Good afternoon: no warm up today, we will continue with the derivative when the bell rings

Limit definition of derivative

ADD TO BOOKLETS

The slope of a line tangent to a function f at (x, f(x)) is given by

$$\underbrace{f'(x)}_{\text{"f prime of x"}} = \underbrace{\frac{df}{dx}}_{\text{ratio of output change to input change}} = \lim_{\Delta x \to 0} \frac{f(x + \Delta x) - f(x)}{\Delta x}$$

Δx sometimes written as h

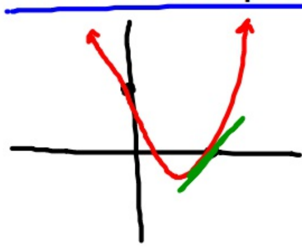
What *is* a derivative?

- Slope of the line tangent to a curve
- Instantaneous rate of change (vs. average rate of change)
- "Velocity" (as opposed to position)
- limit of the difference quotient
- slope at 1 point
- 'curviness' of a function at one point
- a mathematical operator

and much much more!!!

MY FIRST DERIVATIVE

Find the slope of the line tangent to $f(x)=x^2-4x+3$ at the point (3,0)



$$f'(3) = \lim_{\Delta x \to 0} \frac{f(x+\Delta x) - f(x)}{\Delta x}$$

$$\lim_{\Delta x \to 0} \frac{(x+\Delta x)^2 - 4(x+\Delta x) + 3 - [x^2 - 4x + 3]}{\Delta x}$$

$$\lim_{\Delta x \to 0} \frac{\cancel{x^2} + 2x\Delta x + \Delta x^2 \cancel{-4x} - 4\Delta x \cancel{+3} \cancel{-x^2} \cancel{+4x} \cancel{-3}}{\Delta x}$$

$$\lim_{\Delta x \to 0} \frac{2x\Delta x + \Delta x^2 - 4\Delta x}{\Delta x}$$

$$\lim_{\Delta x \to 0} \frac{\cancel{\Delta x}(2x + \Delta x - 4)}{\cancel{\Delta x}}$$

$$\lim_{\Delta x \to 0} 2x + \Delta x - 4 = 2x - 4 = 2(3) - 4$$

2

Find the slope of the line tangent to $f(x)= 2x^2-x+1$ at the point (2,7)

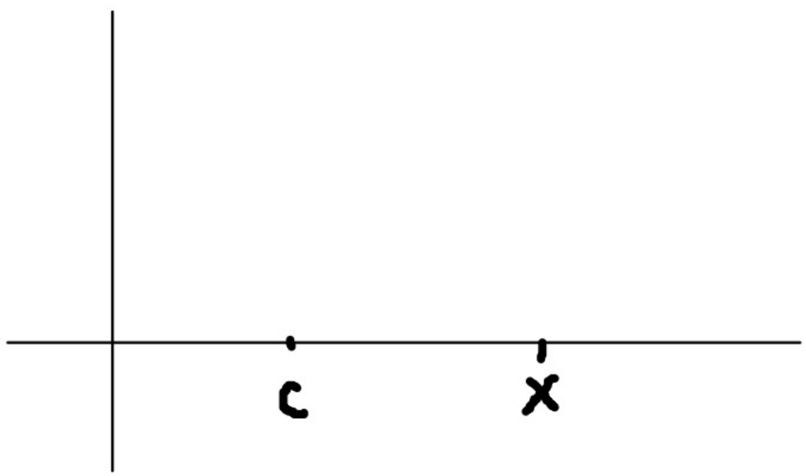
doing this later

BOOKLET

Alternate Form of Derivative:

Derivative of function f(x) at c is

$$f'(c) = \left.\frac{df}{dx}\right|_{x=c} = \lim_{x \to c} \frac{f(x) - f(c)}{x - c}$$



doing this later

Some 'obvious' derivatives (add to booklet)

$$\frac{d}{dx}c = 0 \qquad (where\ c\ is\ a\ constant)$$

$$\frac{d}{dx}cx = c \qquad (where\ c\ is\ a\ constant)$$

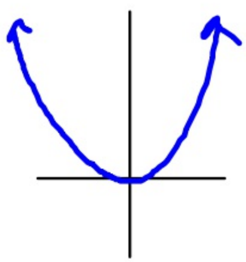
$$\frac{d}{dx}[c * f(x)] = \quad c * f'(x) \text{ [can “factor out” a constant]}$$

$$\lim_{x \to 0} 3\sin(x) = 3 \cdot \lim_{x \to 0} \sin x$$

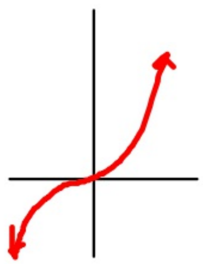
$$\frac{d}{dx}[5 \ln x^3] = 5 \cdot \frac{d}{dx} \ln x^3$$

The Power Rule

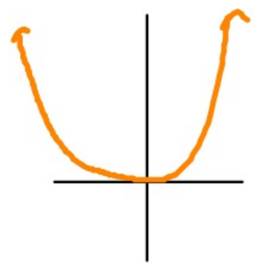
A very useful pattern!!!



