

Biology

Advanced GCE A2 H421

Advanced Subsidiary GCE AS H021

Mark Scheme for the Units

January 2010

HX21/MS/R/10J

F214 Communication, Homeostasis & Energy

Question		Expected Answers		Marks	Additional Guidance				
1	(a)	1	<table border="1"> <thead> <tr> <th><i>excretion</i></th> <th><i>secretion</i></th> </tr> </thead> <tbody> <tr> <td> (metabolic) waste or toxin / harmful or substance is to be removed from body or does not use vesicles </td> <td> useful product or used in cell communication (e.g. to target tissues) or released from glands (ducts or ductless) or uses vesicles or remain in body </td> </tr> </tbody> </table>	<i>excretion</i>	<i>secretion</i>	(metabolic) waste or toxin / harmful or substance is to be removed from body or does not use vesicles	useful product or used in cell communication (e.g. to target tissues) or released from glands (ducts or ductless) or uses vesicles or remain in body	;	One mark per row. CREDIT converse statements on either side or unmatched statements for each 1 IGNORE name or type of product without qualification DO NOT CREDIT any ref to egestion in 'excretion'
			<i>excretion</i>	<i>secretion</i>					
(metabolic) waste or toxin / harmful or substance is to be removed from body or does not use vesicles	useful product or used in cell communication (e.g. to target tissues) or released from glands (ducts or ductless) or uses vesicles or remain in body								
2	<table border="1"> <tbody> <tr> <td> urea / carbon dioxide / water / bile pigment / named example </td> <td> hormone / enzyme / antibodies / mucus / bile salts / neurotransmitter / named example </td> </tr> </tbody> </table>	urea / carbon dioxide / water / bile pigment / named example	hormone / enzyme / antibodies / mucus / bile salts / neurotransmitter / named example	;	2 IGNORE sweat / urine / bile / saliva / salt / (named) digestive juice				
urea / carbon dioxide / water / bile pigment / named example	hormone / enzyme / antibodies / mucus / bile salts / neurotransmitter / named example								

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Question			Expected Answers		Marks	Additional Guidance	
			3	<p><i>one similarity</i></p> <p>requires ATP or (involved in) homeostasis or (compounds) produced by cell(s) / produced by metabolism / need to cross membrane / need to move through membrane / need to leave cell / (may be) transported in blood</p>	;	3	<p>CREDIT method of leaving cell e.g. exocytosis IGNORE going into cells (as some excretory products do)</p>
					3		

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1	(b)		<p>S1 glucose is not the only substrate / there are other substrates ; E1 named alternative substrate ; or</p> <p>S2 ATP is produced / energy is released ; E2 (by) substrate level / oxidative, phosphorylation ; or</p> <p>S3 ATP / energy, required ; E3 (for) phosphorylation / glycolysis ; or</p> <p>S4 is not a single step reaction / other steps involved / other products / other intermediates ; E4 named stage(s) / named intermediate compound(s) ; or</p> <p>S5 enzymes are involved ; E5 dehydrogenation / decarboxylation / oxidative phosphorylation / named (respiratory) enzyme ; or</p> <p>S6 coenzymes / NAD, involved ; E6 oxidative phosphorylation / link reaction / Krebs cycle / glycolysis ; or</p> <p>S7 glucose does not, combine / react , (directly) with oxygen ; E7 (oxygen) used in oxidative phosphorylation / is final electron acceptor / is final hydrogen acceptor ;</p>	<p>S & C</p> <p>1 'fats can (also) be respired' = E1 'fats can be respired as well as glucose' = S1 + E1</p> <p>S2 DO NOT CREDIT energy produced / made / created</p> <p>4 Krebs cycle / ETC , happens = E4 'other stages such as link reaction are involved' = S4 + E4 E4 e.g. pyruvate / acetyl CoA / acetate IGNORE NAD(H) / FAD(H) / ATP</p> <p>S6 DO NOT CREDIT NADP</p> <p>2</p>	<p>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</p> <p>CREDIT one statement and a suitable explanation related to that (first) given statement (e.g. S3 + E3 but not S4 + E1)</p> <p>DO NOT AWARD 2 marks for 2 statements or 2 explanations</p>

