Question	Scheme	Marks	AOs
9	Gradient of chord $=\dfrac{(2(x+h)^3+5)-(2x^3+5)}{x+h-h}$	B1	1.1b
		M1	2.1
	$(x+h)^3 = x^3+3x^2h+3xh^2+h^3$	B1	1.1b
	Gradient of chord $=\dfrac{(2(x^3+3x^2h+3xh^2+h^3)+5)-(2x^3+5)}{1+h-1}$		
	$=\dfrac{2x^3+6x^2h+6xh^2+2h^3+5-2x^3-5}{1+h-1}$		
	$=\dfrac{6x^2h+6xh^2+2h^3}{h}$		
	$=6x^2+6xh+2h^2$	A1	1.1b
	$\dfrac{\mathrm{d}y}{\mathrm{d}x}=\lim\limits_{h\to 0}\left(6x^2+6xh+2h^2\right)=6x^2$ and so at P, $\dfrac{\mathrm{d}y}{\mathrm{d}x}=6(1)^2=6$	A1	2.2a
		(5)	
9 Alt 1	Let a point Q have x coordinate $1+h$, so $y_Q=2(1+h)^3+5$	B1	1.1b
	$\left\{P(1,7),\,Q(1+h,\,2(1+h)^3+3)\ \Rightarrow\right\}$		
	Gradient $PQ=\dfrac{2(1+h)^3+5-7}{1+h-1}$	M1	2.1
	$(1+h)^3 = 1+3h+3h^2+h^3$	B1	1.1b
	Gradient $PQ=\dfrac{2(1+3h+3h^2+h^3)+5-7}{1+h-1}$		
	$=\dfrac{2+6h+6h^2+2h^3+5-7}{1+h-1}$		
	$=\dfrac{6h+6h^2+2h^3}{h}$		
	$=6+6h+2h^2$	A1	1.1b
	$\dfrac{\mathrm{d}y}{\mathrm{d}x}=\lim\limits_{h\to 0}\left(6+6h+2h^2\right)=6$	A1	2.2a
		(5)	
		(5 marks)	

Question 9 Notes:	
B1:	$2(x+h)^3+5$, seen or implied
M1:	Begins the proof by attempting to write the gradient of the chord in terms of x and h
B1:	$(x+h)^3 \to x^3+3x^2h+3xh^2+h^3$, by expanding brackets or by using a correct binomial expansion
M1:	Correct process to obtain the gradient of the chord as $\alpha x^2+\beta xh+\gamma h^2$, $\alpha, \beta, \gamma \neq 0$
A1:	Correctly shows that the gradient of the chord is $6x^2+6xh+2h^2$ and applies a limiting argument to deduce when $y=2x^3+5$, $\frac{dy}{dx}=6x^2$. E.g. $\lim_{h \to 0}\left(6x^2+6xh+2h^2\right)=6x^2$. Finally, deduces that at the point P, $\frac{dy}{dx}=6$. **Note:** δx can be used in place of h
Alt 1	
B1:	Writes down the y coordinate of a point close to P. E.g. For a point Q with $x=1+h$, $\{y_Q\}=2(1+h)^3+5$
M1:	Begins the proof by attempting to write the gradient of the chord PQ in terms of h
B1:	$(1+h)^3 \to 1+3h+3h^2+h^3$, by expanding brackets or by using a correct binomial expansion
M1:	Correct process to obtain the gradient of the chord PQ as $\alpha+\beta h+\gamma h^2$, $\alpha, \beta, \gamma \neq 0$
A1:	Correctly shows that the gradient of PQ is $6+6h+2h^2$ and applies a limiting argument to deduce that at the point P on $y=2x^3+5$, $\frac{dy}{dx}=6$. E.g. $\lim_{h \to 0}\left(6+6h+2h^2\right)=6$ **Note:** For Alt 1, δx can be used in place of h