Influence of Inertial Mass on Acceleration

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Objective:

Determine the relationship between the inertial mass of a system and the linear acceleration of the system, given a constant applied force.

List of equipment:

Grooved metal track
PASCO Smart Cart
Small pulley and string
Series of weights

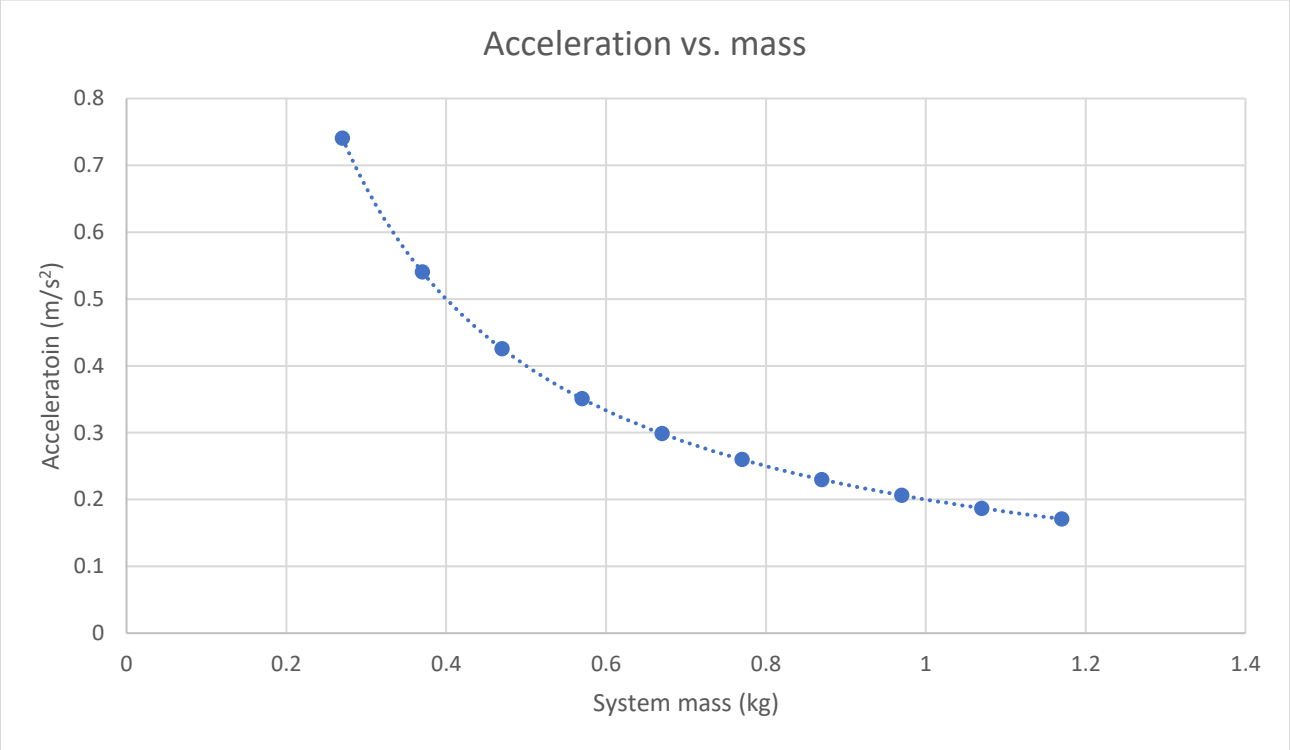
Procedure:

1. Place the Smart Cart on the level, metal track. Tie the string to the cart, over the pulley, with the opposite end of the string tied to a hanging 20g mass.
2. With the 20g mass just below the pulley, release the Smart Cart from rest and use motion tracking software to make a graph of the cart's velocity versus time.
3. Find the slope of the graph (the cart's acceleration) using the software's linear regression tool.
4. Add 100g to the cart and repeat steps two and three. Continue with increasing added masses in intervals of 100g, up to 900g added.

