

Geometry

- 1) Find the area of a 45-45-90 triangle with a hypotenuse of length 12.
 - a. Benchmark 9.3.3.5: Know and apply properties of right triangles, including properties of 45-45-90 triangles.
- 2) Give a counterexample of why two triangles with a congruent angle and two consecutive congruent sides aren't congruent.
 - a. Benchmark 9.3.2.3: Give counterexamples to disprove a statement.

Algebra II

- 1) What is wrong with this equation: $x^2 + 9 = (x - 3)(x + 3)$
 - a. Benchmark 9.2.3.3: Factor the difference of squares.
- 2) If we multiply: $(x^7 + 5x^4 - 3x^2 - x + 1) \cdot (x^4 + 16x^3 - 7x^2 + 2)$ what is the degree of the product polynomial?
 - a. Benchmark 9.2.3.2: Multiply polynomials; divide a polynomial by a polynomial of equal or lower degree.

Pre-Calculus

- 1) On a unit circle, what do radians measure?
 - a. Benchmark HS.F-TF.1: Understand that the radian measure of an angle is the length of the arc on the unit circle.
- 2) Find the inverse function of: $f(x) = x^2 + 4$.
 - a. Benchmark HS.F-BF.4*: Find inverse functions.

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Geometry

Use the five smallest tangram pieces to create a square that is congruent to one made from the 2 large tangram triangles.

-Benchmark: 9.3.3.6 Congruent & Similar Figures

Know and apply properties of congruent and similar figures to solve problems and logically justify results

Recall that we can use $P=2l+2w$ and $A=lw$ to represent perimeter and area of a rectangle respectively where l is the length of a side and w is the width. Use this information to give the dimensions of a rectangle such that $P=1.5A$

-Benchmark: 9.3.4.7 Algebra & Geometry

Use algebra to solve geometric problems... such as solving for an unknown length in a figure...

Algebra

Write two different number pattern sequences that begin with the same two numbers. Write an equation for each sequence.

-Benchmark: 9.2.1.8 Rate of Change

Make qualitative statements about the rate of change of a function

A plane flies roundtrip between Great Hall and Bradford. The trip is 180 miles each way. The trip with the wind (the wind is going in the same direction as the plane) takes 1.5 hours, while the trip against the wind takes 2 hours. What is the speed of the plane in still air? What is the speed of the wind?

Benchmark: 9.2.4.5 Linear Programming Solve linear programming problems in two variables

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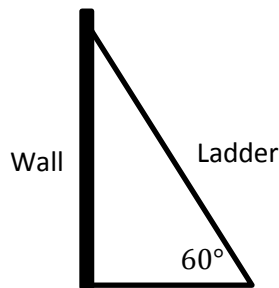
Pre-Calculus

An object is launched directly upward at 64 feet per second (ft/s) from a platform 80 feet high, given by the function $s(t) = -16t^2 + 64t + 80$ where t represents time. What will be the object's maximum height? When will it attain this height?

-Benchmark: 9.2.1.5 Parabolas

-Identify the vertex, line of symmetry and intercepts of the parabola corresponding to a quadratic function, using symbolic and graphical methods, when the function is expressed in the form $f(x) = ax^2 + bx + c$

An eight meter long ladder leans against a building at an angle of 60° with the ground. How far up the wall does the ladder reach? How far from the wall is the base of the ladder? Round your answers to two decimal places, as needed.



- Benchmark: 9.3.4.2 Solve Problems Involving Trigonometric Ratios

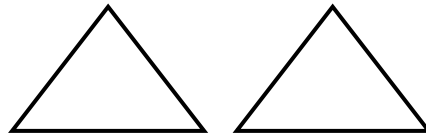
- Apply the trigonometric ratios sine, cosine and tangent to solve problems, such as determining lengths and areas in right triangles and in figures that can be decomposed into right triangles. Know how to use calculators, tables or other technology to evaluate trigonometric ratios

High School Geometry Lesson

(Both problems use the seven piece Tangram set and address the MN Benchmark 9.3.3.6 focusing on knowing the properties of congruent and similar figures.)

