Harry Mackarness
Candidate No. 9225

Physics Sc1 Coursework

‘Investigate the change in depth of a wooden “diver” as the dive height is altered’

Preliminary work and Research

Brainstorm:

Preliminary Prediction:

I predict that the depth to which the diver 'dives' will increase as its starting height increases.
The manipulated variable in this experiment will be the height from which the diver is dropped, and the dependent variables will be the diver, as it will always be the same, and also the volume of water in the measuring cylinder. I must keep both of the dependants the same as otherwise it would not be a fair test.

Necessary Equipment:

- Large measuring cylinder
- Stand
- Boss
- Clamp
- Cylindrical piece of wood attached to a piece of string to be used as the diver
- Metre rule or tape measure

If I am to be able to recreate the results from the experiment in repeat experiments, then I must keep all of the equipment the same and make sure that everything is repeated in exactly the same way.

The results from my preliminary investigation are below:

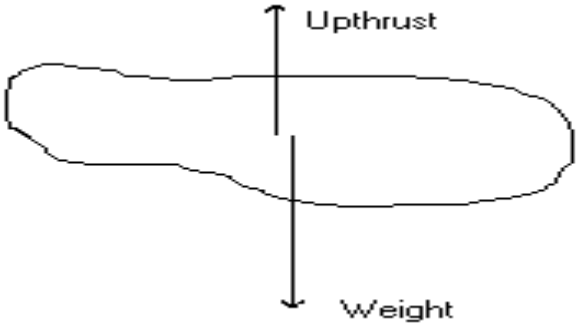
Dive Height (cm)	Dive Depth 1 (cm)
0	15
10	23
20	26
30	29
40	32
50	34

These results clearly show me that the higher the diver starts from, the greater the depth he reaches. The final dive, depth 34cm hit the bottom of the measuring cylinder, so it probably would have gone a little bit further, but it was still ahead of the other results, therefore it is not too big a problem. I

believe that the diver would have reached a greater depth if it had not been for certain forces acting upon it; as it was falling, air resistance slowed it down, when it hit the unbroken water the force against it was very strong, and finally as it was submerged the up-thrust force of the water made it slow down, therefore go less deep.

Archimedes Upthrust

The volume of water displaced by a body submerged in water is equal to the volume of the body - thus if this weighs less than the body then it will sink. On the other hand, if the displaced water weighs more than the body then the upthrust on the body exceeds its weight and the resultant upward force will push it up to the surface. Once there, the volume of the body remaining submerged will displace a volume of water the weight of which is equal to the weight of the body. With the upthrust and the weight now being equal, the body will remain in equilibrium



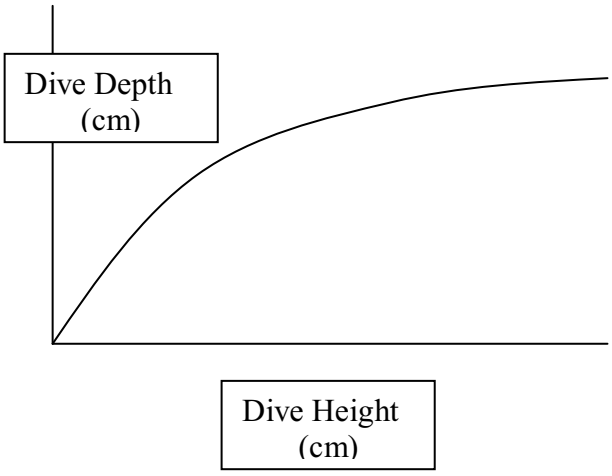
Prediction:

I am going to stick with my prediction from above, as I still believe that the greater the dive height, the greater the dive depth.

I believe that the higher the diver starts from, the deeper it will go. However, I think that this will only be true up to a certain point when the diver reaches terminal velocity. Once this speed is reached, it will not go any faster and therefore no deeper, theoretically. Unfortunately, the faster the diver travels, the greater the up-thrust force of the water that will act upon it.
The manipulated variable in this experiment will be the height that the wooden diver is dropped from, this will be increased from 0cm above the water at 10cm intervals until 50cm, and then it will be repeated. The diver will always be dropped from the stand, and the height will always be measured with the same metre ruler.

The dependent variables here will be the diver, as it must always be the same. Any change in the diver, such as increased surface area, could completely change the results. The other dependent variable will be the measuring cylinder and amount of water. I must use the same cylinder as if that were to widen or shorten then the results would also be completely thrown.

