

- Margaret and I will be available to help you with the problems. You should also ask your group members questions, and share your ideas with each other.
- Focus on **understanding** the solution each problem, and on being able to **explain** them to each other.

### Related Rates

The following steps may be useful in working through these problems.

- Identify the quantities that are changing, and give each one a variable name.
- Draw and label a diagram.
- Find an equation relating the variables.
- Differentiate both sides of this equation, *treating each variable as its own function*.
- Identify the given information in terms of values of the variables, or their rates of change, at the key moment.
- Substitute the given information into the equations, and solve for the desired quantity or rate.
- Answer the original question (in words).

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1. A train goes 40 mph on a straight track going east. The track is crossed by a road going north and south, and a house is on the road one mile south of the track. How fast is the distance between the house and the train changing six minutes after the train crosses the road?
  2. Suppose a snowball remains spherical while it melts with the radius shrinking at one inch per hour. How fast is the volume of the snowball decreasing when the radius is 2 inches?
  3. An oil spill occurs at sea. The oil gushes out from an offshore derrick and forms a circle whose area increases at a rate of 100 ft<sup>2</sup>/min. how fast is the radius of the spill increasing when the spill is 20 feet across the entire diameter?
  4. The sides of a rectangle change with respect to time. The width is increasing at a rate of 2 in/sec. while the length is decreasing at a rate of 3 in/sec. How fast is the area of the rectangle changing when the width is 6 inches and the length is 8 inches?
  5. A box has a square base, and its height is always 10 inches. If the edge of the base is increasing at a rate of 2 in/min, how fast is the volume of the box increasing when the edge is 8 inches?
  6. A conical tank, 14 feet across the entire top and 12 feet deep, is leaking water. The radius of the water level is decreasing at the rate of 2 feet per minute. How fast is the water leaking out of the tank when the radius of the water level is 2 feet?  
Recall the volume of the cone is given by  $V = \frac{1}{3}\pi r^2 h$ .
  7. The top of a ten foot ladder is sliding down a vertical wall at the rate of one foot every second. How fast is distance between the bottom of the ladder and the wall changing when the top of the ladder is three feet above the ground?
  8. A kite starts flying 300 feet directly above the ground. The kite is being blown horizontally at 10 feet per second. When the kite has blown horizontally for 40 seconds, how fast is the string running out?