To: All students enrolled in Pre-calculus CP
From: Mrs. Curtiss, AP Calculus/Pre-Calculus Teacher

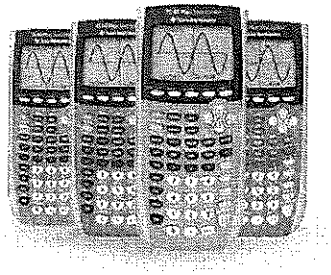
Pre-calculus is a course designed to prepare you for Calculus Honors and AP Statistics. You will develop and improve on skills that have been taught to you over the previous years. Pre-calculus is a combination of advanced algebra topics and trigonometry. It is expected that you will have mastered these skills by the end of the school year. If you do not have solid algebra skills, you will find that you will struggle throughout this course and consistently get problems incorrect next year in calculus, even though you understand the calculus concepts. It is frustrating for students when they are tripped up by the algebra and not the calculus. This summer packet is intended for you to brush up and possibly relearn the prerequisite algebra and geometry topics listed on the next page.

Students need a strong foundation to be ready for the rigorous work required throughout this course. Completing the prerequisite summer assignment should help prepare you for the material. **This packet will be collected on the first day of school. You will be tested on this material the first week of school.** Show all work neatly in the space provided.

Rather than give you a textbook to remind you of the techniques necessary to solve the problem, below I have given you several websites that have full instructions on the techniques. If and when you are unsure of how to attempt these problems, examine these websites. **Don't fake your way through these problems.** Students are notoriously weak in them, even students who have achieved well prior to this class. Use the websites. You need to get off to a good start so ***spend quality time on the packet this summer***.

****A graphing calculator is required for this course. ****

Recommended Calculator: TI-84 Plus



However, **do not rely on your calculator**. Use the calculator only on the problems when absolutely necessary. **Half of our tests in Pre-calculus will be *without* any calculator! Plus, if your goal is to get to Calculus Honors, that entire course is NO Calculator!**

It is a mistake to decide to do this all now. Visit this packet often throughout the entire summer. You need these techniques to be fresh in your mind in the fall. Also, do not wait to do them at the very last minute. These take time and effort. The topics in the review are listed on the next page. You can certainly do **Google** and **YouTube** video searches for any of these. But I have given you several sites that cover pretty much everything.

Video lessons and examples for every topic can be found and watched at:

- http://mathispower4u.yolasite.com/
- https://www.khanacademy.org/math/algebra2
- http://www.ixl.com/math/algebra-2

Reference Information

Quadratic Formula: Given $ax^2+bx+c=0$, then $x=\dfrac{-b\pm\sqrt{b^2-4ac}}{2a}$.

Factoring: $a^3+b^3=(a+b)(a^2-ab+b^2)$ $\quad$ $a^3-b^3=(a-b)(a^2+ab+b^2)$

Laws of Exponents: $(a^m)^n=a^{mn}$ $\quad$ $\dfrac{a^n}{a^m}=a^{n-m}$ $\quad$ $(ab)^n=a^nb^n$

$\left(\dfrac{a}{b}\right)^n=\dfrac{a^n}{b^n}$ $\quad$ $a^{-n}=\dfrac{1}{a^n}$ $\quad$ $a^{\frac{m}{n}}=\sqrt[n]{a^m}$ *or* $\left(\sqrt[n]{a}\right)^m$

Forms of Equations of Lines:

General (Standard) Form: $Ax+By=C$ $\quad$ Slope-Intercept Form: $y=mx+b$

Point – Slope Form: $y-y_1=m(x=x_1)$

Vertical Line: $x=a$ $\quad$ Horizontal Line: $y=b$

Distance Formula (given points (x_1, y_1) and (x_2, y_2)): $d=\sqrt{(x_1-x_2)^2+(y_1-y_2)^2}$

Midpoint Formula (given points (a, b) and (c, d)): $M\left(\dfrac{a+c}{2}, \dfrac{b+d}{2}\right)$

