



MAT 202 Math for Elementary Teachers II Geometry, Measurement and Visualization

Credit Hours: 3

Effective Term: Fall 2015

SUN#: NA

AGEC: Mathematics

Credit Breakdown: 3 Lectures

Times for Credit: 1

Grading Option: A/F Only

Cross-Listed:

Description: Spatial visualization, measurement, geometry, proof, probability and data analysis using appropriate technologies and various strategies. Use physical models, technology and pattern-finding strategies to identify properties of and develop formulas for measuring two- and three-dimensional shapes. This course is designed to meet the requirements for prospective elementary education teachers.

Prerequisites: MAT141 or MAT151

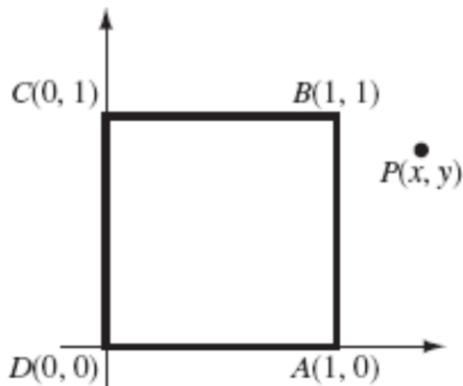
Corequisites: None

Measurable Student Learning Outcomes

1. (Analysis Level) Analyze properties of two- and three-dimensional shapes.

Example 1:

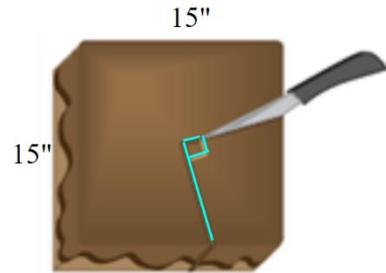
A square in the coordinate plane is shown below, with its vertices at $A(1,0)$, $B(1,1)$, $C(0,1)$, and $D(0,0)$. Since the squared distance between points $P(x,y)$ and $Q(a,b)$ is given by the formula $PQ^2 = (x - a)^2 + (y - b)^2$, we see that $PA^2 = (x - 1)^2 + (y - 0)^2 = x^2 - 2x + 1 + y^2$ is the squared distance between P and vertex A of the square. Find each of the following: PB^2 , PC^2 , and PD^2 . Use those values to describe the set of points P in the plane for which $PA^2 + PC^2 = PB^2 + PD^2$.



2. (Synthesis Level) Develop geometric formulas for area, perimeter, circumference and volume.

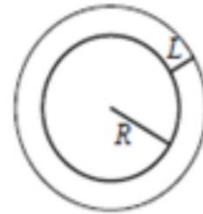
Example 1:

A square cake measures 15" by 15". A wedge-shaped piece is cut by two slices meeting at 90 degrees at the cake's center. What is the area of the top of the piece? Explain your reasoning carefully.



Example 2:

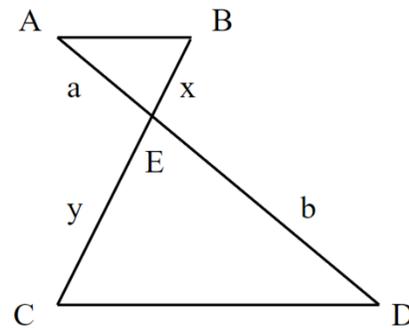
Erin walks her dog Spot with a leash of length L . Spot is very obedient and always walks directly to Erin's right at the end of his leash. Erin follows several different routes and wants to compare the length of her walk with that of Spot. For the following route, how much farther does Spot walk than Erin?



3. (Application Level) Apply proportional reasoning, similarity and congruence to solve problems.

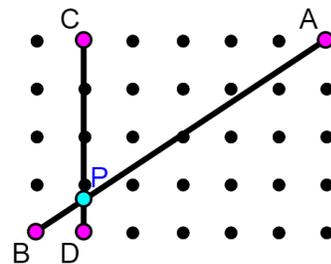
Example 1:

Let \overline{AB} and \overline{CD} be parallel, and let \overline{AD} and \overline{BC} intersect at E. Prove that $a \times y = x \times b$. Label what you know on the drawing and explain anything you add.



Example 2:

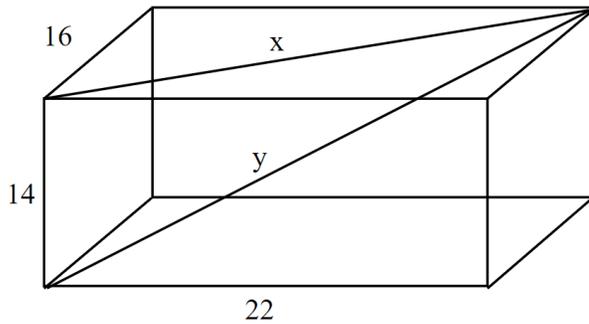
Use similarity to find the distances AP, BP, CP, and DP in the figure shown. The smallest squares on the lattice have sides of unit length.



4. (Analysis Level) Apply the Pythagorean Theorem and analyze the Pythagorean Theorem proof.

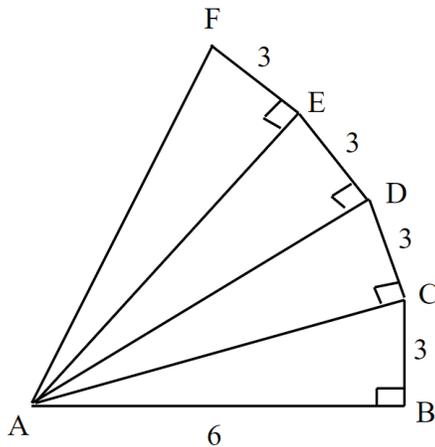
Example 1:

Find the distances x and y in the rectangular prism.



