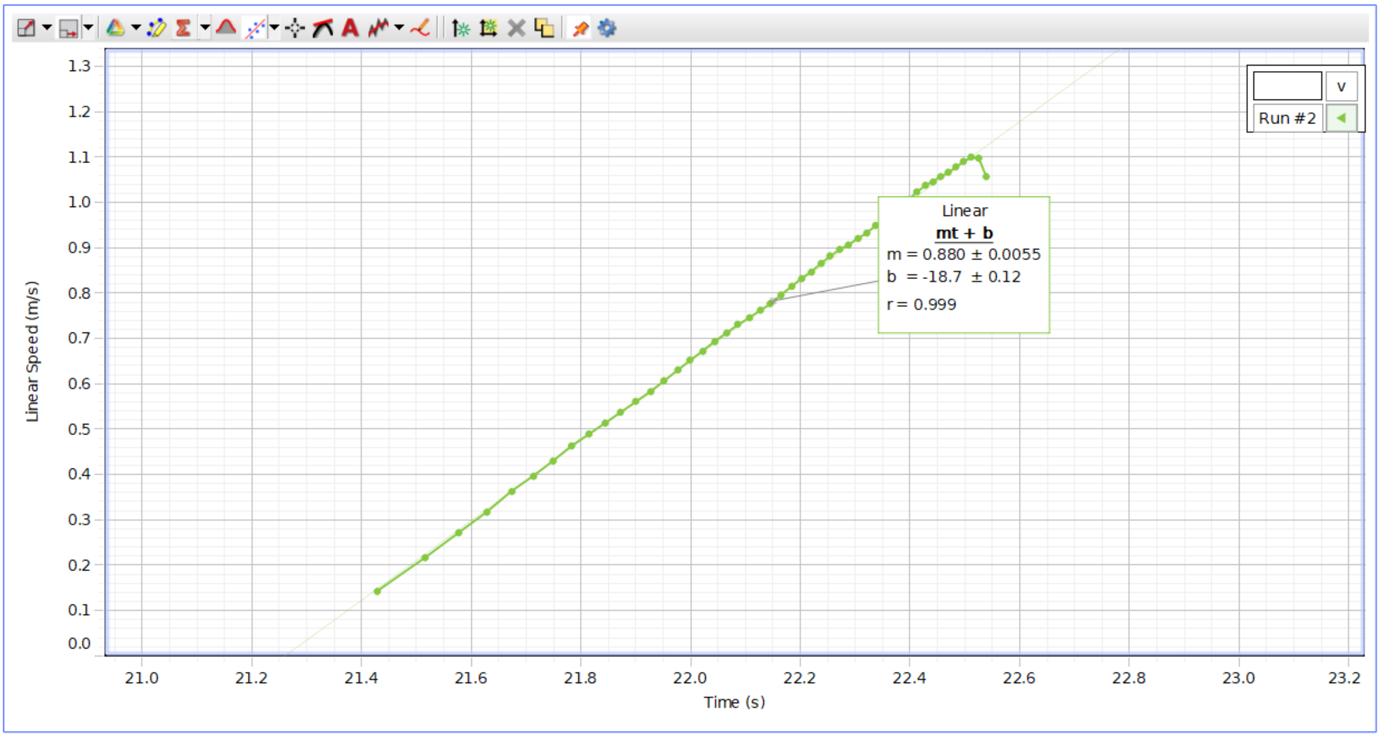
Name	Roman MAKSIMOVICH	LA (1)

B. Results and data analysis (64 pts)

Table 1: Constant total mass (32 pts)

Paste the linear speed vs. time graph here.



Trial	M_1 (kg)	M_2 (kg)	a_{exp} (m/s^2)	F_{net} (N)	$M_1 + M_2$ (kg)	a_{theory} (m/s^2)	Percent error*
Run#1	0.105	0.155	1.60	0.491	0.260	1.88	15.2%
Run#2	0.115	0.145	0.880	0.294	0.260	1.13	22.1%
Run#3	0.125	0.135	0.168	0.098	0.260	0.377	74.0%

