# Palladium Catalysed Intramolecular *O*-Arylation of Enolates: Application to Benzo[*b*]furan Synthesis.

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## Supporting Information

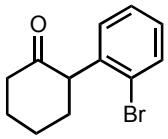
**General Information:** Melting points were determined on a Büchi 535 melting point apparatus and are uncorrected. IR spectra were recorded on a Perkin-Elmer 1600 FT IR spectrophotometer, using NaCl discs or as solids on a Perkin-Elmer Spectrum One FT-IR spectrometer opperating in Attenuated Total Reflectance mode. $^{1}$H NMR spectra were obtained on a Bruker Avance 300 spectrometer operating at 300 MHz, unless otherwise noted, with tetramethylsilane as an internal standard. *J* values are given in Hz. $^{13}$C NMR spectra were obtained on a Bruker Avance 300 spectrometer operating at 75 MHz, unless otherwise noted. All dry solvents were freshly distilled under nitrogen prior to use. Toluene was distilled over sodium wire. Dioxane was distilled over calcium hydride and stored over 4Å molecular sieves. Petroleum ether refers to that fraction obtained between 40-60 $^{o}$C. All glassware was dried in an oven and allowed to cool under nitrogen prior to use. All commercial reagents were used as obtained. Xantphos was purchased from Aldirch chemical company, DPEphos and tris(*tert*-butyl)phoshonium tetrafluoroborate were purchased from Strem chemicals.

Mass spectrometry measurements were performed at the EPSRC National Mass Spectrometry Service Centre, University of Wales Swansea; values are quoted as *m/z* with relative intensity in parentheses.

Thin layer chromatographic analyses were performed on plates coated with Kieselgel 60$F_{254}$. Visualisation was achieved with a 254 nm ultraviolet lamp, followed by

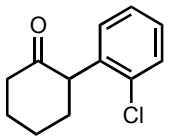
staining with vanillin or potassium permanganate. Flash chromatography was conducted under medium pressure, using matrix 60 silica.

**General procedure for the α-arylation of ketones, exemplified by the preparation of 2-(2-bromophenyl)cyclohexanone**



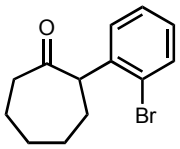

The arylation procedures are adapted from the procedures described by Buchwald and Hartwig and are unoptimized for individual substrates:[1] Cesium carbonate (9.13 g, 27.94 mmol) was added to an oven dried flask charged with $Pd_2(dba)_3$ (58 mg, 0.064 mmol) and Xantphos (88 mg, 0.153 mmol) under nitrogen. The flask was evacuated and back-filled with nitrogen three times. The reagents were suspended in anhydrous dioxane (12.70 mL) and 1-bromo-2-iodobenzene (3.60 g, 1.63 mL, 12.74 mmol) and cyclohexanone (2.50 g, 2.66 mL, 25.48 mmol) were added under nitrogen. The reaction was heated at 80 $^{o}$C for 24 hours. After cooling the reaction mixture was diluted with diethyl ether (*ca.* 50 mL) and shaken with water (100 mL). The product was extracted with diethyl ether (3 × 100 mL). The combined organic extracts were washed with brine (100 mL), dried ($MgSO_4$), filtered and reduced in *vacuo*. The product was purified *via* flash chromatography (5 to 10% diethyl ether – petroleum ether) to yield the title compound (2.51 g, 78%) as a white solid: mp 57.0-58.3 $^{o}$C (MeOH) (Lit.,[2] 58.2-59 $^{o}$C); $\nu_{max}$ (Nujul mull)/cm$^{-1}$ 2920, 2855, 1709, 1566, 1462, 1377, 1281, 1196, 1121, 1070, 1027, 977, 940, 769, 746, 722, 674; $\delta_H$ ($CDCl_3$) 1.71-2.10 (4H, m), 2.15-2.35 (2H, m), 2.51-2.89 (2H, m), 4.11 (1H, dd, $J$ = 12.4 and 5.3), 7.12 (1H, ddd, $J$ = 7.9, 7.2 and 1.9), 7.21 (1H, dd, $J$ = 7.9 and 1.9), 7.31 (1H, td, $J$ = 7.5 and 1.1), 7.56 (1H, 7.9 and 1.5); $\delta_C$ ($CDCl_3$) 25.1, 27.1, 33.6, 41.8, 56.0, 124.6, 126.8, 127.8, 128.9, 132.1, 137.8, 208.3; *m/z* LRMS (CI$^+$) 270.1 ([M+NH$_4$]$^+$, 100%), 253.1 ([M+H]$^+$, 15), 192.1 (10), 173.1 (20), 145.1 (5), 115.0 (10); HRMS (ES$^+$) 253.0225 (M+H)$^+$, calc. 253.0223.

**Preparation of 2-(2-chloro-phenyl)-cyclohexanone**




The general procedure was followed using 1-bromo-2-chlorobenzene (1.00 g, 5.22 mmol, 0.61 mL) and cyclohexanone (1.03 g, 10.45 mmol, 1.08 mL), heating at 100˚C for 20h. The product was purified *via* flash chromatography (5 to 20% diethyl ether – petroleum ether) to yield the title compound (0.64 g, 59%) as a creamy solid: mp 60-62˚C; $\nu_{max}$ (KBr)/cm$^{-1}$ 2938, 2869, 1709, 1560, 1477, 1443, 1430, 1296, 1290, 1197, 1123, 1070, 1051, 1035, 769, 749; $\delta_H$ (300MHz, $CDCl_3$) 1.65-1.90 (2H, m, $CH_2$), 1.90-2.04 (2H, m, $CH_2$), 2.08-2.29 (2H, m, $CH_2$), 2.40-2.53 (2H, m, $CH_2$), 4.034 (1H, dd, *J* 12.4 and 5.3, CH), 7.08-7.23 (3H, m, Ph), 7.30 (1H, d, *J* 7.9, Ph); $\delta_C$ (75MHz, $CDCl_3$) 26.1, 28.1, 34.3, 42.8, 54.4, 127.2, 128.5, 129.7, 129.8, 134.6, 137.1, 209.3; *m/z* (EI+) 211 (M:$^{37}$Cl, 24%), 209 (M:$^{35}$Cl, 80%), 174 (M-$^{35}$Cl, 33%), 173 (M-$^{37}$Cl, 100%), 164 (M, 44%), 151 (M-$C_3H_6O$, 26%), 145 (M-$^{35}$Cl/$^{37}$Cl-CO, 47%), 138 (51%), 129 (100%); (CI+, $NH_3$) 228 ($M^+NH_4$:$^{37}$Cl), 226 ($M^+NH_3$:$^{35}$Cl): HRMS (ES+) 226.0995 ($M^+NH_4$), calc. 226.0993.

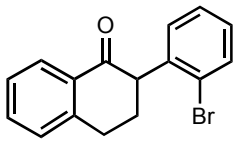
**Preparation of 2-(2-bromophenyl)cycloheptanone**




The general procedure was followed using 1-bromo-2-iodobenzene (1.80 g, 0.82 mL, 6.37 mmol) and cycloheptanone (1.43 g, 1.50 mL, 1.27 mmol) using NaHMDS (1M solution in tetrahydrofuran, 14.00 mL, 14.00 mmol) as the base, heating at 100˚C for 24h. The product was purified *via* flash chromatography: (5 to 20% diethyl ether – petroleum ether) to yield the title compound (1.57 g, 62%) as an amber oil: $\nu_{max}$ (Nujol mull)/cm$^{-1}$ 3062, 2928, 2800, 1705, 1470, 1445, 1439, 1217, 1156, 1134, 1022, 934, 746; $\delta_H$ ($CDCl_3$) 1.32-1.75 (2H, m), 1.72-2.18 (6H, m), 2.50-2.94 (2H, m), 4.39 (1H, dd, *J* = 10.9 and 2.6), 7.110 (1H, td, *J* = 7.9 and 2.3), 7.24-7.34 (2H, m), 7.55 (1H, dd, *J* = 7.9 and 1.1); $\delta_C$ ($CDCl_3$) 24.2, 29.5, 30.2, 32.4, 44.8, 57.0, 124.9, 127.9, 128.6, 130.0, 132.9,

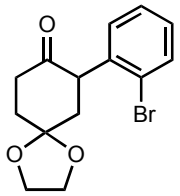
141.3, 213.2; *m/z* LRMS ($CI^+$) 286 ($[M+NH_4]^+$), 267 ($[M+H]^+$), 206, 187; HRMS ($ES^+$) 284.0651 $(M+NH_4)^+$, calc. 284.0645.

**Preparation of 2-(2-bromophenyl)-3,4-dihydro-2*H*-naphthalan-1-one**




The general procedure was followed using 1-bromo-2-iodobenzene (3.60g, 1.63 mL, 12.74 mmol) and α-tetralone (2.24 g, 2.04 mL, 15.29 mmol) using sodium *tert*-butoxide (1.59 g, 16.56 mmol) as the base, heating at 100 $^oC$ for 24 hours. The product was purified *via* flash chromatography (5% diethyl ether – petroleum ether) to yield the title compound (2.00 g, 52%) as a viscous yellow oil; $\nu_{max}$ (Liquid film)/$cm^{-1}$ 3062, 2933, 2871, 1683, 1600, 1566, 1474, 1455, 1435, 1355, 1299, 1223, 1156, 1107, 1025, 898, 745, 685; $\delta_H$ ($CDCl_3$) 2.24-2.46 (2H, m), 2.99 (1H, dt, $J$ = 16.6 and 4.1), 3.15 (1H, dd, $J$ = 10.9 and 4.9), 4.25 (1H, dd, $J$ = 11.9 and 4.9), 7.03-7.12 (2H, m), 7.18-7.32 (3H, m), 7.45 (1H, td, $J$ = 7.5 and 1.5), 7.54 (1H, dd, $J$ = 7.9 and 1.1), 8.04 (1H, dd, $J$ = 7.9 and 1.1); $\delta_C$ ($CDCl_3$) 29.8, 30.9, 54.8, 66.3, 125.7. 127.6, 128.0, 128.2, 128.9, 129.2, 130.0, 133.3, 133.4, 133.9, 140.1, 144.3, 197.3; *m/z* LRMS ($CI^+$) 320.1 ($[M+NH_4]^+$, 100%), 301.1 ($[M+H]^+$, 20), 240.1 (10), 221.1 (10); HRMS ($ES^+$) 318.0488 $(M+NH_4)^+$, calc. 318.0488).

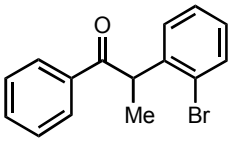
**Preparation of 7-(2-bromophenyl)-1,4-dioxaspiro[4.5]decan-8-one**




The general procedure was followed using 1-bromo-2-iodobenzene (3.60 g, 1.63 mL, 12.74 mmol) and 1,4-cyclohexane-dione monoethylene ketal (3.98 g, 25.48 mol), heating at 100 $^oC$ for 24 hours. The product was purified *via* flash chromatography (5 to 20% diethyl ether – petroleum ether) to yield the title compound (2.30 g, 58%) as white prisms: mp 98.2-100.1 $^oC$ (DCM/hexane); $\nu_{max}$ (Nujul mull)/$cm^{-1}$ 2923, 2854, 1719,

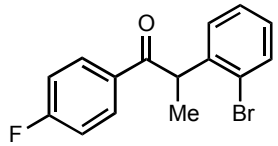
1569, 1465, 1377, 1308, 1121, 1064, 1026, 953, 766, 722; $\delta_H$ (400 MHz, $CDCl_3$) 2.10-2.29 (3H, m), 2.35 (1H, t, $J$ = 13.6), 2.53 (1H, app. dt, $J$ = 14.6 and 3.3), 2.80-2.94 (1H, m), 3.99-4.15 (4H, m), 4.47 (1H, dd, $J$ = 13.6 and 5.5), 7.20-7.18 (2H, m), 7.31 (1H, ddd, $J$ = 8.0, 7.0 and 0.8), 7.57 (1H, dd, $J$ = 8.0 and 0.8); $\delta_C$ (100 MHz, $CDCl_3$) 34.7, 38.5 40.5, 52.6, 64.8, 64.9, 107.3, 125.3, 127.5, 128.7, 129.5, 132.9, 137.3, 207.4; *m/z* LRMS ($CI^+$) 330.1 ($[M+NH_4]^+$, 80%), 311.3 ($[M+H]^+$, 5%), 250.2 (100), 217.2 (20), 141.1 (20), 86.2 (70); HRMS ($ES^+$) 328.0548 $(M+NH_4)^+$, calc. 328.0543).

**Preparation of 2-(2-bromophenyl)-1-phenylpropan-1-one**




The general procedure was followed using propiophenone (2.05 g, 2.03 mL, 15.28 mmol) and 1-bromo-2-iodobenzene (3.60 g, 1.63 mL, 12.74 mmol) using tris(*tert*-butyl)phosphonium tetrafluoroborate (92 mg, 0.319 mmol) as the ligand and sodium *tert*-butoxide (1.60 g, 16.56 mmol) as the base, heating at 60 $^oC$ for 9 hours. The product was purified *via* flash chromatography (2.5% diethyl ether – petroleum ether) to yield the title compound (2.62 g, 71%) as white prisms: mp 51.6-53.2 $^oC$ (MeOH) (Lit.,[3] 49-50 $^oC$); $\nu_{max}$ (Nujul mull)/$cm^{-1}$ 2926, 2855, 1676, 1597, 1581, 1455, 1374, 1327, 1250, 1226, 1181, 1024, 1001, 951, 756, 702, 685, 661; $^1H$ and $^{13}C$ NMR consistent with reported literature;[4] *m/z* LRMS ($CI^+$) 308.1 ($[M+NH_4]^+$, 100%), 289.1 ($[M+H]^+$, 20), 228.1 (25), 209.2 (20), 139.1 (10), 105.1 (10); HRMS ($ES^+$) 289.0227 ($M^+$), calc. 289.0223; Anal. Calc. for $C_{15}H_{13}BrO$: C, 62.30; H, 4.53. Found: C, 62.40; H, 4.65%.

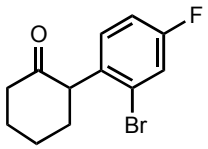
**Preparation of 2-(2-bromophenyl)-1-(4-fluorophenyl)propan-1-one**




The general procedure was followed using 4'-fluoropropiophenone (1.16 g, 1.06 mL, 7.64 mmol) and 1-bromo-2-iodobenzene (1.80 g, 0.82 mL, 6.37 mmol) using tris(*tert*-butyl)phosphonium tetrafluoroborate (46 mg, 0.159 mmol) as the ligand and sodium *tert*-butoxide (0.80 g, 8.28 mmol) as the base, heating at 60 $^oC$ for 6 hours. The product was

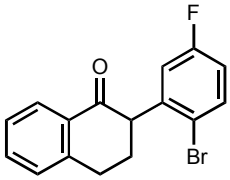
purified *via* flash chromatography (0 to 5% diethyl ether – cyclohexane) to yield the title compound (1.18 g, 60%) as a pale amber oil: $\nu_{max}$ (Liquid film)/cm$^{-1}$ 3069, 2980, 2933, 1684, 1596, 1506, 1470, 1439, 1409, 133, 1224, 1156, 1021, 952, 849, 796, 751, 689; $\delta_H$ (400 MHz, $CDCl_3$) 1.48 (3H, d, $J$ = 6.8), 5.06 (1H, q, $J$ = 6.8), 7.01-7.42 (4H, m), 7.19 (1H, app. dd, $J$ = 7.5 and 7.0), 7.60 (1H, d, $J$ = 8.0), 7.96 (2H, dd, $J$ = 8.5 and 5.5); $\delta_C$ (100 MHz, $CDCl_3$) 17.9, 47.1, 115.7 (d, $J_{CF}$ = 21.6), 123.9, 128.2, 128.6, 128.6, 131.4, (d, $J_{CF}$ = 9.6), 132.4, 133.3, 140.8, 165.6 (d, $J_{CF}$ = 255.7), 196.5; *m/z* LRMS (CI$^+$) 324.1 ([M+$NH_4$]$^+$, 100%), 307.1 (M$^+$, 20), 246.2 (25), 123.1 (40); HRMS (ES$^+$) 307.0130 (M+H)$^+$, calc. 307.0128.

**Preparation of 2-(2-bromo-4-fluorophenyl)cyclohexanone**



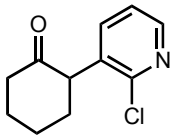

The general procedure was followed using 2-bromo-4-fluoroiodobenzene (3.82 g, 12.74 mmol) and cyclohexanone (2.50 g, 2.66 mL, 25.48 mmol), heating at 80 $^oC$ for 36 hours. The product was purified *via* flash chromatography (10% diethyl ether – petroleum ether) to yield the title compound (1.36 g, 39%) as a white prisms: mp 63.9-66.2 $^oC$ (DCM/hexane); $\nu_{max}$ (Nujul mull)/cm$^{-1}$ 2924, 2854, 1706, 1588, 1489, 1452, 1377, 1227, 1179, 871, 828; $\delta_H$ ($CDCl_3$) 1.72-2.09 (4H, m), 2.16-2.33 (2H, m), 2.52-2.59 (2H, m), 4.08 (1H, dd, $J$ = 12.2 and 5.1), 7.04 (1H, td, $J$ = 8.3 and 2.6), 7.19 (1H, dd, $J$ = 8.7 and 6.0), 7.32 (1H, dd, $J$ = 8.3 and 2.6); $\delta_C$ ($CDCl_3$) 20.1, 25.2, 34.9, 42.8, 56.3, 115.0 (d, $J_{CF}$ = 20.3), 120.2 (d, $J_{CF}$ = 24.0), 125.3 (d, $J_{CF}$ = 9.0), 130.7 (d, $J_{CF}$ = 8.3), 134.7 (d, $J_{CF}$ = 3.8), 161.6 (d, $J_{CF}$ = 248.3), 209.2; *m/z* LRMS (ES$^+$) 273.1 ([M+H]$^+$, 25%), 255.1 (20), 203.0 (50), 189.0 (100), 174 (20), 147.9 (10); HRMS (ES$^+$) 288.0391 (M+$NH_4$)$^+$, calc. 288.0394.

**Preparation of 2-(2-bromo-5-fluoro-phenyl)-3,4-dihydro-2*H*-naphthalen-1-one**




The general procedure was followed using 2-bromo-5-fluoroiodobenzene (0.13 g, 0.42 mmol, 0.05 mL) and α-tetralone (0.07 g, 0.50 mmol, 0.07 mL) using sodium *tert*-butoxide (0.06 g, 0.62 mmol) as the base, heating at 110˚C for 16h. The product was purified *via* flash chromatography (10 to 20% diethyl ether – petroleum ether) to yield the title compound (0.90 g, 57%) as a white crystalline solid: mp 78-79˚C; $\nu_{max}$ (KBr)/cm$^{-1}$ 3065, 2962, 1679, 1599, 1579, 1469, 1455, 1428, 1410, 1294, 1265, 1218, 1166, 1144, 1025, 1011, 869, 824, 809, 758, 749; $\delta_H$ (300MHz, $CDCl_3$) 2.36-2.52 (2H, m, $CH_2$), 3.10 (1H, dt, *J* 16.8 and 4.0, $CH_2$), 3.19-3.33 (1H, m, $CH_2$), 4.31 (1H, dd, *J* 11.4 and 5.9, CH), 6.87-6.97 (2H, m, Ph), 7.33 (1H, d, *J* 7.7, Ph), 7.38 (1H, t, *J* 7.7, Ph), 7.52-7.62 (2H, m, Ph), 8.13 (1H, dd, *J* 8.0 and 1.5, Ph); $\delta_C$ (75MHz, $CDCl_3$) 29.6, 30.6, 54.7, 116.1, 116.7, 127.1, 128.1, 129.0, 133.9, 134.1, 134.2; *m/z* (CI+, $NH_3$) 338 ($M^+NH_4$:$^{81}$Br), 336 ($M^+NH_4$:$^{79}$Br), 321 (M+H:$^{81}$Br), 319 (M+H:$^{79}$Br); HRMS (ES+) 336.0390 ($M^+NH_4$:$^{79}$Br), calc. 336.0394.

