

Chemistry 100: Exam #3
October 25, 2002

Name (printed) _____

100 points. Read Carefully! Draw a **BOX** around the final answer of any calculation.

Useful constants: $R = (0.0821 \text{ L}\cdot\text{atm})/(\text{K}\cdot\text{mol})$ 1 mole of any gas at STP = 22.41 L

Part I: Multiple Choice. (2 pts. each)

- The H_3O^+ ion is called the _____ ion.
a) hydroxide b) hydronium c) hydrogen d) protium e) water
- Which of the following compounds is a salt (product of a neutralization reaction)?
a) HBr b) KNO_3 c) H_2SO_4 d) NaOH e) $\text{C}_6\text{H}_{12}\text{O}_6$
- Considering 0.1 M solutions of each substance, which contains the largest concentration of ions?
a) CoCl_3 b) Na_2SO_4 c) KOH d) MgCl_2 e) PH_3
- What is the conjugate acid of HSO_4^- ?
a) SO_4^{2-} b) H_2SO_4 c) H_3O^+ d) OH^- e) H_2SO_3
- The half-life of sodium-24 is 15 hours. What percentage of a sample of sodium-24 remains after 75 hours?
a) 1.56 %
b) 3.13 %
c) 6.25 %
d) 12.5 %
e) 25.0 %
- What is the conjugate base of H_2PO_4^- ?
a) HPO_4^{2-} b) H_3PO_4 c) PO_4^{3-} d) OH^- e) H_2PO_3^-
- In a gas mixture of 65% He and 35% O_2 the total pressure is 800 mm Hg. What is the partial pressure of O_2 ?
a) 35 mm Hg b) 65 mm Hg c) 100 mm Hg d) 280 mm Hg e) 520 mm Hg
- What is the total pressure of a mixture of N_2 and H_2 if the partial pressures are 320 mm Hg and 800 mm Hg respectively?
a) 60 mm Hg b) 320 mm Hg c) 480 mm Hg d) 760 mm Hg e) 1120 mm Hg
- All of the statements about molarity are correct except:
a) The abbreviation is M.
b) The interpretation of the symbol is "moles of solute per mole of solvent."
c) moles = molarity x volume
d) volume = moles/molarity
e) The molarity of a diluted solution is less than the molarity of the original solution.

Consider the reaction: $\text{CH}_3\text{OH} + \text{HCl} \rightleftharpoons \text{CH}_3\text{OH}_2^+ + \text{Cl}^-$

A conjugate acid-base pair in the reaction shown is:

- HCl and CH_3OH_2^+
 - HCl and H_3O^+
 - CH_3OH and HCl
 - CH_3OH_2^+ and CH_3OH
 - CH_3OH_2^+ and Cl^-
10. Which substance is not an electrolyte?
a) NaCl b) HCl c) NH_4NO_3 d) KOH e) CH_4

11. Which product is formed by alpha emission from gold-185? The atomic number of gold is 79.
a) $^{189}_{81}\text{Tl}$ b) $^{181}_{77}\text{Ir}$ c) $^{183}_{77}\text{Ir}$ d) $^{185}_{79}\text{Au}$ e) $^{181}_{80}\text{Hg}$
12. How many grams are in 10.0 mEq of Mg^{2+} ?
a) 0.122 g
b) 24.3 g
c) 12.2 g
d) 0.486 g
e) 0.243 g
13. Which pair of molecules has the strongest dipole-dipole interactions?
a) NH_3 and CH_4 b) CO_2 and CH_4 c) NH_3 and NH_3 d) CH_4 and CH_4 e) CO_2 and CO_2
14. Which product is formed by beta emission from krypton 87? The atomic number of krypton is 36.
a) $^{83}_{34}\text{Se}$ b) $^{87}_{35}\text{Br}$ c) $^{87}_{36}\text{Kr}$ d) $^{87}_{37}\text{Rb}$ e) $^{91}_{38}\text{Sr}$
15. How many moles of HCl are present in 75.0 mL of a 0.200 M solution?
a) 15.0 mol
b) 2.67 mol
c) 0.375 mol
d) 0.275 mol
e) 0.0150 mol

Part II: True/False. (2 pts. each) Circle T or F.

16. T F one torr of pressure is equal to 760 mm Hg
17. T F NCl_3 would be expected to be a polar compound
18. T F HCO_3^- is the carbonate ion
19. T F a solution with $\text{pH} = 4$ would be acidic
20. T F buffers are formed from strong acids and their conjugate bases
21. T F as the pressure on a gas increases the volume will increase
22. T F an acid is any substance that can accept a proton
23. T F the total pressure exerted by a mixture of gases is equal to the sum of their partial pressures
24. T F $\text{Ca}(\text{OH})_2$ is considered a strong base.
25. T F benzene (C_6H_6) and water would be immiscible liquids
26. T F the solubility of gases in liquids normally increases with increasing temperature
27. T F the pH of a 0.00001 M NaOH solution would be 5
28. T F a buffer can neutralize small amounts of either strong bases or strong acids

Part III: Short Answers

29. (8) How many kilograms of He are contained in a 50-liter tank at 20°C and 50 atm of pressure?

30. (8) If a patient's blood chemistry shows a potassium ion concentration of 3.8 mEq/L, how many mg of potassium are contained in a 25.0 mL blood sample?
31. (8) Which is more concentrated: a 5% (w/v) solution of LiCl or a 0.5 M solution? Show your work.
32. (10) It required 44.39 mL of 0.3012 M KOH to titrate a 10.00-mL portion of phosphoric acid (H_3PO_4) to an endpoint. What was the molarity of the acid? (Don't forget to write the balanced reaction first.)
33. (8) The main component of fire ant venom is formic acid, $\text{HCO}_2\mathbf{H}$ ($K_a = 1.8 \times 10^{-4}$).
- Draw the chemical reaction for the dissociation reaction of formic acid in H_2O . The H in **bold** is the acidic H.
 - If a buffer solution contains 0.060 M sodium formate and 0.040 M formic acid, what is the pH of the solution?

Bonus: Invent a question that you wish I had asked, because you studied it. Answer your question for up to 5 bonus points, depending upon difficulty. Use the back of the page.