

PHYSICS DEMONSTRATIONS

A Sourcebook for Teachers of Physics

CONTENTS

1. MOTION

- 1.1 Bowling Ball Pendulum
- 1.2 Come-back Can
- 1.3 Bicycle Wheel Gyroscope
- 1.4 Guinea and Feather Tube
- 1.5 The Monkey and the Coconut
- 1.6 Ballistics Car
- 1.7 Pail of Water
- 1.8 Inertia Balls
- 1.9 Revolving Ball and Cut String
- 1.10 Toy Rockets
- 1.11 Rolling Chain
- 1.12 Moving Spool
- 1.13 Stack of Cards
- 1.14 Wilberforce Pendulum
- 1.15 Reaction Time
- 1.16 Beaker and Tablecloth
- 1.17 Inclined Plane
- 1.18 Coupled Pendula
- 1.19 Random Walk
- 1.20 Chaotic Pendula

2. HEAT

- General Safety Considerations
- 2.1 Liquid Nitrogen Cannon
- 2.2 Collapsing Can
- 2.3 Carbon Dioxide Trough
- 2.4 Exploding Soap Bubbles
- 2.5 Hero's Engine
- 2.6 Model Geyser
- 2.7 Magdeburg Hemispheres
- 2.8 The Impossible Balloon
- 2.9 Boiling with Ice
- 2.10 Freezing by Evaporation
- 2.11 Nonburning Handkerchief
- 2.12 Liquid Nitrogen Cloud
- 2.13 Heat Transmitter
- 2.14 Ethanol Vapor Explosion

- 2.15 Heat Convection
- 2.16 Exploding Balloons
- 2.17 Smoke Rings
- 2.18 Bell Jar
- 2.19 Liquid Nitrogen
- 2.20 Kinetic Theory Simulator
- 2.21 Firehose Instability
- 2.22 Dripping Faucet

3. SOUND

- Safety Considerations with Sound
- 3.1 Breathing Helium and Sulfur Hexafluoride
- 3.2 Oscilloscope Waveforms
- 3.3 Doppler Effect
- 3.4 Bell in Vacuum
- 3.5 Wave Speed on a Rope
- 3.6 Beat Frequencies
- 3.7 Breaking a Beaker with Sound
- 3.8 Flame Pipe
- 3.9 Ultrasound

4. ELECTRICITY

- Electrical Safety Considerations
- 4.1 Jacob's Ladder
- 4.2 Van de Graaff Generator
- 4.3 Tesla Coil
- 4.4 Faraday Cage
- 4.5 Gas Discharge Tube
- 4.6 Wimshurst Electrostatic Generator
- 4.7 Exploding Wire

5. MAGNETISM

- 5.1 Levitated Ball
- 5.2 Magnet with Cathode Ray Tube
- 5.3 Can Crusher
- 5.4 Jumping Ring

- 5.5 Superconductors

6. LIGHT

- Laser Safety Considerations
- 6.1 Spiral Light Guide
- 6.2 Water Light Guide
- 6.3 Tubeless Television

- 6.4 Optical Illusions
- 6.5 Talking Head
- 6.6 Pepper's Ghost
- 6.7 Prism Rainbow
- 6.8 Laser Gun
- 6.9 Laser Beam
- 6.10 Fluorescence
- 6.11 Twinkling Stars

<http://www.mip.berkeley.edu/physics/physics.html>

U.C. Berkeley Physics Lecture Demonstrations

About the Physics Demonstrations Demonstration Index Applet Index	
Mechanics Waves Properties of Heat and Matter Electricity and Magnetism Optics Modern and Contemporary Physics Astronomy and Perception	Things of Interest (Movies and Images) How to Order Demonstrations Downloadable Demo Notebooks
<i>last updated 2/18/2009</i>	

CONSERVATION OF ENERGY.

A+5+10

Equal Path Lengths Ball Race.

Track 1 and Track 2 are the same shaped curve, but Track 2 is rotated by 180 degrees. A U shaped pin inserted from the back at point A holds two steel balls in place, one on each track. The apparatus is then raised upside down. The pin is pulled to release the two balls at the same time, and they travel down their tracks. (To repeat, insert pin at point B and turn track upside down.)

Question: Which ball wins the race?

