Acid-Base Equilibrium Worksheet

1. 1.23L of H_2 gas at 27°C and 2 atm was obtained by the reaction of 4 g of M metal with the reaction of excess HCl. What is the atomic weight of the metal M?

2. How many liters of H_2 at STP would be produced by the reaction of 500cm^3 of HCl solution whose hydrogen ion concentration is 1M with 32.5 g of zinc?

3. A 50 g sample of magnalium alloy (Mg-Al) is reacted with excess amount of concentrated NaOH solution. If 6.72L of H_2 are obtained at STP, how many percent of 50 g sample is Mg?

4. Calculate the $[H^+]$, $[OH^-]$, pH and pOH of 0,001M HCl solution.

5. What are the $[H^+]$, $[OH^-]$, pH and pOH of 0.005M $Ba(OH)_2$ solution?

6. What are the $[H^+]$, $[OH^-]$, pH and pOH of 4.88 g $Sr(OH)_2$ that is dissolved in enough water to make a 800mL solution. $Sr(OH)_2$ = 122 g/mol

7. Complete the following table.

Solution	**$[H^+]$**	**$[OH^-]$**	**pH**	**pOH**
0.01M HCl				
……M HNO_3			2	
0.05M $Ba(OH)_2$				
……M NaOH	$1x10^{-11}$			

8. Calculate the pH of the solution by dissolving
A. 2.24 L of HCl at STP in enough water to produce 10 L of solution.
B. 17.1 g of $Ba(OH)_2$ in 2 L of solution.
C. 0.1 mol of K_2O in enough water to make 20 L solution.
D. 6 g of CH_3COOH dissolved in 500 mL of solution. (Ka of $CH_3COOH = 1.8x10^{-5}$)

9. 200m L of 0.4 M solution of $HClO_4$ is diluted to 8 L. Calculate the pH of the final solution.

10. 1.68g of KOH is dissolved in water to make 0.3L of solution. Calculate the pH and pOH of the solution.

11. 820 mL of HCl gas at 27°C and 3atm is dissolved in water to make 100L of solution. What is the pH of the solution?

12. 10g sample of NaOH is dissolved in 200mL of solution. If the pH of the solution is measured to be 14, find the percentage of pure NaOH by mass in the sample.

13. A solution was made by dissolving 5.13g of $X(OH)_2$ in 6 L final volume. If pH of the solution was 12, what is the atomic weight of X?

14. A solution is prepared by diluting 100 mL of $2.5x10^{-3}$M HNO_3 to 25 L. What is the ratio of pH to pOH in the solution?

15. Determine the mass of the acid or base in each of the following solutions.
A. A 4L $Ba(OH)_2$ solution whose $[OH^-]$= 0.02M
B. 1250mL HI solution whose $[OH^-]= 2.5x10^{-12}$
C. A 100mL NaOH solution whose pOH= 2
D. A 800mL of HBr solution whose pH= 2

16. A 7g impure sample of KOH is used to prepare 500mL of solution. If the pH of the solution is 13, what is the percentage purity of KOH sample?

17. 1.6g of a strong acid HX is dissolved in 1250L of water. If the pH of the solution is 5, what is the atomic weight of X?

18. Formic acid, HCOOH, is a mono protic acid. It is the irritant that causes the body's reaction to an ant's sting. If the pH of 0.5 M HCOOH is 2, calculate its acid ionization constant, Ka.

19. 0.05 M Acetic acid, CH_3COOH, is a mono protic acid. If it ionizes only 2% what is the Ka of the acetic acid?

20. Cocaine is a mono hydroxy weak base. If the pH of $5x10^{-3}$M-cocaine solution is 10, what is its Kb?

21. A 0.1M solution of a mono hydroxy base has a $[H^+]=1x10^{-10}$M. What is its base constant, Kb?

22. If you dissolve 0.675g of HCN in enough water to make 100mL of solution, what will be the concentration of H^+ and HCN in the final solution? Ka= $4x10^{-10}$

23. 60 g of acetic acid, CH_3COOH, is dissolved in enough water to make 5 L of solution. Calculate the $[OH^-]$ in the solution. Ka= $2x10^{-5}$

24. Calculate the pH of 0.1M solution of HIO_4, for which Ka= $2.3x10^{-2}$ and log (3.8)= 0.58

25. What is the pH of a 0.075M solution of hydroxylamine, NH_2OH, a weak base, for which Kb= $1.2x10^{-8}$?

26. What concentration of ethylamine, $C_2H_5NH_2$, is needed to prepare a solution whose pOH = 2?
Kb for ethylamine is $4.3x10^{-4}$

27. Pyridine, C_5H_5N, is a weak mono hydroxy base. What concentration of pyridine solution has a pH value of 9?
Kb= $1x10^{-9}$

28. 0.16g of X_2H_4, a weak base, is used to prepare a 500mL of solution with a pOH= 4. Find the atomic weight of X if Kb for X_2H_4 is $1x10^{-6}$?

