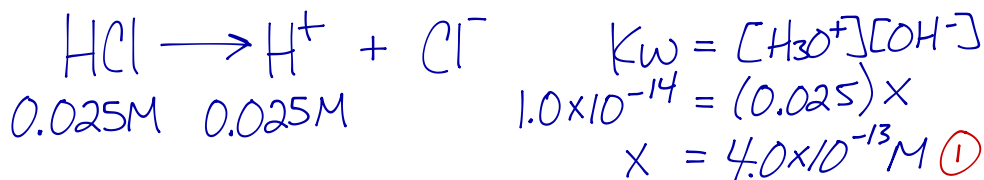
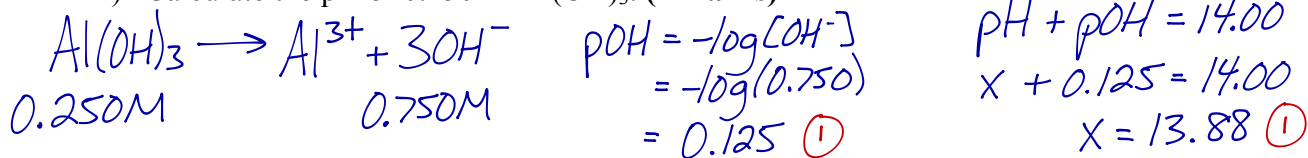


CHEMISTRY 12 – K_w , pH AND pOH WORKSHEET #2

1) What is the $[\text{OH}^-]$ in 0.025 M HCl? (1 mark)



2) Calculate the pH of 0.250 M $\text{Al}(\text{OH})_3$. (2 marks)

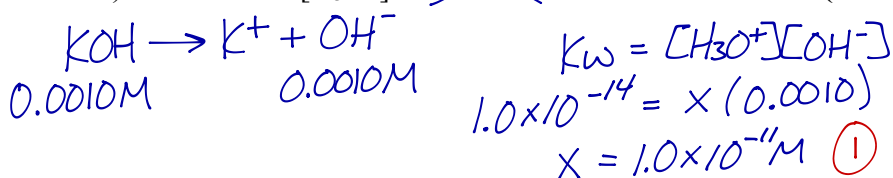


3) Which of the following is possible for an acid?

	ACID STRENGTH	CONCENTRATION	pH
A. (1)	strong	0.01 M	2.0
B.	weak	0.01 M	1.0
C.	strong	3 M	5.5
D.	weak	3 M	-0.5

Strong acid would ionize completely \therefore
 $\text{HA} \rightarrow \text{H}^+ + \text{A}^-$
 0.01M 0.01M
 $\text{pH} = -\log[\text{H}_3\text{O}^+] = -\log(0.01) = 2.0$

4) What is the $[\text{H}_3\text{O}^+]$ in ~~200.0 mL~~ of 0.0010 M KOH? (2 marks)



5) Tomato juice has a pH of 4.20. Calculate the $[\text{H}_3\text{O}^+]$ and $[\text{OH}^-]$ in tomato juice. (2 marks)

$$[\text{H}_3\text{O}^+] = 10^{-\text{pH}}$$

$$= 10^{-4.20}$$

$$= 6.3 \times 10^{-5} \text{ M} \text{ (1)}$$

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

$$1.0 \times 10^{-14} = (6.3 \times 10^{-5}) \times x$$

$$x = 1.6 \times 10^{-10} \text{ M} \text{ (1)}$$

6) A student records the pH of **0.1 M** solutions of two monoprotic acids:

Acid	pH
X	4.0
Y	2.0

\rightarrow if strong, 100% ionization would make $[\text{H}_3\text{O}^+] = 0.1 \text{ M} \therefore$
 $\text{pH} = -\log[\text{H}_3\text{O}^+]$
 $= -\log(0.1)$
 $= 1.0$

What can be concluded from the above data? (2 marks)

Since both acids have a pH > 1.0, they did not undergo complete ionization \therefore both are weak acids, with acid Y being a stronger weak acid. (1) (1)

7) What is the mass of NaOH required to prepare 100.0 mL of NaOH_(aq) that has a pH = 13.62? (2 marks)

$$\begin{aligned} \text{pH} + \text{pOH} &= 14.00 \\ 13.62 + x &= 14.00 \\ x &= 0.38 \end{aligned}$$

$$\begin{aligned} [\text{OH}^-] &= 10^{-\text{pOH}} \\ &= 10^{-0.38} \\ &= 0.42 \text{ M} \end{aligned}$$

$$\text{NaOH} \longrightarrow \text{Na}^+ + \text{OH}^-$$

0.42 M 0.42 M

$$g \text{ NaOH} = 0.1000 \text{ L} \times \frac{0.42 \text{ mol}}{1 \text{ L}} \times \frac{40.0 \text{ g}}{1 \text{ mol}} = 1.7 \text{ g}$$

