INFRARED CARBONYL FREQUENCIES OF HETEROCYCLIC LACTONES

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Submitted in Honor of Professor Koji Nakanishi

Abstract - Infrared carbonyl frequencies of heterocyclic lactones are tabulated on the basis of ring size, number and position of heteroatoms, substituents, unsaturation, and solvent effects.

Among the earliest applications of infrared spectroscopy were structural correlations of lactones, but the pioneering work of Bellamy did not address heterocyclic lactones.[1] Shortly afterwards, Katritzky and coworkers presented excellent treatments of the IR frequencies of heterocyclic systems; but, even twenty-five years ago, there were few literature citations for heterocyclic lactones.[2] More recently, carbonyl frequencies of heterocyclic lactones were reviewed, but the compilation was limited to those ring systems for which the corresponding thiolactone had been reported.[3] This review presents carbonyl frequencies for a wide variety of heterocyclic lactones reported over the past four decades.

The Tables are organized on the basis of ring size, number and position of heteroatoms, degree and position of unsaturation, nature of substituents, and solvent effects. The following abbreviations are used for substituents: Ac, acetyl; Ad, adamantyl; Bn, benzyl; Bu, *n*-butyl; *t*-Bu, *tert*-butyl; Bz, benzoyl; c-C_6H_{11}, cyclohexyl; E, ester (CO_2Me or CO_2Et); Et, ethyl; Me, methyl; Ms, methanesulfonyl; MOM, methoxymethyl; Ph, phenyl; *i*-Pr, isopropyl; *p*-Tol, *para*-tolyl. Solvents are identified by molecular formula, name, or the following abbreviations: DMSO, dimethyl sulfoxide; pyr, pyridine; THF, tetrahydrofuran. Mull refers to dispersion in mineral oil (Nujol); a dash signifies that the phase was unspecified. Values of carbonyl frequencies ($\nu_{C=O}$) are reported in wave numbers, cm^{-1}.

The following trends are observed. Increasing ring size causes a shift to lower frequencies. Endocyclic unsaturation which is conjugated with the carbonyl group causes a shift to lower frequencies, but endocyclic unsaturation which is conjugated with the ring oxygen of the lactone causes a shift to higher frequencies. Exocyclic unsaturation conjugated with the carbonyl group causes a shift to lower frequencies Alkyl substituents α to the carbonyl group cause small shifts to lower frequencies; aryl substituents in the same position cause small shifts to higher frequencies. The Tables include only simple alkyl and aryl groups as representative substituents. In many cases the literature references contain additional derivatives. Solvent effects vary considerably, but higher frequencies are most often observed in carbon tetrachloride.

Table I **Ring Size: 4**
Heteroatoms: 1,2-

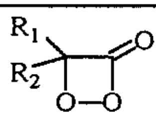
Compound	R_1	R_2	Phase	$\nu_{c=o}$	Ref.
	H	*t*-Bu	CCl_4	1875	4
	H	1-Ad	CCl4	1875	5
	Me	Me	CCl_3F	1870	6
	Ph	Ph	CCl_3F	1870	6

Table II **Ring Size: 5 (saturated)**
Heteroatoms: 1,2-

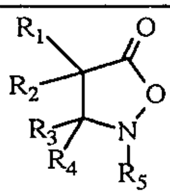
Compound	R_1	R_2	R_3	R_4	R_5	Phase	$\nu_{c=o}$	Ref.
	H	H	H	H	Me	neat	1760	7
	H	H	H	H	Bn	neat	1765	7
	H	H	H	H	*t*-Bu	neat	1760	7
	H	H	H	Me	Me	–	1788,1773	8
	H	H	H	Ph	Me	neat	1795,1776	9
	H	H	Me	Ph	Me	KBr	1789,1773	10
	H	H	Ph	Ph	Me	KBr	1782	10
	H	Me	H	H	Bn	$CHCl_3$	1770	7
	H	H	H	Me	Bn	$CHCl_3$	1760	7
	H	Me	H	Me	Bn	neat	1765	7
	Me	Me	H	Ph	Bn	KBr	1778,1772	11
	Me	Me	H	Ph	Me	$CHCl_3$ KBr	1777,1768 1786,1772	9 9
	Me	Me	H	Ph	c-C_6H_{11}	KBr	1778	11

Table II (continued)

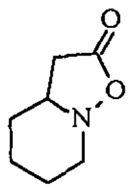
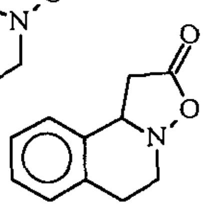
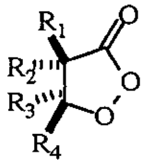
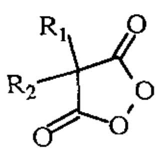
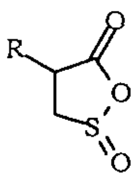
Compound					Phase	$\nu_{C=O}$	Ref.
					neat	1785	12
					neat	1799,1789	9
	R_1	R_2	R_3	R_4			
	H	H	Me	Me	CCl_4	1806	13
	H	H	Me	Ph	CCl_4	1810	14
	Me	Me	H	H	CCl_4	1806	13
	Me	Me	Me	Me	CCl_4	1795	15
	Me	Me	Me	OH	$CHCl_3$	1795	16
	Me	Me	Me	OOH	$CHCl_3$	1795	16
	Ph	Me	Me	Ph	CCl_4	1800	15
	Ph	Me	Me	Bn	CCl_4	1795	15
	Ph	Me	H	Bn	CCl_4	1795	15
	$-(CH_2)_5-$		$-(CH_2)_5-$		CCl_4	1780	17
	$-(CH_2)_6-$		$-(CH_2)_6-$		CCl_4	1782	17
	Me	$-(CH_2)_3-$		OH	$CHCl_3$	1785	16
	Me	$-(CH_2)_3-$		OOH	$CHCl_3$	1790	16
	R_1	R_2					
	Bu	Bu			CCl_4	1783	18
	$-(CH_2)_3-$				$CHCl_3$	1803	19
	R						
	H				–	1700	20
	Ph				–	1810	21

Table III **Ring Size:** **5** **(unsaturated)**
Heteroatoms: **1,2-**

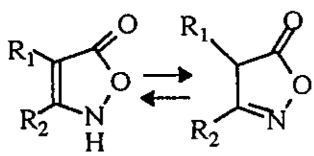
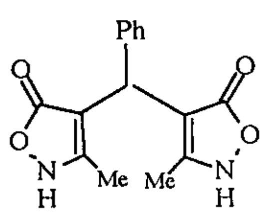
Compound	R_1	R_2	tautomer	Phase	$\nu_{C=O}$	Ref.
	H	H	C–H	$CHCl_3$	1804	22
	H	Me	C–H	neat	1795	23
			C–H	$CHCl_3$	1797	23
	H	*t*-Bu	C–H	$CHCl_3$	1802	23
			C–H	$CHCl_3$	1805	24
	H	Ph	C–H	$CHCl_3$	1807	25
			C–H	$CHCl_3$	1800	26
			N–H	KBr	1714	27
	p-Tol	H	N–H	mull	1735	28
	Me	Me	C–H	neat	1790	29
			C–H	CCl_4	1799	29
			N–H	neat	1690	29
			N–H	CCl_4	1758	29
	Me	*t*-Bu	C–H	KBr	1795	30
			N–H	KBr	1690	30
	Me	Ph	C–H	C_2Cl_4	1808	25
			C–H	$CDCl_3$	1800	31
			N–H	$CHCl_3$	1785,1718	32
			N–H	$CHCl_3$	1735	25
	Bn	Me	N–H	$CHCl_3$	1665	32
			N–H	KBr	1675	33
	Bn	Ph	C–H	$CHCl_3$	1796	34
			N–H	$CHCl_3$	1738	34
				$CHCl_3$	1790,1720	32
	Ph	H	N–H	–	1663	35
	Ph	Me	N–H	$CHCl_3$	1717,1670	32
	Ph	Ph	N–H	KBr	1690,1680	25,31
	–(CH_2)$_4$–		C–H	$CHCl_3$	1782	23
			N–H	$CHCl_3$	1752,1735	23
				mull	1692	23
			N–H	KBr	1690,1660	33

Table III (continued)

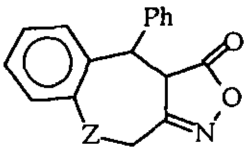
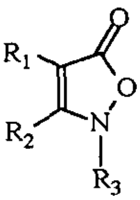
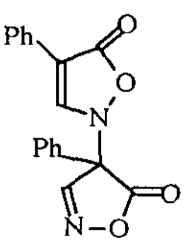
Compound				Phase	$\nu_{c=o}$	Ref.
	Z					
	CH_2		C–H	KBr	1705,1690	36
	O		C–H	KBr	1700,1685	36
	R_1	R_2	R_3			
	H	H	Me	NaCl	1725	37
	H	H	allyl	NaCl	1730	37
	Me	H	Me	$CHCl_3$	1723	23
	Ph	H	Me	–	1734,1701	35
	allyl	H	allyl	NaCl	1730	37
	NO_2	H	Me	mull	1775	38
	Ph	H	Ph	–	1711	35
	E	H	Ph	–	1751,1734	35
	E	H	c-C_6H_{11}	mull	1757	39
	Me	Me	Me	$CHCl_3$ CCl_4	1741,1725 1754	25 29
	Me	Ph	Me	$CHCl_3$ C_2Cl_4	1739,1725 1760	25 25
	Ph	Ph	Me	KBr	1762	31
	Ph	Ph	*t*-Br	KBr	1725	40
	Ph	Ph	Ph	$CHCl_3$ KBr	1741 1720	41 42
	E	Ph	Me	KBr	1772,1750	43
	CN	Ph	Me	KBr	1764	43
	NO_2	H	Ac	mull	1810,1760	38
				mull	1810,1778	28

Table III (continued)

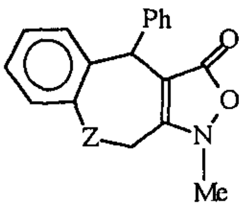
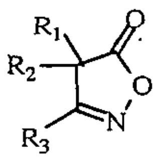
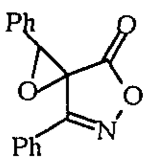
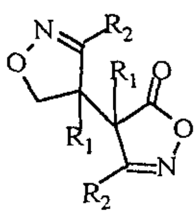
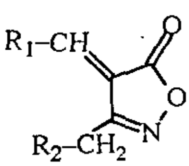
Compound		Phase	$\nu_{c=o}$	Ref.
	Z			
	CH_2	KBr	1735	36
	O	KBr	1730	36
	R_1 R_2 R_3			
	Me Me Me	neat	1790	44
		$CHCl_3$	1793	25
		CCl_4	1794	29
	Me Me Ph	$CHCl_3$	1803	25
		CCl_4	1800	44
		mull	1790	45
	Bn Me Me	neat	1780	44
	Ph Ph Ph	KBr	1680	46
	HO Me *t*-Bu	KBr	1780	30
		mull	1780	47
	R_1 R_2			
	Me *t*-Bu	KBr	1775	30
	Bn Me	KBr	1775,1740	33
	Ph Bn	KBr	1750	36
	Ph PhO	KBr	1750	36

