

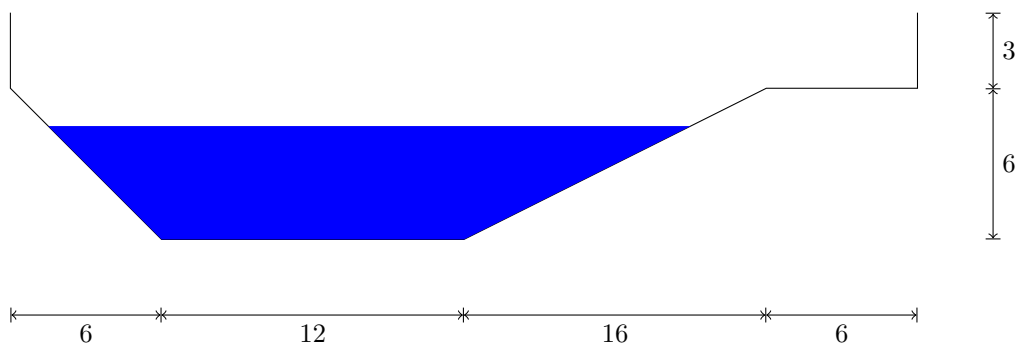
Math 110/002 March 21 Worksheet

In the following problems it may help to consider the following problem solving steps for related rates

- Understand the problem. Draw a picture!
- Introduce notation. Identify the given/required rate.
- Find one (or more) equation(s) relating the relevant quantities.
- Use chain rule to differentiate.
- Solve for the desired quantity and substitute known information.
- Reflect. What are the units? Is the answer reasonable?

When stuck it helps to think about which step you are on and what you should try to do next. Consider a technique from the following non-exhaustive list: Pythagorean Theorem, Similar Triangles, Distance Formula, Trigonometric Formulas, Arc Length Formula, Area/Volume of various shapes/solids, Law of Cosine.

1. At noon, ship Alice is 40 nautical miles due west of ship Bob. Ship Alice is sailing west at 16 knots and ship Bob is sailing north at 17 knots. How fast (in knots) is the distance between the ships changing at 4pm? Note: 1 knot is a speed of 1 nautical mile per hour.
2. A 6 ft tall man walks in a straight line away from a 12 ft tall light post at a constant speed of 2 ft/s. How fast is his shadow growing when he is 3 ft from the light post?
3. A particle moves along the curve $y = \sqrt{1 + x^3}$. As it reaches the point $(2, 3)$ the y -coordinate is increasing at a rate of 4 cm/s. How fast is the x -coordinate of the point changing at that instant?
4. If a snowball melts so that its surface area decreases at a rate of $1 \text{ cm}^2/\text{min}$, find the rate at which the diameter decreases when the diameter is 10 cm.
5. A swimming pool is 20 ft wide, 40 ft long, 3 ft deep at the shallow end and 9 ft deep at its deepest point. A cross-section is shown in the figure.



If the pool is being filled at a rate of $0.8 \text{ ft}^3/\text{min}$, how fast is the water level rising when the depth at the deepest point is 5 ft?

6. 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?