

Problem Definition

Problem 13. **Expanding Cube** All edges of a cube are expanding at a rate of 3 centimeters per second. How fast is the volume changing when each edge is (a) 1 centimeter and (b) 10 centimeters?

Solution Step 1:

If we use the variable x to denote the length of an edge on our cube, the volume denoted by V is given by

$$V = x^3$$

Both x and V are both dependent on time.

Solution Step 2:

The next step is to differentiate the equation with respect the time variable t . The resulting equation relating the rate of change of the volume to the rate of the length of the side is the following.

$$\frac{dV}{dt} = 3x^2 \frac{dx}{dt}$$

Solution Step 3:

To finish the problem we plug in the values for both parts (a) and (b). For part (a), $x = 1$ and $dx/dt = 3$

$$\frac{dV}{dt} = 3(1)^2(3) = 9$$

centimeters per second. For the second part, $x = 10$ and $dx/dt = 3$. The rate of change of the volume for this case is

$$\frac{dV}{dt} = 3(10)^2(3) = 900$$

centimeters per second.