York Catholic AP Calculus AB

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The AP Course: AP Calculus AB is a college level course covering material traditionally taught in the first semester of college calculus. At the end of the course, students are required to sit for the AP Calculus AB exam in early May.

The Prerequisite Packet: Students need a strong foundation to be ready for the rigorous work required throughout the course. Completing the prerequisite packet should prepare you for the material to be covered. This packet consists of topics covered during Algebra II, Trigonometry and Pre-Calculus. Students should anticipate working approximately 10 hours to complete it properly. This packet includes:

- A "Toolkit of Functions"; you should be familiar with each of the graphs.
- A formula and identities section. These are for your reference and do not need to be memorized at this time.
- A unit circle template with which to practice your unit circle. (For students taking Trig simultaneously, it is your responsibility to memorize and understand the unit circle and graphs of sin, cos and tan prior to class).
- A list of skills that you will need for AP Calculus. If you feel you are weak in any of the areas, let me know and I will provide additional resources.
- Calculus Prerequisite Problems, please show all work.

Calculators:

One of the following graphing calculators is required for this class. You will be expected to understand your own calculator and are required to bring it to every class. I strongly recommend by the first day of class you understand how to do the following:

1. Use trig fxns in both Degrees and Radians
2. Graph various functions (linear, quadratic, exponential, trig etc...)
3. Find x-int, y-int and points of intersection for systems of equations by graphing the functions
4. Change the viewing window

TI-84+,TI-84+ Silver, TI-89, TI-89 Titanium

Due Dates for Summer Work:

1. Calculus Pre-requisite problem set #1 is due Thursday, July 19th. Please turn completed work into main office at YC. Feel free to turn work in early. Indicate the assignment is complete on Google Classroom when turned in. For International Students, please scan work if possible. Enter answers on the Answer Sheet page but you must turn in all work.

2. The 2nd packet will be due the 1st day of class and will cover Limits and the use of your graphing calculator. A pdf will be emailed to you once your 1st problem set is submitted.

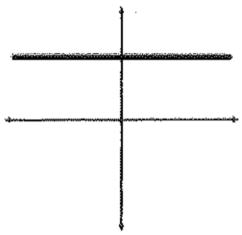
Mr. Autrey is available via email to answer any questions over the summer regarding the packets.

Toolkit of Functions

Students should know the basic shape of these functions and be able to graph their transformations without the assistance of a calculator.

