General Binomial Expansion Exam Questions Sheet 2

Q1.

Question Number	Scheme	Marks
	$(2+3x)^{-3} = \underline{(2)^{-3}}\left(1+\frac{3x}{2}\right)^{-3} = \underline{\frac{1}{8}}\left(1+\frac{3x}{2}\right)^{-3}$ $\underline{(2)^{-3}}$ or $\underline{\frac{1}{8}}$	B1
	$=\left\{\frac{1}{8}\right\}\left[1+(-3)(kx)+\frac{(-3)(-4)}{2!}(kx)^2+\frac{(-3)(-4)(-5)}{3!}(kx)^3+\ldots\right]$ see notes	M1 A1
	$=\left\{\frac{1}{8}\right\}\left[\underline{1+(-3)\left(\frac{3x}{2}\right)+\frac{(-3)(-4)}{2!}\left(\frac{3x}{2}\right)^2+\frac{(-3)(-4)(-5)}{3!}\left(\frac{3x}{2}\right)^3+\ldots}\right]$	
	$=\frac{1}{8}\left[1-\frac{9}{2}x;+\frac{27}{2}x^2-\frac{135}{4}x^3+\ldots\right]$ See notes below!	
	$=\frac{1}{8}-\frac{9}{16}x;+\frac{27}{16}x^2-\frac{135}{32}x^3+\ldots$	A1; A1
		[5] 5
	B1: $\underline{(2)^{-3}}$ or $\underline{\frac{1}{8}}$ outside brackets or $\underline{\frac{1}{8}}$ as constant term in the binomial expansion. **M1:** Expands $(\ldots+kx)^{-3}$ to give any 2 terms out of 4 terms simplified or un-simplified, Eg: $1+(-3)(kx)$ or $(-3)(kx)+\frac{(-3)(-4)}{2!}(kx)^2$ or $1+\ldots\ldots+\frac{(-3)(-4)}{2!}(kx)^2$ or $\frac{(-3)(-4)}{2!}(kx)^2+\frac{(-3)(-4)(-5)}{3!}(kx)^3$ **where** $k\neq 1$ are ok for M1. **A1:** A correct simplified or un-simplified $1+(-3)(kx)+\frac{(-3)(-4)}{2!}(kx)^2+\frac{(-3)(-4)(-5)}{3!}(kx)^3$ expansion with consistent (kx) where $k\neq 1$. *"Incorrect bracketing"* $\left\{\frac{1}{8}\right\}\left[\underline{1+(-3)\left(\frac{3x}{2}\right)+\frac{(-3)(-4)}{2!}\left(\frac{3x^2}{2}\right)+\frac{(-3)(-4)(-5)}{3!}\left(\frac{3x^3}{2}\right)+\ldots}\right]$ is M1A0 unless recovered. **A1:** For $\frac{1}{8}-\frac{9}{16}x$ **(simplified fractions)** or also allow $0.125-0.5625x$. **Allow Special Case A1 for either SC:** $\frac{1}{8}\left[1-\frac{9}{2}x;\ldots\right]$ or SC: $K\left[1-\frac{9}{2}x+\frac{27}{2}x^2-\frac{135}{4}x^3+\ldots\right]$ (where K can be 1 or omitted), with each term in the [.........] either a simplified fraction or a decimal. **A1:** Accept only $\frac{27}{16}x^2-\frac{135}{32}x^3$ or $1\frac{11}{16}x^2-4\frac{7}{32}x^3$ or $1.6875x^2-4.21875x^3$	
ctd	Candidates who write $=\frac{1}{8}\left[1+(-3)\left(-\frac{3x}{2}\right)+\frac{(-3)(-4)}{2!}\left(-\frac{3x}{2}\right)^2+\frac{(-3)(-4)(-5)}{3!}\left(-\frac{3x}{2}\right)^3+\ldots\right]$ where $k=-\frac{3}{2}$ and not $\frac{3}{2}$ and achieve $\frac{1}{8}+\frac{9}{16}x+\frac{27}{16}x^2+\frac{135}{32}x^3+\ldots$ will get B1M1A1A0A0. ***Alternative method:*** Candidates can apply an alternative form of the binomial expansion. $(2+3x)^{-3} = (2)^{-3}+(-3)(2)^{-4}(3x)+\frac{(-3)(-4)}{2!}(2)^{-5}(3x)^2+\frac{(-3)(-4)(-5)}{3!}(2)^{-6}(3x)^3$ **B1:** $\frac{1}{8}$ or $(2)^{-3}$ **M1:** Any two of four (un-simplified) terms correct. **A1:** All four (un-simplified) terms correct. **A1:** $\frac{1}{8}-\frac{9}{16}x$ **A1:** $+\frac{27}{16}x^2-\frac{135}{32}x^3$ **Note:** The terms in C need to be evaluated, so ${}^{-3}C_0(2)^{-3}+{}^{-3}C_1(2)^{-4}(3x)+{}^{-3}C_2(2)^{-5}(3x)^2+{}^{-3}C_3(2)^{-6}(3x)^3$ without further working is B0M0A0.	