Table III (continued)

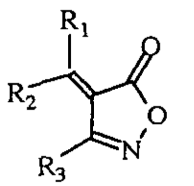
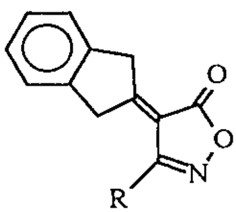
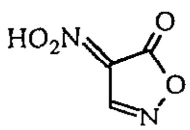
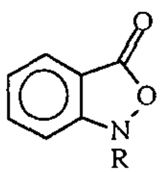
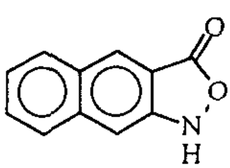
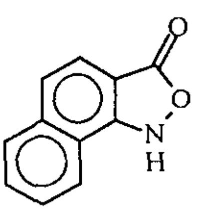
Compound				Phase	$\nu_{C=O}$	Ref.
	R_1	R_2	R_3			
	2-thienyl	H	Ph	$CHCl_3$	1740	48
				KBr	1724	27
	3-thienyl	H	Ph	KBr	1714	27
	3-furyl	H	Ph	KBr	1738	27
	Me	Me	Me	KBr	1755	31
	Me	Me	Ph	KBr	1750	31
	$-(CH_2)_4-$		Me	KBr	1760	31
	$-(CH_2)_4-$		Ph	KBr	1760	31
	R					
	Me			DMSO-d_6	1720	31
	Ph			DMSO-d_6	1730	31
				$CDCl_3$	1705,1685	31
				mull	1700	38
	R					
	H			$CHCl_3$	1773,1751	49
				CH_2Cl_2	1770,1750	50
	CH_2OH			CH_2Cl_2	1765	50
				CCl_4	1780	51
				$CHCl_3$	1758	51

Table III (continued)

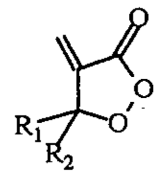
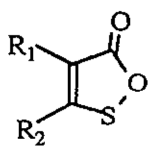
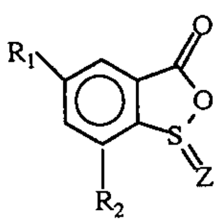
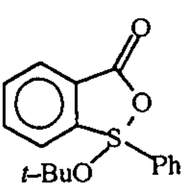
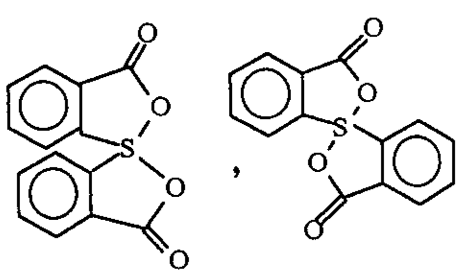
Compound				Phase	$\nu_{C=O}$	Ref.
	R1	R2				
	H	Me		neat	1790	52
	Me	Me		neat	1780	53
	R1	R2				
	CO_2H	Me		KBr	1757,1730,1661	54
	CO_2H	Ph		KBr	1786,1675	54
	R1	R2	Z			
	H	E	–	KBr	1750	55
	H	E	O	KBr	1790	55
	t-Bu	*t*-Bu	–	KBr	1752	56
				$CHCl_3$	1740	56
	t-Bu	*t*-Bu	O	KBr	1792	56
				$CHCl_3$	1640	57
				–	1745	58

Table III (continued)

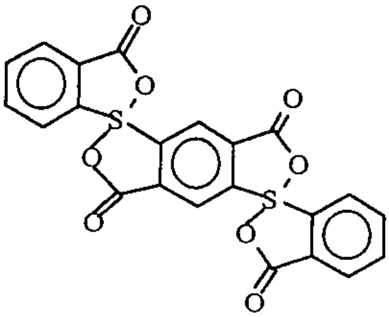
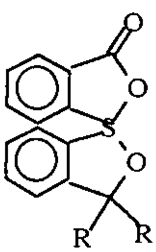
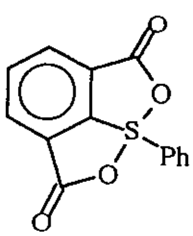
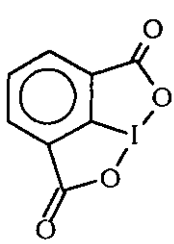
Compound		Phase	$\nu_{C=O}$	Ref.
		KBr	1735	59
	R			
	Me	–	1647	60
	CF_3	–	1708	60
		CH_2Cl_2	1722	61
		DMSO	1686	61

Table IV **Ring Size:** **5** ***(saturated)***
Heteroatoms: **1,3-**

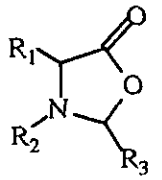
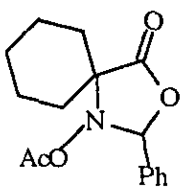
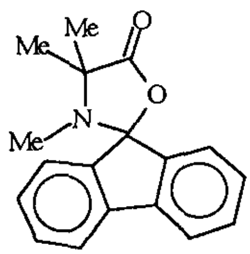
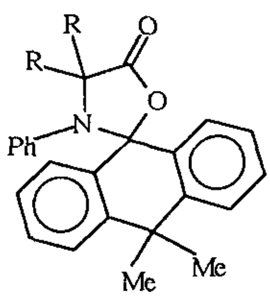
Compound		R1	R2	R3	Phase	$\nu_{C=O}$	Ref.
		Me	Ms	H	$CHCl_3$	1814	62
		Bn	Ms	H	CCl_4	1810	62
		Ph	Ms	H	$CHCl_3$ KBr	1817 1790	62 62
		H	Bz	*t*-Bu	KBr	1800	63
	cis	Me	Ms	Me	$CHCl_3$	1792	62
	cis	Bn	Ms	Me	$CHCl_3$	1790	62
		H	NO	Ph	$CHCl_3$	1820	64
					KBr	1775	65
					KBr	1782	66
		R					
		Me			$CHCl_3$	1780	67
		Ph			$CHCl_3$	1775	67

Table IV (continued)

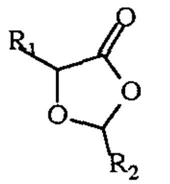
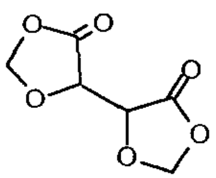
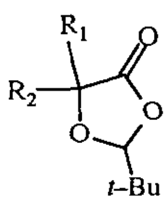
Compound		R_1	R_2	Phase	$\nu_{c=o}$	Ref.
		Me	H	CCl_4	1819	62
		Bn	H	CCl_4	1811	62
		Ph	H	CCl_4	1823	62
		H	Ph	neat	1811	68
		Ph	Ph	KBr	1790	69
	cis	Me	*t*-Bu	$CHCl_3$	1795	70
				$CDCl_3$	1801	71
	trans	Me	*t*-Bu	$CDCl_3$	1801	71
				CCl_4	1810	62
	cis	Bn	*t*-Bu	KBr	1785	70
	cis	Ph	*t*-Bu	KBr	1800	70
				CCl_4	1810	62
	trans	Ph	*t*-Bu	neat	1800	72
				KBr	1801	62
				CCl_4	1810	62
				mull	1795	73
		Me	allyl	$CHCl_3$	1770	70
		Me	Bn	$CHCl_3$	1775	70
		Bn	Me	KBr	1785	70
		Bn	allyl	neat	1795	70

Table IV (continued)

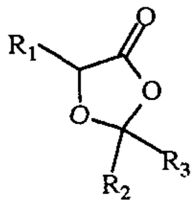
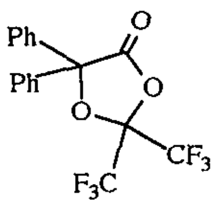
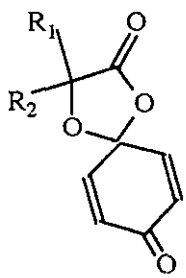
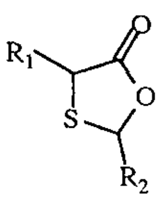
Compound	R_1	R_2	R_3	Phase	$\nu_{c=o}$	Ref.
	Me	Me	Me	CCl_4	1808	62
	Bn	Me	Me	CCl_4	1807	62
				KBr	1790	62
	Ph	Me	Me	CCl_4	1809	62
	Me	*trans* Me	*t*-Bu	KBr	1790	74
	Me	*trans* Me	Ph	KBr	1785	74
	H	$-(CH_2)_5-$		neat	1807,1796	68
				CH_2Cl_2	1795	75
	Me	$-(CH_2)_5-$		NaCl	1800	69
	Ph	$-(CH_2)_5-$		KBr	1805	69
					1830	76
	R_1	R_2				
	Me	H		$CDCl_3$	1800	77
	Me	Me		$CDCl_3$	1790	77
	$-(CH_2)_5-$			KBr	1790	77
	R_1	R_2				
	H	H		neat	1771,1730	78
	H	Me		neat	1774,1752	78
	H	*t*-Bu		neat	1776,1697	78
	H	Ph		KBr	1780,1730	63
	Me	H		neat	1817,1768	78

Table IV (continued)

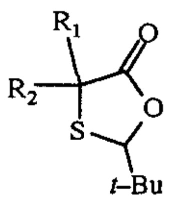
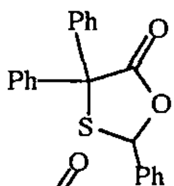
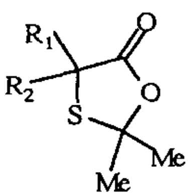
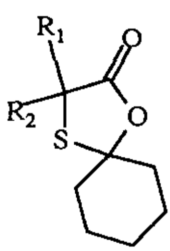
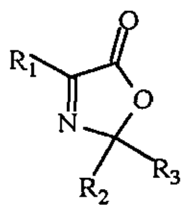
Compound				Phase	$\nu_{c=o}$	Ref.
		R1	R2			
		Me	Me	neat	1769	78
		Me	Ph	KBr	1765	79
		Ph	Me	KBr	1770	79
		Ph	Ph	KBr	1765	79
		R1	R2			
	cis	Me	H	$CHCl_3$	1755	70
				$CDCl_3$	1774	71
	trans	Me	H	$CDCl_3$	1768	71
	cis	Bn	H	KBr	1760	80
	cis	Ph	H	KBr	1765	80
		Me	Ph	–	1765	80
		Me	Bn	–	1765	80
		Me	allyl	$CHCl_3$	1750	70
				C_4Cl_6	1755	81
		R1	R2			
		H	H	neat	1790,1770	78
				$CHCl_3$	1775	82
		Me	H	neat	1766	78
				$CHCl_3$	1770	82
		Ph	H	$CHCl_3$	1768	82
		Me	Me	$CHCl_3$	1765,1745	82,83
		Me	Bn	$CHCl_3$	1743	83
		Bn	Bn	$CHCl_3$	1742	83
		R1	R2			
		H	H	neat	1772	84
		Me	H	CCl_4	1759	85
				NaCl	1760	79
		Ph	H	KBr	1770	79
		Ph	Ph	C_4Cl_6	1755	81

