Question Number	Answer	Additional Guidance	Mark
1(a)	C;		**(1)**

Question Number	Answer	Additional Guidance	Mark
1(b)	1. reference to mitosis ; 2. (followed by) cytokinesis / {cells divide into 2 cells / eq} ; 3. reference to repeated (many times) ;	**Not** meiosis **Ignore** binary fission, asexual reproduction	**(2)**

Question Number	Answer	Additional Guidance	Mark
1(c)(i)	1. i a that each (small) square represents 1% ; 2. {count / determine} numbe of squares containing *Pleurococcus* ; 3. edit an indication of how the percentage was calculated ;		**(2)**

Question Number	Answer	Additional Guidance	Mark
1(c)(ii)	A ;		**(1)**

Question Number	Answer	Additional Guidance	Mark
1(c)(iii)	1. idea of obtaining more data (outside) ; 2. reference to processing the data eg plotting a (scatter) graph, correlation test ; 3. credit correct reference to interpretation of {test / graph}; 4. reference to an extended study eg laboratory experiments ; 5. idea that the extended study would be repeated ; 6. ide of looking at results of previous studies ;	**Do not credit** ref to collecting data at different times of day **Accept** Spearman's rank, Pearson's correlation eg draw a line of best fit	**(3)**

Question Number	Answer	Additional Guidance	Mark
1(c)(iv)	1. suitable named factor ; 2. description of the possible effect on {numbers / distribution} ;	**Ignore** predators snails / grazers /herbivores / primary consumers — less as being eaten disease on trees — less as smaller habitat disease in *Pleurococcus* — less as being destroyed competition (from other organisms) — less due to lack of resources eg light, space	**(2)**

Question Number	Answer	Additional Guidance	Mark
2(a)	C ; nucleus and large (80S) ribosomes		**(1)**

Question Number	Answer	Additional Guidance	Mark
2(b)	A ; algae have chloroplasts, the fungi do not		**(1)**

Question Number	Answer	Additional Guidance	Mark
2(c)	1. (advantage of sexual reproduction / meiosis) {genetically different / greater gene pool / greater genetic diversity /eq} ; 2. (advantage of asexual reproduction / mitosis) faster / one of each organism needed / conserves advantageous alleles ;	**2. Accep** don't need a mate	**(2)**

Question Number	Answer	Additional Guidance	Mark
2(d)(i)	C ; area exposed to bright sunlight and protected from the wind		**(1)**

Question Number	Answer	Additional Guidance	Mark
2(d)(ii)	1. idea of using a quadrat ; 2. idea of {random / systematic} sampling (of wall) ; 3. {count number of squares/ determine area} containing lichen /eq ; 4. credit an indication of how the percentage was calculated ;	**1. Accep** description of quadrat, use of photo and a grid **3. N** reference to measuring percentage cover only is too vague as it is repeating stem of question	**(3)**

Question Number	Answer	Additional Guidance	Mark
2(d)(iii)	1. ref to use of light {probe / sensor /eq} ; 2. idea of taking several measurements ;	**1 Accept** description of a light sensor 2. ccept ref to places or times of day	**(2)**

Question Number	Answer	Additional Guidance	Mark
2(d)(iv)	1. plot a (scatter) graph of light intensity against lichen / eq ; 2. reference to looking for a correlation ; 3. reference to use of statistics test ; 4. appropriate named test eg Spearman's rank, Pearson ;	**2. Accep** ref to line of best fit, ref to correlation coefficient also gets Mp 3	**(3)**

Question Number	Answer	Mark
3(a)(i)	1. (rate of) {production of / energy incorporated into / eq} {biomass / organic material / organic molecules / tissue} ; 2. reference to {losses in respiration / GPP- R } ; 3. in {producers / plants / eq } ;	**(2)**

Question Number	Answer	Mark
3(a)(ii)	1. correct readings from graph indicated e.g. (11 and 1) 2. correct subtraction e.g. (11-1 / 10) ; 3. correct division (by 1) x 100/1 to give 1000% ; [correct answer = 3 marks]	**(3)**

