Measuring Angles

4.7A
4.7B
4.7C

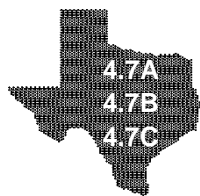**The student is expected to illustrate the measure of an angle as the part of a circle whose center is at the vertex of the angle that is "cut out" by the rays of the angle. Angle measures are limited to whole numbers.**

The student is expected to illustrate degrees as the units used to measure an angle, where 1/360 of any circle is one degree and an angle that "cuts" *n*/360 out of any circle whose center is at the angle's vertex has a measure of *n* degrees. Angle measures are limited to whole numbers.

The student is expected to determine the approximate measures of angles in degrees to the nearest whole number using a protractor.

TELL ME MORE…

An **angle** is for by rotating a ray about its endpoint, which is the **vertex** of the angle. The degree measure of an angle is the amount of rotation between the starting position and the ending position of the ray.
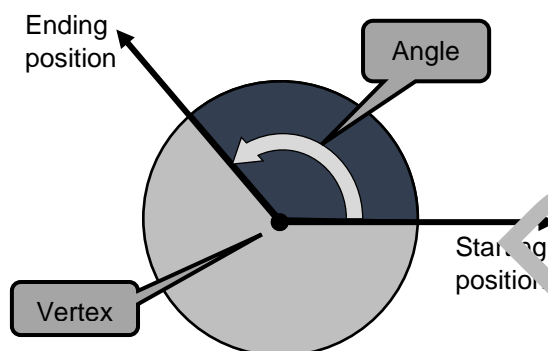

Why 360 Degrees?

We use a base-10 number system where every place value is 10 times the place to its right.

Ancient Babylonians used a base-60 number system where every place value is 60 times the place to its right.

If you draw a hexagon and circle so that their centers line up, the perimeter of the hexagon is 6 times the radius of the circle. 6 × 60 = 360, so Babylonians divided a full circle into 360 degrees. Mathematicians kept this number and we use it today.

You can think of an angle as the part of a full circle that has been cut out of the circle between the two rays, lines, or parts of two lines.

A full circle contains 360 degrees. We use the degree symbol, °, to represent degrees: 360°. 1° is equal to $\frac{1}{360}$ of a full circle. If an angle cuts out one fourth of a circle, then the angle measure is equal to $\frac{1}{4}$ of 360° $\frac{1}{4} = \frac{1 \times 9}{4 \times 90} = \frac{90}{360}$, so this angle measure is 90°.
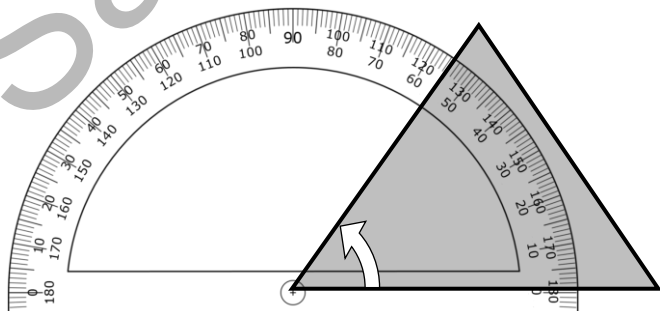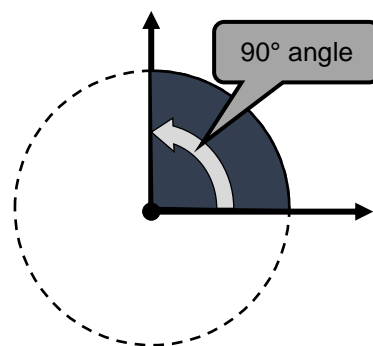
Since an angle is the amount of rotation between two parts of lines, you can use a **protractor**, which is a curved number line, to measure this rotation. The angle of the triangle shown has a measure of 55° since you read up from 0 on the bottom side of the triangle to a line halfway between 50 and 60 for the second side of the triangle.

1

✓ EXAMPLES

Example 1: Use a circle to draw an angle that has a measure of 135°.

Step 1: Draw a circle with a ray whose endpoint is the center of the circle.

