Chapter 13

1. Assume the penny is pure copper. Convert grams to moles and moles to atoms.

2. Find the number of atoms in 26.5 grams of gold, and the number of atoms in 26.5 grams of silver. Then compare them.

3. a) Convert the degrees Farhenheit to Celcius.
   b) Convert the degrees Celcius to Farhenheit.

4. Convert the two Farhenheit temperatures to Celcius.

5. Convert Celsius to Fahrenheit and Fahrenheit to Celsius. Use the equations on page 356.

8. You're given the coefficient of thermal expansion (α), length and change in temperature. Use equation 13-1b for linear expansion and solve for ΔL.

9. Use $\Delta L = \alpha L_o \Delta T$ and solve for ΔL. The coefficient of thermal expansion for iron can be found in Table 13-1 on page 358.

10. Look up the coefficient of linear expansion for steel from Table 13-1 on page 358. Use the equation for linear expansion and solve for ^oC.

23. Stress is Force per unit area. See Example 13-8 on page 361. Look up the Elastic Modulus for aluminum in Table 9-1 on page 238. You are given the change in temperature, solve for F/A.

26. Convert Celsius to Kelvin using $K = {}^oC + 273$. Convert Fahrenheit to Celsius and then to Kelvin.

27. Convert 0 Kelvin first to Celsius and then to Fahrenheit.

28. a) Convert ^oC to Kelvin.
    b) The difference in each case is 273. Just divide 273 by the Kelvin temperature and multiply by 100 for % error.

29. You are given volume at STP (273K and 1atm) and a new pressure and temperature. Convert pressure to N/m^2, temperature to Kelvin and then solve for the new volume using $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$.

30. Use $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$ and solve for T_2. Temperature must be in Kelvin and pressure in N/m^2.

31. ρ = m/V.   #moles = m/(molar mass). Substitute n in the ideal gas equation with mass/(molar mass) and through algebraic wizardry, solve for m/V in terms of P, V, R and molar mass of O_2.

32. PV = nRT.   Temperature remains constant and you are given pressure. Change pressure to N/m^2 Find n for 21.6 kg of N_2 and solve for the volume of the tank.. Then find n for 21.6kg of CO_2 and solve for pressure.

33. Convert grams of nitrogen gas to moles.
   a) Using the universal gas law and the pressure (in N/m^2) and temperature of a gas at STP (in Kelvin) and the moles of gas, calculate the volume.
   b) Calculate the number of moles of nitrogen gas you have if you add the weight given, and repeat what you did in part a).

34. a) Gauge pressure is given but absolute pressure must be used. Absolute pressure is atmospheric pressure at 1.0 atm. + gauge pressure. These must be in N/m^2. Use PV=nRT and solve for volume.
   b) Now use $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$ and solve for T_2. Don't forget, the volume has changed and the new volume must be in N/m^2.

35. Change ^oC to K, L to m^3 and kg of argon to moles of argon. Then plug those into the ideal gas equation and solve for pressure.

39. Use $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$ and the quantities given to solve for P_2.

41. You know 1 mole occupies 22.4L at STP. Convert this to molecules per cubic meter.

42. 1 cubic centimeter of water has a mass of 1g. Convert 1L to cubic centimeters and then to grams of water. Then convert a) to moles and b) to molecules.

43. Find the volume of that much water using 75% of the surface area of the earth times the given depth (in meters). Convert that to grams of water, and grams to molecules.

46. a) See equation 13-8 on page 370 for the average KE.
   b) Find the average KE at 20^oC. Now just multiply the average KE of one molecule by the number of molecules in 1 mole of nitrogen gas.

76. PV = nRT. We can assume the pressure to be 1.0 atm. Convert this to N/m^2 and Celcuis To Kelvin and solve for n.

79. Use $P_1V_1 = P_2V_2$. The pressure of the water at 10m below the surface equals ρgh + 1.0 atmosphere (convert atmospheres to N/m^2). The pressure at the surface is 1.0 atm. Solve for V_2.

82. a) In the ideal gas equation, use mass/(molar mass) of air in place of # moles (n). The molar mass of air is assumed to be 29g/mole although the problem never tells you that. You may also assume a pressure of 1.0 atm – just be sure to change that to Pascal's (or N/m^2). Solve for the mass of air at 20 ^oC (convert to K first).

b) Same as (a) only use -10^oC (convert to K first). Then subtract the two and figure out if the air entered or left.

Chapter 14

1. Use $Q = mc\Delta T$. Look up the specific heat of water from Table 14-1 on page 387.
   Use the value that is expressed in $\frac{J}{kg^oC}$.

