Chemistry – 4311
December 9, 2014

Final Exam **Name** Key

(10) 1. Matching (use a letter only once)

0.00075 equals f.

The unit of energy equals c.

According to the first law of thermodynamics the change in the internal energy ΔU equals j.

The enthalpy H is defined as m.

Work for a reversible, isothermal expansion is h.

If the only work is P-V work, the heat for heating a substance at constant V is t.

At constant P and n, the volume is l to the temperature.

The average kinetic energy of a mole of ideal gas molecules is b.

log(ab) equals r.

For an i process, q = 0.

a. $H = U - PV$

b. $3RT/2$

c. $kg\text{-}m^2/sec^2$

d. inversely proportional

e. $\int C_v dT/T$

f. 7.5×10^{-4}

g. isothermal

h. $-nRT\ln(V_2/V_1)$

i. adiabatic

j. $q + w$

k. $\log(a) \times \log(b)$

l. proportional

m. $H = U + PV$

n. 7.5×10^4

o. kg-m/sec

p. nRT

q. $-P_{ex}\Delta V$

r. $\log(a) + \log(b)$

s. $Mv^2/2$

t. $\int C_v dT$

$c = 3.00 \times 10^8$ m/s F = 96,500 C/mole

$h = 6.626 \times 10^{-34}$ J s R 298 K/F = 0.0257 V

R= 8.314 J/mol-K

R= 1.987 cal/mol-K

R= 0.08206 L-atm/mol-K

$N_A = 6.02 \times 10^{23}$

1 atm = 101.325 kPa = 760 torr

$k_B = 1.381 \times 10^{-23}$ J/K

(10) 2. The reaction for combustion of glycine at 25 °C is

$$NH_2CH_2COOH(s) + 9/4O_2(g) \rightarrow 2CO_2(g) + 5/2H_2O(l) + l/2N_2(g)$$

The heats of formation for the reactants and products are:
$NH_2CH_2COOH(s)$, -969.00 kJ/mol; $CO_2(g)$, - 393.51 kJ/mol, $H_2O(l)$, - 285.83 kJ/mol.
Calculate the enthalpy change ΔH° for this reaction.

$5/_2 \times (-285.83) + 2 \times (-393.51) - (-969.00) = -532.60\ kJ$

(10) 3. At constant pressure, it takes 3390 J of heat to increase the temperature of the amino acid serine from 25 to 50 °C. What is the constant pressure heat capacity of serine?

$q_p = C_p \Delta T$

$C_p = q_p/\Delta T = \frac{3390\ J}{25\ ^\circ C} = \frac{135.6\ J}{^\circ C} = \frac{135.6\ J}{K}$

(10) 4. A pure gas at 1 atm pressure and 25 °C has a density of 1.8 g/L. What is the molecular weight of the gas?

$V_{mole} = 24.4\ L$

$PV = nRT = \frac{w}{M} RT$

$PM = \frac{w}{V} RT$

$= d\,RT$

$M = \frac{dRT}{P}$

$M = \frac{1.8\ g}{L} \times \frac{0.08206\ L\text{-}atm}{mol\text{-}K} \times 298\ K \Big/ 1\ atm$

$M = 44.0\ g/mole$

(10) 5. The differential dG is $dG = VdP - SdT$. Integrate this differential at constant T for an ideal gas and show that $G_2 = G_1 + nRT\ln(P_2/P_1)$

$dG = V\,dP - S\,dT$

T constant

$dG = V\,dP \qquad V = nRT/P$

$\int_1^2 dG = \int_1^2 nRT\,dP/P = nRT \int_1^2 dP/P = nRT \ln\left(\frac{P_2}{P_1}\right)$