Class: Physics II, Dates: Lab performed 2/1/2022

Lab 7: Force Equilibrium

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Abstract

1. Objective: Introduction to Statics

2. Introduction:

The force table is equipped with a rim marked in degrees and clamps with adjustable pulleys that can be set at various angles. Masses can be attached to the center ring via cords passing over the pulleys, which apply the gravitational force of the masses to the ring. The pulleys can be moved, and masses changed until the system is in balance (equilibrium), and the angle between pulleys can be directly read from the calibrated table edge. A pin is provided to hold the ring in place while different weight and angle combinations are tested for balance. If the forces are balanced, the ring will be centered around the pin, with small displacements causing oscillation but eventually settling back to the pin's position. The pin can then be removed for larger oscillation testing, and the ring will rest over the pin's position if the system is in equilibrium.

An object is in translational equilibrium when the vector sum of all the forcwa acting on it is zero.

$$F = mg$$

The components F_x and F_y in the x and y directions of the vector F are related to the magnitude F and angleθ by

$$F_x = F\cos\theta$$

$$F_y = F\sin\theta$$

3. Apparatus and Materials: Force table, weights, camera. Fig. 1(a) and 1(b).

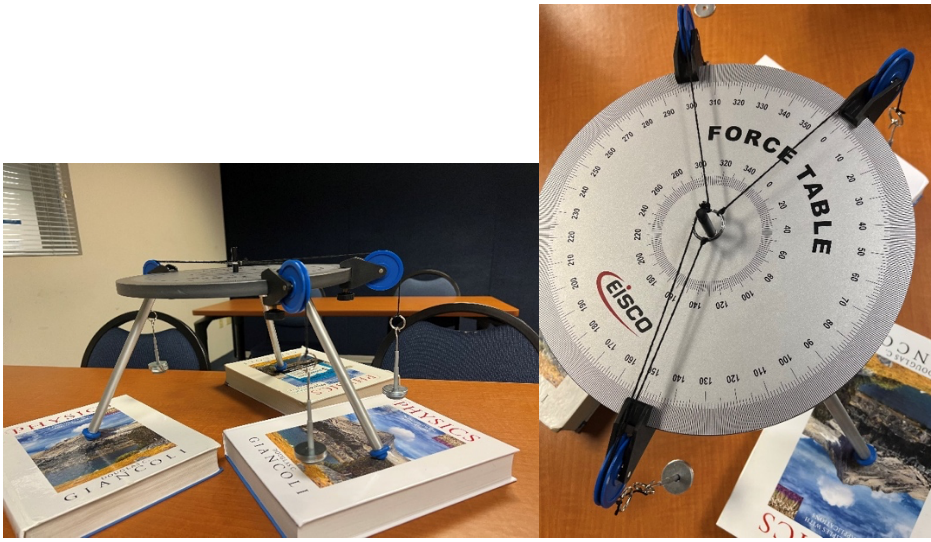

Fig. 1(a) θ=30°

Fig. 2(b) θ=60°

4. Procedure:

For Fig. 1(a). Pin the ring to the center of the table. Place one pulley at 300 degrees. Pass a string and weight hanger over this pulley with a total load of 40 grams. Position a second pulley at 360 degrees and a load of 40 grams. Place a third pulley at 150 degrees with a load of 72grams. This should put the three forces in equilibrium.

For Fig. 2(b). Pin the ring to the center of the table. Place one pulley at 60 degrees. Pass a string and weight hanger over this pulley with a total load of 40 grams.

Position a second pulley at 300 degrees and a load of 40 grams. Place a third pulley at 180 degrees with a load of 80 grams. This should put the three forces in equilibrium.

5. Results & Discussion.

$\theta_1 = 30°$

$\theta_2 = 60°$

n=5=40gr

$F_T = m_3 g$

$m_1 = m_2 = n = 5$

$n_3 = m_3$

$\sum F_x = 0$

$mg \sin 30° - mg \sin 30° = 0$

$\sum F_y = 0$

$m_1 g \cos 30° + m_2 g \cos 30° = F_T$

$n_3 = 2n \cos 30° = 8.7 \approx 9$

$\sum F_x = 0$

$mg \sin 60° - mg \sin 60° = 0$

$\sum F_y = 0$

$m_1 g \cos 60° + m_2 g \cos 60° = F_T$

$n_3 = 2n \cos 60° = 5$

6. Conclusions.

When all the forces that act upon an object balanced, then the object is said to be in a state of equilibrium. The forces are considered to be balanced if the rightward forces are balanced by the leftward forces and the upward forces are balanced by the downward forces. If an object is at equilibrium, then the forces are balanced. Balanced is the key word that is used to describe equilibrium situations. Thus, the net force is zero and the acceleration is also zero.

7. Question.

Can an object be in equilibrium if the sum of all forces is equal zero?

Yes, an object is in equilibrium when the sum of the forces and the momentums (as vectors) are zero and the sum of torque also must be zero.