OH KISLINE

-12.	FSO_3H	$FSO_3^{\ominus}$
-12	$RNO_2^{\oplus}H$	RNO_2H
-10	$HClO_4$	$ClO_4^{\ominus}$
-9	H_2SO_4	$HSO_4^{\ominus}$
-8		
-7		
-6.5	$ArSO_3H$	$ArSO_3^{\ominus}$
-6.5		
-6.4		
-6	CH_3SO_3H	$CH_3SO_3^{\ominus}$
-6		
-6		
-3.5		
-2.4	$CH_3CH_2\overset{\oplus}{O}H_2$	CH_3CH_2OH
-1.7	$H_3\overset{\oplus}{O}$	H_2O
-1.5		
-1.5	$(CH_3)_2\overset{\oplus}{S}OH$	$(CH_3)_2S{=}O$
-1.4	HNO_3	$NO_3^{\ominus}$
-0.5		
0.5		
0.7		

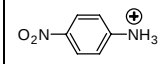
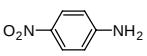
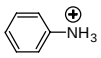
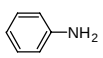
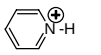
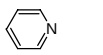
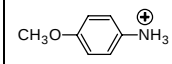
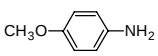
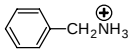
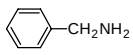
1.5		
1.7		
1.8		
2.0	$HSO_4^{\ominus}$	$SO_4^{2\ominus}$
2.2	H_3PO_4	$H_2PO_4^{\ominus}$
2.4		
2.5		
2.5		
2.9		
3.1		
3.3	HO-N=O	$^{\ominus}$O-N=O
3.4		
3.6		
3.6		
4.2		
4.5		
4.6	$(CH_3)_3\overset{\oplus}{N}$-OH	$(CH_3)_3\overset{\oplus}{N}$-O$^{\ominus}$
4.8		
6.4	H_2CO_3	$HCO_3^{\ominus}$
7.2	$H_2PO_4^{\ominus}$	$HPO_4^{2\ominus}$
7.2		
10.2		

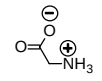
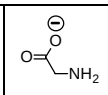
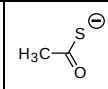
10.3	$HCO_3^{\ominus}$	$CO_3^{2\ominus}$
11.6	HO-OH	$^{\ominus}$O-OH
12.2	$(CH_3)_2C{=}N$-OH	$(CH_3)_2C{=}N$-O$^{\ominus}$
12.4	$HPO_4^{2\ominus}$	$PO_4^{3\ominus}$
12.4	CF_3CH_2OH	$CF_3CH_2O^{\ominus}$
13.3	$HOCH_2OH$	$HOCH_2O^{\ominus}$
14.2	$HOCH_2CH_2OH$	$HOCH_2CH_2O^{\ominus}$
15.5	CH_3OH	$CH_3O^{\ominus}$
15.7	H_2O	$^{\ominus}$OH
16	CH_3CH_2OH	$CH_3CH_2O^{\ominus}$
18	$(CH_3)_2CHOH$	$(CH_3)_2CHO^{\ominus}$
19	$(CH_3)_3COH$	$(CH_3)_3CO^{\ominus}$

CH KISLINE

-5	$HC(CN)_3$	$^{\ominus}C(CN)_3$
3.6	$H_2C(NO_2)$	$H\overset{\ominus}{C}(NO_2)_2$
5		
9		
9		
9.2	N≡CH	N≡C$^{\ominus}$
10		
10.2	H_3C-NO_2	$H_2\overset{\ominus}{C}$-NO_2
10.7		

