

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*-C₆H₁₁, cyclohexyl; E, ester (CO₂Me or CO₂Et); 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 ($\nu_{\text{C=O}}$) 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-

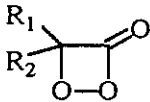
Compound		Phase	$\nu_{C=O}$	Ref.
	R_1 — R_2			
	H <i>t</i> -Bu	CCl ₄	1875	4
	H 1-Ad	CCl ₄	1875	5
	Me Me	CCl ₃ F	1870	6
	Ph Ph	CCl ₃ F	1870	6

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

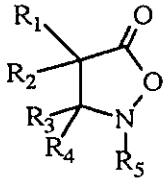
Compound		Phase	$\nu_{C=O}$	Ref.
	R_1 R_2 R_3 R_4 R_5			
	H H H H Me	neat	1760	7
	H H H H Bn	neat	1765	7
	H H H H <i>t</i> -Bu	neat	1760	7
	H H H Me Me	—	1788,1773	8
	H H H Ph Me	neat	1795,1776	9
	H H Me Ph Me	KBr	1789,1773	10
	H H Ph Ph Me	KBr	1782	10
	H Me H H Bn	CHCl ₃	1770	7
	H H H Me Bn	CHCl ₃	1760	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	1777,1768	9
		KBr	1786,1772	9
	Me Me H Ph c-C ₆ H ₁₁	KBr	1778	11

Table II (continued)

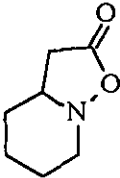
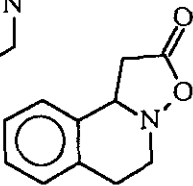
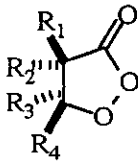
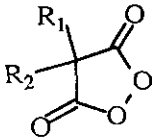
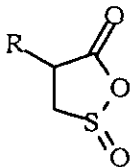
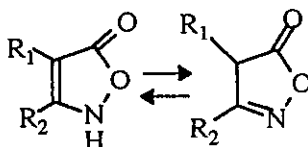
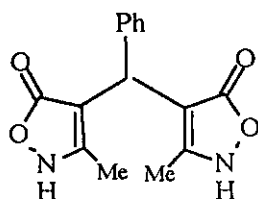
Compound	Phase	$\nu_{C=O}$	Ref.																																																																																														
	neat	1785	12																																																																																														
	neat	1799,1789	9																																																																																														
	<table><tr><th>R_1</th><th>R_2</th><th>R_3</th><th>R_4</th></tr><tr><td>H</td><td>H</td><td>Me</td><td>Me</td></tr><tr><td>H</td><td>H</td><td>Me</td><td>Ph</td></tr><tr><td>Me</td><td>Me</td><td>H</td><td>H</td></tr><tr><td>Me</td><td>Me</td><td>Me</td><td>Me</td></tr><tr><td>Me</td><td>Me</td><td>Me</td><td>OH</td></tr><tr><td>Me</td><td>Me</td><td>Me</td><td>OOH</td></tr><tr><td>Ph</td><td>Me</td><td>Me</td><td>Ph</td></tr><tr><td>Ph</td><td>Me</td><td>Me</td><td>Bn</td></tr><tr><td>Ph</td><td>Me</td><td>H</td><td>Bn</td></tr><tr><td colspan="2">$-(CH_2)_5-$</td><td>$-(CH_2)_5-$</td><td></td></tr><tr><td colspan="2">$-(CH_2)_6-$</td><td>$-(CH_2)_6-$</td><td></td></tr><tr><td>Me</td><td>$-(CH_2)_3-$</td><td>OH</td><td></td></tr><tr><td>Me</td><td>$-(CH_2)_3-$</td><td>OOH</td><td></td></tr></table>	R_1	R_2	R_3	R_4	H	H	Me	Me	H	H	Me	Ph	Me	Me	H	H	Me	Me	Me	Me	Me	Me	Me	OH	Me	Me	Me	OOH	Ph	Me	Me	Ph	Ph	Me	Me	Bn	Ph	Me	H	Bn	$-(CH_2)_5-$		$-(CH_2)_5-$		$-(CH_2)_6-$		$-(CH_2)_6-$		Me	$-(CH_2)_3-$	OH		Me	$-(CH_2)_3-$	OOH		<table><tr><td>CCl₄</td><td>1806</td><td>13</td></tr><tr><td>CCl₄</td><td>1810</td><td>14</td></tr><tr><td>CCl₄</td><td>1806</td><td>13</td></tr><tr><td>CCl₄</td><td>1795</td><td>15</td></tr><tr><td>CHCl₃</td><td>1795</td><td>16</td></tr><tr><td>CHCl₃</td><td>1795</td><td>16</td></tr><tr><td>CCl₄</td><td>1800</td><td>15</td></tr><tr><td>CCl₄</td><td>1795</td><td>15</td></tr><tr><td>CCl₄</td><td>1795</td><td>15</td></tr><tr><td>CCl₄</td><td>1780</td><td>17</td></tr><tr><td>CCl₄</td><td>1782</td><td>17</td></tr><tr><td>CHCl₃</td><td>1785</td><td>16</td></tr><tr><td>CHCl₃</td><td>1790</td><td>16</td></tr></table>	CCl ₄	1806	13	CCl ₄	1810	14	CCl ₄	1806	13	CCl ₄	1795	15	CHCl ₃	1795	16	CHCl ₃	1795	16	CCl ₄	1800	15	CCl ₄	1795	15	CCl ₄	1795	15	CCl ₄	1780	17	CCl ₄	1782	17	CHCl ₃	1785	16	CHCl ₃	1790	16
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	<table><tr><th>R</th></tr><tr><td>H</td></tr><tr><td>Ph</td></tr></table>	R	H	Ph	<table><tr><td>—</td><td>1700</td><td>20</td></tr><tr><td>—</td><td>1810</td><td>21</td></tr></table>	—	1700	20	—	1810	21																																																																																						
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Table III Ring Size: 5 (unsaturated)
Heteroatoms: 1,2-

Compound			Phase	$\nu_{C=O}$	Ref.	
	<u>R₁</u>	<u>R₂</u>	<u>tautomer</u>			
	H	H	C-H	CHCl ₃	1804	22
	H	Me	C-H	neat	1795	23
			C-H	CHCl ₃	1797	23
	H	<i>t</i> -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
<i>p</i> -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	<i>t</i> -Bu		C-H	KBr	1795	30
			N-H	KBr	1690	30
Me	Ph		C-H	C ₂ Cl 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)

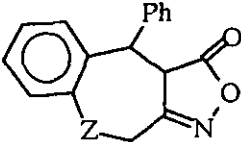
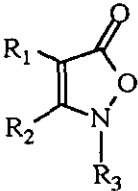
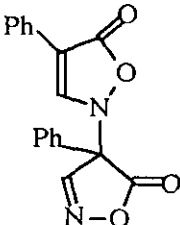
Compound				Phase	$\nu_{C=O}$	Ref.
	Z					
	CH ₂	C-H		KBr	1705,1690	36
	O	C-H		KBr	1700,1685	36
	R ₁	R ₂	R ₃			
	H	H	Me	NaCl	1725	37
	H	H	allyl	NaCl	1730	37
	Me	H	Me	CHCl ₃	1723	23
	Ph	H	Me	-	1734,1701	35
	allyl	H	allyl	NaCl	1730	37
	NO ₂	H	Me	mull	1775	38
	Ph	H	Ph	-	1711	35
	E	H	Ph	-	1751,1734	35
	E	H	c-C ₆ H ₁₁	mull	1757	39
	Me	Me	Me	CHCl ₃	1741,1725	25
				CCl ₄	1754	29
	Me	Ph	Me	CHCl ₃	1739,1725	25
				C ₂ Cl ₄	1760	25
	Ph	Ph	Me	KBr	1762	31
	Ph	Ph	<i>t</i> -Br	KBr	1725	40
	Ph	Ph	Ph	CHCl ₃	1741	41
				KBr	1720	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)

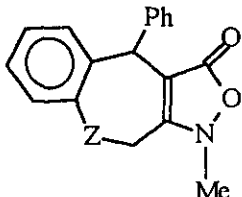
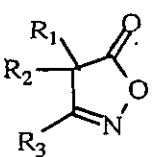
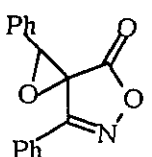
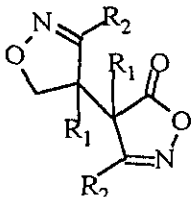
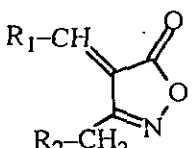
Compound		Phase	$\nu_{C=O}$	Ref.
	$\begin{matrix} Z \\ CH_2 \\ O \end{matrix}$	$\begin{matrix} KBr \\ KBr \end{matrix}$	$\begin{matrix} 1735 \\ 1730 \end{matrix}$	$\begin{matrix} 36 \\ 36 \end{matrix}$
	$\begin{matrix} R_1 & R_2 & R_3 \\ Me & Me & Me \end{matrix}$	$\begin{matrix} neat \\ CHCl_3 \\ CCl_4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

Table III (continued)

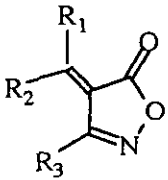
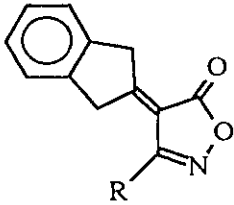
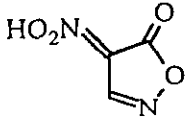
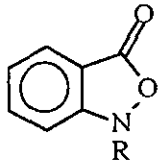
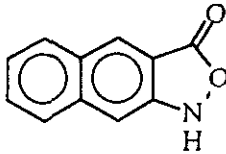
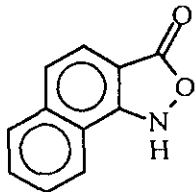
Compound	Phase	$\nu_{\text{C=O}}$	Ref.
	R_1 R_2 R_3 2-thienyl H Ph 3-thienyl H Ph 3-furyl H Ph Me Me Me Me Me Ph $-(CH_2)_4-$ Me $-(CH_2)_4-$ Ph	CHCl ₃ 1740 KBr 1724 KBr 1714 KBr 1738 KBr 1755 KBr 1750 KBr 1760 KBr 1760	48 27 27 27 31 31 31 31
	R Me Ph	DMSO- <i>d</i> ₆ 1720 DMSO- <i>d</i> ₆ 1730 CDCl ₃ 1705,1685	31 31 31
		mull 1700	38
	R H CH ₂ OH	CHCl ₃ 1773,1751 CH ₂ Cl ₂ 1770,1750 CH ₂ Cl ₂ 1765	49 50 50
		CCl ₄ 1780	51
		CHCl ₃ 1758	51

Table III (continued)

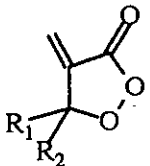
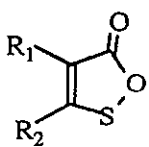
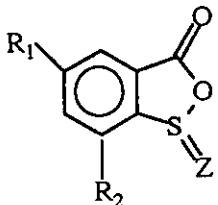
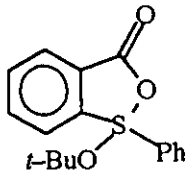
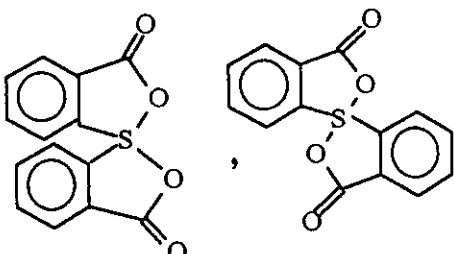
Compound		Phase	$\nu_{C=O}$	Ref.
	$\begin{array}{cc} R_1 & R_2 \\ H & Me \\ Me & Me \end{array}$	neat neat	1790 1780	52 53
	$\begin{array}{cc} R_1 & R_2 \\ CO_2H & Me \\ CO_2H & Ph \end{array}$	KBr KBr	1757,1730,1661 1786,1675	54 54
	$\begin{array}{ccc} R_1 & R_2 & Z \\ H & E & - \\ H & E & O \\ t-Bu & t-Bu & - \\ t-Bu & t-Bu & O \end{array}$	KBr KBr KBr CHCl ₃ KBr	1750 1790 1752 1740 1792	55 55 56 56 56
		CHCl ₃	1640	57
		-	1745	58