Table V **Ring Size: 5 (unsaturated)**
Heteroatoms: 1,3-

Compound	R_1	R_2	R_3	Phase	$\nu_{C=O}$	Ref.
	Bn	H	H	CCl_4	1795	86
	Ph	H	Me	neat	1775	87
	Me	H	CF_3	$CHCl_3$	1810	88
	t-Bu	H	CF_3	neat	1800	89
	Bn	H	CF_3	$CHCl_3$	1810	88
	Ph	H	CF_3	$CHCl_3$	1810	88
	Me	Me	Me	neat	1800	90
	Ph	Me	Me	neat	1776	91
				mull	1780	90
	PhS	Me	Me	KBr	1770	92
	Ph	Me	allyl	neat	1779	87
	Ph	Me	Ph	neat	1775	90
	Ph	Ph	Ph	$CHCl_3$	1788	93
	H	CF_3	CF_3	neat	1835	94
	Me	CF_3	CF_3	neat	1825	94
	Ph	CF_3	CF_3	neat	1821	94
	Me_2N	CF_3	CF_3	mull	1815	95
	BnS	$-(CH_2)_5-$		$CHCl_3$	1776	92
	PhS	$-(CH_2)_5-$		$CHCl_3$	1775	92,96

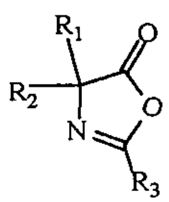
Compound	R_1	R_2	R_3	Phase	$\nu_{C=O}$	Ref.
	H	H	Ph	$CHCl_3$	1821	97
				CH_2Cl_2	1825	98
				KBr	1810	99
	H	Me	Ph	neat	1840	87
				$CHCl_3$	1835	100
				KBr	1830	101
	H	Bn	Ph	$CHCl_3$	1828	100
	H	Ph_2CH	Ph	KBr	1810	102
	H	Ph_3C	Ph	KBr	1820	103
	H	Ph	Ph	KBr	1820	104,105
	H	Ph	Me	–	1831	91
	H	*i*-Pr	BnO	neat	1845	106
	H	*i*-Pr	*t*-BuO	neat	1845	106
	H	*i*-Pr	EtS	KBr	1840	107

Table V (continued)

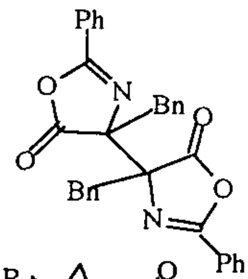
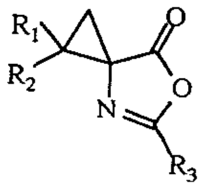
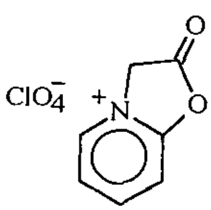
Compound	R_1	R_2	R_3	Phase	$\nu_{C=O}$	Ref.
	Et	Ph	Me	neat	1820	87
	allyl	Ph	Me	neat	1822	87
	Bn	Ph	Me	neat	1820	87
	Me	Me	Ph	KBr	1821	101
				KBr	1825	108
				mull	1820	109
	Me	Bn	Ph	neat	1816	110
				CCl_4	1825	103
	Me	Ph	Ph	KBr	1819	110
				mull	1830,1820	109
	allyl	Ph	Ph	$CHCl_3$	1818	111
	Bn	Ph	Ph	mull	1810,1790	109
				–	1839	112
	**R_1**	**R_2**	**R_3**			
	Ph	H	Me	KBr	1795	113
				mull	1800	114
	H	Ph	Me	KBr	1795	113
				mull	1810	114
	Me	Ph	Me	KBr	1810	113
	Me	H	Ph	KBr	1795	113
	H	Me	Ph	KBr	1810	113
	Ph	H	Ph	KBr	1800	113
				mull	1810	114
	H	Ph	Ph	KBr	1800	113
				mull	1805	114
	Me	Me	Ph	KBr	1790	113
	Me	Bn	Ph	KBr	1790	113
	Bn	Me	Ph	KBr	1790	113
				–	1890	115

Table V (continued)

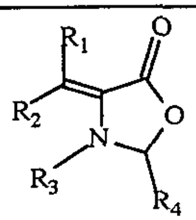
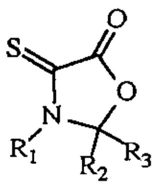
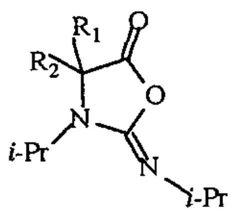
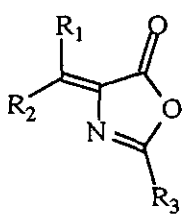
Compound					Phase	$\nu_{C=O}$	Ref.
	R1	R2	R3	R4			
	H	H	Bz	*t*-Bu	$CHCl_3$	1790	116
	H	H	Bz	Ph	–	1791	117
	Me	Me	Me	CF_3	–	1790	118
	Ph	H	Me	CF_3	CCl_4	1815	119
	R1	R2	R3				
	Me	H	Me		KBr	1800	120
	Me	H	Ph		KBr	1795	120
	Ph	H	Ph		KBr	1810	120
	Me	Me	Me		KBr	1800	120
	Ph	Me	Me		KBr	1795	120
	Me	$-(CH_2)_5-$			KBr	1795	120
	R1	R2					
	H	H			–	1795	121
	Me	H			–	1790	121
	Me	Me			–	1785	121
	R1	R2	R3				
	H	Ph	Me		$CHCl_3$ mull	1810,1780 1800,1770	122 123
	H	2-thienyl	Me		mull	1800,1770	124
	H	3-thienyl	Me		mull	1770	124
	H	Ph	Ph		$CHCl_3$ mull	1780,1760 1790,1770	122 123
	H	2-thienyl	Ph		mull	1790,1770	124
	H	3-thienyl	Ph		mull	1795,1760	124
	H	MeS	Ph		mull	1780	125
	H	BnS	Ph		mull	1780	125
	Ph	H	Ph		$CHCl_3$ mull	1780,1760 1780,1760	126 122
	2-thienyl	H	Ph		mull	1790,1765	124
	3-thienyl	H	Ph		mull	1810	124
	1-naphthyl	H	Ph		$CHCl_3$	1775	127
	Me	Ph	Me		KBr mull	1790,1760 1770	113 114

Table V (continued)

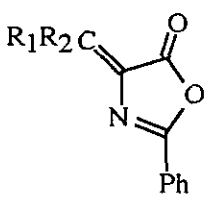
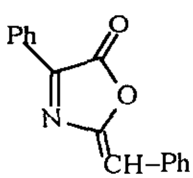
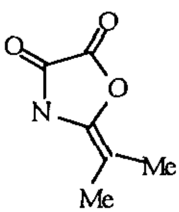
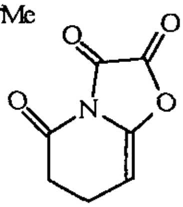
Compound				Phase	$\nu_{C=O}$	Ref.
	R_1	R_2	R_3			
	Me	Me	Ph	CCl_4	1802	128
	Me	Ph	Ph	KBr	1780,1760	113
				mull	1790,1760	123
	Ph	Me	Ph	$CHCl_3$	1770	127
				KBr	1800,1785	113
				mull	1775	114
	Ph	Ph	Ph	$CHCl_3$	1794,1766	129
	H	Ph	BnO	–	1820,1795	130
	$-(CH_2)_5-$		Ph	mull	1780,1750	123
	$-(CH_2)_6-$		Ph	$CHCl_3$	1782,1756	131
				KBr	1782,1765	131
	Ac	Me	Ph	mull	1795	132
	Bz	Me	Ph	mull	1795	132
	R_1	R_2				
	Me	Bn		$CHCl_3$	1790,1760	133
	H	4-pyridyl		mull	1810	134
				$CHCl_3$	1783	135
				KBr	1780	135
				–	1815,1735	136
				–	1840,1800,1720	136

Table V (continued)

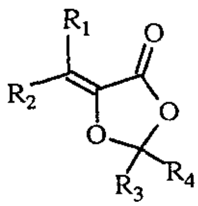
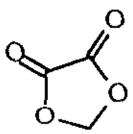
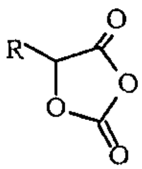
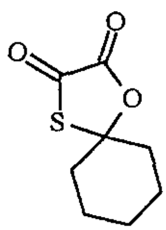
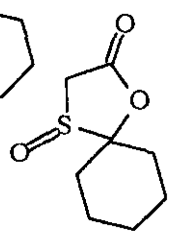
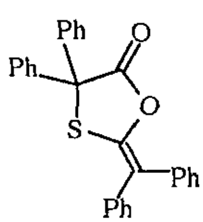
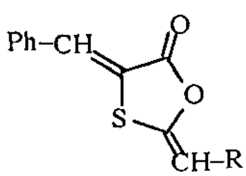
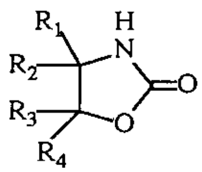
Compound	R_1	R_2	R_3	R_4	Phase	$\nu_{C=O}$	Ref.
	H	H	H	*t*-Bu	$CHCl_3$	1795	116
	H	H	$-(CH_2)_5-$		CH_2Cl_2	1795	75
	H	Me	$-(CH_2)_5-$		CH_2Cl_2	1780	75
	H	Ph	$-(CH_2)_5-$		CH_2Cl_2	1780	75
					$CHCl_3$	1845,1812	137
					KBr	1845,1792	137
			R				
			Me		KBr	1890,1820	138
			Ph		KBr	1900,1820	138
					–	1782,1700	84
					KBr	1780	84
					KBr	1788	139
			R				
			H		KBr	1775	140
			Me		KBr	1772	140

Table VI **Ring Size: 5 (saturated)**
Heteroatoms: 1,4-



Compound	R_1	R_2	R_3	R_4	Phase	$\nu_{C=O}$	Ref.
	H	H	H	H	CCl_4	1782	141
					$CHCl_3$	1760	142
					KBr	1724	143
					mull	1710	144
	i-Pr	H	H	H	$CHCl_3$	1752,1714	145
	Bn	H	H	H	$CHCl_3$	1760,1711	145
	Ph	H	H	H	$CHCl_3$	1760	146
					KBr	1758,1730	147
	Ph	Me	H	H	KBr	1750	147
					KBr	1740	148
	$-(CH_2)_5-$		H	H	KBr	1740	148
	H	H	Me	H	neat	1755	149
					neat	1735	150
	H	H	Ph	H	$CHCl_3$	1760	151
	H	H	Me	Me	$CHCl_3$	1755	152
	H	H	Ph	Me	KBr	1750	148
	H	H	Ph	Ph	KBr	1750	148
	H	H	$-(CH_2)_3-$		mull	1730	153
	H	H	$-(CH_2)_5-$		KBr	1740	148
trans	Ph	H	Me	H	KBr	1740	147
cis	Ph	H	H	Ph	KBr	1745,1710	154
trans	Ph	H	Ph	H	KBr	1750,1730	154
	Ph	H	Me	Me	KBr	1740	155
	Ph	H	$-(CH_2)_5-$		KBr	1740, 1720	148
	Ph	H	Ph	Me	KBr	1740	155
	Ph	H	Ph	Ph	KBr	1744	155
cis	H	$-(CH_2)_2-$		H	CH_2Cl_2	1760	156
					KBr	1735,1715	157
cis	H	$-(CH_2)_3-$		H	KBr	1740,1700	147
cis; trans	H	$-(CH_2)_4-$		H	–	1735	158
cis	H	$-(CH_2)_5-$		H	KBr	1730	147
cis	H	$-(CH_2)_6-$		H	KBr	1740	154,159

