

Mark Scheme (Results)

October 2024

Pearson Edexcel International Advanced Level In Biology (WBI14) Paper 01 Energy, Environment, Microbiology, and Immunity

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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	Answer	Additional guidance	Mark
1(a)	An answer that includes two of the following points:	IGNORE shading / competition	
	 not all wavelengths of light can be absorbed (by the plant) (1) 	ACCEPT colours	
	• green light is reflected (off the leaf) (1)		
	 not all the light falls on the leaves (1) 		
	 {transmitted through/ passes through} {leaf / chloroplast / chlorophyll} (1) 		(2)

Question number	Answer	Additional guidance	Mark
1(b)(i)	• $1.1 \times 10^5 / 1.13 \times 10^5 / 1.1 \cdot 10^5 / 1.13 \cdot 10^5$ (1)	ACCEPT 1.10 × 10 ⁵ DO NOT ACCEPT 1.13× 10 ⁵ recurring	(1)

Question number	Answer	Additional guidance	Mark
1(b)(ii)	• 25 (1)	DO NOT ACCEPT 25.0	(1)

Question number	Answer	Additional guidance	Mark
1(b)(iii)	 0.02 / 0.016 / 0.0162 / 2 × 10⁻² / 1.6 × 10⁻² / 1.62 × 10⁻² (%) (1) 		(1)

Question number	Answer	Additional guidance	Mark
2(a)(i)	An explanation that includes the following points:		
	 {to amplify / to increase the sample / to increase the number of copies} (of DNA) (1) 	ACCEPT (DNA) samples are too small DO NOT ACCEPT to increase the length of DNA	
	 so that there is {enough / more} to {analyse / use in profiling / use in gel electrophoresis} (1) 	ACCEPT so will not be enough to analyse IGNORE easier / more accurate	(2)

Question number		Additional guidance	Mark
2(a)(ii)	A description that includes two of the following points:		
	 and line up the nucleotides along the DNA strands (1) 	ACCEPT forms a (new) strand of DNA / adds nucleotides to the new strand / helps in formation of hydrogen bonds between base pairs / causes complementary base pairing	
	 and form phosphodiester bonds between the nucleotides (on one strand) (1) 		(2)

Question number	Answer	Mark
2(b)(i)	The correct answer is B (restriction enzyme) A is incorrect because integrase joins viral DNA into host DNA C is incorrect because reverse transcriptase makes a DNA copy of RNA D is incorrect because RUBISCO is involved in the light-independent stages of photosynthesis	(1)

Question	Answer	Additional guidance	Mark
number			
2(b)(ii)	An answer that includes three of the following points:		
	 the (original) broccoli and the {genetically modified / clubroot resistant} broccoli OR 	NB Piece together	
	the linseed and the {genetically modified / clubroot resistant} broccoli (1)	ACCEPT hands with resistance gaps	
	 genetically modified plants to check that the resistance gene had been inserted (1) 	ACCEPT bands with resistance gene	
	• the original plants to identify the broccoli bands (1)	ACCEPT idea that the linseed profile is compared to modified broccoli to find	
	• the linseed to identify the resistance {genes / bands} (1)	show successful modification = 3 marks	(3)

Question number	Answer	Additional guidance	Mark
3(a)	A description that includes two of the following points:		
	• (complex) transported to the Golgi (apparatus / body) (in vesicles) (1)		
	• transported in vesicles (from the Golgi through the cytoplasm) to the (surface) membrane (1)		
	• (released onto surface) by fusion of vesicles with membrane (1)	ACCEPT exocytosis from the (surface) {membrane / cell}	(2)

Question number	Answer	Additional guidance	Mark
3(b)(i)	• 0.37 (nm) (1)	3.7 × 10 ⁻¹	(1)

Question number	Answer	Additional guidance	Mark
3(b)(ii)	 the microscope is able to distinguish two lines if they are {3.7 Å / 0.37 nm} or more apart (1) 	 ACCEPT value given in (i) structures / objects / points different / separate e.g minimum distance of 3.7 angstroms required for two things to be seen apart if two objects are closer together than 3.7 angstroms they appear as a single object IGNORE particles resolve / clear / more detail / quality / focus DO NOT ACCEPT magnification 	(1)

