

Name _____ Date _____

Force Table Lab Report

Vector Addition and Resolution

PROCEDURE

I.

A.

5. Experimental Equilibrant, **E**: _____ g N, _____ °6. Predicted Resultant, **R**: _____ g N, _____ °7. Experimental Resultant, **R**: _____ g N, _____ °

B.

1. Graphical Resultant, **R**: _____ g N, _____ °**Figure 2: Graphical Addition; Equilibrant**2. Graphical Equilibrant, **E**: _____ g N, _____ °

3. Draw each of the four vector arrows on Figure 2. Vectors **F₂** and **F₄** should be shown added in their tail to head arrangement. The **E** and **R** vectors should be shown radiating out from the central pin.

Label each vector with its force value in g N units.

4. Take a Screenshot of the force table showing your four force vectors. Make it large enough to include the MT/MR text boxes displaying the mass values. Disable pulley 1 so as to show the system in equilibrium. Save the

figure locally as “FTable_2.png”, print it out, and paste it in the space provided.

5. Describe what we mean by the terms resultant and equilibrant in relation to the forces acting in this experiment?

6. From your figures, which two forces, when added would equal zero?

Circle two F_2 F_4 E R

7. Show this graphical addition in the space to the right. You'll want to offset them a bit since they would otherwise be on top of one another.

8. Create the same arrangement somewhere on the screen on your apparatus. Take a Screenshot, save it locally as “FTable_3.png”, print it out, and paste it in the space provided.

9. What three vectors, when added would equal zero?

Circle three F_2 F_4 E R

10. Show this graphical addition in the space to the right.

11. Create the same arrangement somewhere on the screen on your apparatus. Take a Screenshot, save it locally as “FTable_4.png”, print it out, and paste it in the space provided.

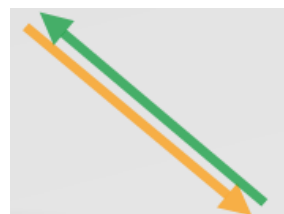


Figure 3: Two Forces Adding to Zero



Figure 4: Three Forces Adding to Zero

12. Vector E should appear in both Figure 3 and Figure 4. Why?

C. Analytical addition with components

8. Add F_{2x} and F_{4x} together.
9. How do these two vectors relate to F_{1x} that is, R_x ?

10. Repeat with the y-components. What similar statement can you make about the y-components?

11. Finally, how is $\mathbf{R}$ related to $\mathbf{R}_x$ and $\mathbf{R}_y$?

12. You've found experimentally and graphically how to add the forces $\mathbf{F}_2$ and $\mathbf{F}_4$ to produce the resultant, $\mathbf{R}$. Now let's try analytical addition. Using the table provided, find the components of $\mathbf{F}_2$ and $\mathbf{F}_4$ and add them to find the components of $\mathbf{R}$. Use these components of $\mathbf{R}$ to determine the magnitude and direction of $\mathbf{R}$. Note that one of the four components will have a negative sign. The components now displayed on the force table should make it clear why.

13. Show **all** your calculations leading to your value for $\mathbf{R}$ below. Remember, a vector has both a magnitude and a direction. A summary of the steps is provided to get you started.

x-Components	y-Components
$F_{2x} = \quad g \text{ N}$	$F_{2y} = \quad g \text{ N}$
$F_{4x} = \quad g \text{ N}$	$F_{4y} = \quad g \text{ N}$
$R_x = \quad g \text{ N}$	$R_y = \quad g \text{ N}$
$\mathbf{R} = \quad g \text{ N}, \quad ^\circ \quad (\text{State your angle between } 0 \text{ and } 360^\circ.)$	

$$F_{2x} = F_2 \cos(\theta_2) = .300 \text{ g N} \cos(\theta_2)$$

$$F_{2y} = F_2 \sin(\theta_4) = .300 \text{ g N} \sin(\theta_4)$$

$$R_x = F_{2x} + F_{4x}$$

$$R_y = F_{2y} + F_{4y}$$

$$R^2 = R_x^2 + R_y^2$$

$$\tan(\theta) = R_y/R_x$$

III. SIMULATION OF A SYMMETRICAL SLACKWIRE PROBLEM.

In Figure 10, Elvira has reached the center of the wire. This is where she would be if she rode a unicycle and just let it take her to the “bottom.” The angle values are just guesses. They’d be between the 10° and 20° we had before, but the actual value would depend on the length of the wire and its elastic properties.



Figure 10: Elvira at the Center of the Slackwire

Without changing the masses used in part II, adjust both angles to 15° .

1. What does the **symmetry** of the figure suggest about how the tensions T_1 , and T_3 should compare?

2. Similarly what can you say about comparative values of the x-components T_{1x} and T_{3x} ? (Ex. Maybe $T_{1x} = 2 \times T_{3x}$?)

3. What can you say about comparative values of the y-components T_{1y} and T_{3y} ?

4. Knowing that the weight being supported is 450 N, what can you say about actual values of the y-components T_{1y} and T_{3y} ?

5. $T_{1y} = T_{3y} = \underline{\hspace{2cm}}$ N

You can now easily calculate T_1 and hence T_3 .

6. $T_1 = T_3 = \underline{\hspace{2cm}}$ N at 15°

Show the calculation of T_1 below.

7. Change each **T** to as close as you can get to this amount. Does this produce equilibrium?

8. With your apparatus, create the two vector arrows to match this amount - one for T_1 and one for T_3 . Add $T_1 + T_3 + W$ graphically. Draw or paste a copy of this graphical addition below.

9. Create the two vector arrows to match this amount - one for T_1 and one for T_3 . Add $T_1 + T_3 + W$ graphically. Draw or paste a copy of this graphical addition in Figure 11.
10. Take a Screenshot, save it locally as “FTable_11.png”, print it out, and paste it in the space provided.

Figure 11: Graphical Addition – Symmetrical 

You'll notice that this figure doesn't differ much from the previous one. The graphical tool we're using is not very precise. The same goes for “the real world.” Measuring the tension in a heavy electrical cable or bridge support cable is very difficult. One good method involves whacking it with a hammer and listening for the note it plays!