1	**(i)**		$\left[\frac{dy}{dx}=\right]$ $4 \times 2 + 3$ or 11 isw	**M1***		
			$9 =$ their $(4 \times 2 + 3) \times 2 + c$	**M1dep***	or $y - 9 =$ their $(4 \times 2 + 3) \times (x - 2)$	
			$y = 11x - 13$ or $y = 11x + c$ and $c = -13$ stated isw	**A1**	or $y - 9 = 11(x - 2)$ isw	
				[3]		
1	**(ii)**		$\frac{4x^2}{2} + 3x$	**M1***		
			$[y =]\ 2x^2 + 3x + c$	**A1**	must see "2" and " + c"; may be earned later eg after attempt to find c	
			$9 = 2\times2^2 + 3\times2 + c$	**M1dep***	must include constant, which may be implied by answer	
			$y = 2x^2 + 3x - 5$ cao	**A1**	allow first 4 marks for $y = 2x^2 + 3x + c$ and $c = -5$ stated	
			(1, 0) *and* (–2.5, 0) oe cao	**B1**	or for $x = 1, y = 0$ and $x = -2.5, y = 0$	**B0** for just stating $x = 1$ and $x = -2.5$
			$x = -\frac{3}{4}$	**B1**		
			$y = -\frac{49}{8}$	**B1**	–6.125 or – 6⅛	
				[7]		

1	**(iii)**		substitution to obtain $[y=]\ f(2x)$ in polynomial form	**M1**	$f(x)$ must be the quadratic in x with linear and constant term obtained in part (ii), may be in factorised form	or their $x = 1 \rightarrow$ their 0.5 and their $x = -2.5 \rightarrow$ their $x = -1.25$
			$y = (2x-1)(4x+5)$ or $y = 8x^2 + 6x - 5$ or $y = 2\left(2x+\frac{3}{4}\right)^2 - \frac{49}{8}$	**A1FT**	must be simplified to one of these forms, **FT** their quadratic in x with linear and constant term obtained in part (ii)	hence $y = (2x-1)(4x+5)$ FT their x-intercepts from their quadratic in x with linear and constant term obtained in part (ii)
			$\left(-\frac{3}{8}, -\frac{49}{8}\right)$ oe	**B1** **[3]**	or **FT** their (both non-zero) co-ordinates for minimum point or their quadratic in x with linear and constant term obtained in part (ii)	

2	$[\frac{dy}{dx} =]\ 32x^3$ c.a.o.	**M1**		
	substitution of $x = ½$ in their $\frac{dy}{dx}$	**M1**	[= 4]	must see kx^3
	grad normal = $\frac{-1}{their\,4}$	**M1**		their 4 must be obtained by calculus
	when $x = ½$, $y = 4\ ½$ o.e.	**B1**		
	$y - 4\frac{1}{2} = -\frac{1}{4}(x - \frac{1}{2})$ i.s.w	**A1**	$y = -\frac{1}{4}x + 4\frac{5}{8}$ o.e.	

3	**(i)**	$\frac{dy}{dx} = 4x^3$ when $x = 2$, $\frac{dy}{dx} = 32$ s.o.i. when $x = 2$, $y = 16$ s.o.i. $y = 32x - 48$ c.a.o.	**M1** **A1** **B1** **A1**	i.s.w.
3	**(ii)**	34.481	**2**	**M1** for $\frac{2.1^4 - 2^4}{0.1}$
3	**(iii) (*A*)**	$16 + 32h + 24h^2 + 8h^3 + h^4$ c.a.o.	**3**	**B2** for 4 terms correct **B1** for 3 terms correct
3	**(iii) (*B*)**	$32 + 24h + 8h^2 + h^3$ or ft	**2**	**B1** if one error
3	**(iii) (*C*)**	as $h \to 0$, result $\to$ their 32 from (iii) (B) gradient of tangent is limit of gradient of chord	**1** **1**	

4	**i**	6.1	2	M1 for $\frac{(3.1^2 - 7) - (3^2 - 7)}{3.1 - 3}$ o.e.	2
	ii	$\frac{((3+h)^2 - 7) - (3^2 - 7)}{h}$ numerator = $6h + h^2$ $6 + h$	M1 M1 A1	s.o.i.	3
	iii	as h tends to 0, grad. tends to 6 o.e. f.t.from "6"+h	M1 A1		2
	iv	$y - 2 = \text{"6"}\,(x - 3)$ o.e. $y = 6x - 16$	M1 A1	6 may be obtained from [illegible]	2
	v	At P, $x = 16/6$ o.e. or ft At Q, $x = \sqrt{7}$ 0.021 cao	M1 M1 A1		3

5	(i) ad of chord = $(2^{3.1} - 2^3)/0.1$ o.e. $= 5.74$ c.a.o. (ii) rrect use of A and C where for C, $2.9 < x < 3.1$ answer in range $(5.36, 5.74)$	M1 A1 M1 A1	or chord with ends $x = 3 \pm h$, where $0 < h \leq 0.1$ s.c.1 for consistent use of reciprocal of gradient formula in parts (i) and (ii)	4