2025/2026 AP Calculus AB/BC

Summer Packet

Dear Students,

Welcome to AP Calculus! Congratulations on deciding to embark on what will be a pleasantly different type of math experience that will help you see the big picture joining all the math you have learned so far. Calculus is a branch of math that deals with infinitely small and infinitely large quantities. In this course you will learn WHY the formula for the volume of a cone is $v = \frac{\pi r^2 h}{3}$*, how to find the slope at a single point, what* $\frac{0}{0}$ *is equal to(hint: it isn't obvious), and why 0.99999… = 1, just to name a few of the interesting experiences.*

On Monday, May 4, 2025, you will all be taking the AB or BC Calculus exam which is equivalent to Calculus I or 2 at the college level. The BC course will begin right after midterms. This challenge will be as important as the road that takes you there. Regardless of your score on the exam, you will learn this year to persevere through challenging content, the importance of collaboration (except on tests!), and how to advocate for yourself when you need assistance. You will, in short, get yourself college ready simply by putting in your best effort every day.

I hope you are as excited as I am to start the new year! Have a restful summer so we can all start fresh in September! I am honored to be able to work with the brightest students in the class of 2026. ***The following summer packet is due on the first day back.*** You **MUST** show all work. You will have a test on that material during the first week back. BE PREPARED!

Sincerely,

Mr. Robillard

Math Enthusiast

AP Calculus AB
Summer Work

Name:____________________________
DUE THE FIRST DAY OF SCHOOL!!!!!!!

This material represents an expectation of skills and concepts that as an AP Calculus student ~~you~~ should have a very firm grasp of. If you need a refresher, refer to your Honors Pre-Calculus notes. A quick Google search should also provide valuable resources.

Factoring
Factor each expression completely.

1. $x^3 + 8$

2. $x^3 - 8$

3. $x^2 + 11x - 80$

4. $ac + cd - ab - bd$

5. $2x^2 + 50y^2 - 20xy$

6. $(x-3)^2(2x+1)^3 + (x-3)^3(2x+1)^2$

7. $6x^5 - 51x^3 - 27x$

8. $3x^3 - 2x^2 - 12x + 8$

Simplifying Expressions
Simplify each espression. Write answers with positive exponents where applicable

9. $(4a^{\frac{5}{3}})^{\frac{3}{2}}$

10. $\dfrac{\frac{2}{x^2}}{\frac{10}{x^3}}$

11. $\dfrac{\frac{1}{2}-\frac{5}{4}}{\frac{3}{8}}$

12. $\dfrac{12x^{-3}y^2}{18xy^{-1}}$

13. $\dfrac{5-x}{x^2-25}$

14. $\dfrac{15x^2}{5\sqrt{x}}$

Complex Fractions

Simplify each of the following expressions.

15. $\dfrac{\frac{25}{a}-a}{5+a}$

16. $\dfrac{2-\frac{4}{x+2}}{5+\frac{10}{x+2}}$

17. $\dfrac{\frac{4}{x^2-9}+\frac{2}{x-3}}{\frac{1}{x+3}+\frac{1}{x-3}}$

18. $\dfrac{36}{\frac{1}{x}+\frac{7}{2x}}$

Solving Rational Equations

Solve each equation for x.

19. $\frac{2}{3}-\frac{5}{6}=\frac{1}{x}$

20. $\frac{x-5}{x+1}=\frac{3}{5}$

21. $\frac{2}{x+5}+\frac{1}{x-5}=\frac{16}{x^2-25}$

22. $\frac{x}{2x-6}-\frac{3}{x^2-6x+9}=\frac{x-2}{3x-9}$

Functions

Let $f(x) = 2x + 1$ and $g(x) = 2x^2 - 1$. Find each of the following

23. $f(2) =$

24. $g(-3) =$

25. $f(t+1) =$

26. $f(g(-2)) =$

27. $g(f(m+2)) =$

28. $\dfrac{f(x+h)-f(x)}{h} =$

Let $f(x) = x^2$, $g(x) = 2x + 5$ and $h(x) = x^2 - 1$. Find each of the following

29. $f(g(x-1)) =$

30. $\dfrac{f(x+h)-f(x)}{h} =$

Interval Notation

Complete the table with the appropriate notation or graph

31. Complete the table with the appropriate notation or graph

Solution	Interval Notation	Graph
$-2 < x \leq 4$		
	[-1, 7)	
		

Domain and Range

Find the domain and range of the following functions.

