This is BCE#22.

I recommend you print out this page and bring it to class. Click here to show a set of five BCE22 student responses randomly selected from all of the student responses thus far in a new window.

John , here are your responses to the BCE and the Expert's response.

Our discussion of acids and bases has prepared you to calculate the pH of the following solutions,

strong acids
weak acids
strong bases
weak bases
the salt of a strong acid and a strong base
the salt of a strong acid and a weak base
the salt of aweak acid and a strong base
common ion - weak acid and its conjugate base
common ion - weak base and its conjugate acid

Our next system to consider in aqueous equilibria is the neutralization reaction. Lets look at a neutralization reaction in the context of the different types of acids and bases.

1. Predict the products of the following neutralization reactions:

a) NaOH(aq) + HNO_3(aq) ---->

NaNO3(aq) + H2O(l)

NaOH(aq) + HNO_3(aq) ----> $NaNO_3$(aq) + H_2O(l) 73%

b) KOH(aq) + HCN(aq) ---->

KCN(aq) + H2O(l)

KOH(aq) + HCN (aq) ----> KCN(aq) + H_2O(l) 73%

c) NH_3 (aq) + HCl(aq) ----> 93%

NH4Cl(aq)

NH_3(aq) + HCl(aq) ----> NH_4Cl(aq)

2. Let get more quantitative with the first neutralization reaction. NOTE: This is solution stoichiometry calculations from CHEM 1314 so watch out! Suppose you are doing a titration (laboratory last week) to determine the concentration of a standardized solution of NaOH. Here is the following data that you collect in the experiment. (NOTE: The endpoint of a titration is when the mol of acid = mol of base)

Volume of standard NaOH solution : 15.00 mL

Concentration of HNO_3 : 0.424 M

Volume of HNO_3 solution required to reach the endpoint of the titration : 10.00 mL

a) how many mol of HNO_3 reacted?

mol HNO_3 0.00424 93%

mol HNO_3 = 0.0100 L * (0.424 mol HNO_3/1 L) = 0.00424 mol HNO_3

b) how many mol of NaOH reacted?

mol NaOH 0.00424 93%

mol NaOH reacting = mol HNO_3 reacting = 0.00424 mol

c) concentration of the standard NaOH solution?

0.283 M NaOH 79%

molarity of NaOH = mol NaOH/ liters solution = 0.00424 mol NaOH/0.015 L = 0.283 M

3. Lets consider a titration where the concentration of NaOH is 0.283 M. In the titration the NaOH is added to a 25.0 mL sample of a 0.424 M HNO_3 solution.

a) Calculate the pH of the HNO_3 solution before any base is added.

pH = 0.372 71%

pH = -log [H^+]

In a solution that is 0.424 M HNO_3 the [H^+] = 0.424 M because HNO_3 is a strong acid.

pH = -log (0.424) = 0.373

b) If 5.00 mL of 0.283 M NaOH is added to the 25.0 mL sample of 0.424 M HNO_3 answer the following questions:

i) How many mol of NaOH have been added when 5.00 mLs of 0.283 M NaOH are added to the acid solution?

mol of NaOH added 0.001415 93%

0.0050 L * (0.283 mol NaOH/1 L) = 0.00142 mol NaOH added

ii) How many mol of HNO_3 would react?

mol of HNO_3 reacting 0.001415 79%

mol HNO_3 reacting = mole of NaOH added = 0.00142 mol HNO_3

iii) How many mol of HNO_3 remain unreated?

mol of HNO_3 remaining 0.009185 79%

The initial number of mol of HNO_3 are

0.0250 L * (0.424 mol HNO_3/1 L) = 0.0106 mol HNO_3

From ii) the mol HNO_3 reacting are = 0.00142 mol

So mol of HNO_3 remaining = mol $(HNO_3)_o$ - mol $(HNO_3)_r$ = 0.0106 mol - 0.00142 mol = 0.00918 mol

iv) What is the new concentration of HNO_3 after addition of NaOH

new $[HNO_3]$ 0.306 M 57% 14% 0.00918 / 0.025

The new concentration of HNO_3 = mol HNO_3/volume solution

We have to be careful with this calcualtion. The mol of HNO_3 are in iii) but the volume of the solution is the volume of the sample of HNO_3 initially plus the volume of NaOH solution added. So the calculation is...

0.00918 mol HNO_3/0.030 L = 0.306 M HNO_3

v) What is the new pH of the solution

pH = 0.514 57%

pH = -log $[H^+]$

In a solution that is 0.306 M HNO_3 the $[H^+]$ = 0.306 M because HNO_3 is a strong acid.

pH = -log (0.306) = 0.514

Notice after adding some NaOH the pH is higher. Since some of the HNO_3 has been neutralized the pH increases.

4. Is there anything about the questions that you feel you do not understand? List your concerns/questions.

nothing

5. If there is one question you would like to have answered in lecture, what would that question be?

nothing