2. See equation 14-2 on page 387. Look up the specific heat of water in Table 14-1 on page 387 and use the value given in $\frac{J}{kg^oC}$. ΔT will be T – the given temperature.
   Substitute variables and solve for T.

3. Cal. Is the abbreviation for kilocalorie.
   a) Convert kilocalories to joules.
   b) Power is work/time, so work = power x time. Convert Joules (which are the same as Watts x seconds) to Kilowatt-hours.
   c) Convert $0.10 per KWhr to cost per day. Then decide if you could eat on that much money per day.

5. You are given KJ per hour, convert to joules/hour. Do the same as you did in problem #1, only leave the time in hours (they'll cancel out on both sides anyway). Solve for mass of water.

6. 350 W = 350 J/s. Use the heat equation and divide both sides by time. Now substitute 350W as heat/s and solve for time.

7. See heat equation 14-2 on page 387. Substitute variables and solve for the specific heat.

8. Convert liters of water to kilograms of water. ($1m^3$ of water weights 1kg). Find the specific heat of water and use the value given as $\frac{J}{kg^oC}$. Use the heat equation on page 420 and solve for heat.

9. Convert kJ to Joules and use the heat equation to solve for specific heat.

11. Some of the heat from the water will heat the thermometer. The heat the water has after the thermometer is placed in it will equal the heat the water had before minus the heat absorbed by the glass thermometer. Look up the specific heat of water and of glass from Table 14-1 on page 387 and use the calorimetry equation in Example 14-5 on page 390 To solve for the original temperature of the water.

12. Assume the calorimeter cup and the water each have the same initial temperature.
    See Example 14-5 on page 390. ΔT for the copper will be (T – the given temperature for copper). ΔT for the water and the calorimeter cup will be (T – the given temperature for water). Substitute given variables in the calorimetry equation and solve for T.

13. Find the specific heat of iron from Table 14-1 on page 387. See Example 14-5 on page 390, and problem 12. This is the same idea.

15. Turn the heat equation into a power equation as you did in problems 6 and 7. Just remember to add both the heat necessary to heat up that volume of water (convert liters of water to kg of water first) as well as the heat necessary to heat up that mass of aluminum from the coffeepot. Both the coffee pot and the water will have the same ΔT because they are being heated together.

17. Look up the specific heat of iron and of aluminum from Table 14-1 on page 387. Use the calorimetry equation from Example 14-6 and solve for the specific heat of glycerin. Both the aluminum calorimetry cup and the glycerin start out at the same temperature.

18. Assume the kinetic energy of the hammer head turns completely into heat when it hits the nail. Since the nail is hit 10 times, multiply by 10. Now use your heat equation (look up the specific heat of iron in Table 14-1 page 387) and solve for ΔT.

21. Find the melting point and the latent heat of silver in Table 14-3 on page 392. Calculate the heat necessary to reach the melting point of silver and then the latent heat (equation 14-3 on page 392) to melt it. Add them.

22. Heat lost by sweating is due to the evaporation of water. Look up the latent heat of vaporization of water in Table 14-3 on page 392. Use the appropriate value and solve for mass in kilograms.

23. Find the heat of vaporization of oxygen in Table 14-3 on page 392. Use equation 14-3 and solve for mass.

26. Use the heat equation, divided by time. Convert kJ/h to joules/h. If you leave time in hours, your answer will be in hours. It is not necessary to convert to seconds in this case. The heat supplied will heat both the water and the iron boiler.
    a) In this case, ΔT will be the difference between the temperature given and the boiling point of water. Use $Q = (mc\Delta T)$for water + $(mc\Delta T)$for iron.
    b) Add the heat necessary to heat the water to boiling, to the heat necessary to vaporize that much water.

30. If "…the temperature of the bullet does not change appreciably…" then all the KE of the bullet will become heat to melt the ice. Use Table of Latent Heats on page 392 and equation 14-3 to calculate the mass of water melted by the bullet.

31. The KE of the skater is absorbed by friction to stop her. You are given the skater's mass and velocity. Use that to calculate her kinetic energy. 50% of that turned into heat. Using that information and the latent heat of ice, calculate the mass of ice that will be melted by that much heat.

32. The kinetic energy of the bullet will become heat that will first heat the bullet from room temperature to melting. Then it will melt it. Look up the specific heat of lead in Table 14-1 on page 387, and then the latent heat of lead from Table 14-3 on page 392. Latent heat is covered on pages 391 and 392.

46. This is a unit conversion problem. Using the value given in kcal/kg for the conversion factor, convert the heat required to heat the house to mass in kilograms. Since 30% is lost up the chimney, your calculated value is 70% of what is needed. Calculate the total mass needed.

