

Supporting Information-II

Conformation-controlled Catalytic Asymmetric Synthesis of Swaminathan Ketones

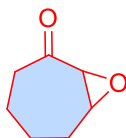
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Dhevalapally B. Ramachary**

Catalysis Laboratory, School of Chemistry, University of Hyderabad, Hyderabad-500 046, India;

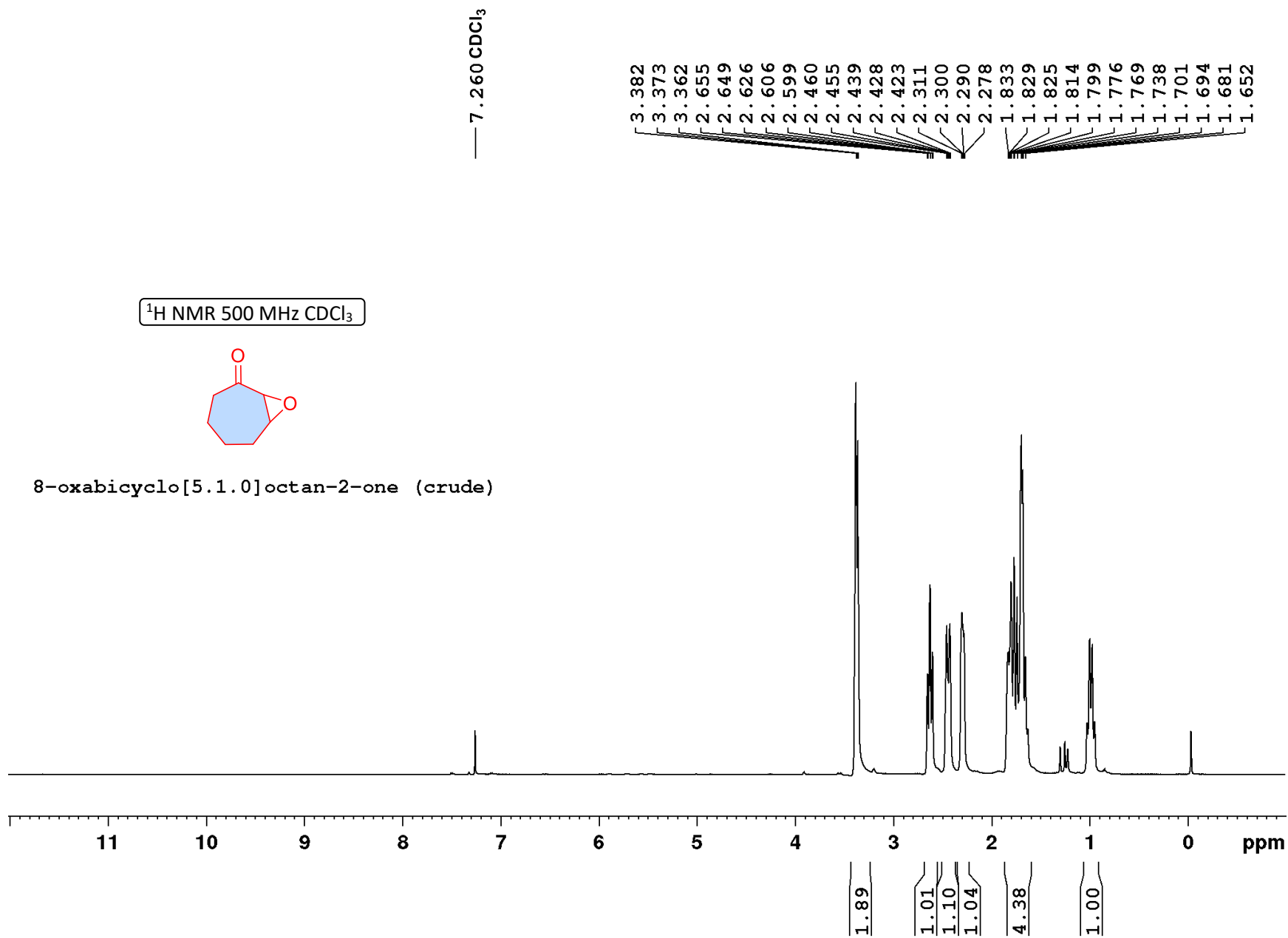
E-mail: ramsc@uohyd.ac.in and ramchary.db@gmail.com

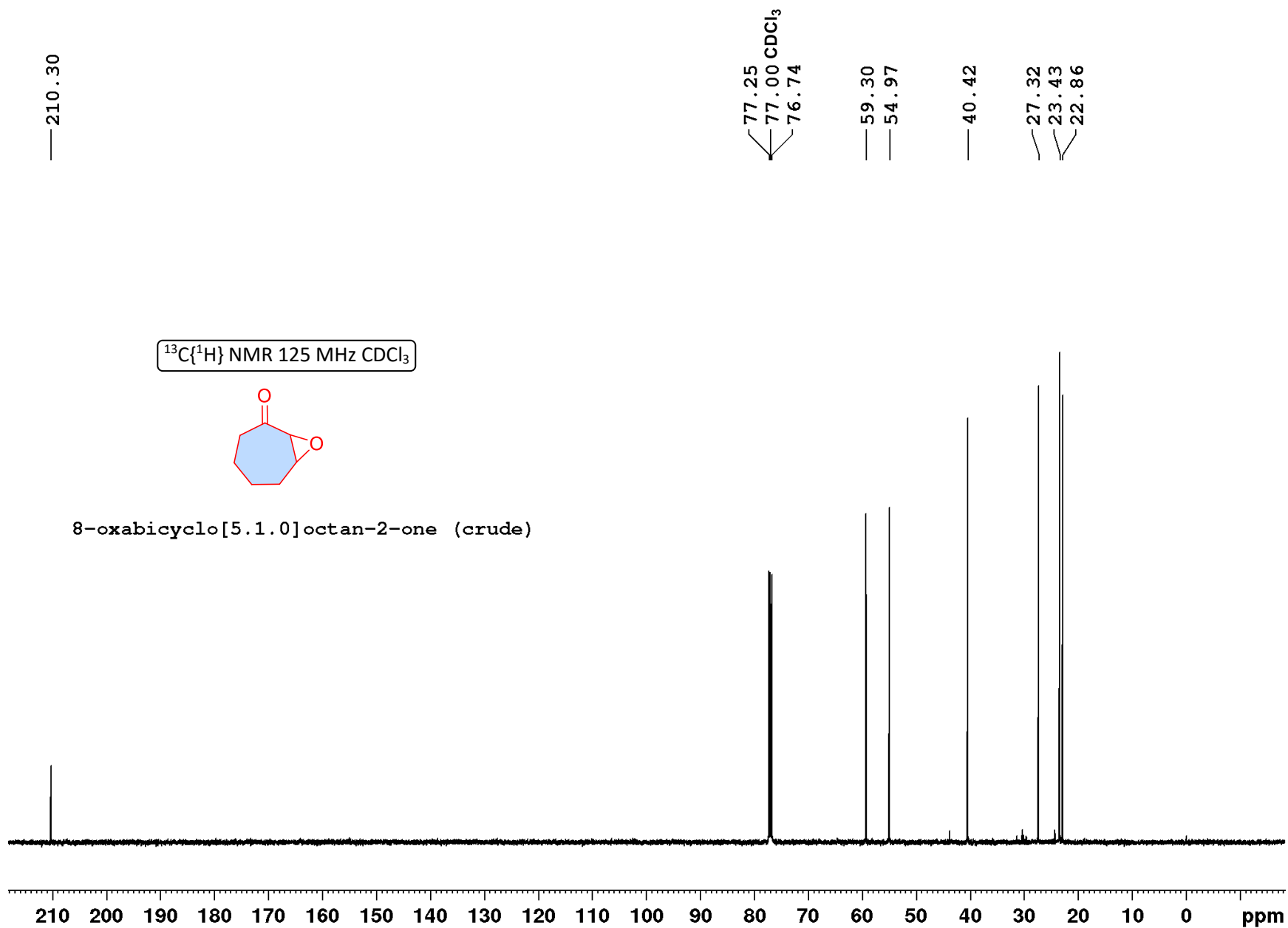
[‡]These authors contributed equally.

¹H NMR 500 MHz CDCl₃

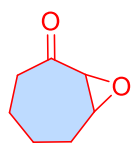


8-oxabicyclo[5.1.0]octan-2-one (crude)

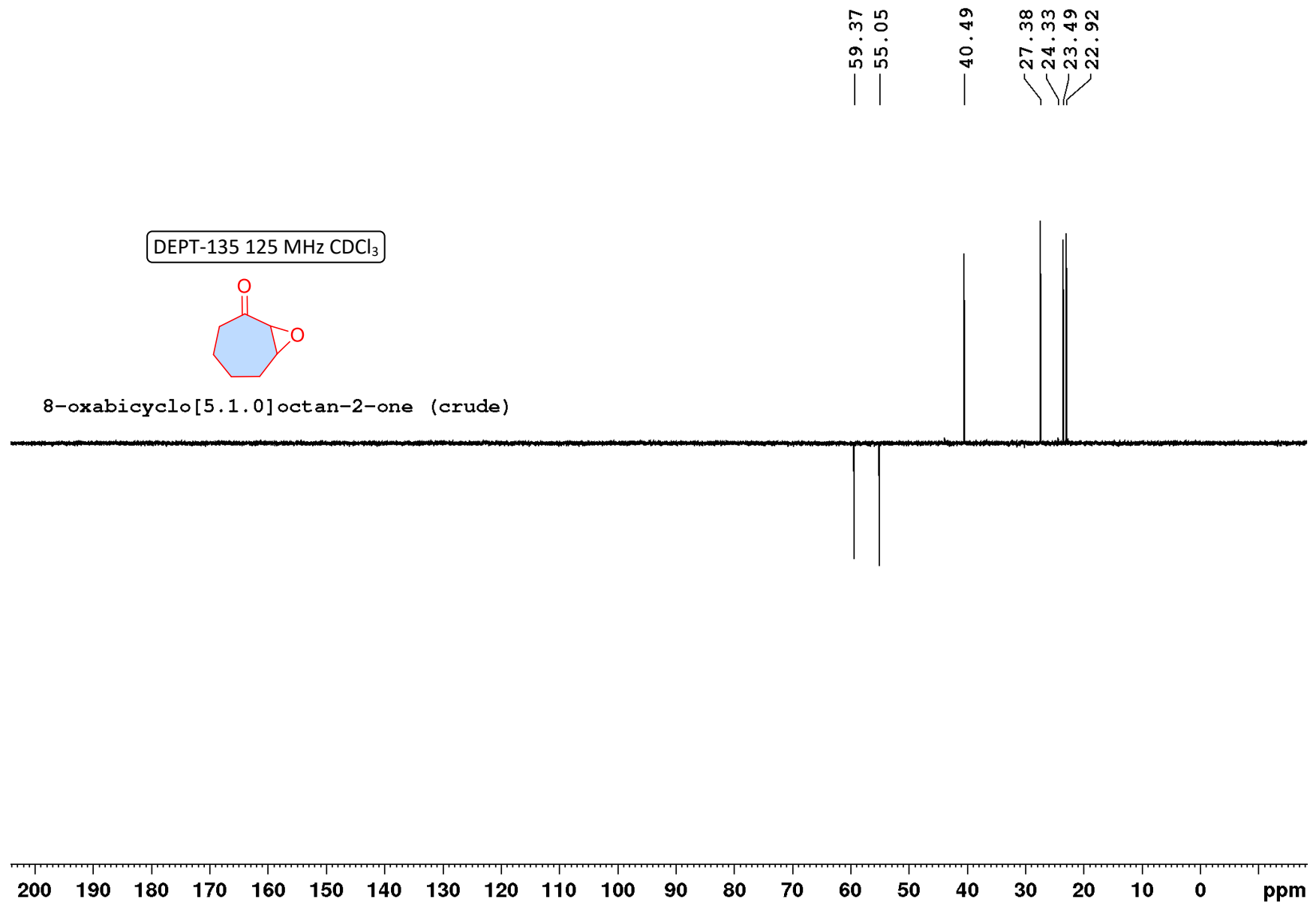




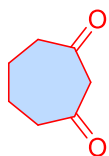
DEPT-135 125 MHz CDCl₃



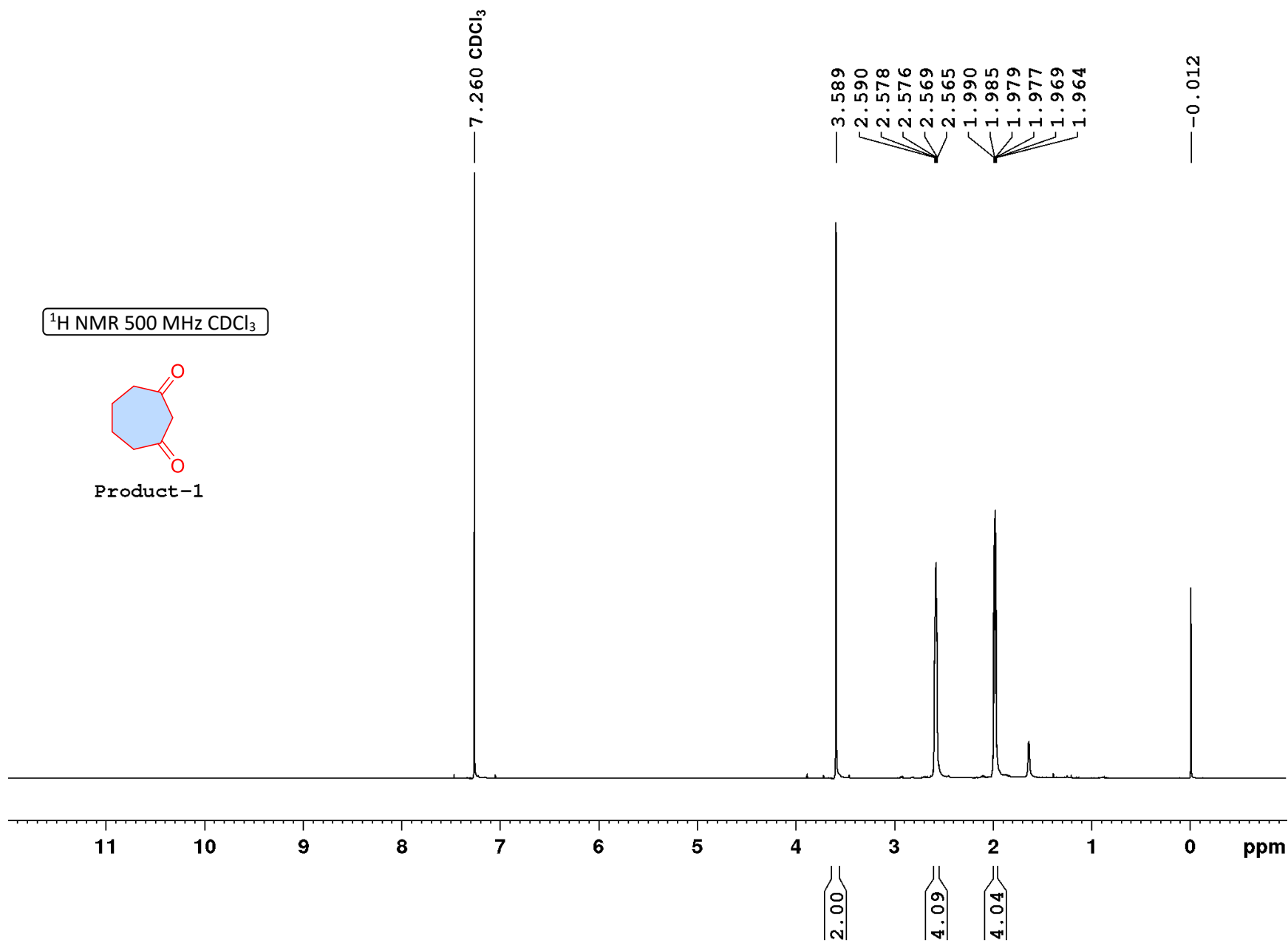
8-oxabicyclo[5.1.0]octan-2-one (crude)

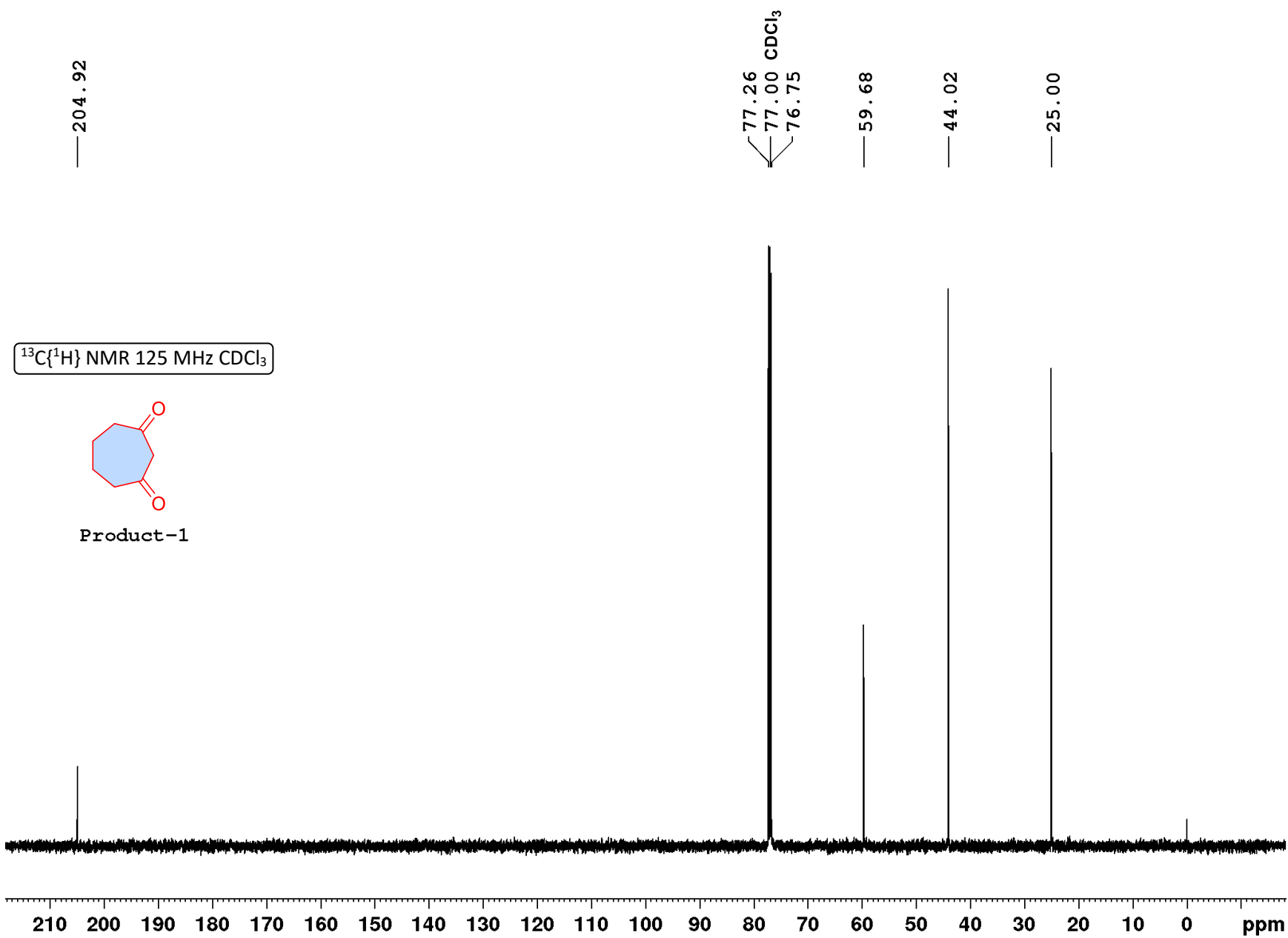


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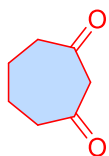


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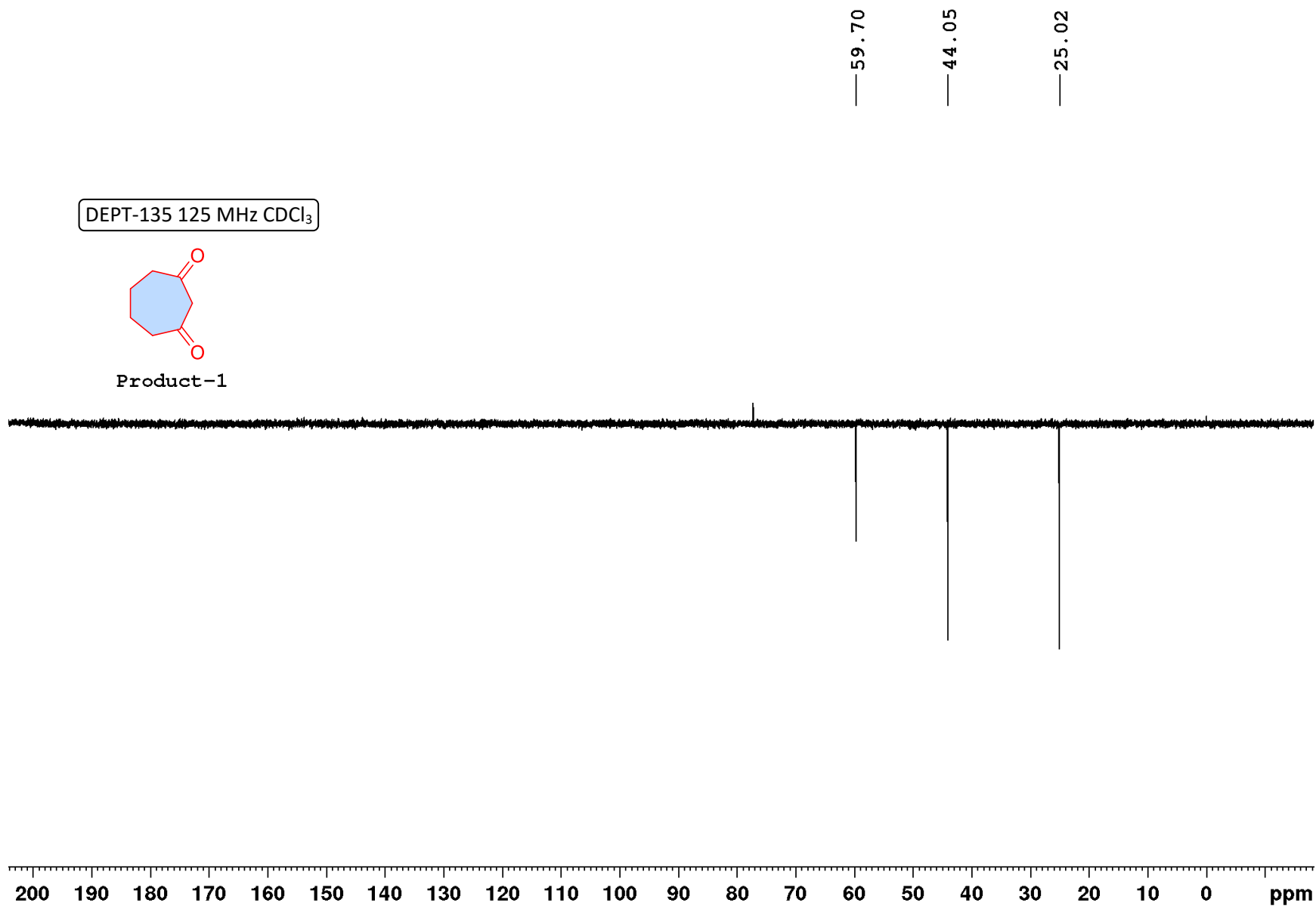




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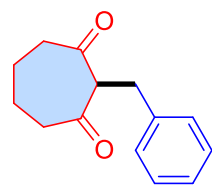
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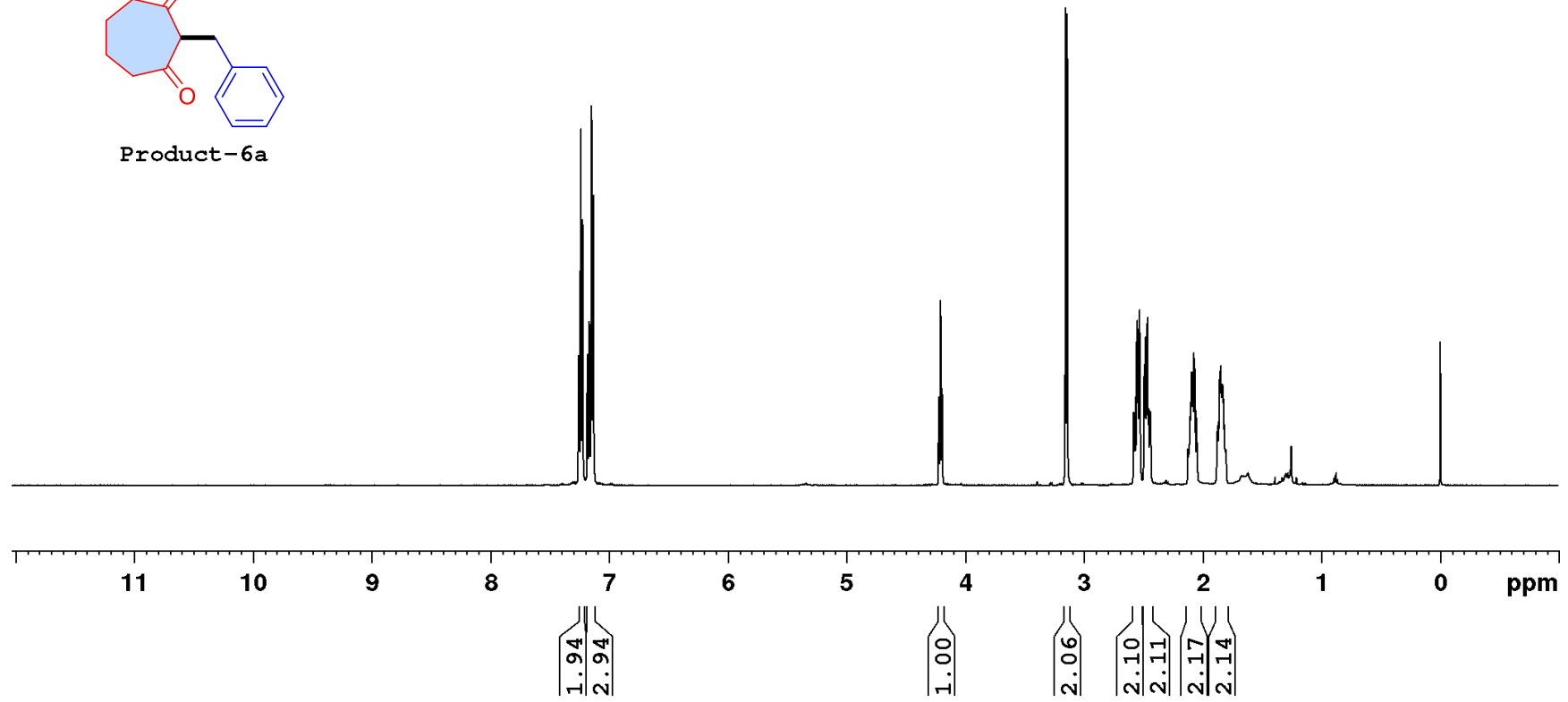
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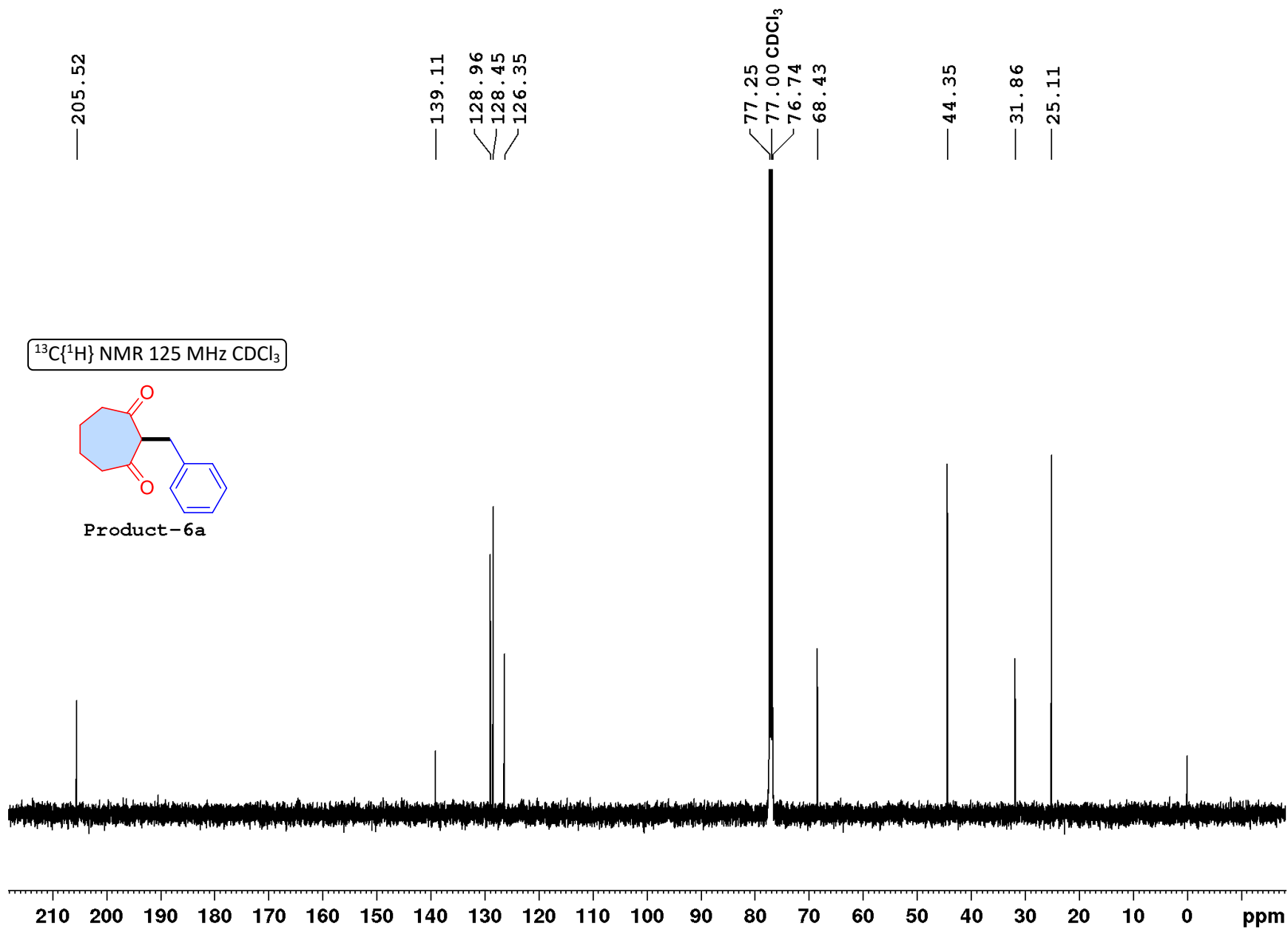
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^1H NMR 500 MHz CDCl_3

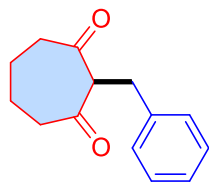


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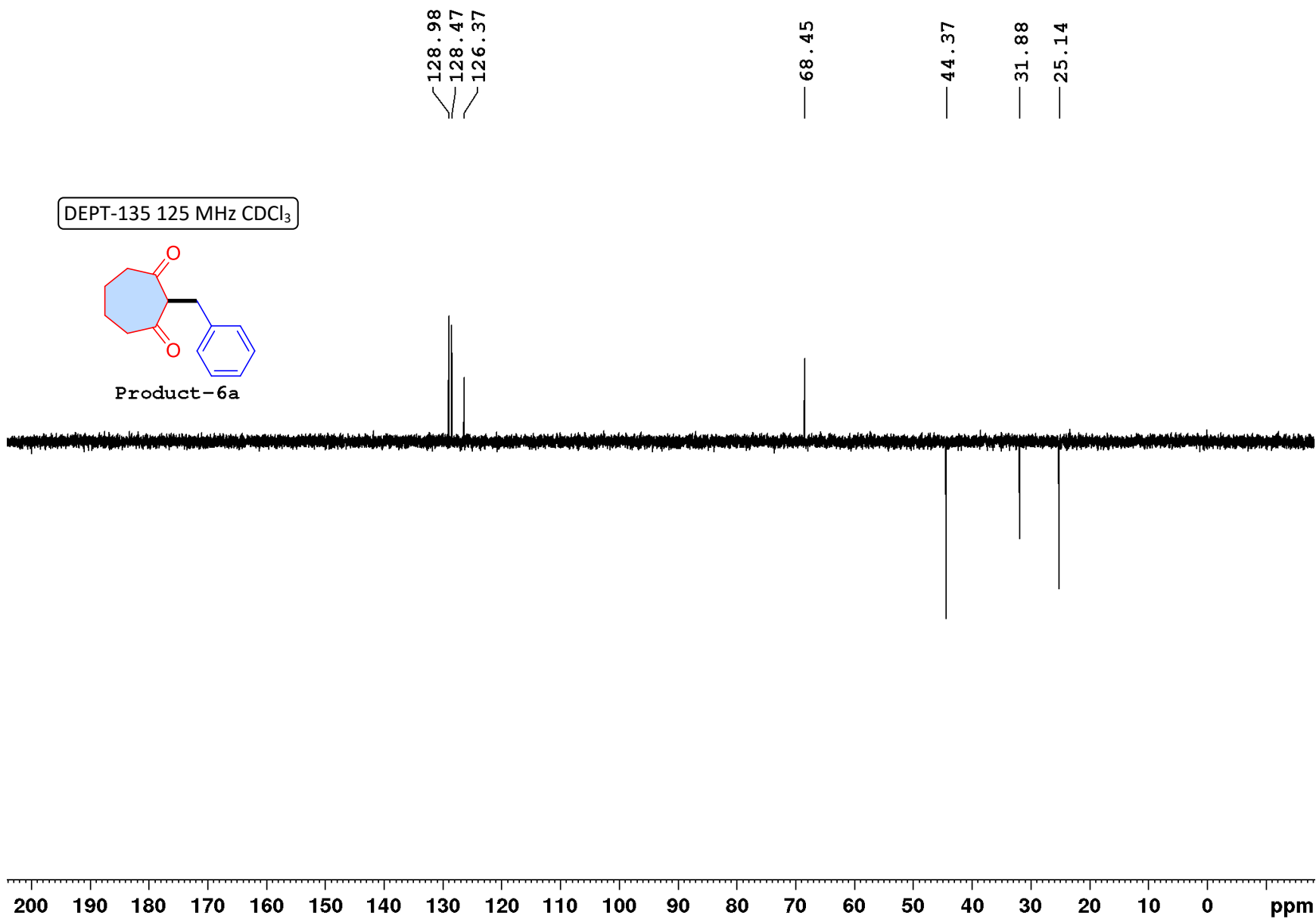




DEPT-135 125 MHz CDCl₃

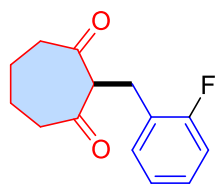


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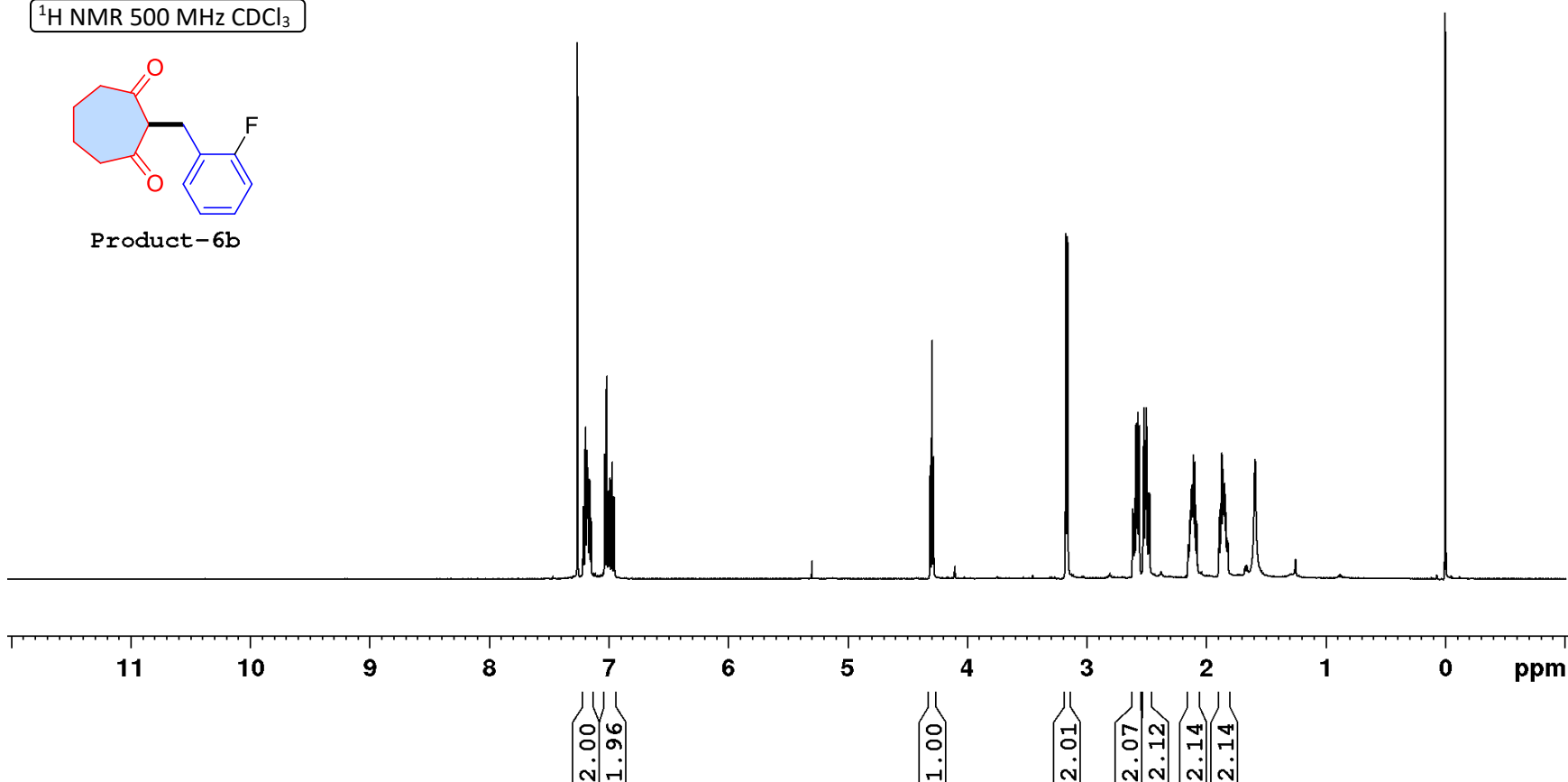


