Good afternoon:
take home tests will be collected at 2:35p

Future retakes will also be take home

When the bell rings, I'll get your tests, we'll randomize, then learn more about indefinite integration (aka antiderivatives)

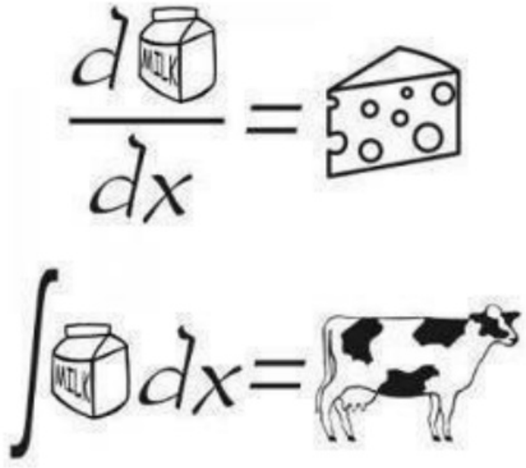
Visibly Random Grouping

More Indefinite Integration

$$\int e^{3t} \cdot dt$$

$$e^{3t} + C$$

$$\frac{1}{3}e^{3t} + C$$


d
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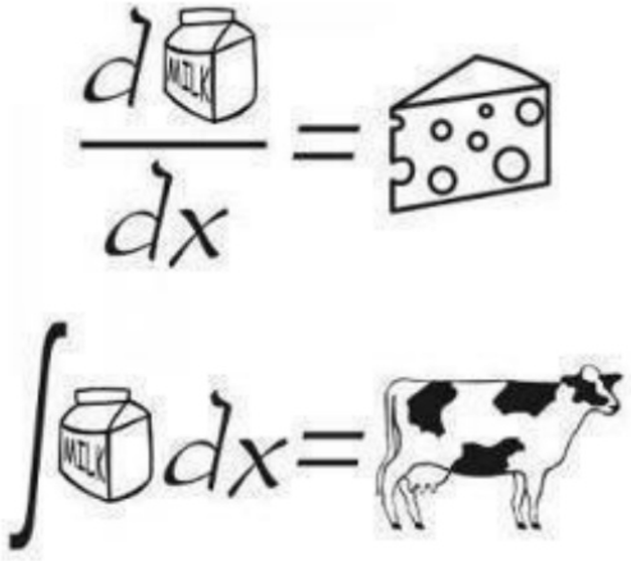
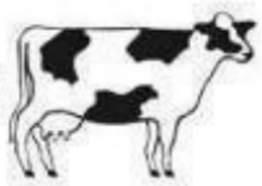
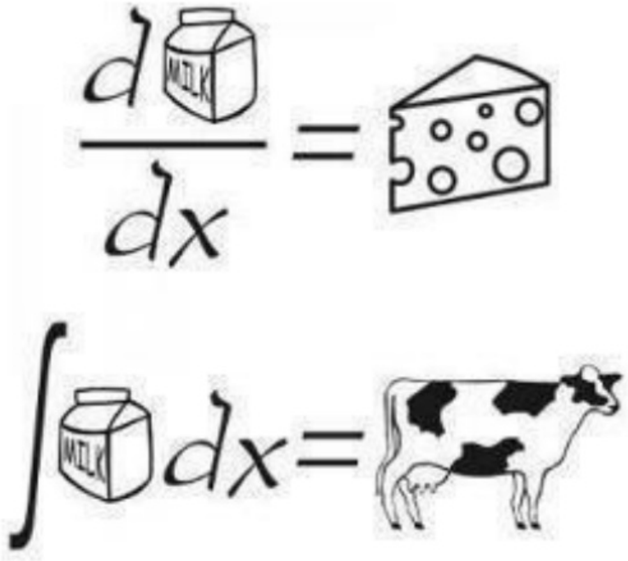


