HW: Page 404 #1 - 15 (odd), 16 - 22 (all) Watch video on u-substitution (first 9 minutes), take notes and bring questions

Our new skill:
Finding antiderivatives

Finding antiderivatives is a little like factoring:
We can use guess and check also.

First Step: How do we tell if we've found the correct antiderivative. Simple: take the derivative of our answer, it should match our integrand.

Are the following antiderivatives correct?

$$\int e^x \sin x dx = e^x \cos x + C$$

$$\frac{d}{dx}\left(e^x \cos x\right) = e^x \cos x + e^x(-\sin x)$$

$$\int \sin(2x)dx = \sin^2(x) + C$$

$$\frac{d}{dx}\left(\sin^2 x\right) = 2\sin x \cos x = \sin 2x$$

Second Step: Remember our antiderivative rules that follow directly from our derivative rules: $+C$

$$\int x^k dx = \frac{x^{k+1}}{k+1} + C \quad k \neq -1$$

$$\int \frac{1}{x} dx = \ln|x| + C$$

$$\int e^x dx = e^x + C$$

$$\int a^x dx = \frac{a^x}{\ln a} + C$$

$$\int \sin x dx = -\cos x + C$$

$$\int \cos x dx = \sin x + C$$

$$\int \sec^2 x dx = \tan x + C$$

$$\int \frac{1}{\sqrt{1-x^2}} dx = \arcsin(x) + C$$

$$\int \frac{1}{1+x^2} dx = \arctan(x) + C$$

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Third Step: Starting with our rules, use some educated guess and check or a little clever algebra to extend our repertoire:

$$\int \cos(2x)dx = \frac{1}{2}\sin(2x) + C$$

$$\frac{d\left(\frac{1}{2}\sin(2x)\right)}{dx} = \cancel{2}\cos(2x)$$

$$\int \frac{6}{1+4x^2}dx = \frac{6}{2}\arctan(2x)$$

$$\frac{d}{dx}\left(\frac{6}{2}\arctan(2x)\right) = \frac{6}{2}\frac{1}{1+4x^2}\cdot 2 = \frac{6}{1+4x^2}$$

$$\int \sin(2x)dx = -\frac{1}{2}\cos(2x) + C$$

$$\int\left(1+\sqrt{x}\right)^2 dx = \int\left(1+2\cancel{\sqrt{x}}x^{\frac{1}{2}}+x\right)dx$$

$$= x + 2\frac{x^{3/2}}{\frac{3}{2}} + \frac{1}{2}x^2\ C$$

$$= x + \frac{4}{3}x^{\frac{3}{2}} + \frac{1}{2}x^2 + C$$