Supporting Information

I_2/CF_3CO_2Ag-mediated iodolactonization of various allenoic acids to access versatile 6- to 9-membered ring vinylic iodolactones

Xiaobo Bao,[#] Guoli Wang,[#] Xu Dong,[#] Mengxiao Zhu, Lili Yang, Junjie Zhu, Qingyuan Shi, Hongzhen Zhang, Dongyin Chen*

Table of contents

1. General methods of synthesis

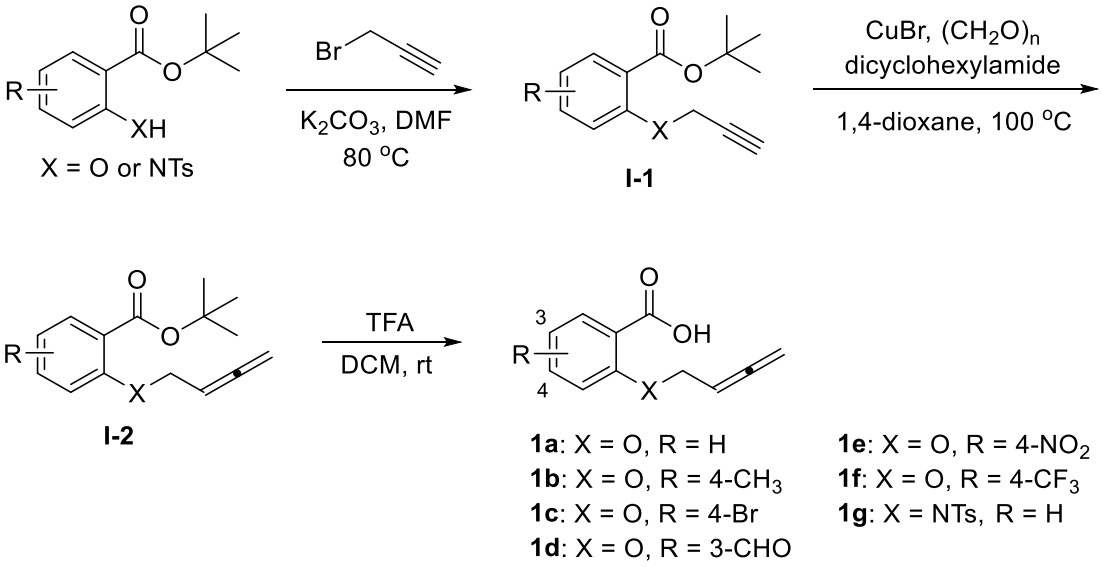
All commercially available solvents and reagents were used without further purification unless otherwise specified. Reactions were monitored by thin layer chromatography (TLC) on Silica Gel 60 F254 plates. Purification was performed by flash column chromatography separations using silica gel (200-300 mesh). Melting points (mp) were measured on a X4 micro melting point apparatus. ^{1}H, ^{13}C and ^{19}F NMR spectra were recorded on a JEOL JNM-ECZS 400MHz NMR spectrometer with Me_4Si as the internal standard in DMSO-d_6 or $CDCl_3$. High resolution mass spectra (HRMS) were recorded on an Agilent 6500 Time-of-Flight (TOF) LC/MS system.

2. General procedure for preparation of 1a-1j

To a solution of tert-butyl 2-hydroxybenzoate (5 mmol) or tert-butyl 2-((4-methylphenyl)sulfonamido)benzoate (5 mmol) in DMF (20 mL) was added K_2CO_3 (2.0 g, 15 mmol) and 3-bromoprop-1-yne (654 mg, 5.5 mmol). The resulting mixture was stirred at 80 ^{o}C until the TLC indicated the consumption of the starting material. The reaction system was quenched by H_2O and extracted with DCM. The combined organic phases were dried over anhydrous Na_2SO_4, filtered, and concentrated under vacuum. The residue was purified by a short silica gel column filtration (petroleum ether/DCM) to give intermediate **I-1** in 51~99% yields.

To a solution of intermediate **I-1** (3 mmol) in 1,4-dioxane (15 mL) was paraformaldehyde (540 mg, 6 mmol), CuBr (300 mg, 2.1 mmol) and dicyclohexylamide (1.1 g, 6 mmol) in sequence. The resulting mixture was stirred at 100 ^{o}C until the TLC indicated the consumption of the starting material. After cooling to room temperature, the solvent was removed under reduced pressure, and the residue was extracted with ethyl acetate. The combined organic phases were dried over anhydrous Na_2SO_4, filtered, and concentrated under vacuum. The residue was further purified by a short silica gel column filtration (petroleum ether/ethyl acetate) to give intermediate **I-2** in 71~80% yields.

To a solution of intermediate **I-2** (2 mmol) in DCM (10 mL) was added TFA (1.0 mL). The resulting mixture was stirred at room temperature until the TLC indicated the consumption of the starting material. The solvent was removed under reduced pressure, and the residue was extracted with DCM. The combined organic phases were dried over anhydrous Na_2SO_4, filtered, and concentrated under vacuum. The residue was further purified by a short silica gel column filtration (DCM/MeOH) to give the desired products **1a**-**1g** in 95~99% yields.

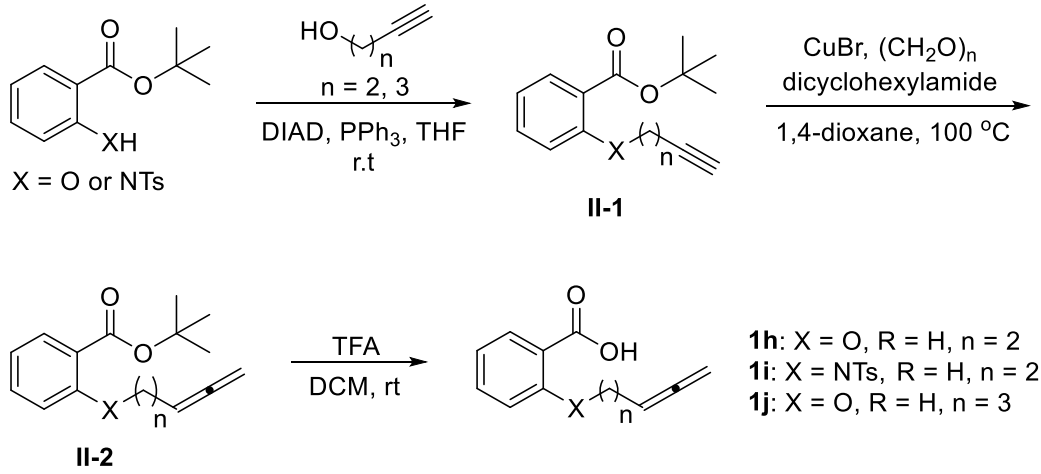


Scheme S1. Synthesis of compounds **1a-1g**.

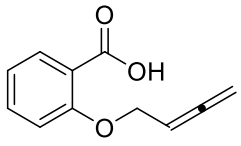
A mixture of DIAD (1.4 g, 7 mmol) and PPh_3 (1.8 g, 7 mmol) in THF (5.0 mL) was stirred at room temperature for 0.5 h. Then, a solution of tert-butyl 2-hydroxybenzoate (5 mmol) or tert-butyl 2-((4-methylphenyl)sulfonamido)benzoate (5 mmol) and alkynol (5 mmol) in THF (25 mL) was slowly added into the mixture. The reaction mixture was stirred at room temperature until TLC indicated the consumption of starting material. The reaction system was quenched by H_2O and extracted with ethyl acetate. The combined organic phases were dried over anhydrous Na_2SO_4, filtered, and concentrated under vacuum. The residue was purified by a short silica gel column filtration (petroleum ether/ethyl acetate) to give intermediate **II-1** in 60~80% yields.

Following the similar procedure carried out for **I-2**, intermediate **II-2** was prepared from **II-1** in 75~83% yields.

Following the similar procedure carried out for **1a**, the desired products **1h**-**1j** were prepared form **II-2** in 95~99% yields.

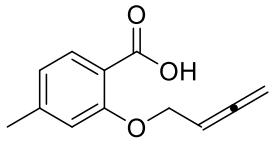


Scheme S2. Synthesis of compounds **1h-1j**.



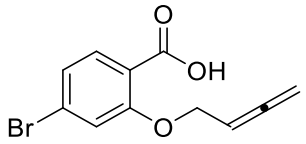
1a

2-((Buta-2,3-dien-1-yl)oxy)benzoic acid (1a). White solid (732 mg, 77% yield over three steps). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.16 (dd, *J* = 7.9, 1.9 Hz, 1H), 7.53 (td, *J* = 7.9, 1.9 Hz, 1H), 7.12 (t, *J* = 7.6 Hz, 1H), 7.03 (d, *J* = 8.4 Hz, 1H), 5.43 (p, *J* = 6.4 Hz, 1H), 4.97 (dt, *J* = 6.1, 2.7 Hz, 2H), 4.78 (dt, *J* = 6.0, 2.8 Hz, 2H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 209.62, 165.49, 157.05, 135.05, 133.96, 122.50, 118.03, 113.07, 85.79, 78.39, 67.29. HRMS calcd for $C_{11}H_{11}O_3$ [M + H]$^+$ *m/z* 191.07027, found 191.07051.



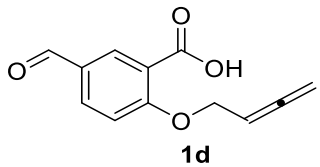
1b

2-((Buta-2,3-dien-1-yl)oxy)-4-methylbenzoic acid (1b). White solid (735 mg, 72% yield over three steps). White solid. ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.05 (d, *J* = 8.1 Hz, 1H), 6.93 (d, *J* = 8.0 Hz, 1H), 6.83 (s, 1H), 5.43 (p, *J* = 6.4 Hz, 1H), 4.98 (dt, *J* = 6.1, 2.7 Hz, 2H), 4.76 (dt, *J* = 5.8, 2.8 Hz, 2H), 2.40 (s, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 209.68, 165.48, 156.96, 146.37, 133.88, 123.46, 115.32, 113.62, 85.80, 78.35, 67.20, 22.08. HRMS calcd for $C_{12}H_{13}O_3$ [M + H]$^+$ *m/z* 205.08592, found 205.08620.



1c

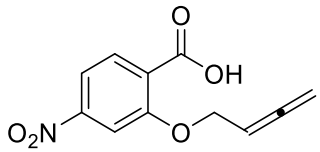
2-((Buta-2,3-dien-1-yl)oxy)-4-bromobenzoic acid (1c). Gray solid (887 mg, 66% yield over three steps). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.03 (d, *J* = 8.4 Hz, 1H), 7.27 (d, *J* = 8.4 Hz, 1H), 7.21 (s, 1H), 5.42 (p, *J* = 6.5 Hz, 1H), 5.01 (dt, *J* = 6.2, 2.9 Hz, 2H), 4.78 (dt, *J* = 6.0, 2.8 Hz, 2H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 209.90, 164.83, 157.21, 135.05, 129.20, 125.85, 117.08, 116.83, 85.39, 78.58, 67.79. HRMS calcd for $C_{11}H_{10}BrO_3$ [M + H]$^+$ *m/z* 268.98078, found 268.98089.



1d

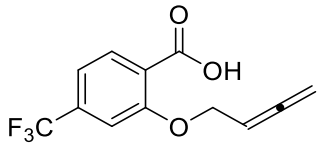
2-((Buta-2,3-dien-1-yl)oxy)-5-formylbenzoic acid (1d). White solid (764 mg, 70% yield over three steps). ^{1}H NMR (400 MHz, $CDCl_3$) δ 9.96 (s, 1H), 8.67 (d, *J* = 2.2 Hz, 1H), 8.11 (dd, *J* = 8.8, 2.3 Hz, 1H), 7.19 (d, *J* = 8.6 Hz, 1H), 5.46 (p, *J* = 6.4 Hz, 1H), 5.01 (dd, *J* = 6.3, 3.0 Hz, 2H), 4.89 (dt, *J* = 6.0, 2.8 Hz, 2H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 209.83, 189.98, 164.58, 161.32, 137.45, 134.55, 130.86, 118.71, 113.81,

85.37, 78.74, 67.88. HRMS calcd for $C_{12}H_{11}O_4$ [M + H]$^+$ *m/z* 219.06573, found 219.06120.



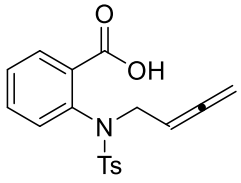
1e

2-((Buta-2,3-dien-1-yl)oxy)-4-nitrobenzoic acid (1e). White solid (799 mg, 68% yield over three steps). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.29 (d, *J* = 9.0 Hz, 1H), 7.93 (d, *J* = 7.1 Hz, 2H), 5.44 (p, *J* = 6.5 Hz, 1H), 5.03 (dt, *J* = 6.3, 2.7 Hz, 2H), 4.90 (dt, *J* = 5.8, 2.7 Hz, 2H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 210.12, 164.89, 157.53, 151.45, 134.81, 123.64, 116.50, 108.76, 85.23, 78.58, 68.27. HRMS calcd for $C_{11}H_8NO_5$ [M + H]$^+$ *m/z* 234.04080, found 234.04034.



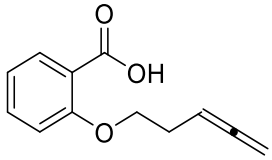
1f

2-((Buta-2,3-dien-1-yl)oxy)-4-(trifluoromethyl)benzoic acid (1f). White solid (852 mg, 66% yield over three steps). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.27 (d, *J* = 8.1 Hz, 1H), 7.37 (d, *J* = 8.1 Hz, 1H), 7.28 (s, 1H), 5.43 (p, *J* = 6.5 Hz, 1H), 4.99 (dd, *J* = 6.5, 2.8 Hz, 2H), 4.86 (dt, *J* = 5.9, 2.7 Hz, 2H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 210.06, 164.76, 157.10, 136.28, 134.67, 123.14, 121.32, 118.87, 110.52, 85.33, 78.43, 67.89. ^{19}F NMR (376 MHz, $CDCl_3$) δ -63.23. HRMS calcd for $C_{12}H_8F_3O_3$ [M -H]$^-$ *m/z* 257.04310, found 257.04281.



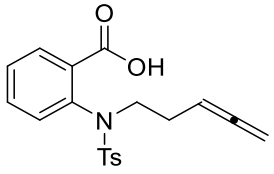
1g

2-((N-(buta-2,3-dien-1-yl)-4-methylphenyl)sulfonamido)benzoic acid (1g). White solid (130 mg, 38% yield over three steps). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.99 (dd, *J* = 7.4, 1.9 Hz, 1H), 7.53 (d, *J* = 8.0 Hz, 2H), 7.50 – 7.38 (m, 2H), 7.25 (d, *J* = 8.0 Hz, 2H), 7.02 (d, *J* = 7.5 Hz, 1H), 5.22 (p, *J* = 7.0 Hz, 1H), 4.59 (d, *J* = 6.3 Hz, 2H), 4.29 (d, *J* = 7.2 Hz, 2H), 2.37 (s, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 210.04, 170.17, 144.00, 138.17, 135.97, 132.97, 132.20, 131.55, 131.46, 129.67, 128.82, 127.90, 86.32, 76.18, 51.31, 21.65. HRMS calcd for $C_{18}H_{16}NO_4S$ [M - H]$^-$ *m/z* 342.08055, found 342.08001.



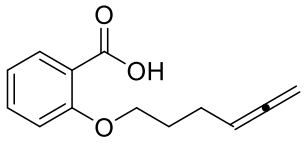
1h

2-((Penta-3,4-dien-1-yl)oxy)benzoic acid (1h). White solid (602 mg, 59% yield over three steps). ^{1}H NMR (400 MHz, $CDCl_3$) δ 10.92 (s, 1H), 8.18 (dt, *J* = 8.5, 2.7 Hz, 1H), 7.61 – 7.44 (m, 1H), 7.16 – 6.88 (m, 2H), 5.24 – 5.02 (m, 1H), 4.80 (dt, *J* = 6.5, 3.2 Hz, 2H), 4.32 (q, *J* = 6.2, 5.6 Hz, 2H), 2.60 (ddt, *J* = 9.4, 6.2, 3.3 Hz, 2H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 209.27, 165.51, 157.42, 135.12, 134.00, 122.36, 117.75, 112.48, 85.50, 76.62, 68.72, 28.25. HRMS calcd for $C_{12}H_{13}O_3$ $[M + H]^+$ *m/z* 205.08647, found 205.08625.



1i

2-((4-Methyl-N-(penta-3,4-dien-1-yl)phenyl)sulfonamido)benzoic acid (1i). White solid (838 mg, 47% yield over three steps). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.03 – 7.98 (m, 1H), 7.53 – 7.48 (m, 2H), 7.47 – 7.43 (m, 2H), 7.25 (s, 2H), 6.91 – 6.81 (m, 1H), 5.04 (p, *J* = 6.8 Hz, 1H), 4.64 (dt, *J* = 6.6, 3.2 Hz, 2H), 3.97 – 3.42 (m, 2H), 2.40 (s, 3H), 2.24 (d, *J* = 37.9 Hz, 2H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 208.92, 168.99, 144.22, 138.14, 134.85, 132.94, 132.30, 132.25, 129.83, 129.71, 128.89, 128.13, 86.51, 75.87, 51.50, 27.47, 21.69. HRMS calcd for $C_{19}H_{20}NO_4S$ $[M + H]^+$ *m/z* 358.11130, found 358.11154.



1j

2-((Hexa-4,5-dien-1-yl)oxy)benzoic acid (1j). White solid (630 mg, 58% yield over three steps). ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.17 (dd, *J* = 7.8, 1.9 Hz, 1H), 7.54 (td, *J* = 7.9, 1.9 Hz, 1H), 7.12 (t, *J* = 7.6 Hz, 1H), 7.04 (d, *J* = 8.5 Hz, 1H), 5.14 (p, *J* = 6.6 Hz, 1H), 4.71 (dt, *J* = 6.7, 3.3 Hz, 2H), 4.29 (t, *J* = 6.4 Hz, 2H), 2.20 (ddq, *J* = 10.1, 6.8, 3.3 Hz, 2H), 2.04 (p, *J* = 6.8 Hz, 2H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 208.68, 165.50, 157.58, 135.14, 133.93, 122.33, 117.78, 112.67, 88.49, 76.08, 69.50, 28.01, 24.35. HRMS calcd for $C_{13}H_{15}O_3$ $[M + H]^+$ *m/z* 219.10212, found 219.10201.

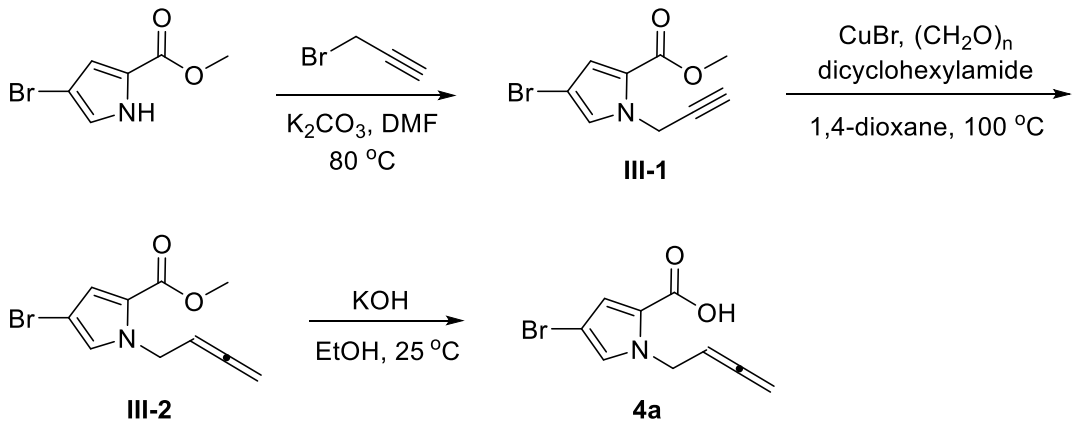
3. General procedure for preparation of 4a-4k

Following the similar procedure carried out for **I-1**, intermediate **III-1** was prepared from methyl 4-bromo-1H-pyrrole-2-carboxylate in 92% yield.

Following the similar procedure carried out for **I-2**, intermediate **III-2** was prepared from **III-1** in 73% yield.

To a solution of **III-2** (2 mmol) in EtOH (10 mL) was added saturated KOH aqueous solution (2.5 mL). The reaction mixture was stirred at 25 ºC until TLC indicated the consumption of starting material. The reaction system was adjusted to pH 2 by the addition of 10% HCl aqueous solution. The aqueous layer was extracted with DCM. The combined organic phases were dried over anhydrous Na_2SO_4, filtered, and

concentrated under vacuum. The residue was further purified by a short silica gel column filtration (DCM/MeOH) to give the desired product **4a** in 99% yield.

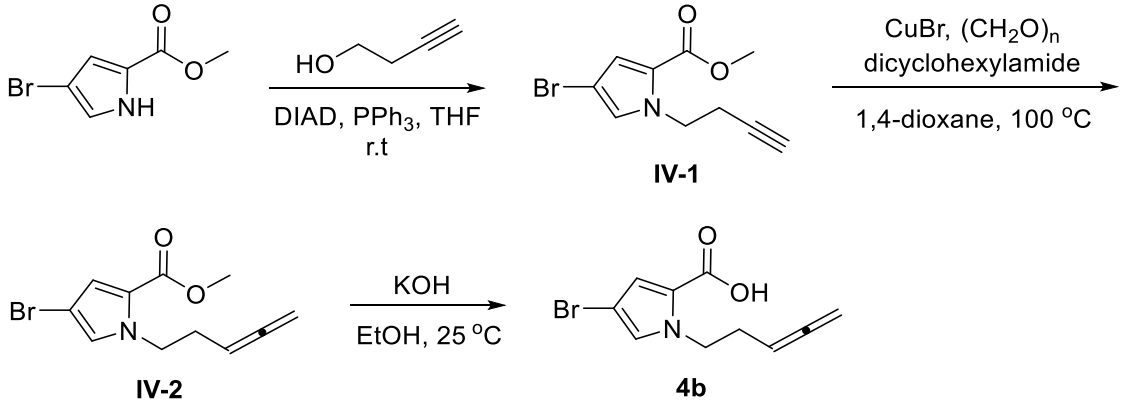


Scheme S3. Synthesis of compounds **4a**.

Following the similar procedure carried out for **II-1**, intermediate **IV-1** was prepared from methyl 4-bromo-1H-pyrrole-2-carboxylate in 52% yield.

Following the similar procedure carried out for **I-2**, intermediate **IV-2** was prepared from **IV-1** in 78% yield.

Following the similar procedure carried out for **4a**, the desired product **4b** was prepared form **IV-2** in 98% yield.

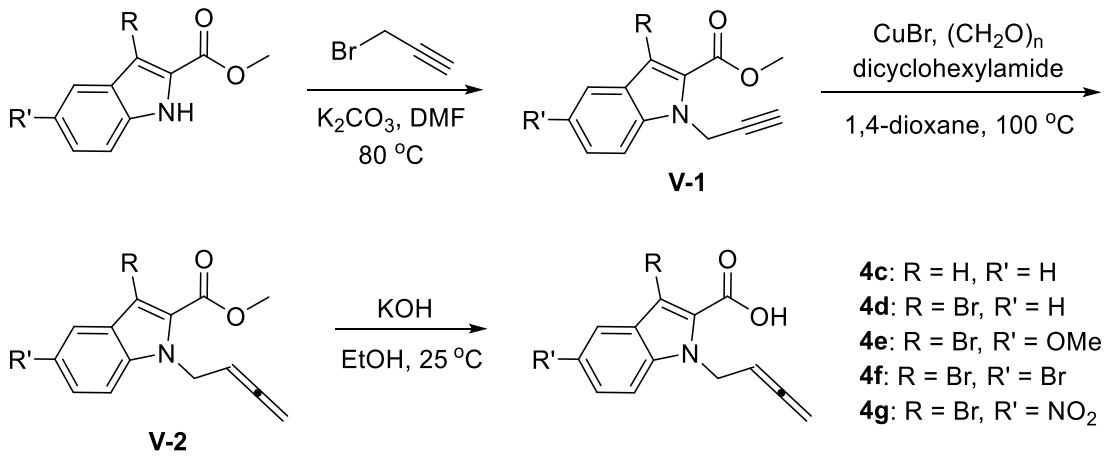


Scheme S4. Synthesis of compounds **4b**.

Following the similar procedure carried out for **I-1**, intermediate **V-1** was prepared from methyl 1H-indole-2-carboxylates in 89~95% yields.

Following the similar procedure carried out for **I-2**, intermediate **V-2** was prepared from **V-1** in 69~78% yields.

Following the similar procedure carried out for **4a**, the desired products **4c**-**4g** were prepared form **V-2** in 95~99% yields.

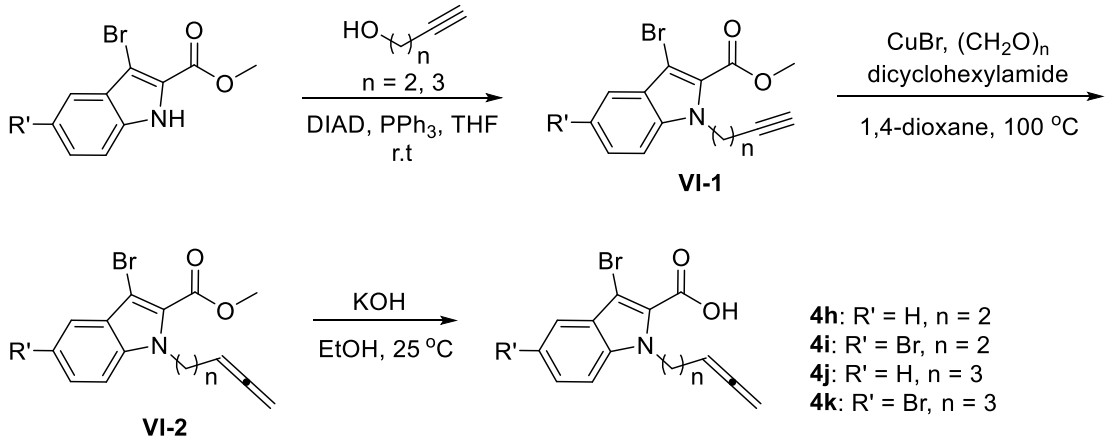


Scheme S5. Synthesis of compounds **4c-4g**.

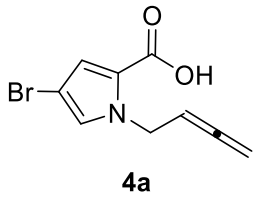
Following the similar procedure carried out for **II-1**, intermediate **VI-1** was prepared from methyl 3-bromo-1H-indole-2-carboxylates in 45~64% yields.

Following the similar procedure carried out for **I-2**, intermediate **VI-2** was prepared from **VI-1** in 74~80% yields.

Following the similar procedure carried out for **4a**, the desired products **4h**-**4k** were prepared form **VI-2** in 95~99% yields.

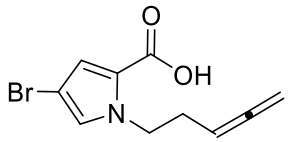


Scheme S6. Synthesis of compounds **4h-4k**.



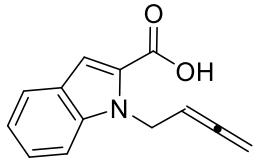
4a

4-Bromo-1-(buta-2,3-dien-1-yl)-1H-pyrrole-2-carboxylic acid (4a). White solid (798 mg, 66% yield over three steps). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.06 (d, *J* = 2.2 Hz, 1H), 6.94 (d, *J* = 2.0 Hz, 1H), 5.36 (p, *J* = 6.5 Hz, 1H), 4.92 – 4.85 (m, 2H), 4.85 – 4.79 (m, 2H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 209.15, 165.25, 129.08, 121.75, 121.43, 96.16, 87.86, 77.38, 48.11. HRMS calcd for $C_9H_7BrNO_2$ $[M - H]^-$ *m/z* 239.96602, found 239.96643.



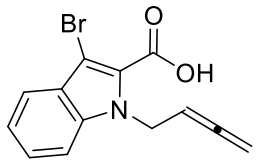
4b

4-Bromo-1-(penta-3,4-dien-1-yl)-1H-pyrrole-2-carboxylic acid (4b). White solid (499 mg, 39% yield over three steps). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.07 (d, *J* = 1.9 Hz, 1H), 6.88 (d, *J* = 1.9 Hz, 1H), 5.04 (p, *J* = 6.9 Hz, 1H), 4.67 (dt, *J* = 6.4, 3.0 Hz, 2H), 4.34 (t, *J* = 7.0 Hz, 2H), 2.49 – 2.37 (m, 2H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 209.15, 165.39, 129.75, 121.84, 121.35, 95.73, 85.99, 75.69, 49.12, 30.35. HRMS calcd for $C_{10}H_{10}BrNNaO_2$ $[M + Na]^+$ *m/z* 277.97926, found 277.97965.



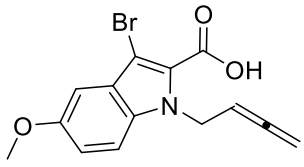
4c

1-(Buta-2,3-dien-1-yl)-1H-indole-2-carboxylic acid (4c). White solid (499 mg, 39% yield over three steps). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.70 (d, *J* = 7.9 Hz, 1H), 7.45 (d, *J* = 14.9 Hz, 2H), 7.38 (t, *J* = 7.6 Hz, 1H), 7.17 (t, *J* = 7.4 Hz, 1H), 5.38 (p, *J* = 6.5 Hz, 1H), 5.22 (dt, *J* = 6.2, 2.8 Hz, 2H), 4.76 (dt, *J* = 6.1, 2.8 Hz, 2H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 208.92, 166.65, 139.78, 126.15, 126.05, 125.89, 123.06, 121.05, 113.09, 111.00, 87.92, 43.52, 32.53. HRMS calcd for $C_{13}H_9NO_2$ $[M - H]^-$ *m/z* 212.07170, found 212.07140.



4d

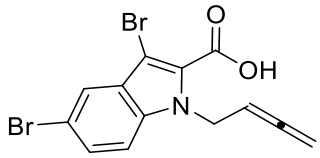
3-Bromo-1-(3l5-buta-2,3-dien-1-yl)-1H-indole-2-carboxylic acid (4d). White solid (1 g, 73% yield over three steps). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.71 (d, *J* = 8.1 Hz, 1H), 7.47 – 7.40 (m, 2H), 7.29 – 7.20 (m, 1H), 5.39 (p, *J* = 6.5 Hz, 1H), 5.20 (dt, *J* = 6.0, 2.7 Hz, 2H), 4.79 (dt, *J* = 6.2, 2.7 Hz, 2H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 208.96, 166.55, 138.42, 127.21, 127.09, 123.50, 121.99, 121.86, 111.12, 102.31, 87.80, 44.63. HRMS calcd for $C_{13}H_{11}BrNO_2$ $[M + H]^+$ *m/z* 291.99732, found 291.99778.



4e

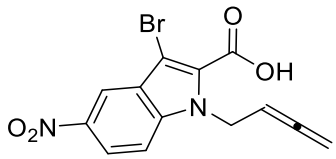
3-Bromo-1-(buta-2,3-dien-1-yl)-5-methoxy-1H-indole-2-carboxylic acid (4e). White solid (1.1 g, 72% yield over three steps). ^{1}H NMR (400 MHz, DMSO-d_6) δ 7.48

(d, *J* = 9.0 Hz, 1H), 7.01 (dd, *J* = 9.0, 2.4 Hz, 1H), 6.89 (d, *J* = 2.3 Hz, 1H), 5.36 (p, *J* = 6.3 Hz, 1H), 5.12 (dt, *J* = 6.0, 3.0 Hz, 2H), 4.74 (dd, *J* = 6.6, 3.2 Hz, 2H), 3.78 (s, 3H). ^{13}C NMR (101 MHz, DMSO-d_6) δ 208.19, 162.36, 155.54, 132.83, 126.85, 126.33, 117.97, 113.34, 100.70, 97.13, 88.60, 78.02, 55.91, 43.86. HRMS calcd for $C_{14}H_{11}BrNO_3$ [M - H]$^-$ *m/z* 319.99224, found 319.99234.



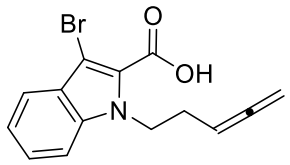
4f

3,5-Dibromo-1-(buta-2,3-dien-1-yl)-1H-indole-2-carboxylic acid (4f). White solid (1.2 g, 63% yield over three steps). ^{1}H NMR (400 MHz, DMSO-d_6) δ 7.65 (d, *J* = 1.7 Hz, 1H), 7.57 (d, *J* = 8.8 Hz, 1H), 7.49 (dd, *J* = 8.9, 2.0 Hz, 1H), 5.39 (p, *J* = 6.1 Hz, 1H), 5.14 (dt, *J* = 6.0, 3.0 Hz, 2H), 4.73 (dt, *J* = 6.3, 3.0 Hz, 2H). ^{13}C NMR (101 MHz, DMSO-d_6) δ 208.34, 162.32, 136.50, 129.29, 128.35, 128.01, 123.21, 114.75, 114.70, 96.68, 88.72, 78.51, 44.17. HRMS calcd for $C_{13}H_8Br_2NO_2$[M - H]$^-$ *m/z* 367.89273, found 369.89002.



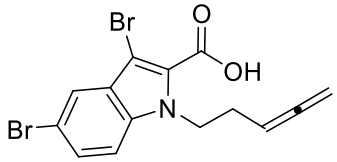
4g

3-Bromo-1-(buta-2,3-dien-1-yl)-5-nitro-1H-indole-2-carboxylic acid (4g). White solid (977 mg, 58% yield over three steps). ^{1}H NMR (400 MHz, DMSO-d_6) δ 8.36 (d, *J* = 1.8 Hz, 1H), 8.19 (dd, *J* = 9.2, 2.3 Hz, 1H), 7.80 (d, *J* = 9.2 Hz, 1H), 5.45 (p, *J* = 6.1 Hz, 1H), 5.21 (dt, *J* = 6.0, 3.2 Hz, 2H), 4.73 (dt, *J* = 6.4, 3.1 Hz, 2H). ^{13}C NMR (101 MHz, DMSO-d_6) δ 207.96, 161.74, 142.80, 140.04, 130.24, 125.79, 120.90, 117.87, 113.34, 99.38, 88.40, 78.58, 44.29, 32.51. HRMS calcd for $C_{13}H_9BrN_2NaO_4$ [M + Na]$^+$ *m/z* 358.96434, found 358.96444.



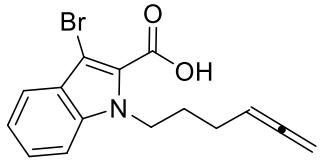
4h

3-Bromo-1-(penta-3,4-dien-1-yl)-1H-indole-2-carboxylic acid (4h). White solid (734 mg, 48% yield over three steps). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.69 (dd, *J* = 15.3, 8.1 Hz, 1H), 7.45 – 7.33 (m, 2H), 7.27 – 7.16 (m, 1H), 5.10 (h, *J* = 7.1 Hz, 1H), 4.67 (td, *J* = 6.6, 5.9, 2.6 Hz, 3H), 4.64 – 4.57 (m, 1H), 3.98 (s, 1H), 2.61 – 2.32 (m, 2H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 209.18, 166.33, 138.37, 127.09, 126.32, 123.66, 122.00, 121.74, 121.48, 110.87, 102.01, 86.36, 75.58, 51.98, 45.37, 29.41. HRMS calcd for $C_{14}H_{12}BrNNaO_2$ [M + Na]$^+$ *m/z* 327.99491, found 327.99493.



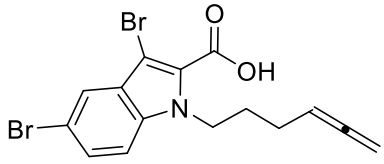
4i

3,5-Dibromo-1-(penta-3,4-dien-1-yl)-1H-indole-2-carboxylic acid (4i). White solid (519 mg, 27% yield over three steps). ^{1}H NMR (400 MHz, DMSO-d_6) δ 7.66 – 7.60 (m, 2H), 7.47 (dd, *J* = 8.9, 2.0 Hz, 1H), 5.08 (p, *J* = 7.0 Hz, 1H), 4.64 – 4.50 (m, 4H), 2.31 (qt, *J* = 6.9, 2.8 Hz, 2H). ^{13}C NMR (101 MHz, DMSO-d_6) δ 208.91, 162.19, 136.32, 128.91, 127.99, 127.83, 122.93, 114.46, 114.38, 96.30, 86.67, 75.80, 45.17, 29.71. HRMS calcd for $C_{14}H_{11}Br_2NNaO_2$[M + Na]$^+$ *m/z* 405.90542, found 405.90587.



4j

3-Bromo-1-(hexa-4,5-dien-1-yl)-1H-indole-2-carboxylic acid (4j). White solid (752 mg, 47% yield over three steps). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.71 (d, *J* = 8.2 Hz, 1H), 7.42 (d, *J* = 3.8 Hz, 2H), 7.28 – 7.21 (m, 1H), 5.14 (p, *J* = 6.5 Hz, 1H), 4.73 (dt, *J* = 6.5, 3.2 Hz, 2H), 4.67 – 4.58 (m, 2H), 2.06 (dtt, *J* = 9.8, 6.5, 3.1 Hz, 2H), 2.01 – 1.91 (m, 2H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 208.64, 166.37, 138.43, 127.05, 126.94, 123.58, 122.01, 121.68, 110.89, 101.97, 89.14, 75.80, 45.35, 29.74, 25.40. HRMS calcd for $C_{15}H_{14}BrNNaO_2$ [M + Na]$^+$ *m/z* 342.01056, found 342.01034.



4k

3,5-Dibromo-1-(hexa-4,5-dien-1-yl)-1H-indole-2-carboxylic acid (4k). White solid (638 mg, 32% yield over three steps). ^{1}H NMR (400 MHz, DMSO-d_6) δ 7.65 – 7.60 (m, 2H), 7.46 (dd, *J* = 8.9, 2.0 Hz, 1H), 5.13 (p, *J* = 6.6 Hz, 1H), 4.70 (dt, *J* = 6.8, 3.5 Hz, 2H), 4.53 (t, *J* = 7.2 Hz, 2H), 1.88 (ddq, *J* = 10.2, 6.6, 3.3 Hz, 2H), 1.79 – 1.67 (m, 2H). ^{13}C NMR (101 MHz, DMSO-d_6) δ 208.27, 162.13, 136.29, 128.92, 127.94, 127.74, 122.94, 114.37, 114.34, 96.22, 89.47, 76.42, 45.20, 30.00, 25.13. HRMS calcd for $C_{15}H_{13}Br_2NNaO_2$ [M + Na]$^+$ *m/z* 419.92107, found 419.92087.

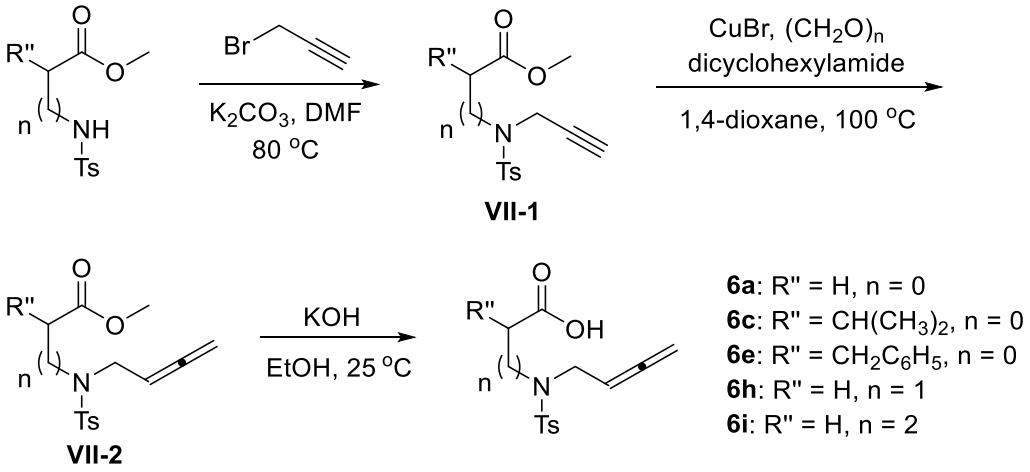
4. General procedure for preparation of 6a-6i

Following the similar procedure carried out for **I-1**, intermediate **VII-1** was prepared from N-Ts amino acid methyl esters in 52~64% yields.

Following the similar procedure carried out for **I-2**, intermediate **VII-2** was prepared from **VII-1** in 68~77% yields.

Following the similar procedure carried out for **4a**, the desired products **6a**, **6c**, **6e**

and **6h-6i** were prepared form **VII-2** in 95~99% yields.

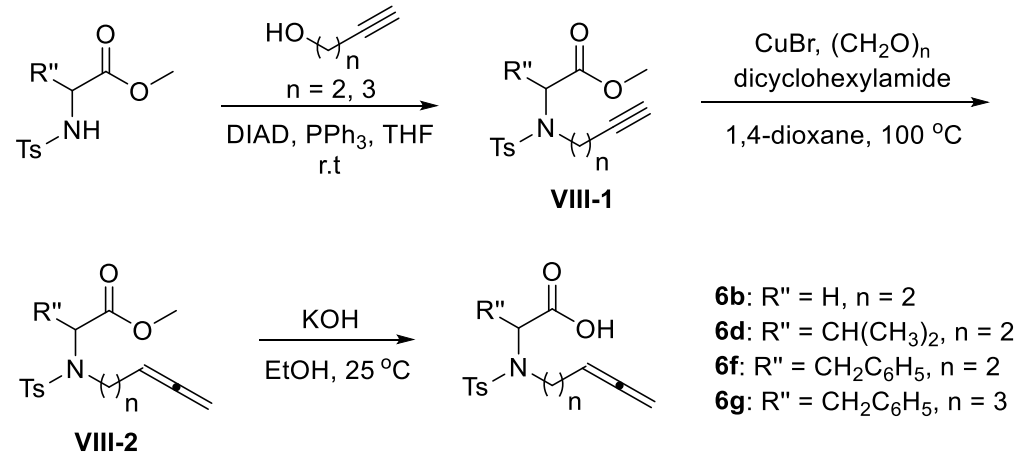


Scheme S7. Synthesis of compounds **6a**, **6c**, **6e** and **6h-6i**.

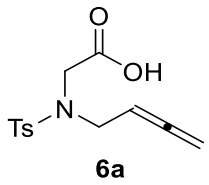
Following the similar procedure carried out for **II-1**, intermediate **VIII-1** was prepared from N-Ts amino acid methyl esters in 35~44% yields.

Following the similar procedure carried out for **I-2**, intermediate **VIII-2** was prepared from **VIII-1** in 68~80% yields.

Following the similar procedure carried out for **4a**, the desired products **6b**, **6d** and **6f-6g** were prepared form **VIII-2** in 95~99% yields.

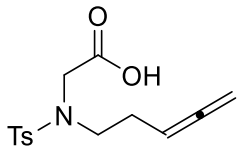


Scheme S8. Synthesis of compounds **6b**, **6d** and **6f-6g**.



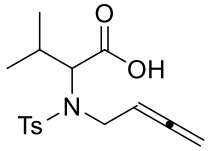
N-(buta-2,3-dien-1-yl)-N-tosylglycine (6a). Gray solid (647 mg, 46% yield over three steps). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.71 (d, *J* = 8.2 Hz, 2H), 7.29 (d, *J* = 8.1 Hz, 2H), 4.94 (p, *J* = 6.9 Hz, 1H), 4.72 (dt, *J* = 6.5, 2.5 Hz, 2H), 4.06 (s, 2H), 3.89 (dt, *J* = 7.2, 2.6 Hz, 2H), 2.41 (s, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 209.93, 174.63, 143.92,

136.63, 129.84, 127.42, 85.35, 76.77, 47.46, 46.94, 21.66. HRMS calcd for $C_{13}H_{14}NO_4S$ [M - H]$^-$ *m/z* 280.06490, found 280.06461.



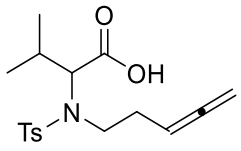
6b

N-(penta-3,4-dien-1-yl)-N-tosylglycine (6b). White solid (472 mg, 32% yield over three steps). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.70 (d, *J* = 8.2 Hz, 2H), 7.28 (d, *J* = 8.0 Hz, 2H), 5.00 (p, *J* = 6.9 Hz, 1H), 4.66 (dt, *J* = 6.7, 3.2 Hz, 2H), 4.06 (s, 2H), 3.34 – 3.24 (m, 2H), 2.41 (s, 3H), 2.22 (tdd, *J* = 10.1, 6.7, 3.1 Hz, 2H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 208.88, 174.44, 174.40, 143.85, 136.47, 129.78, 127.43, 86.40, 75.90, 48.37, 48.10, 27.12, 21.67. HRMS calcd for $C_{14}H_{17}NaO_4S$ [M+ Na]$^+$ *m/z* 318.07760, found 318.07751.



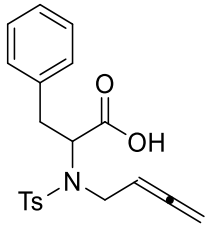
6c

N-(buta-2,3-dien-1-yl)-N-tosylvaline (6c). Light yellow liquid (706 mg, 43% yield over three steps). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.70 (d, *J* = 8.4 Hz, 2H), 7.24 (d, *J* = 8.4 Hz, 2H), 5.20 (dq, *J* = 8.3, 6.5 Hz, 1H), 4.74 – 4.66 (m, 2H), 4.10 (d, *J* = 10.0 Hz, 1H), 4.04 – 3.86 (m, 2H), 2.38 (s, 3H), 2.11 (ddt, *J* = 12.2, 9.4, 6.0 Hz, 1H), 0.96 (d, *J* = 6.4 Hz, 6H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 208.86, 175.84, 143.72, 136.79, 129.56, 127.64, 88.20, 76.18, 65.34, 44.23, 28.36, 21.65, 19.73, 19.59. HRMS calcd for $C_{16}H_{21}NNaO_4S$ [M + Na]$^+$ *m/z* 346.10890, found 346.10868.



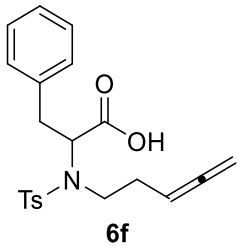
6d

N-(penta-3,4-dien-1-yl)-N-tosylvaline (6d). Light yellow liquid (438 mg, 26% yield over three steps). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.70 (d, *J* = 8.0 Hz, 2H), 7.24 (d, *J* = 7.9 Hz, 2H), 5.01 (p, *J* = 6.7 Hz, 1H), 4.67 (dt, *J* = 6.6, 3.1 Hz, 2H), 4.04 (d, *J* = 10.3 Hz, 1H), 3.40 (ddd, *J* = 16.3, 11.2, 5.4 Hz, 1H), 3.25 (ddd, *J* = 15.8, 11.3, 5.2 Hz, 1H), 2.44 (dtt, *J* = 11.3, 6.1, 2.8 Hz, 1H), 2.37 (s, 3H), 2.30 – 2.18 (m, 1H), 2.11 – 2.03 (m, 1H), 0.94 (t, *J* = 6.7 Hz, 6H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 208.84, 175.96, 143.68, 136.72, 129.57, 127.57, 86.78, 75.66, 65.68, 44.92, 29.25, 28.61, 21.61, 19.82, 19.51. HRMS calcd for $C_{17}H_{21}NO_4S$ [M - H]$^-$ *m/z* 336.12969, found 336.12919.



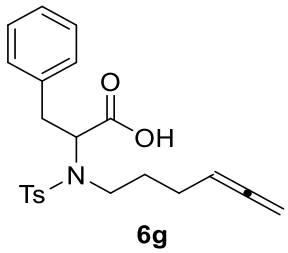
6e

N-(buta-2,3-dien-1-yl)-N-tosylphenylalanine (6e). Light yellow liquid (687 mg, 37% yield over three steps). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.47 (d, *J* = 8.2 Hz, 2H), 7.32 – 7.09 (m, 7H), 5.05 (p, *J* = 6.9 Hz, 1H), 4.87 (dd, *J* = 8.6, 6.4 Hz, 1H), 4.74 (dq, *J* = 6.6, 2.2 Hz, 2H), 4.01 – 3.76 (m, 2H), 3.36 (dd, *J* = 14.4, 6.5 Hz, 1H), 3.00 (dd, *J* = 14.4, 8.6 Hz, 1H), 2.37 (s, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 209.22, 176.31, 143.64, 136.86, 136.82, 129.59, 129.25, 128.74, 127.58, 126.98, 87.62, 76.54, 60.72, 45.01, 35.88, 21.62. HRMS calcd for $C_{20}H_{21}NNaO_4S$ $[M + Na]^+$ *m/z* 394.10890, found 394.10933.



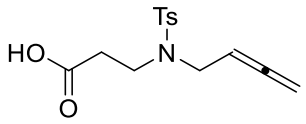
6f

N-(penta-3,4-dien-1-yl)-N-tosylphenylalanine (6f). Light yellow liquid (436 mg, 22% yield over three steps). ^{1}H NMR (400 MHz, DMSO-d_6) δ 7.62 (d, *J* = 8.1 Hz, 2H), 7.25 – 7.04 (m, 7H), 5.05 (p, *J* = 6.7 Hz, 1H), 4.69 (dt, *J* = 6.7, 3.2 Hz, 2H), 4.22 (t, *J* = 7.1 Hz, 1H), 3.35 – 2.99 (m, 3H), 2.55 (dd, *J* = 13.8, 6.9 Hz, 1H), 2.31 (s, 3H), 2.24 – 2.12 (m, 1H), 2.11 – 1.96 (m, 1H). ^{13}C NMR (101 MHz, DMSO-d_6) δ 208.46, 171.31, 129.64, 129.57, 128.42, 127.65, 126.07, 87.76, 75.98, 65.43, 45.05, 38.91, 29.25, 21.47. HRMS calcd for $C_{21}H_{23}NNaO_4S$ $[M + Na]^+$ *m/z* 408.12455, found 408.12425.



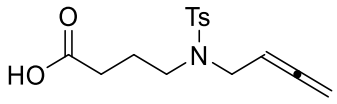
6g

N-(hexa-4,5-dien-1-yl)-N-tosylphenylalanine (6g). Light yellow liquid (470 mg, 23% yield over three steps). ^{1}H NMR (400 MHz, $CDCl_3$) δ 10.61 (s, 1H), 7.59 – 7.50 (m, 2H), 7.30 – 7.07 (m, 7H), 5.02 (p, *J* = 6.6 Hz, 1H), 4.76 (t, *J* = 7.4 Hz, 1H), 4.66 (dt, *J* = 6.5, 3.2 Hz, 2H), 3.42 – 3.24 (m, 2H), 3.17 (ddd, *J* = 15.4, 10.5, 5.6 Hz, 1H), 2.95 (dd, *J* = 14.3, 7.9 Hz, 1H), 2.37 (d, *J* = 2.4 Hz, 3H), 1.92 (qq, *J* = 6.6, 3.3 Hz, 2H), 1.76 – 1.58 (m, 2H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 208.59, 176.06, 143.57, 136.90, 136.72, 129.57, 129.17, 128.72, 127.55, 126.99, 89.05, 75.56, 61.26, 45.66, 36.39, 29.13, 25.53, 21.60. HRMS calcd for $C_{22}H_{25}NNaO_4S$ $[M + Na]^+$ *m/z* 422.14020, found 422.13982.



6h

3-((N-(buta-2,3-dien-1-yl)-4-methylphenyl)sulfonamido)propanoic acid (6h). White solid (664 mg, 45% yield over three steps). ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.70 – 7.66 (m, 2H), 7.29 (d, *J* = 8.0 Hz, 2H), 4.91 (p, *J* = 6.9 Hz, 1H), 4.71 (dt, *J* = 6.5, 2.4 Hz, 2H), 3.84 (dt, *J* = 7.1, 2.6 Hz, 2H), 3.43 (dd, *J* = 8.4, 6.5 Hz, 2H), 2.73 – 2.67 (m, 2H), 2.41 (s, 3H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 209.60, 177.45, 143.73, 136.57, 129.92, 127.31, 85.90, 76.67, 47.72, 42.70, 34.05, 21.63. HRMS calcd for $C_{14}H_{16}NO_4S$ $[M - H]^-$ *m/z* 294.08055, found 294.07975.



6i

4-((N-(buta-2,3-dien-1-yl)-4-methylphenyl)sulfonamido)butanoic acid (6i). White solid (648 mg, 42% yield over three steps). ^{1}H NMR (400 MHz, $CDCl_3$) δ 10.95 (s, 1H), 7.64 (d, *J* = 8.3 Hz, 2H), 7.26 (d, *J* = 8.1 Hz, 2H), 4.84 (p, *J* = 6.9 Hz, 1H), 4.67 (dt, *J* = 6.5, 2.5 Hz, 2H), 3.80 (dt, *J* = 7.3, 2.5 Hz, 2H), 3.18 (t, *J* = 6.9 Hz, 2H), 2.39 (d, *J* = 8.3 Hz, 5H), 1.84 (q, *J* = 7.2 Hz, 2H). ^{13}C NMR (101 MHz, $CDCl_3$) δ 209.56, 179.10, 143.53, 136.85, 129.86, 127.23, 85.78, 76.40, 46.99, 46.22, 30.90, 23.07, 21.60. HRMS calcd for $C_{15}H_{18}NO_4S$ $[M - H]^-$ *m/z* 308.09620, found 308.09541.

5. Single crystal X-ray diffraction data of 2i

Crystal of **2i** was grown by slow evaporation of tert-Butanol solution at room temperature (20 ℃). X-ray diffraction data was collected at 293(2) K on a Bruker Kappa Apex Duo diffractometer with graded-multilayer focused CuK(alpha) X-rays.

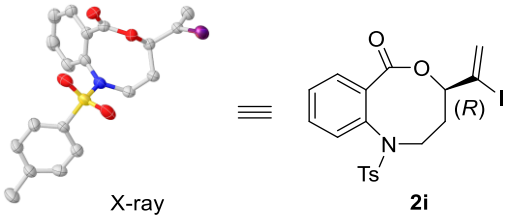
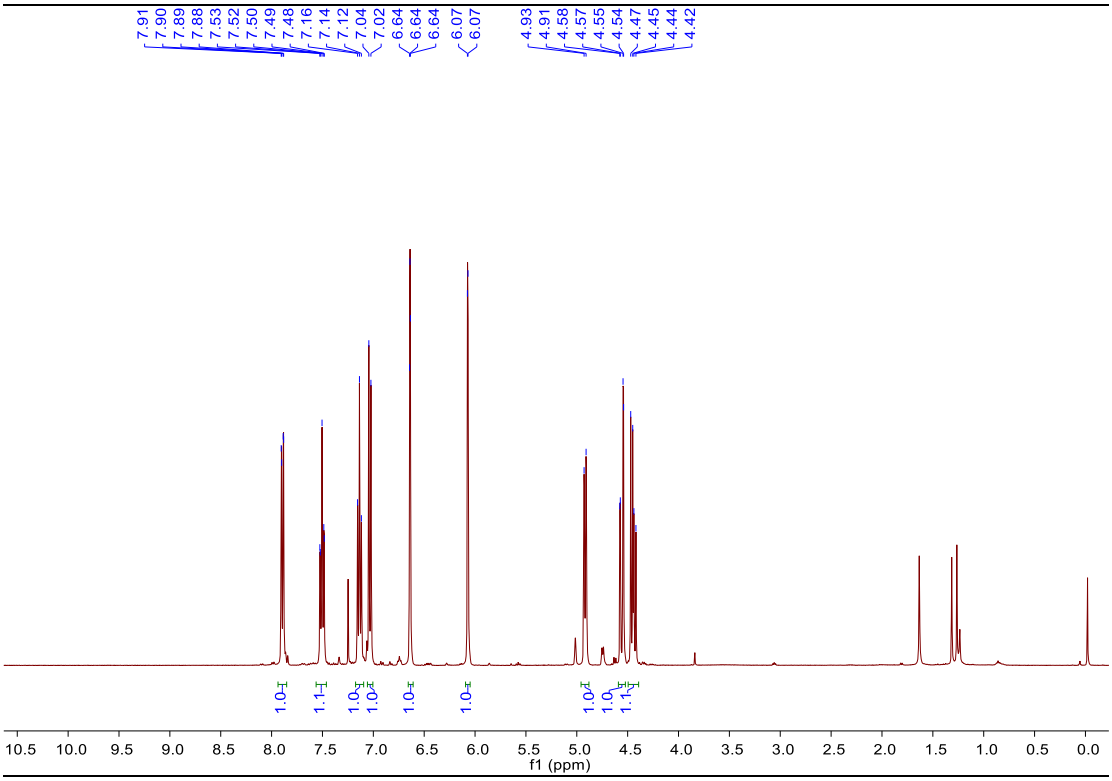


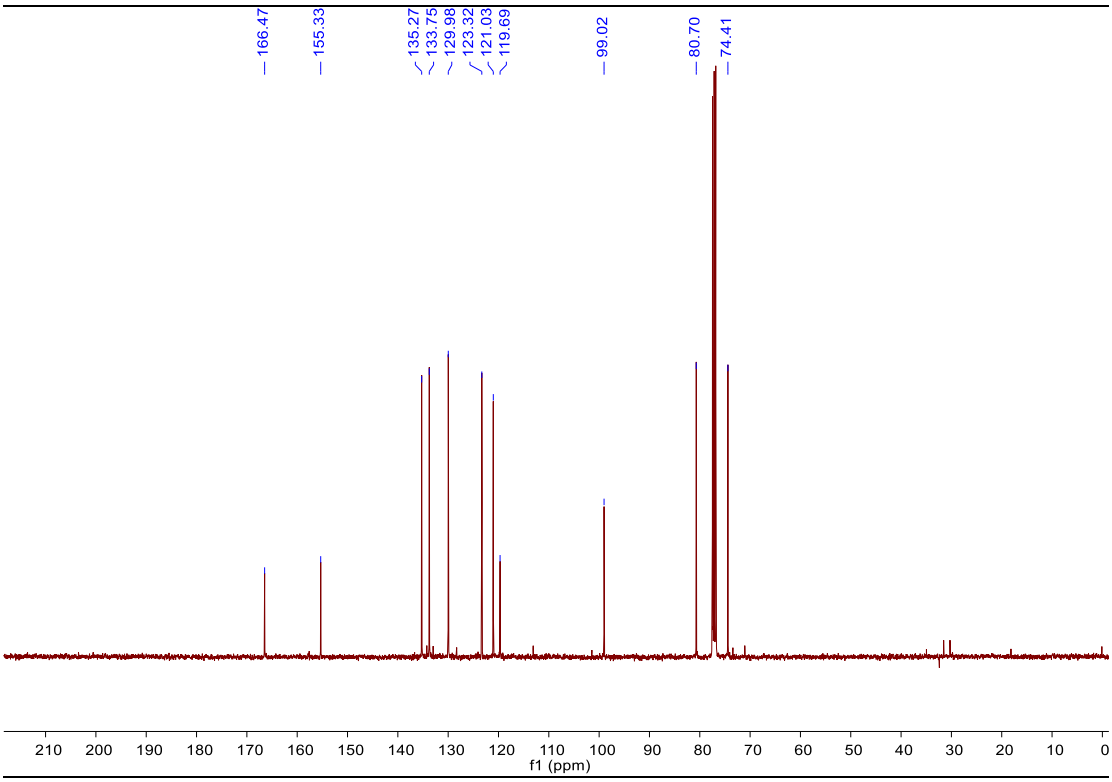
Figure S1. Crystal structure of **2i** with thermal ellipsoids at 30% probability.

