CHEM 441-02 Name _____
College of Charleston
Fall 2001
Exam 3 Score _____ / 125

1(25). The temperature dependence of the molar heat capacity of gaseous ethane is given by

$$(C^{o}_{p,m}/R) = (0.06436) + (2.137 \times 10^{-2}\ \mathrm{K}^{-1})T - (8.263 \times 10^{-6}\ \mathrm{K}^{-2})T^{2} + (1.024 \times 10^{-9}\ \mathrm{K}^{-3})T^{3}$$

A one-molar sample of ethane at 25 °C is isobarically heated to 1000 K by placing it in an oven at 1500 K. (Note: $\int \ln x\, dx = x \ln x - x$) Calculate

a) q b) w c) ΔH d) ΔU

e) ΔS(system) f) ΔG g) ΔA

2(25). The volume of the ethane sample in the first question is isothermally and reversibly decreased from 250 L to 100 L at 1000 K. Calculate

a) q b) w c) ΔH d) ΔU

e) ΔS(system) f) ΔG g) ΔA

3(20). Elemental silicon can be prepared at elevated temperatures by

$$SiO_2(l) + 2\ C(s) \rightarrow Si(l) + 2\ CO(g) \qquad \Delta_r H^{o}_{298} = 730.077\ \mathrm{kJ}$$

Calculate $\Delta_r G^{o}_{3300}$ given $[(G^{o}_{T} - H^{o}_{298})/T]/(\mathrm{J\ K^{-1}\ mol^{-1}}) = -145.191$ for SiO_2(l), -32.756 for C(s), -85.103 for Si(l), and -245.435 for CO(g) at 3300 K.

4(15). Using $dU = T\,dS - P\,dV$, derive the Maxwell relation that begins $(\partial T/\ldots)$.

5(20). Use the one-component phase diagram provided to answer the following questions.

How many critical points are shown?

How many triple points are shown?

Describe in detail what would be observed as a sample of gas originally at point *a* is cooled isobarically.

Describe in detail what would be observed as sample of gas originally at point *a* is isothermally compressed.

Describe what will happen as heat is added isothermally to sample at point *b*.

6(20). The vapor pressure of solid ammonia is given by

$$\ln(P/\text{torr}) = \frac{(-4124.4)}{(T/\text{K})} - (1.81630)\ln(T/\text{K}) + (34.4834)$$

from 146 K to 195 K. Use the Clausius-Clapeyron equation to determine $\Delta_{sub}H^{o}_{175}$ and $\Delta_{sub}S^{o}_{175}$.