8) In a solution at 25°C, the [H₃O⁺] is 3.5 x 10⁻⁶ M. Calculate the [OH⁻]. (1 mark)

$$\begin{aligned} K_w &= [\text{H}_3\text{O}^+][\text{OH}^-] \\ 1.0 \times 10^{-14} &= (3.5 \times 10^{-6})x \\ x &= 2.9 \times 10^{-9} \text{ M} \end{aligned}$$

9) The pH of pure water is 6.52 at 60°C. Calculate the [OH⁻]. (2 marks)

$$\begin{aligned} [\text{H}_3\text{O}^+] &= 10^{-\text{pH}} \\ &= 10^{-6.52} \\ &= 3.0 \times 10^{-7} \text{ M} \end{aligned}$$

Since it is pure water,
[H₃O⁺] = [OH⁻] ∴
[OH⁻] = 3.0 x 10⁻⁷ M

10) Calculate the pH of 0.25 M Sr(OH)₂. (2 marks)

$$\begin{aligned} \text{Sr}(\text{OH})_2 &\longrightarrow \text{Sr}^{2+} + 2\text{OH}^- \\ 0.25 \text{ M} &\qquad\qquad 0.50 \text{ M} \end{aligned}$$

$$\begin{aligned} \text{pOH} &= -\log[\text{OH}^-] \\ &= -\log(0.50) \\ &= 0.30 \end{aligned}$$

$$\begin{aligned} \text{pH} + \text{pOH} &= 14.00 \\ x + 0.30 &= 14.00 \\ x &= 13.70 \end{aligned}$$

11) Calculate the [H₃O⁺] in 100.0 mL of 0.0515 M KOH. (2 marks)

$$\begin{aligned} \text{KOH} &\longrightarrow \text{K}^+ + \text{OH}^- \\ 0.0515 \text{ M} &\qquad\qquad 0.0515 \text{ M} \end{aligned}$$

$$\begin{aligned} K_w &= [\text{H}_3\text{O}^+][\text{OH}^-] \\ 1.0 \times 10^{-14} &= x(0.0515) \\ x &= 1.9 \times 10^{-13} \text{ M} \end{aligned}$$

12) What is the concentration of Sr(OH)₂ in a solution with a pH = 11.00? (2 marks)

$$\begin{aligned} \text{pH} + \text{pOH} &= 14.00 \\ 11.00 + x &= 14.00 \\ x &= 3.00 \end{aligned}$$

$$\begin{aligned} [\text{OH}^-] &= 10^{-\text{pOH}} \\ &= 10^{-3.00} \\ &= 1.0 \times 10^{-3} \text{ M} \end{aligned}$$

$$\begin{aligned} \text{Sr}(\text{OH})_2 &\longrightarrow \text{Sr}^{2+} + 2\text{OH}^- \\ 5.0 \times 10^{-4} \text{ M} &\qquad\qquad 1.0 \times 10^{-3} \text{ M} \end{aligned}$$

13) What is the pOH of a 1.8 M HClO₄ solution? (2 marks)

$$\begin{aligned} \text{HClO}_4 &\longrightarrow \text{H}^+ + \text{ClO}_4^- \\ 1.8 \text{ M} &\qquad\qquad 1.8 \text{ M} \end{aligned}$$

$$\begin{aligned} \text{pH} &= -\log[\text{H}_3\text{O}^+] \\ &= -\log(1.8) \\ &= -0.26 \end{aligned}$$

$$\begin{aligned} \text{pH} + \text{pOH} &= 14.00 \\ -0.26 + x &= 14.00 \\ x &= 14.26 \end{aligned}$$