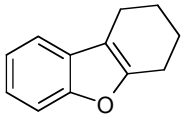
**Preparation of 2-(2-chloropyridin-3-yl)cyclohexanone**




The general procedure was followed using 3-bromo-2-chloropyridine (245 mg, 1.27 mmol) and cyclohexanone (250 mg, 0.27 mL, 2.55 mmol), heating at 100 $^o$C for 24 hours. The product was purified *via* flash chromatography (5 to 20% diethyl ether – petroleum ether) to yield the title compound (94 mg, 35%) as white prisms: mp 109.5-110.3 (DCM/hexane); $\nu_{max}$ (Nujul mull)/cm$^{-1}$ 3505, 2923, 2854, 1705, 1581, 1567, 1450, 1409, 1377, 1289, 1186, 1096, 1055, 806, 737; $\delta_H$ ($CDCl_3$) 1.73-1.99 (3H, m), 2.02-2.13 (1H, m), 2.18-2.37 (2H, m), 2.53-2.62 (2H, m), 4.11 (1H, dd, *J* = 12.2 and 5.5), 7.26 (1H, dd, *J* = 7.9 and 4.9), 7.59 (1H, dd, *J* = 7.9 and 1.9), 8.31 (1H, dd, *J* = 4.9 and 1.9); $\delta_C$ ($CDCl_3$) 25.9, 29.1, 37.5, 42.7, 54.0, 122.9, 133.8, 138.8, 148.3, 151.8, 208.5; *m/z* LRMS

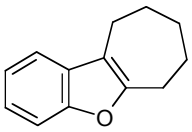
(EI$^+$) 209.2 ($M^+$, 15%), 174.1 (100), 146.2 (70), 139.1 (80), 130.1 (90), 117.2 (80), 104.2 (80); HRMS (EI) 209.0602 ($M^+$), calc. 209.0602.

**General procedure for benzofuran synthesis, exemplified by the preparation of 1,2,3,4-tetrahydro-dibenzofuran, 4 (Table 2, entry 1)**



Cesium carbonate (0.18 g, 0.56 mmol) was added to a flask charged with $Pd_2(dba)_3$ (9 mg, 0.01 mmol) and DPEphos (13 mg, 0.02 mmol) under nitrogen. The reagents were suspended in anhydrous toluene (1 mL) and 2-(2-bromophenyl)cyclohexanone (0.10 g, 0.40 mmol) was added and the reaction heated to 100˚C for 20 hours. After cooling the reaction mixture was filtered through a plug of celite and the filtrate reduced *in vacuo*. The residue was purified *via* flash chromatography (petroleum ether) to yield the title compound (64 mg, 95%) as a colourless oil: $\nu_{max}$ (NaCl)/cm$^{-1}$ 3060, 2927, 2849, 1741, 1640, 1614, 1453, 1363, 1298, 1275, 1257, 1223, 1190, 1122, 1009, 876, 820, 743; $\delta_H$ (300MHz, $CDCl_3$) 1.72-1.82 (2H, m, $CH_2$), 1.82-1.92 (2H, m, $CH_2$), 2.55 (2H, tt, *J* 6.0 and 1.9, $CH_2$), 2.67 (2H, tt, *J* 6.0 and 1.9, $CH_2$), 7.06-7.16 (2H, m, Ph), 7.28-7.35 (2H, m, Ph); $\delta_C$ (75MHz, $CDCl_3$) 20.9, 23.1, 23.4, 23.5, 111.2, 113.2, 118.7, 122.5, 123.3, 129.3, 154.4, 154.7; *m/z* (EI+) 172 (M, 44%), 144 (M-CO), 115 (M-CO-$C_2H_5$, 44%), 69 (M-CO-$C_5H_{13}$, 39%); HRMS (EI) 172.0882 ($M^+$), calc. 172.0883.

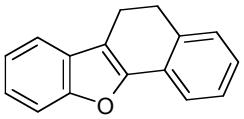
**Preparation of 6,7,8,9-tetrahydro-5*H*-10-oxa-benzo[α]azulene (Table 2, entry 3)**



The general procedure was followed using 2-(2-bromophenyl)cycloheptanone (0.10 g, 0.37 mmol), using NaHMDS (0.80 mL, 0.80 mmol) as the base and heating at 110˚C for 20h. The product was purified *via* flash chromatography (petroleum ether) to yield the title compound (63 g, 95%) as a colourless oil: $\nu_{max}$ (Nujul mull)/cm$^{-1}$ 3036, 2923, 2849, 1626, 1610, 1587, 1475, 1455, 1368, 1308, 1278, 1240, 1228, 1210, 1147, 1096, 1070, 1037, 1009, 815, 743; $\delta_H$ (300MHz, $CDCl_3$) 1.65-1.87 (6H, m, $CH_2$), 2.62 (2H, app. t, *J*

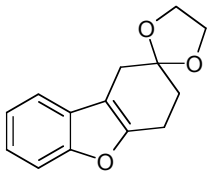
5.7, $CH_2$), 2.85 (2H, app. t, *J* 5.7, $CH_2$), 7.07-7.14 (2H, m, Ph), 7.25-7.35 (2H, m, Ph); $\delta_C$ (75MHz, $CDCl_3$) 23.6, 26.8, 28.7, 29.5, 31.0, 110.9, 116.2, 118.6, 122.3, 123.2, 130.9, 153.7, 156.8; *m/z* (EI+) 186 (M, 54%), 158 (M-CO, 42%), 157 (M-CHO, 75%), 144 (54%), 128 (60%), 115 (100%): (CI+, $NH_3$) 187 ($M^+H$); HRMS (ES+) 187.1119 $(M^+H)^+$, calc. 187.1117.

**Preparation of 5,6-dihydro-benzo[β]naphtho[2,1-δ]furan (Table 1, entry 4)**



The general procedure was followed using 2-(2-bromophenyl)-3,4-dihydro-2*H*-naphthalan-1-one (0.10 g, 0.26 mmol), using NaHMDS (0.38 mL, 0.38 mmol) as the base and heating at 100˚C for 19h. The product was purified *via* flash chromatography: (5% diethyl ether – petroleum ether) to yield the title compound (42 mg, 81%) as a colourless oil: $\nu_{max}$ (KBr)/$cm^{-1}$ 3053, 2933, 2846, 1485, 1456, 1443, 1425, 1357, 1302, 1280, 1263, 1184, 1138, 1114, 1087, 926, 868, 827, 741; $\delta_H$ (300MHz, $CDCl_3$) 2.96 (2H, t, *J* 7.9, $CH_2$), 3.11 (2H, t, *J* 7.9, $CH_2$), 7.18-7.33 (5H, m, Ph), 7.49-7.55 (2H, m, Ph), 7.66 (1H, d, *J* 7.5, Ph); $\delta_C$ (75MHz, $CDCl_3$) 19.7, 29.1, 111.8, 119.6, 120.9, 123.1, 124.5, 127.3, 128.0, 128.4, 136.4; *m/z* (EI+) 221 (M+H, 12%), 220 (M, 70%), 219 (M+, 65%), 218 (M-$H_2$, 100%), 191 (M-CO, 25%), 189 (M-CO-$H_2$, 55%): (CI+, $NH_3$) 221 ($M^+H$); HRMS (ES+) 221.0959 $(M^+H)^+$, calc. 221.0961.

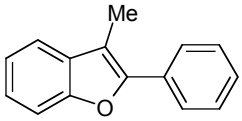
**Preparation of 3,4 dihydro-*1H*-dibenzofuran-2-one ethylene ketal (Table 2, entry 5)**



The general procedure was followed using 7-(2-bromophenyl)-1,4-dioxaspiro[4.5]decan-8-one (0.05 g, 0.16 mmol), using sodium *tert*-butoxide (23 mg, 0.24 mmol) as the base and heating at 100˚C for 17h. The product was purified *via* flash chromatography (5% diethyl ether – petroleum ether) to yield the title compound (27 mg, 73%) as a creamy solid: $\nu_{max}$ (KBr)/$cm^{-1}$ 2922, 2889, 1639, 1609, 1480, 1454, 1439, 1372, 1339, 1295,

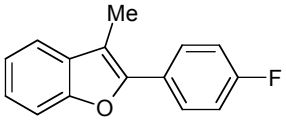
1279, 1263, 1232, 1208, 1178, 1126, 1098, 1058, 1022, 950, 882, 848, 826, 758, 697; $\delta_H$ (300MHz, $CDCl_3$) 2.10 (2H, t, *J* 6.4, $CH_2$), 2.89 (2H, s, $CH_2$), 2.95 (2H, tt, *J* 6.5 and 1.5, $CH_2$), 4.01-4.12 (4H, m, $CH_2$), 7.15-7.24 (2H, m, Ph), 7.34-7.43 (2H, m, Ph); $\delta_C$ (100MHz, $CDCl_3$) 22.1, 31.9, 32.0, 65.2, 108.9, 111.3, 111.5, 118.67, 122.6, 123.7, 129.0, 152.8, 155.7; *m/z* (EI+) 230 (M, 32%), 144 (M-$C_3H_2O_3$, 100%): (CI+, $NH_3$) 249 ($M^+NH_4$), 248 ($M^+NH_3$), 231 ($M^+H$), 230 (M); HRMS (ES+) 248.1279 ($M^+NH_4$), calc. 248.1281.

**Preparation of 3-methyl-2-phenyl-benzofuran (Table 2, entry 6)**




The general procedure was followed using 2-(2-bromophenyl)-1-phenylpropan-1-one (0.10 g, 0.35 mmol), using sodium *tert*-butoxide (48 mg, 0.52 mmol) as the base and heating at 80˚C for 23h. The product was purified *via* flash chromatography (petroleum ether) to yield the title compound (57 mg, 80%) as a colourless oil: $\nu_{max}$ (Nujul mull)/$cm^{-1}$ 3060, 2923, 1494, 1456, 1420, 1344, 1260, 1213, 1137, 1114, 1069, 1006, 766, 744, 693; $\delta_H$ (300MHz, $CDCl_3$) 2.49 (3H, s, $CH_3$), 7.23-7.33 (2H, m, Ph), 7.36 (1H, tt, *J* 7.5 and 1.9, Ph), 7.45-7.57 (4H, m, Ph), 7.82 (2H, d, *J* 8.3, Ph); $\delta_C$ (100MHz, $CDCl_3$); 9.9, 111.3, 111.6, 119.6, 122.7, 124.7, 127.1, 128.3, 128.5, 129.0, 130.1, 131.6, 131.8, 151.1, 154.2; *m/z* (EI+) 209 (M+H, 15%), 208 (M, 100%), 207 (M-H, 66%), 178 (M-$CH_2O$, 47%) 131 (M-$C_4H_8O$, 28%): (CI+, $NH_3$) 209 ($M^+H$); HRMS (ES+) 209.0961 ($M^+NH_4$), calc. 209.0961.

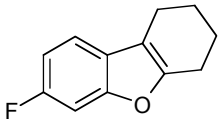
**Preparation of 2-(4-fluoro-phenyl)-3-methyl-benzofuran (Table 2, entry 7)**




The general procedure was followed using 2-(2-bromophenyl)-1-(4-fluorophenyl)propan-1-one (0.10 g, 0.33 mmol), using sodium *tert*-butoxide (47 mg, 0.49 mmol) as the base and heating at 100˚C for 22h. The product was purified *via* flash chromatography (petroleum ether) to yield the title compound (49 mg, 68%) as a colourless oil; $\nu_{max}$

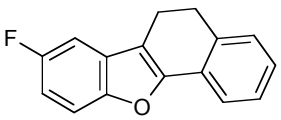
(NaCl)/cm$^{-1}$ 3062, 2922, 2868, 1604, 1584, 1507, 1476, 1454, 1410, 1386, 1347, 1292, 1258, 1233w, 1158, 1115, 1090, 1006, 878, 836, 789, 744; $\delta_H$ (300MHz, $CDCl_3$) 2.37 (3H, s, $CH_3$), 7.09 (2H, app. tt, *J* 8.8 and 2.3, Ph), 7.15-7.25 (2H, m, Ph), 7.38-7.48 (2H, m, Ph), 7.70 (1H, dd, *J* 9.0 and 5.3, Ph), 7.67-7.74 (1H, m, Ph); $\delta_C$ (100MHz, $CDCl_3$); 9.8, 111.3, 116.1 (d, $J_{CF}$ 21.7), 119.7, 122.8, 124.8, 128.0 (d, $J_{CF}$ 3.1), 128.9 (d, $J_{CF}$ 8.1), 131.2, 150.3, 154.1, 162.8 (d, $J_{CF}$ 249.1); *m/z* (EI+) 227 (M+H,13%), 226 (M, 91%), 225 (M-H, 56%), 196 (M-$CH_2O$, 26%): (CI+, $NH_3$) 227 ($M^+H$) 226 (M); HRMS (ES+) 227.0865 $(M^+H)^+$, calc. 227.0867.

**Preparation of 8-fluoro-1,2,3,4-tetrahydro-dibenzofuran (Table 2, entry 8)**




The general procedure was followed using 2-(2-bromo-4-fluorophenyl)cyclohexanone (0.50 g, 1.84 mmol), heating at 100˚C for 22h. The product was purified *via* flash chromatography (petroleum ether) to yield the title compound (284 mg, 81%) as a colourless oil: $\nu_{max}$ (Nujul mull)/cm$^{-1}$ 3081, 2934, 2847, 1645, 1621, 1599, 1489, 1443, 1428, 1361, 1330, 1296, 1269, 1256, 1194, 1116, 1100, 942, 872, 838, 803; $\delta_H$ (300MHz, $CDCl_3$) 1.80-1.99 (4H, m, $CH_2$), 2.57-2.64 (2H, m, $CH_2$), 2.70-2.77 (2H, m, $CH_2$), 6.92-7.00 (1H, m, Ph), 7.13 (1H, dd, *J* 9.0 and 1.9, Ph), 7.30 (1H, dd, *J* 8.4 and 5.4, Ph); $\delta_C$ (75MHz, $CDCl_3$) 20.8, 23.0, 23.2, 23.8, 99.1 (d, $J_{CF}$ 26.7), 110.4 (d, $J_{CF}$ 23.6), 113.0, 118.7 (d, $J_{CF}$ 9.9), 125.5, 154.6, 155.0 (d, $J_{CF}$ 4.3), 160.6 (d, $J_{CF}$ 239.4); *m/z* (EI+) 190 (M, 36%), 162 (M-CO, 100%), 133 (M-$C_3H_5O$, 60%): (CI+, $NH_3$) 191 ($M^+H$), 190 (M-H), 162 (M-CO): (ES+) [$M^+H$] calc. 191.0867, measured 191.0866.

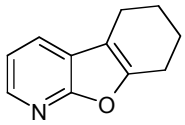
**Preparation of 8-fluoro-5,6-dihydro-benzo[β]naphtha[2,1-δ]furan (Table 2, entry 9)**




The general procedure was followed using 2-(2-bromo-5-fluoro-phenyl)-3,4-dihydro-2*H*-naphthalen-1-one (50 mg, 0.16 mmol), using sodium *tert*-butoxide (23 mg, 0.24 mmol) as the base and heating at 100˚C for 48h. The product was purified *via* flash

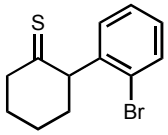
chromatography (5% diethyl ether – petroleum ether) to yield the title compound (28 mg, 74%) as a colourless oil: $\nu_{max}$ (Nujul mull)/cm$^{-1}$ 3053, 2936, 1619, 1593, 1471, 1445, 1435, 1390, 1351, 1321, 1277, 1251, 1219, 1170, 1141, 1108, 1082, 1043, 1021, 958, 925, 883, 831, 800, 758, 728; $\delta_H$ (300MHz, $CDCl_3$) 2.95 (2H, t, *J* 8.3, $CH_2$), 3.13 (2H, t, *J* 7.9, $CH_2$), 6.99 (1H, td, *J* 9.0 and 2.6, Ph), 7.16 (1H, dd, *J* 8.7 and 2.3, Ph), 7.21-7.37 (3H, m, Ph), 7.45 (1H, dd, *J* 8.3 and 4.1, Ph), 7.67 (1H, d, *J* 7.2, Ph); $\delta_C$ (75MHz, $CDCl_3$) 14.4, 19.3, 22.9, 28.7, 29.2, 32.1, 105.1, 112.2, 120.9, 127.1, 128.3, 128.3; *m/z* (EI+) 239 (M+H, 14%), 238 (M, 100%), 237 (M-H, 71%), 209 (M-CHO, 33%), 207 (M-$CH_3O$, 28%); HRMS (ES+) 239.0865 ($M^+NH_4$), calc. 239.0867.

**Preparation of 5,6,7,8-tetrahydro-benzo[4,5]furo[2,3-β]pyridine (Table 2, entry 10)**




The general procedure was followed using 2-(2-chloropyridin-3-yl)cyclohexanone (0.05g, 0.24 mmol), using sodium *tert*-butoxide (34 mg, 0.36 mmol) as the base and heating at 100˚C for 20h. The product was purified *via* flash chromatography (petroleum ether) to yield the title compound (34 mg, 85%) as a colourless oil: $\nu_{max}$ (NaCl)/cm$^{-1}$ 3054, 2933, 2848, 1637, 1586, 1447, 1407, 1393, 1363, 1299, 1256, 1233, 1181, 1117, 991, 791, 776; $\delta_H$ (300MHz, $CDCl_3$) 1.83-2.04 (4H, m, $CH_2$), 2.59-2.69 (2H, m, $CH_2$), 2.76-2.86 (2H, m, $CH_2$), 7.17 (1H, dd, *J* 8 and 5, Ph), 7.74 (1H, dd, *J* 7 and 1.5, Ph), 8.22 (1H, dd, *J* 5 and 1.5, Ph); $\delta_C$ (75MHz, $CDCl_3$) 20.5, 22.7, 22.9, 23.5, 112.5, 118.8, 121.2, 127.1, 142.6, 154.4, 161.9; *m/z* (EI+) 174 (M+H, 5%), 173 (M, 39%), 172 (M-H, 13%), 145 (M-CO, 100%): (CI+, $NH_3$) 174 (M), 175 (M+H); HRMS (ES+) 174.0913 ($M^+NH_4$), calc. 174.0913.

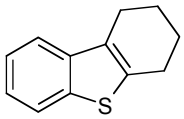
**Preparation of 2-(2-bromo-phenyl)-cyclohexanethione, 5**




2-(2-Bromophenyl)cyclohexanone (0.50 g, 1.98 mmol) was added to a flask charged with phosphorus pentasulfide (0.22 g, 0.49 mmol) under nitrogen, and the reaction mixture

suspended in anhydrous toluene (2.50 mL). The mixture was stirred at room temperature for 10 minutes prior to the addition of hexamethyldisiloxane (0.55 g, 3.36 mmol, 0.71 mL) and heated to 90˚C for 21h. After cooling the reaction mixture was filtered through a plug of silica and the filtrate reduced *in vacuo* to yield the title compound (0.375 g, 71%) as a colourless oil. The product was used without further purification: $\nu_{max}$ (NaCl)/cm$^{-1}$ 3050, 2924, 2855, 1642, 1587, 1559, 1466, 1435, 1334, 1258, 1243, 1136, 1115, 1078, 1050, 1027, 1014, 821, 799, 751, 724, 688; $\delta_H$ (300MHz, $CDCl_3$) 1.63-1.80 (4H, m, $CH_2$), 1.95-2.12 (1H, m, CH), 2.24-2.39 (4H, m, $CH_2$), 7.03-7.10 (2H, m, Ph), 7.24 (1H, td, *J* 7.5 and 1.5, Ph), 7.53 (1H, dd, *J* 8.3 and 1.2, Ph); $\delta_C$ (100MHz, $CDCl_3$); 23.2, 24.0, 32.0, 34.1, 123.4, 125.9, 128.2, 129.0, 130.6, 133.4, 133.7, 143.8; *m/z* (EI+) 271 (M: $^{81}$Br, 53%), 270 (M-H:$^{81}$Br, 52%), 269 (M: $^{79}$Br, 100%), 268 (M-H: $^{79}$Br, 48%), 189 (M-Br, 40%): (CI+, $NH_3$) 288 ($M^+NH_3$: $^{81}$Br), 286 ($M^+NH_3$: $^{79}$Br), 272 ($M^+H$: $^{81}$Br), 271 (M: $^{81}$Br), 270 ($M^+H$: $^{79}$Br), 269 (M: $^{79}$Br): (EI) [$M^+$] calc. 267.9916, measured 267.9917.

