PEARSON EDEXCEL A-LEVEL BIOLOGY B · 9BI0

BIOLOGY



MARK SCHEME

TOPIC 9: CONTROL SYSTEMS

HOMEOSTASIS

SCORE	PERCENTAGE
/96	%

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Mark Scheme

Q1.

Question Number	Answer	Mark
(a)	1. idea that less {food /eq} required to deliver energy requirement ; 2. (so) more likely to have extra food not respired / {extra/surplus} energy ; 3. which could be laid down in body as fat / eq ;	**(2)**

Question Number	Answer	Mark
(b)	Any two from: 1. ADP 2. Pi / inorganic phosphate 3. pyruvate / pyruvic acid / lactate 4. fatty acids 5. NAD / eq 6. acetyl CoA / eq 7. water ; ;	**(2)**

Question Number	Answer	Mark
(c)	1. many {alpha / eq} glucose monomers ; 2. joined by glycosidic bonds ; 3. detail of glycosidic bonds e.g. 1-4 ; 4. reference to side branches present / 1-6 glycosidic bonds ;	**(3)**

Question Number	Answer	Mark
(d)	1. more gonadotropins ; 2. {use / muscle uptake} of (excess) fatty acids ; 3. respired to release (much) energy / increased fat metabolism ; 4. idea of reduced requirement to replenish glycogen stores ;	**(3)**

Question Number	Answer	Mark
(e)	1. (slow twitch muscles) carry out aerobic respiration / full oxidation / eq ; 2. which produces more ATP (than anaerobic) / eq ; 3. 'energy' not locked up in lactate / eq ; 4. idea that it takes longer for lactate levels to build up ;	**(2)**

Question Number	Answer	Mark
***(f)**	QWC – Spelling of technical terms (*shown in italics*) must be correct and the answer must be organised in a logical sequence) 1. Ca^{2+} leaks out of {cell / *cytoplasm* / *sarcoplasmic reticulum*} ; 2. idea of change in Ca^{2+} binding to *troponin* ; 3. causes displacement of *tropomyosin* / eq ; 4. idea of change in number of *myosin* binding sites exposed ; 5. comment on *myosin* binding to *actin* ; 6. (loss of Ca^{2+} from cell / cytoplasm) therefore force exerted by muscle is lower than expected OR (more Ca^{2+} in cytoplasm) results in less ATP so less muscle contraction ;	**(4)**

Question Number	Answer	Mark
(g)	<table><tr><th>Process</th><th>Two nucleic acids involved in the process</th></tr><tr><td>Transcription of the ACE gene</td><td>DNA & mRNA ;</td></tr><tr><td>Production of ACE at a ribosome</td><td>Any **two** from: mRNA, tRNA, rRNA ;</td></tr></table>	**(2)**

Question Number	Answer	Mark
(h)	1. obtain a sample of cells / extract DNA (from cells) ; 2. reference to named enzyme ; 3. idea of how to increase amount of DNA ; 4. reference to electrophoresis ; 5. details of electrophoresis ; 6. use a {DNA / gene} probe ; 7. with a base sequence complementary to that on the {variant / eq} ; 8. idea of matching with known variant profile ;	**(4)**

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

Question Number	Answer	Mark
(j)	1. (higher metabolic rate) means more chemical reactions / eq ; 2. more {energy released / ATP used} / eq ; 3. (which) releases heat / eq ; 4. keeps divers warmer / warm for longer / able to swim without a wetsuit / eq ;	**(3)**

Question Number	Answer	Mark
(k)	1. carbon dioxide due to {deforestation / land cleaning / burning fossil fuels / correct ref to respiration / eq} ; 2. methane from {rice fields / anaerobic bacterial action / ruminant fermentation / named ruminant} ;	**(2)**

Question Number	Answer	Mark
(l)	1. 1.4 ÷ 37 = ; 2. 3.8 (%) ; Correct answer gains both 2 marks	**(2)**

Q2.

Question Number	Answer	Additional Guidance	Mark
(i)	• divide oxygen consumption by body mass (1) • express answer in standard form (1)	Example of calculation 50 ÷ 4 000 = 0.0125 1.25×10^{-2} Correct answer gains full marks, with no working shown **ACCEPT** one mark in working for 0.0125	(2)

Question Number	Answer	Additional Guidance	Mark
(ii)	An explanation that makes reference to four of the following: • {small(er) mammals / small(er) body mass} consume more oxygen (per kg) (1) • mammals are endotherms / maintain body temperature / regulate body temperature (1) • small mammals have larger surface area to volume ratio (1) • therefore lose more heat (1) • heat by respiration (1)	**ACCEPT** large(r) mammals consume more oxygen in $dm^3\ h^{-1}$ **ACCEPT** converse for Mps 1, 3 and 4 and 5	(4)

Q3.

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

Q4.

