# STRUCTURE-REACTIVITY RELATIONSHIPS: HYDROCARBON REACTIVITY

**Date**: **Name** :_____

**TA** :_____

**Section** :_____

**The key to getting the most out of this experiment is a careful and logical analysis of the results. That method should allow you to deduce the answer to what is going on. This template type report will guide you through the process. In order for this to "work" you should completely answer each of the questions in the order that they are asked before moving on to the next question.**

1. On the following page there is a table. Draw line diagram structures for each of the hydrocarbons.
2. Identify the **main functional group** that is present in each of the hydrocarbons.
3. **Research** how each of the three different functional groups react with bromine. For each functional group, give a *balanced equation* for **how that functional group typically reacts with bromine** (including *typical* reaction conditions and reagents) and state the mechanistic reaction type (*e.g.* nucleophilic substitution).

**4.** By comparing the answers in Qu **3** to the experimental conditions used in the hydrocarbon experiment, now complete the "reaction type" column in the table on the next page. Hint: pay careful attention to the reaction conditions and the reagents.

| **Compound** | **1**<br>**Structure** | **2**<br>**Functional group** | **4**<br>**Reaction type** |
|---|---|---|---|
| toluene | | | |
| ethylbenzene | | | |
| isopropylbenzene | | | |
| t-butylbenzene | | | |
| cyclohexene | | | |
| cyclohexane | | | |

## 5. PROCEDURE

(write a procedure for the experiment using the information provided in the Powerpoint materials)

**6.** Based on the information in the Powerpoint materials, show the calculation of the limiting reagent for the reaction of bromine with cyclohexane.

**7.** What are the implications of the limiting reagent in terms of the way in which the experiment is carried out ?

**RESULTS**

In column 2 list any important observations made for each reaction.

In column 3 record the time at which the bromine as added, the time at which the reaction had reached the end point

In column 4 give the time taken in seconds for the reaction to reach the end point.

In column 5, rank the relative reactivity of each of the hydrocarbons as 1 to 6, where 1 is the *most* reactive and 6 the *least* reactive.

| | Observations | Time bromine added and end | Time taken/s | Relative reactivity |
|---|---|---|---|---|
| **A** | | | | |
| **B** | | | | |
| **C** | | | | |
| **D** | | | | |
| **E** | | | | |
| **F** | | | | |

## DISCUSSION

### Rationale of observed reactivity order

With one exception, each of the compounds used in the experiment react with bromine via the same type of reaction (*i.e.* via a similar reaction mechanism).

a. What type of reaction do the majority of the hydrocarbons undergo with bromine?

b. What type of reactive intermediate is involved in this reaction?

c. What controls the rate of this type of reaction with bromine?

d. What factors affect the stability of this type of reactive intermediate?

e. For each of the compounds used in this experiment draw a LINE diagram structure of the hydrocarbon intermediate formed (ignore the “exception”).

What is the relative stability order of these reactive intermediates?

**Indicate this by labeling the structures above 1 to 5 where 1 = most stable, 5 = least stable.**

Use your results to match each of the hydrocarbons to the test tubes A-F.

**A** = **B** =

**C** = **D** =

**E** = **F** =

## CONCLUSIONS

## References