Question	Scheme	Marks
7(a)	$0=10-2x \Rightarrow x=5$ or $y=2, y=10-2x \Rightarrow x=4$	B1
	Examples: $\frac{1}{2}\times 2\left(5+4-a\right)=\frac{27}{4}$ or $\frac{1}{2}\times 2\left(5+4-\frac{2}{k}\right)=\frac{27}{4}$ Trapezium or $\frac{1}{2}\times 2a+\frac{1}{2}\times 2\left(5-a+4-a\right)=\frac{27}{4}$ or $\frac{1}{2}\times 2\times\frac{2}{k}+\frac{1}{2}\times 2\left(5-\frac{2}{k}+4-\frac{2}{k}\right)=\frac{27}{4}$ Triangle + Trapezium or $\frac{1}{2}\times 2a+2\left(4-a\right)+\frac{1}{2}\times 1\times 2=\frac{27}{4}$ or $\frac{1}{2}\times 2\times\frac{2}{k}+2\left(4-\frac{2}{k}\right)+\frac{1}{2}\times 1\times 2=\frac{27}{4}$ Triangle + Rectangle + Triangle or $\frac{1}{2}\times 5\times 2+\frac{1}{2}\left(4-a\right)\times 2=\frac{27}{4}$ or $\frac{1}{2}\times 5\times 2+\frac{1}{2}\left(4-\frac{2}{k}\right)\times 2=\frac{27}{4}$ 2 Triangles	M1
	$\Rightarrow k=\frac{8}{9}, a=\frac{9}{4}$	A1 A1ft
		(4)
(b)	Two of $y\geqslant "\frac{8}{9}" x,\ y\leqslant 10-2x, x>"\frac{9}{4}"$	M1
	All three of $y\geqslant \frac{8}{9}x,\ y\leqslant 10-2x, x>\frac{9}{4}$	A1
		(2)
		(6 marks)

Notes:

(a)

B1: Correct x intercept for $y=10-2x$ or correct x coordinate for intersection of $y = 2$ with $y=10-2x$. May be seen on the diagram or in a sketch or implied by their working.

M1: Correct method for area and sets equal to $\frac{27}{4}$ to form an equation in a or k. The $2\times\frac{1}{2}$ may be implied. May use e.g. trapezium, triangle + trapezium, triangle + rectangle + triangle or 2 triangles. See above for some examples. Note that with a correct "5" and "4" the area is $9-a$ or $9-\frac{2}{k}$.

A1: Correct value for a or k as a single value not a calculation.

A1ft: Correct values for a and k. Correct values or follow through using $ak=2$ from their first value to the second **provided the M1 is scored**. Allow exact equivalents or exact ft equivalents so if correct allow e.g. $k=0.\dot{8}$, $a=2.25$ or $2\frac{1}{4}$

(b)

M1: Any two of the three correct inequalities with their *k* and/or their *a* or the letters *a* and *k*. Note inequalities in *y* may be combined in to one so $"\frac{8}{9}"x < y < 10 - 2x$ would count as two correct inequalities. Inequalities must be in the correct direction but accept with $<$ or $\leqslant$ for the M. Do not allow incorrect notation such as $R_2 \geqslant "\frac{8}{9}"x,\ R_2 \leqslant 10 - 2x$

A1: All three correct with the correct values of *a* and *k* – **there is no follow though for this mark**.

Note inequalities in *y* may be combined in to one as above.

Note that there may be an upper limit on the *x* inequality which is fine provided it is in an acceptable range and consistent.

Note that $y = \frac{8}{9}x$ and $y = 10 - 2x$ intersect when $x = \frac{45}{13}$ so the upper limit may be this value or greater. In general the following are acceptable:

$y \geqslant \frac{8}{9}x,\ y \leqslant 10 - 2x,\ \frac{9}{4} < x \leqslant \alpha$ if $\alpha \geqslant \frac{45}{13}$ or $y \geqslant \frac{8}{9}x,\ y \leqslant 10 - 2x,\ \frac{9}{4} < x < \alpha$ if $\alpha > \frac{45}{13}$

The following examples would score both marks,

$$y \geqslant \frac{8}{9}x,\ y \leqslant 10 - 2x,\ \frac{9}{4} < x \leqslant \frac{45}{13}$$

$$y \geqslant \frac{8}{9}x,\ y \leqslant 10 - 2x,\ \frac{9}{4} < x < 5$$

Note that some candidates are also including limits on *y* and this is acceptable provided the values are in the correct range. Allow strict or non strict inequalities e.g.

