

# SUPPORTING INFORMATION

## **Solvent-free mechanochemical grinding facilitates clean synthesis of N-substituted amines**

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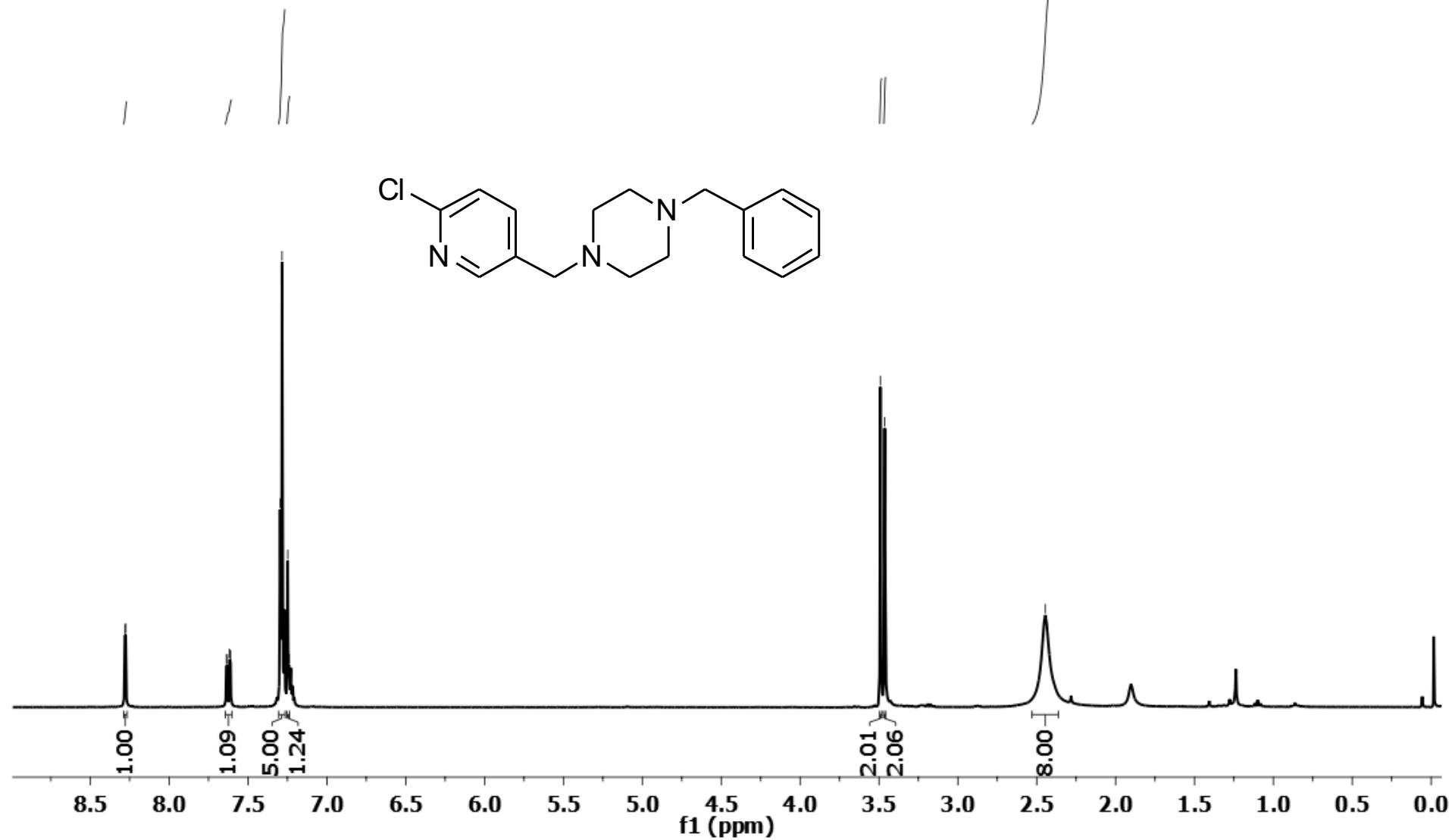
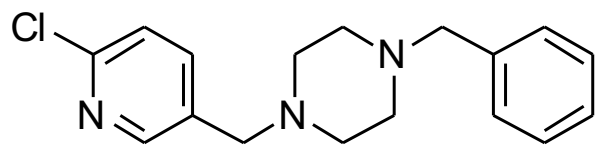
# $^1\text{H}$ NMR and $^{13}\text{C}$ NMR Spectra

$^1\text{H}$  NMR of **3a** in  $\text{CDCl}_3$

8.28  
8.27  
7.64  
7.63  
7.62  
7.61  
7.29  
7.28  
7.25  
7.24

3.49  
3.46

2.45



$^{13}\text{C}$  NMR of **3a** in  $\text{CDCl}_3$

150.26  
150.18

139.67  
138.03

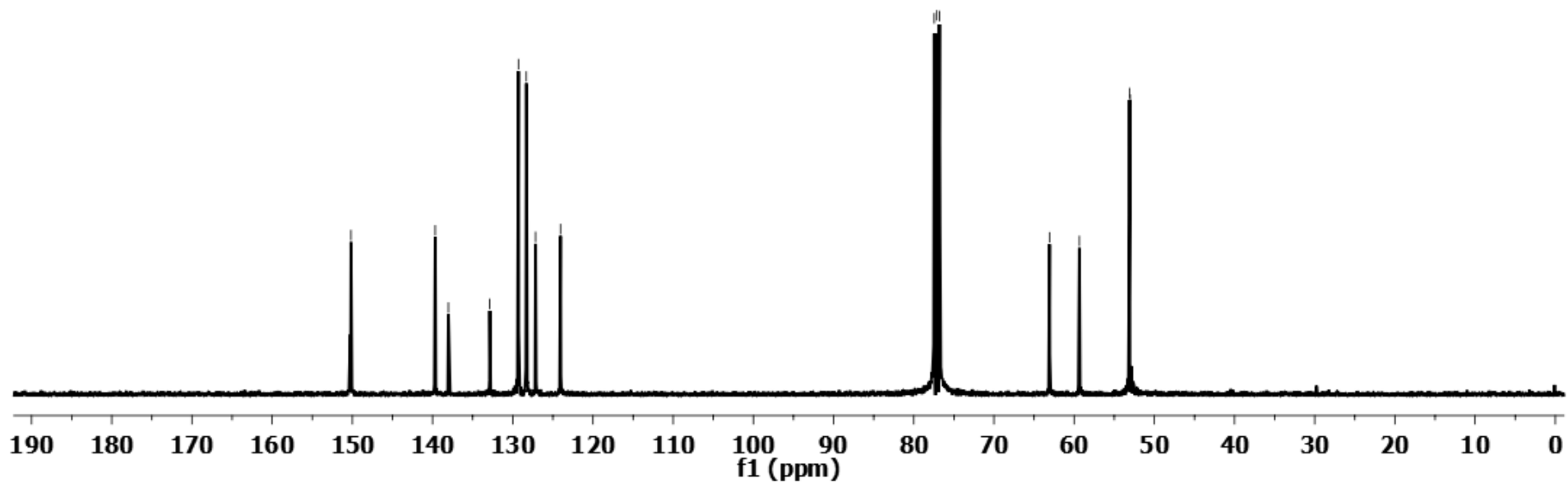
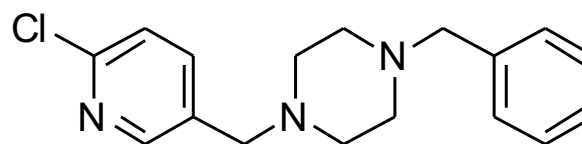
132.86  
129.29

128.31  
127.16

124.05

77.44  
77.12  
76.81

63.07  
59.35  
53.09  
53.01



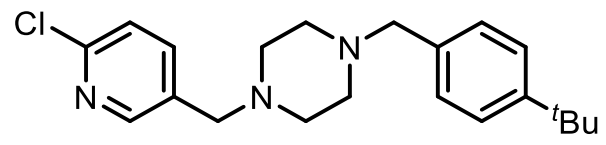
$^1\text{H}$  NMR of **3b** in  $\text{CDCl}_3$

8.28  
8.28  
7.64  
7.63  
7.62  
7.61  
7.32  
7.30  
7.27  
7.22  
7.20

3.47

2.45

1.30



1.02

1.04

2.91

2.10

4.11

8.05

9.05

9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0

f1 (ppm)

$^{13}\text{C}$  NMR of **3b** in  $\text{CDCl}_3$

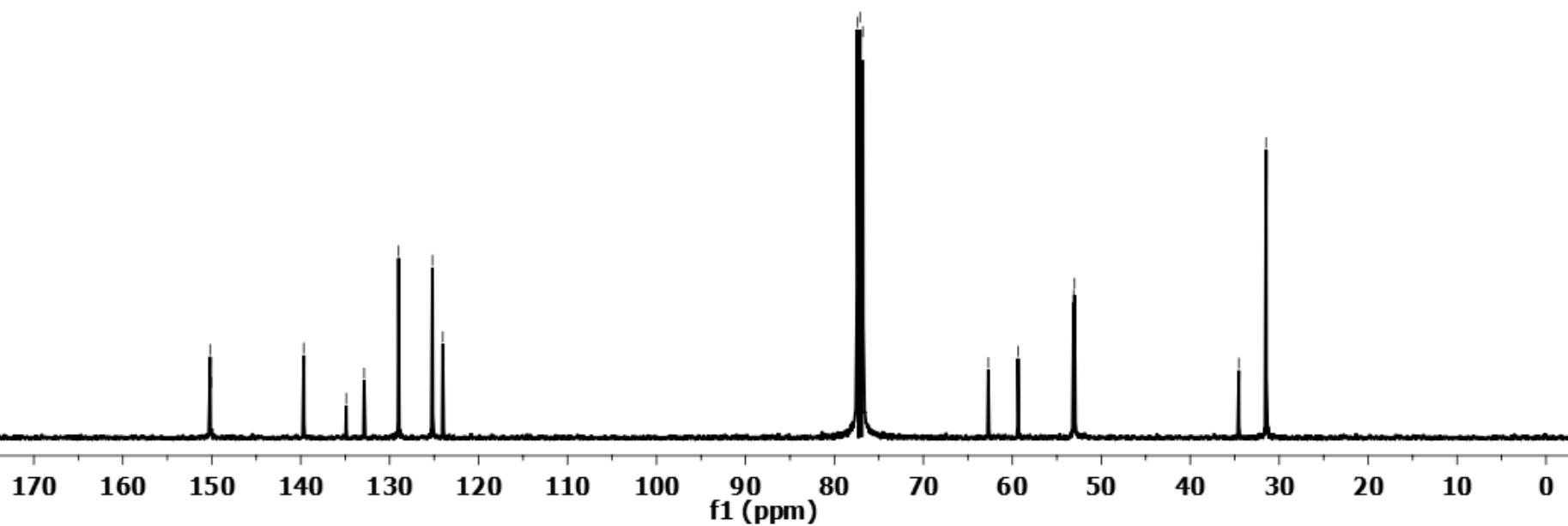
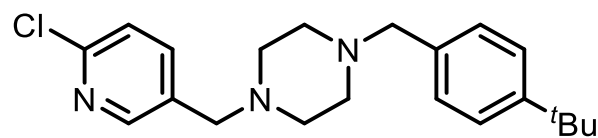
150.26  
150.19  
150.06

139.65  
134.88  
132.87  
129.00  
125.19  
124.03

77.44  
77.12  
76.80

62.69  
59.37  
53.10  
53.00

34.54  
31.47



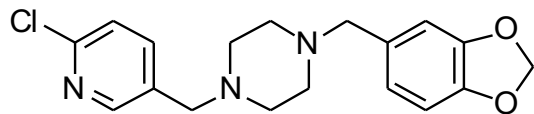
$^1\text{H}$  NMR of **3c** in  $\text{CDCl}_3$

8.27  
8.26  
7.62  
7.62  
7.60  
7.60  
7.26  
7.24  
6.81  
6.70

5.91  
5.90

3.45  
3.38

2.42



1.03

1.10

1.17

1.16

2.25

2.00

2.24

2.25

8.14

9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0

fl (ppm)

$^{13}\text{C}$  NMR of **3c** in  $\text{CDCl}_3$

150.16  
147.67  
146.66

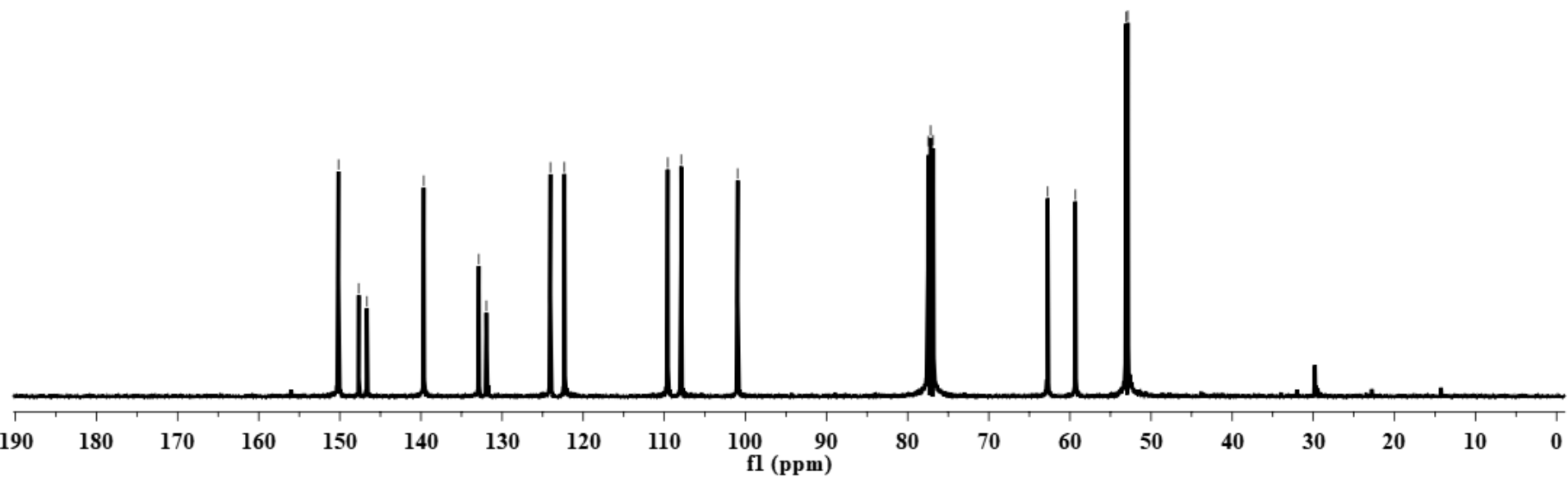
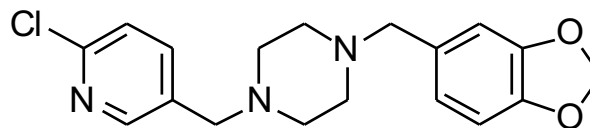
139.66  
132.87  
131.94

124.04  
122.32

109.58  
107.92  
100.96

77.49  
77.17  
76.85

62.74  
59.32  
53.07  
52.85



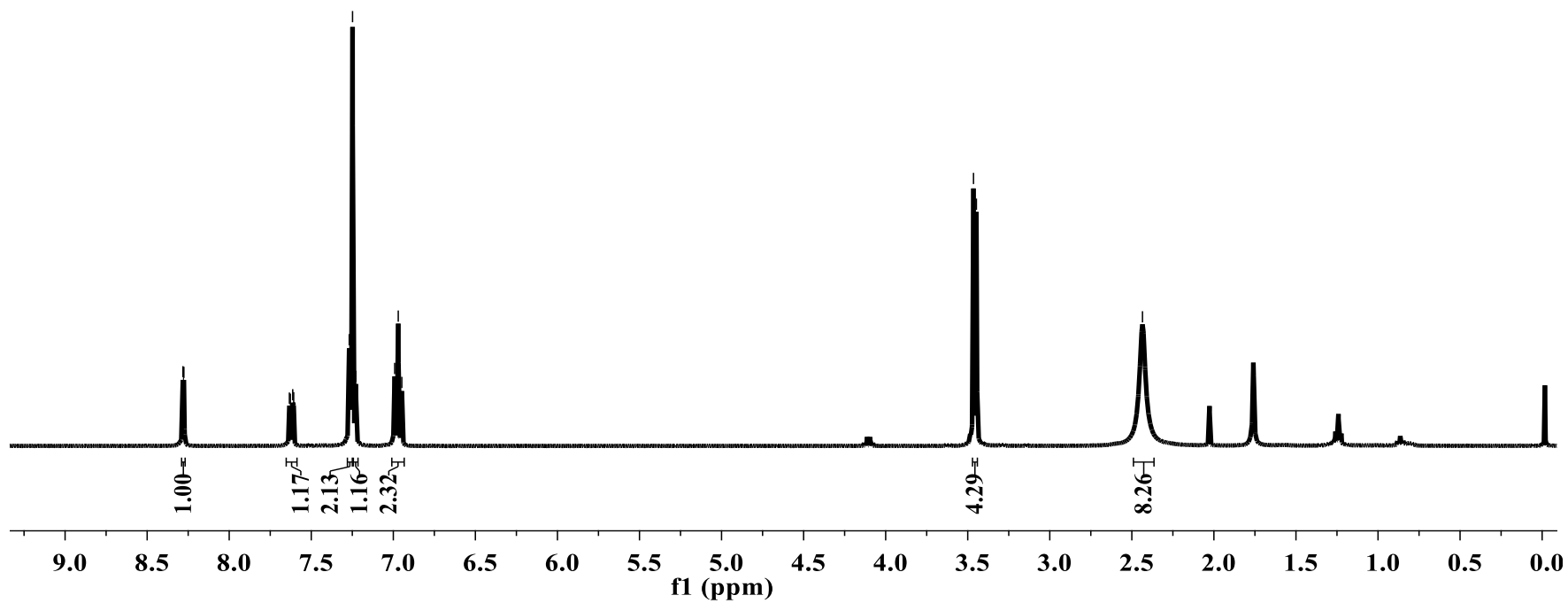
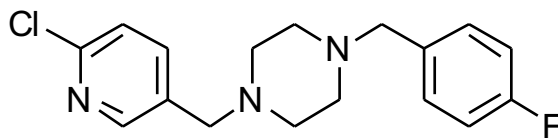


$^1\text{H}$  NMR of **3d** in  $\text{CDCl}_3$

8.28  
8.28  
7.63  
7.63  
7.61  
7.61  
7.27  
7.25  
7.23  
6.99  
6.97  
6.95

3.46  
3.45

2.44



$^{13}\text{C}$  NMR of **3d** in  $\text{CDCl}_3$

163.33  
160.89

150.29  
150.17  
148.34

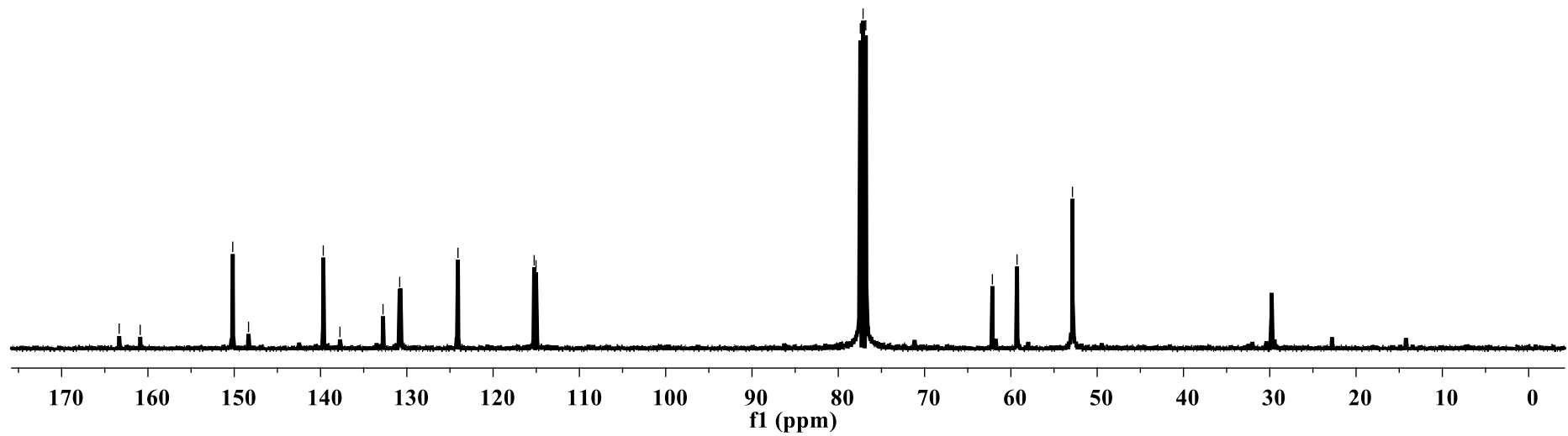
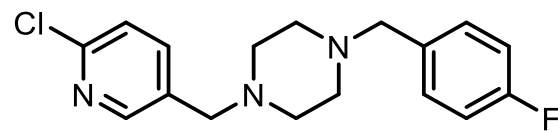
139.68  
137.75  
132.76  
130.82

124.07

115.24  
115.03

77.45  
77.13  
76.81

62.14  
59.29  
52.87

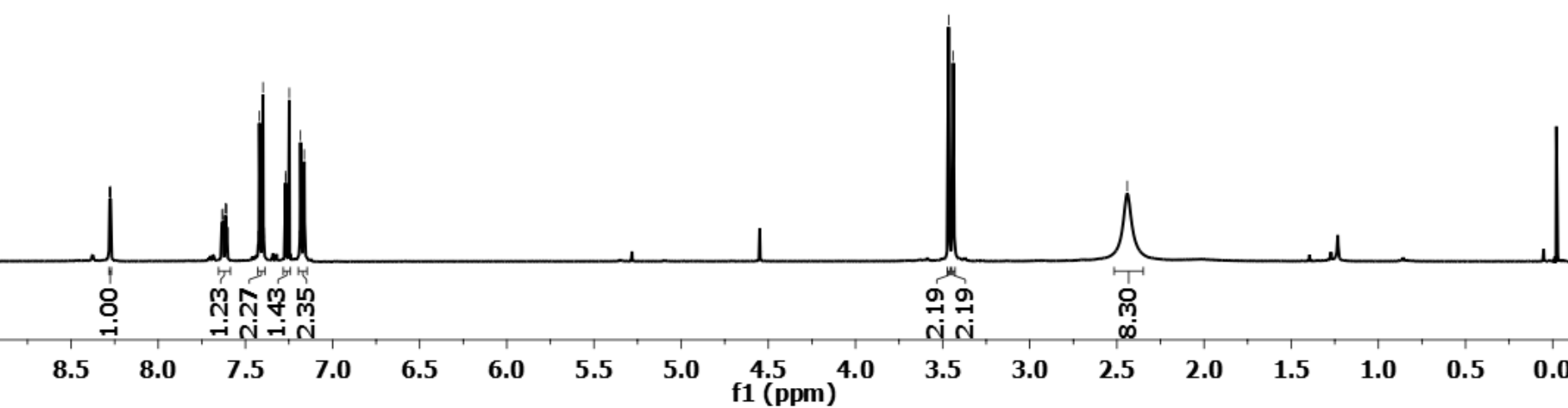
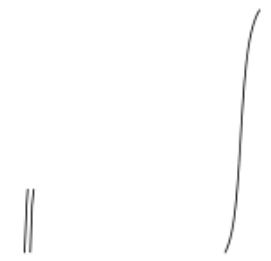
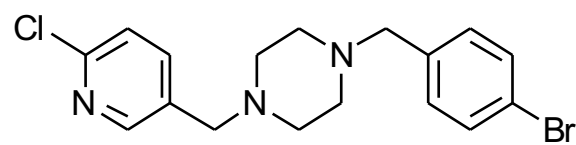