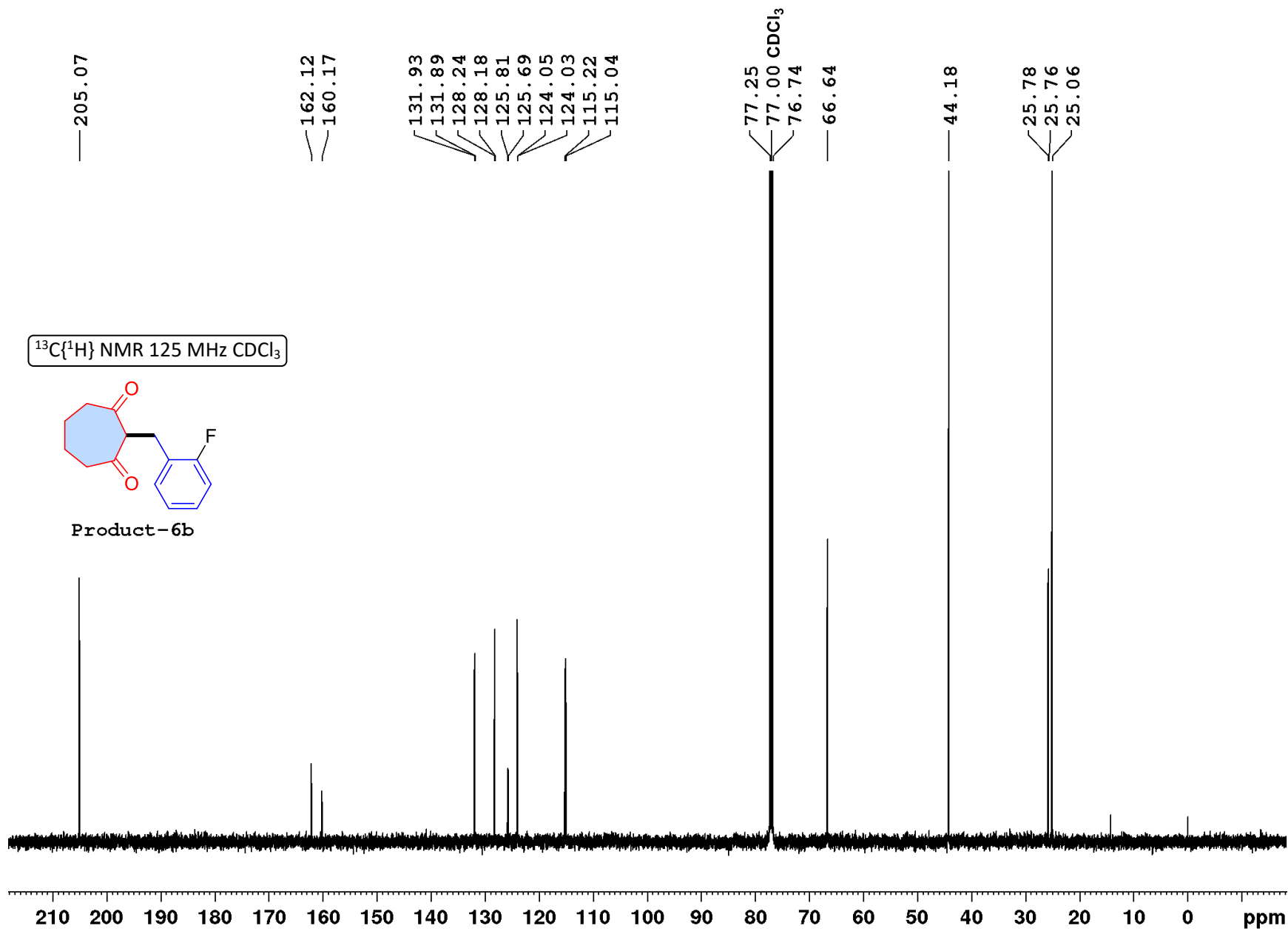
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$^1\text{H NMR}$ 500 MHz CDCl_3

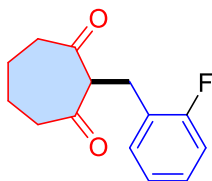


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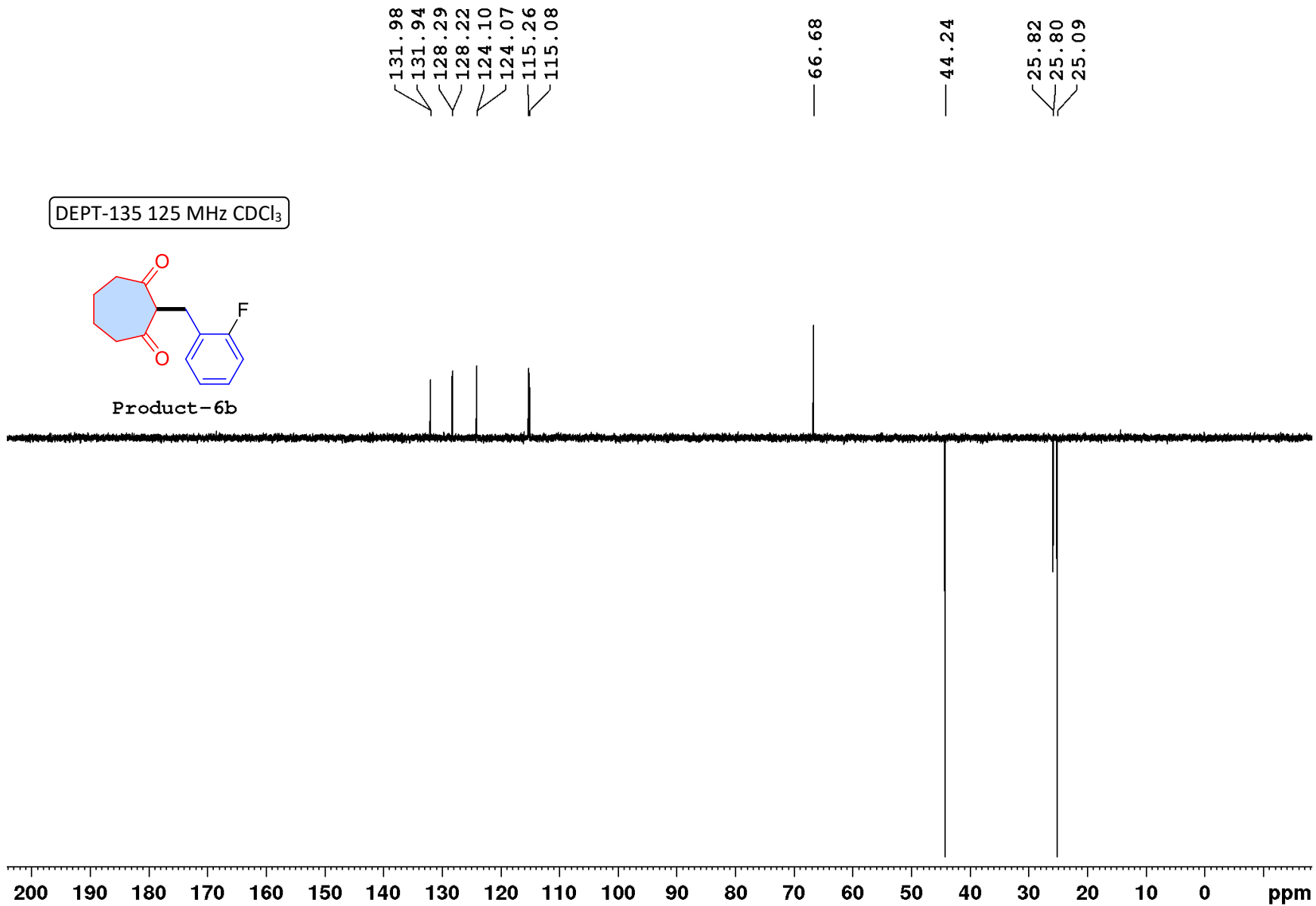




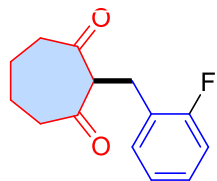
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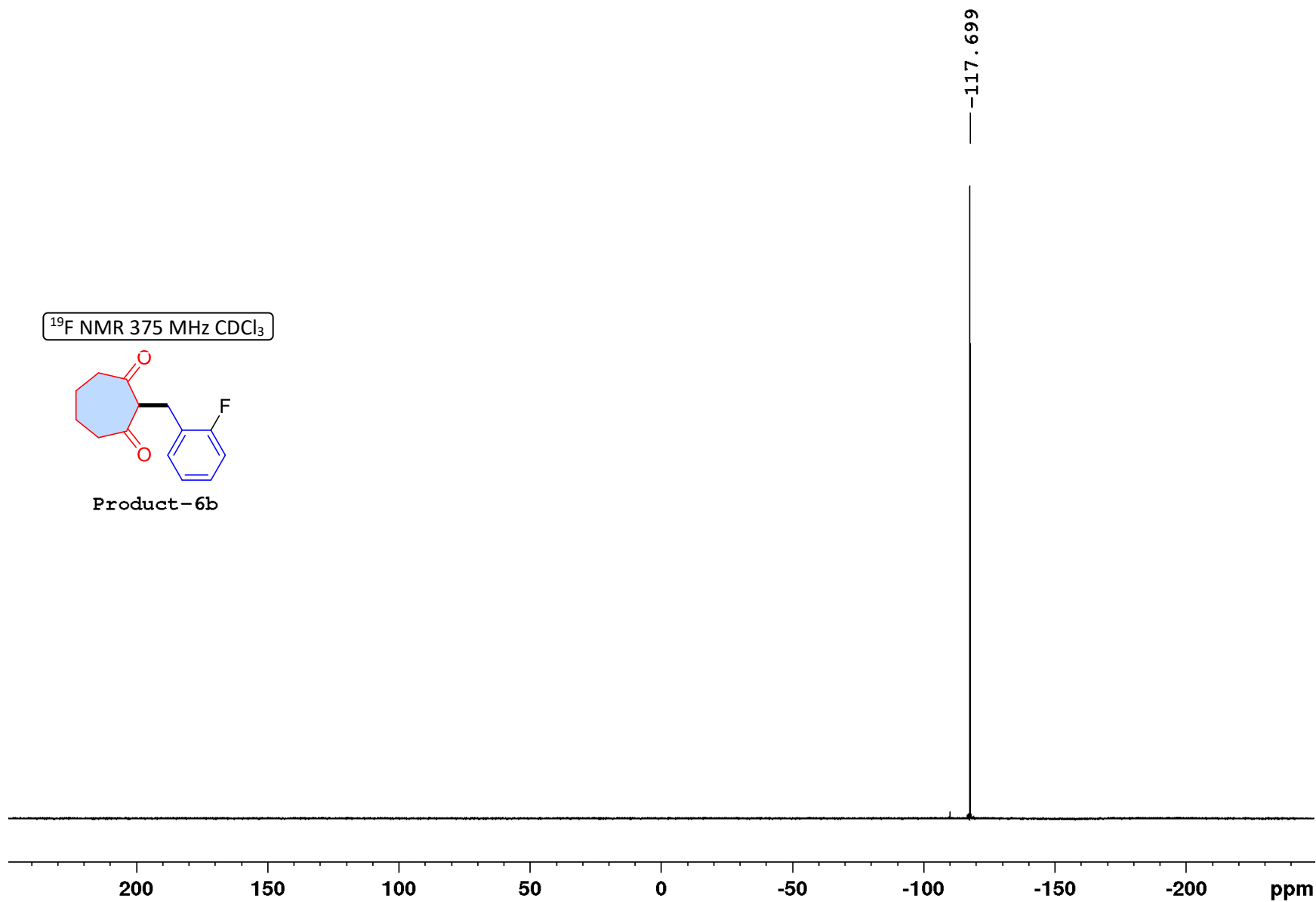
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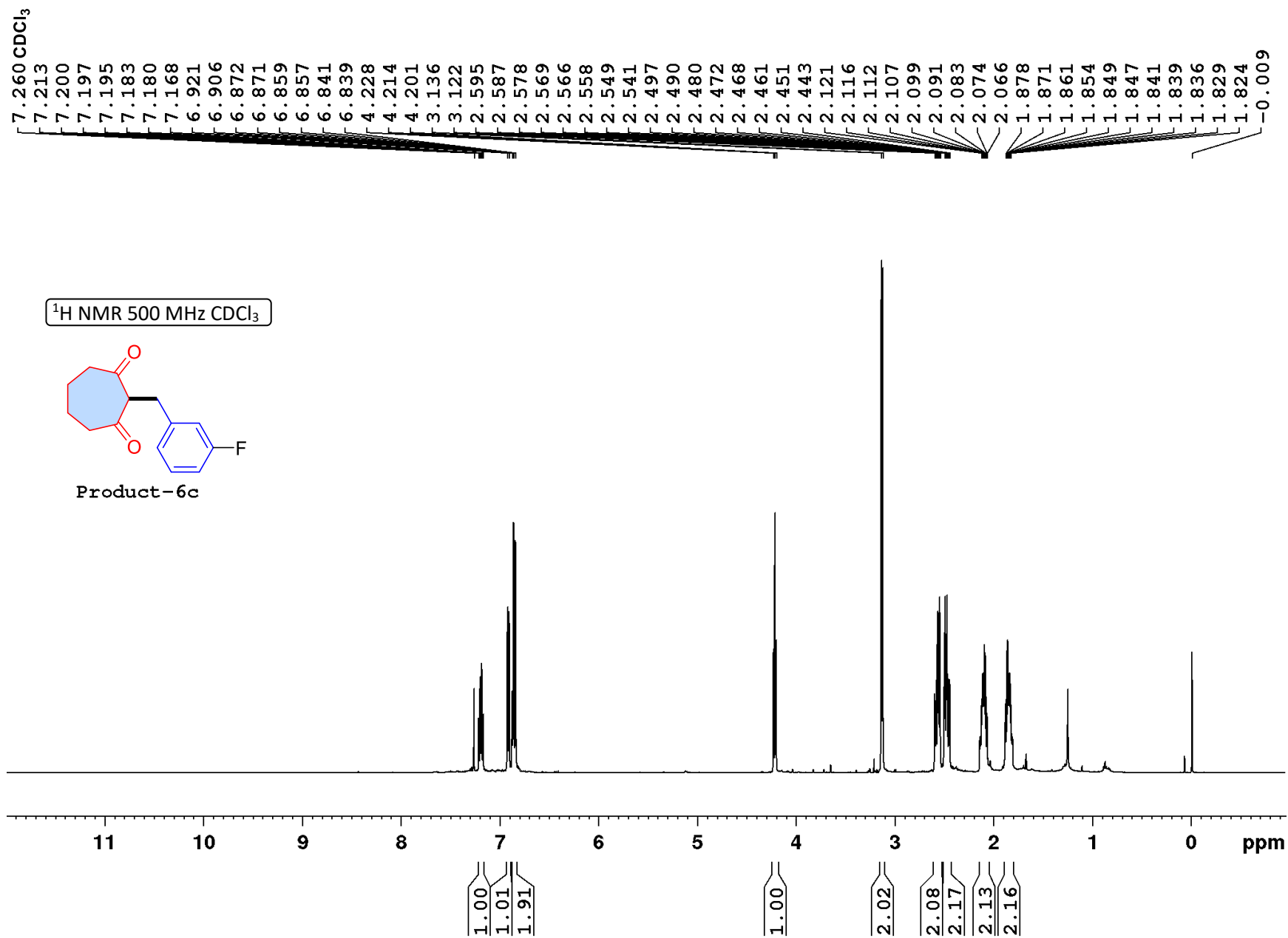


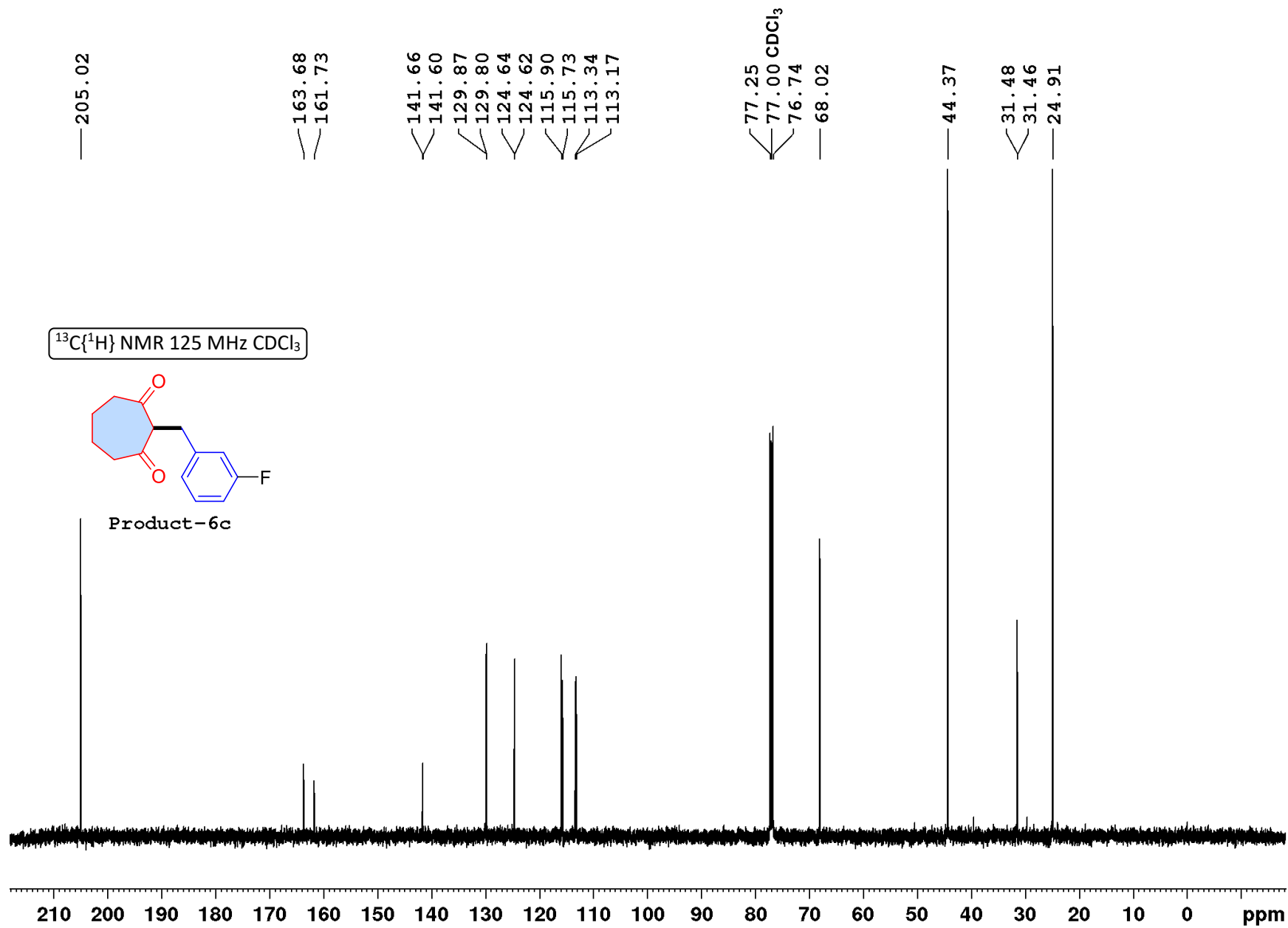
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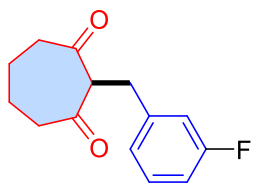
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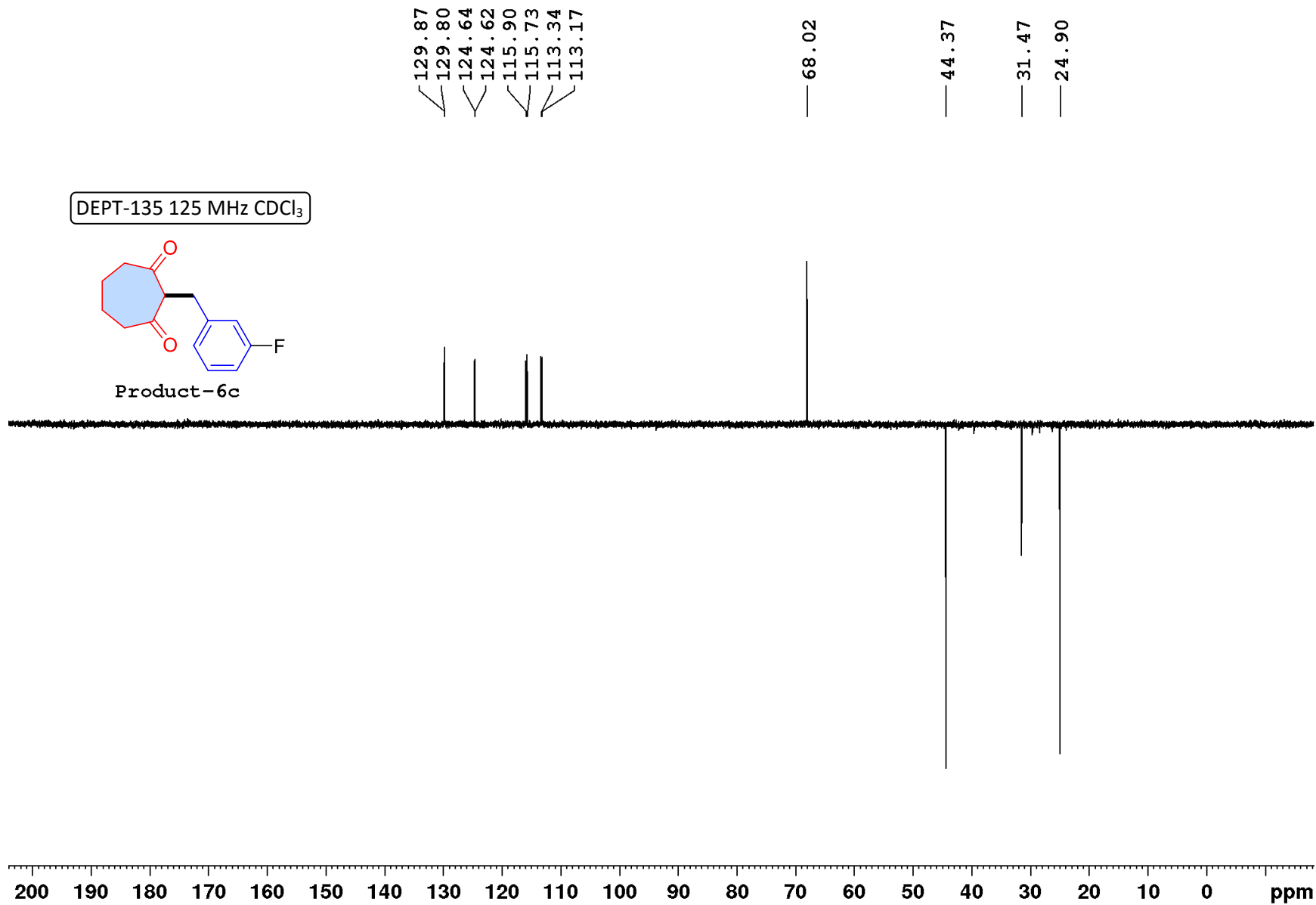




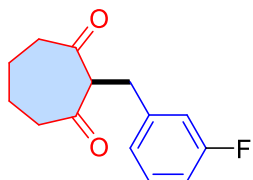
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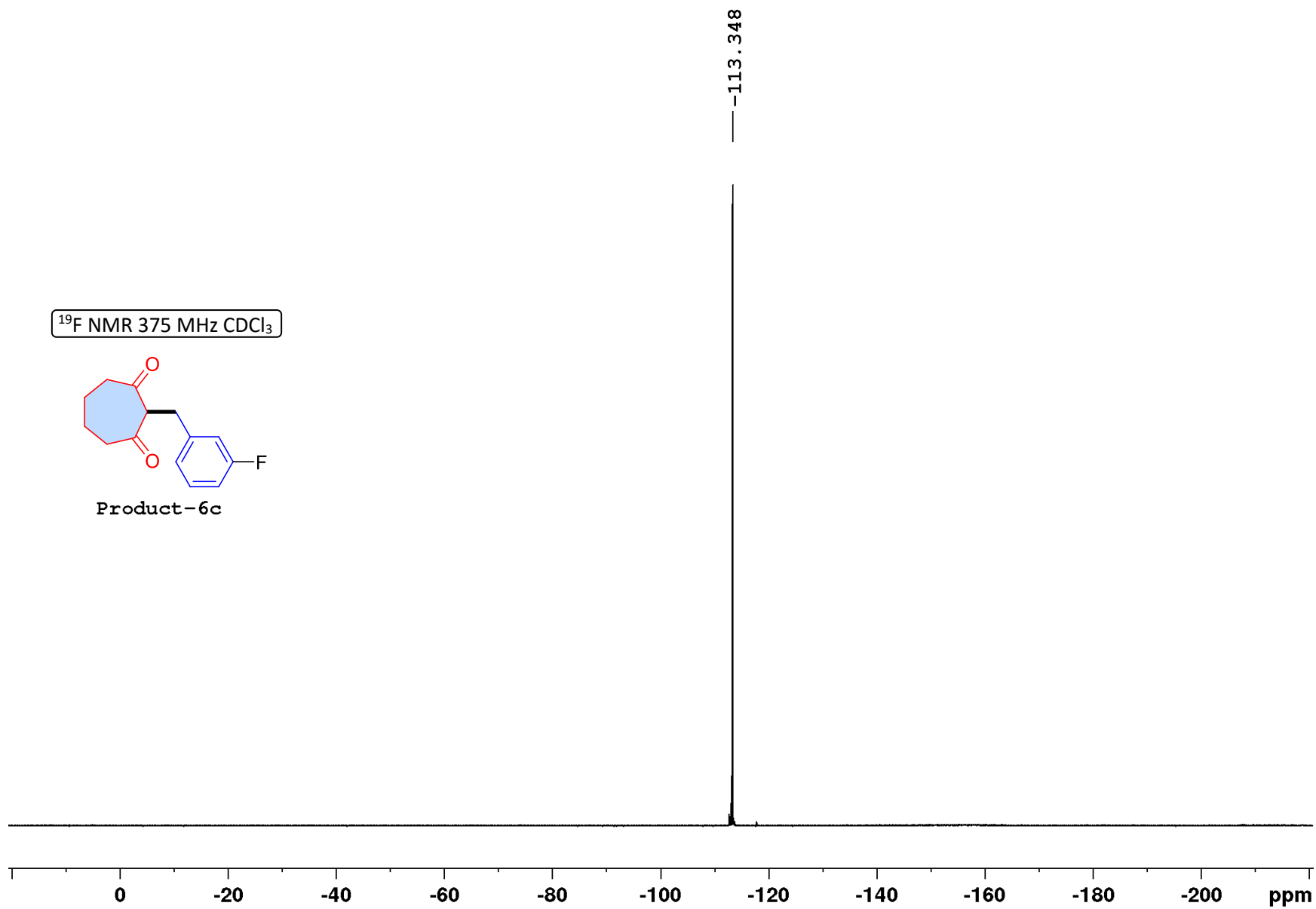
Product-6c



^{19}F NMR 375 MHz CDCl_3

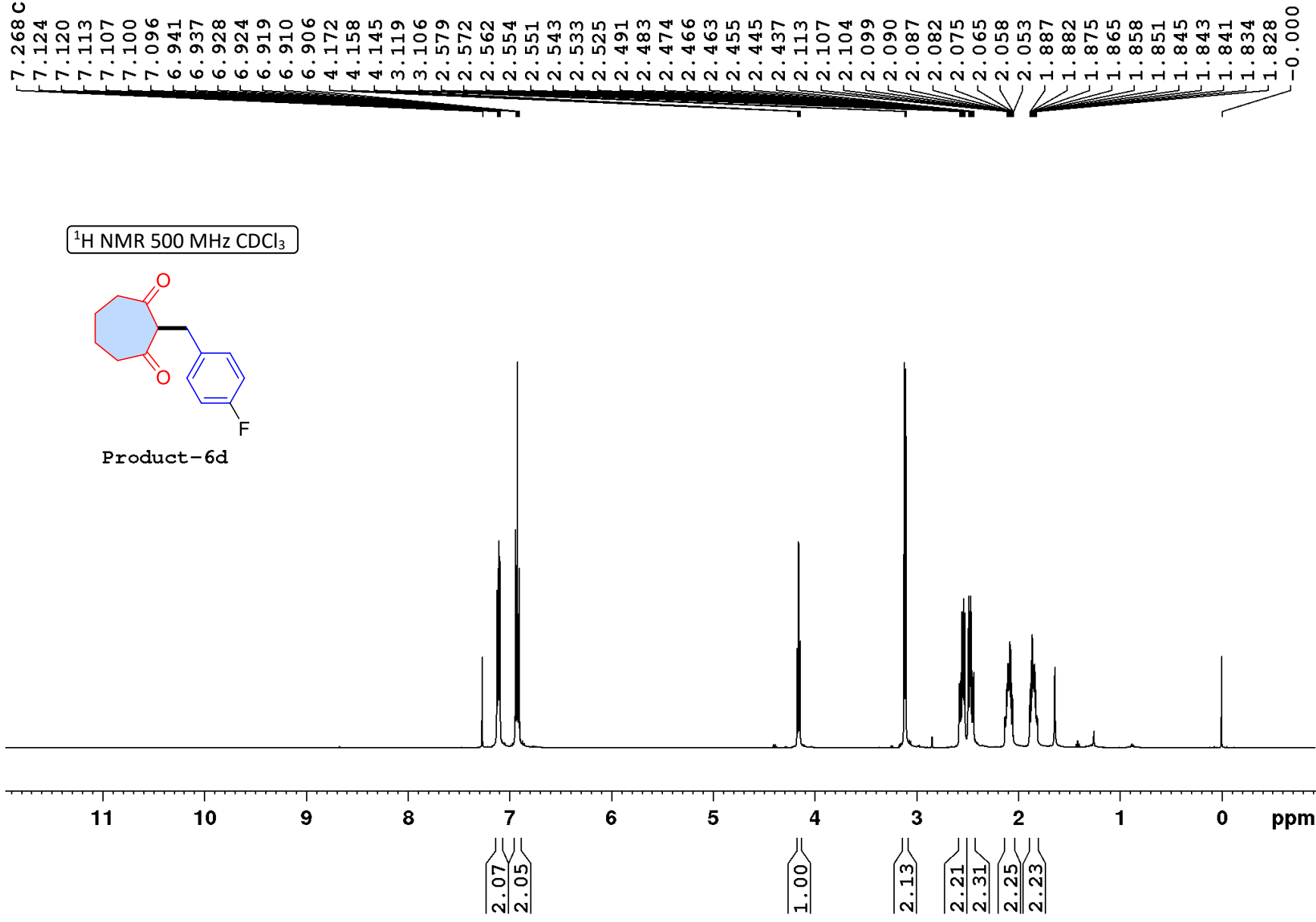
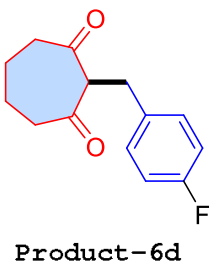


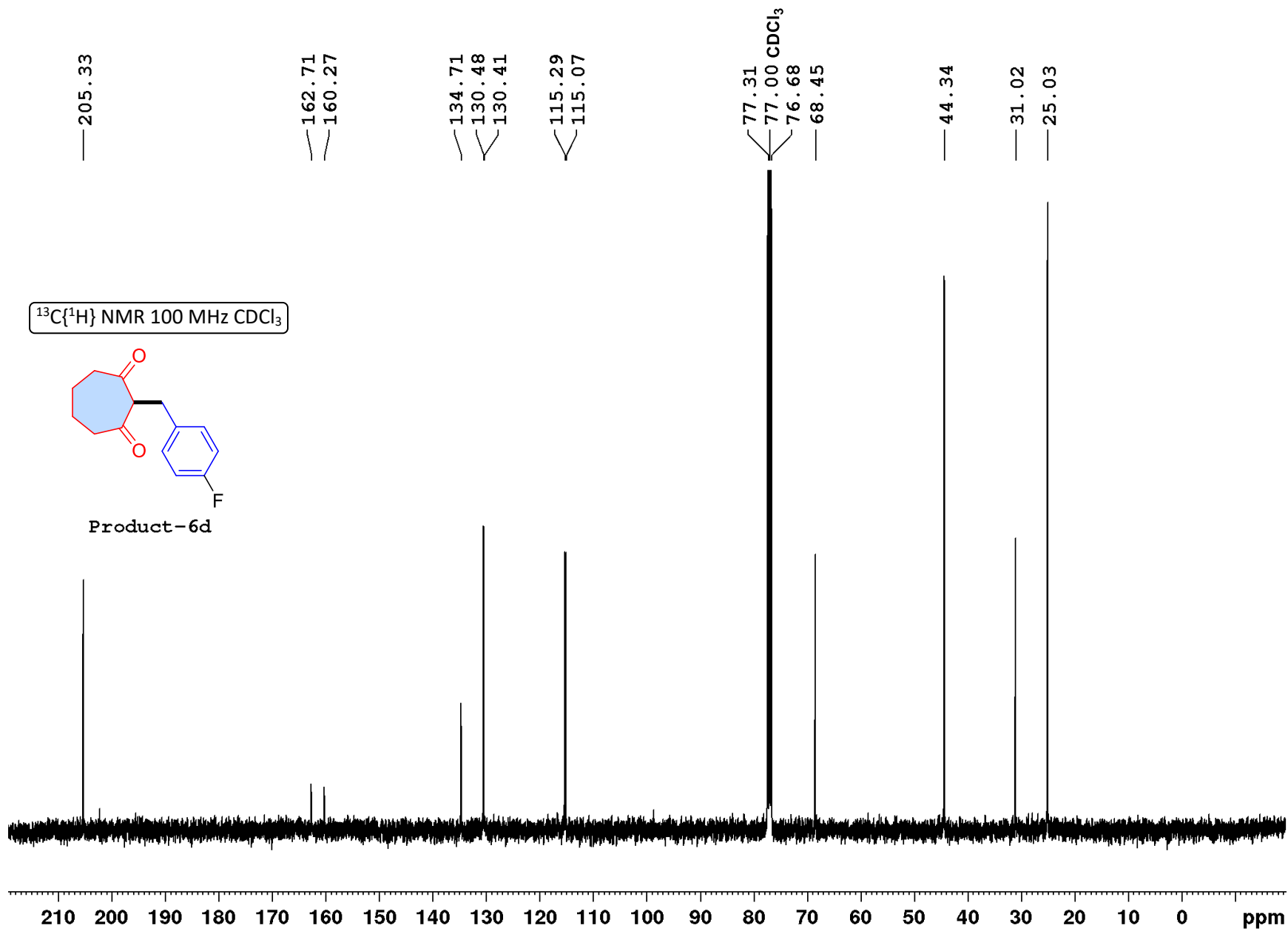
Product-6c



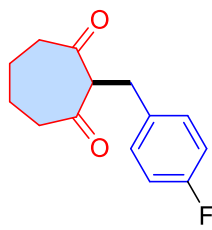
^1H NMR 500 MHz CDCl_3

^1H NMR 500 MHz CDCl_3

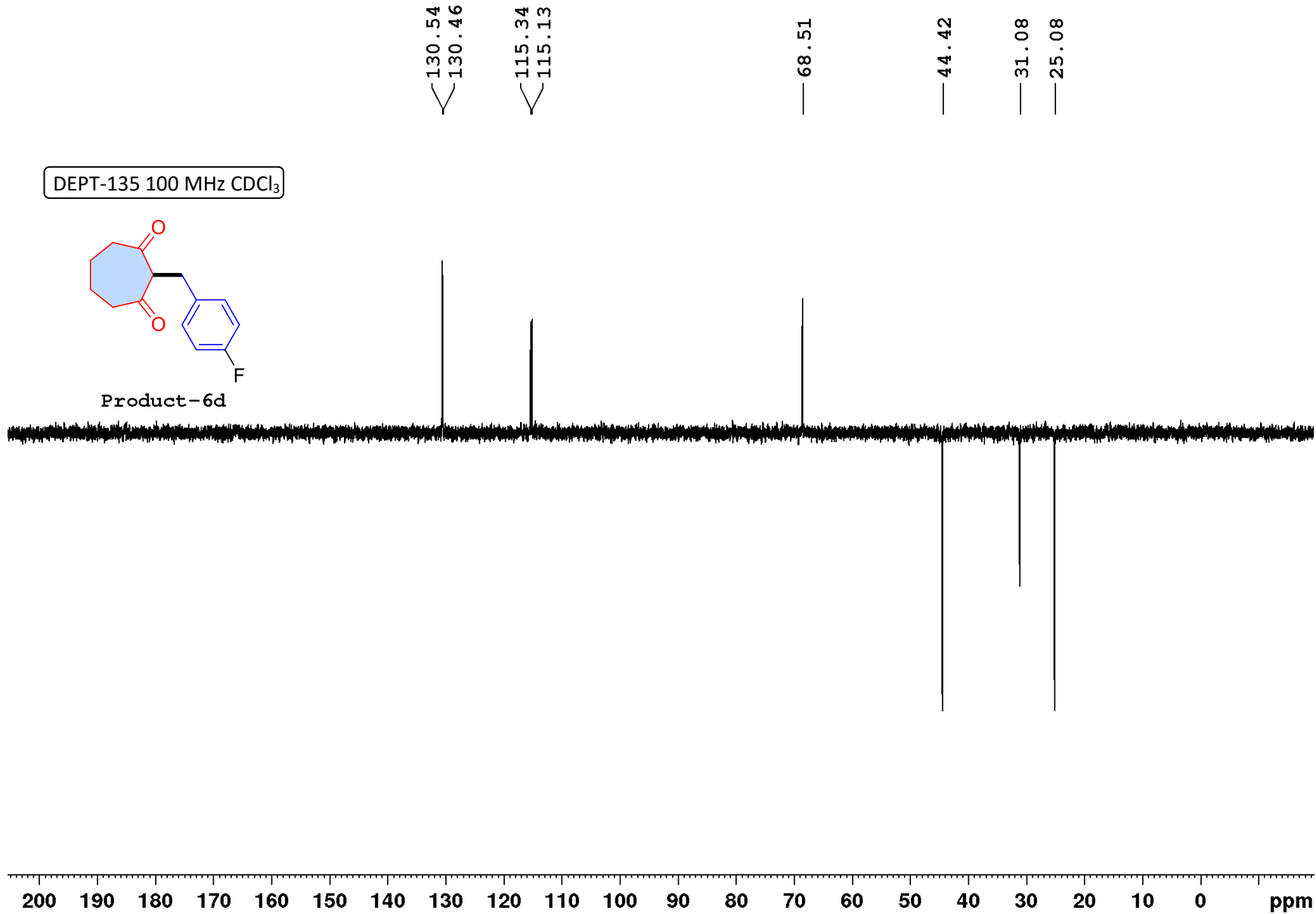




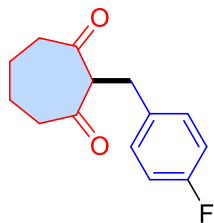
DEPT-135 100 MHz CDCl₃



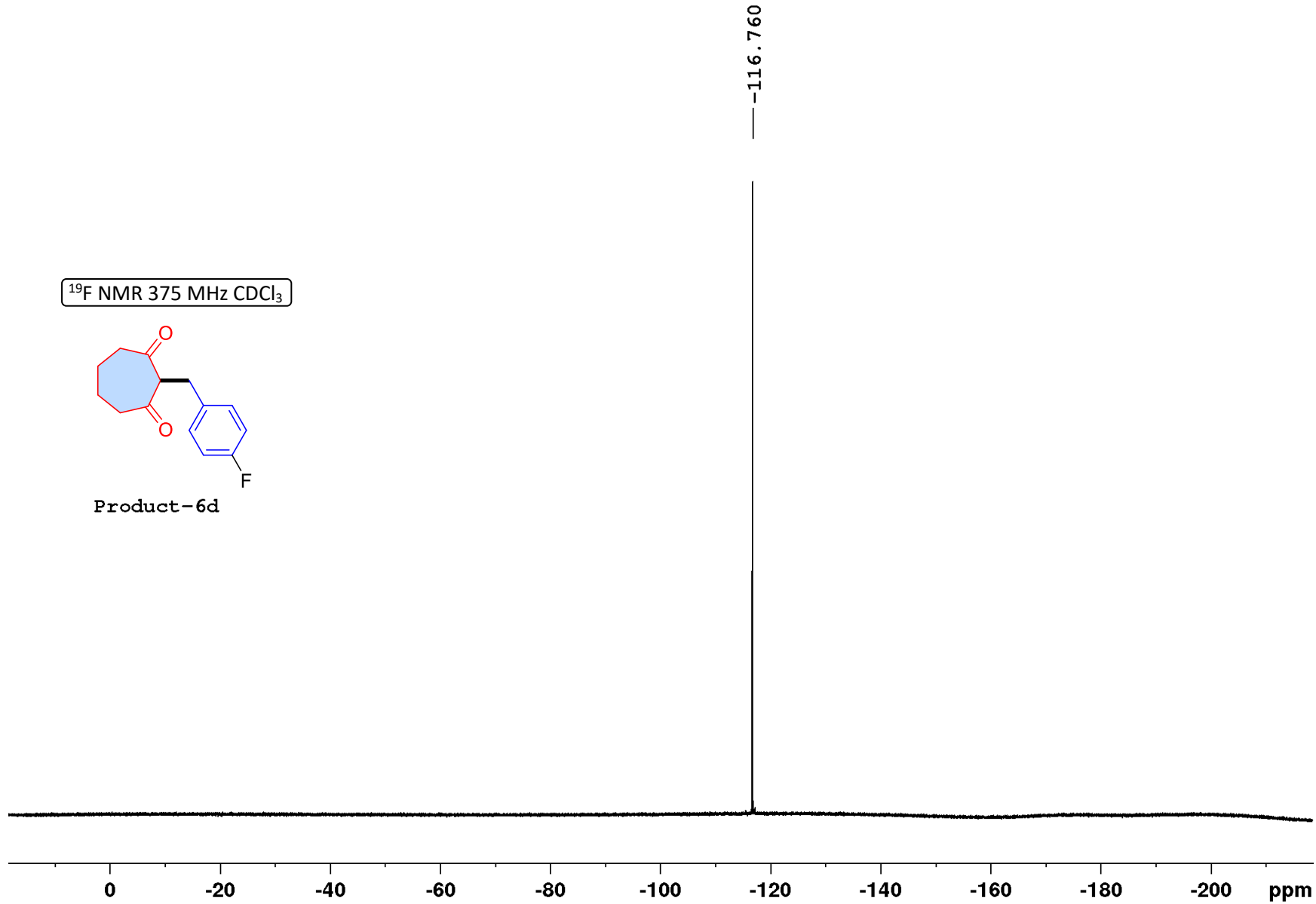
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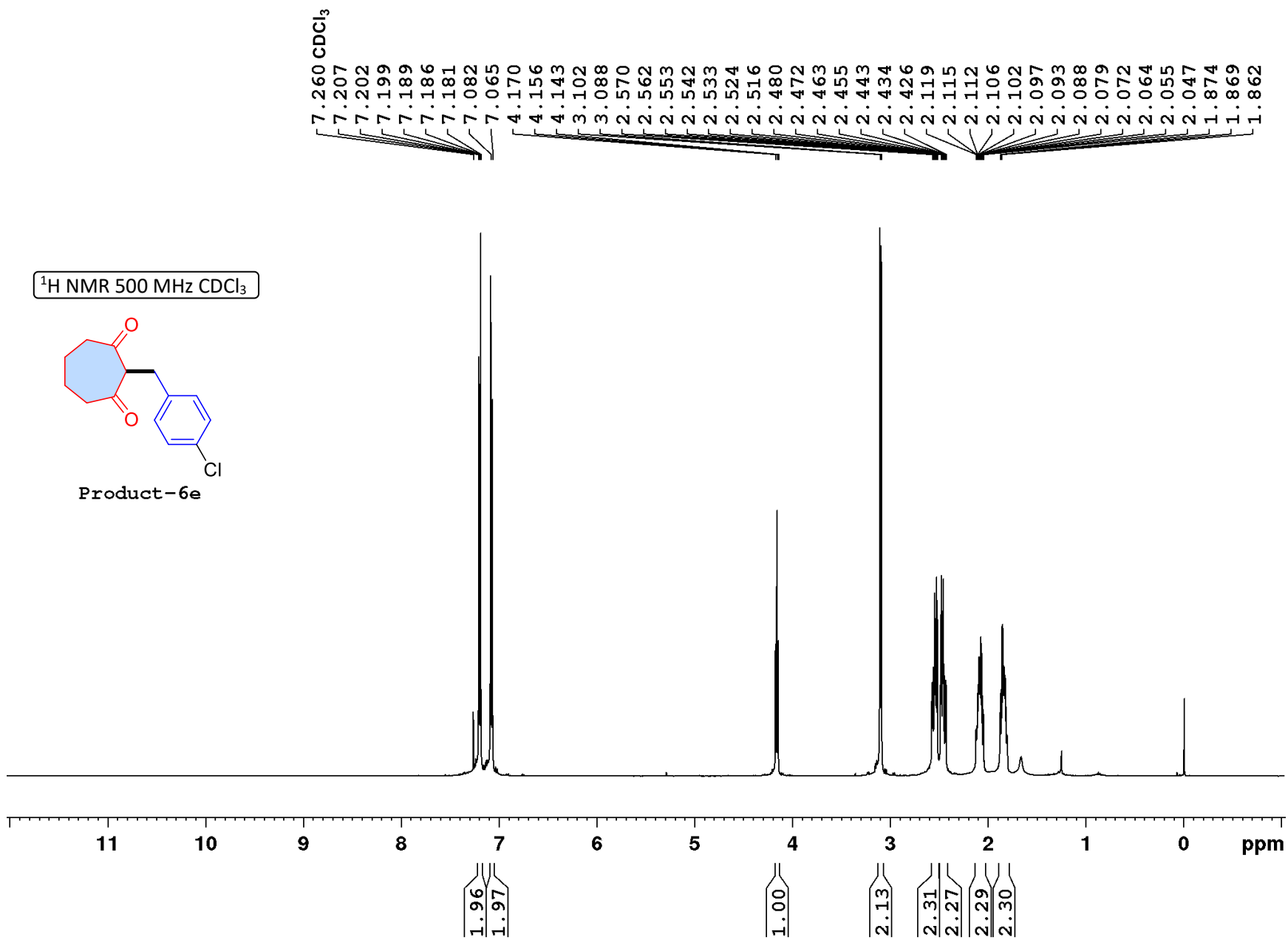
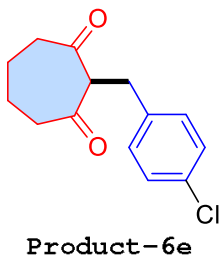
¹⁹F NMR 375 MHz CDCl₃

