Chapter 15
Study Guide – Answers

Name: ____________________

Date:________________ Per:________

Directions: Fill in the blanks.

1. The autoionization of pure water can be described by the equation: ___$H_2O(l) + H_2O(l) \rightarrow H_3O^+(aq) + OH^-(aq)$___. When pure water is ionized the concentrations of $[H_3O^+]$ and $[OH^-]$ are ___equal___. The exact concentration of each at 25°C is ___1.0×10^{-7}___ *M*. Because water is a weak acid/base system its equilibrium position can be described using the equilibrium expression ___$K_{eq} = [H_3O^+][OH^-]$___. The constant calculated in this case is referred to as the water ionization constant, ___K_w___, instead of K_{eq}. The value of the water ionization constant at 25°C is ___1.0×10^{-14}___. In any aqueous solution the product of ___$[H_3O^+]$___ x ___$[OH^-]$___ will be equal to this value. This fact explains the following formulas for determining concentration of unknowns in aqueous solution:

$$[H_3O^+] = \frac{1.0 \times 10^{-14}}{[OH^-]} \quad \text{and} \quad [OH^-] = \frac{1.0 \times 10^{-14}}{[H_3O^+]}$$

2. The formulas for calculating pH and pOH are:

$pH = -\log [H_3O^+]$	$pOH = -\log [OH^-]$

3. The pH and the pOH of a solution always add up to ___14___.

4. Calculate the pH of the following solutions:

   a. $[H^+] = 1.0 \times 10^{-5}\ M$ ___5.00___.

   b. $[H^+] = 3.0 \times 10^{-5}\ M$ ___4.52___.

   c. $[OH^-] = 3.1 \times 10^{-8}\ M$ ___6.49___.

   d. $[OH^-] = 1.0 \times 10^{-10}\ M$ ___4.00___.

5. Calculate the pOH of the following solutions:

   a. $[H^+] = 1.0 \times 10^{-3}\ M$ ___11.00___.

   b. $[H^+] = 5.7 \times 10^{-1}\ M$ ___13.76___.

   c. $[OH^-] = 3.2 \times 10^{-3}\ M$ ___2.49___.

   d. $[OH^-] = 1.0 \times 10^{-8}\ M$ ___8.00___.

6. When the pH or pOH of the solution is known, the $[H^+]$ or $[OH^-]$ concentrations may be calculated using antilogs and the formulas:

$[H^+]$ = antilog(-pH)	$[OH^-]$ = antilog(-pOH)

7. Strong acids ionize completely, therefore the concentration of the acid will be equal to the concentration of ___$[H_3O^+]$___ in solution and the -log of the acid's concentration will be its ___pH___. Strong bases dissociate completely, but some contain more than one ___hydroxide (OH^-)___ ion per formula unit. The concentration of hydroxide, $[OH^-]$, will be equal to the concentration of the base x ___the number of hydroxide ions (OH^-) in the formula___.

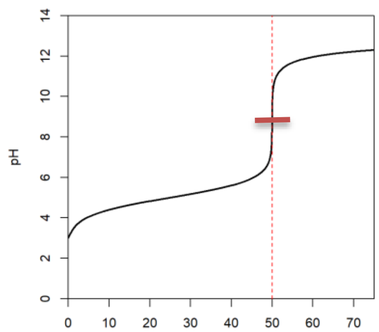
8. Weak acids do not ionize completely and the ___$[H_3O^+]$___ must be calculated using the K_a.

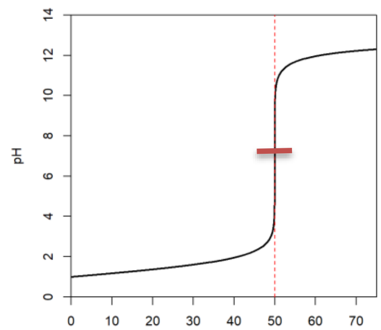
9. A(n) ___indicator___ is a substance that changes color based on pH. They are typically ___weak acids___ or ___weak bases___ that exist at equilibrium. The addition of acid or base ___shifts the equilibrium causing a color change___. The color changes over a range of pHs called the ___transition interval___.

10. The technique used to determine the concentration of an unknown acid or base is called ___titration___. It uses a(n) ___indicator___ to indicate when a ___neutralization___ reaction has occurred. The known solution in the process is called the ___titrant___ and the solution being tested is called the ___analyte___. The process is carried out until the solution changes color at a point known as the ___end___ point. This is different than the point at which the [H+] and [OH–] are equal, which is known as the ___equivalence___ point. The pH of the solution at that point will

depend on the combination of the acid and based being used. When a strong acid is titrated with a strong base or vice versa, the pH at this point will be approximately ____7____. When a strong base is titrated with a weak acid, the pH will be __greater than 7__. When a strong acid is titrated with a weak base the pH will be ___less than 7___.

11. The titration curve located on the left below represents the titration of a ____weak acid____ with a ___strong base___. The curve on the right represents the titration of a ____strong acid____ with a ____strong base____. Label the equivalence point for each graph.





12. Calculate the molarity of a KOH solution if 25.0mL of the solution is neutralized by 14.2mL of 0.5M HI.

a. Write the balanced equation representing the neutralization reaction.

$$HI(aq) + KOH(aq) \rightarrow H_2O(l) + KI(aq)$$

b. Since the acid-base reaction exists in a 1:1 mole ratio, the titration formula may be used.

Mb = ? *MaVa = MbVb*
Vb = 25.0 ml
Va = 14.2 ml
Ma = 0.5 M

$$Mb = \frac{MaVa}{Vb} = \frac{(0.5\ M)(14.2\ ml)}{(25.0\ ml)} = 0.284 \Rightarrow 0.3\ M$$

13. A buffer is made from a __weak acid/base__ and _its conjugate base/acid_. Buffers work by __absorbing or releasing hydrogen ions__. The amount of acid or base that a buffer can neutralize is called the __buffer capacity__.