Q2.

Question Number	Scheme		Marks
	$\left\{(1+kx)^{-4} = 1 + (-4)(kx) + \frac{(-4)(-4-1)}{2!}(kx)^2 + ...\right\}$		
(a)	**Either** $(-4)k = -6$ **or** $(1+kx)^{-4} = 1 + (-4)(kx)$	**see notes**	M1
	leading to $k = \frac{3}{2}$	$k = \frac{3}{2}$ or 1.5 or $\frac{6}{4}$	A1
			[2]
(b)	$\frac{(-4)(-5)}{2}(k)^2$	**Either** $\frac{(-4)(-5)}{2!}$ **or** $(k)^2$ **or** $(kx)^2$	M1
		Either $\frac{(-4)(-5)}{2!}(k)^2$ **or** $\frac{(-4)(-5)}{2!}(kx)^2$	M1
	$\left\{A = \frac{(-4)(-5)}{2!}\left(\frac{3}{2}\right)^2\right\} \Rightarrow A = \frac{45}{2}$	$\frac{45}{2}$ or 22.5	A1
			[3]
			5

		Question Notes
Note	**In this question ignore part labelling and mark part (a) and part (b) together.**	
	Note	Writing down $\{(1+kx)^{-4}\} = 1 + (-4)(kx) + \frac{(-4)(-4-1)}{2!}(kx)^2 + ...$ gets all the method marks in Q2. i.e. (a) M1 and (b) M1M1
(a)	M1	Award M1 for • either writing down $(-4)k = -6$ or $4k = 6$ • or expanding $(1+kx)^{-4}$ to give $1 + (-4)(kx)$ • or writing down $(-4)kx = -6$ or $(-4k) = -6x$ or $-4kx = -6x$
	A1	$k = \frac{3}{2}$ or 1.5 or $\frac{6}{4}$ **from no incorrect sign errors.**
	Note	The M1 mark can be implied by a candidate writing down the correct value of k.
	Note	Award M1 for writing down $4k = 6$ and then A1 for $k = 1.5$ (or equivalent).
	Note	Award M0 for $4k = -6$ (if there is no evidence that $(1+kx)^{-4}$ expands to give $1 + (-4)(kx) + ...$)
	Note	$1 + (-4)(kx)$ leading to $(-4)k = 6$ leading to $k = \frac{3}{2}$ is M1A0.
(b)	M1	For either $\frac{(-4)(-4-1)}{2!}$ or $\frac{(-4)(-5)}{2!}$ or 10 or $(k)^2$ or $(kx)^2$
	M1	Either $\frac{(-4)(-4-1)}{2!}(k)^2$ or $\frac{(-4)(-5)}{2!}(k)^2$ or $\frac{(-4)(-5)}{2!}(kx)^2$ or $\frac{(-4)(-5)}{2!}(\text{their } k)^2$ or $10k^2$
	Note	Candidates are allowed to use 2 instead of 2!
	A1	Uses $k = 1.5$ to give $A = \frac{45}{2}$ or 22.5
	Note	$A = \frac{90}{4}$ which has not been simplified is A0.
	Note	Award A0 for $A = \frac{45}{2}x^2$.
	Note	Allow A1 for $A = \frac{45}{2}x^2$ followed by $A = \frac{45}{2}$
	Note	$k = -1.5$ leading to $A = \frac{45}{2}$ or 22.5 is A0.

