

Lansing Area High School Physics Competition

Problem Set 1

Opening date: November 1st, 2002.

Due date: November 30th, 2002.

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

P1. A small coin is dropped from a height of 10 cm above the surface of a desk. How much time does it take to hit the desk? What is its speed as it hits the desk? (You can use $g = 10 \text{ m/s}^2$ in this problem.)

(3 points)

P2. The average speed of a Greyhound bus from Lansing to Detroit is 60 mph. On the return trip from Detroit to Lansing the average speed is 40 mph on the same road due to heavy traffic. What is the average speed of the bus for the round trip?

(4 points)

P3. An elevator is moving upwards with a constant velocity of 2 m/s. A person in the elevator drops his keys from a height of 1 m. How much time does it take for the keys to hit the floor of the elevator?

(4 points)

P4. Can the kinetic energy of an object be negative? What about the potential energy of the same object? Explain your answer briefly.

(3 points)

P5. What is the period of revolution of the Space Shuttle in a circular orbit 200 km above the surface of the Earth? How many "Shuttle-days" are in one "Earth-day" or in other words how many sunsets do the astronauts on board see in 24 hours ?

(5 points)

P6. How much time does it take for a radio signal to reach the Moon from the Earth? How much time does it take for sunlight to travel through space from the Sun to the Earth? How much time does it take for a radio signal to arrive to Mars from Earth? Discuss your answers briefly.

(4 points)

P7. Two identical glasses are completely filled with water. We then gently place a piece of wood into one of the glasses. After the water which overflowed is cleaned up, what can we say about the weights of the two glasses? Are they different? If yes, which one is heavier? Or are they the same? Explain your answer.

(3 points)

P8. At what angle with respect to the vertical does a diver under the water see the sunrise? Make a sketch to illustrate your answer.

(4 points)

P9. A small sphere with mass m is attached to a light string of length l in a horizontal position. (See Figure 1.) It is then released. When it is at the vertical position, it collides elastically with an identical sphere also of mass m . This second sphere flies off horizontally from a height of l , and then hits the floor. At what distance x will it hit the floor?

(5 points)

P10. Galileo Galilei (1564-1642) found experimentally that small objects sliding down with negligible friction on several different straight inclines reach the bottom point of a vertical circle (point P in Figure 2) in the same time if the starting points (points A , B and C in the Figure) lie on the perimeter of the same circle. Prove his observation from the laws of mechanics.

(5 points)

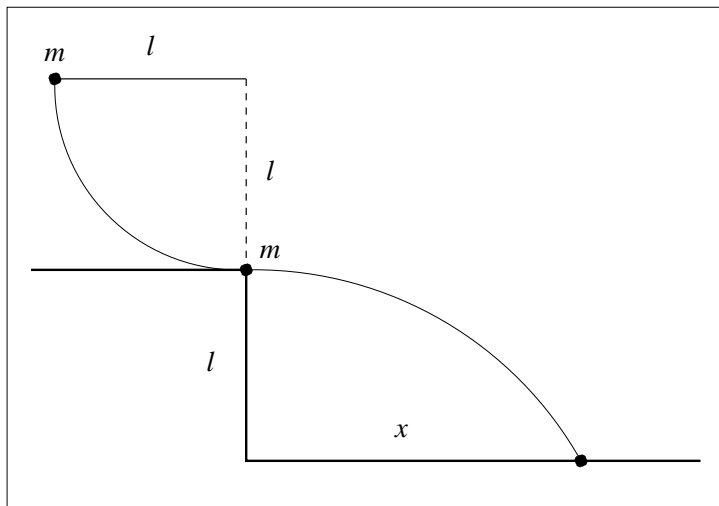


Figure 1: Problem P9.

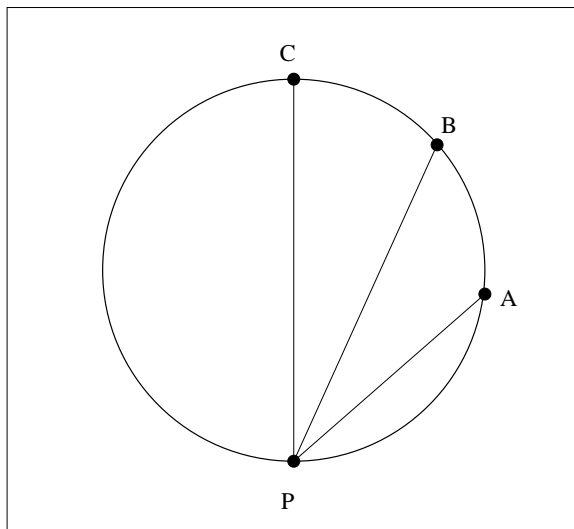


Figure 2: Problem P10.