

TEXAS A&M UNIVERSITY

PHYSICS LECTURE DEMONSTRATIONS

Colleagues,

The Physics Demonstration Program has been reorganized and updated for implementation in the new George P. and Cynthia Woods Mitchell Institute for Fundamental Physics and Astronomy and the George P. Mitchell '40 Physics Building. [Click here to view Mechanics Demonstrations.](#)

The labeling system of the demonstrations has also been changed. The new labeling will incorporate the Demonstration Classification System (DCS) suggested by PIRA, the Physics Instructional Resource Association. The goal of the PIRA Demonstration Classification Scheme is to create a logically organized and universally inclusive taxonomy giving a unique number to every lecture demonstration.

External website references have been added to the demonstration notes when possible. These references have information (historical and practical) to supplement the notes listed in the demo page.

If you are interested in using one of these demonstrations in your classroom, you may send me an email with your class information and the demonstration number and name. Please allow at least two class days notice for the demonstration requests.

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- - 200 Level Physics Teaching Laboratory Program

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Mechanics

[Mechanics – Motion in One Dimension]

1C20.10 PENNY AND FEATHER IN A VACUUM

1C20.30 CONSTANT ACCELERATION OF CART ON PASCO TRACK

[Mechanics – Motion in Two Dimension]

1D50.40 WHIRLING BEAKER OF WATER

1D50.45 WHIRLING COAT HANGER AND COIN

1D60.10 PASCO CART AND PROJECTILE LAUNCHER

1D60.20 DROP AND SHOOT APPARATUS

1D60.30 HUNTER AND MONKEY (PROJECTILE MOTION)

[Newton's First Law]

1F20.10 INERTIA BALL

1F20.20 IRON BLOCK AND HAND

1F20.30 INERTIA OF SODA CANS

[Newton's Second Law]

1G10.40 ATWOOD'S MACHINE

1G20.45 DROPPED SLINKY

[Newton's Third Law]

1H10.06 PULLING ON TWO SCALES

[Statics of Rigid Bodies]

1J10.10 CENTER OF GRAVITY (MAP OF TEXAS)

1J11.50 DOUBLE CONE ON RAILS

1J20.30 CENTER OF GRAVITY WITH A BELT

1J40.10 TORQUE METER

[Applications of Newton's Laws]

1K10.30 SPOOL AND STRING (DYNAMIC TORQUE)

1K20.20 FRICTION OF BLOCK ON BOARD

1K30.10 BED OF NAILS (PRESSURE)

[Work and Energy]

1M40.10 NOSE BASHER WITH CROQUET BALL

1M40.20 LOOP THE LOOP (CONSERVATION OF ENERGY)

[Linear Momentum and Collisions]

1N30.10 COLLISION BALLS

1N30.30 ELASTIC AND INELASTIC COLLISIONS ON TRACK WITH PASCO
CARTS

[Rotational Dynamics]

1Q10.30 RING AND DISK (MOMENT OF INERTIA)

1Q20.50 FASTER THAN GRAVITY (HINGED BOARD)

1Q40.30 ROTATING STOOL WITH BIKE WHEEL AND WEIGHTS
(CONSERVATION OF ANGULAR MOMENTUM)

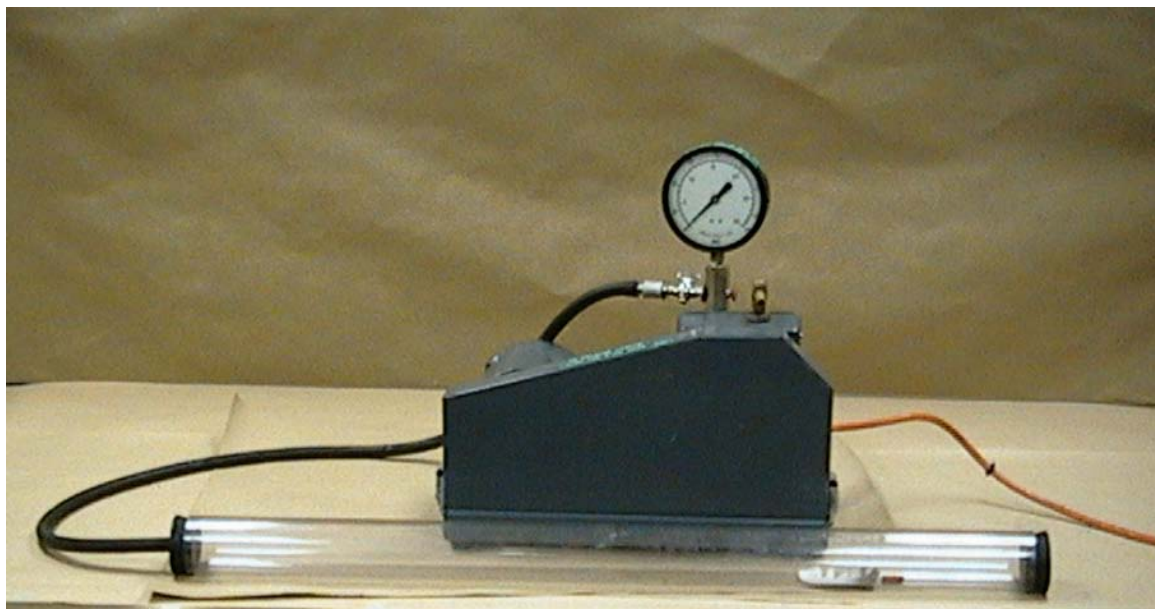
1Q50.21 BIKE WHEEL GYROSCOPE ON ROPE

1Q50.25 PASCO GYROSCOPE

[Properties of Matter]

1R10.10 HOOKE'S LAW

1C20.10 PENNY AND FEATHER IN A VACUUM



Apparatus: Vacuum pump and hose
Lucite tube
Feather and plastic device (coin substitute)

Notes: First, compare how the two objects fall in the tube without a vacuum. Connect the vacuum pump and evacuate the lucite tube. Compare how the two objects fall in a vacuum.

[Top of the Document](#)

1C20.30 CONSTANT ACCELERATION OF CART ON PASCO TRACK



Apparatus: Pasco Linear Track
Pasco cart
1 black metal block
Wood spacers (2 ea, to elevate the track)

Notes: The cart may be used to show acceleration when placed on the track (elevated with the spacers at one end). The cart may also be loaded with the black metal block (which is the about the same mass as the cart). DO NOT ALLOW THE CART TO FALL ON THE FLOOR.

