pH of Strong Acids and Strong Bases

- Strong acids/Strong bases undergoes complete dissociation in water.
- <u>Calculate pH of a strong acids.</u>
- Therefore, the pH of a 0.01 mol dm^{-3} of HCl is 2.

$$HCl \rightarrow H^+ + Cl^-$$

$$0.01 \rightarrow 0.01 + 0.01$$

a) Calculate the pH of 0.00056 mol dm^{-3} of HNO_3.
b) Calculate the pH of 0.0000334 mol dm^{-3} of H_2SO_4.
c) Calculate the concentration of HBr that has a pH of 1.35.

2. The acid dissociation constant for a monobasic acid = 1.0×10^{-4} mol dm^{-3}.

a) What is the pK_a for the acid? 4

b) In 0.01 mol dm^{-3} solution of the acid, what is the concentration of H^+ (aq) ions and the pH?

- 1.0×10^{-3} mol/dm^3; pH = 3

3. The pH of a 1.0 mol dm^{-3} solution of a weak monobasic acid is 4. What is the dissociation constant for the weak acid?

a) 1.0×10^{-2} mol dm^{-3}

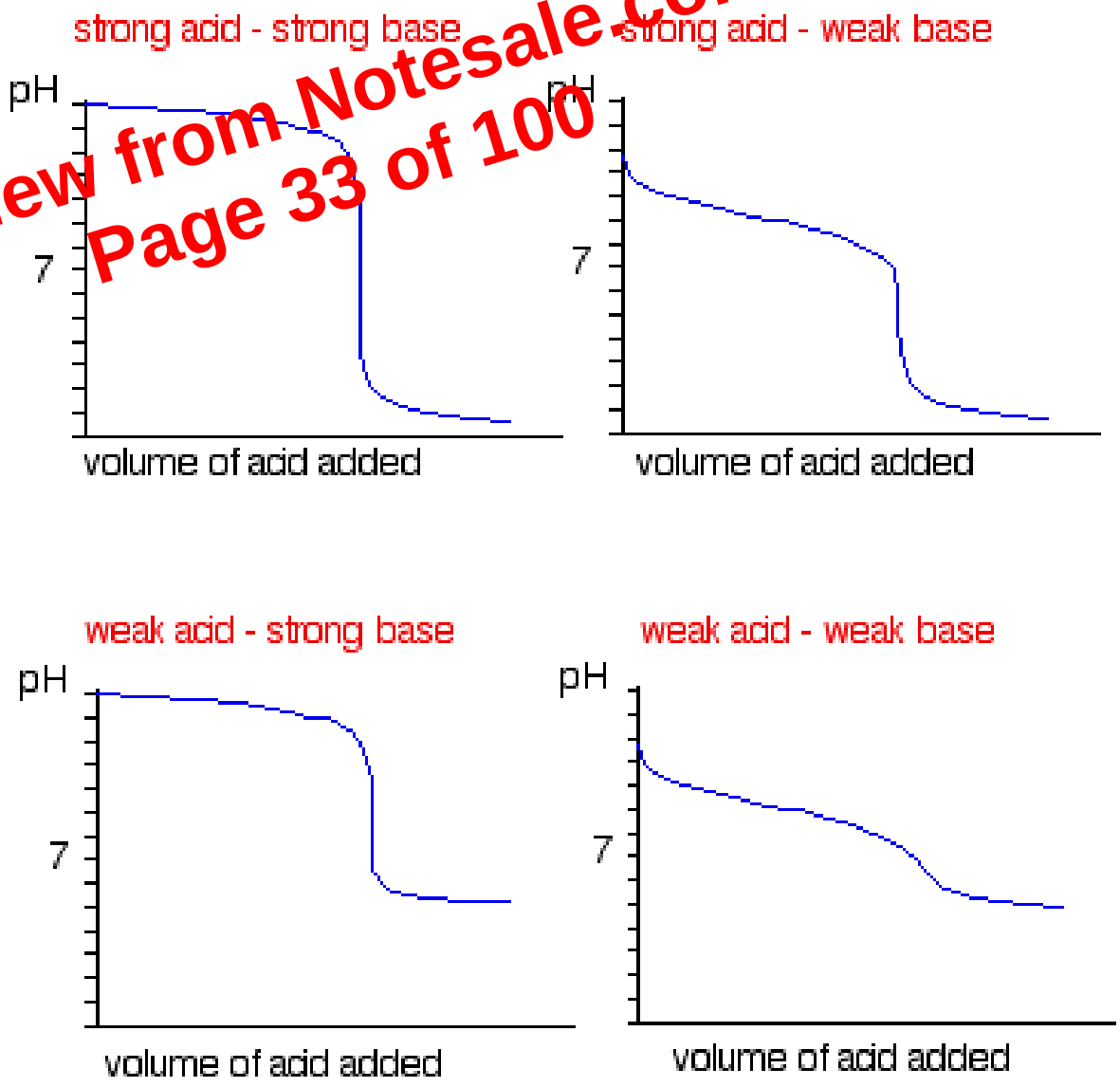
b) 1.0×10^{-4} mol dm^{-3}

c) 1.0×10^{-7} mol dm^{-3}

d) 1.0×10^{-8} mol dm^{-3}

- Red cabbage juice contains a mixture of substances whose color depends on the pH. Each test tube contains a solution of red cabbage juice in water, but the pH of the solutions varies from pH = 2.0 (far left) to pH = 11.0 (far right). At pH = 7.0, the solution is blue.

