

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, $q = 0$.

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

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

$$R = 8.314 \text{ J/mol-K}$$

$$R = 1.987 \text{ cal/mol-K}$$

$$R = 0.08206 \text{ L-atm/mol-K}$$

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

$$1 \text{ atm} = 101.325 \text{ kPa} = 760 \text{ torr}$$

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

a. $H = U - PV$

b. $3RT/2$

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

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

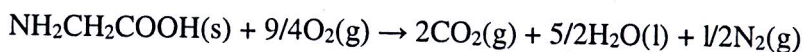
q. $-P_{\text{ex}} \Delta V$

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

s. $Mv^2/2$

t. $\int C_v dT$

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



The heats of formation for the reactants and products are:

$\text{NH}_2\text{CH}_2\text{COOH}(s)$, -969.00 kJ/mol; $\text{CO}_2(g)$, -393.51 kJ/mol, $\text{H}_2\text{O}(l)$, -285.83 kJ/mol.

Calculate the enthalpy change ΔH° for this reaction.

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

(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?

$$q_p = C_p \Delta T$$

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

(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?

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

$$PM = \frac{W}{V} RT = d RT$$

$$M = \frac{d RT}{P}$$

$$V_{\text{mole}} = 24.4 \text{ L}$$

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

$$M = 44.0 \text{ g/mole}$$

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

$$dG = VdP - SdT$$

T constant

$$dG = VdP$$

$$V = nRT/P$$

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

