Chem 155 First Hour Exam 2001

Version I: No answers provided.

Name:_____

Full credit will be given to correct answers only when all necessary steps are shown.

(12) 1. True or false? Just write "T" or "F" after each question.

(a) ΔH is a state function.

(b) P-V work is usually negligible for solids and liquids.

(c) $\Delta S = 0$ for an adiabatic, reversible expansion of an ideal gas.

(d) C_v is always temperature independent for an ideal gas.

(e) In a cyclic process such as $1 \rightarrow 2$ followed by $2 \rightarrow 1$, we have $\Delta G = 0$.

(f) $\left(\frac{\partial U}{\partial V}\right)_T = 0$ for an ideal gas.

(12) 2. List the condition(s) under which each of the following equations can be applied. If no conditions are required, write "none."

(a) $\Delta H = \Delta U + \Delta(PV)$

(b) $P_1V_1^{\gamma} = P_2V_2^{\gamma}$

(c) $w = -nRT\ln\frac{V_2}{V_1}$

(d) $\gamma = \frac{\overline{C}_P}{\overline{C}_v} = \frac{5}{3}$

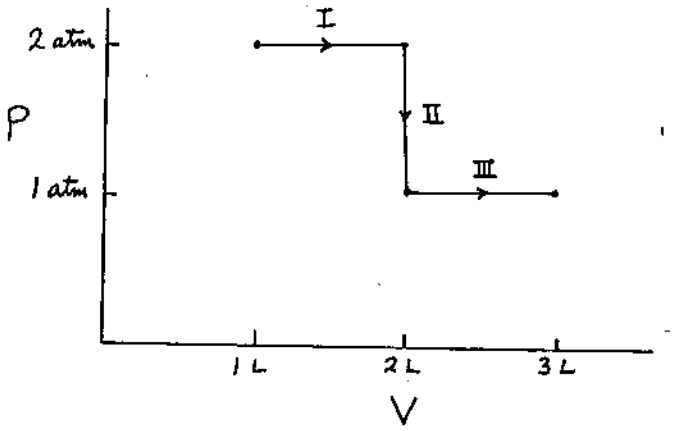
(e) $\Delta S = \frac{\Delta H}{T}$

(f) $\overline{S}^o = 0$ at 0 K.

(4) 3. Circle the only one of the following substances that has a nonzero $\Delta_f \overline{H}°$ value at 25°C,

C(graphite) $O_2(g)$ $H_2(s)$ $Hg(l)$ $Fe(s)$

(6) 4. A gas undergoes an irreversible expansion along the path shown below. Calculate the work done in joules. (*Hint*: Work done is given by area under curve.)



(8) 5. The internal energy (U) of one mole of a monatomic ideal gas is (3/2)RT. Calculate ΔH of the gas in joules when the temperature of the gas is increased from 300 K to 400 K.

(6) 6. List three processes that can increase the entropy of a system.

(12) 7. In class, we focused mostly on gas expansions. Now consider the reversible, isothermal *compression* of 0.50 mole of an ideal gas from 2.0 L to 1.0 L at 298 K. (a) Calculate w, q, ΔU, ΔH, and ΔS for the process. (b) Can you still describe the work done in this case as the *maximum* work done? Explain.

(10) 8. 16.2 moles of Ar and 20.2 moles of Xe are mixed at constant temperature (298 K) and pressure. What is the *total* entropy of the system after mixing? Assume ideal behavior.

(16) 9. For each of the following processes, state whether the following quantities listed are positive (+), negative (–), or zero (0). All the changes refer to the system.

(a) Melting ethanol. (molar volume of liquid ethanol > molar volume of solid ethanol)
(b) Heating a gas at constant volume.
(c) Irreversible, adiabatic expansion of an ideal gas.
(d) Burning hydrogen in air. [$2H_2O(g) + O_2(g) \longrightarrow 2H_2O(l)$]

	q	w	ΔU	ΔH
(a)				
(b)				
(c)				
(d)				

(6) 10. Ammonium nitrate (NH_4NO_3) dissolves spontaneously and endothermically in water. Deduce the sign of ΔS (of the system) for this process. Does your result make sense physically? Explain.

(8) 11. The $\Delta_f \overline{G}^\circ$ of ClF(g) is –56.0 kJ mol^{-1}. (a) Calculate the equilibrium constant for the reaction at 298 K:

$$Cl_2(g) + F_2(g) \rightleftharpoons 2ClF(g)$$

(b) What is ΔG for the reaction if the partial pressures of Cl_2, F_2, and ClF are 1.4 atm, 0.90 atm, and 0.35 atm, respectively. Is the reaction more or less favored under these conditions?

I have neither given nor received aid on this examination.

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Useful information

$R = 8.314\ J\ K^{-1}\ mol^{-1}$

$1\ L\ atm = 101.3\ J$

At 298 K:

$\overline{S}°(Ar) = 154.8\ J\ K^{-1}\ mol^{-1}$

$\overline{S}°(Xe) = 169.6\ J\ K^{-1}\ mol^{-1}$