

V = 22.42 L at STP (ideal gas)  
the other R = 8.31 J/mol·K

Name: \_\_\_\_\_  
Chemistry 120, Section A

$$u_{rms} = \sqrt{\frac{3RT}{M}}$$

Hour Exam 2, October 15, 2004

General Instructions. Read each question carefully and answer the question in the expected format. Show your work on all calculation problems and include appropriate units of measurement. Express your *final* answer in the correct number of significant figures. Use proper English spelling, punctuation and grammar to answer the questions.

Part I. Definitions (1 points each)

1. solution-
  2. \_\_\_\_\_ is the term used to describe compounds breaking apart in solution.
  3. electrolyte-
  4. \_\_\_\_\_ is a compound with react completely with water to give OH<sup>-</sup>.
  5. absolute zero-
  6. \_\_\_\_\_ is 22.42 L at STP.
  7. diffusion-
- Differentiate between the following pairs of terms. (2 points each)
8. oxidation vs. reduction
  9. solute vs. solvent
  10. ideal gas vs. real gas

Part II. Concepts and applications thereof

11. Calculate the molarity of a solution made by dissolving 9.00 g sodium chloride in a total volume of 500.0 mL. (5 points)
12. How many grams *calcium* are in 112.0 mL of a 0.35 M solution of  $\text{CaCl}_2$ ? (5 points)
13. Predict whether the following compounds are soluble in water. (5 points)
- $\text{Co}(\text{OH})_2$
  - $\text{CaF}_2$
  - $\text{NaNO}_3$
  - $\text{BaSO}_4$
  - $\text{FeCrO}_4$
14. What initial concentration is required in order for 1.0 mL of solution diluted to 3.0 mL to have a final concentration of 0.45 M? (4 points)
15. Balance the following redox reaction which takes place in acidic solution. (5 points)
- $$\text{MnO}_4^- + \text{Sn}^{2+} \div \text{Sn}^{4+} + \text{Mn}^{2+}$$

Part III. Multiple choice (2 points each). Place the *capital* letter of the *best* choice in the blank to the left of the question.

- \_\_\_\_\_ 16. Which statement is *false*?
- A. The density of a gas is consistent as long as its temperature remains constant.
  - B. Gas expands without limit.
  - C. Gases diffuse into each other and mix almost immediately when put into the same container.
  - D. The molecular mass of a gaseous compound is an invariable quantity.
  - E. Pressure must be exerted on a sample of a gas in order to confine it.
- \_\_\_\_\_ 17. A 0.397 g sample of a gas occupies a volume of 275 mL at 10°C and 365 mm Hg. What is the molecular weight of the gas?
- A. 59.8 g/mol
  - B. 61.3 g/mol
  - C. 69.8 g/mol
  - D. 72.8 g/mol
  - E. 85.9 g/mol
- \_\_\_\_\_ 18. A sample of gas occupies 1600 milliliters at 20.0°C and 600 mm Hg. What volume will it occupy at the same temperature and 800 mm Hg?
- A.  $1.00 \times 10^3$  mL
  - B.  $1.20 \times 10^3$  mL
  - C.  $1.45 \times 10^3$  mL
  - D.  $2.02 \times 10^3$  mL
  - E.  $2.13 \times 10^3$  mL
- \_\_\_\_\_ 19. What is the oxidation number of bromine in  $\text{KBrO}_3$ ?
- A. -1
  - B. +0
  - C. +3
  - D. +5
  - E. +7
- \_\_\_\_\_ 20. Which of the following is the strongest acid?
- A.  $\text{HClO}_4$
  - B.  $\text{ClO}_4^-$
  - C.  $\text{NH}_3$
  - D.  $\text{NH}_2^-$
  - E.  $\text{CH}_4$

