Acid/Base Review

Infer

Pg 625-626 # 44-49, 51-58, 60, 62-71, 74-76, 78-82

44) Acids ionize to give hydrogen (or hydronium) ions in solution. Bases ionize to give hydroxide ions in solution.

45)
a) $Ca(OH)_2$ arrhenius base
b) HNO_3 arrhenius acid
c) KOH arrhenius base
d) C_2H_5COOH arrhenius acid
e) HBr arrhenius acid
f) H_2SO_4 arrhenius acid

46)
a) $KOH \leftrightarrow K^+ + OH^-$
b) $Mg(OH)_2 \leftrightarrow Mg^{2+} + 2OH^-$

47) $2Li_{(s)} + 2H_2O_{(l)} \leftrightarrow 2LiOH_{(aq)} + H_{2(g)}$

sometimes it helps to think of H_2O as HOH

$Ba_{(s)} + 2H_2O_{(l)} \leftrightarrow Ba(OH)_{2(aq)} + H_2$

48)
a) $HNO_3 + H_2O \rightarrow H_3O^+ + NO_3^-$
(HNO_3: H^+ donor; H_2O: H^+ acceptor; ca; cb)
b) $CH_3COOH + H_2O \leftrightarrow H_3O^+ + CH_3COO^-$
(CH_3COOH: H^+ donor; H_2O: H^+ acceptor; ca; cb)
c) $NH_3 + H_2O \leftrightarrow NH_4^+ + OH^-$
(NH_3: H^+ acceptor; H_2O: H^+ donor; ca; cb)
d) $H_2O + CH_3COO^- \leftrightarrow CH_3COOH + OH^-$
(H_2O: H^+ donor; CH_3COO^-: H^+ acceptor; ca; cb)

49) label conjugate acid & conjugate base
ca cb

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51) $H_2O \leftrightarrow H^+ + OH^-$

or

$H_2O + H_2O \leftrightarrow H_3O^+ + OH^-$

52) pure H_2O = neutral = pH of 7

$[H^+] = 1.0 \times 10^{-7}$

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

53) $pH = -\log [H^+]$

54) $pH = -\log [1.0 \times 10^{-7}]$

$pH = 7$

55) a) $[H^+] = 1 \times 10^{-2}$ M $pH = -\log [1 \times 10^{-2}]$

$pH = 2$ acidic

b) $[OH^-] = 1 \times 10^{-2}$ M $pOH = -\log [1 \times 10^{-2}]$

$pOH = 2$

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

c) $[OH^-] = 1 \times 10^{-8}$ M $pOH = -\log [1 \times 10^{-8}]$

$pOH = 8$

$pH = 6$ acidic $14 - 8 = 6$

56) a) $pH = 4.00$ $[H^+] = 1 \times 10^{-4}$ $[OH^-] = 1 \times 10^{-10}$

b) $pH = 8.00$ $[H^+] = 1 \times 10^{-8}$ $[OH^-] = 1 \times 10^{-6}$

c) $pH = 12.00$ $[H^+] = 1 \times 10^{-12}$ $[OH^-] = 1 \times 10^{-2}$

57) a) $[H^+] = 2.4 \times 10^{-6}$ M $pH = -\log [2.4 \times 10^{-6}]$

$pH = 5.62$

b) $pH = 13.20$ $[H^+] = \text{antilog}(-pH)$

$[H^+] = \text{antilog}(-13.20)$

$[H^+] = 6.3 \times 10^{-14}$

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58) strong or weak look @ K_a values on a chart. low #s are weak

a) NaOH strong base
b) HCl strong acid
c) NH_3 weak base
d) H_2SO_4 strong acid

60) "Strong" relates to their dissociation constants, K_b, which are very high. Their concentration in saturated solution is low because of their low solubility.

