Question	Answer	Marks	Guidance
1 a i	as the temperature increases, the rate of photosynthesis increases and decreases (1) **but** as the temperature increases, the rate of photosynthesis increases, **levels off**, and then decreases (2) **plus** correct uses of data, e.g.: rises to max rate of 20 (arbitrary units) / rises to max rate at 30 (^{o}C) / decreases after 40 (^{o}C) / rate is zero at 55 (^{o}C) / constant / optimum 28 – 40 (^{o}C)	3	(it) increases and goes down = 0 (it) increases, levels off, then decreases (1) **allow** answer in range 28-30 (^{o}C) **allow** answer in range 28-40 (^{o}C)
ii	(as the temperature increases, the rate of photosynthesis) increases because particles/enzymes have more (kinetic) energy / collide more (frequently) / ORA (1) levels off because of some other limiting factor / not enough CO_2 / not enough light / temperature is not a limiting factor (1) decreases because enzymes denature (1)	3	 **ignore** optimum temperature **allow** at start, temperature is the limiting factor (1)
iii	answer in range 28-30 (^{o}C) (1) idea that max rate of photosynthesis and heating any more would be wasteful (1)	2	if give temperature above 30 (^{o}C) then no marks at all **allow** value less than 28 (^{o}C) if explains that reduced rate of photosynthesis / yield is balanced by reduced heating costs = 2 answer below 28 (^{o}C) with no justification = 0

Question	Answer	Marks	Guidance
b	cost of heaters / cost of heating / payback time for heaters (1) idea of pollution / environmental damage / carbon footprint (1)	2	**ignore** simply 'cost' **allow** idea that gas/oil heaters also release carbon dioxide for photosynthesis (1) **allow** idea that transpiration might increase / may need more water (1)
	Total	**10**	

Question	Answer	Marks	Guidance
2 a	from carbon dioxide (from the air / through leaves) (1)	1	**allow** from glucose **allow** correct formula **ignore** from food **ignore** photosynthesis / respiration / breathing
b	from water (from the soil / through roots) (1)	1	**allow** from glucose **allow** correct formula **ignore** from food **ignore** photosynthesis / respiration / breathing
c	from carbon dioxide (from the air / through leaves) (1)	1	**not** from water **allow** from glucose **allow** correct formula **ignore** from food **ignore** photosynthesis / respiration / breathing
d	from nitrates (from the soil / through roots) (1)	1	**allow** correct formula
	Total	**4**	

Question			Answer	Marks	Guidance
3	(a)		$C_6H_{12}O_6$ **and** $6O_2$ (1)	1	**any order** must use subscripts
	(b)		idea that not enough mass/materials/substances/nutrients lost from soil to supply the mass/material/substances/nutrients gained by the tree (1) correct **calculation**: soil lost 1kg but tree gained 78kg (1)	2	**allow** the tree gained (much) more mass than the soil lost **allow** total weight changed from 102kg → 179kg **allow** soil would have been 22kg (if scientists were correct) **allow** the tree gained 77kg from somewhere else (not soil) = 2 marks **allow** tree gains 78kg but soil **only** lost 1kg = 2 bod
	(c)	(i)	(water lost in) transpiration (1) idea that only a **small** proportion is used in photosynthesis (1)	2	**allow** evaporation from plant
		(ii)	more transpiration (1) idea that wind moves away water **vapour** (1)	2	**allow** more water lost through stomata **allow** more evaporation / more diffusion (out of leaf) **ignore** simply 'more water lost'
			Total	**7**	

Question			Answer	Marks	Guidance
4	(a)		**(Level 3)** Answer includes more than one correct assumption **and** a correct calculation **and** a sensible interpretation of the result. Quality of written communication does not impede communication of the science at this level. **(5–6 marks)** **(Level 2)** Answer includes a correct assumption **and** a correct calculation OR Answer includes a correct calculation **and** a sensible interpretation of the result. Quality of written communication partly impedes communication of the science at this level. (**3–4 marks)** **(Level 1)** Answer includes either a correct assumption **or** a correct calculation **or** a sensible interpretation. Quality of written communication impedes communication of the science at this level. **(1–2 marks)** **(Level 0)** Insufficient or irrelevant science. Answer not worthy of credit. **(0 marks)**	6	**This question is targeted from grades D to A** **Indicative scientific points may include:** assumptions: • no immigration / emigration between release and recapture • no death / reproduction between release and recapture • identical sampling methods • the marking does not affect the survival rate • marked slugs have mixed with non-marked slugs • marks don't get removed calculations: ▪ calculation is $\frac{50 \times 45}{5} = 450$ ▪ estimate of population is 450 ▪ the population is halved interpretations: ▪ method of control is working / is successful as population has gone down/halved ▪ an appreciation that these are only estimates. If mostly matches level 3 but only has one assumption, give 5 marks If give formula only i.e. 50x45/5 then award 1 mark if level 1, 3 marks if level 2, 5 marks if level 3 If incorrect calculation, then can give sensible interpretation ecf for L1 **Use L1, L2, L3 annotations in scoris. Do not use ticks**

Question			Answer	Marks	Guidance
	(b)	**(i)**	C (1)	1	
		(ii)	(cells with) **most** chloroplasts / palisade layer is near the top of the leaf (1)	1	**allow** upper epidermis is transparent / one cell thick **ignore** cuticle **ignore** large surface area / thin
		(iii)	they (carotene / xanthophyll) absorb different **wavelengths** (to chlorophyll) (1) a wider range of **wavelengths** can be absorbed / more of the spectrum is absorbed (1)	2	**allow** absorb different colours (of light) **allow** correct reference to just one pigment **ignore** absorb wrong wavelengths **ignore** just 'absorb more light'
			Total	**10**	