Name: Key Number: _____ Class: _____ Date: 18 pts

1. Complete the chart

Compound	Molar Mass (g/mol)	Mass of Solute (g)	Moles of Solute	Volume of solution	Molarity (M)
HCl	36.46	26.0	0.71	600 mL	1.18
H_2SO_4	98.07	62.0	0.63	1.00 L	0.63
H_3PO_4	98.00	75.0	0.77	0.750 L	1.03
CaO	56.08	48.0	0.86	0.250 L	3.44
NaOH	40.00	80.0	2.00	0.6061 L	3.30
KOH	56.11	25.20	0.450	0.549 L	0.82
$Al_2(SO_4)_3$	342.17	171.09	0.500	1.00 L	0.500
$K_2Cr_2O_7$	294.18	88.25	0.300	375 mL	0.800

2. Complete the chart

Compound	Molar Mass (g/mol)	Mass of Solute (g)	Moles of Solute	Mass of solvent (kg)	Molality (m)
$HC_2H_3O_2$	60.05	100	1.67	1.20	1.39
$Mg(OH)_2$	58.33	25.0	0.43	0.10	4.30
HBr	80.91	80.10	0.990	0.50	1.98
Na_2CrO_4	161.98	22.0	0.136	0.34	0.400
$KMnO_4$	158.04	118.53	0.75	2.50	0.30
$CuNH_4(NO_3)_3$	207.63	125.0	0.467	1.24	0.375
$NaHCO_3$	84.01	126.02	1.50	2.86	0.525
$(NH_4)_2SO_4$	132.17	66.09	0.500	0.525	0.952

3. If I make a solution by adding 83.0 grams of sodium hydroxide to 750 mL of water. What is the mass percent of sodium hydroxide in this solution?

83.0 g NaOH
750 mL H_2O
x = mass %

$$\frac{83.0}{833} \times 100 = \boxed{9.96\%\ NaOH}$$

4. How many grams of LiOH are needed to make a 25 g of a 4% solution?

x = g LiOH
25 g solution
4% Solution

$$4 = \frac{x}{25} \times 100$$

$$0.04 = \frac{x}{25}$$

$$\boxed{x = 1.00\ g\ LiOH}$$

5. An 800 g solution of Kool-Aid contains 780 g of water. What is the mass percent of solute in this solution?

$$\frac{20}{800} \times 100 = \boxed{2.50\%}$$

800 g solution
780 g H_2O
mass % = x
20 g solute

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6. If a 4000 g solution of salt contains 40 g of salt, what is its mass percent?

4000g solution
40g NaCl
x = mass %

$\frac{40}{4000} \times 100 =$ **1.00 % NaCl**

7. A solution of 1.00 M NaCl is available. How many milliliters of this solution are needed to make a total of 100 mL of 0.70 M NaCl solution?

1.00 M NaCl = M_2
x = mL solution = V_2
100. mL NaCl = V_1
0.70 M = M_1

$1.00(x) = 0.70(100.0)$

$1x = 70$

x = 70.00 mL

8. You have 5.00 mL of a solution labeled 6.00 M HCl and you add enough water to give a total volume of 14.00 mL. What is the concentration of the new solution.

$V_1 = 5.00$ mL
$M_1 = 6.00$ M
$V_2 = 14.00$ mL
$M_2 = x$

$(6.00)(5.00) = 14.00x$

$30.00 = 14.00x$

x = 2.14 M

9. Concentrated HCl is 12 M. What volume of 12 M solution is needed to make 2 L of 1.00 M HCl solution?

$V_1 = x$
$M_1 = 12$ M
$M_2 = 1.0$
$V_2 = 2$ L

$12x = (1.0)(2)$

x = 0.167 L or 166.67 mL

10. How would you prepare 25 mL of 0.010 M NaCl starting with 0.500 M NaCl solution?

$V_1 = 25$ mL
$M_1 = 0.010$ M
$V_2 = x$
$M_2 = 0.500$ M

$(0.010)(25) = (0.500)x$

$0.25 = 0.500x$

x = 0.50 mL

11. What mass of NaOH is needed to Precipitate the Cd^{+2} ions from 35.0 mL of 0.500 M $Cd(NO_3)_2$ solution? ~~add volume of NaOH~~

x = g NaOH
V = 35.0 mL $Cd(NO_3)_2$
M = 0.500 M $Cd(NO_3)_2$

① $2NaOH + Cd(NO_3)_2 \rightarrow 2NaNO_3 + Cd(OH)_2$

② $\frac{0.500}{1} = \frac{x}{0.035}$ $x = 0.0175$ mol $Cd(NO_3)_2$

③ limiting

④ 1 mol $Cd(NO_3)_2$ = 2 mol NaOH
0.0175 = 0.035

⑤ $0.035 \text{ mol} \left| \frac{40.0 \text{ g NaOH}}{1 \text{ mol NaOH}} \right. =$ **1.40 g NaOH**