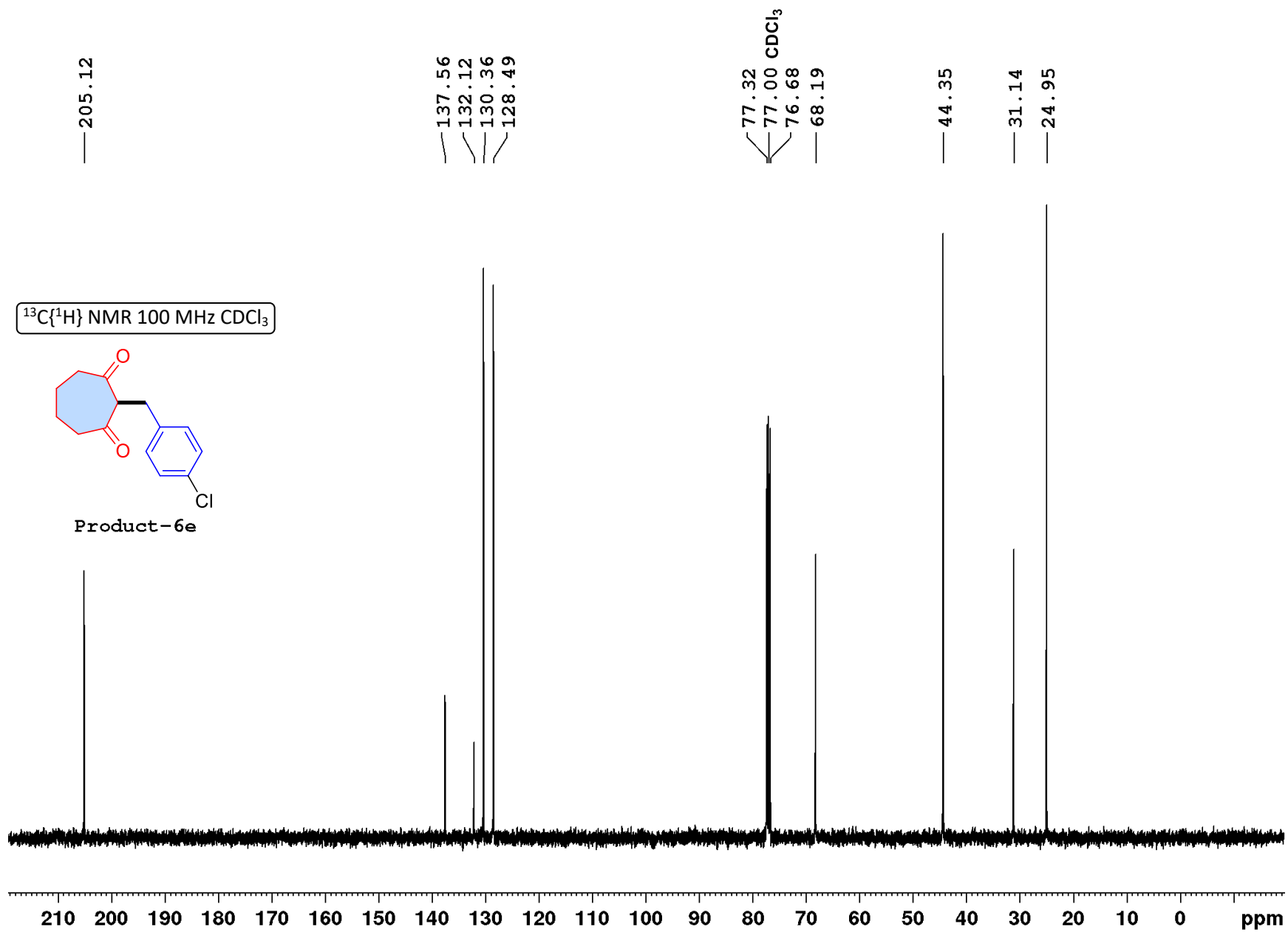


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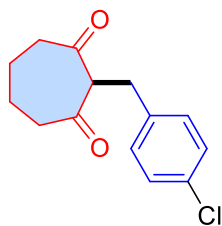


¹H NMR 500 MHz CDCl₃

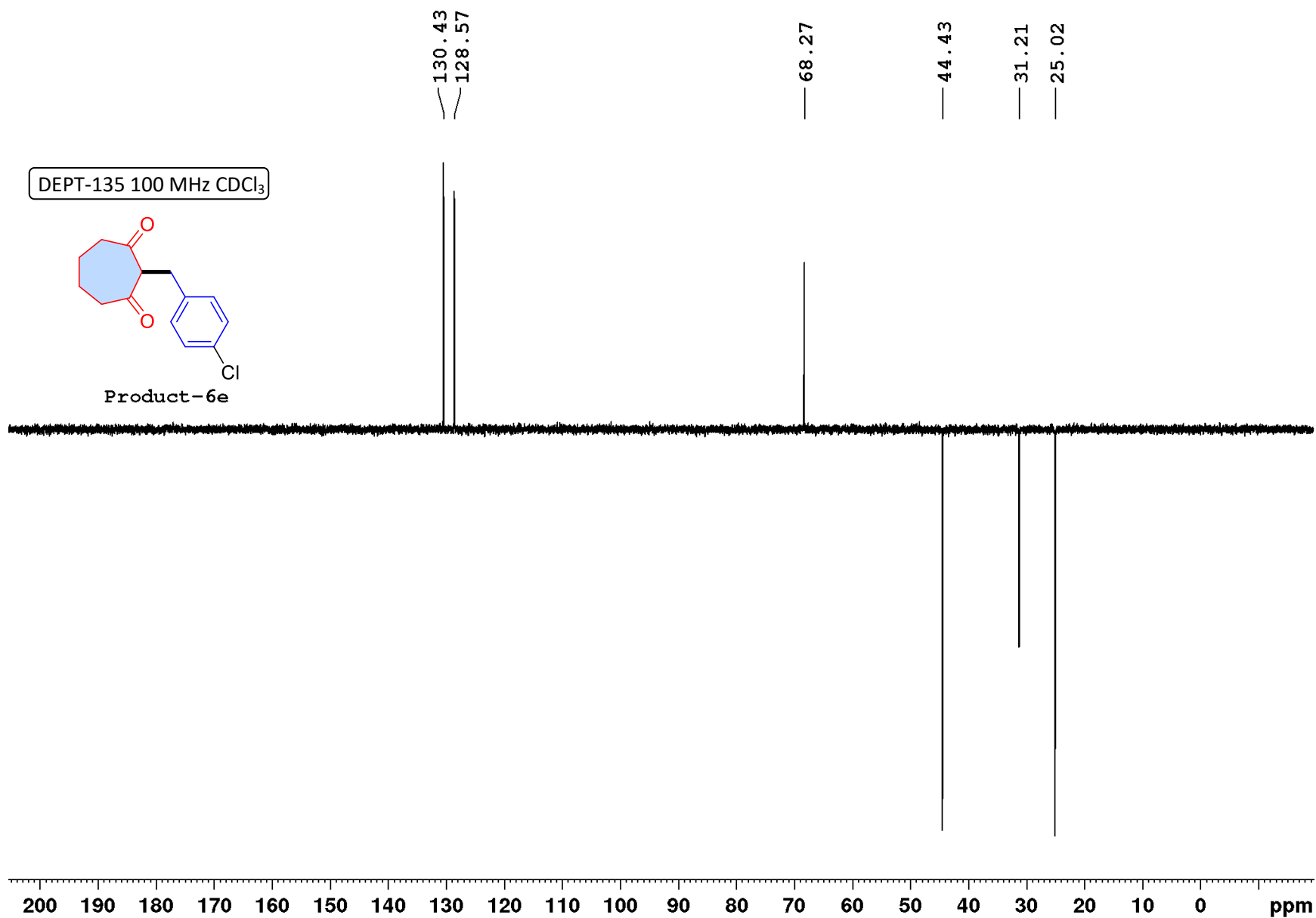




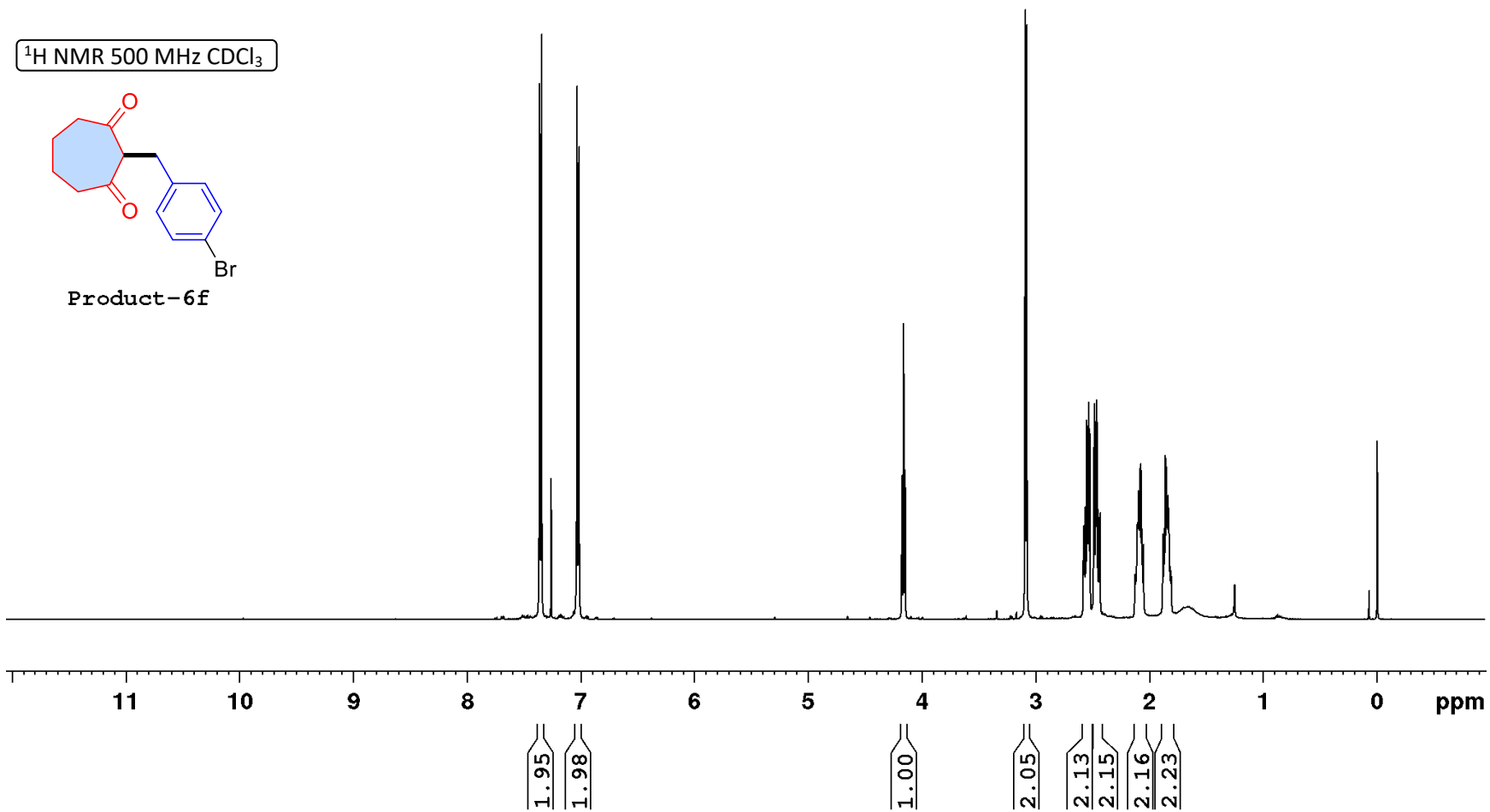
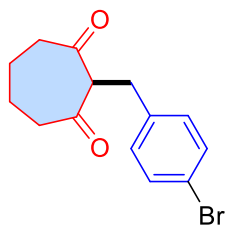
DEPT-135 100 MHz CDCl₃

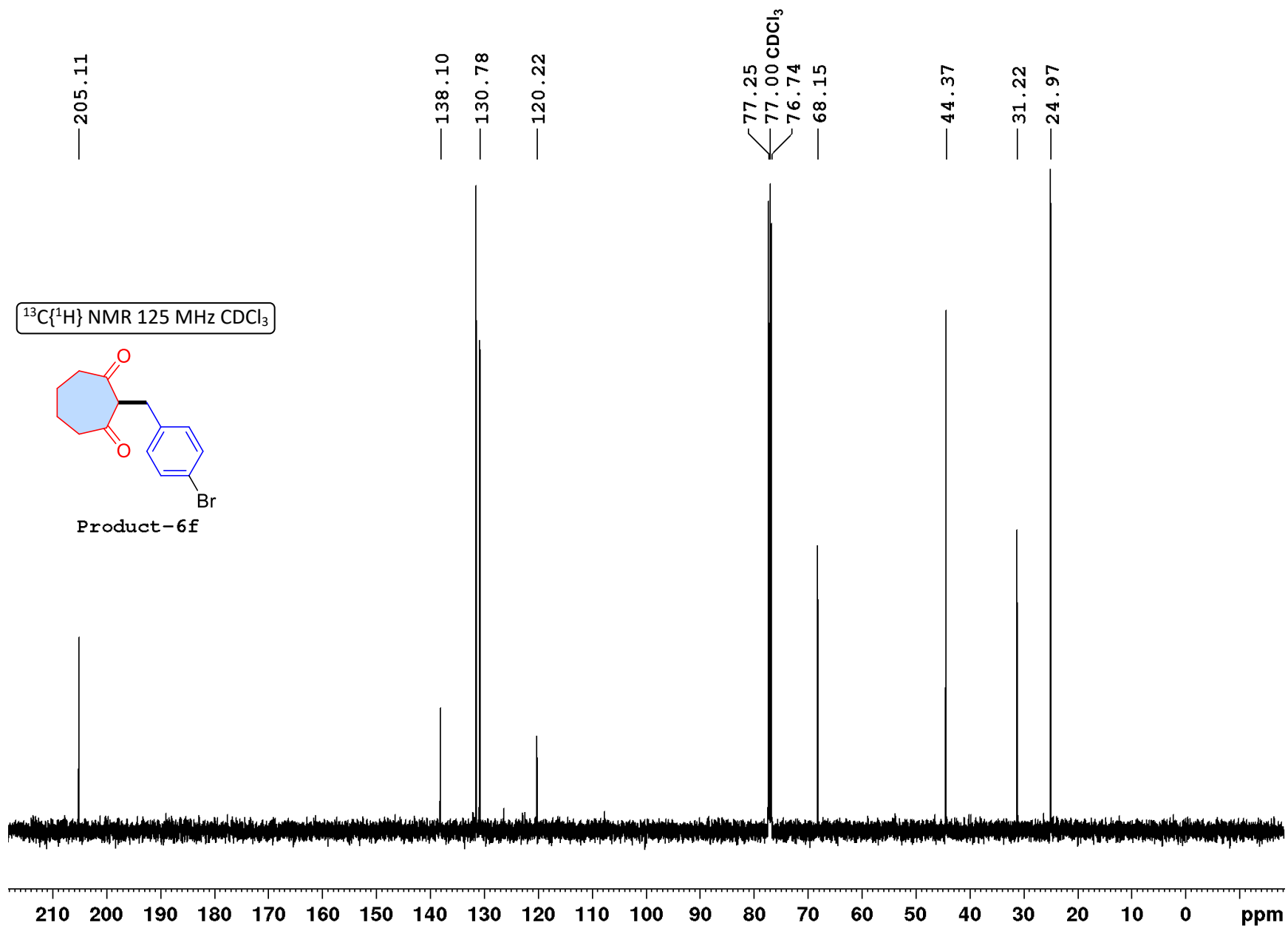


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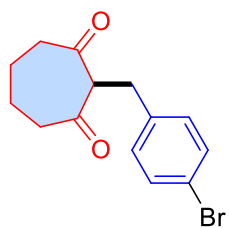


¹H NMR 500 MHz CDCl₃

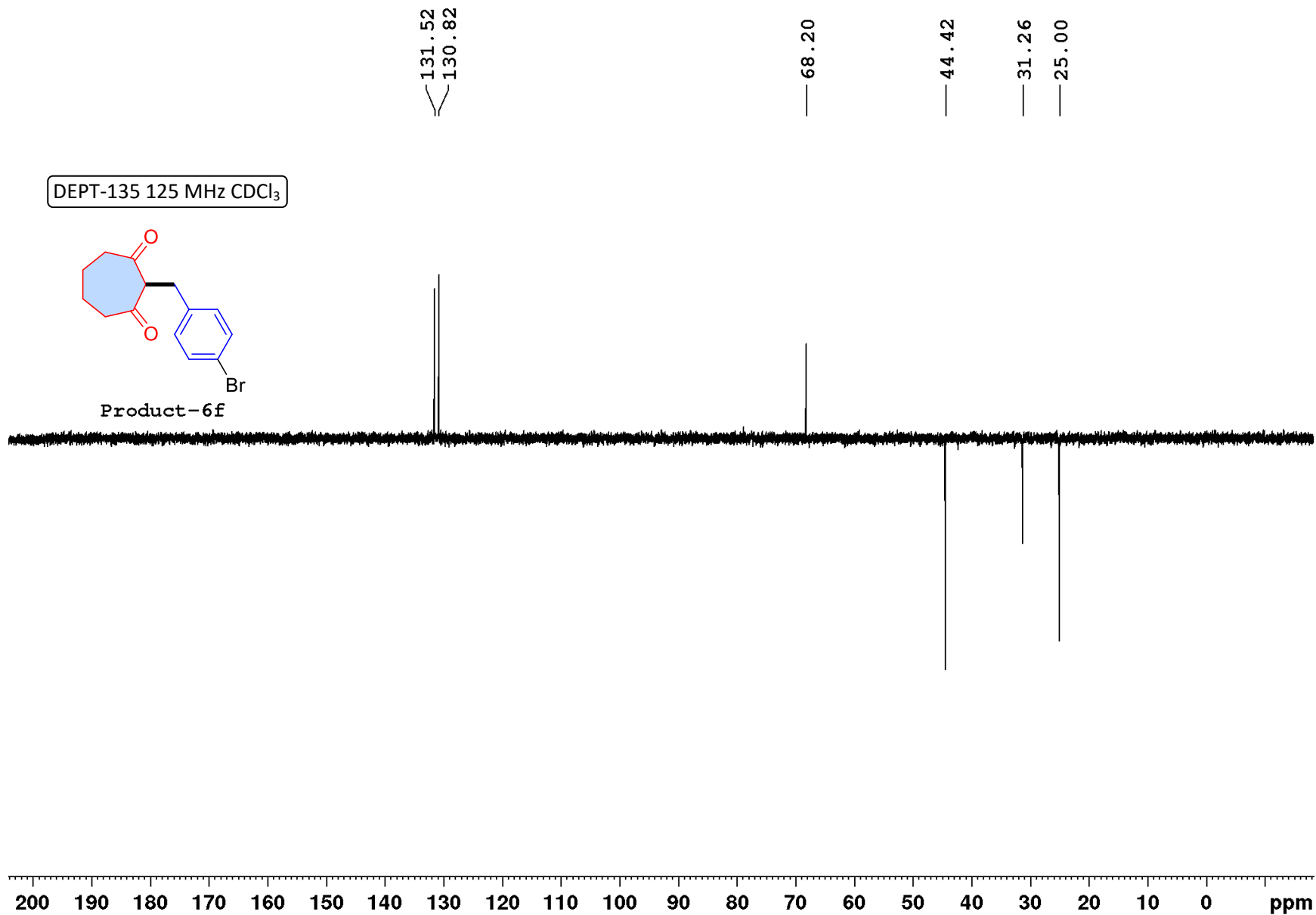




DEPT-135 125 MHz CDCl₃



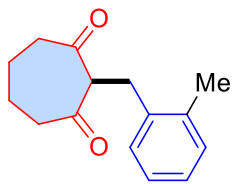
Product-6f



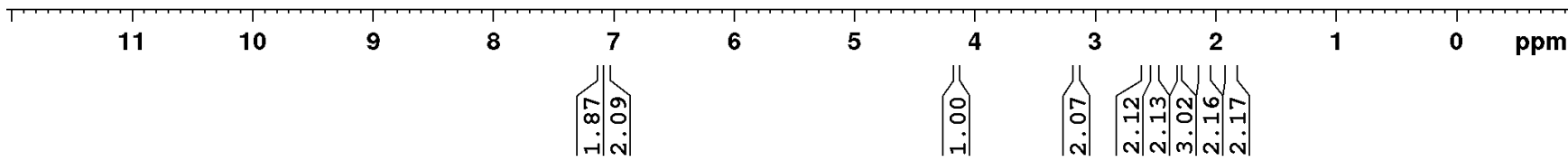
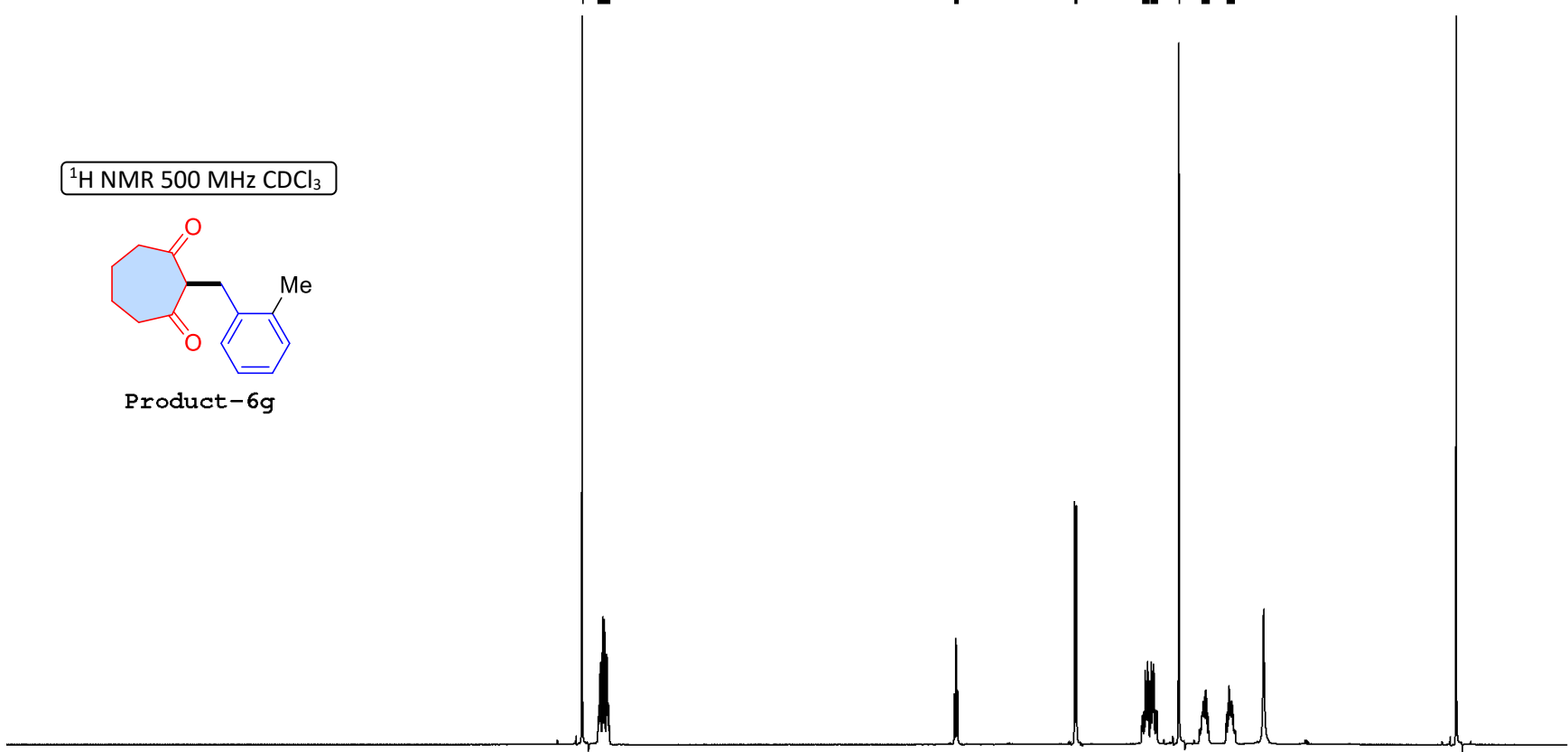
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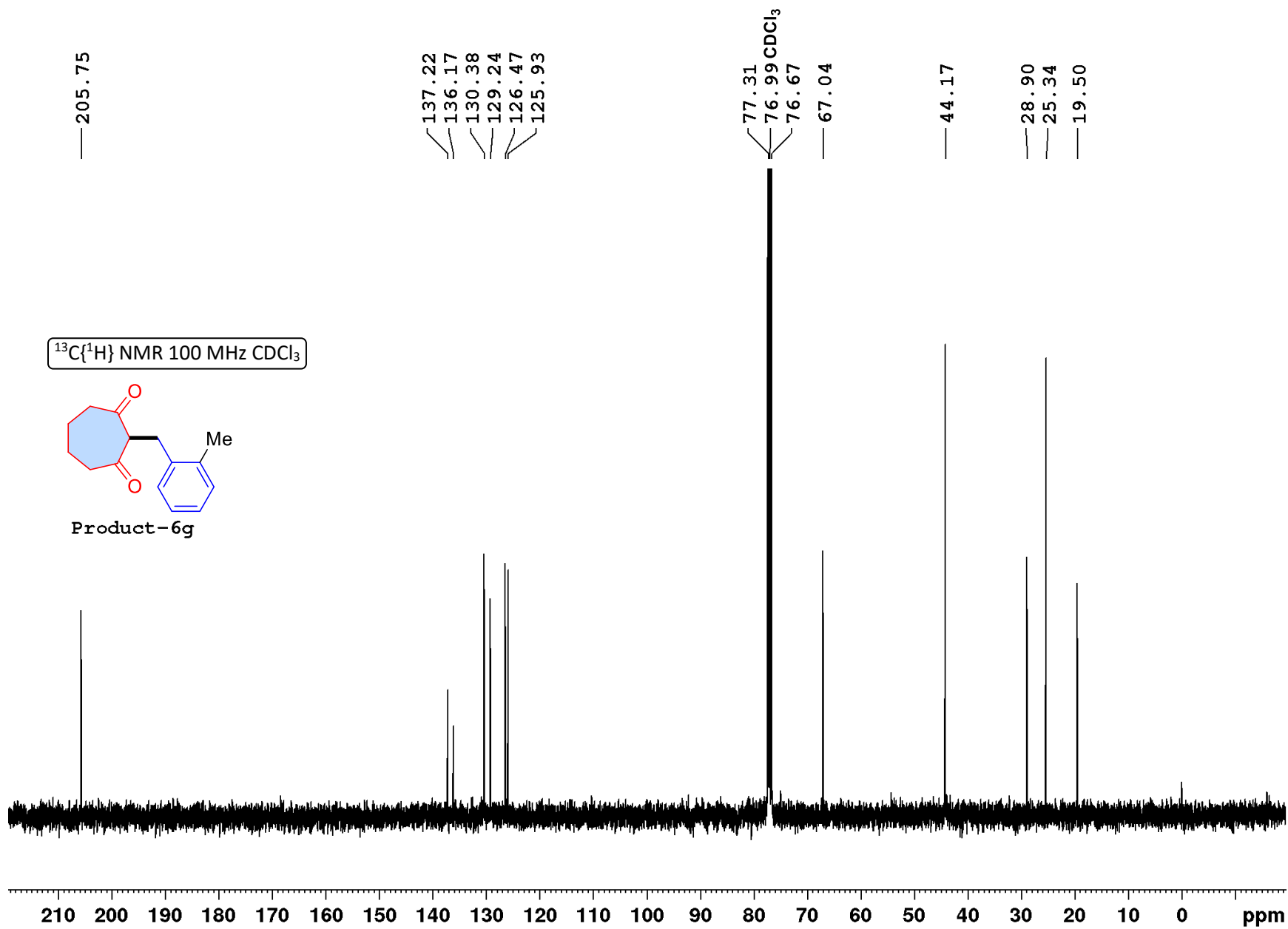
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¹H NMR 500 MHz CDCl₃

