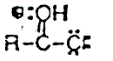
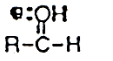
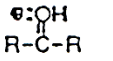
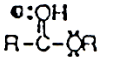
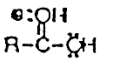
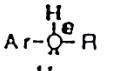
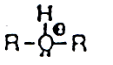
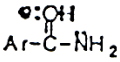
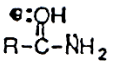
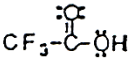
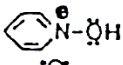
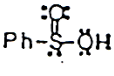
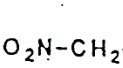
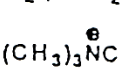
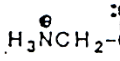
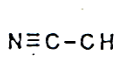
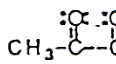
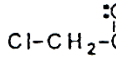
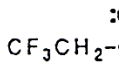
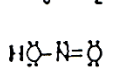
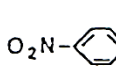
COMPOSITE pK_a CHART

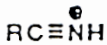
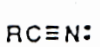
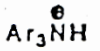
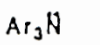
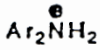
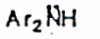
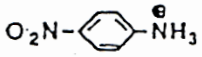
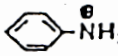
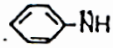
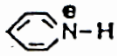
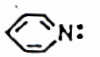
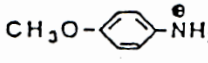
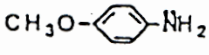
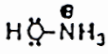
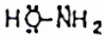
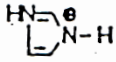
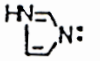
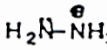
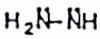
The Acidic H is in Boldface[1]

Oxygen acids

pK_a	Acid	Base
	FSO_3H	FSO_3^-
−12	RNO_2H^+	RNO_2
−10	$HClO_4$	ClO_4^-
	H_2SO_4	HSO_4^-
−9		
−8		
−7		
−6.5	$ArSO_3H$	$ArSO_3^-$
−6	CH_3SO_3H	$CH_3SO_3^-$
−6.5		
−6.4	$ArOH_2^+$	$ArOH$
−6		
−6		$ArOR$
−3.5		ROR
−2.4	$CH_3CH_2OH_2^+$	CH_3CH_2OH
−1.7	H_3O^+	H_2O
−1.5		
−1.5	$(CH_3)_2S=OH^+$	$(CH_3)_2S=O$
−1.4	HNO_3	NO_3^-
−0.5		
0.5		
0.7		
1.5		
1.7		
1.8		
2.0	HSO_4^-	SO_4^{2-}
2.2	H_3PO_4	$H_2PO_4^-$
2.4		
2.5		
2.5		
2.9		
3.1		
3.3		
3.4		
3.6		
3.6		
4.2		
4.5		
4.6		
4.8		
6.4	H_2CO_3	HCO_3^-
7.2	$H_2PO_4^-$	HPO_4^{2-}
7.2		
10.0		
10.2		
10.3	HCO_3^-	CO_3^{2-}
11.6		
12.2		
12.4	HPO_4^{2-}	PO_4^{3-}
12.4	CF_3CH_2OH	$CF_3CH_2O^-$
13.3	$HOCH_2OH$	$HOCH_2O^-$
14.2	$HOCH_2CH_2OH$	$HOCH_2CH_2O^-$
15.5	CH_3OH	CH_3O^-
15.7	H_2O	HO^-
16	CH_3CH_2OH	$CH_3CH_2O^-$
18	$(CH_3)_2CHOH$	$(CH_3)_2CHO^-$

[1] Modified with permission from March, J. *Advanced Organic Chemistry*, 3rd ed; pp.220–222.

