**3.9: Related Rates**

Example 1: A boat is pulled into a dock by a rope attached to the bow of the boat and passing through a pulley on the dock that is 1 m higher than the bow of the boat. If the rope is pulled in at a rate of 1 m/s, how fast is the boat approaching the dock when it is 8 m from the dock?

Example 2: A spotlight on the ground shines on a wall 12 m away. If a man 2 m tall walks from the spotlight toward the building at a speed of 1.6 m/s, how fast is the length of his shadow on the building decreasing when he is 4 m from the building?

Example 3: The minute hand on a watch is 8 mm long and the hour hand is 4 mm long. How fast is the distance between the tips of the hands changing at one o'clock?

Example 4: A lighthouse is located on a small island 3 km away from the nearest point *P* on a straight shoreline and its light makes four revolutions per minute. How fast is the beam of light moving along the shoreline when it is 1 km from *P*?

Example 5: A large spherical balloon is blown up at a constant rate 3 liters every 8 seconds. How fast is the surface area changing when the diameter is 50 cm?

Example 6: A plane flies horizontally at an altitude of 5 km and passes directly over a tracking telescope on the ground. When the angle of elevation is , this angle is decreasing at a rate of . How fast is the plane traveling at that time?