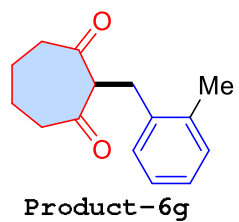


Product-6g





DEPT-135 100 MHz CDCl₃



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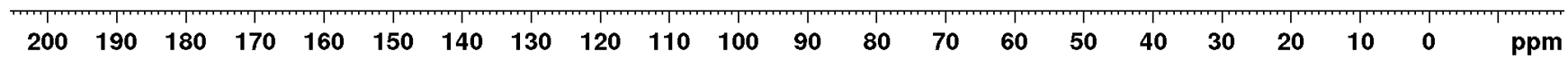
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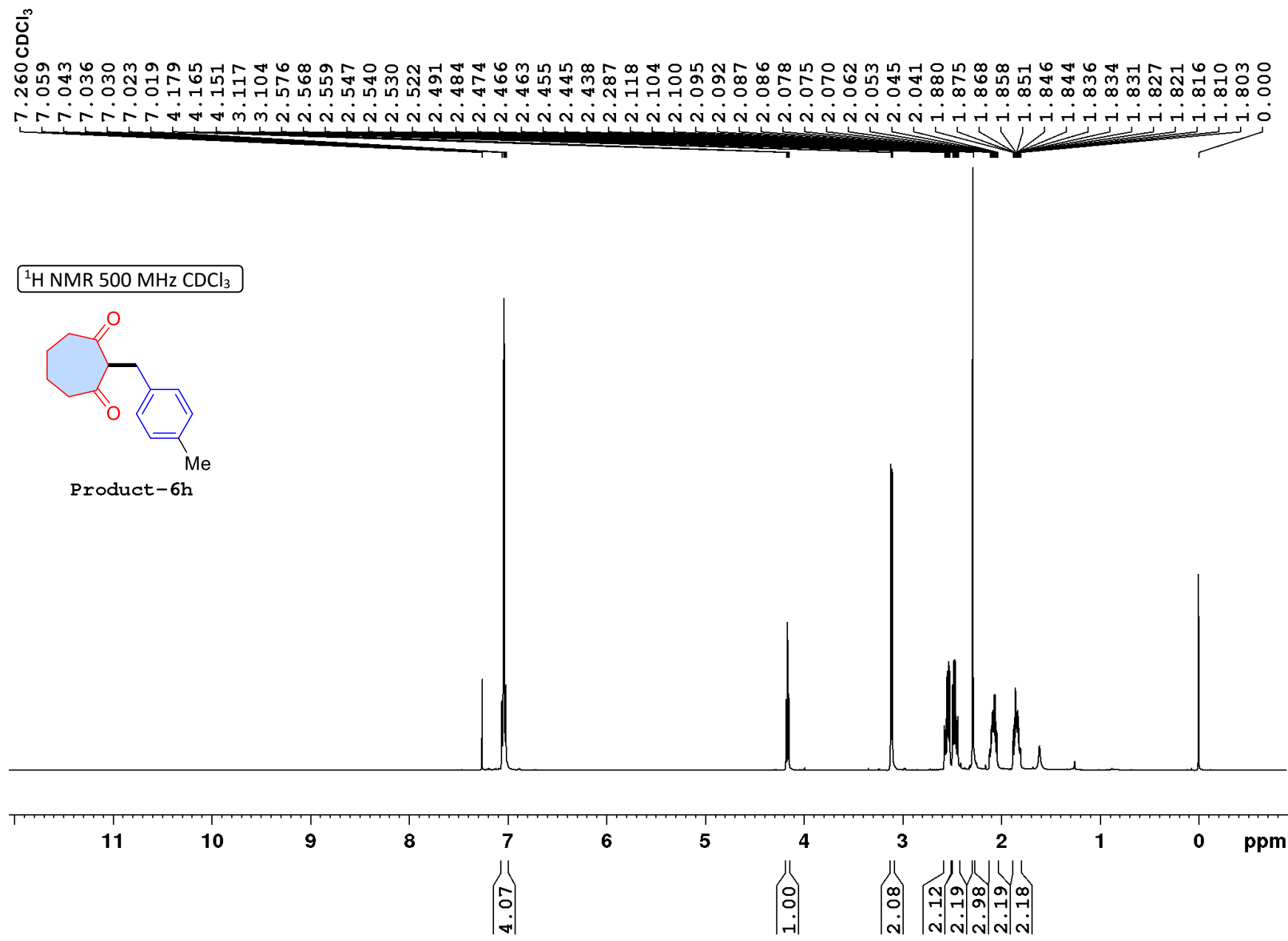
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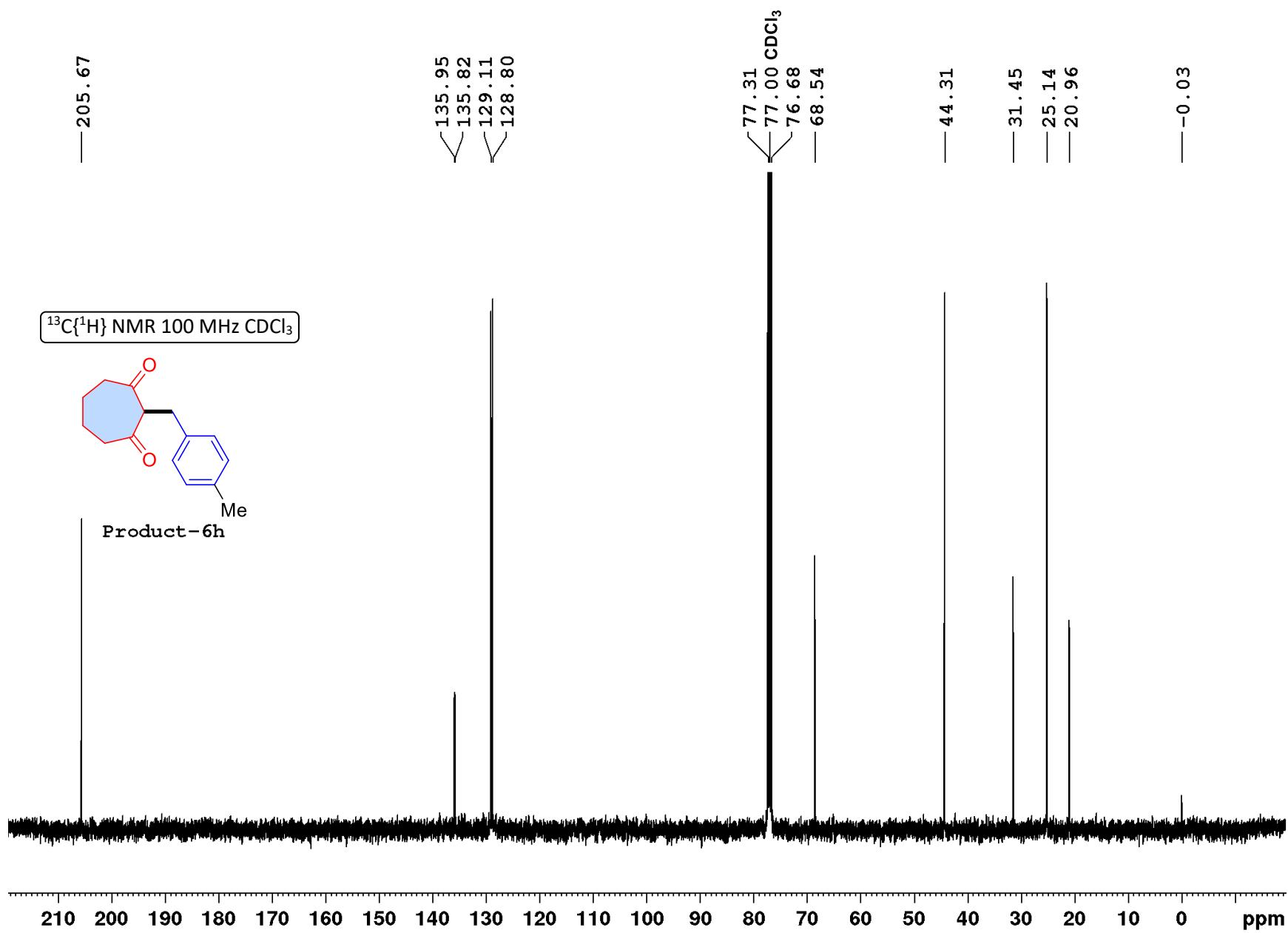
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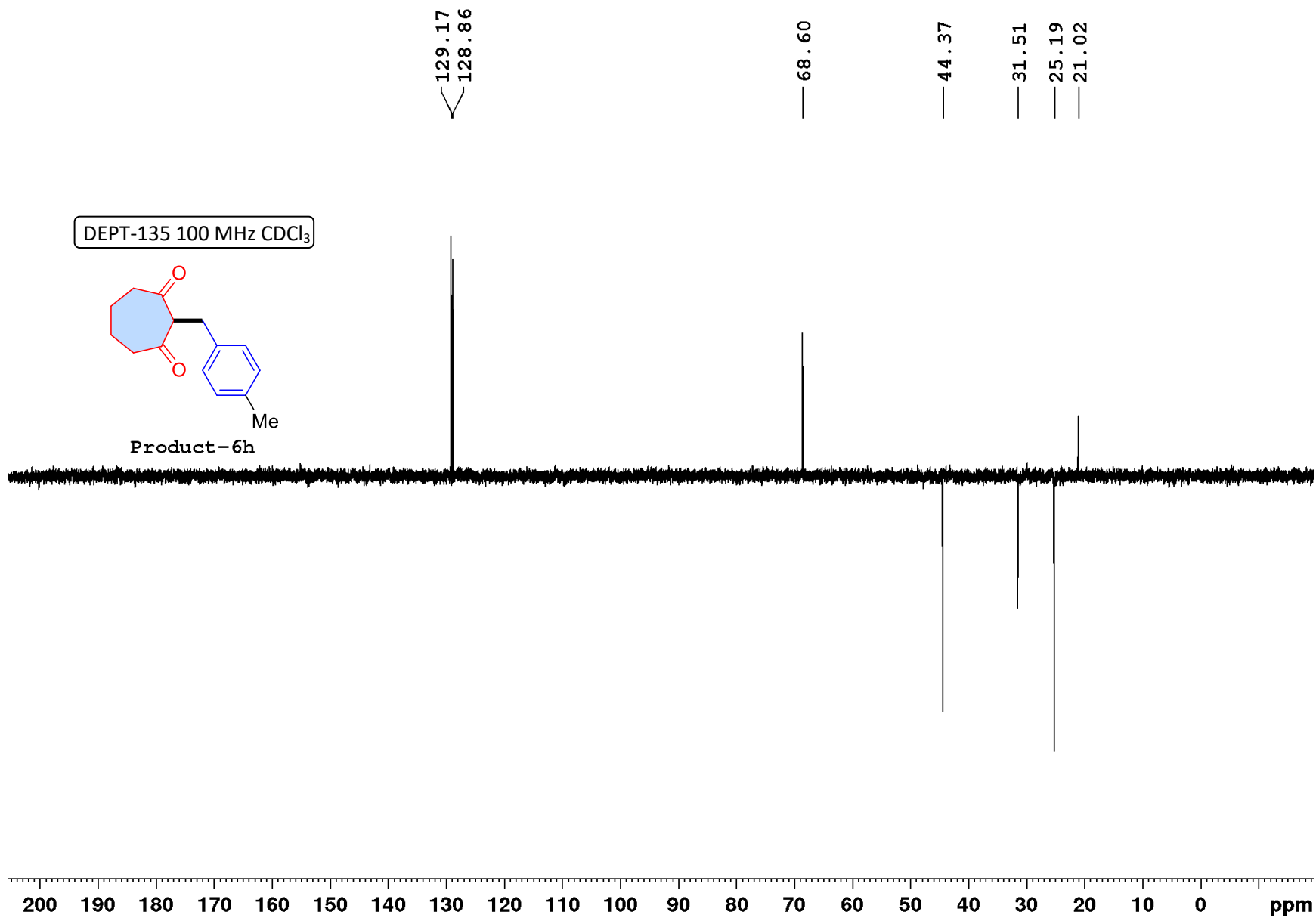
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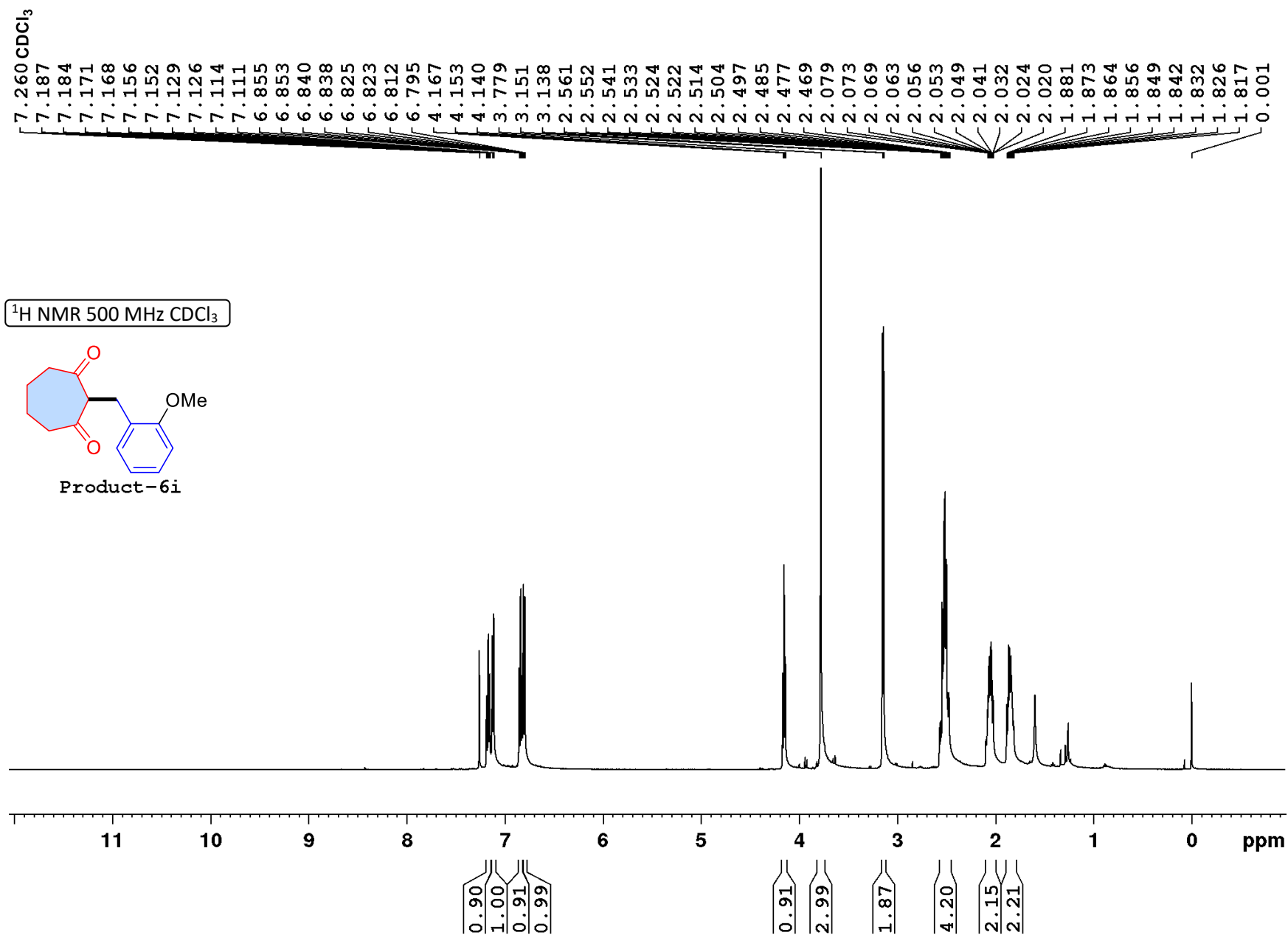
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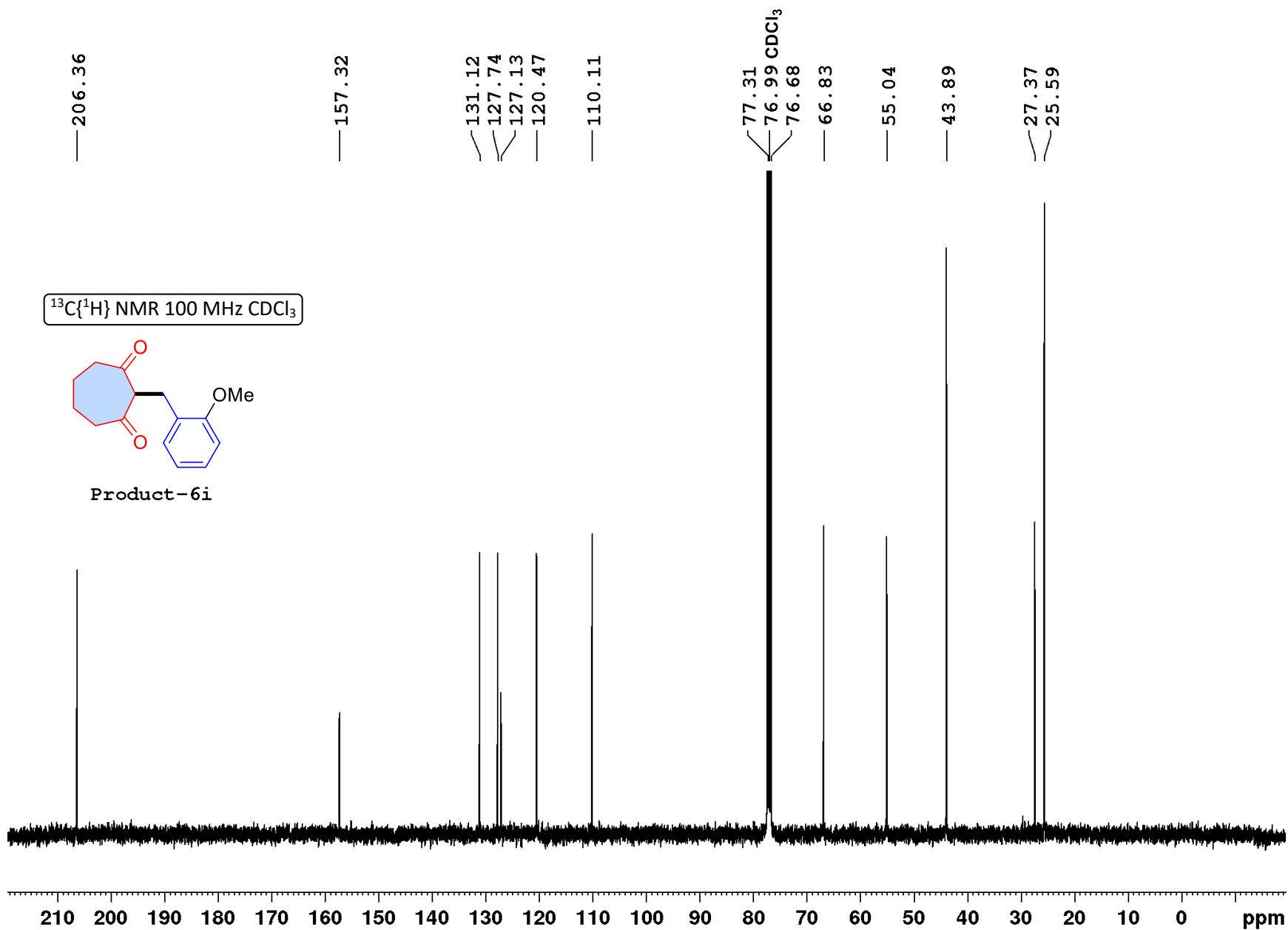


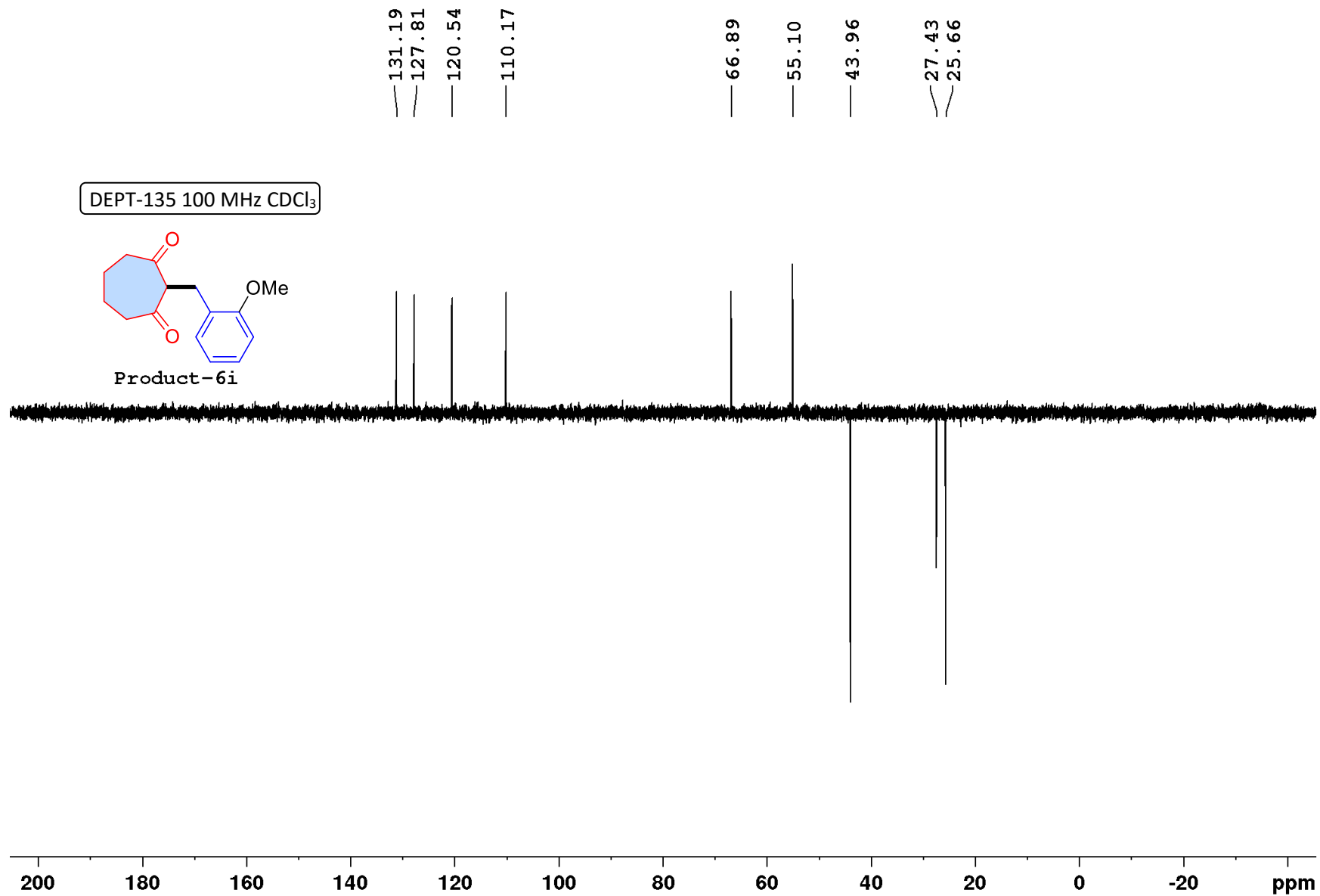


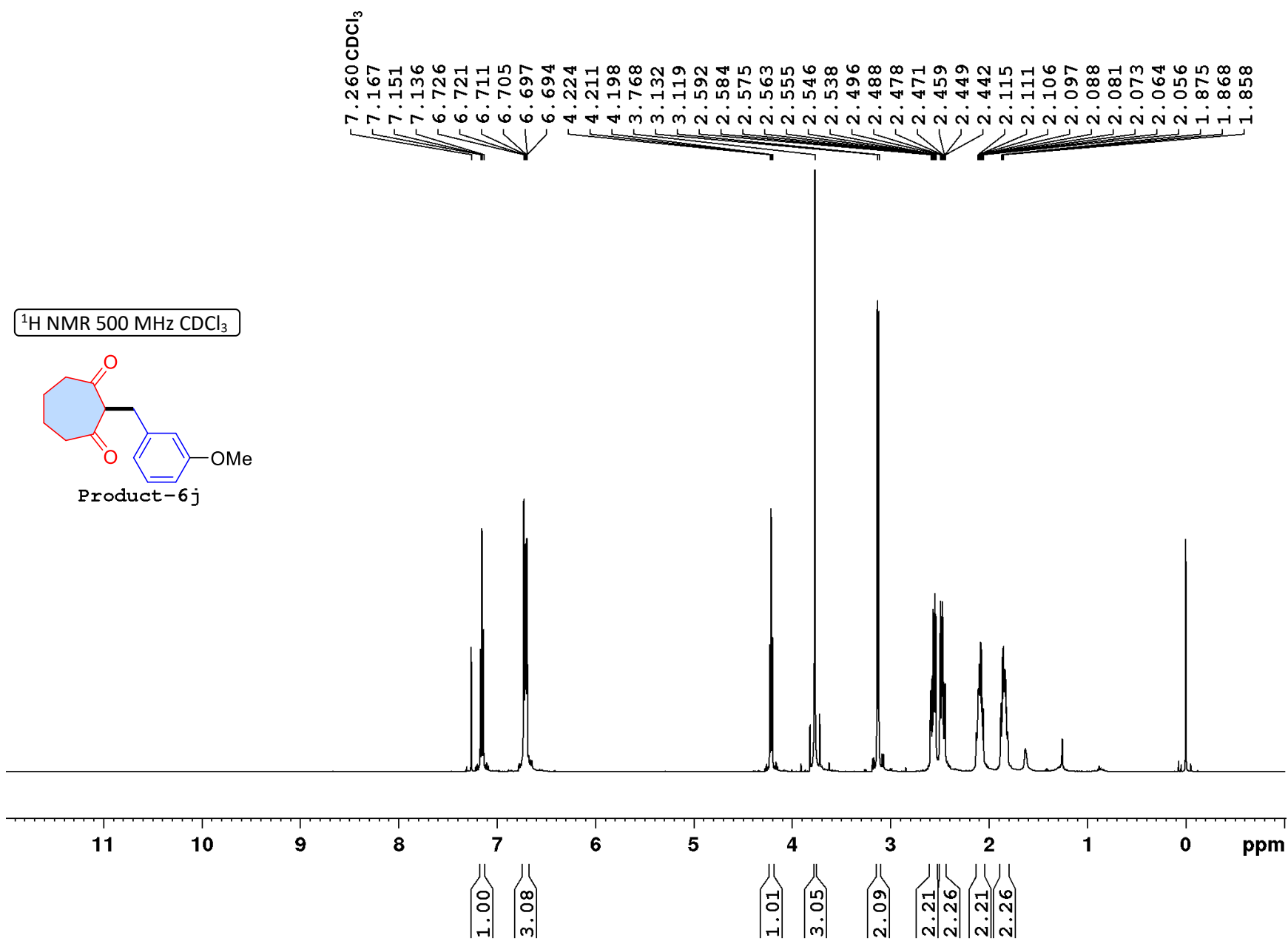


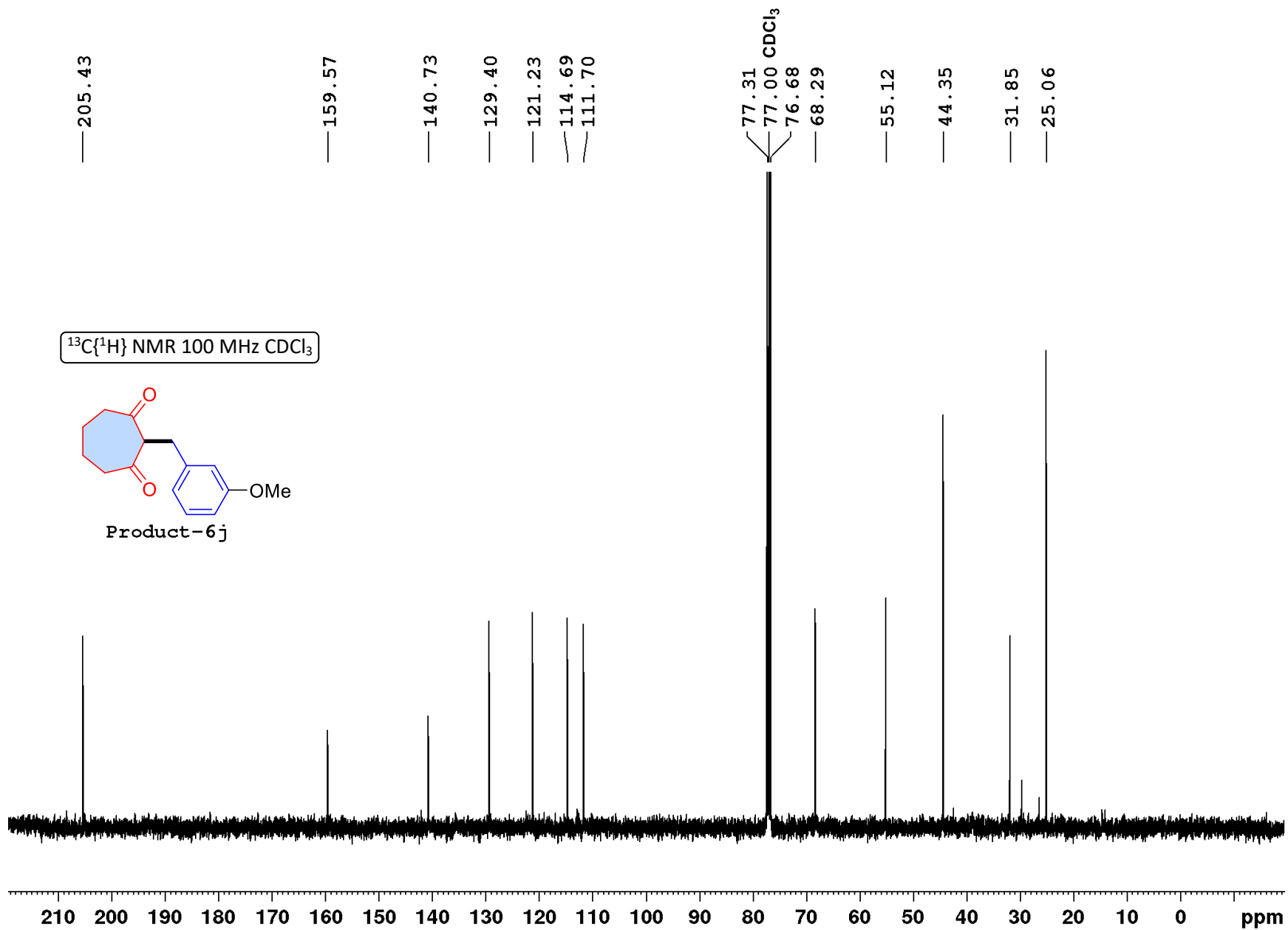




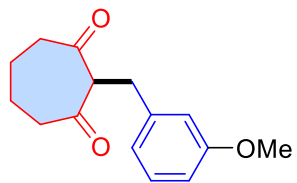




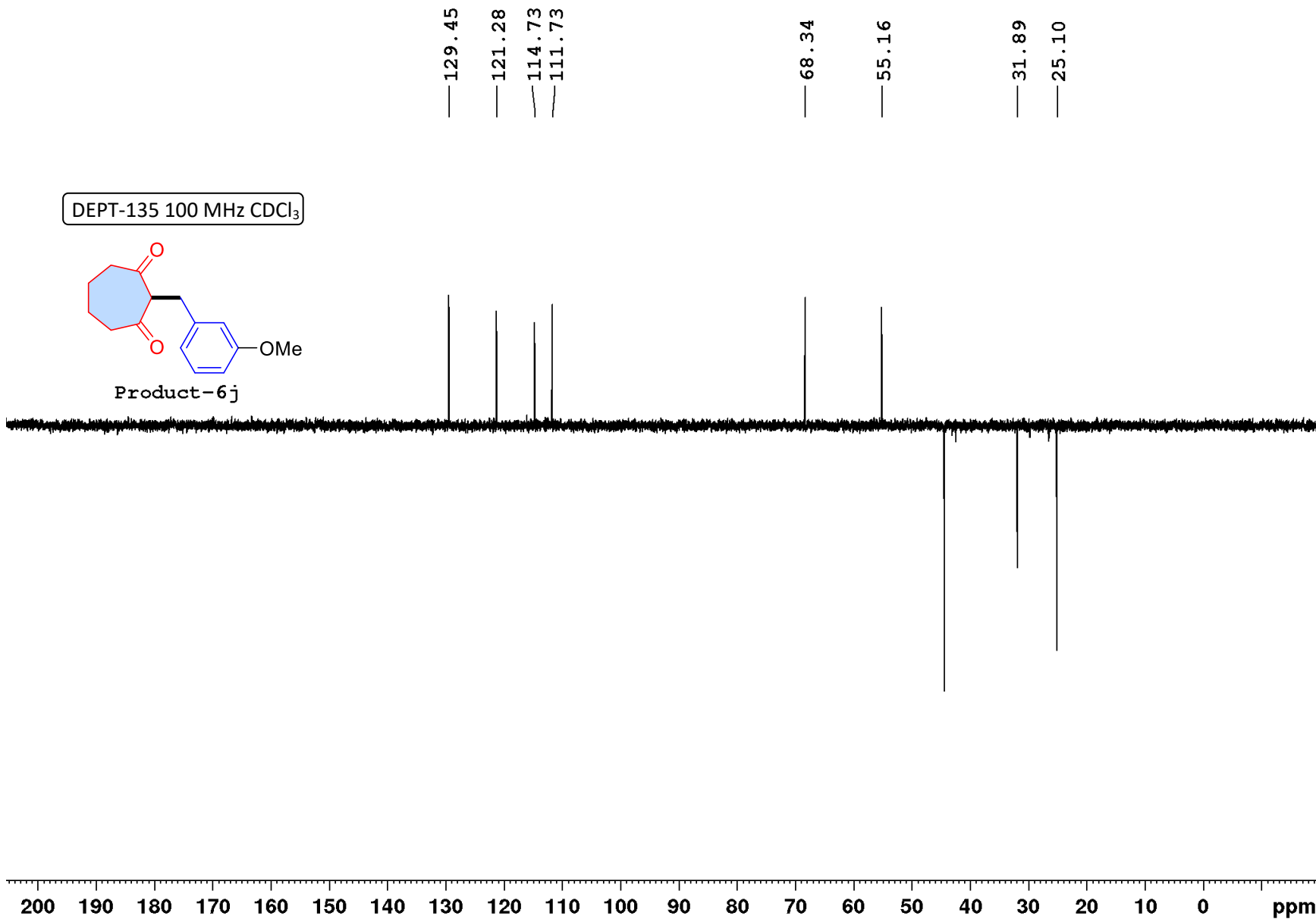




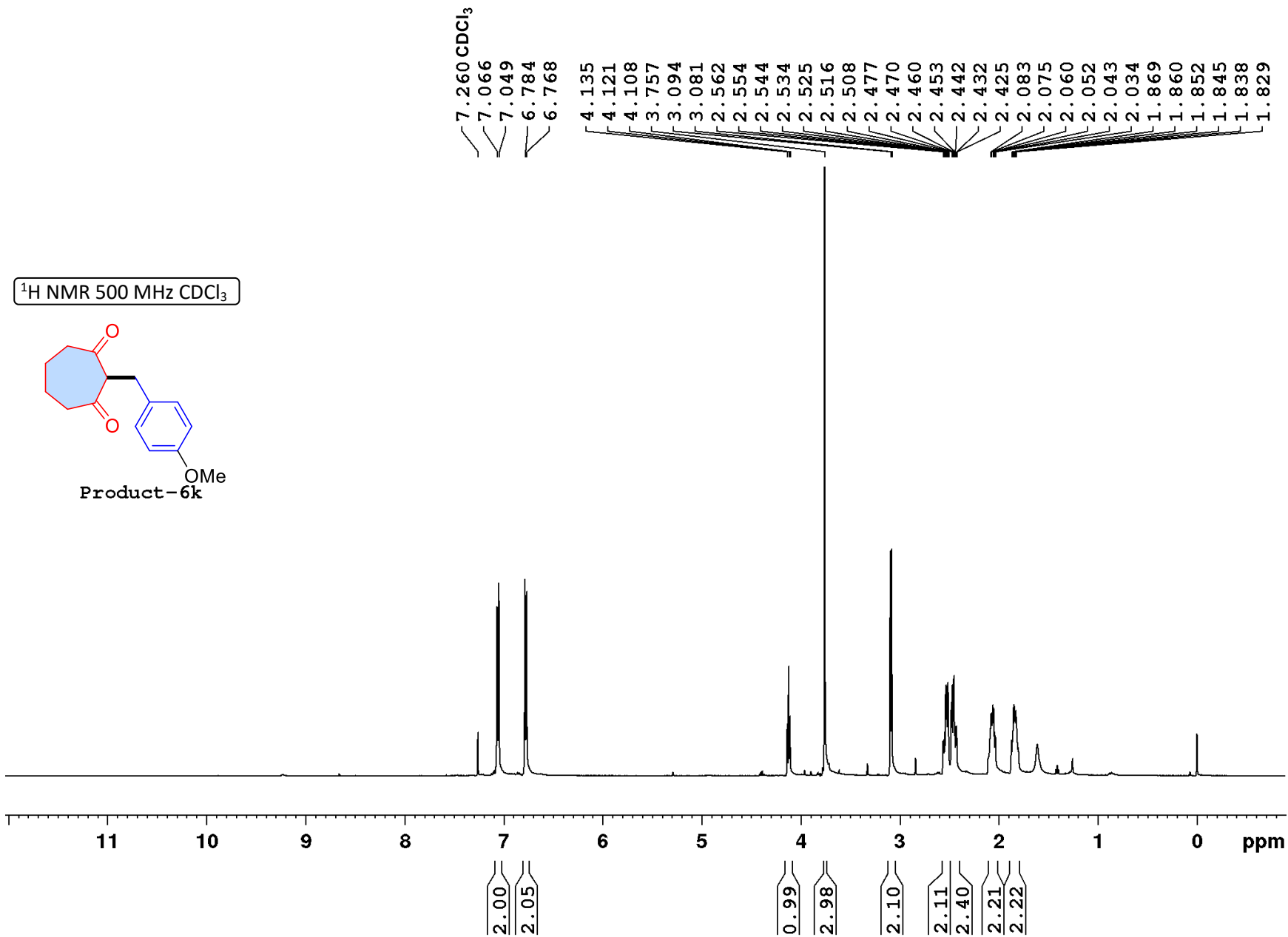
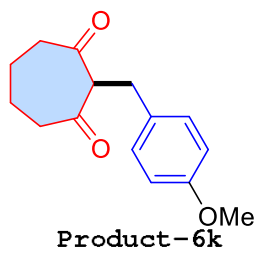
DEPT-135 100 MHz CDCl₃

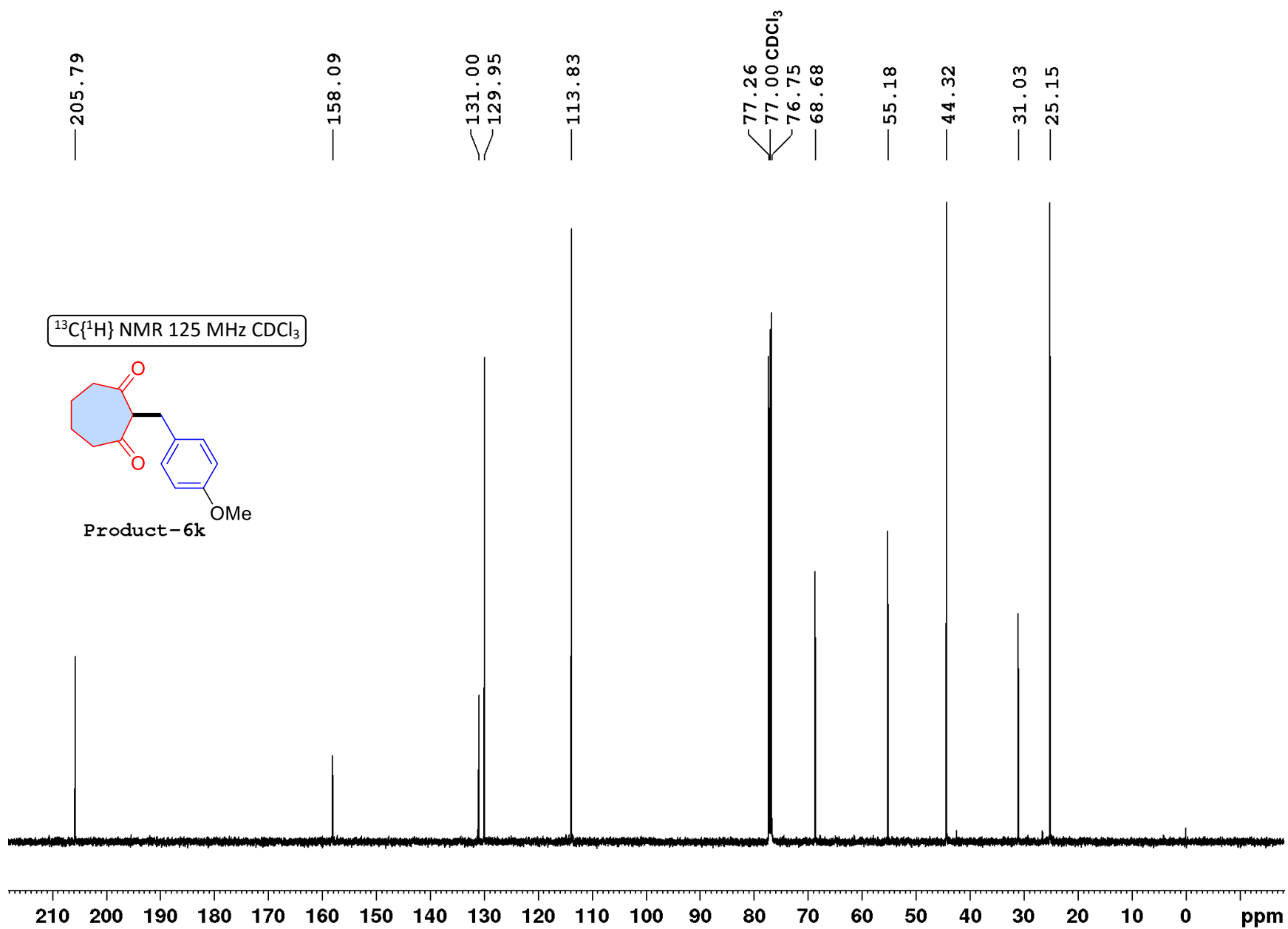


Product-6j

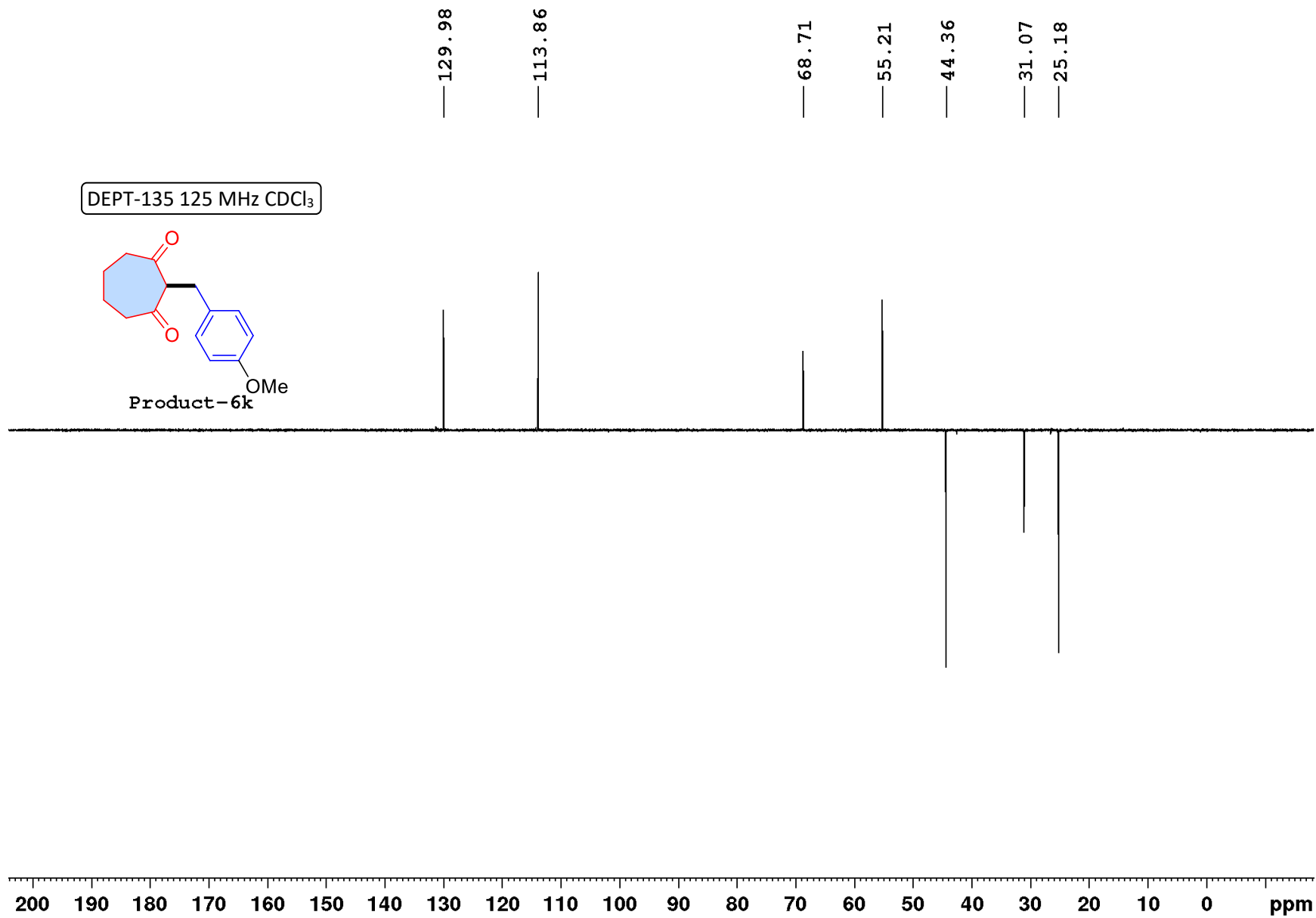
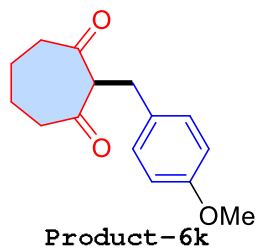


^1H NMR 500 MHz CDCl_3



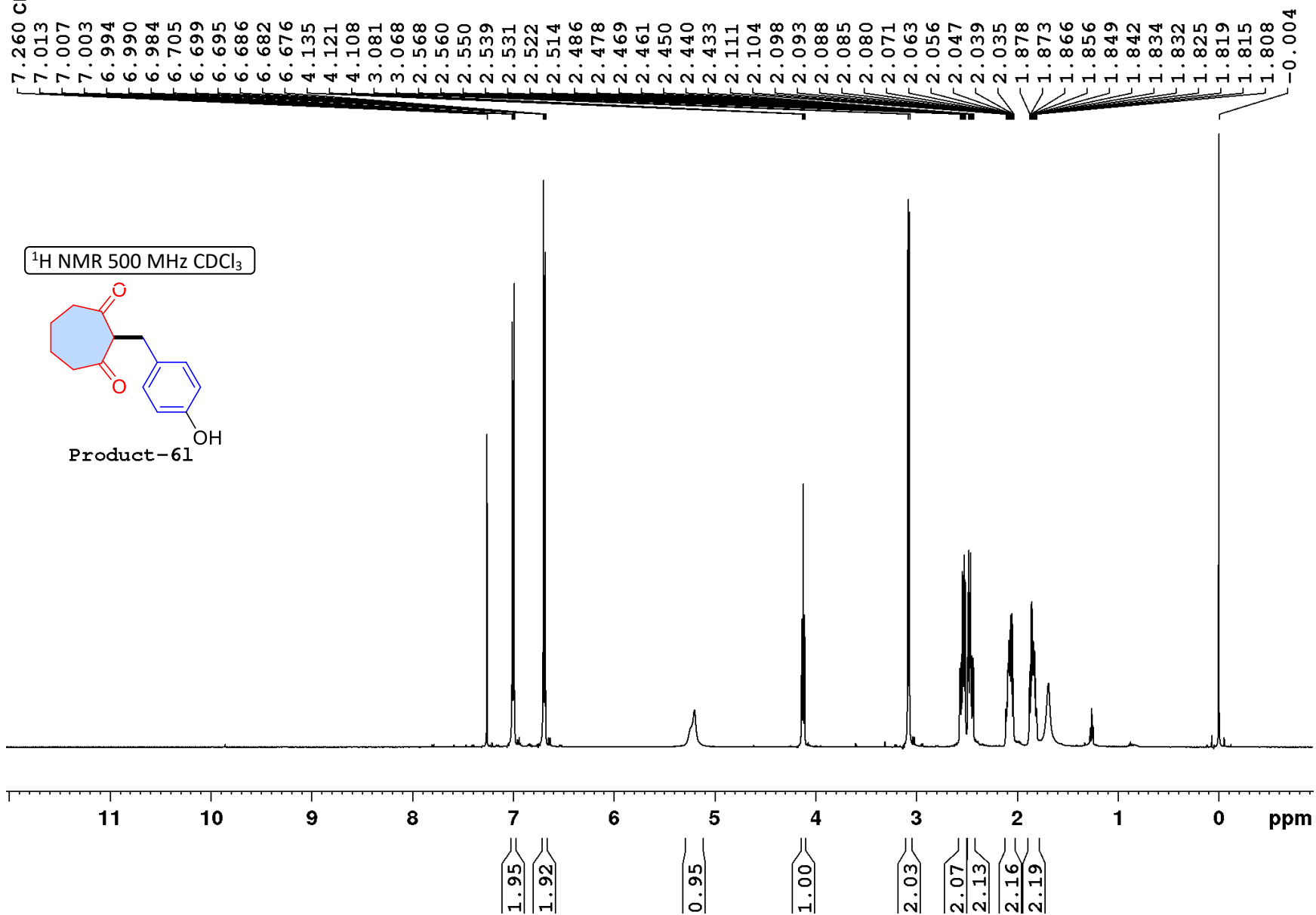
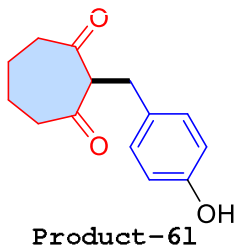