- \_\_\_\_\_ 21. How many liters of  $\text{Cl}_2$  gas can be prepared from 2.0 liters of HCl gas and 2.0 liters of  $\text{O}_2$  gas if all volumes are measured at the same temperature and pressure? The equation for the reaction between HCl and  $\text{O}_2$  is:  $4 \text{HCl} + \text{O}_2 \div 2 \text{H}_2\text{O} + 2 \text{Cl}_2$
- A. 1.0 L
  - B. 2.0 L
  - C. 3.0 L
  - D. 4.0 L
  - E. 6.0 L
- \_\_\_\_\_ 22. What volume of 12.6 M HCl must be added to enough water to prepare 5.00 liters of 3.00 M HCl?
- A. 0.840 L
  - B. 1.19 L
  - C. 2.14 L
  - D. 7.56 L
  - E. 21.0 L
- \_\_\_\_\_ 23. A sample of neon, occupies 1700 mL at STP. At constant pressure, what temperature is necessary to increase the volume to 2100 mL?
- A.  $-52^\circ\text{C}$
  - B.  $-14^\circ\text{C}$
  - C.  $32^\circ\text{C}$
  - D.  $52^\circ\text{C}$
  - E.  $64^\circ\text{C}$
- \_\_\_\_\_ 24. Which of the following statements does *not* describe ideal gases?
- A. The average kinetic energies of molecules of different kinds of gases are the same at a given temperature.
  - B. Under ordinary conditions of temperature and pressure, gas molecules are widely separated.
  - C. Gas molecules move in a rapid, random, straight-line paths until collision occurs with other molecules or with the walls of the container.
  - D. The volume occupied by the gas molecules themselves under ordinary conditions is large in comparison to the total volume occupied by the gas.
  - E. Gases are "less ideal" near their liquifaction points.
- \_\_\_\_\_ 25. If 400 mL of 0.20 M HCl solution is added to 800 mL of 0.050 M  $\text{Ba}(\text{OH})_2$  solution, the solution will be \_\_\_\_\_ molar in  $\text{BaCl}_2$ .
- A. 0.033 M
  - B. 0.067 M
  - C. 0.26 M
  - D. 0.47 M
  - E. 0.67 M

- \_\_\_\_\_ 26. A solution prepared from which of the following has acetone as the solvent and water as the solute?
- 50 mL water, 100 mL alcohol, and 10 mL acetone
  - 50 mL water, 10 mL alcohol, and 5 mL acetone
  - 5 mL water, 100 mL alcohol, and 10 mL acetone
  - 5 mL water, 10 mL alcohol, and 50 mL acetone
  - None of the above
- \_\_\_\_\_ 27. In the equation  $\left(P + \frac{na}{V} - nb\right) = nRT$ ,  $a$  is a “fudge factor” known as the van der Waals constant. This is a correction factor that corrects for
- deviations in the gas constant,  $R$ .
  - the attractive forces between gas molecules.
  - The tendency of the gas molecules to ionize.
  - the average velocities of the gas molecules.
  - the volume occupied by the gas molecules,
- \_\_\_\_\_ 28. Write the balanced molecular equation for the reaction of chromium (III) hydroxide with sulfuric acid. What is the coefficient of water?
- 1
  - 2
  - 3
  - 4
  - 5
- \_\_\_\_\_ 29. Which of the following represents the *net ionic* equation for the reaction of nitric acid with aluminum hydroxide?
- $3 \text{H}_3\text{O}^+ + \text{Al}(\text{OH})_3 \div \text{Al}^{3+} + 6 \text{H}_2\text{O}$
  - $3 \text{HNO}_3 + \text{Al}(\text{OH})_3 \div 3\text{Al}(\text{NO}_3)_3 + 3 \text{H}_2\text{O}$
  - $2 \text{H}_3\text{O}^+ + \text{Al}(\text{OH})_2 \div \text{Al}^{2+} + 4 \text{H}_2\text{O}$
  - $\text{H}_3\text{O}^+ + \text{OH}^- \div 2 \text{H}_2\text{O}$
  - $3 \text{NO}_3^- + \text{Al}^{3+} \div \text{Al}(\text{NO}_3)_3$
- \_\_\_\_\_ 30. What mass of methane ( $\text{CH}_4$ ) is contained in a 500 mL sample of  $\text{CH}_4$  at STP?
- 0.212 g
  - 0.268 g
  - 0.357 g
  - 0.390 g
  - 0.407 g
- \_\_\_\_\_ 31. A mixture of gases contains 21.0 g  $\text{N}_2$ , 106.5 g  $\text{Cl}_2$  and 12.0 g He at  $14^\circ\text{C}$  in a 50.0 L container. What is the partial pressure of  $\text{N}_2$ ?
- 0.353 atm
  - 0.398 atm
  - 0.448 atm
  - 0.501 atm
  - 0.707 atm

