



CAMI Mathematics: Grade 12

12.5 Calculus

12.5 Tangent and normal

1. Gradient of a tangent or normal

- (a) Determine the gradient of $f(x)$ at $x = -2$ if $f(x) = 2x^2 + 2$.
- (b) Determine the gradient of $f(x)$ at $x = 1$ if $f(x) = -x^2 - 2x - 4$.
- (c) Determine the gradient of $f(x)$ at $x = -2$ if $f(x) = -3x^2 - 5x - 5$.
- (d) Determine the gradient of $f(x)$ at $x = 1$ if $f(x) = -3x^2 - 1$.
- (e) Determine the gradient of $f(x)$ at $x = 3$ if $f(x) = -x^2 + 3x - 1$.

2. Equation of a tangent or normal

- (a) Determine the x-value where the gradient of $f(x)$ is -3 and $f(x) = -x^2 - x + 5$.
- (b) Determine the gradient of the normal to $f(x)$ at $x = -2$ if $f(x) = x^2 + 5x - 2$.
- (c) Determine the equation of the tangent to $f(x)$ at $x = 1$ if $f(x) = x^2 - x - 1$.
- (d) Determine the equation of the normal to $f(x)$ at $x = -1$ if $f(x) = x^2 + 4x - 4$.
- (e) Determine the x-value where the gradient of $f(x)$ is 2 and $f(x) = -2x^2 + 2x + 5$.



MEMO

1. Gradient of a tangent or normal [5.7.1.1]

(a) $f(x) = 2x^2 + 2$
 $f'(x) = 4x$
 $f'(-2) = 4(-2) = -8$

(b) $f(x) = -x^2 - 2x - 4$
 $f'(x) = -2x - 2$
 $f'(1) = -2(1) - 2 = -4$

(c) $f(x) = -3x^2 - 5x - 5$
 $f'(x) = -6x - 5$
 $f'(-2) = -6(-2) - 5 = 7$

(d) $f(x) = -3x^2 - 1$
 $f'(x) = -6x$
 $f'(1) = -6(1) = -6$

(e) $f(x) = -x^2 + 3x - 1$
 $f'(x) = -2x + 3$
 $f'(3) = -2(3) + 3 = -3$

2. Equation of a tangent or normal [5.7.1.2]

(a) $f(x) = -x^2 - x + 5$
 $f'(x) = -2x - 1$
 $-2x - 1 = -3$
 $-2x = -2$
 $\therefore x = 1$

(b) $f(x) = x^2 + 5x - 2$
 $f'(x) = 2x + 5$
 $f'(-2) = 2(-2) + 5 = 1$
 $m_{normal} = -1$



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(c) $f(x) = x^2 - x - 1$ and $f(1) = -1$

$$f'(x) = 2x - 1$$

$$f'(1) = 2(1) - 1 = 1$$

Tangent :

$$y = x + c$$

$$-1 = (1) + c$$

$$\therefore c = -2$$

$$y = x - 2$$

(d) $f(x) = x^2 + 4x - 4$ and $f(-1) = -7$

$$f'(x) = 2x + 4$$

$$f'(-1) = 2(-1) + 4 = 2$$

Normal :

$$y = \frac{-1}{2}x + c$$

$$-7 = \frac{-1}{2}(-1) + c$$

$$\therefore c = -\frac{15}{2}$$

$$y = -\frac{1}{2}x - \frac{15}{2}$$

(e) $f(x) = -2x^2 + 2x + 5$

$$f'(x) = -4x + 2$$

$$2 = -4x + 2$$

$$4x = 0$$

$$\therefore x = 0$$