Q3.

Question Number	Scheme		Marks	
	$\mathrm{f}(x) = (\ \dots + \dots)^{-\frac{1}{2}}$		M1	
	$= 9^{-\frac{1}{2}}(\ \dots + \dots)^{-}$	3^{-1}, $\frac{1}{3}$ or $\frac{1}{9^{\frac{1}{2}}}$	B1	
	$(1+kx^2)^n = 1 + nkx^2 + \dots$	n not a natural number, $k \neq 1$	M1	
	$(1+kx^2)^{-\frac{1}{2}} = \dots + \frac{(-\frac{1}{2})(-\frac{3}{2})}{2}(kx^2)^2$	ft their $k \neq 1$	A1 ft	
	$\left(1+\frac{4}{9}x^2\right)^{-\frac{1}{2}} = 1 - \frac{2}{9}x^2 + \frac{2}{27}x^4$		A1	
	$\mathrm{f}(x) = \frac{1}{3} - \frac{2}{27}x^2 + \frac{2}{81}x^4$		A1	**(6)**
				[6]

Q4.

Question Number	Scheme		Marks
(a)	$\dfrac{1}{(2-5x)^2} = (2-5x)^{-2} = \underline{(2)^{-2}}\left(1-\dfrac{5x}{2}\right)^{-2} = \underline{\dfrac{1}{4}}\left(1-\dfrac{5x}{2}\right)^{-2}$	$\underline{(2)^{-2}}$ or $\underline{\dfrac{1}{4}}$	B1
	$=\left\{\dfrac{1}{4}\right\}\left[1+(-2)(**x)+\dfrac{(-2)(-3)}{2!}(**x)^2+\dots\right]$	see notes	M1 A1ft
	$=\left\{\dfrac{1}{4}\right\}\left[\underline{1+(-2)\left(-\dfrac{5x}{2}\right)+\dfrac{(-2)(-3)}{2!}\left(-\dfrac{5x}{2}\right)^2+\dots}\right]$		
	$=\dfrac{1}{4}\left[1+5x;+\dfrac{75}{4}x^2+\dots\right]$	See notes below!	
	$=\dfrac{1}{4}+\dfrac{5}{4}x;+\dfrac{75}{16}x^2+\dots$		A1; A1
			[5]
(b)	$\left\{\dfrac{2+kx}{(2-5x)^2}\right\} = (2+kx)\left(\dfrac{1}{4}+\dfrac{5}{4}x+\left\{\dfrac{75}{16}x^2+\dots\right\}\right)$	*Can be implied by later work even in part (c).*	M1
	x terms: $\dfrac{2(5x)}{4}+\dfrac{kx}{4}=\dfrac{7x}{4}$		
	giving, $10+k=7 \Rightarrow \underline{k=-3}$	$\underline{k=-3}$	A1
			[2]
(c)	x^2 terms: $\dfrac{150x^2}{16}+\dfrac{5kx^2}{4}$		M1
	So, $A=\dfrac{75}{8}+\dfrac{5(-3)}{4} = \dfrac{75}{8}-\dfrac{15}{4} = \underline{\dfrac{45}{8}}$	$\underline{\dfrac{45}{8}}$ or $\underline{5\dfrac{5}{8}}$ or $\underline{5.625}$	A1
			[2]
			9

Q5.

