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| Year 11 Physics– Newton's Second Law Experiment | | | | |
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| **Name:** | **Teacher:** | |  | |
| **Comment:** | | | | **Due Date:** |
| **Pre lab + Report : \_\_\_\_\_\_ out of 57** | | **Scaled Total \_\_\_\_\_\_\_\_ out of 50** | | |

***The lab and write up is worth 50%, the other 50% will be a validation test.***

**AIM :** To investigate the relationship between **force, mass and acceleration**.

**Pre-Lab questions.**

1. Write a statement of Newton's second law of motion. ( 1 mark)

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2. Write a mathematical statement for Newtons second law. (1 mark)

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In this lab the acceleration will be measured using either the PASCO acceleration carts or the wireless force acceleration probe and the SPARKVUE program

3. Explain how doing more than one measurement can reduce the error in the experiment? ( 2 marks – see textbook)

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**Method**

**Equipment required**

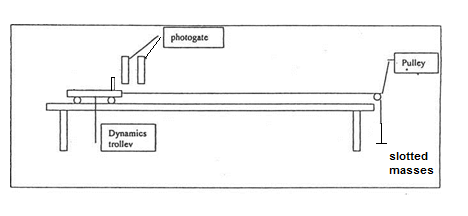
Acceleration cart or force acceleration probe

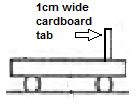
Slotted masses (10 x 50 g) *you don’t need the cardboard or photogate*

ipad Large masses ( 0.5 kg )

Pulley and clamp String

Dynamics trolley if you are using force acceleration probe



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**Method A: Variable force , constant mass**  (4)

**Independent Variable:** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Dependent Variable:** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Controlled Variables:** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Hypothesis-** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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1. Set up the equipment as shown above, ensure that you have some way of stopping the cart fall over the edge.
2. Place up to ten 50 g (including the stand) slotted masses onto the trolley and weigh it. Record the mass.
3. Whilst holding the trolley, take the 50 g stand mass from the trolley and attach it to the end of the string over pulley. (this mass provides the accelerating force (Eg F = mg) Note the total mass of the system has not changed.
4. Place the trolley as far away from the edge of the bench as you can, but with the 50g stand mass hanging over the edge.
5. Run the SPARKVUE program to measure acceleration
6. Release the trolley and record the acceleration.

(be sure to stop the trolley before any possible damage)

1. Repeat for another two trials.
2. Take another 50 g mass from the trolley and place it at the end of the string.
3. Repeat the procedure for 6 sets of data.

**Method B: Variable mass, constant force** (4 marks)

**Independent Variable:** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Dependent Variable:** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Controlled Variable:** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Hypothesis-** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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1. Set up the equipment as for the previous experiment.
2. Record the mass of the trolley and a 100 g mass. This is the **Total accelerated mass** for the first trial
3. Set the trolley in place the 100 g on the end of the string.

Note the 100g is the accelerating force

1. Run the program, release the trolley and record the accleration.
2. Repeat for another two trials before resetting the program
3. Place 200 g on the trolley and repeat.
4. Repeat the procedure using additional masses of 300 g, 400g, 500g and 600g on the trolley.

**Results Part A**  ( 6 marks)

Total mass of system = \_\_\_\_\_\_\_\_\_\_\_\_\_\_(kg)

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| Mass in pan (kg) | Accelerating force  Mass in pan x 9.8  (N) | Acceleration (ms-2) | | | |
| Trial 1 | Trial 2 | Trial 3 | **Average +error** |
| 0.05 |  |  |  |  |  |
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**Results Part B** (6 marks)

Mass of trolley \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_kg\_\_

Constant force = 0.1 x 9.8 = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_N

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| Mass on trolley  (kg) | Total accelerated mass  (Trolley + 0.1 + mass on trolley)  (kg) | acceleration(ms-1) | | | |
| Trial 1 | Trial 2 | Trial 3 | Average  +error |
| 0 |  |  |  |  |  |
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**Processing results**

**Part A**

1. Draw an appropriate graph of accelerating force and acceleration. ( 6 mks)

2. What is the shape of the graph? ( 1 mark)

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3. What is the mathematical term used to describe the relationship between accelerating force and acceleration? ( 1 mark)

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4. Use appropriate graphical techniques to determine the experimental value for the mass of the system and compare it to the measured value. Determine the percentage error and include a discussion on errors. Show all proof of working and logical explanations. (6 marks)

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**Part B**

1.By manipulating the given relationship (pre lab Q2) draw an appropriate **linear** graph of accelerated mass and acceleration. ( 6 marks)

2. What is the mathematical term used to describe the relationship between accelerated mass and acceleration? ( 1 mark)

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3. Using appropriate graphical techniques determine the experimental value for the accelerating force of the system and compare it to the measured value. Determine the percentage error and include a discussion on errors. Show all proof of working and logical explanations. ( 6 marks)

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**Conclusion**- Write appropriate conclusions for each part of the experiment ( 6 marks)

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