Match the sets (1 pt each):

1. The C-C double bond in ethylene consists of a \( \text{G} \) and a \( \text{P} \) bond.
2. The bonds of oxygen in water are \( \text{B} \) bonds formed by \( \text{N} \) hybridization.
3. Acids \( \text{E} \) an electron pair while bases \( \text{I} \) one.
4. Stereoisomers that are not mirror images \( \text{J} \).
5. Ionic bonds are formed by electron \( \text{C} \); covalent bonds by electron \( \text{M} \).
6. An equal mixture of two enantiomers is said to be \( \text{O} \).

Circle the best answer:

7. Which of the following pairs has the LARGER dipole moment?
   a. CO\(_2\)  b. CH\(_3\)OH
   a. ICl  b. F\(_2\)
   a. CH\(_3\)OH  b. CH\(_3\)NH\(_2\)
   a. FCCCl\(_3\)  b. HCCl\(_3\)

8. Show the electronic configurations for the following atoms; CIRCLE the Valence electrons.

\[
\text{C}^6_{12} \quad \text{Na}^{11}_{23}
\]
\[
1s^2 2s^2 2p^2 \quad 1s^2 2s^2 2p^6 3s^1
\]

9. What is the IUPAC name for the following alkane?
   a. 2-Ethyl-4-i-propyloctane
   b. 3-Butyl-5-ethyl-2-methylhexane
   c. 5-i-Propyl-7-ethyloctane
   d. 4-Butyl-2-ethyl-5-methylhexane

10. The alkane in problem 9 has:
   a. No tertiary hydrogens
   b. Fifteen primary, 12 secondary and 2 tertiary hydrogens
   c. Fifteen primary, 10 secondary and 3 tertiary hydrogens
   d. No primary hydrogens
11. Draw electronic dot structures (Lewis structures) for the following (4 pts each):

A. Boron trifluoride \( \text{BF}_3 \)

\[
\begin{array}{c}
\cdot \cdot \\
F \quad B \quad F
\end{array}
\]

B. Carbon dioxide \( \text{CO}_2 \)

\[
\cdot \cdot \\
\cdot \cdot \\
\cdot \cdot
\]

12. Consider the following possible Lewis structures for diazomethane: (8 pts total)

\[
\begin{align*}
\text{H}_3\text{C} & - \text{N}=\text{N} \quad \text{H}_2\text{C} - \text{N}=\text{N} \quad \text{H}_2\text{C} = \text{N}=\text{N} \quad \text{H}_2\text{C} - \text{N} = \text{N} \nonumber \\
1) & \quad 2) & \quad 3) & \quad 4)
\end{align*}
\]

a. Which has a + charge on carbon? 4
b. Which does NOT have a + charge on the center N? 4
c. Which is NOT a legitimate Lewis structure? 3
d. Which is the MOST favorable resonance structure? __________

13. a. Arrange the following in order of INCREASING oxidation state of carbon:

\[
\begin{align*}
\text{CO}_2 & \quad \text{H}_2\text{CO} & \quad \text{CH}_2\text{OH} & \quad \text{CH}_4 & \quad \text{H}_2\text{C} = \text{CH} 
onumber \\
1) & \quad 2) & \quad 3) & \quad 4) & \quad 5) \nonumber
\end{align*}
\]

b. The oxidation number of CARBON in this series ranges from:

1) 0 to +5
2) -4 to +4
3) -2 to +4
4) None of the above

14. Shown below are three conformations of 1,3-dimethylcyclohexane

a. Which is the least stable form? 2
b. Which is the boat form? 2
c. Which is most stable? 3
d. Which is the trans form?
5. Label the following Newman projections as A anti, G gauche or E eclipsed and indicate as
   1 (most) 2 (second) 3 (third) and 4 (least) STABLE (8 pts total)

   A 1   E 4   G 2   E 3

16. Which orbitals overlap to give the STRONGEST bond? Which the WEAKEST?
   a. sp-sp  b. sp^3 - sp^3  c. p-p  d. sp^3 - sp^2
   Strongest  A  Weakest  B

17. For the following reaction which is true?
   H_2SO_4 + NH_3 → NH_4^+ + HSO_4^-
   a. This is an oxidation-reduction
   b. HSO_4^- is the conjugate base of H_2SO_4
   c. NH_4^+ is the conjugate base of H_2SO_4
   d. NH_3 is the conjugate base of H_2SO_4

18. Indicate the hybridization around the atoms shown:

   a.  
   b.  
   c.  
   d.  

