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Maths Assignment

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

from the function to be undefined the denominator be $= 0$

$x - 2 = 0$

$x = 2$

The function $Y = \frac{1}{x-2}$ is (defined) for all real numbers except 2

Domain Real numbers except 2

co domain - Real numbers

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 $2x - 3y - 2 = 0$

$2x - 3y = 2$

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

$Y = \frac{-2 + 2x}{3}$

b = $x^2 + Y^2 = 4$

$Y^2 = 4 - x^2$

$Y = \sqrt{4 - x^2}$

$Y = +\sqrt{4 + x^2}$

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

$P = \sin^{-1}$

$\rightarrow y = \dfrac{x}{\sin}$

$x = \sin x$

differentiation both sides with y

$$\frac{dx}{dy} = \cos x$$

$$\frac{dy}{dx} = \frac{1}{\cos x}$$

Recall

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

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

$$\cos y = \sqrt{1 - \sin^2 y} \qquad \sin \sin y = x$$

$$\cos y = \sqrt{1 - x^2}$$

hence

$$\frac{dy}{dx} = \frac{1}{\cos y} = \frac{1}{\sqrt{1-x^2}}$$

$\therefore$

$$\frac{dy}{dx} = \frac{1}{\cos y} = \frac{1}{\sqrt{1 \cdot t^2}}$$

5 If $f(x) = 2x^2 - 5$ and $g(x) = 4x - 2$, find $f \circ g(x)$ and $g \circ f(x)$

a $f \circ g(x)$

b $g \circ f(x)$

Solution

a) $(f \circ g)x$

$f = (g(x))$

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

$g(x) = 4x - 2$

$(f \circ g)x = f(g(x))$

$f(4x-2)$

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

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

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

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

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

$32x^2 - 32x + 3$

b $(g \circ f)x$

$g(f(x))$

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

$g(x) = 4x - 2$

$g(2x^2-5)$

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

$8x^2-20-2$

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

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

$=f(x)$.

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

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

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

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

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

$$= \frac{6x^2+2}{2} \cdot \frac{\cancel{2}(3x^2+1)}{\cancel{2}}$$

$$= 3x^2+1$$

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

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

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

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

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

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

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

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

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

7 Differentiate $y = \cos x$ from first principle

<u>Solution</u>

$Y = \cos x$

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

Subtract Y from both sides

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

$Y = \cos x$

$\delta Y = \cos(x + \delta x) - \cos x \quad \ldots$ °

Consider from trigonometry

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

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

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

$= -2 \sin A \sin B \cdots\cdots 2$

Compare equ 1 and 2

Let

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

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

Adding (i) and (ii)

$2A = 2x + \delta x$

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

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

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

Compare and

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

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

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

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

To find std limit

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

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

$$= -\sin x + 0) \cdot 1$$

$$= -\sin x$$

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

8 Find dy/dx if $y = 3t^2$ and $x = 1/t^2$

if $y = 3t^2$

$x = 1/t^2$

find dy/dx

$y = 3t^2$, $dy/dt = 6t$

$x = \frac{1}{t^2}$, $\frac{dx}{dt} = -2t^{-3} = \frac{-2}{t^3}$

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

$$= 3t^{-4}$$

9. Find dy/dx if $Y = x^2 \cos 2x e^{4x}$

Solution

$$\ln Y = \ln(x^2 \cos 2x e^{4x})$$

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

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

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

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

$$\frac{1}{Y}\frac{dY}{dx} = \frac{2}{x} - 2\tan 2x + 4$$

Multiplying both sides by Y

$$\frac{dY}{dx} = Y\left(\frac{2}{x} - 2\tan \tan 2x + 4\right)$$

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

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

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

Let $y = 3x^3 + 5$

$y = \sin y$

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

$$\frac{dy}{dx} = \cos y$$

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

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

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

but $u = 3x^3 + 5$

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