32. $f(x) = x^2 - 5$

33. $f(x) = -\sqrt{x+3}$

34. $f(x) = 3sinx$

35. $f(x) = \frac{2}{x-1}$

Inverses

Find the inverse for each function.

36. $f(x) = 2x + 1$

37. $f(x) = \frac{x^2}{3}$

What is the relationship of inverses.....

Numerically?________________________________

Graphically?________________________________

Algebraically?________________________________

Prove f and g are inverses of each other.

38. $f(x) = 9 - x^2, x \geq 0 \; and \; g(x) = \sqrt{9 - x}$

Equations of Lines

Slope Intercept Form: $y = mx + b$ **Point Slope Form:** $y - y_1 = m(x - x_1)$

39. Determine the equation of a line passing through the point (5, -3) with an undefined slope.

40. Determine the equation of a line passing through the point (-4, 2) with a slope of 0.

41. Find the equation of a line passing through the point (2, 8) and parallel to the line $y = \frac{5}{6}x - 1$.

42. Find the equation of a line perpendicular to the y-axis passing through the point (4, 7).

43. Find the equation of a line passing through the points (-3, 6) and (1, 2).

44. Find the equation of a line with an x-intercept of (2, 0) and a y-intercept of (0, 3).

Logarithms
Fill in the following properties for logarithms:

$log_b 1 =$ ________
$log_b b =$ ________
$lob_b b^x =$ ________
$log_b uv =$ ______________________
$log_b \frac{u}{v} =$ ______________________
$log_b u^n =$ ______________________

