1. The basis for the transfer of genetic information is the "base pairing" that occurs between DNA nucleotides. A diagram portraying this base pairing is drawn below The nucleotide deoxycytidine monophosphate, on the left, is pairing with deoxygaunosine monophosphate, on the right. The interaction responsible for base pairing is called hydrogen bonding.
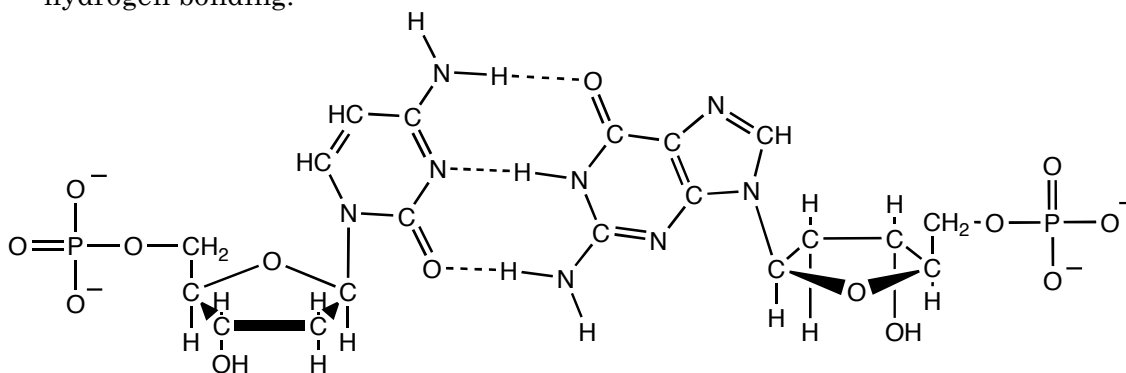
deoxycytidine monophosphate   deoxygaunosine monophosphate

a. (4 pts.) Circle the parts of the molecules that are involved in the hydrogen bond interaction.

b. (4 pts.) Is the so-called hydrogen bond as strong as a covalent bond?

c. (2 pts.) Provide one other example of a molecule that is good at interacting with other molecules using hydrogen bonds.

1. _____
2. _____
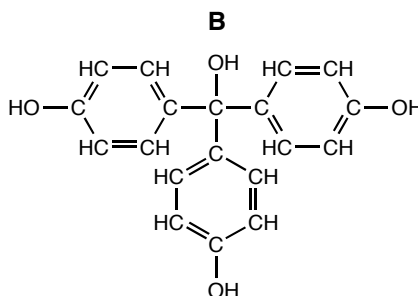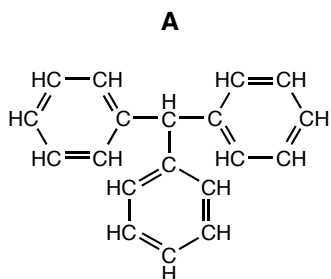3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____
13. _____
14. _____

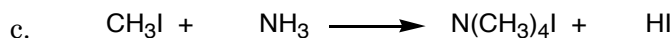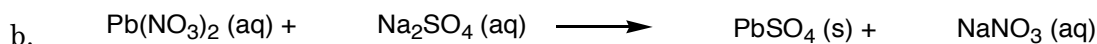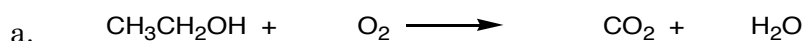2. Thin layer chromatography (TLC) plates are typically coated with alumina (Al_2O_3) or silica gel (SiO_4).
a. (4 pts.) Are these coatings polar or non-polar?

b. (4 pts.) If the two materials drawn below were placed on an alumina-coated TLC plate, which one would travel farther up the plate A or B as the solvent travels up the plate?

A   B

3. (8 pts.) In lab, you used TLC to identify the ingredients in an over the counter pain reliever. Typically, pain relievers use one or two of the following drugs: caffeine, ibuprofen, acetaminophen, and aspirin. Briefly, describe how you can use TLC to determine which drugs are in an analgesic. You may draw a picture to explain the experiment if you wish.

4. (4 pts. each) Balance the following chemical equations.

a. $CH_3CH_2OH + O_2 \longrightarrow CO_2 + H_2O$

b. $Pb(NO_3)_2$ (aq) $+ Na_2SO_4$ (aq) $\longrightarrow PbSO_4$ (s) $+ NaNO_3$ (aq)

c. $CH_3I + NH_3 \longrightarrow N(CH_3)_4I + HI$

5. (6 pts. each) Determine the mass of one mole of the following materials

a. CH_3OH b. $Ba(NO_3)_2$
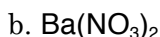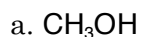
6. (10 pts.) Which of the following statements is true?