Question Number	Scheme		Marks
(a)	$\left\{\sqrt[3]{(8-9x)}\right\} = (8-9x)^{\frac{1}{3}}$	Power of $\frac{1}{3}$	M1
	$= \underline{(8)^{\frac{1}{3}}}\left(1-\frac{9x}{8}\right)^{\frac{1}{3}} = \underline{2}\left(1-\frac{9x}{8}\right)^{\frac{1}{3}}$	$\underline{(8)^{\frac{1}{3}}}$ or $\underline{2}$	$\underline{\text{B1}}$
	$= \{2\}\left[1+\left(\frac{1}{3}\right)(kx)+\frac{(\frac{1}{3})(-\frac{2}{3})}{2!}(kx)^2+\frac{(\frac{1}{3})(-\frac{2}{3})(-\frac{5}{3})}{3!}(kx)^3+\dots\right]$	see notes	M1 A1
	$= \{2\}\left[\underline{1+\left(\frac{1}{3}\right)\left(\frac{-9x}{8}\right)+\frac{(\frac{1}{3})(-\frac{2}{3})}{2!}\left(\frac{-9x}{8}\right)^2+\frac{(\frac{1}{3})(-\frac{2}{3})(-\frac{5}{3})}{3!}\left(\frac{-9x}{8}\right)^3}+\dots\right]$		
	$= 2\left[1-\frac{3}{8}x;-\frac{9}{64}x^2-\frac{45}{512}x^3+\dots\right]$	See notes below!	
	$= 2-\frac{3}{4}x;-\frac{9}{32}x^2-\frac{45}{256}x^3+\dots$		A1; A1
			[6]
(b)	$\left\{\sqrt[3]{7100} = 10\sqrt[3]{71} = 10\sqrt[3]{(8-9x)},\right\}$ so $x = 0.1$	Writes down or uses $x = 0.1$	B1
	When $x = 0.1$, $\sqrt[3]{(8-9x)} \approx 2-\frac{3}{4}(0.1)-\frac{9}{32}(0.1)^2-\frac{45}{256}(0.1)^3+\dots$		M1
	$= 2-0.075-0.0028125-0.00017578125$		
	$= 1.922011719$		
	So, $\sqrt[3]{7100} = 19.220117919\dots = \underline{19.2201}$ (4 dp)	19.2201 cso	A1 cao
			[3]
			9

Notes for Question

(a)	**M1:** Writes or uses $\frac{1}{3}$. This mark can be implied by a constant term of $8^{\frac{1}{3}}$ or 2.
	$\underline{\textbf{B1}}$: $\underline{(8)^{\frac{1}{3}}}$ or $\underline{2}$ outside brackets or $\underline{2}$ as candidate's constant term in their binomial expansion.
	M1: Expands $(\dots+kx)^{\frac{1}{3}}$ to give any 2 terms out of 4 terms simplified or un-simplified,
	Eg: $1+\left(\frac{1}{3}\right)(kx)$ or $\frac{(\frac{1}{3})(-\frac{2}{3})}{2!}(kx)^2+\frac{(\frac{1}{3})(-\frac{2}{3})(-\frac{5}{3})}{3!}(kx)^3$ or $1+\dots\dots+\frac{(\frac{1}{3})(-\frac{2}{3})}{2!}(kx)^2$
	or $\frac{(\frac{1}{3})(-\frac{2}{3})}{2!}(kx)^2+\frac{(\frac{1}{3})(-\frac{2}{3})(-\frac{5}{3})}{3!}(kx)^3$ where $k \neq 1$ are fine for M1.
	A1: A correct simplified or un-simplified $1+\left(\frac{1}{3}\right)(kx)+\frac{(\frac{1}{3})(-\frac{2}{3})}{2!}(kx)^2+\frac{(\frac{1}{3})(-\frac{2}{3})(-\frac{5}{3})}{3!}(kx)^3$ expansion with consistent (kx). Note that (kx) must be consistent (on the RHS, not necessarily the LHS) in a candidate's expansion. Note that $k \neq 1$.
	You would award B1M1A0 for $2\left[\underline{1+\left(\frac{1}{3}\right)\left(\frac{-9x}{8}\right)+\frac{(\frac{1}{3})(-\frac{2}{3})}{2!}(-9x)^2+\frac{(\frac{1}{3})(-\frac{2}{3})(-\frac{5}{3})}{3!}\left(\frac{-9x}{8}\right)^3}+\dots\right]$ because (kx) is not consistent.

Notes for Question Continued

(a) ctd

"Incorrect bracketing" $=\{2\}\left[1+\left(\frac{1}{3}\right)\left(\frac{-9x}{8}\right)+\frac{(\frac{1}{3})(-\frac{2}{3})}{2!}\left(\frac{-9x^2}{8}\right)+\frac{(\frac{1}{3})(-\frac{2}{3})(-\frac{5}{3})}{3!}\left(\frac{-9x^3}{8}\right)+\ldots\right]$

is M1A0 unless recovered.

A1: For $2-\frac{3}{4}x$ **(simplified please)** or also allow $2-0.75x$.

