Lab 4 Report

Introduction:

The purpose of this lab was to use two methods of analysis to establish equilibrium on a force table. The two methods being ~~used~~ used are graphs and ~~a~~ mathematical analysis.

The game is set up where the House hanger is always located at 0°. The rules of the game are as follows:

1. The first die sets the mass added to the House hanger: (50g) × (# of pips)

2. The second die sets the angle of hanger #1: (25°) × (# of pips)

3. The third die sets the ~~mat~~ mass added to hanger #1: (50 g) × (# of pips)

The die is rolled 3 times in total, one time for each rule established. The goal from that point on is to find the location and mass of hanger #2 to ~~create~~ bring the ~~three~~ three hangers to equilibrium.

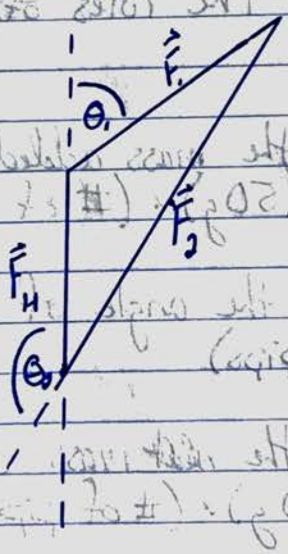
Setup:

Example:

Roll 1: 3 pips
Roll 2: pips 2
Roll 3: 4 pips

$\vec{F}_H = 200_g$ total (150_g added)
$\theta_1 = 50°$
$\vec{F}_1 = 250_g$ total (200_g added)

Graphical:



$\vec{F}_2 \approx$ measure w/ ruler and multiply proportionally

$\theta_2 \approx$ measure w/ protractor

Analytical:

① $m_2 = m_1 \dfrac{\sin\theta_1}{\sin\theta_2}$

② $\tan\theta_2 = \dfrac{\sin\theta_1}{\frac{m_H}{m_1} - \cos\theta_1}$

$$\tan \theta_2 = \frac{\sin(50^\circ)}{\frac{-200g}{250g} - \cos(50^\circ)} = -0.53$$

$$\tan^{-1}(-0.53) = -27.97^\circ$$

$$180^\circ - 27.97^\circ = 152.03^\circ$$

$$m_2 = 250g\left(\frac{\sin(50^\circ)}{\sin(152.03^\circ)}\right) = \boxed{407.93g}$$

Data and Analysis:

In any case, the analytical solution will be more precise than the graphical solution. However, the analytical solution has a more complex problem-solving process.

Taking the setup example; the graphical solution used a ruler and a protractor to illustrate and solve. Using rules of geometry, angles can be calculated from different spots, using different data values to reach them. In the end, the values are a rough estimate of the solution, only as precise as the tools used to calculate them.

On the other hand, the analytical solution required trigonometry rules to be followed. Given that the forces did not create right angles a majority of the times, equations were manipulated to solve for variables one at a time. Misplacing a value or changing a positive to a negative (or vice versa) changed the calculated values completely. θ_2 was always calculated as a negative value because, subtracted from the House hanger, it would direct $\vec{F}_2$ to the correct location. Each time θ_2 was calculated, it was subtracted from 180° and this number was considered θ_2.

In lab a trial had the constraints:

$\vec{F}_H = 150g$
$\vec{F}_1 = 200g$
$\theta_1 = 30°$

The graphical solution was:

$\theta_2 = 103°$
$\vec{F}_2 = 340g$

The analytical solution was:

$\theta_2 = 197°$
$\vec{F}_2 = 390g$

Comparatively, the solutions were not similar enough to have insignificantly different answers. The analytical solution would be considered correct assuming the calculations were done correctly. Error in the graphical solution could be a result of human error or equipment error.

Conclusion:

In summary, the analytical method is more precise than the graphical method. The graphical method is simpler and a better visual representation.

For consistently correct calculations, I prefer to use the analytical method. It's repeatable from person to person and trial to trial.