

$$.04 = \frac{4}{100} = \frac{1}{25}$$

4. [10 pts.] The volume of a right circular cylinder of height h and radius r is $V = \pi r^2 h$. A computer program allows you to manipulate the shape of a cylinder by varying its radius and height independently. You set the program so that the cylinder's height is increasing at a rate of 1 cm/sec and the radius is decreasing at a rate of 0.04 cm/sec. At what rate is the volume changing when the height of the cylinder is 12 cm and the radius is 1 cm? Indicate units. (Notice that in this problem both h and r are functions of t .)

$$\frac{dh}{dt} = 1, \quad \frac{dr}{dt} = -.04, \quad V = \pi r^2 h$$

$$\text{So } \frac{dV}{dt} = \frac{d}{dt}(\pi r^2 h) = 2\pi r h \frac{dr}{dt} + \pi r^2 \frac{dh}{dt}$$

When $h=12$, $r=1$ have

$$\begin{aligned} \frac{dV}{dt} &= 2\pi \cdot 1 \cdot 12 (-.04) + \pi \cdot 1^2 \cdot 1 = \pi \left[-\frac{24}{25} + 1 \right] \\ &= \frac{\pi}{25} \approx .04 \cdot \pi \approx .126 \end{aligned}$$

Final answer:

$$\frac{\pi}{25} \text{ cm}^3/\text{sec.}$$