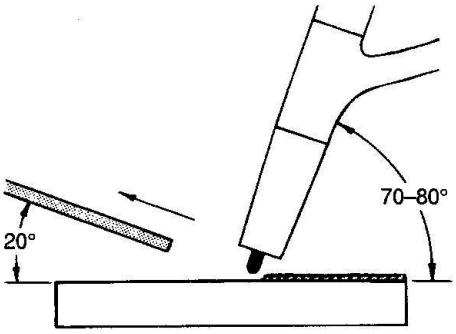
Welding (48.0508) T-Chart

Position GTAW equipment for effective welding	=	Apply geometric concepts to model and solve real world problems

Program Task: Position GTAW equipment and material using degrees and angles for effective welding.

Program Associated Vocabulary:
ANGLE, DEGREE, PARALLEL, PERPENDICULAR

Program Formulas and Procedures:
Welders/Fabricators often use the Gas Tungsten Arc Welding (GTAW) process for fusing thin metals. In order to effectively use GTAW equipment, the welder's torch and filler metal must be positioned at the correct work angles to ensure superior arc characteristics and correct addition of new weld metal to the weld puddle, respectively. A torch angle is typically 70 to 80 degrees (10 to 20 degrees from perpendicular to the base metal). The filler metal is typically held at 20 degrees from parallel to base metal. A welder must be extensively familiar with the degrees of a protractor to successfully prepare for and manipulate welding equipment for this welding process.



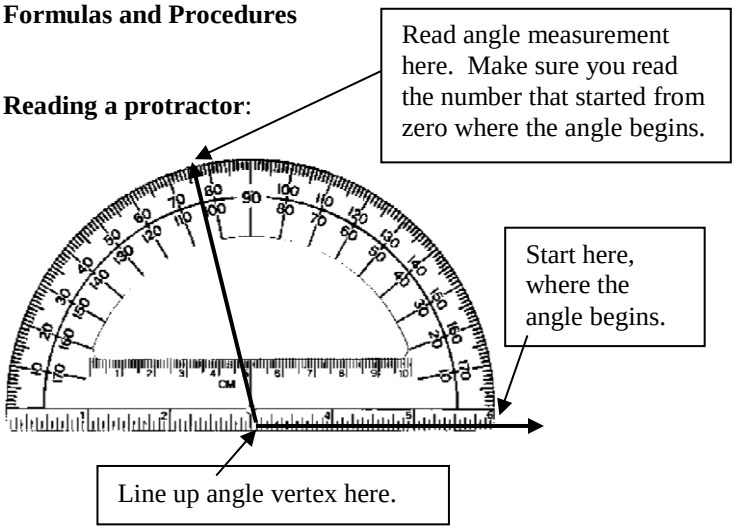
PA Core Standard: CC.2.3.HS.A.14

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

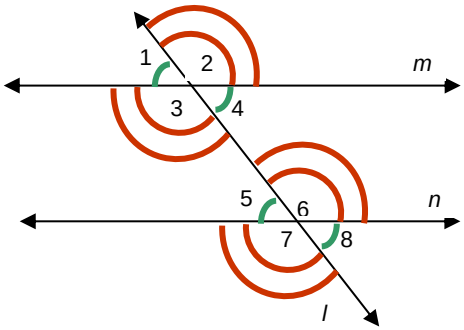
Math Associated Vocabulary
ANGLE, DEGREES, INTERIOR ANGLES, EXTERIOR ANGLES, VERTICAL ANGLES, CORRESPONDING ANGLES, PARALLEL, TRANSVERSAL

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.