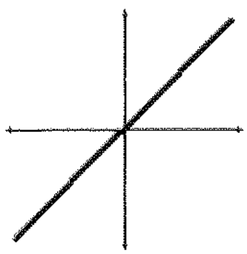
Constant

$f(x) = a$



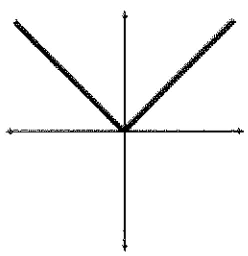
Identity

$f(x) = x$



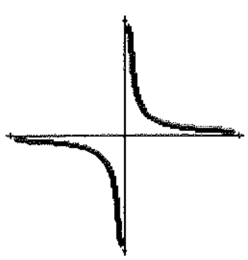
Absolute Value

$f(x) = | x |$



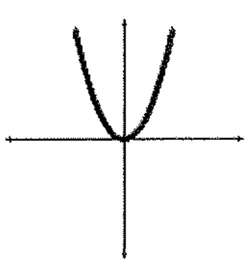
Reciprocal

$f(x) = \frac{1}{x}$



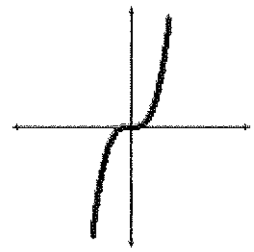
Quadratic

$f(x) = x^2$



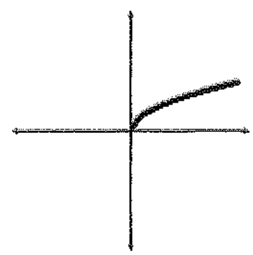
Cubic

$f(x) = x^3$



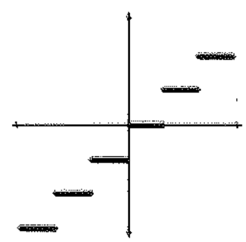
Square Root

$f(x) = \sqrt{x}$



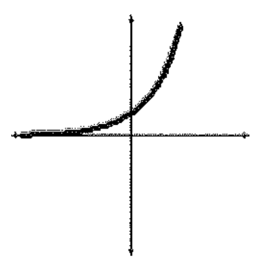
Greatest Integer

$f(x) = [x]$



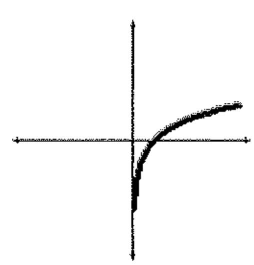
Exponential

$f(x) = a^x$



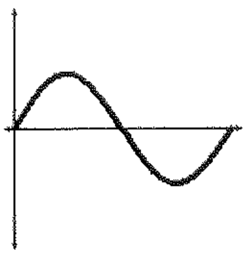
Logarithmic

$f(x) = \ln x$

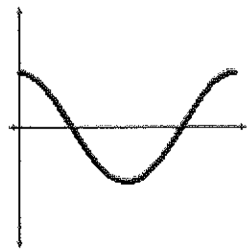


Trig Functions

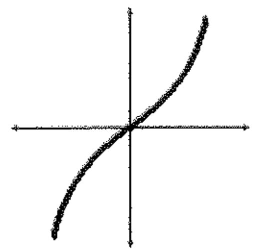
$f(x) = \sin x$



$f(x) = \cos x$



$f(x) = \tan x$



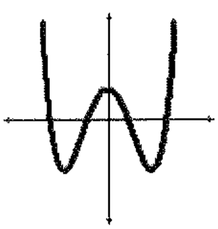
Polynomial Functions:

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, a_2, ... a_n are constants.

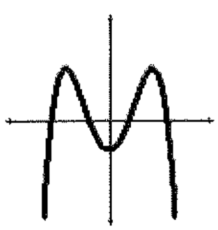
Even degree

Leading coefficient sign

Positive



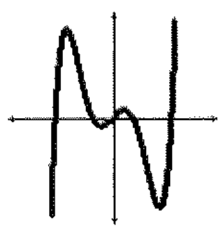
Negative



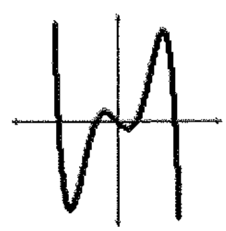
Odd degree

Leading coefficient sign

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 "turns" is less than or equal to (degree – 1).

Formulas and Identities

Trig Formulas:

Arc Length of a circle: $L = r\theta$ or $L = \frac{d}{360} \cdot 2\pi r$

Area of a sector of a circle: $\text{Area} = \frac{1}{2} r^2 \theta$ or $\text{Area} = \frac{d}{360} \cdot \pi r^2$

Solving parts of a triangle:

Law of Sines: $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$

Law of Cosines:

$$a^2 = b^2 + c^2 - 2bc \cos A$$
$$b^2 = a^2 + c^2 - 2ac \cos B$$
$$c^2 = a^2 + b^2 - 2ab \cos C$$

Area of a Triangle:

$\text{Area} = \frac{1}{2} bc \sin A$ or $\text{Area} = \frac{1}{2} ac \sin B$ or $\text{Area} = \frac{1}{2} ab \sin C$

Heron's formula : $\text{Area} = \sqrt{s(s-a)(s-b)(s-c)}$, where s = semi perimeter

Ambiguous Case:

θ is acute

Compute: $\text{alt} = \text{adj} \cdot \sin\theta$

opp < alt	No triangle
opp = alt	1 triangle (right)
opp>adj	1 triangle

alt<opp<adj 2 triangles

θ is obtuse or right

opp ≤ adj	No triangle
opp > adj	1 triangle

Does a triangle exist? Yes - when

(difference of 2 sides) < (third side) < (Sum of 2 sides)

Formulas and Identities, continued

Trig Identities:

Reciprocal Identities:

$$\csc A = \frac{1}{\sin A} \qquad \sec A = \frac{1}{\cos A} \qquad \cot A = \frac{1}{\tan A}$$

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

Pythagorean Identities:

$$\sin^2 A + \cos^2 A = 1 \qquad \tan^2 A + 1 = \sec^2 A \qquad 1 + \cot^2 A = \csc^2 A$$

Sum and Difference Identities:

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

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

$$\tan(A + B) = \frac{\tan A + \tan B}{1 - \tan A \tan B} \qquad \tan(A - B) = \frac{\tan A - \tan B}{1 + \tan A \tan B}$$

Double Angle Identities:

$$\sin(2A) = 2\sin A \cos A \qquad \tan(2A) = \frac{2\tan A}{1 - \tan^2 A}$$

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

Half Angle Identities:

$$\sin\frac{A}{2} = \pm\sqrt{\frac{1 - \cos A}{2}} \qquad \cos\frac{A}{2} = \pm\sqrt{\frac{1 + \cos A}{2}} \qquad \tan\frac{A}{2} = \pm\sqrt{\frac{1 - \cos A}{1 + \cos A}}$$

Polar Formulas:

$$x^2 + y^2 = r^2 \qquad x = r\cos\theta \qquad y = r\sin\theta \qquad \tan^{-1}\frac{y}{x} = \theta \quad x > 0, \quad \tan^{-1}\frac{y}{x} = \theta + \pi \quad x < 0$$

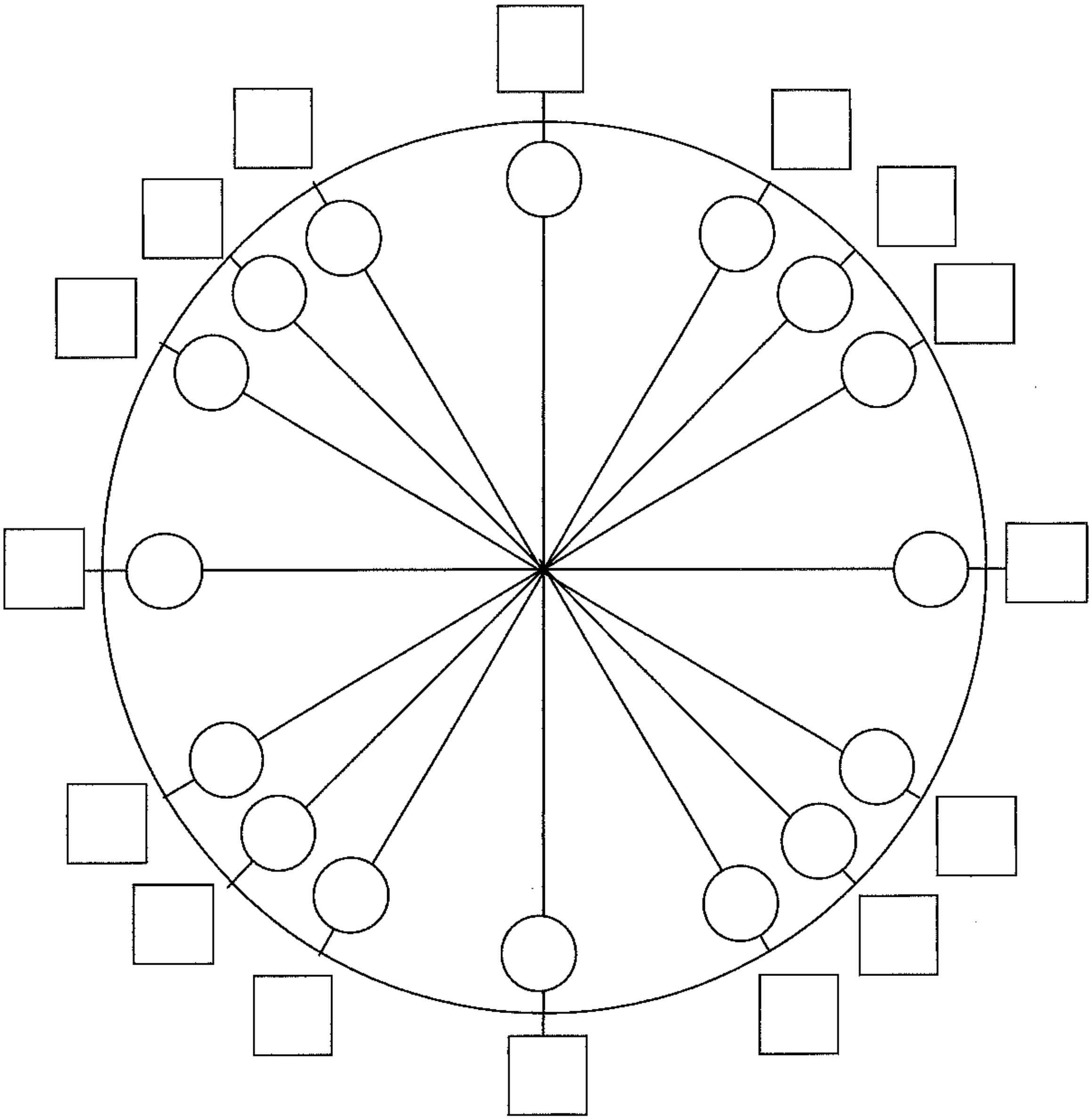
Geometric Formulas:

Area of a trapezoid: $A = \frac{1}{2}h\ b_1 + b_2$ Area of a triangle: $A = \frac{1}{2}bh$

Area of an equilateral triangle: $A = \frac{\sqrt{3}}{4}s^2$

Area if a circle: $A = \pi r^2$ Circumference of a circle: $C = 2\pi r$ or $C = d\pi$

Unit Circle – Degrees and Radians



Place degree measures in the circles.	$\tan\theta$ = ________________
Place radian measure in the squares.	$\cot\theta$ = ________________
Place $(\cos\theta, \sin\theta)$ in parenthesis outside the square.	$\csc\theta$ = ________________
Place $\tan\theta$ outside the parenthesis.	$\sec\theta$ = ________________

SKILLS NEEDED FOR CALCULUS

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. piece-wise, 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 and prove identities
*C. Solve equations
*D. Inverse Trigonometric functions
E. Right triangle trigonometry
*F. Graphs

* A solid working foundation in these areas is very important.

Answer Sheet for AP Calculus Review Name: ______________________________

Functions			
1a.		1b.	
1c.		1d.	
4a.		4b.	
4c.		4d.	
4e.		5.	
7.		10.	
14..		15.	

16.		19.	
20.		22.	
25.		26.	
29.		33.	
35.			
Trig Functions			
1.		2.	
3.		5.	
6.		8.	

9.		10.	
Solving Trig Eqtns			
1.		3.	
7.		12.	
Solving Trig Eqtns with Calc Part 1			
8.		9.	
10.			
Slving Trig Eqtns with Calc Part II			
3.		4.	
7.		9.	

Exponential Functions			
1.		4.	
Logarithmic Functions			
1.		2.	
3.		4.	
5.		6.	
8.		9.	
11.		12.	
13.		14.	

Exponential and Logarithmic Equations			
2.		4.	
5.		7.	
8.		11.	
Common Graphs	Sketch the graphs and include in your work packet		
	#s 2,3,4,5,6,10		

Answer only circled questions

Review : Functions

For problems 1 – 4 the given functions perform the indicated function evaluations.

1. $f(x) = 3 - 5x - 2x^2$
   (a) $f(4)$ (b) $f(0)$ (c) $f(-3)$
   (d) $f(6-t)$ ~~(e) $f(7-4x)$~~ ~~(f) $f(x+h)$~~

2. $g(t) = \dfrac{t}{2t+6}$
   (a) $g(0)$ (b) $g(-3)$ (c) $g(10)$
   (d) $g(x^2)$ (e) $g(t+h)$ (f) $g(t^2 - 3t + 1)$

3. $h(z) = \sqrt{1-z^2}$
   (a) $h(0)$ (b) $h\left(-\frac{1}{2}\right)$ (c) $h\left(\frac{1}{2}\right)$
   (d) $h(9z)$ (e) $h(z^2 - 2z)$ (f) $h(z+k)$

4. $R(x) = \sqrt{3+x} - \dfrac{4}{x+1}$
   (a) $R(0)$ (b) $R(6)$ (c) $R(-9)$
   (d) $R(x+1)$ (e) $R(x^4 - 3)$ ~~(f) $R\left(\frac{1}{x} - 1\right)$~~

The **difference quotient** of a function $f(x)$ is defined to be,

$$\frac{f(x+h) - f(x)}{h}$$

For problems 5 – 9 compute the difference quotient of the given function.

