## **Topic: Moles and Molar Mass**

1. Calculate the number of atoms in 5.00 g of …
2. Ca

5.00 \* 6.022e23/40.08 g

7.51e22

1. N2 (careful.. I want the number of atoms)

2 \* 5.00 \* 6.022e23/14.01 g

4.30e23

1. Ne

5.00 \* 6.022e23/20.18g

1.49e23

1. Hydrogen peroxide (H2O2) decomposes to water and oxygen, as shown below.

2 H2O2*(aq)* → 2 H2O*(l)* + O2*(g)*

A small sample of MnO2 is placed into a beaker of H2O2 while it is placed on a balance. The mass is measured over a period of 10 seconds and the data shown below.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Time (sec) | Mass (g) |  | Time (sec) | Mass (g) |
| 0 | 134.45 |  | 6 | 132.95 |
| 1 | 134.20 |  | 7 | 132.70 |
| 2 | 133.95 |  | 8 | 132.45 |
| 3 | 133.70 |  | 9 | 132.20 |
| 4 | 133.45 |  | 10 | 131.95 |
| 5 | 133.20 |  |  |  |

1. Explain why the beaker lost mass.

O­2 is a gas so it escapes the beaker

1. Determine the moles of oxygen created in the reaction.

2.50g \* mol/16g = 0.156 mol

1. Perform the following calculations.
2. How many molecules are in 1.8 g of H2O?

1.8g \* 6.022e23/18.02g = 6.0e22

1. How many molecules are in 3.8 g of C6H6?

3.8g \* avacado/78.12g = 2.9e22

1. Determine the number of oxygen atoms in 1.00 g of CaCO3

3 \* 1.00g \* avadcado/100.09g = 1.80e22

1. You have a 2.00 g sample of compounds X, Y, and Z. The molar mass (in g/mol) of X is 50, Y is 35, and Z is 90. Arrange the compounds from smallest number of moles present to largest number of moles present.

Z>X>Y

## Topic: Molarity and Dilution of Solutions

1. Describe the procedure a student should use to prepare 250. mL of 0.125 M CuSO4(aq) using 3.000 M CuSO4 in a 50 mL buret and other appropriate equipment selected from the list below. Assume that the student uses appropriate safety equipment.

* 250 mL beaker
* 250 mL graduated cylinder
* 250 mL volumetric flask
* Eye dropper
* 500 mL wash bottle filled with distilled water

.250\*.125=3X  
X=.0104 L

1. Describe the procedure a student should use to prepare 100. mL of 0.250 M NaOH(aq) using NaOH(s) and appropriate equipment selected from the list below. Assume that the student uses appropriate safety equipment.

* 100 mL beaker
* 100 mL graduated cylinder
* 100 mL volumetric flask
* Eye dropper
* 500 mL wash bottle filled with distilled water
* Electronic balance
* Massing Tray

(.250mol/L)/10 = .0250 moles  
.0250 \* 40.00 = 1.00g

1. A student used a 50.0 mL buret to add KMnO4(aq) to H2C2O4(aq) until a faint lavender color was observed in the flask, an indication that the end point of the titration had been reached.
   1. The initial and final volume readings of the solution in the buret are shown below. Write down the initial reading and the final reading and use them to determine the volume of KMnO4(aq) that was added during the titration.

Diagram

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* 1. Determine the moles of KMnO4 delivered if the molarity of the KMnO4(aq) is 0.320 M.

26.20 mL \* 0.320mol/1000mL = .008384

Perform the following calculations:

* 1. A 100 mL sample of 0.500 M NaNO3(aq) solution is mixed with 100 mL of 0.500 M Ca(NO3)2(aq) solution. What is the final concentration of the NO3− ion?

.15mol/.2L = .75 M

* 1. How many grams of CaCO3(s) (molar mass 100. g/mole) are needed to make 10. mL of 0.50 M solution?

.01L \* .5mol/L \* 100g/mol = 0.5g

* 1. A 540 mg sample of glucose (molar mass 180 g/mole) is dissolved in enough water to make 300. mL of solution. What would be the molarity of glucose in 100. mL of the solution?

