

MATHEMATICS – High School

Activities and Assessments

- Standard 1:** Uses a variety of strategies in the problem-solving process.
- Standard 3:** Uses basic and advanced procedures while performing the process of computation.
- Standard 4:** Understands and applies basic and advanced properties of the concepts of measurement.
- Standard 5:** Understands and applies basic and advanced properties of the concepts of geometry.
- Standard 6:** Understands and applies the basic and advanced concepts of statistics and data analysis.
- Standard 8:** Understands and applies basic and advanced properties of functions and algebra.
- Standard 9:** Understands the general nature and uses of mathematics.

Knowledge/Skill:

- Relate to real life
- Graph
- Write equation
- Predict

After teaching an activity similar to the one that follows, give the assessment to determine student achievement:

1. In small groups, students heat 200 ml of water on an electric heater. They make a table that shows time and temperature. The water should not be heated above 60°C.
2. Each student works alone to draw a temperature vs. time graph.
3. Each student draws a “best straight line” on the graph.
4. Each student writes an equation that relates time and temperature.
5. Each student predicts, from the graph or from the equation, the temperature that will be reached 4 minutes after the time when his group stopped heating the water.
6. Each student tells the meaning of the slope of the line.
7. Explain whether the answer to 5 is plausible, and make clear why or why not.

Assessment:

1. Did student assign variable?
2. Did student draw graph?
3. Did student draw a reasonable line?
4. Did student obtain a correct equation of the line?
5. Did student make a reasonable prediction of temperature to answer question in Point 5?
6. Did student correctly give the meaning of “slope” for this problem?

MATHEMATICS – High School

Activities and Assessments

Standard 2: Understands and applies basic and advanced properties of the concepts of numbers.

Knowledge/Skill:

- Simplify Numeric and Algebraic Expressions
- Identify what set numbers belong to
- Simplify Exponential and Radical Expressions

After teaching the concepts indicated on the assessment, give the assessment to determine student achievement.

Assessment Tools: Problems 1-8

Problems:

1. Simplify the following numeric and algebraic expressions:

a.) $5 - 3(4 + 1)$

b.) $2 \cdot 3^2$

c.) $3(2x + y) + 2(5x - 4y)$

2. Identify the following numbers by matching to the best response. Each answer is used exactly once.

a.) $\sqrt{5}$

b.) $\frac{2}{3}$

c.) $5 + 4i$

d.) -3

e.) $\sqrt{-4}$

1. Integer

2. Rational

3. Irrational

4. Imaginary

5. Complex

3. Simplify each exponential form:

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

b.) $(5x2)^3$

c.) $\frac{16 h^3 k^2}{12 h^2 k^5}$

4. Simplify and write in simplest radical form:

a.) $\sqrt{50x^4y^5}$

b.) $\sqrt{3a^3b} \sqrt{6ab^5}$

5. Simplify:

a.) $\frac{9a^4 b^{-6} a^2}{15a^{-2} b^3 c^{-2}}$

6. Choose the set(s) that applies to the following numbers. (Natural, Whole, Integer, Real, Rational, Irrational)

a.) _____ -4

b.) _____ $\sqrt{7}$

c.) _____ $2 \cdot 3$

d.) _____ $-4 \frac{5}{8}$

7. Simplify $\sqrt{72a^5b^4c}$

8. Simplify numerical and algebraic expressions:

A chemist's measurements indicated that 8 bags of absorbent material absorbed 112.4 grams of salt in 6 days. Express in scientific notation the number of grams that were absorbed by each bag per day. Show dimensions of your final answer.

9. Identify all the sets of numbers that each of the following belong to.

	<u>Sets of Numbers</u>
<u>Example:</u> $12\sqrt{-1}$	Imaginary
18.3	
4,500,000	
π	
3	
3.14	
$\sqrt{2}$	

10. Simplify exponential and radical expressions.

A student hypothesized that, if he raised $4x^{1/2}$ to the third power, he would have an expression that would be directly proportional to y . (y represented a temperature). Write the equation he obtained.

11. Use a calculator to find the value, correct to two places to the right of the decimal, of $\sqrt{116}$.

Assessment:

Problem #8

1. Did student get correct numerical answer?
2. Were dimensions of final answer correct? (grams)
(bag) day
3. Did the student defend the plausibility of the answer?

Problem #11

1. Did student use the calculator correctly?
2. Did the student round off his answer correctly?

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Standard 3: Uses basic and advanced procedures while performing the process of computation.

Knowledge/Skill:

By adding or subtracting fractions, students will use the LCM
Factoring polynomials by using the GCF
Use calculator appropriately

Assessment Tools:

Work with recipes
Find perimeter of triangles using fractions

Name: _____

Standard #3: COMPUTATION

Directions: DETERMINE ANSWERS WITHOUT CALCULATOR.

