#  Names:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

## Physics 12: Systems Lab

**Materials:**

1 Dynamics cart

Assorted Masses (2x20g, 2x50g, 2x100g, 200g, 500g,1000g for example)

1 table edge pulley

masking tape

1 stopwatch

~1m length of string

1 metre stick

**Procedure:**

1. Find the mass of the dynamics cart, washers and masses.
2. Set up the apparatus as shown. If needed add some small mass to compensate for any slant to the table and friction in the pulley.
3. Begin with 20g hanging and the other masses on the dynamics cart.
4. On the desk, with tape, mark a start and finish line. The start line should mark the position of the front wheels of the cart when the hanging mass is at its top position. ***The finish line should mark the position of the front wheels of the cart just as the hanging mass reaches the ground but is not yet resting on the ground.***
5. Measure the distance between the start and finish lines. Record this as distance. You may need to adjust the position of the finish line as more masses are added to the hanging mass.
6. With the front wheels of the cart at the start line, release the mass. Simultaneously start the timer.
7. Stop the timer when the **front wheels** of the cart reach the finish line. Repeat until your time is consistent.
8. Transfer a small amount of mass from the cart to the hanging mass. Record the new hanging mass
9. Repeat steps 3-6 with the new hanging mass.
10. Repeat steps 3-7 by transferring more mass until you have 10 data points. The final value of the hanging mass should not exceed 200g.
11. Complete the table below.

**Data: (All Data should be reported with proper units and significant figures) (10 marks)**

Mass of Dynamics cart: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_kg

Mass of SYSTEM: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_kg

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| --- | --- | --- | --- | --- |
| Hanging Mass**(kg)** | Accelerating Force (N) | Distance**(m)** | Time(s) | **Acceleration****(m/s2)****Found by Kinematics!** |
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**Analysis:**

1. Show sample calculations for acceleration (from kinematics) and accelerating force. **(5 marks)**
2. Plot a graph of **F** vs **a** and normalize **(10 marks)**
3. Find the slope of the normalized relation. Clearly indicate points used ON YOUR GRAPH.

(Include units in your calculation. Give results with the correct significant figures.) **(5 marks)**

1. Find the equation relating F and a. **(2 marks)**

##### Questions:

1. What is the independent variable in this experiment? **(1 mark)**
2. What is the dependent variable in this experiment? **(1 mark)**
3. Explain clearly why you transferred mass from the cart to the hanger, rather than simply adding extra mass to the hanger. **(3 marks)**
4. What are the units of the slope? **(1 mark)**
5. Use established physics theory to clearly demonstrate what (exactly) the slope represents. **(4 marks)**
6. Find your percent error.  **(1 mark)**

**Discussion:**

 Describe sources of error, problems or any observations you have. **(2 marks)**

**Conclusion: (10 marks)**

To what extent do the results agree with theory? Explain!

 Does the lab confirm or disconfirm theory? Explain!