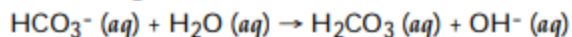


## Acid-Base Sample Questions

### Acid-Base Reactions, Conjugate Acid/Base Pairs

6) In the following reaction:



- A)  $\text{HCO}_3^-$  is an acid and  $\text{H}_2\text{CO}_3$  is its conjugate base.
- B)  $\text{H}_2\text{O}$  is an acid and  $\text{OH}^-$  is its conjugate base.
- C)  $\text{HCO}_3^-$  is an acid and  $\text{OH}^-$  is its conjugate base.
- D)  $\text{H}_2\text{O}$  is an acid and  $\text{H}_2\text{CO}_3$  is its conjugate base.
- E)  $\text{H}_2\text{O}$  is an acid and  $\text{HCO}_3^-$  is its conjugate base.

7) What is the conjugate acid of  $\text{OH}^-$ ?

- A)  $\text{O}^{2-}$
- B)  $\text{H}_2\text{O}$
- C)  $\text{NaOH}$
- D)  $\text{OH}^-$
- E) none of the above

8) What are the products of a neutralization reaction?

- A) salt and carbon dioxide
- B) carbon dioxide and water
- C) water and salt
- D) oil and water
- E) none of the above

4. Write conjugate acids for the following:

- a.  $\text{HSO}_4^{-1}$  \_\_\_\_\_
- b.  $\text{HCO}_3^{-1}$  \_\_\_\_\_
- c.  $\text{H}_2\text{PO}_4^{-1}$  \_\_\_\_\_
- d.  $\text{H}_2\text{O}$  \_\_\_\_\_
- e.  $\text{NH}_3$  \_\_\_\_\_

5. Write conjugate bases for the following:

- a.  $\text{HSO}_4^{-1}$  \_\_\_\_\_
- b.  $\text{HCO}_3^{-1}$  \_\_\_\_\_
- c.  $\text{H}_2\text{PO}_4^{-1}$  \_\_\_\_\_
- d.  $\text{H}_2\text{O}$  \_\_\_\_\_
- e.  $\text{HC}_2\text{H}_3\text{O}_2$  \_\_\_\_\_

3. For the following reaction, which substance is the base?  $2\text{HCl} + \text{Mg}(\text{OH})_2 \rightarrow \text{MgCl}_2 + 2\text{HOH}$

6. What are the reaction products for a neutralization reaction between  $\text{H}_2\text{SO}_4$  and  $\text{KOH}$ ?

7.  $\text{BaCl}_2$  is a salt that must have been formed from the acid \_\_\_\_\_ and the base \_\_\_\_\_.

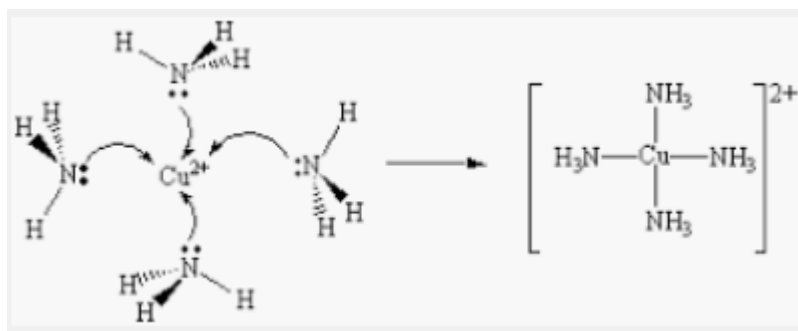
8. Amphoteric Species \_\_\_\_\_.

2. Which of the following statements is not a characteristic of acids?

- a) They are proton donors.
- b) They neutralize bases.
- c) They react with nonmetals to give a salt and oxygen.
- d) They react with bases to give a salt and water.
- e) They taste sour.

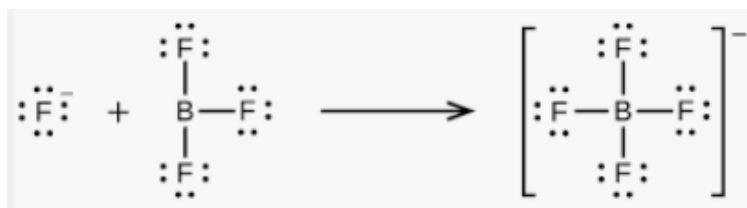
1. Which of the following is a weak base in aqueous solution

- a)  $\text{NH}_3$       b)  $\text{HCl}$       c)  $\text{KOH}$       d)  $\text{NaOH}$       e)  $\text{Ca}(\text{OH})_2$



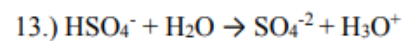
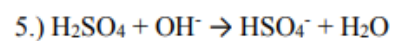
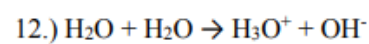
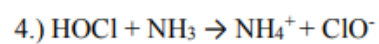
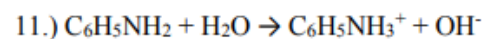
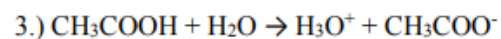
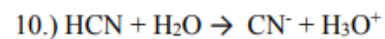
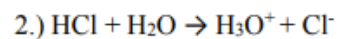
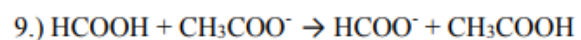
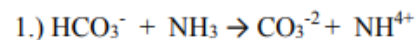
*Lewis Acids ACCEPT an electron pair, Lewis Bases DONATE electron pairs.*  
 In the above reaction,  $\text{NH}_3$  “donates” the lone electron pair on N to create the Bond with  $\text{Cu}^{2+}$ . In this reaction,  $\text{NH}_3$  is the Lewis Base, and  $\text{Cu}^{2+}$  is the Lewis Acid.

