

Chapter 03 Context-rich group problem

$$a) P(y) = P(y=0) e^{-Mgy/RT} \quad (\text{see Lab \#2})$$

$$\Rightarrow \frac{0.7 \text{ atm}}{1.05 \text{ atm}} = e^{-\frac{0.029 \text{ kg/mol} \cdot 9.8 \text{ m/s}^2 \cdot y}{8.3145 \frac{\text{kJ}}{\text{mol} \cdot \text{K}} \cdot 288.15 \text{ K}}}$$

↙ google: 28.97 g/mol

$$\Rightarrow \boxed{y \sim 3416 \text{ m}}$$

$$b) Q = 0 \Rightarrow \Delta U = -W = -\frac{1}{\gamma-1} (P_1 V_1 - P_2 V_2)$$

→ need V_2

$$P_2 V_2^\gamma = P_1 V_1^\gamma \Rightarrow V_2 = V_1 \left(\frac{P_1}{P_2} \right)^{1/\gamma} = 2 \cdot 10^3 \text{ m}^3 \left(\frac{1.05 \text{ atm}}{0.700 \text{ atm}} \right)^{1/1.67}$$

$$= 2.55 \cdot 10^3 \text{ m}^3$$

$$\rightarrow \Delta U = -W = -\frac{1}{1.67-1} \left(1.05 \text{ atm} \cdot 1.013 \cdot 10^5 \frac{\text{Pa}}{\text{atm}} \cdot 2 \cdot 10^3 \text{ m}^3 - 0.700 \cdot 1.013 \cdot 10^5 \cdot 2.55 \cdot 10^3 \right)$$

$$= \boxed{-4.8 \cdot 10^7 \text{ J}} \quad \text{cools down}$$

$$T_2 = T_1 \frac{P_2}{P_1} \frac{V_2}{V_1} \quad \text{or} \quad T_2 = T_1 \left(\frac{V_1}{V_2} \right)^{\gamma-1}$$

Both yield $T_2 = 244.87 \text{ K}$