Crystal data and structure refinement for 2i	
Identification code	2i
CCDC number	2284212
Bond precision	C-C = 0.0064 A
Wavelength	1.54178
Cell	a=9.5458(3) b=10.8218(3) c=18.6882(5) alpha=102.663(1) beta=92.618(1) gamma=90.594(1)
Temperature	150 K
Volume	1881.21(9)
Space group	P -1
Hall group	-P 1
Moiety formula	?
Sum formula	C_{19} H_{18} I N O_4 S
Mr	483.30
Dx,g.cm-3	1.706
Z	4
Mu (mm-1)	14.624
F000	960.0
h,k,lmax	11,13,23
Nref	7613
Tmin,Tmax	0.005,0.087
Data completeness	0.985
Theta(max)	74.712
R(reflections)	0.0690(6825)
wR2(reflections)	0.1889(7613)
S	1.101
Npar	545

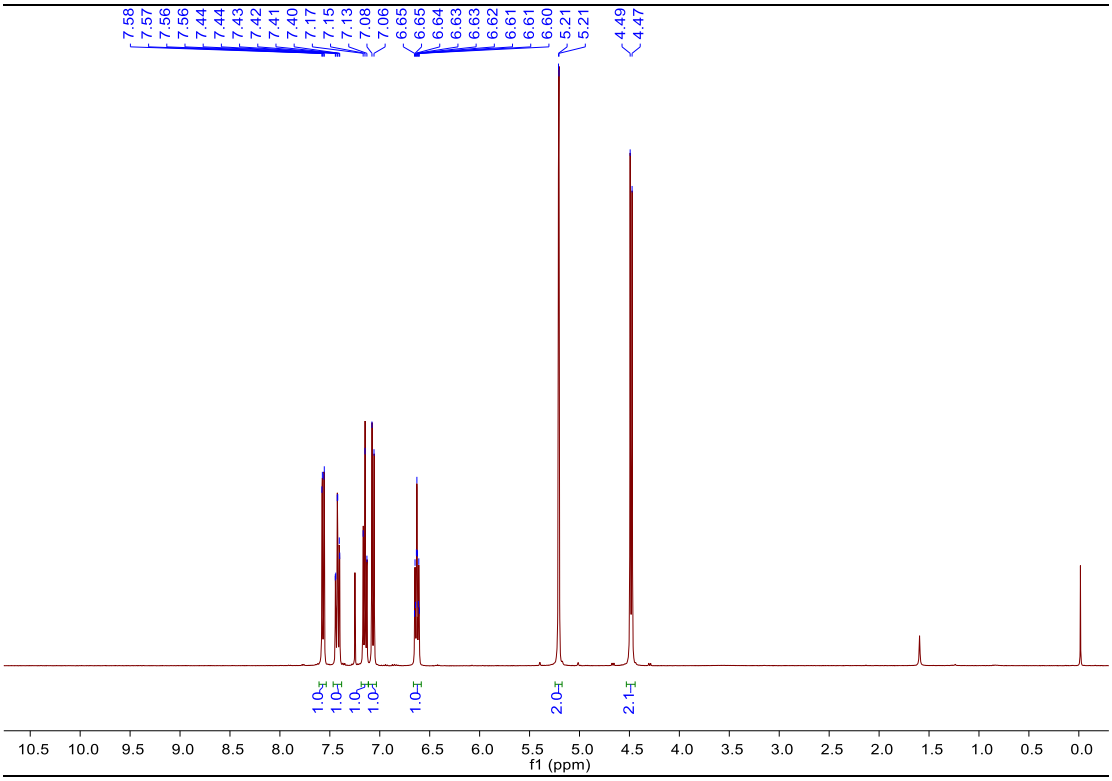
6. Copies of ^{1}H NMR and ^{13}C NMR spectra for 2a-2j, 3a, 3e, 3f, 5a-5k and 7a-7i



