Chem 1062 Exam 1
Spring 2005
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Thursday, February 3, 2005

Instructions:

Time: You have 90 minutes to complete this exam.

Equations and constants:

\[ Q = sm\Delta T \quad \Delta H_{fus, H_2O} = 6.01 \text{ kJ/mol} \]
\[ Q = n\Delta H_{fus or vap} \quad \Delta H_{vap, H_2O} = 40.7 \text{ kJ/mol} \]
\[ \ln P = -\frac{\Delta H_{vap}}{RT} + B \quad s_{H_2O} = 4.184 \text{ J/(g \cdot °C)} \]
\[ \ln \frac{P_2}{P_1} = \frac{\Delta H_{vap}}{R} \left( \frac{1}{T_1} - \frac{1}{T_2} \right) \quad R = 0.08206 \text{ L \cdot atm/(K \cdot mol)} \]
\[ R = 8.315 \text{ J/(K \cdot mol)} \]

Contents:

I. Multiple choice, 14 questions, 3 points each. \hspace{1cm} 42 points
II. Short answer, 19 questions, worth 50 points. \hspace{1cm} 40 points
III. Problems. 2 questions, worth 10 points each. \hspace{1cm} 18 points
Total: \hspace{1cm} 100 points

I, _______________ have read and understand the directions given above, and pledge that I will follow all regulations with regard to Academic Dishonesty as outlined by this college when taking this exam.

Signature _________________________________ Date and Time ____________________
I. Multiple choice

Choose the best answer from the choices given, and clearly circle the letter of your choice. (3 pts each)

1. An alkane named 2,2,4-trimethylpentane has eight carbon atoms. Its molecular formula is
   a. $\text{C}_8\text{H}_8$.
   b. $\text{C}_8\text{H}_{14}$.
   c. $\text{C}_8\text{H}_{16}$.
   d. $\text{C}_8\text{H}_{18}$.
   e. $\text{C}_8\text{H}_{24}$.

2. What is the IUPAC name for isoamyl alcohol, $(\text{CH}_3)_2\text{CHCH}_2\text{CH}_2\text{OH}$?
   a. isoamyl alcohol
   b. isopentyl alcohol
   c. 3-methyl-1-butanol
   d. 3,3-dimethyl-1-propanol
   e. 2-isopropyl-1-ethanol

3. Which of the following structures is incorrect?
   a. \[
   \begin{array}{c}
   \text{O} \\
   \text{H} \quad \text{C} \quad \text{O} \quad \text{H} \\
   \text{H} \quad \text{H} \quad \text{H} \\
   \text{H} \quad \text{H}
   \end{array}
   \]
   b. \[
   \begin{array}{c}
   \text{H} \quad \text{C} \quad \text{O} \quad \text{C} \quad \text{H} \\
   \text{H} \quad \text{H} \quad \text{H} \\
   \text{H} \quad \text{Cl}
   \end{array}
   \]
   c. \[
   \begin{array}{c}
   \text{H} \quad \text{H} \\
   \text{H} \quad \text{H} \\
   \text{H} \quad \text{H} \quad \text{O}
   \end{array}
   \]
   d. \[
   \begin{array}{c}
   \text{N} \quad \text{C} \quad \text{C} \quad \text{O} \quad \text{H} \\
   \text{H} \quad \text{H} \\
   \text{H} \quad \text{H}
   \end{array}
   \]
   e. \[
   \begin{array}{c}
   \text{H} \quad \text{C} \quad \text{C} \quad \text{Br} \\
   \text{H} \quad \text{Br}
   \end{array}
   \]
4. Which of the following compounds is a ketone?
   a. CH₃COCH₃
   b. CH₃OOCH₃
   c. CH₃OCH₃
   d. CH₃CH₂OH
   e. CH₃CHO

5. Which of the following alcohols is a tertiary (3°) alcohol?
   a. 
   b. 
   c. 
   d. 
   e. 

6. A molecule with the structural formula

contains the functional groups
   a. aldehyde, amide, and alcohol.
   b. ketone, amine, and alcohol.
   c. carboxylic acid, amide, and ketone.
   d. aldehyde, amide, and ketone.
   e. ketone, amide, and alcohol.