[Top of the Document](#)

1D50.40 WHIRLING BEAKER OF WATER

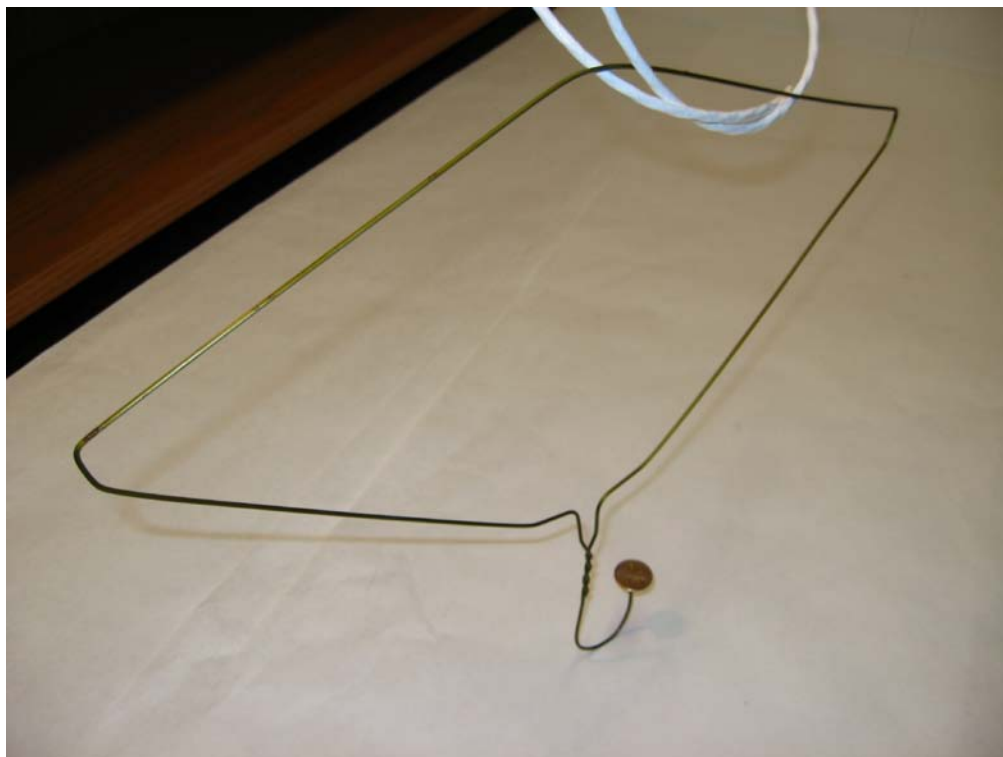


Apparatus: Plastic beaker with string attached

Notes: Pour water into the beaker and swing the beaker in a vertical circle.

[Top of the Document](#)

1D50.45 WHIRLING COAT HANGER AND COIN



Apparatus: Metal clothes hanger

Notes: A metal clothes hanger is supplied. Take a coin (one of your) and place it on the end of the hanger. This is the end that loops over the rack bar in the closet. The hanger is bent to a modified v-shape. It may take some practice to balance the coin on the end. Spin the hanger such that the coin does not fall off (careful-do not spin the hanger in a loop towards the students).

[Top of the Document](#)

1D60.10 PASCO CART AND PROJECTILE LAUNCHER

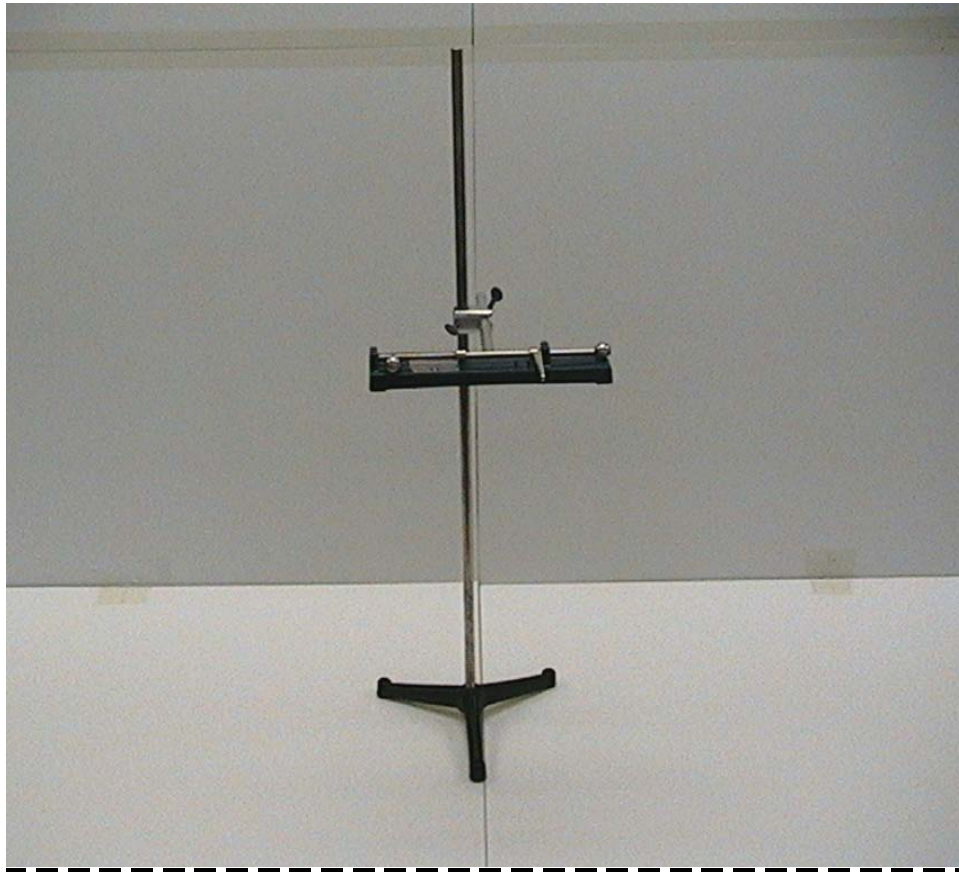


Apparatus: Pasco Track
Cart/launcher and plastic ball
Beam interrupter

Notes: Place the cart/launcher on one end of the track. Press the ball into the launcher. Make sure the slit on the launcher is on the same side as the interrupter. Slowly push the cart on the track and watch the ball go up in the air and land in the launcher.