12.5	$H_2C(SO_2CH_3)_2$	$HC(SO_2CH_3)_2^{\ominus}$
13	$H_2C(\text{-}C(=O)\text{-}OEt)_2$	$HC(\text{-}C(=O)\text{-}OEt)_2^{\ominus}$
13.5	$H_3C\text{-}C(=O)\text{-}O\text{-}C(=O)\text{-}CH_3$	$H_2C^{\ominus}\text{-}C(=O)\text{-}O\text{-}C(=O)\text{-}CH_3$
13.6	$HCCl_3$	$CCl_3^{\ominus}$
~14	$H_3C\text{-}C(=O)\text{-}SR$	$H_2C^{\ominus}\text{-}C(=O)\text{-}SR$
15.9	$H_3C\text{-}C(=O)\text{-}CH_2Ph$	$H_2C^{\ominus}\text{-}C(=O)\text{-}CH_2Ph$
16		
16	$H_3C\text{-}C(=O)\text{-}CH_2Cl$	$H_3C\text{-}C(=O)\text{-}CHCl^{\ominus}$
~16	$H_3C\text{-}C(=O)\text{-}Cl$	$H_2C^{\ominus}\text{-}C(=O)\text{-}Cl$
16.7	$H_3C\text{-}C(=O)\text{-}H$	$H_2C^{\ominus}\text{-}C(=O)\text{-}H$
19.2	$H_3C\text{-}C(=O)\text{-}CH_3$	$H_2C^{\ominus}\text{-}C(=O)\text{-}CH_3$
23	$H_3C\text{-}SO_2CH_3$	$H_2C^{\ominus}\text{-}SO_2CH_3$
24	$H_3C\text{-}C(=O)\text{-}OR$	$H_2C^{\ominus}\text{-}C(=O)\text{-}OR$
25	$H_3C\text{-}C{\equiv}N$	$H_2C^{\ominus}\text{-}C{\equiv}N$
25	$HC{\equiv}CH$	$C{\equiv}CH^{\ominus}$
~28	$H_3C\text{-}C(=O)\text{-}NR_2$	$H_2C^{\ominus}\text{-}C(=O)\text{-}NR_2$
31.1		
31.5	Ph_3CH	$Ph_3C^{\ominus}$
33.5	Ph_2CH_2	$Ph_2CH^{\ominus}$
35	$H_3C\text{-}S(=O)\text{-}CH_3$	$H_2C^{\ominus}\text{-}S(=O)\text{-}CH_3$
35	$CH_3\text{-}PPh_3^{\oplus}$	$CH_2^{\ominus}\text{-}PPh_3^{\oplus}$
41	$H_3C\text{-}Ph$	$H_2C^{\ominus}\text{-}Ph$

43	$H_3C\text{-}HC{=}CH_2$	$H_2C^{\ominus}\text{-}HC{=}CH_2$
43	HPh	$Ph^{\ominus}$
44	$H_2C{=}CH_2$	$HC{=}CH_2^{\ominus}$
48	CH_4	$CH_3^{\ominus}$
50	$H_3C\text{-}CH_3$	$H_2C^{\ominus}\text{-}CH_3$
51	$H_2C(CH_3)_2$	$HC(CH_3)_2^{\ominus}$
>52	$HC(CH_3)_3$	$C(CH_3)_3^{\ominus}$
NH KISLINE		
-10	$RC{\equiv}NH^{\oplus}$	$RC{\equiv}N$
-5	$Ar_3NH^{\oplus}$	Ar_3N
1	$Ar_2NH_2^{\oplus}$	Ar_2NH
1.0		
4.6		
5.2		
5.4		
5.8	$HO\text{-}NH_3^{\oplus}$	$HO\text{-}NH_2$
7.0		
7.9	$H_2N\text{-}NH_3^{\oplus}$	$H_2N\text{-}NH_2$
8.5	$PhSO_2NH_2$	$PhSO_2NH^{\ominus}$
9.2	$NH_4^{\oplus}$	NH_3
9.3		
5.8	$HOCH_2NH_3^{\oplus}$	$HOCH_2NH_2$

9.8		
10.6	$EtNH_3^{\oplus}$	$EtNH_2$
10.7	$Et_3NH^{\oplus}$	Et_3N
11	$Et_2NH_2^{\oplus}$	Et_2NH
13.6	$(NH_2)_2C{=}NH_2^{\oplus}$	$(NH_2)_2C{=}NH$
17		
25.8	$((CH_3)_3Si)_2NH$	$((CH_3)_3Si)_2N^{\ominus}$
27	$PhNH_2$	$PhNH^{\ominus}$
35	NH_3	$NH_2^{\ominus}$
36	Et_2NH	$Et_2N^{\ominus}$
OSTALE KISLINE		
-10	HI	$I^{\ominus}$
-9	HBr	$Br^{\ominus}$
-7	HCl	$Cl^{\ominus}$
-7	$RSH_2^{\oplus}$	RSH
-5.3	$R_2SH^{\oplus}$	R_2S
3.2	HF	$F^{\ominus}$
3.3		
3.9	H_2Se	$HSe^{\ominus}$
7.0	H_2S	$HS^{\ominus}$
10.6	EtSH	$EtS^{\ominus}$
35	H_2	$H^{\ominus}$

