

1. If  $xy^2 = 12$  and  $\frac{dy}{dt} = 6$ , find  $\frac{dx}{dt}$  when  $y = 2$ .
2. If  $x^3 + y^3 = 9$  and  $\frac{dx}{dt} = 4$ , find  $\frac{dy}{dt}$  when  $x = 2$ .
3. How fast is the area of a square increasing when the side is 3 m in length and growing at a rate of 0.8 m/min?
4. How fast is the edge length of a cube increasing when the volume of the cube is increasing at a rate of 144 cm<sup>3</sup>/s and the edge length is 4 cm?
5. A stone is dropped into a lake, creating a circular ripple that travels outward at a speed of 25 cm/s. Find the rate at which the area within the circle is increasing after 4 s.
6. A spherical balloon is being inflated so that the volume is increasing at a rate of 8 m<sup>3</sup>/min. How fast is the radius of the balloon increasing when the diameter is 2 m?
7. A snowball melts so that its surface area decreases at a rate of 0.5 cm<sup>2</sup>/min. Find the rate at which the radius decreases when the radius is 4 cm.
8. The side of an equilateral triangle decreases at the rate of 2 cm/s. At what rate is the area decreasing when the area is 100 cm<sup>2</sup>?
9. The area of a triangle is increasing at a rate of 4 cm<sup>2</sup>/min and its base is increasing at a rate of 1 cm/min. At what rate is the altitude of the triangle increasing when the altitude is 20 cm and the area is 80 cm<sup>2</sup>?
10. A man 2 m tall walks away from a lamppost whose light is 5 m above the ground. If he walks at a speed of 1.5 m/s, at what rate is his shadow growing when he is 10 m from the lamppost?
11. A ladder 4 m long rests against a vertical wall. If the bottom of the ladder slides away from the wall at a speed of 30 cm/s, how quickly is the top of the ladder sliding down the wall when the bottom of the ladder is 2 m from the wall?

12. Joe is driving west at 60 km/h and Dave is driving south at 70 km/h. Both cars are approaching the intersection of the two roads. At what rate is the distance between the cars decreasing when Joe's car is 0.4 km and Dave's is 0.3 km from the intersection?
13. At 1:00 p.m. ship A was 80 km south of ship B. Ship A is sailing north at 30 km/h and ship B is sailing east at 40 km/h. How fast is the distance between them changing at 3:00 p.m.?
14. A waterskier skis over the ramp shown in the figure at a speed of 12 m/s. How fast is she rising as she leaves the ramp?



15. A plane flies horizontally with a speed of 600 km/h at an altitude of 10 km and passes directly over the town of Quinton. Find the rate at which the distance from the plane to Quinton is increasing when it is 20 km away from Quinton.
16. A water trough is 10 m long and a cross-section has the shape of an isosceles triangle that is 1 m across at the top and is 50 cm high. The trough is being filled with water at a rate of 0.4 m<sup>3</sup>/min. How fast will the water level rise when the water is 40 cm deep?
17. Sand is being dumped from a conveyor belt at a rate of 1.2 m<sup>3</sup>/min and 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 growing when the pile is 3 m high?

RELATED RATE PROBLEMS - ANSWERS

1. -18

2. -16

3.  $4.8 \text{ m}^2/\text{min}$

4. 3 cm/s

5.  $5000\pi \approx$   
 $15700 \text{ cm}^2/\text{s}$

6.  $2/\pi \approx$   
 $0.64 \text{ m}/\text{min}$

7.  $1/64\pi \approx$   
 $0.005 \text{ cm}/\text{min}$

8.  ~~$\frac{20}{\sqrt{3}} \approx 11.5 \text{ cm}^2/\text{s}$~~   $20\sqrt{3}$  <sup>(8)</sup>

9. -1.5 cm/min

10. 1 m/s

11.  $\frac{\sqrt{3}}{10} \approx 0.17 \text{ m/s}$

12. 90 km/h  $26.321$   
 $\text{cm}^2/\text{s}$

13.  $\frac{130}{\sqrt{17}} \approx 31.5 \text{ km/h}$

14.  $\frac{6\sqrt{26}}{13} \approx 2.35 \text{ m/s}$

15.  $240\sqrt{5} \approx 537 \text{ km/h}$

16. 5 cm/min

17.  $\frac{8}{15\pi} \approx 0.17 \text{ m}/\text{min}$