# RESULTS WORKSHEET

***NOTE: The following results tables will be available in D2L for use in submission of the formal report for this experiment. Remember that all tables and figures within your report must have both a number and a descriptive title.***

### **Table 4.2: Infrared Spectroscopy**

Predict the appearance of the IR spectra of the compounds in Figure 4.4 by filling in the following table. Indicate the presence of a functional group by marking the box; leave the box empty if the group is not present.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Molecule | **Functional Groups** | | | | | |
|  | **O-H** | **C-H (benzene ring)** | **C-H (singly bonded carbon)** | **C=O** | **C-Cl** | **C-Br** |
| methanol |  |  |  |  |  |  |
| ethanol |  |  |  |  |  |  |
| *t*-butanol |  |  |  |  |  |  |
| 2-propanol |  |  |  |  |  |  |
| acetone |  |  |  |  |  |  |
| ethyl formate |  |  |  |  |  |  |
| ethyl acetate |  |  |  |  |  |  |
| methyl acetate |  |  |  |  |  |  |
| 1,2-dichloroethane |  |  |  |  |  |  |
| 1,4-dichlorobutane |  |  |  |  |  |  |
| 1,2-dibromo-2-methylpropane |  |  |  |  |  |  |
| 2-chloropropane |  |  |  |  |  |  |
| benzene |  |  |  |  |  |  |
| mesitylene |  |  |  |  |  |  |
| *para*-xylene |  |  |  |  |  |  |

**Table 4.3: Nuclear Magnetic Resonance (NMR) Spectroscopy**

Predict the NMR spectrum for each of the compounds in Figure 4.4 by filling in the following table.

|  |  |  |
| --- | --- | --- |
| **Molecule** | **Number of Peaks** | **Ratio of Areas** |
| methanol |  |  |
| ethanol |  |  |
| *t*-butanol |  |  |
| 2-propanol |  |  |
| acetone |  |  |
| ethyl formate |  |  |
| ethyl acetate |  |  |
| methyl acetate |  |  |
| 1,2-dichloroethane |  |  |
| 1,4-dichlorobutane |  |  |
| 1,2-dibromo-2-methylpropane |  |  |
| 2-chloropropane |  |  |
| benzene |  |  |
| mesitylene |  |  |
| *para*-xylene |  |  |

#### **Table 4.5: NMR Spectra of Unknown Compounds**

Tabulate the number of peaks and the relative areas for the NMR spectrum of each unknown compound. When you are measuring the areas of the NMR peaks (also called the *integrations*), measure carefully and be aware that **these numbers are not perfect**; you can expect up to 10 % error in them.

|  |  |  |  |
| --- | --- | --- | --- |
| # | **Sample ID** | **Number of Peaks** | **Ratio of Areas** |
| 1 |  |  |  |
| 2 |  |  |  |
| 3 |  |  |  |

**Table 4.4: Infrared Spectra of Unknown Compounds**

Analyze the spectrum of each unknown compound. If there is a peak present in the spectrum of the unknown compound that corresponds to one of the functional groups listed below, report it by marking the appropriate box. You may want to use a ? to indicate the groups that may possibly be present.

From Table 4.1, remember O-H peaks must be strong and broad, C=O peaks must be strong, etc. There are many other functional groups that absorb in the C-Cl and C-Br regions, so those peaks are relatively weak evidence.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | Functional Groups | | | | | |
| # | **Sample ID** | **O-H** | **C-H (benzene ring)** | **C-H (singly bonded carbon)** | **C=O** | **C-Cl** | **C-Br** |
| 1 |  |  |  |  |  |  |  |
| 2 |  |  |  |  |  |  |  |
| 3 |  |  |  |  |  |  |  |

1. **Identification of unknowns:** Use the information from the tables above to identify your unknowns. Remember to weigh which evidence is strongest when making your determinations.

|  |  |  |  |
| --- | --- | --- | --- |
| # | **Sample ID** | **Most likely compound (letter and name)** | **Other possibilities? (letters)** |
| 1 |  |  |  |
| 2 |  |  |  |
| 3 |  |  |  |

1. **In a few sentences or bullet points each, briefly explain how you identified each unknown:**

###### Worksheet: Either type or print and write in your results on the previous 3 pages. Use your phone camera or a phone scanner app to take legible pictures of your completed worksheet pages (9-11). Upload these in a Word doc or PDF (not .jpg or .heic) to the D2L dropbox folder.