

**Mock Test Questions for Test #2, CHEM 113 – Spring 2005**

These are sample questions that come from recent Tests covering the material in chapters 10, 11, and 12. They are representative in difficulty . . . but there are too many for an actual test. Set aside about 2 hours to complete this! Dr. Bryan

For question 1 through 4, use the following data:

**Data for Benzene( $C_6H_6$ )**

Molar Mass = 78.0 g/mol

Normal Melting Point = 6.0 °C

Normal Boiling Point = 80.0 °C

Vapor Pressure (at 25 °C) = 103.5 torr

 $K_f = 5.12$  °C/m

Heat of Fusion = 9.87 kJ/mol

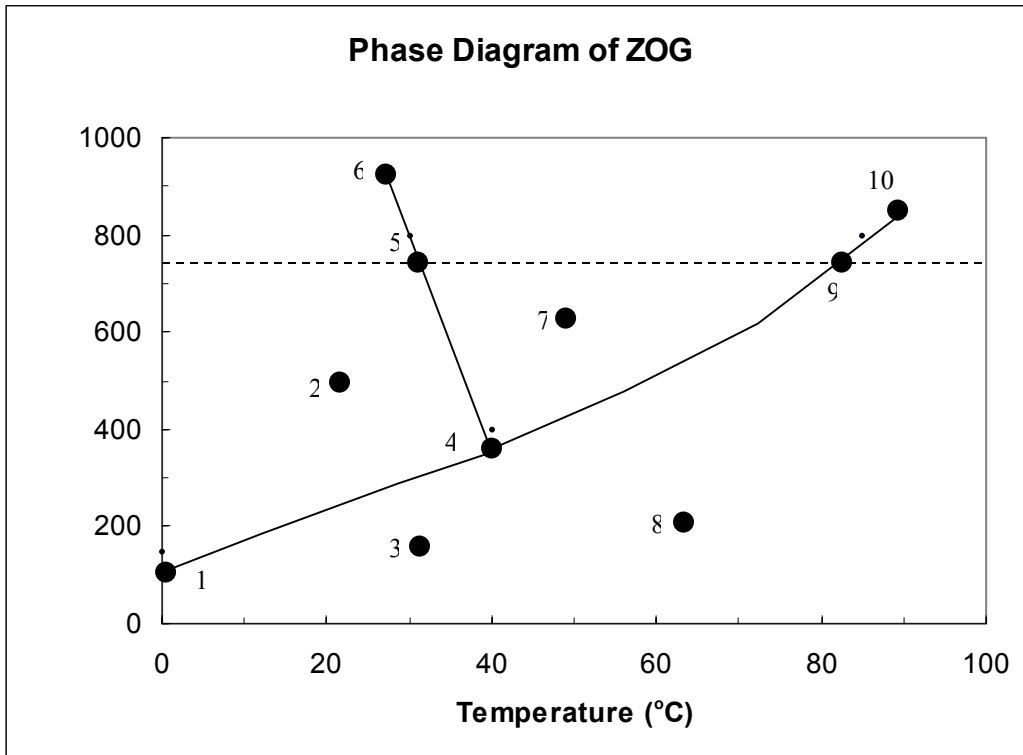
Heat of Vaporization = 30.8 kJ/mol

Specific Heat Capacity for the Liquid = 1.74 J/g °C

 $K_b = 2.53$  °C/m

- How much energy is required to melt 25.0 grams of benzene at 6.0 °C?
  - 261 J
  - 247 kJ
  - 9870 J
  - 527 J
  - 3160 J
- How much energy is required for 1.50 moles of benzene to go through the following process?  
benzene (liquid, 6.0 °C) → benzene (gas, 80.0. °C)
  - 14.8 kJ
  - 15.1 kJ
  - 46.2 kJ
  - 61.3 kJ
  - 76.1 kJ
- 4.00 moles of a nonpolar nonvolatile compound is mixed with 7.00 moles of benzene at 25°C, what will the vapor pressure of the solution be?
  - 65.9 torr
  - 41.4 torr
  - 59.1 torr
  - 37.6 torr
  - 15.1 torr
- What is the freezing point of the solution in **question 3**?
  - 37.5 °C
  - 31.5 °C
  - 20.5 °C
  - 14.5 °C
  - +4.1 °C

Use the following phase diagram for question 5 through 9:



5. What is the normal melting point of this substance?  
A. 1      B. 4      C. 5      D. 9      E. 10
6. What is the approximate vapor pressure of this substance at 50° C?  
A. 200mmHg   B. 300 mmHg   C. 400 mmHg   D. 500 mmHg   E. 600 mmHg
7. What process occurs when you move from **Point 2** to **Point 3** ?  
A. melting  
B. sublimation  
C. evaporation  
D. condensation  
E. fusion
8. Which of the points on the graph represents a “triple point” for the substance?  
A. 1      B. 4      C. 5      D. 9      E. 10
9. What effect does increasing pressure have on the boiling point?  
A. It has no effect.  
B. It raises the boiling point.  
C. It lowers the boiling point.