$^1\text{H}$  NMR of **3e** in  $\text{CDCl}_3$

8.28  
8.28  
8.27  
8.27  
7.63  
7.63  
7.61  
7.61  
7.43  
7.42  
7.41  
7.40  
7.40  
7.39  
7.27  
7.27  
7.25  
7.25  
7.19  
7.18  
7.18  
7.17  
7.16

3.47  
3.44

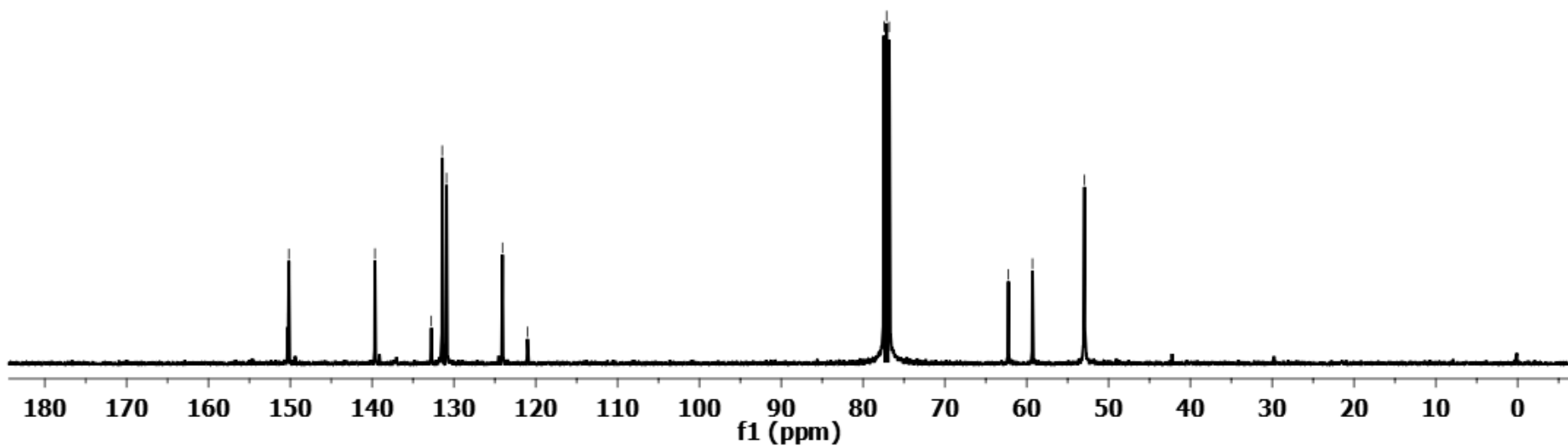
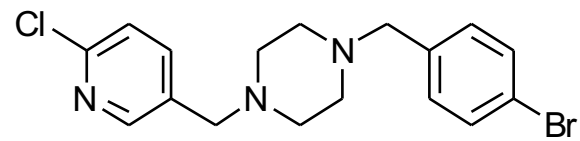
-2.44



$^{13}\text{C}$  NMR of **3e** in  $\text{CDCl}_3$

150.31  
150.17  
— 139.65  
132.76  
131.43  
130.90  
— 124.07  
— 121.01

77.44  
77.12  
76.80  
— 62.24  
— 59.30  
52.98  
52.93

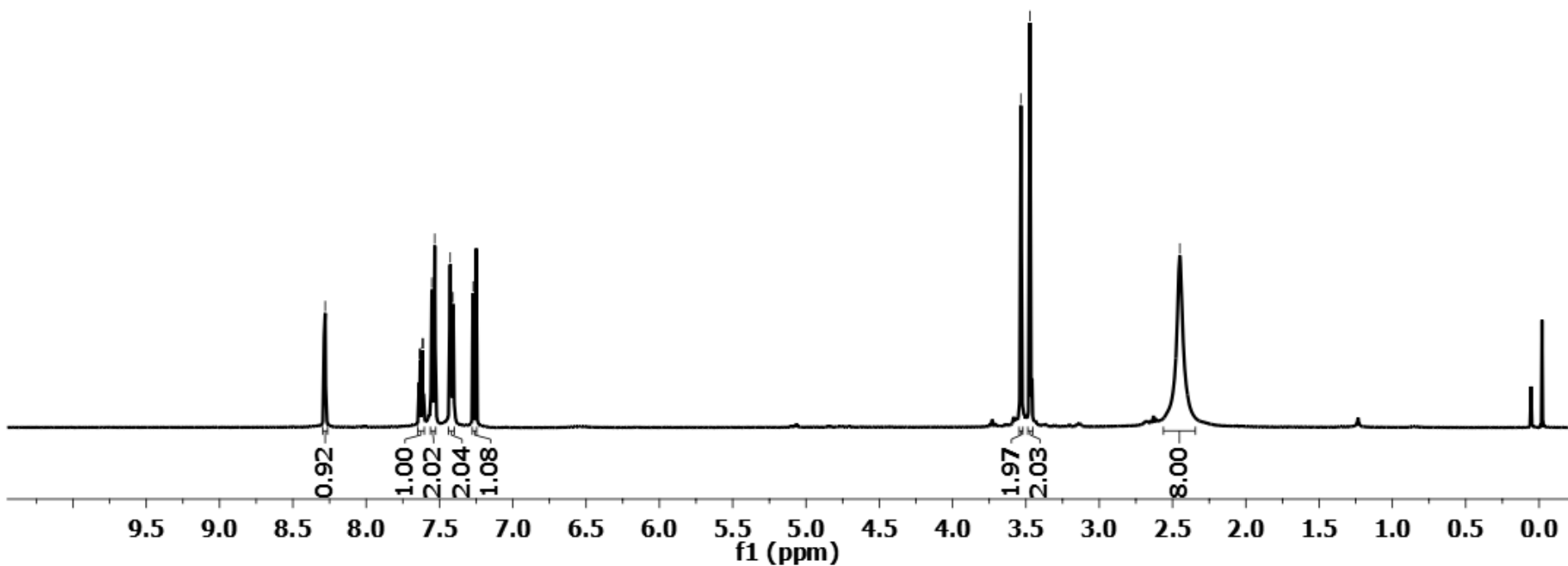
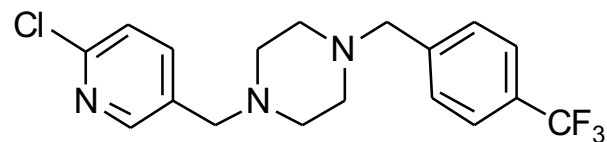


$^1\text{H}$  NMR of **3f** in  $\text{CDCl}_3$

8.28  
7.64  
7.63  
7.62  
7.61  
7.55  
7.53  
7.43  
7.41  
7.27

3.53  
3.47

2.45

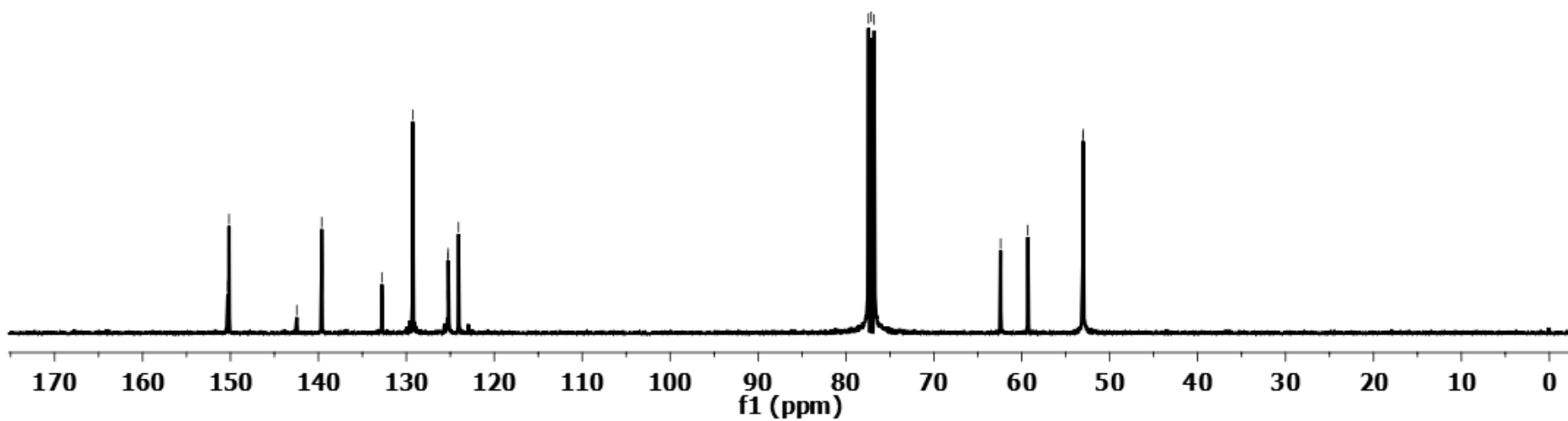
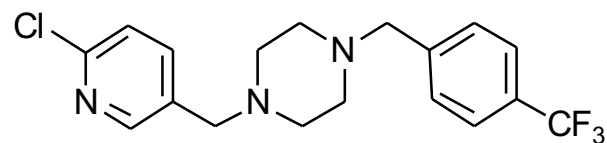


$^{13}\text{C}$  NMR of **3f** in  $\text{CDCl}_3$

150.31  
150.16  
142.46  
139.63  
132.79  
129.27  
125.31  
125.27  
125.23  
125.19  
124.06

77.43  
77.12  
76.80

62.41  
59.31  
53.05  
53.03



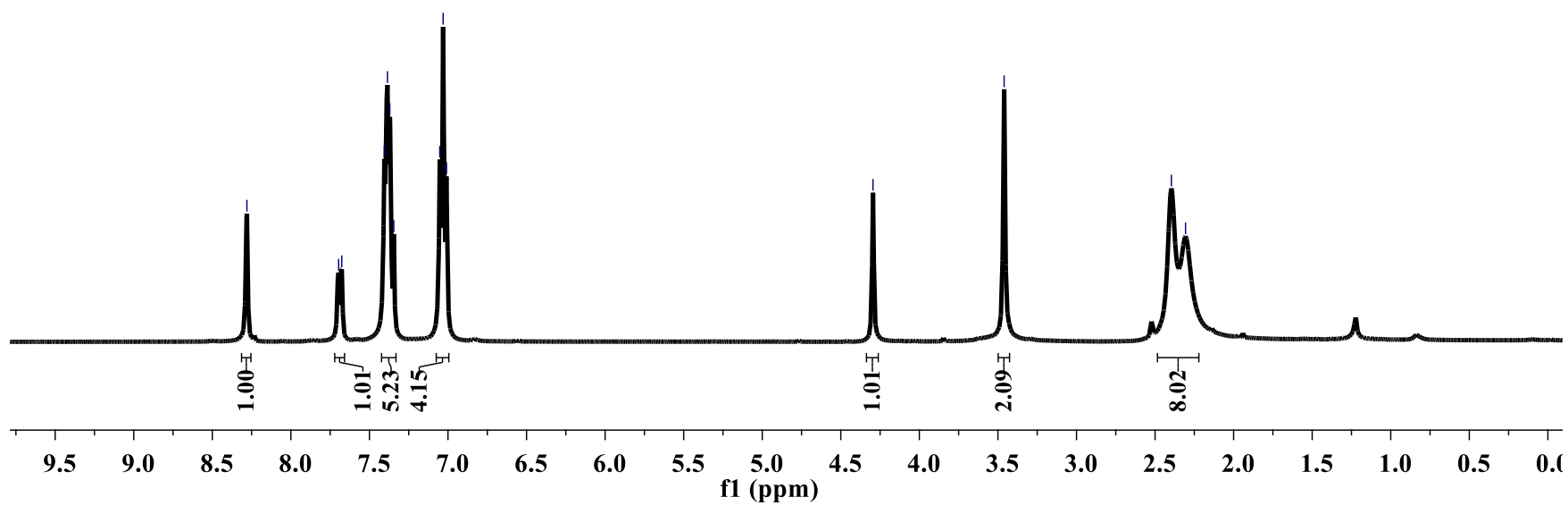
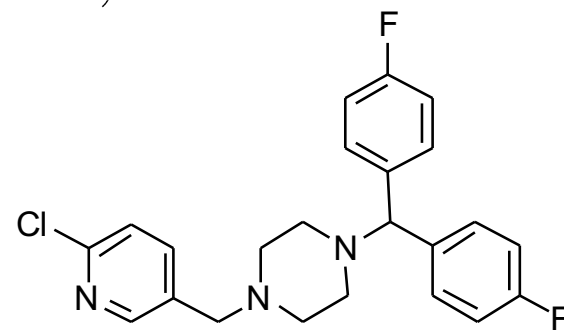
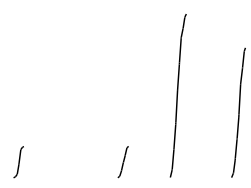
<sup>1</sup>H NMR of **3g** in CDCl<sub>3</sub>

8.28  
7.70  
7.68  
7.41  
7.39  
7.37  
7.34  
7.05  
7.03  
7.01

4.30

3.46

2.40  
2.31



<sup>13</sup>C NMR of 3g in CDCl<sub>3</sub>

163.09  
160.65

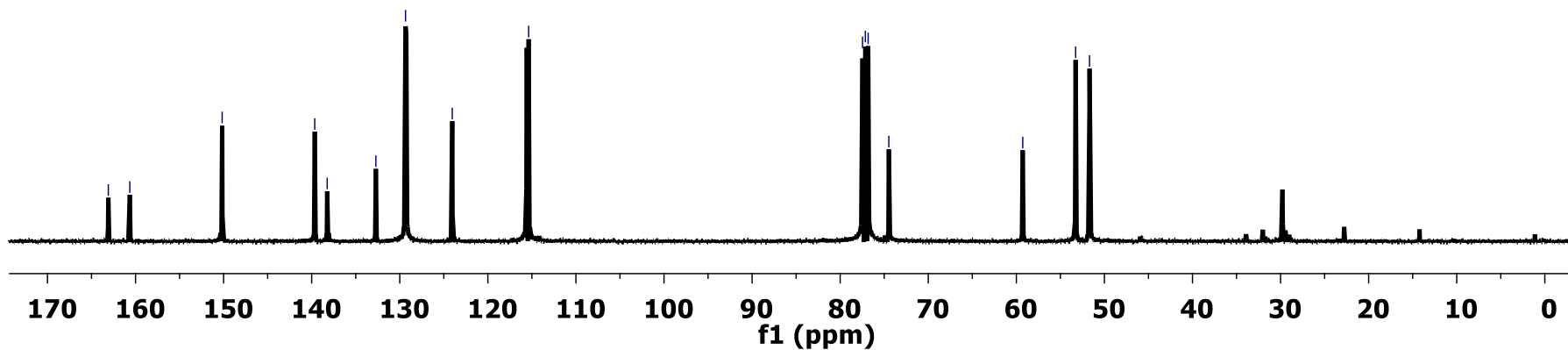
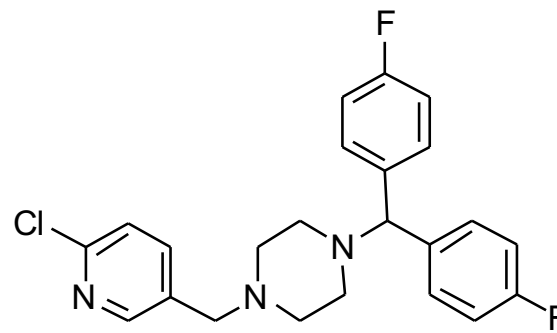
150.16

139.65  
138.24  
132.71  
129.35  
124.04

115.37

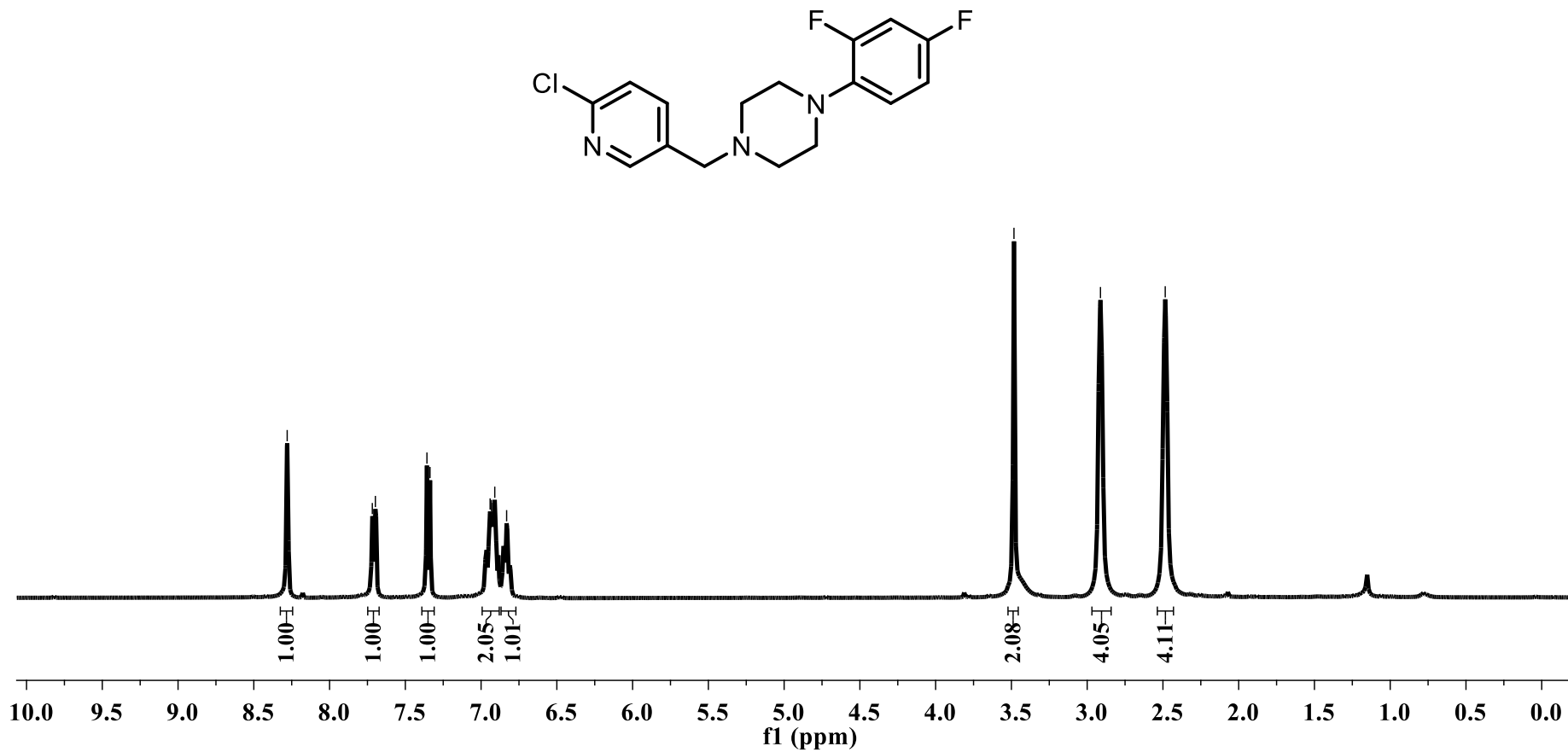
77.46  
77.14  
76.82  
74.48

59.27  
53.27  
51.69





<sup>1</sup>H NMR of **3h** in CDCl<sub>3</sub>

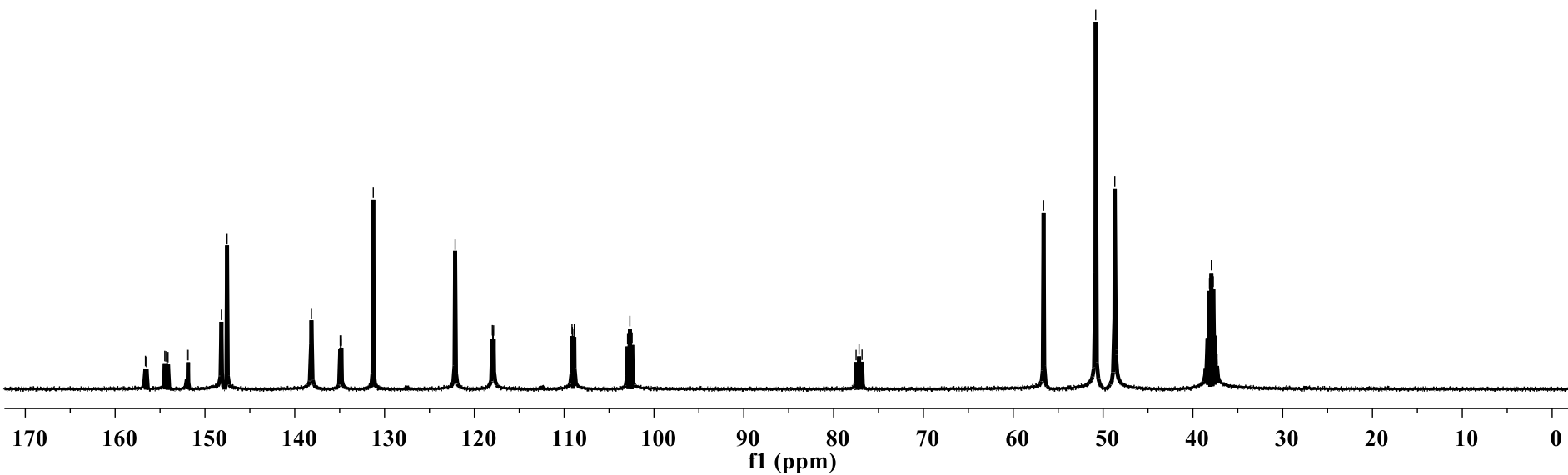
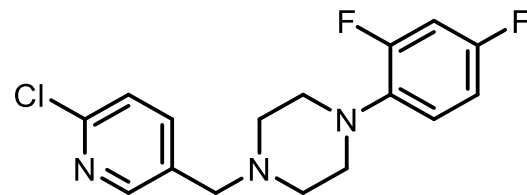


