

• LOGARITHMIC RELATIONSHIPS (to memorize and to be able to use):

$$\text{pH} = -\log[\text{H}_3\text{O}^+]$$

On a calculator,

$$\text{p}K_a = -\log(K_a)$$

whereas

“log” expresses a sci.no.’s value *exponentially*

“antilog” is used to get back to sci.no.form

EXAMPLES:

If you know $K_a = 2.0 \times 10^{-5} \text{ M}$ (this value is in sci.no. form),
how do you calculate $\text{p}K_a = +4.70$ on the calculator?

(Begin with the known sci.no.;

press “log”; press “+/-” to change sign; keep 2 digits past decimal pt.)

If you know $\text{p}K_a = 5.30$ (this is an exponential kind of value),
how do you calculate $K_a = 5.0 \times 10^{-6}$ on the calculator?

(Begin with the known 5.30;

press “+/-” to change sign; *then* press “antilog”; keep 2 sig. figs.)

Perform these interconversions on your calculator:

If K_b for $\text{NH}_3 = 1.8 \times 10^{-5}$, $\text{p}K_b$ for $\text{NH}_3 =$ _____ conjugate is _____

If $K_{a(1)}$ for $\text{H}_2\text{CO}_3 = 4.2 \times 10^{-7}$, $\text{p}K_{a(1)} =$ _____ conjugate is _____

If K_a for $\text{HCO}_3^- = 4.8 \times 10^{-11}$, $\text{p}K_a =$ _____, conjugate is _____

If K_b for $\text{HPO}_4^{2-} = 1.6 \times 10^{-7}$, $\text{p}K_b =$ _____, conjugate is _____

If $\text{p}K_b$ for $\text{CH}_3\text{CO}_2^- = 9.26$, $K_b =$ _____, conjugate is _____

If $\text{p}K_a$ for $\text{CH}_3\text{NH}_3^+ = 3.30$, $K_a =$ _____, conjugate is _____

- Re-express this relationship into " $pK_w = \dots$ " form:

$$K_w = [\text{H}_3\text{O}^+] [\text{OH}^-] = 1.00 \times 10^{-14}$$

Using the K_w relationship and Using the pK_w relationship for re-expressing data —
EXAMPLES TO PRACTICE UPON:

If $[\text{H}_3\text{O}^+] = 4.5 \times 10^{-10} \text{ M}$, or $8.6 \times 10^{-7} \text{ M}$, or 3.0 M ,

convert these values to

pH = _____

pOH = _____

$[\text{OH}^-] =$ _____

If pH = 6.78, or 5.12, or -0.60,

convert these values to

$[\text{H}_3\text{O}^+] =$ _____

$[\text{OH}^-] =$ _____

pOH = _____

★ KEEP DATA IN CALCULATOR THRUOUT ENTIRE SERIES OF CALCULATIONS.

★ WHEN RECORDING ANSWERS,

USE CARE WITH SIG.FIGS., AND DIMENSIONS (if appropriate).

SOME MISCELLANEOUS QUESTIONS:

- 1) If four solutions have pH values of 5.24, 8.71, 0.70, and
 which solution is the most acidic? _____
 which solution is the most alkaline? _____
- 2) If three substances have K_a values of 3.0×10^{-10} , 5.6×10^{-8} , and 1.7×10^{-4} ,
 which substance is the weakest acid? _____
- 3) Which species below should have a pK_a value and also a pK_b value?
 When it reacts as a weak acid, what is its conjugate? _____
 When it reacts as a weak base, what is its conjugate? _____
- $H_2PO_4^-$ H_3PO_4 CO_3^{2-} $CH_3NH_3^+$ HNO_3
- 4) For which species do we write **NEITHER** a pK_a **NOR** a pK_b ? _____ (Why?)
- 5) Show how to **DERIVE** the alternate form (i.e., the pK_w form) of this relationship:

$$K_w = [H_3O^+][OH^-] = 1.00 \times 10^{-14}$$
- 6) What three other data can you calculate for a soln, if you know:
- a) $[OH^-] = 1.0 \times 10^{-2} M$ in the solution? (One of answers is pH = 12.00)
- b) $pOH = 9.36$ in the solution? (One of answers is $[H_3O^+] = 2.3 \times 10^{-5} M$)

More practice at interconversions of pH values (and other pITEMS).

What else is calculable if you know the following facts?

Partial answers given below:

- If K_b for $\text{NH}_3 = 1.8 \times 10^{-5}$?
and info about its conjugate?

$$pK_b = 4.74$$

$$\text{NH}_4^+ \text{ has a } K_a$$

- If $[\text{OH}^-] = 3.0 \times 10^{-2} \text{ M}$?

$$\text{pH} = 12.48$$

etc.

- If $\text{pH} = 0.50$?

$$[\text{H}_3\text{O}^+] = 0.32 \text{ M}$$

$$\text{pOH} = 13.50$$

etc.

- If pK_b for an ion $\text{A}^{2-} = 7.32$?
and info about its conjugate ?

$$K_b = 4.8 \times 10^{-8}$$

etc.

- If $[\text{H}_3\text{O}^+] = 4.0 \times 10^{-3} \text{ M}$?

$$\text{pOH} = 11.60$$

etc.

- If $\text{pH} = 8.92$?

$$[\text{OH}^-] = 8.3 \times 10^{-6} \text{ M}$$

etc.