currents' for 'circuits' **6** **ACCEPT** 'gap' for 'node' **ACCEPT** jumping *between* nodes

Question			Answer	Marks	Guidance
4	(c)	(i)	exocytosis ;	1	**Mark the first answer.** If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = **0 marks** **IGNORE** secretion
4	(c)	(ii)	synaptic knob / synaptic bulb / presynaptic membrane ;	1	**Mark the first answer.** If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = **0 marks** **ACCEPT** bouton **ACCEPT** presynaptic knob **IGNORE** vesicle **DO NOT CREDIT** synapse
4	(c)	(iii)	**1** vesicle cannot fuse with cell membrane **and** acetylcholine not secreted ; **2** protease / enzyme / toxin / it , hydrolyses , VAMP / SNARE / protein / peptide bonds ; **3** (because of hydrolysis) VAMP (protein) cannot bind to SNARE (complex) ; **4** microtubules broken down **so** vesicle cannot move towards membrane ;	2 max	**1** **ACC PT** bind / attach , for fuse (see diagram) **2** **ACC PT** acts on / digests / breaks down , for 'hydrolyses' **3** **ACCEPT** attach / join / lock , for 'bind' **IGNORE** fuse **DO NOT CREDIT** in context of , inhibition / denaturation
			Total	12	

Question			Answer	Marks	Guidance
5	(a)		endocrine ; islets of Langerhans ; glycogen ; glycogenolysis ;	4	**Mark the first answer on each prompt line.** If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = **0 marks** **ACCEPT** 'isles' / 'eyelets' (as phonetic) **DO NOT CREDIT** 'islands' spelling **must be correct** spelling must be **unambiguous** **IGNORE** hydrolysis
	(b)	(i)	adrenaline / epinephrine / noradrenaline / norepinephrine ;	1	**Mark the first answer.** If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = **0 marks** **ACCEPT** thyroxine / (named) corticosteroid
		(ii)	impulses along parasympathetic nerve / impulses along vagus nerve / nerve endings releasing acetycholine ;	1	**Mark the first answer.** If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = **0 marks** Ref to structure alone is not good enough **CREDIT** 'stimulation' / 'action potentials' **,** for 'impulses along' **ACCEPT** 'activates' / 'uses' **,** parasympathetic / vagus **,** nerve **DO NOT CREDIT** 'messages' / 'signals' / 'information'
			Total	6	

Question			Answer	Marks	Guidance
6	(a)	(i)	**A** dendrite(s) **;** **B** dendron (membrane) **;** **C** cell body (of neurone) **;** **D** axon (membrane) **;**	4	**Mark the first answer on each prompt line.** If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = **0 marks** **A** **DO NOT CREDIT** sensory receptor **B** **DO NOT CREDIT** dendrion (as inclusion of the 'i' means that it can be confused with dendrite)
6	(a)	(ii)	direction of (conduction / travel / transmission) **,** impulse / action potential **;**	1	**DO NOT CREDIT** signal / message **DO NOT CREDIT** 'action potential' alone

Question			Answer	Marks	Guidance
6	(b)			3 max	**If symbol for ion not used, must refer to <u>ion</u>** **IGNORE** ref to value of resting potential
			pumping / active **1** **sodium-potassium pump ,** uses ATP / uses energy / by active transport / (pumps) actively ;		**1** **DO NOT CREDIT** if referring to 2 separate pumps
			2 pumps / actively moves , sodium **ions** / Na^+ , out of , cell / axon / neurone , <u>and</u> , potassium ions / K^+ , in ;		**2** **IGN RE** numbers / ratio for this mark **DO NOT CREDIT** in context of (diffusion) channels
			passive / diffusing **3** K^+ , **diffuse** / move / flow / leak , (freely) back out (of cell) ;		
			4 membrane less **permeable** to Na^+ / fewer Na^+ channels open , so fewer Na^+ , diffuse / move / flow / leak , back in ; **ora**		**4** Looking for a comparative statement referring to permeability **<u>and</u>** its consequence **ACCEPT** 'K^+ move out (20x) faster than Na^+ move in' for idea of more K^+ moving out **IGNORE** ref to impermeable to Na^+ / all Na^+ channels closed
			5 **voltage-gate**d (Na^+) , channels closed ;		**5** **IGNORE** ref. ligand-gated channels
			6 AVP ;		**6** e.g. ● 3 Na^+ out and 2 K^+ in ● build up of +ve ions outside ● large (numbers of) , anions / -ve ions , inside ● ref to negatively charged proteins **Note** 'pumps 3 Na^+ out and 2 K^+ into cell' = **2 marks** (mp 2 and mp 6) 'the Na/K pump actively moves 3 Na^+ out of and 2 K^+ into axon' **= 3 marks** (mps 1, 2 and 6)
			QWC – technical terms used appropriately and spelled correctly ;	1	Use of **three** terms from: **sodium-potassium pump**, **ion**(s), **diffuse** (or derived term), **permeable**, **voltage-gate**d **Please insert a QWC symbol next to the pencil icon, followed by a tick (✓) if QWC has been awarded or a cross (×) if QWC has not been awarded. You should use the green dot to identify the QWC terms that you are crediting.**

Question			Answer	Marks	Guidance
6	(c)	(i)	**X** depolarisation **;** **Y** repolarisation **;** **Z** hyperpolarisation **;**	3	**Mark the first answer on each prompt line.** If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = **0 marks** As the term is asked for, **IGNORE** descriptions **X** **ACCEPT** depolarise(d) / depolarising **Y** **ACCEPT** repolarise(d) / repolarising **Z** **ACCEPT** hyperpolarise(d) / hyperpolarising **IGNORE** refractory period
6	(c)	(ii)	threshold (potential / value / voltage) **;**	1	**Mark the first answer.** If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = **0 marks** **DO NOT CREDIT** threshold frequency
6	(c)	(iii)	**1** *idea that* only stimuli **,** that reach / are greater than **,** threshold value / -50mV **,** produce an action potential **;** **ora** **2** (when stimulated) action potential either occurs or does not / all-or-nothing (law) **;** **3** *idea that* the action potential is the same (magnitude / size) **,** no matter how strong the stimulus / even if strength of stimulus increases **;** **4** *idea that* a strong stimulus produces many action potentials (in rapid succession) **;**	2 max	**IGNORE** ref to refractory period as Figs do not indicate this **Note** 'strong stimulus increases frequency but not magnitude of action potential' = **2 marks** (mps 3 & 4)
			Total	15	