Question Number	Answer	Additional Comments	Mark
(a)	1. only (alpha) 1-4 glycosidic bonds in amylose / (alpha) 1-6 only found in amylopectin ; 2. only amylopectin has side branches / only amylose is {coiled / eq} ; 3. Amylopectin is a {larger / eq} molecule than amylose ;	**1. ACCEPT** 1-6 and 1-4 in amylopectin	**(2)**

Question Number	Answer	Additional Comments	Mark
(b)	1. Different individuals in the {colony / eq} take on specific {roles / jobs / eq} ; 2. Example given e.g. queen produces offspring ;	**1. Accept** division of labour **2. Accept** dominance by queen, {few of the males / kings} involved in breeding	**(2)**

Question Number	Answer	Additional Comments	Mark
(c) (i)	Idea that body temperature of animal mimics the ambient temperature ;	**Accept** body temp follows environmental temperature	**(1)**

Question Number	Answer	Additional Comments	Mark
(c) (ii)	1. Lack of insulating layer: Idea that does not impede transfer of heat energy / allows exchange of heat energy more easily ; 2. A marked reduction in sweat glands: Idea that they do not need to cool down OR less water lost ;	**1. Accept** enables heat transfer between environment and NMR	**(2)**

Question Number	Answer	Additional Comments	Mark
(d)	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 mice) / eq ;	**1. Accept** screen for the gene **2. Accept** extracted **3. Accept** correctly named restriction enzyme e.g. EcoR1 **4. Accept** Named egs – retrovirus, virus, liposome, plasmid, bacteria **5. Accept** reference to (micro)injection, microprojectiles, electroporation, gene gun, inhaler, transduction	**(3)**

Question Number	Answer	Additional Comments	Mark
* (e)	QWC – Spelling of technical terms (*shown in italics*) must be correct and the answer must be organised in a logical sequence 1. {*neurone* (cell) surface membrane exposed / no *myelination* / eq} at nodes of *Ranvier* ; 2. Nodes are the site of clusters of {*sodium-gated channel proteins / potassium channels*} ; 3. Which {open / close} when *impulse* arrives / eq ; 4. Allowing *depolarisation* at nodes / eq ; 5. idea that *myelin*/eq acts as an (electrical) *insulator* (on *neurone* surface between nodes) ; 6. reference to *Schwann* cell ; 7. idea that *impulse*/*depolarisation* 'jumps' to next node ; 8. Reference to this being *saltatory conduction* ; 9. idea that this happens between the *myelin* layers of the *Schwann* cell ;	**QWC emphasis on spelling** **3. Accept** influx of sodium ions	**(5)**

Question Number	Answer	Additional Comments	Mark
(f)	1. idea of heart working less efficiently ; 2. idea of less oxygen absorbed at lungs / eq ; 3. less blood pumped to brain ; 4. concentration gradient (for oxygen) at brain reduced / eq ; 5. less oxygen in blood (in brain) diffuses into brain tissue / eq ; 6. idea of less oxygen in brain tissue due to continual (aerobic) respiration ;		(3)

Question Number	Answer	Additional Comments	Mark
(g)	gonadotrophin-releasing (hormone) stimulates gonadotrophin release / gonadotrophin stimulates ovulation / testosterone stimulates {sperm production / (male) secondary sexual characteristics / other named example} ;		(1)

Question Number	Answer	Additional Comments	Mark
(h)	1. Idea of effect on mitochondria ; 2. (therefore) reduced {energy / ATP / eq} for flagellum movement ;	**1. Accept** less efficient / fewer / none **2. Accept** tail for flagellum	(2)

Question Number	Answer	Additional Comments	Mark
(i)	1. idea that fat is an energy store ; 2. reduces dependence on external food source / eq ; 3. enables disperser to travel / eq ; 4. (metabolic) water is released (on oxidation) / eq ; 5. acts as a thermal insulator / eq ;	**Accept** energy-rich	(3)

Question Number	Answer	Additional Comments	Mark
(j)	1. idea that unfamiliar males are likely to be genetically different ; 2. idea that this is outbreeding ; 3. idea that this increases genetic diversity ;	**3. Accept** producing offspring that are genetically different	(2)

Question Number	Answer	Additional Comments	Mark
(k)	the order of the {bases / genes and non-coding sequences / eq} in the DNA (of the naked mole rats) is found / eq ;	**Accept** exons and introns **Ignore** genes unqualified	(1)

Question Number	Answer	Additional Comments	Mark
(l)	Paired responses: 1. reduced sensitivity to chemical pain / disconnection of 'pain nerves' ; 2. Idea of pain relief e.g. dealing with post traumatic pain, post surgical pain, joint pain after a knee operation ; 3. haemoglobin has higher affinity for oxygen ; 4. Idea of dealing with reduced oxygen situations such as due to a heart attack or stroke ; 5. Naked mole rat {incisors / eq } grow through skin (of lip) without damage ; 6. Idea of better prosthesis e.g. new {coatings / permanent seal} at {skin / bone / metal} interface, soft tissue not damaged, avoid infection ; 7. High protein stability / does not (easily) lose 3D shape ; 8. (so) reduced effect of oxidative {damage / stress} / reduced effect of oxygen-containing free radicals / live healthily into old age ; 9. Cell overcrowding early warning gene / ref. to two tiered contact inhibition / presence of gene p16 ; 10.Idea of cancer prevention e.g. cancer resistance, future cancer therapy ; 11.Naked mole rat neurones display immature {characteristics / physiological properties} / brain cells that cope with {low oxygen / hypoxia} ; 12.To treat people with temporary loss of oxygen to brain e.g. heart attack, stroke, drowning / to prevent permanent brain damage ; 13.High levels of oxytocin receptors in {brain / nucleus accumbens}; 14.Idea of links to autism ; 15.Naked mole rats do not experience menopause ; 16.Ref to osteoporosis {treatment / prevention} (without side effects) ; 17.circadian rhythms / sleep patterns of naked mole rats ; 18.Idea that may help with sleep disorders ;	**9. Accept** anticancer mechanism	