Step 2: Determine the part of the full circle represented by a 135° angle.
- A full circle is 360° so a 135° angle is represented by $\frac{135}{360}$ of a circle.
- $\frac{135}{360} = \frac{135 \div 45}{360 \div 45} = \frac{3}{8}$

An angle with a measure of 135° represents $\frac{3}{8}$ of a full circle.

Step 3: Construct a second ray so that it cuts out $\frac{3}{8}$ of the circle you drew in Step 1.
- Break the circle into 8 equal-sized parts.
- Shade 3 of the 8 parts to represent $\frac{3}{8}$ of the circle.
- Draw a ray from the center of the circle (vertex of the angle) along the edge of the third shaded part.
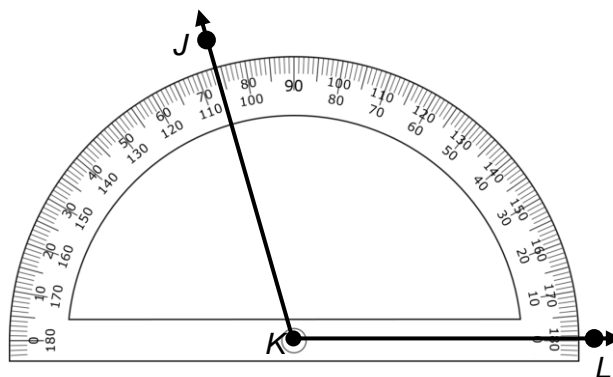
Step 4: Label the angle along the circle.
- $\frac{3}{8}$ of the circle is 135° out of 360°.
- Mark the ray that is the ending point of the rotation as a 135° angle.

135°
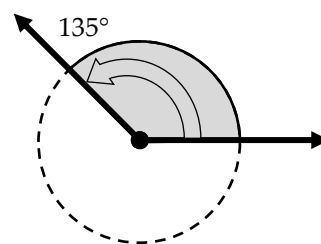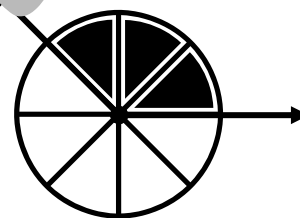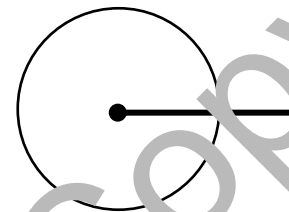
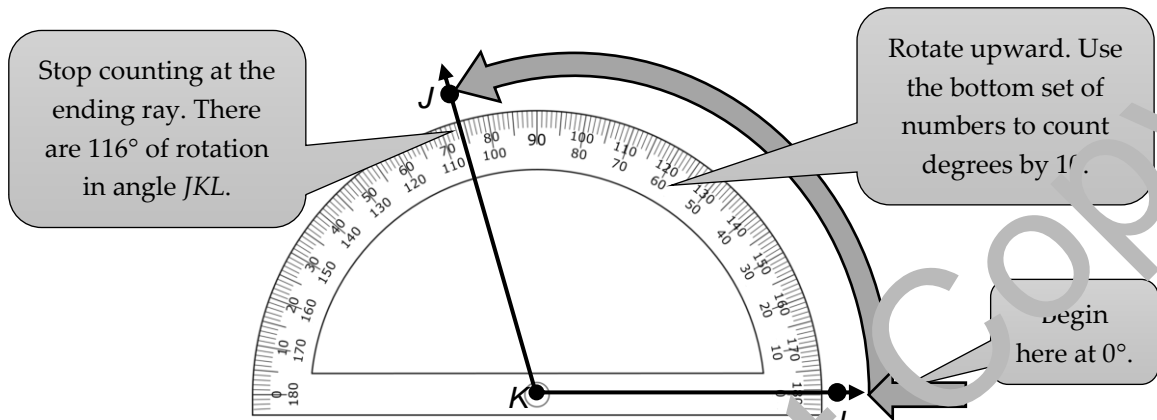**Example 2:** What is the measure of angle *JKL* to the nearest degree?

