CHM 2200C **Hour Test 1** **Name** KEY
February 2, 2005 **(Please Print)**

Page	Points
1	28
2	31
3	26
4	15
Total	100

You should have 4 pages. **Print your name legibly on each page now**. Blank sheets are available for scratch paper if you need them, but please put your answers on the test pages.
If something is not clear, raise your hand and ask!

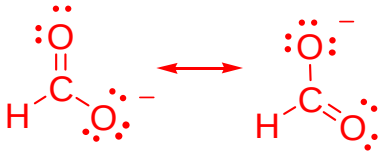
Points

1. The formate ion (HCO_2^-) has a central carbon with one hydrogen and two oxygens attached to it.

(2) (a) How many **valence electrons** are in the Lewis structure?:

18 (H =1, C = 4, O = 2x6 = 12, neg. charge = 1)

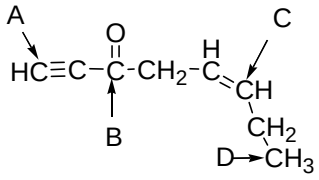
(6) (b) Draw the two Lewis resonance structures for the formate anion.
3 pts each structure;



(2) (c) What is the **hybridization** of the sigma bonds to carbon? sp^2

(2) (d) What is the **geometry** about the carbon atom? trigonal planar (or 120°)

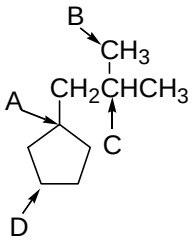
(8) 2. In the structure at the right, identify the **hybridization** of the sigma bonds to each of the carbon atoms specified by a letter.
2 pts each



A: sp B. sp^2

C. sp^2 D. sp^3

(8) 3. In the structure at the right, identify whether each of the specified carbon atoms is a **primary, secondary,** or **tertiary** carbon.
2 pts each

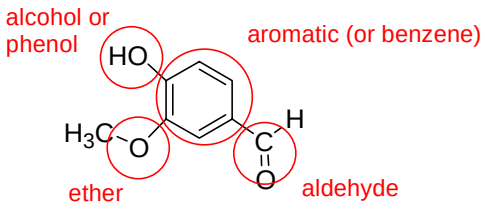


A. tertiary B. primary

C. tertiary D. secondary

(8) 4. The compound **vanillin** is the substance primarily responsible for the flavor and aroma of vanilla. Circle and name each of the **four** functional groups present in the molecule.

2 pts each group correctly identified.

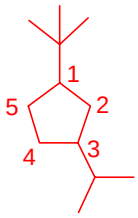


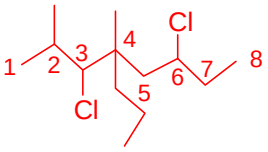
vanillin

(6) 5. Draw the structure of each of the following alkanes (condensed, line, or combination).

3 pts each structure: 1 pt base name, 1 pt for each error in the groups. Numbers not needed. Okay to show C's and H's.

(a) 1-*tert*-butyl-3-isopropylcyclopentane (b) 3,6-dichloro-2,4-dimethyl-4-propyloctane

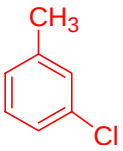


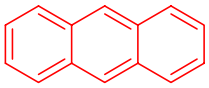


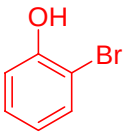
(9) 6. Draw the structure of each of the following aromatic compounds (condensed, line or combination).

3 pts each. Aromatic rings may have circles. -2 pts if only error is correct meta or para positioning.

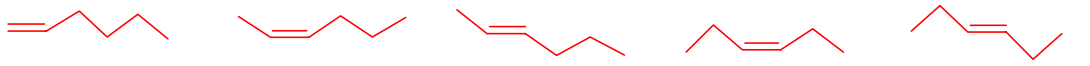
(a) *meta* chlorotoluene (b) anthracene (c) *ortho*-bromophenol







(8) 7 *normal*-Hexene (the linear chain with no branching) has five isomers, including both structural and geometric. Draw and name **four** of them, being sure to indicate *cis* or *trans* where necessary.