[Top of the Document](#)

1D60.20 DROP AND SHOOT APPARATUS

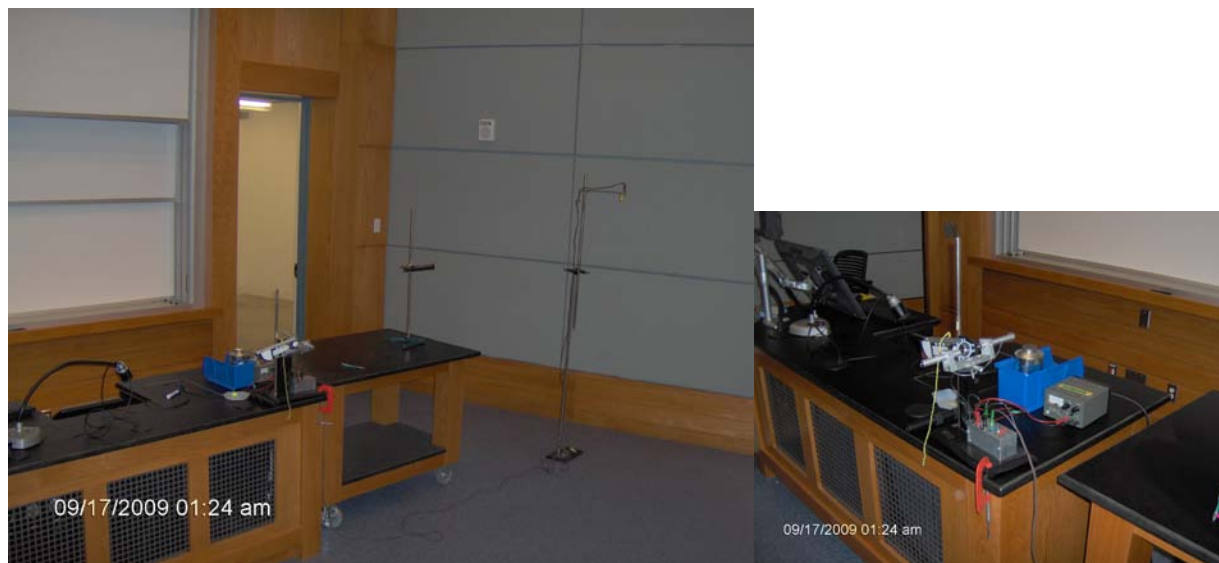


Apparatus: Drop and shoot apparatus w/ two steel balls
Two-way clamp, rod and base

Notes: Place the two balls on the opposite ends of the apparatus and make sure the balls are level with the tabletop. When the spring mechanism is released, one ball will drop and the other ball will shoot to the side. They should strike the floor at the same time (as verified by the sounds of the balls hitting the tabletop).

[Top of the Document](#)

1D60.30 HUNTER AND MONKEY (PROJECTILE MOTION)



Apparatus: Projectile motion apparatus (w/yellow plastic ball)
Long metal tube and three-footed floor stand (large type)
Solenoid, long brown cable and two-way clamp
10 volt Power Supply
Metal can (target) and cardboard box (place under solenoid to catch target)
C-clamp (to hold down the apparatus)

Notes: Use the projectile apparatus to shoot a ball that is aimed at the can that drops as soon as the ball leaves the metal tube.

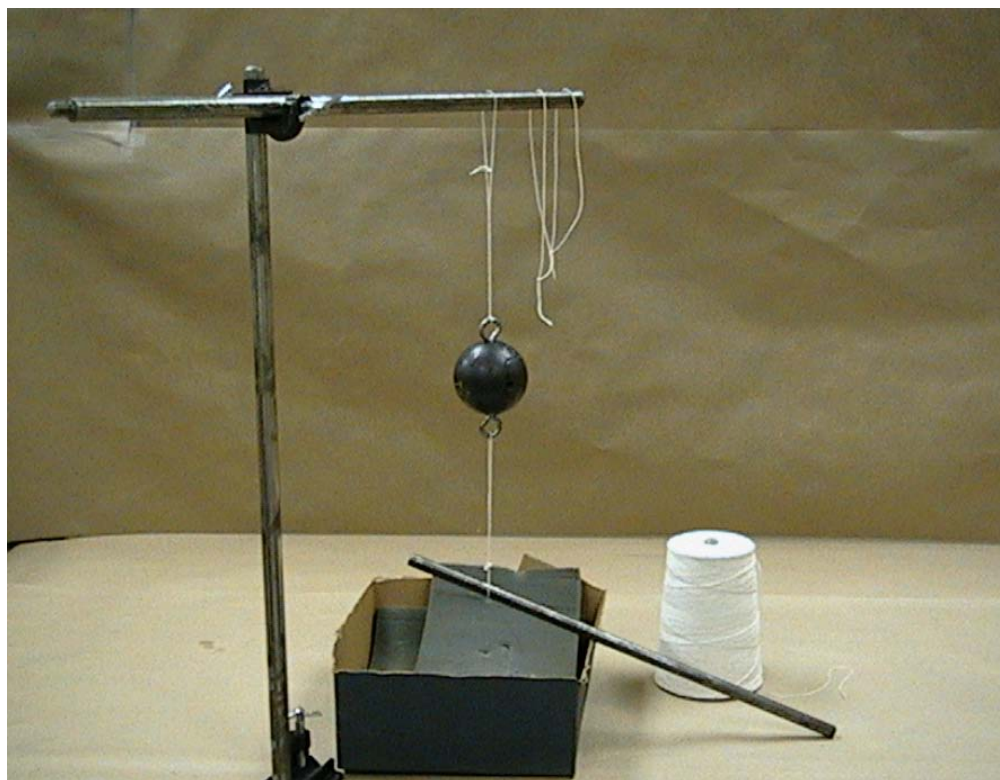
Set the control box to RESET. Check that the power supply (10 volts) and the solenoid leads are connected to the control box (connect red and black jacks on box to the red and black jacks of the PS). Look through the tube and make sure the middle of the can (that is hanging on the solenoid) is visible. Use the c-clamp to hold the apparatus to the table. Use the plunger to push the yellow ball in the tube until 2 clicks are heard. After all alignments and loading of the ball is done, set the control box to FIRE.

