Chemistry 100
Study Guide for Exam 3 (Friday, November 7th)

Note: There will be no laboratory Friday after the exam. The main topics to study for the exam, along with some previous exam questions are provided below.

Chapter 5

1. How many electrons are in the outer most shell of neon (Ne)? **8**
2. What is the maximum number of electrons allowed in a p subshell? **6**
3. Write out the full electron configuration of bromine (Br), with **and** without using the noble gas notation.

   $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^5$

   $[Ar] 4s^2 3d^{10} 4p^5$
4. Write out the full electron configuration of a fluoride ion (F^-), with **and** without using the noble gas notation.

   $1s^2 2s^2 2p^6$

   $[Ne]$
5. What is the difference between UVA and UVB? *See solutions to homework 7*
6. What is a free radical? Identify one chemical property of a free radical. *See solutions to homework 7*
7. When silver bromide film is exposed to light, Ag^+ ions are converted into silver metal. Is this oxidation or reduction?

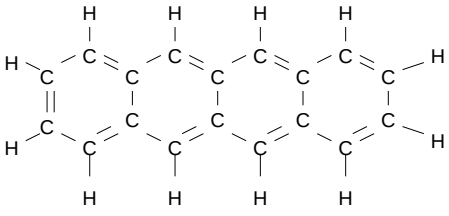
   reduction
8. AgBr is translucent. Why is it used in photography?

   See solutions to homework 7
9. A green object is likely absorbing what color of visible light?

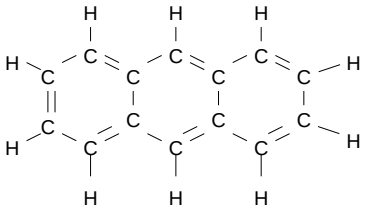
   red
10. Which has more energy: a photon of red light or a photon of violet light?

    violet
11. Which has more energy: a photon of infrared light or a photon in the microwave range?

    infrared
12. One of these molecules exists as a bright orange solid, the other molecule is a colorless solid. Which molecule is the highly colored one?

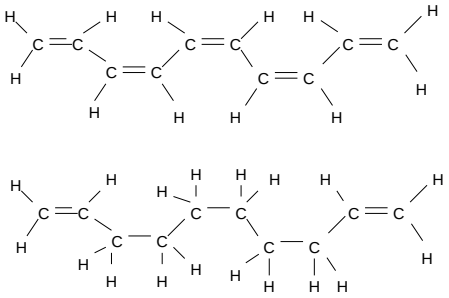


tetracene



anthracene

    Tetracene
13. Which of the following molecules will absorb light of a longer wavelength?



The one with more conjugated double bonds, the first one.

Chapter 6

1. Pb-210 undergoes beta decay. Write a nuclear equation for this process.

$$^{210}_{82}Pb \longrightarrow ^{210}_{83}Bi + ^{0}_{-1}e$$

2. U-234 undergoes alpha decay. Write a nuclear equation for this process.

$$^{234}_{92}U \longrightarrow ^{230}_{90}Th + ^{4}_{2}He$$

3. Describe the process of nuclear fission using as much detail as possible. Include a description of initial and final materials, as well as energy released or absorbed.

   A fissionable nucleus is hit with a neutron. The nucleus splits into two or more smaller nuclei and more neutrons and releasing a large amount of energy.

4. Complete the following reaction:

$$^{59}_{27}Co + ^{1}_{0}n \longrightarrow ^{56}_{25}Mn + \underline{\quad ^{4}_{2}He \quad}$$

5. Name two of the major natural sources of nuclear ionizing radiation humans experience on earth. These should be two of the four mentioned in class.

   The four are: Radon, Cosmic (sun), Rocks and Soil (uranium ore, for example), Internal (K-40 and other natural isotopes.

6. On average, which is the largest source of ionizing radiation exposure for someone in the U.S.?

   Radon (55%)

7. Ionizing radiation is especially damaging to what kind of cells? (several answers possible)

   Fast growing ones, including cancer cells, fetal cells, gametes, bone marrow.

8. Name two possible symptoms associated with a large, but non-lethal dose of ionizing radiation.

   Various answers possible. Vommiting, hair loss, hemmorhaging, nausea, decreased white blood cell count, etc.

9. Complete the following nuclear equation:

$$^{66}_{29}Cu \quad \longrightarrow \quad ^{66}_{30}Zn \quad + \quad \underline{\quad ^{0}_{-1}\beta \quad}$$

10. Suppose that the radioactivity from Rn-222 in your basement was measured as 0.64 picoCuires. If no additional radon entered your basement, how much time would have to pass before the radiation level fell to 0.02 picoCuires picoCuires? The half-life of Rn-222 is 3.8 days.

Radon Concentration (pCi)	*time (days)*	*# half lives*
0.64	*0*	*0*
0.32	*3.8*	*1*
0.16	*7.6*	*2*
0.08	*11.4*	*3*
0.04	*15.2*	*4*
0.02	*19*	*5*

11. What is the isotopic concentration of natural uranium? Can this be used in power plants? Nuclear weapons?

    Natural uranium is 99.3% U-238 and 0.7% U-235. This cannot be used as is in power plants or nuclear weapons. Power plants require 3-5% U-235 to sustain a chain reaction, and nuclear weapons require > 90% U-235 to achieve a chain branching explosion.

Chapter 7

1. Consider the molecules CH_2Cl_2 and CH_2F_2. Both molecules are polar. Which would you expect to have the higher boiling point and why? *(hint: Consider electronegativity trends and types of interactions between molecules.*

   F is more electronegative than Cl, thus, CH_2F_2 will be more polar than CH_2Cl_2. We would then expect CH_2F_2 to have stronger intermolecular interactions (and therefore a higher boiling point) than H_2Cl_2.

2. The compounds C_2H_6 and C_8H_{18} are both nonpolar. The melting point of C_2H_6 (ethane) is -172°C and the melting point of C_8H_{18} (octane) is -57°C. What accounts for this difference in melting points?

   Boh are hydrocarbons and thus are non-polar. Non-polar molecules interact through forces known as induced dipole-induced dipole (or dispersion, van der Waals or London) forces. In larger molecules, these forces are stronger, due to the increased number of electrons. This leads to higher melting and boiling points. Thus we expect the larger of the two, C_8H_{18}, to have a higher melting and boiling point.

3. Why would NH_3 have a higher boiling point (-33 °C) than PH_3 (-88 °C)?

   N is more electronegative than P, thus NH_3 is more polar than PH_3 and its dipole-dipole interactions are stronger. In fact, NH_3 exhibits hydrogen bonding, a particularly strong type of dipole-dipole interaction.

4. Describe how soap works.

   See text, section 7.7

5. Which one of the following types of intermolecular force is the weakest: dipole-induced dipole, dipole-dipole, **induced dipole-induced dipole**, ion-dipole

6. NH_3 is a polar molecule. Would you expect it to be soluble in water? Why or why not?

   Yes, because it it polar and will engage in hydrogen bonding with water. Like dissolves like.