BADMUS TOLUWANI AMINAT
MBBS
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1 $y = 2x^2$ at the point $(1,2)$

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

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

$\therefore m = 4$

(a) Equation of the tangent

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

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

$y = 4x - 4 + 2$

$y = 4x - 2$

(b) Equation of the normal

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

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

$4y - 8 = -x + 1$

$4y = -x + 1 + 8$

$4y = -x + 9$

$4y = 9 - x$

$y = \frac{9}{4} - \frac{x}{4}$

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

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

$\frac{dy}{dx}\Big|_{x=2} = 6(2) - 2 = 12 - 2 = 10$

$\therefore m = 10$

(a) Equation of tangent

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

$2y = 3x + 3 - 1$

$2y = 3x + 2$

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

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

b Equation of the normal

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

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

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

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

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

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

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

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

$y = \frac{-2x}{3} - \frac{7}{6}$

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

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

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

$= 1 + 4 = 5$

$\therefore m = 5$

(a) Equation of a tangent

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

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

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

$y-8 = 10x-20$

$y = 10x-20+8$

$y = 10x-12$

b Equation of normal

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

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

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

$10y-80 = -x+2$

$10y = -x+2+80$

$10y = -x+82$

$10y = 82-x$

$y = \frac{82}{10} - \frac{x}{10}$

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

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

$\left.\frac{dy}{dx}\right|_{x=-1} = \frac{3}{2}(-1)^2 = 3/2$

$m = 3/2$

(a) Equation of the tangent

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

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

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

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

$2y+1 = 3x+3$

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

$y+5 = 5x+10$

$y = 5x+10-5$

$y = 5x+5$

b Equation of the normal

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

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

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

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

$5y+25 = -x-2$

$5y = -x-2-25$

$5y = -27-x$

$y = \frac{-27}{5} - \frac{x}{5}$

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

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

$\left.\frac{dy}{dx}\right|_{x=3} = -(3)^{-2} = -1/9$

$m = -1/9$

(a) Equation of the tangent

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

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

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

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

$9y-3 = -x+3$

$9y = 3+3-x$

$9y = 6-x$

$y = \frac{6}{9} - \frac{x}{9}$ or $9y-3+3+x=0$

$9y-6+x=0$

(b) Equation of the normal

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

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

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

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

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

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