62) Acid + base → a salt + water

63) a) $HNO_3 + KOH \rightarrow H_2O + KNO_3$
b) $2HCl + Ca(OH)_2 \rightarrow 2H_2O + CaCl_2$
c) $H_2SO_4 + NaOH \rightarrow H_2O + NaHSO_4$
then $NaHSO_4 + H_2O \rightarrow SO_4^- + H_3O^+ + Na^+$

64) The indicator changes color

65) NaOH molarity? 20.00 mL NaOH
a) 28.0 mL of 1.00M HCl

$$.028\,L\,HCl \times \frac{1\,mol\,HCl}{1\,L} \times \frac{1\,mol\,NaOH}{1\,mol\,HCl} = \frac{.028\,mol\,HCl}{.020\,L\,HCl}$$

$$= 1.4\,M\,NaOH$$

b) 17.4mL of 1.00M H_3PO_4

$$.0174\,L \times \frac{1\,mol\,H_3PO_4}{L} \times \frac{3\,mol\,NaOH}{1\,mol\,H_3PO_4} = \frac{.0522\,mol}{.020\,L}$$

$$= 2.61\,M\,NaOH$$

$H_3PO_4 + 3NaOH \rightarrow 3H_2O + NaPO_4$

triprotic acid! All 3 H^+ will be donated!

(66) "hydrolyze water" this means that the salt created from an acid base reaction will also react with water. Salts with a cation from a weak base and an anion from a strong acid, or with a cation from a strong base and an anion from a weak acid

(67) $NaHCO_3 + H_2O \leftrightarrow Na^+ + HCO_3^- + H_2O$

$HCO_3^- + H_2O \leftrightarrow H_2CO_3 + OH^-$

↖ this is a salt that hydrolyzes water to make a base!

base

(68) Weak acid anions accept protons from H_2O, increasing the pH of the solution (more basic). Weak base cations donate protons to water, decreasing the pH (more acidic).

(69) Don't worry about this one!

(70) Eventually the buffer capacity of the buffer is exceeded and the pH will change significantly with the addition of a strong acid or base.

(71) Yes! acids like acetic acid (vinegar) dissolve well but ionize poorly.

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74) a) CO_3^{2-}
b) I^-
c) NH_3
d) HSO_3^- and SO_3^{2-}

75) a) $HClO_2$
b) H_3PO_4
c) H_3O^+
d) NH_4^+

76) a) pH = 4.60 to $[OH^-]$
pOH = 9.4 antilog(−pH) = $[OH^-]$
$[OH^-] = 3.9 \times 10^{-10} \sim 4 \times 10^{-10} M$

b) $[OH^-] = 1.8 \times 10^{-2} M \rightarrow$ pH
$pOH = -\log[1.8 \times 10^{-2}]$
pOH = 1.74
pH = 12.26

c) pH = 9.30 → $[OH^-]$
pOH = 4.7 antilog(−4.7) = 1.99×10^{-5}
$\sim 2 \times 10^{-5} M$

d) $[OH^-] = 7.3 \times 10^{-9} \rightarrow$ pH
$pOH = -\log[7.3 \times 10^{-9}]$
pOH = 8.14
pH = 5.86

78) $\underset{\text{BLB}}{KOH} + \underset{\text{BLA}}{HBr} \rightarrow KBr + H_2O$

$\underset{\text{BLA}}{HCl} + \underset{\text{BLB}}{H_2O} \rightarrow Cl^- + H_3O^+$

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79) a) HSO_4^-
b) CN^-
c) OH^-
d) NH_3

80) $H_2PO_4^- + OH^- \leftrightarrow H_2O + HPO_4^{2-}$

81) a) $Mg(OH)_2 + 2HCl \rightarrow MgCl_2 + 2H_2O$

b) $2HCl + CaCO_3 \rightarrow H_2O + CO_2 + CaCl_2$

c) $Al(OH)_3 + 3HCl \rightarrow AlCl_3 + 3H_2O$

82) a) shift to the left
b) shift to the right