2.2 Basic Rules for derivatives (two lessons)

Obj: define and use basic rules of differentiation; use derivatives to find velocity

Rule 1. Derivative of a constant function.

Examples: y=3 f(x)=1207

Rule 2: Power rule (the most used rule)

Examples:

$g(x) = x^4$ $y = \sqrt[3]{x}$

Rule 3. The constant multiple rule.

Examples. $y = 3x^4$ $y = 10t^2$ $y = \dfrac{1}{2\sqrt[3]{x^2}}$

Rule 4. The Sum and Difference Rule

Examples; $f(x) = x^3 - 4x + 5$ $g(x) = -\dfrac{x^4}{2} + 3x^3 - 2x$

Rule 5. Power Rule for negative exponents

Examples: $y = \dfrac{1}{x^3}$ $y = \dfrac{2}{3x^2}$

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Now try. $y=3\sqrt{x}-\frac{4}{x}+x^{\ln 3}+2\pi x-e^5$

The two most important trig derivatives.

Find the derivatives:

$4\sin x-3\cos x+4x^2$

$-\pi\sin x+\tan x\cos x$

Find the tangent line. The most basic derivative application.

$y=x+\sin x-\cos x \quad at \quad x=\frac{\pi}{2}$

Determine all the points at which you have a horizontal tangent.

$y=x^4-2x^2+3$

$y=\frac{1}{x^2}$

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Find k such that the line is tangent to the graph of the function.
$f(x)=k-x^2$ $y=-6x+1$

When is a function differentiable? In other words, when can you find the derivative?
4 cases when not differentiable
1.

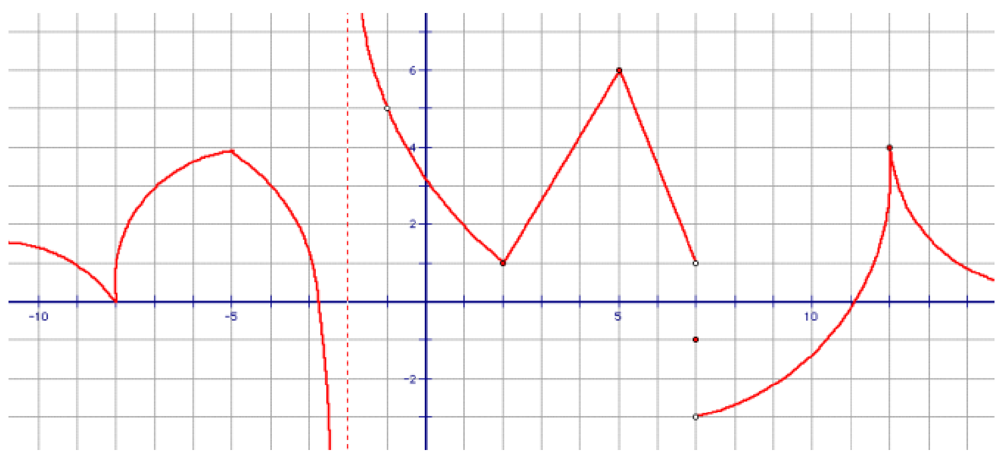
2.

3.

4.

Find all the values where the function is differentiable.

Justify.



Theorem: If f is continuous and

Then f is differentiable (left side derivative =right side derivative)

Theorem: If f is differentiable then

Note: Continuity does not imply differentiability!

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Piecewise functions:

Find the derivative at x=0.

$$y=\begin{cases} x^2 & when\ x\le 0 \\ 2x & when\ x>0 \end{cases}$$

Conclusion if derivative do not =?

Using differentiability and continuity to solve typical MC.

$$f(x)=\begin{cases} x+2 & \text{if } x\le 3 \\ 4x-7 & \text{if } x>3 \end{cases}$$

Let f be the function given above. Which of the following statements are true about f ?

I. $\lim\limits_{x\to 3} f(x)$ exists.

II. f is continuous at $x = 3$.

III. f is differentiable at $x = 3$.

(A) None

(B) I only

(C) II only

(D) I and II only

(E) I, II, and III

Numerical derivatives: To ways to calculate a numerical derivative on the calculator.

$f(x)=x^3-2x^2+1 \qquad Find\ f\ '(2)$

1. Use Math 8 (NDERIV).

Syntax for old software (function, x, value for x you want)

2. Graph. Use calc menu from graph. Make sure your graph shows the value you want. Calc #6 dy/dx

We usually use this method on free response because we will generally have to graph to find other information.

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You can also combine both methods and graph the derivative of a function.
Enter function into y1
In y2 use math 8 to graph nderiv of y1

Introduction to position and velocity.

Position function of an object gives it position at any time t. For vertical freefall it is normally a quadratic function that includes a constant for gravity with the square.

In ft/sec^2: In m/sec^2:

Given $s(t)=-16t^2+100$

Find the average velocity over the first 3 seconds.

Find the instantaneous velocity at t=2.

At time $t = 0$, a diver jumps from a platform diving board that is 32 feet above the water. His initial velocity is 16 ft/sec. The position of the diver is given by $s(t)=-16t^2+v_o t + s_o$ where s is measured in feet and t is measured in seconds.

Find the position function:

a. When does the diver hit the water?

b. What is the diver's velocity at impact?

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Sketching a graph of a derivative: This is a position function. Sketch a graph of the velocity.

Position function graph

You are graphing the slopes!