The document summarizes an experiment to find the resultant force balancing multiple applied forces using vector addition. Students used a force table with masses and strings to apply forces…

Title: Using Slotted Weights and A Force Table to Understand Vectors and How They Act Upon Each Other. Abstract: In this lab report, we are looking at how forces act upon each other, if they can be added together, and how they alter the final force magnitude and direction. What we ended up finding out, is that forces can be added together, but there are certain techniques depending on the direction of the forces. Overall, the implications of the experiment is that the same thing we determined from the force table can also be applied to real life where there are forces acting upon each other everywhere. Introduction: As mentioned above, the results of this experiment matters. The hypothesis is that forces can be added together and you can find the final force on something. That means that you can determine a force being applied on someone or something just by knowing all the smaller forces acting upon it. Although that is quite simple, this is just the basic foundation to much more complicated things in physics. Because of this, you can then go on to calculate all types of forces that help with things you might not even think of, excluding physics. Engineers for example need to understand forces to see if some of their solutions to real life problems are even possible. Materials and methods: Before I begin with the methods of the experiments, I want to mention the equipment needed for the experiment. Obviously a force table with 4 pulleys and pans. The pans are used to stack the slotted weight that we will use in the experiments. There is also a protractor and a ruler to measure anything needed. First off, we were given an equation to calculate tension, which was simply mass multiplied by gravity. After that, the lab wanted us to calculate the sensitivity of the force table. Sensitivity is when you want to see how many more grams you can add to one side while maintaining equilibrium, to potentially see the margin of error you could be receiving on your weight accounts. They wanted us to figure out the sensitivity by adding grams to one side until the equilibrium changed. The next mini experiment the lab wanted us to do was calculate the equilibrant vector. That is fairly simple as the equilibrant is basically the negative resultant. In another mini experiment, we got randomly generated numbers and without doing any analytics or math, we needed to figure out how many grams were needed to balance the system, which was a simple 50 g. We then needed to do a simulation and see the difference in the simulation and what the experiment showed. It was, in our case under the sensitivity. For the next experiment, we needed to figure out the mass needed on the equilibrant to achieve equilibrium while also changing the angle and see how much the mass differs between each. For the final experiment Exp. 4, we generated angles and masses, and needed to find the equilibrant so that when all vectors were added together, we get 0 magnitude. What we did was we calculated the vectors x and y magnitude separately and added each of them , A, B, C, and changed the sign to get the magnitude for D. Results: In the first mini lab, we need to calculate one force, gravity, on an object and are given a formula to do so. Below is the work done to determine the force acting upon the object, creating some amount of tension. Calculations for tension: Tension [N]= m g (mass x gravity) (20 g + 50 g) x 9.81 m/s^2 .07 kg x 9.81 m/s^2 = 0.686 N Direction of Equilibrant= – (Resultant) Resultant= 234 degrees Equilibrant= 234 – 180 = 54 degrees In another mini lab, we wanted to calculate the equilibrant vector, the vector of force that is oppositely equal to the resultant of the forces, but we also wanted to see how it would change as the angle changes. Then we needed to determine a formula to determine the resultant. Below is the table showing the data collected as well as the formula determined. Exp. 3 Table: Angle (°)Mass (g)5 °200 g10 °198 g15 °195 g20 °190 g25 °183 g30 °175 g35 °165 g40 °152 g45 °140 g50 °125 g55 °112 g60 °100 g65 °80 g70 °62 g75 °55 g80 °> 50 g Formula: 200cos(θ) In this lab, we are given 3 different forces at three different angles and are supposed to find the equilibrant. Since they were at various angles, me and my lab partners broke up the forces into linear vectors on the x and y axis so they can easily be added together. Below are the computations. Exp. 4 A x = 0.2 cos (60) = 0.1 A y = 0.2 sin (60) = 0.17 B x = 0.35 sin (5) = -0.03 B y = 0.35 cos (5) = 0.35 C x = 0.2 cos (25) = 0.18 C y = 0.2 cos (25) = 0.085 A x + B x + C x = D x = 0.11 A y + B y + C y = D y = 0.435 Discussion: After looking at the results and the data collected, I see that forces all act upon each other. There aren’t any isolated forces that act on their own. Also, because of the data collected, you can see that changing the forces magnitude or even their angle changed the final force, also called the resultant. One thing that our lab group realized however, is that when we were achieving equilibrium and determining the resultant, it wasn’t completely accurate. The pulleys generate some friction on the string holding the weights. This means that when you add or remove some weight, the equilibrium on the force table might not change whereas it actually isn’t at equilibrium anymore. This does mean that some of our data could be slightly off, however, it doesn’t skew our findings off that much, actually it is very small. Conclusion: All in all, although there are limitations to how accurate experiments can be, all of my groups experiments ended up being successful and being accurate with my hypothesis in the beginning. Because of the experiment, not only do I have a better understanding of how vectors work, but it can also be easily applied to the real world where forces are constantly acting upon each other and you. In the real world, there are so many forces being applied on certain things, and you have to determine it. Here in the experiment, it allowed for a simple and controlled way for people to gain an understanding of how forces act with each other to alter an object. Acknowledgements: I would just like to thank my two lab partners that helped me conduct all the experiments mentioned in this lab report. We all worker together as a team to get the most accurate data, and that’s why I am thankful for their help and addition to the experiment. References: “CCNY Physics Lab.” Force Tables, physicslabs.ccnysites.cuny.edu/labs/207/207-force-tables/forcetables.php. Appendixes: N / A

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