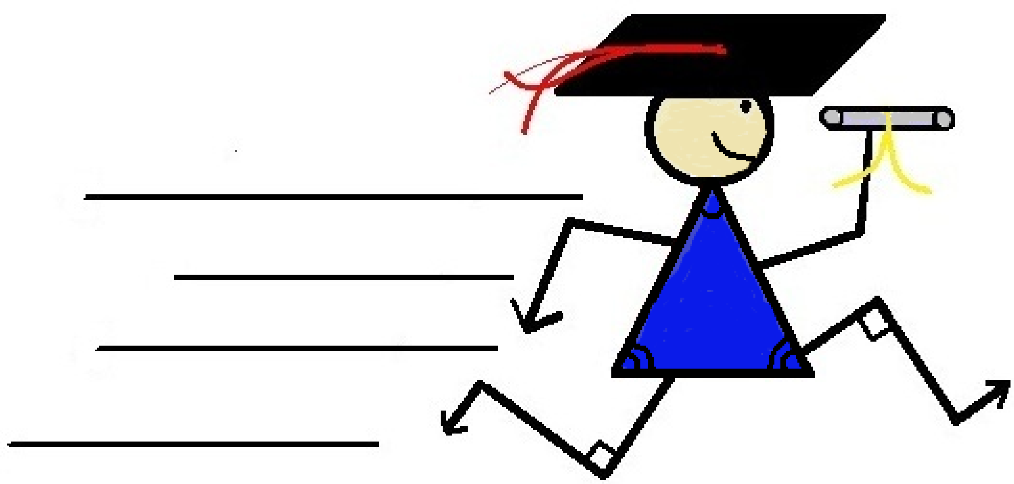
Chapter 1

Lines and Angles



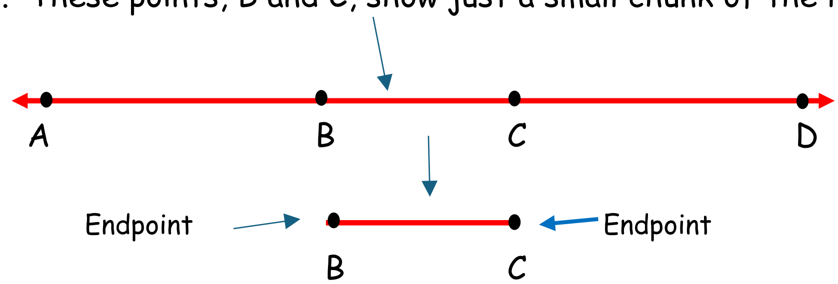
Learn Math Fast

Lesson 1: Lines

Geometry is the study of shapes, angles, and lines. In geometry, a *line* goes on forever with no end. Since we can't draw a line that goes on forever, we put arrows on the end to show that it does. The red line below is called, "line AD."

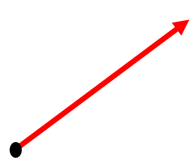
In geometry, it is written $\overleftrightarrow{AD}$ for short. Notice that the little symbol on top of "AD," in the last sentence, is a drawing of a miniature line. You can tell that the drawing above is a "line" because it has arrows on both ends to show that it goes on forever.

Since lines are so long, we usually only talk about one little chunk of a line at a time. In geometry, when you talk about just one small chunk of a line, you mark it with two points, instead of arrows. These points are called *endpoints*, and they create a *line segment*. Below is line AD with some points drawn on it. These points, B and C, show just a small chunk of the line.

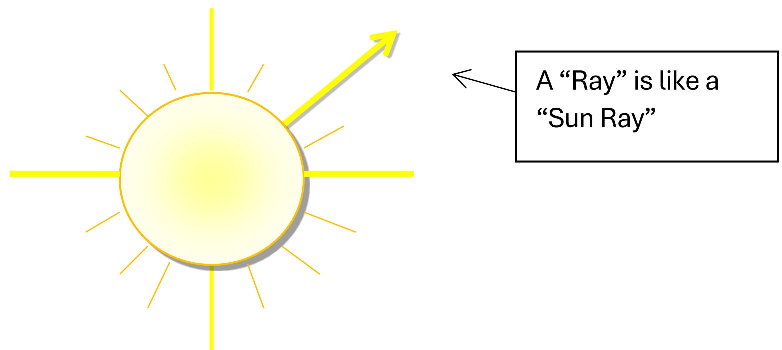


This is called *line segment* BC. To make it shorter, we write $\overline{BC}$ to say, "Line segment BC." Again, the symbol above "BC" is just a miniature line segment. Remember this: a LINE has arrows on the end to show it goes on forever. A LINE SEGMENT has endpoints on the ends to show it is just a chunk.

