Question Number	Scheme	Notes	Marks
4(a)	$y=\tan\left(\frac{3x}{2}\right)\Rightarrow y'=\frac{3}{2}\sec^2\left(\frac{3x}{2}\right)$	Any correct first derivative. Not implied by $y'\left(\frac{\pi}{6}\right)=3$	**B1**
	$\Rightarrow y''=2\times\frac{3}{2}\sec\left(\frac{3x}{2}\right)\times\sec\left(\frac{3x}{2}\right)\tan\left(\frac{3x}{2}\right)\times\frac{3}{2}$ $\left[=\frac{9}{2}\sec^2\left(\frac{3x}{2}\right)\tan\left(\frac{3x}{2}\right)\right]$	Attempts the second derivative achieving $k\sec^2\left(\frac{3x}{2}\right)\tan\left(\frac{3x}{2}\right)$ or unsimplified equivalent. Not implied by $y''\left(\frac{\pi}{6}\right)=9$	**M1**
	$\Rightarrow y'''=\frac{9}{2}\sec^2\left(\frac{3x}{2}\right)\sec^2\left(\frac{3x}{2}\right)\times\frac{3}{2}+\frac{9}{2}\tan\left(\frac{3x}{2}\right)\times2\times\frac{3}{2}\sec^2\left(\frac{3x}{2}\right)\tan\left(\frac{3x}{2}\right)$ $\left[=\frac{27}{4}\sec^4\left(\frac{3x}{2}\right)+\frac{27}{2}\sec^2\left(\frac{3x}{2}\right)\tan^2\left(\frac{3x}{2}\right)\right]$	**d**M1: Attempts third derivative using the product rule, achieving $P\sec^4\left(\frac{3x}{2}\right)+Q\sec^2\left(\frac{3x}{2}\right)\tan^2\left(\frac{3x}{2}\right)$ or unsimplified equivalent. **Requires previous M mark.** A1: Correct differentiation. Accept unsimplified. Not implied by $y'''\left(\frac{\pi}{6}\right)=54$	**dM1 A1**
	If $\sec^2\left(\frac{3x}{2}\right)=\tan^2\left(\frac{3x}{2}\right)+1$ is used the identity must be used correctly and to score M marks expressions of consistent form should be achieved. Note that replacing $\sec^2\left(\frac{3x}{2}\right)$ in $y''\Rightarrow y'''=\frac{27}{4}\sec^2\left(\frac{3x}{2}\right)+\frac{81}{4}\sec^2\left(\frac{3x}{2}\right)\tan^2\left(\frac{3x}{2}\right)$		
	$y\left(\frac{\pi}{6}\right)=1, y'\left(\frac{\pi}{6}\right)=3, y''\left(\frac{\pi}{6}\right)=9, y'''\left(\frac{\pi}{6}\right)=54$ Attempts values (but allow numerical trig expressions) for y and their 3 derivatives at $\frac{\pi}{6}$ - accept stated values or insertion into a series of the correct form		**M1**
	$(y=)1+3\left(x-\frac{\pi}{6}\right)+\frac{9}{2!}\left(x-\frac{\pi}{6}\right)^2+\frac{54}{3!}\left(x-\frac{\pi}{6}\right)^3+\ldots$ Applies Taylor's correctly about $\frac{\pi}{6}$ with their values/numerical trig expressions. If values are not seen separately the work should imply a correct formula but allow a recognisable attempt at the series following the correct general formula stated. **Requires previous M mark.**		**dM1**
	$(y=)1+3\left(x-\frac{\pi}{6}\right)+\frac{9}{2}\left(x-\frac{\pi}{6}\right)^2+9\left(x-\frac{\pi}{6}\right)^3+\ldots$	Correct expression with coeffs. in simplest form. "y = ..." not required. **Requires all previous marks.** Score A0 if **clear evidence** of **use** of any wrong derivative expression.	**A1**
If e.g. $y'''\left(\frac{\pi}{6}\right)$ is found by calculator but $y'(x)$ and $y''(x)$ were seen award 1100110 max			**(7)**
	Note: With responses that work in sin and cos throughout, to score M marks there must be no loss of form when differentiating (sign and coefficient errors only, also allowing sign errors with product/quotient formulae). Any use of identities must be correct. E.g. $y=\tan\left(\frac{3x}{2}\right)=\frac{\sin\left(\frac{3x}{2}\right)}{\cos\left(\frac{3x}{2}\right)}\Rightarrow y'=\frac{\frac{3}{2}\cos^2\left(\frac{3x}{2}\right)+\frac{3}{2}\sin^2\left(\frac{3x}{2}\right)}{\cos^2\left(\frac{3x}{2}\right)}$ $y''=\frac{\frac{9}{2}\cos^3\left(\frac{3x}{2}\right)\sin\left(\frac{3x}{2}\right)+\frac{9}{2}\cos\left(\frac{3x}{2}\right)\sin^3\left(\frac{3x}{2}\right)}{\cos^4\left(\frac{3x}{2}\right)}$ or $\frac{\frac{9}{2}\cos\left(\frac{3x}{2}\right)\sin\left(\frac{3x}{2}\right)}{\cos^4\left(\frac{3x}{2}\right)}$ or $\frac{9\sin\left(\frac{3x}{2}\right)}{2\cos^3\left(\frac{3x}{2}\right)}$ $y'''=\frac{\frac{27}{4}\cos^8\left(\frac{3x}{2}\right)+27\cos^6\left(\frac{3x}{2}\right)\sin^2\left(\frac{3x}{2}\right)+\frac{81}{4}\cos^4\left(\frac{3x}{2}\right)\sin^4\left(\frac{3x}{2}\right)}{\cos^8\left(\frac{3x}{2}\right)}=\frac{27}{4}+27\tan^2\left(\frac{3x}{2}\right)+\frac{81}{4}\tan^4\left(\frac{3x}{2}\right)$		

Question Number	Scheme	Notes	Marks
4(b)	$\left\{y\left(\frac{\pi}{4}\right)=\right\}1+3\left(\frac{\pi}{4}-\frac{\pi}{6}\right)+\frac{9}{2}\left(\frac{\pi}{4}-\frac{\pi}{6}\right)^2+9\left(\frac{\pi}{4}-\frac{\pi}{6}\right)^3$ or $1+3\left(\frac{\pi}{12}\right)+\frac{9}{2}\left(\frac{\pi}{12}\right)^2+9\left(\frac{\pi}{12}\right)^3$ Substitutes $\frac{\pi}{4}$ into their expression for *y* of the correct form with at least the first three terms (series about $\frac{\pi}{6}$). Must have values (not unevaluated trig expressions). If only a decimal value is given then it must be the correct awrt 2.26 to score M1 (2.255314325). If there is no working they must obtain an expression with at least $a+b\pi+c\pi^2$ and correct exact ft *a*, *b* and *c* for their series or $1+\frac{\pi}{4}+c\pi^2$ with correct exact ft *c*		**M1**
	$=1+\frac{\pi}{4}+\frac{\pi^2}{32}+\frac{\pi^3}{192}$ or $1+\frac{1}{4}\pi+\frac{1}{32}\pi^2+\frac{1}{192}\pi^3$	Correct answer or values for *A* (32) and *B* (192). Can be awarded if full marks were not scored in (a).	**A1**
			(2)
			Total 9