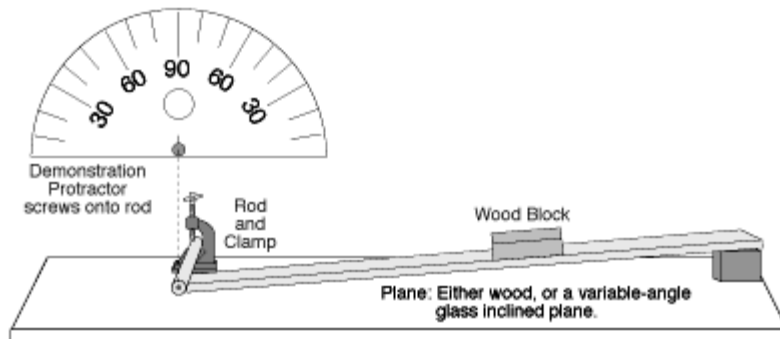


Both balls undergo the same change in height and same change in potential energy. By conservation of energy, both balls will be travelling with the same speed at the bottom of the tracks (assuming rolling without slipping and negligible losses to friction). So, if the geometries are different for the two tracks, Ball 1 takes longer to travel the long flatter portion of track 1 at slow initial speeds, then accelerates to the final speed over the short steep portion. Ball 2 accelerates to a lower final speed over the steep portion of track 2, then travels the long flatter portion, but does so at higher speeds and takes a shorter time. **ANSWER:** The flatter portions are intentionally much longer to make the time spent in the steep portions a small fraction of the total travel time. But simply using the above kinematics based comparisons, a more complicated problem about the shape of the quickest path between the two points can be seen in A+6+10 - Ergonomics.

FRICTION.

A+12+0

Blocks on an Inclined Plane.



A Block is placed at the top of the plane, and the plane is tilted until the block just starts to slip.

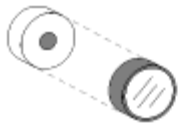
All Blocks are 500 grams. Blocks are available with the following surfaces :

Smooth soft rubber padding	Polished bare wood,
Hard rubber padding	Ribbed (lateral) rubber padding
Sandpaper.	Ribbed (longitudinal) rubber padding

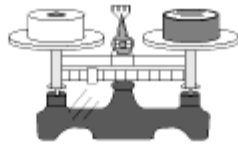
ROTATIONAL INERTIA.

A+25+0

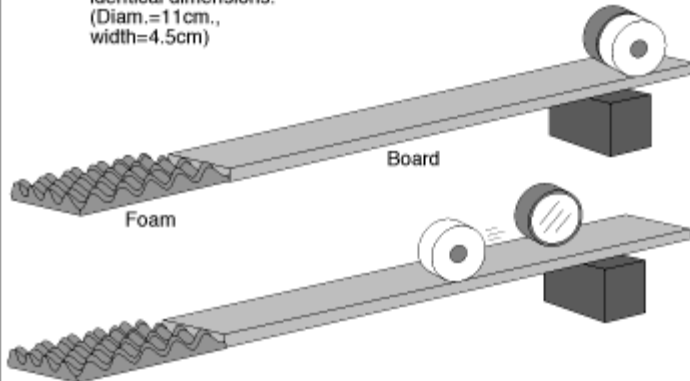
2 cylinders, same dimension, roll at different speeds.



2 cylinders with identical dimensions. (Diam.=11cm., width=4.5cm)



Weighed on the scale, the cylinders are shown to have equal mass.



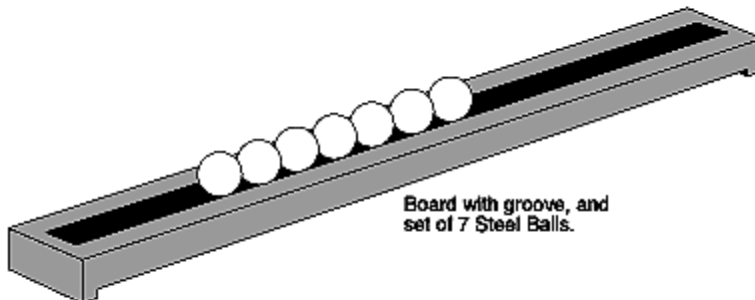
They are released simultaneously on an inclined plane

The cylinder with the weighted center quickly takes the lead over the cylinder with the weighted rim rolling down the incline.

LINEAR MOMENTUM.

A+35+5

Elastic Collisions: Balls in a track.



Board with groove, and set of 7 Steel Balls.