Workshop Exercises: Related Rates

1. The radius of a sphere is decreasing at a rate of 4 centimeters per second. Find the rate of change of the volume of the sphere when the radius is 3 centimeters.

2. A person is standing 30 meters from a road. A bicycle is approaching, moving along the road at a rate of 90 meters per minute. How fast is the distance between the bicycle and the person decreasing when the bicycle is 50 meters from the person?

3. Sand is pouring from a pipe at the rate of 12 cubic feet per second. If the falling sand forms a conical pile on the ground whose height is always $\frac{1}{3}$ the diameter of the base, how fast is the height increasing when the pile is 4 feet high? (The volume of a cone is $V = \frac{1}{3}\pi r^2 h$, where r is the radius of the base and h is the height).

4. A person 6 feet tall is walking toward a wall at the rate of 4 feet per second. Directly behind the person and 40 feet from the wall is a spotlight at ground level. How fast is the length of the person's shadow on the wall changing at the moment when the person is exactly halfway between the spotlight and the wall?

5. Two boats are racing with constant speed toward a finish marker, boat A sailing from the south at 13 miles per hour and boat B approaching from the east. When equidistant from the marker the boats are 16 miles apart and the distance between them is decreasing at the rate of 17 miles per hour. Which boat will win the race?

6. A searchlight is focused on a plane that flies directly above the light at an altitude of 2 miles at a speed of 400 miles per hour. How fast must the light be turning 2 seconds after the plane passes directly overhead? (Your answer should be in the units of radians per second).