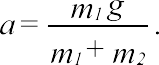
# Experiment 6 Newton's Second Law



g = 9.80665

m\_glider = 1 (mass of the glider)

m1 and m2

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Group Number | *m*1  (grams) | mass added to glider (grams) | Timing Interval (sec) | *m2*  (grams) |
| 1 | 12 | 0 | 1/6 |  |
| 2 | 13 | 0 | 1/6 |  |
| 3 | 14 | 0 | 1/6 |  |
| 4 | 15 | 100 | 1/6 |  |
| 5 | 16 | 100 | 1/6 |  |
| 6 | 17 | 100 | 1/6 |  |
| 7 | 18 | 100 | 1/6 |  |
| 8 | 19 | 200 | 1/6 |  |
| 9 | 20 | 200 | 1/6 |  |
| 10 | 21 | 200 | 1/6 |  |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Group Number | data point | time, multiples of | distance,  s | change in distance | Average velocity |
| 1 | 1 |  |  |  |  |
| 2 |  |  |  |  |
| 3 |  |  |  |  |
| 4 |  |  |  |  |
| 5 |  |  |  |  |
| 6 |  |  |  |  |
| 7 |  |  |  |  |
| 8 |  |  |  |  |
| 2 | 1 |  |  |  |  |
|  | 2 |  |  |  |  |
|  | 3 |  |  |  |  |
|  | 4 |  |  |  |  |
|  | 5 |  |  |  |  |
|  | 6 |  |  |  |  |
|  | 7 |  |  |  |  |
|  | 8 |  |  |  |  |
| 3 | 1 |  |  |  |  |
|  | 2 |  |  |  |  |
|  | 3 |  |  |  |  |
|  | 4 |  |  |  |  |
|  | 5 |  |  |  |  |
|  | 6 |  |  |  |  |
|  | 7 |  |  |  |  |
|  | 8 |  |  |  |  |
| 4 | 1 |  |  |  |  |
|  | 2 |  |  |  |  |
|  | 3 |  |  |  |  |
|  | 4 |  |  |  |  |
|  | 5 |  |  |  |  |
|  | 6 |  |  |  |  |
|  | 7 |  |  |  |  |
|  | 8 |  |  |  |  |
| 5 | 1 |  |  |  |  |
|  | 2 |  |  |  |  |
|  | 3 |  |  |  |  |
|  | 4 |  |  |  |  |
|  | 5 |  |  |  |  |
|  | 6 |  |  |  |  |
|  | 7 |  |  |  |  |
|  | 8 |  |  |  |  |
| 6 | 1 |  |  |  |  |
|  | 2 |  |  |  |  |
|  | 3 |  |  |  |  |
|  | 4 |  |  |  |  |
|  | 5 |  |  |  |  |
|  | 6 |  |  |  |  |
|  | 7 |  |  |  |  |
|  | 8 |  |  |  |  |
| 7 | 1 |  |  |  |  |
|  | 2 |  |  |  |  |
|  | 3 |  |  |  |  |
|  | 4 |  |  |  |  |
|  | 5 |  |  |  |  |
|  | 6 |  |  |  |  |
|  | 7 |  |  |  |  |
|  | 8 |  |  |  |  |
| 8 | 1 |  |  |  |  |
|  | 2 |  |  |  |  |
|  | 3 |  |  |  |  |
|  | 4 |  |  |  |  |
|  | 5 |  |  |  |  |
|  | 6 |  |  |  |  |
|  | 7 |  |  |  |  |
|  | 8 |  |  |  |  |
| 9 | 1  2 |  |  |  |  |
|  | 2 |  |  |  |  |
|  | 3 |  |  |  |  |
|  | 4 |  |  |  |  |
|  | 5 |  |  |  |  |
|  | 6 |  |  |  |  |
|  | 7 |  |  |  |  |
|  | 8 |  |  |  |  |
| 10 | 1 |  |  |  |  |
|  | 2 |  |  |  |  |
|  | 3 |  |  |  |  |
|  | 4 |  |  |  |  |
|  | 5 |  |  |  |  |
|  | 6 |  |  |  |  |
|  | 7 |  |  |  |  |
|  | 8 |  |  |  |  |

# Analysis

Draw free-body diagrams for the two masses, and . Apply Newton's Second Law and derive (3).

Graph the values of instantaneous velocity versus time, with velocity as the ordinate and

4time as the abscissa. Draw two lines that best fit the data: one with maximum slope, , and one



with minimum slope, . Find the slopes of these lines. The best value for the acceleration of the system is then



and the corresponding uncertainty in the acceleration is



Calculate the best value for the acceleration, (4) and the uncertainty, (5).

On a one-dimensional graph, use points and error bars to plot . Be sure to displace vertically the error bar from the axis so that it is clearly visible. Now calculate the theoretical value of the acceleration from (3) and plot it on the graph described above so that the point is displaced slightly above the error bar.

Report in a results table, and the theoretical value of .

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Group number |  |  |  |  | theoretical |
| 1 |  |  |  |  |  |
| 2 |  |  |  |  |  |
| 3 |  |  |  |  |  |
| 4 |  |  |  |  |  |
| 5 |  |  |  |  |  |
| 6 |  |  |  |  |  |
| 7 |  |  |  |  |  |
| 8 |  |  |  |  |  |
| 9 |  |  |  |  |  |
| 10 |  |  |  |  |  |

# Conclusions

Indicate what the major sources of error are, and explain how the experimental values are affected by these sources of error. Explain whether or not the experimental value of the acceleration shows the effects of the sources of error.

# Questions

1. If friction is present between the glider and the air track, then how will the experimental value of the acceleration be different from the theoretical value? Explain why. Do the results indicate the presence of friction? Explain.
2. If the mass of the pulley is not negligible, then how will the experimental value of the acceleration be different from the theoretical value? Explain why.
3. If the experimental value of the acceleration is greater than the theoretical value, then what is the most likely reason for this?