Question			Answer	Marks	AOs		Guidance
9	(i)		Using $y = f\left(\frac{x}{a}\right)$ $y = \left(\frac{x}{½} - 1\right)^2 = (2x-1)^2$ $= 4x^2 - 4x + 1$	M1 A1 [2]	1.1a 2.1	Allow for 2 instead of ½ used for method mark or attempt to write equation of quadratic that touches axis at (0.5, 0) **AG** Must be a convincing argument that references either stretch or $f(2x)$ or similar	$(2x-1)^2$ seen is sufficient for M1
	(ii)		EITHER C_2 is $y = 4.25x - x^2 - 3$ Normal to $y = 4x^2 - 4x + 1$ $\frac{dy}{dx} = 8x - 4$ At (0.1) $\frac{dy}{dx} = -4$ Gradient of normal is $\frac{1}{4}$ (0, 1) on line so equation of normal is $y = \frac{1}{4}x + 1$ Intersection of normal and C_2 $\frac{1}{4}x + 1 = 4.25x - x^2 - 3$ $4x^2 - 16x + 16 = 0$ EITHER $(x-2)^2 = 0$ OR discriminant $16^2 - 4 \times 4 \times 16 = 0$ Repeated root so the normal is a tangent to C_2	B1 M1 M1 A1 M1 A1 E1 [7]	3.1a 1.1a 1.1b 1.1a 3.1a 1.1b 3.2a	Finding the equation of C_2. Any form Finding the derivative Finding negative reciprocal of their gradient FT their value for derivative Attempt to solve simultaneous equations Repeated factor or root, or zero discriminant seen. Must interpret their solution in the context.	

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			OR C_2 is $y = 4.25x - x^2 - 3$	**B1**		Finding the equation of C_2. Any form	
			Normal to $y = 4x^2 - 4x + 1$ $\frac{dy}{dx} = 8x - 4$ At (0.1) $\frac{dy}{dx} = -4$	**M1**		Finding the derivative	
			Gradient of normal is $\frac{1}{4}$	**M1**		Finding negative reciprocal of their gradient	
			Equation of normal is $y = \frac{1}{4}x + 1$	**A1**		FT their value for derivative	
			Point on C_1 where gradient is $\frac{1}{4}$	**M1**		Attempting to find the point on C_1 where tangent parallel to the normal found.	
			$\frac{dy}{dx} = 4.25 - 2x = \frac{1}{4}$ giving $x = 2$ $y = 1.5$	**A1**		Both coordinates required	
			EITHER So the equation of the tangent is $y - \frac{3}{2} = \frac{1}{4}(x - 2)$ Which is the same equation as the normal to C_1	**E1**		Correct equation for the tangent in form that makes it clear it is the same line as the normal.	
			OR show that point (2, 1.5) lies on normal So the normal to C_1 is a tangent to C_2	**(E1)** **[7]**			

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			SPECIAL CASE when the candidate tries to show that the normal to C_2 is a tangent to C_1 C_2 is $y = 4.25x - x^2 - 3$	B1		Finding the equation of C_2. Any form	
			Normal to $y = 4.25x - x^2 - 3$ $\frac{dy}{dx} = 4.25 - 2x$	M1		Finding the derivative	
			At (0, 1) $\frac{dy}{dx} = 4.25$ Gradient of normal is $-\frac{4}{17}$	A1		Finding negative reciprocal of their gradient	
			Equation of normal is $y = -\frac{4}{17}x + 1$	A0			(0, 1) does not lie on C_2
			EITHER point of intersection with C_1 $4x^2 - 4x + 1 = -\frac{4}{17}x + 1$	M1		Attempt to solve simultaneous equations	
			OR Attempt to find both coordinates of the point on C_1 with gradient $-\frac{4}{17}$ $\frac{dy}{dx} = 8x - 4 = -\frac{4}{17}$	(M1)		Attempting to find the point on C_1 where tangent parallel to the normal found. **No further marks are available** **4/7 maximum**	