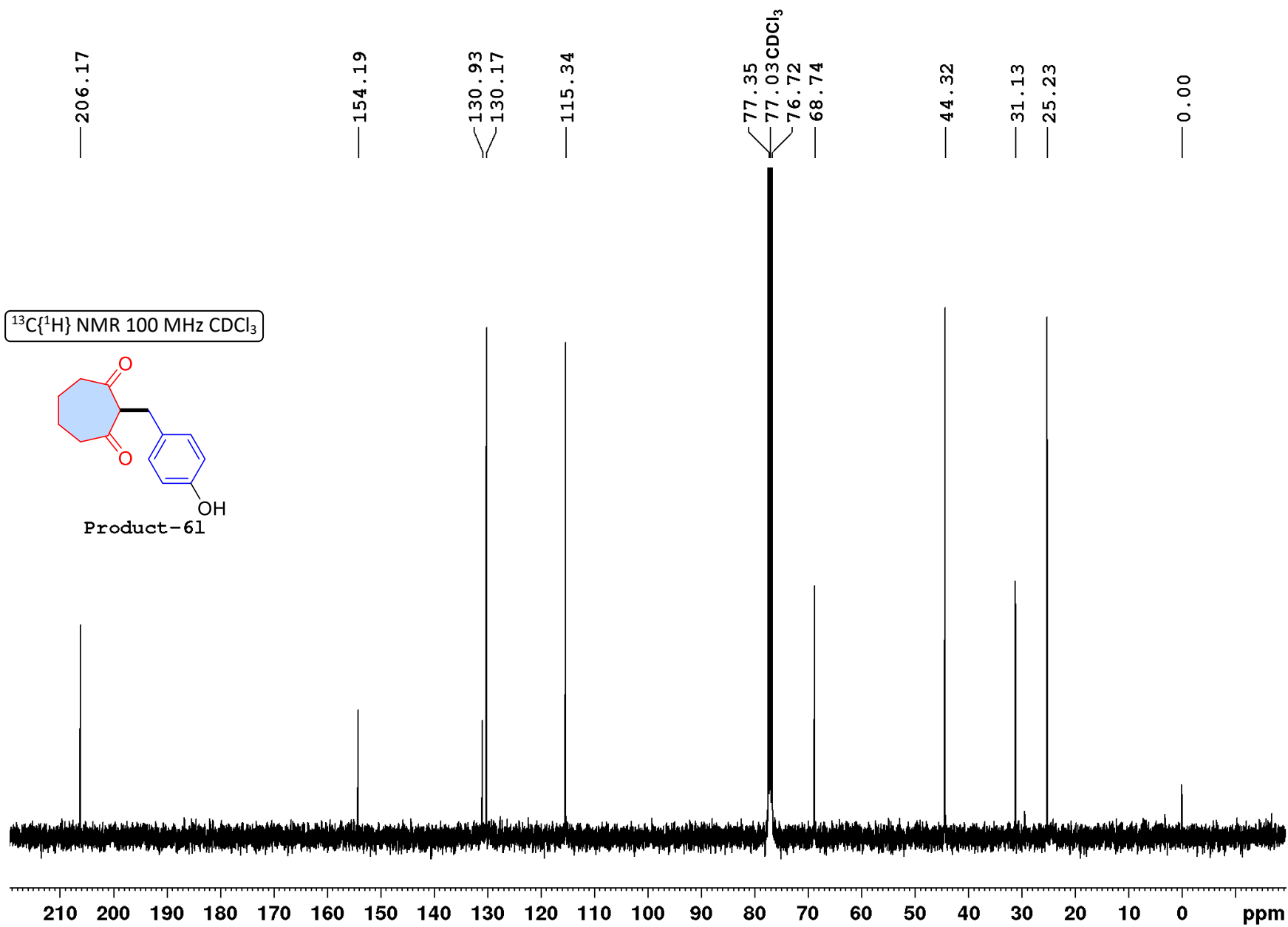
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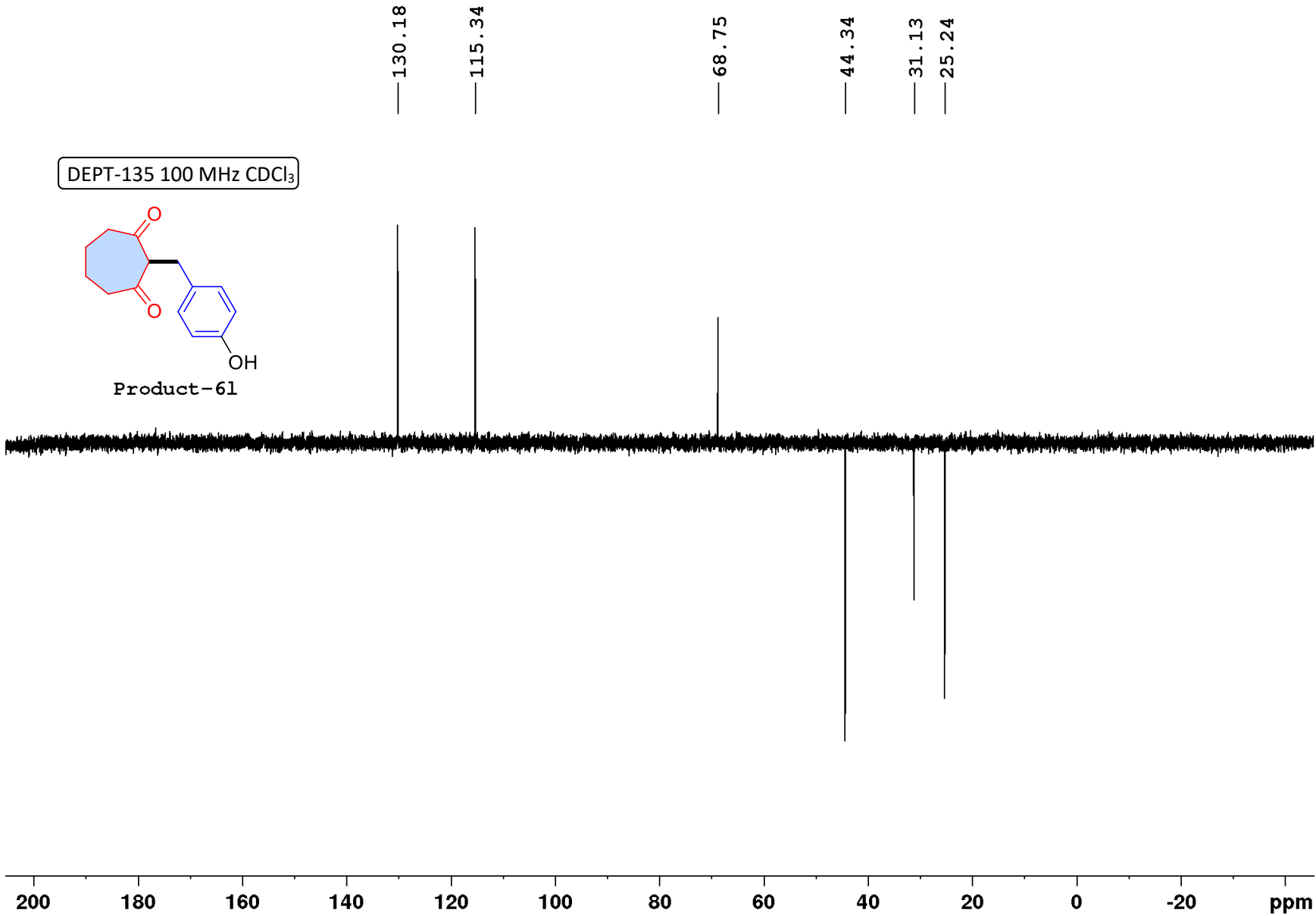
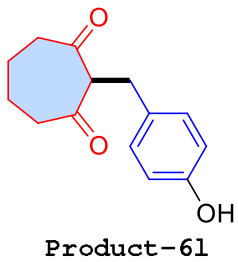
¹H NMR 500 MHz CDCl₃

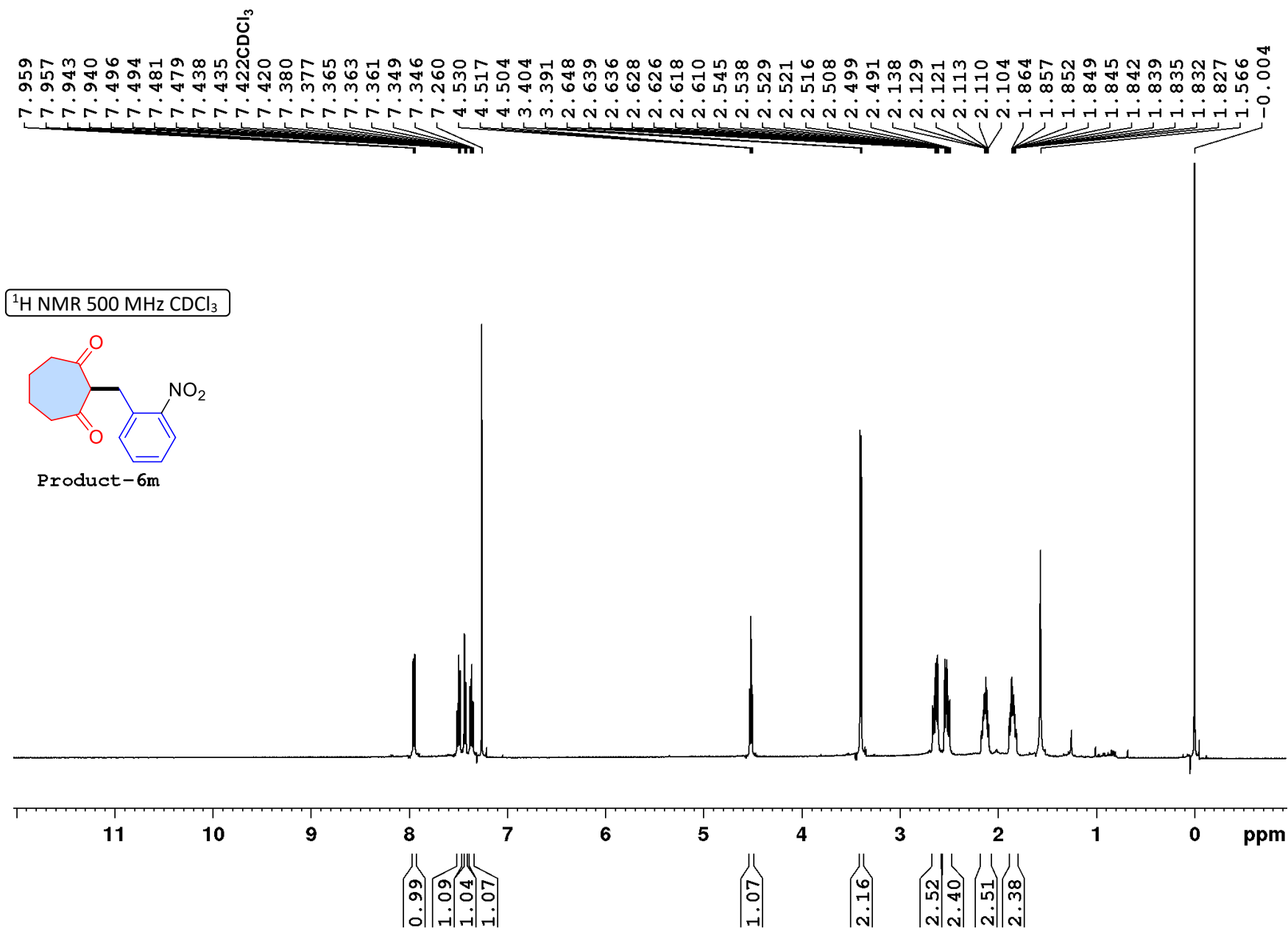
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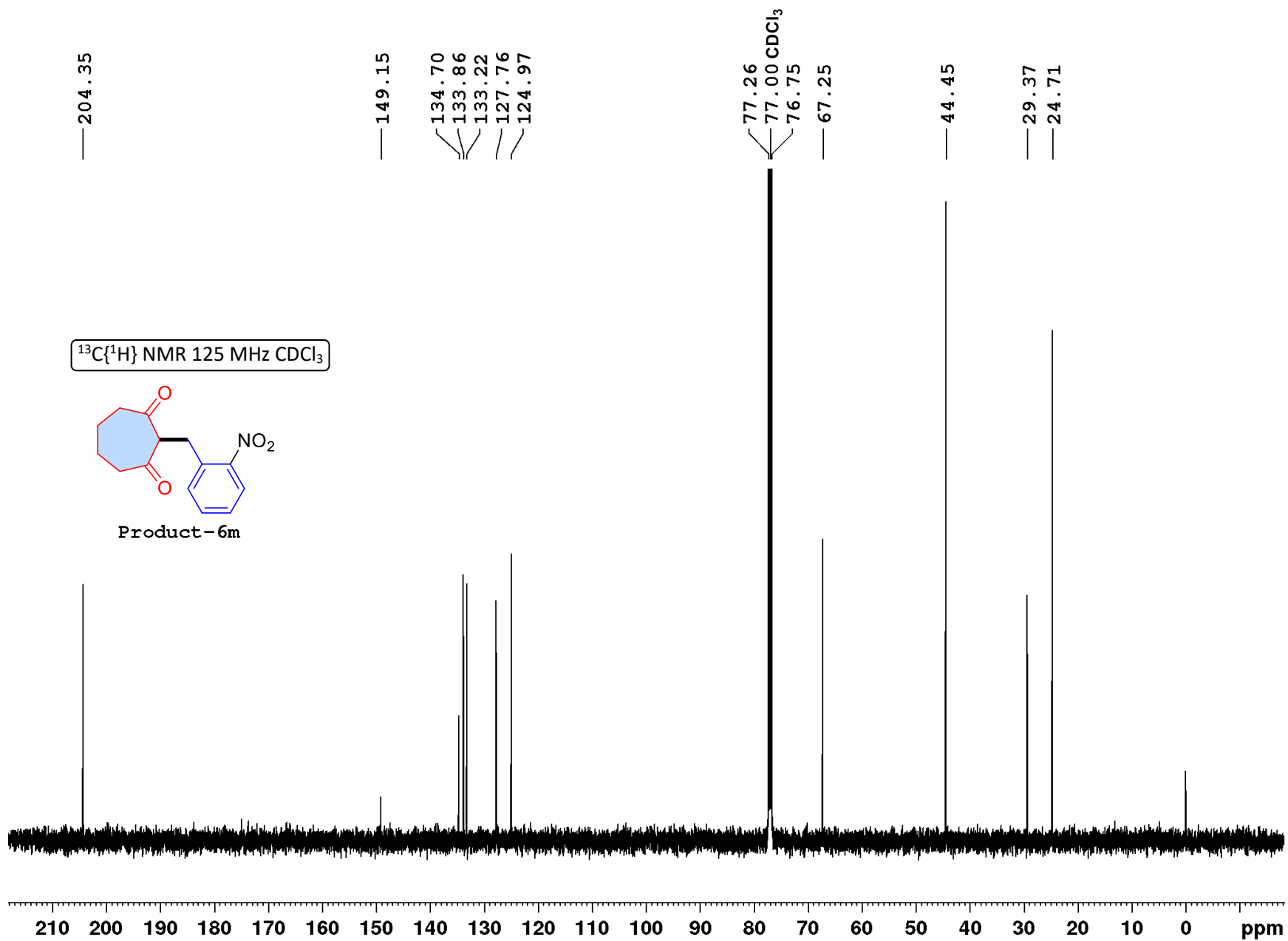


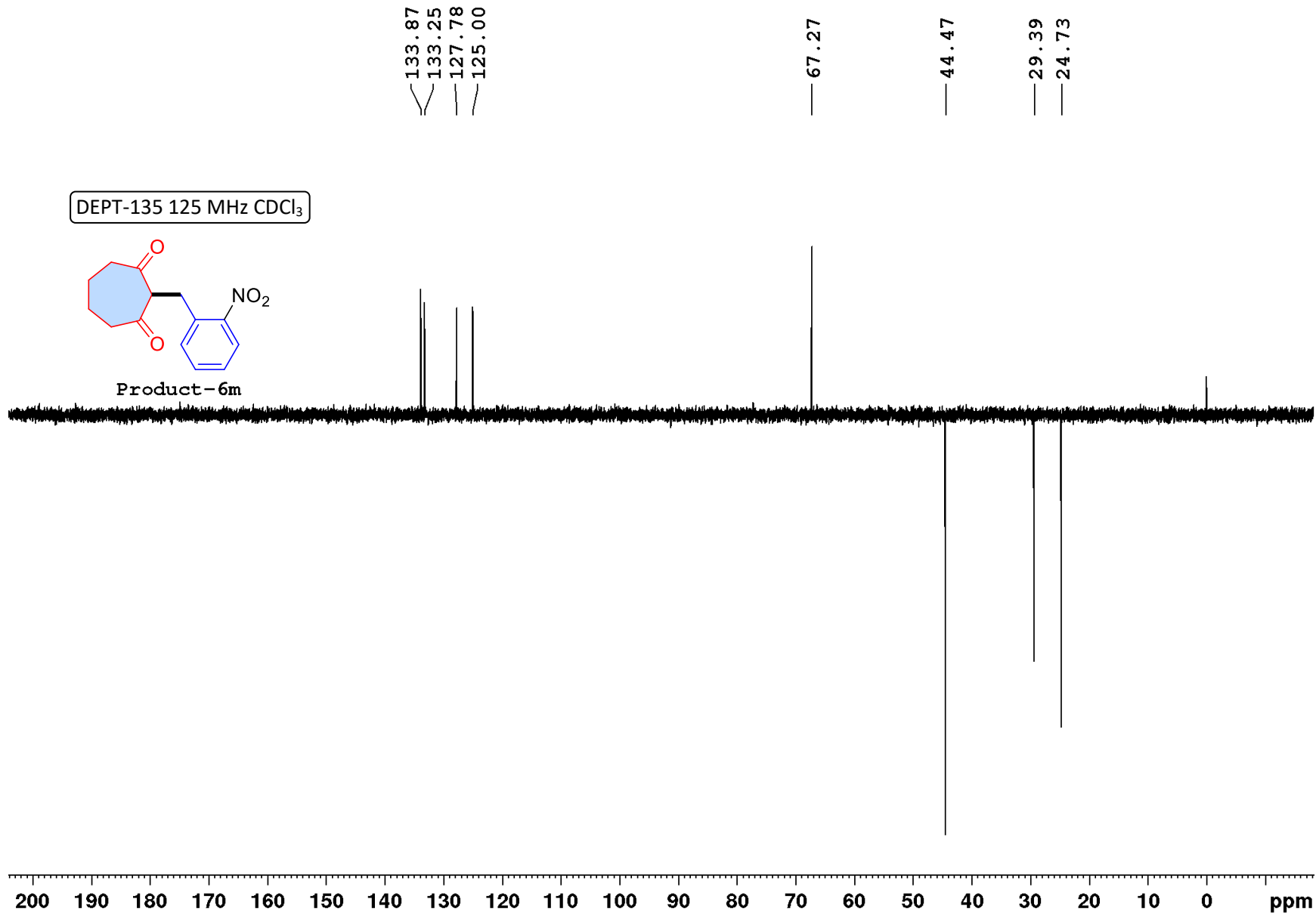


DEPT-135 100 MHz CDCl₃

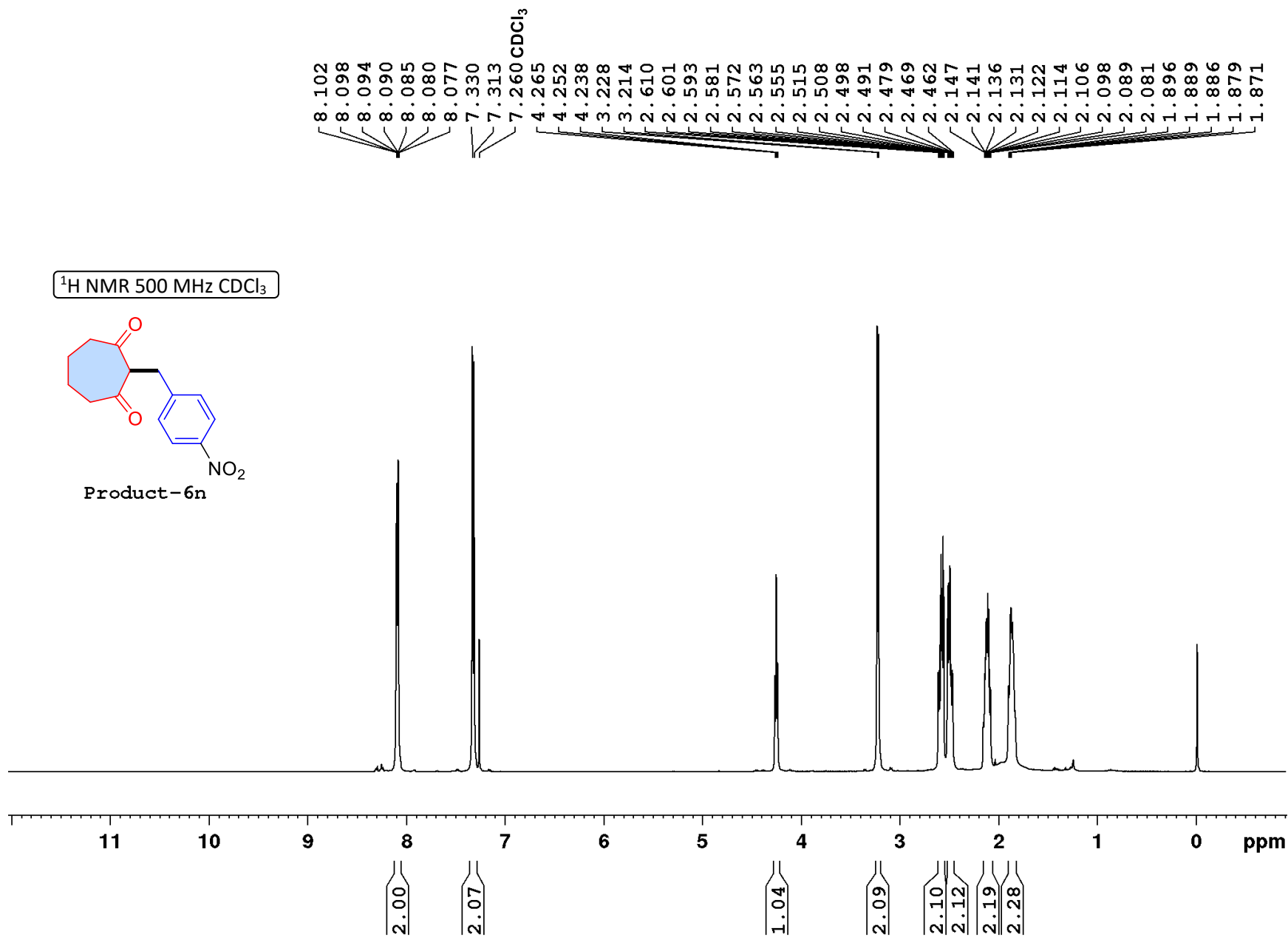
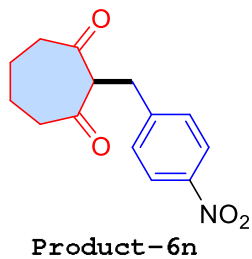


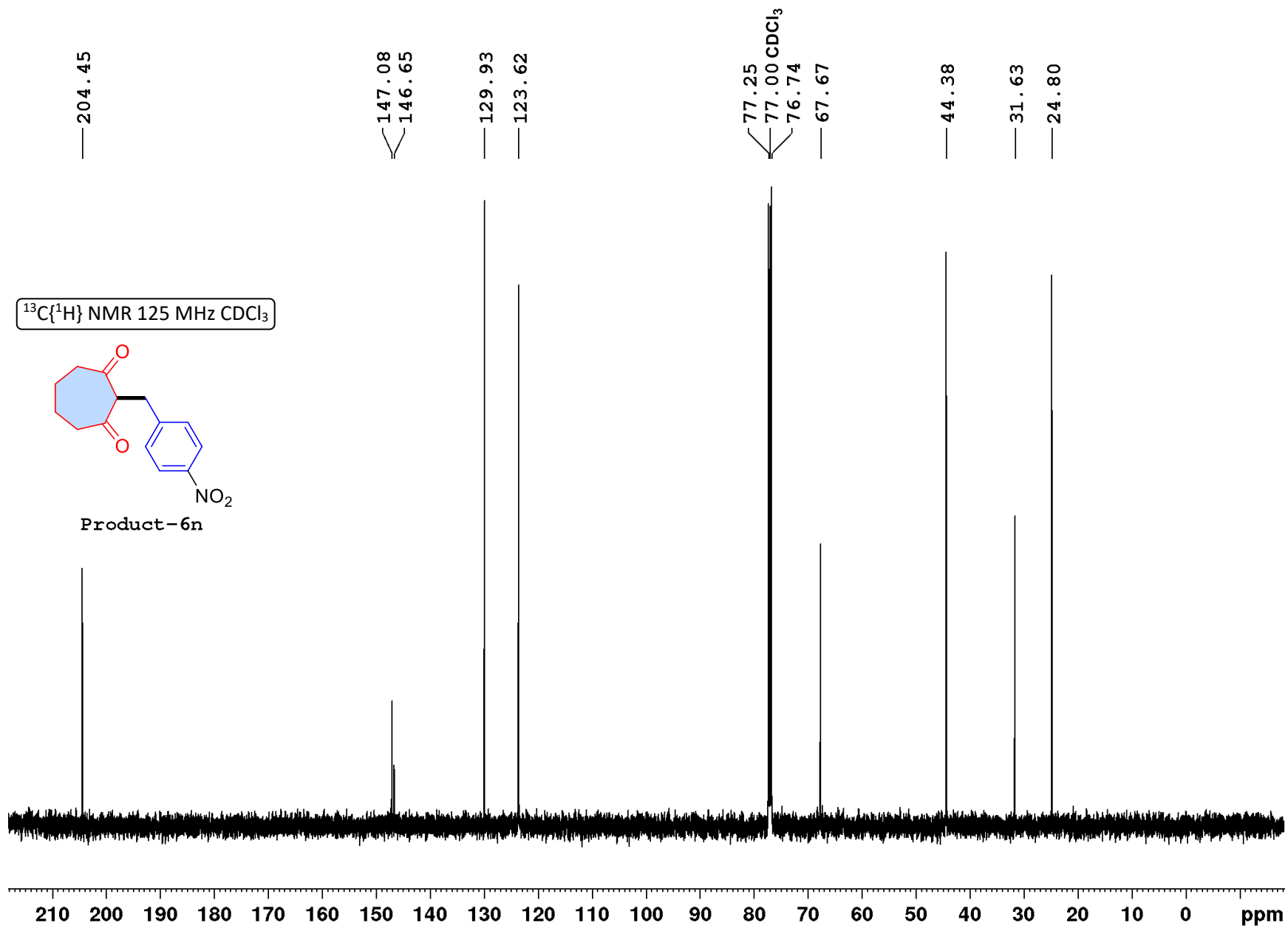




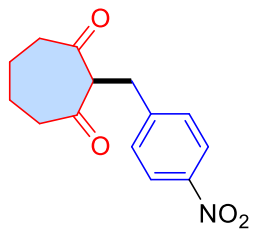


¹H NMR 500 MHz CDCl₃

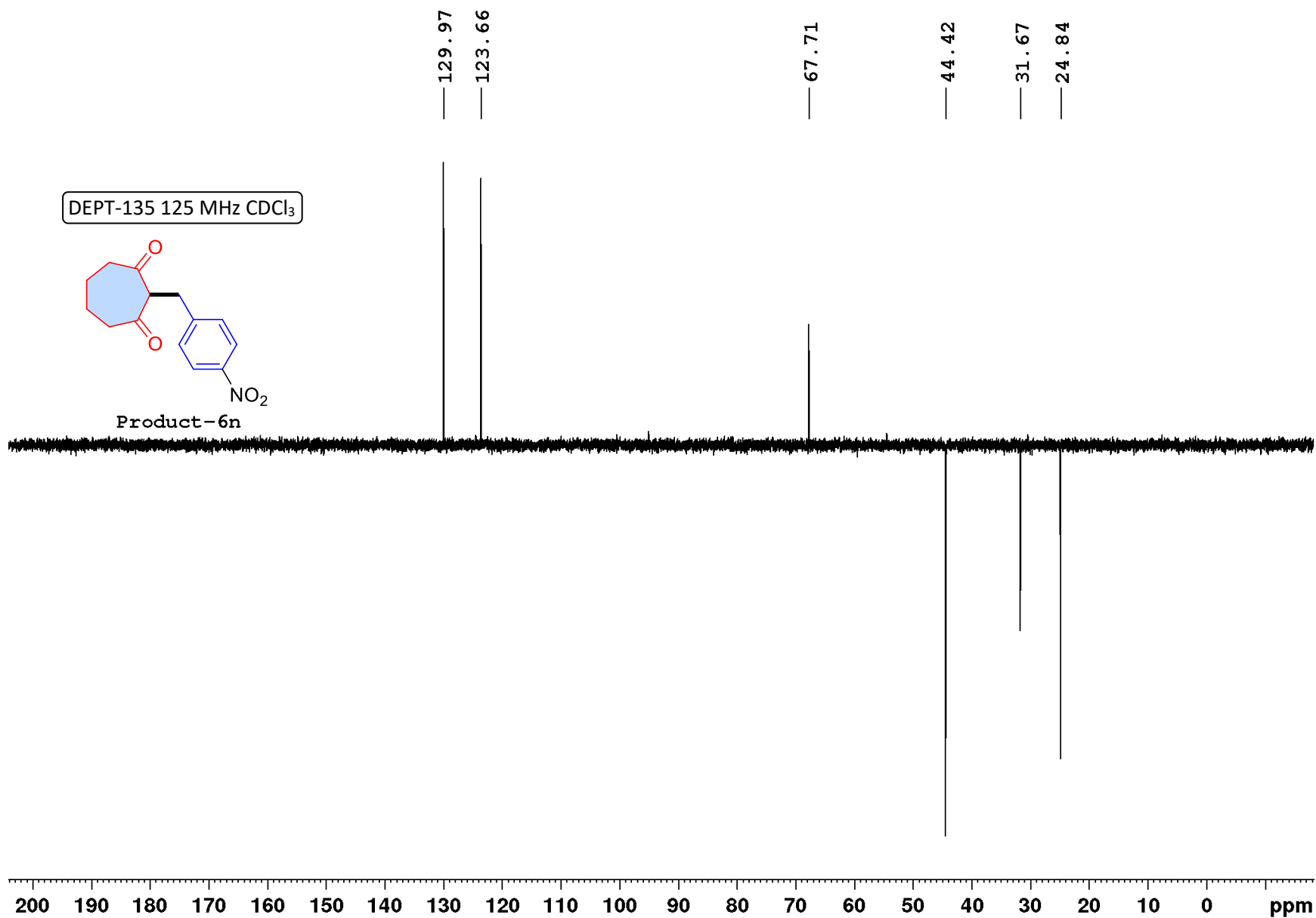


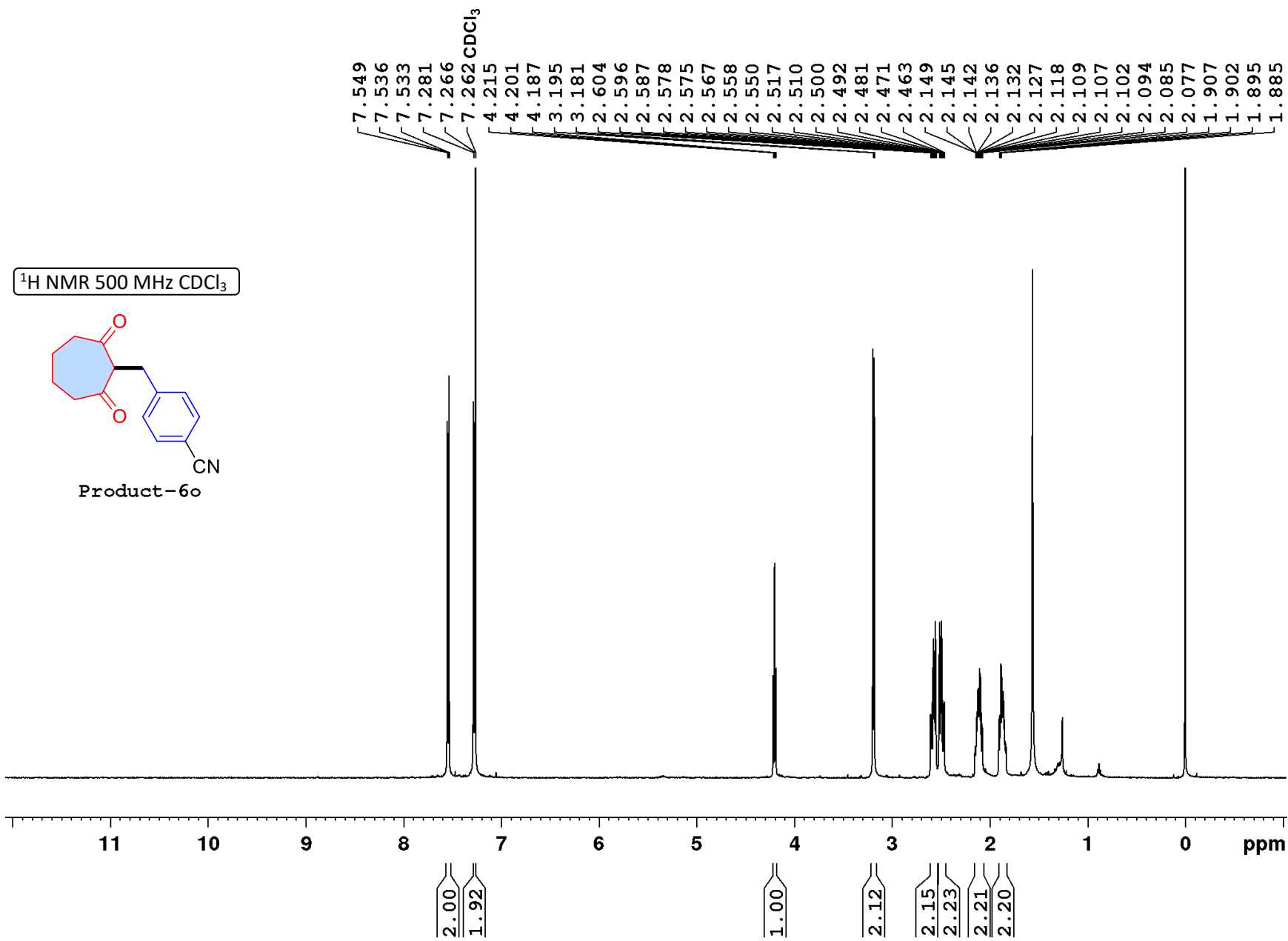


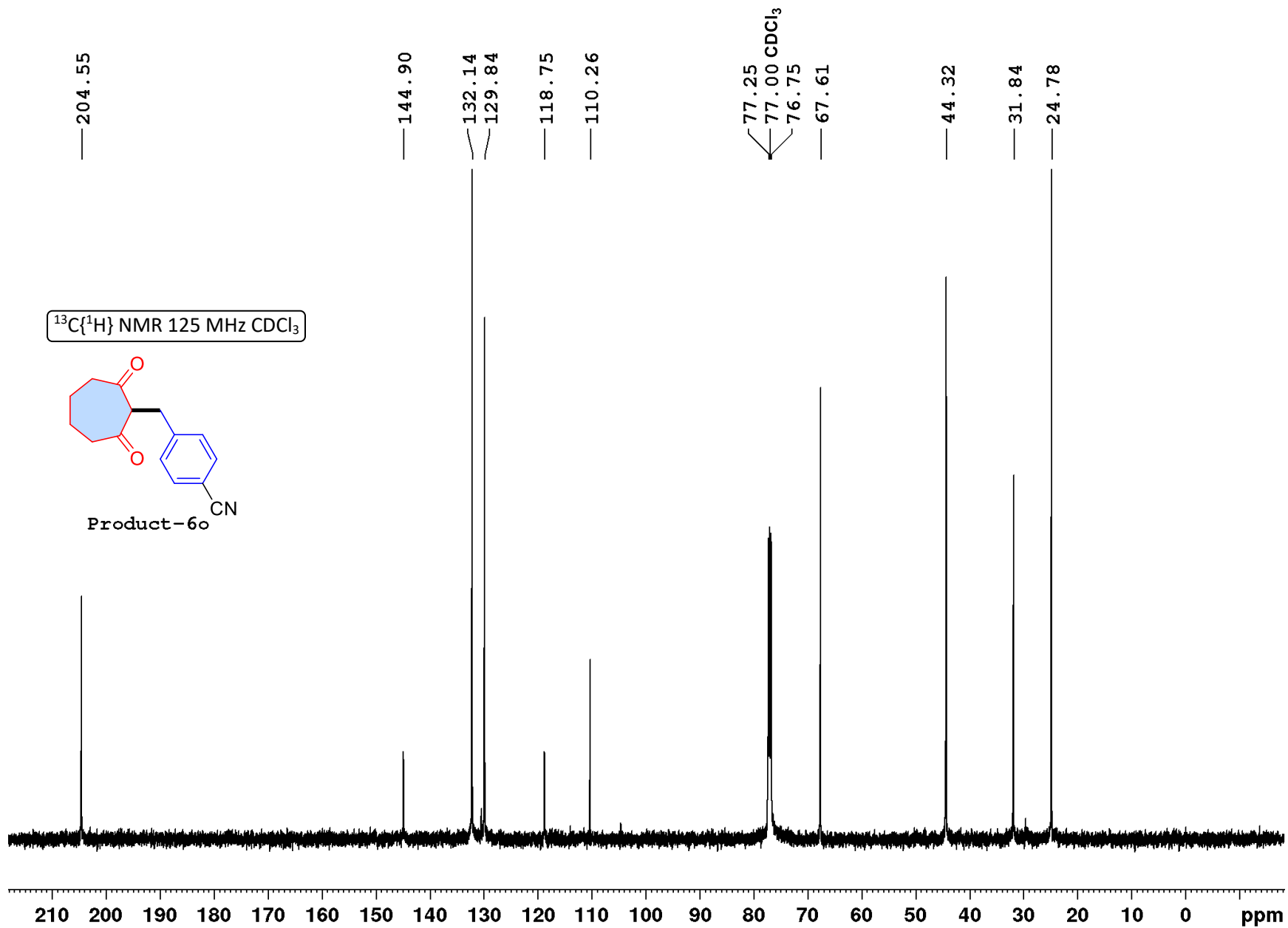
DEPT-135 125 MHz CDCl₃



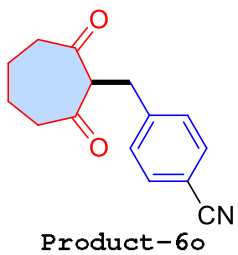
Product-6n







DEPT-135 125 MHz CDCl₃



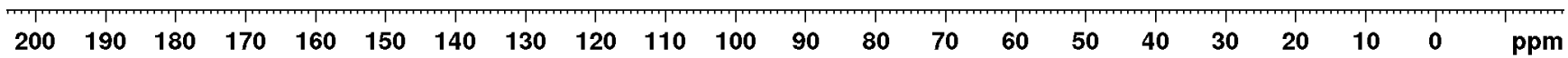
132.23
129.92

67.70

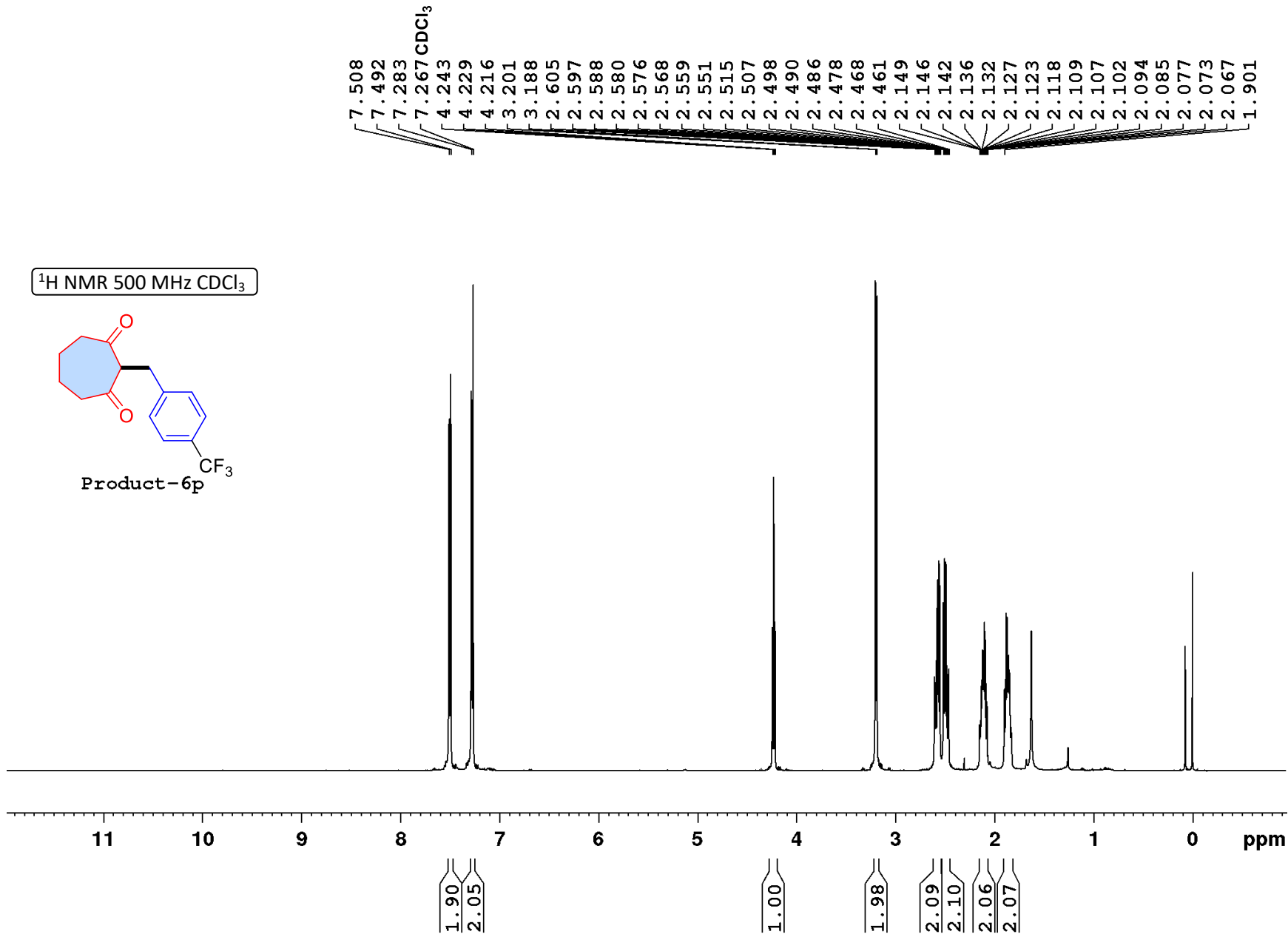
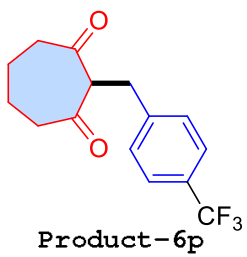
44.41

