Question	Scheme	Marks	AOs
12 (a)	Total mass $= \dfrac{4500(1-(0.98)^{23})}{1-0.98}$ or $\dfrac{4500((0.98)^{23}-1)}{0.98-1}$	M1	3.1b
	$= 83621.86152... = 83600$ (tonnes) (3 sf)	A1	1.1b
		(2)	
(b)	Expected mass in the year 2040 $= 4500(0.98)^{23-1}$	M1	3.4
	$= 2885.268132... = 2890$ (tonnes) (3 sf)	A1	1.1b
		(2)	
(c)	Total cost $= 800(1500(23)) + 600(83621.86152... - 1500(23))$	M1	3.1b
		M1	1.1b
	$= 800(34500) + 600(49121.86152...)$ $= 27600000 + 29473116.91$ $= 57073116.91$		
	$\Rightarrow x =$ (£) 57.1 (million) (3 sf)	A1	3.2a
		(3)	
(c) Alt 1	Total cost $= 200(1500(23)) + 600(83621.86152...)$	M1	3.1b
		M1	1.1b
	$= 200(34500) + 600(49121.86152...)$ $= 6900000 + 50173116.91$ $= 57073116.91$		
	$\Rightarrow x =$ (£) 57.1 (million) (3 sf)	A1	3.2a
		(3)	
			(7 marks)

Question 12 Notes:	
(a)	
M1:	Complete method of applying the correct geometric series summation formula with either $n = 22$ or $n = 23$, $a = 4500$ and $r = 0.98$
A1:	Correct answer to 3 significant figures of 83600 (tonnes)
(b)	
M1:	Uses the geometric series model to apply the correct nth term formula with either $n = 22$ or $n = 23$, $a = 4500$ and $r = 0.98$
A1:	Correct answer to 3 significant figures of 2890 (tonnes)
(c)	
M1:	A ***complete strategy*** to find the total cost
M1:	For either • $800(1500(23))$ {= 27 600 000} • $600(83621.86152... - 1500(23))$ {= 29 473116.91 } • $800(1500(22))$ {= 26 400 000} • $600("80736.59338..." - 1500(22))$ {= 28 641 956.03 }
A1:	Correct answer of $x = (£)57.1$ (million) (3 sf) **Note:** Using rounded answer from part (a) gives • $x = 27\,600\,000 + 29\,460\,000 = 57\,060\,000 = (£)57.1$ (million) (3 sf)
(c) **Alt 1**	
M1:	A ***complete strategy*** to find the total cost
M1:	For either • $200(1500(23))$ {= 6 900 000} • $600(83621.86152...)$ {= 50173116.91 } • $200(1500(22))$ {= 6 600 000}
A1:	Correct answer to 3 significant figures of $x = (£)57.1$ (million) **Note:** Using rounded answer in part (a) gives • $6\,900\,000 + 50\,160\,000 = 57\,060\,000 \Rightarrow x = (£)57.1$ (million) (3 sf)
	Note: Using $n = 22$ throughout gives (a) 80 736.59338... (b) 2944.151155... (c) 55.04195603…