

Cut trim for different shapes using degree and angles = Apply geometric concepts to model and solve real world problems

Program Task: Assemble different shapes by using a compound miter saw; measure and compare the angles in degrees.

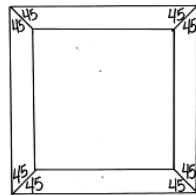
Program Associated Vocabulary:
 ANGLE, BEVEL, DEGREE, MITER, PERPENDICULAR

Program Formulas and Procedures:
 Carpenters often use a compound miter saw to install trim. The most common angle is the 45° angle. Trim is installed around doors and windows. The vertical and horizontal casing makes a square 90°. The vertical and horizontal casing that is installed must be cut on a 45° angle.

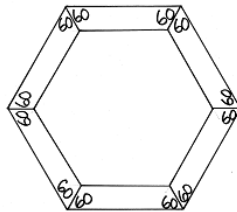
$$\text{Each Corner of a Polygon} = \frac{(n - 2) \times 180}{n}$$

Where n is the number of sides.

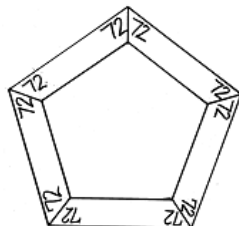
A **square** has 4 sides.
 Each corner = $\frac{(4 - 2) \times 180}{4} = 90$
 Each angle cut = 45°



A **hexagon** has six sides.
 Each corner = $\frac{(6 - 2) \times 180}{6} = 120$
 Each angle cut = 60°



A **pentagon** has five sides.
 Each corner = $\frac{(5 - 2) \times 180}{5} = 108$
 Each angle cut = 72°



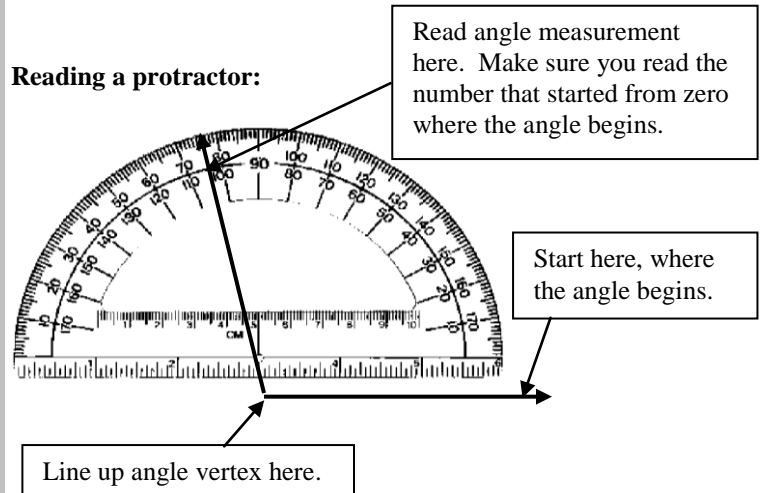
PA Core Standard: CC.2.3.HS.A.14

Description: Apply geometric concepts to model and solve real world problems.

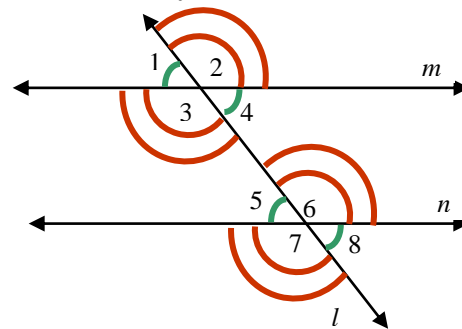
Math Associated Vocabulary
 ANGLE, DEGREES, INTERIOR ANGLES, EXTERIOR ANGLES, VERTICAL ANGLES, CORRESPONDING ANGLES, PARALLEL, TRANSVERSAL

Formulas and Procedures:

Reading a protractor:



Two parallel lines cut by a transversal:



Angles **1&4, 2&3, 5&8, 6&7** are **vertical angles**.
 Angles **1&5, 2&6, 3&7, 4&8** are **corresponding angles**.
 If lines m and n are parallel, then **corresponding angles** are congruent, **Alternate Interior** angles are congruent, and **Alternate Exterior** angles are congruent.
Vertical angles are always congruent.

Example 1: If angle 1 = 40°, what is the measure of angle 8?
 Angle 8 must measure 40°, since ∠1 and ∠8 are alternate exterior angles.

