Question	Scheme	Marks
5(a)	$P(1)=\frac{4-1}{10}+\frac{3}{4}\ln\left(\frac{2}{3^2}\right)$ $(=-0.828...)$	**M1**
	$P(1)=-0.828...$ (which is negative so a loss of £0.828 million,) so approximately £830 000 loss.	**A1***
		(2)
(b)	$P(6)=-0.08799\ldots$ and $P(7)=0.1975\ldots$	**M1**
	There is a sign change and hence as P is continuous on [6,7], so the root for t lies in [6,7].	**A1**
		(2)
(c)	$P=0\Rightarrow\frac{4t-1}{10}=-\frac{3}{4}\ln\left(\frac{t+1}{(2t+1)^2}\right)\Rightarrow t=...$	**M1**
	$\Rightarrow t=\frac{10\left(-\frac{3}{4}\ln\left(\frac{t+1}{(2t+1)^2}\right)\right)+1}{4}=\frac{1}{4}+\frac{30}{16}\ln\left(\frac{t+1}{(2t+1)^2}\right)^{-1}$ $\Rightarrow t=\frac{1}{4}+\frac{15}{8}\ln\left(\frac{(2t+1)^2}{t+1}\right)$ *	**A1***
		(2)
(d)	$t_2=\frac{1}{4}+\frac{15}{8}\ln\left(\frac{13^2}{7}\right)=...(=6.219978...)$	**M1**
	$t_2=$ awrt 6.220	**A1**
	$t_6=6.314$	**A1**
		(3)
(e)	"6.3..."×12 = ... months, or repeated iteration to root 6.31487 gives 75.7785… or allow "0.314..."×12 = "3.768..."	**M1**
	So it will take 76 months. (Accept 75 or awrt 76 months)	**A1**
		(2)
		(11 marks)

Notes:

(a)

M1: Attempts to substitute $t = 1$ into the given formula. Allow if there is a slip but an attempt at substitution is seen, or allow for sight of awrt $-0.828...$

A1*: Correct value for $P(1)$ seen to at least 2.s.f. if substitution has been shown, or at least 3 s.f. if no substitution was shown, followed by suitable conclusion that it is a loss of approximately £830 000, though accept awrt £830 000. Must mention "loss" and include units (£ or pounds). Negative value given is A0.

(b)

M1: Attempts both $P(6)$ and $P(7)$ with at least one correct to 1 s.f. rounded or truncated. A tighter interval could be used but must contain the root (6.31487)

A1: Both correct to1 s.f. rounded or truncated with suitable conclusion made. Must mention sign change and continuity as well as conclusion about root in the interval.

(c)

M1: Attempts to isolate αt from the $\frac{4t-1}{10}$ after setting equal to zero.

A1*: Correct work to reach the given answer with no incorrect work seen and at least one intermediate step with either $\alpha t = ...$ reached or with the power law applied on the ln term (need not see the power explicitly used, but must have been applied correctly).

(d)

M1: Attempts to use the formula with t_1 =6. Accept with 6 embedded in formula followed by a value, or awrt 6.2 (or even 6.3) as implying the attempt.

A1: awrt 6.220 Accept 6.22.

A1: Correct and given to 3 d.p.

(e)

M1: Multiplies their final root from (d) by 12, or uses repeated iteration to narrow further then multiplies by 12. Allow the method if they multiply the fractional part only by 12 and get, e.g., 6 years 3 months.

A1: Accept 75 or 76 months, or anything that rounds to 76 months.

Question	Scheme	Marks
6	$\frac{\mathrm{d}}{\mathrm{d}x}(\cos x+\sin x)=-\sin x+\cos x$	**B1**
	$\frac{\mathrm{d}y}{\mathrm{d}x}=\frac{(\cos x+\sin x)(3\cos x)-(-\sin x+\cos x)(2+3\sin x)}{(\cos x+\sin x)^2}$	**M1 A1**
	$=\frac{3\cos^2 x+\cancel{3\sin x\cos x}+2\sin x+3\sin^2 x-2\cos x-\cancel{3\sin x\cos x}}{\cos^2 x+2\sin x\cos x+\sin^2 x}$ $=\frac{3+2\sin x-2\cos x}{1+2\sin x\cos x}$	**M1**
	$=\frac{3+2\sin x-2\cos x}{1+2\sin x\cos x}\times\frac{\sec x}{\sec x}=\frac{3\sec x+2\sec x\sin x-2}{\sec x+2\sin x}$	**M1**
	$=\frac{2\tan x+3\sec x-2}{\sec x+2\sin x}$	**A1**
		(6)
		(6 marks)

Notes:

B1: Correct differentiation of $\cos x+\sin x\rightarrow-\sin x+\cos x$ seen somewhere in the proof. This can be scored if seen in workings for quotient rule, or even in the denominator of an incorrect attempt at *u*'/*v*'.

M1: Differentiates using the quotient rule or product rule. For quotient rule look for $\frac{(\cos x+\sin x)(\pm a\cos x)-(\pm\sin x\pm\cos x)(2+3\sin x)}{(\cos x+\sin x)^2}$

For product rule look for $(\cos x+\sin x)^{-1}(\pm a\cos x)\pm(\cos x+\sin x)^{-2}(\pm\cos x\pm\sin x)(2+3\sin x)$

A1: Fully correct derivative.

M1: Expands numerator or denominator and applies $\sin^2 x+\cos^2 x=1$ or other appropriate correct Pythagorean identity at least once in the proof.

M1: Attempts to multiply through by sec *x* in numerator and denominator (to achieve the 2sin *x* term). Not dependent and may be scored before the previous M.

A1: Correct answer. Terms may be in different order. Allow minor slips in notation (e.g. a single missing *x*) and recovery from missing brackets if the intent is clear, but A0 for persistent incorrect notation throughout (e.g no *x*'s in the trig terms).