Culver City H.S. • AP Chemistry

Name _____
Period ___ Date ___/___/___

4 • Solution Stoichiometry

PRACTICE TEST

1. On the basis of the solubility rules, which of the following is insoluble?
   a) K_2O
   b) Na_2CO_3
   c) PbS (insoluble)
   d) $(NH_4)_2SO_4$
   e) $Ba(C_2H_3O_2)_2$

2. In a double replacement reaction, formation of which of the following does not necessarily lead to a chemical change?
   a) $HC_2H_3O_2$
   b) AgCl (s)
   c) CO_2 (g)
   d) H_2S
   e) NaCl
   You need a precipitate, a gas, water, or a weak electrolyte.

3. Reaction of an acid with a carbonate (such as $CaCO_3$) always results in the formation of
   a) O_2
   b) $C_{(diamond)}$
   c) CH_4
   d) O_3
   e) CO_2 and H_2O

   acid + CO_3^{2-} → H_2CO_3 → $CO_{2(g)} + H_2O_{(l)}$

4. Which of the following is incorrect?
   a) all salts containing NH_4^+ are soluble.
   b) all salts containing NO_3^- are soluble.
   c) all fluorides are soluble. (except CBS-PM)
   d) all sulfates (except those of Ca^{2+}, Sr^{2+}, Ba^{2+}, and Pb^{2+}) are soluble.
   e) most hydroxides are insoluble, except those of Ca^{2+}, Sr^{2+}, Ba^{2+}, the alkali metals and NH_4^+.

5. One of the gases shown below is NOT usually formed in a double replacement reaction. Which one? $AX + BY \rightarrow BX + AY$
   a) N_2
   b) CO_2
   c) SO_2
   d) NH_3
   e) H_2S

6. Write the balanced molecular equation for the reaction of washing soda, Na_2CO_3 and vinegar, $HC_2H_3O_2$.

   $Na_2CO_{3(aq)} + 2HC_2H_3O_{2(aq)} \rightarrow 2NaC_2H_3O_{2(aq)} + H_2O_{(l)} + CO_{2(g)}$

7. The net ionic equation for the above reaction is:

   $CO_3^{2-}{}_{(aq)} + 2HC_2H_3O_{2(aq)} \rightarrow 2C_2H_3O_2^-{}_{(aq)} + H_2O_{(l)} + CO_{2(g)}$

8. How many moles of H^+ are associated with the acid, H_2SO_3, during neutralization?
   a) 0 b) 1 c) 2 d) 3

9. How many moles Al_2O_3 are needed to neutralize 1 mole of HCl?
   a) 1/3
   b) 2/3
   c) 2
   d) 6
   e) 12
   f) 1/6

   $1Al_2O_3 + 6HCl \rightarrow 2AlCl_3 + 3H_2O_{(l)}$

10. Write the net reaction that will occur when solid ammonium carbonate is added to a solution of hydrosulfuric acid.

    $(NH_4)_2CO_{3(s)} + H_2S_{(aq)} \rightarrow (NH_4)_2S_{(aq)} + H_2O_{(l)} + CO_{2(g)}$

    $2NH_4^+{}_{(aq)} + S^{2-}{}_{(aq)}$

11. When H_2SO_4 and $Ba(OH)_2$ are reacted in a double replacement reaction, one of the products of the reaction is…

a) H_2 d) BaH_2
b) H_2O e) SO_2
c) BaS

$BaSO_4$ is the other

12. In the double replacement reaction between the weak acid, $HC_2H_3O_2$ and strong base, NaOH, which ion(s) are spectator ions?

a) Na^+, $C_2H_3O_2^-$ d) H^+, $C_2H_3O_2^-$
b) Na^+, OH^- e) Na^+ only
c) OH^- only

100.0 : $HC_2H_3O_2 + Na^+ + OH^- \rightarrow H_2O + Na^+ + C_2H_3O_2^-$

13. Which of the following is a base?

a) KOH d) CH_3OH not OH^- (alcohol)
b) C_2H_5OH not OH^- (alcohol) e) CO_2
c) Br^-

14. Which of the following is a strong acid?

a) H_2CO_3 weak d) $HClO_3$
b) HF weak e) HNO_3
c) H_3PO_4 weak

oops, 2 answers.

