

2804 Central Concepts

June 2005

Mark Scheme

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| Abbreviations, annotations and conventions used in the Mark Scheme | / = alternative and acceptable answers for the same marking point ; = separates marking points NOT = answers which are not worthy of credit R = reject () = words which are not essential to gain credit <u> </u> = (underlining) key words which must be used to gain credit ecf = error carried forward AW = alternative wording A = accept ora = or reverse argument |
|---|--|

| Question | Expected Answers | Marks |
|----------|---|-------|
| 1 (a) | S ; R ; S ; A – correct names instead of letters | 3 |
| (b) | (carry genes for) production of m / t / r, RNA ; A transcription R ribosomes (carry genes for) synthesis of (mitochondrial), proteins / polypeptides ; (carry genes for) synthesis of (mitochondrial), enzymes / correctly named enzyme ; ref to mitochondrial replication ; | max 1 |
| (c) | FAD / NAD ; A reduced FAD / reduced NAD / AW | 1 |
| (d) | 1 hydrogen split into protons and electrons ; 2 flow of electrons / electrons pass along, ETC / cytochromes ; 3 energy is released ; R created / produced 4 protons pumped (into intermembranal space) ; 5 sets up, electrochemical / proton, gradient ; 6 protons diffuse (down concentration gradient) ; 7 protons flow through <u>protein</u> channel ; 8 site of ATP, synthase / synthetase ; A ATPase / stalked particle 9 energy of proton gradient linked to ATP formation ; 10 ref to chemiosmosis ; 11 oxygen as final electron acceptor ; | max 5 |
| (e) | 1 no proton gradient set up ; 2 no proton flow through, ATP synthase / ATP synthetase ; A ATPase / stalked particle 3 no ATP formed ; 4 no ATP for muscle contraction / description of muscle contraction ; 5 cardiac muscle fails / intercostals muscles fail ; R diaphragm fails 6 Krebs cycle stops ; 7 only glycolysis occurs ; 8 lactate poisoning / AW ; R lactate build up and refs to pain and fatigue 9 AVP ; e.g. 2 ATP (per mol of glucose) formed in glycolysis, no anaerobic respiration in cardiac muscle | max 3 |

[Total: 13]

| Question | Expected Answers | Marks |
|----------|---|-------|
| 2 (a) | chlorophyll a ; A chlorophyll for one mark as an alternative to chl. a and b chlorophyll b ; xanthophylls ; carotenoids / carotene ; | 2 |
| (b) (i) | thylakoid / lamella / granum ; A membranes R inner membrane | 1 |
| (ii) | <i>must be a comparative statement</i> different, reaction centre / form of chlorophyll a / absorption wavelengths / 700nm (PS1) and 680nm (PS2) / PS1 mainly on intergranal lamellae and PS2 mainly on granal lamellae ; R different pigments A cyclic photophosphorylation involves PS1 only ; A PS1 not involved in photolysis / AW ; | max 1 |
| (c) | ATP reduced NADP ; need both for one mark | 1 |
| (d) | 1 occurs in stroma ; 2 a series of enzyme-controlled reactions ; 3 carbon dioxide fixed by RuBP ; 4 carboxylation ; 5 enzyme is Rubisco ; 6 (unstable) 6C intermediate ; 7 forms (2 molecules) of GP ; 8 forms TP ; 9 using ATP (linked to point 8) ; 10 reduction step ; 11 using reduced NADP ; 12 ref to either ATP or NADP red coming from light dependent reaction ; 13 (most of) TP regenerates RuBP ; 14 rearrangement of carbons to form pentose sugars ; 15 ATP required, for phosphorylation / ribulose phosphate to ribulose biphosphate ; 16 AVP ; e.g. TP can be used to form, lipids / amino acids / hexose sugars / suitable named example | max 7 |
| | QWC – legible text with accurate spelling, punctuation and grammar ; | 1 |

