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Mark Scheme (Results)

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General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- There is no ceiling on achievement. All marks on the mark scheme should be used appropriately.
- All the marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if the candidate's response is not worthy of credit according to the mark scheme.
- Where some judgement is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt regarding the application of the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed out work should be marked UNLESS the candidate has replaced it with an alternative response.

Question Number	Answer	Mark
1(a)(i)	B ;	**(1)**

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

Question Number	Answer	Mark
1(a)(iii)	A ;	**(1)**

Question Number	Answer	Mark
1(a)(iv)	D ;	**(1)**

Question Number	Answer	Mark
1(a)(v)	A ;	**(1)**

Question Number	Answer	Additional guidance	Mark
1(b)	1. Ideas of (muscles) work antagonistically ; 2. circular muscle relaxes ; 3. radial muscle contracts;	ACCEPT 2 stretched	**(2)**

Question Number	Answer	Additional guidance	Mark
2(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
2(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
2(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
2(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
2(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)**

Question Number	Answer	Additional guidance	Mark
3(a)	1. Idea an enzyme converts a named substrate into named product e.g. enzyme 1 converts P to Q ; 2. idea that this product becomes the substrate of next step ; 3. idea of specificity ; 4. {controls / eq} the conversion / eq ; 5. speeds up the conversion / eq ; 6. by reducing activation energy / eq ; 7. credit reference to control of whole process ;	ACCEPT answers in context of respiration ACCEPT 1 - ref to an enzyme converting one named intermediate to the next e.g.{enzyme/ named enzyme} used to convert hexose to phosphorylated hexose ACCEPT 3 - description of specificity e.g. active site of enzyme 1 only accepts substance P or in context of named respiratory intermediate ACCEPT 4 – regulates ACCEPT 5 - catalysis / enzyme acts as a catalyst ACCEPT 7 - end product inhibition or description	**(4)**

Question Number	Answer	Additional guidance	Mark
3(b)(i)	1. W = {NAD / NAD^+ / NAD_{ox} / eq} ; Any two of the following: 2. (due to) reduced NAD {releasing/eq} {electrons / eq} ; 3. Idea of electrons go to {carrier A / ETC / eq} ; 4. idea of H^+ moved into inter-membranal space ;	ACCEPT 2 – being oxidized Releasing hydrogen (atoms), H^+/protons $^-$ ACCEPT 3 – 1st electron carrier/correctly named carrier	**(3)**

Question Number	Answer	Additional guidance	Mark
3(b)(ii)	1. substance **X** is ATP ; Any two of the following : 2. due to H^+ pass through {stalked particle / ATP synthase} ; 3. (H^+ passes) down an electrochemical gradient ; 4. (sufficient) energy is {released / eq} ; 5. to join ADP and {Pi / eq} ; 6. reference to chemiosmosis ;	ACCEPT 2 –ATPase ACCEPT 3 - description of electrochemical gradient ACCEPT 5 – phosphorylation of ADP	**(3)**

<table>
<tr><th>Question Number</th><th>Answer</th><th>Additional guidance</th><th>Mark</th></tr>
<tr><td>3(c)</td><td>
<table>
<tr><th rowspan="2">Situation</th><th colspan="3">Movement of coloured liquid</th></tr>
<tr><th>towards A</th><th>towards B</th><th>does not move</th></tr>
<tr><td>Screw clip is open</td><td></td><td></td><td>☒</td></tr>
<tr><td>Screw clip is closed</td><td>☒</td><td></td><td></td></tr>
<tr><td>Potassium hydroxide is replaced with water and screw clip is closed</td><td></td><td></td><td>☒</td></tr>
</table>
</td><td></td><td>(3)</td></tr>
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Question Number	Answer	Additional guidance	Mark
4(a)(i)	1. (protein in thin filament) - actin / G actin ; 2. (protein in thick filament) - myosin ;		**(2)**

Question Number	Answer	Additional guidance	Mark
4(a)(ii)	1. {Ca^{2+} / calcium ions} bind to troponin ; 2. troponin {changes shape / moves / eq} ; 3. this displaces tropomyosin (away from myosin) / eq ;	ACCEPT 3 – pulls/shifts/moves tropomyosin	**(2)**

Question Number	Answer	Additional guidance	Mark
4(a)(iii)	acetylcholine / {noradrenaline / eq } ;	ACCEPT – ACh, noradrenalin, norepinephrine	**(1)**

Question Number	Answer	Additional guidance	Mark
4(b)	1. the higher troponin T, the longer the stay / eq ; 2. reliability of prediction decreases as troponin T concentration increases ; 3. because {range / eq} increases ; 4. least reliable for 6.0+ as range is largest ; 5. one range stated e.g. for 6.0+ it is 7 to 11 days ; 6. reference to range overlapping between 4.0-5.9 and 6.0+ ; 7. idea that 6.0+ is too wide a category for conc. of troponin T ; 8. idea that the higher the troponin T, the greater the damage to the heart ;	ACCEPT 1 - converse ACCEPT 2 - converse, less reliable at high troponin T ACCEPT 3 - range of the length of stay, range of data ACCEPT 4 - converse for 1.0-3.9 / 4.0-5.9	(3)

