Sample Quiz Questions

In Chemistry 36, 3 quizzes (see schedule) will be given in the labs in the **first 20 min of the lab period**. You will need a calculator to do some of the problems in the quizzes. As soon as you arrive, wipe the surface of your bench, including the hood, with a sponge. Odd or even desk numbers should take the quiz on the open bench-top; students at even or odd desk numbers, in the hood, as instructed on the quiz.

In Chemistry 35, both quizzes and exams are scheduled. Study the examples below in preparation for lab portions of full quizzes.

Sample questions from old quizzes are included here so that you can see the types of questions that are asked. Note that questions cover safety, structures/names of reagents you use, practical questions regarding techniques (why certain procedures are followed or about apparatus that are used) and some theoretical questions, too. When you study for a quiz, do not limit your studying to just these questions.

**Quiz 1 questions covering Lab Safety, Recrystallization and Melting Point Determination, Lab Guide Chapters 2 and 4.**

**Quiz 1** 100 points

1. (10 pts) What are two safety precautions concerning the use of diethyl ether?

2. (16 pts) Complete the missing pieces in the simplified Chemical Data Table below:

<table>
<thead>
<tr>
<th>Name</th>
<th>Structure</th>
<th>State</th>
<th>Liquid Density</th>
<th>Amount</th>
<th>Mol. Wt.</th>
<th>mmol</th>
<th>Toxic?</th>
<th>Waste Cat.</th>
</tr>
</thead>
<tbody>
<tr>
<td>methanol</td>
<td></td>
<td>l</td>
<td>0.791 g/mL</td>
<td>general solvent</td>
<td>N.A.</td>
<td>N.A.</td>
<td>highly toxic</td>
<td></td>
</tr>
<tr>
<td>chromium (VI) trioxide</td>
<td>CrO₃</td>
<td>s</td>
<td>N.A.</td>
<td>0.075 g</td>
<td>100</td>
<td>0.75</td>
<td>highly toxic</td>
<td></td>
</tr>
<tr>
<td>benzamide</td>
<td></td>
<td>s</td>
<td>N.A.</td>
<td>50 mg</td>
<td>121</td>
<td></td>
<td>irritant</td>
<td></td>
</tr>
<tr>
<td>silica</td>
<td>SiO₂</td>
<td>s</td>
<td>N.A.</td>
<td>N.A.</td>
<td>N.A.</td>
<td>N.A.</td>
<td>no</td>
<td></td>
</tr>
<tr>
<td>carbon tetrachloride</td>
<td>CCl₄</td>
<td>l</td>
<td>1.594 g/mL</td>
<td>general solvent</td>
<td>N.A.</td>
<td>N.A.</td>
<td>cancer suspect</td>
<td></td>
</tr>
</tbody>
</table>

3. (21 pts) The seven steps of recrystallization are listed below. Number them in the correct order, beginning with the first step as #1.

   - wash crystals
   - dry crystals
   - dissolve solute
   - choose a solvent
   - filter suspended solids
   - filter off crystals
   - and/or decolorize
   - crystallize solute

4. (10pts) Give two precautions that must be used when heating organic liquids to their boiling point?
Quiz 1 (cont.)

5. (8 pt) Predict which solvent, water or hexane, would be a better solvent for recrystallizing each the following solids and write water or hexane by the corresponding structure:

- E-Cinnamic Acid
  mp 133°C

- E-Stilbene
  mp 123°C

6. (25 pt) Give two methods for
   a. safely heating a flammable solvent to it’s boiling point.
   b. removing residual solvent from a filtered solid.
   c. inducing crystallization from a saturated solution.

7. (10 pts) You are given two samples that are both slightly impure. When you determine the melting points, one, compound X, melts at 51-55°C and the other, compound, Y, at 73-78°C. X and Y are two of the four compounds shown below.
   Draw the structures of X and Y in the corresponding boxes.

- Maleic Anhydride
  mp 54-56°C

- Benzophenone
  mp 49-51°C

- 2-Nitroaniline
  mp 71-73°C

- Naphthalene
  mp 80-82°C

Quiz 2 questions covering Distillation, Boiling Points, and Liquid/Liquid Extraction, Lab Guide chapters 5 and 6.