When ready, pull the yellow string straight up.

[Set ups notes - The projectile apparatus should be approximately horizontal. The distance between the apparatus and the stand holding the can should be about 13 feet. Power supply current setting should be max cw. The support bar that holds the light and photo cell should be located close to the end of the tube. Make sure the light is lit when the power is on.]

[Top of the Document](#)

1F20.10 INERTIA BALL



Apparatus: A frame consisting of a table clamp with a long $\frac{3}{4}$ inch OD steel rod attached vertically and a two-way clamp with a short steel rod extending to one side.
Steel ball (about 8 cm diameter, with 2 eyehooks)
Cardboard box with foam inside (to catch steel ball)
Short steel rod
Ball of light-weight string

Notes: Attach the steel ball to the top cross member of the frame with a short loop of string. Tie another loop of string on the bottom of the steel ball. Place the short metal rod through the loop of string at the bottom of the steel ball and show that a steady downward pull on the rod will break the top string. Retie the loop at the top and then show that a quick downward pull on the rod will break the bottom string. The loops should be about 4 inch diameter. Be sure that the cardboard box is under the steel ball (to prevent it from hitting the table).

[Top of the Document](#)

1F20.20 IRON BLOCK AND HAND

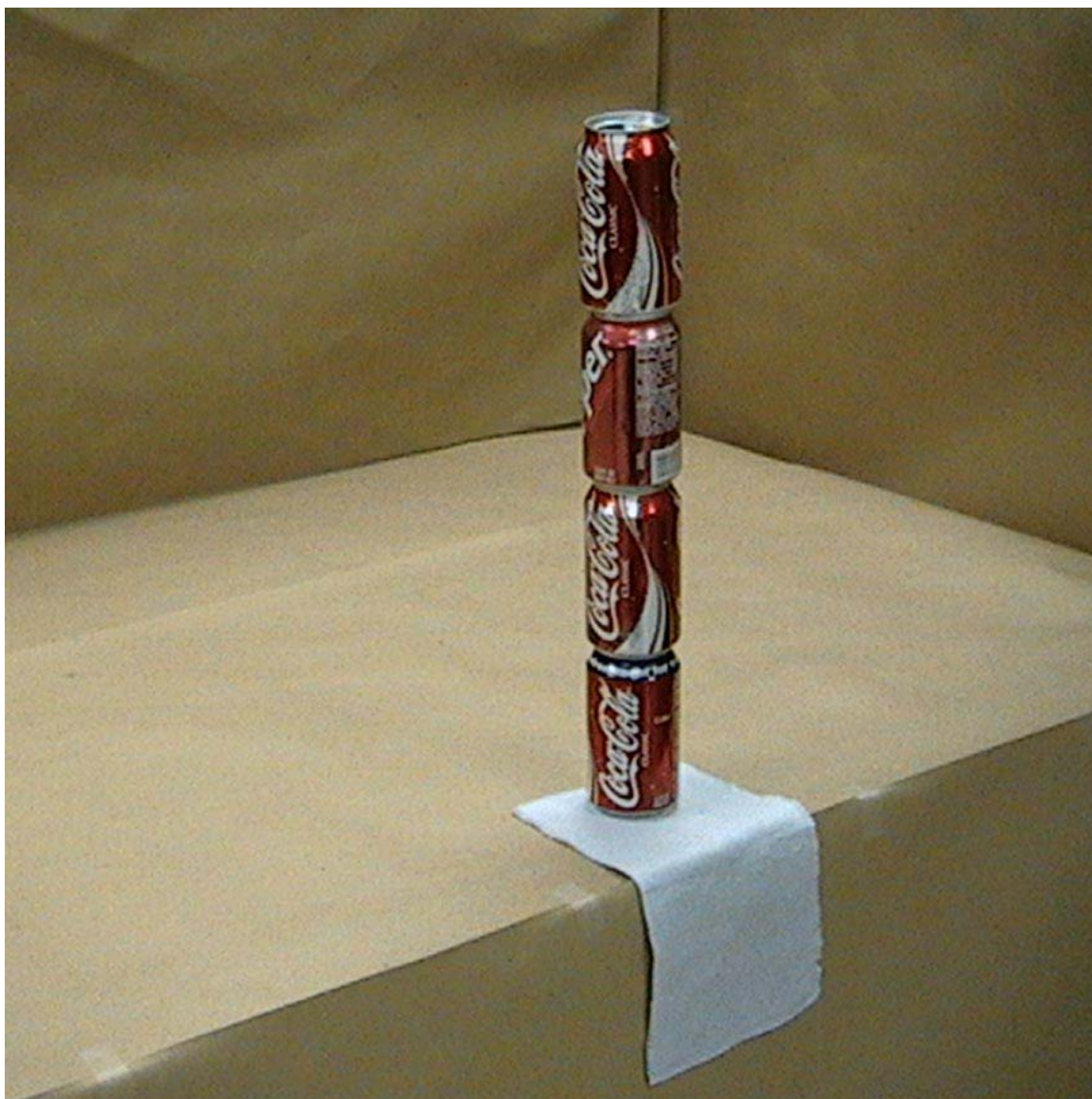


Apparatus: Hammer and steel plate

Notes: Place the steel plate over your hand. (Make sure the hand is flat on the table.) Hit the steel plate with a solid blow (watch out for your fingers).

[Top of the Document](#)

1F20.30 INERTIA OF SODA CANS



Apparatus: 4 or 5 soda cans Small piece of cloth

Notes: Stack 4 or 5 soda cans, one on top of another, on the cloth supplied. Make sure the bottom can is not wet or sticky with leftover soda. Pull the cloth quickly, on a line even with the table top.

[Top of the Document](#)

1G10.40 ATWOOD'S MACHINE



Apparatus: Rod and stand
Two way clamp and short rod with steel ball
Low friction pulley and string
2ea 20 gram hooked masses and a small clip

Notes: The masses are 20 gram hooked masses (2 ea) on a string. The pulley is very frictionless. There is a small alligator clip provided that can be attached near one of the masses.

[Top of the Document](#)

1G20.45 DROPPED SLINKY



Apparatus: Slinky

Notes: The slinky is lifted by one end. The bottom should be just above the table top. When the top of the slinky is released, watch as the bottom end stays in place until the entire slinky has contracted to its original length.