Table VI (continued)

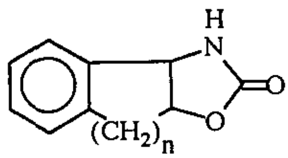
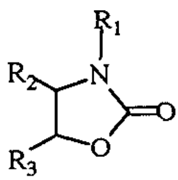
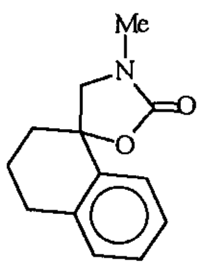
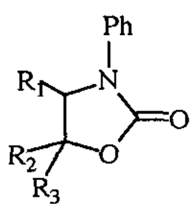
Compound					Phase	$\nu_{C=O}$	Ref.
		n					
	cis	1			KBr	1760,1715	147
	cis	2			KBr	1730	147
		R_1	R_2	R_3			
		$SiMe_3$	H	H	KBr	1750	160
		Me	H	H	$CHCl_3$	1746	142
		Me	H	Me	neat	1740	161,162
		Me	H	Ph	–	1730	163
	cis	Me	Ph	Ph	KBr	1762,1739	164
	cis	Me	$-(CH_2)_4-$		neat	1745	147
					NaCl	1751	165
					–	1750	166
		R_1	R_2	R_3			
		H	H	H	$CHCl_3$	1753	142
		Me	H	H	neat	1740	167
		Ph	H	H	KBr	1750	161,168
		H	Me	H	KBr	1740	162,168
		H	vinyl	H	KBr	1730	168
		H	Ph	H	KBr	1740	161
					KBr	1730	168
	cis	Me	Me	H	–	1740	169
	trans	Me	Me	H	–	1730	169
	cis	Ph	Ph	H	KBr	1730	170
		H	Me	Me	KBr	1740	161
		$-(CH_2)_4-$		H	KBr	1740	161

Table VI (continued)

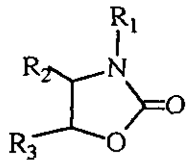
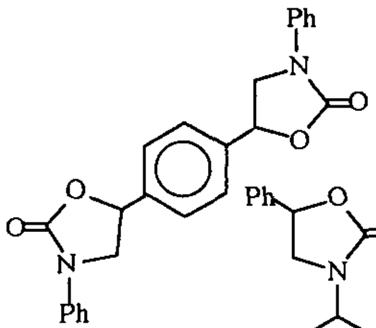
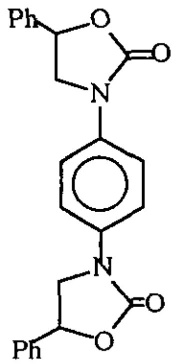
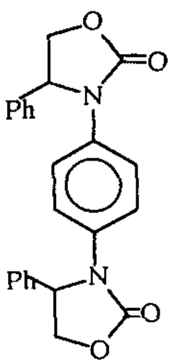
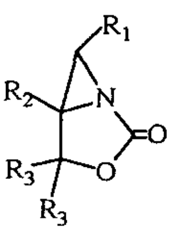
Compound		R_1	R_2	R_3	Phase	$\nu_{C=O}$	Ref.
		Ac	H	H	mull	1775,1770	171
	cis	Ac	$-(CH_2)_2-$		CH_2Cl_2	1785,1710	156
					KBr	1785,1705	157
	cis	Bz	$-(CH_2)_4-$		–	1780	172
					KBr	1735	168
					KBr	1750	168
					KBr	1730	168
		R_1	R_2	R_3			
		H	Et	Ph	KBr	1778	164
		H	Ph	Ph	KBr	1787	164
		Ph	Ph	Ph	$CHCl_3$	1774	164
		Me	Ph	Me	KBr	1768	164

Table VI (continued)

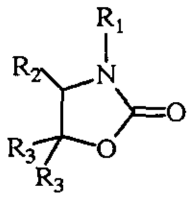
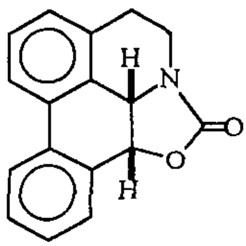
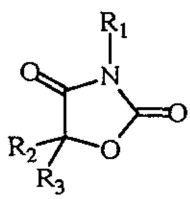
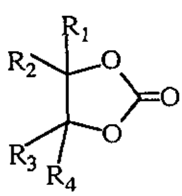
Compound	R_1	R_2	R_3	R_4	Phase	$\nu_{C=O}$	Ref.
	$-(CH_2)_3-$		Ph		neat	1757	173
	$-(CH_2)_4-$		H		neat	1750	174
					KBr	1740	175
	H	Ph	H		KBr	1818,1730	176
	Ph	Me	Me		mull	1818,1727	158
	NH_2	Me	Me		KBr	1820,1740	177
	NH_2	Me	Ph		KBr	1825,1755	177
	NH_2	Ph	Ph		KBr	1820,1750	177
	NH_2	$-(CH_2)_5-$			KBr	1850,1820,1740	177
	NH-Ph	Me	Me		KBr	1830,1750	177
	NH-Ph	Me	Ph		KBr	1825,1760	177
	NH-Ph	Ph	Ph		KBr	1830,1760	177
	H	H	H	H	neat	1800	178
					$CHCl_3$	1812	179,180
					CCl_4	1818	181
					CCl_4	1825	179
	Me	H	H	H	neat	1800	182
					$CHCl_3$	1785	183
					CCl_4	1809	184
	Ph	H	H	H	KBr	1770	154
					CS_2	1816	184
cis; trans	Me	H	Me	H	–	1800	169

Table VI (continued)

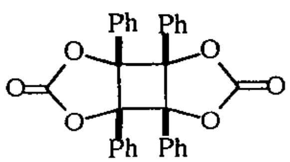
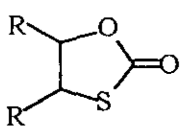
Compound						Phase	$\nu_{C=O}$	Ref.
		R1	R2	R3	R4			
	cis	Ph	H	Ph	H	KBr	1790	154
	trans	Ph	H	H	Ph	KBr	1815	154
		H	$-(CH_2)_4-$		H	–	1800	169
	cis	H	$-(CH_2)_6-$		H	KBr	1805	154,159
		Me	Me	Me	Me	–	1782,1754	185
		Cl	Cl	Cl	Cl	neat	1890	178
	cis	Ph	$-(CH_2)_2-$		Ph	$CHCl_3$	1802	186
	cis	Cl	$-(CH_2)_2-$		Cl	KBr	1900,1845,1820	187
						KBr	1845,1815	188
		R						
		H				neat	1724	189
						$CHCl_3$	1739	190
	cis	Me				neat	1730	191
	trans	Me				neat	1723	191

Table VII Ring Size: 5 (unsaturated)
Heteroatoms: 1,4-

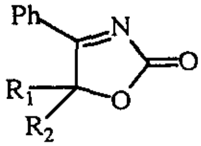
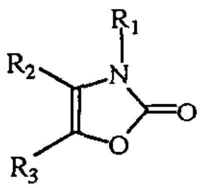
Compound				Phase	$\nu_{c=o}$	Ref.
	R1	R2				
	Me	Me		KBr	1768	155
	Me	Ph		KBr	1780	155
	Bn	Ph		KBr	1788	192
	Ph	Ph		KBr	1780	155
	–$(CH_2)_5$–			KBr	1770	155
	R1	R2	R3			
	H	H	H	CH_2Cl_2	1785,1760	156
				KBr	1765,1740	193
	H	H	Ph	–	1755,1720	194
	H	Me	Ph	–	1780	194
	H	Ph	Ph	–	1750	194
				KBr	1755	192
	H	–$(CH_2)_4$–		–	1732	194
	Me	H	H	KBr	1740	193
	Me	Me	Ph	KBr	1760,1745	165
	Me	Ph	Me	KBr	1755,1695	165
	Me	Ph	Ph	KBr	1749	195
	Me	–$(CH_2)_4$–		KBr	1776,1763 1753,1716	165
	Me	–$(CH_2)_5$–		KBr	1741,1696	165
	Bn	Ph	Ph	KBr	1760	192
	c-C_6H_{11}	Me	H	neat	1740	196
	Ph	Me	H	neat	1745	196
				$CHCl_3$	1760	197
	Ph	Ph	H	mull	1757	198
	Ph	H	Me	KBr	1740	196
	Ph	Me	Me	mull	1761	199
	Ph	Me	Ph	mull	1739	158
	Ph	Ph	Ph	$CHCl_3$	1753	200
				KBr	1750	195
				mull	1750	201
	1-naphthyl	H	Me	neat	1745	196
	–$(CH_2)_4$–		Ph	$CHCl_3$	1740	202
				KBr	1747	202

Table VII (continued)

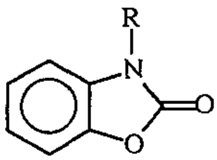
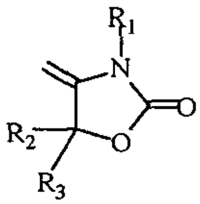
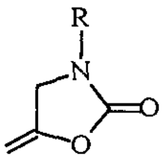
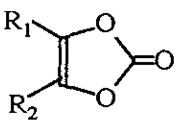
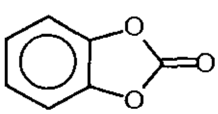
Compound				Phase	$\nu_{C=O}$	Ref.
	R					
	H			KBr	1769,1740	203
	Me			KBr	1769,1740	203
	t-Bu			CH_2Cl_2	1750	204
	R_1	R_2	R_3			
	Ph	H	H	$CHCl_3$	1770	197
				KBr	1760	196
	Ph	Me	H	mull	1770	199
	Ph	Me	Me	CH_2Cl_2	1770	205
				KBr	1752	206
	Bn	Me	Me	KBr	1763	206
	R					
	Me			neat	1750	196
	c-C_6H_{11}			neat	1770	196
	Ph			KBr	1775	196
	R_1	R_2				
	H	H		neat	1830	184
				CCl_4	1833	184
	H	Me		$CHCl_3$	1832,1808	207
				CCl_4	1893,1838,1792	207
	H	Ph		KBr	1873,1835,1802	188
	H	Br		CCl_4	1865,1845,1833	208
	Me	Ph		KBr	1860,1810,1775	188
	Ph	Ph		CCl_4	1870,1840,1820	209
				KBr	1820	210
	$-(CH_2)_4-$			neat	1820,1750	210
	$-(CH_2)_6-$			neat	1820,1730,1710	210
	$-(CH_2)_8-$			neat	1830,1730	210
				–	1855	211
				–	1835	212
				–	1820	213

Table VII (continued)

