

Georgia Institute of Technology

CHEM 1310: Exam II

October 21, 2009

Select the **best** answer for each of the following problems. Each problem is worth 5 points with no partial credit.

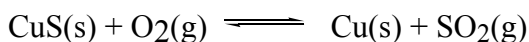
1. Place the following substances in order of *increasing* boiling point.



- A. $\text{Ar} < \text{CH}_3\text{OCH}_3 < \text{CH}_3\text{CH}_2\text{OH}$
- B. $\text{CH}_3\text{CH}_2\text{OH} < \text{Ar} < \text{CH}_3\text{OCH}_3$
- C. $\text{Ar} < \text{CH}_3\text{CH}_2\text{OH} < \text{CH}_3\text{OCH}_3$
- D. $\text{CH}_3\text{CH}_2\text{OH} < \text{CH}_3\text{OCH}_3 < \text{Ar}$
- E. $\text{CH}_3\text{OCH}_3 < \text{Ar} < \text{CH}_3\text{CH}_2\text{OH}$

Answer: A

2. Consider the following reaction at equilibrium. What effect will reducing the volume of the reaction mixture have on the system?



- A. No effect will be observed
- B. The reaction will shift to the left (reactant favored)
- C. The reaction will shift to the right (product favored)
- D. The equilibrium constant will increase
- E. The reaction quotient will decrease

Answer: A

3. What is the pH of pure water at 40°C if the K_w at this temperature is 2.92×10^{-14} ?

- A. 6.77
- B. 0.47
- C. 8.45
- D. 7.23

E. 7.00

Answer: A

4. Identify the aqueous solution with the highest boiling point. All the solutes are nonvolatile. Assume ideal behavior.

A. 0.100 m $C_6H_{12}O_6$ (glucose is a non-dissociating molecule)

B. 0.100 m NaCl

C. 0.100 m $AlCl_3$

D. 0.100 m $MgCl_2$

E. All of the solutions above (A-D) have the same boiling point.

Answer: C

5. Determine the vapor pressure of a solution at $55^\circ C$ that contains 105 g $C_6H_{12}O_6$ (Molecular Weight = 180 g/mol) that has been added to 375 mL of water. The vapor pressure of pure water at $55^\circ C$ is 118.1 torr.

A. 0 torr

B. 80 torr

C. 115 torr

D. 93 torr

E. 40 torr

Answer: C

6. What is the volume of 0.780 moles of Helium (g) at STP?

A. 43.7 L

B. 17.5 L

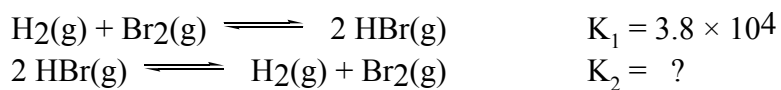
C. 70.0 L

D. 15.6 L

E. 22.4 L

Answer: B

7. The equilibrium constant is given for one of the reactions below. Determine the value of the other equilibrium constant.



- A. 6.4×10^{-4}
- B. 5.3×10^{-5}
- C. 1.6×10^3
- D. 1.9×10^4
- E. 2.6×10^{-5}

Answer: E

8. Determine the pH of a 0.15 M solution of benzoic acid ($K_a = 6.5 \times 10^{-5}$).

- A. 1.6
- B. 2.5
- C. 0.8
- D. 3.2
- E. 4.1

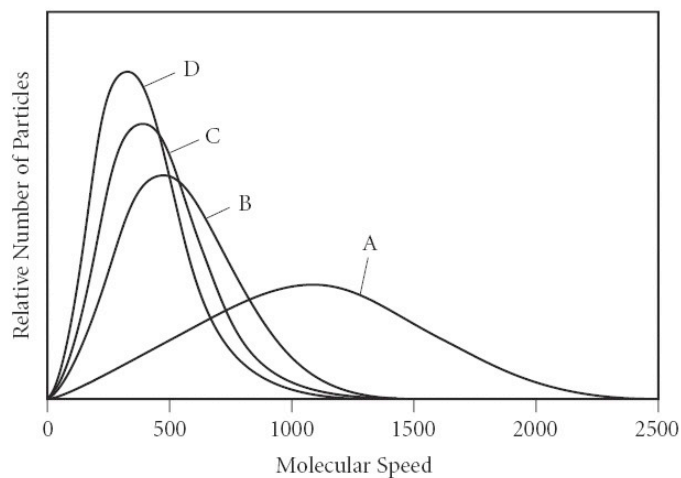
Answer: B

9. Determine the pH of a 50 mL 0.116 M NaOH solution after dilution by the addition of 100 mL of water.

- A. 13.1
- B. 13.4
- C. 12.6
- D. 11.4
- E. 12.9

Answer: C

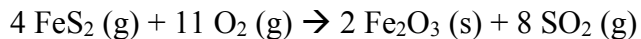
10. The graph shows four gases (A-D), all at the same temperature and pressure. Which gas has the lowest density?



- A. A
 B. B
 C. C
 D. D
 E. All of the gases have the same density.

