Question Number	Scheme	Marks
8.(a)	$y^2 = 4ax,\ \text{at}\ P\left(ap^2, 2ap\right)$	
	$y = 2\sqrt{a}\,x^{\frac{1}{2}} \Rightarrow \dfrac{\mathrm{d}y}{\mathrm{d}x} = \sqrt{a}\,x^{-\frac{1}{2}}$ or (implicitly) $2y\dfrac{\mathrm{d}y}{\mathrm{d}x} = 4a$ or (chain rule) $\dfrac{\mathrm{d}y}{\mathrm{d}x} = 2a \times \dfrac{1}{2ap}$	M1
	When $x = ap^2$, $m_T = \dfrac{\mathrm{d}y}{\mathrm{d}x} = \dfrac{\sqrt{a}}{\sqrt{ap^2}} = \dfrac{\sqrt{a}}{\sqrt{a}\,p} = \dfrac{1}{p}$ or $m_T = \dfrac{\mathrm{d}y}{\mathrm{d}x} = \dfrac{4a}{2(2ap)} = \dfrac{1}{p}$	A1
	$y - 2ap = \dfrac{1}{p}\left(x - ap^2\right)$ Or $y = mx + c \Rightarrow 2ap = \dfrac{1}{p}\left(ap^2\right) + c \Rightarrow c = \cdots (ap)$	M1
	$py - 2ap^2 = x - ap^2 \Rightarrow py = x + ap^2$ Or $\Rightarrow y = \dfrac{1}{p}x + ap \Rightarrow py = x + ap^2$	A1 *
		(4)
(b)	$B\left(-a, \frac{5}{6}a\right) \Rightarrow p\left(\frac{5}{6}a\right) = -a + ap^2$ or $p\left(\frac{5}{6}a\right) = x + ap^2$ or $py = -a + ap^2$	M1
	$\Rightarrow 5ap = -6a + 6ap^2 \left(\Rightarrow 6p^2 - 5p - 6 = 0\right)$	A1
	$6p^2 - 5p - 6 = 0 \Rightarrow p = \ldots$ leading to $p = \ldots$	M1
	$\Rightarrow \left\{p = -\dfrac{2}{3}\ (\text{reject})\right\}\ p = \dfrac{3}{2}$	A1
	$0 = x + a\left(\dfrac{3}{2}\right)^2$	M1
	$x = -\dfrac{9a}{4}$	A1
		(6)
(c)	When $p = \dfrac{3}{2}$, $y_P = 2a\left(\dfrac{3}{2}\right) = 3a$ $\text{Area}(OPD) = \dfrac{1}{2}\left(\dfrac{9a}{4}\right)(3a) = \dfrac{27a^2}{8}$ Or $\text{Area}(OPD) = \dfrac{1}{2}\begin{vmatrix} 0 & \frac{9a}{4} & -\frac{9a}{4} & 0 \\ 0 & 3a & 0 & 0 \end{vmatrix} = \dfrac{1}{2} \times 3a \times \dfrac{9a}{4}$	M1A1
		(2)
		Total 12

Notes

(a)

M1: $\frac{\mathrm{d}y}{\mathrm{d}x} = \pm k x^{-\frac{1}{2}}$ or $k y \frac{\mathrm{d}y}{\mathrm{d}x} = c$ or $\frac{\text{their } \frac{\mathrm{d}y}{\mathrm{d}t}}{\text{their } \frac{\mathrm{d}x}{\mathrm{d}t}}$

A1: $\frac{\mathrm{d}y}{\mathrm{d}x} = \frac{1}{p}$

M1: Applies $y - 2ap = (\text{their } m_T)(x - ap^2)$ Where $(\text{their } m_T)$ is a function of p and has come from calculus or applies $y = mx + c$, substitutes $P(ap^2, 2ap)$ and makes progress to find the c

A1*: Obtains the printed result with at least one line of intermediate working and no incorrect work seen.
E.g. Cannot go from $y - 2ap = \frac{1}{p}(x - ap^2)$ directly to the printed answer

(b)

M1: Substitutes $x = -a$ or $y = \frac{5}{6}a$ or both into **their** equation **(**or their rearranged equation**)** or the printed answer

A1: Correct equation **in any form** with $x = -a$ and $y = \frac{5}{6}a$

M1: Attempts to solve their 3TQ in p having substituted $x = -a$ and $y = \frac{5}{6}a$ (Note that this question has the less strict calculator warning, so that calculators may be used for general processing, but not to formulate a complete solution to the question, so we can allow a calculator to be used here to solve the 3TQ)

A1: $p = \frac{3}{2}$ (Can just be stated from a correct quadratic)

M1: Substitutes their "$p = \frac{3}{2}$" and $y = 0$ into **their** equation **(**or their rearranged equation**)** or the printed answer

A1: $x = -\frac{9a}{4}$

Note: If two values of p are substituted and two values for x are found, and the incorrect value of x is rejected then full marks can be scored in (b). If they don't reject the incorrect value, then the last two A marks are lost.

(c)

M1: Applies $\frac{1}{2}(\text{their } |OD|)(\text{their } y_P \text{ where their } y_p \neq \frac{5}{6}a)$ Allow if $OD < 0$ and a correct method in terms of a and p e.g. $\frac{1}{2} \times -ap^2 \times 2ap$

A1: $\frac{27a^2}{8}$

Useful diagram