$^{13}\text{C}$  NMR of **3h** in  $\text{CDCl}_3$

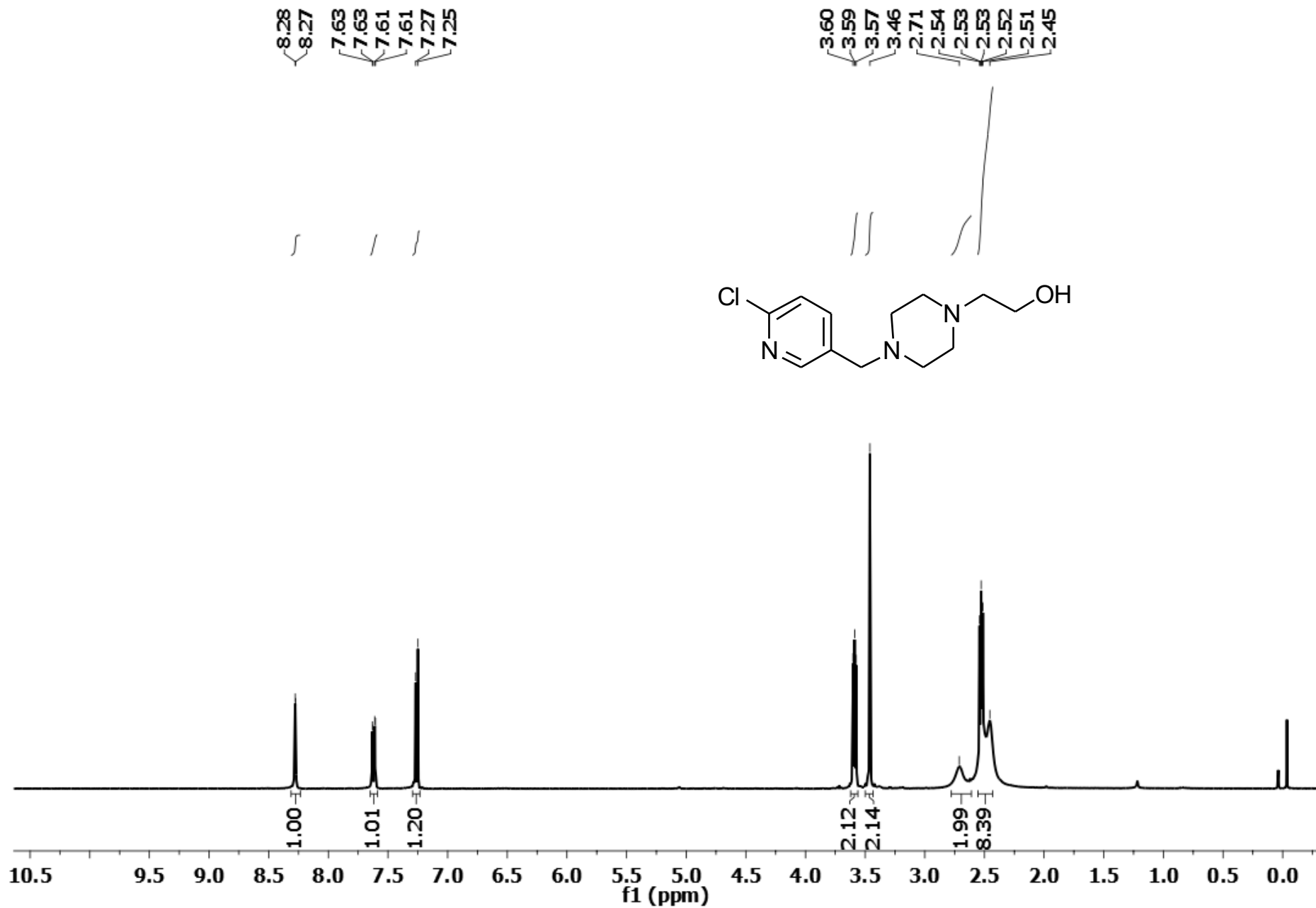
156.6  
154.5  
154.4  
154.2  
154.1  
152.0  
151.9  
148.2  
147.5  
138.1  
134.9  
134.8  
134.8  
131.3  
122.1  
118.0  
117.9  
117.9  
109.1  
109.1  
108.9  
108.9  
102.9  
102.7  
102.4

77.5  
77.2  
76.8

56.6  
50.8  
48.7  
38.6  
38.4  
38.2  
37.9  
37.7  
37.5  
37.3



$^1\text{H}$  NMR of **3i** in  $\text{CDCl}_3$



$^{13}\text{C}$  NMR of **3i** in  $\text{CDCl}_3$

—150.14

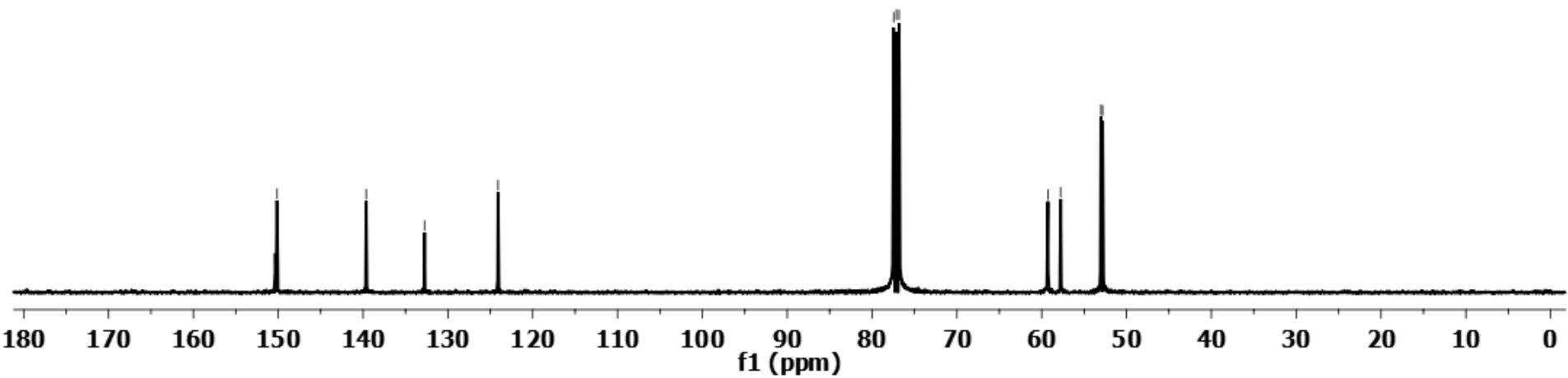
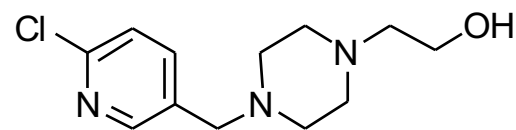
—139.63

—132.75

—124.09

77.45  
77.13  
76.82

59.27  
57.77  
53.02  
52.83

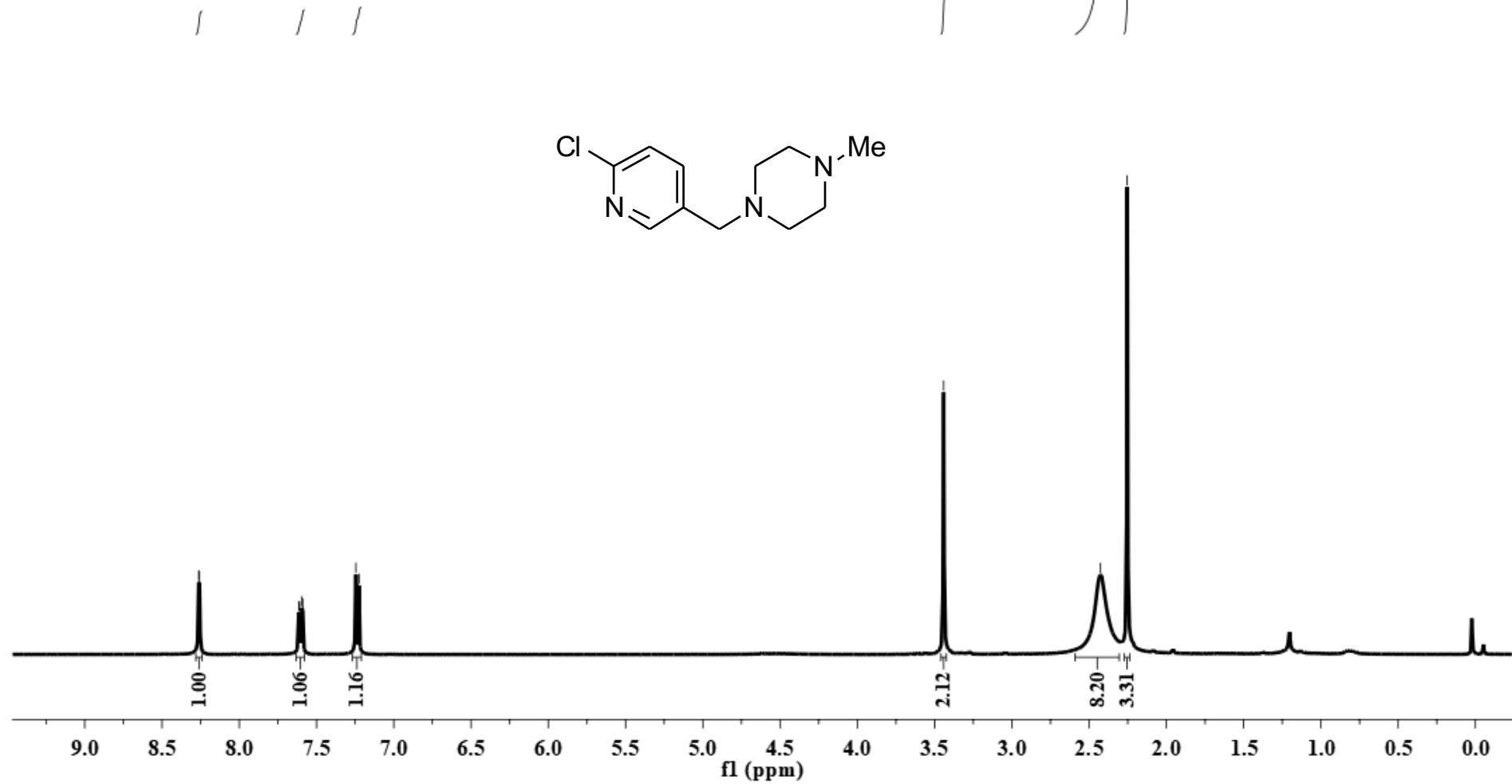
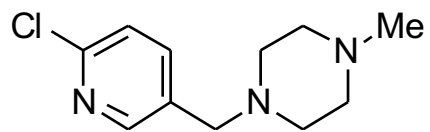


$^1\text{H}$  NMR of **3j** in  $\text{CDCl}_3$

8.26  
8.26  
7.62  
7.61  
7.59  
7.59  
7.25  
7.22

3.44

2.43  
2.25



$^{13}\text{C}$  NMR of **3j** in  $\text{CDCl}_3$

150.30  
150.11

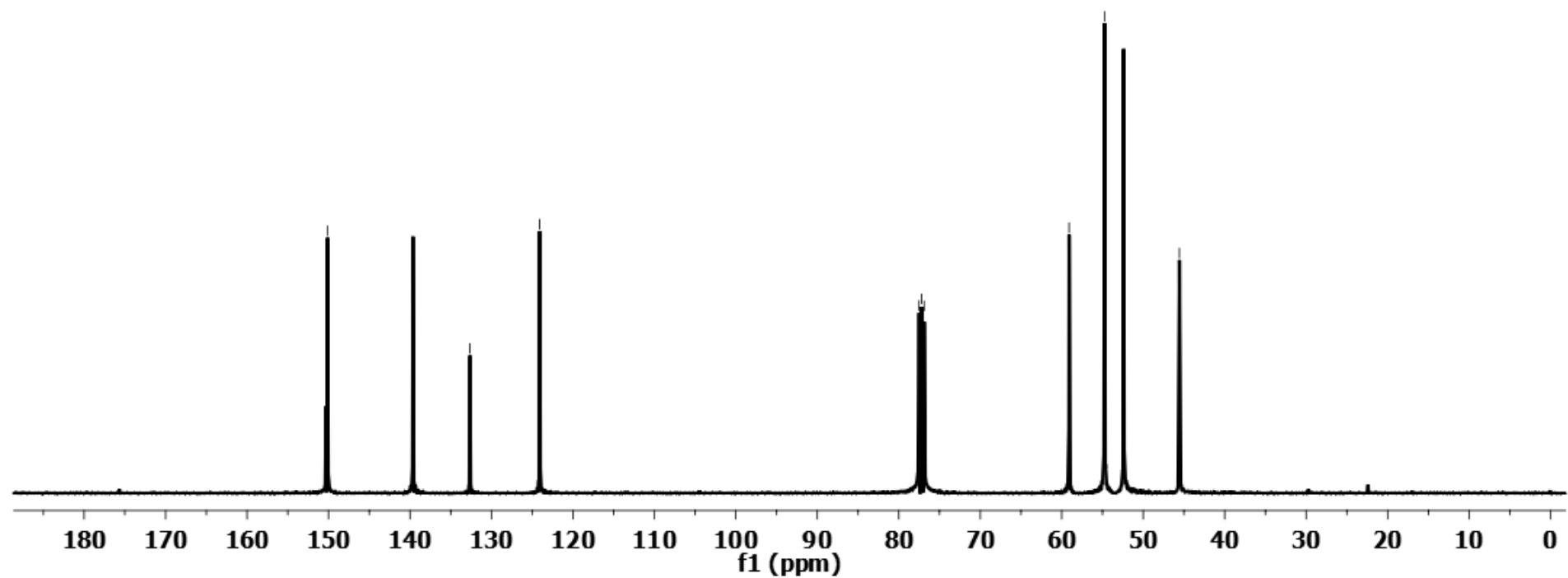
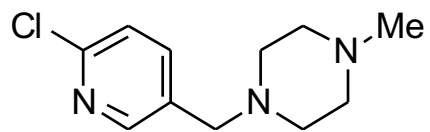
139.66

132.63

124.07

77.52  
77.21  
76.89

59.09  
54.74  
52.42  
45.56



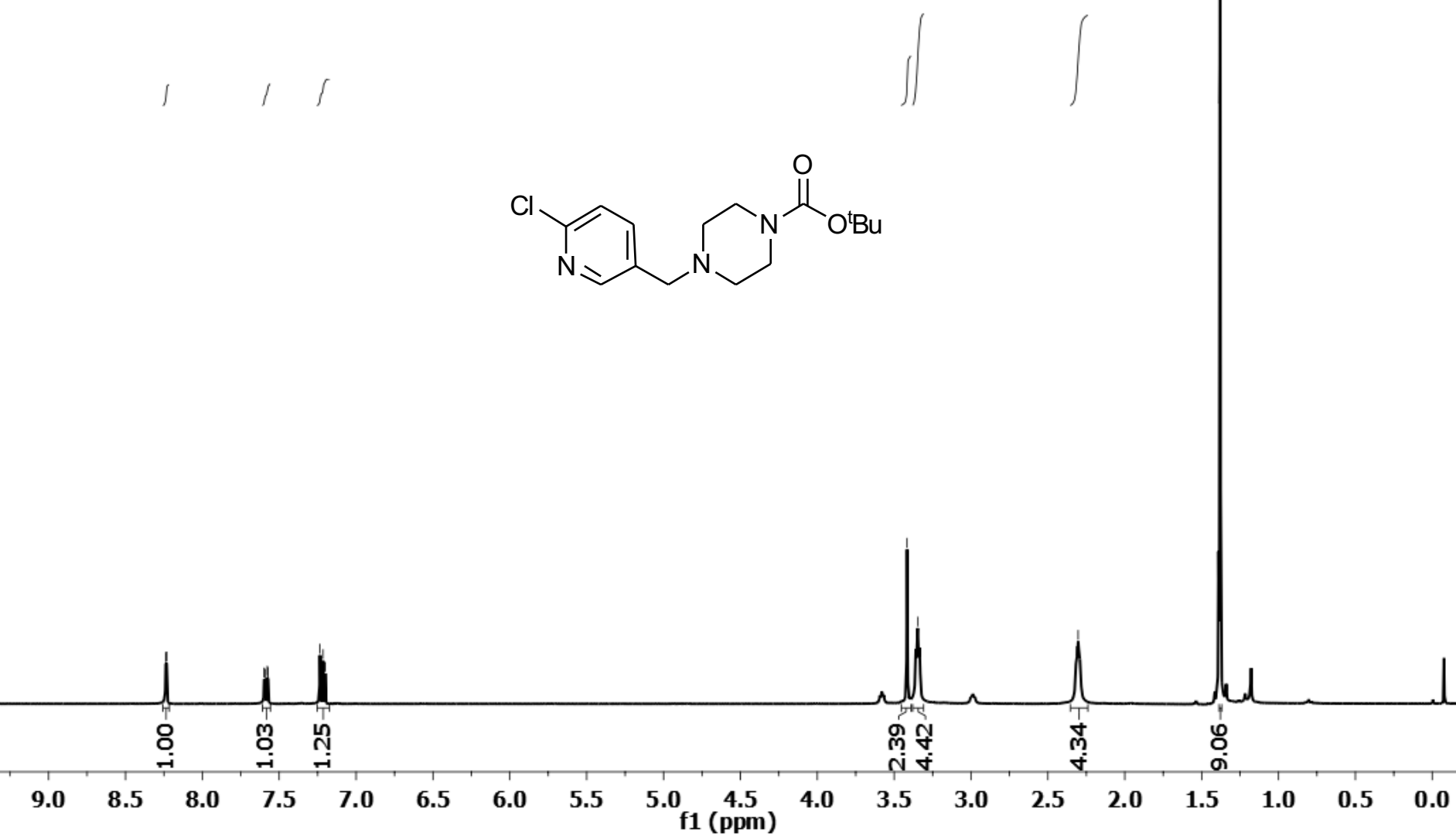
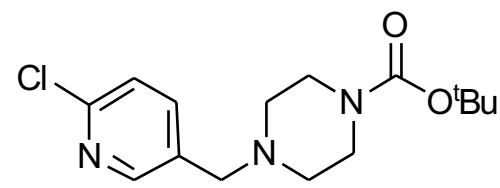
$^1\text{H}$  NMR of **3k** in  $\text{CDCl}_3$

8.24  
8.23  
7.60  
7.59  
7.58  
7.57  
7.24  
7.21  
7.20

3.42  
3.35

2.31  
2.30

1.38



1.00

1.03

1.25

2.39

4.42

4.34

9.06

9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0

f1 (ppm)

$^{13}\text{C}$  NMR of **3k** in  $\text{CDCl}_3$

154.79  
150.45  
150.11

139.58

132.58

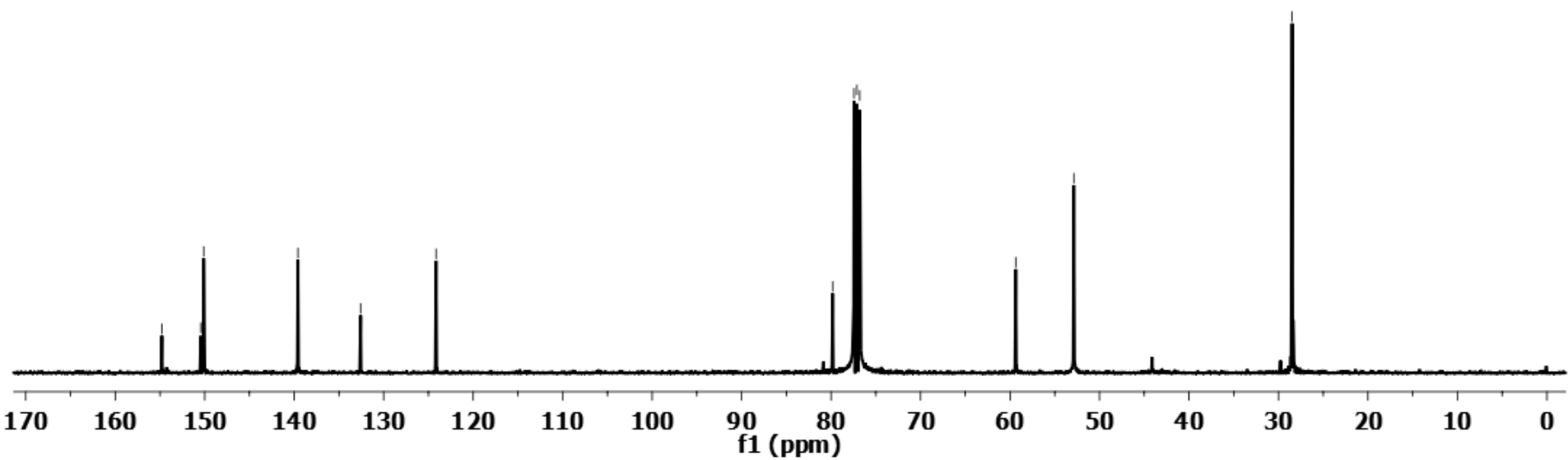
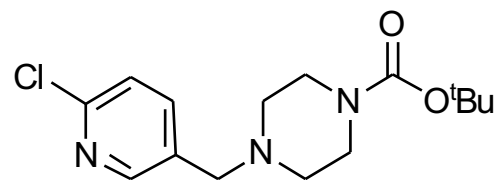
124.15

79.82  
77.44  
77.12  
76.80

59.36

52.87

28.48





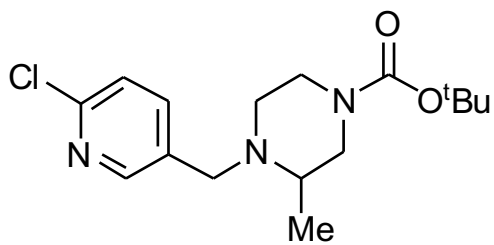
$^1\text{H}$  NMR of **31** in  $\text{CDCl}_3$

8.16  
8.16  
7.55  
7.55  
7.53  
7.53  
7.25  
7.15  
7.13

3.81  
3.78  
3.50  
3.47  
3.11  
3.07  
2.99  
2.97  
2.82  
2.73  
2.46  
2.43  
2.35  
2.34  
2.00  
1.97  
1.95

9.34

0.98  
0.96



1.00

1.04

1.03

1.07

2.14

1.02

1.07

1.08

2.08

1.01

9.35

3.09

9.0

8.5

8.0

7.5

7.0

6.5

6.0

5.5

5.0

4.5

4.0

3.5

3.0

2.5

2.0

1.5

1.0

0.5

0.0

f1 (ppm)