Question number	Answer	Additional guidance	Mark
3(c)	An explanation that includes two of the following points:	ACCEPT cytotoxic T cells / CD8 cells throughout	
	• because antigen presentation is needed to activate the T killer cells (1)	ACCEPT initiate CMI / clonal selection	
	• so that T killer cells will divide (1)	ACCEPT clone / clonal expansion	
	 so that there are {enough / many} T killer cells to {destroy / lyse / release perforins onto} the host-infected cells (1) 	ACCEPT chemicals / enzymes / proteases cause apoptosis	(2)
			(2)

Question number	Answer	Additional guidance	Mark
3(d)	 An explanation that includes the following points: T killer cells {destroy / lyse / perforate} the {infected / host} cells (1) releasing {viruses / viral components} (1) 	ACCEPT pathogen but not bacteria IGNORE damaged DO NOT ACCEPT virus / antigen	
	• so that macrophages can destroy them (1)	 ACCEPT phagocytes / phagocytosis of virus / virus engulfed / virus digested virus particles will not assemble (if components not inside a cell) DO NOT ACCEPT kills virus / T killer cells phagocytose / antibodies destroy 	(3)

Question	Answer	Mark
number		
4(a)(i)	The correct answer is C (forensic entomology)	
	A is incorrect because chromatography is a separation method	
	B is incorrect because dendrochronology is the study of tree growth rings	
	D is incorrect because heterozygosity is a measure of genetic diversity	(1)

Question	Answer	Mark
number		
4(a)(ii)	The correct answer is D (1, 2 and 3)	
	 A is incorrect because all three factors provide the information B is incorrect because all three factors provide the information C is incorrect because all three factors provide the information 	(1)

Question	Answer	Mark
number		
4(b)(i)	The correct answer is B (pushing a temperature probe into the liver)	
	 A is incorrect because this would measure external temperature of body + air temperature effect C is incorrect because the mouth is not deep inside the body D is incorrect because the arm pit is not inside the body 	(1)

Question	Answer	Mark
number		
4(b)(ii)	The correct answer is A (increase, increase)	
	B is incorrect because more clothing will keep the body warmer and increase the time estimate + higher ambient temperature would reduce heat loss and increase the estimate	
	C is incorrect because more clothing will keep the body warmer and increase the time estimate + higher ambient temperature would reduce heat loss and increase the estimate	
	D is incorrect because more clothing will keep the body warmer and increase the time estimate + higher ambient temperature would reduce heat loss and increase the estimate	(1)

Question	Answer	Additional guidance	Mark
4(c)(i)	 An explanation that includes the following points: ATP decreases as {oxygen levels / aerobic respiration (by muscle cells)} decrease (1) 	ACCEPT used during muscle relaxation drop in pH reduces ATP synthase activity	
	 lactic acid increases as anaerobic respiration (in muscle cells) takes place (1) pH decreases because of the {production of / increase in} lactic acid (1) 		(3)

Question number	Answer	Additional guidance	Mark
4(c)(ii)	 An explanation that includes three of the following points: because muscle contraction increases and decreases (with time after death) (1) 	ACCEPT stiffen and relax idea that muscles will be relaxed before and after contraction	
	• gives two different estimates (1)	ACCEPT two quoted times that extent of contraction is the same only useful between 2.4 and 36 hours after death cannot estimate the TOD after 36 hours as the muscles will be relaxed similar contraction at {flat region / between 15 to 23 hours}	
	 (degree of) muscle contraction affected by {other factors / named factor} (1) 		(3)
	• judging (extent of) muscle contraction is subjective (1)		(3)

Question number	Answer	Additional guidance	Mark
5(a)	• (a series of) changes in the (types of) species (within a habitat) with time (1)		(1)

Question	Answer	Mark
number		
5(b)	The correct answer is B (a place that meets the environmental conditions as organism needs to survive)	
	 A is incorrect because it describes a community of organisms C is incorrect because it describes a population D is incorrect because an organism's niche is its role 	(1)

