

All questions are worth 1 point unless otherwise marked.

1. What were the names of the people who gave us the 2 different scientific definitions of acids and bases.

Arrhenius

Bronsted-Lowry

2. How would you define an acid and a base according to the first person(s) you mentioned in question #1? Arrhenius

a. Acid- gives off  $H^+$  when dissolved in water

b. Base- gives off  $OH^-$  when dissolved in water

3. How would you define an acid and a base according to the other person(s) you mentioned in question #1? Bronsted-Lowry

a. Acid- donates a proton ( $H^+$ )

b. Base- accepts a proton ( $H^+$ )

4. Before scientists described acids and bases by the above means, how did we identify acids and bases?

a. Acids- sour taste

b. Bases- bitter taste + slippery feel

5. A base has to gain a proton ( $H^+$ ) to become a conjugate acid.

6. An acid has to lose a proton ( $H^+$ ) to become a conjugate base.

7. Which of the following pairs is a correct acid, conjugate base pair?

a.  $\text{KNO}_3, \text{NaNO}_3$

b.  $\text{H}_2\text{O}, \text{HF}$

c.  $\text{HCl}, \text{Cl}^-$

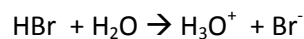
8. Which of the following pairs is a correct base, conjugate acid pair?

a.  $\text{NH}_3, \text{NH}_4^+$

b.  $\text{HF}, \text{SF}_6$

c.  $\text{NaCl}, \text{HCl}$

9. In the following equation, identify the acid, base, conjugate acid and conjugate base:



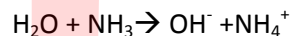
Base  $\text{H}_2\text{O}$

Acid  $\text{HBr}$

Conjugate Base  $\text{Br}^-$

Conjugate Acid  $\text{H}_3\text{O}^+$

10. In the following equation, identify the acid, base, conjugate acid and conjugate base:



Base  $\text{NH}_3$

Acid  $\text{H}_2\text{O}$

Conjugate Base  $\text{OH}^-$

Conjugate Acid  $\text{NH}_4^+$

11. Write the conjugate acid for  $\text{Cl}^-$ :



12. Write the conjugate base for  $\text{HPO}_4^{2-}$ :



13. Write the conjugate acid for  $\text{SO}_3^{2-}$ :



14. Write the conjugate base for  $\text{NH}_3$ :



15. Define "AMPHOTERIC".

able to act as a Bronsted-Lowry acid or base  
able to donate or accept a proton ( $H^+$ )

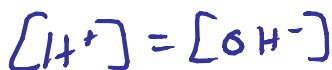
16. Define "ACIDIC" with regard to solutions. You may use words or a math expression.



$$pH < 7$$

or a solution with more hydrogen ion than hydroxide ion  
or a pH of less than 7

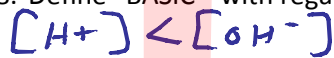
17. Define "NEUTRAL" with regard to solutions. You may use words or a math expression.



$$pH = 7$$

or a solution with an equal amount ( $1 \times 10^{-7} M$  for each) of  
hydrogen and hydroxide ion or a pH equal to 7

18. Define "BASIC" with regard to solutions. You may use words or a math expression.



$$pH > 7$$

or a solution with more hydroxide ion than hydrogen  
ion or a pH greater than 7

19. Write the equation for the ionization of water (water reacting with itself).



20. The pH scale uses what type of mathematical operation?

Logarithmic

21. What base number is used for the pH scale math operation?

Base 10

Answer each question. All questions worth 3 points.

22. If the  $[H^+] = 1 \times 10^{-5} M$  what is the  $[OH^-]$  in the solution? Is the solution Acidic, Basic or Neutral?

$$[H^+][OH^-] = 1 \times 10^{-14}$$

$$1 \times 10^{-5} (x) = 1 \times 10^{-14}$$

$$x = \frac{1 \times 10^{-14}}{1 \times 10^{-5}} = 1 \times 10^{-9} = [OH^-]$$

$$[H^+] > [OH^-] \Rightarrow \text{Acidic}$$

23. If the  $[H^+] = 0.00052 M$  what is the  $[OH^-]$  in the solution? Is the solution Acidic, Basic or Neutral?

$$[H^+][OH^-] = 1 \times 10^{-14}$$

$$(0.00052)(x) = 1 \times 10^{-14}$$

$$x = \frac{1 \times 10^{-14}}{0.00052} = 1.92 \times 10^{-11} = [OH^-]$$

$$[H^+] > [OH^-] \Rightarrow \text{Acidic}$$

24. If the  $[OH^-] = 0.0000001 M$  what is the  $[H^+]$  in the solution? Is the solution Acidic, Basic or Neutral?

$$[H^+][OH^-] = 1 \times 10^{-14}$$

$$(x)(0.0000001) = 1 \times 10^{-14}$$

$$x = \frac{1 \times 10^{-14}}{0.0000001} = 1 \times 10^{-7} = [H^+]$$

$$[H^+] = [OH^-] \Rightarrow \text{Neutral}$$

Answer each question. All questions worth 2 points.

