Question			Mark	Additional Guidance
1	**(a)**	guard (cells) ;	[1]	
	(b) (i)	oxygen is a (waste / by) product of photosynthesis ; more oxygen is produced than used in respiration ; concentration inside the leaf is greater than outside ; ref to air spaces inside the leaf ; oxygen moves down its concentration gradient ; by <u>diffusion</u> ; *idea that* the rate of photosynthesis is greater than the rate of respiration ;	max [3]	**A** word equation / symbol equation
	(ii)	passes through air spaces **;** carbon dioxide dissolves in water (in cell wall) **;** (spongy / palisade) mesophyll **;** passes / diffuses, through, cell wall / cell membrane **;** passes / diffuses, into / through, cytoplasm **;** enters chloroplast / used in chloroplast **;** reacts with water (to form glucose) **;**	max [3]	**A** palisade cells **ignore** spongy cells **A** correct equation

Question			Mark	Additional Guidance
(c)	(i)	stomata on, both sides of the leaf / both upper and lower epidermis ; fewer stomata overall (however expressed) ; fewer stomata on upper epidermis than water lily / **ora** ; fewer stomata on lower epidermis than myrtle / **ora** ; more stomata on lower epidermis than water lily / **ora** ; more stomata on upper epidermis than myrtle / **ora** ; *idea that* about the same number on each surface whereas the numbers are very different on the surfaces of the other plants ;	max [2]	**A** use of numbers to make comparisons with units used at least once in the answer **mp7** also gains **mp1**
	(ii)	*white water lily* (all) stomata (on upper surface) in contact with air / AW ; for absorption of, carbon dioxide / oxygen ; no stomata (on lower epidermis) in contact with water ; diffusion (much) faster in air (than in water) ; (large number of stomata as) plant does not need to restrict, transpiration / water loss / AW ; *common myrtle* (all) stomata (on lower surface), in the shade / away from the sun / out of the heat / in a cooler place ; **ora** reduces / restricts / less, transpiration / evaporation ; **ora** so, less water is lost / water is conserved ;	max [5]	**A** gas exchange / diffusion of gases **ignore** if explained in terms of waxy cuticle only **R** 'prevents'
			[Total: 14]	

2	(a	(i)	pollen / male gamete ;	**[1]**	**R** gamete unqualified
		(ii)	chromosome number halved / becomes haploid ; genetic / DNA variation ; new combinations of alleles ; fertilisation restores diploid number in zygote / ensures number of chromosome remains constant in next generation ;	**[max 2]**	
	(b)	**(i)**	pollen from anther to stigma ; between different plants of same species ;	**[2**	
		(ii)	large petals ; pattern / guide lines on petals ;	**[ma 1]**	
	(c)	**(i)**	temperature / warmth ; light ; water availability ; wind ; pollinator life-cycle timings ; CO$_2$ concentration ; pressure ;	**[ma 1]**	
		(ii)	influence by genes and environment ; range of phenotypes / flowering times results ; (flowering time) is measurable ;	**[ma 2]**	

2	(d)	1	different environments have different selection / competition pressures ;		**A** Survive and reproduce *Idea of* best adapted
		2	variation occurs (at fertilization / meiosis) ;		
		3	ref to mutation ;		
		4	best adapted organisms most likely to survive ;		
		5	(those that survive) pass on their alleles / genes ;		
		6	competition for survival ;		
		7	cross pollination ensures more variation (than self-pollination) ;		
		8	reproductive isolation (by different flowering times) ;		
		9	changes enhanced over generations ;		
		10	no cross-pollination between low and high altitude plants ;	**[max 5]**	
				[Total:14]	

Question	E answers	Mark	Additional Guidance
3 (a)	there are different forms of one, feature / characteristic **;** example of a feature shown by Soay sheep **;** coat / fur, colours patterns of coat / AW with and without horns lengths of horns ear, length / width / size / shape face, length / width / size / shape body mass body shape / body size / AW	[2]	look for a general explanation of 'variation in their phenotype' and an example the example chosen does not have to be visible in Fig. 6.1
(b) (i) 1 2 3	*in years with high populations of sheep* more deaths in total **; A** low survival rate *for all sizes of lambs* more lambs died than survived **;** any comparative data quote using same body mass in high and low population years – units (kg) are not necessary **A** tolerance given in table for bars between gridlines	[max 2]	*looking at sum total of the bars in each graph* *looking at bars for each body mass* e.g. lambs 13-14 (kg), 106 died in hi population year against 12 that died in low population year see page 18 for table of data

Question		E answers	Mark	Additional Guidance
3	(ii)	*in high population – ora for low population* *one mark for competition and two marks for marking points 2-11*		**ignore** explanations about why the population is high in some years and low in others – not relevant
	1	competition for, shelter / food / grass / resources **;**	[1]	
	2	as a result of competition there is shortage of food for each lamb **;**		
		as a result of competition for food		**R** competition for mates
	3	lambs do not store enough fat **;**		
	4	ref insulation **;**		
	5	cannot survive the winter **;**		
	6	ewes / females, produce less milk **;**		
	7	ref to number of lambs per female **;**		
	8	ref to, more likely to die of disease / AW **;** **A** disease more likely to spread		
	9	more small lambs die **;**		
	10	(pregnant) ewes / females, are short of food	[max 2]	

Question	Expected answers	Mark	Additional Guidance
3 (c)	*note that this is **not** a question about artificial selection*		*points need to be in correct sequence and in the context of selection*
1	variation / AW, among the sheep in the population **;**		
2	some are better, adapted / suited / AW, than others **; A** 'best adapted'		**R** better animals survive unqualified by adaptation or some example
3	any example of an adaptive feature for survival in the extreme conditions **;**		'some sheep have thicker coats' = **MP1** and **MP3** **MP3** must be a feature related to survival in extreme conditions, not 'strength', 'fitness' 'healthiness' etc
4	any example of an appropriate selective agent **;** **ignore** 'extreme conditions / weather'		to survive the cold = **MP4**
5	survive and, breed / have offspring **; A ora**		
6	pass on their <u>alleles</u> **;**		
8	*idea that* over time better adapted, features / traits, become more common **;**	[max 4]	

4 (a)

stage	Pr
P	nitrogen fixation ;
Q	protein synthesis ;
R	feeding / digestion ;
S	deamination
T	nitrification ;
U	denitrification ;

[5]

Question	Expected Answers	Marks	Additional Guidance
4 (b) 1 2 3 4	plants from irradiated seeds had more nodules ; plants from irradiated seeds had nodules with more mass ; comparative data quote for number ; comparative data quote for dry mass of nodules ;	[max 3]	Units are required at least once.
(c)	mutation ; change in, gene(s) / DNA ;	[2]	
(d) 1 2 3 4 5 6 7	choose plants with desired feature(s) ; cross / breed plants ; any detail ; e.g. bagging flowers, transfer of pollen with paintbrush collect seeds ; grow seeds and check plants for features ; cross plants showing features with original variety ; keep crossing and selecting ;	[max 4]	
(e) 1 2 3 4	genetic engineering / genetic modification ; introduced a gene from a **different** species ; results, after one generation ; any detail of method involved e.g. use of vector / plasmid ;	[max 2]	
(f) 1 2 3 4	fix nitrogen ; products of fixation / nitrates provide a source of protein ; increases nitrogen in soil when beans decay ; maintain / higher, yields (of maize) ;	[max 2]	
		[Total: 18]	