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Course: Mat104

Department: Pharmacy [MHS]

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

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

2) $K = \ln u$

$\frac{dK}{du} = \frac{1}{u}$

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

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

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

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

$y^2 = 4 - x^2$

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

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

$P = \frac{t}{\sin}$, $t = \sin p \rightarrow *$

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

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

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

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

Hence $dp/dt = ^{1}(1 - t^2)$

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

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

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

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

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

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

$= 8x^2 - 20 - 2$

$= 8x^2 - 22$

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

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

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

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

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

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

$Fe(x) = 3x^2 - 2x + 1 + (3x^2 + 2x + 1)/2$

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

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

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

$Fe(x) + Fo(x) = 3x^2 + 1 - 2x$

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

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 & Subtracting ① & ②

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

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

Comparing ① & ②

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

$= 2\sin(x + dx) - \cos x$

Dividing through by dx

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

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

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

Taking limit $\delta x \to 0$

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

$$\lim_{\delta x \to 0} dy/dx = -\sin(x + \delta x/2) \times 1$$

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

8) $y = 3t^2$; $x = 1/t^2 \quad t^{-2}$

$dy/dx = dy/dt \times dt/dx$

$= dy/dt \div dx/dt$

$dy/dt = 6t$; $dx/dt = \frac{-2}{t^3}$

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

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

$= \frac{6 \times -2}{t^2} = \frac{12}{t^2}$

$dy/dx = -12/t^2$

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

Taking loge of both sides

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

Differentiating both w.r.t 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

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

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

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

Let $u = 3x^3 + 5$

$du/dx = 9x^2$

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

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

$= 9x^2 \cos u$

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