8.9: Numerical Values of Specific and Molar Heat Capacities

The following table is not intended as a definitive, authoritative table of precise heat capacities. It is intended just to give a rough idea of the orders of magnitude and the relative magnitudes for a few substances.

For gases, the heat capacities tabulated are at *constant pressure*. For solids and liquids the difference between C_p and C_v is much smaller than for gases, because of the much smaller coefficient of expansion. Notice that the molar heat capacities for gases, when expressed in terms of R, are about what are expected from the theoretical considerations in this chapter. Notice the relatively large molar heat capacities of organic liquids (the molecules can rotate and can vibrate in many modes), and that, the more complex the molecule, the larger its molar heat capacity. Notice, however, that, because water has a low molecular weight (molar mass), water has the largest *specific* heat capacity of any common liquid or solid. (The specific heat capacities of gaseous H_2 and He are, unsurprisingly, larger still. A kilogram of hydrogen is an enormous number of molecules, so it takes a lot of heat to warm them all up.) We have not studied the theory of the heat capacities of solids in this chapter, but, when you do so in a course on solid state physics or on statistical mechanics, you will understand that the expected molar heat capacity of metals would be about 3*R*, which is approximately what is shown for the three metals in this table.

		Specific Heat Capacity at Constant Pressure		Molar Heat Capacity at Constant Pressure	
		cal g^{-1} $C^{o\ -1}$	J kg^{-1} K^{-1}	J $kmole^{-1}$ K^{-1}	In units of *R*
Helium	(g)	1.25	5250	21000	2.53 *R*
Argon	(g)	0.13	526	21000	2.53 *R*
H_2	(g)	3.44	14400	28800	3.46 *R*
O_2	(g)	0.22	919	29400	3.54 *R*
N_2	(g)	0.25	1040	29100	3.50 *R*
CO_2	(g)	0.20	843	37100	4.46*R*
H_2O	(g)	1	4184	75300	9.1 *R*
C_2H_5OH	(l)	0.58	2430	112000	13.5 *R*
CCl_4	(l)	0.20	852	131000	15.8 *R*
C_6H_6	(l)	0.42	1740	136000	16.4 *R*
Al	(s)	0.22	941	25400	3.1 *R*
Cu	(s)	0.092	384	24400	2.9 *R*
Fe	(s)	0.11	450	25100	3.0 *R*