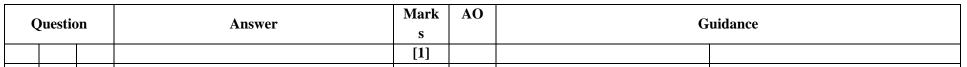
8	(a)		20 (minutes)	B1	3.3	Obtain $t = 20$	Allow [19.9, 20.1] from setting up and
			97.2 (grams)	B1	3.4	Obtain $m = 97.2$	using exponential model Allow [97.1, 97.3] from setting up and using exponential model
				[2]			
8	(b)	(i)	$160e^{-0.055t} = 80$	B1	3.4	Equate given model to 80	soi, so could be $e^{-0.055t} = 0.5$

Question		on	Answer	Mark s	AO	Guidance				
			$e^{-0.055t} = 0.5$	M1	3.4	Attempt correct process to find	Rearrange to $e^{-0.055t} = k$, and hence			
			$-0.055t = \ln 0.5$			value of <i>t</i> , as far as dealing with	obtain $-0.055t = \ln k$			
						exponential term	If introducing logs straight away then			
							need to get as far as			
							$\ln 160 - 0.055t = \ln(\text{their } 80)$			
			t = 12.6 (minutes)	A1	1.1	Obtain $t = 12.6$, or better	If more sig fig given, then allow			
							answers which round to 12.60 (the more			
				[2]			accurate answer is 12.602676)			
0		(••)		[3]	2.4					
8	(b)	(ii)	$\frac{\mathrm{d}m}{\mathrm{d}t} = -8.8\mathrm{e}^{-0.055t}$	B 1	3.4	Correct derivative soi	Allow unsimplified			
							No need to see $\frac{dm}{dt} =$			
			$-8.8e^{-0.055 \times 15}$	M1	3.4	Substitute $t = 15$ into their	Must be of the form $ke^{-0.055t}$, with $k \neq$			
						derivative	160			
							Possibly still with k unsimplified			
							Substitution sufficient, no need to			
			2.96 house and a filling in 2.96	A 1	1 1		evaluate for M1			
			= -3.86, hence rate of decay is 3.86	A1	1.1	Units required, and positive	Must follow correct derivative ie			
			grams/minute			answer	negative coefficient			
							No need to see –3.86 first, but A0 if			
							clear error			
							Accept 3.9 grams/minute			
				[3]			Accept g/m for grams/minute			
				[ວ]						

(Question		Answer	Mark s	AO	Guidance			
8	(C)		For A, $\frac{dm}{dt} = -63.9e^{-0.0511t}$ Rate of decrease at $t = 15$ is 29.7 g/min hence A decaying at a faster rate	B1	3.4	State <i>A</i> , with clear comparison	Insufficient to just say that <i>A</i> has a greater initial mass – needs to consider decay factor as well Allow solutions that identify that <i>B</i> is decaying faster, with supporting evidence eg after 10 minutes, <i>B</i> 's mass is 92.3g which is 58% of initial mass whereas <i>A</i> is 60% of initial mass so <i>B</i> decaying faster eg <i>A</i> 's half-life is 13.6 so <i>B</i> is decaying faster eg change initial mass in model <i>B</i> to 1250 then when $t = 10$ <i>B</i> 's mass would be 721g which is less than 750 hence decaying faster eg compare coefficients of <i>t</i> (for <i>A</i> , coeff is – 0.0511); <i>B</i> 's is of a greater magnitude hence decaying faster For either solution, the conclusion and the supporting evidence must be consistent Numerical supporting evidence must be correct, allowing for slight inaccuracies from using different numbers of sig fig (see appendix)		



APPENDIX

Supporting Evidence for Q8(c)

Choose t =	15										
Substance A					Substance B						
time	0	10	20	50	15	time	0	10	20	50	15
mass (exact)	1250	750	450	97.200	580.948	mass (exact)	160.00	92.312	53.259	10.228	70.11
mass (k=-0.0511)	1250	750	450	97.115	580.796						
mass (k=-0.051)	1250	750	450	97.602	581.667						
Percentage decreased at t =	0	10	20	50	15	Percentage decreased at t =	0	10	20	50	15
Exact k value	0%	40%	64%	92.22%	53.52%	Exact k value	0%	42.31%	66.71%	93.61%	56.18
k=-0.0511	0%	40%	64%	92.23%	53.54%						
k=-0.051	0%	40%	64%	92.19%	53.47%						
Percentage remaining at t =	0	10	20	50	15	Percentage remaining at t =	0	10	20	50	15
Exact k value	100%	60%	36%	7.78%	46.48%	Exact k value	100%	57.69%	33.29%	6.39%	43.829
k=-0.0511	100%	60%	36%	7.77%	46.46%						
k=-0.051	100%	60%	36%	7.81%	46.53%						
When comparing RAT	E of decre	ease at t r	ninutes. S	Substance	e A is showr	n to be decreasing at a fast	er rate.				
						Coloren D					
Substance A						Substance B					
time	0	10	20	50	15	time	0	10	20	50	15
dm/dt (exact)	-63.853	-38.312	-22.987	-4.965	-29.676	dm/dt (exact)	-8.800	-5.077	-2.929	-0.563	-3.85
1 / 11 // 0.05443	-63.875	-38.318	-22.987	-4.963	-29.679						
dm/dt (k=-0.0511)	-05.675	-30,310	-22.307	4.505	25.075						