

Chapter 2 - Homework

- 2.1** A sample of methane [CH_4 , $M=16$] of mass 4.50 g occupies 12.7 L at 37 °C.
- (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 °C
- 2.3** The constant pressure 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 °C to 65 °C at a constant pressure of 1. atm.
- 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 °C. Calculate the constant volume and constant pressure molar heat capacities of Ar(g) .
- 2.5** When 3.0 mol $\text{O}_2(\text{g})$ 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 $\text{O}_2(\text{g})$ 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 °C 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 °C.
 - (b) melting of solid benzene at its freezing point, 8 °C.
 - (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 °C.

- 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 °C.
- 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 °C 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 °C to 200 °C.
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 °C to 200 °C.
- 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.