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°C to -5.0°C in 60 minutes.

a) How much heat is removed?

$$Q_c = -\left[|Q_{\text{cool } H_2O}| + |Q_{\text{convert to ice}}| + |Q_{\text{cool ice}}|\right]$$

$$= -\left|mC_{H_2O}\Delta T_{H_2O}\right| - mL_f - \left|mC_{ice}\Delta T_{ice}\right|$$

$$= -1.80\,\text{kg}\left[\left(4190\ \tfrac{J}{kg\cdot C}\right)(25\,k) + 3.34\cdot10^5\ J/kg + \left(2010\ \tfrac{J}{kg\cdot k}\right)(5k)\right]$$

$$= -8.08\cdot10^5\,J$$

b) How much electrical energy is consumed?

$$W = \frac{|Q_c|}{k} = \frac{8.08\cdot10^5\,J}{2.40} = 3.37\cdot10^5\,J$$

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

$$|Q_H| = |W| + |Q_c| = 3.37\cdot10^5\,J + 8.08\cdot10^5\,J = 1.14\cdot10^6\,J$$

We discussed ch04 ConceptQ 51.html

ConceptQ 52.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!

ConceptQ #3 house would cool, but that would

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

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

example slide 2.html

initial $P_0\ V_0$ $n_0\ T_0$

final $P_1\ n_1$ $V_0\ T_0$

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

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

$m_0 = n_0 M = \frac{P_0 V_0}{RT_0} M = 0.2845\ kg$ $\quad m_1 = n_1 M = \frac{P_1 V_0}{RT_0} M = 0.0896\ kg$

$\Rightarrow m_2 - m_1 = 0.195\ kg$

#2 on slide 2

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

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

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

d) $N \ \frac{1}{2} m v_{av}^2 = 1.25 \cdot 10^4\ J$ OR $\frac{3}{2} nRT = \frac{3}{2} \frac{N}{N_{AV}} RT = 1.25 \cdot 10^4 J$

3rd Q: $a \to c$ $W = p\Delta V = nR\Delta T = 3(8.3145)(92) = 4.789 \cdot 10^3\ J$

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

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

$b \to a \quad W = 0$

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