Fractions

1. A recipe for Molasses Bars calls for the following ingredients:

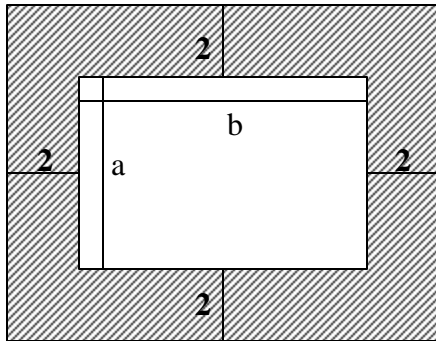
½ Cup	Powdered sugar
6 Tablespoons	Butter
2	Eggs
1/8 Teaspoon	Salt
1/8 Teaspoon	Soda
7/8 Cup	Flour
1 Teaspoon	Vanilla
1 Cup	Broken nut meats

- a.) George plans to triple the recipe. Determine the quantity of each ingredient he should use.

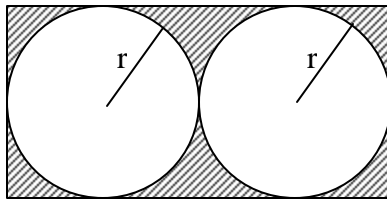
- b.) Helen would like to cut the recipe in half. Determine the quantity of each ingredient she should use.

Factoring Polynomials: Write an expression in factored form for the area of each shaded region. Arrange your work and label expressions to make your reasoning clear to the reader. Comment on your answers to show why your answer seems plausible.

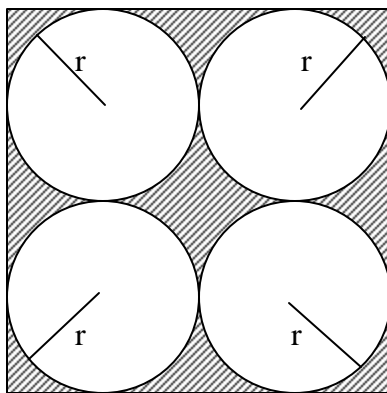
2.



3.



4.



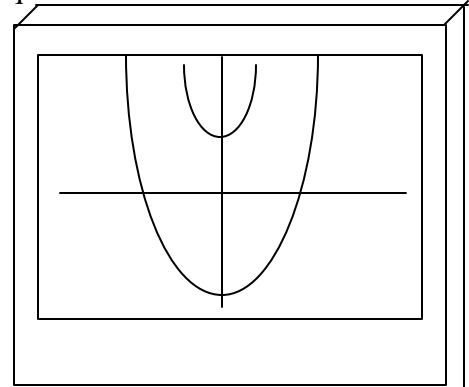
Use Calculator appropriately.

Sketch curves on screen for problems C and D, and answer the question.

Suppose $x^2 - x + 6$ has been factored as $(x + 2)(x - 3)$.

a.) Press $\boxed{Y=}$. Enter $x^2 - x + 6$ for Y_1 and $(x + 2)(x - 3)$ for Y_2 .

b.) Press \boxed{ZOOM} 6. Notice that two different graphs appear. Therefore, $x^2 - x + 6 \neq (x + 2)(x - 3)$



5. Determine whether each equation is a true statement. If it is not correct, state the correct factorization of the trinomial.

a.) $x^2 - x - 2 = (x - 1)(x + 2)$

b.) $x^2 - 2x - 3 = (x - 3)(x + 1)$

c.) $x^2 - 5x + 4 = (x - 4)(x - 1)$

d.) $2x^2 + 3x - 2 = (2x + 2)(x - 1)$

6. Study the model at the right.

a.) **Explain** how this model could help to factor $x^2 - 8x + 12$.

	x	?
x	x^2	$8x$
?	$8x$	12

b.) **Factor** $x^2 - 8x + 12$.

Assessment:

Problem #s 2-4

1. Is the student's argument clear?
2. Is the result correct?

Use the calculator appropriately.

Problem #5

1. Did student follow directions?
2. Did student state the correct factorization?

Problem #6

3. Does student answer to (a) show an understanding of the model? Does the student label the figure?
4. Does the student factor the expression correctly?

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Standard 3: Uses basic and advanced procedures while performing the process of computation.

