國立臺灣大學101學年度碩士班招生考試試題

1. A quauntity of an ideal gas occupied 10 liters at 10 atm and 100K. Calculate (1) the final volume of the system, (2) the work done by the system, (3) the heat entering or leaving the system, and (4) the internal energy and enthalpy changes in the system if it undergoes: (a) A reversible isothermal expansion to 1 atm; (b) A reversible adiabatic expansion to 1 atm. (for the gas the molar heat capacity C_V = 1.5 R) (25%)
2. At a pressure of 1 atm the equilibrium melting temperature of lead is 600 K, and at this temperature the latent heat of fusion of lead is 4810 joules per mole. If 1 mole of supercooled liquid lead spontaneously freezes at 590 K and 1 atm pressure, calculate the entropy produced. The constant-pressure molar heat capacity of liquid lead, as a function of temperature at 1 atm pressure, is given as, $C_{p(l)} = 32.4 - 3.1 \times 10^{-3} T$ joules/degree
   And the corresponding expansion for solid state lead is given as $C_{p(s)} = 23.6 + 9.75 \times 10^{-3} T$ joules/degree (25%)
3. A steam engine operating between 150 and 30°C performs 1000 joules of work. What is the minimu quantity of heat which must be drawn from the heat source in order to obtain this amount of work? Which of the following would give the greater increase in the efficiency of the engine: (a) an increase of ΔT in the temperature of the heat source, or (b) a decrease of ΔT in the temperature of heat sink? (25%)
4. One mole of an ideal gas is subjected to the following sequence of steps: (a) Starting at 25°C and 1 atm, the gas expands freely into a vacuum to double tis volume; (b) The gas is next heated to 125°C at constant volume; (c) The gas is reversibly expanded at constant temperature until its volume is again doubled; (d) The gas is finally cooled to 25°C at constant pressure. Please calculate ΔU, ΔH, q, w, *and* ΔS in the gas. (25%)

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