MATHS ASSIGNMENT

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1) For what values of x is the function $y = \frac{1}{x}$ defined? State the domain and co-domain

Soln:
Is not defined because is a function, because of the use of the ~~deno~~minator. The function is defined for all real numbers except $x = 0$

Domain = Real numbers except $x = 0$

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

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

$$\frac{dk}{dv} = \frac{1}{v}$$

3) Express y as an explicit function of x in the following

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

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

Solution:

$$2x - 3y - 2 = 0$$
$$2x - 3y = 2$$
$$\frac{-3y}{-3} = \frac{2 - 2x}{-3}$$
$$y = \frac{-2 + 2x}{3}$$

b)

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

4) $p = \frac{1}{\sin}$

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

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

$\frac{dt}{dp}$ of (i) $= \cos p$

From eqt 2 $\sin^2 p + \cos^2 p = 1$

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

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

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

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

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

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

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

$g(x) = 4x - 2$

a.) $fog(x)$

$gof(x)$

Solution

a) $(fog)x$

$f(g(x))$

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

$gx = 4x - 2$

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

$f(4x - 2)$

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

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

$2(16x^2 + 4 - 8x - 8x) - 5$

$2(16x^2 - 16x + 4) - 5$

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

$32x^2 - 32x + 3$

b.) i) $g(f(x))$

$g(f(x))$

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

$g(x) = 4x - 2$

$g(2x^2 - 5)$

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

$8x^2 - 20 - 2$

$\underline{8x^2 - 22}$

6. If $f(x) = 3x^2 - 2x + 1 = 0$ show that $f_e(x) + f_o(x) = f x$

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

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

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

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

$= \dfrac{3x^2 + 3x^2 \cancel{-2x} \cancel{+2x} + 2}{2}$

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

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

$= 3x^2 + 1$

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

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

$\dfrac{3x^2 - 2x + 1 - 3x^2 - 2x - 1}{2}$

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

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

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

$\underline{3x^2 - 2x + 1}$

7) Soln:

$y = \cos x$

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

Subtracting y from both sides

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

$y = \cos x$

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

Consider from trig.

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

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

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

$= -2\sin A\sin B$ ---- (2a)

Compare eqt (a) and (2a)

let

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

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

Adding (i) and (ii)

$2A = 2x + \delta x$

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

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

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

Compare (3) and (2a)

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

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

$\frac{2\sin(x+\frac{\delta x}{2})\sin(\frac{\delta x}{2})}{\delta x}$

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

standard limit

$\frac{\sin(\frac{\delta x}{2})}{\frac{\delta x}{2}} = 1$

$\sin(x + \frac{\delta x}{2}) \boxed{\frac{\sin\frac{\delta x}{2}}{\frac{\delta x}{2}}} = -\sin(x+0)\cdot 1 = -\sin x$

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

$y = 3t^2$ ... $= -3t^4$

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

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

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

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

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

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

Multiplying both sides by y, we ha

$\frac{dy}{dx} = y(\frac{2}{x} - 2\tan 2x + 4)$

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

$\frac{dy}{dx} = x^2\cos 2x\, e^{4x}(\frac{2}{x} - 2\tan 2x$

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

let $u = 3x^3 + 5$

$y = \sin u$

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

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

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

$\cos u \times 9x^2$

$= 9x^3\cos u$

but $u = 3x^3 + 5$

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