Question Number	Scheme	Marks
9.(a)	$y = 2x^{\frac{3}{2}}(4-x) = 8x^{\frac{3}{2}} - 2x^{\frac{5}{2}}$	
	$\frac{dy}{dx} = 12x^{\frac{1}{2}} - 5x^{\frac{3}{2}}$	M1, A1
	Stationary point $12x^{\frac{1}{2}} - 5x^{\frac{3}{2}} = 0 \Rightarrow x = \frac{12}{5}$	dM1, A1
		(4)
(b)	$\int 8x^{\frac{3}{2}} - 2x^{\frac{5}{2}} dx = \frac{16}{5}x^{\frac{5}{2}} - \frac{4}{7}x^{\frac{7}{2}}$	M1, A1
	$\frac{16}{5}k^{\frac{5}{2}} - \frac{4}{7}k^{\frac{7}{2}} = 0 \Rightarrow k = \frac{16\times 7}{4\times 5} = \frac{28}{5}$	dM1, A1
		(4) **(8 marks)**

(a)

M1: Complete attempt to differentiate.
Writes as a sum of two terms and reduces the power of at least one term by 1
Alternatively, by the product rule look for $Ax^{\frac{1}{2}}(4-x) - Bx^{\frac{3}{2}}$

A1: $\left(\frac{dy}{dx} =\right) 12x^{\frac{1}{2}} - 5x^{\frac{3}{2}}$ or $3x^{\frac{1}{2}}(4-x) - 2x^{\frac{3}{2}}$. May be left unsimplified

dM1: Sets $\frac{dy}{dx} = 0$ and attempts to solve to find a non-zero value for x. Do not be concerned about the method of solving for this mark.

A1cso: $x = \frac{12}{5}$ from correct work. Ignore reference to $x = 0$. Watch for incorrect methods of solving, such as $\left(12x^{\frac{1}{2}} - 5x^{\frac{3}{2}}\right)^2 = 0 \Rightarrow 144x - 25x^3 = 0 \Rightarrow x = \frac{12}{5}$, which score A0.

(b)

M1: Complete attempt to integrate. Writes as a sum of two terms and increases the power of at least one term by 1. For attempts at integrating by parts they must proceed through the second integration to score the mark.

A1: $\frac{16}{5}x^{\frac{5}{2}} - \frac{4}{7}x^{\frac{7}{2}}$ which may be unsimplified

dM1: Substitutes $x = k$ in their $\frac{16}{5}x^{\frac{5}{2}} - \frac{4}{7}x^{\frac{7}{2}} = 0$ and solves. Alternatively, applies limits 0 and 4 to find the area $R_1 \left(= \frac{1024}{35}\right)$ and sets equal to the negative of the expression from limits 4 to k (or reverses the limits and sets equal) and proceeds to reach a value for k.

A1: $k = \frac{28}{5}$ (ignore references to $k = 0$) Accept as decimal 5.6.

Alt for the dM:

$$\text{Area } R_1 = \left[\frac{16}{5}x^{\frac{5}{2}} - \frac{4}{7}x^{\frac{7}{2}}\right]_0^4 = \frac{1024}{35} \Rightarrow \text{Area } R_2 = \left[\frac{16}{5}x^{\frac{5}{2}} - \frac{4}{7}x^{\frac{7}{2}}\right]_4^k = -\frac{1024}{35} \Rightarrow k = ...$$

Note if $\text{Area } R_1 = \text{Area } R_2 = \left[\frac{16}{5}x^{\frac{5}{2}} - \frac{4}{7}x^{\frac{7}{2}}\right]_0^4 = \frac{1024}{35} = \left[\frac{16}{5}x^{\frac{5}{2}} - \frac{4}{7}x^{\frac{7}{2}}\right]_4^k \Rightarrow k = ...$ is used then this scores dM0. However, if a student realises the areas cancel and effectively achieves the correct equation after stating areas equal then allow recovery for dM1A1.

Question Number	Scheme	Marks
10 (a)	$2000\times1.03^{6} = \text{awrt } 2390$	M1, A1 **(2)**
(b)	$3690 = ab^{4}, 3470 = ab^{7} \Rightarrow b^{3} = \dfrac{3470}{3690} = (0.94...)$	M1
	Hence $b = \sqrt[3]{\dfrac{3470}{3690}} = 0.9797...$ $a = \dfrac{3690}{0.9797..^{4}}$	dM1
	$N = 4000\times0.98^{t}$	A1 **(3)**
(c)	Sets $2000\times1.03^{T} = 4000\times0.98^{T} \Rightarrow \left(\dfrac{1.03}{0.98}\right)^{T} = \dfrac{4000}{2000}$	M1
	$\Rightarrow T\log\left(\dfrac{1.03}{0.98}\right) = \log 2 \Rightarrow T = ...$	dM1
	$\Rightarrow T = 13.9$	A1 **(3)** **(8 marks)**

(a)

M1: Attempts 2000×1.03^{5} or 2000×1.03^{6}. May use successive iterations (finding each year) but end up at one these in effect.

A1: Awrt 2390

(b)

M1: Makes progress in using the model and attempting to find one of the variables a or b^3 (or b). Allow if r is used instead of b for the M's.

Allow from the indexing error $3690 = ab^{3}, 3470 = ab^{6} \Rightarrow b^{3} = \dfrac{3470}{3690}$

dM1: Full method to find values for a and b.

Condone this being scored from $3690 = ab^{3}, 3470 = ab^{6}$

A1: $N = 4000\times0.98^{t}$ Accept awrt 4000 to 2sf,, awrt 0.98. Must be seen as an equation not just values of a and b but allow if the equation is seen (c) (including the N =). Condone n or T used the variables.

(c)

M1: Makes progress towards solving the problem by forming a single term with single power T. Follow through on their equations provided that they are of the correct form.

Alternatively takes logs of both sides $2000\times1.03^{T} = 4000\times0.98^{T}$ and uses addition law and power law of logs, e.g $\ln 2000 + T\ln 1.03 = \ln 4000 + T\ln 0.98$

Award from an attempt on $2000\times1.03^{T-1} = 4000\times0.98^{T} \Rightarrow \left(\dfrac{1.03}{0.98}\right)^{T} = \dfrac{4000\times1.03}{2000}$ or similar index error.

dM1: Full and complete attempt to find T. Dependent upon previous method but may be implied for the correct value for their $a = b^{T}$

A1: cao $T = 13.9$