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Mathe Assignment

1) 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 $(1, 2)$

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

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

$$x_1 = 1, \quad y_1 = 2$$

a) Equation of tangent; $y - y_1 = m(x - x_1)$
 $y - 2 = 4(x - 1)$

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

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

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

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

b) Equation of normal $y - y_1 = \frac{-1}{m}(x - x_1)$

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

$$= 4y - 8 = -1(x - 1)$$

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

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

$$4y + x - 9 = 0$$

∴ Equation of normal = $4y + x - 9 = 0$ (3)

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

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

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

$$= 12 - 2 = 10$$

$$m = 10$$

$$x_1 = 2, \quad y_1 = 8$$

(3) Equation of tangent = $y - y_1 = m(x - x_1)$

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

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

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

Equation of tangent = $y - 10x + 12 = 0$

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

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

$$= 10y - 80 = -1(x - 2)$$

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

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

Problem 3

Equation of normal = $10y - x - 82 = 0$

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

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

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

$$m = 3/2$$

$$x_1 = -1 \quad y_1 = -\frac{1}{2}$$

④ Equation of tangent = $y - y_1 = m(x - x_1)$
 $= y + \frac{1}{2} = \frac{3}{2}(x + 1)$
 ~~$= y + \frac{1}{2}$~~

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

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

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

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

⑤ Equation of normal = $y - y_1 = -\frac{1}{m}(x - x_1)$
 $= y + \frac{1}{2} = -\frac{1}{3/2}(x - x_1)$

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

$$= 6y + 3 = -4(x + 1)$$

$$= 6y + 3 = -4x - 4$$

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$$\text{Equation of normal} = 6y + 13 = -4x - 4$$

$$= 6y + 4x + 3 + 4 = 0$$

$$\text{Equation of normal} = 6y + 4x + 7 = 0$$

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

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

$$\frac{dy}{dx} = 1 - 2(-2)$$

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

$$= 1 + 4 = 5$$

$$m = 5$$

$$x_1 = -2, \quad y_1 = -5$$

① Equation of tangent = $y - y_1 = m(x - x_1)$

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

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

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

Equation of tangent = $y - 5x - 5 = 0$

② Equation of normal = $y - y_1 = -\frac{1}{m}(x - x_1)$

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

$$= 5y + 25 = -1(x + 2)$$

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

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

Equation of normal = $5y + x + 27 = 0$

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

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

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

$$m = -\frac{1}{3}$$

$$x_1 = 3, \quad y_1 = \frac{1}{3}$$

⑥ Equation of tangent = $y - y_1 = m(x - x_1)$
 $= y - \frac{1}{3} = -\frac{1}{3}(x - 3)$
 $= 3y - 1 = -1(x - 3)$
 $= 3y - 1 = -x + 3$
 $= 3y + x - 1 - 3 = 0$

Equation of tangent = $3y + x - 4 = 0$

⑦ Equation of normal = $y - y_1 = -\frac{1}{m}(x - x_1)$
 $= y - \frac{1}{3} = -\frac{1}{-\frac{1}{3}}(x - 3)$
 $= y - \frac{1}{3} = 3(x - 3)$
 $= 3y - 1 = 9(x - 3)$
 $= 3y - 1 = 9x - 27$

$$\therefore 3y - 9x - 1 + 27 = 0$$

Equation of normal = $3y - 9x + 26 = 0$