4.11 pH and pOH

$$pH = -\log [H_3O^+]$$

$$pOH = -\log [OH^-]$$

$$pH + pOH = 14$$

Examples: 1. What is pH of a 0.01M HCl sol^n?

2. What is pH of a 0.0035M Ca(OH)$_2$ sol^n?

↳ Sig figs ... whole # in front of decimal does not count
so if need 2 s.F ... do 2 digits after decimal

Why? (In case you are interested ...)

log 1000 = 3   b/c 3 0's in 1000
→ these 0's don't count for sig figs in original # 1000.

So   log 1500 = 3.18   these 2 sig figs
          2SF

3. What is [H$_3$O$^+$] in an unknown acid with pH of 3.405?

The pH Scale :

- A scale for large changes ... log scale

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$$pH = -\log [H_3O^+] \qquad [H_3O^+] = 10^{-x} \qquad \text{"anti log"}$$
$$[H^+]$$
$$pOH = -\log [OH^-] \qquad [OH^-] = 10^{-x}$$

...wait! .... what? Where did pOH come from?

- the pOH scale measures the $[OH^-]$ in a solution (pH measures $[H_3O^+]$)
- it is the "reverse" of the pH scale. pOH = 0 → 6.9 = Basic!
- pH + pOH = 14 so a sol^n with pH = 11 has pOH = 3
- If question gives $[OH^-]$ & asks for pOH, do 1 step: pOH = -log [OH]
- If question gives $[H_3O^+]$ & asks for pOH ... 2 steps
  1. pH = - log $[H_3O^+]$
  2. pOH = 14 - pH.

pH Scale is meant for use from 0-14 ... But exceptions...

a pH of -1.00 is better handled as $[H_3O^+] = \underline{10}$ M **very strong**

$$pH = -\log [H_3O^+]$$
$$-1.00 = -\log [H_3O]$$
$$10 = [H_3O^+]$$

a pH of 15.0 is better handled as $[OH^-] = \underline{10}$ M
↓
Hint; what is OH = _____

Use pOH instead

pOH = -1 ✗ pH = 15
$$10^{-(-1)}$$

Example #1 What is the pOH of 0.2g of NaOH in 500mL of water?

What is the pH?

Example #2: At a certain temp, neutral water has a pH of 7.791. What is Kw & [OH] at this temp.?

Is this water hotter or colder than 25°C?

Example #3 : Assume a system is not at 25°C but rather involves a sample of pure water at it's boiling temperature.

$$2\ H_2O_{(l)} + 59\,KJ \rightleftharpoons H_3O^+_{(aq)} + [OH^-]_{(aq)}$$

a) What happens to the pH of the water as the temperature increases?

b) What happens to the pOH of the water as the temperature increases?

c) What happens to the value of pKw as the temperature increases?