Question Number	Scheme	Marks
5(a)	$x^n \to x^{n-1}$	M1
	$\left(\frac{dy}{dx} =\right) 12x^2 - \frac{2}{x^2}$	A1
		(2)
(b)	$12x^2 - \frac{2}{x^2} = -5 \Rightarrow ... \Rightarrow 12x^4 + 5x^2 - 2 = 0$ *	M1A1*
		(2)
(c)	$12x^4 + 5x^2 - 2 = 0 \Rightarrow (4x^2 - 1)(3x^2 + 2) = 0 \Rightarrow x^2 = \frac{1}{4} \to x = \frac{1}{2} \quad (x > 0)$	M1
	$y = 4\left(\frac{1}{2}\right)^3 + \frac{2}{\left(\frac{1}{2}\right)} + 9 = ... \left(= \frac{27}{2} \right)$	M1
	$k = "\frac{27}{2}" + 5 \times "\frac{1}{2}" = ...$	dM1
	$k = 16$	A1
		(4)
		(8 marks)

(a)

M1 Decreases the power by one on at least one of the terms in x to achieve a term with a correct index. i.e. $x^3 \to x^2$ or $x^{-1} \to x^{-2}$. The indices do not need to be processed for this mark. e.g. $x^{-1} \to x^{-1-1}$

A1 $12x^2 - \frac{2}{x^2}$ or $12x^2 - 2x^{-2}$. Do not accept unsimplified equivalent expressions e.g. $12x^2 + -2x^{-2}$ isw if a correct answer is seen but they then attempt to e.g. divide by 2 afterwards

(b) Marks in (b) cannot be awarded for work done or seen in (c)

M1 Sets their $\frac{dy}{dx}$ of the form $ax^2 + \frac{b}{x^2}$ equal to -5 and attempts to rearrange to a 3-term quadratic in x^2 = 0. They must multiply through by x^2 and collect all 3 terms on one side of an equation (condone omission of = 0). It cannot be awarded for proceeding directly to the given answer in one step. (They may use an alternative letter so condone $y = x^2$ so they proceed to a 3-term quadratic in that variable instead)
Condone sign slips only for this mark.

A1* Achieves the given answer with no errors seen and at least one intermediate stage of working. Must see "= 0" on their final line. Condone if the order is different to the printed answer, provided all terms are on one side = 0

(c) Note that M0M1dM1A0 is possible. Work labelled as (b) must be used in (c) to score

M1 Solves the **given** quadratic in x^2 by factorising, completing the square or using the formula to find a positive value for x^2 and proceeds to find a positive value for x (usual rules apply).
They cannot just solve the quadratic in x^2 (or the quartic) directly using a calculator. If they just state the root(s) then it is M0

Note that $12x^4+5x^2-2=0 \Rightarrow \left(x^2+\frac{2}{3}\right)\left(x^2-\frac{1}{4}\right)=0 \Rightarrow x^2=...$ is M0 (the factorised version must match the quartic)

Condone poor labelling of x^2 as x if they then go on to square root

e.g. $12x^4+5x^2-2=0 \Rightarrow (3x+2)(4x-1)=0 \Rightarrow x=\frac{1}{4} \Rightarrow x=\frac{1}{2}$

Do not be concerned if they achieve other incorrect roots.

M1 Attempts to substitute their positive value of x (they must not be substituting in x^2) into the original equation to find a value for y. Condone miscopying and arithmetical slips provided the intention is clear. May be implied by a correct value for y but not if labelled as k
Whilst not dependent on the first M, it is dependent on an attempt to solve the given quartic (however poorly including via use of a calculator) and using their positive value of x (not x^2) from this. It cannot be for using their positive value of x from an incorrect quartic.
Ignore if they repeat this process for more than one x value, which may be negative.

dM1 Uses their pair of x and y to find a value for k. Condone slips. It is dependent on the previous method mark. Ignore if they repeat this process for more than one pair. May be implied by $k=16$ provided the correct root is found and the previous method mark has been scored.