- Burette – Acid
- Conical flask - Alkali



- The high conc of both CH_3COOH & CH_3COONa keeps them from dissociating to a large extent, ensuring their concentration in solution does not change significantly.

1. $CH_3COOH\ (aq) \rightleftharpoons H^+\ (aq) + CH_3COO^-\ (aq)$

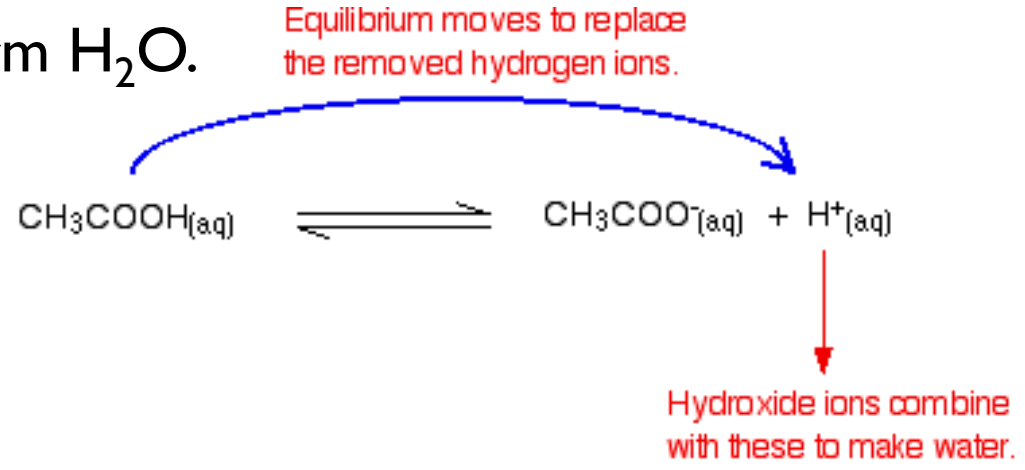
   At eqm: $0.1\ M - x \approx 0.1\ M$

2. $CH_3COONa\ (aq) \rightarrow Na^+\ (aq) + CH_3COO^-\ (aq)$

   At eqm: $0.1\ M$ $0.1\ M$ $0.1\ M$

- **When more base (OH^-) is added, (2 ways to remove)**

2. **Reacts with H^+** from the ionisation of the ethanoic acid to form H_2O.



1. A buffer is prepared by dissolving 0.25 mol CH_3COONa in 200 cm^3 of 0.60 mol dm^{-3} aqueous CH_3COOH.

   K_a = 1.85 x 10^{-5} mol dm^{-3}

   Calculate the pH of the buffer.

2. How many moles of CH_3COONa must be added to 2.00 dm^3 of 0.200 mol dm^{-3} ethanoic acid to produce a buffer solution of pH 4.60?

   K_a = 1.85 x 10^{-5} mol dm^{-3}

3. Calculate the pH of 250 cm^3 solution containing 3.68 g HCOOH and 3.06 g HCOONa.

K_a of HCOOH = 1.8 x 10^{-4} mol dm^{-3}

Calculate pH when acid/base is added into a buffer.