Changing between Logarithmic and Exponential Form: $y=\log_b(x)$ *iff* $b^y=x$

Basic Properties of Logarithms: $\log_b 1=0$ $\quad$ $\log_b b=1$ $\quad$ $\log_b b^y=y$ $\quad$ $b^{\log_b x}=x$

Properties of Logarithms: Product Rule: $\log_b(RS)=\log_b R+\log_b S$

Quotient Rule: $\log_b \dfrac{R}{S}=\log_b R-\log_b S$

Power Rule: $\log_b R^c=c\log_b R$

Imaginary Numbers: $i=\sqrt{-1}$ $\quad$ $i^2=-1$

Complex Number written in Standard Form: a + bi

Properties of Absolute Value: $|a|\geq 0$ $\quad$ $|-a|=|a|$ $\quad$ $|ab|=|a||b|$ $\quad$ $\left|\dfrac{a}{b}\right|=\dfrac{|a|}{|b|}$

Sequences and Series

Arithmetic Series: $a_n=a_1+(n-1)d$, $S_n=n\dfrac{(a_1+a_n)}{2}$

Geometric Series: $a_n=a_1r^{(n-1)}$, $S_n=a_1\left(\dfrac{1-r^n}{1-r}\right)$

$\sum_{i=1}^{n}1=n$, $\sum_{i=1}^{n}i=\dfrac{n(n+1)}{2}$, $\sum_{i=1}^{n}i^2=\dfrac{n(n+1)(2n+1)}{6}$

Slope formula

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

where m = slope and (x_1, y_1) and (x_2, y_2) are points on the line

Slope-intercept form of a linear equation

$$y = mx + b$$

where m = slope and b = y-intercept

Point-slope form of a linear equation

$$y - y_1 = m(x - x_1)$$

where m = slope and (x_1, y_1) is a point on the line

Distance between two points

$P_1(x_1, y_1)$ and $P_2(x_2, y_2)$

$$\sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

Midpoint between two points

$P_1(x_1, y_1)$ and $P_2(x_2, y_2)$

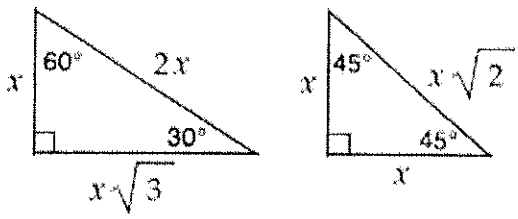
$$\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right)$$

Quadratic formula

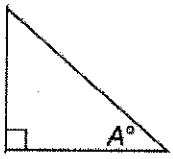
$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

where a, b, and c are coefficients in an equation of the form $ax^2 + bx + c = 0$

Special Right Triangles



Trigonometric Ratios



$$\sin A° = \frac{\text{opposite}}{\text{hypotenuse}}$$

$$\cos A° = \frac{\text{adjacent}}{\text{hypotenuse}}$$

$$\tan A° = \frac{\text{opposite}}{\text{adjacent}}$$

Conversions

1 yard = 3 feet
1 mile = 1,760 yards = 5,280 feet
1 acre = 43,560 square feet
1 hour = 60 minutes
1 minute = 60 seconds

1 cup = 8 fluid ounces
1 pint = 2 cups
1 quart = 2 pints
1 gallon = 4 quarts
1 pound = 16 ounces
1 ton = 2,000 pounds

1 meter = 100 centimeters = 1000 millimeters
1 kilometer = 1000 meters
1 liter = 1000 milliliters = 1000 cubic centimeters
1 gram = 1000 milligrams
1 kilogram = 1000 grams

GETTING TO KNOW YOUR GRAPHING CALCULATOR

Although graphing calculator commands vary from model to model, all graphing calculators perform the same basic tasks listed below. This list is just the beginning, but essential to all work that follows. Utilize the manual that came with your model. You can also find many resources at http://education.ti.com/en/us/home .

