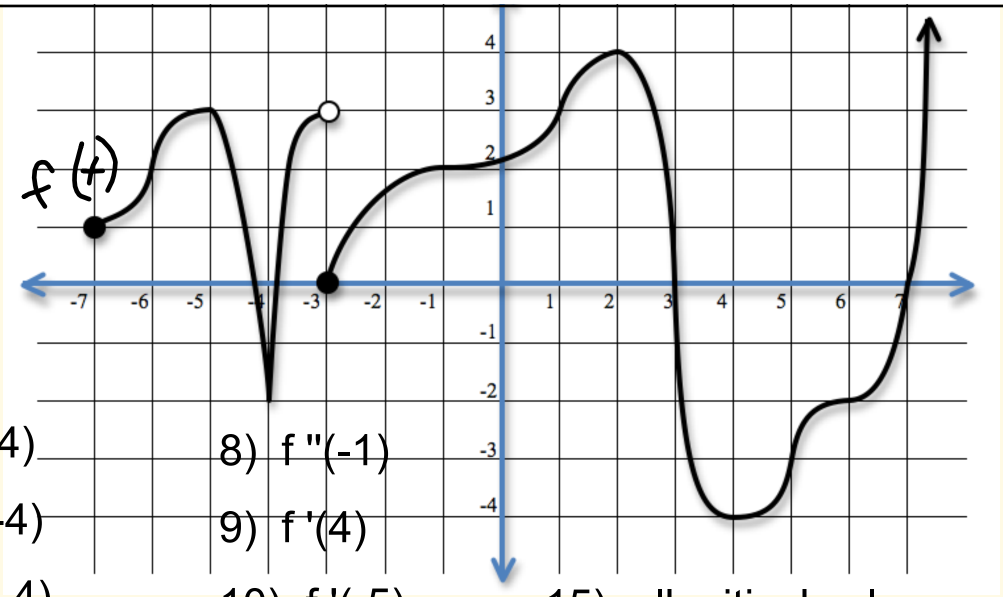
October 10, 2016



1) f (-4)

2) f '(-4)

3) f "(-4)

4) f '(2)

5) f "(3)

6) f (-1)

7) f '(-1)

8) f "(-1)

9) f '(4)

10) f '(-5)

11) f "(-3)

12) f '(-7)

13) f '(6)

14) f "(6)

15) all critical values

16) all relative extrema

17) absolute extrema

18) all points of inflection

1) f (-4) = -2

2) f '(-4) = und

3) f "(-4) = und

4) f '(2) = 0

5) f "(3) = und

6) f (-1) = 2

7) f '(-1) = 0

8) f "(-1) = 0

9) f '(4) = 0

10) f '(-5) = und

11) f "(-3) = und

12) f '(-7) = und

13) f '(6) = 0

14) f "(6) = 0

15) x = -5, -4, -3, -1, 2, 3, 4, 6

16) rel min at (-4, -2), (-4, -4)
b/c f '(x) chgs from (-) to (+)
rel max at (-5, 3), (2, 4)
b/c f '(x) chgs from (+) to (-)

17) no max, min = -4

18) p.o.i. at (-6, -2), (-1, 2),
(1, 3), (3, 0), (5, -3), (6, -2)
b/c f "(x) chgs sign

3.4b Second Derivative Test

for relative extrema!!

ESSENTIAL LEARNING TARGET

At the end of this lesson you will be able to:

- Use the second derivative to determine local (relative) extrema

Suppose $f(3) = 18$, $f'(3) = 0$, and $f''(3) = -10$. Use this information alone to determine the point on $f(x)$ at which there is a relative maximum or minimum and whether it is a max or a min. Use your whiteboards to present how you arrived at your conclusion.

2nd Derivative Test for Relative Extrema

1) Find $f'(x)$ and $f''(x)$
2) Find all values, a, such that $f'(a) = 0$
3) Find $f''(a)$
4) Write answers with because statements

- a relative max occurs at $(a, f(a))$ b/c $f'(a) = 0$ and $f''(a) < 0$
- a relative min occurs at $(a, f(a))$ b/c $f'(a) = 0$ and $f''(a) > 0$

Use the second derivative test to find all relative extrema for f(x) = $x^3 - 4x^2 - 3x$.

$f'(x)=3x^2-8x-3=0$

$(3x+1)(x-3)=0$

$x=-\frac{1}{3}, 3$

$f''(x)=6x-8$

$f''(-\frac{1}{3}) < 0$

$f''(3)=10$

a rel max occurs @ $\left(-\frac{1}{3}, (-\frac{1}{3})^3-4(-\frac{1}{3})^2-3(-\frac{1}{3})\right)$

b/c $f'(-\frac{1}{3})=0$ and $f''(-\frac{1}{3})<0$

a rel min occurs @ $(3, -18)$ b/c

$f'(3)=0$ and $f''(3)>0$

Suppose f (5) = -2, f '(5) = 0, and f ''(5) = 26. What can you conclude from this info?

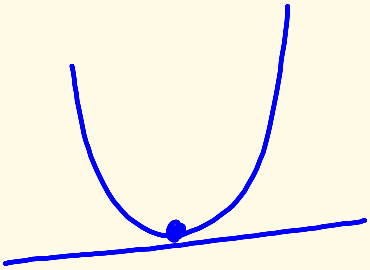
a) a rel max occurs at (5, -2)

[✓ b)] a rel min occurs at (5, -2)

c) a p.o.i. occurs at (5, -2)

d) a rel max occurs at (5, 0)

e) a rel min occurs at (5, 26)



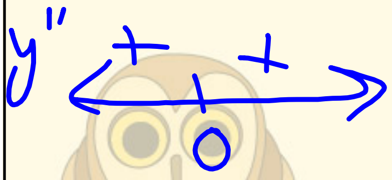
ex) Find all relative extrema for $y = 3x^4 - 8$.

