Physics: Squash Ball Coursework

It has been observed that squash players seem to warm there ball up before a game, and it seems to affect the bounce.

Variables

There are several factors which will effect the bounce of the ball, They are:

- The height that the ball is dropped from.
- The temperature of the ball.
- The mass of the ball.
- The force at which the ball is thrown with.
- The surface of the ball (if it is hard or soft)

The factor I am going to look at will be the temperature of the ball when it is dropped.

The variables that I will not change are

- The height that the ball will be dropped from,
- The ball I will use and
- The surface the ball is dropped on.

I will use all the same equipment. The only thing I will change is the temperature of the water, and in turn the ball

Equipment list:

- 1 squash ball
- 1 clamp stand
- 1 table
- 2 meter sticks
- 1 heat mat
- 1 tripod
- 1 gauze
- 1 beaker
- 100cm³ of water
- 1 thermometer
- 1 pair of tongs
- Several paper towels

Diagram

Preliminary work

Before I conducted my experiment I carried out some preliminary work. The aims of this work were to find a suitable height for me to drop the ball from and to decide what temperatures I would use when heating the ball.

I heated up a beaker with 100ml of water in it. I also had a squash ball in the beaker. I heated it up to 50°C, when the ball was at the right temperature, I dropped the ball from 2 meters. A person was lying on the floor with their head level to where they predicted the ball would boun ce. This

person recorded the height of the bounce. I put the ball back into the beaker and heated the water up to 60°C, 70°C, 80°C and 90°C. and repeated the experiment

The ball bounced higher when the water it had been in was heated to a higher temperature.

I have decided that I will drop the ball from 2 meters. This will make it easier to see and measure the differences between the different bounces. This is because as the ball drops from 2 meters it will gain more kinetic energy as say it was dropped from 1 meter. This means when it hits the ground there is more energy which can be converted into propelling the ball back into the air.

I will drop the ball when the temperature of the water is 20°C, 30°C, 40°C, 50°C, 60°C, 70°C, 80°C, 90°C, and 100°C, This will also help me to see the differences in bounce height because the numbers are well spaced. I will heat the ball in water as I have found it the easiest and most efficient way to heat the ball. To measure the bounce height I will put my head level to t he point where I think the ball will bounce. I will also measure the height the ball bounces 3 times instead of one, as this will enable me to reach a higher level of accuracy.

Preliminary Work Results

Temperat-ure (◇c)	50◇c	60◇c	70◇c	80◇c	90◇c
Height (cm)	50	63	76	93	101

Method

1. Collect all the equipment listed above.
2. Set the equipment up as in the diagrams.
3. Place the squash ball into the beaker and begin to heat the water. Heat it until the thermometer reaches 20°C. When this occurs quickly remove the Bunsen burner so that the water does not keep heating. Remove the ball using the tongs and dry it using a paper towel, this is to remove any water from the ball. Water may effect the bounce height and there is no way of making sure that each bounced ball has the same amount of water on it, so it is best to remove all water. Try to do this quickly so the ball does not lose too much heat and then drop it from two meters. A person should lie on the floor with his eyes level with the point where he expects the ball to bounce.
4. Record the measurement using the meter stick and someone's eyes. Wipe the floor of any water because this may effect the bounce height. Put the ball back into the water to reheat the ball. Reheat the water if necessary. Drop the ball two more times, stopping in between to reheat the ball.

5. Repeat these steps except heat the ball to 30°C, 40°C, 50°C and so on until you reach 100°C.

Safety measures

- I will wear safety glasses at all times to prevent and water splashing in my eyes.
- I will lift the squash ball out of the water with a pair on tongs so that I do not burn myself.
- When the person lies on the floor I will make sure no one is behaving inappropriately so nothing gets pushed over on them.

Prediction

I predict that the higher the temperature of the water and ball, then the high er ball will bounce.

This is because as the rubber becomes softer and more elastic it is able to transfer more of its original gravitational potential energy to elastic potential energy. Because of he increase in elastic potential energy more kinetic energy can be given to the ball to make it bounce higher.

Results:

Temperature of water that the squash ball was placed in (°C)	Height of first bounce when the ball was dropped from 2 meters (cm) (result 1)	Height of first bounce when the ball was dropped from 2 meters (cm) (result 2)	Height of first bounce when the ball was dropped from 2 meters (cm) (result 3)	Average height of first bounce when the ball was dropped from 2 meters. (cm) (Average)
20	36	36	37	36.3
30	38	38	39	38.3
40	42	44	43	43
50	49	51	52	50.6
60	63	63	62	62.6
70	76	75	75	75.3
80	92	92	91.5	91.8
90	99	102	99	100
100	109	108	110	109

Graph:

See following page.

Conclusion

My graph shows that there is a positive corr elation between the temperature of the ball and the height of the bounce. It also shows that as the temperature of the ball increase, the height of its bounce when dropped from 2 meters increases. My prediction was:

"I predict that the higher the tempera ture of the water and ball, then the higher the ball will bounce.
         This is because as the rubber becomes softer and more elastic it is able to transfer more of its original gravitational potential energy to elastic potential energy. Because of he increase in elastic potential energy more kinetic energy can be given to the ball to make it bounce higher. "

After carrying out the experiment I have found my prediction was wrong.
I have found when the molecules of air are heated they gain more energy so will move faster. This means they will hit the sides of the ball at a faster rate causing a higher pressure inside the ball. The ball will become more firm and harder to squash. This means that when the ball hits the floor it will not squash as much, and less s urface area will touch the ground. This means that less energy is lost through the ball to the floor and the ball will bounce higher. However I also found the increase in heat did cause the surface of the ball to become softer because the ball increased in size slightly, but this did not affect how high the ball bounced.

Evaluation:

I have no anomalous results. All my results follow the pattern and fit well into the pattern. My results are by know means exactly correct but they are not positioned far from the line of best fit. This shows that I did conduct my experiment effectively and reliably. This means it would be difficult to improve the reliability of my results, this is because the experiment was carried out in a school science lab, and a school wo uld not possess the equipment needed to gather more accurate results.

Further Work

To extend the investigation and gain more data I could carry on the experiment by heating the ball past 100 ◇c to see when the line of best fit would start curving toward s its maximum bounce height and stop increasing. I could also take the temperature of the ball into minus temperatures to see how the shape of the graph was altered, and try and discover the temperature at which the ball would just hit the ground and not b ounce.