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MAT 104 Assignment

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

Function is defined at $x-2=0$

Hence $x = 2$

Domain = all real numbers of x except 2

Co-domain = all real numbers of y

2. $K = \ln v$

Differentiation of k

$\frac{d}{dk}(\ln v) = \frac{1}{v}$

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

$2x - 3y = 2$

Differentiate all factors

$\frac{d}{dx}(2x) - \frac{d}{dx}(3y) = \frac{d}{dx}(2)$

$2 - 3\frac{dy}{dx} = 0$

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

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

b. $x^2 + y^2 = 4$

Differentiate all factors

$\frac{d}{dx}(x^2) + \frac{d}{dx}(y^2) = \frac{d}{dx}(4)$

$2x + 2y \cdot \frac{dy}{dx} = 0$

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

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

$\frac{dy}{dx} = -\frac{x}{y}$

4 $P = \sin^{-1} t$

find dy/dx

$P = \frac{t}{\sin}$: $t = \sin p$

$\frac{dt}{dp} = \cos p$: $\frac{dp}{dt} = \frac{1}{\cos p}$

Recall $\cos^2 p + \sin^2 p = 1$

$\cos^2 p = 1 - \sin^2 p$

$\cos p = \sqrt{1 - \sin^2 p}$

Since $t = \sin p$

$\cos p = \sqrt{1 - t}$

Hence $\frac{dp}{dt} = \frac{1}{\sqrt{1-t}}$

5 $f(x) = 2x^2 - 5$

$g(x) = 4x - 2$

a) $fog(x)$

$fog(x) = 2(4x-2)^2 - 5$

$= 2\{16x^2 - 16x + 4\} - 5$

$= 32x^2 - 32x + 8 - 5$

$= 32x^2 - 32x + 3$

b $gof(x) = 4(2x^2 - 5) - 2$

$= 8x^2 - 20 - 2$

$= 8x^2 - 22$

6 $f(x) = 3x^2 - 2x + 1 = 0$

Show $f(x) = fe(x) + fo(x)$

$fo = \frac{f(x) + f(+x)}{2}$

$f(-x) = 3(-x)^2 - 2(-x) + 1$

$= 3x^2 + 2x + 1$

$fe(x) = \frac{3x^2 - 2x + 1 + 3x^2 + 2x + 1}{2}$

$= \frac{3x^2 - 2x + 1 - 3x^2 - 2x - 1}{2}$

$= \frac{-4x}{2}$

$= -2x$

Hence

$f(x) = f_e(x) + f_o(x)$

$f x = 3x^2 + 1 + (-2x)$

$f x = 3x^2 - 2x + 1$

7 $y = \cos x$

$y + dy = \cos(x + dx)$

Subtract y from both sides

$dy = \cos(x + dx) - y$

but $y = \cos x$

$dy = \cos(x + \delta x) - \cos x \quad \text{.... } *)$

Consider from trig

$\cos(A+B) = \cos A \cos B - \sin A \sin B$

$\cos(A-B) = \cos A \cos B + \sin A \sin B$

$\cos(A+B) - \cos(A-B) = -2 \sin A \sin B \quad \text{....} (**)$

Compare $(*)$ and $(**)$

Let

$A + B = x + \delta x \quad \text{.....} (i)$

$A - B = x \quad \text{.....} (ii)$

Adding (i) and (ii)

$2A = 2x + \delta x$

$A = \frac{2x + \delta x}{2}$

$$\left.\begin{aligned} A &= x + \frac{\delta x}{2} \\ B &= \frac{\delta x}{2} \end{aligned}\right\} (***)$$

Compare Eqn $(***)$ to Eqn $(**)$

$\cos(x + \delta x) - \cos x = -2 \sin\left(x + \frac{\delta x}{2}\right) \sin\left(\frac{\delta x}{2}\right)$

$dy = -2 \sin\left(\frac{x + dy}{2}\right) \sin\left(\frac{\delta x}{2}\right)$

Dividing through by δx

$$\frac{dy}{dx} = \frac{-2\sin(x+\delta x/_2)\ \sin(\delta x/_2)}{\delta x}$$

$$\frac{\delta y}{\delta x} = -\frac{\sin(x+\delta x/_2)\ \sin(\delta x/_2)}{\frac{\delta x}{2}} \quad \text{- - - - (****)}$$

Take lim of Eqn (****)

$$\lim \frac{\delta y}{\delta x} = \frac{dy}{dx} = -\sin(x+0)\cdot 1$$

$$\delta x \to 0 \qquad = -\sin x$$

$$\lim_{\delta x \to 0} \frac{\delta y}{dx} = \frac{dy}{dx} = -\sin x$$

8. $y = 3t^2 \quad x - 1/t^2$ find dy/dx

$$dy/dx = \frac{dy/dt}{dx/dt}$$

$$\frac{dy}{dt} = 6t$$

$$dx/dt = -2t^{-3} = \frac{-2}{t^3}$$

$$dy/dx = 6t \div \frac{-2}{t^3} \therefore 3 6t \times \frac{t^3}{-2}$$

$$dy/dx = -3t^4$$

9. $y = x^2 \cos 2x\, e^{4x}$

Take logarithm of both sides

$$\ln y = \ln x^2 + \ln \cos 2x + \ln e^{4x}$$

Differentiate both sides with x

$$\frac{1}{y}\frac{dy}{dx} = \frac{1}{x^2}(2x) + \frac{1}{\cos 2x}(-2\sin 2x) + 4$$

$$\frac{1}{y}\frac{dy}{dx} = \frac{2}{x} - \frac{2\sin 2x}{\cos 2x} + 4$$

multiply through by 4

$$\frac{dy}{dx} = y\left(2/_x - \frac{2\sin 2x}{\cos 2x} + 4\right)$$

$\sin\theta \cdot y = x^2 \cos 2x\, e^{4x}$

$\frac{dy}{dx} = x^2 \cos 2x\, e^{4x} \left(\frac{2}{x} - \frac{2\sin x}{\cos 2x} + 4\right)$

10 $y = \sin(3x^3 + 5)$

$u = 3x^3 + 5$

$y = \sin u$

$\frac{du}{dx} = 9x^2$

$\frac{dy}{du} = \cos u$

$\frac{dy}{dx} = \frac{du}{dx} \times \frac{dy}{du}$

$= 9x^2 + \cos u$

$dy/dx = 9x^2 \cdot \cos u$

but $u = 3x^3 + 5$

$\frac{dy}{dx} = 9x^2 \cos 3x^3 + 5$