Question	Scheme	Marks	AOs
2(a)	$\dfrac{\frac{1}{2}\left(\frac{1}{2}-1\right)}{2!}(\pm 9x)^2$ or $\dfrac{\frac{1}{2}\left(\frac{1}{2}-1\right)\left(\frac{1}{2}-2\right)}{3!}(-9x)^3$	M1	1.1b
	$(1-9x)^{\frac{1}{2}} = 1+\dfrac{1}{2}(-9x)+\dfrac{\frac{1}{2}\left(\frac{1}{2}-1\right)}{2!}(\pm 9x)^2+\dfrac{\frac{1}{2}\left(\frac{1}{2}-1\right)\left(\frac{1}{2}-2\right)}{3!}(-9x)^3$	A1	1.1b
	$(1-9x)^{\frac{1}{2}} = 1-\dfrac{9}{2}x-\dfrac{81}{8}x^2-\dfrac{729}{16}x^3$	A1	1.1b
		(3)	
(b)	Expansion is valid for $\lvert x\rvert < \dfrac{1}{9}$ and $x=-\dfrac{2}{9}$ **is outside this range.**	B1	2.4
		(1)	
		(4 marks)	

Notes

(a)

M1: For an attempt at the binomial expansion with $n=\dfrac{1}{2}$ and obtains the correct structure for term 3 **or** term 4. Award for the correct coefficient with the correct power of x.

e.g. $\dfrac{\left(\frac{1}{2}\right)\left(-\frac{1}{2}\right)}{2!}(\lambda x)^2$ **or** $\dfrac{\left(\frac{1}{2}\right)\left(-\frac{1}{2}\right)\left(-\frac{3}{2}\right)}{3!}(\lambda x)^3$ where $\lambda \neq 1$

Condone missing or incorrect brackets around the x terms but the binomial coefficients must be correct. Allow 2! and/or 3! or 2 and/or 6.

Do not allow notation such as $\begin{pmatrix}\frac{1}{2}\\1\end{pmatrix},\begin{pmatrix}\frac{1}{2}\\2\end{pmatrix}$ unless these are interpreted correctly.

A1: Correct unsimplified expression as shown but the bracketing must be correct unless any missing brackets are implied by subsequent work.
May be implied by a correct simplified expression.

OR allow this mark for at least 2 correct simplified terms from $-\dfrac{9}{2}x, -\dfrac{81}{8}x^2$ and $-\dfrac{729}{16}x^3$

A1: $1-\dfrac{9}{2}x-\dfrac{81}{8}x^2-\dfrac{729}{16}x^3$ or simplified equivalent. Correct answer with no working can score full marks. Ignore any extra terms and allow the terms to be listed or in a different order. Apply isw once a correct expansion is seen. Condone $+-$ (equivalent to listing).
Allow recovery if applicable e.g. if an "x" is lost then "reappears".
Allow decimal equivalents $1-4.5x-10.125x^2-45.5625x^3$ provided they are exact.
Allow mixed numbers $1-4\frac{1}{2}x-10\frac{1}{8}x^2-45\frac{9}{16}x^3$

Note: You may see attempts via direct expansion, but these will be scored using the main scheme, ignoring absence of powers on the 1s. The below attempts both score first M1A1.
If you are unsure, send to review.

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

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

(b)

B1: Expansion is valid for $|x| < \frac{1}{9}$ or $|x| \leqslant \frac{1}{9}$ and $x = -\frac{2}{9}$ **is outside this range.**

Requires:

- an acceptable range of validity given
- an acceptable comparison of $-\frac{2}{9}$ **or** $\frac{2}{9}$ with their range leading to e.g. “not valid”.

Examples of acceptable alternatives include:

- (Valid for) $|9x| < 1$ or $|9x| \leqslant 1$ and as $9x = -2$ (the expansion is) not valid.
- (Valid for) $|x| < \frac{1}{9}$ or $|x| \leqslant \frac{1}{9}$ and as $\frac{2}{9} > \frac{1}{9}$ $\left(\text{or } -\frac{2}{9} < -\frac{1}{9}\right)$ the expansion is not valid.
- (Valid for) $-\frac{1}{9} < x < \frac{1}{9}$ and $x = -\frac{2}{9}$ is too small/big (condoned as minimally acceptable).
- (Series converges for) $|-9x| \leqslant 1$ and as $-9x = 2$ the series will diverge.
- (Valid for) $|x| < \frac{1}{9}$ but $\left|-\frac{2}{9}\right| > \frac{1}{9}$ so $-\frac{2}{9}$ cannot be used.

Do not accept vague statements such as "it is too big", "it is outside the range" without any mention of what the range is. $-\frac{2}{9} < -\frac{1}{9}$ alone is insufficient evidence (without any mention of what the range is) and scores B0.
An attempt to evaluate the expansion and compare with $\sqrt{3}$ is not acceptable on its own.