(冶材組)

國立成功大學七十九學年度礦冶研究所考試(普通熱力學試題) 共 2 頁 第 1 頁

1. Determine the temperature above or below which the reduction of MnO by carbon becomes thermodynamically feasible at 1 atm pressure,

$$2C_{(s)} + O_{2(g)} = 2CO_{(g)}, \quad \Delta G^\circ = -223426 - 175.3T \text{ Joule.}$$

10%

$$2Mn_{(s)} + O_{2(g)} = 2MnO_{(s)}, \quad \Delta G^\circ = -798307 + 164.2T \text{ Joule.}$$

2. The melting point of gallium is 30°C at 1atm. The densities of solid and liquid gallium are 5.885 and 6.08 g/cm^3, respectively. The heat of fusion of gallium is 18.5 cal/g.
10% Please calculate the melting point of gallium at 0.8 atm pressure. Atomic weight of gallium is 69.72 g.

3. A brick of heat capacity C_1, originally at temperature T_1, is placed upon a brick of heat capacity C_2, originally at temperature T_2. Heat flows from one brick to the other until thermal equilibrium is
10% established. If $C_1 = 2000$ cal/deg, $T_1 = 0°C$, $C_2 = 1000$ cal/deg, and $T_2 = 100°C$. What is the total entropy change of the bricks? Assuming the bricks are of the same mass.

4. (a) Please describe the complete Carnot cycle.
(b) Which of the three Thermodynamic Laws rule out the possibility of "perpetual motion of machine"?
20% (c) How would one show that, mathematically, a thermodynamic function is a state function?
(d) 四月中同的時候，臺灣的天氣突然刮南風，造成室內地板，牆壁很潮濕(俗稱"返潮")，請解釋其原因。

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5. Derive the equation

$$\left(\frac{\partial H}{\partial T}\right)_P = \left(\frac{\partial E}{\partial T}\right)_V + \left[P + \left(\frac{\partial E}{\partial V}\right)_T\right]\left(\frac{\partial V}{\partial T}\right)_P$$

from the first and second laws of thermodynamics and related definitions. (10%)

6. Suppose that for a certain gas $(\partial E/\partial V)_T = 0$ but $P(V-b) = RT$, where b is a constant. Calculate $(\partial H/\partial V)_T$ and $C_P - C_V$. (10%)

7. An ideal gas undergoes a reversible isothermal expansion from an initial volume of V_1 to a final volume $10V_1$ and thereby does 10,000 cal of work. The initial pressure was 100 atm. (a) Calculate V_1. (b) If there were 2 moles of gas, what must its temperature have been? (10%)

8. Give a process for which (a) $\Delta E = 0$, (b) $\Delta H = 0$, (c) $\Delta A = 0$, (d) $\Delta G = 0$ and (e) $\Delta S = 0$. State all necessary conditions or restrictions clearly. (10%)

9. Ferrous sulfate undergoes a thermal decomposition as follows:

$$2FeSO_{4(s)} = Fe_2O_{3(s)} + SO_{2(g)} + SO_{3(g)}$$

At 929K the total gas pressure is 0.9 atm with both solids present.

(a) Calculate Kp for this temperature.

(b) Calculate the equilibrium total pressure that will be obtained if excess ferrous sulfate is placed in a flask at 929K, which contains an initial SO_2 pressure of 0.6 atm. (10%)