Question	Answer	Mark	AO	Guidance
6	**DR**			For reference T is $(2,8)$ and the tangent is $y = 4x$
	$\frac{dy}{dx} = 2x$	**M1**	**1.1**	Correctly differentiating the equation of the curve
	At $T(a,b)$, $b = (2a)a [= 2a^2]$	**M1**	**3.1a**	Using the fact that T lies on the tangent through the origin to form a second equation of the form $b = \frac{dy}{dx}\|_{x=a} a$ or $b = 2ax$, $a \neq 1$ Condone use of (x,y) here i.e. condone $y = 2x^2$ but not $y = 2x$. Do not allow direct use of $y = 4x$ without supporting working.
	$\Rightarrow 2a^2 = a^2 + 4 \Rightarrow a = \cdots$	**M1**	**3.1a**	Substituting their equation into the curve and attempting to solve Condone $2x^2 = x^2 + 4$ where T is (x,y).
	$a = 2$ [$\Rightarrow b = 8$] [tangent is $y = 4x$]	**A1**	**1.1**	Condone $a = \pm 2$ Dep. on **M1M1M1** (NB candidates who introduce the tangent as $y = 4x$ without supporting working will score **M1M0M1A0** and final **A0** so max. 5/8)
	Alternative method for first 4 marks			
	$x^2 + 4 = kx$	**M1**		Allow any other letter for k (except x)
	$x^2 - kx + 4 = 0$			
	$\left[x = \frac{k \pm \sqrt{k^2 - 16}}{2}\right]$			
	$k^2 - 16 = 0$	**M1**		$b^2 - 4ac = 0$ for their 3-term quadratic.
	$k = 4$	**A1**		Condone $k = \pm 4$ (May see $y = 4x$ as equation of line).
	$x = 2$	**A1**		Dep. on **M1M1**
	$\int (x^2 + 4) - 4x \, dx$	**M1***	**3.1a**	Setting up a correct integral for the shaded region (must have the integral of the curve **and** the line subtracted) using their 2 or a in a tangent of the form $y = 2ax$. Ignore limits for this mark. Allow $\int (x^2 + 4)\,dx - \frac{1}{2} \times 2 \times 8$ (using triangle area) with their 2 or a and their 8 or b (from their tangent and their 2).
	$= \left[\frac{x^3}{3} + 4x - 2x^2\right]$	**A1**	**1.1**	Correct expression integrated correctly. Allow in terms of a. Ignore limits. May see $\left[\frac{x^3}{3} + 4x\right] - 8$. Dep. on previous **M1** only.

$= \left[\frac{2^3}{3} + 4 \times 2 - 2 \times 2^2\right] - [0]$	M1 dep*	2.1	Substituting in their 2 (and 0) correctly to their integrated form – must have a value for a here. May see $\left(\frac{2^3}{3} + 4 \times 2\right)[-0] - 8$.
$= \frac{8}{3}$ or 2.67 (3sf)	A1	1.1	oe (dep. on **all** previous marks)
Alternative method for last 4 marks			
$\frac{1}{2} \times 8 \times 2 - \int \sqrt{y-4}\,dy$	M1*		Setting up a correct integral in the y direction for the shaded region (must have the area of the triangle **and** the curve subtracted) with their $x = \frac{y}{2\times"2"}$. Ignore limits for this mark. Or $\int \frac{y}{4} - \sqrt{y-4}\,dy$
$= 8 - \left[\frac{2}{3}(y-4)^{\frac{3}{2}}\right]$	A1		Correct expression integrated correctly. Ignore limits. Or $\left[\frac{y^2}{8} - \frac{2}{3}(y-4)^{\frac{3}{2}}\right]$
$= 8 - \left[\frac{2}{3}(8-4)^{\frac{3}{2}}\right] - [0]$ $\left[= 8 - \frac{16}{3}\right]$	M1 dep*		Substituting in 4 × their 2 i.e. 8 (and 0) correctly. Or $\left[\frac{y^2}{8}\right]_0^8 - \left[\frac{2}{3}(y-4)^{\frac{3}{2}}\right]_4^8$ but condone $\left[\frac{8^2}{8} - \frac{2}{3}(8-4)^{\frac{3}{2}}\right] - [0]$ (i.e. failing to use two different lower limits explicitly for their values)
$= \frac{8}{3}$ or 2.67 (3sf)	A1		oe (dep. on **all** previous marks)
	[8]		