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(suggested changes/upgrades listed in parentheses)

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Galileo’s Principle for Falling Objects

PURPOSE:
To show that two objects of different mass fall toward the earth with the same acceleration.

EQUIPMENT:
• Piece of binder paper
• Golf ball
• Ping pong ball

EXECUTION:
First, the golf ball and the piece of paper are held at equal heights and released simultaneously. Then, the golf ball and the ping pong ball are released together.

COMMENTS AND SUGGESTIONS:
The demonstration was unclear to me. I guess the point was to show that Galileo's Principle for Falling Objects does not appear to hold true with the presence of air, but that it really does hold true if you can create an environment where air resistance is negligible. The paper accelerated much slower than the golf ball, as everyone would expect. I guess the golf ball / ping pong ball demonstration was meant to show a non-intuitive occurrence; that two objects of different masses would fall at the exact same rate if air friction was not present. It did not accomplish this task. The balls were held at shoulder height and released by hand. The golf ball did actually appear to hit the ground first... oops! Perhaps a better demonstration would be to release several sized spheres of nearly the same density (like a b.b., a ball bearing, and a lead fishing weight) mechanically (so that they are released at the exact same time) from a high platform (so that the demonstration does not flash by the viewers in the blink of an eye).
6/1  **2D Projectile Motion**

(see Phys 41 demo 5/2)

6/2  **The Hunter and the Monkey**

(See Phys 41 demo 5/3)

7/1  **Friction Force on Rolling Wheel at the Point of Contact**

PURPOSE:
To demonstrate that a rolling wheel rolls because of friction.

MATERIALS:
- Bicycle wheel with handles on the axle

EXECUTION:
The wheel is rolled along the desk top while the principle of friction as it applies to rolling objects is explained.

COMMENTS AND SUGGESTIONS:
The demonstration does little to help the student “see” the principle. Possibly a demonstration that compares a frictionless (or near frictionless, at least) surface with a rough surface could help show the principle. A good thing to incorporate might include showing that the velocity of the wheel at its point of contact is zero. This could help the students understand why this is static friction and not kinetic friction.

8/1  **Uniform Circular Motion**

(See Phys 41 demo 6/1)
Work-Energy Principle

PURPOSE:
To demonstrate the Work-Energy Principle by performing work with an object that undergoes a change in kinetic energy.

MATERIALS:
- Wooden block
- Nail partly nailed into the wooden table top

EXECUTION:
The block of wood is dropped onto the nail from a height of a couple feet, performing work on it as the block’s kinetic energy is reduced to zero.

COMMENTS AND SUGGESTIONS:
The concept of the demonstration is valuable. The work performed however, is left to the students’ imagination since no movement of the nail can be detected. If the nail was nailed into a softer surface (like Styrofoam) such that its movement was significant, the performance of work might be presented more clearly.

SKETCH:
PURPOSE:
To provide an example of Conservation of Energy as it applies to objects traveling around a vertical loop.

MATERIALS:
• “Roller coaster” track
• Steel ball (approx. 1” dia.)

EXECUTION:
The steel ball is released from the top of its track. It travels through its loop and off the shorter end of the track (if released from the higher end). A relation for what height the ball must be released from to complete the loop is developed and demonstrated.

COMMENTS AND SUGGESTIONS:
Though this demonstration does not add much explanation, it does show that the minimum height for successful loop completion corresponds to the predicted height.

SKETCH:
Elastic and Inelastic Collisions

PURPOSE:
To give an example of elastic and inelastic behavior of collisions.

MATERIALS:
• Elastic collision setup - 5 steel balls suspended by two strings each, touching while at rest
• Inelastic collision setup - 2 lead balls (one has a piece of putty on its inside) suspended by two strings each, touching while at rest

EXECUTION:
For each setup, the outermost ball is raised and released. The elastic balls transfer the oscillation (the two outer balls take turns swinging out while the 3 center balls remain relatively still). The two inelastic balls oscillate together.

COMMENTS AND SUGGESTIONS:
This demonstration works well but doesn’t seem to warrant much discussion during (or after) its execution. An improvement would be to quantify the energy lost in the inelastic collision compared to conserved energy (hopefully) in the elastic case.

SKETCH:
17/1 2D Center of Mass
(See Phys 41 demo 14/1)

19/1 Ice Skaters and the Conservation of Angular Momentum
(See Phys 41 demo 20/2)

20/1 Moments of Inertia
(See Phys 41 demo 18/1)

21/1 Gyroscopes and Precession
(See Phys 41 demo 20/3)
Simple Harmonic Motion and Uniform Circular Motion

PURPOSE:
To show that an object undergoing uniform circular motion prescribes simple harmonic motion if the object's motion is projected onto a single axis.

MATERIALS:
- Vertical mass-spring system
- Electric motor with ball rigidly attached at a distance from the motor's shaft
- Synchronized oscillation setup
- Overhead projector

EXECUTION:
The mass-spring system and uniform circular motion system are started in phase by the synchronized oscillation setup. The vertical motion of each mass is shown to be nearly identical by projection of their shadows onto a vertical screen.

COMMENTS AND SUGGESTIONS:
This is a very effective way to convince the class that uniform circular motion yields simple harmonic motion in one dimension.

SKETCH:
23/1  The Physical Pendulum

(See Phys 41 demo 23/1)

24/1  Damped Harmonic Oscillator

(See Phys 41 demo 23/2)

25/1  Driven Harmonic Oscillator

(See Phys 41 demo 24/1)

25/2  Transverse and Longitudinal Waves

PURPOSE:
To demonstrate the difference between transverse and longitudinal waves in an outstretched spring.

MATERIALS:
• Extra long slinky, anchored to heavy weight on one end

EXECUTION:
The slinky is stretched out on the floor. Transverse and longitudinal waves are created by hits of the spring.

COMMENTS AND SUGGESTIONS:
The waves travel in the spring best if it is horizontal. With the spring stretched on the floor however, only the first few rows of the class can see it.

SKETCH:
25/3  **Standing Waves in a String**

(See Phys 47 demo 2/1)

25/4  **Superposition of Coherent Waves in a Ripple Tank**

(See Phys 47 demo 2/4)

26/1  **Thermal Expansion of Metals**

(See Phys 47 demo 13/1)

29/1  **Temperature Gradients and their Ability to do Work**

(See Phys 47 demo 17/2)