(ii)	$x\sqrt{27}+21=\dfrac{6x}{\sqrt{3}}$	
	E.g. $\sqrt{27}=3\sqrt{3}$, $\dfrac{6}{\sqrt{3}}=\dfrac{6\sqrt{3}}{3}$ or $2\sqrt{3}$, $\sqrt{27}\times\sqrt{3}=9$	B1
	$\left(3\sqrt{3}-2\sqrt{3}\right)x=-21$ or e.g. $3x=-21\sqrt{3}$	M1
	$x=-\dfrac{21}{\sqrt{3}}=-7\sqrt{3}$	**d**M1 A1
		(4)
		(7 marks)

(ii) Notes

B1: Correct surd work seen. E.g. $\sqrt{27}=3\sqrt{3}$, $\dfrac{6}{\sqrt{3}}=\dfrac{6\sqrt{3}}{3}$ or $2\sqrt{3}$, $\sqrt{27}\times\sqrt{3}=9$

M1: Attempts to collect terms in x

dM1: Attempts to write the answer in the form $a\sqrt{b}$ where $\sqrt{b}$ is irrational.
Depends on the previous method mark.

A1: cso $x=-7\sqrt{3}$

Correct answers with no working in (ii) score no marks.

Question Number	Scheme	Marks
3(a)	$\mathrm{f}(x)=\dfrac{16+24\sqrt{x}+9x}{x}$	
	$=16x^{-1}+24x^{-\frac{1}{2}}+9$	M1 A1
	$\left(\mathrm{f}'(x)=\right)-16x^{-2}-12x^{-\frac{3}{2}}$	M1 A1 A1cso
		(5)

(a) Notes

M1: Expands the numerator into a **3 or 4 term** quadratic expression in $\sqrt{x}$ **and** attempts to divide each term by *x*.

Award this mark for $\left(4+3\sqrt{x}\right)^2\rightarrow p+q\sqrt{x}+rx\left(\text{or}\left(\sqrt{x}\right)^2\right),\ \ p,q,r\neq 0$ followed by at least one of,

$\dfrac{p}{x}$ or $\dfrac{q}{\sqrt{x}}$ oe or *r*.

A1: Correct expression e.g. $16x^{-1}+24x^{-\frac{1}{2}}+9$ or equivalent e.g. $\dfrac{16}{x}$ for $16x^{-1}$ or $\dfrac{12}{\sqrt{x}}+\dfrac{12}{\sqrt{x}}$ for $24x^{-\frac{1}{2}}$

M1: Reduces a **correct index of *x*** by 1 when differentiating.

It is for one of $...x^{-1}\rightarrow ...x^{-2}$ or $...x^{-\frac{1}{2}}\rightarrow ...x^{-\frac{3}{2}}$ or $...x^{-1}\rightarrow ...x^{-1-1}$ or $...x^{-\frac{1}{2}}\rightarrow ...x^{-\frac{1}{2}-1}$

A1: One correct simplified term.

It is for $-16x^{-2}$ oe e.g. $-\dfrac{16}{x^2}$ or for $-12x^{-\frac{3}{2}}$ oe e.g. $-\dfrac{12}{x^{\frac{3}{2}}}$

Apply isw once a correct simplified term is seen.

A1cso: Fully correct and simplified expression $-16x^{-2}-12x^{-\frac{3}{2}}$ oe e.g. $-\dfrac{16}{x^2}-\dfrac{12}{x^{\frac{3}{2}}}$

Do not allow e.g. $-\dfrac{16}{x^2}+-\dfrac{12}{x^{\frac{3}{2}}}$ and do not allow $-\dfrac{16}{x^2}-\dfrac{12}{x^{\frac{3}{2}}}+c$

Apply isw once a correct simplified expression is seen. "$\mathrm{f}'(x)=$" is not required.

See next page for attempts to use the product or quotient rule.

<u>Special case:</u>

It is possible to obtain a correct derivative with an incorrect expansion in the numerator e.g.

$$\mathrm{f}(x)=\frac{16+24\sqrt{x}+kx}{x}=\frac{16}{x}+24x^{-\frac{1}{2}}+k\Rightarrow\left(\mathrm{f}'(x)=\right)-16x^{-2}-12x^{-\frac{3}{2}}$$

If *k* is incorrect, this scores SC M1A0M1A1A0 in (a) but allow full recovery in (b)

(b)	$f'(4) = -1 - \frac{12}{8} = -2\frac{1}{2}$	M1
	$y - 25 = -\frac{5}{2}(x-4) \Rightarrow y = -\frac{5}{2}x + 35$ or $y = -\frac{5}{2}x + c \Rightarrow 25 = -\frac{5}{2} \times 4 + c \Rightarrow c = ...$ $\Rightarrow y = -\frac{5}{2}x + 35$	**d**M1 A1
		(3)
		8 marks

(b) Notes

M1: Substitutes $x = 4$ into their $f'(x)$ from part (a) to find a value which may be implied.
There must have been an attempt to differentiate so do not allow for finding e.g. $f(4)$.
If no substitution is seen and their value is incorrect for their derivative (you may need to check) then score M0

dM1: Attempts an equation of the tangent (**not the normal**) at (4, 25) using a correct method with the values correctly placed. If using $y = mx + c$ must reach as far as finding a value for c.
Depends on the first method mark.

A1: $y = -\frac{5}{2}x + 35$ oe e.g. $y = -2.5x + 35$

Part (a) Using quotient rule:

$$f(x) = \frac{\left(4+3\sqrt{x}\right)^2}{x} \Rightarrow f'(x) = \frac{x \times 2\left(4+3\sqrt{x}\right) \times \frac{3}{2}x^{-\frac{1}{2}} - \left(4+3\sqrt{x}\right)^2}{x^2}$$

M1 for $f'(x) = \frac{...x\left(4+3\sqrt{x}\right) \times x^{-\frac{1}{2}} - \left(4+3\sqrt{x}\right)^2}{x^2}$

A1 can then be scored for fully correct differentiation

Then,

M1 for an attempt to expand, collect terms and simplify to obtain $\frac{...x^{\frac{1}{2}} + ...}{x^2}$

A1 for $\frac{-12x^{\frac{1}{2}} - 16}{x^2}$

A1 for $-\frac{16}{x^2} - \frac{12}{x^{\frac{3}{2}}}$

Part (a) Using product rule:

$$f(x) = \frac{\left(4+3\sqrt{x}\right)^2}{x} = x^{-1}\left(4+3\sqrt{x}\right)^2 \Rightarrow f'(x) = x^{-1} \times 2\left(4+3\sqrt{x}\right) \times \frac{3}{2}x^{-\frac{1}{2}} + \left(4+3\sqrt{x}\right)^2 \times -x^{-2}$$

M1 for $f'(x) = ...x^{-1}\left(4+3\sqrt{x}\right) \times x^{-\frac{1}{2}} + ...\left(4+3\sqrt{x}\right)^2 x^{-2}$

A1 can then be scored for fully correct differentiation

Then,

M1 for an attempt to expand, collect terms and simplify to obtain $...x^{-\frac{3}{2}}$ or $...x^{-2}$

Then the **A** marks as in the main scheme.