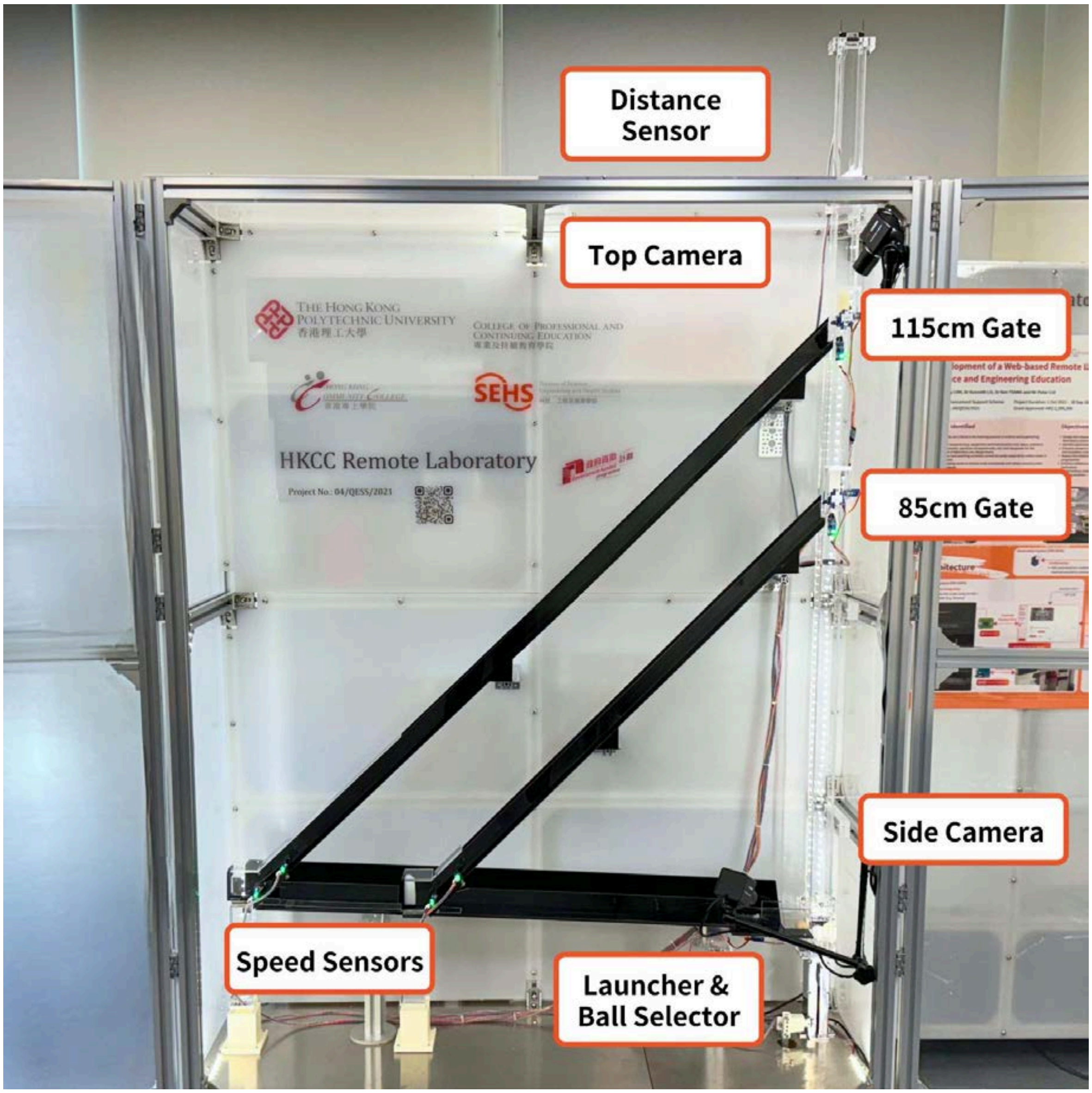
The Hong Kong Polytechnic University
College of Professional and Continuing Education
Hong Kong Community College

HKCC Remote Laboratory System*
Mechanics Experiment: Conservation of Energy Laboratory Worksheet



*HKCC Remote Laboratory is a web-based service to enable remote off-campus access to experimental sets for science and engineering students. The Remote Lab was financially supported by the Quality Enhancement Support Scheme of the Hong Kong Special Administrative Region Government (QESS, HKSAR) and Hong Kong Community College of The Hong Kong Polytechnic University (PolyU HKCC), under the project title, "Development of a Web-based Remote Laboratory for Science and Engineering Education", and project no.: 04/QESS/2021.

Objective

In this experiment, you will investigate two kinds of mechanical energy: kinetic energy and potential energy. You will carry out an experiment that demonstrates the conservation of the total mechanical energy of a system.

Theory

Elastic Potential Energy is the energy associated with the compression or extension of an elastic object, like a spring. It can be calculated by

$$E.P.E. = \frac{1}{2}kx^2$$

where *k* is the spring constant and *x* is the displacement of spring.