25. What is the pH of a solution with a  $[H^+] = 0.049 M$ ?

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

$$-\log 0.049$$

$$pH = 1.30$$

26. What is the pOH of a solution with a  $[OH^-] = 1.8 \times 10^{-11} M$ ?

$$-\log [OH^-] = pOH$$

$$-\log 1.8 \times 10^{-11}$$

$$pOH = 10.74$$

27. What is the pH of a solution with a pOH of 11.80?

$$pH + pOH = 14$$

$$pH + 11.80 = 14$$

$$pH = 14 - 11.80$$

$$pH = 2.20$$

28. What is the pOH of a solution with a  $[H^+]$  of  $4.10 \times 10^{-8} M$ ?

$$[H^+][OH^-] = 1 \times 10^{-14}$$

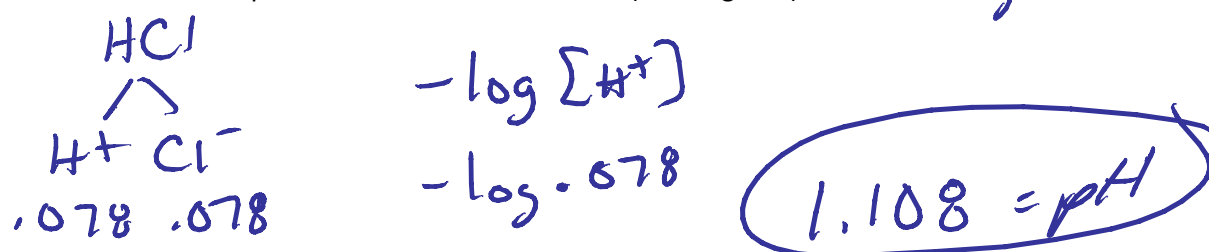
$$(4.10 \times 10^{-8})(x) = 1 \times 10^{-14}$$

$$x = \frac{1 \times 10^{-14}}{4.1 \times 10^{-8}} = 2.439 \times 10^{-7} = [OH^-]$$

$$-\log [OH^-]$$

$$-\log 2.439 \times 10^{-7} = 6.61 = pOH$$

29. What is the pH of a 0.078 M solution of HCl (a strong acid)?



30. If the  $[H^+] = 0.890 \text{ M}$  what is the  $[OH^-]$  in the solution? Is the solution Acidic, Basic or Neutral?

$$[H^+][OH^-] = 1 \times 10^{-14} \quad x = \frac{1 \times 10^{-14}}{0.890} \quad [H^+] > [OH^-] \rightarrow \text{Acidic}$$

$$0.890(x) = 1 \times 10^{-14} \quad 0.89 \quad x = 1.12 \times 10^{-14} \text{ M} = [OH^-]$$

31. If the  $[H^+] = 1 \times 10^{-7} \text{ M}$  what is the  $[OH^-]$  in the solution? Is the solution Acidic, Basic or Neutral?

$$[H^+][OH^-] = 1 \times 10^{-14} \quad x = \frac{1 \times 10^{-14}}{1 \times 10^{-7}} \quad [H^+] = [OH^-] \rightarrow \text{Neutral}$$

$$1 \times 10^{-7}(x) = 1 \times 10^{-14} \quad 1 \times 10^{-7} \quad x = 1 \times 10^{-7} \text{ M} = [OH^-]$$

32. If the  $[OH^-] = 1.2 \text{ M}$  what is the  $[H^+]$  in the solution? Is the solution Acidic, Basic or Neutral?

$$[H^+][OH^-] = 1 \times 10^{-14} \quad x = \frac{1 \times 10^{-14}}{1.2} \quad [H^+] < [OH^-] \rightarrow \text{Basic}$$

$$(x)(1.2) = 1 \times 10^{-14} \quad 1.2 \quad x = 8.33 \times 10^{-15} \text{ M} = [H^+]$$

Answer each question. All questions worth 2 points.

33. What is the pH of a solution with a  $[H^+] = 1.9 \text{ M}$ ?

$$-\log [H^+] = \text{pH}$$

$$-\log 1.9 = \text{pH}$$

$$\text{pH} = -0.28$$

34. What is the pOH of a solution with a  $[OH^-] = 0.198 \text{ M}$ ?

$$-\log [OH^-] = \text{pOH}$$

$$-\log 0.198 = \text{pOH}$$

$$\text{pOH} = 0.703$$

35. What is the pOH of a solution with a pH of 2.91?

$$\text{pH} + \text{pOH} = 14$$

$$2.91 + x = 14$$

$$14 - 2.91 = x$$

$$x = \text{pOH} = 11.09$$

36. What is the pH of a solution with a  $[OH^-]$  of  $1.450 \times 10^{-2} \text{ M}$ ?

$$-\log [OH^-] = \text{pOH}$$

$$-\log 1.450 \times 10^{-2} = \text{pOH}$$

$$\text{pOH} = 1.84$$

$$\text{pH} + \text{pOH} = 14$$

$$x + 1.84 = 14$$

$$14 - 1.84 = x$$

$$12.16 = \text{pH}$$

37. What is the pH of a 0.005M solution of HCl (a strong acid)?