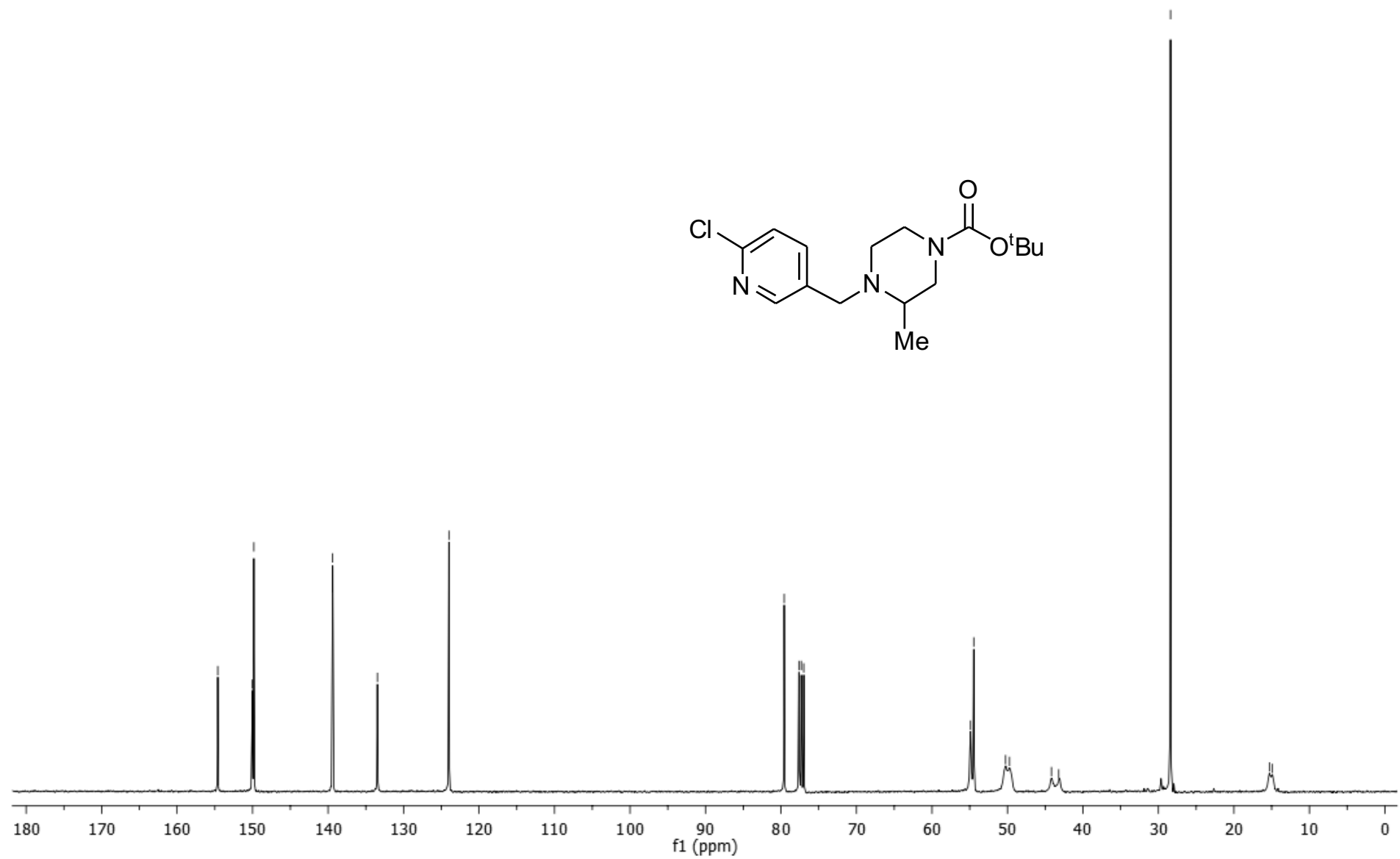
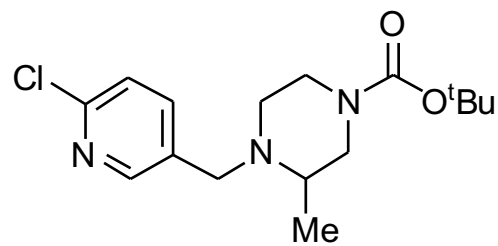
$^{13}\text{C}$  NMR of **31** in  $\text{CDCl}_3$

154.61  
150.04  
149.83  
139.39  
133.47  
123.99

79.57  
77.63  
77.31  
76.99

54.89  
54.46  
50.24  
49.72  
44.17  
43.21

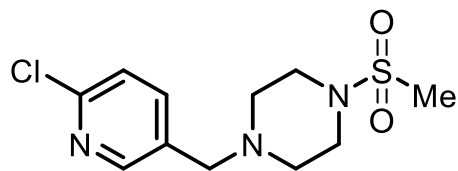
28.39  
15.29  
14.90



$^1\text{H}$  NMR of **3m** in  $\text{CDCl}_3$

8.31  
8.30  
7.65  
7.64  
7.63  
7.62  
7.30  
7.28

3.54  
3.24  
3.23  
2.77  
2.56



1.00

1.15

1.28

2.03

3.97

3.40

4.31

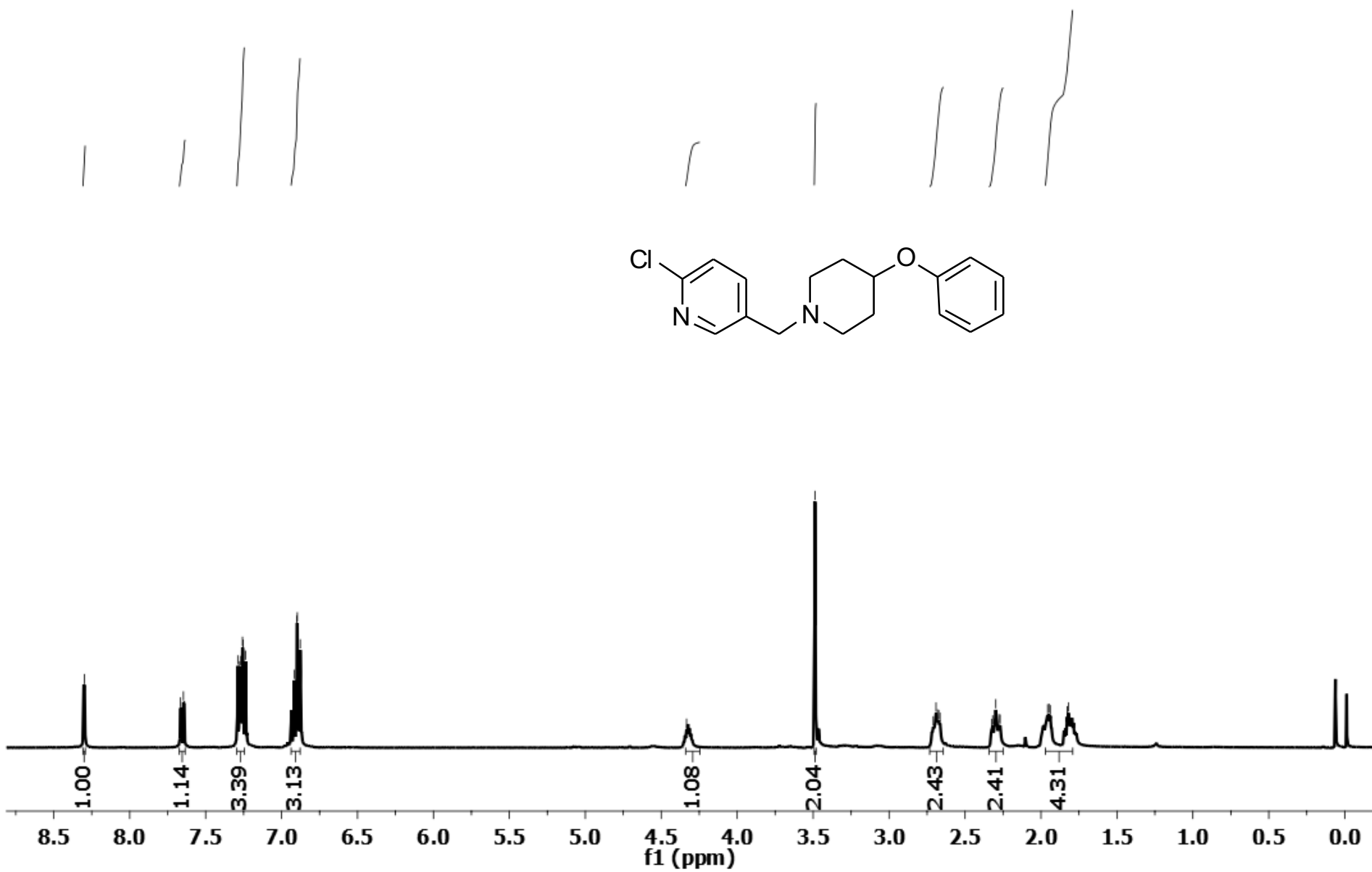
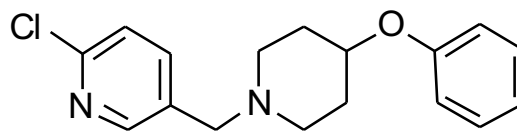
9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0

fl (ppm)



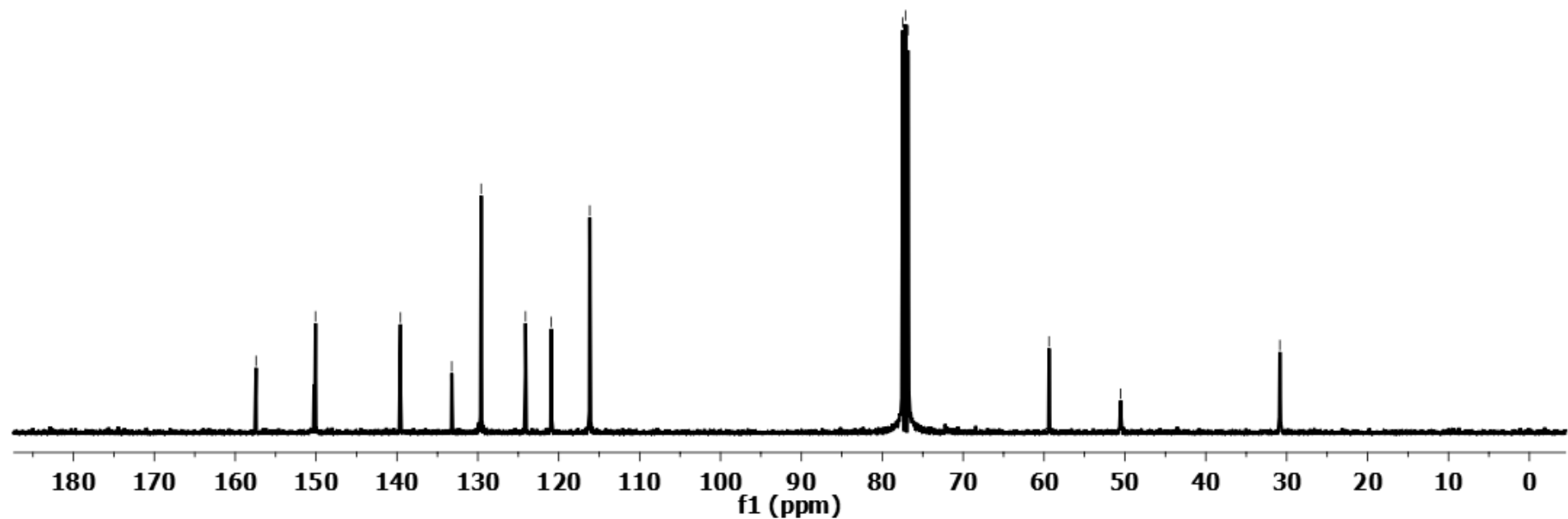
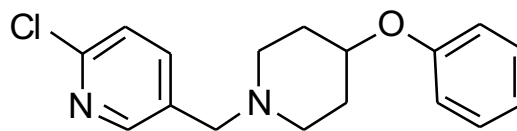
$^1\text{H}$  NMR of **3n** in  $\text{CDCl}_3$

8.30  
7.67  
7.65  
7.26  
7.25  
6.92  
6.90  
6.90  
6.88  
6.87  
4.33  
3.49  
2.71  
2.69  
2.68  
2.67  
2.66  
2.30  
2.28  
1.96  
1.95  
1.94  
1.83  
1.82



$^{13}\text{C}$  NMR of **3n** in  $\text{CDCl}_3$

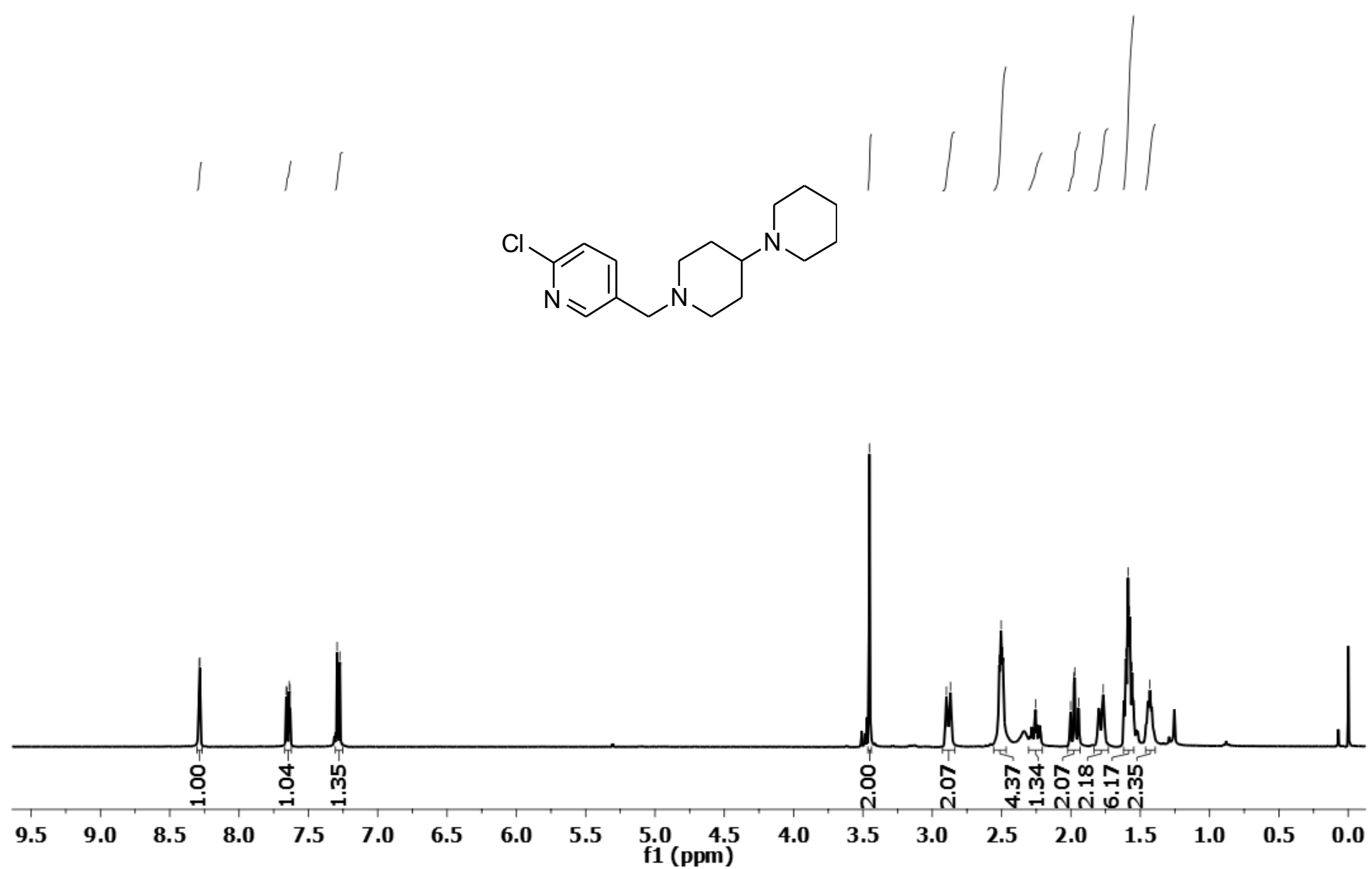
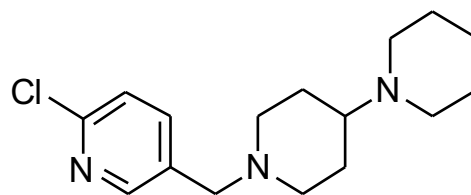
—157.43  
—150.07  
139.57  
133.23  
129.60  
124.11  
120.92  
116.17  
77.46  
77.14  
76.82  
—59.39  
—50.53  
—30.85



$^1\text{H}$  NMR of **30** in  $\text{CDCl}_3$

8.29  
8.28  
7.66  
7.64  
7.63  
7.28  
7.27

3.45  
2.90  
2.87  
2.52  
2.50  
2.49  
2.25  
2.00  
1.98  
1.97  
1.94  
1.77  
1.60  
1.59  
1.58  
1.56  
1.43



$^{13}\text{C}$  NMR of **3o** in  $\text{CDCl}_3$

— 150.06

— 139.57

— 133.26

— 124.03

77.44

77.12

76.80

62.66

59.34

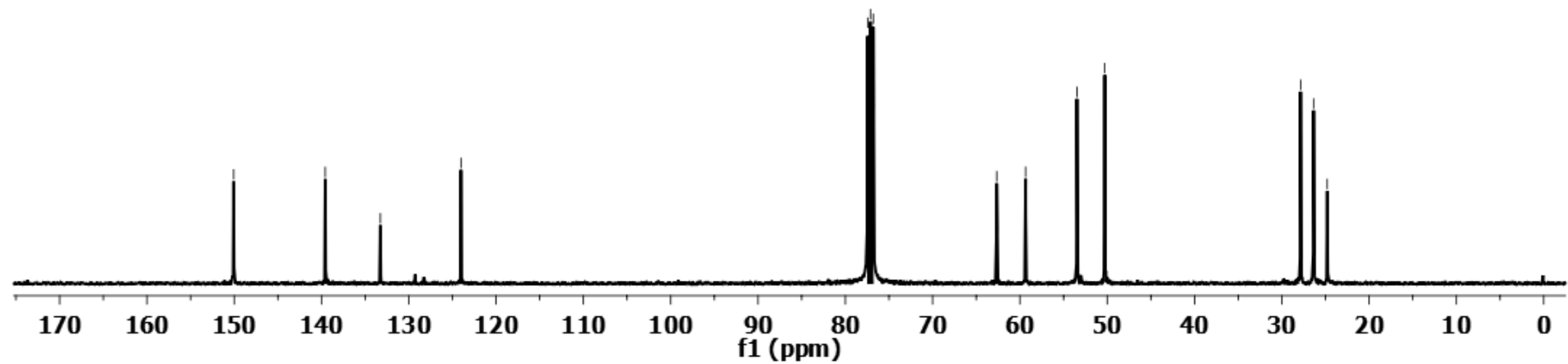
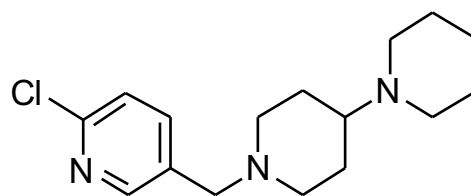
53.47

50.28

27.85

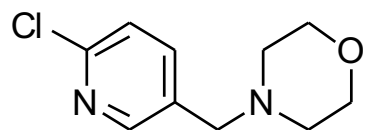
26.36

24.80





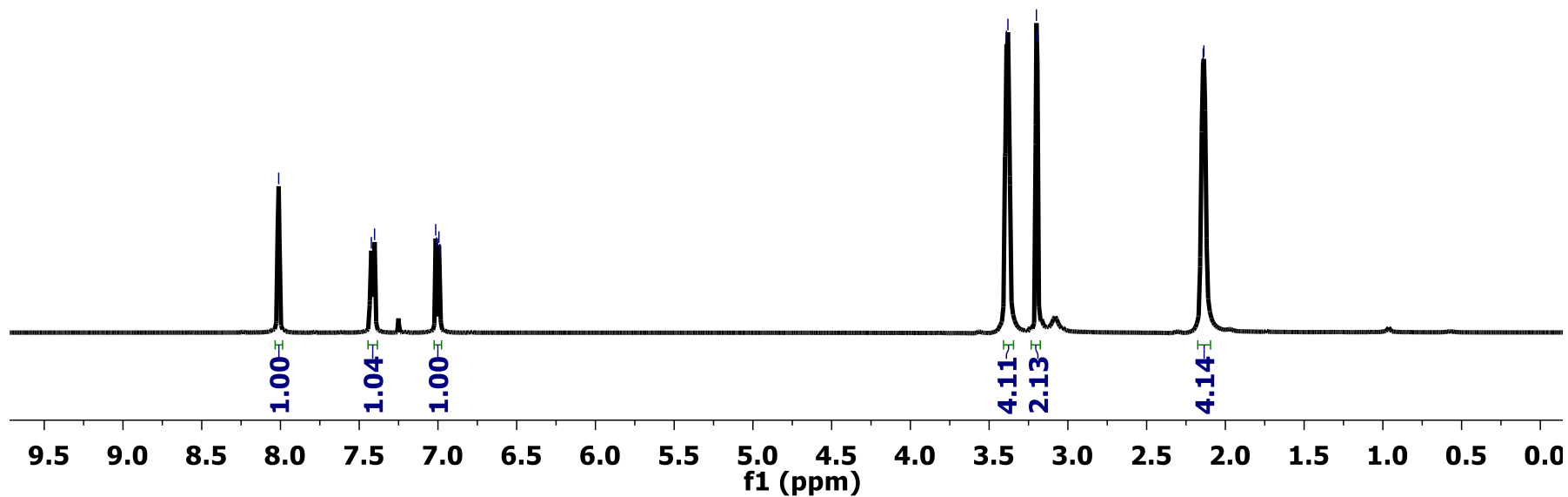
$^1\text{H}$  NMR of **3p** in  $\text{CDCl}_3$



8.01  
7.42  
7.40  
7.01  
7.01  
6.99  
6.99

3.39  
3.38  
3.20  
3.20

2.14  
2.14



<sup>13</sup>C NMR of **3p** in CDCl<sub>3</sub>

— 149.88

— 139.57

— 132.41

— 123.85

77.93

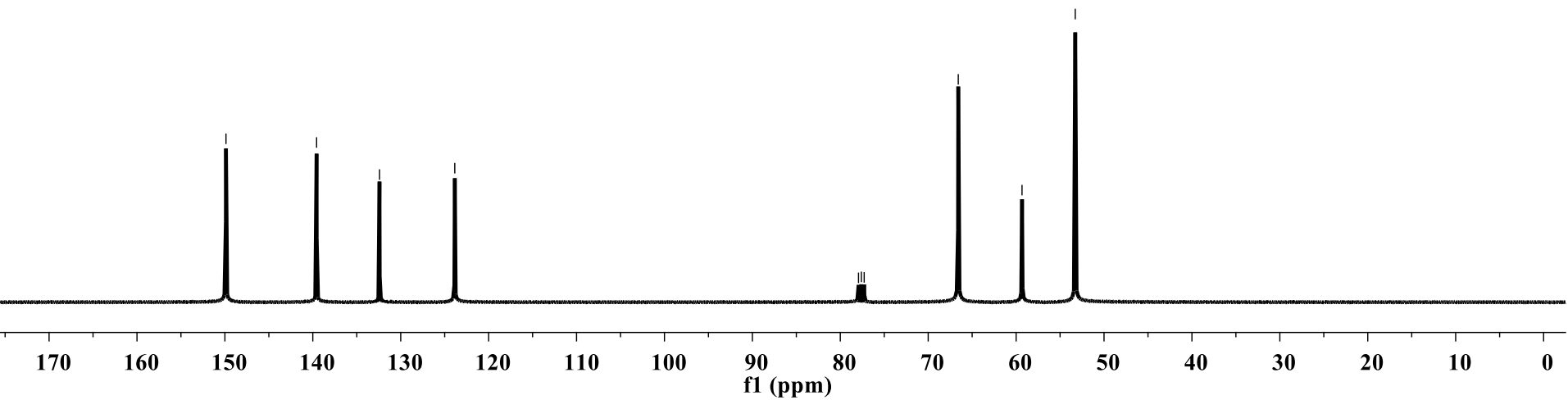
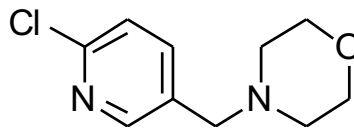
77.60