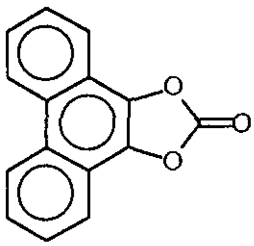
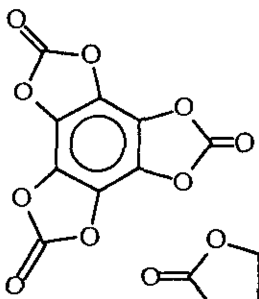
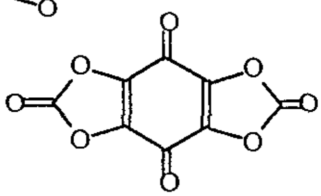
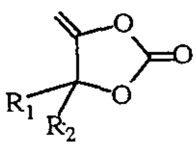
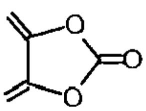
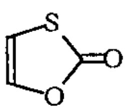
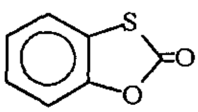
Compound	R_1	R_2	Phase	$\nu_{c=o}$	Ref.
			$CHCl_3$	1885,1855,1823	188
			CCl_4	1880,1848,1815	214
			KBr	1840,1805	210
			THF	1847,1835	215
			THF	1820,1805	215
	H	H	$CDCl_3$	1838	216
	Me	Me	KBr	1822	217
			–	1827	218
	Me	Ph	–	1835	218
	$-(CH_2)_5-$		–	1845	218
			KBr	1845,1825	219
			neat	1736	189
			neat	1800	220
			neat	1760	221

Table VII (continued)

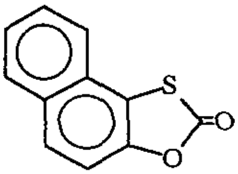
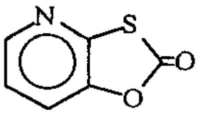
Compound	Phase	$\nu_{C=O}$	Ref.
	CCl_4 KBr	1776,1765 1753,1731	222 222
	KBr	1750	223

Table VIII **Ring Size:** **5**
Heteroatoms: **1,2,3-**

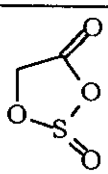
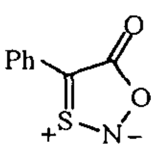
Compound	Phase	$\nu_{C=O}$	Ref.
	–	1825	224
	–	1700	225

Table IX **Ring Size:** **5**
Heteroatoms: **1,2,4-**

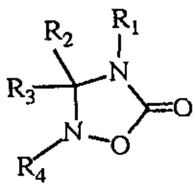
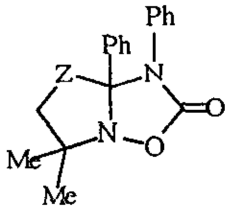
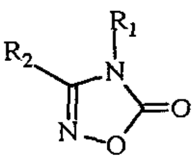
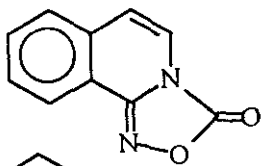
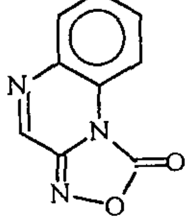
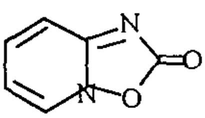
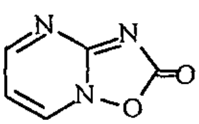
Compound		Phase	$\nu_{C=O}$	Ref.
	R_1 / R_2 / R_3 / R_4			
	Me / $-(CH=CH)_3-$ / Me	KBr	1740	226
	Ph / $-(CH_2)_5-$ / Me	$CHCl_3$	1748	227
	Ph / Ph / H / t-Bu	mull	1738	228
	Bz / Ph / H / Ph	$CHCl_3$	1790	229
	Z			
	CH_2	neat	1750	230
	O	$CHCl_3$	1740	230
	R_1 / R_2			
	H / Me	$CHCl_3$	1786	231
	H / Ph	mull	1770	231
	Me / Me	KBr	1786	232
	Me / Ph	$CHCl_3$	1780	203
	Ph / Ph	$CHCl_3$	1776	233
		KBr	1780	234
		KBr	1786	235
		–	1770	236
		KBr	1780	236

Table IX (continued)

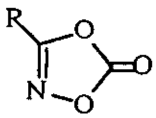
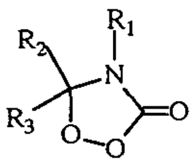
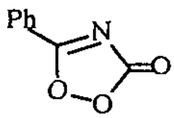
Compound				Phase	$\nu_{C=O}$	Ref.
	R					
	t-Bu			neat	1880,1835	237
	Ph			$CHCl_3$	1866,1834	233
				–	1855,1828	238
	CH_2=C(Ph)			KBr	1880,1840	148
	R_1	R_2	R_3			
	H	Ph	NEt_2	$CHCl_3$	1790	239
	Ph	Ph	CH=CE_2	$CHCl_3$	1776,1736	240
				$CHCl_3$	1815	239

Table X **Ring Size:** **5**
Heteroatoms: **1,3,4-**

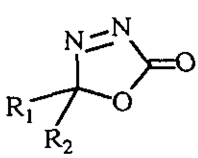
Compound			Phase	$\nu_{C=O}$	Ref.
	R_1	R_2			
	Me	Me	KBr	1800	241
			CCl_4	1835	242
	Me	*t*-Bu	CCl_4	1838	242
	Me	Bn	CCl_4	1830	242
			CCl_4	1827	243
	Bn	Bn	CCl_4	1828	243
	Me	Ph	CCl_4	1835	244
	–$(CH_2)_4$–		CCl_4	1840	245
			–	1825	246
	–$(CH_2)_5$–		CCl_4	1826	245
			–	1820	246
	–$(CH_2)_6$–		–	1820	246

Table X (continued)

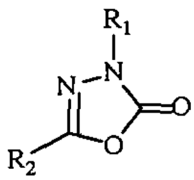
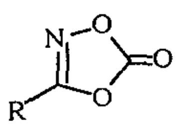
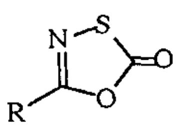
Compound			Phase	$\nu_{C=O}$	Ref.
	R_1	R_2			
	H	Me	–	1770	247
	H	c-C_6H_{11}	neat	1780	248
	H	*t*-Bu	KBr	1770	247
	H	Ph	KBr	1770	247
	Me	Ph	$CHCl_3$	1777	249
			CCl_4	1787	249
			KBr	1764	203
	Me	EtO	CCl_4	1805	250
	Bn	Me	CCl_4	1800	251
	Bn	Ph	CH_2Cl_2	1779	252
			CCl_4	1795	253
	allyl	Ph	KBr	1786	253
	propargyl	Ph	KBr	1773	253
	Ph	Et	mull	1796	254
	Ph	Ph	$CHCl_3$	1781	233
			mull	1783	254
	Ac	Ph	KBr	1790	247
	R				
	CF_3		neat	1887	255
	MOM		neat	1875,1825	256
	R				
	Me		neat	1760	257
	Ph		CCl_4	1780,1750	258
			mull	1740	259
	2-pyridyl		mull	1750	260

Table XI **Ring Size:** **6**
Heteroatoms: **1,2-**

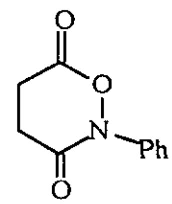
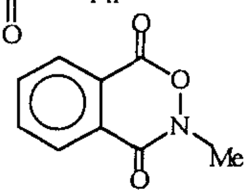
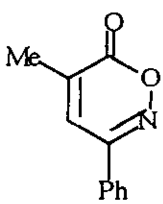
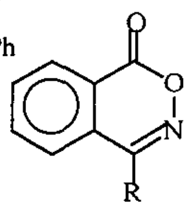
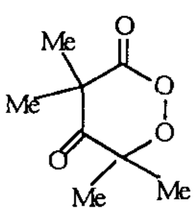
Compound		Phase	$\nu_{C=O}$	Ref.
		$CHCl_3$	1790	261
		dioxane	1760	262
		KBr	1760	262
		KBr	1720	263
	R			
	Bn	mull	1745	264
		–	1750	265
	Ph	$CHCl_3$	1734	266
	MeO	dioxane	1745	262
		CCl_4	1780	267

Table XII **Ring Size:** **6**
Heteroatoms: **1,3-**

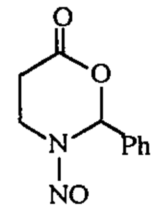
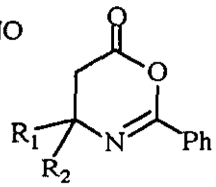
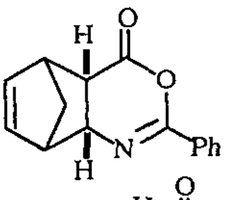
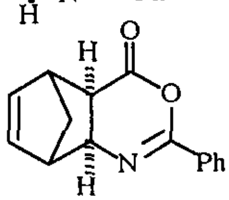
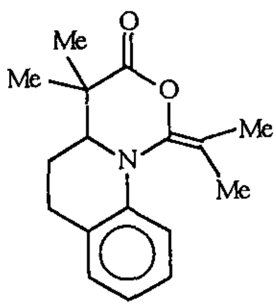
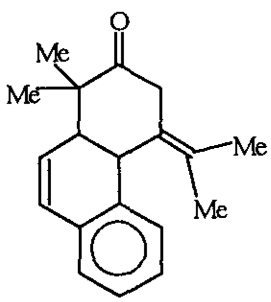
Compound	R_1	R_2	Phase	$\nu_{C=O}$	Ref.
			$CHCl_3$	1770	64
	H	Me	neat	1795,1675	268
	Me	Me	mull	1790,1670	268
			–	1750	269
			–	1770,1760	269
			CCl4	1754	270
			CCl4	1739	270

Table XII (continued)

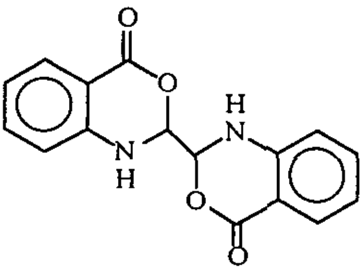
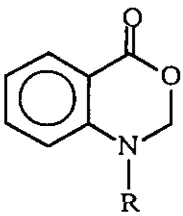
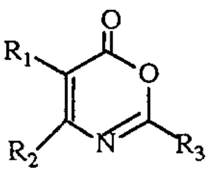
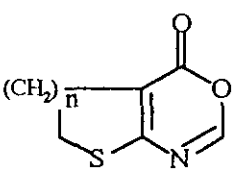
Compound				Phase	$\nu_{C=O}$	Ref.
				KBr	1715	271
	R					
	Me			KBr	1717	272
	Ph			KBr	1712	272
	R_1	R_2	R_3			
	H	H	H	$CDCl_3$	1765	273
	H	H	Ph	KBr	1750	274
	Me	Me	H	CCl_4	1745	273
	Me	Ph	H	$CHCl_3$	1745,1735	32
	Bn	Me	H	$CHCl_3$	1740	32
	Bn	Ph	H	$CHCl_3$	1742,1728	32
	Ph	Me	H	$CHCl_3$	1740	32
	H	Me	Me	$CHCl_3$	1745	273
	H	Me	Ph	mull	1770	275
	H	Ph	Me	mull	1766	275
	H	Ph	Ph	mull	1764	276
	Me	Me	Me	CCl_4	1750	273
	Bn	Me	Ph	KBr	1720	277
	Bn	Bn	Ph	KBr	1722	277
	Ph	Ph	Me	mull	1735	278
	Ph	Ph	Ph	KBr	1727	279
	MeO	Ph	Ph	mull	1740	47
	n					
	1			KBr	1730	280
	2			KBr	1720	280

