

Unit 9 Test

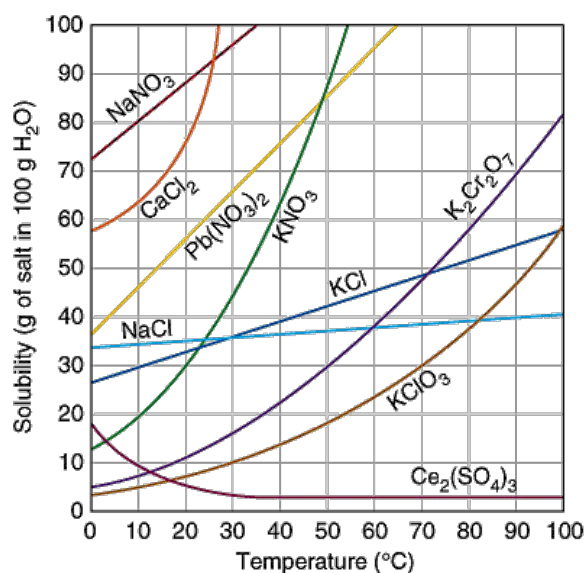
Aqueous Chemistry

Part I. Vocabulary (1 pt. each). *Write the correct term for each definition*

- _____ 1. A proton acceptor.
- _____ 2. A solution that can conduct electricity.
- _____ 3. Description of a solute that will not dissolve in a solvent.
- _____ 4. The number of moles of solute divided by liters of solution.
- _____ 5. A solution contains less than the maximum amount of solute.
- _____ 6. Half reaction involving the loss of electrons.
- _____ 7. Substance that acts like both an acid and a base.
- _____ 8. The product that now has the ability to donate a proton..
- _____ 9. Neutralization point in which moles H^+ is equal to moles of OH^- .

Part II. Multiple Choice (2 pts. each) *Circle the best answer for each of the following questions*

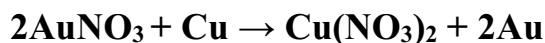
1. Which of the following is NOT a colligative property of solutions?
 (a) vapor pressure (b) melting point (c) freezing point (d) boiling point



2. Which substance is most soluble at 10°C?
 (a) $CaCl_2$ (b) $NaNO_3$
 (c) $KClO_3$ (d) $Ce_2(SO_4)_3$
3. How many grams of potassium chloride will dissolve at 50°C?
 (a) 43 (b) 90 (c) 70 (d) 37
4. At 100°C, how many grams of water are needed to dissolve 120 grams of NaCl?
 (a) 100 (b) 33 (c) 120 (d) 300

5. What is the molarity of a solution containing 5.6 moles of NaOH in 650mL?
 (a) 8.62 M (b) 0.0086 M (c) 3.6 M (d) 8.6 M

6. Which of the following substances would make the strongest electrolyte?
 (a) 0.25 M CO₂ (b) 2.0 M O₂ (c) 1.0 M NaCl (d) 2.0 M KCl
7. Which of the following happens when a solute is dissolved in a solvent?
 I. The boiling point increases
 II. The vapor pressure decreases
 III. The freezing point increases
 (a) I only (c) I and III
 (b) I and II (d) I, II, and III
8. Two salt water solutions are prepared; one has a concentration of 1.0 M and the other has a concentration of 2.5 M. Which would have the lower boiling point and why?
 a) They have the same boiling point because they are both salt water solutions
 b) 2.5 M solution because it has a higher concentration
 c) 1.0 M solution because it has a lower concentration
 d) 2.5 M solution because there are more particles in the solution
9. How much concentrated 12.0 M sulfuric acid is needed to prepare 250. mL of a 1.50 M solution?
 (a) 2000 mL (b) 0.0720 mL (c) 31.3 mL (d) 31300 mL
10. How many grams of MgSO₄ are needed to prepare 400.0 mL of a 0.15 M solution?
 (a) 0.045 g (b) 7.2 g (c) 45 g (d) 7.2 x 10⁶ g
11. What volume of water must be *added* to 75.00 mL of 5.000 M hydrochloric acid to dilute it to a 0.2500 M solution?
 (a) 1500. mL (b) 3.750 mL (c) 300.0 mL (d) 1425 mL
12. Which titration curve below shows a weak base titrated with a strong acid?



13. In the above reaction, which is the reducing agent?
 (a) AuNO₃ (b) Cu (c) Cu(NO₃)₂ (d) Au
14. In the above reaction which species is being oxidized?
 (a) AuNO₃ (b) Cu (c) Cu(NO₃)₂ (d) Au
15. A titration is performed with 3.5 M HNO₃ and 1.50 M KOH. The reaction requires 150. mL of HNO₃ to reach neutralization. How much KOH will be needed to reach the end point?
 (a) 350. mL (b) 64.3 mL (c) 0.0350 mL (d) 0.350 mL
16. Calculate the pH of a solution containing 1.9 x 10⁻⁶ M of OH⁻.
 (a) 5.7 (b) 8.3 (c) 4.6 (d) 9.4
17. What is the hydrogen ion concentration of a solution with a pOH of 11.3?
 (a) 5.01 x 10⁻¹² M (b) 5.01 x 10² M (c) 2.00 x 10¹¹ M (d) 2.00 x 10⁻³ M