1. How do you adjust the contrast on your screen? Do it.

2. How do you enter and save a function to be graphed?
   Try $f(x)=\sqrt{20-x^2}$.

3. Every calculator has a standard window. What is the size of your standard window?

4. How do you graph a function? Graph $f(x)$ using the standard window.

5. How do you use the trace key? Use it to approximate the x-intercepts of $f(x)$.

6. How do you change the size of the window? Change it to $-5 \le x \le 5$, $-5 \le y \le 10$.

7. How do you adjust the screen so that a graph does not appear distorted in the rectangular screen? Try it with $f(x)$.

8. How do you graph a second function on top of the first? Try $g(x)=2x+4$.

9. How do you use the trace key to trace along either graph? Use the trace key to approximate one of the intersections of the two graphs. By the way, how would you find the intersection exactly?

10. How do you "turn off" a function, but still keep it in memory? Turn off $g(x)$.

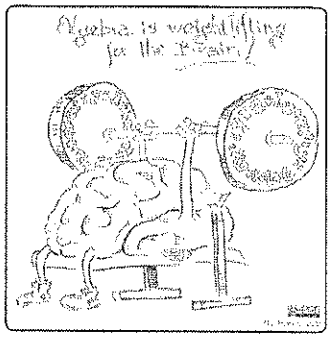
11. How do you zoom in and out? Try this with $h(x)=x\cdot 2^x$. (You should delete $f(x)$ and $g(x)$.)

12. How does the zoom box feature work? Try this with $h(x)$. Focus on the low point of the graph that appears in Quadrant 3.

13. Try some of these features with other types of functions. Be sure to find keys such as the **absolute value** and **root** keys.

Your calculator manual will be very helpful.

SHOW ALL WORK NEATLY:



You must solve by the method indicated and all problems must be solved by hand. This work will be checked, reviewed and tested the first week of school.

1. Solve each inequality.

   Give your answer in interval notation.

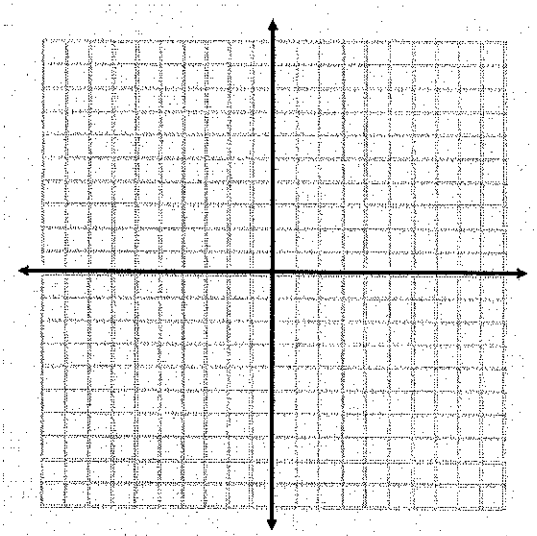
a. $3+5x \le \frac{7x+4}{3}$ Solution Set:	b. $\lvert 2x+5 \rvert < 13$ Solution Set:	c. $2\lvert 4-3x \rvert - 2 < 10$ Solution Set:
d. $2x^2 - 3x - 20 \ge 0$ Solution Set:	e. $5x^2 + 11x > 12$ Solution Set:	f. $\frac{x^3-8}{x^2+5x} \le 0$ Solution Set:

2. Write a linear equation in point-slope form and slope-intercept form for each line described:

a. The line through the point $(4,-2)$ and perpendicular to the line with equation $6x-2y+8=0$ Point-Slope form: _____ Slope-intercept form: _____	b. The line through the points (-1, -4) and (3, 2) Point-Slope form: _____ Slope-intercept form: _____
c. The line through the point (-3, 5) with a slope of 0. Point-Slope form: _____ Slope-intercept form: _____	d. The line through the point (-8, -5) and parallel to the y-axis.