12. 50.0 mL of 0.100 M Na_3PO_4 is mixed with 150.0 mL of 0.250 M $Pb(NO_3)_2$ to produce a solid precipitate of lead (II) phosphate. What mass of this precipitate will be produced?

x = g $Pb_3(PO_4)_2$
V_1 = 50 mL Na_3PO_4
M_1 = 0.100 M Na_3PO_4
V_2 = 150.0 mL $Pb(NO_3)_2$
M_2 = 0.250 M $Pb(NO_3)_2$

① $2Na_3PO_4 + 3Pb(NO_3)_2 \rightarrow 6NaNO_3 + Pb_3(PO_4)_2$

② $\frac{0.100}{2} = \frac{x}{0.05}$ $x = 0.005$ mol Na_3PO_4

③ limiting

$0.250 = \frac{x}{0.150}$ $x = 0.0375$ mol $Pb(NO_3)_2$

④ 2 mol Na_3PO_4 = 1 mol $Pb_3(PO_4)_2$
0.01 = 0.005 mol

⑤ $0.005 \text{ mol} \left| \frac{813.74 \text{ g}}{1 \text{ mol}} \right. =$ **4.07 g $Pb_3(PO_4)_2$**

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13. What mass of solid aluminum hydroxide is produced when 50.0 mL of 0.200 M $Al(NO_3)_3$ is added to 200.0 mL of 0.100 M KOH? ① $Al(NO_3)_3 + 3KOH \rightarrow Al(OH)_3 + 3KNO_3$

$V_1 = 50.0\,mL\ Al(NO_3)_3$
$M_2 = 0.200\,M\ Al(NO_3)_3$
$V_2 = 200.\,mL\ KOH$
$M_2 = 0.100\,M\ KOH$
$x = g\ Al(OH)_3$

② $0.200 = \frac{x}{0.05}$
$x = 0.01\ mol\ Al(NO_3)_3$ ③ limiting

$0.100 = \frac{x}{0.2}$
$x = 0.2\ mol\ KOH$

④ $1\ mol\ Al(NO_3)_3 = 1\ mol\ Al(OH)_3$
$0.01 = 0.01$

⑤ $0.01\ mol\ Al(OH)_3 \left| \frac{78.01\ g}{1\ mol} \right. = \boxed{0.78\ g\ Al(OH)_3}$

14. How many grams of silver chloride can be prepared by the reaction of 100.0 mL of 0.20 M silver nitrate with 100.0 mL of 0.15 M calcium chloride? ① $2AgNO_3 + CaCl_2 \rightarrow 2AgCl + Ca(NO_3)_2$

$x = g\ AgCl$
$V_1 = 100.0\,mL\ AgNO_3$
$M_2 = 0.20\,M\ AgNO_3$
$V_2 = 100.0\,mL\ CaCl_2$
$M_2 = 0.15\,M\ CaCl_2$

② $0.20 = \frac{x}{0.1}$
$x = 0.02\ mol\ AgNO_3$

$0.15 = \frac{x}{0.1}$
$x = 0.015\ mol\ CaCl_2$ ③ limiting

④ $1\ mol\ CaCl_2 = 2\ mol\ AgCl$
$0.015 = 0.03\ mol$

⑤ $0.03\ mol \left| \frac{143.32\ g\ AgCl}{1\ mol} \right. = \boxed{4.30\ g\ AgCl}$

15. What volume of 0.075 M HCl is required to neutralize 100 mL of 0.01 M $Ca(OH)_2$ solution?

$0.075\,M\ HCl$
$V = x\ HCl$
$100\,mL\ Ca(OH)_2$
$0.01\,M\ Ca(OH)_2$

① $2HCl + Ca(OH)_2 \rightarrow 2HOH + CaCl_2$

② $0.01 = \frac{x}{0.1}$
$x = 0.001\ mol\ Ca(OH)_2$ limiting ③

④ $1\ mol\ Ca(OH)_2 = 2\ mol\ HCl$
$0.001 = 0.002\ mol\ HCl$

⑤ $0.075 = \frac{0.002}{x}$
$0.075x = 0.002$
$\boxed{x = 0.027\ L \text{ or } 26.67\ mL}$

