

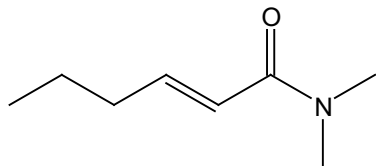
Supporting information for

# Lewis acid enabled copper catalysed asymmetric synthesis of chiral $\beta$ -substituted amides

Mamen Rodríguez-Fernández<sup>†§</sup>, Xingchen Yan<sup>†§</sup>, Juan F. Collados<sup>†§</sup>, Paul B. White<sup>‡</sup>, Syuzanna R. Harutyunyan<sup>†\*</sup>

<sup>†</sup>Stratingh Institute for Chemistry, University of Groningen, Nijenborgh 4, 9747 AG, Groningen, The Netherlands

<sup>‡</sup>Institute for Molecules and Materials, Radboud University, Heyendaalseweg 135, 6525 AJ, Nijmegen, The Netherlands



(E)-1a

6.90  
6.88  
6.86  
6.84  
6.83

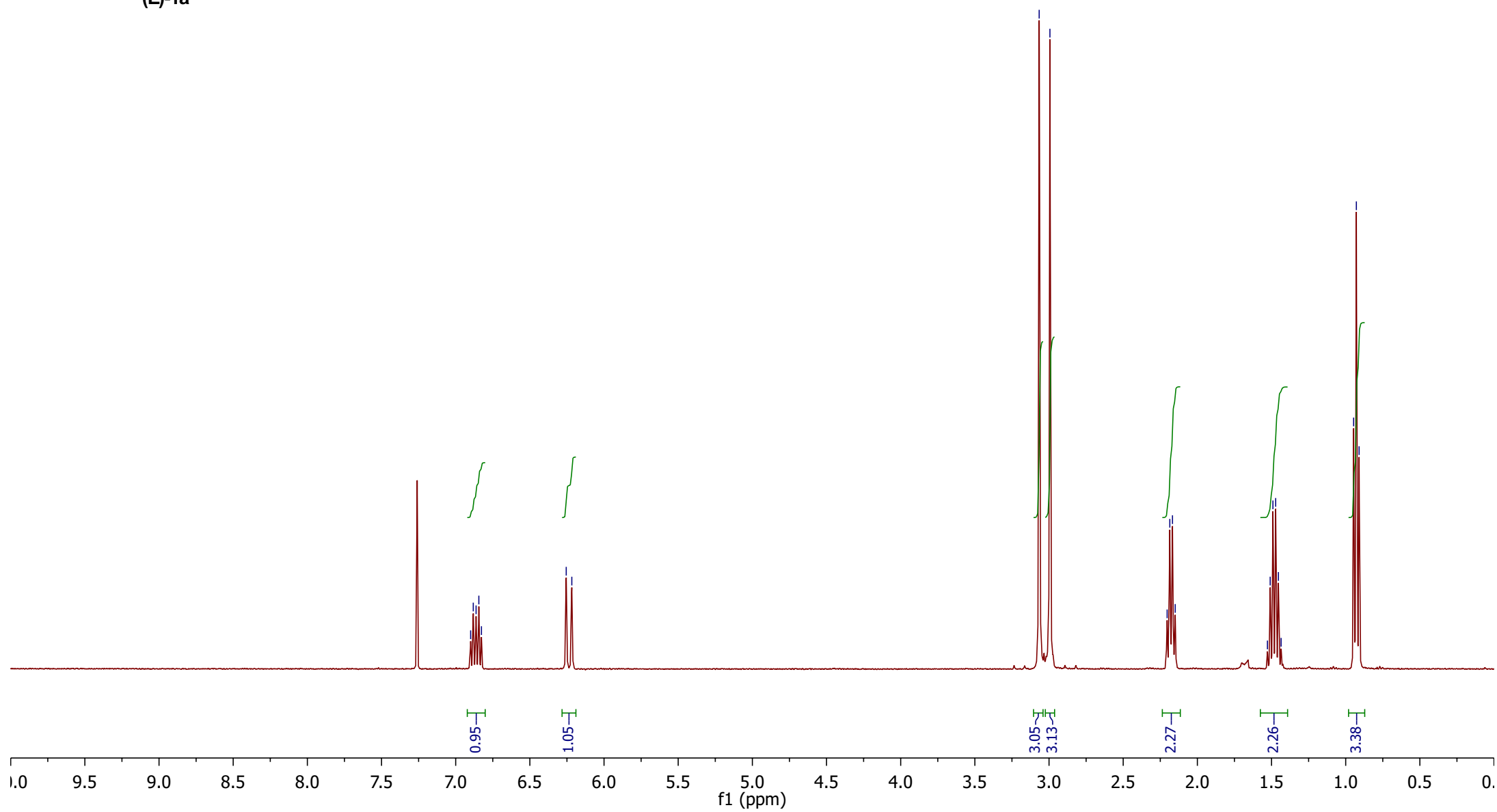
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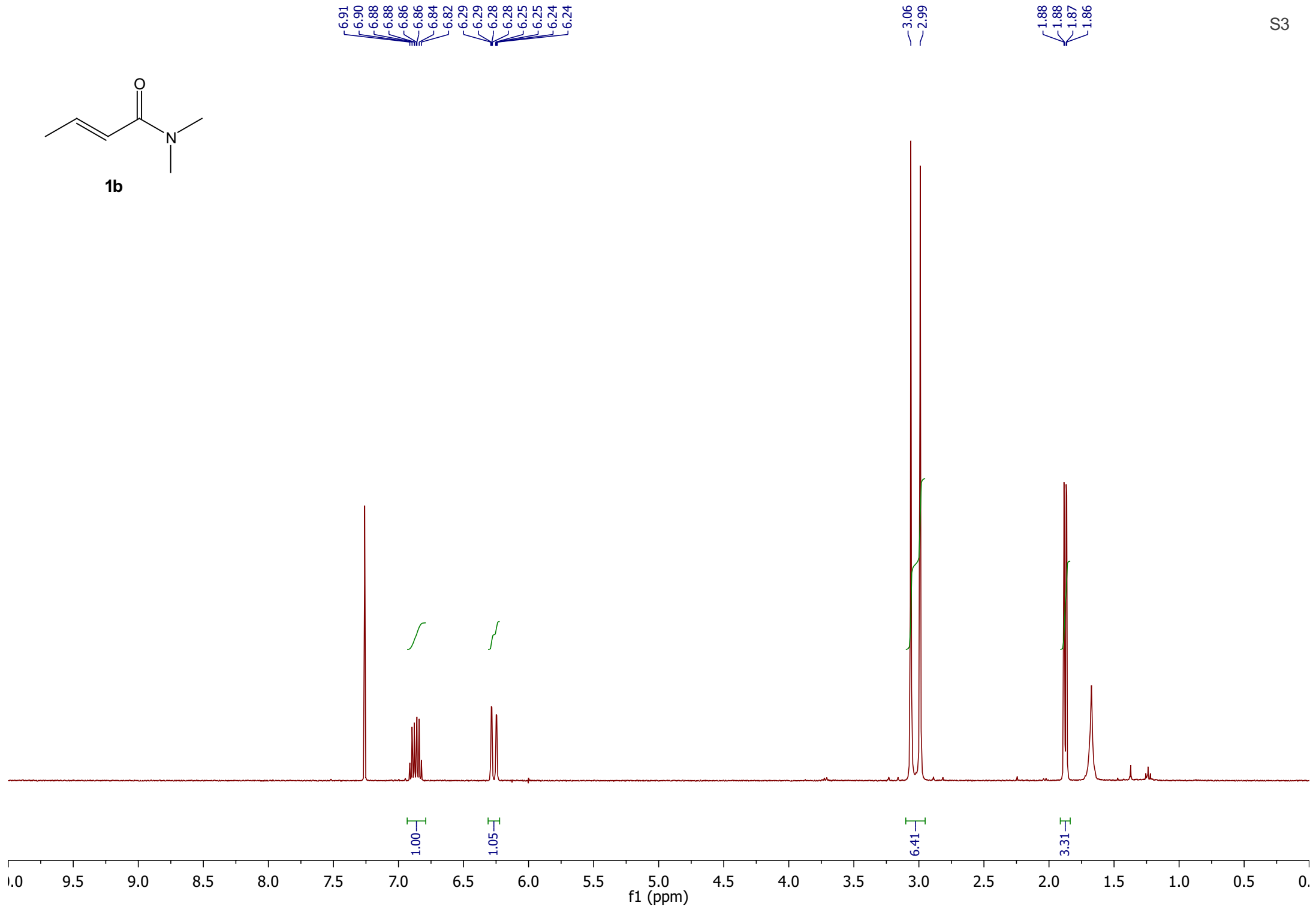
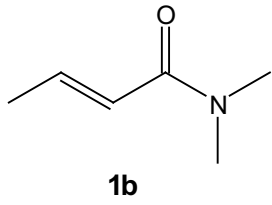
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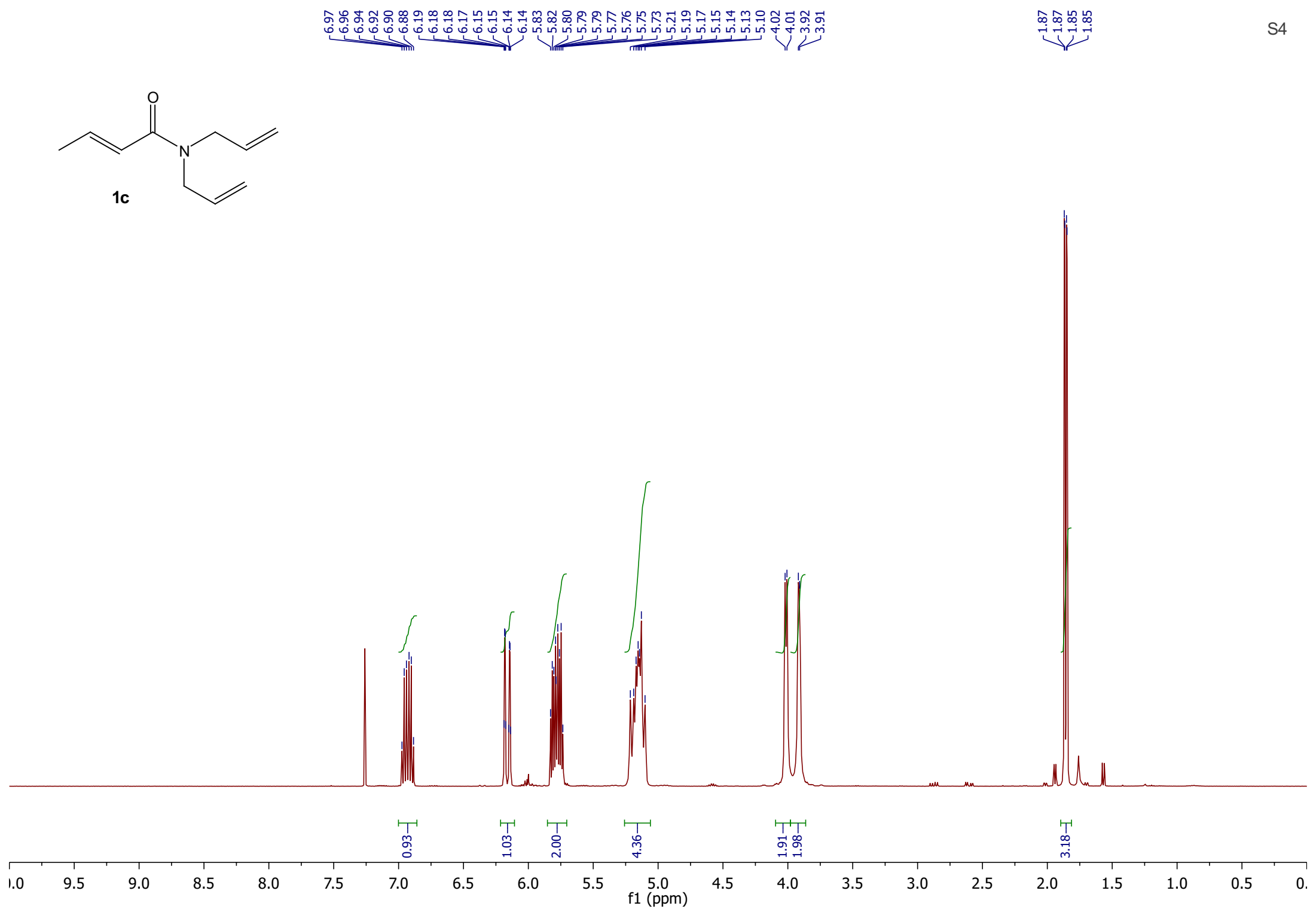
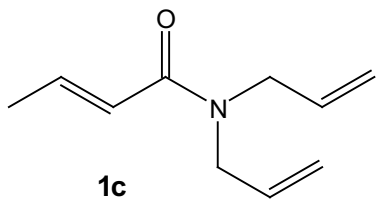
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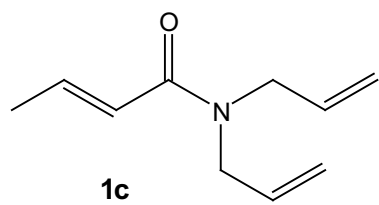
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0.95  
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0.91







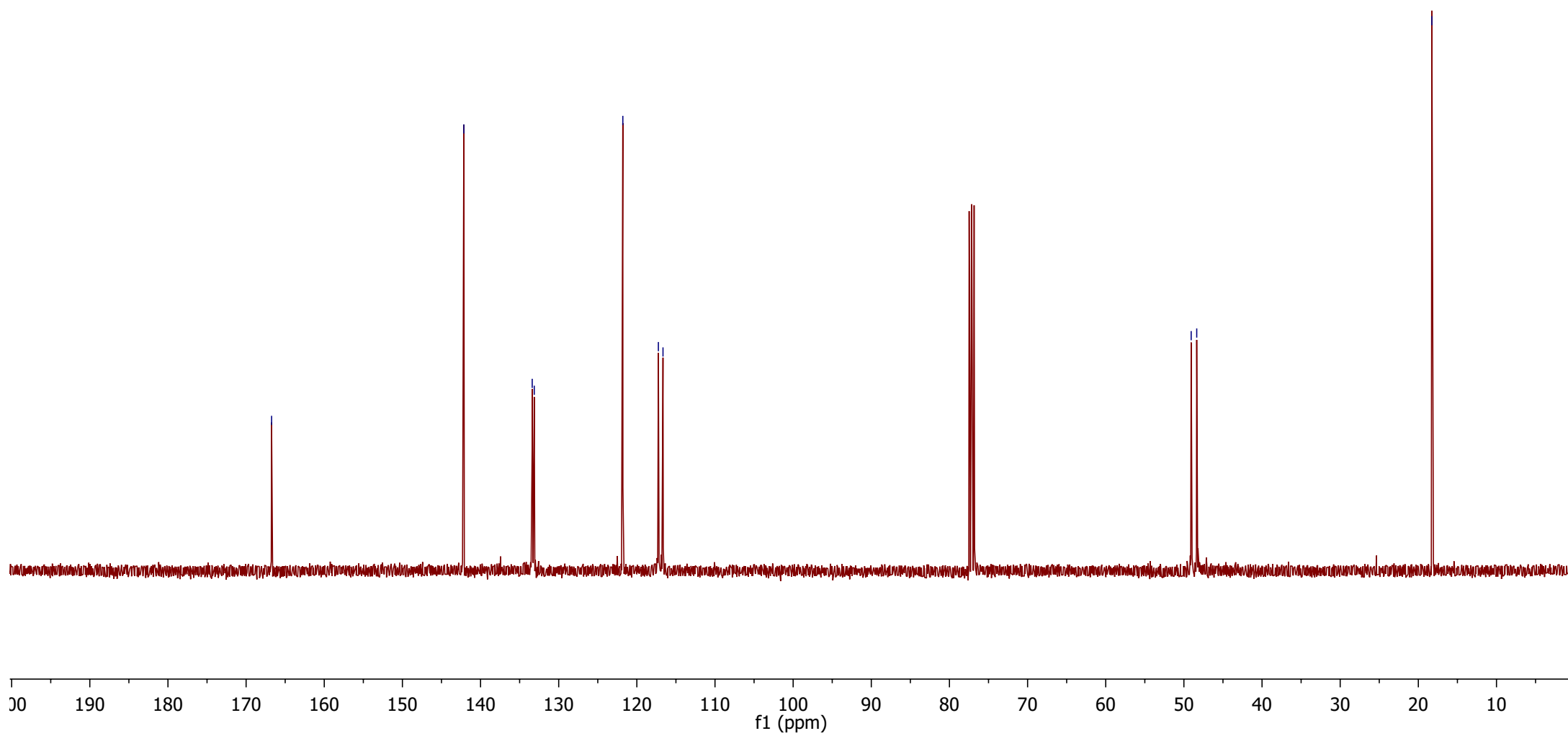


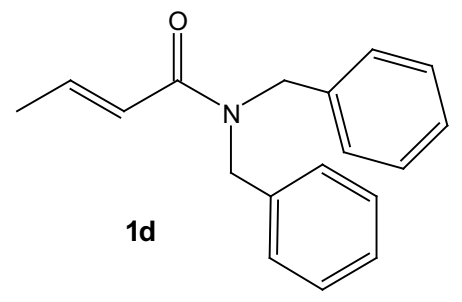
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—142.1

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—18.3

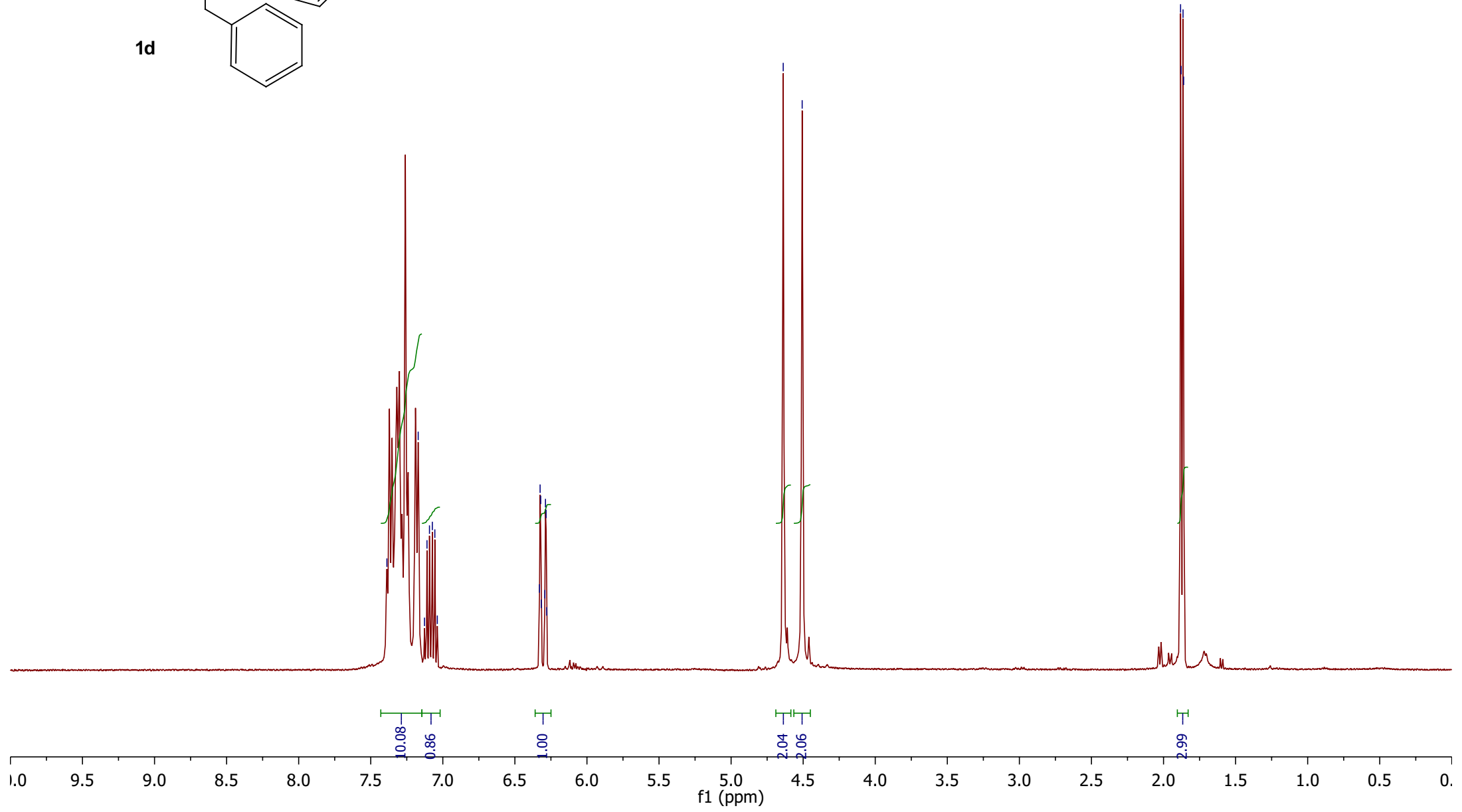


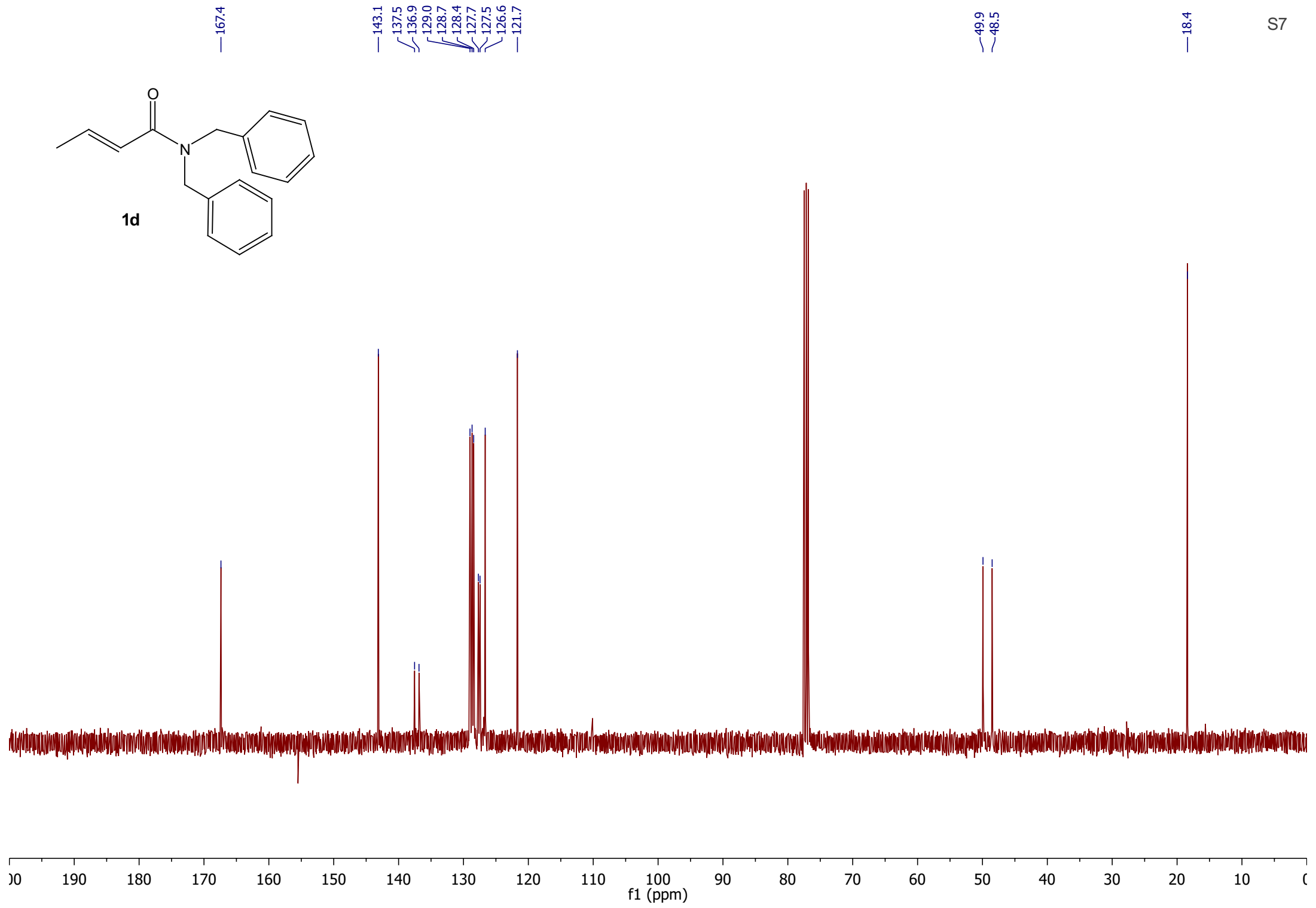
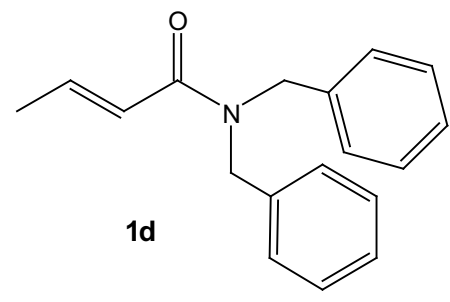


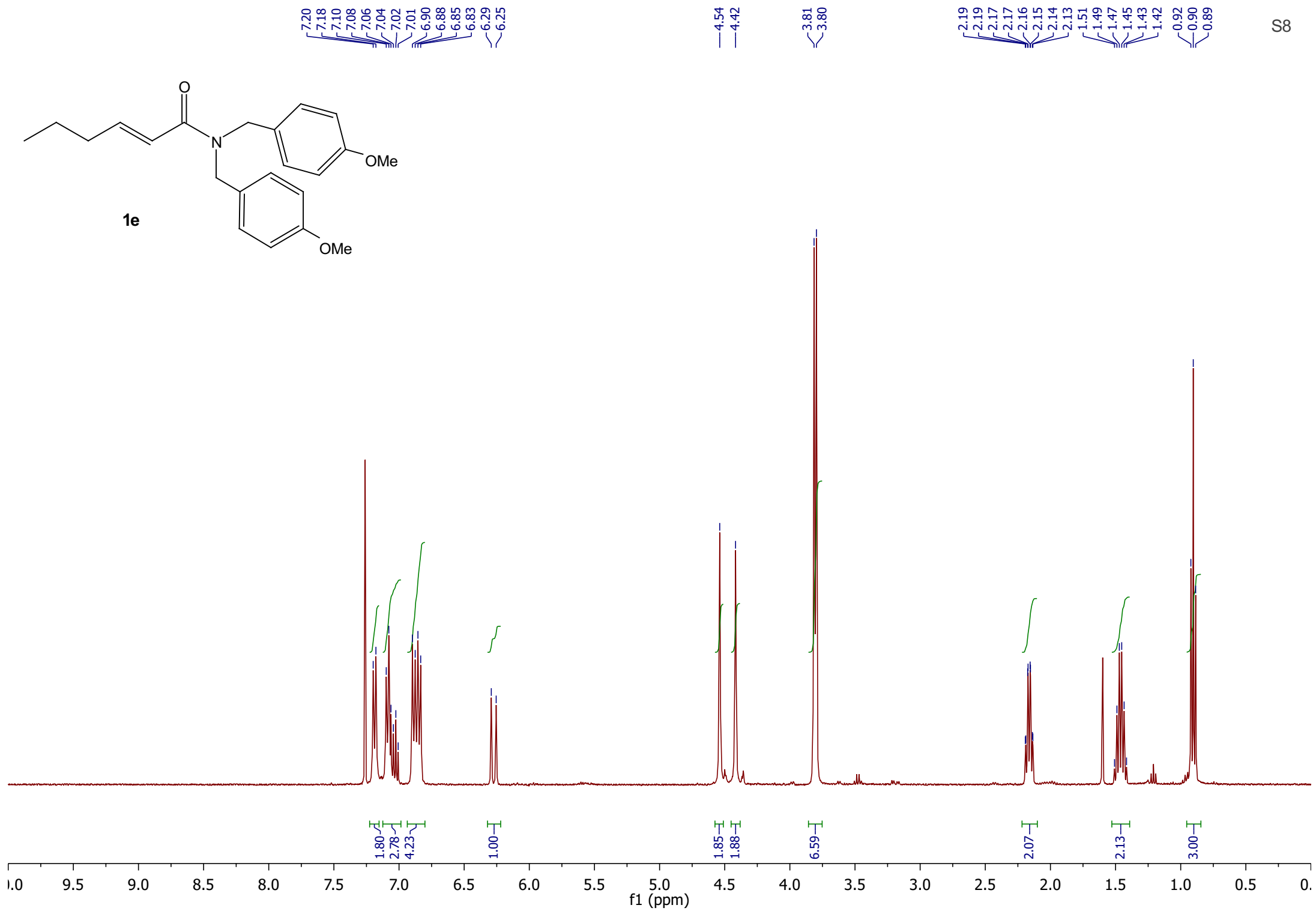
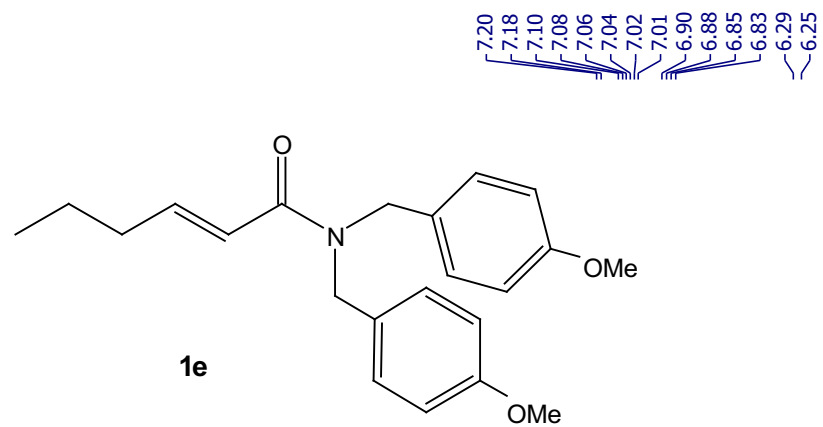
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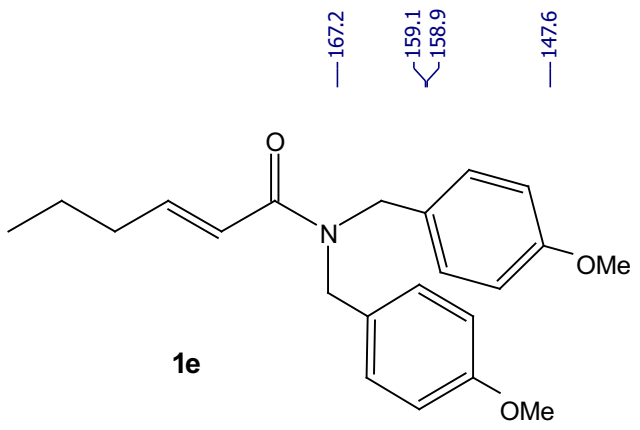
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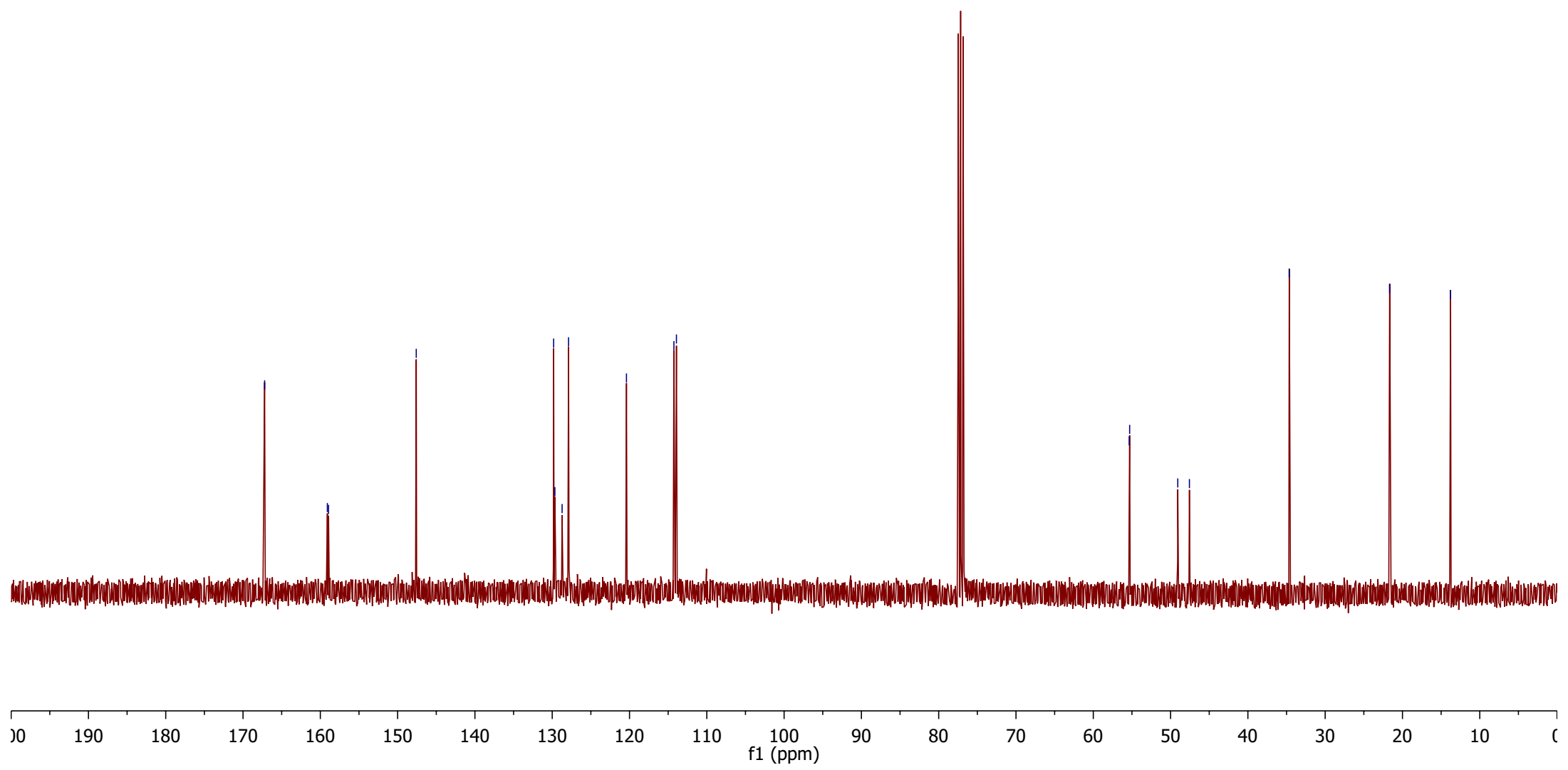


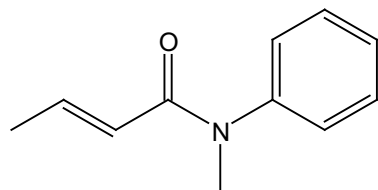
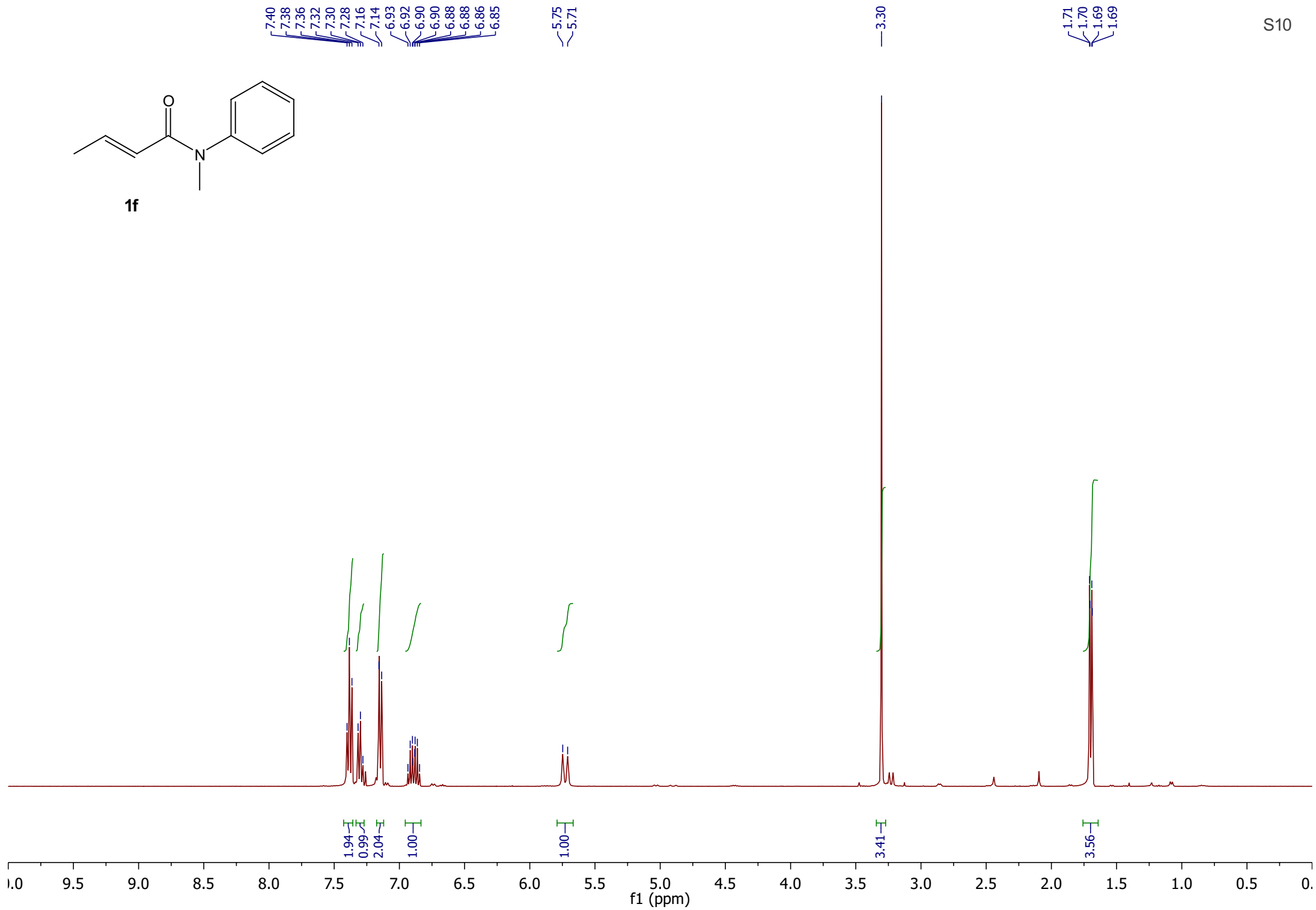


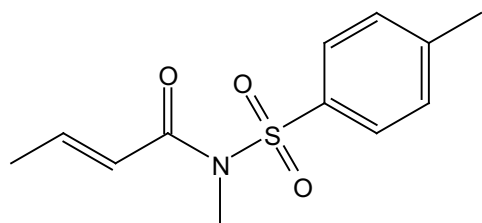
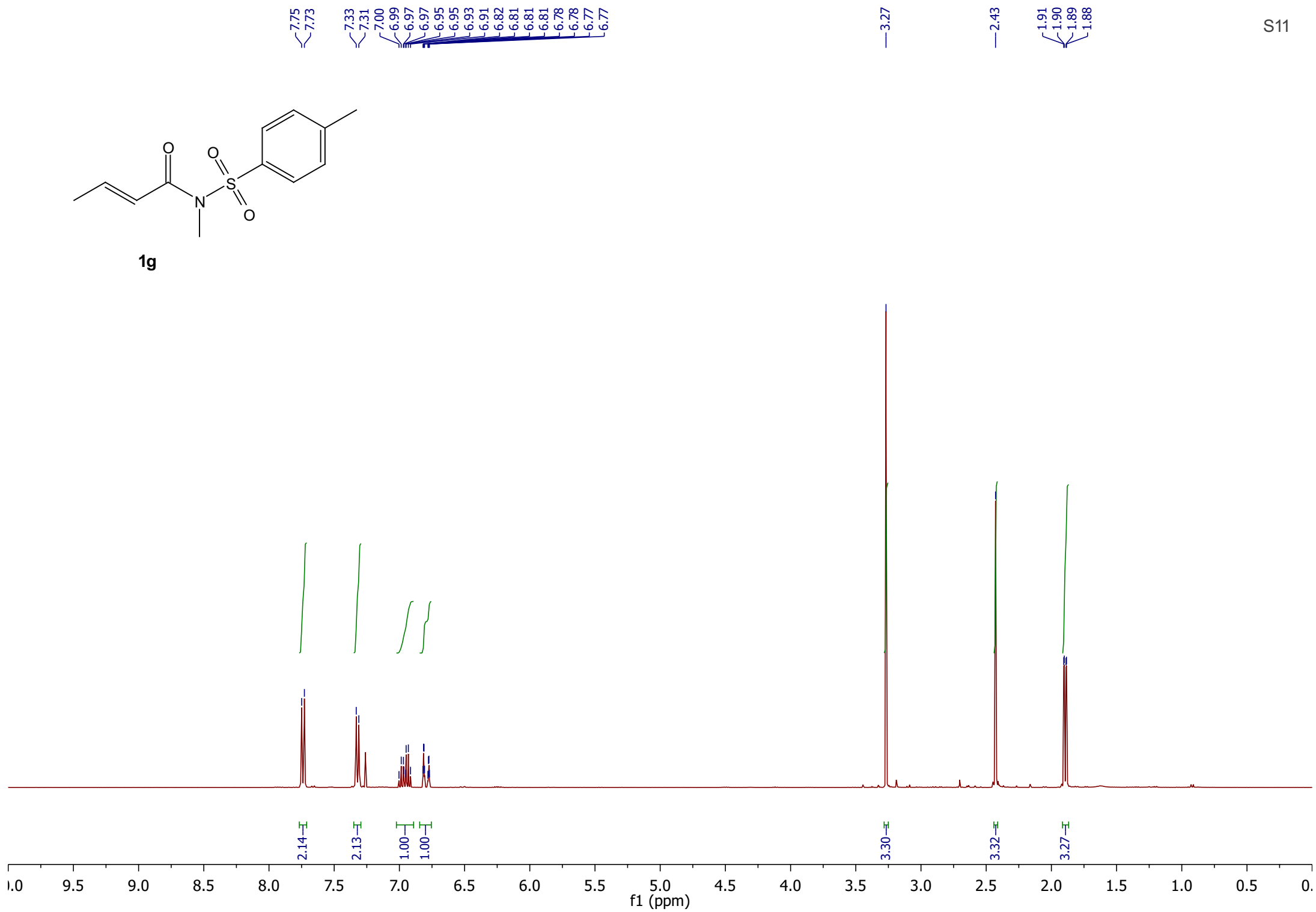


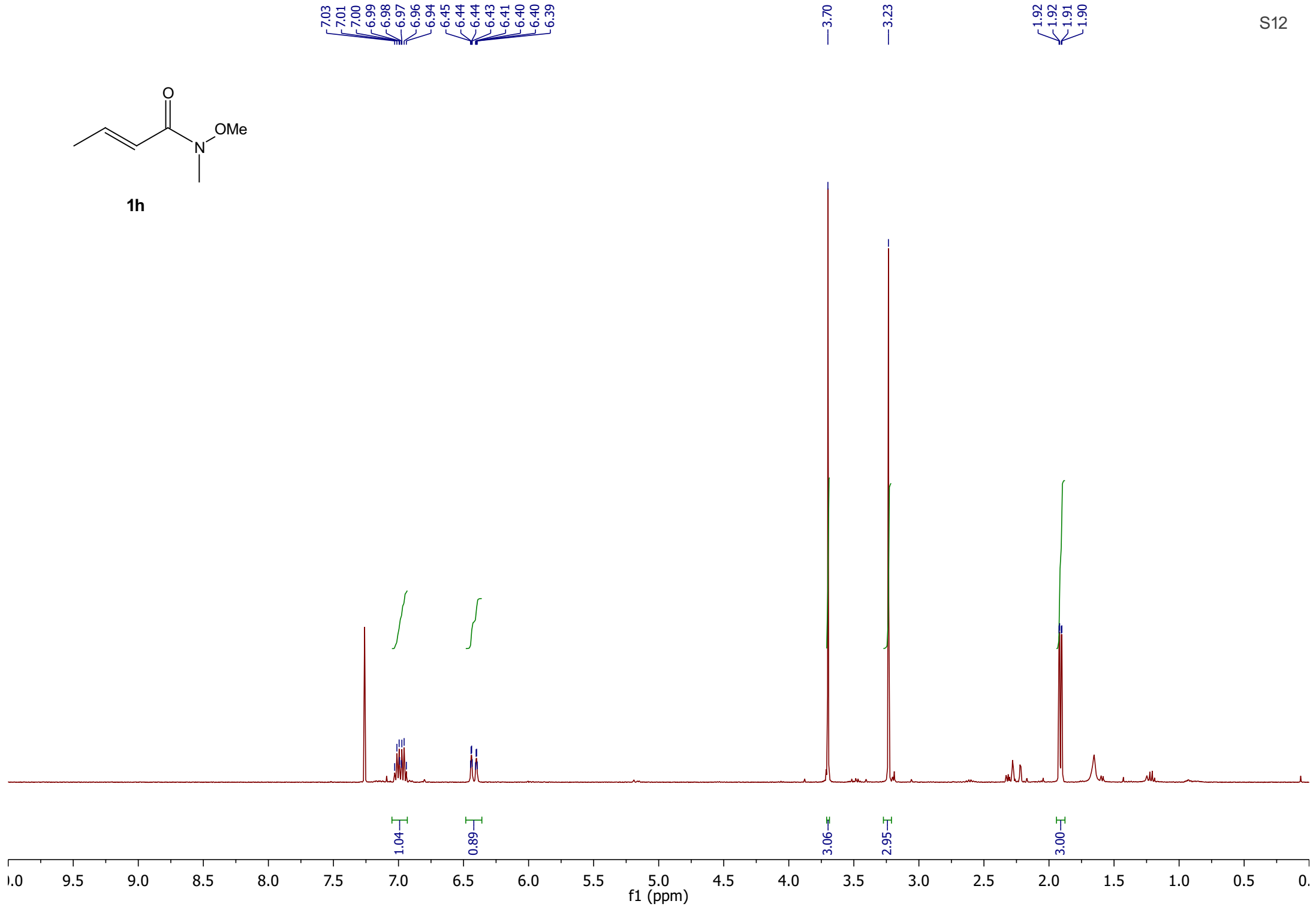
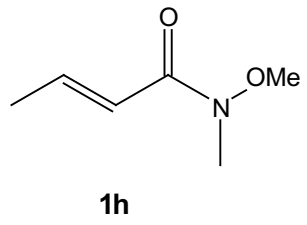


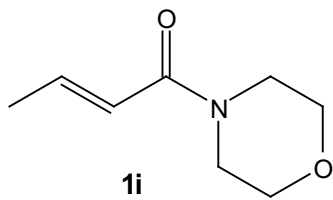
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**1f**

**1g**

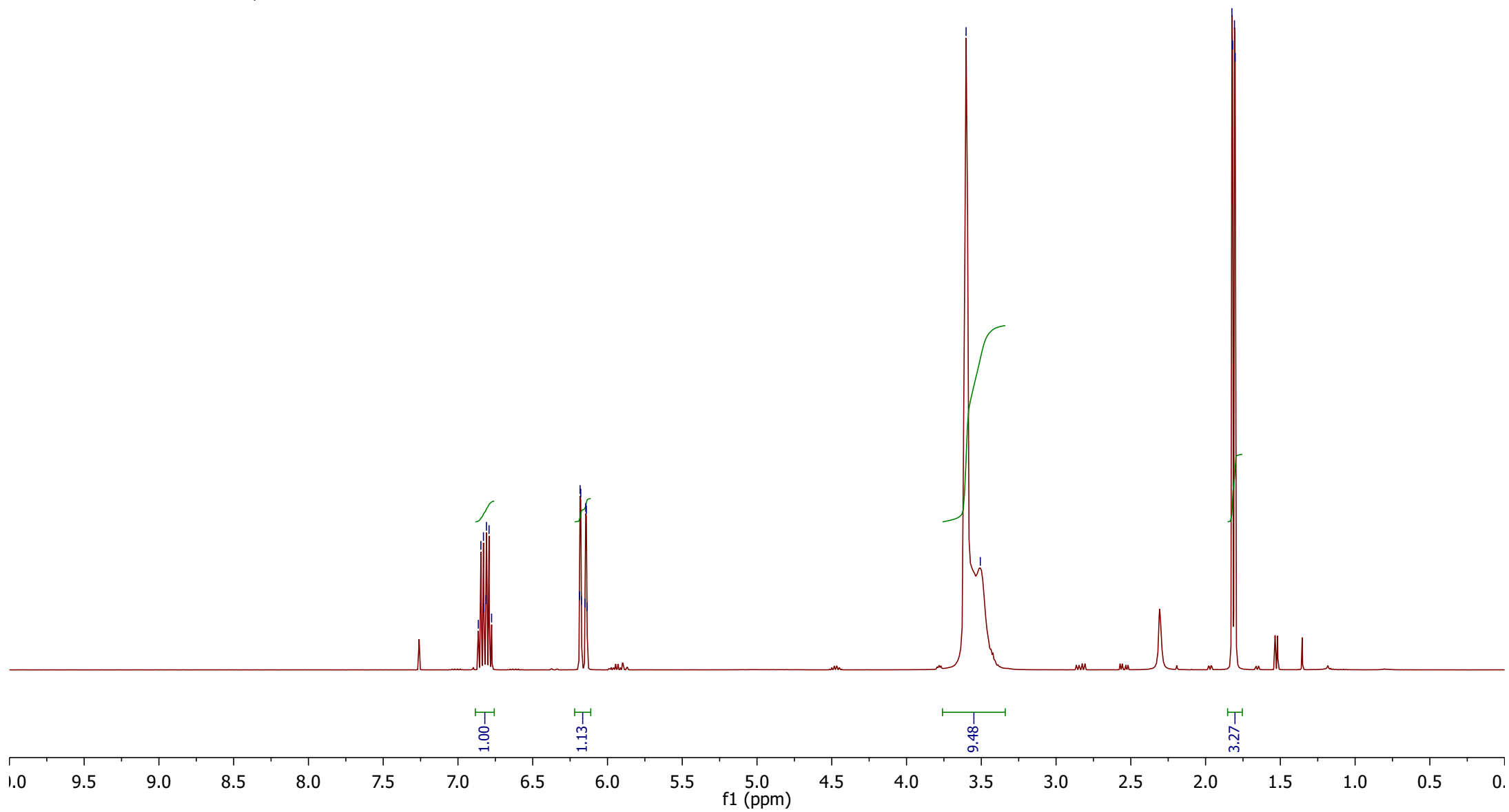


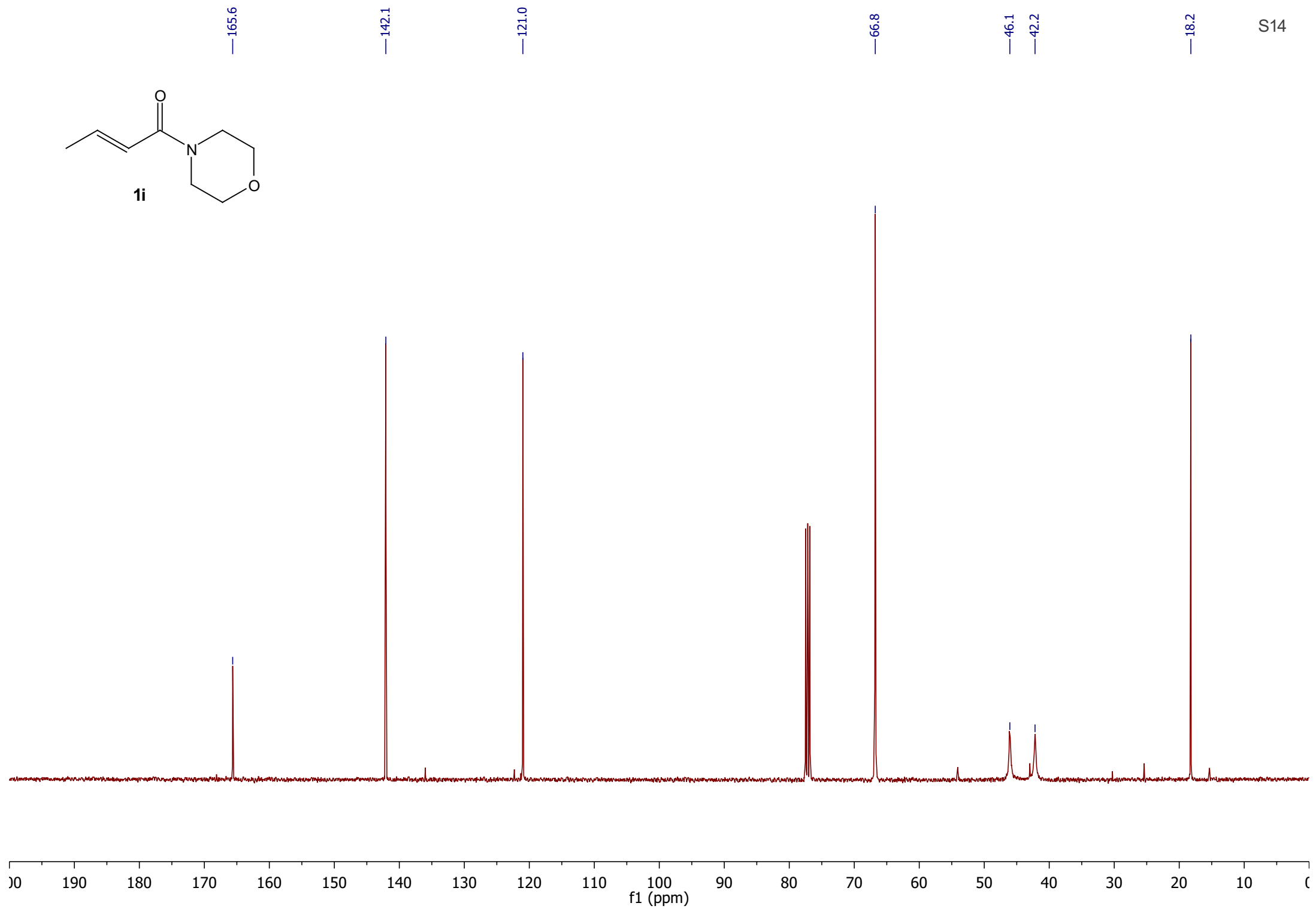
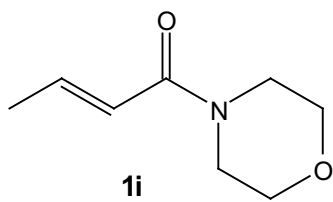


