AP Calculus Summer Assignment
OCHS – Mrs. Pace – 2024/25

Congratulations for making it to Calculus! Calculus is the culmination of much of the mathematics that you have learned on your journey through school. I hope that you will find it challenging, intriguing, and rewarding! Calculus is the branch of mathematics that deals with problems that cannot be solved with ordinary algebra – such as rate problems where slopes are not fixed and areas and volumes of irregular objects. This year, you will learn about the two main branches of calculus – differential and integral calculus.

This is an advanced placement math class. Therefore, it is treated like a college-level course. This means that more of the responsibility for your learning lies in your own hands than you have been accustomed to. By now, you have a good idea of how **you** best learn a complex subject. Do the work necessary and take the responsibility to seek help when you need it.

The problems in this assignment are designed to help you review topics from Algebra and Pre-Calculus which are important to your success in AP Calculus. When you come across a topic that requires a little review, feel free to search a website, call a friend or e-mail me (joy.pace@oldham.kyschools.us) for help. You will be responsible for knowing the math content contained in this packet and will be quizzed over it on the second day of school, after you have a had a chance to ask a few questions.

Since we do not have a textbook, you will be required to keep all of your notes, homework and other miscellaneous work in a binder in order. Organization will be important when we start reviewing for the AP exam. Go ahead and get a 1.5-inch binder and a package of 10 tabs, labeled in this order (we will complete the 8 numbered units):

Miscellaneous
Unit 1. Limits and Continuity
Unit 2. Differentiation: Definition and Basic Derivative Rules
Unit 3. Differentiation: Composite, Implicit, and Inverse Functions
Unit 4. Contextual Applications of Differentiation
Unit 5. Analytical Applications of Differentiation
Unit 6. Integration and Accumulation of Change
Unit 7. Differential Equations
Unit 8. Applications of Integration
Review for AP Exam

This assignment will be the first thing in your binder (Miscellaneous). Please print it out and neatly work out all problems, showing all work.

Good luck and I look forward to having you in class this year!!! It will be so much fun!

Joy Pace

Name _____ **AP Calculus Summer Assignment**

This packet is your first assignment that should be completed in your AP Calculus binder. Print out this assignment and show all necessary work. On the AP exam, all answers must be rounded to at least thousandth place decimal accuracy, so please do so on this assignment as well. Thanks!

Function Notation and Composites

Let $f(x) = \frac{1}{x}$, $g(x) = 4x^2 - 1$ *and* $h(x) = \sin x$. *Find each value without using a calculator.*

1. $g(-3)$
2. $h\left(\frac{2\pi}{3}\right)$
3. $g(x+1)$
4. $f(x) - g(x)$
5. $\frac{h(x)}{f(x)}$
6. $(f \circ g)(x)$
7. $h\left(g\left(\frac{1}{2}\right)\right)$
8. $f(0)$
9. $\frac{f(x+h)-f(x)}{h}$

Exponents and Radicals

Rewrite using exponents, leaving everything in the numerator. Evaluate when possible.

1. $\sqrt{x^3}$
2. $\sqrt[3]{8^5}$
3. $\frac{1}{\sqrt[3]{x^4}}$
4. $125^{-\frac{2}{3}}$
5. $\frac{5x^2}{15\sqrt{x}}$
6. $\frac{x^2+2x}{\sqrt{x}}$
7. $\frac{1}{x} + \frac{4}{x^2} - \frac{1}{(3x)^2}$
8. $\frac{-16x^2+5x-1}{2x^2}$
9. $\frac{\frac{2}{x^2}}{\frac{10}{x^3}}$

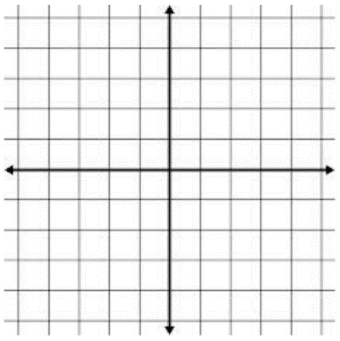
Natural Logarithms

1. Natural logarithms have a base of _____.

2. $e \approx$ _____.

