Experiment 6: Inclined Plane

Ben Giftakis

TA: Ryan Preusse

PS181 Section 3

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DATA:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Times | Run | Run | Run | Run | Run | Run |
| (S) | 1 | 2 | 3 | 4 | 5 | 6 |
| t1 | 1.22 | 0.648 | 0.180 | -0.78 | -1.28 | -1.18 |
| t2 | 1.46 | 0.892 | 0.416 | -0.45 | -0.96 | -0.86 |
| t3 | 1.62 | 1.056 | 0.578 | -0.21 | -0.74 | -0.64 |
| t4 | 1.83 | 1.266 | 0.774 | 0.02 | -0.52 | -0.42 |
| t5 | 1.96 | 1.406 | 0.910 | 0.2 | -0.36 | -0.26 |
| t6 | 2.13 | 1.585 | 1.086 | 0.4 | -0.17 | -0.07 |
| t7 | 2.31 | 1.766 | 1.368 | 0.55 | -0.02 | 0.08 |
| t8 | 2.47 | 1.929 | 1.422 | 0.72 | 0.14 | 0.24 |
| t9 | 2.54 | 2.005 | 1.502 | 0.83 | 0.24 | 0.34 |
| t10 | 2.70 | 2.158 | 1.646 | 0.99 | 0.4 | 0.5 |
| t11 | 3.13 | 2.602 | 2.090 | 1.5 | 0.9 | 1 |
| t12 | 3.30 | 2.776 | 2.258 | 1.67 | 1.06 | 1.16 |
| t13 | 3.38 | 2.864 | 2.348 | 1.78 | 1.17 | 1.16 |
| t14 | 3.57 | 3.053 | 2.526 | 1.97 | 1.36 | 1.35 |
| t15 | 3.77 | 3.268 | 2.742 | 2.14 | 1.52 | 1.51 |
| t16 | 3.99 | 3.493 | 2.958 | 2.37 | 1.73 | 1.72 |
| t17 | 4.16 | 3.669 | 3.130 | 2.57 | 1.92 | 1.91 |
| t18 | 4.20 | 3.948 | 3.394 | 2.86 | 2.19 | 2.18 |
| t19 | 4.66 | 4.191 | 3.630 | 3.18 | 2.46 | 2.45 |
| t20 | 5.04 | 4.603 | 4.004 | 3.74 | 2.88 | 2.87 |

Table 1: Times the gates turn on and off

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| ti down and up | Run | Run | Run | Run | Run | Run |
| (sec) | 1 | 2 | 3 | 4 | 5 | 6 |
| t1,d | 0.40 | 0.41 | 0.40 | 0.57 | 0.54 | 0.54 |
| t2,d | 0.74 | 0.76 | 0.73 | 0.98 | 0.92 | 0.92 |
| t3,d | 1.09 | 1.12 | 1.19 | 1.33 | 1.26 | 1.26 |
| t4,d | 1.32 | 1.36 | 1.32 | 1.61 | 1.52 | 1.52 |
| t1,u | 0.27 | 0.28 | 0.27 | 0.30 | 0.30 | 0.19 |
| t2,u | 0.69 | 0.72 | 0.70 | 0.70 | 0.67 | 0.56 |
| t3,u | 0.90 | 1.17 | 1.14 | 1.19 | 1.13 | 1.02 |
| t4,u | 1.74 | 1.83 | 1.75 | 2.07 | 1.82 | 1.71 |

Table 2: time it takes for the glider to reach the gate

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Run | Run | Run | Run | Run | Run |
|  | 1 | 2 | 3 | 4 | 5 | 6 |
| a\_down | 23.12859 | 20.9832 | 14.49409 | 31.10796 | 34.84725 | 34.84725 |
| a\_up | 39.67796 | 38.59993 | 40.9737 | 34.46281 | 33.14512 | 79.74512 |

Table 3: calculated acceleration

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  | a\_down | **N** | a\_up | **N** |
| Run | 1 | 23.12859 | 6 | 39.67796 | 6 |
| Run | 2 | 20.9832 | **`x** | 38.59993 | **`x** |
| Run | 3 | 14.49409 | **(units)** | 40.9737 | **(units)** |
| Run | 4 | 31.10796 | 26.56806 | 34.46281 | 44.43411 |
| Run | 5 | 34.84725 | **Sx** | 33.14512 | **Sx** |
| Run | 6 | 34.84725 | **(units)** | 79.74512 | **(units)** |
|  |  |  | 8.324688 |  | 17.56342 |
|  |  |  | **S`x** |  | **S`x** |
|  |  |  | **(units)** |  | **(units)** |
|  |  |  | 3.398539 |  | 7.170235 |

Table 4: macro generated stats on acceleration



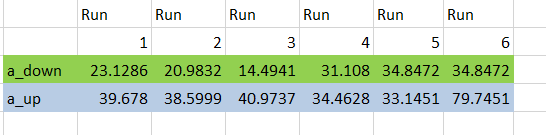
CALCULATIONS:



RESULTS:

The experimental value of g was calculated to be 968.8179172 +- 117.694 cm/s2 with a %diff of 1.17632%. The acceleration up was calculated to be about 26.5681 +- 3.39854 cm/s2 and down 44.4341+- 7.17024 cm/s2. The angle was measured to be 2.1+-0.1 °. The coefficient of friction was calculated out to be 0.00923 +- 0.00425.

DISCUSSION:

Using the precision vs accuracy test on g shows that the accepted value is well within the calculated error. However, the calculated error being more than 10% of the value seems quite high. I can also tell from just looking at the data that there were some careless errors in measuring (or generating) this data. For example, in the image below, one can see that the a\_up value for run 6 is far too high and not in line with the rest of the data. There are some other minor ways error could get into the experiment. For example, it doesn’t account for air resistance, energy lost to heat, sound, etc., although these factors are likely to be considered negligible. If this experiment were to be repeated, the results could be improved by taking greater care in measuring.

QUESTIONS:

* 1. The original g was calculated to be 968.810cm/s2. By subtracting and adding .1 degrees to the angle the g value changes to 924.801 and 1017.24 respectively. That’s about 45cm/s2 difference which is very significant for a such a miniscule change in angle. \*calculated via excel\*
  2. Q2

The speed of the glider based on the acceleration of 23.1286 cm/s2 and reaching the first gate at 1.22 seconds was 28.217m/s. \*work below\*

The length of the glider is 6.21cm based on the initial speed of 28.217, acceleration of 23.1286, and a time of 0.24. \*work below\*

If the glider was released just before the first photogate it would introduce some small potential for error IF the glider was released VERY close to the gate, as the releasing could introduce some force on the glider that manifest in the first timing. However, since the calculations were based on the time it takes between gates this wouldn’t become a big issue.

If the glider was pushed then there would still be potential for error in the first timing. However, the calculations would likely just be working with more extreme numbers but the result should be the same. I would also image if the force was great enough to accelerate the glider to very high speeds air resistance might become a factor more worth considering. If the speeds were too fast the elastic at the end that the glider bounces off could be pushed too far and make contact with the metal after it and that could also skew the data.