Table III (continued)

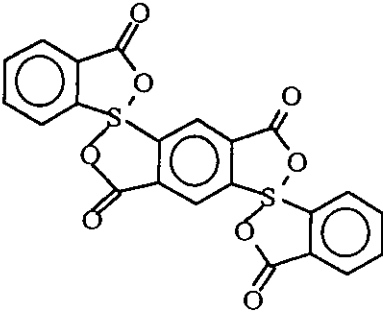
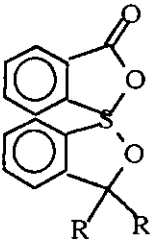
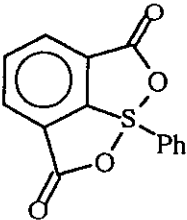
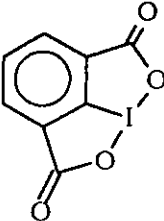
Compound	Phase	$\nu_{C=O}$	Ref.
	KBr	1735	59
	<u>R</u>		
Me	—	1647	60
CF ₃	—	1708	60
	CH ₂ Cl ₂	1722	61
	DMSO	1686	61

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

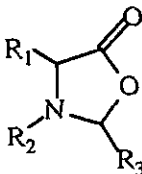
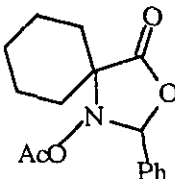
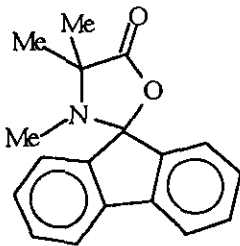
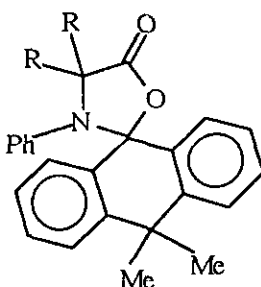
Compound		Phase	$\nu_{C=O}$	Ref.																																															
	<table><tr><th>R_1</th><th>R_2</th><th>R_3</th></tr><tr><td>Me</td><td>Ms</td><td>H</td></tr><tr><td>Bn</td><td>Ms</td><td>H</td></tr><tr><td>Ph</td><td>Ms</td><td>H</td></tr><tr><td>H</td><td>Bz</td><td><i>t</i>-Bu</td></tr><tr><td><i>cis</i> Me</td><td>Ms</td><td>Me</td></tr><tr><td><i>cis</i> Bn</td><td>Ms</td><td>Me</td></tr><tr><td>H</td><td>NO</td><td>Ph</td></tr></table>	R_1	R_2	R_3	Me	Ms	H	Bn	Ms	H	Ph	Ms	H	H	Bz	<i>t</i> -Bu	<i>cis</i> Me	Ms	Me	<i>cis</i> Bn	Ms	Me	H	NO	Ph	<table><tr><td>CHCl₃</td><td>1814</td></tr><tr><td>CCl₄</td><td>1810</td></tr><tr><td>CHCl₃</td><td>1817</td></tr><tr><td>KBr</td><td>1790</td></tr><tr><td>KBr</td><td>1800</td></tr><tr><td>CHCl₃</td><td>1792</td></tr><tr><td>CHCl₃</td><td>1790</td></tr><tr><td>CHCl₃</td><td>1820</td></tr></table>	CHCl ₃	1814	CCl ₄	1810	CHCl ₃	1817	KBr	1790	KBr	1800	CHCl ₃	1792	CHCl ₃	1790	CHCl ₃	1820	<table><tr><td>62</td></tr><tr><td>62</td></tr><tr><td>62</td></tr><tr><td>62</td></tr><tr><td>63</td></tr><tr><td>62</td></tr><tr><td>62</td></tr><tr><td>64</td></tr></table>	62	62	62	62	63	62	62	64
R_1	R_2	R_3																																																	
Me	Ms	H																																																	
Bn	Ms	H																																																	
Ph	Ms	H																																																	
H	Bz	<i>t</i> -Bu																																																	
<i>cis</i> Me	Ms	Me																																																	
<i>cis</i> Bn	Ms	Me																																																	
H	NO	Ph																																																	
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KBr	1800																																																		
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64																																																			
		KBr	1775	65																																															
		KBr	1782	66																																															
	<table><tr><th>R</th></tr><tr><td>Me</td></tr><tr><td>Ph</td></tr></table>	R	Me	Ph	<table><tr><td>CHCl₃</td><td>1780</td></tr><tr><td>CHCl₃</td><td>1775</td></tr></table>	CHCl ₃	1780	CHCl ₃	1775	<table><tr><td>67</td></tr><tr><td>67</td></tr></table>	67	67																																							
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Me																																																			
Ph																																																			
CHCl ₃	1780																																																		
CHCl ₃	1775																																																		
67																																																			
67																																																			

Table IV (continued)

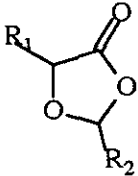
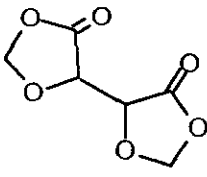
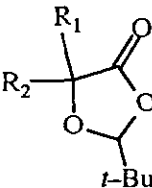
Compound		Phase	$\nu_{C=O}$	Ref.
	R_1 — R_2			
	Me H	CCl ₄	1819	62
	Bn H	CCl ₄	1811	62
	Ph H	CCl ₄	1823	62
	H Ph	neat	1811	68
	Ph Ph	KBr	1790	69
	<i>cis</i> Me <i>t</i> -Bu	CHCl ₃	1795	70
		CDCl ₃	1801	71
	<i>trans</i> Me <i>t</i> -Bu	CDCl ₃	1801	71
		CCl ₄	1810	62
	<i>cis</i> Bn <i>t</i> -Bu	KBr	1785	70
	<i>cis</i> Ph <i>t</i> -Bu	KBr	1800	70
		CCl ₄	1810	62
	<i>trans</i> Ph <i>t</i> -Bu	neat	1800	72
		KBr	1801	62
		CCl ₄	1810	62
		mull	1795	73
	R_1 — R_2			
	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)

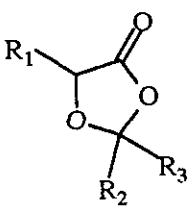
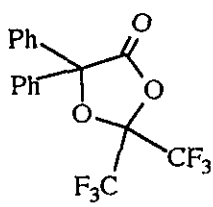
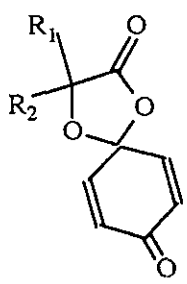
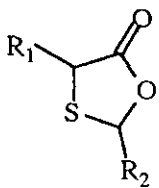
Compound		Phase	$\nu_{C=O}$	Ref.
	<u>R₁</u> <u>R₂</u> <u>R₃</u>			
	Me Me Me	CCl ₄	1808	62
	Bn Me Me	CCl ₄	1807	62
		KBr	1790	62
	Ph Me Me	CCl ₄	1809	62
	Me <i>trans</i> Me <i>t</i> -Bu	KBr	1790	74
	Me <i>trans</i> Me Ph	KBr	1785	74
	H -(CH ₂) ₅ -	neat	1807,1796	68
		CH ₂ Cl ₂	1795	75
	Me -(CH ₂) ₅ -	NaCl	1800	69
	Ph -(CH ₂) ₅ -	KBr	1805	69
			1830	76
	<u>R₁</u> <u>R₂</u>			
	Me H	CDCl ₃	1800	77
	Me Me	CDCl ₃	1790	77
	-(CH ₂) ₅ -	KBr	1790	77
	<u>R₁</u> <u>R₂</u>			
	H H	neat	1771,1730	78
	H Me	neat	1774,1752	78
	H <i>t</i> -Bu	neat	1776,1697	78
	H Ph	KBr	1780,1730	63
	Me H	neat	1817,1768	78

Table IV (continued)

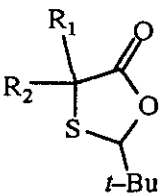
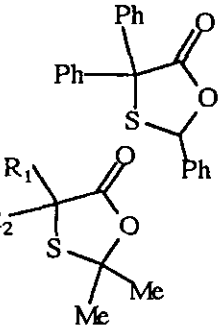
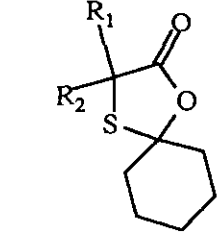
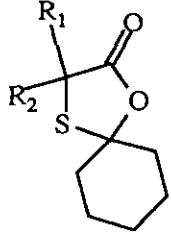
Compound		Phase	$\nu_{C=O}$	Ref.
	R_1 — R_2			
	Me Me	neat	1769	78
	Me Ph	KBr	1765	79
	Ph Me	KBr	1770	79
	Ph Ph	KBr	1765	79
	R_1 — R_2			
	<i>cis</i> Me H	CHCl ₃	1755	70
		CDCl ₃	1774	71
	<i>trans</i> Me H	CDCl ₃	1768	71
	<i>cis</i> Bn H	KBr	1760	80
	<i>cis</i> Ph H	KBr	1765	80
	Me Ph	—	1765	80
	Me Bn	—	1765	80
	Me allyl	CHCl ₃	1750	70
		C ₄ Cl ₆	1755	81
	R_1 — R_2			
	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
	R_1 — R_2			
	H H	neat	1772	84
	Me H	CCl ₄	1759	85
		NaCl	1760	79
	Ph H	KBr	1770	79
	Ph Ph	C ₄ Cl ₆	1755	81

Table V (continued)

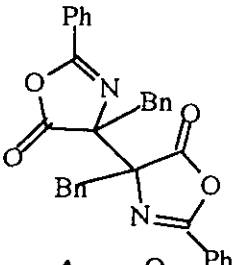
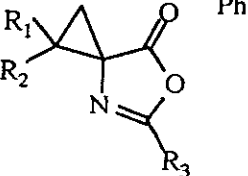
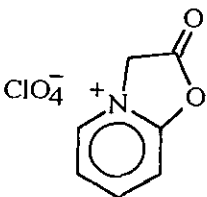
Compound				Phase	$\nu_{C=O}$	Ref.
	<u>R₁</u>	<u>R₂</u>	<u>R₃</u>			
	Et	Ph	Me	neat	1820	87
	allyl	Ph	Me	neat	1822	87
	Bn	Ph	Me	neat	1820	87
	Me	Me	Ph	KBr	1821	101
				KBr	1825	108
				mull	1820	109
	Me	Bn	Ph	neat	1816	110
				CCl ₄	1825	103
	Me	Ph	Ph	KBr	1819	110
				mull	1830,1820	109
	allyl	Ph	Ph	CHCl ₃	1818	111
	Bn	Ph	Ph	mull	1810,1790	109
				-	1839	112
	<u>R₁</u>	<u>R₂</u>	<u>R₃</u>			
	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)

