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 number	Answer	Additional guidance	Mark
1(a)	An answer that includes two of the following points: • not all wavelengths of light can be absorbed (by the plant) (1) • 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)	**IGNORE** shading / competition **ACCEPT** colours	**(2)**

Question number	Answer	Additional guidance	Mark
1(b)(i)	• 1.1×10^5 / 1.13×10^5 / $1.1 \cdot 10^5$ / $1.13 \cdot 10^5$ (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) • so that there is {enough / more} to {analyse / use in profiling / use in gel electrophoresis} (1)	**ACCEPT** (DNA) samples are too small **DO NOT ACCEPT** to increase the length of DNA **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: • to bind to the {DNA / primers} (1) • and line up the nucleotides along the DNA strands (1) • and form phosphodiester bonds between the nucleotides (on one strand) (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	**(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 number	Answer	Additional guidance	Mark
2(b)(ii)	An answer that includes three of the following points: • the (original) broccoli and the {genetically modified / clubroot resistant} broccoli **OR** the linseed and the {genetically modified / clubroot resistant} broccoli (1) • genetically modified plants to check that the resistance gene had been inserted (1) • the original plants to identify the broccoli bands (1) • the linseed to identify the resistance {genes / bands} (1)	**NB Piece together** **ACCEPT** bands with resistance gene **ACCEPT** idea that the linseed profile is compared to modified broccoli to find a {common / over-lapping} band to 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 Ä / 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: • because antigen presentation is needed to activate the T killer cells (1) • so that T killer cells will divide (1) • so that there are {enough / many} T killer cells to {destroy / lyse / release perforins onto} the host-infected cells (1)	**ACCEPT** cytotoxic T cells / CD8 cells throughout **ACCEPT** initiate CMI / clonal selection **ACCEPT** clone / clonal expansion **ACCEPT** chemicals / enzymes / proteases cause apoptosis	**(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) • so that macrophages can destroy them (1)	**ACCEPT** pathogen but not bacteria **IGNORE** damaged **DO NOT ACCEPT** virus / antigen **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 number	Answer	Mark
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 number	Answer	Mark
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 number	Answer	Mark
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 number	Answer	Mark
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 number	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) • lactic acid increases as anaerobic respiration (in muscle cells) takes place (1) • pH decreases because of the {production of / increase in} lactic acid (1)	**ACCEPT** used during muscle relaxation drop in pH reduces ATP synthase activity	**(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) • gives two different estimates (1) • (degree of) muscle contraction affected by {other factors / named factor} (1) • judging (extent of) muscle contraction is subjective (1)	**ACCEPT** stiffen and relax idea that muscles will be relaxed before and after contraction **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}	**(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 number	Answer	Mark
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)	**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 • because seeds brought in • numbers of alder / spruce rise • because the plants reproduce • alder reproduces faster than spruce • because there is little competition from other plants • hemlock last of the three plants to appear • because seeds brought in later • 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 • number of alder fall / drop to zero • because spruce out competes alder for {water / light / mineral ions / space} • because spruce is taller / 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}	(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 / limited explanation of the data 1 mark = a description of some changes 2 marks = a simple explanation for one aspect of data **OR** an account of succession with no reference to the changes shown
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.	Some explanation of the changes 3 marks = simple explanations for two aspects of data 4 marks = simple explanations for three aspects of data
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.	Detailed explanation of the changes 5 marks = plus one additional detailed explanation 6 marks = plus two additional detailed explanations

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

Question number	Answer	Mark
6(a)(ii)	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)**

Question number	Answer	Additional guidance	Mark
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 number	Answer	Additional guidance	Mark
6(c)(i)	An explanation that includes five of the following points: • the vaccine contained (RSV) antigens (1) • the (mother's) immune response was initiated (1) • credit details of humoral immune response (1) • plasma cells released antibodies (to RSV) (1) • these antibodies will pass across the placenta (to fetus) (1) • and remained in the blood until after the baby was born (1)	**ACCEPT** {inactivated / attenuated} {virus / RSV} **DO NOT ACCEPT** dead virus 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 **ACCEPT** antibodies passed from mother's blood into fetus **DO NOT ACCEPT** baby {cells / blood} pass into fetal blood **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) • 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** stated period of time up to 2 years **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: • without chloroplasts the plant will not be able to {photosynthesise / <u>absorb</u> light} (1) • {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) • no magnesium ions for chlorophyll (1) • no {GALP / glucose} will be synthesised (1)	**NB ACCEPT** less for no, throughout **ACCEPT** white parts / streaks will not photosynthesise no light-dependent reaction **IGNORE** mineral ions **ACCEPT** other named ion and function that would prevent photosynthesis from occurring or plant dying **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: • DNA in prokaryotic cells is {circular / looped} and in human cells is linear (1) • DNA in prokaryotic cells has (one) more phosphodiester bond than human cells (of the same number of nucleotides) (1)	**PIECE TOGETHER THROUGHOUT** **IGNORE** numbers of strands / double helix / plasmids / non-structural comments **ACCEPT** prokaryotes do not have 3' and 5' ends but human cells do **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: • 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) • human cells do not have {DNA gyrase / the enzyme} / <u>only</u> bacteria have the enzyme affected (1) • therefore human cells will not be {affected / damaged / harmed} (1)	**NB ACCEPT** pathogen or bacteria or prokaryotic cell throughout **ACCEPT** bactericidal / bacteriostatic **IGNORE** consequences of no supercoiling **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) • so we will not be able to treat {antibiotic-resistant bacteria / diseases / infections} (1)	**ACCEPT** pathogens because bacteria will not be resistant to new antibiotics to win the evolutionary race **DO NOT ACCEPT** viruses **ACCEPT** so people will not die from bacterial infections	**(2)**