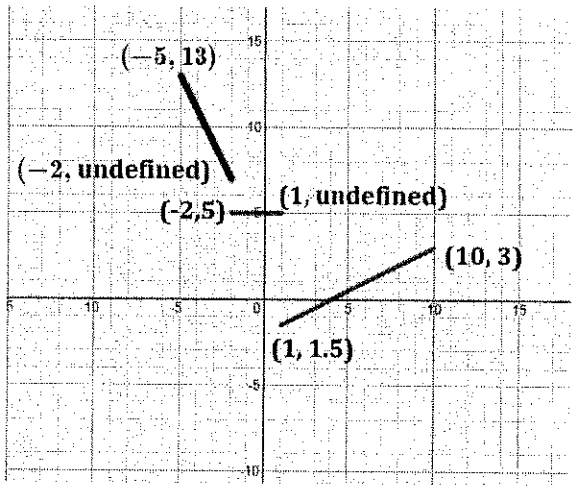
3. Graph the piece-wise function

$$f(x) = \begin{cases} -\frac{2}{3}x + 4, & x \leq -3 \\ 2x - 1, & -3 < x < 4 \\ -5, & x \geq 4 \end{cases}$$



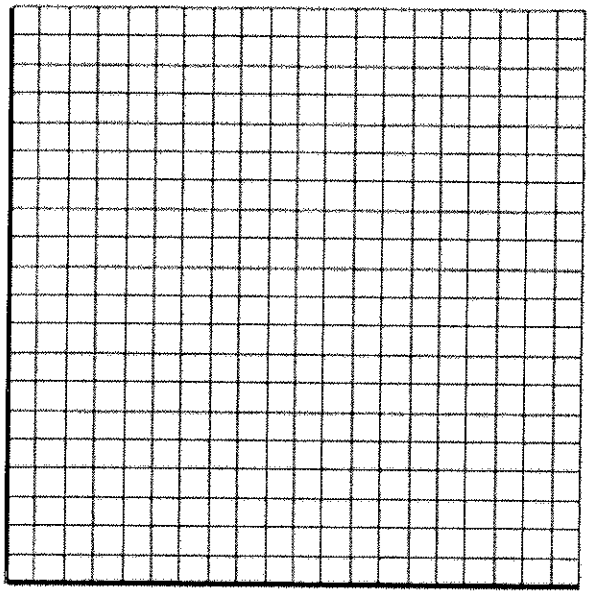
4. Given the graph, write the equation of the piece-wise function:

$f(x) =$ { _____ _____ _____



5. The data in the table below represents the apparent temperature (ºF) vs. the relative humidity (%) in a room whose actual temperature is 72 °F.

a. Create a scatter plot of this data.
b. Find a line of best fit and write the equation of that line.
c. Use this equation to predict the apparent temperature when the relative humidity reaches 110%.



Relative Humidity (%)	Apparent Temperature (ºF)
0	64
10	65
20	67
30	68
40	70
50	71
60	72
70	73
80	74
90	75
100	76

6. Find the solution to each system of linear equations, using the substitution method or elimination method.

   Write the solution in the form (x,y).

a. $\begin{cases} 4x - 5y = -11 \\ x + 2y = 7 \end{cases}$ Solution:	b. $\begin{cases} -2x - 5y = 7 \\ 7x + y = -8 \end{cases}$ Solution:	c. $\begin{cases} 4x + 9y = 2 \\ 2x + 6y = 1 \end{cases}$ Solution:

7. Simplify each expression:

a. $x^5y - 2x + 3xy^3 - 2(-2x - x^5y + 2xy^3)$	b. $(4x^3 - y^4)^3 - 2x(x - y)(x + y) - 3(x^9 - y^{12})$

