Review Sheet #1 Monday, December 8, 2003

$$\bar{x} = \frac{\sum_i x_i}{n} \qquad s = \sqrt{\frac{\sum_i \left(x_i - \bar{x} \right)^2}{n-1}} \qquad \mu = \bar{x} \pm \frac{t\sigma}{\sqrt{n}}$$

$$Q = \frac{d}{w} \qquad K_a = \frac{K_w}{K_b}$$

Know concepts of

- Gaussian Curve
- Systematic Error
- Indeterminate Error
- t-test
- q-test
- Propagation of Uncertainty

1] The Fe content of a meteorite was found to be:

12.6% 11.9% 13.0% 12.7% 12.5%

- **Find the 50% and 95% confidence limit for the Fe analysis.**

- **Describe in words what the confidence interval concept means.**

1] Answer

First calculate $\bar{x} = 12.5\%$
Then standard dev. $s = 0.4$

For n = 5 or df= 4 find the 50% confidence limit in table 4-2,

0.741

Plug into the t-test equation above

$$\mu = \bar{x} \pm \frac{t\sigma}{\sqrt{n}} = 12.5 \pm \frac{0.741(0.4)}{\sqrt{5}} = 12.5 \pm 0.1\%$$

- This calculation tells us that there is a 50% chance that the true mean, μ lies within the interval 12.5% ± 0.1%

Now find the 95% C.L. n = 5, d.f. = 4, 8.610

$$\mu = \bar{x} \pm \frac{t\sigma}{\sqrt{n}} = 12.5 \pm \frac{2.776(0.4)}{\sqrt{5}} = 12.5 \pm 0.5\%$$

- Note that the C.L. interval widens.

2] Decide whether any of the following values can be rejected at the 90% confidence level:

0.217
0.224
0.195
0.221
0.221
0.223

2] Answer

$$Q = \frac{d}{w} = \frac{0.217 - 0.195}{0.223 - 0.195} = 0.786$$

n = 6 use Table 4-6 $Q_{table} = 0.56$

$Q > Q_{table}$ so the point can be discarded

3] Calculate the pH of 0.050 M acetic acid. K_a = 1.75e-5

CH_3COOH	=	CH_3COO^-	+	H^+
0.050		0		0
-x		+x		+x

x^2 / 0.050-x = 1.75e-5

x = 9.35e-4

pH = 3.03

4] What is the molar solubility of $PbCl_2$, K_{sp} = 1.7e-5?

$PbCl_2$	=	Pb^{2+}	+	$2Cl^-$
--		0		0
--		+x		+2x
--		x		2x

$K_{sp} = [Pb^{2+}][Cl^-]^2$

$(2x)^2x$ = 1.7e-5 x = 1.6e-2 M

5] What is the solubility of $PbCl_2$ in 0.10 M NaCl?

Compare the answer with #4's.

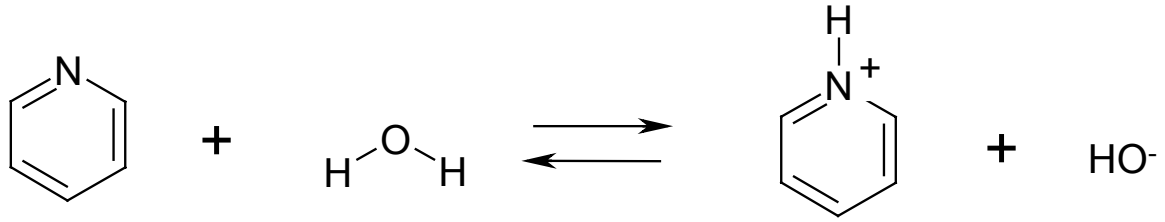
$PbCl_2$	=	Pb^{2+}	+	$2Cl^-$
--		0		0.10
--		+x		+2x
--		x		0.10 + 2x

$(0.10 + 2x)^2\ x = 1.7e\text{-}5$

$(0.10)^2\ x \approx 1.7e\text{-}5$

$x = 1.7e\text{-}3\ M$

6] What is the pH of a 0.20 M solution of pyridine, C_5H_5N, in aqueous solution? The K_b for pyridine is 1.4×10^{-9}.



6] Answer

0.20	+	--	=	0	+	0
-x		--		+x		+x
0.20-x		--		x		x

Assumption: 0.20 >> x

$$K_b = \frac{[HB^+][OH^-]}{[B]} = \frac{x^2}{0.20 - x} = 1.4 \times 10^{-9}$$

$$\frac{x^2}{0.20} = 1.4 \times 10^{-9}$$

$$x = [HO^-] = 1.7 \times 10^{-5}$$

Now calculate the pH from $[OH^-] = 1.7 \times 10^{-5}$.

$$K_w = [H^+][HO^-] = 1.01 \times 10^{-14}$$

$$[H^+][1.7 \times 10^{-5}] = 1.01 \times 10^{-14}$$

$$[H^+] = 5.9 \times 10^{-10}$$

$$pH = 9.23$$

7] What is the molar concentration of 0.65% (w/w) KCl (74.55 g/mol)? Density = 1.00 g/mL

Assume 1 g of solution 0.0065 * 1 g = 0.0065 g KCl

0.0065 g KCl * (mol / 74.55 g) * (1 / 0.00100 L) = 8.7e-2 M