47. This is a units and conversion problem. You have kcal/kg and kcal/winter. Find kg/winter, realizing that that is only 70% of what is needed because 30% goes up the chimney. Then find kg/winter at 100%.

48. All of the kinetic energy from the bullet is turned into heat which is absorbed by the bullet and the block of wood. Use the heat equation, and set that KE = the heat to heat the bullet and the heat to heat the block (find specific heat of lead and wood in Table 14-1 page 387) of wood. ΔT will be the same for both. Perform some algebraic wizardry and solve for v.

51. The potential energy of the rock will turn into kinetic energy as it falls, and 50% of that will heat up the boulder. Use this information and solve for ΔT.

Chapter 15

1. Isothermal means $\Delta T = 0$. If $\Delta T = 0$, then $\Delta U= 0$. If $\Delta U = 0$ then $Q = W$.

2. a) $W = P\Delta V$
   b) $\Delta U = Q-W$. Q is given. Change kilocalories to Joules.

3. See pages 410 to 412 for various processes on a PV diagram.

4. See sample graphs on page 411-413.

5. See sample graphs on page 411-413. To solve for specific values use $\Delta U = Q-W$
   Remember, isothermal means $\Delta T = 0$. Isobaric means constant pressure so volume changes, and Isochoric means no change in volume so pressure changes.

6. a) "…rigid walls…" means the volume did not change. Use this information to calculate work done.
   b) You are given a value for heat, and since the heat left the gas, it is negative. Now use $\Delta U = Q-W$ and the work calculated in part (a) to calculate ΔU.
   Be sure to change kJ to joules.

7. a) Check the definition of "adiabatic" on page 411.
   b) You are given a value for work. Use that and your answer in part (a) to find ΔU.
   c) From chapter 13, $\Delta U = 3/2\ nR\Delta T$ or $\Delta U = 3/2\ Nk\Delta T$.

8. a) This process happened in two steps. Calculate the work done in each step.
   See page 411 for the work done during isobaric and isochoric processes.
   b) The temperature eventually reaches its original value, so the total process is isothermal. If $\Delta T = 0$, $\Delta U = 0$.

10 . This process happened in two steps and the PV diagram is shown.
   a) Calculate the work done in each step. See page 411 for the work done during isochoric and isobaric processes.
   b) The temperature eventually reaches its original value, so the total process is isothermal. If $\Delta T = 0$, $\Delta U = 0$.
   c) Use the First Law of Thermodynamics equation on page 409.

13. Remember definitions. For the First Law equation (page 409), work done by the system is (+) and work done on the system is (-)
   a) Finding the work done $U_a - U_c$ means calculating the work as the process moves from point c to point a (always final – initial).
   b) ΔU between c and a is the same regardless of the path taken. From a to d is an isochoric process; work = 0.
   c) From b to c is an isochoric process. $W = P\Delta V$ at constant pressure.
   d) ΔU between c and a is the same regardless of the path taken. Also, a to d and b to c are isochoric processes.
   e) You found ΔU from a to c in part a and they've given you ΔU from b to a. You're also given the work done from c to a. Use this information to solve for ΔQ form b to c.

17. See efficiency equations on page 418.

18. Change kcal to joules. Calculate efficiency using the proper equation.

19. Since in the equation, $Q = mc\Delta T$, Q is directly proportional to T, the efficiency equation, $e = 1 - \frac{Q_L}{Q_H}$ may be expressed as $e = 1 - \frac{T_L}{T_H}$. Temperature must be in Kelvin.

20. The exhaust temperature is the low temperature. See page 420 for Carnot efficiency equations (there are three).

21. Change ^{o}C to K. They've given you high temp. and low temp. so calculate the efficiency and multiply that by 75%. That will give you your *e* value. The 1.3 GW to produce energy is the work done. From this information you can calculate Q (the exhaust heat). Don't forget to convert GW to Watts and then Watts to Joules/s. They want heat per hour so convert seconds to hours and you're done!

23. Remember power (watts) is energy per second. This problem will take two steps.
   i) First convert the rate of heat used to Joules per second (Watts). From that you can calculate the efficiency of the engine.
   ii) Now you have efficiency and the high temperature. Find the exhaust (low) temperature.

52. a) The system is "…maintained at atmospheric pressure…" which we may assume to be constant. $W = P\Delta V$ when pressure is constant.
   b) The value for heat is given. Since it was added, it is positive. Use the work from part (a) and solve for ΔU.
   c) You are good at this by now.