[Top of the Document](#)

1H10.06 PULLING ON TWO SCALES

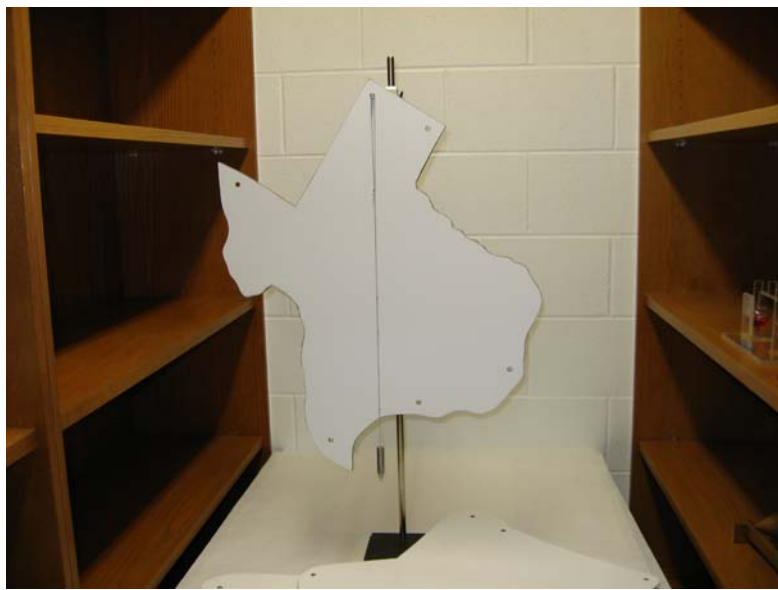


Apparatus: Two spring scales (100 N)

Notes: Attach the two scales, pull on them and compare the readings.

[Top of the Document](#)

1J10.10 CENTER OF GRAVITY (MAP OF TEXAS)

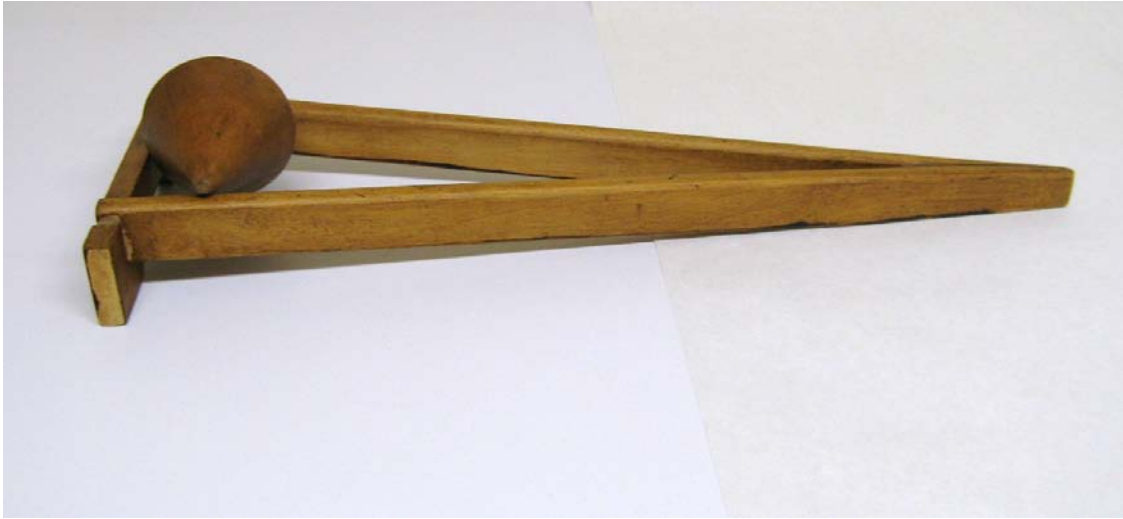


Apparatus: White boards (assortment)
Long rod and base with a two-way clamp
String and plumb bob
Mounting rod (to hold boards and plumb bob)

Notes: Hang one of the boards on the mounting rod and place the string of the plumb bob on the mounting rod. Draw a line (with dry erase marker) next to the string of the plumb bob. Rehang the board on another hole and draw another line. Where the lines intersect, the center of gravity may be found.

[Top of the Document](#)

1J11.50 DOUBLE CONE ON RAILS



Apparatus: Double cone and rail

Notes: Place the cone at the low end of the rails and release. It will appear to roll uphill. Actually, the center of gravity of the cone drops lower as it rolls to the other end.

[Top of the Document](#)

1J20.30 CENTER OF GRAVITY WITH A BELT



Apparatus: Center of gravity device
Your belt

Notes: Place your belt on the groove of the center of gravity device. Illustrate the center of gravity of this system.

[Top of the Document](#)

1J40.10 TORQUE METER

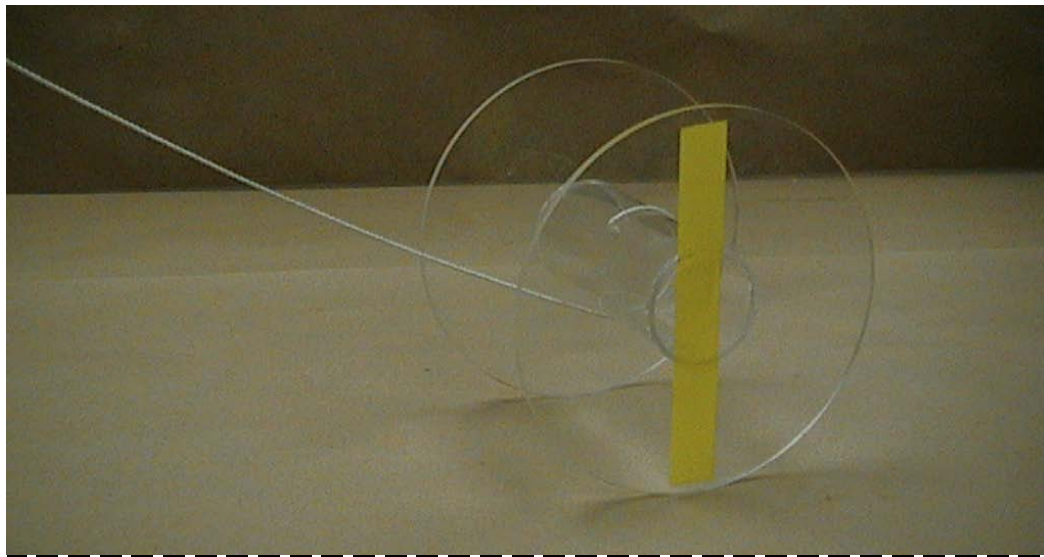


Apparatus: Torque rod with hooked masses

Notes: Place a hooked mass near the handle of the torque rod and feel the torque. Move the mass toward the end of the rod and again lift the mass. The torque has increased considerably.

