

Today we'll finish chapter 4 and do some review

Exam #1 review session? Options Tues or Wed

⇒ review session is 6-7 pm (here!) on Wed Feb 21
maybe even 6-7:30

refrigerator example

A freezer has $k=2.40$ and is used to bring 1.80 kg of H_2O at $25.0^\circ C$ to $-5.0^\circ C$ in 60 minutes.

a) How much heat is removed?

$$\begin{aligned} Q_c &= - \left[|Q_{\text{cool } H_2O}| + |Q_{\text{convert to ice}}| + |Q_{\text{cool ice}}| \right] \\ &= - \left[m C_{H_2O} \Delta T_{H_2O} - m L_f - m C_{\text{ice}} \Delta T_{\text{ice}} \right] \\ &= - \left[1.80 \left(4190 \frac{J}{kg \cdot C} \right) (25K) + 3.34 \cdot 10^5 \frac{J}{kg} + 2010 \left(5K \right) \right] \\ &= -8.08 \cdot 10^5 J \end{aligned}$$

b) How much electrical energy is consumed?

$$W = \frac{|Q_c|}{k} = \frac{8.08 \cdot 10^5 J}{2.40} = 3.37 \cdot 10^5 J$$

c) How much wasted heat is delivered to the room?

$$|Q_H| = |W| + |Q_c| = 3.37 \cdot 10^5 J + 8.08 \cdot 10^5 J = 1.14 \cdot 10^6 J$$

We discussed ch04 Concept Q s1.html

Concept Q s2.html

A. ✓ IF $|Q_c|$ were 0, the $W=Q_H$ and thus $e=1.0$ no!

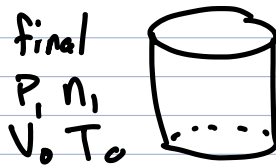
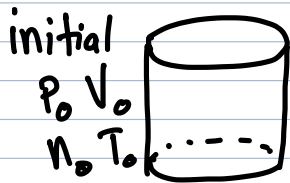
B. ✓ IF Q_H were smaller than W , then $e > 1$ no!

Concept Q #3 house would cool, but that would

violate 2nd Law idea that nature always goes toward a state of increased disorder

Chapter 4 Concept Q #4 we want to minimize the ratio T_c/T_H to maximize $e = 1 - T_c/T_H$

example slide 2.html



$$V_0 = h\pi r^2 = 0.01131 \text{ m}^3$$

$$P_0 = P_{\text{gauge}} + P_{\text{atm}} = 1.40 \cdot 10^6 \text{ Pa}$$

$$m_0 = n_0 M = \frac{P_0 V_0}{RT_0} M = 0.2845 \text{ kg}$$

$$m_1 = n_1 M = \frac{P_1 V_0}{RT_0} M = 0.0896 \text{ kg}$$

$$\Rightarrow m_2 - m_1 = 0.195 \text{ kg}$$

#2 on slide 2

$$a) m_{\text{single } N_2} = \frac{M_{N_2}}{N_A} = \frac{28.0 \text{ g/mol}}{6.022 \cdot 10^{23} \text{ molecules/mol}} = 4.65 \cdot 10^{-26} \text{ kg}$$

$$b) \frac{1}{2} m v_{\text{avg}}^2 = \frac{3}{2} kT = \frac{3}{2} \frac{1.38 \cdot 10^{-23} \text{ J}}{\text{molecule} \cdot \text{K}} (295.15 \text{ K}) = 6.11 \cdot 10^{-21} \text{ J}$$

$$c) N = \frac{PU}{kT} = \frac{1.25 \text{ atm} \cdot 1.013 \cdot 10^5 \text{ Pa} \cdot \frac{4}{3} \pi (0.250 \text{ m})^3}{1.38 \cdot 10^{-23} \text{ J} \cdot 295.15 \text{ K}} = 2.04 \cdot 10^{24} \text{ molecules}$$

$$d) N \frac{1}{2} m v_{\text{av}}^2 = 1.25 \cdot 10^4 \text{ J} \quad \text{OR} \quad \frac{3}{2} NRT = \frac{3}{2} \frac{N}{N_A} RT = 1.25 \cdot 10^4 \text{ J}$$

$$3^{\text{rd}} \text{ Q: } a \rightarrow c \quad W = p\Delta V = nR\Delta T = 3(8.3145)(192) = 4.789 \cdot 10^3 \text{ J}$$

$$c \rightarrow b \quad Q = 0 \Rightarrow \Delta U = -W \Rightarrow W = -nC_V \Delta T \quad \text{where } C_V = C_P - R = 20.8 \frac{\text{J}}{\text{mol} \cdot \text{K}}$$

$$W = -3(20.8)(108) = -6.735 \cdot 10^3 \text{ J}$$

$$b \rightarrow a \quad W = 0$$

$$\rightarrow W_{\text{tot}} = W_{ac} + W_{cb} + W_{ba} = -1.95 \cdot 10^3 \text{ J}$$