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11. 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
3. $y = x$ 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)

$y = 2x^2$

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

$m = \frac{dy}{dx}/x=1 = 4(1)$

$= 4$

For tangent equation

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

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

$y - 2 = 4x - 4$

$y = 4x - 4 + 2$

$y = 4x - 2$

For normal equation

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

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

$5y - 10 = -x + 1$

$5y = -x + 1 + 10$

~~$5y = -x + 11$~~

$5y = -x + 11$

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

$y = 3x^2 - 2x$

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

$m = \left.\frac{dy}{dx}\right|_{x=2} = 6(2) - 1$

$= 12 - 1$

$= 11$

for tangent equation

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

$y - 8 = 11(x - 2)$

$y - 8 = 11x - 22$

$y = 11x - 22 + 8$

$y = 11x - 14$

for normal equation

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

$y - 8 = \frac{-1}{11}(x - 2)$

$11y - 88 = -x + 2$

$11y = -x + 2 + 88$

$11y = -x + 90$

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

$y = x^{3/2}$

$\frac{dy}{dx} = \frac{3x^{1/2}}{2}$

$m = \frac{dy}{dx}/x = \frac{3(-1)^{1/2}}{2}$

$m = \frac{3(1)}{2}$

$m = 3/2$

For tangent eqn

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

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

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

$2y + 1 = 3x + 1$

$2y = 3x + 1 - 1$

$2y = 3x$

For normal equation

$y - y_1 = -1/m (x - x_1)$

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

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

$3y + 3/2 = -2x - 2$

$3y = -2x - 2 - 3/2$

$3y = -2x - 7/2$

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

$y = 1 + x - x^2$

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

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

$= 1 + 4$

$= 5$

For tangent equation

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

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

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

$y = 5x + 10 - 5$

$y = 5x + 5$

For normal equation

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

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

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

$5y + 25 = -x - 2$

$5y = -x - 2 - 25$

$5y = -x - 27$

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

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

$$m = \frac{dy}{dx}\Big|_{x=3} = \frac{1}{3^2}$$

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

For tangent equation

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

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

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

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

$$9y = x - 0$$

$$9y = x$$

For normal equation

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

$$y - \frac{1}{3} = 1 \div \frac{1}{9}(x - x_1)$$

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

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

$$y - 1 = 27x - 81$$

$$y = 27x - 81 + 1$$

$$y = 27x - 80$$