C1 Straight Line Answers

Specimen

9.	$\frac{dy}{dx} = 4x^3 + 1$	B1
	$= 5$ at (1,3).	B1
	Equation is	
	$y - 3 = 5(x - 1)$	M1 (for using gradient)
		A1

2005 Winter

(8) $y = 3x^{\frac{3}{2}} - \frac{32}{x}$

(a) Os yw $x = 4$ yna $y = 3(4)^{\frac{3}{2}} - \frac{32}{4}$

$y = 3(\sqrt{4})^3 - 8$

$y = 3(2)^3 - 8$

$y = 24 - 8$

$y = 16$

$y = 3x^{\frac{3}{2}} - 32x^{-1}$

$\frac{dy}{dx} = 3(\frac{3}{2})x^{\frac{1}{2}} + 32x^{-2}$

$\frac{dy}{dx} = \frac{9}{2}x^{\frac{1}{2}} + 32x^{-2}$

$\frac{dy}{dx} = \frac{9\sqrt{x}}{2} + \frac{32}{x^2}$

Os yw $x = 4$ yna $\frac{dy}{dx} = \frac{9\sqrt{4}}{2} + \frac{32}{4^2}$

$\frac{dy}{dx} = \frac{9 \times 2}{2} + \frac{32}{16}$

$\frac{dy}{dx} = 9 + 2$

$\frac{dy}{dx} = 11$

Hafaliad y Tangiad: $y - y_1 = m(x - x_1)$

$y - 16 = 11(x - 4)$

$y - 16 = 11x - 44$

$y = 11x - 28$

(b) Graddiant y Tangiad = 11

Graddiant y Normal = $-\frac{1}{11}$ (negatif y cilydd)

Hafaliad y Normal: $y - y_1 = m(x - x_1)$

$y - 16 = -\frac{1}{11}(x - 4)$

$11y - 176 = -x + 4$

$11y + x - 180 = 0$

2005 Summer

6. (a) $16.\frac{1}{2\sqrt{x}}, -\frac{32}{x^2}$ (o.e) B1, B1

$\frac{dy}{dx} = \frac{8}{2} - \frac{32}{16} = 2$ B1 (C.A.O.)

(b) Slope of normal $= -\frac{1}{2}$ B1 $\left(\frac{-1}{\text{candidate's } \frac{dy}{dx}}\right)$

When $x=4$, $y = 16\times2 + \frac{32}{4} + 2$

$= 42$ B1 (C.A.O.)

2006 Winter

3. $\frac{dy}{dx} = 8x - 7$ B1 (correct differentiation)

$= 9$ at $(2, 4)$ B1 (numerical result, F.T. one slip)

Gradient of normal $= -\frac{1}{9}$ M1 $\left(\frac{-1}{\text{gradient of tgt}}\right)$

Equation is $y - 4 = -\frac{1}{9}(x - 2)$ A1 (F.T. candidate's gradient of tangent)

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2006 Summer

3.	(*a*)	An attempt to find $\frac{dy}{dx}$	M1
		$\frac{dy}{dx} = 2x - 4$	A1
		Value of $\frac{dy}{dx}$ at $A = -2$ (f.t. candidate's $\frac{dy}{dx}$)	A1
		Equation of tangent at A: $y - 4 = -2(x - 1)$ (or equivalent) (f.t. one error)	A1
	(*b*)	Gradient of normal × Gradient of tangent = −1	M1
		Equation of normal at A: $y - 4 = \frac{1}{2}(x - 1)$ (or equivalent) (f.t. candidate's numerical value for $\frac{dy}{dx}$)	A1

2007 Winter

(*b*)	$\frac{dy}{dx} = 3$ at $x = 2$	B1
	Gradient of normal = $\frac{-1}{\text{candidate's value for } \frac{dy}{dx}}$	M1
	Equation of normal: $y - 1 = -\frac{1}{3}(x - 2)$ (or equivalent) (f.t. candidate's numerical value for $\frac{dy}{dx}$)	A1

2007 Summer

4.	(*a*)	An attempt to differentiate, at least one non-zero term correct	M1
		$\frac{dy}{dx} = -16x^{-2} + 3$	A1
		An attempt to substitute $x = 4$ in expression for $\frac{dy}{dx}$	m1
		When $x = 4$, $\frac{dy}{dx} = -1 + 3 = 2$	A1
		Equation of tangent is $y - 18 = 2(x - 4)$ (f.t. if M1 and m1 both awarded)	A1