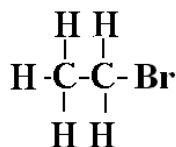
10. Given that the boiling point of argon is about  $-189\text{ }^{\circ}\text{C}$ ,
- A. argon must have fairly large intermolecular forces.
  - B. argon must be a polar substance.
  - C. it is reasonable for xenon to have a boiling point of  $-112\text{ }^{\circ}\text{C}$ .
  - D. it is reasonable for helium to have a boiling point of  $-165\text{ }^{\circ}\text{C}$ .
  - E. A, C, and D are true.
11. Which of the following molecules interact primarily through dispersion forces?
- A.  $\text{SO}_2$
  - B.  $\text{CCl}_4$
  - C.  $\text{CH}_2\text{Cl}_2$
  - D.  $\text{H}_2\text{S}$
  - E. all are nonpolar
12. Which of the following liquids should have the lowest vapor pressure at room temperature?
- A.  $\text{CH}_3\text{OH}$
  - B.  $\text{CH}_3\text{CH}_2\text{OH}$
  - C.  $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$
  - D.  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$
  - E.  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_3$
13. At  $60\text{ }^{\circ}\text{C}$ , pure hexane ( $\text{C}_6\text{H}_{14}$ ) and pure benzene ( $\text{C}_6\text{H}_6$ ) have the vapor pressures,  $573\text{ mmHg}$  and  $391\text{ mmHg}$ , respectively. What is the vapor pressure of a solution prepared by mixing  $6.85$  moles of hexane with  $5.64$  moles of benzene?
- A.  $473\text{ mmHg}$
  - B.  $314\text{ mmHg}$
  - C.  $259\text{ mmHg}$
  - D.  $214\text{ mmHg}$
  - E.  $491\text{ mmHg}$
14. Three acid solutions are prepared:  $1.0\text{ M HCl (aq)}$ ,  $1.0\text{ M HNO}_3\text{ (aq)}$ , and  $1.0\text{ M HC}_2\text{H}_3\text{O}_2\text{ (aq)}$ . The osmotic pressures were measured at room temperature. Which of the following should be observed.
- A. All three have the same osmotic pressure.
  - B. The osmotic pressure of the  $\text{HCl}$  solution is significantly higher than the other two.
  - C. The osmotic pressure of the  $\text{HNO}_3$  solution is significantly lower than the other two.
  - D. The osmotic pressure of the  $\text{HC}_2\text{H}_3\text{O}_2$  solution is significantly lower than the other two.
  - E. All three have osmotic pressures that are lower than a  $1.0\text{ M NaCl(aq)}$  solution.
15. An equal number of moles of each of the following “salts” are dissolved in separate beakers, each containing the same mass of water. Which solution will have the greatest boiling point?
- A.  $\text{KCl}$
  - B.  $\text{K}_2\text{SO}_4$
  - C.  $\text{MgCl}_2$
  - D.  $\text{Na}_3\text{PO}_4$
  - E. all are about the same

16. What concentration of glucose solution would have the same osmotic pressure as blood which has an osmotic pressure of 7.65 atm at 37 °C ? (The molar mass of glucose is 180 g/mol.)
- A. 0.30 M  
 B. 0.15 M  
 C. 2.5 M  
 D. 1.5 M  
 E. 0.25 M

17. Calculate the osmotic pressure of a solution that is prepared by dissolving 0.25 moles of  $\text{MgCl}_2$  in enough water to make 500. mL of solution at 25 °C .
- A. 3.08 atm  
 B. 12.2 atm  
 C. 18.4 atm  
 D. 1.03 atm  
 E. 36.7 atm

18. The compound shown below contains which of the following intermolecular forces:

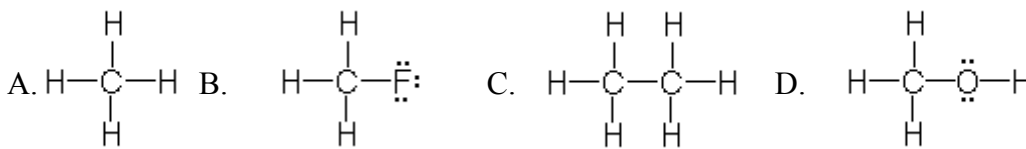
- A. dipole-dipole  
 B. hydrogen-bonding  
 C. dispersion forces  
 D. Both A and C  
 E. A, B, and C.



