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COURSE: MAT 104
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$y = 2x^2$ at the point $(1,2)$

Sol

$y = 2x^2$

$\frac{dy}{dx} = 4x \quad (1,2)$

$m = \frac{dy}{dx}\Big|_{x=1}$

$m = 4$

Equation of the tangent

$(y - y_1) = m(x - x_1)$

$(y - 2) = 4(x - 1)$

$y - 2 = 4x - 4$

$y - 2 - 4x + 4 = 0$

$y - 4x + 2 = 0 \quad \therefore y - 4x + 2 = 0$

Equation of the normal

$(y - y_1) = \frac{-1}{m}(x - x_1)$

$m = \frac{-1}{m} = \frac{-1}{4}$

$y - 2 = \frac{-1}{4}(x - 1)$

$4y - 8 = -x + 1$

$4y - 8 + x - 1 = 0$

$4y + x - 9 = 0$

2. $y = 3x^2 - 2x$ at the point $(2,8)$

Sol

$y = 3x^2 - 2x$ $\quad (2,8)$

$\frac{dy}{dx} = 6x - 2$

$m = \left.\frac{dy}{dx}\right|_{x=2}$

$m = 6(2) - 2 = 10$

(a) Equation of the tangent

$(y - y_1) = m(x - x_1)$

$(y - 8) = 10(x - 2)$

$y - 8 = 10x - 20$

$y - 8 - 10x + 20 = 0$

$y - 10x + 12 = 0$

(b) Equation of the normal

$(y - y_1) = \frac{-1}{m}(x - x_1)$

$m = \frac{-1}{m} = \frac{-1}{10}$

$(y - 8) = \frac{-1}{10}(x - 2)$

$10y - 80 = -x + 2$

$10y - 80 + x - 2 = 0$

$10y + x - 82 = 0$

3) $y = \frac{x^3}{2}$ $(-1, -\frac{1}{2})$

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

$m_1 = \frac{3}{2}x^2$ = Gradient

Gradient at point $x = -1$

$m_1 = \frac{3}{2} \times 1 = \frac{3}{2}$

The equation of the tangent at the point (x_1, y_1)

$= y - y_1 = m(x - x_1)$

$y + \frac{1}{2} = \frac{3}{2}(x+1)$

$y + \frac{1}{2} = \frac{3(x+1)}{2}$

$2y + 1 = 3x + 3$

$2y = 3x + 2$

$y = \frac{1}{2}(3x+2)$

The equation of the normal

$m_1 m_2 = -1$

$\frac{3}{2} m_2 = -1$

$m_2 = \frac{-2}{3}$ = gradient of the normal

$y - y_1 = m(x - x_1)$

$y + \frac{1}{2} = \frac{-2}{3}(x+1)$

$3(y + \frac{1}{2}) = -2(x+1)$

$3y + \frac{3}{2} = -2x - 2$

$y = \frac{-4x - 7}{6}$

4) $y = 1 + x - x^2$ at the point $(-2, -5)$

Sol

$y = 1 + x - x^2$

$\frac{dy}{dx} = 1 - 2x$

$m = \frac{dy}{dx}\Big|_{x=(-2)}$

$m = 1 - 2(-2) = 5$

(a) Equation of the tangent

$(y - y_1) = m(x - x_1)$

$(y - (-5)) = 5(x - (-2))$

$(y + 5) = 5(x + 2)$

$y + 5 = 5x + 10$

$y + 5 - 5x - 10 = 0$

$y - 5x - 5 = 0$

(b) Equation of the normal

$(y - y_1) = \frac{-1}{m}(x - x_1)$

$m = \frac{-1}{m} = \frac{-1}{5}$

$(y - (-5)) = \frac{-1}{5}(x - (-2))$

$(y + 5) = \frac{-1}{5}(x + 2)$

$5y + 25 = -x - 2$

$5y + 25 + x + 2 = 0$

$5y + x + 27 = 0$

$y = \frac{1}{x}$ $\qquad (3, \tfrac{1}{3})$

$\frac{dy}{dx} = \frac{-1}{x^2}$ $\qquad x \quad y$

$m_1 = -\frac{1}{x^2}$ = Gradient

Gradient at point $x = 3$

$m_1 = \frac{-1}{9}$

$y - y_1 = m(x - x_1)$

$y - \frac{1}{3} = \frac{-1}{9}(x - 3)$

$y - \tfrac{1}{3} = \frac{-1}{9}(x - 3)$

$y - \tfrac{1}{3} = \frac{-x + 3}{9}$

$9y - 3 = 3 - x$

$9y = 6 - x$

$y = \tfrac{1}{9}(6 - x)$ equation of the tan

equation of the normal

$m_1 m_2 = -1$

$-\tfrac{1}{9} m_2 = -1$

$-m_2 = -9$

$m_2 = 9$ gradient of the normal

$y - y_1 = m_2(x - x_1)$

$y - \tfrac{1}{3} = 9(x - 3)$

$y - \tfrac{1}{3} = 9x - 27$

$y = \frac{9x}{1} - \frac{27}{1} + \frac{1}{3}$

$y = 27x - 81 + 1$

$y = \tfrac{1}{3}(27x - 80)$

$4y - 8$ $\qquad \equiv$

$4y - 8 + x$