	Question		Answer	Marks	AO	Guidance
11	(a)	(i)	Substitute $t = 10$, $h = 10$ and $t = 85$, $h = 200$ $10 = a + b\ln 10$ $200 = a + b\ln 85$ Solve simultaneous equations to give $b = \left[\dfrac{190}{\ln\frac{85}{10}} = \dfrac{190}{2.14}\right] = 88.8$	**M1** **E1**	**3.3** **2.1**	Forms two equations and attempt to solve simultaneously (BC) Allow if $10 = a + 2.303b$ and $200 = a + 4.443b$ used AG must be 3 s.f. If by simultaneous equations solved BC, 88.78…..or better must also be seen
				[2]		
11	(a)	(ii)	$a = -194$	**B1**	**3.3**	Accept awrt -194 or -195
				[1]		
11	(b)	(i)	For small values of *t* the model for *h* predicts a negative height [which is not possible]	**E1**	**3.5b**	argument based on negativity
				[1]		
11	(b)	(ii)	The model predicts that the sunflower would continue to increase in height for ever, which is not possible	**E1**	**3.5b**	argument based on contrast between ever increasing height <u>predicted by the model</u> and reality
				[1]		

11	(c)		height at $\frac{85}{2}$ days $a+88.8\ln\frac{85}{2}$ cm	M1	3.4	Also allow for 84.5 days used for 85
			[using given answers above] 139 cm which is more than 1 m	E1	2.2a	Established using a value of h between 137.9 and 139 needed.
			Alternative method time to reach 1 m: $100=a+88.8\ln t$	M1		Equate to 100 and solve for t. Condone $h=1$ used
			[using given answers above] 27.4 days which is less than $\frac{85}{2}$	E1		Established using a value of t between 27 and 28 needed.
				[2]		
11	(d)		rate of growth $\dfrac{\mathrm{d}h}{\mathrm{d}t}=\dfrac{b}{t}$	M1	3.1b	Attempt to differentiate to give expression of the form $\frac{k}{t}$
			rate 3 cm per day when $\dfrac{b}{t}=3$	M1	3.4	equates their derivative to 3
			$t=\dfrac{b}{3}=29.6$	A1	1.1b	allow 29 or 30 days
				[3]		