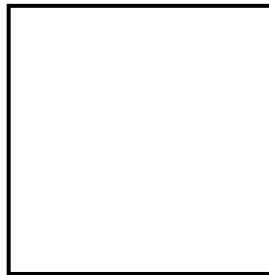
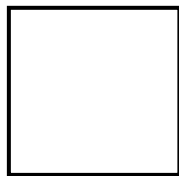
- 1) Directions: Using 2 – 7 Tangram pieces, work with a partner to create 3 pairs of congruent triangles. Have the teacher check your solutions.

EXAMPLE:



- 2) Directions: Using 1 – 7 Tangram pieces, work with your partner to create 3 similar polygons from smallest to largest. Have the teacher check your solutions.

Example:

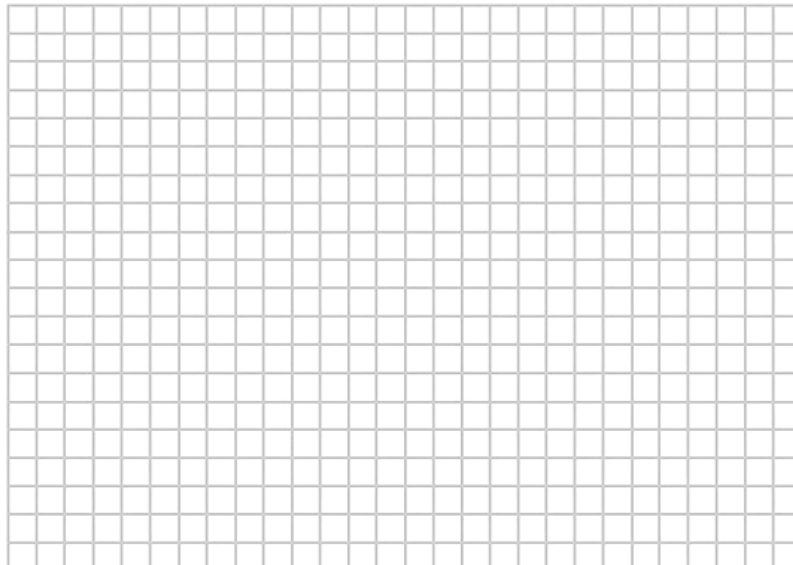


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2 Problems for High School Algebra-2 Lesson

- 1) If a city with a population of 1,000,000 doubles in size every 28 years, what will the population be 84 years from now? (MN Benchmark 9.2.2.2: Represent and solve problems in various contexts using exponential functions, such as population growth.)

- 2) Sketch the graph of the parabola $x - y^2 = -7$ and which direction the parabola is open? (MN Benchmark 9.2.2.3: Sketch the graph of a quadratic function.)

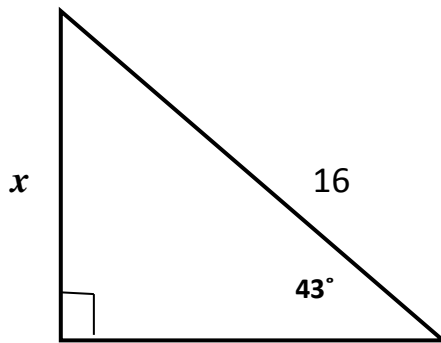


- A) Up
- B) Down
- C) Right
- D) Left

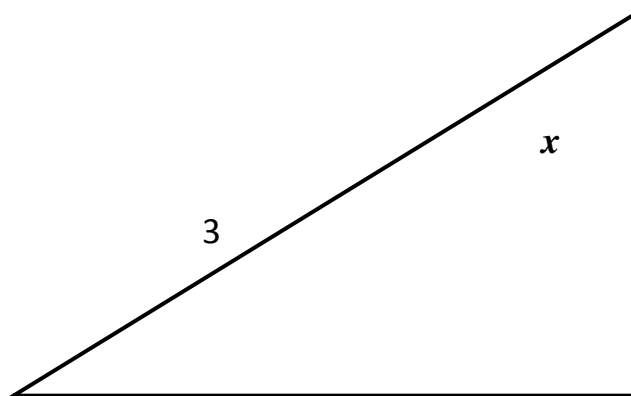
2 Problems for High School Pre-Calculus Lesson

Directions: Use sine, cosine, or tangent ratios to find the side of x in the right triangles below:

1)



2)



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Algebra II

Benchmark: 9.2.1.8 Rate of Change: Make qualitative statements about the rate of change of a function, based on its graph or table of values.

