THE DEMONSTRATION CORNER

PENDULUM, CENTRE OF MASS, AND MAGNETIC FORCE

by

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A HUGE PENDULUM

When studying the physics of a pendulum, we have used a long (4-m) wire in a lecture room with a high ceiling in two effective ways.

First, using a very heavy iron ball (mass > 10 kg) as the bob, the pendulum is swung right to the edge of the room where the instructor puts the ball next to his/her nose while resting his/her head against the wall. (This is a real test of your confidence in the laws of physics!) If the bob is released WITHOUT ANY PUSH, it returns exactly to the starting point, neither crushing the instructor's nose, nor falling short. Students are asked to time the period using their own watches (there's always someone with a stopwatch who is proud to show it off), and then determine either the acceleration of gravity or the length of the pendulum. The period is sufficiently long for quite accurate values of "g" to be obtained from 10 oscillations.

Second, the bob is replaced with a short length of pipe on which the instructor sits. IT IS IMPORTANT TO BE SURE THAT THE ANCHOR SUPPORTING THE PENDULUM IS SUFFICIENTLY STRONG TO DO THIS. The instructor is left swinging long enough in front of the class for the period to be measured. Since your centre of mass is close to your buttocks, the period is almost identical to the one obtained before, in spite of the fact that the mass if much greater. Class discussions can expand to cover air resistance; it leads to the instructor's amplitude getting smaller, but not to a significantly different period of oscillation. This demonstration always leads to an interesting discussion of simple physics, and will be long remembered by students.

CENTRE OF MASS

Where is the centre of mass of a person? Most of us know that it is between the knees and the shoulders, but where? To determine this, and to do a class experiment using simple lever principles, we use a standard 2" × 12" piece of lumber, balanced over a simple fulcrum (a short piece of angle iron with its right angle up) at its centre. A student (whose mass is known) is asked to lie down on the previously balanced "plank" which is set in front of the class on the work bench, while other students locate a known mass (cement block, brick, etc.) along the other end of the plank to re-establish the balanced condition. Appropriate distances are recorded on the chalk-board. The class is then asked to draw a force diagram, to determine the location of the student's centre of mass on the plank, and then to determine the location of his/her centre of mass relative to the student's feet, and as a percentage of the student's height. If you use a 10'-long plank, part of the student's body will be "across the other side of the fulcrum." Good discussion will take place if you ask if this has been omitted (or even subtracted) in the experiment. Also, why can the mass of the plank be ignored? I am told that the results of this experiment taken from large samples of students show conclusively that the centre of gravity of females is significantly lower in the body than for males, when the results are presented as a percentage of overall height.

MAGNETIC FORCE

The influence of a magnetic field on a beam of electrons can easily be seen by bringing a magnet up to the screen of a black and white TV picture tube, a monochrome computer monitor, or an oscilloscope screen. (DO NOT DO THIS WITH A COLOUR TV or a COLOUR COMPUTER MONITOR; it will damage the screen.) A horseshoe magnet has the strongest lateral field (perpendicular to the beam), and produces a deflection according to the appropriate right or left hand rule. A bar magnet, while weaker, will show some evidence of rotation of a recognisable image on the screen, and this rotation depends on the direction of the magnet.

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Submissions describing demonstrations will be gladly received by the column editor.
