Answers to selected problems (see also answers in the Appendix!):

Note: 1) An answer is not correct without the correct units
2) Please try to work through the problems as you would on an exam. When that fails, you can go to the answer and try to work backwards. But in the end, be certain that were you to get the same (or a similar) problem again, with different numbers, you could work it through without knowing the answer.

Chapter 2 (recommended: 1, 3, 4, 6-20, 23)

1.
3. a) 981 J; b) 2.38×10^5 J; c) 1.00×10^3 N/m; d) –203 J; e) -203×10^{-6} J; f) –111 J
6. a) 41.9 kJ; b) –33.3 kJ; c) 226 kJ
7. a) –2.49 kJ; b) $\Delta E = 6.24$ kJ, $\Delta H = 8.73$ kJ; c) 8.73 kJ
8. a) 5.74 kJ; b) $T_2 = 192$ K, $\Delta E = -1.347$ kJ, $\Delta H = -2.245$ kJ
9. a) $q_T = 2.23$ kJ; b) $q = 1.559$ kJ, $\Delta H = 2.182$ kJ; c) 1.252 atm; d) T2 < T1
11. a) $q = 40.66$ kJ mol^{-1} (Table 2.2); $w = -3.10$ kJ; $\Delta E = 37.56$ kJ mol^{-1}; $\Delta H = q$
    b) $q = 37.56$ kJ mol^{-1}; $w = 0$; $\Delta E = q$; $\Delta H = 40.66$ kJ mol-1
13. a) $T_f = 113.1$ °C; $\Delta V = -0.98$ L
    b) $T_f = 94.7$ °C; $\Delta V = 18.75$ mL
    c) $T_f = 100$ °C; $\Delta V = -0.30$ L; phase change of 9.84×10^{-3} mol of water
    d) (a), (+)
15. a) $q = 0$; $w = 0$; $\Delta E = 0$; $\Delta H = 0$; $\Delta V \approx 0$
    b) $q = 0$; $w > 0$; $\Delta E > 0$; $\Delta H > 0$; $\Delta(PV) \approx 0$
    c) $q = 0$; $w = 0$; $\Delta E = 0$; $\Delta H = 0$; ideal gases
18. Heat loss = 180 kJ /day (1.5% of food energy)
19. a) w = 750 kJ /24 hr; b) 765 kg (about 0.85 tons)

Chapter 3 (recommended: 1, 4, 5, 9, 10, 12a+d, 14-17, 20-24, 25a)

1. a) $w = -1247.1$ J; $q = -415.7$ J
   b) $w = -415.7$ J; $q = -831.4$ J
9. a) $\Delta G = +129.66$ kJ mol^{-1} (some friend you've got…)
   b) $\Delta G = -70.48$ kJ mol^{-1}
   c) $\Delta G = -1150.15$ kJ mol-1
10. a) irreversibly, b) system+surroundings; c) enthalpy change; d) greater than
12. d) –4.18 J K^{-1} mol^{-1} conversion will be even less favorable (why?)
16. a) $w = -P_m(\Delta V_m)$; $\Delta E = q_m + w$ $\Delta H = q_m$ $\Delta S = \frac{q_m}{T_m}$ $\Delta G = 0$

    b) $\Delta H = q_m + \left(C_{p,\beta} - C_{p,\alpha}\right)\left(T^* - T_m\right)$ $\Delta S = \frac{q_m}{T_m} + \left(C_{p,\beta} - C_{p,\alpha}\right)\ln\frac{T^*}{T_m}$
21. a) -3.53 J K^{-1}; b) 7.5 J K^{-1}; c) 145.05 J K^{-1}
23. a) decrease; b) zero; c) decrease

Chapter 4 (recommended: 1-17, 30, 32a

2. a) –48.1 kJ mol^{-1} b) 48.1 kJ mol^{-1}
3. a) –14.3 kJ mol^{-1} b) 846 c) 3.11 x 10^{-5}
4. a) 5200 b) 2.72x10^{-7}
5. a) 0.22 b) –25,200 J mol^{-1} forward
6. a) 496 J mol^{-1} b) 4596 J mol^{-1} c) 0.130
7. a) -70.9 kJ mol^{-1} b) 1.23 x 10^{12}
9. a) -48.1 kJ mol^{-1} b) 48.1 kJ mol^{-1} c) $\Delta G' = -200$ J mol^{-1}
32. a) $K = \frac{f}{(1-f)C_p}$

Chapter 5 (recommended: 1-11, 16-21, 24-32

2. a) P_1 b)P_1 c) 101, 0.0101
3. b) 1.35 x 10^{-3} M c) >
4. 9.4
6. a) $\Delta\bar{G} = RT \ln \frac{a_{outside}}{a_{inside}}$ b) 3573 J c) 10719 J d) 0 e) 0 f) 0.30 M g) 1.67x10^{6} M
7. Identical, independent sites; 5 sites per molecule; K = 1.0 x 10^{-5} M^{-1}
9. $\Delta H° = 38$ kJ mol^{-1} $\Delta G°$ (293K) = –22.4 kJ mol^{-1} $\Delta S° = 182$ J K^{-1}
10. a) (2.6/4.8/17) x 10^{-4} M (O_2/N_2/CO_2) b) 23.755 torr
11. a) 101°C
17. a) 0.0942 torr b) 1.000 c) 7.1/7.2 atm
19. 957 mL
24. 69200
27. a) 24.4/0.367 atm c) 43.8 J d) the lake
32 a) 0.980 b) 4.51 torr c) 271 K