
الملاحق

جدول (1): إنثالبيات الاحتراق (الحرارة المنطلقة في تفاعل احتراق عند ضغط ثابت ودرجة حرارة 25°C). المواد الناتجة $\text{CO}_2(\text{g})$ و $\text{H}_2\text{O}(\text{l})$.

KJ mol^{-1}		KJ mol^{-1}		KJ mol^{-1}	
1366.95	(l) إيثانول	2878.51	(g) بيوتان (عادي)	285.84	H_2
872.4	(l) حمض خليك	2871.65	(g) إيزوبيوتان	393.51	C جرافيت
2815.8	(s) جلوكوز	4811.2	(g) هبتان (عادي)	282.99	$\text{CO}(\text{g})$
5646.7	(s) سكروز	1410.97	(g) إيثيلين	890.35	$\text{CH}_4(\text{g})$
		1299.63	(g) استينين	1559.88	$\text{C}_2\text{H}_6(\text{g})$
		3301.51	(g) بنزين	2220.07	$\text{C}_3\text{H}_8(\text{g})$

جدول (2): إنثالبي الرابطة عند 25°C (K.Cal/mol).

Bond	ΔH	Bond	ΔH
H-H	104	C-Cl	79
H-F	135	C-Br	66
H-Cl	103	C-S	62
H-Br	88	C=S	114
O-O	33	C-N	70
O=O	118	C=N	147
O-H	111	$\text{C}\equiv\text{N}$	210
C-H	99	N-N	38
C-O	84	N=N	100
C=O	170	$\text{N}\equiv\text{N}$	226
C-C	83	N-H	93
C=C	147	F-F	37
$\text{C}\equiv\text{C}$	194	Cl-Cl	58
C-F	105	Br-Br	46

$\text{C}(\text{s, graphite}) = \text{C}(\text{g})$ 172.

جدول (3): حرارات التكوين لبعض المركبات عند 25°C وضغط 1 جو.

ΔH_f°			ΔH_f°		
Compound	(K/cal/mol)	(KJ/mol)	Compound	(K/cal/mol)	(KJ/mol)
H ₂ O _(g)	-57.80	-241.8	COCl _{2(g)}	-53.3	-323
H ₂ O _(l)	-68.32	-285.9	SO _{2(g)}	-70.96	-296.9
HF _(g)	-64.20	-269	CO _(g)	-26.42	-110.5
HCl _(g)	-22.66	-92.30	CO _{2(g)}	-94.05	-393.5
HBr _(g)	-8.66	-36.2	NO _(g)	+21.60	+90.37
HI _(g)	+6.20	+25.9	NO _{2(g)}	+8.09	+33.8
H ₂ S _(g)	-4.82	-20.2	HNO _{3(l)}	+41.40	-173.2
HCN _(g)	+31.2	+130.5	NH ₄ NO _{3(s)}	-87.27	-365.1
NH _{3(g)}	-11.04	-46.19	NaCl _(s)	-98.23	-411.0
PH _{3(g)}	+2.21	+9.25	MgO _(s)	-143.84	-601.83
CH _{4(g)}	-17.89	-74.85	CaO _(s)	-151.9	-635.5
C ₂ H _{6(g)}	-20.24	-84.68	Ca(OH) _{2(s)}	-235.80	-986.59
C ₂ H _{4(g)}	+12.50	+52.30	CaCO _{3(s)}	-288.45	-1206.9
C ₂ H _{2(g)}	+54.19	+226.7	Ca ₃ P _{2(s)}	-120.50	-504.17
C ₆ H _{6(l)}	+11.72	+49.04	BaO _(s)	-133.4	-588.1
CH ₃ OH _(g)	-48.08	-201.2	BaCO _{3(s)}	-291.3	-1218
CH ₃ OH _(l)	-57.02	-238.6	Al ₂ O _{3(s)}	-399.09	-1669.8
CH ₃ OH _{2(g)}	-6.7	-28	Fe ₂ O _{3(s)}	-196.5	-822.2
NF _{3(g)}	-27.20	-117	AgCl _(s)	-30.36	-127.0

جدول (4): متوسط طاقات الرابطة.

Average bond energies			Average bond energies		
Bond	(K/cal/mol)	(KJ/mol)	Bond	(K/cal/mol)	(KJ/mol)
H-H	104	435	N-Cl	48	201
H-F	135	565	C-C	83	374
H-Cl	103	431	C=C	148	619
H-Br	87	364	C≡C	194	812
H-I	71	297	C-H	99	414
F-F	37	155	C-O	80	335
Cl-Cl	58	243	C=O	169	707
O-O	33	138	C-F	116	485
O ₃	118	494	C-Cl	78	326
O-H	111	464	C-N	70	293
O-F	44	184	C=M	210	879
O-Cl	49	205	S-G	81	329
N-N	38	159	S-Cl	66	276
N≡N	445	941	P-H	76	318
N-H	93	389	P-Cl	78	326

جدول (5): طاقة جيبس الحرة للتكوين عند 25°C وضغط 1 جو.

