

**CIE On-line Science Simulations - Ball and Ramp Student Worksheet**

**Task 1**

To investigate how the displacement of the ball along a horizontal ramp is dependent on its initial velocity.

**Instructions:**

Select under Gravity "Earth".

Select under Ramp "1 Section of Ramp".

Raise the left-hand pillar supporting the ramp to its maximum height.

Raise the right-hand pillar to its maximum height.

Place the ball at the left-hand end of the ramp and notice that the displacement arrow is set at zero.

Select an initial velocity of +1m/s.

Start the experiment.

- a) Calculate the gradient of the displacement – time graph obtained.
- b) Repeat the experiment with initial velocities 2, 3, 4 and 5 m/s.
  - (i) How does the gradient of the graph change as the initial velocity increases?
  - (ii) For each experiment record the initial velocity and the displacement of the ball at 3 s in a table.
  - (iii) How does the displacement of the ball at 3s depend on the initial velocity?
- c)
  - (i) How would you expect the results to change if it were carried out on Mars with an initial velocity of 5 m/s?
  - (ii) Select under Gravity "Mars" and check your answer.



## Task 2

To investigate the behaviour of a ball rolling up a ramp.

### Instructions:

Select under Gravity "Earth".

Select under Ramp "1 Section of Ramp".

Ensure that the height of the left-hand pillar is at its lowest value.

Ensure that the height of the right-hand pillar is at its largest value.

Ensure that the initial displacement of the ball is zero.

- a)      Select an initial velocity of 4 m/s.  
          Start the experiment.
  - (i)      Relate the shape of the graph to the motion of the ball up the ramp.
  - (ii)     Use the graph obtained to estimate the time taken by the ball to reach its maximum displacement. (Use the middle point of the flat section of the graph at the top of the curve.)
- b) Repeat the experiment with an initial velocity of 2 m/s.
  - (i)      Estimate the time taken by the ball to reach its maximum displacement in this case.
  - (ii)     Calculate the ratio:

$$\frac{\text{time taken in (a)(ii)}}{\text{time taken in (b)(i)}}$$

b) Repeat the experiment with initial velocities of 5, 3, and 1 m/s.

(i) Complete the table below using the values already obtained and the three new graphs.

initial velocity/m/s	time to reach maximum displacement/s
5	
4	
3	
2	
1	
0	0

(i) Plot these readings on graph paper, with time along the horizontal axis. Draw the best straight line through the points.

(ii) Calculate the gradient of the line.

b) Clear the graph.

Select an initial velocity of 2.5 m/s.

Start the experiment.

Repeat the experiment having selected under Gravity "Mars" and then again having selected "Moon".

(i) Account for the different appearances of the three graphs. Use the word "acceleration" in your answer.

(ii) The gravitational field on the planet Jupiter is much stronger than that on the Earth. If the experiment were performed near the surface of Jupiter how would the graph obtained compare with the three graphs already obtained? You may sketch a graph if you wish.