Question number	Answer	Mark
*5(c)		(6)
	Early changes:	
	bare rock needs breaking down	
	 by pioneer species / presence of alder and spruce 	
	soil conditions improve when organisms die	
	Increase in numbers of plants:	
	alder / spruce one of first plants to appear	
	because early soil is suitable / early stages of succession have to take place	
	Decause seeds brought in	
	humbers of alder / spruce rise hossues the plants reproduce	
	 Declause the plants reproduce alder reproduces faster than spruce 	
	 alder reproduces faster than spruce because there is little competition from other plants 	
	 because there is trace competition nom other plants bemlock last of the three plants to appear 	
	 because seeds brought in later 	
	 because seeds blodging in rates because early soil is not suitable for this plant 	
	 numbers of hemlock increase 	
	 because of reproduction 	
	Numbers of hemlock become stable:	
	 because only this number can be supported by the environment 	
	because still too many spruce trees present	
	Decrease in number of plants:	
	numbers of alder / spruce fall	
	 due to competition for {water / light / mineral ions / space} 	
	due to disease	
	• uue to disease	
	Inditible of alder fail / drop to zero	
	because spruce out competes alder for {water / light / mineral lons / space}	
	because spruce is tailer / grows faster	
	affected more by the appearance of hemlock	
	spruce numbers do not fall to zero	
	 numbers of hemlock are not high enough to completely out compete the species 	
	climax community not yet reached	
	Numbers of alder remain at zero:	
	 because they are {extinct / (completely) eaten by animals / disease has wiped them out} 	

			Additional guidance
Level 0	0	No awardable content	
Level 1	1-2	An explanation may be attempted but with limited interpretation or analysis of the scientific information and with a focus on mainly just	Simple descriptions / limited explanation of the data
		one piece of scientific information. The explanation will contain basic information, with some attempt made to link knowledge and	1 mark = a description of some changes
		understanding to the given context.	2 marks = a simple explanation for one aspect of data OR
			an account of succession with no reference to the
			changes shown
	2.4		
Level 2	3-4	An explanation will be given, with occasional evidence of analysis,	Some explanation of the changes
		information. The explanation shows some linkages and lines of	3 marks = simple explanations for two aspects of data
		scientific reasoning, with some structure.	
			4 marks = simple explanations for three aspects of data
Level 3	5-6	An explanation is made that is supported throughout by sustained	Detailed explanation of the changes
		evaluation of both pieces of scientific information. The explanation	5 marks = plus one additional detailed explanation
		shows a well-developed and sustained line of scientific reasoning,	
		which is clear and logically structured.	6 marks = plus two additional detailed explanations

Question	Answer	Mark
number		
6(a)(i)	The correct answer is A ($\frac{5}{11}$)	
	B is incorrect because it is $(3.3-1.8) \div 3.3 = \frac{5}{11}$ C is incorrect because it is $(3.3-1.8) \div 3.3 = \frac{5}{11}$ D is incorrect because it is $(3.3-1.8) \div 3.3 = \frac{5}{11}$	(1)

Answer	Mark
The correct answer is B (logarithmic)	
A is incorrect because this is already a linear scale C is incorrect because standard deviation is not an axis scale D is incorrect because standard form is not an axis scale	(1)
Ar Th A / C /	nswer ne correct answer is B (logarithmic) is incorrect because this is already a linear scale is incorrect because standard deviation is not an axis scale is incorrect because standard form is not an axis scale

Question	Answer	Additional guidance	Mark
number			
6(b)	An answer that includes the following points:		
	 each subtype had {same / similar} antigens (1) the vaccine contained {two types / more than one type} of antigen (1) 	ACCEPT vaccine contained two types of {attenuated / deactivated} virus vaccine stimulates production of more than one type of antibody	(2)

Question	Answer Additional guidance I				
6(c)(i)	An explanation that includes five of the following points:				
	• the vaccine contained (RSV) antigens (1)	ACCEPT {inactivated / attenuated} {virus / RSV}			
 the (mother's) immune response was initiated (1) 					
	• credit details of humoral immune response (1)	e.g. macrophages presented antigen to T helper cells / cytokines released from T helper cell stimulated B cells / activated B cells differentiated into plasma cells IGNORE details of CMI			
	• plasma cells released antibodies (to RSV) (1)				
	• these antibodies will pass across the placenta (to fetus) (1)	ACCEPT antibodies passed from mother's blood into fetus DO NOT ACCEPT baby {cells / blood} pass			
	 and remained in the blood until after the baby was born (1) 	ACCEPT remain in the blood temporarily	(5)		