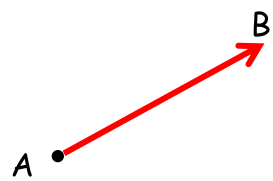
Below, I've drawn another type of line. It is called a *ray*. A *ray* is different from a line or a line segment because it has ONE endpoint and ONE arrow. The arrow goes on forever, but the end has a fixed point called the *endpoint*.



Think of a ray as a "sun ray." The endpoint is attached to the sun, and the arrow is the sun RAY shooting out to the earth.

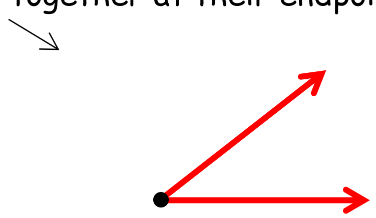


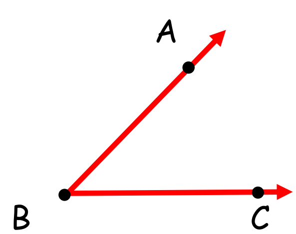
The point that is attached to the sun is called the *endpoint*. The endpoint in ray AB below is called endpoint A.



Ray AB is written $\overrightarrow{AB}$ for short. Notice the symbol above AB. It is a drawing of a miniature ray.

When two rays join together at their endpoints, they can't help but create an *angle*.





The picture above is an *angle*. It is written $\angle ABC$. (Notice the little angle drawn in front of the letters). You can call it angle B for short because that is the letter at the endpoint. When endpoints come together to make an angle, the point where they overlap becomes a *vertex*. Can you name the vertex in the angle above? The vertex of the angle is B.

Let's go over the new geometry words you learned in this lesson. First, you learned that a line goes on forever, so it is drawn with an arrow on both ends. A small piece of that line is called a line segment, and it has an endpoint on both ends. A ray has one of each, an arrow on one end and an endpoint on the other. When two rays join endpoints, they morph and become an angle with a vertex.

Take a quick test to make sure you understand everything so far. Be sure to include arrows in your drawings whenever necessary.

Name: ________________________________ Date: _________________

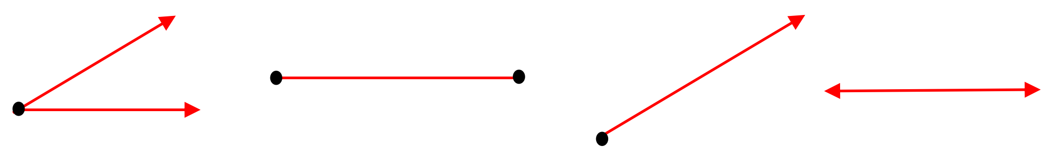
WORKSHEET 4-1

1. Draw a line with two points creating a line segment AB.

2. Draw an angle and label the points as CDE with point D being the vertex.

3. Draw ray KL with K as the endpoint.

4. Name each picture as a line, a line segment, a ray, or an angle.



A. ___________ B. ____________ C.____________ D.___________

5. Using the little symbols we just learned: $\leftrightarrow$, $\rightarrow$, $\overline{}$, and $\angle$, write the short name for each of the following.