Table XII (continued)

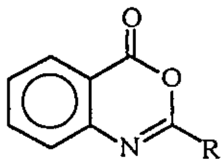
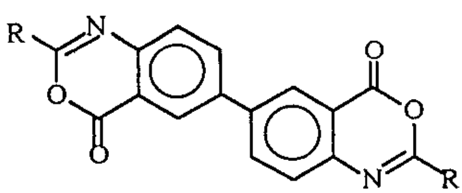
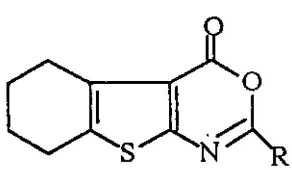
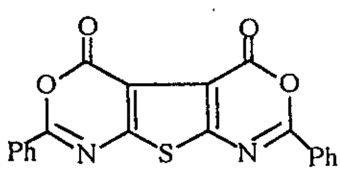
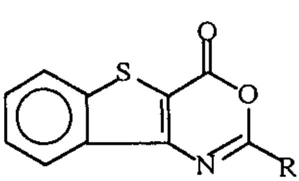
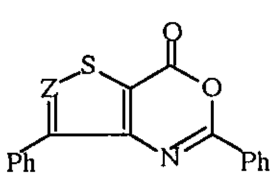
Compound		Phase	$\nu_{c=o}$	Ref.
	R			
	Me	CH_2Cl_2	1760	281
		KBr	1760	282
	t-Bu	mull	1760	283
	Ph	$CHCl_3$	1773	284
		CCl_4	1770	281
		KBr	1770	282
	EtO	–	1760	285
	EtS	KBr	1760	107
	R			
	Me	KBr	1757,1740	282
	Bn	KBr	1760	286
	Ph	KBr	1760	282
	R			
	Me	KBr	1740	280
	Ph	KBr	1760	280,287
		KBr	1890,1790	287
	R			
	Me	mull	1765	288
	Ph	mull	1770	288
	Z			
	Ph–C	KBr	1770	289
	N	KBr	1760	289

Table XII (continued)

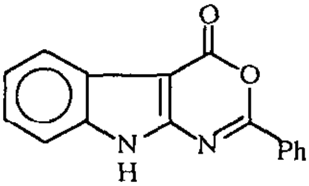
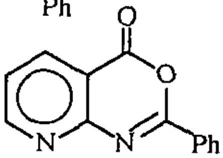
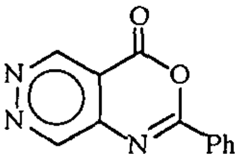
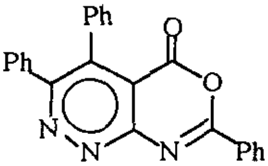
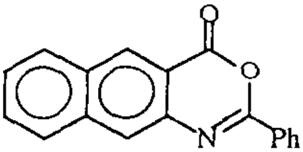
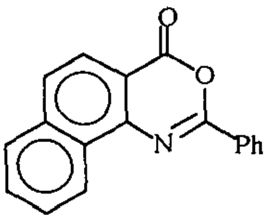
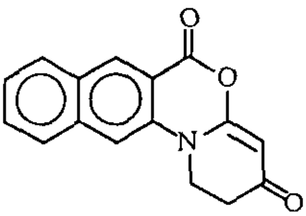
Compound	Phase	$\nu_{c=o}$	Ref.
	$CHCl_3$	1760	176
	–	1751	290
	KBr	1780	291
	KBr	1770	287
	KBr	1753	292
	KBr	1754	292
	–	1755	293

Table XII (continued)

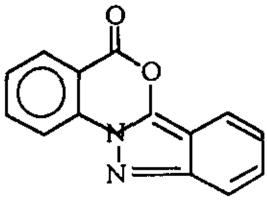
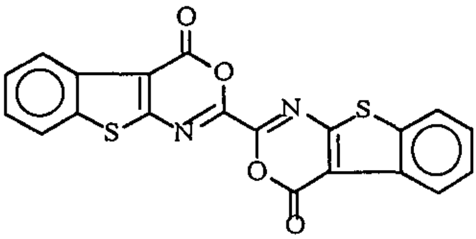
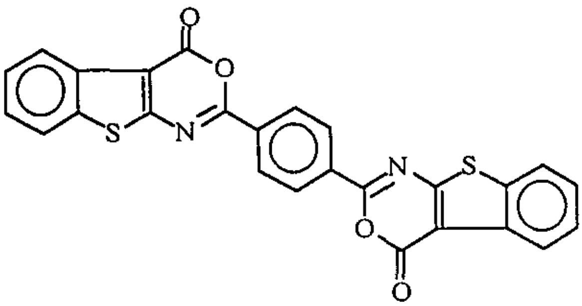
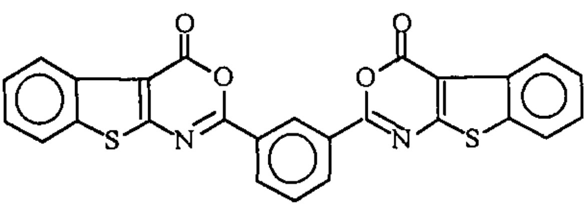
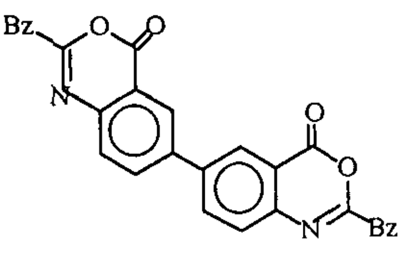
Compound	Phase	$\nu_{C=O}$	Ref.
	KBr	1770,1758	294
	KBr	1750	295
	KBr	1760	295
	KBr	1760	295
	KBr	1770	286

Table XII (continued)

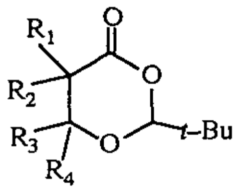
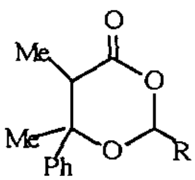
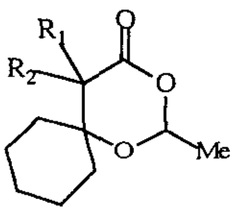
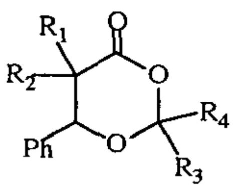
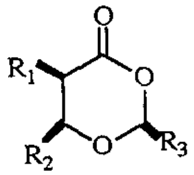
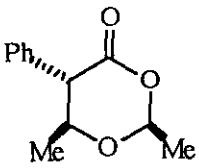
Compound							Phase	$\nu_{C=O}$	Ref.
		R1	R2		R3	R4			
		H	H		H	H	KBr	1750,1720	116
	cis	Me	H		H	H	KBr	1740	296
	trans	Me	H		H	H	KBr	1730	296
		Me	Bn		H	H	KBr	1720	296
	cis	H	H		Me	H	KBr	1740,1725	297
		H	Me	*cis*	Me	H	KBr	1755	296
		H	Me	*trans*	Me	H	KBr	1730	296
	cis	Me	Me		Me	H	KBr	1740	296
		Me	Bn		Me	H	KBr	1730	296
	cis	Me	H		Me	Me	KBr	1750	296
		R							
		H					–	1770	298
		Me					–	1770	298
		R1	R2						
		H	H				neat	1760	299
		Me	H				neat	1755	299
		Me	Me				neat	1750	299
		R1	R2		R3	R4			
		Me	H		H	H	–	1760	298
		Me	H		H	Me	–	1750	298
		Me	H		H	Ph	–	1750	298
		Me	H		$-(CH_2)_4-$		–	1750	298
		Me	H		$-(CH_2)_5-$		–	1745	298
		Me	Me		H	H	–	1755	298
		Me	Me		H	Me	–	1750	298
		Me	Me		H	Ph	–	1755	298
		Me	Me		Me	Ph	–	1750	298
		Me	Me		$-(CH_2)_4-$		–	1745	298
		Me	Me		$-(CH_2)_5-$		–	1745	298

Table XII (continued)

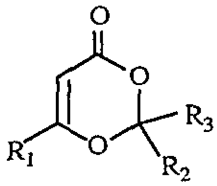
Compound			Phase	$\nu_{C=O}$	Ref.



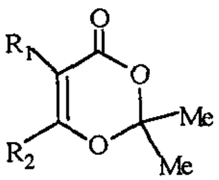
R_1	R_2	R_3	Phase	$\nu_{C=O}$	Ref.
H	Me	Me	neat	1750	297
$-(CH_2)_3-$		H	KBr	1730	300
$-(CH_2)_3-$		*t*-Bu	KBr	1735,1720	300
$-(CH_2)_4-$		H	neat	1745	300
$-(CH_2)_4-$		*t*-Bu	KBr	1750	300



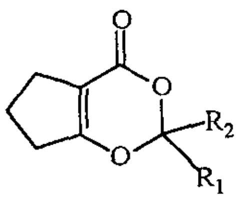
Phase	$\nu_{C=O}$	Ref.
neat	1745	301



R_1	R_2	R_3	Phase	$\nu_{C=O}$	Ref.
H	H	*t*-Bu	$CHCl_3$	1745,1730	302
H	H	c-C_6H_{11}	$CHCl_3$	1735	303
H	H	Ph	$CHCl_3$	1745	303
H	$-(CH_2)_4-$		$CHCl_3$	1730	303
H	$-(CH_2)_5-$		$CHCl_3$	1730	303
Me	H	*t*-Bu	KBr	1740	116



R_1	R_2	Phase	$\nu_{C=O}$	Ref.
H	H	$CHCl_3$	1725	304
H	Me	$CHCl_3$	1722	305
H	CF_3	neat	1759	306
H	Ph	$CHCl_3$	1717	304
Me	Me	$CHCl_3$	1725	304
Me	Ph	$CHCl_3$	1710	304
Bn	Me	$CHCl_3$	1712	304
Ph	Me	$CHCl_3$	1718	304



R_1	R_2	Phase	$\nu_{C=O}$	Ref.
H	*t*-Bu	KBr	1730	300
H	Ph	KBr	1735	307
Me	Me	$CHCl_3$	1720	307
		KBr	1734	307
Me	Ph	KBr	1725	307
$-(CH_2)_5-$		KBr	1735	307

Table XII (continued)