Here is what I predict my graph to look like when I have my results.



Method:

1. Collect all of the equipment stated above.
2. Fill the measuring cylinder full of water, and set up the stand.
3. Place the measuring cylinder underneath the stand.
4. Thread the string from the diver through the boss clamp, and hold it in place.
5. Once you have positioned yourself so that you can see how deep the diver dives, draw the diver to the correct height above the water, and let it go.

6. Watch carefully as the dive into the water and mark the lowest point on the measuring cylinder that it reaches.
7. This must be repeated six times for the heights 0cm, 10cm, 20cm, 30cm, 40cm, and 50cm. Make sure that the experiment is repeated and all of the results are carefully recorded in the table as shown below.

The other variables that I have identified and I cannot control are as follows:

When the diver makes contact with the surface of the water, it may hit unevenly therefore the divers trajectory through the water may be crooked, therefore this will affect the depth at which the diver dives to.

Another variable is that I have to do the experiment by myself therefore holding the string and trying to see where the diver goes is quite difficult therefore the results may not be entirely accurate.

In order to make it a fair test I must make sure the surface of the water is unbroken every time I do the experiment otherwise it may make entrance to the water easier or more difficult for the diver.

Another reason that the results may not be so accurate is that the scale which I am using to measure with is a meter ruler and the scale of the measuring cylinder, and unfortunately neither of these are very accurate.

Precision and Range

Precision is quite important in this exercise; however it is not vital that I have exact measurements in millimetres, that is why all my results will be in whole centimetres.

As I said above the precision will not be exact as I'm using not very exact scales, but it will be precise enough for me to carry out this investigation in a suitable manner.

In order to get more usable results I will repeat the experiment twice or maybe three times in order to get the results however if the results are very similar on the second dive as the first dive, I will not need to repeat it a third time.
Risk assessment

This experiment does not carry a huge amount of risks, however that does not mean that I should be careless whilst completing it. The things that I should watch out for all that the cylinder is made of glass and if I am not careful I may knock it over and injure those around me and also myself. Also the sender will be filled with water, if I was to knock this over it may make the lab floor, slippery therefore people may get injured.

Pre-prepared table

Below is a copy of my pre-prepared table, in this table I will record all of my results from the experiment.

Dive Height (cm)	Dive Depth 1 (cm)	Dive Depth 2 (cm)	Average Depth (cm)
0			
10			
20			
30			
40			
50			

Doing the Experiment:

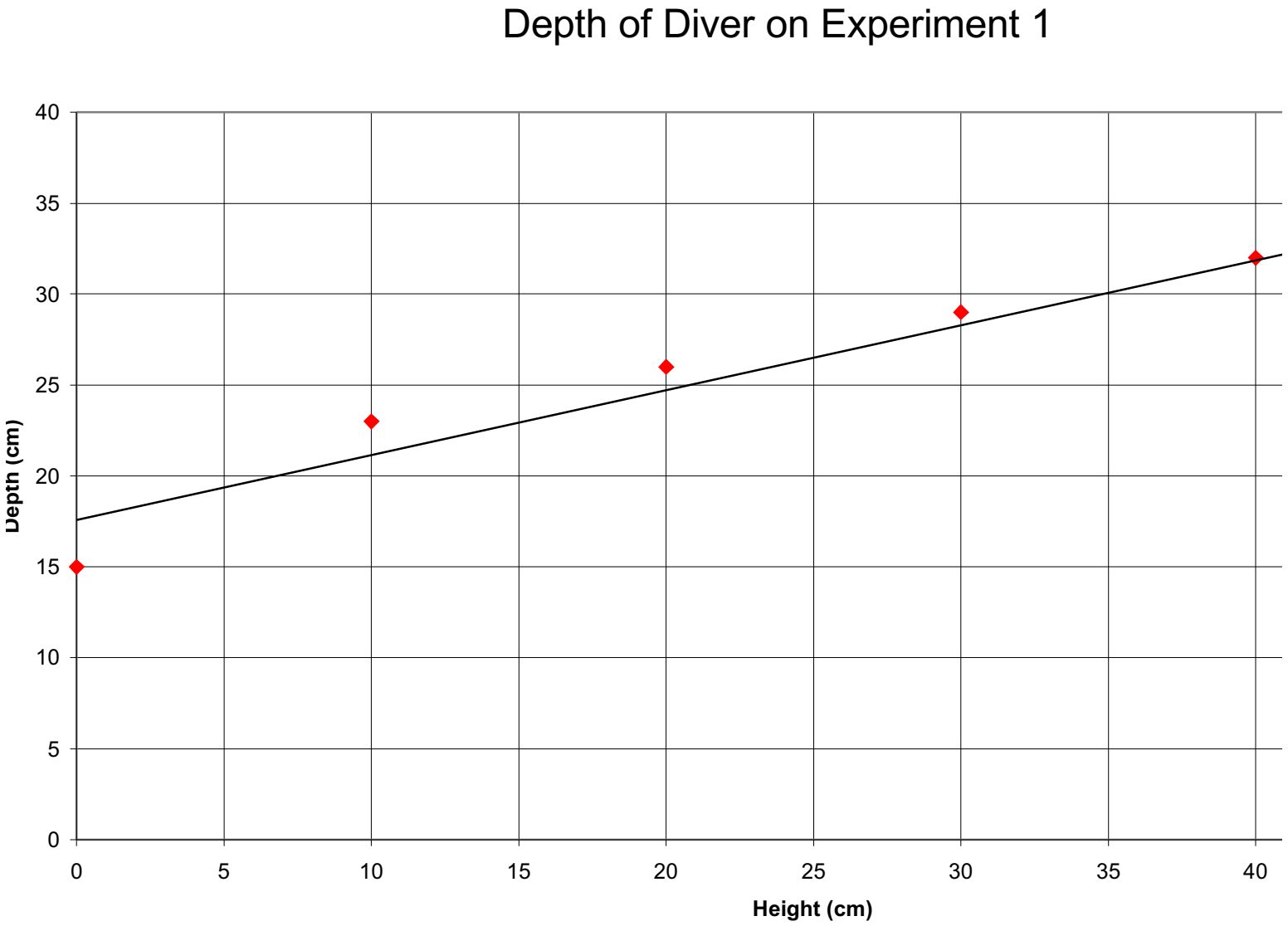
As I completed the experiment, I recorded all of my results in the table as shown above. The results are below, I believe that I completed this experiment in a satisfactory manner which meant that I was able to get good results and that they will be very useful in determining whether or not my prediction is right.

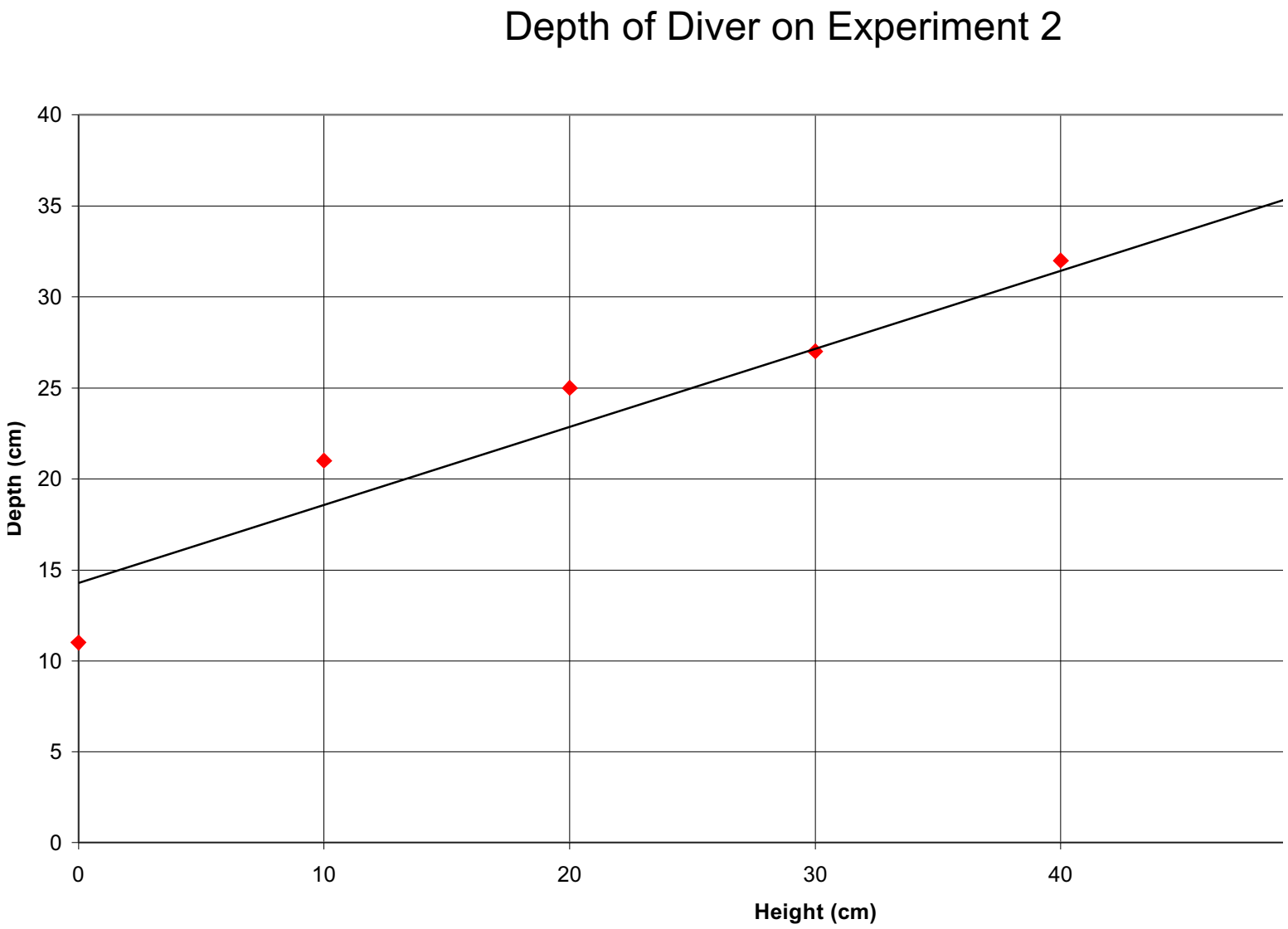
Although I expressed my concerns earlier about the accuracy of the scales I was using, I believe that the results came out very well and that the accuracy is fine. Here are my results, the average depth is expressed in the column on the right hand side of the table this is the value which I believe will be most useful to me.

