

Please print:

Last name: Answer Key

First name: _____

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:

$$\begin{aligned} Q &= sm\Delta T & \Delta H_{\text{fus, H}_2\text{O}} &= 6.01 \text{ kJ/mol} \\ Q &= n\Delta H_{\text{fus or vap}} & \Delta H_{\text{vap, H}_2\text{O}} &= 40.7 \text{ kJ/mol} \\ \ln P &= \frac{-\Delta H_{\text{vap}}}{RT} + B & s_{\text{H}_2\text{O}} &= 4.184 \text{ J/(g} \cdot ^\circ\text{C)} \\ & & R &= 0.08206 \text{ L} \cdot \text{atm}/(\text{K} \cdot \text{mol)} \\ \ln \frac{P_2}{P_1} &= \frac{\Delta H_{\text{vap}}}{R} \left(\frac{1}{T_1} - \frac{1}{T_2} \right) & R &= 8.315 \text{ J}/(\text{K} \cdot \text{mol)} \end{aligned}$$

Contents:

I. Multiple choice , 14 questions, 3 points each.	42 points
II. Short answer , 19 questions, worth 50 points.	40 points
III. Problems . 2 questions, worth 10 points each.	<u>18 points</u>
Total: 100 points	

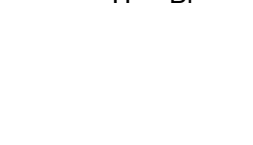
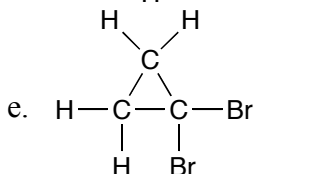
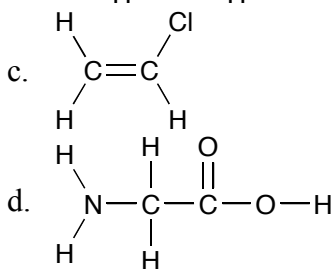
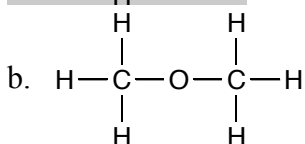
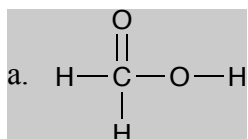
I, _____ have read and understand the directions given above, and pledge that I will follow all regulations with regard to Academic Dishonesty as outlined by this college when taking this exam.

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)

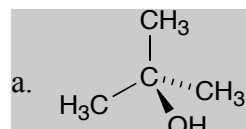
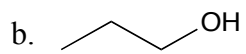
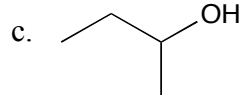
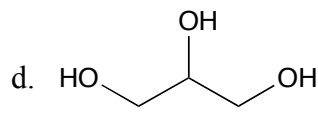
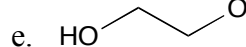
1. An alkane named 2,2,4-trimethylpentane has eight carbon atoms. Its molecular formula is
 - a. C_8H_8 .
 - b. C_8H_{14} .
 - c. C_8H_{16} .
 - d. C_8H_{18} .
 - e. C_8H_{24} .
2. What is the IUPAC name for isoamyl alcohol, $(CH_3)_2CHCH_2CH_2OH$?
 - a. isoamyl alcohol
 - b. isopentyl alcohol
 - c. 3-methyl-1-butanol
 - d. 3,3-dimethyl-1-propanol
 - e. 2-isopropyl-1-ethanol
3. Which of the following structures is incorrect?



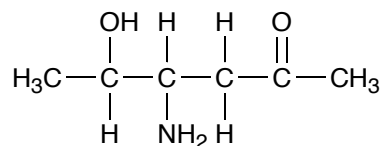
4. Which of the following compounds is a ketone?

- a. CH_3COCH_3
- b. CH_3OOCH_3
- c. CH_3OCH_3
- d. $\text{CH}_3\text{CH}_2\text{OH}$
- e. CH_3CHO

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

- a. 
- b. 
- c. 
- d. 
- e. 

