# AP Calculus BC
# 2017-2018
# Mrs. Howard

# Summer Assignment

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Dear Future AP Student,

I hope you are excited for the year of Calculus that we will be pursuing together! I 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, integrals, and series. You don't need to know what those things are (yet) but I 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 infinitely 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 start the year with.

Calculus BC is a ***fast-paced*** class! There is a lot of material to cover, and we must do it by ***Tuesday, May 15th*** with (hopefully) some time to review before then. To help save us some time, I've prepared a summer assignment that covers the entire first chapter (Limits and Continuity) using the Khan Academy site. You will be watching videos (most are 2-6 min long, but there are a few 10-min ones) and answering questions on their site. You will be **tested** on this material about a week after returning to school, so that you will still have time to get some practice and ask questions, but we can jump right into the second chapter fairly quickly after the year begins.

The following page gives you directions for what to do, and the pages after that include a checklist to help keep you organized. If you have any questions at all while doing this, please email me at LHoward@wvcsd.org. See you in September!

1. First, go to www.khanacademy.org
2. You should have gotten an email from me (on your school account) inviting you to Khan Academy. Use the link in that email with the code 3B6FPK and log into Khan Academy.
3. You should see a list of topics. Look under "Math by subject" and find "AP Calculus BC". Click on that.
4. The first section is called "Limits Basics". Click on that.
    a. The first section is called "Limits Introduction" and has 2 videos – you may watch them or skip them. Up to you.
    b. The second section is called "Limits from tables". There is a video and practice questions underneath. Watch the video AND answer the questions. If you do not do well with the questions, the site will prompt you to watch the video again. I will be able to see how many questions you got right!
    c. The next section is called "Limits from graphs". There are 3 videos and a set of practice questions. Again, watch the videos and answer the questions.
    d. Continue as above for the following sections: "One-sided limits", "One-sided vs. Two-sided limits", and the final practice set of "Review: Limits basics".

        NOTE: YOU MAY SKIP **FORMAL DEFINITION OF LIMITS**! It is not required for the AP exam.

5. Continue on to the next section, "Continuity". The process is the same as above – watch the videos and answer the questions. The sections you are responsible for are:
    a. "Continuity at a point"
    b. "Limits of Combined and Composite Functions"
    c. "Continuous functions"
    d. "Intermediate Value Theorem"
    e. "Review: Continuity" (this just has questions – no video)

6. Continue on to the next section, "Limits from equations", and do the following three sections:
    a. "Limits from equations (direct substitution)"
    b. "Limits from equations (factoring and rationalizing)"
    c. "Squeeze theorem"
    d. "Limits of trig functions"
    e. "Removable discontinuities"
    f. "Review: Limits from equations" (questions only, no video)

7. Continue on to the next section, "Infinite limits", and do all sections contained here:
    a. "Unbounded limits (vertical asymptotes)"
    b. "Limits at infinity (horizontal asymptotes)"
    c. "Review: Infinite limits" (questions only, no video)

NOTE: This is the **FIRST TIME** I'm using Khan Academy for my summer assignment! So I will be asking you how you liked it when you return. I hope it proves to be helpful and saves us some time.

Keep in mind that this might be a good idea for you to do *all year long*. Last year a student would watch Khan Academy videos before I taught a lesson, so he would have some background knowledge before getting to class. Feel free to do this as well.

If any **questions** arise that you can't answer, write them down and/or email me!

