

## Matter and Motion Fall 2015

### Chemistry Equations, Conversion Factors and Constants

$$c = 3.00 \times 10^8 \text{ m/s}$$

$$h = 6.626 \times 10^{-34} \text{ Js}$$

$$N = 6.022 \times 10^{23} \text{ mol}^{-1}$$

$$e = 1.602 \times 10^{-19} \text{ Coulombs}$$

$$1 \text{ in.} = 2.54 \text{ cm}$$

$$0 \text{ K} = -273.15 \text{ }^{\circ}\text{C}$$

$${}^{\circ}\text{C} = \frac{5}{9}({}^{\circ}\text{F} - 32)$$

$${}^{\circ}\text{F} = \frac{9}{5}({}^{\circ}\text{C}) + 32$$

$$(KE)_{\text{avg}} = \frac{3}{2}RT$$

$$R = 8.3145 \frac{J}{mol \cdot K} = 0.082057 \frac{L \cdot atm}{mol \cdot K} = 62.364 \frac{L \cdot torr}{mol \cdot K}$$

$$E = hv$$

$$c = \lambda v$$

$$\text{Bond Order} = \frac{\# \text{ bonding electrons} - \# \text{ antibonding electrons}}{2}$$

$$\text{Rate} = -\frac{\Delta[A]}{\Delta t} = k[A]^n$$

$$k = A \cdot e^{E_a/RT}$$

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

$$\text{p}K_a = -\log(K_a)$$

$$K_w = 1 \times 10^{-14}$$

$$K_a \times K_b = K_w$$

$$\text{pH} = \text{p}K_a + \log\left(\frac{[\text{base}]}{[\text{acid}]}\right)$$

**TABLE 14.3** > Values of  $K_b$  for Some Common Weak Bases

Name	Formula	Conjugate Acid	$K_b$
Ammonia	$\text{NH}_3$	$\text{NH}_4^+$	$1.8 \times 10^{-5}$
Methylamine	$\text{CH}_3\text{NH}_2$	$\text{CH}_3\text{NH}_3^+$	$4.38 \times 10^{-4}$
Ethylamine	$\text{C}_2\text{H}_5\text{NH}_2$	$\text{C}_2\text{H}_5\text{NH}_3^+$	$5.6 \times 10^{-4}$
Aniline	$\text{C}_6\text{H}_5\text{NH}_2$	$\text{C}_6\text{H}_5\text{NH}_3^+$	$3.8 \times 10^{-10}$
Pyridine	$\text{C}_5\text{H}_5\text{N}$	$\text{C}_5\text{H}_5\text{NH}^+$	$1.7 \times 10^{-9}$

**TABLE 14.4** > Stepwise Dissociation Constants for Several Common Polyprotic Acids

Name	Formula	$K_{a_1}$	$K_{a_2}$	$K_{a_3}$
Phosphoric acid	$\text{H}_3\text{PO}_4$	$7.5 \times 10^{-3}$	$6.2 \times 10^{-8}$	$4.8 \times 10^{-13}$
Arsenic acid	$\text{H}_3\text{AsO}_4$	$5 \times 10^{-3}$	$8 \times 10^{-8}$	$6 \times 10^{-10}$
Carbonic acid	$\text{H}_2\text{CO}_3$	$4.3 \times 10^{-7}$	$5.6 \times 10^{-11}$	
Sulfuric acid	$\text{H}_2\text{SO}_4$	Large	$1.2 \times 10^{-2}$	
Sulfurous acid	$\text{H}_2\text{SO}_3$	$1.5 \times 10^{-2}$	$1.0 \times 10^{-7}$	
Hydrosulfuric acid*	$\text{H}_2\text{S}$	$1.0 \times 10^{-7}$	$\sim 10^{-19}$	
Oxalic acid	$\text{H}_2\text{C}_2\text{O}_4$	$6.5 \times 10^{-2}$	$6.1 \times 10^{-5}$	
Ascorbic acid (vitamin C)	$\text{H}_2\text{C}_6\text{H}_6\text{O}_6$	$7.9 \times 10^{-5}$	$1.6 \times 10^{-12}$	

\*The  $K_{a_2}$  value for  $\text{H}_2\text{S}$  is very uncertain. Because it is so small, the  $K_{a_2}$  value is very difficult to measure accurately.

**TABLE 14.2** > Values of  $K_a$  for Some Common Monoprotic Acids

Formula	Name	Value of $K_a^*$
$\text{HSO}_4^-$	Hydrogen sulfate ion	$1.2 \times 10^{-2}$
$\text{HClO}_2$	Chlorous acid	$1.2 \times 10^{-2}$
$\text{HC}_2\text{H}_2\text{ClO}_2$	Monochloracetic acid	$1.35 \times 10^{-3}$
HF	Hydrofluoric acid	$7.2 \times 10^{-4}$
$\text{HNO}_2$	Nitrous acid	$4.0 \times 10^{-4}$
$\text{HC}_2\text{H}_3\text{O}_2$	Acetic acid	$1.8 \times 10^{-5}$
$[\text{Al}(\text{H}_2\text{O})_6]^{3+}$	Hydrated aluminum(III) ion	$1.4 \times 10^{-5}$
$\text{HOCl}$	Hypochlorous acid	$3.5 \times 10^{-8}$
HCN	Hydrocyanic acid	$6.2 \times 10^{-10}$
$\text{NH}_4^+$	Ammonium ion	$5.6 \times 10^{-10}$
$\text{HOC}_6\text{H}_5$	Phenol	$1.6 \times 10^{-10}$

\*The units of  $K_a$  are customarily omitted.