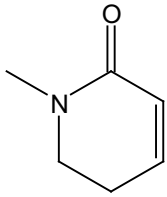
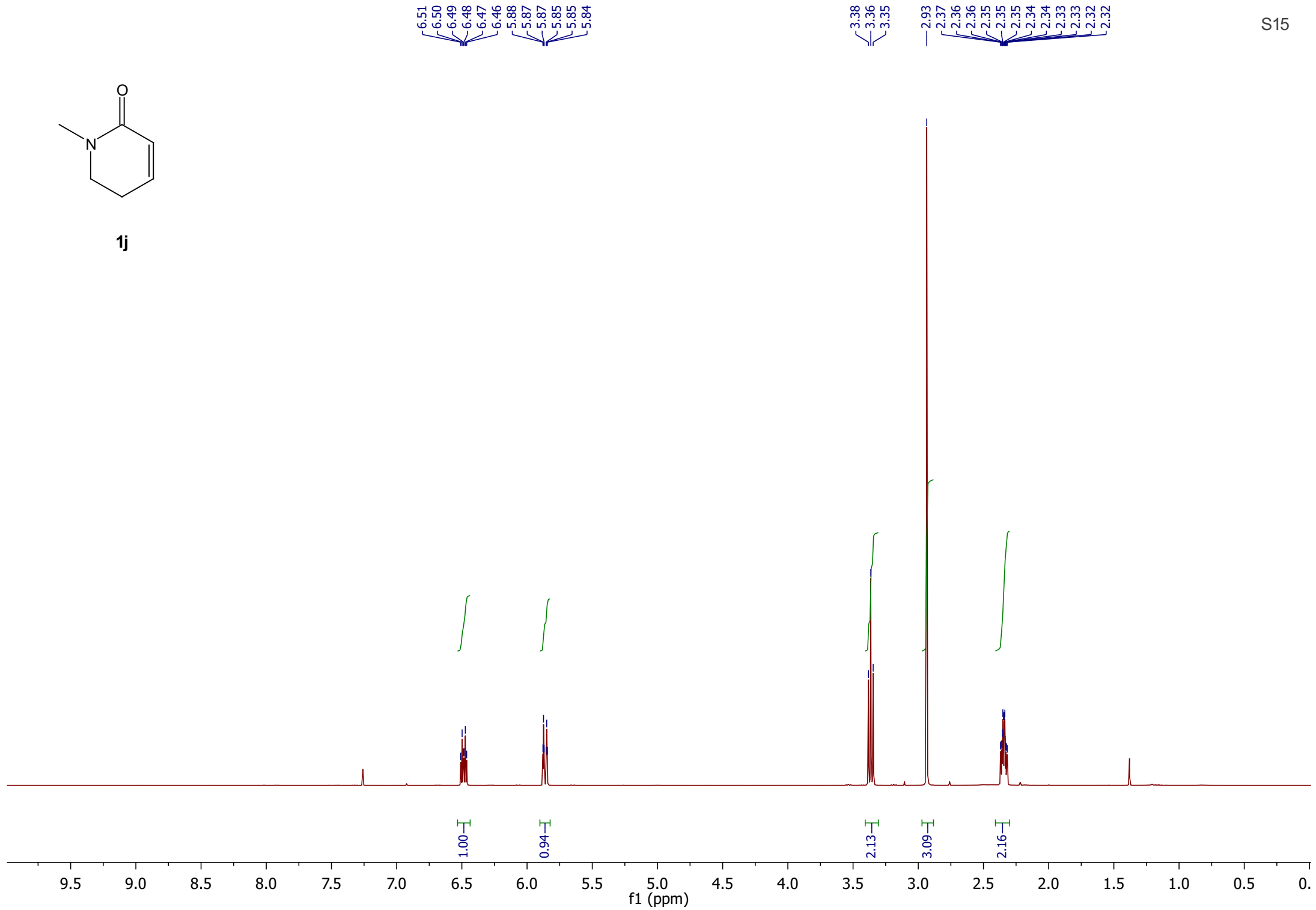
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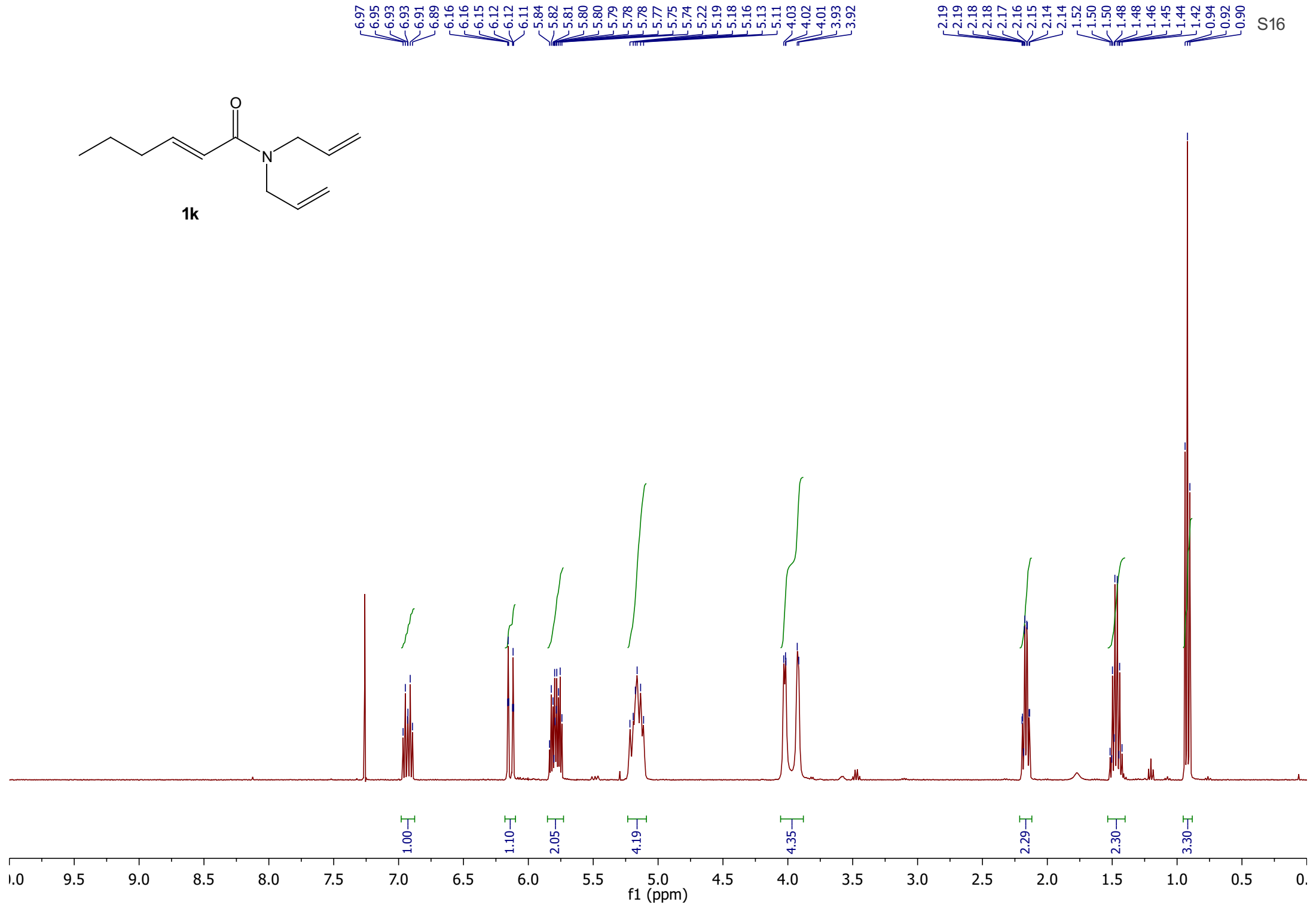
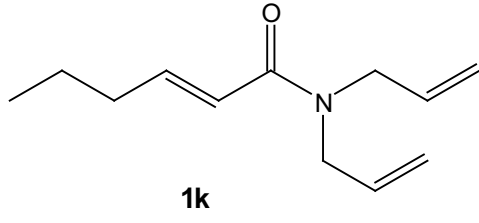
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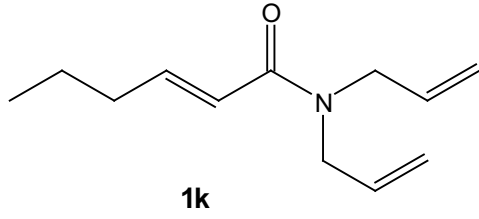




**1j**







—166.9

—147.1

133.5

133.2

120.4

117.4

116.8

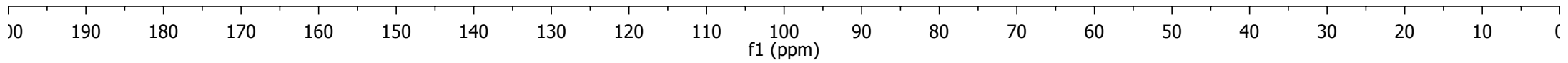
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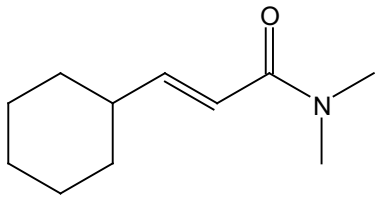
48.5

—34.7

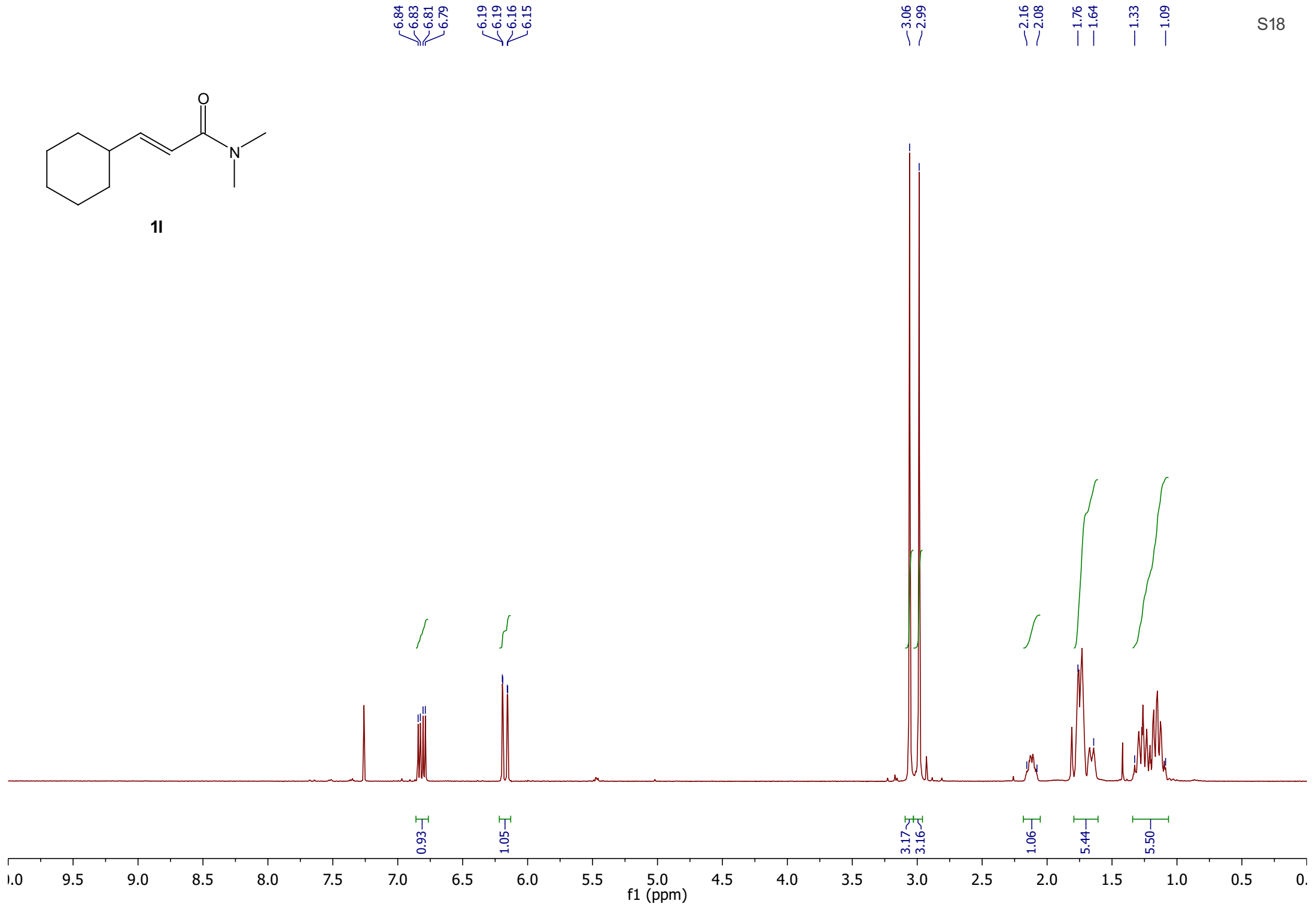
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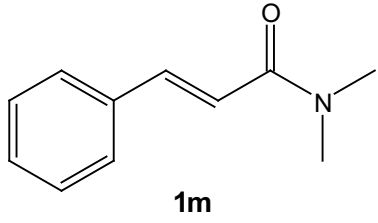
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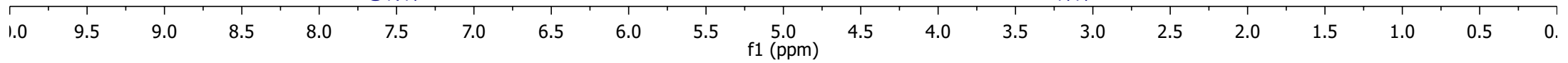
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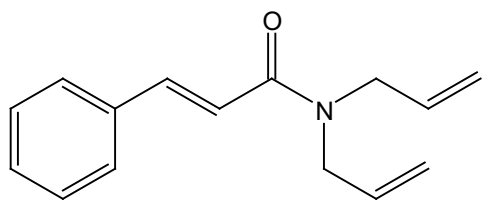
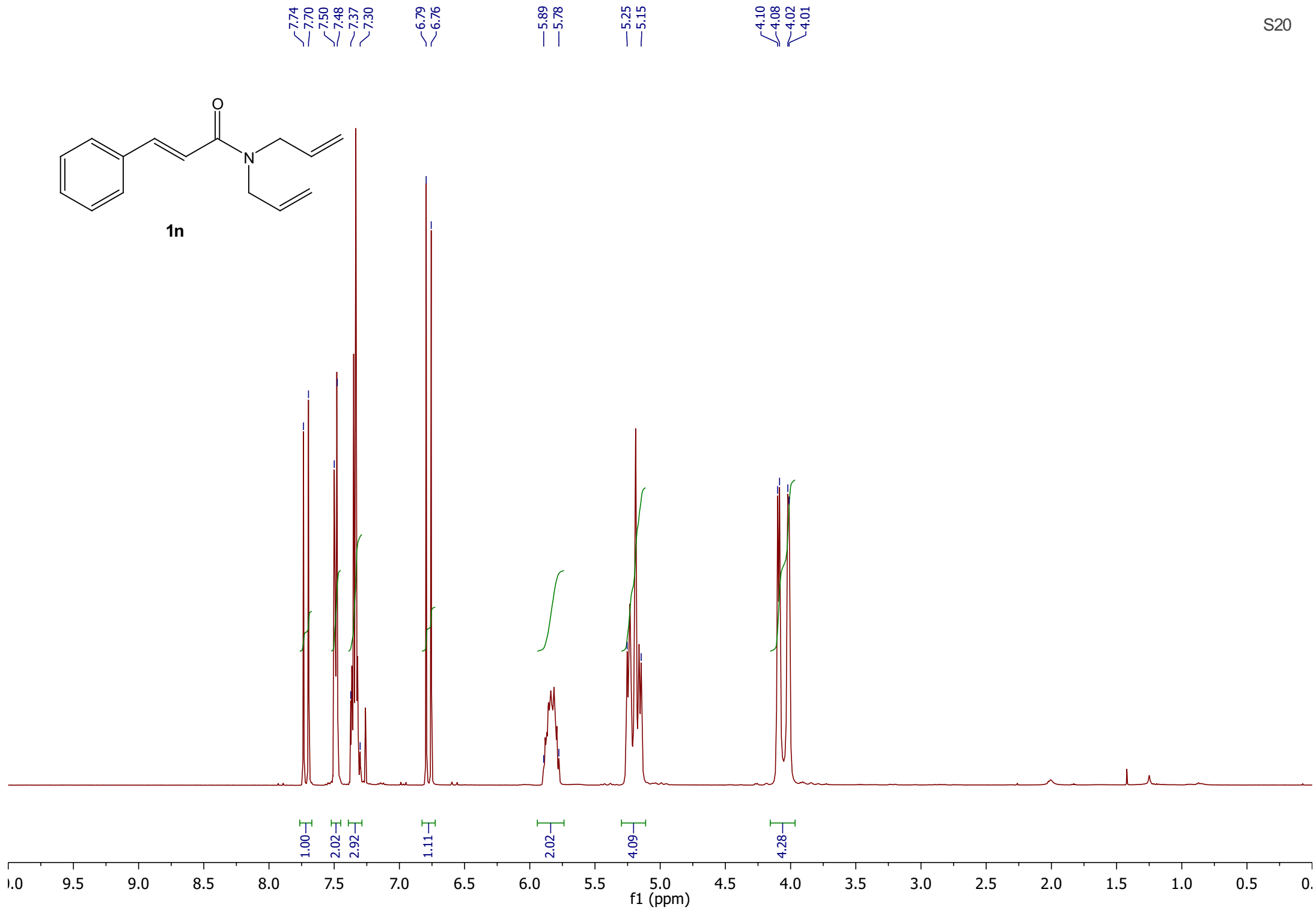


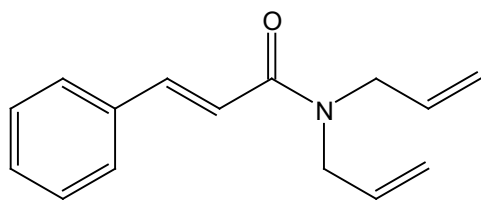
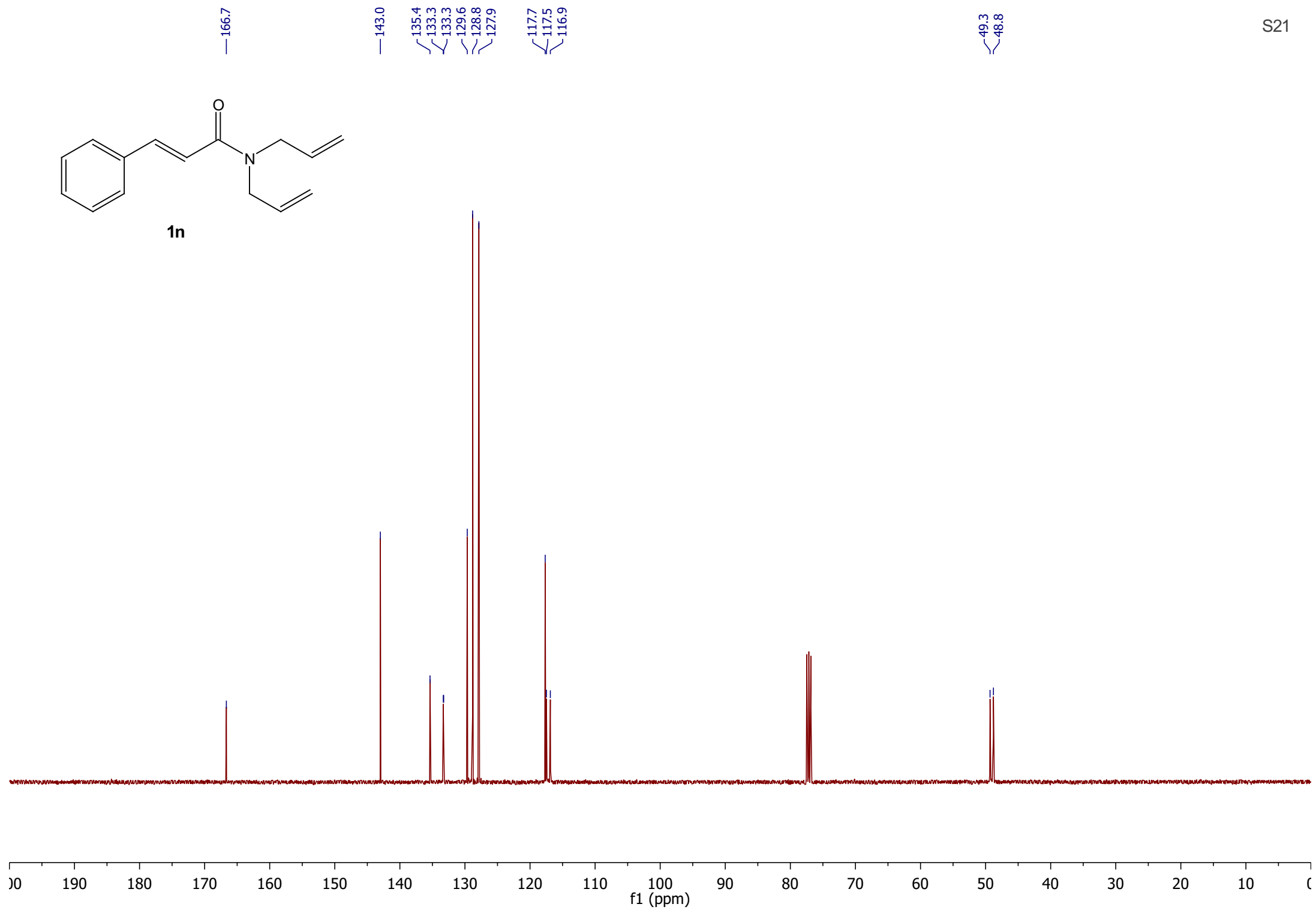


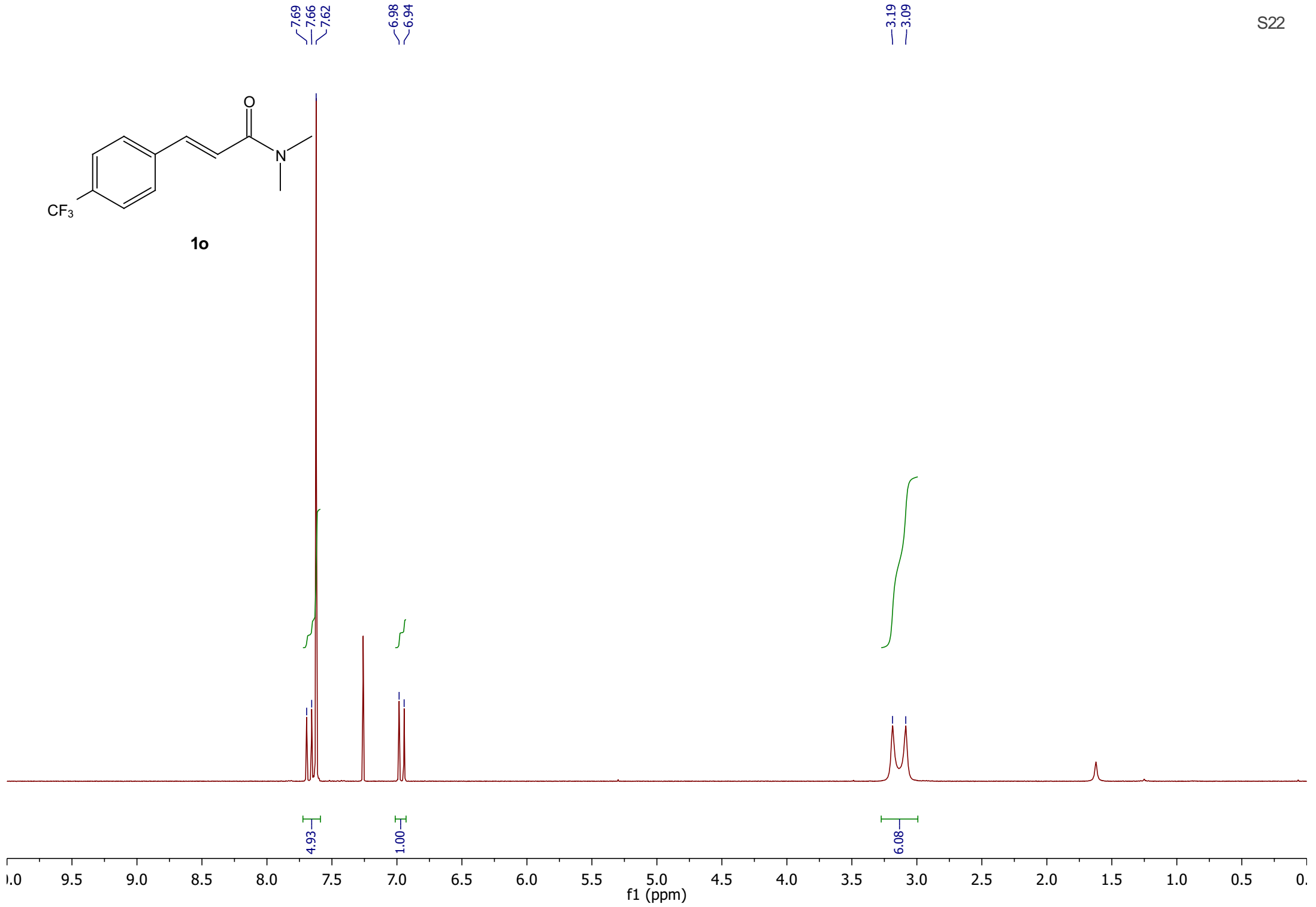
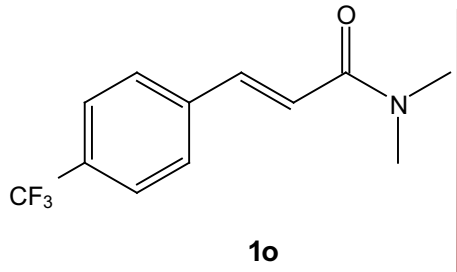
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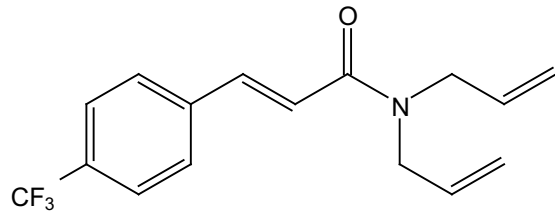
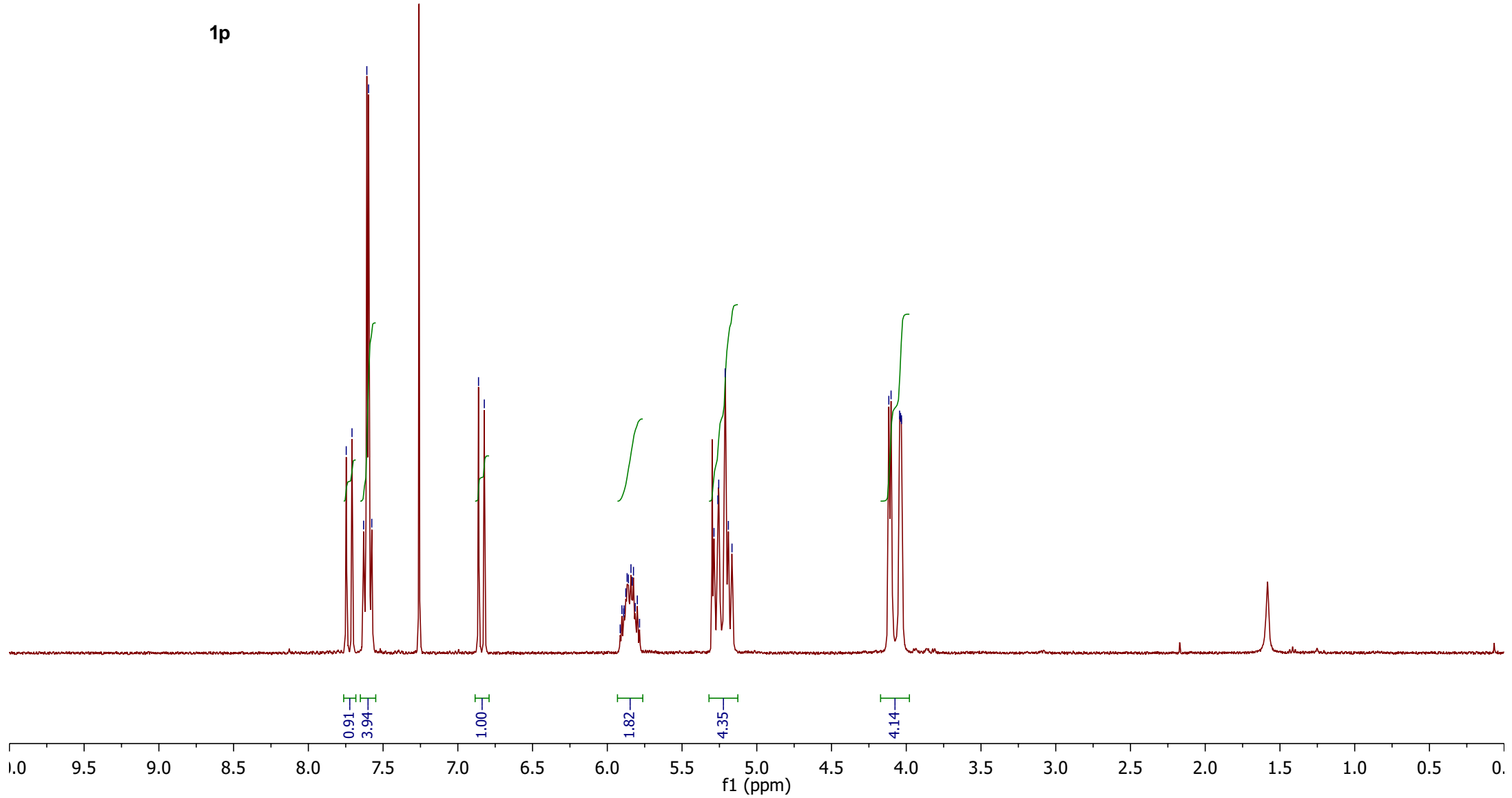
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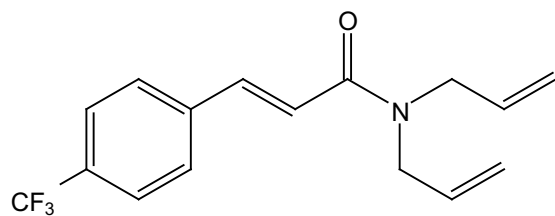


**1n**

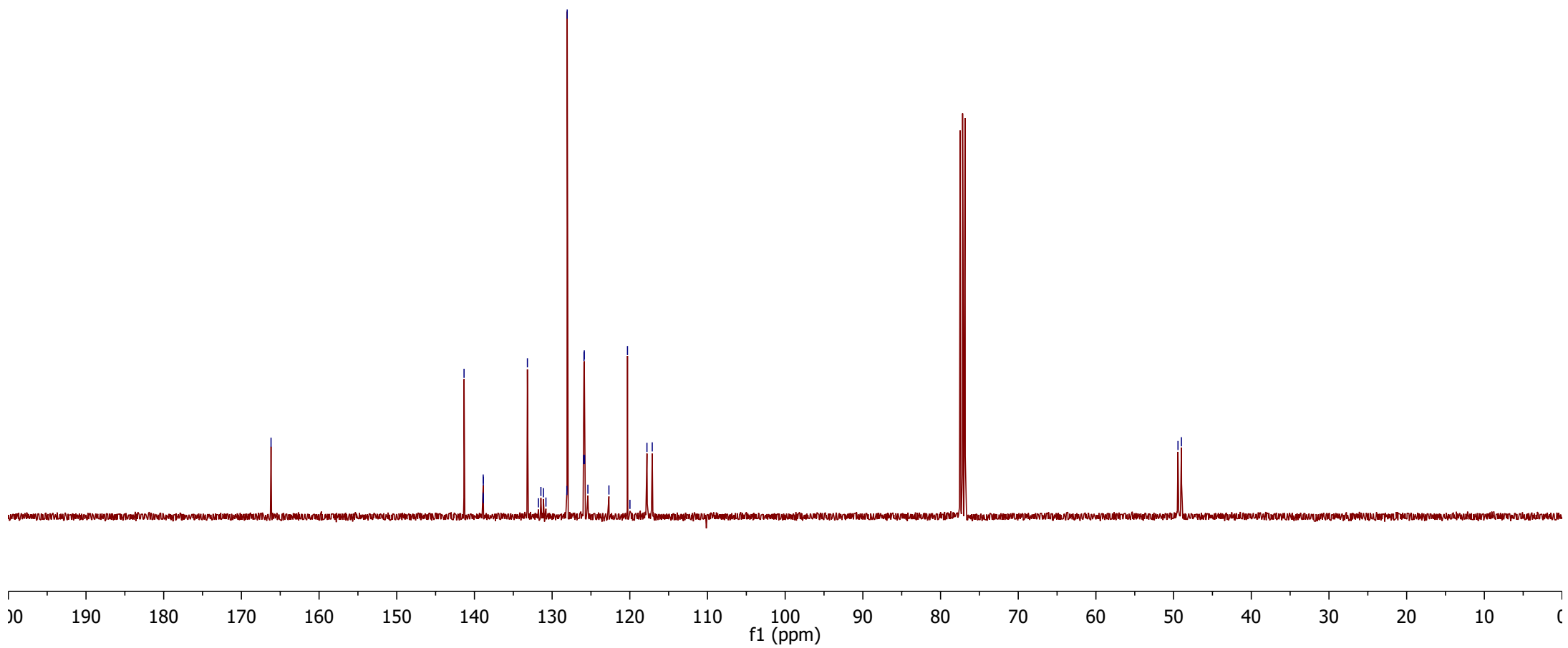
**1n**



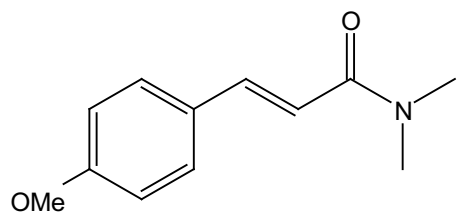
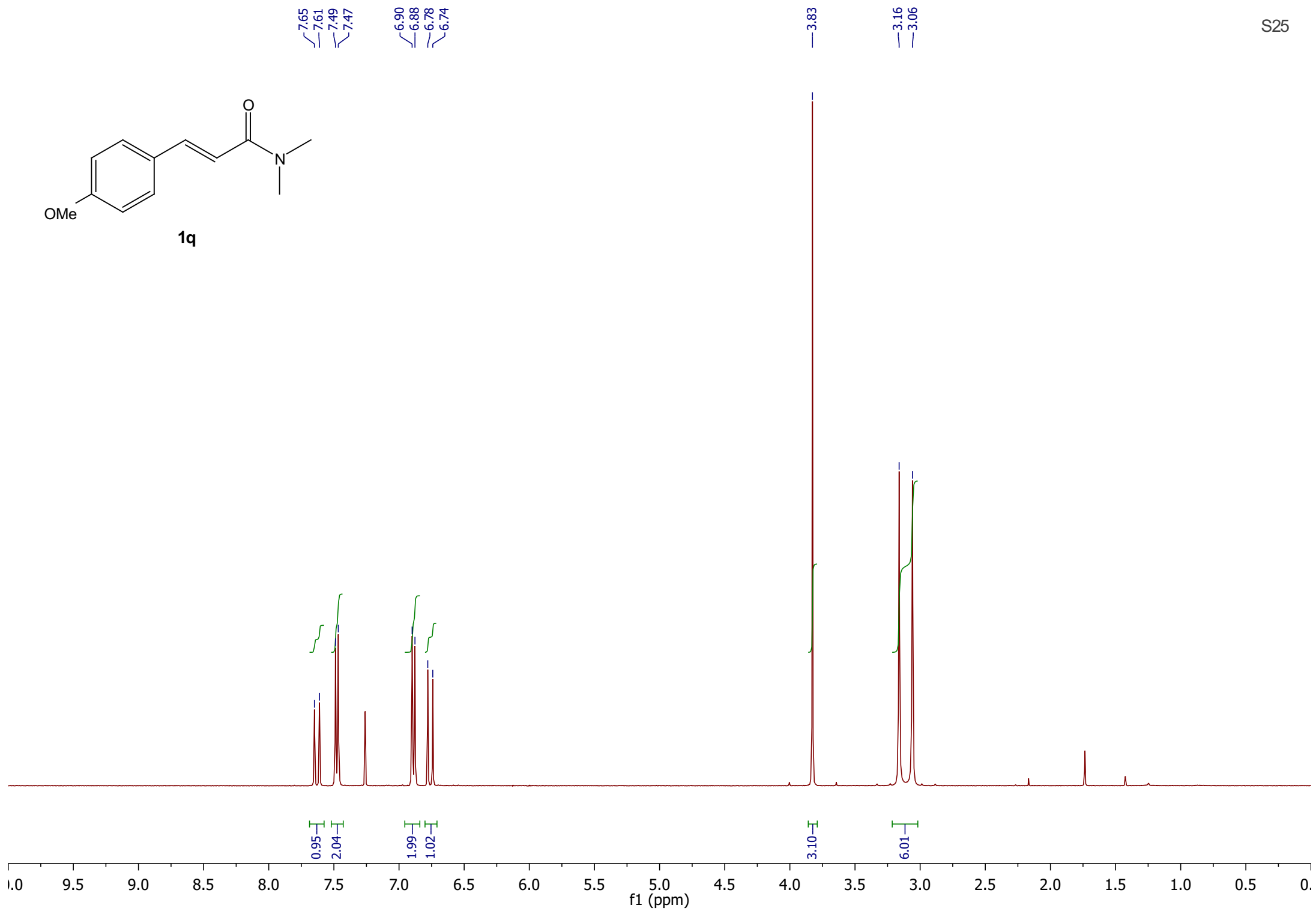
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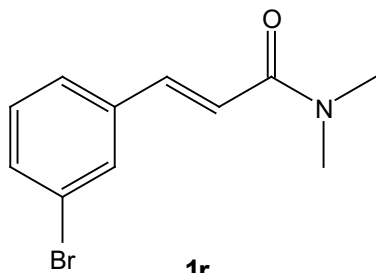
**1p**

166.2

141.3  
138.9  
138.9  
138.8  
133.2  
131.8  
131.4  
131.1  
130.8  
128.1  
128.1  
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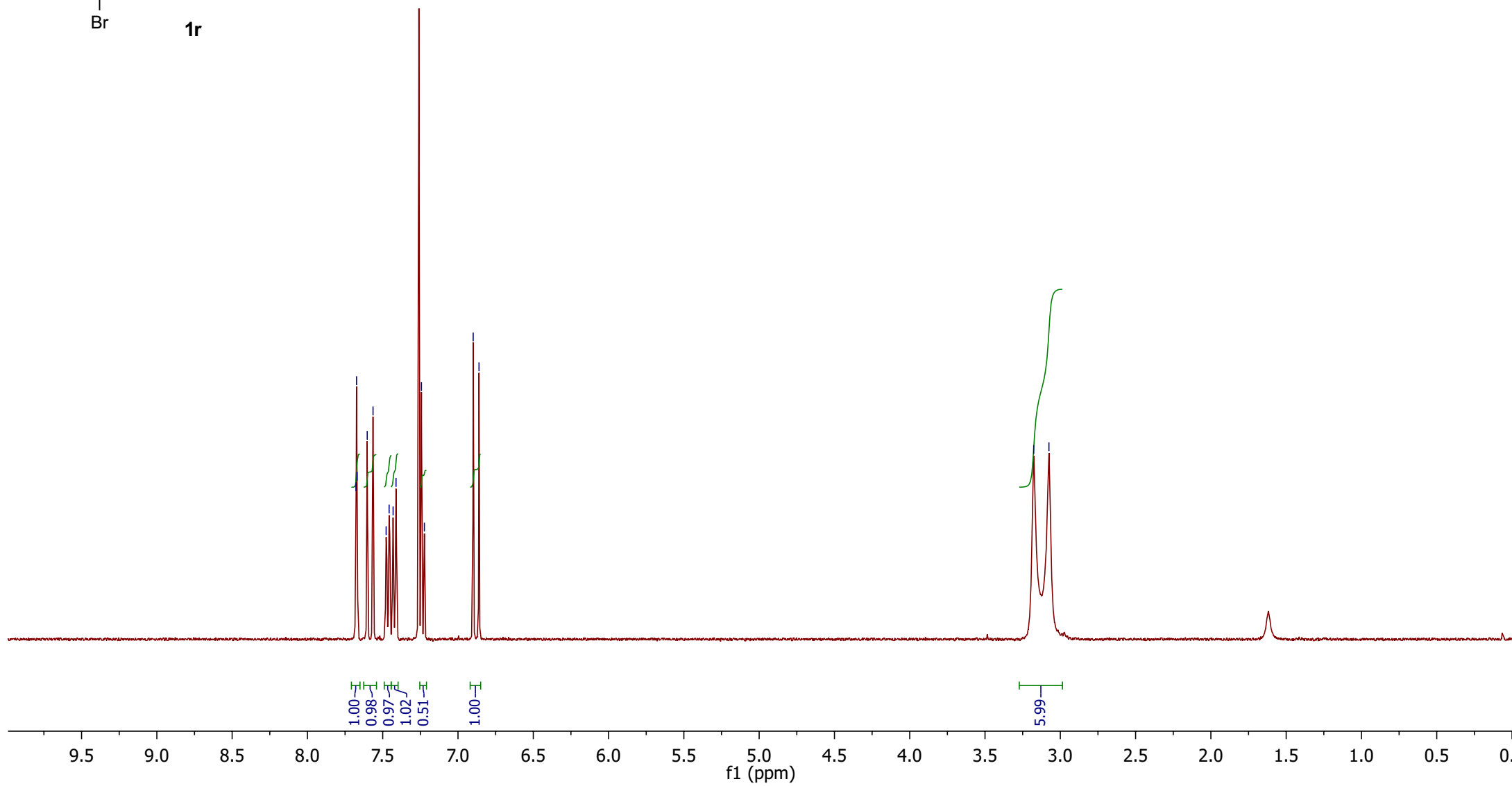


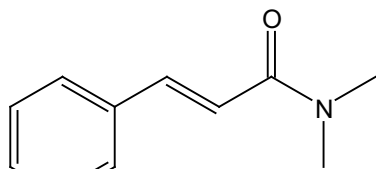
**1q**



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7.67  
7.60  
7.56  
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7.46  
7.43  
7.41  
7.24  
7.22  
6.90  
6.86

3.18  
3.08





Br

**1r**

— 166.3

— 140.8

— 137.6

— 132.4

— 130.4

— 130.2

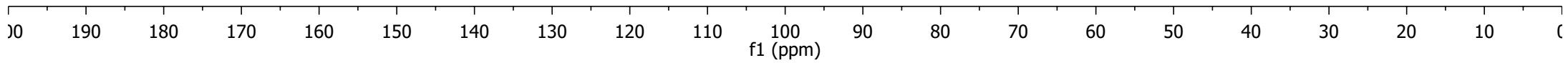
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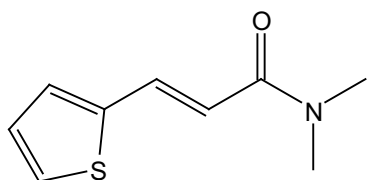
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— 119.0

— 37.5

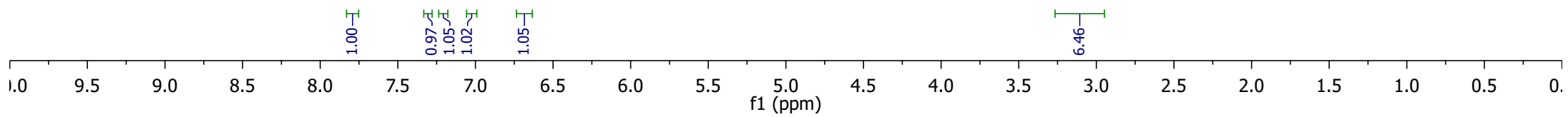
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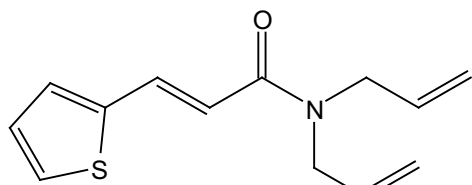
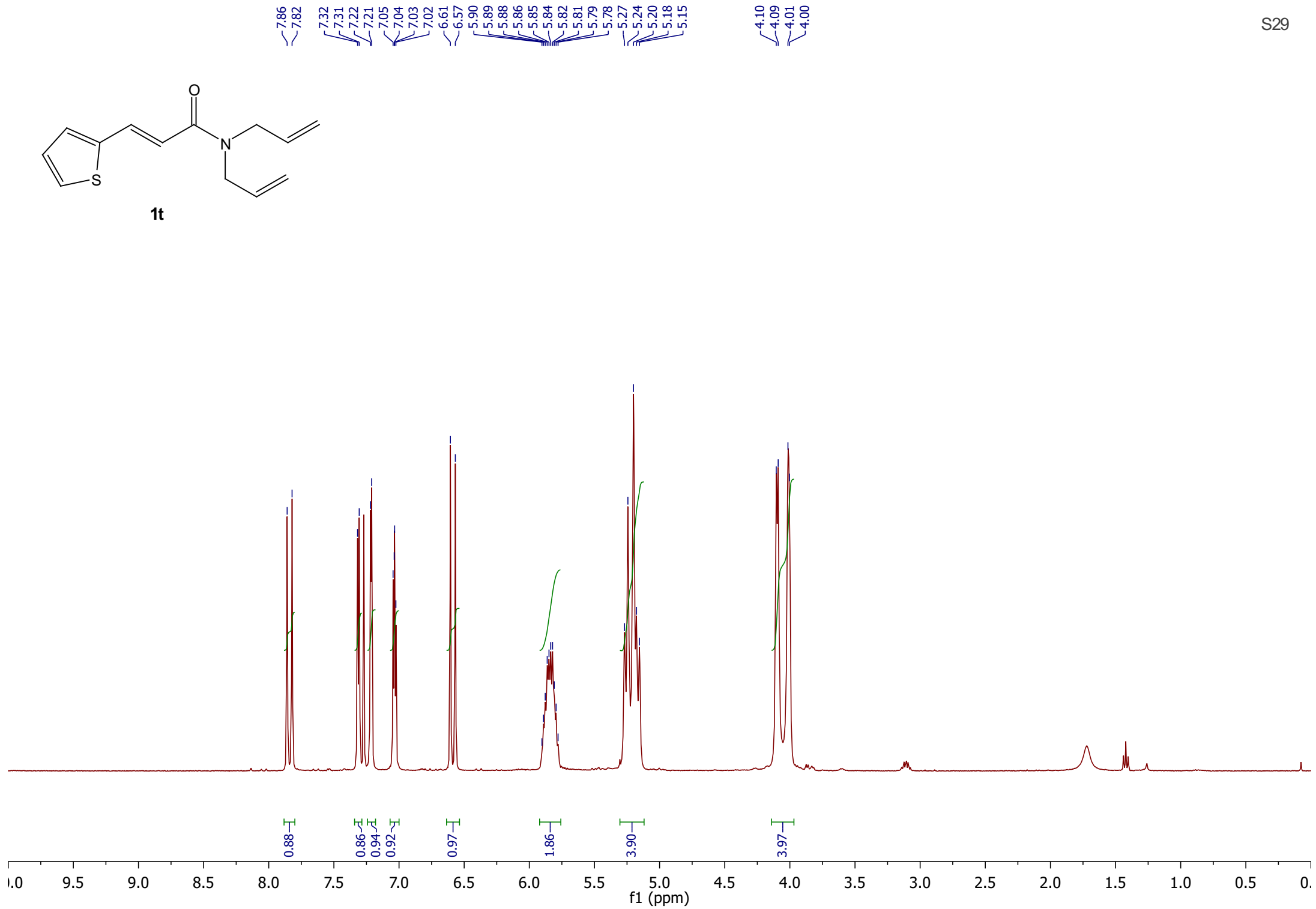


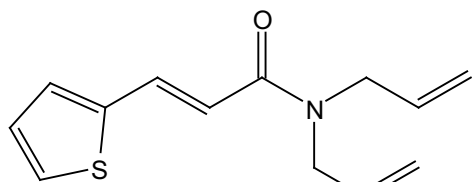
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7.21  
7.21  
7.04  
7.03  
7.03  
7.02  
6.71  
6.67

3.14  
3.07



**1t**

**1t**

—166.4

—140.6

—135.8

—133.4

—133.3

—130.3

—128.1

—127.3

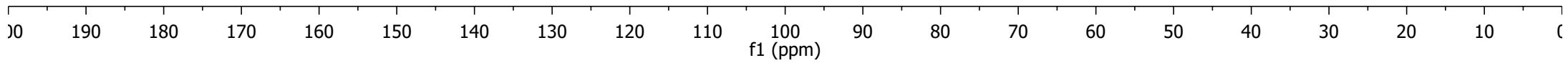
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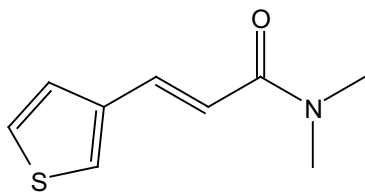
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—116.5

—49.4

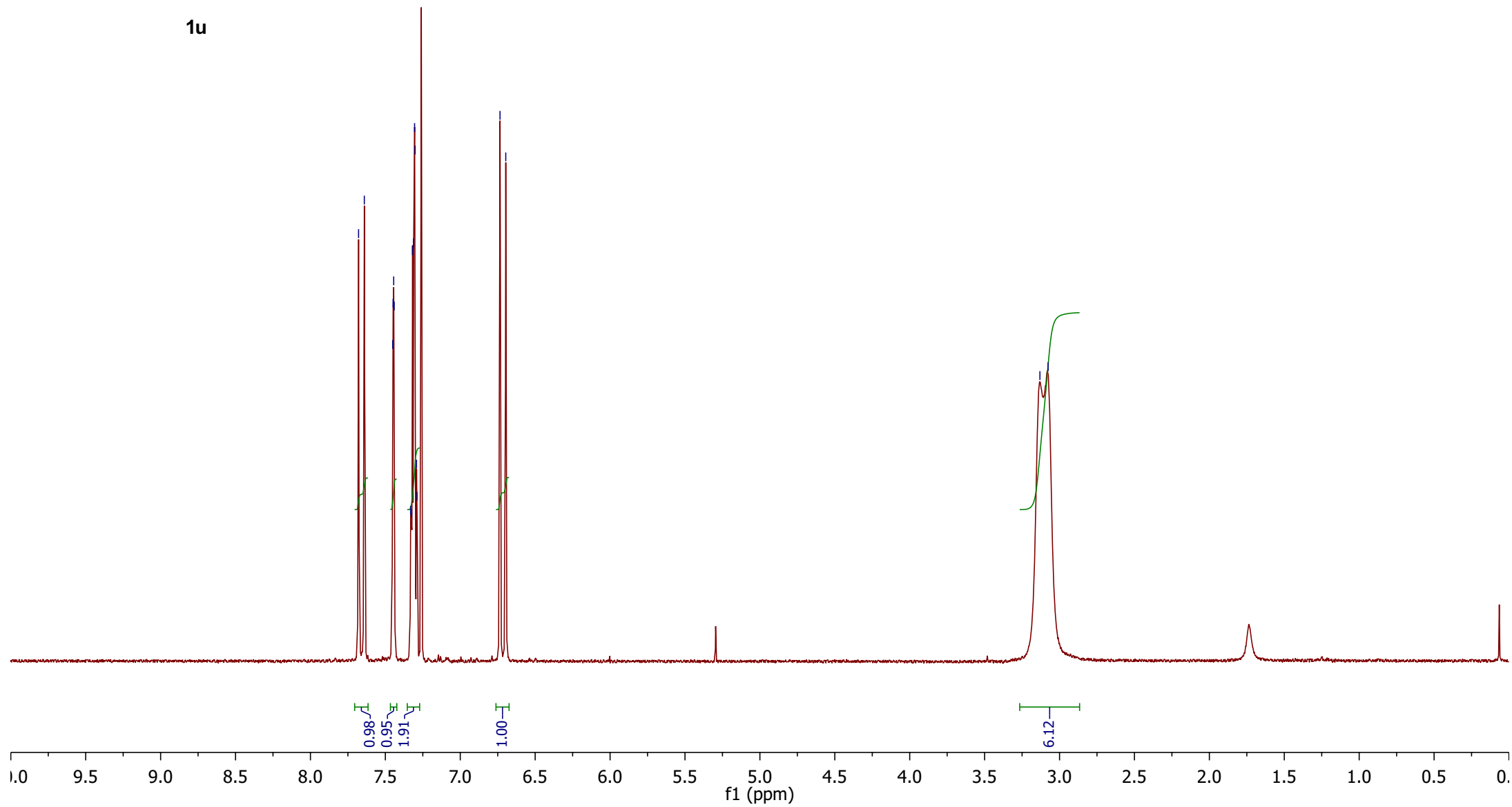
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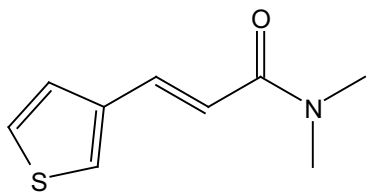
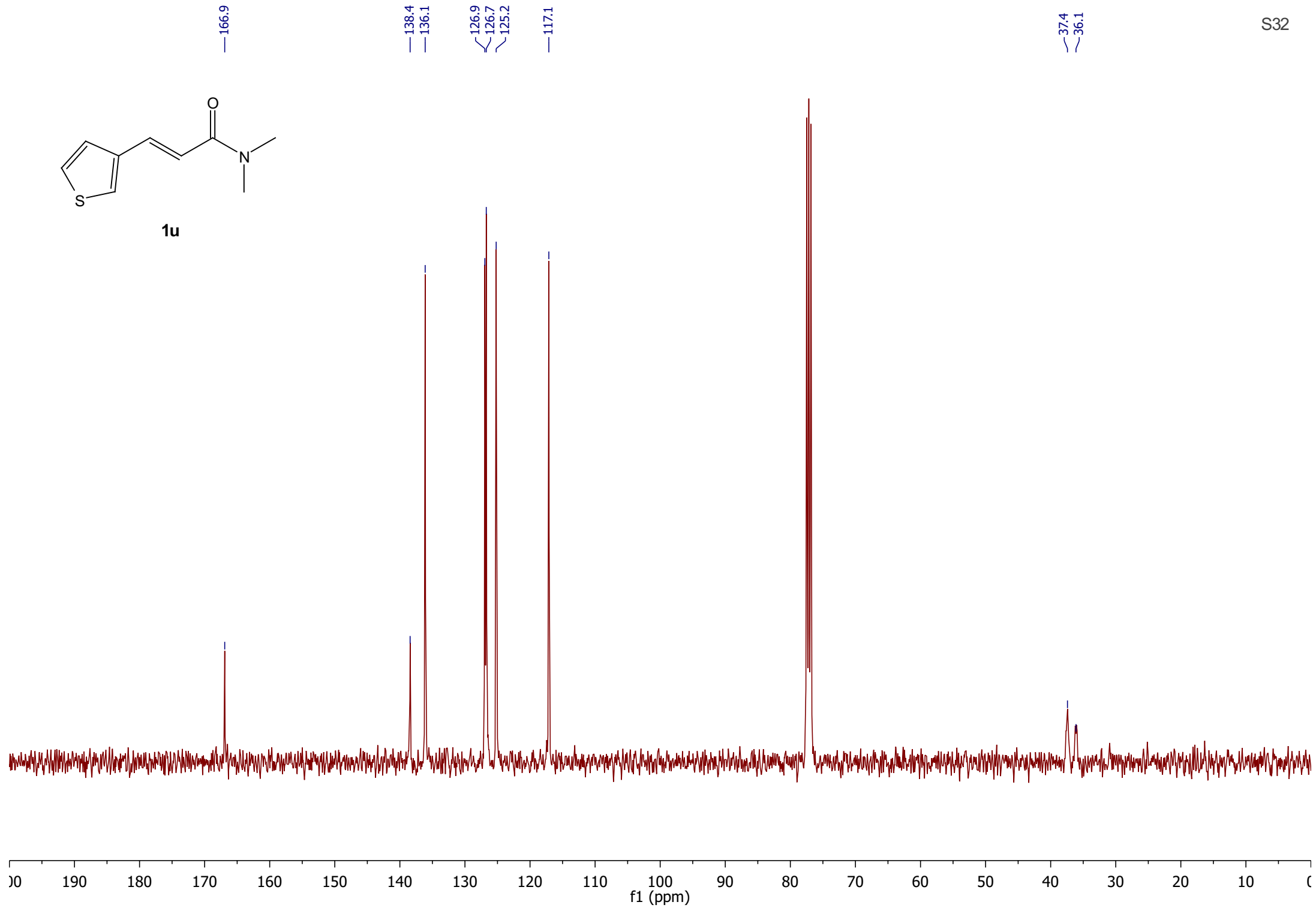


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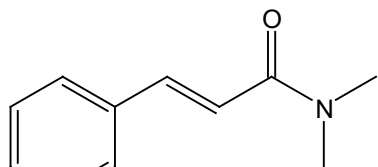
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6.70