Evaluate without a calculator

53. $log_4 64 =$

54. $log_8 \frac{1}{2} =$

55. $lne^8 =$

56. $log_{1/3} 27 =$

Solve

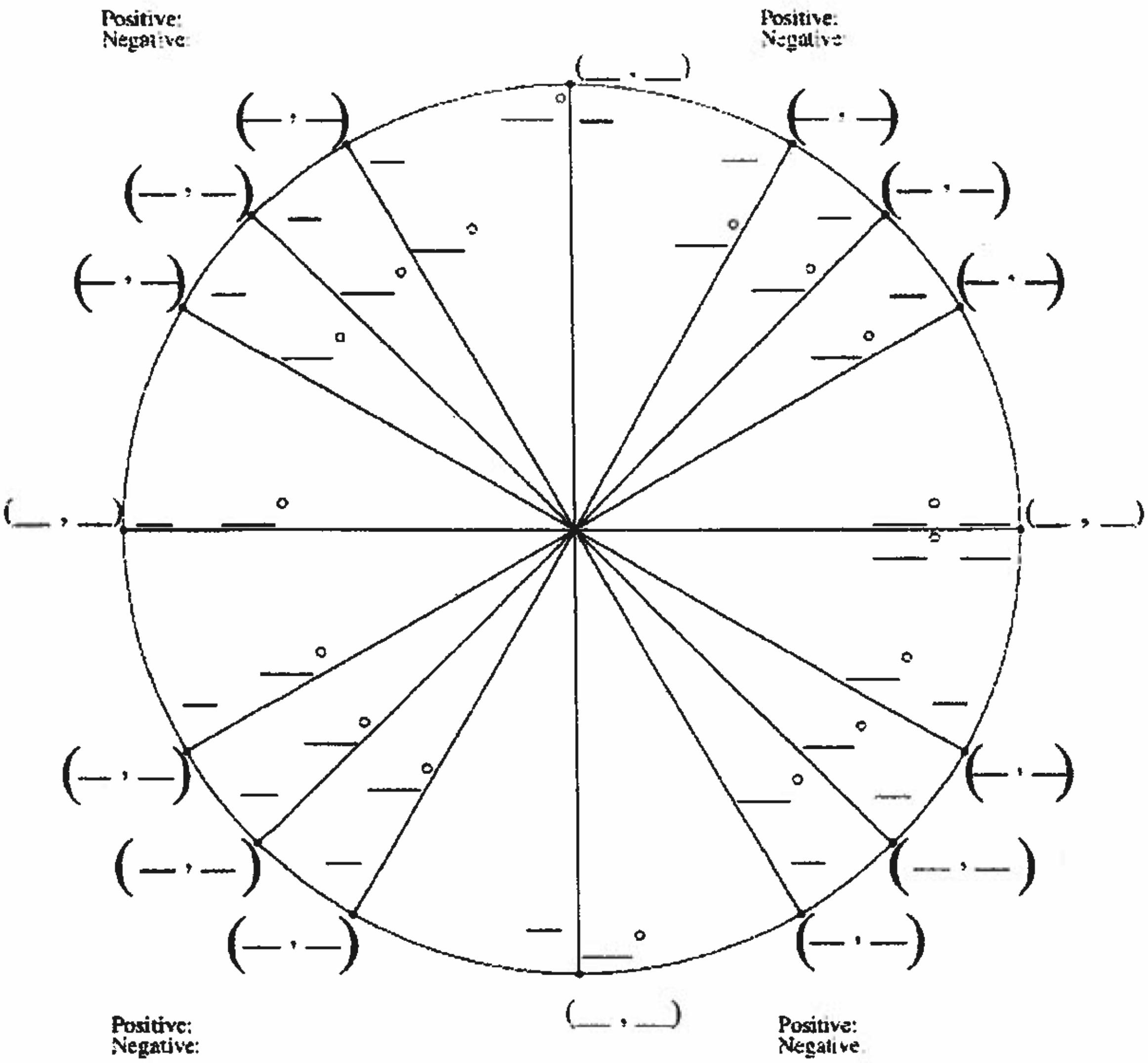
57. $12 = 10^{x+5} - 7$

58. $5 - lnx = 7$

59. $3e^{-x} - 4 = 9$

60. $5log_3(x - 2) = 10$

Fill in The Unit Circle



Evaluate...exactly...no calculator

45. $sin\pi =$

46. $cos\frac{5\pi}{4} =$

47. $\sin\left(-\frac{\pi}{2}\right) =$

48. $sin\frac{11\pi}{6} =$

49. $tan\frac{2\pi}{3} =$

50. $sec\frac{7\pi}{6} =$

51. $tan\frac{\pi}{2} =$

52. $csc\frac{\pi}{3} =$

AP Calculus AB – Summer Work – Functions and Graphs

For the following functions find the a) domain, b) range, c) vertical, horizontal, slant asymptotes or holes, and d) graph.

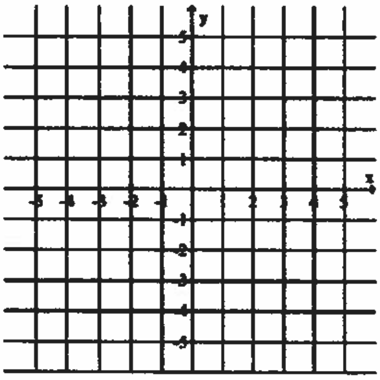
6 1. $y = 1 + \frac{1}{x}$

a) ______________

b) ______________

c) ______________

d)



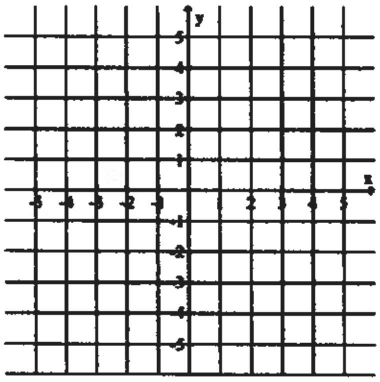
6 2. $y = 2 + \sqrt{x-1}$

a) ______________

b) ______________

c) ______________

d)