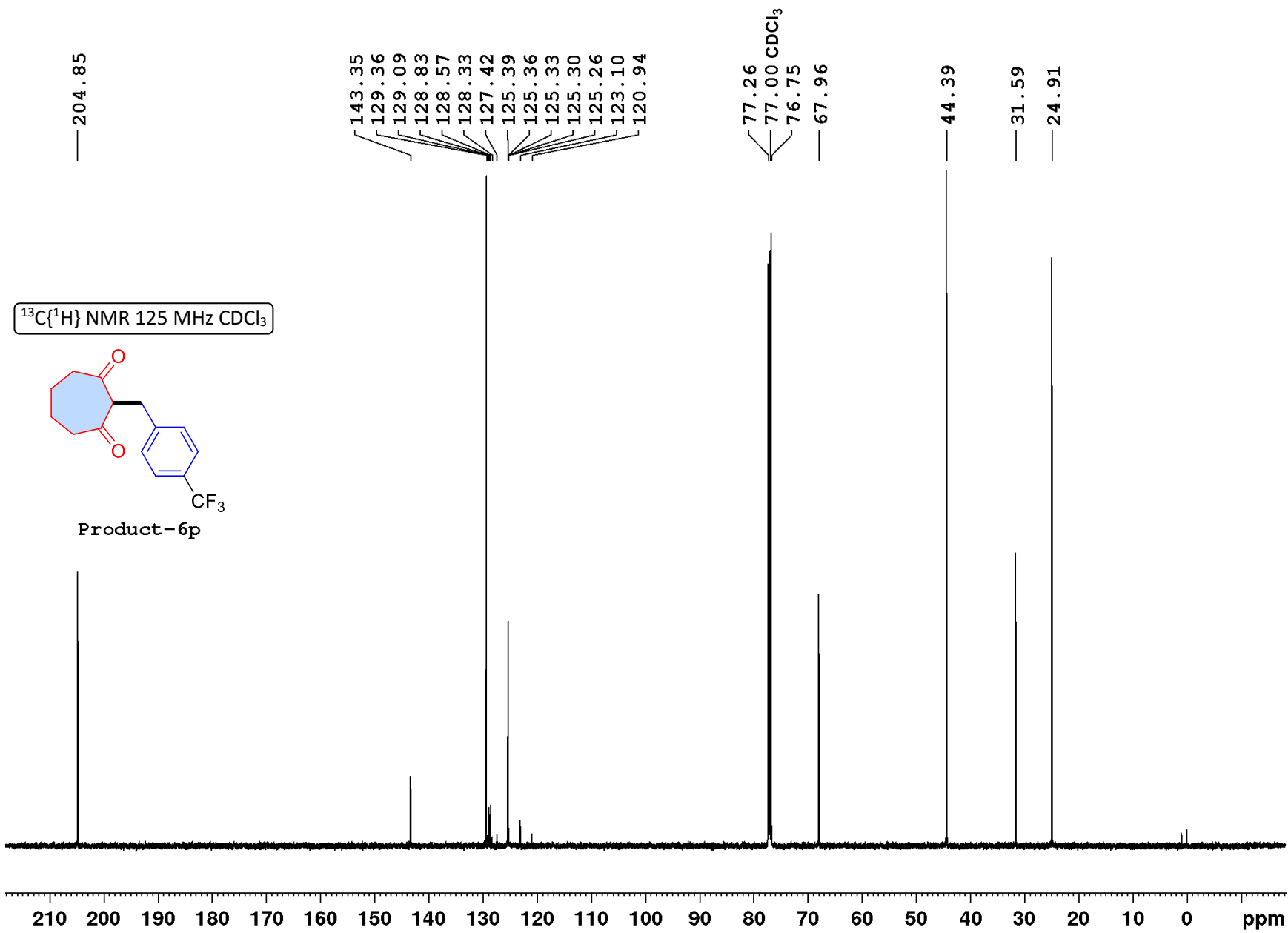
31.92

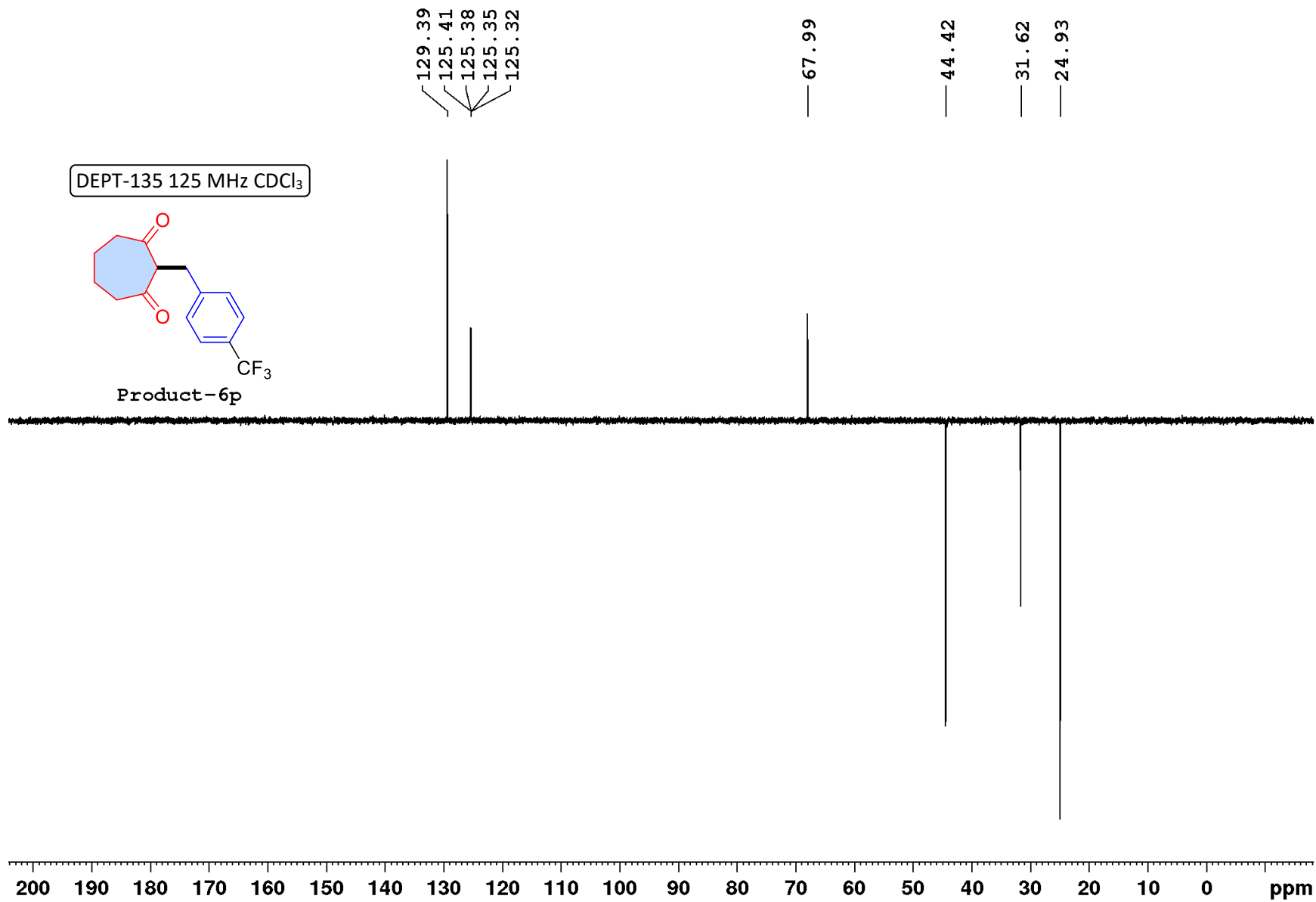
24.86



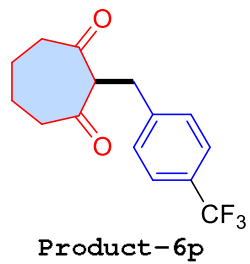
¹H NMR 500 MHz CDCl₃



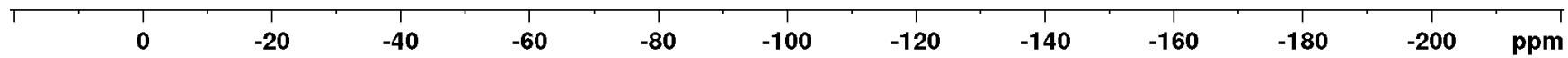


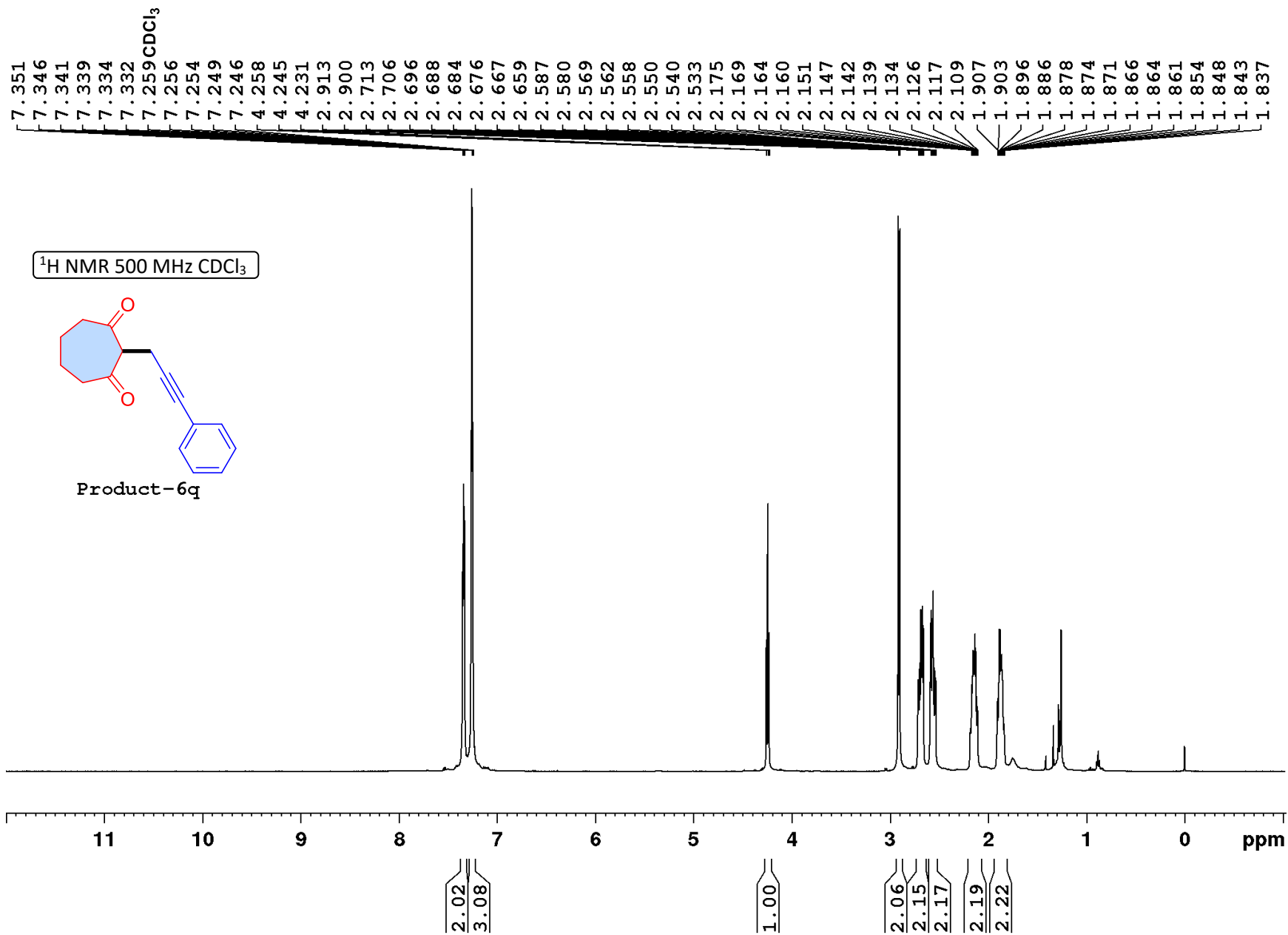


^{19}F NMR 375 MHz CDCl_3

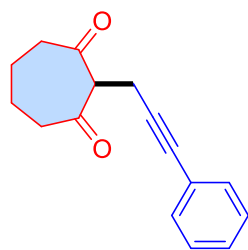


-62.466

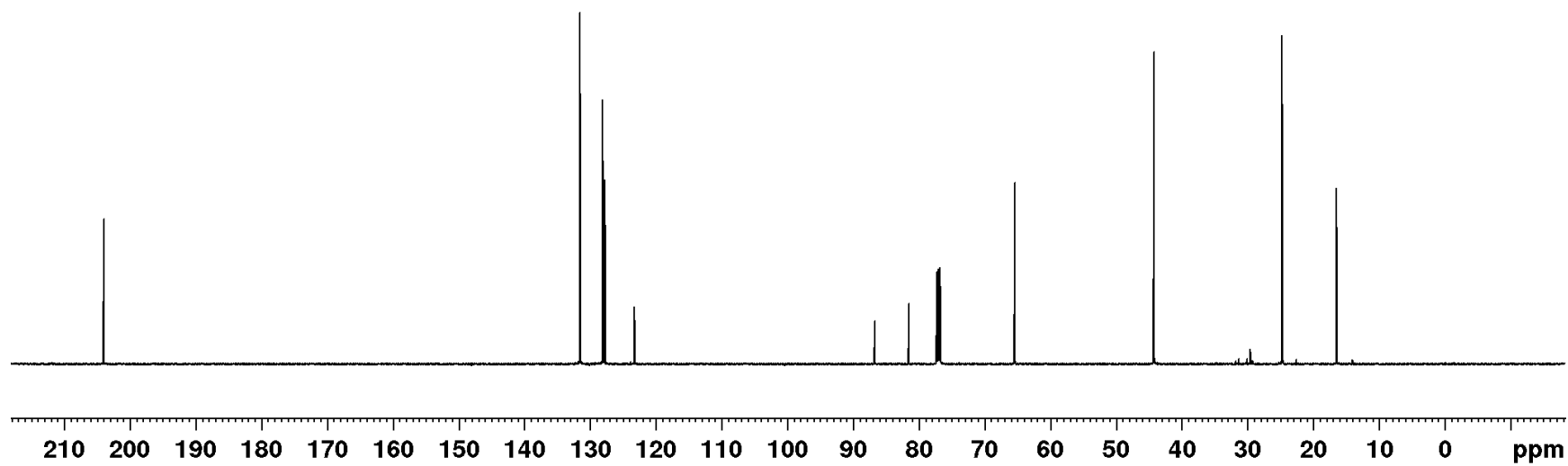




$^{13}\text{C}\{^1\text{H}\}$ NMR 125 MHz CDCl_3



Product-6q



— 204.01

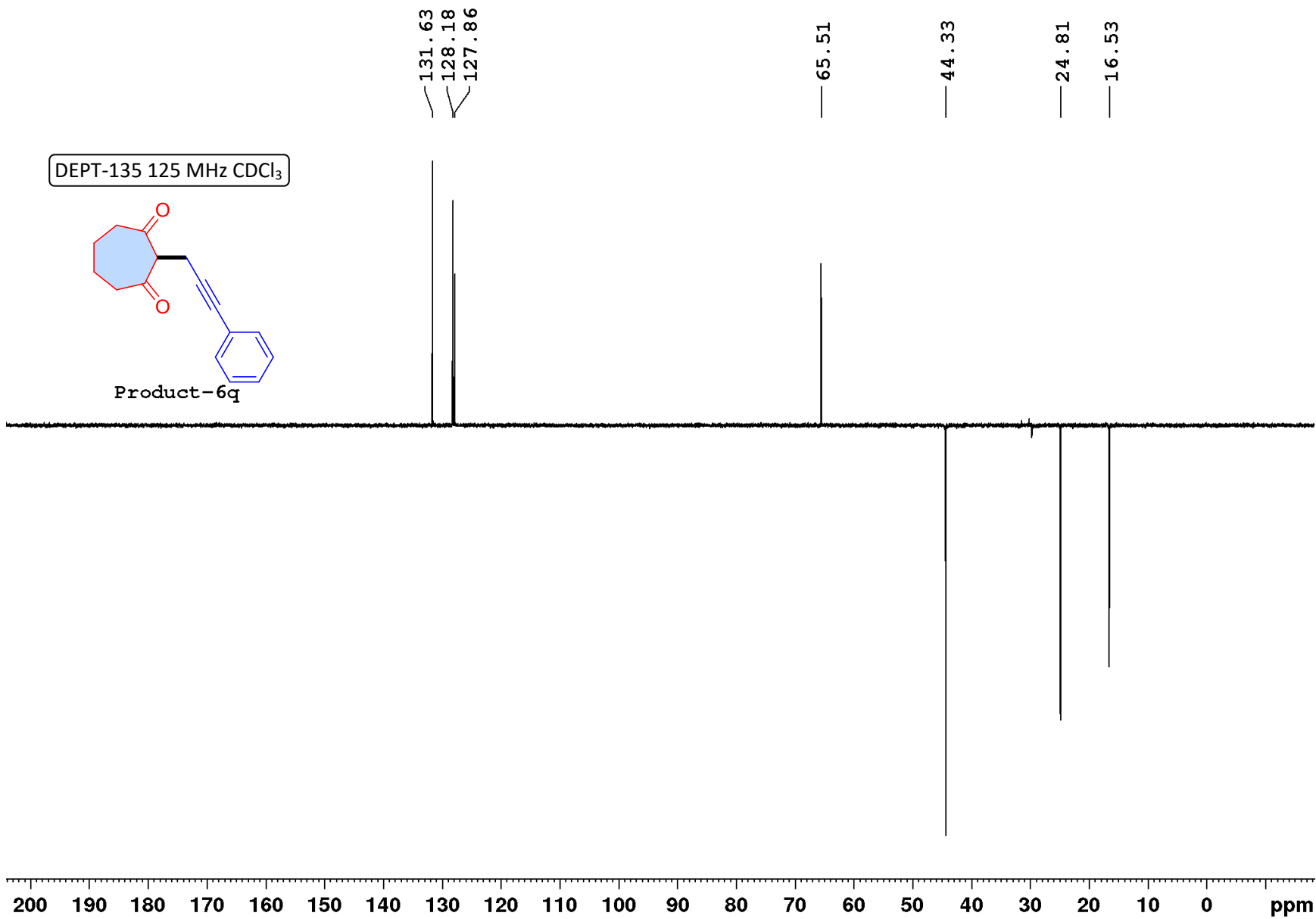
131.53
128.09
127.76
123.27

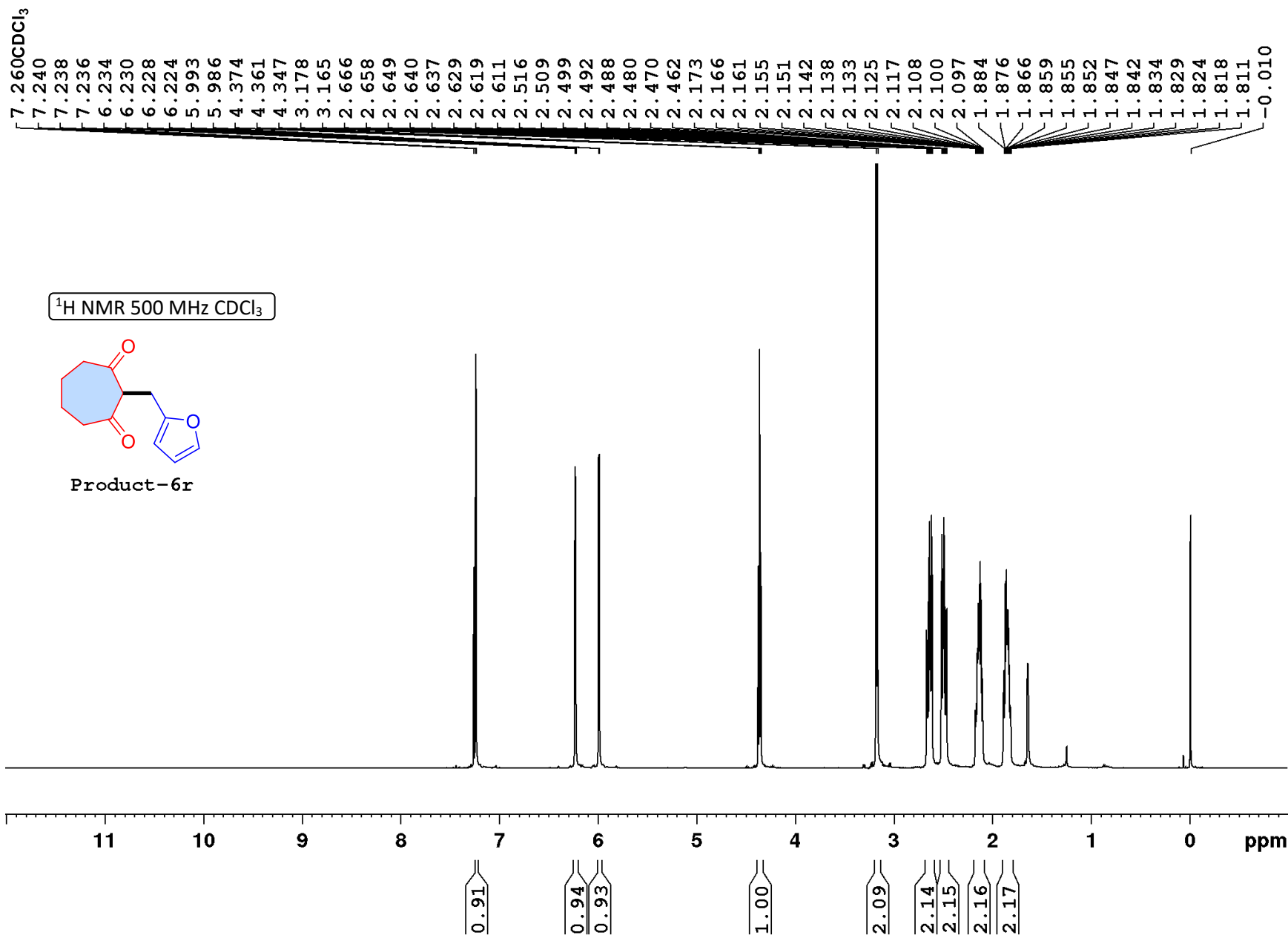
86.72
81.51
77.26
77.00 CDCl_3
76.75
— 65.42

