$$= \lim_{x \to \infty} \left\{ \frac{\frac{x}{x} - \frac{\cos x}{x}}{\frac{x}{x}} \right)$$

$$= \lim_{x \to \infty} \left\{ \frac{1 - \cos x/x}{1} \right\}$$

As $x \to \infty$, $1/x \to 0$

$$\therefore \lim_{x \to \infty} \left\{ \frac{1 - \frac{\cos x}{x}}{1} \right\} = 1$$

2 $y = -3 \tan 7x e^{3x}$ find dy/dx

$u = -3\tan 7x$, $v = e^{3x}$, $du = 21\sec^2 7x$, $dv = 3e^{3x}$

$\therefore \frac{dy}{dx} = u\,dv + v\,du = -3\tan 7x \cdot 3e^{3x} + e^{3x} \cdot -21\sec^2 7x$

$= -9e^{3x}\tan 7x + -21e^{3x}\sec^2 7x$

3 ~~Find~~ $y = \cos 3x$, find dy/dx for the first Principle

$y = \cos 3x$

$y + \Delta y = \cos 3(x + \Delta x) - y$

$\Delta y = \cos 3(x + \Delta x) - \cos 3x$

Recall $\cos A - \cos B = -2 \sin \frac{A+B}{2} \cdot \sin \frac{A-B}{2}$

$A = 3x + 3\Delta x$, $B = 3x$

hence $\delta y = -2\sin\left(\frac{6x+3\Delta x}{2}\right)\cdot\sin\left(\frac{3\Delta x}{2}\right)$

$$\frac{\Delta y}{\Delta x} = \frac{-2\sin\left(3x+\frac{3\Delta x}{2}\right)\sin\left(\frac{3\Delta x}{2}\right)}{\Delta x}$$

$$\frac{\Delta y}{\Delta x} = \frac{-\sin\left(3x+\frac{3\Delta x}{2}\right)\sin\left(\frac{3\Delta x}{2}\right)}{\frac{\Delta x}{2}}$$

$$= -\sin\left(3x+\frac{3\Delta x}{2}\right)\frac{\sin\frac{3\Delta x}{2}}{\frac{\Delta x}{2}}$$

$$\lim_{\Delta x\to 0}\frac{\sin\frac{3\Delta x}{2}}{\frac{\Delta x}{2}} = 1$$

$$\lim_{\Delta x\to 0} -\sin\left(3x+\frac{3\Delta x}{2}\right) = -\sin 3x$$

$$\therefore \frac{dy}{dx} = -\sin 3x$$

4 B $f(x) = 2x^3 - 7x$

$g(x) = -3x$

$(f-g)(5) = ?$

$f-g = 2x^3 - 7x - (-3x)$

$= 2x^3 - 7x + 3x = 2x^3 - 4x$

$(f-g)(5) = 2(5)^3 - 4(5) = 230.$

5 find $fog(x)$ if $f(x) = 4x^2 + 2$; $g(x) = 2x + 3$

$fog(x) = 4(2x+3)^2 + 2$

$= 4((2x+3)(2x+3)) + 2$

$= 4(4x^2 + 6x + 6x + 9) + 2$

$= 16x^2 + 24x + 24x + 36 + 2$

$fog(x) = 16x^2 + 48x + 38.$

6 find the gradient of $x^2 + 2xy + y^2 = 1020.$

$$2x\frac{dx}{dx} + 2\left[x\frac{dy}{dx} + y\frac{dx}{dx}\right] + 2y\frac{dy}{dx} = 0$$

$$2x + 2x\frac{dy}{dx} + 2y + 2y\frac{dy}{dx} = 0$$

$$2x + \frac{dy}{dx}(2x + 2y) + 2y = 0$$

$$\frac{dy}{dx} = \frac{-2y - 2x}{2x + 2y}$$

$$\frac{dy}{dx} = \frac{+2(-y - x)}{2(x + y)}$$

$$\frac{dy}{dx} = \frac{-x - y}{x + y}$$

let point $(1, 1)$

$$\therefore m = \frac{-1 - 1}{1 + 1} = \frac{-2}{2} = -1,$$

find the derivative of function $y = x^2 \cos x$

$u = x^2$, $v = \cos x$

$du = 2x$ $dv = -\sin x$

$$\frac{dy}{dx} = u\,dv + v\,du$$

$$= x^2 \cdot -\sin x + \cos x \cdot 2x$$

$$= -x^2 \sin x + 2x \cos x$$