

# Calculus Honors - M7H

## Related Rates - Homework 1

1. The radius  $r$  of a circle is increasing at a rate of 3 cm/s. The formula for the area of a circle is  $A = \pi r^2$ . At what rate is the area increasing when the radius is 10 cm?
2. Water is being poured into a cylindrical tank of radius 4 ft at a rate of 2 ft<sup>3</sup>/min. The formula for the volume of a cylinder is  $V = \pi r^2 h$ . How fast is the height of the water rising?
3. A 13-ft ladder is leaning against a wall. The bottom of the ladder is sliding away from the wall at 2 ft/s. If  $x$  is the distance from the wall to the bottom of the ladder and  $y$  is the height of the top of the ladder above the ground, then  $x^2 + y^2 = 13^2$ . How fast is the top of the ladder sliding down when the bottom is 5 ft from the wall?
4. Car A travels east at 40 mph and Car B travels north at 30 mph. Both leave the same intersection at the same time. If  $x$  is the eastward distance of Car A from the intersection,  $y$  is the northward distance of Car B from the intersection, and  $z$  is the distance between the cars, then  $x^2 + y^2 = z^2$ . How fast is the distance between the cars increasing after 2 hours?
5. A spherical balloon is being inflated so that its radius increases at 0.5 cm/s. The formula for the volume of a sphere is  $V = \frac{4}{3}\pi r^3$ . How fast is the volume increasing when the radius is 6 cm?
6. Water is being poured into a conical tank of height 12 ft and base radius 6 ft at a rate of 3 ft<sup>3</sup>/min. The formula for the volume of a cone is  $V = \frac{1}{3}\pi r^2 h$ . How fast is the water level rising when the water is 4 ft deep?
7. A 6-ft tall person walks away from a 15-ft tall streetlight at a rate of 4 ft/s. Let  $x$  be the distance from the pole to the person and  $y$  be the length of the shadow. Use similar triangles:  $\frac{15}{x+y} = \frac{6}{y}$ . How fast is the tip of the shadow moving when the person is 10 ft from the pole?
8. A spotlight is on the ground 20 m from a wall. The light rotates upward so that the angle of elevation  $\theta$  increases at 0.2 rad/s. If  $y$  is the height of the light spot on the wall, then  $\tan \theta = \frac{y}{20}$ . How fast is the height of the light spot increasing when  $\theta = \frac{\pi}{4}$ ?

9. A spherical tank is leaking water so that the volume decreases at  $5 \text{ ft}^3/\text{min}$ . The formula for the volume of a sphere is  $V = \frac{4}{3}\pi r^3$ . How fast is the radius decreasing when the radius is 3 ft?
10. Object A moves along the x-axis toward the origin at 5 units/s. Object B moves along the y-axis away from the origin at 12 units/s. If  $x$  and  $y$  are their distances from the origin and  $z$  is the distance between them, then  $x^2 + y^2 = z^2$ . How fast is the distance between them changing when  $x = 9$  and  $y = 16$ ?
11. A rectangle is changing so that its length increases at 2 cm/s and its width decreases at 1 cm/s. The formula for the area of a rectangle is  $A = lw$ . How fast is the area changing when the length is 10 cm and the width is 6 cm?
12. Two sides of a triangle are increasing at rates of 3 cm/s and 4 cm/s, and the included angle remains constant at  $\theta = \frac{\pi}{6}$ . The formula for the area of a triangle is  $A = \frac{1}{2}ab \sin \theta$ . How fast is the area changing when the side lengths are 5 cm and 7 cm?