- \_\_\_\_\_ 32. What is the molecular weight of a gas that diffuses 1.414 times as fast as nitrogen,  $N_2$ ?
- A. 4.85 g/mol
  - B. 14.0 g/mol
  - C. 23.5 g/mol
  - D. 32.6 g/mol
  - E. 46.6 g/mol
- \_\_\_\_\_ 33. What is the order of increasing rate of effusion for the following gases?
- A.  $N_2 < Ar < CO_2 < He$
  - B.  $Ar < CO_2 < He < N_2$
  - C.  $Ar < He < CO_2 < N_2$
  - D.  $CO_2 < N_2 < Ar < He$
  - E.  $CO_2 < Ar < CO_2 < He$
- \_\_\_\_\_ 34. All the following statements, except one, are important postulates of the kinetic-molecular theory of gases. Which one?
- A. Gases consist of large numbers of particles in rapid, random motion.
  - B. The volume of the molecules of a gas is very small compared to the total volume in which the gas is contained.
  - C. The average kinetic energy of the molecules is inversely proportional to the absolute temperature.
  - D. The time during which a collision between two molecules occurs is negligibly short compared to the time between collisions.
  - E. There are no attractive or repulsive forces between these individual molecules.
- \_\_\_\_\_ 35. Which of the following are not strong bases?
- A.  $CH_3OH$
  - B.  $NaOH$
  - C.  $NH_3$
  - D.  $Ca(OH)_2$
  - E. More than one correct answer
- \_\_\_\_\_ 36. Which of the following salts is *insoluble* in water?
- A.  $MgCO_3$
  - B.  $(NH_4)_2SO_4$
  - C.  $Cu(NO_3)_2$
  - D.  $Fe(SO_4)_3$
  - E. No correct answer
- \_\_\_\_\_ 37. Which of the following is a strong, soluble base?
- A.  $Cu(OH)_2$
  - B.  $Fe(OH)_3$
  - C.  $Al(OH)_3$
  - D.  $Sr(OH)_2$
  - E.  $Mg(OH)_2$

- \_\_\_\_\_ 38. Which of the following is *not* a salt
- A.  $K_2SO_4$
  - B.  $Mn(OH)_2$
  - C.  $CaCrO_4$
  - D.  $CoCl_2$
  - E.  $KMnO_4$
- \_\_\_\_\_ 39. Ammonia and hydrochloric acid are both gases, which react with each other to form 'smoke' of ammonium chloride. If a sample of each is allowed to enter a glass tube 1.000 m long at the same time from opposite ends of the tube, where will the 'smoke' form?
- A. 0.682 m from HCl end
  - B. 0.318 m from HCl end
  - C. Exactly in the middle
  - D. 0.318 m from  $NH_3$  end
  - E. 0.682 m from  $NH_3$  end
- \_\_\_\_\_ 40. The root mean square velocity of  $N_2$  gas molecules at body temperature,  $37^\circ C$ , is
- A. 552 m/s
  - B. 276 m/s
  - C. 65.9 m/s
  - D. 32.9 m/s
  - E. None of the above
- \_\_\_\_\_ 41. The interaction between solute particles and water molecules, which tends to cause a salt to fall apart in water, is called
- A. coagulation
  - B. conductivity
  - C. dispersion
  - D. hydration
  - E. polarization
- \_\_\_\_\_ 42. What is the molarity of 75.0 mL of solution that contains 18.0 g of HCl?
- A. 0.162 M
  - B. 0.240 M
  - C. 3.82 M
  - D. 4.20 M
  - E. 6.58 M
- \_\_\_\_\_ 43. What mass of  $H_3PO_4$  is contained in 3.00 L of 0.800 M  $H_3PO_4$  solution?
- A. 310 g
  - B. 294 g
  - C. 235 g
  - D. 115 g
  - E. 78.4 g