Question Number	Scheme	Marks
1(a)	$(8-3x)^{-\frac{1}{3}}=\frac{1}{2}\left(1-\frac{3}{8}x\right)^{-\frac{1}{3}}$	B1
	$\left(1-\frac{3}{8}x\right)^{-\frac{1}{3}}=1+\left(-\tfrac{1}{3}\right)\left(-\frac{3}{8}x\right)+\frac{-\frac{1}{3}\left(-\frac{1}{3}-1\right)}{2!}\left(-\frac{3}{8}x\right)^2+\frac{-\frac{1}{3}\left(-\frac{1}{3}-1\right)\left(-\frac{1}{3}-2\right)}{3!}\left(-\frac{3}{8}x\right)^3+\dots$	M1
	$(8-3x)^{-\frac{1}{3}}=\frac{1}{2}+\frac{1}{16}x+\frac{1}{64}x^2+\frac{7}{1536}x^3+\dots$	A1 A1
		(4)
(b)	$\frac{1}{2}+\frac{1}{16}\left(\frac{2}{3}\right)+\frac{1}{64}\left(\frac{2}{3}\right)^2+\frac{7}{1536}\left(\frac{2}{3}\right)^3+\dots=\frac{2851}{5184}\Rightarrow\sqrt[3]{6}=\left(\frac{2851}{5184}\right)^{-1}=\dots$	M1
	$=\frac{5184}{2851}$ or $1\frac{2333}{2851}$	A1
		(2)
		Total 6

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

Question	Scheme	Marks
1(a)	$A=\frac{1}{9}$	B1
		(1)
(b)	$"3^{-2}"(1+\underline{(-2)(\frac{kx}{3})}+\underline{\frac{(-2)(-3)}{2}(\frac{kx}{3})^2}+...)$ or $x:\quad 3^{-2}(-2)\left(\frac{k}{3}\right)\left(=-\frac{2k}{27}\right)$ and $x^2:\quad 3^{-2}\frac{(-2)(-3)}{2}\left(\frac{k}{3}\right)^2=\frac{k^2}{27}$	B1
	$\frac{(-2)(-3)}{2}\left(\frac{k}{3}\right)^2=3\times(-2)\left(\frac{k}{3}\right)\Rightarrow ...k^2=...k$	M1
	$k^2+6k=0$ *	A1*
		(3)
(c)(i)	$k=-6$	B1
(ii)	$3^{-2}\frac{(-2)(-3)(-4)}{3!}\left(\frac{"-6"}{3}\right)^3=\frac{32}{9}$	M1A1
		(3)
		(7 marks)

Question Number	Scheme	Marks
4 (a)	$\frac{1}{\sqrt{1-2x}}=(1-2x)^{-\frac{1}{2}}=1+\left(-\frac{1}{2}\right)(-2x)+\frac{\left(-\frac{1}{2}\right)\left(-\frac{3}{2}\right)}{2!}(-2x)^2$	M1A1
	$\frac{2+3x}{\sqrt{1-2x}}=(2+3x)(1+x+\frac{3}{2}x^2+...$	dM1
	$=2+5x+6x^2$ *	A1*
		(4)
(b)	Sub $x=\frac{1}{20}$ into both sides of $\frac{2+3x}{\sqrt{1-2x}}=2+5x+6x^2$	M1
	$\frac{\frac{43}{20}}{\sqrt{\frac{9}{10}}}=\frac{453}{200}\Rightarrow\sqrt{10}=..$	dM1
	$\sqrt{10}=\frac{1359}{430}$	A1
		(3)
		(7 marks)