Question Number	Answer	Additional guidance	Mark
5(a)	**A** - cell body ; **B** - axon ;		**(2)**

Question Number	Answer	Additional guidance	Mark
5(b)(i)	1. increasing Eugenol concentration increases percentage inhibition / positive correlation ; 2. description of non linear correlation ; 3. credit correct manipulation of the data e.g. between 0.1 and 1.0 mmol dm^3 percentage inhibition to increase by 55% ;	ACCEPT 2 – e.g. greatest increase in inhibition is between eugenol concentration of 0.2 and 0.4 mmol dm^{-3}	**(2)**

Question Number	Answer	Additional guidance	Mark
***5(b)(ii)**	QWC – Spelling of technical terms (*shown in italics*) must be correct and the answer must be organised in a logical sequence) 1. {reduced / eq} Ca^{2+} enters { *presynaptic membrane* / into *sensory neurone*} ; 2. due to Ca^{2+} channel not opening / decreased sensitivity of *membrane* to Ca^{2+} ; 3. fewer *vesicles* {move towards / fuse} with *presynaptic membrane* ; 4. less *neurotransmitter* {released into / less diffuses across} {*synaptic* gap / eq} ; 5. less *neurotransmitter* binds to receptors on {*post-synaptic membrane* / adjacent neurone} ; 6. idea of reduced depolarisation / less Na^{+} or cation channels open ; 7. idea of { threshold intensity / *action potential* / *impulse*} less likely to occur ; 8. idea of pain not being sensed as impulse {stopped before entering CNS / leaving the *sensory neurone*} ;	ACCEPT 1 – into *synaptic* knob / pre-synaptic neurone ACCEPT 4 (& 5) - named neurotransmitter example ACCEPT 7 - not reached as alternative to less likely to be reached	**(6)**

Question Number	Answer	Additional guidance	Mark
6(a) (i)	(cut shoot) without IAA present / without agar blocks ;	ACCEPT - agar block with no IAA, empty agar block, agar block with water ACCEPT - auxin(s) as alternative to IAA	**(1)**

Question Number	Answer	Additional guidance	Mark
6(a) (ii)	1. (both sides of) shoot taller / eq ; 2. than the control / eq ; 3. both IAA's diffuse {down / out of agar / to zone of elongation} / eq ; 4. reference to cell elongation / eq ; 5. details of cell elongation / eq ; 6. shoot bends to the right / eq ; 7. (due to) more growth on {left side of shoot / side with artificial IAA} / eq ;	ACCEPT - auxin as alternative to IAA throughout ACCEPT 1 – grow {taller/higher/up/ towards the light} ACCEPT 3 – away from the light/agar block ACCEPT 6 - bends away from side with artificial IAA	**(5)**

Question Number	Answer	Additional guidance	Mark
6(b)	1. idea that IAA enters the cell ; 2. reference to movement within cell / IAA in cytoplasm to nucleus ; 3. effect when binds to transcription factor e.g. forms a transcription initiation complex or countering an inhibitor ; 4. reference to switching on gene ; 5. activity at promoter region / eq ; 6. allows formation of (m)RNA / eq ; 7. idea of translation produces protein ;	ACCEPT - auxin as alternative to IAA throughout ACCEPT 3 - joins to promoter region or activates transcription factor ACCEPT 5 – ref to RNA polymerase activity	**(4)**

Question Number	Answer	Additional guidance	Mark
7(a)	1. alpha glucose in starch and beta glucose in cellulose; 2. only {starch / amylopectin} can be branched / cellulose only a linear molecule ; 3. starch contains two types of molecule, cellulose only one ; 4. alternate monomers rotated through 180^0 in cellulose only ; 5. only {amylopectin / starch} can have 1-6 glycosidic bonds / cellulose has 1-4 glycosidic bonds only ;	ACCEPT 3 - the two named molecules of starch – amylose and amylopectin ACCEPT 5 – starch can have 1-6 & 1-4 glycosidic bonds but cellulose only 1-4	**(2)**

Question Number	Answer	Additional guidance	Mark
7(b)(i)	1. thermoreceptors in hypothalamus / eq ; 2. detect the increase in (core) blood temperature / eq ; 3. reference to heat loss centre activated ; 4. reference to autonomic nervous system ; 5. reference to impulses down motor neurones ; 6. to {effectors / named effector} / eq ; 7. detail of method of heat loss / eq ;	ACCEPT 5 - effector neurone for motor neurone ACCEPT 7 – vasodilation of blood vessels, sweat released, heat loss from blood through radiation	**(4)**

