Big Rules from 3.1

① $\frac{d}{dx}(e^x) = e^x$

② $\frac{d}{dx}(e^u) = u'e^u$

Differentiate.

quotient rule:
$\frac{d}{dx}\left(\frac{u}{v}\right) = \frac{vu' - uv'}{v^2}$

$$F(x) = \frac{e^{2x}}{x^{10}}$$

$$= \frac{x^{10} \cdot \frac{d}{dx}(e^{2x}) - e^{2x} \cdot \frac{d}{dx}(x^{10})}{(x^{10})^2}$$

$$= \frac{x^{10}(2e^{2x}) - e^{2x}(10x^9)}{x^{20}}$$

$$= \frac{2x^9e^{2x}(x-5)}{x^{20}}$$

$$= \frac{2e^{2x}(x-5)}{x^{11}}$$

$$\frac{d}{dx}(uv) = uv' + vu'$$

Find the derivative with respect to x if $f(x) = (5x^2 - 10x + 10)\,e^x$.

$$f'(x) = (5x^2 - 10x + 10)\frac{d}{dx}(e^x) + e^x \cdot \frac{d}{dx}(5x^2 - 10x + 10)$$

$$= (5x^2 - 10x + 10)e^x + e^x(10x - 10)$$

$$= e^x\left[(5x^2 - 10x + 10) + (10x - 10)\right]$$

$$= e^x(5x^2 \cancel{-10x} \cancel{+10} \cancel{+10x} \cancel{-10})$$

$$= e^x(5x^2) = 5x^2 e^x$$

Find f ′(x).

$$\frac{d}{dx} e^u = u' e^u$$

$$f(x) = e^{\sqrt{x-16}} = e^{(x-16)^{\frac{1}{2}}}$$

$$f'(x) = \underbrace{\frac{1}{2}(x-16)^{-\frac{1}{2}}(1)}_{u'} e^{\sqrt{x-16}}$$

$$= \frac{e^{\sqrt{x-16}}}{2\sqrt{x-16}}$$

Differentiate.

$$\frac{d}{dx}\left[f(x)\right]^n = n\left[f(x)\right]^{n-1} \cdot f'(x)$$

$y = \sqrt{e^{x} + 16}$

$$= (e^x + 16)^{\frac{1}{2}}$$

$$= \frac{1}{2}(\underbrace{e^x + 16}_{f(x)})^{-\frac{1}{2}}(e^x)$$

$$= \frac{e^x}{2\sqrt{e^x + 16}}$$

Find the slope of the tangent line to the curve $f(x) = e^{x}$ at (2.3,9.97).

$$m = f'(x) = e^x$$

$$m = f'(2.3) = e^{2.3} = 9.97$$