8) $y = 3t^2 \therefore dy/dt = 6t$

$x = 1/t^2 \therefore dx/dt = -2t^{-3}$

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

$$= -3t^4$$

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

Take $\log_e$ of both sides

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

Differentiate with respect to x

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

$+4$

To eliminate $1/y$ multiply through by y

$$\therefore 1/y \times y\left(dy/dx\right) = y\left(\frac{2}{x} - \frac{2\sin 2x}{\cos 2x} + 4\right)$$

$dy/$~~dx that $y = x^2\cos 2x$~~

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

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

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

let $u = 3x^3 + 5 \therefore y = \sin u$

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

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

$= 9x^2 \cos u$

but $u = 3x^3 + 5$

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

a) $f\circ g(x) = 2(4x-2)^2 - 5$

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

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

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

b) $g\circ f(x) = 4(2x^2 - 5) - 2$

$= 8x^2 - 20 - 2$

$= 8x^2 - 22$

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

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

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

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

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

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

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

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

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

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

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

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

$= 3x^2 - 2x + 1 = 0$

7) $y = \cos x \rightarrow$ differentiate

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

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

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

recall

$\cos(A + B) - \cos(A - B) = -2\sin A \sin B$ --- ②

comparing ① & ②

$A + B = x + \Delta x$

$A - B = x$

$B = \Delta x/2$ & $A = x + \Delta x/2$

comparing ① & ②

$\Delta y = \cos(x + \Delta x) - \cos x = -2\sin A \sin B$

$\therefore -2\sin\left(x + \frac{\Delta x}{2}\right)\sin(\Delta x/2)$

Divide through by Δx

$\dfrac{\Delta y}{\Delta x} = \dfrac{-2\sin(x + \Delta x/2)\sin(\Delta x/2)}{\Delta x}$

$\dfrac{\Delta y}{\Delta x} = \dfrac{-\sin(x + \Delta x/2)\sin(\Delta x/2)}{\Delta x/2}$

$= -\sin\left(x + \frac{\Delta x}{2}\right) \times \dfrac{\sin(\Delta x/2)}{(\Delta x/2)}$

Taking limit $\Delta x \to 0$

$= \lim_{\Delta x \to 0} \dfrac{\sin(\Delta x/2)}{(\Delta x/2)} = 1$

$\lim_{\Delta x \to 0} \dfrac{\Delta y}{\Delta x} = -\sin x + 0/2 \times 1$

$\therefore \Delta y/\Delta x = -\sin x$

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

but $y = \frac{1}{2-2} = \frac{1}{0} =$ undefined

- $\therefore$ The function $y = \frac{1}{x-2}$ is defined for all set of real numbers except $x = 2$
- Domain = all set of real numbers except $x = 2$
- Codomain = all set of real numbers except $y = 0$

2) $h = \ln U$

if $h = \ln U$

$\frac{d}{dx}(\ln U) = \frac{1}{U}\frac{dU}{dx}$

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

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

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

$x^2 + y^2 = 4$

$y^2 = -x^2 + 4$

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

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

$P = \frac{t}{\sin}$

$t = \sin P$

$\frac{dt}{dP} = \cos P$ but we need $\frac{dP}{dt} = \frac{1}{\cos P}$

recall

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

so $\cos^2 P = 1 - \sin^2 P$

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

but $\sin P = t \Rightarrow \sin^2 P = t^2$

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

hence

$\frac{dP}{dt} = \frac{1}{\cos P} = \frac{1}{\sqrt{1-t^2}}$

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

$g(x) = 4x - 2$

dx du