5. $f(x) = 4x - 9$

6. $g(x) = 6 - x^2$

7. $f(t) = 2t^2 - 3t + 9$

8. $y(z)=\dfrac{1}{z+2}$

9. $A(t)=\dfrac{2t}{3-t}$

For problems 10 – 17 determine all the roots of the given function. No calculator

10. $f(x)=x^5-4x^4-32x^3$

11. $R(y)=12y^2+11y-5$

12. $h(t)=18-3t-2t^2$

13. $g(x)=x^3+7x^2-x$

14. $W(x)=x^4+6x^2-27$

15. $f(t)=t^{\frac{5}{3}}-7t^{\frac{4}{3}}-8t$

16. $h(z)=\dfrac{z}{z-5}-\dfrac{4}{z-8}$

17. $g(w)=\dfrac{2w}{w+1}+\dfrac{w-4}{2w-3}$

For problems 18 – 22 find the domain and range of the given function.

18. $Y(t)=3t^2-2t+1$

19. $g(z)=-z^2-4z+7$

20. $f(z)=2+\sqrt{z^2+1}$

21. $h(y)=-3\sqrt{14+3y}$

22. $M(x)=5-|x+8|$

For problems 23 – 31 find the domain of the given function.

23. $f(w) = \dfrac{w^3 - 3w + 1}{12w - 7}$

24. $R(z) = \dfrac{5}{z^3 + 10z^2 + 9z}$

25. $g(t) = \dfrac{6t - t^3}{7 - t - 4t^2}$

26. $g(x) = \sqrt{25 - x^2}$

27. $h(x) = \sqrt{x^4 - x^3 - 20x^2}$

28. $P(t) = \dfrac{5t + 1}{\sqrt{t^3 - t^2 - 8t}}$

29. $f(z) = \sqrt{z - 1} + \sqrt{z + 6}$

30. $h(y) = \sqrt{2y + 9} - \dfrac{1}{\sqrt{2 - y}}$

31. $A(x) = \dfrac{4}{x - 9} - \sqrt{x^2 - 36}$

32. $Q(y) = \sqrt{y^2 + 1} - \sqrt[3]{1 - y}$

For problems 33 – 36 compute $(f \circ g)(x)$ and $(g \circ f)(x)$ for each of the given pair of functions.

33. $f(x) = 4x - 1, \quad g(x) = \sqrt{6 + 7x}$

34. $f(x) = 5x + 2, \quad g(x) = x^2 - 14x$

35. $f(x) = x^2 - 2x + 1, \quad g(x) = 8 - 3x^2$

36. $f(x) = x^2 + 3$, $g(x) = \sqrt{5 + x^2}$

Review : Inverse Functions

For each of the following functions find the inverse of the function. Verify your inverse by computing one or both of the composition as discussed in this section.

1. $f(x) = 6x + 15$

2. $h(x) = 3 - 29x$

3. $R(x) = x^3 + 6$

4. $g(x) = 4(x-3)^5 + 21$

5. $W(x) = \sqrt[5]{9 - 11x}$

6. $f(x) = \sqrt[7]{5x + 8}$

7. $h(x) = \dfrac{1 + 9x}{4 - x}$

8. $f(x) = \dfrac{6 - 10x}{8x + 7}$

Review : Trig Functions

Determine the exact value of each of the following without using a calculator.

Note that the point of these problems is not really to learn how to find the value of trig functions but instead to get you comfortable with the unit circle since that is a very important skill that will be needed in solving trig equations.

1. $\cos\left(\dfrac{5\pi}{6}\right)$

2. $\sin\left(-\frac{4\pi}{3}\right)$

3. $\sin\left(\frac{7\pi}{4}\right)$

4. $\cos\left(-\frac{2\pi}{3}\right)$

5. $\tan\left(\frac{3\pi}{4}\right)$

6. $\sec\left(-\frac{11\pi}{6}\right)$

7. $\cos\left(\frac{8\pi}{3}\right)$

8. $\tan\left(-\frac{\pi}{3}\right)$

9. $\tan\left(\frac{15\pi}{4}\right)$

10. $\sin\left(-\frac{11\pi}{3}\right)$

11. $\sec\left(\frac{29\pi}{4}\right)$

Review : Solving Trig Equations

Without using a calculator find the solution(s) to the following equations. If an interval is given then find only those solutions that are in the interval. If no interval is given then find all solutions to the equation.