3.13  
3.08



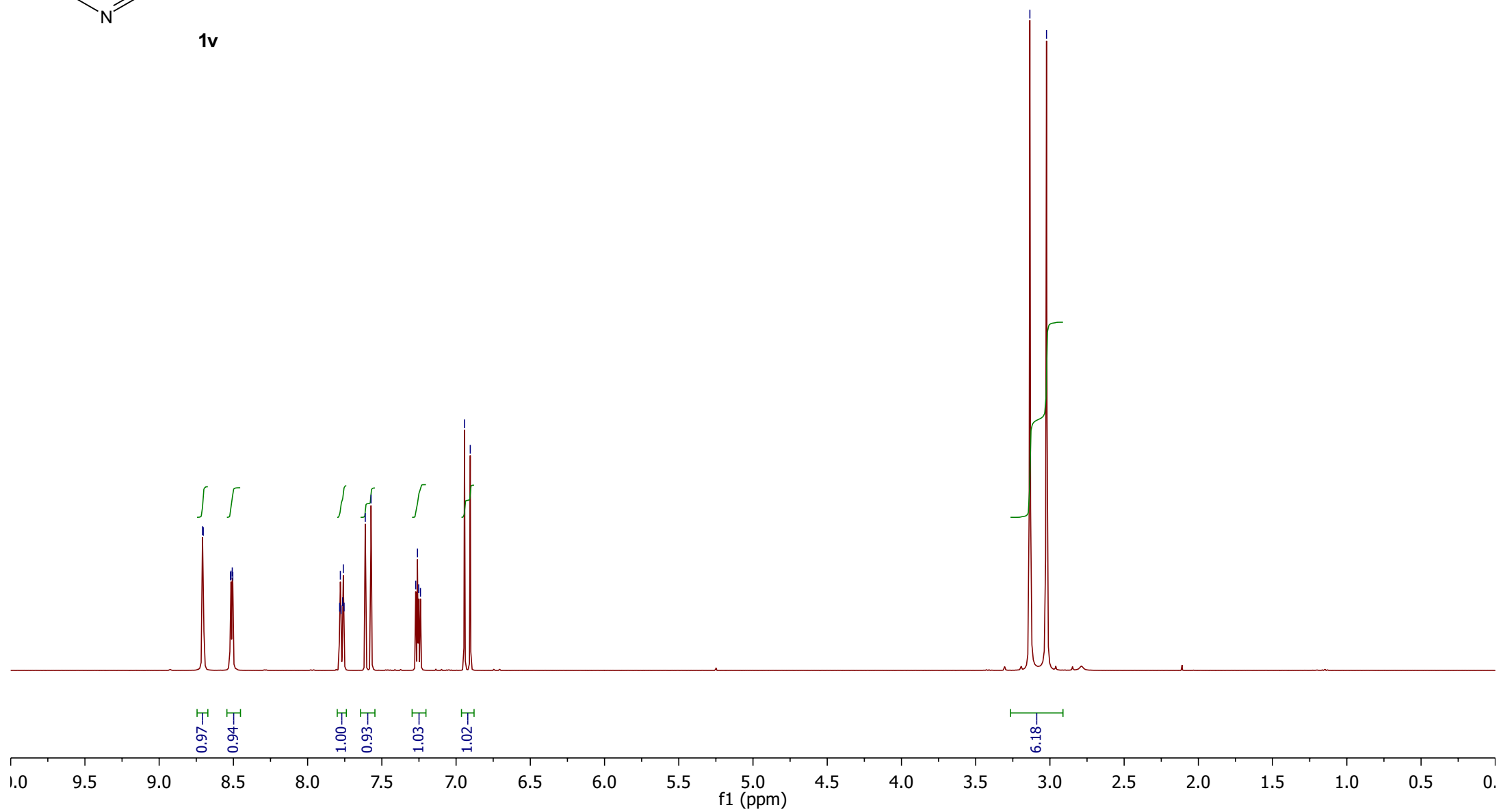
**1u**

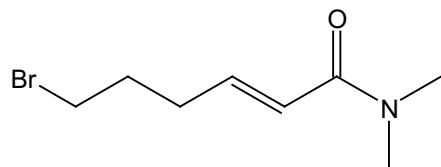


**1v**

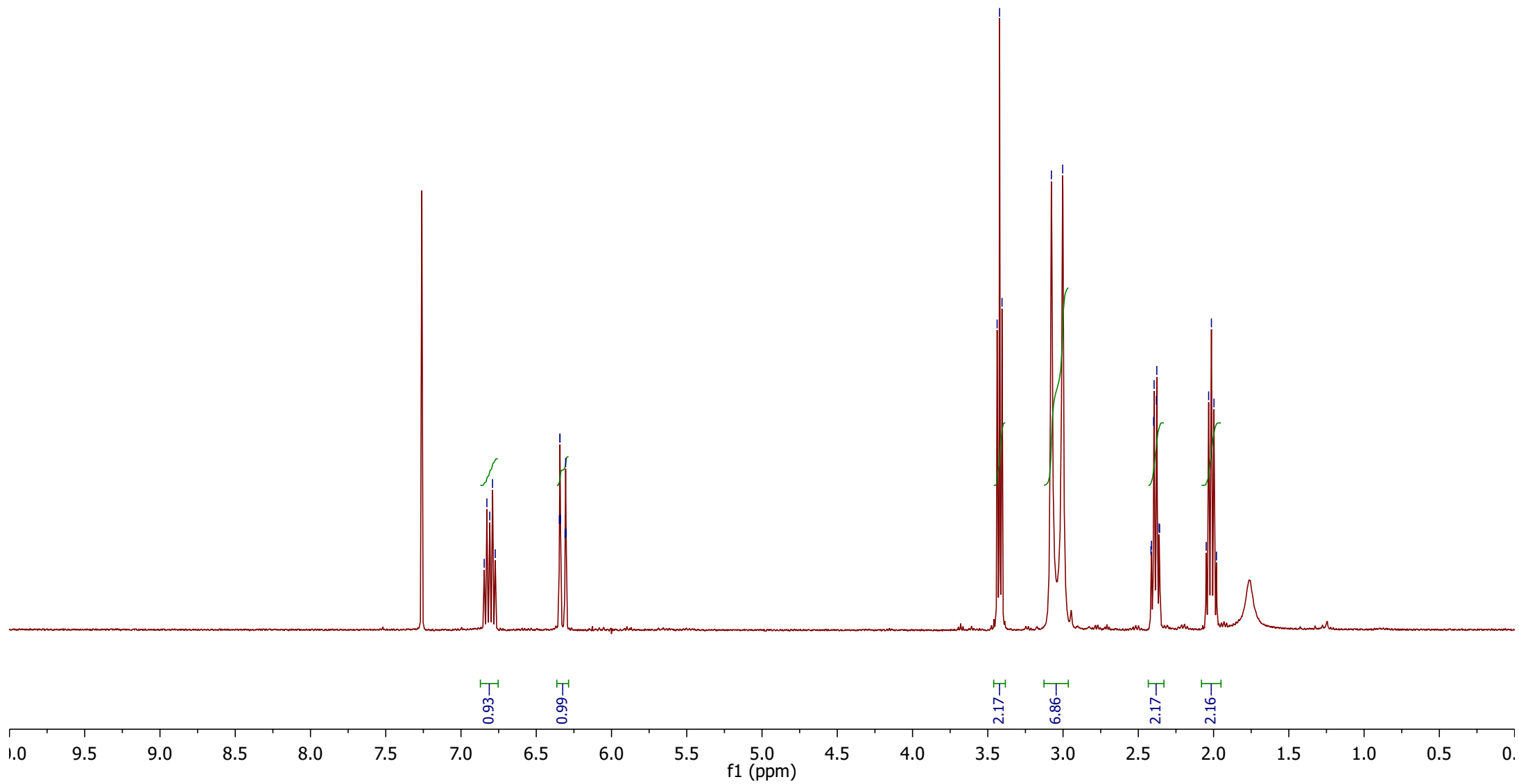
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7.78  
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7.77  
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7.27  
7.26  
7.25  
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6.90

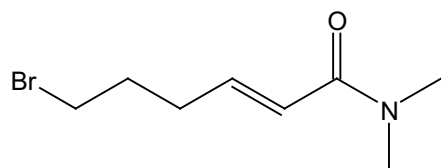
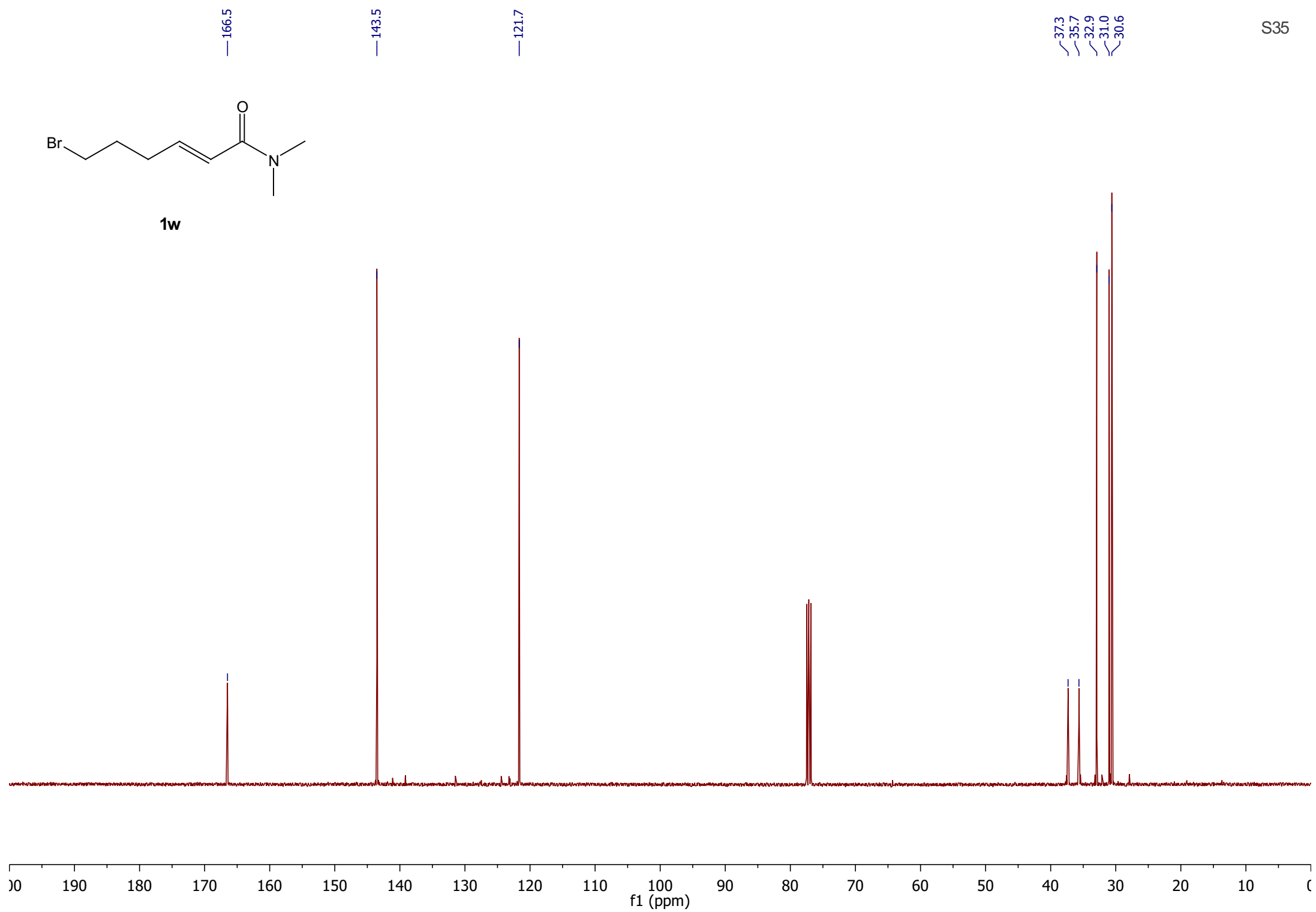
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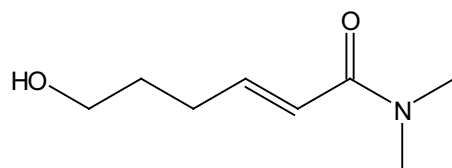




1w



**1w**

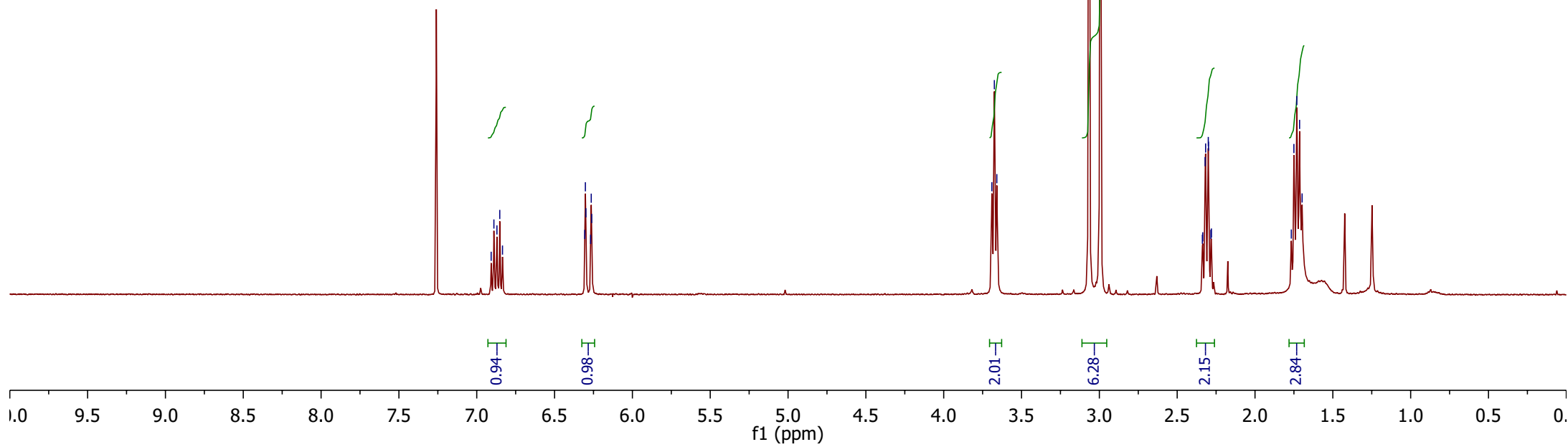
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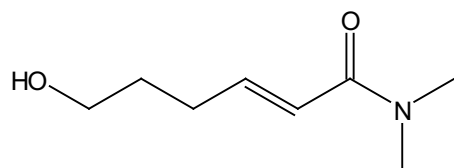
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6.27  
6.26  
6.26

3.69  
3.67  
3.66

3.07  
2.99  
2.34  
2.34  
2.32  
2.32  
2.30  
2.30  
2.28  
2.28

1.77  
1.75  
1.73  
1.71  
1.70





1x

—167.0

—145.8

—120.4

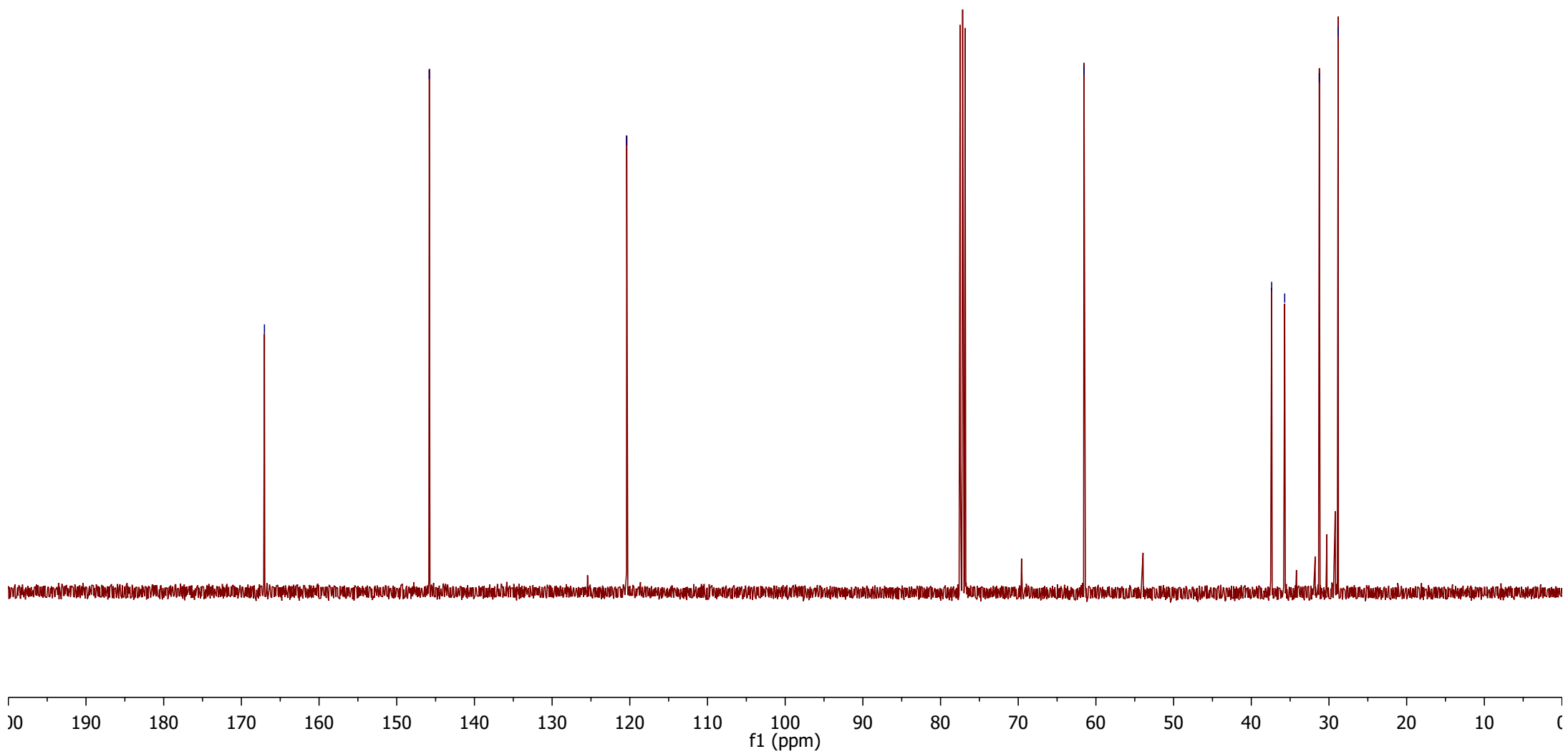
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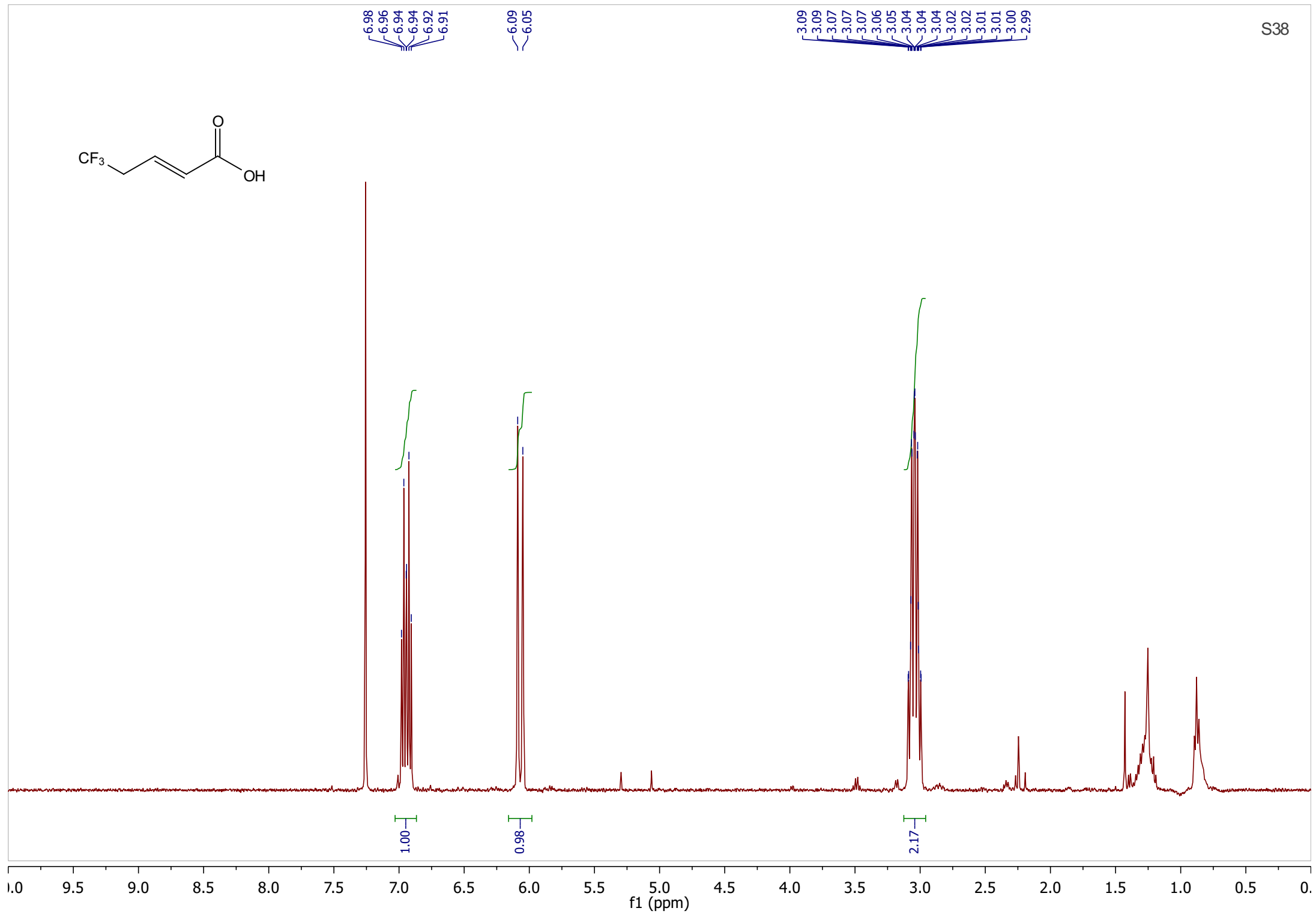
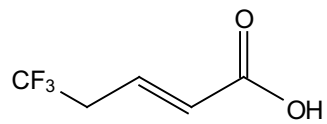
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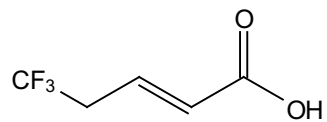
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—31.2

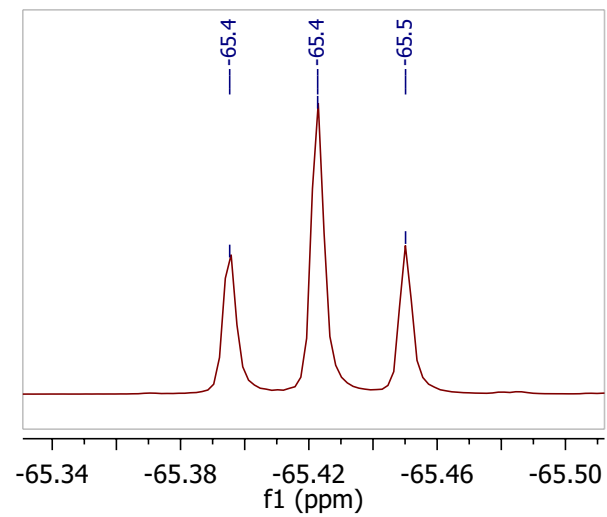
—28.8



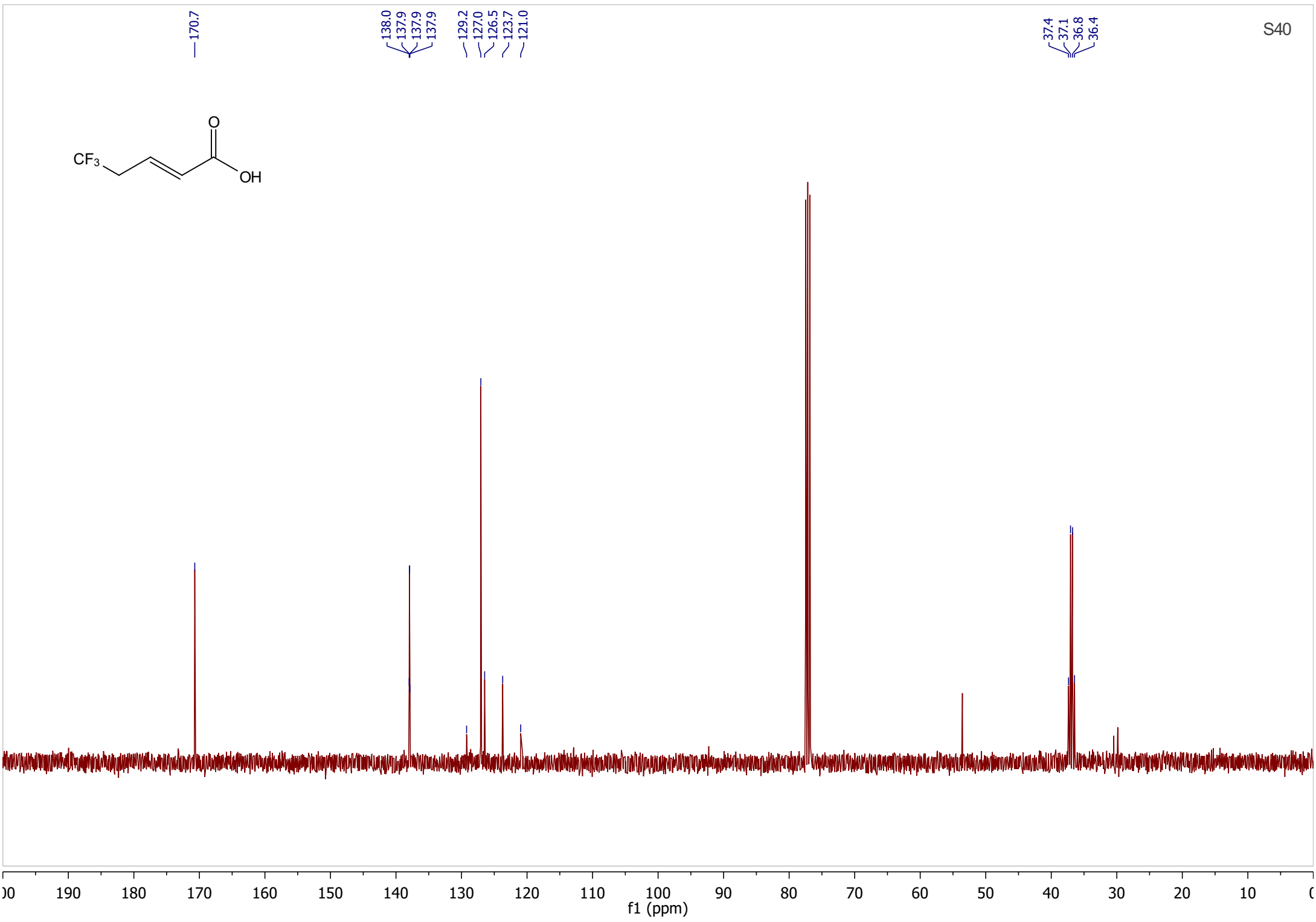
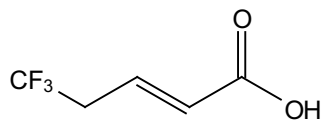




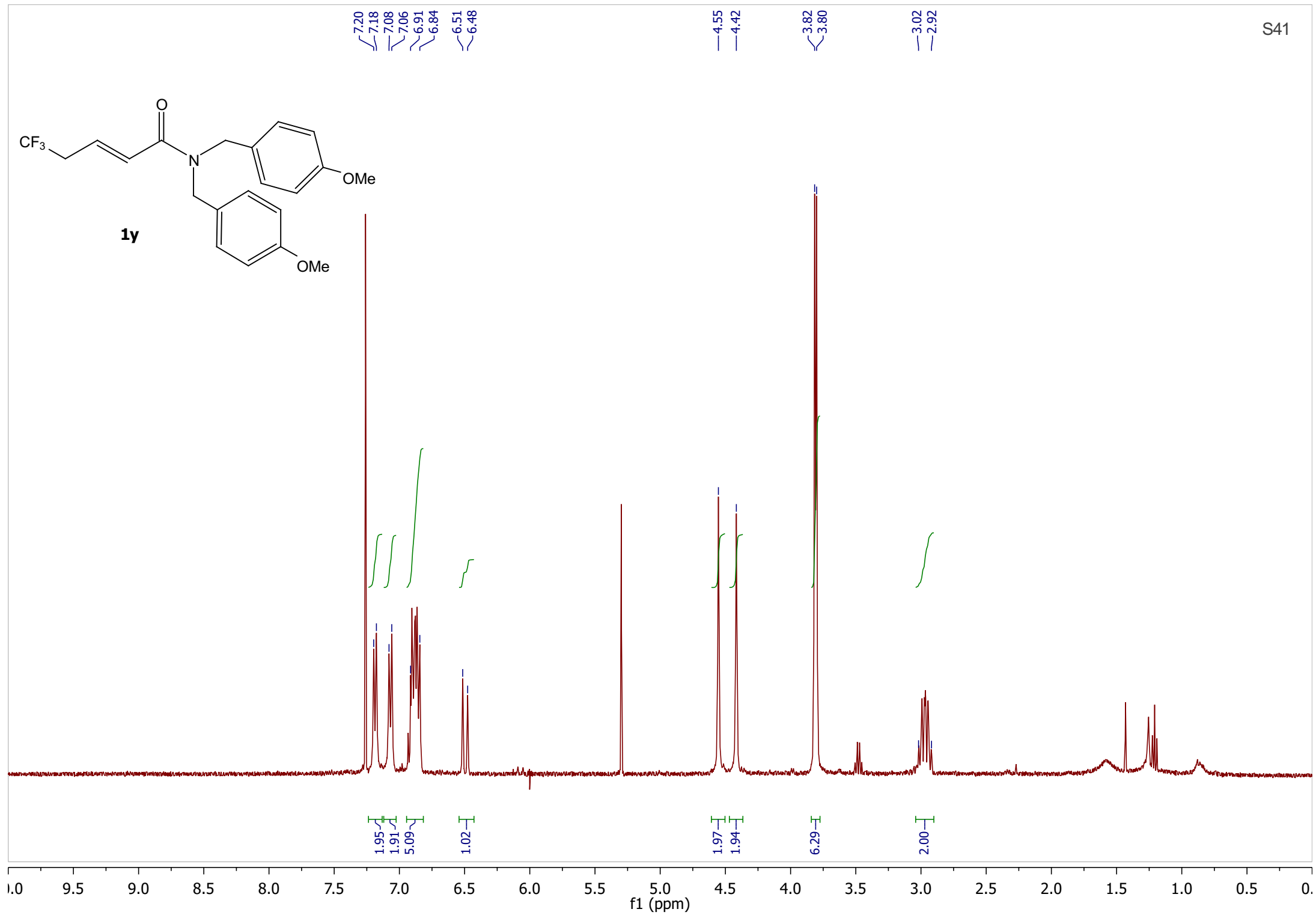
-65.4  
-65.4  
-65.5

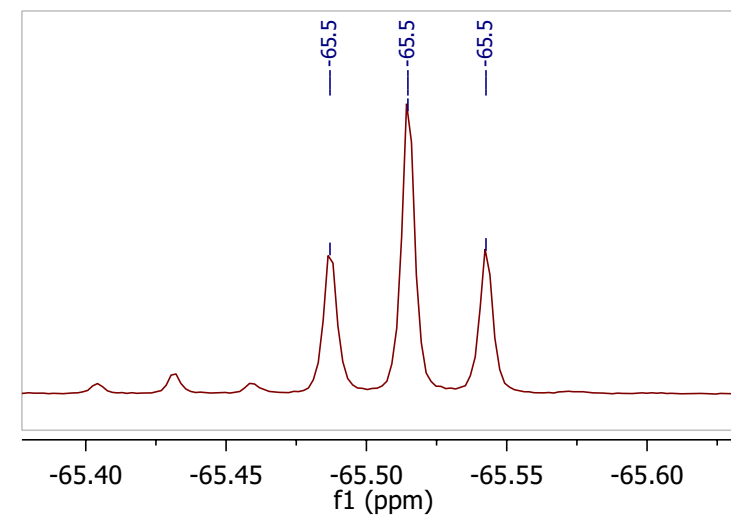
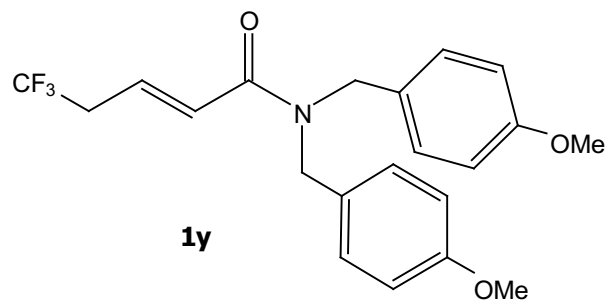


30 20 10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190 -200  
f1 (ppm)



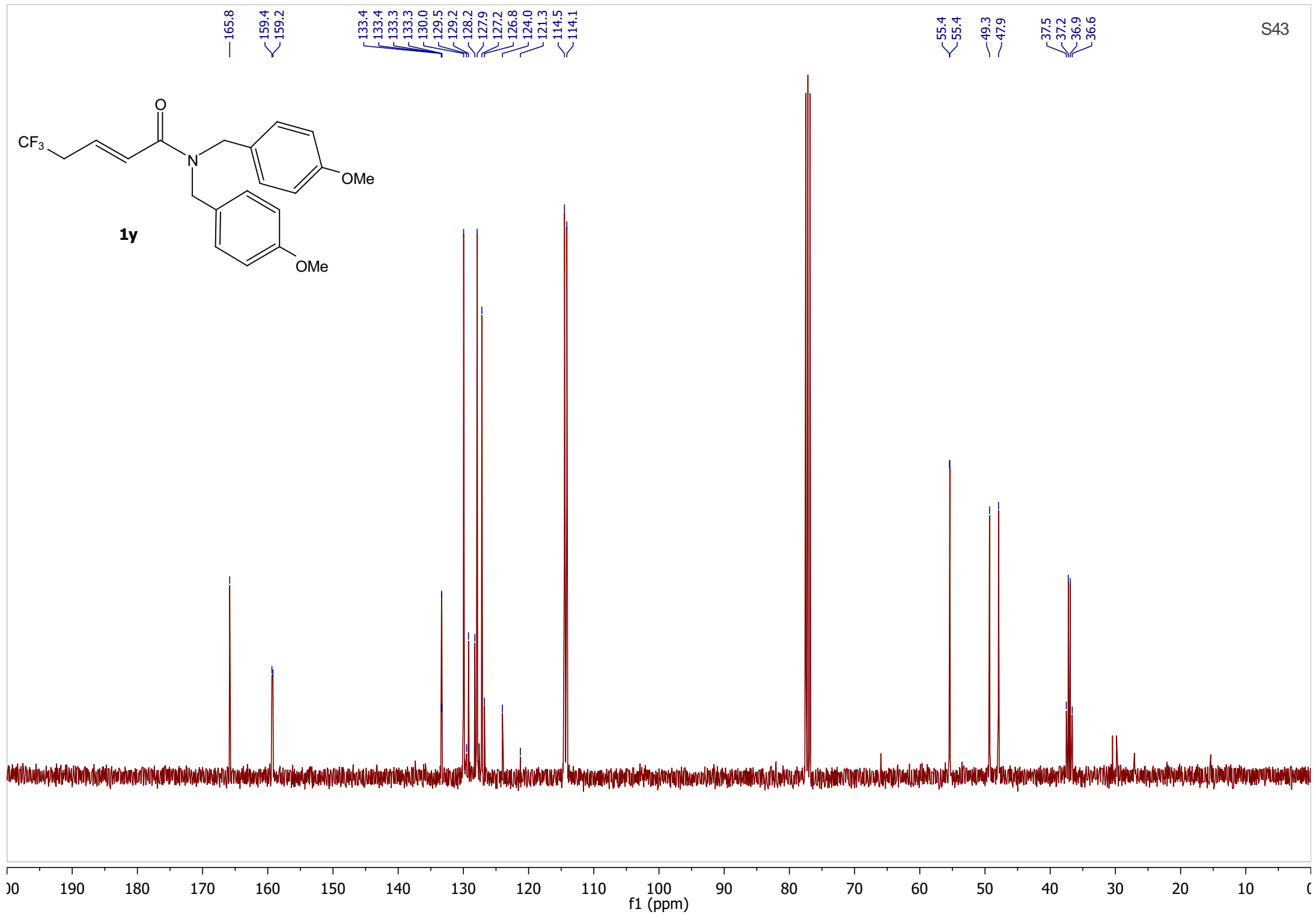


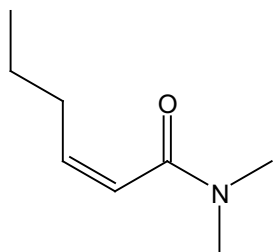




20 10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190

f1 (ppm)



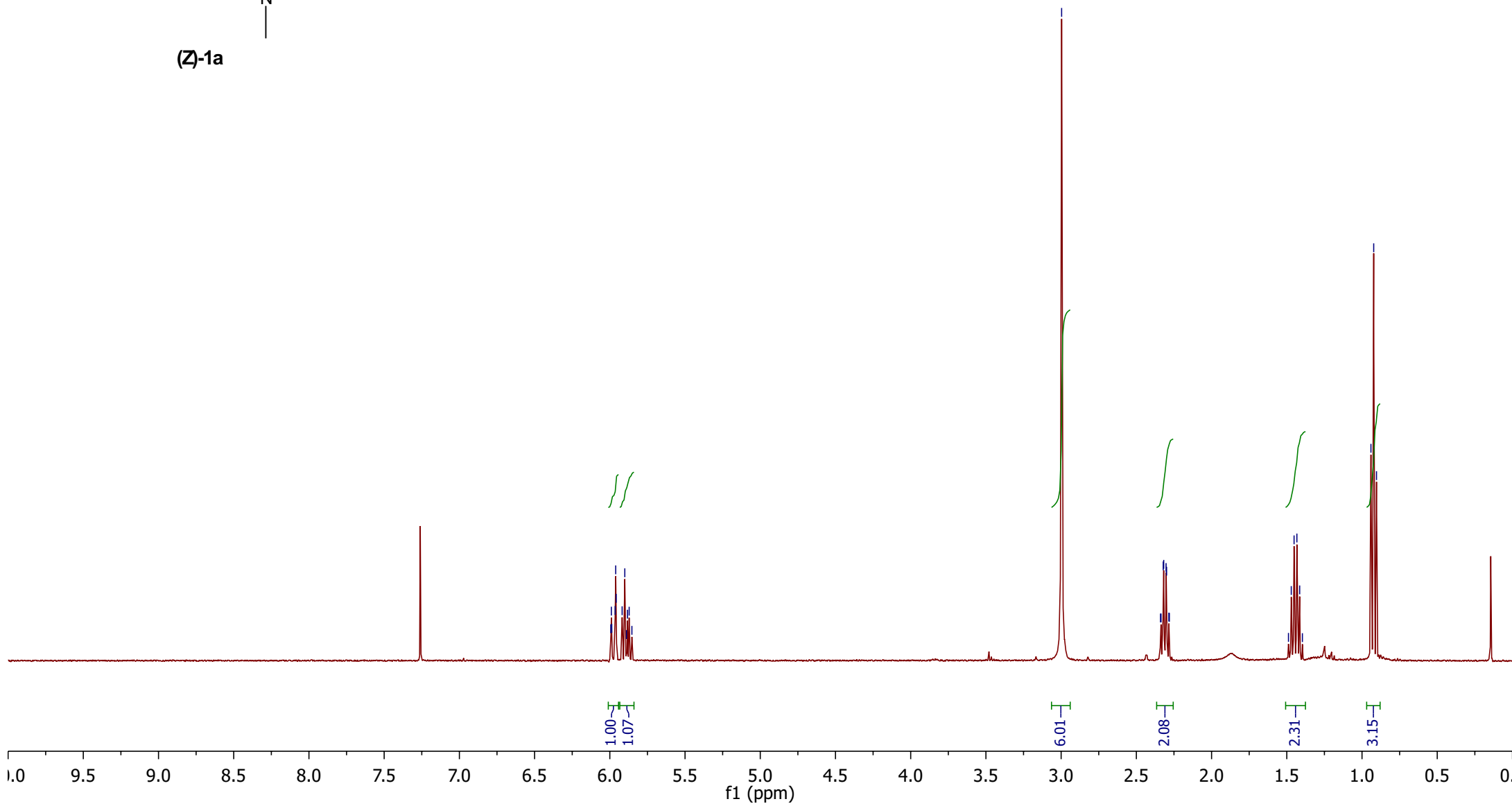


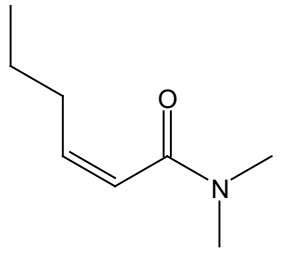
(Z)-1a

5.99  
5.99  
5.96  
5.96  
5.92  
5.90  
5.89  
5.88  
5.87  
5.85

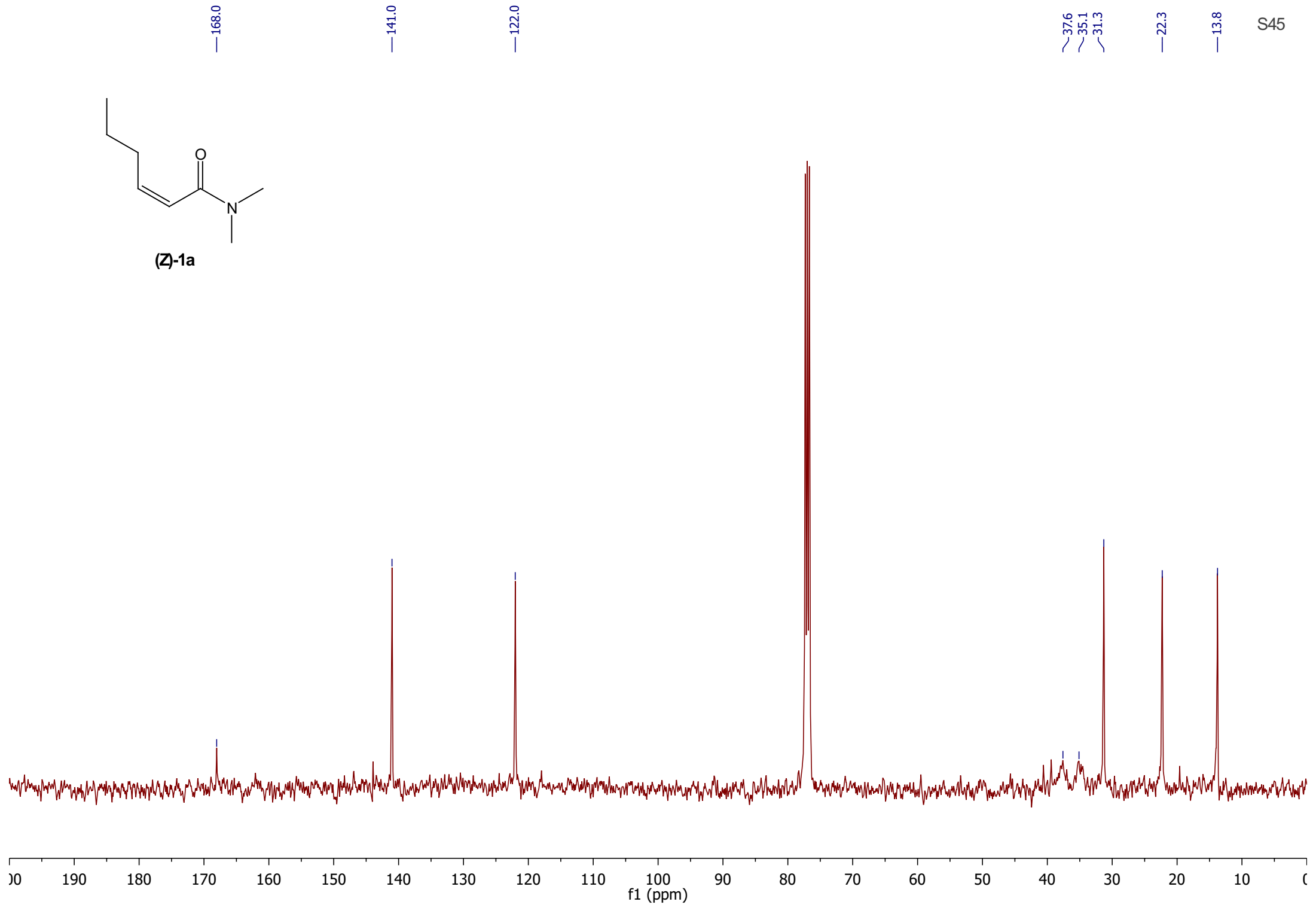
3.00  
2.34  
2.34  
2.32  
2.32  
2.30  
2.30  
2.28  
2.28  
1.49  
1.47  
1.45  
1.43  
1.41  
1.40  
0.94  
0.92  
0.90

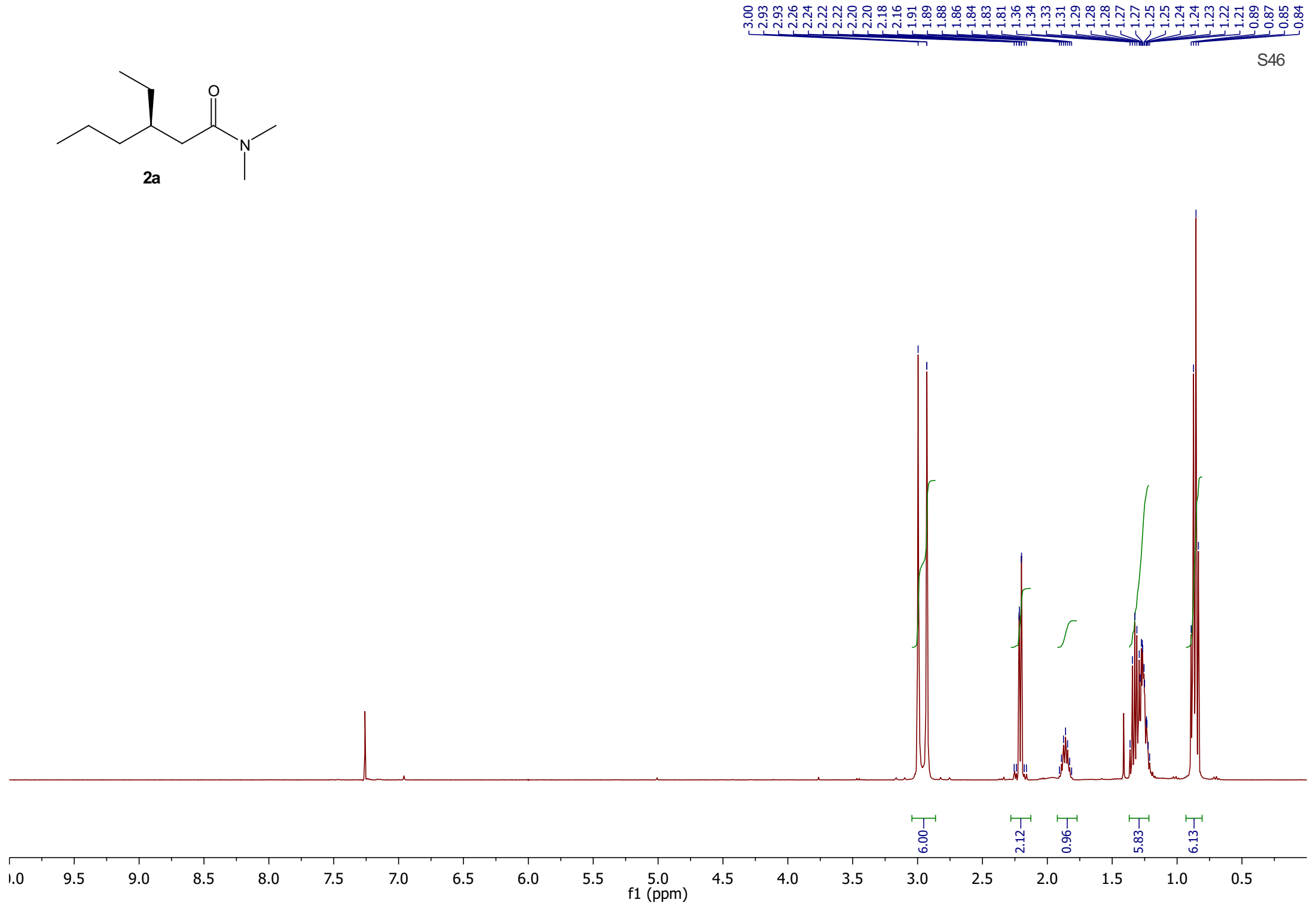
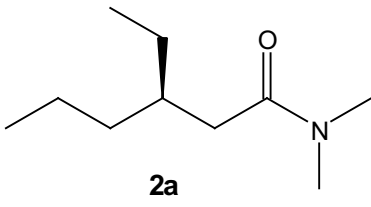
S4

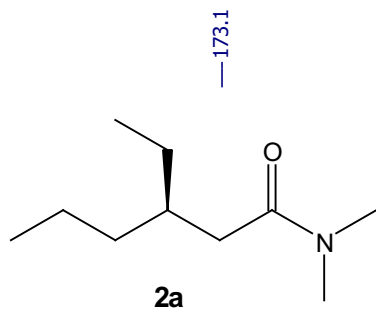




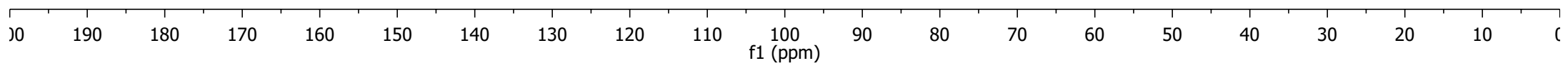
**(Z)-1a**

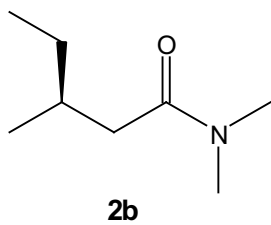




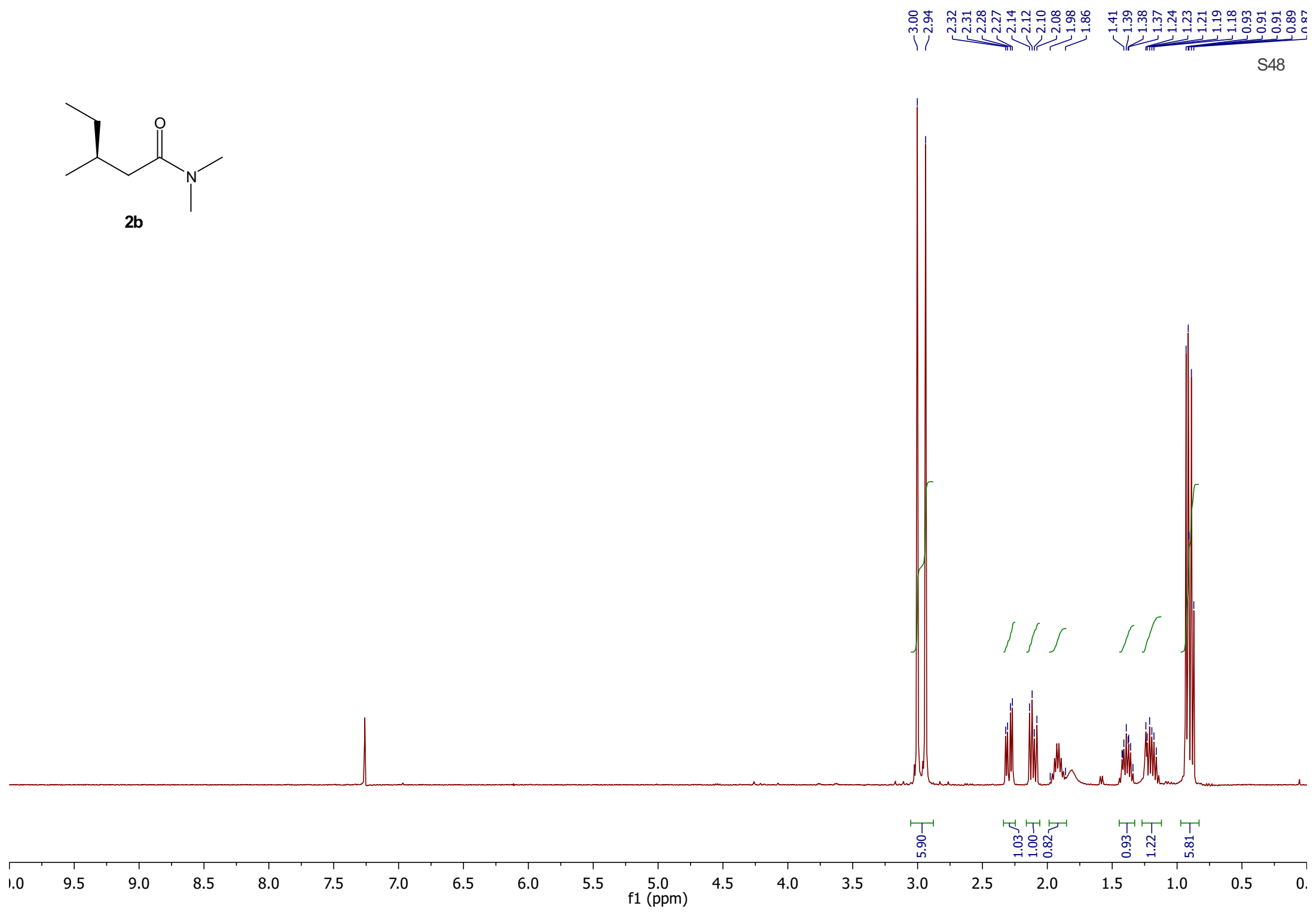


37.8  
37.6  
36.1  
35.9  
35.5  
— 26.4  
— 19.9  
— 14.5  
— 11.0 S47

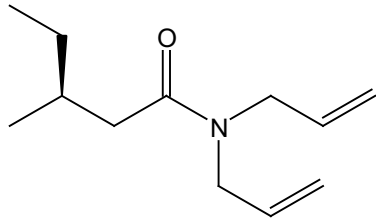




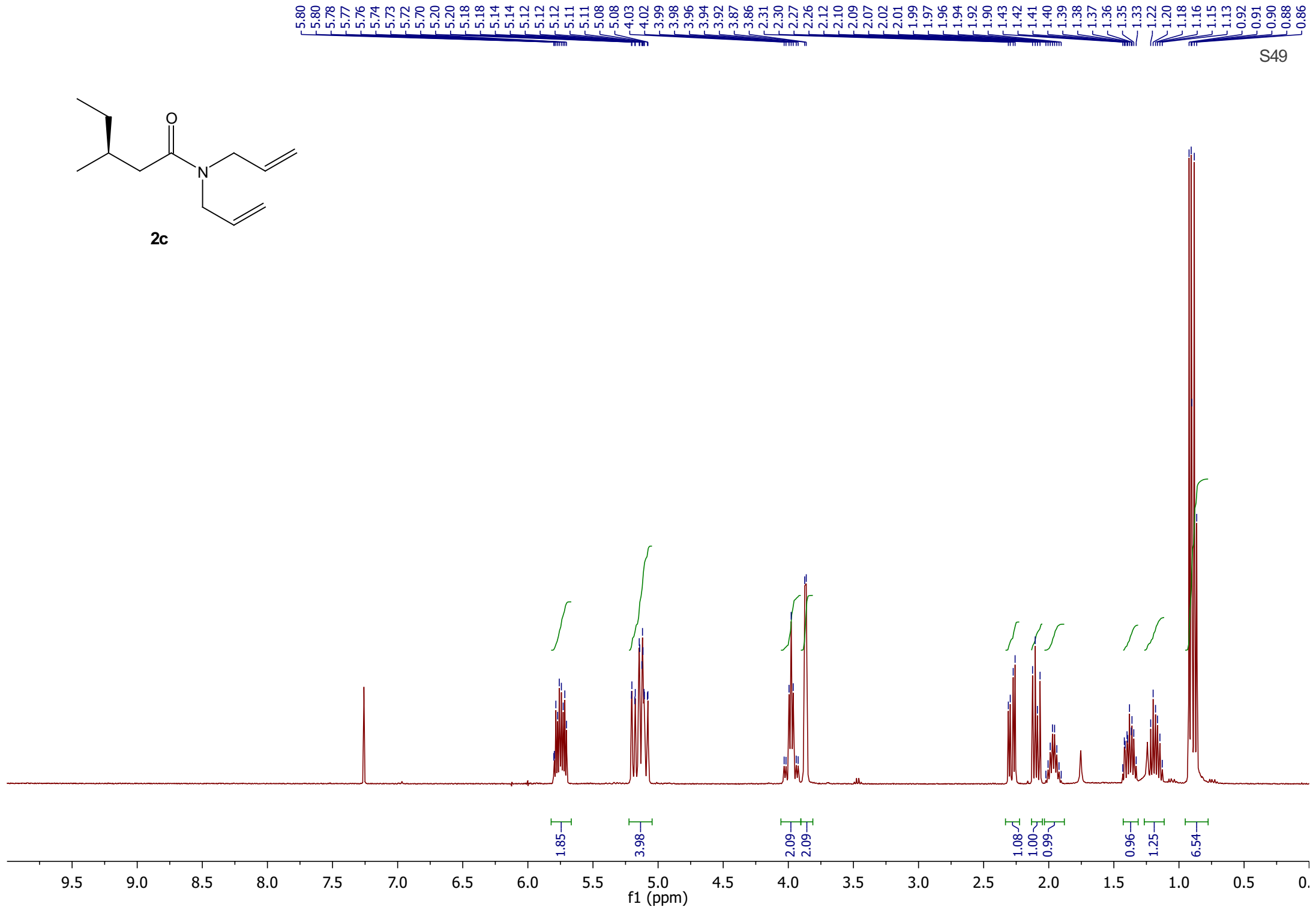
S48

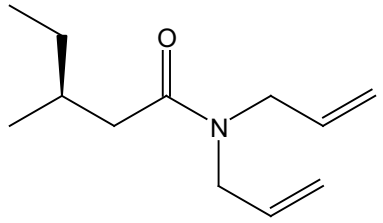




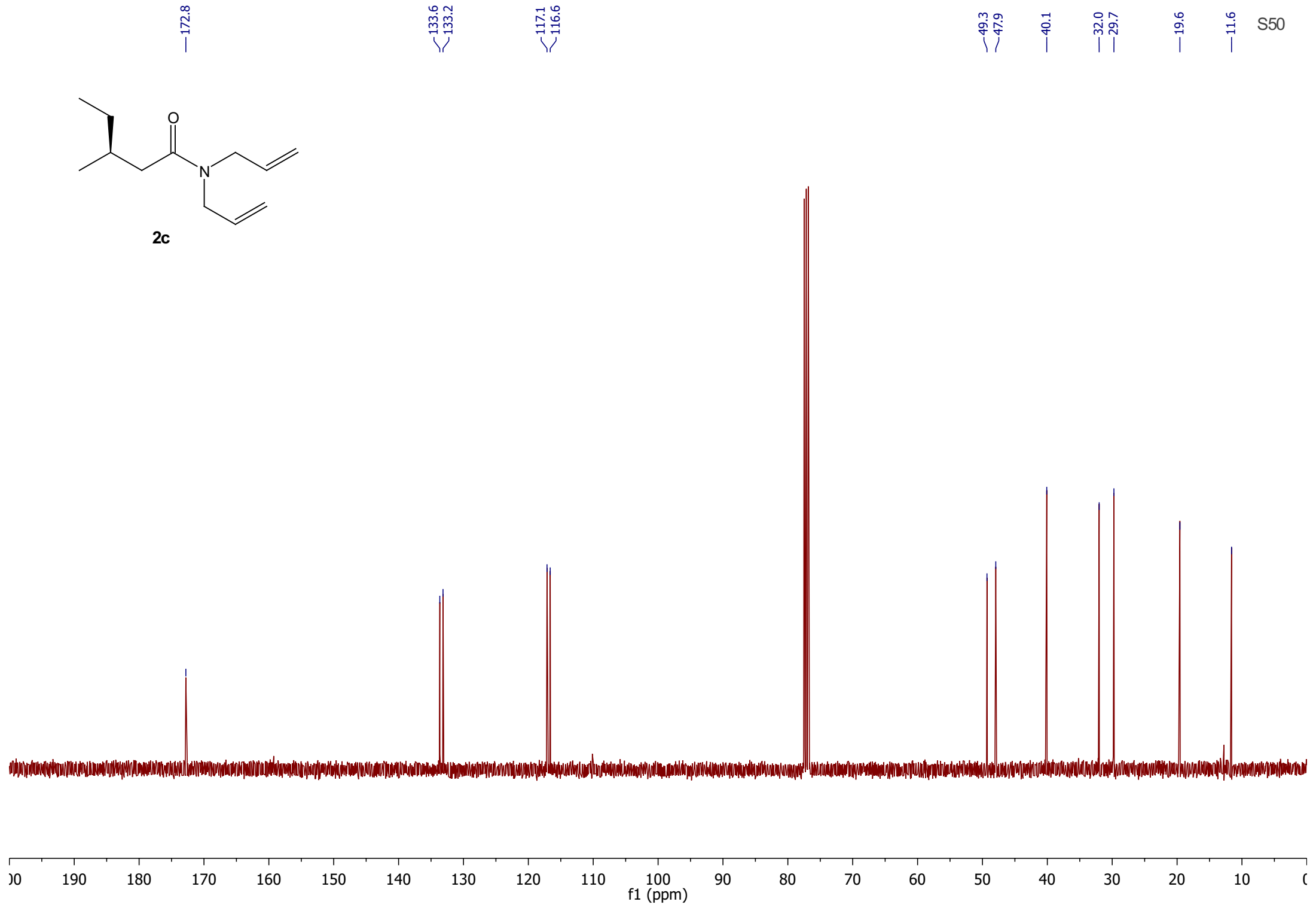


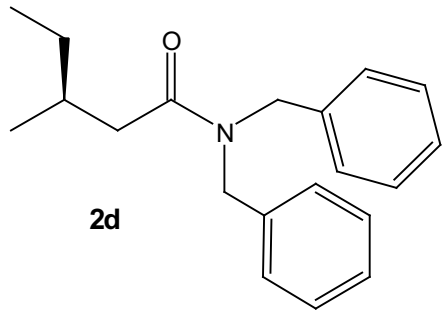
2c





2c





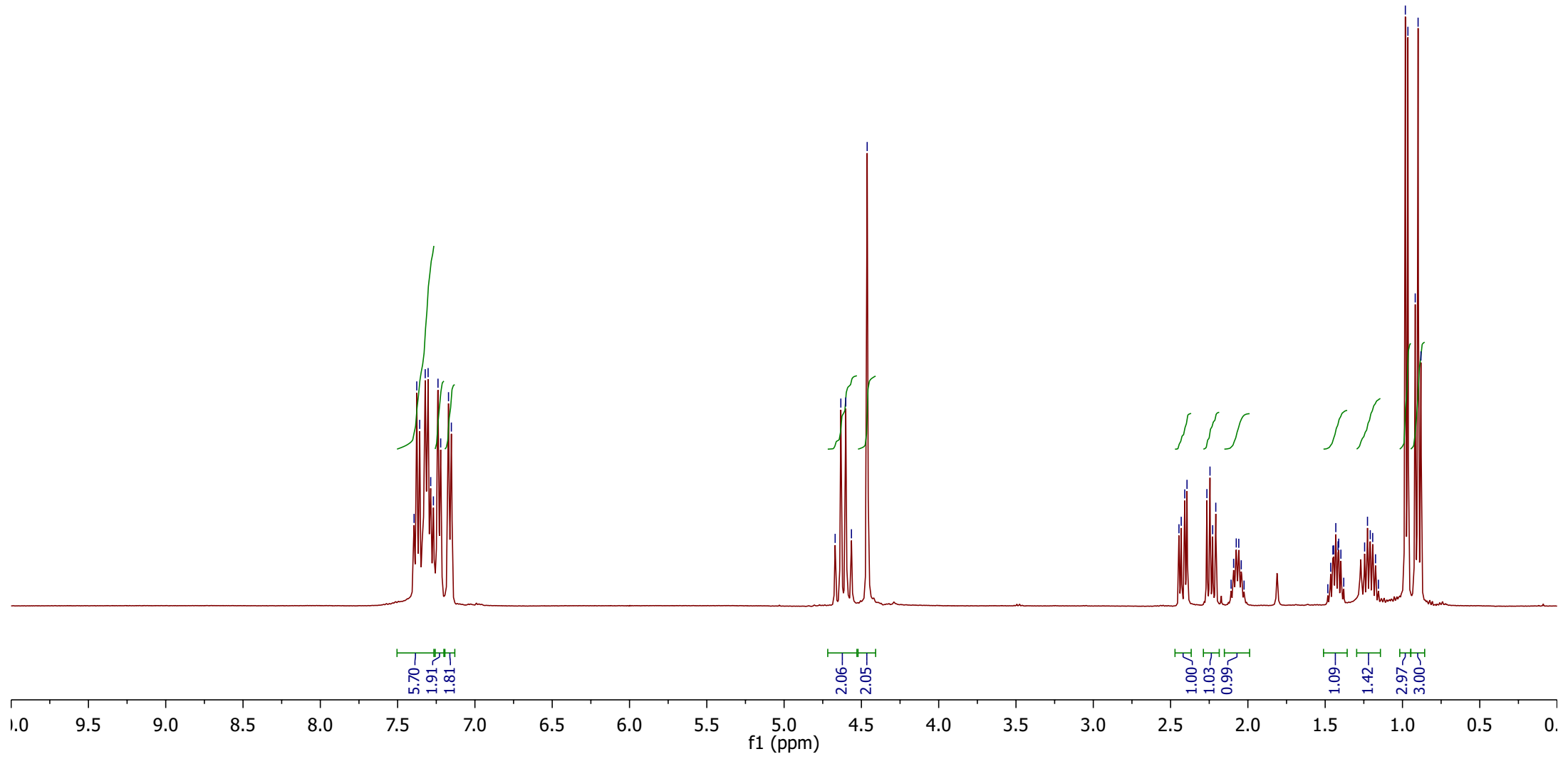
7.39  
7.38  
7.36  
7.32  
7.30  
7.29  
7.27  
7.24  
7.22  
7.17  
7.15