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Question			Expected Answers	Marks	Additional Guidance
1	(c)	(i)	<p>1 unable to produce (enough) insulin / do not secrete insulin / produces ineffective insulin ;</p> <p>2 insulin-producing cells / beta cells / islets of Langerhans, not functioning (correctly) / damaged / destroyed / attacked ;</p> <p>3 by (body's own) immune system / by (body's own) antibodies / auto-immune disease ;</p> <p>4 (idea of) family history / genetic / hereditary ;</p> <p>5 (condition can be) triggered by , virus / environmental factor ;</p>	2 max	<p>Max 1 if referring to insulin receptors</p> <p>1 DO NOT CREDIT 'excrete' as incorrect</p> <p>2 ALLOW lack of beta cells / ref to b cells DO NOT CREDIT alpha cells / B cells (if lymphocytes implied)</p> <p>3 CREDIT description</p> <p>5 e.g. <ul style="list-style-type: none"> • shock • drugs side effect • (pancreatic) cancer • infection / disease </p>
1	(c)	(ii)	<p>1 increasing age / older / ageing / more prevalent over 40 ;</p> <p>2 (idea of) family history / genetic / hereditary ;</p> <p>3 (more common in) males ;</p> <p>4 (more common in) some ethnic groups / African / Afro-Caribbean / Asian / Hispanic / Oceanic ;</p> <p>5 obese / overweight / fat around abdomen ;</p> <p>6 high / frequent, intake of , sugar / highly processed food / high GI food ;</p> <p>7 lack of physical activity / sedentary lifestyle ;</p> <p>8 high blood pressure ;</p> <p>9 excessive alcohol intake ;</p>	3 max	<p>Mark the first 3 responses only</p> <p>1 DO NOT CREDIT age without 'older' implication</p> <p>5 CREDIT 'apple shaped'</p> <p>6 IGNORE 'poor diet' / 'bad diet' / 'unhealthy diet' IGNORE fat / carbohydrate , in diet</p> <p>8 CREDIT history of , heart attack / stroke</p> <p>9 idea of <i>too much</i> is needed</p>
			Total	10	

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Question			Expected Answers	Marks	Additional Guidance
2	(a)	(i)	glycolysis / glycolytic pathway ;	1	<p>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</p> <p>CREDIT phonetic spelling but must have 'glycol...'</p>
2	(a)	(ii)	cytoplasm ;	1	<p>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</p> <p>CREDIT cytosol DO NOT CREDIT cytoplasm, in / of, mitochondrion</p>
2	(a)	(iii)	<p>D ATP ;</p> <p>E NAD ;</p> <p>F pyruvate ;</p>	3	<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 mark</p> <p>E ALLOW oxidised NAD DO NOT CREDIT NADP / reduced NAD</p> <p>F ACCEPT pyruvic acid</p>

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Question		Expected Answers	Marks	Additional Guidance
2	(b)	<p>1 (pyruvate / F) converted to lactate ;</p> <p>2 F / pyruvate , accepts hydrogen (atoms) ;</p> <p>3 hydrogen from , reduced NAD / reduced E ;</p> <p>4 (catalysed by) <u>lactate</u> dehydrogenase ;</p> <p>5 no, oxygen / O₂ , to act as (final), hydrogen / electron, acceptor ;</p> <p>6 (so) link reaction / Krebs cycle / ETC, cannot take place ;</p> <p>7 NAD / E, regenerated / recycled / able to be re-used ;</p> <p>8 allows glycolysis to continue / pyruvate continues to be made ;</p> <p>9 limited / small amount of / some, ATP can be produced ;</p>	5 max	<p>Award marks from labelled / annotated diagrams – but ensure that mp 2 only awarded if H clearly shown to be accepted by pyruvate</p> <p>1 ACCEPT lactic acid DO NOT CREDIT if pyruvate → ethanol in the animal is indicated/implied DO NOT CREDIT wrong reaction type (e.g. oxidation)</p> <p>2 ACCEPT pyruvic acid DO NOT CREDIT hydrogen ions (unless also e⁻) / molecules</p> <p>3 ACCEPT NADH / NADH₂ / NADH + H⁺</p> <p>4 for pyruvate → lactate ACCEPT LDH</p> <p>6 Needs a clear statement of not taking place CREDIT no , electron transport chain / electron carrier chain / chemiosmosis / oxidative phosphorylation</p> <p>7 IGNORE reduced NAD , oxidised / reoxidised (as this does not give the idea of reusing it)</p> <p>8 Needs a clear statement</p> <p>9 CREDIT 1 ATP (per pyruvate) / 2 ATP (rather than 28-38 per glucose) / only substrate level phosphorylation IGNORE 'enough ATP for ...'</p>

