Name : OTOTOKU DOREEN EMRUBO
Department: MEDICAL LABOURATORY SCIENCE
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1. 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 $k = \ln v$
$\frac{dk}{dv} = \frac{1}{v}$ //

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

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

4. If $P = \sin^{-1} t$
$\frac{dP}{dt} = \frac{1}{\sqrt{1-t^2}}$ //

5. $F(x) = 2x^2 - 5$ and $g(x) = 4x - 3$
$fog(x) = 2(4x-2)^2 - 5$
$= 2(4x-2)^2 - 5$
$= 2(4x-2)(4x-2) - 5$
$2(16x - 8x - 8x + 4) - 5$
$32x - 16x - 16x + 8 - 5$
$32x - 32x + 8 - 5$
$= 3$ //

$gof(x)$ $4x - 2$
$4(2x^2 - 5) - 2$
$8x^2 - 20 - 2$
$8x^2 - 22$ //

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

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

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

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

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

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

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

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

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

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

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

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

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

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

7. $y = \cos x$ from first 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 (A) and (B)

Let $A + B = x + \delta x$ ...... (1)

$A - B = x$ .... (1)

adding (1) and (4)

$2A = 2x + \delta x$

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

Substitute equation 3 in equation (2)

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

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

Compare equation (*) and (2*)

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

$\therefore \delta y = -2\sin(x + \delta x/2)\sin(\delta x/2)$

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

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

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

A standard limit

$\lim_{\delta x \to 0} = \frac{\sin(\delta x/2)}{\delta x/2} = 1$

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

$\lim_{\delta x \to 0} \frac{\delta y}{\delta x} = \lim -\sin(x + \delta x/2)\frac{\sin(\delta x/2)}{\delta x/2}$

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

$= -\sin x$

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

8. $y = 3t^2$

$x = 1/t^2$

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

$\frac{dy}{dt} = 6t$

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

$\frac{dy}{dt} = 6t \quad \frac{dt}{dx} = \frac{1}{-2t^{-3}}$

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

$= -\frac{3}{t^4}$ //

9. $\frac{dy}{dx}$ $y = x^2 \cos 2x \; e^{4x}$

$\frac{1}{y}\frac{dy}{dx} = \frac{1}{u}\frac{du}{dv} + \frac{1}{v}\frac{dv}{dx} + \frac{1}{w}\frac{dw}{dx}$

$\frac{dy}{dx} = \frac{1}{u}\frac{du}{dv} + \frac{1}{v}\frac{dv}{dx} + \frac{1}{w}\frac{dw}{dx} \times y$

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

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

$\frac{dy}{dx} = (2x^{-1} - 2\tan 2x + 4 \times x^2 \cos 2x \; e^{4x})$

$\frac{dy}{dx} = \frac{2}{x} - 2\tan 2x + 4 \times x^2 \cos 2x \; e^{4x}$ //

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

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

$\frac{dy}{dx} = 3\cos 3x^3 + 5$

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