General Chemistry Peer Mentoring at UCI
Professor Holton
Chem 1B
https://sites.google.com/view/gcpm-uci

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Midterm 1 Review Packet

Outline of topics:

→ **Lecture 1**
- **Thermochemistry**
- **Heat & Work**

→ **Lecture 2**
- **Calorimetry**
- **dE for a Chemical Reaction**

→ **Lecture 3**
- **Enthalpy**
- **Exothermic vs Endothermic**

→ **Lecture 4**
- **Hess' Law**
- **Lattice Energy**

Bond Enthalpy for Reference

TABLE 10.3 Average Bond Energies

Bond	Bond Energy (kJ/mol)	Bond	Bond Energy (kJ/mol)	Bond	Bond Energy (kJ/mol)
H—H	436	N—N	163	Br—F	237
H—C	414	N=N	418	Br—Cl	218
H—N	389	N≡N	946	Br—Br	193
H—O	464	N—O	222	I—Cl	208
H—S	368	N=O	590	I—Br	175
H—F	565	N—F	272	I—I	151
H—Cl	431	N—Cl	200	Si—H	323
H—Br	364	N—Br	243	Si—Si	226
H—I	297	N—I	159	Si—C	301
C—C	347	O—O	142	S—O	265
C=C	611	O=O	498	Si=O	368
C≡C	837	O—F	190	S=O	523
C—N	305	O—Cl	203	Si—Cl	464
C=N	615	O—I	234	S=S	418
C≡N	891	F—F	159	S—F	327
C—O	360	Cl—F	253	S—Cl	253
C=O	736*	Cl—Cl	243	S—Br	218
C≡O	1072			S—S	266
C—Cl	339				

*799 in CO_2

Lecture 1:

1. Which statement is true of the internal energy of the system and its surroundings following a process in which ΔE_{sys} = + 65 kJ? Explain. (Tro 1st Ed., Ch 10, #133)
   a. The system and the surroundings both lose 65 kJ of energy.
   b. The system and the surroundings both gain 65 kJ of energy.
   c. The system loses 65 kJ of energy, and the surroundings gain 65 kJ of energy.
   d. The system gains 65 kJ of energy, and the surroundings lose 65 kJ of energy.

2. How much work (in J) is required to expand the volume of a pump from 0.0 L to 2.5 L against an external pressure of 1.1 atm? (Tro 2nd Ed., Ch. 9 #45)

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3. When 1 mol of fuel burns at constant pressure, it produces 3452 kJ of heat and does 11 kJ of work. What are ΔE and ΔH for the combustion of the fuel? (Tro 1st Ed., Ch 10, #49)

Lecture 2:

1. We submerge a silver block, initially at 58.5°C, into 100.0 g of water at 24.8°C, in an insulated container. The final temperature of the mixture upon reaching thermal equilibrium is 26.2°C. What is the mass of the silver block? (Tro 1st Ed., Ch 10, #59)

2. An ice cube of mass 9.0 g is added to a cup of coffee. The coffee's initial temperature is 90.0°C and the cup contains 120.0 g of liquid. Assume the specific heat capacity of the coffee is the same as that of water. The heat of fusion of ice (the heat associated with ice melting) is 6.0 kJ/mol. Find the temperature of the coffee after the ice melts. (Tro 1st Ed., Ch 10, #125).

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3. The temperature of the calorimeter rose from 25.00°C to 35.84°C. If the heat capacity of the calorimeter and its contents is 13.43 kJ/C, what is the enthalpy change for the reaction (in kJ/moL)? (Ebbing 9th ed., Ch 6, #6.107)

Lecture 3:

1. Hydrogen, a potential future fuel, can be produced from carbon (from coal) and steam by this reaction. Use average bond energies to calculate ΔH_{rxn} for the formulation of hydrogen. (Tro 1st Ed., Ch 10, #79)

   $C(s) + 2\ H_2O(g) \rightarrow 2\ H_2(g) + CO_2(g)$

2. Ethanol is a possible fuel. Use average bond energies to calculate ΔH_{rxn} for the combustion of ethanol. (Tro 1st Ed., Ch 10, #78)
   $CH_3CH_2OH(g) + 3\ O_2(g) \rightarrow 2\ CO_2(g) + 3\ H_2O(g)$

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Lecture 4:

1. Calculate ΔH_{rxn} for the reaction:

   $Fe_2O_3(s) + 3\ CO(g) \rightarrow 2\ Fe(s) + 3\ CO_2(g)$

   Use the following reactions and given ΔH values:

   [1] $2\ Fe(s) + \frac{3}{2}O_2(g) \rightarrow Fe_2O_3(s)$ $\Delta H = -824.2$ kJ

   [2] $CO(g) + \frac{1}{2}O_2(g) \rightarrow CO_2(g)$ $\Delta H = -282.7$ kJ

   (Tro 2nd Ed. Ch. 9 #73)

2. Calculate ΔHrxn for the reaction.
   $5\ C(s) + 6\ H_2(g) \rightarrow C_5H_{12}(l)$
   Use the following reactions and given ΔH's:

   $C_5H_{12}(l) + 8\ O_2(g) \rightarrow 5\ CO_2(g) + 6\ H_2O(g)$ $\Delta H = -3244.8$ kJ

   $C(s) + O_2(g) \rightarrow CO_2(g)$ $\Delta H = -393.5$ kJ

   $2\ H_2(g) + O_2(g) \rightarrow 2\ H2O(g)$ $\Delta H = -483.5$ kJ

   (Tro 1st Ed., Ch 10, #75)

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3. What volume does 0.118 mol of helium gas at a pressure of 0.97 atm and a temperature of 305K occupy? Would the volume be different if the gas was argon (under the same conditions)? (Tro 2nd Ed., Ch 10 #37)