**Preparation of 1,2,3,4-tetrahydro-dibenzothiophene, 6**




Cesium carbonate (0.18 g, 0.56 mmol) was added to a flask charged with $Pd_2(dba)_3$ (9 mg, 0.01 mmol) and DPEphos (13 mg, 0.02 mmol) under nitrogen. The reagents were suspended in anhydrous toluene (0.5 mL) and the 2-(2-bromo-phenyl)-cyclohexanethione (0.10 g, 0.37 mmol) added under nitrogen and the reaction heated to 100˚C for 20 hours. After cooling the reaction mixture was filtered through a plug of celite and the filtrate reduced *in vacuo*. The residue was purified *via* flash chromatography (petroleum ether) to yield the title compound (52 mg, 74%) as a colourless oil: $\nu_{max}$ (NaCl)/cm$^{-1}$ 3058, 2933, 2855, 2838, 1580, 1461, 1445, 1349, 1300, 1250, 1151, 1124, 1066, 1024, 966, 950, 931, 848, 819, 804, 750, 728, 714; $\delta_H$ (300MHz, $CDCl_3$) 1.87-1.99 (4H, m, $CH_2$), 2.72-2.79 (2H, m, $CH_2$), 2.84-2.90 (2H, m, $CH_2$), 7.22-7.36 (2H, m, Ph), 7.57 (1H, dd, *J* 7.2 and 1.1, Ph), 7.76 (1H, app. d, *J* 7.2, Ph); $\delta_C$ (100MHz, $CDCl_3$); 22.7, 24.0, 24.1, 26.1, 120.8, 122.6, 123.9, 124.2, 129.9, 137.1, 138.8, 140.2; $^1$H and $^{13}$C NMR consistent with reported

literature;[4,5] *m/z* (EI+) 188 (M, 100%), 187 (M-H, 60%): (CI+, $NH_3$) 189 ($M^+H$), 188 (M), 187 ($M^-H$): (EI) [$M^-H$] calc. 187.0576, measured 187.0570.

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1. a) J. M. Fox, X. Huang, A. Chieffi, S. L. Buchwald, *J. Am. Chem. Soc.* **2000**, *122***,** 1360; b) M. Kawatsura, J. F. Hartwig, *J. Am. Chem. Soc.* **1999**, *121***,** 1473.
2. T. G. Cochran, D. V. Wareham A. C. Huitric, *J. Pharm. Sci.* **1971**, *60***,** 180.
3. M. T. Baumgarter, L. B. Jimenez, A. B. Pierini, R. A. Rossi, *J. Chem. Soc., Perkin Trans. 2* **2002**, 1092.
4. J. C. DiCesare, L. B. Thompson, R. J. Andersen, J. Nail *Org*. *Prep*. *Proced*. *Int*. **2000**, *32*, 169-174.
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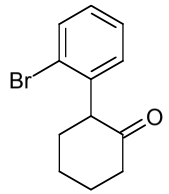
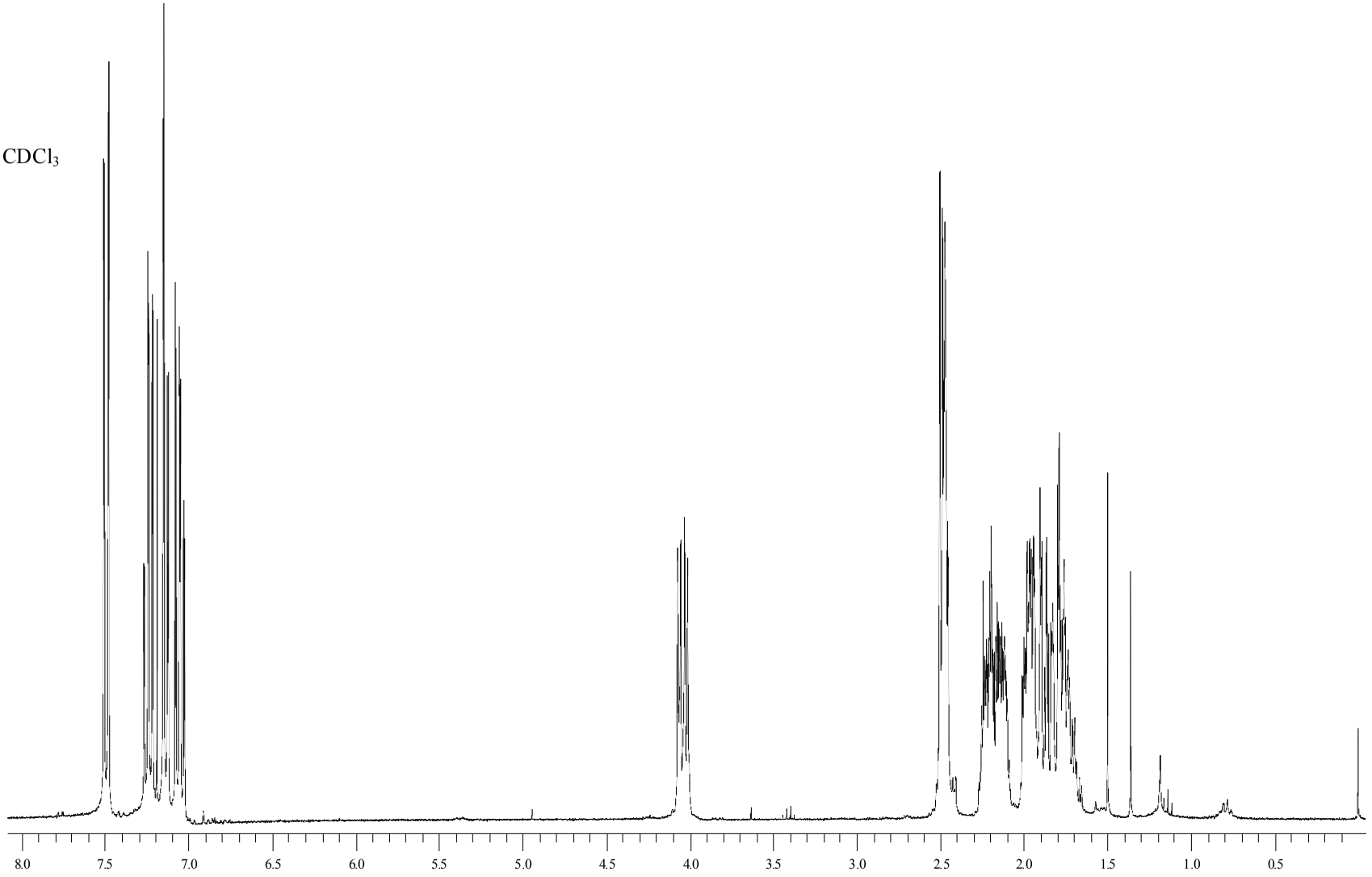
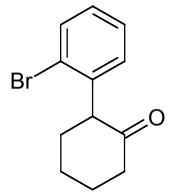
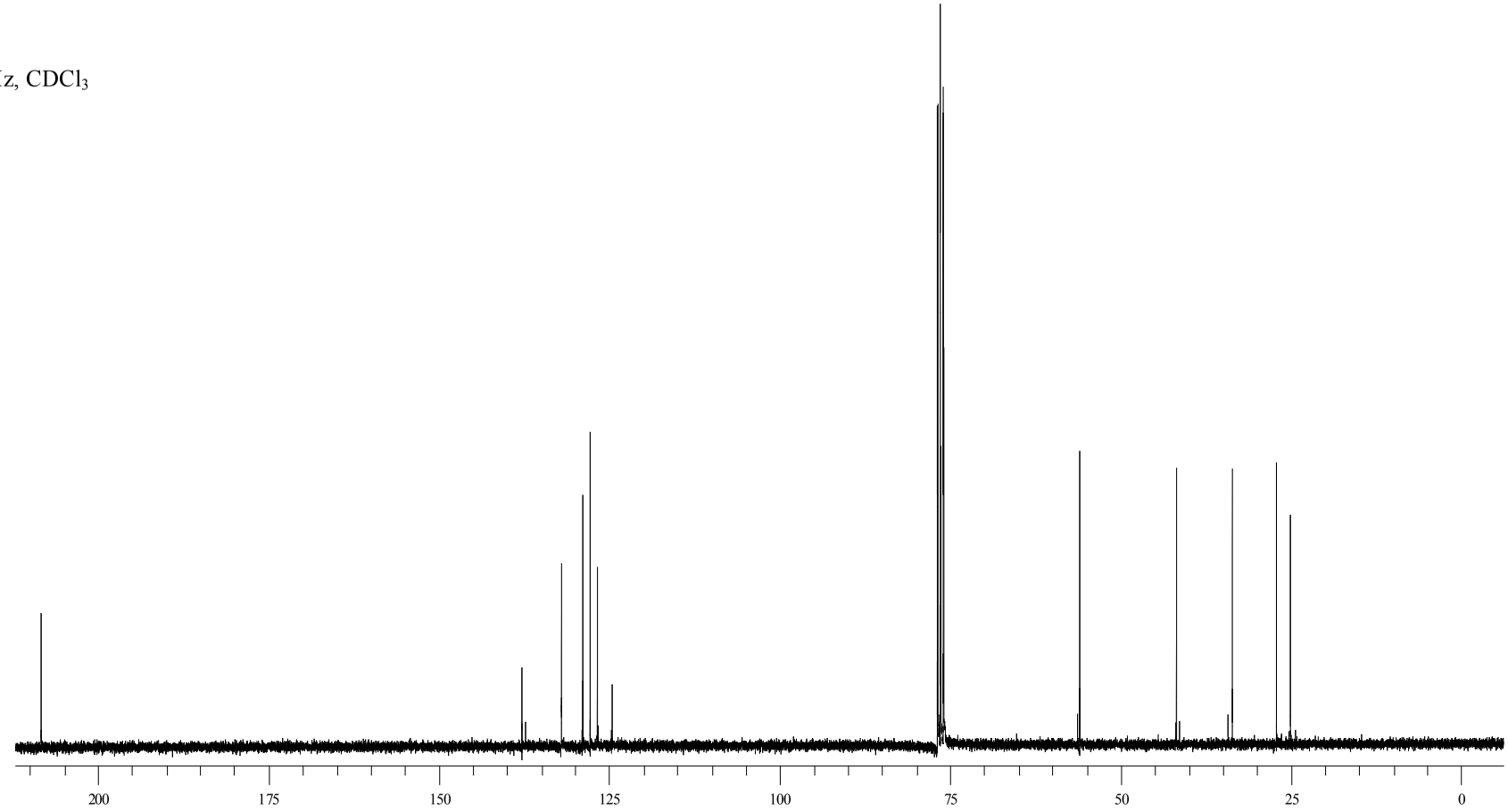


