Investigate to see if adding mass

Plan

Key Variables

* Drag, or air resistance, is a force that is a variable that can affect the accuracy of the results that we will get.

* Mass is a key variable too.

* Wind currents are a key variable.

* The height from which the cupcake cases are dropped.

Background Knowledge

Acceleration: Is the change in velocity of an object per unit time. This happens when two unbalanced forces act on each other.

Force: The force of weight makes any given object fall towards the earth’s centre. As the object falls it accelerates, because of its weight, till it reaches a speed, were it does not accelerate any more because the forces acting on each other; drag and the weight; become balanced, this is known as terminal velocity. Here are a few formulas that I know form previous encounters with this subject:

F = m * a

A = Change in velocity / time taken

A = F / a

A = V / (a * t)

The air resistance force, otherwise known as drag, acts in the exact opposite direction to the gravitational force (which acts towards the centre of the earth).

When the object hits the ground, the forces of the object that it lands on and the gravitational force, balance out which causes that object stay in a set position.

Previously, in measuring acceleration I measured the acceleration of a car; I used the following formula to find the rate at which the car accelerated:

Acceleration= change in velocity/time taken

I know that the more mass that the object has, the more gravitational potential energy it contains. For example, if drop a pair of keys and a brick, they will both hit the ground at the same time but the brick will make a dent in the ground while the keys will not have any impact on the ground.

Preliminary Work

For the experiment I am going to measure the rate at which a cupcake case falls to the floor. I am going to try to find out, by changing the mass of the cupcake cases, if the speed at which they accelerate affected.

Test 1:

For my Preliminary Work we dropped cupcake cases from 2. 5 meters, changing the mass of the cupcake case after dropping the cupcake case from 2. 5 meters three times. We increased the mass by adding one cupcake case to the cupcake cases after repeating the experiment three times. We

repeated this process until we obtained the result for 3 cupcake cases. These are our results for the first test.

1 cupcake case from 2. 5 meters

Attempt:

1

2

3

Average

Time (sec):

2. 00

1. 94

1. 81

1. 90

2 cupcake cases from 2. 5 meters

Attempt:

1

2

3

Average

Time (sec):

1. 50

1. 32

1. 51

1. 44

3 cupcake cases from 2. 5 meters

Attempt:

1

2

3

Average

Time (sec):

1. 19

1. 11

1. 20

1. 117

Test 2:

We then added two more cupcake cases to the results to see if we can notice anything that may stand out.

4 cupcake cases from 2. 5 meters

Attempt:

1

2

3

Average

Time (sec):

1. 17

1. 15

1. 03

1. 12

5 cupcake cases from 2. 5 meters

Attempt:

1

2

3

Average

Time (sec):

1. 16

1. 00

1. 09

1. 08

As you can see from the results above, they are not very accurate and because they are not very accurate I cannot use them for the final test. I will try several different methods to see if I can find some result that would be suitable for the experiment.

Test 3:

We will increase the mass by adding 2 cupcake cases every time. We will start with two cupcake cases and repeat the experiment until we reach 10 cupcake cases. We will drop the cases from 2. 5 meters and using a stopwatch, will record how long it takes the cupcake case to hit the floor from the time it leaves my hand.

Test 4:

I will weigh the cupcake cases and repeat the previous experiment. According to the structure going up by two. I will do this to see if the cupcake cases are of different masses.

Test 5:

I will change the height from which we drop the cupcake cases from 2. 5 meters to 2 meters. I will use the same method as I did in the second test.

Comment on the results

I believe that the most accurate method that we used was the method in the third test, as it seemed to be the best way of getting the results. In the first test we saw that the results fluctuated too much. And the second test was just an add-on to the first test and did not do much better, according to the accuracy of the results. I believe that we should take the weight of each cupcake case into hand to make sure that all the masses are the same.

Prediction

I think that the more mass that you add on to cupcake cases the faster that the cupcake case will accelerate. I believe if we were to drop the cupcake cases from about two meters higher and use the same method the cupcake case would reach terminal velocity. The reason that I think that our cupcake cases will not reach terminal velocity at 2. 5 meters is because whilst doing the preliminary work we never came across a constant speed at which the cupcake case reached the floor. I think that if the cupcake cases were raised up off the ground a few more meters they will have enough time to reach their terminal velocity. As the mass of the cupcake cases get heavier and

heavier I believe that the difference in the time it takes to hit the floor will become less. I base this upon our preliminary work where as the mass of the cupcake cases increased the difference between the times decreased.

When only one to three cases are dropped, the air resistance is considerably greater, causing increased times.

Method

1. First I will collect all the apparatus needed to perform the test.

2. I will than measure out 2. 5 meters and place the tip the long wooden ruler at the top of 2. 5 meters.

3. I am going to than set a stool up so that I can reach 2. 5 meters.

4. We will than collect two cupcake cases and drop it from 2. 5 meters when my partner says go.

5. My partner will use a stopwatch to time how long it takes for the cupcake cases to hit the floor.

6. We than will write down the results in a table.

7. We will repeat the test using two cupcake cases five times.

8. We than will move onto four cupcake cases and repeat the test again following the exact same method.

9. We repeat this process until we have reach 10 cupcake cases.

Apparatus List

* Cupcake cases

* Stool

* Long Wooden Ruler

* Stop Clock

* Clamp

* Scale

Controlling Variables

To make sure that my tests are fair I am going to:

* Make sure that all the cupcake cases weight the exact same amount. (Use a scale to measure the mass of each of the cupcake case.)