   a. Line AB ____________________

   b. Line segment CD ______________

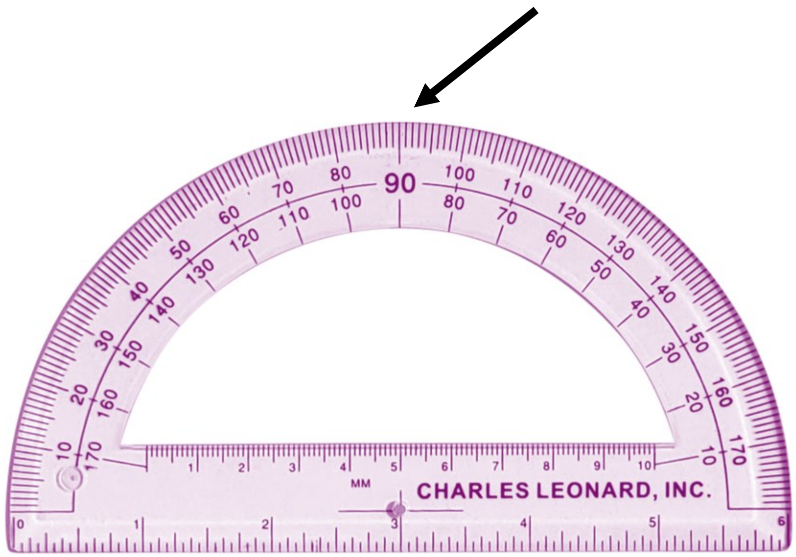
   c. Ray BC _____________________

   d. Angle EFG ___________________

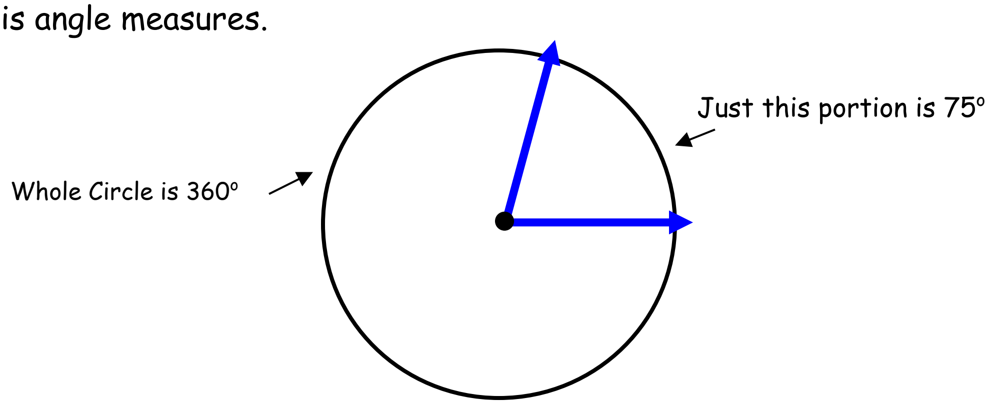
Lesson 2: Angles

If you correctly answered all the problems on the last worksheet, then you are ready to move on. If you got a wrong answer, go back, find out why and then move on.

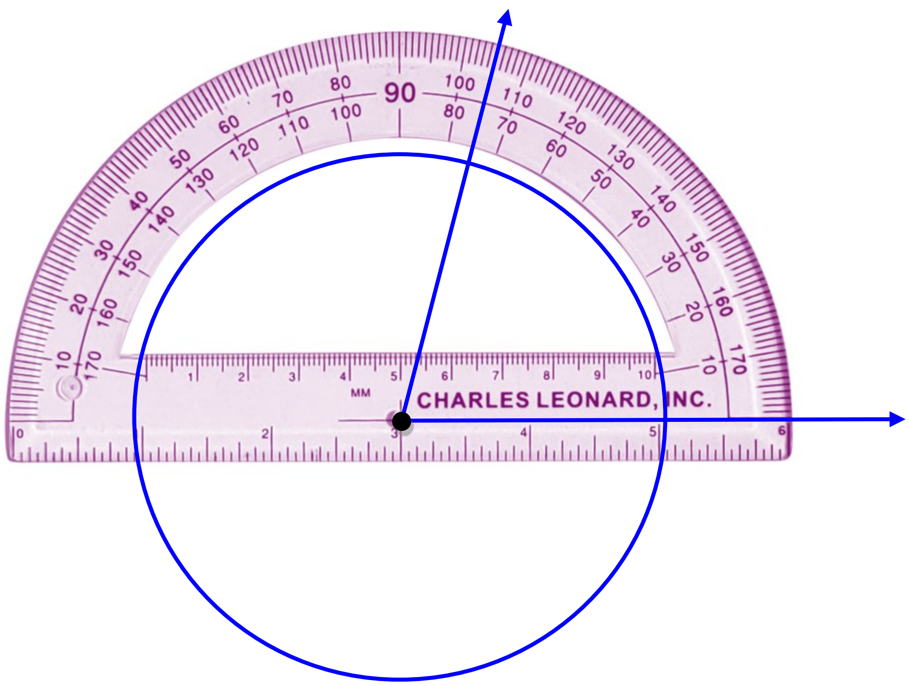
You will need the protractor from the Geometry Kit for this next lesson. If you don't have the Geometry Kit, any other protractor will work. Look at your protractor. The numbers go around the edge from 0 to 180 in both directions. But no matter which direction you go, 90 will always be on top, in the center.