1. $4\sin(3t) = 2$

2. $4\sin(3t)=2$ in $\left[0,\frac{4\pi}{3}\right]$

3. $2\cos\left(\frac{x}{3}\right)+\sqrt{2}=0$

4. $2\cos\left(\frac{x}{3}\right)+\sqrt{2}=0$ in $[-7\pi,7\pi]$

5. $4\cos(6z)=\sqrt{12}$ in $\left[0,\frac{\pi}{2}\right]$

6. $2\sin\left(\frac{3y}{2}\right)+\sqrt{3}=0$ in $\left[-\frac{7\pi}{3},0\right]$

7. $8\tan(2x)-5=3$ in $\left[-\frac{\pi}{2},\frac{3\pi}{2}\right]$

8. $16=-9\sin(7x)-4$ in $\left[-2\pi,\frac{9\pi}{4}\right]$

9. $\sqrt{3}\tan\left(\frac{t}{4}\right)+5=4$ in $[0,4\pi]$

10. $\sqrt{3}\csc(9z)-7=-5$ in $\left[-\frac{\pi}{3},\frac{4\pi}{9}\right]$

11. $1-14\cos\left(\frac{2x}{5}\right)=-6$ in $\left[5\pi,\frac{40\pi}{3}\right]$

12. $15=17+4\cos\left(\frac{y}{7}\right)$ in $[10\pi,15\pi]$

  [redacted]

Review : Solving Trig Equations with Calculators, Part I

Find the solution(s) to the following equations. If an interval is given then find only those solutions that are in the interval. If no interval is given then find all solutions to the equation. These will require the use of a calculator so use at least 4 decimal places in your work.

1. $7\cos(4x)+11=10$

2. $6+5\cos\left(\frac{x}{3}\right)=10$ in $[0,38]$

3. $3=6-11\sin\left(\frac{t}{8}\right)$

4. $4\sin(6z)+\frac{13}{10}=-\frac{3}{10}$ in $[0,2]$

5. $9\cos\left(\frac{4z}{9}\right)+21\sin\left(\frac{4z}{9}\right)=0$ in $[-10,10]$

6. $3\tan\left(\frac{w}{4}\right)-1=11-2\tan\left(\frac{w}{4}\right)$ in $[-50,0]$

7. $17-3\sec\left(\frac{z}{2}\right)=2$ in $[20,45]$

8. $12\sin(7y)+11=3+4\sin(7y)$ in $\left[-2,-\frac{1}{2}\right]$

9. $5-14\tan(8x)=30$ in $[-1,1]$

10. $0=18+2\csc\left(\frac{t}{3}\right)$ in $[0,5]$

11. $\frac{1}{2}\cos\left(\frac{x}{8}\right)+\frac{1}{4}=\frac{2}{3}$ in $[0,100]$

12. $\frac{4}{3}=1+3\sec(2t)$ in $[-4,6]$

Review : Solving Trig Equations with Calculators, Part II

Find all the solution(s) to the following equations. These will require the use of a calculator so use at least 4 decimal places in your work.

1. $3-14\sin(12t+7)=13$

2. $3\sec(4-9z)-24=0$

3. $4\sin(x+2)-15\sin(x+2)\tan(4x)=0$

4. $3\cos\left(\frac{3y}{7}\right)\sin\left(\frac{y}{2}\right)+14\cos\left(\frac{3y}{7}\right)=0$

5. $7\cos^2(3x)-\cos(3x)=0$

6. $\tan^2\left(\frac{w}{4}\right)=\tan\left(\frac{w}{4}\right)+12$

7. $4\csc^2(1-t)+6=25\csc(1-t)$

8. $4y\sec(7y)=-21y$

9. $10x^2\sin(3x+2)=7x\sin(3x+2)$

10. $(2t-3)\tan\left(\frac{6t}{11}\right)=15-10t$

Review : Exponential Functions

~~Sketch the graphs of each of the following functions.~~

State the domain and range

1. $f(x)=3^{1+2x}$

2. $h(x)=2^{3-\frac{x}{4}}-7$

3. $h(t) = 8 + 3\mathbf{e}^{2t-4}$

4. $g(z) = 10 - \frac{1}{4}\mathbf{e}^{-2-3z}$

Review : Logarithm Functions

Without using a calculator determine the exact value of each of the following.

1. $\log_3 81$

2. $\log_5 125$

3. $\log_2 \frac{1}{8}$

4. $\log_{\frac{1}{4}} 16$

5. $\ln \mathbf{e}^4$

6. $\log \frac{1}{100}$

Write each of the following in terms of simpler logarithms

7. $\log\left(3x^4 y^{-7}\right)$

8. $\ln\left(x\sqrt{y^2 + z^2}\right)$

9. $\log_4\left(\frac{x-4}{y^2 \sqrt[5]{z}}\right)$

Combine each of the following into a single logarithm with a coefficient of one.

