Question	E Answers	Marks	Guidance
1 (a) (i)	any time within the range 06.00 – 06.30 / 6.00 – 6.30 (am) ;	[1]	**A** in **(i)** and **(ii)** if 0600 etc
(ii)	08.00 / 8.00 (am) , 19.00 / 7.00 (pm) ;	[1]	**A** within range 18.45 to 19.00
(iii)	*one of the following* plant (only) respires rate of respiration > rate of photosynthesis no photosynthesis, only respiration ;	[1]	IGNORE anaerobic respiration (in plants) **A** only respire at night **R** 'respires instead of photosynthesises'
(iv)	1 (carbon dioxide) required for photosynthesis / making food / released in respiration ; 2 photosynthesis / food made, in day is greater than, respiration / food use / energy release, at night ; 3 so surplus food produced / surplus energy / growth is possible ; *ora* 2 if rate of uptake during the day and release at night are the same ; 3 no, growth / no surplus / no food / no glucose / no energy ; **A** not enough, for growth / food / glucose / energy	[max 2]	*note that CO_2 is in the question* **R** comments on [CO_2] in atmosphere ACCEPT descriptions of photosynthesis and respiration ACCEPT respiration and photosynthesis might balance
(b) (i)	*award two marks if the correct answer (12.56 / 12.6 / 13) is given if answer missing or incorrect, award one mark for correct working* (95.0 – 84.4 = 10.6) $\frac{10.6}{84.4} \times 100$ 12.56 / 12.6 / 13 ;;	[2]	

Question	Expected Answers	Marks	Guidance
(ii) 1	1 (taller plants / more leaves) = more yield ; 2 *height* more, flowers / fruits / tomatoes / leaves ; 3 ref to competition for light / access to more light ; 4 *leaves* increase surface area ; 5 more, chlorophyll / chloroplasts ; 6 for, absorption / trapping, of light ; 7 more stomata for uptake of carbon dioxide ; 8 more photosynthesis ; 9 production of more, sugars / food / starch / AW ;	[max 3]	**look for idea of more / increase where indicated in some of the MPs** 1 question says 'affects' so description is OK 2 **A** more space for tomatoes to grow 3 more chance of pollination 9 **R** 'making energy'
(c)	1 planted at same time / same growing period / same age *or* size at planting ; *same* 2 specie / variety / strain / type, of plant **;** **R** same seeds unqualified ; 3 soil type ; 4 soil pH ; 5 distance between plants / planting density ; 6 soil water / quantity of water applied / AW ; 7 type of, fertiliser / minerals / nutrients ; 8 quantity of, fertiliser / minerals / nutrients ; 9 ref to protection against, pests / diseases ; 10 AV **;** e.g. soil, quantity / depth ;	[max 3]	IGNORE light intensity / carbon dioxide concentration / temperature / humidity / air movement **9 A** spraying (named) pesticide
(d)	1 ref to, sensor(s) / thermostat / AW ; 2 computer control / negative feedback / automated control ; 3 ref to, reducing / controlling, effect of <u>limiting factors</u> ; 4 provide (artificial) light (when light intensity is low) ; 5 provide shade ; 6 temperature control / heating / cooling / ventilation / air conditioning ; 7 <u>carbon dioxide</u>, enrichment ; **A** method described ; 8 control humidity / misting ; 9 watering ; 10 soil-less cultivation / hydroponics / described **; A** sterile conditions 11 ref to, fertilisers / minerals / nutrients ; 12 AVP ;	[max 4]	**examples of AVP** protection from, wind / hail / gales / extreme weather easier to control, pests / diseases can control / exclude, (named) grazers easier to control, weeds / competitors **R** ref. to day length / photoperiod **R** use animals to give off carbon dioxide
		[Total: 17]	

Question	Answer	Mark	Additional Guidance
2 **(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	Answer	Mark	Additional Guidance
2 (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]	

Question	Answer	Marks	Additional Guidance
3 (a)		max 4	mark nucleus and next 3 answers **R** chlorophyll

structural feature	animal cell	plant cell
cell wall	×	✓
nucleus	✓	✓;
(cell) membrane	✓	✓;
cytoplasm	✓	✓;
chloroplast	×	✓;
(large) vacuole	×	✓;
vacuolar sap	×	✓;
vacuolar membrane / tonoplast	×	✓;
nuclear membrane	✓	✓;
nucleolus	✓	✓;

3 **(b)**	water moves (in) by <u>osmosis</u>; down a water <u>potential</u> gradient / from high water <u>potential</u> to low water <u>potential</u>; through partially permeable membrane; (both cells / vacuole) enlarge / swell / increase in volume; <u>animal</u> cell bursts; <u>plant</u> cell becomes turgid / AW;	**max 4**	**I** water concentration **A** semi / selectively **A** cell wall prevents bursting
(c) (i)	phloem;	**1**	
(ii)	(transport of sucrose out of the leaves) is low(er) in, **B** / magnesium-deficient plants; **ORA** any data quote about **B**; (sucrose concentration in the leaves) is high(er) in, **B** / magnesium-deficient plants; **ORA** any data quote about **B**;	**4**	assume "it" refers to B A – B = 2.4 – 2.6, A is 3 – 4 times more B > 100, A – B = approx 90, A approx 10 times more
(iii)	max 2 for symptoms yellowing leaves / chlorosis / necrosis; less / stunted, growth; more sugar in leaves**;** max 2 for explanation plants that are deficient in magnesium make, less / no, chlorophyll; less photosynthesis; less (named) sugar available to plant (due to reduce photosynthesis / reduced sucrose transport);	**max 3**	**I** stunted roots **A** magnesium is part of chlorophyll **I** energy / food (for sugar)
		[Total: 16]	