Label the Lewis acid and the Lewis base in the reactions below:



### Bronsted-Lowry Acids and Bases

Identify the conjugation acid-base pairs in the following reactions. An acid donates a proton to become a conjugate base. A base accepts a proton to form a conjugate acid.



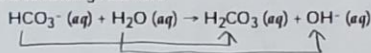
Answers/ Key Below:

Acid-Base Sample Questions

**Acid-Base Reactions, Conjugate Acid/Base Pairs**

*Key*

6) In the following reaction:



- A)  $\text{HCO}_3^-$  is an acid and  $\text{H}_2\text{CO}_3$  is its conjugate base.
- B)  $\text{H}_2\text{O}$  is an acid and  $\text{OH}^-$  is its conjugate base.
- C)  $\text{HCO}_3^-$  is an acid and  $\text{OH}^-$  is its conjugate base.
- D)  $\text{H}_2\text{O}$  is an acid and  $\text{H}_2\text{CO}_3$  is its conjugate base.
- E)  $\text{H}_2\text{O}$  is an acid and  $\text{HCO}_3^-$  is its conjugate base.

(B)

Acids Donate  $\text{H}^+$   
Bases Accept  $\text{H}^+$

$\text{HCO}_3^-$  "becomes"  $\text{H}_2\text{CO}_3$  (takes  $\text{H}^+$ )  
 $\text{H}_2\text{O}$  "becomes"  $\text{OH}^-$  (gives  $\text{H}^+$ )  
↑ Acting as Acid

7) What is the conjugate acid of  $\text{OH}^-$ ?

- A)  $\text{O}^{2-}$
- B)  $\text{H}_2\text{O}$
- C)  $\text{NaOH}$
- D)  $\text{OH}^-$
- E) none of the above

(B)

$\text{OH}^-$  acting as base  
Bases accept  $\text{H}^+$   
 $\therefore$  conjugate acid of  $\text{OH}^- = \text{H}_2\text{O}$   
(base)

8) What are the products of a neutralization reaction?

- A) salt and carbon dioxide
- B) carbon dioxide and water
- C) water and salt
- D) oil and water
- E) none of the above

(C)

Ex: Acid + Base  $\rightarrow$   
 $\text{HCl} + \text{KOH} \rightarrow \text{KCl} + \text{H}_2\text{O}$   
"Salt"  
(ionic compound)

4. Write conjugate acids for the following:

- a.  $\text{HSO}_4^-$       $\text{H}_2\text{SO}_4$
- b.  $\text{HCO}_3^-$       $\text{H}_2\text{CO}_3$
- c.  $\text{H}_2\text{PO}_4^-$       $\text{H}_3\text{PO}_4$
- d.  $\text{H}_2\text{O}$           $\text{H}_3\text{O}^+$
- e.  $\text{NH}_3$            $\text{NH}_4^+$

\* If asked for the conjugate acids of these formulas, these are behaving as BASES (accept  $\text{H}^+$ )  
\* Add  $\text{H}^+$  to given formulas to obtain conjugate acid of each base

5. Write conjugate bases for the following:

- a.  $\text{HSO}_4^-$       $\text{SO}_4^{2-}$
- b.  $\text{HCO}_3^-$       $\text{CO}_3^{2-}$
- c.  $\text{H}_2\text{PO}_4^-$       $\text{HPO}_4^{2-}$
- d.  $\text{H}_2\text{O}$           $\text{OH}^-$
- e.  $\text{HC}_2\text{H}_3\text{O}_2$     $\text{C}_2\text{H}_3\text{O}_2^-$

\* If asked for the conjugate bases of these formulas, then these are behaving as ACIDS (donate  $\text{H}^+$ )

\* Note that  $\text{HSO}_4^-$ ,  $\text{HCO}_3^-$ ,  $\text{H}_2\text{O}$ , &  $\text{H}_2\text{PO}_4^-$  are Amphoteric!