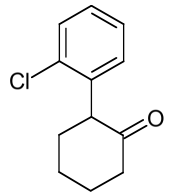

$^{1}$HNMR, 300MHz, $CDCl_3$



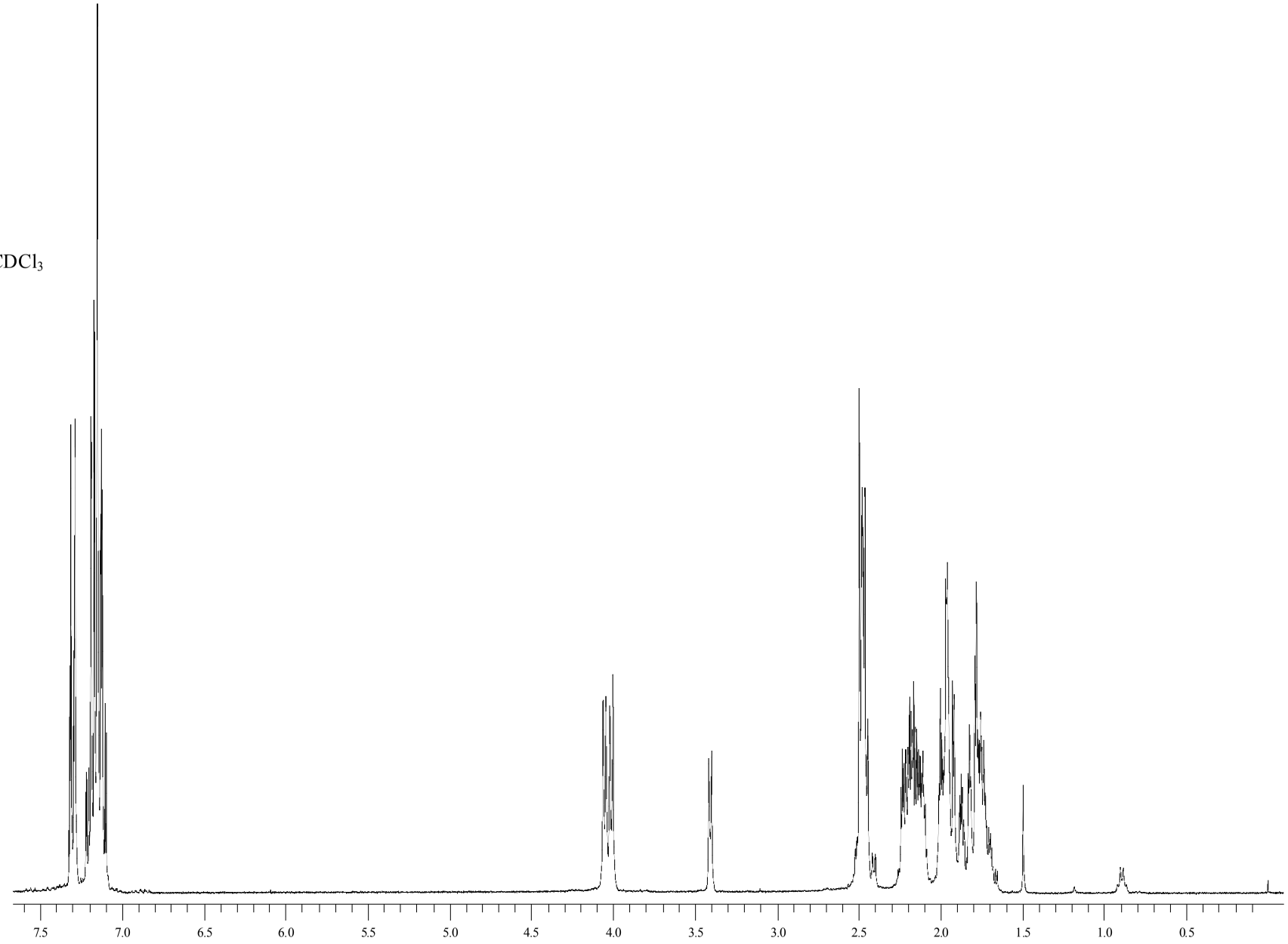


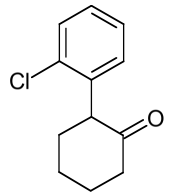

$^{13}$CNMR, 75MHz, $CDCl_3$



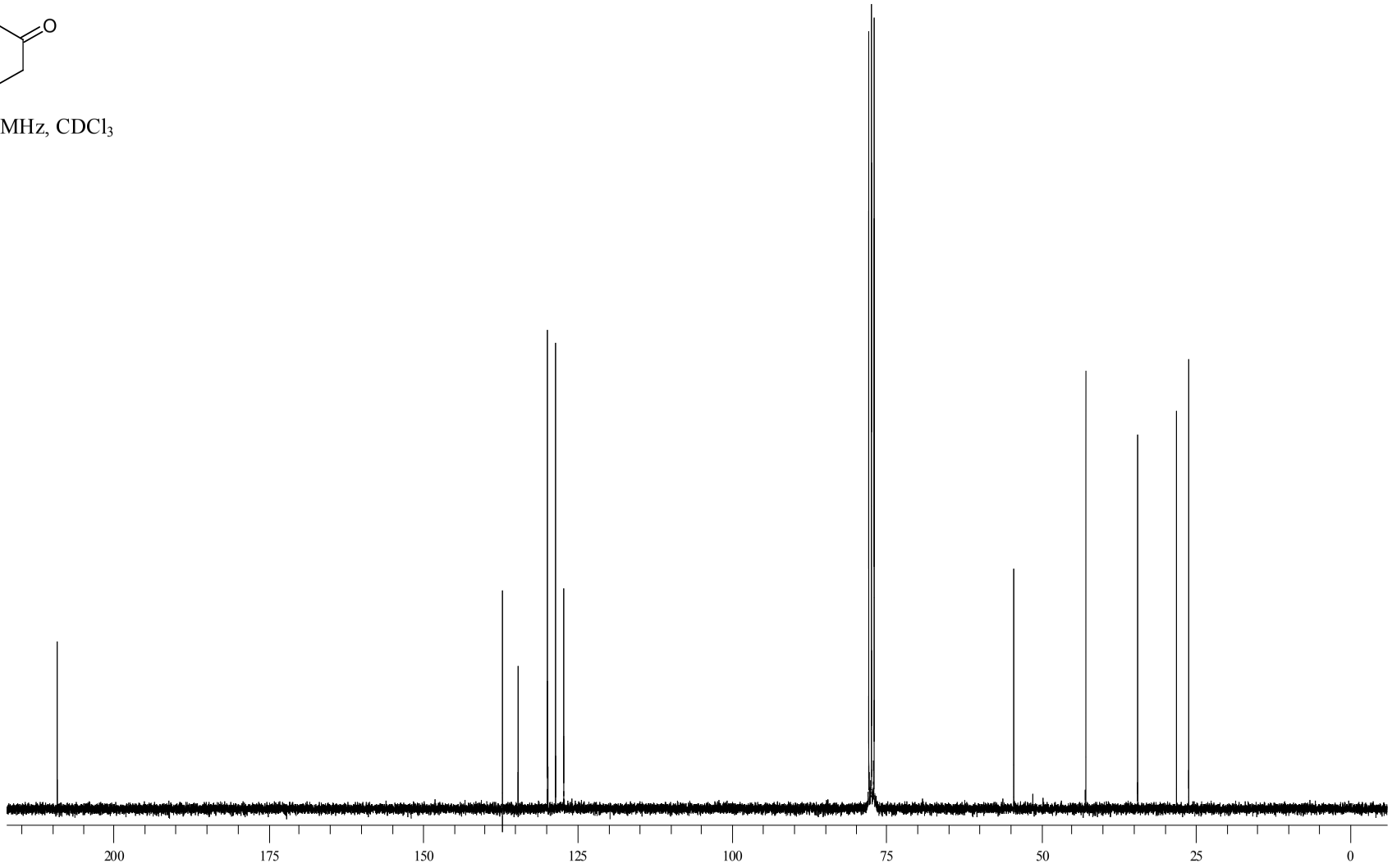


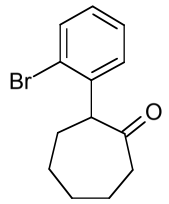

$^{1}$HNMR, 300MHz, $CDCl_3$



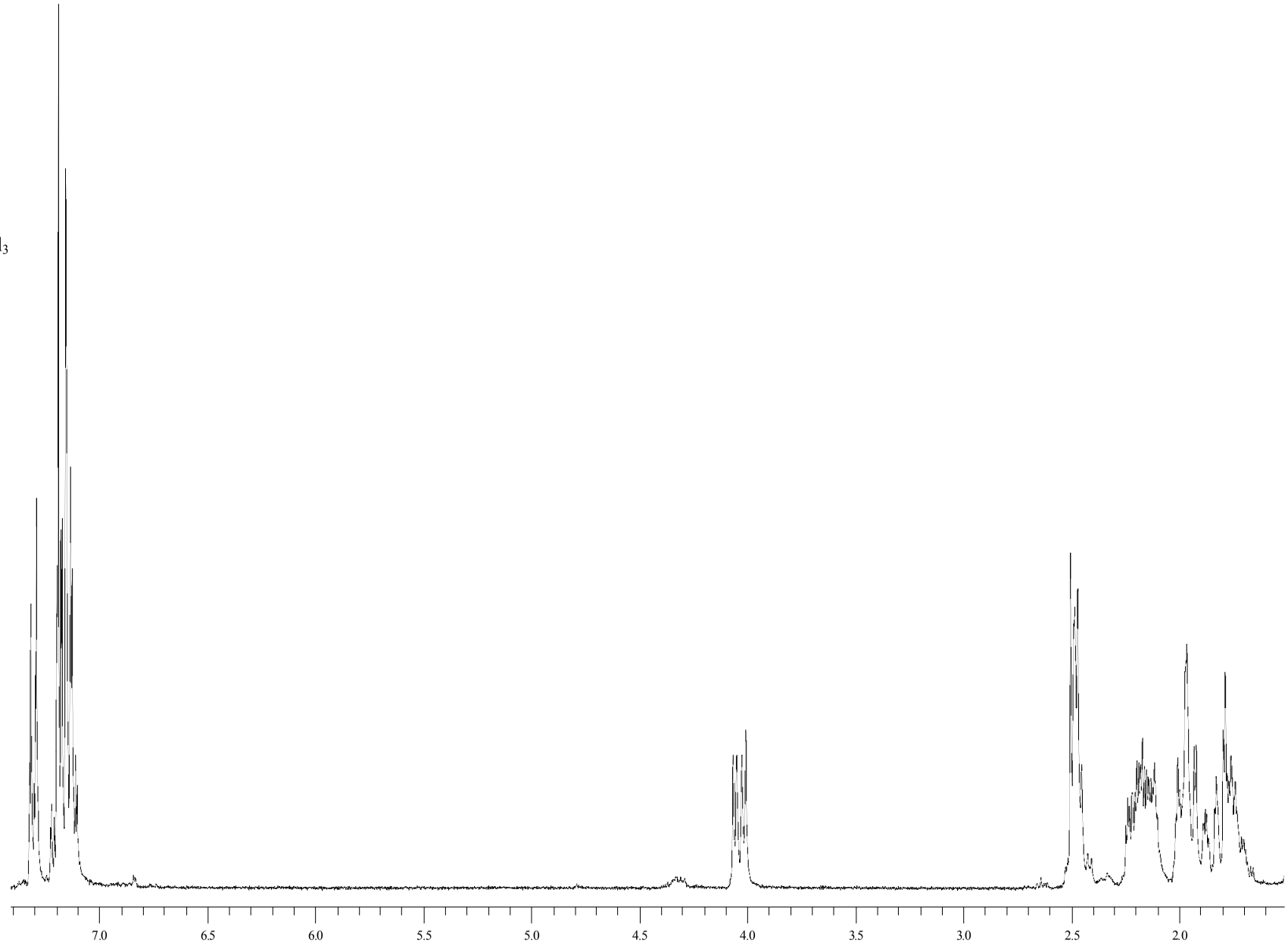


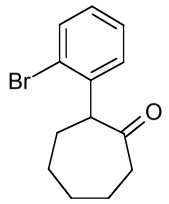

$^{13}$CNMR, 75MHz, $CDCl_3$



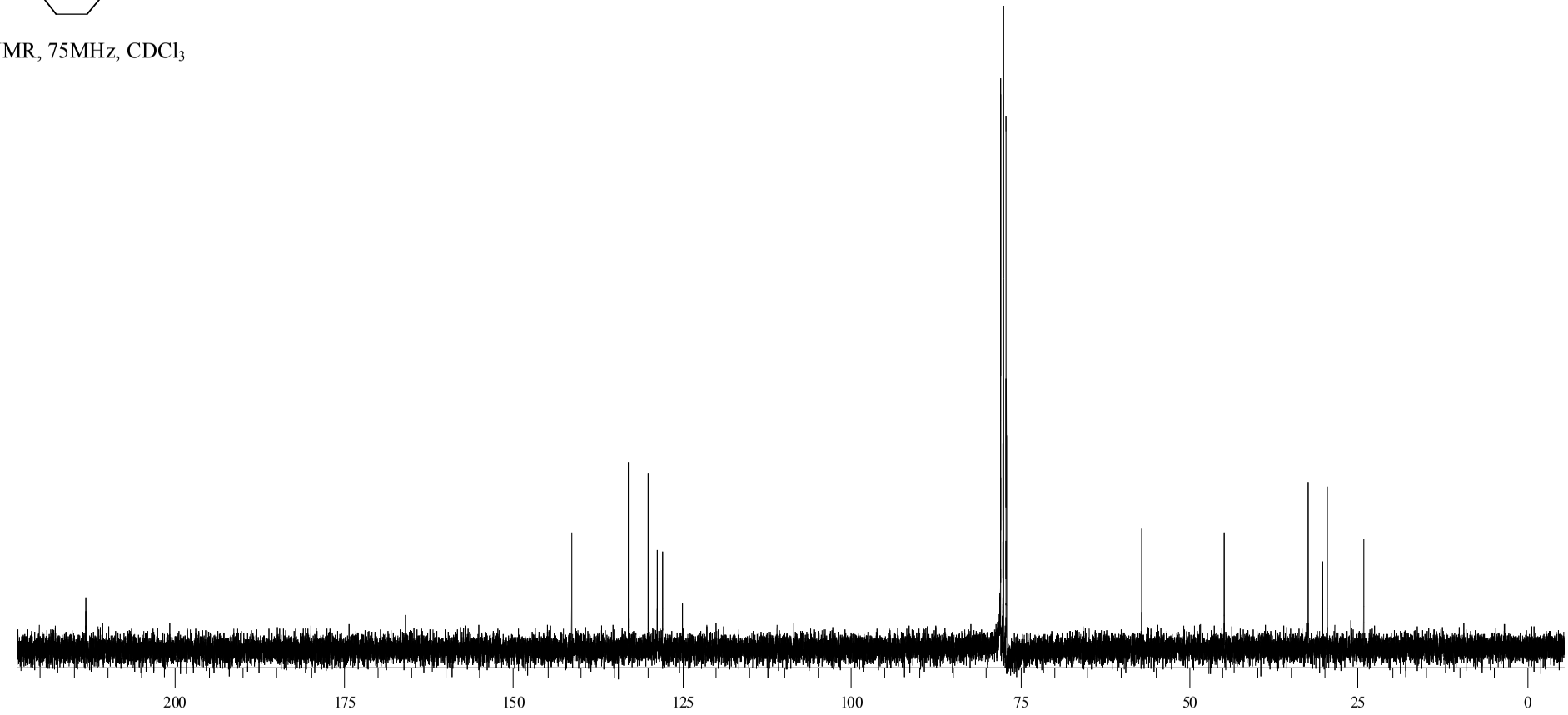


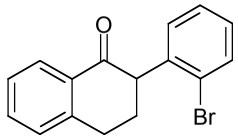

1HNMR, 300MHz, $CDCl_3$



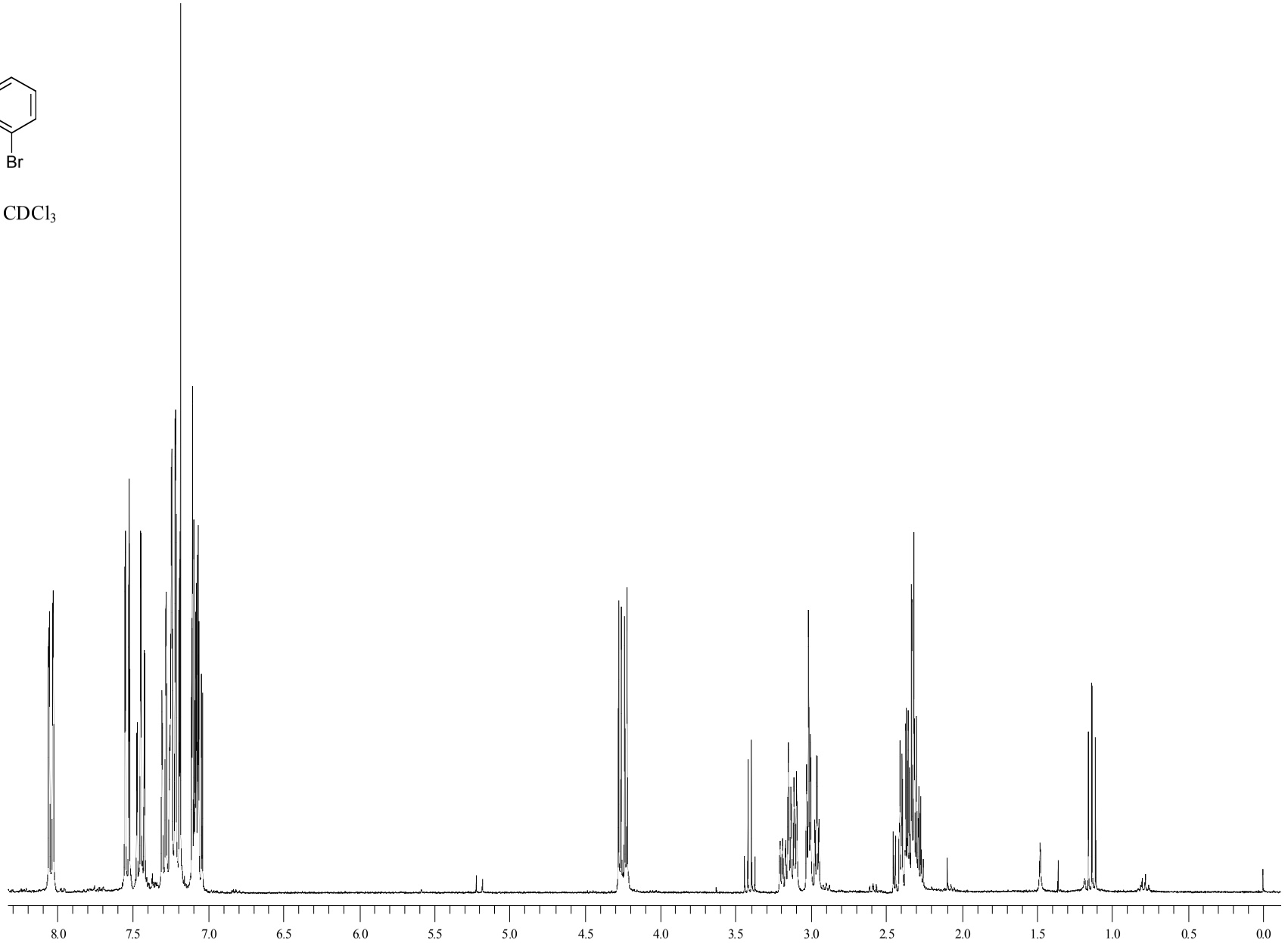


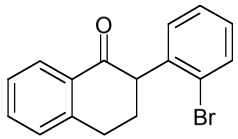

$^{13}$CNMR, 75MHz, $CDCl_3$



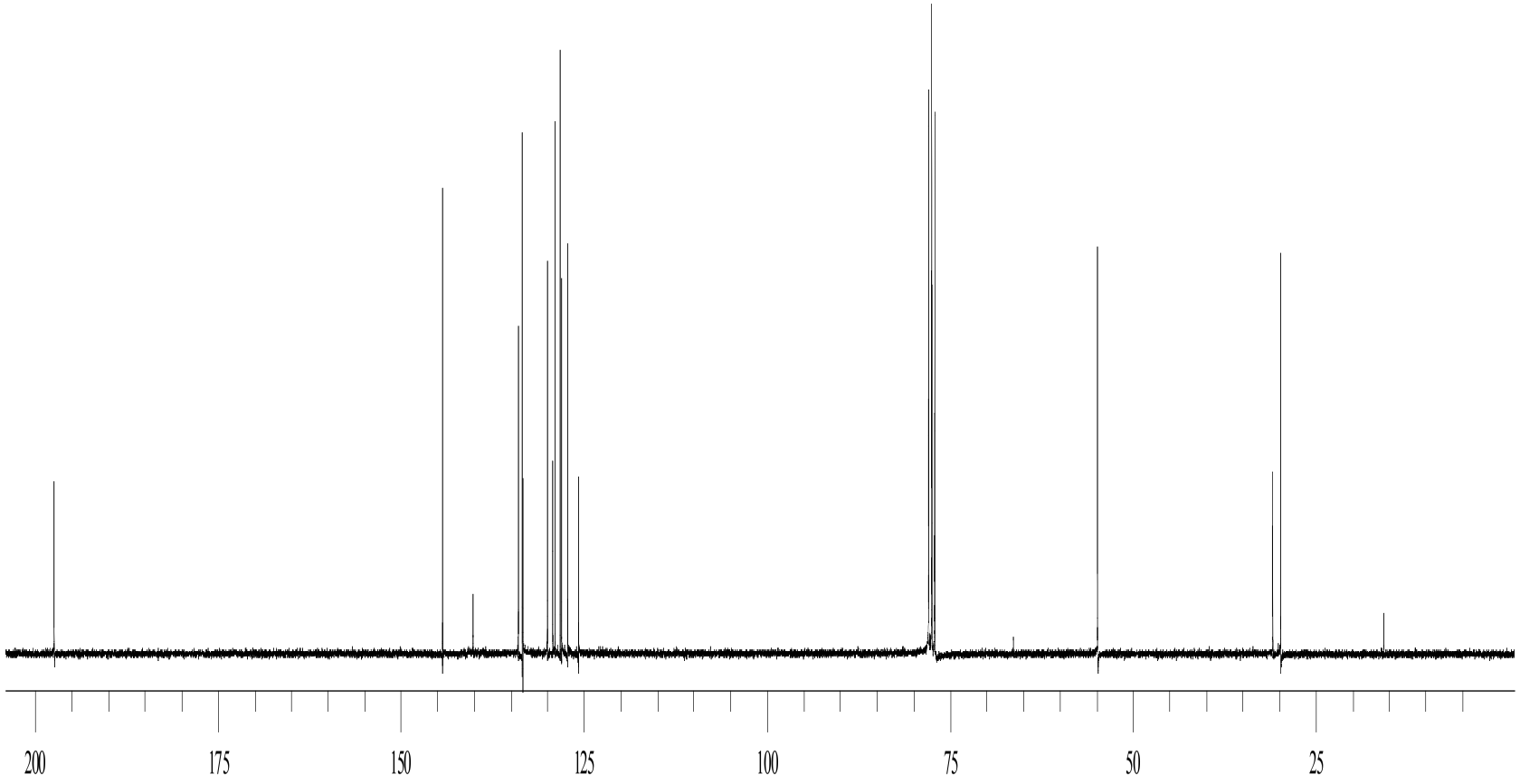


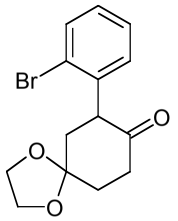

$^{1}$HNMR, 300MHz, $CDCl_3$



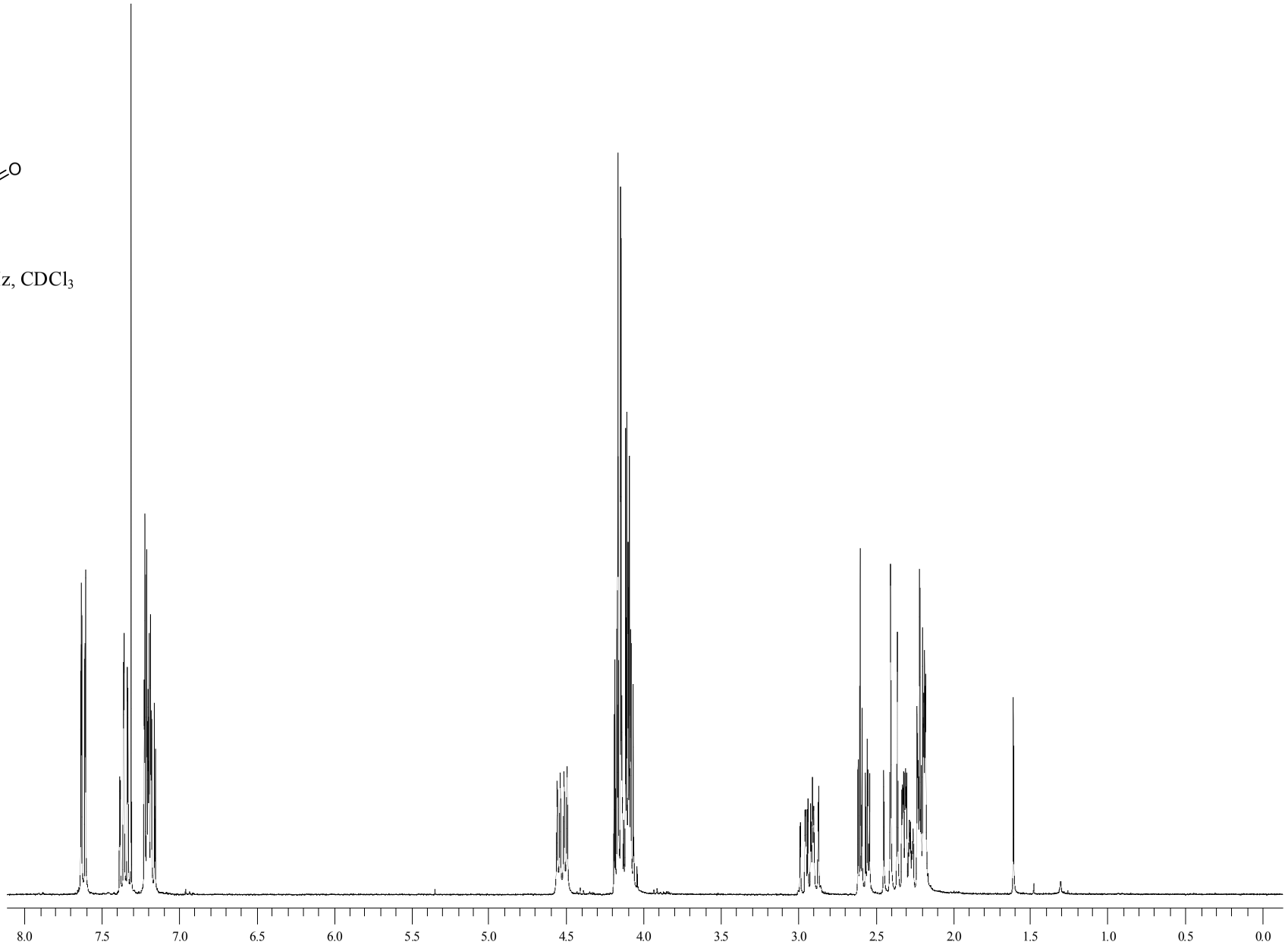


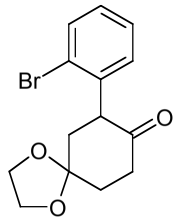

$^{13}$CNMR, 75MHz, $CDCl_3$



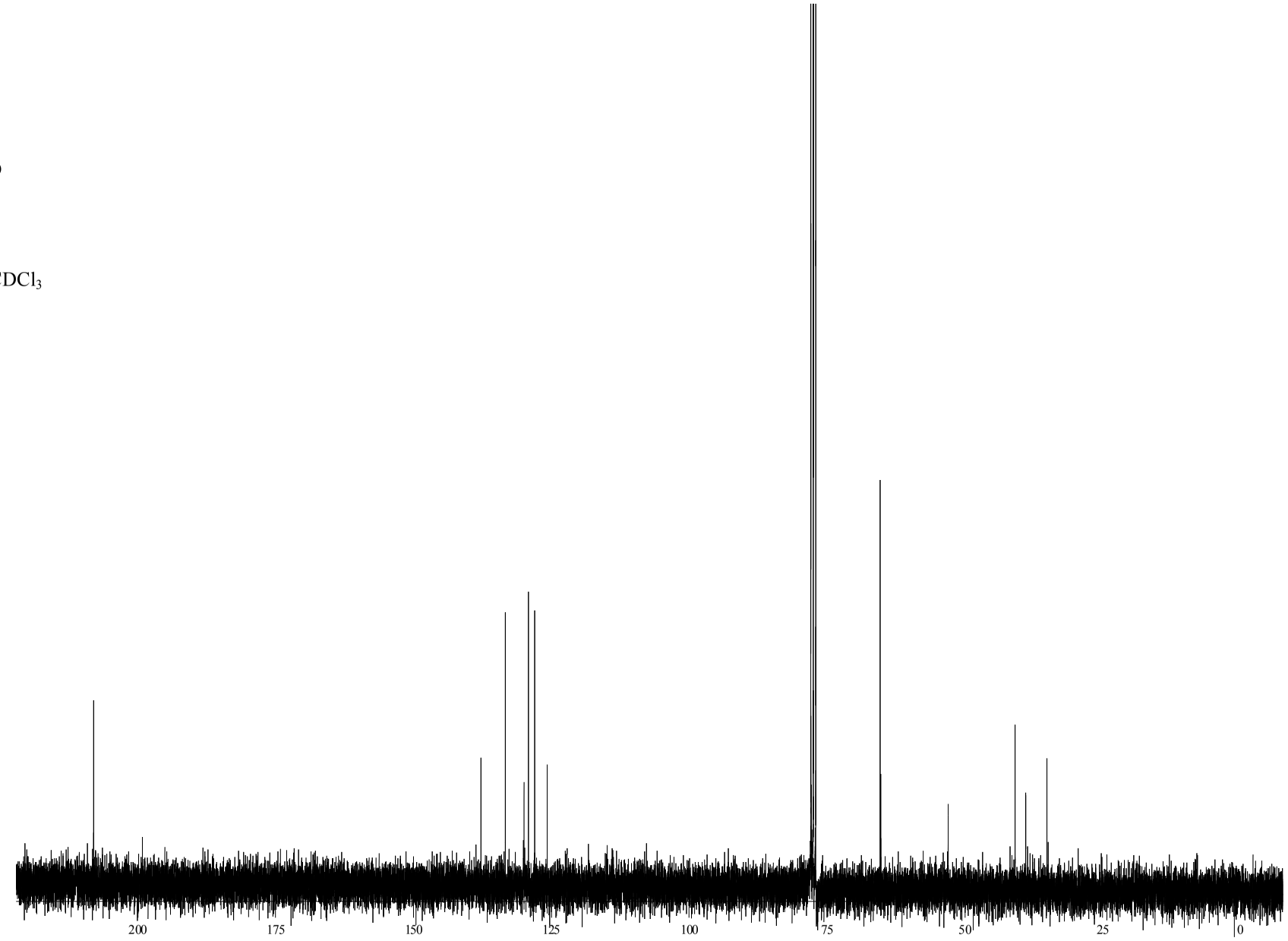


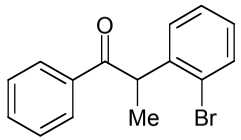

$^{1}$HNMR, 300MHz, $CDCl_3$



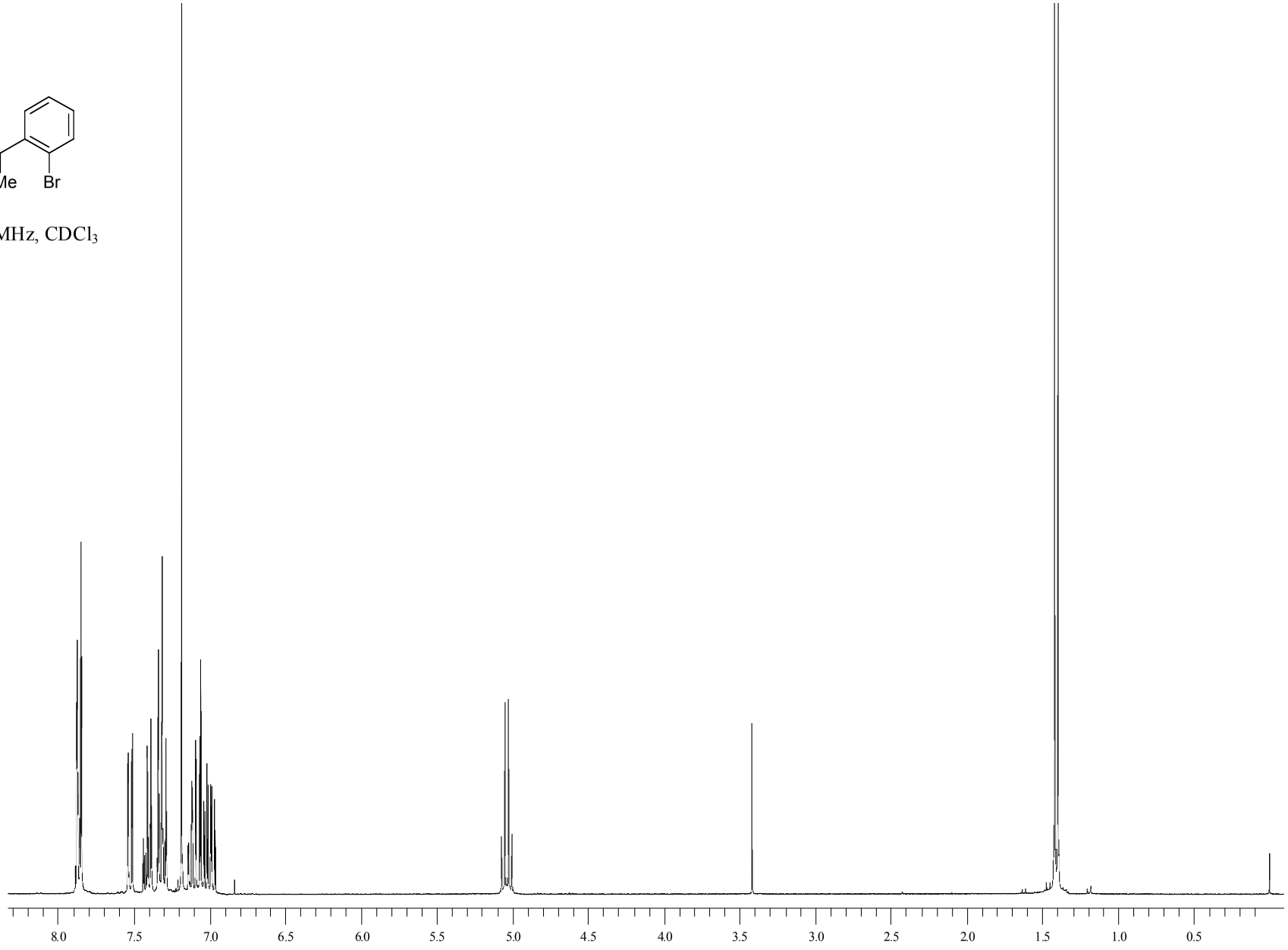


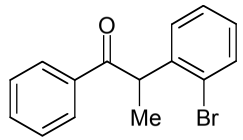

$^{13}$CNMR, 75MHz, $CDCl_3$



