Question Number	Scheme	Marks
2. (i)	$\dfrac{3y^3\left(2x^4\right)^3}{4x^2y^4}=\dfrac{6x^{10}}{y}$	B1, B1, B1 **(3)**
(ii)	$\dfrac{16}{\sqrt{3}+1}=a\sqrt{27}+4$	
	States or uses $\sqrt{27}=3\sqrt{3}$	B1
	Correct attempt at rationalising seen e.g. $\dfrac{16}{\sqrt{3}+1}\times\dfrac{\sqrt{3}-1}{\sqrt{3}-1}$	M1
	Correct attempt to make "a" the subject and make progress towards the form $p\sqrt{3}+q$ e.g. $8\sqrt{3}-8=3a\sqrt{3}+4\Rightarrow 3a\sqrt{3}=8\sqrt{3}-12\Rightarrow a=\dfrac{8\sqrt{3}}{3\sqrt{3}}-\dfrac{12}{3\sqrt{3}}$	M1
	$a=-\dfrac{4}{3}\sqrt{3}+\dfrac{8}{3}$	A1cso
		(4) **(7 marks)**

(i)

B1: For any one of 6, x^{10} or $\dfrac{1}{y}$ Allow y^{-1} for $\dfrac{1}{y}$ - may be seen separately, and allow for one correctly simplified term even if a spurious extra term in the same variable is present.

B1: For any two of the above as the only term in that variable within a single expression. E.g. $2x^{10}\times\dfrac{3}{y}$ is fine for B1B1 but $2x^{10}+\dfrac{3}{y}$ is B1B0.

B1: For $\dfrac{6x^{10}}{y}$ or $6x^{10}y^{-1}$ - must be one expression. Allow with y^1 in the denominator.

(ii)

B1: States or uses $\sqrt{27}=3\sqrt{3}$. May be implied by working as long as it is seen before the final answer.

M1: Correct attempt at rationalisation seen anywhere. This can be on any expression with a two term surd expression in a denominator during their working. The denominator may be simplified without the multiplication being seen (and need not be correct), but the evidence of the process must be clear.

M1: Attempts to make "a" the subject and make progress towards the form $p\sqrt{3}+q$ $\left(p,q\neq 0\right)$ - must reach a two term expression for a (but may be over common denominator), though the $\sqrt{27}$ may not have been simplified. E.g. accept for $a=\dfrac{8\sqrt{3}-12}{\sqrt{27}}$. Can be scored if a calculator was used to rationalise the surd expression but there must be an intermediate step before their final answer to show the method.

A1cso: $a=-\frac{4}{3}\sqrt{3}+\frac{8}{3}$ but isw after a correct expression. Must have score all previous marks, showing the relevant steps as outline above before the final answer is given but condone if "invisible brackets" are recovered. Accept with terms in the other order, and allow $\frac{1}{3}\left(8-4\sqrt{3}\right)$

Note that there are many ways of attempting (b). The above scheme can still be applied
A common alternative method is;

$\frac{16}{\sqrt{3}+1}=a\sqrt{27}+4\Rightarrow 16=\left(a\sqrt{27}+4\right)\left(\sqrt{3}+1\right)=9a+4+4\sqrt{3}+3\sqrt{3}a$ for B1

$\Rightarrow 12-4\sqrt{3}=\left(9+3\sqrt{3}\right)a\Rightarrow a=\frac{12-4\sqrt{3}}{9+3\sqrt{3}}\times\frac{9-3\sqrt{3}}{9-3\sqrt{3}}$ for M1

$\Rightarrow a=\frac{144-72\sqrt{3}}{54}=-\frac{4}{3}\sqrt{3}+\frac{8}{3}$ for M1 A1