ΔH°_f			ΔH°_f		
Compound	(K/cal/mol)	(KJ/mol)	Compound	(K/cal/mol)	(KJ/mol)
H ₂ O _(g)	-54.64	-328.61	CO _(g)	-32.18	-137.28
H ₂ O _(l)	-56.69	-237.19	CO _{2(g)}	-94.26	-394.38
HF _(g)	-64.7	-270.7	NO _(g)	+20.72	+86.69
HCl _(g)	-22.77	-95.27	NO _{2(g)}	+12.39	+51.84
HBr _(g)	+12.72	-53.22	NaCl _(s)	-97.79	-384.05
HI _(g)	+0.31	+1.30	CaO _(s)	-144.4	-604.2
H ₂ S _(g)	-7.89	-33.0	Ca(OH) _{2(s)}	-214.33	-896.76
NH _{3(g)}	-3.98	-16.7	CaCO _{3(s)}	-269.78	-1128.76
CH _{4(g)}	-12.14	-50.79	BaO _(s)	-126.3	-528.4
C ₂ H _{6(g)}	-7.86	-32.89	BaCO _{3(s)}	-272.2	-1138.9
C ₂ H _{4(g)}	+16.28	+68.12	Al ₂ O _{3(s)}	-376.77	-1576.41
C ₂ H _{2(g)}	+50.00	+209.20	Fe ₂ O _{3(s)}	-177.1	741.0
C ₆ H _{6(l)}	+30.99	+129.66	AgCl _(s)	-26.22	-109.70
SO _{2(g)}	+71.79	-300.37	ZnO _(s)	-76.05	318.19

جدول (6): الإنتروبي المطلق (J/K.mol) عند 25°C وضغط 1 جول لبعض العناصر والمركبات.

Substance	S°	Substance	S°
Ag _(s)	42.72	HCl _(g)	186.7
AgCl _(s)	96.11	HF _(g)	173.5
Al _(s)	28.3	Hg _(l)	77.4
Al ₂ O _{3(s)}	51.00	HgO _(s)	72.0
Br _{2(l)}	152.3	HI _(g)	206.3
C (graphite)	5.69	H ₂ O _(g)	188.7
Ca _(s)	41.6	H ₂ O _(l)	69.96
CaCO _{3(s)}	92.9	H ₂ S _(g)	205.6
CaO _(s)	39.8	I _{2(s)}	116.7
Ca(OH) _{2 (s)}	76.1	La _(s)	57.3
CH _{4(g)}	186.2	Li _(s)	28.0
C ₂ H _{2(g)}	200.8	N _{2(g)}	191.5
C ₂ H _{4(g)}	219.5	Na _(s)	51.0
C ₂ H _{6(g)}	229.5	NaCl _(s)	72.38
Cl _{2(g)}	223.0	NH _{3(g)}	192.5
CO _(g)	197.9	NO _(g)	210.6
CO _{2(g)}	213.6	NO _{2(g)}	240.5
F _{2(g)}	203.3	O _{2(g)}	205.03
Fe _(s)	27.2	S (rhombic)	31.9
Fe ₂ O _{3(s)}	90.0	SO _{2(g)}	248.5
H _{2(g)}	130.6	Zn _(s)	41.6
HBr _(g)	198.5	ZnO _(s)	43.9

جدول (7): ثوابت معادلات السعة الحرارية الجزيئية لبعض المواد.

Substance	Range (°K)	a	b x 10 ³	c x 10 ⁷	d x 10 ⁹
H _{2(g)}	300–2500	6.62	0.81		
N _{2(g)}	300–2500	6.76	0.606	1.3	
O _{2(g)}	300–2500	6.76	0.606	1.3	
CO _(g)	300–2500	6.60	1.2		
HCl _(g)	300–1500	6.70	0.84		
H ₂ O _(g)	300–1500	7.219	2.374	2.67	
H ₂ S _(g)	300–1800	6.955	3.675	-7.40	-0.585
NH _{3(g)}	300–1000	6.189	7.887	-7.28	
CO _{2(g)}	300–1500	5.166	15.177	-95.78	2.260
CH _{4(g)}	300–1500	3.422	17.845	-41.65	
C ₂ H _{4(g)}	300–1500	2.706	29.160	-90.59	
C ₂ H _{6(g)}	300–1000	1.375	41.852	-138.27	
		a	b x 10 ³	c x 10 ⁻⁵	
Cl _{2(g)}	300–1500	8.76	0.271	-0.656	
NO _{2(g)}	300–2500	8.05	0.233	-1.56	
C (s. graphite)	300–1400	2.673	2.617	-1.169	
C (s. diamond)	300–1300	2.162	3.059	-1.303	

جدول (8): حرارات احتراق بعض المركبات العضوية عند 25°C .

