Solutions to LM problems, part 1

Comments: (i) Typos and errors are always possible – please point out any issues and errors, so that I can fix them! (ii) I have copied the answers from the Laidler/ Meiser solution manual, and I may have not always paid full attention to the proper number of significant figures.

LM1 $3.24 * 10^{16}$ particles for $P = 10^{-6}$ Torr; $3.24 * 10^{7}$ particles for $P = 10^{-15}$ Torr.
LM2 (i) 0.470L; (ii) 0.500L
LM3 31.7 g mol^{-1}
LM4 $x(N_2) = 0.6111$; $x(CO_2) = 0.3889$; $P(N_2) = 35.399$ bar; $P(CO_2) = 22.531$ bar
LM5 ideal gas: 701kPa; van der Waals gas: 650. kPa

LM6 $\Delta U = \Delta H$ *to the accuracy given*; w = 0.165 J mol^{-1}
LM7 $\Delta U = 37.6$ kJ mol^{-1}; work done by system = -w = 3.06 kJ
LM8 $\Delta H = -5.65$ kJ mol^{-1}
LM9 molar heat capacity: 75.4 J K^{-1} mol^{-1}
LM10 (a) zero; (b) 4.22 kJ; (c) 4.22 kJ; (d) final P = 547 kPa; (e) $\Delta H = 5.89$ kJ
LM11 (a) 15.5 L; (b) w = 1.66 kJ; (c) q = 5.88 kJ; (d) $\Delta H = 5.88$ kJ; (e) $\Delta U = 4.22$ kJ
LM12 (a) $\Delta U = 0$; (b) P = 800 kPa; (c) w = 3.15 kJ; (d) -q = 3.15kJ; (e) $\Delta H = 0$
LM13 (a) $P_2 = 0.552$ bar; $T_2 = 183$ K; (b) $\Delta U = -430.$ J; $\Delta H = -604$ J
LM14 $\Delta U_m = -1.501$ kJ mol^{-1}; $\Delta H_m = -2.100$ kJ mol^{-1}

LM15 (a) $\varepsilon = 0.800$; (b) 30.0 kJ; (c) entropy increase 150. J K^{-1};
(d) entropy decrease -150. J K^{-1}; (e) $\Delta S = 0$; (f) *Oops, we didn't do ΔG just yet; anyways* $\Delta G = -150.$ kJ
LM16 Rectangle – think carefully about the direction of change! (counterclockwise)
LM17 $T_{hot} = 400.$K; $q_{cold} = -30.0$kJ; $q_{hot} = 40.0$kJ

LM18 C_6H_6: 87.3 J K^{-1} mol^{-1}
$CHCl_3$: 88.0 J K^{-1} mol^{-1}
H_2O: 109 J K^{-1} mol^{-1}
C_2H_5OH: 110. J K^{-1} mol^{-1}
LM19 (a) $\Delta S_m = 3.52$ J K^{-1} mol^{-1}; (b) $\Delta S_m = 2.11$ J K^{-1} mol^{-1}
LM20 $\Delta S = 21.9$ J K^{-1}
LM21 $\Delta S = 26.0$ J K^{-1}
LM22 $\Delta S = 4.61$ J K^{-1}
LM23 (a) system: 19.1 J K^{-1}, surr.: -19.1 J K^{-1}; (b) T stays constant (no work nor heat, thus $\Delta U = 0$); $\Delta S_{gas} = 19.1$ J K^{-1}, $\Delta S_{surr} = 0$; net $\Delta S_{universe} = 19.1$ J K^{-1}
LM24 (a) 132.59 J K^{-1} mol^{-1}; (b) close to that value; due to the simplification made for the temperature dependence of the heat capacity, it is not identical.
LM25 $\Delta S = 42.4$ J K^{-1}
LM26 system: -21.63 J K^{-1}; surr.: 21.87 J K^{-1}; universe: 0.24 J K^{-1}
LM27 system: -23.73 J K^{-1}; surr.: 24.78 J K^{-1}; universe: 1.05 J K^{-1}
LM28 0.80 J K^{-1}