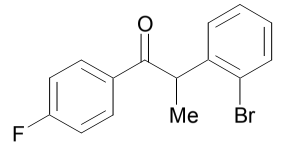



$^{1}$HNMR, 300MHz, $CDCl_3$






$^{13}$CNMR, 75MHz, $CDCl_3$

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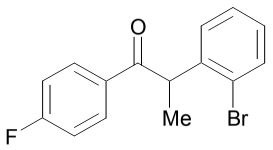
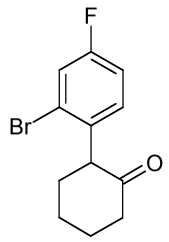



$^{13}$CNMR, 75MHz, $CDCl_3$

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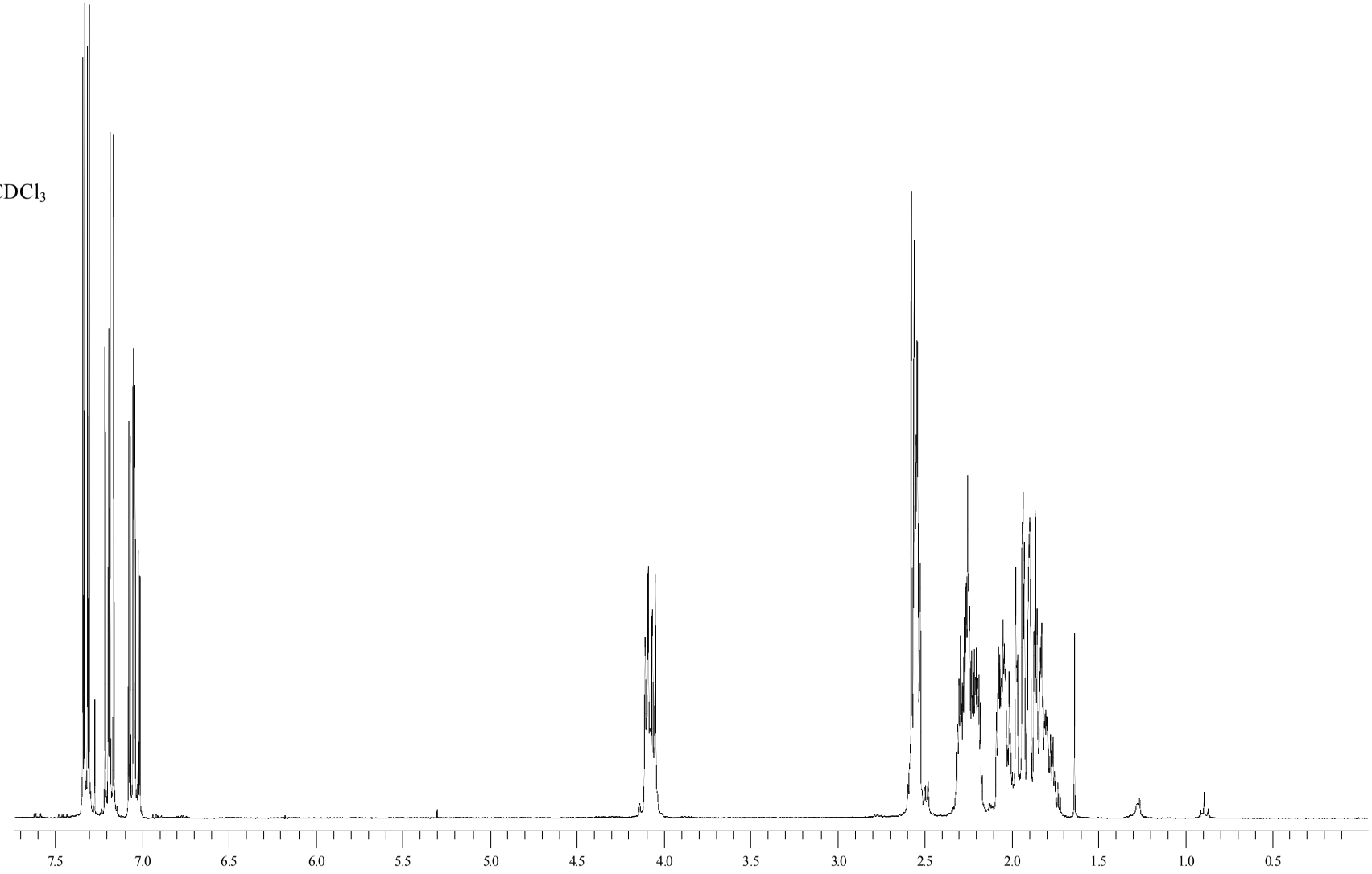
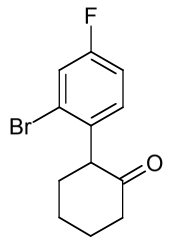
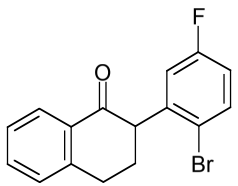
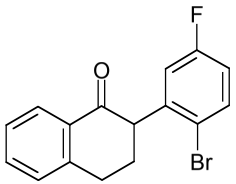




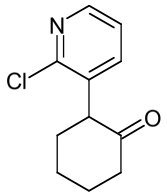

$^{13}$CNMR, 75MHz, $CDCl_3$




$^{1}$HNMR, 300MHz, $CDCl_3$




$^{13}$CNMR, 75MHz, $CDCl_3$

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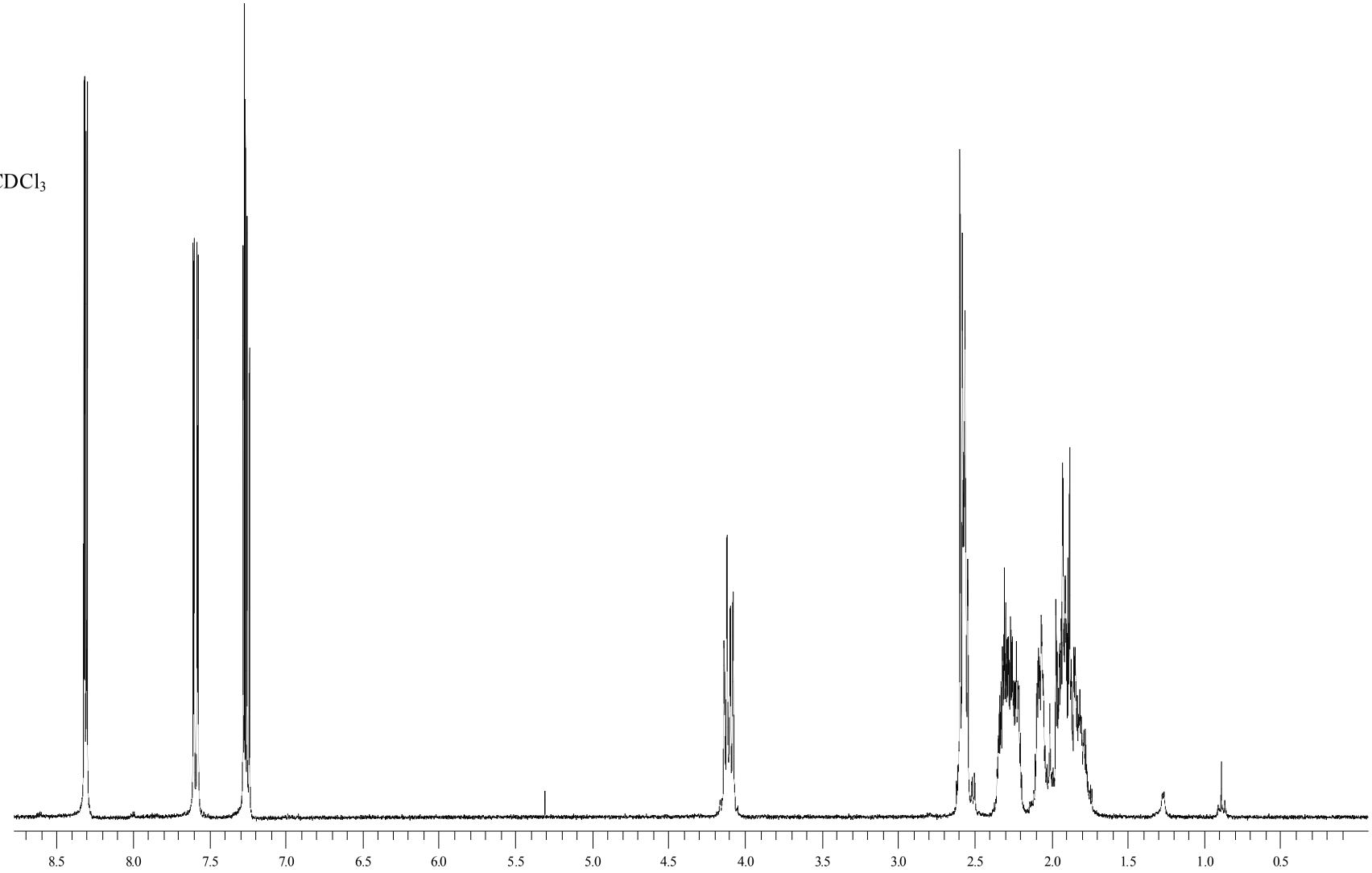
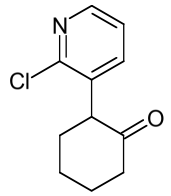
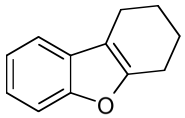





$^{13}$CNMR, 75MHz, $CDCl_3$



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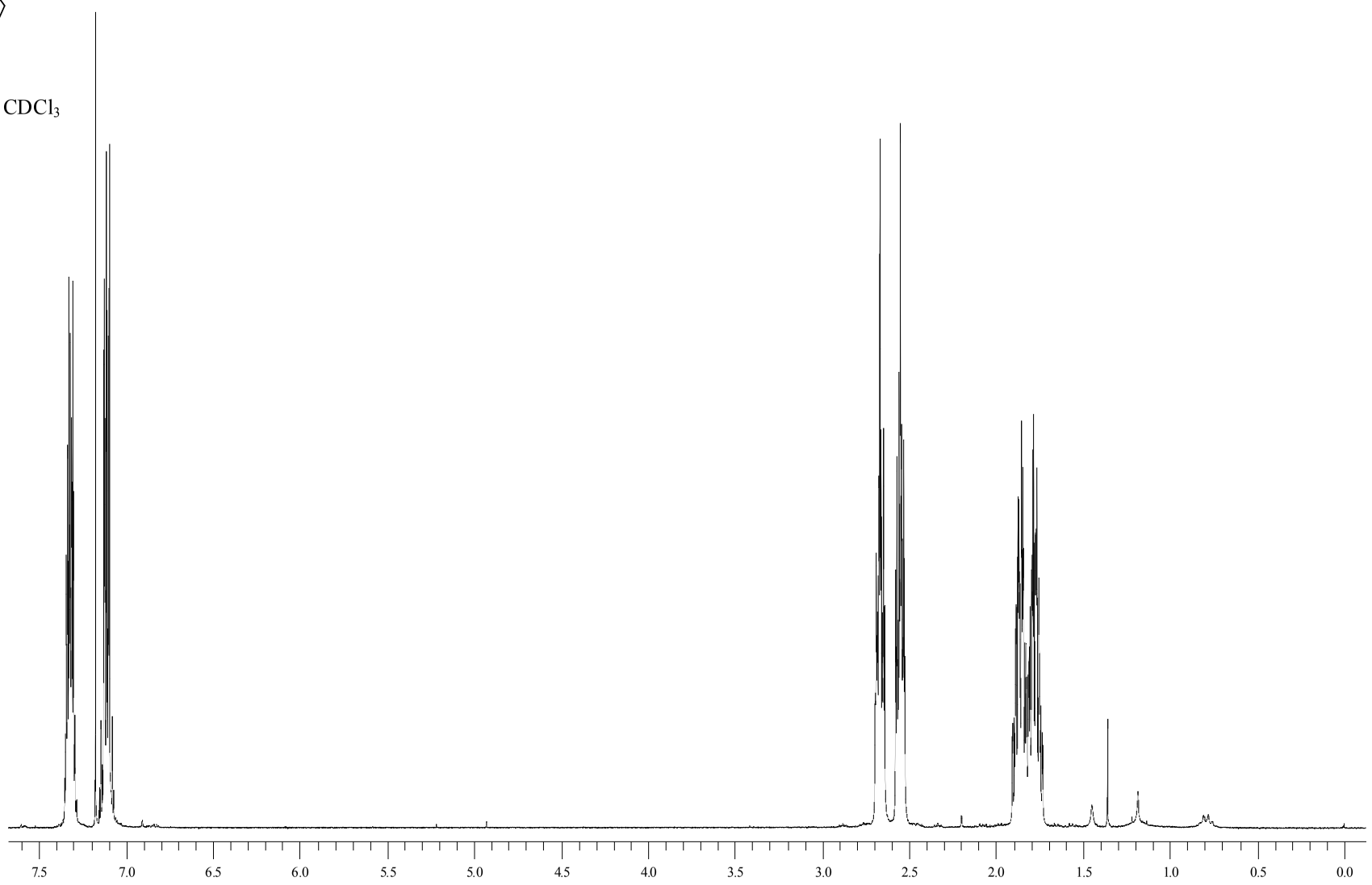
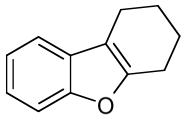
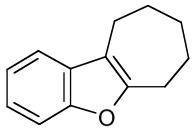




$^{13}$CNMR, 75MHz, $CDCl_3$



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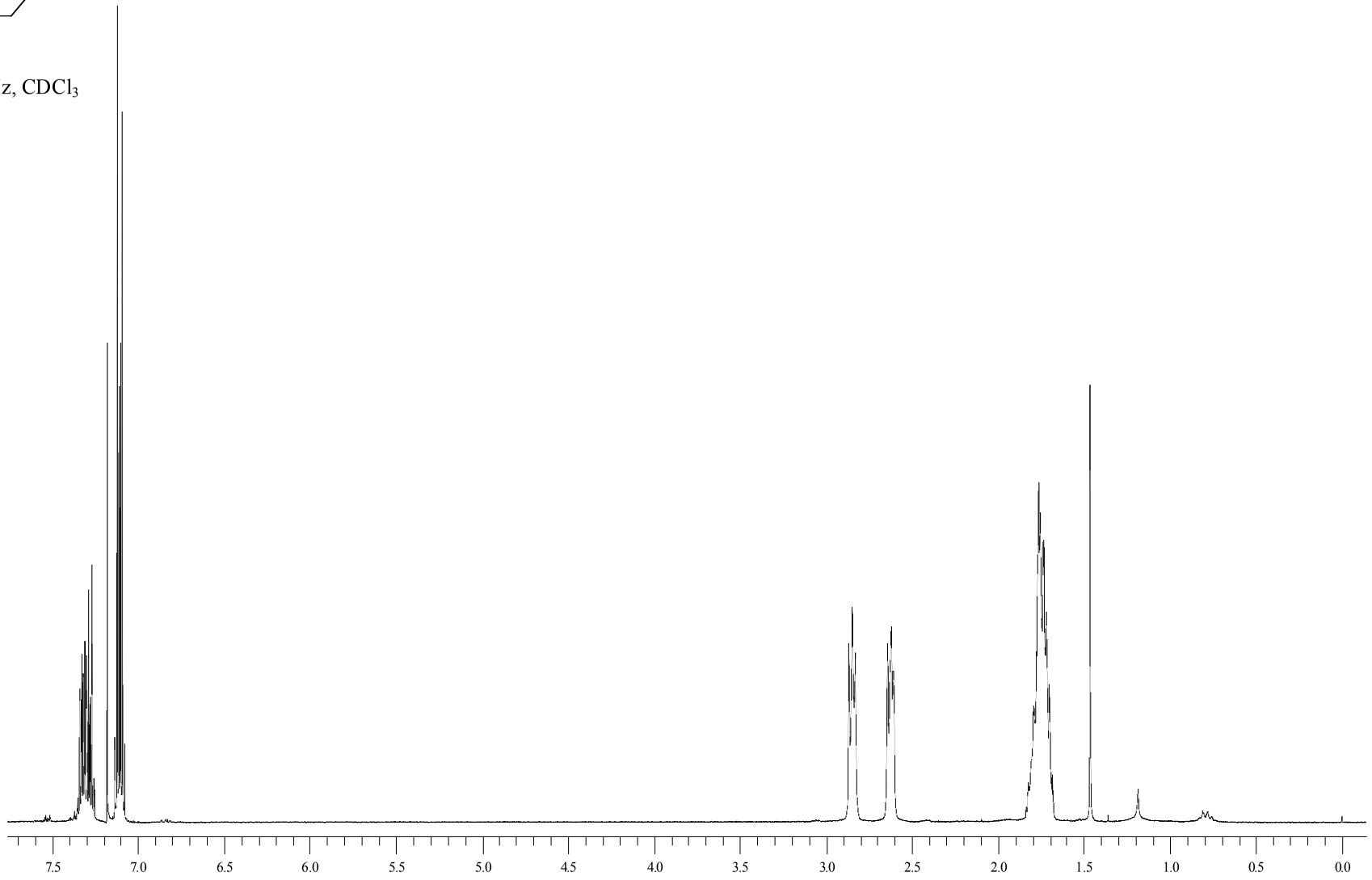