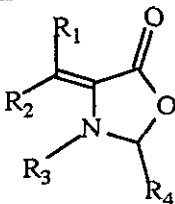
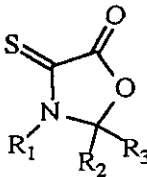
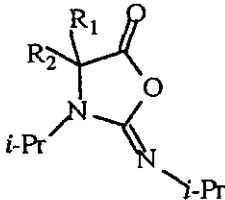
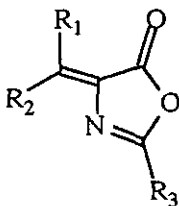
Compound		Phase	$\nu_{C=O}$	Ref.
	R_1 R_2 R_3 R_4 H H Bz <i>t</i> -Bu H H Bz Ph Me Me Me CF ₃ Ph H Me CF ₃	CHCl ₃ – – CCl ₄	1790 1791 1790 1815	116 117 118 119
	R_1 R_2 R_3 Me H Me Me H Ph Ph H Ph Me Me Me Ph Me Me Me $-(CH_2)_5-$	KBr KBr KBr KBr KBr KBr	1800 1795 1810 1800 1795 1795	120 120 120 120 120 120
	R_1 R_2 H H Me H Me Me	– – –	1795 1790 1785	121 121 121
	R_1 R_2 R_3 H Ph Me H 2-thienyl Me H 3-thienyl Me H Ph Ph H 2-thienyl Ph H 3-thienyl Ph H MeS Ph H BnS Ph Ph H Ph 2-thienyl H Ph 3-thienyl H Ph 1-naphthyl H Ph Me Ph Me	CHCl ₃ mull mull mull CHCl ₃ mull mull mull mull CHCl ₃ mull mull mull CHCl ₃ KBr mull	1810,1780 1800,1770 1800,1770 1770 1780,1760 1790,1770 1790,1770 1795,1760 1780 1780 1780,1760 1780,1760 1790,1765 1810 1775 1790,1760 1770	122 123 124 124 122 123 124 124 125 125 126 122 124 124 127 113 114

Table V (continued)

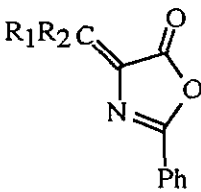
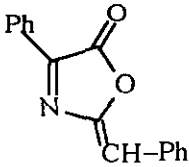
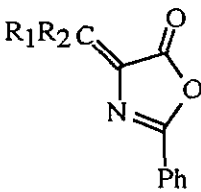
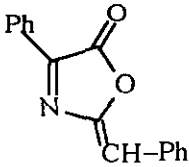
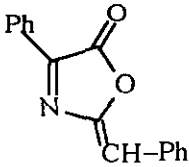
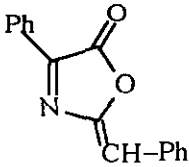
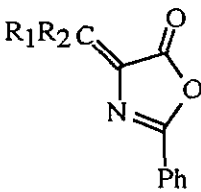
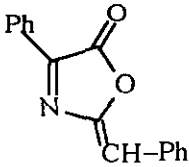
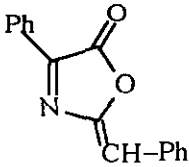
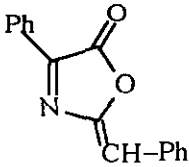
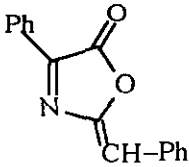
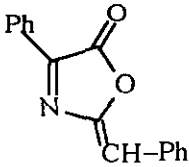
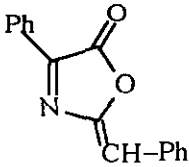
Compound	Phase	$\nu_{C=O}$	Ref.				
R_1 R_2 R_3 Me Me Ph Me Ph Ph Ph Me Ph Ph Ph Ph H Ph BnO -(CH₂)₅- Ph -(CH₂)₆- Ph Ac Me Ph Bz Me Ph CCl₄ KBr mull CHCl₃ KBr mull CHCl₃ - mull CHCl₃ KBr mull mull 1802 1780,1760 1790,1760 1770 1800,1785 1775 1794,1766 1820,1795 1780,1750 1782,1756 1782,1765 1795 1795 128 113 123 127 113 114 129 130 123 131 131 132 132 <tr><td>  <tr><td> R_1 R_2 Me Bn H 4-pyridyl CHCl₃ mull 1790,1760 1810 133 134 <tr><td>  <tr><td> CHCl₃ KBr 1783 1780 135 135 <tr><td>  <tr><td> - 1815,1735 136 <tr><td> - 1840,1800,1720 136 </td></tr></td></tr></td></tr></td></tr></td></tr></td></tr></td></tr>	 <tr><td> R_1 R_2 Me Bn H 4-pyridyl CHCl₃ mull 1790,1760 1810 133 134 <tr><td>  <tr><td> CHCl₃ KBr 1783 1780 135 135 <tr><td>  <tr><td> - 1815,1735 136 <tr><td> - 1840,1800,1720 136 </td></tr></td></tr></td></tr></td></tr></td></tr></td></tr>	R_1 R_2 Me Bn H 4-pyridyl CHCl₃ mull 1790,1760 1810 133 134 <tr><td>  <tr><td> CHCl₃ KBr 1783 1780 135 135 <tr><td>  <tr><td> - 1815,1735 136 <tr><td> - 1840,1800,1720 136 </td></tr></td></tr></td></tr></td></tr></td></tr>	 <tr><td> CHCl₃ KBr 1783 1780 135 135 <tr><td>  <tr><td> - 1815,1735 136 <tr><td> - 1840,1800,1720 136 </td></tr></td></tr></td></tr></td></tr>	CHCl₃ KBr 1783 1780 135 135 <tr><td>  <tr><td> - 1815,1735 136 <tr><td> - 1840,1800,1720 136 </td></tr></td></tr></td></tr>	 <tr><td> - 1815,1735 136 <tr><td> - 1840,1800,1720 136 </td></tr></td></tr>	- 1815,1735 136 <tr><td> - 1840,1800,1720 136 </td></tr>	- 1840,1800,1720 136
 <tr><td> R_1 R_2 Me Bn H 4-pyridyl CHCl₃ mull 1790,1760 1810 133 134 <tr><td>  <tr><td> CHCl₃ KBr 1783 1780 135 135 <tr><td>  <tr><td> - 1815,1735 136 <tr><td> - 1840,1800,1720 136 </td></tr></td></tr></td></tr></td></tr></td></tr></td></tr>	R_1 R_2 Me Bn H 4-pyridyl CHCl₃ mull 1790,1760 1810 133 134 <tr><td>  <tr><td> CHCl₃ KBr 1783 1780 135 135 <tr><td>  <tr><td> - 1815,1735 136 <tr><td> - 1840,1800,1720 136 </td></tr></td></tr></td></tr></td></tr></td></tr>	 <tr><td> CHCl₃ KBr 1783 1780 135 135 <tr><td>  <tr><td> - 1815,1735 136 <tr><td> - 1840,1800,1720 136 </td></tr></td></tr></td></tr></td></tr>	CHCl₃ KBr 1783 1780 135 135 <tr><td>  <tr><td> - 1815,1735 136 <tr><td> - 1840,1800,1720 136 </td></tr></td></tr></td></tr>	 <tr><td> - 1815,1735 136 <tr><td> - 1840,1800,1720 136 </td></tr></td></tr>	- 1815,1735 136 <tr><td> - 1840,1800,1720 136 </td></tr>	- 1840,1800,1720 136	
R_1 R_2 Me Bn H 4-pyridyl CHCl₃ mull 1790,1760 1810 133 134 <tr><td>  <tr><td> CHCl₃ KBr 1783 1780 135 135 <tr><td>  <tr><td> - 1815,1735 136 <tr><td> - 1840,1800,1720 136 </td></tr></td></tr></td></tr></td></tr></td></tr>	 <tr><td> CHCl₃ KBr 1783 1780 135 135 <tr><td>  <tr><td> - 1815,1735 136 <tr><td> - 1840,1800,1720 136 </td></tr></td></tr></td></tr></td></tr>	CHCl₃ KBr 1783 1780 135 135 <tr><td>  <tr><td> - 1815,1735 136 <tr><td> - 1840,1800,1720 136 </td></tr></td></tr></td></tr>	 <tr><td> - 1815,1735 136 <tr><td> - 1840,1800,1720 136 </td></tr></td></tr>	- 1815,1735 136 <tr><td> - 1840,1800,1720 136 </td></tr>	- 1840,1800,1720 136		
 <tr><td> CHCl₃ KBr 1783 1780 135 135 <tr><td>  <tr><td> - 1815,1735 136 <tr><td> - 1840,1800,1720 136 </td></tr></td></tr></td></tr></td></tr>	CHCl₃ KBr 1783 1780 135 135 <tr><td>  <tr><td> - 1815,1735 136 <tr><td> - 1840,1800,1720 136 </td></tr></td></tr></td></tr>	 <tr><td> - 1815,1735 136 <tr><td> - 1840,1800,1720 136 </td></tr></td></tr>	- 1815,1735 136 <tr><td> - 1840,1800,1720 136 </td></tr>	- 1840,1800,1720 136			
CHCl₃ KBr 1783 1780 135 135 <tr><td>  <tr><td> - 1815,1735 136 <tr><td> - 1840,1800,1720 136 </td></tr></td></tr></td></tr>	 <tr><td> - 1815,1735 136 <tr><td> - 1840,1800,1720 136 </td></tr></td></tr>	- 1815,1735 136 <tr><td> - 1840,1800,1720 136 </td></tr>	- 1840,1800,1720 136				
 <tr><td> - 1815,1735 136 <tr><td> - 1840,1800,1720 136 </td></tr></td></tr>	- 1815,1735 136 <tr><td> - 1840,1800,1720 136 </td></tr>	- 1840,1800,1720 136					
- 1815,1735 136 <tr><td> - 1840,1800,1720 136 </td></tr>	- 1840,1800,1720 136						
- 1840,1800,1720 136							

Table V (continued)

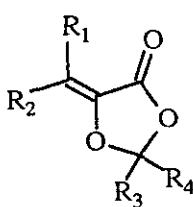
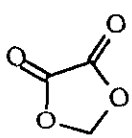
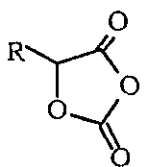
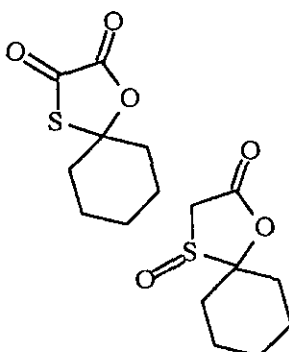
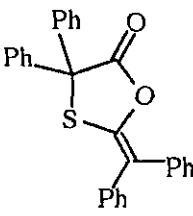
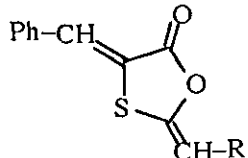
Compound		Phase	$\nu_{C=O}$	Ref.
	R_1 H H H H R_2 H Me Ph R_3 H H H H R_4 <i>t</i> -Bu $-(CH_2)_5-$ $-(CH_2)_5-$ $-(CH_2)_5-$	CHCl ₃ CH ₂ Cl ₂ CH ₂ Cl ₂ CH ₂ Cl ₂	1795 1795 1780 1780	116 75 75 75
		CHCl ₃ KBr	1845,1812 1845,1792	137 137
	R Me Ph	KBr KBr	1890,1820 1900,1820	138 138
		— KBr	1782,1700 1780	84 84
		KBr	1788	139
	R H Me	KBr KBr	1775 1772	140 140

Table VI (continued)

