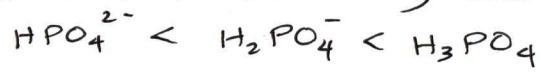


# Answers to Chapter 15

- 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  $\text{OH}^-$  when dissolved in  $\text{H}_2\text{O}$ . All other choices are correct.
- ③ All choices has a hydrogen to give off forming hydronium ion with water except C.
- ④  $\text{H}_2\text{O}_{(l)} + \text{HPO}_4^{2-} \rightleftharpoons \text{H}_2\text{PO}_4^- + \text{OH}^-$   
A B CA CB
- choice A has the right conjugate acid-base pair
- ⑤ conjugate base of  $\text{H}_2\text{PO}_4^-$  means one less H so it is  $\text{HPO}_4^{2-}$ .
- ⑥ All other choices has a complete octet except  $\text{Al}^{3+}$  which can allow them to function as electron-pair donor.
- ⑦ Of all the choices  $\text{H}^-$  has an electron-pair that can act as donor which makes  $\text{H}^-$  a Lewis base.
- ⑧ since  $\text{HCO}_3^-$  is the weakest acid, its conjugate base  $\text{CO}_3^{2-}$  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  $\text{H}_3\text{PO}_4 > \text{H}_2\text{PO}_4^- > \text{HPO}_4^{2-}$

in terms of increasing acid strength



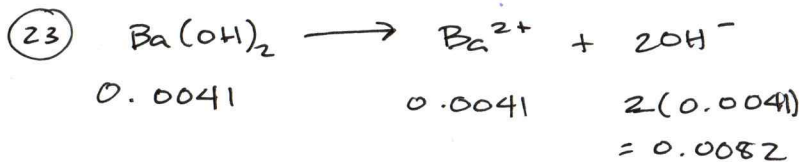
- ⑪  $K_w = [\text{H}_3\text{O}^+][\text{OH}^-] \quad 3.3 \times 10^{-14} = (x)(x)$   
 $x = \sqrt{3.3 \times 10^{-14}} = 1.8 \times 10^{-7} = [\text{H}_3\text{O}^+]$   
 $\text{pH} = -\log [\text{H}_3\text{O}^+] = -\log 1.8 \times 10^{-7} = 6.74$
- ⑫  $K_c = [\text{NH}_4^+][\text{NH}_2^-] \quad 1.8 \times 10^{-24} = (x)(x)$   
 $x = \sqrt{1.8 \times 10^{-24}} = 1.3 \times 10^{-12} = [\text{NH}_2^-]$
- ⑬  $K_w = [\text{H}_3\text{O}^+][\text{OH}^-]$   
 $[\text{H}_3\text{O}^+] = \frac{K_w}{[\text{OH}^-]} = \frac{1 \times 10^{-14}}{7.48 \times 10^{-5}} = 1.34 \times 10^{-10}$
- ⑭  $\text{Ba}(\text{OH})_2 \rightarrow \text{Ba}^{2+} + 2\text{OH}^-$   
 $0.0025 \quad \quad 0.0025 \quad 2 \times 0.0025 = 0.0050$   
 $K_w = [\text{H}_3\text{O}^+][\text{OH}^-]$   
 $[\text{H}_3\text{O}^+] = \frac{K_w}{[\text{OH}^-]} = \frac{1 \times 10^{-14}}{0.0050} = 2.0 \times 10^{-12}$
- ⑮  $-\log K_w$  will give you  $\text{p}K_w$  not  $\text{pH}$
- ⑯  $\text{pOH} = 12.5$  would mean a  $\text{pH}$  of 1.5 which is very acidic
- ⑰  $\text{HI} \rightarrow \text{H}^+ + \text{I}^- \quad \text{pH} = -\log 0.047$   
 $0.047 \quad 0.047 \quad 0.047 \quad \quad \quad = 1.33$   
 $\text{pOH} = 14 - 1.33 = 12.67$
- ⑱ Get  $\text{pH}$  of given concentration and multiply with fraction of volume of each solution and add them
- |  |       |
|--|-------|
| $\text{pH} = -\log 0.021 = 1.68 \times \frac{25}{60} = 0.70$ | 0.70  |
| $\text{pH} = -\log 0.037 = 1.43 \times \frac{35}{60} = 0.83$ | +0.83 |
|  | 1.53  |

(19)  $\text{pH} = -\log 10.0$   
 $= -1.0$

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

(21)  $14 = \text{pH} + \text{pOH}$      $\text{pOH} = 14 - 3.36 = 10.64$

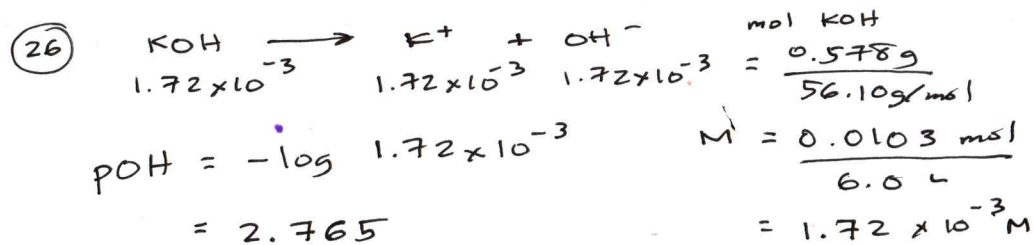
(22) Choice B is strong basic & getting the  $\text{pOH} = -\log 0.2 = 0.70$  which means its pH is 13.30



$\text{pOH} = -\log 0.0082 = 2.09$   
 $\text{pH} = 14 - 2.09 = 11.91$

(24)  $\text{pH} = -\log 0.0080 = 2.10$   
 $\text{pOH} = 14 - 2.10 = 11.90$

(25)  $\text{pH} = -\log 0.024 = 1.62$   
 $\text{pOH} = 14 - 1.62 = 12.38$



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

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

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

$[\text{H}^+] = \frac{K_w}{[\text{OH}^-]} = \frac{1 \times 10^{-14}}{5.01 \times 10^{-6}} = 2.0 \times 10^{-9}$

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

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

excess  $[\text{H}^+] = 0.064 - 0.0546 = 9.4 \times 10^{-3}$

$[\text{OH}^-] = \frac{1 \times 10^{-14}}{9.4 \times 10^{-3}} = 1.1 \times 10^{-12} \text{ M}$

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