Engineering GatorTRAX

Projectile Motion Module
Introductory Level

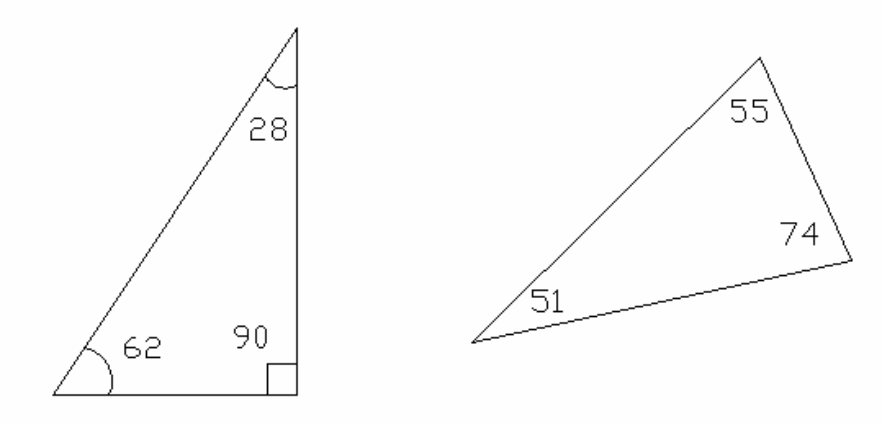
Designed in accordance with Tau Beta Pi MindSET standards
By ***University of Florida Engineering Ambassadors, 2009***

Angles
Definition: A measure of how far one line is rotated off of another line. Angles are measured in degrees or radians. Radians have no units. Going between degrees and radians involves a number called pi that is about equal to 3.14. The formula for the conversion is below. We will work in degrees during most of this lesson

Radians = Degrees x pi / 180

Angles are important to us today for positioning purposes. Our rockets will travel further if they are launched from the good angle. It has been proven that the best angle for today's practices is 45°.

Triangles
Definition: A closed figure with three sides. All triangles have 180° in them when you add up the three angles. The largest angle is always opposite the longest side and the smallest angle is always opposite the smallest side.



Types of Triangles
Right Triangle: a triangle that has one 90°angle in it. Triangles can have no more than one 90° angle.

Acute Triangle: a triangle with every angle less than 90°.

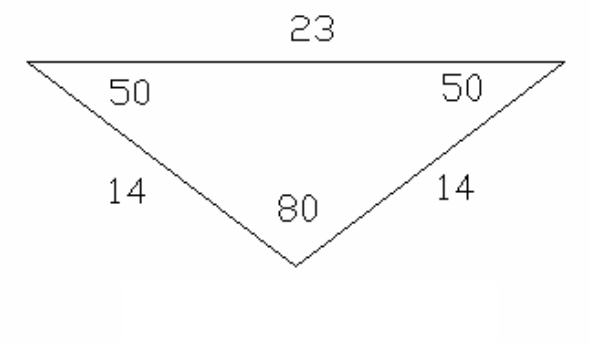
Obtuse Triangle: a triangle that has one angle greater than 90°. The other two angles would then have to be less than 90° when added together.

Scalene Triangle: a triangle that has all three sides not equal to each other in length. They also have three different angles

Equilateral Triangle: a triangle with every side equal to the same length which means every angle is also the same. Each angle will be 60°.

Isosceles Triangle: a triangle with two sides of the same length which means they also have two angles the same (the ones opposite of the two equal sides).

Can you identify what type of triangles are featured below?



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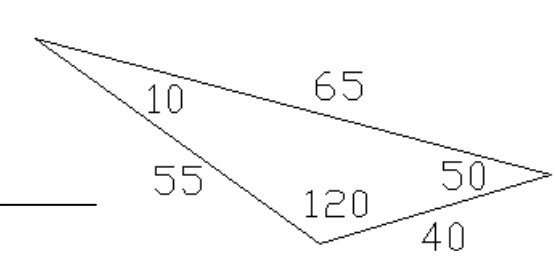

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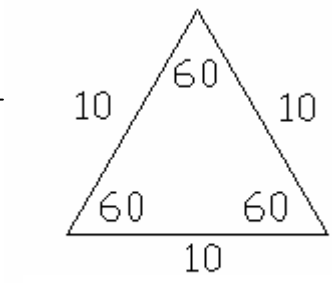

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Fraction: a portion of a number. This is simply a division problem. The fraction bar is the same as a division sign. An example of a fraction is 2/3. The top number is called the numerator and the bottom number is called the denominator. In the example 2/3, 2 is the numerator and 3 is the denominator. A fraction is in its simplest form when the numerator and denominator cannot be divided by a whole number to give two smaller whole numbers. 4/6 is not in the simplest form, because 4 and 6 can be divided by 2 to give 2/3. 2/3 and 4/6 are the same fraction but 2/3 is in the simplest form. You should always simplify your fractions.

Improper fractions have a numerator that is larger then the denominator. When divided out, improper fractions are larger than 1 and proper fractions are less than 1. You should not use improper fractions unless told to do so. You should convert an improper fraction to a mixed number, which is a whole number and a fraction.

Example: 3/4 → Proper Fraction
5/4 → Improper Fraction
1 ¼ → Mixed Number

Can you identify which of these fractions are improper? Circle all improper numbers.

