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DEPARTMENT: MEDICAL LABORATORY SCIENCE (MLS)
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1. The function is undefined when $x - 2 = 0$
The function is defined, provided $x \neq 2$
Domain $= \{x : x \in R,$ except $x = 2\}$
$x = \{\ldots, -2, -1, 0, 1, 3 \ldots\}$
when $x = -2$
$f(-2) = \frac{1}{-2-2} = \frac{-1}{4}$
when $x = -1$
$f(-1) = \frac{1}{-1-2} = \frac{-1}{3}$
when $x = 0$
$f(0) = \frac{1}{0-2} = -\frac{1}{2}$
when $x = 1$
$f(1) = \frac{1}{1-2} = -1$
when $x = 3$
$f(3) = \frac{1}{3-2} = 1$
Codomain $= \{\ldots, -1/4, -1/3, -1/2, -1, 1, \ldots\}$

2. $k = \ln v$, $y = \ln x$, $dy/dx = 1/x$
$\therefore \frac{dk}{dv} = \frac{1}{v}$

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

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

4. $P = \sin^{-1} t \Rightarrow P = \frac{t}{\sin}$
$\sin P = t$
$P = \sin^{-1} t$ and $t = \sin P$

$dp/dt = \cos(\sin^{-1}t)$ $\quad dt/dp = \cos p$

$\cos(\sin^{-1}t) = \cos p$

using the identity

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

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

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

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

substitute $\cos p = \sqrt{1-\sin^2 p}$ into

$\cos(\sin^{-1}t) = \cos p$

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

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

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

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

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

$g(x) = 4x - 2$

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

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

$g(x) = 4x - 2$

$f(gx) = f(4x-2)$

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

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

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

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

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

$y = 2x^2 - 5$

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

$= 4x^2 - 20 - 2$

$= 4x^2 - 22$

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

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

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

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

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

$= 3x^2 + 1$

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

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

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

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

$f_o(x) = -2x$

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

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

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

(7) $y = \cos x$

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

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

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

using the compound angles

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

$\Delta y = \cos x \cos \Delta x - \sin x \sin \Delta x - \cos x$

$\Delta y = \cos x \cos \Delta x - \cos x - \sin x \sin \Delta x$

$\Delta y = \cos x (\cos \Delta x - 1) - \sin x \sin \Delta x$

$\frac{\Delta y}{\Delta x} = \frac{\cos x(\cos \Delta x - 1) - \sin x \sin \Delta x}{\Delta x}$

$\frac{\Delta y}{\Delta x} = \frac{\cos x(\cos \Delta x - 1)}{\Delta x} - \frac{\sin x \sin \Delta x}{\Delta x}$

$$\lim_{\Delta x \to 0} \frac{\Delta y}{\Delta x} = \cos x\left(\frac{\cos \Delta x - 1}{\cos \Delta x}\right) - \sin x\left(\frac{\sin \Delta x}{\Delta x}\right)$$

$$\lim_{x \to 0}\left(\frac{\cos x - 1}{x}\right) = 0$$

$$\lim_{x \to 0}\left(\frac{\sin x}{x}\right) = 1$$

$$\frac{dy}{dx} = \cos x(0) - \sin x(1)$$

$$\frac{dy}{dx} = -\sin x(1)$$

$$\frac{dy}{dx} = 1 - \sin x$$

8. $y = 3t^2 \quad x = 1/t^2$

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

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

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

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

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

9. $y = x^2 \cos 2x$

$$\frac{dy}{dx} = \ln\left(\frac{1}{u}\frac{du}{dx} + \frac{1}{v}\frac{dv}{dx} + \frac{1}{w}\frac{dw}{dx}\right)$$

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

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

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

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

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

$$= x^2\cos 2x e^{4x}(2/x - 2\tan 2x + 4).$$

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

using chain rule

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

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

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

$$\frac{dy}{dx} = 9x^2 + 5 \times \cos u$$

$$\frac{dy}{dx} = 9x^2 + 5 \cos u$$

Since $u = 3x^3 + 5$

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