A protractor is a tool we use to measure angles. Angles are measured in *degrees*. Let me explain. Below is a circle with an angle drawn inside of it. The entire circle measures 360 degrees. Our angle below is only 75 of the 360 degrees. A protractor is used to find out exactly how many degrees this angle measures.

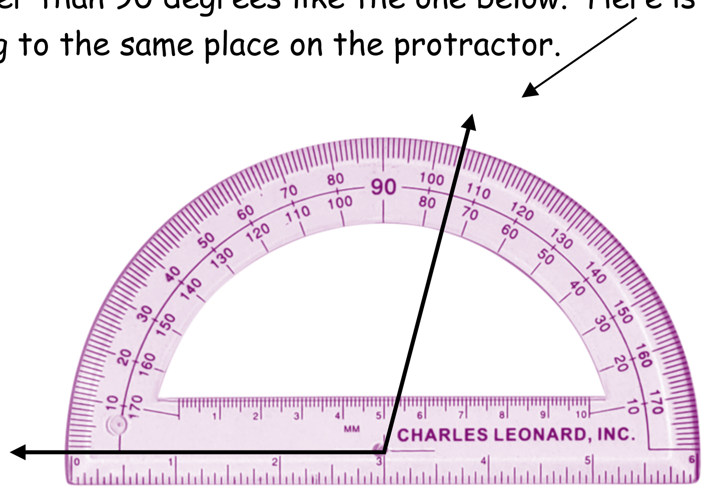


Look at the picture to see how a protractor can measure this angle.

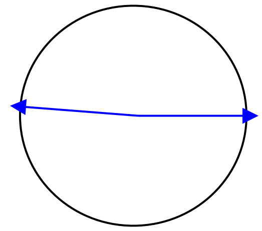


I lined up the bottom ray of the angle with the zero line on the protractor. The vertex is positioned over pinhole in the center of the protractor. Now, count up from zero to find the number that the other ray of the angle is pointing to. This angle measures 75 degrees.

You might think it measures 105 degrees, but that upper row is for angles that are larger than 90 degrees like the one below. Here is a 105-degree angle pointing to the same place on the protractor.



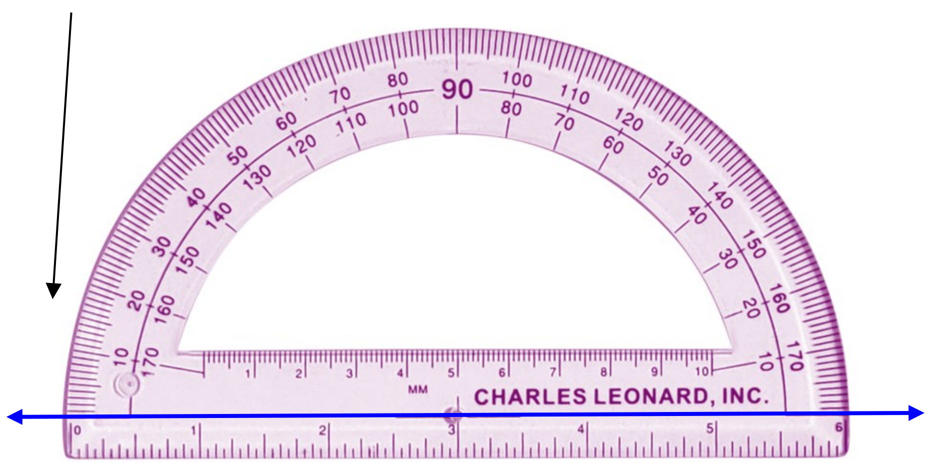
Our protractor is only half of a circle. It measures from 0 to 180 degrees. Below is a picture of an angle that is so big, it is almost the entire half circle. It measures about 179°. It is nearly a straight line.



If this angle gets one degree bigger, it WILL BE a straight line; also called a straight angle. It is hard to tell the difference between a straight line and a straight angle, but technically a straight angle would be 180 degrees and a line…is just a line.

You may have heard someone say, "He made a one-eighty and came right back." Look at your protractor. A completely straight angle, which looks just like a straight line, is 180 degrees. So, if someone were walking with their arm pointing straight out in front of them and then turned around to face the opposite direction, their arm would have made a 180 degree arc; that's why making a "180" is making a complete turn-around.