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Question		Expected Answers	Marks	Additional Guidance		
2	(c)	1	S & C	1		
		1		large nostrils (open) to take in air ;	1	ACCEPT oxygen
		2		(when submerged) nostrils close / nose closes , to , keep air in / stop air from escaping ;	2	ACCEPT oxygen IGNORE ref to keeping water out
		3		lungs / airways , have high (vital) capacity ;	3	ACCEPT deep / barrel / large , chest IGNORE big lungs CREDIT large lung <u>volume</u> / takes in large <u>volume</u> of oxygen / larger numbers of alveoli / larger (exchange) surface area / increased number of capillaries
		4		<i>links to respiration</i> <i>idea that</i> seal , has low(er) metabolic rate / has low(er) respiratory rate / has low(er) energy requirements / uses (relatively) little ATP ;	4	e.g. • (streamlined, less resistance so) uses less energy • (insulated so retain heat so) uses less energy • (buoyant so) less energy required • (small flippers so less surface area of extremity so loses less heat so) uses less energy
		5		able to respire anaerobically for a long time / more glycolysis ;	5	'anaerobic' needs time ref
		6		large supplies of NAD (to accept H) ;		
		7		(this) prevents , build-up of lactate / lowering of pH ;	7	ACCEPT lactic acid
		8		<i>idea that</i> (seal) tolerates lactate / removes lactate quickly ;	8	ACCEPT lactic acid
		9		<i>idea that</i> (seal) tolerates high CO ₂ concentration ;		
		10		<i>idea that</i> (seal) tolerates low pH / has more pH buffers ; <i>synoptic / inference</i>		
		11		<i>idea that</i> blood diverted from certain regions / certain regions have reduced metabolic activity ;	11	DO NOT CREDIT zero respiration rate
		12		<i>idea that</i> has plenty of , haemoglobin / red blood cells / myoglobin (as oxygen source) ;		
13	<i>idea that</i> haemoglobin has a higher affinity for oxygen / dissociates less readily / dissociation curve shifted to left ;	3 max				
Total			13			