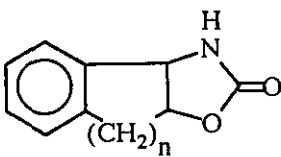
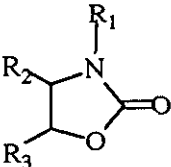
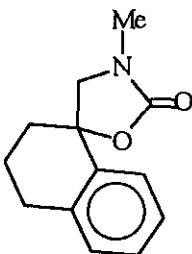
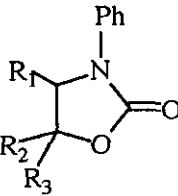
Compound		Phase	$\nu_{C=O}$	Ref.
	n			
	<i>cis</i> 1	KBr	1760,1715	147
	<i>cis</i> 2	KBr	1730	147
	R_1	R_2	R_3	
	SiMe ₃	H	H	KBr 1750 160
	Me	H	H	CHCl ₃ 1746 142
	Me	H	Me	neat 1740 161,162
	Me	H	Ph	- 1730 163
	<i>cis</i> Me	Ph	Ph	KBr 1762,1739 164
	<i>cis</i> Me	-(CH ₂) ₄ -		neat 1745 147
				NaCl 1751 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
	<i>cis</i> Me	Me	H	- 1740 169
	<i>trans</i> Me	Me	H	- 1730 169
	<i>cis</i> Ph	Ph	H	KBr 1730 170
	H	Me	Me	KBr 1740 161
	-(CH ₂) ₄ -	H		KBr 1740 161

Table VI (continued)

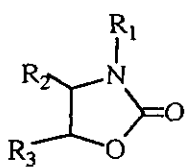
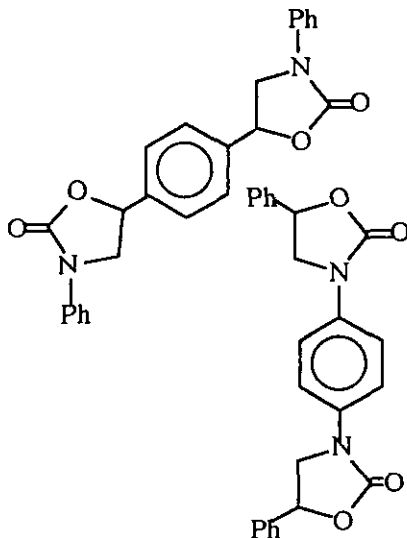
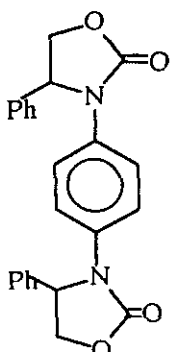
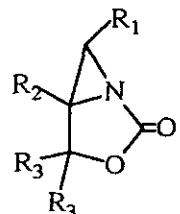
Compound	Phase	$\nu_{C=O}$	Ref.															
	<table><tr><th>R_1</th><th>R_2</th><th>R_3</th></tr><tr><td>Ac</td><td>H</td><td>H</td></tr><tr><td><i>cis</i> Ac</td><td>$-(CH_2)_2-$</td><td></td></tr><tr><td><i>cis</i> Bz</td><td>$-(CH_2)_4-$</td><td></td></tr></table>	R_1	R_2	R_3	Ac	H	H	<i>cis</i>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

Table VI (continued)

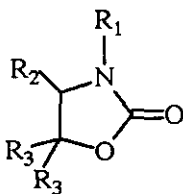
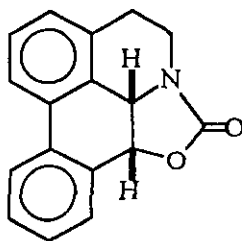
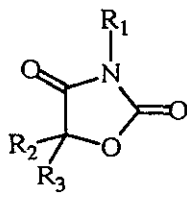
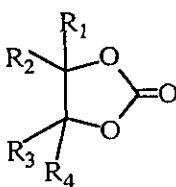
Compound	Phase	$\nu_{C=O}$	Ref.																																																									
	<table><tr><th>R₁</th><th>R₂</th><th>R₃</th></tr><tr><td>-(CH₂)₃-</td><td>Ph</td><td></td></tr><tr><td>-(CH₂)₄-</td><td>H</td><td></td></tr></table>	R ₁	R ₂	R ₃	-(CH ₂) ₃ -	Ph		-(CH ₂) ₄ -	H		<table><tr><td>neat</td><td>1757</td><td>173</td></tr><tr><td>neat</td><td>1750</td><td>174</td></tr></table>	neat	1757	173	neat	1750	174																																											
R ₁	R ₂	R ₃																																																										
-(CH ₂) ₃ -	Ph																																																											
-(CH ₂) ₄ -	H																																																											
neat	1757	173																																																										
neat	1750	174																																																										
	KBr	1740	175																																																									
	<table><tr><th>R₁</th><th>R₂</th><th>R₃</th></tr><tr><td>H</td><td>Ph</td><td>H</td></tr><tr><td>Ph</td><td>Me</td><td>Me</td></tr><tr><td>NH₂</td><td>Me</td><td>Me</td></tr><tr><td>NH₂</td><td>Me</td><td>Ph</td></tr><tr><td>NH₂</td><td>Ph</td><td>Ph</td></tr><tr><td>NH₂</td><td>-(CH₂)₅-</td><td></td></tr><tr><td>NH-Ph</td><td>Me</td><td>Me</td></tr><tr><td>NH-Ph</td><td>Me</td><td>Ph</td></tr><tr><td>NH-Ph</td><td>Ph</td><td>Ph</td></tr></table>	R ₁	R ₂	R ₃	H	Ph	H	Ph	Me	Me	NH ₂	Me	Me	NH ₂	Me	Ph	NH ₂	Ph	Ph	NH ₂	-(CH ₂) ₅ -		NH-Ph	Me	Me	NH-Ph	Me	Ph	NH-Ph	Ph	Ph	<table><tr><td>KBr</td><td>1818,1730</td><td>176</td></tr><tr><td>mull</td><td>1818,1727</td><td>158</td></tr><tr><td>KBr</td><td>1820,1740</td><td>177</td></tr><tr><td>KBr</td><td>1825,1755</td><td>177</td></tr><tr><td>KBr</td><td>1820,1750</td><td>177</td></tr><tr><td>KBr</td><td>1850,1820,1740</td><td>177</td></tr><tr><td>KBr</td><td>1830,1750</td><td>177</td></tr><tr><td>KBr</td><td>1825,1760</td><td>177</td></tr><tr><td>KBr</td><td>1830,1760</td><td>177</td></tr></table>	KBr	1818,1730	176	mull	1818,1727	158	KBr	1820,1740	177	KBr	1825,1755	177	KBr	1820,1750	177	KBr	1850,1820,1740	177	KBr	1830,1750	177	KBr	1825,1760	177	KBr	1830,1760	177	
R ₁	R ₂	R ₃																																																										
H	Ph	H																																																										
Ph	Me	Me																																																										
NH ₂	Me	Me																																																										
NH ₂	Me	Ph																																																										
NH ₂	Ph	Ph																																																										
NH ₂	-(CH ₂) ₅ -																																																											
NH-Ph	Me	Me																																																										
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KBr	1818,1730	176																																																										
mull	1818,1727	158																																																										
KBr	1820,1740	177																																																										
KBr	1825,1755	177																																																										
KBr	1820,1750	177																																																										
KBr	1850,1820,1740	177																																																										
KBr	1830,1750	177																																																										
KBr	1825,1760	177																																																										
KBr	1830,1760	177																																																										
	<table><tr><th>R₁</th><th>R₂</th><th>R₃</th><th>R₄</th></tr><tr><td>H</td><td>H</td><td>H</td><td>H</td></tr><tr><td>Me</td><td>H</td><td>H</td><td>H</td></tr><tr><td>Ph</td><td>H</td><td>H</td><td>H</td></tr><tr><td>Me</td><td>H</td><td>Me</td><td>H</td></tr></table>	R ₁	R ₂	R ₃	R ₄	H	H	H	H	Me	H	H	H	Ph	H	H	H	Me	H	Me	H	<table><tr><td>neat</td><td>1800</td><td>178</td></tr><tr><td>CHCl₃</td><td>1812</td><td>179,180</td></tr><tr><td>CCl₄</td><td>1818</td><td>181</td></tr><tr><td>CCl₄</td><td>1825</td><td>179</td></tr><tr><td>neat</td><td>1800</td><td>182</td></tr><tr><td>CHCl₃</td><td>1785</td><td>183</td></tr><tr><td>CCl₄</td><td>1809</td><td>184</td></tr><tr><td>KBr</td><td>1770</td><td>154</td></tr><tr><td>CS₂</td><td>1816</td><td>184</td></tr><tr><td>-</td><td>1800</td><td>169</td></tr></table>	neat	1800	178	CHCl ₃	1812	179,180	CCl ₄	1818	181	CCl ₄	1825	179	neat	1800	182	CHCl ₃	1785	183	CCl ₄	1809	184	KBr	1770	154	CS ₂	1816	184	-	1800	169								
R ₁	R ₂	R ₃	R ₄																																																									
H	H	H	H																																																									
Me	H	H	H																																																									
Ph	H	H	H																																																									
Me	H	Me	H																																																									
neat	1800	178																																																										
CHCl ₃	1812	179,180																																																										
CCl ₄	1818	181																																																										
CCl ₄	1825	179																																																										
neat	1800	182																																																										
CHCl ₃	1785	183																																																										
CCl ₄	1809	184																																																										
KBr	1770	154																																																										
CS ₂	1816	184																																																										
-	1800	169																																																										
<i>cis; trans</i>																																																												

Table VI (continued)

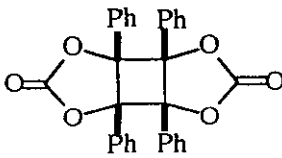
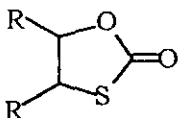
Compound					Phase	$\nu_{C=O}$	Ref.
	R_1	R_2	R_3	R_4			
<i>cis</i>	Ph	H	Ph	H	KBr	1790	154
<i>trans</i>	Ph	H	H	Ph	KBr	1815	154
	H	$-(CH_2)_4-$	H		—	1800	169
<i>cis</i>	H	$-(CH_2)_6-$	H		KBr	1805	154,159
	Me	Me	Me	Me	—	1782,1754	185
	Cl	Cl	Cl	Cl	neat	1890	178
<i>cis</i>	Ph	$-(CH_2)_2-$	Ph		$CHCl_3$	1802	186
<i>cis</i>	Cl	$-(CH_2)_2-$	Cl		KBr	1900,1845,1820	187
					KBr	1845,1815	188
					R		
		H			neat	1724	189
					$CHCl_3$	1739	190
<i>cis</i>	Me				neat	1730	191
<i>trans</i>	Me				neat	1723	191

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

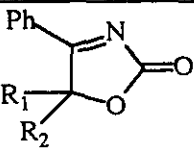
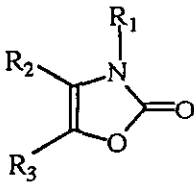
Compound		Phase	$\nu_{C=O}$	Ref.
	$R_1 \text{---} R_2$			
	Me Me	KBr	1768	155
	Me Ph	KBr	1780	155
	Bn Ph	KBr	1788	192
	Ph Ph	KBr	1780	155
	$-(CH_2)_5-$	KBr	1770	155
	$R_1 \text{---} R_2 \text{---} R_3$			
	H H H	CH ₂ Cl ₂ KBr	1785,1760 1765,1740	156 193
	H H Ph	—	1755,1720	194
	H Me Ph	—	1780	194
	H Ph Ph	— KBr	1750 1755	194 192
	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 ₆ H ₁₁ Me H	neat	1740	196
	Ph Me H	neat CHCl ₃	1745 1760	196 197
	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 KBr mull	1753 1750 1750	200 195 201
	1-naphthyl H Me	neat	1745	196
	$-(CH_2)_4-$ Ph	CHCl ₃ KBr	1740 1747	202 202

Table VII (continued)