3. Write in exponential form and solve for x. $y + 1 = \ln(4x - 3)$

4. Sketch a graph of $y = e^x$ *and* $y = \ln x$ on the same coordinate plane. How are they related to each other?



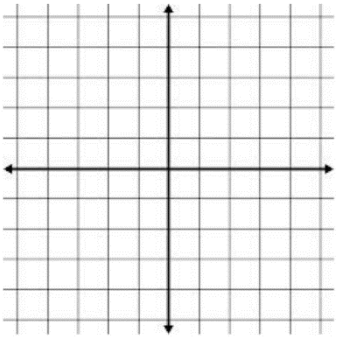
5. Write as a single logarithm. $\ln 12 - \ln 6 + 2\ln 3$

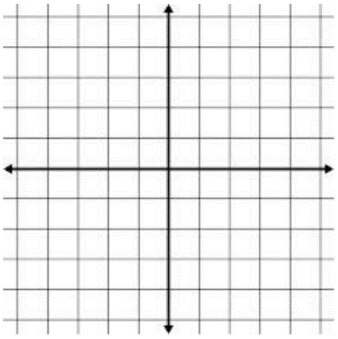
Piecewise Functions

Recall that piecewise functions are the result of combining two or more functions together. To graph them, just graph each function on its specified domain.

1. $f(x) = \begin{cases} 2x & if \quad x < 2 \\ 4 & if \quad 2 \le x < 4 \\ -\frac{1}{4}x + 5 & if \quad 4 \le x \end{cases}$

2. $g(x) = \begin{cases} x, & x < 2 \\ x^2, & x \ge 2 \end{cases}$





Are all piecewise functions continuous?

Behavior of Functions

Give the domain and range of each function in interval notation. Then, give the end behavior, if it exists.

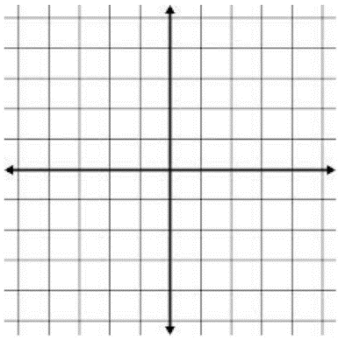
Function	Domain	Range	End Behavior
1. $f(x) = x^2 - 5$			
2. $f(x) = -\sqrt{x+3}$			
3. $f(x) = 3\sin x$			
4. $f(x) = \frac{2}{x-1}$			

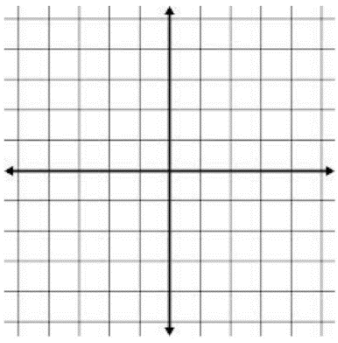
Inverses

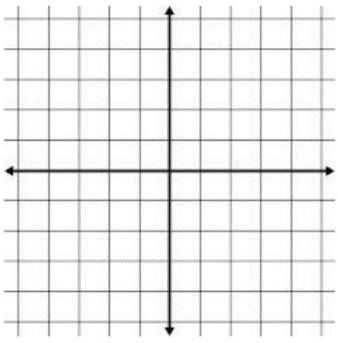
To find the inverse of a function, simply switch the x and y and solve for y (if you are able) in the new equation. Recall that the graphs of inverse functions are the reflection over the line y = x.

Find the equation of the inverse for each function below and graph the function and its inverse. The function and the inverse should look very similar, just oriented differently.

1. $f(x) = 3x + 1$
2. $g(x) = x^2 + 2$
3. $y = |x + 3| - 1$







Equations of Lines

In Calculus, it is more common to use the **Point-Slope form** for the equation of a line. You need to be comfortable using that form, and in many cases, may leave it in that form. However, you should be able to put the equation of a line in other forms, such as slope-intercept or standard form.

