1. Ethyl cyanide is prepared from ethyl bromide in the following reaction.
   a. Fill in the table with the corresponding values based on the given information. Be sure to use the proper units.
   b. Box the limiting reagent.
   c. What volume (mL) would C₂H₅CN occupy? Write your answer in the box to the bottom right.

```
C₂H₅Br + NaCN → C₂H₅CN + NaBr
```

<table>
<thead>
<tr>
<th>Molecule</th>
<th>Molar Mass (g/mol)</th>
<th>Density (g/mL)</th>
<th>grams</th>
<th>mmol</th>
<th>Theoretical Yield (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>C₂H₅Br</td>
<td>108.97</td>
<td>1.47</td>
<td>11.0 g</td>
<td>100.9</td>
<td></td>
</tr>
<tr>
<td>NaCN</td>
<td>49.007</td>
<td>1.60</td>
<td>8.53 g</td>
<td>174.1</td>
<td></td>
</tr>
<tr>
<td>C₂H₅CN</td>
<td>55.079</td>
<td>0.77</td>
<td></td>
<td>100.9</td>
<td>5.557</td>
</tr>
<tr>
<td>NaBr</td>
<td>102.89</td>
<td>3.21</td>
<td></td>
<td>100.9</td>
<td>10.38</td>
</tr>
</tbody>
</table>

Calculations:

\[
\frac{11 \text{ g C}_2\text{H}_5\text{Br}}{108.97 \text{ g C}_2\text{H}_5\text{Br}} = 0.1009 \text{ mol C}_2\text{H}_5\text{Br}
\]

\[
\frac{8.53 \text{ g NaCN}}{49.007 \text{ g NaCN}} = 0.1741 \text{ mol NaCN}
\]

\[
\frac{0.1009 \text{ mol C}_2\text{H}_5\text{CN}}{1 \text{ mol C}_2\text{H}_5\text{CN}} = 5.557 \text{ g C}_2\text{H}_5\text{CN}
\]

\[
\frac{0.1009 \text{ mol C}_2\text{H}_5\text{Br}}{1 \text{ mol NaBr}} = 102.89 \text{ g NaBr}
\]

\[
\frac{102.89 \text{ g NaBr}}{1 \text{ mol NaBr}} = 10.38 \text{ g NaBr}
\]
5.557 g $\text{C}_2\text{H}_5\text{CN}$ | 1 mL $\text{C}_2\text{H}_5\text{CN}$ | 0.77 g $\text{C}_2\text{H}_5\text{CN}$ = 7.217 mL $\text{C}_2\text{H}_5\text{CN}$

Volume of $\text{C}_2\text{H}_5\text{CN}$: 7.217 mL

2. Use the following IR, H-NMR, and C-NMR spectra to identify the structure.

**IR Spectra:**

sp2 C-H 3000-3100 cm$^{-1}$ (maybe b/c OH peak overlaps it, so it's hard to tell)

OH: 2500-3000 cm$^{-1}$

Due to the really broad peak with a huge range, it's most like a carboxylic acid.

sp3 C-H 2900-3000 cm$^{-1}$

C=O, carboxylic acid 1710 cm$^{-1}$

C=C, 1680 cm$^{-1}$

**H-NMR:**

8 peaks, means dq (so, the H is next to another H and CH3)

2 peaks, so it’s a H next to a H

CH3 with 2 peaks, so it’s next to a H

Carboxylic Acid
Andrew recrystallizes 0.250 g of crude product after doing an acid-base separation. However, he gets 0.015 g of the recrystallized product. What is the percent recovery?

Percent Recovery = (recrystallized mass/crude mass) * 100 = (0.015/0.250) * 100 = 6%

Yes, this would be too low. A potential error was adding too much ethanol, so most of it stayed dissolved.
4. Suppose Chris and Alice run the TLC plate to the right in a 7:3 hexanes/ethyl acetate solvent of the following compounds:

Chris argues that spots ABC are aromatic, carboxylic acid, and alcohol, respectively. Alice argues that spots ABC are carboxylic acid, aromatic, and alcohol, respectively. Who is correct? Why? What did Chris/Alice do wrong?

Alice is correct, polar compounds travel more slowly, therefore the carboxylic acid travelled the slowest & the aromatic travelled the fastest.

Chris had it reversed, so she may have thought that nonpolar compounds travel more slowly.

5. Suppose Nathan finds it difficult to analyze his gas chromatogram. The peaks are too close to each other. What is a possible reason why his peaks are so close? What can he do to resolve the problem?

Nathan may have performed his column in a temperature that is too high. The high temperature forces the molecules to be excited and elute more quickly, thus resulting in poor separation.

He should cool the temperature of his column to get better peak separation on his chromatogram.

6. Where do dispose TLC spotters?
   a. In the liquid waste.
   b. In the trash can.
   c. **In the broken glass container.**
   d. In the secondary container.

7. Suppose Lucy spills a liquid outside the fume hood. Her eyes start to get irritated and she cries uncontrollably. What type of liquid may this be, what is the protocol?

The liquid may be a lachrymator. She should remain calm and notify her TA for further instructions.