Equilibrium: force table

Science, Physics

Abstract Equilibrium is the condition of a system in which competing influences are balanced. In the experiment we measured and experimented for the equilibrant force, conditions and center of gravity. Our results showed consideration as to disregarding other forces than weight and tension. 1. Introduction Equilibrium is a state of balance in which it is a condition where there is no change in the state of motion of a body. Equilibrium may be observed on objects which are at rest and also to objects which are moving at a constant velocity. Two conditions for equilibrium are that the net force acting on the object is zero, and the net torque acting on the object is zero. In the experiment done, conditions for equilibrium are observed. Equilibrant forces were determined using the force table and component methods. The unknown forces were also determined using the first and second conditions for equilibrium. Another part of the experiment was to locate the center of gravity of a composite body and to determine rotational equilibrium. 2. Theory An object at equilibrium has none influences to cause it to move, either in translation or rotation. The basic conditions for equilibrium are: The conditions for equilibrium are basic to the design of any load-bearing structure such as a bridge or a building since such structures must be able to maintain equilibrium under load. They are also important for the study of machines, since one must first establish equilibrium and then apply extra force or torque to produce the desired movement of the machine In the first activity, formulas used were: Ta= (Pan A +added weight)9. 8 m/s2 Tb = (Pan B + added weight)9. 8m/s2 To get the Experimental Equilibrant we used the weight of the pan A plus the weight added to it. % Error =|(Exp. — Theoretical)|*100% In computing the Experimental Equilibrant for the second activity we used âˆ‘ F= 0 Tx-T0x= 0 T1cos0-T2coso= 0 T1= T2 On the third activity, to get the x-coordinate and y-coordinate we used these formulas: x=(XCWC+XSWS)/W and y=(YCWC+YSWS)/W On activity 4, we used these formulas: -T1(lo/2) + Wc(lo/2 - . 05) + T2(lo/2) = 0 (T1 is the reading of spring scale, lo isthe length of bar, Wc= weight of cylinder.) 3. Methodology Materials used were force table, force board, cylinder, spring scale, electronic gram balance, card board, aluminum bar, and protractor. In the first activity: We first weighed three pans then labeled it as A, B and C. Then we hanged each of the in the force table. We then placed 100 g on pan A and 150g on pan B. We then record Ta and Tb. We balanced two tensions in the string. We then recorded magnitude and position of equilibrant and solved for the theoretical equilibrant then computed for the percent error. In the second activity: We used force board and suspended cylinder by means of two strings. We attached a spring scale to one of the strings then recorded the reading. We measure the angle on the other string using a protractor. We weighed the cylinder for the accepted value and computed for the % error. In the third activity: We used the prepared 10cm diameter square and circle. We weighed it separately and the one with the both shapes. Re determined the center of gravity using the balancing method and plumb line method. We specified position of center of gravity the checked results using the formulas given. In the last activity: We located center of gravity of the bar, hanged the cylinder 5. 0 cm from the end of the bar. We drew free body diagram then used the second condition for equilibrium in determining the weight of the bar. We weighed the bar using the electronic gram balance and then computed for the % error. 4. Results and Discussion Table 1: Equilibrant

Force Tension Magnitude Position (º) Ta 1. 51 N 30 º Tb 1. 96 N 200 º E. Equilibrant 0. 53 N 335 º T. Equilibrant 0. 54 N 344 º %error 1. 9% The table above shows the results for the equilibrant force, magnitude and position of the equilibrant, theoretical equilibrant of the two tensions and the percent error. Table 2: First Condition for Equilibrium T1 3. 32 N Angle 147 º T2 3. 97 N E. Weight 1. 96 N T. Weight 2. 16 N %Error 10. 20% The table above shows the tension of the string attached to the spring scale; angle formed by the string the tension 2 and the computed % error. Table 3: Locating the Center of Gravity Method X- Coordinate Y- Coordinate Plumb Line 0. 95 m 0. 5 m Balancing 0. 104 m 0. 5 m Computation 0. 07 m 0. 07 m The table above shows the results we gathered in locating the center of gravity and the x and y coordinates of the cardboard. Table 4: Second Condition for Equilibrium Reading of the Spring Scale 0. 8 N Weight of Cylinder 1. 96 N Tension of string 0. 784 N E. Weight of Bar 0. 84 N T. Weight of Bar 1. 0834 N % Error 22. 2% The table above shows the center of gravity given by the aluminum bar, spring scale and the cylinder. 5. Conclusion In conclusion, computing for the unknown tension theoretically may vary from experimental estimation. Overall no major discrepancy from the theoretical to the experimental values should arise, unless mistakes in measuring or computing are made. 6. Application 1. The first condition for equilibrium states that “ The vector sum of all external forces is zero. " Taking into consideration that only the vector sum should be zero it does not necessarily mean that there is no force acting on a body in equilibrium. A body may be in equilibrium but still have forces acting upon it for example a box on earth is pulled by gravity and at the same time the box pulls the earth with the same magnitude of force but in an anti-parrallel direction. 2. The forces acting upon the femur are the 3 tensions of the wires with the weight corresponding is 5kg. The force needed to immobilize the femur is 134. 39 N from the computations done and it is supplied by the vector sum of the tensions acting upon the femur. 3. a. When his upper right extremity is amputated, the center of gravity tends to shift to the lower left part of his body since the mass has also been removed from the upper right of the body. b. When he carries his books using his right arm only, the center of gravity will shift to the upper right part of his body. 4. To find out your center of gravity, stand upright and little by little bend in the middle. Keep tipping frontward until you feel you are going to tumble. After that, draw a line at a 90-degree angle tithe ground from the tip of your toes upwards and see where it overlaps your body. That will be the Y coordinate of your center of gravity. To find the X-coordinate, do the same tipping but this time, do it slanting sideways. 5. It is true that, in general, women's centers of gravity tend to be lower than men. This is primarily because women have bigger pelvis area. The skeletal structure of women make it so that their pelvis is bigger, since they will need the extra support come the time that they become pregnant, and their bodies will support a baby. In physics terms, this means that the lower body of women is generally heavier in comparison to their whole body, as opposed to the lower body of men. This would make the center of gravity of women slightly lower, because more of their body mass is concentrated at the lower portion of their body. 7. References Serway R., Vuille C., Physics Fundamentals 1., CENGAGE Learning, C&E Publishing, Inc.