Step 1: Begin at the ray that is lined up with the baseline of the protractor. The baseline is one of the two lines marked with 0°.
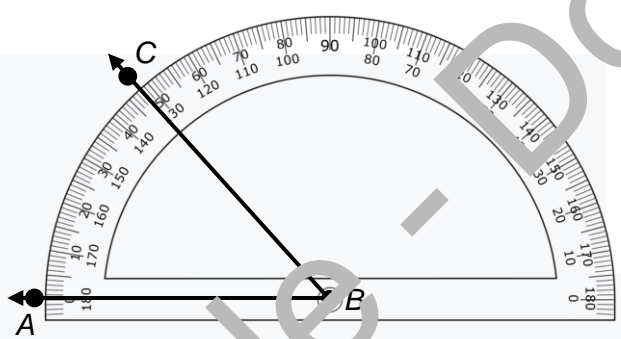
Step 2: Read the angle measure from the protractor.

- Rotate upward along the protractor, counting by 10 degrees, until you reach the ending ray of the angle.

Stop counting at the ending ray. There are 116° of rotation in angle *JKL*.

Rotate upward. Use the bottom set of numbers to count degrees by 10.

Begin here at 0°.

The measure of angle *JKL* is 116°.

You Try It!
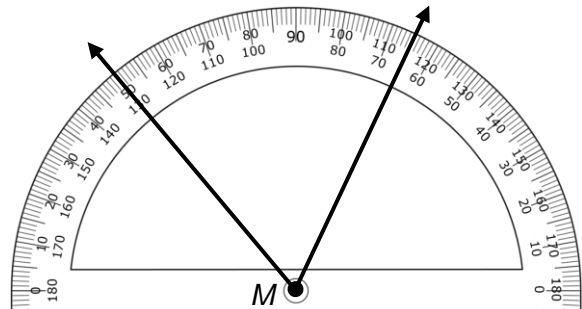
What is the measure of angle *ABC*?

Begin near point *A* at the 0° mark. Rotate upward along the protractor. The measure of angle *ABC* is Circle one:

48°   132°

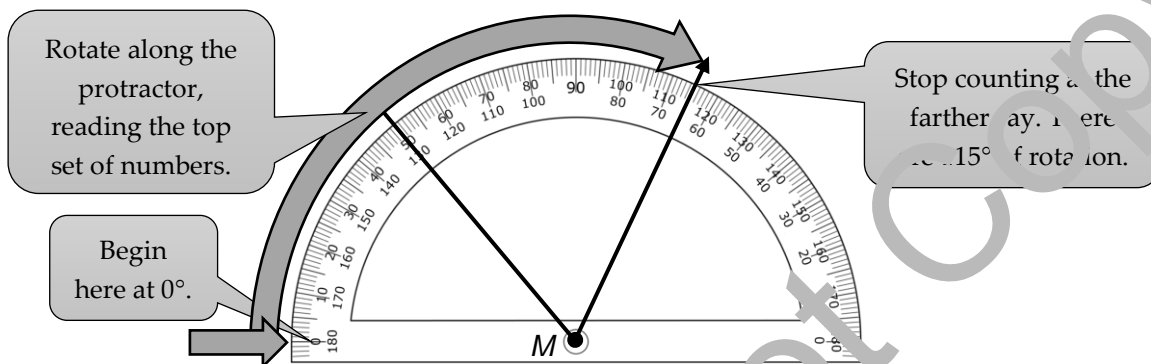**Example 3:** Angle *M* is shown on this protractor. What is the measure of angle *M* to the nearest degree? Explain your thinking.

Measuring Angles

Step 1: Think of the protractor as a curved number line from 0 to 180. Determine the amount of rotation to the farther of the two rays.
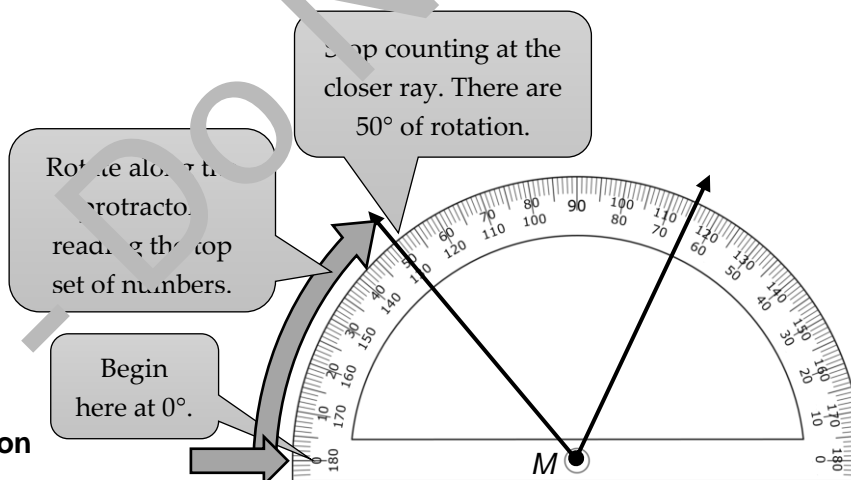- Begin at the 0° mark on the left-hand side.
- Rotate along the protractor until reaching the farther ray.
- Since 0 on the left-hand side is the top of the two numbers, use the top number to read along the protractor.

