Robots

<u>Balloon Equipment Validation</u>

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Per. 1

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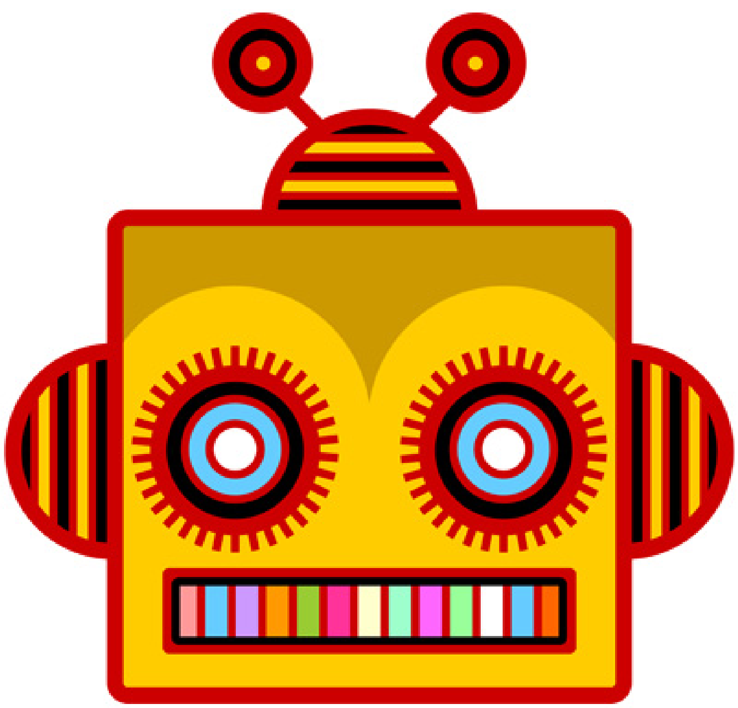
This document is a record of all of our equipment tests that we did to prepare for Balloon Fest. It is a test that all of our equipment works, and it is proof that we know how to use the equipment.



<u>Description Of Experiment:</u>

Because we are sending a helium balloon hundreds of feet into the air, our experiment is used to find the most accurate way of measuring the altitude of the balloon between a laser range finder, barometer and trigonometry with the altitude finder.

<u>Equipment To Be Tested:</u>

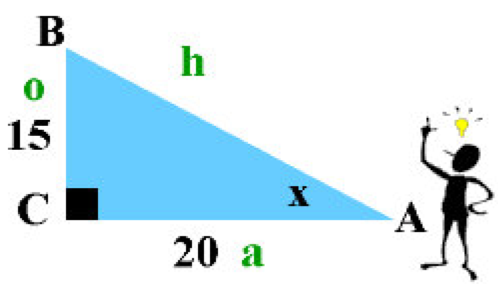
The equipment we will be using is: a barometer connected to a labpro, a Laser Range Finder, and an Altitude Finder to help us use trigonometry to measure the height of the balloon.

<u>Research:</u>

:

$\sin A = \frac{\text{opposite leg}}{\text{hypotenuse}}$	$\cos A = \frac{\text{adjacent leg}}{\text{hypotenuse}}$	$\tan A = \frac{\text{opposite leg}}{\text{adjacent leg}}$

Ex.



$$\tan A = \frac{\text{opposite leg}}{\text{adjacent leg}}$$

$$\tan x = \frac{15}{20}$$

Now, divide 15 by 20 to change the fraction into a decimal.

$$\tan x = 0.75$$

You now need to find an angle whose tangent is 0.75. To do this, use your scientific or graphing calculator. (On the scientific calculator, enter 0.75. You now need to activate the **$\tan^{-1}$** key (it is located above the **tan** key). To activate this **$\tan^{-1}$** key, press **2nd** (or shift) and then the **tan** key. On the graphing calculator, activate the **$\tan^{-1}$** first, and then enter 0.75.)

$x = 36.87 = 37°$ rounding as directed.