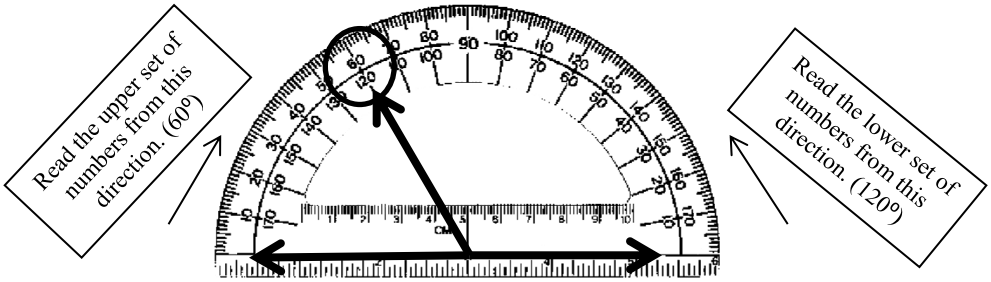
Examples:

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.
2. If $m\angle 2 = 3x + 4$, and $m\angle 3 = x + 8$, solve for x
   $3x + 4 = x + 8$ (subtract x from both sides)
   $2x + 4 = 8$ (subtract 4 from both sides)
   $2x = 4$ (divide both sides by 2)
   $x = 2$

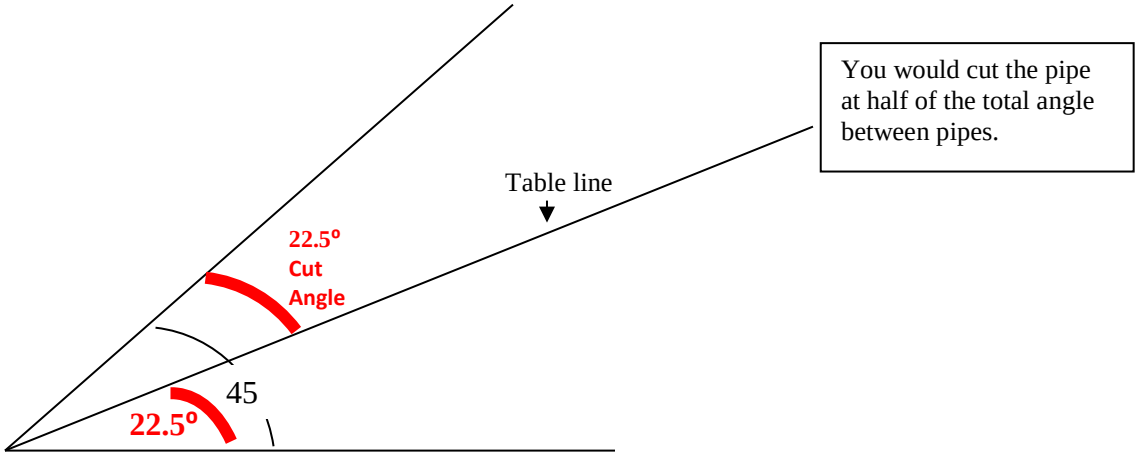
Instructor's Script - Comparing and Contrasting
The welding example on page one illustrates the types of angle measurements that welders must use in day-to-day activities. A welder must make these calculations to determine the angle the torch and filler metal should be held in order to create an accurate weld. Before moving to the welding shop, the CTE instructor can assess a student's ability to find given angle measurements with a protractor. Students can also practice holding the torch and filler metal at given angle measurements.

Common Mistakes Made By Students

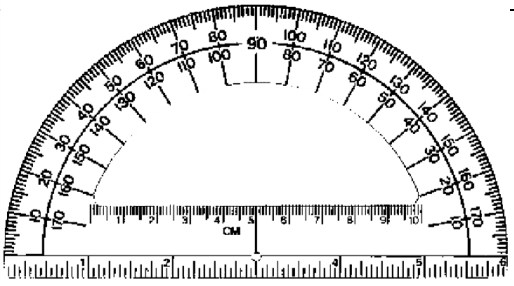
- Not aligning the index line (line along the bottom of the protractor) with one side of the angle in question
- Not placing the vertex of the angle at the hole or point at the bottom-center of the protractor
- Not clearly specifying a reference or starting point for an angle
- Reading the wrong indicator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

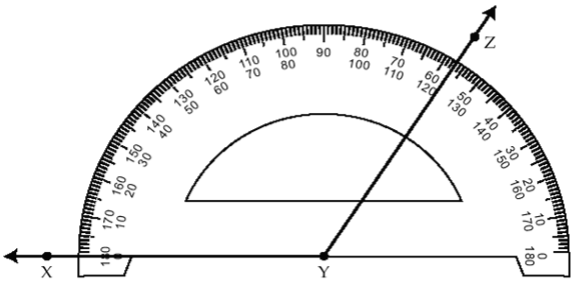
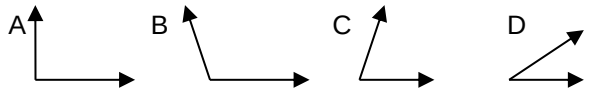
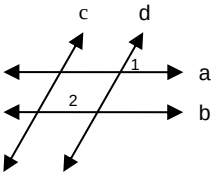


