

TABLE 8-2 Scale of Acidities





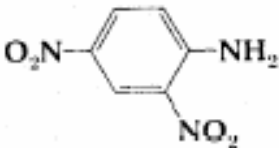
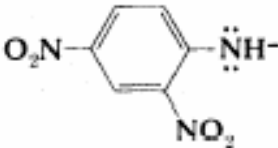
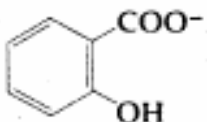
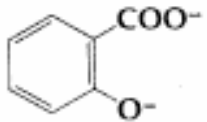
Conjugate acid	pK <sub>a</sub>	Conjugate base
Cyclohexane	45	C <sub>6</sub> H <sub>11</sub> <sup>-</sup>
CH <sub>3</sub> -CH <sub>3</sub>	42	CH <sub>3</sub> CH <sub>2</sub> <sup>-</sup>
CH <sub>4</sub>	40	:CH <sub>3</sub> <sup>-</sup>
Benzene	37	C <sub>6</sub> H <sub>5</sub> <sup>-</sup>
Ethylene	36	CH <sub>2</sub> =CH: <sup>-</sup>
NH <sub>3</sub>	36	$\ddot{\text{N}}\text{H}_2^-$
φCH <sub>3</sub>	35	φCH <sub>2</sub> : <sup>-</sup>
CH <sub>2</sub> =CH-CH <sub>3</sub>	35	CH <sub>2</sub> =CH-CH <sub>2</sub> : <sup>-</sup>
φ <sub>3</sub> CH	32	φ <sub>3</sub> C: <sup>-</sup>
φNH <sub>2</sub>	27	φ $\ddot{\text{N}}\text{H}^-$
HC≡CH	25	HC≡C: <sup>-</sup>
φ <sub>2</sub> NH	23	φ <sub>2</sub> $\ddot{\text{N}}^-$
CH <sub>3</sub> COCH <sub>3</sub>	20	CH <sub>3</sub> COCH <sub>2</sub> : <sup>-</sup>
<i>t</i> -BuOH	19	<i>t</i> -BuO <sup>-</sup>
	18.5	
C <sub>2</sub> H <sub>5</sub> OH (ROH)	17	C <sub>2</sub> H <sub>5</sub> O <sup>-</sup>
RCONHR'	~16	RCON $\ddot{\text{R}}^-$
CH <sub>3</sub> OH	16	CH <sub>3</sub> O <sup>-</sup>
H <sub>2</sub> O	15.7	HO <sup>-</sup>
	15	
	15	
(ROOC) <sub>2</sub> CH <sub>2</sub>	13.5	(ROOC) <sub>2</sub> $\ddot{\text{C}}\text{H}^-$
	13.4	

TABLE 8-2 Scale of Acidities (Continued)

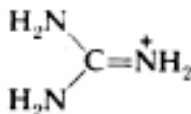
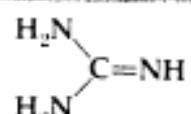
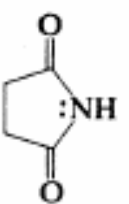
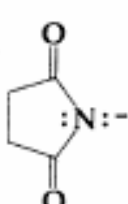
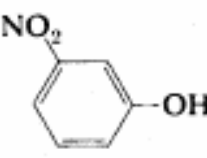
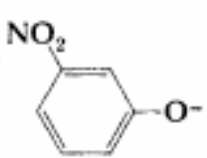
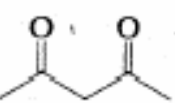
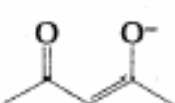
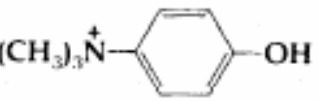
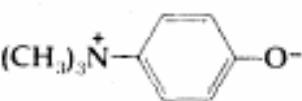

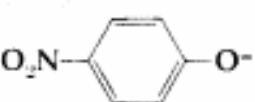
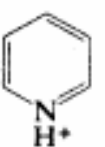
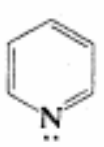
Conjugate acid	pK <sub>a</sub>	Conjugate base
	13.4	
(NC) <sub>2</sub> CH <sub>2</sub>	11.2	(NC) <sub>2</sub> CH <sup>-</sup>
CH <sub>3</sub> COCH <sub>2</sub> COOR	10.2	CH <sub>3</sub> COCH <sup>-</sup> COOR
$\left. \begin{array}{l} \text{RNH}_3^+ \\ \text{R}_2\text{NH}_2^+ \\ \text{R}_3\text{NH}^+ \end{array} \right\}$	~10	$\left\{ \begin{array}{l} \text{RNH}_2 \\ \text{R}_2\text{NH} \\ \text{R}_3\text{N} \end{array} \right.$
CH <sub>3</sub> NO <sub>2</sub>	10.2	:CH <sub>2</sub> NO <sub>2</sub>
HCO <sub>3</sub> <sup>-</sup>	10.2	CO <sub>3</sub> <sup>2-</sup>
φ-OH	10	φ-O <sup>-</sup>
	9.6	
	9.3	
NH <sub>4</sub> <sup>+</sup>	9.2	:NH <sub>3</sub>
HCN	9.1	:CN <sup>-</sup>
	9.0	
	8.0	
	7.2	
H <sub>2</sub> CO <sub>3</sub>	6.5	HCO <sub>3</sub> <sup>-</sup>
O <sub>2</sub> NCH <sub>2</sub> COOCH <sub>3</sub>	5.8	O <sub>2</sub> NCH <sup>-</sup> COOCH <sub>3</sub>
	5.2	