Question Number	Scheme	Marks
8(a)	$\dfrac{1}{\sqrt{4+x}}=4^{-\frac{1}{2}}\left(1+\dfrac{x}{4}\right)^{-\frac{1}{2}}$	M1
	$\left(1+\dfrac{x}{4}\right)^{-\frac{1}{2}}=1+\left(-\dfrac{1}{2}\right)\left(\dfrac{x}{4}\right)+\dfrac{\left(-\frac{1}{2}\right)\left(-\frac{1}{2}-1\right)}{2!}\left(\dfrac{x}{4}\right)^2+\ldots$	M1
	$\dfrac{1}{2}-\dfrac{1}{16}x+\dfrac{3}{256}x^2+\ldots$	A1A1
		(4)
(b)	$\dfrac{1}{2}+\dfrac{1}{16}x+\dfrac{3}{256}x^2+\ldots$	B1ft
		(1)
(c)	$\left(\dfrac{1}{2}-\dfrac{1}{16}x+\dfrac{3}{256}x^2\right)\left(\dfrac{1}{2}+\dfrac{1}{16}x+\dfrac{3}{256}x^2\right)=\dfrac{1}{4}+\dfrac{1}{128}x^2$	M1A1
		(2)
(d)	$\dfrac{1}{\sqrt{5}}\times\dfrac{1}{\sqrt{3}}=\text{"}\dfrac{1}{4}\text{"}+\text{"}\dfrac{1}{128}\text{"}=\text{"}\dfrac{33}{128}\text{"}$	M1
	$\text{"}\dfrac{128}{33}\text{"}\times3=\dfrac{128}{11}$ (see alt (d) for alternative answer)	dM1A1
		(3)
Alt(d)	$\dfrac{1}{\sqrt{5}}\times\dfrac{1}{\sqrt{3}}=\text{"}\dfrac{1}{4}\text{"}+\text{"}\dfrac{1}{128}\text{"}=\text{"}\dfrac{33}{128}\text{"}$	M1
	$\dfrac{1}{\sqrt{15}}\times\dfrac{\sqrt{15}}{\sqrt{15}}=\dfrac{\sqrt{15}}{15}\approx\text{"}\dfrac{33}{128}\text{"}\Rightarrow\sqrt{135}=3\sqrt{15}\approx3\times15\times\text{"}\dfrac{33}{128}\text{"}=\dfrac{1485}{128}$	dM1A1
		(10 marks)

Question Number	Scheme	Marks
4(a)	$\sqrt{1-4x^2}=1-\dfrac{1}{2}\times4x^2$	B1
	$\dfrac{\frac{1}{2}\times-\frac{1}{2}\times\left(-4x^2\right)^2}{2}$ or $\dfrac{\frac{1}{2}\times-\frac{1}{2}\times-\frac{3}{2}\times\left(-4x^2\right)^3}{3!}$	M1
	$=1-2x^2-2x^4-4x^6+\ldots$	A1, A1 **(4)**
(b)	Substitutes $x=\dfrac{1}{4}$ into both sides of (a) e.g. $\sqrt{\dfrac{3}{4}}\approx1-2\times\left(\dfrac{1}{4}\right)^2-2\left(\dfrac{1}{4}\right)^4-4\left(\dfrac{1}{4}\right)^6$	M1
	$\sqrt{3}\approx1.7324$ cao	A1 **(2)**
		(6 marks)

Question Number	Scheme	Marks
1(a)	$(2-5x)^{-2} = \frac{1}{4}\left(1-\frac{5x}{2}\right)^{-2}$ or e.g. $\frac{8}{4\left(1-\frac{5x}{2}\right)^{2}}$	B1
	$=8\times\frac{1}{4}\underline{\underline{\left(1+(-2)\times\left(-\frac{5x}{2}\right)+\frac{(-2)\times(-3)}{2!}\times\left(-\frac{5x}{2}\right)^{2}+\frac{(-2)\times(-3)\times(-4)}{3!}\times\left(-\frac{5x}{2}\right)^{3}...\right)}}$	M1A1
	$\frac{8}{(2-5x)^{2}} = 2+10x+\frac{75}{2}x^{2}+125x^{3}...$	A1
		(4)
Alt (a) by direct expansion	$8\times(2-5x)^{-2}$ $=8\times\underline{\underline{\left(2^{-2},+(-2)2^{-3}(-5x)^{1}+\frac{-2\times-3}{2!}2^{-4}(-5x)^{2}+\frac{-2\times-3\times-4}{3!}2^{-5}(-5x)^{3}\right)}}$	B1, <u>M1A1</u>
	$\frac{8}{(2-5x)^{2}} = 2+10x+\frac{75}{2}x^{2}+125x^{3}...$	A1
(b)	$\lvert x\rvert<\frac{2}{5}$ o.e.	B1
		(1)
		(5 marks)

Question Number	Scheme	Marks
3(a)	$B=6\times4^{-\frac{1}{2}}=3$	B1
	$3\times\left(-\frac{1}{2}\right)\left(\frac{A}{4}\right)=-\frac{1}{4}\Rightarrow A=\frac{2}{3}$	M1 A1
	$C=3\times\frac{\left(-\frac{1}{2}\right)\left(-\frac{1}{2}-1\right)}{2}\left(\frac{A}{4}\right)^{2}\Rightarrow C=\frac{1}{32}$	M1 A1
		(5)

