3.1
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Practice in class:

#4. \( f(x) = \sqrt{30} \quad f'(x) = 0 \)

#6. \( f(x) = -4x^{10} \quad f'(x) = -4 \cdot 10x^{10-1} = -40x^9 \)

#10. \( f(t) = \frac{1}{2}t^6 - 3t^4 + t \)

\[
f'(x) = \frac{1}{2} \cdot 6t^{6-1} - 3 \cdot 4t^{4-1} + 1 \cdot t^{1-1} = 3t^5 - 12t^3 + 1
\]

#16. \( R(x) = \frac{\sqrt{10}}{x^2} \quad f'(x) = \sqrt{10}x^{-7} = -7\sqrt{10}x^{-7-1} = -7\sqrt{10}x^{-8} \)

#18. \( y = f(x) = \sqrt[3]{x} = x^{\frac{1}{3}} \quad f'(x) = \frac{1}{3}x^{\frac{1}{3}-1} = \frac{1}{3}x^{-\frac{2}{3}} \)

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The Sum Rule:
If \( f(x) \) and \( g(x) \) are both differentiable, then,

\[
\frac{d}{dx} [f(x) + g(x)] = \frac{d}{dx}f(x) + \frac{d}{dx}g(x)
\]

\[
\frac{d}{dx} [f(x) - g(x)] = \frac{d}{dx}f(x) - \frac{d}{dx}g(x)
\]

Proof:

Since \( f(x) \) and \( g(x) \) are both differentiable,

\[
\frac{d}{dx}f(x) = \lim_{h \to 0} \frac{f(x+h) - f(x)}{h}
\]

\[
\frac{d}{dx}g(x) = \lim_{h \to 0} \frac{g(x+h) - g(x)}{h}
\]

\[
\frac{d}{dx} [f(x) + g(x)] = \lim_{h \to 0} \frac{[f(x+h) + g(x+h)] - [f(x) + g(x)]}{h}
\]

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

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

Leave the proof of subtraction for you after class.

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\( f(x) = e^x \)

![Graph of y = e^x](image-url)
\[
\frac{d}{dx}f(x) = \frac{d}{dx}e^x = e^x
\]
\[
f(0) = e^0 = 1
\]
\[
\frac{d}{dx}f(x) |_{x=0} = e^0 = 1
\]

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**#32.**

\[
f(x) = e^{x+1} + 1
\]

\[
f(x) = e^x \cdot e^1 + 1 = e \cdot e^x + 1
\]

\[
f'(x) = (e \cdot e^x)' = e \cdot e^x = e^{x+1}
\]

Using Chain Rule later, we will get the same result in a different way.

**#40.** Find an equation of the tangent line to the surface at the given point.

\[
f(x) = (1 + 2x)^2, (1,9)
\]

\[
f(x) = (1 + 2x)^2 = 1 + 4x + 4x^2
\]

\[
f'(x) = 4 + 8x
\]

\[
m = f'(1) = 4 + 8 \cdot 1 = 12
\]

Let the line be \( y = 12x + b \). Since it passes \((1, 9)\),

\[
9 = 12 \cdot 1 + b \Rightarrow b = -3
\]

The line equation is: \( y = 12x - 3 \)