10. $2\log_4 x + 5\log_4 y - \frac{1}{2}\log_4 z$

11. $3\ln(t+5) - 4\ln t - 2\ln(s-1)$

12. $\frac{1}{3}\log a - 6\log b + 2$

Use the change of base formula and a calculator to find the value of each of the following.

13. $\log_{12} 35$

14. $\log_{\frac{2}{3}} 53$

Review : Exponential and Logarithm Equations

For problems 1 – 10 find all the solutions to the given equation. If there is no solution to the equation clearly explain why.

1. $12 - 4\mathbf{e}^{7+3x} = 7$

2. $1 = 10 - 3\mathbf{e}^{z^2-2z}$

3. $2t - t\mathbf{e}^{6t-1} = 0$

4. $4x + 1 = (12x+3)\mathbf{e}^{x^2-2}$

5. $2\mathbf{e}^{3y+8} - 11\mathbf{e}^{5-10y} = 0$

6. $14\mathbf{e}^{6-x} + \mathbf{e}^{12x-7} = 0$

7. $1 - 8\ln\left(\frac{2x-1}{7}\right) = 14$

8. $\ln(y-1) = 1 + \ln(3y+2)$

9. $\log(w)+\log(w-21)=2$

10. $2\log(z)-\log(7z-1)=0$

11. $16=17^{t-2}+11$

12. $2^{3-8w}-7=11$

Compound Interest. If we put P dollars into an account that earns interest at a rate of r (written as a decimal as opposed to the standard percent) for t years then,

a. if interest is compounded m times per year we will have,

$$A=P\left(1+\frac{r}{m}\right)^{tm}$$

dollars after t years.

b. if interest is compounded continuously we will have,

$$A=P\mathbf{e}^{rt}$$

dollars after t years.

13. We have \$10,000 to invest for 44 months. How much money will we have if we put the money into an account that has an annual interest rate of 5.5% and interest is compounded

(a) quarterly (b) monthly (c) continuously

14. We are starting with \$5000 and we're going to put it into an account that earns an annual interest rate of 12%. How long should we leave the money in the account in order to double our money if interest is compounded

(a) quarterly (b) monthly (c) continuously

Exponential Growth/Decay. Many quantities in the world can be modeled (at least for a short time) by the exponential growth/decay equation.

$$Q=Q_0\mathbf{e}^{kt}$$

If k is positive then we will get exponential growth and if k is negative we will get exponential decay.

15. A population of bacteria initially has 250 present and in 5 days there will be 1600 bacteria present.

(a) Determine the exponential growth equation for this population.

(b) How long will it take for the population to grow from its initial population of 250 to a population of 2000?

16. We initially have 100 grams of a radioactive element and in 1250 years there will be 80 grams left.
   (a) Determine the exponential decay equation for this element.
   (b) How long will it take for half of the element to decay?
   (c) How long will it take until there is only 1 gram of the element left?

Review : Common Graphs

Without using a graphing calculator sketch the graph of each of the following.

1. $y = \frac{4}{3}x - 2$

2. $f(x) = |x-3|$

3. $g(x) = \sin(x) + 6$

4. $f(x) = \ln(x) - 5$

5. $h(x) = \cos\left(x + \frac{\pi}{2}\right)$

6. $h(x) = (x-3)^2 + 4$

7. $W(x) = \mathbf{e}^{x+2} - 3$

8. $f(y) = (y-1)^2 + 2$

9. $R(x) = -\sqrt{x}$

10. $g(x) = \sqrt{-x}$

11. $h(x) = 2x^2 - 3x + 4$

12. $f(y) = -4y^2 + 8y + 3$

13. $(x+1)^2 + (y-5)^2 = 9$

14. $x^2 - 4x + y^2 - 6y - 87 = 0$

15. $25(x+2)^2 + \frac{y^2}{4} = 1$

16. $x^2 + \frac{(y-6)^2}{9} = 1$

17. $\frac{x^2}{36} - \frac{y^2}{49} = 1$

18. $(y+2)^2 - \frac{(x+4)^2}{16} = 1$