AP CHEMISTRY

TOPIC 7: ACIDS & BASES, PART C — EXAMPLES, PART II — Day 77:

- Bases
- Weak bases
- No 5% Rule

Example: Calculate the pH of a 0.00750 *M* solution of diethylamine. $(C_2H_5)_2NH$, $K_b = 1.30 \times 10^{-3}$

Do not use the 5 % rule for this problem… You will see one like this on the homework and on the quiz …

Answers: ***WEAK BASE …***

	$[\ (C_2H_5)_2NH\ ]$	+	$[\ H_2O\ ]$	$\rightleftharpoons$	$[\ (C_2H_5)_2NH_2^{+1}\ ]$	+	$[\ OH^{-1}\ ]$
I	0.0075 *M*		-		0		0
C	$-x$		-		$+x$		$+x$
E	$0.0075 - x$		-		x		x

$$K_b = 1.3 \times 10^{-3} = \frac{\left[\ (C_2H_5)_2 NH_2^{+1}\ \right]\left[\ OH^{-1}\ \right]}{\left[\ (C_2H_5)_2 NH\ \right]} = \frac{x^2}{0.0075 - x}$$

$$\frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

$$K_b = 1.3 \times 10^{-3} = \frac{x^2}{0.0075 - x};\quad \left(\ 1.3 \times 10^{-3}\ \right)\left(\ 0.0075 - x\ \right) = x^2$$

$$9.75 \times 10^{-6} - 1.3 \times 10^{-3}\ x = x^2$$

$$0 = x^2 + 1.3 \times 10^{-3}\ x - 9.75 \times 10^{-6}$$

$$\frac{-\left(\ 1.3 \times 10^{-3}\ \right) \pm \sqrt{\left(\ 1.3 \times 10^{-3}\ \right)^2 - 4\left(\ 1\ \right)\left(\ -9.75 \times 10^{-6}\ \right)}}{2\ (\ 1\ )}$$

$$x = 2.54 \times 10^{-3} \quad OR \quad -3.84 \times 10^{-3}$$

We cannot have negative concentrations, therefore $x = 0.00254$

CHECK: $K_b = 1.3 \times 10^{-3} = \frac{\left(\ 0.00254\ \right)^2}{0.0075 - 0.00254}$, Check is perfect !!!

pOH = - log (0.00254) = 2.60, **pH** = 14 – 2.60 = **11.40**

If you did not use the quadratic equation, $x = 3.21 \times 10^{-3}$ (22.9 % error),

and your WRONG pH would have been equal to 11.51