Rotate along the protractor, reading the top set of numbers.

Stop counting at the farther ray. There are 115° of rotation.

Begin here at 0°.

**There are 115° of rotation to the farther ray.**

Step 2: Determine the amount of rotation to the closer of the two rays.
- Begin at the 0° mark on the left-hand side.
- Rotate along the protractor until reaching the closer ray.

Stop counting at the closer ray. There are 50° of rotation.

Rotate along the protractor, reading the top set of numbers.

Begin here at 0°.

There are 50° of rotation to the closer ray.

Step 3: Use a number line to represent the amount of rotation to either ray.

closer ray

farther ray

0 10 20 30 40 50 60 70 80 90 100 110 120 130 140
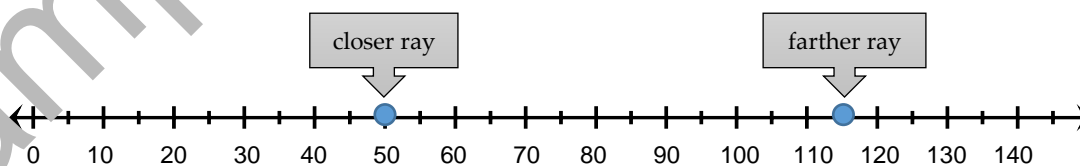
Step 4: Use the number line to determine the measure of angle M.
- Determine the difference between the amount of rotation for the farther ray and the closer ray.
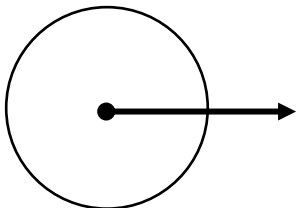- $115 - 50 = 65$

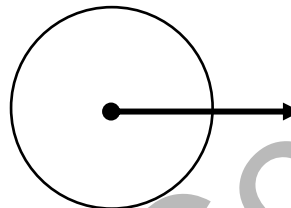**The measure of angle M is 65°, because 115° minus 50° equals 65°.**

4

PRACTICE

For questions 1-4, use a circle to draw an angle with the given measure as the part of a full circle that is cut out by the two rays forming the angle.
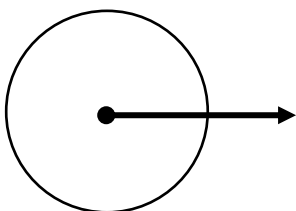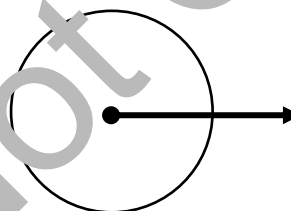
1. 90°

$$\frac{90}{360} = \underline{\quad}$$

3. 45°

$$\frac{}{360} = \underline{\quad}$$
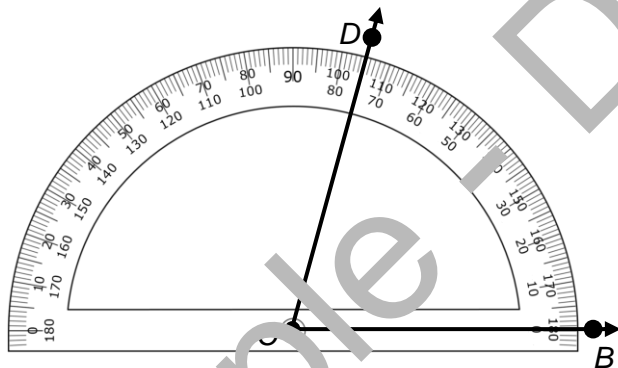
2. 180°