8. Simplify each radical expression:

a. $\sqrt{-100}$	b. $\sqrt{-4 \cdot -9}$	c. $(i\sqrt{7})^2$	d. $\frac{8}{-2i}$
e. $\frac{4}{\sqrt{10}-\sqrt{6}}$	f. $5\sqrt{18}+3\sqrt{8}-2\sqrt{72}-\sqrt{50}$	g. $(\sqrt{5}+9\sqrt{2})(3\sqrt{5}-4\sqrt{2})$	h. $(3+i\sqrt{5})^2$
i. $(3+2i)(3-2i)$	j. $\sqrt[3]{2x} \cdot \sqrt[3]{4x^2y^2} \cdot \sqrt[3]{2y^4}$	k. $\sqrt[5]{-160x^{10}y^6z^{-15}}$	l. $\frac{2\sqrt[4]{4x}}{\sqrt[4]{9x^3}}$

9. Factor each polynomial completely.

a. $x^3 - 400x$	b. $2x^2 + x - 15$	c. $x^2 - 11x - 26$
d. $10x^2 - 19x + 7$	e. $x^4 - 21x^2 + 108$	f. $x^3 - 64$
g. $x^3 - 4x^2 + 4x$	h. $x^4 - 16$	i. $x^3 - 3x^2 - 4x + 12$
j. $8x^3 - 1$	k. $x^3 - 2x^2 - 4x + 8$	l. $6x^2 - 7x - 3$

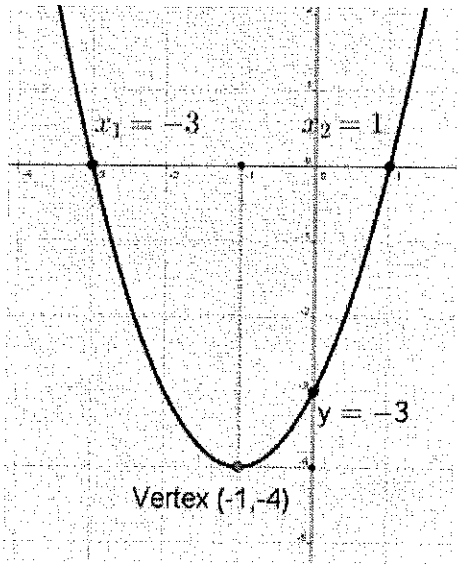
10. Solve each quadratic equation for x. Use factoring, the quadratic formula, or completing the square.

a. $(x-1)(x+3)=0$	b. $2x^2-32x=0$	c. $x^2+4x=-3$
d. $2x^2+7x=-5$	e. $x(x-4)=2(4-x)$	f. $x^2-4x-7=0$
g. $x^2+2x=5$	h. $(x-2)(x-4)=4$	i. $2(3x+9)^2-8=100$