16. If it takes 54 mL of 0.1 M NaOH to neutralize 125 mL of an HCl solution what is the concentration of the HCl? $NaOH + HCl \rightarrow HOH + NaCl$

$V = 54\,mL\ NaOH$
$M = 0.1\,M\ NaOH$
$V = 125\,mL\ HCl$
$M = x\ HCl$

② $0.1 = \frac{x}{0.054}$
$x = 0.0054\ mol\ NaOH$
limiting ③

④ $1\ mol\ NaOH = 1\ mol\ HCl$
$0.0054\,mol = 0.0054\,mol$

⑤ $\frac{0.0054}{0.125} = \boxed{4.32 \times 10^{-2}\ M}$

17. If it takes 25 mL of 0.05 M HCl to neutralize 345 mL of NaOH solution, what is the concentration of the NaOH solution? ① $HCl + NaOH \rightarrow HOH + NaCl$

$V = 25\,mL\ HCl$
$M = 0.05\,M\ HCl$
$V = 345\,mL\ NaOH$
$M = x\ NaOH$

② $0.05 = \frac{x}{0.025}$
$x = 0.00125\ mol\ HCl$
limiting ③

④ $1\ mol\ HCl = 1\ mol\ NaOH$
$0.00125\,mol = 0.00125\,mol$

⑤ $\frac{0.00125\ mol\ NaOH}{0.345\ L} = \boxed{4.31 \times 10^{-4}\ M\ NaOH}$

18. What volume of 0.175 M solution of KOH is needed to titrate 30.0 mL of 0.200 M H_2SO_4? ① $2KOH + H_2SO_4 \rightarrow 2HOH + K_2SO_4$

$V = x\ KOH$
$M = 0.175\,M\ KOH$
$V = 30\,mL\ H_2SO_4$
$M = 0.200\,M\ H_2SO_4$

② $0.200 = \frac{x}{0.03}$
$x = 0.006\ mol\ H_2SO_4$
limiting ③

⑤ $1\ mol\ H_2SO_4 = 2\ mol\ KOH$
④ $0.006 = 0.012\ mol\ KOH$

⑤ $\frac{0.012\ mol\ KOH}{x} = 0.175$
$0.012 = 0.175x$
$\boxed{x = 0.068\ L \text{ or } 68.57\ mL}$

19. What is the normality of 0.1381 M NaOH?

$x = N$
$0.1381\,M\ NaOH$
$MM = 40.00\ g/mol$

$0.1381\ mol \left| \frac{40.00\ g}{1\ mol} \right. = 5.524\ g \left| \frac{\frac{40.00}{1}}{40.00} \right. = \frac{0.1381\ eq\ wt}{1\ L} = \boxed{0.1381\ N}$

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20. What is the normality of 0.0521 M H_3PO_4?

x = N
0.0521 M
MM = 96.99
1 L

$0.0521 = \frac{x}{1L}$

$\frac{96.99}{2} = 48.50\ g/eq.wt$

$x = 0.0521\ mol \left| \frac{96.99\ g}{1\ mol} \right. = 5.05\ g \left| \frac{1\ eq.wt}{48.50\ g} \right. = 0.10\ eq\ wt$

$\frac{0.10}{1L} = \boxed{0.10\ N}$

21. Calculate the normality of 6.32 g of $Ca(OH)_2$ in 5.85 L of solution.

6.32 g $Ca(OH)_2$
5.85 L
x = N
MM = 74.10 g/mol

$\frac{74.10}{2} = 37.05\ eq.wt$

$6.32 \left| \frac{1\ eq\ wt}{37.05\ g} \right. = 0.17\ eq\ wt$

$\frac{0.17}{5.85} = \boxed{0.03\ N \text{ or } 2.91 \times 10^{-2}\ N}$

22. Calculate the normality of 94.21 g of $Al(OH)_3$ in 2.0 L of solution.

94.21 g $Al(OH)_3$
2.0 L
x = N
MM = 78.01

$\frac{78.01}{3} = 26.00\ g/eq.wt$

$94.21\ g \left| \frac{1\ eq.wt}{26.00\ g} \right. = 3.62\ eq\ wt$

$\frac{3.62}{2.0} = \boxed{1.81\ N\ Al(OH)_3}$

Home work

- Complete 4 compounds for questions 1 + 2 (M, m)
- Complete 2 questions from each of the following groups
  - 3 - 6 = mass %
  - 7 - 10 = dilution
  - 11 - 14 = solution stoic.
  - 15 - 18 = Acid - base
  - 19 - 22 = Normality