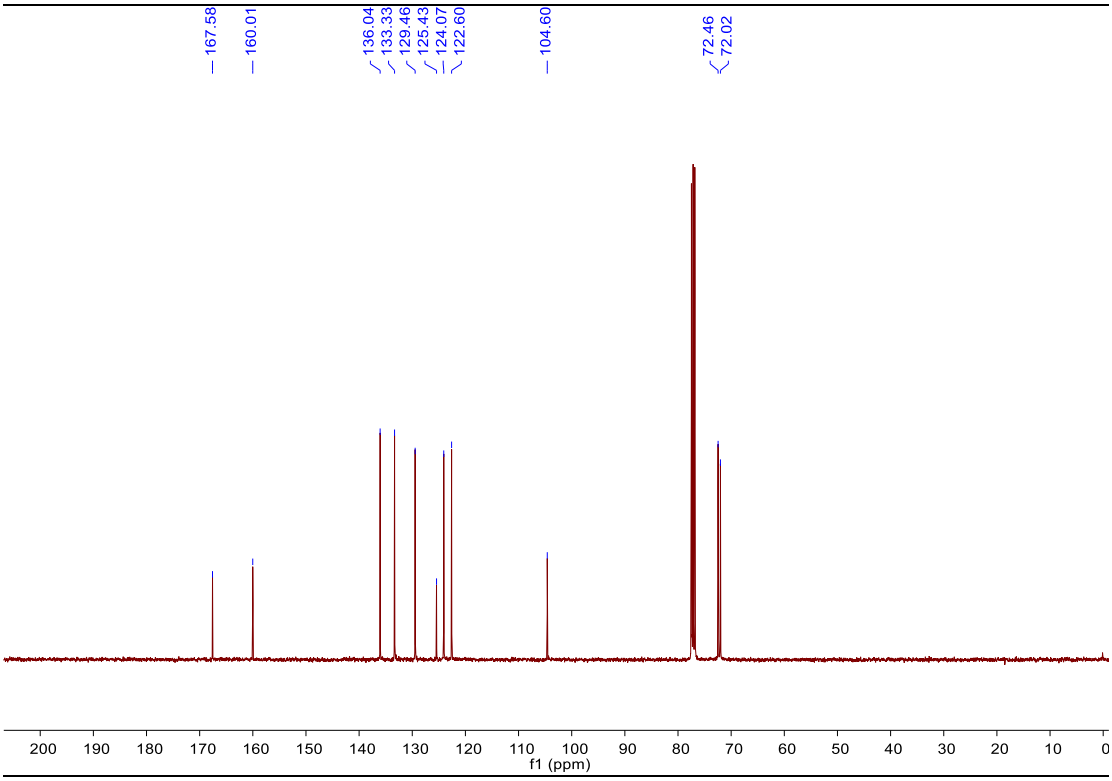
^{1}H NMR spectrum of 2a



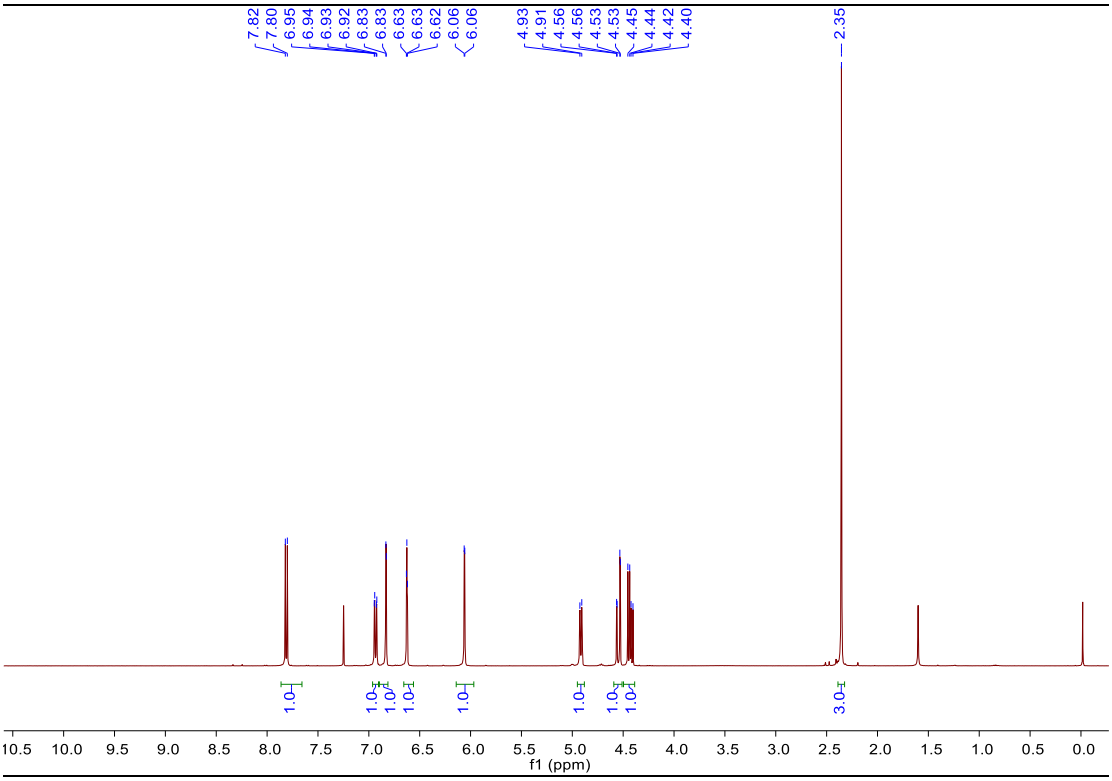
^{13}C NMR spectrum of 2a



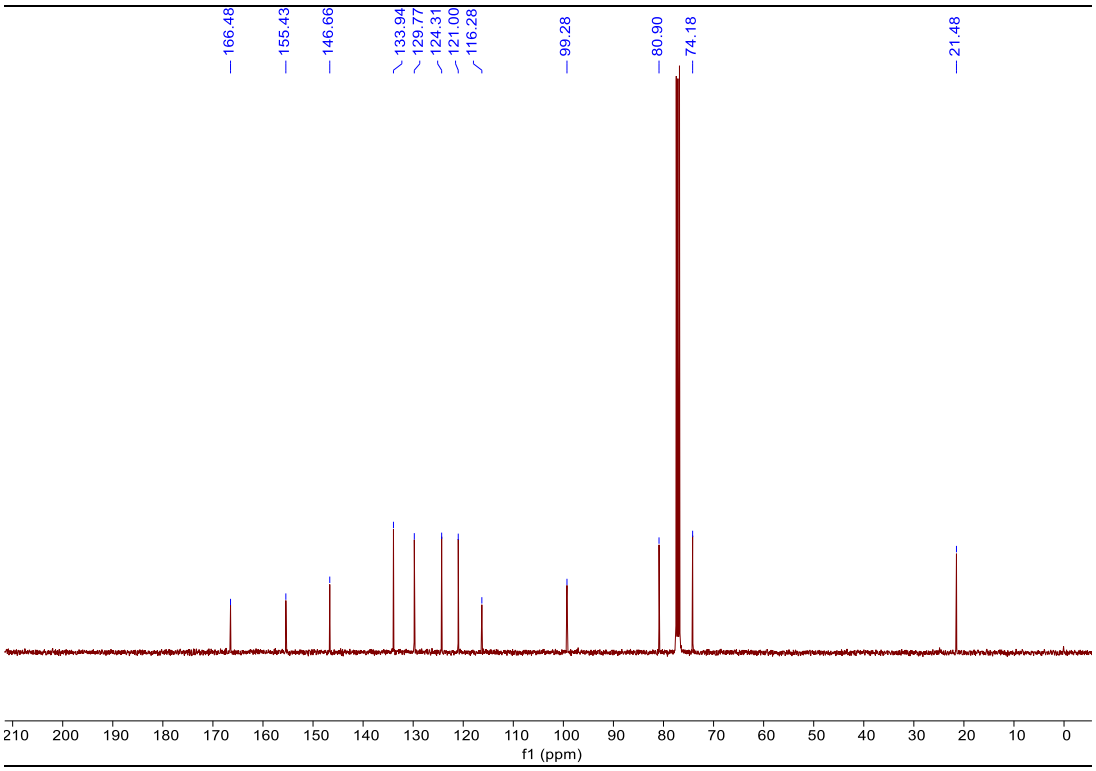
^{1}H NMR spectrum of 3a



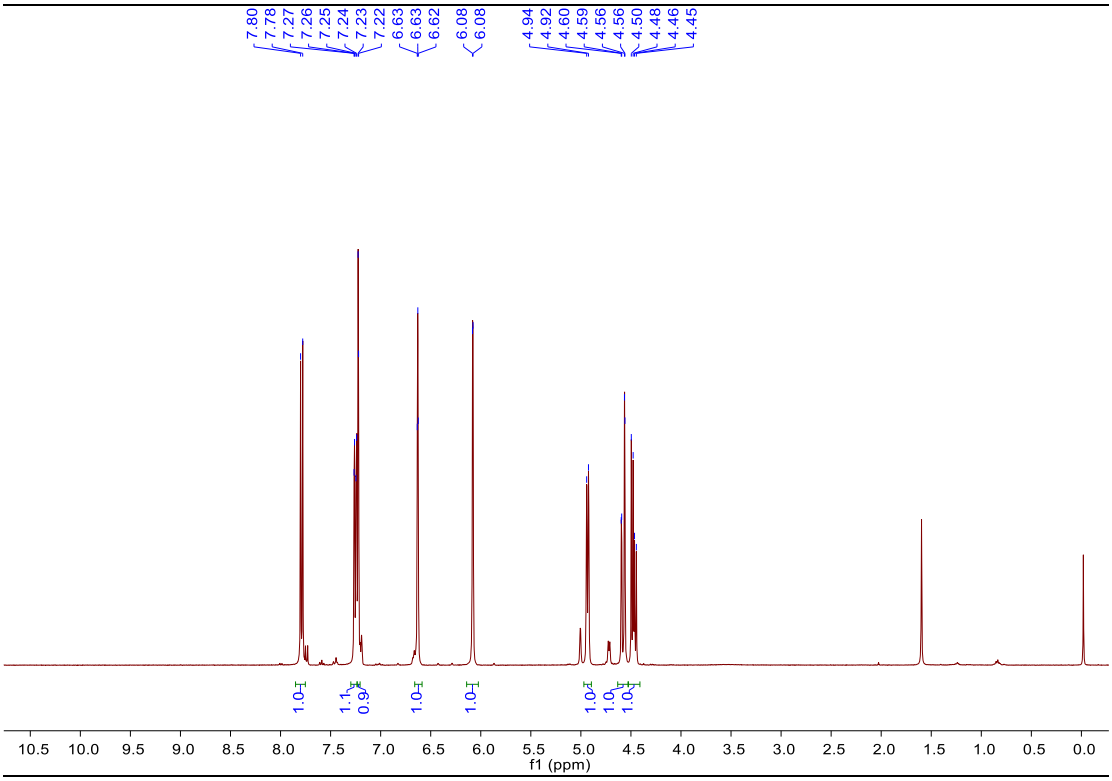
^{13}C NMR spectrum of 3a



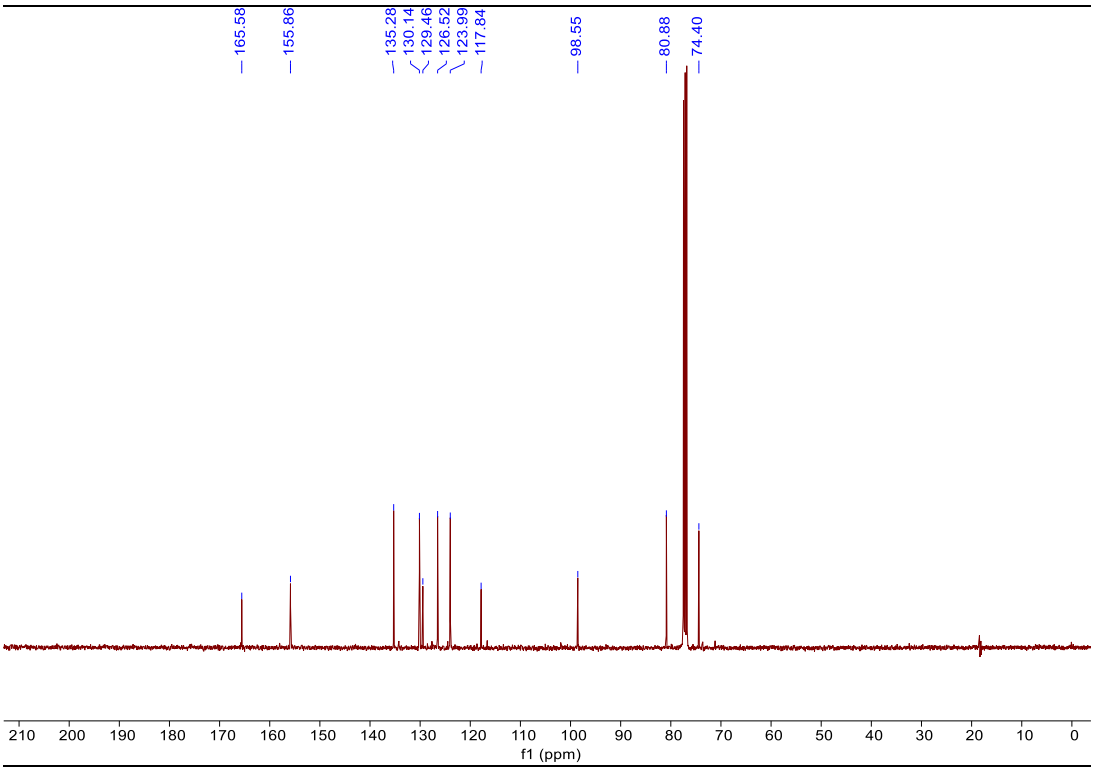
^{1}H NMR spectrum of 2b



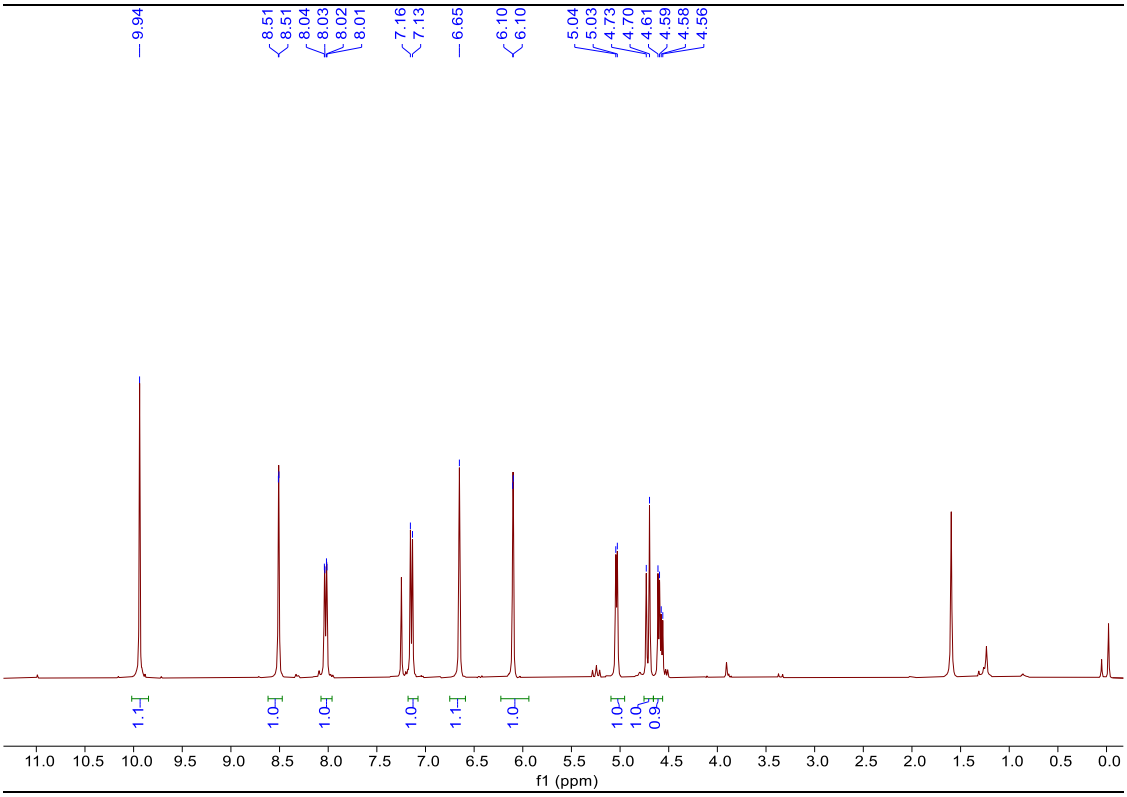
^{13}C NMR spectrum of 2b



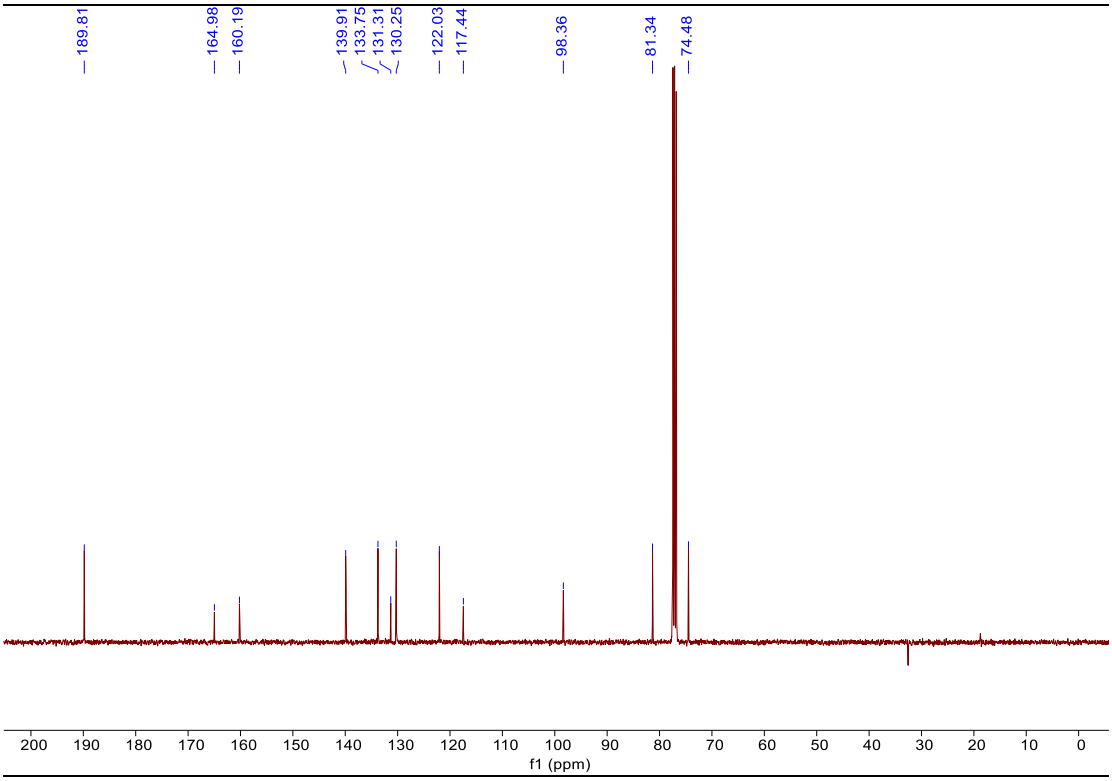
^{1}H NMR spectrum of 2c



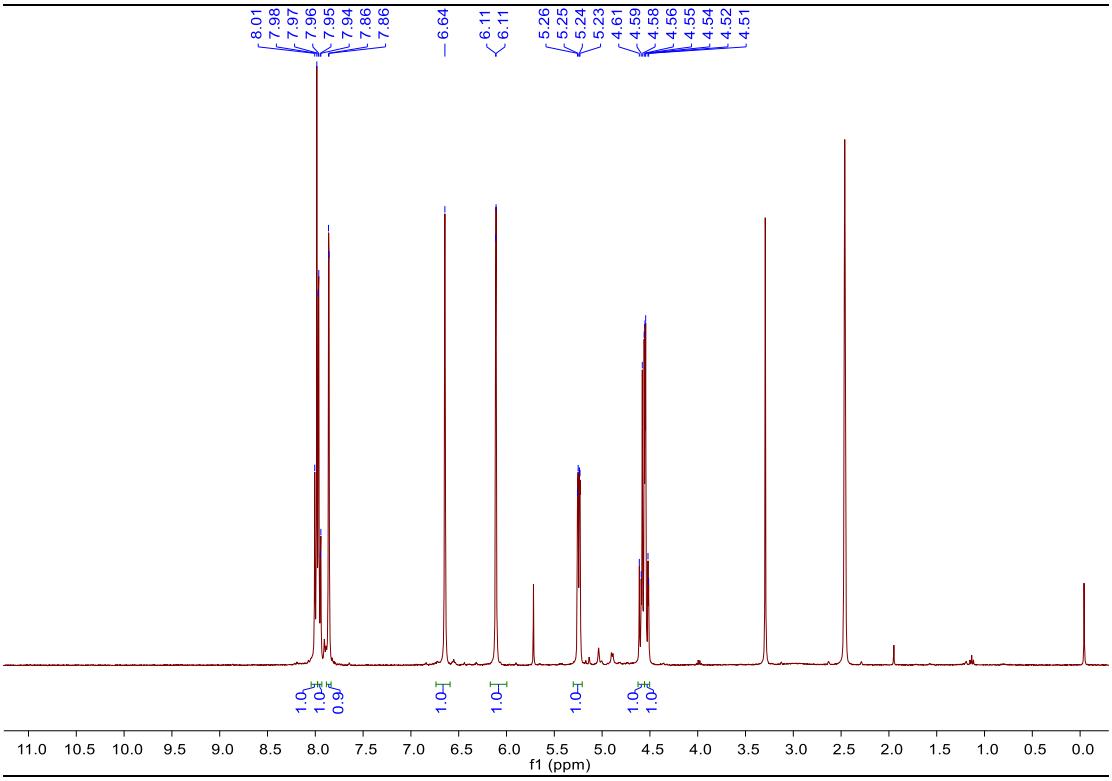
^{13}C NMR spectrum of 2c



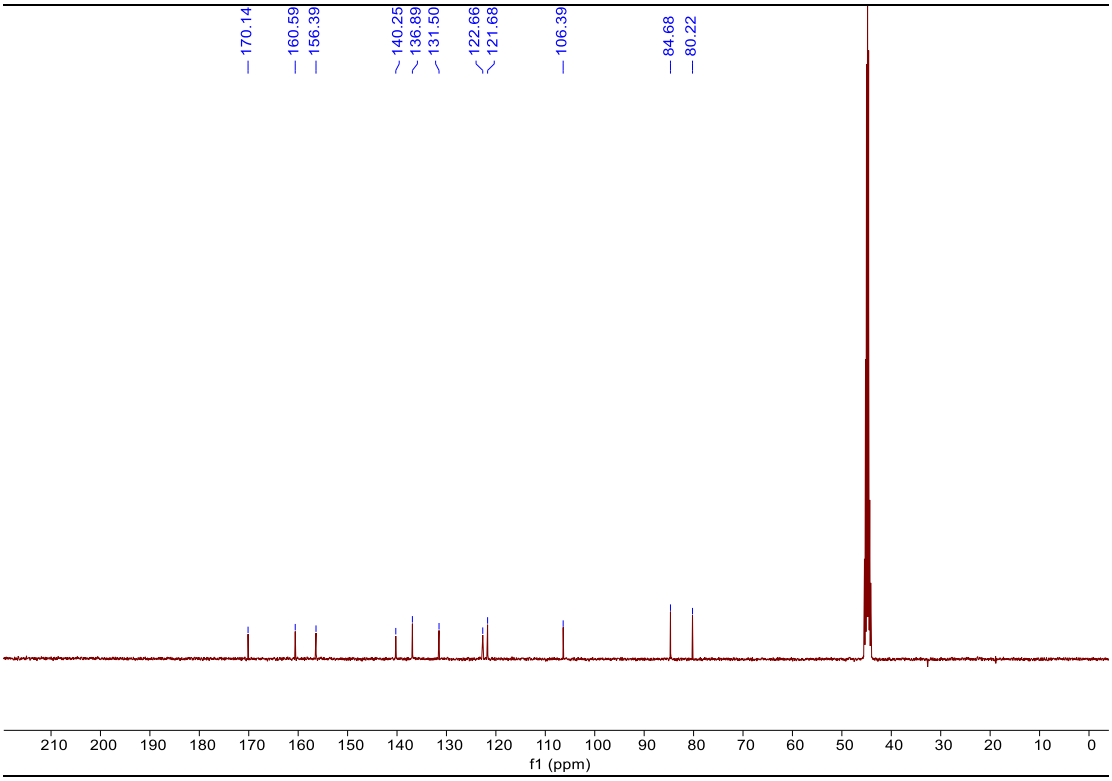
^{1}H NMR spectrum of 2d



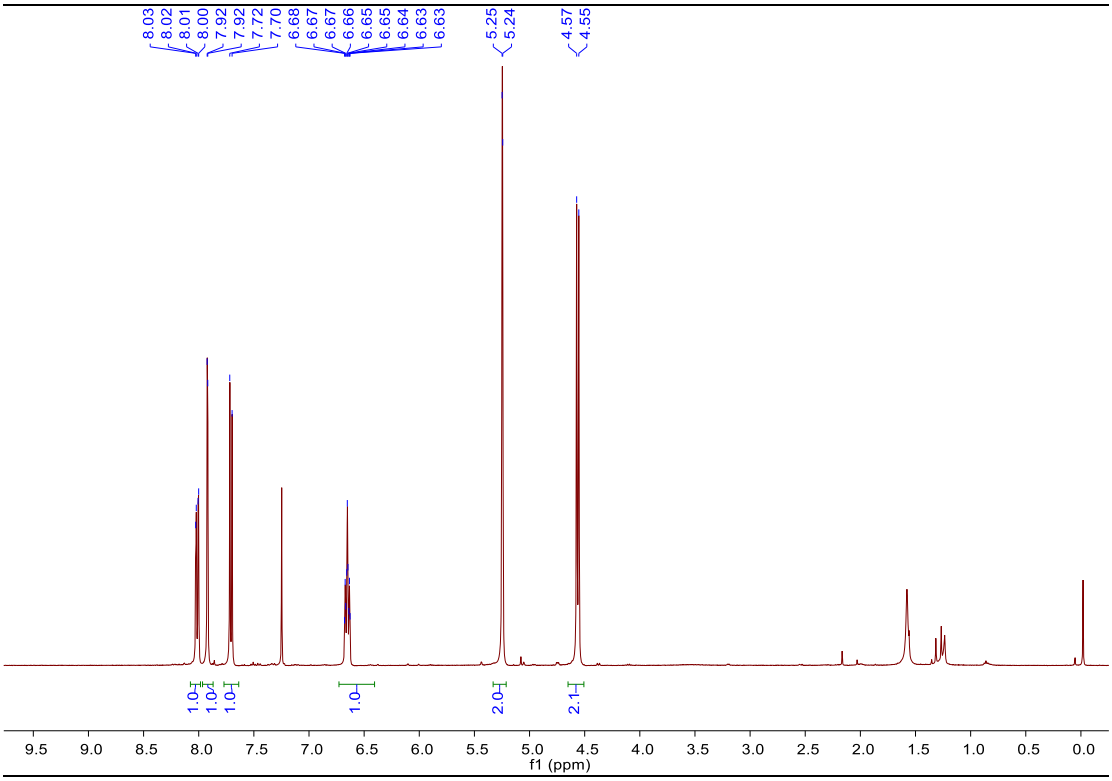
^{13}C NMR spectrum of 2d



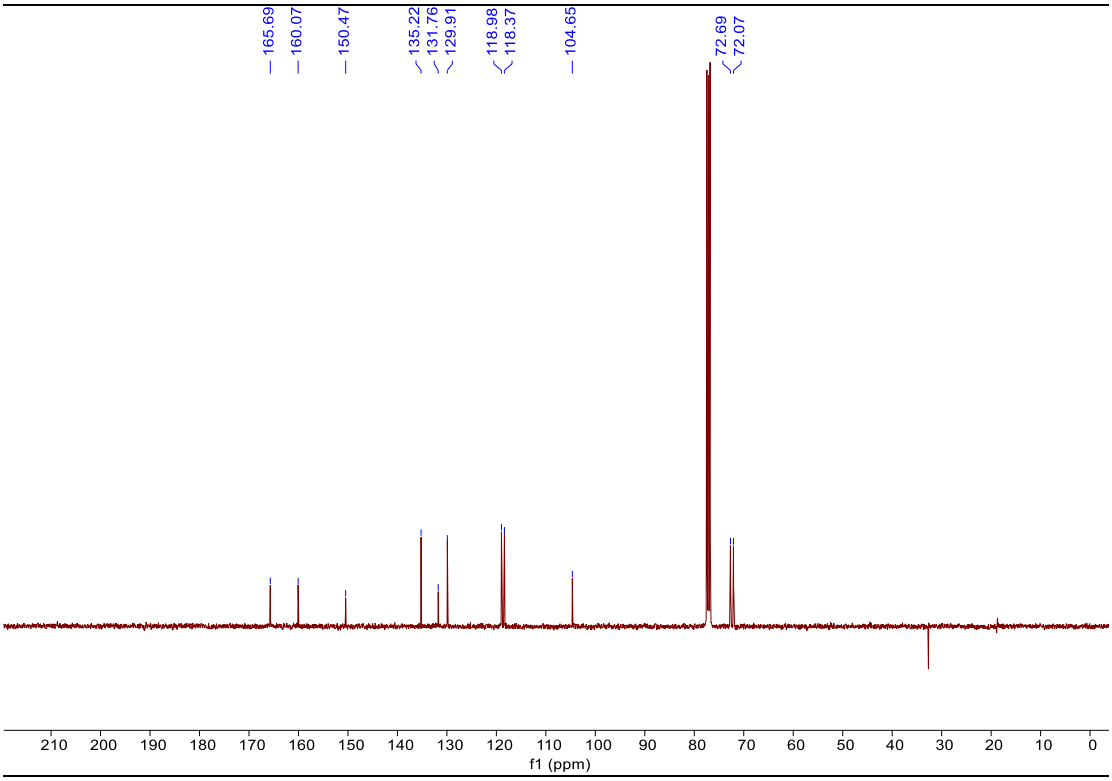
^{1}H NMR spectrum of 2e



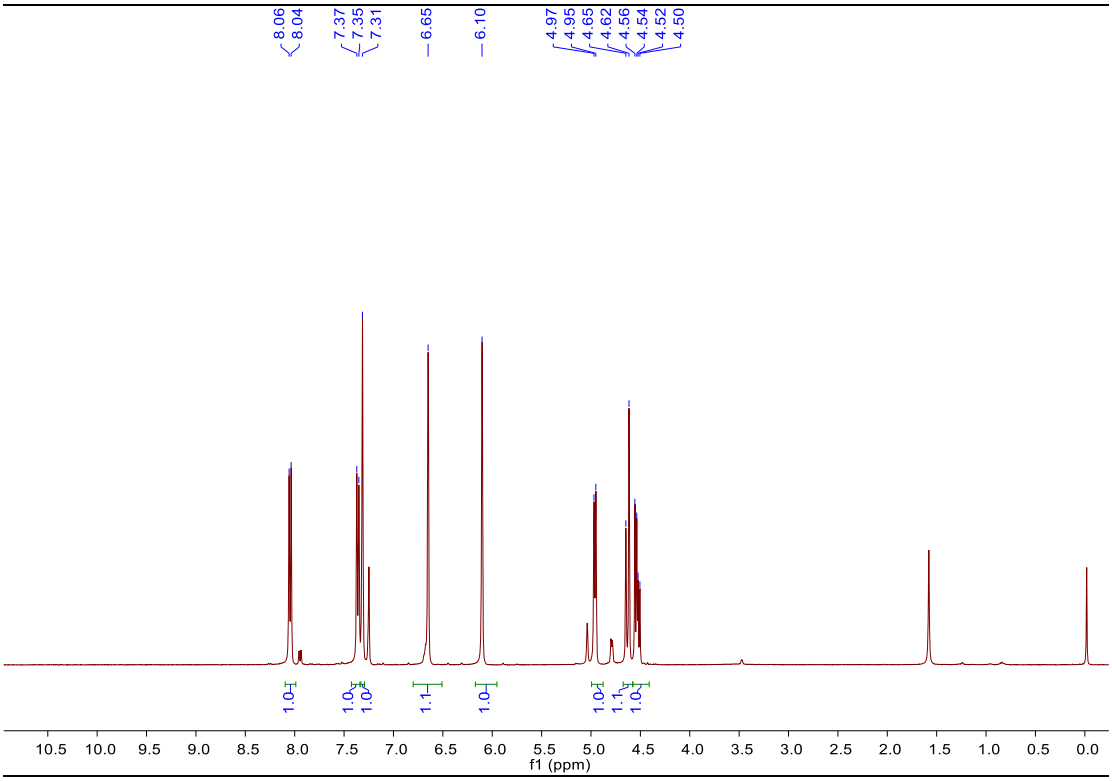
^{13}C NMR spectrum of 2e



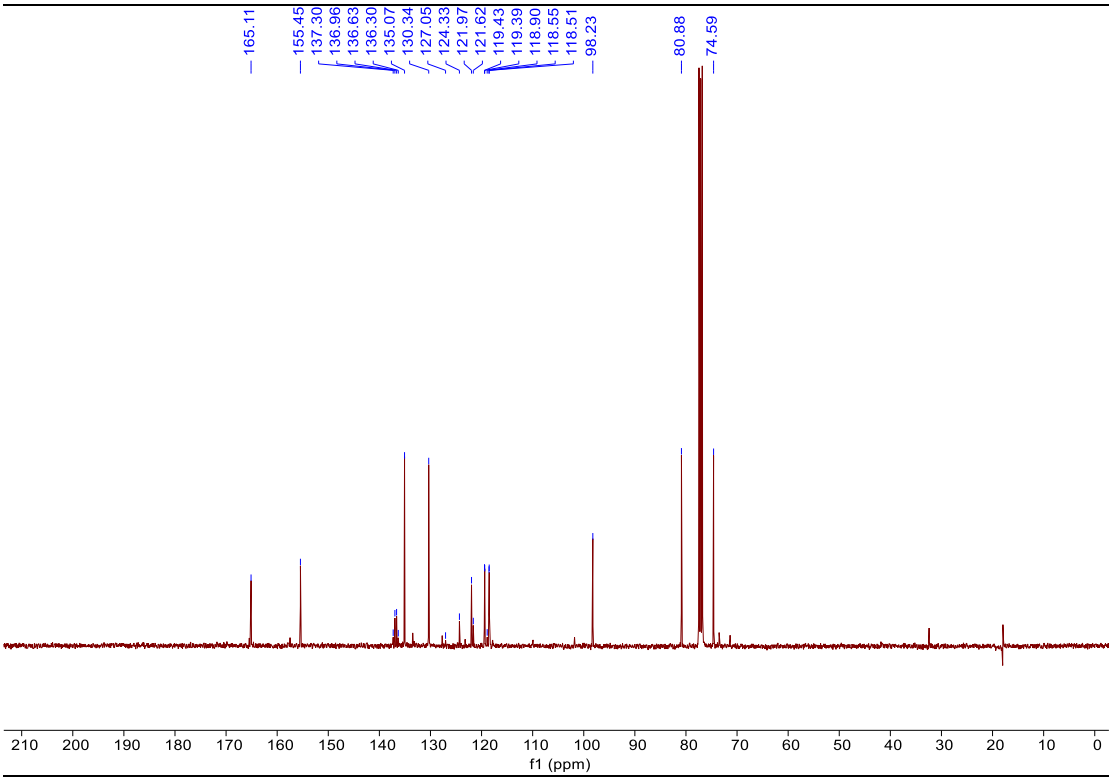
^{1}H NMR spectrum of 3e



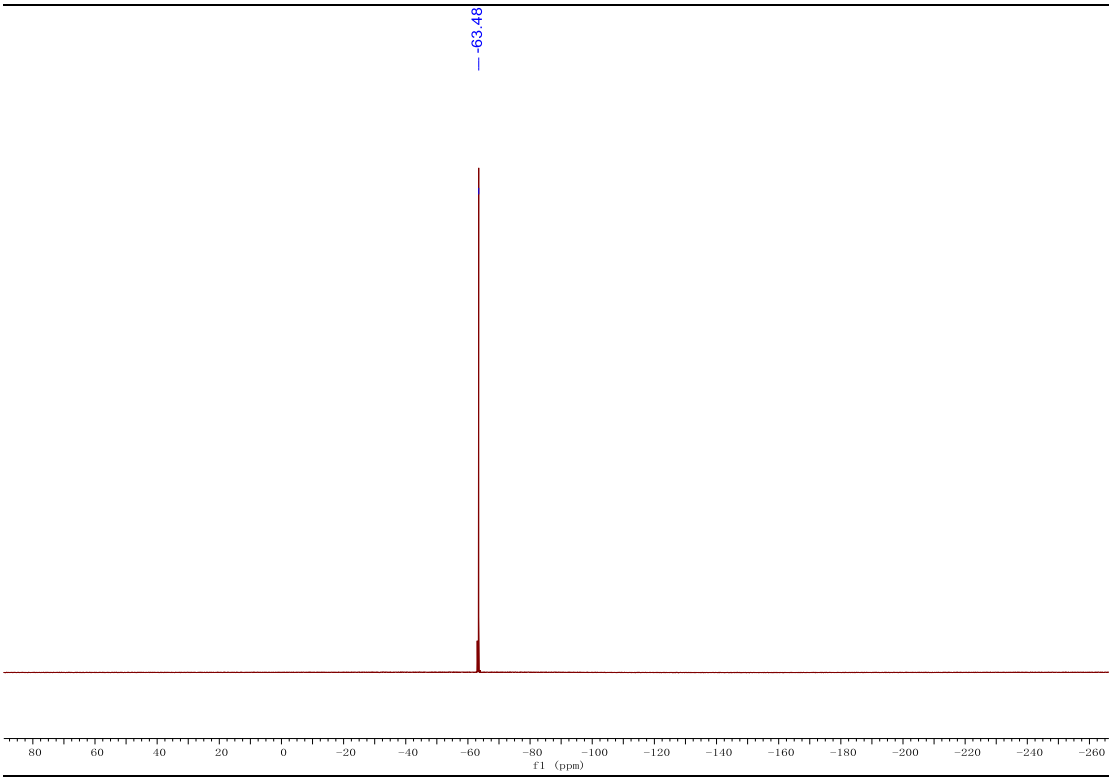
^{13}C NMR spectrum of 3e



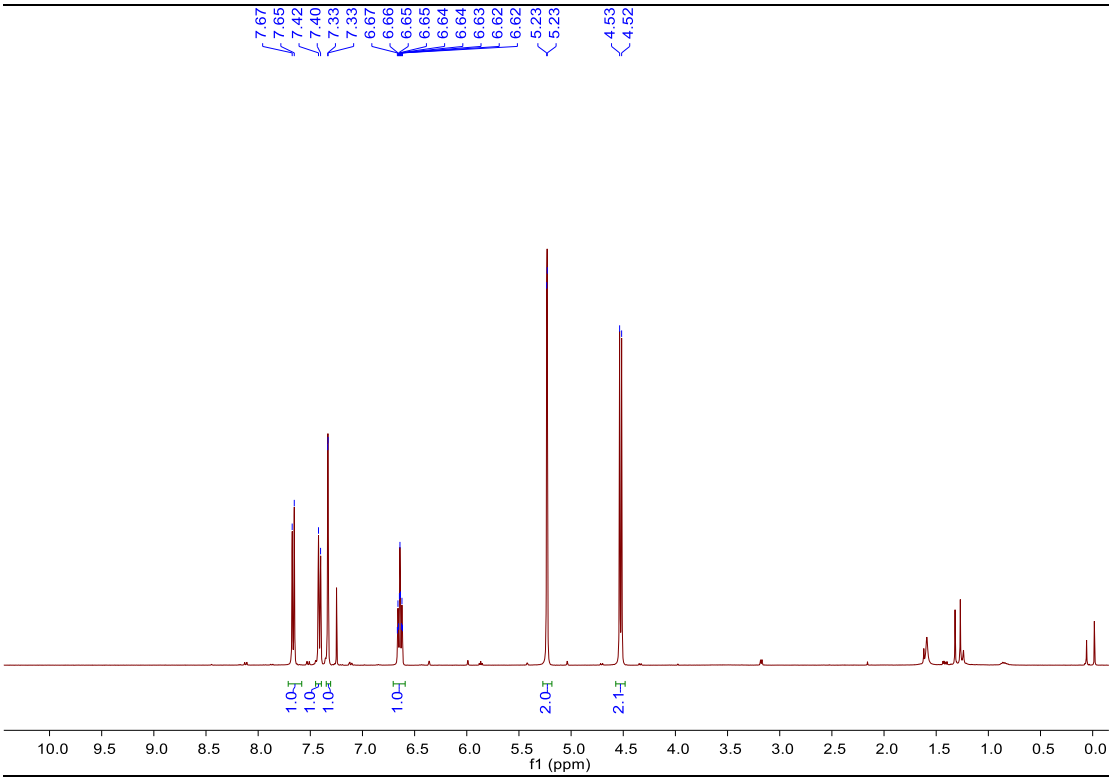
^{1}H NMR spectrum of 2f



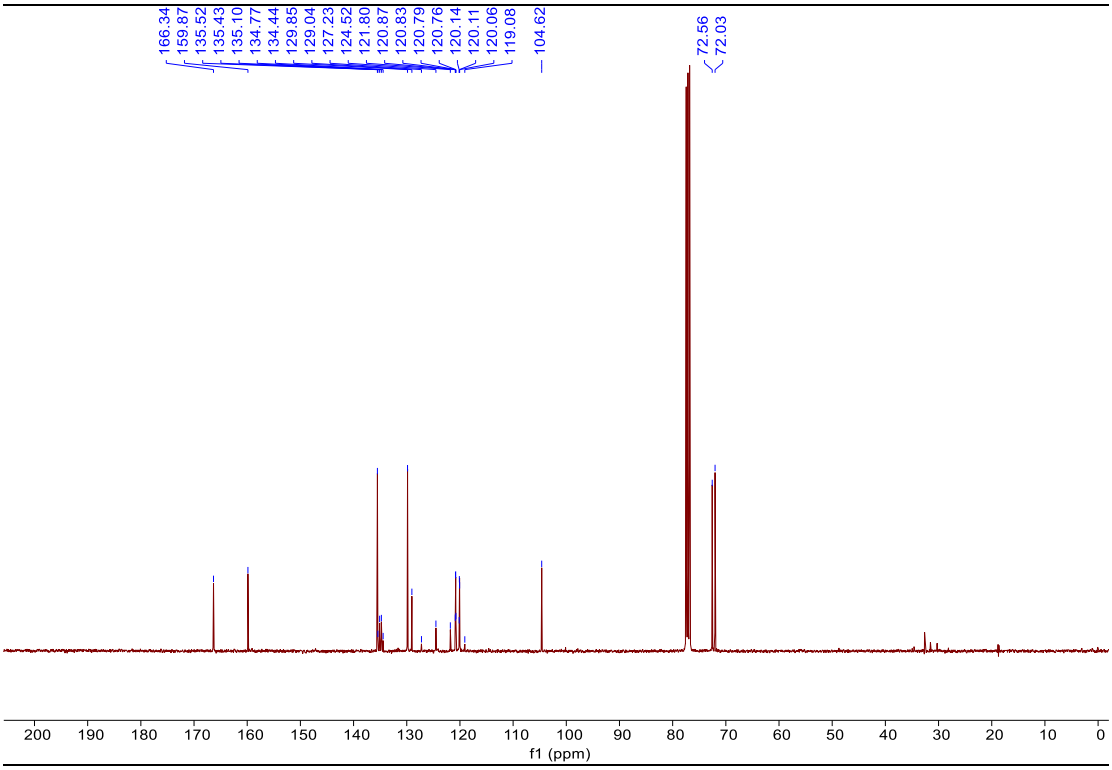
^{13}C NMR spectrum of 2f



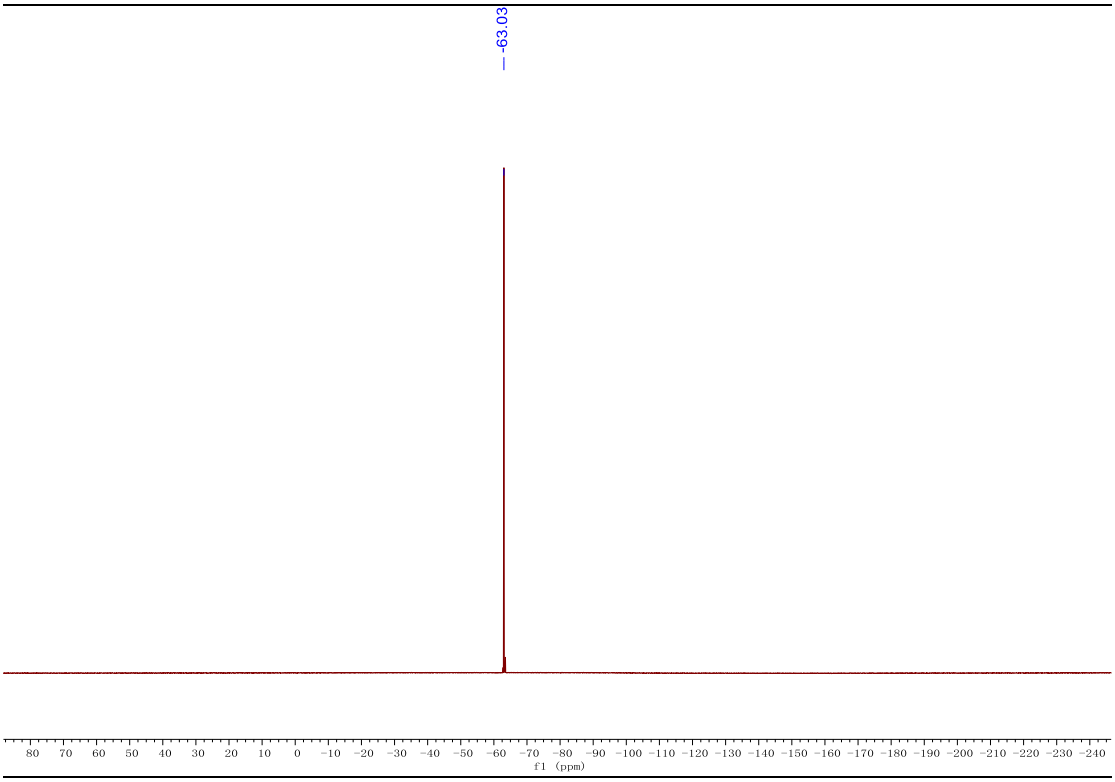
^{19}F NMR spectrum of 2f



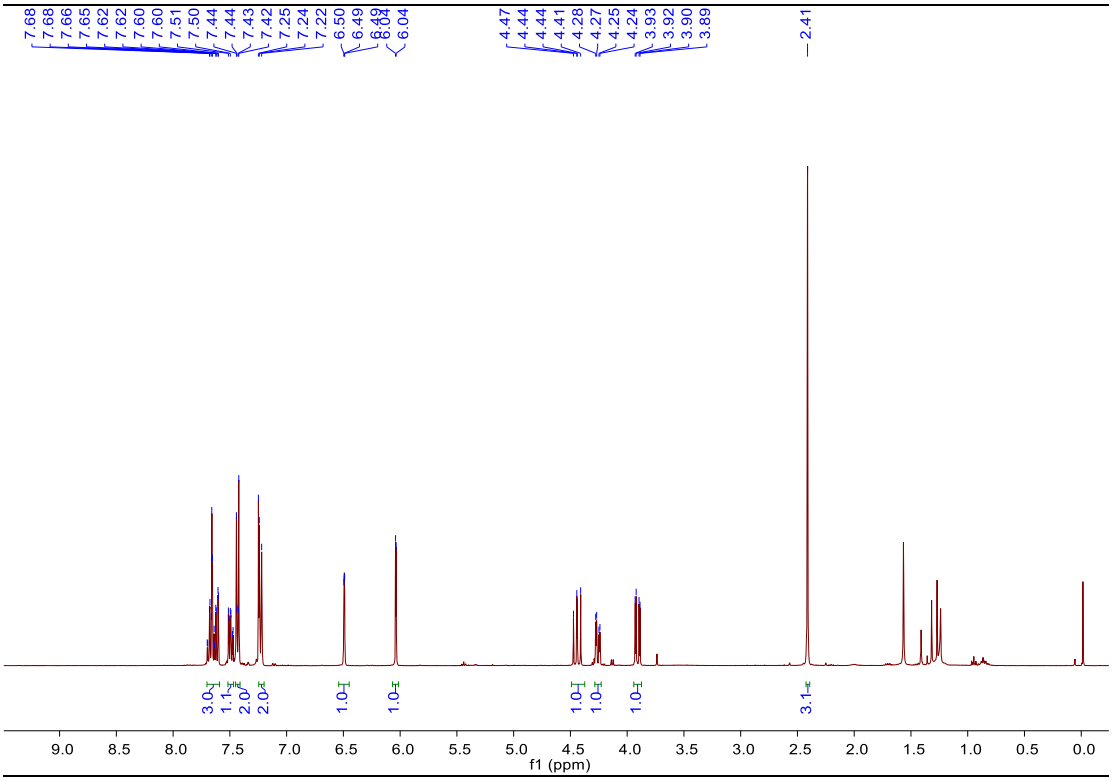
^{1}H NMR spectrum of 3f



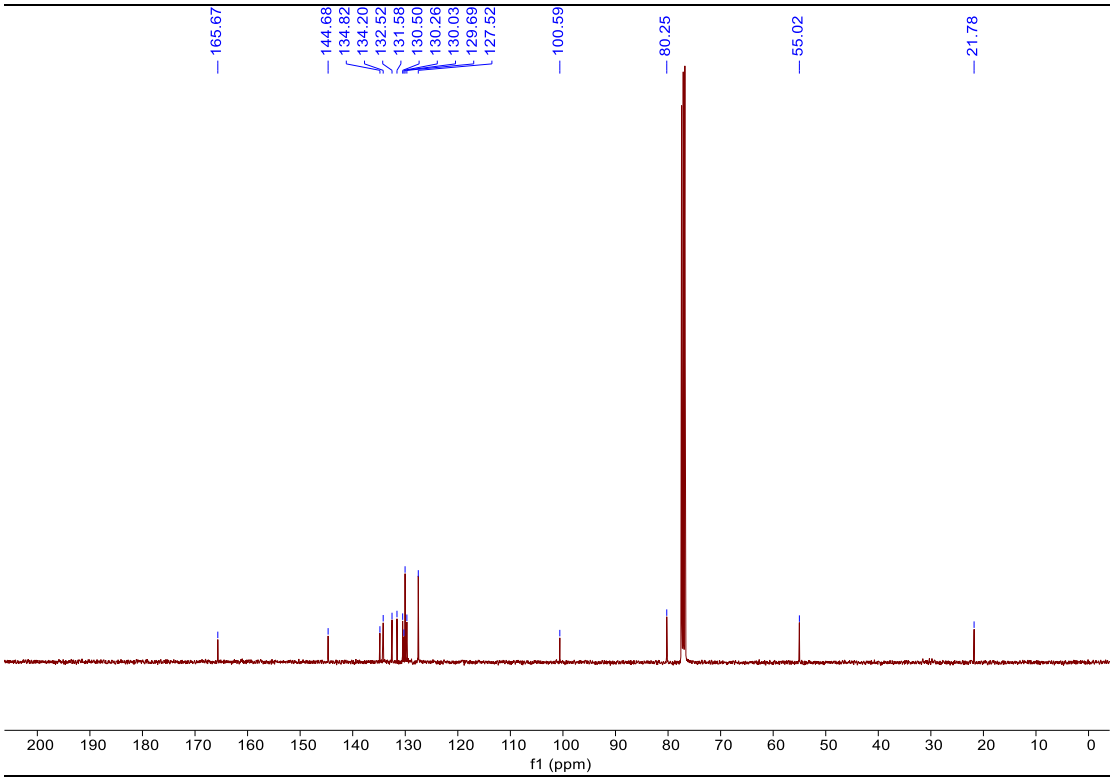
^{13}C NMR spectrum of 3f



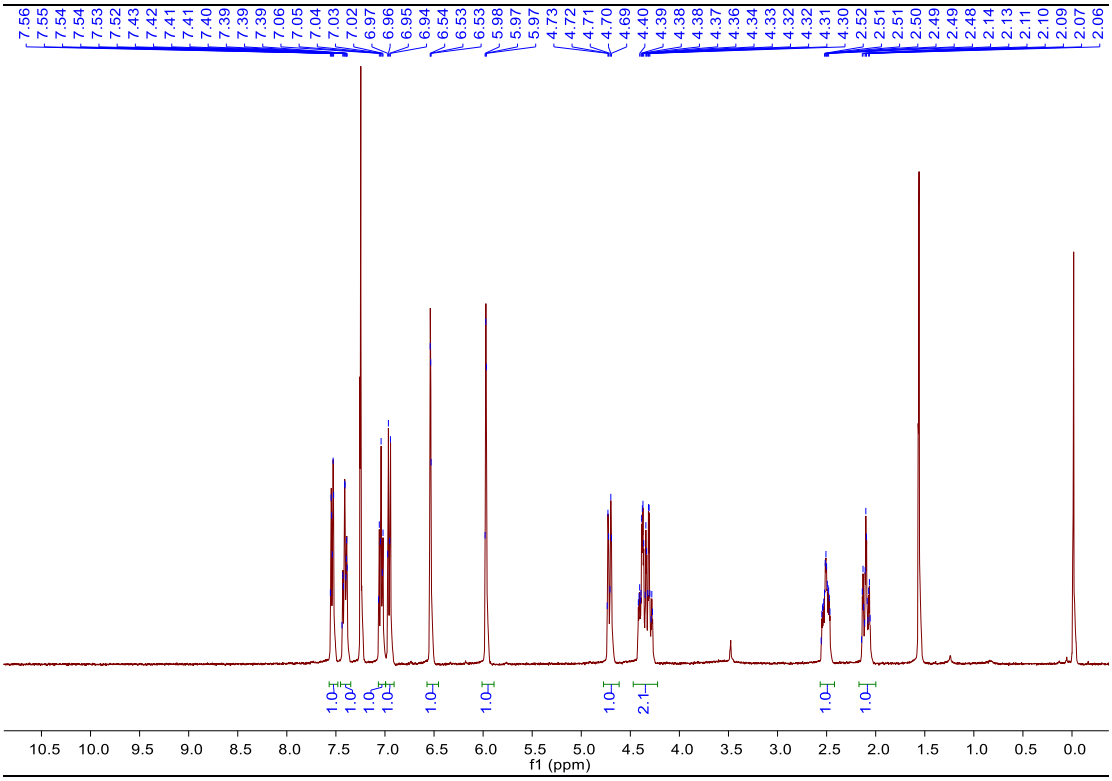
^{19}F NMR spectrum of 3f



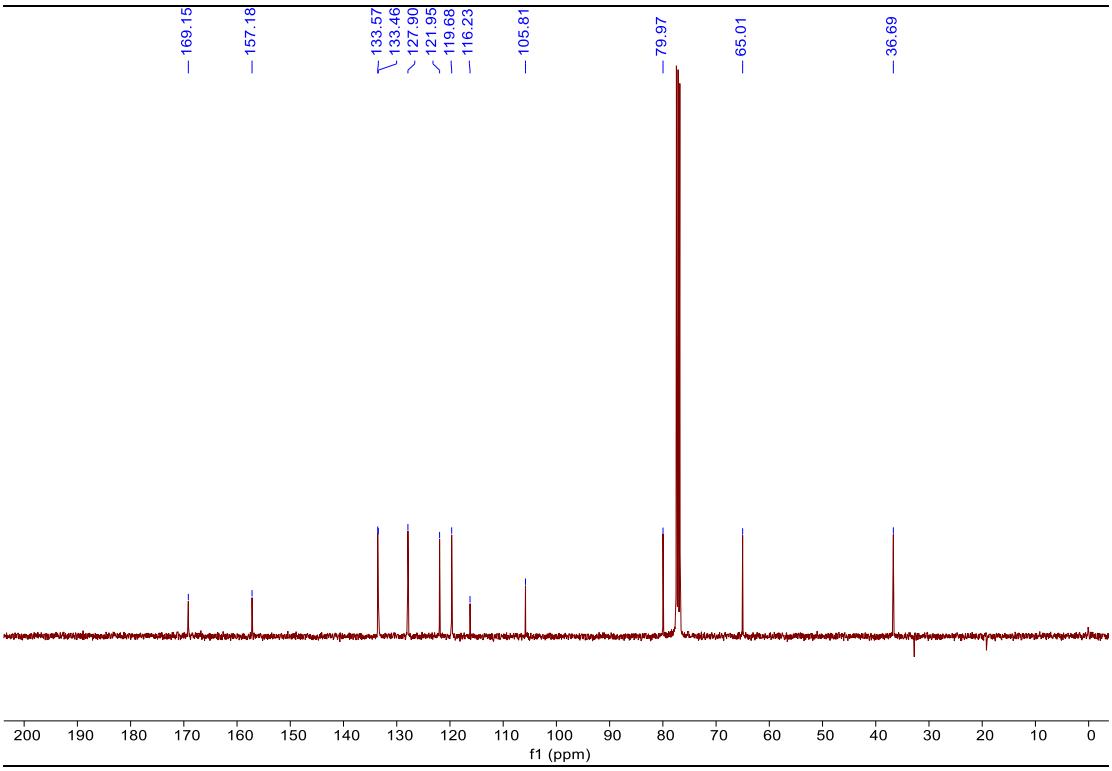
^{1}H NMR spectrum of 2g



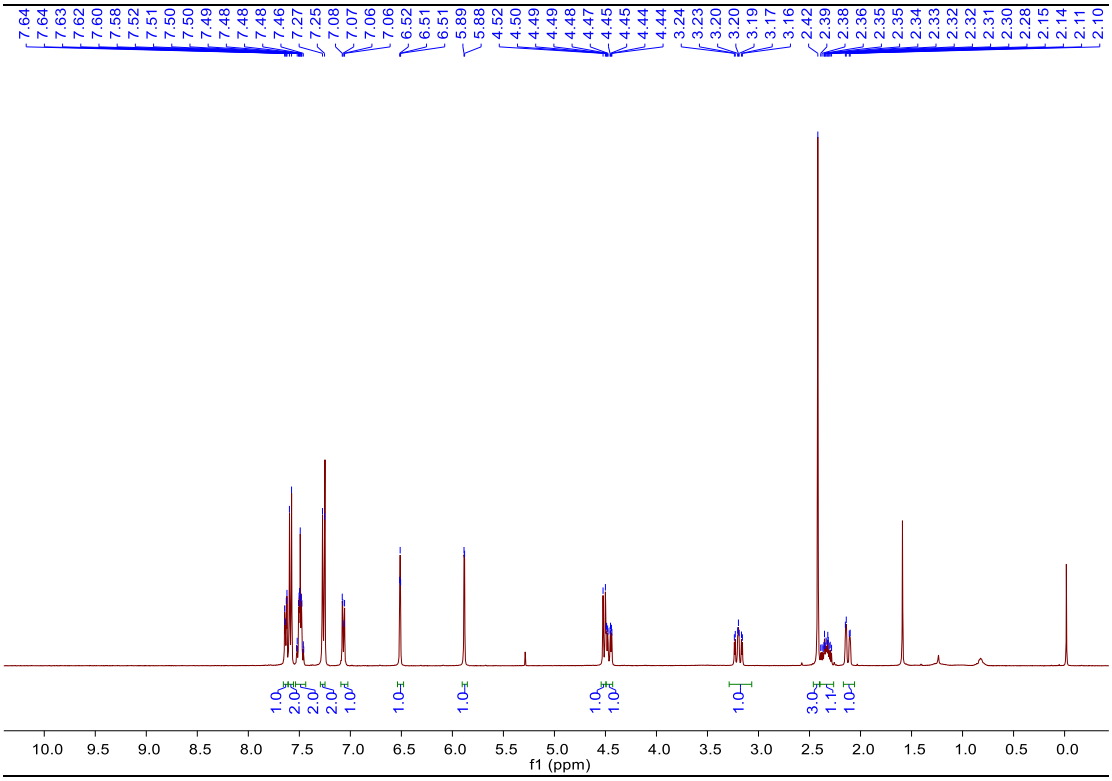
^{13}C NMR spectrum of 2g



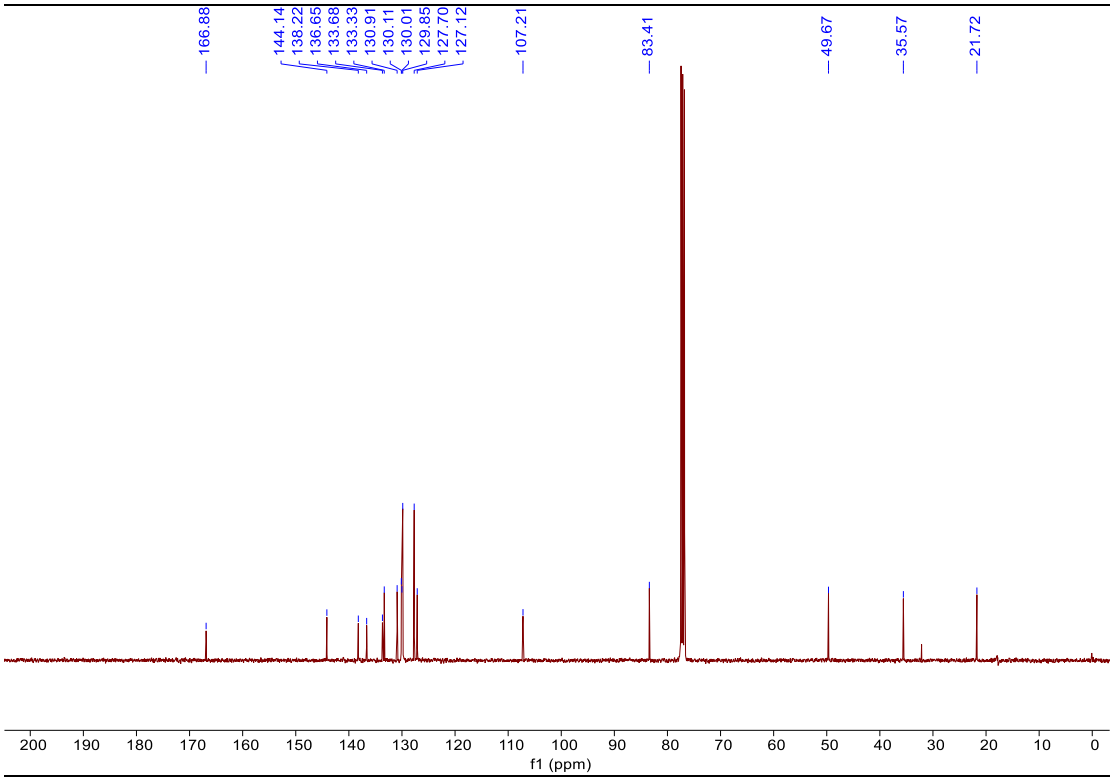
^{1}H NMR spectrum of 2h



