The Second Fundamental Theorem of Calculus

**Second Fundamental Theorem of Calculus**

Let $f$ be continuous on $[a,b]$ and $F$ be any antiderivative of $f$ on $[a,b]$.

Then

$$\int_{a}^{b} f(x) \, dx = F(b) - F(a)$$

EX 1

$$\int_{-1}^{2} x^4 \, dx$$

EX 2

$$\int_{\pi/6}^{\pi/2} 2 \sin t \, dt$$
**Substitution Rule for Indefinite Integrals**

Let $g$ be differentiable and $F$ be any antiderivative of $f$.

Then if $u = g(x)$,

$$\int f(g(x))g'(x)\,dx = \int f(u)\,du = F(u) + C = F(g(x)) + C$$

**EX 3**

$$\int \sqrt{x^3 + 1} \,(3x^2)\,dx$$

**EX 4**

$$\int_0^{\pi/2} \sin^7(3x)\cos(3x)\,dx$$

**EX 5**

$$\int \frac{x^2 + 1}{\sqrt{x^3 + 3x}}\,dx$$

**EX 6**

$$\int_{-3}^{1} \frac{1-s^4}{2s^3}\,ds$$
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\int_{a}^{b} f(x) \, dx = F(b) - F(a)
\]

\[
\int_{a}^{b} f'(x) \, dx = f(b) - f(a)
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