19. Which of the following would be most soluble in water?

- A.  $\text{CCl}_4$   
 B.  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_3$   
 C.  $\text{CO}_2$   
 D.  $\text{CH}_4$   
 E.  $\text{NH}_3$

20. Which of the following would have the lowest vapor pressure at room temperature?

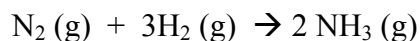


21. A sample of water undergoes the following change:  
 $\text{H}_2\text{O}(\text{gas}, 110\text{ }^\circ\text{C}) \rightarrow \text{H}_2\text{O}(\text{gas}, 100\text{ }^\circ\text{C})$   
Other than mass and temperature, what data are needed to calculate the energy change for this process?
- A.  $\Delta H_{\text{vap}}$  and heat capacity of  $\text{H}_2\text{O}(\text{g})$
  - B.  $\Delta H_{\text{fus}}$  and heat capacity of  $\text{H}_2\text{O}(\text{l})$
  - C.  $\Delta H_{\text{vap}}$  only
  - D. heat capacity of  $\text{H}_2\text{O}(\text{g})$  only
  - E.  $\Delta H_{\text{vap}}$ , heat capacities of  $\text{H}_2\text{O}(\text{g})$  and  $\text{H}_2\text{O}(\text{l})$
22. Colligative properties are similar in that they all
- A. are dependent on the chemical properties of the solvent.
  - B. are dependent on the number of solute particles in the solution.
  - C. are independent of the physical properties of the solvent.
  - D. are independent of solvent temperature.
  - E. none of the above.
23. The temperature at which the vapor pressure of a liquid equals the external pressure on the liquid is called the:
- A. boiling point
  - B. melting point
  - C. critical point
  - D. Clausius temperature
  - E. Van't Hoff temperature
24. Which of the following would have the lowest boiling point at 1.0 atm?
- A.  $\text{PbH}_4$
  - B.  $\text{SnH}_4$
  - C.  $\text{SiH}_4$
  - D.  $\text{GeH}_4$
  - E.  $\text{CH}_4$
25. Which of the following statements is true?
- A. All molecules contain dispersion forces except those exhibiting hydrogen bonding.
  - B. Dispersion forces are more significant in smaller molecules.
  - C. Large atoms are more easily polarized than small atoms.
  - D. A molecule that exhibits hydrogen bonding is not polar.
  - E. None of these are true.

26. Liquid A has a pure vapor pressure of 115 torr at room temperature. Liquid B has a pure vapor pressure of 250 torr at room temperature. Both liquids are nonpolar and volatile at room temperature.
- Which of the following must be true concerning the two liquids?
- A. Liquids A and B are immiscible.
  - B. Liquid B must have the higher boiling point.
  - C. Neither liquid shows evidence of dispersion forces.
  - D. Liquid A must have greater intermolecular forces.
  - E. The individual vapor pressures of the liquids are increased when the solution is formed.
27. A 2.00 g sample of unknown substance is dissolved in enough water to make 250.0 mL of solution. If the osmotic pressure of the solution is measured to be 3.53 atm at 25.0 °C, what is the most likely identity of the compound?
- A.  $C_6H_{12}O_6$     B. NaF    C.  $MgCl_2$     D. KF    E.  $CaCl_2$
28. Two chemical reactions are studied at different temperatures. If the Activation Energy of Reaction A is greater than the Activation Energy of Reaction B, then:
- A. Reaction A must be endothermic.
  - B. Reaction B must be exothermic.
  - C. Reaction A is less likely than Reaction B.
  - D. As temperature increases, the rate of reaction B will decrease.
  - E. All of these are true.
29. Which of the following best describes the role of a catalyst in a reaction?
- A. It decreases the temperature of the reaction.
  - B. It decreases the rate of the reaction.
  - C. It decreases the activation energy of the reaction.
  - D. It increases the collision frequency of the reaction.
  - E. It increases the reaction enthalpy.
30. During the course of a chemical reaction,
- A. the rate of reaction stays fairly constant.
  - B. the rate of reaction increases.
  - C. the rate of reaction decreases.
  - D. the rate of reaction is independent of time.
  - E. the rate of reaction is independent of concentration of reactants.

