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

a) For equation at tangent

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

$$m_1 = \frac{dy}{dx}\Big|_{x = x_1}$$

$$m_1 = 4(1) = 4$$

$$y - y_1 = m_1(x - x_1)$$

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

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

$y - 4x + 2 = 0$ is the equation at the tangent.

b) For equation at normal

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

$$y - y_1 = \frac{-1}{m_1}(x - x_1)$$

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

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

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

$\therefore 4y + x - 9 = 0$ is the equation of normal

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

a) For the equation at tangent

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

$$m_1 = \frac{dy}{dx}\Big|_{x = x_1}$$

$$m_1 = 6(2) - 2$$

$$m_1 = 10$$

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

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

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

$y - 10x + 12 = 0$ is the equation at tangent.

b) For the equation at normal

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

$$y - y_1 = \frac{-1}{m_1}(x - x_1)$$

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

$$10(y - 8) = -1(x - 2)$$

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

$\therefore 10y + x - 82 = 0$ is the equation at normal

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

a) For equation at tangent

$\frac{dy}{dx}\left(\frac{x^3}{2}\right)$ Using Quotient Rule

let $x^3 = u$; $2 = v$

$3x^2 = du/dx$; $0 = dv/dx$

$$\frac{dy}{dx} = \frac{V\frac{dy}{dx} - U\frac{dy}{dx}}{V^2}$$

$$\frac{dy}{dx} = \frac{2(3x^2) - (0)}{2^2}$$

$$\frac{dy}{dx} = \frac{6x^2}{4}$$

$$m_1 = \frac{dy}{dx}\Big|x = x_1$$

$$m_1 = \frac{6(-1)^2}{4} = \frac{6}{4} = \frac{3}{2}$$

$$y - y_1 = m_1(x - x_1)$$

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

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

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

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

$2y + 3x$ ' $2y - 3x - 1 = 0$; equation of the tangent

) For equation at normal

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

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

$$y - y_1 = \frac{-1}{m_1}(x - x_1)$$

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

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

$$y + 3/3x + 7/6 = 0$$

(Divide through by 6)

$6y + 4x + 7 = 0$ is the equation of the normal

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

a) For the equation at tangent

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

$m_1 = \frac{dy}{dx} \Big| x - x_1$

$m_1 = -2(-2) + 1 = 5$

$y - y_1 = m_1 (x - x_1)$

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

$y + 5 = 5x + 10$

$y - 5x - 5 = 0$ is the equation at tangent

b) For the equation at normal

$m_2 = -1/m_1 = -1/5$

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

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

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

$5y + 25 = -x - 2$

$\therefore 5y + x + 27 = 0$ (is the equation at normal)

(a) $y = 1/x \quad (3, 1/3)$

$dy/dx = -x^{-2}$

$m_1 = (-3)^{-2} = -1/9$

$dy/dx \Big| x = 3 \quad = -1/9$

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

$y - 1/3 = -1/9 (x - 3)$

$9y - 3 = -1(x - 3)$

$9y + x - 6 = 0$ (equation of tangent)

b) $y - y_1 = -1/m_1 (x - x_1)$

$y - 1/3 = -(-9)(x - 3)$

$y - 1/3 = 9(x - 3)$

$3y - 1 = 27(x - 3)$

$3y - 1 = 27x - 81$

$3y - 27x + 80$ (equation of normal)