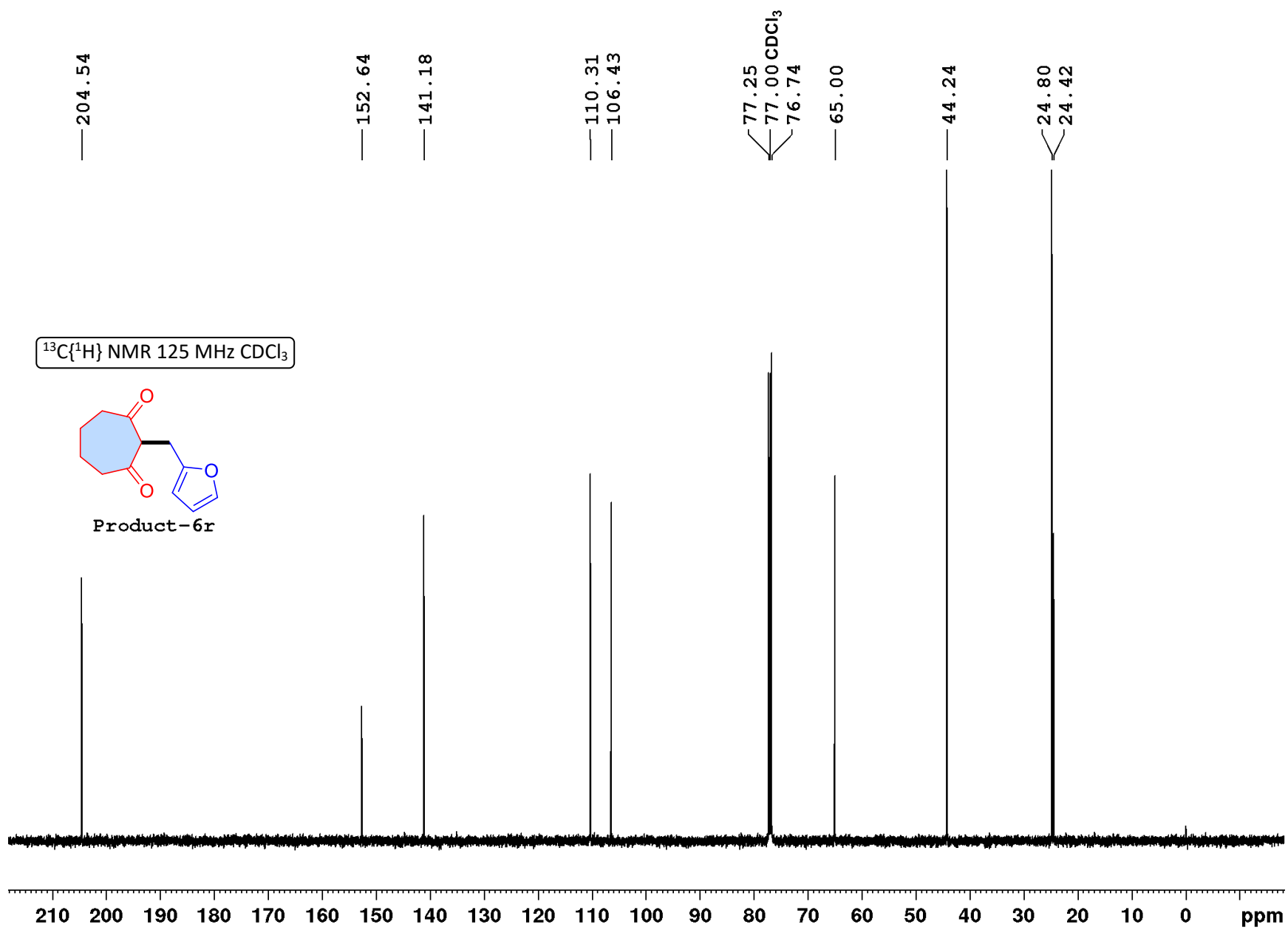
— 44.23

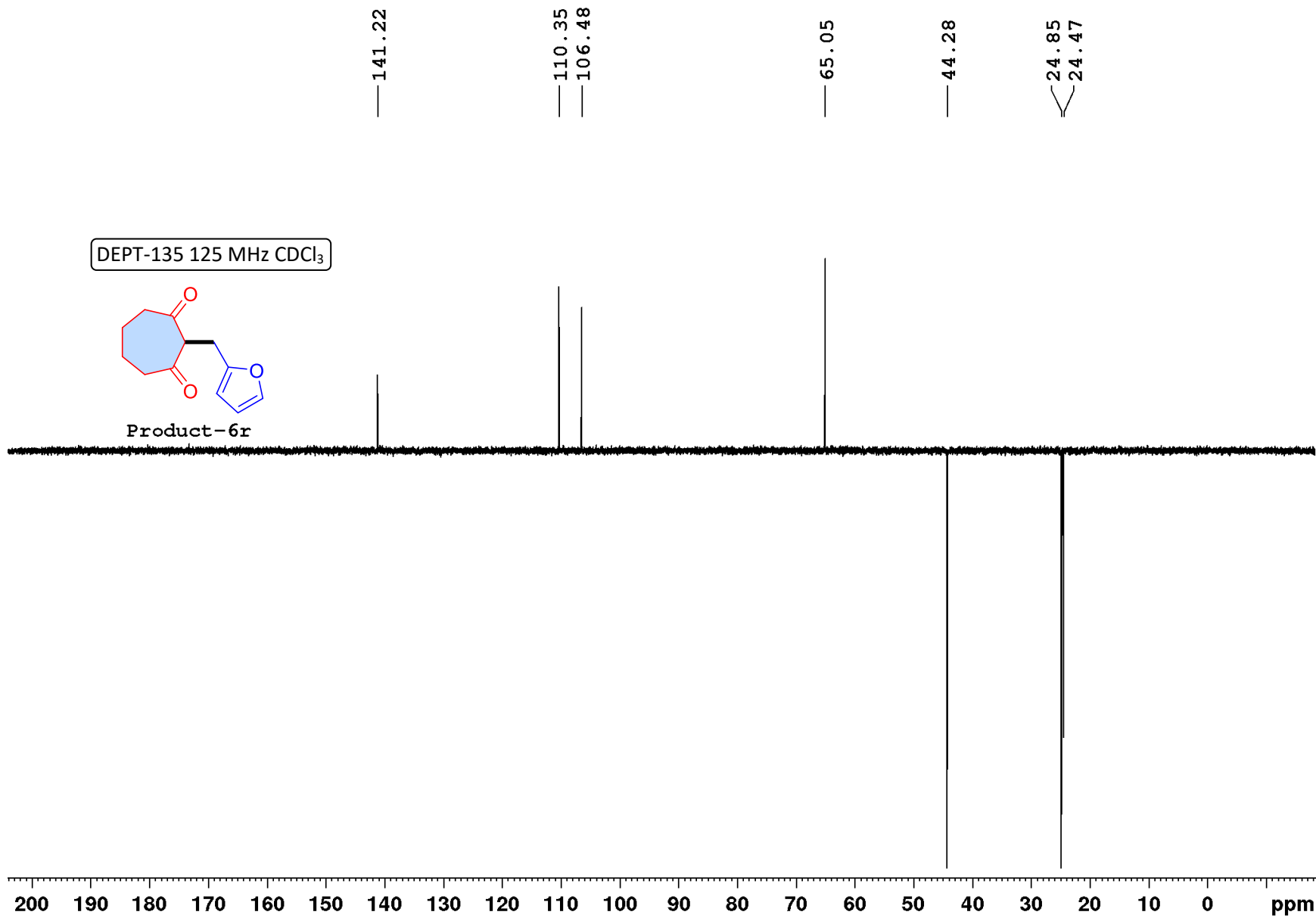
— 24.72

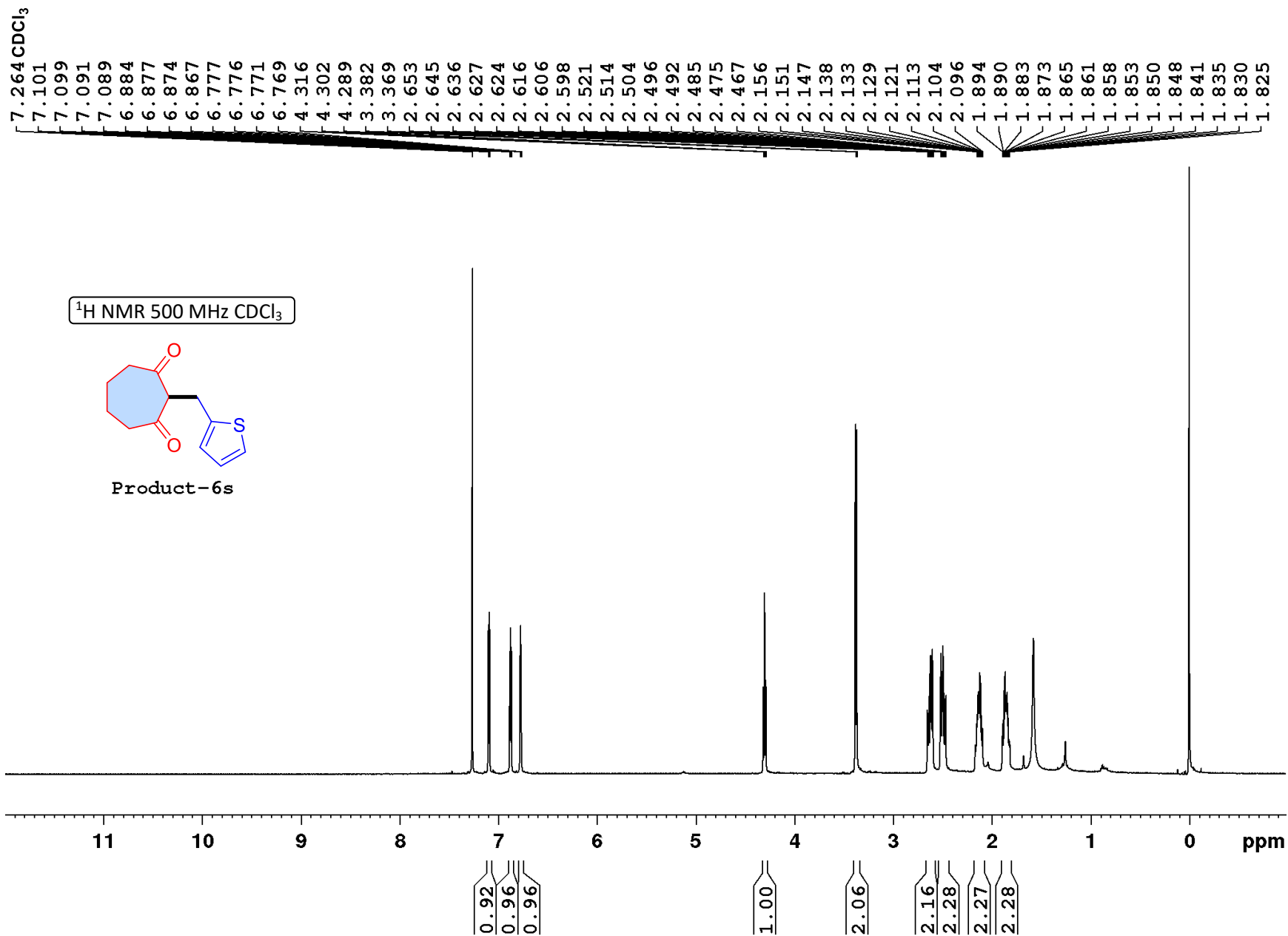
— 16.43

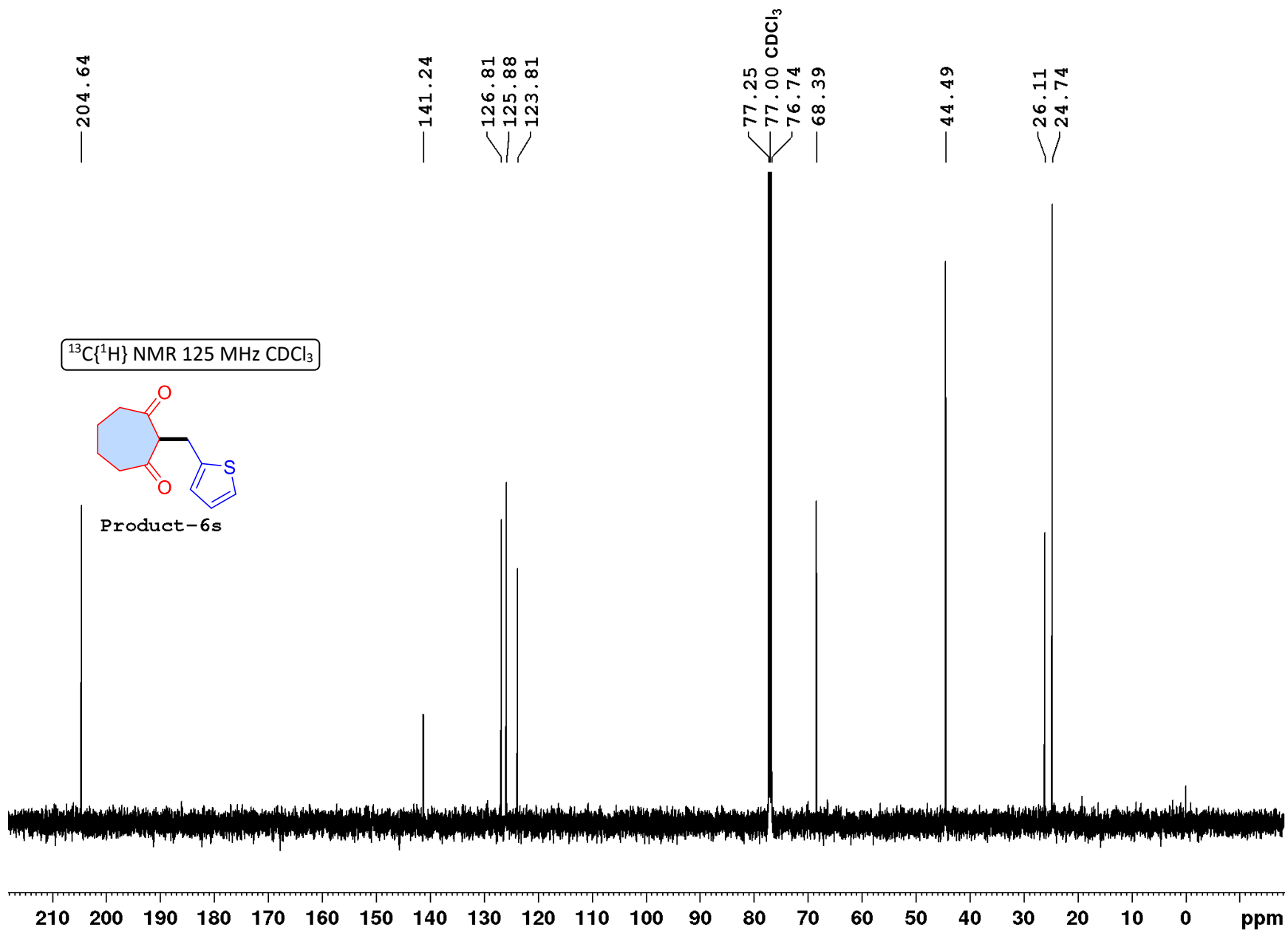




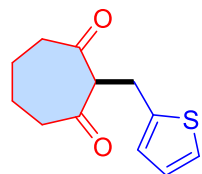




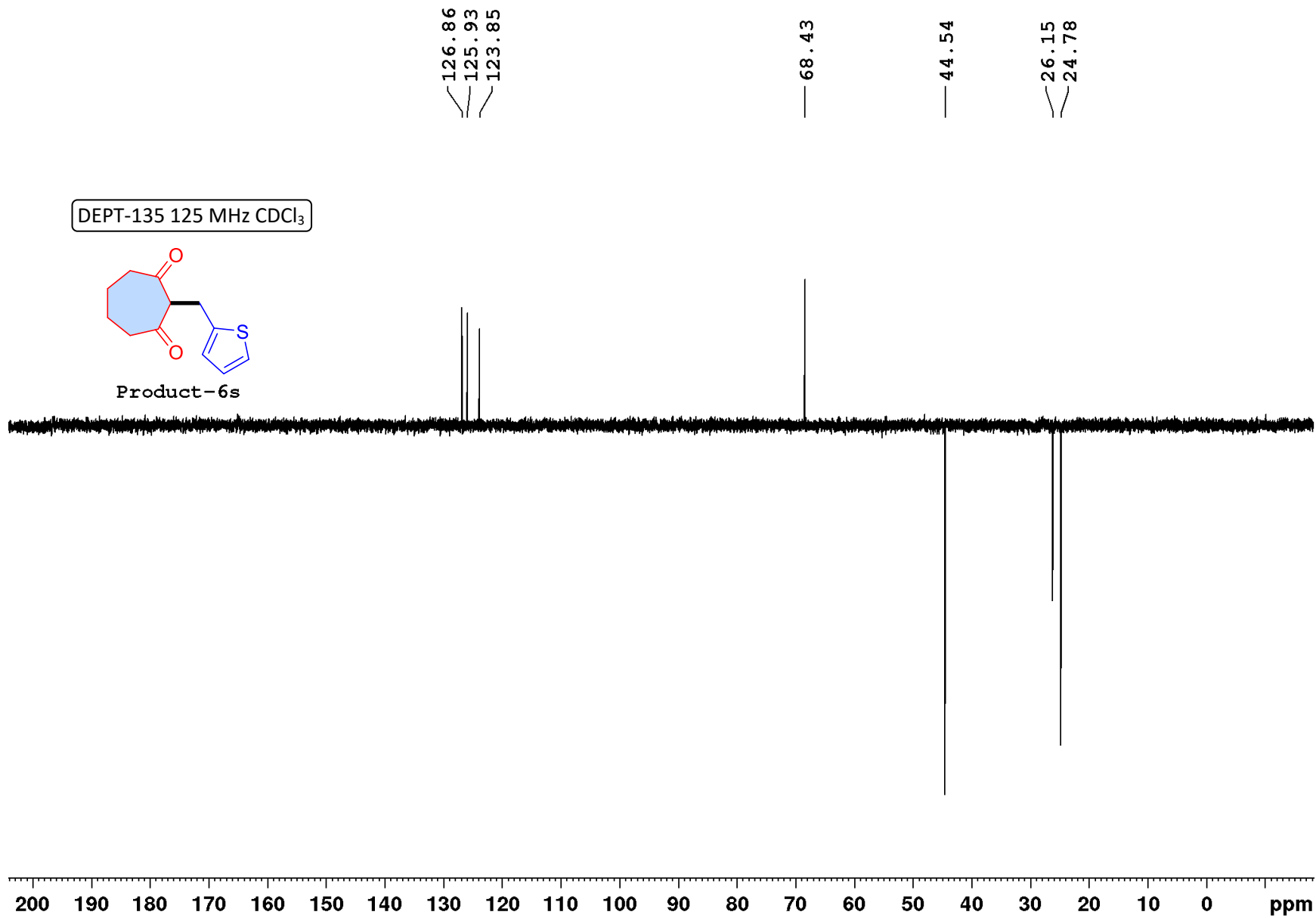


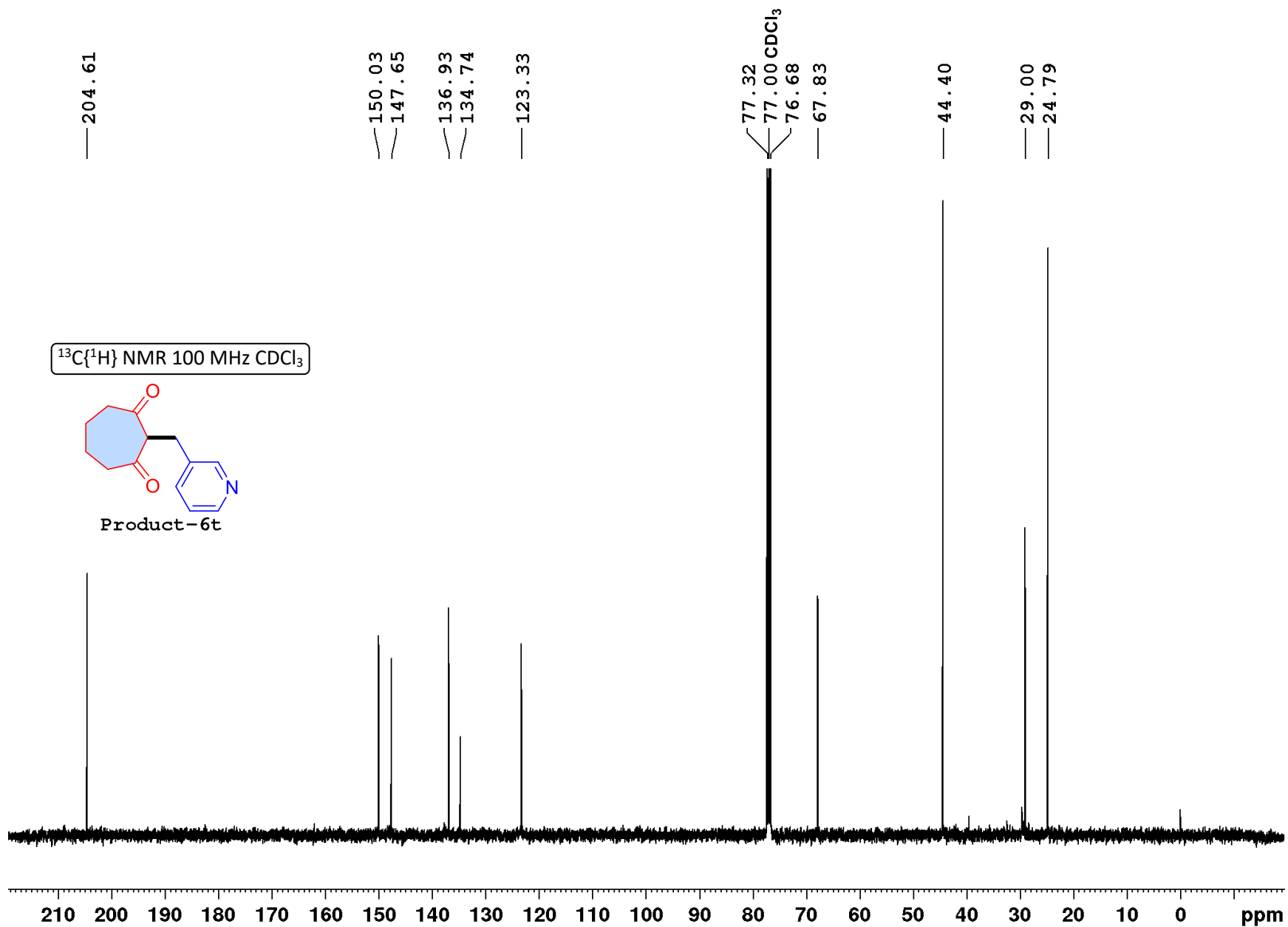


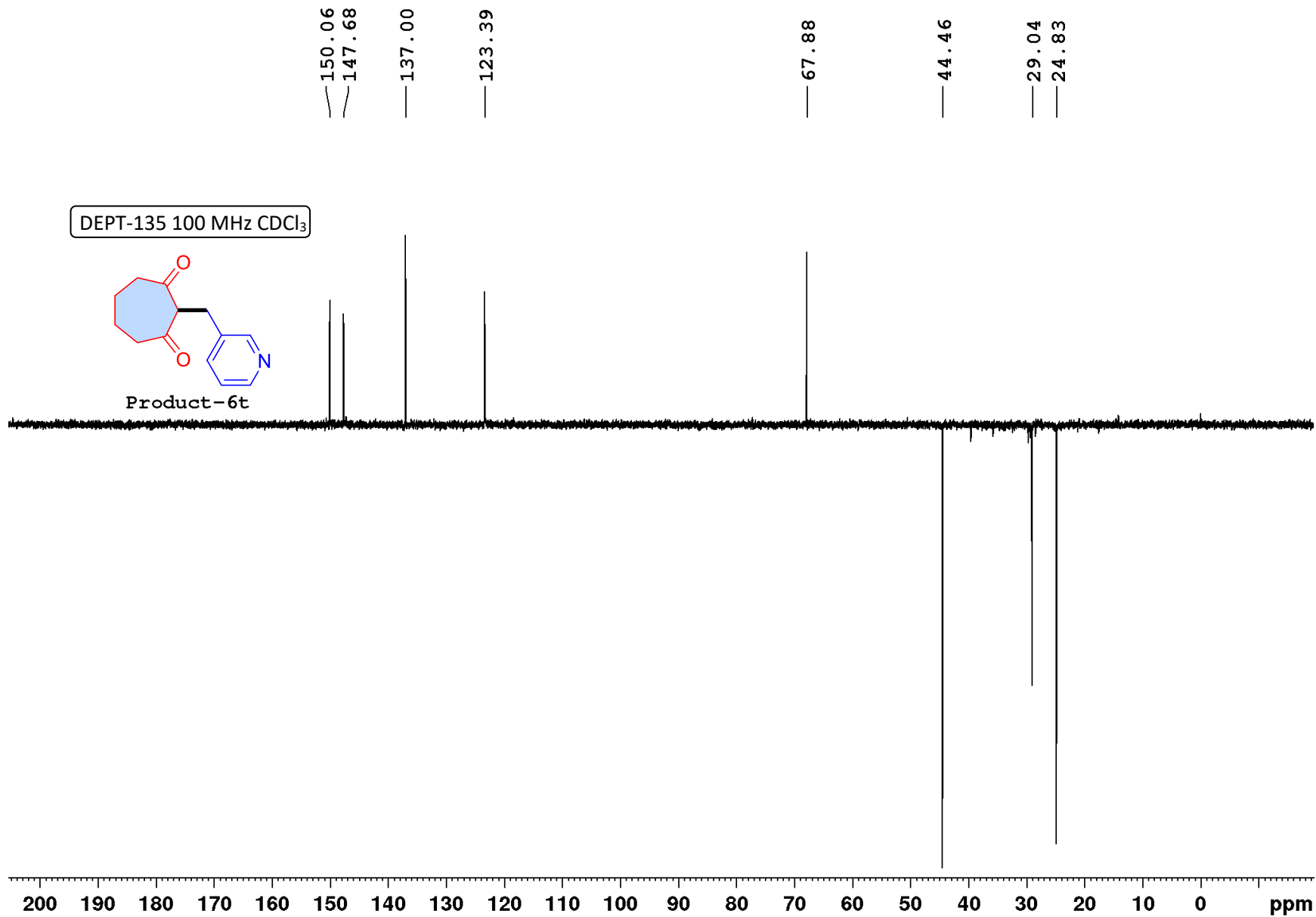
DEPT-135 125 MHz CDCl₃

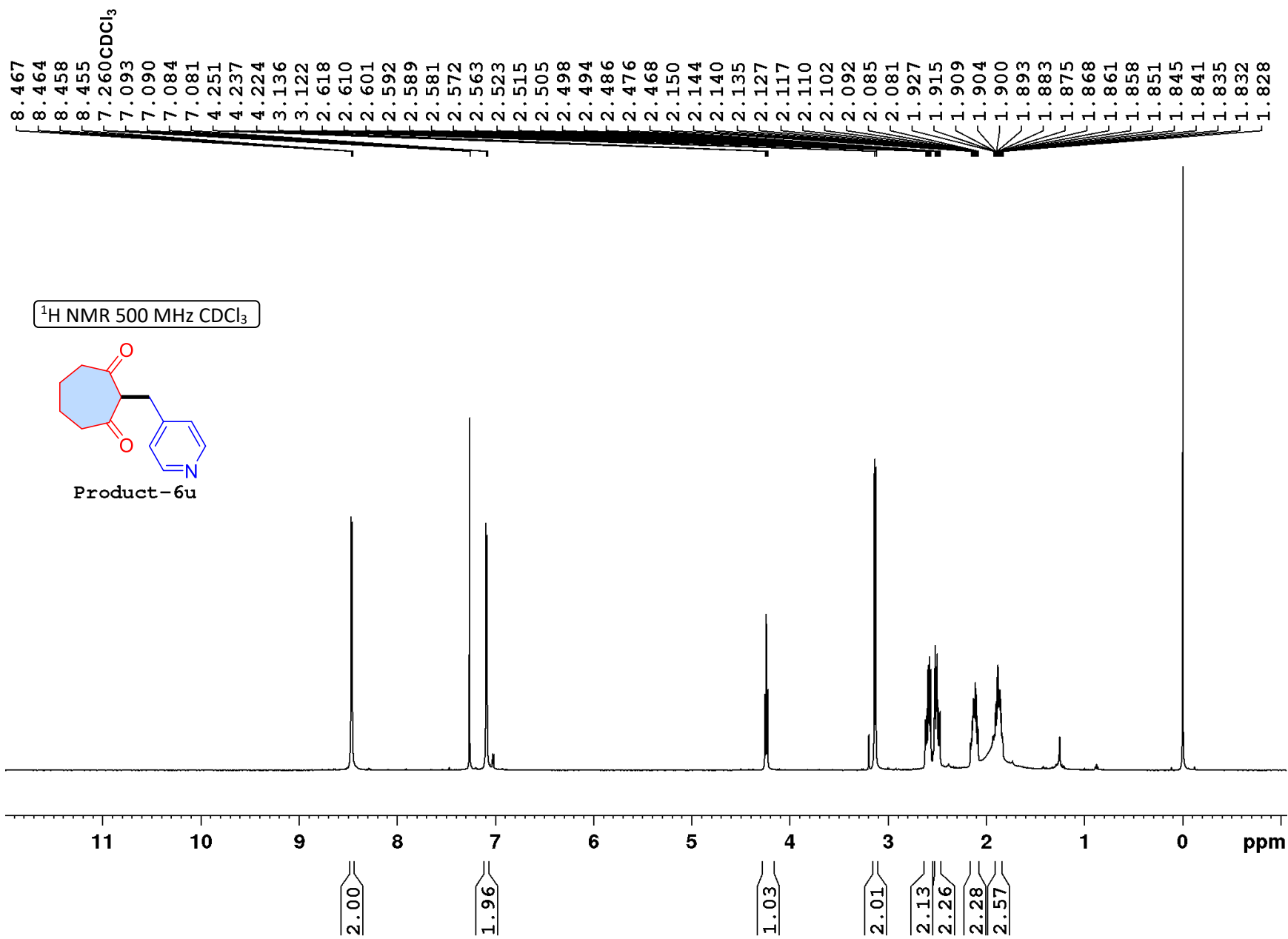


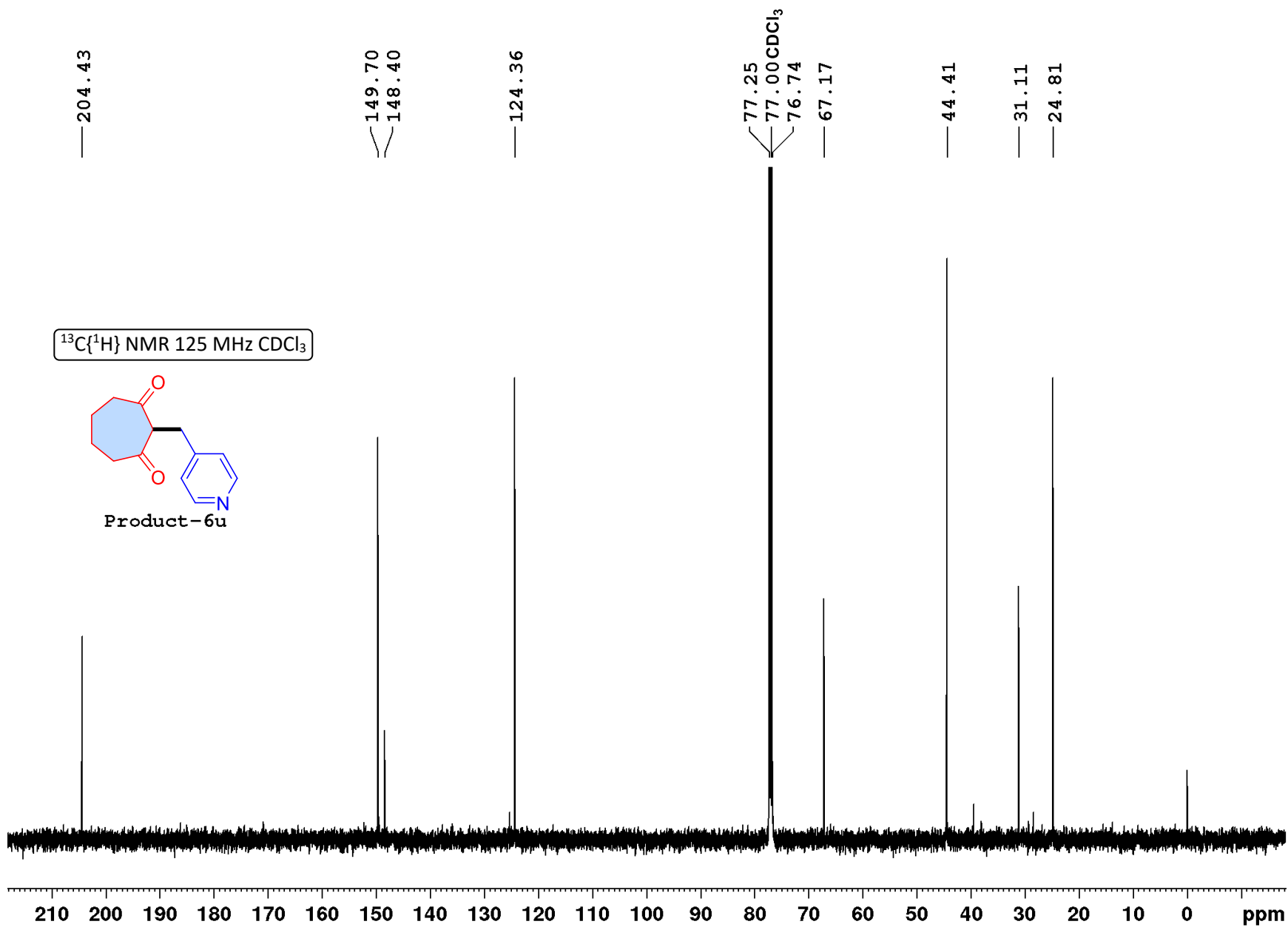
Product-6s

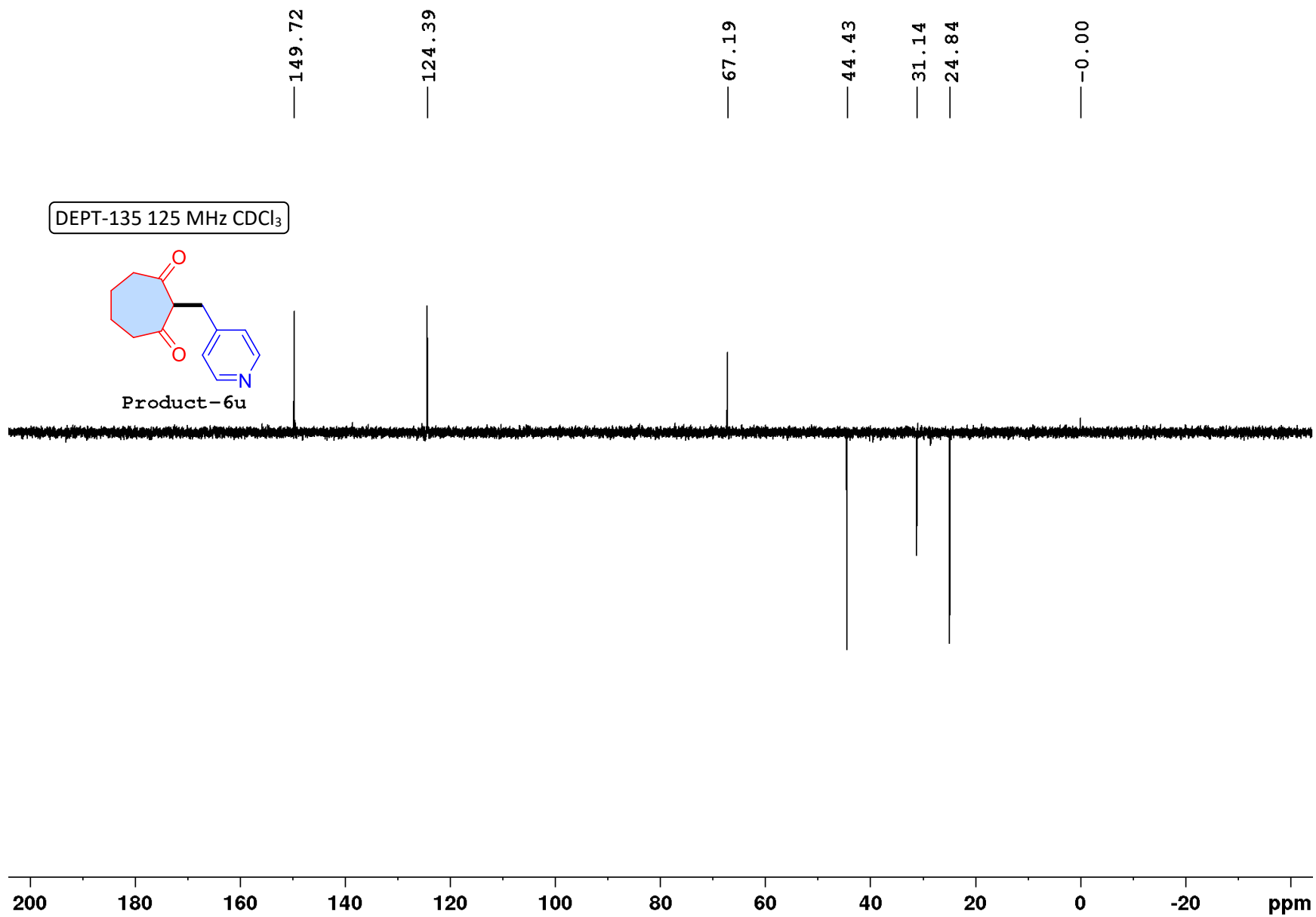


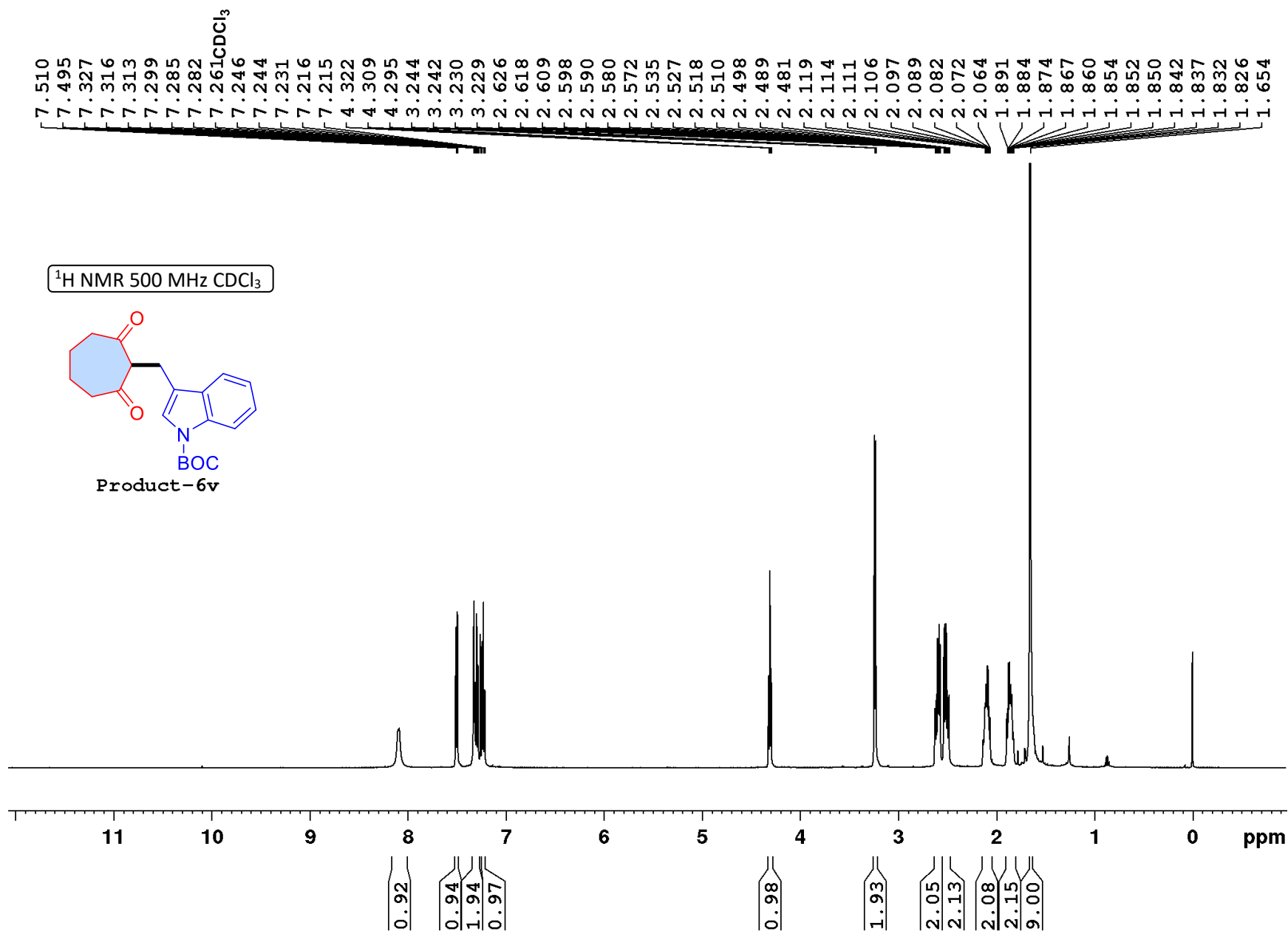


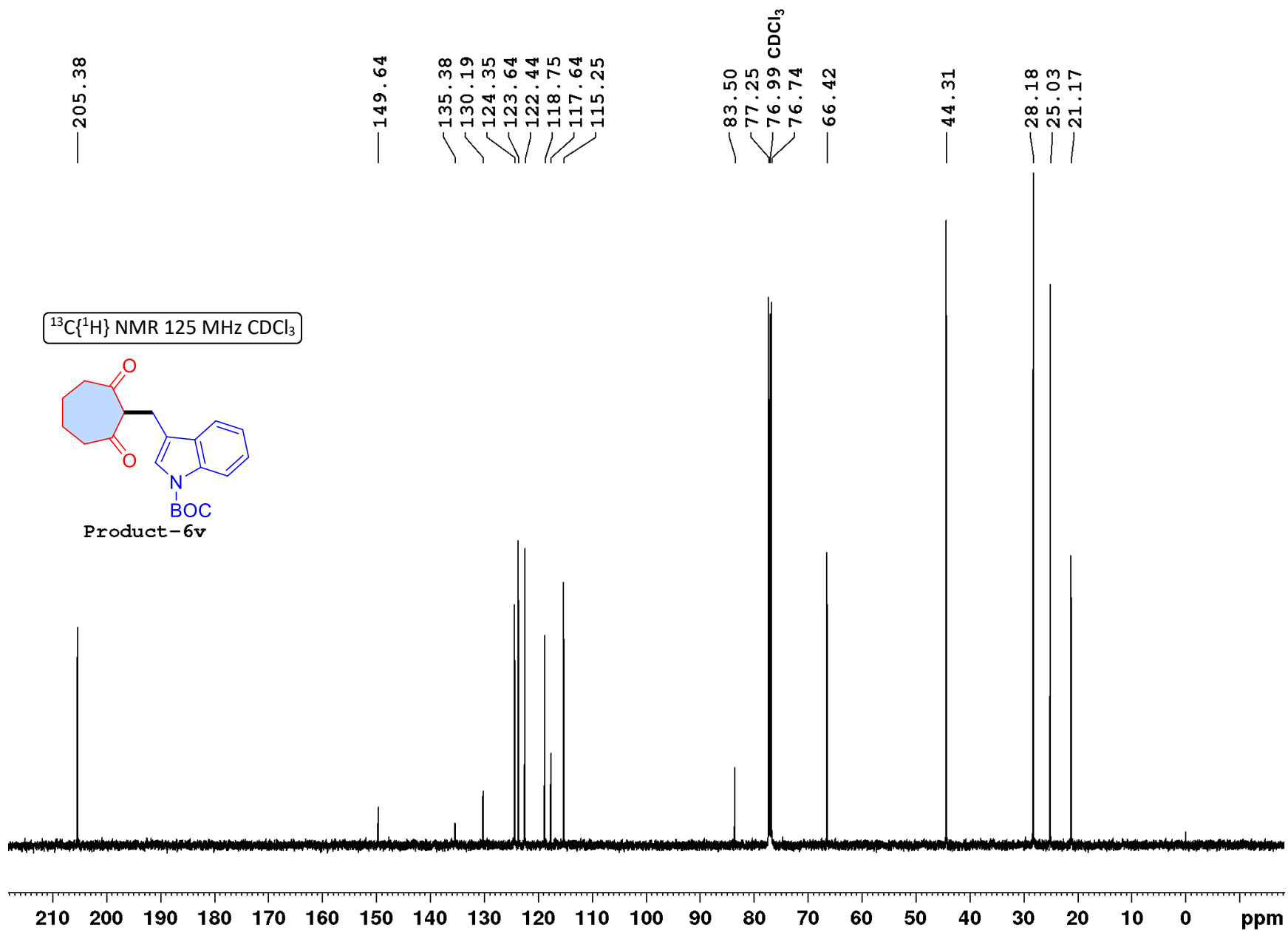




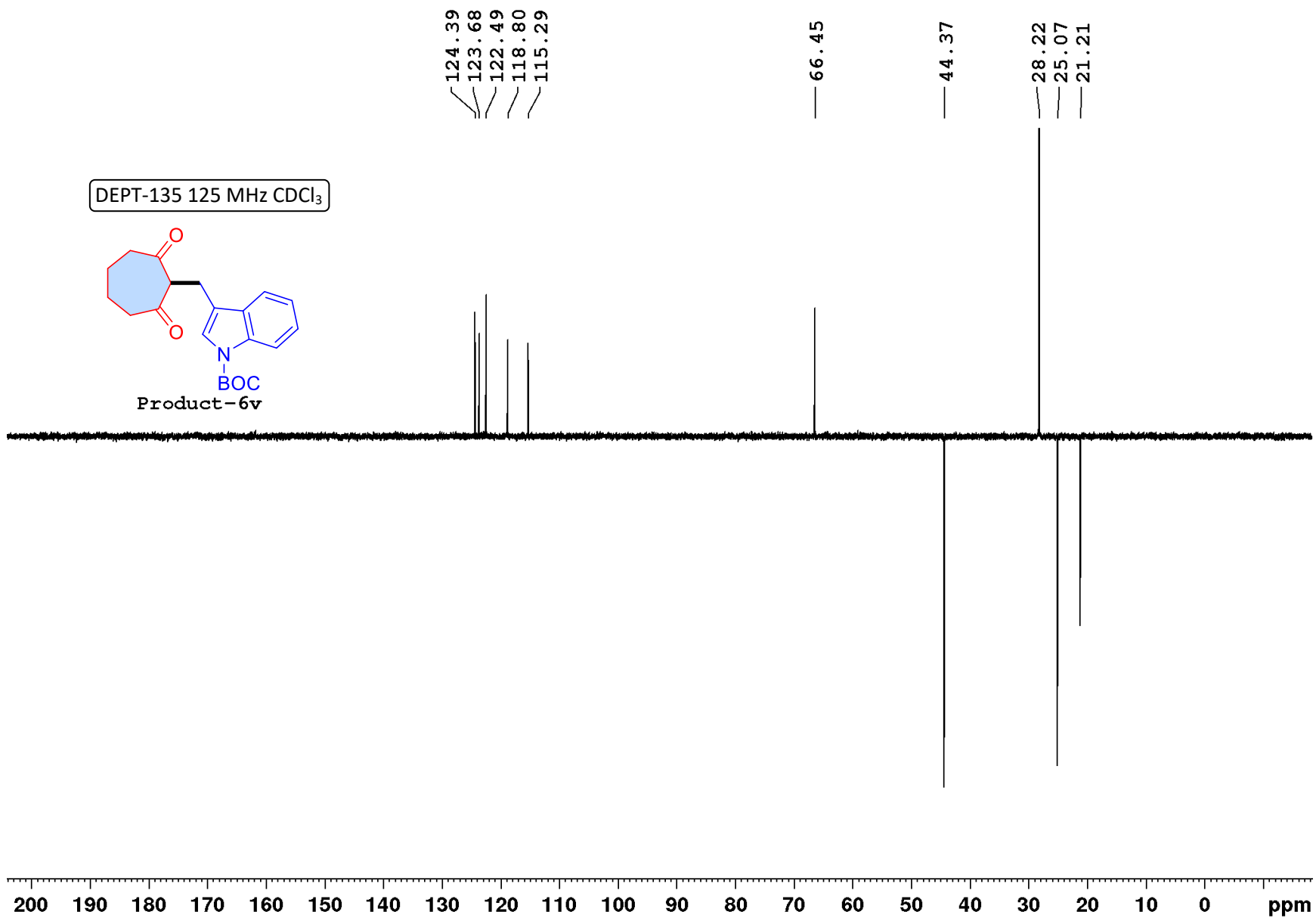
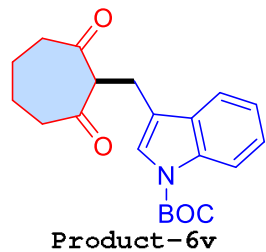


