Office Hours:

Instructor:

Peter M. Garfield
garfield@math.ucsb.edu
South Hall 6510

Tuesdays 1:30–2:30PM
Wednesdays 11AM–12PM
Thursdays 10:30–11:30AM & 1:30–2:30 o
Or by appointment

TAs:

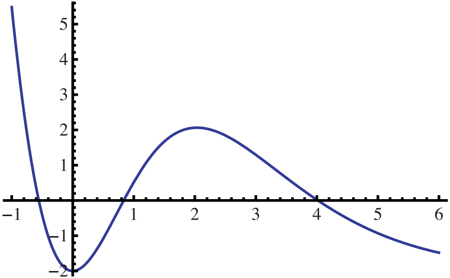
Christine Alar christine@math.ucsb.edu	Tuesdays 1–2PM South Hall 6431 U
Justin Rogers justin_rogers@math.ucsb.edu	Thursdays 2–3PM South Hall 6432 V
Abe Schulte aschulte@math.ucsb.edu	Thursdays 11AM–12PM South Hall 6432 M

Review:

1. Where is $f(x) = 3x^2 + 18x - 4$ increasing?

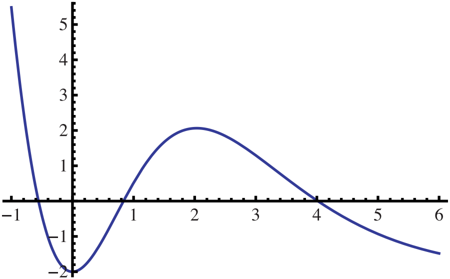
(A) $x < -3$ (B) $x > -3$ (C) $x < 3$ (D) $x > 3$ (E) $x = 3$ $\boxed{\text{B}}$

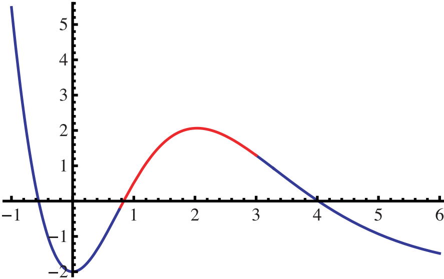
2. Where is $f(x)$ increasing?



(A) $x < 0$ (B) $x > 2$ (C) $x < 2$ (D) $0 < x < 2$ (E) $x > 0$ $\boxed{\text{D}}$

Continuing Review





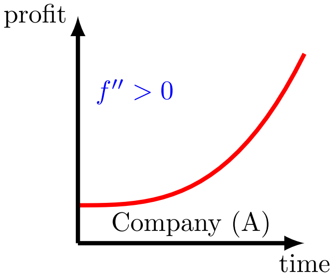
3. Where is $f''(x) < 0$? Answer: A

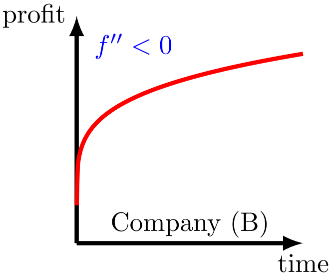
(A) $1 < x < 3$ (B) $x > 3$ (C) $x > 2$ (D) $0 < x < 2$ (E) $x < 1$

4. Where is $f'(x)$ decreasing? Answer: A

(A) $1 < x < 3$ (B) $x > 3$ (C) $x > 2$ (D) $0 < x < 2$ (E) $x < 1$

Which Company Is Better?



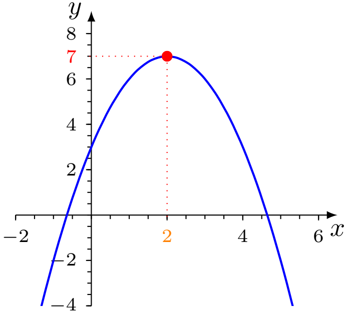


Question: Which company, A or B, would you invest in?

- During this time period, A has made smaller profits than B.
- But it looks like A will do better in the future.
- Why? The concavity! Getting better or getting worse.
- For profit we want concave up. But for the spread of an infectious disease we want concave down.

§8.13: Max/Min problems

Often want to find the biggest, smallest, most, least, maximum, minimum of something.



Here's the graph of
$y = f(x) = -x^2 + 4x + 3$

The maximum value or just maximum of the function is 7.

The value of x which gives the maximum of $f(x)$ is $x = 2$

We write $f(2) = 7$.