This line measures 180 degrees.

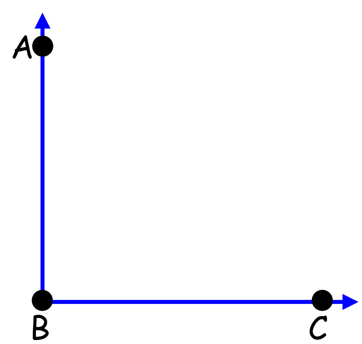


Instead of writing out the word "degrees" every time, you can use a symbol. The symbol for degrees is a little circle drawn towards the top, right side of a number like this, 180°.

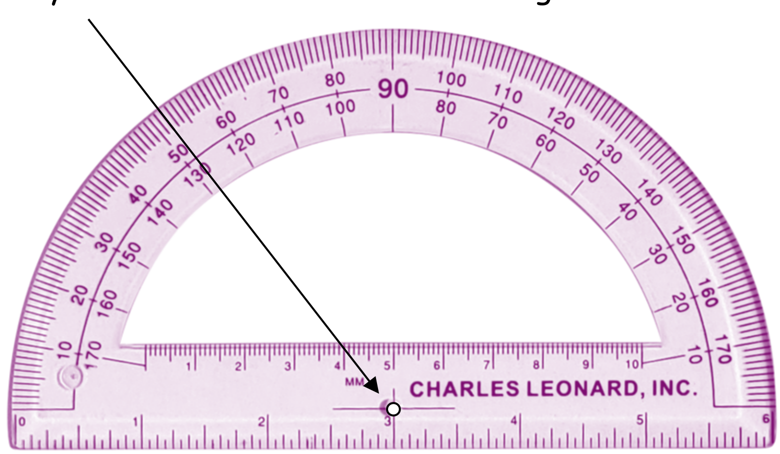
Often times, during a sports competition you'll hear, "He did a three-sixty!" When someone does a "360" on a snowboard, it means he jumped up and made a complete circle before landing. That's because turning in a complete circle is a 360° turn. Look at your protractor again. If you start at zero and spin a half circle, it is 180°. If you keep spinning to make a full circle, you will have gone twice that much or 360 degrees. That's why the symbol for degrees is a little circle above the number. At least I think that's why - it makes sense.

$$360^\circ$$

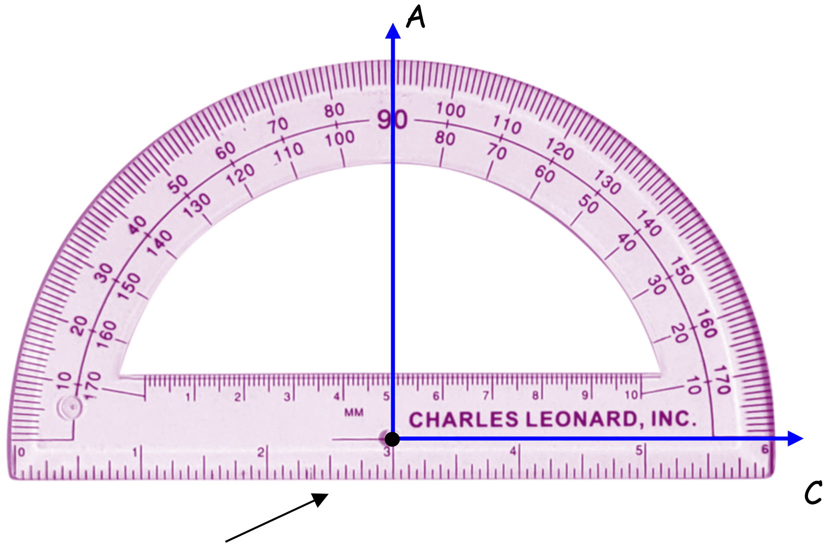
We use a protractor to measure angles in degrees. Below, I have drawn a perfect 90° angle. Find the vertex of this angle.



Now look at your protractor again. Along the flat edge in the very center, you will see a tiny hole. That's where the vertex goes.

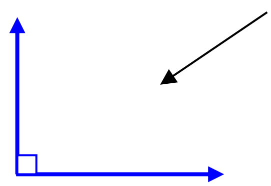


Let me show you what I mean. I will measure the angle from the last page.