18. Circle all acids.

- (a) H_2O (b) $\text{pOH} = 10.4$ (c) H_2CO_3 (d) litmus paper turns red (e) bitter taste

19. Circle all bases.

- (a) $[\text{OH}^-] > [\text{H}^+]$ (b) $\text{pOH} = 10.4$ (c) CsOH (d) H_2O (e) sour taste

20. Circle all solutes that will dissolve in water.

- (a) CBr_4 (b) H_2SO_4 (c) SiO_2 (d) I_2 (e) MgCl_2 (f) AlCl_3

21. The half reaction, $\text{Br}_2(\text{l}) + 2\text{e}^- \rightarrow 2\text{Br}^-(\text{aq})$, is classified as:

- (a) oxidation (b) neutralization (c) reduction (d) synthesis

Part III. True/False (1 pts. each) Determine if the statement is true or false, if false correct the statement.

- _____ 1. The vapor pressure of a solution will decrease with an increase in concentration because the solute allows more gas particles to form.
- _____ 2. For a solution to be neutral, the hydrogen ion concentration must be equal to the hydroxide ion concentration.
- _____ 3. A diluted solution contains the same number of moles of solute as the concentrated solution.
- _____ 4. Redox reactions involve the transfer of electrons among atoms.
- _____ 5. In the neutralization reaction between beryllium hydroxide and hydrochloric acid, 2 moles of water and 2 moles of beryllium chloride will form

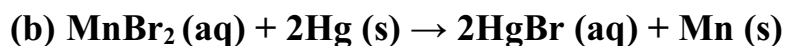
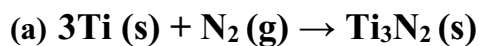
Part IV. Cumulative Review (1 pts. each)

1. Which of the following is the correct name for the compound TiO_2 ?
(a) titanium oxide (c) titanium (II) oxide
(b) dititanium tetraoxide (d) titanium (IV) oxide
2. Suppose an irregular object had a mass of 1.55 g. If you measured out 50.0 mL of water in a graduated cylinder and the object caused the water to rise to 53.5 mL, what is the density of the object?
(a) 0.44 g/mL (b) 0.029 g/mL (c) 0.031 g/mL (d) 2.3 g/mL
3. If atoms are isotopes of each other, they have a different number of _____
(a) protons (b) neutrons (c) electrons (d) all of the above
4. Put the following in order of increasing electronegativity. Magnesium, Chlorine, Aluminum, Sulfur
(a) Mg, Cl, Al, S (b) Cl, S, Al, Mg (c) Mg, Al, S, Cl (d) S, Cl, Mg, Al
5. Which element has the following electron configuration? $1s^2 2s^2 2p^6 3s^2 3p^6 4s^2 3d^{10} 4p^5$
(a) Selenium (b) Bromine (c) Krypton (d) Chlorine
6. Which of the following formulas contains iron, Fe, with a +3 oxidation number?
(a) FeCl_2 (b) $\text{Fe}(\text{NO}_3)_3$ (c) FeSO_4 (d) $\text{Fe}_3(\text{PO}_4)_2$

7. What is the mass in grams of 6.0×10^{23} molecules of CO_2 ?
(a) 22 g (b) 44 g (c) 66 g (d) 88 g
8. A gas cylinder is filled with 128 grams of oxygen gas at 300.0 K. The piston is compressed to yield a pressure of 400.0 kPa. What is the volume inside the cylinder? ($R = 8.314 \text{ L kPa/K mol}$)
(a) 2.19 L (b) 24.9 L (c) 6.25 L (d) 31.5 L
9. What is the free energy for the reaction shown below if it occurs at 30°C ? (Remember to convert!)
- | | | |
|---|-------------------------------|--|
| $2\text{Mg (s)} + \text{O}_2 \text{ (g)} \rightarrow 2\text{MgO (s)}$ | $\Delta H = -32.2 \text{ kJ}$ | $\Delta S = -122 \text{ J/K}$ |
| (a) 3630 J | (b) 4770 J | (c) -28,540 J (d) 117,900 J |

Part V. Free Response Section (5 points each)

1. Identify which atom is oxidized and which atom is reduced in the following reactions by showing all balanced half reactions with correct electron #s. Also label the oxidizing agents and reducing agents.



2. How many grams of Ca(OH)_2 are formed when 56.2 grams of sodium hydroxide are reacted with calcium chloride? (Include a balanced reaction in your answer.)

3. Now create a 3.00 M calcium hydroxide solution based on the mass from question 2, how many mL of water are needed? If 100 mL of this solution are needed to make a diluted calcium hydroxide solution of 500 mL, what is the final concentration?

4. Calculate the pH of a solution containing 1.77×10^{-9} M of hydrogen ions. Now calculate the hydroxide ion concentration of this solution. Classify this solution.

5. 50 mL of the above solution is titrated with 25 mL of 1.5M sulfuric acid which has a $[H^+]$ of 0.0122 M. Determine the final concentration of the unknown solution and then carefully draw and label a titration curve with exact pH and volume measurements, include the equivalence point as well.

6. Determine the molality of a solution containing 501 grams of copper (III) chloride in 625 mL of water (Density of water = 0.998 g/mL).