الملاحق

جدول (1): إنثالبيات الاحتراق (الحرارة المنطلقة فى تفاعل احتراق عند ضغط ثابت ودرجة حرارة (25°C). المواد الناتجة $CO_{2(g)}$ و $H_2O_{(\ell)}$.

KJ mol^{-1}		KJ mol^{-1}		KJ mol^{-1}	
1366.95	(ℓ) ايثانول	2878.51	(g) بيوتان (عادى)	285.84	H_2
872.4	(ℓ) حمض خليك	2871.65	(g) ايزوبيوتان	393.51	C جرافيت
2815.8	(s) جلوكوز	4811.2	(g) هبتان (عادى)	282.99	CO(g)
5646.7	(s) سكروز	1410.97	(g) ايثيلين	890.35	CH_4(g)
		1299.63	(g) استينين	1559.88	C_2H_6(g)
		3301.51	(g) بنزين	2220.07	C_3H_8(g)

جدول (2): إنثالبى 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	C≡N	210
C–H	99	N–N	38
C–O	84	N=N	100
C=O	170	N≡N	226
C–C	83	N–H	93
C=C	147	F–F	37
C≡C	194	Cl–Cl	58
C–F	105	Br–Br	46

C (s, graphite) = C (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)
$H_2O_{(g)}$	–57.80	–241.8	$COCl_{2(g)}$	–53.3	–323
$H_2O_{(l)}$	–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
$H_2S_{(g)}$	–4.82	–20.2	$HNO_{3(l)}$	+41.40	–173.2
$HCN_{(g)}$	+31.2	+130.5	$NH_4NO_{3(s)}$	–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
$C_2H_{6(g)}$	–20.24	–84.68	$Ca(OH)_{2(s)}$	–235.80	–986.59
$C_2H_{4(g)}$	+12.50	+52.30	$CaCO_{3(s)}$	–288.45	–1206.9
$C_2H_{2(g)}$	+54.19	+226.7	$Ca_3P_{2(s)}$	–120.50	–504.17
$C_6H_{6(l)}$	+11.72	+49.04	$BaO_{(s)}$	–133.4	–588.1
$CH_3OH_{(g)}$	–48.08	–201.2	$BaCO_{3(s)}$	–291.3	–1218
$CH_3OH_{(l)}$	–57.02	–238.6	$Al_2O_{3(s)}$	–399.09	–1669.8
$CH_3OH_{2(g)}$	–6.7	–28	$Fe_2O_{3(s)}$	–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^a_2	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.

$\Delta H°_f$			$\Delta H°_f$		
Compound	(K/cal/mol)	(KJ/mol)	Compound	(K/cal/mol)	(KJ/mol)
$H_2O_{(g)}$	–54.64	–328.61	$CO_{(g)}$	–32.18	–137.28
$H_2O_{(l)}$	–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
$H_2S_{(g)}$	–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
$C_2H_{6(g)}$	–7.86	–32.89	$BaCO_{3(s)}$	–272.2	–1138.9
$C_2H_{4(g)}$	+16.28	+68.12	$Al_2O_{3(s)}$	–376.77	–1576.41
$C_2H_{2(g)}$	+50.00	+209.20	$Fe_2O_{3(s)}$	–177.1	741.0
$C_6H_{6(l)}$	+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): الإنتروبى المطلق (J/K.mol) عند 25°C وضغط 1 جو 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
$Al_2O_{3(s)}$	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	$ZnO_{(s)}$	43.9

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		
$H_2O_{(g)}$	300–1500	7.219	2.374	2.67	
$H_2S_{(g)}$	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	
$C_2H_{4(g)}$	300–1500	2.706	29.160	–90.59	
$C_2H_{6(g)}$	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)	$C_{12}H_{22}O_{11}$	–1,348,900
Methanol (l)	CH_3OH	–173,670
Ethanol (l)	C_2H_5OH	–326,700
Acetic acid (l)	CH_3COOH	–208,340
Benzoic acid (s)	C_6H_5COOH	–771,200

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

Compound	$\Delta G°_f$	Compound	$\Delta G°_f$
$AgCl_{(s)}$	–109.70	Fe_2O_3	–741.0
$Al_2O_{3(s)}$	–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	$H_2O_{(g)}$	–228.61
$Ca(OH)_{2(s)}$	–896.76	$H_2O_{(l)}$	–237.19
$CH_{4(g)}$	–50.79	$H_2S_{(g)}$	–33.0
$C_2H_{2(g)}$	+209.20	$NaCl_{(s)}$	–384.05
$C_2H_{4(g)}$	+68.12	$NH_{3(g)}$	–16.7
$C_2H_{6(g)}$	–32.89	$NO_{(g)}$	+86.69
$C_6H_{6(l)}$	+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): الإنتروبى المطلق (J/K.mol) لبعض المركبات عند 25°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 (°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