11. Write the equation for the parabola shown in vertex form and standard form:

Vertex form:_____

Standard form: _____

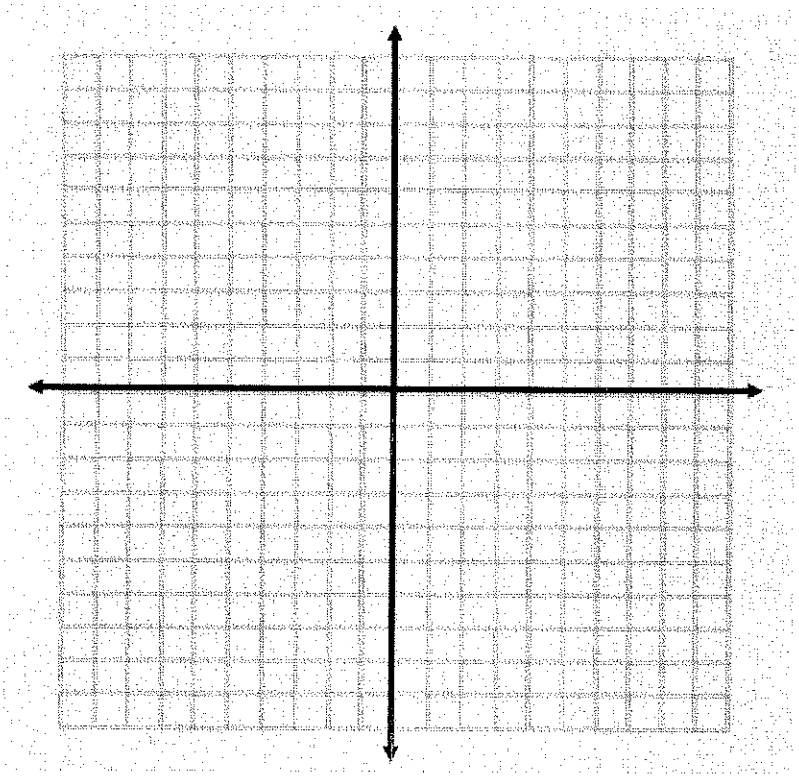


12. Given the quadratic function: $f(x) = -\frac{1}{2}(x+4)^2 - 5$

a. Identify the vertex

b. Solve the function to find the x-intercepts

c. Graph the parent $y = x^2$ and the given function $f(x) = -\frac{1}{2}(x+4)^2 - 5$ on the same plane:

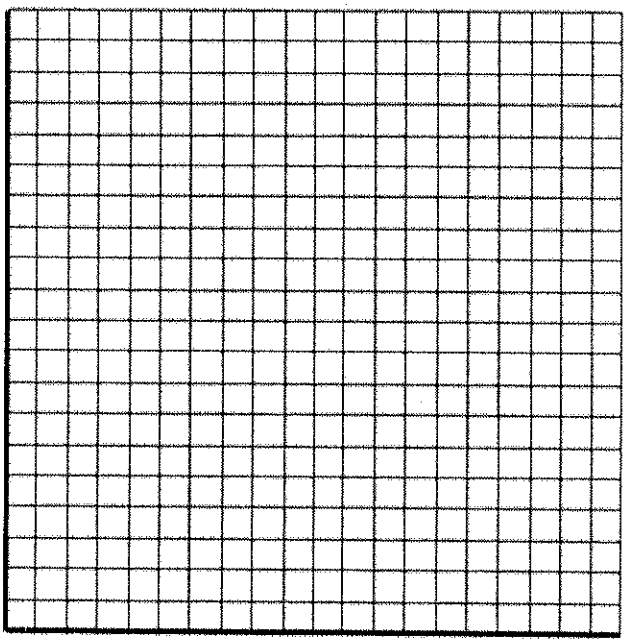


d. Describe the transformations of the parent function $y = x^2$ that can be used to obtain the graph of the given function $f(x) = -\frac{1}{2}(x+4)^2 - 5$

13. Suppose an object is launched vertically from a point 5 feet above the ground with an initial velocity of 48 ft/sec. The vertical height, h (in feet,) of the object, t seconds, after it is launched is modeled by $h(t) = -16t^2 + 48t + 5$.

a. Sketch an accurate graph of this function.

t	$h(t)$
0	
0.5	
1	
1.5	
2	
2.5	
3	



b. When will the projectile's height be 15 ft? Solve algebraically and show all work. You may need to use the quadratic formula.

c. When does the object reach the maximum height? (Hint: Find the vertex.)

d. What is the maximum height the projectile will reach?

e. How long will it take for the object to hit the ground? (Hint: $h(t)=0$ when on the ground)

14. Solve each radical equation for x. Make sure to check for extraneous solutions.

a. $\sqrt{x+3}+3=x$	b. $\sqrt[4]{x+10}=2$	c. $2\sqrt[3]{x-5}+8=2$
d. $\sqrt{3x+13}-5=x$	e. $\sqrt{2x+1}+2=\sqrt{6x+1}$	

15. Simplify each expression using properties of exponents. (Do not use calculator!)

a. $\frac{(z^2w^{-1})^3}{(z^3w^2)^2}$	b. $(4)^{\wedge(-3/2)}$	c. $\frac{10\cdot 2^6}{8\cdot 2^{-2}}$	d. $(-2x^3)^2$
e. $-2(x^3)^2$	f. $\frac{\left(2x^0y^{-3}z^2\right)^3}{\left(3x^5y^{-2}z^{-4}\right)^{-2}}$	g. $\left(2x^2\right)^3y^3\bullet(3x)^0y^4$	h. $\left(2xy^{-2}z^5\right)^{-4}$