3(b)	$-6<x\leqslant 6$	B1ft
		(1)
(c)	coefficient of x^3 is $3\times\frac{\left(-\frac{1}{2}\right)\left(-\frac{3}{2}\right)\left(-\frac{5}{2}\right)}{3!}\left(\frac{A}{4}\right)^{3}=...$	M1
	$-\frac{5}{1152}$	A1
		(2)

Question Number	Scheme	Marks
4 (a)		
	$\frac{1}{\sqrt{1-2x}}=(1-2x)^{-\frac{1}{2}}=1+\left(-\frac{1}{2}\right)(-2x)+\frac{\left(-\frac{1}{2}\right)\left(-\frac{3}{2}\right)}{2!}(-2x)^2$	M1A1
	$\frac{2+3x}{\sqrt{1-2x}}=(2+3x)(1+x+\frac{3}{2}x^2+...$	dM1
	$=2+5x+6x^2$ *	A1*
		(4)
(b)	Sub $x=\frac{1}{20}$ into both sides of $\frac{2+3x}{\sqrt{1-2x}}=2+5x+6x^2$	M1
	$\frac{\frac{43}{20}}{\sqrt{\frac{9}{10}}}=\frac{453}{200}\Rightarrow\sqrt{10}=..$	dM1
	$\sqrt{10}=\frac{1359}{430}$	A1
		(3)
		(7 marks)

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

Question Number	Scheme	Marks
1(a)	$(2-5x)^{-2}=\dfrac{1}{4}\left(1-\dfrac{5x}{2}\right)^{-2}$ or e.g. $\dfrac{8}{4\left(1-\dfrac{5x}{2}\right)^2}$	B1
	$=8\times\dfrac{1}{4}\left(1+(-2)\times\left(-\dfrac{5x}{2}\right)+\dfrac{(-2)\times(-3)}{2!}\times\left(-\dfrac{5x}{2}\right)^2+\dfrac{(-2)\times(-3)\times(-4)}{3!}\times\left(-\dfrac{5x}{2}\right)^3\ldots\right)$	M1A1
	$\dfrac{8}{(2-5x)^2}=2+10x+\dfrac{75}{2}x^2+125x^3\ldots$	A1
		(4)
Alt (a) by direct expansion	$8\times(2-5x)^{-2}$ $=8\times\left(2^{-2},+(-2)2^{-3}(-5x)^1+\dfrac{-2\times-3}{2!}2^{-4}(-5x)^2+\dfrac{-2\times-3\times-4}{3!}2^{-5}(-5x)^3\right)$	B1, M1A1
	$\dfrac{8}{(2-5x)^2}=2+10x+\dfrac{75}{2}x^2+125x^3\ldots$	A1
(b)	$\lvert x\rvert<\dfrac{2}{5}$ o.e.	B1
		(1)
		(5 marks)

Question Number	Scheme	Marks
1 (a)	$(1+kx)^{\frac{1}{2}}=1+\left(\frac{1}{2}\right)\times(kx)+\frac{\left(\frac{1}{2}\right)\times\left(-\frac{1}{2}\right)}{2!}\times(kx)^2+\frac{\left(\frac{1}{2}\right)\times\left(-\frac{1}{2}\right)\times\left(-\frac{3}{2}\right)}{3!}\times(kx)^3\ldots$	
(i)	$\frac{1}{2}k=\frac{1}{8}\Rightarrow k=\frac{1}{4}$	M1A1
(ii)	$A=\frac{\left(\frac{1}{2}\right)\times\left(-\frac{1}{2}\right)}{2!}\times"k"^2=-\frac{1}{128}$ $\quad B=\frac{\left(\frac{1}{2}\right)\times\left(-\frac{1}{2}\right)\times\left(-\frac{3}{2}\right)}{3!}\times"k"^3=\frac{1}{1024}$	M1 A1 A1
		(5)
(b)	Substitutes $x=0.6\Rightarrow\sqrt{1.15}=1+\frac{1}{8}\times0.6-"\frac{1}{128}"\times0.6^2+"\frac{1}{1024}"\times0.6^3=1.072398$	M1 A1
		(2)
		(7 marks)
1(b) alt	$(1+kx)^{\frac{1}{2}}=1+\left(\frac{1}{2}\right)\times(kx)-\left(\frac{1}{8}\right)\times(kx)^2+\left(\frac{1}{16}\right)\times(kx)^3$ Substitutes $"kx"=0.15$ $\Rightarrow\sqrt{1.15}=1+\frac{1}{2}\times0.15-\frac{1}{8}\times0.15^2+\frac{1}{16}\times0.15^3=1.072398$	M1A1
		(2)

