Submit answers to 2) and 7) on 1st August 2014 during class.

1) What is the molar volume of ethane at 350 K and 70 bar according to the ideal gas and the van der Waals equation of state? The van der Waals constants for ethane are 5.562 L^2 bar mol^{-2} and 0.064 L mol^{-1}.

2) The cubic expansion coefficient α is defined by $\alpha = \frac{1}{V}\left(\frac{\partial V}{\partial T}\right)_P$ and the isothermal compressibility β is defined by $\beta_T = -\frac{1}{V}\left(\frac{\partial V}{\partial P}\right)_T$. Calculate these quantities for an ideal and van der Waals gas.

3) For each of the following processes deduce whether each of the quantities $q, w, \Delta U, \Delta H$ is positive, zero, or negative. (a) Reversible melting of solid benzene at 1 atm and the normal melting point.
   (b) Reversible melting of ice at 1 atm and 0 °C.
   (c) Reversible adiabatic expansion of a perfect gas
   (d) Reversible isothermal expansion of a perfect gas
   (e) Adiabatic expansion of a perfect gas into vacuum
   (f) Reversible heating of a perfect gas at constant P
   (g) Reversible cooling of a perfect gas at constant V

4) One mole of a liquid water is vaporized at 100 °C and 1.013 bar. The heat of vaporization is 40.69 kJ mol^{-1}. What are the values of (a) w_{rev}, (b) q, (c) ΔU, and (d) ΔH?

5) How much work is done when a mole of sodium metal is added to an open beaker containing water at 25 °C?

6) How high can a person climb on an ounce of chocolate if its combustion releases 628 kJ?

7) 100 g of ice at 0 °C is dropped into an insulated beaker containing 150 g of water at 100 °C. Calculate ΔS for this process.

8) A mixture of CO(g), H$_2$(g), and CH$_3$OH(g) at 500 K with $P_{CO} = 10$ bar, $P_{H_2} = 1$ bar, and $P_{CH_3OH} = 0.1$ bar is passed over a catalyst. Can more methanol be formed? Given $\Delta G^0 = 21.21$ kJ mol^{-1}.

9) For each of the following sets of quantities , all the quantities except one have something in common. State what they have in common and state which quantity does not belong with the others.
   (a) H, U, q, S, T;
   (b) $T, \Delta S, q, w, \Delta H$;
   (c) $q, w, U, \Delta U, V, H$;
   (d) ρ, S_m, M, V;
   (e) $\Delta H, \Delta S, dV, \Delta P$;
   (f) $U, V, \Delta H, S, T$