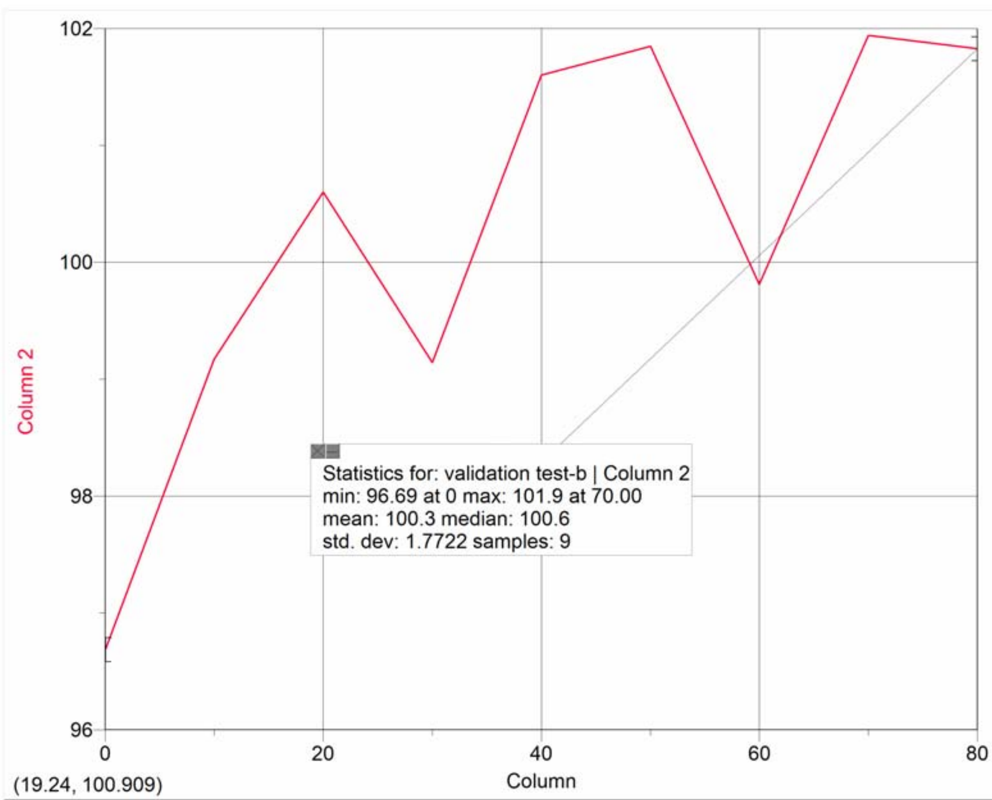
Determining atmospheric pressure: $p = p_0 e^{-\left(h/h_0\right)}$	where: *p = atmospheric pressure (measured in bars)* *h = height (altitude)* p_0 *= is pressure at height h = 0 (surface pressure)* h_0 *= scale height* *Earth:* $p_0 = 1$ and $h_0 = 7$

Test Plan:

