

1. An airplane is flying toward a radar station at a constant altitude of 6 km. If the distance s between the airplane and the radar station is decreasing at a rate of 400 km per hour when $s = 10$ km, what is the horizontal speed of the plane?
2. A light is on the ground 20 m from a building. A 2 m tall crate is being moved from the light directly toward the building at 1 m/s. How fast is the length of its shadow on the building changing when it is 14 m from the building?
3. A conical cup is 4 cm across the top and 6 cm deep. Water leaks out of the bottom at a rate of $2 \text{ cm}^3/\text{s}$. How fast is the water level dropping when the height of the water is 3 cm?
4. 2 m tall Kadim walks on level ground toward a lamppost at a rate of 0.5 m/s. The light is 5 m above the ground. How fast is the length of Kadim's shadow decreasing when he is 3 m from the post?
5. Air is escaping from a spherical balloon at a rate of $2 \text{ cm}^3/\text{min}$. How fast is the surface area shrinking when the radius is 1 cm?
6. A funnel in the shape of an inverted cone is 30 cm deep and has a diameter across the top of 20 cm. Liquid is flowing out of the funnel at a rate of $12 \text{ cm}^3/\text{s}$. At what rate is the height of the liquid decreasing at the instant the liquid is 20 cm deep?
7. A boat is being pulled into a dock by a rope attached to it. The rope goes through a pulley on the dock, positioned 6 m vertically higher than the boat. If the rope is reeled in at a rate of 3 m/s, how fast is the boat approaching the dock when it is 8 m from the dock?
8. The cross section of a water trough is an isosceles triangle (see figure below). The height of the trough is 0.75 m and the width at the top is 1.0 m. Its length is 3 m.

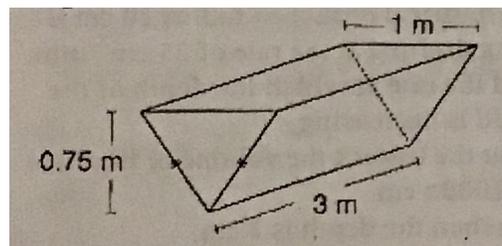


Figure 1: Water trough in the shape of an isosceles triangle.

- (a) Find a formula that gives the volume of water in the trough when the depth is h m.
- (b) Several thirsty horses are drinking at the trough such that its depth is decreasing by $0.05 \text{ m}/\text{min}$. How fast is the volume decreasing when the depth is 0.5 m?

9. Find the rate of change of the area A of a circle with respect to its circumference C .
10. A water tank has the shape of an inverted right circular cone, with a radius at the top of 15 m and a depth of 12 m. Water is flowing into the tank at a rate of $2 \text{ m}^3/\text{min}$. How fast is the depth of water increasing when the depth is 8 m?
11. A ladder 10 m long is leaning against a vertical wall with its other end on the ground. The top end of the ladder is sliding down the wall. When the top end is 6 m from the ground, it is sliding down at 2 m/s. How fast is the bottom moving away from the wall at this instant?
12. For its first few months of life, a fish grows so that its length is always double its height and six times its width. If its width is increasing at 0.2 cm/week , at what rate is its volume increasing when the width is 2 cm?
13. Two cars leave an intersection at the same time. One car is heading west at 80 km/h and the other south at 100 km/h . Assuming no changes in velocity or direction, at what rate are the cars separating after half an hour?
14. A southbound car travelling 100 km/h passes through an intersection 6 minutes before a westbound car travelling at 80 km/h . Assuming no changes in velocity or direction, at what rate are the cars separating half an hour after the westbound car passes the intersection?
15. A rectangular swimming pool has dimensions $25 \times 15 \text{ m}$. The bottom of the pool is slanted so that at one end of the long side, the depth is 6 m, and at the other end, the depth is 1 m. Water is pumped into the pool at a rate of $10 \text{ m}^3/\text{min}$. At what rate is the depth of water changing when the depth at the deep end is
 - (a) 3.5 m?
 - (b) 5.5 m?
16. Two ships leave port at the same time. Ship A travels west at 20 km/h , while ship B heads south at 25 km/h . At what rate are the ships separating after one hour?
17. A westbound ship travelling 20 km/h leaves port 45 minutes before a southbound ship travelling at 25 km/h . At what rate are the ships separating one hour after the southbound ship leaves port?
18. Two ships leave port at the same time. Ship A travels southwest at 20 km/h while ship B heads south at 25 km/h . At what rate are the ships separating after one hour? Hint: Use the cosine law for triangles.