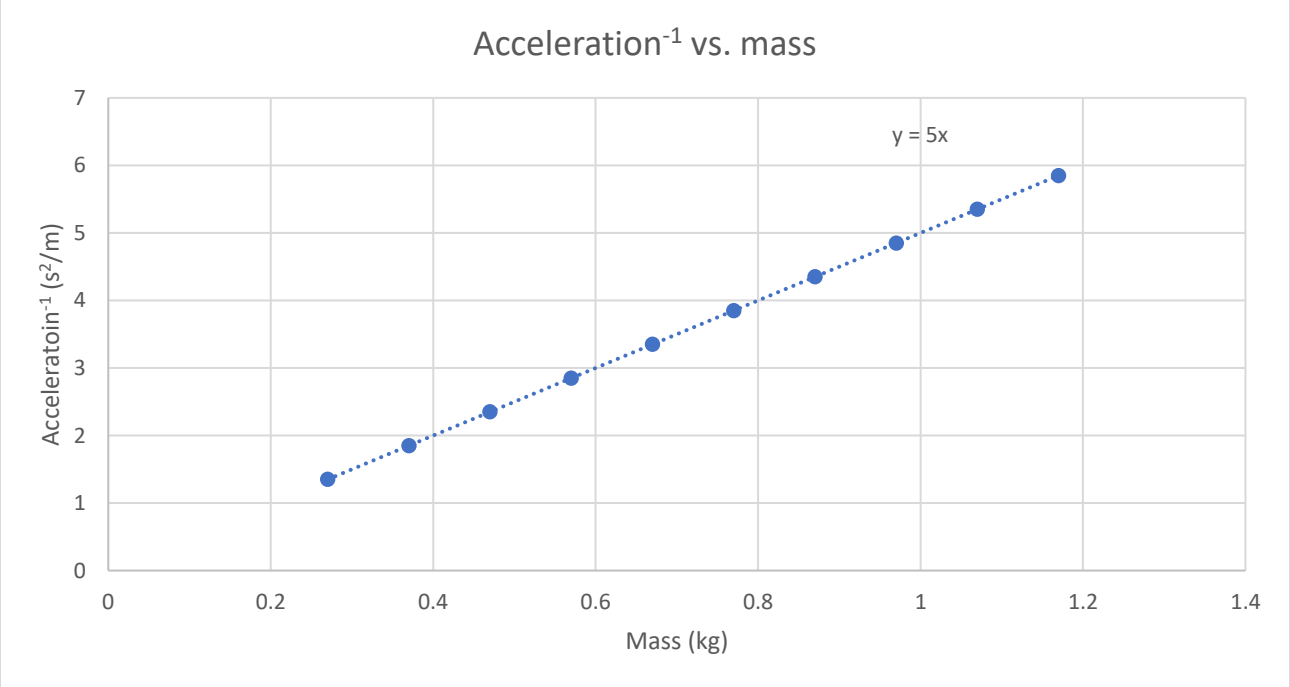
Data table:

Mass added to the cart (kg)	Total mass of the cart / added mass (kg)	Acceleration (m/s^2)
0.00	0.270	0.74
0.10	0.370	0.54
0.20	0.470	0.43
0.30	0.570	0.35
0.40	0.670	0.30
0.50	0.770	0.26
0.60	0.870	0.23
0.70	0.970	0.21
0.80	1.070	0.19
0.90	1.170	0.17

Experimental graph:



Linearized graph:



Function of the experimental graph:

From the linearized graph, $\frac{1}{a}$ = 5m

Solving for acceleration as a function of mass to match the experimental graph, a = $\frac{0.20}{m}$

Summary of results:

The function of the experimental graph shows that acceleration is inversely related to the inertial mass of the system. As the inertial mass increases, the acceleration decreases.

Supplementary questions:

1. The function of the experimental graph shows that acceleration is inversely related to the inertial mass of the system. As the inertial mass increases, the acceleration decreases.

2. If the hanging 20g mass was increased, each value for the acceleration of the original graph would increase proportionally. This would cause the original graph to stretch vertically.