WARM UP - No Calculator

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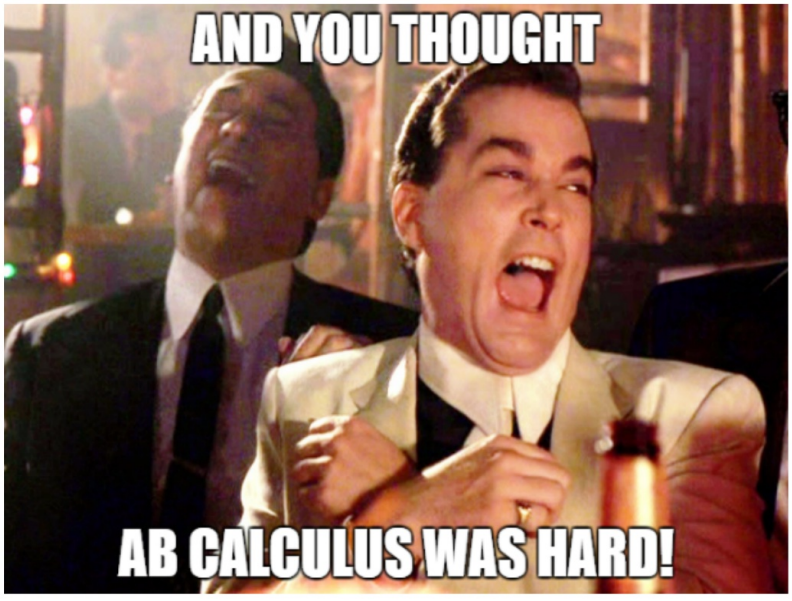
1. Water runs into a conical tank at the rate of $9ft^3/min$. The tank stands point down and has a height of 10ft and a base radius of 5ft. How fast is the water level rising when the water is 6ft deep?

2. Evaluate: $\int_0^{\frac{\pi}{3}} tanx\ sec^2x\ dx$

Welcome to BC Calculus!



INTEGRATION BY PARTS

Objective:

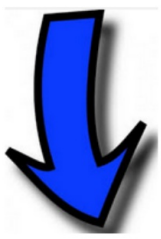
- Integrate using parts.
- Apply "LIPET" to help chose "u" value

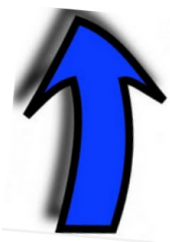
Integration by parts is like the the product rule for integration.

$$\int u\,dv = uv - \int v\,du$$

$u =$ pick a part to take the derivative

$v =$





$du =$

$dv =$ pick a part to integrate

Why does the formula work?

$$\frac{d}{dx}\left[f(x)g(x)\right] = f'(x)g(x) + f(x)g'(x)$$

Rearranging and integrating both sides, we get:

$$\int f'(x)g(x)dx + \int f(x)g'(x)dx = \int \frac{d}{dx}\left[f(x)g(x)\right]dx$$

$$\int f(x)g'(x)dx = f(x)g(x) - \int f'(x)g(x)dx$$

If we, for the sake of simplicity, let $u = f(x)$ and $v = g(x)$, we get

$$\boxed{\int udv = uv - \int vdu}$$

"**LIPET**" - is a guideline for which part to make *u*

L = logarithm functions

I = inverse functions

P = polynomial functions

E = exponential functions

T = trig functions

Example 1: $\int x\, e^x\, dx$

Example 2: $\int 2x \cos(3x)\, dx$

Example 3: $\int x^2 \sin x dx$

Tabular method - a way to organize repeated integration by parts. What to look for....

"u" - a function that will go to zero if you keep taking the derivative (usually a polynomial).

"dv" - a function that doesn't go away when you keep integrating (ln, e^x, trig, etc.)

Example 3: $\int x^2 \sin x dx$

Sign u dv

Example 4: $\int t^4 e^{2t} dt$

Example 5: $\int \ln x dx$