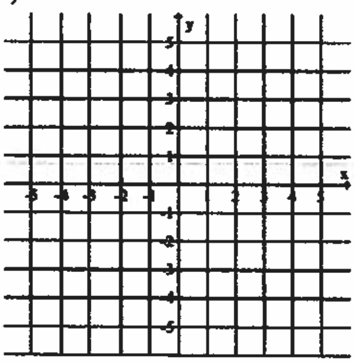
6 3. $y = e^x$

a) ______________

b) ______________

c) ______________

d)



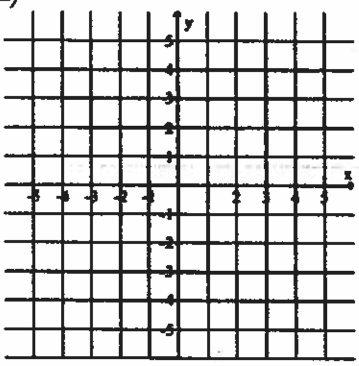
6 4. $y = \ln x$

a) ______________

b) ______________

c) ______________

d)



AP Calculus AB – Summer Work – Exponential Functions

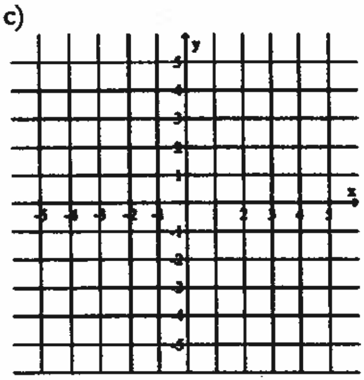
For the following functions find the a) domain, b) range, c) graph, and d) any intercepts.

65. $y=2^x$

a) ____________________

b) ____________________

c)



d) ____________________

____

66. The population of Standardsville is 500,000 and is increasing at the rate of 3.75% each year. Approximately when will the population reach 1 million?

AP Calculus AB – Summer Work – Trigonometric Functions

For each of the following radians, find a) sine, b) cosine, and c) tangent.

67. $\frac{\pi}{3}$

a) ____________

b) ____________

c) ____________

68. $\frac{\pi}{6}$

a) ____________

b) ____________

c) ____________

69. $\frac{\pi}{2}$

a) ____________

b) ____________

c) ____________

70. π

a) ____________

b) ____________

c) ____________

71. $\csc\frac{\pi}{4} =$ ____________

72. $\cot\pi =$ ____________

Give the measure of the angle in radians. Give exact answers.

73. $\sin^{-1}\left(\frac{1}{2}\right) =$ ____________

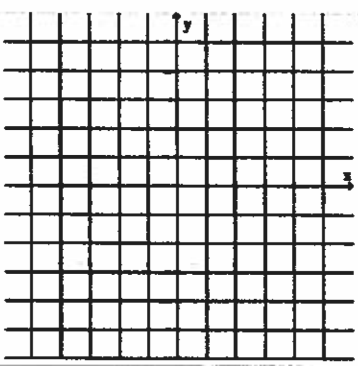
74. $\sin^{-1}\left(-\frac{\sqrt{2}}{2}\right) =$ ____________

75. $\tan^{-1}(1) =$ ____________

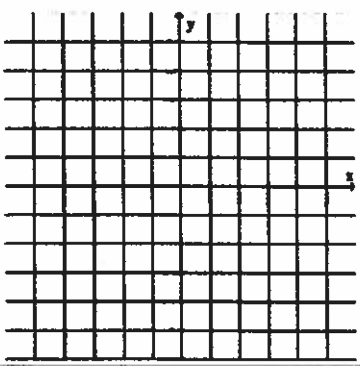
76. $\cos^{-1}\left(\frac{\sqrt{3}}{2}\right) =$ ____________

Graph the following.

