According to the U.S. standard atmospheric model, developed by the National Oceanic and Atmospheric Administration for use in aircraft and rocket design, atmospheric temperature T (in degrees Celsius), pressure P (kPa = 1,000 Pascals), and altitude h (meters) are related by the formulas (valid in the troposphere h ≤ 11,000):

$$T = 15.04 - 0.000649h, \qquad P = 101.29 + \left(\frac{T+273.1}{288.08}\right)^{5.256}$$

Calculate $\frac{dP}{dh}$. Then estimate the change in P (in Pascals, Pa) per additional meter of altitude when h = 3,000. one approach: $\frac{dP}{dh} = \frac{dP}{dT} \cdot \frac{dT}{dh}$

$$\frac{dP}{dT} = 5.256\left(\frac{T+273.1}{288.08}\right)^{4.256}\left(\frac{1}{288.08}\right)$$

$h = 3000 \rightarrow T = 15.04 - 0.000649(3000) = 13.093$

$$\frac{dT}{dh} = -0.000649$$

$$\frac{dP}{dT} = 5.256\left(\frac{13.093+273.1}{288.08}\right)^{4.256}\left(\frac{1}{288.08}\right) = 0.0177$$

$$\frac{dP}{dh} = \frac{dP}{dT} \cdot \frac{dT}{dh} = (0.0177)(-0.000649) = -0.0000114 \ \frac{kPa}{m}$$

Given the relation: $\sin(x + y) + x^2 = 1$, estimate the slope of the curve at the point (1, 2.15). $\frac{d}{dx}\left(\sin(x+y) + x^2 = 1\right) \rightarrow \cos(x+y)(1+y') + 2x = 0$

$(\cos 3.15)(1+y') + 2 = 0 \qquad -(1+y') + 2 = 0$

$-1 - y' + 2 = 0 \qquad -y' + 1 = 0 \qquad y' = 1$

Slope ≈ 1