2008 Winter

3. $\frac{dy}{dx} = 4x - 10$

(an attempt to differentiate, at least one non-zero term correct) M1

An attempt to substitute $x = 3$ in candidate's expression for $\frac{dy}{dx}$ m1

Gradient of tangent at $P = 2$ (c.a.o.) A1

Equation of tangent at P: $y - 4 = 2(x - 3)$ (or equivalent)

(f.t. candidate's value for $\frac{dy}{dx}$ provided both M1 and m1 awarded) A1

2008 Summer

3. $\frac{dy}{dx} = 6x - 8$

(an attempt to differentiate, at least one non-zero term correct) M1

An attempt to substitute $x = 2$ in candidate's expression for $\frac{dy}{dx}$ m1

Value of $\frac{dy}{dx}$ at $P = 4$ (c.a.o.) A1

Gradient of normal = $\dfrac{-1}{\text{candidate's value for } \frac{dy}{dx}}$ m1

y-coordinate of $P = 3$ B1

Equation of normal to C at P: $y - 3 = -{}^{1}/_{4}(x - 2)$ (or equivalent) A1

(f.t. **one** slip in **either** candidate's value for $\frac{dy}{dx}$ **or** candidate's value for the y-coordinate at P provided M1and both m1's awarded)

2009 Winter

3. (*a*) $\frac{dy}{dx} = 2x - 9$ (an attempt to differentiate, at least one non-zero term correct) M1

An attempt to substitute $x = 6$ in candidate's expression for $\frac{dy}{dx}$ m1

Gradient of tangent at $P = 3$ (c.a.o.) A1

Equation of tangent at P: $y - (-5) = 3(x - 6)$ (or equivalent)

(f.t. candidate's value for $\frac{dy}{dx}$ provided both M1 and m1 awarded) A1

(*b*) Use of gradient of tangent at $Q \times {}^{1}/_{7} = -1$ M1

Equating candidate's expression for $\frac{dy}{dx}$ and candidate's value for gradient of tangent at Q m1

$2x - 9 = -7 \Rightarrow x = 1$ (f.t. candidate's expression for $\frac{dy}{dx}$) A1

2009 Summer

3. $\frac{dy}{dx} = 4x + 6$ (an attempt to differentiate, at least one non-zero term correct) M1

An attempt to substitute $x = -1$ in candidate's expression for $\frac{dy}{dx}$ m1

Gradient of tangent at $P = 2$ (c.a.o.) A1

y-coordinate at $P = 3$ B1

Equation of tangent at P: $y - 3 = 2[x - (-1)]$ (or equivalent)

(f.t. one slip provided both M1 and m1 awarded) A1

2010 Winter

3. An attempt to differentiate, at least one non-zero term correct M1

$\frac{dy}{dx} = 6 \times -2 \times x^{-3} + \frac{7}{4}$ A1

An attempt to substitute $x = 2$ in candidate's derived expression for $\frac{dy}{dx}$ M1

Value of $\frac{dy}{dx}$ at $P = \frac{1}{4}$ (c.a.o.) A1

Gradient of normal = $\frac{-1}{\text{candidate's derived value for } \frac{dy}{dx}}$ M1

Equation of normal to C at P: $y - 3 = -4(x - 2)$ (or equivalent)

(f.t. candidate's value for $\frac{dy}{dx}$ provided all three M1's are awarded) A1

2010 Summer

3. (*a*) $\frac{dy}{dx} = 2x - 8$

An attempt to differentiate, at least one non-zero term correct) M1

An attempt to substitute $x = 3$ in candidate's expression for $\frac{dy}{dx}$ m1

Value of $\frac{dy}{dx}$ at $P = -2$ (c.a.o.) A1

Gradient of normal = $\frac{-1}{\text{candidate's value for } \frac{dy}{dx}}$ m1

Equation of normal to C at P: $y - (-5) = {}^1/_2(x - 3)$ (or equivalent)

(f.t. candidate's value for $\frac{dy}{dx}$ provided M1 and both m1's awarded) A1

(*b*) Putting candidate's expression for $\frac{dy}{dx} = 4$ M1

x-coordinate of $Q = 6$ A1

y-coordinate of $Q = -2$ A1

$c = -26$ A1

(f.t. candidate's expression for $\frac{dy}{dx}$ and at most one error in the enumeration of the coordinates of Q for all three A marks provided both M1's are awarded)

2011 Winter

8. (*a*) y-coordinate at $P = 2$ B1

$\frac{dy}{dx} = 2x - 6$ (an attempt to differentiate, at least one non-zero term correct) M1

