Tutorial 5

Group A

Q1. At a pressure of 1 atm the equilibrium melting temperature of lead is 600 K. and, at this temperature, the latent heat of melting of lead is 4810 J/mole. Calculate the entropy produced when 1 mole of super cooled liquid lead spontaneously freezes at 590 K and 1 atm pressure. The constant-pressure molar heat capacity of liquid lead, as a function of temperature, at 1 atm pressure is given by

$$C_{p(l)} = 32.4 - 3.1 \times 10^{-3} T \ \text{J/K}$$

and the corresponding expression for solid lead is

$$C_{p(s)} = 23.56 + 9.75 \times 10^{-3} T \ \text{J/K}$$

The entropy produced during the irreversible freezing of the lead equals the difference between the change in the entropy of the lead and the change in the entropy of the constant-temperature heat reservoir (at 590 K) caused by the process.

Q2. One mole of a monatomic ideal gas is subjected to the following sequence of steps:

a. Starting at 300 K and 10 atm, the gas expands freely into a vacuum to triple its volume.

b. The gas is next heated reversibly to 400 K at constant volume.

c. The gas is reversibly expanded at constant temperature until its volume is again tripled.

d. The gas is finally reversibly cooled to 300 K at constant pressure.

Calculate the values of q and w and the changes in U, H. and S.