Question Number	Scheme	Marks
4(a)	$4^{\frac{1}{2}}\left(1+\frac{5}{4}x\right)^{\frac{1}{2}}$	B1
	$\left(1+\frac{5}{4}x\right)^{\frac{1}{2}}=1+\left(\frac{1}{2}\right)\left(\frac{5}{4}x\right)+\frac{\left(\frac{1}{2}\right)\left(-\frac{1}{2}\right)}{2!}\left(\frac{5}{4}x\right)^2+\frac{\left(\frac{1}{2}\right)\left(-\frac{1}{2}\right)\left(-\frac{3}{2}\right)}{3!}\left(\frac{5}{4}x\right)^3+\ldots$	M1A1
	$4^{\frac{1}{2}}\left(1+\frac{5}{4}x\right)^{\frac{1}{2}}=2+\frac{5}{4}x-\frac{25}{64}x^2+\frac{125}{512}x^3$	A1A1
		(5)
(b)	$\lvert x\rvert\leqslant\frac{4}{5}$	B1
		(1)
(c)(i)	$2-\frac{5}{4}x-\frac{25}{64}x^2-\frac{125}{512}x^3$	B1ft
		(1)
(c)(ii)	$"2"+"2"+"-\frac{25}{64}"x^2+"-\frac{25}{64}"x^2=4-\frac{25}{32}x^2$	M1A1
		(2)
		(9 marks)

Question Number	Scheme	Marks
1(a)	$\left(\frac{1}{4}-\frac{1}{2}x\right)^{-\frac{3}{2}}=8(1-2x)^{-\frac{3}{2}}$	B1
	$(1-2x)^{-\frac{3}{2}}=1+\left(-\tfrac{3}{2}\right)(-2x)+\frac{-\frac{3}{2}\left(-\frac{3}{2}-1\right)}{2!}(-2x)^2+\frac{-\frac{3}{2}\left(-\frac{3}{2}-1\right)\left(-\frac{3}{2}-2\right)}{3!}(-2x)^3+\ldots$	M1 A1
	$\left(\frac{1}{4}-\frac{1}{2}x\right)^{-\frac{3}{2}}=8+24x+60x^2+140x^3+\ldots$	A1, A1
		(5)
(b)	$n=2$	B1
		(1)
(c)	$\left(\frac{1}{4}-\frac{1}{2}x\right)^2=\frac{1}{16}-\frac{1}{4}x+\frac{1}{4}x^2$	B1
	$\left(\frac{1}{4}-\frac{1}{2}x\right)^{\frac{1}{2}}=\left(\frac{1}{16}-\frac{1}{4}x+\frac{1}{4}x^2\right)\left(8+24x+60x^2+140x^3+\ldots\right)$ $=8\times\frac{1}{16}+24x\times\frac{1}{16}+60x^2\times\frac{1}{16}-8\times\frac{1}{4}x-24x\times\frac{1}{4}x+8\times\frac{1}{4}x^2$	M1
	$=\frac{1}{2}-\frac{1}{2}x-\frac{1}{4}x^2+\ldots$	A1
		(3)
		Total 9

Question Number	Scheme	Marks
3(a)	$B=6\times 4^{-\frac{1}{2}}=3$	B1
	$3\times\left(-\frac{1}{2}\right)\left(\frac{A}{4}\right)=-\frac{1}{4}\Rightarrow A=\frac{2}{3}$	M1 A1
	$C=3\times\frac{\left(-\frac{1}{2}\right)\left(-\frac{1}{2}-1\right)}{2}\left(\frac{A}{4}\right)^2\Rightarrow C=\frac{1}{32}$	M1 A1
		(5)

3(b)	$-6<x\leqslant 6$	B1ft
		(1)
(c)	coefficient of x^3 is $3\times\frac{\left(-\frac{1}{2}\right)\left(-\frac{3}{2}\right)\left(-\frac{5}{2}\right)}{3!}\left(\frac{A}{4}\right)^3=\ldots$	M1
	$-\frac{5}{1152}$	A1
		(2)

Question	Scheme	Marks
1	$(1-4x)^{-3}=1\underline{\pm}3\times4x\pm\underline{\frac{-3\times-4}{2}}(...x)^2\pm\underline{\frac{-3\times-4\times-5}{6}}(...x)^3+...$	**M1**
	$(1-4x)^{-3}=1+3\times4x+\frac{-3\times-4}{2}(-4x)^2+\frac{-3\times-4\times-5}{6}(-4x)^3+...$	**A1**
	$=1+12x+96x^2+640x^3+...$	**A1A1**
		(4)
		(4 marks)

