1 (a) (i)	maintain constant temperature / prevent heat from the lamp heating the water / absorbs heat from the lamp / heat shield ; (thermometer) to measure / check / monitor / record, water ; prevent temperature (change), influencing / affecting, the results / rate of photosynthesis ; temperature is a, control(led) / standardised, variable ;	**[max 2]**	1 mark for 'controlling' 1 mark for 'measuring'
(ii)	maintain constant light intensity ; (light meter) to measure / check / monitor / record, the light intensity ;		1 mark for 'controlling' 1 mark for 'measuring'

Question	Answers	Marks	Additional Guidance
1	prevent light intensity (change) influencing / affecting the, results / rate of photosynthesis ; make sure the lamp is always, in the same place / at right distance ; light, intensity / level, is dependent on distance ; light intensity is, a controlled / standardised, variable ;	[max 2]	**A** (ruler) to measure the distance between lamp and plant
(b) (i)	rate / photosynthesis / bubbles: increases as carbon dioxide concentration increases and then, levels off AW ; increases to 0.40 % ; **A** rate remains constant above 0.40% little / slow, increase up to 0.1 % ; **ora** one data quote with CO_2 concentration and rate with units ;	[max 3]	units must be used at least once anywhere in the answer to award marking points that require them **A** bpm for bubbles per minute
(ii)	carbon dioxide / CO_2, concentration / % / level / availability ;	[1]	**R** 'amount of carbon dioxide'
(iii)	ref to limiting factor in suitable context ; carbon dioxide (concentration), is no longer limiting / AW ; light, intensity / level, could be limiting / AW ; reference to light providing energy for photosynthesis ; temperature could be limiting / AW ; reference to temperature influencing the activity of enzymes ;	[ma 4]	

Question	Answers	Marks	Additional Guidance
1	chloroplast / chlorophyll / number of leaves / size of plant, could be limiting factor ;		
(c)	measure <u>volume</u> (of oxygen / gas) ; use, inverted test-tube / measuring cylinder / syringe (barrel) ; reference to, graduations / markings ; **A** 'take readings from…' / 'record results…' filled with water ; gas collects at the top and pushes out the water / downward displacement of water; gas syringe ; attached by (delivery) tube to, flask / AW ; oxygen sensor ; data logger for any other suitable electronic method ; reference to equilibration / described ; reference to time period ; **A** rate = volume divided by time	**[max 3]**	
(d) (i)	use / combustion / burning, of fossil fuels ; reason for increased demand for energy ; carbon dioxide from, volcanic activity / volcanoes ;	**[max 2]**	**A** named fossil fuel(s) **A** named example, e.g. increased use of cars / heating / air-conditioning

Question	Answers	Marks	Additional Guidance
1	deforestation ; burning of, forests / trees ;		
(ii)	carbon dioxide is a greenhouse gas ; (enhanced) greenhouse effect (in context of carbon dioxide) ; heat / infra-red / long wavelength radiation, radiated / emitted, from / absorbed / trapped / AW, by, carbon dioxide / greenhouse gases ; travels / AW, back to the surface ; heat cannot, leave (from the atmosphere) / pass into outer space ;	[ma 4]	**R** 'ozone causes greenhouse effect' **A** reflected as an alternative to radiated **ignore** UV light / visible light / (solar) radiation
		[Total: 21]	

2 **(a) (i)**	*Caenorhabditis* ;	[1]	
(ii)	thread-like bodies / filamentous / filament-like ; unsegmented body ; hydrostatic skeleton ; body, tapers / is pointed, at, one / both, ends ; through gut / mouth and anus ; relatively large pharynx / sucking mouthparts ;	max [2]	
(b)	prevents accumulation of dead matter / removes (organic) waste ; recycles nutrients / named nutrient(s) ; releases (carbon as) carbon dioxide ; (carbon dioxide) for photosynthesis ; decreases particle size of food for decomposers ; ref to energy flow in, food chain / food web / ecosystem ;	max [3]	**R** energy cycling / recycling
(c) (i)	gametes from same individual ; self-fertilisation / described ; only new source of variation is mutation ; variation produced by meiosis ;	max [2]	
(ii)	6 ;	[1]	

2	**(iii)**	***P*** *meiosis* reduction division / chromosome number is halved **;** prevents doubling of chromosome number, with each generation / when gametes fuse together / at fertilisation **;** ref to haploid (cells / gametes / sex cells) **;** gamete / sex cell, production **;** ***Q*** *mitosis* growth is taking place **;** producing (genetically) identical cells **;** more diploid cells **;**	max [3]	producing haploid gametes = 2
	(d)	in chromosomes **;** in the nucleus **;** in mitochondria **;**	max [2]	**A** in plasmids **;**

Question		Marks	Additional Guidance
3 (a) (i)	xylem;	1	
(ii)	thick / lignified, cell walls; for support; lignin; cell walls are waterproof / no water leaks out; long / hollow / no cytoplasm / no organelles / no end walls; water passes through easily / low resistance (to flow); pits; for lateral movement; AVP;;	max 2	one feature linked to a reason max 1 for feature
(b)	**1** transpiration / transpiration pull; **2** creates a, tension / negative pressure; **3** water potential gradient; **4** osmosis into leaf cells; **5** continuous column of water; **6** cohesion of water molecules / described; **7** adhesion of water to, cell wall / xylem; **8** water evaporates, into airspaces (in mesophyll); **9** water (vapour), diffuses / passes, out through stomata; **10** root pressure;	max 4	**I** water into roots **I** water concentration **A** evaporates

Question		Marks	Additional Guidance
3 (c) (i)	**1** two peaks; **2** at 10 h, and 14 / 15 h; **3** no water conduction before 4 h; **4** slow / gradual, increase from 4 h to 6 h / 7 h; **5** maximum water conduction rate of 2.4 dm^3 per hour; **6** steep increase in rate of water conduction at 7 h / 7.5 h; **7** decrease in rate of water conduction after 14.5 – 15 h; **8** any other data quote;	**max 3**	Correct units (dm^3 per hour) for water conduction must be stated at least once. If no units at all, only penalise once. **A** at 15 h
(ii)	add the volume (of water conducted) for each hour / calculate area under curve / AW;	**1**	**A** half hour
(iii)	possible reasons: different rates of transpiration; different numbers of leaves / different surface areas; different rates of evaporation; factors affecting transpiration: (sun)light / shade; temperature / heat; humidity; wind speed; different species; different diameters of xylem / AW; any feature of leaf structure; e.g. thickness of cuticle / stomatal density / hairs length of roots; different ages; AVP;	**max 3**	

Question		Marks	Additional Guidance
3 (d)	abiotic: increase in carbon dioxide, concentration / production; decrease in oxygen, concentration / production; increased soil erosion; reduced soil fertility; less soil water / faster flow of water from the land; increased, flooding / landslips; disrupts water cycle; greater exposure / AW; biotic: habitat / ecosystem, loss; disruption to, food chain / food webs; less biodiversity; extinction described; seeds germinate / seedlings grow / regeneration; AVP;	max 4	**I** global warming / greenhouse effect **A** less decomposition **I** desertification **A** silting of rivers **A** 'loss of / no, food' **A** 'species die out' / local extinction examples of AVP: organisms exposed to greater, grazing / predation
		[Total: 18]	