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Standard 4: (A) Uses basic and advanced procedures while performing the processes of computation. (Complete either standard 4A or 4B)

Knowledge/Skill:

Measure length of shadows

Use geometric formulas: perimeter, area and volume

Translate graphs into equations and equations into graphs

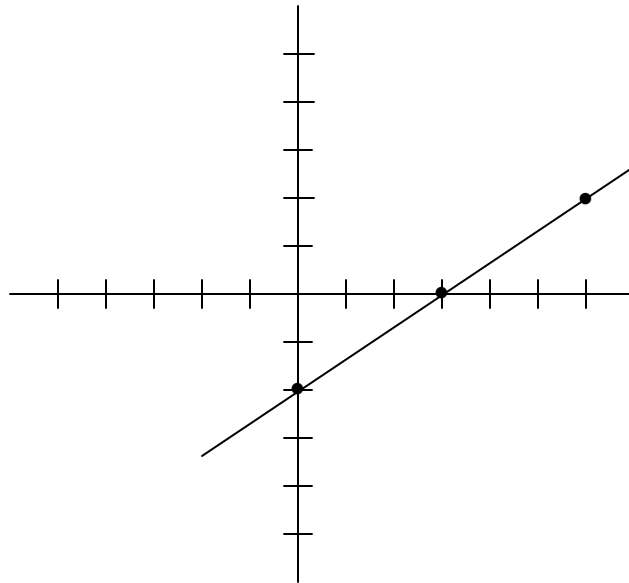
After teaching the concepts indicated on the assessment, give the assessment to determine student achievement.

Assessment Tools:

Problems 1-6

5. Find the area, in terms of π , of a circle having a diameter with length equal to 10 feet.

6. What equation (in slope-intercept form) is represented by the line below?



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Standard 4: (B) Understands and applies basic and advanced properties of the concepts of measurement. (Complete either standard 4A or 4B)

Assessments:

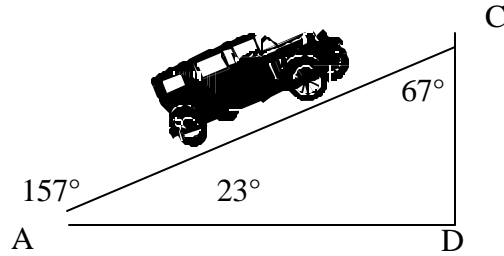
Problems 1-6

Name: _____

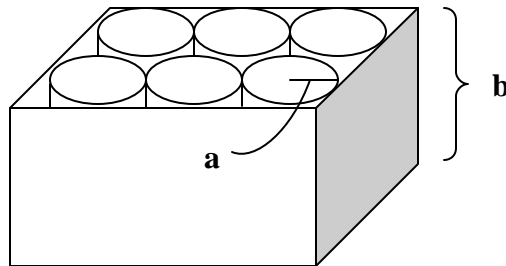
Problems: CONCEPTS OF MEASUREMENT

Directions:

1. Make measurements on this photograph and calculate the slope of the ramp. (Ruler and/or protractor needed.) Show work clearly and present results clearly.



2. The figure below represents a box that contains six right cylinders. Show work clearly and label expressions.



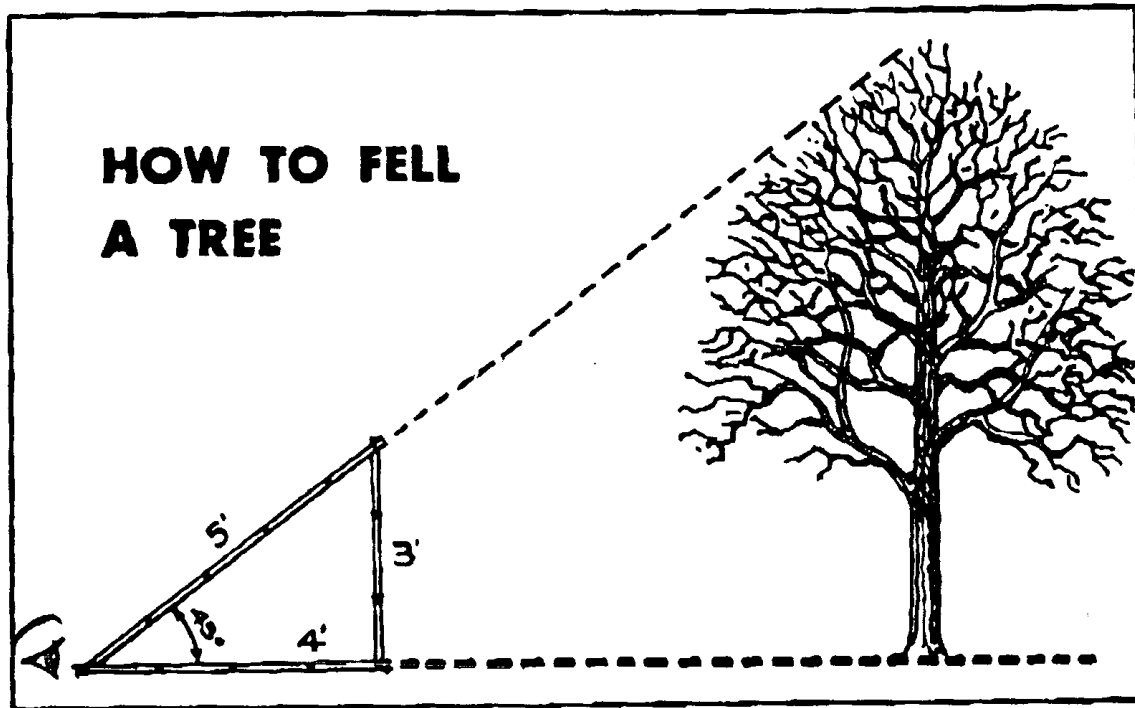
- a.) Write an expression for the total volume of the cylinders.
- b.) Write an expression for the volume of the box.
- c.) What percentage of the volume of the box is filled by the cylinders?