15. Which of the following is an acid in aqueous solutions?

a) H_2CO_3 H^+X^- d) H_2O neutral
b) Al_2O_3 e) BaO
c) CH_4 neutral

16. SO_2 (gas) turns into which acid in solution?

a) HNO_3 d) H_2S
b) H_2SO_3 e) HNO_2
c) H_2SO_4

$SO_2 + H_2O \rightarrow H_2SO_3$

17. What is the oxidation number of C in CO_3^{2-}?

a) +6 d) +1 $x + 3(-2) = -2$
b) +4 e) −1 $x = +4$
c) +2

18. What is the oxidation number of Br in $KBrO_4$? (H +1, O −2)

a) +1 b) −1 c) +5 d) +7 e) +8

19. For each change below, label the change of the underlined element as **O**xidation, **R**eduction, or Neither

R $\underline{Cu}^{+2} \rightarrow \underline{Cu}^{0}$ gain of 2e⁻
O $\underline{C}H_4 \rightarrow \underline{C}O_2$ loss of 8e⁻
R $H_2\underline{O}_2 \rightarrow H_2\underline{O}$ gain of 1e⁻
N $\underline{C}O_2 \rightarrow H_2\underline{C}O_3$

20. How many milliliters of 0.123 M NaOH solution contain 25.0 g of NaOH (molar mass = 40.00 g/mol)?

a) 5.08 mL d) 625 mL
b) 50.8 mL e) 5080 mL
c) 508 mL

$25.0\,g\,NaOH \times \frac{1\,mol\,NaOH}{40.0\,g} \times \frac{1000\,mL}{.123\,mol\,NaOH} =$

21. If you need 1.00 L of 0.125 M H_2SO_4, how would you prepare this solution?

a) Add 950. mL of water to 50.0 mL of 3.00 M H_2SO_4.
b) Add 500. mL of water to 500. mL of 0.500 M H_2SO_4.
c) Add 750 mL of water to 250 mL of 0.375 M H_2SO_4.
d) Dilute 36.0 mL of 1.25 M H_2SO_4 to a volume of 1.00 L.
e) Dilute 20.8 mL of 6.00 M H_2SO_4 to a volume of 1.00 L.

$M_1V_1 = M_2V_2$
test each answer! → ( ) = (.125 M)(1.00 L)

22. What is the ion concentration in a 0.12 M solution of $BaCl_2$? $BaCl_{2\,(aq)} \rightarrow Ba^{2+}_{(aq)} + 2\,Cl^-_{(aq)}$

a) $[Ba^{2+}] = 0.12$ M and $[Cl^-] = 0.12$ M.
b) $[Ba^{2+}] = 0.12$ M and $[Cl^-] = 0.060$ M.
c) $[Ba^{2+}] = 0.12$ M and $[Cl^-] = 0.24$ M.
d) $[Ba^{2+}] = 0.060$ M and $[Cl^-] = 0.060$ M.
e) $[Ba^+] = 0.12$ M and $[Cl_2^-] = 0.12$ M.

23. What is the molarity of the solution that results when 60.0 g NaOH is added to enough water to make 500. mL solution?

a) 1.33 M
b) 12.0 M
c) 3.00 M
d) 8.0 M
e) 1.50 M

$M = \frac{\text{moles NaOH}}{\text{Liters solution}} = \frac{\left(60.0\text{g NaOH} \times \frac{1\text{mol}}{40.0\text{g}}\right)}{.500\text{L}} =$

24. What is the molarity of the solution that results when 45.0 g HCl is dissolved in enough water to make 250. mL solution?

a) 4.94 M
b) 4.50 M
c) 3.24 M
d) 1.80 M
e) 1.46 M

$M = \frac{\text{moles HCl}}{\text{Liters soln}} = \frac{\left(45.0\text{g HCl} \times \frac{1\text{mol}}{36.46\text{g}}\right)}{.250\text{L}} =$

25. What is the concentration of Cl^- ion in 0.60 M $AlCl_3$ solution? $[Cl^-] = 3(.60\text{ M}) = 1.8\text{ M}$

a) 1.8 M
b) 0.60 M
c) 0.20 M
d) 0.30 M
e) 0.10 M

$AlCl_3(aq) \rightarrow Al^{3+}(aq) + 3Cl^-(aq)$

26. How many grams of Na_2CO_3 (molar mass = 106.0 g/mol) are required for complete reaction with 25.0 mL of 0.155 M HNO_3?

