Reading a protractor

A protractor has the degrees already printed on it. How do you line it up, which of its two rows of numbers do you read, and how do you draw an angle of a given size?

WORDS TO KNOW

Protractor: a half circle with degrees marked from 0 to 180 around its curved edge.

Center mark: the small mark or hole halfway along the base line.

Benchmark: a size you know by heart, used to judge other sizes.

Base line: the line along the straight edge of the protractor.

Inner and outer scale: the two rows of numbers. One starts at 0 on the right end, the other at 0 on the left end.

KEY IDEAS

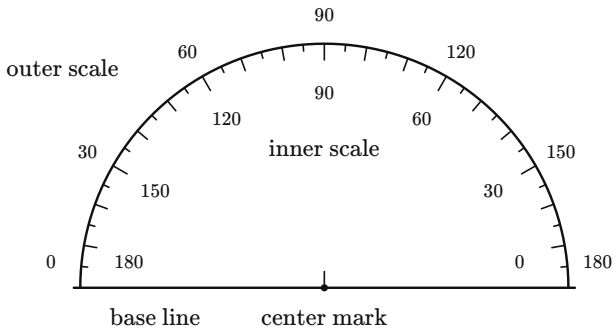
1. Line up two things, then read

Center mark on the vertex. The protractor counts turn about its center mark.

Base line along one arm. That arm is where the turn starts, so it must sit on a 0.

Then read where the other arm crosses the curved edge, on the row whose 0 is on your first arm.

Not every mark has a number. Find what one space is worth before you count spaces.

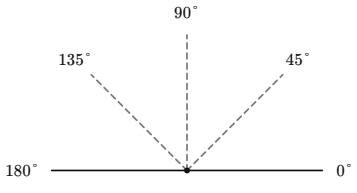


2. The two rows always add to 180

Both rows count the same half turn, from opposite ends. So an arm always crosses at two numbers that add to 180. Put your finger on the 0 under your first arm and follow that same row.

3. Estimate first

90° is a square corner, 45° is half of one, 135° is a square corner and a half, and 180° is a straight line. Narrower than a square corner means less than 90°; wider means more. Since the two numbers add to 180, one is below 90 and one above (unless both are 90), so the estimate picks the right one.



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4. Drawing, short arms and long turns

To draw an angle: draw one arm. Put the center mark on its endpoint and the base line along it. Count up the row whose 0 is on that arm, make a dot at your number, and join it to the endpoint with a ruler.

Arms too short to reach the numbers: make them longer with a ruler, in the same direction. The angle does not change.

A turn the long way around: the protractor stops at 180, so measure the inside angle. The long way is 360° minus the inside angle.

WATCH OUT

- **Read the row whose 0 is on your arm.** Do not just remember "inner" or "outer"; some protractors print the rows the other way.
- **The center mark must sit exactly on the vertex.** Anywhere else, the marks count turn about the wrong point.
- **Extend an arm straight.** Bending or shifting it changes the angle.

WORKED EXAMPLES

Example 1. The center mark is on the vertex, and the first arm runs to the left end of the base line. The other arm crosses the outer row two long marks past the label 150. What is the angle?

1. The first arm runs to the left end. The row with its 0 at the left end is the outer row, so read the outer row.
2. Numbers come every 30, and the long marks between them cut that into 3 spaces of 10.
3. Two long marks past 150: 150 + 10 + 10 = 170.

Answer: 170°. **Check:** the inner row reads 180 − 170 = 10 there, but its 0 is at the right end, where no arm runs. An angle of 170° is between 135° and 180°, almost a straight line.

Example 2. A ray points right. Use a protractor to draw an angle of 110° on it.

1. Put the center mark on the ray's endpoint and the base line along the ray.
2. The ray runs to the right end, where the inner row has its 0. Count up the inner row.
3. Past the label 90, the long marks are 100 and 110: 90 + 10 + 10 = 110. Make a dot there.
4. Lift the protractor and join the endpoint to the dot with a ruler.

Answer: the new arm leans a little past straight up, away from the first ray. **Check:** 110 is between 90 and 135, a bit wider than a square corner.

Example 3. A fan blade turns the long way around from one arm to another. The protractor reads 140° for the inside angle. How far did the blade turn?

1. The inside opening and the long way around together make a full turn, 360°.
2. So the long way is what is left: 360 − 140 = 220.

Answer: the blade turned 220°. **Check:** 220 is more than 180, as a turn the long way must be, and 220 + 140 = 360.

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