Answer all 22 questions (150 pts). Hold ________________

1. (13) Name the following molecule using IUPAC rules. Do not assign E or Z designations.
   a) ![molecule](image1.png)  
   b) ![molecule](image2.png)  

   2,4,6-trimethyl-1-octen-7-yne  
   8-ethyl-1,5-dimethyl-1-cyclooctene

2. (3) Which of the following carbocations is the least stable?
   ![carbocations](image3.png)

3. (3) Which of the following alkenes is the most stable?
   ![alkenes](image4.png)

4. (4) Circle the choice to the right which provides the correct configuration for the following:
   ![configuration](image5.png)

   a) (2E, 4E)  
   b) (2Z, 4Z)  
   c) (2Z, 4E)  
   d) (2E, 4Z)

5. (3) Circle the reaction conditions below which would convert 2-pentyne to cis-2-pentene?
   a) Pd and H₂  
   b) Lindlar's catalyst and H₂  
   c) Na in liquid NH₃ then water  
   d) NaNH₂

6. (3) Circle the reagent below, which would convert a tertiary alcohol to a chloro product.
   a) SOCl₂  
   b) PBr₃  
   c) HBr  
   d) HCl  
   e) Cl₂

7. (8) Classify each of the following as a nucleophile or electrophile
   a) I₂  
   b) HgBr₂  
   c) LiCH₂CH₂CH₃  
   d) KBH₄

   electrophile  
   electrophile  
   nucleophile  
   nucleophile

8. (5) How many different monochloro derivatives are possible for the molecule shown? Draw one.
   ![molecule](image6.png)

   a) two  
   b) three  
   c) four  
   d) five
9. (42) In each of the following reactions, either reactants or products are missing. Fill in the blanks with the appropriate molecules. If more than one step is involved, indicate this by using 1)......; 2)....... Show the stereochemistry of the products, as appropriate.

a) 
\[
\begin{align*}
\text{Br}_2 & \quad \text{H}_2\text{O} \\
\quad & \quad \\
\quad & \quad \\
\quad & \quad \\
\quad & \quad \\
\quad & \quad \\
\quad & \quad \\
\end{align*}
\]

b) 
\[
\begin{align*}
\text{H}_2, \text{Lindlar's} \\
& \quad \text{or} \\
\text{1. Li, NH}_3 \\
& \quad \text{2. H}_2\text{O} \\
\quad & \quad \\
\quad & \quad \\
\quad & \quad \\
\quad & \quad \\
\quad & \quad \\
\end{align*}
\]

c) 
\[
\begin{align*}
\quad & \quad \\
\quad & \quad \\
\quad & \quad \\
\quad & \quad \\
\quad & \quad \\
\quad & \quad \\
\quad & \quad \\
\end{align*}
\]

10. (3) If a molecule with 1° of unsaturation did not react with H\textsubscript{2} and Pd, or any other electrophile, what could you conclude about this molecule?

It has one ring.

11. (5) Draw another resonance form for the following molecule:
12. (10) Circle any statement in the box to the right of each reaction which is an appropriate description.

a) 

b) 

13. (5) Circle any of the alkenes shown below which could react with hydrogen / Pd to form the product given.

14. (5) How many degrees of unsaturation are there in C₄H₃BrClNO?

Equivalent hydrocarbon = C₄H₄  
Comparable saturated hydrocarbon = C₄H₁₀

Therefore, a difference of 10 – 4 = 6 and 3° of unsaturation.

15. (4) Which one of the following can exist as a pair of cis-trans isomers?

a) CH₃CH =CH₂  b) (CH₃)₂C =CHCH₃  c) CH₃CH₂CH =CHCH₃  d) (CH₃)₂C =C(CH₃)CH₂CH₃

c is the only one that can display cis – trans isomerism

16. (4) A molecule with 6 degrees of unsaturation could contain which of the following? Circle all which apply.

a) 3 ring & 3 double bonds  b) 3 rings & 1 triple bond  c) 3 triple bonds  d) 2 triple bonds

e) 3 double bonds, 1 ring & 1 triple bond  f) 2 rings, 1 triple bond & 1 double bond
17. (3) True or False? The mixture of molecules shown below would be a racemic mixture (racemate).

\[
\begin{align*}
\text{CH}_3 &- \text{NH}_2 & \text{Br} & \text{R} \\
\text{H} &- \text{NH}_2 & \text{Br} & \text{H} \\
\text{both are identical therefore this is not a racemic mixture}
\end{align*}
\]

18. (3) cis-2-butene reacts with KMnO4 under basic conditions to give a meso diol because:

a) The reaction is a syn addition  
   b) The reaction is an anti addition  
   c) All 1,2-diol products are meso  
   d) The alkene is meso

19. (4) Which of the following compounds is / are chiral?
   a) 1-bromopentane  
   b) 3-bromopentane  
   c) 1-bromo-2-methylbutane  
   d) 2-bromo-2-methylbutane

20. (5) Draw a structure that corresponds to the following name:

(E)-4-ethyl-3-methyl-3-heptene

21. (10.5) Identify the electrophile (E) and the nucleophile (N) in each of the following reactions. Then draw curved arrows to illustrate the bond-making and bond-breaking processes.

a) \[
\begin{align*}
\text{H}_3\text{C} &- \text{C} = \text{CH}_2 & \text{N} \\
\text{OH} &- \text{Br} & \text{E} \\
\text{H}_3\text{C} &- \text{C} = \text{CH}_2 & \text{N} \\
\text{H}_3\text{C} &- \text{C} = \text{CH}_2 & \text{N} \\
\end{align*}
\]

b) \[
\begin{align*}
\text{H}_3\text{C} &- \text{C} = \text{CH}_2 & \text{E} \\
\text{H}_3\text{C} &- \text{C} = \text{CH}_2 & \text{N} \\
\text{H}_3\text{C} &- \text{C} = \text{CH}_2 & \text{N} \\
\text{H}_3\text{C} &- \text{C} = \text{CH}_2 & \text{N} \\
\end{align*}
\]

22. (4.5) Which of the following is the major organic product of the reaction shown?

\[
\begin{align*}
\text{D} &- \text{H} & \text{CH}_3 & \text{1. BH}_3 \\
\text{D} &- \text{H} & \text{CH}_3 & \text{2. H}_2\text{O}_2, \text{HO}^- \\
\end{align*}
\]