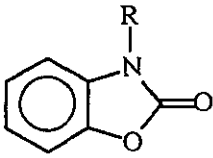
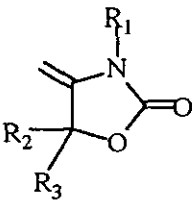
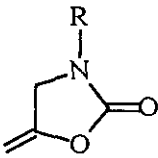
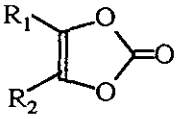
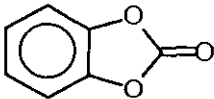
Compound		Phase	$\nu_{\text{C=O}}$	Ref.
	<u>R</u>			
	H	KBr	1769,1740	203
	Me	KBr	1769,1740	203
	t-Bu	CH ₂ Cl ₂	1750	204
	<u>R</u> ₁ <u>R</u> ₂ <u>R</u> ₃			
	Ph H H	CHCl ₃	1770	197
		KBr	1760	196
	Ph Me H	mull	1770	199
	Ph Me Me	CH ₂ Cl ₂	1770	205
		KBr	1752	206
	Bn Me Me	KBr	1763	206
	<u>R</u>			
	Me	neat	1750	196
	c-C ₆ H ₁₁	neat	1770	196
	Ph	KBr	1775	196
	<u>R</u> ₁ <u>R</u> 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)

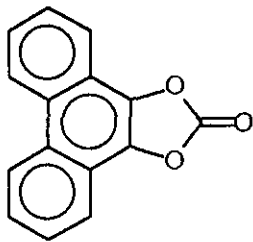
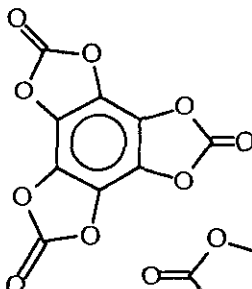
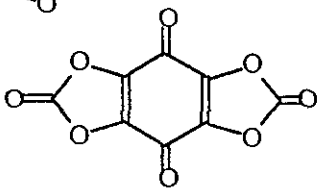
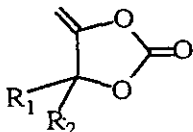
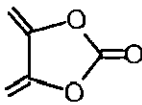
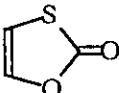
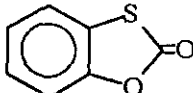
Compound	Phase	$\nu_{C=O}$	Ref.	
	CHCl ₃ CCl ₄ KBr	1885,1855,1823 1880,1848,1815 1840,1805	188 214 210	
	THF	1847,1835	215	
	THF	1820,1805	215	
	$\begin{array}{cc} R_1 & R_2 \\ \hline H & H \\ \\ Me & Me \\ \\ Me & Ph \\ \\ -(CH_2)_5- & \end{array}$	CDCl ₃ KBr - - -	1838 1822 1827 1835 1845	216 217 218 218 218
	KBr	1845,1825	219	
	neat neat	1736 1800	189 220	
	neat	1760	221	

Table VII (continued)

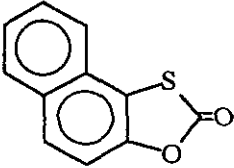
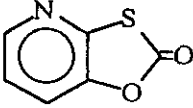
Compound	Phase	$\nu_{C=O}$	Ref.
	CCl ₄	1776, 1765	222
	KBr	1753, 1731	222
	KBr	1750	223

Table VIII

Ring Size: 5
Heteroatoms: 1,2,3-

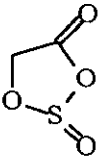
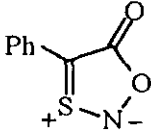
Compound	Phase	$\nu_{C=O}$	Ref.
	—	1825	224
	—	1700	225

Table IX

Ring Size: 5
Heteroatoms: 1,2,4-

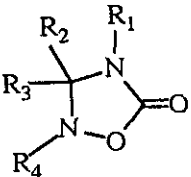
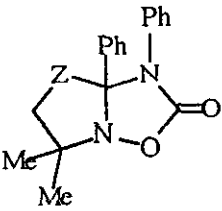
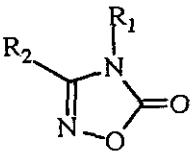
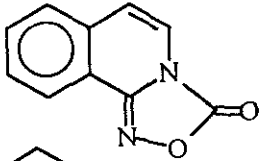
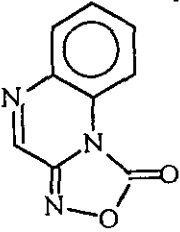
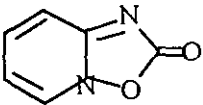
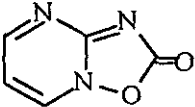
Compound	Phase	$\nu_{C=O}$	Ref.
	$\begin{matrix} R_1 & R_2 & R_3 & R_4 \\ Me & -(CH=CH)_3- & Me & \\ Ph & -(CH_2)_5- & Me & \\ Ph & Ph & H & t-Bu \\ Bz & Ph & H & Ph \end{matrix}$	KBr CHCl ₃ mull CHCl ₃	226 227 228 229
	$\begin{matrix} Z \\ CH_2 \\ O \end{matrix}$	neat CHCl ₃	230 230
	$\begin{matrix} R_1 & R_2 \\ H & Me \\ H & Ph \\ Me & Me \\ Me & Ph \\ Ph & Ph \end{matrix}$	CHCl ₃ mull KBr CHCl ₃ CHCl ₃	231 231 232 203 233
		KBr	234
		KBr	235
	-		236
	KBr		236

Table IX (continued)

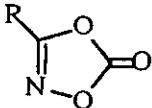
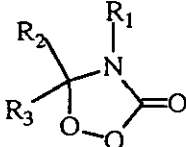
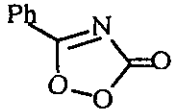
Compound		Phase	$\nu_{C=O}$	Ref.
	$\underline{R}$			
	<i>t</i> -Bu	neat	1880,1835	237
	Ph	CHCl ₃	1866,1834	233
		—	1855,1828	238
	CH ₂ =C(Ph)	KBr	1880,1840	148
	$\underline{R_1} \quad \underline{R_2} \quad \underline{R_3}$			
	H Ph NEt ₂	CHCl ₃	1790	239
	Ph Ph CH=CE ₂	CHCl ₃	1776,1736	240
		CHCl ₃	1815	239

Table X

Ring Size: 5
Heteroatoms: 1,3,4-

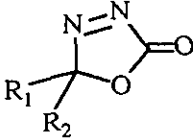
Compound		Phase	$\nu_{C=O}$	Ref.
	$\underline{R_1} \quad \underline{R_2}$			
	Me Me	KBr	1800	241
		CCl ₄	1835	242
	Me <i>t</i> -Bu	CCl ₄	1838	242
	Me Bn	CCl ₄	1830	242
		CCl ₄	1827	243
	Bn Bn	CCl ₄	1828	243
	Me Ph	CCl ₄	1835	244
	—(CH ₂) ₄ —	CCl ₄	1840	245
		—	1825	246
	—(CH ₂) ₅ —	CCl ₄	1826	245
		—	1820	246
	—(CH ₂) ₆ —	—	1820	246

Table X (continued)

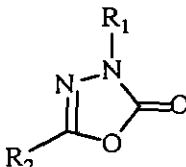
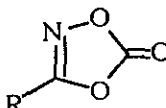
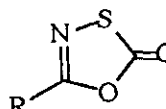
Compound		Phase	$\nu_{\text{C=O}}$	Ref.																																																																													
	<table><tr><th>R_1</th><th>R_2</th></tr><tr><td>H</td><td>Me</td></tr><tr><td>H</td><td><i>n</i>-C₆H₁₁</td></tr><tr><td>H</td><td><i>t</i>-Bu</td></tr><tr><td>H</td><td>Ph</td></tr><tr><td>Me</td><td>Ph</td></tr><tr><td>Me</td><td>EtO</td></tr><tr><td>Bn</td><td>Me</td></tr><tr><td>Bn</td><td>Ph</td></tr><tr><td>allyl</td><td>Ph</td></tr><tr><td>propargyl</td><td>Ph</td></tr><tr><td>Ph</td><td>Et</td></tr><tr><td>Ph</td><td>Ph</td></tr><tr><td>Ac</td><td>Ph</td></tr></table>	R_1	R_2	H	Me	H	<i>n</i> -C ₆ H ₁₁	H	<i>t</i> -Bu	H	Ph	Me	Ph	Me	EtO	Bn	Me	Bn	Ph	allyl	Ph	propargyl	Ph	Ph	Et	Ph	Ph	Ac	Ph	<table><tr><td>—</td><td>1770</td><td>247</td></tr><tr><td>neat</td><td>1780</td><td>248</td></tr><tr><td>KBr</td><td>1770</td><td>247</td></tr><tr><td>KBr</td><td>1770</td><td>247</td></tr><tr><td>CHCl₃</td><td>1777</td><td>249</td></tr><tr><td>CCl₄</td><td>1787</td><td>249</td></tr><tr><td>KBr</td><td>1764</td><td>203</td></tr><tr><td>CCl₄</td><td>1805</td><td>250</td></tr><tr><td>CCl₄</td><td>1800</td><td>251</td></tr><tr><td>CH₂Cl₂</td><td>1779</td><td>252</td></tr><tr><td>CCl₄</td><td>1795</td><td>253</td></tr><tr><td>KBr</td><td>1786</td><td>253</td></tr><tr><td>KBr</td><td>1773</td><td>253</td></tr><tr><td>mull</td><td>1796</td><td>254</td></tr><tr><td>CHCl₃</td><td>1781</td><td>233</td></tr><tr><td>mull</td><td>1783</td><td>254</td></tr><tr><td>KBr</td><td>1790</td><td>247</td></tr></table>	—	1770	247	neat	1780	248	KBr	1770	247	KBr	1770	247	CHCl ₃	1777	249	CCl ₄	1787	249	KBr	1764	203	CCl ₄	1805	250	CCl ₄	1800	251	CH ₂ Cl ₂	1779	252	CCl ₄	1795	253	KBr	1786	253	KBr	1773	253	mull	1796	254	CHCl ₃	1781	233	mull	1783	254	KBr	1790	247
R_1	R_2																																																																																
H	Me																																																																																
H	<i>n</i> -C ₆ H ₁₁																																																																																
H	<i>t</i> -Bu																																																																																
H	Ph																																																																																
Me	Ph																																																																																
Me	EtO																																																																																
Bn	Me																																																																																
Bn	Ph																																																																																
allyl	Ph																																																																																
propargyl	Ph																																																																																
Ph	Et																																																																																
Ph	Ph																																																																																
Ac	Ph																																																																																
—	1770	247																																																																															
neat	1780	248																																																																															
KBr	1770	247																																																																															
KBr	1770	247																																																																															
CHCl ₃	1777	249																																																																															
CCl ₄	1787	249																																																																															
KBr	1764	203																																																																															
CCl ₄	1805	250																																																																															
CCl ₄	1800	251																																																																															
CH ₂ Cl ₂	1779	252																																																																															
CCl ₄	1795	253																																																																															
KBr	1786	253																																																																															
KBr	1773	253																																																																															
mull	1796	254																																																																															
CHCl ₃	1781	233																																																																															
mull	1783	254																																																																															
KBr	1790	247																																																																															
	<table><tr><th>R</th></tr><tr><td>CF₃</td></tr><tr><td>MOM</td></tr></table>	R	CF ₃	MOM	<table><tr><td>neat</td><td>1887</td><td>255</td></tr><tr><td>neat</td><td>1875,1825</td><td>256</td></tr></table>	neat	1887	255	neat	1875,1825	256																																																																						
R																																																																																	
CF ₃																																																																																	
MOM																																																																																	
neat	1887	255																																																																															
neat	1875,1825	256																																																																															
	<table><tr><th>R</th></tr><tr><td>Me</td></tr><tr><td>Ph</td></tr><tr><td>2-pyridyl</td></tr></table>	R	Me	Ph	2-pyridyl	<table><tr><td>neat</td><td>1760</td><td>257</td></tr><tr><td>CCl₄</td><td>1780,1750</td><td>258</td></tr><tr><td>mull</td><td>1740</td><td>259</td></tr><tr><td>mull</td><td>1750</td><td>260</td></tr></table>	neat	1760	257	CCl ₄	1780,1750	258	mull	1740	259	mull	1750	260																																																															
R																																																																																	
Me																																																																																	
Ph																																																																																	
2-pyridyl																																																																																	
neat	1760	257																																																																															
CCl ₄	1780,1750	258																																																																															
mull	1740	259																																																																															
mull	1750	260																																																																															