Example 2: If m ∠2 = 3x + 4, and m ∠3 = x + 8, solve for x.
 (Vertical angles are equal.)
 3x + 4 = x + 8 (subtract x from both sides)
 2x + 4 = 8 (subtract 4 from both sides)
 2x = 4 (divide both sides by 2)
 x = 2

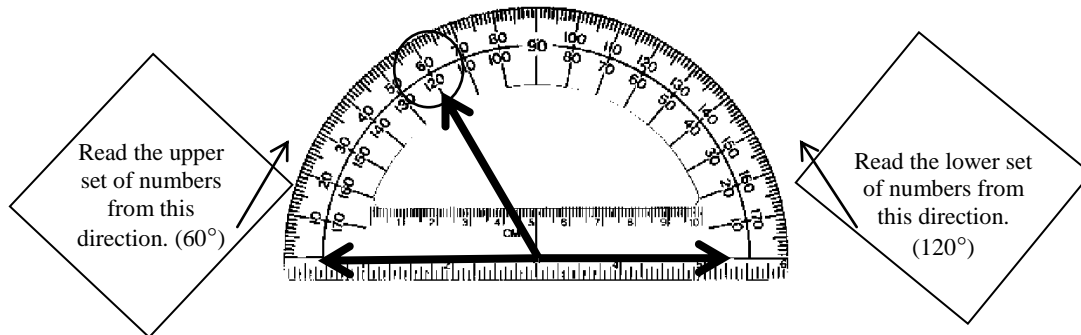
Instructor's Script - Comparing and Contrasting

The carpentry example on page one illustrates the types of angle measurements with which carpenters must be able to work. The example also demonstrates the types of calculations a carpenter must make to determine the cut angle measurements. Sample problems for this eligible content can assess a student's ability to find the given angle measurement on a protractor.

Common Mistakes Made By Students

- Not aligning the index line (line along the bottom of the protractor) with one side of the angle in question
- Not placing the vertex of the angle at the hole or point at the bottom-center of the protractor
- Not clearly specifying a reference or starting point for an angle
- Reading the wrong indicator on the protractor (bottom number versus top number, or vice-versa).

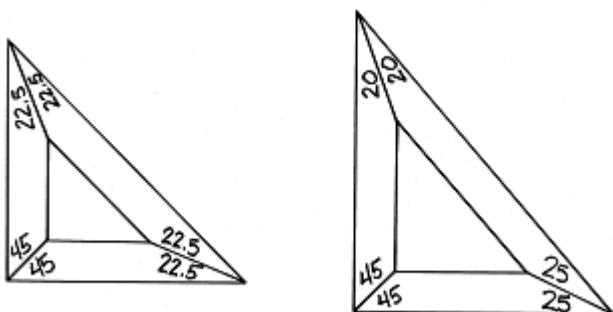
Example of how to read correctly:


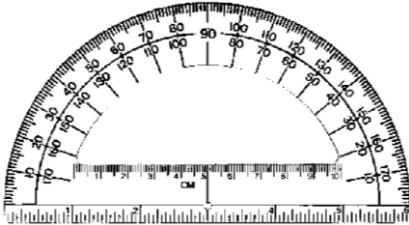
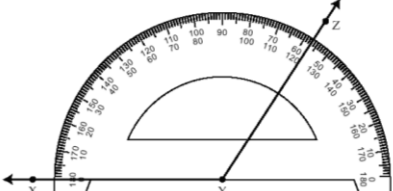
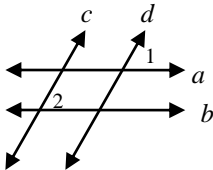
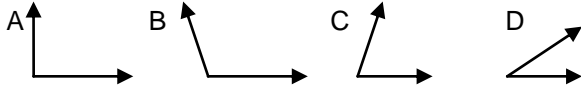




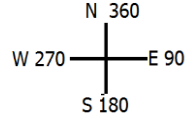
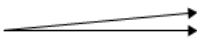
CTE Instructor's Extended Discussion

Carpenters need to determine the proper angle and degrees when cutting trim for different shapes. This procedure is also helpful when cutting decking boards for any shape gazebo. If the proper procedure is used when determining degrees and angles the carpenter will not need to guess what angle the miter saw has to be set at.

