Let r(t) be the rate at which the world's oil is consumed, where t is measured in years starting at t = 0 on January 1, 2000, and r(t) is measured in barrels per year.

What does $\int_0^{17} r(t)\,dt$ represent?

Try this one:

Use the Left Endpoint Rule, Right Endpoint Rule, Midpoint Rule, and the Trapezoid Rule with n = 5 to estimate

$$\int_3^{18} x^2 - 7\,dx$$

Which is the closest to the actual answer?

5.5 The Substitution Method
AKA u-substitution

I think there is no question this is the hardest thing you'll have to do this year.

Let's review

Evaluate:

$$\frac{d}{dx}\sin\left(4x^2\right)$$

So there are 2 ways to look at this (FTC part 1)!!

And on the flip side:

<u>Substitution Rule</u>(A fancy way to say backwards chain rule):
If u=g(x) is a differentiable function whose range is an interval I and f is continuous on I, then:

$$\int f(g(x))g'(x)dx = \int f(u)du$$

When using the Substitution Rule, we <u>replace</u> a relatively <u>complicated</u> integral by a more <u>simple</u> one. This is accomplished by changing from the original variable x to a new variable u that is a function of x.

For Example:

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

How can we change or "substitute" into this integral so that it follows the form of our substitution rule?

$g(x) = u =$ ☐ $du =$ ☐

$$\int f(g(x))g'(x)dx = \int f(u)du$$

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

For Example: $$\int x^3 \cos(x^4 + 2)\, dx$$

$g(x) = u =$

$du =$

$$\int f(g(x))g'(x)dx = \int f(u)du$$

$$\int x^3 \cos(x^4 + 2)\, dx =$$

$=$

$=$

$=$

$$\int x \cos x^2 \, dx$$

$$du =$$

$$g(x) = u =$$

$$\int f(g(x))g'(x)dx = \int f(u)du$$

$$\int x \cos x^2 \, dx =$$

$$=$$

$$=$$

For Example: $$\int \frac{x}{\sqrt{1-4x^2}}\,dx$$

$du =$ [ ]

$g(x) = u =$ [ ]

[ ]

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

$$\int \frac{x}{\sqrt{1-4x^2}}\,dx =$$ [ ]

= [ ]

= [ ]

= [ ]

= [ ]

For Definite Integrals:

If g' is continuous on [a,b] and f is continuous on the range of u=g(x), then

$$\int_a^b f\big(g(x)\big)g'(x)\,dx = \int_{g(a)}^{g(b)} f(u)\,du$$

This is a shortcut we can use to avoid cumbersome substitution multiple times in each problem.

For Example: $$\int_1^e \frac{\ln x}{x}\,dx$$

$u = g(x) =$ $\qquad$ $du =$

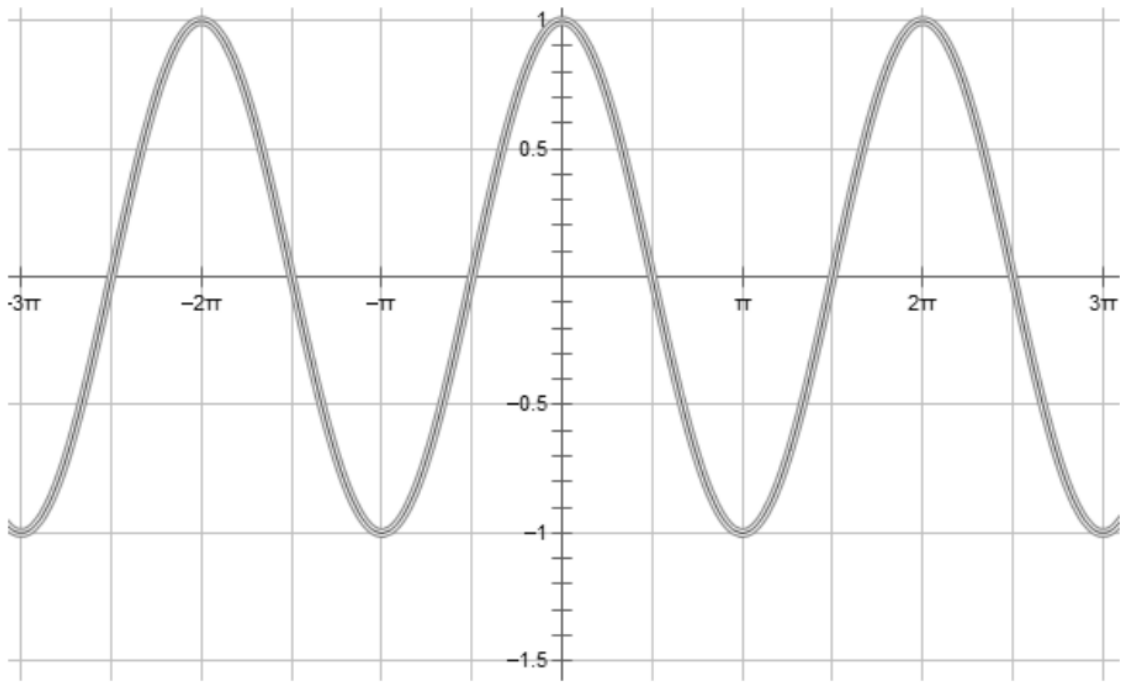
$g(b) =$ $\qquad$ $g(a) =$

$$\int_a^b f\big(g(x)\big)g'(x)\,dx = \int_{g(a)}^{g(b)} f(u)\,du$$

$$\int_1^e \frac{\ln x}{x}\,dx =$$

Integrals of Symetric Functions:
If my function is **<u>even</u>** [f(-x)=f(x)...symetric about the y axis], what can be said about:

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



Integrals of Symetric Functions:

If my function is **odd** [f(-x)=-f(x)...symetric about the origin], what can be said about:

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