5.3

Need to know two things:

\[ f(x) \]

"Net" Area is

\[ \text{definite integral} \int_a^b f(x) \, dx = F(x) \bigg|_a^b = F(b) - F(a) \]

Where \( F'(x) = f(x) \)

ie \( F(x) \) is an antiderivative for \( f(x) \).
\[ \int_{1}^{2} x^3 \, dx = \frac{1}{4} x^4 \bigg|_{1}^{2} = \frac{1}{4} a^4 - \frac{1}{4} \cdot 1^4 = 4 - \frac{1}{4} = 3 \frac{3}{4} \]
The other thing is that

\[ f'(x) \]

\[
\int_a^x f(t) \, dt = F(x)
\]

Observe

\[
\int_a^a f(t) \, dt = F(a) = 0
\]

Cool thing

\[ F'(x) = f(x) \]
Practically

\[
\frac{d}{dx} \int_a^x f(t) \, dt = f(x)
\]

\[
\frac{d}{dx} \int_a^x \frac{-3t}{2 - 18t + 3 \ln(\sin 16t)} + \tan t \, dt
\]

\[
= \frac{-3^3}{2 - 18x + 3 \tan x} \ln(\sin 16x)
\]
A little chain rule for Gabe.

\[
\frac{d}{dx} \int_2^{x^2} \sin t \cdot e^t \, dt
\]

\[
= \sin x^2 \cdot e^{x^2} \cdot \frac{d}{dx} x^2
\]

\[
= \sin x^2 \cdot e^{x^2} \cdot 2x
\]