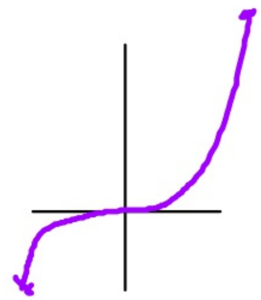
x^2



x^3



x^4



x^5

https://www.youtube.com/watc
h?v=S0_qX4VJhMQ

BOOKLET

$$\frac{d}{dx}x^n = nx^{n-1}$$

Power Rule

ex: Find the slope of the line tangent to $f(x)=x^5-2x^3+2x-3$ at (1,-2)

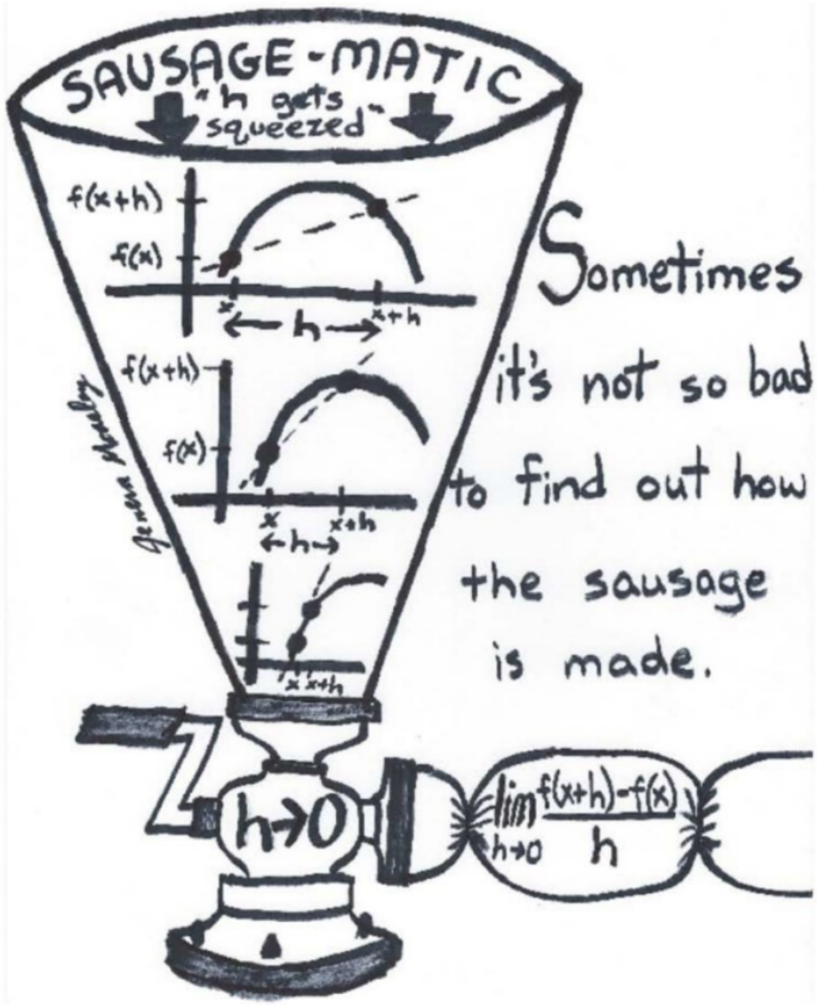
$f(x)= x^5 - 2\underline{x}^3 + 2x - 3$

$f'(x) = 5x^4 - 2\cdot 3x^2 + 2 + 0$

$f'(x)\ 5x^4 - 6x^2 + 2$

$f'(1) = 5 - 6 + 2$

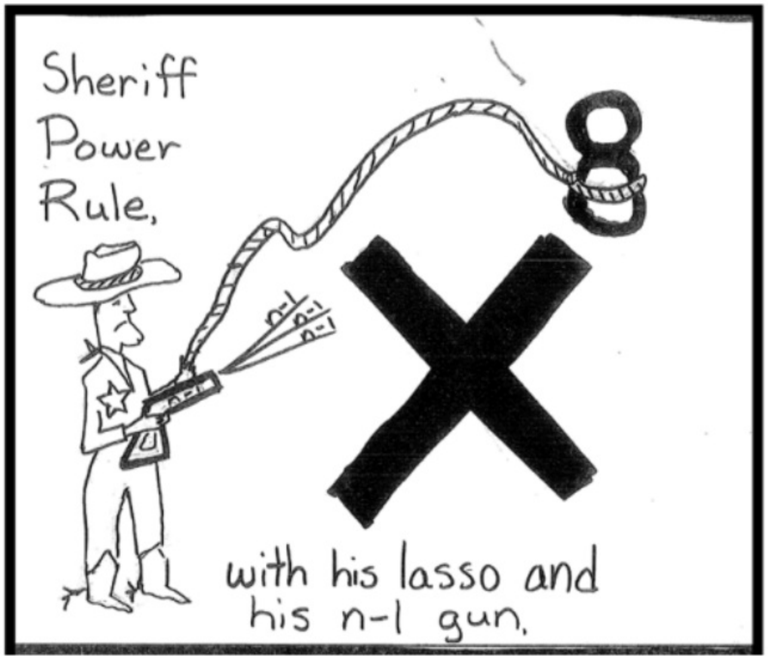
1



Calculus cartoons from