77. $y = \sin x$



78. $y = \cos x$



79. **Find the following formulas.**

Pythagorean Theorem = ________________

Area of a triangle = ________________________

Area of a trapezoid = ______________________

Area of a circle = _________________________

Circumference of a Circle = _______________________

Total surface area of a cylinder = ___________________

Surface area of a sphere = _________________________

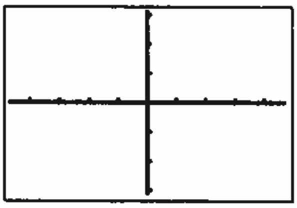
Volume of a cylinder = ___________________

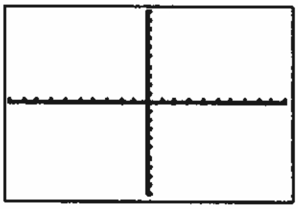
Volume of a cone = _____________________

Volume of a sphere = ___________________

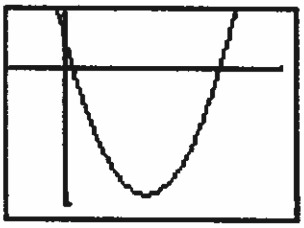
Graphing Skill #1: You should be able to graph a function in a viewing window that shows the important features. You should be familiar with the built-in zoom options for setting the window such as zoom-decimal and zoom-standard. You should also be able to set the window conditions to values you choose.

80. Graph $y = x^2 - 3$ using the built in zoom-decimal and zoom-standard options. Draw each.



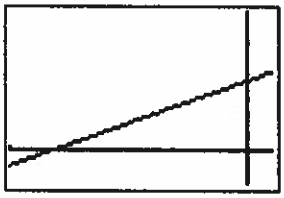
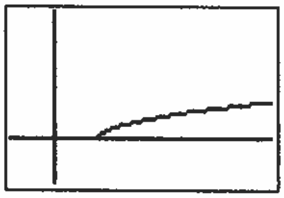
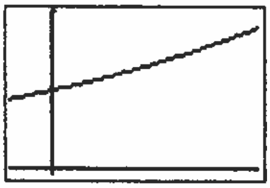
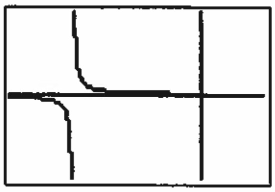


81. Find the appropriate viewing window to see the intercepts and the vertex defined by $y = x^2 - 11x + 10$. Use the window editor to enter the x and y values.



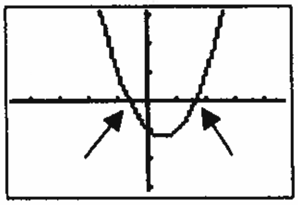
Window: Xmin = _______
Xmax = _______
Xscl = _______
Ymin = _______
Ymax = _______
Yscl = _______

82. Find the appropriate viewing windows for the following functions:

$y = 10 + \frac{1}{4}x$	$y = \sqrt{x-5}$	$y = 100(1.06)^x$	$y = \frac{1}{x+10}$
			
Xmin = _______	Xmin = _______	Xmin = _______	Xmin = _______
Xmax = _______	Xmax = _______	Xmax = _______	Xmax = _______
Xscl = _______	Xscl = _______	Xscl = _______	Xscl = _______
Ymin = _______	Ymin = _______	Ymin = _______	Ymin = _______
Ymax = _______	Ymax = _______	Ymax = _______	Ymax = _______
Yscl = _______	Yscl = _______	Yscl = _______	Yscl = _______

Graphing Skill #2: You should be able to graph a function in a viewing window that shows the x-intercepts (also called roots and zeros). You should be able to accurately estimate the x-intercepts to 3 **decimal places.** Use the built-in root or zero command. [You should use your graphing calculator]

83. Find the x-intercepts of $y = x^2 - x - 1$. Window [-4.7, 4.7] x [-3.1, 3.1]



(Write intercepts as points)

x-intercepts: ______________

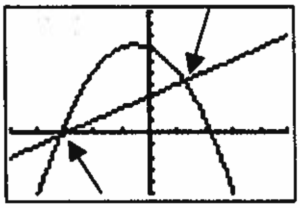
Find the x-intercepts of $y = x^3 - 2x - 1$.

x-intercepts: ______________

84. **Graphing Skill #3:** You should be able to graph two functions in a viewing window that shows the intersection points. Sometimes it is impossible to see all points of intersection in the same viewing window. You should be able to accurately estimate the coordinates of the intersection points to 3 **decimal places.** Use the built-in intersection command.

Find the coordinates of the intersection points for the functions:

$f(x) = x + 3 \qquad g(x) = -x^2 - x + 7$.



