Note: problems containing a * means that the problem was taken from an online source or a textbook (rather than created by me). The link to these sources will be provided in the answer sheet. If you would like additional practice problems or a more in depth explanation then I recommend checking out these links!

Additional note: do NOT use this as your only study material for the final. While I will try to include ACS style questions, this is not an accurate replication of your final and should be used as SUPPLEMENTAL practice instead.

Chapter 1 Practice Questions

1. List five homogenous mixtures and five heterogenous mixtures, then explain the difference between a homogenous mixture and a heterogeneous mixture.

2. List five physical changes and five chemical changes, then explain the difference between a physical change and a chemical change.

3. *Find the correct number of significant figures in the following problems, solve if needed:
    a. $7.065 + 4.9 =$
    b. $134.2 - 55.77 =$
    c. $11.01 \times 8.3 =$
    d. $267.954 \div 109.0 =$

4. Label the following as intensive or extensive properties:
    a. Density
    b. Concentration
    c. Volume
    d. Temperature
    e. Mass
    f. Heat Capacity
    g. Color
    h. Amount of substance
5. *Convert the following into the desired unit:
    a. Find the mass in pounds (lbs) of a 275-gram sample of sugar.

    b. Find the number of cm in 0.286 miles.

    c. Find the volume in quarts of 10.7 kg of iron. The density of iron is 7.87 g/cm^3 (1 L is 1.075 qts).

Chapter 2 Practice Questions

6. *Phosphorus has two isotopes, ^{32}P and ^{30}P. The experimentally determined mass of phosphorus is 30.97376g/mol. What are the percentages of the two isotopes?

7. *Write the nuclear symbols for the isotopes of neon which contain 10 neutrons and 12 neutrons.

8. *Provide the common names of Groups 1, 2, 17 and 18.

9. How many moles are in 52 g of NaCl? How many atoms? Molar mass of NaCl = 58.443

10. *

Complete the following chart:

Isotope name	atomic #	mass #	# of protons	# of neutrons	# of electrons
Potassium-37					
Oxygen-17					
uranium-235					
uranium-238					
boron-10					
boron-11					

Chapter 3 Practice Questions

11. Provide either the name or the formula of the given compounds:
    a. Na_2SO_3
    b. Barium Sulfate
    c. $KClO_2$
    d. Ammonium Bromide
    e. $CaBr_2$

12. *Determine the number of moles of the compound and determine the number of moles of each type of atom in each of the following:
    a. 2.12 g of potassium bromide, KBr
    b. 0.1488 g of phosphoric acid, H_3PO_4
    c. 23 kg of calcium carbonate, $CaCO_3$

13. *Dichloroethane, a compound that is often used for dry cleaning, contains carbon, hydrogen, and chlorine. It has a molar mass of 99 g/mol. Analysis of a sample shows that it contains 24.3% carbon and 4.1% hydrogen. What is its molecular formula?

14. *What is the mass of ammonia, in grams, that can be made from 250 g N_2 (g)?
$N_2 + H_2 \rightarrow NH_3$ (not balanced)

15. *Calculate the mass, in grams, of 0.350 mol Cu.

Chapter 4 Practice Questions

16. Balance the following chemical equations:
    a. $__SiF_4(s) + _NaOH(aq) \rightarrow __Na_4SiO_4(s) + __NaF(aq) + __H_2O(l)$
    b. $__FeCl_2 + __KNO_3 + __HCl \rightarrow __FeCl_3 + __NO + __H_2O + __KCl$
    c. $__Cu + __HNO_3 \rightarrow __Cu(NO_3)_2 + __NO + __H_2O$

17. *For the balanced chemical reaction $4KO_2(s) + 2CO_2(g) \rightarrow 2K_2CO_3(s) + 3O_2(g)$, determine the number of moles of both products formed when 6.88 mol of KO_2 react.

18. *For the balanced chemical reaction $4NH_3(g) + 5O_2(g) \rightarrow 4NO(g) + 6H_2O(\ell)$, how many moles of H_2O are produced when 0.669 mol of NH_3 react?

19. *Consider the following reaction: $3\ Si + 2\ N_2 \rightarrow Si_3N_4$
    a. When 21.44 moles of Si reacts with 17.62 moles of N_2, how many moles of Si_3N_4 are formed?
    b. What is the limiting reactant?
    c. For the reactant in excess, how many moles are left over at the end of the reaction?