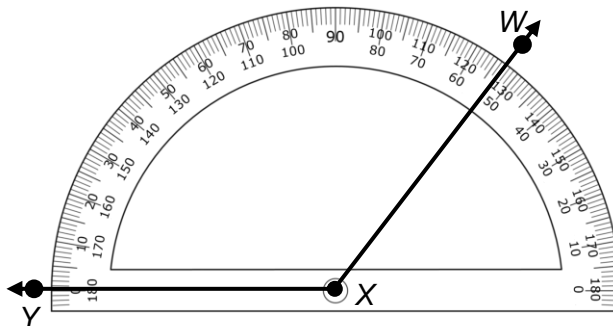$$\frac{180}{360} = \underline{\quad}$$

4. 120°

$$\frac{}{360} = \underline{\quad}$$

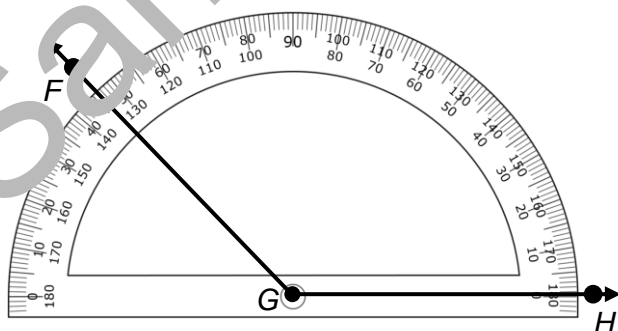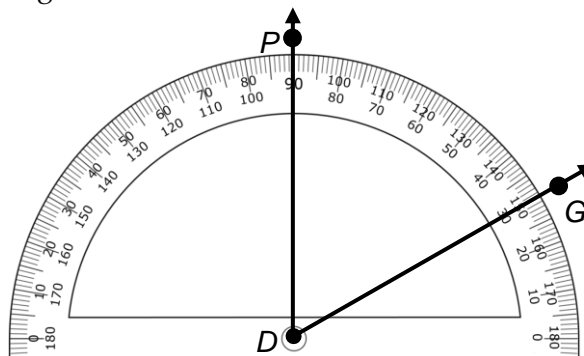*For questions 5-8, determine the measure of the given angle to the nearest degree.*
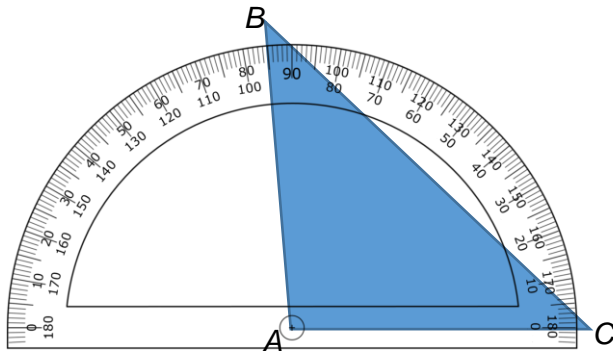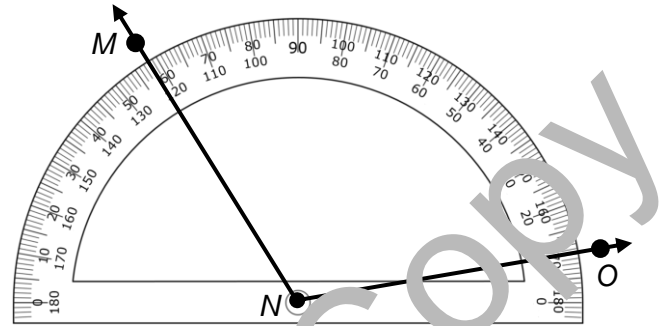
5. Angle *BCD*

7. Angle *WXY*

6. Angle *FGH*

8. Angle *PDG*

9. Triangle *ABC* is shown on the protractor. What is the measure of angle *BAC*?

10. What is the measure of angle *MNO*, shown on the protractor, to the nearest degree?

A 112°, because 122° minus 10° equals 112°.

B 52°, because 62° minus 10° equals 52°.

C 232°, because 62° plus 170° = 232°.

D 48°, because 170° minus 122° = 48°.

11. Which angle does NOT appear to have a measure of 57°?

A

C

B

D