Show all work: unjustified answers may receive less than full credit.

1. Use the definition of the derivative to show that \((f(x)g(x))' = f(x)g'(x) + g(x)f'(x)\).

\[
(f(x)g(x))' = \lim_{h \to 0} \frac{f(x+h)g(x+h) - f(x)g(x) + f(x+h)g(x) - f(x)g(x)}{h} \\
= \lim_{h \to 0} \left[ f(x+h)g(x+h) - f(x)g(x) + f(x+h)g(x) - f(x)g(x) \right] = f(x)g'(x) + g(x)f'(x)
\]

If is continuous since it is assumed to be differentiable.

2. Calculate \(\frac{du}{dx}\) for the following functions (you cannot use your calculator for this problem!).

\[ a \ y = \frac{x}{1-x^2} \quad \frac{dy}{dx} = \frac{(1-x^2)(1) - x(-2x)}{(1-x^2)^2} \]

\[ b \ y = \sqrt[4]{e^x \sin(x)} \]

\[ c \ y^2 \cos(x) + \sin(2x) = xy \]

\[ d \ y = \cos^4(\sin(x)) \]

\[ \frac{dy}{dx} = 4(\cos(\sin(x)))^3 (-\sin(\sin(x))) \cos(x) \]

3. Suppose \(C(x) = 2000 + 3x + .01x^2 + .0002x^3\) is the cost of producing \(x\) pairs of jeans, and let \(A(x) = C(x)/x\). Calculate \(A'(100)\) and explain its meaning.

\[
A'(x) = \frac{x \cdot C'(x) - C(x)}{x^2} = \frac{0.006x^3 + 0.02x^2 + 3x - 0.0002x^3 - 0.01x^2 - 3x - 2000}{x^2}
\]

\[ = -0.004x^3 - 0.01x^2 - 2000 \]

\[ A'(100) = \frac{100 + 100 - 2000}{10,000} = -0.15 \]

The average cost per pair of jean is decreasing at 15 cents per pair when 100 have been produced.