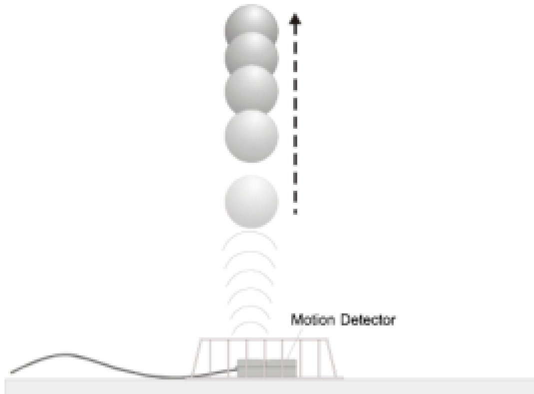
ENERGY OF A TOSSED BALL



When a ball is tossed straight upward, the ball slows down until it reaches the top of its path and then speeds up on its way down. In this experiment, you will study energy changes using Logger *Pro*.

<u>PURPOSE</u>: To measure the change in kinetic and potential energies as a ball moves in free fall and to see how the total energy of the ball changes during free fall.

<u>MATERIALS</u>: motion detector, soccer ball, 4 books

Before going to the program, answer the following questions (or make the following predictions).

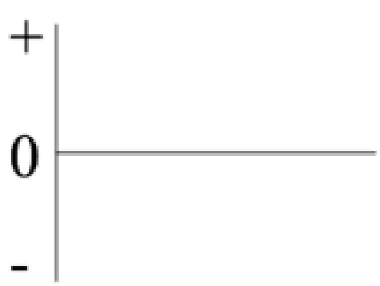
1. As the ball rises, what happens to its kinetic energy?

2. As the ball rises, what happens to its gravitational potential energy?

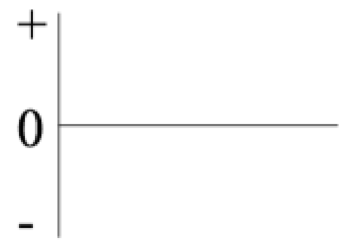
3. As the ball rises, what happens to is total energy?

4. What form of energy does the ball have while momentarily at rest at the top of the path?

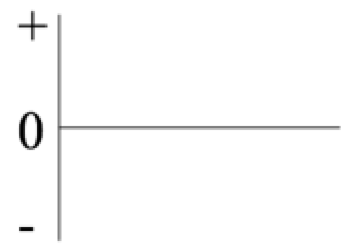
5. Sketch a graph of displacement vs. time for the ball from when it leaves the hand to when it returns.



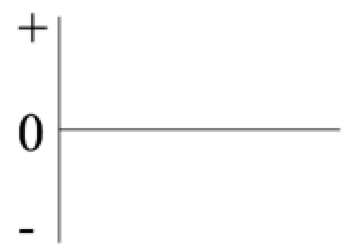
6. Sketch a graph of velocity vs. time for the ball from when it leaves the hand to when it returns.



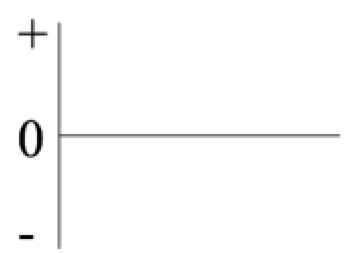
7. Sketch a graph of kinetic energy vs. time for the ball from when it leaves the hand to when it returns.



8. Sketch a graph of potential energy vs. time for the ball from when it leaves the hand to when it returns.



9. Sketch a graph of total energy vs. time for the ball from when it leaves the hand to when it returns.



PROCEDURE:

A. Connect the motion detector to the LabQuest. Place the motion detector on the lab bench and protect it by placing two books on either side. Just like in the previous tossed ball lab, use two hands to gently toss the ball straight up and don't catch it on its way down. Verify that the distance *vs*. time graph corresponding to the free-fall motion is parabolic in shape, without spikes or flat regions, before you continue. This step may require some practice. If necessary, repeat the toss, until you get a good graph.

B. Display both position vs. time and velocity vs. time graphs on your Labquest. You should be able to move the styls across either graph and see what the distance and velocity are at any given point in time. Choose a time when the ball had left your hands and was in free fall and was still traveling up. Record that time in the chart below along with the corresponding height and velocity. Do this for 2 more data points on the way up.

C. Do the same for when the ball is at its highest point. You may not be able to hover over the exact spot when the speed is zero, but that's fine. Just get a point that's as near to the top as you can.

D. Repeat three more times when the ball is traveling down but before it lands on the books.

Position	Time (s)	Height (m)	Velocity (m/s)	K (J)	U (J)	E (J)
Traveling Up (1)						
Traveling Up (2)						
Traveling Up (3)						
Top of path						
Traveling Down (1)						
Traveling Down (2)						
Traveling Down (3)						

E. For each of the points in the data table, **calculate** the Potential Energy (U), Kinetic Energy (K), and Total Energy (E) by hand. The total energy is the sum of the Potential and Kinetic Energies. Use the position of the Motion Detector as the zero line for your gravitational potential energy. Find the mass of your ball using the balance.

F. Create new columns in your data table in the Labquest for K, U, and E. Enter your data in these columns.

G. Display the three graphs on your screen - kinetic, potential, and total energy. Zoom in on your time frame. Draw these three graphs below on the same set of axes. Label on your graphs which line corresponds to which type of energy.

H. In the space below, summarize in a few sentences what happens to the kinetic, potential, and total energy of the ball as it moves up and down in free fall. Does the total energy of the ball remain constant? Should the total energy remain constant? Why? For ideal results, where should this experiment be performed?