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

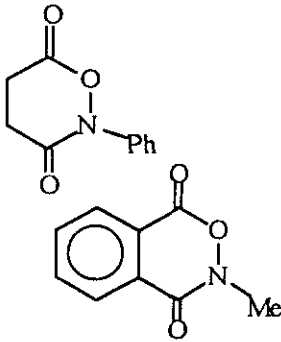
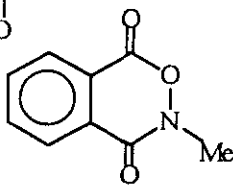
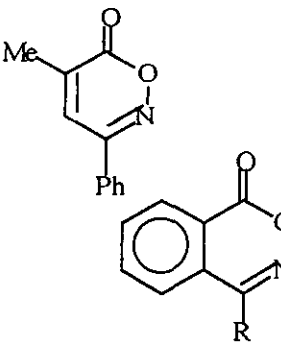
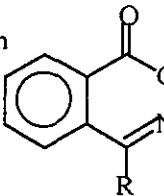
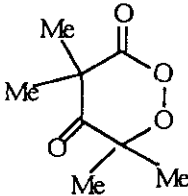
Compound	Phase	$\nu_{C=O}$	Ref.	
	CHCl ₃	1790	261	
	dioxane KBr	1760 1760	262 262	
	KBr	1720	263	
	<u>R</u>			
	Bn	mull	1745	264
		—	1750	265
	Ph	CHCl ₃	1734	266
	MeO	dioxane	1745	262
	CCl ₄	1780	267	

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

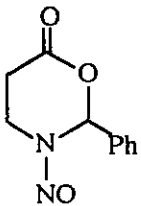
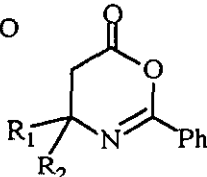
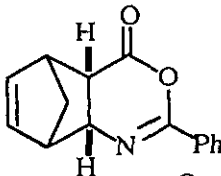
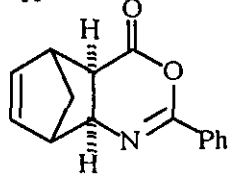
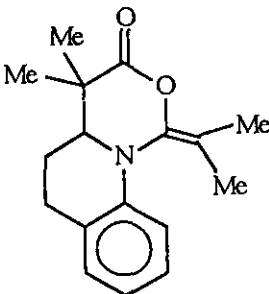
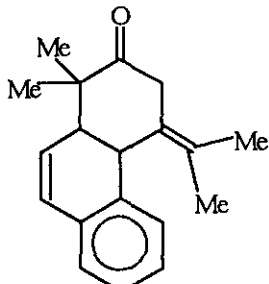
Compound	Phase	$\nu_{C=O}$	Ref.
	CHCl ₃	1770	64
	$\begin{matrix} R_1 & \text{---} & R_2 \\ H & & Me \\ Me & & Me \end{matrix}$	neat 1795,1675 mull 1790,1670	268 268
	—	1750	269
	—	1770,1760	269
	CCl ₄	1754	270
	CCl ₄	1739	270

Table XII (continued)

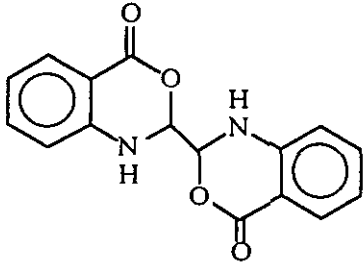
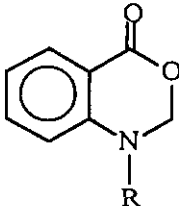
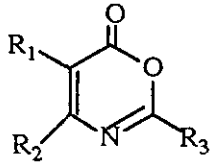
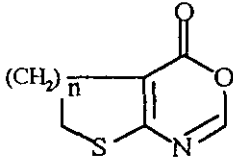
Compound		Phase	$\nu_{\text{C=O}}$	Ref.
		KBr	1715	271
	R			
	Me	KBr	1717	272
	Ph	KBr	1712	272
	R ₁ R ₂ R ₃			
	H H H	CDCl ₃	1765	273
	H H Ph	KBr	1750	274
	Me Me H	CCl ₄	1745	273
	Me Ph H	CHCl ₃	1745, 1735	32
	Bn Me H	CHCl ₃	1740	32
	Bn Ph H	CHCl ₃	1742, 1728	32
	Ph Me H	CHCl ₃	1740	32
	H Me Me	CHCl 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)

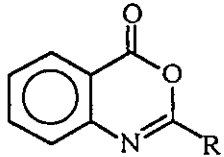
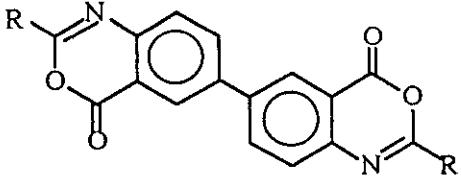
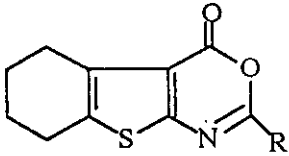
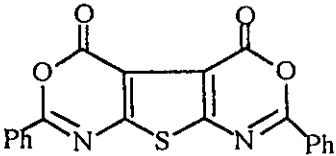
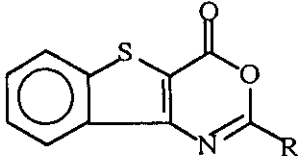
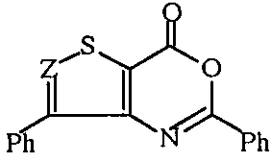
Compound		Phase	$\nu_{C=O}$	Ref.
	<u>R</u>			
	Me	CH ₂ Cl ₂	1760	281
		KBr	1760	282
	<i>t</i> -Bu	mull	1760	283
	Ph	CHCl ₃	1773	284
		CCl ₄	1770	281
		KBr	1770	282
	EtO	—	1760	285
	EtS	KBr	1760	107
	<u>R</u>			
	Me	KBr	1757,1740	282
	Bn	KBr	1760	286
	Ph	KBr	1760	282
	<u>R</u>			
	Me	KBr	1740	280
	Ph	KBr	1760	280,287
		KBr	1890,1790	287
	<u>R</u>			
	Me	mull	1765	288
	Ph	mull	1770	288
	<u>Z</u>			
	Ph-C	KBr	1770	289
	N	KBr	1760	289

Table XII (continued)

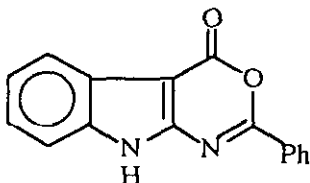
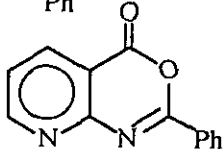
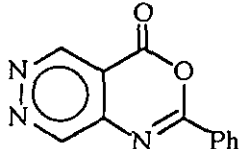
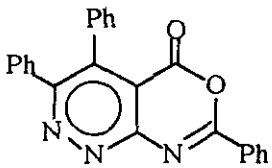
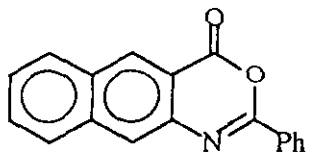
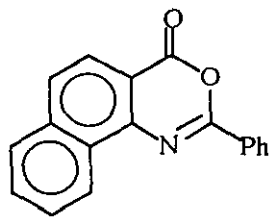
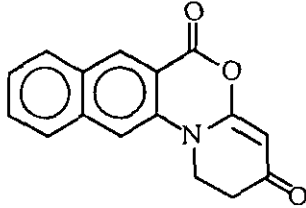
Compound	Phase	$\nu_{\text{C=O}}$	Ref.
	CHCl ₃	1760	176
	—	1751	290
	KBr	1780	291
	KBr	1770	287
	KBr	1753	292
	KBr	1754	292
	—	1755	293

Table XII (continued)

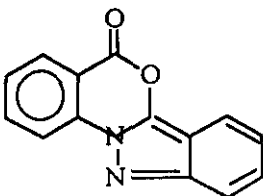
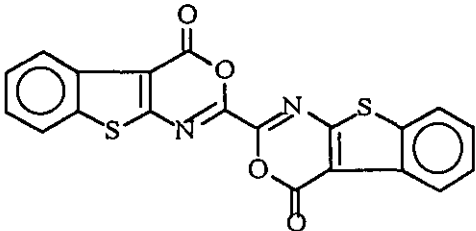
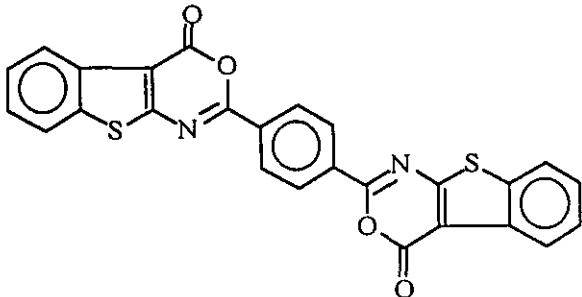
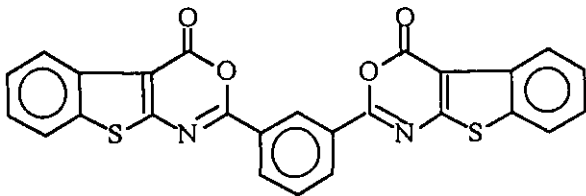
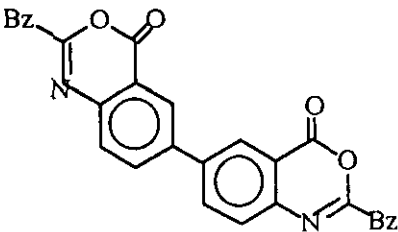
Compound	Phase	$\nu_{\text{C=O}}$	Ref.
	KBr	1770,1758	294
	KBr	1750	295
	KBr	1760	295
	KBr	1760	295
	KBr	1770	286

Table XII (continued)

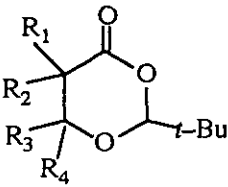
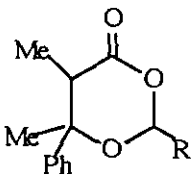
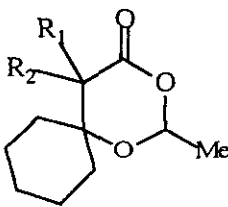
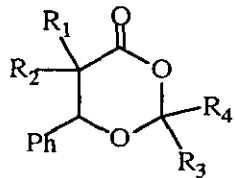
Compound		Phase	$\nu_{\text{C=O}}$	Ref.
	$\begin{matrix} R_1 & R_2 & R_3 & R_4 \end{matrix}$			
	H H H H	KBr	1750,1720	116
	<i>cis</i> Me H H H	KBr	1740	296
	<i>trans</i> Me H H H	KBr	1730	296
	Me Bn H H	KBr	1720	296
	<i>cis</i> H H Me H	KBr	1740,1725	297
	H Me <i>cis</i> Me H	KBr	1755	296
	H Me <i>trans</i> Me H	KBr	1730	296
	<i>cis</i> Me Me Me H	KBr	1740	296
	Me Bn Me H	KBr	1730	296
	<i>cis</i> Me H Me Me	KBr	1750	296
	$\underline{R}$			
	H	—	1770	298
	Me	—	1770	298
	$\begin{matrix} R_1 & R_2 \end{matrix}$			
	H H	neat	1760	299
	Me H	neat	1755	299
	Me Me	neat	1750	299
	$\begin{matrix} R_1 & R_2 & R_3 & R_4 \end{matrix}$			
	Me H H H	—	1760	298
	Me H H Me	—	1750	298
	Me H H Ph	—	1750	298
	Me H $-(\text{CH}_2)_4-$	—	1750	298
	Me H $-(\text{CH}_2)_5-$	—	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 $-(\text{CH}_2)_4-$	—	1745	298
	Me Me $-(\text{CH}_2)_5-$	—	1745	298