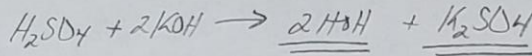
\* remove  $\text{H}^+$  from given formulas to obtain conjugate bases of each acid

3. For the following reaction, which substance is the base?  $2\text{HCl} + \text{Mg}(\text{OH})_2 \rightarrow \text{MgCl}_2 + 2\text{H}_2\text{O}$

↑  
OH<sup>-</sup> accepts H<sup>+</sup> to create H<sub>2</sub>O  
∴ Mg(OH)<sub>2</sub> is BASE

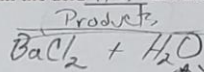
Not asked for...  
but good thought...  
For reverse rxn, Cl<sup>-</sup> accept H<sup>+</sup> to form HCl (MgCl<sub>2</sub> for rxn)

6. What are the reaction products for a neutralization reaction between H<sub>2</sub>SO<sub>4</sub> and KOH?



7. BaCl<sub>2</sub> is a salt that must have been formed from the acid HCl and the base Ba(OH)<sub>2</sub>.

Think "backwards" for answer →



\* You know Acid + Base → Salt + H<sub>2</sub>O

2. Which of the following statements is not a characteristic of acids?

- a) They are proton donors. ✓
- b) They neutralize bases. ✓
- c) They react with nonmetals to give a salt and oxygen.
- d) They react with bases to give a salt and water. ✓
- e) They taste sour. ✓

Not all acids contain O, so not always produced

\* Oxidic acids contain O!  
\* Organic acids contain O!

1. Which of the following is a weak base in aqueous solution

(A)

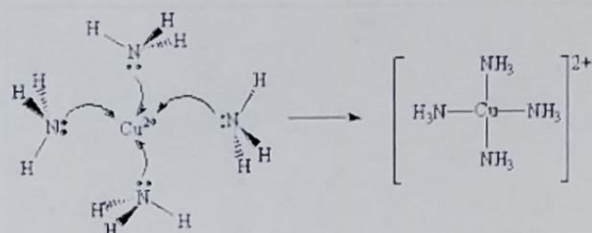
a) NH<sub>3</sub>

b) HCl  
|  
strong acid

c) KOH  
|  
strong base

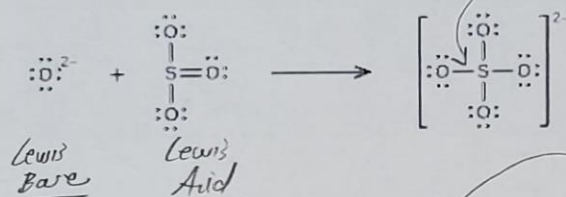
d) NaOH  
|  
strong base

e) Ca(OH)<sub>2</sub>  
|  
strong base

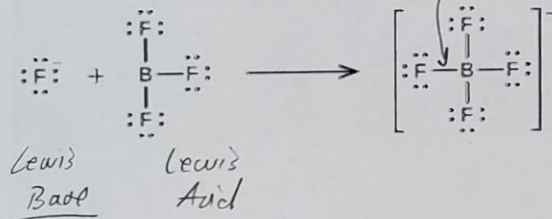


Lewis Acids ACCEPT an electron pair, Lewis Bases DONATE electron pairs.  
 In the above reaction,  $\text{NH}_3$  "donates" the lone electron pair on N to create the Bond with  $\text{Cu}^{2+}$ . In this reaction,  $\text{NH}_3$  is the Lewis Base, and  $\text{Cu}^{2+}$  is the Lewis Acid.

Label the Lewis acid and the Lewis base in the reactions below:



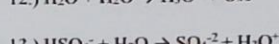
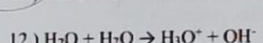
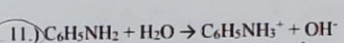
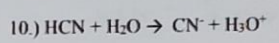
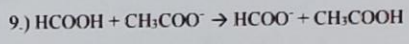
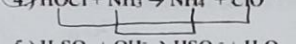
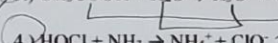
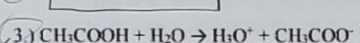
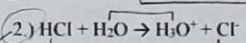
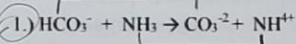
"New" bond created from lone pair  $e^-$  from  $\text{O}^{2-}$



"New" bond created from lone pair donated from  $\text{F}^{-1}$

### Bronsted-Lowry Acids and Bases

Identify the conjugation acid-base pairs in the following reactions. An acid donates a proton to become a conjugate base. A base accepts a proton to form a conjugate acid.



1.  $\text{HCO}_3^-$ ,  $\text{CO}_3^{2-}$   
Acid Base  
 $\text{NH}_3$ ,  $\text{NH}_4^+$   
Base Acid

2.  $\text{HCl}$ ,  $\text{Cl}^-$   
Acid Base  
 $\text{H}_2\text{O}$ ,  $\text{H}_3\text{O}^+$   
base acid

3.  $\text{CH}_3\text{COOH}$ ,  $\text{CH}_3\text{COO}^-$   
Acid Base  
 $\text{H}_2\text{O}$ ,  $\text{H}_3\text{O}^+$   
Base Acid

4.  $\text{HOCl}$ ,  $\text{ClO}^-$   
Acid Base  
 $\text{NH}_3$ ,  $\text{NH}_4^+$   
Base Acid

11.  $\text{C}_6\text{H}_5\text{NH}_2$ ,  $\text{C}_6\text{H}_5\text{NH}_3^+$   
Base Acid  
 $\text{H}_2\text{O}$ ,  $\text{OH}^-$   
Acid Base