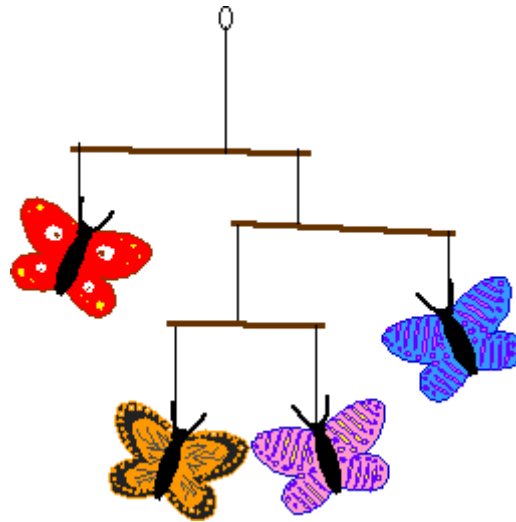




MND Physics

Investigating Statics Building a Zero Net-Torque Mobile



The subject of statics (all forces and all torques in balance) is important because it allows us to study certain forces on or within an object when some of the forces on it are already known. When 2 or more objects are balanced about a point, we say that the net torque is zero, that is, the counterclockwise torque equals the clockwise torque.

In this lab you will build a mobile based on several criteria, the most critical being that all the supporting arms must end up being parallel to the ground (i. e. the net torque is zero for each arm).

EQUIPMENT:

String, 4 wooden rods, spring force scale, and student supplied hanging objects (5 minimum), triple beam balance.

PROCEDURE:

1. First determine a theme for your mobile. The hanging objects must all relate to your theme. Clearly indicate your theme in your report.
2. Select 4 wooden rods from the supply provided.
3. Design a mobile using all 4 wooden rods. Your design must include at least 2 off center rods (2 rods cannot be hung from the center point of the rod)
4. Draw a model of your mobile.
5. Assemble your mobile using your themed objects (5 objects minimum). Make sure that all rods in your finished mobile are parallel to the ground.
6. Calculate the clockwise and counter-clockwise torque for any 2 rods of your mobile showing all your work on your drawing. You may use the triple beam balance to calculate the weight of your objects. Record your data in a table.

For each of your hanging rods, the following must be true:

$$\tau_{CW} = \text{Weight of object(s)} \times \text{lever arm 1}$$

$$\tau_{CCW} = \text{Weight of object(s)} \times \text{lever arm2}$$

DATA

TORQUE DATA:

Trial	Net Force Left Side (N)	Lever Arm Distance (m)	τ_{CCW} Counter Clockwise Torque (Nm)	Net Force Right Side (N)	Lever Arm Distance (m)	τ_{CW} Clockwise Torque (Nm)
Rod 1						
Rod 2						

ANALYSIS:

- Since all parts of the mobile are in equilibrium, the clockwise torque should equal the counter-clockwise torque for each rod. Perform an error calculation as follows:

$$\% \text{ difference} = \frac{|\text{counter-clockwise torque} - \text{clockwise torque}|}{\text{counter-clockwise torque}} \times 100\%$$

- Since the system is in equilibrium, prove that all forces upward equal all forces downward. Use a spring force scale for this part.
- Discuss all possible sources of error.

QUESTION:

1. Two children, a boy and a girl, are sitting on a balanced teeter-tauter. The child on the left hand side is 3.00 m from the pivot point and has a mass of 40.0 kg. The child on the right hand side is 5.91 m from the first child. What is the child's mass on the right hand side? The boy is heavier than the girl. Which side is the girl on, left or right?