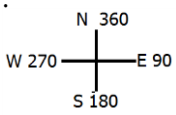
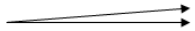
CTE Instructor's Extended Discussion
Welders can determine the proper angle and degrees when manipulating GTAW equipment to produce a sound weld bead. This procedure is also helpful when preparing stock (piping/tubing) to meet the specifications of a shop drawing. If the proper procedure is used when determining degrees and angles, the welder will not need to guess what angle to cut stock.



Problems	Occupational (Contextual) Math Concepts	Solutions
1. A welder is fitting piping/tubing in an octagonal configuration. There will be eight equal length pieces of tubing. At what angle does each piece of trim need to be cut?		
2. Steel kick plates will be installed on a knee wall that is installed at a 45 ^{o} angle. When cutting the base kick plates what bevel cut will the horizontal band saw be set at?		a) 22.5° b) 45° c) 90° d) 120°
3. When preparing a 60 ^{o} V-Groove butt joint, what angle should each piece be beveled at?		a) 22.5° b) 30° c) 45° d) 60°

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^{o} b) 45^{o} c) 90^{o} d) 120^{o}
5. Your GPS indicates that you are traveling in a direction (bearing) that is determined to be 270^{o}. If 90^{o} is east, in which direction are you traveling?		
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 ∠ XYZ? a) 57° b) 63° c) 123° d) 137°		
8. Which of the angles on the right is closest to 76°?		
9. Given: a ∥ b, c ∥ d If m ∠ 1 = 2x + 16 and m ∠ 2 = x + 18, then what is the value of x?		

Problems	Occupational (Contextual) Math Concepts	Solutions
1. A welder is fitting piping/tubing in an octagonal configuration. There will be eight equal length pieces of tubing. At what angle does each piece of trim need to be cut? (See drawing in Lab Teacher Extension.)		An octagon as eight sides 360° ÷ 8 = 45° 45° ÷ 2 = 22.5° Each piece of tubing will be cut on a 22.5° angle
2. Steel kick plates will be installed on a knee wall that is installed at a 45° angle. When cutting the base kick plates, what bevel cut will the horizontal band saw be set at?		a) 22.5° b) 45° c) 90° d) 120° 45° ÷ 2 = 22.5° **Answer = a** The two pieces of kick plate will be cut at a 22.5° bevel; the two pieces of baseboard = 45°.
3. When preparing a 60° V-Groove butt joint, what angle should each piece be beveled at?		a) 22.5° b) 30° c) 90° d) 120° 60° ÷ 2 = 30° **Answer = b** Each piece will be cut at a 30° bevel; the two pieces of the V-Groove = 60°.
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^o b) 45^o c) 90^o d) 120^o 		The correct answer is "a" because a 10^o interior angle turn would very nearly turn a driver back in the direction from which she/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^o. If 90^o is east, in which direction are you traveling?		You are traveling west when your bearing is 270^o. 90^o is East; 180^o is South; 360^o 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.		
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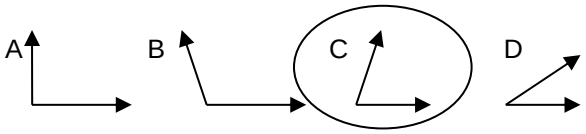
7. What is the angle measure of ∠XYZ? a) 57° b) 63° c) 123° d) 137°		c) 123°
8. Which of the angles on the right is closest to 76°?		
9. Given: a ∥ b, c ∥ d If m∠1 = 2x + 16 and m∠2 = x + 18, then what is the value of x?		Angles 1 and 2 are congruent angles so, $2x + 16 = x + 18$ $x + 16 = 18$ $x = 2$ (Subtract x from each side, then subtract 16 from each side.)