For the questions below, show your answers in both point-slope form and slope-intercept form.

Point-Slope form: $y - y_1 = m(x - x_1)$	**Slope-intercept form: $y = mx + b$**	**Standard form: $Ax + By = C$**
Vertical Line: $x = c$ (slope is undefined)	**Horizontal Line: $y = c$ (slope is 0)**	

1. The line that passes through the point (6, -7) with a slope of –2/3.

2. The line that passes through (9, -3) and (7, -3).

3. The line with undefined slope that passes through the point (7, 11).

4. The line that passes through (4, 3) and (7, -2).

5. The line that passes through the point (1, -7) and is parallel to the line with equation 3x – 2y = 8.

6. The line the passes through the point (-3, -4) and is perpendicular to y = 6x + 5.

Horizontal Asymptotes

Find the equation of the horizontal asymptote, if there is one, of each function.

1. $f(x) = \frac{3x^4-6x^3-8}{2x^3}$

2. $f(x) = \frac{8x^5-6x^3-1}{2x^5+7x^2-x}$

3. $f(x) = \frac{x^4-x^3-8}{3x^7-x}$

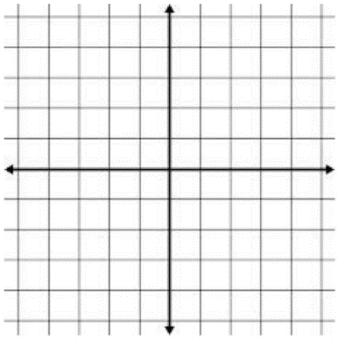
Discontinuity

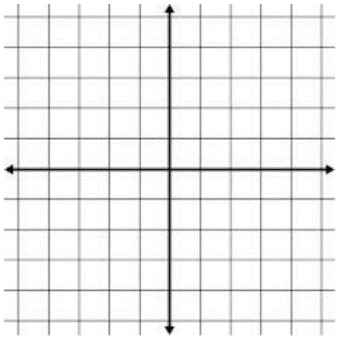
There are three types of discontinuity – removable (point), jump, and infinite. Graph the equations below and tell which type of discontinuity is represented and explain what causes the discontinuity.

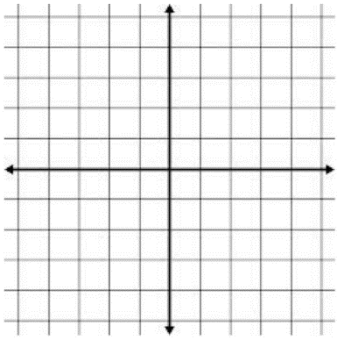
1. $f(x) = \frac{5}{x^2-4}$

2. $g(x) = \begin{cases} x-3, & x < 0 \\ \sqrt{x}, & x \geq 0 \end{cases}$

3. $h(x) = \frac{x^2-6x+8}{x-4}$







Using the Graphing Calculator

For Calculus, you should be comfortable with graphing a function in an appropriate viewing window, finding the zeros for a function, and finding the intersection of two functions. NOTE: your calculator should ALWAYS be in radian mode for this course!

Find all zeros on the interval. Round all answers to the nearest thousandth.