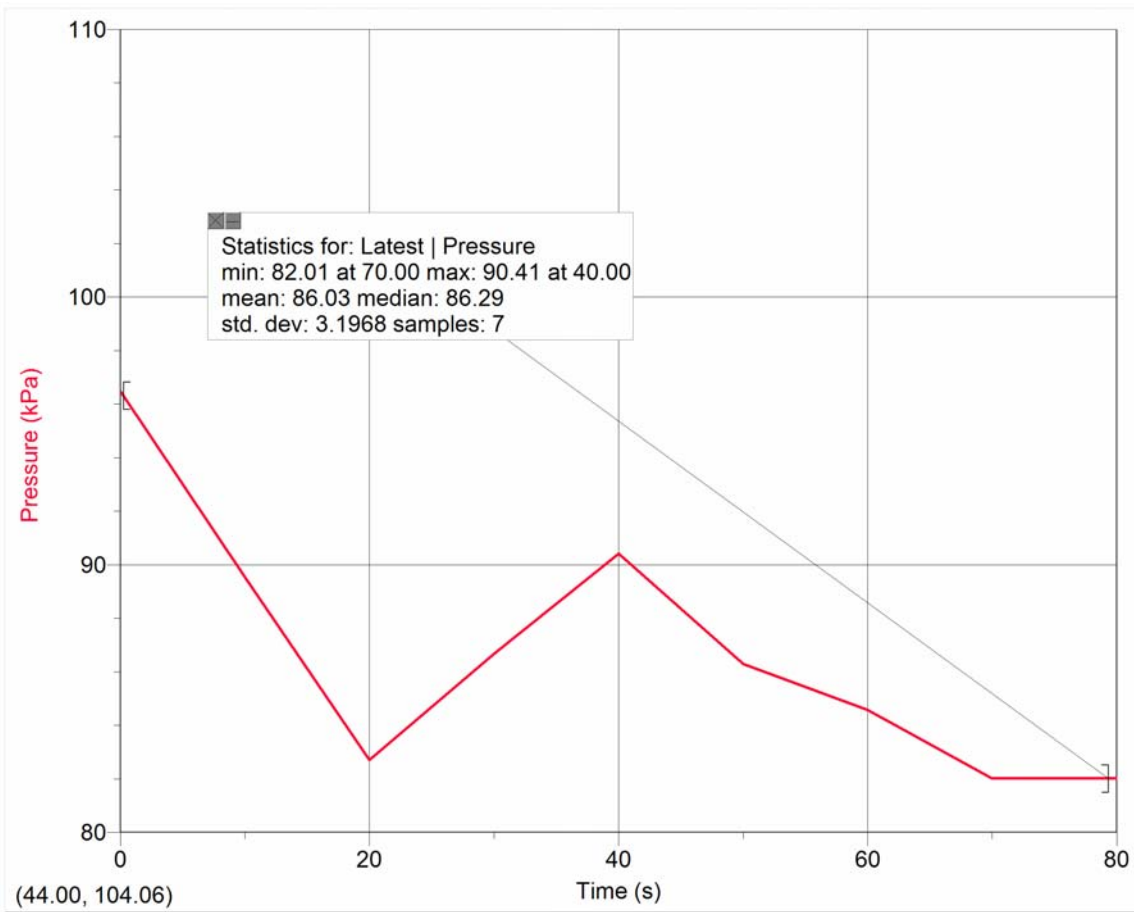
Barometer

In both graphs, a mason jar was hooked up to a one-way valve, which was connected via tube to the barometer. A syringe could be added or removed at any time using the one-way valve, and the pressure inside the jar recorded by the barometer would remain more or less constant.

Test Results:



In the first graph, air was being added to the jar. At zero seconds, the syringe had not been added yet, and the measure was of the average air pressure. From zero to ten seconds, the syringe added air to the jar, thus increasing air pressure. This was the same for ten to twenty seconds. From twenty to thirty seconds, the syringe took a little longer to fill with air, and no air was added. Moreover, there must have been a leak in the apparatus, because the recorded air pressure went down. From thirty to forty seconds, more air was added to the jar. From forty to fifty seconds, the air pressure must have been nearing its maximum, because the amount of increase in air pressure was not as intense as previously. From fifty to sixty seconds, the jar must have leaked again, because the pressure decreased. From sixty to seventy seconds, air was once again added to the jar. Finally, from seventy to eighty seconds, the valve was held as tight as possible to prevent leakage, but some air did leak anyway, because there is a slight decrease in pressure. The **Uncertainty** of the test was about +/- 1.77. the test was not very accurate so we will do another test.



In the second graph, air was being removed from the jar. Again, at zero seconds the air pressure was the average room air pressure. From zero to twenty seconds, while air was being removed from the jar, it was done so steadily and quickly, because the decrease remained pretty much constant. From twenty to forty seconds, the syringe was not doing anything, and some air leaked in, resulting in the increase of air pressure in the jar. From forty to seventy seconds, though it wasn't as constant, there was a decrease in air pressure as air was removed. From seventy to eighty seconds, the pressure remained constant, as no air was removed and none leaked. The **uncertainty** of the graph was +/- 3.19.