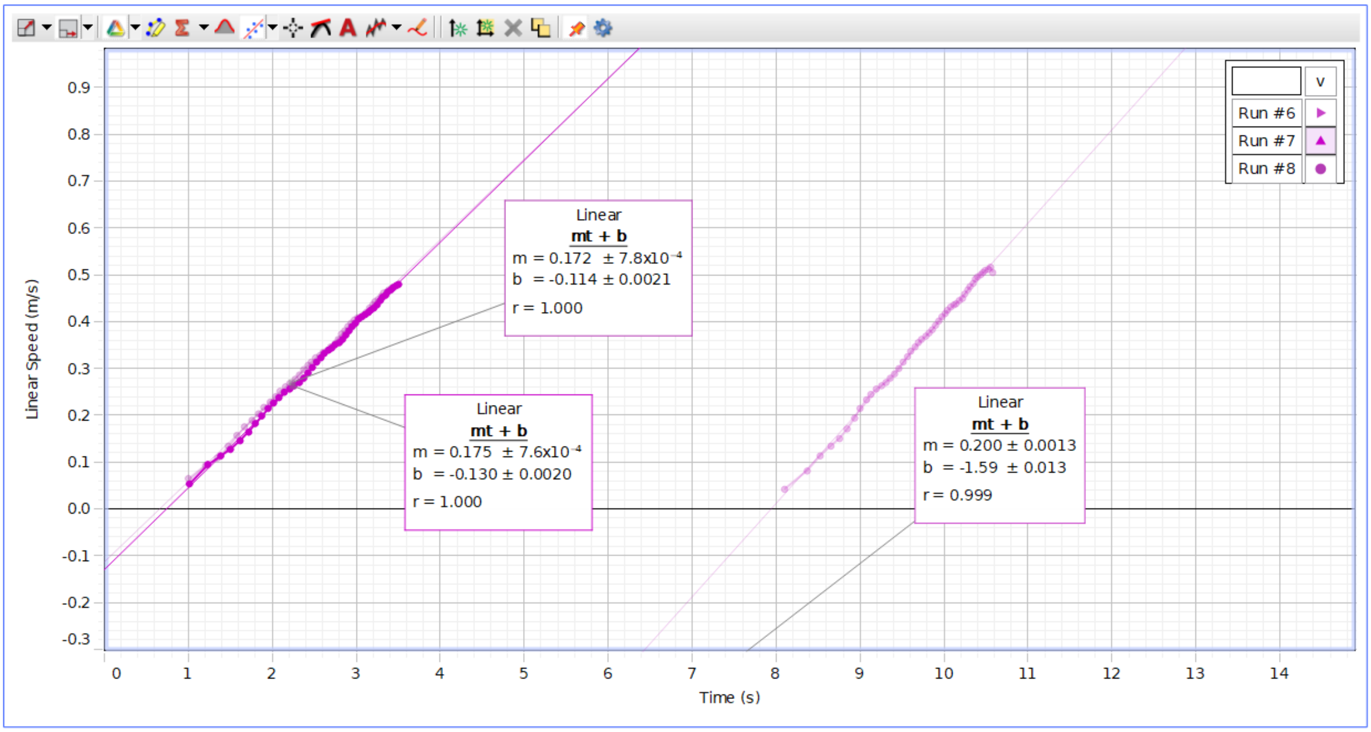
- Calculate the net force $F_{net} = g(M_2 - M_1)$.
- Calculate the theoretical acceleration $a_{theory} = g\left(\frac{M_2 - M_1}{M_1 + M_2}\right)$.

*** **NOTE:** Use g = 9.81m/s^2 for all the calculations in this laboratory course. ***

* Percent error = $\frac{|a_{exp} - a_{theory}|}{a_{theory}} \times 100\%$

Table 2: Constant net force (32 pts)

Paste the linear speed vs. time graph here.



Trial	M_1 (kg)	M_2 (kg)	a_{exp} (m/s^2)	F_{net} (N)	$M_1 + M_2$ (kg)	a_{theory} (m/s^2)	Percent error
Run#1	0.105	0.110	0.200	0.0491	0.215	0.228	12.3%
Run#2	0.115	0.120	0.175	0.0491	0.235	0.209	16.2%
Run#3	0.125	0.130	0.172	0.0491	0.255	0.192	10.6%

- Calculate the net force $F_{net} = g(M_2 - M_1)$.
- Calculate the theoretical acceleration $a_{theory} = g\left(\dfrac{M_2 - M_1}{M_1 + M_2}\right)$.

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C. Answer the following questions after the experiment (7 pts each)

2. Compare the values of the percent error between the measured value of the acceleration and the theoretical value, as shown in Tables 1 and 2. What are the main sources of error in this experiment?

As seen in the tables, the error is usually within 10-20%, only once reaching ~70%. In all cases we see that a_{exp} is lower than a_{th}. What slows the weights down may be friction in the pulley (decreasing the net force) or air resistance (doing the same). However, at low speeds the influence of friction and air resistance is usually negligible, which leads me to think there may be a systematic error in measurement (around 10-20%), and a random error of ~70% (in table 1).

3. Why is a better result obtained when you use a very large net force?

As discussed, one source of error is unaccounted forces, such as friction. When the theoretical net force is very big, the relative influence of unaccounted forces diminishes, and the percentage error is decreased. If F_{ext} is the net unaccounted force, we have

$$F_{net} \gg F_{ext} \Rightarrow \text{error} = \frac{|F_{net} - (F_{net} + F_{ext})|}{F_{net}} = \left|\frac{F_{ext}}{F_{net}}\right| \ll 1.$$

4. In the calculation of the acceleration a, we have assumed that the pulley is frictionless. Can you find a simple way in the experiment to test whether this is true? If so, how to correct for it?

If the pulley has friction, it could be detected by arranging a very small difference $M_2 - M_1$, and thus a very small net force. If F_{net} is small enough, the system will not move due to static friction. By adjusting $M_2 - M_1$, one could zero in on the value of maximum static friction and correct for it manually in the received results.