Lab 3.2

Balancing Torque

Submitted To: Mr. Lista
Submitted By: Katie DeCaria
Julija Simonelis
Melanie Yeung
Matt Wiechec
Date Due: Oct. 31, 2002
Course: SPH 4UI

Lab 3.2
Balancing Torque

Problem: To examine the second condition for static equilibrium: the balance of torques.

Hypothesis: The sum of the vector torques will equal zero.

Apparatus: Force table or peg force board
Metre stick with hole drilled in centre
Newton spring scales
Masses (with hangars)
String
Pulleys (mounted on pegboard)

Procedure:

1. The metre stick was placed onto a peg on the pegboard such that it is horizontally balanced but can freely rotate.

Part A: Force at 90^0

2. A 153.5g mass (m_1) was placed at the 10-cm mark at the left end of the metre stick. A 295g mass (m_2) was hung on the opposite end of the metre stick such that the metre stick was balanced horizontally. All masses, angles and positions were recorded in a data table in our notebook.
3. Another 153.5g mass, m_3, was placed at the 30-cm mark on the left side of the metre stick, beside m_1. The second mass m_2 was moved to the right along the metre stick was balanced. All masses, angles and positions of all three masses were recorded in a data table in our notebook.

Part B: Forces at an Angle

4. The metre stick was held and a peg with pulley was placed into the board two spaces to the left of the string from m_1 below the metre stick.. The string was grasped from mass m_1 and was draped over the ped.
5. Before releasing the metre stick, m_2 was draped over a peg in a similar way that m_1 was draped but towards the right of the apparatus. The third mass, m_3, was slid back and forth until the metre stick was balanced when released.
6. All masses, angles and positions from the pivot were recorded in a data table in our notebook.

Observation:

Table 1

Masses (kg)			Angles			Distance from pivot (m)			Torques (N·m)			Sum of all torques (N·m)
m_1(g)	m_2(g)	m_3(g)	Θ_1	Θ_2	Θ_3	r_1	r_2	r_3	τ_1	τ_2	τ_3	τ_{total}
Part A: Forces at 90^0												
153.5	295	---	90^0	90^0	---	-0.01	0.005	---	-15	14.6	---	-0.4
153.5	295	153.5	90^0	90^0	90^0	-0.01	0.021	-0.03	-15	60	-45	-0.1
Part B: Forces at an Angle												
153.5	295	153.5	16^0	13^0	90^0	-0.32	0.23	-0.01	-132	149	-15	2

Discussion Question:

1. The sum of all the torques is approximately zero, considering all the uncertainties. Some discrepancies would be due tp the fact that our masses are not precise. Human error with calculating and measuring exact angles and distances from the pivot. Also, the peg and the metre stick may not have been level due to the instability of the peg.
2. The friction in the pivot would affect the result because the meter stick could not freely rotate. Friction can cause a slight change in the balancing of the torque.

Conclusion:

The results of our lab prove the second condition for static equilibrium. The sum of all the vector torques equals approximately zero, considering all uncertainties.

$$\vec{\tau}_{net} = \vec{\tau}_1 + \vec{\tau}_2 + \vec{\tau}_3 + \ldots + \vec{\tau}_n \doteq 0$$