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

- The function is defined for all real numbers except $x = 2$
- The domain is the set of real numbers except $x = 2$
- The codomain is the set of real number except $y = 0$

2) $K = \ln V$

$\frac{dK}{dV} = \frac{1}{V}$

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

$-3y = 2 - 2x$

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

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

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

$y^2 = 4 - x^2$

$y = \pm\sqrt{4 - x^2}$

4) Find dP/dt, $P = \sin^{-1} t$

$P = \frac{1}{\sin t}$; $t = \sin P - 1$

$dt/dP = \cos P$; $\therefore dP/dt = \frac{1}{\cos P}$

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

$\cos y = \pm\sqrt{1 + \sin^2 y}$

$t = \sin P$

$\therefore \cos P = \sqrt{1 - t^2}$

Hence $dP/dt = 1/(1 - t^2)$

$f(x) = 2x^2 - 5$; $g(x) = 4x - 2$

$f o g(x) = 2(4x - 2)^2 - 3$

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

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

$g o f(x) = 4(2x^2 - 5) - 2$

$= 8x^2 - 20 - 2$

$= 8x^2 - 22$

6) Show that $f(x) = f(x) + fo(x)$

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

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

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

$3x^2 + 2x + 1$

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

$= \frac{6x^2 + 2}{2} = 3x^2 + 1$

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

$= -4x/2 = -2x$

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

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

7) Differentiate $y = \cos x$

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

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

Recall

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

Comparing (1) & (2)

$A + B = x + \delta x$ — (3)

$A - B = x$ — (4)

Adding (3) & (4) & Substracting (3) & (4)

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

Solution

Taking Loge of both sides

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

Differentiating both wrt x

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

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

Multiplying both sides by y: $\frac{dy}{dx} = y\left(\frac{2}{x} - \frac{2\sin 2x}{\cos 2x} + 4\right)$

$$= x^2 \cos 2x\, e^{4x} \times \frac{2}{x} - \frac{2\sin 2x}{\cos 2x}$$

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

Let $u = 3x^3 + 5$

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

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

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

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

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

$$= 9x^2 \cos 3x^3 + 5$$

$2A = 2x + \delta x$ $\quad \boxed{B = \delta x/2}$

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

$A = x + \delta x/2$

comparing (1) & (2)

$\delta y = \cos - \cos x$

$= 2\sin(x + \delta x/2)\sin(\delta x/2)$

Dividing through by δx

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

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

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

Taking limit $\delta x \to 0$

$\frac{\sin \delta x/2}{\sin \delta x/2} = 1$

$\delta y/\delta x = -\sin(x + 0/2) \times 1$
$\delta x \to 0$

$\delta y/\delta x = -\sin x$

(6) $\frac{dy}{dx} = \frac{dy}{dt} \times \frac{dt}{dx}$

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

$\frac{dy}{dt} = 6t$; $\frac{dx}{dt} = \frac{-2}{t}$

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

$= 6t \times \frac{-2}{t^3} = \frac{6x - 2}{t^2} = \frac{2}{t^2}$

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

$= 6t \times \frac{-2}{t^3} = \frac{dx}{t^2} = \frac{-2x + 2}{t^2}$

$dy/dx = \frac{-12}{t^2}$