1. Winnie's savings account balance changed from \$2050 in July to \$1975 in December. Find the average rate of change per month. Round your answer to the nearest dollar.

Benchmark: 9.2.2.4 Geometric Sequences: Express the terms in a geometric sequence recursively and by giving an explicit (closed form) formula.

2. Write out the first eight terms of the following sequence:
 $F(x) = n^2$

Geometry

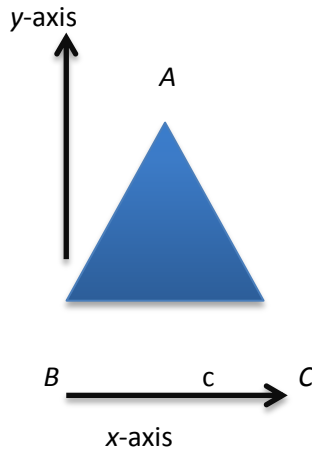
Benchmark: 9.3.3.7 Properties of Polygons: Use properties of polygons-including regular polygons- solve problems.

3. A regular polygon has 5 diagonals. What are the measures of each of its exterior angles?

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Benchmark: 9.3.4.6 Transformations: Rotations about the origin to solve problems involving figures on a graph.

4. Rotate the triangle ABC around the x-axis.



Benchmark: HS.A-REI.8: Representing a system of linear equations as a single matrix equation

5. Write the system of linear equations as a single matrix equation.

$$\begin{cases} 5x+2y=0 \\ x+y=2 \end{cases}$$

Benchmark: HS.A-REI.9: Finding the inverse of a matrix if it exists.

6. Find the inverse of a matrix,

$$\begin{bmatrix} 1 & 2 & 0 \\ 2 & 4 & 5 \end{bmatrix} * \begin{bmatrix} a & b & c \\ d & e & f \end{bmatrix}$$

Continuity- Pre-Calculus

Given are three piecewise functions with one piece of the function missing. Find a piece which can be put into each missing interval to make the whole function continuous. Know that there are many correct answers, but some correct answers are easier to find than others!

$$1.) f(x) = \begin{cases} ??? & x < 2 \\ x^3 + 9x - 4 & x \geq 2 \end{cases}$$

22, $x < 2$ is an effective and simple solution.

$$2.) g(x) = \begin{cases} 4, & x < 0 \\ ???, & 0 \leq x < 5 \\ x^2 + 4, & x \geq 5 \end{cases}$$

If we want to use a line, we know the slope is 5 (25/5) and the y-intercept is 4.

$$5x + 4, \quad 0 \leq x < 5$$

$$3.) h(x) = \begin{cases} -x - 5, & x \leq -4 \\ ???, & -4 < x < 3 \\ x - 5, & x \geq 3 \end{cases}$$

Can use a line again, slope is -1/7 and passes through (-4, -1). $y+1 = -1/7(x+4)$

$$-\frac{1}{7}x - \frac{11}{7}, \quad -4 < x < 3$$

Counterexamples - Geometry, Standard 9.3.2.3

All of the arguments below have a false premise. Identify the false element and show that they are false by providing a counterexample. Remember that it only takes one counterexample to disprove a statement.

- 1.) Mr. Bauer's geometry course is very difficult; he gives us a test every day!

Students could mention any day of class which we did not have a test.

- 2.) The British have one of the largest navies on Earth, and they have never lost a war. Therefore, the British are masters of combat.

Students are hopefully familiar with the American Revolutionary War, which the British did not win.

- 3.) Let $f(x) = x^2$ and $g(x) = \frac{1}{x}$. Then $f(g(x)) = \frac{x^2}{x} = x$ for all x . Therefore $g(x)$ is the inverse of $f(x)$.

