

Exam #1 for Physical Chemistry for Energy Science
Department of Nuclear Engineering, Seoul National University
10/10/02 Thursday PM 2:30-4:00

One hour, closed book, and one A4-size spike sheet(two sides) allowed.

Clearly state your assumptions and unit of each number.

1. Ammonia gas is used to enrich deuterium from natural water in a heat cycle. For NH₃ gas,

a)(10) determine C_{vm} at room temperature using the principle of equipartition of energy

b)(10) show that at low pressure C_{vm} + R = C_{pm}.

2. For a van der Waals gas with the equation of state;

$$P = RT/(V_m - b) - a/V_m^2$$

a)(10) show that the critical compressibility factor z_c = 0.375

b)(10) show that enthalpy imperfection function

$$H_i = bRT/(V_m - b) - 2a/V_m$$

3.(15) Concept of thermodynamics

a) what is the equation of state?

b) What is a reversible process?

c) What does the second law mean?

$$\left(\frac{\partial U}{\partial V} \right)_T = P - \frac{a}{V^2}$$

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$$dH = dU + PdV + vdp$$

$$PV_m = \frac{RT}{P}$$

$$P = \frac{RT}{V_m}$$

R

4. (15) A mole of a monatomic ideal gas in a piston was expanded from V_1 to V_2 in an irreversible isothermal process at T_1 . $V_2 - V_1$
 T_1
- What is the change in entropy due to the volume increase?
 - What is the physical meaning of the entropy change by the volume increase?
 - If the molar entropy of the gas at standard temperature and pressure is given as S_m° , derive an expression for the standard molar entropy at $T(\gg 25\text{ C})$. S_m°

5. (15) Show that:

- $(\partial A / \partial T)_V = -S$
- $(\partial S / \partial V)_T = (\partial P / \partial T)_V$
- $(\partial U / \partial V)_T = T(\partial P / \partial T)_V - P$

6. (15) For the third law;

- what is meant by third law?
- Why can't we reach absolute 0 K?
- What are the values of internal energy and entropy at absolute 0 K?

End of exam#1 problems

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