Example 2:

Find AF in this spiral of right triangles.



5. (Synthesis Level) Create geometric constructions.

Example 1:

Let P be a point not on line m . Explain, in diagrams and words, how to construct the point C that is the reflection of point P across line m using straightedge and compass.

Example 2:

Let P be a point not on line m . Explain, in diagrams and words, how to construct the following.

- (a) The point F on line m that is closest to point P using straightedge and compass. That is, explain how to construct the foot F of point P on line m .
- (b) The circle centered at P that is tangent to the line m .

6. (Synthesis Level) Apply geometry transformations to figures using symmetry, reflections, translations, and rotations to formulate conjectures.

Example 1:

In each of the following statements, give an answer between 0 degrees and 360 degrees.

(a) A clockwise rotation of 50 degrees is equivalent to a counterclockwise rotation of _____.

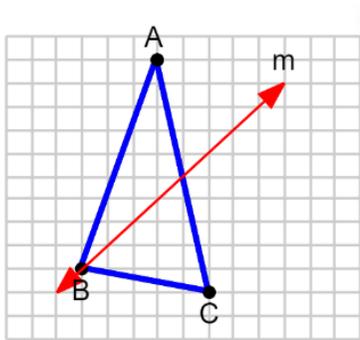
(b) A counterclockwise rotation of 407 degrees is equivalent to a counterclockwise rotation of _____.

(c) A clockwise rotation of 3635 degrees is equivalent to a clockwise rotation of _____.

(d) A sequence of two consecutive clockwise rotations, first of 280 degrees and next of 90 degrees comma about the same center is equivalent to a single clockwise rotation of _____.

Example 2:

Sketch the reflection of triangle ABC across the mirror line m.



7. (Synthesis Level) Solve problems from a variety of contexts using various strategies including technology.

Example 1:

Determine the region produced by connecting the points (0,0), (0,2), (3,2) & (3,0). Now rotate this 2-dimensional region about the x-axis and identify the shape and determine its volume. Now rotate the 2-dimensional region about the y-axis and identify the shape and determine its volume. Compare the two results and explain why they are the same or different.

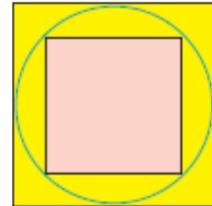
8. (Application Level) Conduct probability experiments using concrete models and technology and interpret the results.

Example 1:

The math club intends to hold a raffle, in which tickets costing \$2 are sold and the winner receives a graphing calculator valued at \$120. Compute the expected value to a ticket buyer if (a) 100 tickets are sold and (b) 200 tickets are sold.

Example 2:

A point is chosen at random in the large square that circumscribes a circle. What is the probability it is a point in the smaller square that inscribes the circle?



9. (Application Level) Use counting principles such as permutations, combinations and factorials.

Example 1:

(a) Mrs. Ruiz has 14 boys and 15 girls in her class. In how many ways can she select a committee to organize a class party if the committee must contain 4 boys and 4 girls?

(b) Lourdes, a girl, and Andy, a boy, always fight. How many ways can Mrs. Ruiz select the committee of part (a) if she does not want both Lourdes and Andy on the committee? Note that Lourdes can be on the committee, and Andy not on the committee, or vice versa.

Example 2:

It is well known that the candidate listed first on a ballot has an advantage in an election. To be equally fair to all candidates, many states require that the ballots be printed in all possible orders with an equal number of ballots in each order. Suppose there are three candidates for governor, four candidates for senate and six for representative. How many different forms of ballots must be prepared, where all ballots list the races for governor, senator, and representative in that order?

10. (Evaluation Level) Find and interpret measures of central tendency (mean/weighted mean, median, mode), variability (range, variance, standard deviation), and rank (quartiles, percentiles, z-scores, stanines).

Example 1:

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|--|----|-----|----|
| For the given data set, to the right, determine the following. | 28 | 25 | 26 |
| (a) Compute the quartiles for the data set. | 32 | 115 | 32 |
| (b) Give the 5-number summary for the data set. | 22 | 24 | 30 |
| (c) Draw a box plot for the data set. | 24 | 28 | 25 |
| (d) Determine the interquartile range, IQR, for the data set. | 28 | 30 | 26 |
| (e) Identify any outliers in the data set. | | | |

Example 2:

- (a) The mean of each of the following collections of data is 55.

$$R = \{55, 50, 60, 45, 65, 35, 75\}$$

$$S = \{55, 50, 60, 45, 65, 35, 75, 55, 55\}$$

$$T = \{55, 50, 60, 45, 65, 35, 75, 80, 30\}$$

Which of R and S has the smaller standard deviation? No computation is needed; justify your response with a single sentence.

- (b) Like the means of R and S in part (a), the mean of T is 55. Is the standard deviation for this set the same as that for S? Note that both of these sets have the same number of entries. Explain your conclusion.

11. (Analysis Level) Organize, create and interpret statistical graphs and charts including the normal distribution and identify patterns/trends.

Example 1:

For a population with a normal distribution with mean 23.5 and a standard deviation 2.5, determine the following.

- (a) About 68% of the population lies between what limits?
 (b) About 95% of the population lies between what limits?
 (c) About 99.7% of the population lies between what limits?

12. (Analysis Level) Analyze levels of the VanHiele Theorem of geometric development.

Example 1:

List the levels of the VanHiele Theorem of geometric development and use an example that helps clarify its meaning and how it impacts the learning of students.