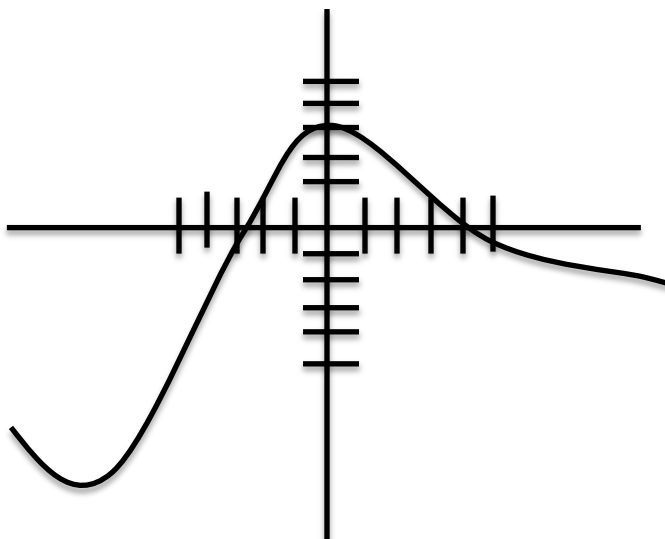
$f(g(x))$ is undefined for $x = 0$.

- 4.) This class is very homogenous; everyone has blue eyes and dark hair.

Students could name any member of the class who either does not have blue eyes or does not have dark hair (or both).

Translations - Algebra Standard 9.2.2.6

Below is the graph of a function, $f(x)$:



Sketch what each of the following would look like using your knowledge of functions and translations

$$f(x) + 2$$

The shape of the graph should be the same, but students will shift the function up two units.

$$f(x + 2)$$

The shape of the graph should be the same, but students will shift the function two units to the left.

$$\frac{1}{2}f(x)$$

The function will have been “squished” to half of its height, both above and below.

Imaginary Roots - Algebra Standard 9.2.3.5

Given below are four complex or imaginary numbers and four polynomials. Use substitution to match each complex or imaginary number with the polynomial which it is a solution to.

$$\frac{1+i}{2}$$
$$5+3i$$
$$2i$$
$$\frac{-1+i\sqrt{7}}{2}$$

$$x^2 - 10x + 34 = 0$$

$$5+3i$$

$$x^2 + 4 = 0$$

$$2i$$

$$2x^2 - 2x + 1 = 0$$

$$\frac{1+i}{2}$$

$$x^2 + x + 2 = 0$$

$$\frac{-1+i\sqrt{7}}{2}$$

Binomial Expansion - Pre-Calculus

Do not try to expand any of the following binomials by hand! Use the Binomial Theorem to write the expansion.

