1. $[H^+] = 1.0 \times 10^{-3}$ M — 3.00 ACIDIC

2. $[H^+] = 2.4 \times 10^{-5}$ M — 4.62 ACIDIC

3. $[H^+] = 5.11 \times 10^{-13}$ M — 12.292 BASIC

4. $[H^+] = 7.352 \times 10^{-2}$ M — 1.1336 ACIDIC

5. $[H^+] = 3.5 \times 10^{-6}$ M — 5.46 ACIDIC

6. $[H^+] = 1.0 \times 10^{-7}$ M — 7.00 NEUTRAL

7. $[H^+] = 6.85 \times 10^{-10}$ M — 9.164 BASIC

8. $[H^+] = 4.99 \times 10^{-8}$ M — 7.302 BASIC

9. $[H^+] = 3.389 \times 10^{-1}$ M — 0.4699 ACIDIC

10. 6.3

5×10^{-7} ACIDIC

11. 8.17

6.8×10^{-9} BASIC

12. 3.50

3.2×10^{-4} ACIDIC

13. 7.00

1.0×10^{-7} NEUTRAL

14. 13.22

6.0×10^{-14} BASIC

15. 7.98

1.0×10^{-8} BASIC

16. 11.61

2.5×10^{-12} BASIC

17. 1.671

0.0213 or 2.13×10^{-2} ACIDIC

5.62×10^{-6} ACIDIC

18. 5.250

1. For each of the following concentrations of $[H^+]$, calculate the pH:
   a) 3.28×10^{-4} — **3.484**
   b) 9.43×10^{-13} — **12.025**
   c) 2.71×10^{-8} — **7.567**
   d) 1.00×10^{-3} — **3.000**
   e) 1.00×10^{-12} — **12.000**
2. For each of the following pH values, calculate the concentration of $[H^+]$:
   a) pH = 5 — **10^{-5}**
   b) pH = 3 — **10^{-3}**
   c) pH = 2.8 — **2×10^{-3}**
   d) pH = 13.7 — **2×10^{-14}**
   e) pH = 6.9 — **1×10^{-7}**
3. For each of the following pOH values, determine whether the solution is acidic, basic, or neutral:
   a) pOH = 4.5 — **BASIC**
   b) pOH = 9.2 — **ACIDIC**
   c) pOH = 7 — **NEUTRAL**
   d) pOH = 13.8 — **ACIDIC**
   e) pOH = 0.4 — **BASIC**

REMEMBER THAT
pH + pOH = 14

so pH = 14 - pOH
if pH > 7 then BASIC
pH < 7 then ACIDIC

4. For each of the following concentrations of $[OH^-]$, calculate pOH:
   A) 6.32×10^{-2} — **1.199**
   B) 9.28×10^{-9} — **8.032**
   C) 7.56×10^{-3} — **2.121**
   D) 1.00×10^{-5} — **5.000**
   E) 1.00×10^{-11} — **11.000**

5. For each of the following pOH values, calculate the concentration of $[OH^{-1}]$:
   A) pOH = 3.5 — **3×10^{-4}**
   B) pOH = 9.1 — **8×10^{-10}**
   C) pOH = 4.6 — **3×10^{-5}**
   D) pOH = 2.4 — **0.004 or 4×10^{-3}**
   E) pOH = 7.0 — **1×10^{-7}**

6. Using the pH square, fill in the blanks on the following chart:

$[H^+]$	pH	pOH	$[OH^{-1}]$
1.0×10^{-4}	**4.00**	**10.00**	**1.0×10^{-10}**
1×10^{-4}	3.9	**10.1**	**8×10^{-11}**
2×10^{-13}	**12.8**	1.2	**6×10^{-2}**
1.2×10^{-7}	**6.92**	**7.08**	8.3×10^{-8}

	$[H^+]$	pH	$[OH^-]$	pOH	Acidic or Basic
1.	10^{-5} M	5	10^{-9} M	9	Acidic
2.	10^{-7}	7	10^{-7}	7	Neutral
3.	10^{-10}	10	10^{-4} M	4	Basic
4.	10^{-2} M	2	10^{-12}	12	Acidic
5.	10^{-3}	3	10^{-11}	11	Acidic
6.	10^{-12}	12	10^{-2}	2	Basic
7.	10^{-9}	9	10^{-5} M	5	Basic
8.	10^{-11} M	11	10^{-3}	3	Basic
9.	10^{-1}	1	10^{-13}	13	Acidic
10.	10^{-6}	6	10^{-8}	8	Acidic