6. A molecule with the structural formula

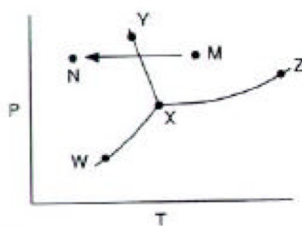


contains the functional groups

- 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. CH_3OCH_3
 - b. **$\text{CH}_3\text{CH}_2\text{OH}$**
 - c. $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_3$
 - d. $\text{CH}_3\text{CH}_2\text{CH}_3$
 - e. CH_3Cl

8. Which compound should have the **lowest** heat of vaporization (ΔH_{vap})?
- a. C_5H_{12}
 - b. C_6H_{14}
 - c. C_7H_{16}
 - d. C_8H_{18}
 - e. C_8H_{16}
9. Which of the following phase changes is/are exothermic?
- I. vaporization
 - II. sublimation
 - III. condensation
- 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)?
- a. London dispersion forces
 - b. covalent bonding to form a network solid
 - c. ionic bonding
 - d. metallic bonding
 - e. dipole-dipole interactions
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?
- a. The normal boiling point of CCl_4 must be greater than 178°C .
 - b. Liquid CCl_4 can exist at temperatures greater than 283°C if the pressure is greater than 45 atm.
 - c. The triple point must be less than 178°C .
 - d. Liquid and solid can only be in equilibrium at one temperature—the freezing point.
 - e. Vapor and liquid can only be in equilibrium at one temperature—the normal boiling point.

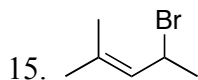
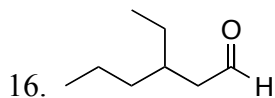
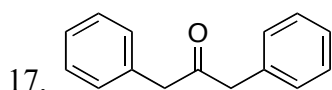
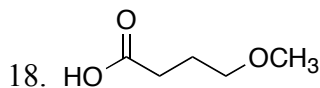
12. From a consideration of the phase diagram below, a change from point **M** to point **N** corresponds to



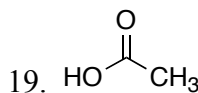
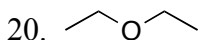
- a. sublimation.
 - b. condensation.
 - c. evaporation.
 - d. freezing.
 - e. melting.
13. How many atoms are there in a face-centered cubic unit cell of lead?
- a. 1
 - b. 2
 - c. 4
 - d. 6
 - e. 8
14. Assume that a particular solid metal crystallizes with some type of cubic unit cell. The edge of the cubic unit cell is 4.5×10^{-8} cm. Which of the following cubic unit cells would give a material with the **highest** density?
- a. a simple cubic unit cell
 - b. a body-centered cubic unit cell
 - c. a face-centered cubic unit cell
 - d. The density would be identical for all these cells if the edge of each cell were 4.5×10^{-8} cm.
 - e. We are not given enough information to determine.

II. Short answer

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

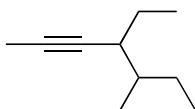
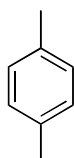
name: 4-bromo-2-methyl-2-pentenename: 3-ethyl-1-hexanal or 3-ethylhexanalname: 1,3-diphenyl-2-propanone or 1,3-diphenylpropanonename: 4-methoxybutanoic acid

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

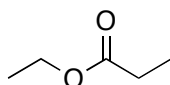
name: acetic acidname: diethyl ether (or ether)