Gravitational Potential Energy (or ***Potential Energy***) is the energy associated with an object due to its position in the gravitational field. It can be calculated by

$$P.E. = mgh$$

where *m* is the mass of an object, *g* is the acceleration due to gravity, and *h* is the height of an object.

Kinetic Energy is the energy associated with the motion of an object. It can be calculated by

$$K.E. = \frac{1}{2}mv^2$$

where *m* and *v* are the mass and speed of an object respectively.

Part 1 of the experiment

The vertical spring in the launcher will be compressed by a designated downward displacement. Once the trigger is released, the ball will be launched with its maximum initial velocity and travel upward in air with decreasing velocity (*v*) as its height (*h*) increases to the maximum value. The total energy of the ball remains constant in an ideal case, i.e. E. P. E. stored in spring = max. K. E. of the ball = max P. E. of the ball. At any time during the ball's flight in the air, K. E. + P. E. will be constant.

Part 2 of the experiment

The ball is now resting at a certain height on the track. Once the gate is open, the ball will be rolling down from the track freely. The ball starts with all potential energy at the top, and ends up with all kinetic energy at the bottom. At any time during its rolling, K.E. + P. E. will also be constant.

Procedure

1. Select the ball materials (wood or plastic) and height for rolling down through the track (85 or 115 cm) under the “Controls” tab. Then, click “Start” button to begin the experiment.

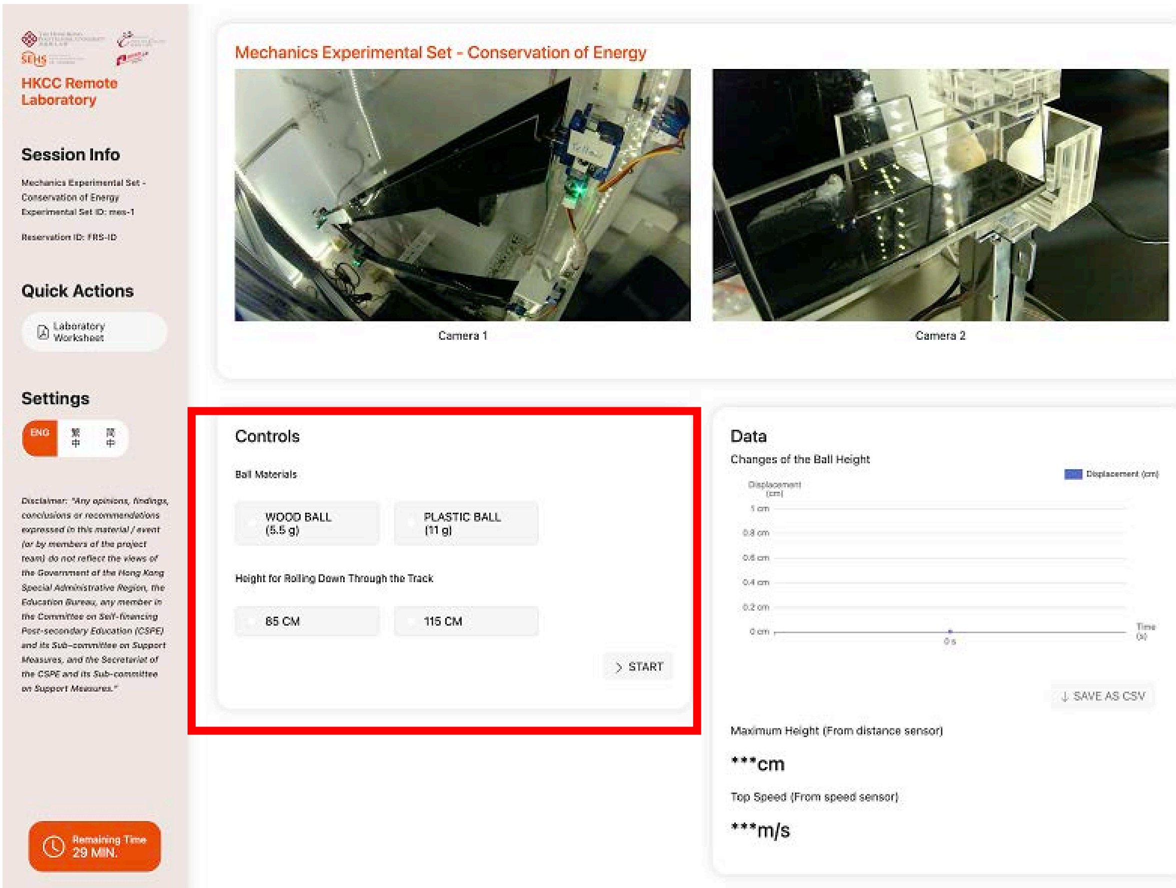


Figure 1. Select the ball materials and height for rolling the ball down the track.

2. Observe your selected ball will be placed to the spring launcher. You can click on the live Camera 2 to enlarge the view.

3. Then, the spring within the launcher will be compressed by the trigger. The ball will be fired vertically, and the change of ball height will be recorded by the distance sensor automatically after the release of the trigger.

4. The ball will be held at your selected height. You can click on the live Camera 1 to enlarge the view. The ball will then roll down from the track automatically.