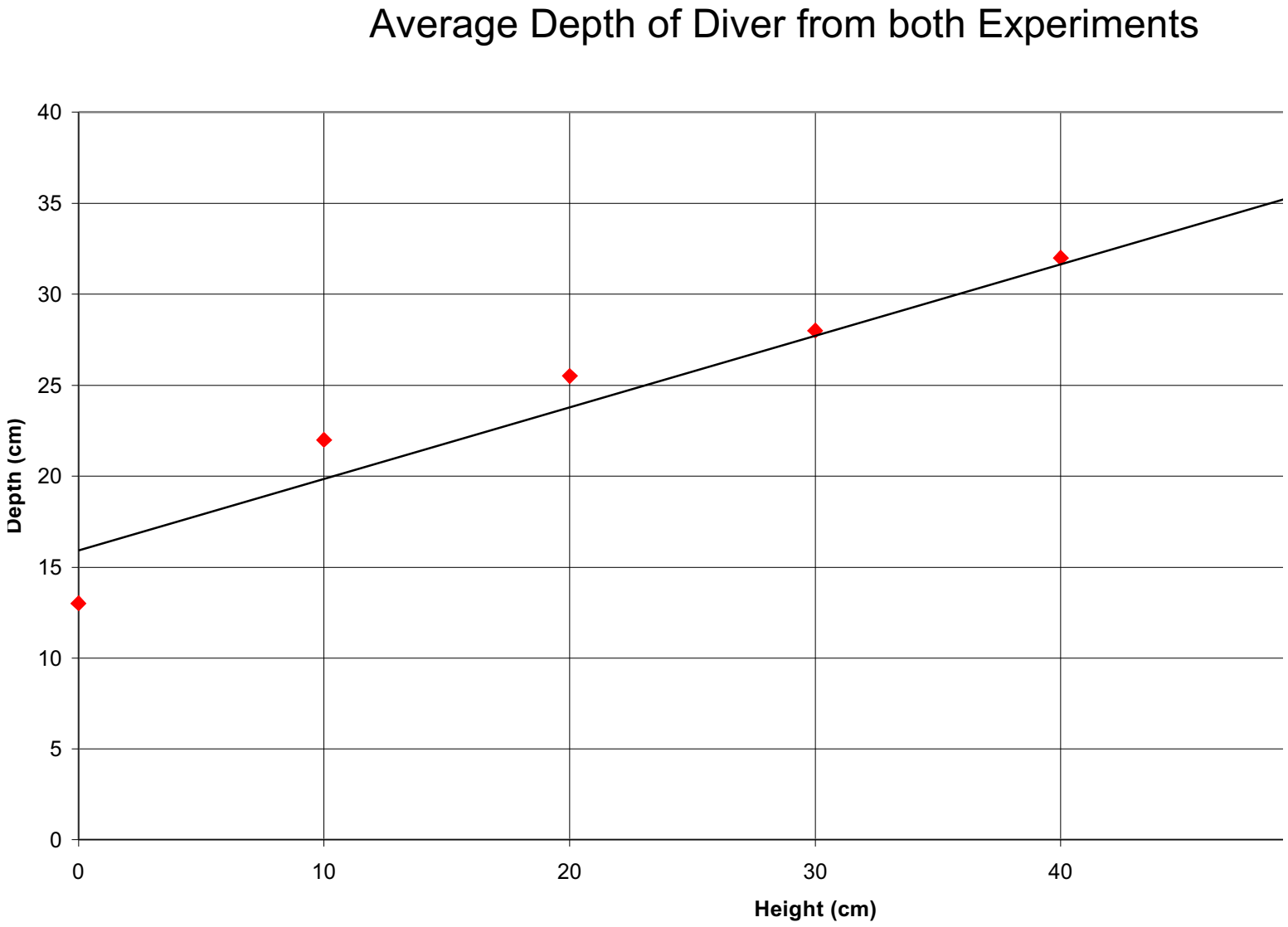
Dive Height (cm)	Dive Depth 1 (cm)	Dive Depth 2 (cm)	Average Depth (cm)
0	15	11	13
10	23	21	22
20	26	25	25.5
30	29	27	28
40	32	32	32
50	34	34	34