An attempt to substitute $x = 5$ in candidate's expression for $\frac{dy}{dx}$ m1

Use of candidate's numerical value for $\frac{dy}{dx}$ as gradient of tangent at P m1

Equation of tangent at P: $y - 2 = 4(x - 5)$ (or equivalent)
(f.t. only candidate's value for y-coordinate at P) A1

(*b*) (i) $x^2 - 6x + 7 = \frac{1}{2}x - 2$ (o.e.) M1

An attempt to collect terms, form and solve quadratic equation m1

$2x^2 - 13x + 18 = 0 \Rightarrow (x - 2)(2x - 9) = 0 \Rightarrow x = 2, x = 4\frac{1}{2}$
(both values, c.a.o.) A1

When $x = 2, y = -1$, when $x = 4\frac{1}{2}, y = \frac{1}{4}$
(both values f.t. one numerical slip) A1

(ii) Values of $\frac{dy}{dx}$ at points of intersection of C and L are 3 and -2
(at least one correct, f.t. candidate's derived x-coordinates at points of intersection of C and L) B1

Use of the fact that
gradient of normal $= -\frac{1}{\frac{dy}{dx}}$
at at least one of the candidate's points of intersection of C and L M1

Normal to C at point with x-coordinate 2 has gradient ½
(c.a.o.) A1

Since gradient of L = ½, L and this normal must coincide A1

2011 Summer

3. y-coordinate at $P = -5$ B1

$\frac{dy}{dx} = 6x - 9$ (an attempt to differentiate, at least one non-zero term correct) M1

An attempt to substitute $x = 2$ in candidate's expression for $\frac{dy}{dx}$ m1

Use of candidate's numerical value for $\frac{dy}{dx}$ as gradient of tangent at P m1

Equation of tangent at P: $y - (-5) = 3(x - 2)$ (or equivalent)
(f.t. only candidate's derived value for y-coordinate at P) A1

2012 Winter

3. y-coordinate of $P = 7$ B1

$\frac{dy}{dx} = 4x - 8$

(an attempt to differentiate, at least one non-zero term correct) M1

An attempt to substitute $x = 3$ in candidate's expression for $\frac{dy}{dx}$ m1

Value of $\frac{dy}{dx}$ at $P = 4$ (c.a.o.) A1

Gradient of normal = $\frac{-1}{\text{candidate's value for } \frac{dy}{dx}}$ m1

Equation of normal to C at P: $y - 7 = -{}^1/_4(x - 3)$ (or equivalent)

(f.t. candidate's value for $\frac{dy}{dx}$ and the candidate's derived y-value at $x = 3$ provided M1 and both m1's awarded) A1

2012 Summer

3. (*a*) $\frac{dy}{dx} = 4x - 11$ (an attempt to differentiate, at least one non-zero term correct) M1

An attempt to substitute $x = 2$ in candidate's expression for $\frac{dy}{dx}$ m1

Use of candidate's numerical value for $\frac{dy}{dx}$ as gradient of tangent at P m1

Equation of tangent at P: $y - (-1) = -3(x - 2)$ (or equivalent)

(c.a.o.) A1

(*b*) Gradient of tangent at $Q = 9$ B1

An attempt to equate candidate's expression for $\frac{dy}{dx}$ and candidate's derived value for gradient of tangent at Q M1

$4x - 11 = 9 \Rightarrow x = 5$

(f.t. one error in candidate's expression for $\frac{dy}{dx}$) A1

2013 Winter

3. y-coordinate at $P = -2$ B1

$\frac{dy}{dx} = 6x - 14$ (an attempt to differentiate, at least one non-zero term correct) M1

An attempt to substitute $x = 3$ in candidate's expression for $\frac{dy}{dx}$ m1

Use of candidate's numerical value for $\frac{dy}{dx}$ as gradient of tangent at P m1

Equation of tangent at P: $y - (-2) = 4(x - 3)$ (or equivalent)
(f.t. only candidate's derived value for y-coordinate at P) A1

2013 Summer

3. (*a*) $\frac{dy}{dx} = 4x - 10$ (an attempt to differentiate, at least one non-zero term correct) M1

An attempt to substitute $x = 3$ in candidate's expression for $\frac{dy}{dx}$ m1

Value of $\frac{dy}{dx}$ at $P = 2$ (c.a.o.) A1

Use of gradient of normal = $\frac{-1}{\text{candidate's value for } \frac{dy}{dx}}$ m1