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3	(a)		<ol style="list-style-type: none"> 1 myelin / myelinated / lipid / fatty (sheath) ; 2 (Schwann) <u>cell</u>, wrapped around / surrounds / AW, <u>axon</u> ; 3 except at nodes of Ranvier / (sheath) not continuous / presence of gaps (in the sheath) ; 	2 max	<ol style="list-style-type: none"> 1 DO NOT CREDIT fatty acids 3 must be in the context of structure rather than function (as many refer to it in context of saltatory conduction) 																												
3	(b)	(i)	<ol style="list-style-type: none"> 1 (myelination produces) <u>greater</u> speeds ; 2 unmyelinated needs larger diameter to produce same speed ; 3 comparative figs, all with units, to support either the general trend or the exception to the trend with the mollusc ; 	2 max	<ol style="list-style-type: none"> 1 IGNORE ref to axon diameter for this mp 3 1 speed for myelinated (25 / 30 / 35 , m s^{-1}) and 1 speed for unmyelinated (3 / 30 , m s^{-1}) (allow m/s) or calculated difference in speed between myelinated and unmyelinated (with units unless a multiple e.g. approx. x12) 																												
3	(b)	(ii)	<ol style="list-style-type: none"> 1 larger axon diameter produces <u>greater</u> speeds ; ora 2 comparative figs, all with units, to support ; 	2 max	<ol style="list-style-type: none"> 1 needs to be a general statement 2 2 diameters & speeds (both with units) for myelinated or calculated difference in diameter for 2 stated speeds (both with units unless diameter is a multiple e.g. around x 1.4 / around 140%) <table border="1"> <thead> <tr> <th>type of neurone</th> <th>diameter (μm)</th> <th>speed (m s^{-1})</th> <th>animal taxon</th> </tr> </thead> <tbody> <tr> <td>myelinated</td> <td>4</td> <td>25</td> <td>mammal</td> </tr> <tr> <td>myelinated</td> <td>10</td> <td>30</td> <td>amphibian</td> </tr> <tr> <td>myelinated</td> <td>14</td> <td>35</td> <td>amphibian</td> </tr> </tbody> </table> <p>or</p> <ol style="list-style-type: none"> 2 diameters & speeds (both with units) for unmyelinated or calculated difference in diameter for 2 stated speeds (both with units unless diameter is a multiple e.g. about x10) <table border="1"> <thead> <tr> <th>type of neurone</th> <th>diameter (μm)</th> <th>speed (m s^{-1})</th> <th>animal taxon</th> </tr> </thead> <tbody> <tr> <td>unmyelinated</td> <td>15</td> <td>3</td> <td>mammal</td> </tr> <tr> <td>unmyelinated</td> <td>1 000</td> <td>30</td> <td>mollusc</td> </tr> </tbody> </table>	type of neurone	diameter (μm)	speed (m s^{-1})	animal taxon	myelinated	4	25	mammal	myelinated	10	30	amphibian	myelinated	14	35	amphibian	type of neurone	diameter (μm)	speed (m s^{-1})	animal taxon	unmyelinated	15	3	mammal	unmyelinated	1 000	30	mollusc
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3	(c)	(i)	<p>1 increased <u>kinetic energy</u> / <u>KE</u> so,</p> <ul style="list-style-type: none"> ions <u>diffuse</u>, across (axon) membrane / into neurone / into cell / between nodes / along neurone, more quickly <p><i>or</i></p> <ul style="list-style-type: none"> faster movement of (neurotransmitter) vesicles / exocytosis (of neurotransmitter) <p><i>or</i></p> <ul style="list-style-type: none"> neurotransmitter diffuses more quickly across, synapse / synaptic cleft <p><i>or</i></p> <ul style="list-style-type: none"> neurotransmitter (ACh) broken down by enzyme (acetylcholinesterase) more quickly ; <p>2 faster <u>diffusion</u> of ions leads to,</p> <ul style="list-style-type: none"> faster depolarisation <p><i>or</i></p> <ul style="list-style-type: none"> shorter duration of action potential <p><i>or</i></p> <ul style="list-style-type: none"> shorter refractory period <p><i>or</i></p> <ul style="list-style-type: none"> faster repolarisation ; 	<p>S & C</p> <p>1 max</p>	<p>description of ion movement must be correct (e.g. Na⁺ in for depolarisation / Ca²⁺ into presynaptic knob)</p>
3	(c)	(ii)	<p>1 ion, channels / pumps, disrupted / denatured / no longer function ;</p> <p>2 fluidity of, membrane / phospholipid / bilayer, disrupted ;</p> <p>3 (named) synaptic enzymes denatured ;</p>	<p>1 max</p>	<p>DO NOT CREDIT general denaturation of proteins / enzymes</p> <p>2 IGNORE leaky membrane unless qualified</p>

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Question		Expected Answers	Marks	Additional Guidance
3	(d)	<p>1 calcium channels open ;</p> <p>2 Ca^{2+} / Ca^{++} / calcium ions , enter / diffuse into,</p> <p>3 acetylcholine / ACh / neurotransmitter, in vesicle(s) ;</p> <p>4 (synaptic) vesicles move towards presynaptic membrane ;</p> <p>5 vesicles fuse with membrane ;</p> <p>6 release acetylcholine, by exocytosis , into synaptic cleft ;</p>	3 max	<p>IGNORE ref to influx of Na^+ and events when action potential arrives at the synaptic knob – start when the Ca^{2+} channels open</p> <p>2 DO NOT CREDIT ‘calcium’ alone DO NOT CREDIT Ca^+ DO NOT CREDIT ‘enter membrane’ – must cross it</p> <p>4 CREDIT pre-synaptic</p> <p>5 DO NOT CREDIT attach / bind / join</p> <p>‘vesicles move and fuse with presynaptic membrane’ = mps 4 & 5 ‘vesicles move and fuse with membrane’ = mp 5 only</p>
		<p>QWC – technical terms used appropriately and spelt correctly ;</p>		1
Total			12	