As you can see the results most them a very similar however the difference between the average depth from 0cm and the average depth from 10cm is a very large difference in deed.

These results seem to concur with my hypothesis that as the dive height increases the dive depth increases as well. The next few pages will contain graphs showing how the depth relates to the height in a pictorial manner.


Depth of Diver on Experiment 1
Depth (cm)
Height (cm)
0
5
10
15
20
25
30
35
40


Depth of Diver on Experiment 2
Depth (cm)
Height (cm)
0
5
10
15
20
25
30
35
40
0
10
20
30
40


Average Depth of Diver from both Experiments
Depth (cm)
0
5
10
15
20
25
30
35
40
0
10
20
30
40
Height (cm)

These results are very strongly correlated, and therefore would seem to support my hypothesis. All of the graphs show that as the dive height increases so does the dive depth. However there is one thing which I did fail to predict in the earlier part of this experiment, I felt that the line and would flatten off as it got high and would eventually become a flat line however this was wrong and I can see from the graph that the results make an almost straight line .

Although the prediction of the shape of the graph was wrong, my overall hypothesis was right. My conclusion from this graph is that the maximum depth of the diver does increase as the dive height is elevated. This shows that my theory was correct, I predicted that as dive height increases, so does the depth of the diver and as my results show, this is right. The higher the diver dives from the more time and has to get to a faster velocity and eventually will reach terminal velocity, and therefore it will not die if any deeper once it has reached its velocity however as it is accelerating with more than height it will dive deeper.

Procedure:

I believe that the procedure went very well as there were no major faults and I did not have to restart the experiment at any time. As I said earlier I believe the only files was the fact that my quip and was not hugely precise and therefore up had not had to measure by eye, I believe that these results would have been far more useful. I also think that if I have had some way to make sure all but the diver always entered the water at the same angle that would have better too.

Quality of Evidence:

In general, I think that the results which I collected from this experiment were very good, despite the fact that there were some factors which I could not control. Obviously the results are not perfect but they are very good considering the standard of the equipment I used and the affecting factors.

I repeated each height twice, therefore hopefully pointing out any anomalous readings, of which there were none. Although they were repeated, they still would not be the same. However good my evidence seems to be, I can never expect to repeat the same results with the methods I used, therefore I would need far more sophisticated equipment.

Anomalies in Results

I did not get any anomalous results in my evidence, however the only strange reading was when the diver was dropped from 0cm; the gap between the depths of this and 10cm were very large.

Further Work

There is not a great amount of further work that can be done with this experiment, apart from changing the masses, shapes, and heights of the diver(s). If the diver were to be heavier or fatter, then it would hit the water differently, therefore altering the results.

I believe that doing some more research with many more heights to diver from would give me a greater insight into the trends and patterns that occur in the results from this experiment; I may even find out whether or not the graph flattened off.