Equation of normal at P: $y - (-5) = -{}^{1}/_{2}(x - 3)$ (or equivalent)
(f.t. candidate's value for $\frac{dy}{dx}$ provided M1 and both m1's awarded) A1

(*b*) An attempt to put candidate's expression for $\frac{dy}{dx} = 0$ M1

x-coordinate of $Q = 2{\cdot}5$
(f.t. one error in candidate's expression for $\frac{dy}{dx}$) A1

2014 Winter

3. An attempt to differentiate, at least one non-zero term correct M1

$\frac{dy}{dx} = 20 \times -1 \times x^{-2} + 4x$ A1

An attempt to substitute $x = 2$ in candidate's derived expression for $\frac{dy}{dx}$ m1

Value of $\frac{dy}{dx}$ at $P = 3$ (c.a.o.) A1

Gradient of normal = $\frac{-1}{\text{candidate's derived value for } \frac{dy}{dx}}$ m1

Equation of normal to C at P: $y - 7 = -\frac{1}{3}(x - 2)$ (or equivalent)

(f.t. candidate's value for $\frac{dy}{dx}$ provided all three method marks are awarded) A1

2014 Summer

3. An attempt to differentiate, at least one non-zero term correct M1

$\frac{dy}{dx} = 20 \times -1 \times x^{-2} + 4x$ A1

An attempt to substitute $x = 2$ in candidate's derived expression for $\frac{dy}{dx}$ m1

Value of $\frac{dy}{dx}$ at $P = 3$ (c.a.o.) A1

Gradient of normal = $\frac{-1}{\text{candidate's derived value for } \frac{dy}{dx}}$ m1

Equation of normal to C at P: $y - 7 = -\frac{1}{3}(x - 2)$ (or equivalent)

(f.t. candidate's value for $\frac{dy}{dx}$ provided all three method marks are awarded) A1

2015

3. (*a*) y-coordinate of $P = -4$ B1

$\frac{dy}{dx} = 3x^2 - 2x - 13$

(an attempt to differentiate, at least one non-zero term correct) M1

An attempt to substitute $x = 2$ in candidate's expression for $\frac{dy}{dx}$ m1

Value of $\frac{dy}{dx}$ at $P = -5$ (c.a.o.) A1

Gradient of normal $= \frac{-1}{\text{candidate's value for } \frac{dy}{dx}}$ m1

Equation of normal to C at P: $y - (-4) = {}^1/_5(x - 2)$ (or equivalent)
(f.t. candidate's value for $\frac{dy}{dx}$ and the candidate's derived y-value at $x = 2$ provided M1 and both m1's awarded) A1

(*b*) Putting candidate's expression for $\frac{dy}{dx} = -8$ M1

An attempt to collect terms, form and solve quadratic equation in a (or x) either by correct use of the quadratic formula or by getting the equation into the form $(ma + n)(pa + q) = 0$, with $m \times p =$ candidate's coefficient of a^2 and $n \times q =$ candidate's constant m1

$3a^2 - 2a - 5 = 0 \Rightarrow a = -1$ or $\frac{5}{3}$ (both values) (c.a.o.) A1

2016

3. y-coordinate at $P = 11$ B1

An attempt to differentiate, at least one non-zero term correct M1

$\frac{dy}{dx} = 12 \times (-2) \times x^{-3} + 7$ A1

An attempt to substitute $x = 2$ in candidate's derived expression for $\frac{dy}{dx}$ m1

Use of candidate's derived numerical value for $\frac{dy}{dx}$ as gradient in the equation of the tangent at P m1

Equation of tangent to C at P: $y - 11 = 4(x - 2)$ (or equivalent)
(f.t. only candidate's derived value for y-coordinate at P) A1

2017

3. (*a*) $\frac{dy}{dx} = \frac{3x}{2} - 4$ (an attempt to differentiate, at least one non-zero term correct) M1

An attempt to substitute $x = 6$ in candidate's expression for $\frac{dy}{dx}$ m1

Value of $\frac{dy}{dx}$ at $P = 5$ (c.a.o.) A1

Equation of tangent at P: $y - (-7) = 5(x - 6)$ (or equivalent)

(f.t. candidate's value for $\frac{dy}{dx}$ provided M1 and m1 both awarded) A1

(*b*) Use of gradient of tangent = $\dfrac{-1}{\text{gradient of normal}}$ (o.e.) M1

An attempt to put candidate's expression for $\frac{dy}{dx} = \frac{1}{2}$

(f.t candidate's derived value for gradient of tangent) m1

x-coordinate of $Q = 3$ (c.a.o.) A1