Question Number	Scheme	Marks
1(a)	$\left(\frac{1}{4}-\frac{1}{2}x\right)^{-\frac{3}{2}}=8(1-2x)^{-\frac{3}{2}}$	B1
	$(1-2x)^{-\frac{3}{2}}=1+\left(-\tfrac{3}{2}\right)(-2x)+\frac{-\frac{3}{2}\left(-\frac{3}{2}-1\right)}{2!}(-2x)^2+\frac{-\frac{3}{2}\left(-\frac{3}{2}-1\right)\left(-\frac{3}{2}-2\right)}{3!}(-2x)^3+...$	M1 A1
	$\left(\frac{1}{4}-\frac{1}{2}x\right)^{-\frac{3}{2}}=8+24x+60x^2+140x^3+...$	A1, A1
		(5)
(b)	$n=2$	B1
		(1)
(c)	$\left(\frac{1}{4}-\frac{1}{2}x\right)^2=\frac{1}{16}-\frac{1}{4}x+\frac{1}{4}x^2$	B1
	$\left(\frac{1}{4}-\frac{1}{2}x\right)^{\frac{1}{2}}=\left(\frac{1}{16}-\frac{1}{4}x+\frac{1}{4}x^2\right)(8+24x+60x^2+140x^3+...)$ $=8\times\frac{1}{16}+24x\times\frac{1}{16}+60x^2\times\frac{1}{16}-8\times\frac{1}{4}x-24x\times\frac{1}{4}x+8\times\frac{1}{4}x^2$	M1
	$=\frac{1}{2}-\frac{1}{2}x-\frac{1}{4}x^2+...$	A1
		(3)
		Total 9

Question Number	Scheme	Marks
4(a)	$4^{\frac{1}{2}}\left(1+\frac{5}{4}x\right)^{\frac{1}{2}}$	B1
	$\left(1+\frac{5}{4}x\right)^{\frac{1}{2}}=1+\left(\frac{1}{2}\right)\left(\frac{5}{4}x\right)+\frac{\left(\frac{1}{2}\right)\left(-\frac{1}{2}\right)}{2!}\left(\frac{5}{4}x\right)^2+\frac{\left(\frac{1}{2}\right)\left(-\frac{1}{2}\right)\left(-\frac{3}{2}\right)}{3!}\left(\frac{5}{4}x\right)^3+...$	M1A1
	$4^{\frac{1}{2}}\left(1+\frac{5}{4}x\right)^{\frac{1}{2}}=2+\frac{5}{4}x-\frac{25}{64}x^2+\frac{125}{512}x^3$	A1A1
		(5)

(b)	$\lvert x\rvert \leqslant \frac{4}{5}$	B1
		(1)
(c)(i)	$2-\frac{5}{4}x-\frac{25}{64}x^2-\frac{125}{512}x^3$	B1ft
		(1)
(c)(ii)	$"2"+"2"+"-\frac{25}{64}"x^2+"-\frac{25}{64}"x^2=4-\frac{25}{32}x^2$	M1A1
		(2)
		(9 marks)

Question Number	Scheme	Notes	Marks
1(a)	$\frac{2}{\sqrt{9-2x}}=\frac{2}{3\sqrt{\left(1-\frac{2}{9}x\right)}}$ or $\frac{2}{\sqrt{9-2x}}=2(9-2x)^{-\frac{1}{2}}=2\times\frac{1}{3}\left(1-\frac{2}{9}x\right)^{-\frac{1}{2}}$	Obtains $\sqrt{9-2x}=3\sqrt{(1-...)}$	B1
	$\left(1-\frac{2}{9}x\right)^{-\frac{1}{2}}=1+\left(-\tfrac{1}{2}\right)\left(-\tfrac{2}{9}x\right)+\frac{-\frac{1}{2}\left(-\frac{1}{2}-1\right)}{2!}\left(-\tfrac{2}{9}x\right)^2+\frac{-\frac{1}{2}\left(-\frac{1}{2}-1\right)\left(-\frac{1}{2}-2\right)}{3!}\left(-\tfrac{2}{9}x\right)^3+...$ 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 $=1+\frac{1}{9}x+\frac{1}{54}x^2+\frac{5}{1458}x^3+...$)		M1 A1
	$\frac{2}{\sqrt{9-2x}}=\frac{2}{3}+\frac{2}{27}x+\frac{1}{81}x^2+\frac{5}{2187}x^3+...$	2 correct simplified terms	A1
		All correct	A1
			(5)
(b)	$x=1\Rightarrow\frac{2}{\sqrt{9-2}}=\frac{2}{3}+\frac{2}{27}+\frac{1}{81}+\frac{5}{2187}+...$ $\Rightarrow\sqrt{7}\approx2\div"\frac{1652}{2187}"$ or $2\times"\frac{2187}{1652}"$ Substitutes $x = 1$ and divides into 2 or equivalent		M1
	$=2.6477$	Correct approximation	A1
			(2)
	Alternative for (b):		
	$x=1\Rightarrow\frac{2}{\sqrt{9-2}}=\frac{2}{3}+\frac{2}{27}+\frac{1}{81}+\frac{5}{2187}+...$ $\frac{2}{\sqrt{7}}=\frac{2\sqrt{7}}{7}\Rightarrow\sqrt{7}\approx\frac{7}{2}\times"\frac{1652}{2187}"$ Substitutes $x = 1$ and multiplies by $\frac{7}{2}$		M1
	$=2.6438$	Correct approximation	A1
			Total 7