Table XII (continued)

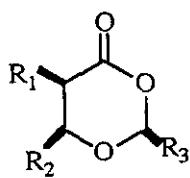
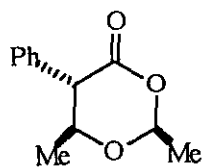
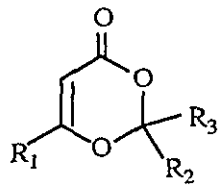
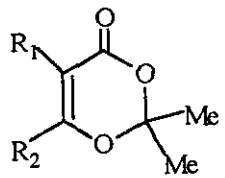
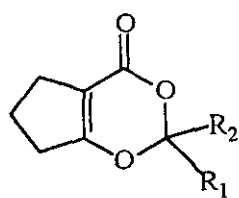
Compound		Phase	$\nu_{C=O}$	Ref.
	R_1 — R_2 — R_3 H Me Me -(CH ₂) ₃ - H -(CH ₂) ₃ - <i>t</i> -Bu -(CH ₂) ₄ - H -(CH ₂) ₄ - <i>t</i> -Bu	neat KBr KBr neat KBr	1750 1730 1735,1720 1745 1750	297 300 300 300 300
		neat	1745	301
	R_1 — R_2 — R_3 H H <i>t</i> -Bu H H <i>c</i> -C ₆ H ₁₁ H H Ph H -(CH ₂) ₄ - H -(CH ₂) ₅ - Me H <i>t</i> -Bu	CHCl ₃ CHCl ₃ CHCl ₃ CHCl ₃ CHCl ₃ KBr	1745,1730 1735 1745 1730 1730 1740	302 303 303 303 303 116
	R_1 — R_2 H H H Me H CF ₃ H Ph Me Me Me Ph Bn Me Ph Me	CHCl ₃ CHCl ₃ neat CHCl ₃ CHCl ₃ CHCl ₃ CHCl ₃ CHCl ₃ CHCl ₃	1725 1722 1759 1717 1725 1710 1712 1718	304 305 306 304 304 304 304 304
	R_1 — R_2 H <i>t</i> -Bu H Ph Me Me Me Me Me Ph -(CH ₂) ₅ -	KBr KBr CHCl ₃ KBr KBr KBr	1730 1735 1720 1734 1725 1735	300 307 307 307 307 307

Table XII (continued)

Compound		Phase	$\nu_{C=O}$	Ref.
	$\begin{matrix} R_1 & R_2 \\ H & t-Bu \\ Me & Me \end{matrix}$	 KBr CHCl ₃	 1725 1716	 300 304
		KBr	1725	300
	$\begin{matrix} R \\ H \\ t-Bu \end{matrix}$	 KBr KBr	 1725 1725	 300 300
	$\begin{matrix} R_1 & R_2 \\ H & H \\ H & Ph \\ Me & PhO \\ Me & BnO \\ Me & t-BuO \end{matrix}$	 CHCl ₃ mull neat KBr neat	 1747 1745 1750 1735 1750	 308 309 310 310 310
		KBr	1730	311
	$\begin{matrix} R_1 & R_2 \\ H & H \\ H & Me \\ H & Ph \\ Me & Me \\ Ph & Ph \\ Cl & Cl \end{matrix}$	 CCl ₄ KBr CCl ₄ CCl ₄ KBr CCl ₄ - -	 1743 1720 1742 1743 1730 1739 1730 1776	 312 313 312 312 313 312 314 315

Table XII (continued)

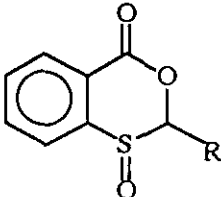
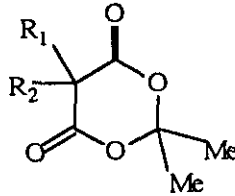
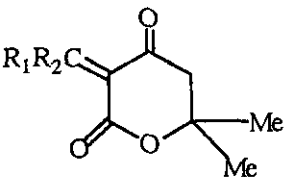
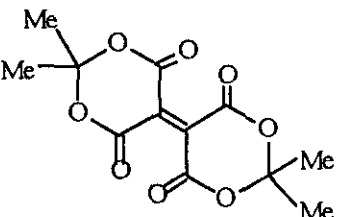
Compound		Phase	$\nu_{C=O}$	Ref.
	$\underline{R}$			
	H	KBr	1723	313
	Me	KBr	1745	316
	<i>R,R/S,S</i> Ph	KBr	1727	313
	<i>R,S/S,R</i> Ph	KBr	1742	313
	$\underline{R_1} \quad \underline{R_2}$			
	H H	CHCl ₃	1787,1760	317
		CCl ₄	1794,1770	318
		KBr	1789,1745	318
	H Me	CHCl ₃	1790,1755	319
	H Ph	CHCl ₃	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
	$\underline{R_1} \quad \underline{R_2}$			
	Me H	CH ₂ Cl ₂	1763,1738	324
	<i>t</i> -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-

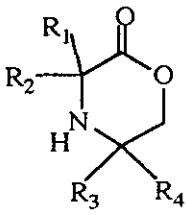
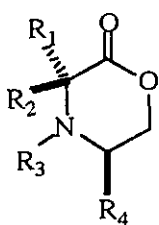
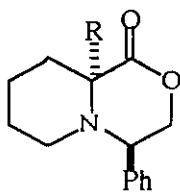
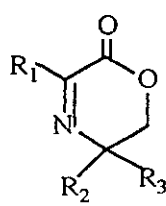
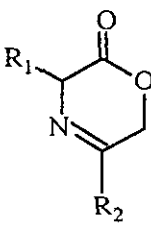
Compound	Phase	$\nu_{C=O}$	Ref.	
	$\underline{R_1}$ $\underline{R_2}$ $\underline{R_3}$ $\underline{R_4}$ Me Me Me Me -(CH₂)₅- Me Me	-	1720	325
		-	1725	325
	$\underline{R_1}$ $\underline{R_2}$ $\underline{R_3}$ $\underline{R_4}$ H H Me H H Bn Bn Ph Me Bn Bn Ph Bn Bn Bn Ph	neat	1750	326
		mull	1730	327
		CHCl ₃	1738	327
		CHCl ₃	1725	327
	$\underline{R}$ H Me Bn	neat	1735	328
		neat	1737	328
		neat	1750	328
	$\underline{R_1}$ $\underline{R_2}$ $\underline{R_3}$ Me H Ph Me Me Me Ph Me Me	KBr	1735	329
		neat	1735	330
		neat	1740	330
	$\underline{R_1}$ $\underline{R_2}$ Me Me Me 2-naphthyl <i>i</i>-Pr Ph Ph Ph	CHCl ₃	1755	331
		KBr	1747	332
		KBr	1738	332
		KBr	1735	332

Table XIII (continued)

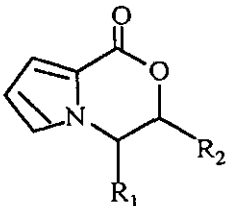
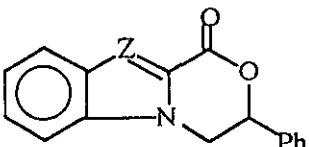
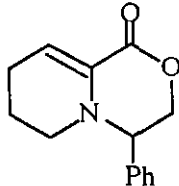
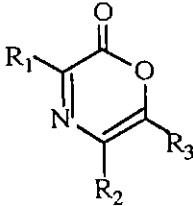
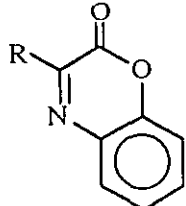
Compound		Phase	$\nu_{C=O}$	Ref.
	R_1 — R_2			
	H — Me	CCl ₄	1705	333
	H — <i>t</i> -Bu	CCl ₄	1715	333
	H — Ph	CCl ₄	1730	333
		KBr	1710	333,334
	<i>trans</i> —(CH ₂) ₄ —	KBr	1740	333
	<i>trans</i> —(CH ₂) ₄ —	mull	1700	334
	Z			
	CH	KBr	1735	335
	N	KBr	1740	335
		neat	1731	328
	R_1 — R_2 — R_3			
	Cl — 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)

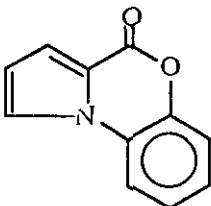
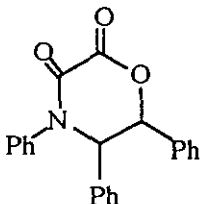
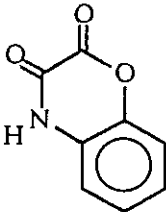
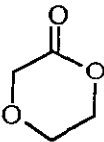
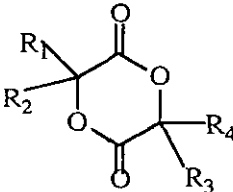
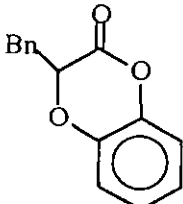
Compound		Phase	$\nu_{C=O}$	Ref.
		mull	1725	340
	<i>cis</i>	KBr	1745	341
	<i>trans</i>	KBr	1750	341
		—	1770,1700	342
		neat	1740	343
	R_1 — R_2 — R_3 — R_4			
	Me H Me H	mull	1750	344
	Me Ph Me Ph	—	1750	345
	Ph Ph Ph Ph	—	1750	345
		neat	1775	346

Table XIII (continued)

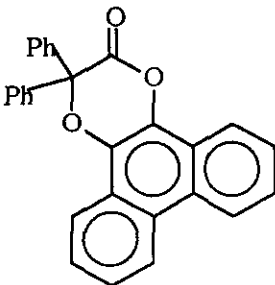
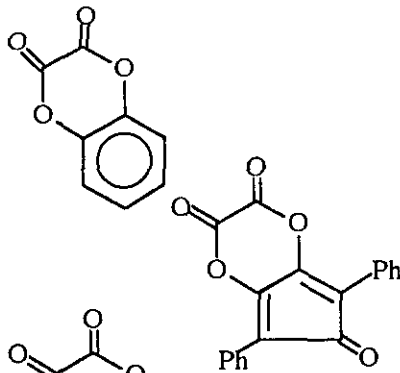
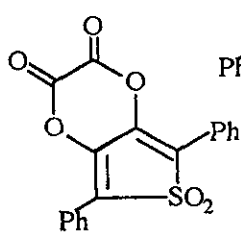
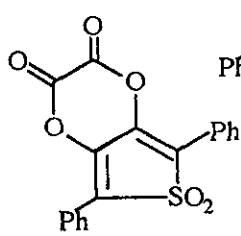
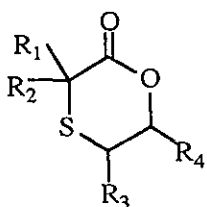
Compound	Phase	$\nu_{C=O}$	Ref.	
	KBr	1783	347	
	CHCl ₃	1805,1790	348	
	KBr	1820	349	
	KBr	1830	349	
	R₁ R₂ R₃ R₄ H H H H Me H H H <i>t</i>-Bu H H H H H Me H H H Ph H H H H Me H H H <i>t</i>-Bu H H H vinyl H H H Ph <i>cis</i> Me H H Ph Me Me H H Me Me H Ph <i>trans</i> H H $-(CH_2)_4-$	- neat neat - KBr neat neat CHCl₃ CCl₄ KBr KBr neat KBr neat	1740 1735 1735 1740 1727 1735 1745 1738 1765,1750 1715 1719 1723 1722 1723	350 351 351 350 352 352 351 152 353 352 352 352 352 351