Nitrogen acids

pK_a	Acid	Base
−10		
−5		
1		
1.0		
4.6		
5.2		
5.4		
5.8		
7.0		
7.9		
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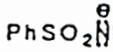
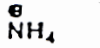
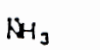
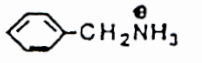
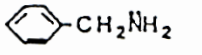
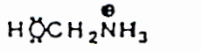
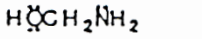
8.5		
9.2		
9.3		
5.8		
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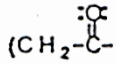
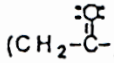
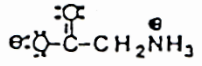
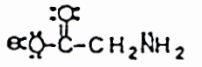
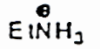
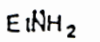
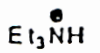
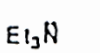
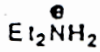
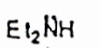
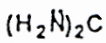
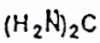
9.6		
9.8		
10.6		
10.7		
11		
11.6	DBU·H⊕	DBU
13.6		
17		
25.8		
27		
35		
36		

Carbon acids

pK_a	Acid	Base
−5		
3.6		
5		
9		
9		
9.2		
10		
10.2		
10.7		
11.2		
12.5		
13		
13.5		
13.6		
−14		
15.9		
16		
16		
−16		
16.7		
19.2		
23		
24		
25		
25		
−28		
31.1		
31.5		

Carbon acids (continued)

pK_a	Acid	Base
33.5	Ph_2CH_2	$Ph_2\ddot{C}H^{-}$
35	$H_3C-S(=\ddot{O}:)-CH_3$	$H_2\ddot{C}^{-}-S(=\ddot{O}:)-CH_3$
35	$H_3C-P^{+}Ph_3$	$H_2\ddot{C}^{-}-P^{+}Ph_3$
41	H_3C-Ph	$H_2\ddot{C}^{-}-Ph$
43	$H_3C-HC=CH_2$	$H_2\ddot{C}^{-}-HC=CH_2$
43	HPh	$^{-}:Ph$
44	$H_2C=CH_2$	$H\ddot{C}^{-}=CH_2$
48	CH_4	$^{-}:CH_3$
50	H_3C-CH_3	$H_2\ddot{C}^{-}-CH_3$
51	$H_2C(CH_3)_2$	$H\ddot{C}^{-}(CH_3)_2$
>52	$HC(CH_3)_3$	$^{-}:C(CH_3)_3$

Miscellaneous acids

pK_a	Acid	Base
−10	HI	I^{-}
−9	HBr	Br^{-}
−7	HCl	Cl^{-}
−7	$R\ddot{S}H_2^{+}$	RSH
−5.3	$R_2\ddot{S}H^{+}$	R_2S
2.7	Ph_3PH^{+}	$Ph_3P:$
3.2	HF	F^{-}
3.3	$CH_3-C(=\ddot{O}:)-SH$	$CH_3-C(=\ddot{O}:)-\ddot{S}^{-}$
3.9	H_2Se	HSe^{-}
6.5	$Ph\ddot{S}H$	$Ph\ddot{S}^{-}$
7.0	$H_2\ddot{S}$	$H\ddot{S}^{-}$
8.7	Et_3PH^{+}	$Et_3P:$
10.6	$Et\ddot{S}H$	$Et\ddot{S}^{-}$
35	H_2	$H:^{-}$

Acid Strength

Strong acids have low pK_a's

Base Strength

Strong bases have high p$K_{a\mathrm{bH}}$'s

Proton Transfer

Proton transfer reactions usually form the weaker base.

$$\log K_{eq} = \mathrm{p}K_{a}\mathrm{bH} - \mathrm{p}K_{a}\mathrm{HA}$$

$$K_{eq} = 10^{(\mathrm{p}K_{a}\mathrm{bH} - \mathrm{p}K_{a}\mathrm{HA})}$$

Simply take the pK_{a}bH of the base and subtract from it the pK_a of the acid to get the exponent of the K_{eq}. If the K_{eq} is equal to or greater than approximately 10^{-8} (negative by 8 pK_a units), the proton transfer is within the useful range. If the proton transfer K_{eq} is greater than 10^{+7}, it can for all practical purposes be considered irreversible. Proton transfer is the first thing that happens in many common reactions.

The ΔpK_a Rule

The leaving group or anion produced should be no more than about 8 pK_a units more basic than the incoming nucleophile or base. Reactions tend to form the weaker base. No reaction has huge jumps upward in the pK_abH of its intermediates. The energy drops if the pK_abH drops significantly.

Hard and Soft Acids and Bases

The HSAB principle: Hard bases favor binding with hard acids; soft bases favor binding with soft acids.

When a pair of molecules collide, two attractive forces lead to reaction: the hard–hard attraction (opposite charges attracting each other), and the soft–soft attraction (the interaction of filled orbitals with empty orbitals).