16. Find the remainder when $2x^4-8x^2+5x+3$ is divided by $x+3$

17. Given the following functions: $f(x) = -x + 4$, $g(x) = x^2 + 3$, and $h(x) = \frac{2}{x+4}$.

Find each new function, function value, or inverse function from the given function operations:

a. $f(2) + g(3)$	b. $g(1) \cdot h(-2)$	c. $g(f(x))$
d. $g(x + 2)$	e. $\frac{h(2)}{h(-3)}$	f. $h^{-1}(x)$
g. $f^{-1}(x)$	h. $g^{-1}(x)$	i. $f^{-1}(h(-3))$

18. Divide using long division: $(5x^4 + 2x^3 - 3x + 1) \div (x^2 - 3)$

19. Simplify each rational expression.

a. $\frac{x^2-25}{x^2+7x+10}$	b. $\frac{x^2-5x+6}{x^2-4} \cdot \frac{x^2+3x+2}{x^2-2x-3}$	c. $\frac{2x}{x-3} - \frac{x}{x+3}$
d. $\frac{5}{x^2+x-6} - \frac{2}{x-2} + \frac{4}{x^2-4}$	e. $\frac{\frac{2x}{x+5}}{\frac{6x^2}{2x+10}}$	f. $\frac{2x+\frac{13x-3}{x-4}}{2x+\frac{x+3}{x-4}}$

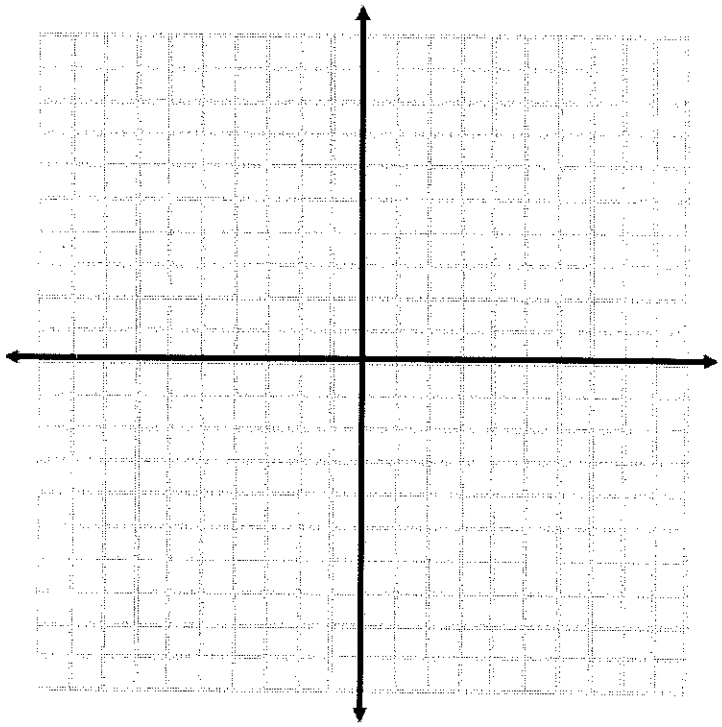
20. Solve each rational equation for x. Make sure to check for extraneous solutions.

a. $\frac{x+3}{x+8} = \frac{x-5}{x-4}$	b. $\frac{15}{x^2+2x-48} = \frac{x-4}{x+8}$
c. $\frac{x}{x+3} - \frac{1}{x-3} = \frac{15}{x^2-9}$	d. $\frac{5}{x-1} + 1 = \frac{4}{x^2+3x-4}$

21. Given the rational function: $f(x) = \frac{2x^2-3x+4}{x-5}$

a. Identify the domain.