Dr Jeneva Moseley (UTK/Lee U)

$$\lim_{\Delta x \to 0} \frac{(x + \Delta x)^n - x^n}{\Delta x}$$

$$\frac{d}{dx} x^n = n x^{n-1}$$


Sheriff
Power
Rule,
n-1
n-1
n-1
8
X
with his lasso and
his n-1 gun,


cleaning up
this town,
7
8X
n-1
one derivative at a time.

Find dy/dx is y= 4 $\sqrt[3]{x^2}$

rewrite to make ready for calculus

$$y = 4\sqrt[3]{x^2}$$

$$y = 4\,x^{\frac{2}{3}}$$

power rule

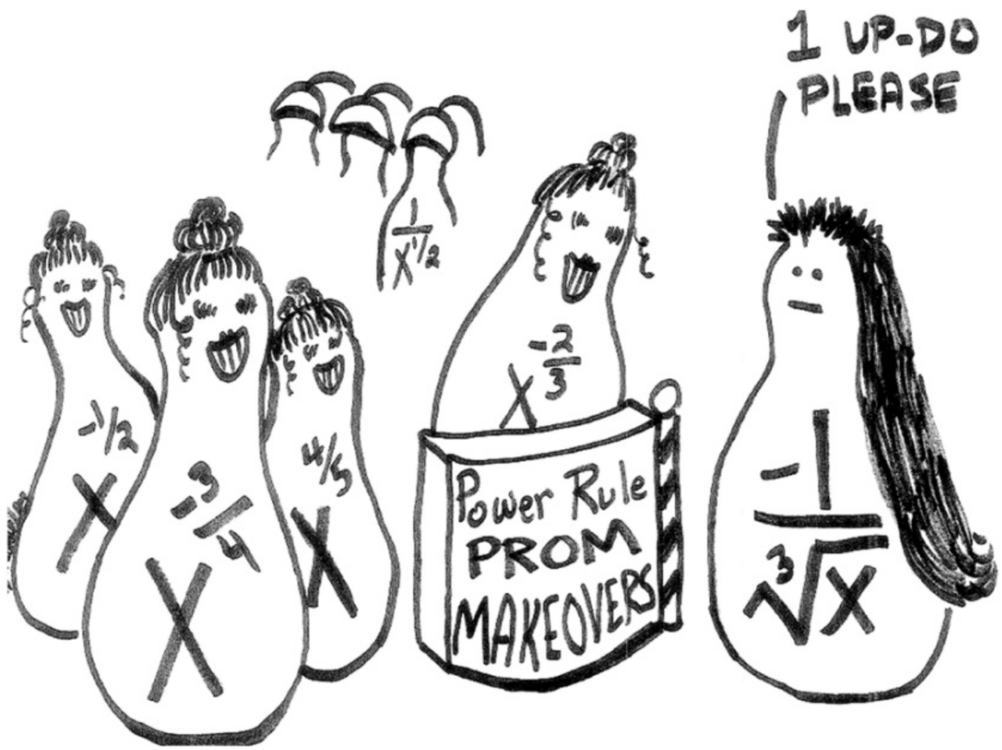
$$\frac{dy}{dx} = 4 \cdot \frac{2}{3} x^{-\frac{1}{3}}$$

