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).

Note also that dividing by $x^{-\frac{3}{2}}$ is an equivalent to multiplying by $x^{\frac{3}{2}}$.

A1*: Reaches $3x^2+10x-25=0$ showing all steps with no errors. Note that they must work correctly with the equation, if they state $f'(x)=3x^2+10x-25$ before setting equal to 0 then allow the M (if suitable method shown) but it is A0.

(b)(ii)

B1: $\left(x=\right)\frac{5}{3}$ only. The other root need not be seen, but if shown it must be subsequently rejected in some way. Note that $1.\dot{6}$ (1.6 recurring) is acceptable as the answer for B1, but 1.67 is B0.

Question Number	Scheme	Marks
4 (a)	States or implies that $\left[\text{f}(x)=\right]kx(x-4)$	M1
	Attempts to find k. E.g. $-4.8=k\times2\times(2-4)\Rightarrow k=...$	dM1
	$\left[\text{f}(x)=\right]1.2x(x-4)$	A1
		(3)
(b)	States or implies that $\left[\text{g}(x)=\right]\lambda x(x-4)^2$	M1
	Attempts to find λ . E.g. $7.2=\lambda\times6\times(6-4)^2\Rightarrow\lambda=...$	dM1
	$\left[\text{g}(x)=\right]0.3x(x-4)^2$	A1
		(3)
(c)	Sets their $1.2x(x-4)=0.3x(x-4)^2$	B1ft
	Valid attempt to solve $1.2\cancel{x}\cancel{(x-4)}=0.3\cancel{x}(x-4)^{\cancel{2}}\Rightarrow x=4+\dfrac{1.2}{0.3}$	M1
	$x=8$	A1
	$\left(8,38.4\right)$	A1
		(4) **(10 marks)**

(a)

M1: States or implies that $\text{f}(x)=kx(x-4)$. Allow with k = 1. The f(x) need not be seen – assume they are working with f(x) in part (a)

Alternatives include $\text{f}(x)=k(x-2)^2-4.8$ Allow with k = 1 and $\text{f}(x)=ax^2+bx$ with at least one of $4a+b=0$ and/or $4a+2b=-4.8$

dM1: Attempts to find all the constants in their equation for $\text{f}(x)$ using $\left(2,-4.8\right)$. E.g. $-4.8=k\times2\times(2-4)\Rightarrow k=...$

A1: $\left[\text{f}(x)=\right]1.2x(x-4)$ o.e. such as $\left[\text{f}(x)=\right]1.2x^2-4.8x$ or $\left[\text{f}(x)=\right]1.2(x-2)^2-4.8$ and isw. Accept with (x − 0). The f(x) may be missing, it can be assumed (but use of g(x) is A0). Allow if the full expression is given in latter parts if all the work was correct in (a) to find the constants.

(b)

M1: States or implies that $\text{g}(x)=\lambda x(x-4)^2$ Allow with λ = 1. The g(x) need not be seen – assume they are working with g(x) in part (b).

Alternatives include $\text{g}(x)=ax^3+bx^2+cx$ with at least two of $64a+16b+4c=0$, $48a+8b+c=0$, and/or $216a+36b+6c=7.2$ (allow minor slips).

dM1: Attempts a full equation for $\text{g}(x)$ using $\left(6,7.2\right)$

E.g. $7.2=\lambda\times6\times(6-4)^2\Rightarrow\lambda=...$

A1: $\left[\text{g}(x)=\right]0.3x(x-4)^2$ o.e. such as $\left[\text{g}(x)=\right]0.3x^3-2.4x^2+4.8x$ and isw. Accept with (x − 0). The g(x) may be missing, it can be assumed (but use of f(x) is A0). Allow if the full expression in used in (c) if all the work was correct in (b) to find the constants.