

Name: Kay 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 ₂ SO ₄	98.07	62.0	0.63	1.00 L	0.63
H ₃ PO 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	0.600 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 ₂ Cr ₂ O 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 ₂ H ₃ O 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 ₂ CrO ₄	161.98	22.0	0.136	0.34	0.400
KMnO ₄	158.04	118.53	0.75	2.50	0.30
Cu(NH ₄) ₂ (NO ₃) ₂	267.163	125.0	0.467	1.24	0.375
NaHCO ₃	84.01	126.02	1.50	2.86	0.525
(NH ₄) ₂ SO ₄	132.17	66.09	0.500	0.525	0.953

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 H₂O
x = mass %

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

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

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

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

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

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

800 g solution
780 g H₂O
mass % = x
20 g solute

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

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

4000 g solution
40 g NaCl
 $x = \text{Mass \%}$

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

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_1
 $x = \text{mL solution} = V_1$
100. mL NaCl = V_2
0.70 M = M_2

$$1.00(x) = 0.70(100.0)$$

$$\frac{1x = 70}{x = 70.00 \text{ mL}}$$

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?

$V_1 = 5.00 \text{ mL}$
 $M_1 = 6.00 \text{ M}$
 $V_2 = 14.00 \text{ mL}$
 $M_2 = x$

$$(6.00)(5.00) = 14.00x$$

$$30.00 = 14.00x$$

$$\boxed{x = 2.14 \text{ M}}$$

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

$V_1 = x$
 $M_1 = 12 \text{ M}$
 $M_2 = 1.0 \text{ M}$
 $V_2 = 2 \text{ L}$

$$12x = (1.0)(2)$$

$$\boxed{x = 0.167 \text{ L or } 166.67 \text{ mL}}$$

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

$V_1 = 25 \text{ mL}$
 $M_1 = 0.010 \text{ M}$
 $V_2 = x$
 $M_2 = 0.500 \text{ M}$

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

$$0.25 = 0.500x$$

$$\boxed{x = 0.50 \text{ mL}}$$

11. What mass of NaOH is needed to Precipitate the Cd²⁺ ions from 35.0 mL of 0.500 M Cd(NO₃)₂ solution? $2\text{NaOH} + \text{Cd}(\text{NO}_3)_2 \rightarrow 2\text{NaNO}_3 + \text{Cd(OH)}_2$ odd volume of NaOH

$x = \text{g NaOH}$ (2) $0.500 = \frac{x}{0.035}$ (4) $1 \text{ mol Cd}(\text{NO}_3)_2 = 2 \text{ mol NaOH}$
 $V = 35.0 \text{ mL Cd}(\text{NO}_3)_2$ $x = 0.0175 \text{ mol}$ $0.0175 = \frac{0.035}{0.035}$
 $M = 0.500 \text{ M Cd}(\text{NO}_3)_2$ (3) limiting (5) $\frac{0.035 \text{ mol}}{1 \text{ mol NaOH}} | 40.0 \text{ g NaOH} = \boxed{1.40 \text{ g NaOH}}$

12. 50.0 mL of 0.100 M Na₃PO₄ is mixed with 150.0 mL of 0.250 M Pb(NO₃)₂ to produce a solid precipitate of lead (II) phosphate. What mass of this precipitate will be produced?

$V_1 = 50 \text{ mL Na}_3\text{PO}_4$ (1) $2\text{Na}_3\text{PO}_4 + 3\text{Pb}(\text{NO}_3)_2 \rightarrow 6\text{NaNO}_3 + \text{Pb}_3(\text{PO}_4)_2$ (5) $\frac{0.005 \text{ mol}}{1 \text{ mol Na}_3\text{PO}_4} | 313.74 \text{ g} = \boxed{4.07 \text{ g Pb}_3(\text{PO}_4)_2$
 $M_1 = 0.100 \text{ M Na}_3\text{PO}_4$
 $V_2 = 150.0 \text{ mL Pb}(\text{NO}_3)_2$
 $M_2 = 0.250 \text{ M Pb}(\text{NO}_3)_2$

$x = 0.005 \text{ mol Na}_3\text{PO}_4$ (2) limiting (4) $2 \text{ mol Na}_3\text{PO}_4 = 1 \text{ mol Pb}(\text{NO}_3)_2$ $0.005 = \frac{0.005}{0.005}$