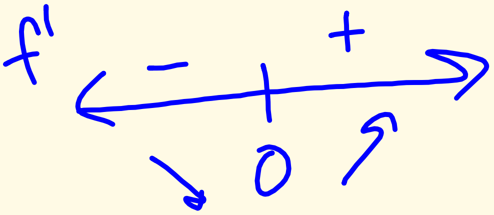
$y' = 12x^3 = 0$

$x = 0$

$y'' = 36x^2$

$y''(0) = 0$



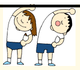


a rel min @ $(0, -8)$ b/c $f'(x)$ chgs from $(-)$ to $(+)$

So, based on the fact that the second derivative test doesn't always work, when is it best to use this method as opposed to the first derivative test for relative extrema?

Only when you don't have enough info to make an f' sign line

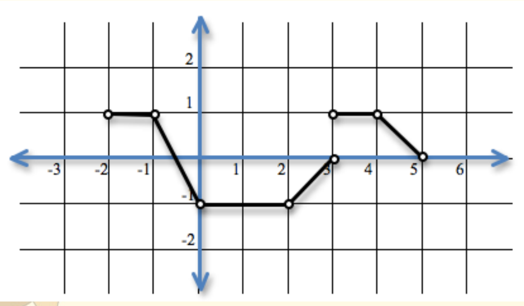
Let's put that test to the test! Let's try 2004 #4!

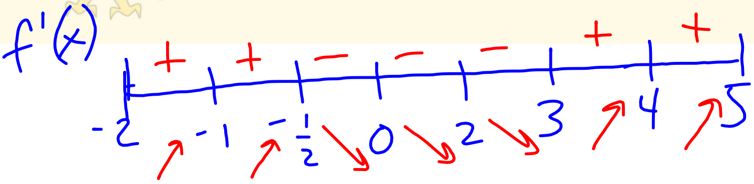


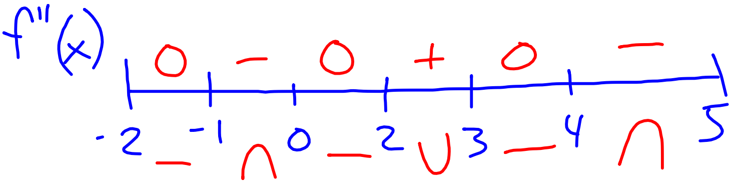
Review!!

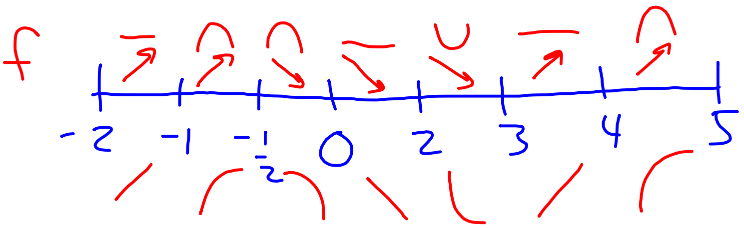
The graph of f '(x) is shown below. If f(x) is <u>continuous</u> and f (-2) = -2, sketch f(x).

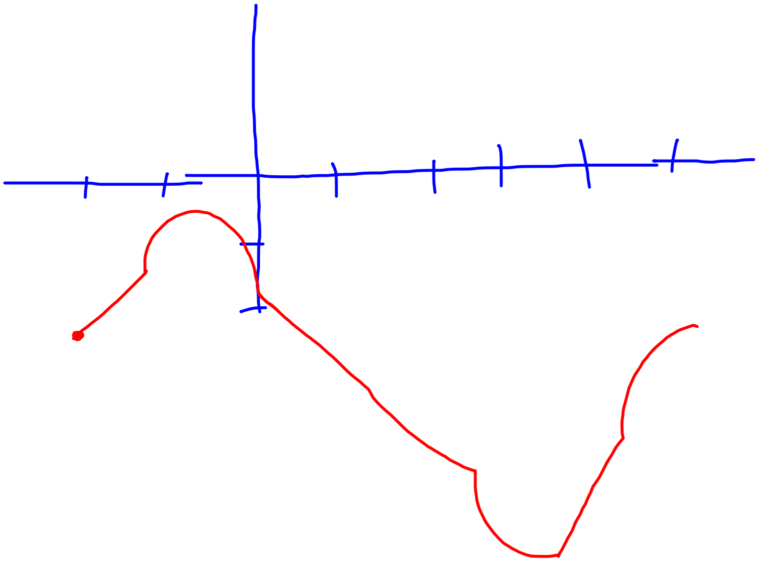
(Hint: This is tougher than it looks. Start by making sign lines for both f '(x) and f "(x).)











What have we learned?

- Is the 2nd derivative test used to determine points of inflection or relative extrema?
- What are the steps for the 2nd derivative test?
- If f '(a) = 0 and f ''(a) < 0, then (a, f(a)) would be a relative __________ .
- True or false: the second derivative test can and should always be used to locate relative extrema.