What is

$\frac{d}{dx}$ 

milk

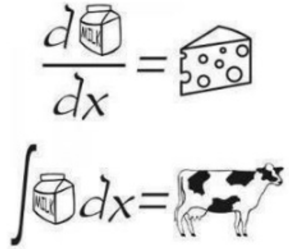


What is

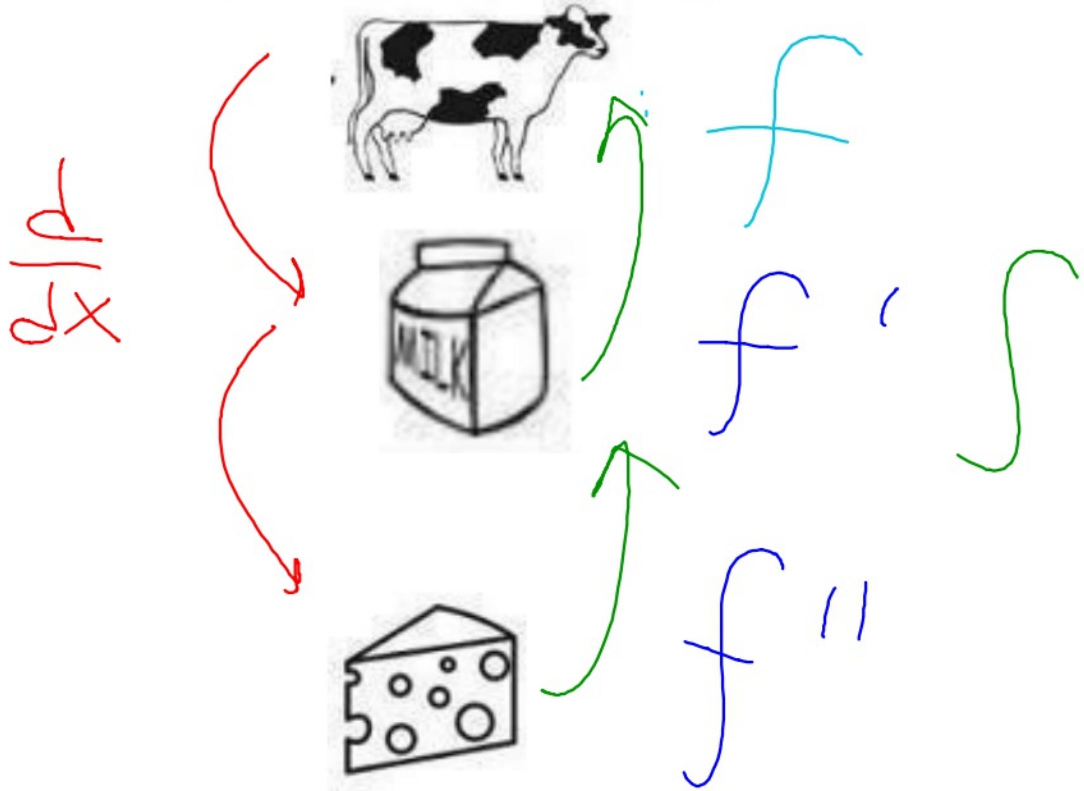
$\int$  dx ?

milk

Rank



think: position, velocity, acceleration



Derivative and Antiderivatives as Inverses

$$\cancel{\int \frac{d}{dx}}\, x = x$$

The Reverse Chain Rule

What do chain rule derivatives look like?

$$y = (4x^3 + 5)^5$$

$$\frac{dy}{dx} = 5(4x^3+5)^4 \cdot 12x^2$$

$$60x^2(4x^3+5)^4$$

$$y = (-4x^5 - 5)^2$$

$$\frac{dy}{dx} = 2(-4x^5-5)^1 \cdot -20x^4$$

$$= -40x^4(-4x^5-5)^1$$

Reverse Chain Rule (in general)

$$\int \cancel{\frac{d}{dx}} f(g(x)) = \int f'(g(x)) \cdot g'(x)$$

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

$$\int f'(g(x)) \cdot g'(x)\, dx = f(g(x)) + C$$

ex $\frac{1}{2}\int 2x\,(x^2+1)^7\,dx$

$$\frac{1}{2}\cdot\frac{(x^2+1)^8}{8}+C$$

$$\boxed{\frac{1}{16}(x^2+1)^8+C}$$

$$\cancel{\frac{1}{16}}\cdot 8(x^2+1)^7\cdot 2x \to \underline{x(x^2+1)^7}$$

Is the derivative of the inner, on the outside?

Can it be? (tweak coefficient)

Account for the 'tweaking'

Ignore the chain, anti-derive the main function

$$\int 3x^2 \cdot \sqrt{2x^3-4} \cdot dx$$

$$\frac{1}{2}\int 2\cdot 3x^2 \left(2x^3-4\right)^{1/2} \cdot dx$$

want: $\underline{6x^2}$

$$\frac{1}{2}\int \cancel{6x^2} \cdot \left(2x^3-4\right)^{1/2} dx$$

$$\frac{1}{2}\left[\frac{\left(2x^3-4\right)^{3/2}}{3/2}+C\right]$$

$$\frac{1}{\cancel{2}}\cdot\frac{\cancel{2}}{3}\left(2x^3-4\right)^{3/2}+C \longrightarrow \boxed{\frac{1}{3}\left(2x^3-4\right)^{3/2}+C}$$

Is the derivative of the inner, on the outside?

Can it be? (tweak coefficient)

Account for the 'tweaking'

Ignore the chain, anti-derive the main function

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

$$\frac{1}{4}\int 4 \cdot 3x^2 \cdot \cos(\underline{4x^3})\,dx$$

want: $12x^2$

$$\frac{1}{4}\int \cancel{12x^2} \cdot \cos(4x^3)\,dx$$

$$\boxed{\frac{1}{4}\sin(4x^3) + C}$$

$$\frac{\sin(4x^3)}{4} + C$$

Anti Derivative Rules to know

look at the inside cover of your textbook!