5. Record the maximum (vertical) height of the ball and the top speed from rolling down the track from your selected height (Figure 2), and other settings in the “Data” Section below.

6. The change of ball height can be downloaded in .CSV format for further analysis (Figure 2).

7. You may start a new trial of the experiment with same or new settings.

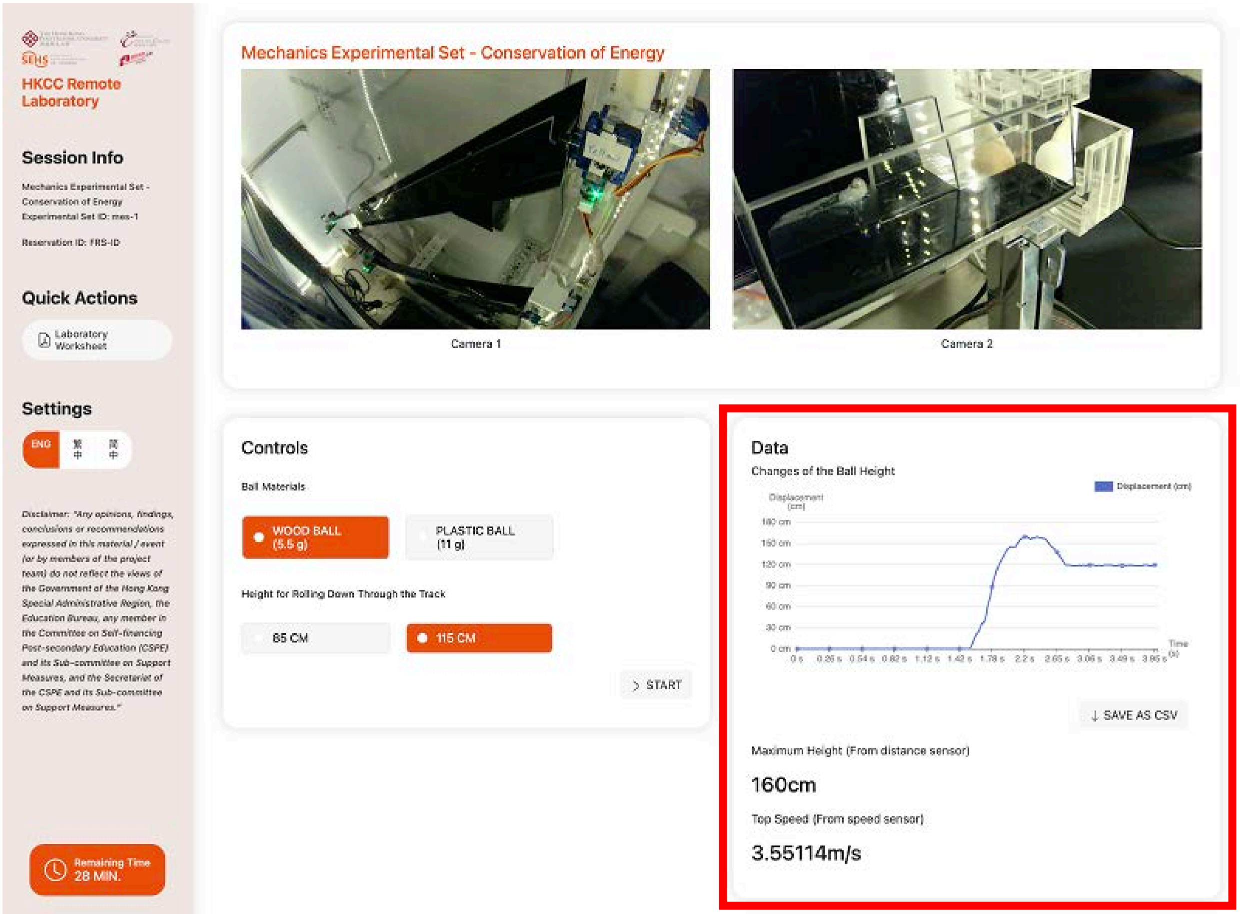


Figure 2. The experimental result.

Data

Trial	Ball Materials Selected (Wood or Plastic)	Height for Rolling Down through the Track (115 or 85 cm)	Maximum Height (cm)	Top Speed (m/s)
1				
2				
3				
4				

Analysis and Discussion

8. Calculate the elastic potential energy stored by the spring in the launcher if the spring constant (k) is 22 N/m. Given the displacement of spring for wood ball is 8.8 cm and plastic ball is 7.6 cm respectively.

Elastic Potential Energy (E.P.E.) Stored	
E.P.E. (wood ball)	
E.P.E. (plastic ball)	

9. Calculate the (average) potential energy stored by the ball after reaching its maximum height after launching.

(Average) Potential Energy (P.E.) Stored (at its maximum height)	
P.E. (wood ball)	
P.E. (plastic ball)	

10. Calculate the (average) kinetic energy of the ball as rolling down through the track.

(Average) Kinetic Energy (K.E.) of the ball	
K.E. (wood ball)	
K.E. (plastic ball)	

11. Does the total energy for the ball remain the same in part 1 and part 2 of the experiment? Explain why and why not.

End of Laboratory Worksheet