Average Single Bond Energies in kcal/mol (kJ/mol)

	I	Br	Cl	S	P	Si	F	O	N	C	H
H	71 (297)	87 (364)	103 (431)	83 (347)	77 (322)	76 (318)	135 (565)	111 (464)	93 (389)	99 (414)	104 (435)
C	51 (213)	68 (285)	81 (339)	65 (272)	63 (264)	72 (301)	116 (485)	86 (360)	73 (305)	83 (347)	
N			46 (192)				65 (272)	53 (222)	39 (163)		
O	48 (201)	48 (201)	52 (218)		141 (590)	108 (452)	45 (188)	47 (197)			
F	58 (243)	60 (251)	61 (255)	68 (285)	117 (490)	135 (565)	37 (155)				
Si	56 (234)	74 (310)	91 (381)			53 (222)					
P	44 (184)	63 (264)	78 (326)		48 (201)						
S		52 (218)	61 (255)	60 (251)							
Cl	50 (209)	52 (218)	58 (243)								
Br	42 (176)	46 (192)									
I	36 (151)										

C=C	146 (611)	C≡C	200 (837)
C=N	147 (615)	C≡N	213 (891)
C=O	177 (741)		
C=S	128 (536)		
N=N	100 (418)	N≡N	226 (946)
N=O	145 (607)		
O=O	119 (498)		

Table 2.1 $\Delta G°$ and K_{eq} Values for 25°C

$\Delta G°$ kcal/mol	K_{eq}	Reactant	Product	$\Delta G°$ (kJ/mol)
+5.46	0.0001	99.99	0.01	+22.84
+4.09	0.001	99.9	0.1	+17.11
+2.73	0.01	99	1	+11.42
+1.37	0.1	91	9	+5.73
+1.0	0.18	85	15	+4.18
+0.5	0.43	70	30	+2.09
0	1	50	50	0
-0.5	2.33	30	70	-2.09
-1.0	5.41	15	85	-4.18
-1.37	10	9	91	-5.73
-2.73	100	1	99	-11.42
-4.09	1,000	0.1	99.9	-17.11
-5.46	10,000	0.01	99.99	-22.84
-9.56	10^7	Essentially complete		-40.00

Substituent X	**pK_a *p*-X-benzojska k.**	**pK_a *m*-X-benzojska k.**	**σp**	**σm**
NH_2	**4.82**	**4.20**	**–0.62**	**0.00**
OCH_3	**4.49**	**4.09**	**–0.29**	**0.11**
CH_3	**4.37**	**4.26**	**–0.17**	**–0.06**
H	**4.20**	**4.20**	**0.00**	**0.00**
F	**4.15**	**3.86**	**0.05**	**0.34**
I	**3.97**	**3.85**	**0.23**	**0.35**
Cl	**3.98**	**3.83**	**0.22**	**0.37**
Br	**3.97**	**3.80**	**0.23**	**0.40**
CO_2CH_3	**3.75**	**3.87**	**0.45**	**0.33**
$COCH_3$	**3.71**	**3.83**	**0.49**	**0.37**
CN	**3.53**	**3.58**	**0.67**	**0.62**
NO_2	**3.43**	**3.47**	**0.77**	**0.73**