$Na_2CO_3 + 2HNO_3 \rightarrow 2NaNO_3 + CO_2 + H_2O$

a) 0.122 g
b) 0.205 g
c) 0.410 g
d) 20.5 g
e) 205 g

$\frac{0.155\text{ mol}}{1000\text{ mL}} \times 25.0\text{ mL} \times \frac{1\text{ mol } Na_2CO_3}{2\text{ mol } HNO_3} \times \frac{106.0\text{ g } Na_2CO_3}{1\text{ mol } Na_2CO_3} = .205\text{ g}$

(M × volume → to find moles HNO_3; stoich. → to find moles Na_2CO_3; m.m. → to find grams Na_2CO_3)

27. What volume of 0.150 M NaOH is needed to react completely with 3.45 g iodine according to the equation:

$3\ I_2 + 6\ NaOH \rightarrow 5\ NaI + NaIO_3 + 3\ H_2O$

a) 181 mL
b) 45.3 mL
c) 4.08 mL
d) 2.04 mL
e) 1.02 mL

$3.45\text{g } I_2 \times \frac{1\text{mol } I_2}{253.8\text{g } I_2} \times \frac{6\text{mol NaOH}}{3\text{mol } I_2} \times \frac{1000\text{mL}}{.150\text{mol NaOH}} = 181.245\text{ mL}$

(to find moles I_2 (m.m.); to find moles NaOH (stoich.); use M to find mL)

28. What is the concentration of an NaOH solution if it takes 16.25 mL of a 0.100 M HCl solution to titrate 25.00 mL of the NaOH solution?

a) 0.0165 M
b) 0.151 M
c) 0.0650 M
d) 0.100 M
e) 0.413 M

$NaOH + HCl \rightarrow NaCl + H_2O(l)$

29. A 4.00 M solution of H_3PO_4 will contain ___ g of H_3PO_4 in 0.250 L of solution.

a) 196 g
b) 98.0 g
c) 49.0 g
d) 24.0 g
e) 12.0 g

$.250\text{L} \times \frac{4.0\text{ mole}}{1\text{ Liter}} \times \frac{98.00\text{g } H_3PO_4}{1\text{mol}} = 98.0\text{g}$

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PRACTICE FRQ

For each of the following reactions, in part (i) write a balanced equation for the reaction and in part (ii) answer the question about the reaction. In part (i), coefficients should be in terms of lowest whole numbers. Assume that solutions are aqueous unless otherwise indicated. Represent substances in solutions as ions if the substances are extensively ionized. Omit formulas for any ions or molecules that are unchanged by the reaction. You may use empty space at the bottom of the page for scratch work, but only equations that are written in the answer boxes provided will be graded.

EXAMPLE:

A strip of magnesium metal is added to a solution of silver(I) nitrate.

(i) Balanced equation:

$Mg + 2\,Ag^+ \longrightarrow Mg^{2+} + 2\,Ag$

(ii) Which substance is oxidized in the reaction?

Mg is oxidized.

$Pb(NO_3)_2\,(aq) + H_2SO_4\,(aq) \rightarrow PbSO_4\,(s) + 2\,HNO_3\,(aq)$

a) Solutions of lead(II) nitrate and sulfuric acid are mixed..

(i) Balanced equation:

$Pb^{2+} + SO_4^{2-} \rightarrow PbSO_4\,(s)$

(ii) If the reaction mixture is filtered, what substance will end up in the filter?

The solid $PbSO_4$ will be on the filter.

$\overset{0}{Mg}_{(s)} + \overset{+2\ -1}{FeCl_2}\,(aq) \rightarrow \overset{0}{Fe}_{(s)} + \overset{+2\ -1}{MgCl_2}\,(aq)$

b) A strip of magnesium metal is placed in a solution of iron(II) chloride.

(i) Balanced equation:

$Mg + Fe^{2+} \rightarrow Mg^{2+} + Fe$

(ii) Which chemical is the oxidizing agent?

$FeCl_2$ is the oxidizing agent since Fe^{2+} is being reduced.