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

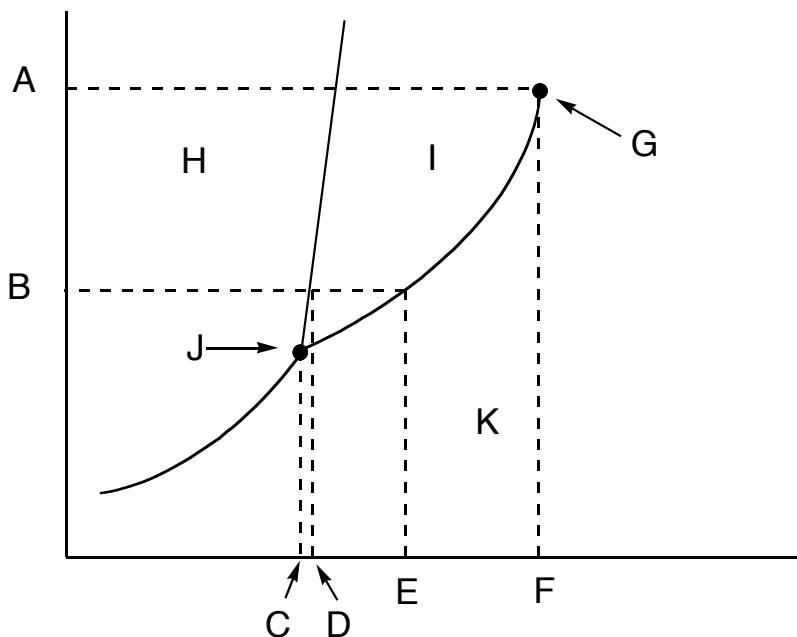
21. 4,5-diethyl-2-heptyne

22. *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. C 5.35 °C

25. B 1 atm

26. I liquid

27. J triple point

28. K gas

29. A 48.2 atm

30. E 80.2 °C

31. G critical point

32. H solid

33. F 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)

$$\ln\left(\frac{P_2}{P_1}\right) = \frac{\Delta H_{\text{vap}}}{R} \left(\frac{1}{T_1} - \frac{1}{T_2} \right)$$

$$P_1 = 760 \text{ mm Hg} \quad P_2 = 253 \text{ mm Hg}$$

$$T_1 = 100 \text{ °C} = 373.15 \text{ K} \quad T_2 = ?$$

$$\Delta H_{\text{vap}} = 40.7 \text{ kJ/mol} = 4.07 \times 10^4 \text{ J/mol}$$

$$R = 8.315 \text{ J/K} \cdot \text{mol}$$

$$\ln\left(\frac{P_2}{P_1}\right) \left(\frac{R}{\Delta H_{\text{vap}}} \right) - \frac{1}{T_1} = -\frac{1}{T_2}$$

$$\ln\left(\frac{253 \text{ mm Hg}}{760 \text{ mm Hg}}\right) \left(\frac{8.315 \text{ J/K} \cdot \text{mol}}{4.07 \times 10^4 \text{ J/mol}} \right) - \frac{1}{373.15 \text{ K}} = -\frac{1}{T_2}$$

$$-2.9046 \times 10^{-3} \text{ K}^{-1} = -\frac{1}{T_2}$$

$$T_2 = 344.28117 \text{ K} - 273.15 = 71.1 \text{ °C}$$

36. Solid aluminum metal has a cubic unit cell structure. If the edge length of a unit cell is $4.05 \times 10^{-10} \text{ m}$, 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)

$$l = 4.05 \times 10^{-10} \text{ m} = 4.05 \times 10^{-8} \text{ cm}$$

$$d = 2.702 \text{ g/cm}^3$$

$$\text{aw}_{\text{Al}} = 26.98 \text{ g/mol}$$

$$\frac{26.98 \text{ g}}{\text{mol}} \times \frac{\text{mol}}{6.022 \times 10^{23} \text{ atoms}} = 4.4802 \times 10^{-23} \text{ g/atom}$$

$$(4.05 \times 10^{-8} \text{ cm})^3 = 6.643 \times 10^{-23} \text{ cm}^3 \times \frac{2.702 \text{ g}}{\text{cm}^3} = 1.7949 \times 10^{-22} \text{ g/unit cell}$$

$$\frac{1.7949 \times 10^{-22} \text{ g/unit cell}}{4.4802 \times 10^{-23} \text{ g/atom}} = 4.006 \approx 4 \text{ atoms/unit cell}$$

A face - centered cubic unit cell has 4 atoms/unit cell

-END OF EXAM-