Question Number	Scheme	Marks
4(i)(a)	ay^3	B1
		(1)
(i)(b)	$\dfrac{5}{\left(3a^{1-x}\right)^{-2}}=\dfrac{45}{\ldots}$ $\left(\ldots a^{1-x}\right)^{-2}=a^{-2}\times a^{2x}$ $=\dfrac{45a^2}{y^2}$	B1 M1 A1
		(3)
(ii)(a)	e.g. $3^{4t+2}=\left(3^{2t}\right)^2\times 9=9p^2$ (see notes) $\Rightarrow 27\times p^2+3=82\times p\Rightarrow 27p^2-82p+3=0$ *	M1 A1*
		(2)
(ii)(b)	Solves the quadratic $\Rightarrow$ 3, $\dfrac{1}{27}$ --- $\left(3^t\right)^2=3$ or $9^t=3\Rightarrow t=\dfrac{1}{2}$ or $\left(3^t\right)^2=\dfrac{1}{27}\Rightarrow 3^t=\dfrac{1}{3\sqrt{3}}\Rightarrow t=-\dfrac{3}{2}$ or $9^t=\dfrac{1}{27}\Rightarrow t=-\dfrac{3}{2}$ --- $(t=)\ \dfrac{1}{2},\ -\dfrac{3}{2}$	B1 M1 A1
		(3)
		(9 marks)

Check answers by the questions but if there is a contradiction between by the question and the main body of the text then the main body of the text takes precedence

(i)

(a)

B1 ay^3 or y^3a Condone $a(y)^3$. Do not isw and do not accept e.g. $a\times y^3$ or e.g. a^1y^3

(b) **Note a correct answer with no working can score full marks in this part only**

B1 Correct coefficient of 45. Sight of 45 can imply this mark but do not allow e.g. -45, $\dfrac{1}{45}, \dfrac{45}{9}$

M1 Uses index laws to proceed from $\left(a^{1-x}\right)^{-2}\rightarrow$ e.g. $\left(\dfrac{a}{a^x}\right)^{\pm 2}$ or $\dfrac{a^2}{y^2}$ or $a^{-2}\div a^{-2x}$

If they write as a product then look for $\left(a^{1-x}\right)^{-2}\rightarrow$ e.g. $\left(a\times a^{-x}\right)^{\pm 2}$ or $a^2\times y^{-2}$ or $a^{-2}\times a^{2x}$ (i.e. the signs of the indices cannot be the same)

Do not be concerned with any coefficients which are not in the indices. e.g. $5a^2\div 3y^2$ is M1

Do not penalise if they make subsequent errors or they have multiple attempts. Score for sight of the expression. Do not be concerned as to whether it is on the numerator or denominator of the fraction.

A1 $\dfrac{45a^2}{y^2}$ or simplified equivalent including e.g. $\dfrac{45y^{-2}}{a^{-2}}$, $45a^2y^{-2}$ but not $45\left(\dfrac{a}{y}\right)^2$. isw once a correct answer is seen.

(ii) **Mark (a) and (b) together**

(a)

M1 Using the power law on 3^{4t+2}

It requires one of the following to be **seen** in their solution:

$3^{4t+2} \rightarrow \left[(3^2)^{2t} \text{ or } (3^{2t})^2 \text{ or } (9)^{2t} \text{ or } \left(9^t\right)^2 \right] \times \left[3^2 \text{ or } 9 \right]$ **or** $3^{4t+2} = 9^{2t+1}$

Do not accept e.g. $3^{4t+2} = 9p^2$ or e.g. $3^{4t} \times 9 = 9p^2$ as they do not explicitly show the power law being applied.

Do not accept 81^t and do not accept valid expressions appearing from incorrect stages of working e.g. $3^{4t+2} = 9^{2t+2} = 9^{2t} \times 9$ M0A0*

Note they may multiply out the brackets first leading to 3^{4t+3} so we would need to see

$3^{4t+3} \rightarrow \left[(3^2)^{2t} \text{ or } (3^{2t})^2 \text{ or } (9)^{2t} \text{ or } \left(9^t\right)^2 \right] \times \left[3^3 \text{ or } 27 \right]$ **or** $3^{4t+3} = 9^{2t+1.5}$

Do not be concerned with the rest of the equation for this mark.

If arithmetical slips result in not achieving one of the required forms above then M0A0*

A1* Proceeds to the given answer with no errors seen.

Their solution requires at least one intermediate stage of working which involves multiplying out the brackets (which may have been done earlier) before proceeding to the given answer.

e.g. $3\left(9 \times \left(3^{2t}\right)^2 + 1\right) = 82p \Rightarrow 27p^2 + 3 = 82p \Rightarrow$ given answer

If they attempt to work backwards then send to review.

(b) Condone poor labelling provided the intention is clear

B1 3 and $\frac{1}{27}$

M1 Attempts to find a value for t using one of their roots. May use logarithmic methods to solve to find a value e.g. $9^t = 3 \Rightarrow t = \log_9 3 = ...$ If using logarithms, the expression should be correct for their roots. May be implied by a correct value for t for one of their roots. You may need to check this.

A1 $\left(t =\right) \frac{1}{2}$ and $-\frac{3}{2}$ o.e. This mark can only be scored following **sight of correct roots** to the given quadratic in p

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