A1 $k=16$ only (this can only be scored provided all method marks in this part have been awarded)

Alt(c) Using curve = tangent

M1: As above in main scheme and notes

M1: Sets $4x^3+\frac{2}{x}+9=k-5x$ and substitutes in their positive value of x. Condone slips if the attempt at the substitution is seen. (Must be seen or used in (c) to score or if there is a lack of labelling they must be attempting to find k not attempting to achieve the quartic in (b)). If the substitution is not explicitly seen then you will need to check this for their positive value of x.

dM1: Proceeds to find a value for k. You do not need to check the mechanics of the rearrangement as long as a value is achieved. It is dependent on the previous method mark. May be implied by $k=16$ provided the correct root is found and the previous method mark has been scored.

A1 $k=16$ only (this can only be scored provided all method marks have been awarded)

Question Number	Scheme	Marks
6(a)	$\dfrac{2(4)^2+a\times4+b}{4\sqrt{4}}=7\Rightarrow 32+4a+b=56\Rightarrow 4a+b=24$ *	M1A1*
		(2)
(b)	$4a+b=24,\ a+b=-9\Rightarrow a=11,\ b=-20$	M1A1
	$\dfrac{x^{\frac{3}{2}}}{2}+\dfrac{11x^{\frac{1}{2}}}{4}-5x^{-\frac{1}{2}}$	M1
	$\displaystyle\int \dfrac{x^{\frac{3}{2}}}{2}+\dfrac{11x^{\frac{1}{2}}}{4}-5x^{-\frac{1}{2}}\ \mathrm{d}x\Rightarrow \text{Two of } \dfrac{x^{\frac{5}{2}}}{5},\ \dfrac{"11"x^{\frac{3}{2}}}{6},\ \dfrac{"-20"}{2}x^{\frac{1}{2}}$	dM1A1ft
	$\dfrac{(4)^{\frac{5}{2}}}{5}+\dfrac{11(4)^{\frac{3}{2}}}{6}-10(4)^{\frac{1}{2}}+c=-5\Rightarrow c=...$	M1
	$\left(\mathrm{f}(x)=\right)\dfrac{1}{5}x^{\frac{5}{2}}+\dfrac{11}{6}x^{\frac{3}{2}}-10x^{\frac{1}{2}}-\dfrac{91}{15}$	A1
		(7)
(c)	$(7,-5)$	B1
		(1)
		(10 marks)

Mark (a) and (b) together

(a)

M1 Attempts to substitute $x=4$ into $\mathrm{f}'(x)$ and sets equal to 7. Condone slips or incorrect manipulation prior to substituting in $x=4$ provided the intention is clear.

A1* Rearranges and achieves the given answer with no errors and at least one intermediate stage of working seen.

(b)

M1 Attempts to solve the two equations in *a* and *b* simultaneously to find a value for *a* or *b*. You do not need to be concerned with the mechanics of the rearrangement. Implied by any value for *a* or *b*

A1 $a=11,\ b=-20$ (correct values for *a* and *b* scores M1A1)

M1 Attempts to split the fraction and achieves at least one term with a correct index i.e. $x^{\frac{3}{2}}$, $x^{\frac{1}{2}}$ or $x^{-\frac{1}{2}}$ (for the relevant term). Do not allow for e.g. $\dfrac{\dots}{x^{\frac{1}{2}}}$ but the required index $x^{-\frac{1}{2}}$ may be implied by further work. You do not need to be concerned by the coefficient of the term, which may be in terms of *a* or *b*.

Do not allow to be scored for e.g. $\dfrac{2x^2}{4\sqrt{x}}\rightarrow ...x^{\frac{1}{2}}$

dM1 Increases the power by one on one of the terms in *x* with a correct index. It is dependent on the previous method mark. $x^{\frac{3}{2}}\rightarrow x^{\frac{5}{2}}$, $x^{\frac{1}{2}}\rightarrow x^{\frac{3}{2}}$ or $x^{-\frac{1}{2}}\rightarrow x^{\frac{1}{2}}$. The index does not need to be processed for this mark e.g. $x^{\frac{3}{2}}\rightarrow x^{\frac{3}{2}+1}$.

Do not award this mark for increasing the power by one on the denominator term.