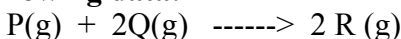
**For questions 31 and 32**

Given the reaction below:

with the following rate law :

$$\text{Rate of Loss of H}_2 = k [\text{N}_2][\text{H}_2], \text{ where } k = 3.02 \times 10^{-2} \text{ M}^{-1}\text{s}^{-1} \text{ at } 280 \text{ K.}$$

31. What will be the rate of formation of NH<sub>3</sub> when  $[\text{N}_2]_0 = 0.50 \text{ M}$  and  $[\text{H}_2]_0 = 0.25 \text{ M}$ ?
- A.  $3.8 \times 10^{-2} \text{ M/s}$   
 B.  $2.5 \times 10^{-3} \text{ M/s}$   
 C.  $7.6 \times 10^{-2} \text{ M/s}$   
 D.  $5.7 \times 10^{-3} \text{ M/s}$   
 E.  $1.3 \times 10^{-3} \text{ M/s}$
32. Rate measurements are made while  $[\text{N}_2]$  is held constant and  $[\text{H}_2]$  is tripled. What will be the effect on the rate of reaction when this change is made?
- A. rate will be unchanged.  
 B. rate will decrease.  
 C. rate will increase by a factor of two.  
 D. rate will increase by a factor of three.  
 E. rate will increase by a factor of six.

**For Questions 33 and 34 use the following data:**

| Experiment | $[\text{P}]_0$ | $[\text{Q}]_0$ | Rate of Loss of P                 |
|------------|----------------|----------------|-----------------------------------|
| #1         | 0.240 M        | 0.150 M        | $8.03 \times 10^{-3} \text{ M/s}$ |
| #2         | 0.480 M        | 0.150 M        | $8.05 \times 10^{-3} \text{ M/s}$ |
| #3         | 0.480 M        | 0.300 M        | $3.20 \times 10^{-2} \text{ M/s}$ |

33. What is the numerical value for the rate constant (k)?
- A. 1.49  
 B. 0.116  
 C. 0.223  
 D. 0.139  
 E. 0.357
34. What is the order of reaction for the reactant Q?
- A. 0            B. 1            C. 2            D. 3            E. 4

For Questions 35 and 36 use the following data:

The decomposition of  $\text{N}_2\text{O}_4$  is written as:  $\text{N}_2\text{O}_4(\text{g}) \rightarrow 2\text{NO}_2(\text{g})$ . Consider the rate of loss of  $\text{N}_2\text{O}_4$  to be first order in  $\text{N}_2\text{O}_4$  with a rate constant of  $4.67 \times 10^{-2} \text{ s}^{-1}$ .

35. Which of the following initial concentrations of  $\text{N}_2\text{O}_4$  will give the smallest rate of reaction?
- 0.100 M
  - 0.200 M
  - 0.400 M
  - 0.500 M
  - all will give the same rate
36. How long will it take 50.0% of the  $\text{N}_2\text{O}_4$  to decompose when  $[\text{N}_2\text{O}_4]_0 = 0.250 \text{ M}$ ?
- 3.71 s
  - 7.42 s
  - 12.5 s
  - 14.8 s
  - 194 s
37. For the reaction:  $\text{A}(\text{g}) + 3\text{B}(\text{g}) \rightarrow 4\text{C}(\text{g}) + 2\text{D}(\text{g})$ , the rate,  $\frac{\Delta[\text{C}]}{\Delta t}$ , is equal to
- $-\frac{1}{3} \frac{\Delta[\text{B}]}{\Delta t}$
  - $-4 \frac{\Delta[\text{A}]}{\Delta t}$
  - $\frac{1}{2} \frac{\Delta[\text{D}]}{\Delta t}$
  - $-\frac{3}{4} \frac{\Delta[\text{B}]}{\Delta t}$
  - $-2 \frac{\Delta[\text{D}]}{\Delta t}$
38. A chemical reaction decomposes by a second order process, i.e. Rate of loss of A =  $k[\text{A}]^2$ . If the initial concentration of A,  $[\text{A}]_0 = 0.500 \text{ M}$  and  $k = 0.385 \text{ M}^{-1} \text{ min}^{-1}$ , what concentration of A will remain after 15.0 minutes?
- $1.55 \times 10^{-3} \text{ M}$
  - 0.450 M
  - 0.385 M
  - 0.227 M
  - 0.129 M
39. Cobalt-64 decays by a first order process called beta emission. If cobalt-64 has a half-life of 7.8 minutes, how long will it take for 93.8% of the cobalt to undergo decay?
- 7.8 min
  - 15.6 min
  - 23.4 min
  - 31.2 min
  - 39.0 min