Chemistry-4311
September 23, 2016

Quiz #3 **Name** Key

$R = 8.314$ J/mol-K = 0.08206 L-atm/mol-K = 1.987 cal/mol-K, $N_A = 6.02 \times 10^{23}$

1. Matching (Use a letter only once)

For an adiabatic process __b__ is zero.

Protein unfolding is an __i__ process.

The difference in $C_p - C_v$ for an ideal gas is __c__.

__a__ is used to measure heat changes for physical and and chemical processes.

The probability that a molecule has energy E, is proportional to the Boltzmann factor __f__.

a. Calorimetry
b. q
c. nR
d. exp(-RT)
e. exothermic
f. exp(-E/k_BT)
g. Isothermal
h. w
i. endothermic
j. PV

2. One mole of an ideal gas is heated from 25 °C to 100 °C at a constant pressure of 1 atm.

+1 (a) Calculate the initial and final volumes of the gas.

$V = nRT/P$

$V_i = 0.08206 \times 298 = 24.5$ L

$V_f = 0.08206 \times 373 = 30.6$ L

+2 (b) What are ΔH, ΔU, w, and q for this process. C_v for one mole of the gas is 3R/2.

$C_p = 5R/2$

$\Delta U = C_v \Delta T = \frac{3 \times 8.314}{2}(75\,K) = 935$ J

$\Delta H = C_p \Delta T = \frac{5 \times 8.314}{2}(75) = 1559$ J.

$q_p = \Delta H = 1559$ J

$w = -P\Delta V = -nR\Delta T = -8.314 \times 75 = -624$ J

$\Delta U = q + w$
$q = \Delta U - w = 935 + 624 = 1559$

3. For the oxidation of glucose, $C_6H_{12}O_6(s) + 6O_2(g) \rightarrow 6CO_2(g) + 6H_2O(l)$, the ΔH_f° values are $C_6H_{12}O_6(s) = -1274.5$, $CO_2(g) = -393.5$, and $H_2O(l) = -285.8$ kJ/mol.

ΔH_f° are at 298 K

+1 (a) What is ΔH_r°?

$\Delta H_r^\circ = 6 \times (-285.8) + 6 \times (-393.5) + 1274.5$
$= -2801.3$ kJ

+1 (b) What is ΔU_r°?

$\Delta H = \Delta U + P\Delta V$

assume $\Delta V = \Delta V_{gas}$

$P\Delta V = \Delta n RT$

$\uparrow n_{products} - n_{reactants}$

$\Delta U_r^\circ = \Delta H_r^\circ$

$\Delta n = 0$