Quiz 2  100 Points

1. (2 pts) What was the purpose of the stainless steel-packing (Chore Boy) used in fractional distillation?

2a. (2 pts) The boiling points of water and 2-methyl-2-propanol are 100 °C and 82.2 °C respectively. Which liquid has a lower vapor pressure at a given temperature?

2b. (1 pt) Is it possible to completely separate these two liquids by fractional distillation?

3a. (3 pts) The phase diagram of compound X is given in figure 2. Shade the area of the phase diagram where the temperature and the pressure are compatible with sublimation.

3b. (2 pts) Define sublimation.

4. (2 pts) In the Liquid/Liquid extraction experiment drying agents are frequently used. Give the name and chemical formula of any drying agent and give a chemical explanation of how they dry.

5. (2 pts) Describe two ways that can be used to identify which layer is organic and which layer is the aqueous layer in an extraction.
Quiz 2 (cont.)

6. (6 pts) Complete the following chart by drawing structures for the chemical species present at each step.

\[
\begin{align*}
\text{Br} & \quad \text{NH}_2 \\
\text{ether layer} & \quad \text{aqueous layer} \\
\text{dissolve in ether} & \quad \text{extract with HCl, separate layers} \\
\text{add K}_2\text{CO}_3 & \quad \text{filter} \\
\text{extract with NaHCO}_3 & \quad \text{separate layers} \\
\text{aqueous layer} & \quad \text{ether} \\
\text{add HCl, filter} & \quad \text{evaporate} \\
\end{align*}
\]

2. (4 pts) Using the phase diagram below (Figure 1), describing a simple distillation for a mixture of two miscible liquids, determine the boiling point of a 80 mL:20 mL solution of cyclohexane:toluene. (1 pt) What will the mol % composition of the initial distillate? (Important info: cyclohexane MW=84g/mol, d=0.78g/mL, bp=82°C; toluene MW=92g/mol, d=0.87g/mL, bp=111°C.) Show all work!!!
Quiz 3 100 Points

1. (8 pts) A mixture of the following two compounds are eluted from a silica gel chromatography column. Which compound will elute first? (Circle the correct structure.)

2. (12 pts) What are the two most common stationary phases used in column and thin layer chromatography? (Give their chemical names and simplest formulas for full credit.)

3a. (4 pt) Why does your sample have to be water-free before running a liquid IR?
3b. (4pt) You have just washed your NMR tube with acetone. What is the best way to dry it?

4a. (8pts) An unknown sample spotted on a TLC plate is eluted with hexane. Only one spot, \( R_f \) value 0.1, is observed. Does this indicate that the unknown is a pure compound? If so, how could the purity be verified?
4b. (6 pts) A mixture of the following two compounds are separated by TLC. Which compound will have a higher \( R_f \) value? (Circle the correct structure.)

5. (20 pts) Methylamine and 1,4-diacyetylbenzene undergo a reaction to give the product, \( \text{I} \), according to the equation below. Calculate the theoretical yield of the product, \( \text{I} \), from 0.180 g of 1,4-diacyetylbenzene and 0.080 g methylamine. (Show all work and give the limiting reagent.)

6. (8 pts) High-performance liquid chromatography (HPLC) utilizes a "reverse phase" stationary phase. (The 15 cm column is packed with C-18 - very nonpolar stationary phase). Apply the same principles used for column chromatography to this new system. Which of the compounds below will elute first from the column? (Circle the correct answer.)

7. (8 pts) What is the most common mobile phase in gas chromatography? (Circle the right answer.)
a. benzene  b. hexane  c. hydrogen  d. helium

8. (12 pts) A mixture of three compounds is to be analyzed using gas chromatograph with polar stationary phase. Predict the order of elution. (1 = first to elute, 3 = last)

9. (10 pts) You have narrowed the possibilities for unknown down to two (A or B). What is the most convenient spectroscopic method (IR, MS, NMR) for distinguishing between the two? Briefly explain.