_____ a. A mole of items is equal to the number of ^{12}C atoms whose total mass is exactly 12 grams.

_____ b. A mole of items is 6.02 x 10^{23} items.

_____ c. A mole of items is 12 items.

_____ d. There are the same number of atoms in 14.01 g of N as there are in 55.85 g of Fe.

_____ e. The mass of a mole of carbon atoms is the same as the mass of a mole of oxygen atoms.

7. (4 pts.) Which of the statements in 6 is the definition of the mole?

8. Lead ions react with chloride to form lead(II) chloride according to the equation written below.

$$Pb^{2+}(aq) + 2\ NaCl(aq) \longrightarrow PbCl_2(s) + 2\ Na^+(aq)$$
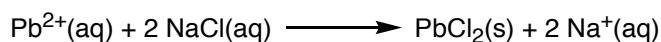
a. (2 pts.) In the equation written above, what does the "(aq)" mean?

b. (2 pts.) In the equation written above, what does the "(s)" mean?

c. (4 pts.) If 12 Pb^{2+} ions are floating around in solution, how many molecules of NaCl must be added to react with the lead ions.

d. (4 pts.) How many moles of $PbCl_2$ can be produced from 0.442 moles of NaCl? Show work to receive credit.

9. A chemist dissolved 0.5110 g of lead paint in nitric acid. After filtering out the paint chips, the lead was precipitated from the solution as $PbCl_2$. The chemist collected 0.0103 g of $PbCl_2$.

a. (8 pts.) Determine the mass of the lead (the Pb^{2+}) that the chemist collected. Show your work to receive credit. Referring to the equation in question 8 may help.

b. (4 pts.) Determine the percent lead in the paint. Show your work to receive credit.

10. (8 pts.) Define molarity.

11. To do the reaction in question 9 the chemist needed to prepare 50.0 mL of a NaCl solution with a concentration of 0.100 mol/L.

   a. (6 pts.) How many moles of NaCl does the chemist need to make this solution?

   b. (2 pts.) What is the mass of one mole of NaCl?

   c. (2 pts.) How many grams of NaCl does the chemist need to make the solution in part a?

12. A microbrewery produces a beer with an alcohol content of 7.9%. This beverage also comes in a nonstandard size, 22 fluid ounces. Typically, the alcohol content of beer is around 5%, and beer usually comes in 12-fluid ounce containers.

   a. (6 pts) Determine the volume of alcohol in the microbrew beer. Show your work to receive credit.

   b. (4 pts) Consuming a 22-fluid ounces bottle of the microbrew beverage would be equivalent to how many regular 12-ounce bottles of beer. Show your work to receive credit.

13. For a solute to dissolve in a solvent, the two must interact well with each other. Ascorbic acid (vitamin C) dissolves well in water. On the other hand, oleic acid (a major component in olive oil) does not dissolve well in water.
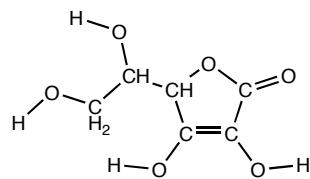
Vitamin C
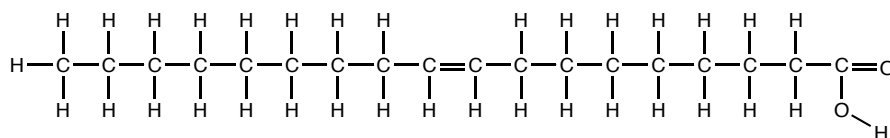
oleic acid

a. (3 pts.) Classify vitamin C as polar or non-polar. Explain your choice.

b. (3 pts.) Classify oleic acid as polar or non-polar. Explain your choice.

c. (4 pts.) What kind of intermolecular interactions can form between water molecules and molecules of ascorbic acid.

b. (4 pts.)Explain why vitamin C dissolves in water, whereas oleic acid does not dissolve in water.

14. When ionic compounds dissolve in water, they separate into ions.
   a. (4 pts.) What ions form when LiCl dissolves in water?

   b. (4 pts.) Draw a diagram that shows how water molecules interact with the ions from part a.