$y > 2, y \geqslant 2,\ 2 < y < \frac{11}{2},\ 2 \leqslant y \leqslant \frac{11}{2}$ but e.g. $y < 2, y \leqslant 2$ scores A0

Question 8 – General Guidance for marking

Note that some candidates are misreading the $x^{-\frac{1}{2}}$ as $x^{\frac{1}{2}}$ in part (a) and/or part (b)

In the majority of cases it will be clear if this is the case as candidates often write down the expression before they differentiate in part (a) or integrate in part (b)

If it is clear that a candidate thinks the expression is $\frac{1}{4}x^3 - 8x^{\frac{1}{2}}$ in either or both parts then <u>FULL</u> marks should be awarded for correct work – details are below. We are condoning the fact that $P(4,12)$ does not lie on $y = \frac{1}{4}x^3 - 8x^{\frac{1}{2}}$

If candidates do not write down the original expression (in (a) or (b)) then evidence of misreading or not can be taken from their derivative or integral.

<u>Note:</u>

If candidates integrate in (a) and differentiate in (b) then the maximum marks available are:

(a) M0A0M1dM1A0 (b) M0A0dM0A0

If parts are not labelled then you should assume that the first attempt is part (a) and the second attempt is part (b).

8. Scheme - No Misread

Question	Scheme	Marks
8(a)	$y=\frac{1}{4}x^3-8x^{-\frac{1}{2}} \Rightarrow \left(\frac{\mathrm{d}y}{\mathrm{d}x}=\right)\frac{1}{4}\times 3x^2-8\times-\frac{1}{2}x^{-\frac{3}{2}}$	**M1 A1**
	$\left.\frac{\mathrm{d}y}{\mathrm{d}x}\right\vert_{x=4}=\ldots\left(\frac{25}{2}\right)$	**M1**
	$y-12=\text{"}\frac{25}{2}\text{"}\left(x-4\right)$	**dM1**
	$25x-2y-76=0$ oe e.g. $-25x+2y+76=0$	**A1**
		(5)
(b)	$\left(\mathrm{f}(x)=\right)\int\frac{1}{4}x^3-8x^{-\frac{1}{2}}\,\mathrm{d}x=\frac{1}{4}\frac{x^4}{4}-\frac{8x^{\frac{1}{2}}}{\frac{1}{2}}(+c)$	**M1 A1**
	$\mathrm{f}(4)=12\Rightarrow 16-32+c=12\Rightarrow c=\ldots(28)$	**dM1 A1**
	So $\left(\mathrm{f}(x)=\right)\frac{x^4}{16}-16\sqrt{x}+\text{"28"}$	**A1ft**
		(5)
		(10 marks)

Notes:

(a)

M1: Correct method of differentiation, at least one power reduced by 1.

Award for $\frac{1}{4}x^3\rightarrow\ldots x^2$ or $-8x^{-\frac{1}{2}}\rightarrow\ldots x^{-\frac{3}{2}}$

A1: Correct differentiation, need not be simplified.

M1: Finds $\frac{\mathrm{d}y}{\mathrm{d}x}$ at $x = 4$. Requires the substitution of $x = 4$ into a "changed" function to find a value.

Note that some candidates are using the "12" in some way to find the gradient e.g.

$$12=\frac{1}{4}\times 3(4)^2-8\times-\frac{1}{2}(4)^{-\frac{3}{2}}+c\Rightarrow c=2\Rightarrow m=2$$ and this scores M0

dM1: Depends on previous M. Correct method for the tangent **not** the normal. Uses their $\frac{\mathrm{d}y}{\mathrm{d}x}$ at $x = 4$ with $y = 12$ and $x = 4$ correctly placed. If using $y = mx + c$ they must proceed as far as finding a value for c.

A1: Correct equation in the required form including "= 0" or any non-zero integer multiple of it.

(b)

M1: Attempts to integrate f(x), look for power increased by 1 on at least one term.

