

Mark Scheme for January 2011

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All Examiners are instructed that alternative correct answers and unexpected approaches in candidates' scripts must be given marks that fairly reflect the relevant knowledge and skills demonstrated.

Mark schemes should be read in conjunction with the published question papers and the Report on the Examination.

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| Question | | Expected Answers | | Marks | Additional Guidance | |
|----------|------------------------------|---|------------------------------|-------|--|-------------------------------|
| 1 | (a) | Award 1 mark per correct row | | 3 | <p>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</p> <p>ACCEPT phonetic spelling except for ethanal and ethanol</p> <p>ACCEPT pyruvic acid (instead of pyruvate) ACCEPT acetaldehyde (instead of ethanal) IGNORE formulae The spelling of ethanal must be unambiguous</p> <p>ACCEPT 2 molecules for yeast (from 1 glucose molecule)</p> <p>ACCEPT lactic acid (instead of lactate) ACCEPT ethyl alcohol (instead of ethanol) IGNORE alcohol IGNORE formulae The spelling of ethanol must be unambiguous</p> | |
| | | | <i>mammal</i> | | | <i>yeast</i> |
| | | <i>name of hydrogen acceptor after glycolysis</i> | pyruvate | | | ethanal |
| | | <i>is CO₂ produced?</i> | no / ✘ / none / no molecules | | | yes / ✓ / some / one molecule |
| | <i>name of final product</i> | lactate | ethanol | | | |

| Question | | Expected Answers | | Marks | Additional Guidance |
|--------------|-----|------------------|--|----------|---|
| 1 | (b) | 1 | <i>idea that</i> ATP produced / energy released ; | 1 max | <p>IGNORE ref to specific metabolic reactions other than glycolysis (mp 3)</p> <p>IGNORE ref to respiration without oxygen</p> <p>1 DO NOT CREDIT this mark point with any ref to energy , generated / produced / made [eg energy made in the form of ATP = 0 ATP (energy) is produced = 0]</p> <p>2 ACCEPT 'reoxidises red NAD' (as implies recycling)</p> <p>CREDIT NADH / NADH⁺ / NADH₂ for red NAD</p> <p>DO NOT CREDIT 'oxidises red NAD' without further qualification</p> <p>3 If glycolysis used as a term, the spelling of 'glyco' must be correct.</p> |
| | | 2 | <i>idea that</i> recycles NAD / NAD can be used again ; | | |
| | | 3 | allows , glycolysis / description of glycolysis , to take place / to continue ; | | |
| TOTAL | | | | 4 | |

| Question | | | Expected Answers | Marks | Additional Guidance |
|----------|-----|-----|---|-------|---|
| 2 | (a) | (i) | <p>1 structure A / Schwann cell / it , produces myelin ;</p> <p>2 (electrical) <u>insulation</u> / <u>insulates</u> ;</p> <p>3 prevents movement of ions , into / out of , neurone / axon or prevents depolarisation ;</p> <p>4 speeds up , conduction / transmission / passage , of , impulse / action potential ;</p> <p>5 action potentials / local circuits / depolarisation / only occur at , gaps / nodes (of Ranvier) ;</p> <p>6 saltatory conduction / described ;</p> | 3 max | <p>1 Needs the idea of production rather than simply stating 'it is a myelin sheath'</p> <p>2 CREDIT insulate or derived term. IGNORE impermeable DO NOT CREDIT <i>idea of thermal insulation</i></p> <p>3 CREDIT 'across membrane' instead of , in / out, of axon IGNORE ion exchange IGNORE impermeable DO NOT CREDIT ions moving , into / out of , membrane DO NOT CREDIT movement of ions without qualification</p> <p>4 Statement must be comparative eg <u>faster</u> DO NOT CREDIT message / signal / wave of depolarisation</p> <p>5 ACCEPT longer local circuits ACCEPT 'local currents' instead of local circuits</p> <p>6 eg • impulse jumps from , node to node / gap to gap Note: 'saltatory conduction' = 2 QWC terms</p> |
| | | | <p>QWC – technical terms used appropriately with correct spelling ;</p> | | 1 |

