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Maths 104
19/mhs01/333
MHS/MBBS

For the curve from equation 1 to 5, at the points given
(a) Equation of the tangent
(b) 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 $y = 2x^2$, points (1,2)

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

Find the gradient at $x = 1$

$\frac{dy}{dx}\Big|_{x=1} = 4(1) = 4$

$m = 4$

$x_1 = 1, y_1 = 2$

Equation of a tangent

$y - y_1 = m(x - x_1)$
$y - 2 = 4(x - 1)$
$y - 2 = 4x - 4$
$y - 4x + 4 + 4 = 0$
$y - 2x = 0$

Equation of the tangent $= y - 2x = 0$

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

Equation of the tangent $= y - 4x + 2 = 0$

Equation of the normal

$m_1 \cdot m_2 = -1$
$4 \cdot m_2 = -1$
$m_2 = -1/4$

$y - y_1 = m_2(x - x_1)$
$y - 2 = -1/4(x - 1)$
$\frac{y-2}{1} = \frac{-x+1}{4}$
$4y - 8 = -x + 1$
$4y + x - 9 = 0$

Equation of the normal $= 4y + x - 7 = 0$

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

$\frac{dy}{dx} = 3x^2 - 2x = 9x - 2$

Find the gradient at $x = 2$

$\frac{dy}{dx}\Big|_{x=2}$

$m = 9x - 2$

$m = 9(2) - 2$

$m = 18 - 2 = 16$

Equation of a tangent

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

$y - 8 = 16(x - 2)$

$y - 8 = 16x - 32$

$y - 16x + 8 + 32 = 0$

$y - 16x + 24 = 0$

Equation of the tangent = $y - 16x + 24 = 0$

Equation of the normal

$m_1 \cdot m_2 = -1$

$16 \cdot m_2 = -1$

$m_2 = -1/16$

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

$y - 8 = -1/16 (x - 2)$

$16y - 128 = -x + 2$

$16y + x - 130 = 0$

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

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

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

m Find the gradient at $x = -1$

$m = 2(-1)^2$

$m = 2(1)$

$m = 2$

Equation of the tangent

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

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

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

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

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

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

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

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

Equation of the tangent.

Equation of the normal

$m_1 \cdot m_2 = -1$

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

$m_2 = -1/2$

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

$y - (-1/2) = -1/2\,(x - (-1))$

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

$2y + x' = -x - 1$

$2y = -x - 1$

$2y + x + 1 = 0$

Equation of the normal

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

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

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

Find the gradient at point $x = -2$

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

$m = 4 + 1$

$m = 5$

Equation of the tangent

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

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

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

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

$y + 5 = 5x + 10$

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

$y - 5x - 5 = 0$

Equation of the tangent.

Equation of the normal

$m_1 m_2 = -1$

$5 \cdot m_2 = -1$

$m_2 = -1/5$

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

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

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

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

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

$5y + x + 27 = 0$

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

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

Find the gradient at $x = 3$

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

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

$m = -1 \times \frac{1}{9}$

$m = -1/9$

Equation of the tangent

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

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

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

$9y - 3 = -x + 3$

$9y + x = 0$

Equation of the tangent

Equation of the normal

$m_1 \cdot m_2 = -1$

$-1/9 \cdot m_2 = -1$

$m_2 = \frac{-1}{-1/9}$

$m_2 = -1 \times -\frac{9}{1}$

$m_2 = 9$

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

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

$y - 1/3 = 9x - 27$

$y - 9x = -1/3 + 27$

$y - 9x = 26\frac{2}{3}$

Equation of the normal