Solvent	*fp*[c] (°C)	*bp*[d] (°C)	ε[e] at 25 °C	$\mu \cdot 10^{30}$ [f] (C m)	n_D^{20} [g]	$E_T(30)$[h] (kcal/mole)
1. Water	0.0	100.0	78.39	6.07	1.3330	63.1
2. Formamide	2.5	210.5	111.0 (20°)	11.24	1.4475	56.6
3. 1,2-Ethanediol	− 13	197.3	37.7	7.61	1.4318	56.3
4. Methanol	− 97.7	64.7	32.70	5.67	1.3284	55.5
5. *N*-Methylformamide	− 3.8	180–185	182.4	12.88	1.4319	54.1
6. Diethylene glycol	− 6.5	244.8	31.69 (20°)	7.71	1.4475	53.8
7. Triethylene glycol	− 4.3	288.0	23.69 (20°)	9.97	1.4561	53.5
8. 2-Methoxyethanol	− 85.1	124.6	16.93	6.81	1.4021	52.3
9. *N*-Methylacetamide	30.6	206.7	191.3 (32°)	14.65	1.4286 (28°)	52.0
10. Ethanol	−114.1	78.3	24.55	5.77	1.3614	51.9
11. 2-Aminoethanol	10.5	171.0	37.72	7.57	1.4539	51.8
12. Acetic acid	16.7	117.9	6.15 (20°)	5.60	1.3719	51.2[i]
13. Benzyl alcohol	− 15.3	205.5	13.1 (20°)	5.54	1.5404	50.8
14. 1-Propanol	−126.2	97.2	20.33	5.54	1.3856	50.7
15. 1-Butanol	− 88.6	117.7	17.51	5.84	1.3993	50.2
16. 2-Methyl-1-propanol, Isobutyl alcohol	−108	107.7	17.93	5.97	1.3959	49.0
17. 2-Propanol	− 88.0	82.3	19.92	5.54	1.3772	48.6
18. 2-Butanol, *sec*-Butyl alcohol	−114.7	99.6	16.56	5.5[illegible]	1.3972	47.1
19. 3-Methyl-1-butanol, Isoamyl alcohol	−117.2	130.5	14.7	6.07	1.4071	47.0
20. Cyclohexanol	25.2	161.1	15.0	6.20	1.4648 (25°)	46.9
21. 4-Methyl-1,3-dioxol-2-one, Propylene carbonate[k]	− 48.8	241.7	65.1	16.7	1.4209	46.6
22. 2-Pentanol, *sec*-Amyl alcohol		119.0	13.82 (22°)	5.54	1.4064	46.5
23. Nitromethane	− 28.6	101.2	35.87 (30°)	11.88	1.3812	46.3
24. Acetonitrile	− 43.8	81.6	37.5 (20°)	11.48	1.3441	46.0
25. 3-Pentanol	− 75	115.3	13.02 (22°)	5.47	1.4103	45.7
26. Dimethylsulfoxide	18.5	189.0	46.68	13.0	1.4783	45.0
27. Aniline	− 5.98	184.4	6.89 (20°)	5.04	1.5863	44.3
28. Tetrahydrothiophene-1,1-dioxide, Sulfolane	28.5	287.3	43.3 (30°)	16.05	1.4820 (30°)	44.0
29. Acetic anhydride	− 73.1	140.0	20.7 (19°)	9.41	1.3904	43.9[i]
30. 2-Methyl-2-propanol, *tert*-Butyl alcohol	25.8	82.4	12.47	5.54	1.3877	43.9
31. *N*,*N*-Dimethyl-formamide	− 61	152.3	37.0	12.88	1.4269 (25°)	43.8
32. *N*,*N*-Dimethyl-acetamide	− 20	166.1	37.78	12.41	1.4384	43.7
33. Propionitrile	− 92.8	97.4	27.2 (20°)	11.91	1.3658	43.7
34. 1-Methyl-2-pyrrolidinone[m]	− 24.4	204.0-204.8	32.0	13.64	1.4700	42.2
35. Acetone	− 94.7	56.3	20.70	9.54	1.3587	42.2
36. Nitrobenzene	5.8	210.8	34.82	13.44	1.5500 (25°)	42.0
37. Benzonitrile	− 12.8	191.1	25.20	13.51	1.5282	42.0