TABLE 8-2 Scale of Acidities (Continued)

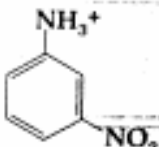
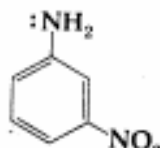



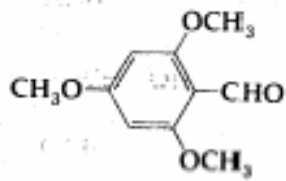
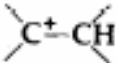
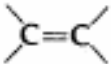
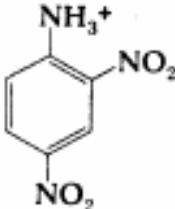
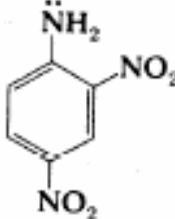


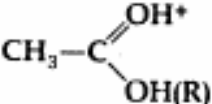
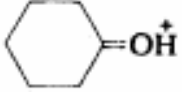
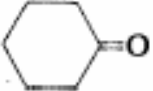
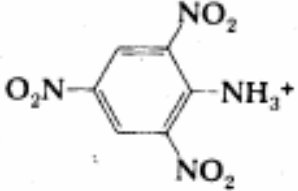
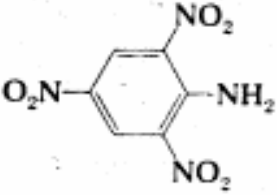
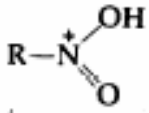
Conjugate acid	pK <sub>a</sub>	Conjugate base
$\phi\text{-N}(\text{CH}_3)_2^+$	5.1	$\phi\ddot{\text{N}}(\text{CH}_3)_2$
$\phi\text{-NH}_3^+$	4.6	$\phi\text{-}\ddot{\text{N}}\text{H}_2$
RCOOH	4.5 ± 0.5	RCOO <sup>-</sup>
2,4-Dinitrophenol	4.0	(NO <sub>2</sub> ) <sub>2</sub> φ-O <sup>-</sup>
HCOOH	3.7	HCOO <sup>-</sup>
CH <sub>2</sub> (NO <sub>2</sub> ) <sub>2</sub>	3.6	<sup>-</sup> :CH(NO <sub>2</sub> ) <sub>2</sub>
ClCH <sub>2</sub> COOH	2.8	ClCH <sub>2</sub> COO <sup>-</sup>
	2.5	
$\text{R-CH}(\text{COOH})\text{NH}_3^+$	2.4	$\text{R-CH}(\text{COO}^-)\text{NH}_3^+$
Cl <sub>2</sub> CHCOOH	1.3	Cl <sub>2</sub> CHCOO <sup>-</sup>
	1.0	
φ <sub>2</sub> NH <sub>2</sub> <sup>+</sup>	1.0	φ <sub>2</sub> ÑH
Cl <sub>3</sub> CCOOH	0.9	Cl <sub>3</sub> CCOO <sup>-</sup>
2,4,6-Trinitrophenol	0.4	(NO <sub>2</sub> ) <sub>3</sub> φ-O <sup>-</sup>
CF <sub>3</sub> COOH	0	CF <sub>3</sub> COO <sup>-</sup>
CH <sub>3</sub> CONH <sub>3</sub> <sup>+</sup>	0.3	CH <sub>3</sub> CONH <sub>2</sub>
HNO <sub>3</sub>	-1.4	NO <sub>3</sub> <sup>-</sup>
φCONH <sub>3</sub> <sup>+</sup>	-2	φCONH <sub>2</sub>
CH <sub>3</sub> OH <sub>2</sub> <sup>+</sup>	-2	CH <sub>3</sub> OH
	-2.1	
(CH <sub>3</sub> ) <sub>2</sub> OH <sup>+</sup>	-3.8	(CH <sub>3</sub> ) <sub>2</sub> O

TABLE 8-2 Scale of Acidities (Continued)

Conjugate acid	pK <sub>a</sub>	Conjugate base
$t\text{-BuOH}_2^+$	-4	$t\text{-BuOH}$
	~ -4 (?)	
	-4.5	
$(\text{CH}_3)_2\text{SH}^+$	-5.2	$(\text{CH}_3)_2\text{S}$
	-5.5	
	-6.2	$\text{CH}_3\text{-COOH(R)}$
$\phi\text{OH}_2^+$	-6.7	$\phi\text{OH}$ (or $\phi\text{OR}$ )
	-6.8	
$\phi\text{CH=OH}^+$	-7.1	$\phi\text{CHO}$
	-9.4	
$\text{R-C}\equiv\text{NH}^+$	~ -10	$\text{RCN}$
	~ -11	$\text{R-NO}_2$
$\text{H}_2\text{SO}_4$	?	$\text{HSO}_4^-$
$\text{HBF}_4$	?	$\text{BF}_4^-$
$\text{FSO}_3\text{H}$	?	$\text{FSO}_3^-$
$\text{HClO}_4$	~ -20	$\text{ClO}_4^-$
$\text{HPF}_6$	-20	$\text{PF}_6^-$
$\text{SbF}_5 \cdot \text{FSO}_3\text{H}$ (strongest acid)	< -20	$\text{SbF}_5 \cdot \text{FSO}_3^-$