Question number	Answer	Additional guidance	Mark
6(c)(ii)	An answer that includes three of the following points:		
	• pregnant women were used and were given the (RSV) vaccine (1)		
	 one large group of {pregnant vaccinated women / babies of these pregnant vaccinated women / babies with passive immunity to RSV} (1) 		
	 babies (from vaccinated pregnant women) monitored for a period of time (1) 	ACCEPT stated period of time up to 2 years	
	 number of babies who developed RSV infections requiring medical attention and number not requiring medical attention recorded 		
	OR		
	number of babies who developed RSV not requiring medical attention divided by the total number of infected babies (× 100) (1)	ACCEPT converse for calculating percentage who did need medical attention	(3)

Question number	Answer	Additional guidance	Mark
7(a)	An explanation that includes four of the following points:	NB ACCEPT less for no, throughout	
	 without chloroplasts the plant will not be able to {photosynthesise / absorb light} (1) 	ACCEPT white parts / streaks will not photosynthesise no light-dependent reaction	
	 {bacteria living in the xylem / sticky gum} could prevent {water / mineral ions} {reaching the leaves / being transported (up)} (1) 		
	 no water for {photolysis / hydration / turgidity} (1) 	IGNORE mineral ions	
	 no magnesium ions for chlorophyll (1) 	ACCEPT other named ion and function that would prevent photosynthesis from occurring or plant dying	
	 no {GALP / glucose} will be synthesised (1) 	ACCEPT named molecule e.g. sucrose / chlorophyll biomass no ATP	(4)

Question number	Answer	Additional guidance	Mark
7(b)(i)	A description that includes the following points:	PIECE TOGETHER THROUGHOUT IGNORE numbers of strands / double helix / plasmids / non- structural comments	
	 DNA in prokaryotic cells is {circular / looped} and in human cells is linear (1) 	ACCEPT prokaryotes do not have 3' and 5' ends but human cells do	
	• DNA in prokaryotic cells has (one) more phosphodiester bond than human cells (of the same number of nucleotides) (1)	ACCEPT prokaryotes have no unbound phosphate group but humans do	(2)

Question number	Answer	Additional guidance	Mark
7(b)(ii)	An answer that includes the following points:	NB ACCEPT pathogen or bacteria or prokaryotic cell throughout	
	 because the bacteria will {die / not be able to grow / will not be able to divide} (due to the inability of DNA to supercoil) (1) 	ACCEPT bactericidal / bacteriostatic	
	 human cells do not have {DNA gyrase / the enzyme} / <u>only</u> bacteria have the enzyme affected (1) 	IGNORE consequences of no supercoiling	
	 therefore human cells will not be {affected / damaged / harmed} (1) 	DO NOT ACCEPT in context of no {chloroplasts / xylem}	(3)

Question number	Answer	Additional guidance	Mark
7(b)(iii)	An explanation that includes the following points:		
	• because bacteria are becoming (increasingly) resistant to antibiotics (1)	ACCEPT pathogens because bacteria will not be resistant to new antibiotics to win the evolutionary race DO NOT ACCEPT viruses	
	 so we will not be able to treat {antibiotic-resistant bacteria / diseases / infections} (1) 	ACCEPT so people will not die from bacterial infections	(2)

