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COURSE: MAT 104 ASSIGNMENT

DEPT: MEDICINE & SURGERY

For the curves in problem 1 to 5, at the points given, find (a) the equation of the tangent and (b) the equation of the normal.

1) $y = 2x^2$ at the point (1, 2)

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

3) $y = x^3/2$ at the point (-1, -1/2)

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

5) $y = 1/x$ at the point (3, 1/3)

SOLUTION

1) $y = 2x^2$ at the point (1, 2)

$$m = \frac{dy}{dx} = 4x$$

(a) $\left. \frac{dy}{dx} \right|_{x=1} = 4(1) = 4$

$$m = 4, x = 1, y = 2$$

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

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

$$y - 2 = 4x - 4$$

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

$$y - 4x + 2 = 0 \quad \{ \text{Equation of the tangent} \}$$

(b) The equation of the normal

$$m_1, m_2 = -1$$

$$m_2 = \frac{-1}{m_1} = \frac{-1}{4}$$

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

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

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

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

$$4y + x - 9 = 0 \quad \{ \text{Equation of the normal} \}$$

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

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

$$\left. \frac{dy}{dx} \right|_{x=2} = 6(2) - 2 = 12 - 2 = 10$$

$$m = 10, x = 2, y = 8$$

④ $y - y_1 = m(x - x_1)$

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

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

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

$$y - 10x + 12 = 0 \quad \{ \text{Equation of the tangent} \}$$

⑤ $m_1, m_2 = -1$

$$m_2 = \frac{-1}{m_1} = \frac{-1}{10}$$

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

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

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

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

$$10y + x - 82 = 0 \quad \{ \text{Equation of the normal} \}$$

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

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

$$\left. \frac{dy}{dx} \right|_{x=-1} = \frac{3(-1)^2}{2} = \frac{3}{2}$$

$$m = \frac{3}{2}, x = -1, y = -\frac{1}{2}$$

⑥ $y - y_1 = m(x - x_1)$

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

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

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

$$2y + 1 = 3x + 3$$

$$2y + 1 - 3x - 3 = 0$$

$$2y - 3x - 2 = 0 \quad \{ \text{Equation of the tangent} \}$$

⑥ $m_1 m_2 = -1$

$$m_2 = \frac{-1}{m_1} = -1 \div \frac{3}{2} = -\frac{2}{3}$$

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

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

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

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

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

$$3y + \frac{3}{2} + 2x + 2 = 0$$

$$3y + 2x + \frac{7}{2} = 0 \quad \{ \text{Equation of the normal} \}$$

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

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

$$dx$$

$$m = \frac{dy}{dx} \Big|_{x=-2} = 1 - 2(-2) = 1 + 4 = 5$$

$$m = 5, x = -2, y = -5$$

⑥ $y - y_1 = m(x - x_1)$

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

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

$$y + 5 = 5x + 10$$

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

$$y - 5x - 5 = 0 \quad \{ \text{Equation of the tangent} \}$$

⑥ $m_1 m_2 = -1$

$$m_2 = -\frac{1}{m_1} = -\frac{1}{5}$$

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

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

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

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

$$5y + x + 27 = 0 \quad \{ \text{Equation of the normal} \}$$

5. $y = 1/x$ at the point $\{3, \frac{1}{3}\}$

$$\frac{dy}{dx} = x^{-1} = -1 \times x^{-1-1} = -1x^{-2} = -x^{-2} \therefore m = -x^{-2}$$

$$\left. \frac{dy}{dx} \right|_{x=3} = -x^{-2} = (-3)^{-2} = \frac{1}{(-3)^2} = \frac{1}{9}$$

$$m = \frac{1}{9}, x = 3, y = \frac{1}{3}$$

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

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

$$9y - 3 = x - 3$$

$$9y - 3 - x + 3 = 0$$

$$9y - x = 0 \quad \{ \text{Equation of the tangent} \}$$

(b) $m_2 = -\frac{1}{m_1} = -1 \div \frac{1}{9} = -9$

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

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

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

$$y - \frac{1}{3} + 9x - 27 = 0$$

$$y + 9x - 82/3 = 0$$

$$3y + 27x - 82 = 0 \quad \{ \text{Equation of the normal} \}$$