77.28

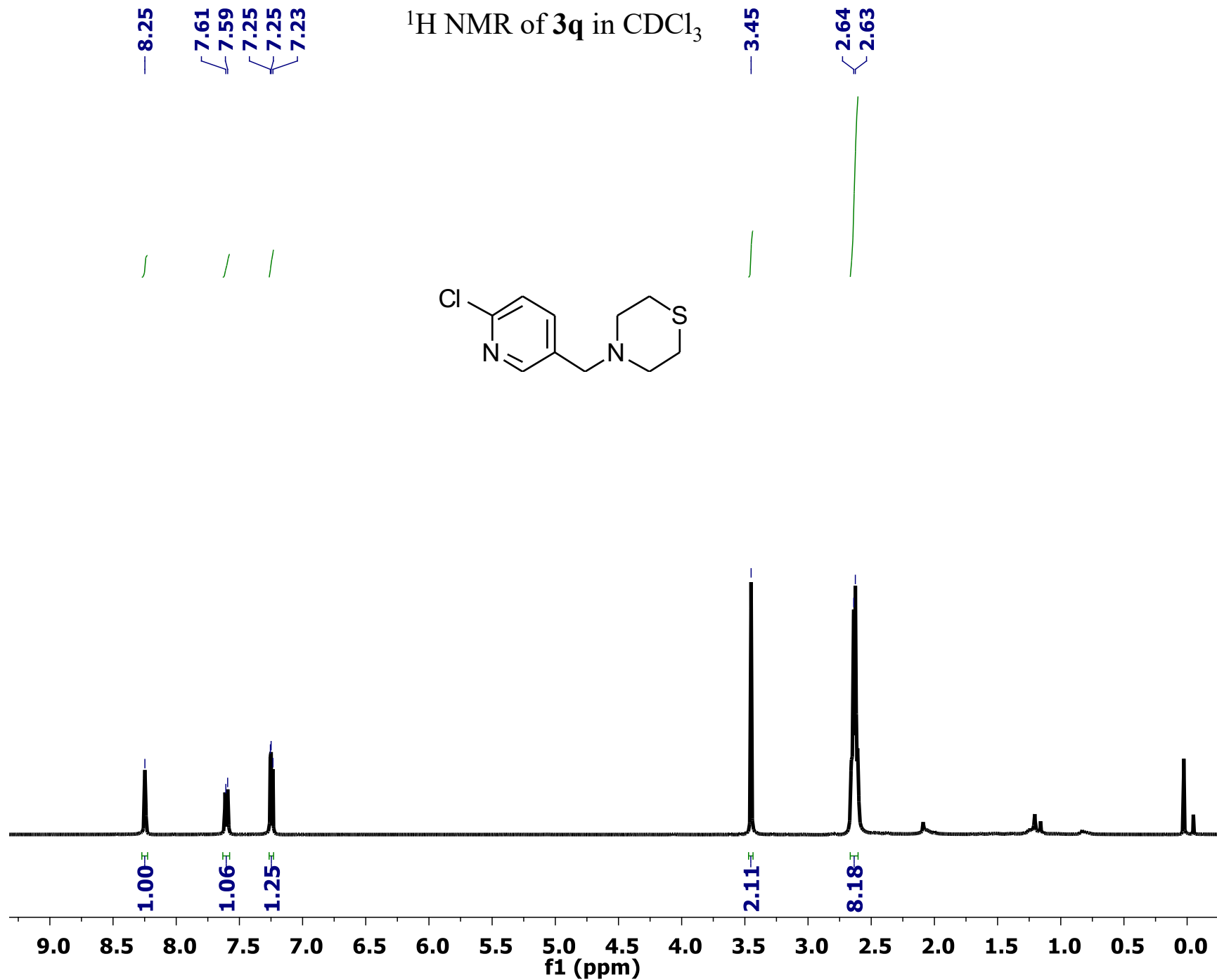
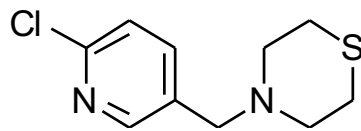
— 66.58

— 59.33

— 53.27



<sup>1</sup>H NMR of **3q** in CDCl<sub>3</sub>



$^{13}\text{C}$  NMR of **3q** in  $\text{CDCl}_3$

150.32  
150.03

139.50

132.78

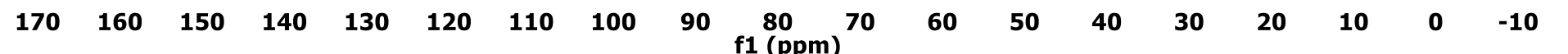
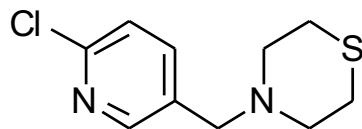
124.11

77.50  
77.18  
76.86

59.98

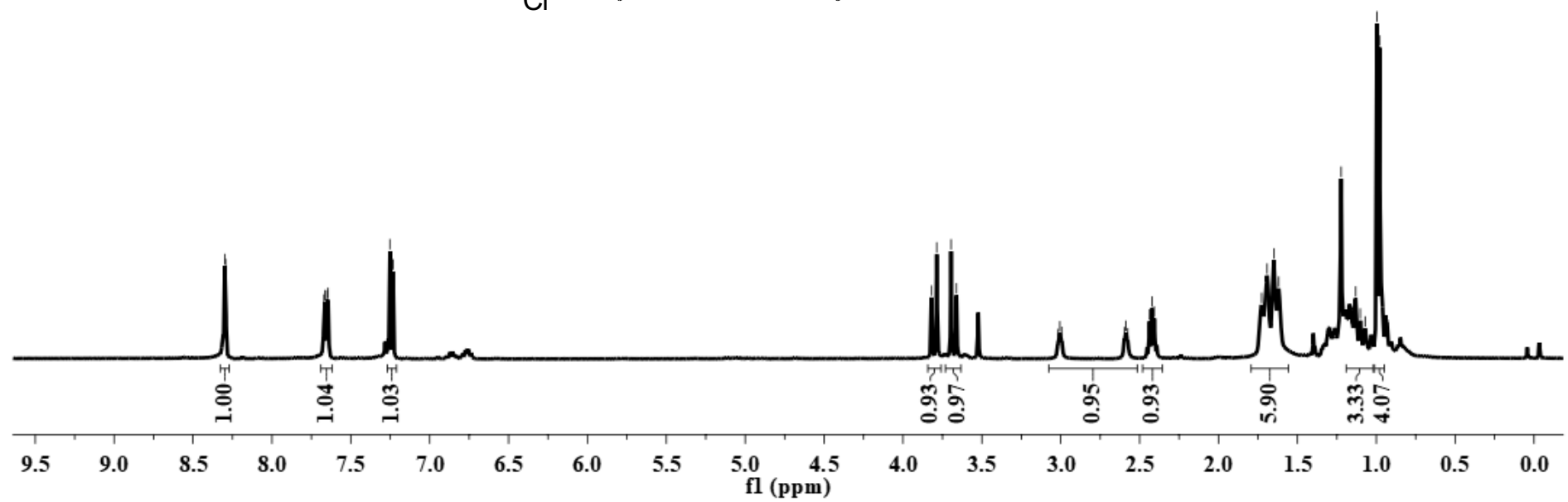
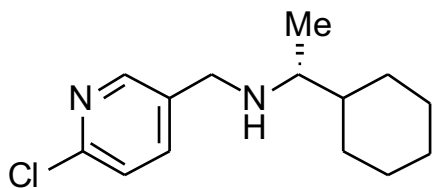
54.91

28.01



$^1\text{H}$  NMR of **3r** in  $\text{CDCl}_3$

8.30  
8.29  
7.66  
7.65  
7.64  
7.25  
7.23  
3.82  
3.79  
3.70  
3.66  
3.02  
3.01  
2.99  
2.59  
2.44  
2.42  
2.41  
1.69  
1.65  
1.62  
1.15  
1.13  
1.10  
1.07  
1.00  
0.98



$^{13}\text{C}$  NMR of **3r** in  $\text{CDCl}_3$

149.93  
149.39

138.84  
135.51

124.01

77.45  
77.14  
76.82

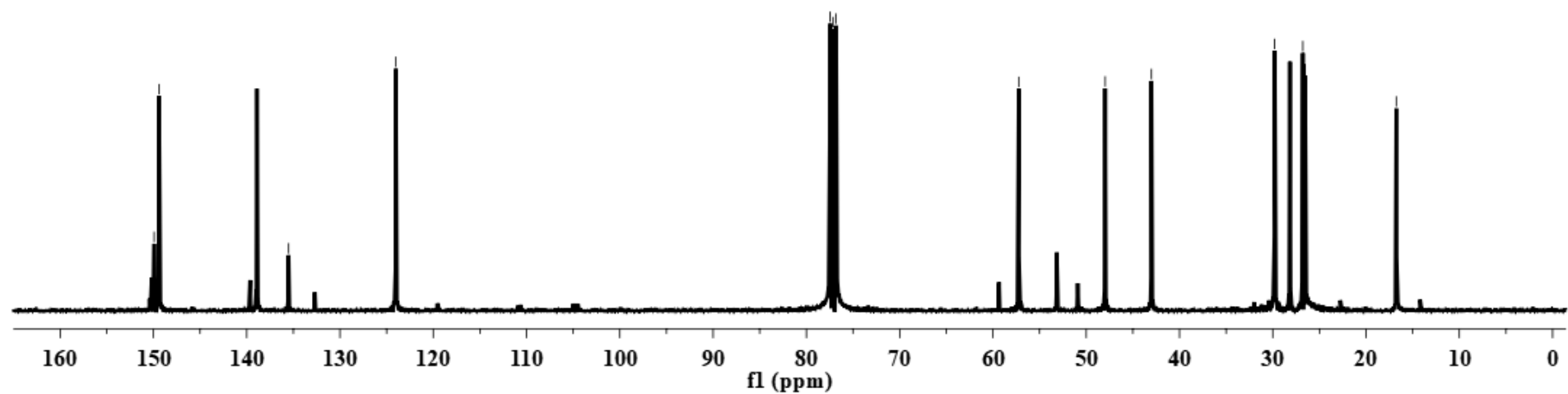
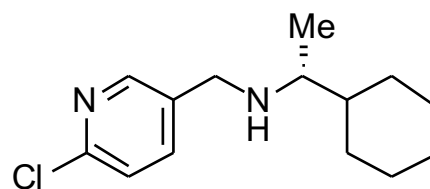
57.23

47.97

43.01

29.79  
28.13  
26.78  
26.66  
26.54

16.75

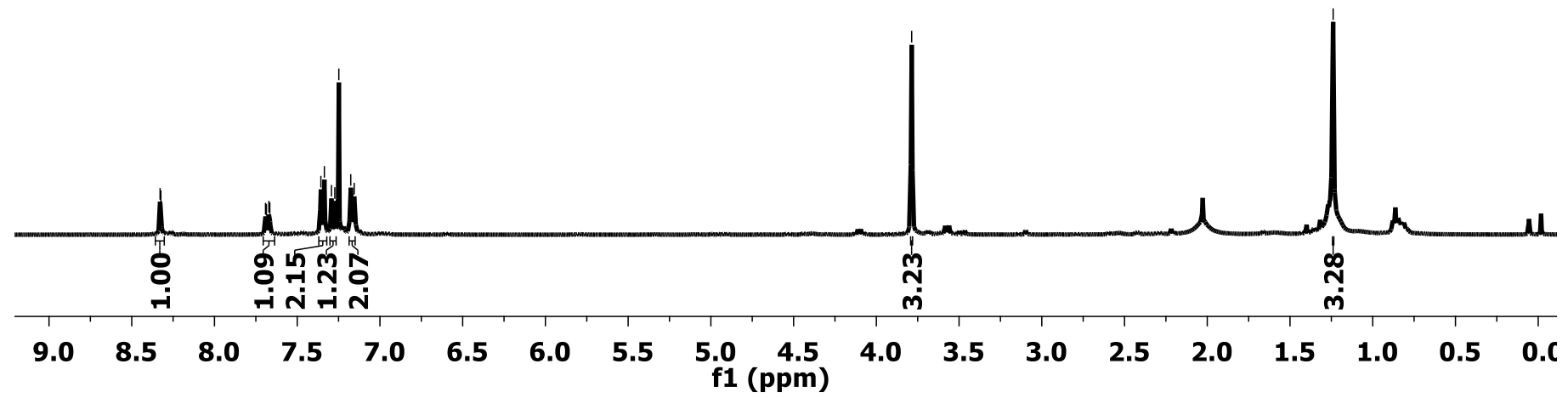
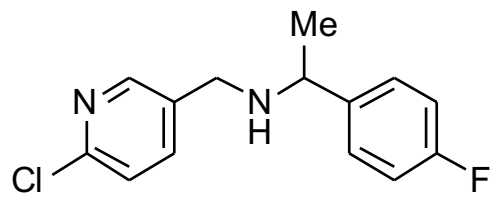


8.33  
8.32  
7.69  
7.69  
7.67  
7.67  
7.36  
7.34  
7.29  
7.27  
7.25  
7.18  
7.16

<sup>1</sup>H NMR of **3s** in CDCl<sub>3</sub>

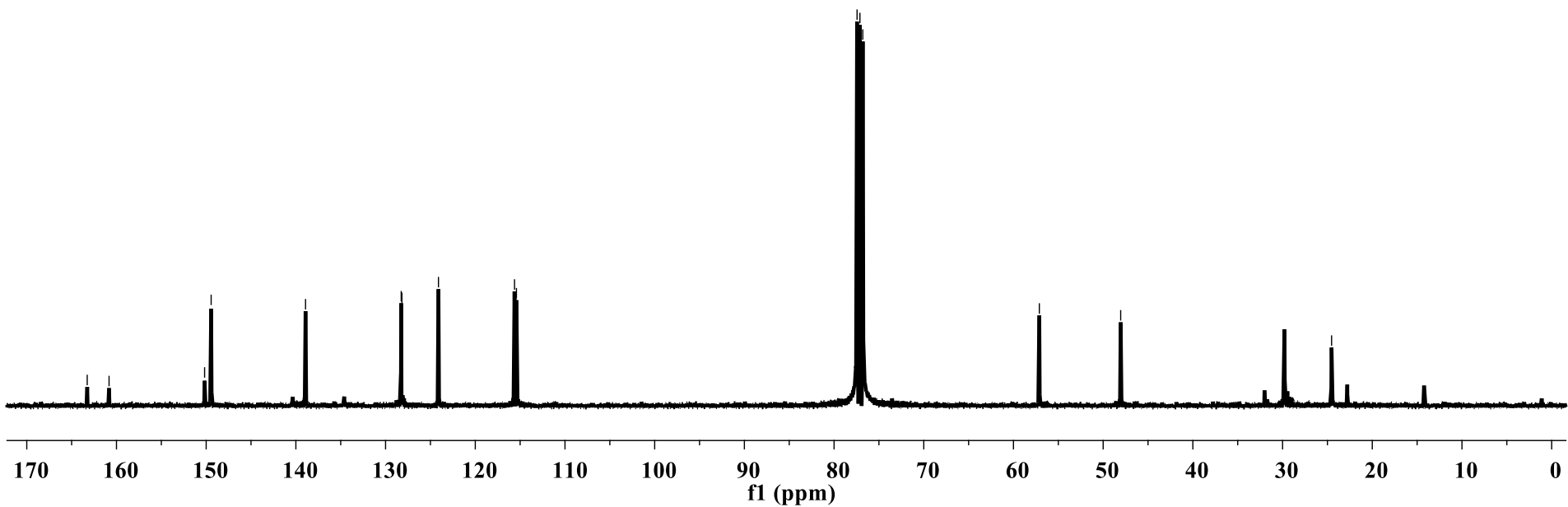
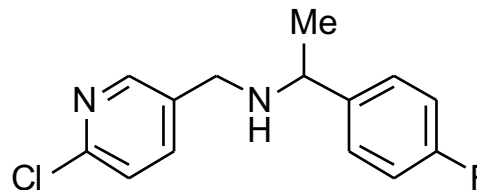
3.79

1.24



$^{13}\text{C}$  NMR of **3s** in  $\text{CDCl}_3$

~ 163.26  
~ 160.83  
  
{ 150.18  
  149.45  
  
— 138.92  
  
{ 128.26  
  128.18  
  124.10  
  
{ 115.62  
  115.41  
  
{ 77.44  
  77.12  
  76.80  
  
— 57.12  
— 48.05  
  
— 24.54

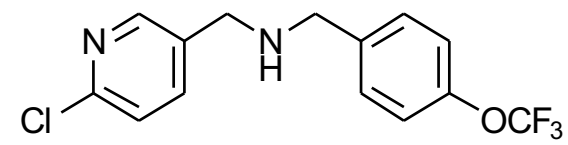




$^1\text{H}$  NMR of **3t** in  $\text{DMSO } d_6$

8.54  
8.54  
8.12  
8.11  
8.10  
8.09  
7.72  
7.69  
7.62  
7.60  
7.57  
7.55  
7.40  
7.38

4.19  
4.17



1.46

1.17

1.00

2.02

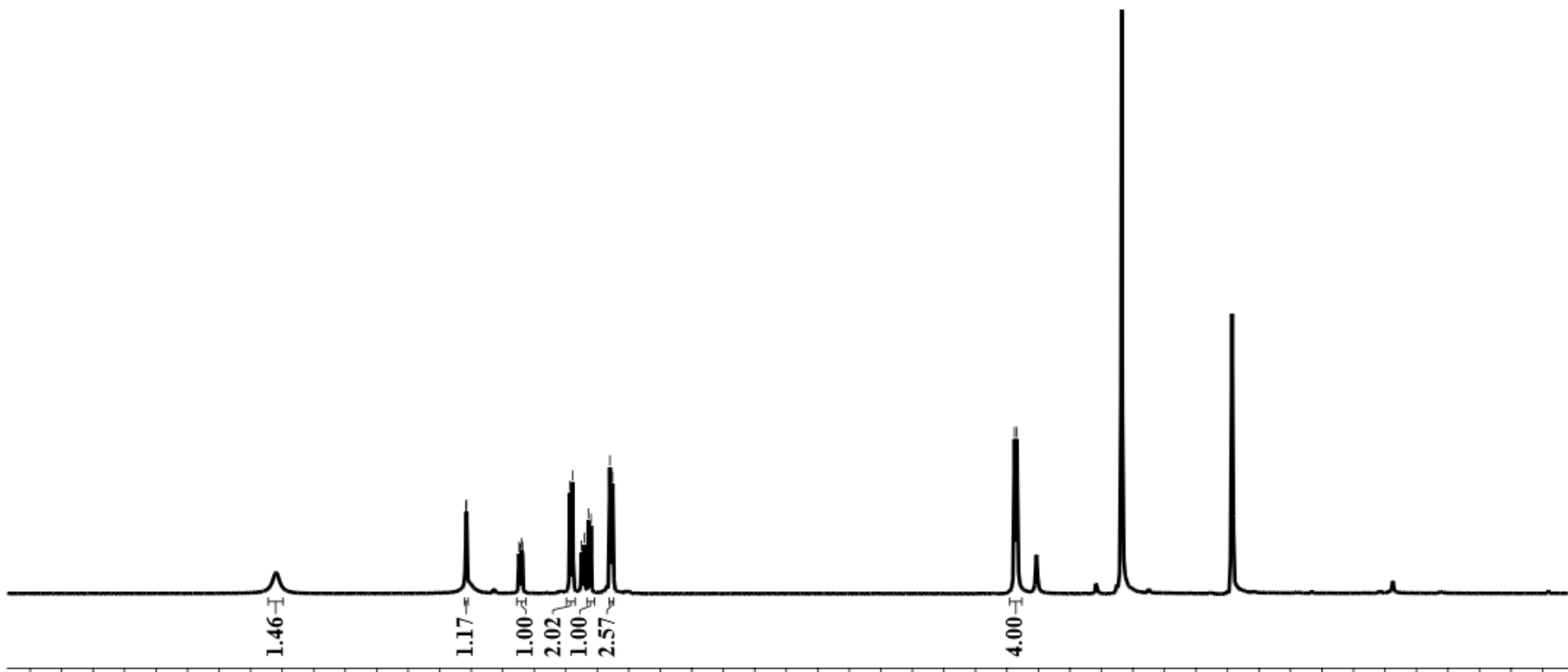
1.00

2.57

4.00

11.5 10.5 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0

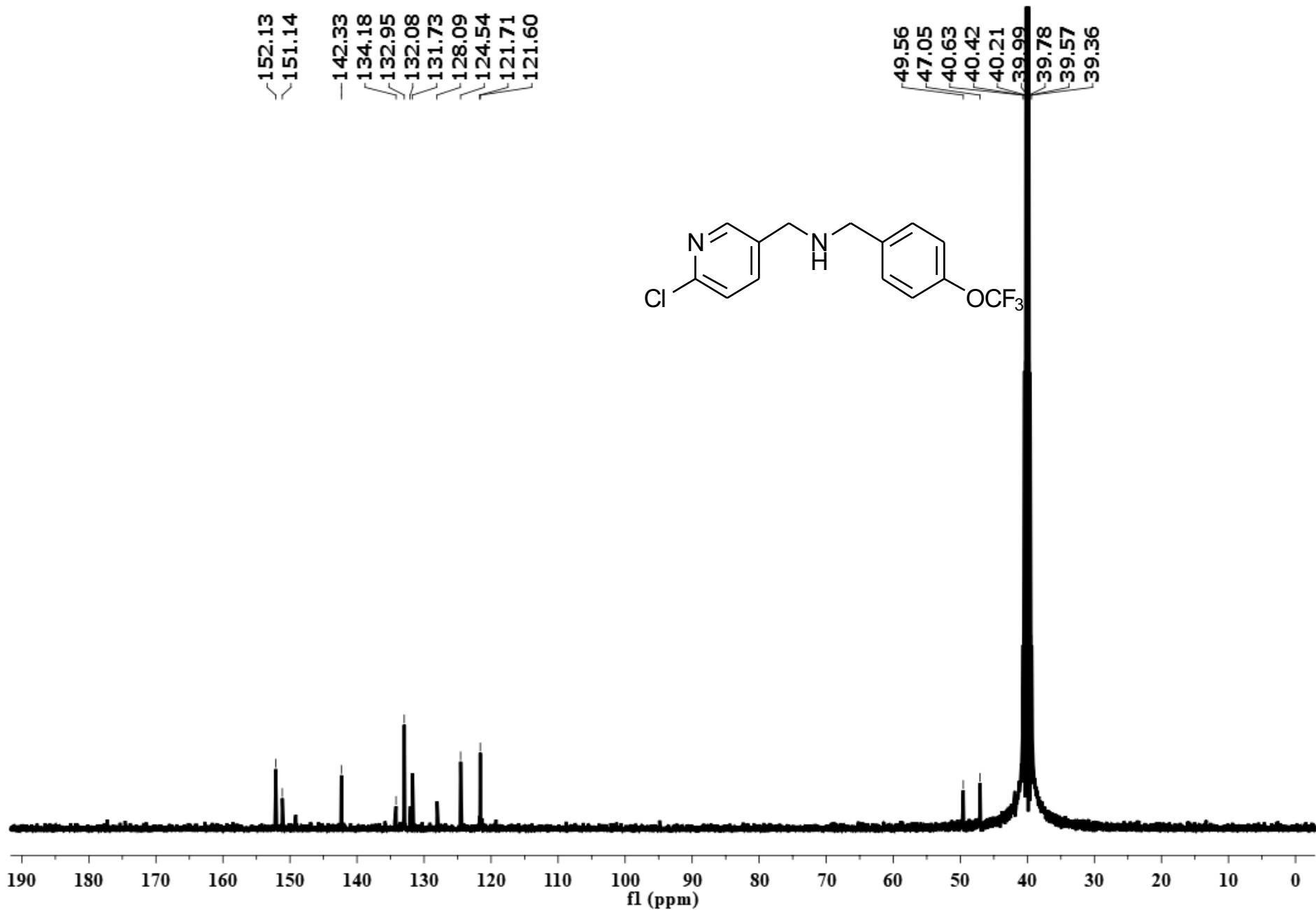
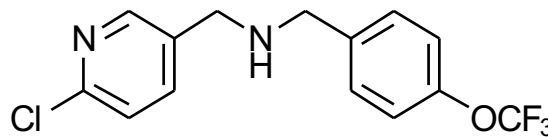
fl (ppm)