1. Calculate the pH change to the following buffer solutions when 0.10 mol/dm^3 KOH(s) is added. [Ka = HCOOH = 1.8 X 10^{-4}]
   a) Solution mixture of 0.20 mol/dm^3 HCOOH and 0.20 mol/dm^3 HCOOK
   b) Solution mixture of 1.00 mol/dm^3 HCOOH and 1.00 mol/dm^3 HCOOK

- *Step 1: Write equation,*
- *Step 2: build I.C.E equilibrium table filling only* ***no of MOLES****.*
- *Ste[3: Substitute into formula.*

2. Calculate the pH of a mixture containing 0.1 mol dm^{-3} ethanoic acid and 0.25 mol dm^{-3} sodium ethanoate. (Ka CH3COOH = 1.8 X 10^{-5} mol dm^{-3})

- Calculate the change in pH when 10 cm^3 of 1.0 mol dm^{-3} HCl is added to 1 dm^3 of the buffer.

- Calculate the change in pH when 10 cm^3 of 1.0 mol dm^{-3} NaOH is added to 1 dm^3 of the buffer.

Longman pre-U text STPM chemistry pg167 Ex 11.16

Buffers in blood system

- If the pH of the human blood (7.35-7.45) is changed by as little as 0.4, it could be fatal.

- If the pH of the blood is pH < 7.35 – acidosis
- If the pH of the blood is pH > 7.45 – alkalosis

- The pH of the blood is kept by few systems:

a) Hydrogencarbonate ions HCO_3^-
b) Dihydrogenphosphate ($H_2PO_4^-$) & hydrogenphosphate (HPO_4^{2-})
c) Haemoglobin and plasma proteins

- Solubility product, K_{sp} is the product of the concentrations of each ion in a saturated solution of a sparingly soluble salt at 298 K, raised to the power of their relative concentrations.

- Write the equation & the expression of the solubility products with its respective units of the following salts:
- $BaSO_4$,
- $Ca(OH)_2$,
- $Al(OH)_3$,
- $Ca_3(PO_4)_2$,
- Silver chromate(VI) Ag_2CrO_4

Solubility Exercise

1. The solubility of cadmium phosphate, $Cd_3(PO_4)_2$ is x mol dm^{-3} at 25 °C. What is the expression of the solubility product of cadmium phosphate?

   A. $6x^2$

   B. $12x^3$

   C. $36x^5$

   D. $108x^5$

2. The solubility of lead chromate, $PbCrO_4$ is 1.39×10^{-7} mol dm^{-3}. Calculate the value of K_{sp} for lead chromate.

3. The solubility of manganese carbonate, $MnCO_3$ is 4.2×10^{-6} mol dm^{-3}. Calculate the value of K_{sp} for manganese carbonate.

- When aqueous NaCl is added to a solution of AgCl, will a precipitate of AgCl be formed?

- To predict whether a precipitate would be formed or not, we have to calculate the solubility quotient, Q of the mixture, and compare it with the given K_{sp}.

$$AgCl\ (s) \rightleftharpoons Ag^{+}\ (aq) + Cl^{-}\ (aq)$$

- $Q = [Ag^{+}]\ [Cl^{-}]$
- If $Q > K_{sp}$, a precipitate will be formed.
- If $Q < K_{sp}$, no precipitate will be formed.
- If $Q = K_{sp}$, the solution is saturated.

Step 1: Find the ion concentration (solubility) of the limiting ion from its given Ksp

Step 2: Assume the common ion concentration comes from the added solution

Step 3: Find the NEW ion concentration of the limiting ion from the Ksp and the common ion concentration.

Step 4: Compare the original and new conc of the limiting ion.

http://www.chemguide.co.uk/physical/ksp/common ion.html

- Exercise 3
- Calculate the mass of PbBr2 precipitated when 200 cm^3 of 1.0 mol dm^{-3} $Pb(NO_3)_2$ is added to 200 cm^3 of 2.0 mol dm^{-3} NaBr. K_{sp} $PbBr_2$ = 8.0×10^{-5} mol^3 dm^{-9}.

Question 4

- 1.00 g of X in 100 cm^3 water was shaken with 10 cm^3 of ether. Calculate how much mass of X was extracted into the ether layer. K_{pc} of X = 40.

- 1.00 g of X in 100 cm^3 water was shaken with 5 cm^3 of ether. Calculate how much mass of X was extracted into the ether layer. K_{pc} of X = 40.

- How much of X would be extracted in total by using the 2 times of 5 cm^3 ether for each extraction instead of 1 extraction by using 10 cm^3 ether?