Student's Name: ________________________________

Student's Name: ________________________________

Lab day & time: ____________________ Date: ___________________

Newton's Laws of Motion (M2) - Data Sheets

Show all calculations and write all results on the data sheets in ink.

Activity 1: Constant Acceleration *(1.5 p.)*

Print a copy of the acceleration vs. time graph.

Be sure to fill-in the correct units in the space provided: (   )

	Acceleration values ( )	Deviations from the average acceleration: $\Delta a = a - a_{AV}$	Squared deviations from the average acceleration: $(\Delta a)^2$
1			
2			
3			
4			
5			
Average	a_{AV} =		Sum =

<u>Find the selected data points</u> on the printout and <u>clearly mark</u> these points with a pen (for example, circle them).

Average value of the acceleration: a_{AV} = ____________ (   ) (as average of five instantaneous acceleration values).

Calculate the <u>standard deviation of acceleration</u> s_a using the formula given in the Error Analysis section of the lab manual. The final result of the acceleration measurements (1-5) should be written as: $\boldsymbol{a = a_{AV} \pm s_a}$ *{e.g., $a = 0.43 \pm 0.12\ m/sec^2$}*

Show your work below:

s_a = ____________ (   )

Therefore, the result for average acceleration is:

a = __________ ± __________ (   )

Calculate the theoretical value of acceleration (see Figure 1 and Figure 3 of "M2 – Theory and Procedure"). Measure the distance between the two outside legs supporting the track (use the ruler on the track to measure this value).

l = _____________ (m)

The height of the aluminum block under one of the legs: Δh = 5.08 cm = 0.0508 m

$a_{theor.}$ = _________________ (   )

Calculate the absolute difference between experimental value and the theoretical value of acceleration:

$\Delta a = |a_{AV} - a_{theor.}|$ = ___________ (   )

Calculate the percent difference between experimental value and the theoretical value of acceleration: Show your work.

$\Delta a = 100\% * |(a_{AV} - a_{theor.}) / a_{theor.}|$ = ___________ (%)

Activity 2: Newton's Second Law *(1 p.)*

Mass of the cart m_1 = ___________ (   )

Be sure to fill-in the correct units in the space provided: (   )

Print a copy of the acceleration vs. time graph.

Mass of the hanging object (including hanger) m_2 = 30 (g)

Weight of the hanging object (including hanger) = ___________ (   )

m_2 = 30 g	Acceleration values ( )	Deviations from the average acceleration: $\Delta a = a - a_{AV}$	Squared deviations from the average acceleration: $(\Delta a)^2$
1			
2			
3			
4			
5			
Average	a_{AV} =		Sum =

Find the selected data points on the printout and clearly mark these points with a pen (for example, circle them).

Average value of the acceleration: a_{AV} = ____________ ( ) (as average of five instantaneous accelerations).

Calculate the standard deviation of acceleration s_a using the formula given in the Error Analysis section of the lab manual. The final result of the acceleration measurements (1-5) should be written as: $\boldsymbol{a = a_{AV} \pm s_a}$ *{e.g., a = 0.43 ± 0.12 m/sec²}*

Show your work below:

s_a = _____________ ( )

Therefore, the result for average acceleration is:

a = ____________ ± ___________ ( )

Calculate the theoretical value of acceleration. Show your work!

$a_{theor.}$ = _________________ ( )

Calculate the absolute difference between experimental value and the theoretical value of acceleration. Show your work.

$\Delta a = |a_{AV} - a_{theor.}|$ = ______________ ( )

Calculate the percent difference between experimental value and the theoretical value of acceleration:

$$\Delta a = 100\%*|(a_{AV} - a_{theor.})/\ a_{theor.}| = \text{\_\_\_\_\_\_\_\_\_\_\_\_\_\_}\ (\ \%\ )$$

Activity 3: Force Probe as Electronic Balance *(0.5 p.)*

Mass of Object (grams)	Calculated Weight ( )	Measured Force ( )	Relative Error (%)
205 grams			

Activity 4: Newton's Third Law *(0.5 p.)*

A. Attach the hooks of the two force probes together as shown in Figure 6 of "M2 – Theory and Procedure". Pull on the two probes in opposite directions for a variety of force values, but **do not use excessive force** (i.e., exceeding 10 N). Collect data. **Print** the graph. Write your name and the names of your partners on the graph. Label this graph, "*Equal and opposite forces*."

Keep the probes hooked together. Try to pull only one probe and do not pull the other one. Can you get a zero-force recorded by one probe and significantly non-zero force measured by the other probe?

Can you really pull only one probe without pulling the other? (**Yes** or **No**) ____________

Which physics law describes this situation? ______________________________________

B. Attach probe "B" to the lab bench using the clamp and hold probe "A" in your hand.

Are the measured forces still nearly equal and opposite?

(Yes or No) ___________________

Which physics law describes this situation? ______________________________________

Students are expected to **complete the lab report and return it to the lab TA** before the end of the scheduled lab time.