Carpenters might also need to frame a right triangle. Right triangles can take on many different shapes depending on how the 180° is dispersed between the angles. The main thing to remember is that the angle cut is always half of the angle. Two examples of right triangles are shown below.



Problems	Career and Technical Math Concepts	Solutions
<p>1. A carpenter is installing trim around an octagon window in a bathroom. There will be eight equal length pieces of casing. At what angle does each piece of trim need to be cut?</p>		
<p>2. Baseboard will be installed on a knee wall that is installed at a 45 degree angle. When cutting the base board trim, at what bevel cut should the compound miter saw be set?</p> <p>a) 22.5° b) 45° c) 90° d) 120°</p>		
<p>3. When installing a pressure treated rim joist around a 12' pentagon deck, at what bevel will the circular saw be set to cut to the lumber?</p> <p>a) 22.5° b) 45° c) 54° d) 60°</p>		
Problems	Related, Generic Math Concepts	Solutions
<p>4. Which angle would you estimate to be the interior angle of the hairpin shown here? How would you describe a "hairpin turn" in the road?</p> <p>a) 10° b) 45° c) 90° d) 120°</p> 		
<p>5. Your GPS indicates that you are traveling in a direction (bearing) that is determined to be 270°. If 90° is east, in which direction are you traveling?</p>		
<p>6. To be wheelchair accessible, the steepness of ramps must not exceed 1 foot of rise per 12 feet of run. This equates approximately to a 5° angle. Use the protractor provided to draw this angle measure.</p>		
Problems	PA Core Math Look	Solutions
<p>7. What is the angle measure of $\angle XYZ$?</p> <p>a) 57° b) 63° c) 123° d) 137°</p>		
<p>8. Given: $a \parallel b$, $c \parallel d$ If $m\angle 1 = 2x + 16$ and $m\angle 2 = x + 14$, then what is the value of x?</p>		
<p>9. Which of the angles on the right is closest to 76°?</p>		

Problems	Career and Technical Math Concepts	Solutions
1. A carpenter is installing trim around an octagon window in a bathroom. There will be eight equal length pieces of casing. At what angle does each piece of trim need to be cut?	An octagon as eight sides. $\frac{(8 - 2) \times 180}{8} = 135$	Each angle will need to be cut on $135 \div 2 = 67.5^\circ$
2. Baseboard will be installed on a knee wall that is installed at a 45 degree angle. When cutting the base board trim, at what bevel cut should the compound miter saw be set? a) 22.5° b) 45° c) 90° d) 120°	 $45^\circ \div 2 = 22.5^\circ$	Answer = a. The two pieces of baseboard will be cut at a 22.5° bevel; the two pieces of baseboard will total 45°.
3. When installing a pressure treated rim joist around a 12' pentagon deck, at what bevel will the circular saw be set to cut to the lumber? a) 22.5° b) 45° c) 54° d) 60°	Answer = c. $\frac{(5 - 2) \times 180}{5} = 108$	The five rim joist will be cut to equal lengths and need to be cut square with a 54° bevel.
Problems	Related, Generic Math Concepts	Solutions
4. Which angle would you estimate to be the interior angle of the hairpin shown here? How would you describe a "hairpin turn" in the road? a) 10° b) 45° c) 90° d) 120°		The correct answer is "a" because a 10° interior angle turn would very nearly turn a driver back in the direction from which s/he came. Hairpin turns get their name because they have interior angles similar to a real hairpin.
5. Your GPS indicates that you are traveling in a direction (bearing) that is determined to be 270°. If 90° is east, in which direction are you traveling?	You are traveling west when your bearing is 270°. 90° is east, 180° is south, and 360° is north.	
6. To be wheelchair accessible, the steepness of ramps must not exceed 1 foot of rise per 12 feet of run. This equates approximately to a 5° angle. Use the protractor provided to draw this angle measure.		
Problems	PA Core Math Look	Solutions
7. What is the angle measure of $\angle XYZ$? a) 57° b) 63° c) 123° d) 137°		Answer = c. 123°
8. Given: $a \parallel b, c \parallel d$ If $m\angle 1 = 2x + 16$ and $m\angle 2 = x + 14$, then what is the value of x?		Angles 1 and 2 are congruent angles so, $2x + 16 = x + 18$ $x + 16 = 18$ $x = 2$ (Subtract x from each side, then subtract 16 from each side.)
9. Which of the angles on the right is closest to 76°?	