AP Calculus Summer Reading & Assignments

Congratulations on making it to Calculus! Pretty much all your high school math up to now has been preparation for this moment – when we hop a flight on *Newton Airlines* and go from the world of photos and slide shows (Algebra) to the world of video and motion pictures (Calculus). I'll be your copilot as you learn how to fly this plane.

Archimedes nearly invented the Calculus almost 2300 years ago. He was infinitesimally close, but didn't quite reach the limit (this is a calculus joke; you might not get it until later in the course). It would be another 2000 years before anybody else was good enough at math to finish the job.

It was actually two people who invented Calculus at about the same time – Isaac Newton in England and Gottfried Leibnitz in Germany (actually, Saxony; Germany wasn't a country yet). Newton invented Calculus so he could finish his science homework. Leibnitz invented it mostly, it seems, because it was his idea of fun. Both of them, while being brilliant, owed a lot to earlier mathematicians such as Rene Descartes, Cavalieri and Fermat.

And now you get to pull back the curtain and learn the magic – how to find the velocity of things that are moving, speeding up and slowing down, how to find the slope of curved lines, how to find the area of weird shapes.

Algebra helped people build the pyramids. Calculus helped us get to the moon.

Algebra is like the kiddie rides at Worlds of Fun. You're ready for the big-kid rides now. So fasten your seatbelts, keep your seats in the upright position and get ready for our flight. And please enjoy the reading material as we taxi down the runway to Fall 2017.

And yes, the summer reading and assignments are required! You need to brush up on some of the levers and controls so that you'll be ready for takeoff.

Have a great summer.

Sincerely,

Phillip Gegen
Training pilot, AP Calculus

Attachments: *"A Quick and Fun Guide to Mathematical Jargon"*

Summer Assignment: Complete the odd exercises for sections P.1, P.2 and P.3 from our textbook. You will find the questions at the web link below. You may click the "s" next to each question to check your solution.

college.cengage.com/mathematics/blackboard/content/larson/calc8e/calc8e_solution_main.html?CH=00&SECT=a&TYPE=se

If you have any trouble at all accessing the online problems, or have questions, please email me this summer at Phillip.Gegen@nkcschools.org

AP Calculus Summer Reading & Assignments

A Quick and Fun Guide to Mathematical Jargon

(sort of alphabetical, sort of grouped by meaning)

Pre-Calculus Terms

Algebra: Okay, if I have to explain what this is – a bunch of letters pretending to be numbers and a bunch of rules for playing around with them – then you shouldn't be taking calculus. Do not pass GO, do not collect $200.

Constant: a fixed number, like 3, or $\sqrt{2}$, as opposed to a variable which has unknown or changing values. Constant means unchanging, unwavering, as in "My teacher **constant**ly picks on me just because I don't do any homework and am **constant**ly texting in class."

Variable: the word used most often by meteorologists. In math, a quantity that can vary. Often represented by a letter of the alphabet just to confuse students and irritate English teachers, and sometimes with Greek letters just to really mess people up.

Exponent: that little number that appears as a superscript next to another number. Not to be confused with a person who supports a cause, i.e., an exponent of taking Calculus.

Exponential function: The function $f(x) = e^x$. It's most famous property? It is its own derivative. Kind of like a *mog* is its own best friend (*Spaceballs* reference)

Exponential growth: growth that starts off very boring and slow and suddenly seems to take off like a fighter plane going vertical. This is the model people use for population growth when they want to scare you to death about humans reproducing like bacteria and not having enough food until we all starve and die.

Exponential decay: exactly like exponential growth, except the base number is between 0 and 1, so it starts off really exciting and ends rather calmly, like a plane doing a nosedive toward earth and leveling off for a gentle landing at the last minute.

Absolute value: like, a number's *value*, like absolutely, know what I mean? Like no need to be negative, it doesn't matter what *direction* you go from zero, it's all good. Like -3 is worth just as much as 3 when you look at it that way. Absolutely.

Absolute maximum: the absolute, bar-none, highest value for a function. The Mt. Everest of values. As opposed to a local (or relative) maximum, which would just be the highest point in this area. Taum Sauk Mountain, the local maximum in Missouri, might be a big deal in our state, but Rocky Mountains just chuckle at it and pick it last when choosing dodge ball teams. Meanwhile, they're also just local maximums. Mt. Everest is the ABSOLUTE maximum.

Absolute minimum: just like absolute maximum except, of course, the opposite. Relative (or local) minimums are like having a bad day because your dog ate your Calculus homework, where absolute minimum is like the country song where your spouse ran away with your best friend, stole your ~~car~~ truck, burned your ~~house~~ trailer, and shot your dog.

AP Calculus Summer Reading & Assignments

Extremum (plural extrema): just a word to replace both minimum and maximum. If Dickens had been a mathematician, he might have written, "It was the extrema of times" instead of "It was the best of times, it was the worst of times." Not as catchy, perhaps, but efficient.

Function: a REALLY important type of relationship between variables in math. With functions you always have a starting value and an ending value. What's really important is that with a function you always know what you're going to get. No surprises. You know those gumball machines where you put in 50 cents and get different prizes, and you're hoping you get that one prize but it ends up being something you don't want? Well, that's NOT a function.

Dictionary table tennis: see lexicon ping-pong.

Domain: Think of an Oak Park football game. At the start of the game all the players are suited up on the sideline. That's the domain – the coach can put any of those players in the game. All of us in the stands, we're not in the domain – the coach can't use us. The domain of a function is just like that – it's the set of numbers we're allowed to put into a function. Usually we get all Real numbers for our domain. Sometimes there are restrictions, numbers we can't us because they blow up the function (try putting 2 into $\frac{5}{x-2}$), or because they don't "keep it real" (like using 5 in $\sqrt{3-x}$). Sometimes WE limit the domain, as in this example:

> *The population of Kansas City can be modeled by the equation* $P(t) = 300{,}000 + 2000x$ *for* $0 \leq x \leq 50$, *where* $x = 0$ *represents the year 1950.*

I deliberately restricted the domain because I only care about the years 1950 to 2000, or because the model only fits for that time frame. Either way, domain is IMPORTANT. Pay attention to it!

Range: While the starting numbers are the domain, the range is the set of answers or results you get – it's where you end up. Often all Real numbers, but not always. In the Kansas City example above, the range is from 300,000 to 400,000 ($f(0)$ *to* $f(50)$).

Ellipse: like a circle but just a little off, like a circle's crazy cousin. We even use the word *eccentric* to describe them.

Coordinate plane: the xy-plane or grid that we commonly call a graph. But it's NOT a graph. A graph is what we DRAW on a coordinate plane.

Cartesian plane: another name for coordinate plane. It's what all the cool kids say. Named after Rene Descartes, the French mathematician who came up with the idea. Yes, like so many frustrating things in life, we can blame the French for graphs.

Vertical line test: if a vertical line crosses a graph no more than once, then it is the graph of a function.

Vertical line test haiku:

Vertical Line Test
Function crossed twice by same line
Is not a function

Linear equation: if you don't know, go ask your Algebra 1 teacher.

AP Calculus Summer Reading & Assignments

Logarithm: turns out this has nothing to do with dancing trees. Logs are good for fires and building presidential birth places. Seriously, logarithms are very useful in math, and easy to use if you remember one thing: logarithms are exponents. Logarithms are exponents.
Say it with me, "Logarithms are exponents."

Origin: The point in space where the coordinates are zero, for nothing. We can set the origin wherever we want. Usually somewhere in Iowa.

Parabola: When you throw something – a rock, a basketball, a rocket – it wants to go in a straight line. Gravity turns it into a parabola. Straight lines go with $y = mx + b$. Parabolas go with $y = ax^2 + bx + c$. Notice the only difference? It's the x^2 part. That's because of gravity.

A Few Calculus Terms

Derivative: One of the two most important ideas in all of calculus. It is the slope of a curve. More precisely, it is the slope of the tangent line to the graph of a curve at the point where the tangent touches the curve. We spend a lot of time in Calculus finding derivatives. They're kind of a big deal.

Antiderivative: You guessed it – it's the opposite of a derivative. This is the other most important idea in all of calculus. The antiderivative is the equation of the curve that the derivative (slope) comes from. For instance, if I tell you the slope (derivative) of some line is 3, you could say that the antiderivative is $y = 3x - 7$. Or it could be $y = 3x + 2$. Or $y = 3x - 81$. Pretty much $y = 3x + C$, where C is whatever you want.

Indefinite Integral: another name for antiderivative. It's "indefinite" because there are so many possible right answers (see "$y = 3x + C$" above).

Definite Integral: a lot like indefinite integrals, except we have a starting and stopping point on our function, and are able to tell the *area* under the graph for that section.

There are many more definitions we'll encounter, but that's good for starters.

Finally, some terms commonly used by math teachers:

clearly: I don't want to write down all the "in- between" steps.

obviously: I hope you were paying attention earlier, because I refuse to repeat it.

recall: I shouldn't have to tell you this, but if you erase your memory after every test...

hint: The hardest of several possible ways to do a proof. *(I do this sometimes)*

similarly: At least one line of this example is the same as a previous example.

briefly: I'm running out of time, so I'll just write and talk faster. *(yeah, I'm guilty of this too)*

proof omitted: Trust me, It's true. *(I'll rarely use this one – you should almost NEVER trust someone just because they say so. Even experts. Maybe especially experts.)*