1. $f(x) = 1 + 2\sin\left(\frac{x^2}{2}\right)$ *on* $0 < x < 3$

2. $g(x) = -2 + (x^2 + 3x)^{\frac{6}{5}} - x^3$ *on* $0 \leq x \leq 5$

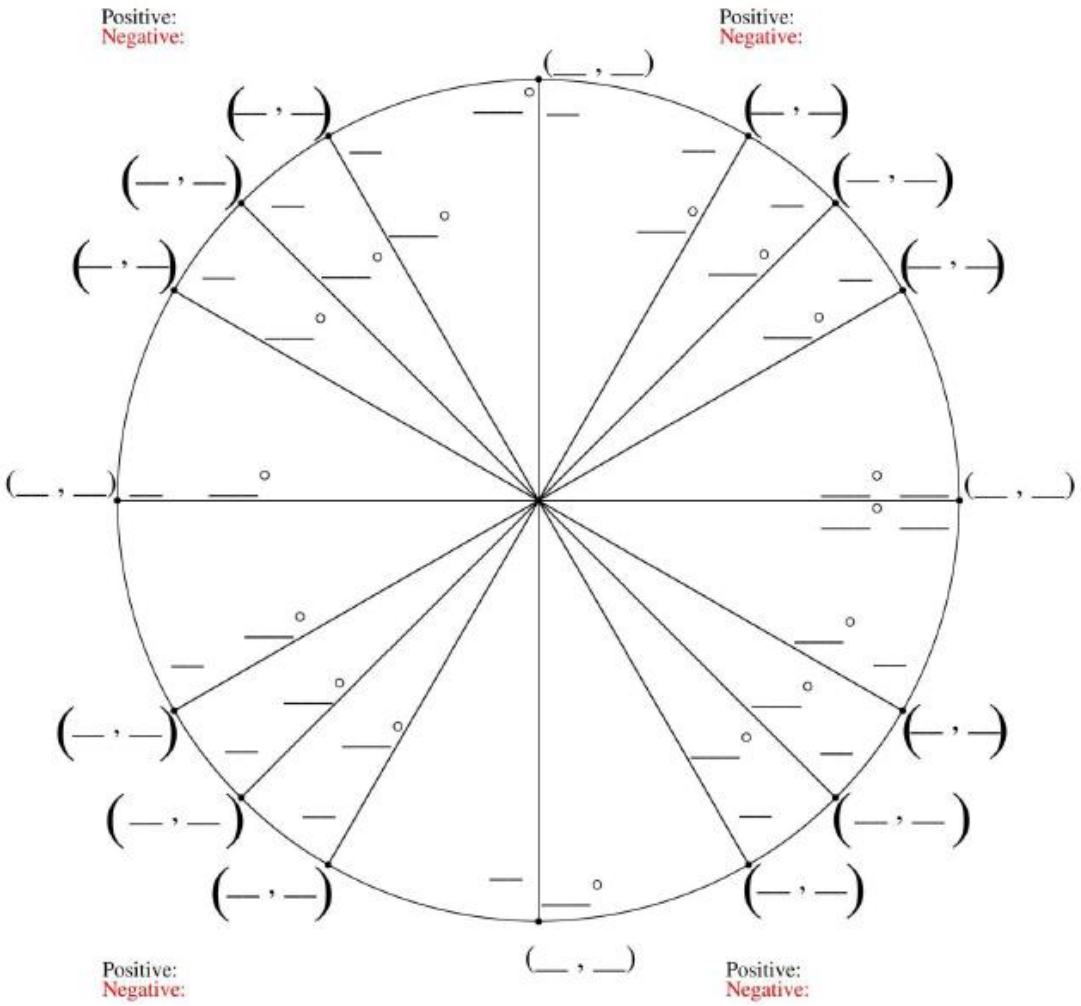
Find all solutions either by graphing both sides of the equation (in Y_1 and Y_2) and finding the points of intersection or by getting one side of the equation equal to 0 and graphing and finding the roots.

3. $x^4 - 2.3x^3 + 4 = 3$

4. $\ln x = 5 - x$

Unit Circle

Fill in the coordinates, along with the angles in degrees and radians and complete the problems at the bottom WITHOUT a calculator. MEMORIZE this unit circle if you have not done so already!



1. sin 0 = _____	2. cos $\frac{\pi}{6}$ = _____	3. tan $\frac{7\pi}{4}$ = _____
4. cos $\frac{5\pi}{6}$ = _____	5. sin $\frac{3\pi}{2}$ = _____	6. tan $\frac{3\pi}{2}$ = _____
7. cos π = _____	8. sin $\frac{\pi}{4}$ = _____	9. csc $\frac{5\pi}{2}$ = _____
10. cos $\frac{11\pi}{6}$ = _____	11. tan 0 = _____	12. sin π = _____
13. cot π = _____	14. csc $\frac{\pi}{4}$ = _____	15. sec $\frac{\pi}{3}$ = _____