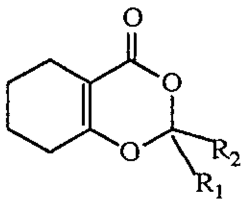
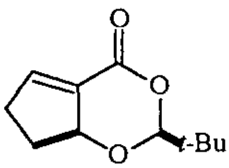
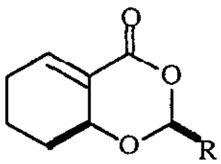
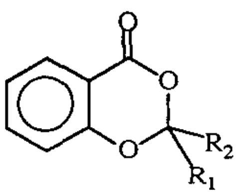
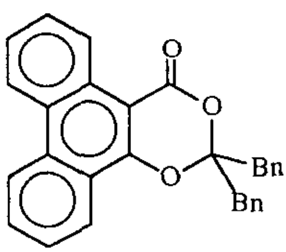
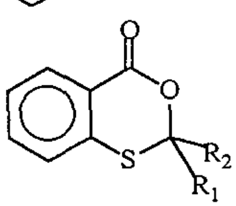
Compound			Phase	$\nu_{c=o}$	Ref.
	R1	R2			
	H	*t*-Bu	KBr	1725	300
	Me	Me	$CHCl_3$	1716	304
			KBr	1725	300
	R				
	H		KBr	1725	300
	t-Bu		KBr	1725	300
	R1	R2			
	H	H	$CHCl_3$	1747	308
	H	Ph	mull	1745	309
	Me	PhO	neat	1750	310
	Me	BnO	KBr	1735	310
	Me	*t*-BuO	neat	1750	310
			KBr	1730	311
	R1	R2			
	H	H	CCl_4	1743	312
			KBr	1720	313
	H	Me	CCl_4	1742	312
	H	Ph	CCl_4	1743	312
			KBr	1730	313
	Me	Me	CCl_4	1739	312
	Ph	Ph	–	1730	314
	Cl	Cl	–	1776	315

Table XII (continued)

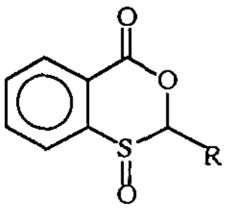
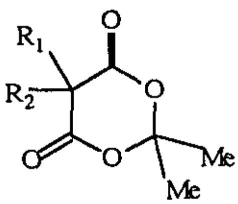
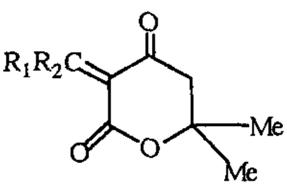
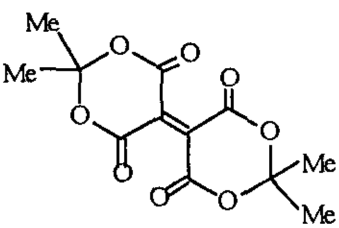
Compound			Phase	$\nu_{c=o}$	Ref.
		R			
		H	KBr	1723	313
		Me	KBr	1745	316
	R,R/S,S	Ph	KBr	1727	313
	R,S/S,R	Ph	KBr	1742	313
	R1	R2			
	H	H	$CHCl_3$	1787,1760	317
			CCl_4	1794,1770	318
			KBr	1789,1745	318
	H	Me	$CHCl_3$	1790,1755	319
	H	Ph	$CHCl_3$	1792,1754	320
	Me	Me	$CHCl_3$	1770,1735	321
			CCl_4	1787,1749	321
			mull	1780,1745	321
	Me	Ph	$CHCl_3$	1783,1745	322
	Bn	Ph	KBr	1777,1739	323
	Ph	Ph	KBr	1782,1744	323
	R1	R2			
	Me	H	CH_2Cl_2	1763,1738	324
	t-Bu	H	CCl_4	1770,1740	318
	Ph	H	KBr	1752,1720	318
	$-(CH_2)_4-$		$CHCl_3$	1786,1745	322
	$-(CH_2)_5-$		–	1755,1730	317
			mull	1770,1755	317

Table XIII **Ring Size: 6**
Heteroatoms: 1,4-

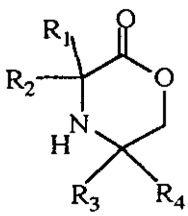
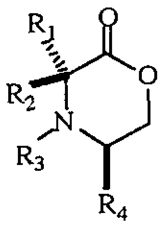
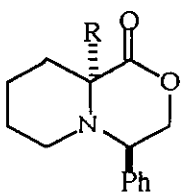
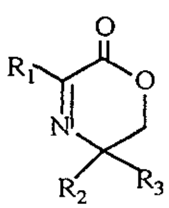
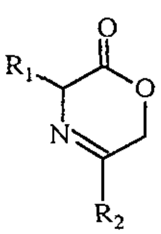
Compound					Phase	$\nu_{C=O}$	Ref.
	R1	R2	R3	R4			
	Me	Me	Me	Me	–	1720	325
	$-(CH_2)_5-$		Me	Me	–	1725	325
	R1	R2	R3	R4			
	H	H	Me	H	neat	1750	326
	H	Bn	Bn	Ph	mull	1730	327
	Me	Bn	Bn	Ph	$CHCl_3$	1738	327
	Bn	Bn	Bn	Ph	$CHCl_3$	1725	327
	R						
	H				neat	1735	328
	Me				neat	1737	328
	Bn				neat	1750	328
	R1	R2	R3				
	Me	H	Ph		KBr	1735	329
	Me	Me	Me		neat	1735	330
	Ph	Me	Me		neat	1740	330
	R1	R2					
	Me	Me			$CHCl_3$	1755	331
	Me	2-naphthyl			KBr	1747	332
	i-Pr	Ph			KBr	1738	332
	Ph	Ph			KBr	1735	332

Table XIII (continued)

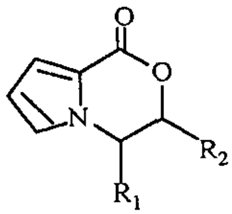
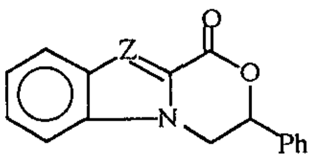
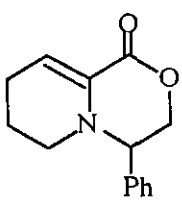
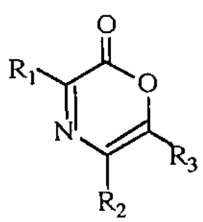
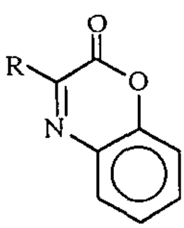
Compound				Phase	$\nu_{c=o}$	Ref.
		R1	R2			
		H	Me	CCl_4	1705	333
		H	*t*-Bu	CCl_4	1715	333
		H	Ph	CCl_4	1730	333
				KBr	1710	333,334
		$-(CH_2)_4-$		KBr	1740	333
	trans	$-(CH_2)_4-$		mull	1700	334
		Z				
		CH		KBr	1735	335
		N		KBr	1740	335
				neat	1731	328
	R1	R2	R3			
	Cl	Cl	H	KBr	1770	336
	Cl	Cl	Me	KBr	1760	336
	Cl	Cl	Bn	KBr	1755	336
	Cl	Cl	Ph	KBr	1770	336
	Br	Br	Me	KBr	1740	336
		R				
		H		KBr	1759,1740	337
		Me		$CHCl_3$	1752,1745	338
		Ph		$CHCl_3$	1740	338
		NH_2		mull	1790	339

Table XIII (continued)

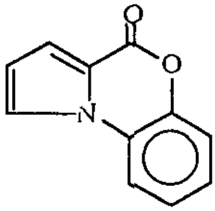
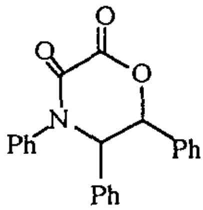
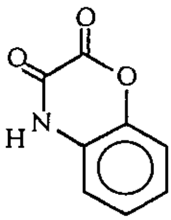
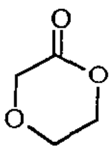
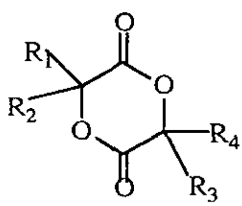
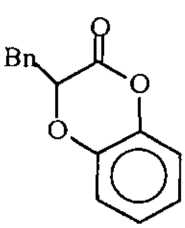
Compound					Phase	$\nu_{c=o}$	Ref.
					mull	1725	340
	*cis*				KBr	1745	341
	trans				KBr	1750	341
					–	1770,1700	342
					neat	1740	343
	R_1	R_2	R_3	R_4			
	Me	H	Me	H	mull	1750	344
	Me	Ph	Me	Ph	–	1750	345
	Ph	Ph	Ph	Ph	–	1750	345
					neat	1775	346

Table XIII (continued)

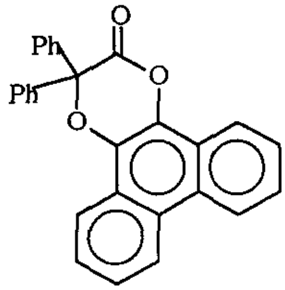
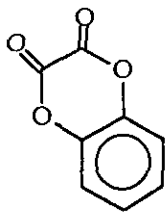
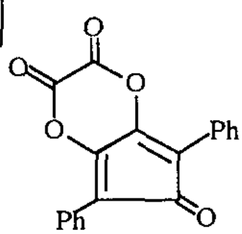
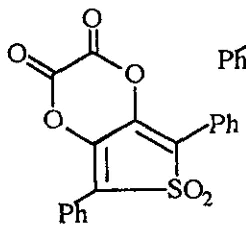
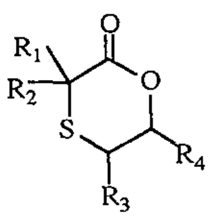
Compound		R_1	R_2	R_3	R_4	Phase	$\nu_{c=o}$	Ref.
						KBr	1783	347
						$CHCl_3$	1805,1790	348
						KBr	1820	349
						KBr	1830	349
		H	H	H	H	–	1740	350
		Me	H	H	H	neat	1735	351
		t-Bu	H	H	H	neat	1735	351
		H	H	Me	H	–	1740	350
		H	H	Ph	H	KBr	1727	352
		H	H	H	Me	neat	1735	352
		H	H	H	*t*-Bu	neat	1745	351
		H	H	H	vinyl	$CHCl_3$ CCl_4	1738 1765,1750	152 353
		H	H	H	Ph	KBr	1715	352
	cis	Me	H	H	Ph	KBr	1719	352
		Mc	Me	H	H	neat	1723	352
		Me	Me	H	Ph	KBr	1722	352
	trans	H	H	$-(CH_2)_4-$		neat	1723	351

Table XIII (continued)

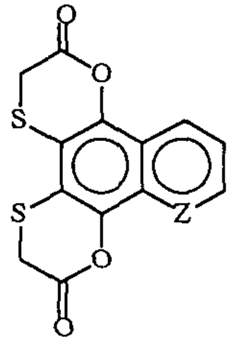
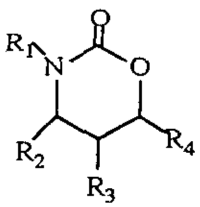
Compound		Phase	$\nu_{C=O}$	Ref.
	Z			
	CH	mull	1750	354
	N	mull	1760	354

Table XIV **Ring Size: 6**
Heteroatoms: 1,5-

Compound		R_1	R_2	R_3	R_4	Phase	$\nu_{C=O}$	Ref.
		H	H	H	H	neat	1692	355
						KBr	1699	144
	cis; trans	H	$-(CH_2)_5-$		H	KBr	1695	356
	cis; trans	H	H	$-(CH_2)_4-$		–	1690	357
	cis	H	H	$-(CH_2)_5-$		KBr	1690	356
	trans	H	H	$-(CH_2)_5-$		KBr	1700	356
		Ph	H	H	H	KBr	1680	358
		Ph	H	Me	H	KBr	1680	358
		Ph	H	H	Me	KBr	1685	358