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Question			Expected Answers	Marks	Additional Guidance
4	(a)	(i)	<u>ultrafiltration</u> ;	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 This term required but ACCEPT phonetic spelling
4	(a)	(ii)	17.9 ; ;	2	Correct answer = 2 marks If answer incorrect, not rounded or incorrectly rounded then allow 1 mark for working $125 \div 700$ or an unrounded answer e.g. 17.857412
4	(b)	(i)	(cuboidal) epithelium / epithelial ;	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 'epithelium cells ' / 'ciliated epithelium' / 'squamous epithelium' / endothelium ALLOW columnar epithelium
4	(b)	(ii)	<u>microvilli</u> / <u>microvillus</u> ;	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 'brush border' DO NOT CREDIT cilia

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Question			Expected Answers	Marks	Additional Guidance
4	(b)	(iii)	<i>This is a QWC question</i>		
		1	selective reabsorption ;	S & C	2 DO NOT CREDIT if glucose & amino acids & proteins 3 ACCEPT direct uptake , of glucose / amino acids, by active transport
		2	of glucose and amino acids ;		
3	co-transport / facilitated diffusion / uptake described ;				
4		water follows by osmosis so concentration of, ions / nitrogenous waste / urea / remaining substances , increases ;			5 e.g. <ul style="list-style-type: none"> • microvilli provide large surface area for uptake • many mitochondria provide energy for uptake • many brush border enzymes (ATPase) for active uptake • active secretion of nitrogenous waste into lumen
5	AVP ;				
			QWC - technical terms used appropriately and spelt correctly ;	3 max	
				1	Use of three terms from: reabsorption (or derived term), co-transport (or derived term), facilitated diffusion, osmosis

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Question			Expected Answers	Marks	Additional Guidance
4	(c)	(i)	L artery / shunt / vein (at arterial end of shunt) AND M vein ;	1	IGNORE names of artery / vein (e.g. renal) DO NOT CREDIT aorta and vena cava
4	(c)	(ii)	so that clots don't form, while in the (dialysis) machine / during dialysis ;	1	ALLOW congeal instead of clot IGNORE prevents clotting in the body IGNORE clumping
4	(c)	(iii)	<i>idea of allowing blood to clot normally after treatment ;</i>	1	CREDIT preventing low blood pressure (as low viscosity)
4	(c)	(iv)	(simple) <u>diffusion</u> ;	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 dialysis DO NOT CREDIT facilitated diffusion
4	(c)	(v)	<i>idea that it, maintains diffusion gradient / maintains concentration gradient / maximises diffusion gradient / maximises concentration gradient / allows maximum removal of waste / allows maximum rate of diffusion / AW ;</i>	1	IGNORE unqualified ref to countercurrent e.g. <ul style="list-style-type: none"> • solutions in contact over greater distance • provides maximum contact for exchange • allows exchange over longer distance IGNORE ref to surface area
Total				14	

F214

Mark Scheme

January 2010

Question			Expected Answers	Marks	Additional Guidance
5	(a)	(i)	control ;	1	<p>CREDIT a description e.g.</p> <ul style="list-style-type: none"> • comparison • to compare results with • to show that (wavelengths of) light is producing the effect • to show the result produced without light • create baseline • create set point • validity <p>IGNORE 'fair test' DO NOT CREDIT 'control variable' / 'controlled variable'</p>

