Atwood’s Machine

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Objective: To compare theoretical measurements for acceleration and experimental measurements for acceleration to see if they are the same.

Conclusion: The theoretical approach and experimental approach both bring you to the same conclusion.

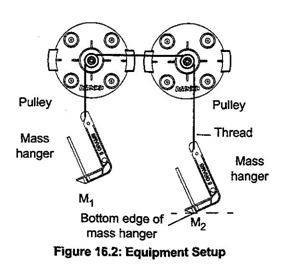
Introduction: An object’s acceleration depends on its mass and its net force. In an Atwood machine the mass is represented by each weight and the net force is the difference between the two weights.

Materials:

* Statics board
* Mass and hanger set
* Stopwatch
* 2 pulleys
* Thread
* yardstick

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.

1. 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. 2. 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. The stopwatch was stopped 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. 3. One gram was moved from the light mass to the heavy mass and step 2 was repeated. 4. Step 3 was then repeated 3 more times for a total of 5 trials. 5. 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 2 was then repeated. 6. Next 20g was added to each mass and step 2 was repeated. 7. Step 6 was repeated 3 more time for a total of 5 trials.



Observations: There were inconsistencies from when the weight was released and when the watch was started.

Data:

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  | Constant mass | |  |  |  |  |  |
| Trial | d | M1 | M2 | M | t1 | t2 | t3 | tavg | aTheoretical | aMeasured | %diff |
|  | m | 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 | 24.77631 |
| 2 | 0.5969 | 0.132 | 0.128 | 0.002 | 2.5 | 2.6 | 2.4 | 2.5 | 0.151 | 0.191 | 26.49536 |
| 3 | 0.5969 | 0.133 | 0.127 | 0.003 | 1.8 | 1.9 | 1.9 | 1.87 | 0.226 | 0.343 | 51.59665 |
| 4 | 0.5969 | 0.134 | 0.126 | 0.004 | 1.7 | 1.7 | 1.7 | 1.70 | 0.302 | 0.413 | 36.78132 |
| 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 |
|  | m | 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 |

Analysis: While there are some trials that have large differences in some of the trials for the most part the difference between the theoretical and measured accelerations fall within reasonable percentages of 20 to 30. A possible reason for the larger differences is inaccurate time keeping. For instance the mass could have been falling before the clock was started or the mass could have hit the ground and the clock was still running.