.54g \* mol/180g = .003 mol  
.003mol/.1L = .03 M

* 1. A student dilutes 100. mL of 2.00 M CaCl2(aq) to a final volume of 400. mL with distilled water.
     1. How many moles of chloride ion are in the 100. mL solution?

2/10\*2=.4 moles

* + 1. How many moles of chloride ion are in the 400. mL solution?

.4 moles

* + 1. What is the molarity of chloride ion in the 100. mL solution?

4M

* + 1. What is the molarity of chloride ion in the 400. mL solution?

.1\*2.00 = .4x => x=.5 M  
Cl ion concentration = .5\*2=1 M

1. When a solution of glucose, C6H12O6, is diluted, the number of moles of the solute in the original solution is (greater than, less than, **the same as**) the number of moles of solute in the resulting less concentrated solution.

The same as

1. Calculate the *molarity* of the resulting solution if a certain volume of water was added to 50.0 mL of 2.10 M KOH solution to make a solution with a volume of 1.40 L.

.05\*2.1=1.4x =>.075M

1. Commercial concentrated hydrochloric acid is 12.0 M HCl. What *volume* of concentrated HCl is required to prepare 2.50 L of 2.20 M HCl solution?

12x=2.5\*2.2 x=0.46L

1. A 250. mL of a sodium hydroxide solution is diluted to 825 mL with water to form a 0.80 M solution. What was the molarity of the original solution?

.25x=.825\*.8 x=2.64M

1. A lab technician needs one liter of 0.250 M HCl. However, in her lab, there is only 2.0 M HCl solution available. Describe what the lab technician will do.

1\*.25=2x =>x=.125 L

1. Calculate the *molarity* of a solution prepared by mixing 50.0 mL of 0.250 M Na2SO4 and 100. mL of 0.125 M Na2SO4 solution.

.05\*(.25mol/L)=.0125 mol -> α

.1\*(.125mol/L)=.0125 mol ->β  
(α+β)/(.1+.05) = .167 M

## Topic: Dissociation Concepts

1. Use the key below to draw the solutions indicated.

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|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  |
| Dilute KCl(aq) |  | Concentrated KCl(aq) |  | Dilute Al(NO3)3(aq) |  | Concentrated Al(NO3)3(aq) |
|  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |
| Dilute Na3PO4(aq) |  |  |  |  |  |  |

1. Beaker X contains a solution of AgNO3 while Beaker Y contains a solution of MgCl2.
   1. Determine which beaker below is correct for Beaker X. Explain your reasoning. Be certain to discuss all beakers in your explanation. *Equal proportions*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
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| Beaker 1 |  | Beaker 2 |  | Beaker 3 |

* 1. Determine which beaker below is correct for Beaker Y. Explain your reasoning. Be certain to discuss all beakers in your explanation. *1:2 ratio*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| A picture containing text, electronics  Description automatically generated |  | A picture containing text, electronics  Description automatically generated |  | A picture containing text, electronics  Description automatically generated |
| Beaker 4 |  | Beaker 5 |  | Beaker 6 |

1. Add the appropriate cations Cu+ or Cu2+ to the beakers draw an accurate representation of the dissociation of the following aqueous salts:

|  |  |  |
| --- | --- | --- |
| CuNO3(aq) |  | Cu(NO3)2(aq) |
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1. In the box below draw the most likely orientation of H2O(l) molecules around the Cu2+ ion.

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1. Shown below is a representation of water and a crystal of LiCl. Answer the questions that follow about a student making a solution of LiCl(aq).

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* 1. Determine the identity of each particle below. Explain your reasoning.

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* 1. In the space provided below, show the interactions of the components of LiCl(aq) by making a drawing that represents the different particles present in the solution. Base the particles in your drawing on the particles shown in the representation above. Include only one formula unit of LiCl and no more than ten molecules of water. Your drawing must include the following details:
* Identify of ions (symbol and charge)
* The arrangement and proper orientation of the particles in the solution

Graphical user interface

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## Topic: Acids and Bases

1. Write one equation that can be used to calculate …
   1. the pH of a solution if [H3O+] is known.

-log([H3O+])

* 1. the pOH of a solution if [OH−] is known.

-log([OH-])

* 1. the pH of a solution if pOH is known.