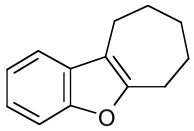

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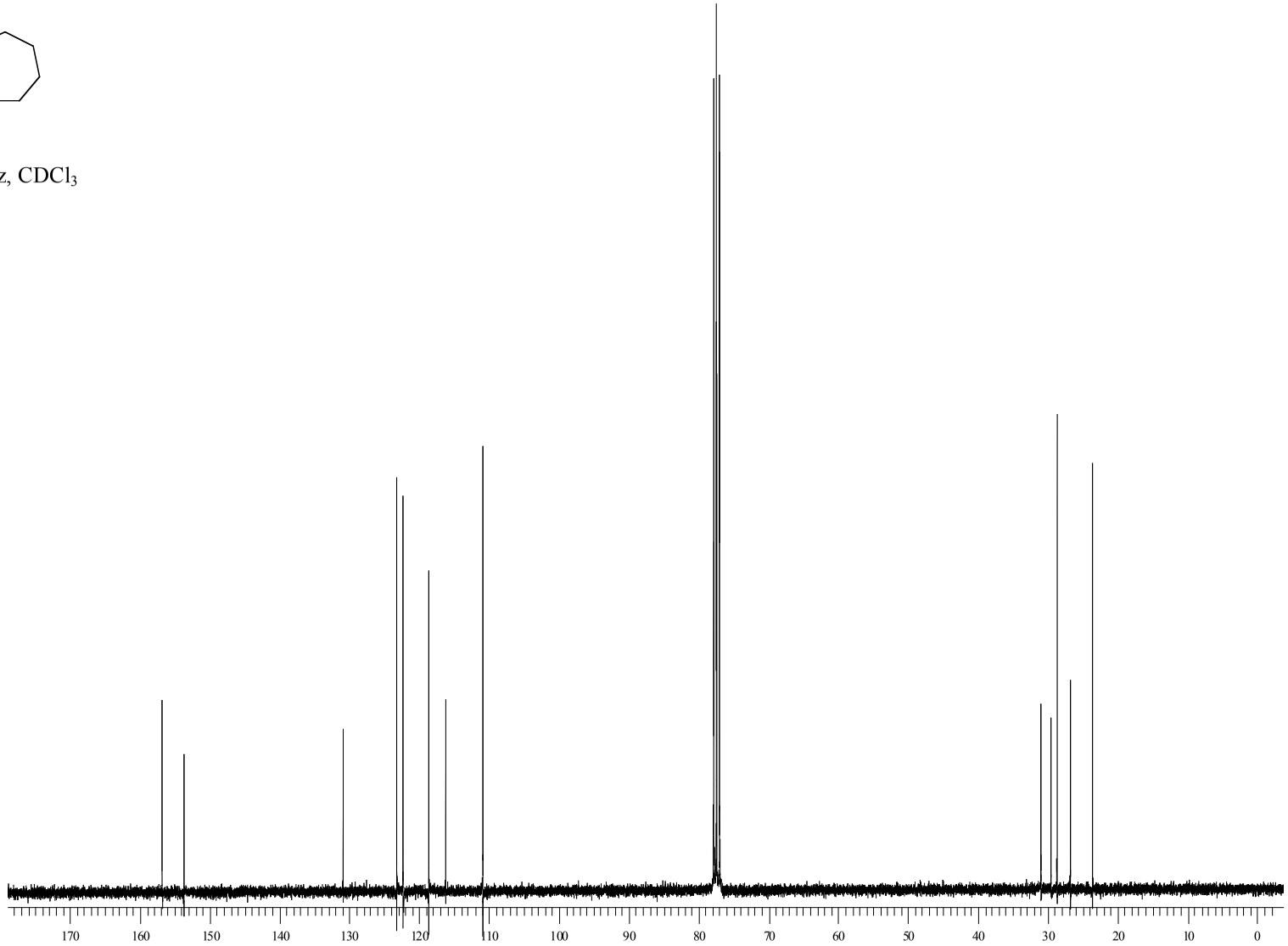
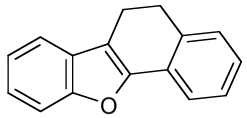
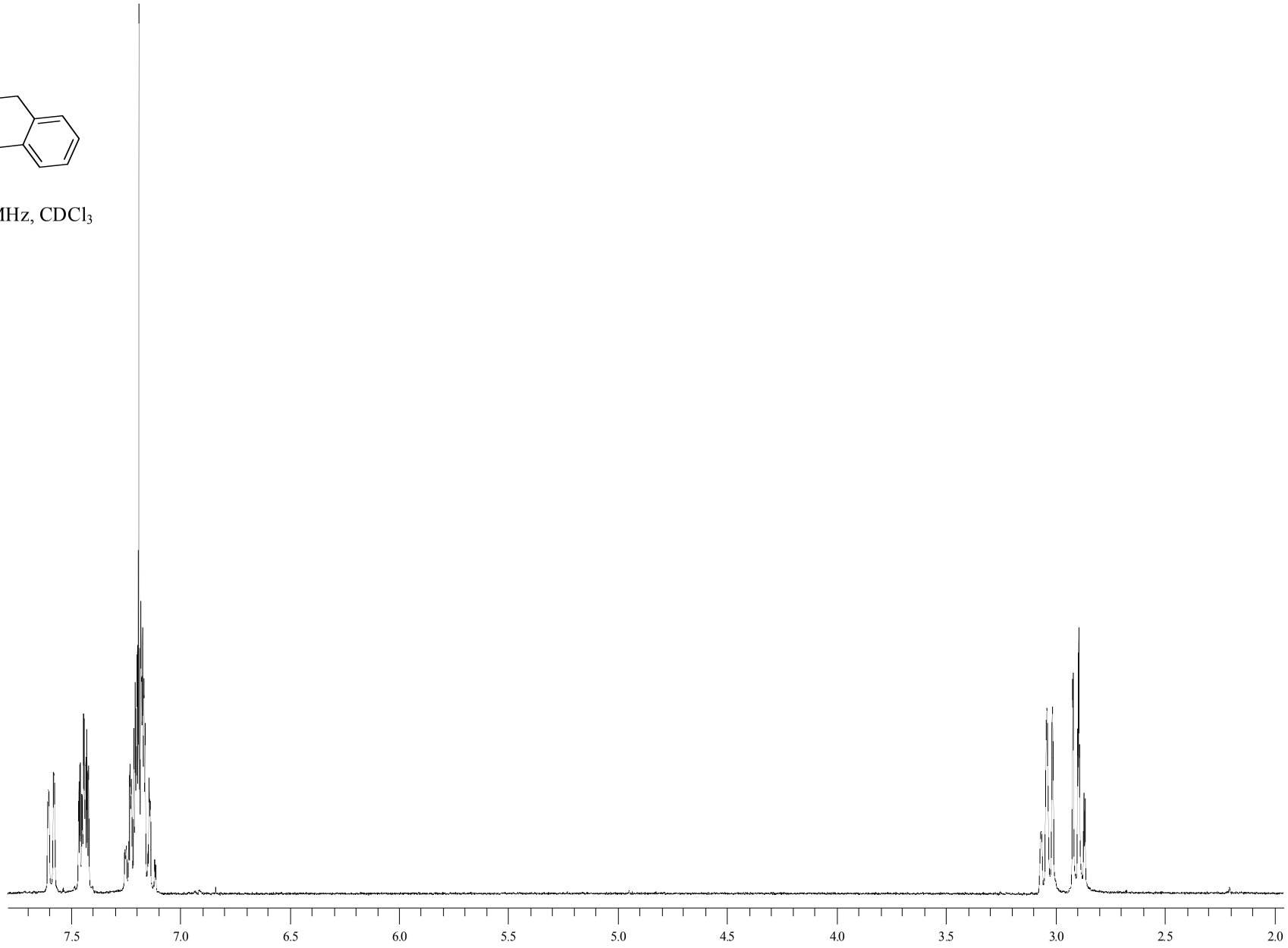
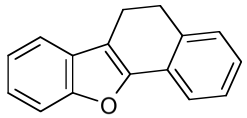