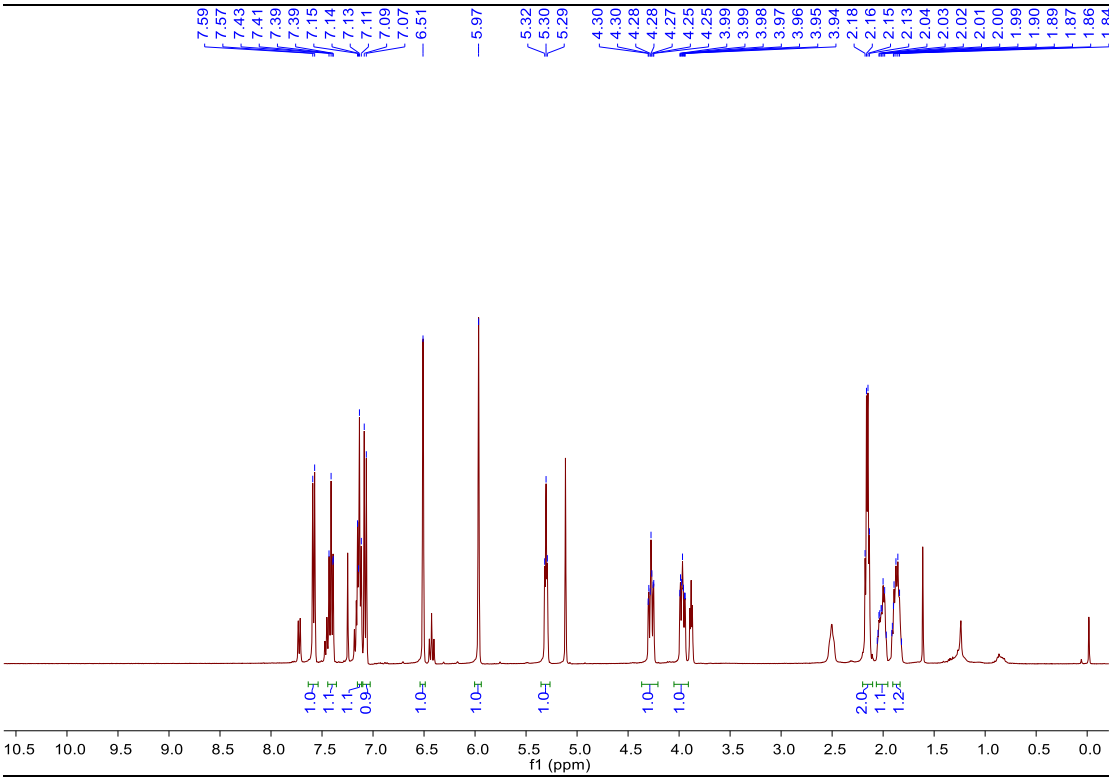
^{13}C NMR spectrum of 2h



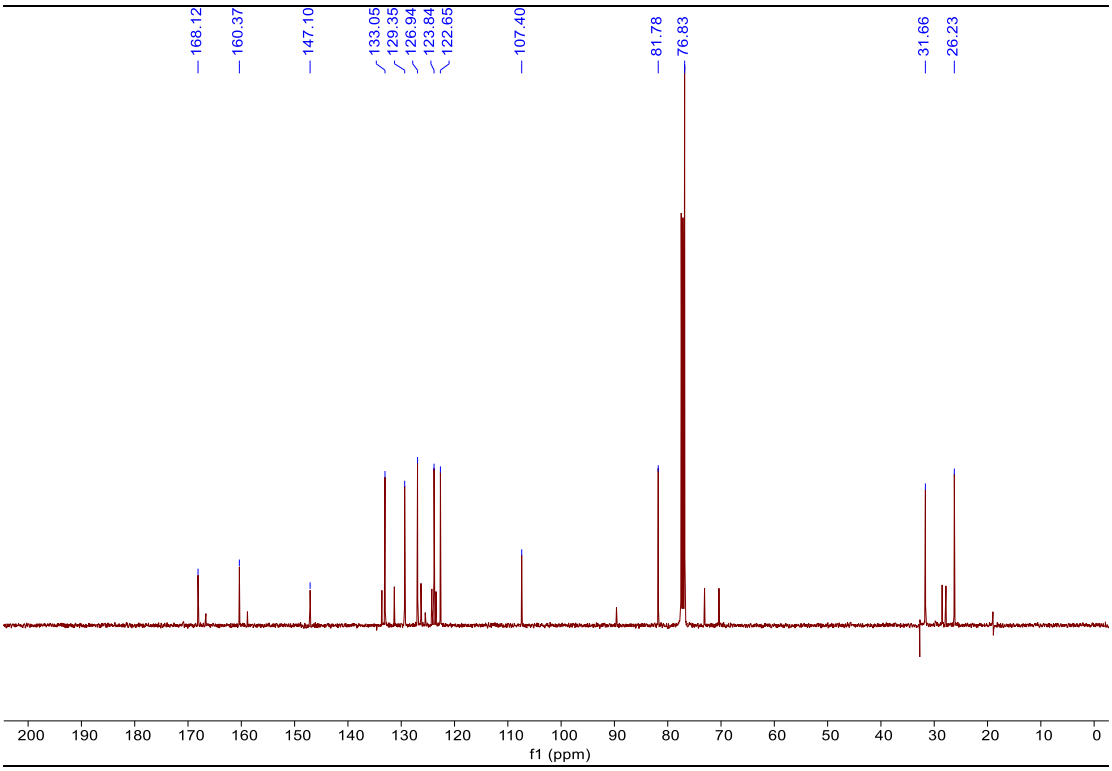
^{1}H NMR spectrum of 2i



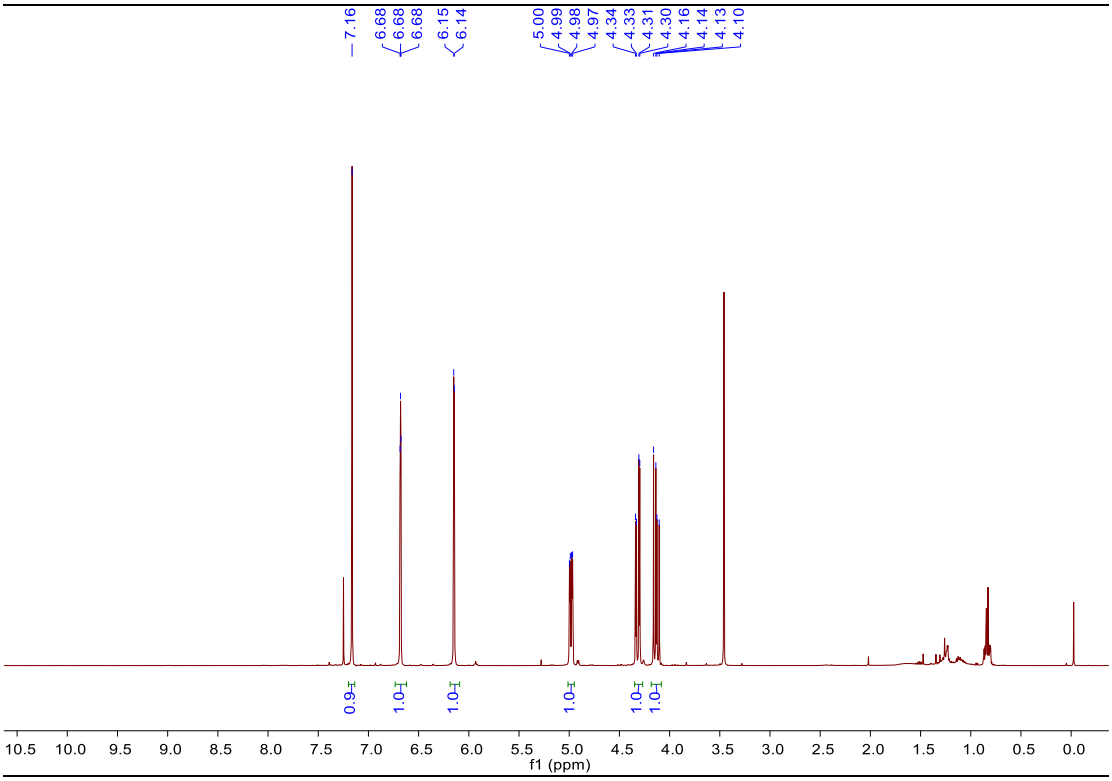
^{13}C NMR spectrum of 2i



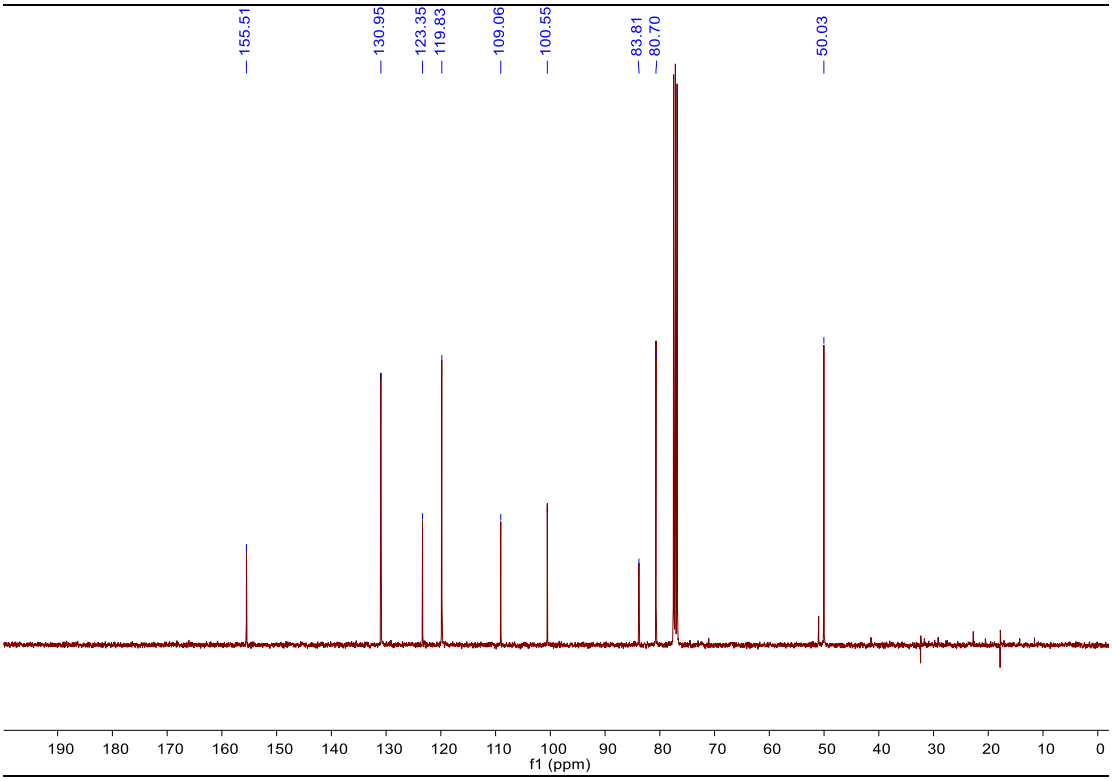
^{1}H NMR spectrum of 2j



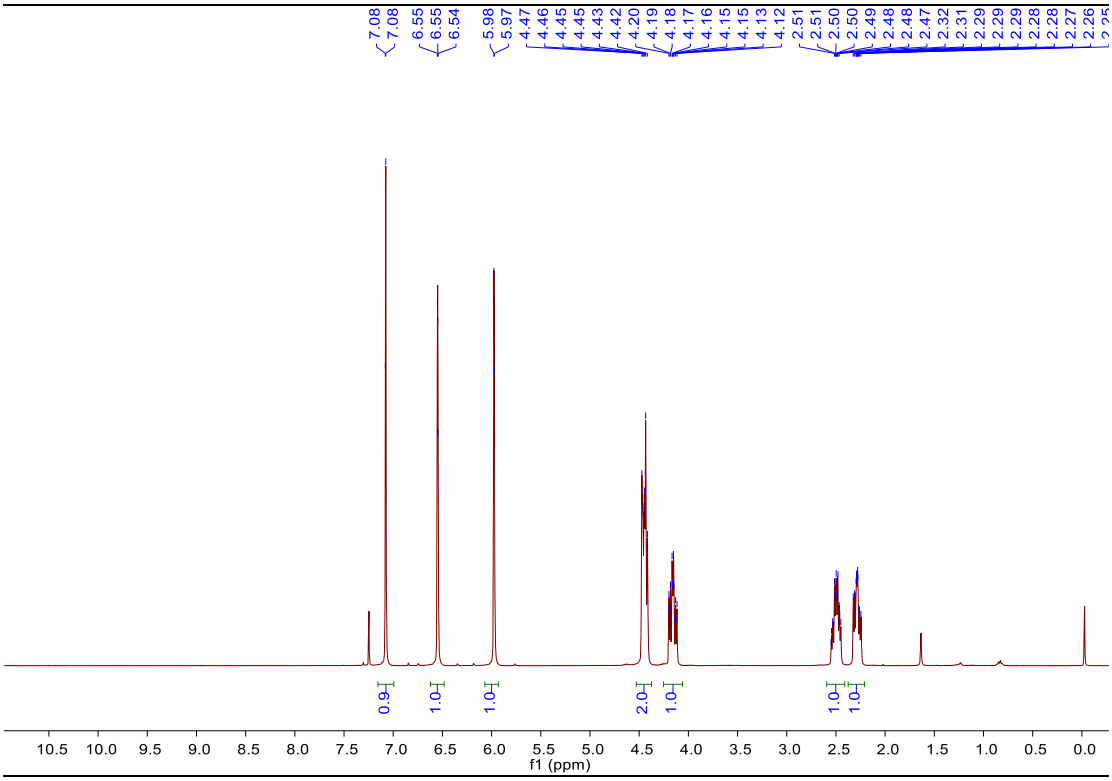
^{13}C NMR spectrum of 2j



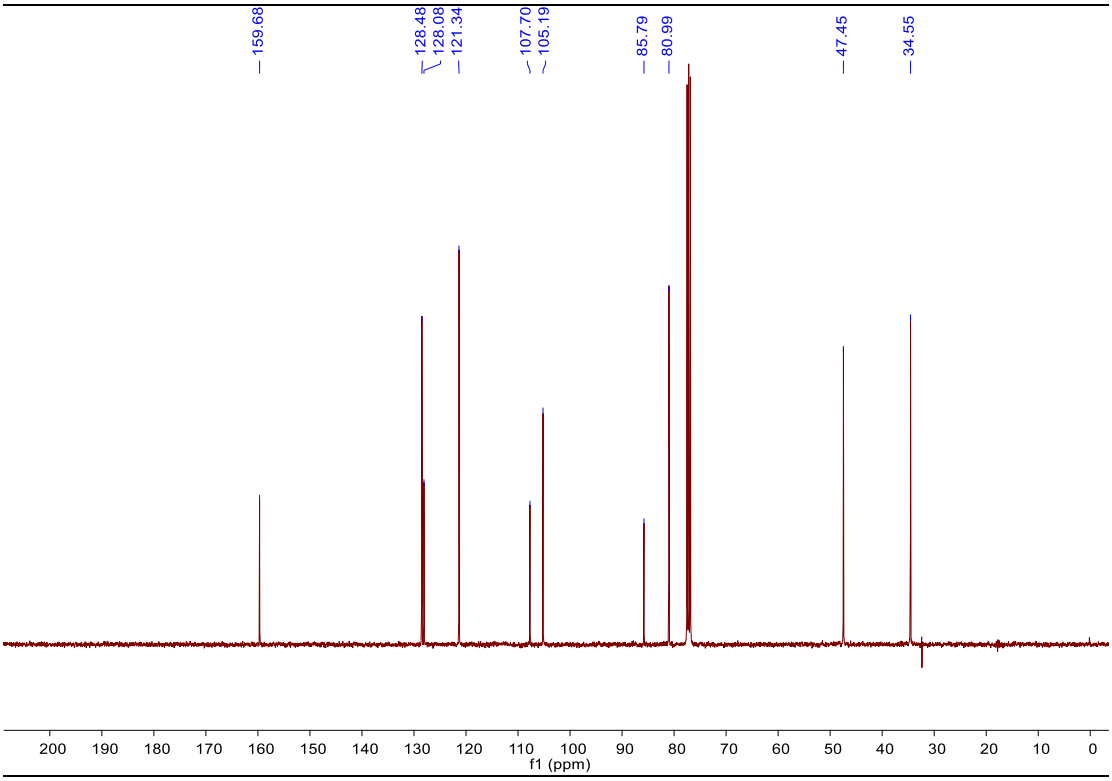
^{1}H NMR spectrum of 5a



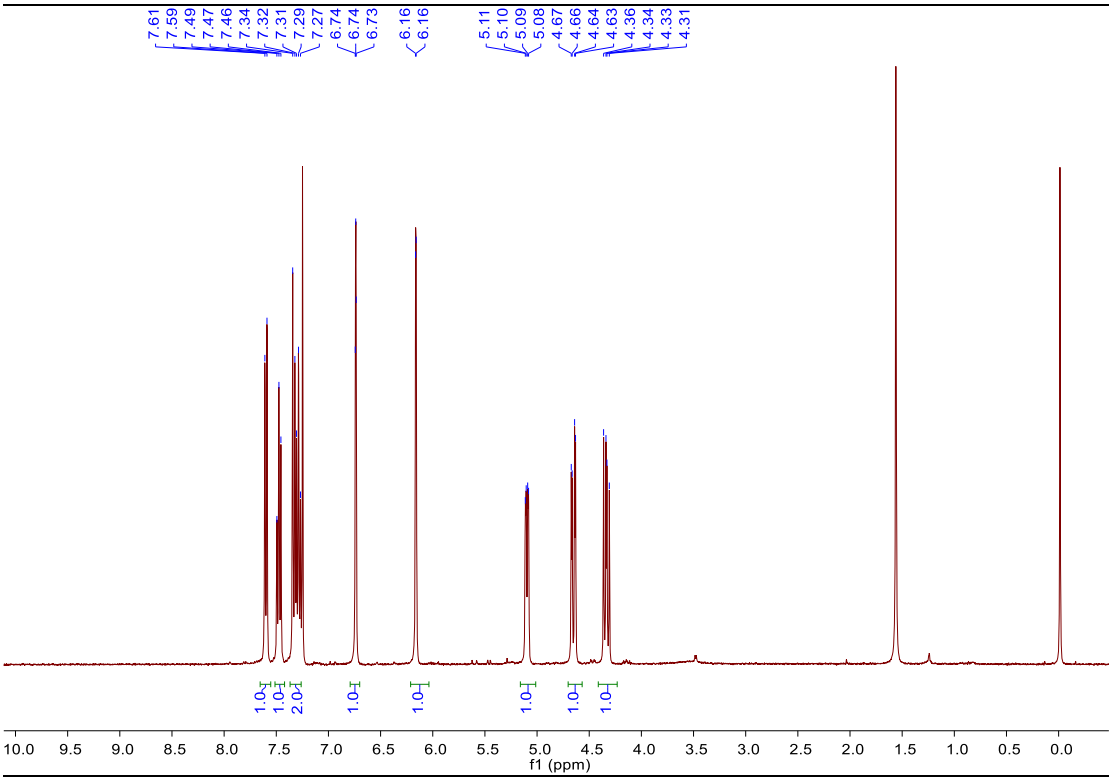
^{13}C NMR spectrum of 5a



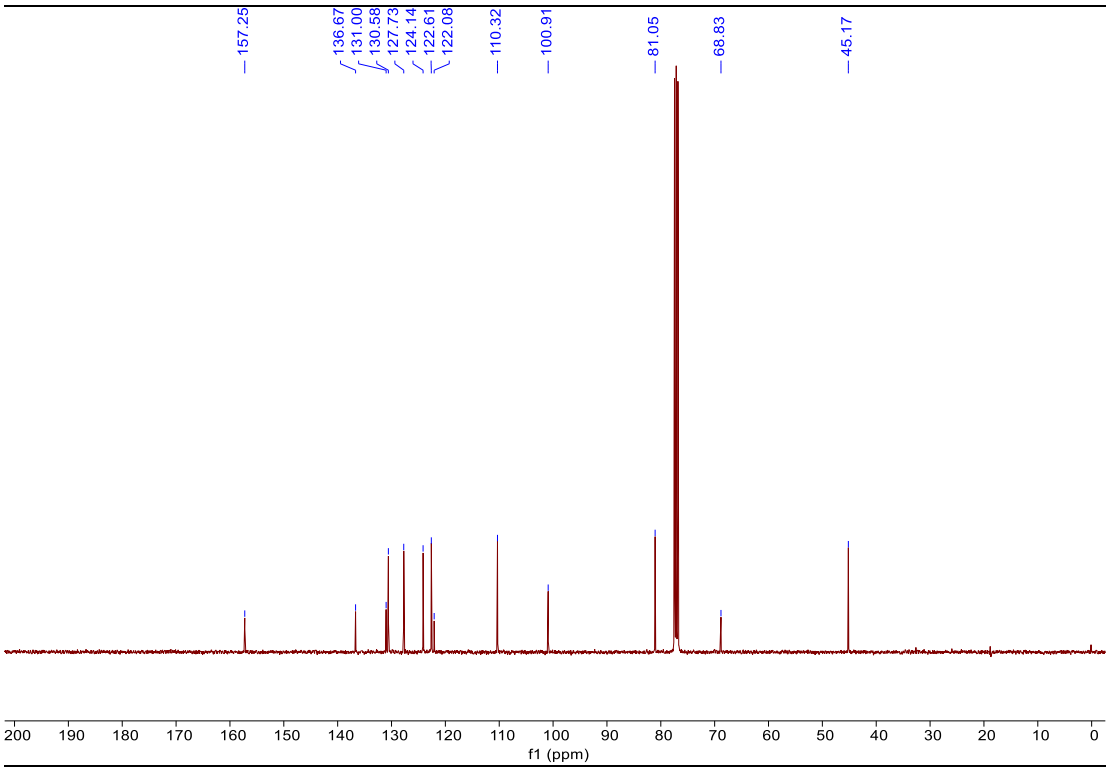
^{1}H NMR spectrum of 5b



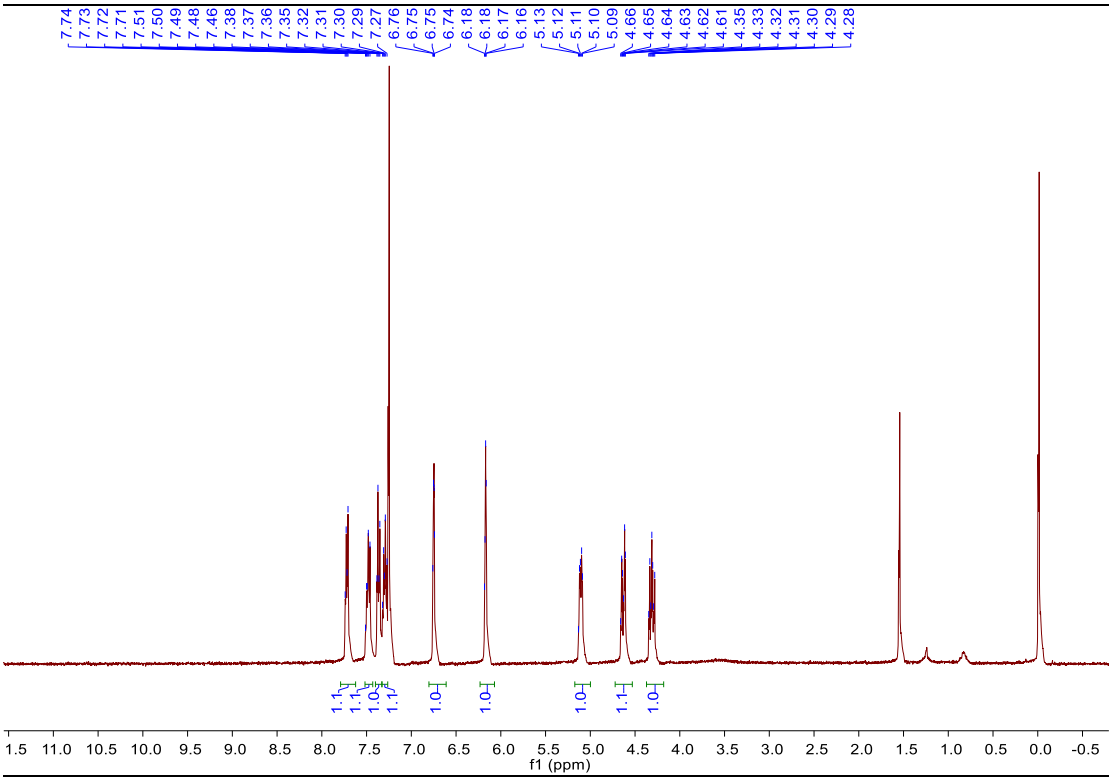
^{13}C NMR spectrum of 5b



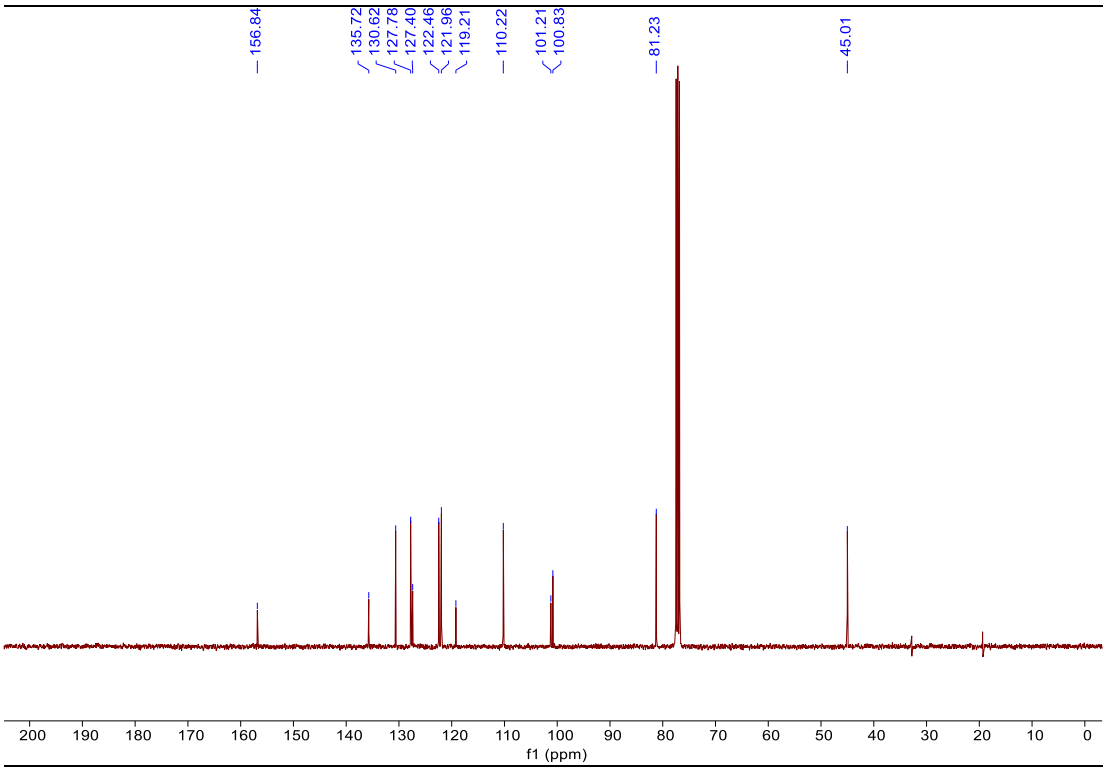
^{1}H NMR spectrum of 5c



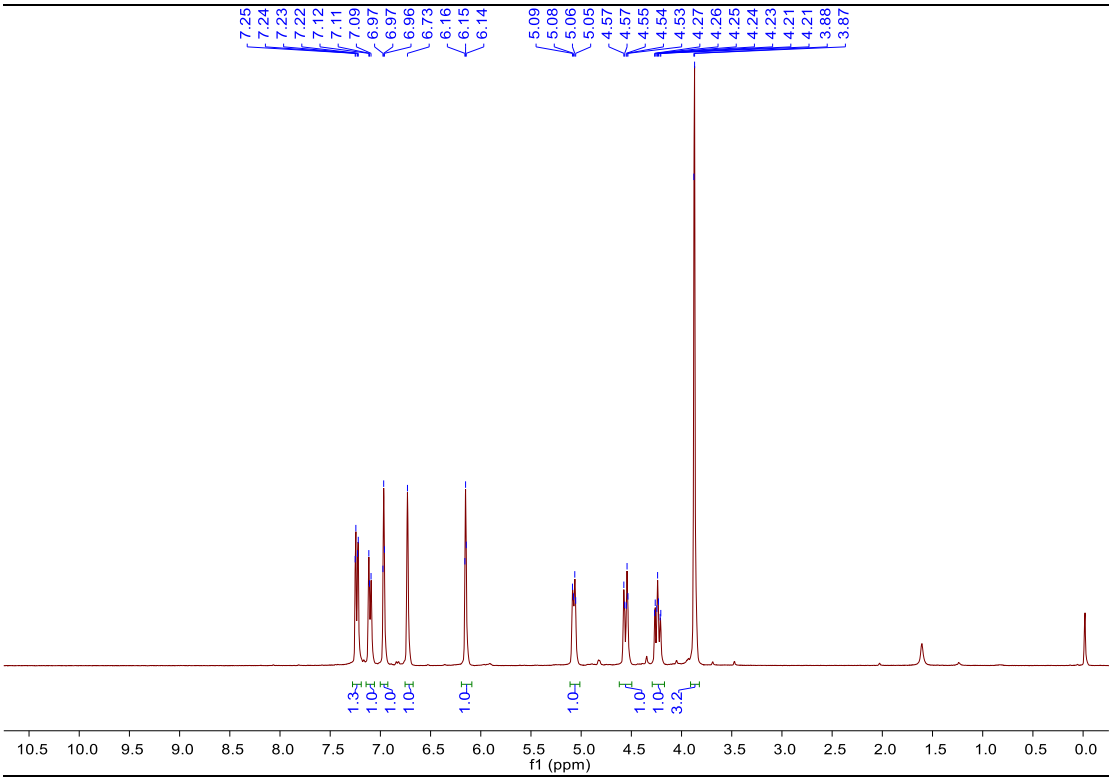
^{13}C NMR spectrum of 5c



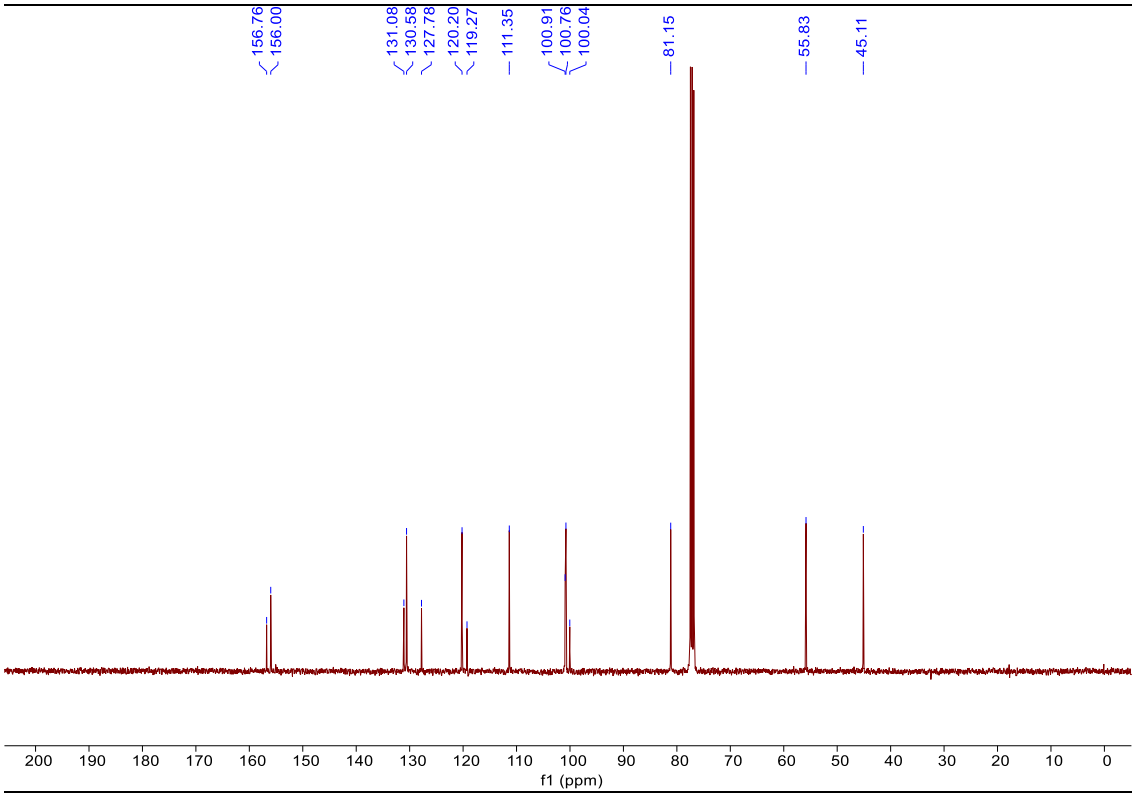
^{1}H NMR spectrum of 5d



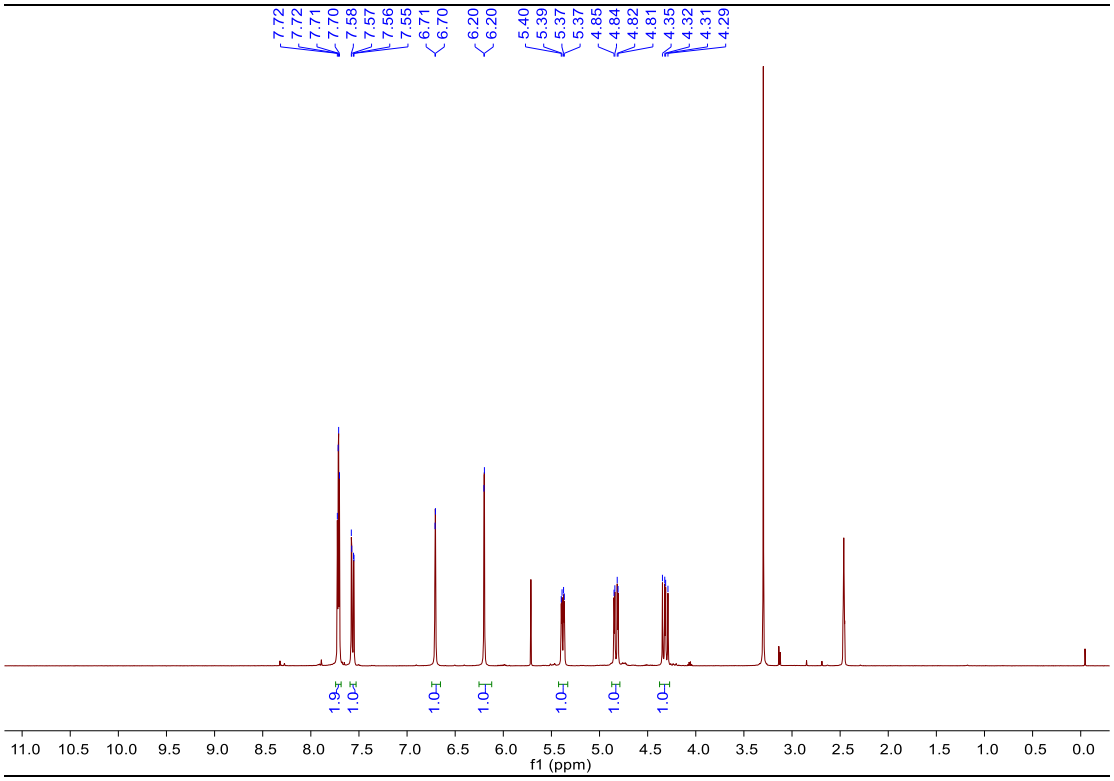
^{13}C NMR spectrum of 5d



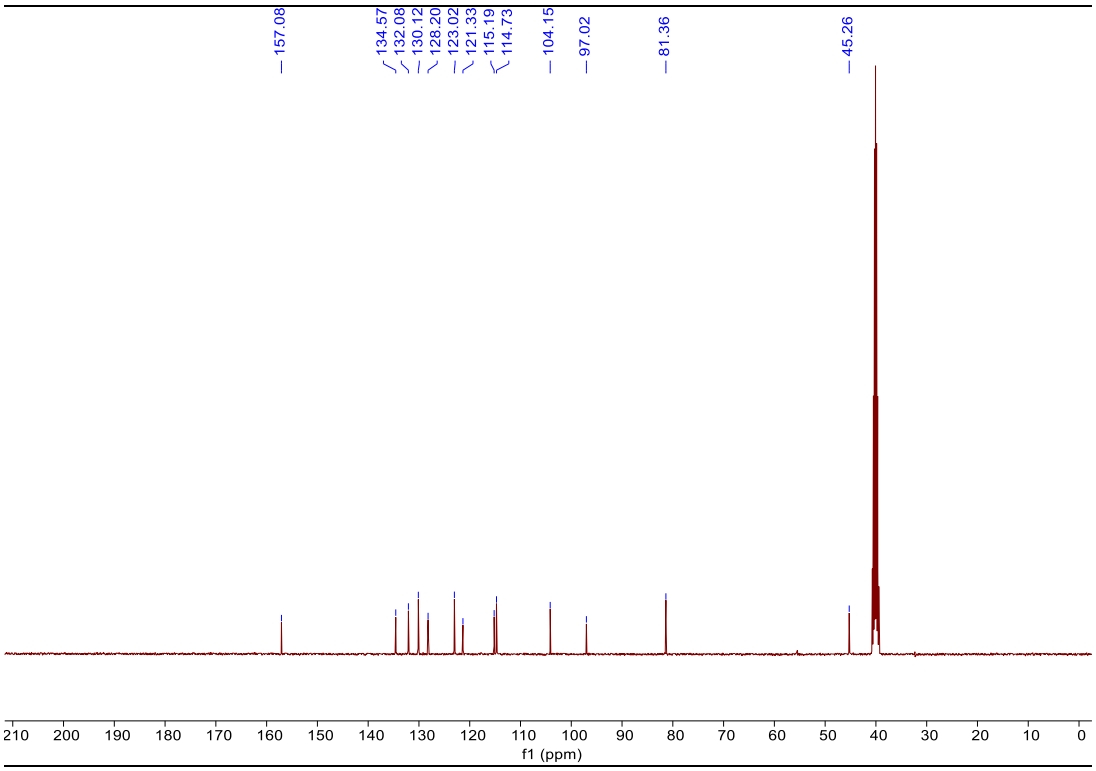
^{1}H NMR spectrum of 5e



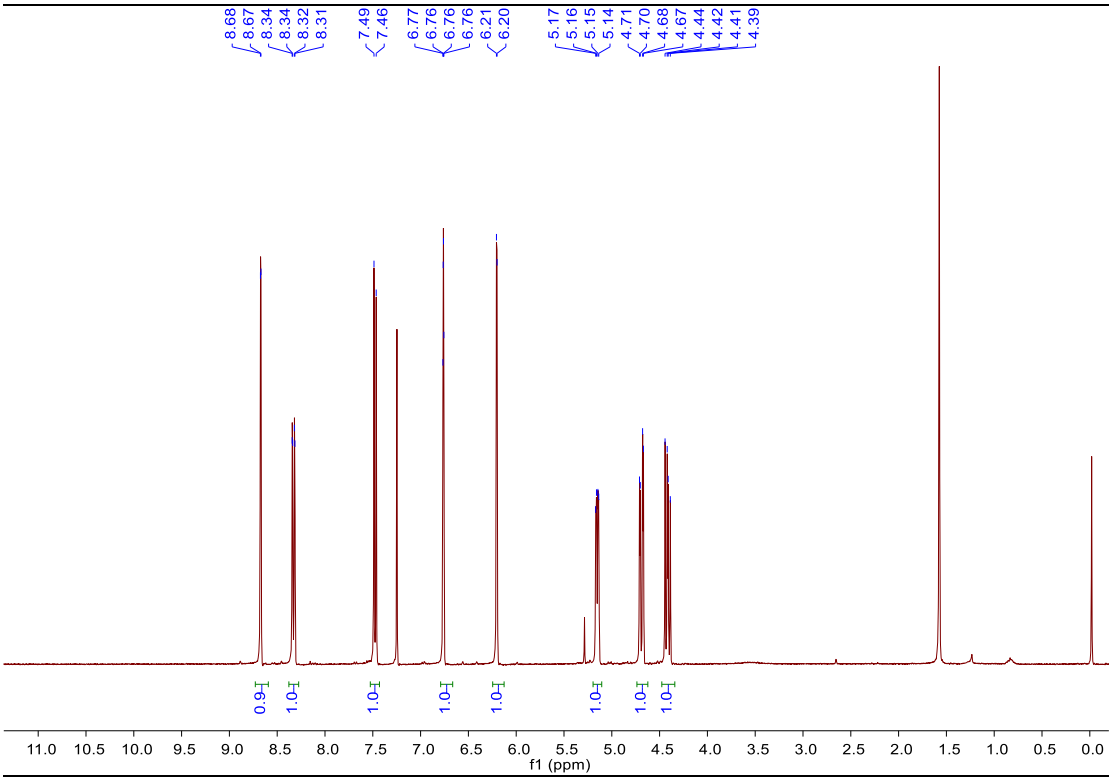
^{13}C NMR spectrum of 5e



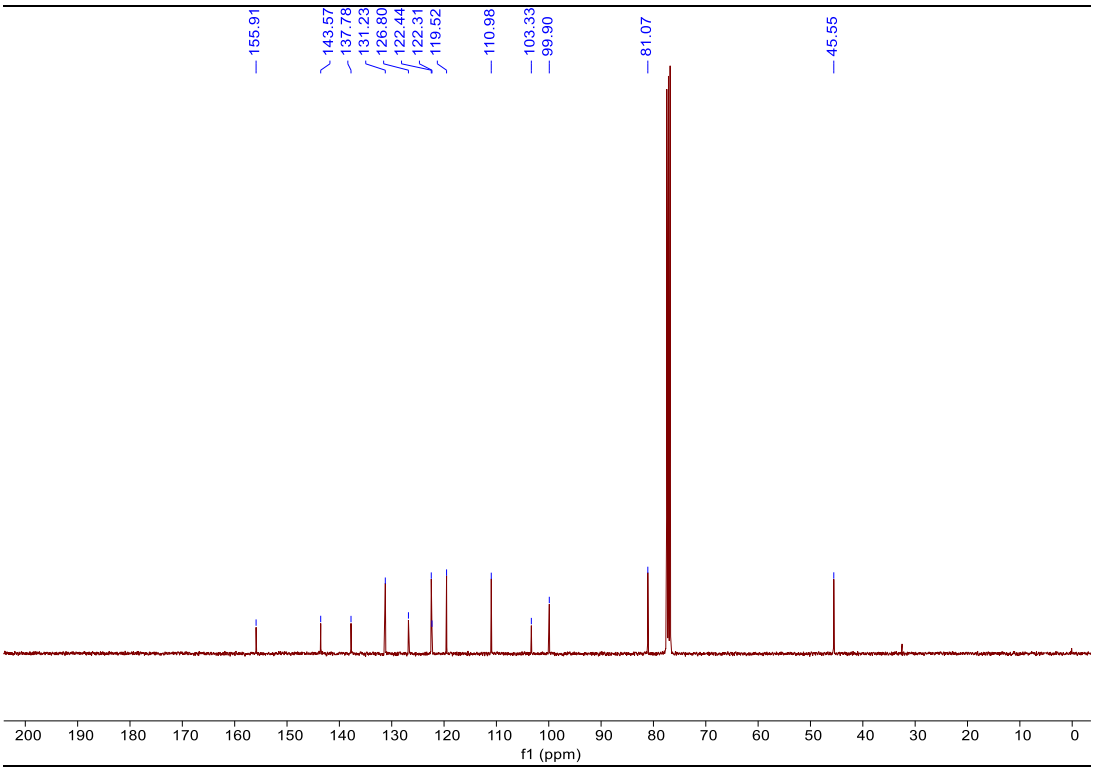
^{1}H NMR spectrum of 5f



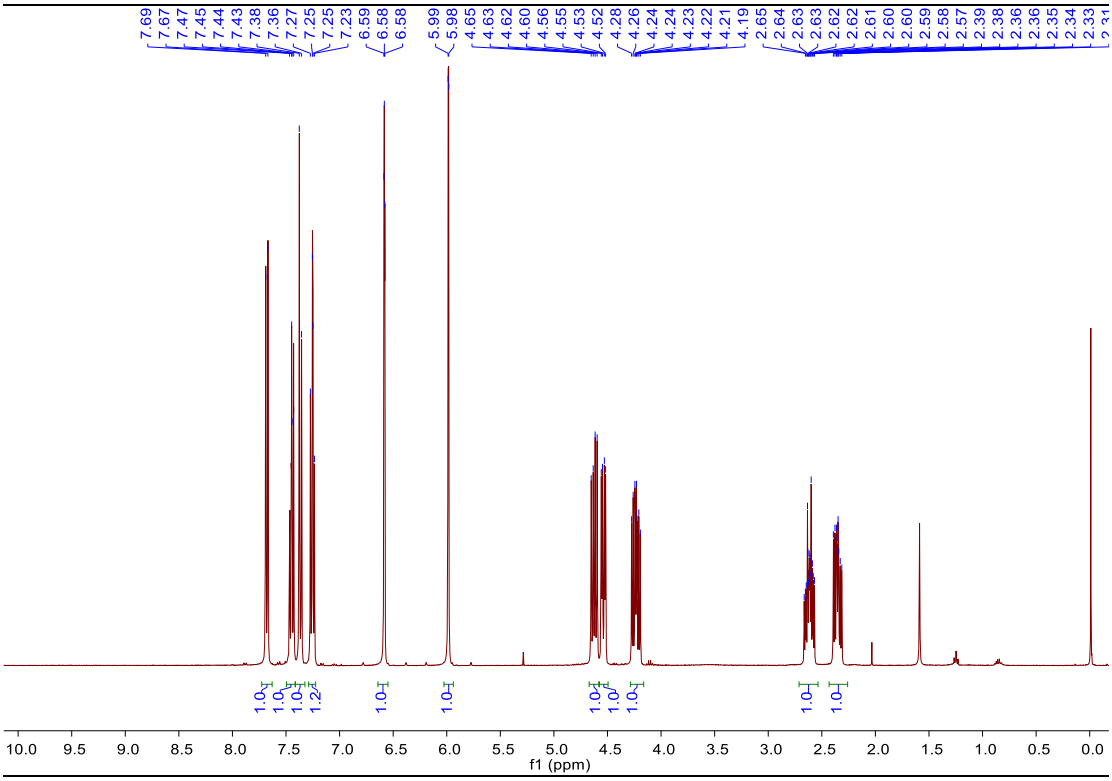
^{13}C NMR spectrum of 5f



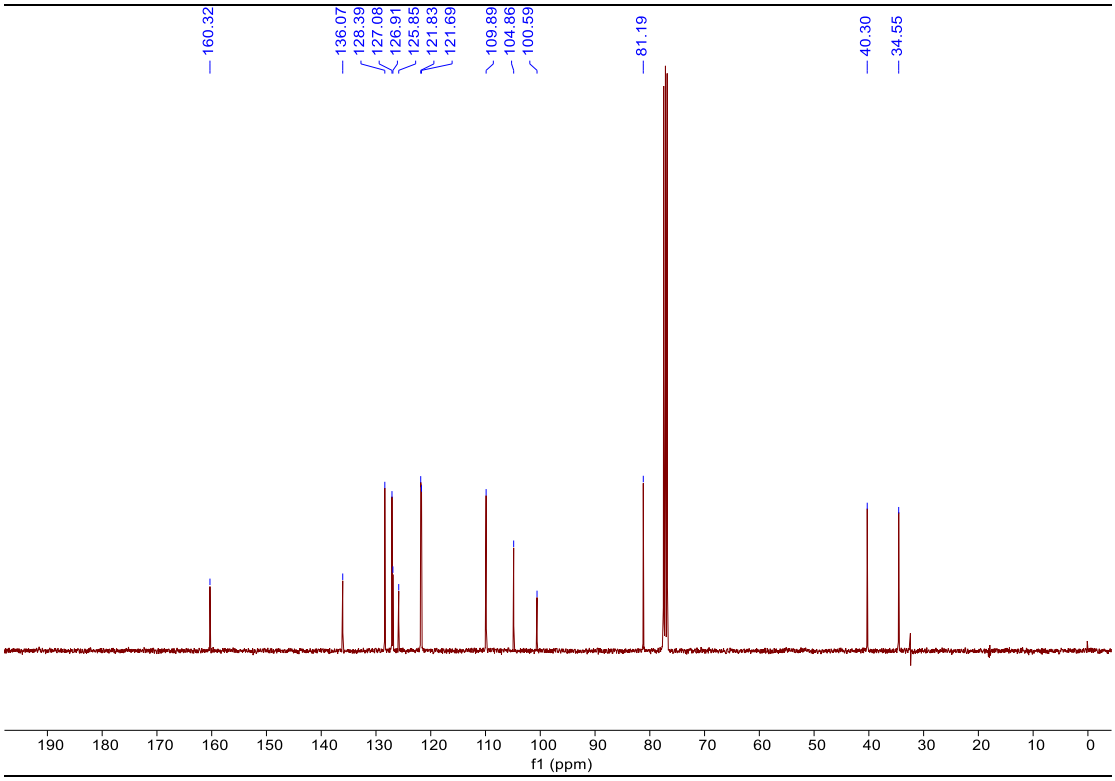
^{1}H NMR spectrum of 5g



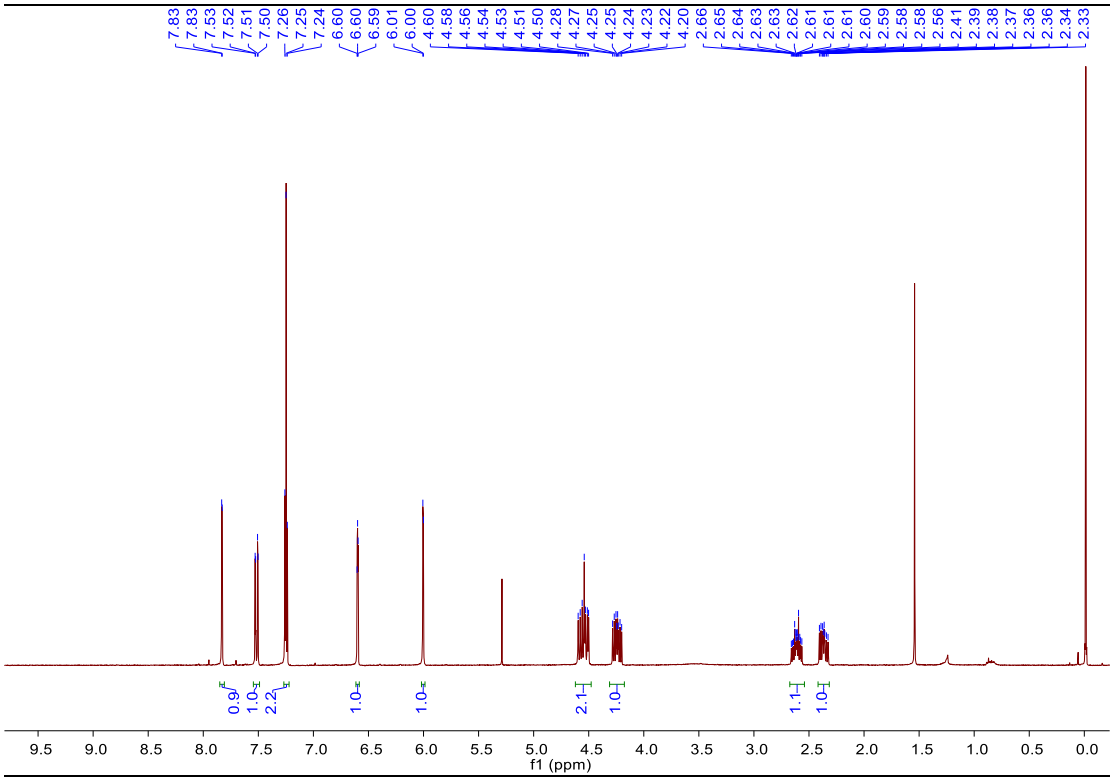
^{13}C NMR spectrum of 5g



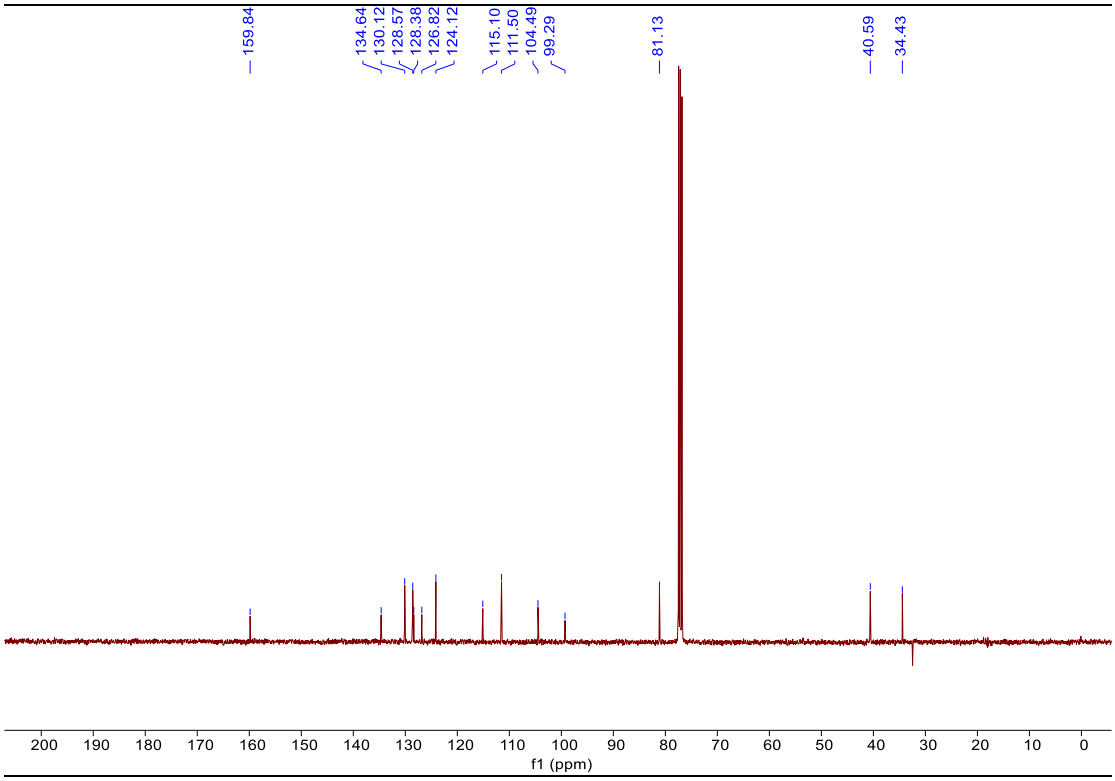
^{1}H NMR spectrum of 5h



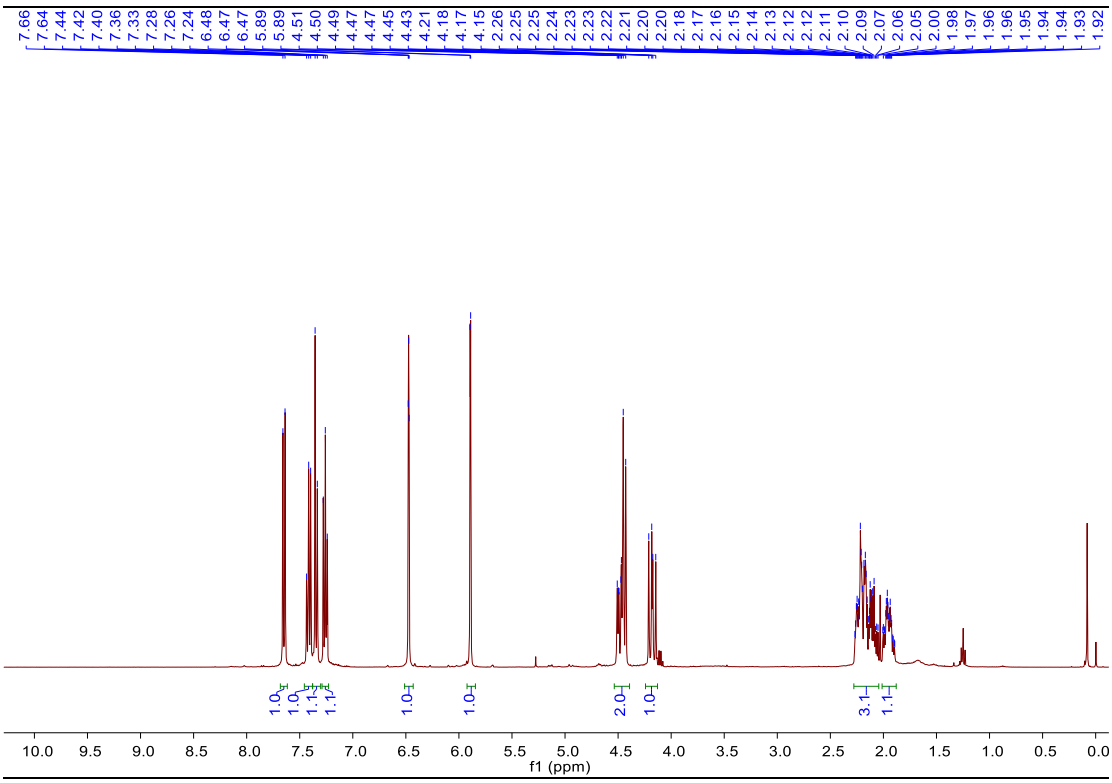
^{13}C NMR spectrum of 5h



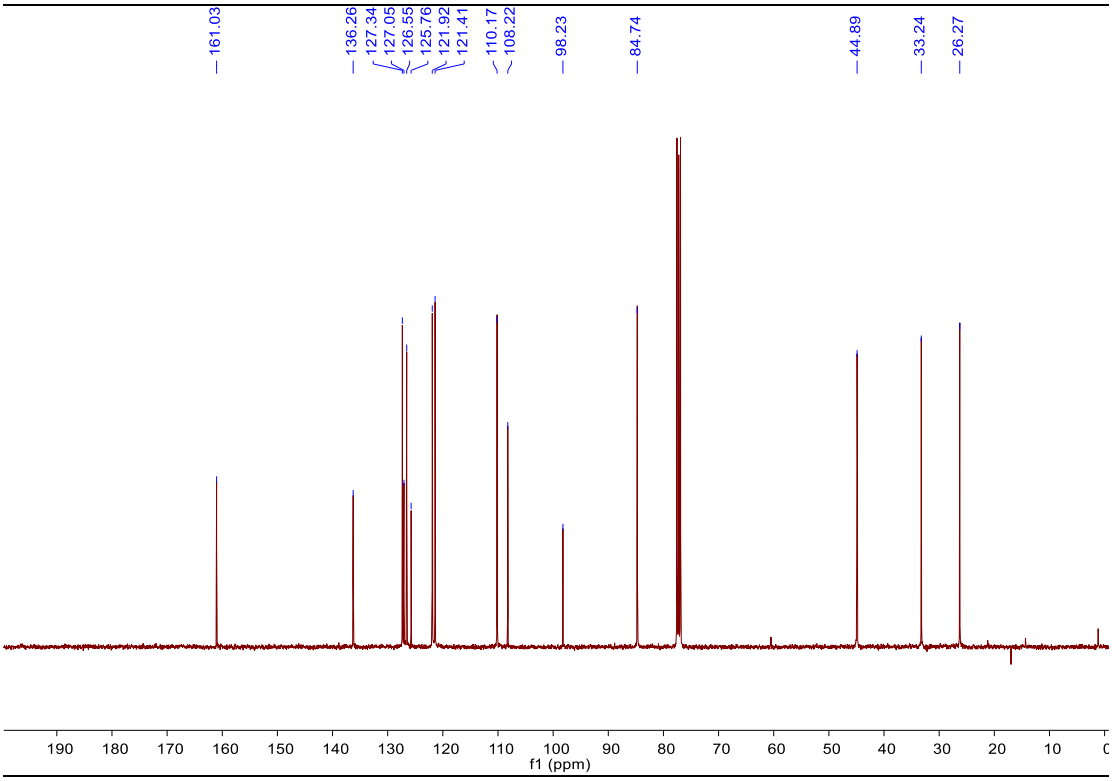
^{1}H NMR spectrum of 5i



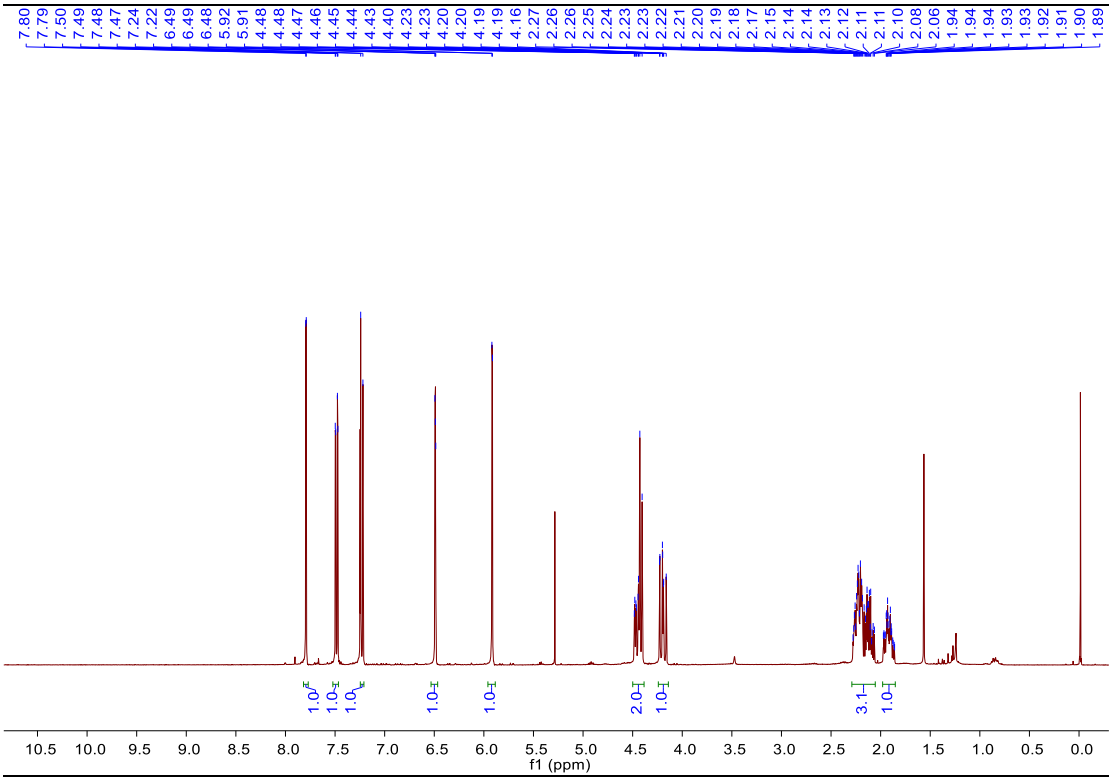
^{13}C NMR spectrum of 5i