20. *Consider the following reaction: $4\ FeS_2 + 11\ O_2 \rightarrow 2\ Fe_2O_3 + 8\ SO_2$
    a. When 26.62 moles of FeS_2 reacts with 5.44 moles of O_2, how many moles of SO_2 are formed?
    b. What is the limiting reactant?
    c. For the reactant in excess, how many moles are left over at the end of the reaction?

Chapter 5 Practice Questions

21. *What is the molarity of a solution that was prepared by dissolving 14.2 g of $NaNO_3$ (molar mass = 85.0 g/mol) in enough water to make 350 mL of solution?

22. *A 0.5010 g sample of diprotic acid H_2A (MW 120.0) is titrated with 35.0 mL of an NaOH solution. What is the concentration of the NaOH solution?

$$2NaOH\ (aq) + H_2A\ (aq) \rightarrow Na_2A\ (aq) + 2H_2O$$

23. *A 25 ml solution of 0.5 M NaOH is titrated until neutralized into a 50 ml sample of HCl. What was the concentration of the HCl?

24. *If it takes 50 mL of 0.5 M KOH solution to completely neutralize 125 mL of sulfuric acid solution (H_2SO_4), what is the concentration of the H_2SO_4 solution?

25. *Write the net ionic equation for the following reactions:
    a. Magnesium metal reacts with copper(II) chloride solution to form copper metal and a colourless solution.

    b. $SO_3(g) + H_2O(l) \rightarrow H_2SO_4(aq)$

Chapter 6 Practice Questions

26. *A 35 L tank of oxygen is at 315 K with an internal pressure of 190 atmospheres. How many moles of gas does the tank contain?

27. *500.0 liters of a gas in a flexible-walled container are prepared at 700.0 mmHg and 200.0 °C. The gas is placed into a tank under high pressure. When the tank cools to 20.0 °C, the pressure of the gas is 30.0 atm. What is the volume of the gas?

28. *A sample of a B vitamin, pantothenic acid, has a mass of 72.52 mg and gives 3.87 mL of nitrogen gas at 22.7°C at 784 mm Hg. What is the volume of nitrogen at STP?

29. *A sample of helium has a volume of 475 mL at 45.3°C and 742 mm Hg. The temperature is decreased to 21.0°C and the volume is increased to 555 mL. What is the new pressure?

30. *Consider four identical 1.0-L flasks containing the following gases each at 25℃ and 1 atm pressure. Which gas had the highest density?
    a. H_2
    b. O_2
    c. NH_3
    d. SO_2
    e. Same for all gases

Chapter 7 Practice Questions

31. *Lead, water, sulfur, and arsenic have specific heats of 0.218, 4.18, 0.706, and 0.329 J/g℃ respectively. Which of these would require the smallest amount of heat to increase its temperature by 10℃ (assume all samples have the same mass)?

32. *How much heat is needed to raise the temperature of 5.28 gal of water from 25.0℃ to 88.0℃ (1 gal = 3.885 L)?

33. *How many milliliters of water at 23 °C with a density of 1.00 g/mL must be mixed with 180 mL (about 6 oz) of coffee at 95 °C so that the resulting combination will have a temperature of 60 °C? Assume that coffee and water have the same density and the same specific heat (4.184 J/g °C).

34. *A sample of 0.562 g of carbon is burned in oxygen in a bomb calorimeter, producing carbon dioxide. Assume both the reactants and products are under standard state conditions, and that the heat released is directly proportional to the enthalpy of combustion of graphite. The temperature of the calorimeter increases from 26.74 °C to 27.93 °C. What is the heat capacity of the calorimeter and its contents?

35. *Calculate ΔH for $O_3(g) + 2NO_2(g) \rightarrow N_2O_5(g) + O_2(g)$
    Given the following equations:
    $O_3(g) + NO_2(g) \rightarrow NO_3(g) + O_2(g)$ $\Delta H = 10.1$ kJ
    $N_2O_5(g) \rightarrow NO_3(g) + NO_2(g)$ $\Delta H = 48.3$ kJ

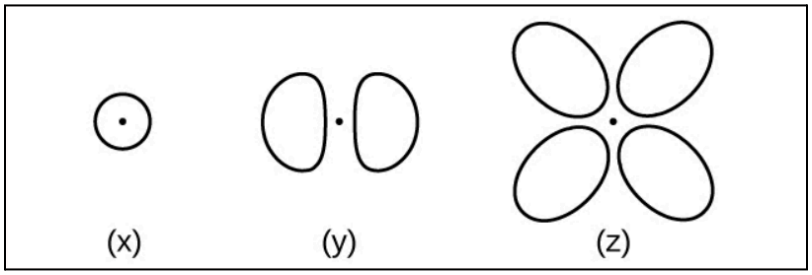
Chapter 8 Practice Questions

36. *Violet light has a wavelength of 4.10×10^{-12} m. What is the frequency?

