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## 11 - Product \& Quotient Rules

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## Theorem: Product Rule

Let $f$ and $g$ be differentiable.

$$
\begin{aligned}
\frac{d}{d x}[f(x) g(x)] & =f(x) \frac{d}{d x}[g(x)]+g(x) \frac{d}{d x}[f(x)] \\
{[f(x) g(x)]^{\prime} } & =f(x) g^{\prime}(x)+g(x) f^{\prime}(x)
\end{aligned}
$$

1. Find the derivative of $f(x)=\left(\sqrt[3]{x}+7 x^{5}\right)\left(1+e^{x}\right)$.
2. Suppose that $h(x)$ is function for which $h^{\prime}(x)=x^{2} h(x)$ and $h(2)=10$.
(a) Find $h^{\prime}(2)$.
(b) Find $h^{\prime \prime}(2)$.

Theorem: Quotient Rule
Let $f$ and $g$ be differentiable.

$$
\begin{aligned}
\frac{d}{d x}\left[\frac{f(x)}{g(x)}\right] & =\frac{g(x) \frac{d}{d x}[f(x)]-f(x) \frac{d}{d x}[g(x)]}{(g(x))^{2}} \\
{\left[\frac{f(x)}{g(x)}\right]^{\prime} } & =\frac{g(x) f^{\prime}(x)-f(x) g^{\prime}(x)}{(g(x))^{2}}
\end{aligned}
$$

3. Find the derivative of $f(x)=\frac{\sqrt{x}+x e^{x}}{e^{x}-x}$
4. Let $f(x)=\frac{x^{2}}{h(x)}$ where the graph of $y=h(x)$ is below. Find $f^{\prime}(1)$.

