

Supplementary Related Rate Problems

1. A pebble is dropped into a pond and the waves begin to spread. The radius of the circle of waves grows at the rate of 1 foot per second. Find the rate of increase of the area at the instant the radius is 8 feet.
2. A spherical balloon increases in diameter at the rate of 1 inch per minute. Find the rate of increase of surface area:
 - a) When the radius is 1.5 feet.
 - b) When the surface area is 4π sq. feet.
 - c) When the volume is $\frac{\pi}{6}$ cu. ft.
3. A spherical balloon is being inflated at 3π ft³/min. Find the rate of increase of the diameter 12 minutes after the inflation begins.
4. An inverted conical tank has a depth of 8 feet and a top radius of 3 feet. If water runs out at the rate of 4 cubic feet per minute, how fast is the level falling when the depth is 6 feet?
5. Car A approaches an intersection from the east at 40 ft/sec and car B approaches from the north at 50 ft/sec. How fast is the distance between them changing at the instant that car A is 30 feet east of the intersection and car B is 40 feet north?
6. A kite flying 100 feet high is blown by the wind horizontally at 4 feet/sec. If the string is let out from a fixed position, how fast is the length of the string changing when it is 125 feet long?
7. A ladder 20 feet long rests against a wall. The foot of the ladder slips out from the wall at a rate of 1 inch per second. Find the rate at which the top of the ladder slips down the wall at the instant the ladder makes a 60 degree angle with the ground.
8. A fast jet flying north at 600 mph passes over a town at 12 noon. A second jet flying east at 540 mph passes over the town at 12:01. If the altitudes of the two planes are the same, how fast are they moving apart at 12:06?
9. A man 6 feet tall walks away from a streetlamp 18 feet high at 4 ft/sec. Find the speed of the tip of his shadow at the instant the man is 24 feet from the base of the lamp.
10. A dog chases a squirrel at 12 ft/sec. The squirrel runs up a tree at 6 ft/sec. How fast is the distance between them changing at the instant the dog is 12 feet from the tree and the squirrel is 5 feet up the tree?
11. A fisherman standing on a dock pulls in a rope attached to her boat. Her hands are 6 feet above the point of attachment of the rope to the boat. She pulls it in at a rate of 1 ft/sec. How fast is the boat approaching the dock when the rope is 10 feet long?
12. Sand falls onto a conical pile at a rate of 10 ft³/min. the radius of the base of the pile is always one half of the altitude. How fast is the altitude changing when it is 5 feet deep?
13. A spherical iron ball 8 inches in diameter is coated with ice. If the ice melts at a rate of 10 cubic inches/min, how fast is the thickness of the ice decreasing when it is 2 inches thick? How fast is the outer surface area changing when the ice layer is 2 inches thick?
14. A weather balloon, with a radius of 9 feet, spring a leak and is losing air at the rate of 171π cubic feet per minute. Find the rate of decrease of the radius after 4 minutes.
15. If the length of the sides of an equilateral triangle is increasing at a rate of 3 in./min., how fast is the area changing when the sides are 8 inches long?
16. Water is flowing at the rate of 8 cubic feet per minute into a tank in the form of a cylinder. If the radius of the base is 2 feet, how fast is the water level rising?
17. Water is withdrawn from a conical reservoir, 8 feet in diameter and 10 feet deep, at the rate of 5 cubic feet per minute. How fast is the water level falling when the depth of the water is 6 feet?

Answers

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| 1. 16π ft ² /sec | 6. 2.4 ft/sec | |
| 2. a) $\frac{\pi}{2}$ ft ² /min | 7. $\frac{\sqrt{3}}{36}$ ft/min | $\frac{10}{3}$ in ² /min |
| b) $\frac{\pi}{3}$ ft ² /min | 8. 804 mph | 14. $\frac{19}{16}$ ft/min |
| c) $\frac{\pi}{6}$ ft ² /min | 9. 6 ft/sec | 15. $\sqrt{3}$ in ² /min |
| 3. $\frac{1}{6}$ ft/min | 10. -8.77 ft/sec | 16. $\frac{2}{\pi}$ ft/min |
| 4. $\frac{64}{81\pi}$ ft/min | 11. 1.25 ft/sec | 17. $\frac{125}{144\pi}$ ft/min |
| 5. 64 ft/sec | 12. $\frac{8}{5\pi}$ ft/min | |
| | 13. $\frac{5}{72\pi}$ in/min | |