Question Number	Scheme	Marks
1(a)	$\left(\frac{1}{4}-5x\right)^{\frac{1}{2}}=\frac{1}{2}(...)$	B1
	$=(1-20x)^{\frac{1}{2}}=1+\left(\frac{1}{2}\right)\times(-20x)+\frac{\left(\frac{1}{2}\right)\times\left(-\frac{1}{2}\right)}{2!}\times(-20x)^2+\frac{\left(\frac{1}{2}\right)\times\left(-\frac{1}{2}\right)\times\left(-\frac{3}{2}\right)}{3!}\times(-20x)^3...$	M1A1
	$=\frac{1}{2}-5x-25x^2-250x^3+...$	A1 A1
	Special case: If the final answer is left as $\frac{1}{2}\left(1-10x-50x^2-500x^3+...\right)$ Award SC B1M1A1A1A0	
		(5)
	Alternative by direct expansion	
	$\left(\frac{1}{4}-5x\right)^{\frac{1}{2}}=\left(\frac{1}{4}\right)^{\frac{1}{2}}+\left(\frac{1}{2}\right)\left(\frac{1}{4}\right)^{-\frac{1}{2}}(-5x)^1+\frac{\frac{1}{2}\times-\frac{1}{2}}{2}\left(\frac{1}{4}\right)^{-\frac{3}{2}}(-5x)^2+\frac{\frac{1}{2}\times-\frac{1}{2}\times-\frac{3}{2}}{3!}\left(\frac{1}{4}\right)^{-\frac{5}{2}}(-5x)^3$	B1M1A1
	$=\frac{1}{2}-5x-25x^2-250x^3+...$	A1A1
(b)	$\left(\frac{1}{4}-\frac{5}{100}\right)^{\frac{1}{2}}=\left(\frac{1}{5}\right)^{\frac{1}{2}}=\frac{1}{2}-5\times\frac{1}{100}-25\left(\frac{1}{100}\right)^2-250\left(\frac{1}{100}\right)^3+...$ $\frac{\sqrt{5}}{5}\approx\frac{1789}{4000}$ or $\frac{1}{\sqrt{5}}\approx\frac{1789}{4000}$ $\Rightarrow\sqrt{5}\approx5\times\frac{1789}{4000}$ or $\sqrt{5}\approx1\div\frac{1789}{4000}$	M1
	$\sqrt{5}\approx\frac{1789}{800}$ or $\frac{4000}{1789}$	A1
		(2)
		(7 marks)

Question	Scheme	Marks
2(a)	$\left(1+4x^3\right)^{\frac{1}{3}}=1+\frac{1}{3}\left(\ldots x^{\cdots}\right)+\ldots$	M1
	$\left(1+4x^3\right)^{\frac{1}{3}}=\ldots+\frac{\frac{1}{3}\left(-\frac{2}{3}\right)}{2}\left(4x^3\right)^2+\ldots$	M1
	$=1+\frac{4}{3}x^3+\ldots$ or $=\ldots-\frac{16}{9}x^6$	A1
	$\left(1+4x^3\right)^{\frac{1}{3}}=1+\frac{4}{3}x^3-\frac{16}{9}x^6+\ldots$	A1
		(4)
(b)	$1+4x^3=1+4\times\left(\frac{1}{3}\right)^3=\frac{31}{\ldots}$ **or** $1+\frac{4}{3}\left(\frac{1}{3}\right)^3-\frac{16}{9}\left(\frac{1}{3}\right)^6$	M1
	$\sqrt[3]{31}\approx 3\times\left(1+\frac{4}{3}\left(\frac{1}{3}\right)^3-\frac{16}{9}\left(\frac{1}{3}\right)^6\right)$	dM1
	$=\frac{6869}{2187}$	A1
		(3)
		(7 marks)
Notes:		