Give the answer in interval notation.



b. Find f(0)

c. Find f(7)

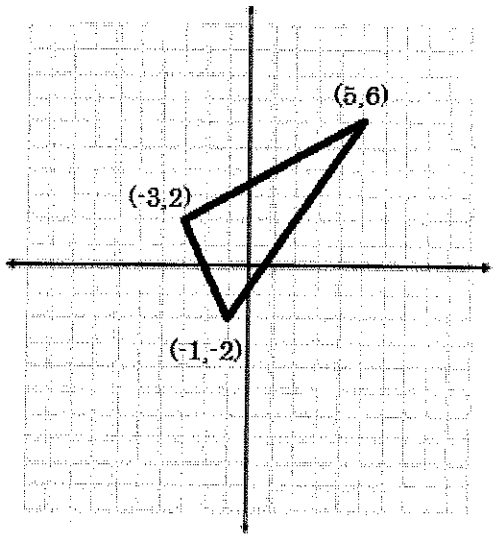
d. Find the x values when f(x)=0 (Zeros)

e. Describe the end behavior of the graph.

f. Sketch a graph of the function:

22. Pythagorean Theorem/Distance Formula:

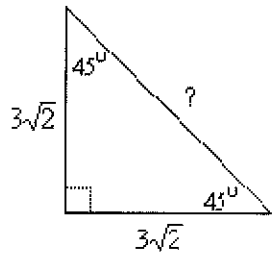
a. Find the lengths of the sides of the triangle in the figure.



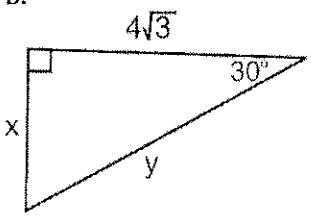
b. Then use Pythagorean Theorem to show that it is a right triangle.

23. Solve for all unknown values using special right triangle ratios:

a.

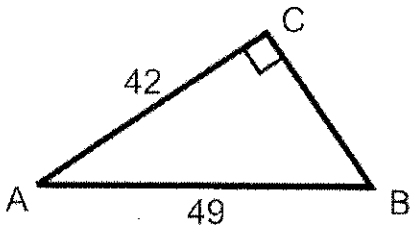


b.

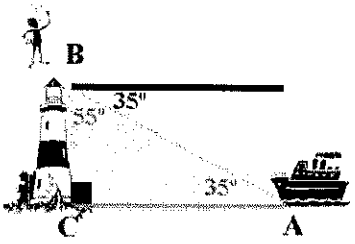


24. Right Triangle Trigonometry (SOH_CAH_TOA):

a. Find the measure of the two unknown angles, ∠A & ∠B, and the unknown side, CB, of the following right triangle.



b. A light house attendant points a light at an approaching ship from the top of the building forming an angle of depression of 35°. If the ship is 156m from the building, how high above the ground is the light? Round your answer accurately to the nearest thousandth meter.



25. **Dimensional Analysis**-Show your work including cancelling all units.

a.How many inches are there in a mile? (Hint: 1mile=5280ft)	b. An adult mosquito's lifespan is about 16 days. How many minutes is that?
c. If there are three teaspoons in a tablespoon, 16 tablespoons in a cup, 2 cups in a pint, and 8 pints in a gallon. How many tablespoons are in a 1000-gallon swimming pool?	d. A Space shuttle does one full orbit every 90 minutes and the Earth is 25,000 miles around. What is the apparent speed of the shuttle in miles per hour?

26. Evaluating Logarithms (without a calculator):

a. $\log_3 81$	b. $\ln e^5$	c. $\log \frac{1}{10}$	d. $\log_2 \sqrt{2}$
e. $\log_4 \frac{1}{64}$	f. $\log_{49} 7$	g. $\log 0.0001$	h. $\ln \frac{1}{e^5}$

27. Solve each equation for x. (Hint: logs are not needed! Use rules of exponents to rewrite as equal bases.)

a. $2^x = 32$	b. $27 = \frac{1}{3^x}$	c. $\frac{1}{\sqrt[3]{49}} = 7^x$