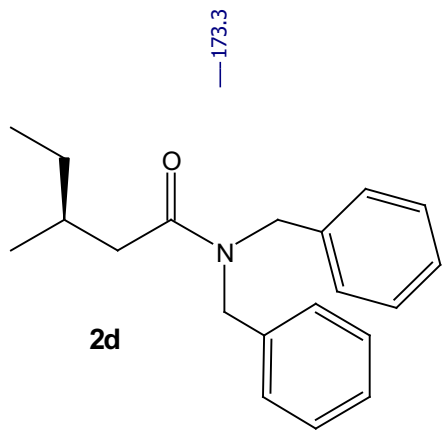
4.67  
4.63  
4.60  
4.56  
4.46

2.45  
2.43  
2.41  
2.39  
2.27  
2.25  
2.23  
2.21  
2.11  
2.09  
2.08  
2.06  
2.04  
2.02

1.45  
1.45  
1.43  
1.42  
1.41  
1.40  
1.24  
1.23  
1.21  
1.19  
1.19  
0.96  
0.92  
0.90

S51





— 173.3

— 137.8

— 136.8

— 129.0

— 128.7

— 128.4

— 127.7

— 127.4

— 126.5

— 50.0

— 48.1

— 40.3

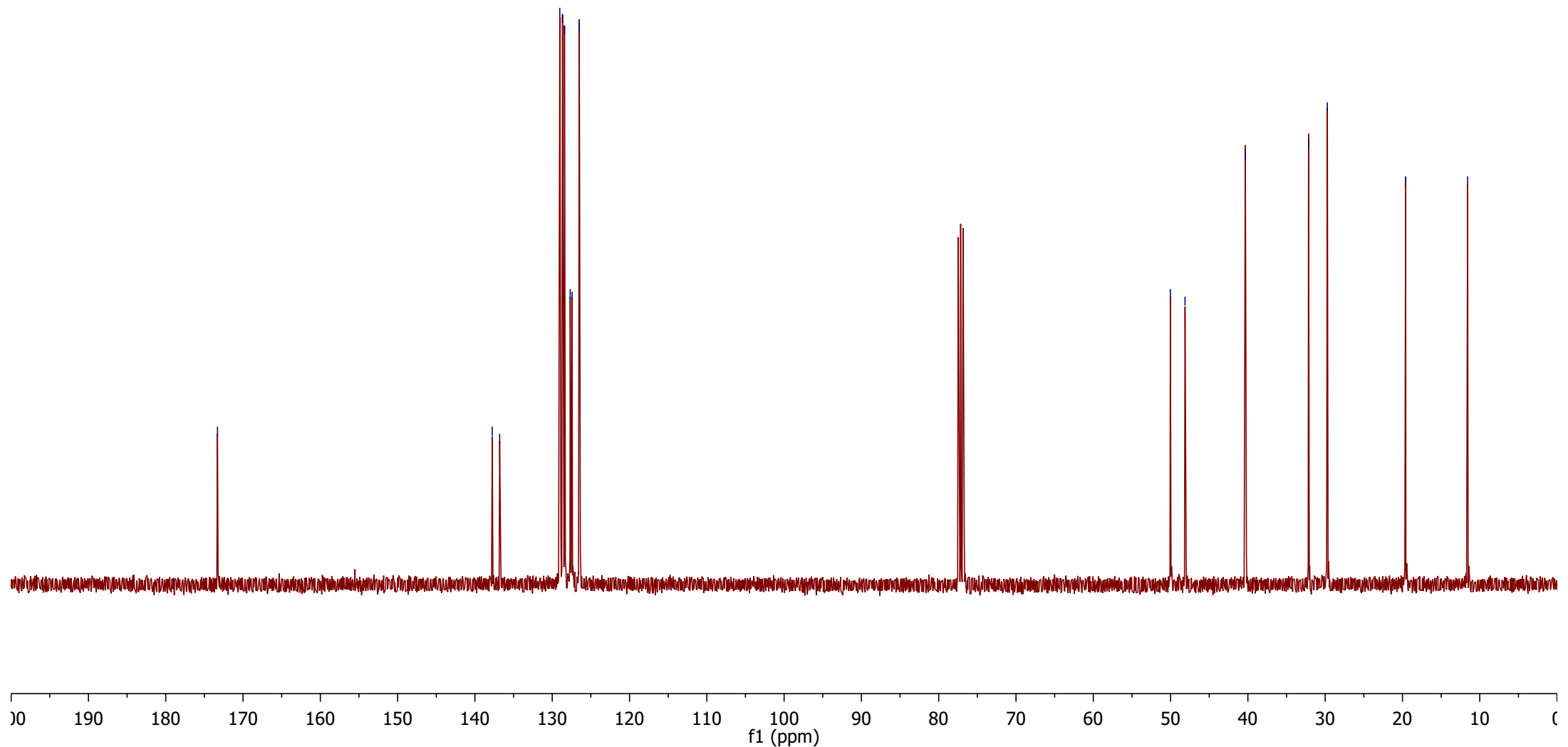
— 32.2

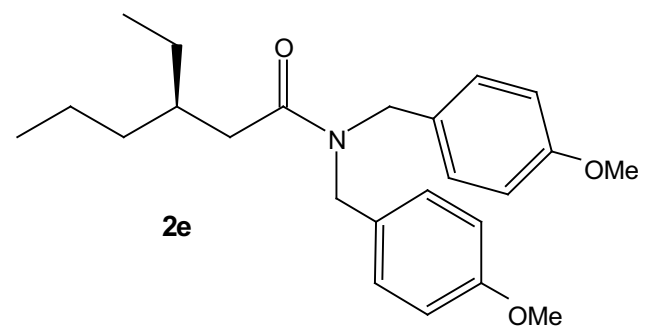
— 29.7

— 19.6

— 11.6

S52



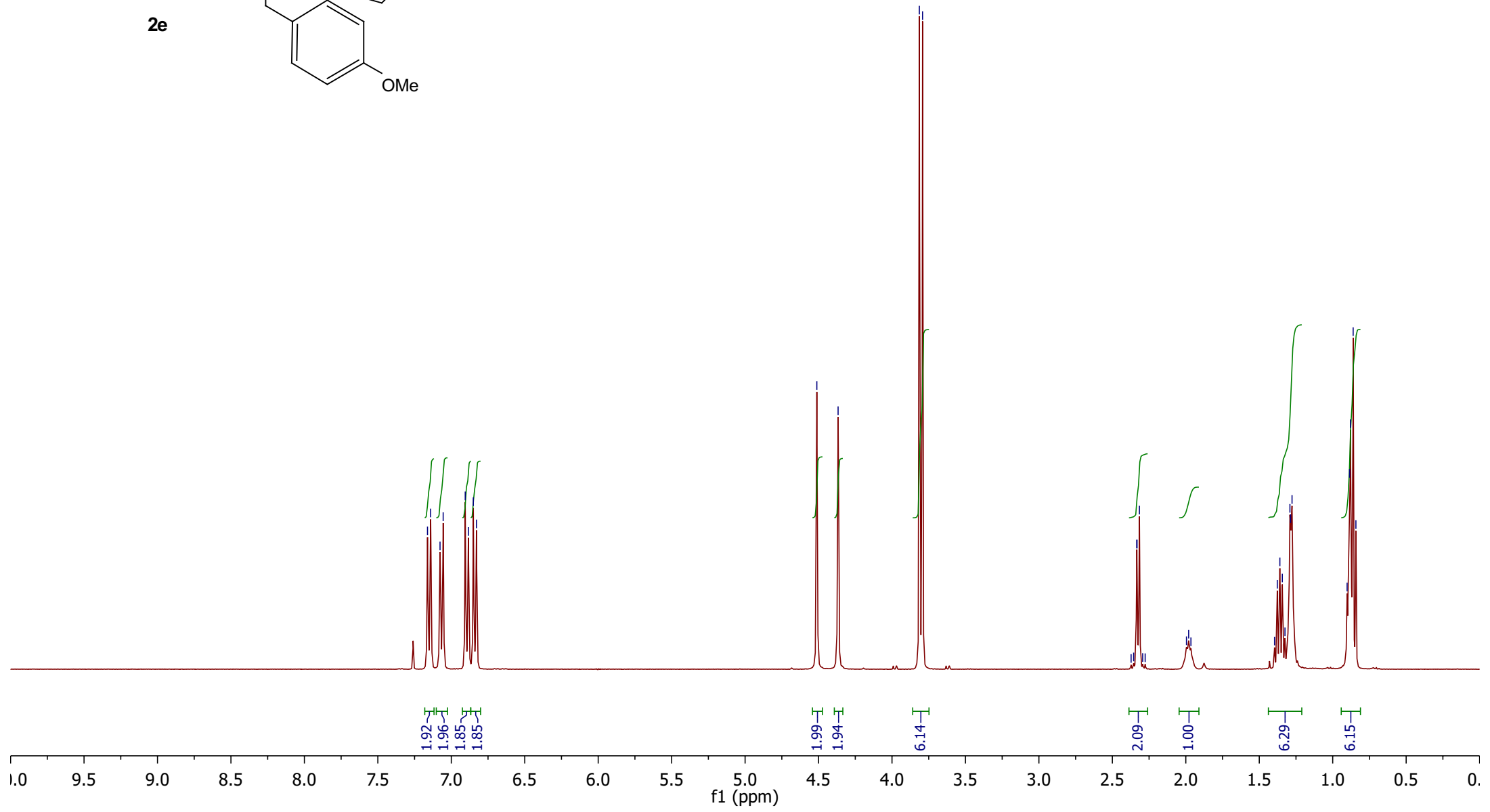


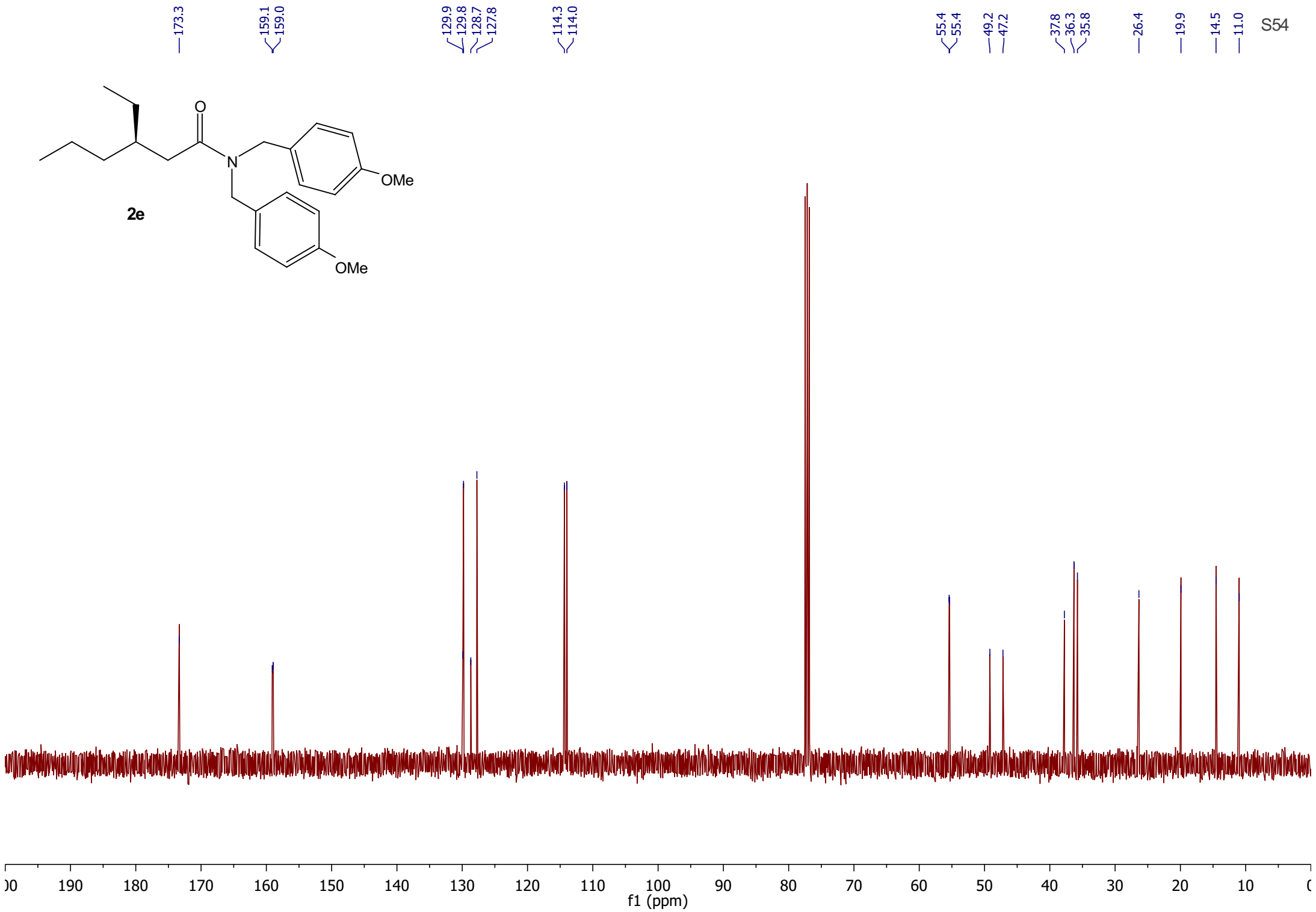
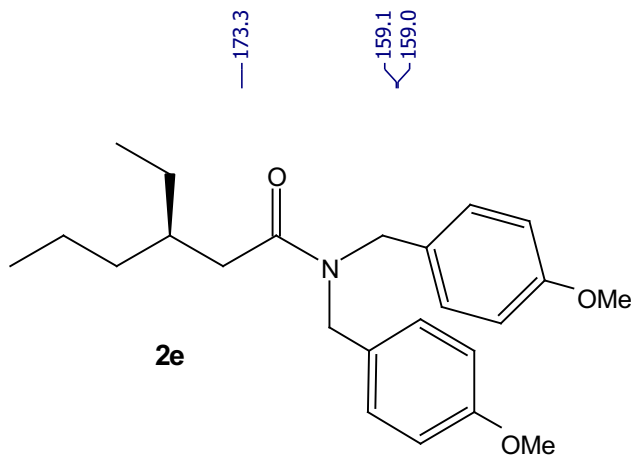
7.16  
7.14  
7.08  
7.06  
6.91  
6.88  
6.85  
6.83

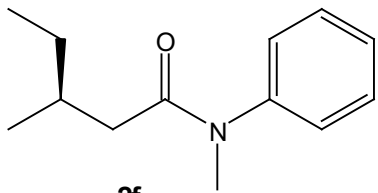
4.51  
4.37

3.81  
3.79

2.37  
2.35  
2.33  
2.33  
2.32  
2.29  
2.28  
2.00  
1.98  
1.97  
1.40  
1.38  
1.36  
1.34  
1.32  
1.29  
1.29  
1.28  
0.90  
0.89  
0.88  
0.86  
0.84







2f

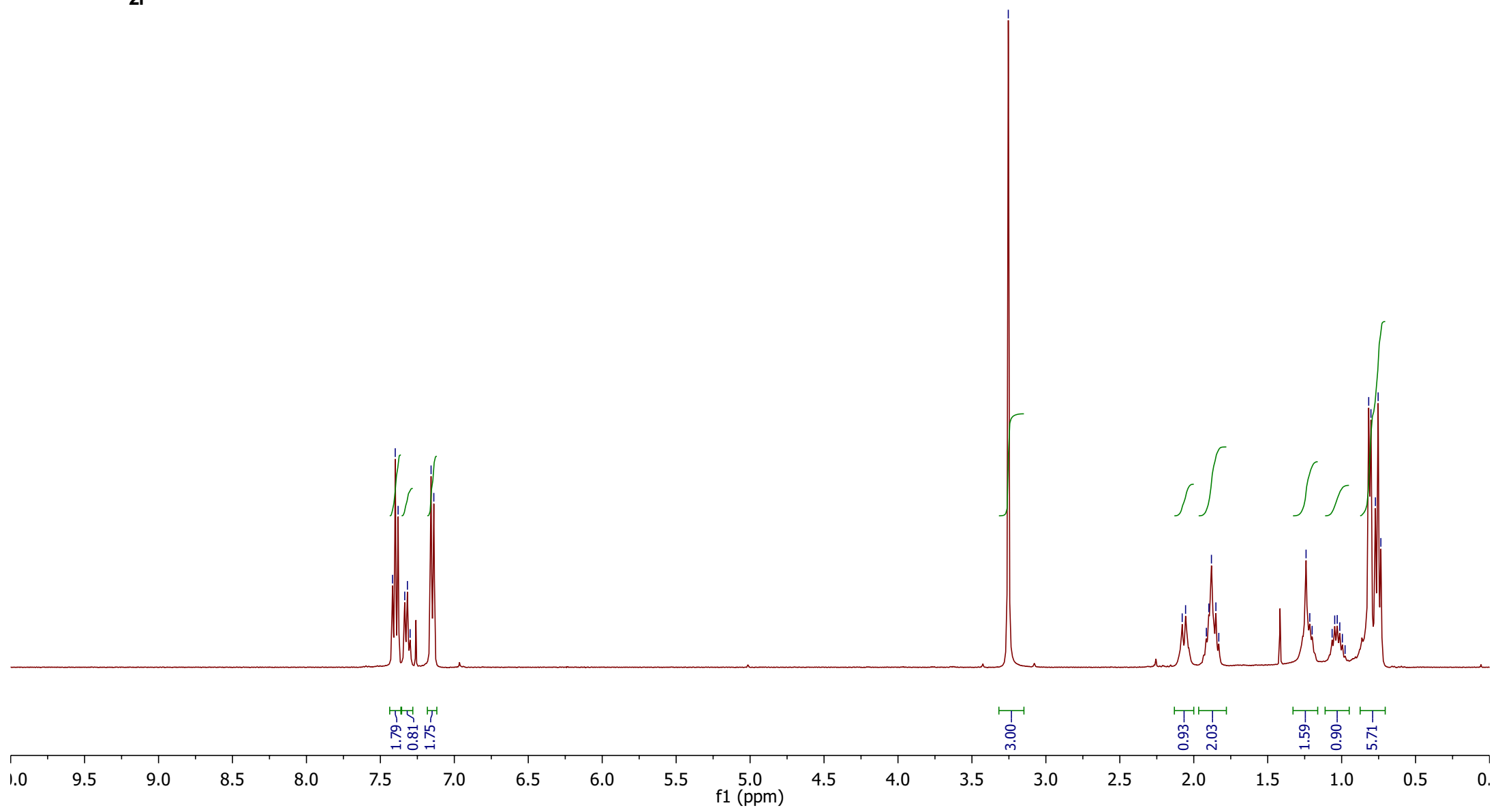
7.42  
7.40  
7.38  
7.34  
7.32  
7.30  
7.16  
7.14

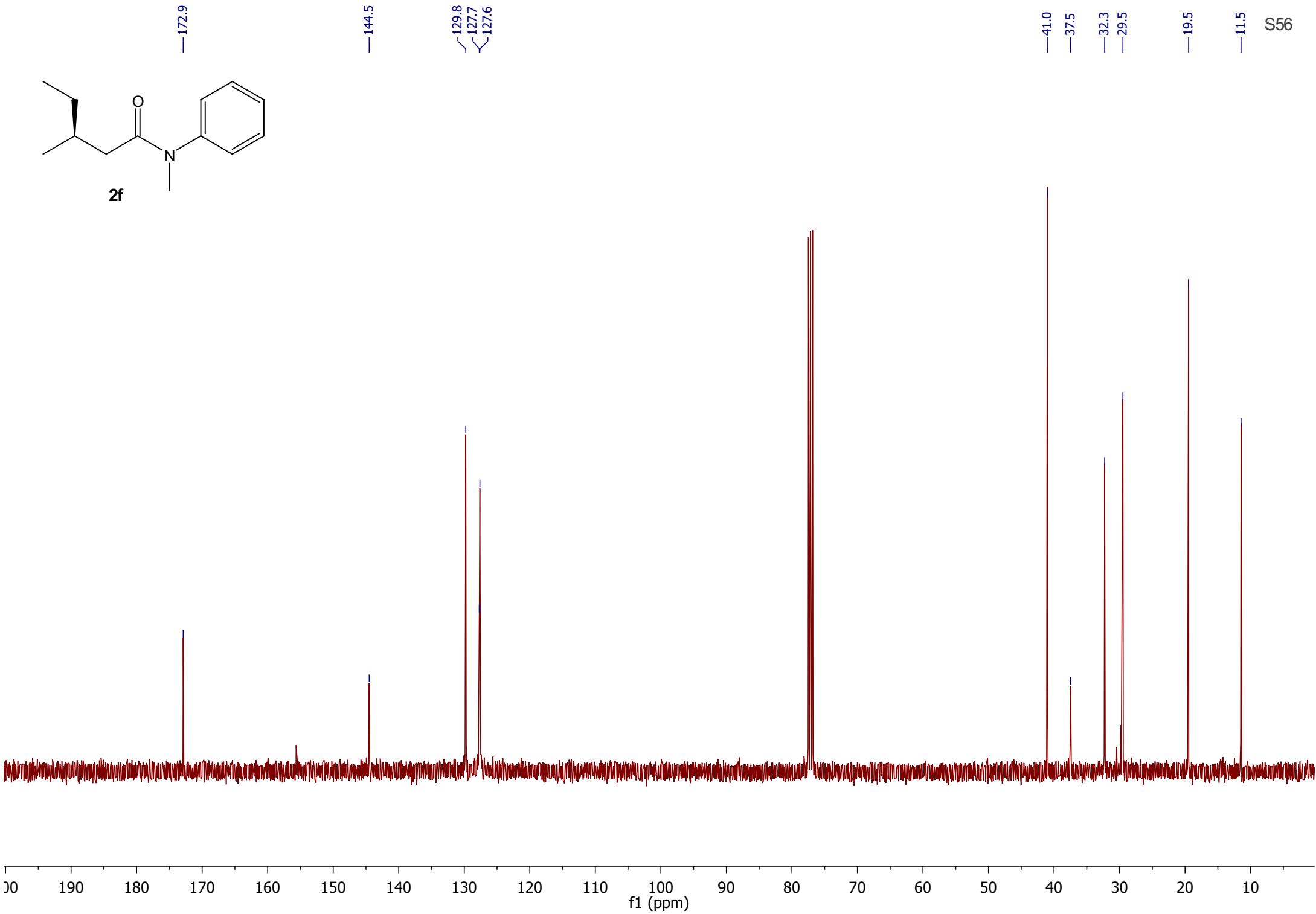
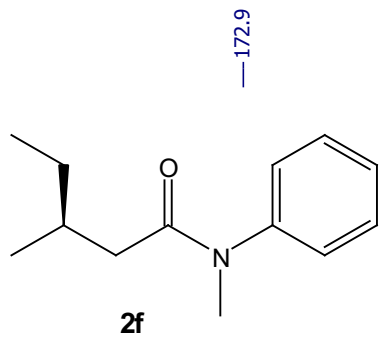
3.25

2.08  
2.06  
1.91  
1.90  
1.88  
1.85  
1.83

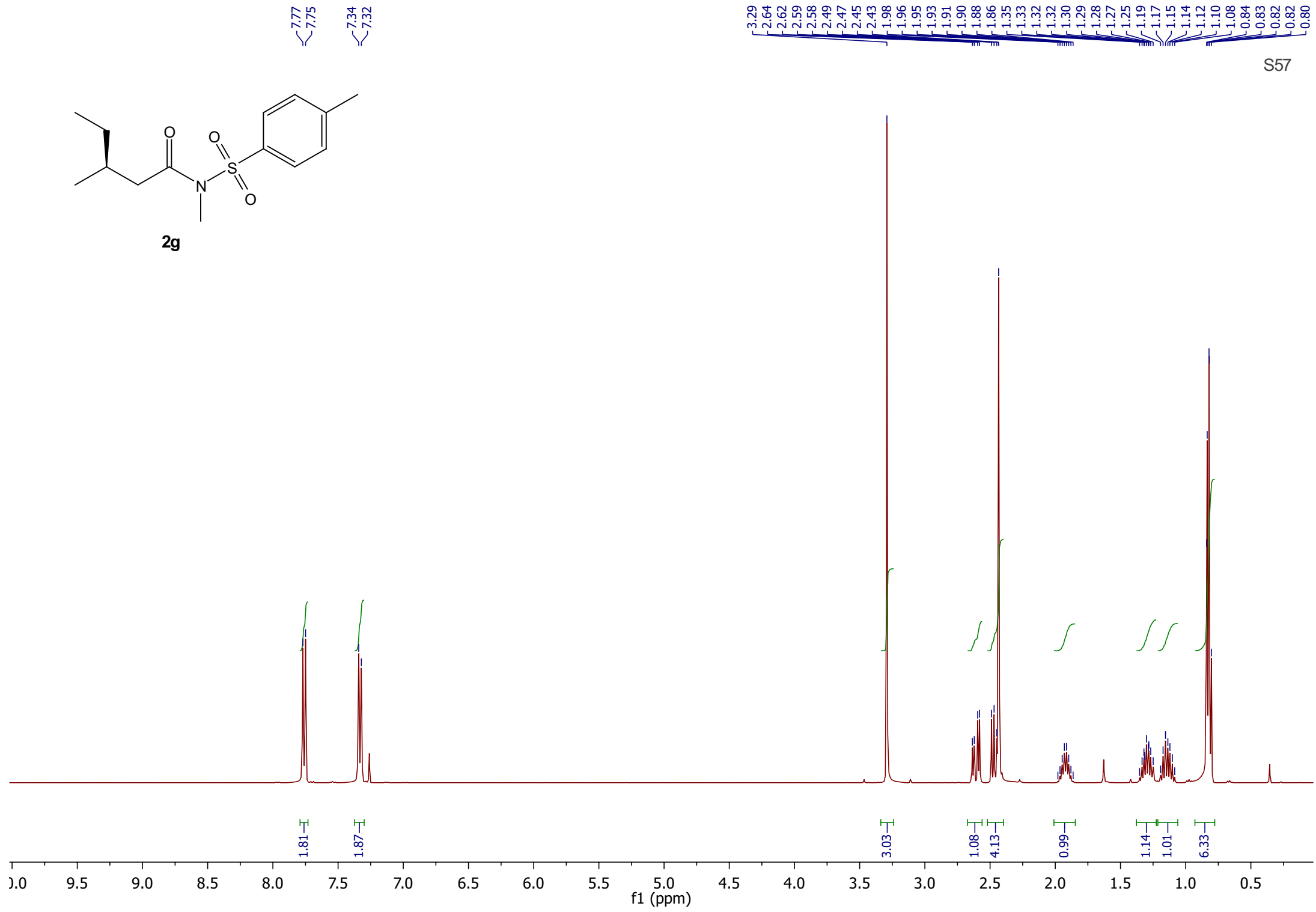
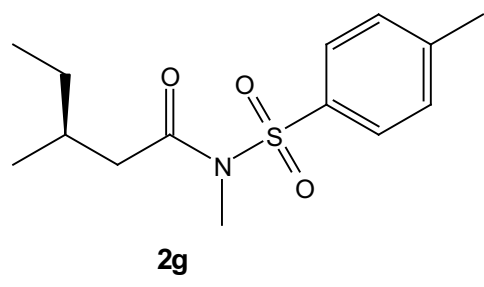
1.24  
1.22  
1.20  
1.06  
1.05  
1.03  
1.01  
1.00  
0.82  
0.80  
0.77  
0.75  
0.73

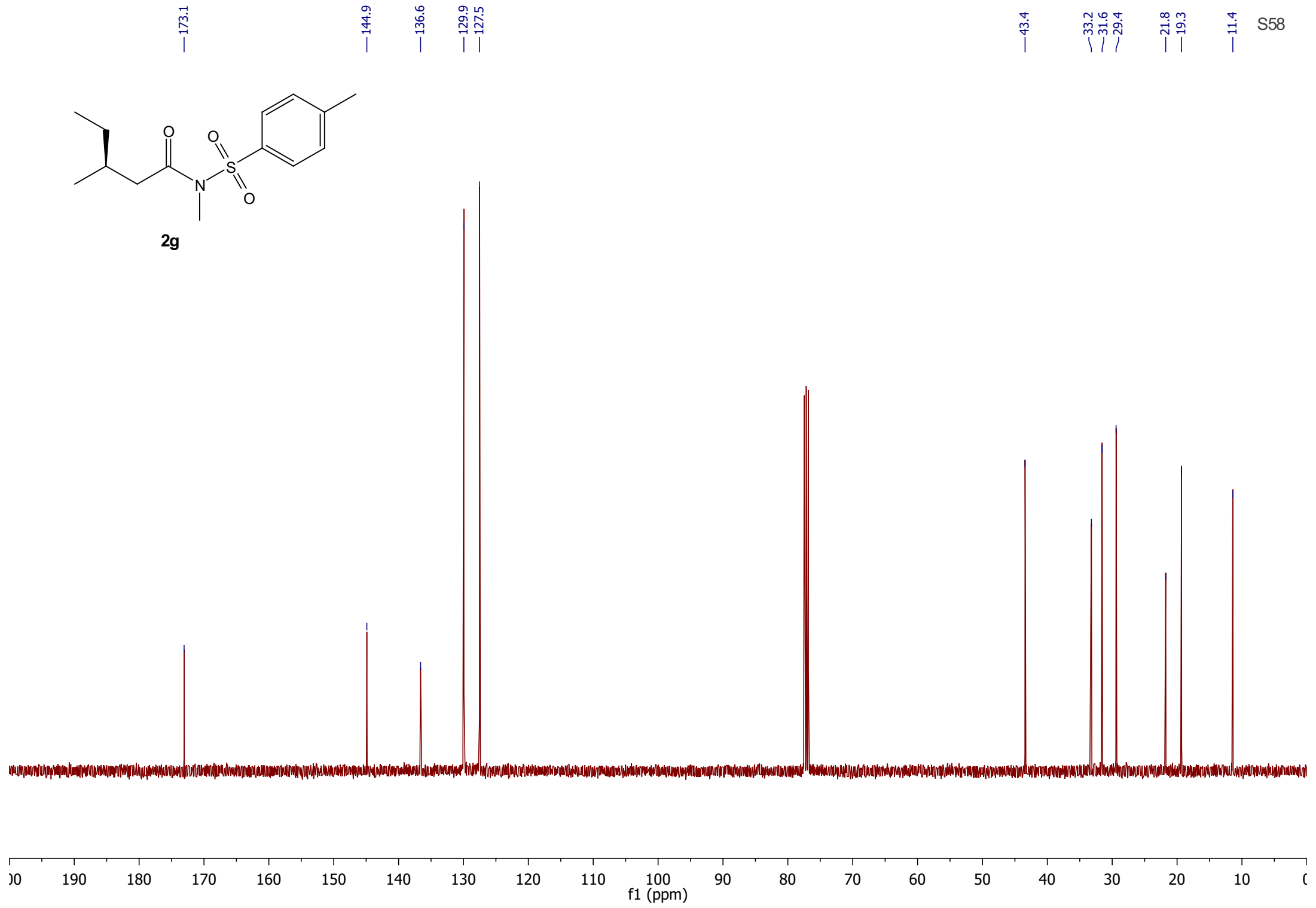
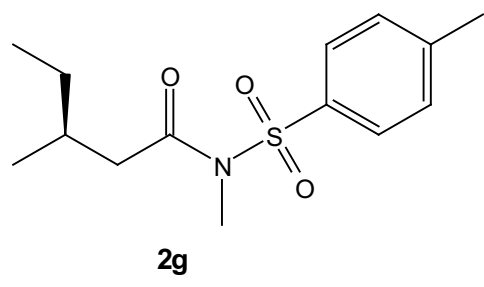
S55

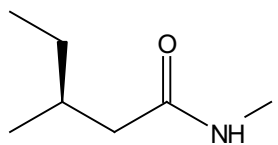




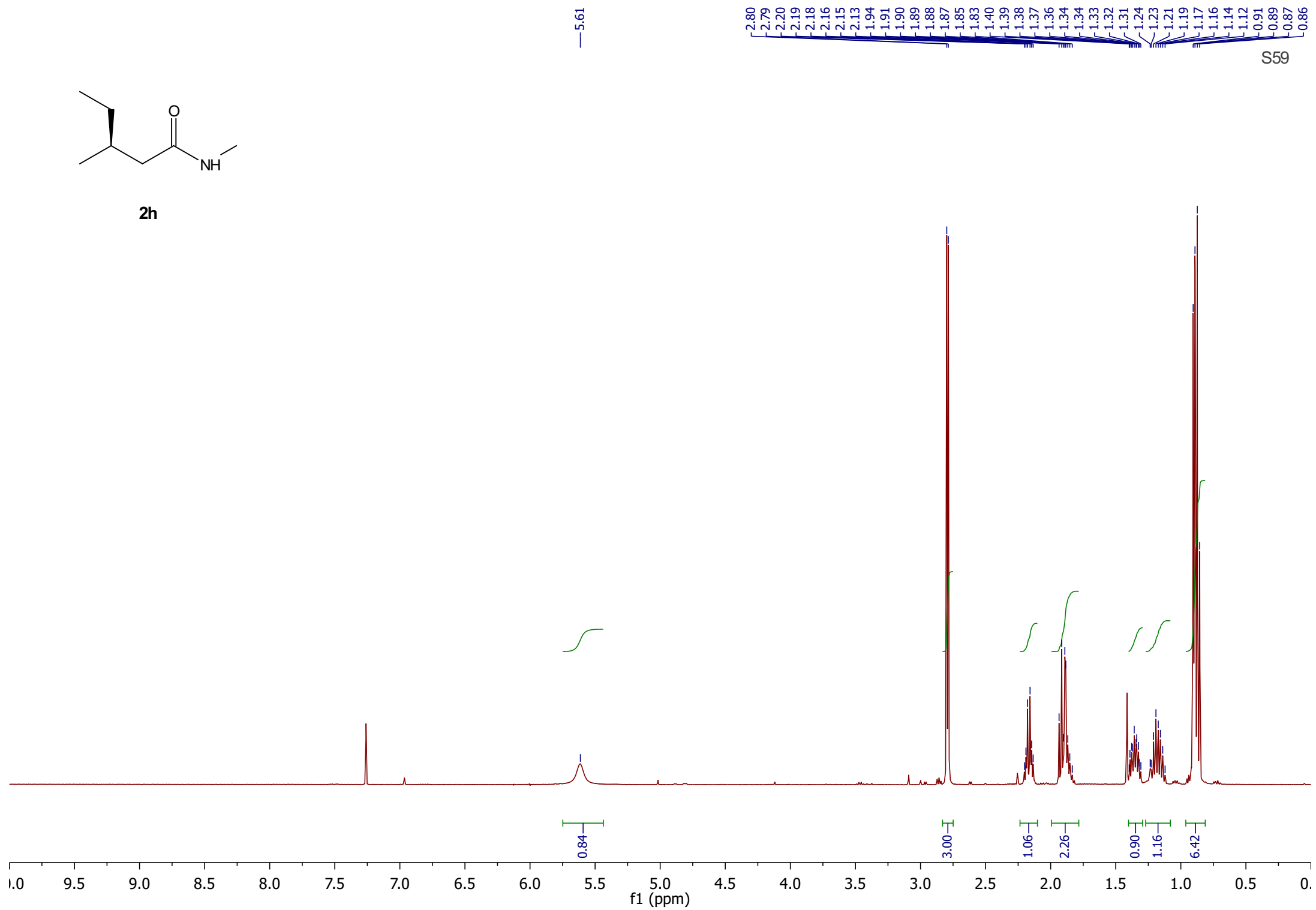


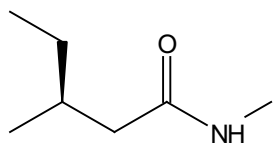






2h





2h

—173.6

—44.3

—32.4

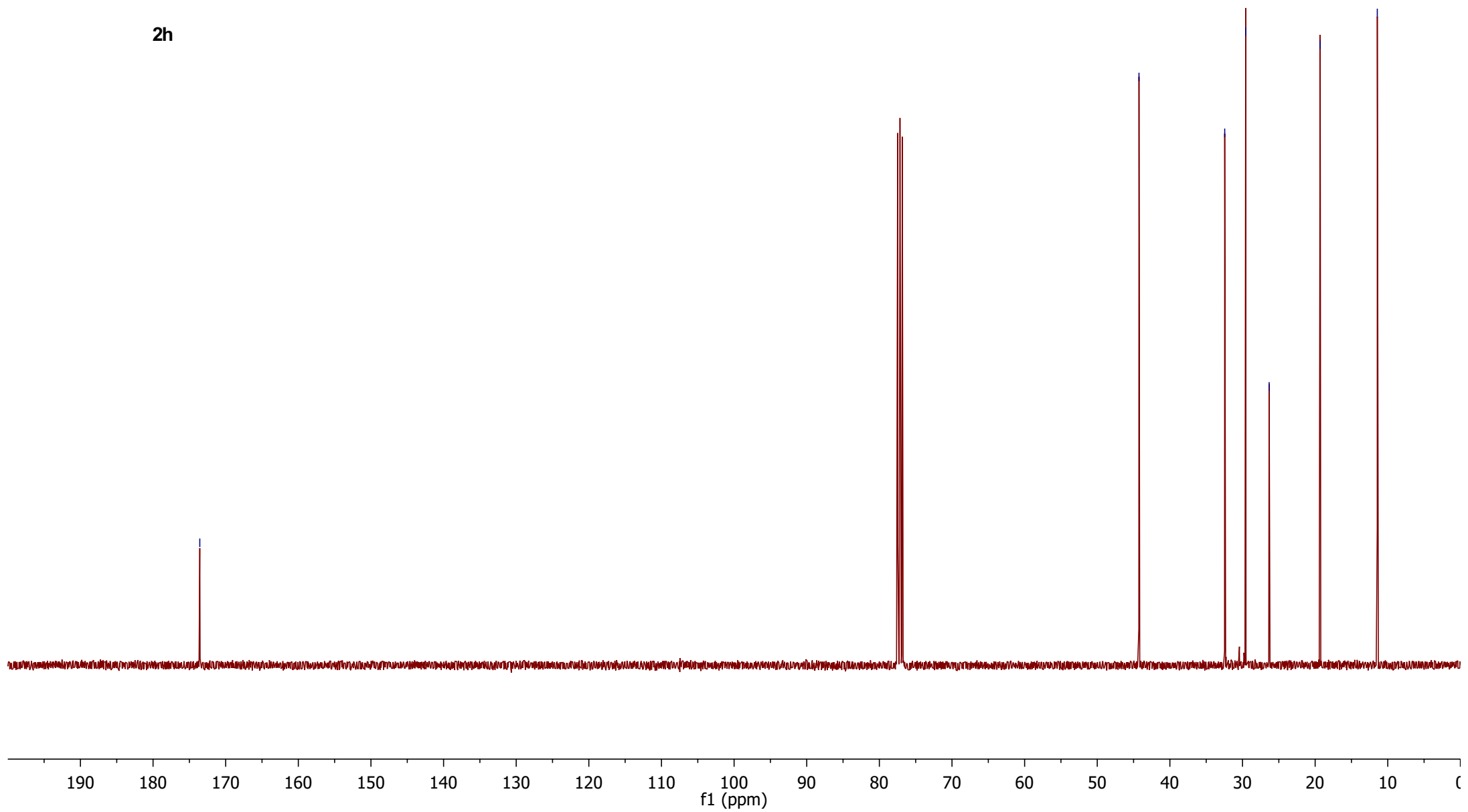
—29.6

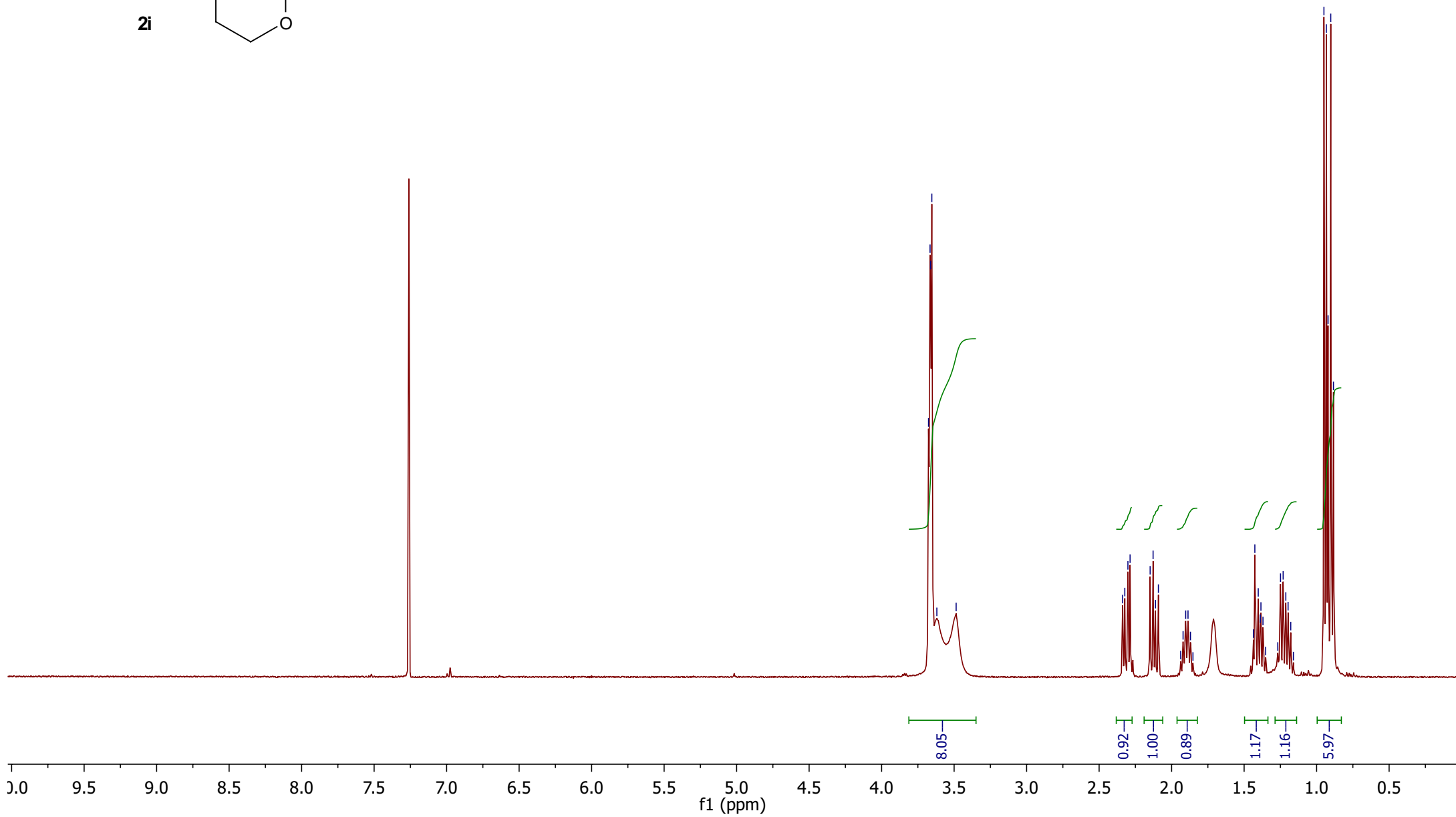
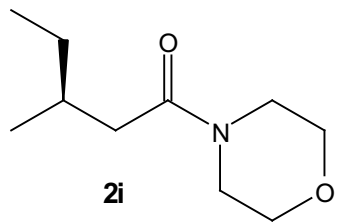
—26.3

—19.3

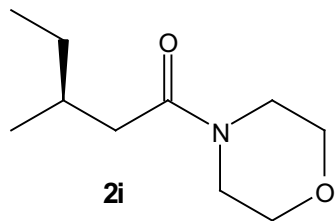
—11.4

S60





3.68  
3.67  
3.66  
3.65  
3.62  
3.49  
2.34  
2.32  
2.30  
2.29  
2.15  
2.13  
2.11  
2.09  
1.94  
1.92  
1.90  
1.89  
1.87  
1.85  
1.43  
1.40  
1.39  
1.38  
1.37  
1.25  
1.23  
1.21  
1.20  
0.95  
0.93  
0.92  
0.90  
0.88



