**TOTAL: /18**

**Motion PRAC 7: VERIFYING NEWTON II: ACCELERATION OF A VARIOUS MASSES BY A CONSTANT FORCE**

### *Background*

The purpose of this experiment is to investigate how the acceleration of an object depends on its mass when acted upon by a constant force. We will add mass to the glider to investigate the relationship between this acceleration and the mass.

### *Method*

1. Measure and record the following quantities:
2. Width of light shutter (card attached to glider) = 0.04 m
3. Separation of photo-gates = 0.5 m
4. Mass of falling object = 0.04 kg
5. Gravitational force acting on falling object (*W* = *mg*) = 0.392 N
6. Set up the glider several centimetres before the first gate so it can stabilise after it is released.
7. Repeat the experiment 3 times for each force to obtain an average acceleration and add an additional brass block to the glider to systematically increase the mass of the glider and hence the total moving mass.
8. Acceleration is determined using kinematics, because we can calculate an initial and final speed and we know the distance this has occurred over (separation of the photo gates).

Using the equation: , we can find the acceleration ***a***.

Make sure you understand this algebra before you start taking results.

1. Complete the following table with your results: [1]

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  | Gate 1 | | Gate 2 | |  |  |
|  | Glider Mass (kg) | Total Moving Mass (kg) | (kg) | Time (s) | Speed (m/s) | Time (s) | Speed (m/s) | Acceleration (m/s2) | Average acceleration (m/s2) |
| 1 | 0.0252 | 0.0292 | 34.25 | 0.052 | 1.05 | 0.031 | 1.290 | 1.073 | 1.079 |
|  |  |  | 0.038 | 0.769 | 0.027 | 1.481 | 1.084 |
|  |  |  |  |  |  |  |  |
| 2 | 0.0352 | 0.0392 | 25.51 | 0.047 | 0.861 | 0.034 | 1.176 | 0.659 | 0.667 |
|  |  |  | 0.065 | 0.615 | 0.039 | 1.025 | 0.674 |
|  |  |  |  |  |  |  |  |
| 3 | 0.0452 | 0.0492 | 20.33 | 0.046 | 0.870 | 0.033 | 1.111 | 0.712 | 0.611 |
|  |  |  | 0.047 | 0.851 | 0.036 | 1.212 | 0.510 |
|  |  |  |  |  |  |  |  |
| 4 | 0.0552 | 0.0592 | 16.89 | 0.049 | 0.816 | 0.036 | 1.052 | 0.568 | 0.584 |
|  |  |  | 0.056 | 0.714 | 0.038 | 1.191 | 0.599 |
|  |  |  |  |  |  |  |  |

1. Plot a scatter graph of **acceleration** (*y*-axis) vs. **total moving mass**. Include data, appropriate title and axis labels with appropriate units. [3]
2. Comment on the shape of the graph (part 6). Predict the relationship between the acceleration *a* and the total moving mass *m.* [2]

The graph is hyperbolic in nature there is a non-linear relation between the acceleration and the moving mass. And it would eventually level out into a near straight horizontal line.

1. Now, test your prediction. What possible “acceleration vs …” could you plot so as to obtain a straight line? Use the blank column to enter values for this new *x* data. [1 + 1 = 2]

*A plot of acceleration vs m-1 will give a straight positive line.*

1. Plot the new graph using the data from part 8. Include a trendline and R2 value. State the gradient. Where has this value appeared before? [5 + 1 + 1 = 7]

The gradient is 0.0289 which is like the moving mass

1. Write a suitable conclusion summarising your results (discuss what you see in each graph) and the relationship between acceleration, mass and a constant force. [3]

*The hyperbolic property of the initial graph is a property of newtons second law of motion where a = ​Fnet / Mtotal leading to a non-linear relation between acceleration and total mass when a constant force (in the form of the falling weights) is present. However, when inverting mass, it smooths out and linearises the data.​ As this would make the equation a = Fnet \* Mtotal*