1.) $(X + 5)^2$

$$x^2 + 5x + 25$$

2.) $(a + b)^3$

$$a^3 + 3a^2b + 3ab^2 + b^3$$

3.) $(m + n)^4$

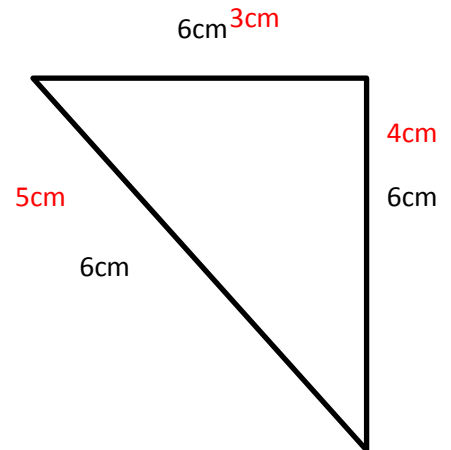
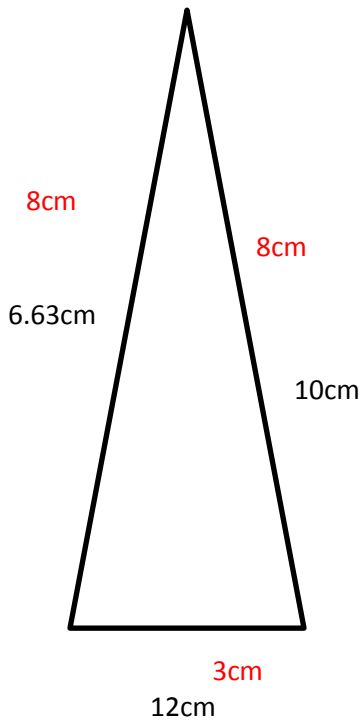
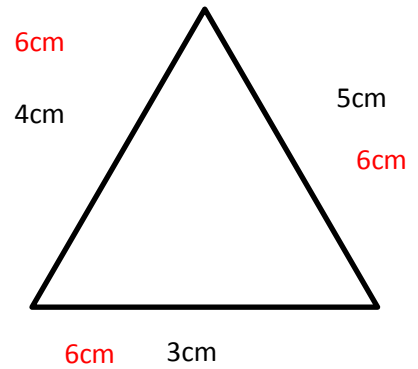
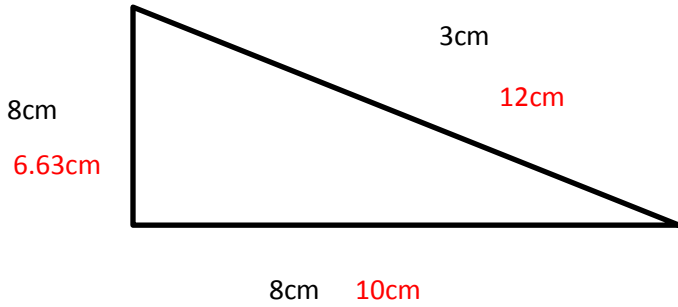
$$m^4 + 4m^3n + 6m^2n^2 + 4mn^3 + n^4$$

4.) When do you feel that using the binomial theorem became easier than expanding by hand?

Opinion, probably either the cube or the fourth power.

Converse of the Pythagorean Theorem - Geometry Standard 9.3.3.4

Given are four triangles, two of them are right triangles, one is isosceles and one is equilateral. However, the side lengths are incorrectly matched with another triangle. Use your knowledge of the Pythagorean Theorem and different types of triangles to determine which side lengths correspond to which triangle.



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$f(x) =$ \sqrt{x} (Round 1)	$g(x) =$ $x + 3$ (Round 1)	$h(x) =$ $2x$ (Round 1)
$f(x) =$ $x - 5$ (Round 2)	$g(x) =$ $ x $ (Round 2)	$h(x) =$ $\frac{1}{x}$ (Round 2)
$f(x) =$ $2x - 7$ (Round 3)	$g(x) =$ \sqrt{x} (Round 3)	$h(x) =$ x^3 (Round 3)
$f(x) =$ $\frac{3}{x}$ (Round 4)	$g(x) =$ $x^2 - 1$ (Round 4)	$h(x) =$ $5x$ (Round 4)
$f(x) =$ $\frac{1}{x}$ (Round 5)	$g(x) =$ $\frac{x}{4}$ (Round 5)	$h(x) =$ $0.5x + 7$ (Round 5)

This is an anticipatory board game for addition, multiplication and composition of functions. Hand out to students and call out a variety of actions such as: Review functions and a good introduction to a variety of pre-calculus materials such as using generated function to talk about 1-1 and inverse functions.

$$f(x) + g(x) + h(x)$$

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

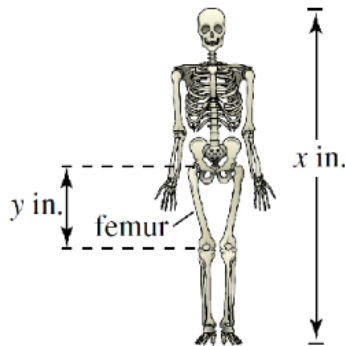
Math 416 – 2014 Class Anticipatory Problems

1. *Anthropology* The relationship between the length of an adult's femur (thigh bone) and the height of the adult can be approximated by the linear equations

$$y = 0.432x - 10.44 \text{ Female}$$

$$y = 0.449x - 12.15 \text{ Male}$$

where y is the length of the femur in inches and x is the height of the adult in inches (see figure).