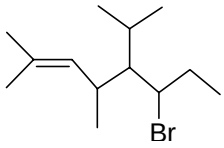


any four. 1 pt structure, 1 pt name.

(12) 8 Name the following compounds, including a *cis* or *trans* designation if necessary.

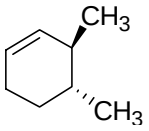
3 pts each. -1 if order of groups wrong, -1 if only a number is wrong, -1 if trans or meta is wrong

(a)



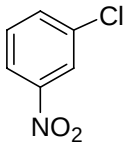
Name: 6-bromo-5-isopropyl-2,4-dimethyl-2-octene

(b)



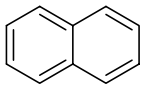
Name: trans-3,4-dimethyl-cyclohexene

(c)



Name: meta-chloronitrobenzene

(d)

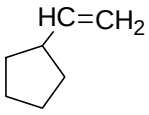


Name: naphthalene

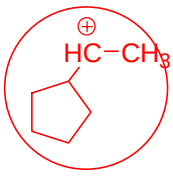
(6) 9. In the acid catalyzed addition reaction of HCl to an alkene, the proton of the acid acts as a(n) electrophile (electrophile or nucleophile?) attacking the π electrons of the double bond. An unstable intermediate carbocation (carboanion or carbocation?) is formed. The chloride ion, acting as a(n) nucleophile (electrophile or nucleophile?) then forms a sigma bond with this unstable intermediate. With unsymmetrical alkenes, two unstable intermediates are possible.

(8)

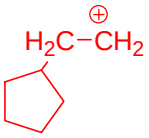
(a) For the reaction of vinylcyclopentane (structure to the right) with HCl, draw the structures of both of these unstable intermediates, and **circle** the one that is the most stable.



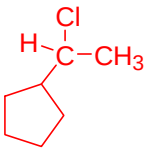
(b) Then draw the structure of the major product of HCl addition.



more stable



Intermediates

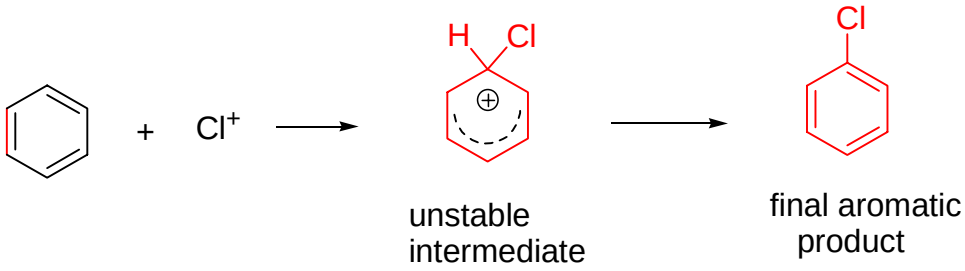


Major Product

2 pts each structure, 2 pts correct one circled.

(6) 10 Aromatic compounds are more stable than alkenes and do not undergo simple addition reactions. They do undergo **electrophilic substitution** reactions, though, when a proper catalyst is present. Benzene does not react readily with Cl_2, for example, except in the presence of a catalyst such as iron (III) chloride ($FeCl_3$). The $FeCl_3$ reacts with the Cl_2 to form a **chloronium ion** (Cl^+), which then reacts with the benzene. Complete the reaction scheme below by drawing the structure of the unstable intermediate formed when Cl^+ reacts with benzene, followed by the final aromatic product.

3 pts each structure. Intermediate should have a positive charge, but could have 2 double bonds instead of the dotted circle.



(9) 11 Complete the following reactions with the structure of the organic product:

3 pts each structure