Question Number	Scheme	Marks
1	Attempt at chain rule $y^2 \to ...y\dfrac{dy}{dx}$	M1
	Attempt at product rule $3x^2y \to ...x^2\dfrac{dy}{dx}+...xy$	M1
	Correct differentiation $2-8y\dfrac{dy}{dx}+6xy+3x^2\dfrac{dy}{dx}=8x$	A1
	Substitutes $x=3, y=2 \Rightarrow \dfrac{dy}{dx}=-\dfrac{14}{11}$	M1, A1
	Correct method for normal at $(3,2) \Rightarrow y-2=\dfrac{11}{14}(x-3)$	dM1
	$11x-14y-5=0$	A1
		(7) **(7 marks)**

Question Number	Scheme	Marks
1 (a)	$\dfrac{5x+10}{(1-x)(2+3x)} \equiv \dfrac{A}{1-x}+\dfrac{B}{2+3x} \Rightarrow$ Value for A or B	**M1**
	One correct value, either $A=3$ or $B=4$	**A1**
	Correct PF form $\dfrac{3}{1-x}+\dfrac{4}{2+3x}$	**A1**
		(3)
(b)(i)	$\dfrac{A}{1-x}=A(1-x)^{-1}=A\left(1+x+x^2+...\right)$	**B1**
	$\left\{\dfrac{B}{2}\right\}\left(1+\dfrac{3x}{2}\right)^{-1}=\left\{\dfrac{B}{2}\right\}\left(1+(-1)\dfrac{3x}{2}+\dfrac{(-1)(-2)}{2}\left(\dfrac{3x}{2}\right)^2+...\right);=\dfrac{B}{2}\left(1-\dfrac{3x}{2}+\dfrac{9x^2}{4}+...\right)$	**M1; A1**
	$f(x)= 3\times\left(1+x+x^2+...\right)+ \dfrac{4}{2}\left(1-\dfrac{3x}{2}+\dfrac{9x^2}{4}+...\right)$	**M1**
	$=5+\dfrac{15}{2}x^2+...$	**A1**
		(5)
(b)(ii)	$\lvert x\rvert<\dfrac{2}{3}$	**B1**
		(1)
		(9 marks)

Question Number	Scheme	Notes	Marks
1(a)	$\dfrac{2}{\sqrt{9-2x}}=\dfrac{2}{3\sqrt{\left(1-\dfrac{2}{9}x\right)}}$ or $\dfrac{2}{\sqrt{9-2x}}=2(9-2x)^{-\frac{1}{2}}=2\times\dfrac{1}{3}\left(1-\dfrac{2}{9}x\right)^{-\frac{1}{2}}$	Obtains $\sqrt{9-2x}=3\sqrt{(1-...)}$	B1
	$\left(1-\dfrac{2}{9}x\right)^{-\frac{1}{2}}=1+\left(-\frac{1}{2}\right)\left(-\frac{2}{9}x\right)+\dfrac{-\frac{1}{2}\left(-\frac{1}{2}-1\right)}{2!}\left(-\frac{2}{9}x\right)^2+\dfrac{-\frac{1}{2}\left(-\frac{1}{2}-1\right)\left(-\frac{1}{2}-2\right)}{3!}\left(-\frac{2}{9}x\right)^3+...$ M1: Attempts the binomial expansion of $(1+kx)^n$ to get the third and/or fourth term with an acceptable structure. The correct binomial coefficient must be combined with the correct power of x and the correct power of 2. A1: Correct simplified or unsimplified expansion (NB simplified is $=1+\dfrac{1}{9}x+\dfrac{1}{54}x^2+\dfrac{5}{1458}x^3+...$)		M1 A1
	$\dfrac{2}{\sqrt{9-2x}}=\dfrac{2}{3}+\dfrac{2}{27}x+\dfrac{1}{81}x^2+\dfrac{5}{2187}x^3+...$	2 correct simplified terms	A1
		All correct	A1
			(5)
(b)	$x=1\Rightarrow\dfrac{2}{\sqrt{9-2}}=\dfrac{2}{3}+\dfrac{2}{27}+\dfrac{1}{81}+\dfrac{5}{2187}+...$ $\Rightarrow\sqrt{7}\approx 2\div"\dfrac{1652}{2187}"$ or $2\times"\dfrac{2187}{1652}"$ Substitutes $x=1$ and divides into 2 or equivalent		M1
	$=2.6477$	Correct approximation	A1
			(2)
	Alternative for (b):		
	$x=1\Rightarrow\dfrac{2}{\sqrt{9-2}}=\dfrac{2}{3}+\dfrac{2}{27}+\dfrac{1}{81}+\dfrac{5}{2187}+...$ $\dfrac{2}{\sqrt{7}}=\dfrac{2\sqrt{7}}{7}\Rightarrow\sqrt{7}\approx\dfrac{7}{2}\times"\dfrac{1652}{2187}"$ Substitutes $x=1$ and multiplies by $\dfrac{7}{2}$		M1
	$=2.6438$	Correct approximation	A1
			Total 7

