21) basic solutions: $[OH^-] > 1.0 \times 10^{-7}$ M pOH < 7.00

$[H^+] < 1.0 \times 10^{-7}$ M pH > 7.00

basic solutions: b, c, d

23) # of decimal places in pH determines the number of sig figs in $[H^+]$

- all three pH values, $[H^+]$ should be expressed with two sig figs because the pH has two decimal places

33 a) $HClO_{4(aq)} + H_2O_{(l)} \rightarrow H_3O^+_{(aq)} + ClO_4^-{}_{(aq)}$

or $HClO_{4(aq)} \rightarrow H^+_{(aq)} + ClO_4^-{}_{(aq)}$

b) $CH_3CH_2CO_2H_{(aq)} + H_2O_{(l)} \rightleftharpoons H_3O^+_{(aq)} + CH_3CH_2CO_2^-{}_{(aq)}$

or $CH_3CH_2CO_2H_{(aq)} \rightleftharpoons H^+_{(aq)} + CH_3CH_2CO_2^-{}_{(aq)}$

c) $NH_4^+{}_{(aq)} + H_2O_{(l)} \rightleftharpoons H_3O^+_{(aq)} + NH_{3(aq)}$

or $NH_4^+{}_{(aq)} \rightleftharpoons H^+_{(aq)} + NH_{3(aq)}$

39) $K_a \uparrow$ acid strength $\uparrow$

$HClO_4 > HClO_2 > NH_4^+ > H_2O$

43) a) $[OH^-] = \frac{K_w}{[H^+]} = \frac{1.0 \times 10^{-14}}{1.0 \times 10^{-7}} = 1.0 \times 10^{-7}\ M$

neutral

b) $[OH^-] = \frac{K_w}{[H^+]} = \frac{1.0 \times 10^{-14}}{8.3 \times 10^{-16}} = 12\ M$

basic

c) $[OH^-] = \frac{K_w}{[H^+]} = \frac{1.0 \times 10^{-14}}{12} = 8.3 \times 10^{-16}\ M$

acidic

d) $[OH^-] = \frac{K_w}{[H^+]} = \frac{1.0 \times 10^{-14}}{5.4 \times 10^{-5}} = 1.9 \times 10^{-10}\ M$

acidic

49 a) $pOH = 14.00 - 6.88 = 7.12$

$[H^+] = 10^{-6.88} = 1.3 \times 10^{-7}\ M$

$[OH^-] = 10^{-7.12} = 7.6 \times 10^{-8}\ M$ acidic

b) $[H^+] = \frac{1.0 \times 10^{-14}}{8.4 \times 10^{-14}} = 0.12\ M$

$pH = -\log(0.12) = 0.92$

$pOH = 14.00 - 0.92 = 13.08$ acidic

c) $pH = 14.00 - 3.11 = 10.89$

$[H^+] = 10^{-10.89} = 1.3 \times 10^{-11}\ M$

$[OH^-] = 10^{-3.11} = 7.8 \times 10^{-4}\ M$ basic

d) $pH = -\log(1.0 \times 10^{-7}) = 7.00$

$pOH = 14.00 - 7.00 = 7.00$

$[OH^-] = 10^{-7.00} = 1.0 \times 10^{-7}\ M$ neutral