Acid-Base Water, pH and pOH Worksheet

Name _____

1. Assuming 100% ionization of HCl in dilute solutions, what is the pH of 0.010 M HCl?

pH = 2.00

2. Determine the $[OH^-]$, $[H_3O^+]$, pOH and pH of a 0.01 mol/L KOH solution.

$KOH \rightarrow K^+ + OH^-$
0.01 0.01 mol/L

pOH = 2
pH = 12
$[H_3O^+] = 1 \times 10^{-12}$

3. Determine the $[OH^-]$, $[H_3O^+]$, pOH and pH of a 0.045 mol/L HCl solution.

$HCl \rightarrow H^+ + Cl^-$
0.045 0.045

pH = 1.35
pOH = 12.65

4. What is the $[H_3O^+]$ of a solution having a pH of 3.4?

3. 4×10^{-4} mol/L

5. If nitric acid is 100% ionized in a 0.0050 M solution, what is the pH of this solution? $HNO_3(aq) \rightarrow H^+ + NO_3^-$
0.0050

pH = 2.30

6. A sodium hydroxide solution is prepared by dissolving 6.0 g NaOH in 1.00 L of solution. Assuming that 100% dissociation occurs, what is the pOH and the pH of this solution? NaOH = 40 g/mol $NaOH \Rightarrow Na^+ + OH^-$

$\frac{40 g}{1 mol} = \frac{6.0 g}{0.15}$ $C = \frac{n}{V} = \frac{0.15}{1.00} = 0.15$ mol/L

pOH = 0.82
pH = 13.18

7. A solution was made by dissolving 0.837 g $Ba(OH)_2$ in 100 mL final volume. If $Ba(OH)_2$ is fully broken up into its ions, what is the pOH and the pH of this solution?

Molar mass 171.359 g/mol $C = \frac{n}{V}$ $Ba(OH)_2 \Rightarrow Ba^{2+} + 2OH^-$
0.00488 0.009769

$\frac{171.359}{1 mol} = \frac{0.837}{0.00488}$ $= \frac{0.00488}{0.100}$ pOH = 1.010
pH = 12.99

$C = 0.00488$ mol/L

8. A certain brand of beer had a hydrogen ion concentration equal to 1.9×10^{-5} mol/L. What is the pH of this beer?

$-\log(1.9 \times 10^{-5})$
= 4.72

9. A soft drink was put on the market $[H^+] = 1.4 \times 10^{-5}$ mol/L. What is its pH?

pH = 4.85

10. Calculate the value of both pH and pOH of the following solutions.

(a) 0.020 M HCl $HCl \rightarrow H^+ + Cl^-$

0.020 0.020

$pH = -\log(0.020) = 1.70$ $pOH = 14 - pH = 14 - 1.70 = 12.30$

(b) 0.0050 M NaOH $NaOH \rightarrow Na^+ + OH^-$

0.0050 0.0050

$pOH = -\log(0.0050) = 2.30$ $pH = 11.70$

(c) A blood specimen containing 7.2×10^{-8} H^+ mole/L. Is the blood specimen slightly acidic or slightly basic?

$pH = -\log(7.2 \times 10^{-8}) = 7.14$

↖ slightly basic

(d) 0.00035 M $Ba(OH)_2$, where this compound has to be considered to be 100% dissociated. $Ba(OH)_2 \rightarrow Ba^{2+} + 2OH^-$

0.00035 $= 2 \times 0.00035 = 0.0007$

$pOH = -\log(0.007) = 3.15$ $pH = 14 - pOH$ $pH = 10.85$

11. "Calcareous soil is soil rich in calcium carbonate (lime). The pH of such soil generally ranges from just over 7 to as high as 8.3. What value of $[H^+]$ corresponds to a pH of 8.3? Is the soil slightly acidic or slightly basic?

slightly basic

~~pH = -log~~

$[H^+] = 10^{-8.3} = 5 \times 10^{-9}$ mol/L

12. Find the values of $[H^+]$, pOH and $[OH^-]$ that correspond to each of the following values of pH.

(a) 2.90 (the approximate pH of lemon juice)

$pH = 2.90$ $pOH = 14 - 2.90 = 11.10$ $[OH^-] = 10^{-pOH} = 10^{-11.10} = 7.9 \times 10^{-12}$ mol/L

$[H^+] = 10^{-2.90} = 1.3 \times 10^{-3}$ mol/L

(b) 3.85 (the approximate pH of sauerkraut)

$pH = 3.85$ $pOH = 10.15$

$[H^+] = 1.4 \times 10^{-4}$ mol/L $[OH^-] = 7.1 \times 10^{-11}$ mol/L

(c) 10.81 (the pH of milk of magnesia)

$pH = 10.81$ $pOH = 3.19$

$[H^+] = 1.5 \times 10^{-11}$ mol/L $[OH^-] = 10^{-3.19} = 6.5 \times 10^{-4}$ mol/L

(d) 4.11 (the pH of orange juice, on the average)

$pH = 4.11$ $pOH = 9.89$

$[H^+] = 7.8 \times 10^{-5}$ mol/L $[OH^-] = 1.0 \times 10^{-10}$ mol/L

→ weak acid

13. Estimate the percentage ionization of acetic acid in solutions with concentrations of (a) 0.010 M and (b) 0.0010 M.

1%

14. What is the pOH of a 0.010 M NaOH solution?

$NaOH \rightarrow Na^+ + OH^-$
0.010 0.010

$pOH = -\log(0.010) = 2$

What is the pH of this solution?

$pH = 14 - 2$
$pH = 12$

15. Determine the $[OH^-]$, $[H_3O^+]$, pOH and pH of a 0.001 M KOH solution.

$KOH \rightarrow K^+ + OH^-$
0.001 0.001 → $[OH^-] = 0.001$

$pOH = -\log(0.001) = 3$
$pH = 11$

$[H^+] = 10^{-11} = 1 \times 10^{-11}$ mol/L

16. Calculate the $[H_3O^+]$, $[OH^-]$, pH and pOH of these solutions;

find pH then pOH
$pH = -\log[H^+]$
$[OH^-] = 10^{-pOH}$

a) 1.0 M HCl,

b) 0.50 M HNO_3,

c) 0.0020 M $HClO_4$,

d) a solution prepared by dissolving 0.040 g NaOH in 2.0 L of solution,

Molar mass = 40 g/mol

$\frac{40\text{ g}}{1\text{ mol}} = \frac{0.040\text{ g}}{?\text{ mol}}$ mole = 0.001 moles

$C = \frac{n}{V} = \frac{0.001\text{ mol}}{2.0\text{ L}} = 0.0005\text{ mol/L}$

e) a solution prepared by diluting 1.0 mL of 0.20 M HCl to a total volume of 5.0 L,

$NaOH \rightarrow Na^+ + OH^-$
0.0005 0.00

$pOH = -\log(0.0005)$
$pOH = 3.30$
$pH = 10.70$
$[H^+] = 2 \times 10^{-11}$ mol/L

f) a solution made by dissolving 0.10 mol Na_2O in 1.0 L of solution.