| Question | | | Expected Answers | Marks | Additional Guidance |
|----------|-----|-----|--|--------------|--|
| 2 | (b) | (i) | <p>1 <i>idea that</i> atropine , binds to / occupies / competes for , (ACh) <u>receptor</u> on postsynaptic , membrane / neurone ;</p> <p>2 <i>idea that</i> prevents ACh binding / blocks binding site / blocks receptor ;</p> <p>3 ion gates / ion channels / sodium channels / protein channels , do not open / remain closed ;</p> <p>4 Na⁺ cannot enter / K⁺ cannot leave , neurone / (nerve) cell ;</p> <p>5 no / insufficient , depolarisation / postsynaptic potential / excitatory postsynaptic potential / epsp / generator potential ;</p> <p>6 (so) does not reach threshold (value / potential) ;</p> | 3 max | <p>IGNORE ref to atropine and ACh having similar shapes (as given in Q)</p> <p>ACCEPT ACH / ach throughout</p> <p>Only credit ORA for the mark points if candidate clearly states that these events do <u>NOT</u> take place with atropine.</p> <p>1 IGNORE ref inhibition DO NOT CREDIT active site DO NOT CREDIT ref to bouton / bulb / etc</p> <p>2</p> <p>3 CREDIT fewer ion channels open</p> <p>4 CREDIT sodium ions / potassium ions DO NOT CREDIT Na / K DO NOT CREDIT ions entering the membrane</p> <p>5 IGNORE action potential (as given in Q)</p> <p>6</p> |

| Question | | | Expected Answers | Marks | Additional Guidance |
|----------|-----|------|---|---------------------------|---|
| 2 | (b) | (ii) | <p>1 <i>idea that</i> will , bind to / occupy / compete for / block , (some of ACh) receptors ;</p> <p>2 so acetylcholine / ACh , cannot bind / less likely to bind (to receptor / to postsynaptic membrane) ;</p> <p>3 prevents / reduces , constant stimulation / overstimulation / constant depolarisation , of postsynaptic neurone or prevents / reduces , constant firing of action potentials / tetanus / (muscle) spasm ;</p> <p>4 AVP ;</p> | | <p>ACCEPT ACH / ach throughout</p> <p>1 DO NOT CREDIT ref to active site</p> <p>2 ACCEPT <i>idea that</i> ACh remains in synaptic cleft</p> <p>3</p> <p>4 eg</p> <ul style="list-style-type: none"> • effective if administered soon after exposure • cannot counteract inhibition of acetylcholinesterase |
| | | | TOTAL | 2 max 12 | |

| Question | | | Expected Answers | | Marks | Additional Guidance | |
|----------|-----|------|------------------|---|--------------|--|---|
| 3 | (a) | (i) | | <p>W glycolysis ;</p> <p>X Calvin cycle / light-independent stage (of photosynthesis) ;</p> <p>Y Krebs cycle ;</p> | | <p>Mark the first answer for each letter. If the answer is correct and an additional answer is given that is incorrect or contradicts the correct answer then = 0 marks</p> <p>W : CREDIT glycolytic pathway ACCEPT phonetic spelling but must have 'glycol' IGNORE respiration</p> <p>X : IGNORE dark reaction / photosynthesis ACCEPT phonetic spelling</p> <p>Y : ACCEPT citric acid cycle / TCA cycle / (tri)carboxylic acid cycle ACCEPT phonetic spelling IGNORE respiration / link reaction</p> | |
| 3 | (a) | (ii) | 1 | take place in different , parts / organelles , of the cell or compartmentalisation / reactions separated by membranes ; | | 1 | Must be a clear statement and not implied from others. DO NOT CREDIT different parts of the leaf DO NOT CREDIT no interference between pathways (as rephrasing the Q) |
| | | | 2 | W / glycolysis , in cytoplasm ; | | 2 | |
| | | | 3 | X / Calvin cycle , in , chloroplast / stroma (of chloroplast) ; | | 3 | DO NOT CREDIT if thylakoid / membranes stated or implied |
| | | | 4 | Y / Krebs cycle , in , mitochondrion / matrix (of mitochondrion) ; | | 4 | DO NOT CREDIT if cristae / membranes stated or implied |
| | | | 5 | AVP ; | | 5 | eg <ul style="list-style-type: none"> • different enzymes for each pathway • different conditions for each pathway |
| | | | | | 3 max | | |

| Question | | | Expected Answers | Marks | Additional Guidance |
|----------|-----|-------|--|-------|--|
| 3 | (a) | (iii) | X ; W and Y ; | 2 | <p>IGNORE names. The question has asked for letters.</p> <p><i>photosynthesis</i> Mark the first answer. If the answer is correct and an additional letter is given then = 0 marks</p> <p><i>aerobic respiration</i> Mark the first two answers. If these answers are correct and an additional letter (ie 3rd etc) is given then = 0 marks</p> <p>Both letters required for this mark, in any order.</p> |
| 3 | (a) | (iv) | ATP / adenosine triphosphate ; water / H ₂ O ; (oxidised) NAD / FAD ; | 2 | <p>If any answer(s) incorrect then Max 1</p> <p>IGNORE energy / heat IGNORE numbers</p> <p>eg oxygen (×) and ATP (✓) and water = max 1 oxygen (×) and energy (<i>ignore</i>) = 0 ATP (✓) and energy (<i>ignore</i>) and H₂O (✓) = 2 reduced NAD (×) and ATP (✓) and energy (<i>ignore</i>) and H₂O = max 1</p> |