Allow Special Case A1A0 for either SC: $=2\left[1-\frac{3}{8}x;\ \ldots\right]$ **or** SC: $K\left[1-\frac{3}{8}x-\frac{9}{64}x^2-\frac{45}{512}x^3+\ldots\right]$

(where K can be 1 or omitted), with each term in the [.........] either a simplified fraction or a decimal.

A1: Accept only $-\frac{9}{32}x^2-\frac{45}{256}x^3$ or $-0.28125x^2-0.17578125x^3$

Candidates who write $=2\left[1+\left(\frac{1}{3}\right)\left(\frac{9x}{8}\right)+\frac{(\frac{1}{3})(-\frac{2}{3})}{2!}\left(\frac{9x}{8}\right)^2+\frac{(\frac{1}{3})(-\frac{2}{3})(-\frac{5}{3})}{3!}\left(\frac{9x}{8}\right)^3+\ldots\right]$ where $k=\frac{9}{8}$

and not $-\frac{9}{8}$ and achieve $2+\frac{3}{4}x;-\frac{9}{32}x^2+\frac{45}{256}x^3+\ldots$ will get B1M1A1A0A0.

Note for final two marks:

$2\left[1-\frac{3}{8}x;-\frac{9}{64}x^2-\frac{45}{512}x^3+\ldots\right]=2+\frac{3}{4}x-\frac{9}{32}x^2-\frac{45}{256}x^3+\ldots$ scores final A0A1.

$2\left[1-\frac{3}{8}x;-\frac{9}{64}x^2-\frac{45}{512}x^3+\ldots\right]=2-\frac{3}{4}-\frac{9}{32}x^2-\frac{45}{256}x^3+\ldots$ scores final A0A1

Alternative method: Candidates can apply an alternative form of the binomial expansion.

$\left\{\sqrt[3]{(8-9x)}\right\}=(8-9x)^{\frac{1}{3}}=(8)^{\frac{1}{3}}+\left(\frac{1}{3}\right)(8)^{-\frac{2}{3}}(-9x)+\frac{(\frac{1}{3})(-\frac{2}{3})}{2!}(8)^{-\frac{5}{3}}(-9x)^2+\frac{(\frac{1}{3})(-\frac{2}{3})(-\frac{5}{3})}{3!}(8)^{-\frac{8}{3}}(-9x)^3$

B1: $(8)^{\frac{1}{3}}$ or 2

M1: Any two of four (un-simplified or simplified) terms correct.

A1: All four (un-simplified or simplified) terms correct.

A1: $2-\frac{3}{4}x$

A1: $-\frac{9}{32}x^2-\frac{45}{256}x^3$

Note: The terms in C need to be evaluated,

so ${}^{\frac{1}{3}}C_0(8)^{\frac{1}{3}}+{}^{\frac{1}{3}}C_1(8)^{-\frac{2}{3}}(-9x)+{}^{\frac{1}{3}}C_2(8)^{-\frac{5}{3}}(-9x)^2+{}^{\frac{1}{3}}C_3(8)^{-\frac{8}{3}}(-9x)^3$ without further working is B0M0A0.

(b)

B1: Writes down or uses $x=0.1$

M1: Substitutes their x, where $|x|<\frac{8}{9}$ into at least two terms of their binomial expansion.

A1: 19.2201 **cao**

Be Careful! The binomial answer is 19.22011719

and the calculated $\sqrt[3]{7100}$ is 19.21997343... which is 19.2200 to 4 decimal places.

Q6.

