1.2 Measurement of Segments and Angles

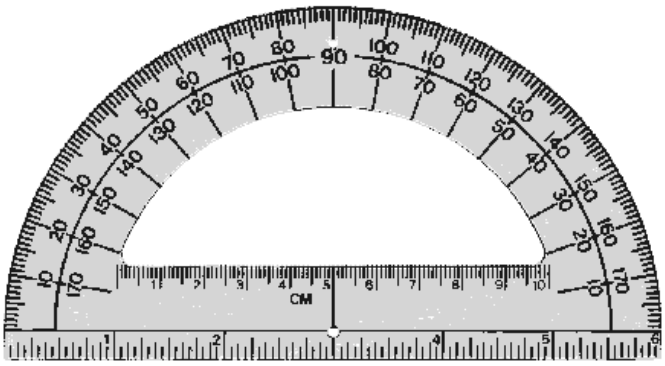
Lesson Objectives – *The purpose of this section is to enable students to correctly measure segments & angles and to understand the concept of congruence. After studying this section, you will be able to:*

- *Measure segments*
- *Measure angles*
- *Classify angles by size*
- *Name the parts of a degree*
- *Recognize congruent angles and segments*

Segments are generally measured using either standard units (inches, feet, yards, etc.) or by metric units (millimeters, centimeters, meters, etc.).

If anyone has difficulty using a ruler, please see me.

Angle* measures** are determined by the ***rotation in degrees between the two rays forming the angle. A protractor is used to measure the rotation. Angles have measures between 0 and 180 degrees. There are angles with measures greater than 180°, called reflex angles; however most of the angles you will encounter will not be of this type.



If you do not know how to use a protractor go the following website and follow the directions
http://www.ex.ac.uk/cimt/mepres/book7/bk7i5/bk7_5i2.htm

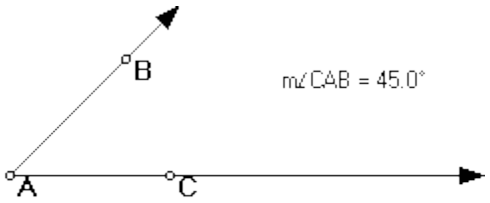
NOTATION:
You will need to know how to **read/use** *the following:*

- $\overline{AB}$, **means segment** AB (has a length)
- $\overleftrightarrow{AB}$, **means line** AB (impossible to measure)
- $\overrightarrow{AB}$, **means ray** AB (impossible to measure)
- AB, means **length of segment** $\overline{AB}$
- $\measuredangle$ symbol for angle
- $\measuredangle s$ symbol for angles
- ^{0} symbol for degrees
- **m** $\measuredangle$ **A** means "the measure of angle A"
- $\cong$ **congruent** $\ncong$ **not congruent**

Classification of Angles

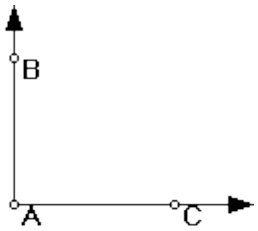
Acute angle - any angle whose measure is *greater than 0º and less than 90º*

Between 0 and 90!



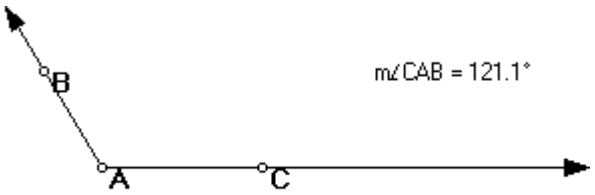
Right Angle – any angle whose measure is <u>exactly</u> 90º

Exactly 90!



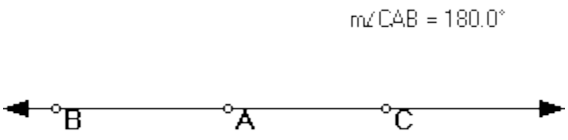
Obtuse Angle – any angle whose measure is *greater than 90º but less than 180º*

Between 90 and 180!



Straight Angle – any angle whose measure is <u>exactly</u> 180º

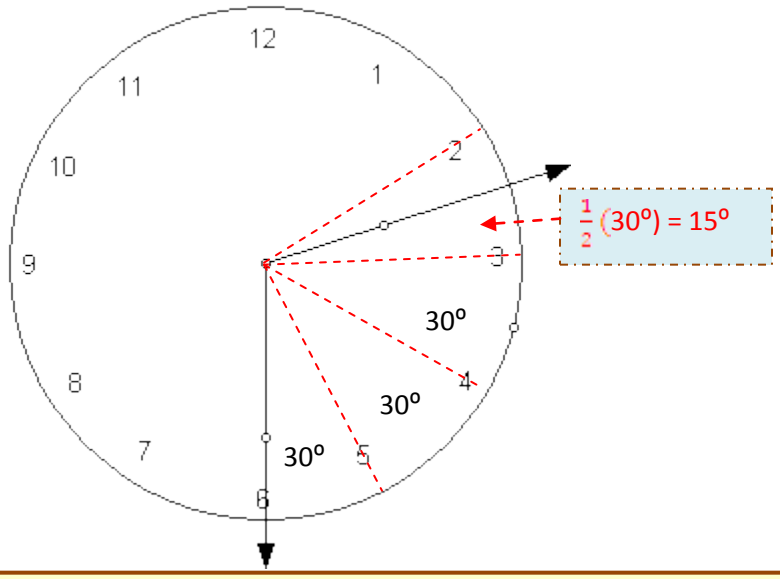
Exactly 180!



