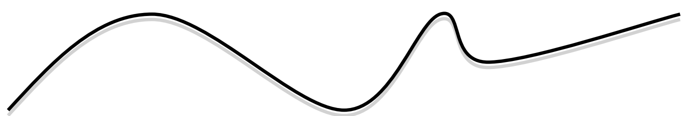
AP Calculus 2011-2012 Summer Assignment

Dear Future AP Student,

We hope you are excited for the year of Calculus that we will be pursuing together! We don't know how much you know about Calculus, but it is not like any other branch of math that you have learned so far in your math careers. We will be having a lot of fun – and doing a lot of work – learning about derivatives (for the first semester) and integrals (for the second semester). You don't need to know what those things are (yet) but we will tell you that Calculus is described as the "mathematics of change" – how fast things change, how to predict change, and how to use information about change to understand the systems themselves.

Actually, in some ways, Calculus is taking what you already know a step further. You know how to find the slope of a line, right? You probably don't know how to find the slope of a curve because it's constantly *changing* – but Calculus helps us do that. So 'traditional' math tells us how to find the slope of a line, and Calculus tells us how to find the slope of a curve. 'Traditional' math tells us how to find the length of a rope pulled taut, but Calculus tells us how to find the length of a curved rope. 'Traditional' math tells us how to find the area of a flat, rectangular roof, but Calculus tells us how to find the area of a curved dome-shaped roof. Get the idea?

How does Calculus manage to pull this off? Imagine a curve like this:



If you were to zoom in a few times, each part of the curve would look kind of like a line, wouldn't it? And if "a few times" wasn't enough, you could zoom in more. And more. And more. In fact, you could zoom in nearly an infinite number of times until the curve became enough like a line that you could treat it that way. "What makes calculus such a fantastic achievement is that it actually zooms in *infinitely*. In fact, everything you do in calculus involves infinity in one way or another, because if something is constantly changing, it's changing infinitely often from each infinitesimal moment to the next." (taken from http://media.wiley.com/product_data/excerpt/84/07645249/0764524984.pdf)

This process – doing something an infinite number of times until the problem becomes figure-out-able – is the foundation of Calculus. The process is called a "limit" and it's what we'll be talking about for the first month of AP Calculus together.

In order to give you a head start in the understanding of limits, we've designed a few things for you to do. We've tried to make it fairly straightforward so you can still enjoy your summer, but we think this will get us rolling more quickly in August and therefore will put you in a better position to take your AP in May. Please answer the questions that follow and bring this packet with you for the first day of school in August. Feel free to send an email to jlerossignol@murrieta.k12.ca.us if you have any questions.

See you in August.

LIMITS!

First of all, watch some explanations of limits online. Go to the following website http://www.calculus-help.com/tutorials and watch lessons 1-5. We've included some questions below that go with each lesson. Then answer the corresponding questions after watching each lesson.

Lesson 1: What is a limit?

1. How would you describe a limit?

2. Some graphs are straightforward, like $f(x) = x^2$. What's $\lim_{x \to 3} x^2$?

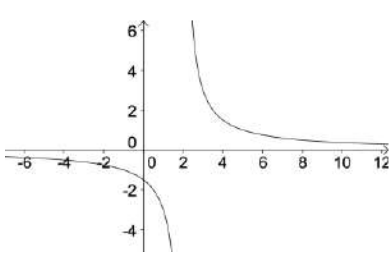
3. Some graphs are more 'mysterious', like $f(x) = \dfrac{x^2 + 3x - 4}{x - 1}$. What's $\lim_{x \to 1} \dfrac{x^2 + 3x - 4}{x - 1}$?

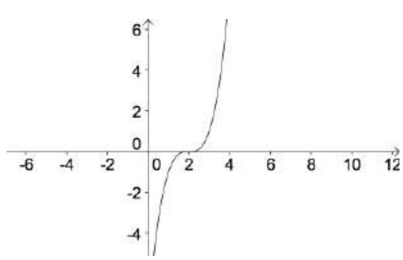
   (Either find the limit, if you know how, or describe how to find it based on the explanation you saw online)

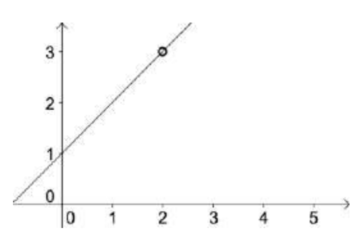
Lesson 2: When does a limit exist?

4. How is a limit like two friends meeting at a diner?

5. Look at the following graphs. Which one(s) have a limit that exists at x=2, and which one(s) don't have a limit that exists at x=2?

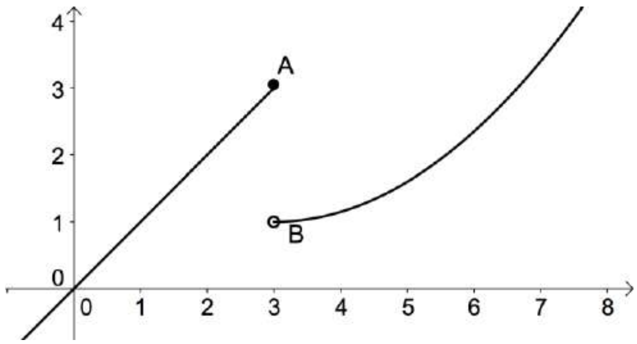






6. What is meant by a "right hand limit" and a "left hand limit"?

7. For the following graph, find: $\lim_{x \to 3^+} f(x) =$ $\lim_{x \to 3^-} f(x) =$



8. For a limit to exist, what has to be true for the left hand and the right hand limits?

Lesson 3: How do you evaluate limits?

9. What are the 3 methods for evaluating limits?

10. When can you use the substitution method?

11. When can you use the factoring method?

12. When can you use the conjugate method?

13. Figure out which method to use for the following limits, and evaluate them:

 a. $\lim_{x \to 9} \frac{\sqrt{x} - 3}{x - 9} =$

b. $\lim_{x \to 1} \frac{4x+5}{6x-1} =$

c. $\lim_{x \to 1} \frac{x^2+3x-4}{x-1} =$

Lesson 4: Limits and Infinity

14. How do you know if a function has a vertical asymptote?

15. When you take the limit of a function at its vertical asymptote, the limit will be _____ or ______.

16. To determine if a function has a horizontal asymptote, look at the…

17. If the degrees of the numerator and denominator are equal, how do you find the horizontal asymptote?

18. If the degree of the denominator is greater than that of the numerator, what's the horizontal asymptote?

19. If the degree of the denominator is less than that of the numerator, what's the horizontal asymptote?

20. If we say that the limit of a function EQUALS INFINITY, this really means that….

Lesson 5: Continuity

21. What does it mean for a function to be continuous?

22. What are the 3 types of discontinuity? Draw an example of a graph of each kind below:

23. In order to be continuous, 3 things must be true:

- There must be no _______________
- There must be no _______________
- The limit must be equal to the ____________________________________

24. An "easy" way to tell if a function is continuous is this: