AP Calculus Summer Packet

Instructor: Mr. Andrew Nichols and Ms. Talyssa Hunter
Email questions to atnichols@atlanta.k12.ga.us

Help Session: Tuesday, July 31, 3:30 – 5:30
Due Date: First Day of Class
Prerequisites Quiz: Second Day of Class

Instructions: Work on this packet over the summer. This packet is due on the first day of class and will be graded for completion and accuracy. This is your first graded assignment of the fall semester in AP Calculus. You must SHOW YOUR WORK to receive credit.

Strategies for Success:
1) Start working on this packet NOW while you have the support of your PreCalculus teacher.
2) Review the entire packet first and identify problems that you don't recognize or have struggled with in the past.
3) Identify a study group that you can work with over the summer either in person or online.
4) Ask a more experienced student for help.
5) Use internet resources like Khan Academy, CoolMath, and YouTube.
6) Email Mr. Nichols if you get stuck and need help.
7) Don't procrastinate. This packet will take longer than you expect to complete and putting it off only makes it more stressful.

Submission: Write the answers to problems 1 – 9 in this packet. **Work all other problems on your own paper.** Organize your work and answers so that they can be easily graded. When you hand in your work, remove problems 1 – 9 from the packet and staple them to your work and answers for the remaining problems.

A Note About Calculators: most of the problems in this packet should be solved without using a calculator unless the instructions say explicitly "use your calculator too…" However, a graphing calculator is REQUIRED for the last section. It is strongly recommended that you purchase a ***TI Nspire CX CAS*** graphing calculator and familiarize yourself with its use. Here is a link to this model on Amazon: https://goo.gl/CuQSFn. **Be sure to buy the CX CAS model.**

Join our Google Classroom! Use the code **snu3b10** to join AP Calculus AB 18-19 for next school year. This is where we will post important documents (including the solutions to this packet) over the summer.

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SKILLS NEEDED FOR CALCULUS

A working knowledge of these topics is important for success in AP Calculus. Items marked with and asterisk (*) are vital. The practice problems at the end of this packet cover these topics. For a more exciting, and interactive version of this list, see https://goo.gl/nx44vQ

I. Algebra

A. *Exponents (operations with integer, fractional, and negative exponents)
B. *Factoring (GCF, trinomials, difference of squares and cubes, sum of cubes, grouping)
C. Rationalizing (numerator and denominator)
D. *Simplifying rational expressions
E. *Solving algebraic equations and inequalities (linear, quadratic, higher order using synthetic division, rational, radical, and absolute value equations)
F. Simultaneous equations

II. Graphing and Functions

A. *Lines (intercepts, slopes, write equations using point-slope and slope intercept, parallel, perpendicular, distance and midpoint formulas)
B. Conic Sections (circle, parabola, ellipse, and hyperbola)
C. *Functions (definition, notation, domain, range, inverse, composition)
D. *Basic shapes and transformations of the following functions (absolute value, rational, root, higher order curves, log, ln, exponential, trigonometric. piecewise, inverse functions)
E. Tests for symmetry: odd, even

III. Geometry

A. Pythagorean Theorem
B. Area Formulas (Circle, polygons, surface area of solids)
C. Volume formulas
D. Similar Triangles

IV. Logarithmic and Exponential Functions

A. *Simplify Expressions (Use laws of logarithms and exponents)
B. *Solve exponential and logarithmic equations (include ln as well as log)
C. *Sketch graphs
D. *Inverses

**** V. Trigonometry***

A. *Unit Circle (definition of functions, angles in radians and degrees)
B. Use of Pythagorean Identities and formulas to simplify expressions
C. and prove identities
D. *Solve trigonometric equations
E. *Inverse Trigonometric functions
F. Right triangle trigonometry
G. *Graphs

VI. Limits

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A. Concept of a limit

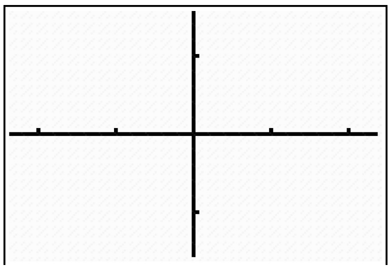
B. Find limits as x approaches a number and as x approaches ∞

Toolkit of Functions

In Calculus it is expected that students know the basic shape of many functions and be able to graph their transformations ***without the assistance of a calculator***.

(1) For each function below, <u>accurately</u> sketch its graph and give its domain and range.

Constant: $y = c$



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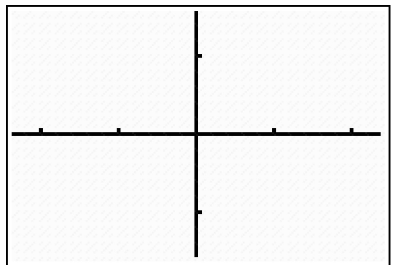
Linear: $y = x$



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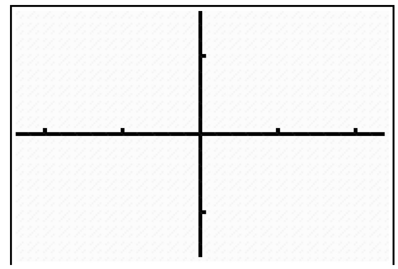
Quadratic: $y = x^2$



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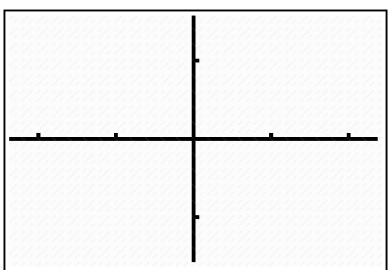
Cubic: $y = x^3$



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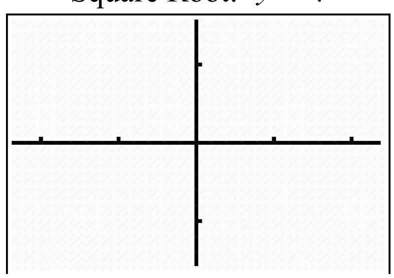
Square Root: $y = \sqrt{x}$



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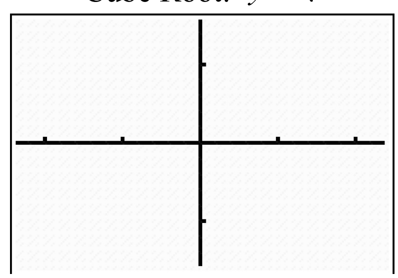
Cube Root: $y = \sqrt[3]{x}$



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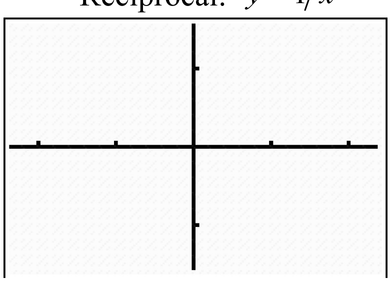
Reciprocal: $y = 1/x$



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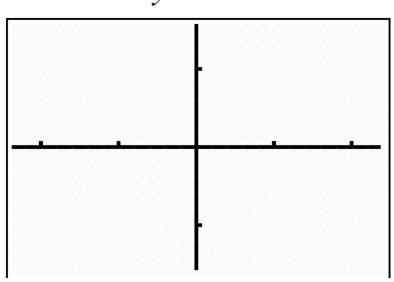
$y = x^{2/3}$



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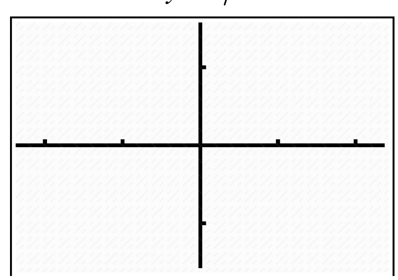
$y = 1/x^2$



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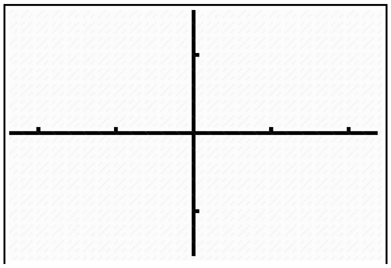
$y = x^{3/2}$



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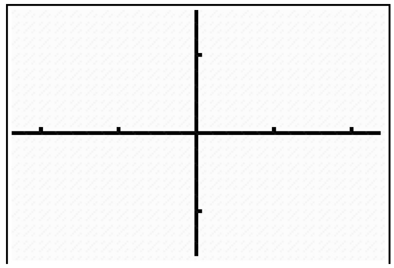
$y = 1/(x^2+1)$



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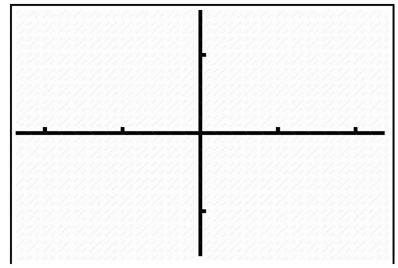
Absolute Value: $y = |x|$



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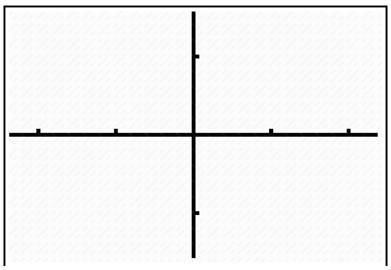
Semicircle: $y = \sqrt{1-x^2}$



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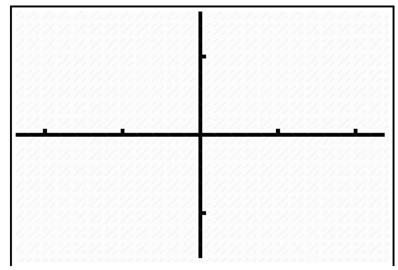
Greatest Integer: $y = [[x]]$

See https://goo.gl/KrSsAB



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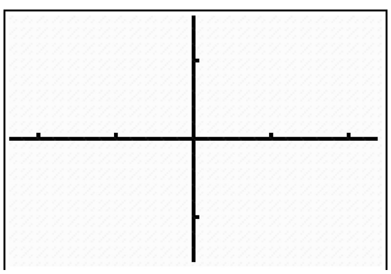
Sine: $y = \sin x$



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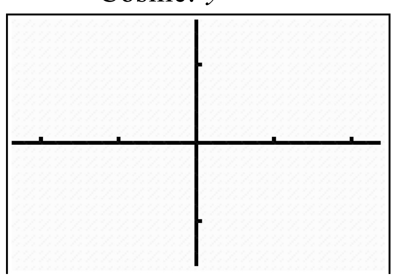
Cosine: $y = \cos x$



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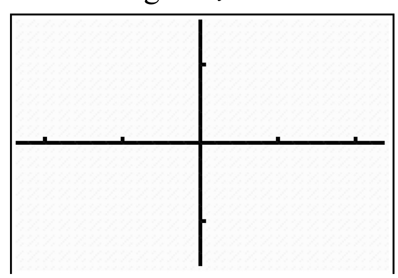
Tangent: $y = \tan x$



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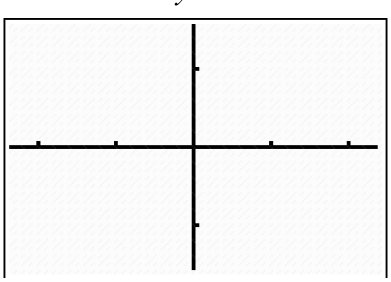
Natural Exponential

$y = e^x$



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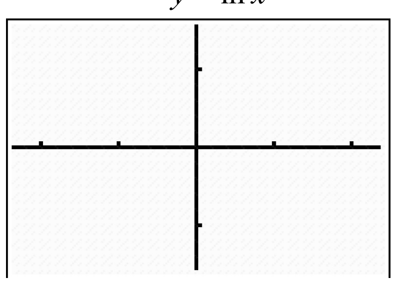
Natural Log

$y = \ln x$



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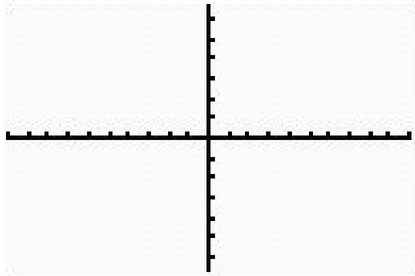
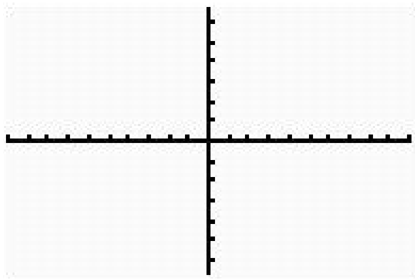
(2) Use your *Toolkit of Functions* and your knowledge of transformations to sketch the graphs of the following functions without using your calculator (except to check your answer). See https://goo.gl/P6UUWu for help.

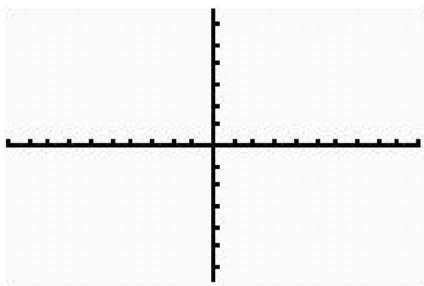
(a) $y = |x-2|$



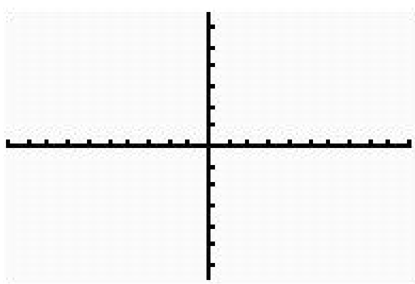
(b) $y = \dfrac{1}{x-2}$



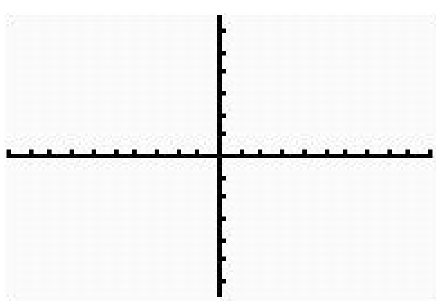
(c) $y = 2^{-x}$



(d) $y = 3\sin\left(2\left(x - \dfrac{\pi}{6}\right)\right)$



(e) $y = \ln(x-1) + 1$

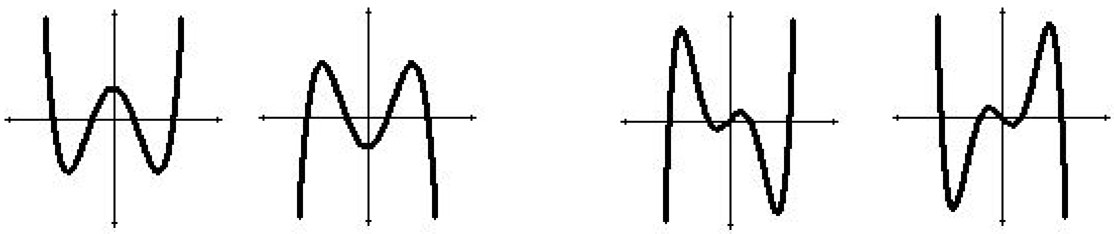


Graphing Polynomial Functions - See https://goo.gl/fhdYuu for help with graphing polynomials.

A function P is called a polynomial if $P(x) = a_n x^n + a_{n-1}x^{n-1} + \ldots + a_2 x^2 + a_1 x + a_0$

Where n is a nonnegative integer and the numbers $a_0, a_1, \cdots a_n$ are constants.

Even degree		Odd degree	
Leading coefficient sign		Leading coefficient sign	
Positive	Negative	Positive	Negative

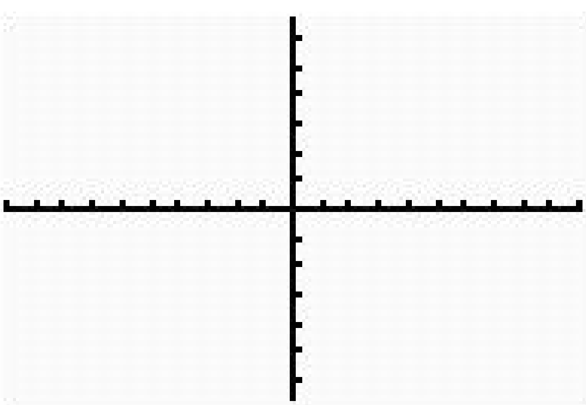


- Number of roots equals the degree of the polynomial.
- Number of x intercepts is less than or equal to the degree.
- Number of "bends" is less than or equal to (degree – 1).
- Roots with even multiplicity "bounce" off of the x-axis.
- Roots with odd multiplicity cross the x-axis.

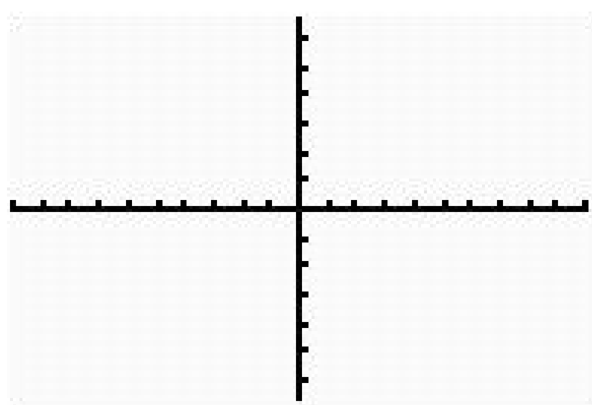
(2) Make a rough sketch the graph of each polynomial without using a calculator. By following the steps below:

A. Factor the polynomial to find its roots (x-intercepts)
B. Use the roots you found to plot the x-intercepts on the x-axis. For each root, use its multiplicity to determine if its a "bounce" or a "cross."
C. Identify the degree of the polynomial and use it to determine the general shape.
D. Use the sign of the leading coefficient to determine the end behavior.
E. Use all of the above to make a rough sketch of the polynomial.

$y = -\frac{1}{2}x^2 + x$



$y = x^3 - 3x^2 - x + 3 = (x^2 - 1)(x - 3)$



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Rational Functions

Locating Asymptotes

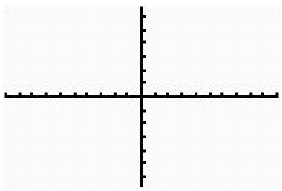
(3) Use the following rational functions to investigate asymptotes. Before you begin,

(a) Factor the numerator and denominator of each function,

(b) Determine the domain for each, and

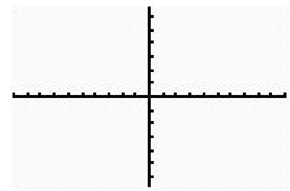
(c) Graph the function on your calculator in the standard viewing window and sketch the graph on the coordinate axis.

$f(x)=\dfrac{x}{x^2-1}$



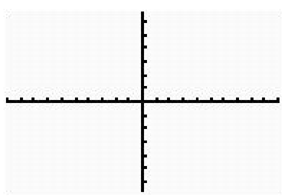
D: ________________

$g(x)=\dfrac{x^2-9}{x^2-x-6}$



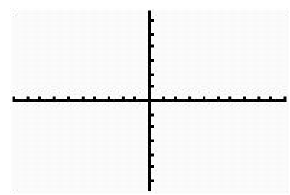
D: ________________

$h(x)=\dfrac{x^3-x}{x^2-1}$



D: ____________________

$k(x)=\dfrac{2x^4-x^2}{x^3+x^2}$



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**In the notes below "$\rightarrow$" means "approaches." So $x \to 2$ is read "x approaches 2." The statement $y \to \infty$ means that y grows without bound or y "goes to positive infinity."

Vertical Asymptotes - *See* https://goo.gl/CbHLWB *for help.*

Each domain restriction is the location of either

(a) a point discontinuity (i.e. hole in the graph) or

(b) a vertical asymptote (a vertical line that, as the function approaches the line, $y \to \pm\infty$).

(4) Refer back the the functions f, g, h, and k on the previous page. Classify each domain restriction ($x \neq c$) as either a vertical asymptote or point discontinuity by examining the graph of the function:

$f(x)$

Point discontinuities at $x =$ ________

Vertical asymptotes at $x =$ __________

$g(x)$

Point discontinuities at $x =$ ________

Vertical asymptotes at $x =$ __________

$h(x)$

Point discontinuities at $x =$ ________

Vertical asymptotes at $x =$ __________

$k(x)$

Point discontinuities at $x =$ ________

Vertical asymptotes at $x =$ __________

(5) How could you tell the difference between a point discontinuity and a vertical asymptote without looking at the graph and just examining the equation of the function? Write your answer in the space provided below.

____

____

____

____

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Horizontal Asymptotes - See https://goo.gl/N1iYSn for help.

The end behavior of a function $y = f(x)$ determines its **horizontal asymptotes** (a horizontal line that the function approaches as $x \to \pm\infty$).

(a) If a function has infinite end behavior, then it has no horizontal asymptotes, but

(b) If $y \to c$ as $x \to \pm\infty$, then $y = c$ is a horizontal asymptote for $y = f(x)$.

(6) Again refer to f, g, h, and k above. Determine the end behavior of each function and write the equations of any horizontal asymptotes.

In the function $f(x)$:

As $x \to \infty$, $y \to$ ____

As $x \to -\infty$, $y \to$ ____

Horizontal asymptotes: $y =$ _______

In the function $g(x)$:

As $x \to \infty$, $y \to$ ____

As $x \to -\infty$, $y \to$ ____

Horizontal asymptotes: $y =$ _______

In the function $h(x)$:

As $x \to \infty$, $y \to$ ____

As $x \to -\infty$, $y \to$ ____

Horizontal asymptotes: $y =$ _______

In the function $k(x)$:

As $x \to \infty$, $y \to$ ____

As $x \to -\infty$, $y \to$ ____

Horizontal asymptotes: $y =$ _______

Summary of Horizontal Asymptotes for Rational Functions

Let $f(x) = \dfrac{p(x)}{q(x)}$ be a rational function, i.e., $p(x)$ and $q(x)$ are polynomials.

Let $n =$ degree of $p(x)$ and $m =$ degree of $q(x)$.

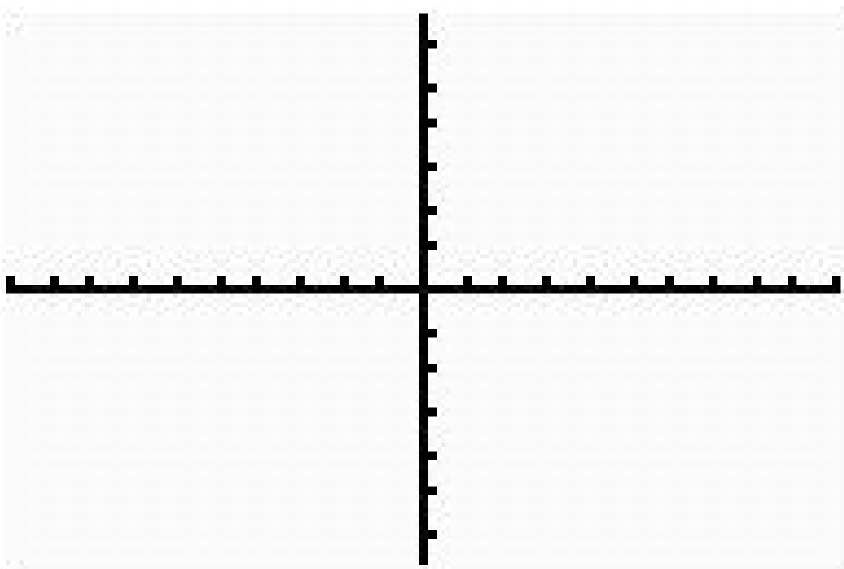
Let $a =$ leading coefficient of $p(x)$ and $b =$ leading coefficient of $q(x)$.

(a) If $n < m$, then $f(x)$ has the horizontal asymptote $y = 0$.

(b) If $n = m$, then $f(x)$ has the horizontal asymptote $y = \dfrac{a}{b}$.

(c) If $n > m$, then $f(x)$ has no horizontal asymptote.

(7) Make a detailed sketch of the graph of $f(x) = \dfrac{2x^3 - 8x}{x^3 - 2x}$ without the use of your graphing calculator. Show your analysis and make your sketch below. See https://goo.gl/SDRsCz for help.



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Trigonometric Identities

You are expected to *memorize* the Reciprocal, Quotient, and Pythagorean Identities.

Reciprocal Identities: $\csc A = \dfrac{1}{\sin A}$ $\sec A = \dfrac{1}{\cos A}$ $\cot A = \dfrac{1}{\tan A}$

Quotient Identities: $\tan A = \dfrac{\sin A}{\cos A}$ $\cot A = \dfrac{\cos A}{\sin A}$

Pythagorean Identities: $\sin^2 A + \cos^2 A = 1$ $\tan^2 A + 1 = \sec^2 A$ $1 + \cot^2 A = \csc^2 A$

You do *not* need to memorize any of the following identities, but you do need to know how to use them.

Sum and Difference Identities:

$\sin(A + B) = \sin A \cos B + \cos A \sin B$ $\sin(A - B) = \sin A \cos B - \cos A \sin B$

$\cos(A + B) = \cos A \cos B - \sin A \sin B$ $\cos(A - B) = \cos A \cos B + \sin A \sin B$

Double Angle Identities:

$\sin(2A) = 2\sin A \cos A$

$\cos(2A) = \cos^2 A - \sin^2 A = 2\cos^2 A - 1 = 1 - 2\sin^2 A$

Half Angle Identities:

$\sin\dfrac{A}{2} = \pm\sqrt{\dfrac{1-\cos A}{2}}$ $\cos\dfrac{A}{2} = \pm\sqrt{\dfrac{1+\cos A}{2}}$

Geometry Formulas Needed For Calculus

Go to https://goo.gl/AWMX49 and review all four pages of geometry formulas you need to know for Calculus.

 Name: ________________________

Unit Circle

You are expected to memorize the First Quadrant of the Unit Circle and be able to extend that knowledge to the other quadrants as needed.

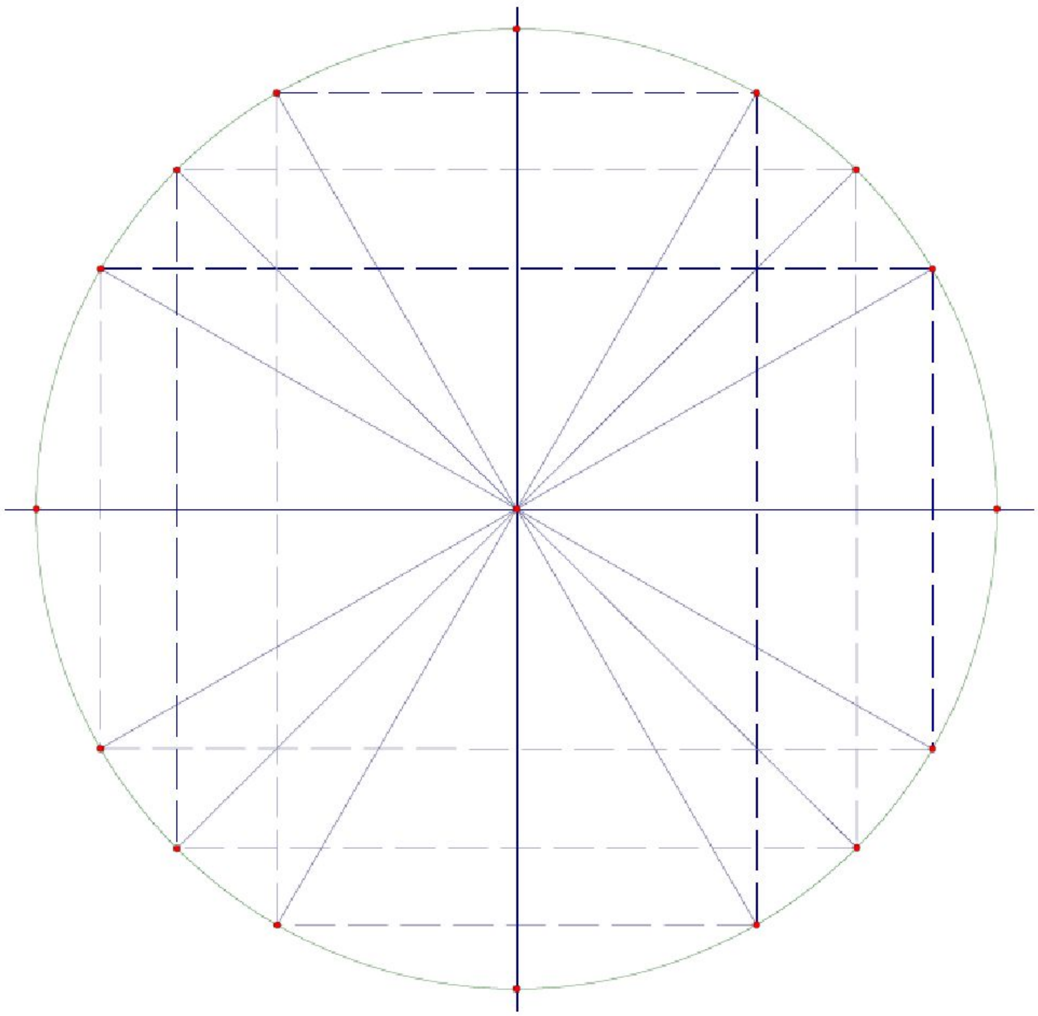
The sixteen points marked on the Unit Circle below correspond to quadrantal angles, special angles, and their multiples. See https://goo.gl/1Q8zZu for help with the Unit Circle.

(8) Label each point with

(a) the corresponding positive angle measure between 0° and 360°,

(b) positive radian measure between 0 and 2π, and

(c) its (x,y)-coordinates.



(9) For an angle θ in standard position whose terminal side intersects the Unit Circle at (x,y),

sin θ =	**cos θ =**	**tan θ =**
csc θ =	**sec θ =**	**cot θ =**

THE REMAINING PROBLEMS IN THIS PACKET SHOULD BE WORKED ON YOUR OWN PAPER AND ATTACHED TO THE PACKET WHEN HANDED IN.

(10) Go to https://goo.gl/SBF5Kn and review the properties of exponents. Here is a summary:

(i) $b^1 = b$

(ii) If $n > 1$, $b^n = b \cdot b \cdot b \cdots b$, n times.

(iii) $b^0 = 1$

(iv) $a^m a^n = a^{m+n}$

(v) $\left(\frac{a}{b}\right)^m = \frac{a^m}{b^m}$, where $b \neq 0$

(vi) $\left(\frac{a}{b}\right)^m = \frac{a^m}{b^m}$, where $b \neq 0$

(vii) If $b \neq 0$, $b^{-n} = \frac{1}{b^n}$

(viii) $\frac{a^n}{a^m} = a^{n-m} = \frac{1}{a^{m-n}}$, where $a \neq 0$

(ix) If $b \geq 0$ and $n > 1$, $b^{\frac{1}{n}} = \sqrt[n]{b}$.

(x) If $b \neq 0$ and m and n are integers with $n > 1$, $b^{\frac{m}{n}} = \sqrt[n]{b^m} = \left(\sqrt[n]{b}\right)^m$

Simplify and write without using negative exponents:

(a) $3(2xy)^{-3}$

(b) $\left(\frac{5xy}{x^2y^4}\right)^{-1}$

$\frac{\left(8x^3yz\right)^{1/3}(2x)^3}{4x^{1/3}\left(yz^{2/3}\right)^{-1}}$

For 10 - 11, use the properties of exponents to simplify the radical expressions. For help, see https://goo.gl/k36zbA

(11) Express using a single radical and positive integer powers: $6^{1/4}x^{3/4}y^{1/4}$

(12) Express using positive rational exponents and without radicals: $\sqrt[5]{x^{10}y^2} \cdot \sqrt[4]{z^2}$

(13) Expand each expression and combine like terms. See https://goo.gl/AQ43nz for help.

(a) $(a+b)^2$

(b) $(a-b)^2$

(c) $\left[x\left(y^2+1\right)\right]^2$

(14) Factor completely. See https://goo.gl/hHvD2o for help.

(a) $9x^2 + 3x - 3xy - y$ *Hint: use grouping*

(b) $64x^6 - 1$ *Hint: factor as a difference of squares first, then as the sum and difference of cubes.*

(c) $42x^4 + 35x^2 - 28$

(15) Simplify: $\dfrac{(x+1)^3(x-2)+3(x+1)^2}{(x+1)^4}$ *Hint*: factor the GCF from the numerator first.

(16) Use polynomial long division to write each rational expression as a sum of terms. See https://goo.gl/NAT6ru for assistance.

(a) Use division to show that
$$\frac{x^2+3x-1}{x+1} = x+2-\frac{3}{x+1}$$

(b) Use division to show that
$$\frac{x^5+3x^2-1}{x^2+1} = x^3-x+\frac{x-1}{x^2+1}$$

(17) Solve the following equations and inequalities algebraically. Check your solutions by graphing.

(a) $(x+3)^2 > 4$

(b) $\dfrac{x+5}{x-3} = 0$

(c) $3x^3 - 14x^2 - 5x = 0$

(d) $\dfrac{x^2-9}{x+1} \ge 0$

(e) $\dfrac{1}{x-1} + \dfrac{4}{x-6} = 0$

(f) $|2x+1| < 1/4$

(18) Solve each system of equations algebraically and then check your answer by graphing. For help with linear systems see https://goo.gl/NSesFe. For quadratic systems see https://goo.gl/X6TA4D

(a) $\begin{cases} x+3y=5 \\ 2x-y=1 \end{cases}$

(b) $\begin{cases} x-y+1=0 \\ y-x^2=-5 \end{cases}$

(c) $\begin{cases} x^2-4x+3=y \\ -x^2+6x-9=y \end{cases}$

(19) Write the equation for the line described by the given information. For assistance see https://goo.gl/DeyCSd and https://goo.gl/E5RLiK

(a) Passes through the point $(2,-1)$ and has slope $-\dfrac{1}{3}$.

(b) Passes through the point $(4,-3)$ and is perpendicular to $3x+2y=4$.

(c) Passes through $(-1,2)$ and is parallel to $y=\dfrac{3}{5}x-1$.

(20) Find the domain of each function. For help with domain see https://goo.gl/VnUR9p and https://goo.gl/Ws6fFB

Recall that domain restrictions may result from any of the following

(i) Denominator must be $\neq 0$
(ii) Argument (input) for a log must be > 0
(iii) Radicand (input) for an even root must be > 0

(a) $y = \dfrac{3}{x-2}$

(b) $y = \log(x-3)$

(c) $y = x^4 + x^2 + 2$

(d) $y = \sqrt{2x-3}$

(e) $y = |x-5|$

(f) $y = \dfrac{\sqrt{x+1}}{x^2-1}$

(21) Sketch the graph of the piecewise function $f(x)$ given below on the interval $[-3,3]$. What is the range of *f* on this domain? For help see https://goo.gl/NnjdwH

$$f(x) = \begin{cases} x & \text{if } x \geq 0 \\ 1 & \text{if } -1 \leq x < 0 \\ x-2 & \text{if } x < -1 \end{cases}$$

(22) Use the functions *f*, *g*, and *h* defined below to compute each inverse or composition. For help with composition see https://goo.gl/iGbaqX. For help with inverses see https://goo.gl/F7S2np for graphical help and https://goo.gl/5P33Ez for algebraic help.

$f(x) = x^2 + 3x - 2$ $\quad g(x) = 4x - 3$ $\quad h(x) = \ln x$ $\quad w(x) = \sqrt{x-4}$

(a) $g^{-1}(x)$

(b) $h^{-1}(x)$

(c) $w^{-1}(x)$ for $x \geq 4$

(d) $f(g(x))$

(e) $h[g(f(1))]$

(23) Does $y = 3x^2 - 9$ have an inverse function? Justify your answer.

(24) Let $f(x) = 2x$, $g(x) = -x$, and $h(x) = 4$ then find

(a) $f(g(x))$

(b) $f(g(h(x)))$

(25) Let $s(x) = \sqrt{4-x}$ and $t(x) = x^2$ then find the domain of $s(t(x))$.

(26) Express the function $F(x) = \dfrac{1}{\sqrt{x+\sqrt{x}}}$ as the composition of three functions *f*, *g*, & *h* so that $F(x) = f(g(h(x)))$.

 Name: ________________________

(27) Identify each function as odd, even, or neither and justify your answer *algebraically*.

Use these algebraic tests below and see https://goo.gl/qotY2y for more help.

f is and even function if and only $f(-x)=f(x)$ for all x.

(i) f is and odd function if and only $f(-x)=-f(x)$ for all x

(a) $f(x)=x^3+3x$ $f(x)=\dfrac{x^3-x}{x^2}$ (d) $f(x)=x^2+x$

(e)

(b) $f(x)=x^4-6x^2+3$ (c) $f(x)=\sin 2x$

(28) The graph of an equation is symmetric with respect to the

(i) y-axis if the equation is unchanged when replacing x with $-x$.

(ii) x-axis if the equation is unchanged when replacing y with $-y$.

(iii) origin if the equation is unchanged when replacing x with $-x$ AND y with $-y$.

Even functions are symmetric with respect to the ________.

Odd functions are symmetric with respect to the ________.