Answer: A

11. Determine the volume of SO_2 (at STP= 273K 1 atm) formed from the complete reaction of 96.7 grams of FeS_2 (molecular weight = 120 g/mol) and 55.0 L of O_2 (398 K, 1.20 atm).



- A. 27.6 L
 B. 36.1 L
 C. 18.1 L
 D. 32.9 L
 E. 45.3 L

Answer: D



$$\text{FeS}_2: (96.7 \text{ g})[4(120 \text{ g/mol})]^{-1} = 0.20 \text{ mol}$$

$$\text{O}_2: (55.0 \text{ L})(1.2 \text{ atm}) [11(0.082 \text{ L-atm/mole-K})(398 \text{ K})]^{-1} = 0.18 \text{ mol}$$

O_2 is the limiting reagent.

$$\text{Use } V = nRT/P = 8(0.18\text{mol})(0.082 \text{ L-atm/mole-K})(273 \text{ K})(1.0 \text{ atm})^{-1} = 32.3 \text{ L}$$

12. Consider the following reaction and its equilibrium constant:



A mixture of the four gases has the following partial pressures:

$$P (\text{SO}_2) = 0.39 \text{ atm}$$

$$P (\text{NO}_2) = 0.14 \text{ atm}$$

$$P (\text{SO}_3) = 0.11 \text{ atm}$$

$$P (\text{NO}) = 0.14 \text{ atm}$$

Which of the following statements is TRUE concerning this system?

- A. The equilibrium constant will decrease.
- B. The reaction will proceed in the direction of the reactants.
- C. The reaction will proceed in the direction of the products.
- D. The reaction quotient will decrease.
- E. The system is at equilibrium.

Answer: C

13. What is the strongest type of intermolecular force present in CHF_3 (l)?

- A. Ion-dipole
- B. Hydrogen bonding
- C. Dipole-dipole
- D. Dispersion
- E. Ionic

This question will not be scored and will not be counted

14. A solution is prepared by dissolving 49.3 g of KBr in enough water to form 473 mL of solution. Calculate the mass percentage of KBr in the solution if the density is 1.12 g/mL.

- A. 10.1%
- B. 9.3%
- C. 11.7%

- D. 8.6%
- E. 10.4%

Answer: B

15. Which of the following acid-base reactions will have the largest equilibrium constant?

- A. $\text{NH}_3 + \text{HCN} \rightleftharpoons$
- B. $\text{NH}_3 + \text{H}_2\text{O} \rightleftharpoons$
- C. $\text{NH}_3 + \text{HClO}_2 \rightleftharpoons$
- D. $\text{NH}_3 + \text{HClO} \rightleftharpoons$
- E. $\text{NH}_3 + \text{CH}_3\text{COOH}$ (Acetic Acid) \rightleftharpoons

Answer: C

16. Which of the following has the greatest concentration of hydroxide ions?

- A. Apple Juice (pH = 3.1)
- B. Orange Juice (pH = 2.5)
- C. Coca-Cola (pH = 3.8)
- D. Lemon Juice (pH = 2.1)
- E. Milk (pH = 6.4)

Answer: E

17. What is the conjugate acid of HPO_4^{2-} ?

- A. H_2O
- B. PO_4^{3-}
- C. H_3O^+
- D. H_2PO_4^-
- E. OH^-

Answer: D

18. Place the following substances in order of decreasing vapor pressure at a given temperature.

PF_5 BrF_3 CF_4

- A. $\text{CF}_4 > \text{BrF}_3 > \text{PF}_5$
- B. $\text{PF}_5 > \text{BrF}_3 > \text{CF}_4$
- C. $\text{BrF}_3 > \text{CF}_4 > \text{PF}_5$

- D. $\text{CF}_4 > \text{PF}_5 > \text{BrF}_3$
- E. $\text{BrF}_3 > \text{PF}_5 > \text{CF}_4$

This question will not be scored and will not be counted

19. Which of the following will cause the volume of an ideal gas to triple?
- A. Lowering the absolute temperature by a factor of 3 while increasing the pressure by a factor of 3.
 - B. Raising the absolute temperature by a factor of 3 while increasing the pressure by a factor of 3.
 - C. Lowering the absolute temperature by a factor of 3 at constant pressure.
 - D. Raising the temperature from 25°C to 75°C at constant pressure.
 - E. Lowering the pressure by a factor of three while the temperature stays constant.

Answer: E

20. Which of the following statements is TRUE?
- A. The equilibrium constant for the forward reaction is equal to the equilibrium constant for the reverse reaction.
 - B. Equilibrium indicates that the amount of reactants and products are equal.
 - C. When the reaction quotient (Q) is larger than the equilibrium constant, the reaction will be proceed in the forward direction.
 - D. The forward and reverse reactions stop at equilibrium.
 - E. The reaction shows no macroscopic evidence of change at equilibrium.

Answer: E

21. Identify your version (look at the bottom of the page). (No points awarded, but required)
- A. Version A
 - B. Version B
 - C. Version C
 - D. Version D