

# Lansing Area High School Physics Competition

## Problem Set 3

Opening date: January 20th, 2003.

Due date: February 26th, 2003.

Send solutions by mail to:

LAHSPC, Department of Physics, MSU, East Lansing, MI 48824

For more details see: [www.pa.msu.edu/~nagy\\_t/lahspc/lahspc.html](http://www.pa.msu.edu/~nagy_t/lahspc/lahspc.html)

**P21.** A small object is falling freely. At one point in space its velocity is 2 m/s, at another point it is 4 m/s. What is the distance between these two points?

(4 points)

**P22.** A very light but solid rod of length  $l = 2$  m is suspended at the midpoint  $M$  and can rotate without friction. A small but heavy ring  $R$  is permanently attached to the rod at a distance of  $l/4$  from the end. (See Figure 1.) The rod is then released from this horizontal position. Describe what happens. (Hint: Neglect the mass of the rod.) What is the speed of the rod's end point when the rod goes through its vertical position?

(5 points)

**P23.** Can the coefficient of friction be larger than 1? Explain your answer.

(3 points)

**P24.** We have a spring with spring constant  $k = 6$  N/m. We cut the spring at the middle into two identical parts. What is the spring constant of one of the springs? We then connect the two springs parallel to each other. What is the net spring constant of this system?

(4 points)

**P25.** An object is moving to East, but accelerates to West. Is this motion possible? If yes, what is the direction of the net force acting on the object and what is the object's path? Another object is moving to East, but accelerates to North. Is this motion possible? If yes, what is the direction of the net force acting on the object and what is the object's path?

(4 points)

**P26.** A person with mass  $m$  is standing at the end of a boat which has a mass  $M$  and length  $L$ . The person moves to the other end of the boat. Will the boat move? If yes, which direction and how far? (Neglect the friction between the boat and the water.)

(4 points)

**P27.** Satellite dishes are installed on the roofs of houses. Each dish has a fixed position and points to a particular TV satellite. The satellites however orbit around the Earth. How can a permanently mounted dish constantly see a moving satellite? What is the orbit the satellite moves on? What is the radius of this orbit and what is the period of the satellite on it? Can we place more than one satellite on this orbit?

(5 points)

**P28.** A half filled glass is precisely balanced on a two-armed scale. (See Figure 2.) Then a steel ball on a thread is carefully lowered into the water. All the water stays inside the glass. The ball is completely submerged in the water, but it does not touch the wall or the bottom of the glass. Will the balance change or not? If yes, then how? Explain your answer.

(3 points)

**P29.** In the Biomedical and Physical Sciences building at MSU there are 139 steps from the ground floor to the sixth floor. Each step is 17 cm tall. It takes 2 minutes for a person with a mass of 72 kg to walk all the way up. How much work did the person do? What was the average power performed by the person during the walk?

(4 points)

**P30.** By what percent does the output power of a light bulb change from its nominal value when the voltage in the outlet increases by 10 percent from the official value? What if the voltage decreases by 10 percent?

(4 points)

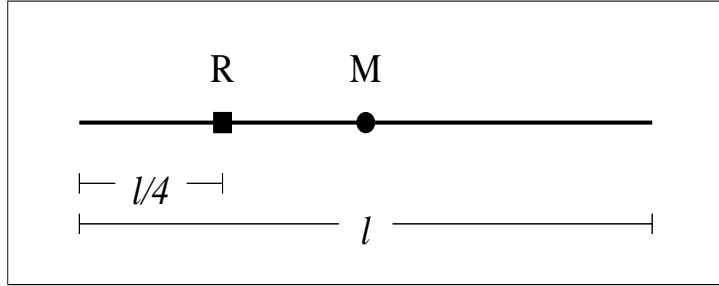


Figure 1: Problem P22.

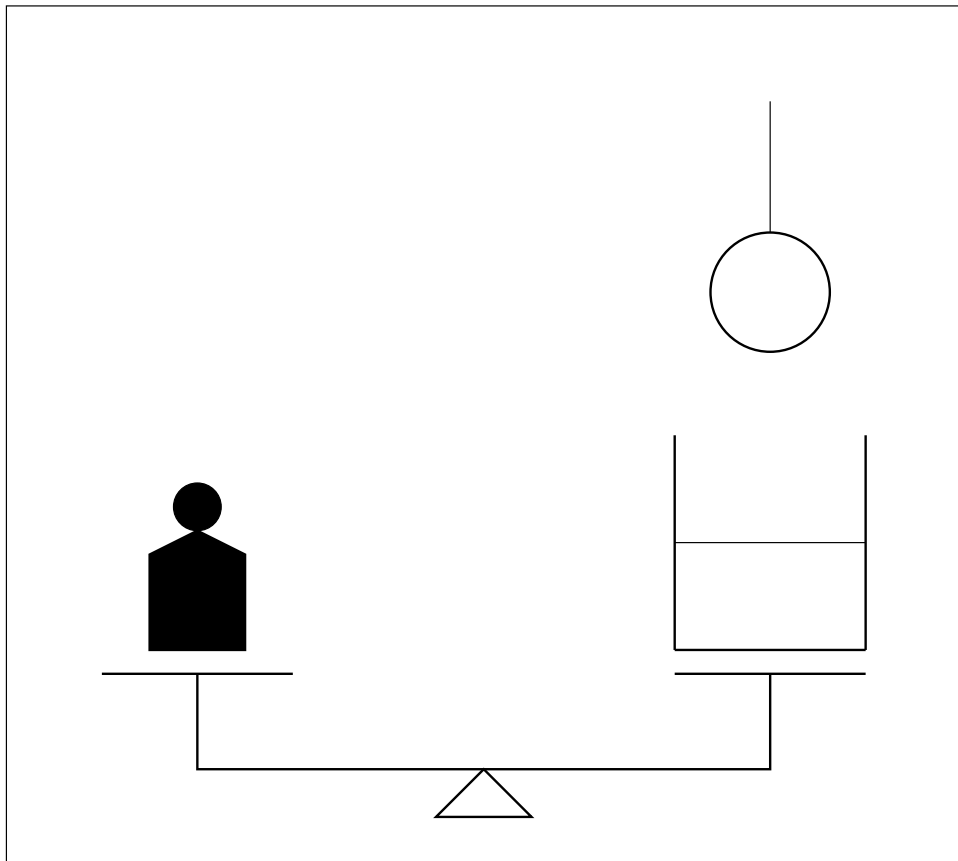


Figure 2: Problem P28.