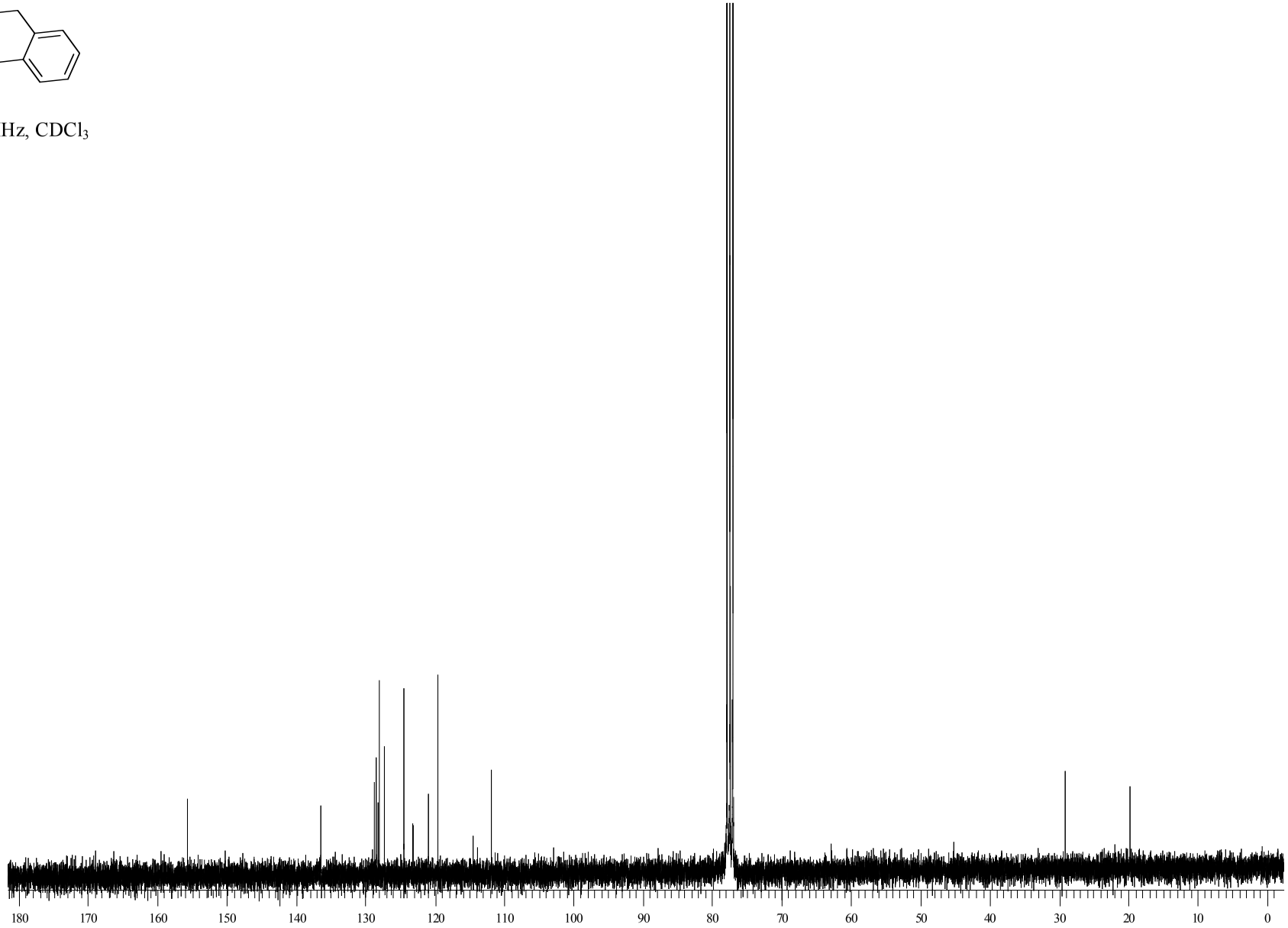


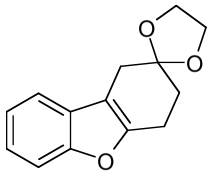
$^{1}$HNMR, 300MHz, $CDCl_3$



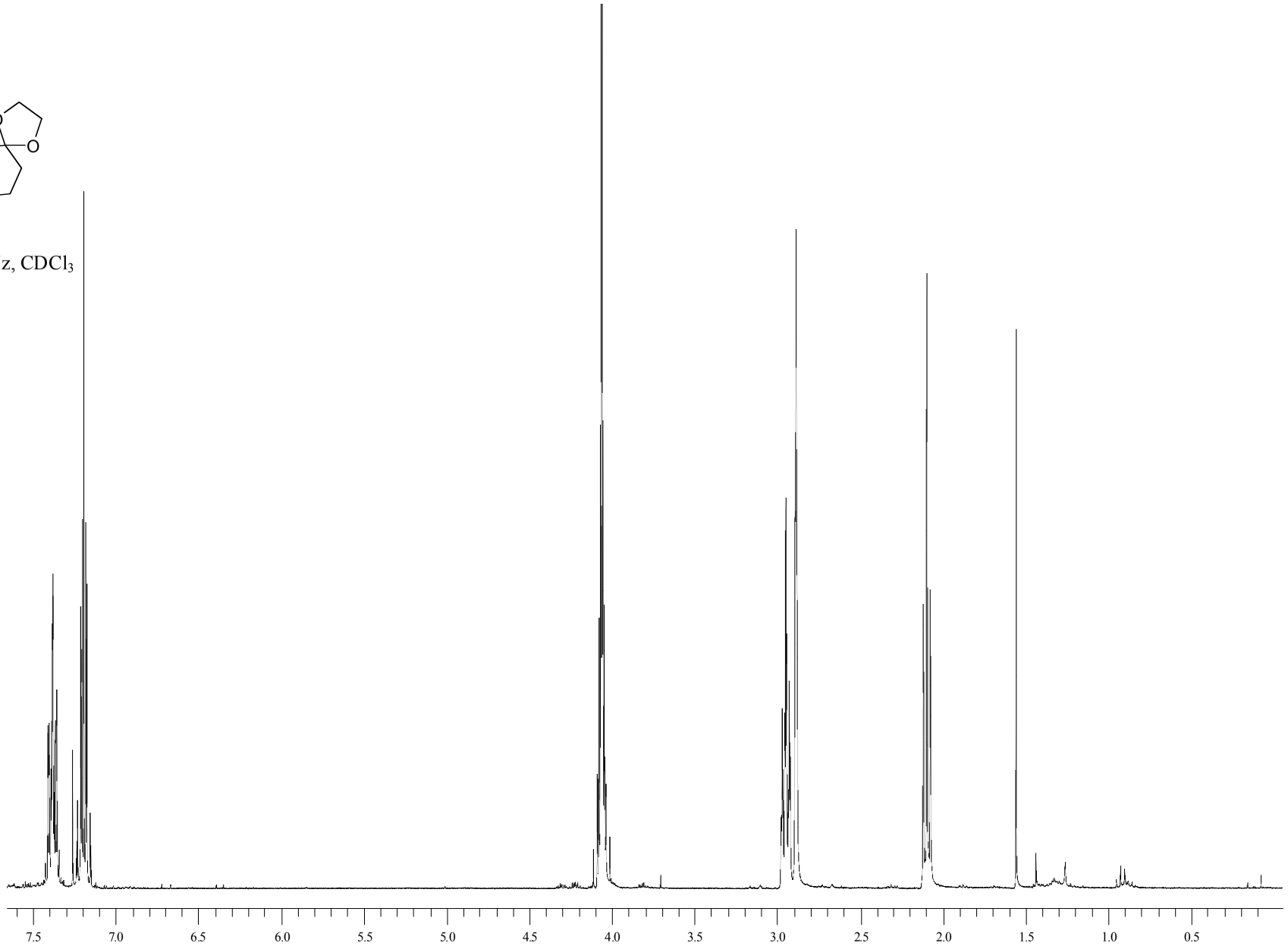


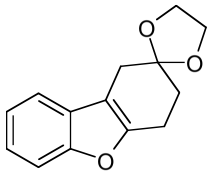
$^{13}$CNMR, 75MHz, $CDCl_3$



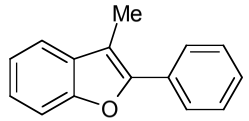


$^{1}$HNMR, 300MHz, $CDCl_3$

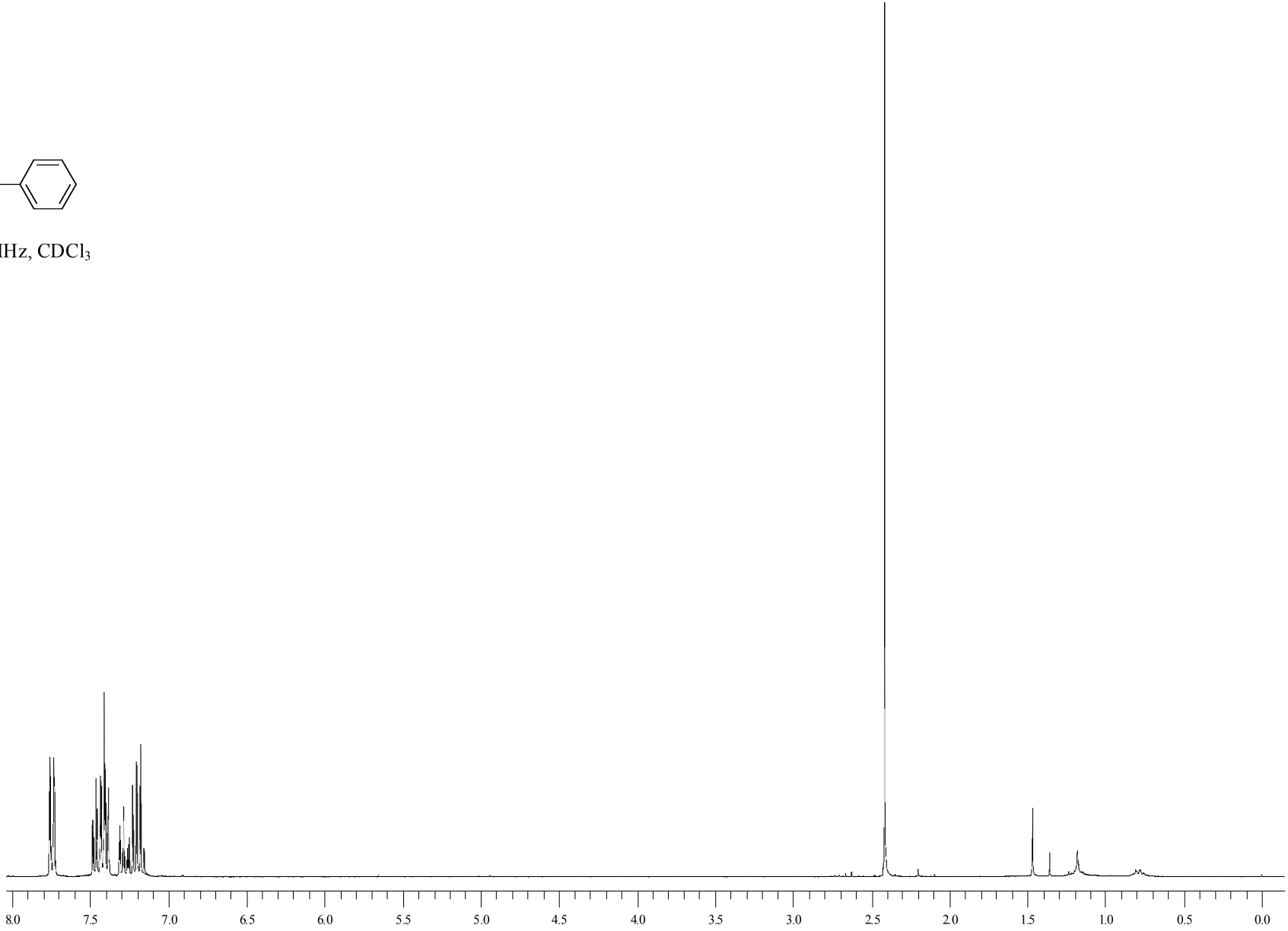


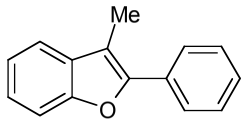


$^{13}$CNMR, 75MHz, $CDCl_3$

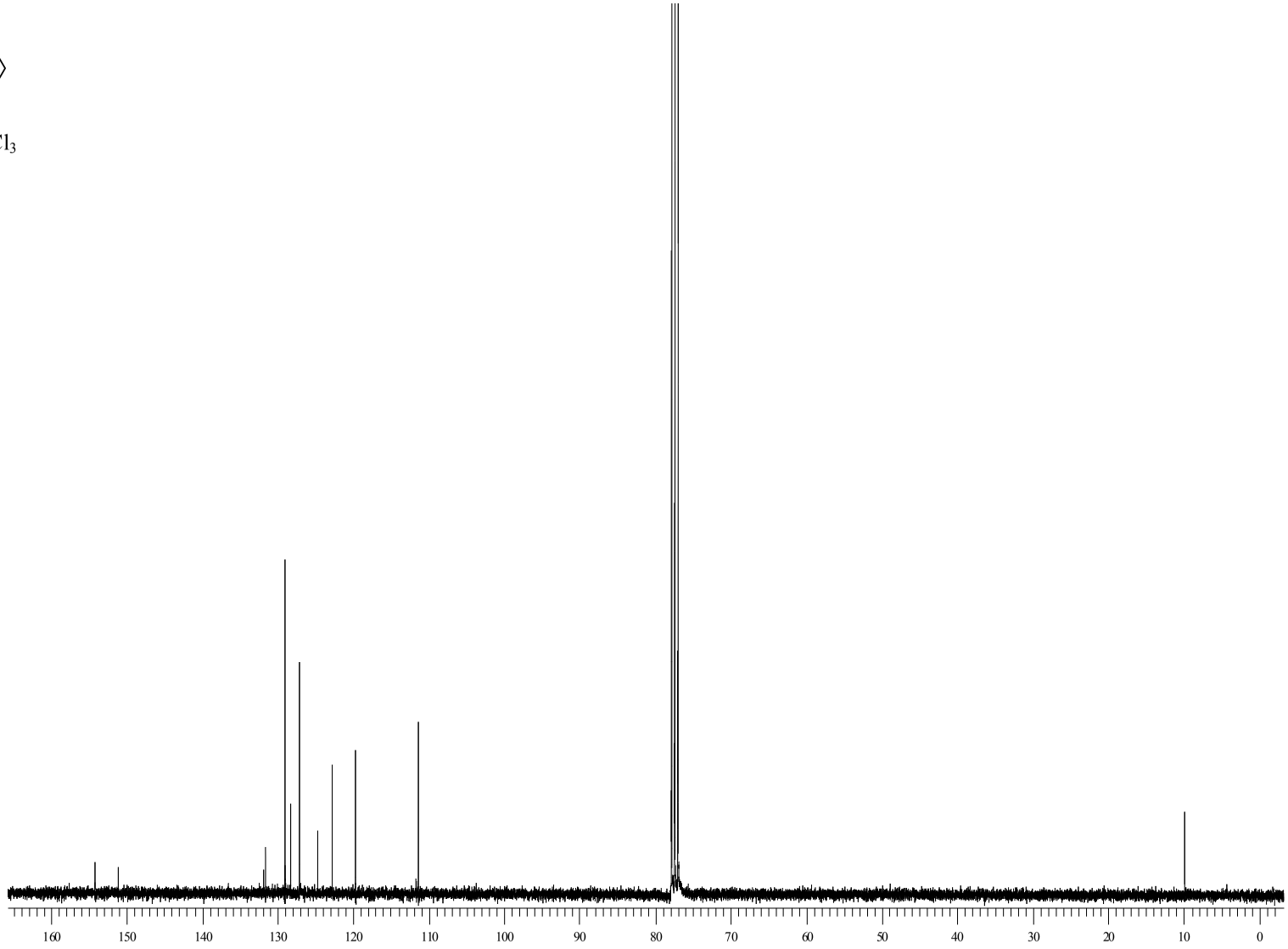


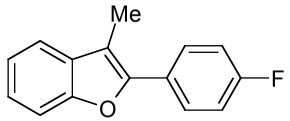

$^{1}$HNMR, 300MHz, $CDCl_3$



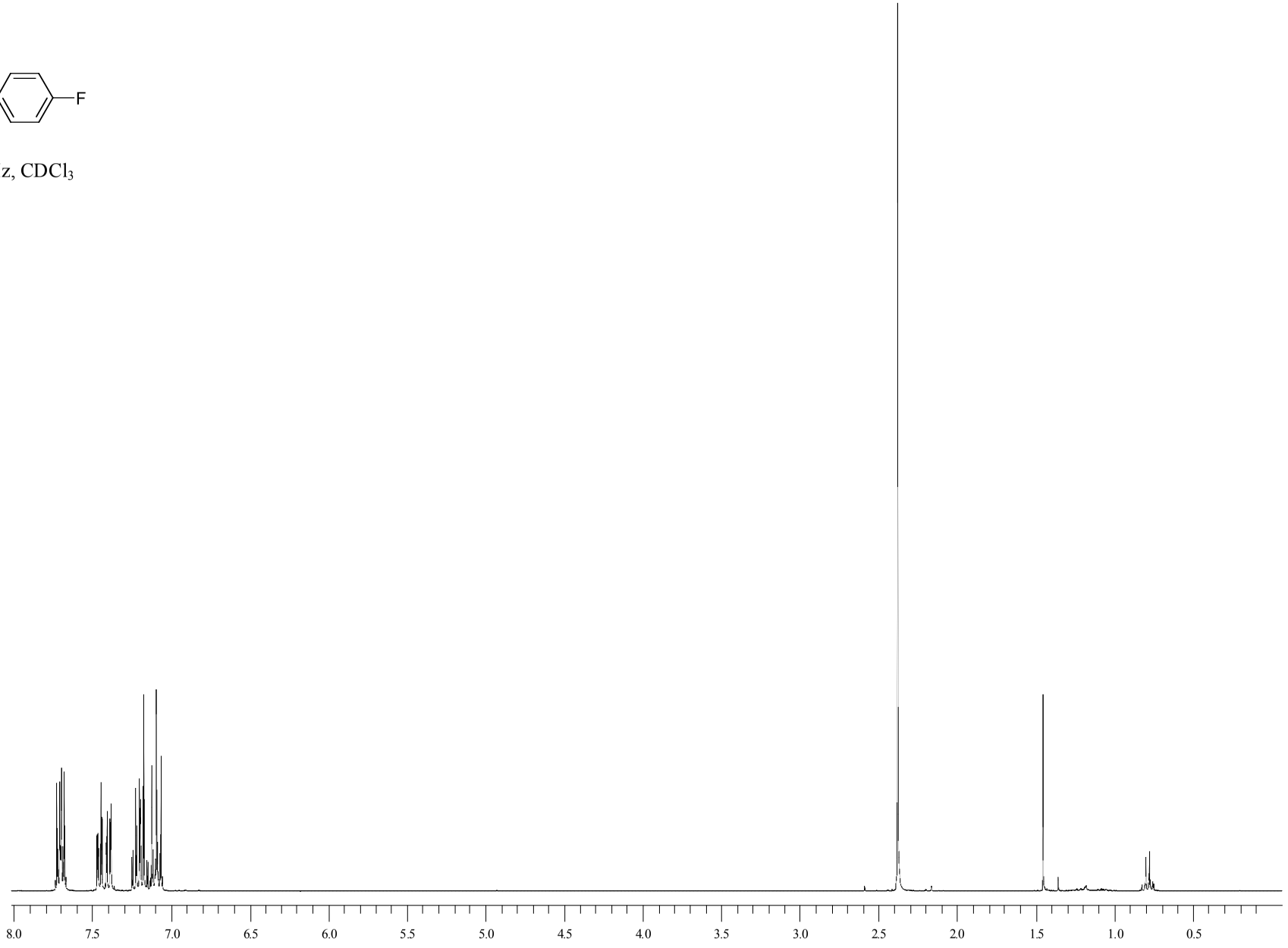


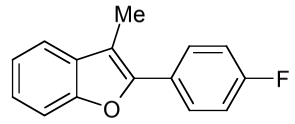

$^{13}$CNMR, 75MHz, $CDCl_3$



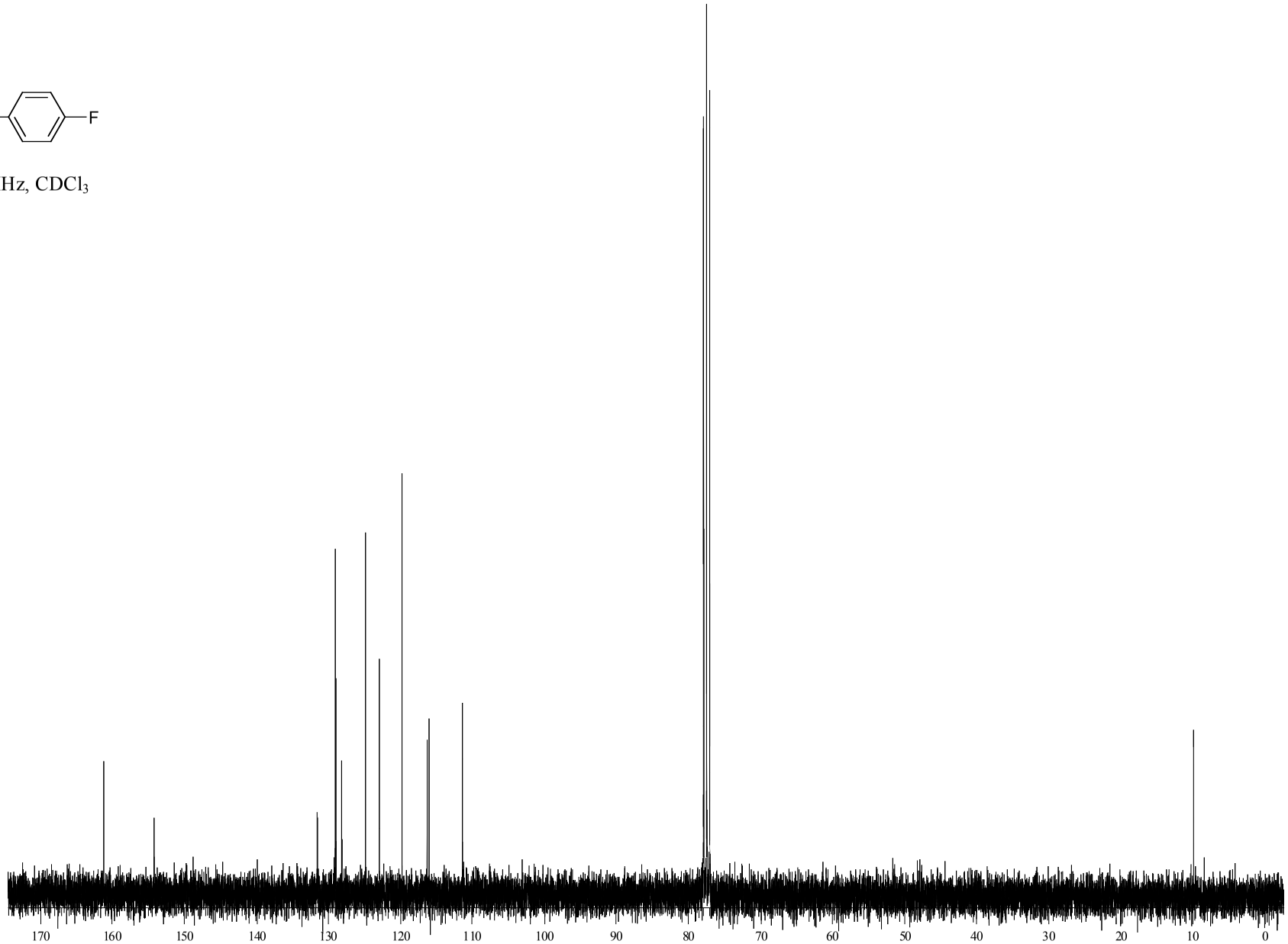


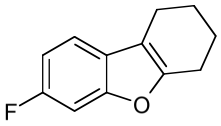

$^{1}$HNMR, 300MHz, $CDCl_3$



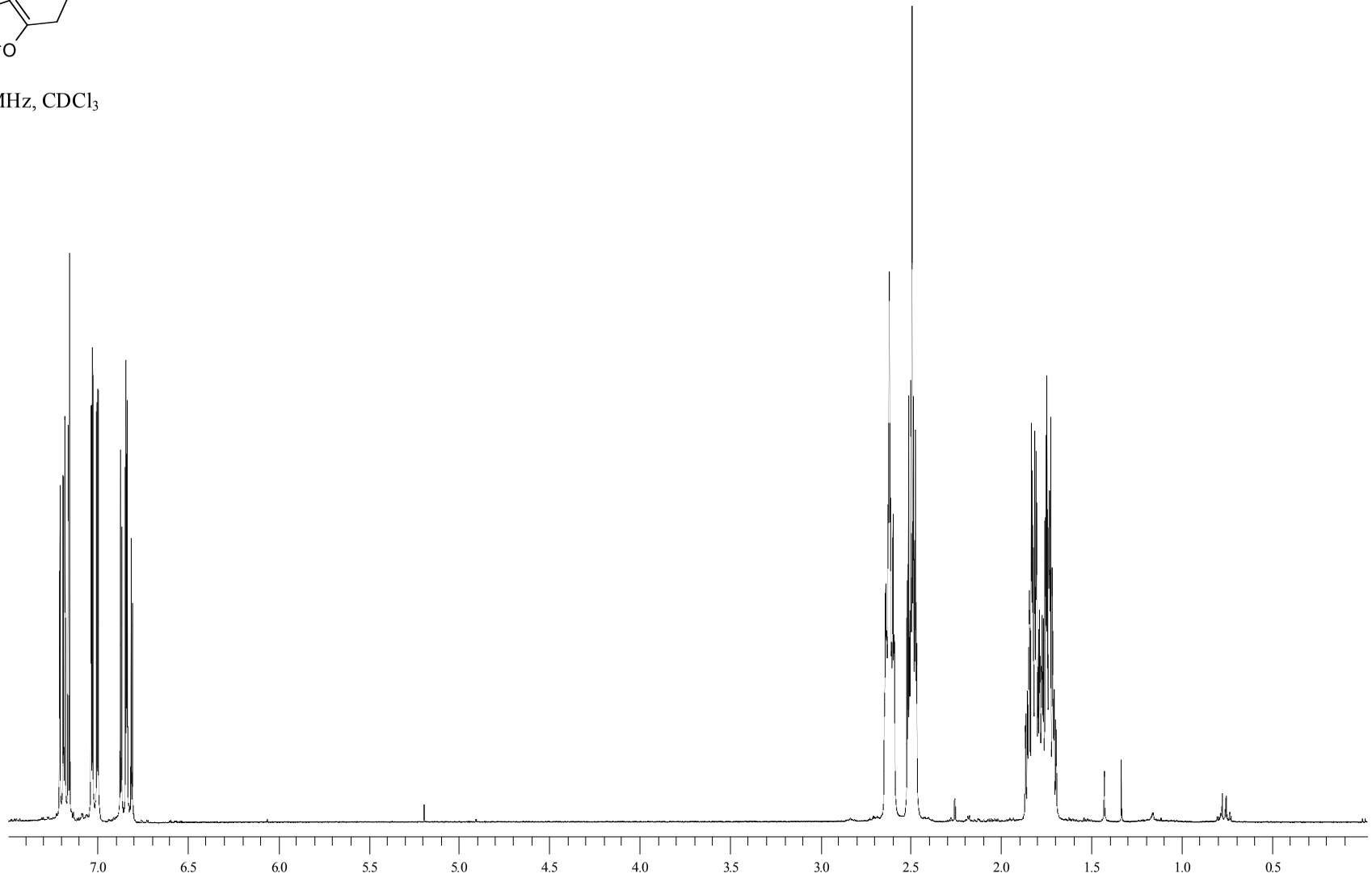


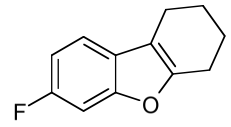

$^{13}$CNMR, 75MHz, $CDCl_3$



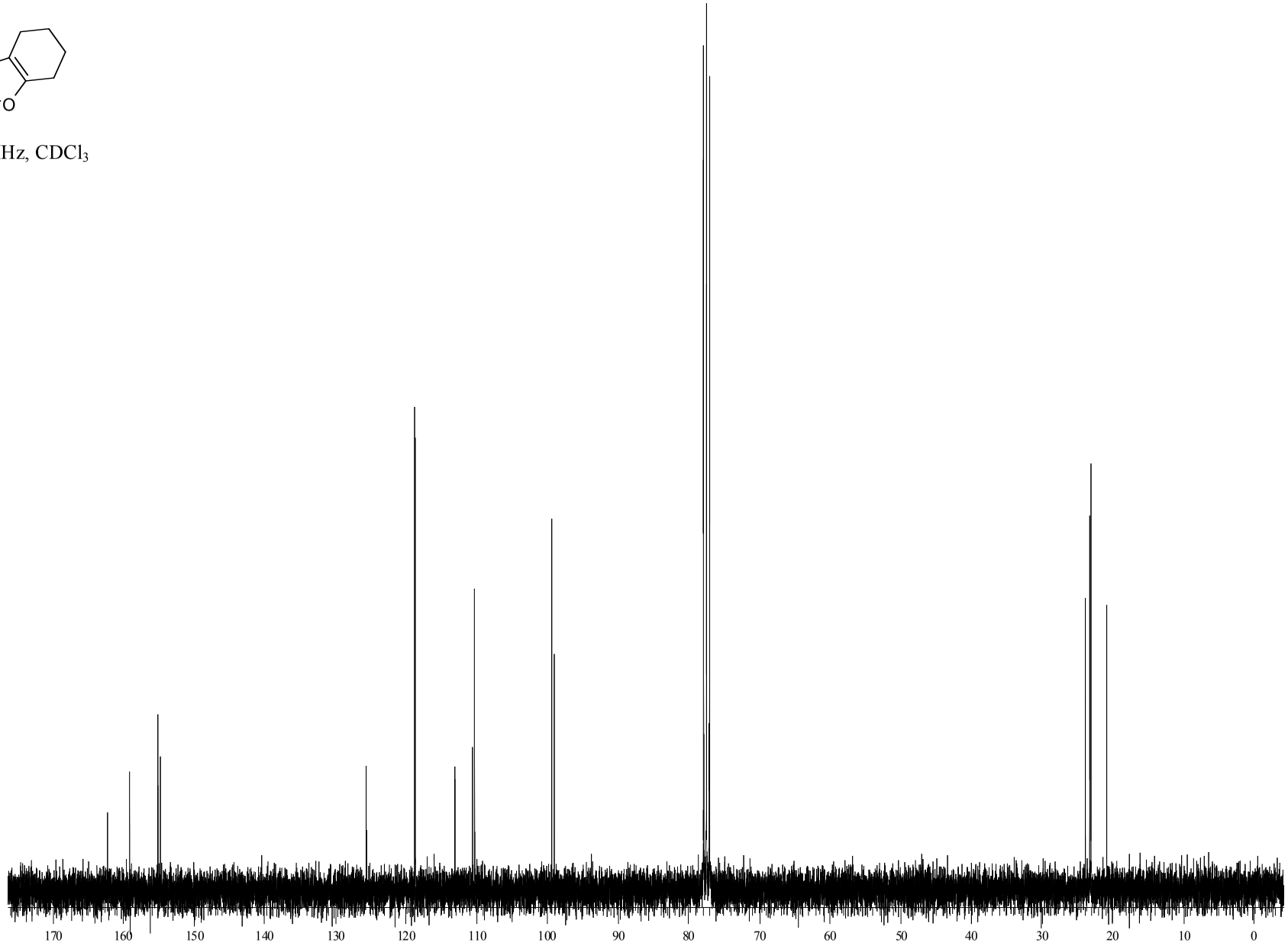