Question Number	Scheme		Marks
(a)	$\left\{\frac{1}{\sqrt{(9-10x)}} = \right\} (9-10x)^{-\frac{1}{2}}$	$(9-10x)^{-\frac{1}{2}}$ or uses power of $-\frac{1}{2}$	B1
	$= \underline{(9)^{-\frac{1}{2}}}\left(1-\frac{10x}{9}\right)^{-\frac{1}{2}} = \underline{\frac{1}{3}}\left(1-\frac{10x}{9}\right)^{-\frac{1}{2}}$	$\underline{(9)^{-\frac{1}{2}}}$ or $\underline{\frac{1}{3}}$	<u>B1</u>
	$= \left\{\frac{1}{3}\right\}\left[1 + \left(-\frac{1}{2}\right)(kx) + \frac{(-\frac{1}{2})(-\frac{3}{2})}{2!}(kx)^2 + \ldots\right]$	At least two correct terms. **See notes**	M1
	$= \left\{\frac{1}{3}\right\}\left[1 + \left(-\frac{1}{2}\right)\left(\frac{-10x}{9}\right) + \frac{(-\frac{1}{2})(-\frac{3}{2})}{2!}\left(\frac{-10x}{9}\right)^2 + \ldots\right]$		
	$= \frac{1}{3}\left[1 + \frac{5}{9}x + \frac{25}{54}x^2 + \ldots\right]$		
	$= \frac{1}{3} + \frac{5}{27}x; + \frac{25}{162}x^2 + \ldots$		A1; A1
			[5]
(b)	$\frac{3+x}{\sqrt{(9-10x)}} = (3+x)(9-10x)^{-\frac{1}{2}}$		
	$= (3+x)\left(\frac{1}{3} + \frac{5}{27}x + \left\{\frac{25}{162}x^2 + \right\}\ldots\right)$	*Can be implied by later work* **See notes**	M1
	$= 1 + \frac{5}{9}x + \frac{25}{54}x^2 + \frac{1}{3}x + \frac{5}{27}x^2 + \ldots$	Multiplies out to give exactly one constant term, exactly 2 terms in x and exactly 2 terms in x^2. Ignore terms in x^3. Can be implied.	M1
	$= 1 + \frac{8}{9}x + \frac{35}{54}x^2 + \ldots$		A1
			[3]

Q7.

Question Number	Scheme		Marks
(a)	$\left\{\sqrt{\left(\frac{1+x}{1-x}\right)}\right\} = (1+x)^{\frac{1}{2}}(1-x)^{-\frac{1}{2}}$	$(1+x)^{\frac{1}{2}}(1-x)^{-\frac{1}{2}}$	B1
	$= \left(1+\left(\frac{1}{2}\right)x+\frac{(\frac{1}{2})(-\frac{1}{2})}{2!}x^2+\ldots\right)\times\left(1+\left(-\frac{1}{2}\right)(-x)+\frac{(-\frac{1}{2})(-\frac{3}{2})}{2!}(-x)^2+\ldots\right)$	See notes	M1 A1 A1
	$= \left(1+\frac{1}{2}x-\frac{1}{8}x^2+\ldots\right)\times\left(1+\frac{1}{2}x+\frac{3}{8}x^2+\ldots\right)$		
	$= 1+\frac{1}{2}x+\frac{3}{8}x^2+\frac{1}{2}x+\frac{1}{4}x^2-\frac{1}{8}x^2+\ldots$	See notes	M1
	$= 1+x+\frac{1}{2}x^2$	*Answer is given in the question.*	A1 *
			[6]
(b)	$\sqrt{\left(\frac{1+(\frac{1}{26})}{1-(\frac{1}{26})}\right)} = 1+\left(\frac{1}{26}\right)+\frac{1}{2}\left(\frac{1}{26}\right)^2$		M1
	ie: $\frac{3\sqrt{3}}{5} = \frac{1405}{1352}$		B1
	so, $\sqrt{3} = \frac{7025}{4056}$	$\frac{7025}{4056}$	A1 cao
			[3]
			9

Q8.

