

RESOLUTION AND COMPOSITION OF FORCES

Purpose:

To determine if the sum (resultant) of two or three "force" vectors is equal in magnitude to the equilibrant but in the opposite direction. To accomplish this, you will do several different trials.

Procedure:

Setting up the hangers:

1. To set up a "force" vector on the force table, place the white ring over the center post. Spread the four strings out across the table.
2. Then set a pulley at the angle required and gently tighten the long thumbscrew from below the table. Make sure the notch on the pulley frame is set at the chosen number of degrees.
3. Loosen the short pivot thumbscrew on the side of the pulley. Adjust the pulley so that the top of the cutouts in the pulley are level with the top of the pulley frame. Tighten the pivot thumbscrew.
4. Run one of the strings over the pulley wheel. Make sure the white ring is over the center post.
5. Hold the mass hanger with the notched end away from your hand. Take the loose end of the string and place its end halfway between the notch and the base. Hold the end down with your thumb.
6. Now wrap the other section of the string around the top of the hanger and through the notch about 12 times. **DO NOT TIE THE STRING!** Friction will hold it in place.

Trial 1:

7. The answer to this trial is fairly obvious, but do it for the practice.
8. In the first trial you will start with one "force" vector. Set up the force table with one known "force" as follows, or as your physics coach provides (**approximately 180 grams at 78 degrees**).
9. NOTE: The mass given includes the mass of the hanger. The hangers are 50 grams as marked. Put a small piece of masking tape on the side of the hanger. Find the hanger's mass using the electronic balance and record it on the masking tape.
10. RECORD the magnitude and direction for this given "force" vector.
11. The equilibrant is the magnitude ("force" in grams) and direction (angle in degrees) of the "force" vector needed to balance your original "force" vector. The vectors are balanced when the white ring is exactly centered on the center post.
12. Take the opposite free string in your hand and, keeping it low to the table, find the angle and pull needed to center the white ring.
13. Now set a pulley at that angle. Make sure the pulley is set up as mentioned above. Hang your string over it and attached a hanger and enough "force" to make the white ring center on the post.
14. When you are sure the ring is centered, pluck it up a few times to make sure it is in equilibrium. If needed, adjust the angle and/or mass and check the ring again for equilibrium.
15. RECORD both the magnitude and direction of the equilibrant.

Trial 2:

16. In the second trial you will work with two "force" vectors. Set up the force table with two known "forces" as follows, or as your physics coach provides.
approximately 105 grams at 37 degrees
approximately 205 grams at 155 degrees
17. Using the method from trial 1, find both the magnitude and the angle of the single equilibrant "force" which is needed to balance these two forces and center the white ring. RECORD the force and angle.

Trial 3:

18. In the third trial, set up your own problem using two given "forces" and various angles. Do not choose forces and angles such that the answer is obvious. Don't exceed 205 grams at any position. RECORD these two forces and their angles on the data table.
19. Using the method from trial 1, find both the magnitude and the angle of the single equilibrant "force" needed to balance the white ring and RECORD them.

Trial 4:

20. In the fourth trial you will work with three given vectors. Set up the force table with three known "forces" as follows, or choose your own vectors. Don't exceed 205 grams at any position. Again, don't set up an obvious problem. RECORD these magnitudes and angles.
approximately 205 grams at 123 degrees
approximately 105 grams at 247 degrees
approximately 155 grams at 296 degrees

21. Using the method from trial 1, find both the magnitude and the angle of the single equilibrant "force" needed to center the white ring and RECORD them.
22. CALCULATE the magnitude and direction of the equilibrant "force" necessary to establish equilibrium. COMPARE the theoretical and experimental values as directed.

FORCE TABLE LAB (addition of vectors) - DATA and RESULTS

1. EQUILIBRANT OF ONE ASSIGNED "FORCE"

"Force" (g) angle (degrees)

1) _____ , _____ Equilibrant (measured) _____ , _____

2. RESULTANT AND EQUILIBRANT OF TWO ASSIGNED "FORCES"

"Force" (g) angle (degrees)

1) _____ , _____ Equilibrant (measured) _____ , _____

2) _____ , _____ Resultant (calculated) _____ , _____

Resultant (theoretical) _____ , _____

Equilibrant (theoretical) _____ , _____

3. RESULTANT AND EQUILIBRANT OF TWO STUDENT-CHOSEN "FORCES"

"Force" (g) angle (degrees)

1) _____ , _____ Equilibrant (measured) _____ , _____

2) _____ , _____ Resultant (calculated) _____ , _____

Resultant (theoretical) _____ , _____

Equilibrant (theoretical) _____ , _____

4. RESULTANT AND EQUILIBRANT OF THREE STUDENT-CHOSEN "FORCES"

"Force" (g) angle (degrees)

1) _____ , _____ Equilibrant (experimental) _____ , _____

2) _____ , _____ Resultant (experimental) _____ , _____

3) _____ , _____ Resultant (theoretical) _____ , _____

Equilibrant (theoretical) _____ , _____