

Example 1:

Before today: (We could only work prblms. substitution**Today:** We are going to use the

that the derivative of the inside was constant. Method for solving

$$\int \sin(5x) dx$$

$$\boxed{-\frac{\cos(5x)}{5} + C}$$

This only works if $\frac{d}{dx}[AT] = \text{constant}$

Example 2:

$$\int 2x(x^2 + 1)^2 dx \quad u = x^2 + 1$$

$$\int u^2 du \quad du = 2x dx$$

$$\frac{u^3}{3} + C$$

$$\boxed{\frac{1}{3}(x^2 + 1)^3 + C}$$

$$\int \sin(5x) dx \quad \frac{d}{dx}(u = 5x)$$

$$\frac{1}{5} \int \sin u du \quad \frac{du}{dx} = 5$$

$$\frac{1}{5} (-\cos u) + C \quad du = 5 dx$$

$$\boxed{-\frac{1}{5} \cos(5x) + C} \quad \frac{1}{5} du = dx$$

Example 3:

$$\int x(x^2 + 1)^2 dx \quad u = x^2 + 1$$

$$\frac{1}{2} \int u^2 du \quad du = 2x dx$$

$$\frac{1}{2} \frac{u^3}{3} + C$$

$$\boxed{\frac{1}{6}(x^2 + 1)^3 + C}$$

$$\frac{1}{2} du = x dx$$

Example 4:

$$\int \sqrt{2x-1} dx \quad u = 2x-1$$

$$\frac{1}{2} \int u^{1/2} du \quad du = 2 dx$$

$$\frac{1}{2} \cdot \frac{2}{3} u^{3/2} + C \quad \frac{1}{2} du = dx$$

$$\boxed{\frac{1}{3}(2x-1)^{3/2} + C}$$

Example 5:

A. $\int \sin^2 x \cos x dx$

B. $\int \sin^2(3x) \cos(3x) dx$

$$\int (\sin x)^2 \cos x dx$$

$$\int u^2 du \quad u = \sin x$$

$$\frac{u^3}{3} + C$$

$$\boxed{\frac{1}{3} \sin^3 x + C}$$

3. $\int (2x+1)(x^2+x) dx$

$$\int u du$$

$$\frac{u^2}{2} + C$$

$$\boxed{\frac{1}{2}(x^2+x)^2 + C}$$

$$u = x^2 + x$$

$$du = (2x+1) dx$$

Your Turn ☺

1. $\int (3x-1)^4 dx$

2. $\int 3x^2 \sqrt{x^3-2} dx$

4. $\int \frac{-4x}{(1-2x^2)^2} dx$

$$\int \frac{1}{u^2} du = \int u^{-2} du \quad u = 1-2x^2$$

$$\frac{u^{-1}}{-1} + C = -\frac{1}{u} + C = \boxed{-\frac{1}{1-2x^2} + C}$$

$$du = -4x dx$$

5. $\int x(x^2+1)^3 dx$ $u = x^2+1$
 $\frac{1}{2} \int u^3 du$ $du = 2x dx$
 $\frac{1}{2} \cdot \frac{1}{2} u^4 + C$ $\frac{1}{2} du = x dx$
 $\frac{1}{8} (x^2+1)^4 + C$

6. $\int \sqrt{5x-4} dx$ $u = 5x-4$
 $\frac{1}{5} \int u^{1/2} du$ $du = 5 dx$
 $\frac{1}{5} \cdot \frac{2}{3} u^{3/2} + C$ $\frac{1}{5} du = dx$
 $\frac{2}{15} (5x-4)^{3/2} + C$

What happens when you are missing not just a number? But a variable.....

Example 6:

$$\int \frac{x}{\sqrt{2x-1}} dx$$

Example 7:

$\int x\sqrt{x+2} dx$ $u = x+2$ solve for x
 $\int (u-2)u^{1/2} du$ $du = dx$ $\frac{u = x+2}{-2 \quad +2}$
 $\int u^{3/2} - 2u^{1/2} du$ $x = u - 2$
 $\frac{2}{5} u^{5/2} - 2 \cdot \frac{2}{3} u^{3/2} + C$
 $\frac{2}{5} (x+2)^{5/2} - \frac{4}{3} (x+2)^{3/2} + C$

Example 8:

$$\int x^2 \sqrt{1-x} dx$$

Example 9:

$$\int x\sqrt{2x+1} dx$$