Force Table

As you work through the steps in the lab procedure, record your experimental values and the results on this worksheet. Use the exact values you record for your data to make later calculations. For each direction answer enter an angle between 0° and 359° with respect to the force table.

Force Table Lab – Simulation

Open the force table simulation to do this lab.

IA. Addition of Two-Dimensional Vectors – Experimental Addition; the Equilibrant

In this part, you'll add two forces to find their resultant using *experimental addition*, *graphical addition*, and *analytical addition*. The two forces you'll work with are as follows.

$\mathbf{F_2}$ = 0.300 gN at 285°
$\mathbf{F_4}$ = 0.180 gN at 40°

(The notation "0.180 gN" is a shorthand for 0.180 kg×g. So $\mathbf{F_4}$ = 0.180×9.81 N/kg = 1.77 N. *Note: The value(s) given may be different in the WebAssign question.*)

5. Record your experimental equilibrant, $\mathbf{E}$.

6. Using your value of $\mathbf{E}$, record your predicted resultant, $\mathbf{R}$ (the resultant of $\mathbf{F_2}$ and $\mathbf{F_4}$).

7. Record your experimental resultant, **R**.

IB. Addition of Two-Dimensional Vectors – Graphical Addition

2. Record the values for your graphical resultant, **R**.

3. Record the values for your graphical equilibrant, **E**.

4. Upload a file with your vector drawing. (Submit a file with a maximum size of 1 MB. *You will upload this file in the WebAssign question.*)

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? (Select all that apply. *Note: the order of these options may be different in the WebAssign question.*)

- **F₂**

- **F₄**

- **E**

- **R**

7. Upload a file showing your graphical representation of this addition. (Submit a file with a maximum size of 1 MB. *You will upload this file in the WebAssign question.*)

8. What three vectors when added would equal zero? (Select all that apply. *Note: the order of these options may be different in the WebAssign question.*)

- **F₂**

- **F₄**

- **E**

- **R**

9. Upload a file that shows this graphical addition. (Submit a file with a maximum size of 1 MB. *You will upload this file in the WebAssign question.*)

10. Vector **E** should appear in both of these last two cases of the vectors adding to zero. Why?

IC. Addition of Two-Dimensional Vectors – Analytical Addition with Components

8-12. Complete the following table. Remember, a vector has both a magnitude and a direction. (Assume the $+x$ and $+y$ directions correspond to 0° and 90° on the force table, respectively. Indicate the direction with the sign of your answer.)

Table 1

x-components		y-components	
$F_{2x} =$	gN	$F_{2y} =$	gN
$F_{4x} =$	gN	$F_{4y} =$	gN
$R_x =$	gN	$R_y =$	gN
R =	gN, °		

Show *all* your calculations leading to your value for **R** in Table 1.

IIA. Simulation of a Slackwire Problem – Experimental Determination of T_1 and T_3

1. Preliminary prediction: Which tension do you think is greater, $\mathbf{T_1}$ or $\mathbf{T_3}$?

Elvira weighs 600 N. Use this weight in your slackwire problem experiment. (*Note: The value(s) given may be different in the WebAssign question.*)

4. Prediction: Since $\theta_3 = 2 \times \theta_1$, do you think $\mathbf{T_3}$ will be about twice $\mathbf{T_1}$?

7. Record your experimental values for $\mathbf{T_1}$ and $\mathbf{T_3}$.

9. Write a statement about the relationship between the steepness of the rope and the tension in that rope for this vertical arrangement.

IIB. Simulation of a Slackwire Problem – Graphical Check of Your Results

2. Upload a file with your vector drawing of the forces acting on Elvira. (Submit a file with a maximum size of 1 MB. *You will upload this file in the WebAssign question.*)

3. How can we graphically check to see if our values for $\mathbf{T_1}$ and $\mathbf{T_3}$ are reasonably correct? How are $\mathbf{T_1}$, $\mathbf{T_3}$, and $\mathbf{W}$ related? What would happen if any one of them suddenly went away?

Elvira would no longer be in _____ .

6. What about your new figure of the vector addition of $\mathbf{T_1}$, $\mathbf{T_3}$, and $\mathbf{W}$ says (approximately) that the three forces are in equilibrium?

8. Upload a file with your vector drawing of the vector addition of $\mathbf{T_1}$, $\mathbf{T_3}$, and $\mathbf{W}$. (Submit a file with a maximum size of 1 MB. *You will upload this file in the WebAssign question.*)

IIC. Simulation of a Slackwire Problem – Analytical Check of Your Results

1. When you add up the x-components of all three vectors, the sum should be _____ N.

2. When you add up the y-components of all three vectors, the sum should be _____ N.

3. Test your predictions using the following table. Don't forget the direction signs!

Table 2

x-components		y-components	
$F_{1x} =$	N	$F_{1y} =$	N
$F_{3x} =$	N	$F_{3y} =$	N
$W_x =$	N	$W_y =$	N
$\Sigma F_x =$	N	$\Sigma F_y =$	N

Show your calculations below for the eight values in Table 2.

III. Simulation of a Symmetrical Slackwire Problem

Without changing the masses, adjust both angles to 15°.

2. What does the *symmetry* of the figure suggest about how the tensions $\mathbf{T_1}$ and $\mathbf{T_3}$ should compare?

3. Similarly, what can you say about *comparative* values of the x-components, T_{1x} and T_{3x}?

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

5. Knowing that the weight being supported is 600 N, what can you say about *actual* values of the y-components, T_{1y} and T_{3y}? (Enter the exact values. Do not round your answers. *Note: The value(s) given may be different in the WebAssign question.*)

6. You can now easily calculate $\mathbf{T_1}$ and, hence, $\mathbf{T_3}$.

Show the calculation of $\mathbf{T_1}$ below.

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

9. Upload a file with your vector drawing of this vector addition of $\mathbf{T_1}$, $\mathbf{T_3}$, and **W**. (Submit a file with a maximum size of 1 MB. *You will upload this file in the WebAssign question.*)

IV. Vector Subtraction

3. Upload a file with your graphical representation of this vector addition. Label your three vectors $\mathbf{Larry_3}$, $\mathbf{-Darryl_1}$, and $\mathbf{-Darryl_2}$. (Submit a file with a maximum size of 1 MB. *You will upload this file in the WebAssign question.*)

4. Record $\mathbf{Larry_3}$ (graphical).

5. Record $\mathbf{Larry_3}$ (experimental).