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Question

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)

$$y = 2x^2$$

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

$$M = dy/dx \mid x = x_1$$

$$m = 4 \quad (1)$$

$$m = 4.$$

a) Equation of the tangent

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

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

$y - 2 = 4x - 4$

$y = 4x - 4 + 2$

$y = 4x - 2$;

$y - 4x + 2 = 0$.

b) Equation of the normal

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

$m_2 = -1/4$

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

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

$y - 2 = -x/4 + 1/4$

multiply through by 4

$4y - 8 = -x + 1$

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

$4y + x - 9 = 0$.

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

$y = 3x^2 - 2x$

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

$m = 6(2) - 2$

$m = 12 - 2$

$m = 10$.

a) Equation of the tangent

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

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

$y - 8 = 10x - 20$

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

$y - 10x + 12 = 0$.

b) Equation of the normal.

$m_2 = -1/m_1$

$m_2 = -1/10$

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

$y - 8 = -x/10 + 1/5$

multiply through by 10.

$10y - 80 = -x + 2$

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

$10y + x - 82 = 0$.

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

$y = \frac{x^3}{2}$

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

$m = dy/dx \mid x = x$

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

$m = 3/2$

a) Equation of the tangent.

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

$y - (-4/2) = 3/2 (x - (-1))$

$y + 4/2 = 3/2 x + 3/2$

multiply through by 2

$2y + 1 = 3x + 3$

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

$2y - 3x - 2 = 0$.

b) Equation of the normal

$m_2 = -1/m_1$

$m_2 = -1/3/2$.

$m_2 = -2/3$

$y + 4/2 = -2/3 (x+1)$

multiply through by 6.

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

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

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

$6y + 4x + 7 = 0$.

4. $y = 1 + x - x^2$ at the point

$(-2, -5)$

$y = 1 + x - x^2$

$dy/dx = 1 - 2x$

$m = 1 - (-2)$

$m = 1 + 2$

$m = 3$.

a) Equation of the tangent.

$y - y_2 = m(x - x_2)$

$y - (-5) = 3(x - (-2))$

$y + 5 = 3(x + 2)$

$y + 5 = 3x + 6$

$y - 3x + 5 - 6 = 0$

$y - 3x - 1 = 0$.

b) Equation of the normal.

$m_2 = -1/m_1$

$m_2 = -1/3$

$y + 5 = -1/3 (x + 2)$

Multiply through by 3

$3y + 15 = -1(x + 2)$

$3y + 15 = -x - 2$

$3y + x + 15 + 2 = 0$

$3y + x + 17 = 0$.

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

$y = 1/x$

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

$m = dy/dx|_{x = x_1}$

$m = -1/3^2$

$m = -1/9$.

a) Equation of the tangent

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

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

multiply through by 9

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

$9y - 3 = x + 3$.

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

$9y + x - 6 = 0$.

b) Equation of the normal

$m_2 = -1/m_1$

$m_2 = -1/-1/9$

$m_2 = 9$.

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

multiply through by 3

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

$3y - 1 = 27x - 81$

$3y - 27x - 1 + 81 = 0$

$3y - 27x + 80 = 0$.