Laser Range Finder

To use the laser range finder, the device would simply be pointed at the balloon from a ground point, then it would find the altitude based off of mechanical echolocation. Then the data would be inputted into the laptop, and then we find the answer. To test it out, we chose to point it at an object that is a measured distance away.

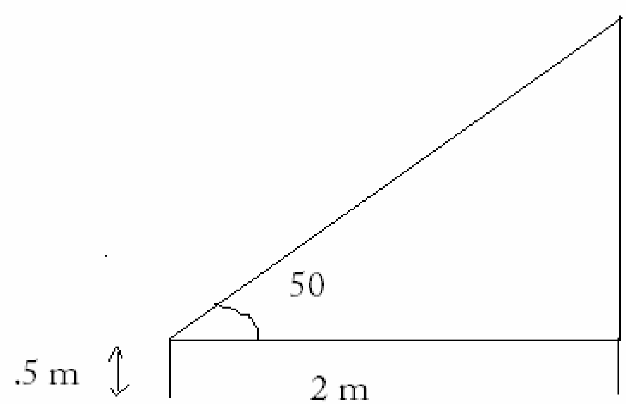
Test 1: We stood exactly 33 meters away from a building and then used the laser range finder to calculate the distance. The laser range finder was accurate and said the building was 33 meters away.

Test 2: We stood exactly 29 meters away from Tiffany (who is much smaller than a building) and then used the laser range finder to calculate the distance. The laser range finder was accurate and said she was exactly 29 meters away.

Trigonometry With Altitude finder

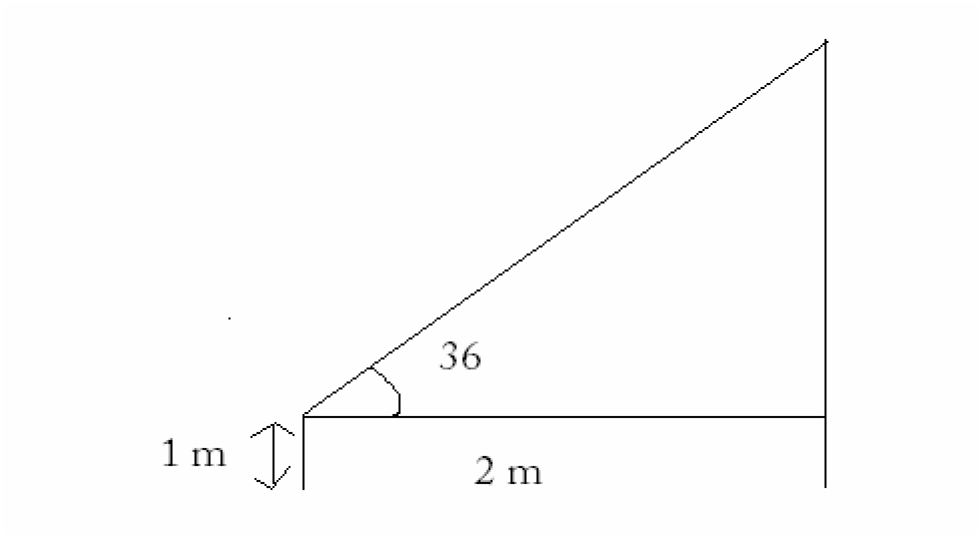
To use trigonometry, we would use the altitude finder to find the angle of the balloon in the air in comparison to the ground. We would then use trigonometry to measure the height of the balloon by using the line length, and the angle formed between the launch station and the balloon, then we would use Sine to measure the balloon's altitude. We can test this by measuring the height of a wall in our class room, that way we can physically measure the height of the wall with a tape measurer and can compare it to our data.

Test 1:



We used 2Tan50=X and got 2.38. when we added .5 m. we got a total of 2.8 meters. The actual height of the wall was 2.82 so this was very accurate.

Test 2:



We used 2Tan36=X and got 1. 78. When we added 1 m we got 2. 78. this was a little less accurate than test 1 but still pretty close.