LAB # 3

Modified Atwood’s Machine

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METC 111

**OBJECTIVE:** To compare experimental measurements for acceleration and theoretical measurements for acceleration and to determine how accurate they are compared to eachother.

**CONCLUSION:** The theoretical approach and experimental approach both bring you to the same general conclusion, however the theoretical approach is more accurate.

**BACKROUND:** An object’s acceleration depends on its mass and its net force. In an Atwood’s Machine, the tension on two hanging masses are equivalent even though the masses themselves are not this results in an acceleration of both masses as the heavier one pulls the lighter one upwards.

**MATERIALS:** Statics board, Mass and hanger set, Stopwatch device, 2 “frictionless” pulleys, a Yardstick, and Thread to suspend the hanging masses over both pulleys.

**PROCEDURE:** Two mass hangers were placed parallel to each other on the statics board with a small distance between them. The statics board was placed at the edge of a table so that the pulleys hung over the table. A string was cut so that it could touch the ground when laid over the pulleys. One mass hanger was tied to each end of the string and the string was placed over the pulleys.

a. A total mass of 131g was added to one mass hanger and 129g was added to the other both taking into account that the mass of the mass hanger.

b. The lighter mass was pulled to the floor and the distance from the two masses was recorded. The lighter mass was released and the stopwatch was started. When the heavy mass hit the ground, the time was recorded. This process was repeated two more times for a total of three runs and the times were averaged.

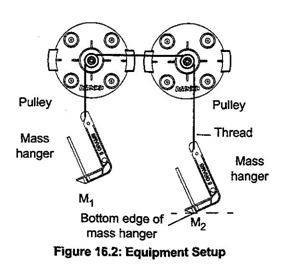
c. One gram was moved from the light mass to the heavy mass and step b. was repeated.

d. Step c. was then repeated 3 more times for a total of 5 trials.

e. A total mass of 50g was added to one mass hanger and 55g was added to the other both taking into account that the mass of the mass hanger step b. was then repeated.

f. Next 20g was added to each mass and step b. was repeated.

g. Step f. was repeated 3 more times for a total of 5 trials.



**DATA:**

Constant Mass:

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Trial | d | M1 | M2 | M | t1 | t2 | t3 | tavg | aTheoretical | aMeasured | %diff |
| units | meters | kg | kg | kg | sec | sec | sec | sec | m/sec^2 | m/sec^2 |  |
| 1 | 0.5969 | 0.131 | 0.129 | 0.001 | 4 | 5 | 4.8 | 4.6 | 0.075 | 0.056 | 24.7 |
| 2 | 0.5969 | 0.132 | 0.128 | 0.002 | 2.5 | 2.6 | 2.4 | 2.5 | 0.151 | 0.191 | 26.5 |
| 3 | 0.5969 | 0.133 | 0.127 | 0.003 | 1.8 | 1.9 | 1.9 | 1.87 | 0.226 | 0.343 | 51.6 |
| 4 | 0.5969 | 0.134 | 0.126 | 0.004 | 1.7 | 1.7 | 1.7 | 1.70 | 0.302 | 0.413 | 36.7 |
| 5 | 0.5969 | 0.135 | 0.125 | 0.005 | 1.5 | 1.4 | 1.4 | 1.43 | 0.377 | 0.581 | 54.13307 |

Constant NET Force:

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Trial | d | M1 | M2 | M | t1 | t2 | t3 | tavg | aTheoretical | aMeasured | %diff |
| units | meters | kg | kg | kg | sec | sec | sec | sec | m/sec^2 | m/sec^2 |  |
| 1 | 0.5969 | 0.05 | 0.055 | 0.005 | 1.2 | 1.4 | 1.4 | 1.33 | 0.467 | 0.672 | 43.79283 |
| 2 | 0.5969 | 0.07 | 0.075 | 0.005 | 1.6 | 1.8 | 1.7 | 1.7 | 0.338 | 0.413 | 22.21289 |
| 3 | 0.5969 | 0.09 | 0.095 | 0.005 | 1.7 | 1.9 | 2 | 1.87 | 0.265 | 0.343 | 29.2862 |
| 4 | 0.5969 | 0.11 | 0.115 | 0.005 | 2 | 2 | 2 | 2 | 0.217 | 0.298 | 37.53456 |
| 5 | 0.5969 | 0.13 | 0.135 | 0.005 | 2.1 | 2.2 | 2.3 | 2.2 | 0.185 | 0.247 | 33.32589 |

**DISSCUSSION:** The difference between the theoretical and measured accelerations fall within the boundaries of 20% and 30%. Possibly the larger differences could be attributed to inconsistent and inaccurate time keeping. If the mass was falling before the clock was started or the clock was still ticking even after the mass hit the ground then the result of that trial run would be skewed.