Notes: The B mark can be implied by working as long as it is seen before the final answer.
So, for example, $\frac{8\sqrt{3}+4}{\sqrt{27}}\times\frac{\sqrt{27}}{\sqrt{27}}=\frac{72+12\sqrt{3}}{27}=...$ is sufficient to score the B mark.
An acceptable equivalent of rationalising the denominator of an expression for the first M is rationalising the coefficient of *a* in a rearranged expression, e.g.
$\left(9+3\sqrt{3}\right)a=12-4\sqrt{3}\rightarrow(81-27)\,a=\left(9-3\sqrt{3}\right)\left(12-4\sqrt{3}\right)$
The second M mark requires an attempt to make *a* the subject and make progress towards the form $p\sqrt{3}+q$, which means the denominator must have been reduced to a single term with two terms in the numerator. So $a=\frac{12-4\sqrt{3}}{9+3\sqrt{3}}$ is not sufficient progress. In the example above the M is not awarded until the final line where the denominator is 54.
However, once the first B and M are scored (having seen evidence before the final answer) reaching the correct answer will then be sufficient for the M (and A if all correct).
But from $\frac{12-4\sqrt{3}}{9+3\sqrt{3}}$ to $\frac{8-4\sqrt{3}}{3}$ with no further work shown is 2nd M0 (calculator use with no further progress). However, if a correct attempt to rearrange this to $-\frac{4\sqrt{3}}{3}+\frac{8}{3}$ (or with terms reversed) follows (or similar if there were errors) then the 2nd M becomes eligible as there is further work to support the method.

Question Number	Scheme	Marks
3. (a)	$\int \mathrm{f}(x)\,\mathrm{d}x = \int x^{\frac{3}{2}} + 10x^{\frac{1}{2}} + 25x^{-\frac{1}{2}}\,\mathrm{d}x = \frac{2}{5}x^{\frac{5}{2}} + \frac{20}{3}x^{\frac{3}{2}} + 50x^{\frac{1}{2}} + c$	M1 A1 A1 A1 **(4)**
(b) (i)	$\mathrm{f}'(x) = \frac{3}{2}x^{\frac{1}{2}} + 5x^{-\frac{1}{2}} - \frac{25}{2}x^{-\frac{3}{2}}$	M1 A1
	$\mathrm{f}'(x) = 0 \Rightarrow \frac{3}{2}x^{\frac{1}{2}} + 5x^{-\frac{1}{2}} - \frac{25}{2}x^{-\frac{3}{2}} = 0$ AND $\times x^{\frac{3}{2}}$	dM1
	$\frac{3}{2}x^{2} + 5x^{1} - \frac{25}{2} = 0 \Rightarrow 3x^{2} + 10x - 25 = 0$ *	A1*
(ii)	$\left(x = \right)\frac{5}{3}$ only	B1 **(5)** **(9 marks)**

(a)

M1: For attempting to divide by $x^{\frac{1}{2}}$ and increasing a correct power by 1 (ie must have expanded). Must be seen in part (a)

A1: For one correct term (allow un simplified)

A1: For two correct terms simplified.

A1: $\frac{2}{5}x^{\frac{5}{2}} + \frac{20}{3}x^{\frac{3}{2}} + 50x^{\frac{1}{2}} + c$ or exact equivalent. Must include the constant of integration. Condone if they write "y =" and ignore any spurious integral signs or extra dx

(b)(i)

M1: For attempting to divide by $x^{\frac{1}{2}}$ and decreasing a correct power by one. Must be seen or used in part (b). For attempts at the quotient or product rule look for correct denominator and one correct numerator term in $\frac{A(x+5)\sqrt{x} - B(x+5)^2 x^{-1/2}}{\left(\sqrt{x}\right)^2}$ (oe for product rule)

A1: For $\mathrm{f}'(x) = \frac{3}{2}x^{\frac{1}{2}} + 5x^{-\frac{1}{2}} - \frac{25}{2}x^{-\frac{3}{2}}$ **(**oe e.g from quotient rule**)** which may be left un simplified.

dM1: Sets $\alpha x^{\frac{1}{2}} + \beta x^{-\frac{1}{2}} + \chi x^{-\frac{3}{2}} = 0$ and attempts to multiply by $x^{\frac{3}{2}}$ seen in at least two terms or explicitly shown in a step before the final answer.

This may be derived in stages, first multiplying by $x^{\frac{1}{2}}$ and then by x. This is permissible for the M (and A) as evidence of the correct method has been shown by the stages. The dM can be scored if the index work is correct in at least two indices, and A1 if all is correct.

So $\frac{3}{2}x^{\frac{1}{2}} + 5x^{-\frac{1}{2}} - \frac{25}{2}x^{-\frac{3}{2}} = 0 \Rightarrow \frac{3}{2}x + 5 - \frac{25}{2}x^{-1} = 0 \Rightarrow \frac{3}{2}x^{2} + 5x - \frac{25}{2} = 0$ is sufficient for the dM1 as long as the middle step is seen with two correct powers (and the A1 if they then multiply through be 2).