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Matric No: 19/MHS01/103
Course code: MAT 104
Course title: General mathematics III

① $y = 2x^2$ at the point $(1,2)$.

Soln

$x_1 = 1$

$y_1 = 2$

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

$$\therefore \frac{dy}{dx}\Big|_{x=1} = 4 \quad \therefore M = 4.$$

For eqn of tangent.

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

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

$y - 2 = 4x - 4$

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

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

Eqn of normal.

$M_1 \cdot M_2 = -1$

$4M_2 = -1$

$M_2 = -1/4$

$\therefore y - y_2 = -\frac{1}{m}[x - x_1]$

$y - 2 = -1/4[x - 1]$

$4y - 8 = -x + 1$

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

$4y + x - 9 = 0$ eqn of the normal.

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

$x_1 = -1$

$y_1 = -1/2.$

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

$\frac{dy}{dx}\Big|_{x=-1} = \frac{3(-1)^2}{2} = 3/2 ; \therefore M = 3/2$

for tangent.

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

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

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

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

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

$2y - 3x - 2 = 0$ for tangent

for normal.

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

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

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

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

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

$6y + 4x + 7 = 0$ for the normal.

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

soln

$y_1 = 1/3$

$x_1 = 3$

$dy/dx = -1/x^2$

$dy/dx \mid x=3 = -1/3^2 = -1/9 \therefore m = -1/9$

for tangent.

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

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

$9y - 3 = -x + 3$

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

$9y + x - 6 = 0$ for tangent.

for normal.

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

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

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

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

$y - 9x - 1/3 + 27 = 0$

$y - 9x + \frac{80}{3} = 0$ for normal.

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

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

soln

$x_1 = -2$

$y_1 = -5$

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

$\frac{dy}{dx}\Big|_{x=-2} = 1-2(-2) = 1+4 = 5 \therefore m = 5.$

Eqn for tanjent

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

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

$y+5 = 5[x+2]$

$y+5 = 5x+10$

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

$y-5x-5 = 0$ for tanjent.

Eqn for normal.

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

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

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

$5y+25 = -x-2$

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

$5y+x+27 = 0$ for normal.

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

Soln

$x_1 = 2$

$y_1 = 8$

$dy/dx = 6x - 2$

$dy/dx|_{x=2} = 10 \quad \therefore M = 10$

For the eqn of tangent.

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

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

$y - 8 = 10x - 20$

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

$y - 10x + 12 = 0$ for the eqn of the tangent.

Eqn of the normal.

$y - y_1 = -1/M [x - x_1]$

$y - 8 = -1/10 [x - 2]$

$10y - 80 = -x + 2$

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

$10y + x - 82 = 0$ for the eqn of the normal.