* Make sure that all the cupcake cases have the same shape. (The same amount of drag)

* Make sure that I always drop the cupcake cases for 2. 5 meters exactly.

* Make sure that there are no wind currents in the room. (Do the experiment with all the windows closed.)

Safety

* Make sure that the long wooden ruler is fastened securely to the clamp so that it does not hit anyone on the head.

* Make sure that the stool that we stand on to drop the cupcake cases is sturdy.

Table that I am going to put my final results in:

Time to fall 2. 5m (s)

Attempt:

1

2

3

4

5

Average

2 Cupcake Cases

4 Cupcake Cases

6 Cupcake Cases

8 Cupcake Cases

10 Cupcake Cases

Accuracy and Reliability

In making our results more reliable and accurate

* Instead of measuring our results to a tenth of a second we are going to measure to a hundredth of a second.

* We will make sure that 2. 5 meters is centimetre perfect.

* We will make sure that I drop the cupcake case at exactly the right time and that my partner presses the timer at exactly the right time.

Results

Time to fall 2. 5m (s)

Attempt:

1

2

3

4

5

Average

2 Cupcake Cases

1. 41

1. 09

1. 41

1. 52

1. 44

1. 42

4 Cupcake Cases

1. 64

1. 17

1. 18

1. 17

1. 09

1. 17

6 Cupcake Cases

1. 04

0. 89

0. 85

0. 85

0. 97

0. 96

8 Cupcake Cases

0. 83

0. 84

0. 95

0. 80

0. 85

0. 81

10 Cupcake Cases

0. 82

0. 80

0. 77

0. 79

0. 87

0. 80

All the cupcake cases had the mass of 0. 57g’s. So for two cupcake cases the weight was 1. 14g’s and so on and so forth.

Analysis

Attempt

Average fall Time

A = 2*d/t

2 Cupcake Cases

1. 42

3. 52 m/s2

4 Cupcake Cases

1. 17

4. 27 m/s2

6 Cupcake Cases

0. 96

5. 21 m/s2

8 Cupcake Cases

0. 81

6. 17 m/s2

10 Cupcake Cases

0. 80

6. 25 m/s2

Graph Analysis

In my Acceleration graph I was surprised to see an anomalous result, on my graph. But after I looked more carefully into the reason why there was this result, it because clear to me that the reason for this result is because the cup cake cases were nearing there terminal velocity. This therefore means that there were more air particles hitting the cases as they fell and this decreased the steady increase in acceleration. So I can concluded that this graph was correct and the anomalous result is supposed to be were it is.

In my time graph it is quite obvious that there is a steady decrease in time. This is what I expected from this graph because from my understanding of my results as the mass of the cupcake cases increases so does the time that it takes for the cases to hit the floor. This graph is very basic yet it can help you see these tests in a whole different light. There is a point that is slightly out of place but that has the same reason as my previous result, the cases are reaching terminal velocity.

Conclusion

After carefully looking over my results and my graph I have come to the distinct conclusion that the more mass a cupcake case/s has the greater the gravitational potential energy and therefore the faster that it will fall towards the earths centre. I have also seen from my results that they are not all valid. I had to choose two results that were not reliable for my test. This is because of human reactions, and natural causes like wind etc.

I would have liked to have raised the height from which we dropped the cases and see if they could reach there terminal velocity. We would extend our test further if it was not for the lack of time. I believe that if we were to raise the distance substantially we would find that the cases would reach their terminal velocity.

Evaluation

Overall I was quite pleased with my success in the experiments. Apart from learning many things through my study of physics I have been able to grasp, many formula, and other information about free fall. I will state that my results are not perfect to the hundredth of a second. This cannot be changed though. First of all my results will never be perfect because we as humans are not perfect, (we cannot press the start and stop button on the stop clock exactly on the hundredth of a second.)

Secondly not every cupcake will necessarily weigh the same. Although is shows all of the cupcakes weighing the same on the balance they theoretically speaking to not weigh the same to the thousandth. The reason that these results are not 100% perfect can never be solved, unless we are given advanced computerised equipment to perform the experiment.

I have predicted that I would come up with results that are very similar to mine. I knew that the greater the gravitational potential energy the time in which it takes for the cupcake case to hit the ground would be greater. I predicted that that there would be more air resistance when there is less cupcakes. This prediction was wrong. There is more air resistance as the mass of the cases increases.

I have come to the conclusion that the majority of my predictions have been correct. There have been faults in my tests but many of the faults I can blame on the earth, (e. g. wind). If I were to change anything to make my results more reliable I would increase the amount of times that I perform each test. I have learnt many things from performing these tests and have become more aware of why things fall at the speed they do.