CHAPTER 2
THERMODYNAMICS: THE FIRST LAW
CHAPTER OUTLINE

HW: Questions are below. Solutions are in separate file on the course web site.

Sect.	**Material**
1.	Definitions + Heat and Work
2.	Internal Energy and the First Law of Thermodynamics
3.	Mathematical Preliminaries: Logarithms and Integral Calculus
4.	Pressure-Volume Work
5.	Het Capacity
6.	Constant Volume Processes: Heat and Internal Energy (U)
7.	Constant Pressure Processes: Heat and Enthalpy (H)
8.	Differential Scanning Calorimetry
9.	The Temperature Dependence of U and H
10.	Perfect Gas Expansions and Compressions

Chapter 2 - Homework

2.1 A sample of methane [CH_4, M=16] of mass 4.50 g occupies 12.7 L at 37 ^oC.

(a) Calculate the work involved when the gas expands isothermally against a constant external pressure of 30.0 kPa to 16.0 L

(b) Calculate the work involved if the same expansion occurred isothermally and reversibly.

2.2 A strip of magnesium metal [M=24.3] of mass 12.5 g is dropped into a beaker of dilute Hydrochloric acid [HCl]. Given that magnesium is the limiting reactant, calculate the work involved as a result of the reaction. The atmospheric pressure is 1.00 bar, and the temperature is 20.2 ^oC

2.3 The molar heat capacity of water [M=18] is 75.3 J/mol-K. Calculate the heat involved to heat 250 g of water from 25 ^oC to 65 ^oC.

2.4 When 229 J of energy is supplied as heat to 3.00 mol of Ar(g) at constant pressure, the temperature of the sample increases by 2.55 ^oC. Calculate the constant volume and constant pressure molar heat capacities of Ar(g).

2.5 When 3.0 mol O_2(g) is heated at a constant pressure of 3.25 atm, the temperature increases from 260 K to 285 K. Given that the constant pressure molar heat capacity of O_2(g) is 29.4 J/mol-K, calculate q, ΔH and ΔU.

2.6 The constant pressure molar heat capacity of water vapor [M=18] is 33.6 J/mol-K. Calculate the final temperature if 2.80 kJ of heat is added at constant pressure to 45 grams of water vapor initially at 150 ^oC and 1.0 bar.

2.7 Predict whether q, w, ΔU and ΔH are positive, zero or negative for:
(a) condensation of water vapor to liquid water at 100 ^oC.
(b) melting of solid benzene at its freezing point, 8 ^oC.
(c) reversible isothermal compression of a perfect gas.
(d) reversible adiabatic expansion of a perfect gas.

Note: HW #2.8 - #2.12: All 5 questions deal with calculating q, w, ΔU and ΔH for processes beginning with 50 grams of O_2(g) initially at 50 ^oC.

2.8 Calculate q, w, ΔU and ΔH when 50 grams of O_2(g) [M=32] is compressed isothermally and reversibly from 1 bar to 20 bar at 50 ^oC.

2.9 Calculate q, w, ΔU and ΔH when 50 grams of O_2(g) [M=32] is compressed irreversibly from 1 bar to 20 bar at 50 ^oC by applying an external pressure of 20 bar.

2.10 Calculate q, w, ΔU and ΔH when 50 grams of $O_2(g)$ [M=32] is heated at a constant pressure of 1 bar from 50 ^oC to 200 ^oC.
Info: The constant volume heat capacity of O_2 is 21.1 J/mol-K.

2.11 Calculate q, w, ΔU and ΔH when 50 grams of $O_2(g)$ [M=32] is heated at a constant volume of 45 L from 50 ^oC to 200 ^oC.

2.12 Calculate q, w, ΔU and ΔH when 50 grams of $O_2(g)$ [M=32] initially at a pressure of 1 bar and volume of 42 L is compressed reversibly and adiabatically to a pressure of 5 bar and volume of 16 L.