Question	Scheme	Marks
8	$\int\left(18x^2-2x+13\right)\,\mathrm{d}x=\frac{18x^3}{3}-\frac{2x^2}{2}+13x(+c)$	M1A1
	$\mathrm{f}\left(\frac{1}{2}\right)=6\times\left(\frac{1}{2}\right)^3-\left(\frac{1}{2}\right)^2+13\times\left(\frac{1}{2}\right)+c=0\Rightarrow c=-7$	M1A1
	$\mathrm{f}(x)=6x^3-x^2+13x-7$ oe	A1
	$2x-1\overset{3x^2+x+7}{\overline{\left)6x^3-x^2+13x-7\right.}}$	M1A1
	$b^2-4ac=1^2-4\times3\times7=-83$	M1
	Conclusion: $b^2-4ac<0$ so there is only one root/intersection with the x-axis $\left[\text{at }\left(\frac{1}{2},0\right)\right]$	A1cso [9]
		Total 9 marks

Mark	Notes
M1	For integrating the given $\mathrm{f}'(x)$. $+c$ is not required for this mark This can be simplified or unsimplified. Accept $\frac{18x^3}{3}-\frac{2x^2}{2}+13x(+c)$ or $6x^3-x^2+13x(+c)$ At least two terms must be integrated correctly, with no differentiation.
A1	For the correct integrated expression. Ignore the absence of $+c$
M1	For substituting $x=\frac{1}{2}$ into their integrated expression (which must include +c, otherwise it is M0) and setting equal to 0. **ALT** Some candidates are completing this step using polynomial division. If they do not have $+c$ at this stage then it is M0. If it is clear they are attempting to find the value of c by finding a numerical value for c [even if it is incorrect], award both this mark and the next M mark provided they obtain a quotient of $3x^2+x+k$

A1	For the correct value of $c = -7$
A1	For the fully correct $\mathrm{f}\left(x\right)=6x^3-x^2+13x-7$ all on one line. You do not need to see f(x) = … Accept even when you see this as a complete dividend in the 'bus stop' or when equating coefficients.
M1	Polynomial division For dividing their f (x) by ($2x - 1$) to achieve as a minimum $3x^2+x$. Award this for correct attempts even without either + c or a value for c. Allow also: $\begin{array}{r} 6x^2+2x\ \left(+l\right) \\ x-\frac{1}{2}\overline{\smash{)}6x^3-x^2+13x-7} \end{array}$ [the correct quotient is $6x^2+2x+14$] **ALT** Equating coefficients. They must achieve a correct value for A and B for the award of this mark. $6x^3-x^2+13x-7=\left(2x-1\right)\left(Ax^2+Bx+C\right)\Rightarrow A=3,\quad B=1$ OR $6x^3-x^2+13x-7=\left(x-\frac{1}{2}\right)\left(Ax^2+Bx+C\right)\Rightarrow A=6,\quad B=2$
A1	For the correct quotient/quadratic factor $3x^2+x+7$ or $6x^2+2x+14$
M1	For using b^2-4ac on their f (x) which must be a 3TQ Accept this as part of the quadratic formula. Sight of the complex roots $\left(\frac{-1\pm\left(\sqrt{83}\right)\mathrm{i}}{6}\right)$ is M1 Allow this mark even if they do not have +c or find the correct cubic expression.
A1 **cso**	For concluding that as $b^2-4ac<0$ then there is only one root/intersection with the x-axis. Do not accept statements such as 'not possible' or 'will not factorise' without reference to a negative discriminant. Accept evidence of a statement such as $1^2<4\times3\times7\Rightarrow b^2<4ac$ oe, or embedded in a formula without explicit evaluation. Complex roots must be followed by a comment that as the roots are not real, there are no intersections with the x-axis. Quoting the complex roots without a correct explanation is A0. If they have not found +c at the start, this mark is not available as this solution is cso.