Question Number	Answer	Mark
3(b)	1. idea that the rate of {(bio)chemical / metabolic / photosynthetic / named} reactions increases ; 2. idea of increase in {movement / kinetic energy} of {enzyme / substrate / molecules / particles} / eq ; 3. idea of (increase in reaction rate) because of more enzyme substrate interaction ;	**(2)**

Question Number	Answer	Mark
3(c)	1. (between January and April) NPP increases as light increases ; 2. idea of a correlation between NPP and light ; 3. idea that the changes in NPP are occurring after the changes in light / peak light is April and peak NPP is May ; 4. reference to increase in light increases {(rate of) photosynthesis / (ATP) energy available for Calvin Cycle / eq} ; 5. credit correct details of photosynthesis e.g. light results in excitation of electrons ; 6. idea that there is no real correlation between temperature and NPP / reference to temperature fluctuating ; 7. idea that the temperature affects how quickly enzymes work ; 8. reference to NPP falling (from May) but temperature remaining high ; 9. reference to (light / temperature) limiting factor ;	**(4)**

Question Number	Answer	Mark
3(d)	Any **two** biotic factors e.g. 1. grazing / {consumers / herbivores / named herbivore} / eq ; 2. trampling / eq ; 3. shading by {plants / named plant} / eq ; 4. competition from other plants / eq ; 5. disease / eq ;	**(2)**

Question Number	Answer	Mark
4(a)(i)	1. drawing mark - recognisable {granum / grana} with clear stacks (of thylakoids / eq) shown / eq; 2. label mark - {granum / grana / thylakoids} labelled / eq ;	**(2)**

Question Number	Answer	Mark
4(a)(ii)	<table><tr><th>Statement</th><th>True</th><th>Fa</th></tr><tr><td>Electrons in chlorophyll are excited as light energy is absorbed</td><td>✓</td><td></td></tr><tr><td>The energy absorbed by chlorophyll is used to generate ADP and NADP</td><td></td><td>✓</td></tr></table> 1 mark each correct row ;;	**(2)**

Question Number	Answer	Mark
4(a)(iii)	1. reference to energy from light ; 2. reference to photolysis ; 3. of water ;	**(2)**

<table>
<tr><th>Question Number</th><th>Answer</th><th>Mark</th></tr>
<tr><td>4(b)(i)</td><td>
<table>
<tr><th>Position on shore</th><th>Ulva lactuca</th><th>Schizymenia dubyi</th></tr>
<tr><td>Top of the shore</td><td>✓</td><td></td></tr>
<tr><td>Middle of the shore</td><td></td><td></td></tr>
<tr><td>Lower down the shore</td><td></td><td></td></tr>
<tr><td>All regions</td><td></td><td>✓</td></tr>
</table>
OR
<table>
<tr><th>Position on shore</th><th>Ulva lactuca</th><th>Schizymenia dubyi</th></tr>
<tr><td>Top of the shore</td><td></td><td></td></tr>
<tr><td>Middle of the shore</td><td></td><td></td></tr>
<tr><td>Lower down the shore</td><td></td><td></td></tr>
<tr><td>All regions</td><td>✓</td><td>✓</td></tr>
</table>
1 mark each correct column ;;
</td><td>(2)</td></tr>
</table>

Question Number	Answer	Mark
4(b)(ii)	general points: 1. idea of (rate of) growth is linked to (rate of) photosynthesis ; 2. idea of top of the shore is shallower water where most wavelengths are available / lower shore is deeper water where only green (and blue) available ; 3. idea that red weeds {reflect / do not absorb} red light OR green weeds {reflect / do not absorb} green light ; *Ulva lactuca* / green seaweed*:* 4. high(est) rates in {red / blue} light / eq / {very low / lowest} in green light ; 5. would grow well if {all / (blue and) red} light available ; *Schizymenia dubyi* / red seaweed: 6. high(est) rate in green light / eq ; 7. can grow where only green light available / any light available / eq ;	**(4)**