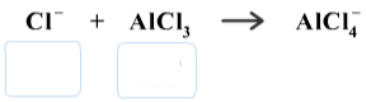
Acid and Base

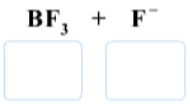
4.

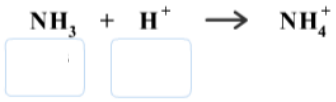
Identify the Lewis acid and Lewis base in each of the following reactions.



Lewis base

Lewis acid





14.

An unknown mass of Na_2O (molar mass = 61.979 g/mol) was dissolved in enough water to create a 200.0 mL stock solution. A 5.00 mL sample of the stock solution was transferred to a volumetric flask and diluted to 500.0 mL. The pH of the dilute solution is 13.09.

Calculate the concentration of OH^- ions in the dilute solution.

Number

M

Next, calculate the concentration of OH^- ions in the stock solution.

Number

M

Finally, determine the original mass of Na_2O dissolved in the stock solution.

Number

g

20. Ranks these acids according to their expected pKa values.

CH2CH2COOH, ClCH2COOH, Cl2CHCOOH, ClCH2CH2COOH

21.

oose the phrases that best complete the statements regarding the relative acid strength of these acids.

HIO HClO because

- the electronegativities of I and Cl are the same.
- I is the more electronegative central atom.
- Cl is the more electronegative central atom.

$HBrO_3$ HBrO because

- the acids have the same central atom, the bonds to the central atom are of similar polarity and strength.
- HBrO has less oxygen atoms, which creates more polar and stronger bonds to the central atom.
- $HBrO_3$ has more oxygen atoms, which creates more polar and stronger bonds to the central atom.

24.

If enough of a monoprotic acid is dissolved in water to produce a 0.0112 M solution with a pH of 6.40, what is the equilibrium constant, K_a, for the acid?

$K_a =$ Number

32.

Calculate the concentrations of all species in a 1.58 M Na_2SO_3 (sodium sulfite) solution. The ionization constants for sulfurous acid are $K_{a1} = 1.4 \times 10^{-2}$ and $K_{a2} = 6.3 \times 10^{-8}$.

$[Na^+] =$ Number M $\quad [SO_3^{2-}] =$ Number M

$[HSO_3^-] =$ Number M $\quad [H_2SO_3] =$ Number M

$[OH^-] =$ Number M $\quad [H^+] =$ Number M

37.

A large volume of 0.1590 M $H_2SO_3(aq)$ is treated with enough NaOH(s) to adjust the pH of the solution to 5.55. Assuming that the addition of NaOH(s) does not significantly affect the volume of the solution, calculate the final molar concentrations of $H_2SO_3(aq)$, $HSO_3^-(aq)$, and $SO_3^{2-}(aq)$ in solution given that the K_{a1} and K_{a2} values are 1.50×10^{-2} and 1.20×10^{-7}, respectively.

$[H_2SO_3] =$ Number ____ M

$[HSO_3^-] =$ Number ____ M

$[SO_3^{2-}] =$ Number ____ M

45.

Carbon dioxide dissolves in water to form carbonic acid. Estimate the thermodynamic equilibrium constant for this reaction using the $\Delta G_f°$ values in the table.

Substance	$\Delta G_f°$ (kJ/mol)
$H_2CO_3(aq)$	−616.1
$H_2O(l)$	−237.1
$CO_2(g)$	−394.4

$K =$ Number ____

Carbonic acid then ionizes in water ($K_{a1} = 4.5 \times 10^{-7}$).

Ignoring K_{a2}, estimate K for the overall process by which CO_2 and H_2O form H^+ and HCO_3^-.

$K =$ Number ____

What is the pressure of CO_2 in equilibrium with carbonated water at 25 °C and pH = 4.67?

$P_{CO_2} =$ Number ____ atm

50.

Calculate the pH of the solution that results from mixing

67.0 mL of 0.057 M HCN(*aq*) with 33.0 mL of 0.020 M NaCN(*aq*). The K_a value for HCN is 4.9×10^{-10}.

pH = Number ____

37.0 mL of 0.031 M HCN(*aq*) with 63.0 mL of 0.070 M NaCN(*aq*).

pH = Number ____

50.0 mL of 0.111 M HCN(*aq*) with 50.0 mL of 0.111 M NaCN(*aq*).

pH = Number ____

52.

Calculate the change in pH when 9.00 mL of 0.100 M HCl(*aq*) is added to 100.0 mL of a buffer solution that is 0.100 M in $NH_3(aq)$ and 0.100 M in $NH_4Cl(aq)$. A list of ionization constants can be found here.

$\Delta pH =$ Number

Calculate the change in pH when 9.00 mL of 0.100 M NaOH(*aq*) is added to the original buffer solution.

$\Delta pH =$ Number

57.

Calculate the pH for each of the following cases in the titration of 50.0 mL of 0.190 M HClO(*aq*) with 0.190 M KOH(*aq*). The ionization constant for HClO can be found here.

(a) before addition of any KOH Number

(b) after addition of 25.0 mL of KOH Number

(c) after addition of 35.0 mL of KOH Number

(d) after addition of 50.0 mL of KOH Number

(e) after addition of 60.0 mL of KOH Number

Corr

65.

A certain indicator, HA, has a K_a value of 4.0×10^{-8}. The protonated form of the indicator is red and the ionized form is yellow.

What is the pK_a of the indicator?

$pK_a =$ Number

What is the color of this indicator in a solution with pH = 5?

red
orange
yellow

70.

The pK_b values for the dibasic base B are pK_{b1} = 2.10 and pK_{b2} = 7.73.
Calculate the pH at each of the following points in the titration of 50.0 mL of a 0.75 M B(*aq*) with 0.75 M HCl(*aq*)

before addition of any HCl — Number

(b) after addition of 25.0 mL of HCl — Number

(c) after addition of 50.0 mL of HCl — Number

(d) after addition of 75.0 mL of HCl — Number

(e) after addition of 100.0 mL of HCl — Number

Correct.