29. Complete the following neutralization reactions.
A. $HCl + Ba(OH)_2 \rightarrow$ B. $H_3PO_4 + KOH \rightarrow$ C. $H_2SO_4 + Sr(OH)_2 \rightarrow$ D. $HI + NaOH \rightarrow$

30. What volume of 0.2 M NaOH solutions will be needed to neutralize each of the followings?
A. 50 mL of 0.2M HCl B. 10 mL of 0.4M H_2SO_4 C. 0.2 mol of a strong tri protic acid.

31. 20mL of KOH solution is required to neutralize 50mL of 0.1M HCl. Calculate the molarity of the KOH solution.

32. How many mL of 0.1M H_3PO_4 are necessary to neutralize 150mL of 0.1M $Ba(OH)_2$ solution?

33. When a 4 L of unknown concentration of NaOH solution is added to 400 mL of 0.05 M H_2SO_4 solution, the pH of the resulting solution is 7. Calculate the pH of the NaOH solution.

34. A 10 g impure sample of $Ba(OH)_2$ is completely neutralized by 200 mL of 0.25 M H_2SO_4 solution. Calculate the percentage of $Ba(OH)_2$ by mass in the original sample. $Ba(OH)_2$= 171g/mol

35. A 0.5 g impure sample of diprotic acid, which is 90% acid by mass is completely neutralized by 50 mL of 0.2 M KOH solution. Find the molecular weight of the acid.

36. 3.42g of $Ba(OH)_2$ is added to a 200mL of 0.1M HCl solution. Calculate the pH and pOH of the resulting solution.

37. What is the pH of each of the following solution?
A. A solution prepared by adding 100 mL of $2x10^{-3}$ M HCl to 100 mL of $1x10^{-3}$ M $Sr(OH)_2$
B. A solution prepared by adding 200 mL of 0.5 M H_2SO_4 to 300 mL of 0.5 M KOH
C. A solution prepared by adding 300 mL of solution with pH is equal to 3 to 200 mL of solution with pH=11.

38. When 300mL of NaOH solution is added to 200mL of 0.4M H_2SO_4, the pH of the resulting solution is measured as 13. Calculate the concentration of the NaOH solution.

39. 6.4 g impure sample of NaOH is completely neutralized by 50mL of 0.4M HCl. Calculate the percentage of pure NaOH in the sample.

40. To neutralize 5.88 g solution of a tri protic acid that is 50% acid by mass, a 200 mL of 0.15 M NaOH solution is used. Find the molecular weight of the acid.

41. A diprotic acid has the following composition by mass: 26.68%C, 71.1%O and 2.22%H. If 50mL of 1M NaOH may neutralize 2.25g of this acid, what is the molecular formula of this acid? ($C_2H_2O_4$)

42. 800 mL of NaOH solution are required to neutralize a 90 g sample of a diprotic acid. If 500 mL of 0.75 M H_2SO_4 solution can neutralize 600 mL of the same NaOH solution, calculate the molecular weight of the acid?

43. A 100mL sample of HCl solution is completely neutralized by 80 mL of NaOH solution. A 10g sample of $CaCO_3$ is allowed to react with 30 mL of the same acid solution. If the remaining acid is neutralized by 8 mL sample of NaOH solution given above, find the molarity of the acid solution.

44. Calculate the pH value of each of the solution obtained by mixing
A. 200 mL of 0.014 M HCl and 300 mL of 0.011 M NaOH
B. 100 mL of 0.2 M HBr and 100 mL of 0.1 M $Ba(OH)_2$ 10 mL of 0.4 M HCl and 30 mL of 0.12 M KOH
C. 100 mL of a solution with a pH= 2 and 100 mL of a solution with a pOH= 12.
D. 100 mL of a solution with a pH= 3 and 100 mL of a solution with a pH= 11.
E. 450 mL of a solution with a pH = 4 and 550 mL of a solution with a pH= 10.

45. What volume of 0.6M H_2SO_4 must be added to 200mL 0f 0.4M KOH solution so that the pH of the resulting solution will be 12?

46. A 200 mL of solution with pH= 2 and another 300 mL of solution with pH= 12 are mixed. What volume of 0.05 M NaOH or H_2SO_4 will be needed to neutralize the resulting solution?

47. A quantity of 5.6 g of KOH is added to 300 mL of 1 M HCl. Excess $CaCO_3$ is then added to the solution. What volume of CO_2 at STP is formed?

48. Calculate the pH of a solution prepared by dissolving 10.6 g of Na_2CO_3 in 500 mL of solution. Ka of H_2CO_3 is $2.5x10^{-4}$

49. Calculate the mass of NH_4NO_3 must be dissolved to obtain a 500 mL solution with a pH of 5.45. Kb of NH3 is $1.8x10^{-5}$

50. Calculate the pH of resulting solution obtained by mixing 400 mL of 2 M HF and 200 mL of 4 M KOH solutions. Ka of HF is $7.2x10^{-4}$.