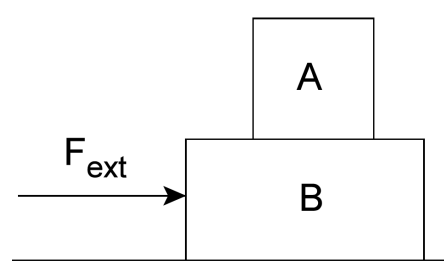


Physics@Mac Online Physics Competition
December 5, 2013

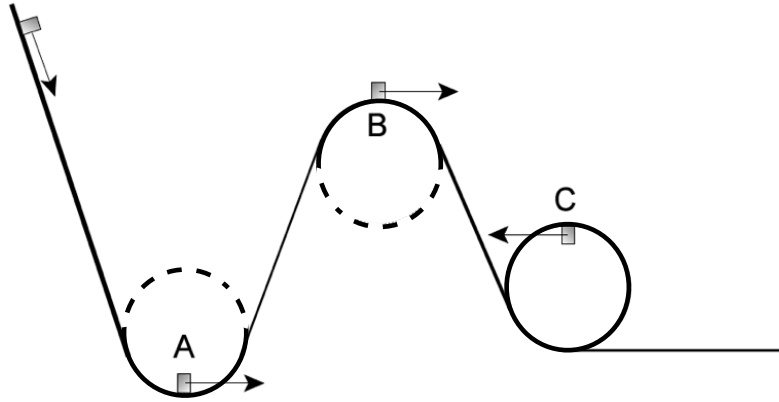
1. An oak tree is 20m tall. Approximately how many leaves are on the tree?
 - a) 10^2
 - b) 10^4
 - c) 10^6
 - d) 10^8
2. The speed of waves in shallow water depends only on the acceleration of gravity (g) and the water depth (h). Which of the following formulas describe the speed of the waves?
 - a) $\frac{1}{2} g \cdot h^2$
 - b) $g \cdot h$
 - c) h/g
 - d) $\text{sqrt}(g \cdot h)$

3. Block A is sitting on top of block B when an external force begins to push on block B, as shown in the diagram. The force increases in magnitude as a function of time. At first, block A and block B move together, but eventually block A starts to slide relative to block B. Which of the following statements regarding the frictional force on block A is correct?

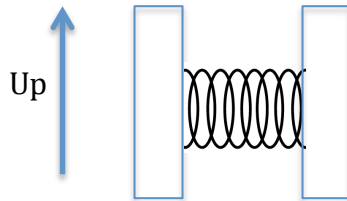


- a) Before it slides, a static frictional force acts to the left. After it slides a kinetic frictional force acts to the left.
 - b) Before it slides, a static frictional force acts to the right. After it slides a kinetic frictional force acts to the left.
 - c) Before it slides, a static frictional force acts to the left. After it slides a kinetic frictional force acts to the right.
 - d) Before it slides, a static frictional force acts to the right. After it slides a kinetic frictional force acts to the right.
4. Two identical conducting sphere A and B carry equal charge. A distance much larger than their sizes separates them. A third identical object C has a charge twice as large as A . Object C is first touched to A, then to B, and finally removed. As a result, the electrostatic force between A and B, which was originally F becomes
 - a) $F/4$
 - b) $9F/4$
 - c) $15F/8$
 - d) $25F/16$

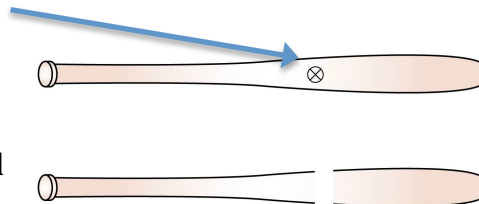
5. A block slides along a frictionless track into a valley, A, over a hill, B, and inside a “loop-the-loop”, C, as shown in the diagram. The peak, valley and loop all have the same radius of curvature. Rank the magnitudes of the acceleration of the block at the positions A, B and C, from largest to smallest.