14-pOH

* 1. the [H3O+] if pH is known.

10^(-pH)

* 1. the [OH−] if pOH is known.

10^(-pOH)

* 1. the [H3O+] if [OH−] is known.

1.0e-14/[OH-]

1. How would you calculate:

the pH of a solution if [OH−] is known.

14-(-log([OH-]))

the pOH of a solution if [H3O+] is known.

14-(-log([H3O+]))

1. Does the pH of the solution in the reaction below increase, decrease, or remain the same as the reaction proceeds? Justify your answer.

5 H2O2*(aq)* + 2 MnO4 –*(aq)* + 6 H+*(aq)* → 2 Mn2+*(aq)* + 8 H2O*(l)* + 5 O2*(g)*

Decrease because free floating proton ions are dead

1. At 25°C the autoionization of water is represented as

H2O(l) + H2O(l) 🡪 H3O+(aq) + OH-(aq)

and

[H3O+] x [OH-] = 1.0 x 10-14 = Kw

Because this reacts in a 1:1 ratio this means [H3O+] = [OH-] = 1.0 x 10-7 M and the pH = 7.00

When the same reaction is heated to 50 ℃ and the pH drops to 6.63.

* 1. Did the ionization of water increase or decrease with an increase in temperature? Justify your answer.

Increase because ph decreases meaning autoionization increases

* 1. What is the [H3O+] if pH =6.63?

2.3e-7

* 1. What is the [OH−]?

2.3e-7

* 1. Calculate the new value of Kw at 50 ℃.

5.476 x 10-14

* 1. Is the solution still neutral? Justify your answer.

Yes because ratios still the same

1. By what factor must a solution of a strong acid be diluted to increase the pH by 1? Give an example to justify your answer.

10 times

1. How do you identify strong acids?

Basic inorganic acids: Metal+h except Fl or O is 2 greater than H

1. What physical property of an acid makes it a strong acid?

Complete dissociation

1. What is the general formula of a strong base?

Metal + OH

1. What physical property of a base makes it a strong base?

Complete dissociation

1. Write the dissociation equation for HCl(aq) dissolved in water.

HCl -> H+ + Cl-

1. Calculate the pH of the strong acids and bases given below:
   1. A 0.002 M solution of HCl

-log(.002)=2.7 pH

* 1. A 3.45 x 10−4 M solution of HNO3

-log(3.45e-4)=3.46 pH

* 1. A solution made by dissolving 3.2 g of KOH into 450 mL of total solution.

3.2g\*mol/56.11g=.057 mol

.57mol/.45L = .13 M  
-log(.13)=0.89 pOH  
14-.89=13.1 pH

* 1. 100 mL of a 1 x 10−4 M HBr solution.

4 pH

* 1. The solution from d that is diluted to a total volume of 1000 mL.

.1\*1e-4 = x =>1e-5  
-log(1e-5)=5.0 pH

* 1. 100 mL of a 0.10 M HNO3 solution added to 100 mL of 0.25 M HCl and diluted to a final volume of 1200 mL

.1 \* .1/L + .1 \* .25/L = .035 mol

.035/1.2 = .029 M

-log(.29) = 1.5 pH

* 1. A solution of Ca(OH)2 made by dissolving 120. g in 3500 mL of total solution.

120g\*mol/74.09g = 1.619 mol

2\*[1.619/3.5] = .93 M

14-(-log(.93))=13.97 pH

1. Complete the following table without a calculator. Then check your work with a calculator.

|  |  |  |
| --- | --- | --- |
| [H+] or [OH−] | pH between … | |
| [H+] = 1.25 x 10 −2 M | 1 to 2 | 2 to 3 |
| 3 to 4 | 4 to 5 |
| 5 to 6 | 6 to 7 |
|  |  |  |
| [H+] = 4.56 x 10 −4 M | 1 to 2 | 2 to 3 |
| 3 to 4 | 4 to 5 |
| 5 to 6 | 6 to 7 |
|  |  |  |
| [OH−] = 7.88 x 10 −11 | 1 to 2 | 2 to 3 |
| 3 to 4 | 4 to 5 |
| 5 to 6 | 6 to 7 |