[Total: 13]

| Question | Expected Answers | Marks |
|----------|--|--------|
| 3 (a) | <p>parental genotypes RrBb x Rrbb ;</p> <p>gametes RB Rb rB rb Rb rb ;</p> <p>offspring genotypes RRBb RrBb (RrBb) Rrbb RRbb (Rrbb) rrBb rrbb ;</p> <p>offspring phenotypes rough black rough white smooth black smooth white ;</p> <p>expected ratio 3 : 3 : 1 : 1 ;</p> <p>accept correct gametes, offspring genotypes and offspring phenotypes in Punnett square</p> <p>use ecf except for ratio Reject the ratio 6 : 6 : 2 : 2</p> <p>ratio not a stand alone mark – there must be some correct working to support it</p> | 5 |
| (b) (i) | <p>length of DNA ;</p> <p>codes for a (specific), polypeptide / protein / RNA ;</p> <p>found at a, locus / particular position on, a chromosome ;</p> <p>variety / form of a gene ; R type of gene A type of a gene</p> | 2 1 |
| (ii) | <p>assume the allele = coat colour allele</p> <p>(coat colour) gene / alleles, only on X chromosome ;</p> <p>A no (coat colour), gene / allele, on Y chromosome</p> <p>male cats, XY / only have one X chromosome ;</p> <p>(males have) only one (coat colour) <u>allele</u> / cannot have two (coat colour) <u>alleles</u> ;</p> <p>need black and orange <u>alleles</u> for tortoiseshell colour ;</p> | max 2 |
| (c) | <p>1 ref to <u>operon</u> ;</p> <p>2 normally <u>repressor</u> substance bound to <u>operator</u> ;</p> <p>3 prevents RNA polymerase binding (at promoter) / prevents transcription ;</p> <p>4 lactose binds to <u>repressor</u> ;</p> <p>5 changes shape of protein molecule ;</p> <p>6 unable to bind (to operator) ;</p> <p>7 RNA polymerase binds (at promoter) / transcription occurs / genes switched on ;</p> <p>8 production of <u>lactose permease</u> ;</p> <p>9 production of <u>beta – galactosidase</u> ;</p> | max 5 |

[Total: 15]

| Question | Expected Answers | Marks |
|----------|---|-------|
| 4 (a) | ductless gland ; secretes hormones ; R excrete (directly) into blood ; | max 2 |
| (b) (i) | islets of Langerhans ; | 1 |
| (ii) | <u>glucagon</u> ; | 1 |
| (iii) | insulin ; | 1 |
| (iv) | negative feedback ; | 1 |
| (v) | binds to (glucagon) receptors ; on cell surface membrane ; activation of phosphorylase ; stimulates breakdown of glycogen to glucose ; <u>glycogenolysis</u> ; use of fatty acids as main respiratory fuel ; production of glucose from other molecules ; <u>gluconeogenesis</u> ; glucose released into blood ; AVP ; e.g. ref to cAMP | max 5 |
| (c) | insulin produced by, microorganisms / bacteria ; cheaper source of insulin / more reliable supply / ref to large scale production ; more rapid response / shorter duration of response ; less chance of, immune / allergic, response ; R reference to rejection better for people who have developed a tolerance for animal insulin / less needed ; R immune acceptable to people who have ethical, moral or religious objections ; A vegetarians no risk of, infection / contamination ; | max 3 |

[Total: 14]

| Question | Expected Answers | Marks |
|----------|--|-------|
| 5 (a) | <p>$R^R R^R$ - low, do not have enough vitamin K in diet / ref to figures ;</p> <p>$R^R R^S$ - high, (warfarin resistant) and have enough vitamin K / ref to figures ;</p> <p>$R^S R^S$ - low , will be killed by warfarin / ref to effects of warfarin ;</p> <p><i>If quote probabilities for survival less than 50% is low and over 50% is high</i></p> | 3 |
| (b) (i) | <p>mutation / named mutation ; change in DNA base sequence ;</p> | max 1 |
| (ii) | <p>variation within population ; some individuals produce enzyme not susceptible to warfarin ; these individuals survive / selective advantage ; reproduce / breed ; pass, resistance / advantageous <u>allele</u> , to offspring ; R gene those without resistance die ; ref to selective pressure of warfarin ;</p> | max 5 |
| (c) | <p>does not directly involve humans ; environment selects individuals that will reproduce ;</p> | max 1 |
| (d) | <p>resistant allele / R^R , will decrease and , susceptible allele / R^S , will increase ; $R^R R^R$ at a disadvantage due to vitamin K requirements / $R^S R^S$ at an advantage due to warfarin being removed ;</p> <p>A frequencies of both alleles will stay the same ; <i>must be linked to second statement</i> no longer any selective pressure / no directional selection ;</p> | max 2 |