3. The Federal Aviation Agency requires that, as some airplanes come in for a landing, the angle of descent must be 3° for the last four miles. Show work clearly.

a.) Use your ruler and protractor to make a scale drawing illustrating this. Let 1 inch represent a mile.

b.) Use your drawing to estimate the approximate altitude in feet at which such an airplane should be over four mile before landing (1 mile = 5,280 feet).

4. Read carefully and show work clearly.



Drawing by Leavitt Dudley

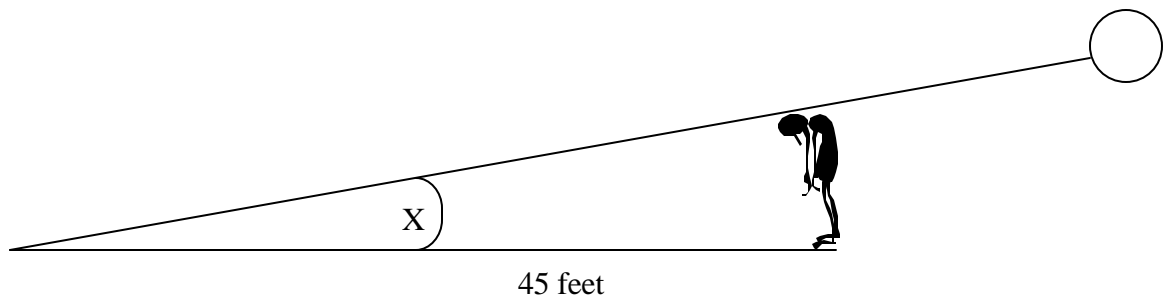
Tree removal used to be a hard, hazardous job, one better left to tree removal companies. But along came the lightweight chain saw and now it's easy to cut a 30-foot-tall tree into neat fireplace-length logs in a few hours. There's just one problem. Felling the tree is still hazardous, although it need not be. If you have analyzed its fall correctly and have made the proper cuts, it will fall exactly where you plan. But if you haven't, no amount of guy wires or ropes can be trusted to guide its crash to the ground.

The first thing you have to do is find how much room it needs when it falls. You can do this by using the Boy Scout method of measuring heights. A triangle with sides of three, four and five feet is placed so that you sight along the five-foot side while you move the triangle to a point where the top of the tree comes into sight, as shown above. That's how far the tree will reach when it's felled.

This article about how to cut down a tree appeared in a newspaper several years ago. You know enough geometry now to be able to recognize that something in the article is incorrect.

1. What is it? Explain.
2. How do you think the article should be corrected? Explain.

5. What is the angle of elevation of the moon if a 7-foot creature that walks in the night casts a shadow 45 feet long?



6. On a trip to an amusement park, Obtuse Ollie and Acute Alice wondered how tall the Ferris wheel was. They asked the man operating the wheel, but he didn't know. Ollie thought that he could find out by climbing to the top of the wheel, but Alice thought of a simpler way to estimate the height of the wheel that did not require any climbing at all. What do you think it was?



Assessment:

Problem #1

1. Does the student's work show that he understands the meaning of "slope"?
2. Are measurements and calculations correct?

Problem #2 – a, b, c

1. Does student use correct methods for calculating volumes?
2. Does student use correct methods for calculating percentages?

Problem #3 – a, b

1. Does student make a useful and correct drawing?
2. Does student find needed altitude correctly?

Problem #4

1. Does student find the error?

Problem # 5

1. Does student use a correct method for finding the angle of elevation?

Problem #6

1. Does student describe clearly a method for answering the question?

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Standard 5: (A) Understands and applies basic and advanced properties of the concepts of geometry. (Complete either standard 5A or 5B)

Knowledge/Skill:

Write a 2-column proof proving triangles.

Difference between deductive, inductive reasoning

Pythagorean theorem – be able to use (solve for 3rd side)

Knowledge of circles and special right triangles

After teaching the concepts indicated on the assessment, give the assessment to determine student achievement.