- a) $A > C > B$
b) $A = B = C$
c) $A > B > C$
d) $B > C > A$
6. A spring is compressed and then stuck between two very heavy vertical books as shown. The book and the spring remain at rest once it is placed between the books. Which statement best describes the forces acting on the spring?

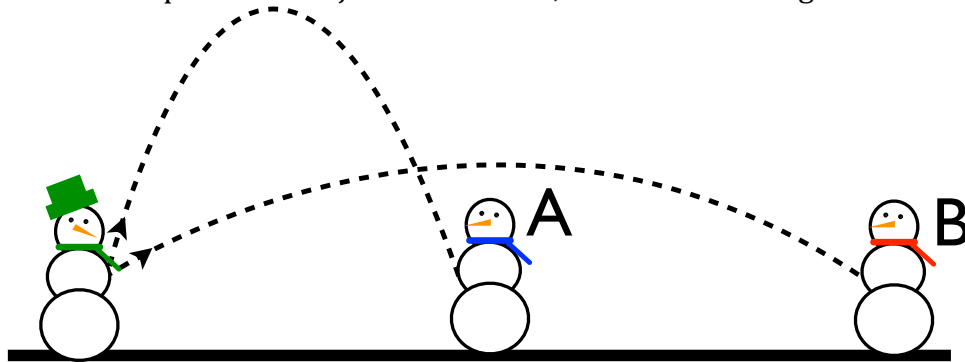


- a) The friction force acts up, normal force acts sideways, and gravity acts down.
b) The normal force acts up, gravity acts down, and friction acts sideways.
c) The spring force acts up, friction acts up, and gravity acts down.
d) The force of gravity is not acting on the spring.
7. A baseball bat is cut in half at its center of mass. Which end is heavier?

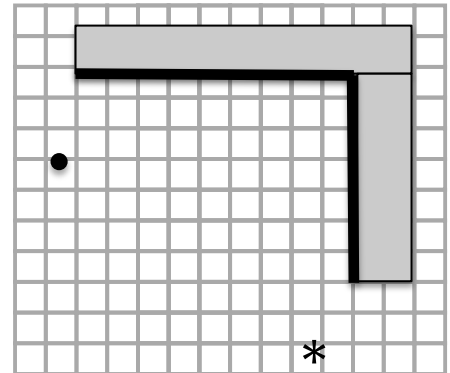


- a) The handle end (left end).
b) The batting end (right end).
c) The two ends weigh the same.
d) Impossible to determine without the total mass of the bat.

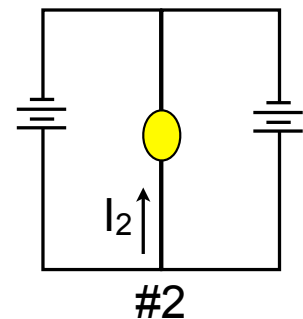
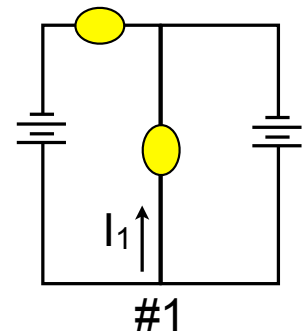
8. Frosty simultaneously throws two snowballs at the same speed at snowmen A and B. If the snowballs follow the parabolic trajectories shown, which snowman gets hit first?



- a) Snowman A.
 b) Both get hit at the same time.
 c) Snowman B.
 d) Need more information.
9. Two pieces of mirror meet at right angles as shown to the right. The circle is an object that mirrors form an image of. The asterisk is the location of a person's eye that views the image. How many different images of the circle does the eye see in the mirror?



- a) zero
 b) one
 c) two
 d) three
10. In circuit #1 and circuit #2 illustrated to the right, all the batteries are identical and all the light bulbs are identical. When the currents I_1 and I_2 are compared,



- a) $I_1 > I_2 > 0$
 b) $I_2 > I_1 > 0$
 c) $I_1 = I_2 \neq 0$
 d) At least one of the currents is zero.