Question	Answer	Additional guidance					Mark						
8(a)	• (radius calculated) 37 / 25 (1)												
	• (radius converted into mm) 0.037 / 0.025 (1)	ECF if	62 is us	sed									
	• (mm ³) expressed to max of 3 sig figures (1)		PT stan	dard fo	orm								
		ECF TO	r wron	g conv	ersion								
		Correc	t bald	answe many	r = 3 mar sig figs =	ks, but 2 mar	t with v ks. or b	vrong ord	der of i	magnit Jagnitu	ude = 2 de and	2 too	
		many	sig figs	= 1 m	ark	2 11101	113, 01 2			aginea			
		Corre	t bald	answe	r for d = 0	52 = 2	marks,	but with	wrong	g order	of		
		magni	tude =	1 mar	k or too r	nany s	ig figs =	= 1 mark					
			- ()	- ()				-					
		D	R (µm) mp 1	R(mm) mp 2	R3	π	4×π×R3	÷3	1 sig fig mp 3	2 sig tigs	3 sig figs	Stand for	
		74	37	0.037	0.000050653	3	0.000608	0.0002026	0.0002	0.00020	0.000203	10 -4	
		74	37	0.037	0.000050653	3.14	0.000636	0.000212067	0.0002	0.00021	0.000212	10 -4	
		74	37	0.037	0.000050653	3.142	0.000637	0.000212202	0.0002	0.00021	0.000212	10 -4	
		74	37	0.037	0.000050653	3.141593	0.000637	0.000212175	0.0002	0.00021	0.000212	10 -4	
		50	25	0.025	0.000015625	3	0.000188	0.0000625	0.00006	0.000063	0.0000625	10 -5	
		50	25	0.025	0.000015625	3.14	0.000196	6.54167E-05	0.00007	0.000065	0.0000654	10 -5	
		50	25	0.025	0.000015625	3.142	0.000196	6.54583E-05	0.00007	0.000065	0.0000655	10 -5	
		50	25	0.025	0.000015625	3.141593	0.000196	6.54498E-05	0.00007	0.000065	0.0000654	10 -5	
		62		0.031	0.000029791	3	0.000357	0.000119164	0.0001	0.00012	0.000119	10 -4	
		62		0.031	0.000029791	3.14	0.000374	0.000124725	0.0001	0.00012	0.000125	10 -4	
		62		0.031	0.000029791	3.142	0.000374	0.000124804	0.0001	0.00012	0.000125	10 -4	
		62		0.031	0.000029791	3.141593	0.000374	0.000124788	0.0001	0.00012	0.000125	10 -4	
												1	(3)

Question	Answer	Additional guidance	Mark	
number				
8(b)(i)	15 / 15.0	DO NOT ACCEPT any other values	(1)	

Question	Answer Additional guidance Ma						
8(b)(ii)	A description that includes the following points:						
	 credit for appropriate {sample to be used / details of method} (1) 	e.g. cells and shed plates / two groups of cells / one large group of cells / put together in a tank of sea water / use a microscope					
	• {stain / dye} {plates / (plates and) cells} (1)	ACCEPT marker / fluorescent tag IGNORE genetic profiling / gel electrophoresis / carbon dating NB if using unstained plates and unstained (naked) <i>E. huxley</i> this mark would be awarded for use of microscope and something else would be credited in mp 1					
	• credit what is being compared that would work (1)	e.g. coloured plates attached to cells / cells different colour to plates ECF DNA profiling / gel electrophoresis : different bands on plates and cells	(3)				
		ECF carbon dating : differences in					

	year plates produced	

Question	Answer	Mark
number		
*8(b)(iii)	Effect of healthy <i>E. huxleyi</i> :	
	 carbon dioxide absorbed from the oceans to make plates 	1
	carbon dioxide absorbed for photosynthesis	
	Effect of marine snow :	
	 {decomposers / increase in animals feeding on snow} respire 	
	 {releasing carbon dioxide / increasing carbon dioxide} levels in {water / air} 	
	 so more carbon dioxide will be released from water into air 	
	• plates sunk to the bottom of the ocean will act like a carbon sink	
	 therefore carbon dioxide levels {will not increase / fall} in {water / air} 	l
	 as {no / less} carbon dioxide will dissolve in the water from the air 	
	• {plates / <i>E. huxleyi</i> } stuck together will have a lower surface area	
	 so will absorb less carbon dioxide from {water / air} 	l
	so less carbon dioxide will dissolve in the water from the air	
	 marine snow will block light reaching {seaweeds / plants} 	
	 so less photosynthesis so less carbon dioxide removed from {water / air} 	l
	less carbon dioxide will be absorbed by the water from the air	
	Effects on global warming / climate change:	
	 more / less carbon dioxide accumulates in atmosphere so more / less infrared radiation will be trapped in the earth's atmosphere 	
Implications of climate change :		
	 flooding / melting of ice caps / enzyme denaturation 	(6)