Question Number	Scheme		Marks
	** represents a constant (which must be consistent for first accuracy mark)		
(a)	$(8-3x)^{\frac{1}{3}} = \underline{(8)^{\frac{1}{3}}}\left(1-\frac{3x}{8}\right)^{\frac{1}{3}} = \underline{2}\left(1-\frac{3x}{8}\right)^{\frac{1}{3}}$	Takes 8 outside the bracket to give any of $\underline{(8)^{\frac{1}{3}}}$ or $\underline{2}$.	B1
	$= 2\left\{\underline{1+(\tfrac{1}{3})(**x); + \frac{(\frac{1}{3})(-\frac{2}{3})}{2!}(**x)^2 + \frac{(\frac{1}{3})(-\frac{2}{3})(-\frac{5}{3})}{3!}(**x)^3 + ...}\right\}$	Expands $(1+**x)^{\frac{1}{3}}$ to give a simplified or an un-simplified $1+(\frac{1}{3})(**x)$;	M1;
	with $** \neq 1$	A correct simplified or an un-simplified $\{\underline{.........}\}$ expansion with candidate's followed through $(**x)$	A1 $\sqrt{}$
	$= 2\left\{\underline{1+(\tfrac{1}{3})(-\tfrac{3x}{8}) + \frac{(\frac{1}{3})(-\frac{2}{3})}{2!}(-\tfrac{3x}{8})^2 + \frac{(\frac{1}{3})(-\frac{2}{3})(-\frac{5}{3})}{3!}(-\tfrac{3x}{8})^3 + ...}\right\}$	Award SC M1 if you see $\frac{(\frac{1}{3})(-\frac{2}{3})}{2!}(**x)^2 + \frac{(\frac{1}{3})(-\frac{2}{3})(-\frac{5}{3})}{3!}(**x)^3$	
	$= 2\{1 - \tfrac{1}{8}x; - \tfrac{1}{64}x^2 - \tfrac{5}{1536}x^3 - ...\}$	Either $2\{1-\frac{1}{8}x\ ....\}$ or anything that cancels to $2-\frac{1}{4}x$;	A1;
	$= 2 - \frac{1}{4}x; - \frac{1}{32}x^2 - \frac{5}{768}x^3 - ...$	Simplified $-\frac{1}{32}x^2 - \frac{5}{768}x^3$	A1
			[5]
(b)	$(7.7)^{\frac{1}{3}} \approx 2 - \frac{1}{4}(0.1) - \frac{1}{32}(0.1)^2 - \frac{5}{768}(0.1)^3 - ...$	*Attempt to substitute* $x = 0.1$ into a candidate's binomial expansion.	M1
	$= 2 - 0.025 - 0.0003125 - 0.0000065104166...$		
	$= 1.97468099...$	awrt 1.9746810	A1
			[2]
			7 marks

You would award B1M1A0 for

$= 2\left\{\underline{1+(\tfrac{1}{3})(-\tfrac{3x}{8}) + \frac{(\frac{1}{3})(-\frac{2}{3})}{2!}(-\tfrac{3x}{8})^2 + \frac{(\frac{1}{3})(-\frac{2}{3})(-\frac{5}{3})}{3!}(-3x)^3 + ...}\right\}$

because ** is not consistent.

If you see the constant term "2" in a candidate's final binomial expansion, then you can award B1.

Be wary of calculator value of $(7.7)^{\frac{1}{3}} = 1.974680822...$

Question Number	Scheme		Marks
Aliter (a) **Way 2**	$(8-3x)^{\frac{1}{3}}$		
		2 or $(8)^{\frac{1}{3}}$ (**See note** ↓)	B1
	$=\left\{(8)^{\frac{1}{3}}+(\tfrac{1}{3})(8)^{-\frac{2}{3}}(**x);+\frac{(\frac{1}{3})(-\frac{2}{3})}{2!}(8)^{-\frac{5}{3}}(**x)^2 + \frac{(\frac{1}{3})(-\frac{2}{3})(-\frac{5}{3})}{3!}(8)^{-\frac{8}{3}}(**x)^3+\ldots\right\}$	Expands $(8-3x)^{\frac{1}{3}}$ to give an un-simplified or simplified $(8)^{\frac{1}{3}}+(\frac{1}{3})(8)^{-\frac{2}{3}}(**x)$;	M1;
	with $**\neq 1$	A correct un-simplified or simplified $\{\ldots\ldots\}$ expansion with candidate's followed through $(**x)$	A1 √
	$=\left\{(8)^{\frac{1}{3}}+(\tfrac{1}{3})(8)^{-\frac{2}{3}}(-3x);+\frac{(\frac{1}{3})(-\frac{2}{3})}{2!}(8)^{-\frac{5}{3}}(-3x)^2 + \frac{(\frac{1}{3})(-\frac{2}{3})(-\frac{5}{3})}{3!}(8)^{-\frac{8}{3}}(-3x)^3+\ldots\right\}$	Award SC M1 if you see $\frac{(\frac{1}{3})(-\frac{2}{3})}{2!}(8)^{-\frac{5}{3}}(**x)^2 + \frac{(\frac{1}{3})(-\frac{2}{3})(-\frac{5}{3})}{3!}(8)^{-\frac{8}{3}}(**x)^3$	
	$=\left\{2+(\tfrac{1}{3})(\tfrac{1}{4})(-3x)+(-\tfrac{1}{9})(\tfrac{1}{32})(9x^2)+(\tfrac{5}{81})(\tfrac{1}{256})(-27x^3)+\ldots\right\}$		
	$=2-\frac{1}{4}x;-\frac{1}{32}x^2-\frac{5}{768}x^3-\ldots$	Anything that cancels to $2-\frac{1}{4}x$; or $2\{1-\frac{1}{8}x\ \ldots\ldots\}$	A1;
		Simplified $-\frac{1}{32}x^2-\frac{5}{768}x^3$	A1
			[5]