(a) An anthropologist discovers a femur belonging to an adult human female. The bone is 16 inches long. Estimate the height of the female.

(b) From the foot bones of an adult human male, an anthropologist estimates that the person's height was 69 inches. A few feet away from the site where the foot bones were discovered, the anthropologist discovers a male adult femur that is 19 inches long. Is it likely that both the foot bones and the thigh bone came from the same person?

(c) Complete the table to determine if there is a height of an adult for which an anthropologist would not be able to determine whether the femur belonged to a male or a female.

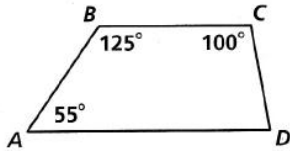
Height x	Female femur length, y	Male femur length, y
60		
70		
80		
90		
100		
110		

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For the following diagrams, write a conclusion that follows from the given information. If you are not sure what to write, fill in the blanks of the sentence with the correct information.

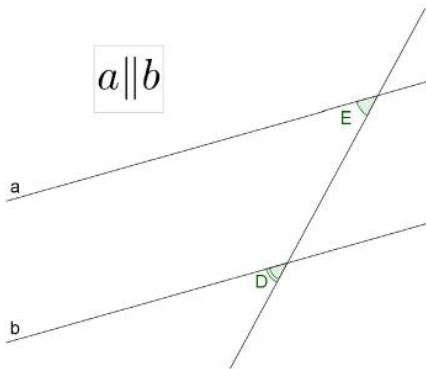
Since _____, _____ because of the _____
 hypothesis of (your conclusion) theorem that justifies your conclusion.
 theorem/postulate

For example:

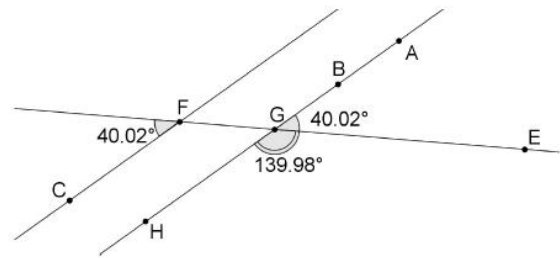


Since angle A and angle B are supplementary, line segments BC and AD are parallel by the converse of the same-side interior angles theorem.

(a)



(b)



9.3.3.1 and 9.3.3.2



The Diagram shows a large equilateral triangle divided by three straight lines into seven regions. The three grey regions are equilateral triangles with sides of length 5cm and the central black region is an equilateral triangle with sides of length 2cm .

What is the side length of the original large triangle?

Hungry Hamsters

Five hamsters ? Arnie, Betty, Carl, Debby, and Ernie ? are learning to go through a maze. Each time a hamster reaches the end of the maze, it gets a pellet of food.

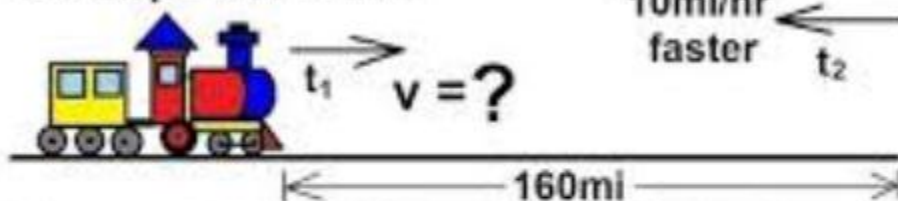
So far, Arnie has gotten four more pellets than Betty; Betty has gotten seven fewer pellets than Carl; Carl has gotten five more pellets than Debby; and Debby has gotten three more pellets than Ernie. Betty and Debby have gotten ten pellets between them.

How many times has each hamster gone through the maze so far? (Each hamster has gone through more than once.)

MN State Benchmark: 9.2.2.1

How fast was the train going in each direction?

Total trip = 7hr 12min



Let x = speed going

$x + 10$ = speed coming back

$d = vt$

$$t_1 + t_2 = 7.2 \text{ hrs}$$

$$\frac{160}{x} + \frac{160}{x + 10} = 7.2$$