Question Number	Scheme	Marks
1(a)	$(8-3x)^{-\frac{1}{3}}=\frac{1}{2}\left(1-\frac{3}{8}x\right)^{-\frac{1}{3}}$	B1
	$\left(1-\frac{3}{8}x\right)^{-\frac{1}{3}}=1+\left(-\frac{1}{3}\right)\left(-\frac{3}{8}x\right)+\frac{-\frac{1}{3}\left(-\frac{1}{3}-1\right)}{2!}\left(-\frac{3}{8}x\right)^2+\frac{-\frac{1}{3}\left(-\frac{1}{3}-1\right)\left(-\frac{1}{3}-2\right)}{3!}\left(-\frac{3}{8}x\right)^3+\ldots$	M1
	$(8-3x)^{-\frac{1}{3}}=\frac{1}{2}+\frac{1}{16}x+\frac{1}{64}x^2+\frac{7}{1536}x^3+\ldots$	A1 A1
		(4)
(b)	$\frac{1}{2}+\frac{1}{16}\left(\frac{2}{3}\right)+\frac{1}{64}\left(\frac{2}{3}\right)^2+\frac{7}{1536}\left(\frac{2}{3}\right)^3+\ldots=\frac{2851}{5184}\Rightarrow\sqrt[3]{6}=\left(\frac{2851}{5184}\right)^{-1}=\ldots$	M1
	$=\frac{5184}{2851}$ or $1\frac{2333}{2851}$	A1
		(2)
		Total 6

Question Number	Scheme	Marks
1(a)	$(8-3x)^{-\frac{1}{3}}=\frac{1}{2}\left(1-\frac{3}{8}x\right)^{-\frac{1}{3}}$	B1
	$\left(1-\frac{3}{8}x\right)^{-\frac{1}{3}}=1+\left(-\frac{1}{3}\right)\left(-\frac{3}{8}x\right)+\frac{-\frac{1}{3}\left(-\frac{1}{3}-1\right)}{2!}\left(-\frac{3}{8}x\right)^2+\frac{-\frac{1}{3}\left(-\frac{1}{3}-1\right)\left(-\frac{1}{3}-2\right)}{3!}\left(-\frac{3}{8}x\right)^3+\dots$	M1
	$(8-3x)^{-\frac{1}{3}}=\frac{1}{2}+\frac{1}{16}x+\frac{1}{64}x^2+\frac{7}{1536}x^3+\dots$	A1 A1
		(4)
(b)	$\frac{1}{2}+\frac{1}{16}\left(\frac{2}{3}\right)+\frac{1}{64}\left(\frac{2}{3}\right)^2+\frac{7}{1536}\left(\frac{2}{3}\right)^3+\dots=\frac{2851}{5184}\Rightarrow\sqrt[3]{6}=\left(\frac{2851}{5184}\right)^{-1}=\dots$	M1
	$=\frac{5184}{2851}$ or $1\frac{2333}{2851}$	A1
		(2)
		Total 6