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Question			Expected Answers	Marks	Additional Guidance
5	(a)	(ii)	<p>1 discs, the same size / cut with same cutter, so same surface area ;</p> <p>2 discs taken from same part of the leaf / leaves used from the same part of the plant so same amount of , pigment / chloroplast ;</p> <p>3 tubes same distance from light source so light intensity is the same ;</p> <p>4 light bulb the same (wattage) each time so light intensity is the same ;</p> <p>5 same thickness of filter so light intensity is the same ;</p> <p>6 carry out in darkened room / only 1 light source in room / completely cover tube with filter, so only light of desired wavelength enters ;</p> <p>7 CO₂ in excess / AW, so CO₂ not limiting / enough CO₂ for photosynthesis / enough CO₂ for Calvin cycle / enough CO₂ for light independent stage ;</p> <p>8 same , <u>volume</u> / <u>concentration</u> / batch, of indicator so that colour changes are comparable ;</p> <p>9 heat, sink / shield, between light source and tube to reduce temperature changes ;</p> <p>10 carry out at, same / constant, temperature as temperature affects enzyme, activity / structure ;</p> <p>11 carry out , repeats / replicates, to, calculate <u>mean</u> / identify anomalies ;</p> <p>12 AVP (to include precaution and explanation) ; ;</p>	2 max	<p>Read as paragraph. Mark the first 2 responses only. DO NOT CREDIT ref to time / same number of leaf discs / same plant (as these given in the question) IGNORE 'fair test' without further explanation</p> <p>1 ALLOW for same amount of pigment / chloroplast</p> <p>10 Enzyme ref must be qualified</p> <p>11 IGNORE ref to improving reliability IGNORE how anomalies dealt with DO NOT CREDIT preventing anomalies</p> <p>12 CREDIT any reasonable precaution with a suitable explanation (even if explanation already given) e.g. • rinse test tubes with distilled water so starting pH is the same</p>

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Question			Expected Answers	Marks	Additional Guidance
5	(a)	(iii)	chlorophyll a ;	1	<p>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</p> <p>ALLOW chlorophyll A / chlorophyll α</p> <p>IGNORE p680 / p700 / PSI / PSII</p> <p>DO NOT CREDIT chlorophyll a and b</p> <p>DO NOT CREDIT chlorophyll alone</p>
5	(a)	(iv)	<p>1 chlorophyll / pigments / leaf, reflect / does not absorb / absorbs little, green light / light of this wavelength ;</p> <p>2 (green light) cannot be used in photosynthesis / no photosynthesis / little photosynthesis / no light dependent reaction (or described) / little light dependent reaction (or described) correct ref to action spectrum in green region ;</p> <p>3 little / no, photolysis / splitting of water ;</p> <p>4 little / no, CO₂ , taken up / fixed (in light independent reaction) ;</p> <p>5 some CO₂ produced during respiration ;</p> <p>6 (slight) increase in CO₂, increases acidity / decreases pH ;</p> <p>7 AVP ;</p>	3 max	<p>1 Needs to refer to green rather than other colours</p> <p>2 Needs to refer to green rather than other colours</p> <p>3 CREDIT (some) photolysis with accessory pigments</p> <p>6 CREDIT increase in H⁺ decreasing pH for accessory pigments</p> <p>7 e.g. • accessory pigments absorb (some) green light</p>

Grade Thresholds

Advanced GCE (Biology) (H021 H421)
January 2010 Examination Series

Unit Threshold Marks

Unit		Maximum Mark	A	B	C	D	E	U
F211	Raw	60	40	35	31	27	23	0
	UMS	90	72	63	54	45	36	0
F212	Raw	100	69	62	56	50	44	0
	UMS	150	120	105	90	75	60	0
F214	Raw	60	40	36	32	28	25	0
	UMS	90	72	63	54	45	36	0

Specification Aggregation Results

Overall threshold marks in UMS (ie after conversion of raw marks to uniform marks)

	Maximum Mark	A	B	C	D	E	U
H021	300	240	210	180	150	120	0

The cumulative percentage of candidates awarded each grade was as follows:

	A	B	C	D	E	U	Total Number of Candidates
H021	8.8	28.6	54.1	78.4	95.1	100.0	1505

1505 candidates aggregated this series

For a description of how UMS marks are calculated see:

<http://www.ocr.org.uk/learners/ums/index.html>

Statistics are correct at the time of publication.