Name
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1-10 Are True/False (10pts)

1) Cyclopentane has zero ring strain
2) The conjugate base of H₂SO₄ is HSO₄⁺
3) \[ \begin{array}{c} \bullet \\ \hline \end{array} \quad \text{is more stable than} \quad \begin{array}{c} \bullet \\ \hline \end{array} \]
4) A π bond is formed by the sideways overlap of p orbitals
5) Ring strain is comprised of angle strain and torsional strain
6) The rate determining step is the step with the highest energy transition state
7) A Lewis base is a two electron donor
8) Bond dissociation energy is the energy required to break a covalent bond into ions
9) Exothermic reaction steps have late (product like) transitions states
10) Boron has 5 valence electrons

11) For each of the molecules below, indicate the number of:
(i) lone pairs of electrons
(ii) sp² hybridized atoms. (2+2pts)

(a) HOOH

(b) \[ \text{NH}_2 \]

\[ \text{Cl} \]
12) i) Draw the following molecule using a Newman projection. (2pts)

\[ \begin{array}{c}
\text{F} \\
\text{H} \\
\text{H} \\
\text{H} \\
\text{OH} \\
\end{array} \]

ii) What name is given to the above orientation where the C-F and C-O bonds have a dihedral angle of 180°? (1pt)

13) Using “fish hook” arrows (which represent the movement of ONE electron), draw the mechanism for this reaction. (3pts)

\[ \text{Cl—Cl} \quad \bullet \text{CH}_2\text{CH}_3 \quad \rightarrow \quad \text{Cl•} \quad \text{Cl—CH}_2\text{CH}_3 \]

14) Draw in all the axial C-H bonds on this chair cyclohexane. (3pts)
15) Name the following compounds in IUPAC form. (3+4pts)

(a) ![Chemical structure](image1)

(b) ![Chemical structure](image2)

16) Draw 1,1-diethylcyclopentane using a line angle formula (stick figure). (3pts)

17) i) Why (or when) do we use resonance structures?

ii) For the below resonance structures, draw the electron movement that converts the left hand side structure into the other.

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

iii) Which resonance structure is of lower energy? (1+4+1pts)
18) Circle the lowest energy member of each threesome. (4pts)

(a) 

(b) 

(c) 

(d) 

19) Predict the hybridization of each of the following carbons. (1+1+1+2+2pts)

***BONUS POINT (1point)***

What is the name of the [OCN]$^-$ anion in Q17? Hint: it starts with the letter C.
1-10 Are True/False (10pts)

1) Cyclopentane has zero ring strain  
   
2) The conjugate base of H₂SO₄ is HSO₄⁻  

3) 
   
4) A π bond is formed by the sideways overlap of p orbitals  

5) Ring strain is comprised of angle strain and torsional strain  

6) The rate determining step is the step with the highest energy transition state  

7) A Lewis base is a two electron donor  

8) Bond dissociation energy is the energy required to break a covalent bond into ions  

9) Exothermic reaction steps have late (product like) transitions states  

10) Boron has 5 valence electrons  

11) For each of the molecules below, indicate the number of:
    (i) lone pairs of electrons
    (ii) sp² hybridized atoms. (2+2pts)

   (a) HOOH
      (i) 4
      (ii) zero

   (b) 
      (i) 4
      (ii) 2

   NH₂

   Cl
12) i) Draw the following molecule using a Newman projection. (2pts)

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

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

ii) What name is given to the above orientation where the C-F and C-O bonds have a dihedral angle of 180°? (1pt)

\text{ANTI}

13) Using "fish hook" arrows (which represent the movement of ONE electron), draw the mechanism for this reaction. (3pts)

\[
\text{Cl—Cl} \quad \text{CH}_2\text{CH}_3 \rightarrow \text{Cl—CH}_2\text{CH}_3
\]

14) Draw in all the axial C-H bonds on this chair cyclohexane. (3pts)
15) Name the following compounds in IUPAC form. (3+4pts)

(a) \[ \text{2,2-DIMETHYL HEXANE} \]

(b) \[ \text{TRANS-ETHYL-4-METHYL CYCLOHEPTANE} \]

16) Draw 1,1-diethylcyclopentane using a line angle formula (stick figure). (3pts)

17) i) Why (or when) do we use resonance structures?

For species that cannot be accurately described by a single Lewis structure, i.e. delocalized or non-classical structures.

ii) For the below resonance structures, draw the electron movement that converts the left hand side structure into the other.

\[ \text{\begin{align*}
\begin{array}{c}
\text{O} \\
\text{C} \\
\text{N}
\end{array}
\end{align*}} \quad \leftrightarrow \quad \text{\begin{align*}
\begin{array}{c}
\text{O} \\
\text{C} \\
\text{N}
\end{array}
\end{align*}} \]

iii) Which resonance structure is of lower energy? (1+4+1pts)

\[ \text{\begin{align*}
\begin{array}{c}
\text{O} \\
\text{C} \\
\text{N}
\end{array}
\end{align*}} \]
18) Circle the lowest energy member of each threesome. (4pts)

(a)

(b)

(c)

(d)

19) Predict the hybridization of each of the following carbons. (1+1+1+2+2pts)

\[ \text{CH}_3 \quad \text{CH}_3 \quad \text{CH}_3 \]

***BONUS POINT (1point)***

What is the name of the \([\text{OCN}]^-\) anion in Q17? Hint: it starts with the letter C.

CYANATE