— 171.6

67.1

66.8

46.4

42.0

40.1

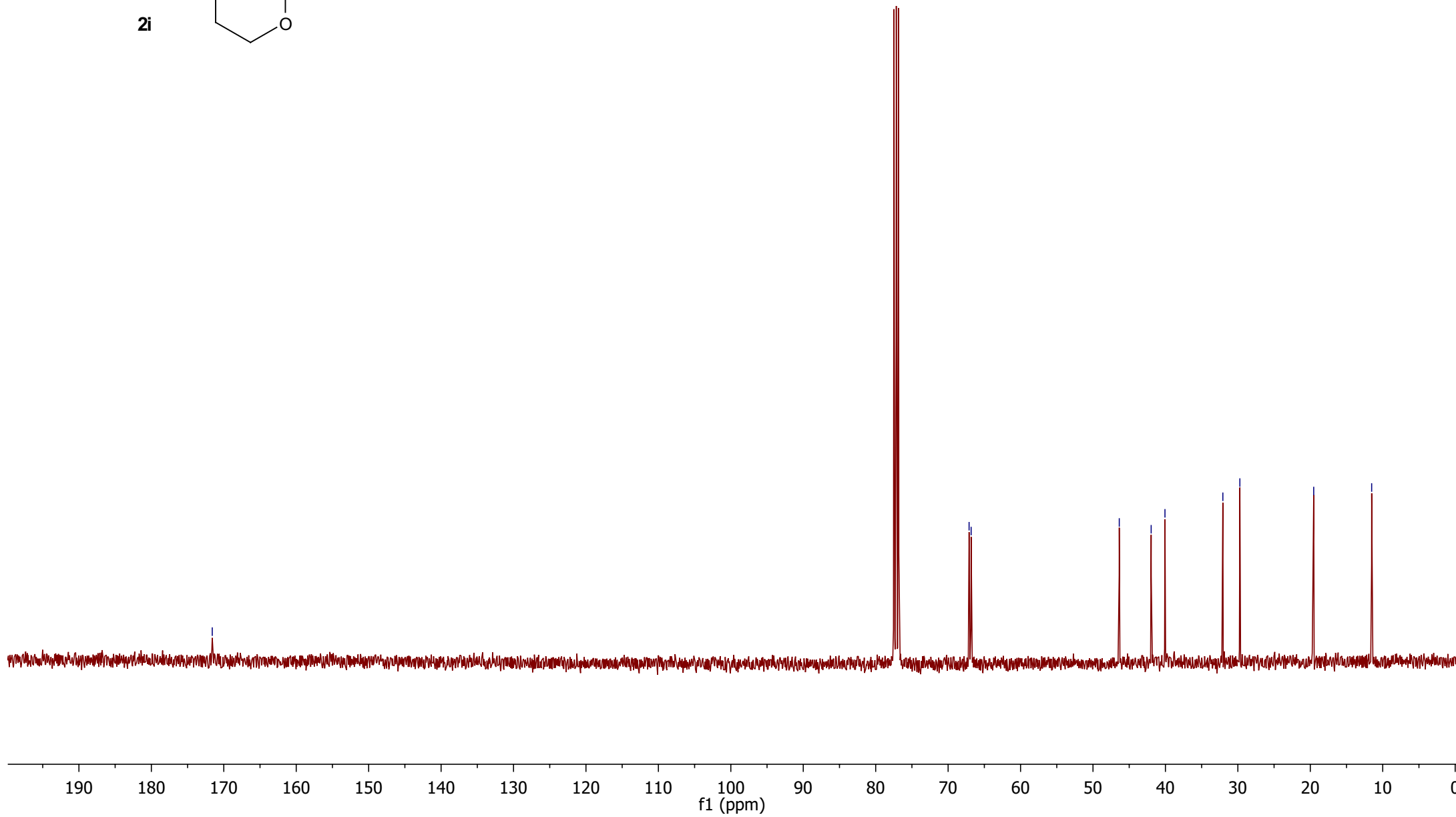
32.1

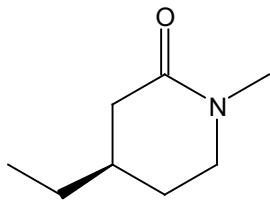
29.7

— 19.5

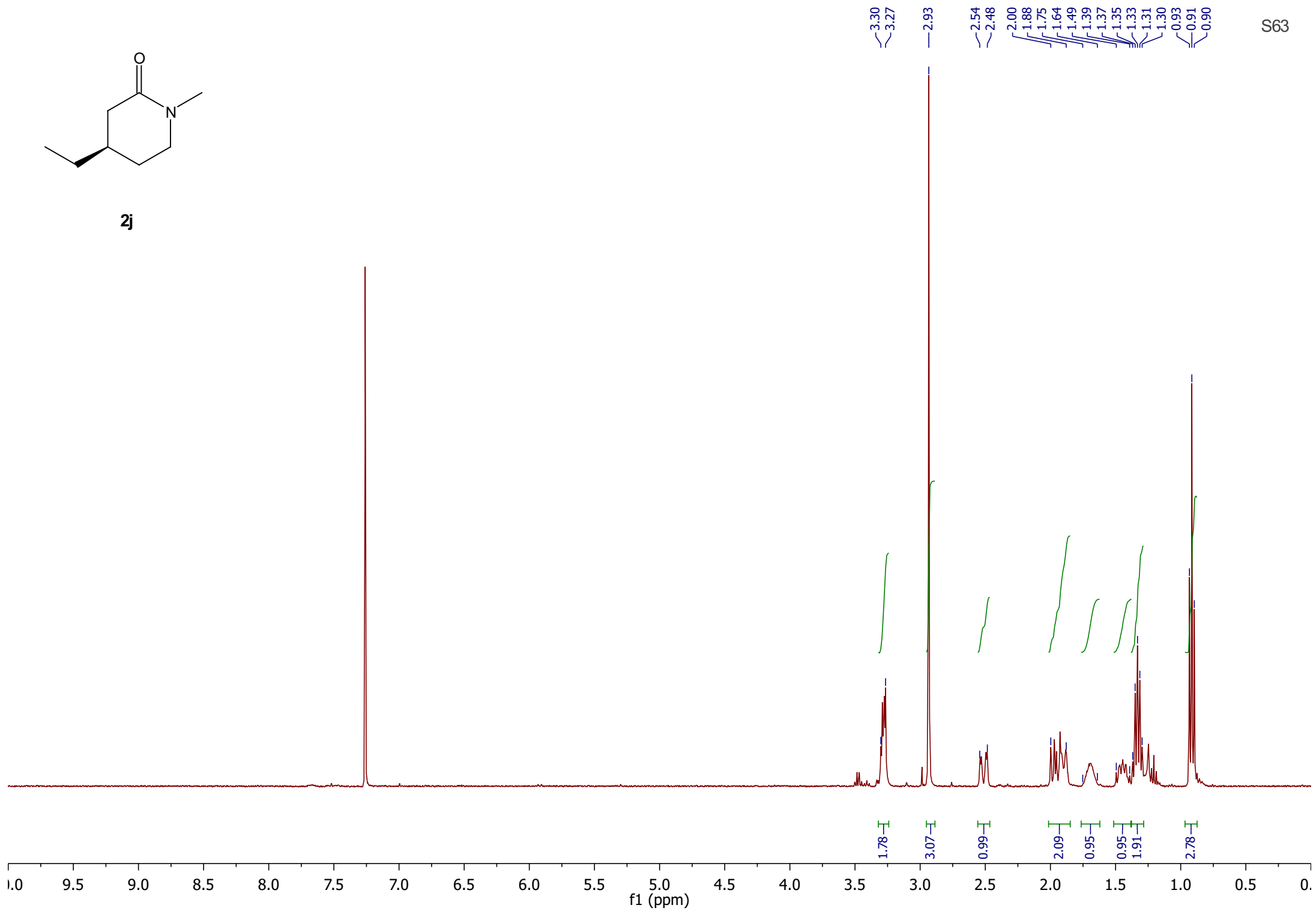
— 11.5

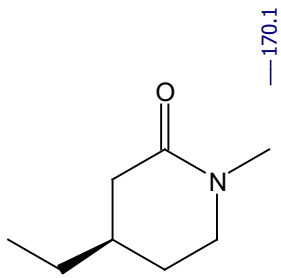
S62



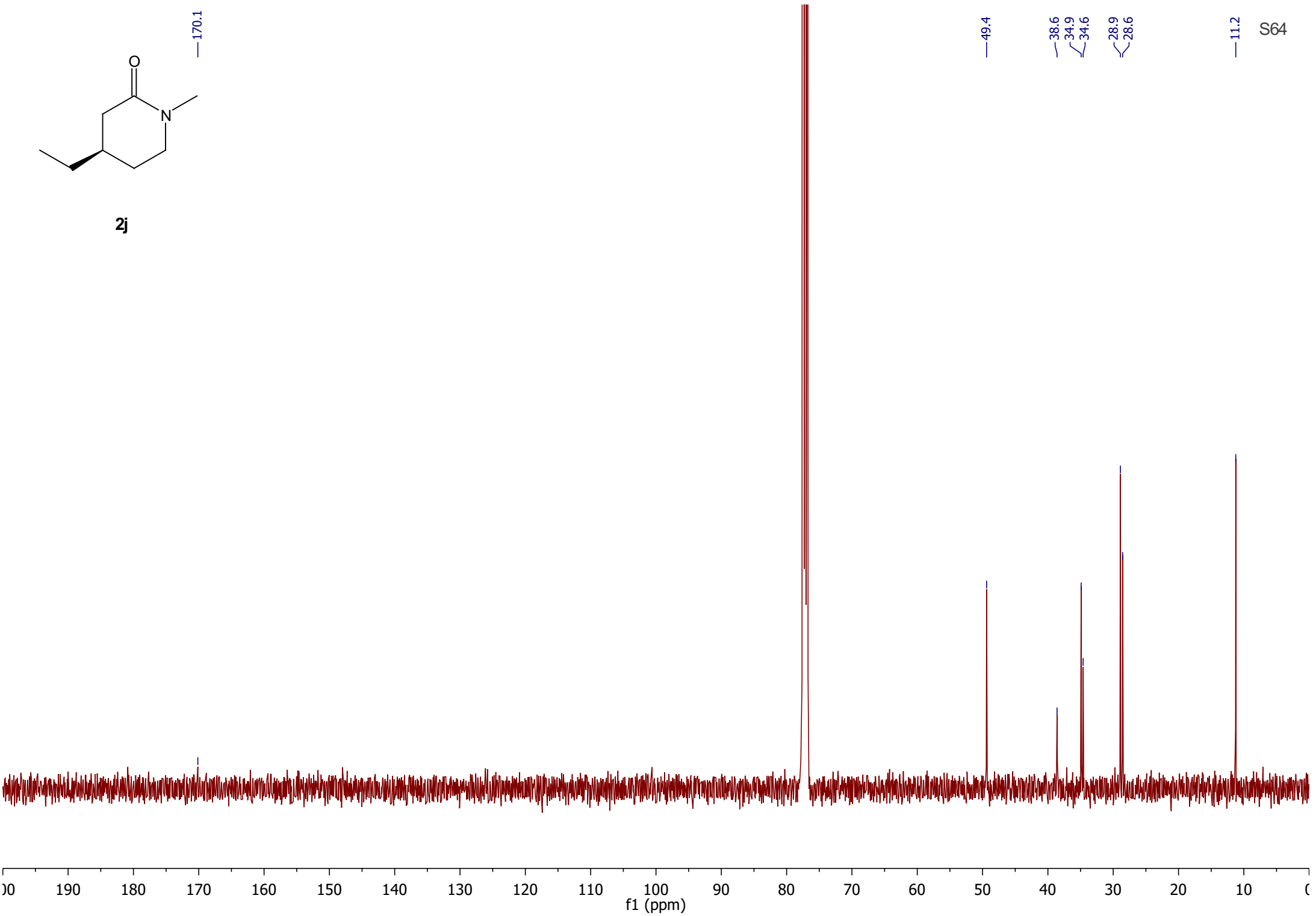


2j

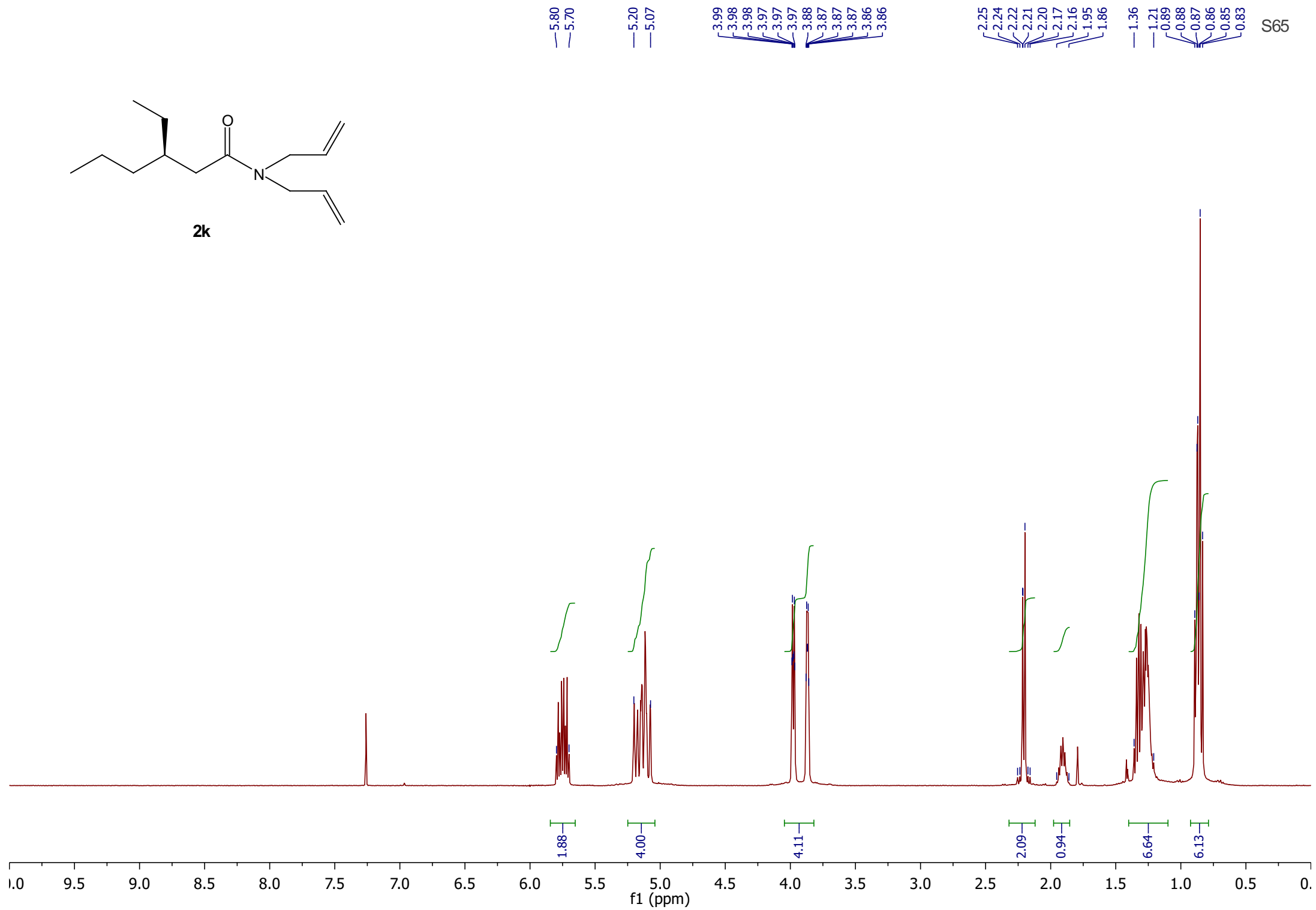
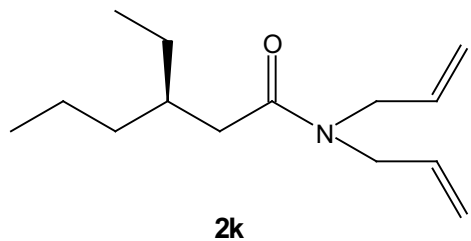


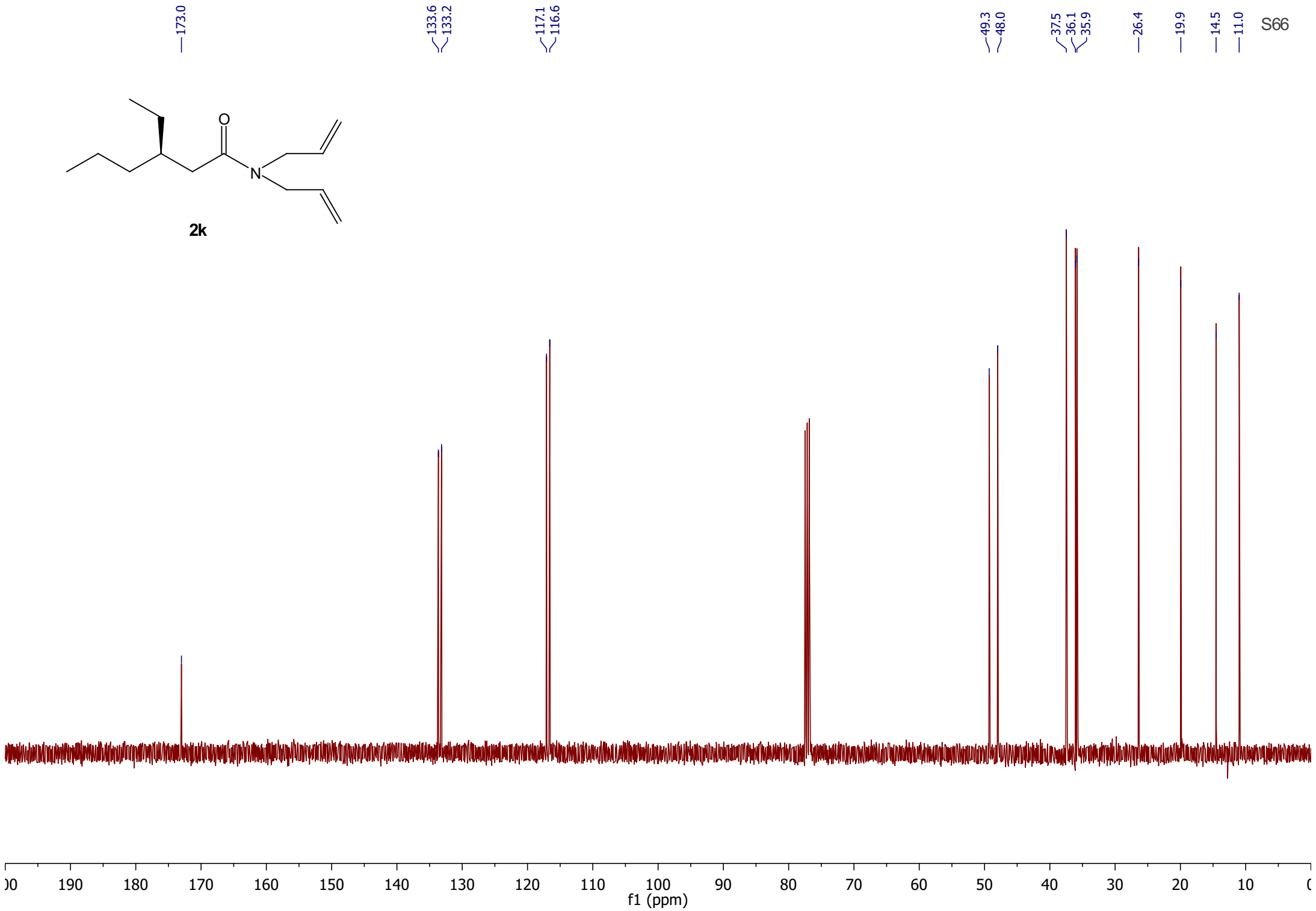
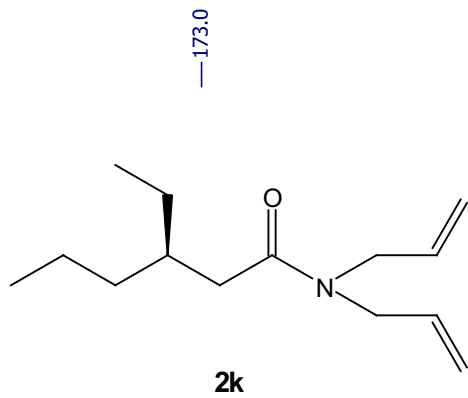


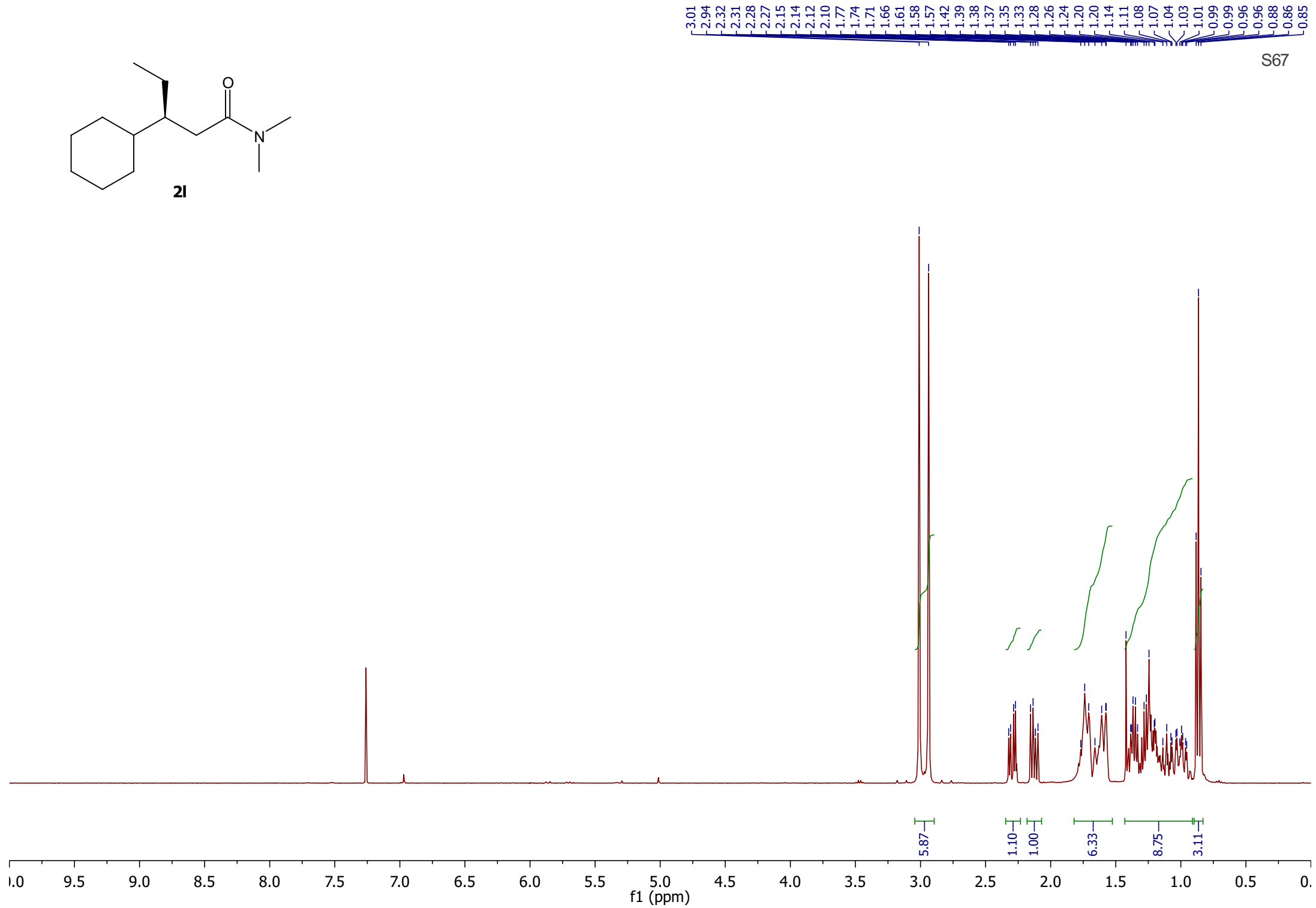
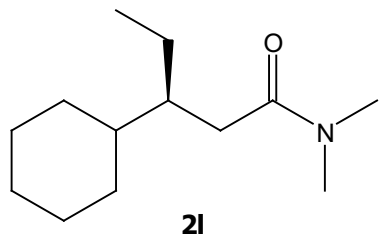
2j

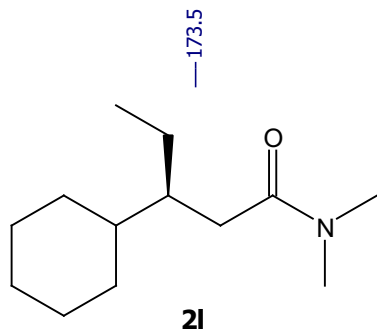






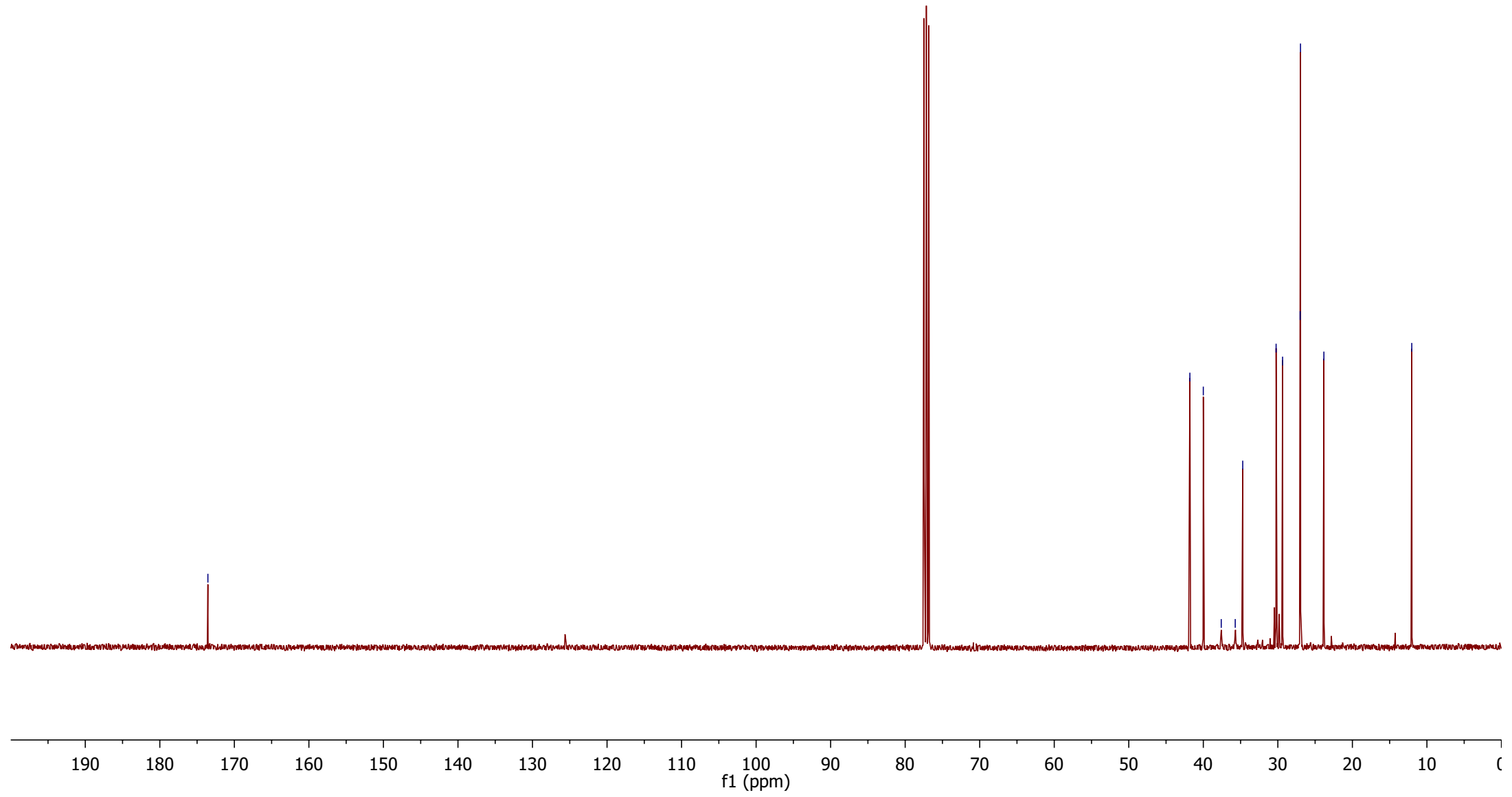


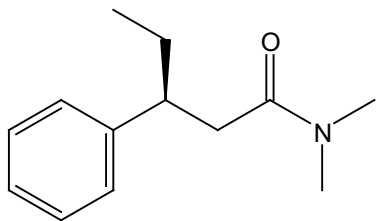




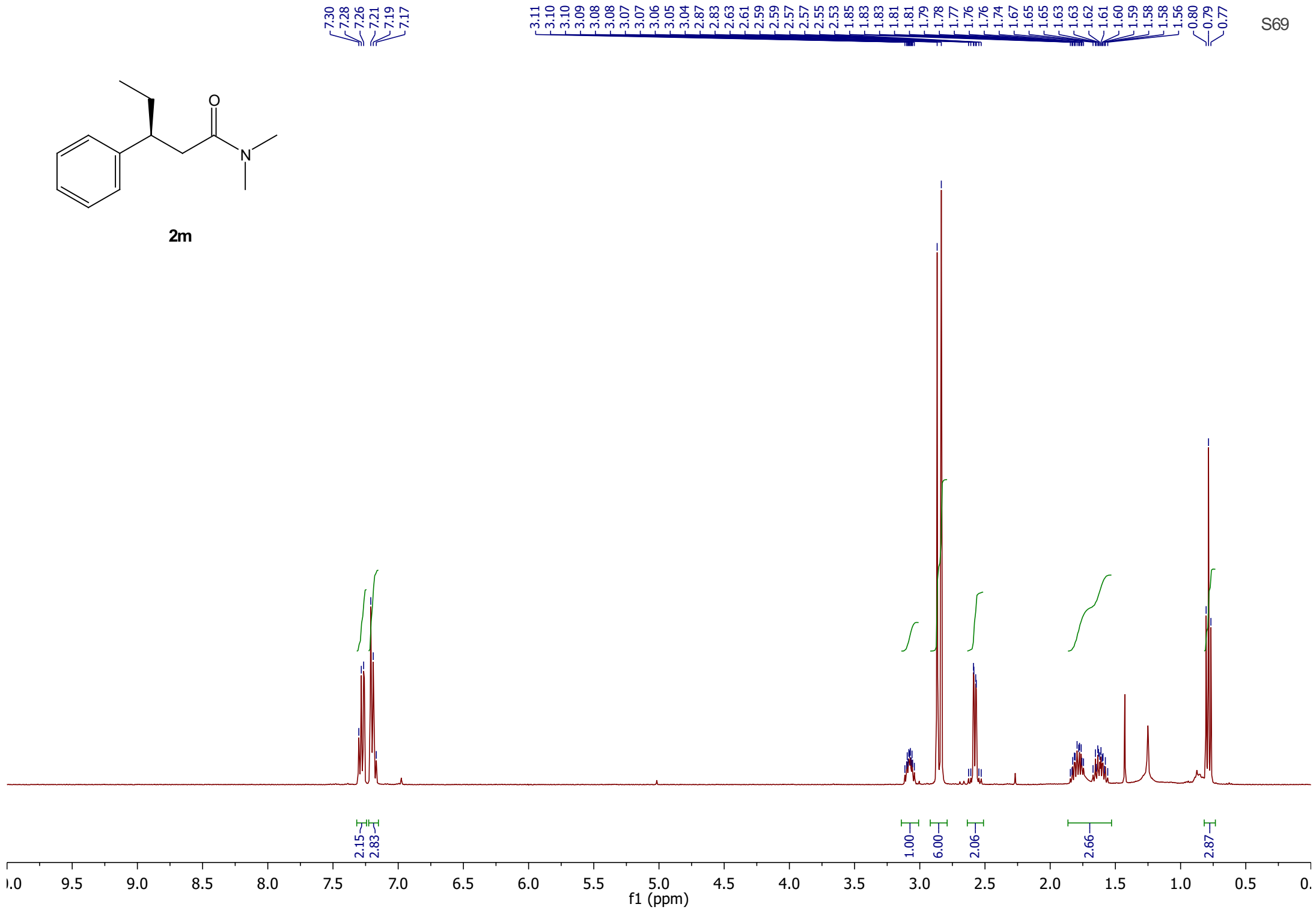
41.8  
40.0  
37.6  
35.7  
34.7  
30.2  
29.4  
27.0  
27.0  
23.8  
12.0

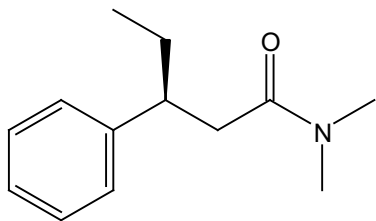
S68





2m





2m

— 172.0

— 144.9

— 128.5

— 127.8

— 126.4

— 44.2

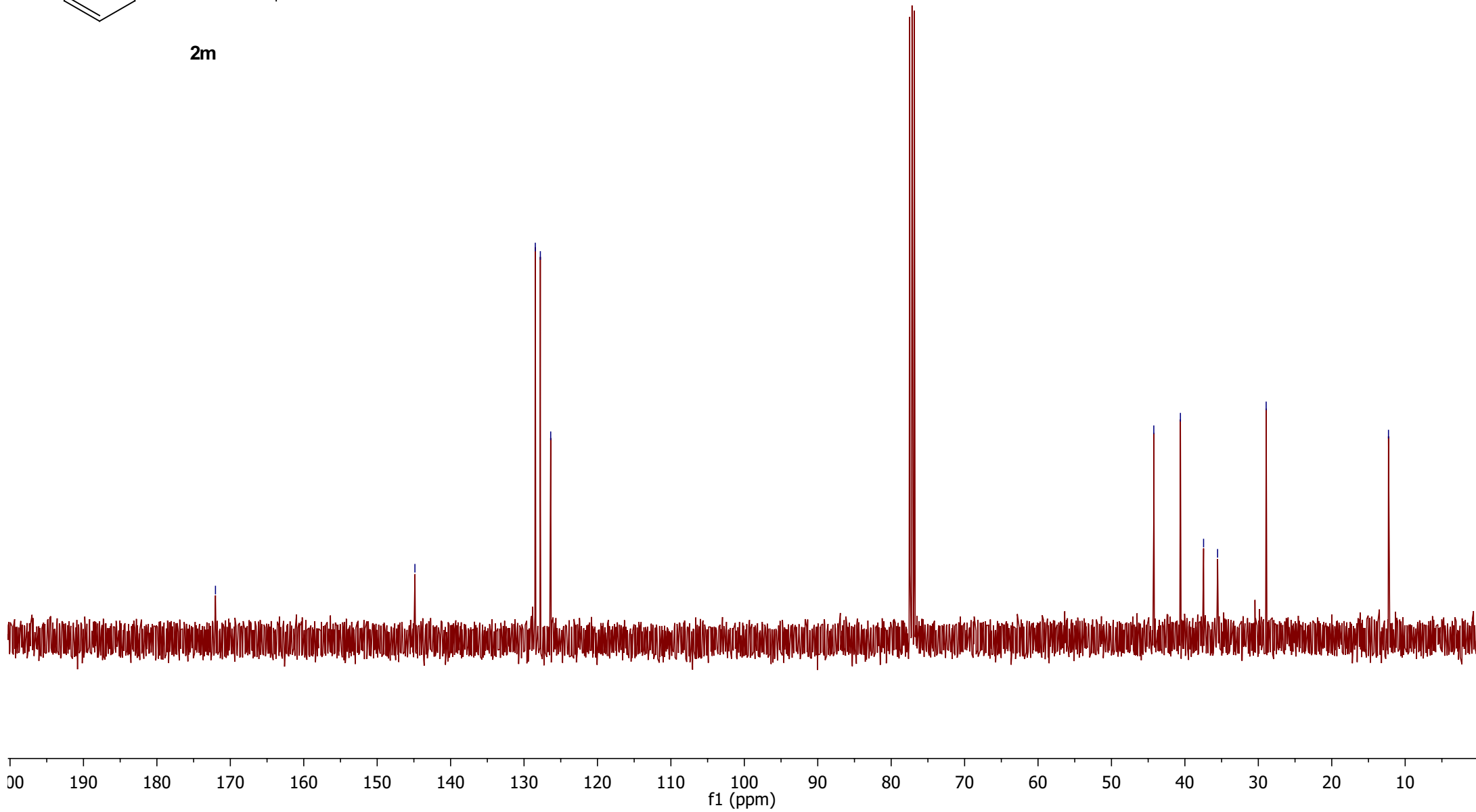
— 40.6

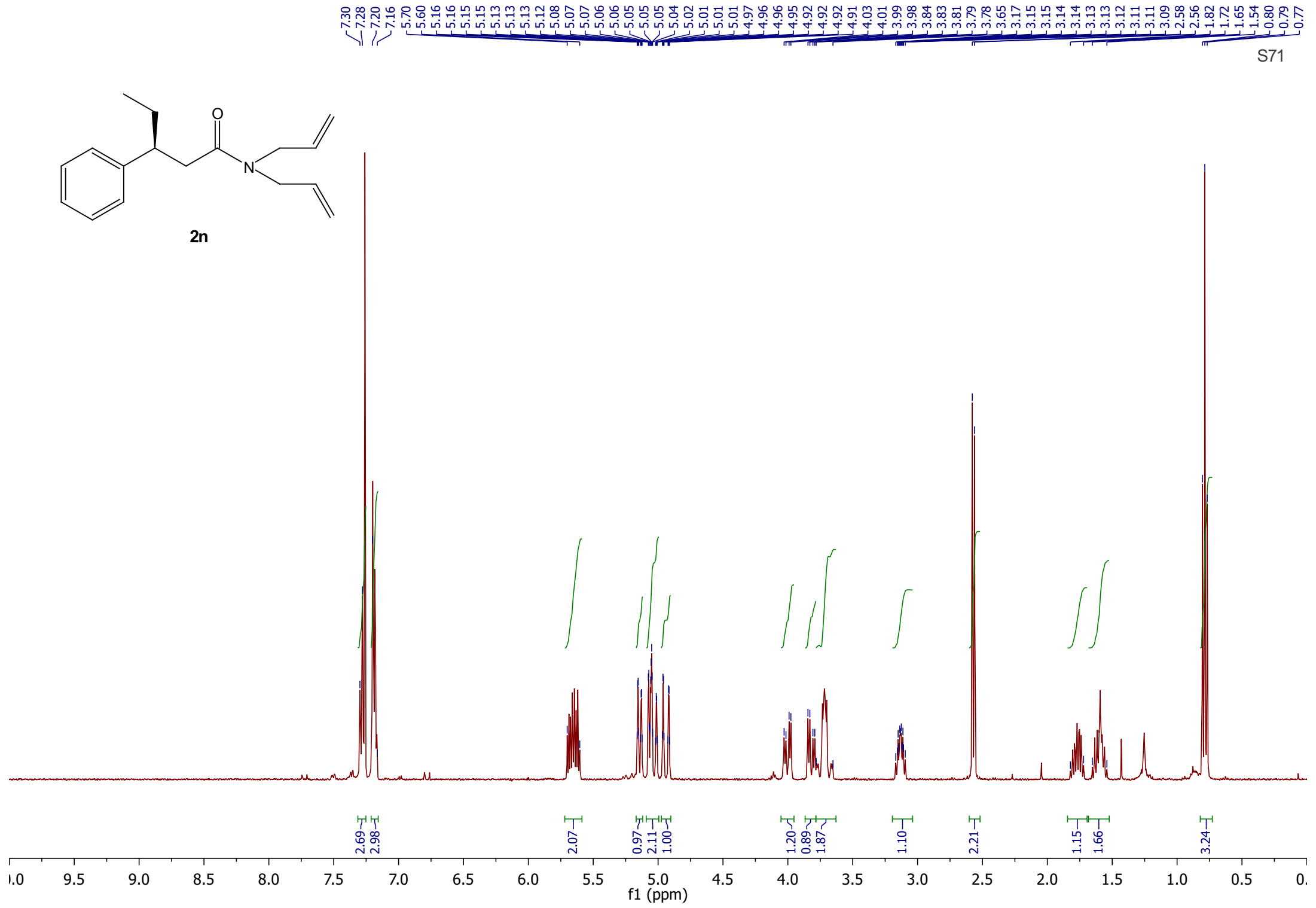
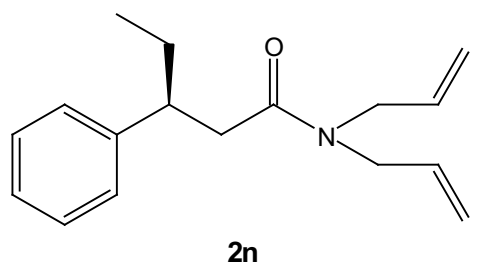
— 37.5

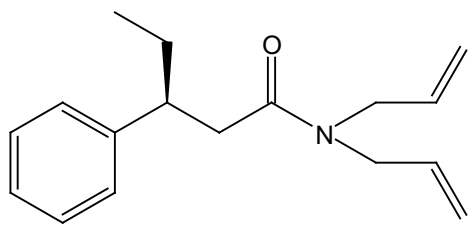
— 35.5

— 28.9

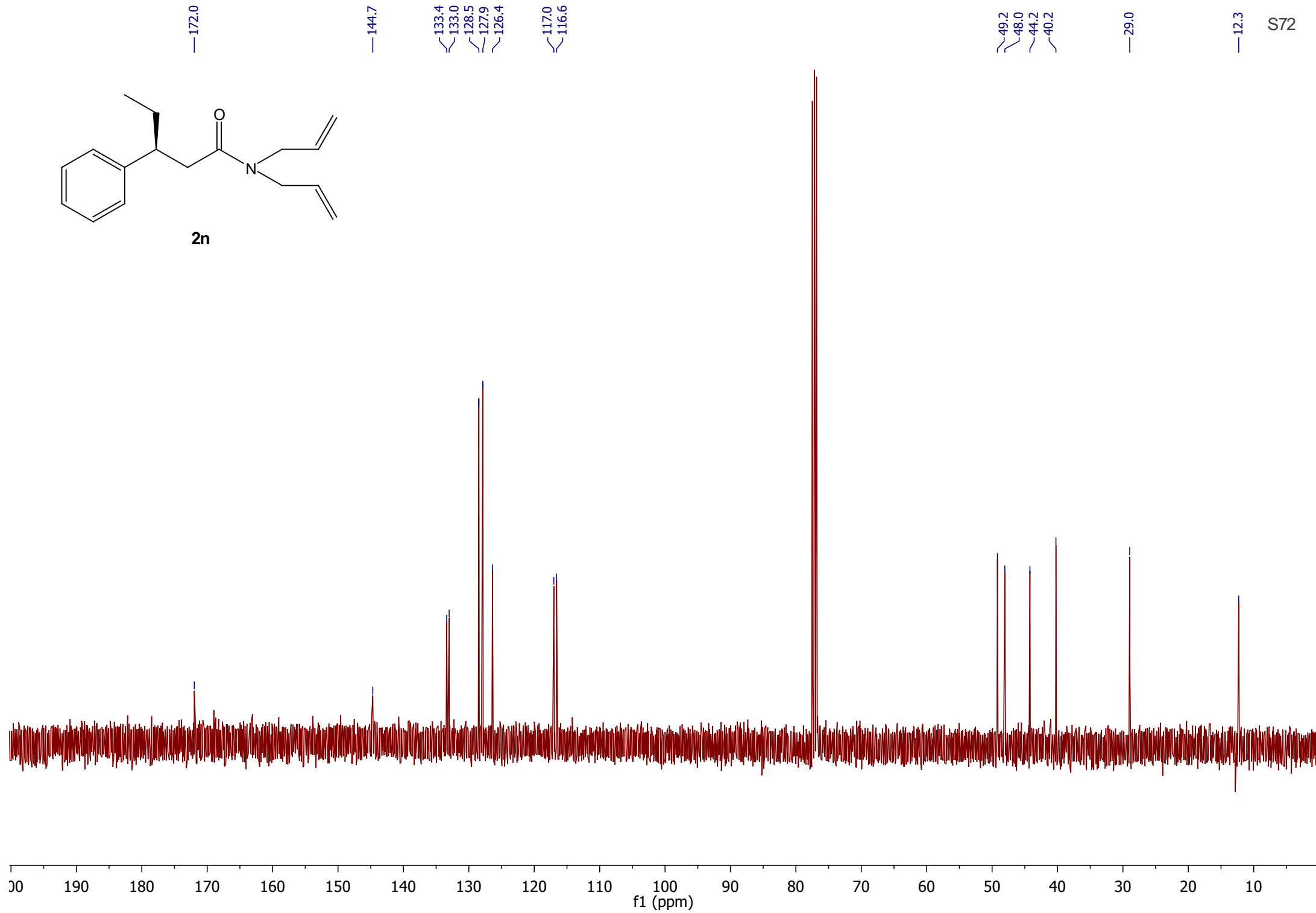
— 12.3



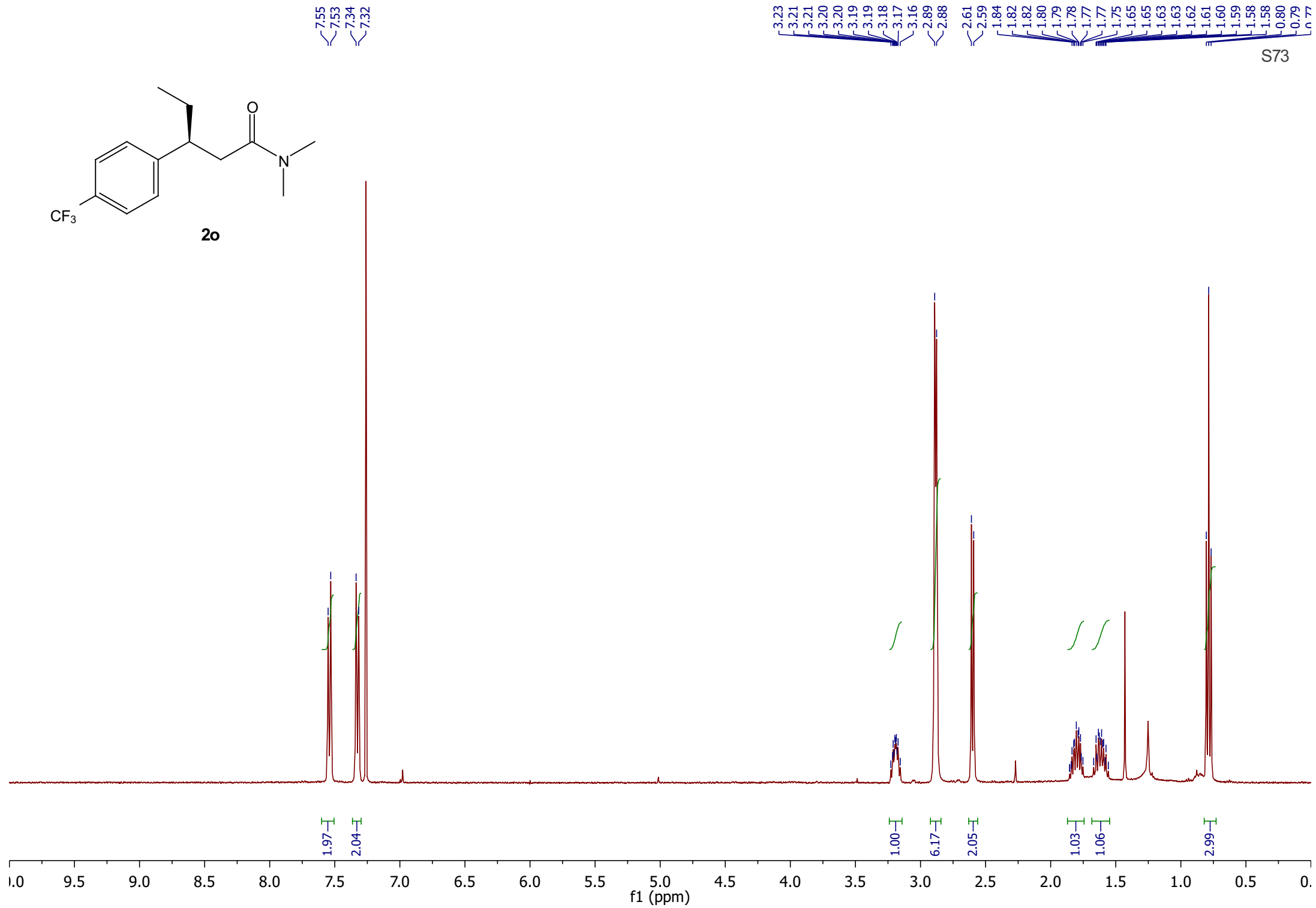
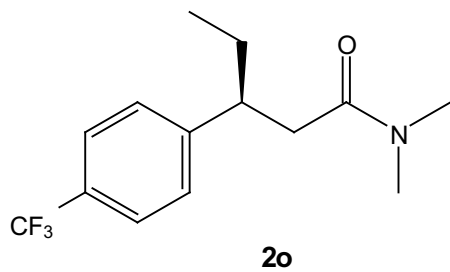


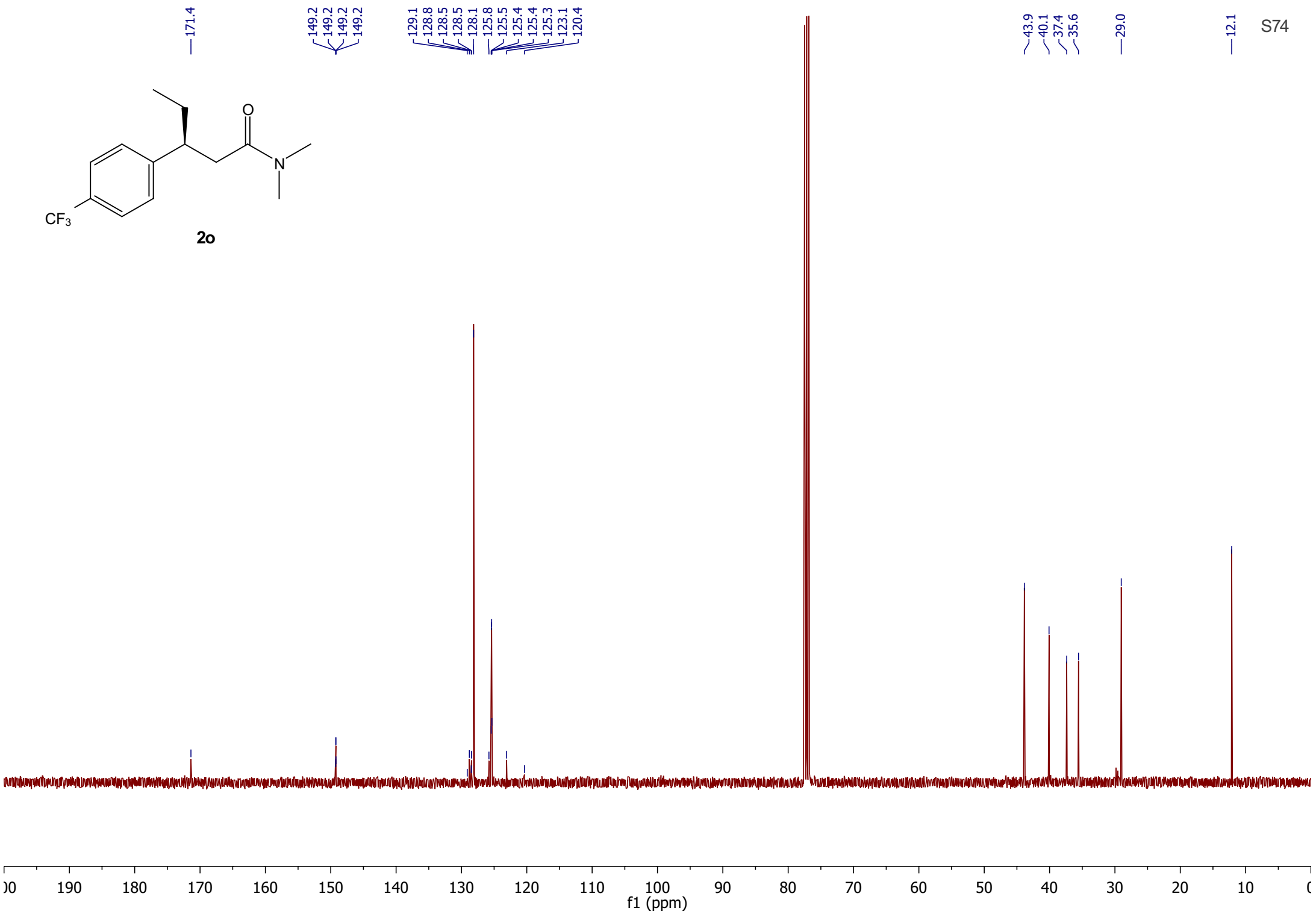
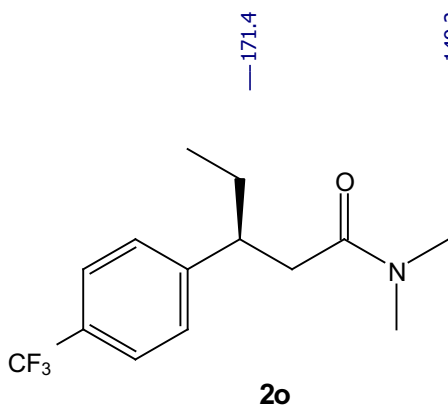


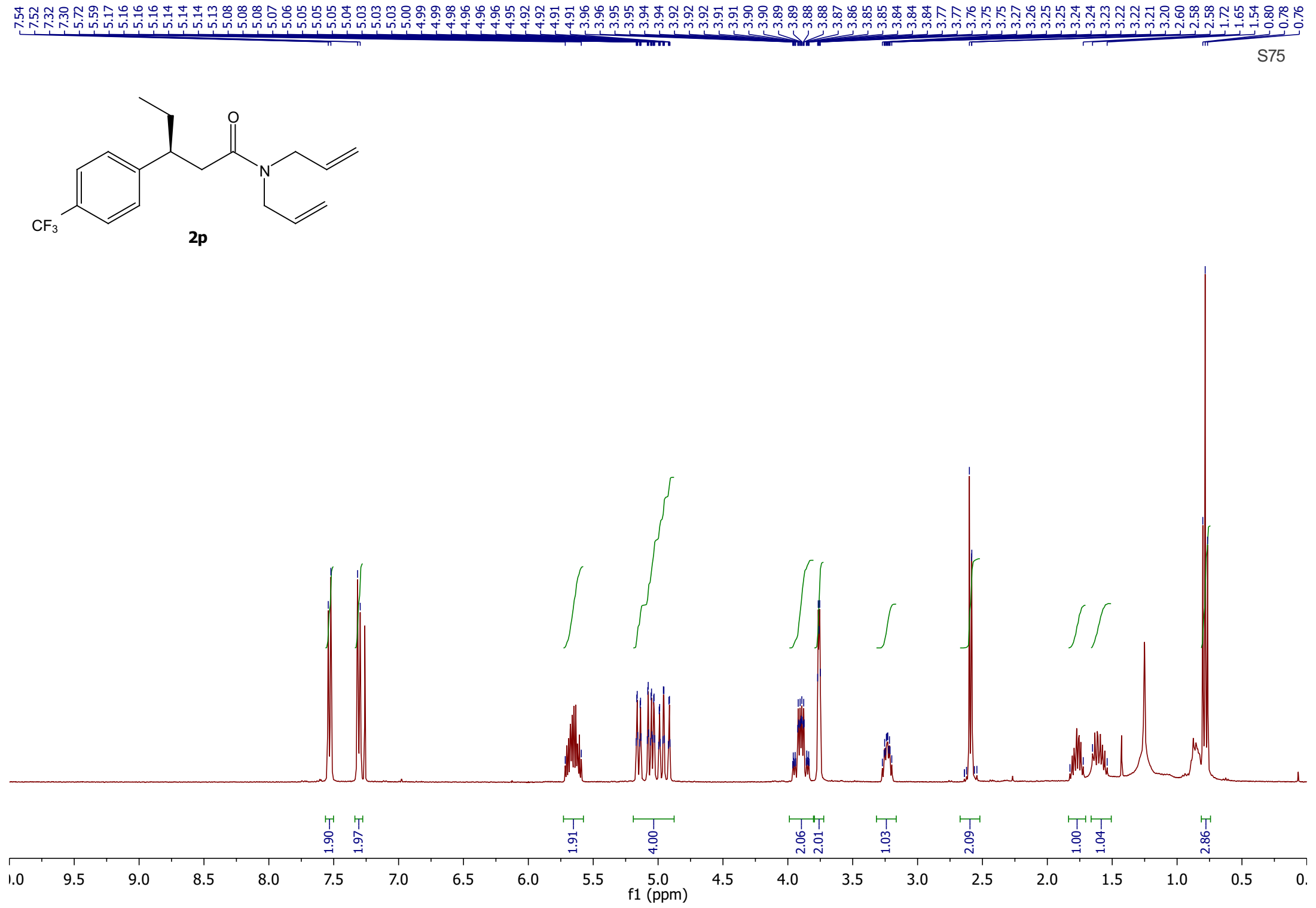
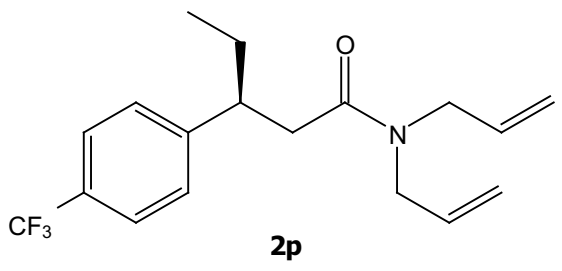
2n

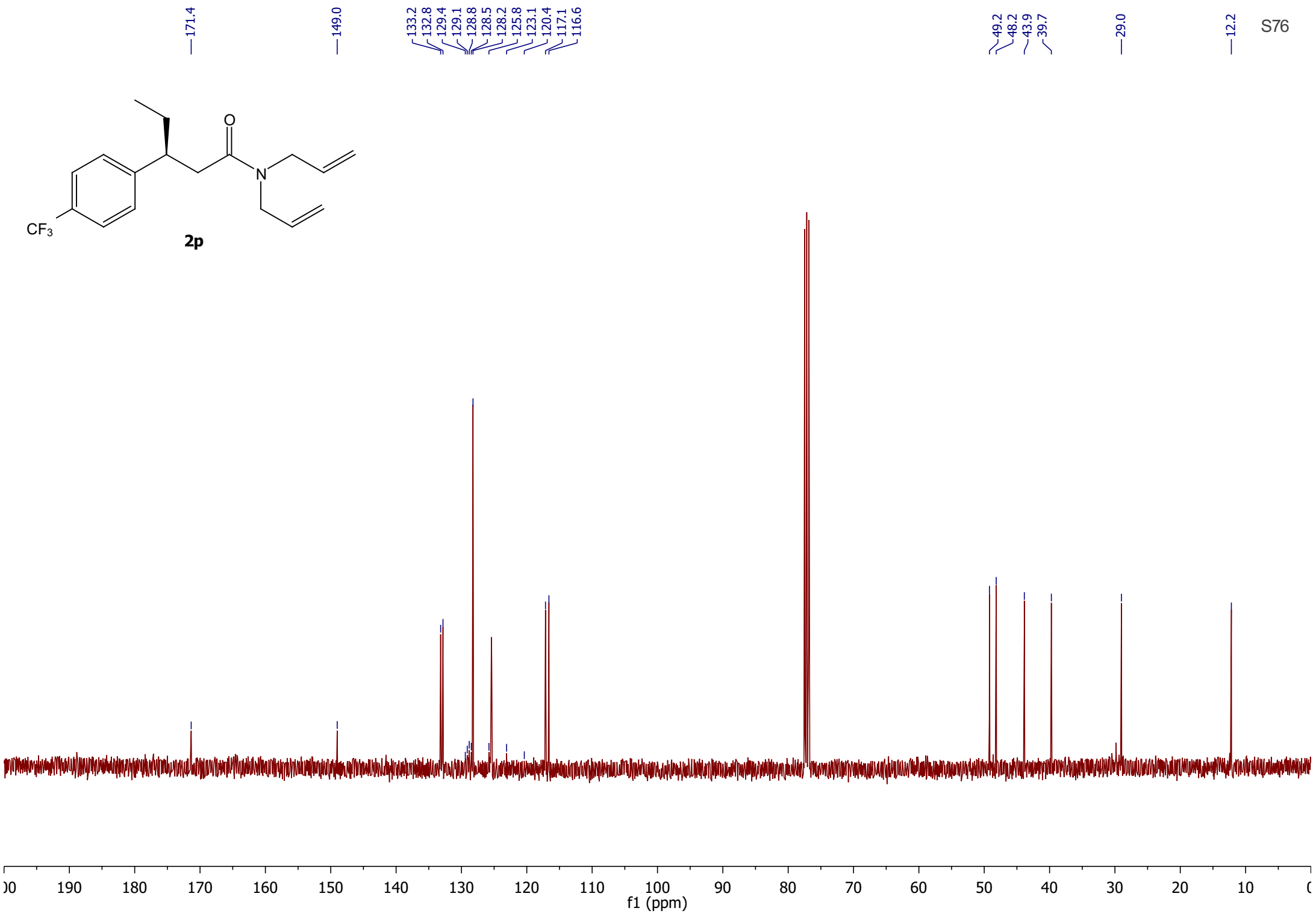
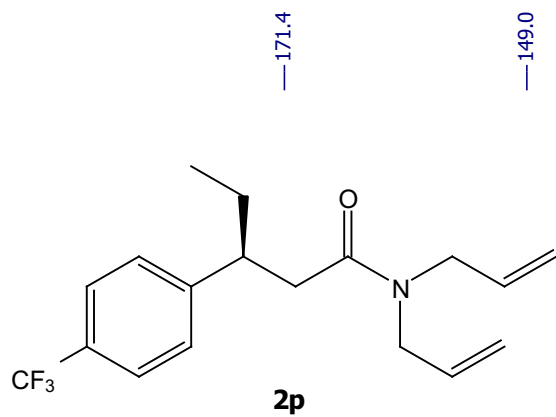




