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)**

(a)

M1: Uses the binomial expansion with $n=-\frac{1}{2}$ to achieve correct binomial coefficients for terms 2 and 3 combined with the correct powers of *x*

Look for $1+\left(-\frac{1}{2}\right)(*x)+\frac{\left(-\frac{1}{2}\right)\times\left(-\frac{3}{2}\right)}{2}(*x)^2...$

or $1+\left(-\frac{1}{2}\right)(\pm 2x)+\frac{\left(-\frac{1}{2}\right)\left(-\frac{3}{2}\right)}{2!}(\pm 2x)^2$ condoning missing/invisible brackets.

If no intermediate form is seen award for $1\pm x\pm\frac{3}{2}x^2$

A1: Correct simplified or unsimplified expression for $(1-2x)^{-\frac{1}{2}}$.

The correct simplified form $1+x+\frac{3}{2}x^2$ scores M1, A1. Condone additional terms

dM1: Multiplies their binomial expansion by $(2+3x)$. It is dependent upon the previous M.

Note that this is a proof with a given answer so individual terms must be seen, and not just the simplified expansion

Look for 4 correct terms of the 5 for their $(2+3x)(1+ax+bx^2+) = 2+2ax+2bx^2+3x+3ax^2+....$

A1*: $2+5x+6x^2$ Correct answer only and it must follow all M1, A1, dM1.

There must be no extra terms

(b)

M1: Sub $x = \frac{1}{20}$ into **both sides** of the given expression AND sets equal. Condone missing brackets.

So allow $\frac{2+3\times\frac{1}{20}}{\sqrt{1-2\times\frac{1}{20}}} = 2+5\times\frac{1}{20}+6\times\frac{1}{20}^{2}$

It is acceptable to have partially simplified or indeed simplified expressions.

E.g. $\frac{43/20}{\sqrt{9/10}} = \frac{453}{200}$ or $\frac{43\sqrt{10}}{60} = \frac{453}{200}$

dM1: For an allowable method of proceeding to an answer for $\sqrt{10}$ as a fraction

Examples of allowable methods are

- simplifying the lhs to $\frac{43\sqrt{10}}{60}$ and then multiplying their $\left(2+5\times\frac{1}{20}+6\times\frac{1}{20}^{2}\right)$ by $\frac{60}{43}$ o.e
- simplifying the lhs to $\frac{43}{6\sqrt{10}}$ o.e. and then dividing $\frac{43}{6}$ o.e by their $\left(2+5\times\frac{1}{20}+6\times\frac{1}{20}^{2}\right)$

A1: Accept $\sqrt{10} = \frac{1359}{430}$ or $\sqrt{10} = \frac{4300}{1359}$

Question Number	Scheme	Marks
5.	One of $\frac{dA}{dt}=\frac{\pi}{20}$, $\frac{dA}{dx}=2\pi x$, $\frac{dV}{dx}=18\pi x^2$	B1
	Two of $\frac{dA}{dt}=\frac{\pi}{20}$, $\frac{dA}{dx}=2\pi x$, $\frac{dV}{dx}=18\pi x^2$	B1
	All three of $\frac{dA}{dt}=\frac{\pi}{20}$, $\frac{dA}{dx}=2\pi x$, $\frac{dV}{dx}=18\pi x^2$	B1
Main	Full attempt to find $\frac{dV}{dt}$ E.g. $\frac{dV}{dt}=\frac{dV}{dx}\times\frac{dx}{dA}\times\frac{dA}{dt}=18\pi x^2\times\frac{1}{2\pi x}\times\frac{\pi}{20}$	M1
	Finds $\frac{dV}{dt}$ at $x=2\Rightarrow$ $\frac{dV}{dt}=18\pi 2^2\times\frac{1}{80}=\frac{9}{10}\pi$	dM1 A1 **(6 marks)**
	Note that the M1 may be found in two steps: E.g.I Finds $\frac{dx}{dt}$ from $\frac{dA}{dt}=\frac{dA}{dx}\times\frac{dx}{dt}$ followed by $\frac{dV}{dt}=\frac{dV}{dx}\times\frac{dx}{dt}$ E.g II Finds $\frac{dV}{dA}$ from $\frac{dV}{dx}=\frac{dV}{dA}\times\frac{dA}{dx}$ followed by $\frac{dV}{dt}=\frac{dV}{dA}\times\frac{dA}{dt}$	
Alt	$\frac{dA}{dt}=\frac{\pi}{20}$	B1
	$V=6\pi x^3, A=\pi x^2\Rightarrow V=6\pi\left(\frac{A}{\pi}\right)^{\frac{3}{2}}$ $\frac{dV}{dA}=9\left(\frac{A}{\pi}\right)^{\frac{1}{2}}$	B1, B1
	$\frac{dV}{dt}=\frac{dV}{dA}\times\frac{dA}{dt}\Rightarrow\frac{dV}{dt}=9\left(\frac{A}{\pi}\right)^{\frac{1}{2}}\times\frac{\pi}{20}$	M1
	$x=2\Rightarrow A=4\pi$ $\Rightarrow \left.\frac{dV}{dt}\right\|_{A=4\pi}=\frac{9}{10}\pi$	dM1A1 **(6 marks)**

Main method:

Condone the use of other letters such as *S* for *A* or *r* for *x*

Ignore any reference to units

The marks have now changed in this question to B1, B1, B1, M1, dM1, A1

B1: States or uses one of $\frac{dA}{dt}=\frac{\pi}{20}$, $\frac{dA}{dx}=2\pi x$, $\frac{dV}{dx}=18\pi x^2$

B1: States or uses two of $\frac{dA}{dt}=\frac{\pi}{20}$, $\frac{dA}{dx}=2\pi x$, $\frac{dV}{dx}=18\pi x^2$

B1: States or uses all three of $\frac{dA}{dt}=\frac{\pi}{20}$, $\frac{dA}{dx}=2\pi x$, $\frac{dV}{dx}=18\pi x^2$

Note that the circumference of the circle is $2\pi x$. You should not be awarding B1 for sight of $2\pi x$ unless you can see it set equal to, or implied equal to $\frac{dA}{dx}$