7/12 20/ 3 12/12 15/7 3/5 1/2 9/8

A mixed number is a whole number and a proper fraction together. 5 ¾ is a mixed number. This would be 23/4 if it were an improper fraction. You convert mixed numbers by multiplying the denominator by the whole number and then adding the value you get to the numerator. All of that becomes the numerator for the improper fraction. Keep the same denominator. 4*5=20 and 20+3=23. Put the 23 over the 4 and you have 5 ¾ as an improper fraction of 23/4. To convert 23/4 to the mixed number form, just do 23 divided by 4. 4 goes into 23 5 times so that is the integer value and you have a remainder of 3 so ¾ is the proper fraction in the mixed number.

Find the mixed numbers for the following improper fractions.

8/7 _____ 14/9 _____ 11/6 _____

Decimals: these are a way to write percentages and fractions. It is the fraction divided out. 85% as a decimal is .85. Divide 85 by 100. In fraction form this would be 85/100. Take the decimal number and multiply it by 100 to get the percent.

Percent: A portion of the whole is called a percent. you have a cake with 10 slices and you eat 1 slice, there are 9 slices left. This leaves you with 9/10 of the cake which when multiplied by 100 gives you 90%.

What percentages do these decimals represent?

.87 _____ .35_____ .05 _____

Estimation

Rounding makes numbers that are easier to work with in your head. Rounded numbers are only approximations. An exact answer generally can not be obtained using rounded numbers. Use rounding to get an answer that is close but that does not have to be exact.

How to round numbers Make the numbers that end in 1 through 4 into the next lower number that ends in 0. For example 74 rounded to the nearest ten would be 70. Numbers that end in a digit of 5 or more should be rounded up to the next even ten. The number 88 rounded to the nearest ten would be 90.

Front End Estimation: Front end estimation mostly produces a closer estimate of sums or differences than the answer produced by adding or subtracting rounded numbers.

How to estimate a sum by front end estimation: Add the digits of the two highest place values. Insert zeros for the other place values

Example 1: 4496 + 3745 is estimated to be 8100 by front end estimation (i.e. 4400 + 3700).

Example 2: 4496 + 745 is estimated to be 5100 by front end estimation (i.e. 4400 + 700).

Estimate of a sum by rounding

A quick way to estimate the sum of two numbers is to round each number and then add the rounded numbers. This probably won't be the exact answer but it may be close enough for some purposes.

Round each term that will be added. Add the rounded numbers

An estimate can sometimes be improved. If the sum of 345 + 440 were estimated, we would round 345 to 300 and 440 to 400. The estimate would be 300 + 400 or 700. Both numbers were rounded down. The number 345 was rounded down by 45 and 440 was rounded down by 40. Adding 45 + 40 gives 85, which rounds to 100. Therefore, a better estimate would be 800. The actual sum is 785.

How to Improve the Estimate.

Round each term that will be added. Add the rounded numbers. If both are rounded down or both rounded up see if the amount of rounding is more than 50. If it is, add or subtract 100 to the estimate.. If one number is rounded down and the other is rounded up a closer estimate will not be produced by this method.

Some uses of rounding are:

1. Checking to see if you have enough money to buy what you want.

2. Getting a rough idea of the correct answer to a problem

Significant Figures: In science it is sometimes difficult to include too many decimal places, so many times the answer we need is asked for with a certain number of significant figures. Significant figures of a number are those digits that carry meaning contributing to its precision.
All non-zero digits are considered significant.

Zeros appearing anywhere between two non-zero digits are significant.
For Example: 101.12 has five significant figures: 1, 0, 1, 1 and 2.

Leading zeros are not significant.
For example, 0.00012 has two significant figures: 1 and 2.

Trailing zeros in a number containing a decimal point are significant.
For example, 12.2300 has six significant figures:

How many significant figures are in the following numbers?

0.0134 _____ 1.407_____ 12000 _____

Measurements: There are several different units that can be applied to each aspect of measurement. There are two standardized systems that are used in measuring. The S.I (International Standard) units, also known as metric units, are used worldwide especially in the world of science and engineering, The other system is known as Imperial System and is specific to the United States and not often used worldwide.

Important for us today are units including length, mass, and time.

S.I Units
meter **m** (length)
kilogram **kg** (mass)
second **s** (time)

Length	Mass	Time
1 kilometer= 1000 meters	1 kilogram = 1000 grams	1 hour = 60 minutes
1 meter = 100 centimeters	1 gram = 1000 milligrams	1 minute = 60 seconds
1 centimeter = 10 millimeters	1 kilogram = 1,000,000 grams	1 hour =3600 seconds

Imperial Units
inch **in,** foot **ft** (length)
ounce **oz**, pound **lb** (mass)
second **s** (time)

Length	Mass	Time
1 yard = 3 feet	1 pound = 16 ounces	1 hour = 60 minutes
1 foot = 12 inches		1 minute = 60 seconds
1 yard = 36 inches		1 hour =3600 seconds

Measure the following lines with a ruler (inches) and convert these measurements into Mixed numbers.

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We will use all of these concepts when we launch our rockets. We are going to estimate how far we think our rockets will travel and then measure the actual distances.