Assessment Tools:

Problems 1-7

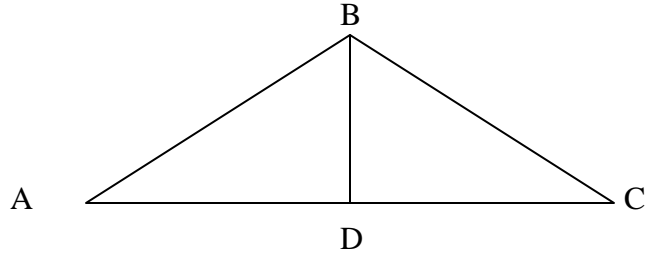
Problems:

1. Write a two-column proof for the following:

Given: $AB \cong CD$

BD bisects AC

Prove: $\triangle ABD \cong \triangle CBD$

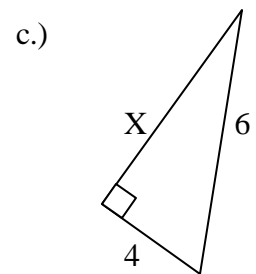
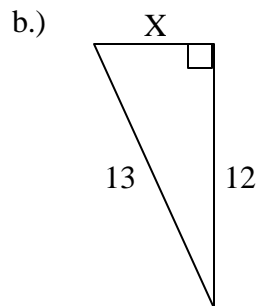
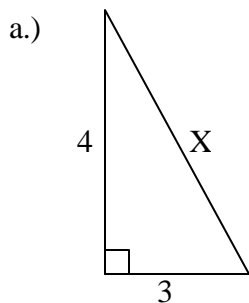


2. Identify the following statements as inductive or deductive.

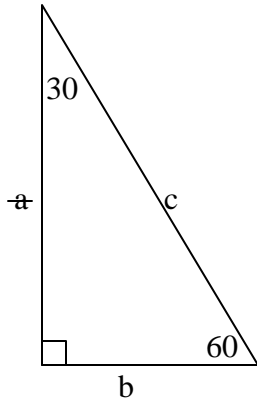
_____ a.) If lines are parallel, then corresponding \angle s are \cong . Since $\angle 1$ and $\angle 2$ are corresponding \angle s formed by parallel lines, then $\angle 1 \cong \angle 2$.

_____ b.) Tuna has been served in the school cafeteria each of the last 5 Tuesdays. Since tomorrow is Tuesday, tuna will be served.

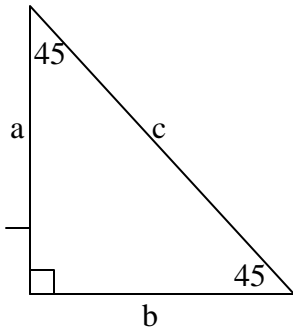
3. Use Pythagorean's Theorem to solve the missing parts. Write answer in simplest radical form.



4. Solve the missing sides in special triangles.

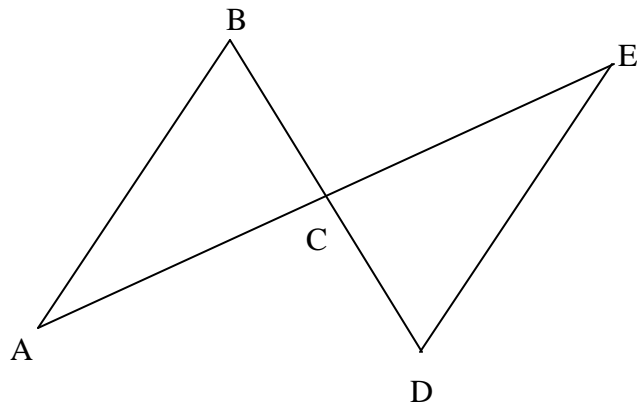


a	b	c
	5	
$4\sqrt{3}$		
		20

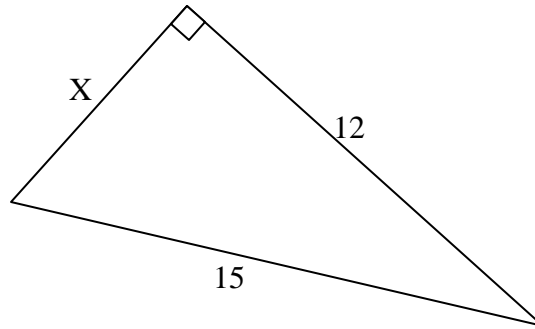


a	b	c
2		
	7	
		$11\sqrt{2}$

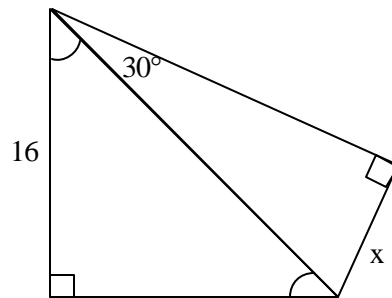
5. Given: $\angle A \cong \angle E$,
 \overline{BD} bisects \overline{AE}
 Prove: $\triangle ABC \cong \triangle EDC$



6. Find x



7. Find x



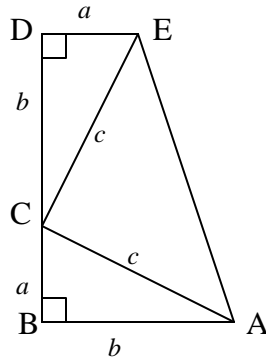
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Standard 5: Understands and applies basic and advanced properties of the concepts of geometry.