| Question | | Expected Answers | Marks | Additional Guidance | |
|--------------|-----|------------------|---|---------------------|--|
| 3 | (b) | 1 | NAD / FAD / NADP , can , accept hydrogen / accept H / be reduced ; | 1 | DO NOT CREDIT hydrogen ions / protons , unless there is an electron as well DO NOT CREDIT accepts hydrogen molecules /H ₂ CREDIT equation showing the reduction ACCEPT eg NAD converted to NADH IGNORE 'carries hydrogen' |
| | | 2 | reduced , NAD / FAD , supplies / carries , electrons , to the electron transport chain / for oxidative phosphorylation ; | 2 | Must refer to <i>reduced</i> NAD or <i>reduced</i> FAD or NADH / NADH ⁺ / NADH ₂ / FADH / FADH ⁺ / FADH ₂ |
| | | 3 | reduced , NAD / FAD , supplies / carries , hydrogen ions for , chemiosmosis / oxidative phosphorylation ; | 3 | Must refer to <i>reduced</i> NAD or <i>reduced</i> FAD or NADH / NADH ⁺ / NADH ₂ / FADH / FADH ⁺ / FADH ₂ |
| | | 4 | reduced NADP , supplies / carries , hydrogen to , light independent stage / Calvin cycle / X ; | 4 | Must refer to <i>reduced</i> NADP or NADPH / NADPH ⁺ / NADPH ₂ |
| | | 5 | coenzyme A / CoA , carries , <u>acetate</u> / <u>ethanoate</u> / <u>acetyl group</u> , to , Krebs cycle / Y ; | 5 | DO NOT CREDIT acetyl CoA carries acetate |
| | | 6 | AVP ; | 6 | eg • co-enzyme(s) / cytochrome(s) , transfer / accept and release , electrons along the electron transport chain • can be , recycled / oxidised and reduced |
| TOTAL | | | 3 max 13 | | |

| Question | | Expected Answers | | Marks | Additional Guidance |
|----------|-----|------------------|---|-------|--|
| 4 | (a) | 1 | <u>water potential</u> / Ψ , of plasma / outside cells , would be higher than that of the (blood) cells ; | 2 max | 1 Must be a clear comparative statement relating to outside and inside cells CREDIT ora IGNORE water concentration |
| | | 2 | water would enter (blood) <u>cells</u> ; | | 2 IGNORE osmosis / down water potential gradient |
| | | 3 | blood cells , swell / (might) burst / lyse ; | | 3 CREDIT haemolysis / haemolysed DO NOT CREDIT plasmolysis / turgid Note: 'cells become turgid and burst' = 0 'cells swell and become turgid' = 0 |
| 4 | (b) | | <i>type of monomer</i> amino acid ; <i>name of bond</i> peptide / amide ; | 2 | 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 DO NOT CREDIT amine IGNORE covalent DO NOT CREDIT dipeptide / polypeptide |

| Question | | Expected Answers | | Marks | Additional Guidance |
|----------|-----|------------------|--|-------|---|
| 4 | (c) | | <p>1 osmoreceptor / neurosecretory ;</p> <p>2 hypothalamus ;</p> <p>3 axon(s) ;</p> <p>4 posterior pituitary ;</p> <p>5 collecting duct ;</p> <p>6 (plasma / cell) membrane(s) ;</p> <p>7 aquaporins(s) ;</p> <p>8 osmosis ;</p> | 8 | <p>Mark the first answer on each prompt line in the passage. If the answer is correct and an additional answer is given for that 'gap' that is incorrect or contradicts the correct answer then = 0 marks</p> <p>ACCEPT phonetic spelling throughout</p> <p>1 : ACCEPT osmotic receptor</p> <p>2</p> <p>3</p> <p>4 : DO NOT CREDIT 'pituitary' without correct qualification</p> <p>5 : ACCEPT distal (convoluted) tubule / second convoluted tubule</p> <p>6</p> <p>7 : DO NOT CREDIT aqua pores</p> <p>8</p> |

