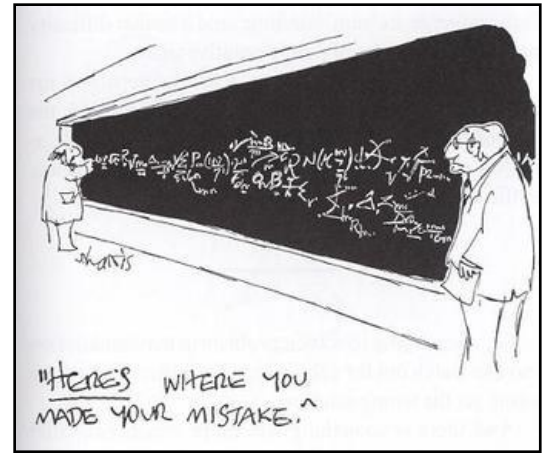


Fun with Related Rates – show work on your own paper!

For each problem, draw and label a picture, write an equation, take the derivative, plug in known values and solve. Include units with your answer.



1. Air is being pumped into a spherical balloon so that its volume increases at a rate of $100 \text{ cm}^3/\text{s}$. How fast is the radius of the balloon increasing when the diameter is 50 cm?
2. A ladder 10 ft long rests against a vertical wall. If the bottom of the ladder slides away from the wall at a rate of 1 ft/s, how fast is the top of the ladder sliding down the wall when the bottom of the ladder is 6 ft from the wall?
3. A water tank has the shape of an inverted cone with a base radius 2m and a height of 4m. If water is being pumped into the tank at a rate of $2\text{m}^3/\text{min}$, find the rate at which the water level is rising when the water is 3m deep.
4. A man walks along a straight path at a speed of 4 ft/s. A searchlight is located on the ground 20 ft from the path and is kept focused on the man. At what rate is the searchlight rotating when the man is 15 ft from the point on the path closest to the searchlight?
5. 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.
6. At noon ship A is 150 km west of ship B. Ship A is sailing east at 35 km/h and ship B is sailing north at 25 km/h. How fast is the distance between the ships changing at 4:00 PM.?
7. Two cars start moving from the same point. One travels south at 60 mi/h and the other travels west at 25 mi/h. At what rate is the distance between the cars increasing 2 hours later?
8. A spotlight on the ground shines on 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?
9. A baseball diamond is a square with sides that are 90 ft. A batter hits the ball and runs toward 1st base at a rate of 24 ft/s.
 - a. At what rate is his distance from second base decreasing when he is halfway to first base?
 - b. At what rate is his distance from third base increasing at the same moment?
10. The altitude of a triangle is increasing at a rate of 1 cm/min while the area of the triangle is increasing at a rate of $2 \text{ cm}^2/\text{min}$. At what rate is the base of the triangle changing when the altitude is 10 cm and the area is 100 cm^2 ?

11. A boat is pulled into a dock by a rope attached to the bow of a 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?
12. At noon, ship A is 100 km west of ship B. Ship A is sailing south at 35 km/h and ship B is sailing north at 25 km/h. How fast is the distance between the ships changing at 4:00P.M.?
13. Water is leaking out of an inverted conical tank at a rate of $10,000 \text{ cm}^3/\text{min}$ at the same time that water is being pumped into the tank at a constant rate. The tank has height 6 m and the diameter of the base is 4 m. If the water level is rising at a rate of $20 \text{ cm}/\text{min}$ when the height of water is 2 m, find the rate at which water is pumped into the tank.
14. Gravel is being dumped from a conveyor belt at a rate of $30 \text{ ft}^3/\text{min}$ and its coarseness is such that it forms a pile in the shape of a cone whose base diameter and height are always equal. How fast is the height of the pile increasing when the pile is 10 ft high?
15. A kite 100 ft above the ground moves horizontally at a speed of 8 ft/s. At what rate is the angle between the string and the horizontal decreasing when 200 ft of string have been let out?

Answers

1. $1/25\pi \text{ cm/s}$
2. $-.75\text{ft/s}$
3. $8/9\pi$
4. $.128 \text{ rads/s}$
5. $.016 \text{ cm/min}$
6. 21.39kph
7. 65 mph
8. $.6 \text{ m/s}$
9. a. 10.733 ft/s b. 10.733 ft/s
10. $-1.6\text{cm}/\text{min}$
11. 1.0077 m/s
12. 55.4 kph
13. approx $289252 \text{ cubic cm}/\text{min}$
14. $.38 \text{ ft}/\text{min}$
15. $.02 \text{ rads/s}$