Question Number	Scheme	Marks
8(a)	$\frac{1}{\sqrt{4+x}} = 4^{-\frac{1}{2}}\left(1+\frac{x}{4}\right)^{-\frac{1}{2}}$	M1
	$\left(1+\frac{x}{4}\right)^{-\frac{1}{2}} = 1+\left(-\frac{1}{2}\right)\left(\frac{x}{4}\right)+\frac{\left(-\frac{1}{2}\right)\left(-\frac{1}{2}-1\right)}{2!}\left(\frac{x}{4}\right)^2+\ldots$	M1
	$\frac{1}{2}-\frac{1}{16}x+\frac{3}{256}x^2+\ldots$	A1A1
		(4)
(b)	$\frac{1}{2}+\frac{1}{16}x+\frac{3}{256}x^2+\ldots$	B1ft
		(1)
(c)	$\left(\frac{1}{2}-\frac{1}{16}x+\frac{3}{256}x^2\right)\left(\frac{1}{2}+\frac{1}{16}x+\frac{3}{256}x^2\right)=\frac{1}{4}+\frac{1}{128}x^2$	M1A1
		(2)
(d)	$\frac{1}{\sqrt{5}}\times\frac{1}{\sqrt{3}}=\text{"}\frac{1}{4}\text{"}+\text{"}\frac{1}{128}\text{"}=\text{"}\frac{33}{128}\text{"}$	M1
	$\text{"}\frac{128}{33}\text{"}\times 3=\frac{128}{11}$ (see alt (d) for alternative answer)	dM1A1
		(3)
Alt(d)	$\frac{1}{\sqrt{5}}\times\frac{1}{\sqrt{3}}=\text{"}\frac{1}{4}\text{"}+\text{"}\frac{1}{128}\text{"}=\text{"}\frac{33}{128}\text{"}$	M1
	$\frac{1}{\sqrt{15}}\times\frac{\sqrt{15}}{\sqrt{15}}=\frac{\sqrt{15}}{15}\approx\text{"}\frac{33}{128}\text{"}\Rightarrow\sqrt{135}=3\sqrt{15}\approx 3\times 15\times\text{"}\frac{33}{128}\text{"}=\frac{1485}{128}$	dM1A1
		(10 marks)

Question Number	Scheme	Marks
9(a)	$\tan\theta=\sqrt{3}\Rightarrow k=\frac{\pi}{3}\left(\text{or } 60°\right)$ (Allow $x=\sqrt{3}\Rightarrow\theta=\frac{\pi}{3}\left(\text{or } 60°\right)$)	B1
	$V=(\pi)\int y^2\mathrm{d}x=(\pi)\int\left(2\sin 2\theta\right)^2\sec^2\theta\,\mathrm{d}\theta$ oe	M1A1
	$4(\pi)\int\sin^2 2\theta\sec^2\theta\ \mathrm{d}\theta=4(\pi)\int 4\sin^2\theta\cancel{\cos^2\theta}\times\frac{1}{\cancel{\cos^2\theta}}\ \mathrm{d}\theta$	**d**M1
	$=16(\pi)\int\sin^2\theta\,\mathrm{d}\theta$ oe e.g. $16(\pi)\int\left(1-\cos^2\theta\right)\mathrm{d}\theta$	A1
	$\sin^2\theta=\frac{1-\cos 2\theta}{2}\Rightarrow 16(\pi)\int\sin^2\theta\ \mathrm{d}\theta=16(\pi)\int\frac{1-\cos 2\theta}{2}\ \mathrm{d}\theta$	**d**M1
	Volume $=\int_0^{\frac{\pi}{3}}8\pi\left(1-\cos 2\theta\right)\mathrm{d}\theta$	A1 **Cso**
		(7)
(b)	$\int\left(1-\cos 2\theta\right)\mathrm{d}\theta\rightarrow\theta-\frac{\sin 2\theta}{2}$	B1
	Volume $=\int_0^{\frac{\pi}{3}}8\pi\left(1-\cos 2\theta\right)\mathrm{d}\theta=\left[8\pi\theta-4\pi\sin 2\theta\right]_0^{\frac{\pi}{3}}=\frac{8}{3}\pi^2-2\sqrt{3}\pi$	M1 A1
		(3)
		(10 marks)

Question	Scheme	Marks
1	$(1-4x)^{-3}=1\underline{\pm}3\times 4x\pm\frac{-3\times-4}{\underline{2}}(...x)^2\pm\frac{-3\times-4\times-5}{\underline{6}}(...x)^3+...$	**M1**
	$(1-4x)^{-3}=1+3\times 4x+\frac{-3\times-4}{2}(-4x)^2+\frac{-3\times-4\times-5}{6}(-4x)^3+...$	**A1**
	$=1+12x+96x^2+640x^3+...$	**A1A1**
		(4)
		(4 marks)

Question Number	Scheme	Marks
3	Differentiates wrt x $\quad 3^x \ln 3 + 6\frac{dy}{dx} = \frac{3}{2}y^2 + 3xy\frac{dy}{dx}$ Substitutes (2, 3) **AND** rearranges to get $\frac{dy}{dx}$ or vice versa $\Rightarrow 9\ln 3 + 6\frac{dy}{dx} = \frac{27}{2} + 18\frac{dy}{dx} \Rightarrow \frac{dy}{dx} = \frac{9\ln 3 - \frac{27}{2}}{12} = \frac{6\ln 3 - 9}{8} = \frac{-9 + \ln 729}{8}$	B1 B1, M1, A1 M1 A1, A1 **(7)** **(7 marks)**