Table XIII (continued)

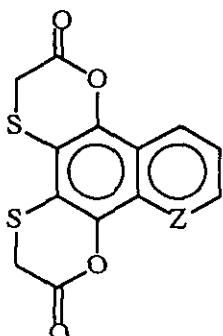
Compound		Phase	$\nu_{C=O}$	Ref.
	$\underline{Z}$			
	CH	mull	1750	354
	N	mull	1760	354

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

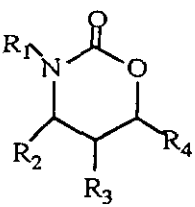
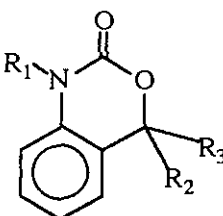
Compound		Phase	$\nu_{C=O}$	Ref.
	$\underline{R_1} \quad \underline{R_2} \quad \underline{R_3} \quad \underline{R_4}$			
	H H H H	neat	1692	355
		KBr	1699	144
	<i>cis; trans</i> H $-(CH_2)_5-$ H	KBr	1695	356
	<i>cis; trans</i> H H $-(CH_2)_4-$	-	1690	357
	<i>cis</i> H H $-(CH_2)_5-$	KBr	1690	356
	<i>trans</i> 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
	$\underline{R_1} \quad \underline{R_2} \quad \underline{R_3}$			
	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)

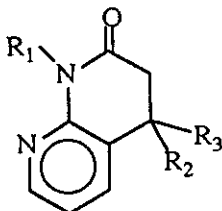
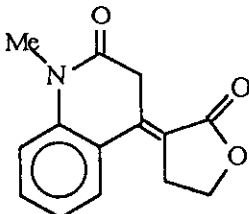
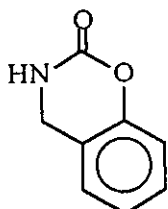
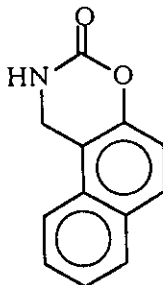
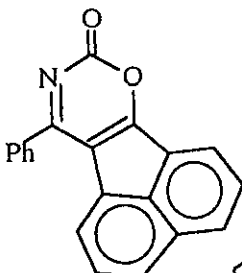
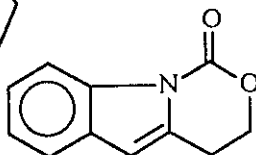
Compound	Phase	$\nu_{\text{C=O}}$	Ref.	
	$\begin{array}{ccc} \underline{R_1} & \underline{R_2} & \underline{R_3} \\ \text{H} & \text{--(CH}_2\text{)}_4\text{--} & \\ \text{H} & \text{--(CH}_2\text{)}_5\text{--} & \\ \text{Me} & \text{--(CH}_2\text{)}_4\text{--} & \end{array}$	mull mull mull	1740 1720 1725	360 360 360
	$\begin{array}{c} Z \\ E \end{array}$	mull mull	1760,1695 1760,1710	361 361
		KBr	1724	362
		KBr	1745	363
		KBr	1735	364
		—	1735	365

Table XIV (continued)

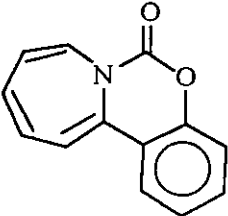
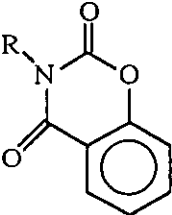
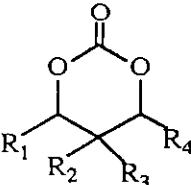
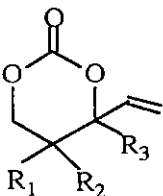
Compound		Phase	$\nu_{C=O}$	Ref.
		—	1760,1720	366
	<u>R</u>			
	H	pyr	1770	367
	Et	—	1763	368
	Bn	—	1770	368
	Ph	CHCl ₃ mull	1770 1760	367 369
	Bz	—	1784	368
	OH	KBr	1785	367
	<u>R₁</u> <u>R₂</u> <u>R₃</u> <u>R₄</u>			
	H H H H	neat	1747	144
		CHCl ₃	1779,1753	180
		CCl ₄	1776,1768	180
<i>cis</i>	Me H H Me	CHCl ₃	1742	370
<i>trans</i>	Me H H Me	CHCl ₃	1752,1737	370
	H Me Me H	CHCl ₃	1749	370
	<u>R₁</u> <u>R₂</u> <u>R₃</u>			
	H H H	neat	1740	371
	H H Me	neat	1740	371
	—(CH ₂) ₅ — H	neat	1745	371

Table XIV (continued)

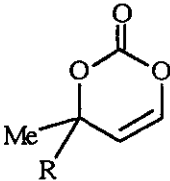
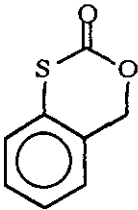
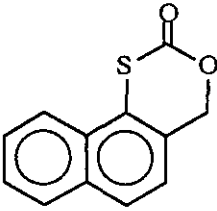
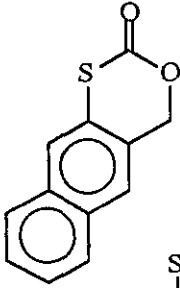
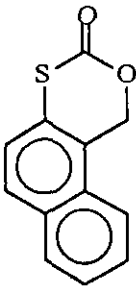
Compound		Phase	$\nu_{C=O}$	Ref.
	$\underline{R}$			
	H	neat	1755	372
	Me	CH ₂ Cl ₂	1800	372
		KBr	1695,1680	373
		KBr	1700	373
		KBr	1700	373
		KBr	1685	373

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

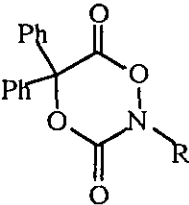
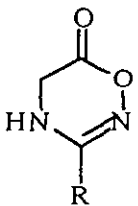
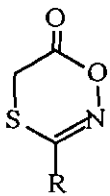
Compound		Phase	$\nu_{C=O}$	Ref.
	<u>R</u>			
	<i>i</i> -Pr	KBr	1790,1745	374
	<i>n</i> -C ₆ H ₁₁	KBr	1800,1740	374
	<u>R</u>			
	Bn	KBr	1775	375
	Ph	KBr	1776	375
	<u>R</u>			
	Ph	KBr	1750	376
	2-thienyl	KBr	1745	376
	3-thienyl	KBr	1775	376

Table XVI

Ring Size: 6
Heteroatoms: 1,2,5-

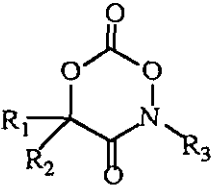
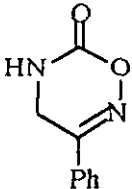
Compound	Phase	$\nu_{\text{C=O}}$	Ref.
	R_1 R_2 R_3 Me Ph Me KBr 1820,1700 177 Ph Ph Me KBr 1805,1700 177 -(CH₂)₅- Me KBr 1800,1700 177 Me Me Bn KBr 1800,1700 177		
	KBr	1750	377

Table XVII

Ring Size: 6
Heteroatoms: 1,3,4-

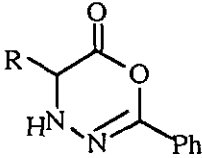
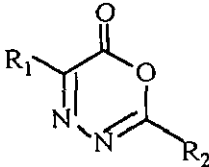
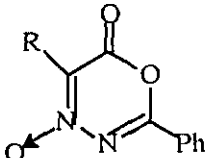
Compound	Phase	$\nu_{\text{C=O}}$	Ref.
	R Me mull 1785 378 Ph KBr 1795 378		
	R_1 R_2 Me Ph KBr 1695 379 Ph Me KBr 1763 379 Ph Bn KBr 1760 379 Ph Ph KBr 1750 380 Ph 4-pyridyl - 1765 381		
	R Me KBr 1755 382 Ph KBr 1755 382		

Table XVIII **Ring Size:** **6**
Heteroatoms: **1,3,5-; 1,4,5-; 1,2,4,5-**

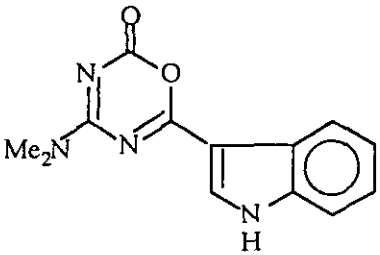
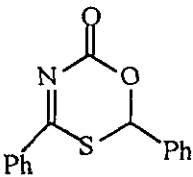
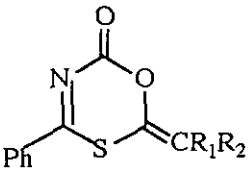
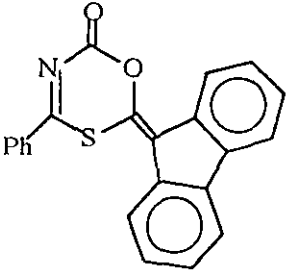
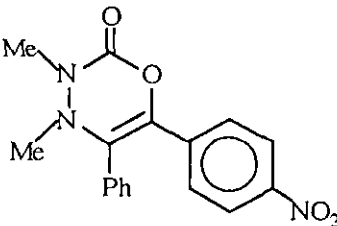
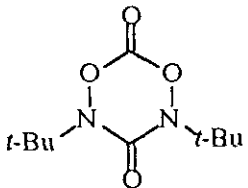
Compound	Phase	$\nu_{C=O}$	Ref.
	KBr	1750,1735	383
	CHCl ₃	1720	384
	$\begin{matrix} R_1 & \text{---} & R_2 \\ \text{Ph} & & \text{Ph} \\ \text{Ph} & & \text{1-naphthyl} \end{matrix}$	CHCl₃ 1740 CCl₄ 1750	385 385
	CHCl ₃	1735	385
	KBr	1740	386
	neat	1810,1740	387

Table XIX

Ring Size: 7
 Heteroatoms: 1,2-; 1,4-; 1,5-; 1,6-

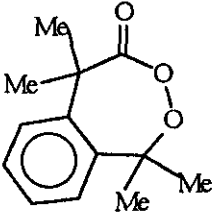
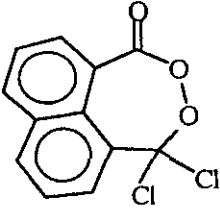
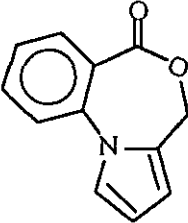
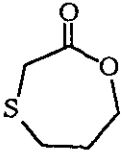
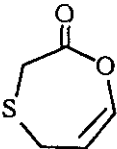
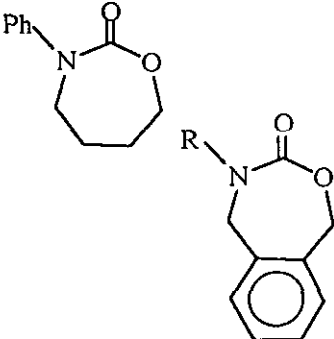
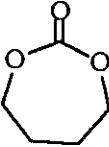
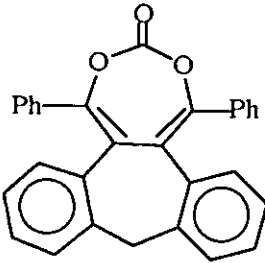
Compound	Phase	$\nu_{C=O}$	Ref.
	—	1750	388
	CCl ₄	1730	389
	mull —	1715 1710	390 391
	—	1725	350
	neat	1760	353
	CHCl ₃	1700	392
R			
H	mull	1700,1670	393
Me	mull	1665	393
Ph	mull	1660	393

Table XIX (continued)

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

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