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13. What mass of solid aluminum hydroxide is produced when 50.0 mL of 0.200 M $\text{Al}(\text{NO}_3)_3$ is added to 200.0 mL of 0.100 M KOH? $\text{① Al}(\text{NO}_3)_3 + 3\text{KOH} \rightarrow \text{Al(OH)}_3 + 3\text{KNO}_3$

$$\begin{aligned} V_1 &= 50.0 \text{ mL } \text{Al}(\text{NO}_3)_3 \\ M_1 &= 0.200 \text{ M } \text{Al}(\text{NO}_3)_3 \\ V_2 &= 200.0 \text{ mL KOH} \\ M_2 &= 0.100 \text{ M KOH} \\ x &= \text{g } \text{Al(OH)}_3 \end{aligned}$$

$$\begin{array}{l} \text{② } 0.200 = \frac{x}{0.100} \\ x = 0.02 \text{ mol KOH} \\ \text{③ limiting} \end{array}$$

$$\begin{array}{l} \text{④ } 1 \text{ mol } \text{Al}(\text{NO}_3)_3 = 1 \text{ mol } \text{Al(OH)}_3 \\ 0.01 = 0.01 \end{array}$$

$$\begin{array}{l} \text{⑤ } \frac{0.01 \text{ mol } \text{Al(OH)}_3}{1 \text{ mol}} \left| \begin{array}{c} 78.01 \text{ g} \\ 1 \text{ mol} \end{array} \right| = 0.789 \text{ g } \text{Al(OH)}_3 \end{array}$$

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? $\text{① } 2\text{AgNO}_3 + \text{CaCl}_2 \rightarrow 2\text{AgCl} + \text{Ca}(\text{NO}_3)_2$

$$\begin{aligned} x &= \text{g AgCl} \\ V_1 &= 100.0 \text{ mL } \text{AgNO}_3 \\ M_1 &= 0.20 \text{ M } \text{AgNO}_3 \\ V_2 &= 100.0 \text{ mL } \text{CaCl}_2 \\ M_2 &= 0.15 \text{ M } \text{CaCl}_2 \end{aligned}$$

$$\begin{array}{l} \text{② } 0.20 = \frac{x}{0.15} \\ x = 0.03 \text{ mol AgCl} \\ \text{③ limiting} \end{array}$$

$$\begin{array}{l} \text{④ } 1 \text{ mol } \text{CaCl}_2 = 2 \text{ mol AgCl} \\ 0.015 = 0.03 \text{ mol} \end{array}$$

$$\begin{array}{l} \text{⑤ } \frac{0.03 \text{ mol}}{1 \text{ mol}} \left| \begin{array}{c} 143.32 \text{ g AgCl} \\ 1 \text{ mol} \end{array} \right| = 4.30 \text{ g AgCl} \end{array}$$

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

$$\begin{aligned} 0.075 \text{ M HCl} \\ V = x \text{ HCl} \\ 100 \text{ mL } \text{Ca}(\text{OH})_2 \\ 0.01 \text{ M } \text{Ca}(\text{OH})_2 \end{aligned}$$

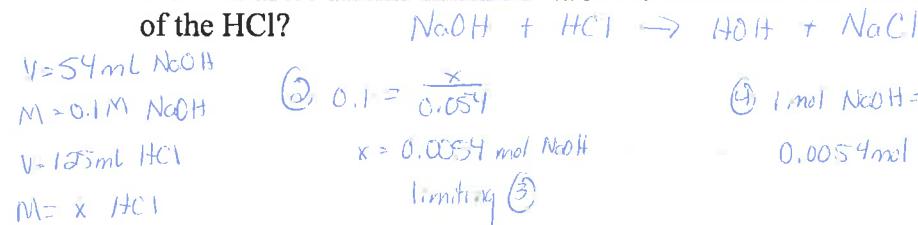
$$\begin{array}{l} \text{① } 2\text{HCl} + \text{Ca}(\text{OH})_2 \rightarrow 2\text{H}_2\text{O} + \text{CaCl}_2 \\ \text{② } 0.01 = \frac{x}{0.075} \\ x = 0.00075 \text{ mol HCl} \\ \text{Ca}(\text{OH})_2 \text{ limiting } \text{③} \end{array}$$

$$\begin{array}{l} \text{④ } 1 \text{ mol } \text{Ca}(\text{OH})_2 = 2 \text{ mol HCl} \\ 0.001 = 0.002 \text{ mol HCl} \end{array}$$

$$\begin{array}{l} \text{⑤ } 0.075 = \frac{0.002}{x} \\ 0.075 x = 0.002 \end{array}$$

$$x = 0.027 \text{ L or } 26.67 \text{ mL}$$

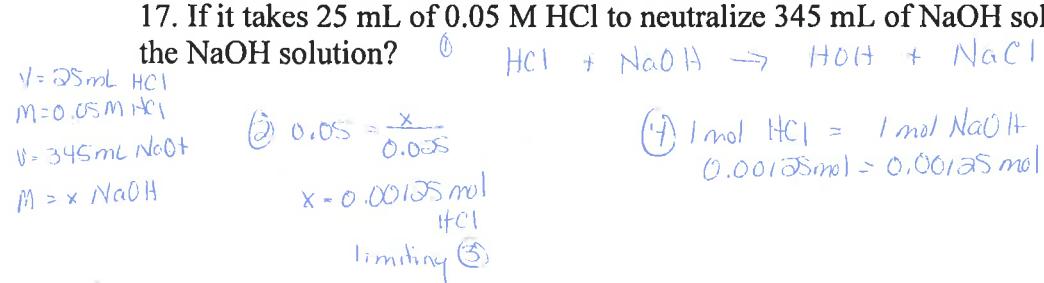
16. If it takes 54 mL of 0.1 M NaOH to neutralize 125 mL of an HCl solution what is the concentration of the HCl?