   Incorrect b/c there are 5 bonds to carbon

   sp^2  sp  sp^3  sp^3

19. Consider the following five compounds and answer the questions (14 pts total):

   A  B  C  D  E

   Which two are ENANTIOMERS?  A and D
   Show two DIASTEREOMERS:  A and C
   Which is a MESO compound?  C
   Which are OPTICALLY INACTIVE?  E and C
20. In each of the following pairs which (a or b) is the more stable? (circle letter)

\[ \text{CH}_3\text{E} \] \[ \text{CH}_3\text{E} \]
\[ \text{EA} \rightarrow \text{AE} \] \[ \text{EE} \rightarrow \text{AA} \]
\[ \text{CH}_3\text{E} \] \[ \text{CH}_3\text{E} \]
\[ \Delta \text{E} \] \[ \Delta \text{E} \]
\[ \text{CH}_3\text{E} \] \[ \text{CH}_3\text{E} \]
\[ \text{CH}_3\text{E} \] \[ \text{CH}_3\text{E} \]

21. Which structures are CHIRAL?

\[ \text{CH}_3\text{CHCH}_2\text{CH}_3 \]
\[ \text{CH}_3\text{CHCH}_3 \]
\[ \text{CH}_3\text{CHCH}_3 \]
\[ \text{CH}_3\text{CHCH}_3 \]
\[ \text{Cl} \]
\[ \text{Cl} \]
\[ \text{Cl} \]
\[ \text{Cl} \]

\[ \text{a. 1 and 4 only} \]
\[ \text{b. 1, 2 and 4} \]
\[ \text{c. 1 and 2 only} \]
\[ \text{d. 1 and 3 only} \]

22. What is the configuration of the compounds shown?

\[ \text{CH}_3\text{CHCH}_2\text{CH}_3 \]
\[ \text{Cl} \]
\[ \text{Cl} \]
\[ \text{Cl} \]
\[ \text{Cl} \]
\[ \text{Cl} \]
\[ \text{Cl} \]
\[ \text{Cl} \]
\[ \text{Cl} \]

\[ \text{a. 2R, 3R} \]
\[ \text{b. 2S, 3S} \]
\[ \text{c. 2S, 3R} \]
\[ \text{d. 2R, 3S} \]

23. Which of the following reactions MAY give an optically active product?

1) \[ \text{CH}_3\text{CHCH}_2\text{CH}_2\text{Br} + \text{OH}^\rightarrow \text{CH}_3\text{CHCH}_2\text{CH}_2\text{OH} \]
S(-)-4-Bromo-2-butanol

2) \[ \text{CH}_3\text{CCH}_2\text{CH}_3 + \text{Cl}_2 \text{light} \rightarrow \text{CH}_3\text{CCH}_2\text{CH}_3 \]
R(+)-2-Chlorobutane

\[ \text{a. 1 only} \]
\[ \text{b. 2 only} \]
\[ \text{c. 1 and 2} \]
\[ \text{d. 1 and 3} \]
BONUS QUESTION: A Stevens student was studying the Markovnikov addition of HBr and HCl to optically pure S(+-)-3-Chloro-1-butene.

\[
\begin{align*}
\text{HCl} & \quad \rightarrow \quad \text{HBr} \\
\text{CH}_3\text{CCH}==\text{CH}_2 & \quad \rightarrow \quad \text{CH}_3\text{CCHBrCH}_3 \\
\text{Cl} & \quad \rightarrow \quad \text{Cl} \\
\end{align*}
\]

WHAT DO YOU EXPECT WOULD HAPPEN?

a.  HCl would give two products, both optically active; HBr would give two products only one active.
b.  Both would give two products, both active (enantiomers).

\[ \textbf{C} \]  HBr would give two products, both optically active; HCl would give two products, only one active
d.  Both would give three products, two of which are optically active.