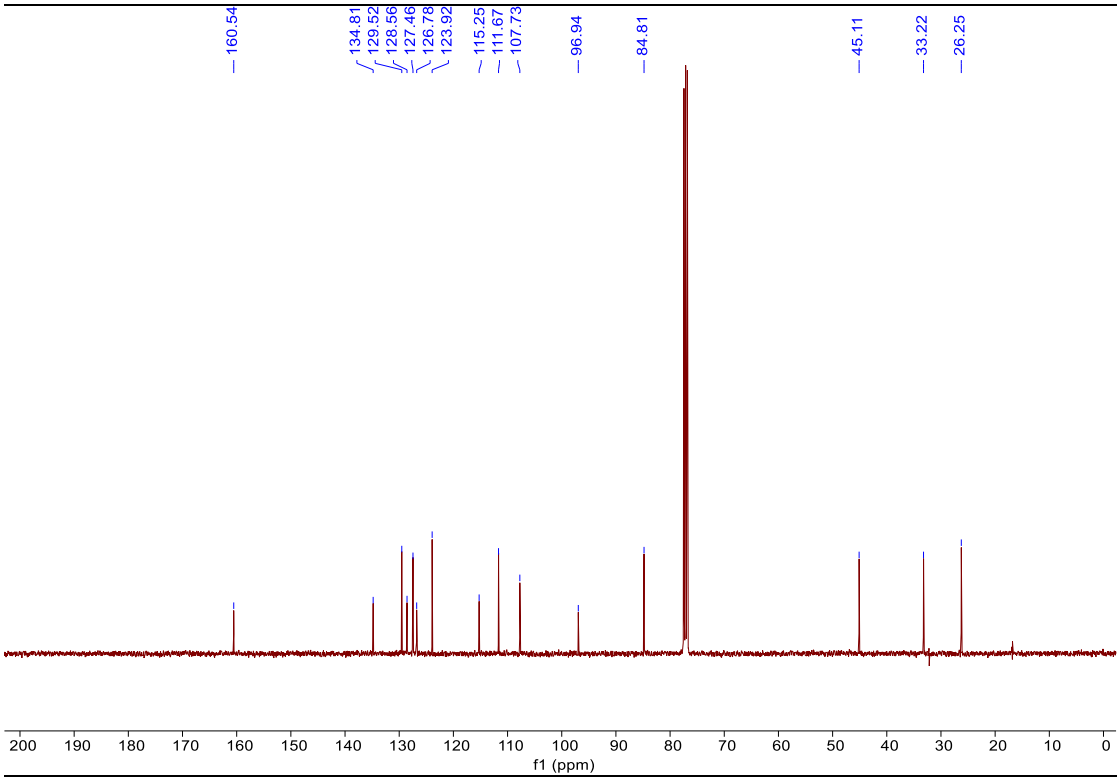
^{1}H NMR spectrum of 5j



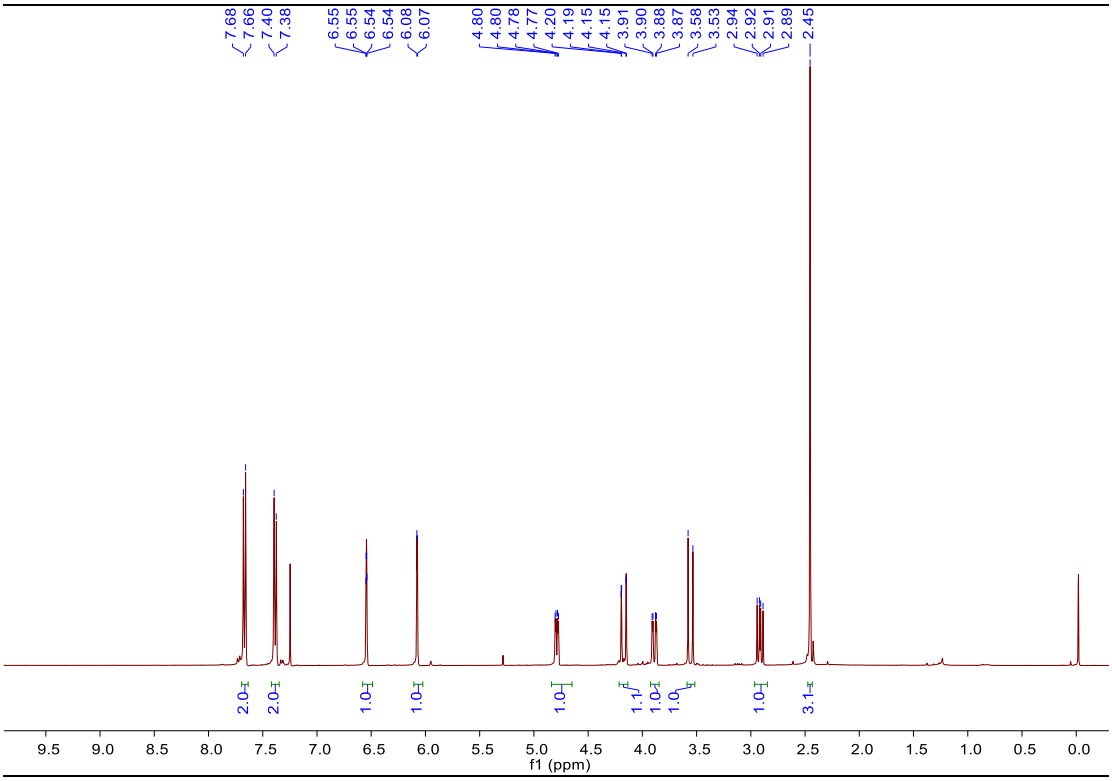
^{13}C NMR spectrum of 5j



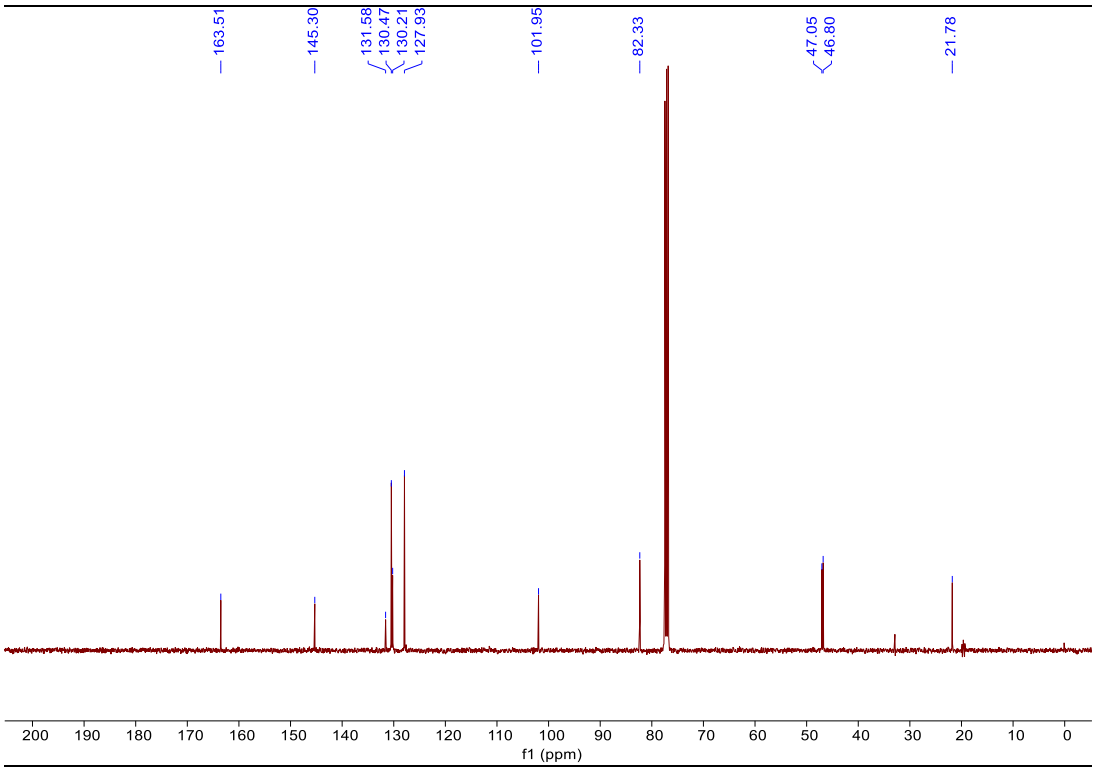
^{1}H NMR spectrum of 5k



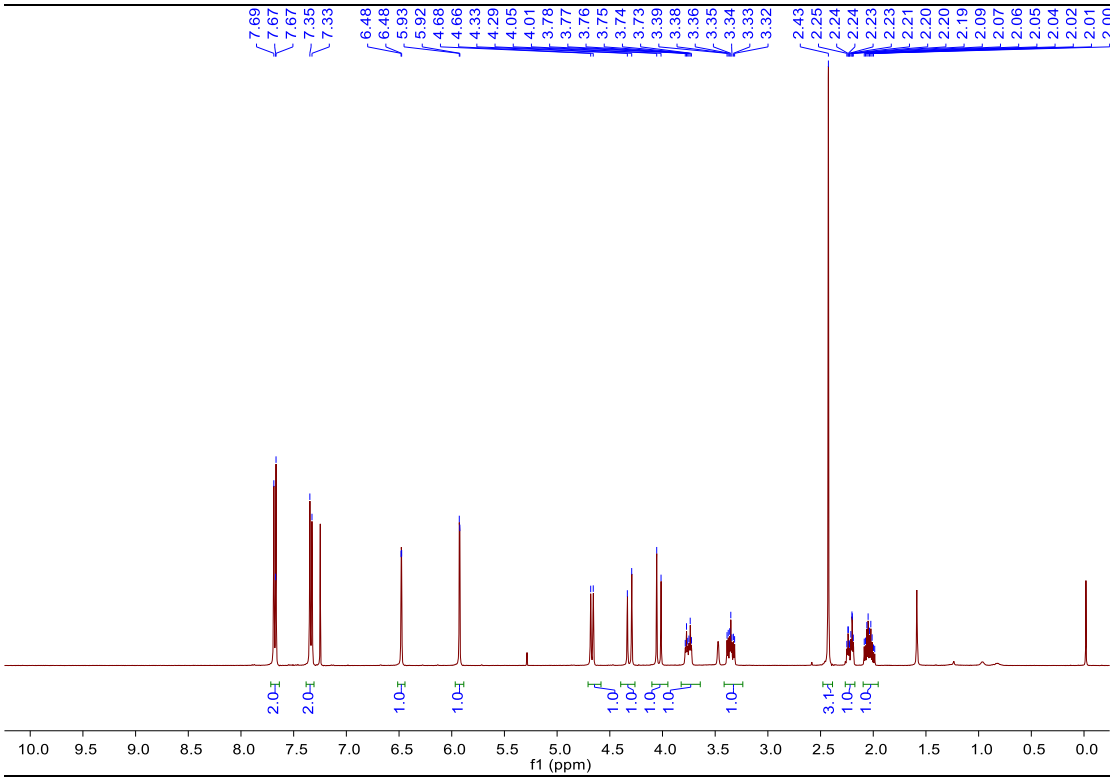
^{13}C NMR spectrum of 5k



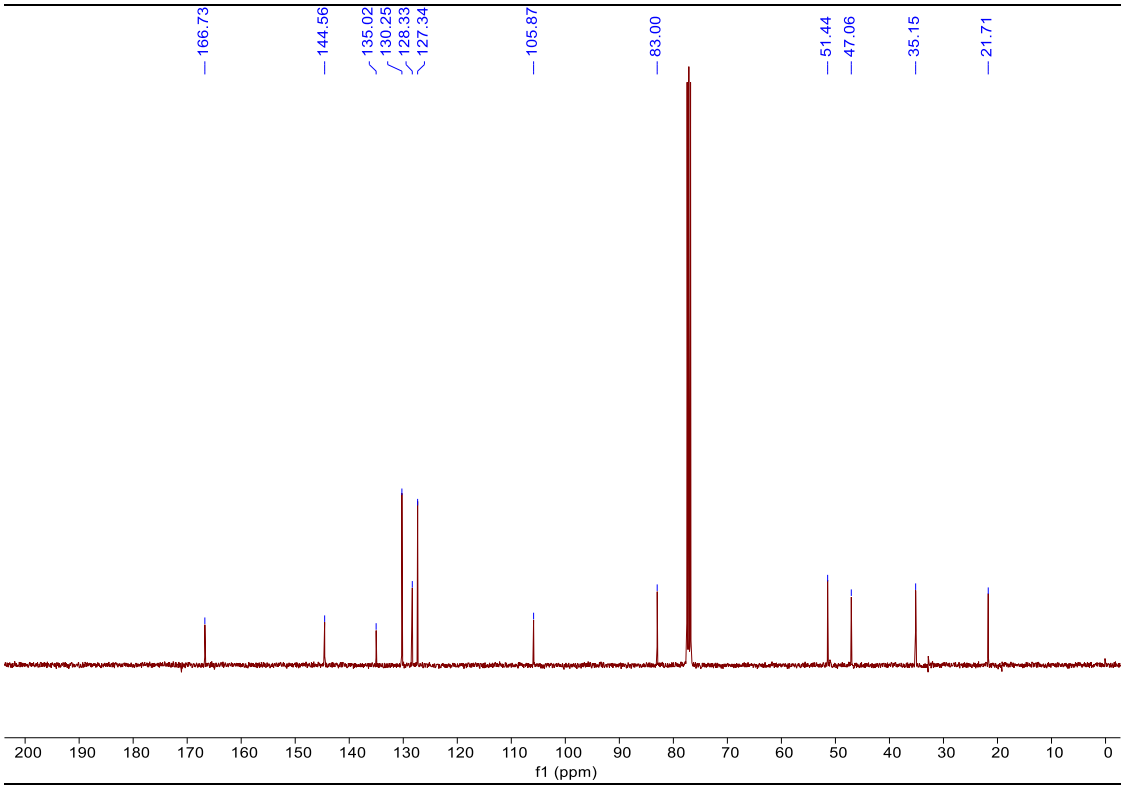
^{1}H NMR spectrum of 7a



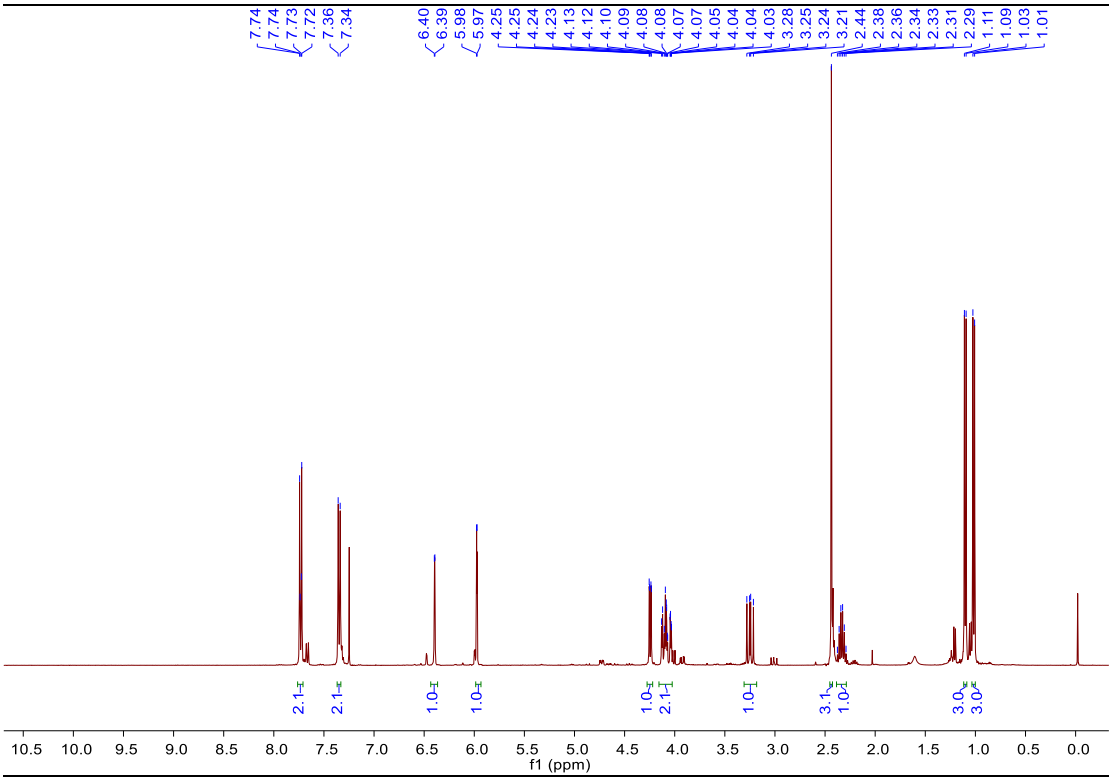
^{13}C NMR spectrum of 7a



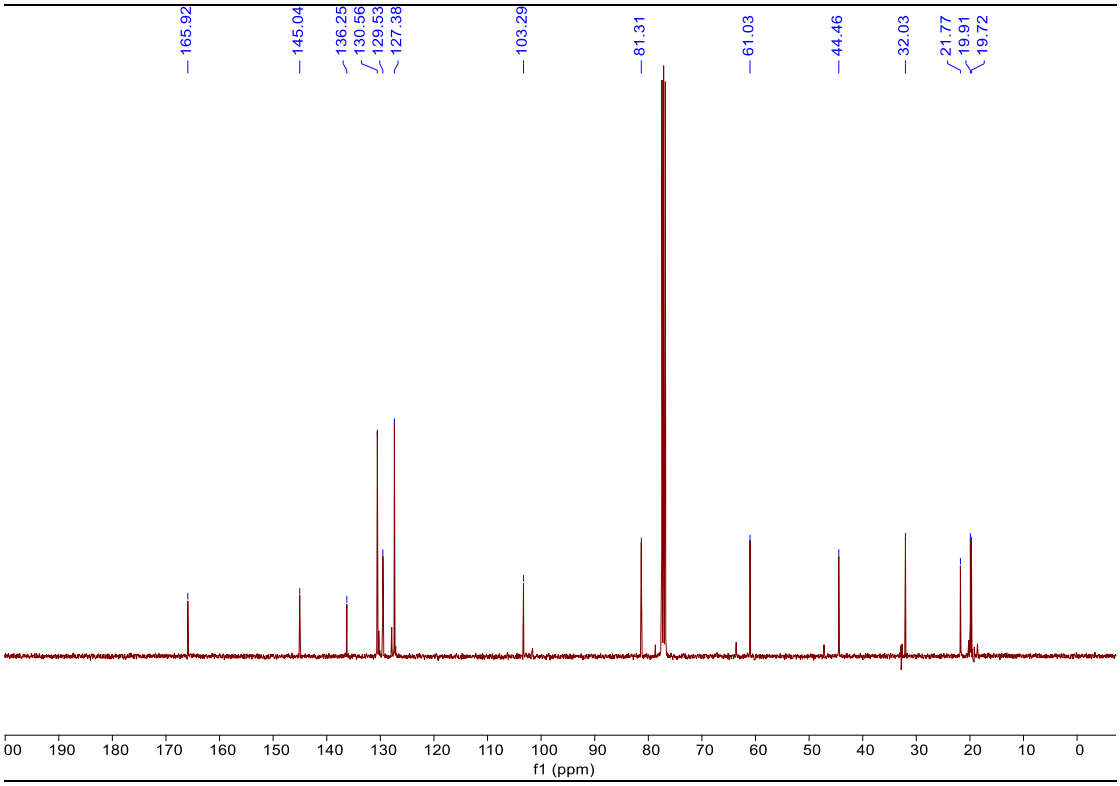
^{1}H NMR spectrum of 7b



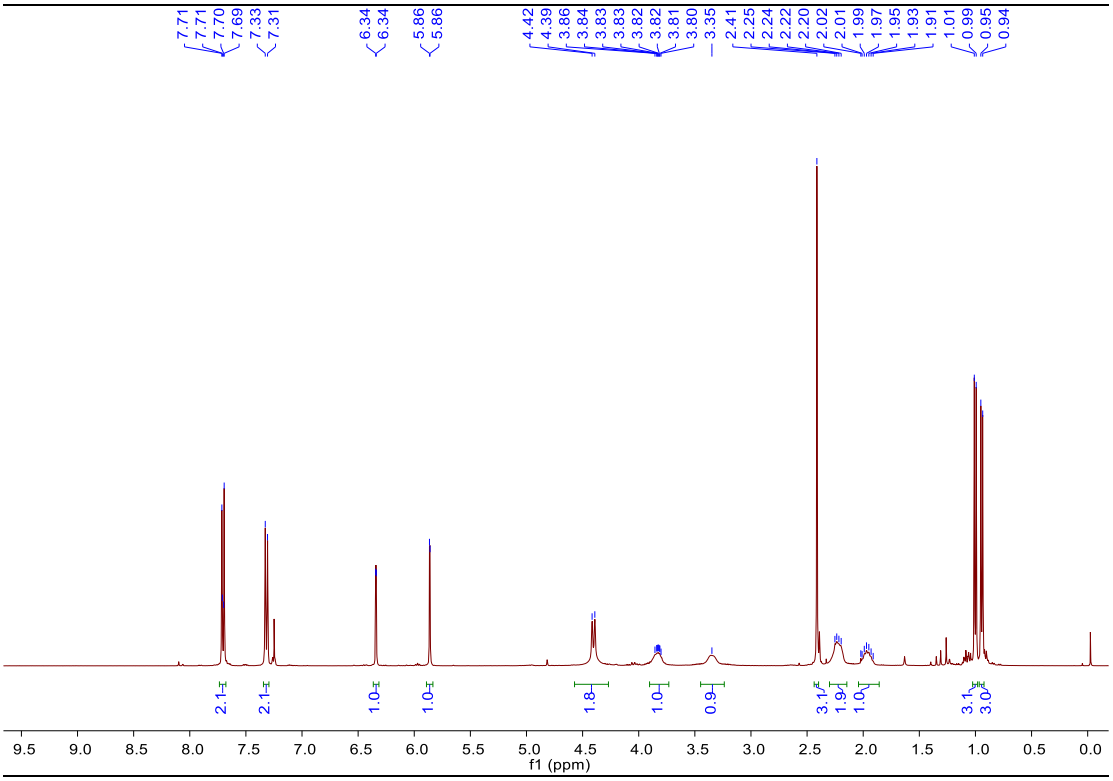
^{13}C NMR spectrum of 7b



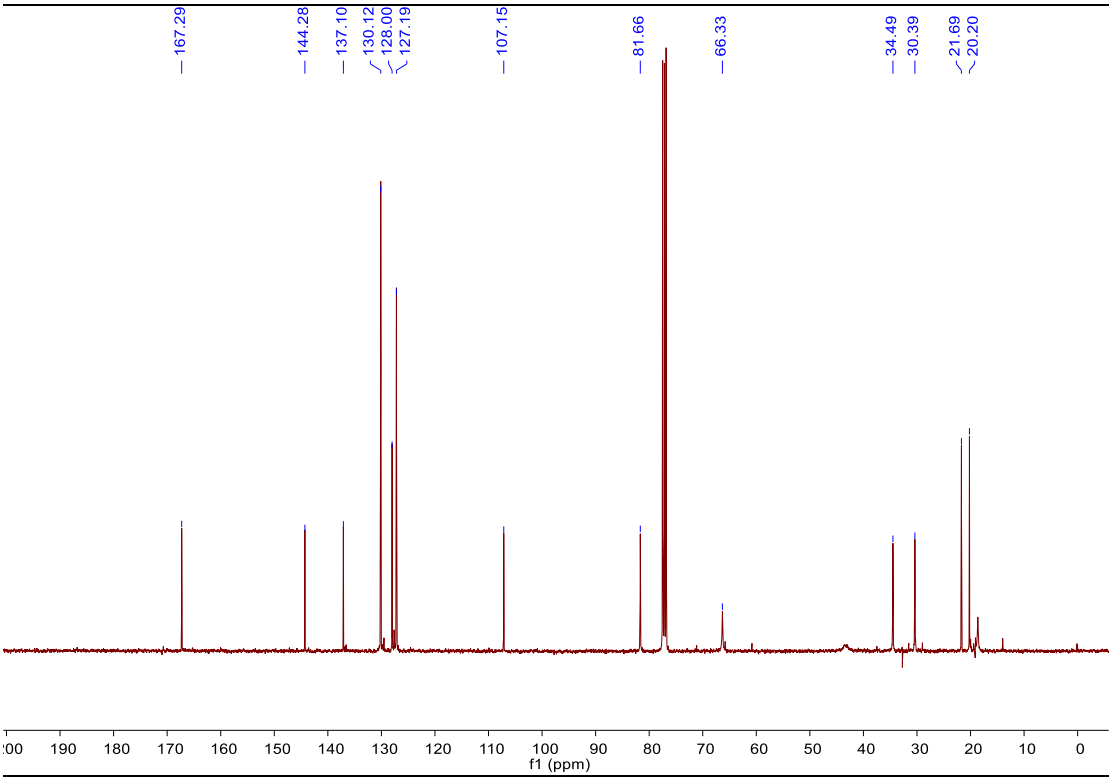
^{1}H NMR spectrum of 7c



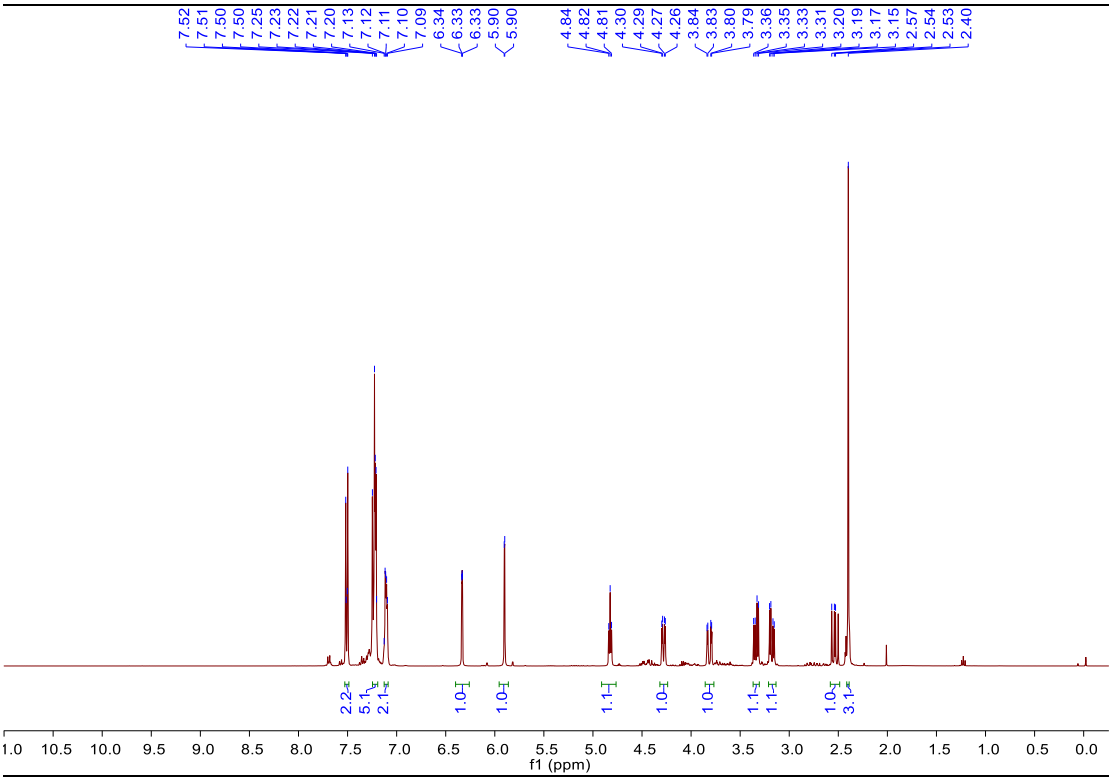
^{13}C NMR spectrum of 7c



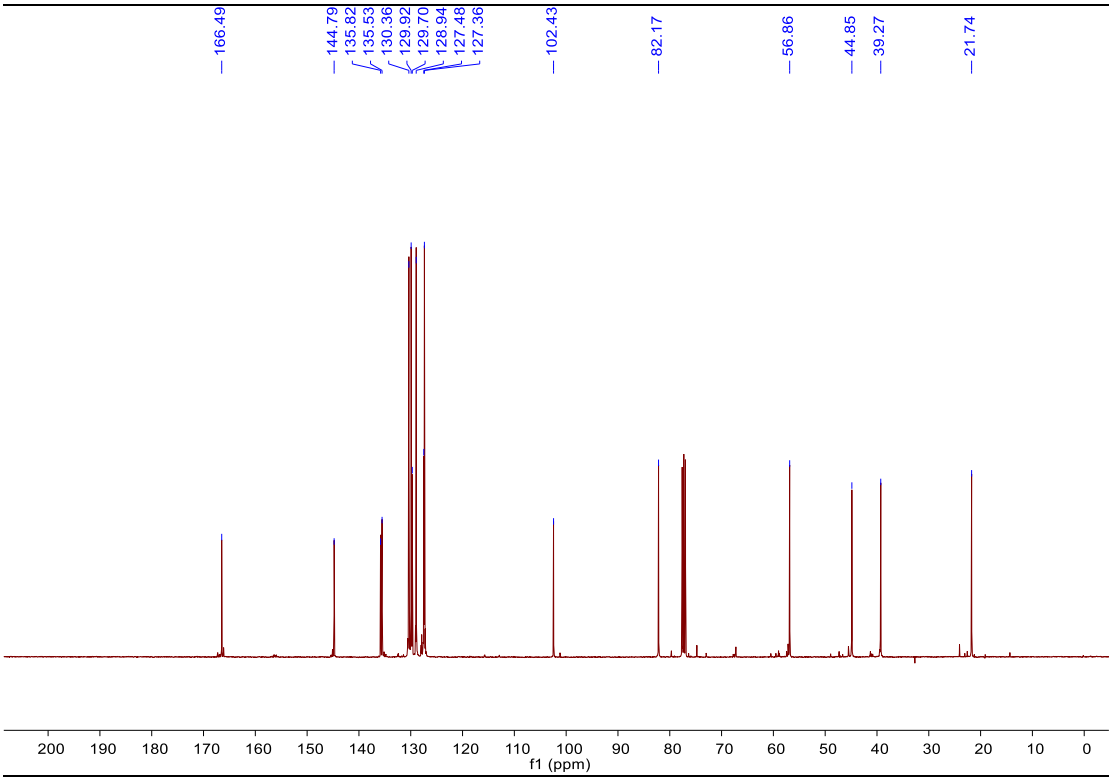
^{1}H NMR spectrum of 7d



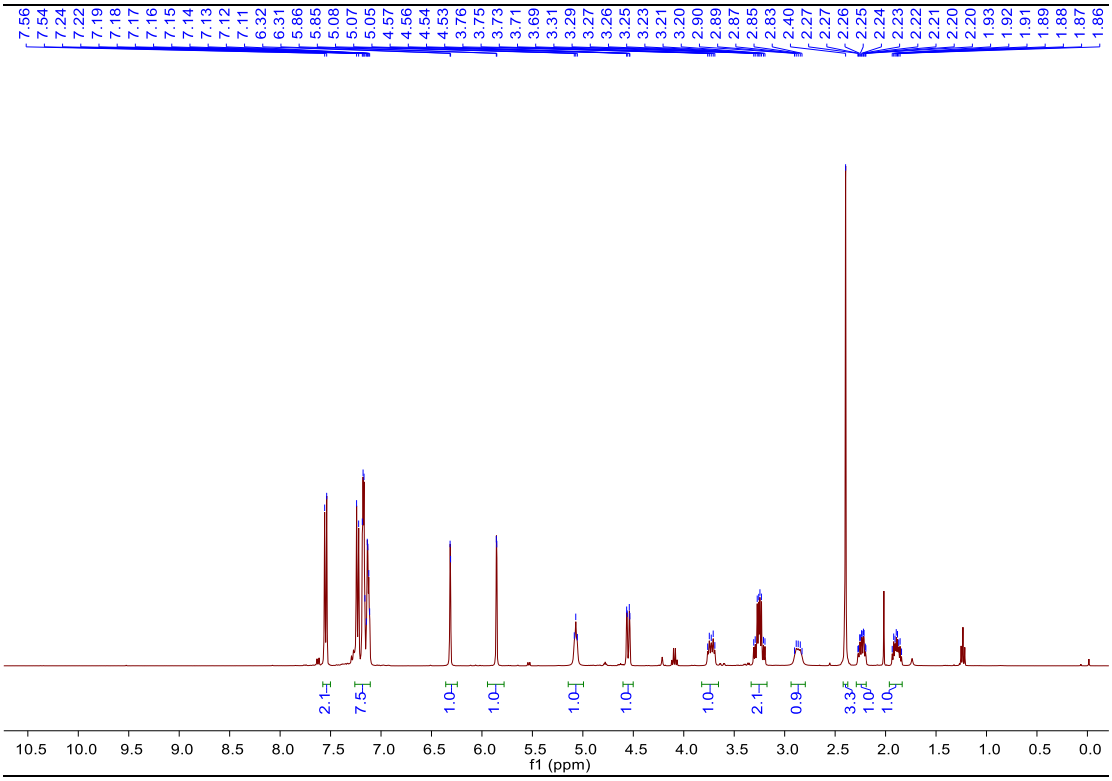
^{13}C NMR spectrum of 7d



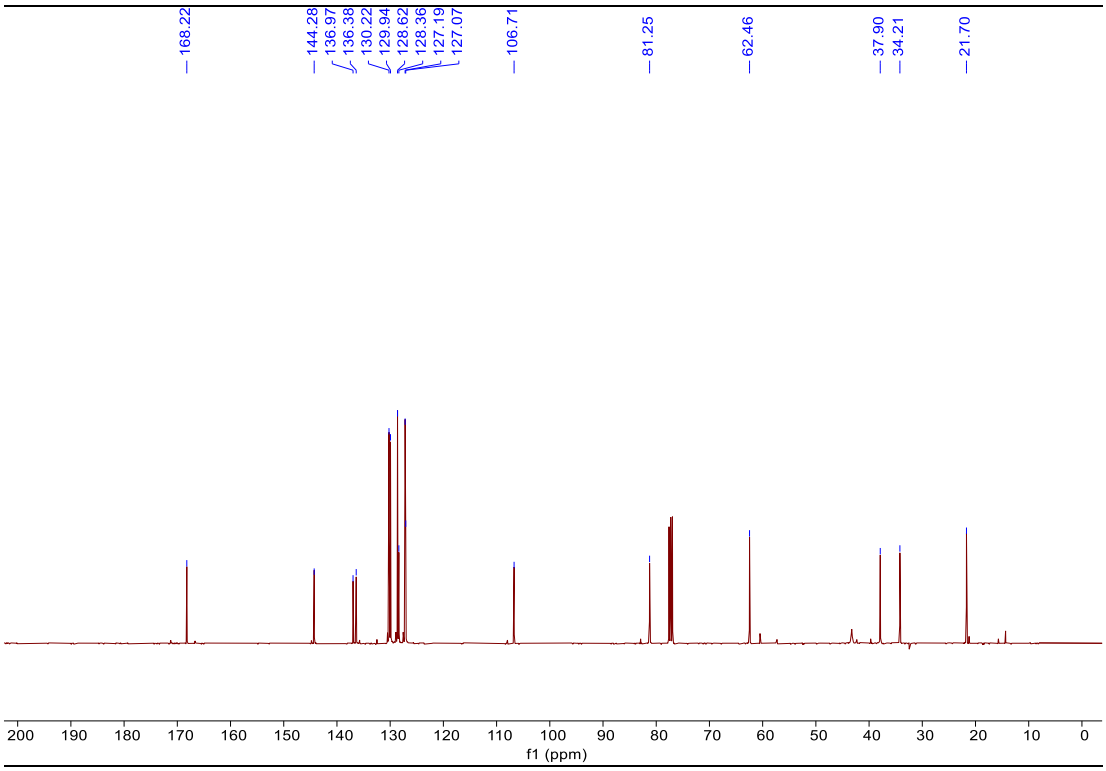
^{1}H NMR spectrum of 7e



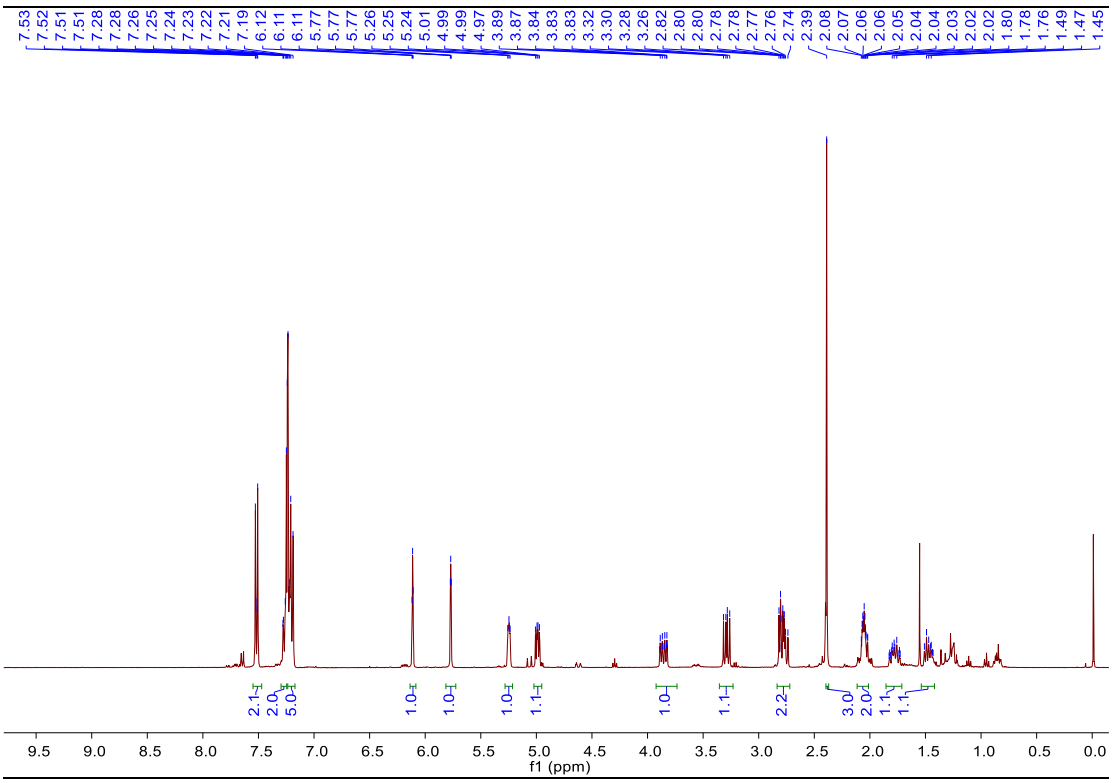
^{13}C NMR spectrum of 7e



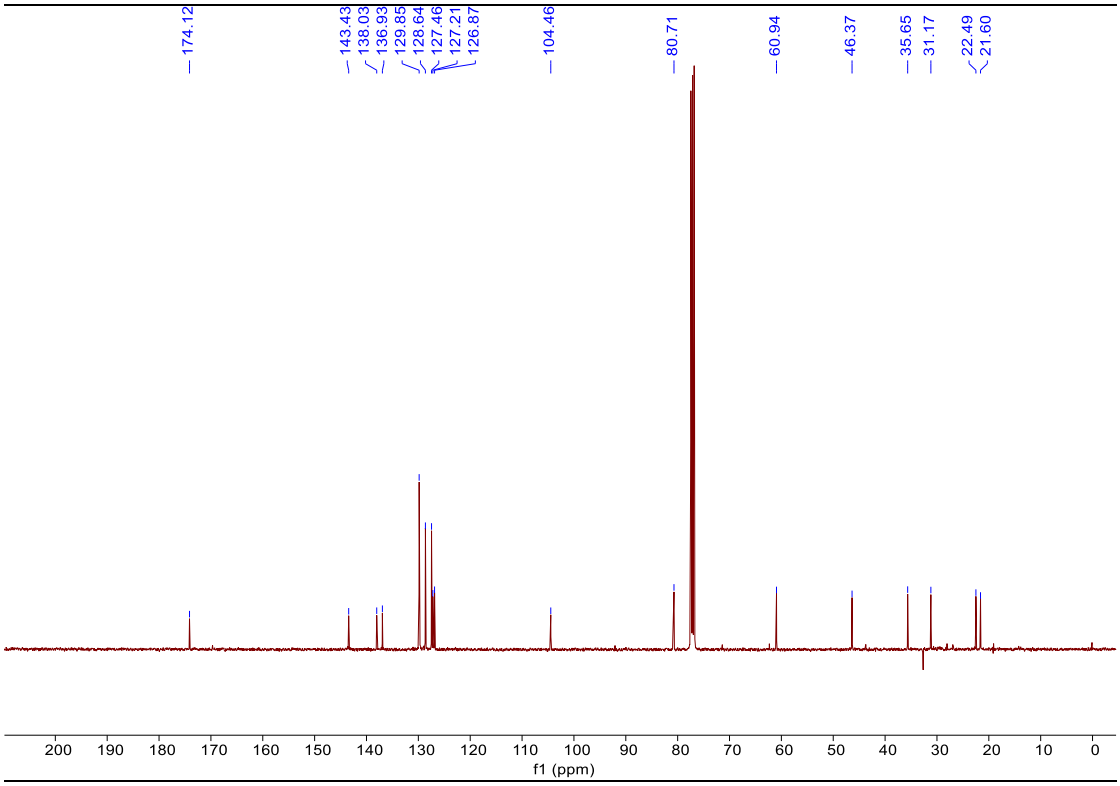
^{1}H NMR spectrum of 7f



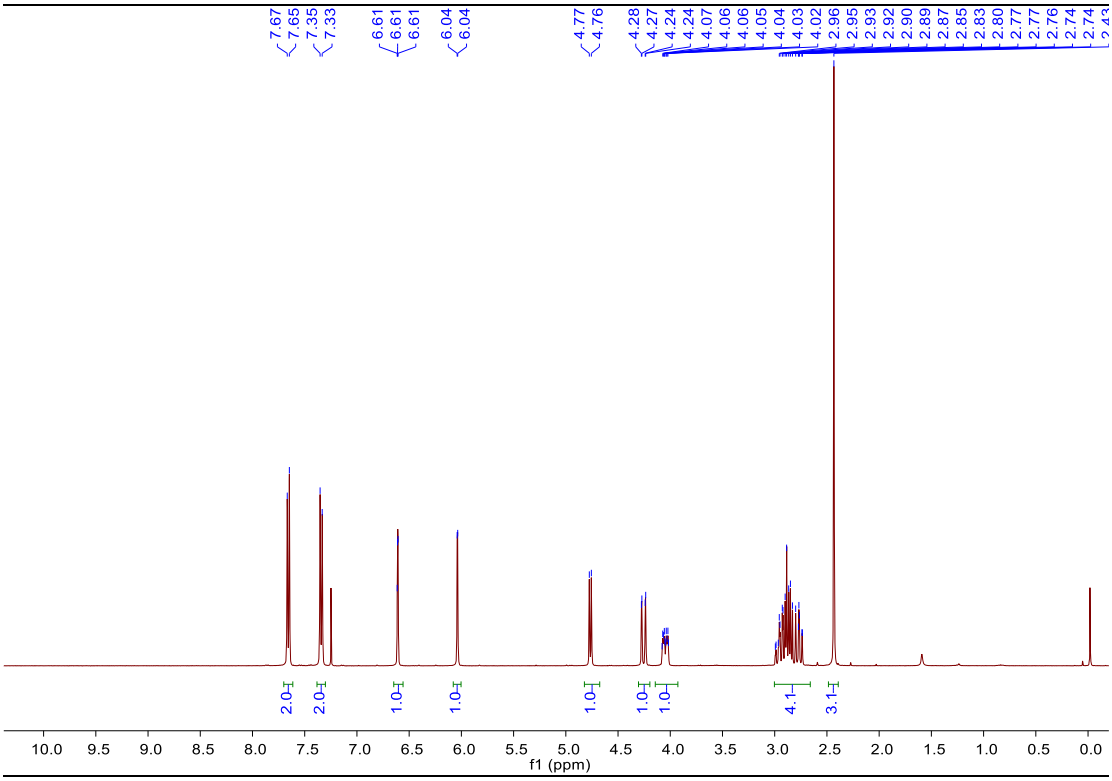
^{13}C NMR spectrum of 7f



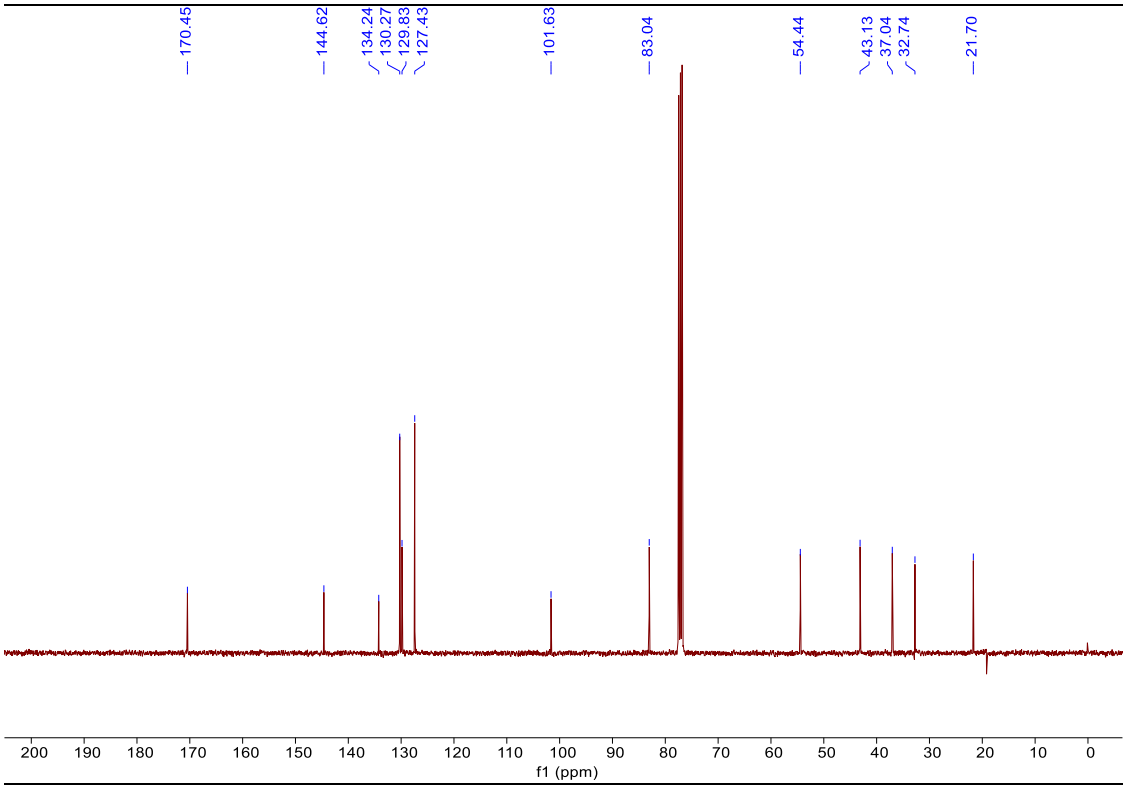
^{1}H NMR spectrum of 7g



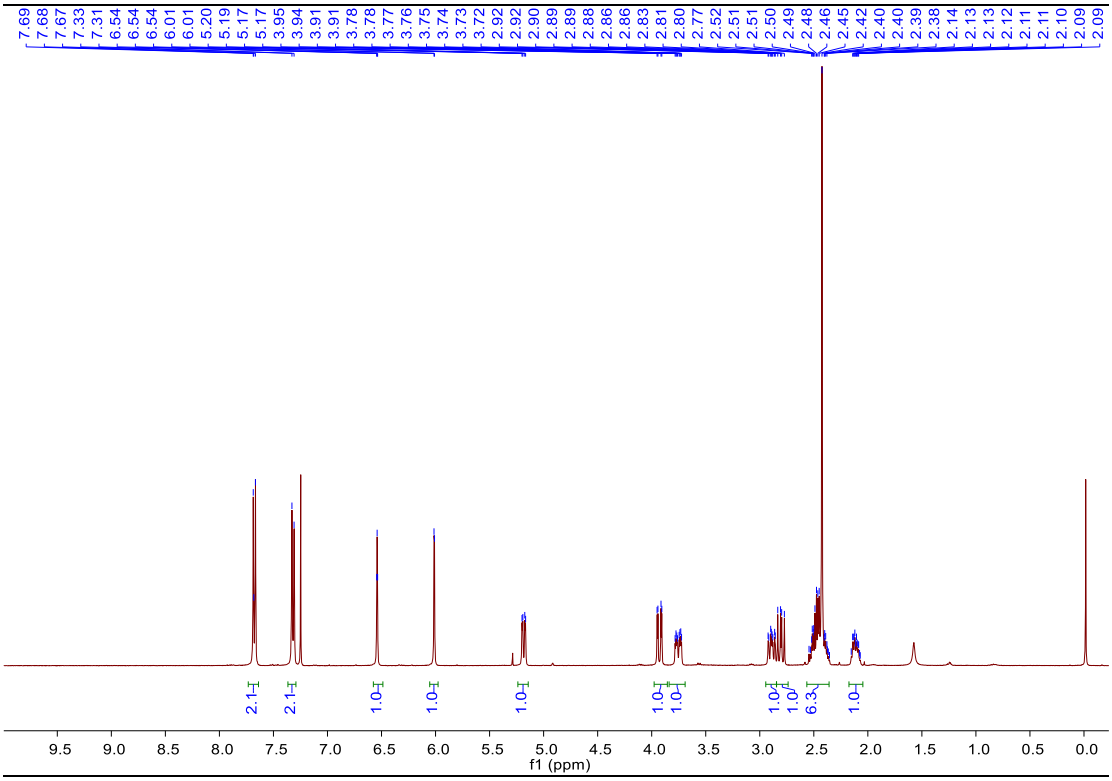
^{13}C NMR spectrum of 7g



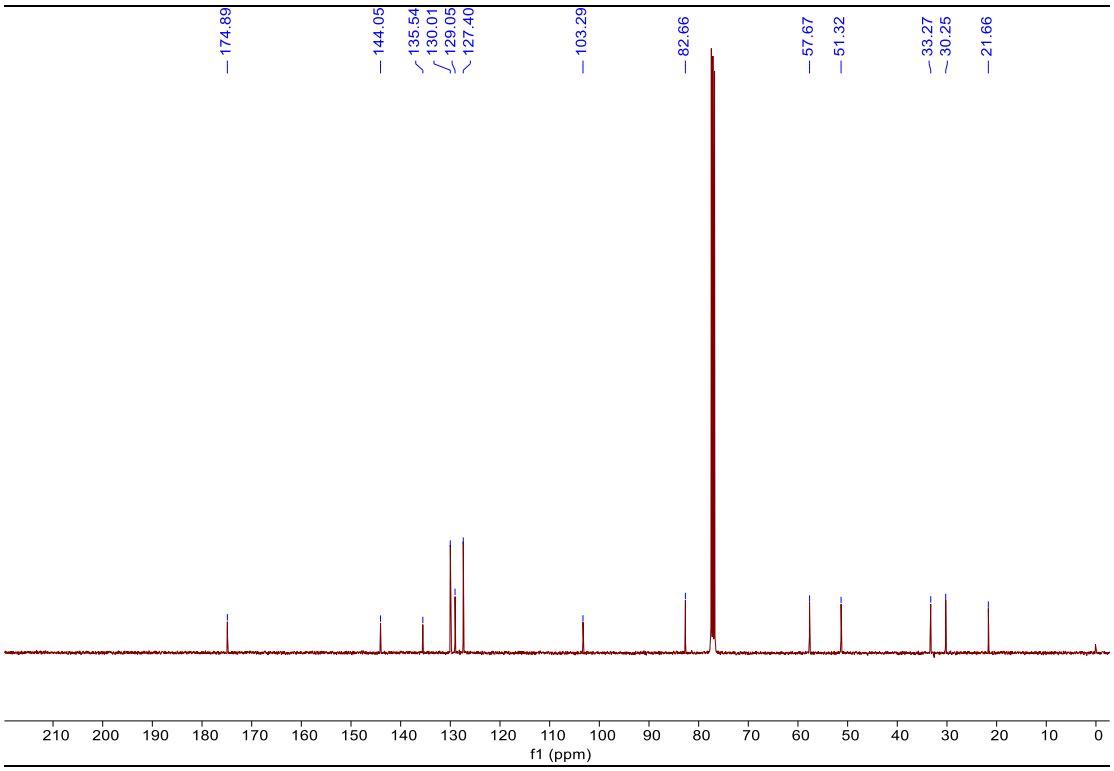
^{1}H NMR spectrum of 7h



^{13}C NMR spectrum of 7h

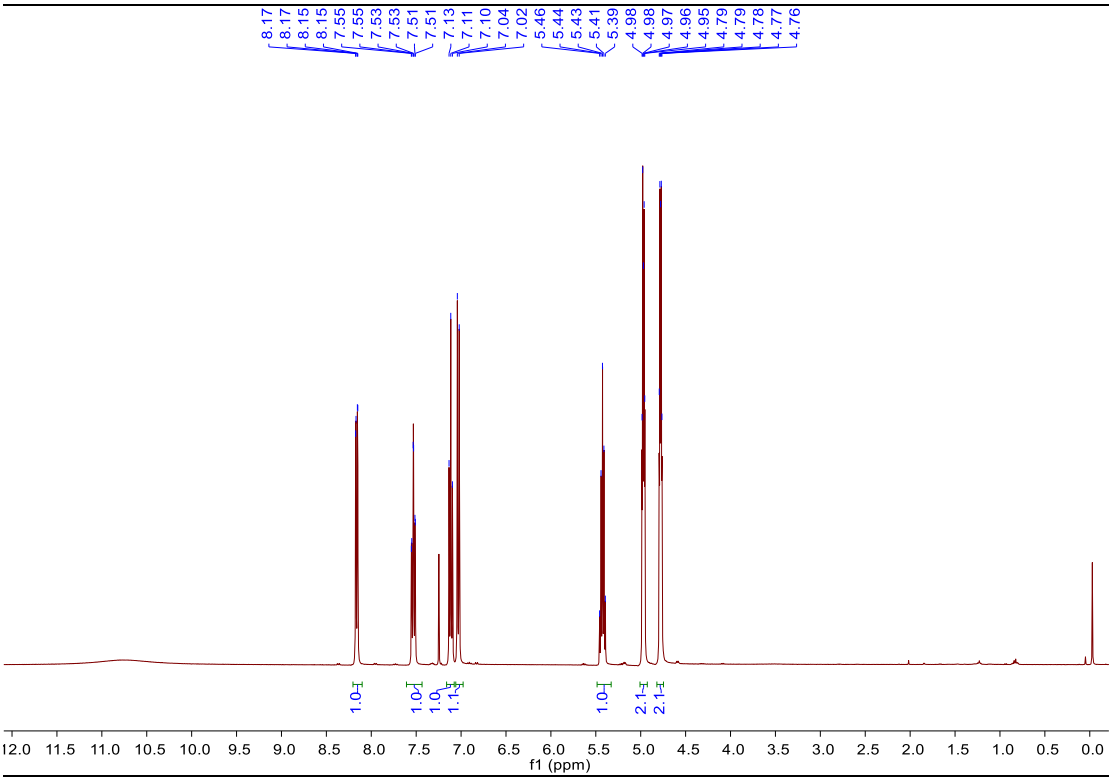


^{1}H NMR spectrum of 7i

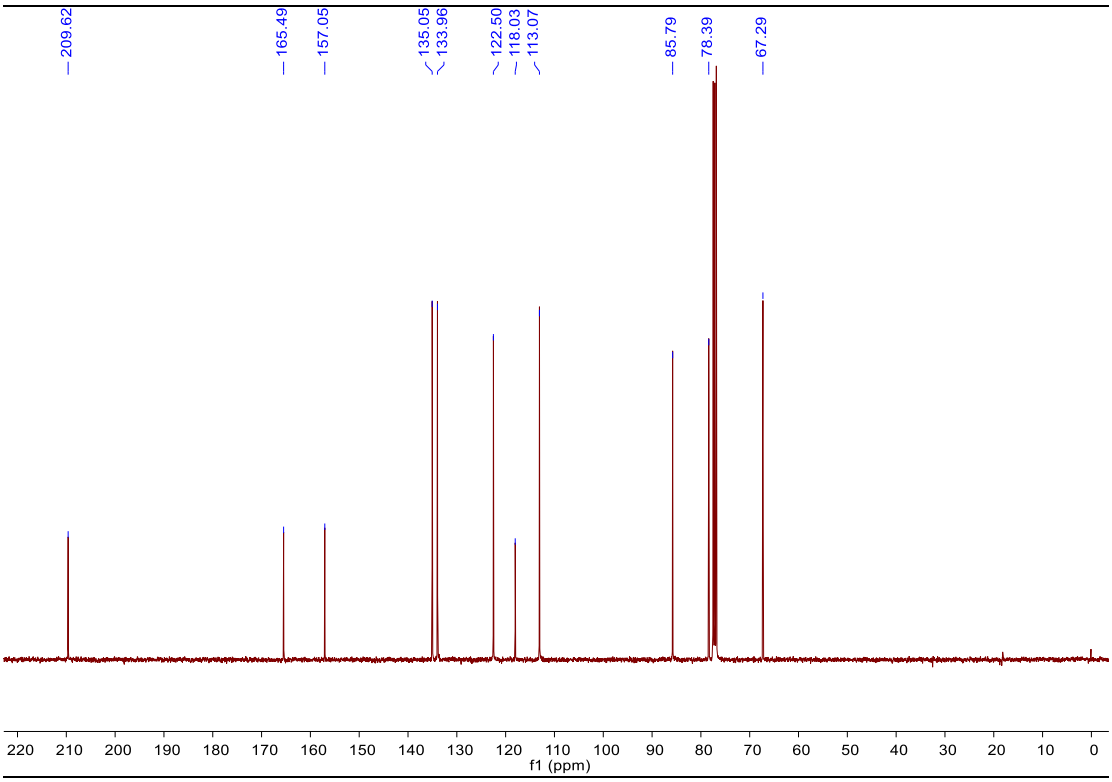


^{13}C NMR spectrum of 7i

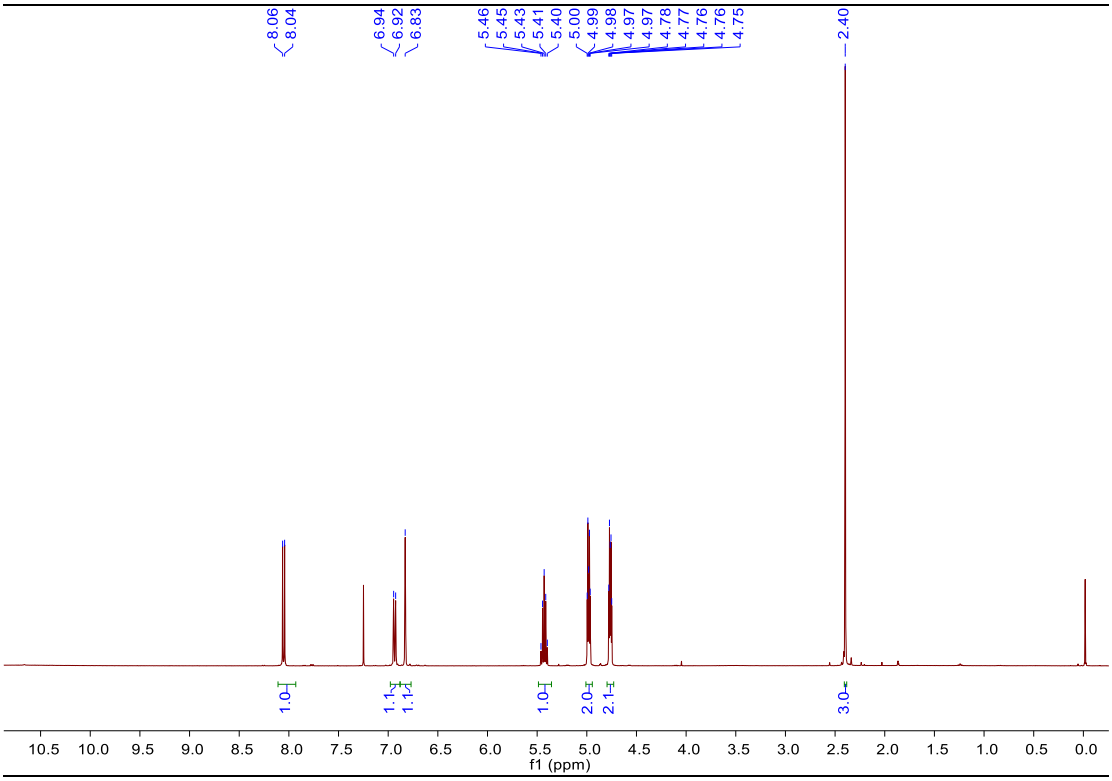
7. Copies of ^{1}H NMR and ^{13}C NMR spectra for 1a-1j, 4a-4k and 6a-6i