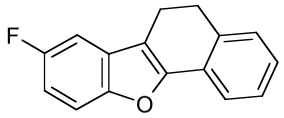

$^{1}$HNMR, 300MHz, $CDCl_3$



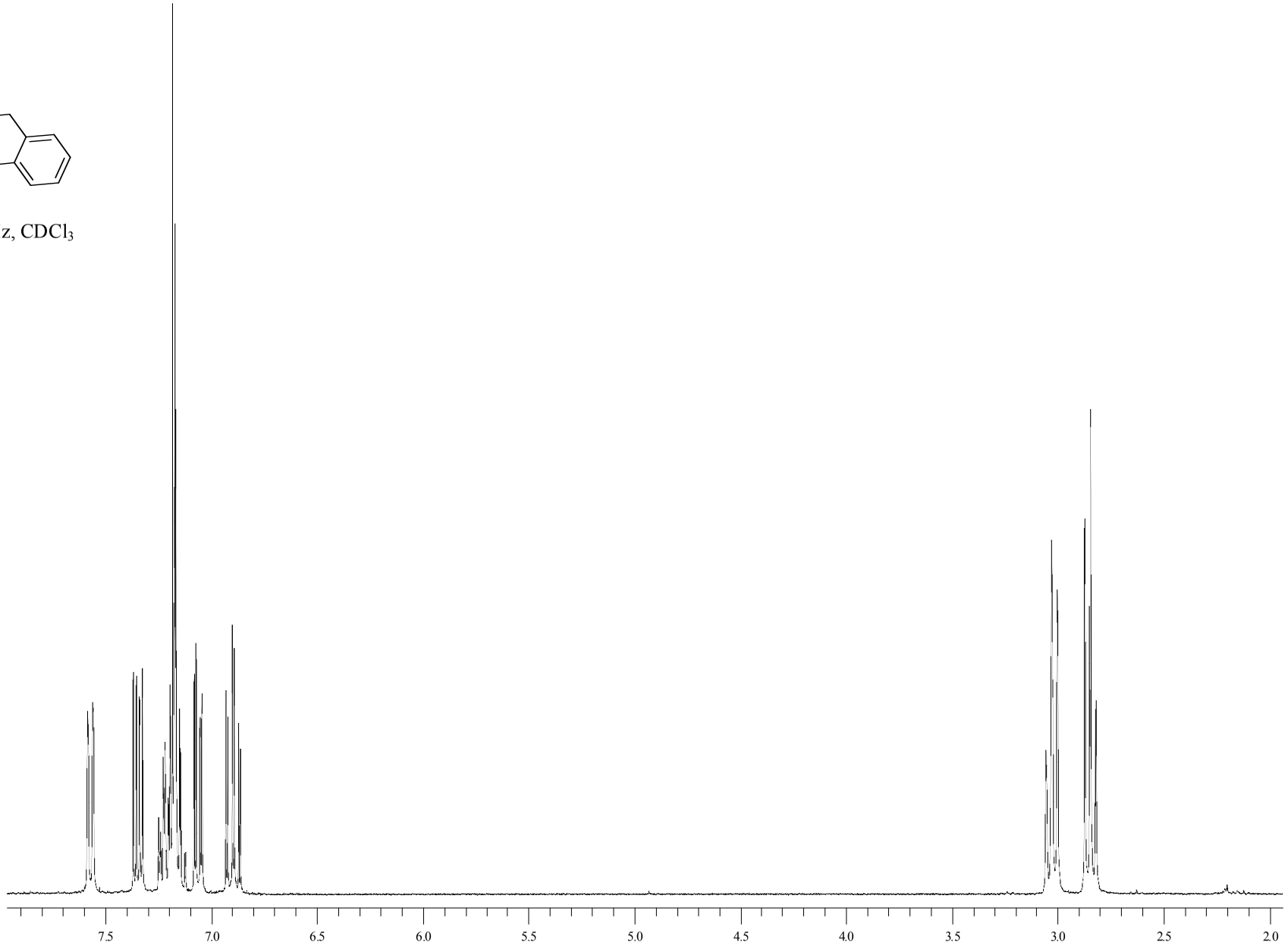


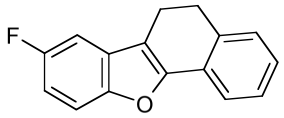

$^{13}$CNMR, 75MHz, $CDCl_3$



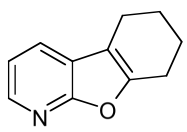



$^{1}$HNMR, 300MHz, $CDCl_3$






$^{13}$CNMR, 75MHz, $CDCl_3$

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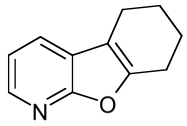
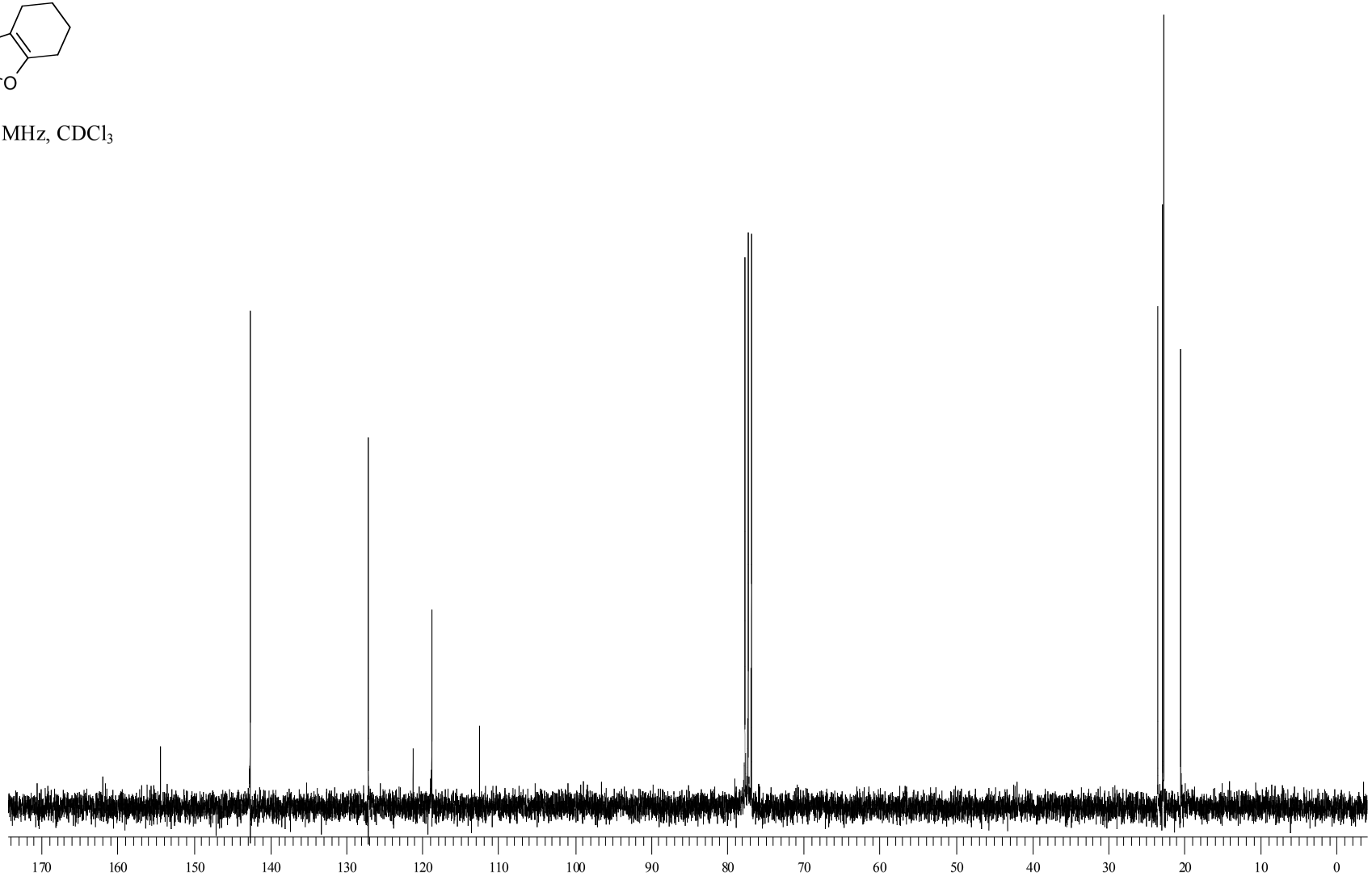
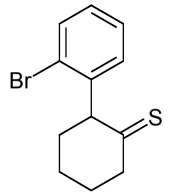
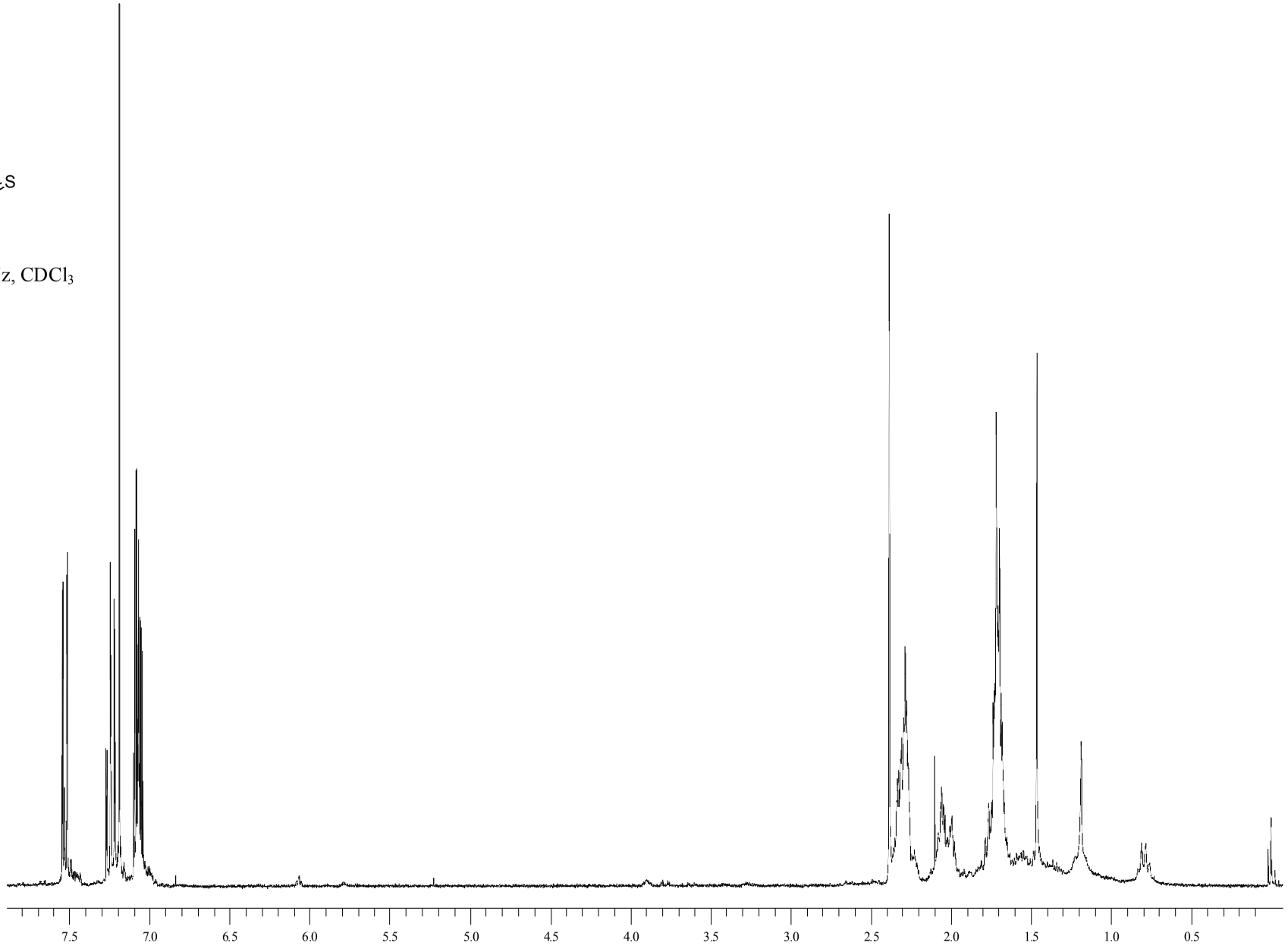


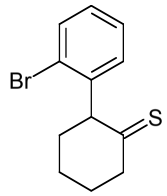

$^{13}$CNMR, 75MHz, $CDCl_3$



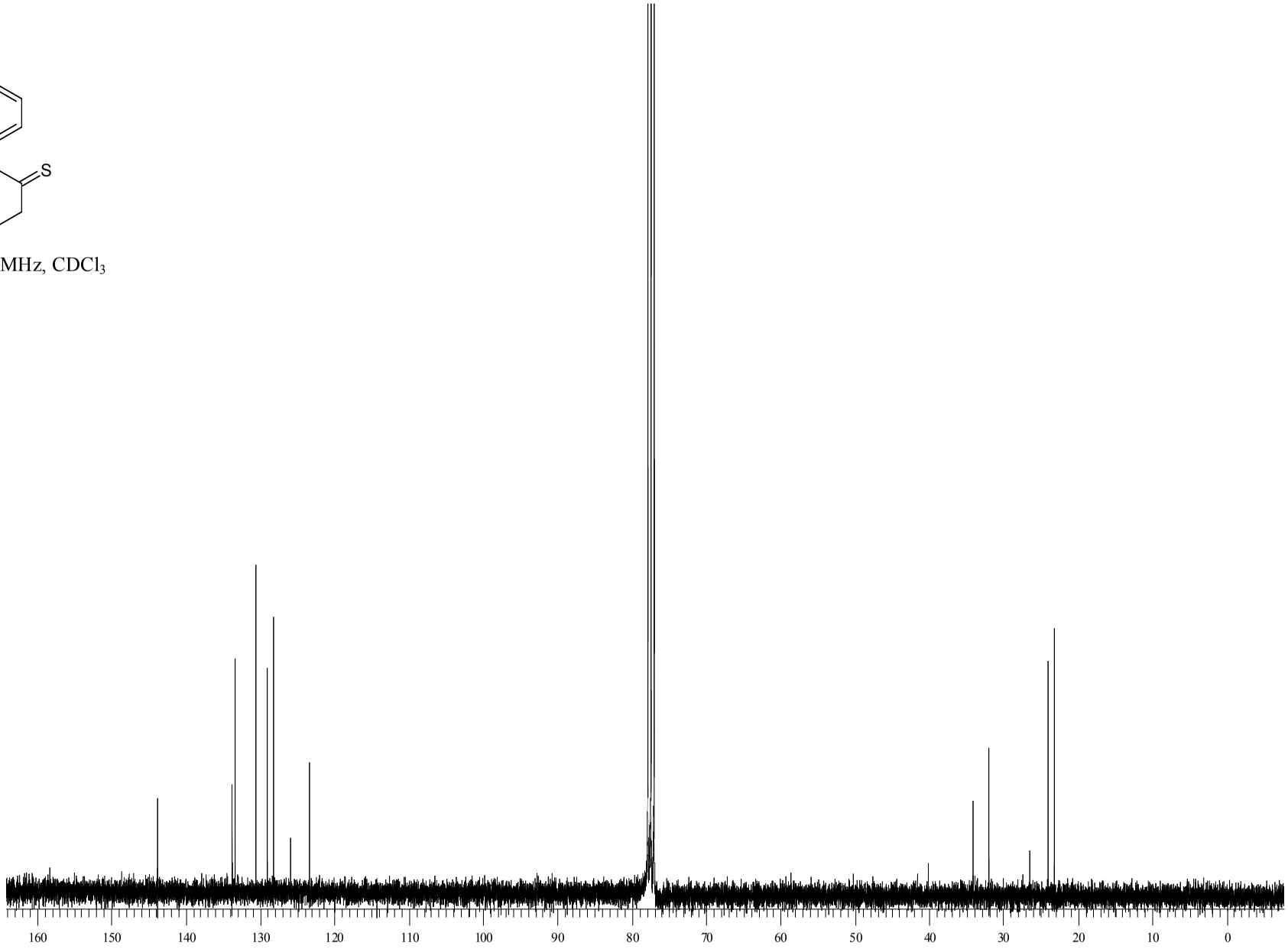


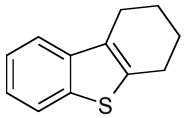

$^{1}$HNMR, 300MHz, $CDCl_3$



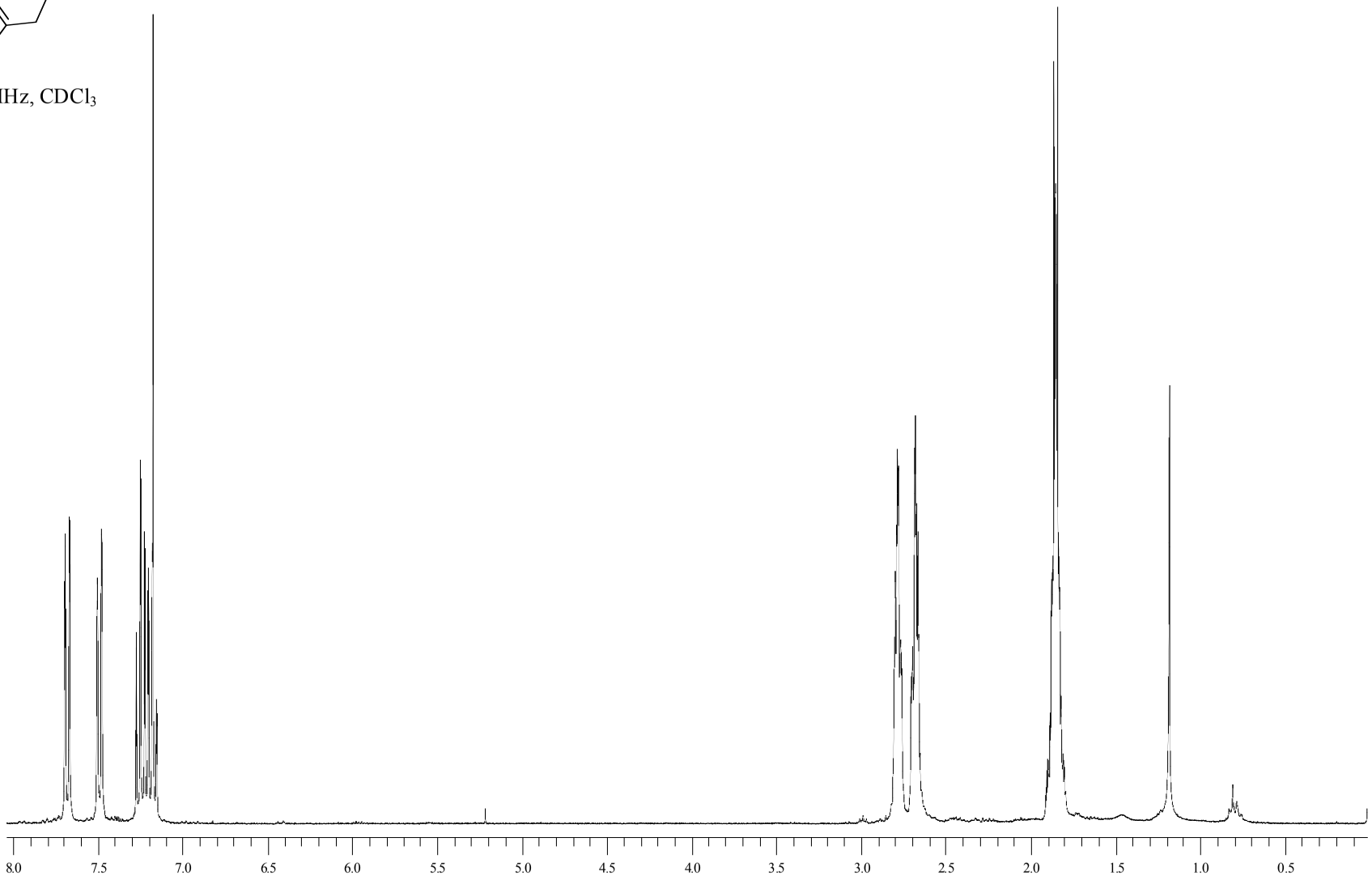


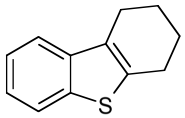

$^{13}$CNMR, 75MHz, $CDCl_3$






$^{1}$HNMR, 300MHz, $CDCl_3$






$^{13}$CNMR, 75MHz, $CDCl_3$