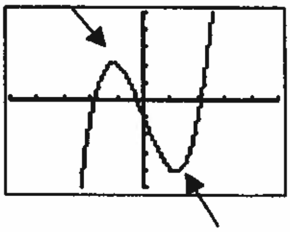
Intersection points: ______________

85. Find the coordinates of the intersection points of: $f(x) = 4x^2 \qquad g(x) = 2^x$.

Intersection points: ______________

<u>Graphing Skill #4:</u> **You should be able to graph a function and estimate the local maximum or minimum values to 3 decimal places. Use the built-in max/min command.**

86. Find the maximum and minimum values of the function $y = x^3 - 4x - 1$.



(Value means the y-value)

Minimum value: ______________

Maximum value: ______________

87. Find the maximum and minimum values of the function $y = x^3 - 4x^2 + 4x$.

88. Find the x-intercepts, relative maximum, and relative minimum of $y = x^3 + 2x^2 - 1$

89. Find the coordinates of the intersection points for the functions $f(x) = 2x^2 + x - 9$ and $g(x) = -\frac{3}{4}x + 3$

Exponential Growth Model:
Consider an initial quantity y_0 that changes exponentially with time t. At any time t the amount y units of time may be given by:

$$Y = Y_0 e^{kt}$$

Where k>0 represents the growth rate and k<0 rep0resents the decay rate.

90. Suppose that the cholera bacteria in a colony grow according to the exponential model $P = P_0 e^{kt}$. The colony starts with 1 bacterium and doubles in number every half hour. How many bacteria will the colony contain at the end of 24 hours?

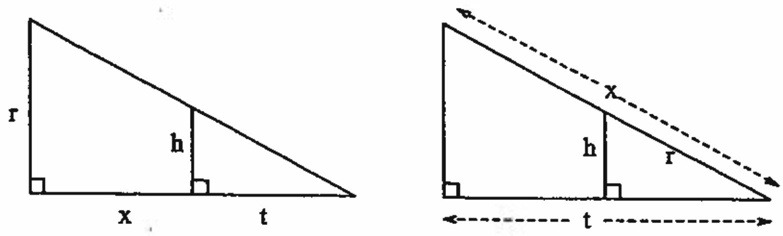
91. A colony of bacteria is grown under the ideal conditions in a laboratory so that the population increases exponentially with time. At the end of 3 hours there are 10,000 bacteria. At the end of 5 hours there are 40,000 bacteria. How many bacteria were present initially?

92. Find the half-life of a radioactive substance with decay equation $Y = Y_0 e^{kt}$ and show that the half-life depends only on k. (set up the equation $\frac{1}{2} Y_0 = Y_0 e^{kt}$ and solve algebraically for t)

Half-life = ______________

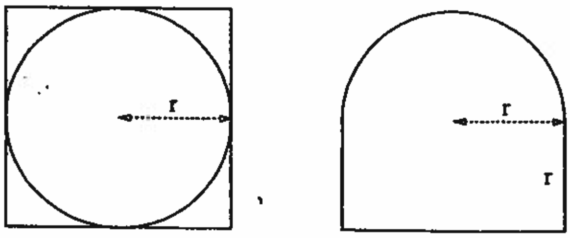
93. Scientists who do carbon-14 dating use 5700 years for its half-life. Find the age of a sample in which 10% of the radioactive nuclei originally present have decayed.

94. Express x in terms of the other variables in the picture.



(a) (b)

95. (a) Find the ratio of the area inside the square but outside the circle to the area of the square in the picture (a) below.



(a) (b)

(b) Find a formula for the perimeter of a window of the shape in the picture (b) above.

(c) A water tank has the shape of a cone (like an ice cream cone without ice cream). The tank is 10m high and has a radius of 3m at the top. If the water is 5m deep (in the middle) what is the surface area of the top of the water?

(d) Two cars start moving from the same point. One travels south at 100km/hour, the other west at 50 km/hour. How far apart are they two hours later?

(e) A kite is 100m above the ground. If there are 200m of string out, what is the angle between the string and the horizontal. (Assume that the string is perfectly straight.)