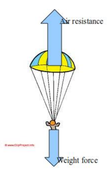
How is the Terminal Velocity of a Parachute affected by different masses?

Introduction

The experiment conducted was to investigate the Terminal Velocity of a parachute. Terminal Velocity is defined by the constant speed that a freely falling object (the parachute) eventually reaches, when the air resistance it is falling through prevents it from further acceleration. As the parachute falls through the air, there are forces acting upon it, these forces are the force of gravity pulling it down and the force of air resistance pushing upwards



According to Newton's second law Fnet=ma. R – Mg= MA. For the parachute to reach terminal velocity, the parachute will need to reach constant speed while free falling. When constant speed is reached acceleration is equal to 0. Therefore, R – Mg = 0 which can be rearranged to R= Mg, thus the parachute will reach terminal velocity when air resistance is equal to its weight.

Aim

The aim is to investigate the terminal velocity of a parachute and to observe how different masses of plasticine will alter the time taken for the parachute to reach its terminal velocity.

Dependant Variables:

- Terminal velocity
- Time taken for the parachute to reach the floor

Independent Variables:

- Mass of Plasticine

Controlled Variables

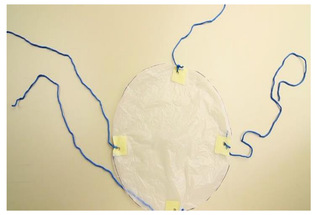
- The parachute
- The height of release
- The environment (i.e. Air Resistance)

Hypothesis

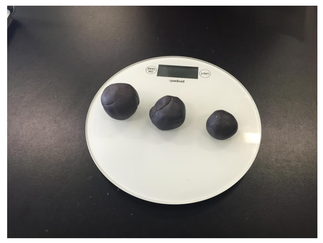
It is hypothesised that as the mass of plasticine is increased, the parachute will take a longer time to reach terminal velocity.

Method

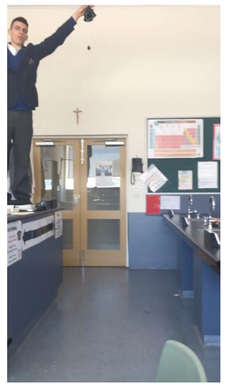
- The parachute was constructed using a plastic bag cut out in the shape of a circle.
- Several holes were placed within the plastic bag to place strings through to hold the plasticine all together at the bottom.
- Three different masses were created using plasticine, being 10g, 20g, and 30g.
- A total of three trials were taken for each mass, and measurements for acceleration, velocity, and time were recorded. Videos were taken of each trial, then the motion of parachute was analysed using Tracker.
- All masses were dropped from the same height.



The Parachute Model

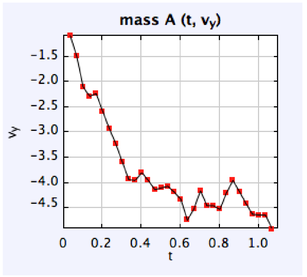


Plasticine balls of 10g, 20g and 30g weight

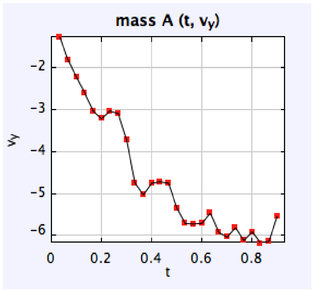


Parachute being released from a height of 2.87 meters in the school lab

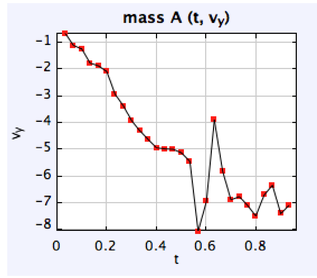
Results



Vertical velocity vs. Time graph for the 10g mass



Vertical velocity vs. Time graph for the 20g mass



Vertical velocity vs. Time graph for the 30g mass

According to Newton's second law, for a freely falling object to be accelerating, weight must be greater then air resistance. However when air resistance and weight are equal the object or parachute reaches terminal velocity. It can be drawn from the graphs that the time taken to reach terminal velocity is approximately the same despite the different mass' of the parachutes. It can also be seen that the lightest parachute has the smallest terminal velocity of 4units per second while the heaviest parachute had the greatest terminal velocity of 5 units per second.

Discussion

According to the graphs the parachute begins at initial speed of 0 m/s. As it begins to fall the mass of the parachute is greater than the air resistance thus the downwards acceleration is large which is shown by the steep line on the graph. At time t = 0.4 seconds it can be observed that the parachute reaches terminal velocity at this time shown by the horizontal line on the graph. After this time period, the air resistance becomes greater than the mass of the parachute causing it to decelerate and eventually stop which is represented by the gradient of the line from t =0.6s to t =1s being less than the gradient of the line from t =0s to t=0.4s.

Conclusion

It was hypothesised that as the mass of plasticine increases, the time taken for the parachute to reach terminal velocity is increased. By analysing the results, this hypothesis was rejected as all parachutes of different masses reached their terminal velocity at approximately the same time yet the measurement of this velocity differed, The heavier parachute recorded the greatest terminal velocity whereas the lighter parachute recorded the smallest terminal velocity.

Acknowledgements

Jacaranda Physics VCE Units 1 and 2 pages 154 to 159