Award for $\frac{1}{4}x^3\rightarrow\ldots x^4$ or $-\frac{1}{8}x^{-\frac{1}{2}}\rightarrow\ldots x^{\frac{1}{2}}$

A1: Correct integration, need not be simplified. (no need for constant for this mark).

dM1: Depends on first M. Sets f (4) = 12 and proceeds to find a value for c - must have a constant of integration to score this mark.

A1: Correct value for c found.

A1ft: Correct answer following through their c only i.e. the algebraic part must be correct.

Accept with fractional index rather than square root. Allow $0.0625x^4$ for $\frac{x^4}{16}$. **Depends on the previous method mark.**

The "f (x) =" is **not** required so just look for the correct expression. Apply isw if necessary, e.g. correct work leading to $\left(\text{f}(x)=\right)\frac{x^4}{16}-16x^{\frac{1}{2}}+28$ followed by $\left(\text{f}(x)=\right)x^4-256x^{\frac{1}{2}}+448$ can score full marks in (b).

Condone poor notation e.g. leaving the final answer as $\left(\text{f}(x)=\right)\int\frac{x^4}{16}-16x^{\frac{1}{2}}+28$

8. Scheme – Misread in (a) and/or (b)

Question	Scheme	Marks
8(a)	$y=\frac{1}{4}x^3-8x^{\frac{1}{2}} \Rightarrow \left(\frac{\mathrm{d}y}{\mathrm{d}x}=\right)\frac{1}{4}\times 3x^2-8\times\frac{1}{2}x^{-\frac{1}{2}}$	**M1 A1**
	$\left.\frac{\mathrm{d}y}{\mathrm{d}x}\right\vert_{x=4}=\ldots(10)$	**M1**
	$y-12="10"\left(x-4\right)$	**dM1**
	$10x-y-28=0$ oe e.g. $-10x+y+28=0$	**A1**
		(5)
(b)	$\left(\mathrm{f}(x)=\right)\int\frac{1}{4}x^3-8x^{\frac{1}{2}}\,\mathrm{d}x=\frac{1}{4}\frac{x^4}{4}-\frac{8x^{\frac{3}{2}}}{\frac{3}{2}}(+c)$	**M1 A1**
	$\mathrm{f}(4)=12\Rightarrow 16-\frac{128}{3}+c=12\Rightarrow c=\ldots\left(\frac{116}{3}\right)$	**dM1 A1**
	So $\left(\mathrm{f}(x)=\right)\frac{x^4}{16}-\frac{16}{3}x^{\frac{3}{2}}+"\frac{116}{3}"$	**A1ft**
		(5)
		(10 marks)

Notes:

(a)

M1: Correct method of differentiation, at least one power reduced by 1.

Award for $\frac{1}{4}x^3\rightarrow\ldots x^2$ or $-8x^{\frac{1}{2}}\rightarrow\ldots x^{-\frac{1}{2}}$

A1: Correct differentiation, need not be simplified. Ignore any spurious "= 0".

M1: Finds $\frac{\mathrm{d}y}{\mathrm{d}x}$ at $x = 4$. Requires the substitution of $x = 4$ into a "changed" function to find a value.

Note that some candidates are using the "12" in some way to find the gradient e.g.

$$12=\frac{1}{4}\times 3(4)^2-8\times-\frac{1}{2}(4)^{-\frac{1}{2}}+c\Rightarrow c=2\Rightarrow m=2$$ and this scores M0

dM1: Depends on previous M. Correct method for the tangent **not** the normal. Uses their $\frac{\mathrm{d}y}{\mathrm{d}x}$ at $x = 4$ with $y = 12$ and $x = 4$ correctly placed. If using $y = mx + c$ they must proceed as far as finding a value for c.

A1: Correct equation in the required form including "= 0" or any non-zero integer multiple of it.

(b)

M1: Attempts to integrate f (x), look for power increased by 1 on at least one term.

Award for $\frac{1}{4}x^3\rightarrow\ldots x^4$ or $-\frac{1}{8}x^{\frac{1}{2}}\rightarrow\ldots x^{\frac{3}{2}}$

A1: Correct integration, need not be simplified. (no need for constant for this mark).

dM1: Depends on first M. Sets f (4) = 12 and proceeds to find a value for c - must have a constant of integration to score this mark.

A1: Correct value for c found.