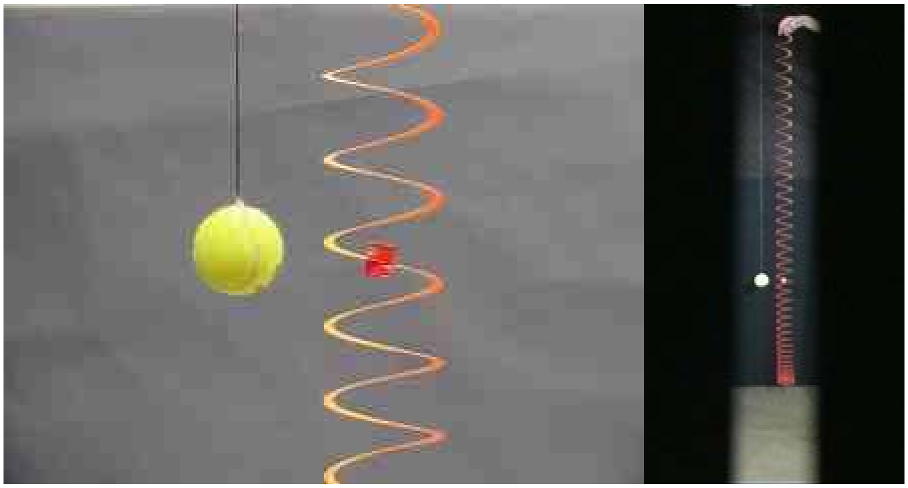
Answer #238

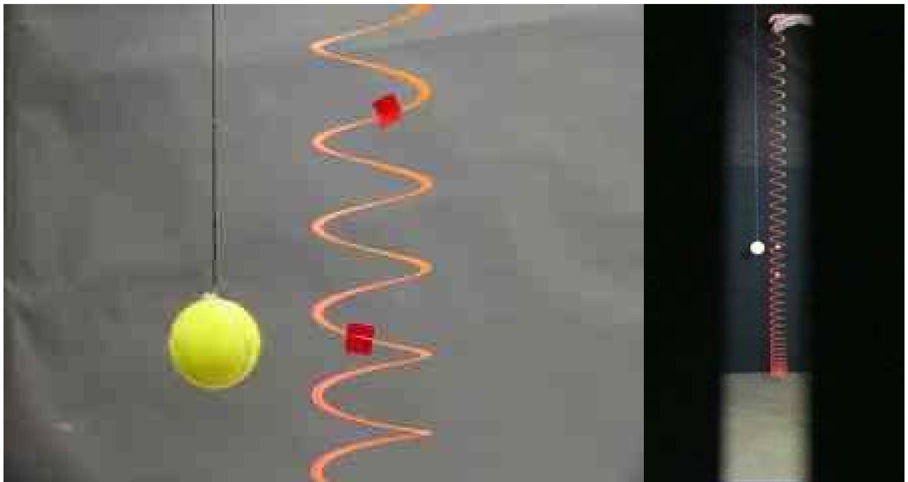
The answer is (a): the ball will reach the floor first, as can be seen in a slow-motion mpeg video by clicking your mouse on the photograph at the right below.

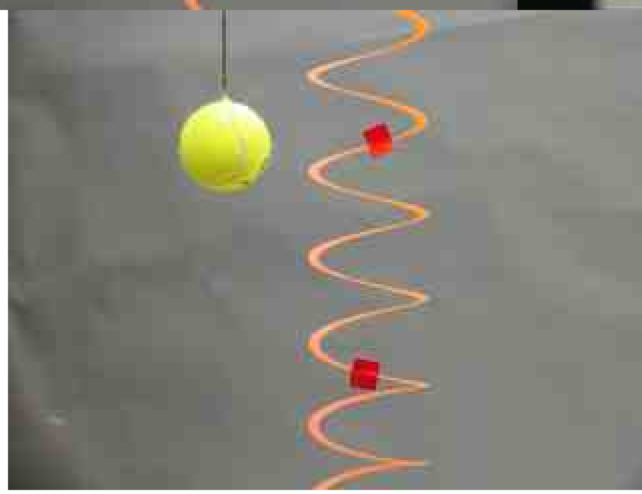


In this case the motion of the spring is somewhat unusual, as seen [Question #9](#).

Note, first, that when the spring is extended by being held at one end, the center of mass of the extended spring is *not* at the same point as when the spring is compressed. Although the coil turn *at the center of mass of the compressed spring* does not immediately begin to move, the *location* of the center of mass of the extended spring, initially above the center of mass of the compressed spring, does begin to fall *with the acceleration of gravity* when the top end of the spring is released. Before the spring is fully compressed the center of mass is accelerating downward at the acceleration of gravity even though the actual center of mass marked on the compressed spring may not have moved. After the spring has become compressed, the center of mass marked by the tape continues to accelerate with the acceleration of gravity. For the short time interval between when the marked center of mass begins to move and when the SLINKY is completely compressed, the mark is actually accelerating faster than the acceleration of gravity.

What must be done to this system so that the ball and the SLINKY will reach the floor at the same time? Because the center of mass of the spring falls with the acceleration of gravity, as does the ball, they will reach the floor at the same time if you place the ball *at the center of mass of the extended SLINKY*! The position of the center of mass of the extended SLINKY, marked on the spring in the figure below, is about 2 1/2 turns above the CM of the compressed spring. Click your mouse on the center photograph below to see the video.





The complex motion of the SLINKY is irrelevant; the only issue that must be considered is that, at the time they are released, the ball must be at the same height as the center of mass of the SLINKY, which is the *extended* SLINKY at the time it is released.

The model used to compute the location of the center of mass for this demonstration included 38 turns of orange plastic SLINKY, where each turn was represented by a single mass unit, connected by identical massless springs.

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UNIVERSITY OF MARYLAND 1856
DEPARTMENT OF PHYSICS
UNIVERSITY OF MARYLAND
COMPUTER MATHEMATICAL & PHYSICAL SCIENCES

For questions and comments regarding the *Question of the Week* contact

Dr. Richard E. Berg by e-mail or using phone number or regular mail address given on the Lecture-Demonstration Home Page.