Name: _____

Problems: CONCEPTS OF MEASUREMENT

1. President Garfield invented an original proof for the Pythagorean Theorem in 1876 when he was a member of the House of Representatives. It is based on the figure shown here.



- a.) Write expressions for the areas of the three triangles in terms of a , b and c .
- b.) What kind of quadrilateral is ABDE?
- c.) Write an expression for ABDE in terms of a and b .
- d.) Write an equation relating the areas of the three triangles to ABDE.
- e.) Finish Garfield's proof by substituting your expressions for the areas of the triangles and the area of ABDE into this equation and simplifying it.

2. *Deductive Reasoning:* Lorelei’s boyfriend has given her a “diamond” ring but she isn’t certain that it is genuine. Consider the following argument:

If a stone is a diamond, its index of refraction is more than 2.

The stone in Lorelei’s ring has an index of refraction of 2.4.

Therefore, the stone in Lorelei’s ring is a diamond.

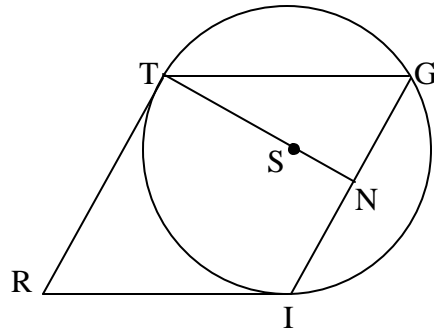
- a.) Assuming that the first two statements in this argument are true, does it follow that the third statement is true?

- b.) Explain why or why not.

Inductive Reasoning: Your friend Larry does not understand what is meant by the term “inductive reasoning.” Give an example of inductive reasoning that involves the index of refraction of a stone. Your example should be helpful to Larry.

In the figure below, TRIG is a parallelogram and TN bisects IG in circle S.

3. *Circles*



a.) Why is $\overline{RT} \perp \overline{IG}$?

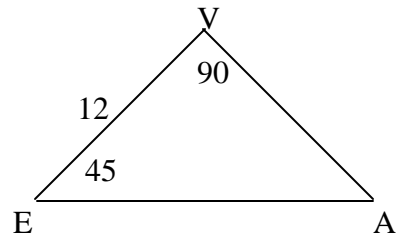
b.) Why is $\overline{TN} \perp \overline{IG}$?

c.) Why is $\overline{TN} \perp \overline{RT}$?

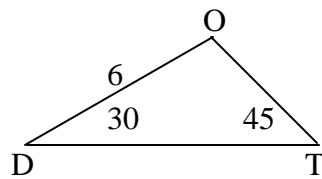
c.) Why is \overline{RT} tangent to circle S?

4. *Special Triangles:* Find the lengths of the other two sides of each of the following triangles. Label your diagrams to make your reasoning clear.

a.)



b.)



Assessment:

1. ***Two-column proof, areas of triangles, trapezoids***
 - a.) Does student show that he understands this two-column proof?
 - b1) How well does student understand this proof?
 - b2) Can student prove that $\angle ECA$ is a right \angle ?

2. ***Deductive Reasoning:***

- a.) Does the student explain clearly why the argument is invalid?
- b.) Does the student discuss the structure of the argument?

Inductive Reasoning

- a.) Does the student's example show an understanding of the meaning of the term, "Inductive Reasoning?"

3. ***Circles***

- a.) Are answers expressed clearly and correctly?

4. ***Special Triangles***

- a.) Are problems solved correctly?

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Standard 6: (A) Understands and applies basic and advanced properties of the concepts of statistics and data analysis. (Complete either standard 6A or 6B)

Knowledge/Skill:

- Define and use Mean, Median, Mode for Probability and Statistics
- Interpret and graph data
- Known use of various types of graphs

After teaching the concepts indicated on the assessment, give the assessment to determine student achievement.

Assessment Tools:

Problems 1 & 2

Problems:

1. Write out a definition for the following terms:

a.) mean

b.) median

c.) mode

2. Find Mean, Median and Mode

Number	Frequency of Number
0	1
1	2
2	4
3	7
4	3
5	7

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Standard 6: Understands and applies basic and advanced properties of the concepts of statistics and data analysis.

3. Here are the numbers of home runs that Babe Ruth hit in his 15 years with the New York Yankees, 1920 to 1934:

Babe Ruth

54 59 35 41 46 25 47 60 54 46 49 46 34 22

Roger Maris, who broke Ruth's single-year record, had these home run totals in his 10 years in the American League.

13 23 26 16 33 61 28 39 14 8

Find the median number of home runs hit in a season by each player.