[Top of the Document](#)

1K10.30 SPOOL AND STRING (DYNAMIC TORQUE)

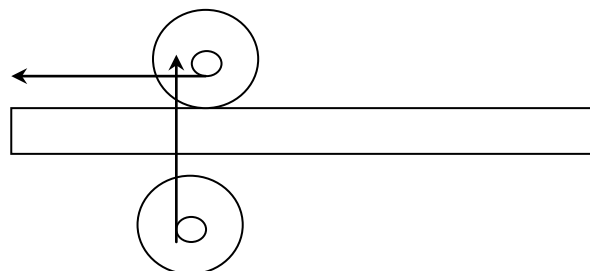


Apparatus: Large spool with a string attached

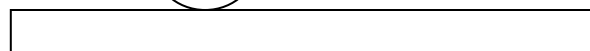
Notes: If the string attached to the spool is pulled in the direction of the arrow, which way will the spool move (rotate) for each of the cases below?

- 1) Roll counter-clockwise to the left
- 2) Roll clockwise to the right
- 3) Not rotate but gets dragged on the table (in direction of arrow)

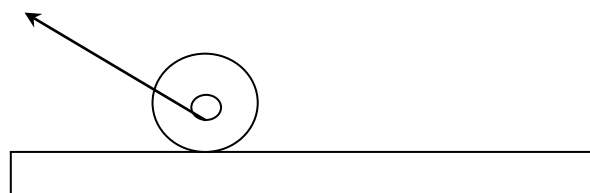
A



B

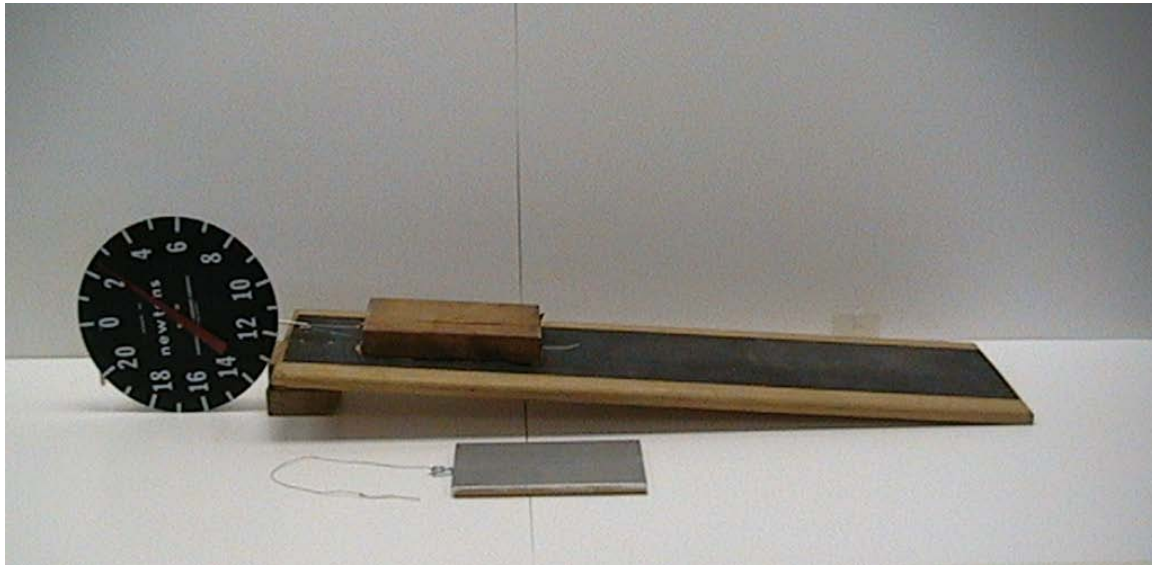


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[Top of the Document](#)

1K20.20 FRICTION OF BLOCK ON BOARD



Apparatus: Wood board (1ft x 3ft, with sandpaper strip on one side)
20N spring scale
Wood block (w/string attached)
Aluminum block (w/string attached)
Wood spacers (used to elevate board)

Notes: Use the spring scale to pull on the blocks (with the board level on the table or elevated with the supports). Show the variation of friction of the two blocks. The wood board may also be raised at one end until the block slides.

[Top of the Document](#)

1K30.10 BED OF NAILS (PRESSURE)



Apparatus: Wood board with many nails
Short green metal stool

Notes: Place the bed of nails on the stool. Sit on the nails and show that there is no pain or injury..... (One can place a sheet of paper on the nails and then sit on it. Some of the nails will produce the outline of the object sitting on the nails.)

[Top of the Document](#)

1M40.10 NOSE BASHER WITH CROQUET BALL

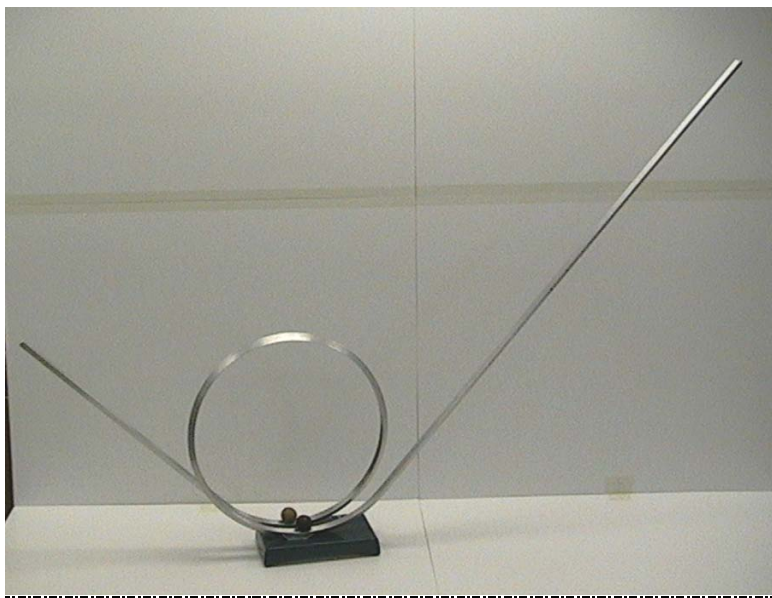


Apparatus: Wood ball with string attached
2 long (8ft) rods, 2 table clamps, 2 two-way clamps and
a long cross member rod