1. 0.01 M HCl

$[H^+] = 0.01\ M \quad pH = 2.00$

2. 0.0010 M NaOH

$[OH^-] = 0.0010\ M \quad pOH = 3.00 \quad pH = 11.00$

3. 0.050 M $Ca(OH)_2$

$[OH^-] = 0.0020\ M \quad pOH = 2.70 \quad pH = 11.30$

4. 0.030 M HBr

$[H^+] = 0.030\ M \quad pH = 1.52$

5. O.150 M KOH

$[OH^-] = 0.150\ M \quad pOH = 0.824 \quad pH = 13.176$

6. 2.0 M $HC_2H_3O_2$ (Assume 5.0% dissociation.)

$[H^+] = 0.10$ M pH = 2.00

7. 3.0 M HF (Assume 10.0% dissociation.)

$[H^+] = 0.30$ M pH = 0.52

8. 0.50 M HNO_3

$[H^+] = 0.50$ M pH = 0.30

9. 2.50 M NH_4OH (Assume 5.00% dissociation.)

$[OH^-] = 0.125$ M pOH = 0.903 pH = 13.907

10. 5.0 M HNO_2 (Assume 1.0% dissociation.)

$[H^+] = 0.050$ M pH = 1.30

1. Identify the acid, base, conjugate acid and conjugate base for each of the following.

a) $HClO_4(aq) + H_2O(l) \rightleftarrows H_3O^+(aq) + ClO_4^-(aq)$

Acid Base Conj. Acid Conj. Base

b) $H_2SO_3(aq) + H_2O(l) \rightleftarrows H_3O^+(aq) + HSO_3^-(aq)$

Acid Base Conj. Acid Conj. Base

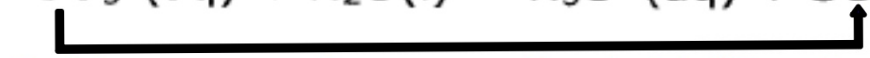
c) $HC_2H_3O_2(aq) + H_2O(l) \rightleftarrows H_3O^+(aq) + C_2H_3O_2^-(aq)$

Acid Base Conj. Acid Conj. Base

d) $H_2S(g) + H_2O(l) \rightleftarrows H_3O^+(aq) + HS^-(aq)$

Acid Base Conj. Acid Conj. Base

e) $HSO_3^-(aq) + H_2O(l) \rightleftharpoons H_3O^+(aq) + SO_3^{2-}(aq)$



Acid **Base** **Conj. Acid** **Conj. Base**

f) $NH_3(g) + H_2O(l) \rightleftharpoons NH_4^+(aq) + OH^-(aq)$

Base **Acid** **Conj. Acid** **Conj. Base**

g) $HF(aq) + HSO_3^-(aq) \rightleftharpoons F^-(aq) + H_2SO_3(aq)$

Acid **Base** **Conj. Base** **Conj. Acid**

h) $HNO_2(aq) + HS^-(aq) \rightleftharpoons NO_2^-(aq) + H_2S(aq)$

Acid **Base** **Conj. Base** **Conj. Acid**

2. Complete the equation for the reaction of each of the following with water. Indicate whether the ion or molecule is an acid or base, and whether each reaction is explained by Arrhenius, Bronsted-Lowry, o both.

a) $HI(aq) + H_2O(l) \longrightarrow I^-_{(aq)} + H_3O^+_{(aq)}$

Both Arrhenius and Bronsted-Lowry Acid

b) $HF(aq) + H_2O(l) \longrightarrow F^-_{(aq)} + H_3O^+_{(aq)}$

Both Arrhenius and Bronsted-Lowry Acid

c) $C_2H_3O_2^-(aq) + H_2O(l) \longrightarrow HC_2H_3O_{2(aq)} + OH^-_{(aq)}$

Bronsted-Lowry Base Only

d) $CO_3^{2-}(aq) + H_2O(l) \longrightarrow HCO_3^-{}_{(aq)} + OH^-_{(aq)}$

Bronsted-Lowry Base Only

e) $O^{2-}(aq) + H_2O(l) \longrightarrow 2\ OH^-_{(aq)}$

Bronsted-Lowry Base Only