Question Number	Answer	Mark
1(a)(i)	C ;	(1)

Question Number	Answer	Mark
1(a)(ii)	B ;	(1)

Question Number	Answer	Mark
1(a)(iii)	C ;	(1)

Question Number	Answer	Mark
1(b)	ACCEPT any mark point from a clearly annotated diagram 1. reference to {granum / grana} ; 2. reference to (a granum is) a stack of {thylakoids / membranes} OR grana are connected by lamellae ; 3. reference to (thylakoids contain) {electron carriers / eq} / chlorophyll / photosystems ; 4. reference to (membranes contain) {ATPase / ATPase channel} ; 5. idea that {electron carriers / ATPase /eq} are associated with {thylakoid / thylakoid membranes} ;	(3)

Question Number	Answer	Mark
1(c)	1. GALP is a 3C molecule / eq ; 2. reference to formation of {glucose / hexose/ 6C sugar} (from GALP) ; 3. idea of enzymes involved in the synthesis of {glucose / cellulose} ; 4. idea that cellulose consists of {ß-glucose / beta glucose } ; 5. joined by glycosidic bonds / eq; 6. reference to 1-4 (bonds) ; 7. reference to condensation reactions (between glucoses) ; 8. idea that cellulose is a long chain molecule e.g. polysaccharide, polymer ; 9. {unbranched / eq} molecule ;	(5)

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

Question Number	Answer	Mark
2(b)(i)		

Position on shore	*Ulva lactuca*	*Schizymenia dubyi*
Top of the shore	✓	
Middle of the shore		
Lower down the shore		
All regions		✓

OR

Position on shore	*Ulva lactuca*	*Schizymenia dubyi*
Top of the shore		
Middle of the shore		
Lower down the shore		
All regions	✓	✓

1 mark each correct column ;;

(2)

Question Number	Answer	Mark
2(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)

Question Number	Answer	Mark
3(a)(i)	B ;	(1)

Question Number	Answer	Mark
3(a)(ii)	D ;	(1)

Question Number	Answer	Mark
3(a)(iii)	D ;	(1)

Question Number	Answer	Mark
3(b)(i)	1. idea of carbon fixation produces {GP / eq} ; 2. (product) is converted to {starch / sugar / eq} ; 3. {faster / eq} C-fixation means faster {sugar / starch / eq} production / eq ; 4. reference to rate of {growth / development} depends on rate of carbon fixation ; 5. reference to increased GPP (of crop) ;	**max (3)**

Question Number	Answer	Mark
3(b)(ii)	1. reference to effect of temperature change on {kinetic energy / movement} of {molecules / particles / eq} / eq ; 2. therefore this effects number of {collisions / enzyme-substrate complex} ;	(2)

Question Number	Answer	Mark
3(b)(iii)	1. A ; [award if written in text instead] Any **four** from: 2. idea that (in Central Europe) {temperatures never reach $25^{o}C$ / data for $25^{o}C$ is irrelevant} / $14^{o}C$ is {within the range / close to the average temperature} ; 3. {mean / eq} temperatures (in Central Europe) {15.25 / 15.3}^{o}C ; 4. A has highest rates of CO_2 fixation at $14^{o}C$ / eq ; 5. (therefore) A {will grow well / eq} in temperature (range) of Central Europe / eq ; 6. {B / C / D /E / F / others} would have relatively low {growth / yield / eq} at $14^{o}C$ / eq ;	max (5)

Question Number	Answer	Mark
4(a)(i)	between 7 and 8 <u>hours</u> / 8 <u>hours</u> ;	(1)

Question Number	Answer	Mark
4(a)(ii)	1. idea of not enough time (in the dark) ; 2. idea that {Pfr /active phytochrome} levels remain too high ; 3. reference to threshold e.g. once Pfr below a certain level (flowering happens) ; 4. flowering {stimulated / eq} (by fall in Pfr) ;	max (2)

Question Number	Answer	Mark
4(b)	1. reference to control ; 2. idea of comparison e.g. to show that flowering would not happen (without the cover) / eq ;	(2)

Question Number	Answer	Mark
4(c)	1. six hours too short (to cause flowering in plant E) / eq ; 2. eight hours {is long enough / causes flowering / eq} ; 3. idea of enough stimulus if part of the plant is in the dark for {8 hours / long time / enough time / eq} ; 4. leaf is (photo) receptor / eq ; 5. {phytochrome / Pfr / Pr} in leaves ; 6. signal must be passed to {growing points/site of flower production} from leaves / eq ;	max (4)

Question Number	Answer	Mark
4(d)	1. idea of {flowering / development /eq} happens at the right time ; 2. therefore flowers when insects available / leaf fall in autumn / same species flower at the same time / seeds germinate at the right time / eq ; 3. idea that day length changes to a set pattern e.g. always {short days in winter / long days in summer} ; 4. comparison with other less regular stimuli e.g. temperature ;	**max (3)**

Question Number	Answer	Mark