Equilibrium

Olympic College Phys 110

# Overview

In this lab, you’ll use a simulation to investigate torque and equilibrium. The simulation can be found at <https://phet.colorado.edu/en/simulation/balancing-act>. It is written in html5 so it will run in your web browser.

## Data and calculations

In the tables below, you’ll record both data and calculations. The mass and distance (from the center of the balance beam) you will determine directly from the simulation. The force is the weight of the object you place on the balance beam. The torque is the force times the distance; you’ll also need to include a + or - sign to indicate direction. Remember, for torque direction is based on rotation: - A torque is positive if it would cause counterclockwise rotation - A torque is negative if it would cause clockwise rotation.

# Procedure

Open the simulation and click on the “Balance Lab” tile. Play around a bit and familiarize yourself with how the simulation works. Then perform the following tests:

1. Place a stack of bricks at some point on the beam; place an equal mass at the correct location to make the beam balance.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Mass (kg) | Force (N) | Distance (m) | Torque (N.m) |
| Stack 1 |  |  |  |  |
| Stack 2 |  |  |  |  |

1. Place a stack of bricks at some point on the beam; place a *different* mass at the correct location to make the beam balance.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Mass (kg) | Force (N) | Distance (m) | Torque (N.m) |
| Stack 1 |  |  |  |  |
| Stack 2 |  |  |  |  |

1. Place two stacks of bricks at different points on the beam; place a third stack at the correct location to make the beam balance.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Mass (kg) | Force (N) | Distance (m) | Torque (N.m) |
| Stack 1 |  |  |  |  |
| Stack 2 |  |  |  |  |
| Stack 3 |  |  |  |  |

1. Place a mystery object (click the purple arrows by the bricks to get to the mystery objects) on the beam; place one or more stacks of bricks at the correct location(s) to make the beam balance.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Mass (kg) | Force (N) | Distance (m) | Torque (N.m) |
| Mystery object | (unknown) | (unknown) |  | (unknown) |
| Stack 2 |  |  |  |  |
| Stack 3 |  |  |  |  |

*You are not required to use 2 stacks for this; you may use as many or few as you need; edit the data table accordingly.*

# Questions

1. For the beam to balance, what must be true about the torque exerted on the beam?
2. Determine the mass of the mystery object you used above. Show all your work in the space below.
3. Why did you not need to include the mass of the beam in your calculations?
4. Look up images of a “balancing bird” toy. In your own words, explain how it balances.

# Just for fun

If you have time, try this: take two forks and a toothpick or match. Interleave the tines of the fork and stick the toothpick between them so that it’s sticking straight out. Balance this on the rim of a glass. Attach a picture if you get it to work! Once you get the hang of it, it makes a fun bar trick.