| Question | | Expected Answers | Marks | Additional Guidance |
|--------------|-----|--|---------------------|--|
| 4 | (d) | <p>1 <i>how ADH is dealt with as a protein</i> in , liver / hepatocytes ;</p> <p>2 hydrolysis / acted on by protease ;</p> <p>3 deamination / amine group removed / formation of ammonia / formation of NH₃ ;</p> <p>4 ornithine cycle / formation of urea / formation of CO(NH₂)₂ ;</p> <p>5 amino acids / keto acids , used in (named) metabolic pathway ;</p> <p><i>how ADH or urea is dealt with as a small molecule</i> 6 in kidney ;</p> <p>7 (ultra)filtered from blood / moves from blood into nephron ;</p> <p>8 (because) small molecule ;</p> <p>9 urea not (all) reabsorbed / ADH not reabsorbed / (ADH or urea) present in urine ;</p> <p>10 <u>excreted</u> ;</p> | <p>3 max</p> | <p>1 DO NOT CREDIT if linked directly to excretion eg 'excreted by the liver'</p> <p>2 'broken down' is not quite enough</p> <p>3 DO NOT CREDIT 'amine group deaminated'</p> <p>4 DO NOT CREDIT 'amino acid enters ornithine cycle'</p> <p>5 eg</p> <ul style="list-style-type: none"> • amino acids used for protein synthesis • keto acids used in , Krebs cycle / respiration • used in gluconeogenesis <p>6</p> <p>7</p> <p>8</p> <p>9 DO NOT CREDIT 'removed as urine'</p> <p>10 DO NOT CREDIT if linked directly to the liver eg 'excreted by the liver'</p> |
| TOTAL | | | 15 | |

| Question | | | Expected Answers | Marks | Additional Guidance |
|----------|-----|------|--|-------|--|
| 5 | (a) | (i) | <p><i>2nd messenger</i> cAMP / cyclic AMP / cyclic adenosine monophosphate ;</p> <p><i>1st messenger</i> adrenaline / adrenalin ;</p> | 2 | <p>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</p> <p>ACCEPT CAMP / camp DO NOT CREDIT adenine monophosphate</p> <p>IGNORE chemicals not named in Fig. 5.1</p> |
| 5 | (a) | (ii) | <p>1 <u>glycogen</u> → <u>glucose</u> / <u>glycogenolysis</u> ;</p> <p>2 by <u>hydrolysis</u> ;</p> <p>3 <i>correct ref to</i> protein kinase / glycogen phosphorylase kinase (activates glycogen phosphorylase) or glycogen phosphorylase (stimulates conversion of glycogen) or inhibition of glycogen synthase (preventing glucose conversion to glycogen) ;</p> | 1 max | <p>1 DO NOT CREDIT gluconeogenesis / glycogenesis</p> <p>2 This term must be used, or a derived term.</p> <p>3</p> |

| Question | | | Expected Answers | Marks | Additional Guidance |
|----------|-----|-------|--|---------------------|---|
| 5 | (a) | (iii) | <p>1 different tissues have different (types of adrenaline) receptors ;</p> <p>2 (causing) cAMP concentration to increase or decrease ;</p> <p>3 second messenger (may be) different ;</p> <p>4 cAMP / second messenger , activates , different / other , enzymes / enzyme reactions (in different target cells) ;</p> | <p>2 max</p> | <p>IGNORE reasons not related to adrenaline (as Q specifies 'how the adrenaline molecule can cause ...')</p> <p>IGNORE descriptions of stated effects in different tissues as Q asks <i>how</i> adrenaline causes these different effects</p> <p>1</p> <p>2 ACCEPT adenylyl cyclase / cAMP , inhibited</p> <p>3</p> <p>4</p> |