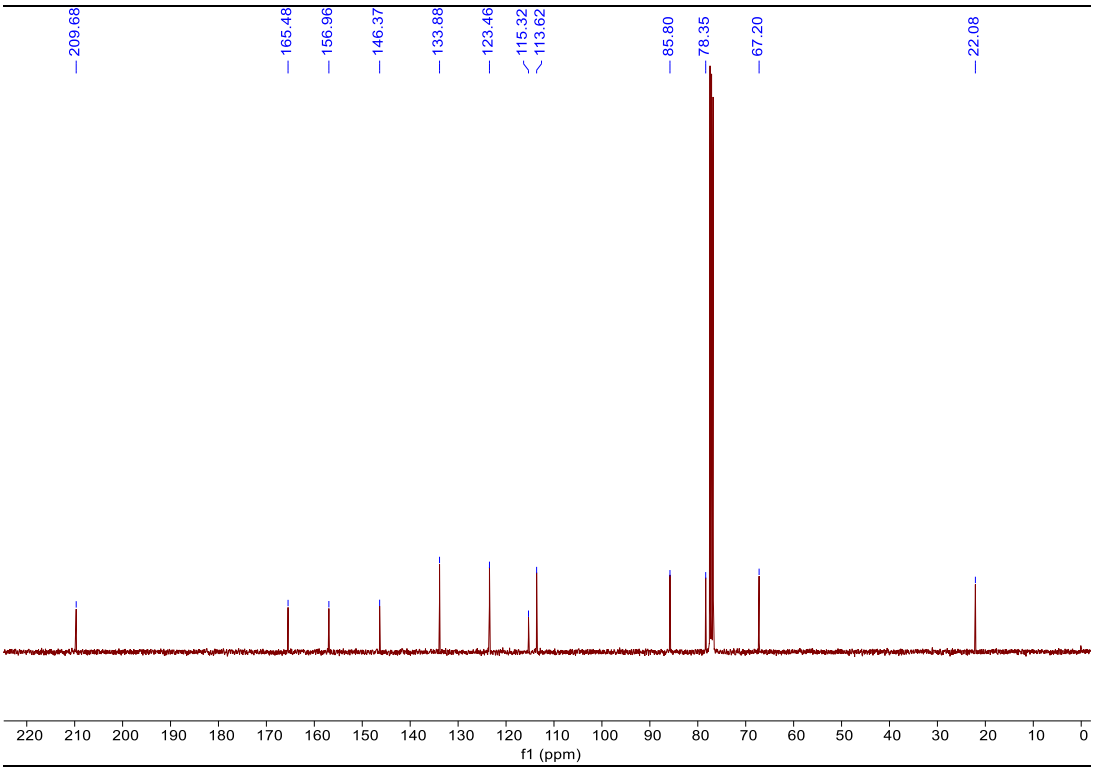
^{1}H NMR spectrum of 1a



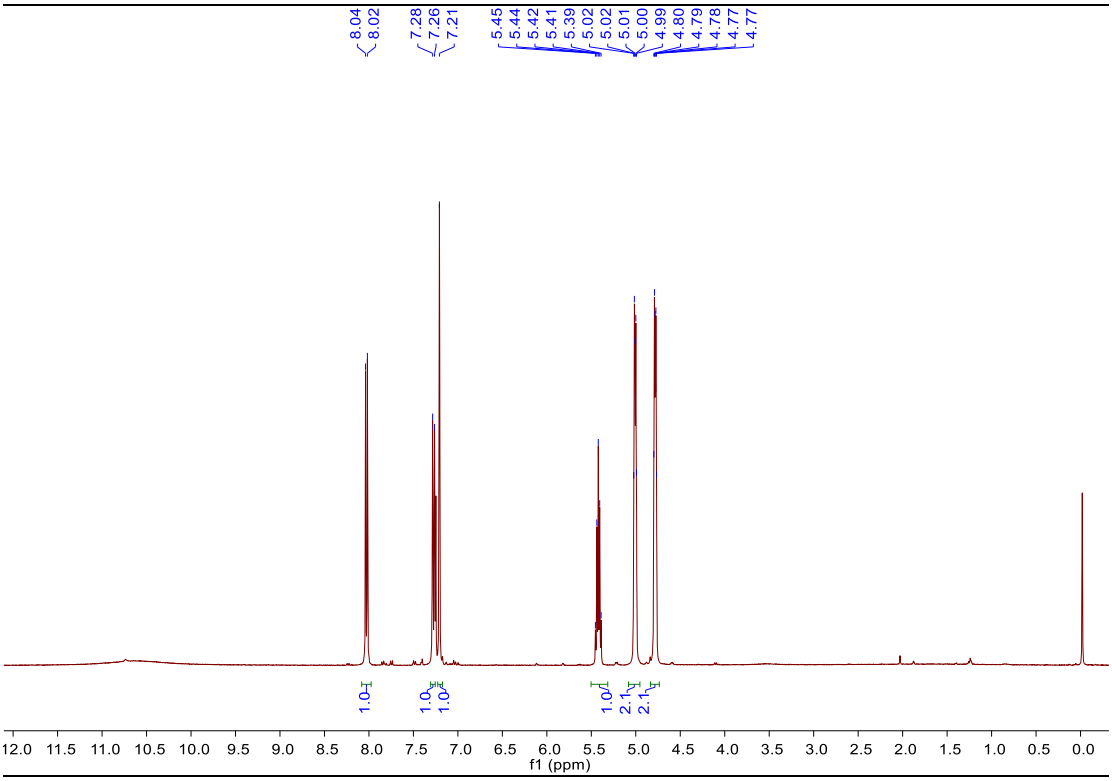
^{13}C NMR spectrum of 1a



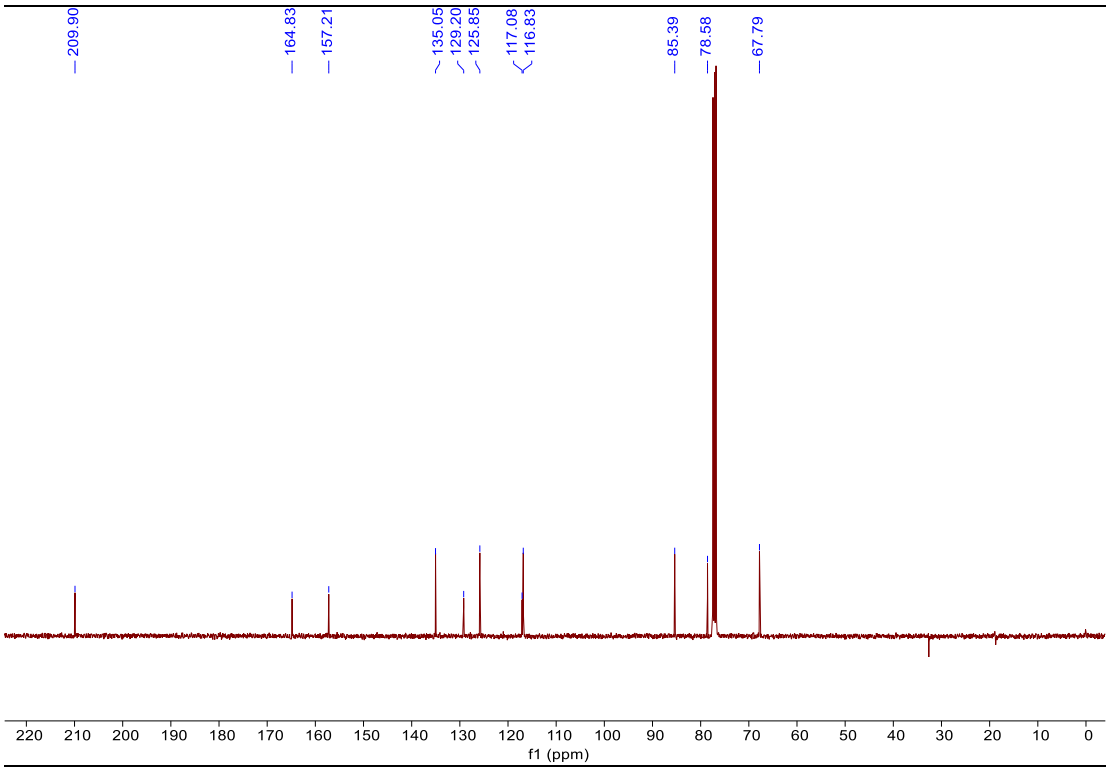
^{1}H NMR spectrum of 1b



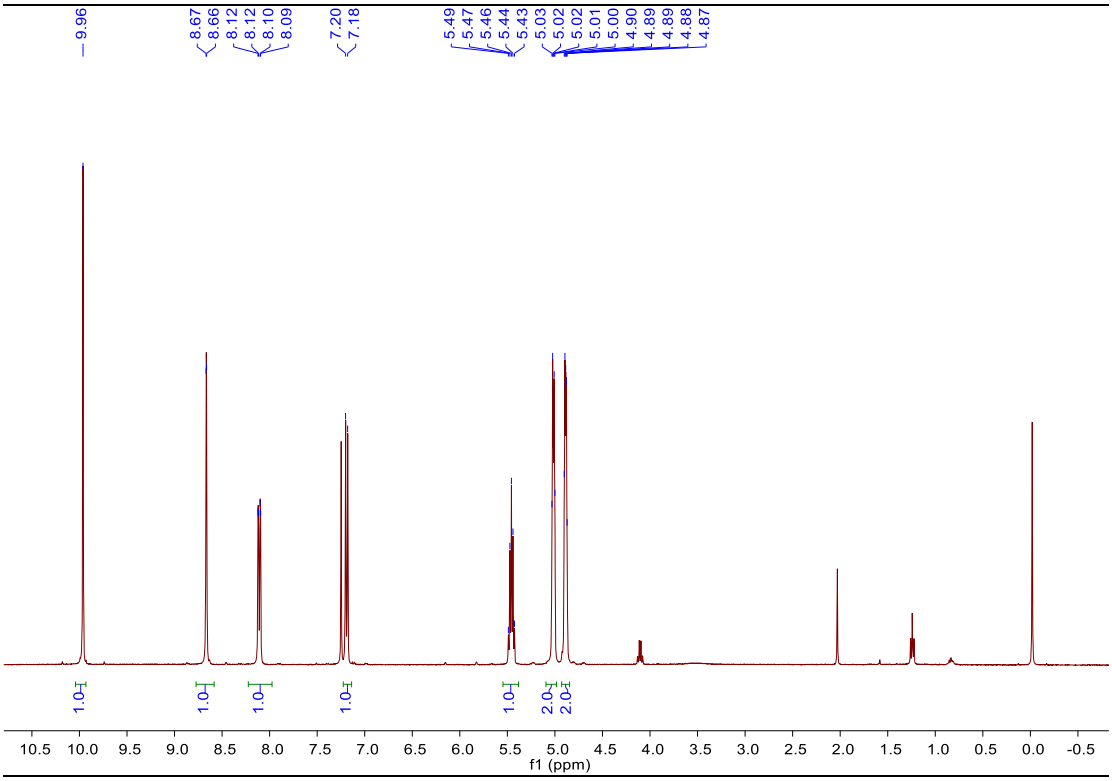
^{13}C NMR spectrum of 1b



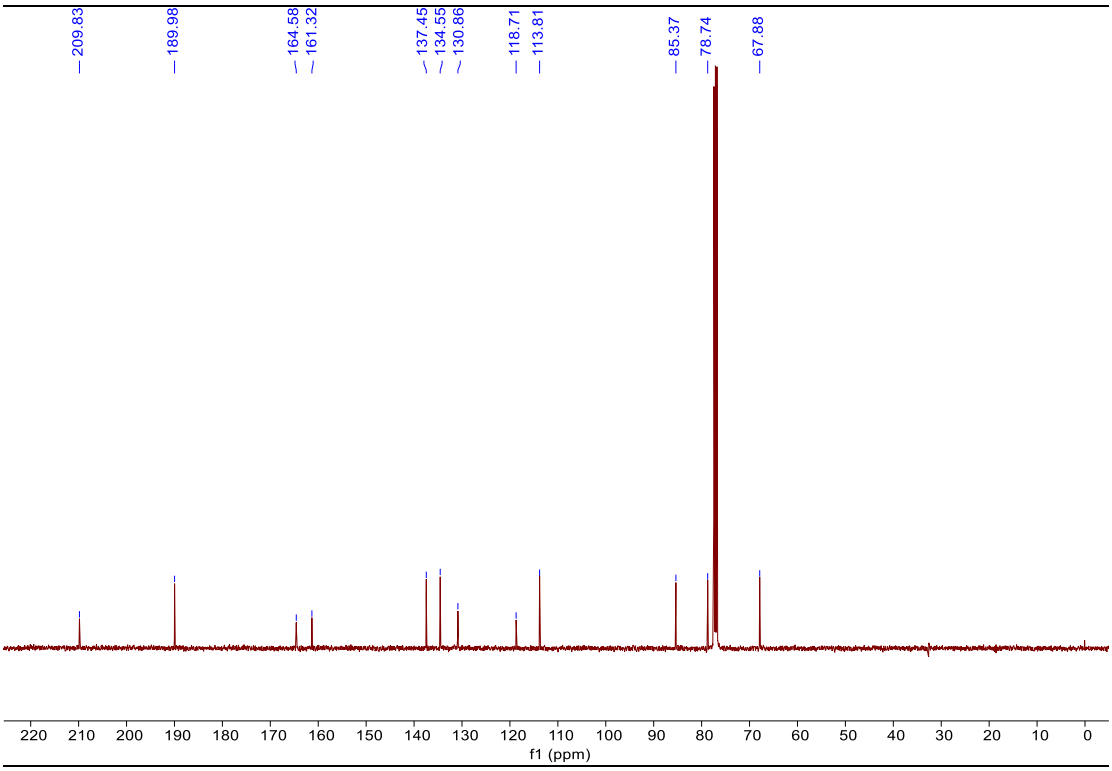
^{1}H NMR spectrum of 1c



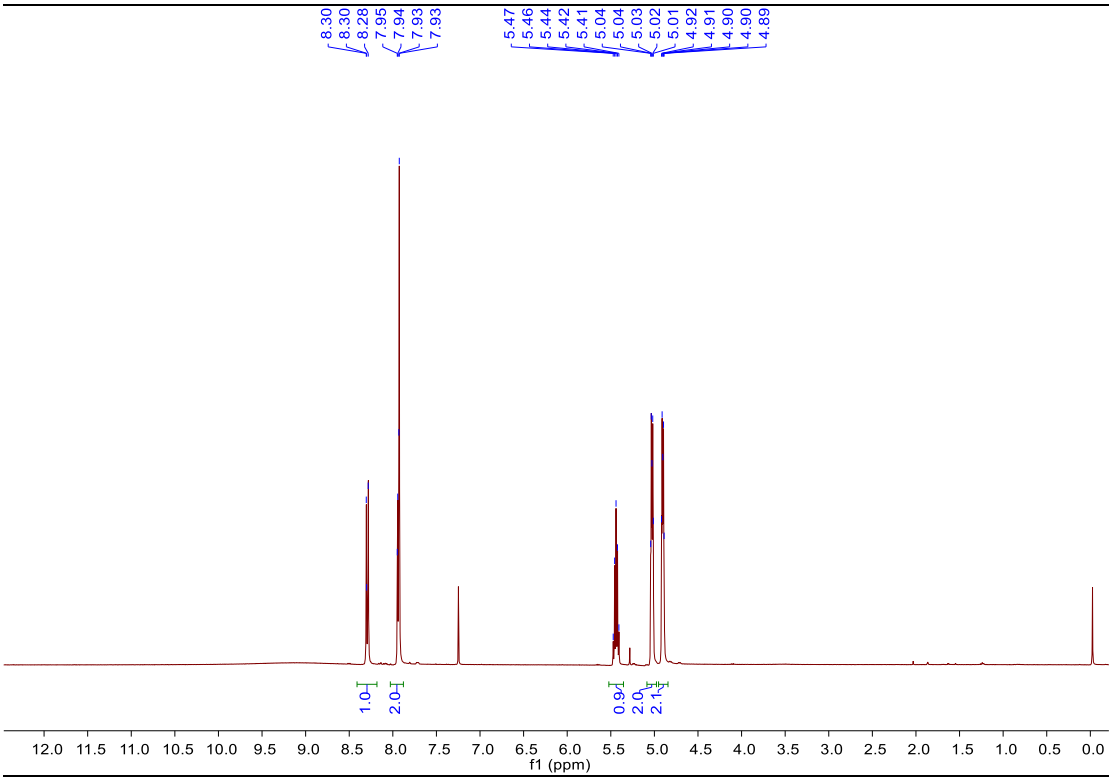
^{13}C NMR spectrum of 1c



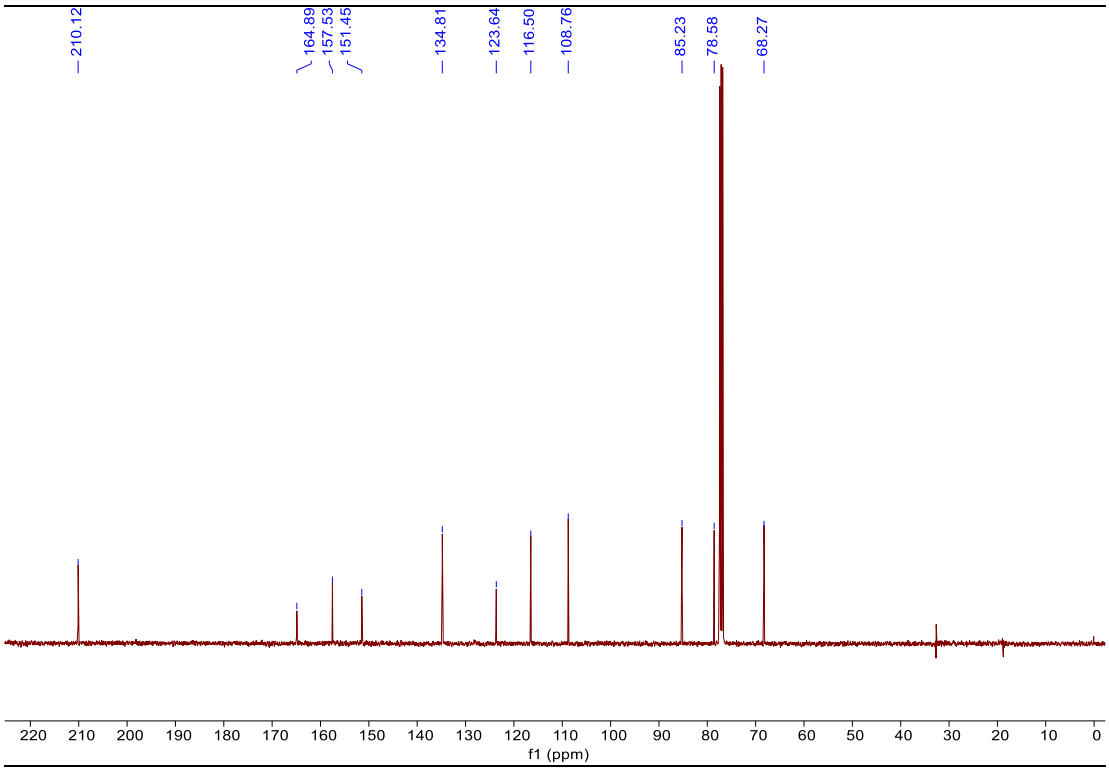
^{1}H NMR spectrum of 1d



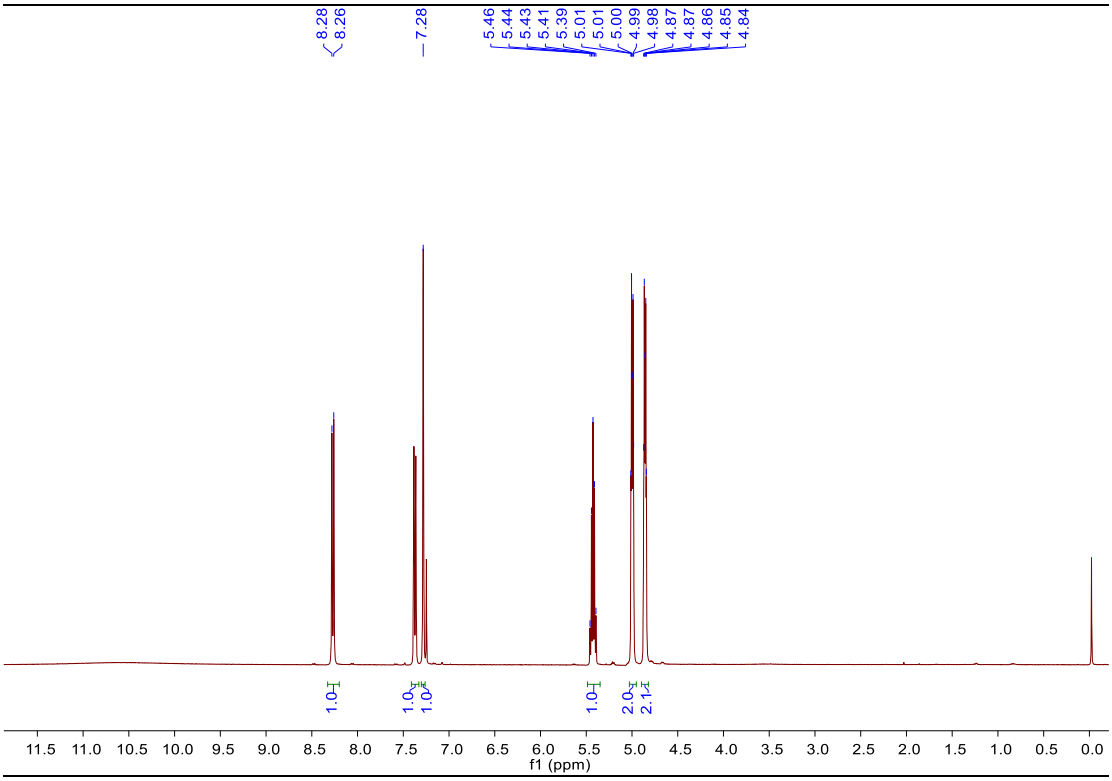
^{13}C NMR spectrum of 1d



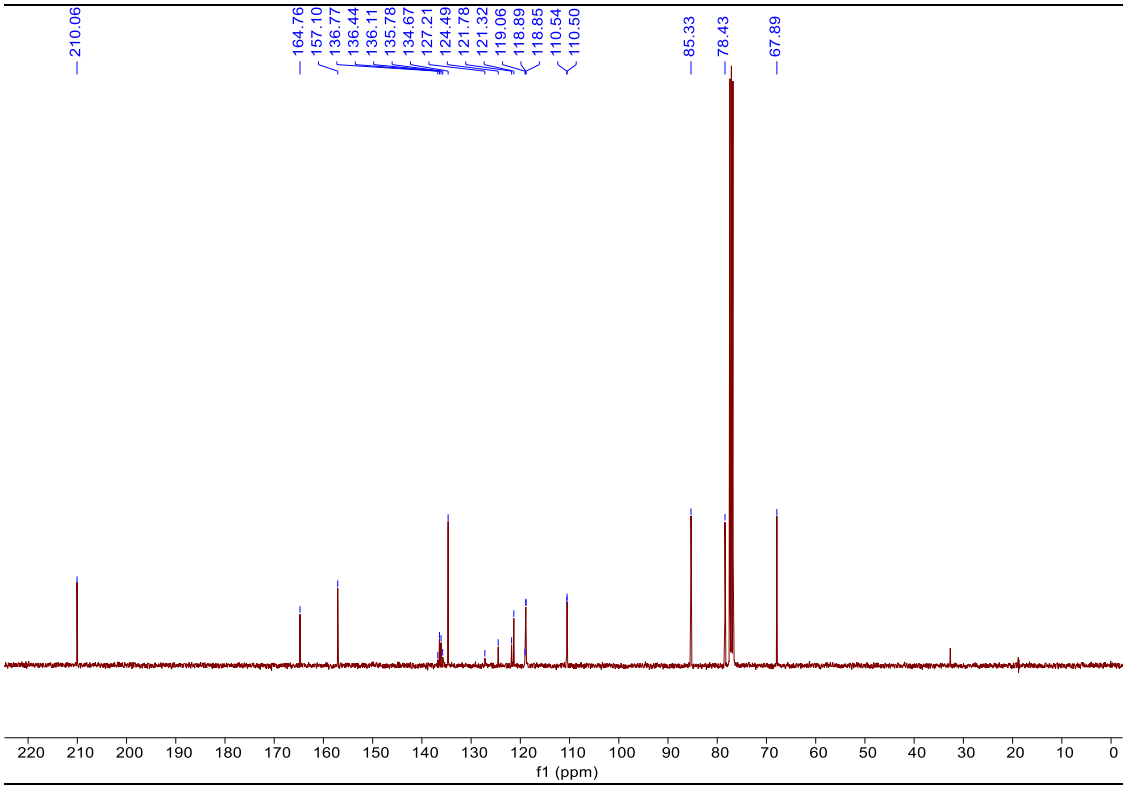
^{1}H NMR spectrum of 1e



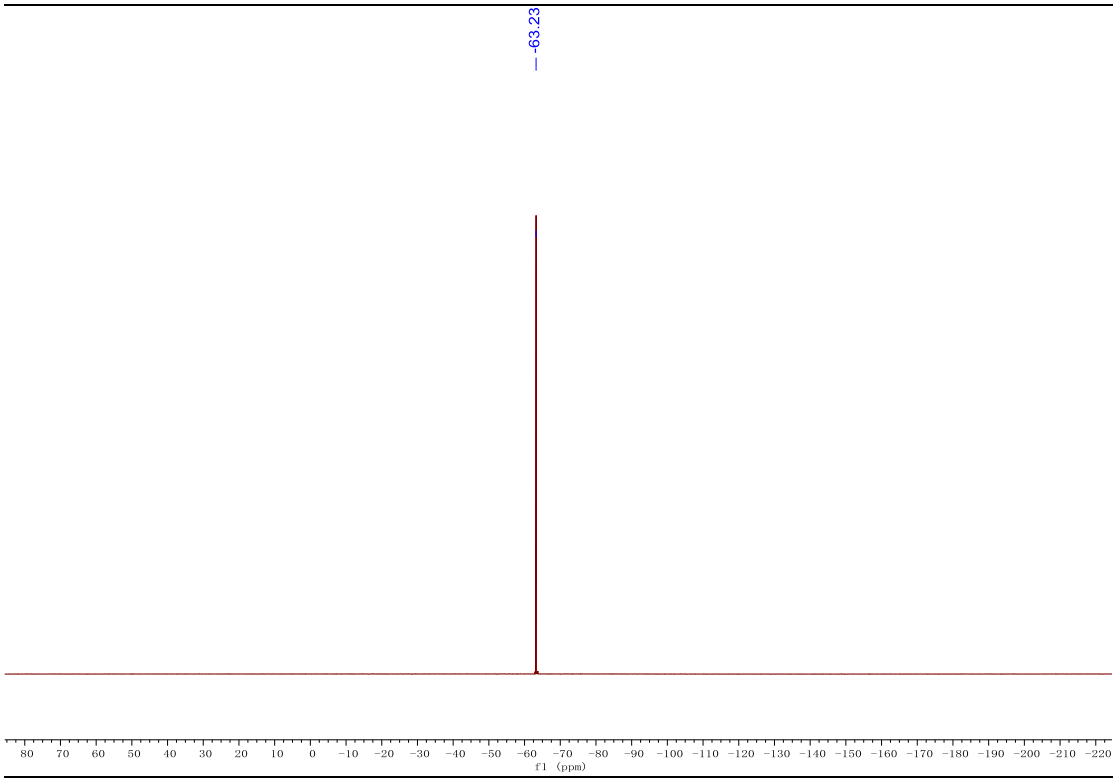
^{13}C NMR spectrum of 1e



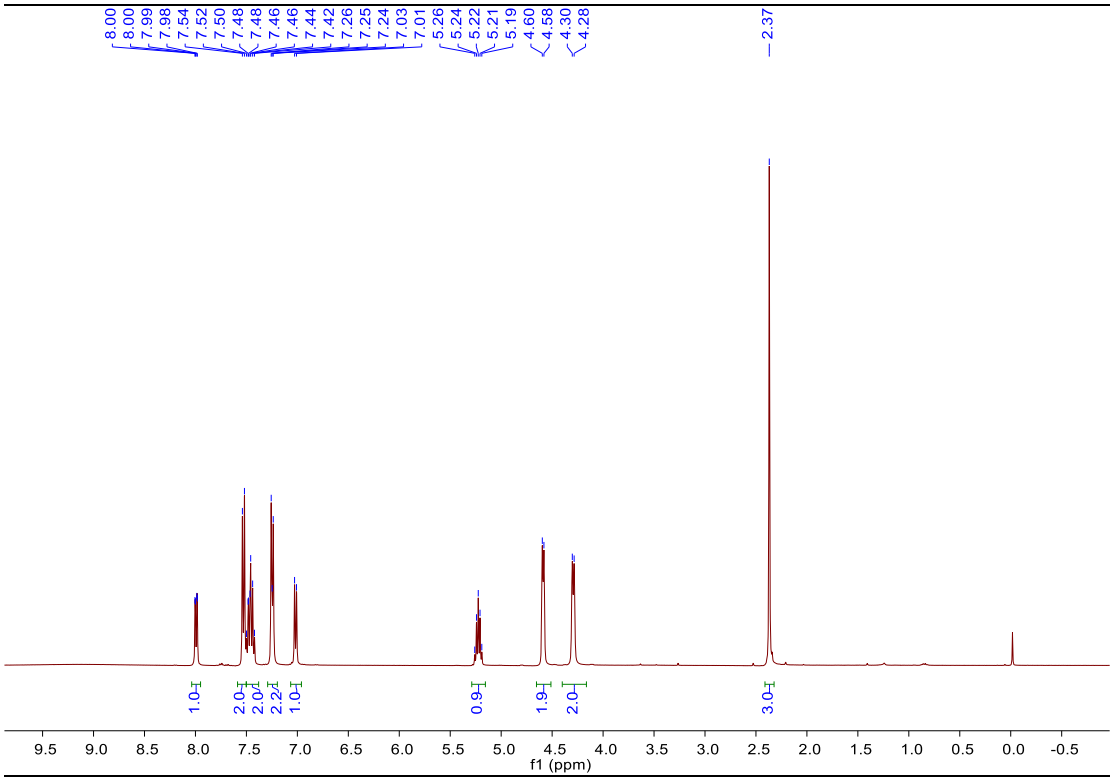
^{1}H NMR spectrum of 1f



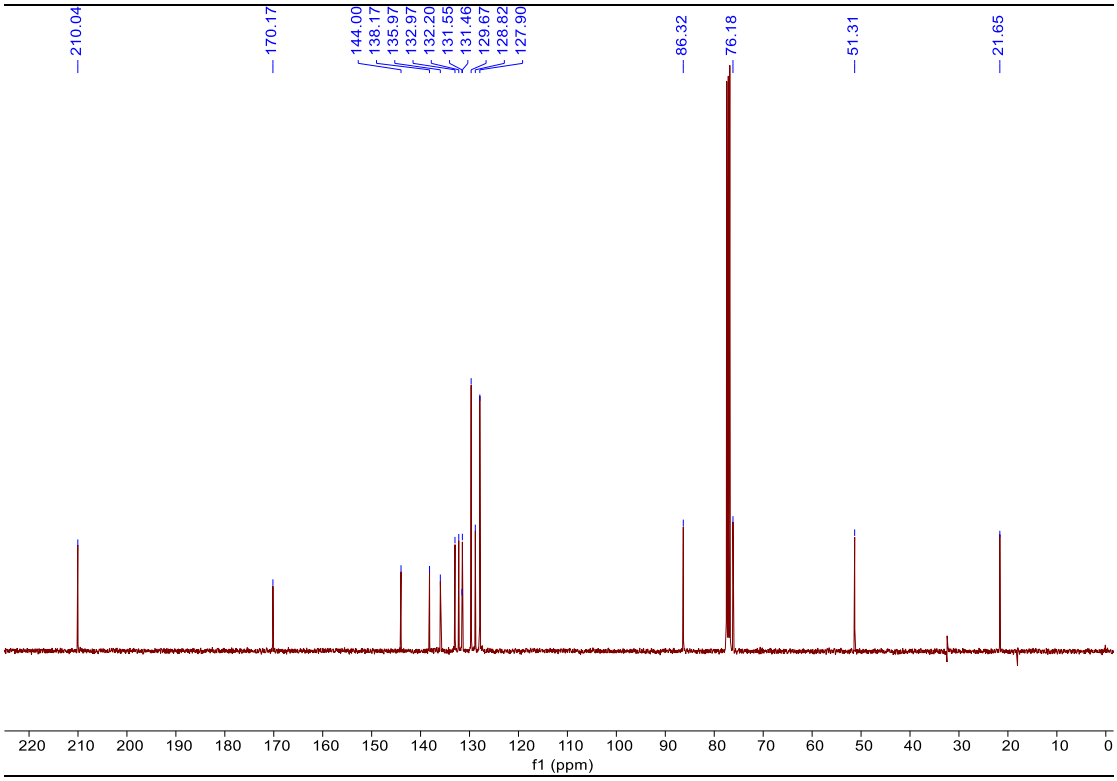
^{13}C NMR spectrum of 1f



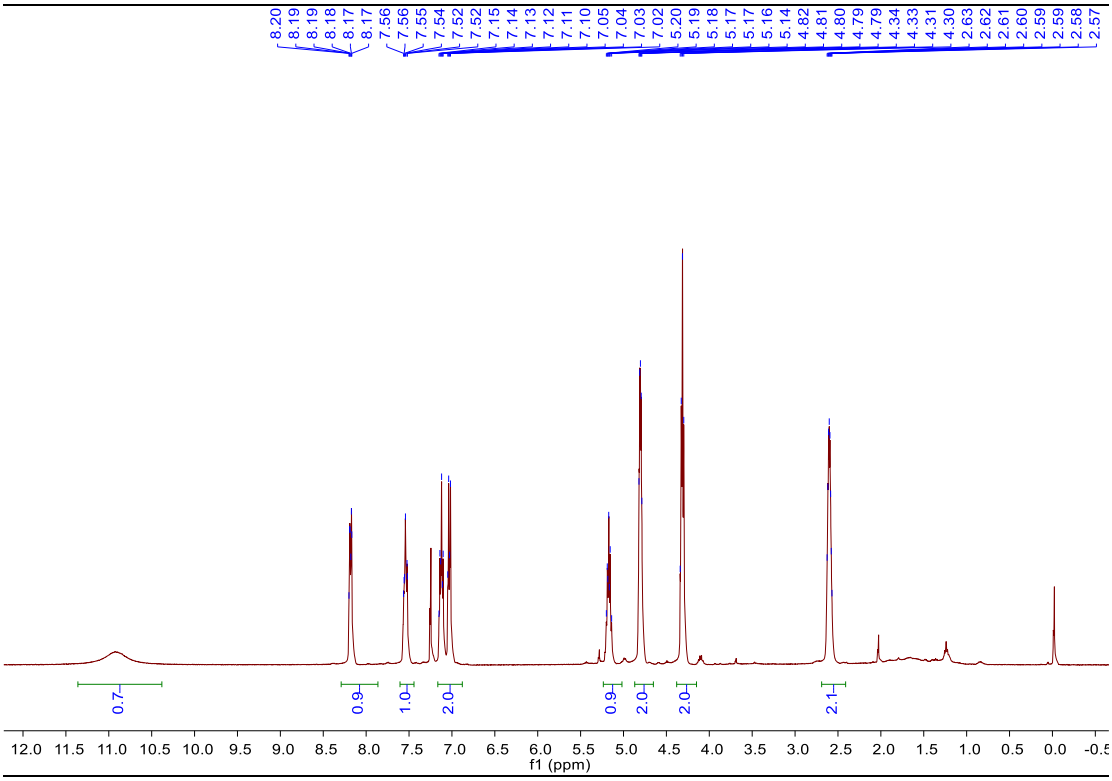
^{19}F NMR spectrum of 1f



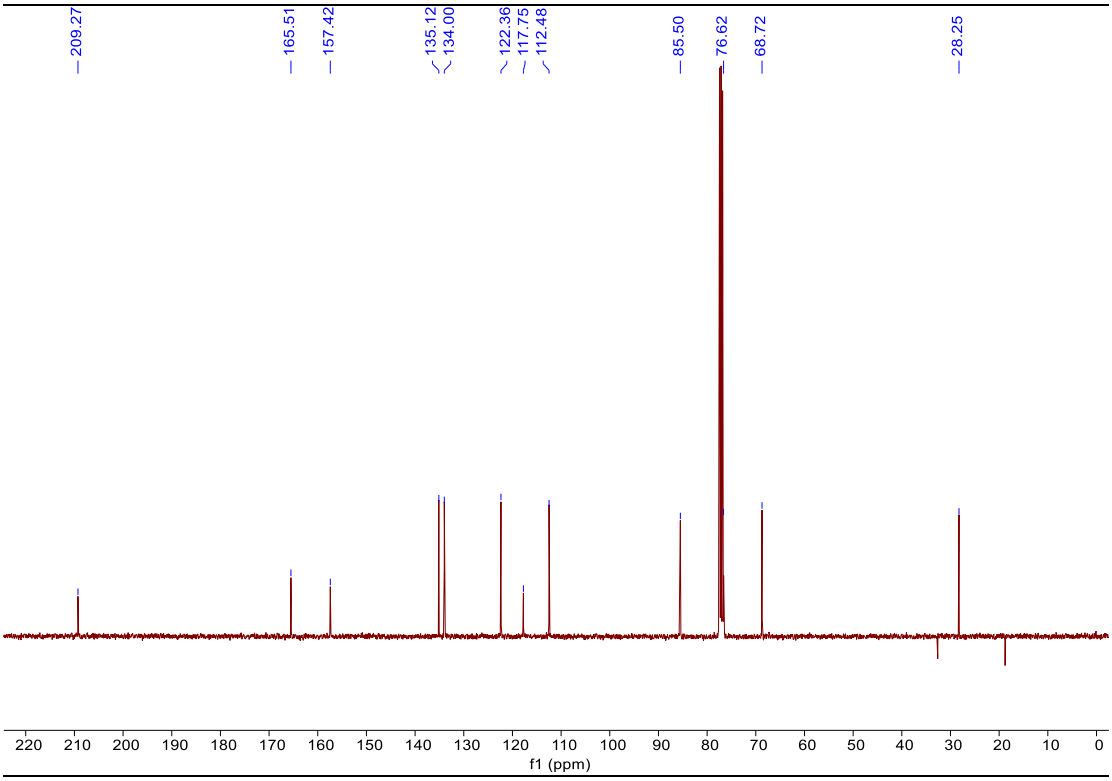
^{1}H NMR spectrum of 1g



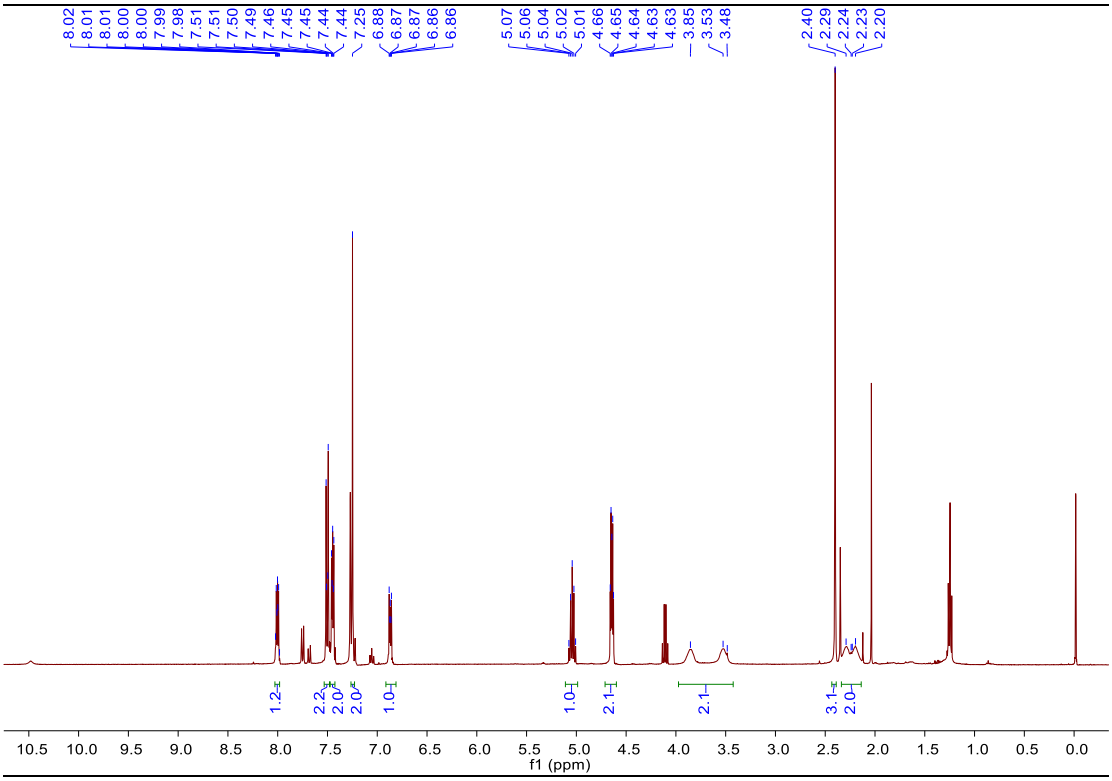
^{13}C NMR spectrum of 1g



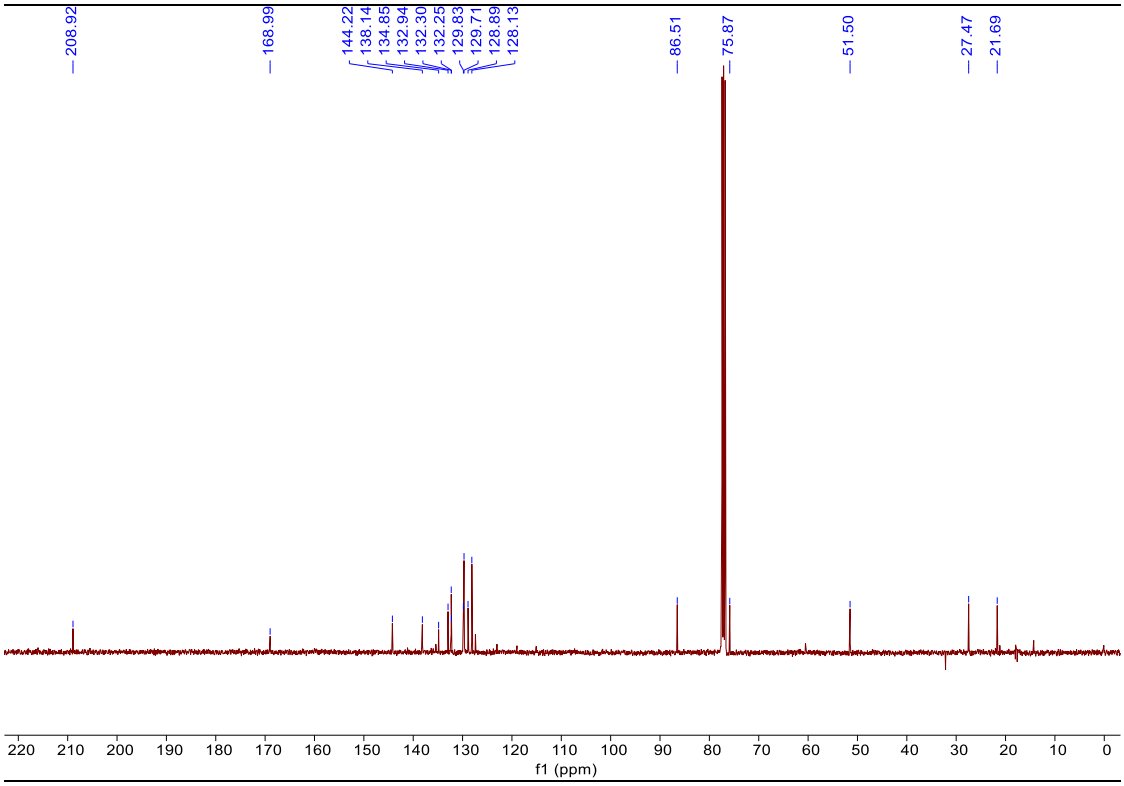
^{1}H NMR spectrum of 1h



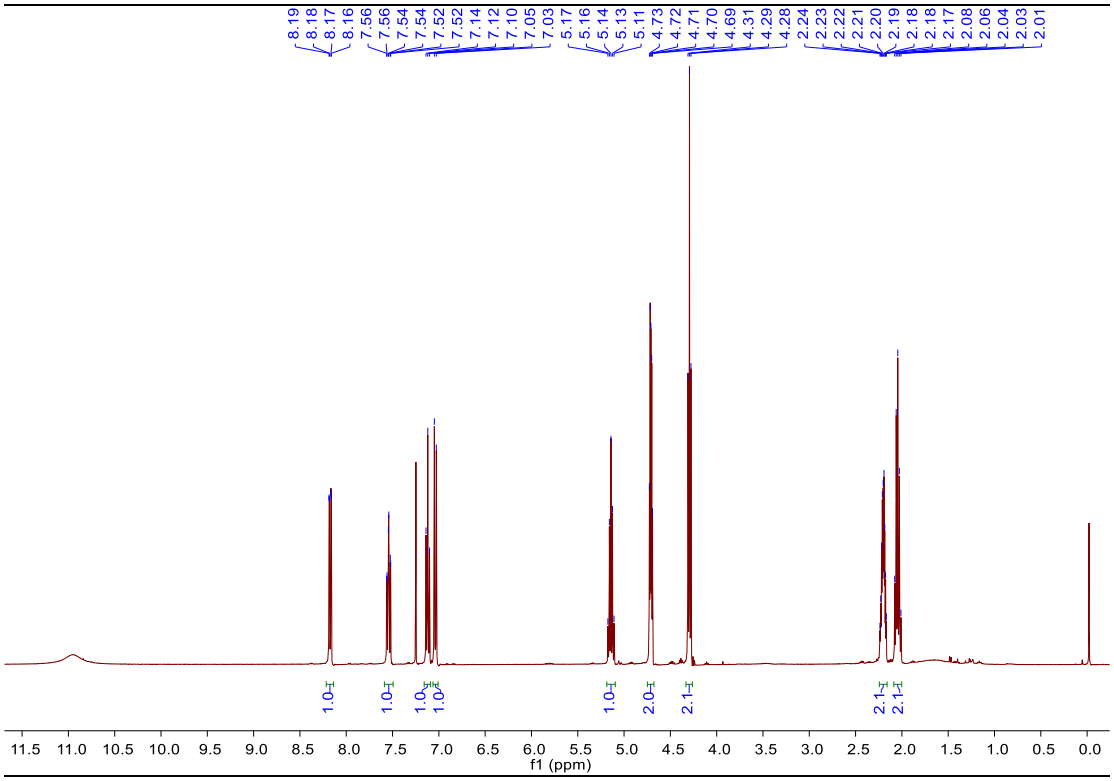
^{13}C NMR spectrum of 1h



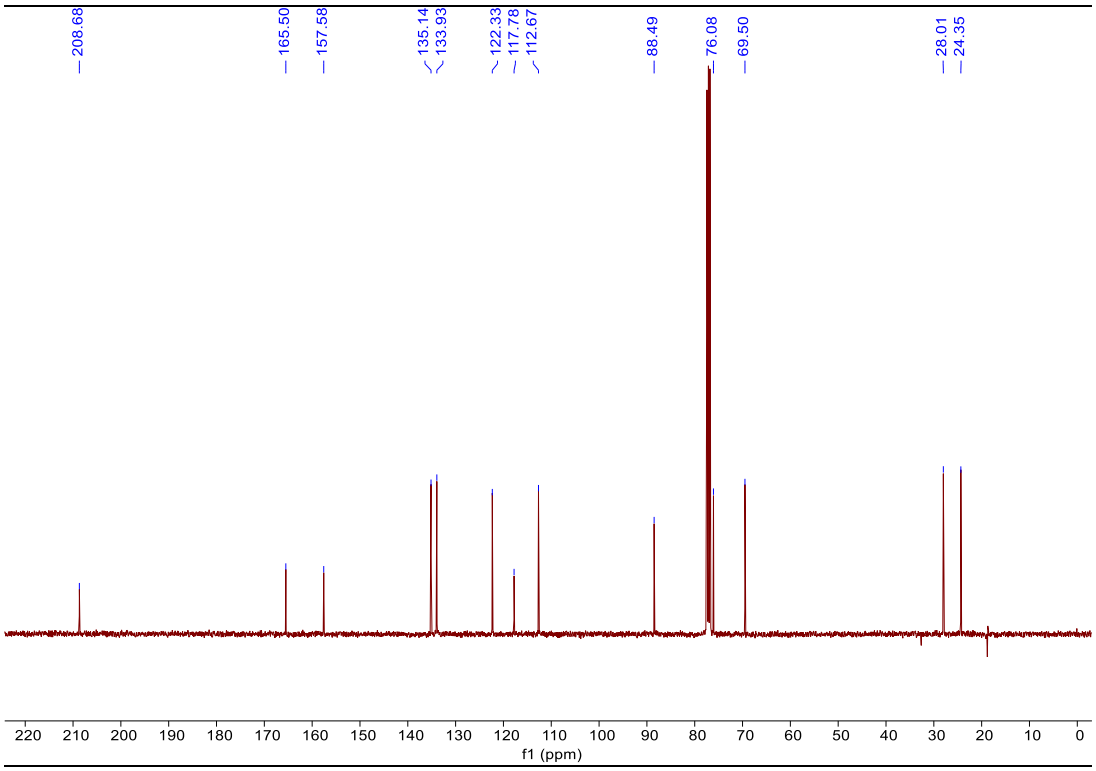
^{1}H NMR spectrum of 1i



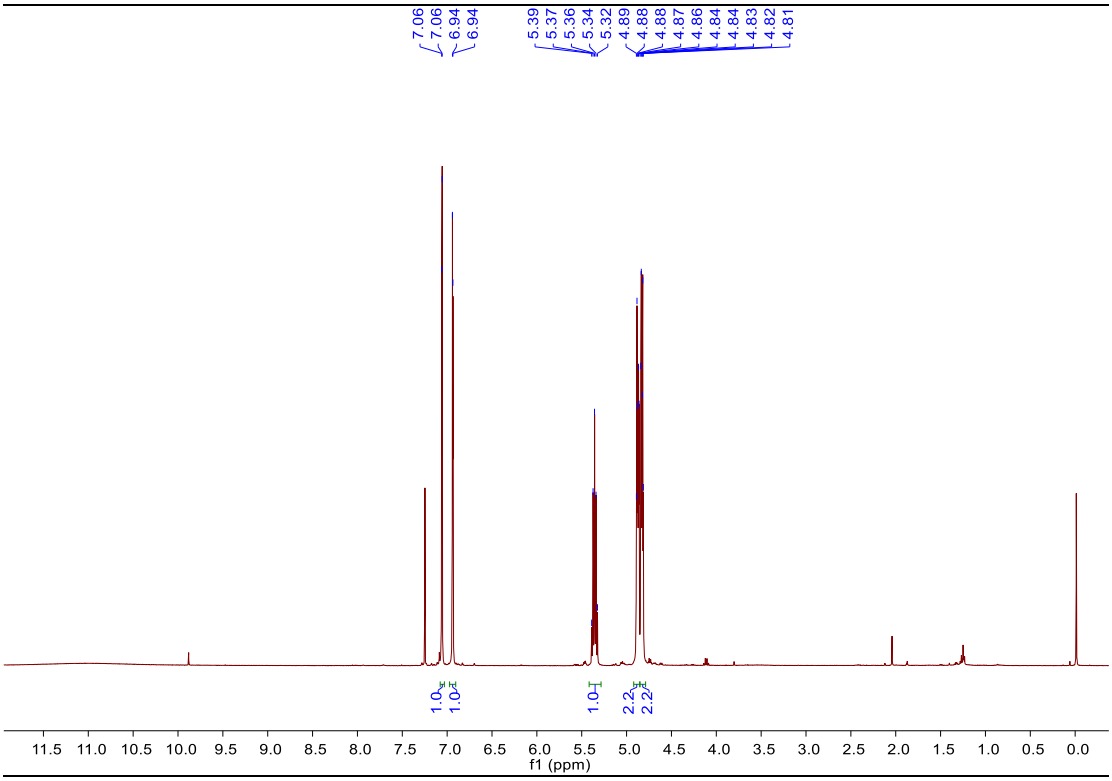
^{13}C NMR spectrum of 1i



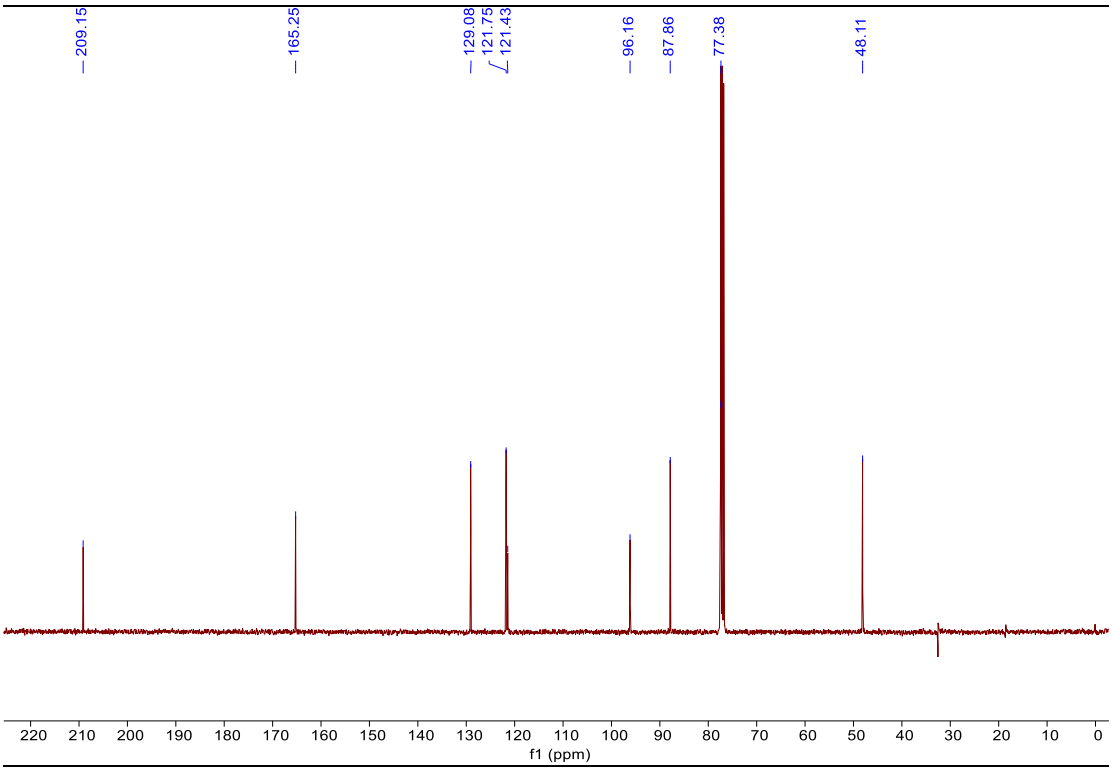
^{1}H NMR spectrum of 1j



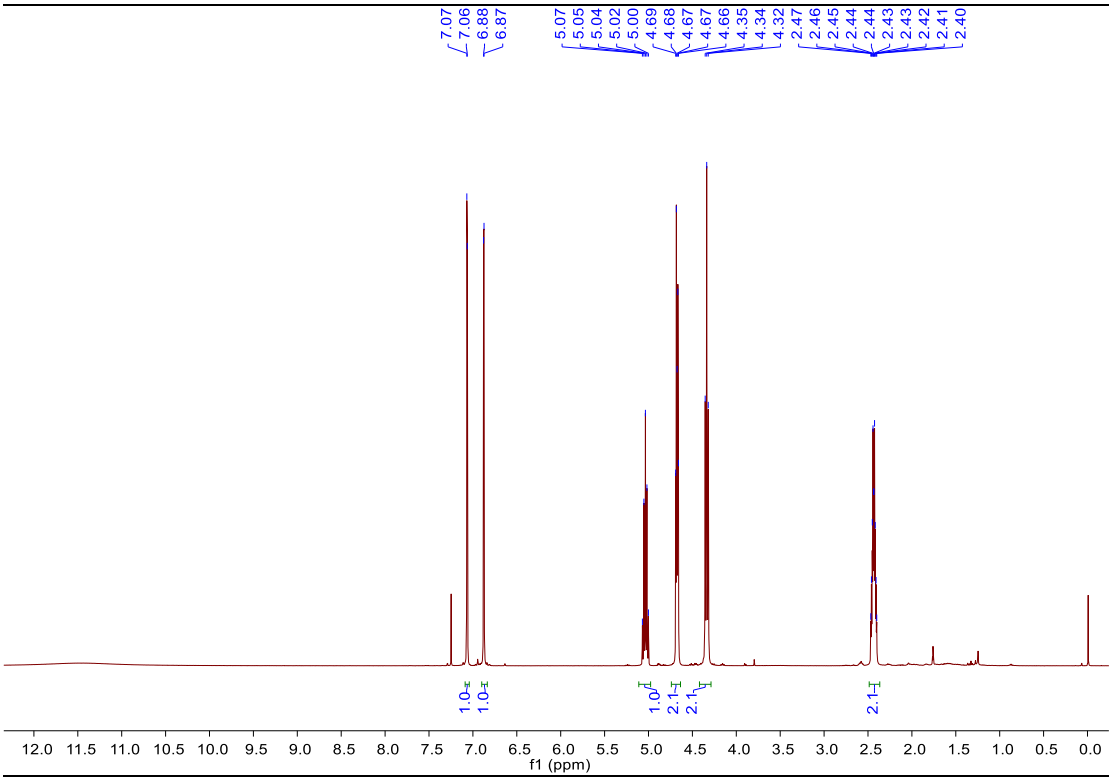
^{13}C NMR spectrum of 1j



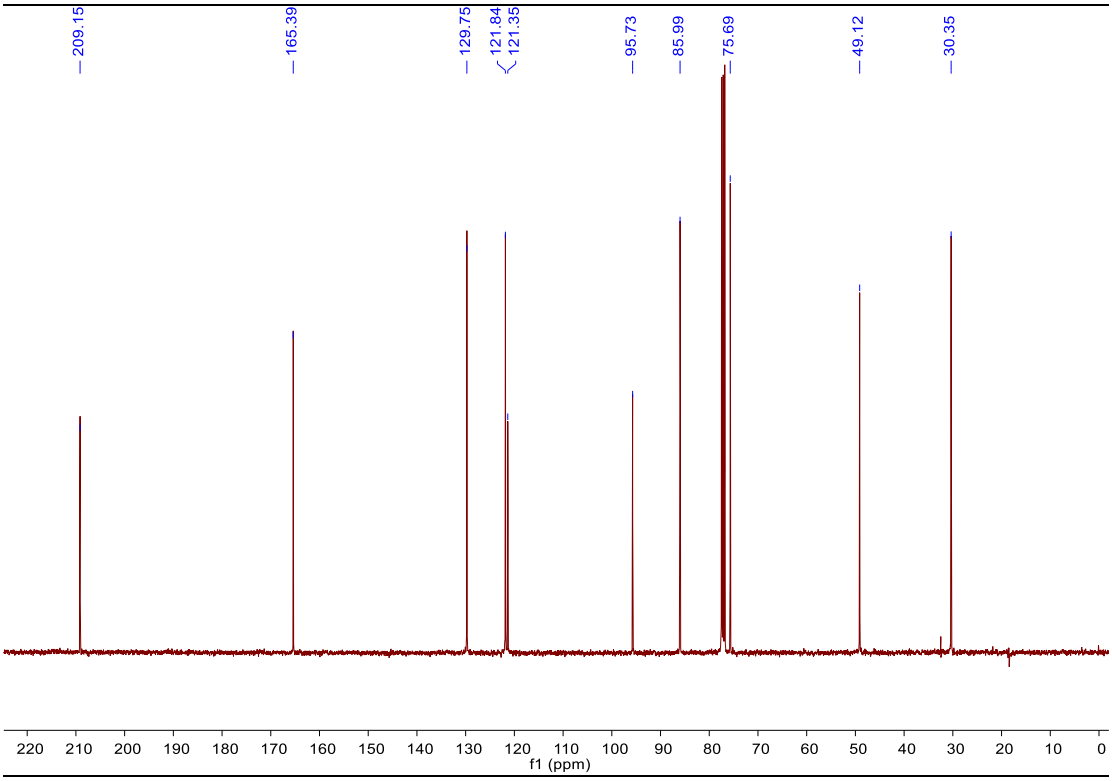
^{1}H NMR spectrum of 4a



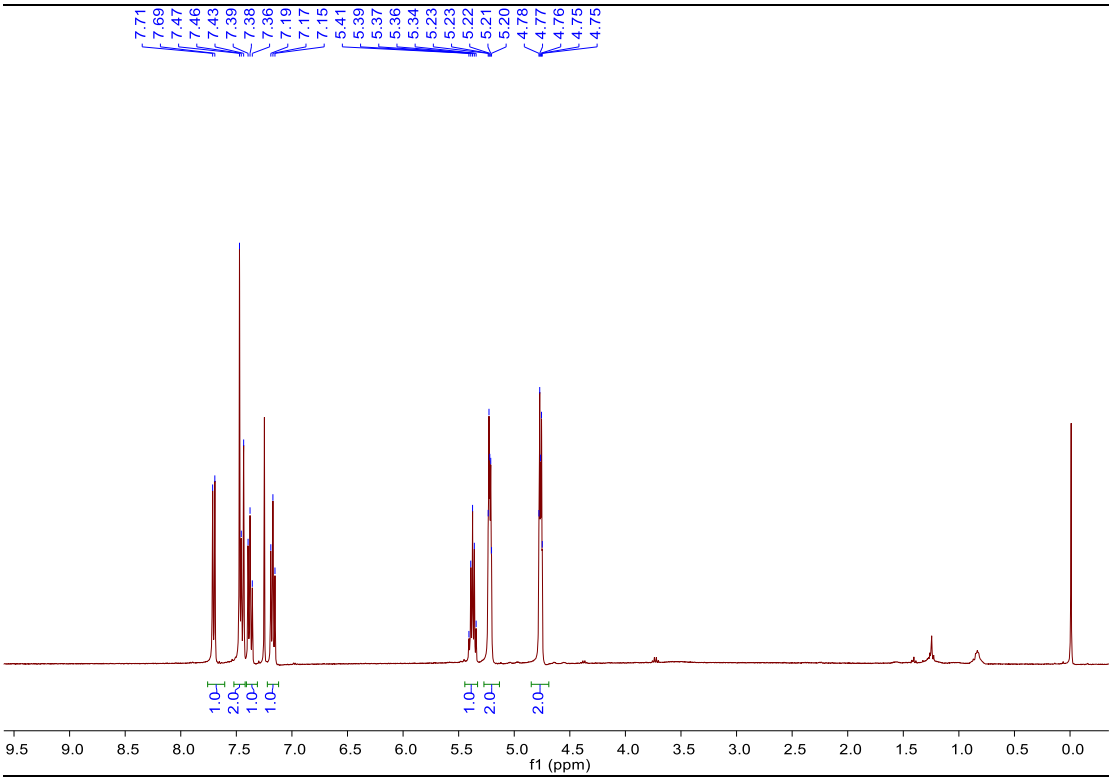
^{13}C NMR spectrum of 4a



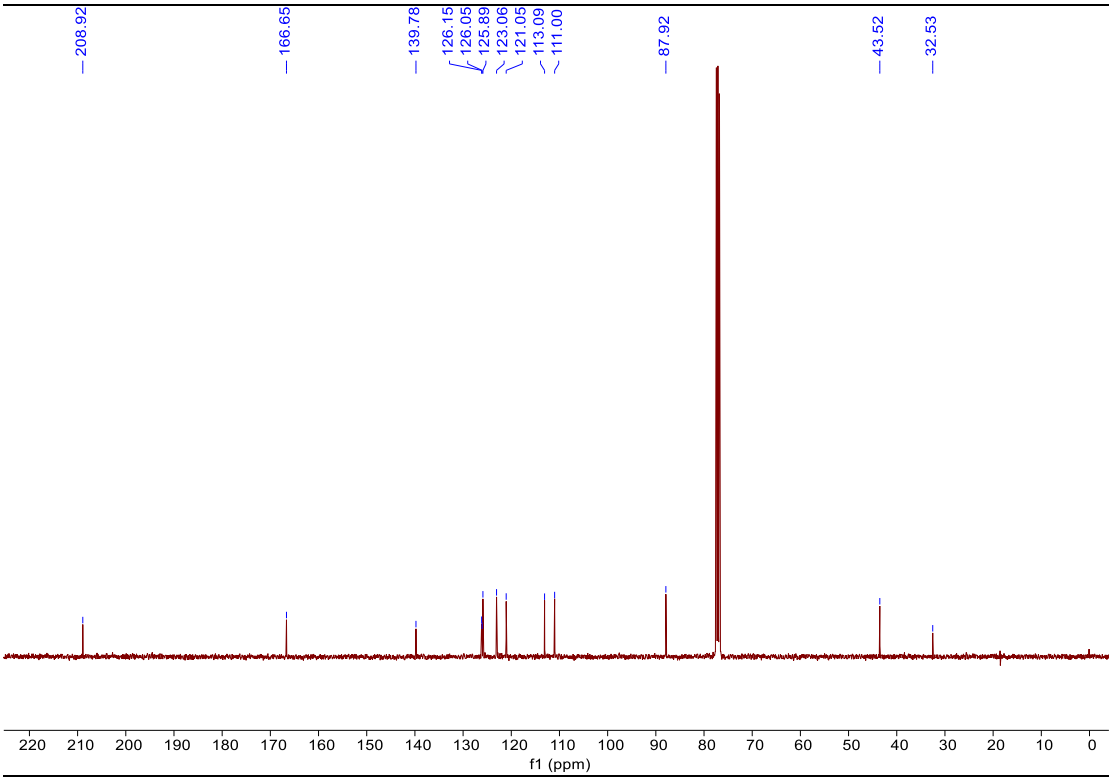
^{1}H NMR spectrum of 4b



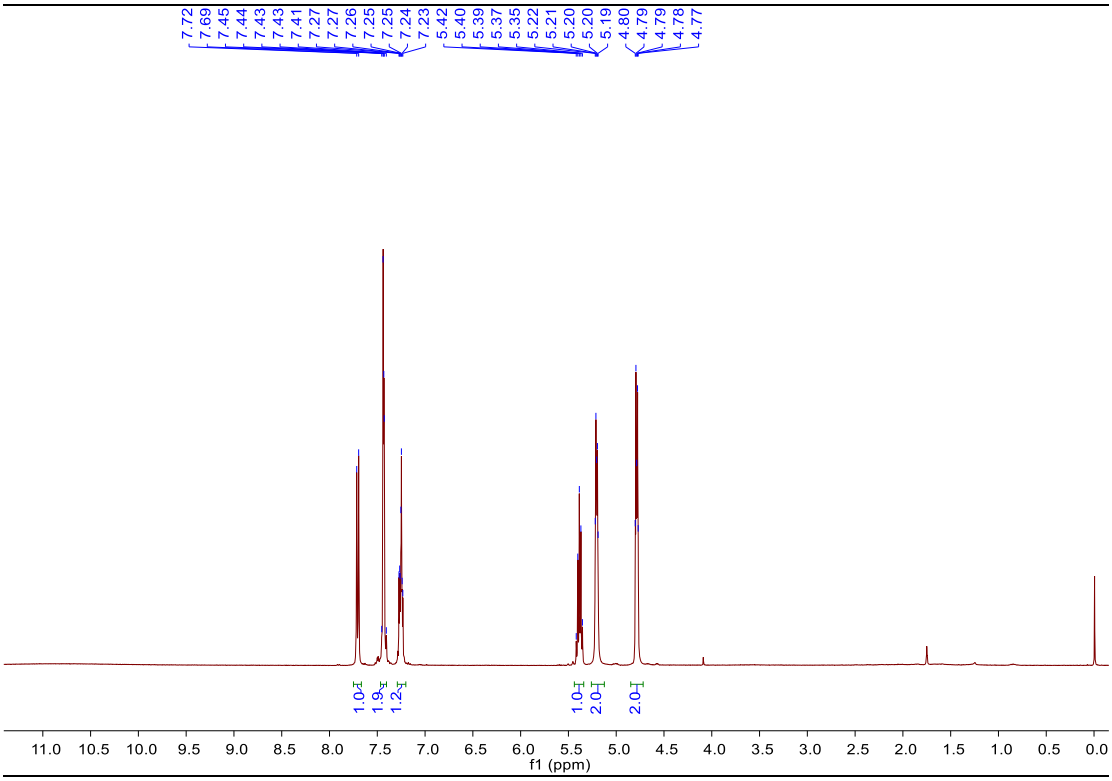
^{13}C NMR spectrum of 4b



