Midterm 2 Review Packet Key

1) Rank the following molecules in order of increasing boiling point: \_b_<_a_<_c_
   (a) pentane \([\text{CH}_3(\text{CH}_2)_2\text{CH}_3]\)
   (b) neopentane \([((\text{CH}_3)_4\text{C})\]
   (c) Hexane \([\text{CH}_3(\text{CH}_2)_4\text{CH}_3]\)

   Boiling point increases when these increase:
   Strength of IMs, \# of IMs, Surface Area, Polarity

2) Rank the following molecules in order of increasing solubility in pentane \([\text{CH}_3(\text{CH}_2)_3\text{CH}_3]\):
   \_c_<_a_<_b_
   (a) butanol \((\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH})\)
   (b) butanal \((\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CHO})\)
   (c) potassium bromide

   Most ionic compounds are water soluble
   Organic compounds w/ less than or equal to 5 C’s
   with Oxygen/Nitrogen for hydrogen bonding.

3) The repeating structures of two important types of synthetic polymers are given below.
   In the box provided, name the most important molecular force for each polymer.

   \[
   \begin{align*}
   \text{Polyethylene} & \quad \text{Intermolecular Forces} \\
   \text{Nylon 6,6} & \quad \text{Van Der Waal’s} \\
   & \quad \text{H-Bonding}
   \end{align*}
   \]

4) Explain why benzene has a lower boiling point but a much higher melting point than toluene.

   \[
   \begin{align*}
   \text{benzene} & \quad \text{bp} = 80^\circ C \\
   & \quad \text{mp} = 5^\circ C \\
   \text{toluene} & \quad \text{bp} = 111^\circ C \\
   & \quad \text{mp} = -93^\circ C
   \end{align*}
   \]

   Benzene is more symmetric than toluene. Therefore, it has a higher melting point.
5) Calculate the degrees of unsaturation for the following molecules:
(a) C\textsubscript{8}H\textsubscript{9}Br  
(b) C\textsubscript{8}H\textsubscript{9}ClO  
(c) C\textsubscript{10}H\textsubscript{18}ClNO

(d)  

(e)  

Note: Triple bonds consist of 1 sigma bond and 2 pi bonds. Therefore, a triple bond constitutes as 2 D.O.U

6) Which of these molecules correspond to the IR spectrum below?

![IR Spectrum](image)
7) Match each compound to its IR spectrum.

(A) OH at ~3500-2500
C=O at ~1700

(B) C=C peak ~1650
C<sup>sp</sup><sup>2</sup> peak ~3150

(C) C<sub>sp</sub><sup>3</sup> peak ~3150
Phenyl ring ~1600-1500

(D) No other peaks beside C<sub>sp</sub><sup>3</sup>

(E) C=O at ~1700

(F) OH ~3600-3200
C<sub>sp</sub><sup>3</sup> ~3000-2850
8) Identify the IUPAC name for the following compounds.

a. 4-tertbutyl-6-ethyl-2,7,7-trimethylnonane

b. 6-ethyl-4-isopropyl-3,5,5-trimethylnonane

c. 2-bromo-1-cyclobutyl-3,3,4-methylpentane
9) Draw the skeletal structure of the following IUPAC names. Be sure to add wedges/dashes if necessary.

a. 5-isopropyl-2,2-dimethylnonane

b. cis-1-iodo-3-propylcyclopentane

c. trans-1-bromo-3-ethylcyclohexane

d. 1-sec-butyl-2-methylcyclopentane

e. 2-flouro-3-ethylheptane

f. 1-bromo-3-isopropyl-1-methylcyclohexane
10) The molecule below is alprazolam, commonly known as Xanax, is a drug used to treat anxiety disorders, panic disorders, and anxiety caused by depression. Use this structure to classify each carbon as 1°, 2°, 3°, or 4° where indicated.

11) a. Draw the skeletal structure of 1-bromopropane
b. Using your skeletal structure of 1-bromopropane, draw the following Newman conformations looking down the C1-C2 bond.

- Anti-conformation
- Gauched-conformation
- Eclipsed-conformation

12) Convert the following Newman projections into skeletal structure, then determine the IUPAC name for each.

a. 

2-bromopentane

b. 

2-chloro-3-methylhexane
13) Use the following structures to draw a Newman projection looking down on the indicated bond.

a.

b.

c.
14) For the following examples:

i. Draw both chair conformations.

ii. Circle the arrows for the favored chair at equilibrium.

a. 1-bromocylohexane

b. trans-1-chloro-2methylcyclohexane

c. cis-1-ethyl-3-methylcyclohexane

d. cis-1-tert-butyl-3-chlorocyclohexane

e. trans-1-bromo-3-tert-butylecyclohexane

Note: Answers may vary. Please email us or come to office hours if you have any questions or concerns.
15) Name the following chairs, be sure to include whether the chair is in *trans* or *cis* position if needed.

a. 

b. 

\[
\text{trans-1-isopropyl-2-methylcyclohexane}
\]

\[
\text{cis-1-bromo-4-ethylcyclohexane}
\]

c. 

d. 

\[
\text{1-sec-butylcyclohexane}
\]

\[
\text{trans-1-ethyl-3-methylcyclohexane}
\]

e. 

f. 

\[
\text{cis-1-tert-butyl-2-methylcyclohexane}
\]

\[
\text{cis-1-chloro-2-methylcyclohexane}
\]
16) A) Order the following molecules from least oxidized to most oxidized:

![Molecules]

\[ \text{D < A < C < B} \]

Oxidation results in an increase in the # of C-Z bonds OR a decrease in the # of C-H bonds.

B) Circle the stereogenic centers in the following compound:

![Compound]

A stereogenic center is a carbon atom bonded to 4 different groups.
OMIT: All C's w/ 2+ H's, all sp and sp\(^2\) hybridized atoms, and all heteroatoms.

C) Draw the enantiomer of the following molecule. Then, indicate the configuration of the stereogenic center and provide the IUPAC name for both.

![Molecules]

- At the stereogenic center, draw 2 bonds in the plane of the page, one in front (wedge), and one behind (dash). Then draw the mirror image for the enantiomer.
- If 2 atoms are the same when assigning priority, look at what they are bonded to and assign priority based on the atomic # of these atoms.
D) Draw all possible stereoisomers for the following compound. Label the configuration of each stereogenic center, and indicate the interrelationships of these isomers.

Max # of stereoisomers = \(2^n\)

Enantiomers have the exact opposite R,S designations. Diastereomers w/ 2 stereogenic centers have one center the same and one different.

E) Indicate the relationship between the two molecules as enantiomers (E), diastereomers (D), the same molecule (S), or constitutional isomers (C):

Constitutional isomers = differ in the way atoms are connected
Stereoisomers = differ in the way atoms are oriented in space (3-D)
- Enantiomers = stereoisomers that are nonsuperimposable mirror images
- Diastereomers = stereoisomers that are not mirror images