

Racing Marbles: Final Velocity

Teacher's Notes

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|-------------------------|------------------------|
| Main Topic | Energy |
| Subtopic | Conservation of Energy |
| Learning Level | Middle |
| Technology Level | Low or High |
| Activity Type | Student |

Description: To compare the final velocities of two marbles that roll on two different ramps that share starting and ending points.

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|--------------------|---|
| Required Equipment | Racing Marbles apparatus, one $\frac{3}{4}$ " steel marble, photogate and datalogger OR carbon paper, tape and meter stick. |
| Optional Equipment | |

Educational Objectives

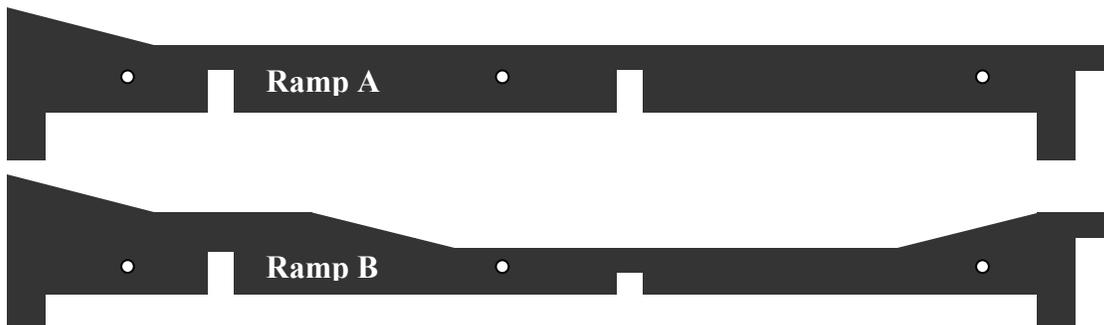
- To compare the final velocities of two marbles that roll on two different ramps that share starting and ending points.

Key Question

- How does the shape of an object's path affect its final velocity?

Concept Overview

A marble will roll on different paths, starting and ending at the same height. Students will predict and then measure the final velocities of the marble. Ramp A is the nearly horizontal ramp, and Ramp B dips down in the middle.



Because the ramps start and end at the same elevation, a marble rolled on Ramp A will end with the same velocity as one rolled on Ramp B, even though they take different times to complete the trip.

Lab Tips

Follow this lab with Racing Marbles: The Race to help students recall what they learned earlier about average velocity.

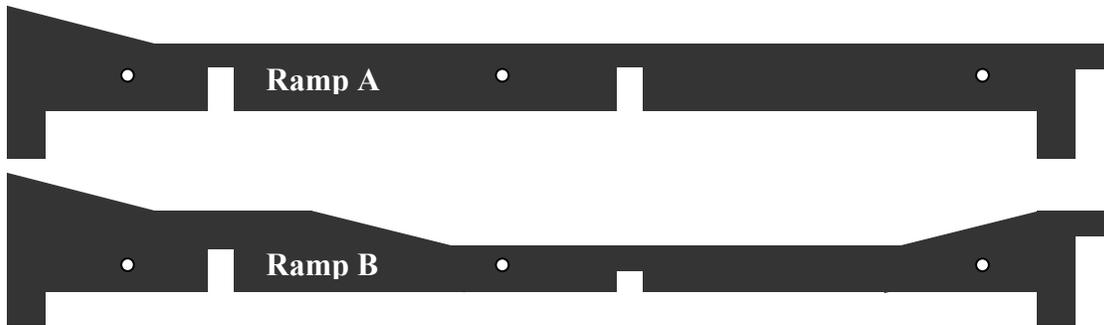
Racing Marbles: Final Velocity

Objective: To compare the final velocities of two marbles that roll on two different ramps.

Materials: Racing Marbles apparatus, one $\frac{3}{4}$ " steel marble, photogate and datalogger OR carbon paper, tape and meter stick.

Background:

A marble will roll on different paths, starting and ending at the same height. Students will predict and then measure the final velocities of the marble. **Ramp A** is the nearly horizontal ramp, and **Ramp B** dips down in the middle.



Procedure:

1. Place the Racing Marbles apparatus on a level table or floor.
2. Prediction: Which ramp causes the marble to have the higher final velocity (as it leaves the end of the ramp)? _____
3. Hold the marble at the top end of Ramp A. Release it and observe.
4. Hold the marble at the top end of Ramp B. Release it and observe.
5. Describe your observations. Can you confirm or deny your prediction from #2?

6. If you have a photogate available, continue with #7. Otherwise, skip to #12.

Racing Marbles I

Name: _____

Class: _____

Quantitative Analysis using a Photogate

7. Place the photogate at the very end of Ramp A and program the datalogger to display velocity. (The ball's width is 1.9cm.)
8. Release the marble on Ramp A and record its final velocity. _____
9. Move the photogate to Ramp B, release the marble, and record its final velocity. _____
10. How do the two velocities compare?

11. Skip to #19.

Qualitative Analysis using Carbon Paper

12. Obtain a sheet of carbon paper and a sheet of white paper.
13. Place the carbon paper on top of the white paper, carbon side down, in the region where the marble will land after it rolls off the ramp. Use small pieces of tape to secure the papers.
14. Roll the marble off Ramp A.
15. Look for the mark made by the carbon paper where the marble first landed. How far from the end of the ramp is the mark? _____
16. Reposition the paper, and roll the marble off Ramp B.
17. Look for the mark made by the carbon paper where the marble first landed. How far from the end of the ramp is the mark? _____
18. Compare the two distances. What does this tell you about the two velocities from the ramps?

Conclusions

19. Explain the result, using the concept of energy.

20. Describe some possible sources of error in this experiment.