Analog Clock Angles (Canadian: "Analogue"): A common type of question that is often asked is to find the measure of the angle formed by the hands of a clock at a certain time of day.

Since there are 12 numbers on the clock, each section located between any two numbers will always have a 30 degree measure. (360º ÷ 12 = 30º)

The problem is that when the minute hand moves, the hour hand is also moving, but at a slower rate, towards the next number. If the time is 2:30, the hour hand will be located exactly halfway between 2 and 3.



By addition: $3(30º) + \frac{1}{2}(30º) = 90º + 15º =$ **105 degrees**

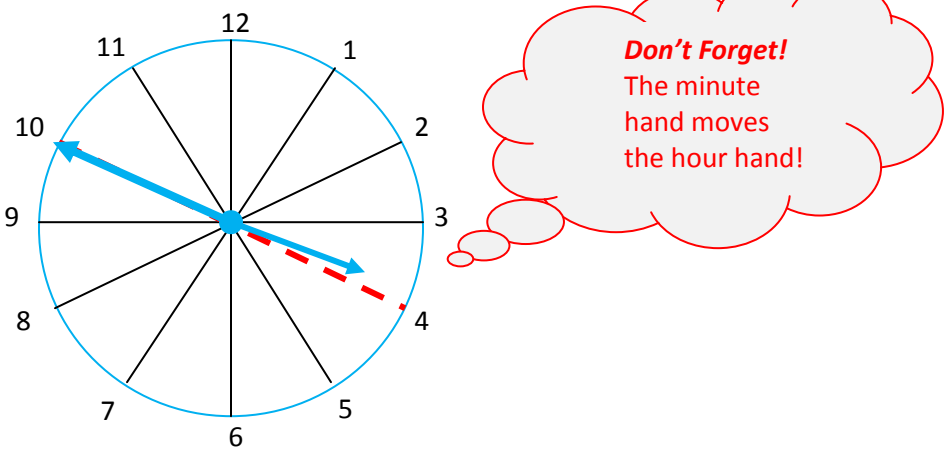
~ or ~

By subtraction: $4(30º) - \frac{1}{2}(30º) = 120º - 15º =$ **105 degrees**

Whatever the fraction of the hour in minutes (in this case 2:30 means $\frac{30\ min}{60\ min}$, or $\frac{1}{2}$), it is then multiplied times the 30 total degrees in the partial section. This determines the number of degrees the hour hand has moved through as it approaches the next (hour) number.

Angles with Analog Clocks Example:

Problem: Find the measure of the angle formed by the hands of a clock at 3:50.



Hmmm… since the minute hand is exactly on the 10 at 3:50, *if only* the hour hand was exactly on the 4 we would have a straight angle!

- The measure of a straight angle is 180 (6 • 30º = 180º!), but we don't quite have that much of the 30º angle between the numbers 3 and 4.
- We almost have all of it -- we have 50 minutes out of 60 minutes, or 5/6 of it!
- We don't have 10 minutes out of 60 minutes of that region, or 1/6 of it!
- I think we will use the subtraction method.
- What is 1/6 of 30º? Answer: 5º.
- So if we subtract what we don't have from a straight angle: 180º - 5º,
- the answer is that there is a 175º angle between the hands of the clock at 3:50!

Changing fractional degrees into minutes and seconds:

If it is necessary to be more accurate than unit degrees, the **fractional parts of a degree (º)** are divided into **minutes (')** and **seconds (")**. A one degree rotation is split into 60 minutes and each minute is split into 60 seconds. These rotations are minuscule when on paper, but when dealing with astronomy or longitude, a fraction of a degree becomes a great distance the further out on the rays you travel. Therefore a system of breaking down the degrees into portions is necessary. To change a fraction of a degree into minutes, multiply the fraction times 60.

$$4\frac{1}{2}\text{ degrees} = 4\text{ degrees} + \frac{30\ min}{60\ min} = 4\text{ degrees, 30 minutes} = 4º\ 30'\ 00"$$

Go to the following site to see a good explanation of changing into degrees minutes and seconds. There is also a converter on the site. Your scientific calculators will also convert.

This site has a good explanation of changing fractions of degrees into minutes and seconds.
http://id.mind.net/~zona/mmts/trigonometryRealms/degMinSec/degMinSec.htm