●Thermodynamics

A gas sample is heated in a cylinder, using 586 kJ of heat. A piston compresses the gas, using 611 kJ of work. What is the change in internal energy of the gas during this process?

Determine the Standard entropy of reaction:
$2\ CO(g) + O_2(g) \rightarrow 2CO_2(g)$. Absolute entropies are as follows: carbon monoxide gas, 197.5 J/molK; oxygen gas, 205.0 J/molK; carbon dioxide gas, 213.7 J/molK.

Predict whether entropy should increase or decrease for the following:
Cooling of water from 50°C to 4°C.
Sublimation of dry ice, $CO_2(s) \rightarrow CO_2(g)$.
Oxidation of nitrogen, $N_2(g) + 2O_2(g) \rightarrow 2NO_2(g)$.

The standard enthalpy of formation of liquid acetone, CH_3COCH_3 (solvent used in nail polish remover), at 25°C is –247.6 kJ/mol. The standard enthalpy of formation of gaseous acetone at 25°C is –216.6 kJ/mol. What is the entropy change when 1.00 mol liquid acetone vaporizes at 25°C?

Determine the standard free energy change for the following reaction:
$4HCN(l) + 5O_2(g) \rightarrow 2H_2O(g) + 4CO_2(g) + 2N_2(g)$. The ΔG^o_f values (in kJ/mol) are as follows:
$HCN(l) = 121$; $H_2O(g) = -228.6$; $CO_2(g) = -394.4$.

Consider the following:
$Ba(OH)_2\ 8H_2O(s) + 2NH_4NO_3(s) \rightarrow 2NH_3(g) + 10H_2O(l) + Ba(NO_3)_2(aq)$
Predict the sign of the standard entropy change.
The standard enthalpy change at 25°C is 170.4 kJ; the standard entropy change at 25°C is 657 J/K. What is the standard free energy change at 25°C? Interpret the values of these thermodynamic quantites.

Determine the value of the thermodynamic equilibrium constant at 25°C for the reaction
$N_2O_4(g) \rightleftharpoons 2\ NO_2(g)$.
The standard free energy of formation values (in kJ/mol) at 25°C are $N_2O_4(g)$, 97.82; $NO_2(g)$, 51.30.

The equilibrium constant (Kp) for the reaction
$H_2(g) + CO_2(g) \rightleftharpoons H_2O(g) + CO(g)$ is 4.40 at 2000K. Calculate ΔG^o for the reaction. Calculate ΔG for the reaction when the partial pressures are $P_{H2} = 0.25$ atm, $P_{CO2} = 0.78$, $P_{H2O} = 0.66$ atm, and $P_{CO} = 1.20$ atm.

Calculate the standard free energy change for the following process at 75°C and at 110°C.
$H_2O(l) \rightleftharpoons H_2O(g)$