$$\begin{array}{l} \text{④ } 1 \text{ mol NaOH} = 1 \text{ mol HCl} \\ 0.0054 \text{ mol} = 0.0054 \text{ mol} \end{array}$$

$$\begin{array}{l} \text{⑤ } \frac{0.0054}{0.125} = 4.32 \times 10^{-2} \text{ M} \end{array}$$

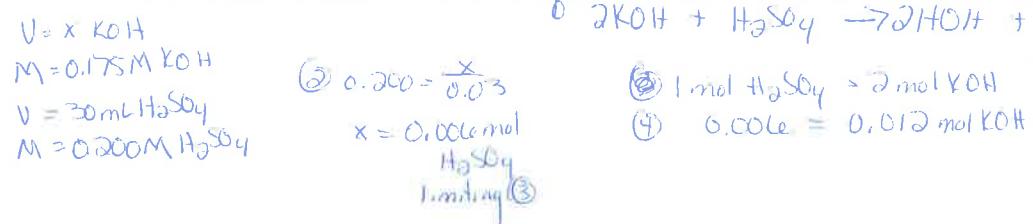
17. If it takes 25 mL of 0.05 M HCl to neutralize 345 mL of NaOH solution, what is the concentration of the NaOH solution?



$$\begin{array}{l} \text{④ } 1 \text{ mol HCl} = 1 \text{ mol NaOH} \\ 0.00125 \text{ mol} = 0.00125 \text{ mol} \end{array}$$

$$\begin{array}{l} \text{⑤ } \frac{0.00125 \text{ mol NaOH}}{0.345 \text{ L}} = 4.31 \times 10^{-4} \text{ M NaOH} \end{array}$$

18. What volume of 0.175 M solution of KOH is needed to titrate 30.0 mL of 0.200 M H_2SO_4 ?

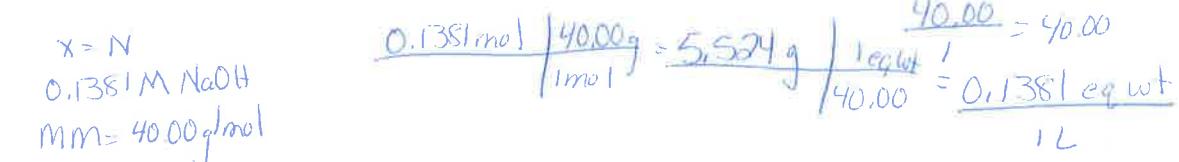


$$\begin{array}{l} \text{④ } 1 \text{ mol } \text{H}_2\text{SO}_4 = 2 \text{ mol KOH} \\ 0.0175 = 0.035 \text{ mol KOH} \end{array}$$

$$\begin{array}{l} \text{⑤ } \frac{0.035}{x} = 0.175 \\ x = 0.02 \text{ mol} \end{array}$$

$$x = 0.068 \text{ L or } 68.57 \text{ mL}$$

19. What is the normality of 0.1381 M NaOH?



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20. What is the normality of 0.0521 M H_3PO_4 ?

$$x = N$$

$$0.0521 \text{ M}$$

$$\text{mm} = 96.99$$

$$1 \text{ L}$$

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

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

$$x = \frac{0.0521 \text{ mol}}{1 \text{ mol}} \left| \begin{array}{c} 96.99 \text{ g} \\ 1 \text{ mol} \end{array} \right| = \frac{5.05 \text{ g}}{48.50 \text{ g}} = 0.10 \text{ eq/wt} \quad \frac{0.10}{1 \text{ L}} = \boxed{0.10 \text{ N}}$$

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

$$6.32 \text{ g } \text{Ca}(\text{OH})_2$$

$$5.85 \text{ L}$$

$$x = N$$

$$\text{mm} = 74.10 \text{ g/mol}$$

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

$$\frac{6.32}{37.05} = 0.17 \text{ eq. wt}$$

$$\frac{0.17}{5.85} = \boxed{0.03 \text{ N}}$$

or
 $2.91 \times 10^{-2} \text{ N}$

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

$$94.21 \text{ g } \text{Al}(\text{OH})_3$$

$$2.0 \text{ L}$$

$$x = N$$

$$\text{mm} = 78.01$$

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

$$\frac{94.21}{26.00} = 3.62 \text{ eq. wt}$$

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

Home work

- Complete 4 compounds for questions 1 + 2
- 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