Substance	Formula	ΔH° (cal/mole)
Methane (g)	CH_4	-212,800
Ethane (g)	C_2H_6	-372,820
Propane (g)	C_3H_8	-530,600
n-Butane (g)	C_4H_{10}	-687,980
n-Pentane (g)	C_5H_{12}	-845,160
Ethylene (g)	C_2H_4	-337,230
Acetylene (g)	C_2H_2	-310,620
Benzene (g)	C_6H_6	-787,200
Benzene (l)	C_6H_6	-780,980
Toluene (l)	C_7H_8	-934,500
Naphthalene (s)	C_{10}H_8	-1,228,180
Sucrose (s)	$\text{C}_{12}\text{H}_{22}\text{O}_{11}$	-1,348,900
Methanol (l)	CH_3OH	-173,670
Ethanol (l)	$\text{C}_2\text{H}_5\text{OH}$	-326,700
Acetic acid (l)	CH_3COOH	-208,340
Benzoic acid (s)	$\text{C}_6\text{H}_5\text{COOH}$	-771,200

جدول (9): الطاقة الحرة لجيبس للتكوين (KJ/mol)
لبعض المركبات عند 25°C وضغط 1 جو.

Compound	ΔG°_f	Compound	ΔG°_f
AgCl _(s)	-109.70	Fe ₂ O ₃	-741.0
Al ₂ O _{3(s)}	-1576.41	HBr _(g)	-53.22
BaCO _{3(s)}	-1138.9	HCl _(g)	-95.27
BaO _(s)	-528.4	HF _(g)	-270.7
CaCO _{3(s)}	-1128.76	HI _(g)	+1.30
CaO _(s)	-604.2	H ₂ O _(g)	-228.61
Ca(OH) _{2(s)}	-896.76	H ₂ O _(l)	-237.19
CH _{4(g)}	-50.79	H ₂ S _(g)	-33.0
C ₂ H _{2(g)}	+209.20	NaCl _(s)	-384.05
C ₂ H _{4(g)}	+68.12	NH _{3(g)}	-16.7
C ₂ H _{6(g)}	-32.89	NO _(g)	+86.69
C ₆ H _{6(l)}	+129.66	NO _{2(g)}	+51.84
CO _(g)	-137.28	SO _{2(g)}	-300.37
CO _{2(g)}	-394.38	ZnO _(g)	-318.19

جدول (10): الإنتروبي المطلق ($J/K.mol$) لبعض المركبات عند $25^\circ C$ وضغط 1 جو.

Subst ance	S°	Substance	S°
$Ag_{(s)}$	42.72	$HCl_{(g)}$	186.7
$AgCl_{(s)}$	96.11	$HF_{(g)}$	173.5
$Al_{(s)}$	28.3	$Hg_{(l)}$	77.4
$Al_2O_{3(s)}$	51.00	$HgO_{(s)}$	72.0
$Br_{2(l)}$	152.3	$HI_{(g)}$	206.3
C (graphite)	5.69	$H_2O_{(g)}$	188.7
$Ca_{(s)}$	41.6	$H_2O_{(l)}$	69.96
$CaCO_{3(s)}$	92.9	$H_2S_{(g)}$	205.6
$CaO_{(s)}$	39.8	$I_{2(s)}$	116.7
$Ca(OH)_{2(s)}$	76.1	$La_{(s)}$	57.3
$CH_{4(g)}$	186.2	$Li_{(s)}$	28.0
$C_2H_{2(g)}$	200.8	$N_{2(g)}$	191.5
$C_2H_{4(g)}$	219.5	$Na_{(s)}$	51.0
$C_2H_{6(g)}$	229.5	$NaCl_{(s)}$	72.38
$Cl_{2(g)}$	223.0	$NH_{3(g)}$	192.5
$CO_{(g)}$	197.9	$NO_{(g)}$	210.6
$CO_{2(g)}$	213.6	$NO_{2(g)}$	240.5
$F_{2(g)}$	203.3	$O_{2(g)}$	205.03
$Fe_{(s)}$	27.2	S (rhombic)	31.9
$Fe_2O_{3(s)}$	90.0	$SO_{2(g)}$	248.5
$H_{2(g)}$	130.6	$Zn_{(s)}$	41.6
$HBr_{(g)}$	198.5	$ZnO_{(s)}$	43.0

جدول (11): قيم مكافئ جول - طومسون لغاز النيتروجين.

P	μ at ($^{\circ}\text{C}$ atm. L)					
(atm)	-150°C	-100°C	0°C	100°C	200°C	300°C
1	1.266	0.6490	0.2656	0.1292	0.0558	0.0140
20	1.125	0.5958	0.2494	0.1173	0.0472	0.0096
33.5	0.1704	0.5494	0.2377	0.1100	0.0430	0.0050
60	0.0601	0.4506	0.2088	0.0975	0.0372	-0.0013
100	0.0202	0.2754	0.1679	0.0768	0.0262	-0.0075
140	-0.0056	0.1373	0.1316	0.0582	0.0168	-0.0129
180	-0.0211	0.0765	0.1015	0.0462	0.0094	-0.0160
200	-0.0284	0.0087	0.0891	0.0419	0.0070	-0.0171