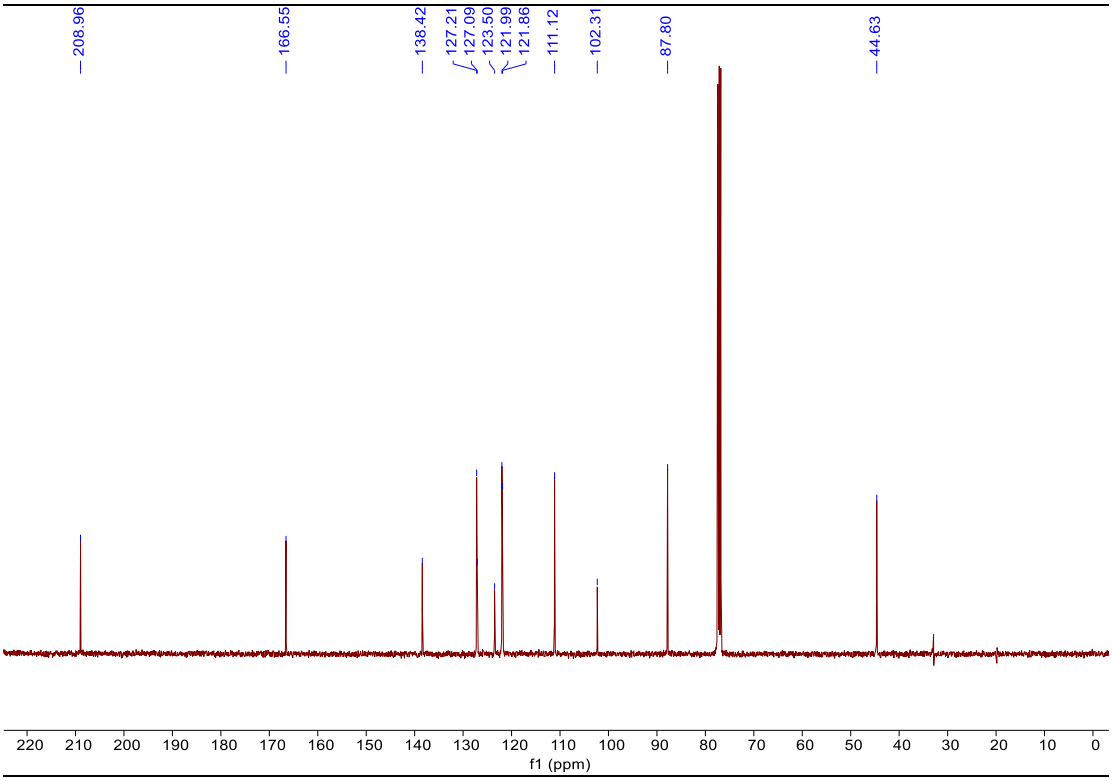
^{1}H NMR spectrum of 4c



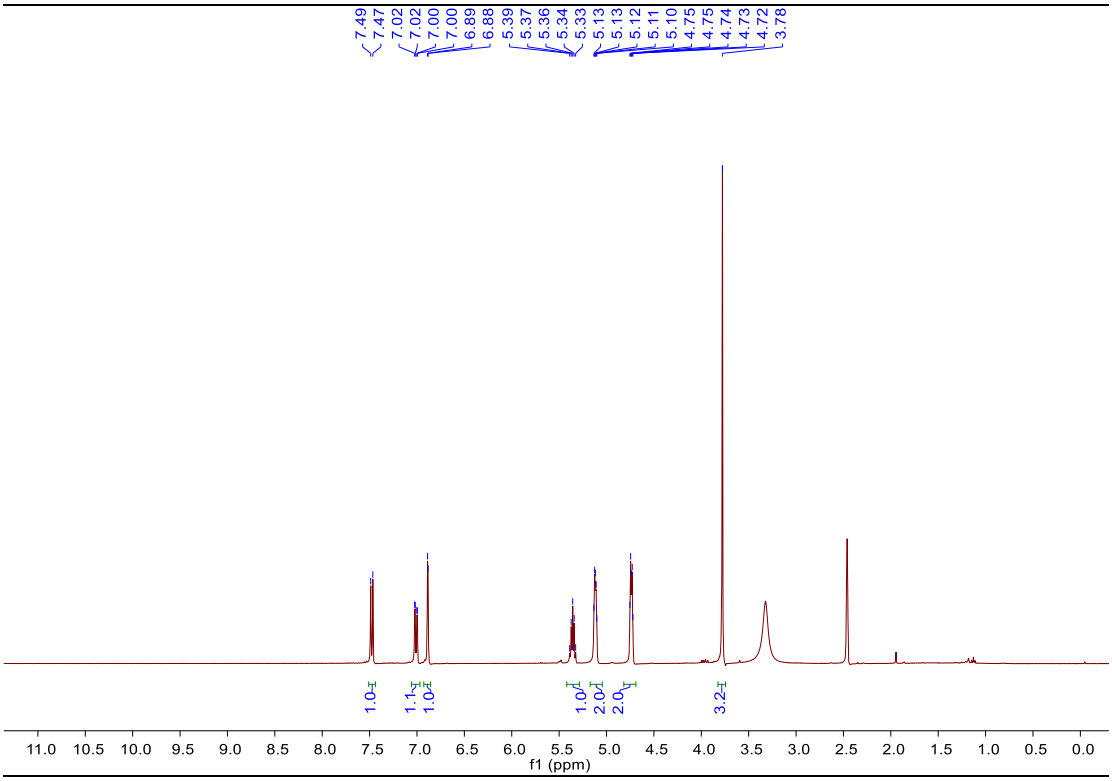
^{13}C NMR spectrum of 4c



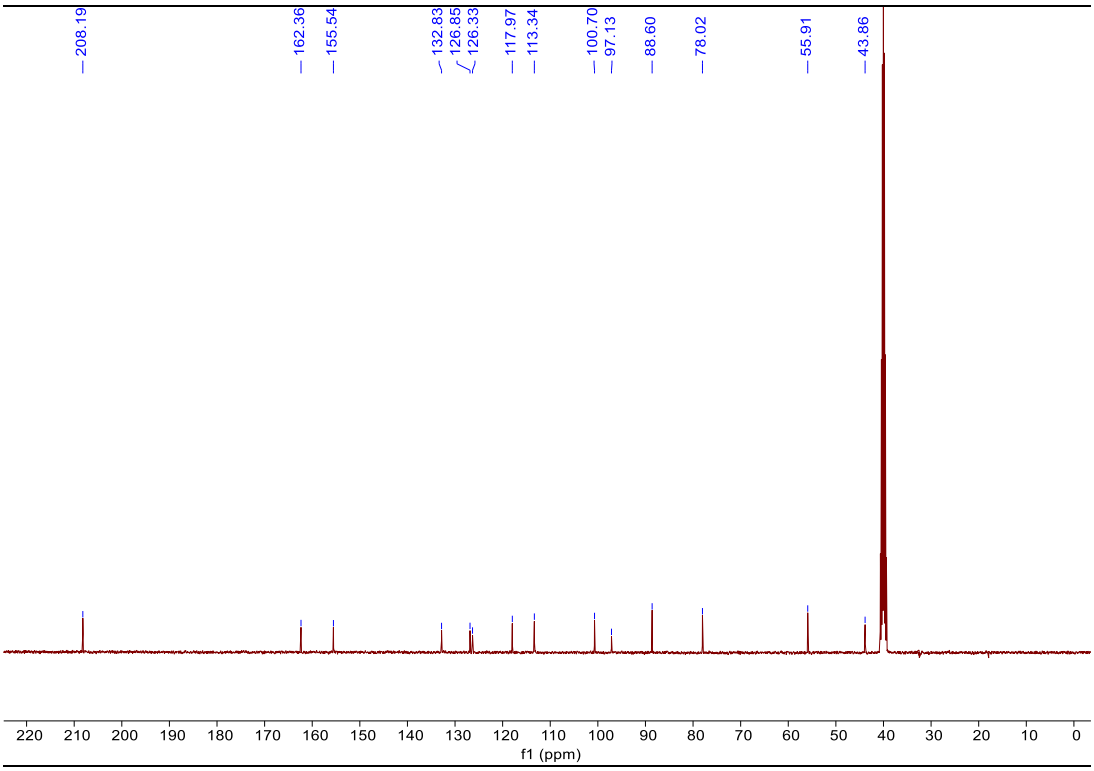
^{1}H NMR spectrum of 4d



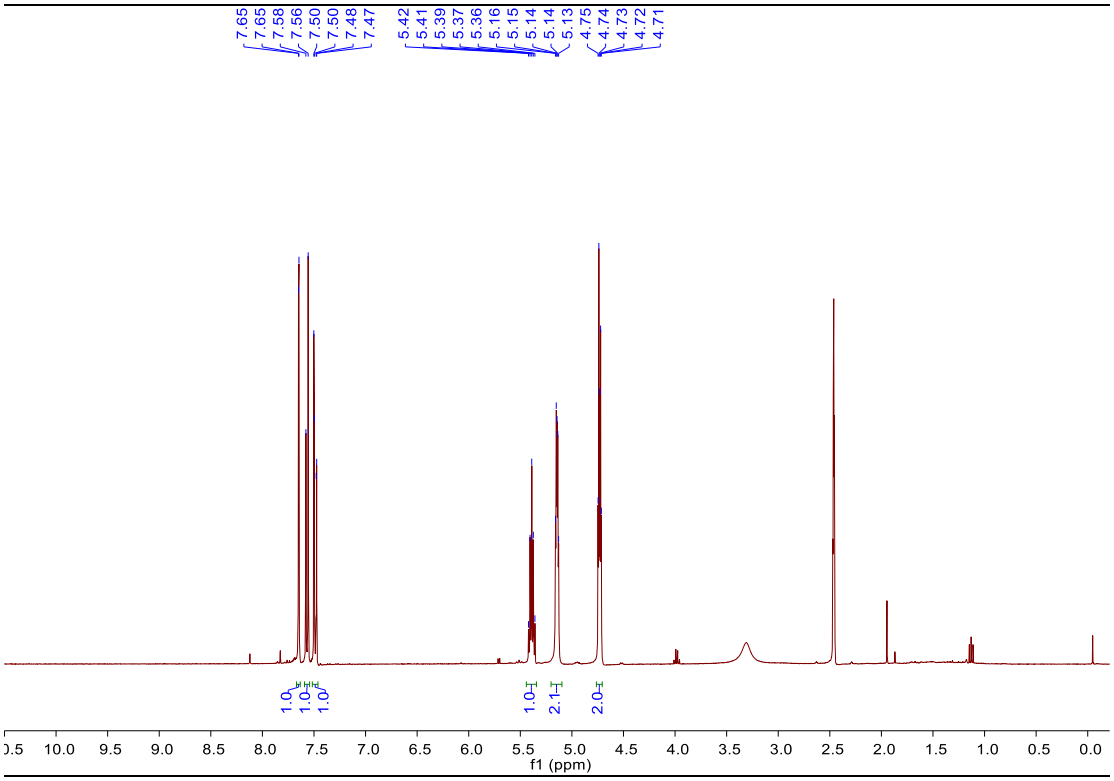
^{13}C NMR spectrum of 4d



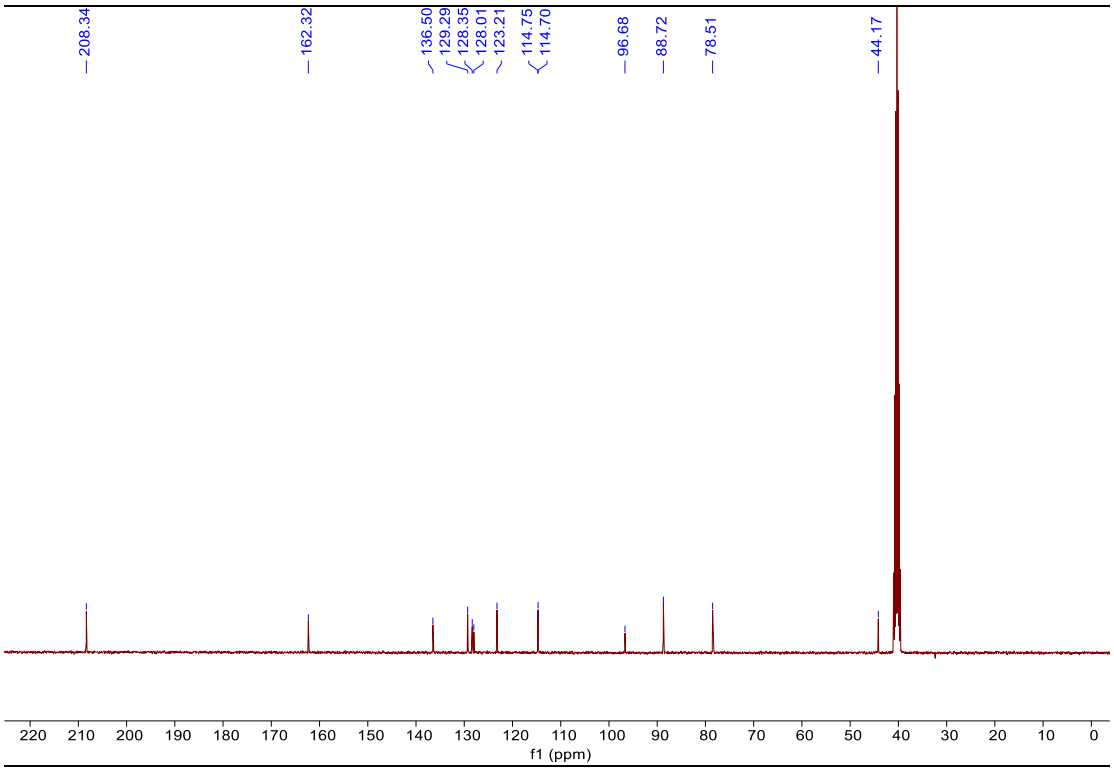
^{1}H NMR spectrum of 4e



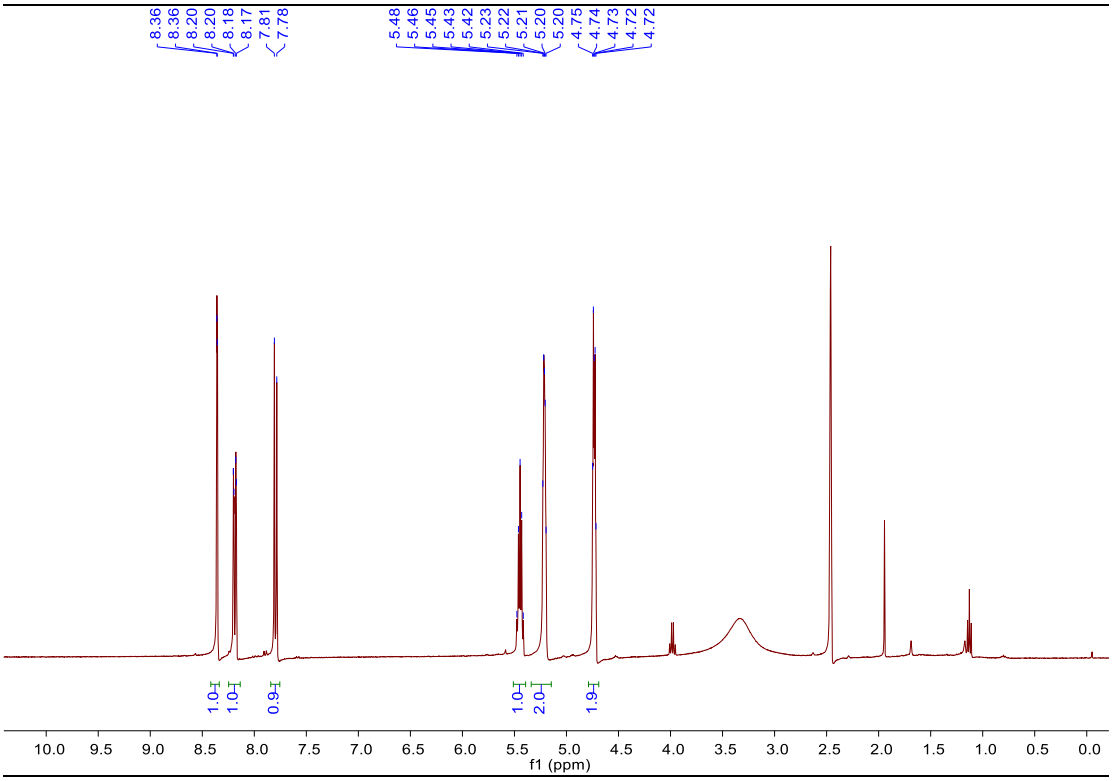
^{13}C NMR spectrum of 4e



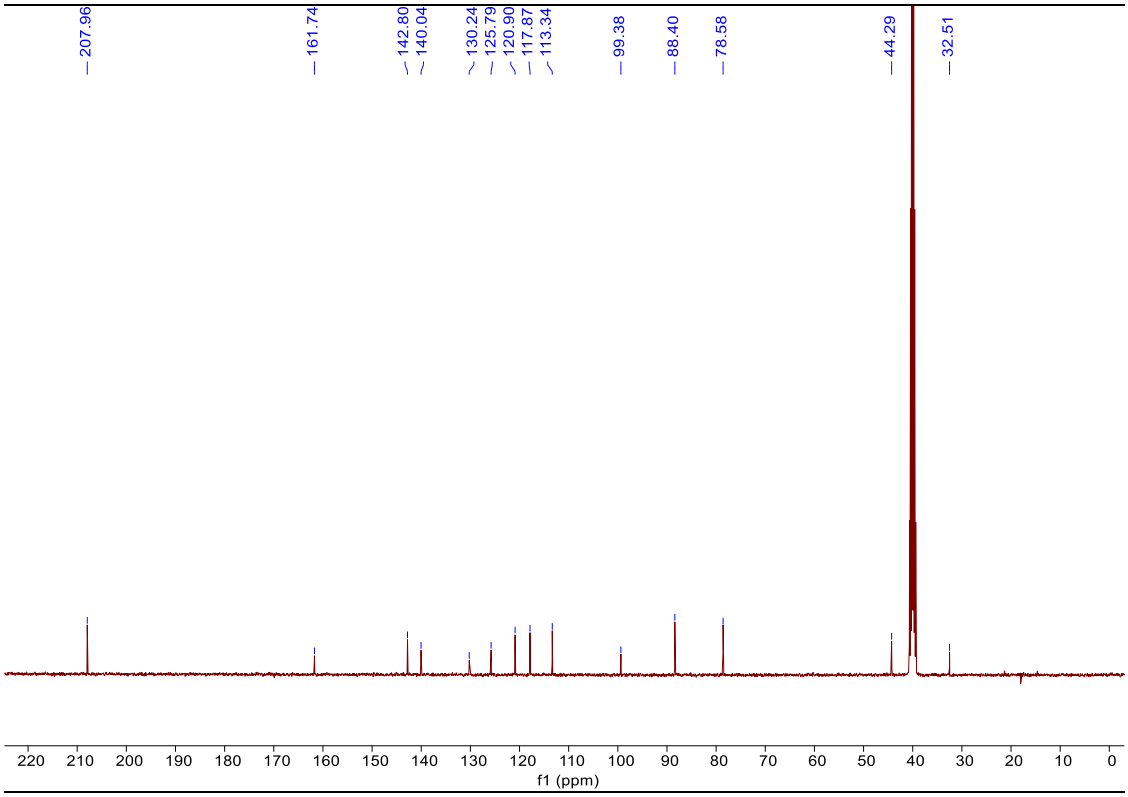
^{1}H NMR spectrum of 4f



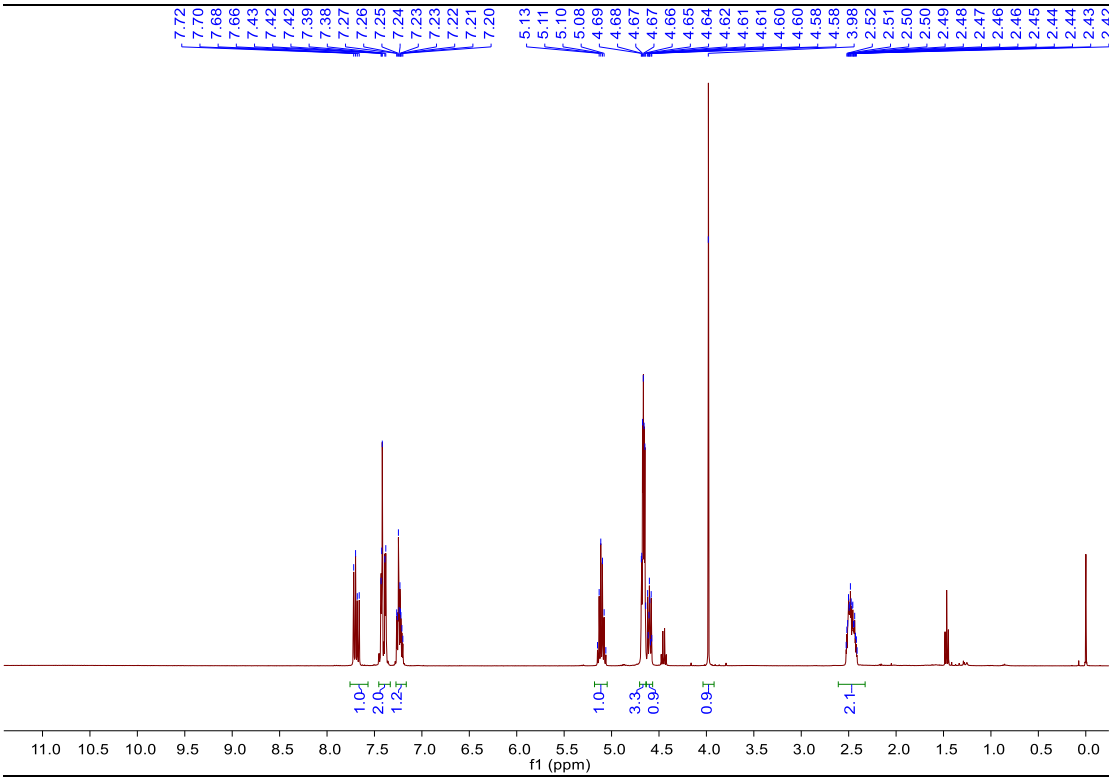
^{13}C NMR spectrum of 4f



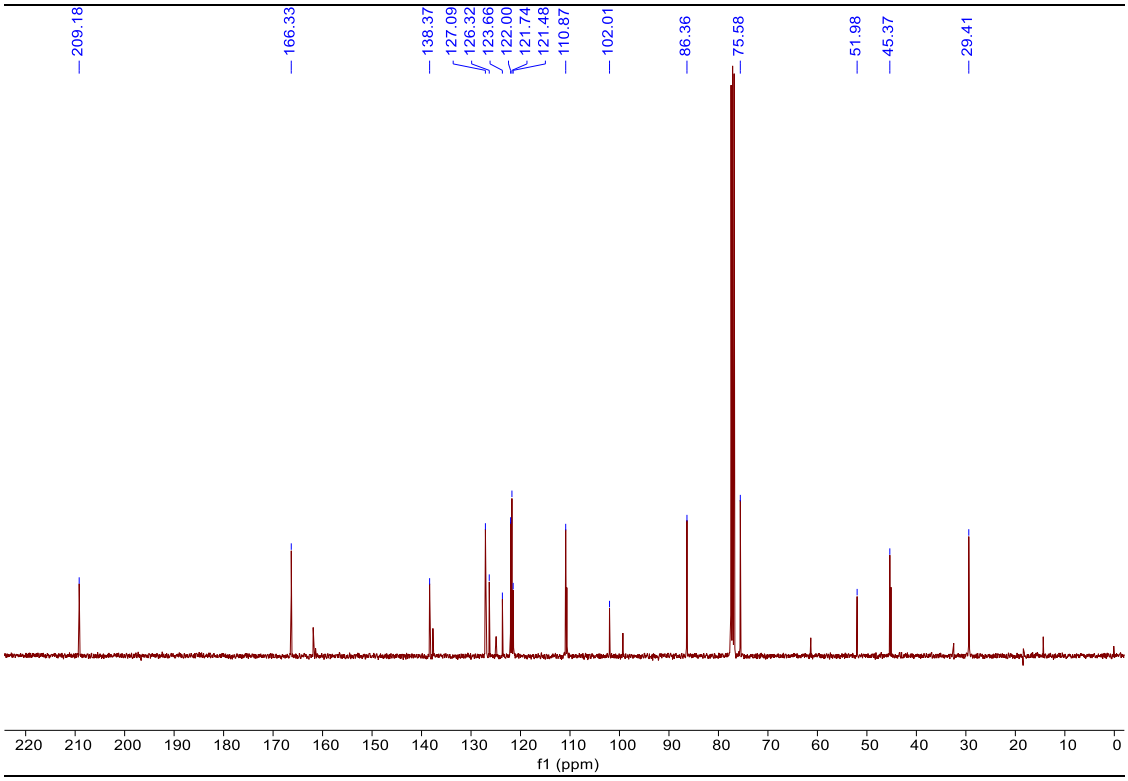
^{1}H NMR spectrum of 4g



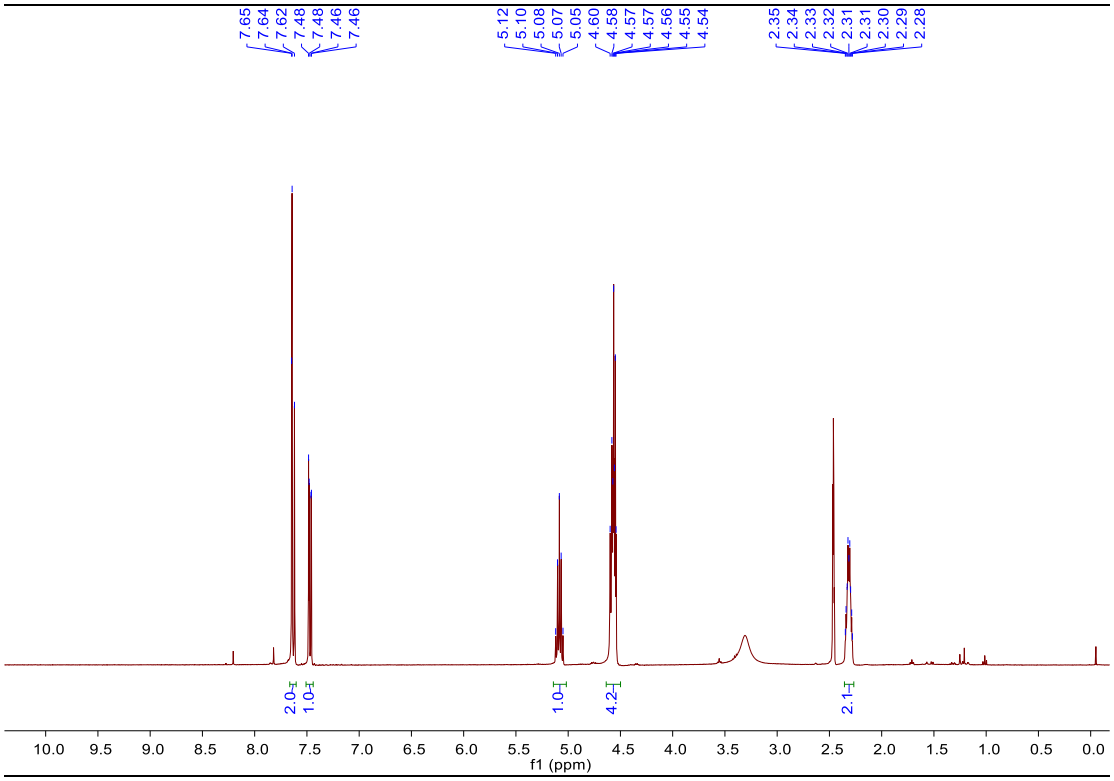
^{13}C NMR spectrum of 4g



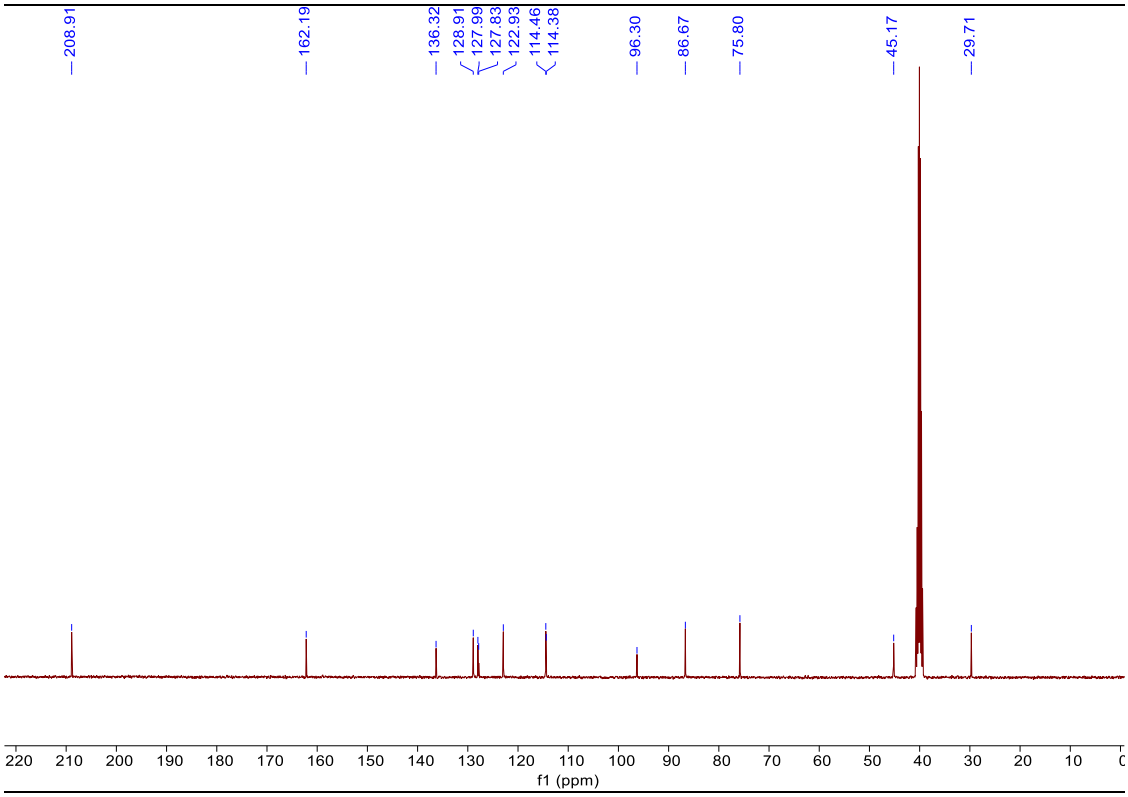
^{1}H NMR spectrum of 4h



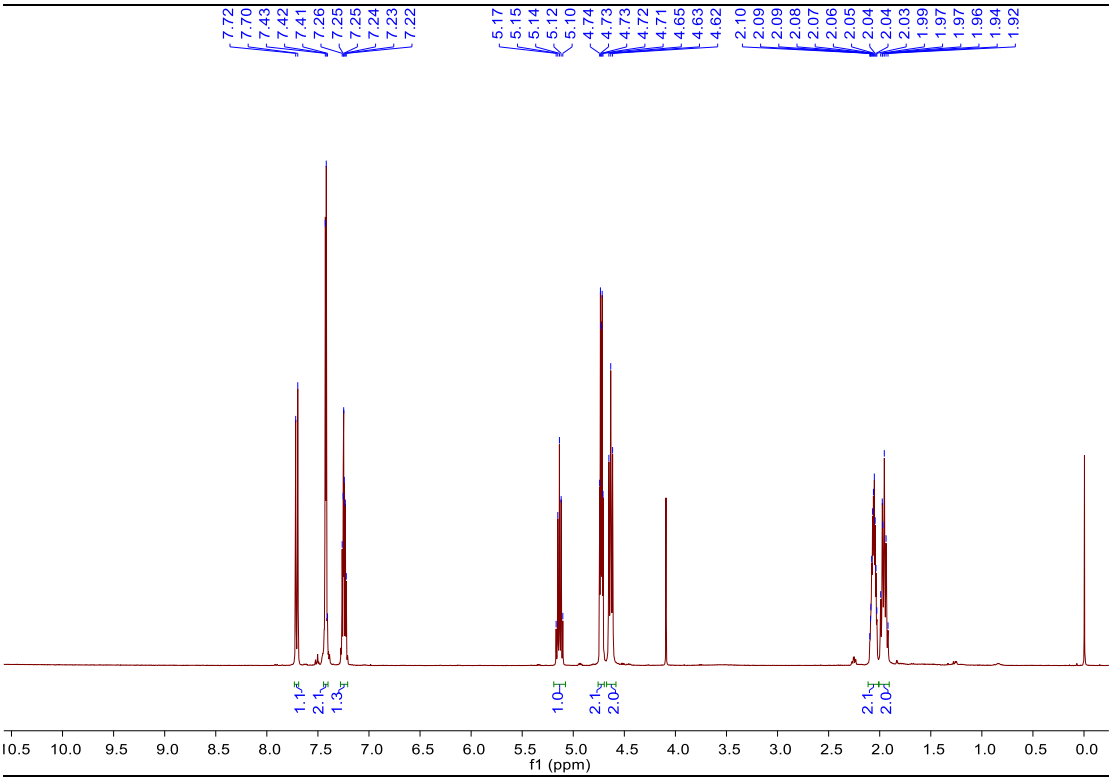
^{13}C NMR spectrum of 4h



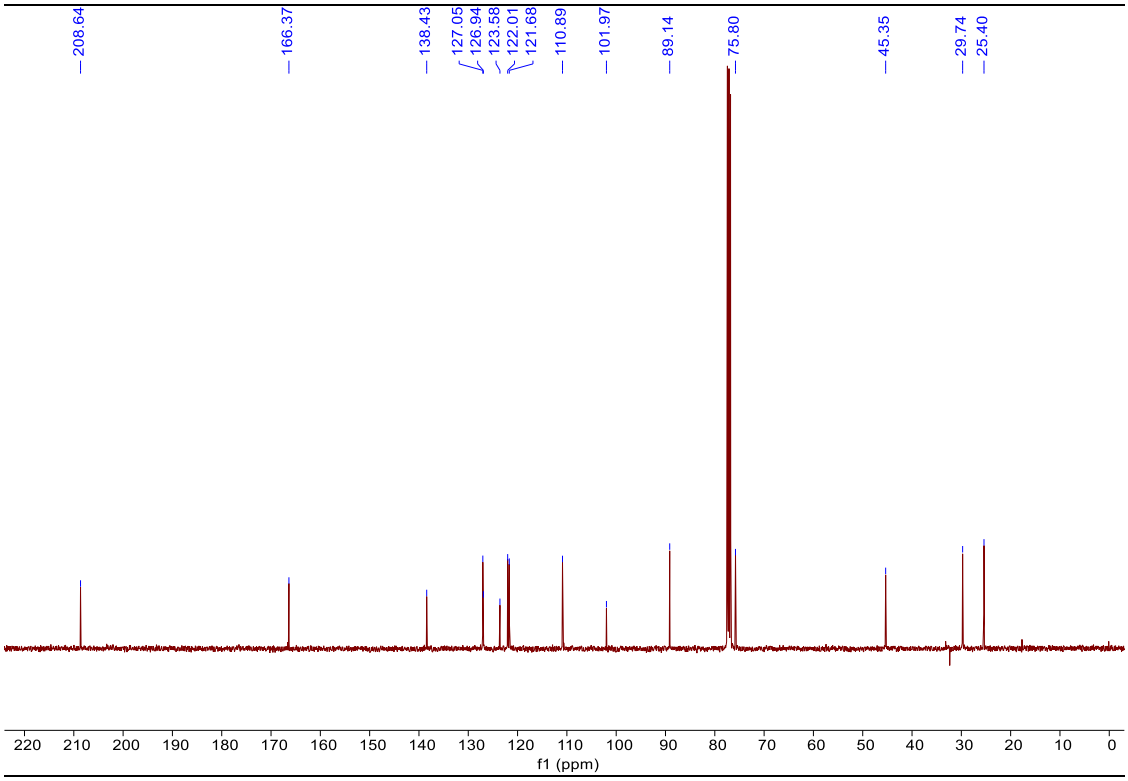
^{1}H NMR spectrum of 4i



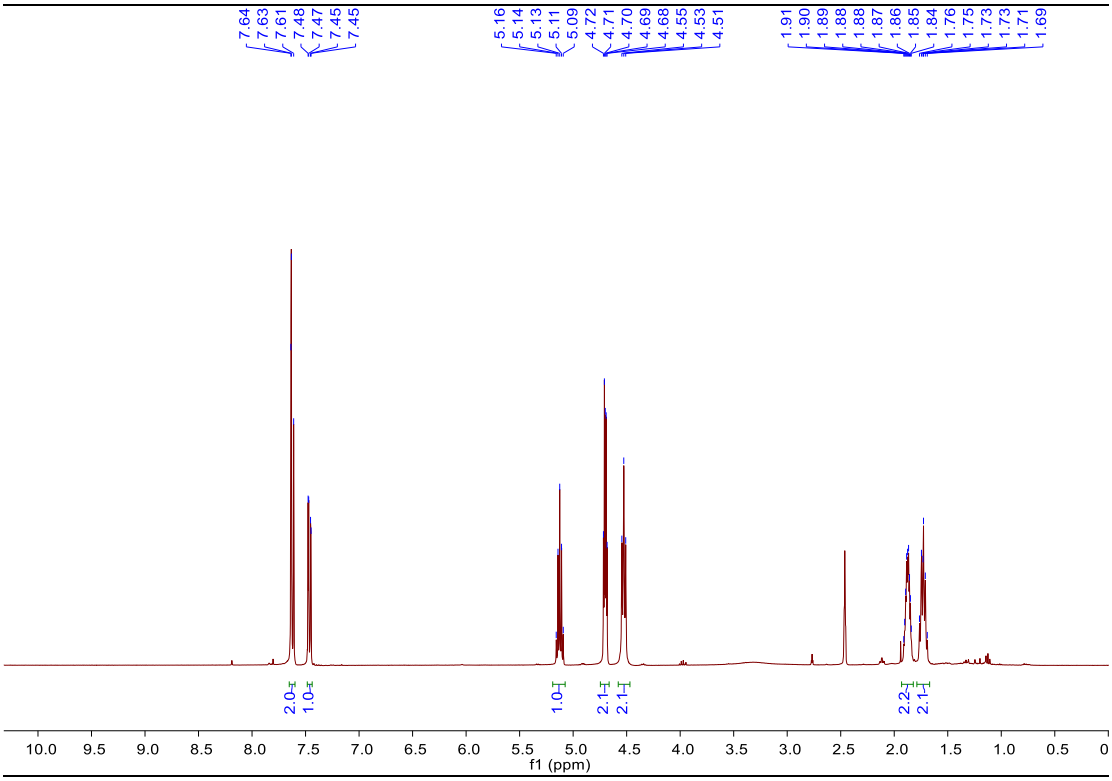
^{13}C NMR spectrum of 4i



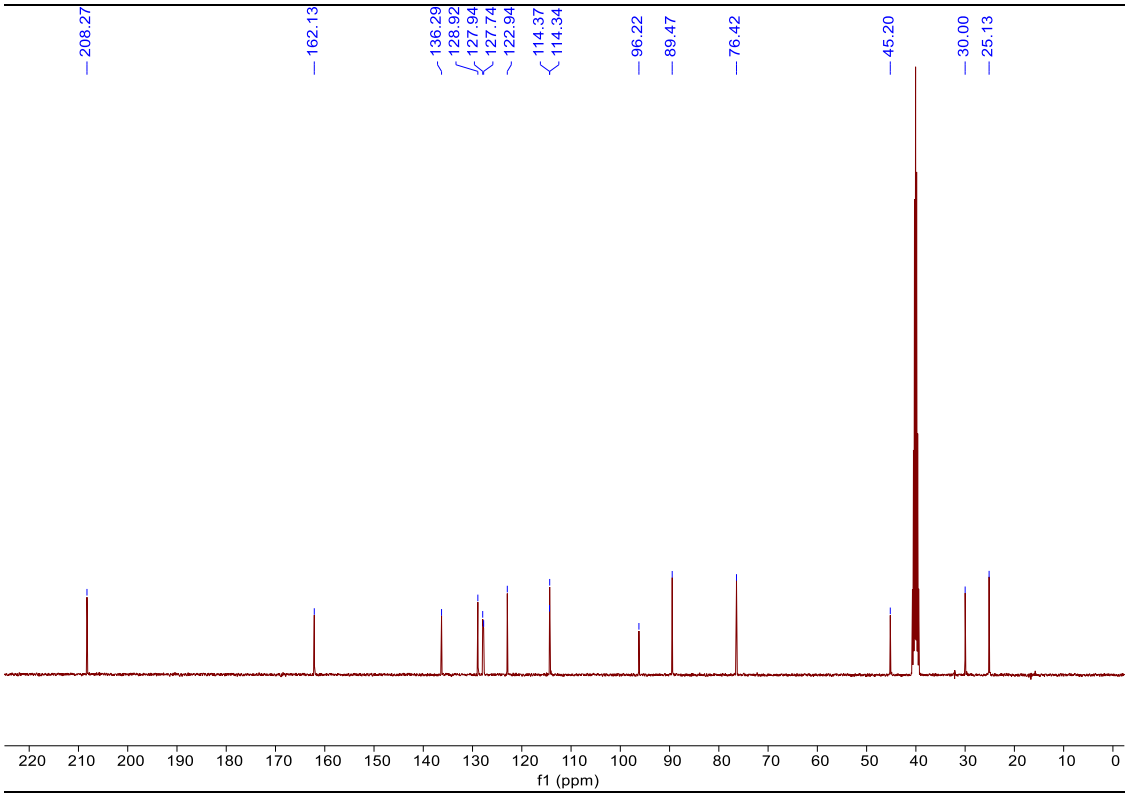
^{1}H NMR spectrum of 4j



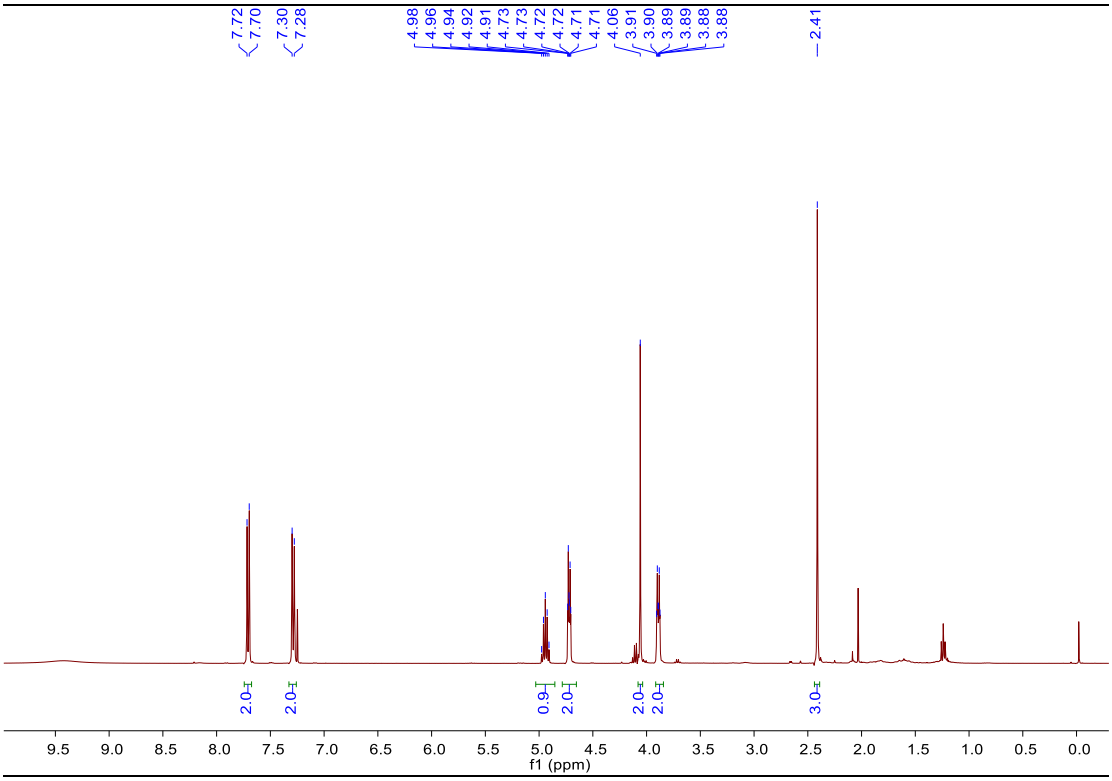
^{13}C NMR spectrum of 4j



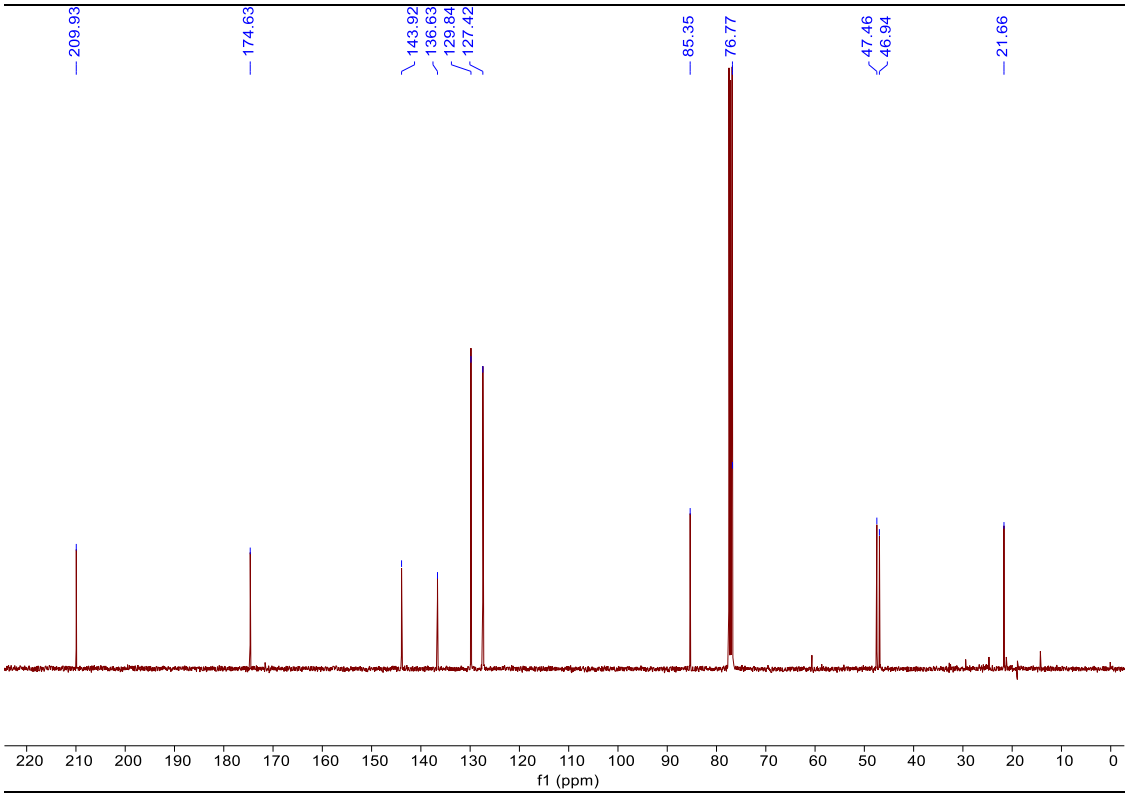
^{1}H NMR spectrum of 4k



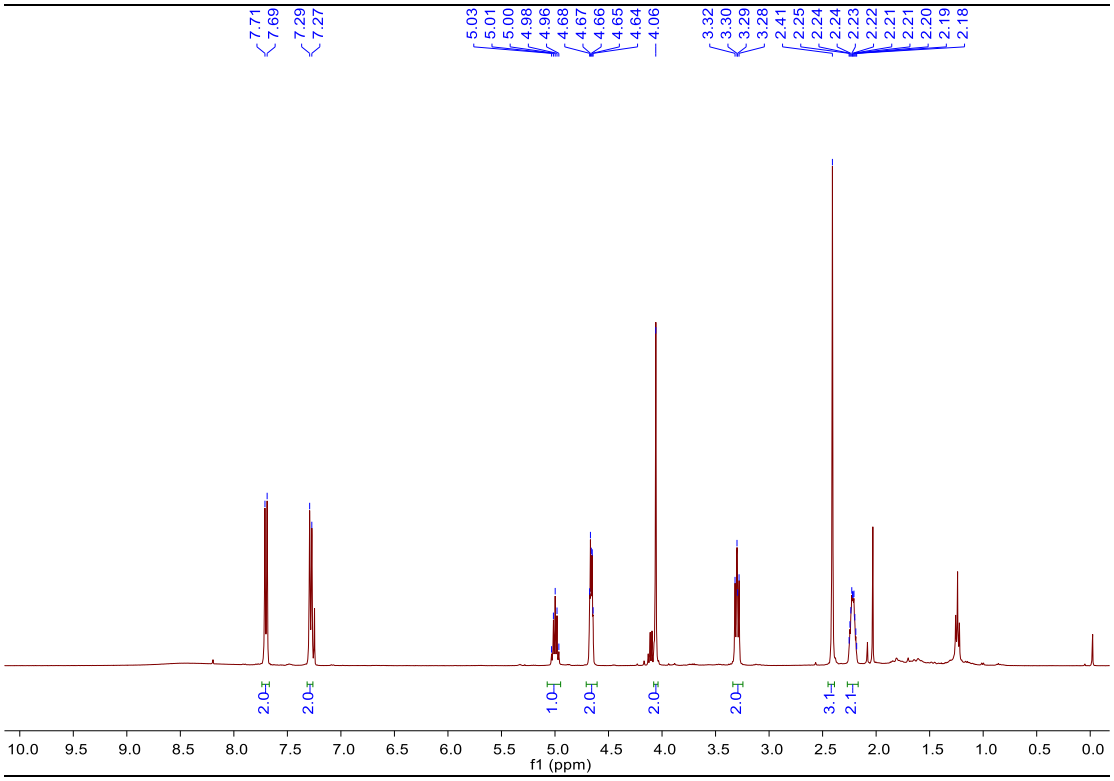
^{13}C NMR spectrum of 4k



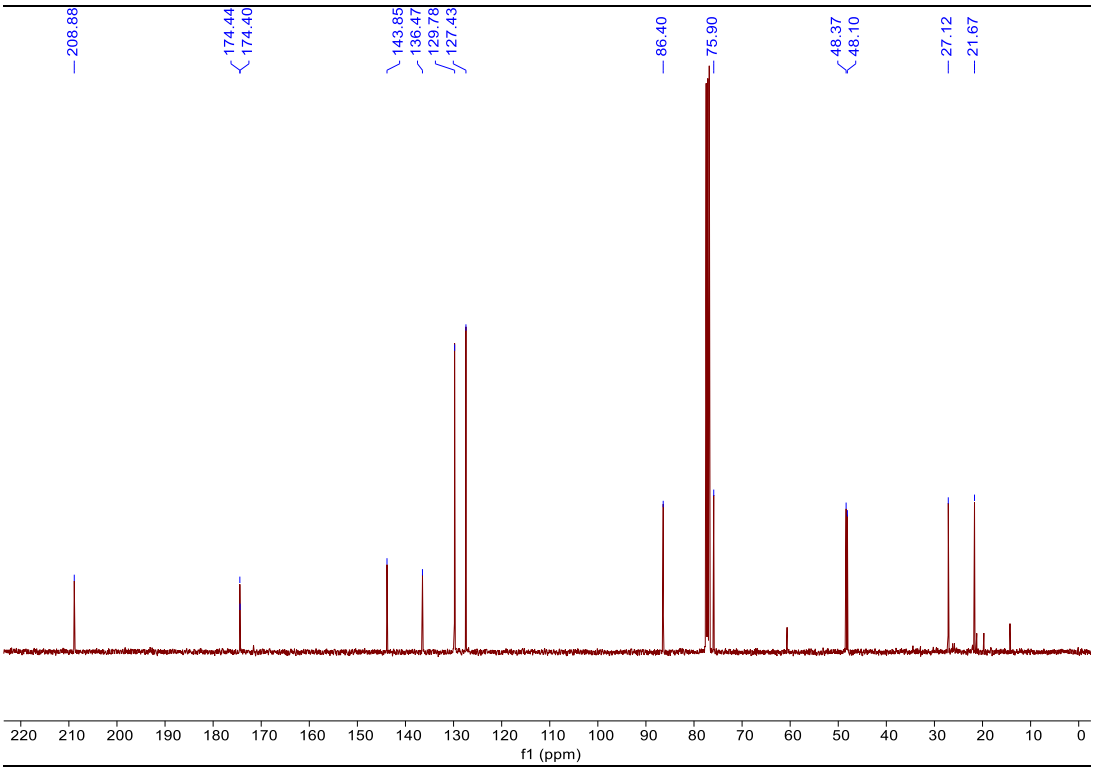
^{1}H NMR spectrum of 6a



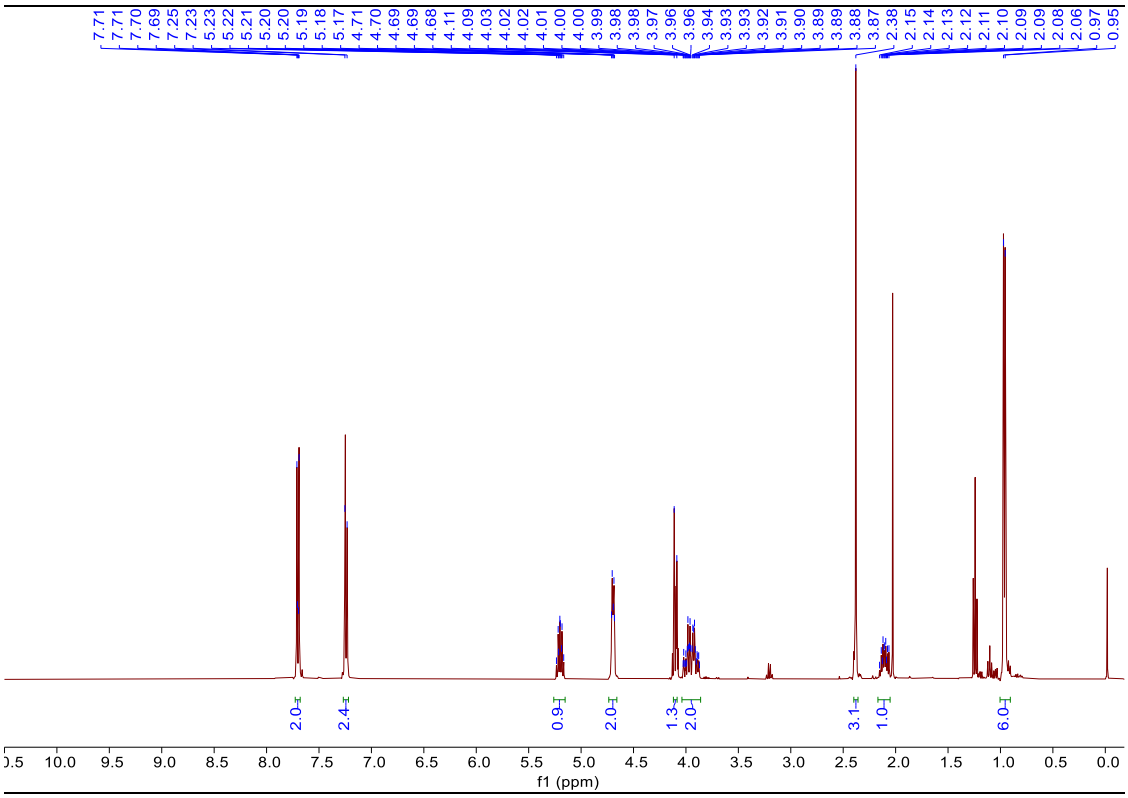
^{13}C NMR spectrum of 6a



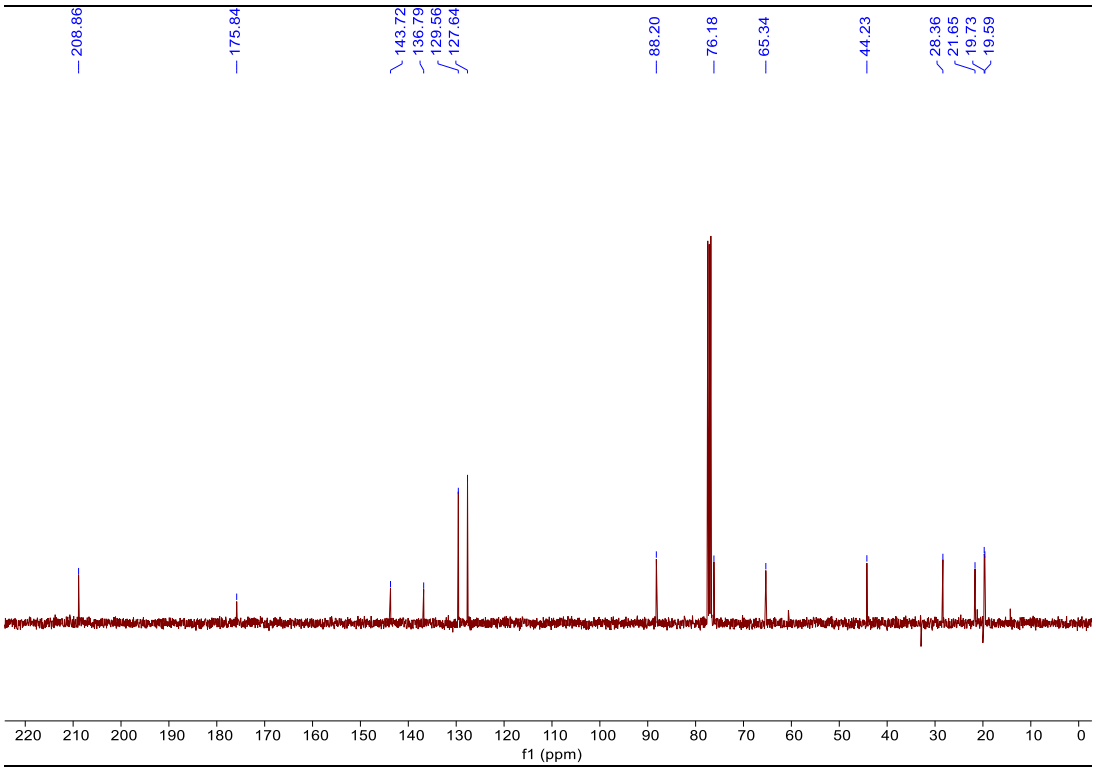
^{1}H NMR spectrum of 6b



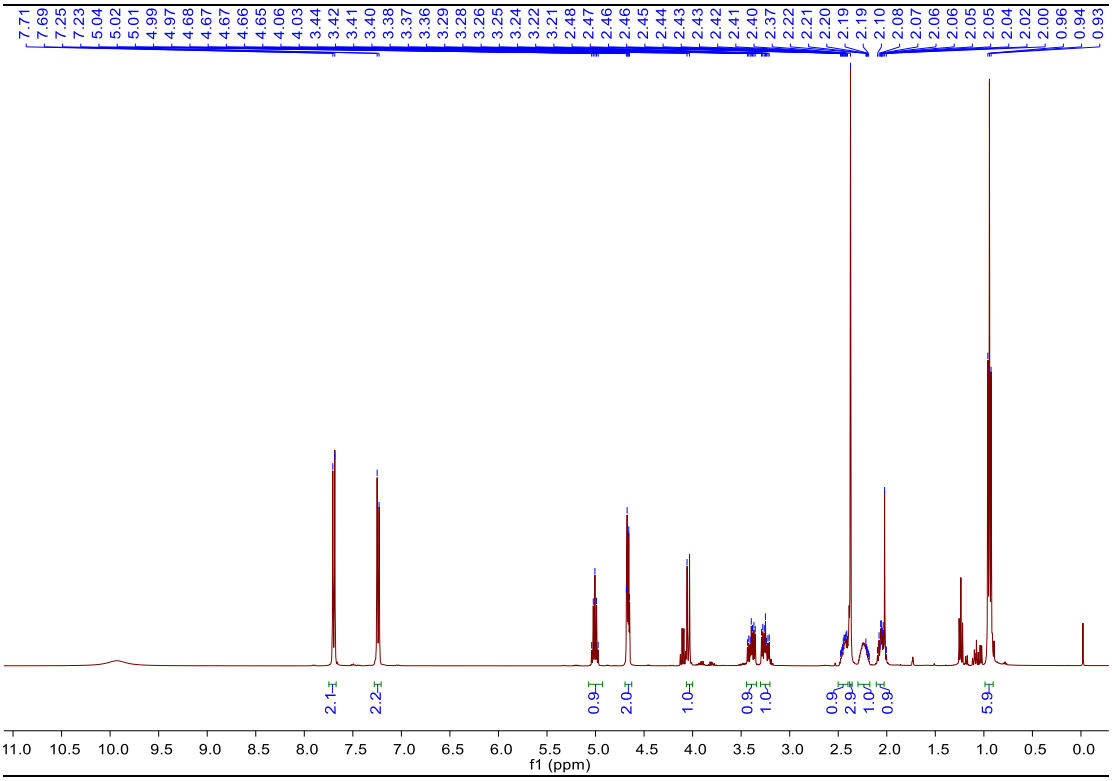
^{13}C NMR spectrum of 6b



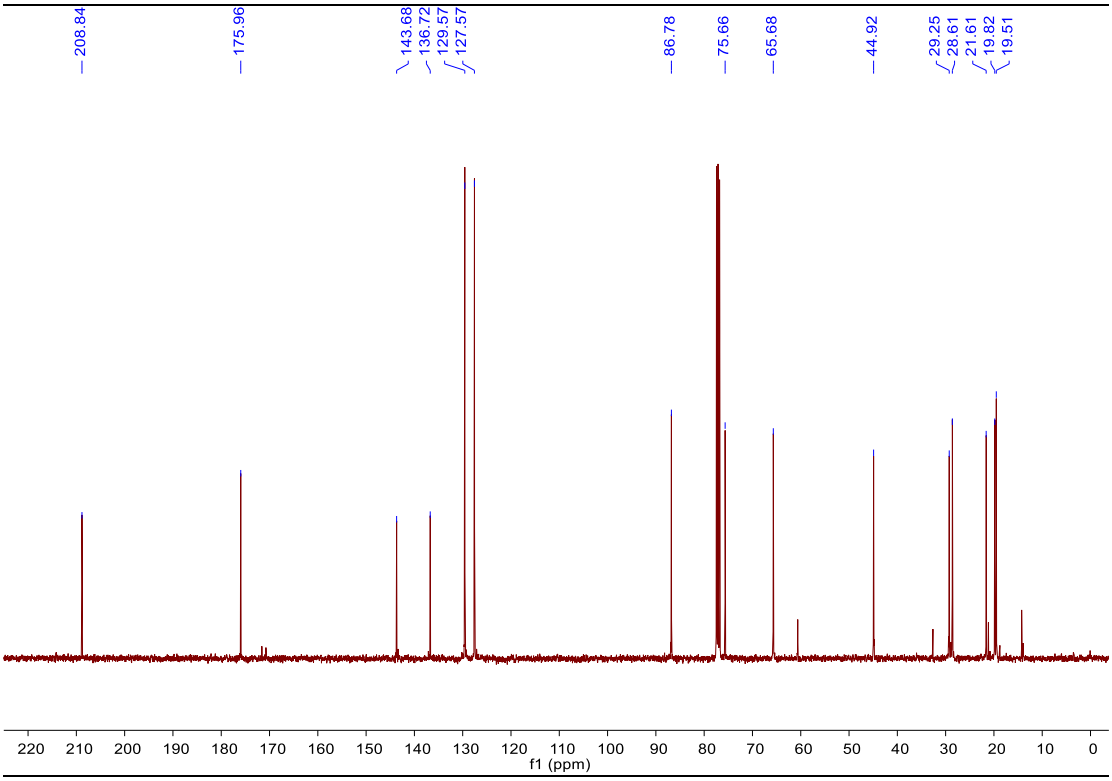
^{1}H NMR spectrum of 6c



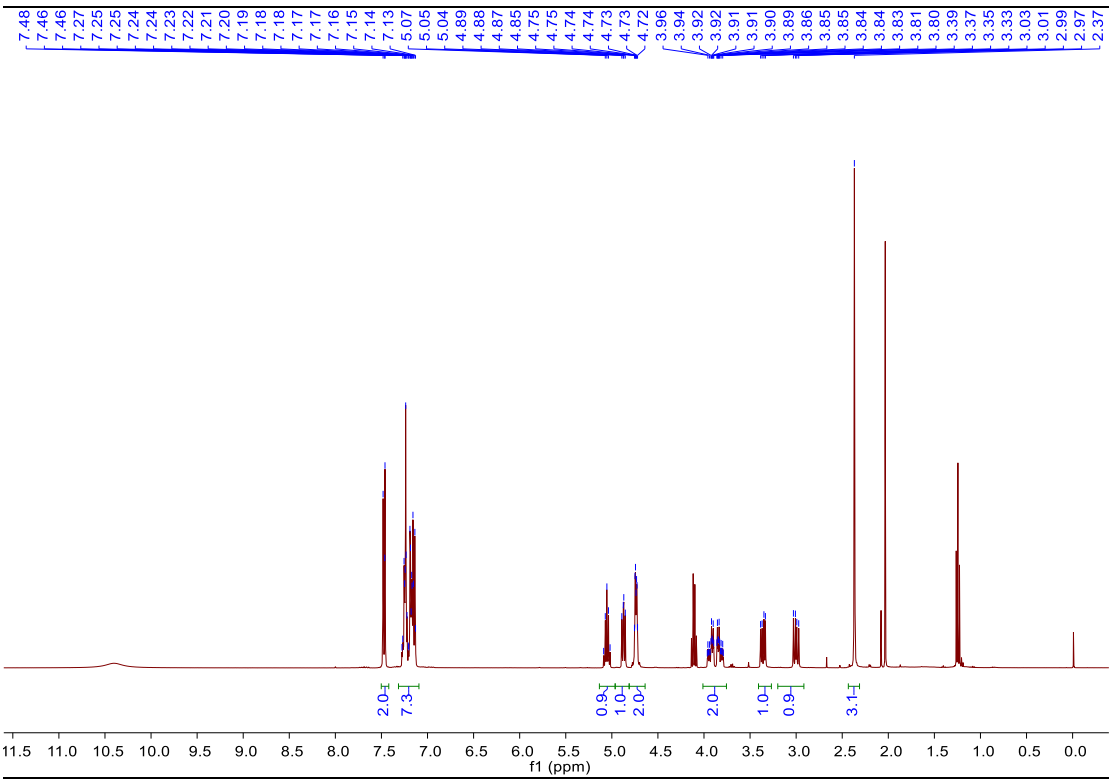
^{13}C NMR spectrum of 6c



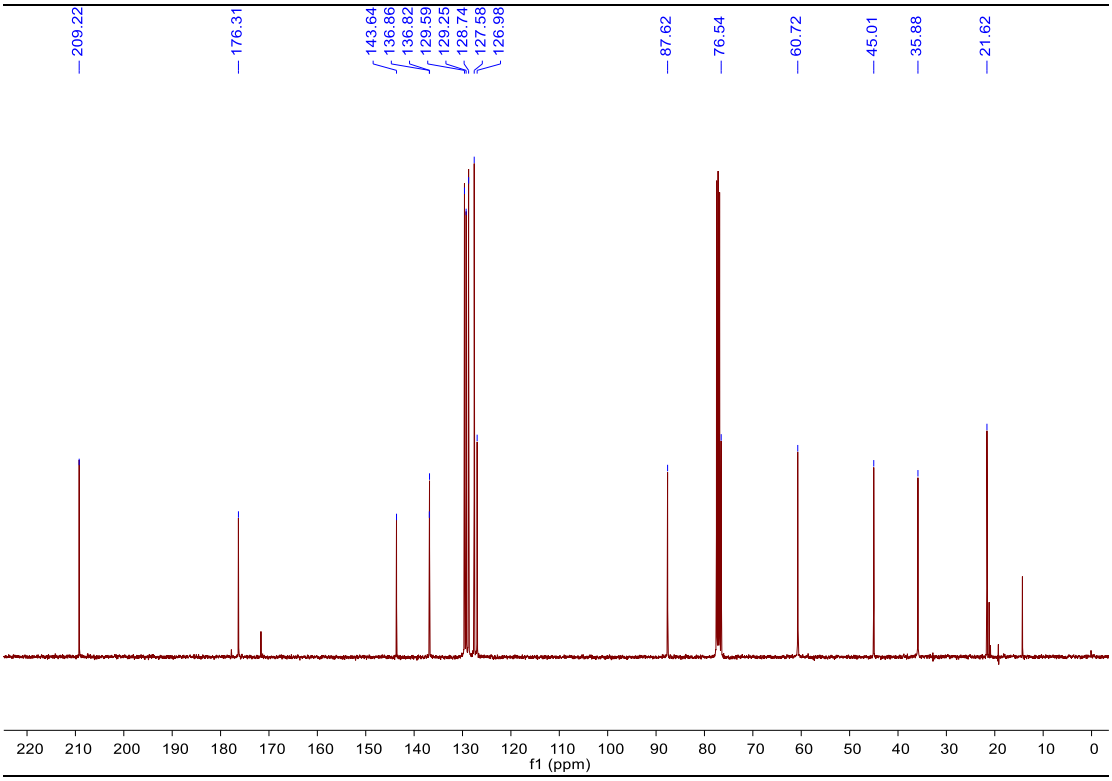
