Answers to Chapter 15

(1) All choices are correct except C. An Arrhenius acid would turn litmus paper to red.

(2) The definition of Arrhenius base is its gives OH^- when dissolved in H_2O. All other choices are correct.

(3) All choices has a hydrogen to give off forming hydronium ion with water except C.

(4) $H_2O_{(l)} + HPO_4^{2-} \longleftrightarrow H_2PO_4^- + OH^-$
A B CA CB

Choice A has the right conjugate acid-base pair

(5) conjugate base of $H_2PO_4^-$ means one less H so it is HPO_4^{2-}

(6) All other choices has a complete octet except Al^{3+} which can allow them to function as electron-pair donor.

(7) Of all the choices H^- has an electron-pair that can act as donor which makes H^- a Lewis base.

(8) since HCO_3^- is the weakest acid, its conjugate base CO_3^{2-} will be strongest base

(9) All of elements are on the same period and base on electronegativity, F is the most electronegative hence HF is the strongest acid.

(10) $H_3PO_4 > H_2PO_4^- > HPO_4^{2-}$
in terms of increasing acid strength
$HPO_4^{2-} < H_2PO_4^- < H_3PO_4$

(11) $K_w = [H_3O^+][OH^-]$ $\quad 3.3\times10^{-14} = (x)(x)$

$x = \sqrt{3.3\times10^{-14}} = 1.8\times10^{-7} = [H_3O^+]$

$pH = -\log [H_3O^+] = -\log 1.8\times10^{-7} = 6.74$

(12) $K_c = [NH_4^+][NH_2^-]$ $\quad 1.8\times10^{-24} = (x)(x)$

$x = \sqrt{1.8\times10^{-24}} = 1.3\times10^{-12} = [NH_2^-]$

(13) $K_w = [H_3O^+][OH^-]$

$[H_3O^+] = \frac{K_w}{[OH^-]} = \frac{1\times10^{-14}}{7.48\times10^{-5}} = 1.34\times10^{-10}$

(14) $Ba(OH)_2 \longrightarrow Ba^{2+} + 2OH^-$
$0.0025 \quad 0.0025 \quad 2\times0.0025 = 0.0050$

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

$[H_3O^+] = \frac{K_w}{[OH^-]} = \frac{1\times10^{-14}}{0.0050} = 2.0\times10^{-12}$

(15) $-\log K_w$ will give you pK_w not pH

(16) pOH = 12.5 would mean a pH of 1.5 which is very acidic

(17) $HI \longrightarrow H^+ + I^-$
$0.047 \quad 0.047 \quad 0.047$

$pH = -\log 0.047$
$= 1.33$
$pOH = 14 - 1.33$
$= 12.67$

(18) Get pH of given concentration and multiply with fraction of volume of each solution and add them

$pH = -\log 0.021 = 1.68 \times \frac{25}{60} = 0.70$

$pH = -\log 0.037 = 1.43 \times \frac{35}{60} = 0.83$

$0.70 + 0.83 = 1.53$

(19) $pH = -\log 10.0$

$= -1.0$

(20) Vinegar is a weak acid so most likely it is slighty acidic and has a pH around 3

(21) $14 = pH + pOH$ $\quad pOH = 14 - 3.36 = 10.64$

(22) Choice B is strong basic & getting the $pOH = -\log 0.2 = 0.70$ which means its pH is 13.30

(23) $Ba(OH)_2 \longrightarrow Ba^{2+} + 2OH^-$

0.0041 $\quad$ 0.0041 $\quad$ 2(0.0041) = 0.0082

$pOH = -\log 0.0082 = 2.09$

$pH = 14 - 2.09 = 11.91$

(24) $pH = -\log 0.0080 = 2.10$

$pOH = 14 - 2.10 = 11.90$

(25) $pH = -\log 0.024 = 1.62$

$pOH = 14 - 1.62 = 12.38$

(26) $KOH \longrightarrow K^+ + OH^-$

$1.72\times10^{-3} \quad 1.72\times10^{-3} \quad 1.72\times10^{-3}$

$pOH = -\log 1.72\times10^{-3}$

$= 2.765$

$\text{mol KOH} = \frac{0.578\,g}{56.10\,g/mol}$

$M = \frac{0.0103\ mol}{6.0\ L}$

$= 1.72\times10^{-3}\,M$

(27) highest $[OH^-]$ which means lowest pOH or highest pH

Pure water has a pH = 7.0 so this has the highest $[OH^-]$

(28) $[OH^-] = 10^{-pOH} = 10^{-5.30} = 5.01\times10^{-6}$

$[H^+] = \frac{K_w}{[OH^-]} = \frac{1\times10^{-14}}{5.01\times10^{-6}} = 2.0\times10^{-9}$

(29) $[H^+] = 0.16\ \frac{mol}{L}\left(\frac{200\,mL}{500\,mL}\right) = 0.064$

$[OH^-] = 0.091\ \frac{mol}{L}\left(\frac{300\,mL}{500\,mL}\right) = 0.0546$

excess $[H^+] = 0.064 - 0.0546 = 9.4\times10^{-3}$

$[OH^-] = \frac{1\times10^{-14}}{9.4\times10^{-3}} = 1.1\times10^{-12}\,M$

(30) The first 4 choices are all basic and only the last choice is acidic which turns blue litmus to red.