Question Number	Scheme	Marks
2(a)	$4^{-\frac{1}{2}}$ or $\frac{1}{4^{\frac{1}{2}}}$ or $\frac{1}{2}$	B1
	$(4-5x)^{-\frac{1}{2}}=\frac{1}{2}\left(1-\frac{5x}{4}\right)^{-\frac{1}{2}}$	
	$=\dots\left(1+\left(-\frac{1}{2}\right)\times\left(-\frac{5x}{4}\right)+\frac{\left(-\frac{1}{2}\right)\times\left(-\frac{3}{2}\right)}{2!}\times\left(-\frac{5x}{4}\right)^2+\dots\right)$	M1A1
	$=\frac{1}{2}+\frac{5}{16}x+\frac{75}{256}x^2+\dots$	A1
		(4)
	$\frac{2+kx}{(2-3x)^3}=(2+kx)\left(\frac{1}{2}+\frac{5}{16}x+\frac{75}{256}x^2+\dots\right)$	
(b)	Compares x terms leading to $k=$ .... E.g. $\frac{10}{16}+\frac{k}{2}=\frac{3}{10}\Rightarrow k=-\frac{13}{20}$	M1 A1
		(2)
(c)	Compares x^2 terms leading to $m=$ ... E.g. $m=\frac{75}{128}+\frac{5}{16}\times\text{'}-\frac{13}{20}\text{'}\Rightarrow m=\frac{49}{128}$	M1 A1
		(2)
		(8 marks)
Alt (a)	$4^{-\frac{1}{2}}$ or $\frac{1}{4^{\frac{1}{2}}}$	B1
	$(4-5x)^{-\frac{1}{2}}=4^{-\frac{1}{2}}+\left(-\frac{1}{2}\right)4^{-\frac{3}{2}}(-5x)+\frac{-\frac{1}{2}\times-\frac{3}{2}}{2}4^{-\frac{5}{2}}(-5x)^2$	M1A1
	$=\frac{1}{2}+\frac{5}{16}x+\frac{75}{256}x^2+\dots$	A1
		(4)

Question	Scheme	Marks
1	$(1-4x)^{-3}=1\underline{\pm3}\times4x\pm\underline{\frac{-3\times-4}{2}}(\ldots x)^2\pm\underline{\frac{-3\times-4\times-5}{6}}(\ldots x)^3+\ldots$	**M1**
	$(1-4x)^{-3}=1+3\times4x+\frac{-3\times-4}{2}(-4x)^2+\frac{-3\times-4\times-5}{6}(-4x)^3+\ldots$	**A1**
	$=1+12x+96x^2+640x^3+\ldots$	**A1A1**
		(4)
		(4 marks)

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

Question Number	Scheme	Marks
1(a)	$(8-3x)^{-\frac{1}{3}}=\frac{1}{2}\left(1-\frac{3}{8}x\right)^{-\frac{1}{3}}$	B1
	$\left(1-\frac{3}{8}x\right)^{-\frac{1}{3}}=1+\left(-\frac{1}{3}\right)\left(-\frac{3}{8}x\right)+\frac{-\frac{1}{3}\left(-\frac{1}{3}-1\right)}{2!}\left(-\frac{3}{8}x\right)^2+\frac{-\frac{1}{3}\left(-\frac{1}{3}-1\right)\left(-\frac{1}{3}-2\right)}{3!}\left(-\frac{3}{8}x\right)^3+\ldots$	M1
	$(8-3x)^{-\frac{1}{3}}=\frac{1}{2}+\frac{1}{16}x+\frac{1}{64}x^2+\frac{7}{1536}x^3+\ldots$	A1 A1
		(4)
(b)	$\frac{1}{2}+\frac{1}{16}\left(\frac{2}{3}\right)+\frac{1}{64}\left(\frac{2}{3}\right)^2+\frac{7}{1536}\left(\frac{2}{3}\right)^3+\ldots=\frac{2851}{5184}\Rightarrow\sqrt[3]{6}=\left(\frac{2851}{5184}\right)^{-1}=\ldots$	M1
	$=\frac{5184}{2851}$ or $1\frac{2333}{2851}$	A1
		(2)
		Total 6

Question Number	Scheme	Marks
4(a)	$\frac{1}{\sqrt{4-x^2}}=\left(4-x^2\right)^{-\frac{1}{2}}=4^{-\frac{1}{2}}\left(1-...\right)$	B1
	$\left(1-\frac{1}{4}x^2\right)^{-\frac{1}{2}}=1+\left(-\frac{1}{2}\right)\left(-\frac{1}{4}x^2\right)+\frac{\left(-\frac{1}{2}\right)\times\left(-\frac{3}{2}\right)}{2}\left(-\frac{1}{4}x^2\right)^2+\frac{\left(-\frac{1}{2}\right)\times\left(-\frac{3}{2}\right)\times\left(-\frac{5}{2}\right)}{3!}\left(-\frac{1}{4}x^2\right)^3$	M1, A1
	$\frac{1}{\sqrt{4-x^2}}=\frac{1}{2}+\frac{1}{16}x^2+\frac{3}{256}x^4+\frac{5}{2048}x^6$	A1, A1
		(5)
(b)	$\lvert x\rvert<2$	B1
		(1)
(c)	Substitutes an appropriate value of x in both sides with LHS in terms of $\sqrt{3}$	M1
	E.g. with $x=1$ $\sqrt{3}=\frac{2048}{1181}$ or $\frac{3543}{2048}$	A1
		(2)
		(8 marks)