38. 1,2-Diaminoethane	11.3	117.3	12.9	6.34	1.4568	42.0
39. 1,2-Dichloroethane	− 35.7	83.5	10.36	6.20	1.4448	41.9
40. 2-Methyl-2-butanol, *tert*-Amyl alcohol	− 8.8	102.0	5.82	5.7	1.4049	41.9
41. 2-Butanone	− 86.7	79.6	18.51 (20°)	9.21	1.3788	41.3
42. Acetophenone	19.6	202.0	17.39	9.87	1.5342	41.3
43. Dichloromethane	− 95.1	39.8	8.93	5.17	1.4242	41.1
44. 1,1,3,3-Tetramethyl-urea	− 1.2	175.2	23.45[a]	11.58	1.4493 (25°)	41.0
45. Hexamethylphos-phoric triamide[o]	7.2	235	29.6	18.48	1.4584	40.9
46. Cyclohexanone	− 32.1	155.7	18.3 (20°)	10.04	1.4510	40.8
47. Pyridine	− 41.6	115.3	12.4 (21°)	7.91	1.5102	40.2
48. Methyl acetate	− 98.1	56.3	6.68	5.37	1.3614	40.0
49. 4-Methyl-2-pentanone	− 84.0	116.5	13.11 (20°)		1.3957	39.4
50. 1,1-Dichloroethane	− 97.0	57.3	10.0 (18°)	6.61	1.4164	39.4
51. Quinoline	− 14.9	237.1	9.00	7.27	1.6273	39.4
52. 3-Pentanone	− 38.9	102.0	17.00 (20°)	9.41	1.3923	39.3
53. Chloroform	− 63.6	61.2	4.81 (20°)	3.84	1.4429 (25°)	39.1
54. Triethylene glycol dimethyl ether, Triglyme		222	7.5		1.4233	38.9
55. Diethylene glycol dimethyl ether, Diglyme		159.8		6.57	1.4097	38.6
56. 1,2-Dimethoxyethane, Monoglyme	− 58	85[p]	7.20	5.70	1.3796	38.2
57. 1,2-Dichlorobenzene	− 17.0	180.5	9.93	7.57	1.5515	38.1
58. Ethyl acetate	− 84.0	77.1	6.02	6.27	1.3724	38.1
59. Fluorobenzene	− 42.2	84.7	5.42	4.90	1.4684 (15°)	38.1
60. Iodobenzene	− 31.3	188.3	4.63 (20°)	4.64	1.6200	37.9
61. Chlorobenzene	− 45.6	131.7	5.62	5.14	1.5248	37.5
62. Bromobenzene	− 30.8	155.9	5.40	5.17	1.5571 (25°)	37.5
63. Tetrahydrofuran	−108.5	66	7.58	5.84	1.4072	37.4
64. Anisole	− 37.5	153.8	4.33	4.17	1.5170	37.2
65. Phenetole	− 29.5	170.0	4.22 (20°)	4.54	1.5074	36.4
66. 1,1,1-Trichloroethane	− 30.4	74.0	7.53 (20°)	5.24	1.4379	36.2
67. 1,4-Dioxane	11.8	101.3	2.21	1.50	1.4224	36.0
68. Trichloroethylene	− 86.4	87.2	3.42 (16°)	2.7	1.4767 (21°)	35.9
69. Piperidine	− 10.5	106.4	5.8 (20°)	3.97	1.4525	35.5
70. Diphenyl ether	26.9	258.3	3.69 (20°)	3.87	1.5763 (30°)	35.3 (30°)
71. Diethyl ether	−116.3	34.6	4.34 (20°)	4.34	1.3524	34.6
72. Benzene	5.5	80.1	2.28	0.0	1.5011	34.5
73. Diisopropyl ether	− 85.5	68.3	3.88	4.20	1.3681	34.0
74. Toluene	− 95.0	110.6	2.38	1.43	1.4969	33.9
75. Di-*n*-butyl ether	− 95.2	142.2	3.08 (20°)	3.94	1.3992	33.4
76. Triethylamine	−114.7	89.5	2.42	2.90	1.4010	33.3
77. 1,3,5-Trimethyl-benzene	− 44.7	164.7	2.28 (20°)	0.0	1.4994	33.1
78. Carbon disulfide	−111.6	46.2	2.64 (20°)	0.0	1.6280	32.6