^{1}H NMR spectrum of 6d



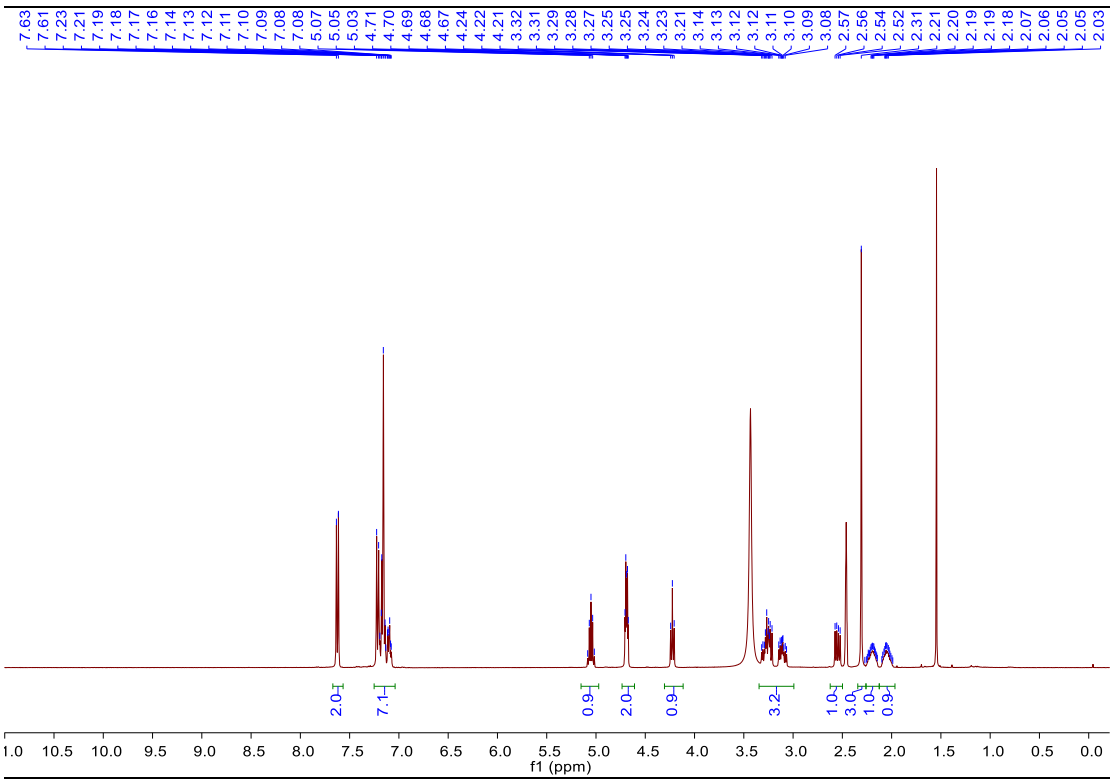
^{13}C NMR spectrum of 6d



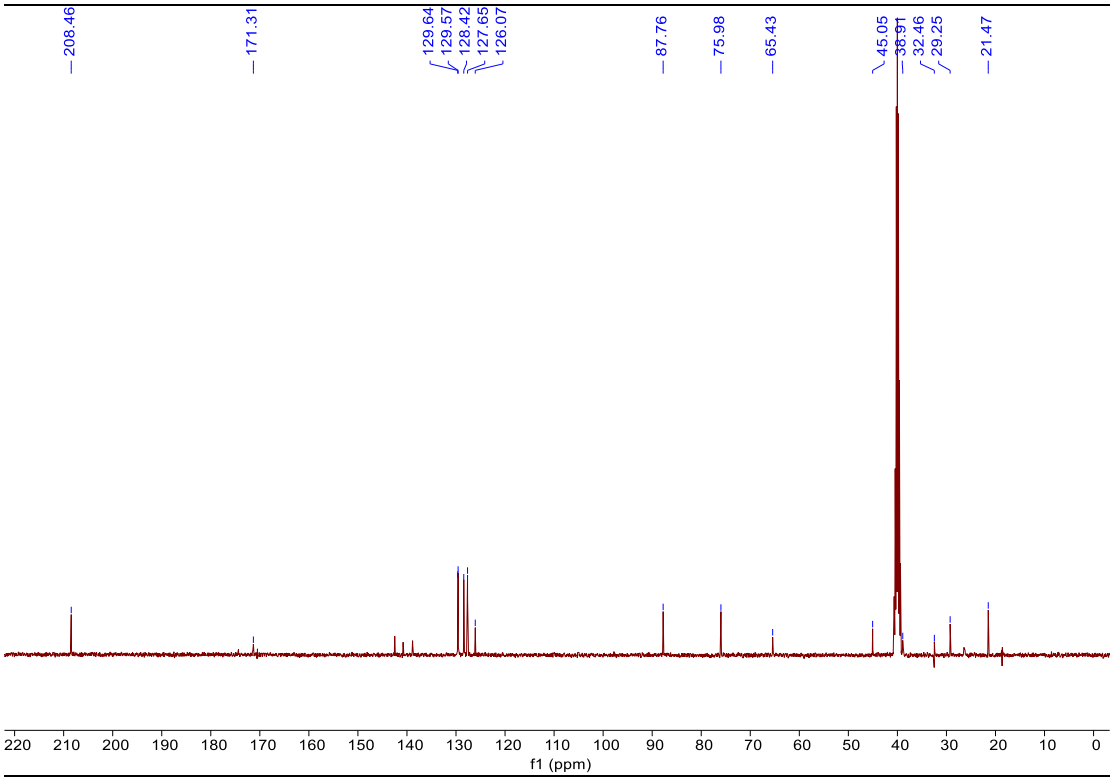
^{1}H NMR spectrum of 6e



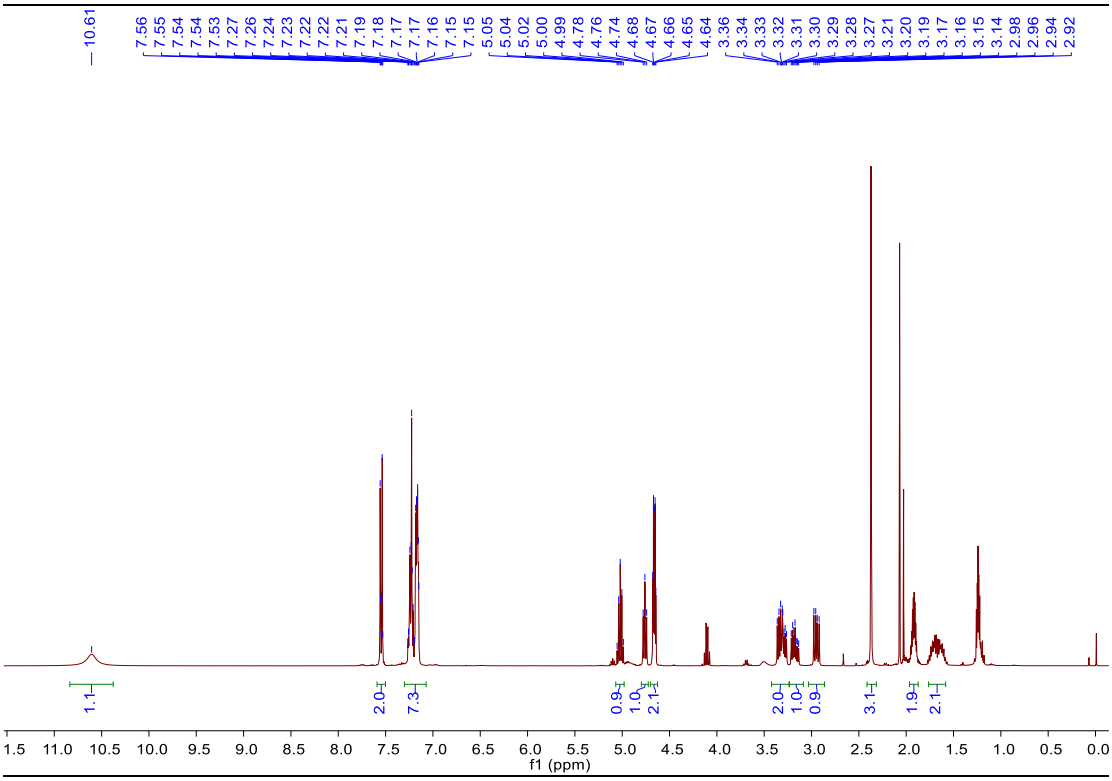
^{13}C NMR spectrum of 6e



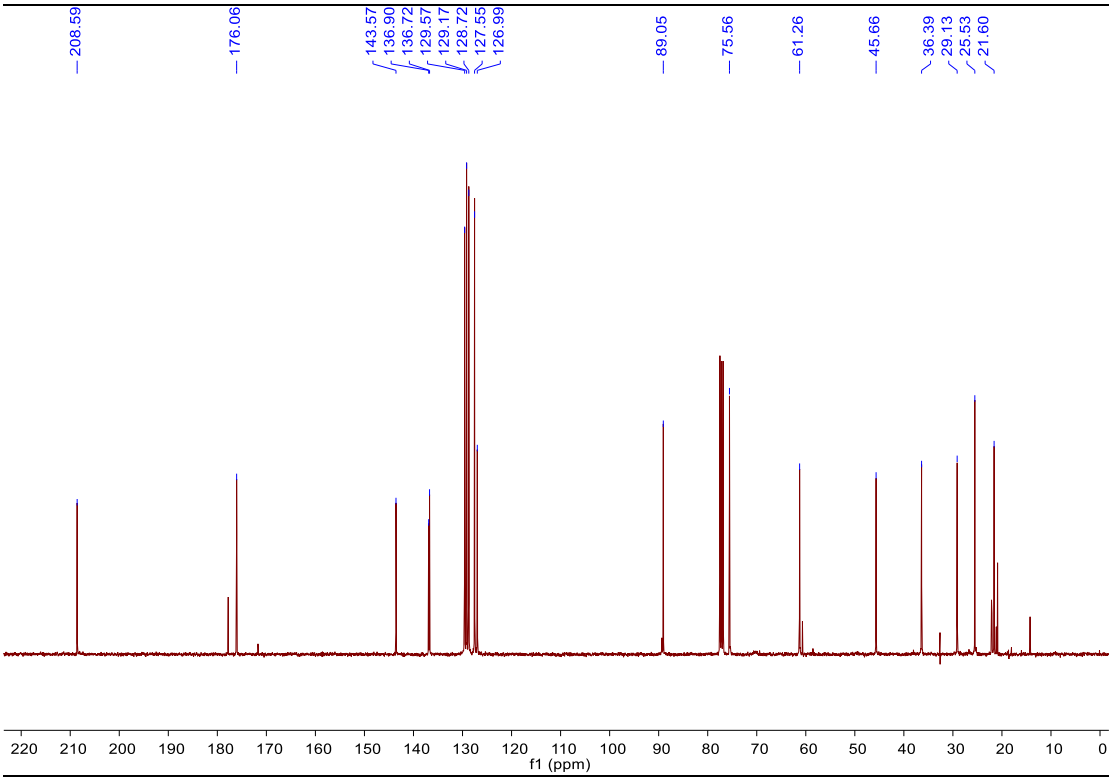
^{1}H NMR spectrum of 6f



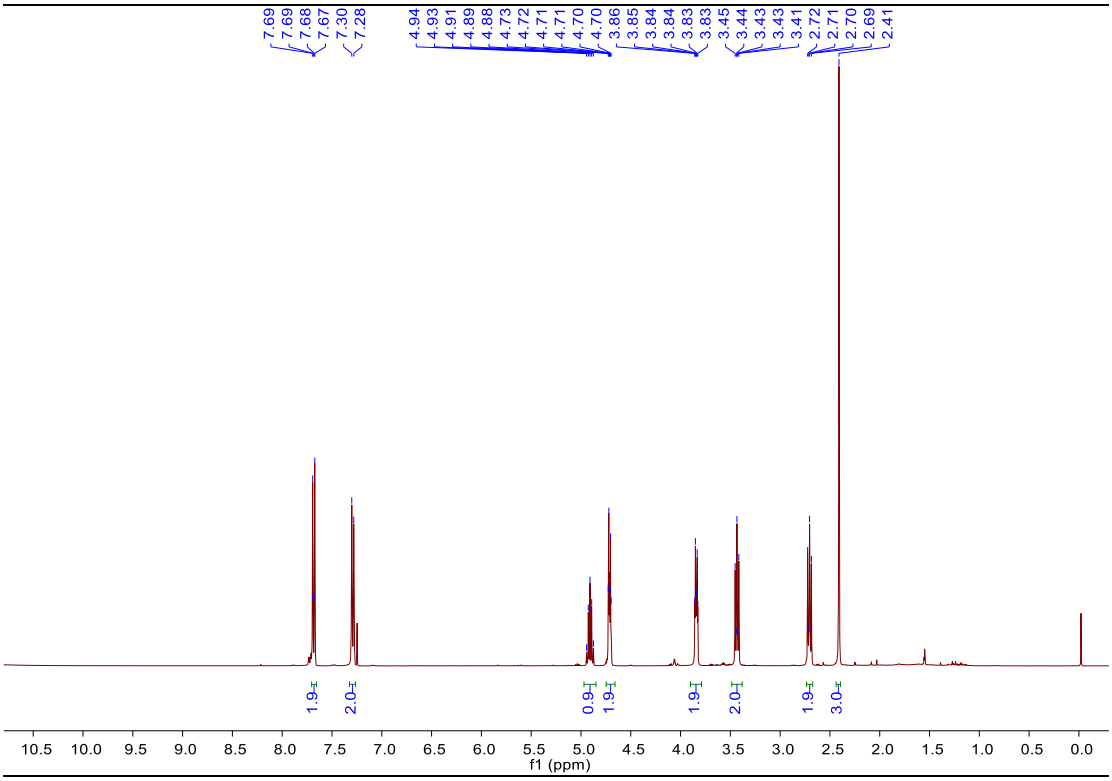
^{13}C NMR spectrum of 6f



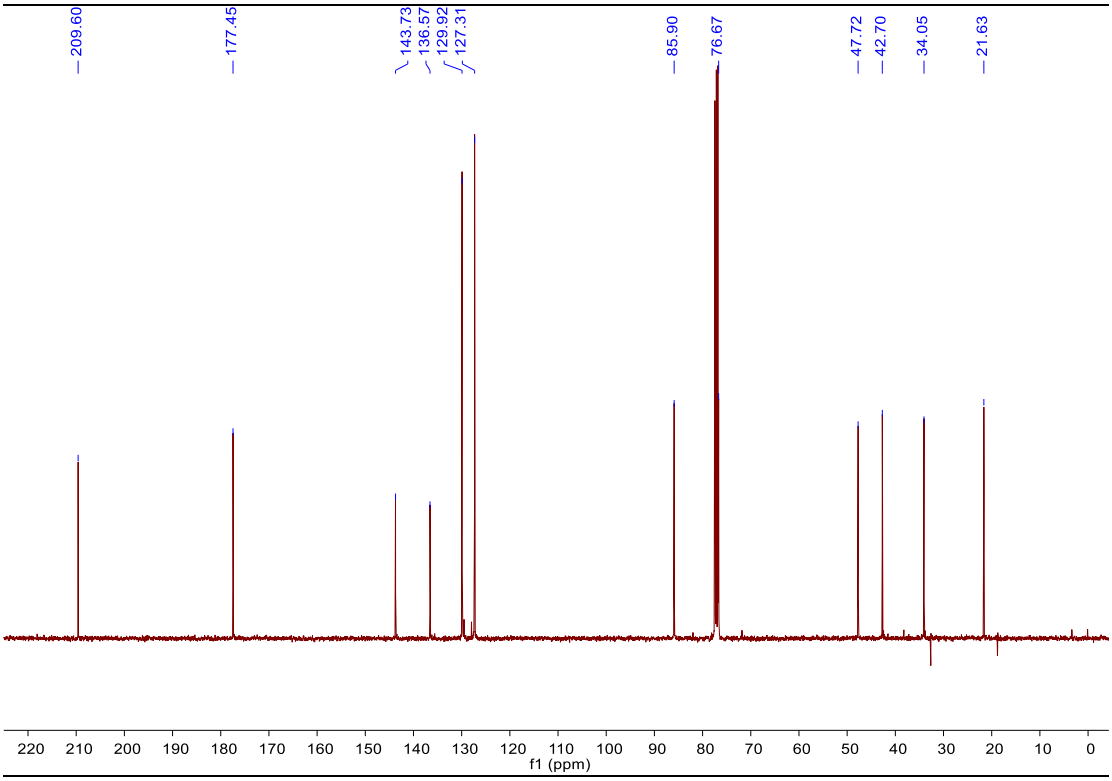
^{1}H NMR spectrum of 6g



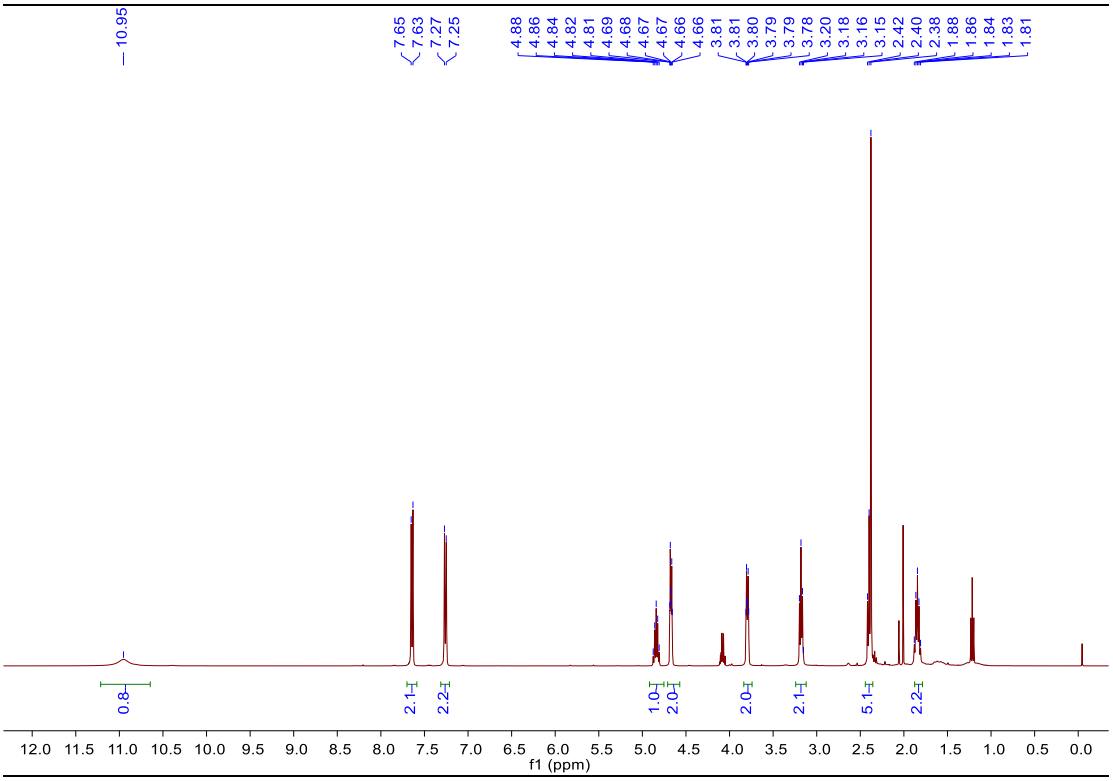
^{13}C NMR spectrum of 6g



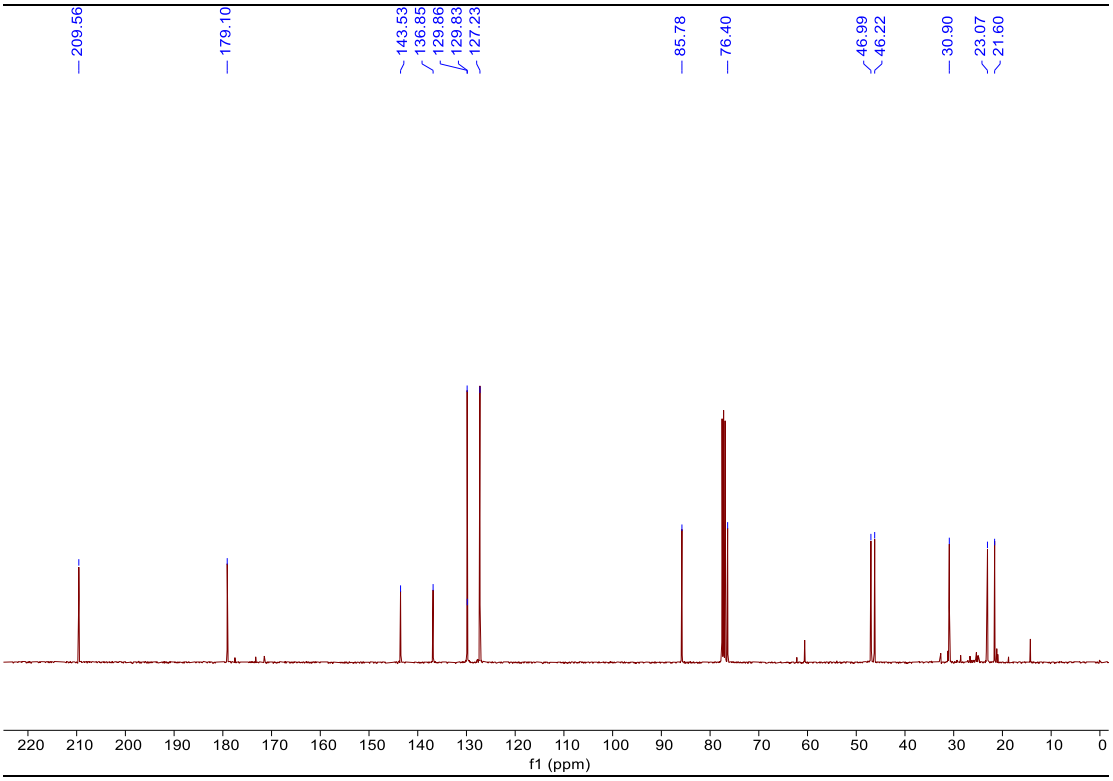
^{1}H NMR spectrum of 6h



^{13}C NMR spectrum of 6h

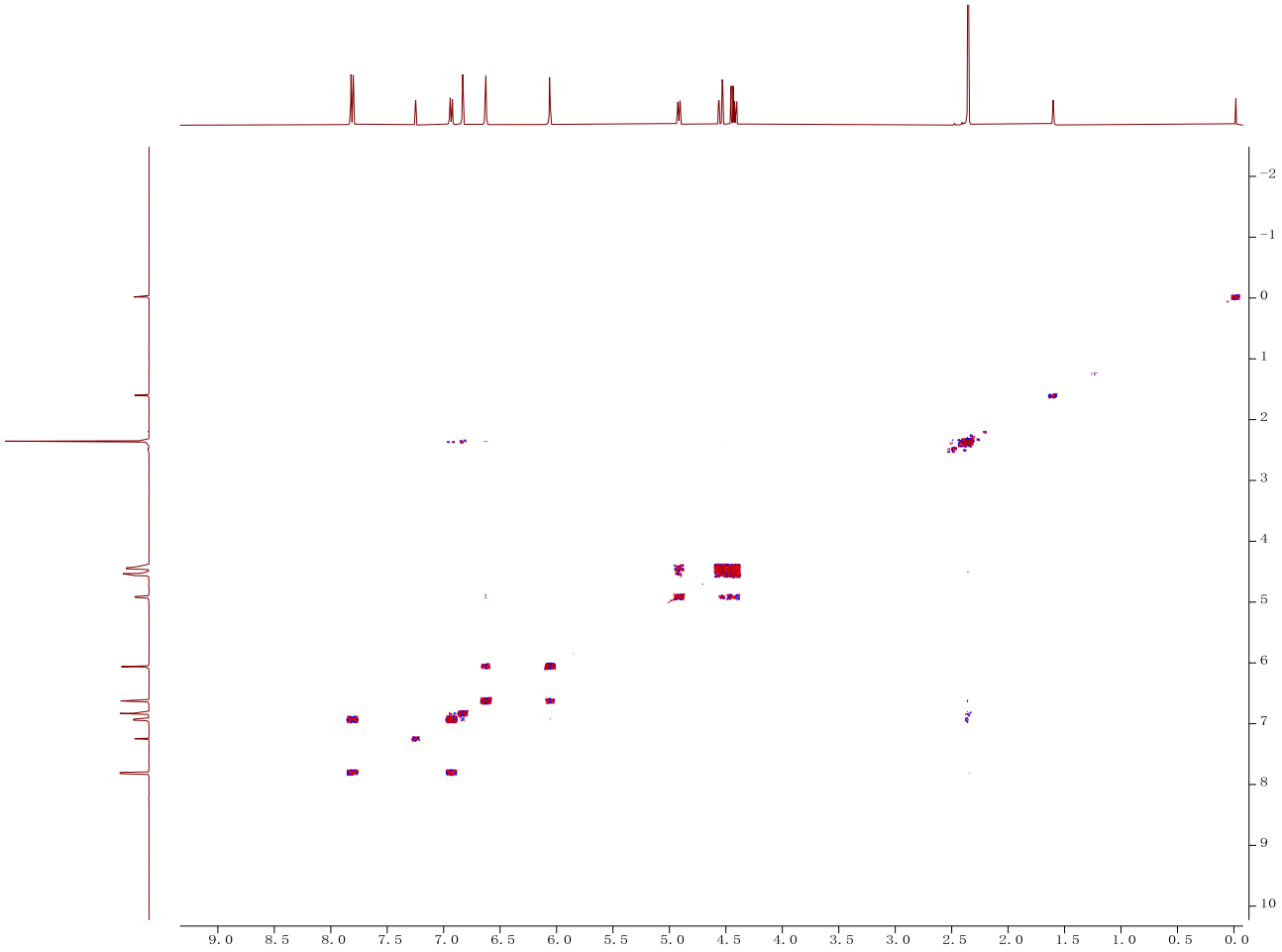


^{1}H NMR spectrum of 6i

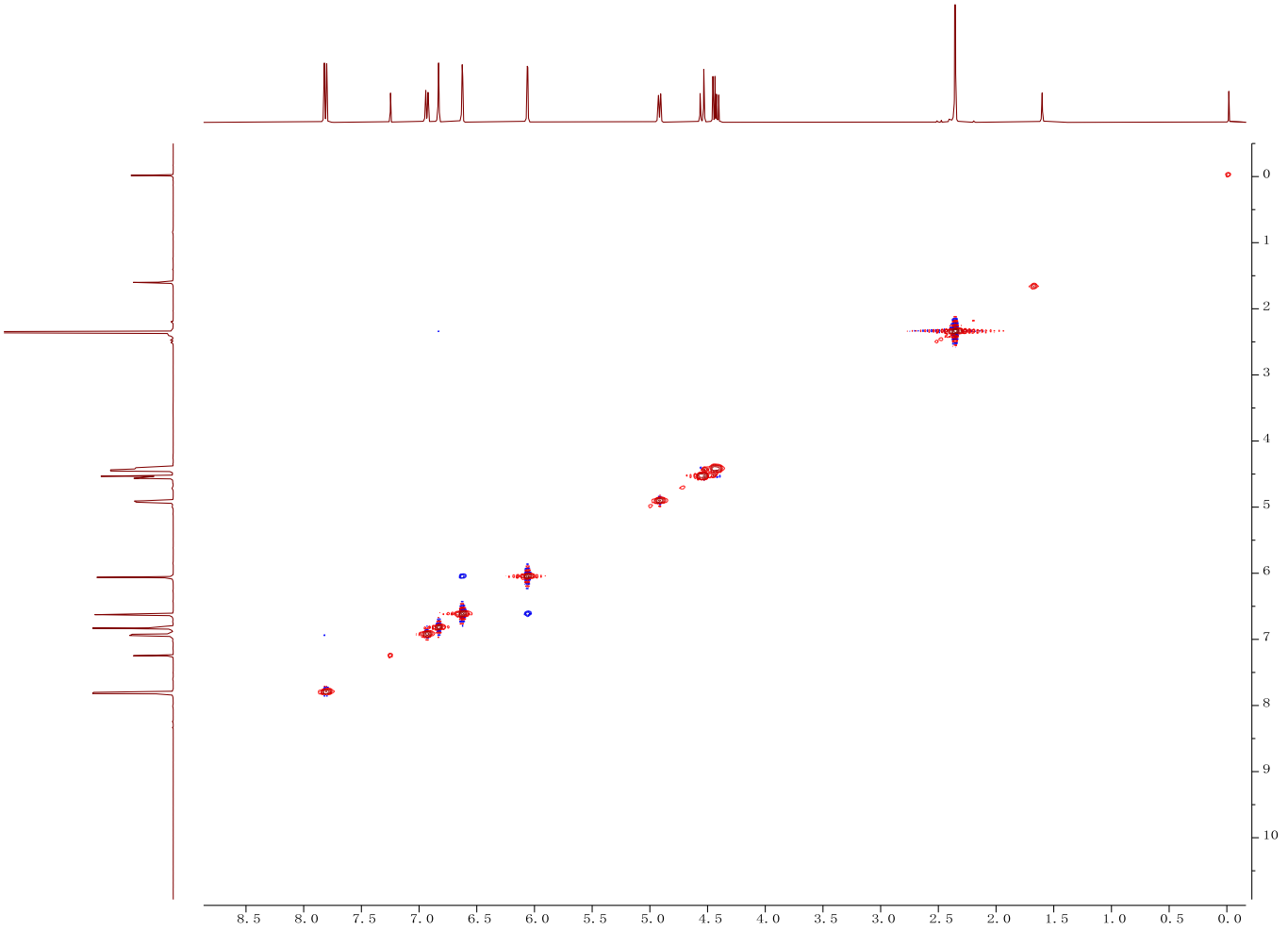


^{13}C NMR spectrum of 6i

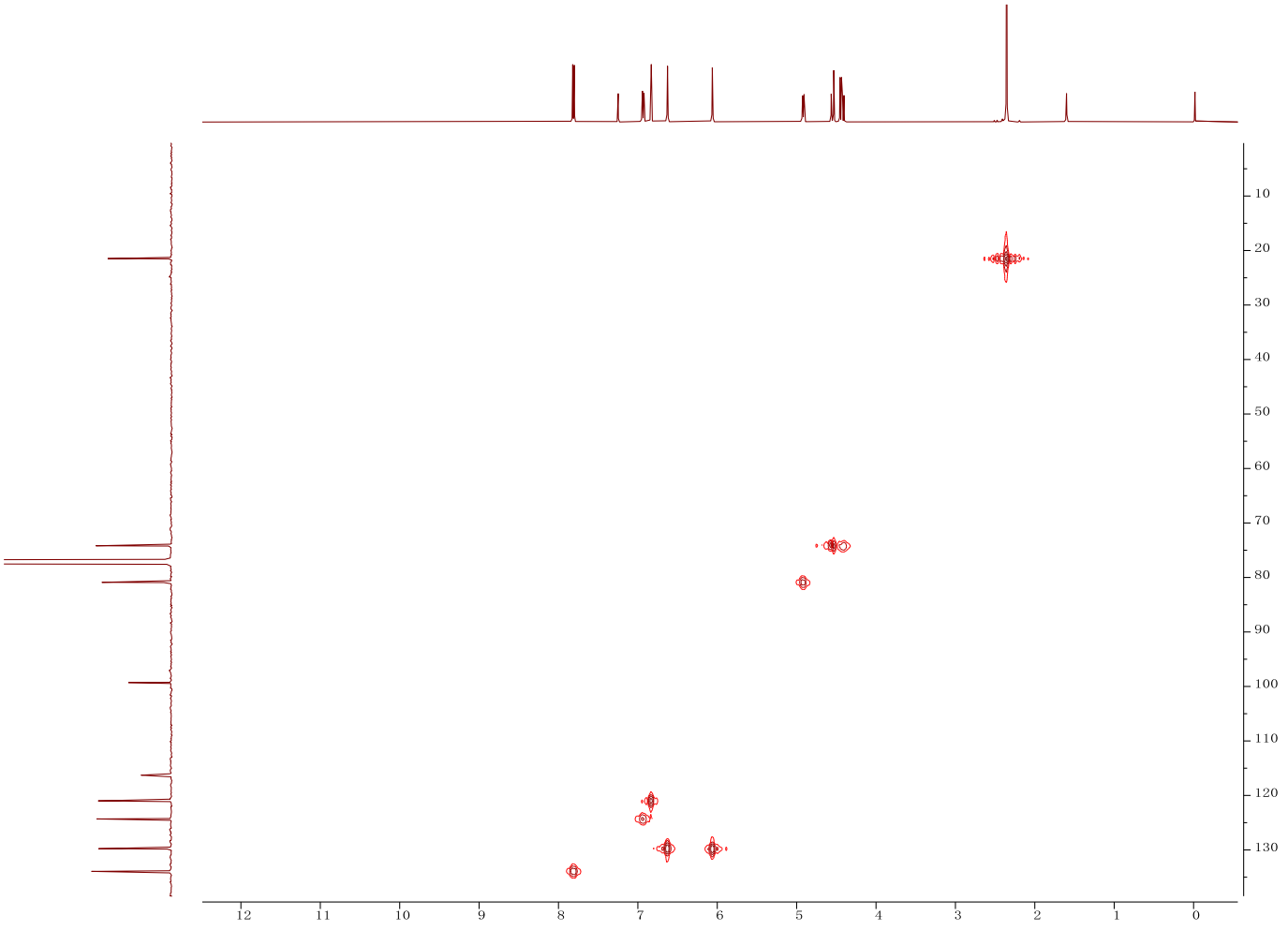
8. Copies of 2D NMR spectra for 2b, 5d and 7b



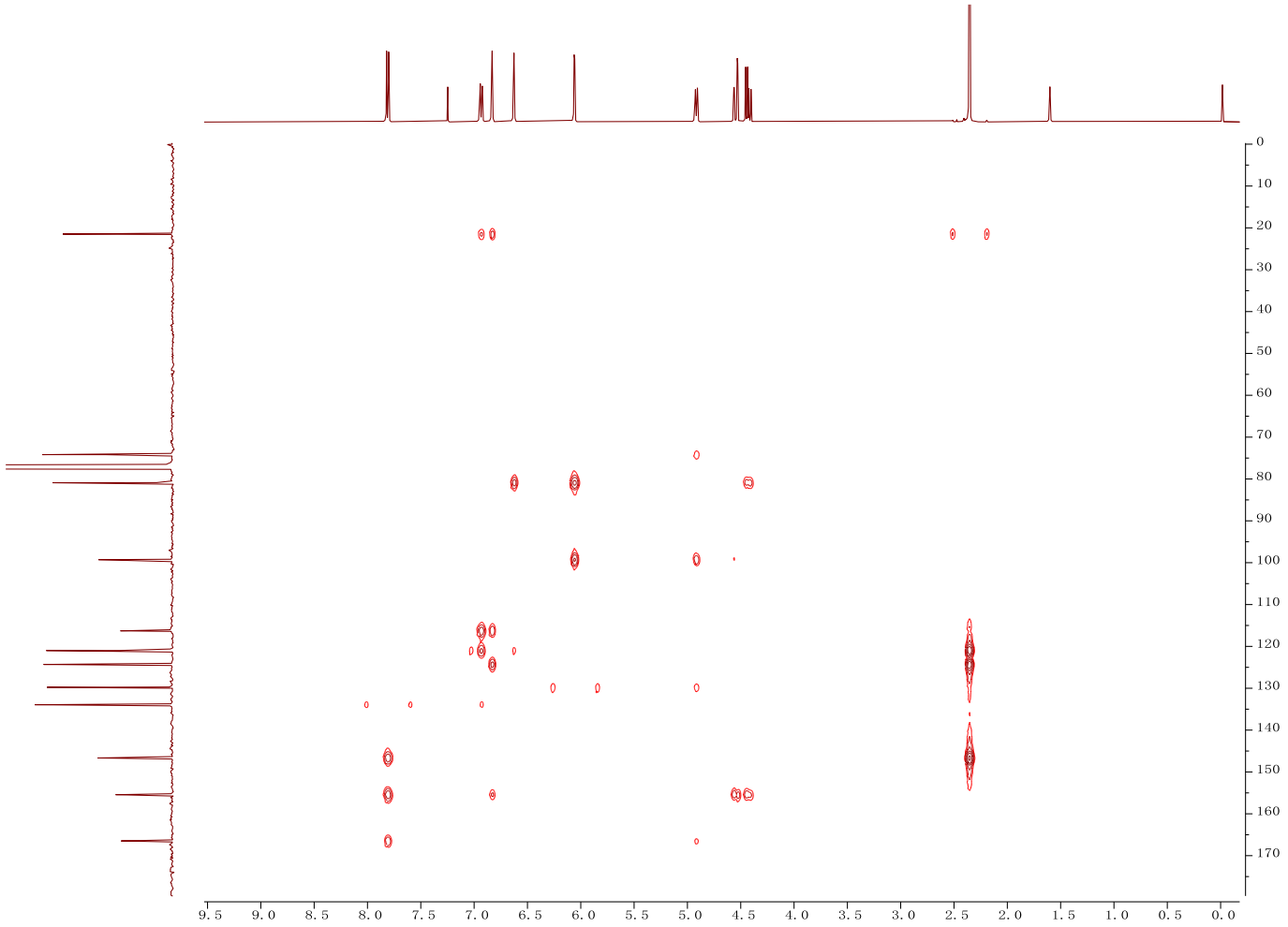
COSY NMR spectrum of 2b



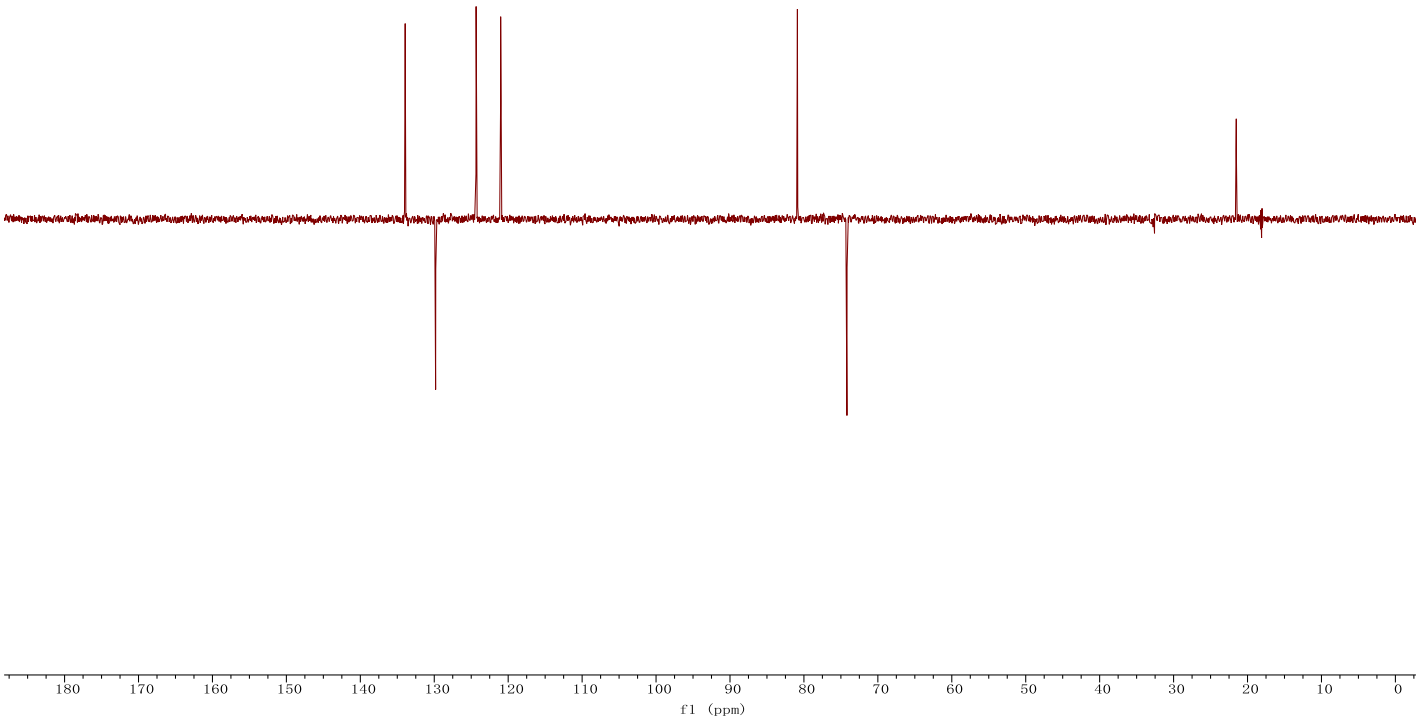
NOESY NMR spectrum of 2b



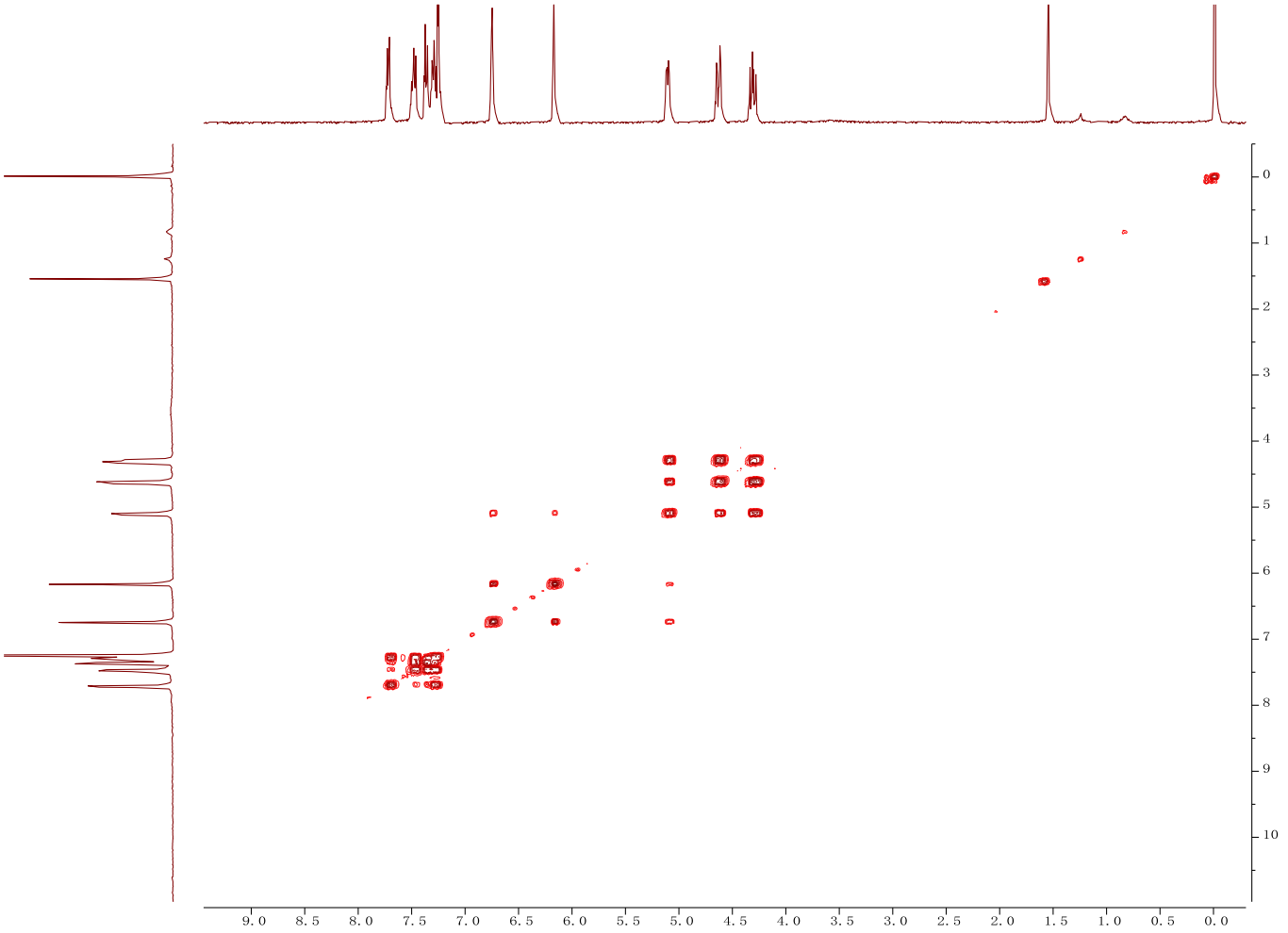
HMQC NMR spectrum of 2b



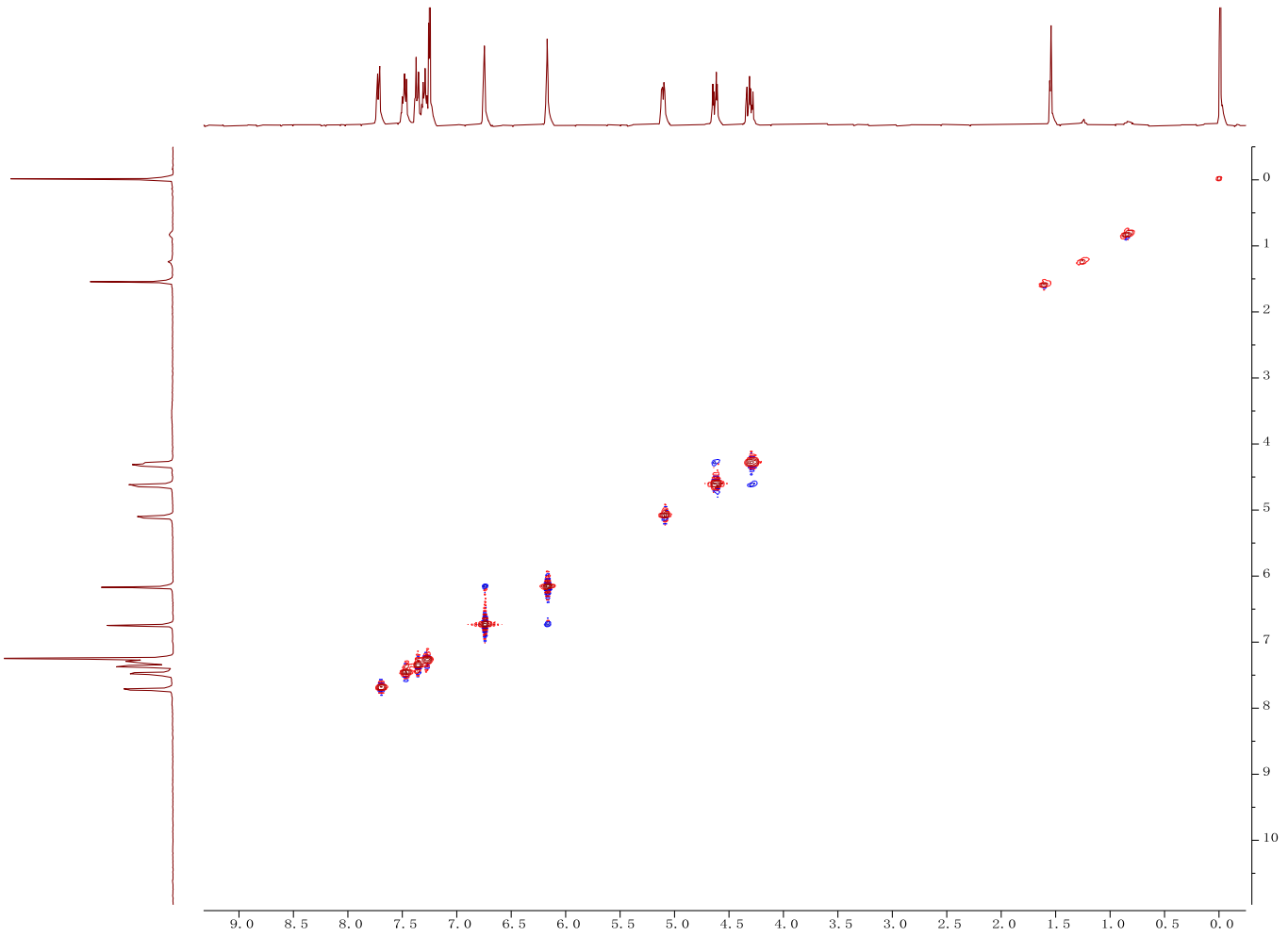
HMBC NMR spectrum of 2b



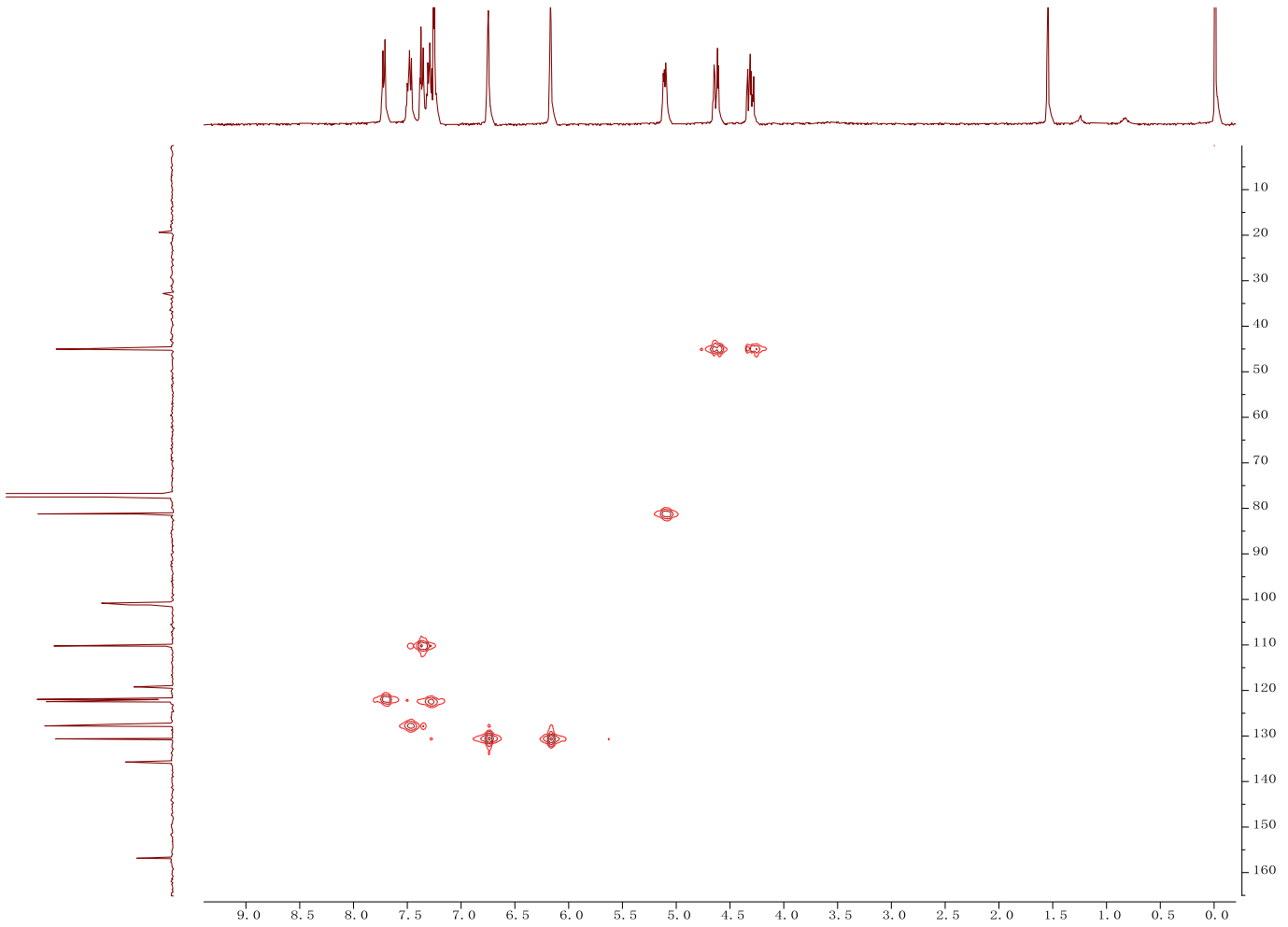
DEPT NMR spectrum of 2b



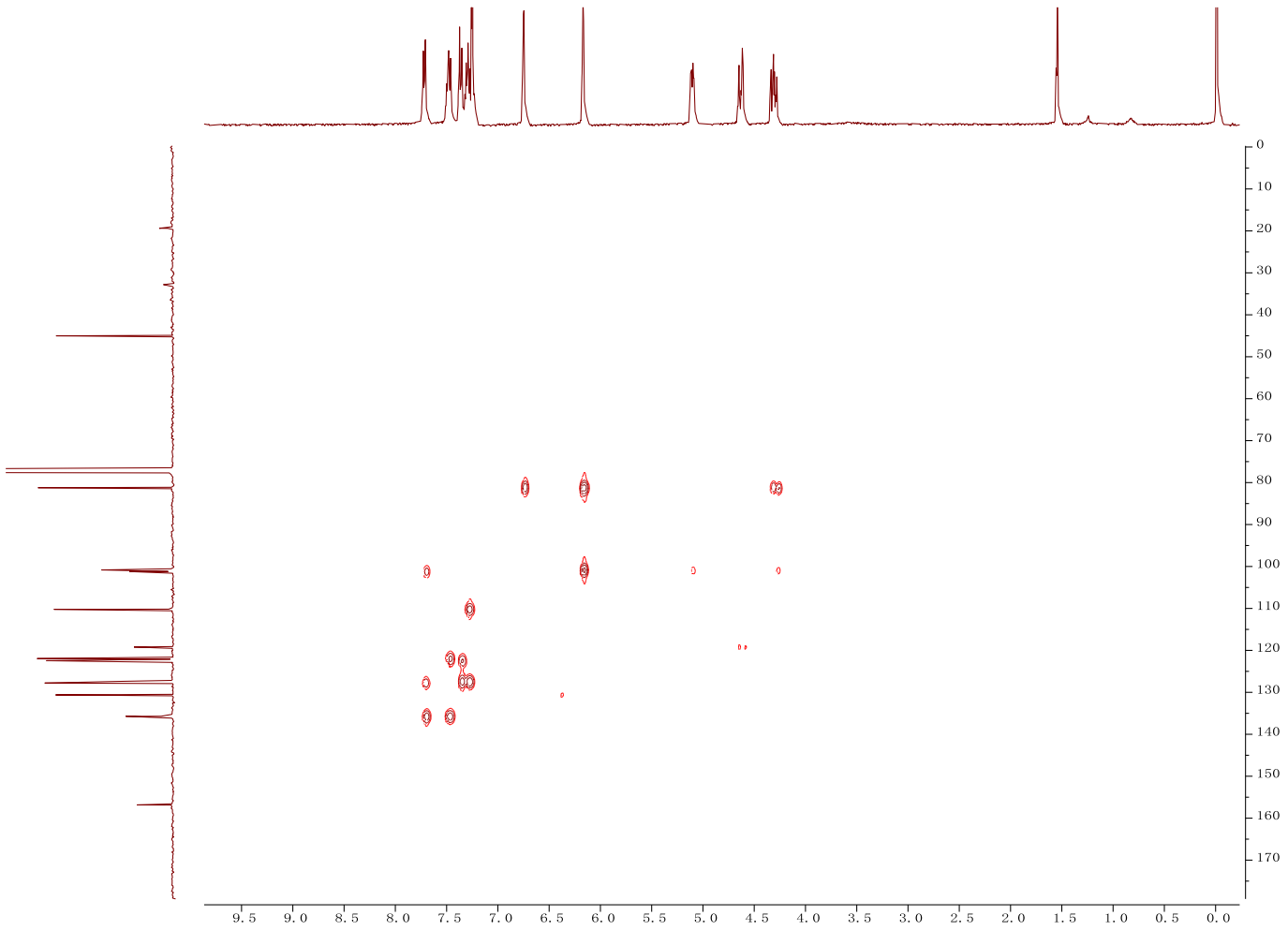
COSY NMR spectrum of 5d



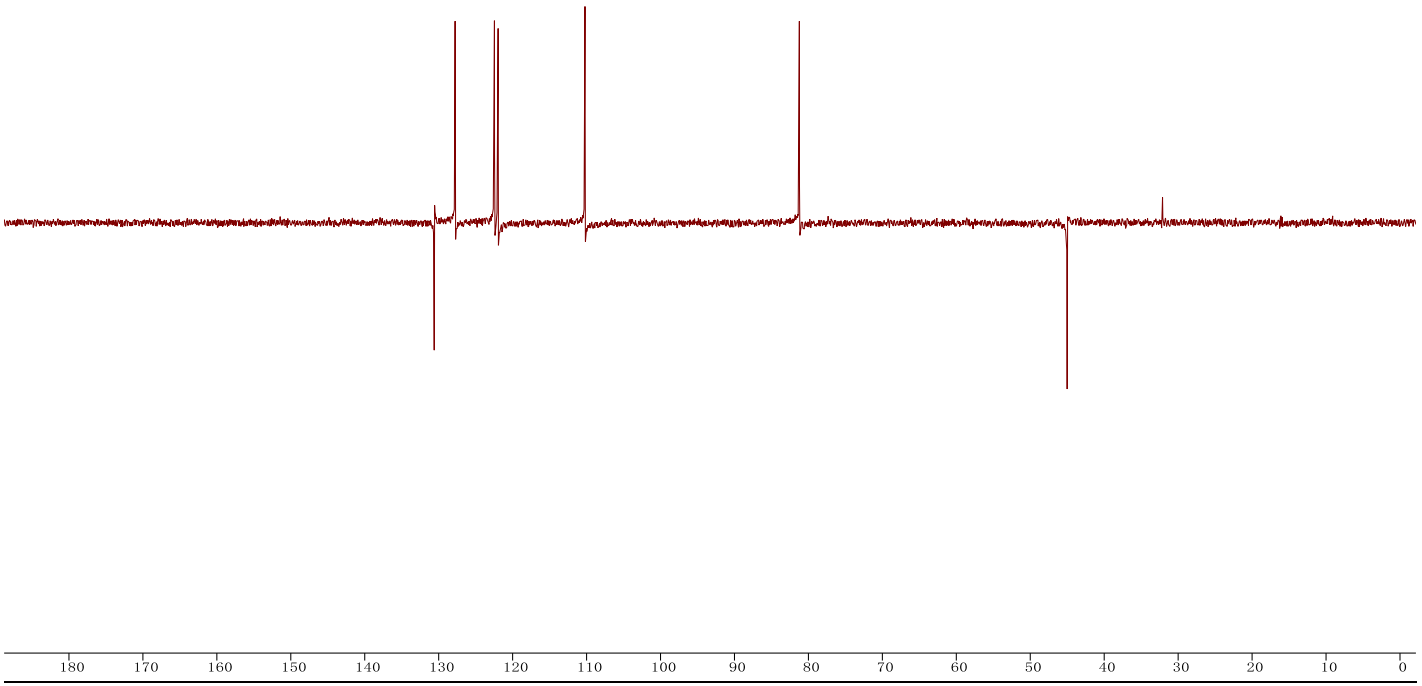
NOESY NMR spectrum of 5d



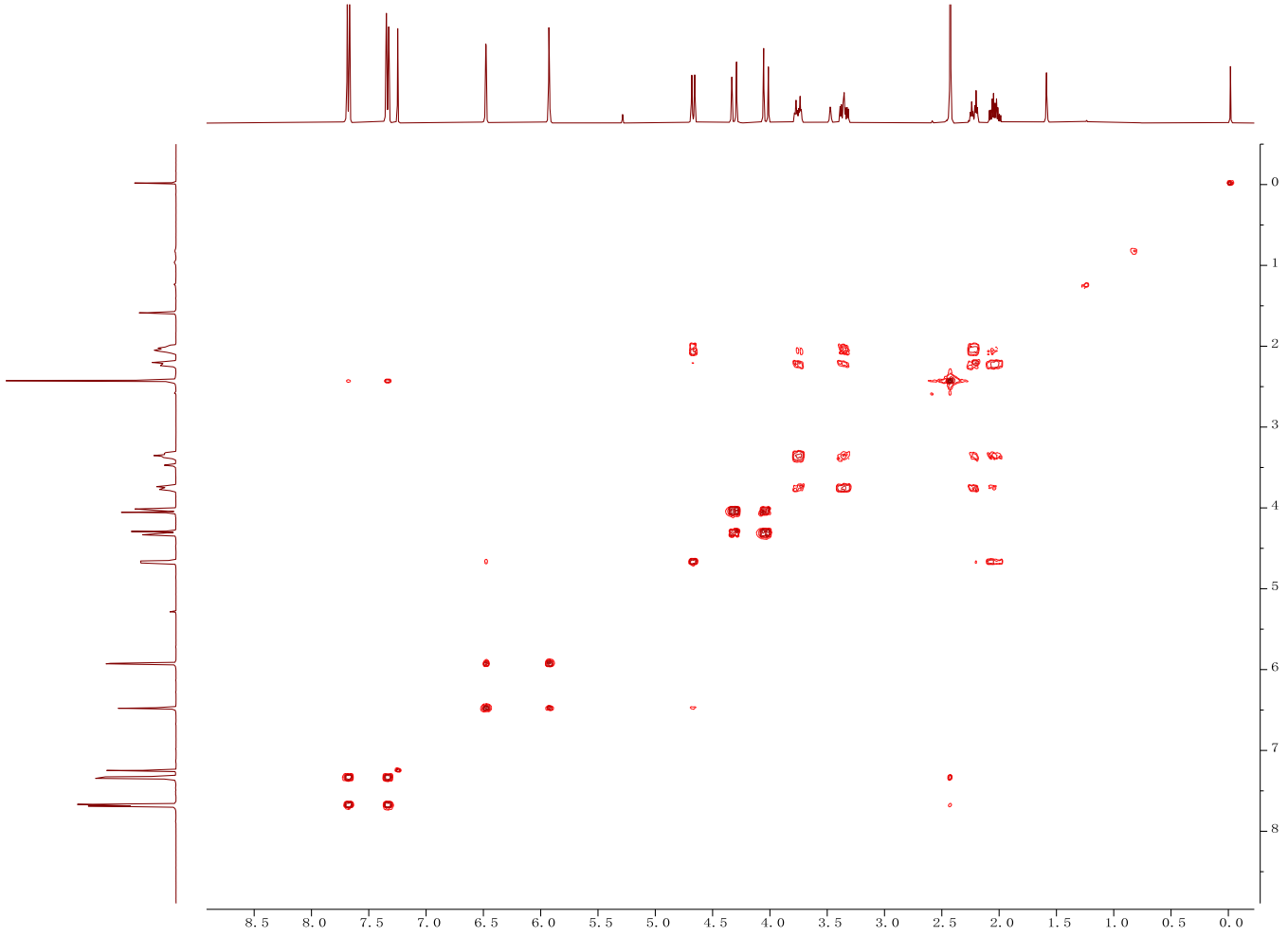
HMQC NMR spectrum of 5d



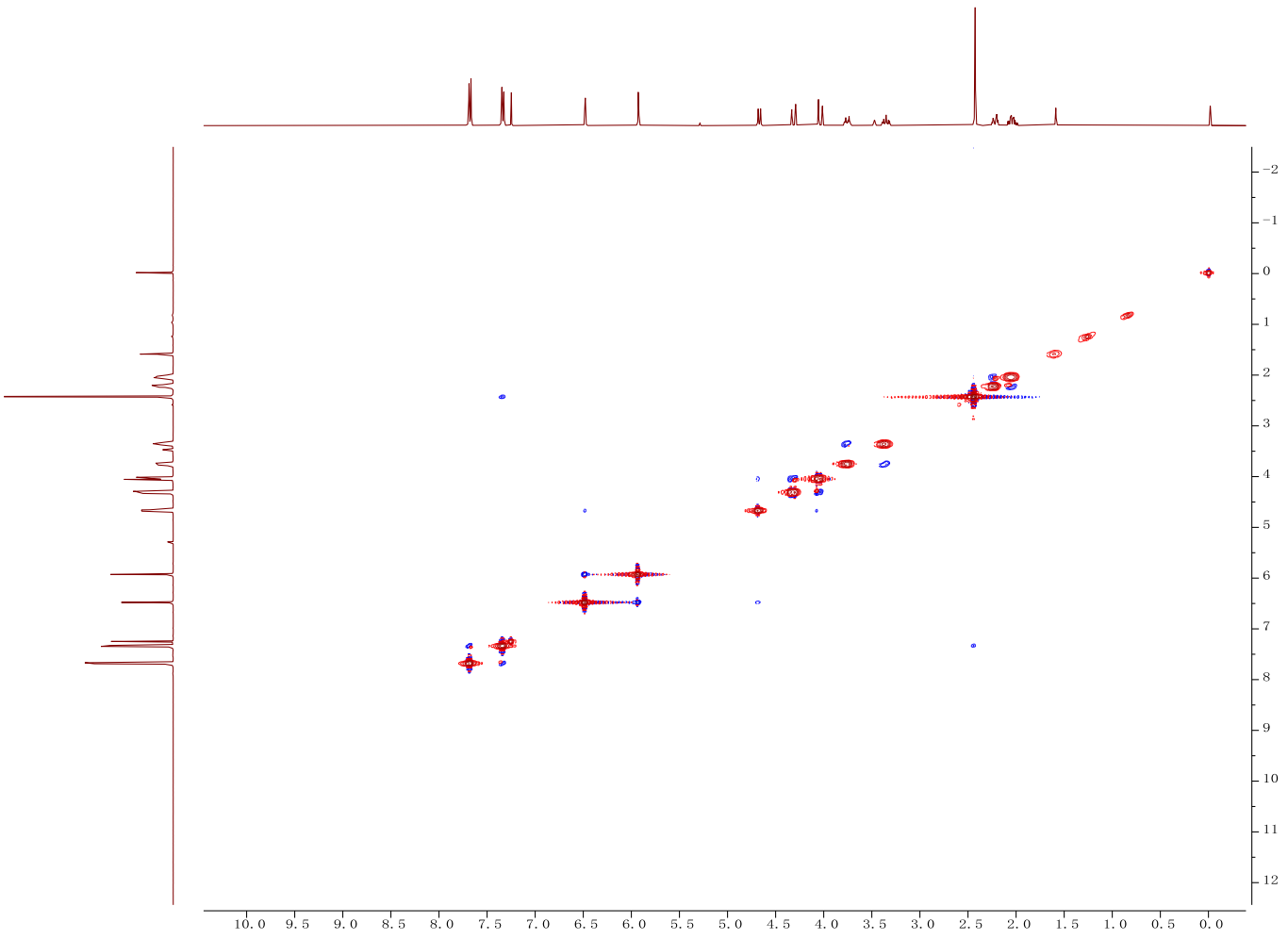
HMBC NMR spectrum of 5d



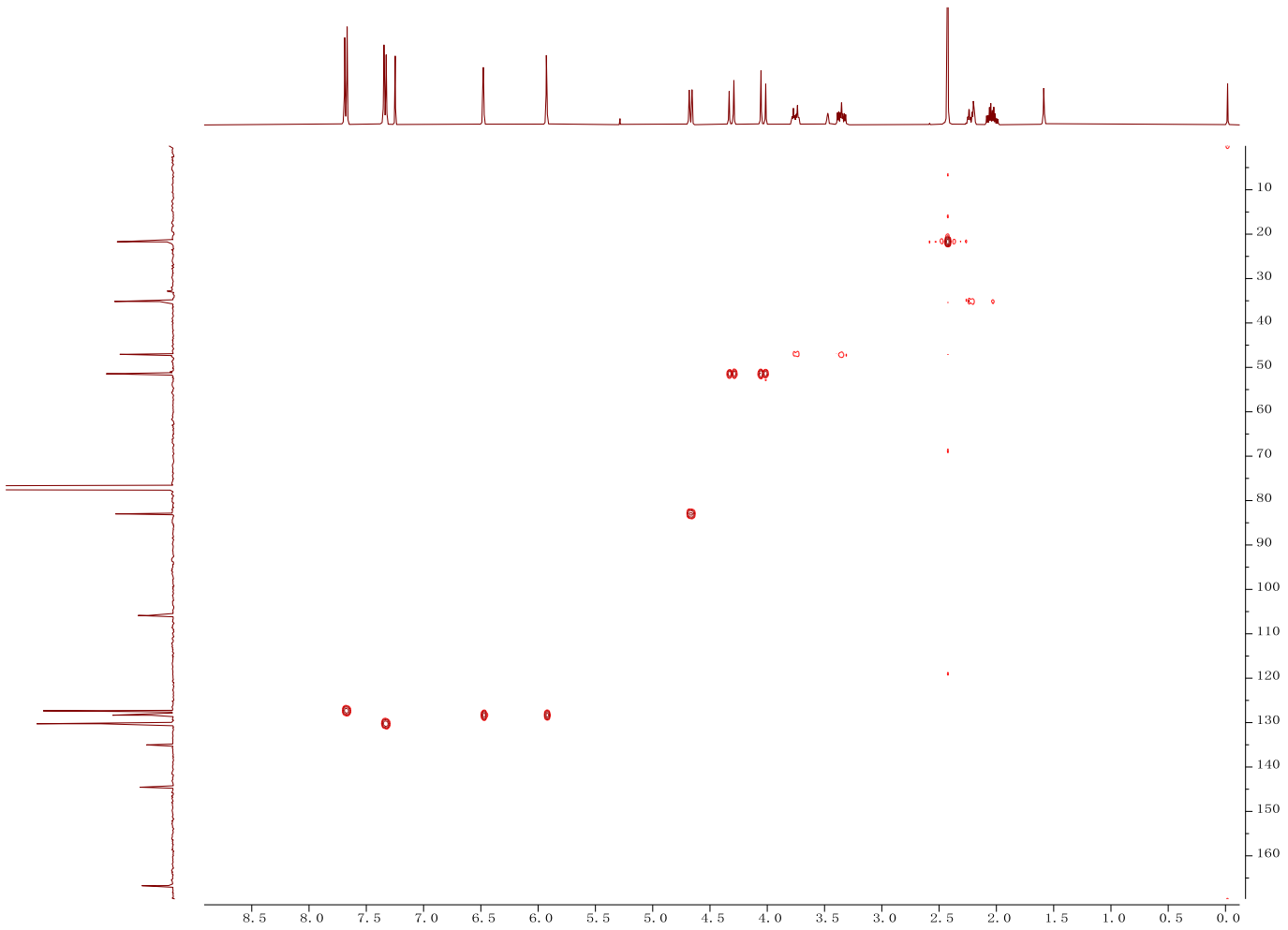
DEPT NMR spectrum of 5d



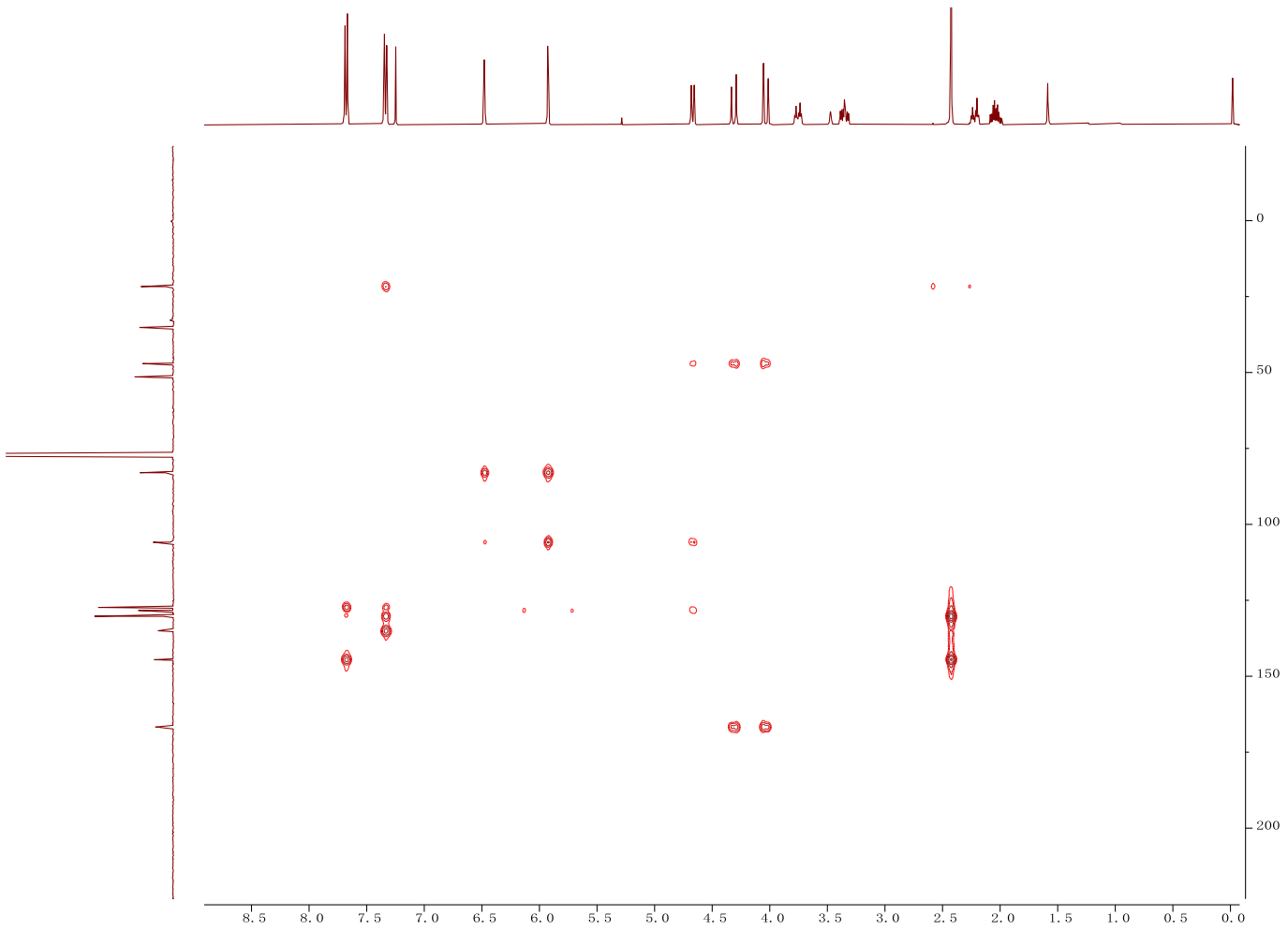
COSY NMR spectrum of 7b



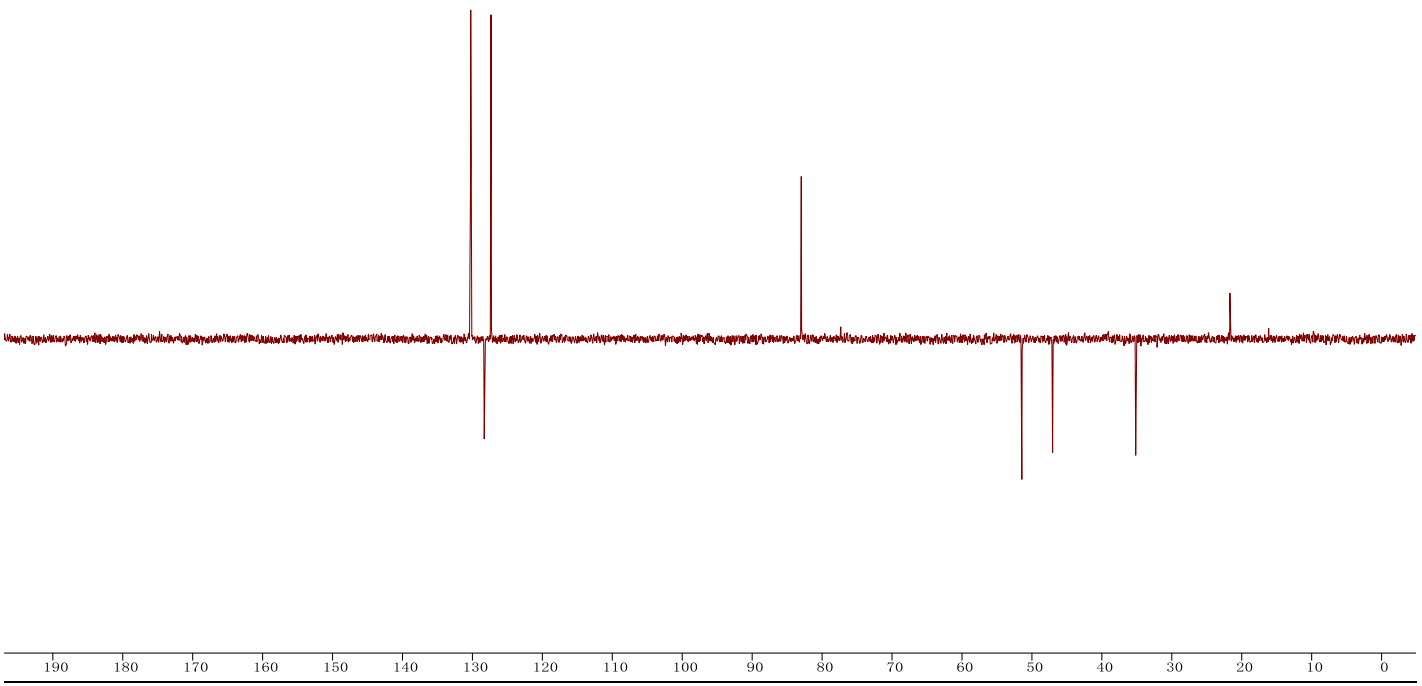
NOESY NMR spectrum of 7b



HMQC NMR spectrum of 7b



HMBC NMR spectrum of 7b



DEPT NMR spectrum of 7b