Iona Physics
Lab: Inelastic Collisions and COR

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In a perfectly elastic collision (like perfect gas molecules smacking into each other) kinetic energy is conserved. If it were not, then the temperature (which is a measure of average kinetic energy of the molecules) would be constantly decreasing.
In an inelastic collision, some of the kinetic energy is converted to some other form of energy, and thus the kinetic energy decreases with each collision. Consider a bouncing ball, for example. If you drop it from a given height, it will not bounce back to the same height, some of the energy will be lost and it will rebound to a lesser height with each bounce.

There are a couple of ways of looking at this. You may look at what fraction of energy is retained in each collision, or you may look at a parameter which is called the Coefficient of restitution. The Coefficient of Restitution (COR) is defined as follows: COR = sqrt(h2/h1)
Where h2 is the height of the second bounce and h1 is the height of the first bounce.

In this experiment you will compare the CORs of two different balls. You can use whatever you happen to have. Perhaps a ping pong ball, a golf ball, a lacrosse ball, a super ball. Whatever.

Procedure:

1. Start Phyphox using the (in)elastic collision function. It will listen for the sound of bounces, and record the amount of time between bounces. Because you are listening for bounces, this needs to be performed in a relatively quiet area. Also, you may need to go to the settings tab and adjust the Threshold so that ambient noise does not trigger the timer.
2. Choose a height (I suggest 0.5 meters - or about 20 inches) from which you will drop the ball.

3. Go to the Heights tab in Phyphox. Start collecting data by pushing the little triangle. It may take several trials before you get a good set of data because the ball may take a crazy bounce, or hit something.
4. Using the heights tab, make a data table USING YOUR NUMBERS, Not mine. The first column will have height number, the second the height, the third the ratio of the previous height to the current one, and the fourth will be the square root of the third.
5. The Coefficient of restitution is the average of the last column.
6. Because instruction 4 is a bit difficult to understand, I've provided an example. Your data table should look like the following, but using your numbers, not mine.

	Heights (cm)	Ratios	COR
		h(n)/h(n-1)	sqrt(h(n)/h(n-1))
h(0)	52.49		
h(1)	43.23	0.8235854448	0.9075160852
h(2)	35.6	0.8235021975	0.9074702185
h(3)	29.8	0.8370786517	0.9149200247
h(4)	24.82	0.832885906	0.9126258303
h(5)	19.73	0.7949234488	0.8915847962
	Average	0.8223951298	0.906823391

In this case the conclusion would be "The COR was measured to be 0.907"

Incidentally, note that the second and third columns are ratios of similar items, therefore there are no units, because they cancel out.

Here is a video which demonstrates this experiment.
https://www.youtube.com/watch?v=ikvtPDwV1FE