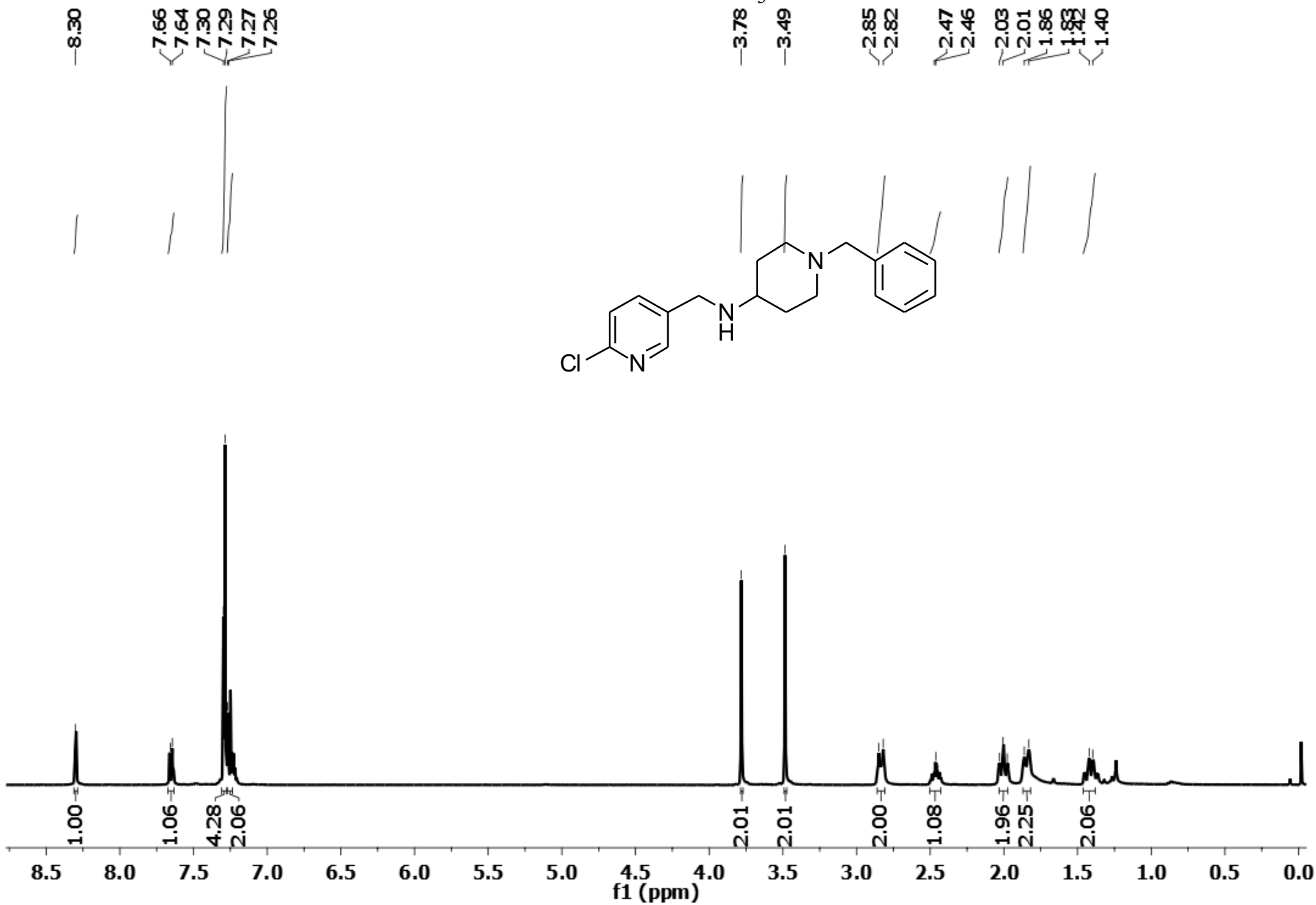
$^{13}\text{C}$  NMR of **3t** in  $\text{DMSO } d_6$

152.13  
151.14  
142.33  
134.18  
132.95  
132.08  
131.73  
128.09  
124.54  
121.71  
121.60

49.56  
47.05  
40.63  
40.42  
40.21  
39.99  
39.78  
39.57  
39.36



$^1\text{H}$  NMR of **3u** in  $\text{CDCl}_3$



$^{13}\text{C}$  NMR of **3u** in  $\text{CDCl}_3$

150.03  
149.32

138.82  
135.32  
129.24  
128.28  
127.10  
124.11

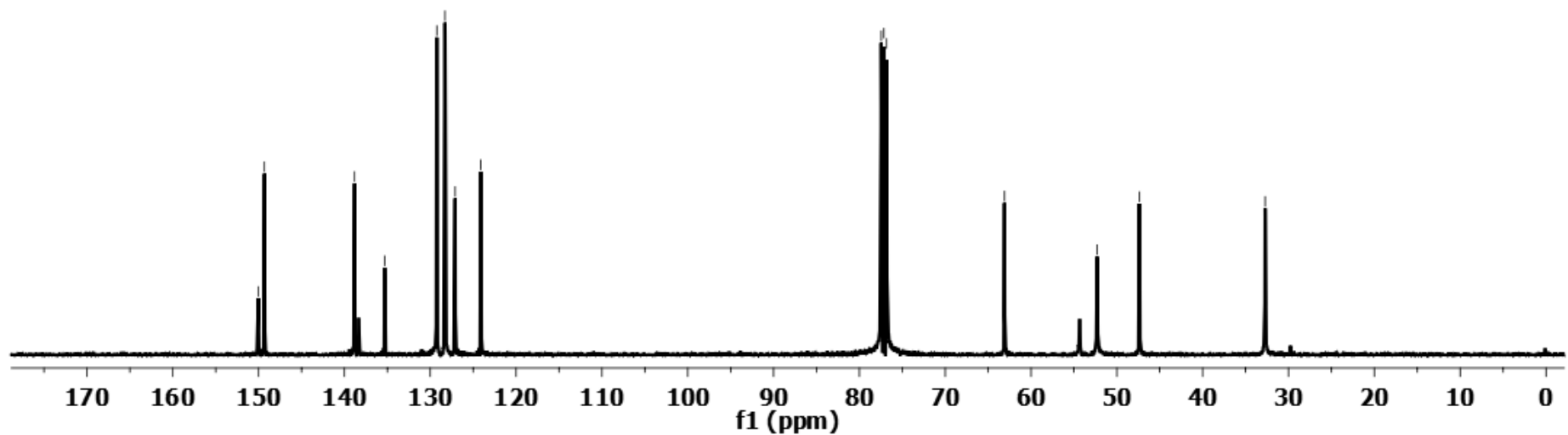
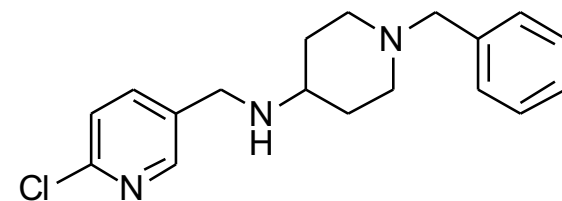
77.46  
77.15  
76.83

63.09

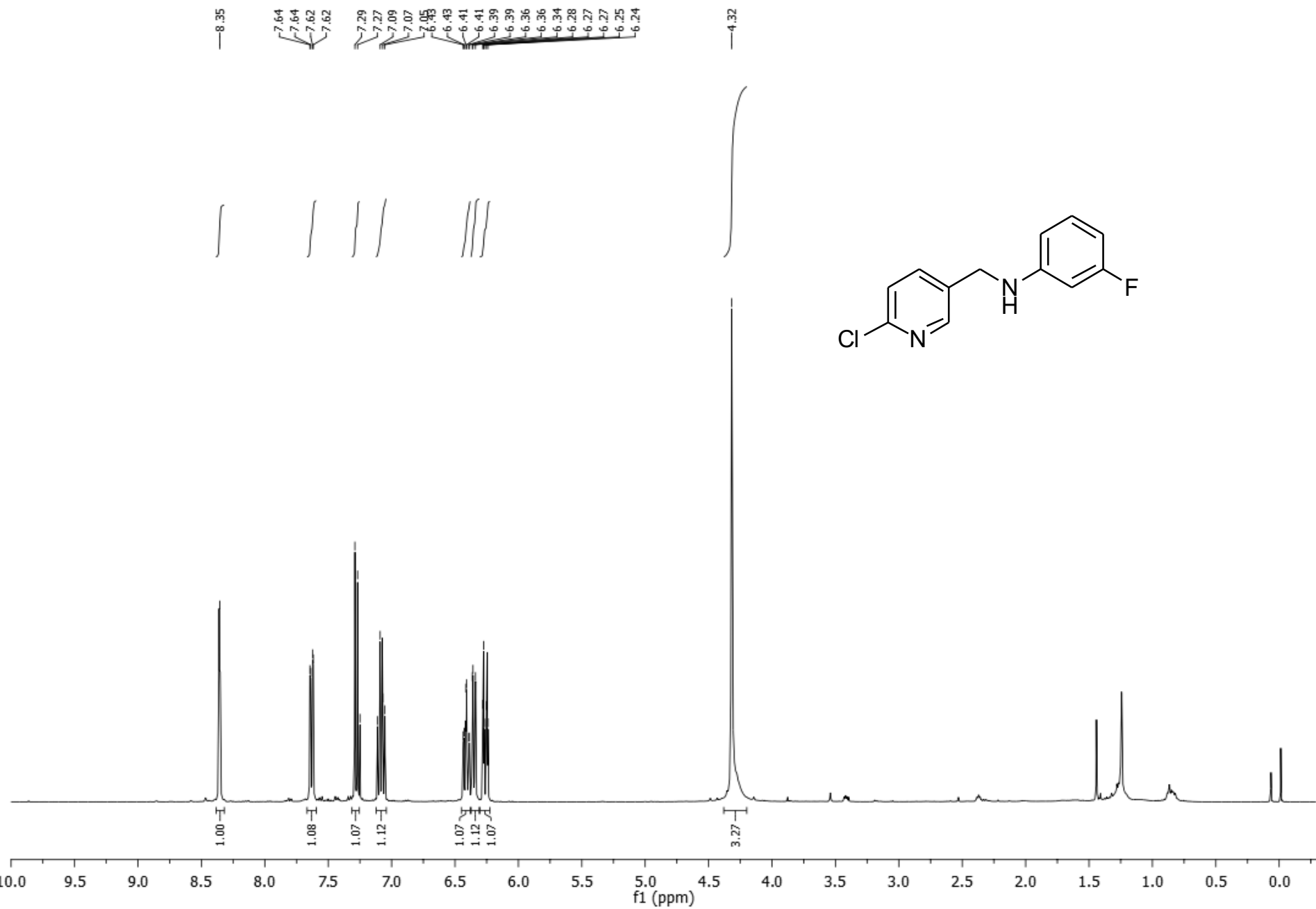
52.30

47.36

32.72



$^1\text{H}$  NMR of **3v** in  $\text{CDCl}_3$



$^{13}\text{C}$  NMR of **3v** in  $\text{CDCl}_3$

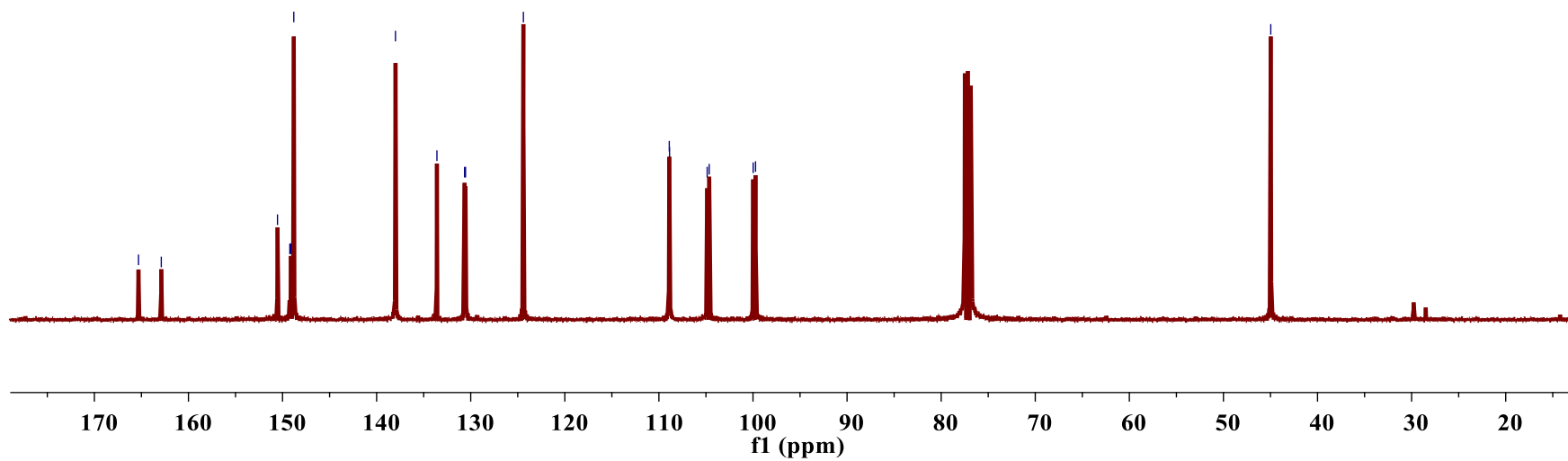
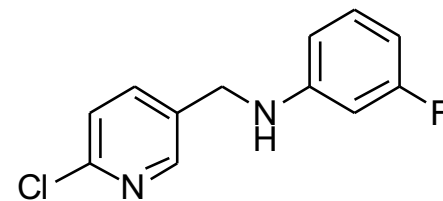
~ 165.31  
~ 162.89

150.54  
149.23  
149.12  
148.80

~ 138.00  
~ 133.59  
130.65  
130.55  
~ 124.40

108.90  
108.87  
104.87  
104.65  
99.98  
99.73

— 44.97



$^1\text{H}$  NMR of **3w** in  $\text{CDCl}_3$

8.38  
8.38

7.67  
7.65

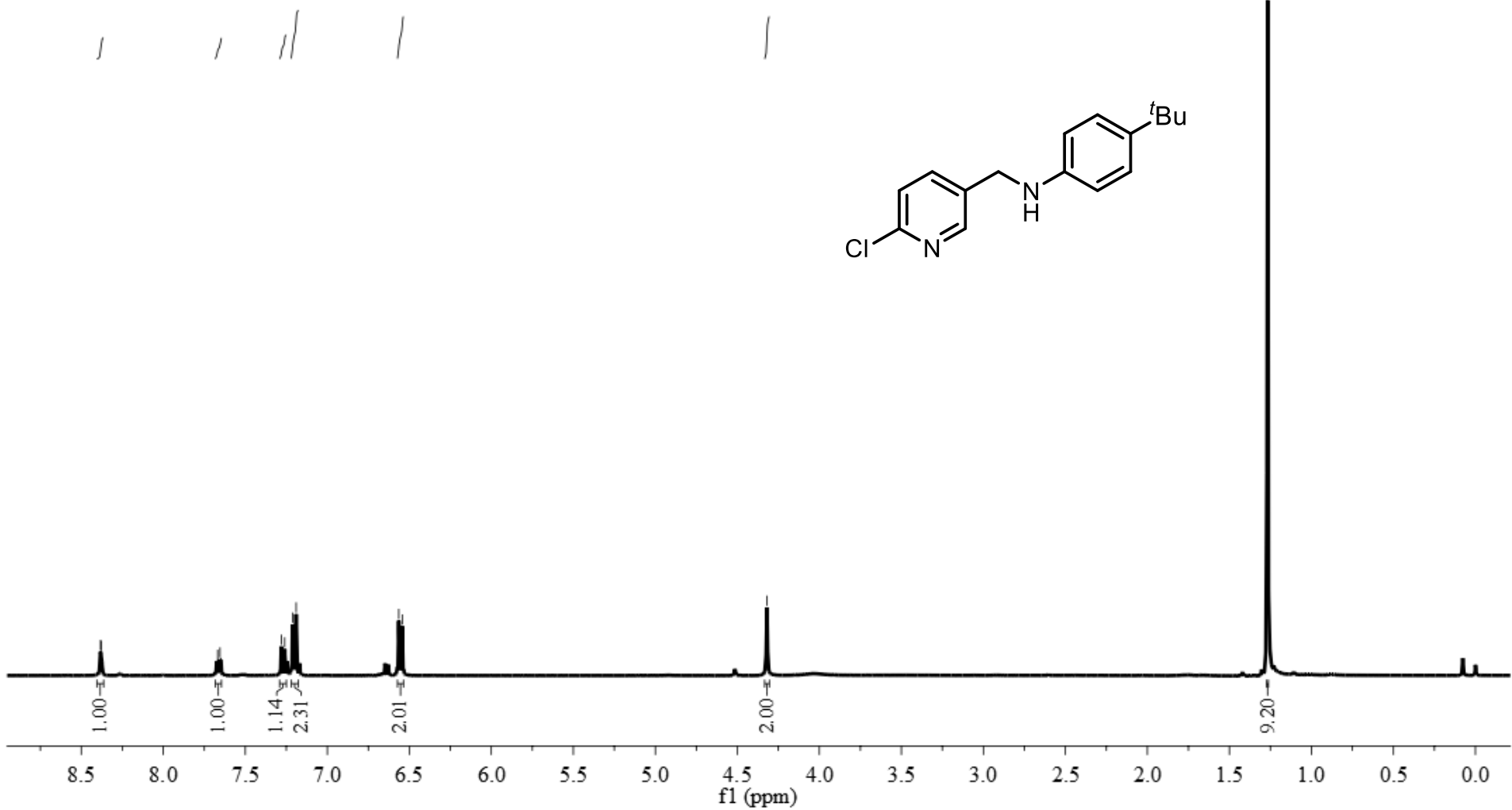
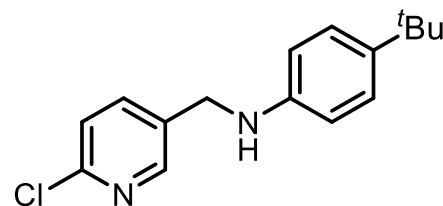
7.28  
7.26

7.21  
7.19

6.56  
6.54

4.32

1.27



$^{13}\text{C}$  NMR of **3w** in  $\text{CDCl}_3$

150.31  
148.91  
145.07  
141.20  
138.13  
134.43

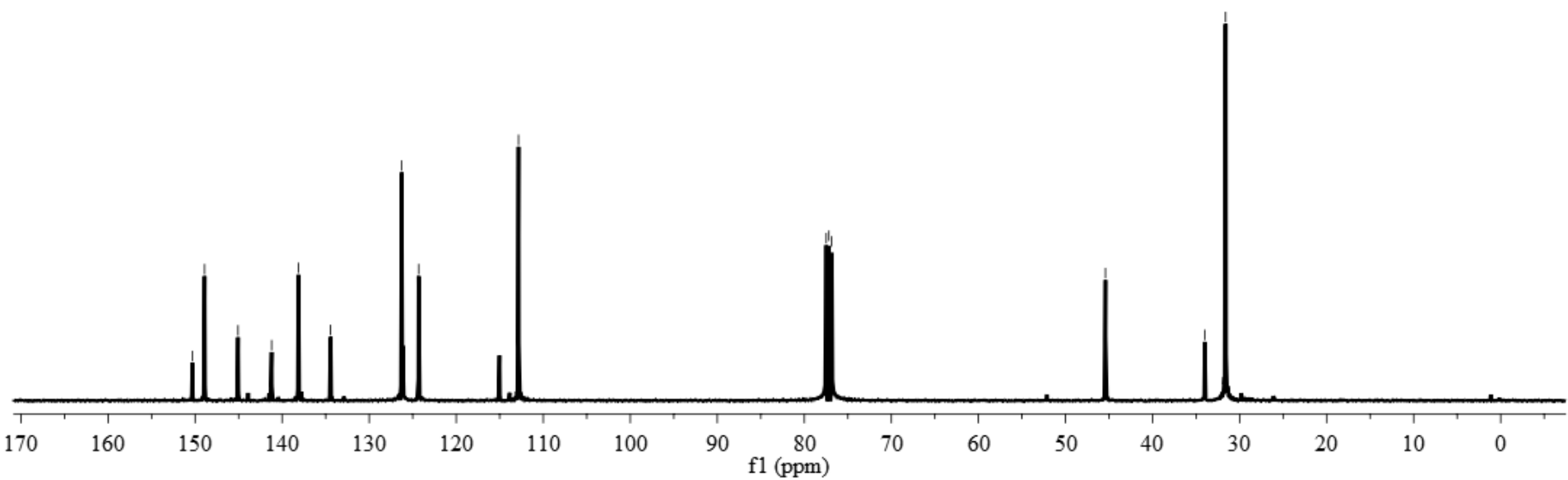
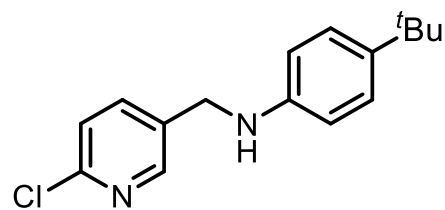
126.26  
124.31