In case this is at all confusing, here is your checklist. Check off the videos and the practice questions as you do them.

| Topic | Videos/Practice questions | How'd you do? |
|---|---|---|
| LIMITS BASICS<br>Limits Introduction | Vid: Newton, Leibniz, and Usain Bolt (optional)<br>Vid: Intro to Limits (optional) | N/A |
| Limits from tables | Vid: Limits from tables ☐<br>Prac: Limits from tables ☐ → | |
| Limits from graphs | Vid: Limits from graphs: functions defined ☐<br>Vid: Limits from graphs: point discontinuity ☐<br>Vid: Limits from graphs: asymptote ☐<br>Prac: Approximating limits from graphs ☐ → | |
| One-sided limits | Vid: One-sided limits from graphs ☐<br>Vid: One-sided limits from graph: asymptote ☐<br>Prac: One-sided limits from graphs ☐ →<br>Vid: One-sided limits from tables ☐ | |
| One-sided vs. two-sided limits | Vid: 1-sided vs. 2-sided limits (graphical) ☐<br>Vid: 1-sided vs. 2-sided limits (algebraic) ☐<br>Vid: 1-sided vs. 2-sided limits (more examples) ☐ | |
| Review: Limits basics | Prac: Limits basics challenge ☐ → | |
| CONTINUITY<br>Continuity at a point | Vid: Continuity introduction ☐<br>Vid: Continuity at a point ☐<br>Prac: Continuity at a point ☐ → | |
| Limits of combined and composite functions | Vid: Limit Properties ☐<br>Vid: Limits of combined functions ☐<br>Prac: Limits of combined functions ☐ →<br>Vid: Limits of composite functions ☐<br>Prac: Limits of composite functions ☐ → | |

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|---|---|---|
| Continuous Functions | Vid: Functions continuous on all real numbers<br>Vid: Functions continuous at specific x-values<br>Prac: Continuity and common functions | |
| Intermediate Value Theorem | Vid: Intermediate Value Theorem<br>Vid: Intermediate Value Theorem example<br>Prac: Intermediate Value Theorem | |
| Review: Continuity | Prac: Continuity Challenge | |
| LIMITS FROM EQUATIONS<br>Limits from equations (direct substitution) | Vid: Limits by direct substitution<br>Prac: Direct Substitution<br>Vid: Undefined limits by direct substitution<br>Prac: Direct substitution with limits that don't exist | |
| Limits from equations (factoring and rationalizing) | Vid: Finding limits by factoring<br>Prac: Limits by factoring<br>Prac: Rational function points of discontinuity<br>Vid: Limits by rationalizing<br>Prac: Limits by rationalizing | |
| Squeeze Theorem | Vid: Squeeze theorem intro<br>Vid: Using the squeeze theorem<br>Proof: Limit of sin x / x at x=0 | |
| Limits of Trig functions | Vid: Trig limit using Pythagorean identity<br>Vid: Trig limit using double angle identity<br>Prac: Limits using trig identities | |
| Limits of piecewise functions | Vid: Analyzing functions for discontinuities (continuous example)<br>Vid: Analyzing functions for discontinuities (discontinuous example)<br>Prac: Limits of piecewise functions | |

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|---|---|---|
| Removable discontinuities | Vid: Removing discontinuities (factoring)<br>Vid: Removing discontinuities (rationalization)<br>Prac: Removable discontinuities | |
| Review: Limits from equations | Prac: Limits from equations challenge | |
| INFINITE LIMITS<br>Unbounded limits (vertical asymptotes) | Vid: Infinite limits intro<br>Vid: Unbounded limits: graphical<br>Prac: Infinite limits and graphs<br>Vid: Unbounded limits: algebraic (rational)<br>Vid: Unbounded limits: algebraic (cosine)<br>Prac: Unbounded limits: algebraic | |
| Limits at infinity (horizontal asymptotes) | Vid: Infinite limits intro<br>Vid: Limits at infinity of rational functions (more examples)<br>Vid: Limits at infinity of rational functions<br>Prac: Limits at infinity of rational functions<br>Vid: Limits at infinity of rational functions: radicals (odd power)<br>Vid: Limits at infinity of rational functions: radicals (even power)<br>Prac: Limits at infinity of rational functions: radicals<br>Vid: Limits at infinity of rational functions: trig<br>Vid: Limits at infinity of rational functions: trig (limit undefined)<br>Prac: Limits at infinity of rational functions: trig<br>Vid: Limit at infinity of a difference of functions | |
| Review: Infinite limits | Prac: Infinite limits challenge | |