Question Number	Scheme	Marks
6a	$4(p-2x)=\dfrac{12+15p}{x+p}$ $8x^2+4px+12+15p-4p^2 \quad (=0)$	M1
	e.g. $a=8,\ b=4p,\ c=12+15p-4p^2$ $(4p)^2-4\times8\times(12+15p-4p^2) \quad (>0)$	dM1
	$3p^2-10p-8>0$ *	A1*
		(3)
b	e.g. $(p-4)(3p+2)\ (=0)\Rightarrow 4,\ -\dfrac{2}{3}$	M1
	$p<-\dfrac{2}{3}$ or $p>4$	M1A1
		(3)
		(6 marks)

Allow part (b) to follow on from (a) without any labelling of specific parts

(a)

M1: Multiplies by $(x+p)$, multiplies out the brackets and collects terms on one side.
Condone slips and the omission of = 0, but there must be an $...x^2$ term.
May be implied by further work e.g. their attempt at the discriminant.

dM1: Attempts b^2-4ac for their quadratic in *x* with their *b* and their *c* both being in terms of *p*.
The values/expressions for *a*, *b* and *c* for their quadratic in *x* must be embedded in the correct positions in the expression but condone invisible brackets and sign slips miscopying.
It is dependent on the previous method mark.

Condone for this mark if they work in terms of *x* instead of *p* provided the coefficients were actually those in terms of *p* from their original quadratic. i.e.

$8x^2+4px+12+15p-4p^2=0\Rightarrow a=8,\ b=4p,\ c=12+15p-4p^2$

$\Rightarrow(4x)^2-4\times8\times(12+15x-4x^2)\ (>0)$ (they have just written *x* instead of *p* which is fine)

A1*: Achieves $3p^2-10p-8>0$ with all stages of working shown:

- Multiplying out $(p-2x)(x+p)$
- Collecting terms on one side of an equation (=0 may be implied)
- Finding the discriminant
- At least one intermediate stage of working between the discriminant and the final answer

There must be no errors seen including invisible brackets but condone a missing trailing bracket if it does not alter the processing. e.g. $(4p)^2-4\times8\times(12+15p-4p^2$

Condone the > 0 appearing for the first time in their final answer, provided an incorrect inequality has not been used in earlier working.
Do not withhold this mark if they state e.g. "$b^2-4ac=0$" as part of their working.

(b)

M1: Attempts to find critical values by solving the given quadratic by either

- factorising (do not accept $(p-4)(p+\frac{2}{3})$ unless they have divided both sides of the inequality/equation by 3 first)
- completing the square $3\left(p-\frac{5}{3}\right)^2 \pm ... \Rightarrow (p=)\ ...$
- quadratic formula

Usual rules apply (see general marking principles for guidance). May be in another variable. Allow this mark to be scored if seen in (a).
This mark cannot be awarded from directly using a calculator and stating the roots.

M1: Attempts to find the outside region for their critical values. May use another variable e.g. x
May be implied by $p \leqslant "-\frac{2}{3}"$, $p \geqslant "4"$ or incorrect use of inequalities e.g. $4 < p < -\frac{2}{3}$
This is **not** dependent on the first method mark so if a calculator has been used then this mark can still be scored.

A1: $p < -\frac{2}{3}$ or $p > 4$ (or equivalent). (may appear on separate lines). Isw once a correct answer is seen, provided there is no contradiction and no part of the range is rejected.
This can only be scored provided both previous method marks have been awarded.
Must be in terms of *p*

Accept e.g. $p < -\frac{2}{3},\ p > 4$, $p < -\frac{2}{3}$ $p > 4$ $\left\{p : p < -\frac{2}{3} \cup p > 4\right\}$ or variations of these. Accept $\left(-\infty, -\frac{2}{3}\right),\ (4, \infty)$

Do not accept e.g. $p < -\frac{2}{3}$ and $p > 4$ $\left\{p : p < -\frac{2}{3} \cap p > 4\right\}$ or variations of these

Do not accept $\left(-\infty, -\frac{2}{3}\right],\ [4, \infty)$ $p \leqslant -\frac{2}{3},\ p \geqslant 4$ $4 < p < -\frac{2}{3}$

Question Number	Scheme	Marks
7ai	$f'(4)=\dfrac{4(4)^2+10-7(4)^{\frac{1}{2}}}{4(4)^{\frac{1}{2}}}=\dfrac{15}{2}$	B1
ii	$"\dfrac{15}{2}"\rightarrow-\dfrac{2}{15}$	M1
	$y+1="-\dfrac{2}{15}"(x-4)$	M1
	$2x+15y+7=0$	A1
		(4)
b	$\dfrac{4x^2+10-7x^{\frac{1}{2}}}{4x^{\frac{1}{2}}}=\pm...x^{\frac{3}{2}}\pm...x^{-\frac{1}{2}}\pm...$	M1
	Two of the terms of $x^{\frac{3}{2}}+\dfrac{5}{2}x^{-\frac{1}{2}}-\dfrac{7}{4}$	A1
	$\int\left(x^{\frac{3}{2}}+\dfrac{5}{2}x^{-\frac{1}{2}}-\dfrac{7}{4}\right)\mathrm{d}x=\dfrac{2}{5}x^{\frac{5}{2}}+5x^{\frac{1}{2}}-\dfrac{7}{4}x\ (+c)$	dM1A1ft
	$\dfrac{2}{5}(4)^{\frac{5}{2}}+5(4)^{\frac{1}{2}}-\dfrac{7}{4}(4)+c=-1\Rightarrow c=...$	ddM1
	$\left(f(x)=\right)\dfrac{2}{5}x^{\frac{5}{2}}+5x^{\frac{1}{2}}-\dfrac{7}{4}x-\dfrac{84}{5}$	A1
		(6)
		(10 marks)

Mark (a) and (b) together so do not be concerned with labelling of the parts

(a)

(i)

B1: $\dfrac{15}{2}$ oe stated (as the gradient of f(x) at P).

(ii)

M1 Finds the negative reciprocal of their gradient in part (i). If they do not have a gradient in (i) then only allow $-\dfrac{2}{15}$ or an attempt at $-\dfrac{1}{f'(4)}$

M1 Attempts to find the equation of the normal using a changed gradient to that found in (i) and $(4,\ -1)$ with the coordinates in the correct positions. If they do not have a gradient in (i) then allow any gradient $\neq\dfrac{15}{2}$. If they use $y=mx+c$ they must proceed as far as $c=...$

A1: $2x+15y+7=0$ or any multiple of this where all the coefficients are integers and all terms are on the same side of the equation. e.g. $30y+14+4x=0$ scores A1