Be wary of calculator value of $(7.7)^{\frac{1}{3}}=1.974680822\ldots$

If you see the constant term "2" in a candidate's final binomial expansion, then you can award B1.

Q9.

Question Number	Scheme		Marks	
	(a) $A=2$		B1	
	$2x^2+5x-10=A(x-1)(x+2)+B(x+2)+C(x-1)$			
	$x\to 1$ $\quad -3=3B \Rightarrow B=-1$		M1 A1	
	$x\to -2$ $\quad -12=-3C \Rightarrow C=4$		A1	**(4)**
	(b) $\dfrac{2x^2+5x-10}{(x-1)(x+2)}=2+(1-x)^{-1}+2\left(1+\dfrac{x}{2}\right)^{-1}$		M1	
	$(1-x)^{-1}=1+x+x^2+\ldots$		B1	
	$\left(1+\dfrac{x}{2}\right)^{-1}=1-\dfrac{x}{2}+\dfrac{x^2}{4}+\ldots$		B1	
	$\dfrac{2x^2+5x-10}{(x-1)(x+2)}=(2+1+2)+(1-1)x+\left(1+\dfrac{1}{2}\right)x^2+\ldots$		M1	
	$=5+\ldots$	ft their $A-B+\frac{1}{2}C$	A1 ft	
	$=\ldots+\dfrac{3}{2}x^2+\ldots$	$0x$ stated or implied	A1 A1	**(7)**
				[11]

Q10.

Question	Scheme	Marks	AOs
(a)(i)	$50x^2+38x+9 \equiv A(5x+2)(1-2x)+B(1-2x)+C(5x+2)^2$ $\Rightarrow B=...$ or $C=...$	M1	1.1b
	$B=1$ and $C=2$	A1	1.1b
(a)(ii)	E.g. $x=0$ $x=0 \Rightarrow 9=2A+B+4C$ $\Rightarrow 9=2A+1+8 \Rightarrow A=...$	M1	2.1
	$A=0$*	A1*	1.1b
		(4)	
(b)(i)	$\frac{1}{(5x+2)^2}=(5x+2)^{-2}=2^{-2}\left(1+\frac{5}{2}x\right)^{-2}$ or $(5x+2)^{-2}=2^{-2}+...$	M1	3.1a
	$\left(1+\frac{5}{2}x\right)^{-2}=1-2\left(\frac{5}{2}x\right)+\frac{-2(-2-1)}{2!}\left(\frac{5}{2}x\right)^2+...$	M1	1.1b
	$2^{-2}\left(1+\frac{5}{2}x\right)^{-2}=\frac{1}{4}-\frac{5}{4}x+\frac{75}{16}x^2+...$	A1	1.1b
	$\frac{1}{(1-2x)}=(1-2x)^{-1}=1+2x+\frac{-1(-1-1)}{2!}(2x)^2+.$	M1	1.1b
	$\frac{1}{(5x+2)^2}+\frac{2}{1-2x}=\frac{1}{4}-\frac{5}{4}x+\frac{75}{16}x^2+...+2+4x+8x^2+...$	dM1	2.1
	$=\frac{9}{4}+\frac{11}{4}x+\frac{203}{16}x^2+...$	A1	1.1b
(b)(ii)	$\|x\|<\frac{2}{5}$	B1	2.2a
		(7)	
			(11 marks)
	Notes		