Compute the following derivatives.

$$\frac{d}{dx} f(x)g(x) = f'(x)g(x) + f(x)g'(x)$$

$$\frac{d}{dx} \sqrt{x}\left(x^2+3x^4\right) = \frac{1}{2}x^{-1/2}\left(x^2+3x^4\right) + \sqrt{x}\left(2x+12x^3\right)$$

$$\frac{d}{dx} \sqrt[3]{x}\left(x^6+2x\right) = \frac{1}{3}x^{-2/3}\left(x^6+2x\right) + \sqrt[3]{x}\left(6x^5+2\right)$$

$$\frac{d}{dx} \sqrt[4]{x}\left(\sqrt{x}+5\right) = \frac{1}{4}x^{-3/4}\left(\sqrt{x}+5\right) + \sqrt[4]{x}\left(\frac{1}{2}x^{-1/2}\right)$$

$$\frac{d}{dx} \left(x^3+\sqrt{x}\right)\left(x^{1/3}+x^{3/4}\right) = \left(3x^2+\frac{1}{2}x^{-1/2}\right)\left(x^{1/3}+x^{3/4}\right) + \left(x^3+\sqrt{x}\right)\left(\frac{1}{3}x^{-2/3}+\frac{3}{4}x^{-1/4}\right)$$

$$\frac{d}{dx} \left(x^{5/4}+6\right)\left(x^2+6x+2\right) = \left(\frac{5}{4}x^{1/4}\right)\left(x^2+6x+2\right) + \left(x^{5/4}+6\right)\left(2x+6\right)$$

$$\frac{d}{dx} \left(x^2+3x^{-1}\right)\left(2x-10x^2\right) = \left(2x-3x^{-2}\right)\left(2x-10x^2\right) + \left(x^2+3x^{-1}\right)\left(2-20x\right)$$

$$\frac{d}{dx} \left(4x^7+7x^2\right)\left(\sqrt{x}+x^{-3}\right) = \left(28x^6+14x\right)\left(\sqrt{x}+x^{-3}\right) + \left(4x^7+7x^2\right)\left(\frac{1}{2}x^{-1/2}-3x^{-4}\right)$$

$$\frac{d}{dx} \left(\frac{1}{x}+x^3\right)\left(x^{-1}+\frac{1}{x^3}\right) = \left(\frac{-1}{x^2}+3x^2\right)\left(x^{-1}+\frac{1}{x^3}\right) + \left(\frac{1}{x}+x^3\right)\left(-x^{-2}-3x^{-4}\right)$$

$$\frac{d}{dx} \left(\frac{1}{x^2}+x^3\right)\left(4x-90\right) = \left(-2x^{-3}+3x^2\right)\left(4x-90\right) + \left(\frac{1}{x^2}+x^3\right)\left(4\right)$$

Let $\frac{d}{dx}\sin(x) = \cos(x)$ and $\frac{d}{dx}\cos(x) = -\sin(x)$.

Compute:

$$\frac{d}{dx}\sin(x)(x^2+\sqrt{x}) = \cos(x)(x^2+\sqrt{x}) + \sin(x)(2x+\tfrac{1}{2}x^{-1/2})$$

$$\frac{d}{dx}\sin(x)\cdot\sin(x) = \cos(x)\sin(x) + \sin(x)\cos(x)$$

$$\frac{d}{dx}(\sqrt{x}+5x^9)\cos x = \left(\tfrac{1}{2}x^{-1/2}+45x^8\right)\cos(x) + (\sqrt{x}+5x^9)(-\sin(x))$$

$$\frac{d}{dx}\cos(x)(3x^2+2x-9) = -\sin(x)(3x^2+2x-9)+\cos(x)(6x+2)$$

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

$$\frac{d}{dx}\left(\frac{1}{x}+\frac{1}{\sqrt[3]{x}}\right)\sin(x) = \frac{d}{dx}(x^{-1}+x^{-1/3})\sin x =$$
$$(-x^{-2}-\tfrac{1}{3}x^{-4/3})\sin x + \left(\frac{1}{x}+\frac{1}{\sqrt[3]{x}}\right)\cos x$$

$$\frac{d}{dx}\left(\frac{3}{x^2}+\frac{4}{\sqrt[7]{x^3}}\right)\cos(x) = \frac{d}{dx}(3x^{-2}+4x^{-3/7})\cos(x)$$
$$= \left(-6x^{-3}-\tfrac{12}{7}x^{-11/7}\right)\cos(x) + \left(\frac{3}{x^2}+\frac{4}{\sqrt[7]{x^3}}\right)(-\sin(x))$$

If $f'(2)=3$ and $g'(2)=4$, compute $(f\cdot g)'(2)$ given $f(2)=10$ and $g(2)=8$.

$$(f\cdot g)'(x) = f'(x)\cdot g(x) + f(x)g'(x)$$
$$(f\cdot g)'(2) = f'(2)\cdot g(2) + f(2)\cdot g'(2)$$
$$= 3\cdot 8 + 10\cdot 4 = 64$$