

Chapter 13 & 14 — Review Set

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March 16, 2020

1. Calculate:

(a) pH when $[\text{OH}^-] = 2.3 \cdot 10^{-6}$

$$-\log_{10} \left(\frac{1 \cdot 10^{-14}}{2.3 \cdot 10^{-6}} \right) = 8.36 \quad (1)$$

(b) pOH when $[\text{H}_3\text{O}^+] = 2.8 \cdot 10^{-8}$

$$-\log_{10} \left(\frac{1 \cdot 10^{-14}}{2.8 \cdot 10^{-8}} \right) = 6.45 \quad (2)$$

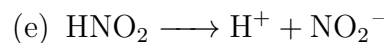
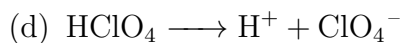
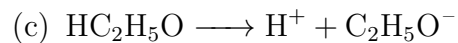
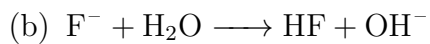
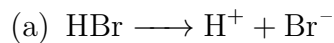
(c) $[\text{H}_3\text{O}^+]$ when pH is 8.53

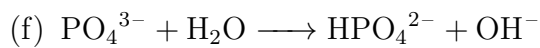
$$10^{-8.53} = 2.95 \cdot 10^{-9} [\text{M}] \quad (3)$$

(d) $[\text{OH}^-]$ when pH is 2.36

$$\frac{1 \cdot 10^{-14}}{10^{-2.36}} = 2.29 \cdot 10^{-12} [\text{M}] \quad (4)$$

2. Write the dissociation equation:





3.

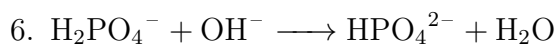
$$\begin{aligned}\frac{x^2}{1.5} &= .00014 \\ x &= .0145[\text{M}]\end{aligned}\tag{5}$$

4.

$$\begin{aligned}\frac{x^2}{.126} &= 1.5 \cdot 10^{-9} \\ x &= \sqrt{.126 \cdot 1.5 \cdot 10^{-9}} \\ 14 + \log_{10}(x) &= 9.14\end{aligned}\tag{6}$$

5.

$$\begin{aligned}[\text{H}^+] &= 10^{-9.8} = 1.585 \cdot 10^{-10} \\ [\text{OH}^-] &= 6.31 \cdot 10^{-5} \\ \frac{(6.31 \cdot 10^{-5})^2}{.0278} &= 1.432 \cdot 10^{-7} [\text{M}]\end{aligned}\tag{7}$$



$$\begin{aligned}\text{pKa} &= -\log_{10}(6.2 \cdot 10^{-8}) = 7.208 \\ \text{pH} &= 7.208 + \log_{10}\left(\frac{.137 + \frac{.05}{.72}}{.5 - \frac{.05}{.72}}\right) \\ &= 6.89\end{aligned}\tag{8}$$

7. (a)

$$\begin{aligned}.006 \cdot .532 &= .003192[\text{mol}] \\ .032 \cdot .201 &= .006432 - .003192 = .00324[\text{mol}] \\ [\text{H}^+] &= \frac{(1.5 \cdot 10^{-5})(.00324)}{.003192} \\ &= 1.52 \cdot 10^{-5} \\ \text{pH} &= 4.817\end{aligned}\tag{9}$$

(b)

$$\begin{aligned}V_b &= \frac{.032 \cdot .201}{.532} \\&= .0121[\text{L}] \\ .0121 \cdot .532 &= .006432[\text{mol}] \\ \frac{.006432}{.0121 + .032} &= .14585[\text{M}] \\ \text{Kb} &= \frac{10^{-14}}{1.5 \cdot 10^{-5}} = 6.67 \cdot 10^{-10} \\ x &= \sqrt{.14585 \cdot 6.67 \cdot 10^{-10}} = 9.86 \cdot 10^{-6}[\text{M}] \\ \text{pH} &= 14 + \log_{10}(9.86 \cdot 10^{-6}) = 9\end{aligned}\tag{10}$$

8. (a)

$$\begin{aligned}.094 \cdot .1035 &= .009729[\text{mol}] \\ .044 \cdot .332 &= .014608 - .009729 = .004879[\text{mol}] \\ [\text{OH}^-] &= \frac{(5.6 \cdot 10^{-10})(.004879)}{.009729} \\ &= 2.808 \cdot 10^{-10} \\ \text{pH} &= 4.45\end{aligned}\tag{11}$$

(b)

$$\begin{aligned}V_b &= \frac{.044 \cdot .332}{.1035} \\ &= .141[\text{L}] \\ .141 \cdot .1035 &= .0146[\text{mol}] \\ \frac{.0146}{.0141 + .044} &= .2513[\text{M}] \\ \text{Ka} &= \frac{10^{-14}}{5.6 \cdot 10^{-10}} = 1.786 \cdot 10^{-5} \\ x &= \sqrt{.2513 \cdot 1.786 \cdot 10^{-5}} = .002119[\text{M}] \\ \text{pH} &= -\log_{10}(.002119) = 2.674\end{aligned}\tag{12}$$

9. (a)

$$\begin{aligned}x &= \sqrt{.178 \cdot 1.9 \cdot 10^{-4}} \\ &= .00582[\text{M}] \\ -\log_{10}(.00582) &= 2.24\end{aligned}\tag{13}$$

(b)

$$\begin{aligned} .0048 \cdot .523 &= .00251[\text{mol}] \\ .03 \cdot .178 &= .00534 - .00251 = .00283[\text{mol}] \\ [\text{H}^+] &= \frac{(1.9 \cdot 10^{-4}) (.00283)}{.00251} \\ \text{pH} &= 3.67 \end{aligned} \tag{14}$$

10. (a)

$$\begin{aligned} x &= \sqrt{.244 \cdot 7.14 \cdot 10^{-11}} \\ &= 4.174 \cdot 10^{-6} \\ 14 + \log_{10} (4.174 \cdot 10^{-6}) &= 8.621 \end{aligned} \tag{15}$$

(b)

$$\begin{aligned} .078 \cdot .1033 &= .00806[\text{mol}] \\ .05 \cdot .244 &= .0122 - .00806 = .00414[\text{mol}] \\ [\text{H}^+] &= \frac{(7.14 \cdot 10^{-11}) (.00414)}{.00806} \\ \text{pH} &= 3.56 \end{aligned} \tag{16}$$

(c)

$$\begin{aligned} V_b &= \frac{.05 \cdot .244}{.1033} \\ &= .1181[\text{L}] \\ .1181 \cdot .1033 &= .0122[\text{mol}] \\ \frac{.0122}{.1181 + .05} &= .0726[\text{M}] \\ \text{Ka} &= \frac{10^{-14}}{7.14 \cdot 10^{-11}} \\ &= 1.4 \cdot 10^{-4} \\ x &= \sqrt{.0726 \cdot 1.4 \cdot 10^{-4}} \\ &= .003189 \\ -\log_{10} (.003189) &= 2.5 \end{aligned} \tag{17}$$