[Total: 12]

| Question | Expected Answers | Marks | | | | | | |
|---------------------|---|----------------|------------------------|-----------------|----------------|------------|--------------------------------|---|
| 6 (a) | <p>thick axons transmit impulses quicker than thin ones / AW ; myelinated fibres quicker than unmyelinated / AW ; invertebrates have slower speed of impulse / <i>ora</i> ; ref to one set of comparative figures from table ;</p> | max 2 | | | | | | |
| (b) | <p>1 depolarisation of membrane ; 2 sodium ions move into axoplasm ; 3 sodium ions flow sideways inside axon ; A move down axon 4 ref to local circuit ; 5 towards, negatively charged region / region at resting potential ; 6 sodium voltage gated channels open ; 7 region behind local circuit not yet recovered / sodium voltage gated channels closed ; 8 impulse moves in one direction along axon ; 9 myelin sheath acts as (electrical) insulator ; 10 ref to Schwann cell and myelin ; 11 lack of sodium and potassium gates in myelinated regions ; 12 ref to nodes of Ranvier ; 13 depolarisation occurs at nodes only ; 14 (therefore) longer local circuits ; 15 jumps from one node to another ; 16 saltatory conduction ; 17 AVP ; e.g. detail of why thicker axons have faster impulses i.e. less leakage of ions or offer less resistance</p> | max 7 | | | | | | |
| | <p>QWC – clear well organised using specialist terms ;</p> <p><i>award the QWC mark if four of the following are used in correct context</i></p> <table border="0" style="width: 100%;"> <tr> <td style="width: 50%;">depolarisation</td> <td>voltage gated channels</td> </tr> <tr> <td>node of Ranvier</td> <td>local circuits</td> </tr> <tr> <td>saltatory,</td> <td>sodium ions or Na⁺</td> </tr> </table> | depolarisation | voltage gated channels | node of Ranvier | local circuits | saltatory, | sodium ions or Na ⁺ | 1 |
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| node of Ranvier | local circuits | | | | | | | |
| saltatory, | sodium ions or Na ⁺ | | | | | | | |
| (c) | <p>following an action potential ; need to, redistribute sodium and potassium ions / restore <u>resting potential</u> ; sodium voltage gated channels are closed ; (during which) another impulse cannot be, generated / conducted ; ensures impulses separated ; determines maximum frequency of impulse transmission ; impulse passes in one direction only along axon ; AVP ; e.g. ref to absolute and relative refractory periods</p> | max 4 | | | | | | |
| [Total: 14] | | | | | | | | |

| Question | Expected Answers | Marks |
|----------|--|--------------|
| 7 (a) | <p>B ; C ; D ; A ;</p> | 4 |
| (b) (i) | <p><i>award two marks if correct answer (26.18 / 26.2 / 26) is given</i></p> <p>24 x 60 = 1440 ÷ 55 ;</p> <p>26.18 ; A 26 / 26.2</p> | 2 |
| (ii) | <p>less oxygen / <i>ora</i> ; reduced amount of nutrients / <i>ora</i> ; ref to pH / <i>ora</i> ; competition from other bacteria / interspecific competition / <i>ora</i> ; use of antibiotics ; AVP ; ref to intestinal enzymes or immune system R reference to temperature</p> <p><i>treat toxins as neutral</i></p> | max 3 |

[Total: 9]