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MATS 104
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(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 $t = \sin P$

∴ $\cos P = \sqrt{1 - t^2}$

Hence $dp/dt = \frac{1}{\sqrt{1-t^2}}$

(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) $gof(x)$

∴ $gof(x) = 4(2x^2 - 5) - 2$

$= 8x^2 - 20 - 2$

$= 8x^2 - 22$

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

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

$\Rightarrow f_o(x) = \frac{f(x) + f(-x)}{2}$

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

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

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

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

(7)... Take lim of Equation (iv)

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

$$= -\sin x$$

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

(8) $y = 3t^2 \quad x = 1/t^2$

Find dy/dx: $\quad dy/dx = \frac{dy/dt}{dx/dt}$

$dy/dt = 6t$

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

$dy/dx = 6t \div -2/t^3 = {}^{3}\cancel{6}t \times \frac{t^3}{\cancel{-2}_1}$

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

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

Take the Logarithm of Both Sides

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

Differentiate Both Sides with x.

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

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

Multiply Through by y

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

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

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

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

$u = 3x^3 + 5 \therefore y = \sin u$

$\frac{du}{dx} = 9x^2 ; \; dy/du = \cos u.$

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

$= 9x^2 \times \cos u$

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

But $u = 3x^3 + 5$

$\therefore dy/dx = 9x^2 \cos 3x^3 + 5$

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① $y = \dfrac{1}{x-2}$

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

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

③ (a) $2x - 3y - 2 = 0$

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

Differentiate all factors

$$\frac{d}{dx}(2x) - \frac{d}{dx}(3y) = \frac{d}{dx}(2)$$
$$2 - 3 \cdot \frac{dy}{dx} = 0$$
$$2 = \frac{3dy}{dx} \therefore \frac{dy}{dx} = 2/3.$$

(b) $x^2 + y^2 = 4$

Differentiate All Factors

$$\frac{d}{dx}(x^2) + \frac{d}{dx}(y^2) = \frac{d}{dx}(4)$$
$$2x + 2y \cdot \frac{dy}{dx} = 0$$
$$2y\frac{dy}{dx} = -2x$$
$$\therefore \frac{dy}{dx} = \frac{-2x}{2y}$$
$$\frac{dy}{dx} = -x/y$$

⑥ .... $= -\frac{4x}{2}$

$= -2x$.

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

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

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

⑦ $Y = \cos x$

$y + \delta y = \cos(x + \delta x)$

Subtract y from Both Sides

$\delta y = \cos(x + \delta x) - y$

when $y = \cos x$

$\delta y = \cos(x + \delta x) - \cos x$ ..... (i)

Trigonometric Rules;

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

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

$\cos(A+B) - \cos(A-B) = -2 \sin A \sin B$ ..... (ii)

Compare Equation (i) & (ii)

When; $A + B = x + \delta x$ —— (1)

$A - B = x$ —— (11)

Add (1) & (11)

$\therefore 2A = 2x + \delta x$

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

$A = x + \frac{\delta x}{2}$, $B = \frac{\delta x}{2}$ —— (iii)

Compare Equation (iii) & (ii)

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

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

Divide through by dx

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

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