7. Which of the following compounds is expected to have the **highest** boiling point?
   a. CH₃OCH₃
   b. CH₃CH₂OH
   c. CH₃CH₂CH₂CH₃
   d. CH₃CH₂CH₃
   e. CH₃Cl
8. Which compound should have the \textit{lowest} heat of vaporization ($\Delta H_{\text{vap}}$)?
   a. C$_5$H$_{12}$
   b. C$_6$H$_{14}$
   c. C$_7$H$_{16}$
   d. C$_8$H$_{18}$
   e. C$_8$H$_{16}$

9. Which of the following phase changes is/are exothermic?
   \begin{itemize}
     \item I. vaporization
     \item II. sublimation
     \item III. condensation
   \end{itemize}
   a. I only
   b. II only
   c. III only
   d. I and II only
   e. II and III only

10. Which interaction best describes the primary intermolecular forces in dry ice, CO$_2$ (s)?
   \begin{itemize}
     \item a. London dispersion forces
     \item b. covalent bonding to form a network solid
     \item c. ionic bonding
     \item d. metallic bonding
     \item e. dipole-dipole interactions
   \end{itemize}

11. The critical point of carbon tetrachloride is 283 °C and 45 atm pressure. Liquid carbon tetrachloride has a vapor pressure of 10.0 atm at 178 °C. Which of the following statements must be true?
   \begin{itemize}
     \item a. The normal boiling point of CCl$_4$ must be greater than 178 °C.
     \item b. Liquid CCl$_4$ can exist at temperatures greater than 283 °C if the pressure is greater than 45 atm.
     \item c. The triple point must be less than 178 °C.
     \item d. Liquid and solid can only be in equilibrium at one temperature—the freezing point.
     \item e. Vapor and liquid can only be in equilibrium at one temperature—the normal boiling point.
   \end{itemize}
12. From a consideration of the phase diagram below, a change from point M to point N corresponds to

- sublimation.
- condensation.
- evaporation.
- freezing.
- melting.

13. How many atoms are there in a face-centered cubic unit cell of lead?

- 1
- 2
- 4
- 6
- 8

14. Assume that a particular solid metal crystallizes with some type of cubic unit cell. The edge of the cubic unit cell is $4.5 \times 10^{-8}$ cm. Which of the following cubic unit cells would give a material with the highest density?

- a simple cubic unit cell
- a body-centered cubic unit cell
- a face-centered cubic unit cell
- The density would be identical for all these cells if the edge of each cell were $4.5 \times 10^{-8}$ cm.
- We are not given enough information to determine.
II. Short answer

Provide IUPAC names for the following organic molecules. (3 pts each)

15. \[ \begin{array}{c}
\text{Br} \\
\text{Br}
\end{array} \]  
name: ________________________________

16. \[ \begin{array}{c}
\text{O} \\
\text{H}
\end{array} \]  
name: ________________________________

17. \[ \begin{array}{c}
\text{H} \\
\text{O}
\end{array} \]  
name: ________________________________

18. \[ \begin{array}{c}
\text{O} \\
\text{H} \\
\text{O} \\
\text{CH}_3
\end{array} \]  
name: ________________________________

Provide common names for the following organic molecules. (3 pts each)

19. \[ \begin{array}{c}
\text{O} \\
\text{H} \\
\text{O} \\
\text{CH}_3
\end{array} \]  
name: ________________________________

20. \[ \begin{array}{c}
\text{O} \\
\text{O}
\end{array} \]  
name: ________________________________

Draw line-angle formulas for the following organic molecules. (4 pts each)

21. 4,5-diethyl-2-heptyne

22. \textit{p}-dimethylbenzene

23. ethyl propanoate
Below is a not-to-scale phase diagram of benzene:

Using the thermochemistry data in the box, write the correct letters from the drawing above in the blanks next to corresponding label they represent. One letter will not be used. (1 pt each)

24. _____ 5.35 °C  
   25. _____ 1 atm  
   26. _____ liquid  
   27. _____ triple point  
   28. _____ gas  
   29. _____ 48.2 atm  
   30. _____ 80.2 °C  
   31. _____ critical point  
   32. _____ solid  
   33. _____ 288.9 °C

**Benzene:**  
Normal boiling point: 80.2 °C  
Normal melting point: 5.49 °C  
Critical point: 288.9 °C at 48.2 atm  
Triple point: 5.35 °C
III. Problems

Show all your work and draw a box around your final answer.

35. The average atmospheric pressure at the peak of Mount Everest is 253 mm Hg. At what temperature (in °C) will water boil at this location? (8 pts)

36. Solid aluminum metal has a cubic unit cell structure. If the edge length of a unit cell is $4.05 \times 10^{-10}$ m, and the density of aluminum is 2.702 g/cm$^3$, how many atoms are contained within one unit cell? Which type of cubic unit cell does aluminum have? (simple cubic, body-centered cubic, or face-centered cubic) (8 pts)