**Homework #3**
Problems (#16-#21)
Section Questions Q4.6, Q4.8,Q4.14,Q4.19, E&R^{4th}ed

16. E&R$_{4th}$ P4.33

    [for part b. use Appendix A (4.1) only; **no peeking** at A(4.2) !!]

17. (from *Physical Chemistry: Principles and Applications in Biological Sciences*, by Tinoco, Sauer, Wang, Puglisi, published by Prentice Hall).

    Photosynthesis can produce 20kg of carbohydrate (e.g. sucrose) per hectare per hour in bright sunlight. Using the following 'model reaction:

    $$12\,CO_2\,(g) + 11\,H_2O\,(\ell) \xrightarrow[chlorophyll]{light} C_{12}H_{22}O_{11}\,(s) + 12\,O_2\,(g)$$
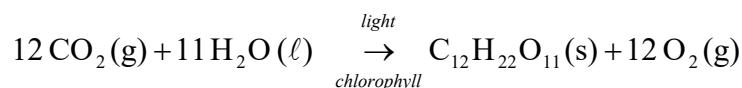
    a. What is the enthalpy change associated with the production of 1 mol of sucrose from carbon dioxide and water?

    b. Assume that photosynthesis can yield 20kg of sucrose per hectare per hour (5.56×10^{-4} g m^{-2} s^{-1}). If sunlight strikes the earth with power 10^3 Wm^{-2}, what fraction of this light energy is "stored" as sucrose by photosynthesis (W=watt)?

18. The fermentation of sugar by yeast is one of the oldest chemical processes utilized by *homo sapiens*.
    $$C_6H_{12}O_6\,(s) \xrightarrow{\text{yeast}} 2C_2H_5OH\,(\ell) + 2CO_2\,(g)$$
    a. Use the data in Appendix A to calculate ΔH^o for fermentation of 1 mole of α-D-glucose at 25° C

    b. If the fermentation reaction was carried out by a thermophilic bacterium at 80° C, what would be ΔH for 1 mole of α-D-glucose (assume temperature independent $\overline{C_P}$'s)?

19.★ For the combustion of carbon monoxide

$CO(g) + \frac{1}{2} O_2(g) \rightarrow CO_2(g)$ $\Delta H°_{298}$ = -283 kJ/mol CO

The temperature dependent heat capacities of the reactants and products are given by the power series $\bar{C}_P(T)\left[JK^{-1}mol^{-1}\right] = a + bT + cT^2 + dT^3$ with

(from E&R Appendix A, Table 2.5, 4th ed):

	a *[Jmol⁻¹K⁻¹]* A(1) E&R	**b** *[Jmol⁻¹K⁻²]* A(2)*K⁻¹ E&R	**c** *[Jmol⁻¹K⁻³]* A(3)*K⁻² E&R	**d** *[Jmol⁻¹K⁻⁴]* A(4))*K⁻³ E&R
O₂ (g)	32.83	-0.03633	1.1532×10^{-4}	-1.2194×10^{-7}
CO (g)	31.08	-0.01452	3.1415×10^{-5}	-1.4973×10^{-8}
CO₂ (g)	18.86	0.07937	-6.7834×10^{-5}	2.4426×10^{-8}

show that (per mole CO):

ΔH (T) =
$[-2.783 \times 10^5 - 28.635(T/K) + 0.0560 (T/K)^2 - 5.230 \times 10^{-5} (T/K)^3 + 2.509 \times 10^{-8} (T/K)^4]$ J/mol

20. $\left(\Delta\bar{H}_f^0\right)_{298}$ for cyclopropane, C_3H_6 (g) , is 53.30 kJ/mol.

a. Use this value of $\left(\Delta\bar{H}_f^0\right)_{298}$ to calculate the C~C bond enthalpy for the carbon-carbon bonds in cyclopropane. Assume standard H~H and C~H bond enthalpies of 436 kJ/mole and 413 kJ/mole, respectively, and a $\Delta H_{sublimation}$ of 717 kJ/mole for C(gr) .

b. Tables of bond enthalpies (values averaged over a number of hydrocarbons) give a standard C~C bond enthalpy of 348 kJ/mol. Why does the C~C bond enthalpy *[correctly]* calculated in part (a) differ from this standard value?

c. Would the experimental value of 53.30 kJ/mol be larger or smaller than $(\Delta H°_f)_{298}$ calculated using standard bond enthalpies?

21. E&R₄ₜₕ P4.5d **(d only)** (use data in Table 4.1)