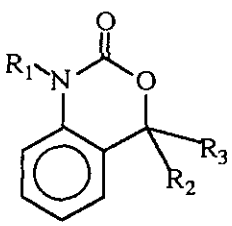
Compound	R_1	R_2	R_3	Phase	$\nu_{C=O}$	Ref.
	H	Ph	Ph	mull	1720	359
	H	Ph	MeO	mull	1720	359
	Me	$-(CH_2)_4-$		mull	1710	360
	Me	$-(CH_2)_5-$		mull	1690	360

Table XIV (continued)

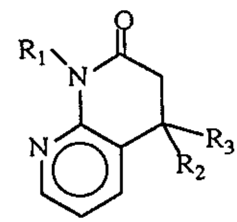
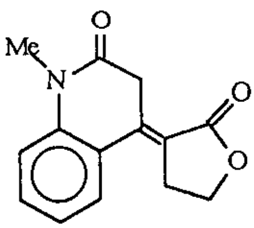
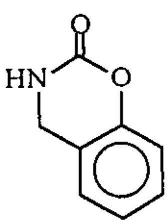
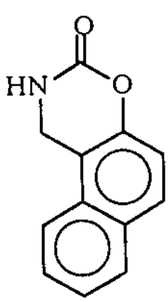
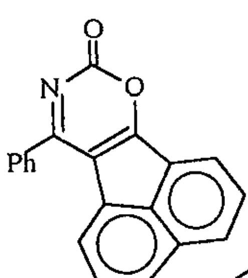
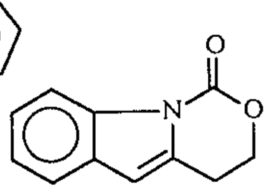
Compound			Phase	$\nu_{C=O}$	Ref.
	R_1	R_2 R_3			
	H	$-(CH_2)_4-$	mull	1740	360
	H	$-(CH_2)_5-$	mull	1720	360
	Me	$-(CH_2)_4-$	mull	1725	360
	*Z*		mull	1760,1695	361
	E		mull	1760,1710	361
			KBr	1724	362
			KBr	1745	363
			KBr	1735	364
			–	1735	365

Table XIV (continued)

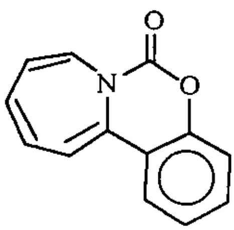
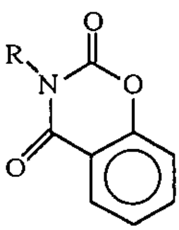
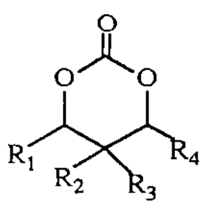
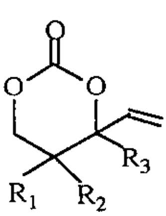
Compound						Phase	$\nu_{C=O}$	Ref.
						–	1760,1720	366
		R						
		H				pyr	1770	367
		Et				–	1763	368
		Bn				–	1770	368
		Ph				$CHCl_3$	1770	367
						mull	1760	369
		Bz				–	1784	368
		OH				KBr	1785	367
		R_1	R_2	R_3	R_4			
		H	H	H	H	neat	1747	144
						$CHCl_3$	1779,1753	180
						CCl_4	1776,1768	180
	cis	Me	H	H	Me	$CHCl_3$	1742	370
	trans	Me	H	H	Me	$CHCl_3$	1752,1737	370
		H	Me	Me	H	$CHCl_3$	1749	370
		R_1	R_2	R_3				
		H	H	H		neat	1740	371
		H	H	Me		neat	1740	371
		$-(CH_2)_5-$		H		neat	1745	371

Table XIV (continued)

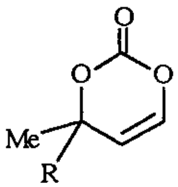
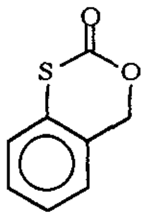
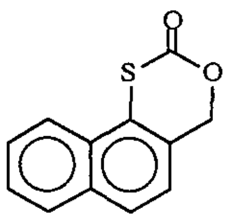
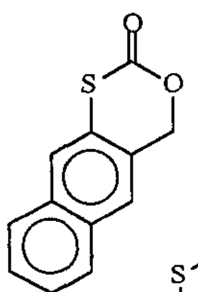
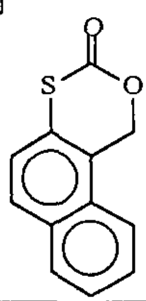
Compound		Phase	$\nu_{C=O}$	Ref.
	R			
	H	neat	1755	372
	Me	CH_2Cl_2	1800	372
		KBr	1695,1680	373
		KBr	1700	373
		KBr	1700	373
		KBr	1685	373

Table XV Ring Size: 6
Heteroatoms: 1,2,4-

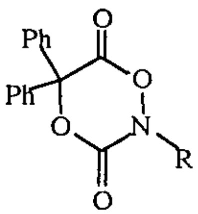
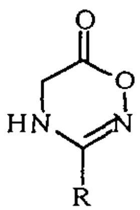
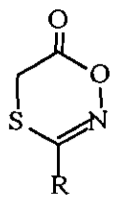
Compound		Phase	$\nu_{C=O}$	Ref.
	R			
	i-Pr	KBr	1790,1745	374
	c-C_6H_{11}	KBr	1800,1740	374
	R			
	Bn	KBr	1775	375
	Ph	KBr	1776	375
	R			
	Ph	KBr	1750	376
	2-thienyl	KBr	1745	376
	3-thienyl	KBr	1775	376

Table XVI **Ring Size:** **6**
Heteroatoms: **1,2,5-**

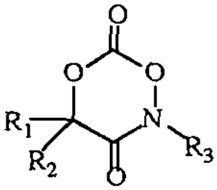
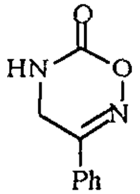
Compound	R_1	R_2	R_3	Phase	$\nu_{C=O}$	Ref.
	Me	Ph	Me	KBr	1820,1700	177
	Ph	Ph	Me	KBr	1805,1700	177
	–(CH_2)$_5$–		Me	KBr	1800,1700	177
	Me	Me	Bn	KBr	1800,1700	177
				KBr	1750	377

Table XVII **Ring Size:** **6**
Heteroatoms: **1,3,4-**

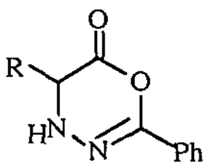
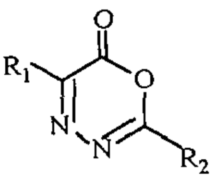
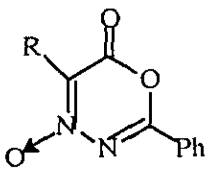
Compound	R / R_1	R_2	Phase	$\nu_{C=O}$	Ref.
	R				
	Me		mull	1785	378
	Ph		KBr	1795	378
	R_1	R_2			
	Me	Ph	KBr	1695	379
	Ph	Me	KBr	1763	379
	Ph	Bn	KBr	1760	379
	Ph	Ph	KBr	1750	380
	Ph	4-pyridyl	–	1765	381
	R				
	Me		KBr	1755	382
	Ph		KBr	1755	382

Table XVIII Ring Size: 6

Heteroatoms: 1,3,5-; 1,4,5-; 1,2,4,5-

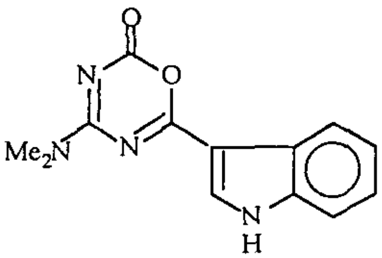
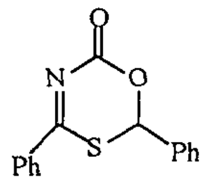
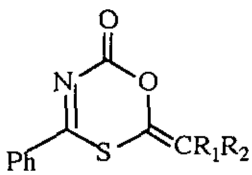
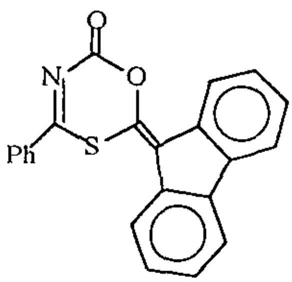
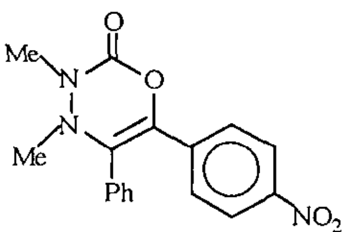
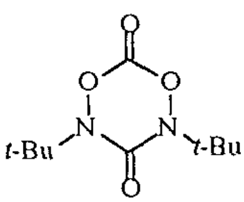
Compound		Phase	$\nu_{C=O}$	Ref.
		KBr	1750,1735	383
		$CHCl_3$	1720	384
	R_1 / R_2			
	Ph / Ph	$CHCl_3$	1740	385
	Ph / 1-naphthyl	CCl_4	1750	385
		$CHCl_3$	1735	385
		KBr	1740	386
		neat	1810,1740	387

Table XIX **Ring Size:** **7**

Heteroatoms: **1,2-; 1,4-; 1,5-; 1,6-**

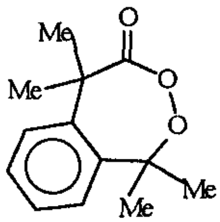
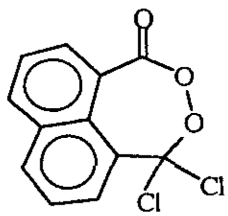
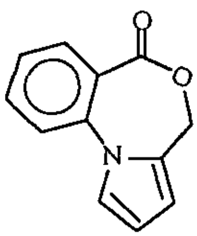
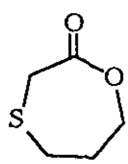
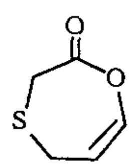
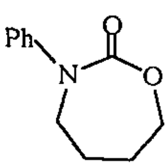
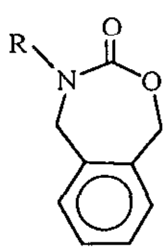
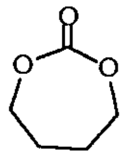
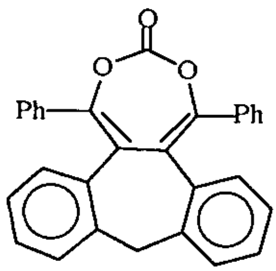
Compound		Phase	$\nu_{C=O}$	Ref.
		–	1750	388
		CCl_4	1730	389
		mull	1715	390
		–	1710	391
		–	1725	350
		neat	1760	353
		$CHCl_3$	1700	392
	R			
	H	mull	1700,1670	393
	Me	mull	1665	393
	Ph	mull	1660	393

Table XIX (continued)

Compound	Phase	$\nu_{C=O}$	Ref.
	–	1730,1718	185
	–	1800,1680	394

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