Affect of angle of ramp on the acceleration of a rolling ball

Rationale:

Original experiment:

A cart was rolled down a ramp and timed with varying amounts of blocks under one end of the ramp to create slopes of different steepness.

Research Question:

What is the affect of the angle of a ramp on the acceleration of a ball rolling down a ramp?

Modifications to Original Experiments:

* A ball was used instead of a cart to reduce friction, instability and the randomness associated with the use of a more complicated system.
* A camera was used to record the trials as using this to time how long the trials were as this is more accurate then using a stopwatch and removes human error.
* The ramp’s steepness was measured with the angle to the ground and not height in blocks. This added consistency as the position of the blocks along the ramp greatly affected the steepness.

Risk Assessment:

Raw Data:

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Angle (Degrees) | Distance (m) | Mass (Kg) | Trial 1 | Trial 2 | Trial 3 | Trial 4 | Trial 5 |
| 2 | 2.50 | 0.05050 | 4.90 | 4.77 | 4.73 | 4.73 | 4.63 |
| 4 | 2.50 | 0.05050 | 3.30 | 3.43 | 3.43 | 3.40 | 3.40 |
| 6 | 2.50 | 0.05050 | 2.77 | 2.73 | 2.73 | 2.73 | 2.80 |
| 8 | 2.50 | 0.05050 | 2.37 | 2.37 | 2.37 | 2.37 | 2.43 |
| 10 | 2.50 | 0.05050 | 2.10 | 2.00 | 2.06 | 2.10 | 2.03 |

Processed Data:

Figure 1: Acceleration of Ball Rolling Down a Ramp

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Angle (degrees) | Average Time(s) | Average Speed  (m/s) | Final Speed (m/s) | Average Acceleration (m/s/s) | Standard Deviation | Coefficient of Variation |
| 2 | 4.75 | 0.53 | 1.05 | 0.22 | 0.10 | 2.05 |
| 4 | 3.39 | 0.74 | 1.47 | 0.43 | 0.05 | 1.58 |
| 6 | 2.75 | 0.91 | 1.82 | 0.66 | 0.03 | 1.16 |
| 8 | 2.38 | 1.05 | 2.10 | 0.88 | 0.03 | 1.13 |
| 10 | 2.06 | 1.21 | 2.43 | 1.18 | 0.04 | 2.13 |

Trends patterns and relationships:

Figure 1 shows a clear linear increase of acceleration when increasing the angle of the ramp. When the ramp was set to two degrees the ball had an average acceleration of 0.22 m/s/s and at accelerated fastest at 10 degrees with an acceleration 1.18 m/s/s. The coefficient of variation between trials was highest at ten degrees with 2.13. The average increase of acceleration was 0.236. The standard deviation of the average increase of acceleration was 0.035. This shows very little deviation between the trend line and the results in figure 1.

Evaluation of Methodology:

The method of the experiment measured only the time for the ball to reach the end of the ramp. The acceleration was then calculated by assuming that the final speed was the double the average speed which may not be the case.

Appendix