Question Number	Answer	Additional guidance	Mark
7(b)(ii)	1. (shivering) is muscle contraction ; 2. which uses {respiration / ATP / eq} ; 3. which release heat (to warm body) / eq ;	ACCEPT 2 - oxidative phosphorylation, ATP being converted to ADP and Pi	**(2)**

Question Number	Answer	Additional guidance	Mark
7(c)	1. (cancer causing) gene identified / eq ; 2. gene {cut / isolated / eq} from DNA / eq ; 3. using a {restriction / eq} enzyme / eq ; 4. gene in {vector / named vector} ; 5. mechanism for getting {gene / vector} into host cells (of naked mole rats) / eq ;	ACCEPT 4 – named examples including retrovirus, virus, liposome ACCEPT 5 - reference to (micro)injection, microprojectiles, electroporation, gene gun, inhaler	**(3)**

Question Number	Answer	Additional guidance	Mark
***7(d)**	QWC – Spelling of technical terms (*shown in italics*) must be correct and the answer must be organised in a logical sequence) 1. idea that this air has higher CO_2 content ; 2. {CO_2 level in blood increases / pH of blood falls / eq} ; 3. change detected by chemoreceptors in {carotid body / carotid artery / aortic body / aorta / medulla} ; 4. reference to {ventilation centre / eq} (in medulla) ; 5. sends more impulses along neurones / eq ; 6. to intercostal muscles / diaphragm / eq ; 7. causing an increased {ventilation rate / rate of breathing / depth of breathing} / eq ;	ACCEPT 2 - high, higher (for CO_2) ACCEPT 4 – respiratory centre, inspiratory centre for ventilation centre ACCEPT 5 – impulses sent more often	**(5)**

Question Number	Answer	Additional guidance	Mark
7(e)	1. naked mole rat's {incisors / eq} grow through {skin / lip} without {damage / eq} ; 2. lead to new {coatings / permanent seal /eq} at {skin / bone / metal} interface ; 3. so soft tissue is {not damaged / eq } (by the prosthetic) / eq ;		**(2)**

Question Number	Answer	Additional guidance	Mark
7(f)	gonadotrophin-releasing (hormone) and anterior pituitary / gonadotrophins and {ovaries / testes} ;	ACCEPT - testosterone and testes ACCEPT - gonads for testes or ovaries	**(1)**

Question Number	Answer	Additional guidance	Mark
7(g)	1. idea of irregularity of flagellum ; 2. Idea of irregularity associated with mid-region ;	ACCEPT 1 – no or more than one flagellum ACCEPT 2 – not enough mitochondria	**(2)**

Question Number	Answer	Additional guidance	Mark
7(h)	1. idea of high levels of inbreeding ; 2. low level of genetic diversity / eq ; 3. idea that there is some variation because more than one male is involved in ; 4. unfamiliar males used as mates (by queen) / eq ; 5. fusion of colonies / eq ; 6. arrival of a dispersal phenotype (from a different colony) ; 7. mutations / eq ;	ACCEPT 1 – accept idea in context of only one queen/female breeds ACCEPT 2 – restricted gene pool, low genetic variation	**(3)**

Question Number	Answer	Additional guidance	Mark
7(i)	1. reduces inbreeding (depression) / eq ; 2. increases outbreeding / outbreeding qualified ; 3. (leading to) increase in genetic diversity ; 4. idea of colony size regulation ; 5. idea of increase in fecundity ; 6. idea of increased chance of survival ;	ACCEPT 1 - less genetic drift ACCEPT 2 – disperser/new comer more likely to breed ACCEPT 3 – increased genetic variation, increase in variety of alleles ACCEPT 6 – appropriate ref to natural selection, due to environmental changes	**(2)**

Question Number	Answer	Additional guidance	Mark
7(j)	Paired responses: 1. reduced sensitivity to chemical pain / disconnection of 'pain nerves' ; 2. high CO_2 in air (of tunnels) ; 3. haemoglobin has higher affinity for oxygen / brain can tolerate eq ; 4. low O_2 levels (in tunnels) / eq ; 5. increased number of oxytocin receptors in brain ; 6. overcrowding / eq ; 7. non-pigmented ; 8. lack of UV light ; 9. outbreeding mechanisms such as disperser; 10. low genetic diversity ; 11. hairless/ naked/ reduction of sweat gland / loose skin / no insulating layer / poikilothermic ; 12. due to nature of its temperature environment / eq ; 13. teeth arrangement / eq ; 14. for digging underground ; 15. keen sense of smell/reduce eyesight / ref to circadian rhythms ; 16. dark conditions ; 17. division of labour ; 18. for the survival of the eusocial colony ;	ACCEPT1 - lack or receptor for chemical pain ACCEPT 3 – ref to brain's hypoxia response, neurones or brain resistance to hypoxia ACCEPT13 - forward of lips or long	**(4)**

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