4. *Stemplot*

Here are the numbers of home runs that Babe Ruth hit in his 15 years with the New York Yankees, 1920 to 1934:

Babe Ruth

54 59 35 41 46 25 47 60 54 46 49 46 34 22

- a.) Make a stemplot for these data. Is the distribution roughly symmetric, clearly skewed, or neither? About how many home runs did Ruth hit in a typical year? Is his famous 60 home runs in 1927 an outlier?
- b.) Babe Ruth's home run record for a single year was broken by another Yankee, Roger Maris, who hit 61 home runs in 1961. Here are Maris's home run totals for his 10 years in the American League:

13 23 26 16 33 61 28 39 14 8

Make a back-to-back stemplot with Ruth's data on the right and Maris's data on the left. Is Maris's record 61 an outlier in his distribution of home runs hit? How does your plot show Ruth's superiority as a home run hitter? Explain.

5. Get a partner and take turns doing jumping jacks for 30 seconds. One person count while other person jumps. Report data to teacher. After all data is collected using a calculator, find the mean, median and mode for the set of numbers. Construct a bar graph to show the comparison of findings for mean, median and mode.

Assessment:

1. *Mean, Median and Mode*
 - a.) Does the student follow directions?
 - b.) Does the student seem to understand the term?
 - c.) Does the student express his example clearly?

2. *Median and Boxplots*
 - a.) Are Minimum, Q_1 , Median, Q_3 , and Maximum found correctly...
 - i.) By hand?
 - ii.) With calculator?

3. *Stemplot*
 - a.) Are stemplots constructed correctly? Are his/her conclusions reasonable?
 - b.) Do student comments about possible outlier show that he understand the meaning of the term?
 - c.) Does student's comparison of Ruth and Maris show that he understands this kind of plot?

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Standard 7: Understands and applies basic and advanced properties of the concepts of probability.

Knowledge/Skill:

- Can construct tree diagrams for Probability and Statistics
- Define probability, outcomes, events
- Determine the probability of a certain event

After teaching the concepts indicated on the assessment, give the assessment to determine student achievement.

Assessment Tools:

Problems 1-5

4. Evaluate

$${}_6P_4, {}_5P_2, {}_4C_3, {}_7C_2$$

5. Expand

$$(x - 2)^5$$

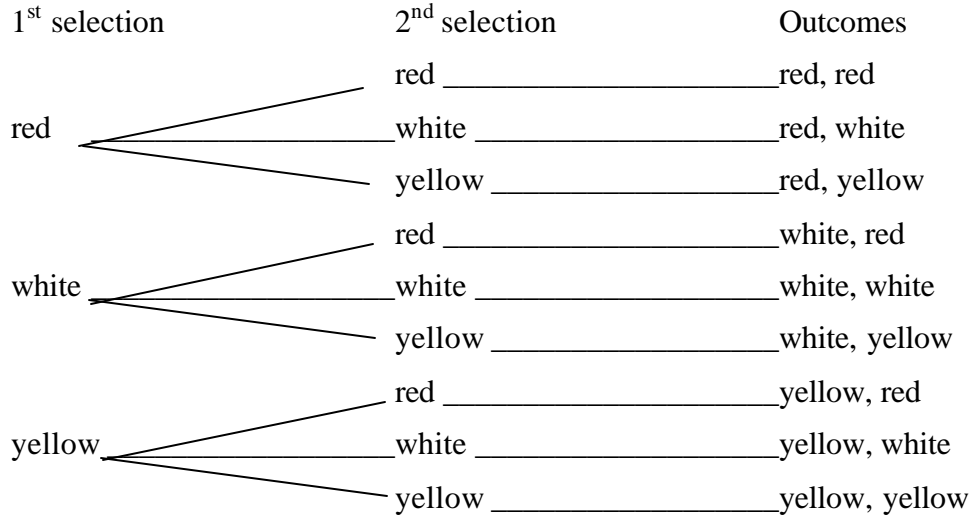
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Standard 7: Understands and applies basic and advanced properties of the concepts of probability.

Standard 9: Understands the general nature and uses of mathematics

Answers:

- A. 1.) First, let's draw a tree diagram to see the possibilities of drawing 2 marbles of the same color.



There are 9 outcomes.

- 2.) There are 3 ways out of 9 to draw the same color twice. The probability for each draw is equally likely, so the probability is $\frac{3}{9}$ or 0.3.

Assessment:

- 1.) Is tree diagram drawn correctly?
- 2.) Does student understand the meaning of the term "outcome"?
- 3.) Does student calculate probability correctly?

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Standard 8: Understands and applies basic and advanced properties of the concepts of function and algebra.

Knowledge/Skill:

Identify functions and their domain or range (Algebra II and Pre-Calculus/Advanced Math)

Solve quadratic equations

Graph functions

Simplify and factor polynomials

Be able to complete the square

Solve systems of equation

After teaching the concepts indicated on the assessment, give the assessment to determine student achievement.

