(24 pts.) 1. a. Identify the functional groups in the following molecule. (Don’t be confused by the arrows…they are pointed at specific atoms for part b.) (14 pts)

![Molecule Diagram]

b. Identify the hybridization and shape of five of the indicated atoms a -f. (The indicated atoms have arrows pointed at them.) (10 pts)

a. sp², trigonal planar
b. sp², trigonal planar
c. sp, linear
d. sp³, tetrahedral
e. sp³, tetrahedral
f. sp², trigonal planar

(6 pts) 2. Identify 3 polar bonds in the following molecule and show the direction of the bond dipole for each.

![Molecule Diagram]

(dipole arrows were also counted as correct)
(16 pts) 3. Draw **GOOD** Lewis structures AND resonance forms for the following molecules. (8 pts each)

a. \((\text{CH}_3\text{CH}_2\text{C(OH)OCH}_2\text{CH}_3)^+\)

\[
\begin{align*}
\text{O} & \quad \text{O} \\
\text{H} & \quad \text{OH} \\
\text{O} & \quad \text{O}
\end{align*}
\]

Minor (-1)

b. \((\text{CH}_2\text{CN})^-\)

\[
\begin{align*}
\text{O} & \quad \text{O} \\
\text{N} & \quad \text{C}_-\text{N}
\end{align*}
\]

(12 pts) 4. Name or Draw the following compounds.

a. \(\text{Cl}\)

**3-chloro-4-ethyl-2,5-dimethylhexane**

b. 3-cyclohexyl-2-methylhexane (draw)

\[
\begin{align*}
\text{C}_6\text{H}_{11} & \quad \text{CH}_3 \\
\text{CH}_2 & \quad \text{CH}_3 \\
\text{CH}_3 & \quad \text{CH}_3 \\
\text{CH}_3 & \quad \text{CH}_2\text{CH}_3
\end{align*}
\]

c. \(\text{CH}_3\text{CH}_2\text{CH(iPr)CH}_2\text{CH(tBu)CH}_2\text{CH}_3\)

(name)

**3,5-diethyl-2,2,6-trimethylheptane**

d. \(\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_3\)

**6-methyl-2-heptyne**
(8 pts) 5. Name the following compound. Draw a constitutional/structural isomer of it and name the isomer.

3,8-diethyl-7-isopropyl-2,2,4-trimethylundecane

8-ethyl-3,7-diisopropyl-2,4-dimethylundecane
(any reasonable answer accepted here, this is just an example)

(24 pts) 6. Identify the relationship between 6 of the 7 of the following pairs of compounds. You may choose from same, resonance forms, constitutional/structural isomers, geometric isomers, or no relationship.

a. \(\text{HO-}\text{CH}2\text{CH}2\text{CHO}\) AND \(\text{HO-}\text{CH}2\text{CH}2\text{CHO}\)
   Structural isomers

b. \(\text{HO-}\text{CH}2\text{CH}2\text{CHO}\) AND 5-cyclohexyl-2,2-dimethylheptane
   identical

c. \(\text{HO-}\text{CH}2\text{CH}2\text{CHO}\) AND \(\text{HO-}\text{CH}2\text{CH}2\text{CHO}\)
   No relationship

d. \(\text{CH}_{3}\text{CH}_{2}\text{CHCHCHCH}_{3}\) AND \(\text{CH}_{3}\text{CH}_{2}\text{CHCHCHCH}_{3}\)
   resonance
(10 pts) 7. Draw all the staggered Newman projections of 3,3-dimethyl-1-pentene from the perspective of the C3-C4 bond.

Your answer may not look like this, but all correct answers were accepted.

(4 pts) **Extra Credit.**

Name two television shows that have a scientific premise.

All reasonable answers were accepted.