Notes: The ball is mounted on a frame work (like a pendulum) above the lecture table. Pull the ball towards you until it almost touches your nose or chin. Release the ball and watch how close it returns to your nose or chin. Do not push the ball. Hold your head perfectly still. Make sure the ball does not hit anything on top of the lecture table. The ball should be about 6 inches above the table when mounted on the frame.

[Top of the Document](#)

1M40.20 LOOP THE LOOP (CONSERVATION OF ENERGY)



Apparatus: Loop the loop apparatus with two balls

Notes: What speed must a ball have at the bottom of a circular loop to just make it around the loop without falling off? If the ball is to just reach the top of the ramp and not fall off, its speed must be such that the only force keeping it in a circular path is gravity. This should happen when $v^2 = gR$.

The next question is at what height (H) on the longer v-track of the loop-the-loop should the ball be released so that the ball will have enough speed to be able to complete the loop without falling off? The equation below shows that the mass of the ball cancels out and the height is related to the Radius (R) of the loop minus the radius of the ball.

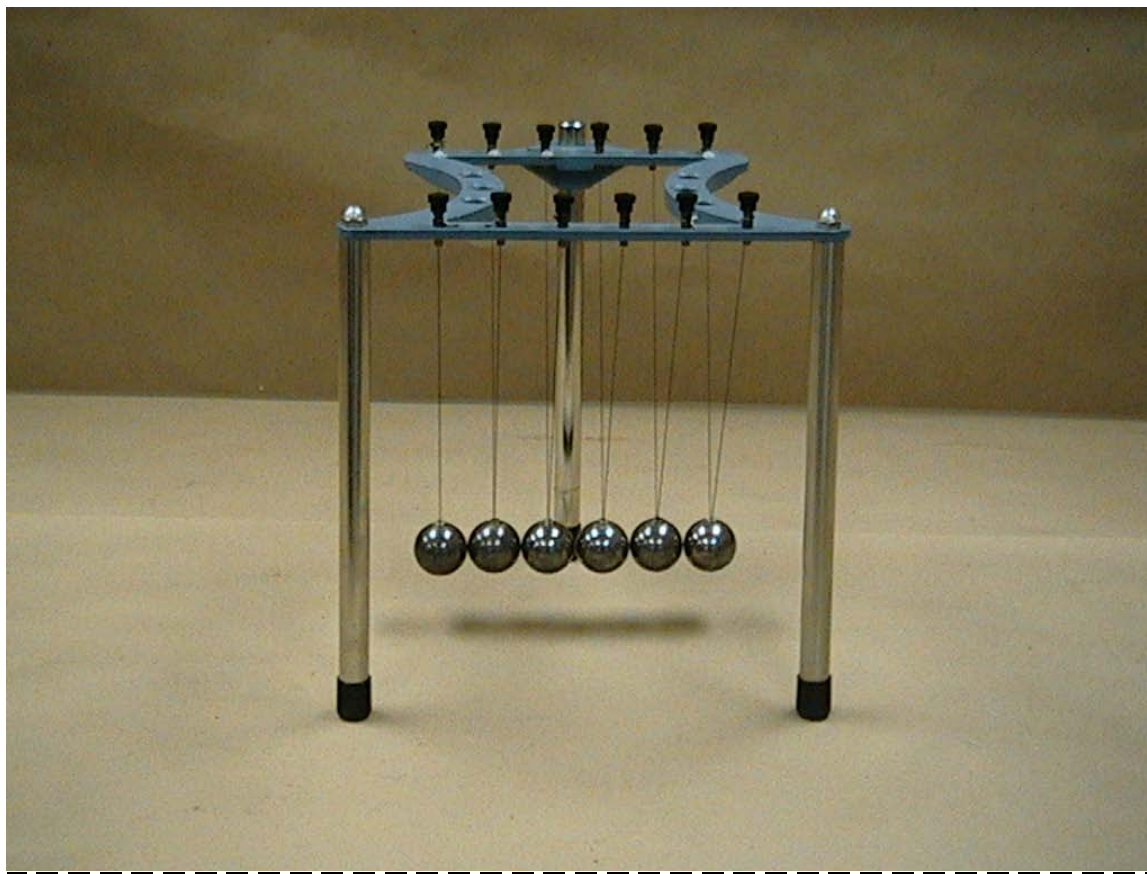


$$mgH = mg2R + \frac{1}{2}mv^2 = mg2R + \frac{1}{2}m(gR)$$

$$H = \frac{5}{2}R$$

[Top of the Document](#)

1N30.10 COLLISION BALLS



Apparatus: Collision ball apparatus

Notes: Apparatus has 6 balls of equal mass on strings. May be used to show conservation of momentum.

[Top of the Document](#)