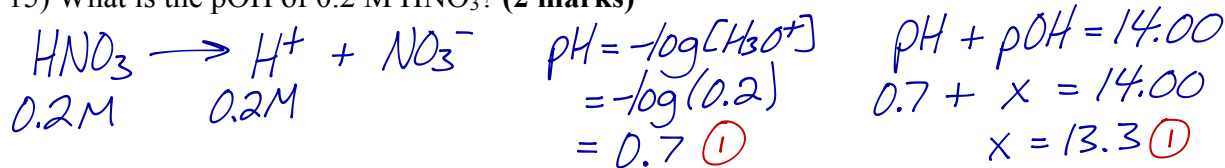
14) Calculate the $[H_3O^+]$ in a solution with a $[OH^-]$ of 1.5×10^{-4} M. (1 mark)

$$K_w = [H_3O^+][OH^-]$$

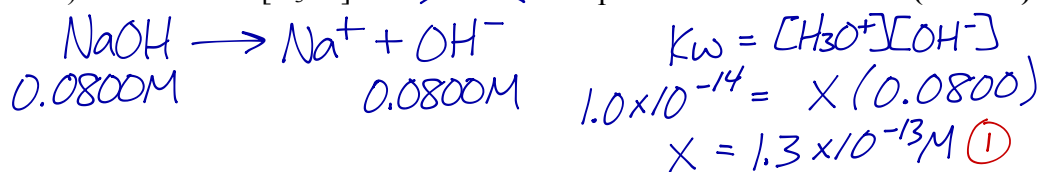
$$1.0 \times 10^{-14} = x (1.5 \times 10^{-4})$$

$$x = 6.7 \times 10^{-11} \text{ M} \quad \textcircled{1}$$

15) What is the pOH of 0.2 M HNO_3 ? (2 marks)



16) Calculate the $[H_3O^+]$ in a ~~100.0~~ mL sample of 0.0800 M NaOH. (1 mark)



17) Calculate the $[H_3O^+]$ of a solution with a pOH of 4.60. (2 marks)

$$pH + pOH = 14.00$$

$$x + 4.60 = 14.00$$

$$x = 9.40 \quad \textcircled{1}$$

$$[H_3O^+] = 10^{-pH}$$

$$= 10^{-9.40}$$

$$= 4.0 \times 10^{-10} \text{ M} \quad \textcircled{1}$$

18) Four monoprotic acids of the same concentration are labeled as follows:

SOLUTION	LABEL
A	$[OH^-] = 5.0 \times 10^{-11}$ M
B	$[H^+] = 0.20$ M
C	pOH = 11.30 M
D	pH = 1.20 M

List the four solutions in order of decreasing acidity. Use calculations to support your answer. (4 marks)

calculate pH for all acids to be able to compare them

B: $pH = -\log[H_3O^+] = -\log(0.20) = 0.70 \quad \textcircled{1}$

C: $pH + pOH = 14.00$
 $x + 11.30 = 14.00$
 $x = 2.70 \quad \textcircled{1}$

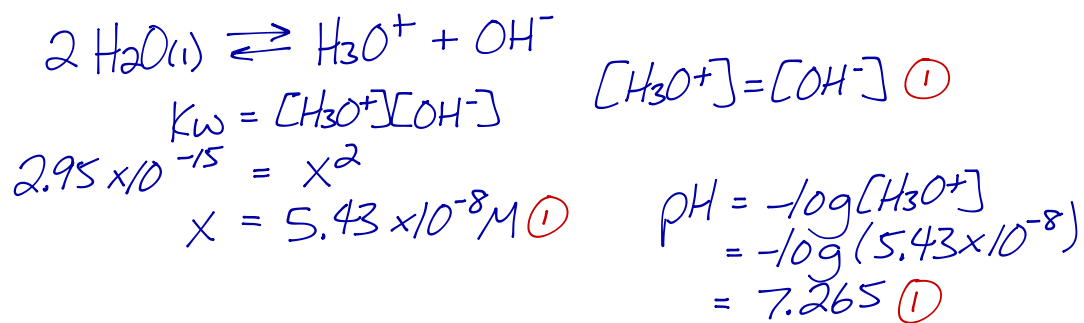
A: $K_w = [H_3O^+][OH^-]$
 $1.0 \times 10^{-14} = x (5.0 \times 10^{-11})$
 $x = 2.0 \times 10^{-4} \text{ M}$
 $pH = -\log[H_3O^+] = -\log(2.0 \times 10^{-4}) = 3.70 \quad \textcircled{1}$

In order of decreasing acidity means from most acidic (lowest pH) \rightarrow least acidic (highest pH) \therefore

B, D, C, A $\textcircled{1}$

19) At 10°C, $K_w = 2.95 \times 10^{-15}$.

(a) Determine the pH of water at 10°C. (3 marks)



(b) State whether water at this temperature is acidic, basic or neutral, and explain. (1 mark)

water is always neutral since the $[\text{H}_3\text{O}^+] = [\text{OH}^-]$ (1)

20) Calculate the value of K_w for a sample of water with a pH = 7.30. (2 marks)