<table>
<tr><th>Question number</th><th>Answer</th><th>Additional guidance</th><th>Mark</th></tr>
<tr><td>8(a)</td><td>

(radius calculated) 37 / 25 (1)
(radius converted into mm) 0.037 / 0.025 (1)
(mm^3) expressed to max of 3 sig figures (1)

</td><td>
ECF if 62 is used

ACCEPT standard form
ECF for wrong conversion

Correct bald answer = 3 marks, but with wrong order of magnitude = 2 marks or too many sig figs = 2 marks, or both order of magnitude and too many sig figs = 1 mark
Correct bald answer for d = 62 = 2 marks, but with wrong order of magnitude = 1 mark or too many sig figs = 1 mark

<table>
<tr><th>D</th><th>R (μm)
mp 1</th><th>R(mm)
mp 2</th><th>R3</th><th>π</th><th>4×π×R3</th><th>÷3</th><th>1 sig fig
mp 3</th><th>2 sig figs
mp 3</th><th>3 sig figs
mp 3</th><th>Stand for</th></tr>
<tr><td>74</td><td>37</td><td>0.037</td><td>0.000050653</td><td>3</td><td>0.000608</td><td>0.0002026</td><td>0.0002</td><td>0.00020</td><td>0.000203</td><td>10 -4</td></tr>
<tr><td>74</td><td>37</td><td>0.037</td><td>0.000050653</td><td>3.14</td><td>0.000636</td><td>0.000212067</td><td>0.0002</td><td>0.00021</td><td>0.000212</td><td>10 -4</td></tr>
<tr><td>74</td><td>37</td><td>0.037</td><td>0.000050653</td><td>3.142</td><td>0.000637</td><td>0.000212202</td><td>0.0002</td><td>0.00021</td><td>0.000212</td><td>10 -4</td></tr>
<tr><td>74</td><td>37</td><td>0.037</td><td>0.000050653</td><td>3.141593</td><td>0.000637</td><td>0.000212175</td><td>0.0002</td><td>0.00021</td><td>0.000212</td><td>10 -4</td></tr>
<tr><td>50</td><td>25</td><td>0.025</td><td>0.000015625</td><td>3</td><td>0.000188</td><td>0.0000625</td><td>0.00006</td><td>0.000063</td><td>0.0000625</td><td>10 -5</td></tr>
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<tr><td>62</td><td></td><td>0.031</td><td>0.000029791</td><td>3.14</td><td>0.000374</td><td>0.000124725</td><td>0.0001</td><td>0.00012</td><td>0.000125</td><td>10 -4</td></tr>
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<tr><td>62</td><td></td><td>0.031</td><td>0.000029791</td><td>3.141593</td><td>0.000374</td><td>0.000124788</td><td>0.0001</td><td>0.00012</td><td>0.000125</td><td>10 -4</td></tr>
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Question number	**Answer**	**Additional guidance**	**Mark**
8(b)(i)	15 / 15.0	**DO NOT ACCEPT** any other values	**(1)**

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

		year plates produced	

Question number	Answer	Mark
*8(b)(iii)	**Effect of healthy *E. huxleyi*:** • carbon dioxide absorbed from the oceans to make plates • 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} • as {no / less} carbon dioxide will dissolve in the water from the air • {plates / *E. huxleyi*} stuck together will have a lower surface area • so will absorb less carbon dioxide from {water / air} • 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} • 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 *E. huxleyi* 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 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) • because {electrons released (from the water) are needed to replace those lost from the photosystems / hydrogen ions are used to reduce NADP} (1) • 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)	**ACCEPT** description of photolysis **ACCEPT** protons / H^+ to produce {reduced NADP / NADPH}	**(3)**

Question number	Answer	Additional guidance	Mark
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) • because there is more (light) energy available (for photosynthesis) (1) • leaf biomass will be high when photosynthesis is fast (1) • as more {glucose / GALP} synthesised to produce {(insoluble) organic molecules / biomass} (1) • 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)	**ACCEPT** low rate of photosynthesis in amber light **ACCEPT** converse for amber **ACCEPT** converse **ACCEPT** converse	**(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) • the type of light shone at the plants affects the concentrations of pigments found (1) • {chlorophyll a is the most abundant / anthocyanins are the least abundant} (in all four groups / in total) (1) • 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} by the type of light (1)	**ACCEPT** mass for concentration throughout **ACCEPT** type of light affects each pigment differently **ACCEPT** proportion / amount / highest / lowest **ACCEPT** all had similar concentrations	**(3)**

Question number	Answer	Additional guidance	Mark
9(b)(iv)	An explanation that includes the following points: • credit **two** appropriate genes named (1) • credit correct explanation for one named gene (1) • credit correct explanation for the other named gene (1)	**e.gs** ATP synthase : phosphorylation of ADP chlorophyll (a) (production) : absorption of light / to release electrons / table shows increased chlorophyll a concentrations 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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