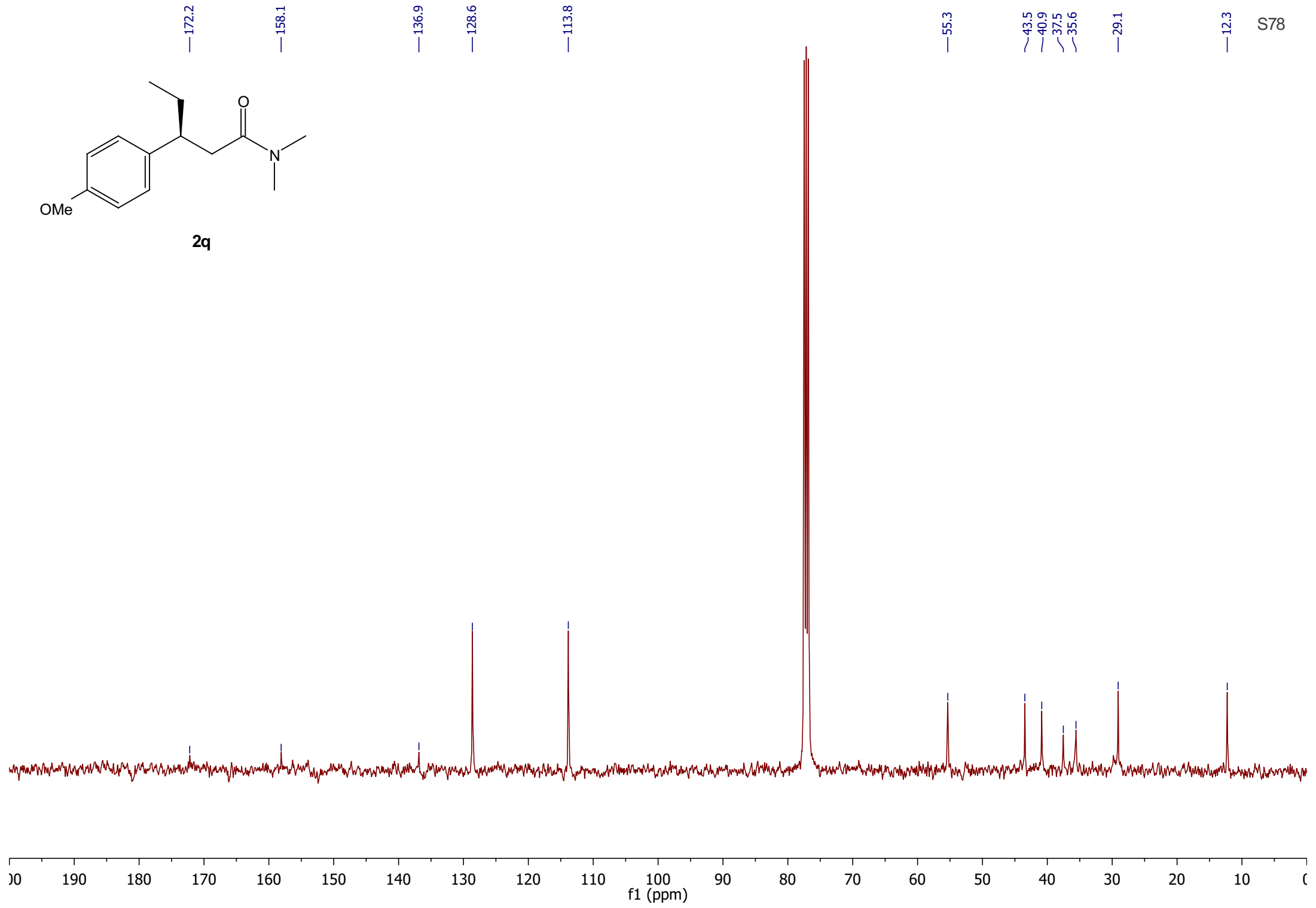
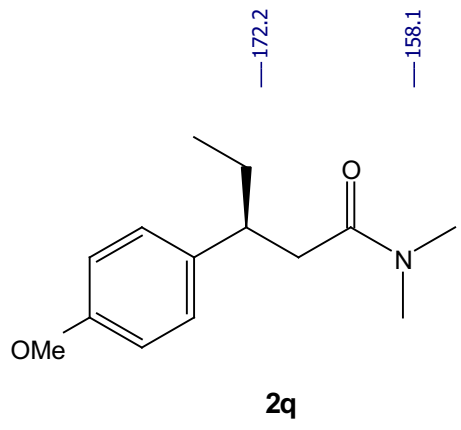


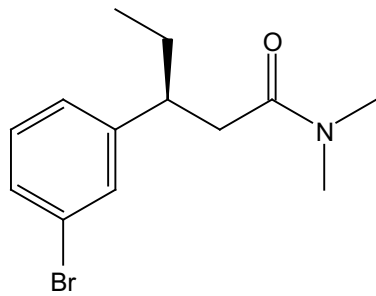




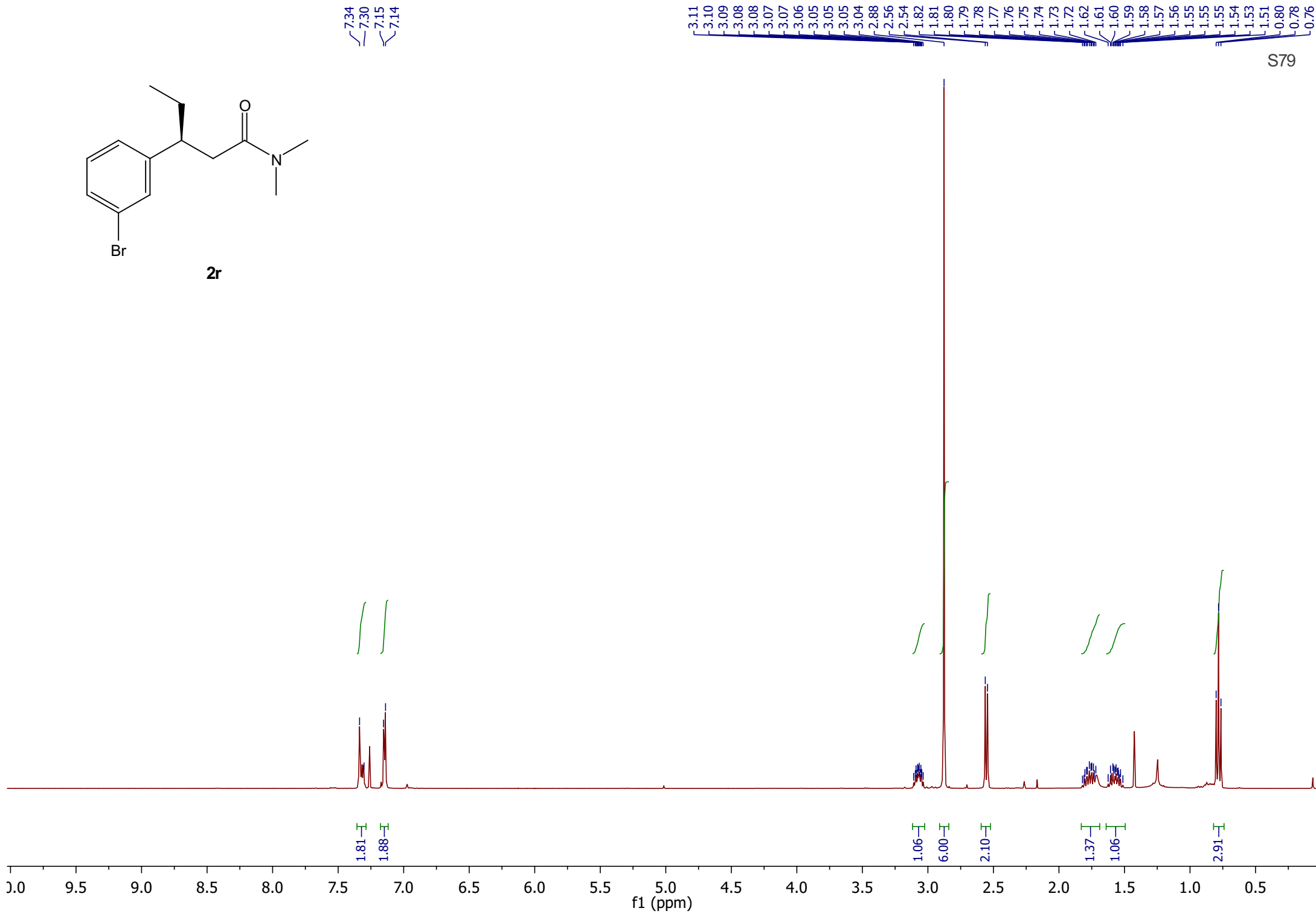


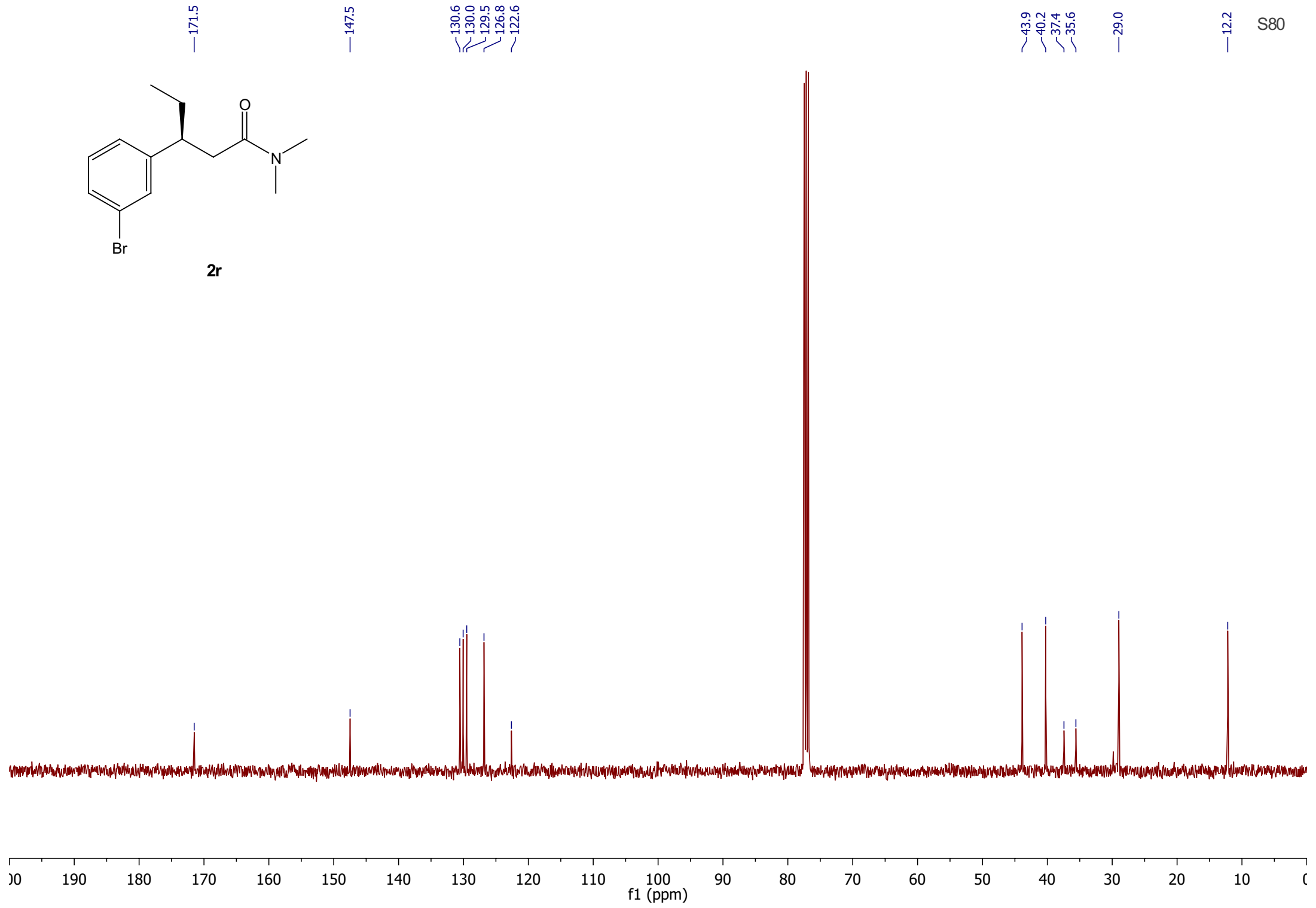
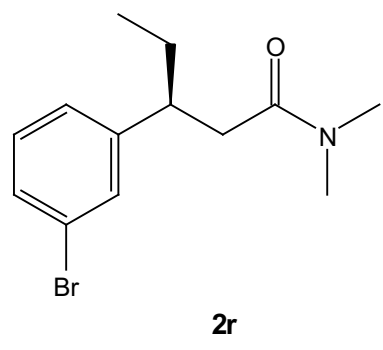




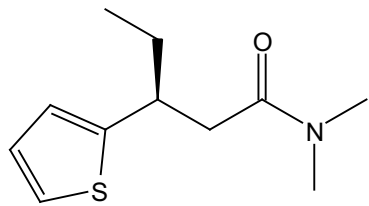


2r







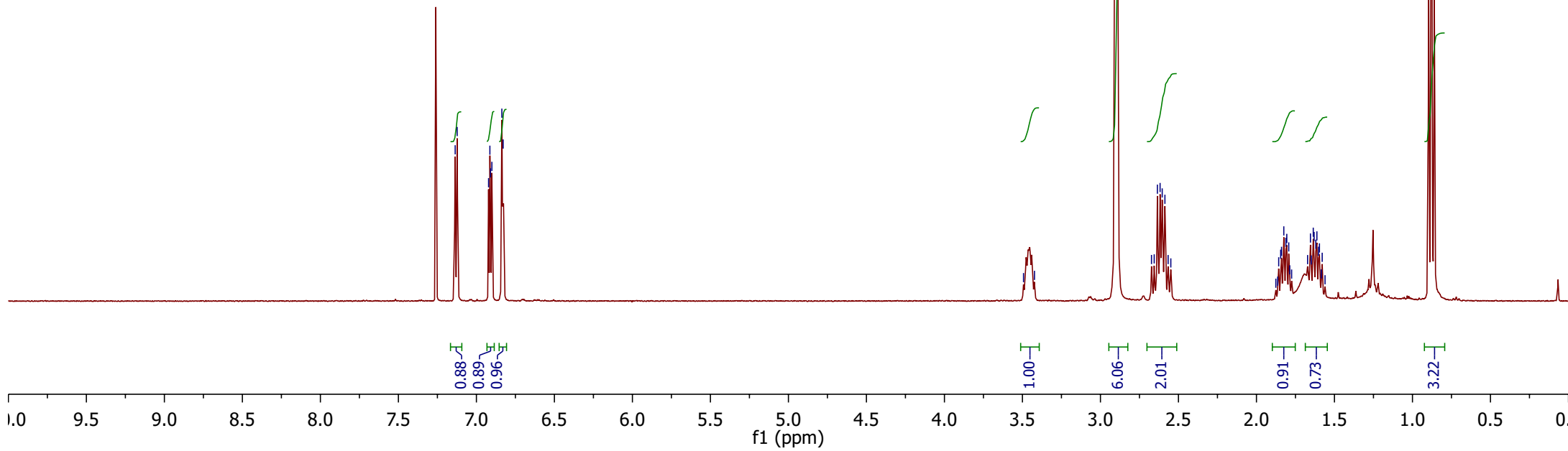


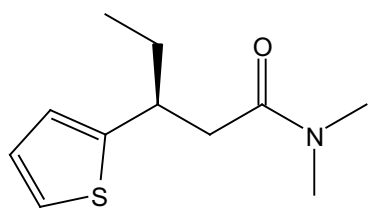
2s

7.14  
7.12  
6.92  
6.91  
6.91  
6.90  
6.84  
6.83

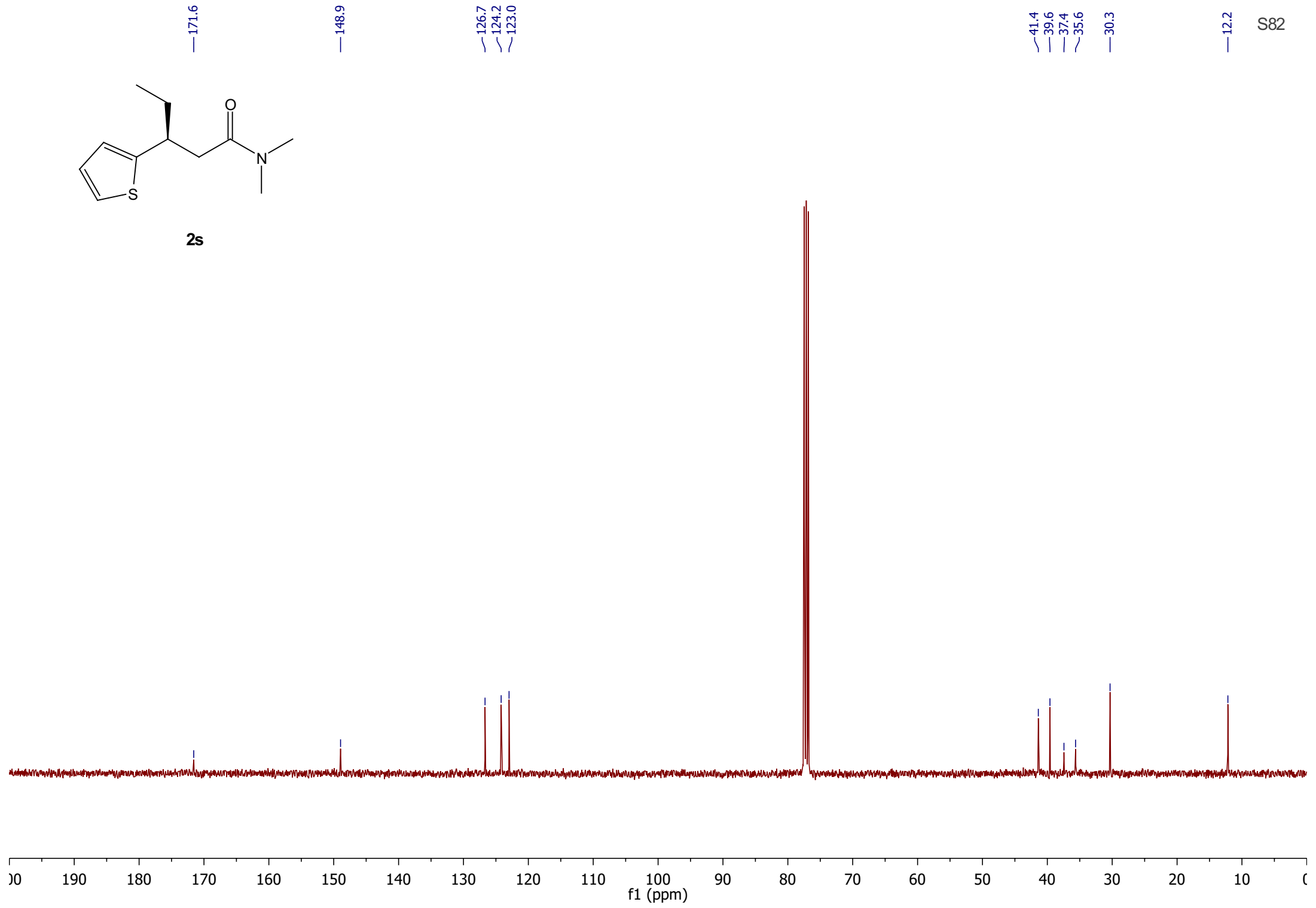
3.49  
3.42  
2.90  
2.89  
2.67  
2.66  
2.63  
2.62  
2.60  
2.59  
2.57  
2.55  
1.88  
1.86  
1.86  
1.84  
1.84  
1.82  
1.81  
1.81  
1.79  
1.77  
1.67  
1.65  
1.65  
1.64  
1.63  
1.62  
1.61  
1.60  
1.60  
1.58  
1.58  
1.56  
1.56  
0.90  
0.88  
0.86