$$\frac{8}{3} x^{-1/3}$$

$$\frac{8}{3} \cdot \frac{1}{x^{1/3}} \Rightarrow \frac{8}{3x^{1/3}} \Rightarrow \frac{8}{3\sqrt[3]{x}}$$

$$\sqrt[a]{x^b} \rightleftarrows x^{\frac{b}{a}}$$

$$x^{-n} \rightleftarrows \frac{1}{x^n}$$

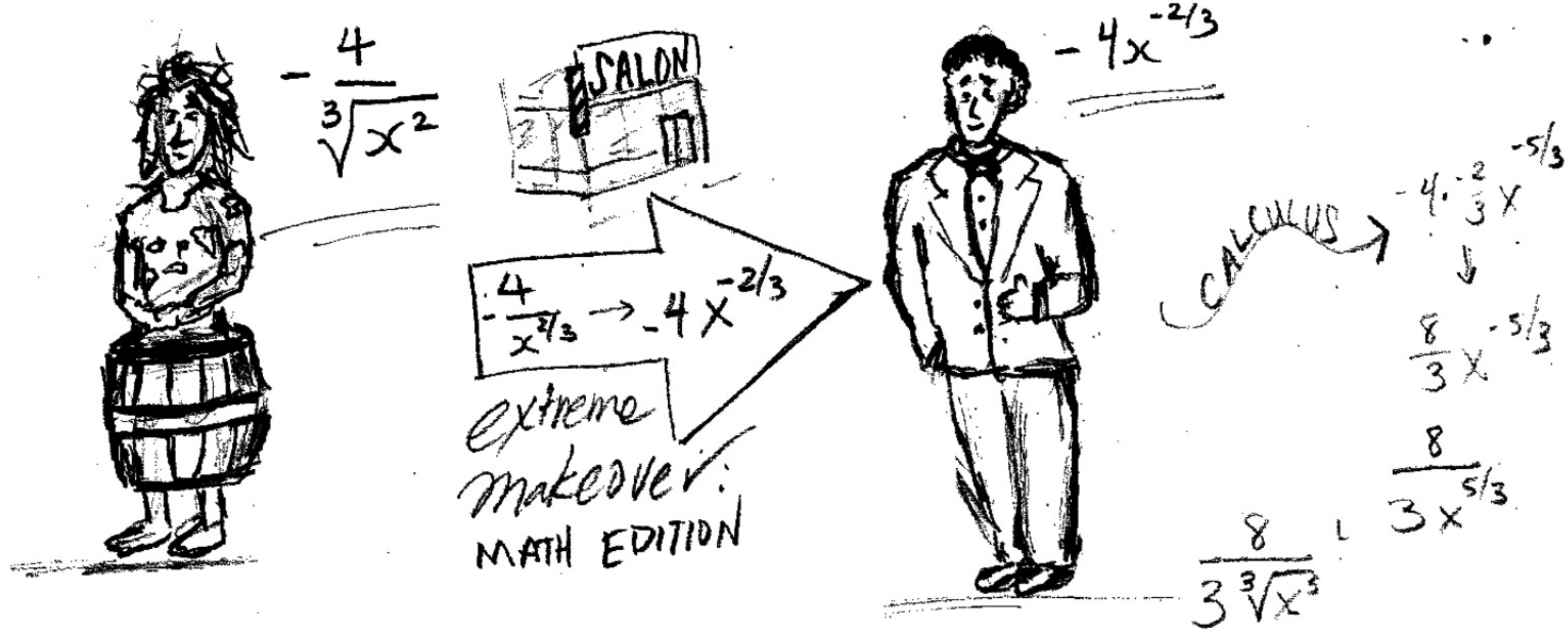


To use the Power Rule
a function/term
must be in this form:

ax^n

Find f ' (x) for $f(x) = \dfrac{3}{\sqrt[4]{x^5}}$

doing this later



$-\frac{4}{\sqrt[3]{x^2}}$
SALON
$-\frac{4}{x^{2/3}} \to -4x^{-2/3}$
extreme makeover: MATH EDITION
$-4x^{-2/3}$
CALCULUS
$-4 \cdot -\frac{2}{3}x^{-5/3}$
$\frac{8}{3}x^{-5/3}$
$\frac{8}{3x^{5/3}}$
$\frac{8}{3\sqrt[3]{x^5}}$

HW

p.114 #5-18, 25-35

due
weds.