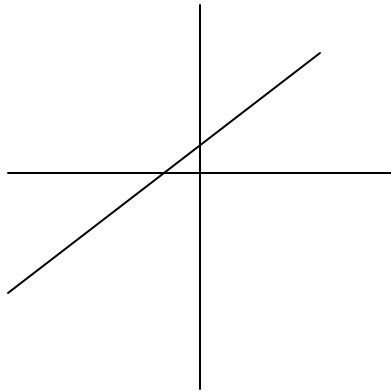
Assessment Tools:

Problems 1-14

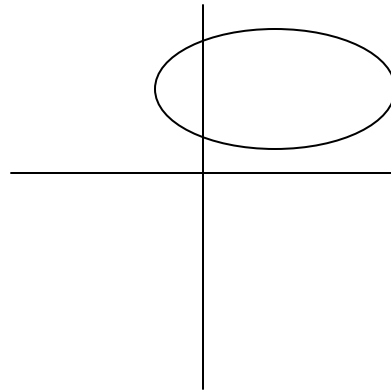
Problems:

1. Identify the following graphs that are functions:

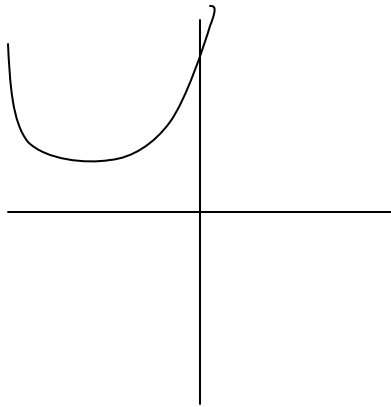
a.)



b.)



c.)



2. Find the domain and range, and determine if the following are functions:

a.) $\{(1, 3); (5, -2); (4, 7); (1, 9)\}$

b.) $\{(0, 2); (5, 3); (4, 2); (1, 8)\}$

3. Solve each quadratic equation:

a.) $x^2 - 5x - 24 = 0$

b.) $x^2 + 4x + 1 = 0$

c.) $w^2 - 8w + 4 = 0$

4. Graph the following functions:

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

b.) $f(x) = x^2 + 2$

5. Simplify each polynomial operation:

a.) $(x^2 + 3x - 5) + (x^2 - 2x + 7)$

b.) $(3z^2 - 4z - 8) - (2z^2 - 4z - 1)$

c.) $(w - 2)(w^2 + 2w + 7)$

6. Factor each polynomial completely:

a.) $z^3 - 9z$

b.) $k^2 - 5k + 6$

c.) $h^3 + 3h^2 - 10h$

7. Solve by completing the square:

$$X^2 - 10x + 5 = 0$$

8. Solve each system of equation:

a.) $x + y = 8$

$$x - 6 = 6$$

b.) $2x - 3y = 9$

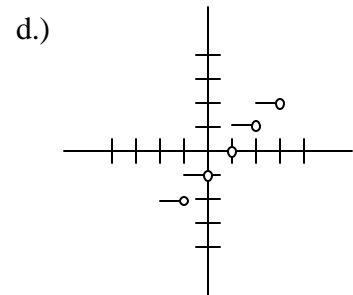
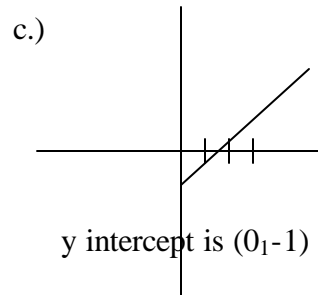
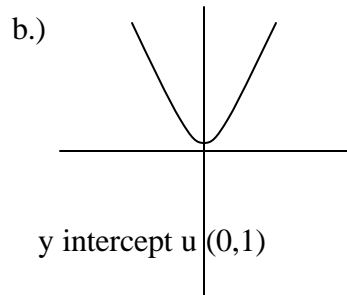
$$4x - 6y = 12$$

c.) $x = 2y + 5$

$$2x + 4y = 10$$

9. State the domain and range for the following:

a.) $\{(2, -1), (-3, 0), (5, 7)\}$



10. Solve $3x^2 + 5x = 7x - 3$

11. Without using a calculator, graph the following:

a.) $f(x) = -2/5x + 4$

b.) $f(x) = -2(x - 3)^2 + 5$

c.) $f(x) = x^2 + 4x - 3$

12. Factor completely:

$$-3x^6y + 48x^2y$$

13. Fill in the blanks:

a.) $x^2 - 8x + \underline{\hspace{2cm}} = (x - \underline{\hspace{2cm}})^2$

b.) $2x^2 + 20x + \underline{\hspace{2cm}} = 2(x + \underline{\hspace{2cm}})^2$

14. Solve the following system:

a.) $5x - 2y = -19$

$$2x + 3y = 0$$