South Pasadena • AP Chemistry

Name Key
Period ___ Date ___/___/___

5 • Reactions In Aqueous Solution

PRACTICE TEST

1. On the basis of the solubility rules, which of the following is insoluble?
   a) K_2O d) $(NH_4)_2SO_4$
   b) Na_2CO_3 e) $Ba(C_2H_3O_2)_2$
   c) PbS Sulfides are NOT Soluble

2. In a metathesis (DOUBLE REPLACEMENT) reaction, formation of which of the following does not necessarily lead to a chemical change?
   a) $HC_2H_3O_2$ d) H_2S
   b) AgCl e) NaCl
   c) CO_2 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 d) O_3
   b) $C_{(diamond)}$ e) CO_2 and H_2O
   c) CH_4

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. See Rule
   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 metathesis reaction. Which one?
   a) N_2 d) NH_3
   b) CO_2 e) H_2S
   c) SO_2

6. Write the balanced molecular equation for the reaction of washing soda, Na_2CO_3 and vinegar, $HC_2H_3O_2$.
   $Na_2CO_3 + 2HC_2H_3O_2 \rightarrow H_2O + CO_2 + 2NaC_2H_3O_2$

7. The net ionic equation for the above reaction is:
   $CO_3^{2-} + 2HC_2H_3O_2 \rightarrow H_2O + CO_2 + 2C_2H_3O_2^-$

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

9. How many moles Al_2O_3 are needed to neutralize 1 mole of HCl? HINT: "mix $Al_2O_3 + H_2O$ → $Al(OH)_3$"
   a) 1/3 d) 6
   b) 2/3 e) 12
   c) 2 f) 1/6
   BAD GUY
   $Al_2O_3 + 6HCl \rightarrow 2AlCl_3 + 6H_2O$

10. Write the net reaction that will occur when solid ammonium carbonate is added to a solution of hydrosulfuric acid.
    $(NH_4)_2CO_{3(s)} + H_2S \rightarrow H_2O + CO_2 + 2NH_4^+ + S^{2-}$

11. When H_2SO_4 and $Ba(OH)_2$ are reacted in a "DOUBLE REPLACEMENT" metathesis 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 metathesis 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
    Ionic: $HC_2H_3O_2 + Na^+ + OH^- \rightarrow H_2O + Na^+ + C_2H_3O_2^-$

13. Which of the following is a base?
a) KOH
b) C_2H_5OH alcohol
c) Br^- ← nope
d) CH_3OH alcohol
e) CO_2 ← acid anhydride

14. Which of the following is a strong acid?
a) H_2CO_3 weak
b) HF weak
c) H_3PO_4 weak
d) $HClO_3$ oops! both are on our strong acid list
e) HNO_3

15. Which of the following is an acid in aqueous solutions?
a) H_2CO_3
b) Al_2O_3 ← basic anhydrides
c) CH_4 neutral
d) H_2O neutral
e) BaO ← basic anhydrides

16. SO_2 turns into which acid in solution?
a) HNO_3
b) H_2SO_3
c) H_2SO_4
d) H_2S
e) HNO_2
$SO_2 + H_2O \rightarrow H_2SO_3$

17. What is the oxidation number of C in CO_3^{2-}?
a) +6
b) +4
c) +2
d) +1
e) −1
$x + 3(-2) = -2$
$x = +4$

18. What is the oxidation number of Br in $KBrO_4$?
a) +1 b) −1 c) +5 d) +7 e) +8
$1 + x + 4(-2) = 0$ $x = +7$

19. For each change below, label the change of the underlined element as **O**xidation, **R**eduction, or **N**either
R $\underline{Cu}^{2+} \rightarrow \underline{Cu}^{\circ}$ $+2 \rightarrow 0$
O $\underline{C}H_4 \rightarrow \underline{C}O_2$ $-4 \rightarrow +4$
R $H_2\underline{O}_2 \rightarrow H_2\underline{O}$ $-1 \rightarrow -2$
N $\underline{C}O_2 \rightarrow H_2\underline{C}O_3$ $+4 \rightarrow +4$
↑ THIS IS ACID-BASE

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
b) 50.8 mL
c) 508 mL
d) 625 mL
e) 5080 mL
See pages 4 & 5

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.
See pages 4 & 5

22. What is the ion concentration in a 0.12 M solution of $BaCl_2$?
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 $[Cl^-] = 0.12$ 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
See pages 4 & 5

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

25. What is the concentration of Cl^- ion in 0.60 M $AlCl_3$ solution?

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

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

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

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

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

See answer pages 4 & 5 for worked out answers.