For this example you can see this is the maximum because

$$f(x) = -x^2 + 4x + 3 = -(x-2)^2 + 7$$

$(x-2)^2$ is always positive except when $x = 2$
so the maximum must be at $x = 2$.

How To Find A Maximum

(1) Find $f'(x)$

(2) Solve $f'(x) = 0$. This is the x value that gives the max.

(3) To find the maximum plug the value of x found in (2) back into $f(x)$.

5. Use this method to find the maximum of $f(x) = -x^2 + 8x + 5$. The maximum value is...

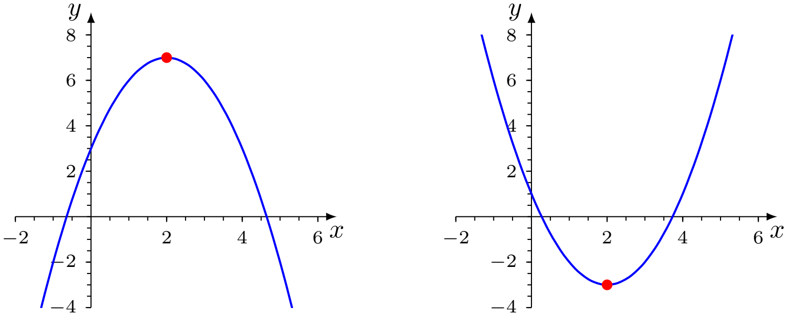
(A) 4 (B) 5 (C) $-2x + 8$ (D) 21 (E) 15 D

6. Find the value of x which makes $f(x) = (2 - x)(x + 6)$ a maximum.

The value of x is...

(A) 16 (B) 1 (C) -1 (D) 2 (E) -2 E

How To Find A Minimum?



What this technique actually does is find both maxima and minima

In Math 34A a problem will have either a maximum **or** a minimum, **but not both**. So the technique will find what you want. In Math 34B you discover how to do problems which have both a maximum and a minimum and find out which is which.

More Examples

7. What is the minimum of $f(x) = (x+2)(x+4)+3$?

(A) 0 (B) 1 (C) 2 (D) 3 (E) 4

Answer: C

8. What is minimum of $f(x) = x^2 + 16x^{-2}$?

(A) 2 (B) 4 (C) 6 (D) 8 (E) 16

Answer: D

9. Find the value of x which makes $f(x) = -e^x - e^{-2x}$ a maximum.

(A) 0 (B) $\ln(2)$ (C) $-\ln(2)$ (D) $3\ln(2)$ (E) $\ln(2)/3$

Answer: E

Word Problem #1

A ball is thrown into the air. After t seconds the height in meters above the ground of the ball is $h(t) = 40t - 10t^2$. How many meters high did the ball go?

(A) 2 (B) $40 - 20t$ (C) 20 (D) 40 $\boxed{\text{D}}$

Word Problem #2

If an airline sells tickets at a price of $\$200 + 5x$ each the number of tickets it sells is $1000 - 20x$. What price should the tickets be if the airline wants to get the most money?

(A) 5 (B) 25 (C) 175 (D) 200 (E) 225 $\boxed{\text{E}}$

Word Problem #3

A fenced garden with an area of 100 m^2 will be made in the shape of a rectangle. It will be surrounded on all four sides by a fence. What length and width should be used so the least amount of fence is needed?

Approach:

(1) Express the total length of fence in terms of only one variable, either L = length of field, or W = width of field. This gives a formula for P = (total length of fence) involving, say, W.

(2) Find minimum by solving $\dfrac{dP}{dW} = 0$.

Students always find (1) the hardest part.
You have been prepared for this by word problems from chapter 3!

Word Problem #4 (a sequel!)

A fenced garden with an area of 1000 m^2 will be made in the shape of a rectangle. It will be surrounded on all four sides by a fence. Three sides are wood fence, and the remaining side is a brick wall.

- The wood fence costs \$5 per meter length.
- The brick wall costs \$20 per meter length.
- C = total cost of the fence and brick wall
- L = length of the brick wall / W = width of the other side

(a) Find a formula for C in terms of only L.

(A) $2W + 2L$ (B) $2000L^{-1} + 2L$ (C) $25L + 10000L^{-1}$

(D) $20L + 10000WL^{-1}$ (E) $5L + 3000$ $\boxed{\text{C}}$

(b) What length of brick wall gives lowest cost?

(A) 20 (B) 40 (C) 50 (D) 100 (E) 25 $\boxed{\text{A}}$