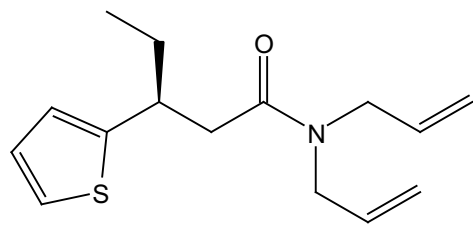
S81



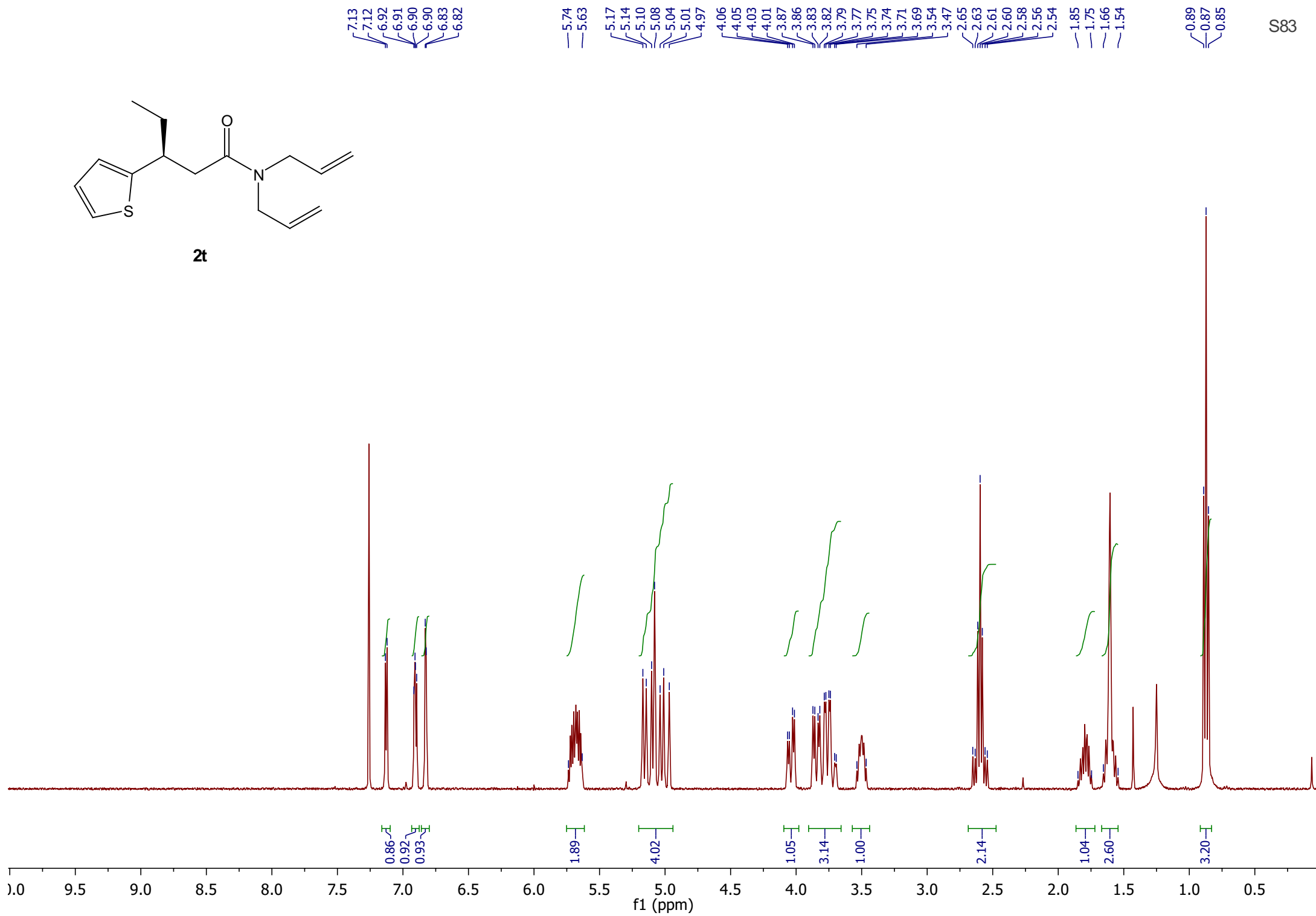


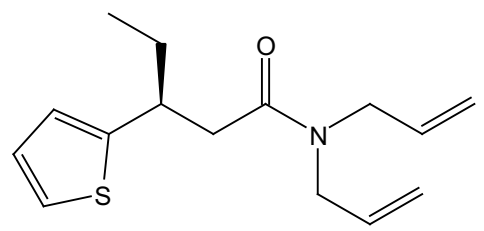
2s



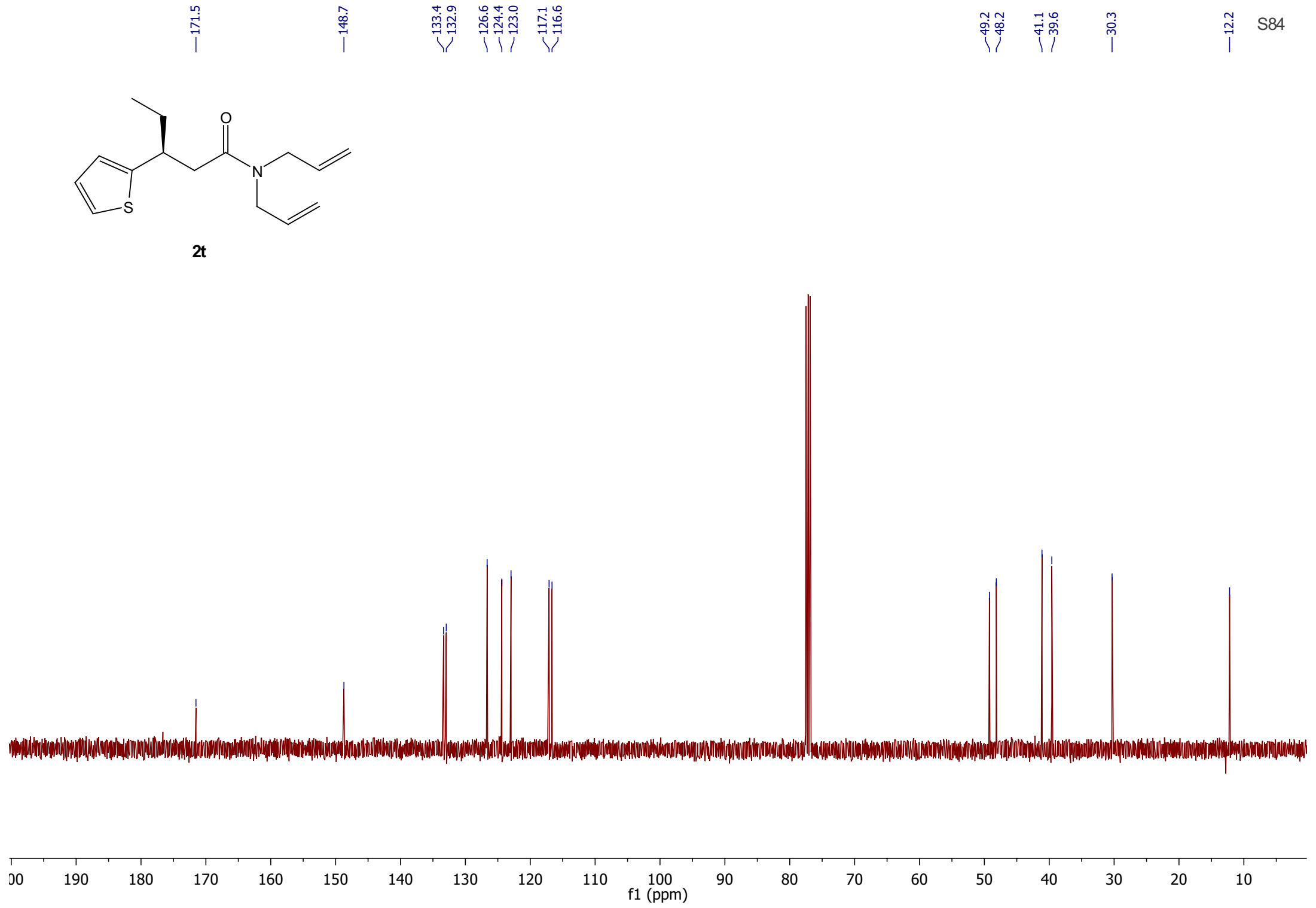


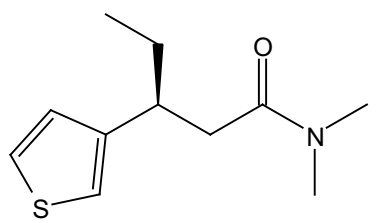
2t



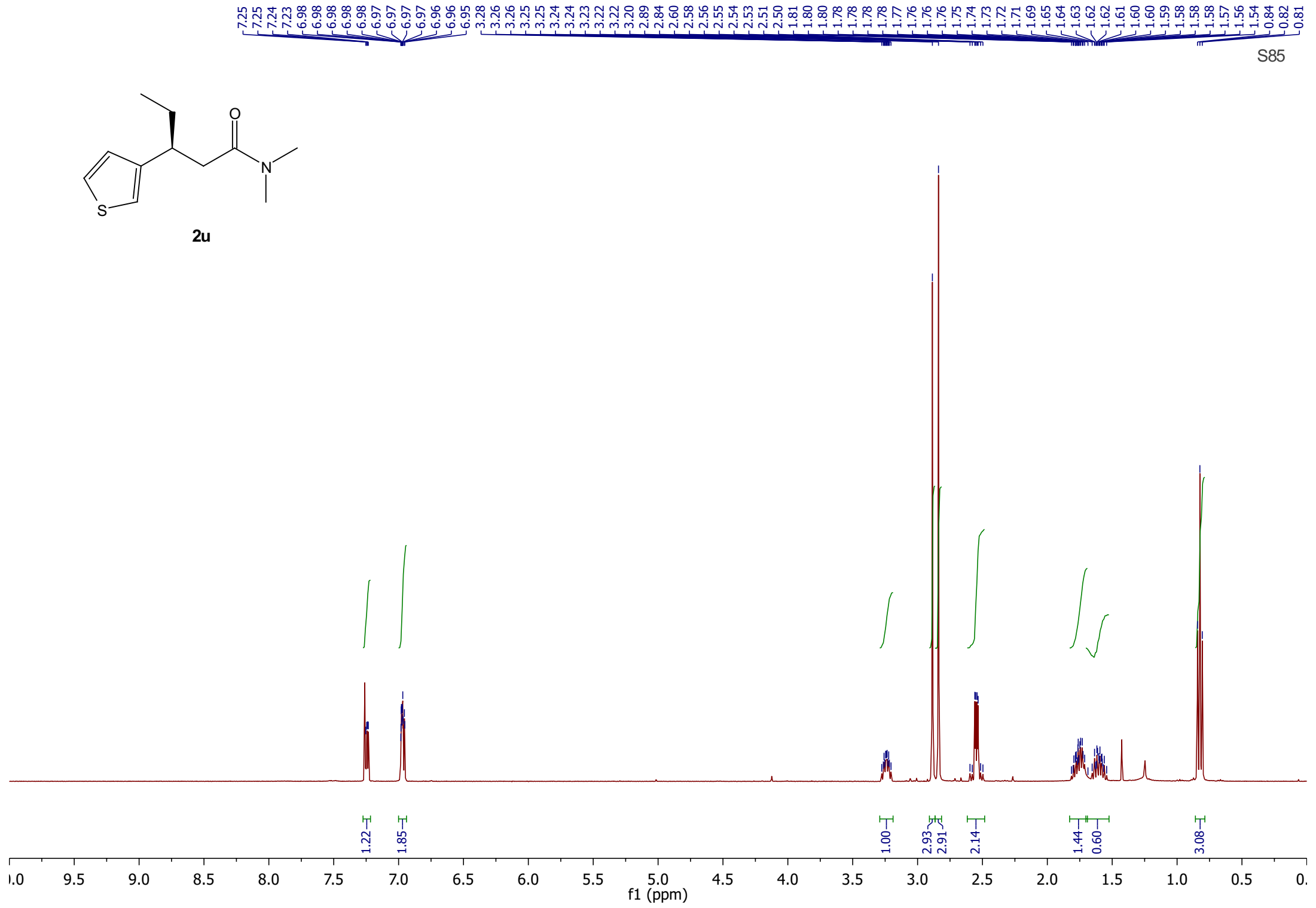


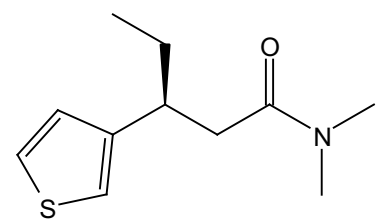
2t



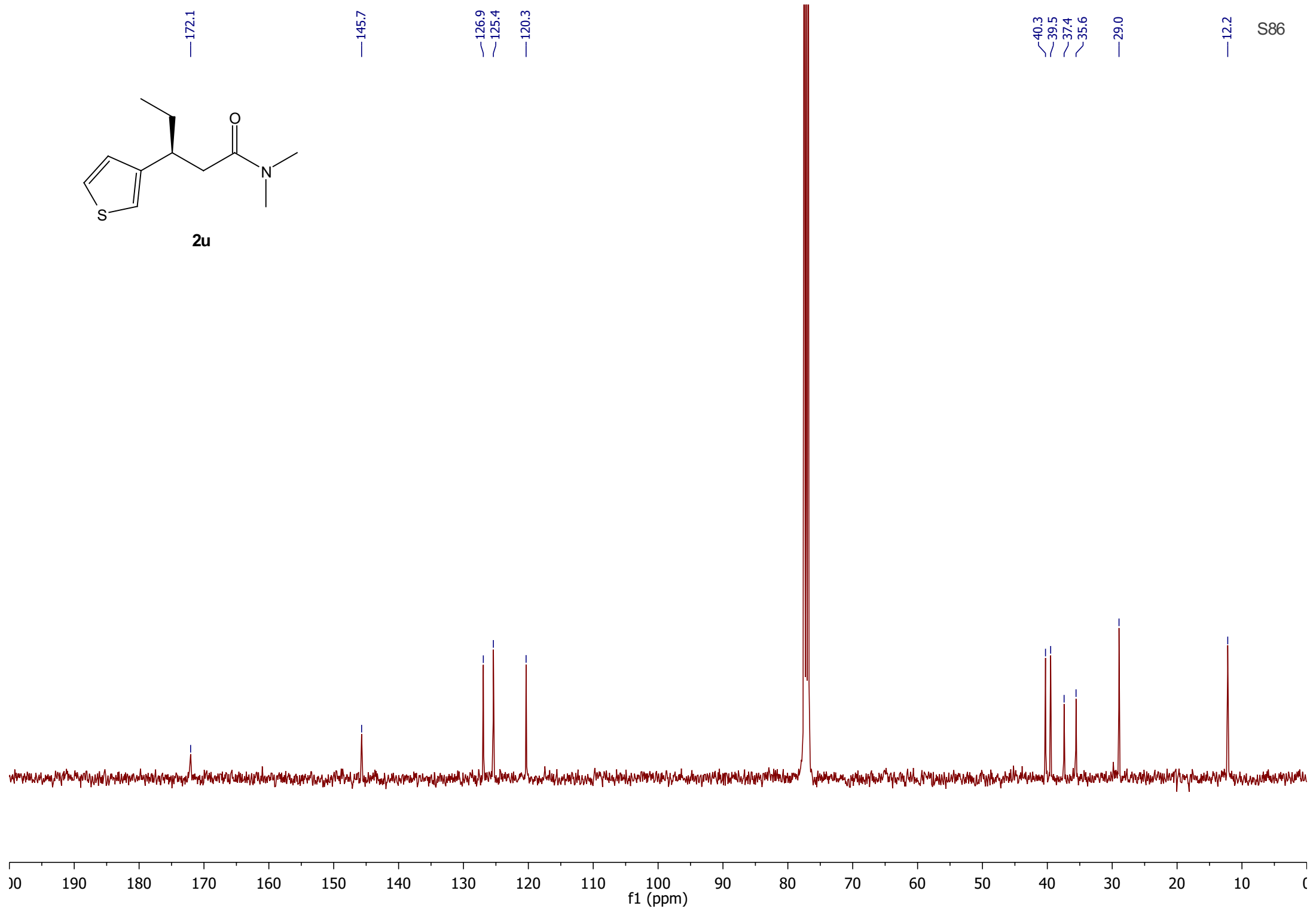


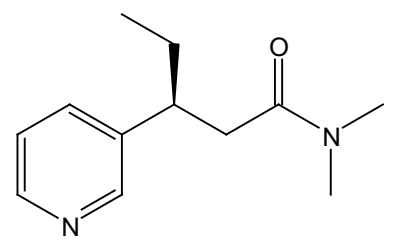
2u



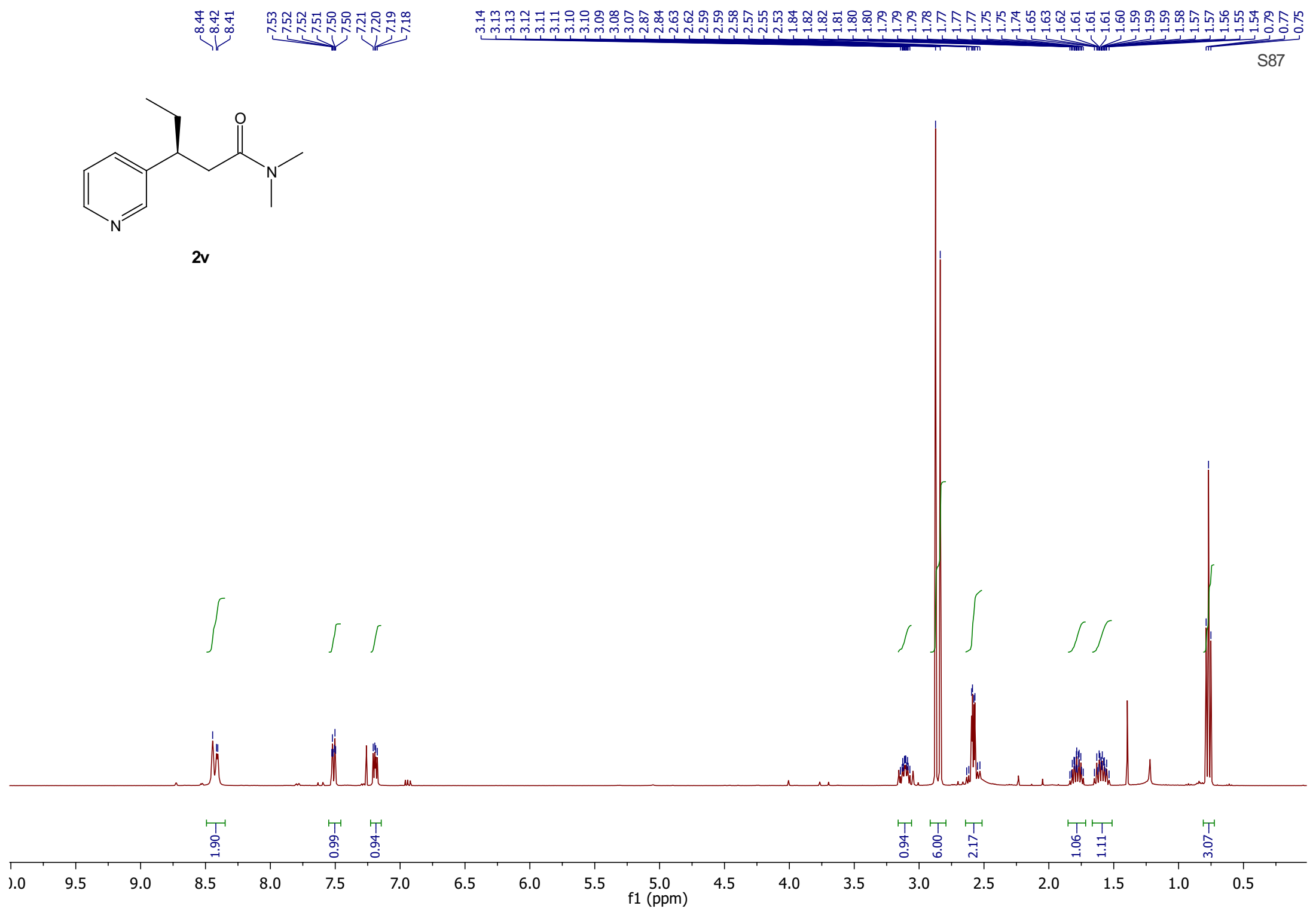


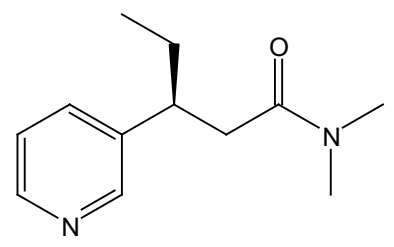
2u



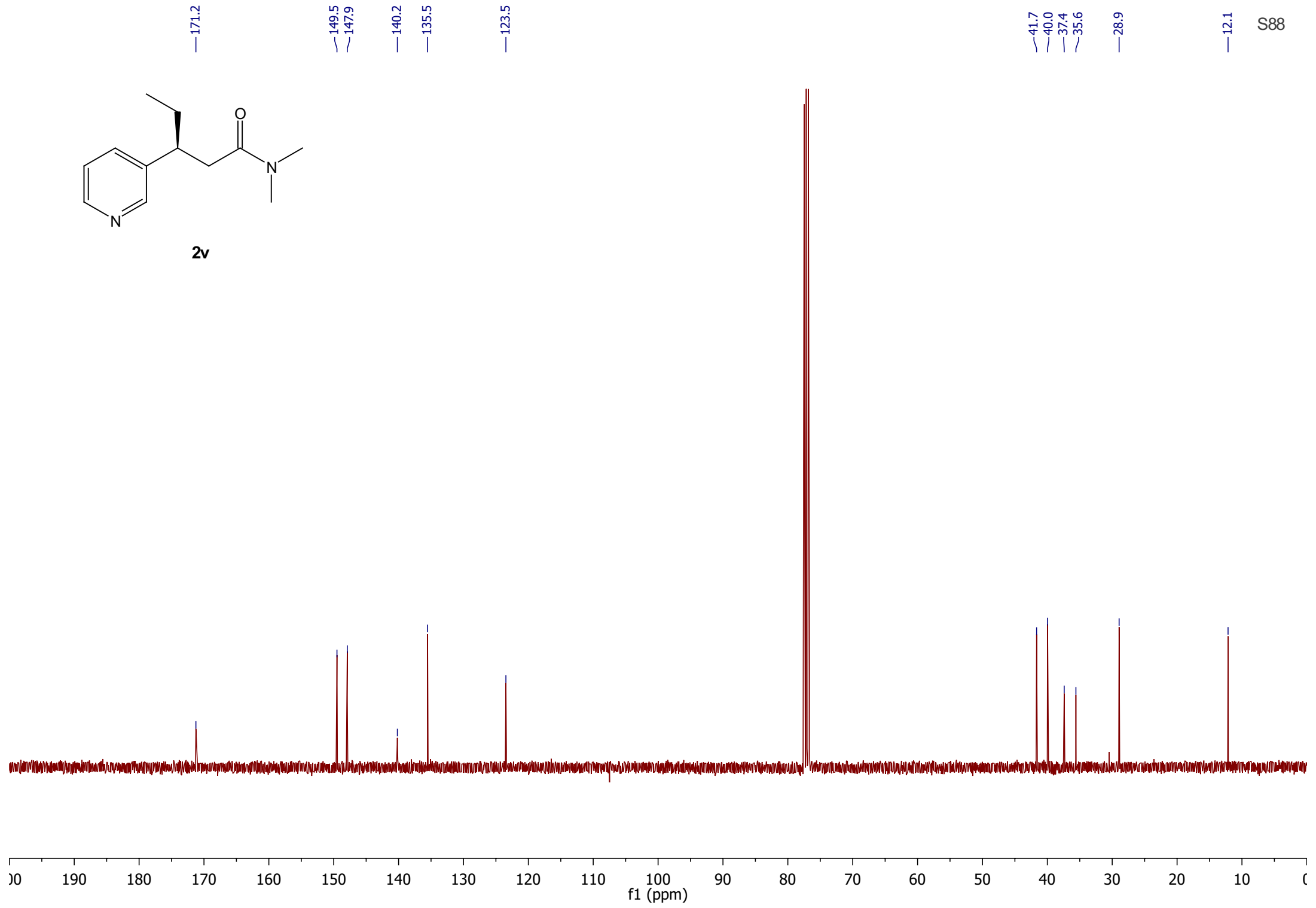


2v

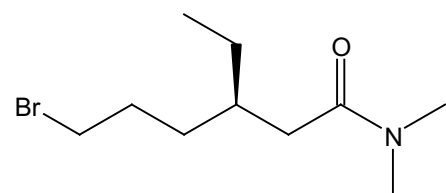




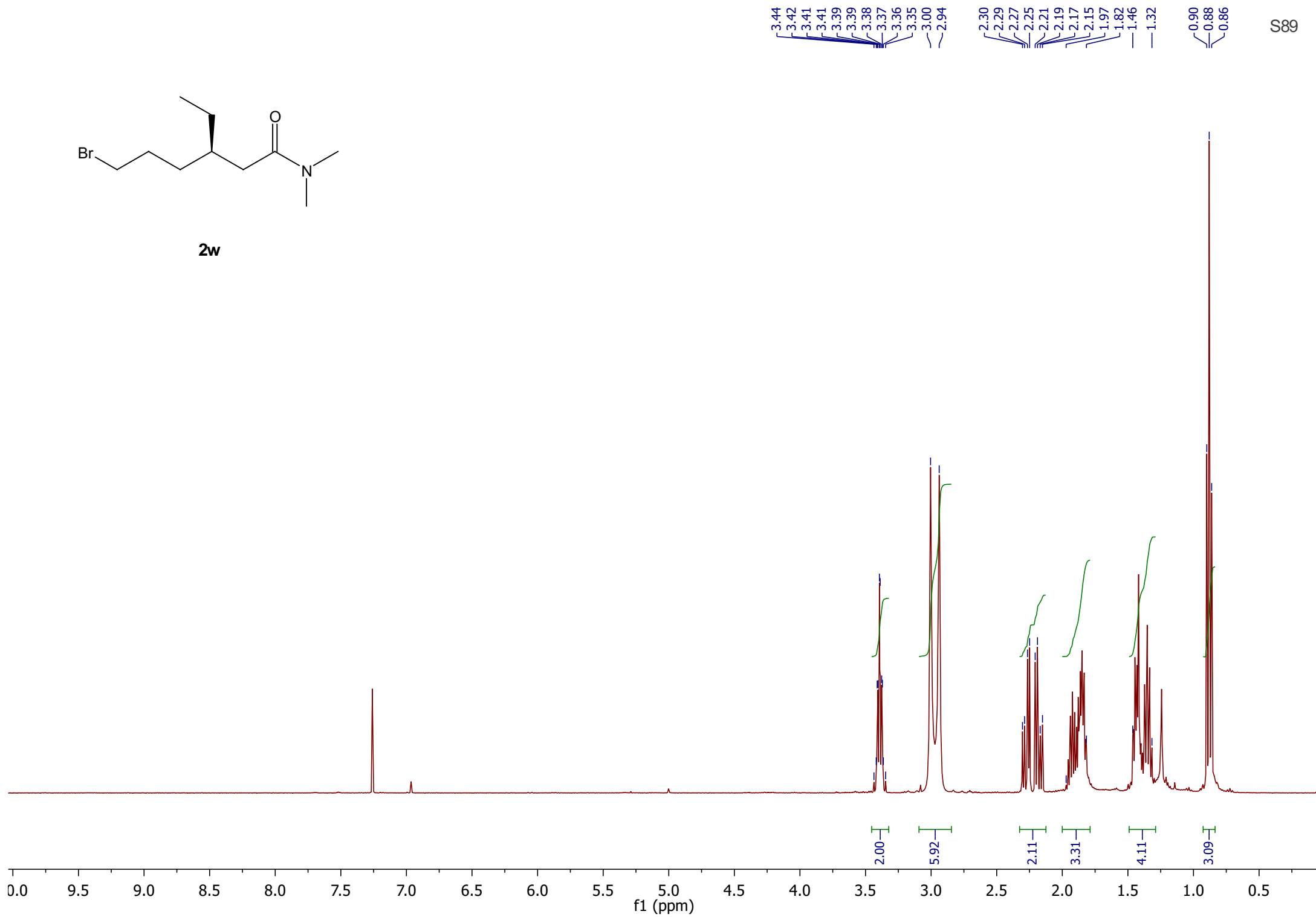
2v

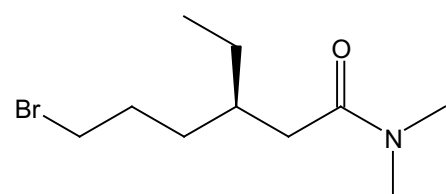






2w





**2w**

—172.6

—37.6

—35.6

—34.3

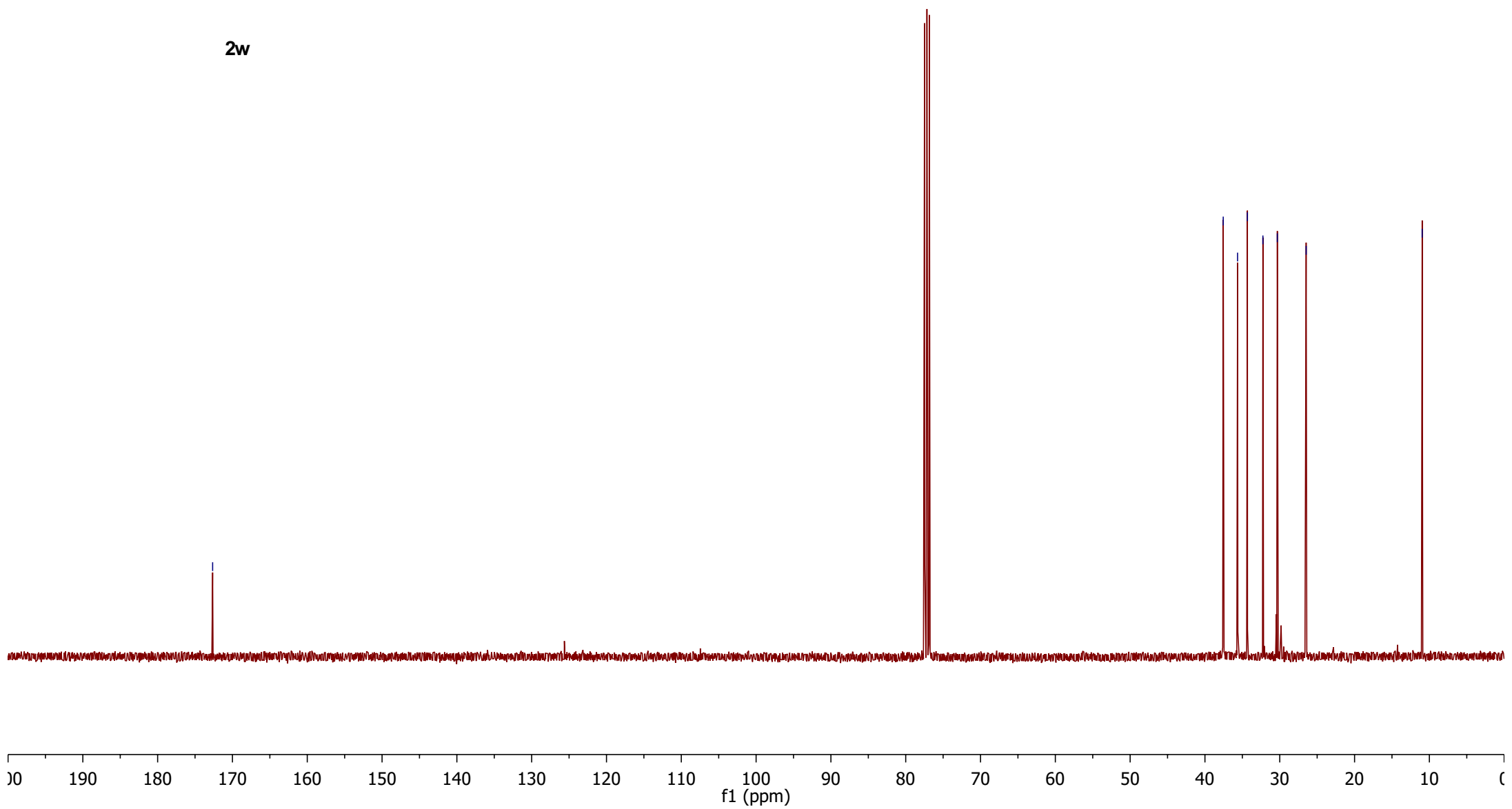
—32.3

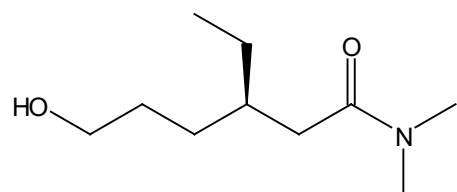
—30.3

—26.5

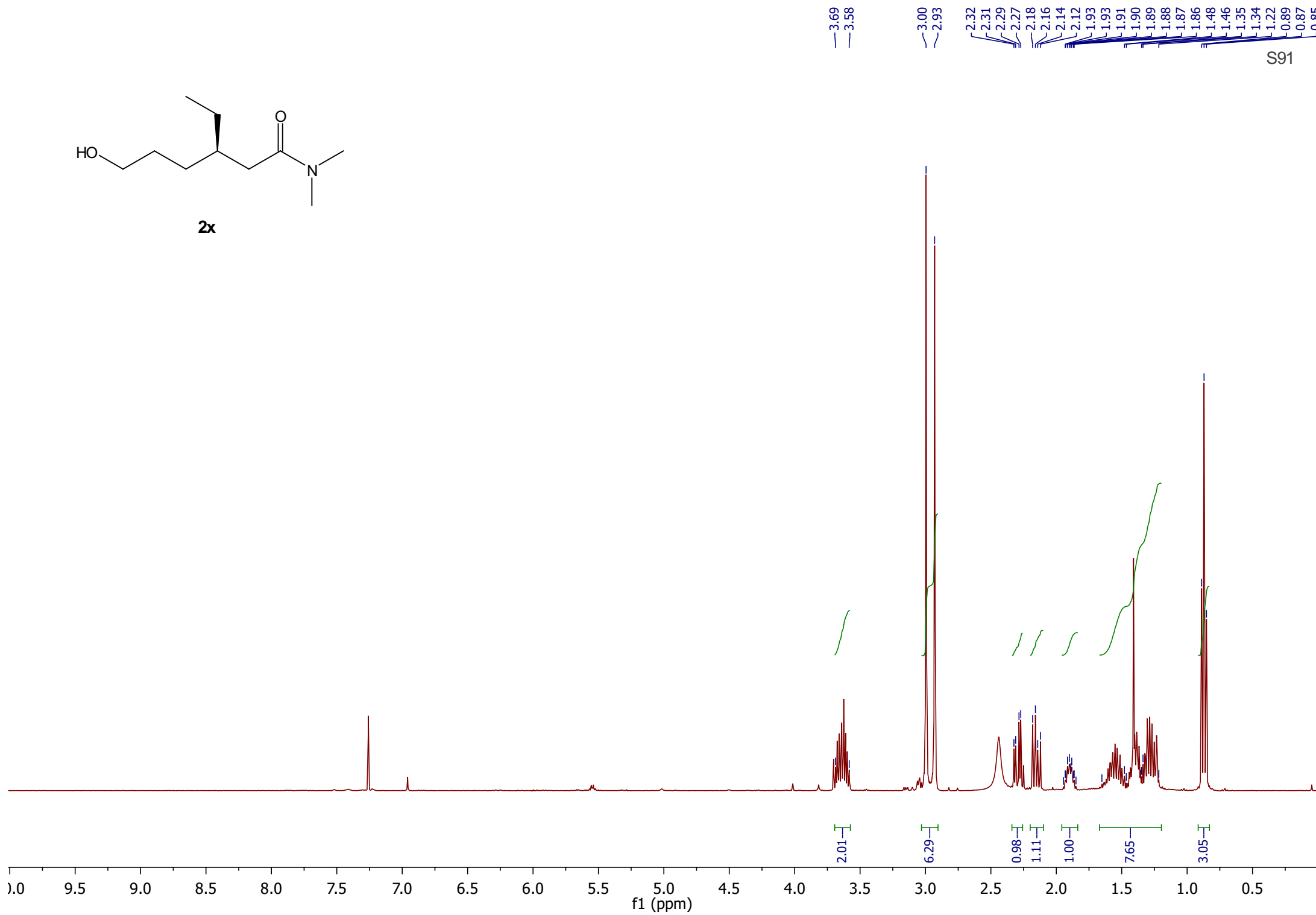
—11.0

S90

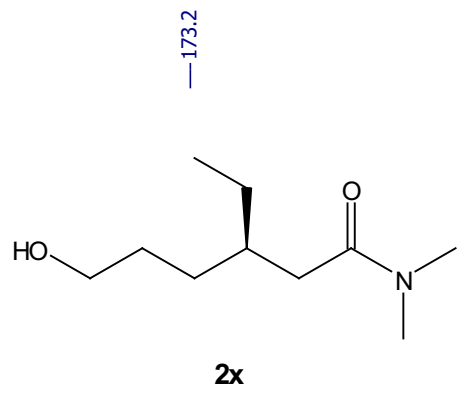




2x



S91



—173.2

—62.5

37.7

37.5

35.6

35.1

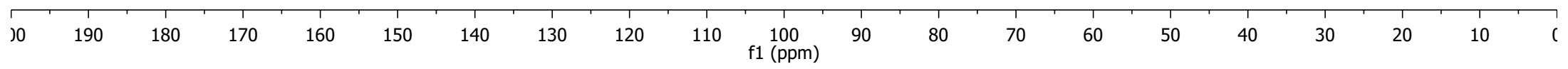
29.7

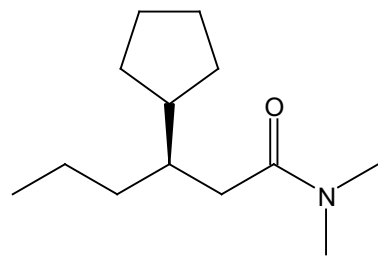
29.4

26.6

—11.2

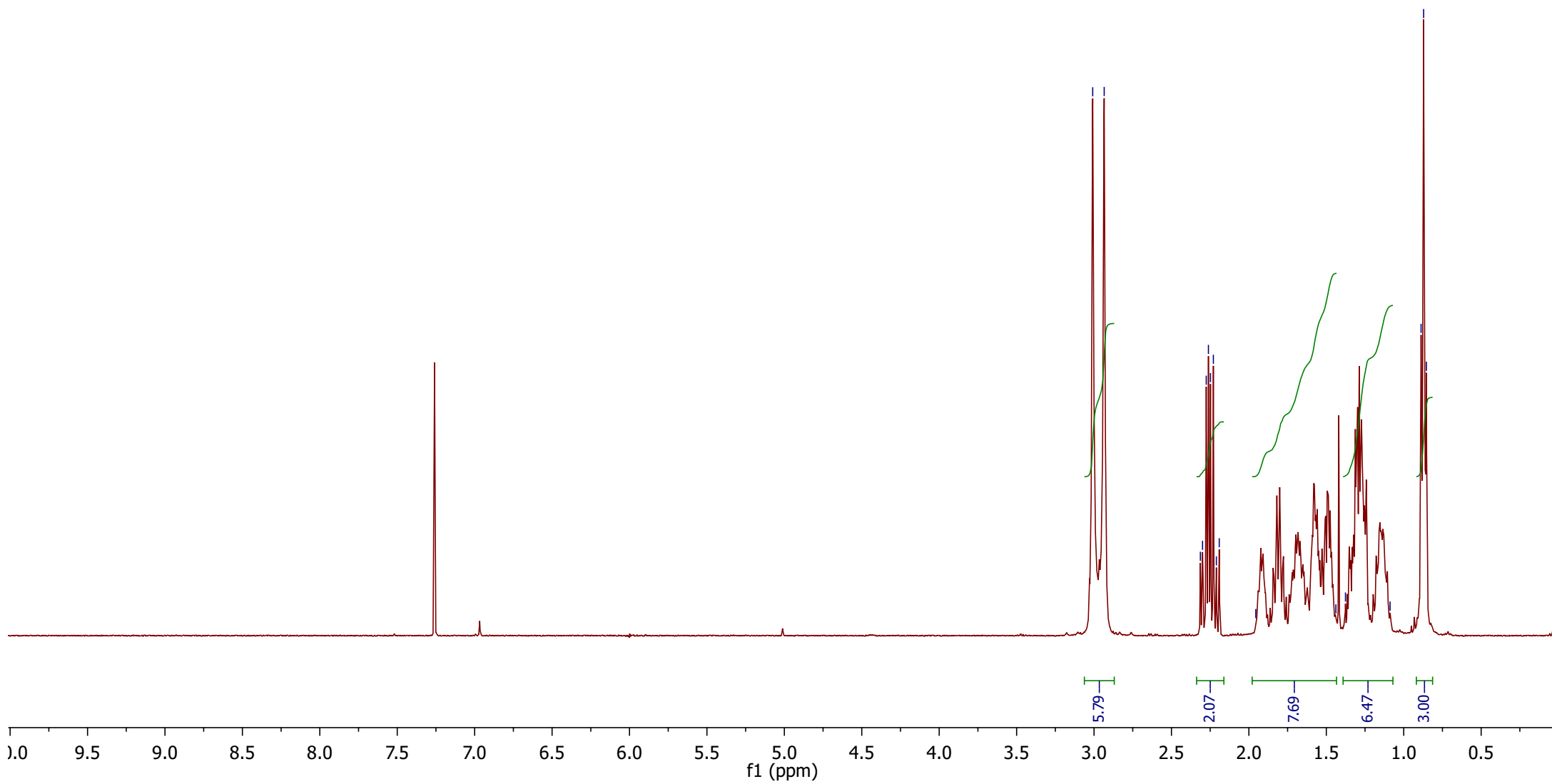
S92

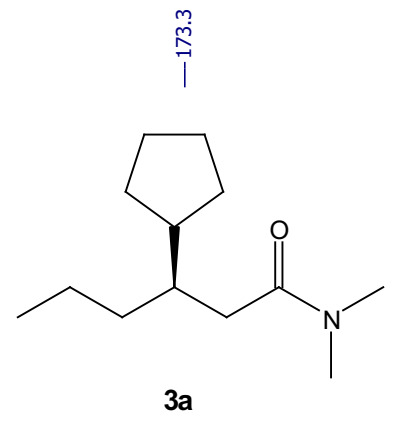




3a

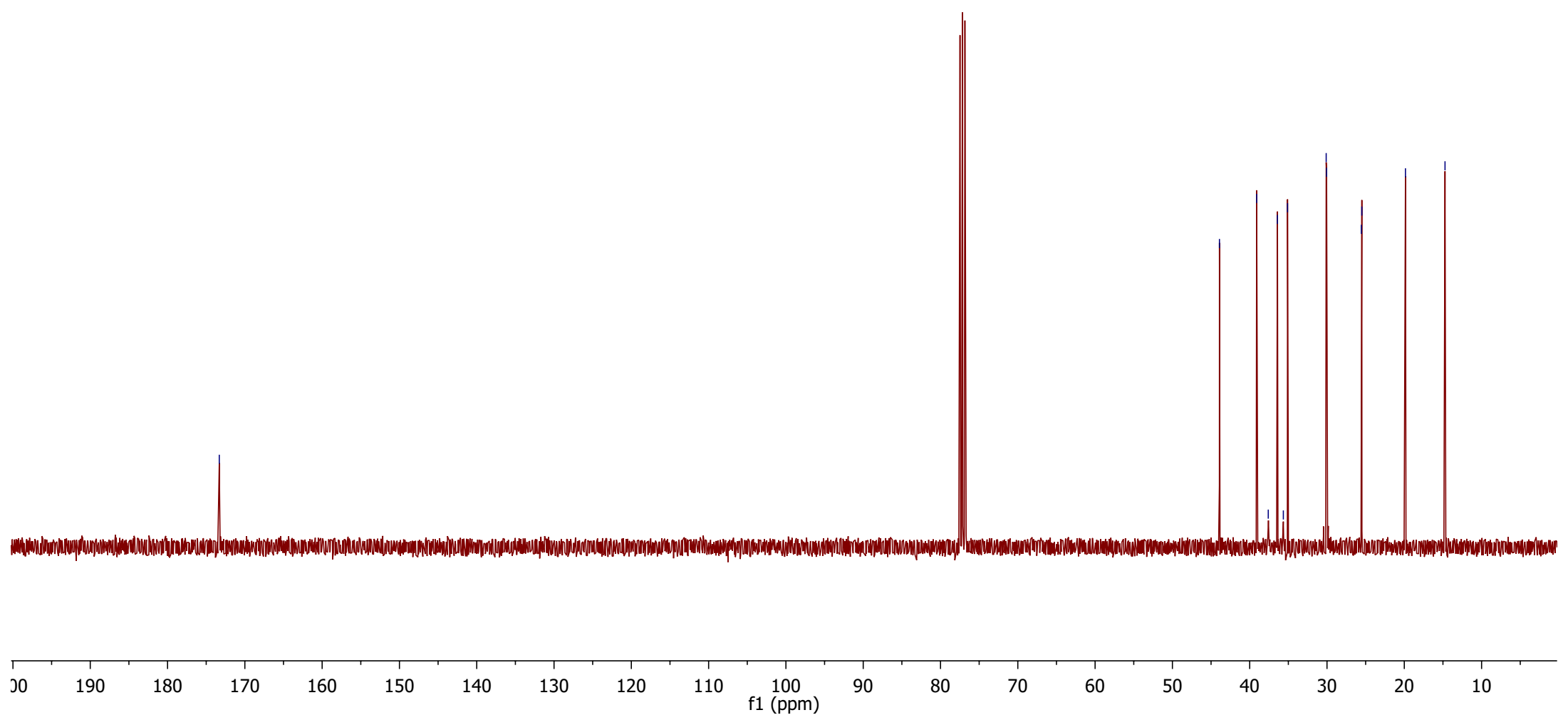
3.01  
2.93  
2.31  
2.30  
2.28  
2.26  
2.25  
2.23  
2.21  
2.19  
1.96  
1.44  
1.38  
1.09  
0.89  
0.87  
0.85

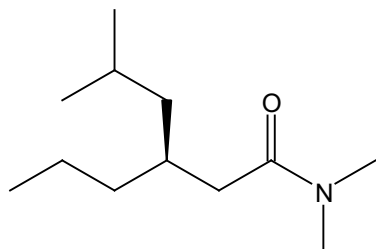




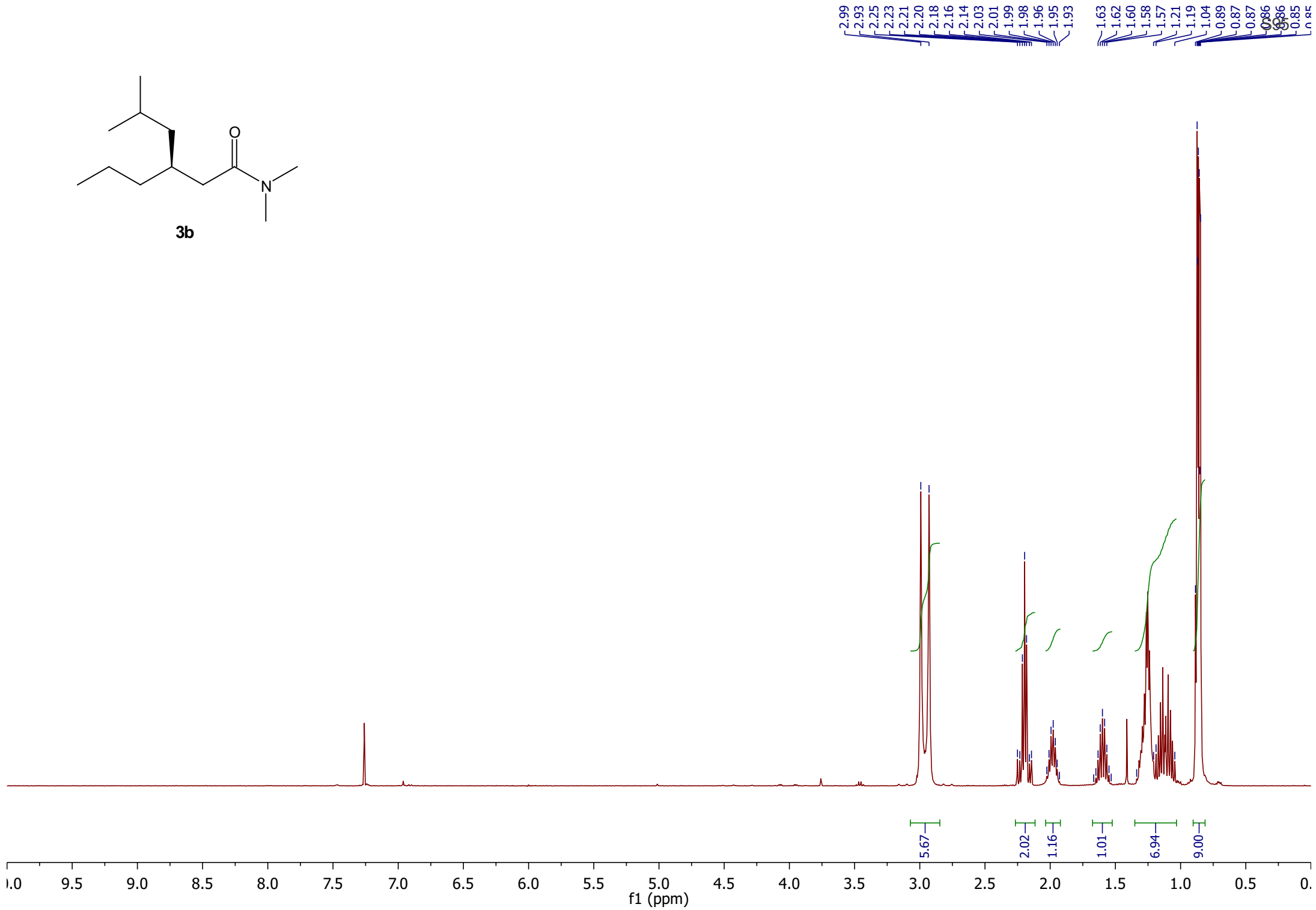
— 173.3

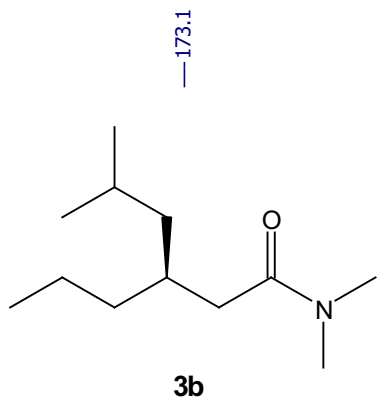
43.9  
39.1  
37.6  
36.4  
35.6  
35.1  
30.1  
30.1  
25.6  
25.5  
— 19.8  
— 14.7





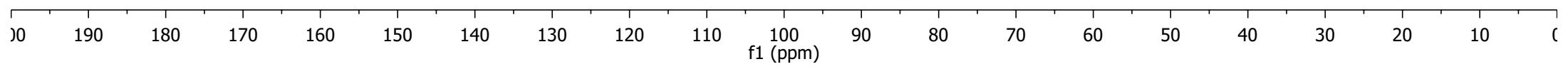
3b





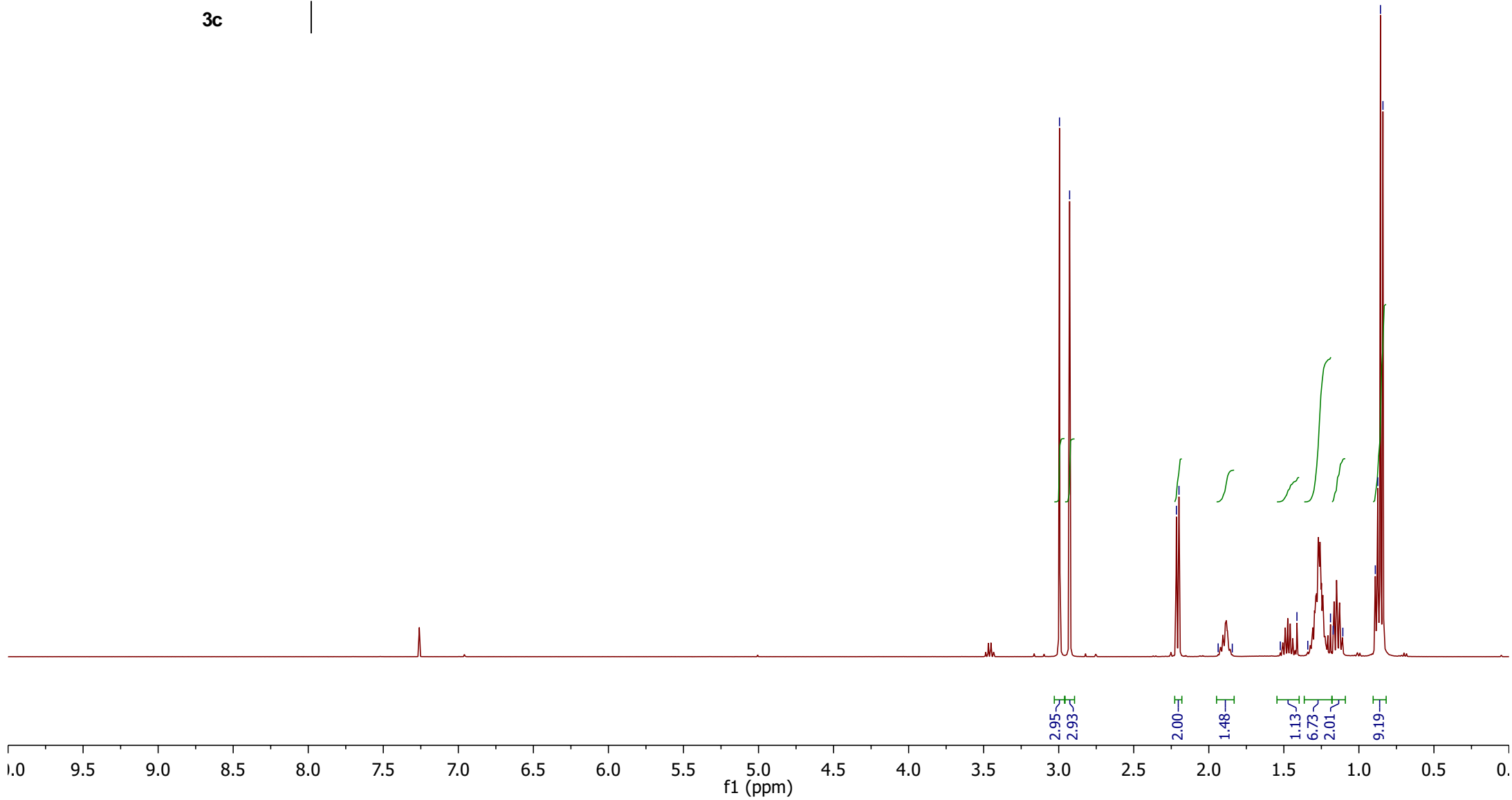
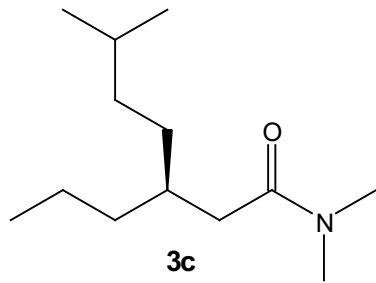
— 173.1

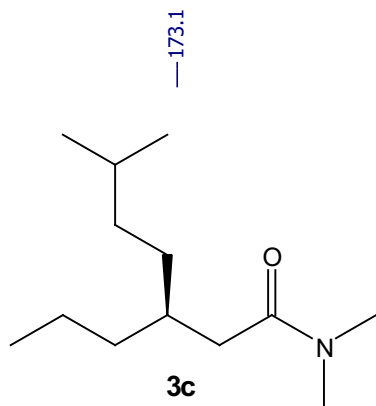
— 44.1  
— 38.6  
— 37.6  
— 36.8  
— 35.6  
— 32.5  
— 25.5  
— 23.1  
— 22.9  
— 19.7  
— 14.6



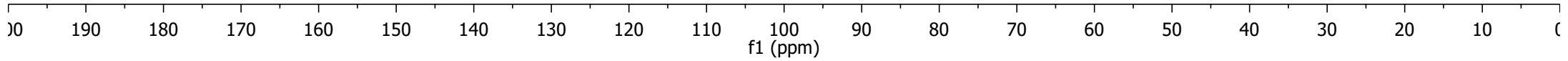


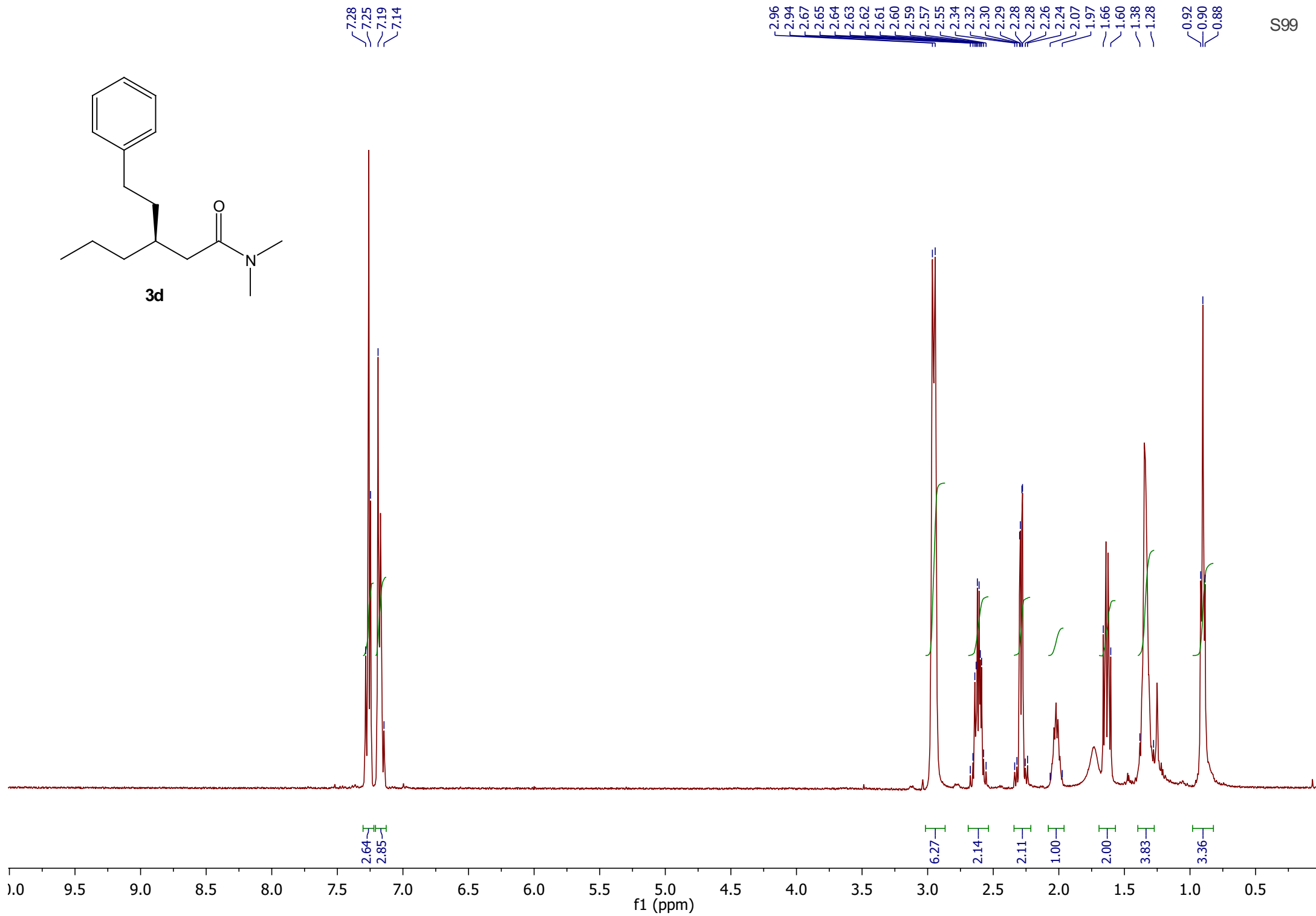
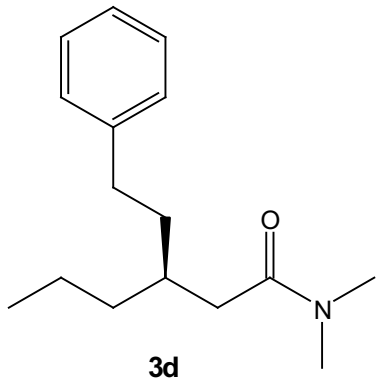
2.99  
2.93  
2.22  
2.20  
1.94  
1.84  
1.52  
1.41  
1.34  
1.19  
1.17  
1.11  
0.89  
0.87  
0.86  
0.84

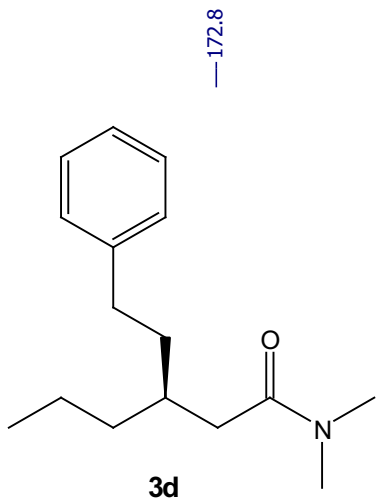




— 173.1

38.2  
37.6  
36.4  
35.9  
35.6  
34.9  
31.8  
28.4  
22.8  
22.7  
19.9  
— 14.5





— 172.8

— 142.9

— 128.5

— 128.4

— 125.8

— 38.2

— 37.6

— 36.4

— 36.0

— 35.6

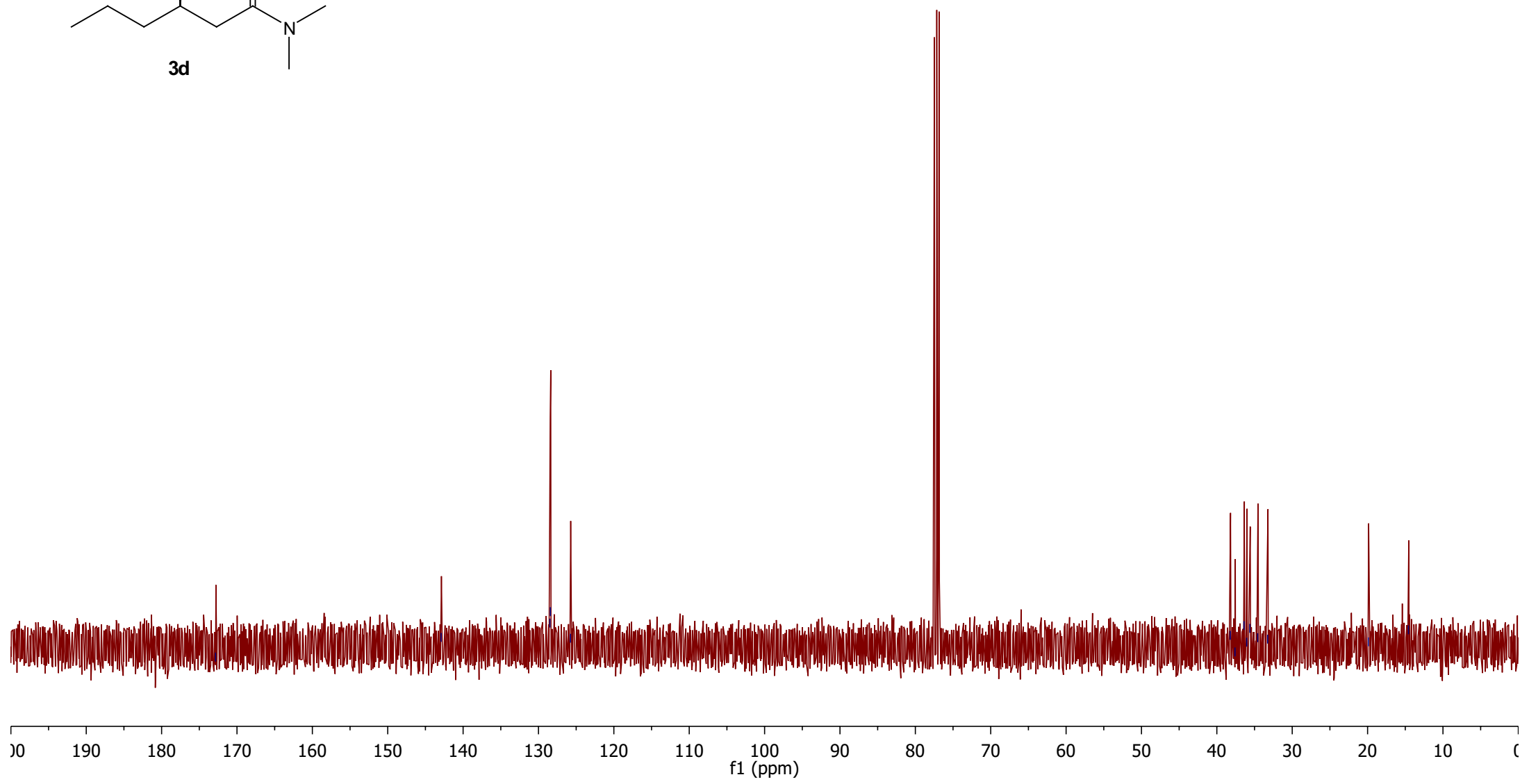
— 34.6

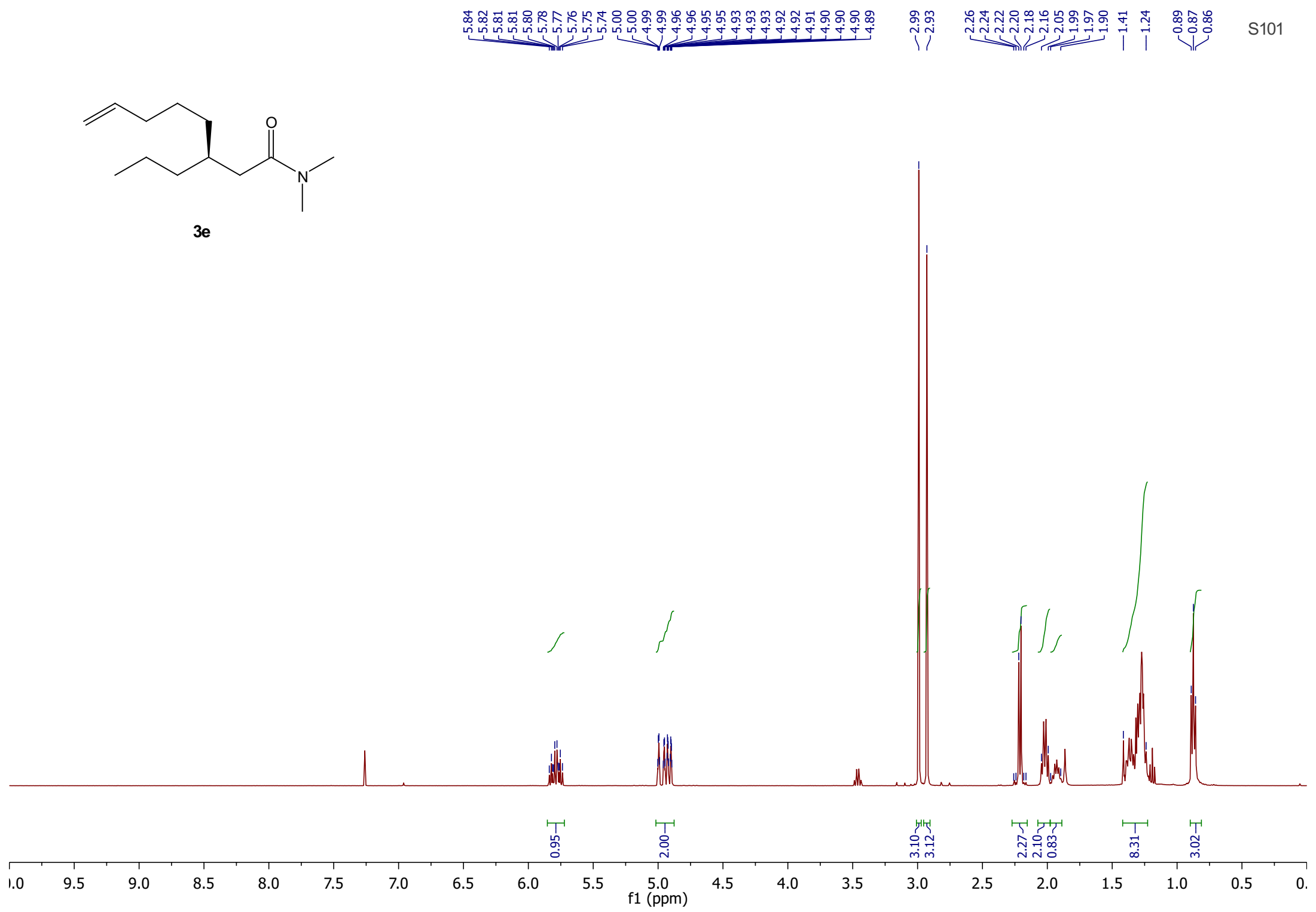
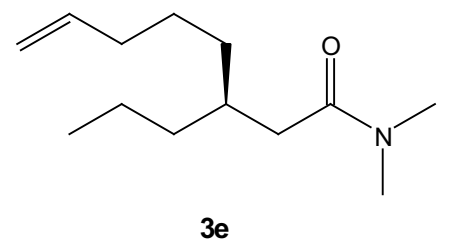
— 33.3

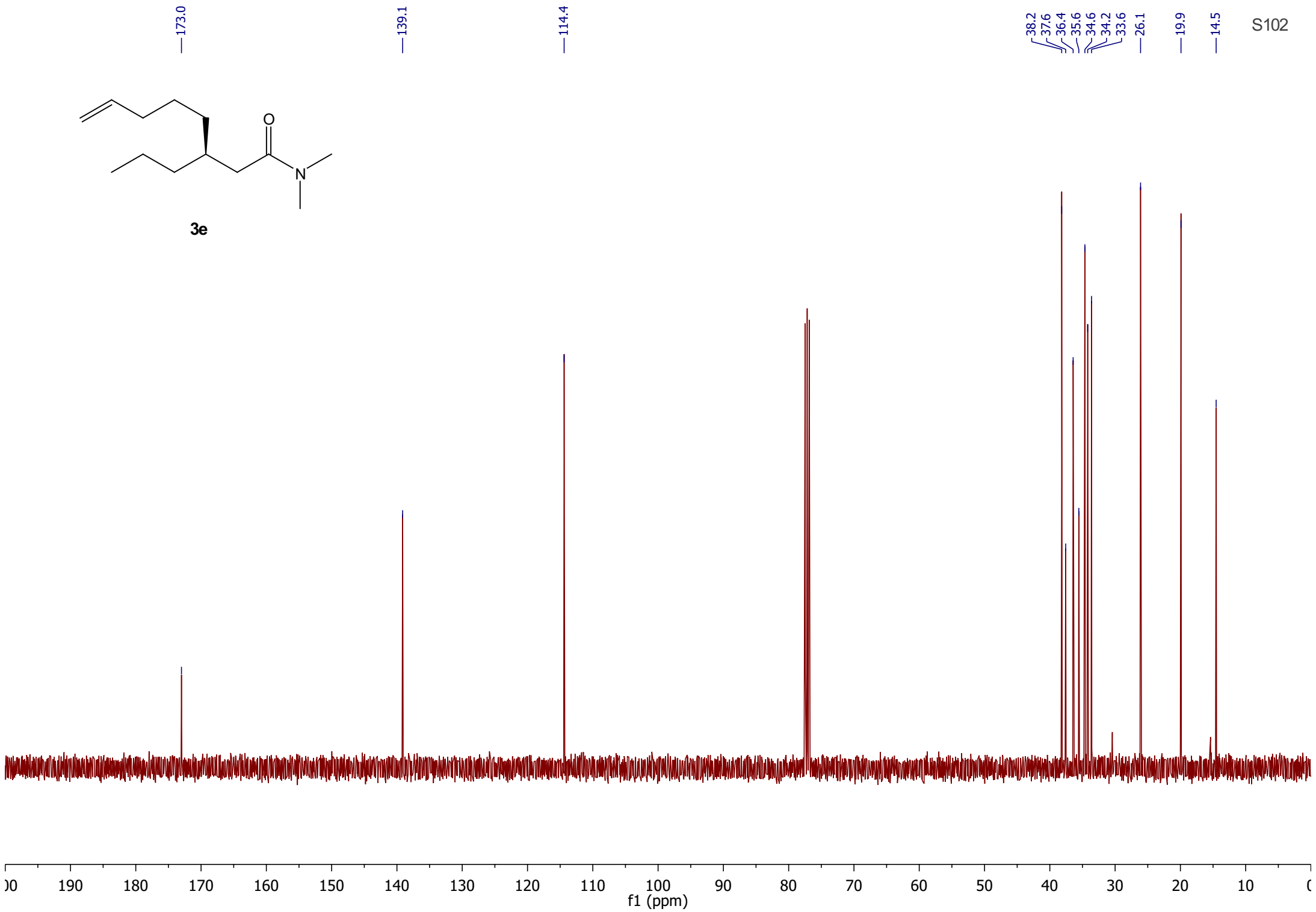
— 19.9

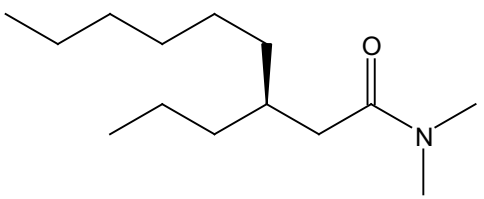
— 14.6

S100



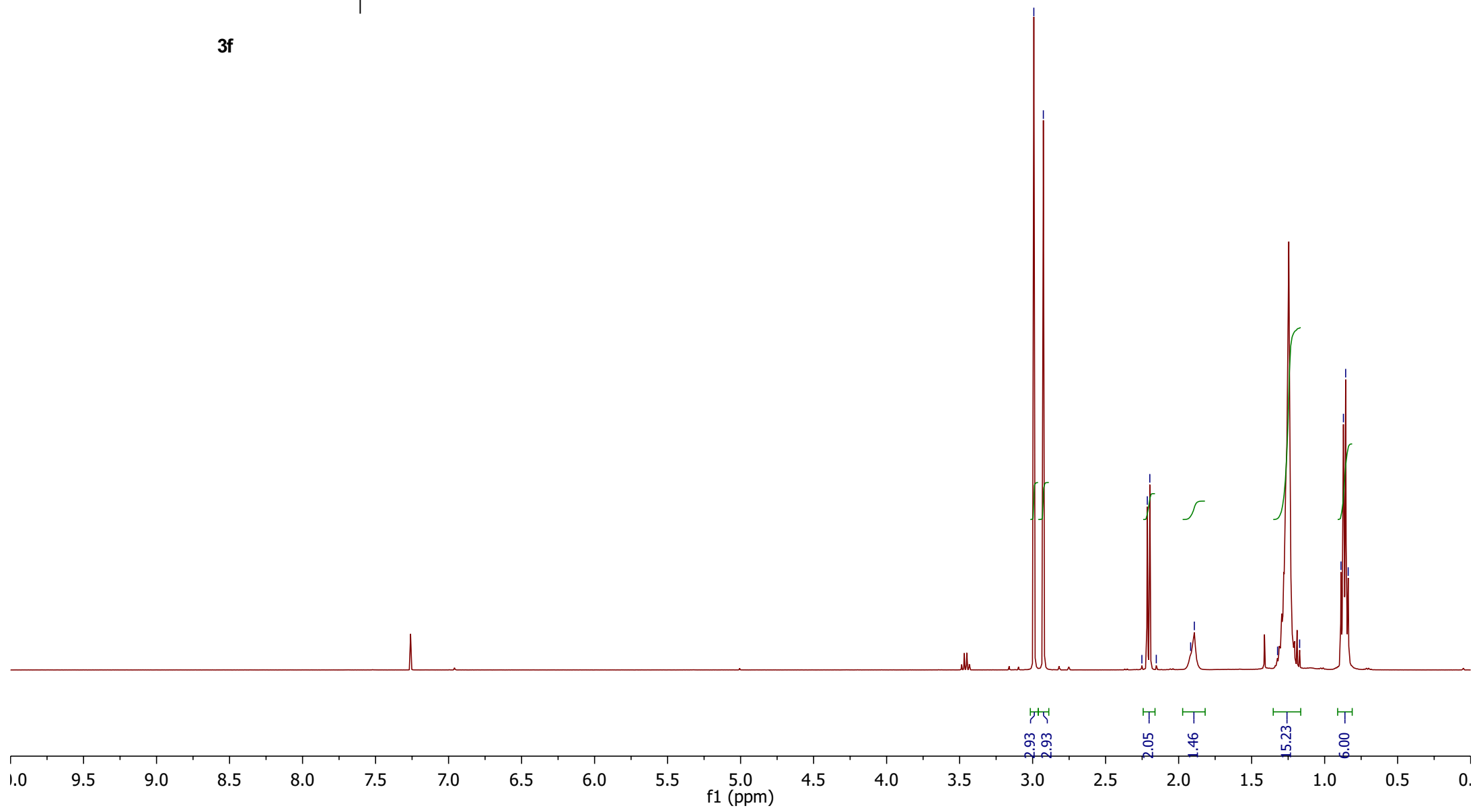


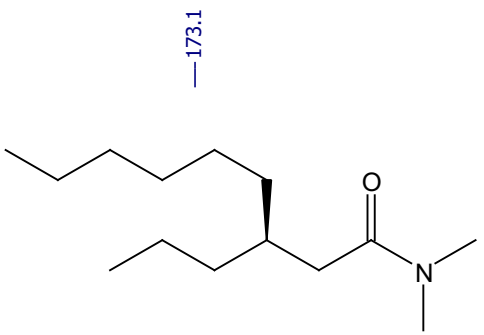




3f

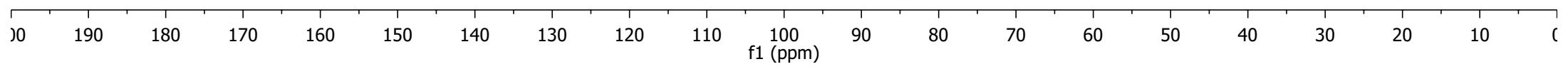
2.99  
2.93  
2.25  
2.21  
2.20  
2.15  
1.92  
1.89  
1.32  
1.17  
0.89  
0.87  
0.86  
0.84





3f

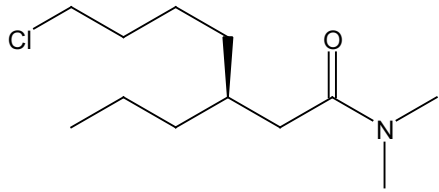
- 38.2
- 37.6
- 36.5
- 35.6
- 34.8
- 34.1
- 32.0
- 29.8
- 26.7
- 22.8
- 19.9
- 14.5
- 14.2



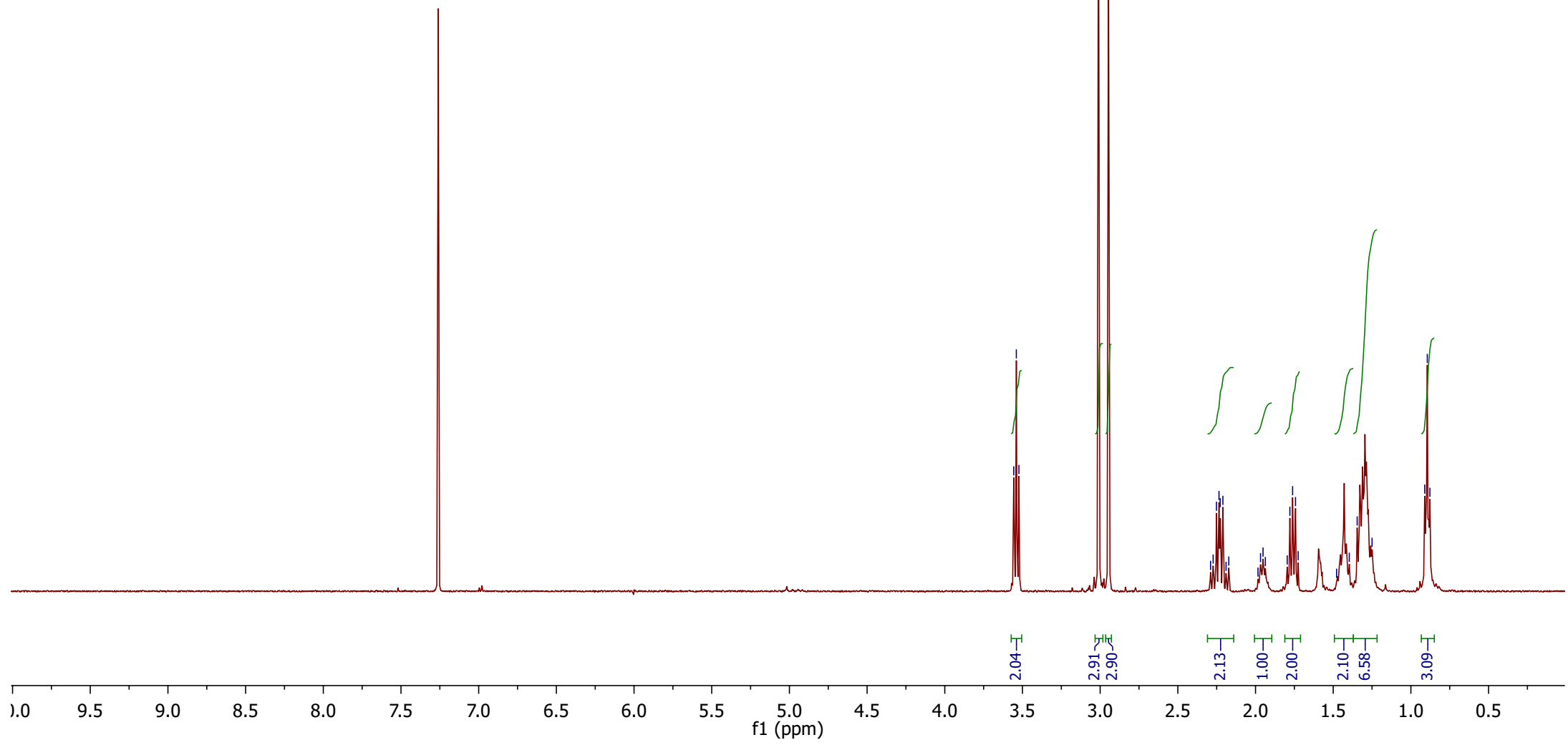


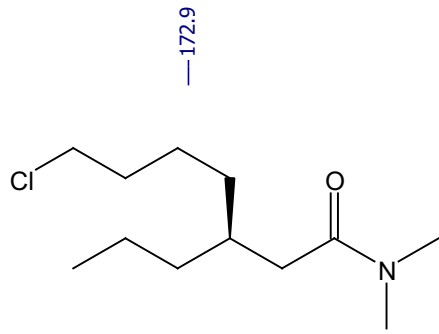
3.56  
3.54  
3.52  
3.01  
2.95  
2.27  
2.25  
2.24  
2.23  
2.21  
2.19  
2.17  
1.98  
1.97  
1.95  
1.94  
1.80  
1.78  
1.76  
1.74  
1.73  
1.48  
1.40  
1.35  
1.25  
0.91  
0.89  
0.88

S105



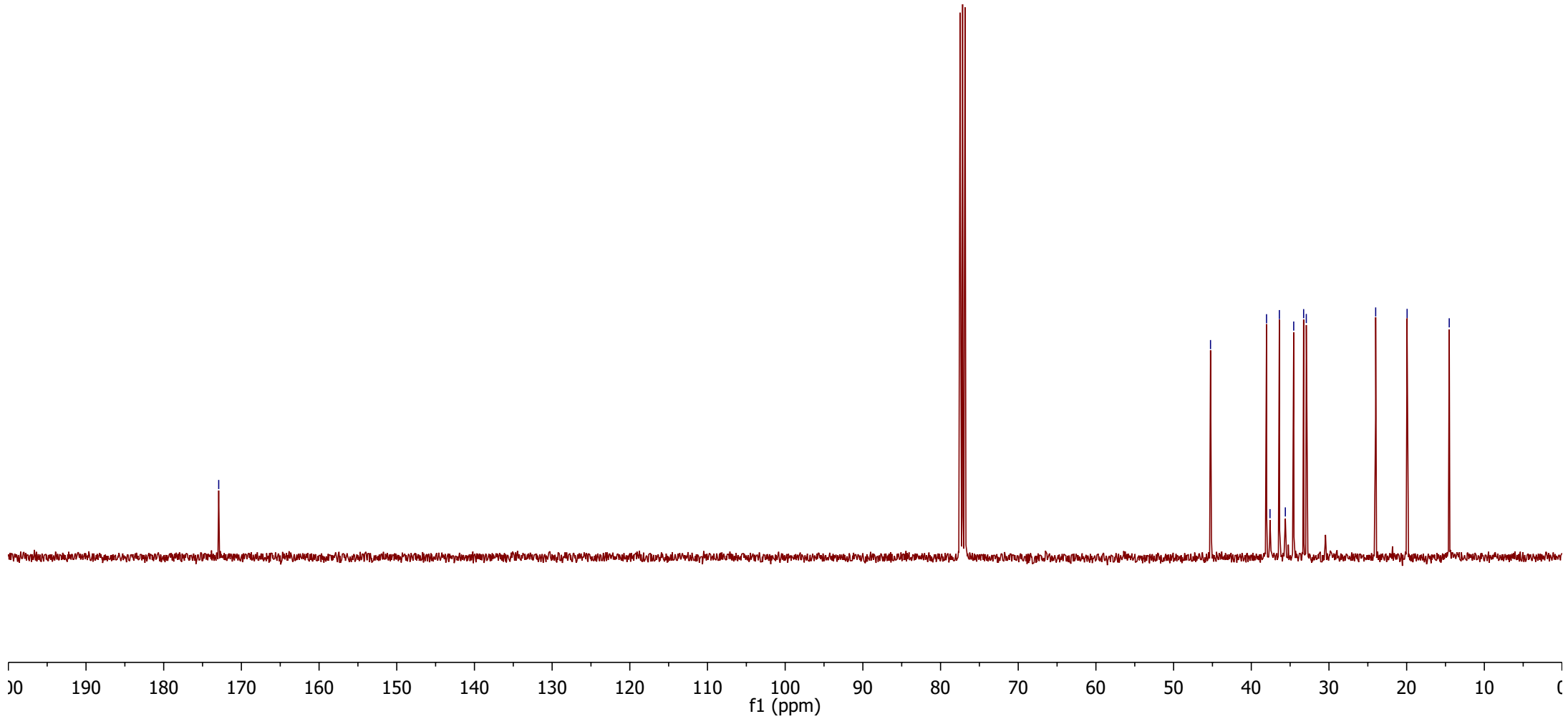
3g



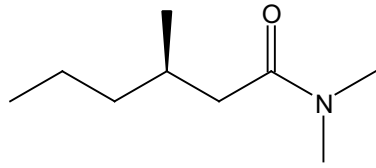


3g

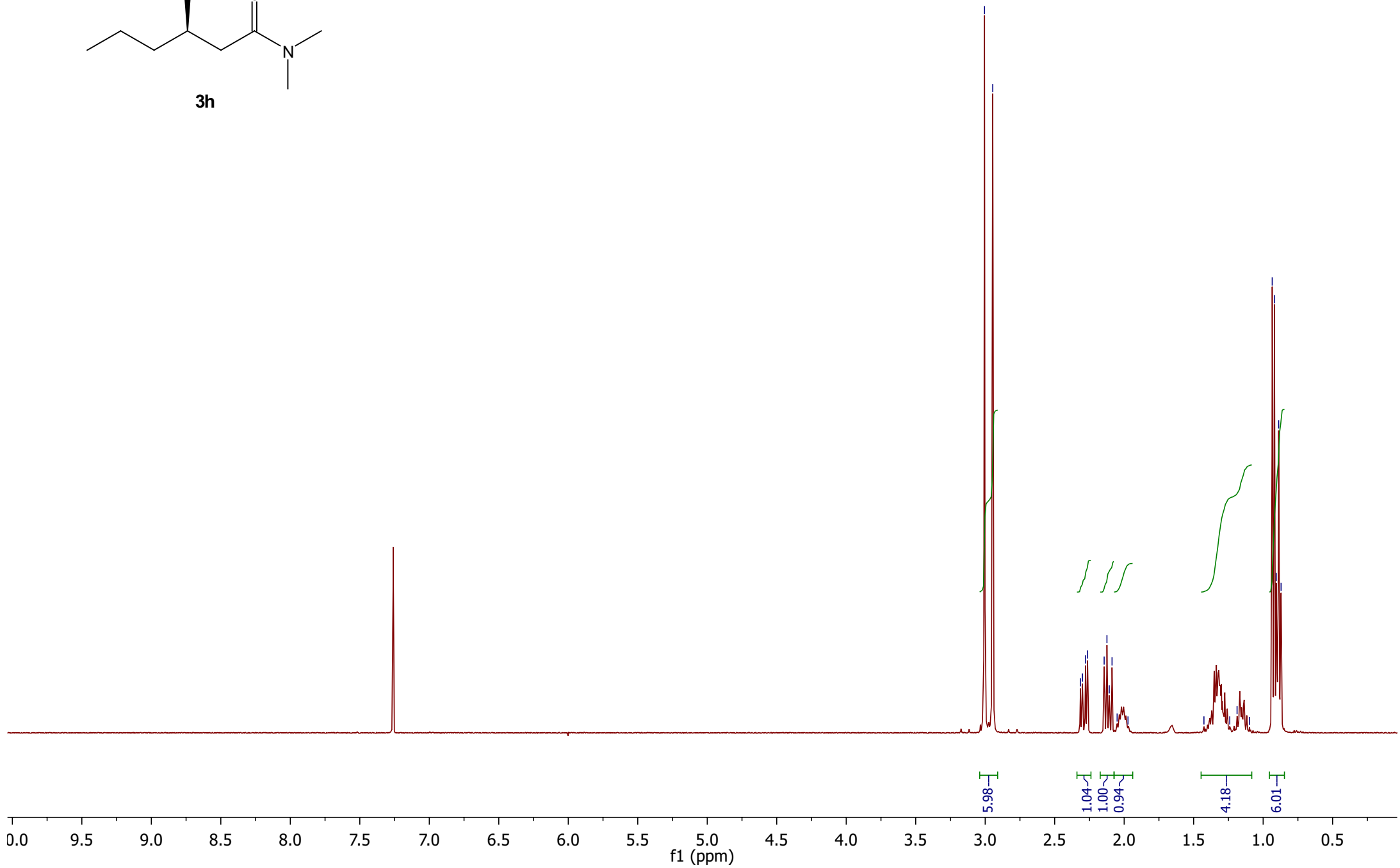
— 45.2  
— 38.0  
— 37.6  
— 36.4  
— 35.6  
— 34.5  
— 33.3  
— 32.9  
— 24.0  
— 19.9  
— 14.5



3.00  
2.95  
2.31  
2.30  
2.28  
2.26  
2.14  
2.12  
2.11  
2.09  
2.05  
1.97  
1.43  
1.24  
1.19  
1.10  
0.93  
0.92  
0.91  
0.89  
0.87

