**Unit 3 – Moments (Student Sheet)**

Engineering Statics in Physics Project

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**3.1 Tendencies of forces to rotate a body constrained to pivot about a point**

Apply a force with the spring scale to each of the different hooks on the “L” of the moment apparatus. In response to the applied force, the “L” rotates. Try to pull hard enough so that the L lies perpendicular to the base and the two lines marked on the apparatus are aligned.

 

**The moment due to a force about a point is the tendency of the force to cause a body to rotate about that point.**

*Experiment 1: with the applied force perpendicular with the arm attached to the pivot*

For each of the hooks shown, measure the force needed to make the arm attached to the pivot rotate so it is perpendicular to the base. Measure the perpendicular distance for each force and compute the moment due to each force about the rod (force times perpendicular distance).

A

B

C

D

E

F

|  |  |  |  |
| --- | --- | --- | --- |
| **Hook** | **Force** | **Perpendicular distance** | **Moment** |
| **A** |  |  |  |
| **B** |  |  |  |
| **C** |  |  |  |
| **D** |  |  |  |
| **E** |  |  |  |
| **F** |  |  |  |

*Experiment 2: with the applied force parallel to the arm attached to pivot arm*

Measure the force needed to make the L perpendicular to the base when applied to each of the hooks as shown. Measure the perpendicular distance for each force and compute the moment due to each force about the rod (force times perpendicular distance).

E

F

|  |  |  |  |
| --- | --- | --- | --- |
| **Hook** | **Force** | **Perpendicular distance** | **Moment** |
| **E** |  |  |  |
| **F** |  |  |  |

*Experiment 3: with the applied force at an angle with respect to the “pulled” arm*

In this experiment, the force is applied to hook F at an angle θ with respect to the horizontal. Measure the force needed to make the L perpendicular to the base when the angle is 30°, 45°, and 60°.

For each angle, measure the perpendicular distance. This is the distance from the pivot rod to the line through the force - it may be challenging to measure this distance accurately. Then, compute the moment due to the force about the rod (force times perpendicular distance).

Next, for each angle, resolve the applied force into its horizontal and vertical components. Measure the perpendicular distance associated with each component and compute the moment contributed by each component. Sum the two moments and compare this result with the moment determined by the unresolved force.

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|  |  |  |  |
| --- | --- | --- | --- |
| **Angle** | **Force** | **Perpendicular distance** | **Moment** |
| **30°** |  |  |  |
|  | **Force Comp** | **Perpendicular distance** | **Moment of Force Comp** |
| **30°** |  |  |  |
| **30°** |  |  |  |
|  |  |  | **Total Moment** |
| **30°** |  |  |  |
|  |  |  |  |
|  | **Force** | **Perpendicular distance** | **Moment** |
| **45°** |   |  |  |
|  | **Force Comp** | **Perpendicular distance** | **Moment of Force Comp** |
| **45°** |  |  |  |
| **45°** |  |  |  |
|  |  |  | **Total Moment** |
| **45°** |  |  |  |
|  |  |  |  |
|  | **Force** | **Perpendicular distance** | **Moment** |
| **60°** |  |  |  |
|  | **Force Comp** | **Perpendicular distance** | **Moment of Force Comp** |
| **60°** |  |  |  |
| **60°** |  |  |  |
|  |  |  | **Total Moment** |
| **60°** |  |  |  |

**3.2 Direction of rotation produced by a force**

Place an L-shaped body so rests freely on a horizontal surface such as a table or the floor. While pressing with a finger on one corner (the pivot), loop a piece of string to the far hook. When the direction of the applied force is varied, observe the resulting sense of rotation: clockwise or counterclockwise. Find the angle of the force that produces no rotation.

Press down lightly with finger here to allow pivoting about this point