37. *What is the frequency of an electromagnetic wave that has a wavelength of 1.00×10^{-12}m?

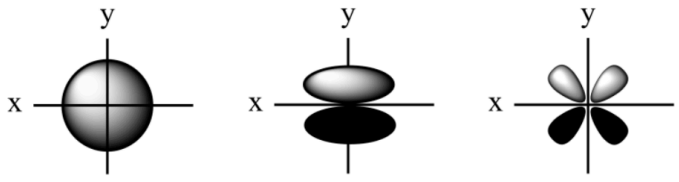
38. *Identify the subshell in which electrons with the following quantum numbers are found:
    a. $n = 3, l = 2$
    b. $n = 1, l = 0$
    c. $n = 4, l = 3$

39. *Consider the orbitals shown here in the outline:



    a. What is the maximum number of electrons contained in an orbital of type (x)? Of type (y)? Of type (z)?
    b. How many orbitals of type (x) are found in a shell with $n = 2$? How many of type (y)? How many of type (z)?
    c. Write a set of quantum numbers for an electron in an orbital of type (x) in a shell with $n = 4$. Of an orbital of type (y) in a shell with $n = 2$. Of an orbital of type (z) in a shell with $n = 3$.
    d. What is the smallest possible n value for an orbital of type (x)? Of type (y)? Of type (z)?
    e. What are the possible l and m_l values for an orbital of type (x)? Of type (y)? Of type (z)?

40. Label the following orbitals:



Chapter 9 Practice Questions

41. In one area of Australia, the cattle did not thrive despite the presence of suitable forage. An investigation showed the cause to be the absence of sufficient cobalt in the soil. Cobalt forms cations in two oxidation states, Co^{2+} and Co^{3+}. Write the electron structure of the two cations.

42. *Rank the following elements by increasing electronegativity: sulfur, oxygen, neon, aluminum

43. *Determine if the following are paramagnetic or diamagnetic:
    a. Mn
    b. Ni

44. *The second ionization energy of all elements is higher than the first ionization energy, but in sodium the second ionization energy is extra large. Considering the structure of the sodium atom, explain why this might be.

45. *As the size of an atom increases, what happens to the ionization energy? Why does the ionization energy depend on the size?

Chapter 10 Practice Questions

46. *Using the given table, calculate the enthalpy change for the given reaction:

Table 1 Average Bond Energies (kJ/mol)

Bond	Energy
H–H	432
H–F	565
C–H	413
C–O	358
C≡O	1072
C–C	347
C–Cl	339

Bond	Energy
F-F	154
O–H	467
Cl–Cl	239
C=C	614
C=O	745
C=O (for CO_2(g))	799
O=O	495

a. $CH_4\,(g) + 2O_2\,(g) \rightarrow CO_2\,(g) + 2H_2O\,(g)$
b. $H_2\,(g) + F_2\,(g) \rightarrow 2\,HF(g)$

47. *Which ionic compound has the highest lattice energy?
    a. MgO vs NaF
    b. NaF vs KCl

48. *Draw the lewis structures for the following compounds:
    a. BSF

    b. N_2F_4

    c. C_2H_5OH

49. *Draw all of the possible resonance structures for C_4H_4

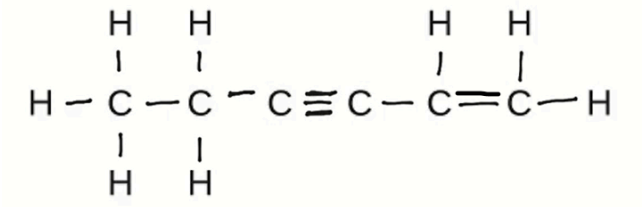
50. *Draw all valid Lewis structures and find the formal charge of each atom in the compound XeO_3, then determine which is more favorable.

Chapter 11 Practice Questions

51. *Draw the Lewis structure of SO_2Cl_2 then determine the number of pi bonds and the number of sigma bonds.

52. *A molecule with the formula AB_3 could have one of two different shapes. Give the shape and the hybridization of the central A atom for each.

53. *Determine the hybridization of each carbon in the following molecule:



54. *Determine the hybridization, electron geometry, and the shape of NCl_3.

55. *Identify the electron pair geometry and the molecular structure for each of the following:
    a. CF_4
    b. BF_3
    c. $BeCl_2$