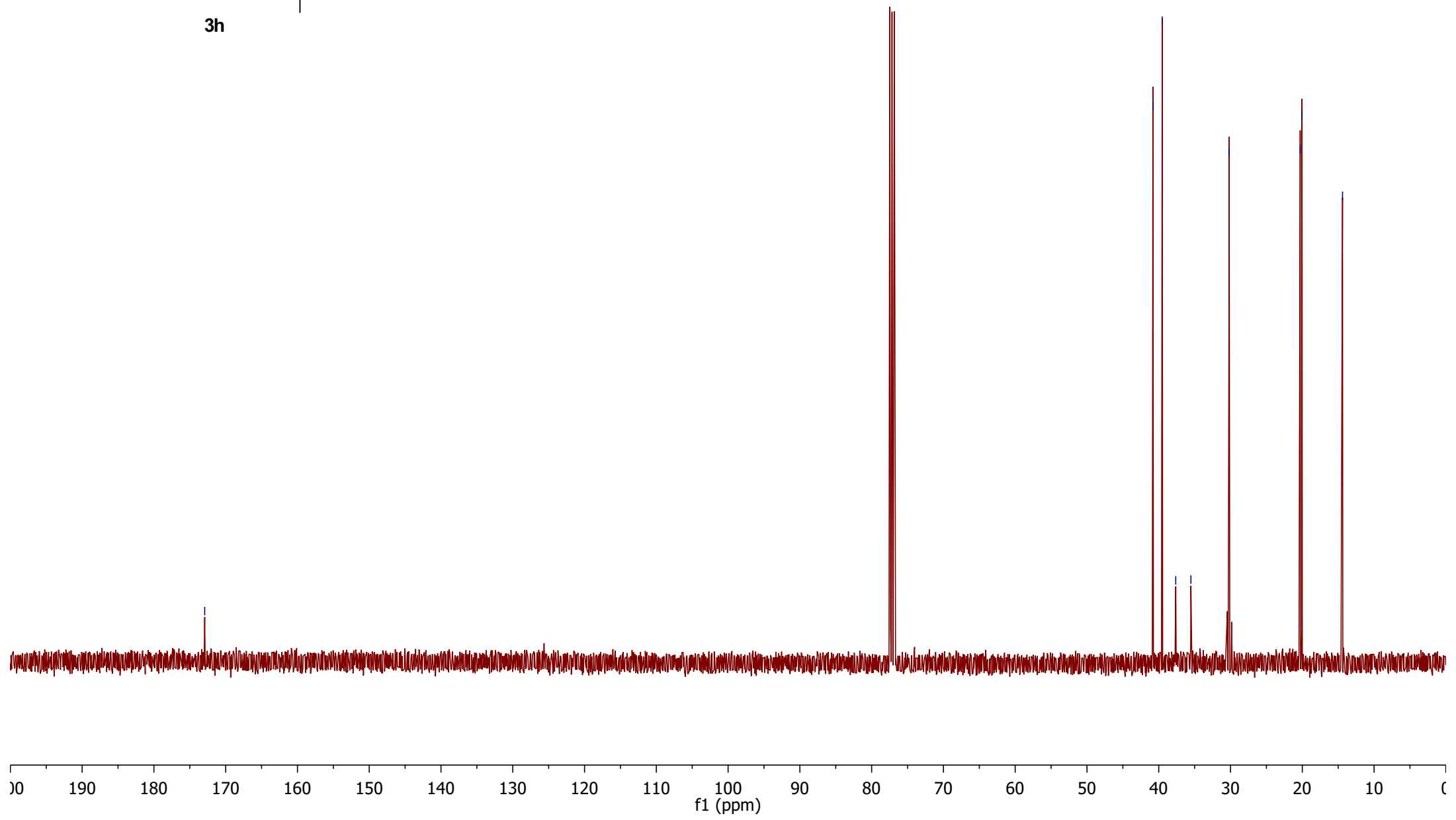
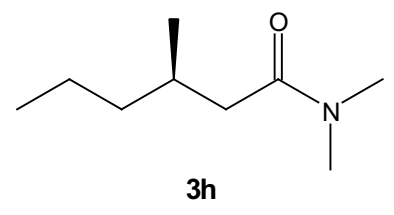


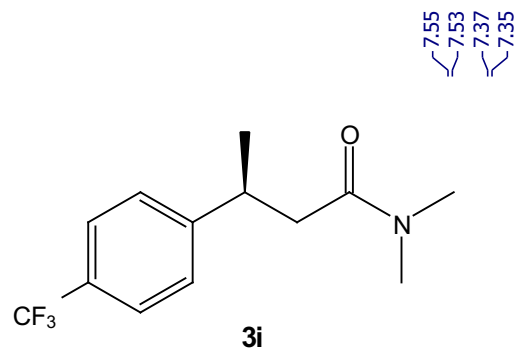
3h



40.8  
39.5  
37.6  
35.5  
30.2  
20.3  
20.0  
14.4

172.9

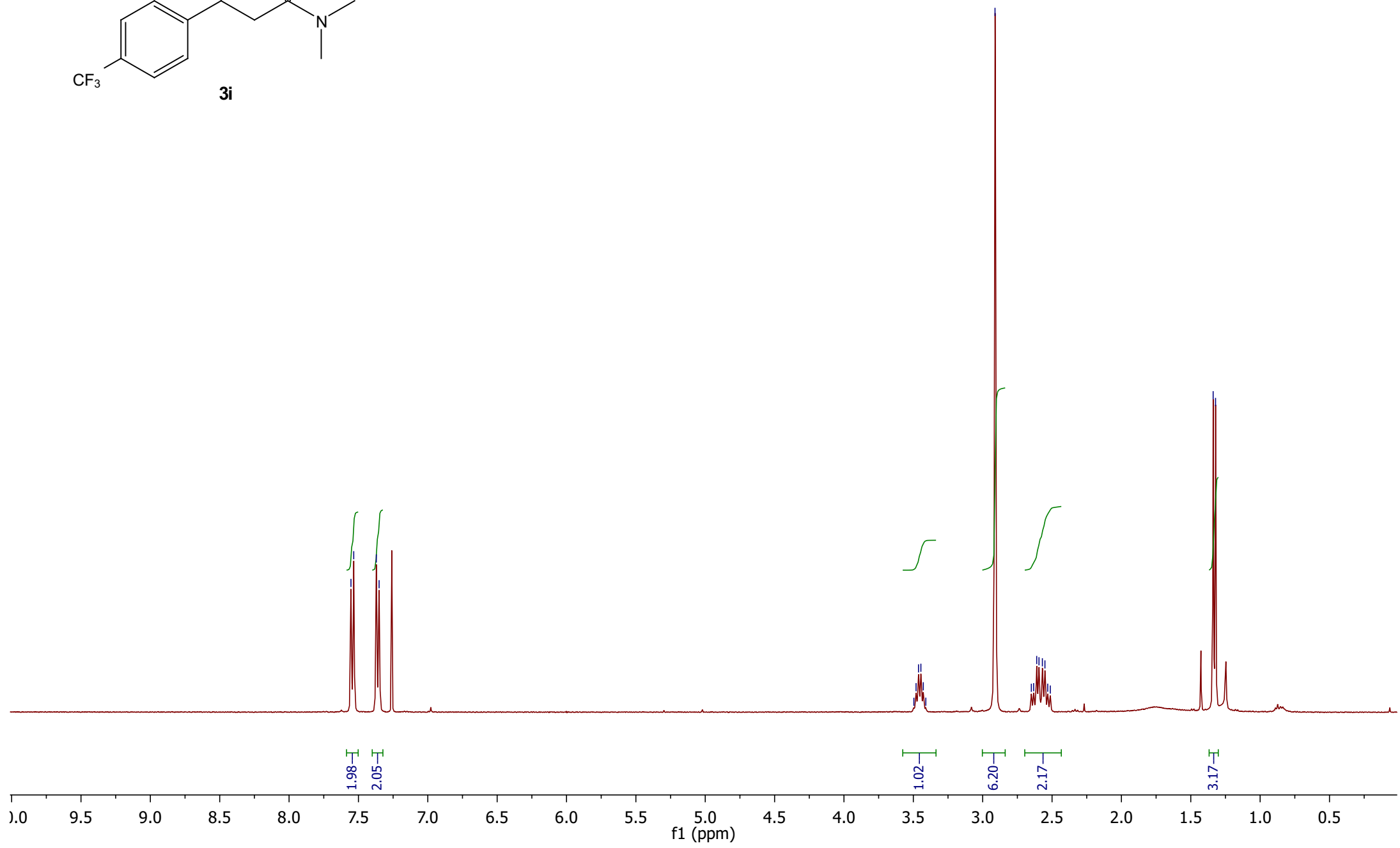


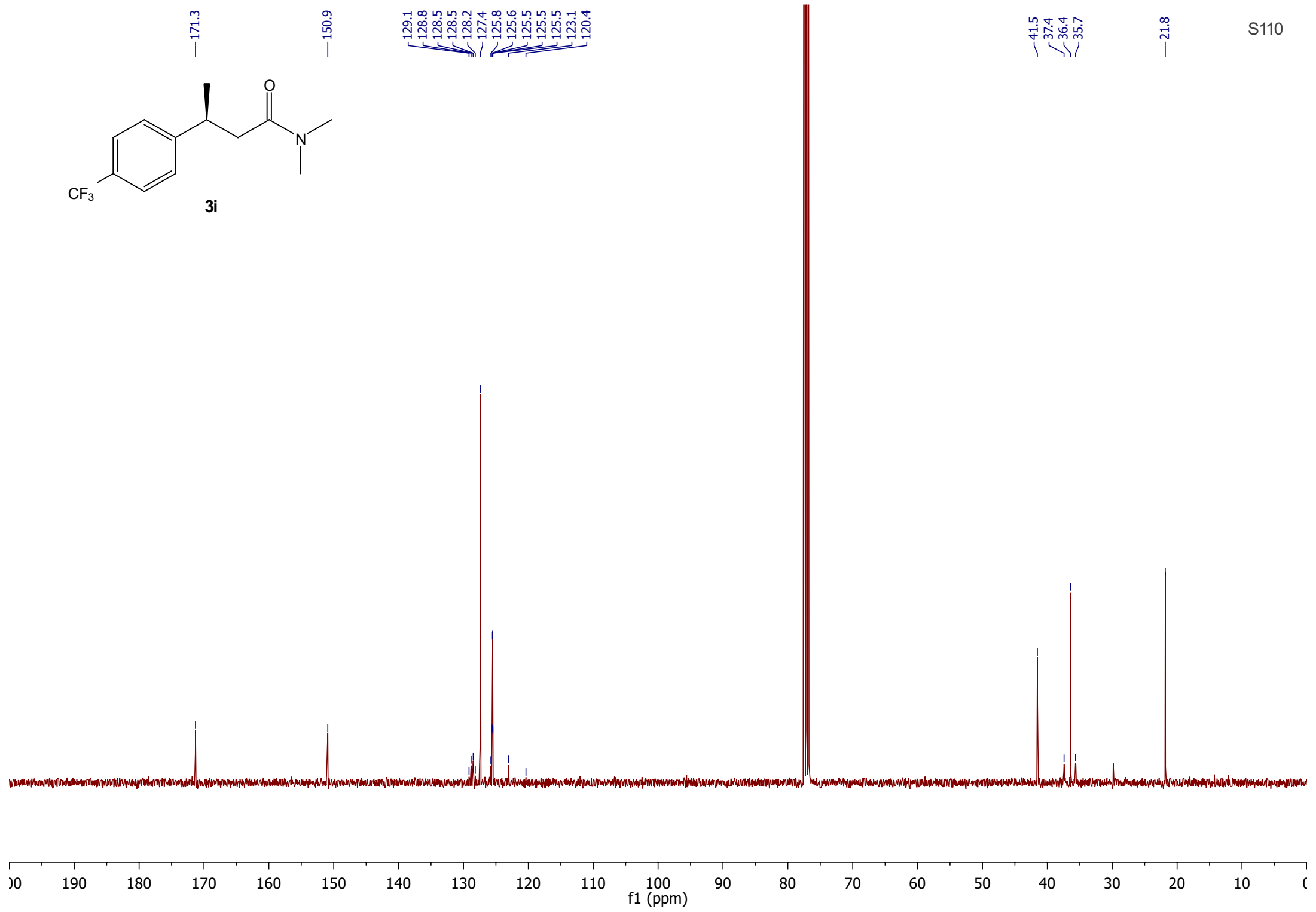
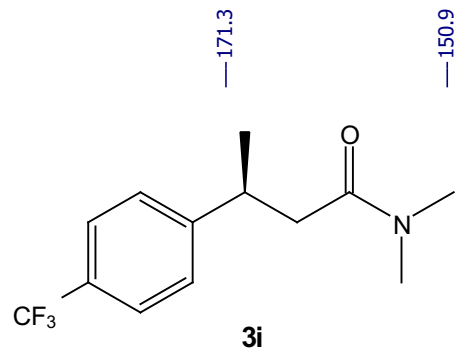


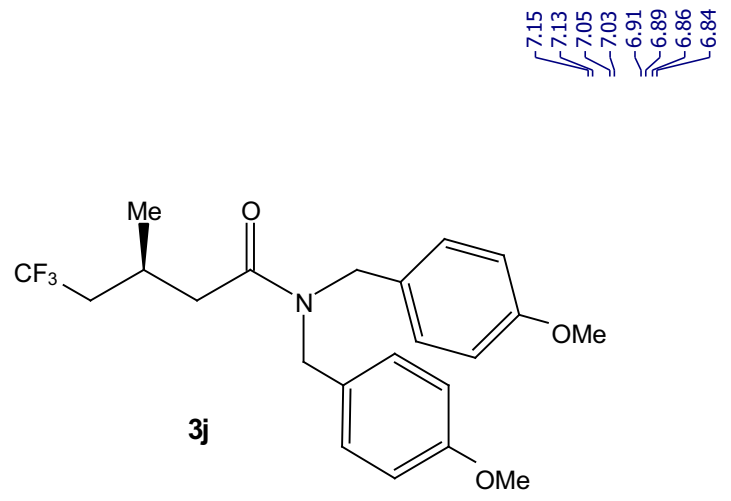
7.55  
7.53  
7.37  
7.35

3.50  
3.48  
3.46  
3.45  
3.43  
3.41  
2.91  
2.65  
2.63  
2.61  
2.59  
2.57  
2.55  
2.53  
2.51

1.34  
1.32







7.15  
7.13  
7.05  
7.03  
6.91  
6.89  
6.86  
6.84

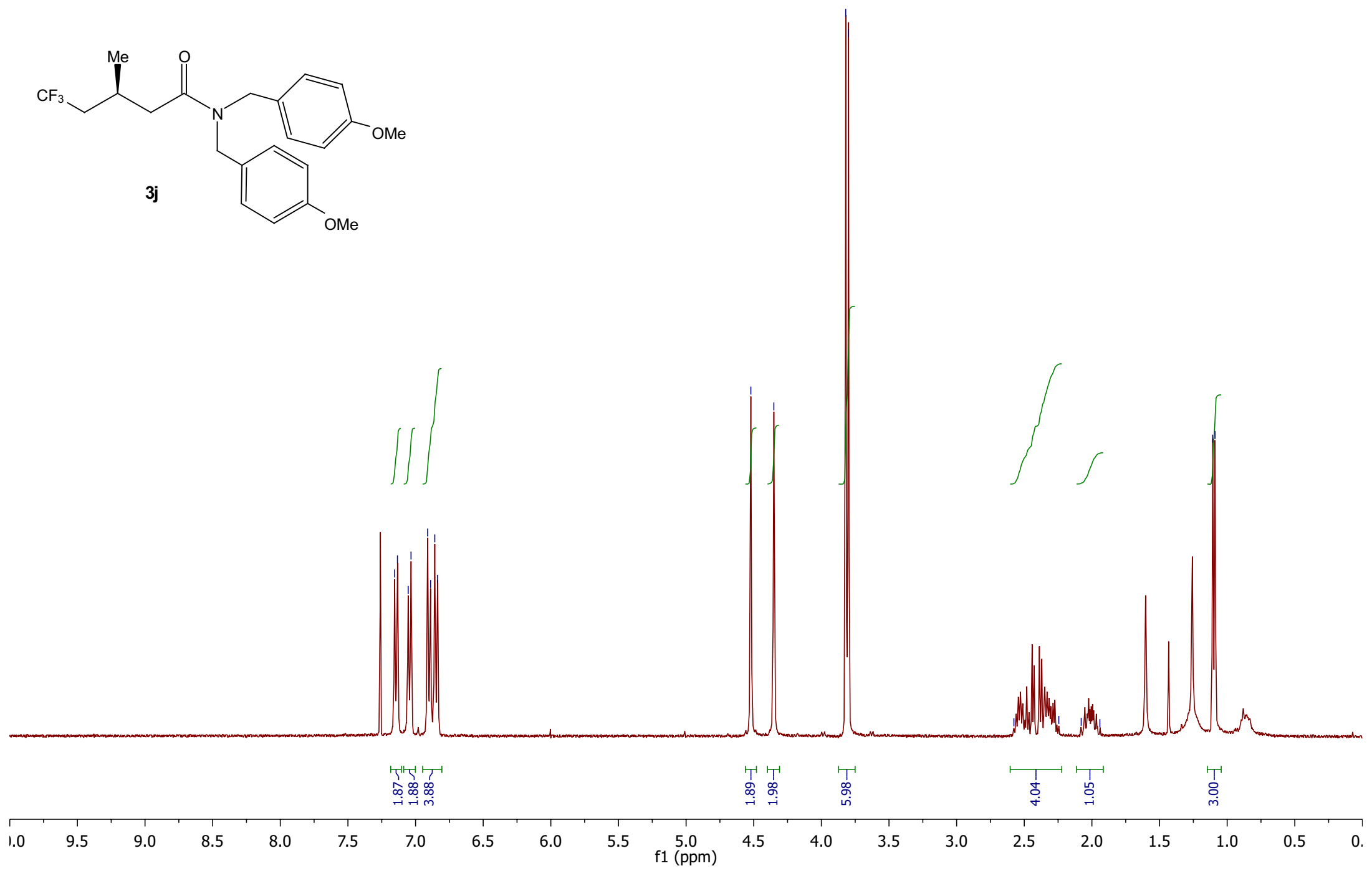
4.52  
4.35

3.82  
3.80

2.58

2.24  
2.08  
1.94

1.11  
1.09



1.87  
1.88  
3.88

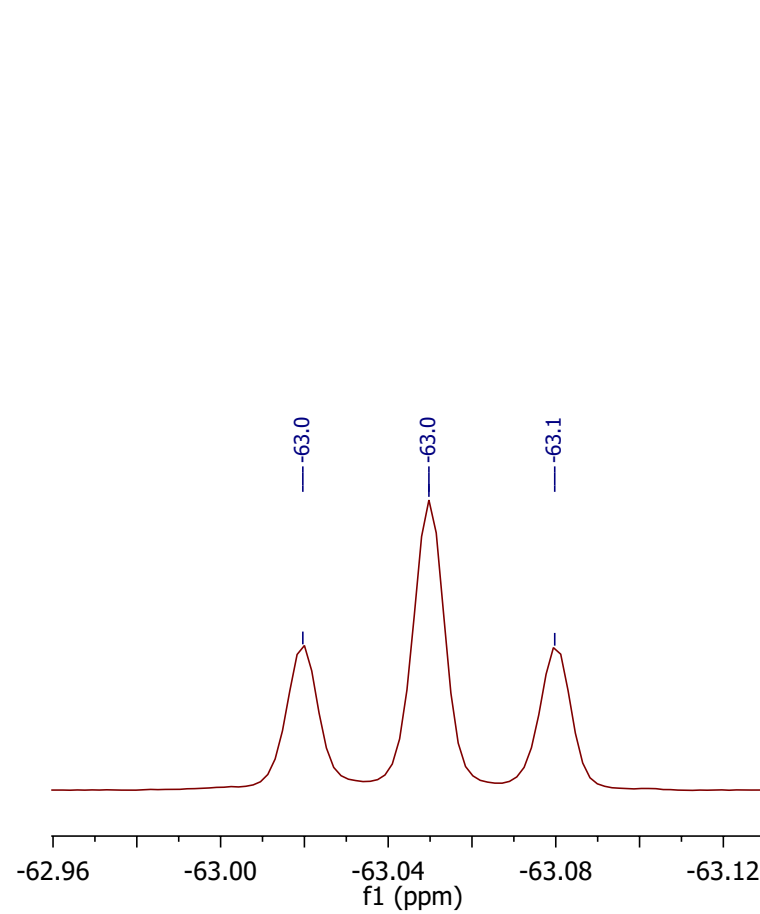
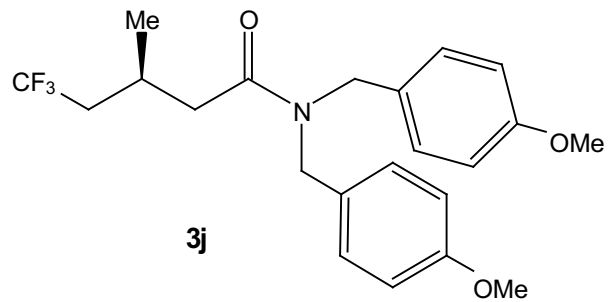
1.89  
1.98

5.98

4.04

1.05

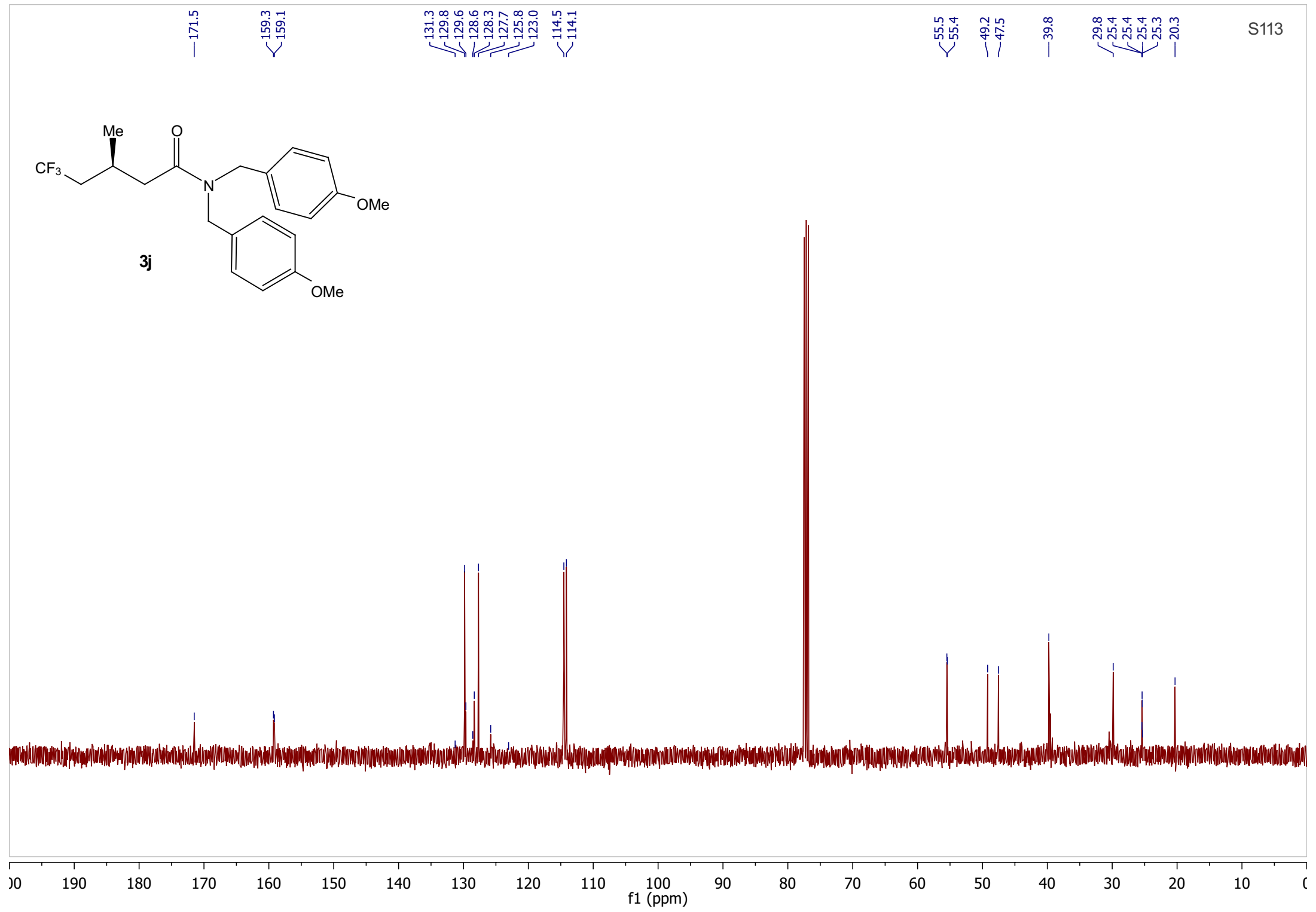
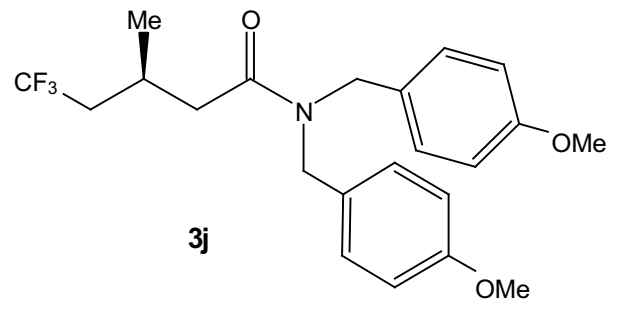
3.00



20 10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190

f1 (ppm)

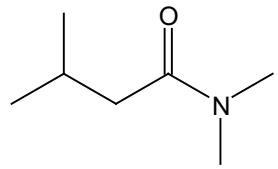




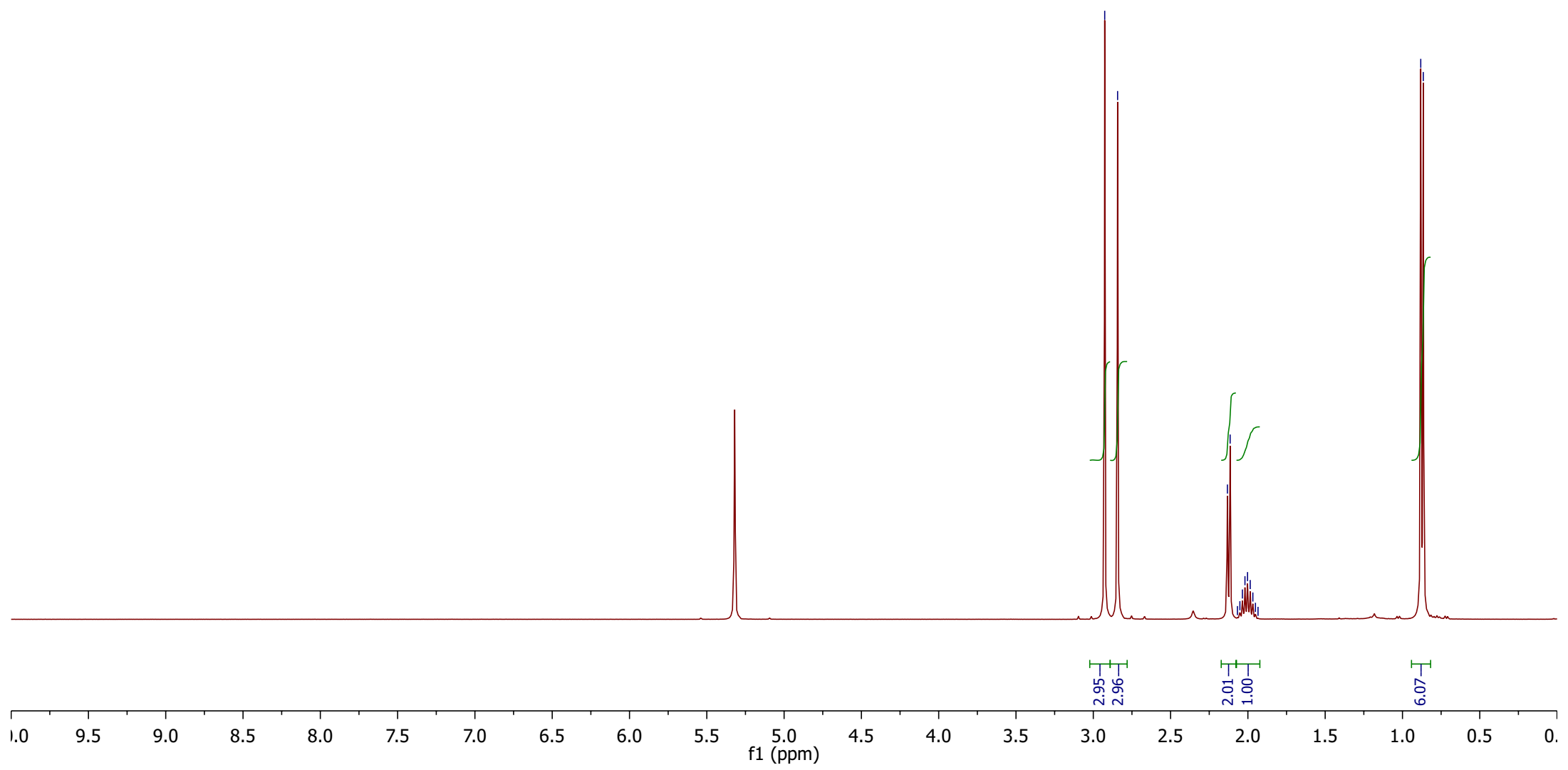
2.93  
2.84  
2.13  
2.11  
2.07  
2.05  
2.04  
2.02  
2.00  
1.98  
1.97  
1.95  
1.93

0.88  
0.87

S114

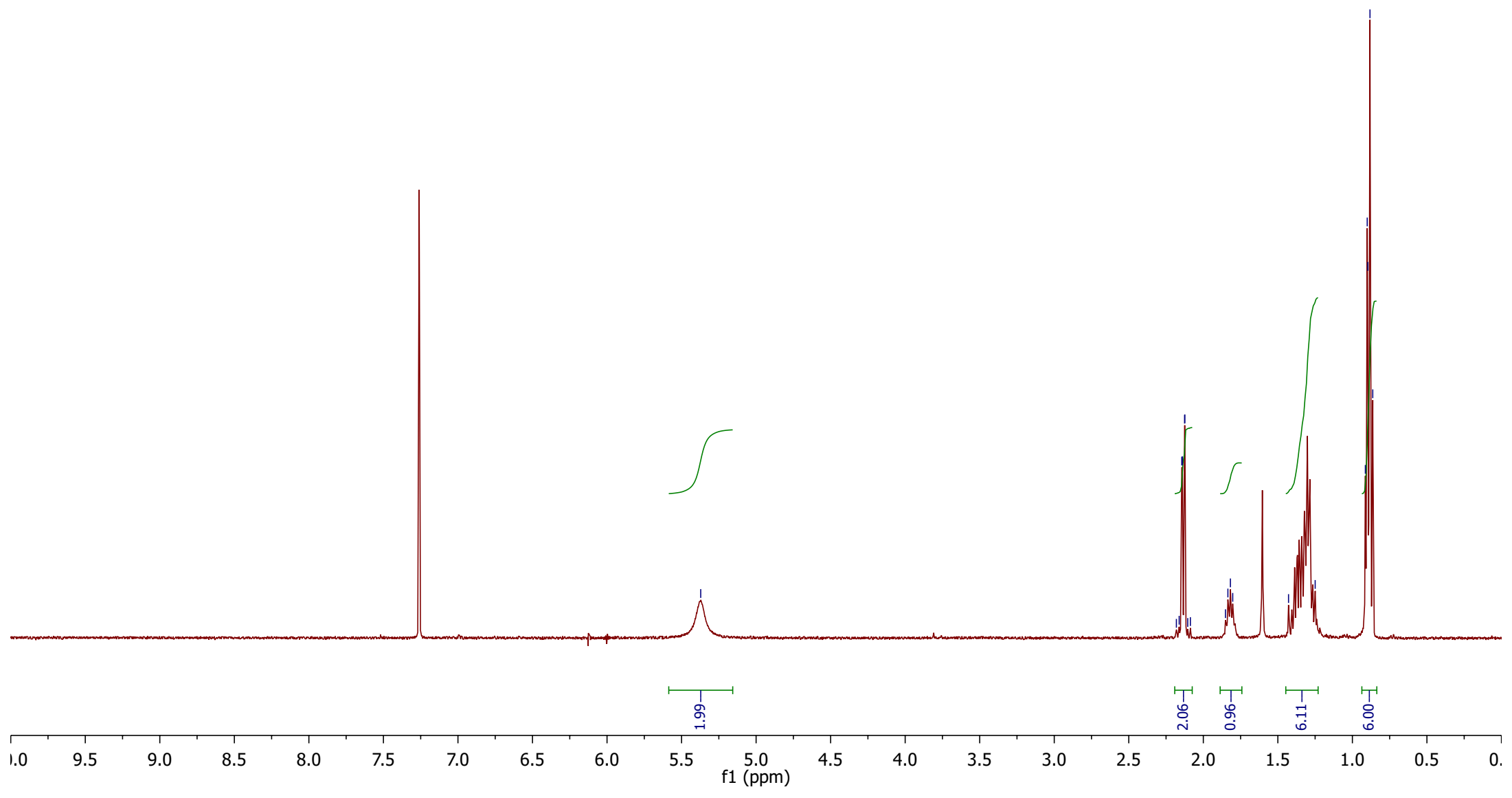
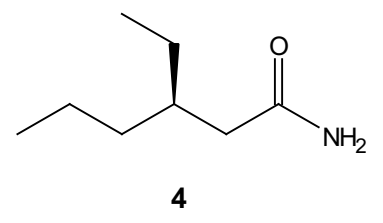


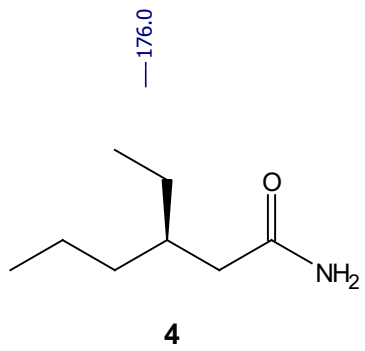
3k



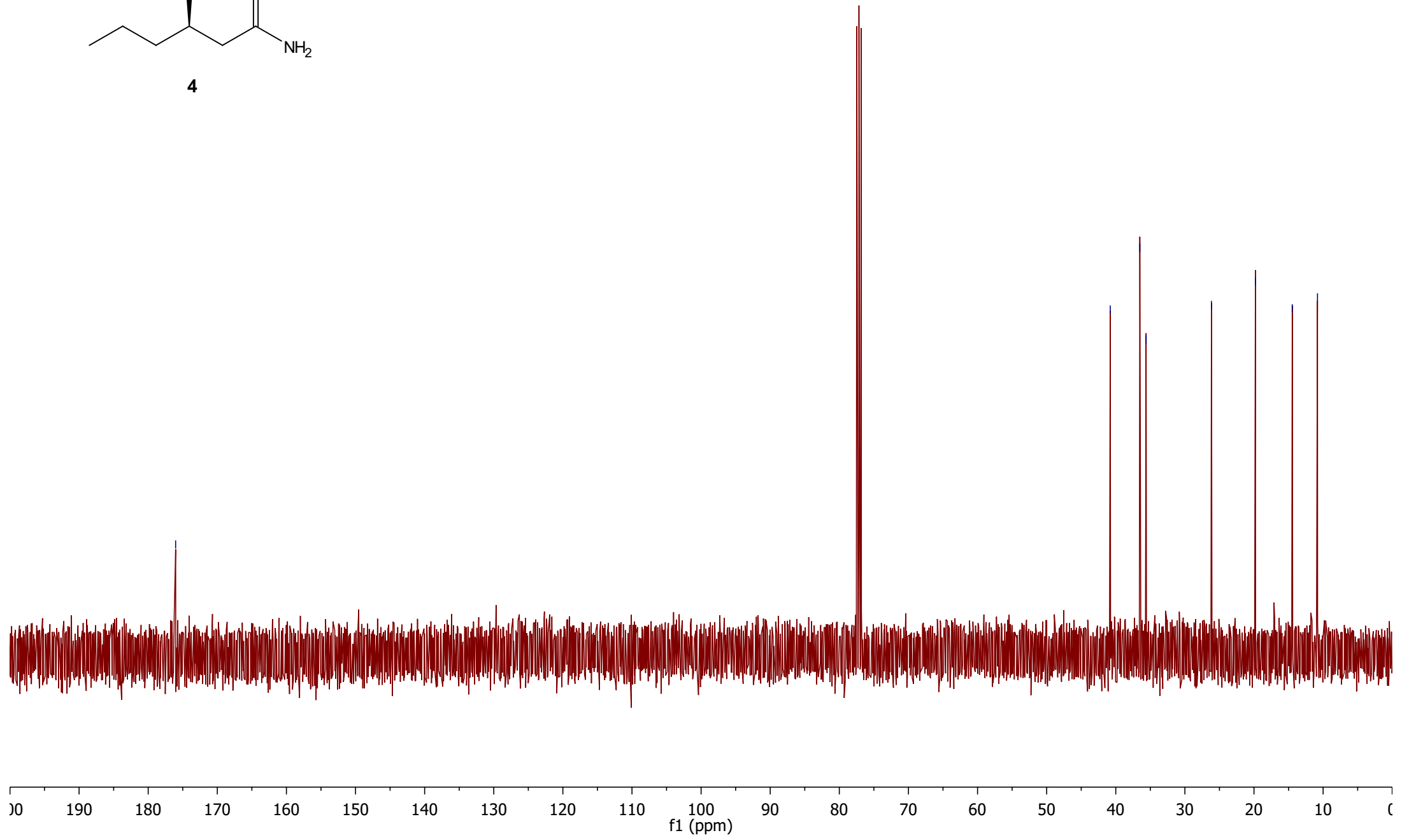
2.18  
2.16  
2.14  
2.14  
2.13  
2.12  
2.10  
2.09  
1.85  
1.84  
1.82  
1.80  
1.43  
1.25  
0.91  
0.90  
0.88  
0.86

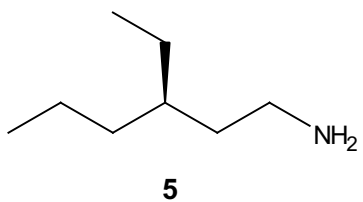
5.37



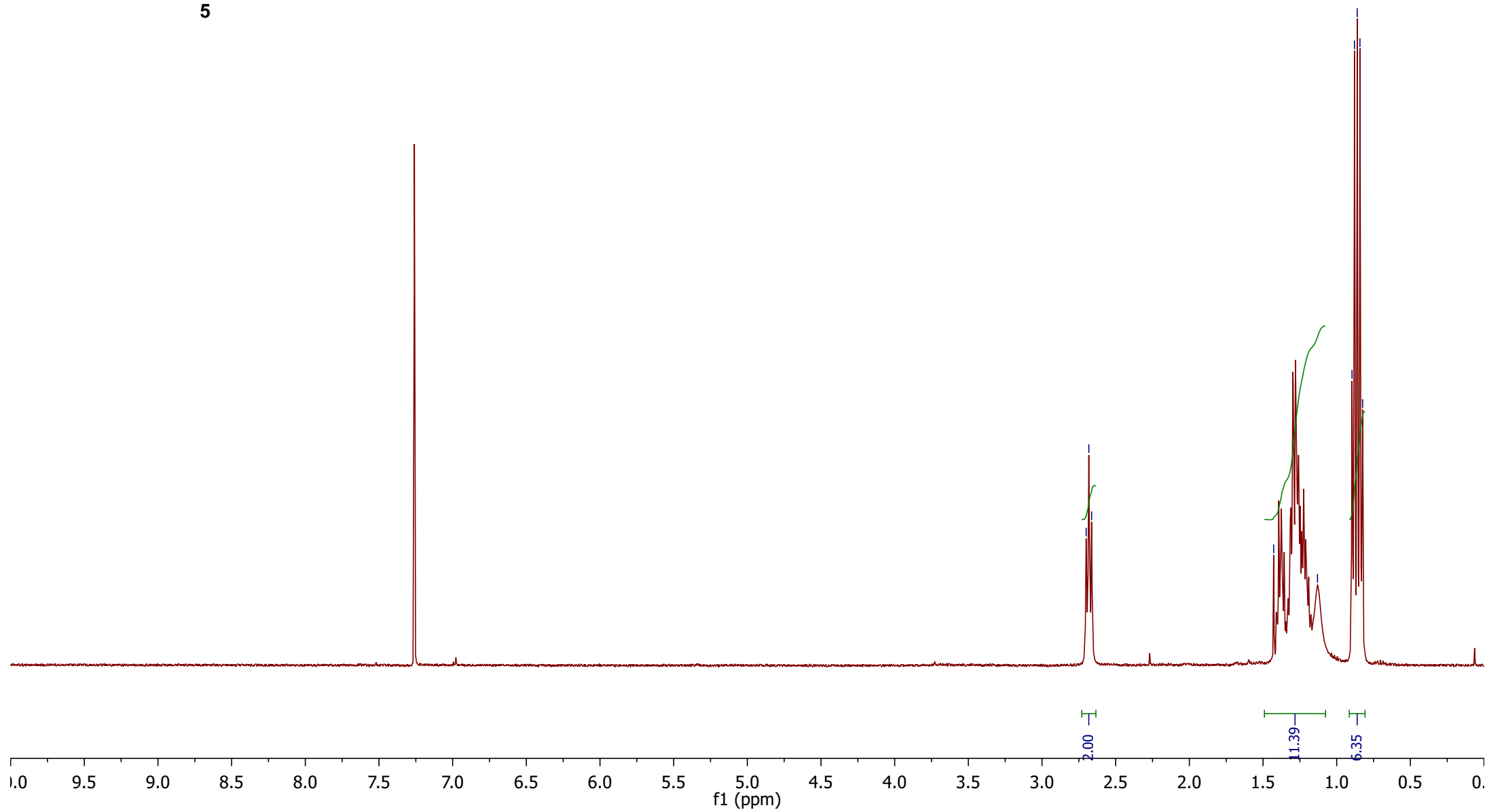


40.8  
36.5  
35.6  
26.2  
19.8  
14.5  
10.8 S116

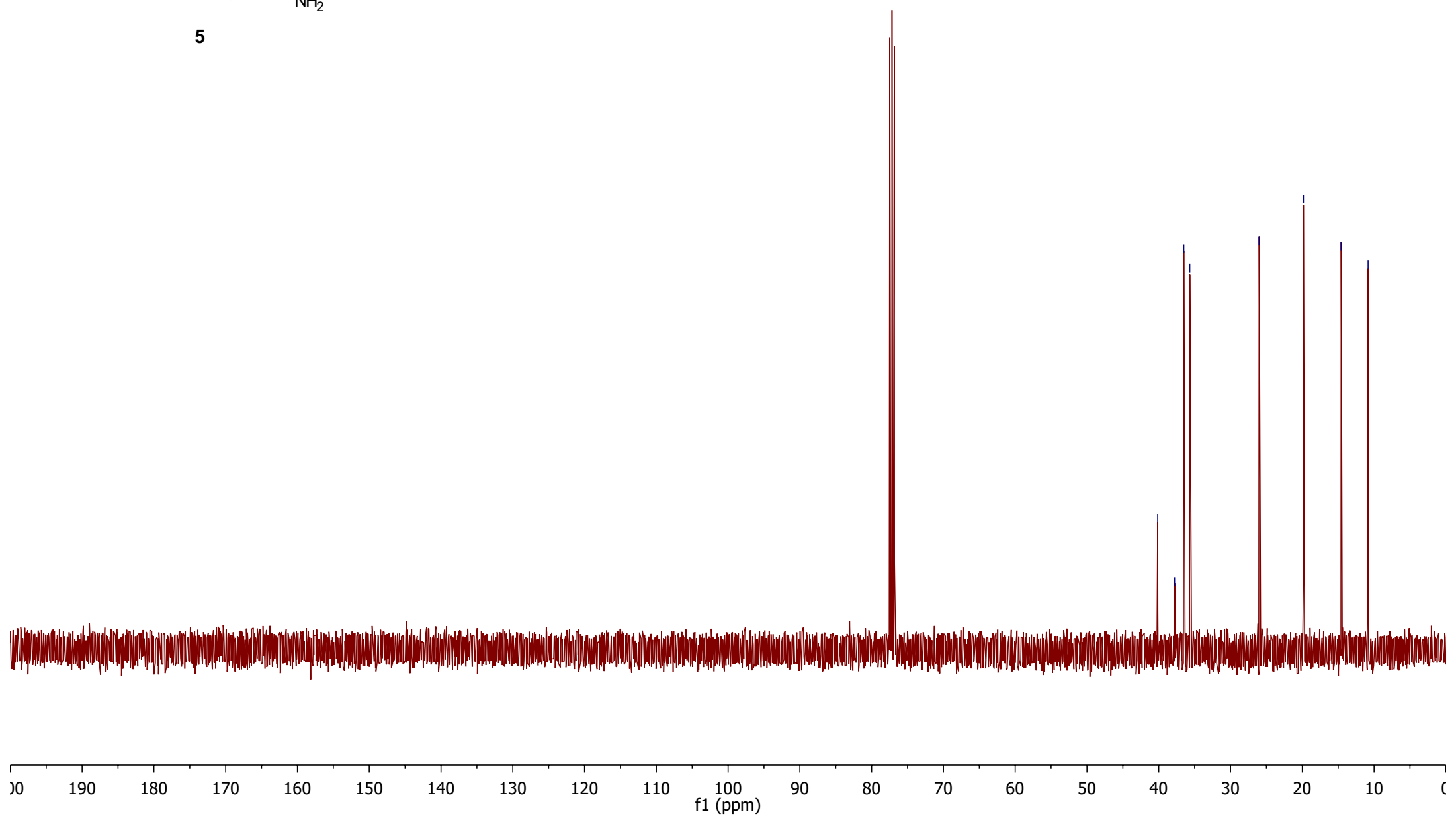
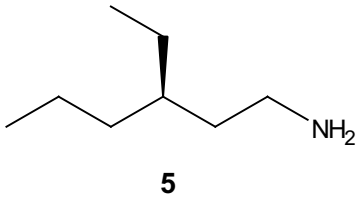


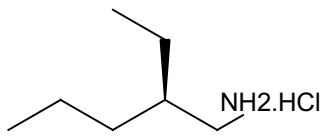


2.70  
2.68  
2.66  
1.43  
1.13  
0.90  
0.88  
0.86  
0.84  
0.82 S117



40.1  
37.8  
36.5  
35.7  
26.0  
19.8  
14.6  
10.8 S118





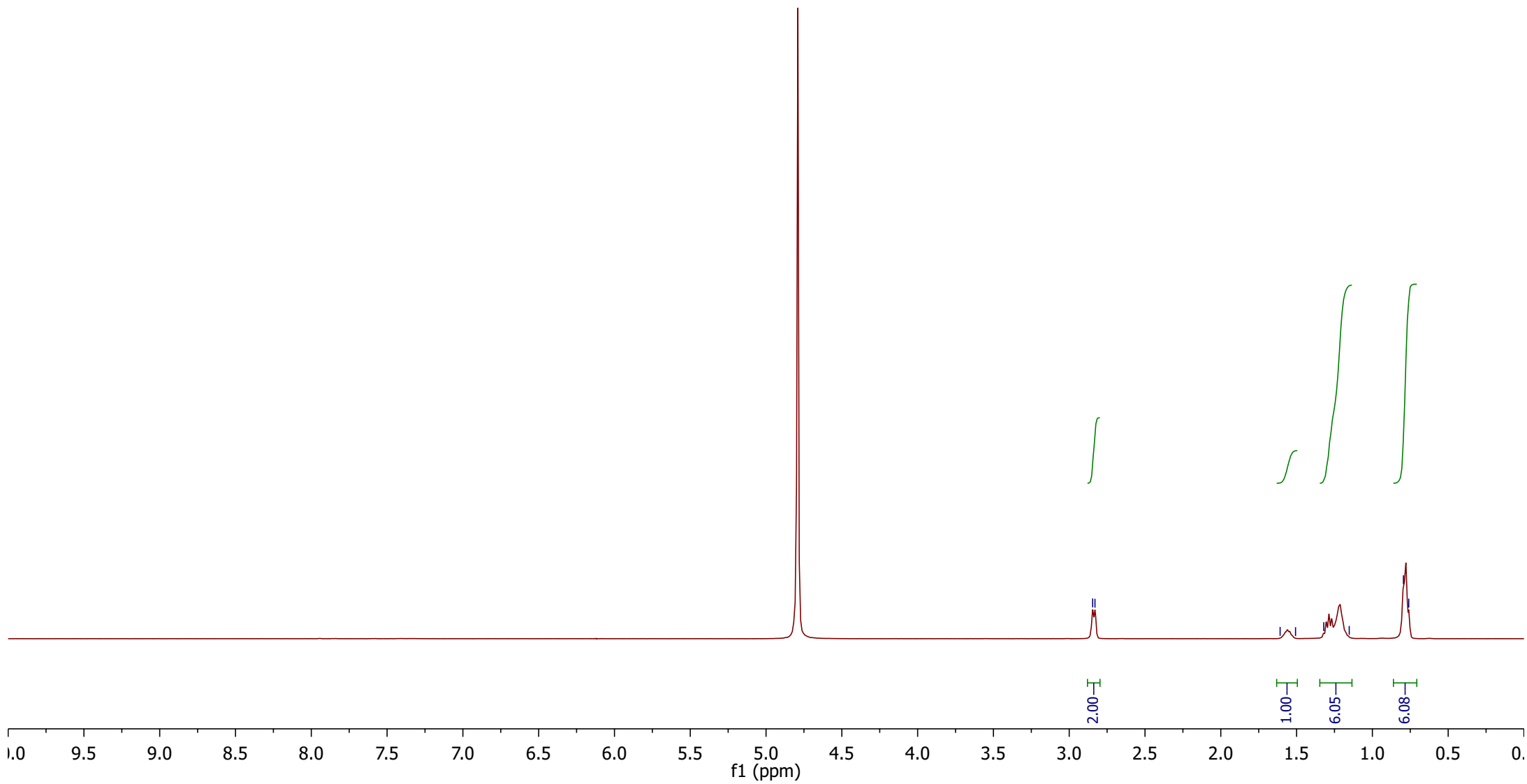
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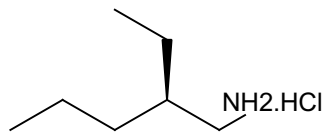
2.85  
2.83

1.61  
1.51  
1.32  
1.15

0.80  
0.76

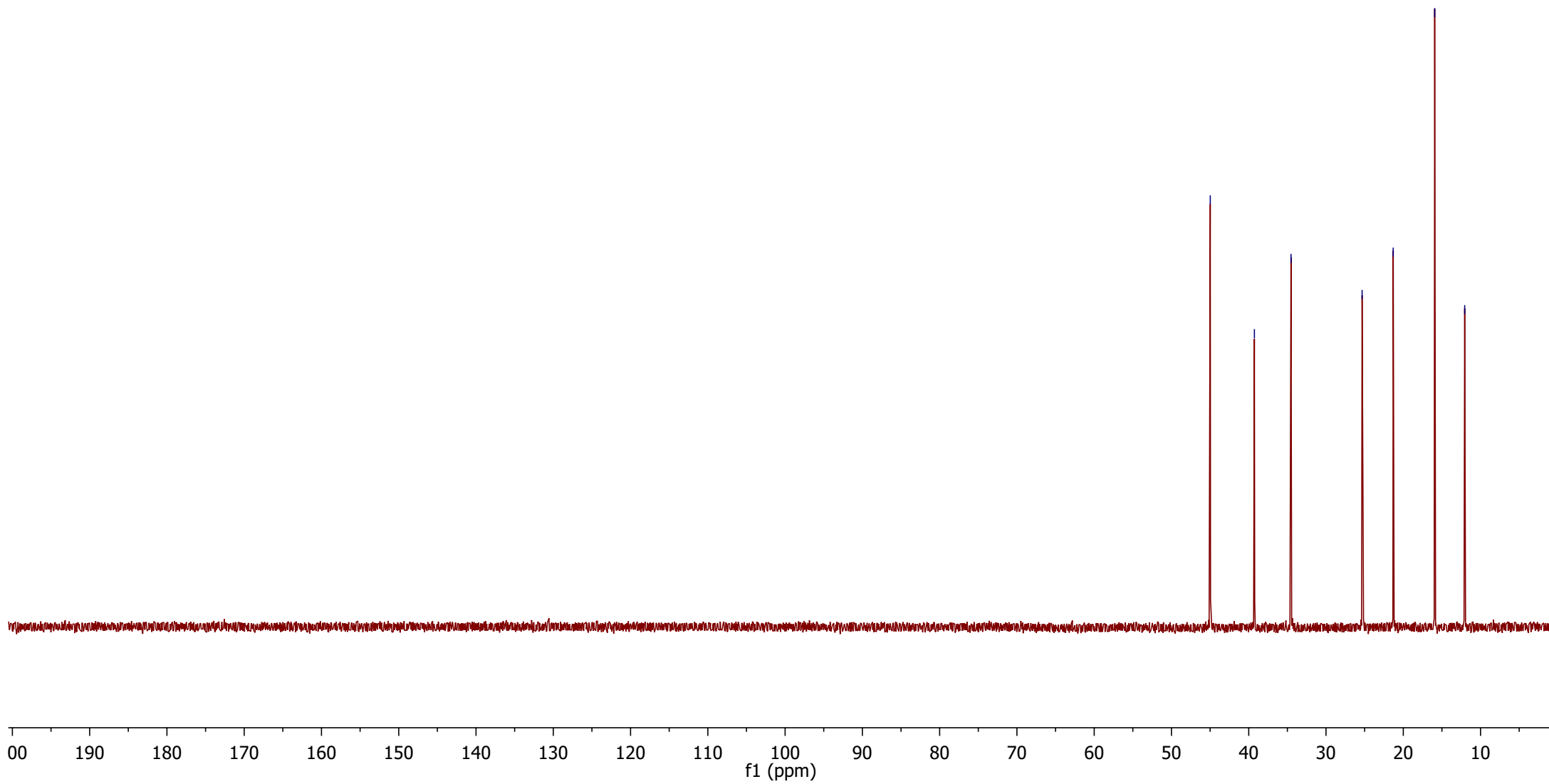
S119



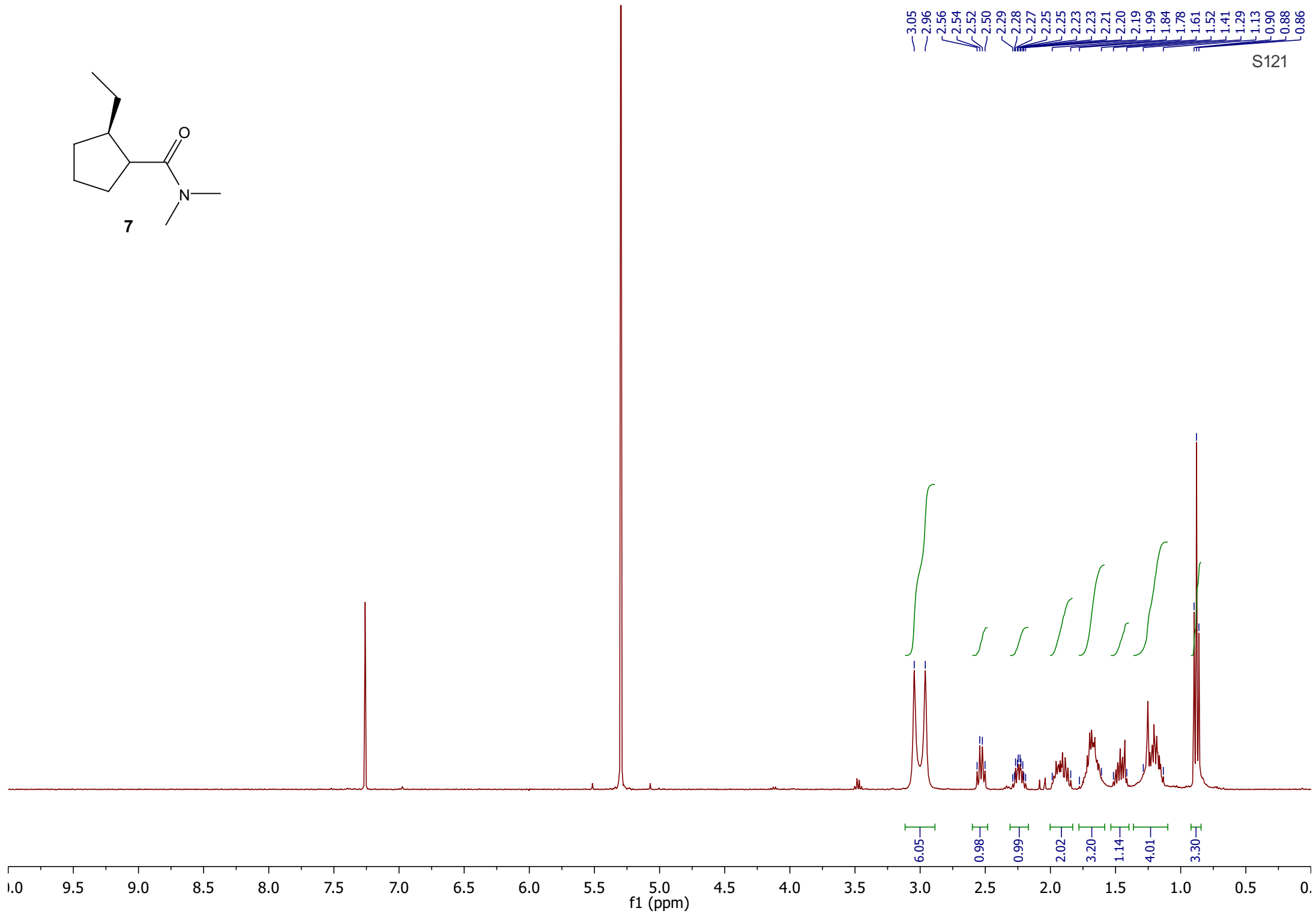
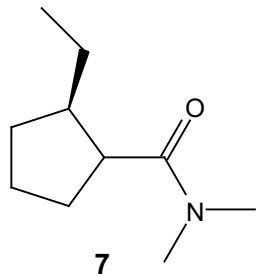


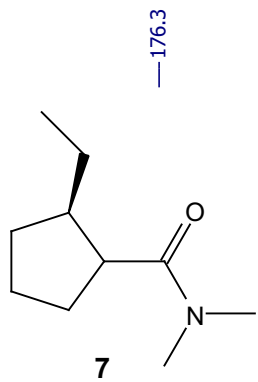
6

—45.0  
—39.3  
—34.5  
—25.3  
—21.3  
—15.9  
—12.1 S120









—47.6  
—45.8  
—37.4  
—35.8  
—31.9  
—30.7  
—28.0  
—24.7  
—12.9

S122