112.84

77.49  
77.18  
76.86

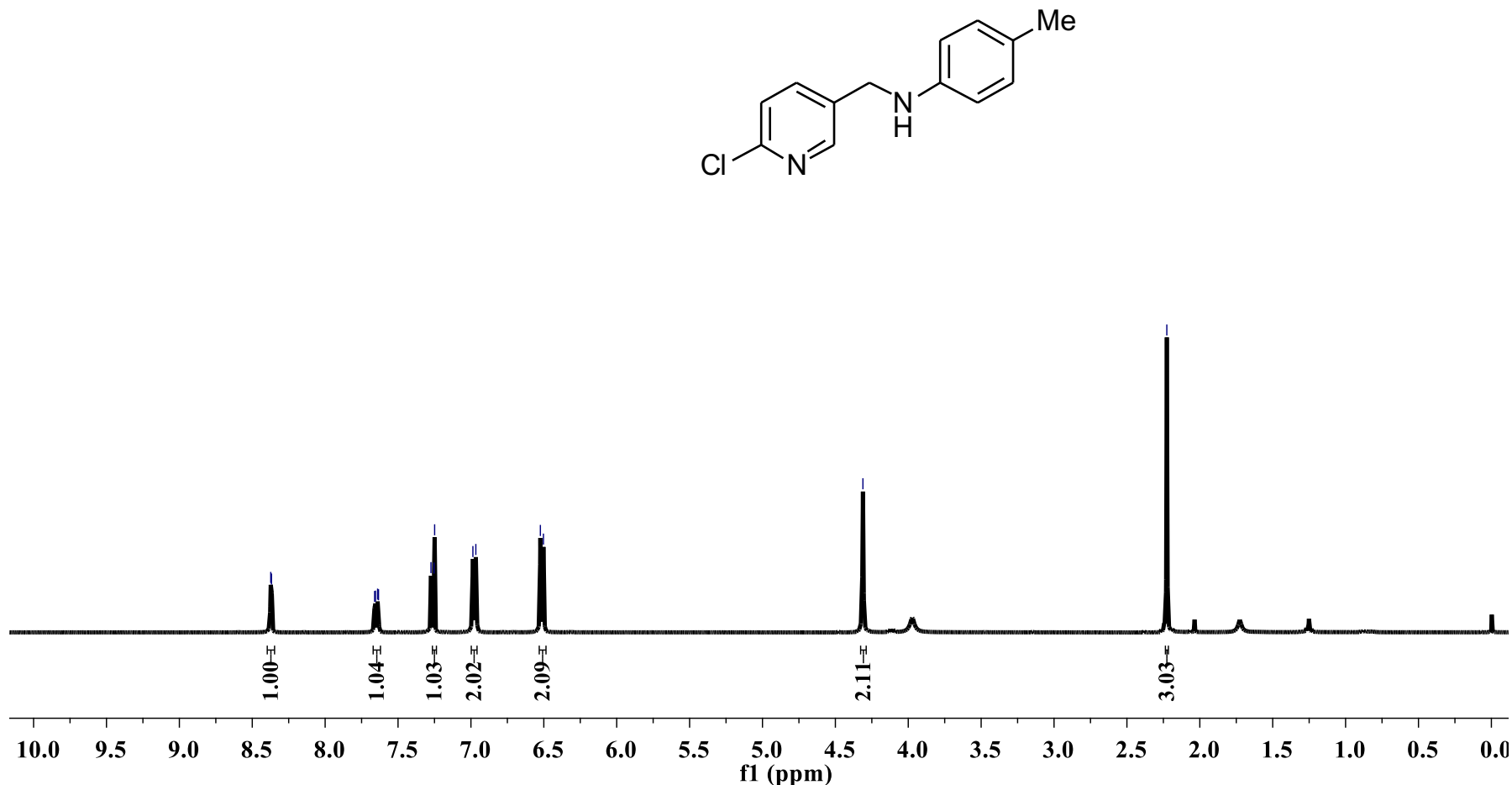
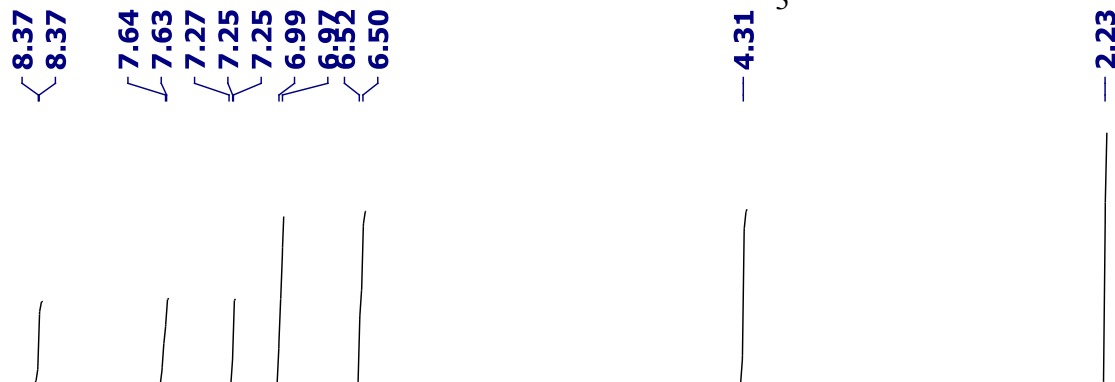
45.41

33.99  
31.60





<sup>1</sup>H NMR of **3x** in CDCl<sub>3</sub>



<sup>13</sup>C NMR of **3x** in CDCl<sub>3</sub>

150.33  
148.89  
145.11

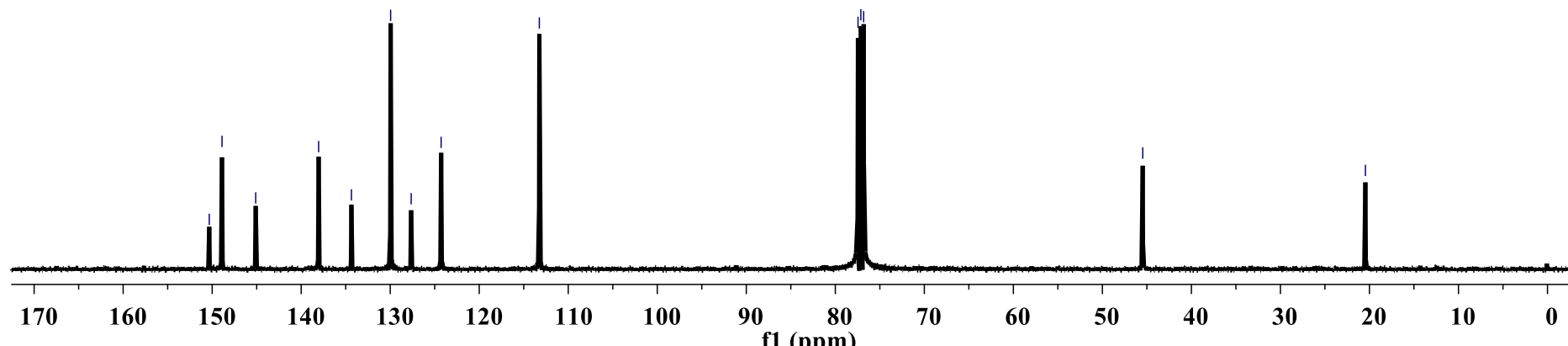
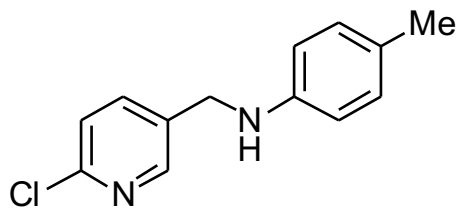
138.04  
134.36  
129.95  
127.65  
124.28

113.25

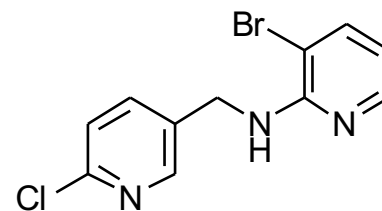
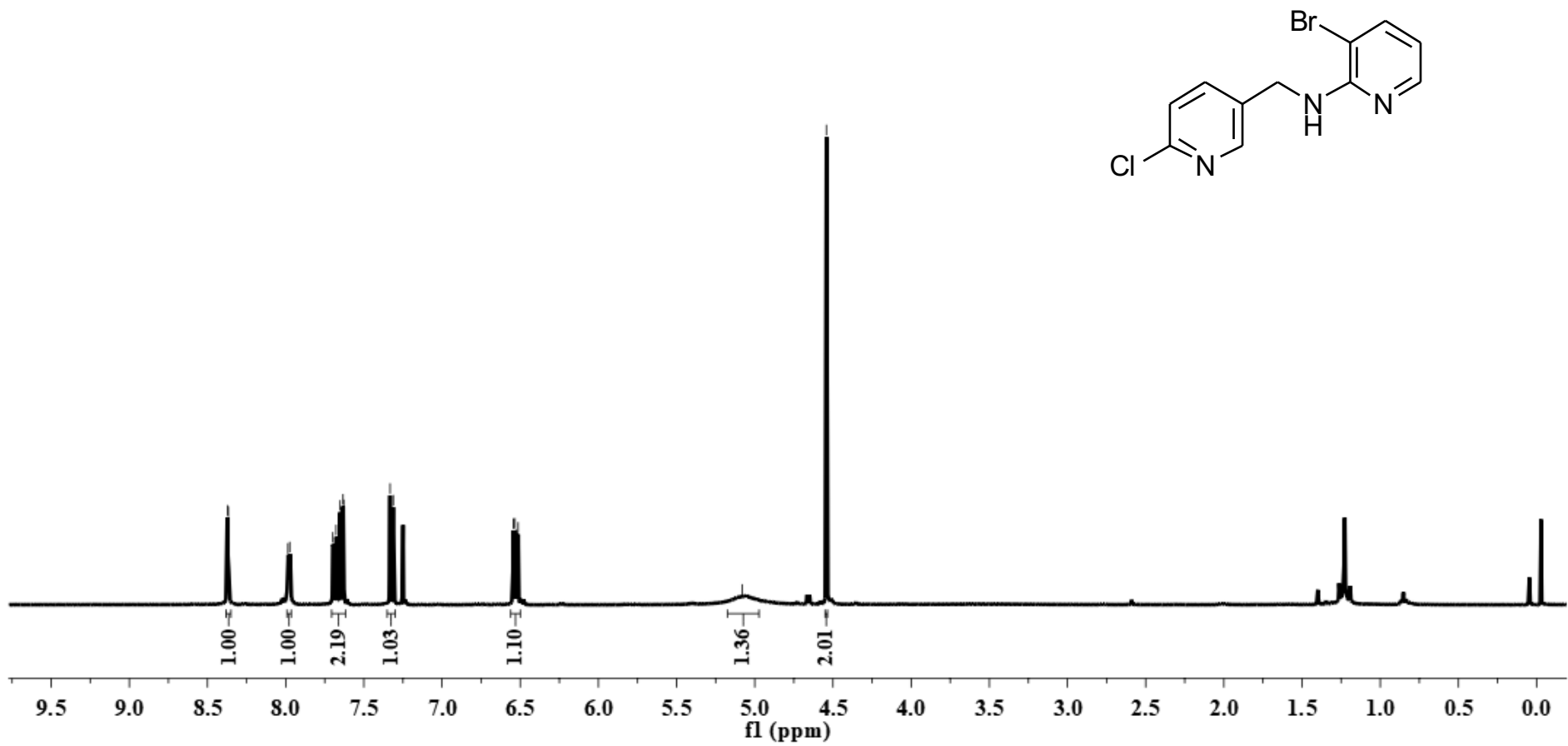
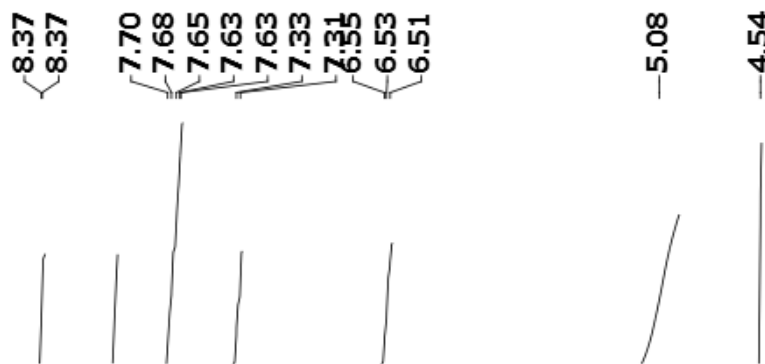
77.45  
77.13  
76.81

45.46

20.45



$^1\text{H}$  NMR of **3y** in  $\text{CDCl}_3$



$^{13}\text{C}$  NMR of **3y** in  $\text{CDCl}_3$

150.69  
148.84  
147.53

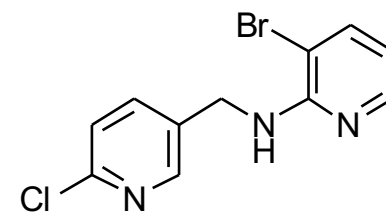
138.05  
133.32  
129.94

124.48

115.90

109.37

44.92



160 150 140 130 120 110 100 90 80 70 60 50 40 30 20

f1 (ppm)

$^1\text{H}$  NMR of **5** in  $\text{CDCl}_3$

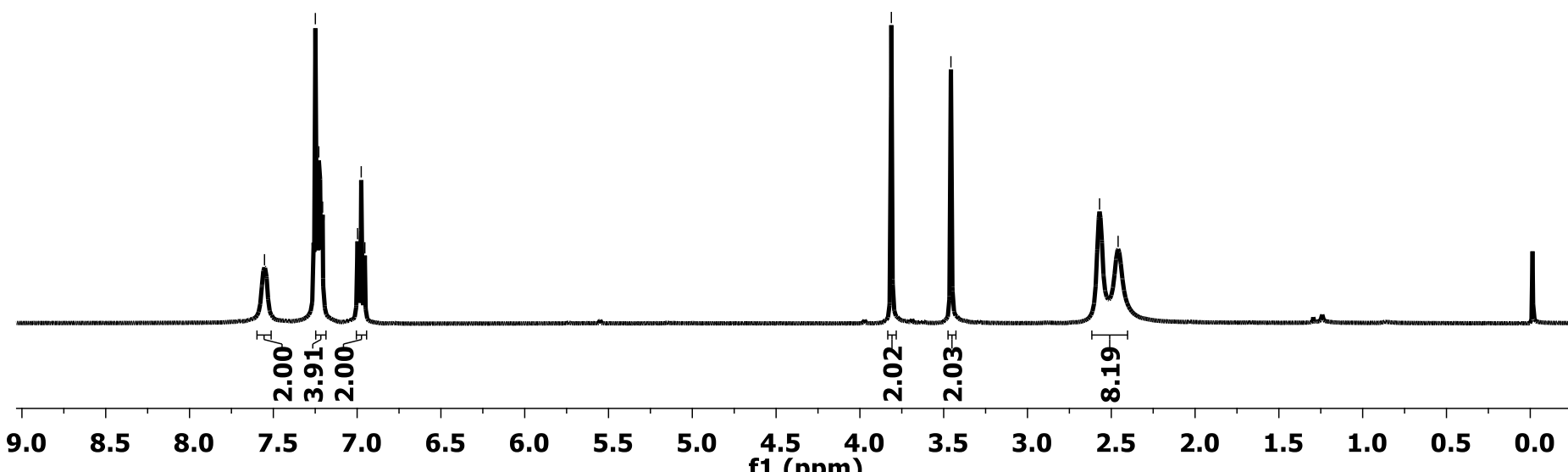
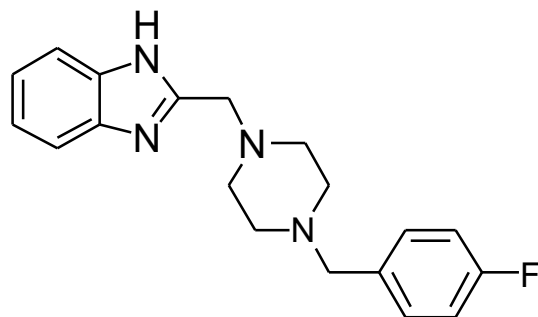
7.55  
7.25  
7.24  
7.23  
7.22  
7.21  
7.21  
7.00  
6.98  
6.95

3.81

3.46

2.57

2.46



<sup>13</sup>C NMR of **5** in CDCl<sub>3</sub>

~ 163.35  
~ 160.92

— 151.98

∧ 133.56

∧ 133.53

∧ 130.71

∧ 130.62

— 122.54

∧ 115.26

∧ 115.05

∧ 77.42

∧ 77.10

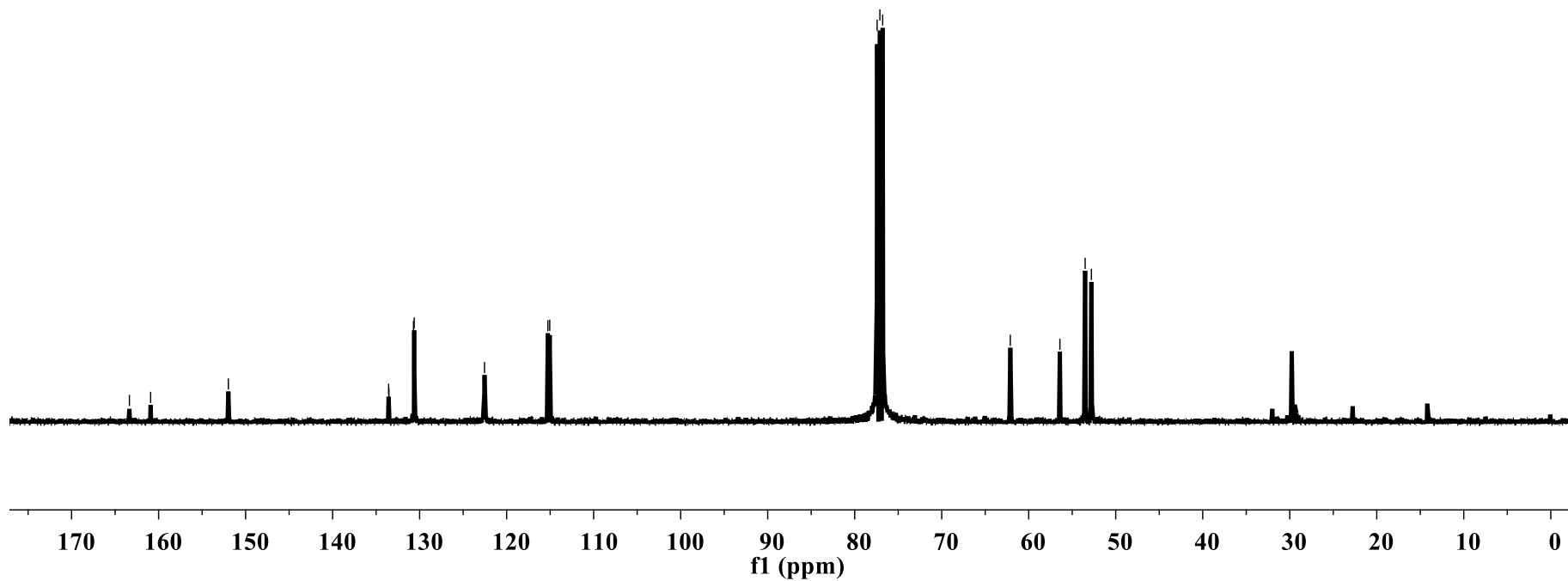
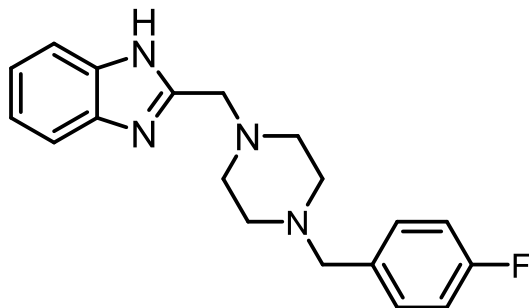
∧ 76.79

∧ 62.12

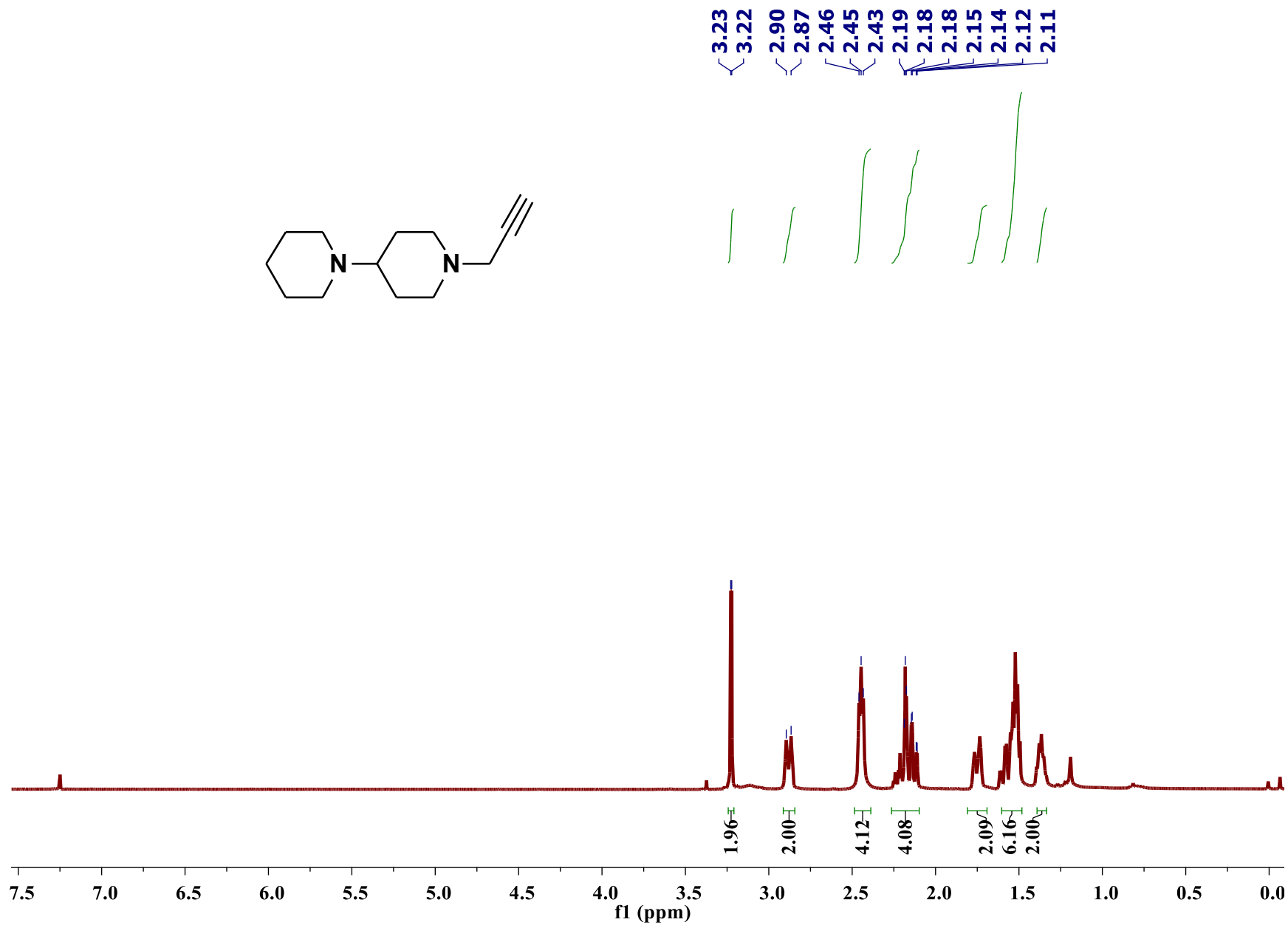
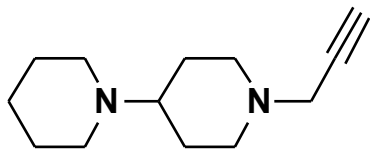
∧ 56.42