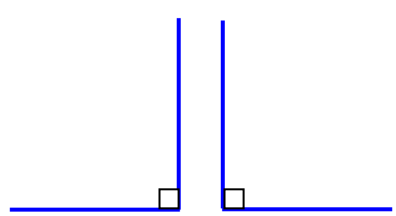
Once you have vertex B lined up with the center hole and ray BC set to equal "zero degrees," you will see that ray BA is pointing to exactly 90°. That's how you know it is a 90° angle. A perfect 90° angle is called a *right angle.*

To show that the angle is exactly 90°, we draw a little box in the corner.

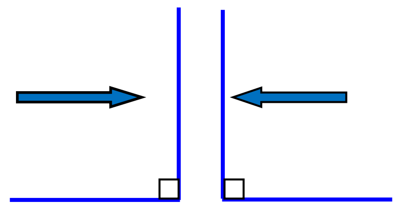


That little box tells us that this angle is not 89°, and it is not 91°. It is exactly 90°, in other words, a right angle. Knowing it is exactly 90° will be helpful later in geometry when we have to try to solve mystery numbers.

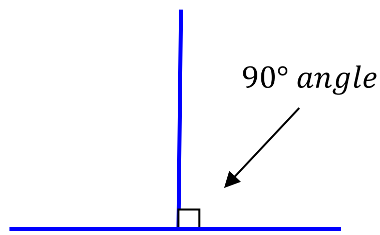
Below are two 90° angles, back-to-back.



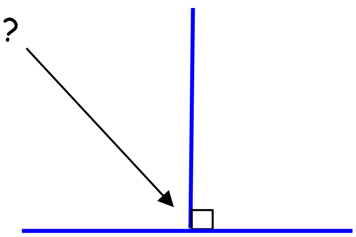
Now let's squish them together.



Now they look like this…



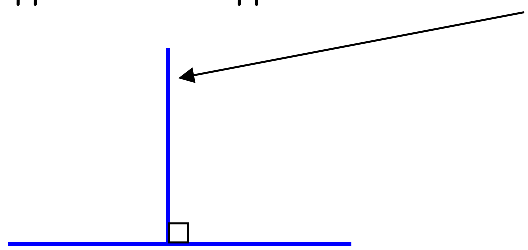
Now we have our first mystery. It is a super easy mystery to solve, but it is still a mystery. What is the measurement of the angle without a box?



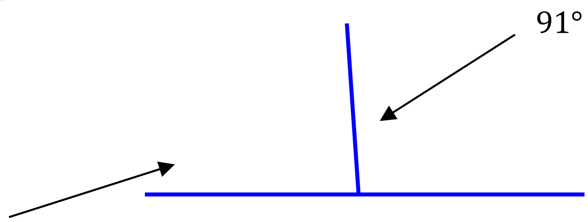
That's simple; you know it measures 90° because we just squished two 90° angles together, but you could have figured it out mathematically. Let me tell you how. Earlier we learned that a straight line is 180°, so whatever angles are on top of a straight line HAVE to equal 180°. If one side is 90°, then the other side must also be 90° because $90 + 90 = 180$.

Most of the geometry questions you will answer will be "find the missing number" type of questions. You will be given a few clues and then you use those clues to figure out the missing number without protractor.

Now what do you suppose would happen if I moved this line over by 1°?



First of all, we would have to remove the little box in the corner because it would no longer be a 90° angle. If I made that angle 1° bigger, it would become a 91° angle.

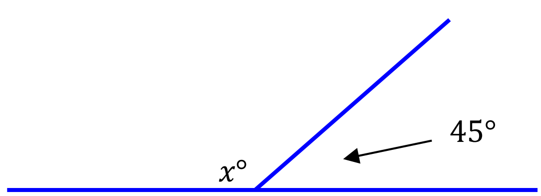


Now, how big is this angle?

When I moved the line over by one degree, it made the angle on the right bigger, but the other angle got one degree smaller, so it must be 89° now.

You can also figure this out mathematically instead of logically. You know that a straight line measures 180°, and you know that one of the angles measures 91°. Do the math 180 – 91 = 89. That proves the angle is 89°.

Now I will move the line even further. Now, try to solve for x. Don't bother using a protractor. In geometry, the pictures aren't always accurate. You are expected to use the information you are given. In this case, the angle measures 45 degrees, so how much is x?