(20) G: 25.0 g NaOH

D: ? mL

$$25.0\text{ g NaOH} \times \frac{1\text{ mol NaOH}}{40.0\text{ g NaOH}} \times \frac{1\text{ L NaOH}}{.123\text{ mol NaOH}} \times \frac{1000\text{ mL}}{1\text{ L}} = 5081.3$$

$$\approx \boxed{5080\text{ mL}}$$

21) $M\ V = M\ V$ — TEST EACH ANSWER when!

$$(.125)\left(\frac{1000\text{ mL}}{1\text{ L}}\right) = (6.00\text{ M})(20.8\text{ mL})$$

"e"

22) $BaCl_{2(aq)} \rightarrow Ba^{2+} + 2Cl^-$

$$[Ba^{2+}] = [BaCl_2] = \boxed{.12\text{ M}}$$

$$[Cl^-] = 2 \times [BaCl_2] = \boxed{.24\text{ M}}$$

23) $M = \frac{\text{moles NaOH}}{\text{Liters solution}} = \frac{\left(60.0\text{ g NaOH} \times \frac{1\text{ mol NaOH}}{40.0\text{ g}}\right)}{.500\text{ L}} = \boxed{3.00\text{ M}}$

24) $M = \frac{\text{mols HCl}}{\text{Liters soln}} = \frac{\left(45.0\text{ g HCl} \times \frac{1\text{ mol HCl}}{36.46\text{ g HCl}}\right)}{.250\text{ L}} = 4.9369\text{ M}$

$$\approx \boxed{4.94\text{ M}}$$

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

$$[Cl^-] = 3 \times [AlCl_3] = 3 \times .60\text{ M} = \boxed{1.8\text{ M}}$$

26) G: 25.0 mL HNO_3 solution

D: ? g Na_2CO_3

(M) ♡ (MM)

$$25.0\text{ mL } HNO_3 \times \frac{1\text{ L}}{1000\text{ mL}} \times \frac{.155\text{ mol } HNO_3}{1\text{ L } HNO_3} \times \frac{1\text{ mol } Na_2CO_3}{2\text{ mol } HNO_3} \times \frac{106.0\text{ g } Na_2CO_3}{1\text{ mol } Na_2CO_3} = \boxed{.205\text{ g}}$$

27) G: 3.45 g I_2

D: ? mL NaOH

I 53
126.9

(MM) ♡

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

$\cong$ **181 mL**

28) $V_{H^+} \cdot \underline{M}_{H^+} = V_{OH^-} \cdot \underline{M}_{OH^-}$ (TITRATION)

$(16.25\,mL)(.100\,\underline{M}) = (25.00\,mL)\,x$

$$x = \frac{(16.25)(.100)}{(25.00)} = \boxed{.0650\,\underline{M}}$$

– OR – DO IT AS A STOICHIOMETRY PROB.

$$HCl + NaOH \rightarrow H_2O + NaCl$$

$$\underline{M} = \frac{\text{moles NaOH}}{\text{Liters NaOH}} = \frac{n\ NaOH}{\underline{25.00\,mL\ NaOH}} = \frac{1.625 \times 10^{-3}\,mol}{.025\,L} =$$

$$= \boxed{.0650\,\underline{M}}$$

G: 16.25 mL HCl

D: ? mol NaOH

(M)

$$16.25\,mL\,HCl \times \frac{.100\,mol\,HCl}{1000\,mL} \times \frac{1\,mol\,NaOH}{1\,mol\,HCl} = 1.625 \times 10^{-3}\,mol\,NaOH$$

29) G: .250L H_3PO_4 soln

D: ? g H_3PO_4

$H_3 = 3.03$
$P = 30.97$
$O_4 = 64.00$
98.00

$$.250\,L \times \frac{4.00\,mol\,H_3PO_4}{1.00\,L} \times \frac{98.00\,g\,H_3PO_4}{1\,mol\,H_3PO_4} = \boxed{98.0\,g\,H_3PO_4}$$