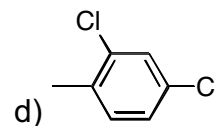
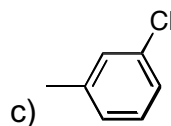
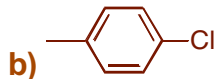
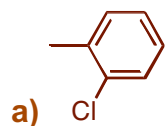


21 points (3 points each) Mark your answers on the scantron sheet. You may keep this copy.

1. What is the major product of the reaction of toluene with  $\text{Cl}_2$  and  $\text{FeCl}_3$ ?

(either accepted)



2. Nucleophilic Aromatic Substitution will only occur if . . .

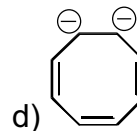
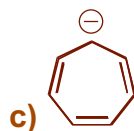
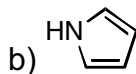
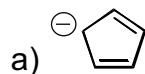
a) there are electron donating groups on the aromatic ring.

**b) there are electron withdrawing groups on the ring.**

c) there are no ortho substituents.

d) none of the above

3. Which of the following molecules are **not** aromatic?



4. Which of the following is **not** an ortho-para directing group?

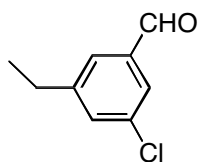
a)  $-\text{CH}_3$

b)  $-\text{Cl}$

c)  $-\text{NH}_2$

**d)  $-\text{SO}_3\text{H}$**

5. What is a correct name for the following compound?



a) meta-chloro-meta-ethylbenzaldehyde

b) 3-chloro-5-carboxytoluene

**c) 3-chloro-5-ethylbenzaldehyde**

d) 3-chloro-5-ethylbenzoic acid

6. Which of the following would be an activating group for electrophilic aromatic substitution?

**a)  $-\text{OCH}_3$**

b)  $-\text{NH}_3^+$

c)  $-\text{Cl}$

d)  $-\text{NO}_2$

7. Which of the following is **not** a valid resonance structure for nitrobenzene?