1N30.30 ELASTIC AND INELASTIC COLLISIONS ON TRACK WITH PASCO CARTS

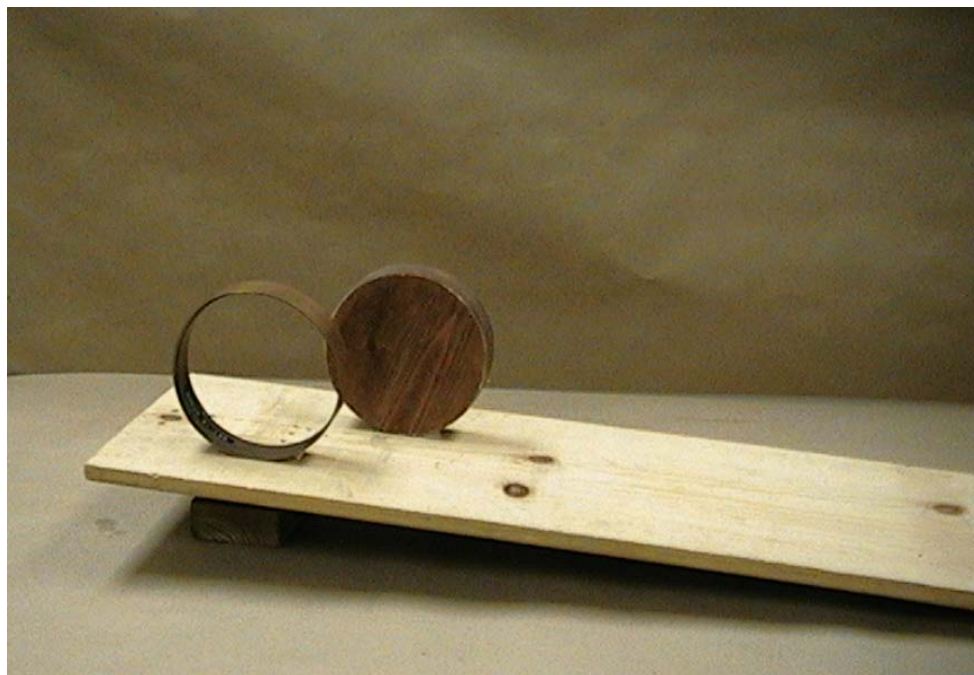


Apparatus: Pasco linear track
2 Pasco carts (w/ springs on one side and velcro on the other)
1 black metal block (about the same mass as the cart)

Notes: May be used to show elastic and inelastic collisions.

[Top of the Document](#)

1Q10.30 RING AND DISK (MOMENT OF INERTIA)



Apparatus: Wood board (1ft x 3ft)
Spacers (2 wood blocks)
Solid wood disk
Thin metal ring

Notes: Incline the wood board using the spacers. Place the disk and ring side by side and release at the same time. The disk and ring have the same mass and the same radii. The ring (which has the greater moment of inertia) rolls more slowly than the disk. DO NOT ALLOW THE DISK OR RING TO FALL ON THE FLOOR.

[Top of the Document](#)

1Q20.50 FASTER THAN GRAVITY (HINGED BOARD)



Apparatus: Hinged board apparatus
Steel ball
Support stick

Notes: Position the support stick to hold up the hinged board. Place the steel ball at the end of this board. Quickly pull out the support and show how the ball will land in the cup.

(set up info – When the support stick is pulled away, the board freefalls but it is attached at the hinge at the other end so it rotates as it falls. This rotational force causes the end below the ball to accelerate faster than the ball.)

[Top of the Document](#)

1Q40.30 ROTATING STOOL WITH BIKE WHEEL AND WEIGHTS (CONSERVATION OF ANGULAR MOMENTUM)



Apparatus: Bike wheel with rope attached
Rotating platform and attached chair
2Kg masses (2)

Notes: Sit on the rotating platform while holding the spinning bike wheel in a vertical position and then turn the axle horizontally. Does this cause one to rotate on the platform? Sit on the platform and hold one of the 2Kg masses in each hand, with the arms extended from the sides. Have someone cause the person on the platform to rotate. Have the person on the platform bring in his arms to his side.

[Top of the Document](#)

1Q50.21 BIKE WHEEL GYROSCOPE ON ROPE

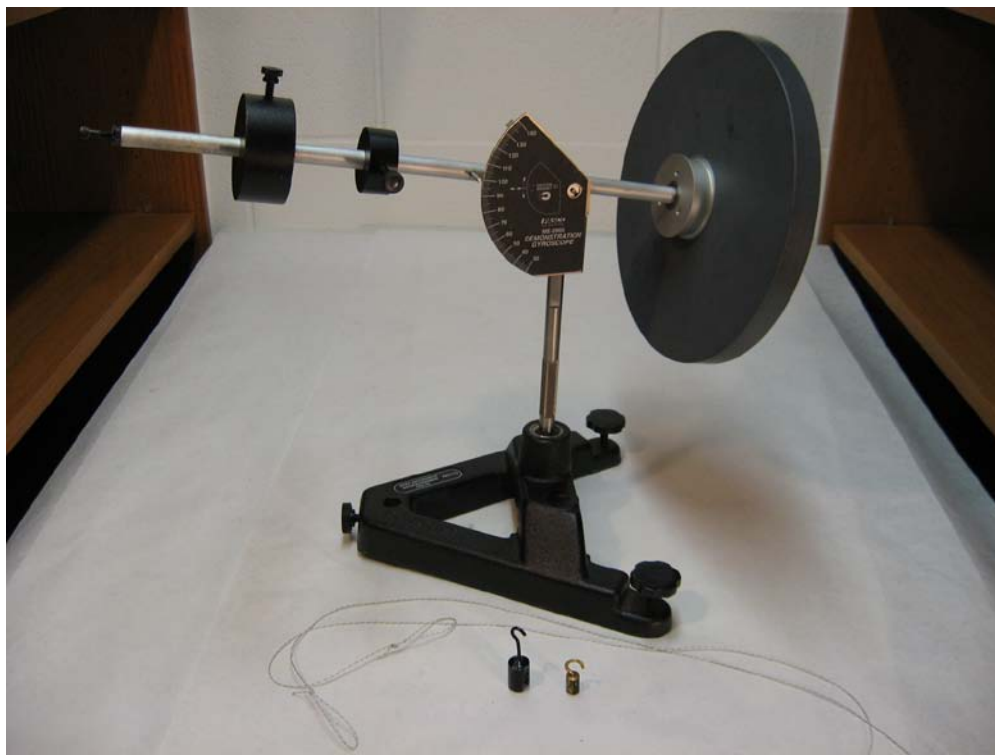


Apparatus: Bike wheel with rope

Notes: To show vertical precession, rotate the bike wheel and hold the bike wheel by the rope.

[Top of the Document](#)

1Q50.25 PASCO GYROSCOPE



Apparatus Large Pasco gyroscope
 Hooked masses (10g and 20g)
 String with loops

Notes: Spin the gyroscope ring with the string provided. Attach a hooked mass to end of the gyro to show precession.

[Top of the Document](#)

1R10.10 HOOKE'S LAW



Apparatus: Large spring on tall rod and stand
Mass hanger
2 – 50g slotted masses
Meter stick and support

Notes: Use the masses to show that the spring obeys Hooke's law.

[Top of the Document](#)