			Additional guidance
Level 0	0	No awardable content	
Level 1	1-2	An explanation may be attempted but with limited interpretation or analysis of the scientific information and with a focus on mainly just one piece of scientific information. The explanation will contain basic information, with some attempt made to link knowledge and understanding to the given context.	Simple descriptions 1 mark = one relevant comment 2 marks = description of global warming / effects on climate change / what healthy <i>E. huxleyi</i> do
Level 2	3-4	An explanation will be given, with occasional evidence of analysis, interpretation and/or evaluation of both pieces of scientific information. The explanation shows some linkages and lines of scientific reasoning, with some structure.	 Explanation of how {infected cells / marine snow} affects global warming / levels of carbon dioxide in air / water 3 marks = explanation of how {infected cells / marine snow} results in uptake or release of carbon dioxide 4 marks = plus a second reason for a change or the effect of a change on global warming or effect of a change on global warming or effect of a change on carbon dioxide levels {in water / in air}
Level 3	5-6	An explanation is made that is supported throughout by sustained application of relevant evidence of analysis, interpretation and/or evaluation of both pieces of scientific information. The explanation shows a well-developed and sustained line of scientific reasoning, which is clear and logically structured.	 Clear explanation of how the infected cells / marine snow affects climate change and its effects 5 marks = explanation includes either the implications of climate change or an understanding of how the levels of carbon dioxide in the water affect the carbon dioxide in the air 6 marks = explanation includes either the implications of climate change and an understanding of how the levels of carbon dioxide in the water affect the carbon dioxide in the air

Question number	Answer	Additional guidance	Mark
9(a)	An explanation that includes three of the following points:		
	 because {it / light} is needed for photolysis (1) 	ACCEPT description of photolysis	
	 because {electrons released (from the water) are needed to replace those lost from the photosystems / hydrogen ions are used to reduce NADP} (1) 	ACCEPT protons / H ⁺ to produce {reduced NADP / NADPH}	
	 because {it / light} is needed to {excite / release} the electrons of the {photosystems / chlorophyll / PS / photosynthetic pigments} (1) 		
	 electrons (from photosystems) used to produce ATP (and reduced NADP) (1) 		(3)

Question	Answer	Additional guidance	Mark
number			
9(b)(i)	The correct answer is D (sunlight)		
	 A is incorrect because green light would have been a negative control B is incorrect because green light is not included in the study C is incorrect because ultra violet is not part of the visible spectrum 		(1)

Question number	Answer	Additional guidance	Mark
9(b)(ii)	An explanation that includes four of the following points:		
	 high rate of photosynthesis in {red / blue and red} light (1) 	ACCEPT low rate of photosynthesis in amber light	
	• because there is more (light) energy available (for photosynthesis) (1) ACCEPT converse for amber	
	 leaf biomass will be high when photosynthesis is fast (1) 	ACCEPT converse	
	 as more {glucose / GALP} synthesised to produce {(insoluble) organic molecules / biomass} (1) 	C ACCEPT converse	
	 the control light does not have as much red and blue light so {the rate of photosynthesis will not be so high / leaf biomass will be lower} (1) 		(4)

Question number	Answer	Additional guidance	Mark
9(b)(iii)	 An answer that includes three of the following points: all three types of pigment are found regardless of the type of light shone on the plants (1) 	ACCEPT mass for concentration throughout	
	 the type of light shone at the plants affects the concentrations of pigments found (1) 	ACCEPT type of light affects each pigment differently	
	 {chlorophyll a is the most abundant / anthocyanins are the least abundant} (in all four groups / in total) (1) 	ACCEPT proportion / amount / highest / lowest	
	 red light results in the highest (total) concentration of pigments / amber light results in the lowest concentration of pigments (1) 		
	• anthocyanin content least {affected / varied} <u>by the type of ligh</u> t (1)	ACCEPT all had similar concentrations	(3)

Question	Answer	Additional guidance	Mark
9(b)(iv)	An explanation that includes the following points:		
	 credit two appropriate genes named (1) 	e.gs ATP synthase : phosphorylation of ADP	
	• credit correct explanation for one named gene (1)	chlorophyll (a) (production) : absorption of light / to release electrons / table shows increased chlorophyll a concentrations	
	• credit correct explanation for the other named gene (1)	carotene (production) : absorption of light / to release electrons	
		RUBISCO: carbon fixation / description	
		ETC (proteins) : pump protons into thylakoid (space) / pass protons to NADP to reduce it	
		RNA polymerase: to synthesise RNA	
		enzymes to catalyse reduction of NADP : so reduced NADPH can be produced for conversion of GP into GALP	
		named enzyme in Calvin Cycle : reaction specified	
		NB Explanations for chlorophyll and carotene must be different to award full marks	(3)

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