Test each function for symmetry *graphically*. If the function is even or odd, say so. See https://goo.gl/pX68KD for assistance.

(a) $y=x^4+x^2$ (b) $y=\sin x$ (c) $y=\cos x$ (d) $x=y^2+1$ (e) $y=\dfrac{|x|}{x^2+1}$

(29) Recall the properties of logarithms below. For a review of these properties and how to use them see https://goo.gl/2c9gcb.

(i) $\log_b 1=0$

(ii) $\log_b b=1$

(iii) $\log_b b^n=n$

(iv) $\log_b mn=\log_b m+\log_b n$

(v) $\log_b \dfrac{m}{n}=\log_b m-\log_b n$

(vi) $\log_b m^p=p\log_b m$

(vii) If $\log_b m=\log_b n$, then $m=n$

Simplify each logarithmic expression below using the properties of logarithms.

(a) $\log_4\left(\dfrac{1}{16}\right)$

(b) $3\log_3 3-\dfrac{3}{4}\log_3 81+\dfrac{1}{3}\log_3\left(\dfrac{1}{27}\right)$

(c) $\log_9 27$

(d) $\log_{125}\left(\dfrac{1}{5}\right)$

(e) $\log_w w^{45}$

(f) $\ln e$

(g) $\ln 1$

(h) $\ln e^2$

(30) Solve each equation below for x. For helps with log equations see https://goo.gl/ZaWZ9d. For help with exponential equations see https://goo.gl/LP18Dk

(a) $\log_6(x+3)+\log_6(x+4)=1$ (b) $\log x^2 - \log 100 = \log 1$ (c) $3^{x+1}=15$

(31) Under ideal conditions a certain bacteria population is known to double in size every three hours. Suppose that there are initially 100 bacteria.

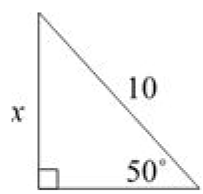
(a) What is the size of the bacteria population after 15 hours?
(b) What is the size of the bacteria population after t hours?
(c) How long will it take the bacteria population to grow to 50,000?

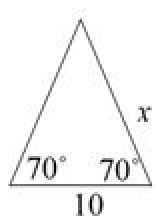
For help with using exponential equations to solve word problems, see https://goo.gl/PZwoDB and https://goo.gl/mJN1XJ

(32) Solve each equation for $0 \le x \le 2\pi$:

(a) $\cos^2 x = \cos x + 2$ (b) $2\sin 2x = \sqrt{3}$ (c) $\cos^2 x + \sin x + 1 = 0$

(33) Solve for x in each diagram.

(a) 

(b) 

Graphing Calculator Section

A graphing calculator is REQUIRED for this section. It is strongly recommended that you purchase a ***TI Nspire CX CAS*** graphing calculator and familiarize yourself with its use. Here is a link to this model on Amazon: **https://goo.gl/CuQSFn. Be sure to buy the CX CAS model.**

For tutorial for using your TI-Nsprie CX CAS see https://www.atomiclearning.com/ti_nspire

(34) Familiarize yourself with the following graphing tools on your calculator

(i) Graphing functions
(ii) Adjusting the window setting for a graph.
(iii) Finding the roots of a graph
(iv) Finding a minimum or maximum on a graph.
(v) Finding intersection points on a graph.

Given $f(x) = 2x^4 - 11x^3 - x^2 + 30x$:

(a) Find an appropriate calculator viewing window that shows all of the important features of the function. Sketch the resulting graph on your paper.
(b) Find the *x*-coordinates all of the roots of the function accurate to three decimal places.
(c) Find the (*x*,*y*)-coordinates of all local maximums accurate to three decimal places.
(d) Find the (*x*,*y*)-coordinates of all local minimums accurate to three decimal places.
(e) Find the value of $f(-1)$, $f(2)$, $f(0)$, and $f(0.125)$ accurate to three decimal places.

(35) Graph the following functions and find their points of intersection using the Intersect command on your calculator (do not use TRACE). Sketch the graphs on your paper and state your answer accurate to three decimal places.

(a) $\begin{cases} y = x^3 + 5x^2 - 7x + 2 \\ y = 0.2x^2 + 10 \end{cases}$ (b) $\begin{cases} y = e^{\sin x} \\ y = 2x - 1 \end{cases}$ (c) $\begin{cases} y = (\ln x)(\cos x) \\ y = x^2 - 2 \end{cases}$

(d)

(36) Familiarize yourself with the following calculator tools.

(a) Storing a function
(b) Evaluating a stored function
(c) Solving an equation
(d) Storing a constant

Use the tools listed above to solve the following problem.

The velocity of a spaceship is given by the function $v(t)$ for $0 < t < 10$ and is shown below. Velocity is measuring in meters per second

$$v(t) = \frac{t^2 + 1}{t + 1} + e^{\sin t}$$

(a) Store $v(t)$ on your calculator and use it to calculate $v(2)$, approximated to three decimal places.
(b) Use the Solve tool to find all times when the velocity of the ship is 4 meters per second.

(37) The population of a certain species of tree frogs in a limited environment and initial population of 100 can be predicted using $P(t)=\dfrac{100{,}000}{100+900e^{-t}}$.

(a) Use your calculator to graph this function in an appropriate viewing window. Sketch the graph.

(b) Based on the graph, what seems to be the maximum number of frogs this environment can accommodate?

(c) Using the graph, estimate how long it takes for the population to reach 900 frogs.

(d) Using the solve tool, find the exact time required for the population to reach 900. Compare with the result of part (c).