∧ 53.52

∧ 52.80



$^1\text{H}$  NMR of **7** in  $\text{CDCl}_3$



$^{13}\text{C}$  NMR of **7** in  $\text{CDCl}_3$

79.08  
77.48  
77.16  
76.85  
73.04

62.35

52.31

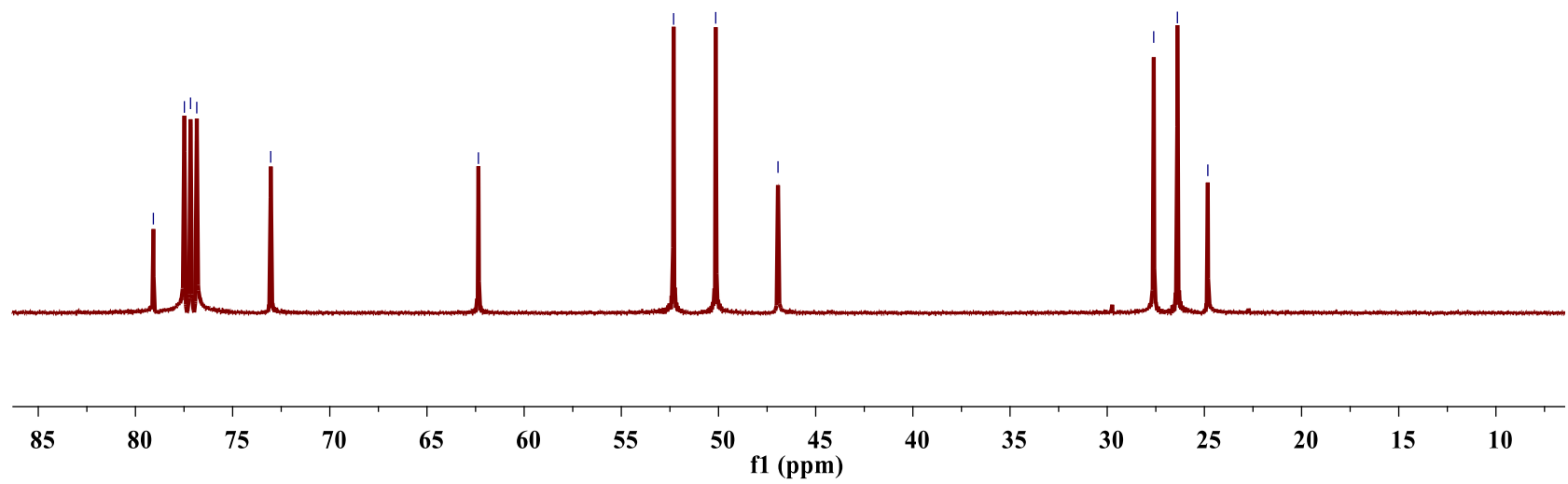
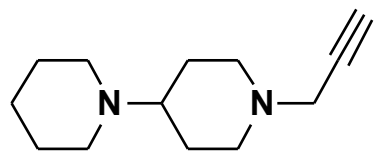
50.14

46.94

27.61

26.39

24.82



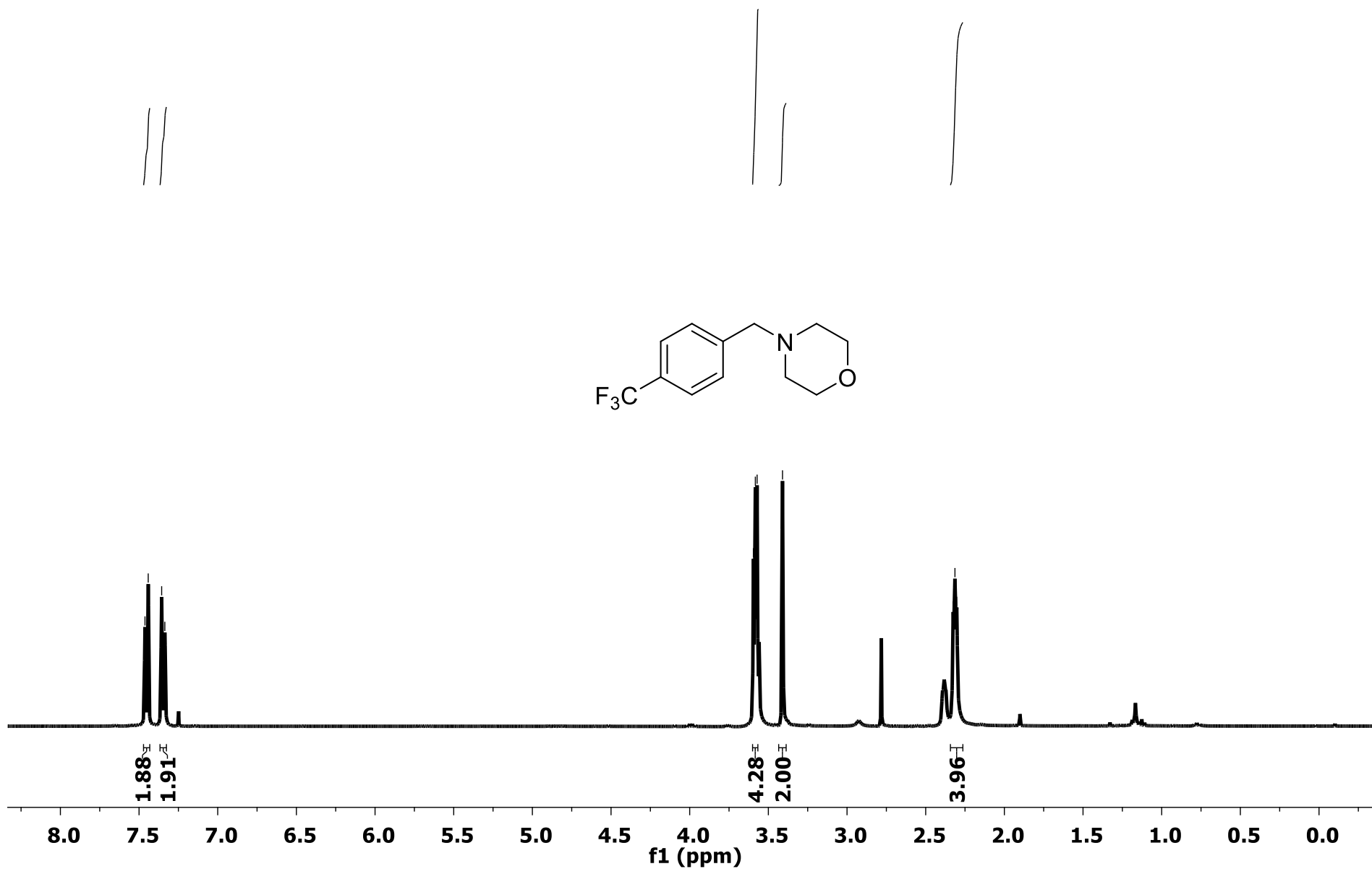
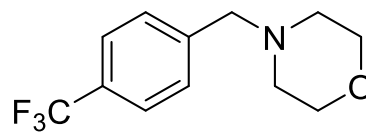


<sup>1</sup>H NMR of **9** in CDCl<sub>3</sub>

7.46  
7.44  
7.36  
7.34

3.60  
3.58  
3.57  
3.41

2.33  
2.31  
2.30



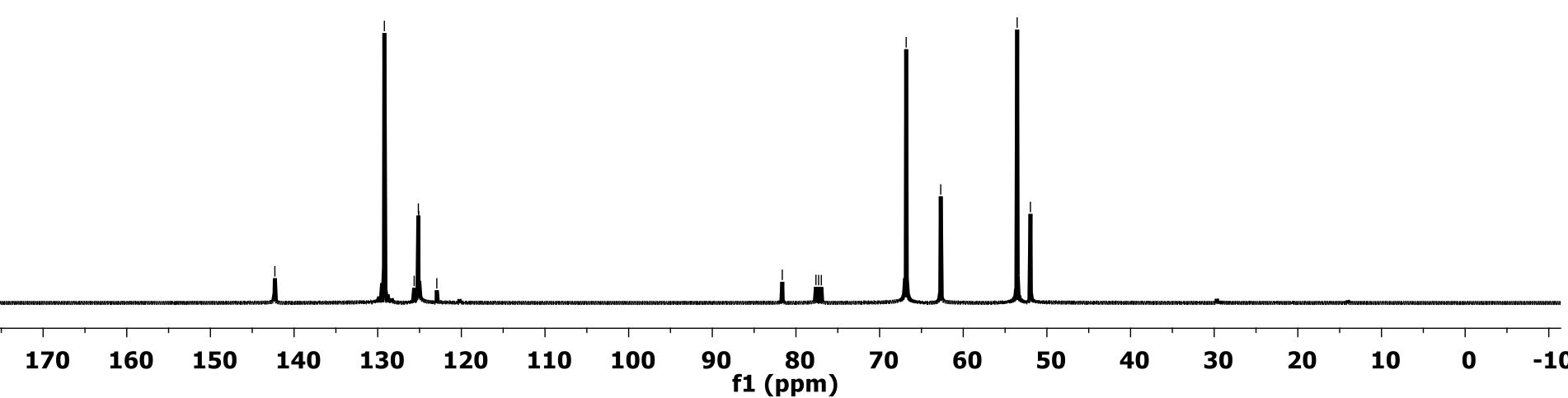
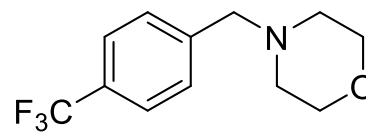
$^{13}\text{C}$  NMR of **9** in  $\text{CDCl}_3$

— 142.30  
— 129.20  
— 125.64  
— 125.18  
— 125.14  
— 125.10  
— 125.06  
— 122.93

— 81.63  
— 77.61  
— 77.29  
— 76.97

— 66.82  
— 62.69

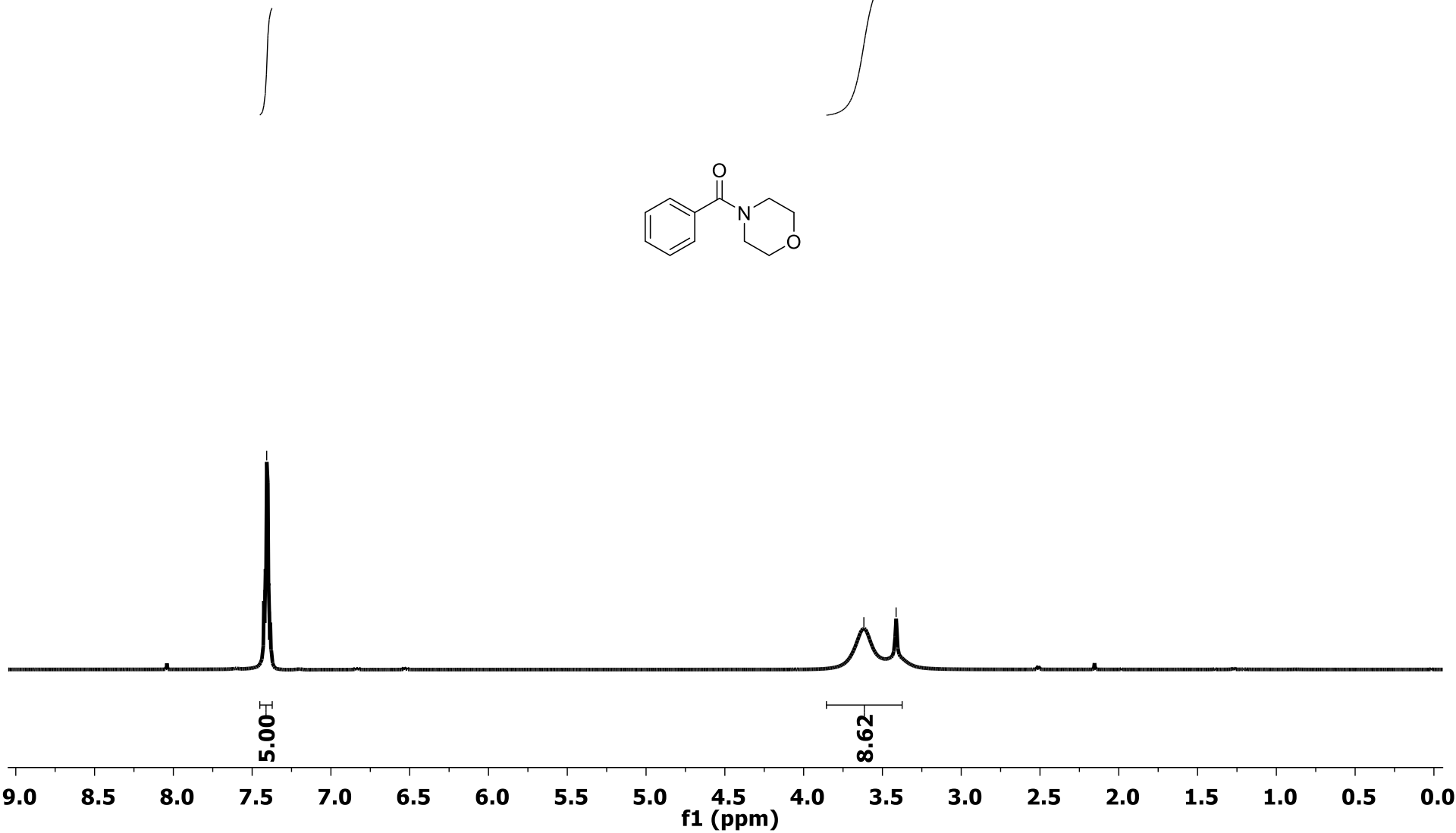
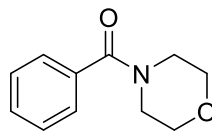
— 53.56  
— 51.97



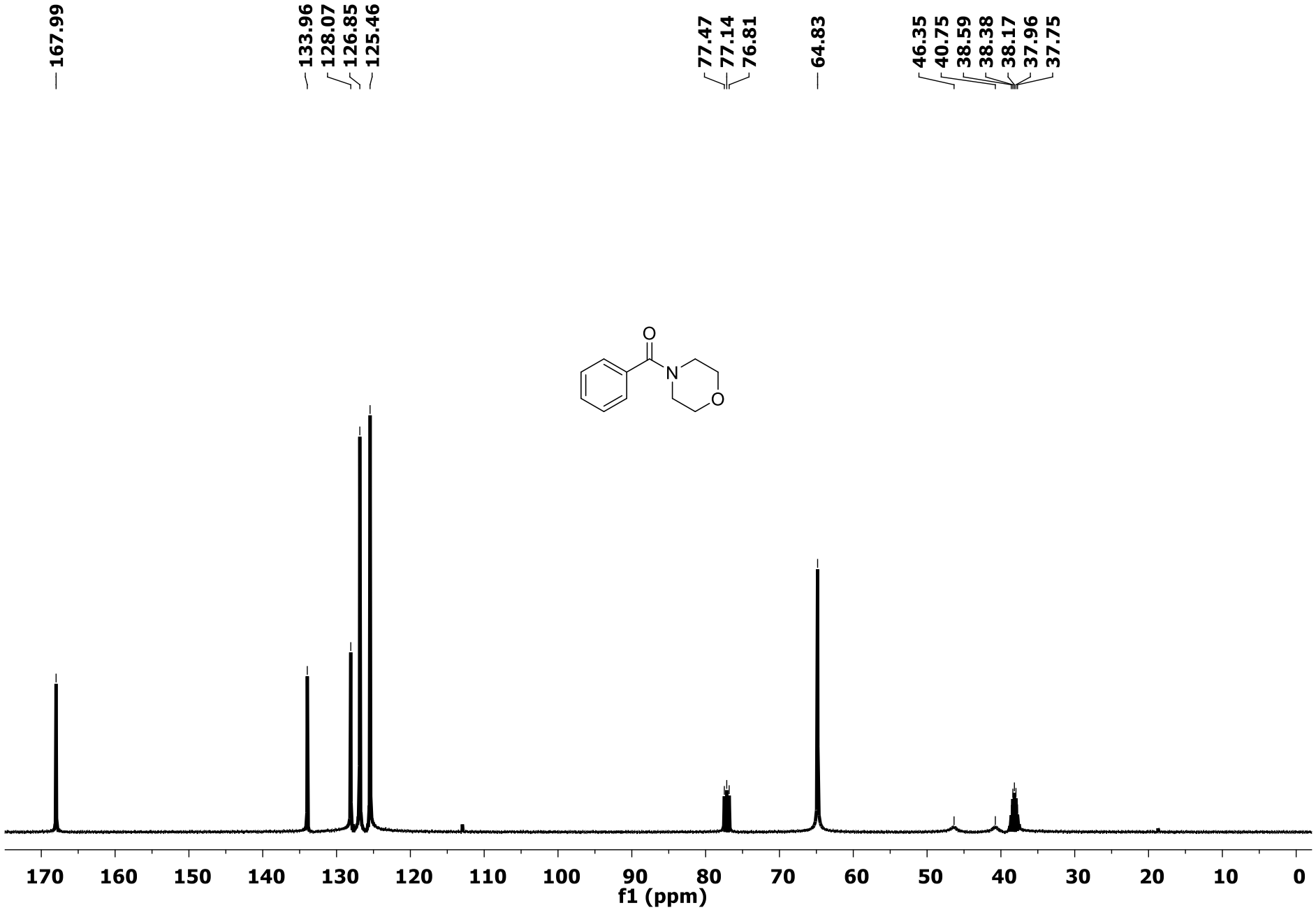
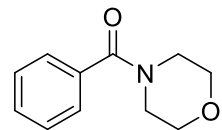
$^1\text{H}$  NMR of **11** in  $\text{CDCl}_3/\text{DMSO-d}_6$

7.43  
7.41  
7.41  
7.40  
7.40  
7.38

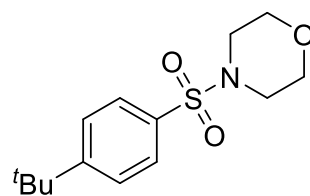
3.62  
3.41



<sup>13</sup>C NMR of **11** in CDCl<sub>3</sub>/DMSO-d<sub>6</sub>



<sup>1</sup>H NMR of **13** in CDCl<sub>3</sub>

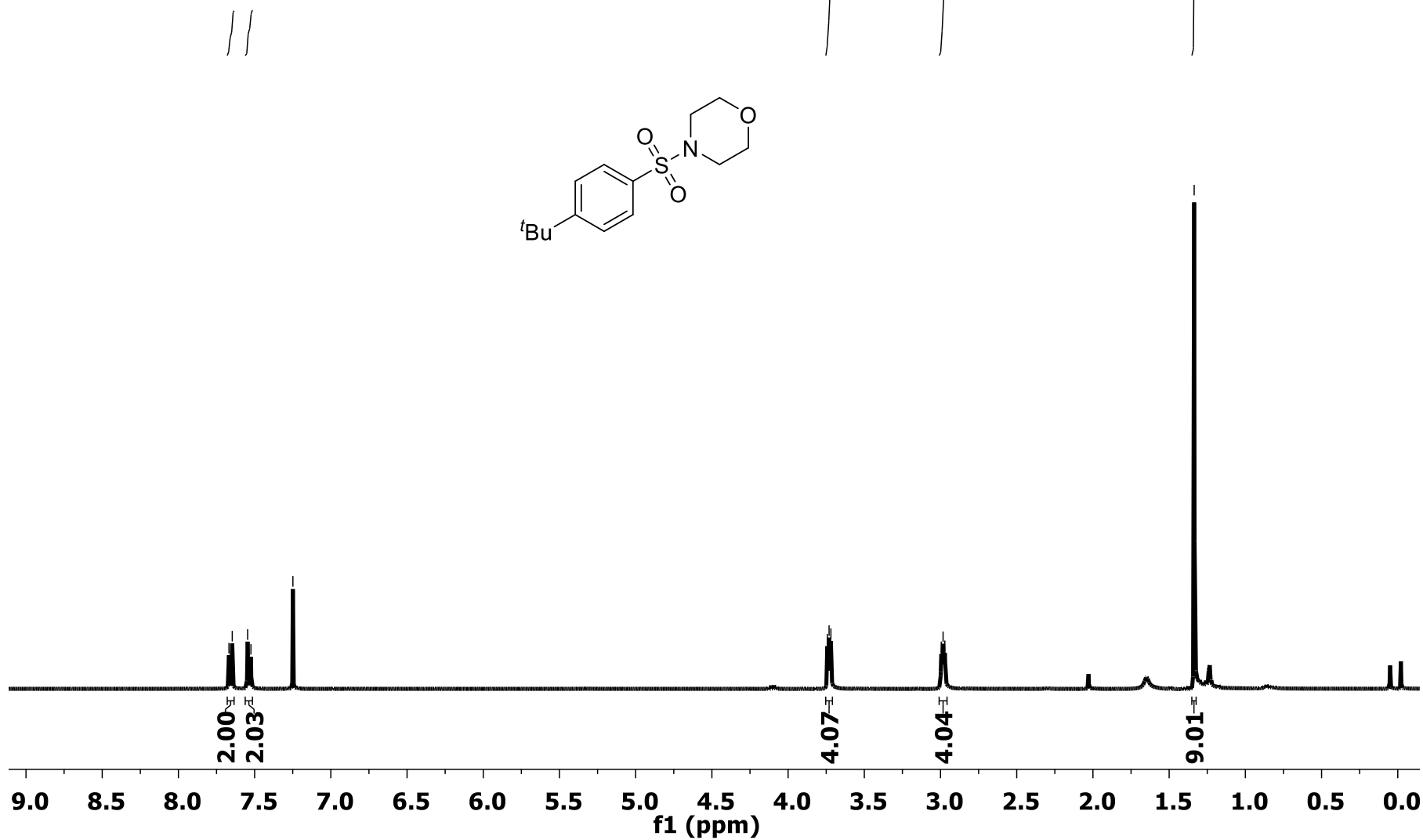


7.67  
7.65  
7.55  
7.52  
7.25

3.74  
3.73  
3.72

3.00  
2.98  
2.97

1.34



<sup>13</sup>C NMR of **13** in CDCl<sub>3</sub>

— 156.97

— 131.96

— 127.87

— 126.18

— 77.43

— 77.11

— 76.79

— 66.20

— 46.05

— 35.29

— 31.15