[redacted]

1. $\int kf(u)\,du = k\int f(u)\,du$

2. $\int [f(u) \pm g(u)]\,du = \int f(u)\,du \pm \int g(u)\,du$

3. $\int du = u + C$

4. $\int u^n\,du = \dfrac{u^{n+1}}{n+1} + C, \quad n \neq -1$

5. $\int \dfrac{du}{u} = \ln|u| + C$

6. $\int e^u\,du = e^u + C$

7. $\int a^u\,du = \left(\dfrac{1}{\ln a}\right)a^u + C$

8. $\int \sin u\,du = -\cos u + C$

9. $\int \cos u\,du = \sin u + C$

10. $\underline{\int \tan u\,du = -\ln|\cos u| + C} = \ln|\sec x| + C$

11. $\int \cot u\,du = \ln|\sin u| + C$

12. $\int \sec u\,du = \ln|\sec u + \tan u| + C$

13. $\int \csc u\,du = -\ln|\csc u + \cot u| + C$

14. $\int \sec^2 u\,du = \tan u + C$

15. $\int \csc^2 u\,du = -\cot u + C$

16. $\int \sec u \tan u\,du = \sec u + C$

17. $\int \csc u \cot u\,du = -\csc u + C$

18. $\int \dfrac{du}{\sqrt{a^2 - u^2}} = \arcsin\dfrac{u}{a} + C$

19. $\int \dfrac{du}{a^2 + u^2} = \dfrac{1}{a}\arctan\dfrac{u}{a} + C$

20. $\int \dfrac{du}{u\sqrt{u^2 - a^2}} = \dfrac{1}{a}\,\text{arcsec}\,\dfrac{|u|}{a} + C$

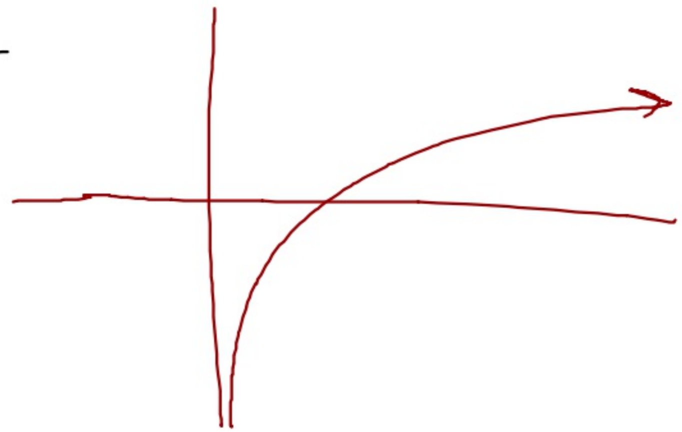
Some particular rules to focus on:

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

$$\cancel{\int x^{-1}\,dx}$$

$$\cancel{\frac{x^{0}}{0} + C}$$

??



$$\int \tan x \cdot dx$$

$$\int \frac{\sin(x)}{\cos(x)}\, dx$$

$$-\int -\sin(x) \cdot \frac{1}{\underbrace{\cos(x)}} \cdot dx$$

want: $-\sin(x)$

$$\boxed{-\ln|\cos x| + c}$$

$$\int \frac{1}{u}\, du = \ln|u| + c$$

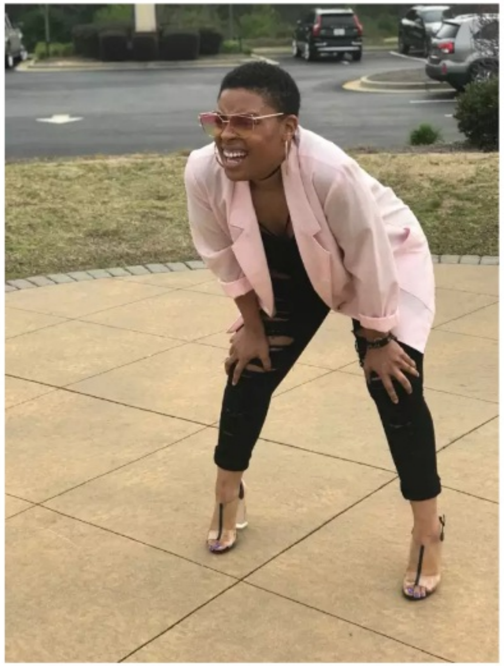
$$\int \frac{1}{x}\, dx = \ln|x| + c$$

$$5\int -\frac{15}{5}\csc 3x\cot 3x \cdot e^{\boxed{\csc 3x}}\,dx$$

want: $-3\csc 3x \cdot \cot 3x$

$$5\int \cancel{-3\csc 3x\cot 3x} \cdot e^{\csc 3x} \cdot dx$$

$$\boxed{5e^{\csc 3x} + C}$$



$$\int \frac{4\sec^2 2x}{\tan 2x}\,dx$$

$$2\int \tfrac{1}{2}\, 4\sec^2 2x \cdot \frac{1}{\tan 2x} \cdot dx$$

want: $2\sec^2 2x$

$$2\int \cancel{2\sec^2 2x} \cdot \frac{1}{\tan 2x} \cdot dx$$

$$\boxed{2 \cdot \ln|\tan 2x| + C} \longrightarrow \ln(\tan 2x)^2 + C$$

HW
handout, evens (both sides)

first antiderivative test: Thursday