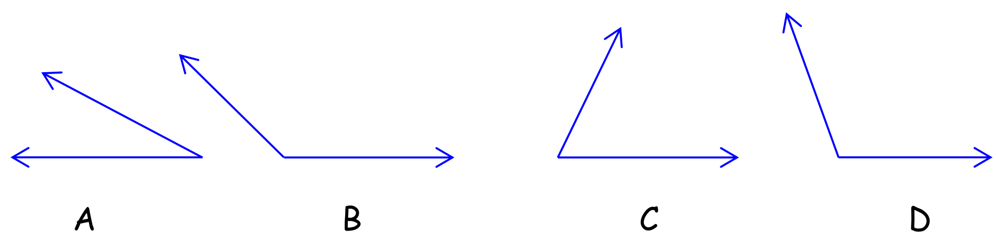
Since a straight line is 180°, we know that the two angles must equal 180. We know one of the angles is 45°, so the other angle must be 135°.

If this seems super easy, you're right, it is. If this sounds complicated, you are over thinking it. Go back and read the last few pages again. This should be as easy as adding two numbers together that equal 180.

Earlier I told you that a 90° angle is called a right angle. Well, here is another geometry fact. Any angle that is smaller than 90° is called an *acute* angle. You can remember this by thinking, "Oh, what *a cute* little angle."

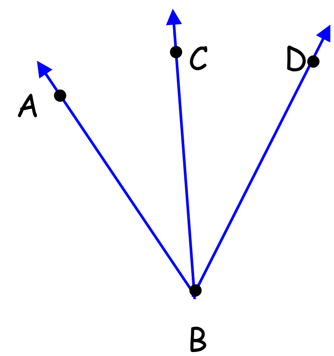
Any angle that is bigger than 90° is called an *obtuse* angle. The 135° angle from the last problem is an obtuse angle, and the 45° angle is an acute angle.

These two words are very important in geometry, so you have to learn them. If you don't know the difference between an acute angle and an obtuse angle, then you don't know geometry. Look at the angles below. Which ones are acute? Which ones are obtuse? Are any of them right angles?



A right angle is such a perfect 90° angle, you can fit a box snuggly in the corner. None of the angles above could comfortably hold a square box in the corner, so none of these are right angles. Angles A and C are smaller than 90°, so they are called acute angles. Angles B and D are larger than 90°, so they are obtuse.

When two angles share one side AND a vertex, they are called *adjacent angles*. Look at the drawing below.



Angles ABC and CBD are *adjacent* angles because they share side, BC, AND they share a vertex.

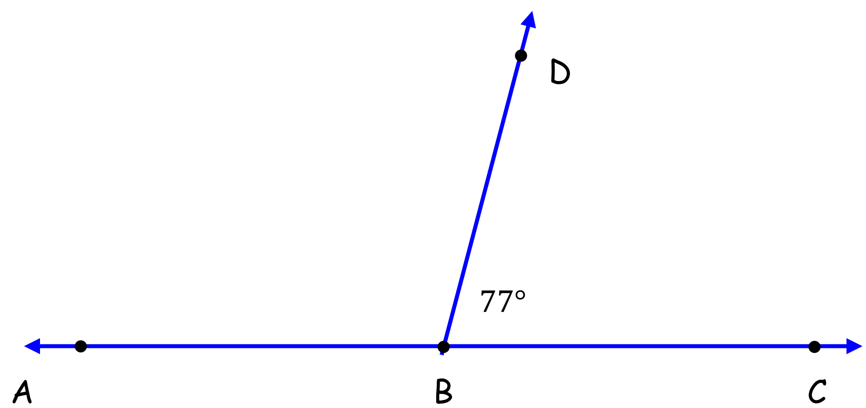
Let's review those last three new words: acute, obtuse, and adjacent angles. An acute angle is smaller than 90°. It's "a cute" little angle. An obtuse angle is bigger than 90°- it's obese. And adjacent angles are right next to each other sharing one side and a vertex.

Get some practice using those new words on the next worksheet.

Name: ________________ Date:____________________

WORKSHEET 4-2

Look at the drawing below and then answer the questions.



1. Is angle ABD obtuse or acute? _____________
2. Is angle DBC obtuse or acute? _____________
3. What is the measurement of angle ABD? _____________
4. What is the measurement of angle DBC? _________
5. Look at angle ABD. Which letter is the vertex? ___________
6. Name the angle that is adjacent to angle DBC. ___________