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1. Function $y = 1/x-2$

Solution

The function is defined for all real numbers except $x = 2$

Domain = Real numbers except $x = 2$

Co-domain = Real numbers except $y = 0$

2) If $k = \ln v$, differentiate k

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

3. Express y as an explicit function of x if

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

$$2x - 2 = 3y$$

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

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

$$x^2 - 4 = y^2$$

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

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4. If $P = \sin^{-1} t$, find the derivative of P

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

$t = \sin p$ - - - (1)

Recall that $\sin^2 p + \cos^2 y = 1$ - - - - (2)

$\frac{dt}{dp} = D_p(T) = \cos p$

from (2) $\sin^2 p + \cos^2 p = 1$

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

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

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

$\frac{dt}{dp} = \cos p = \sqrt{1 - t^2}$

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

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5. $f(x) = 2x^2 - 5$, $g(x) = 4x - 2$ find $fog(x)$ and $gof(x)$

Solution

a) $(fog)x = f(g(x))$

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

$g(x) = 4x - 2$

$f(g(x)) = F(4x - 2)$

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

$= (8x - 4)^2 - 5$

$= 64x^2 - 32x - 32x + 16 - 5$

$= 64x^2 - 64 + 11$

b) $(gof)x$

$g(f(x)) = g[2x^2 - 5]$

$= 4x - 2[2x^2 - 5]$

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

$= [8x^2 - 20] - 2$

$= 8x^2 - 20 - 2$

$= 8x^2 - 22$

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

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

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

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

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

$f_e(x) = \dfrac{3x^2 - \cancel{2x} + 1 + 3x^2 + \cancel{2x} + 1}{2}$

5 $= \dfrac{6x^2 + 2}{2}$

$= \dfrac{\cancel{2}(3x^2 + 1)}{\cancel{2}}$

$\therefore f_e(x) = 3x^2 + 1$

$f_o(x) = \dfrac{3x^2 - 2x + 1 - (3x^2 + 2x + 1)}{2}$

$f_o(x) = \dfrac{3x^2 - 2x + 1 - 3x^2 - 2x}{2}$

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

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

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

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

7. $y = \cos x$ from 1st Principle

$y = \cos x$

$y + \delta y = \cos[x + \delta x]$

Subtract y from both sides.

$\delta y = \cos[x + \delta x] - y$

but $y = \cos x$

$\therefore \delta y = \cos[x + \delta x] - \cos x$ ---- *

Consider from Trig

$\cos[A+B] = \cos A \cos B - \sin A \sin B$

$\cos[A-B] = \cos A \cos B + \sin A \sin B$

$\cos[A+B] - \cos[A-B] = 2 \sin A \sin B$ ---- 2*

Compare [*] and [2*]

Let $A + B = x + \delta x$ ---- (i)

$A - B = x$ ---- (ii)

adding [i] and [ii]

$2A = 2x + \delta x$

$A = \frac{2x + \delta x}{2} \Rightarrow A = x + \frac{\delta x}{2}$ ---- (3)

Substitute Eqn(3) in Eqn(2)

$x + \frac{\delta x}{2} - B = x$

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$B = \frac{\delta x}{2}$

Compare eqn [*] and [2*]

$\cos[x + \delta x] - \cos x = -2\sin[x + \delta x/2]\sin[\delta x/2]$

$\therefore \delta y = -2\sin[x + \delta x/2]\sin[\delta x/2]$

$\frac{\delta y}{\delta x} = \frac{-2\sin[x + \delta x/2]\sin[\delta x/2]}{\delta x}$

$\frac{\delta y}{dx} = \frac{-\sin[x + \delta x/2]\sin[\delta x/2]}{\delta x/2}$

$\frac{\delta y}{dx} = -\sin[x + \delta x/2]\frac{\sin[\delta x/2]}{\delta x/2}$ ---(4)

A Standard limit:

$\lim_{\delta x \to 0} \frac{\sin[\delta x/2]}{\delta x/2} = 1$

Find limit of 4 as $\delta x \to 0$

$\lim_{\delta x \to 0} \frac{dy}{\delta x} = \lim -\sin[x + \delta x/2]\frac{\sin[\delta x/2]}{\delta x/2}$

$= -\sin[x + 0] \cdot 1$

$= -\sin x$

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

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8. $y = 3t^2 \quad x = 1/t^2$
Soln
$\frac{dx}{dt} = -2t \qquad \frac{dy}{dt} = 6t$

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

$= \frac{6t}{-2t}$

$= -3t$

10: $y = \sin(3x^2+5)$
$dy/dx = dy/dx \times \frac{dy}{du}$
$u = 3x^2+5 \qquad y = \sin u$
$= 6x \qquad y = \sin \cos u$
$\frac{dy}{dx} = 6x \times \cos u$
$= 6x\cos u$
Since $u = 3x^2+5$
$dy/dx = 6x\cos(3x+5)$

9. $y = \cancel{x^2 2\cos} \cdot x^2 \cos(2xe^{4x})$

Using the Product rule

$\frac{dy}{dx} = V\frac{du}{dx} + U\frac{dv}{dx}$

let $U = x^2$ and $V = \cos 2xe^{4x}$

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

$V = \cos(2xe^{4x})$

Using the Chain rule $dy/dx = du/dx \times \frac{dy}{dx}$

$u = 2xe^{4x}$ and $y = \cos u$

$du/dx = 2 \times 4 \times e^{4x}$ and $y = -\sin u$

$du = 8e^{4x}$ and $y = -\sin u$

$dy/dx = 8e^{4x} \times -\sin(2xe^{4x})$

$= -8e^{4x}\sin(2xe^{4x})$

$\frac{dy}{dx} = \cos(2xe^{4x}) \times 2x + x^2 \times - 8e^{4x}\sin(2xe^{4x})$

$= 2x\cos(2xe^{4x}) + - 8x^2e^{4x}\sin(2xe^{4x})$