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

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

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

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

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

7 $y = x^2 \cos x$ Find the first derivative

Product rule

$$y = uv$$

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

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

$\frac{du}{dx} = 2x \quad \frac{dv}{dx} = -\sin x$

$$\frac{dy}{dx} = (\cos x) \times 2x + (x^2)(-\sin x)$$

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

$dy = \cos A - \cos B$

$dy = -2 \sin\left(\frac{A+B}{2}\right) \cdot \sin\left(\frac{A-B}{2}\right)$

$dy = -2 \sin\left(\frac{6x+3dx}{2}\right) \cdot \sin\left(\frac{3dx}{2}\right)$

$\frac{dy}{dx} = -2 \sin\left(\frac{6x+3dx}{2}\right) \cdot \frac{\sin\left(\frac{3dx}{2}\right)}{dx}$

Multiply the numerator and denominator by $3/2$

$\frac{3}{2} \times -2 \sin\left(\frac{6x+3dx}{2}\right) \cdot \frac{\sin\frac{3dx}{2}}{\frac{3dx}{2}}$

$\lim_{x \to 0} \frac{\sin\left(\frac{3dx}{2}\right)}{\frac{3dx}{2}} = 1$

$\therefore \frac{dy}{dx} = -3 \sin\frac{6x+0}{2}$

$= -3 \sin 3x$

4 $f(x) = 2x^3 - 7x \qquad g(x) = -3?$

Find $(f-g)(5)$

$2(5)^3 - 7(5) - 3(5)$

$= 200$

$(f-g)(5) = 200$

5 $f(x) = 4x^2 + 2 \qquad g(x) = 2x + 3$ Find $(f \circ g)$

$(f \circ g)(x) = 4(2x+3)^2 + 2$

$= 4(4x^2 + 12x + 9) + 2$

$= 16x^2 + 48x + 36 + 2$

$= 16x^2 + 48x + 38$

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1 Limit of the function

$$\lim_{x \to 0} = \frac{x - \cos x}{x}$$

differentiate

$$\lim_{x \to 0} = \frac{1 + \sin x}{1}$$

$$\frac{1 + \sin 0}{1}$$

$$= 1$$

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

~~$\tan y = 7x e^{3x}$~~

Product rule

$y = uv$ $y = v\frac{du}{dx} + u\frac{dv}{dx}$

$u = -3$ $v = \tan 7x e^{3x}$

$\frac{du}{dx} = 0$ $\frac{dv}{dx} = 21x^2 e^{3x} \sec^2 7x e^{3x}$

$$\frac{dy}{dx} = (0 \times \tan 7x - 3)\left(\tan 7x e^{3x} \times 0\right) + -3 \times 21x^2 e^{3x} \sec^2 7x e^{3x}$$

$$\frac{dy}{dx} = -63x^2 e^{3x} \sec^2 7x e^{3x}$$

3 $y = \cos 3x$ find $\frac{dy}{dx}$ using 1st principle

$y = \cos 3x$

$y + \delta y = \cos 3(x + \delta x)$

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

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

Let $A = 3(x + \delta x)$ and $B = 3x$