| Question | | Expected Answers | | Marks | Additional Guidance |
|--------------|--|--|---|-----------|--|
| 5 | (b) | 1 | adrenalin(e) increases , heart rate / stroke volume / cardiac output ; | 4 max | 1 |
| | | 2 | cardiovascular centre in medulla oblongata ; | | 2 |
| 3 | idea of nervous connection to , SAN / sino-atrial node ; | 3 | ACCEPT SAN for mp 3 but not for QWC | | |
| 4 | (which) controls frequency of waves of , excitation / depolarisation ; | 4 | CREDIT in relation to mp 2 or mp 3 | | |
| 5 | vagus / parasympathetic , nerve decreases heart rate ; | 5 | ONLY CREDIT vagus or parasympathetic for QWC | | |
| 6 | accelerator / sympathetic , nerve increases heart rate ; | 6 | ONLY CREDIT accelerator or sympathetic for QWC ACCEPT phrenic nerve | | |
| 7 | high blood pressure detected by , stretch receptors / baroreceptors ; | 7 | DO NOT CREDIT proprioceptor | | |
| 8 | low blood pH / increased levels of blood CO ₂ , detected by chemoreceptors ; | 8 | | | |
| 9 | (receptors) in , aorta / carotid sinus / carotid arteries ; | 9 | | | |
| | | QWC – technical terms used appropriately with correct spelling ; | | 1 | <p>Correct use of adrenalin(e) (Identify using the tick 1 <input checked="" type="checkbox"/> AND MUST BE INCLUDED FOR QWC TO BE AWARDED)</p> <p>plus use of 2 terms from: cardiovascular centre, medulla oblongata, sino-atrial node, vagus or parasympathetic, carotid, accelerator or sympathetic, chemoreceptor</p> <p>You should use the GREEN DOT to identify the remaining QWC terms that you are crediting.</p> <p>Please insert a QWC symbol next to the PENCIL ICON, followed by a tick (✓) if QWC has been awarded or a cross (x) if QWC has not been awarded</p> |
| TOTAL | | | | 10 | |

| Question | | Expected Answers | Marks | Additional Guidance |
|----------|-----|-------------------------|-------|---|
| 6 | (a) | 124 (%) / 123.7 (%) ; ; | 2 | <ul style="list-style-type: none"> • Correct answer = 2 marks $(208 - 93) \div 93 \times 100$ • ACCEPT 55 (%) / 55.3 (%) for 2 marks $(208 - 93) \div 208 \times 100$ • Correct numerical answer but inappropriate units (eg 124 μm) = 1 mark • If answer not rounded correctly (to nearest whole number or to 1 dp) or if answer incorrect, then allow 1 mark for seeing either 115 or (208 – 93) |

| Question | | Expected Answers | Marks | Additional Guidance |
|----------|-----|---|-------|--|
| 6 | (b) | <p>1a <i>benefit</i> allows entry of more CO₂ ;</p> <p>2a <i>explanation</i> (CO₂) for , light-independent reaction / Calvin cycle or 2b light-dependent reaction is taking place quickly / reduced NADP building up / ATP building up or 2c CO₂ not as limiting (than when there are fewer stomata) or 2d <i>idea that</i> increases access to air spaces for distribution of CO₂ ;</p> <p>OR</p> <p>1b <i>benefit</i> reduces transpiration ;</p> <p>2e <i>explanation</i> <i>idea of</i> stomata sheltered from , air currents / heat (when on lower surface) or 2f <i>idea that</i> diffusion shells maintained ;</p> | 2 | <p>Read through complete answer. Award 2 marks if a benefit and explanation <u>are</u> correctly linked.</p> <p>If benefit and explanation <u>are not</u> correctly linked: Award Max 1 for <u>either</u> a benefit <u>or</u> an explanation.</p> <p>1a Must indicate the idea of <i>more and imply going in</i> eg 'allows more gas exchange so that there is more CO₂ for photosynthesis' the mention of gas exchange implies that the CO₂ must be going in</p> <p>2a DO NOT CREDIT 'CO₂ fixed' without further qualification (eg ref to Rubisco / GP formation)</p> <p>2b</p> <p>2c CREDIT with fewer stomata CO₂ is limiting</p> <p>2d</p> <p>1b DO NOT CREDIT description of transpiration ACCEPT 'plant less likely to wilt'</p> <p>2e</p> <p>2f</p> |

| Question | | Expected Answers | Marks | Additional Guidance |
|----------|-----|--|---------------------|--|
| 6 | (c) | <p>1 equal sample size for sun and shade leaves / increase sample size of shade leaves / greater numbers of sun and shade leaves ;</p> <p>2 measure thickness of cuticle / make cuticle observations quantitative ;</p> <p>3 record range / calculate SD / calculate SE / (named) statistical analysis ;</p> <p>4 record data on leaf, length / width / area / colour / chlorophyll content ;</p> <p>5 record data on , size of stomata / stomatal count on upper surface ;</p> <p>6 define what is a sun or shade leaf / measure light levels to classify type of leaf ;</p> <p>7 repeat / replicate , the (whole) experiment / using other plants of the same species ;</p> | <p>2 max</p> | <p>DO NOT CREDIT refs to controlling temperature or light or wind or time</p> <p>1</p> <p>2</p> <p>3</p> <p>4</p> <p>5</p> <p>6</p> <p>7 IGNORE ref to other species DO NOT CREDIT 'repeats' unqualified or implying the same individual plant</p> |
| | | TOTAL | 6 | |

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