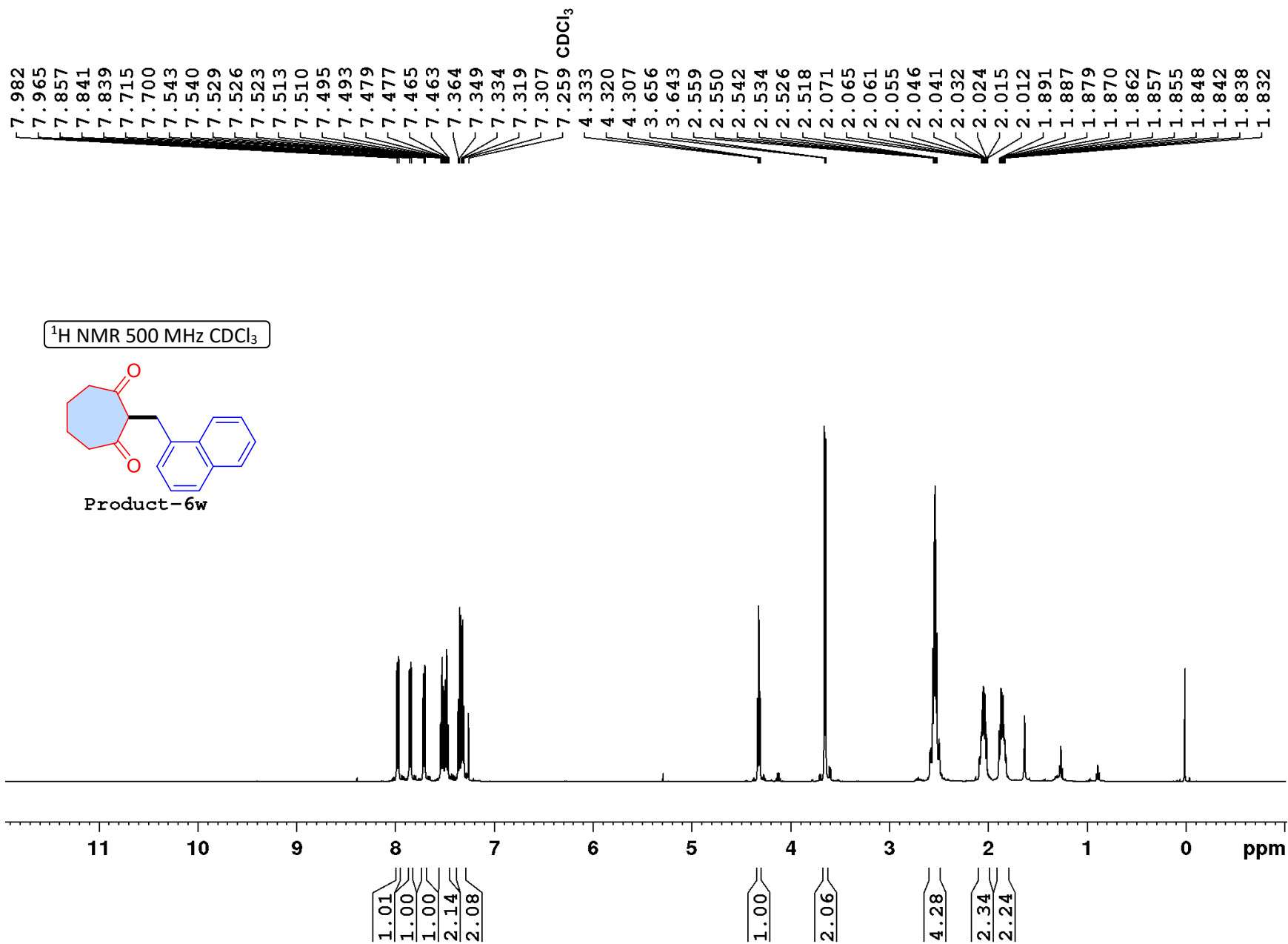


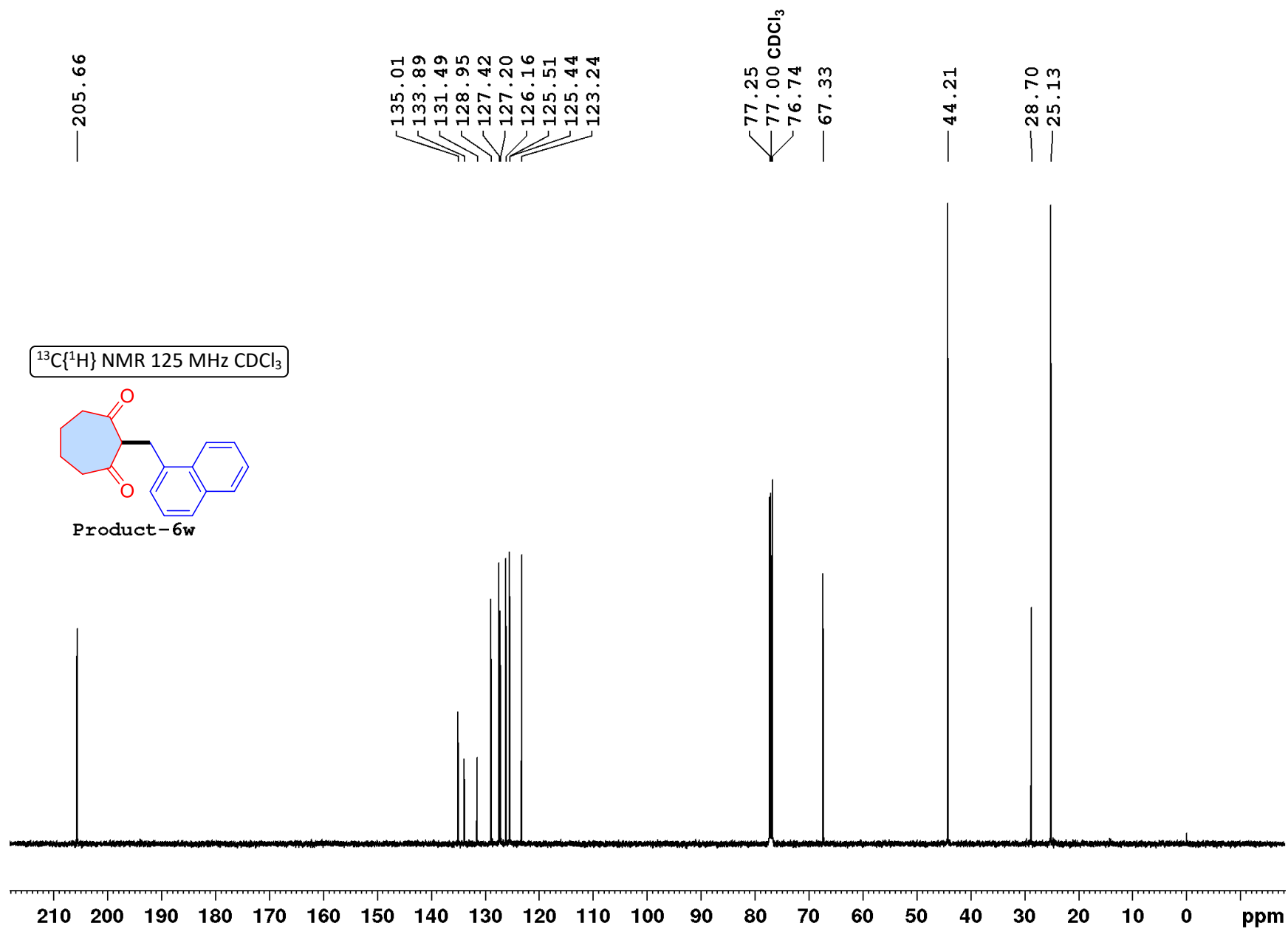




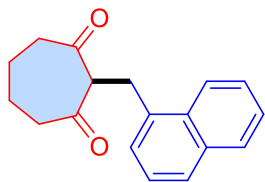
DEPT-135 125 MHz CDCl₃







DEPT-135 125 MHz CDCl₃



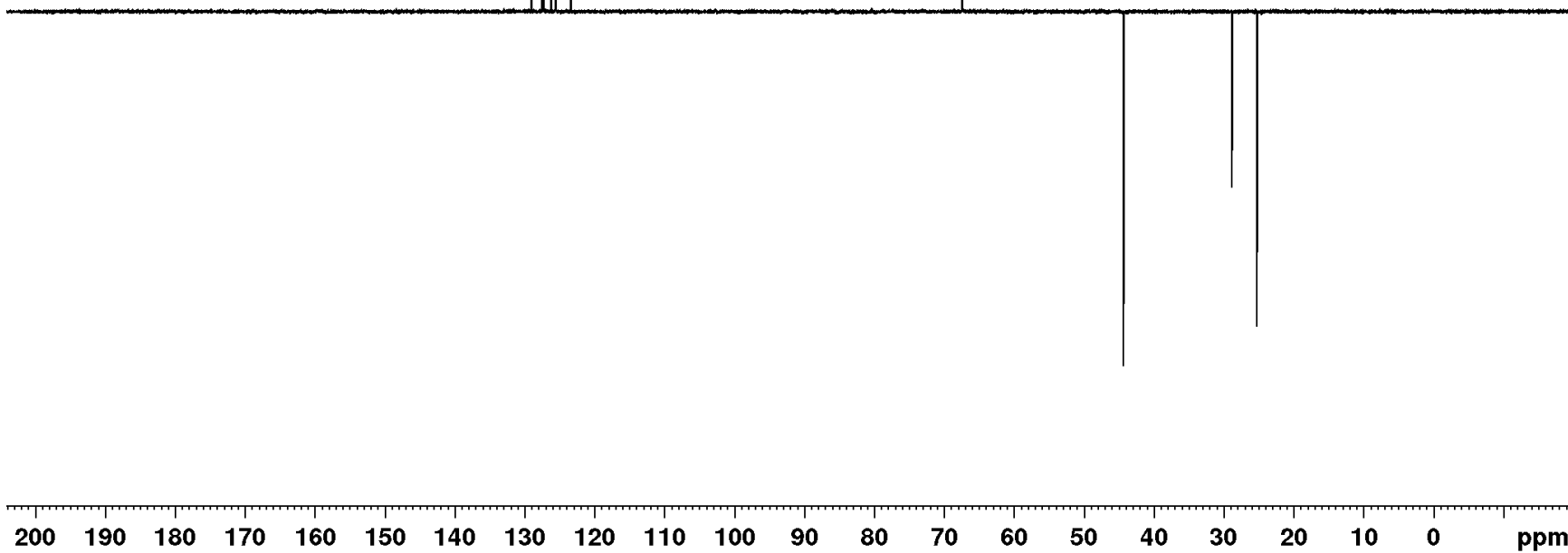
Product-6w

129.02
127.49
127.26
126.22
125.58
125.51
123.31

67.39

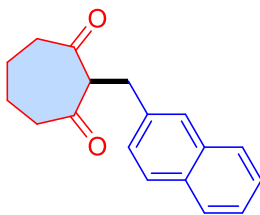
44.27

28.76
25.19

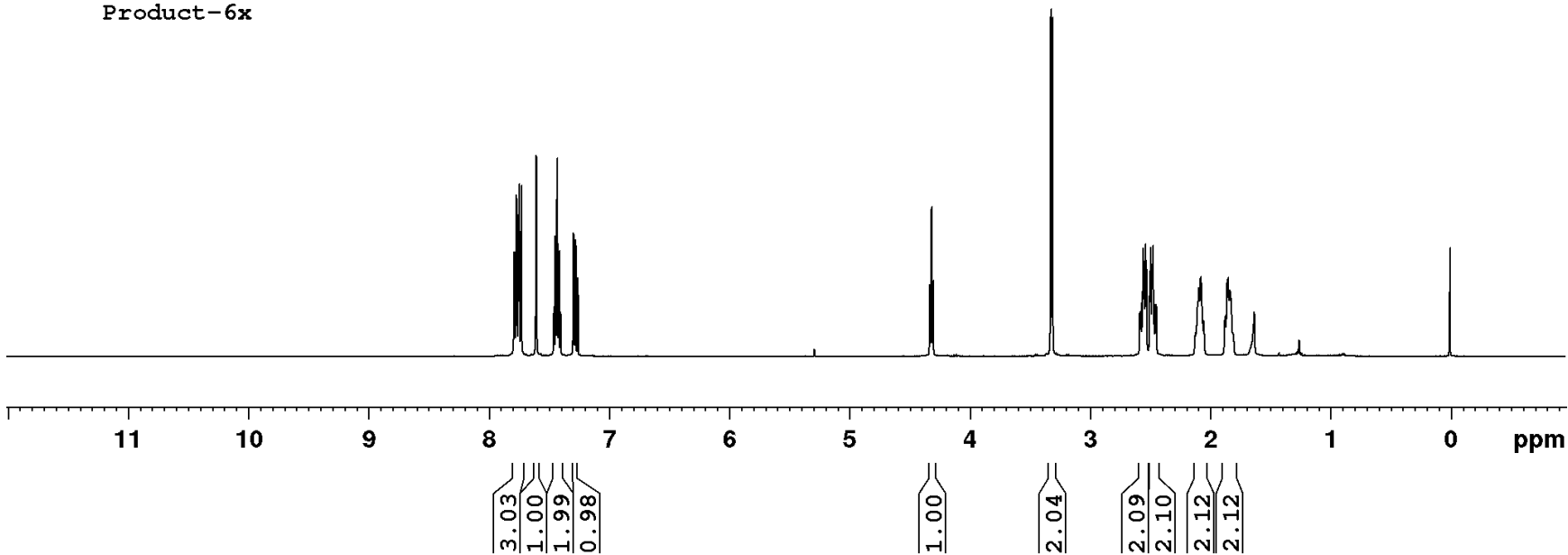


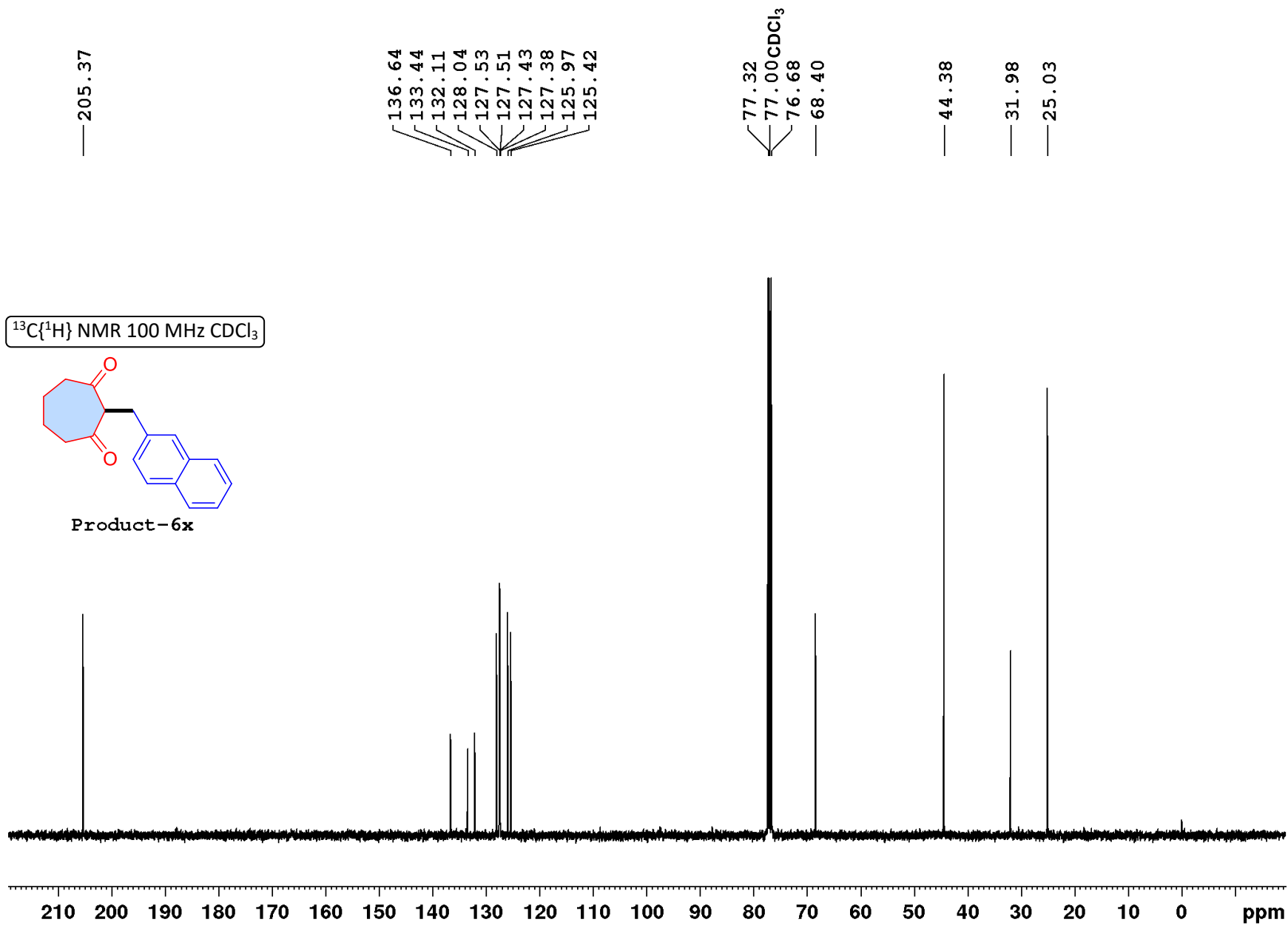
7.789
7.774
7.770
7.767
7.751
7.747
7.729
7.605
7.458
7.447
7.444
7.433
7.429
7.418
7.415
7.404
7.297
7.294
7.280
7.277
7.260 CDCl₃
4.332
4.318
4.305
3.326
3.312
2.586
2.578
2.569
2.557
2.549
2.540
2.532
2.502
2.495
2.485
2.477
2.466
2.456
2.449
2.110
2.104
2.096
2.088
2.085
2.080
2.073
2.064
1.870
1.860
1.853
1.849
1.846
1.838
1.835
1.831
1.828
1.823

¹H NMR 500 MHz CDCl₃

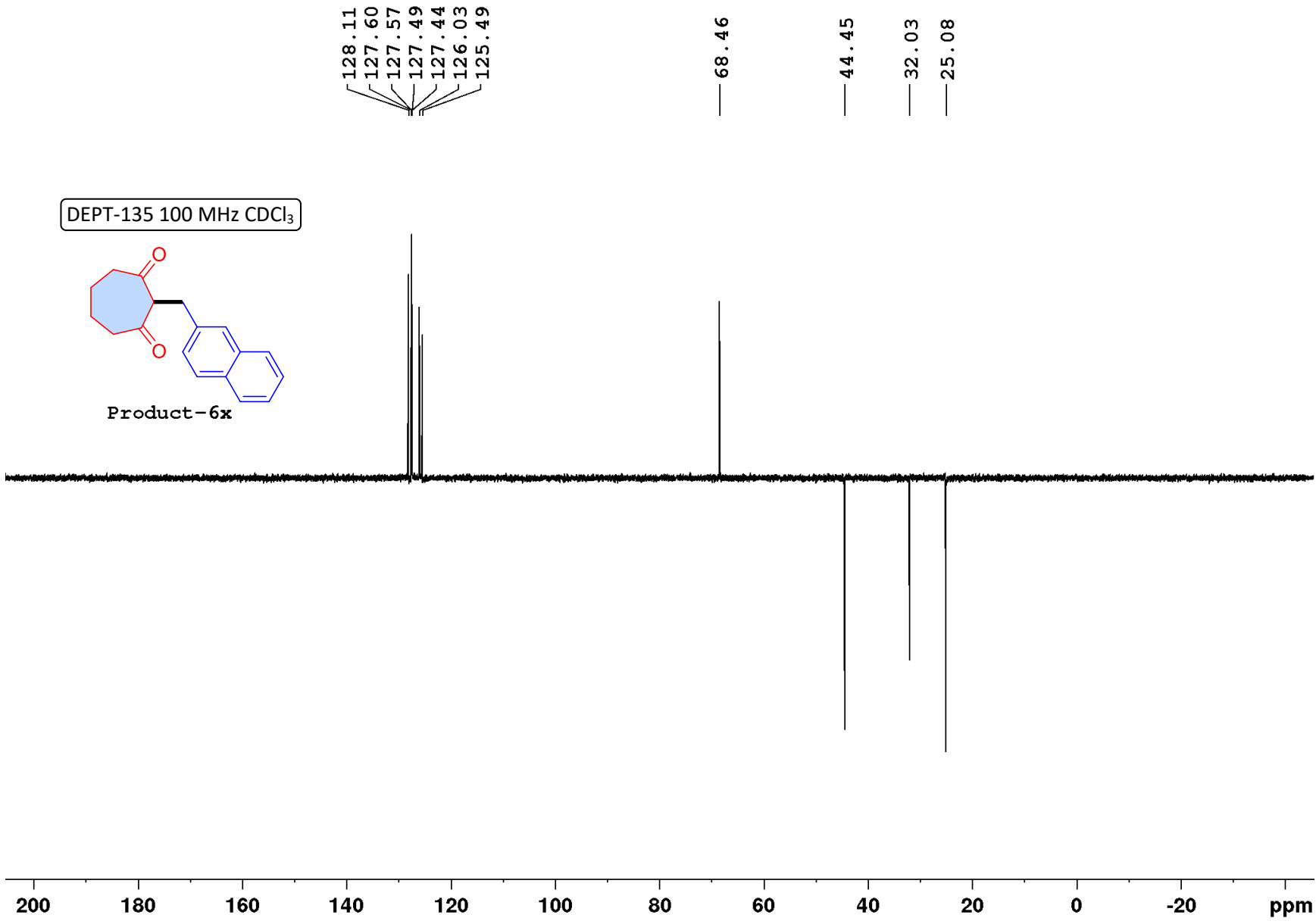
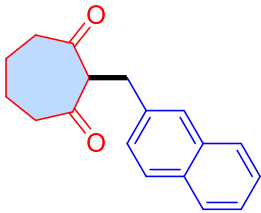


Product-6x

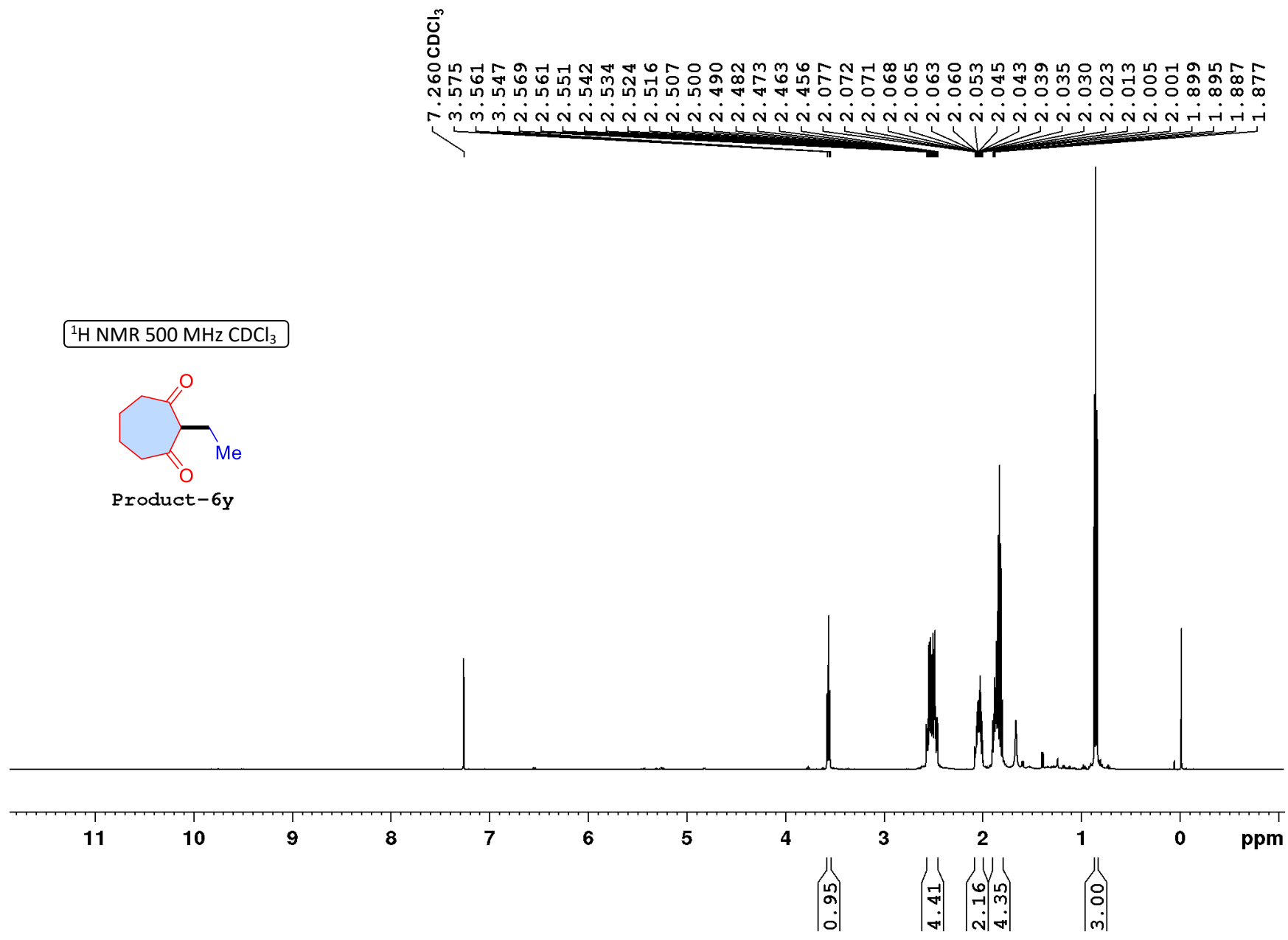
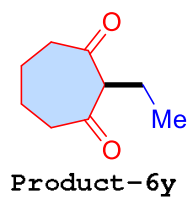


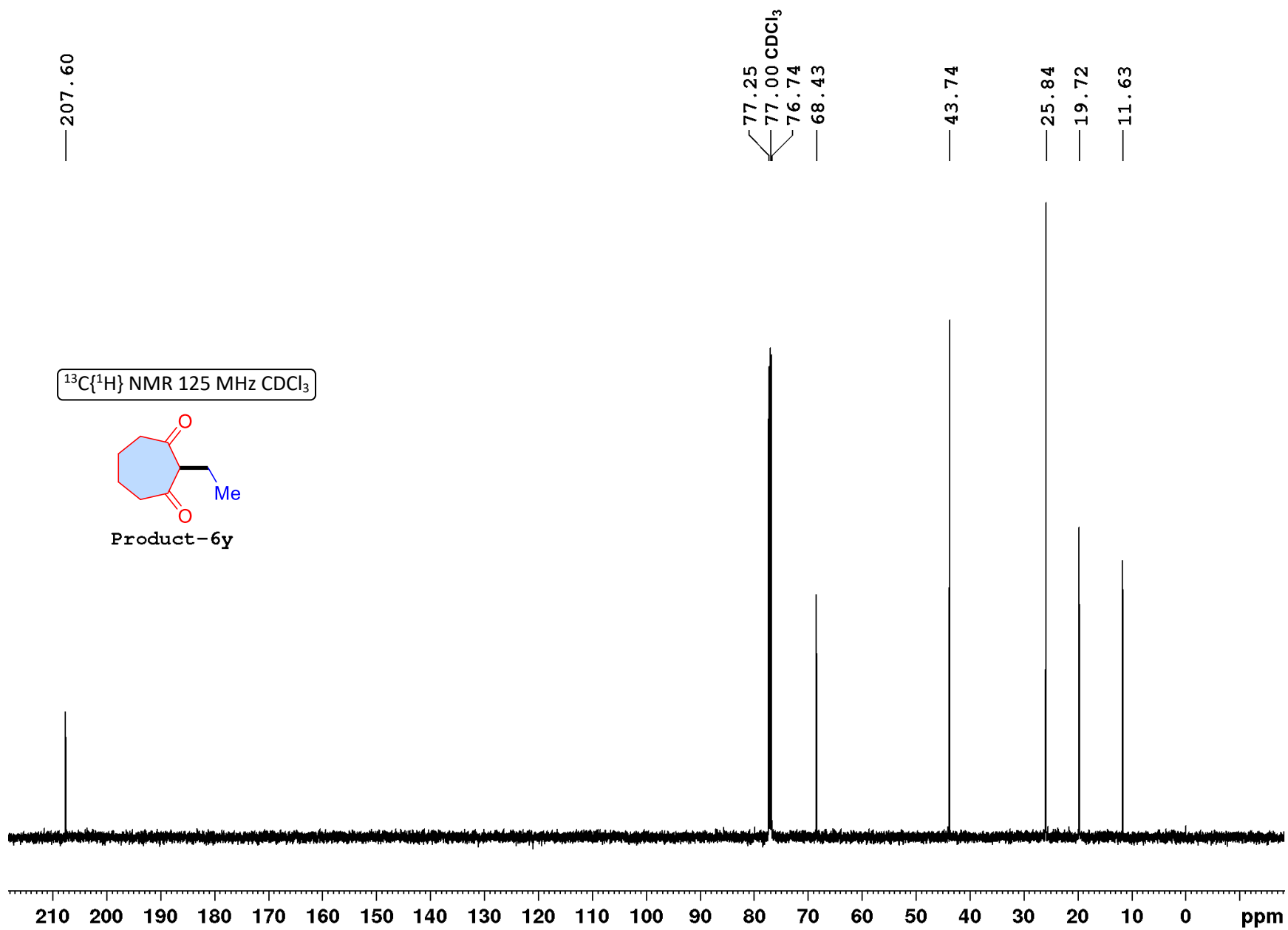


DEPT-135 100 MHz CDCl₃

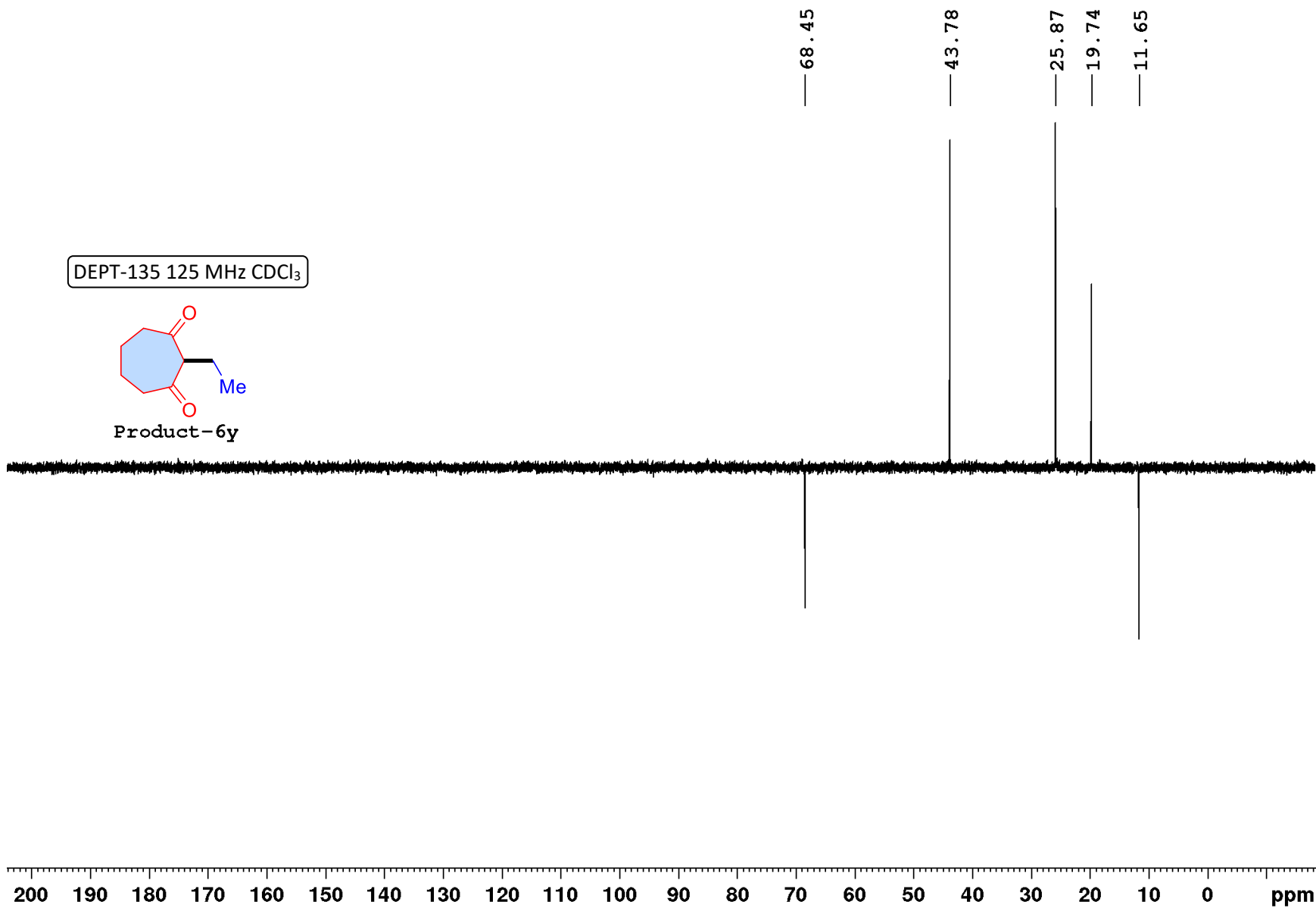
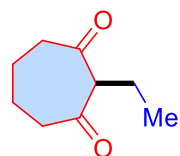


^1H NMR 500 MHz CDCl_3

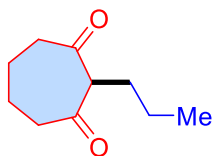




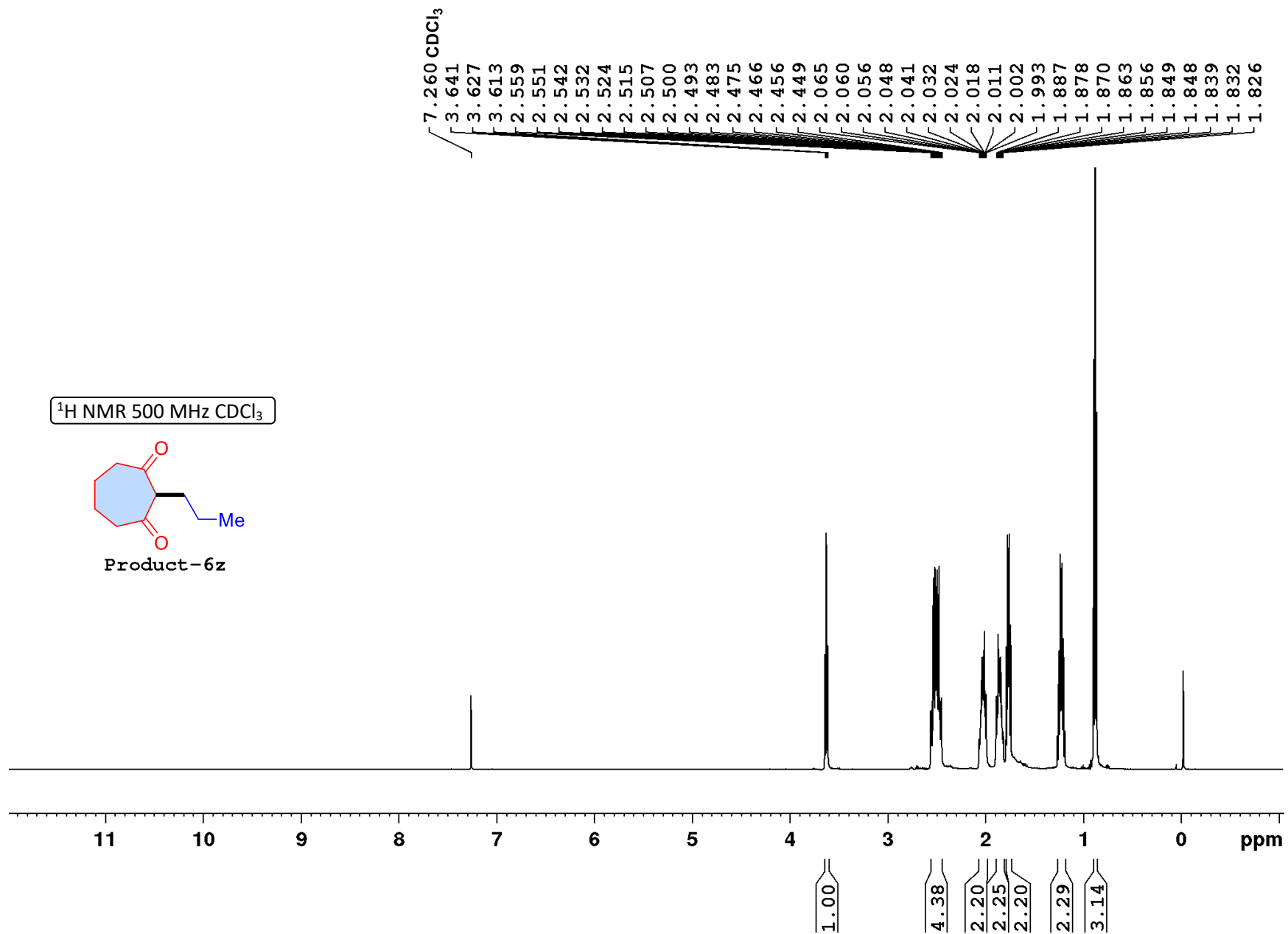
DEPT-135 125 MHz CDCl₃

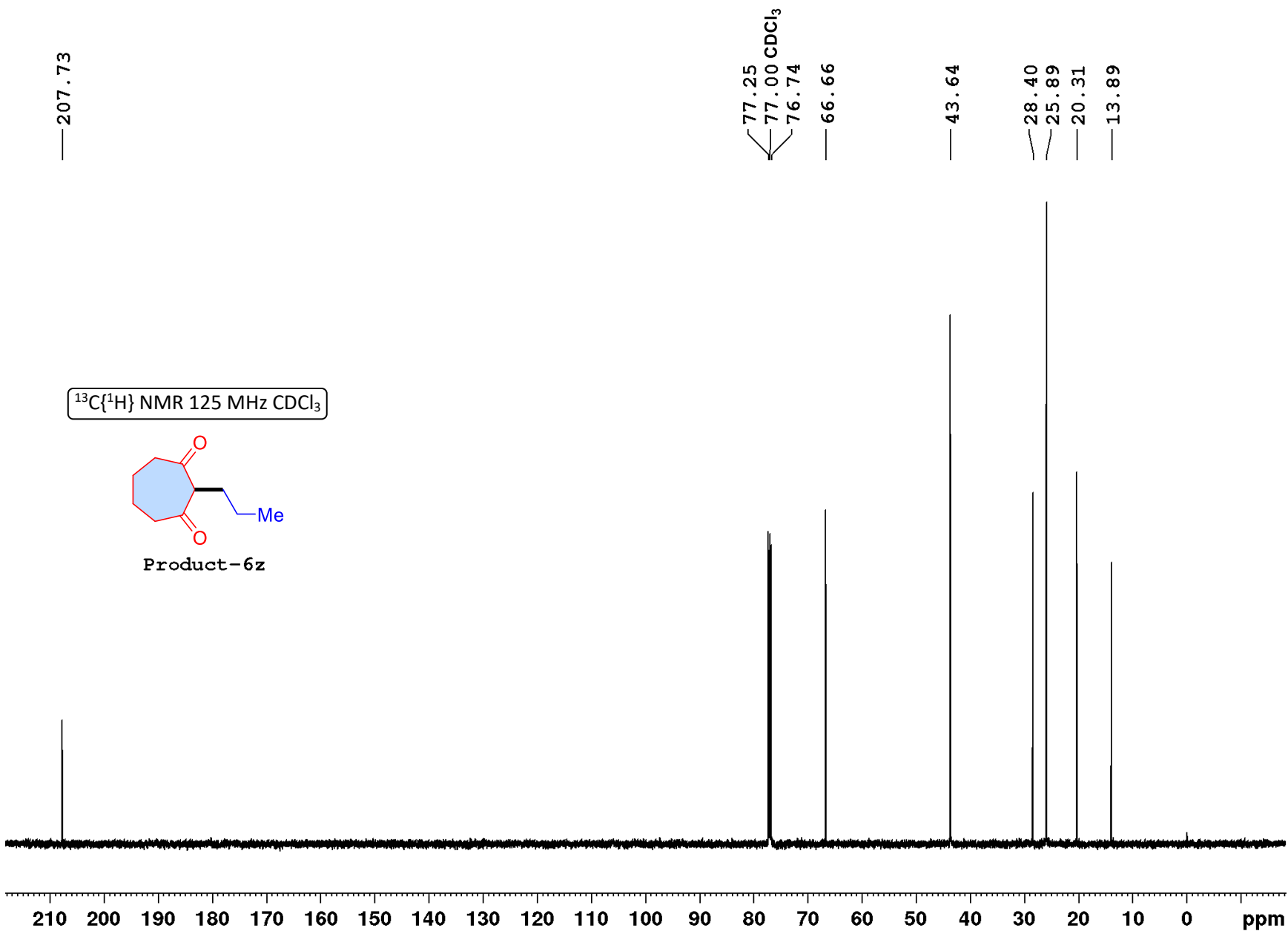


¹H NMR 500 MHz CDCl₃

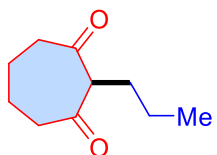


Product-6z

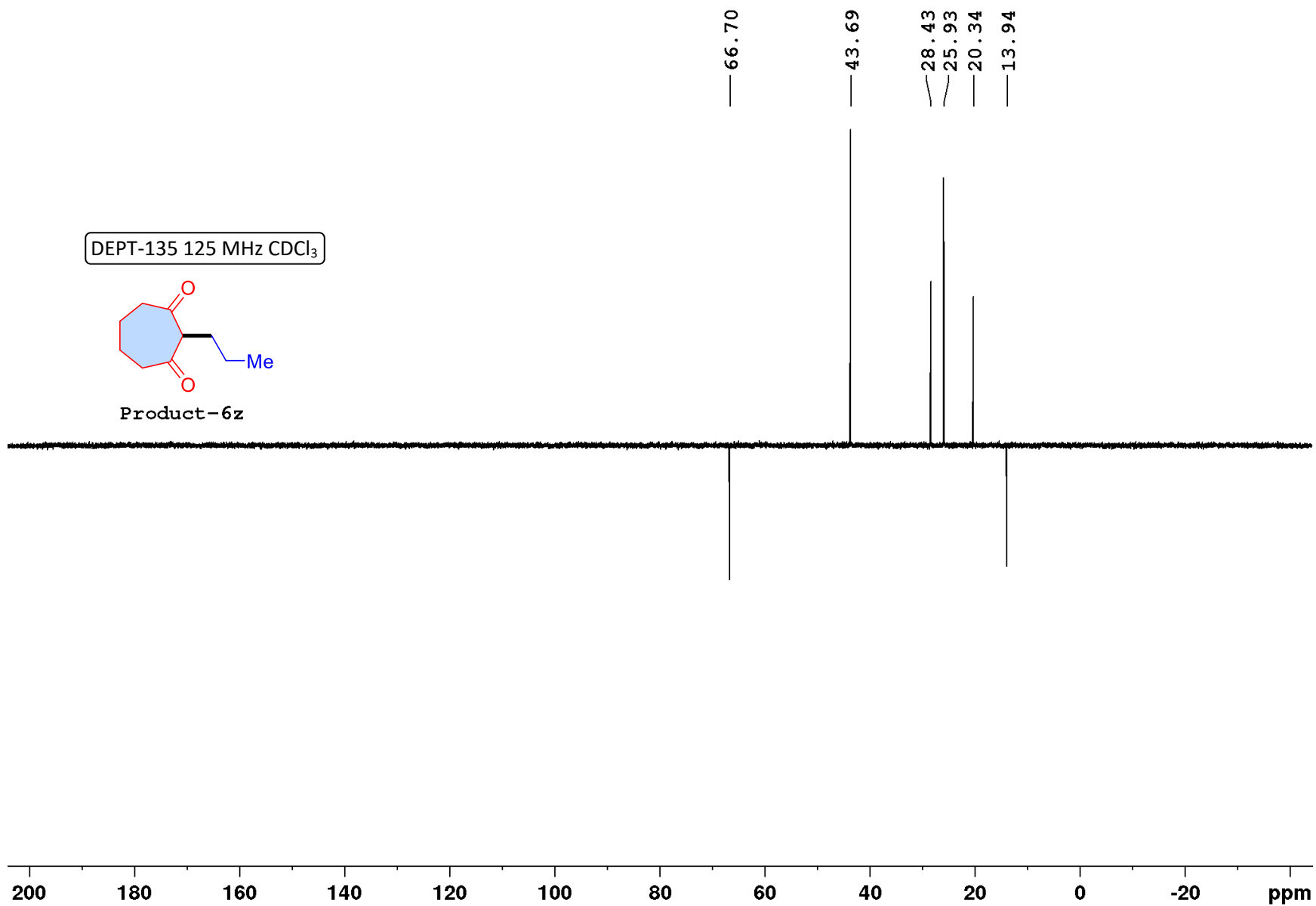




DEPT-135 125 MHz CDCl₃

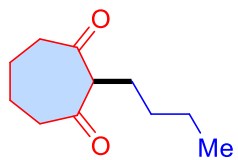


Product-6z

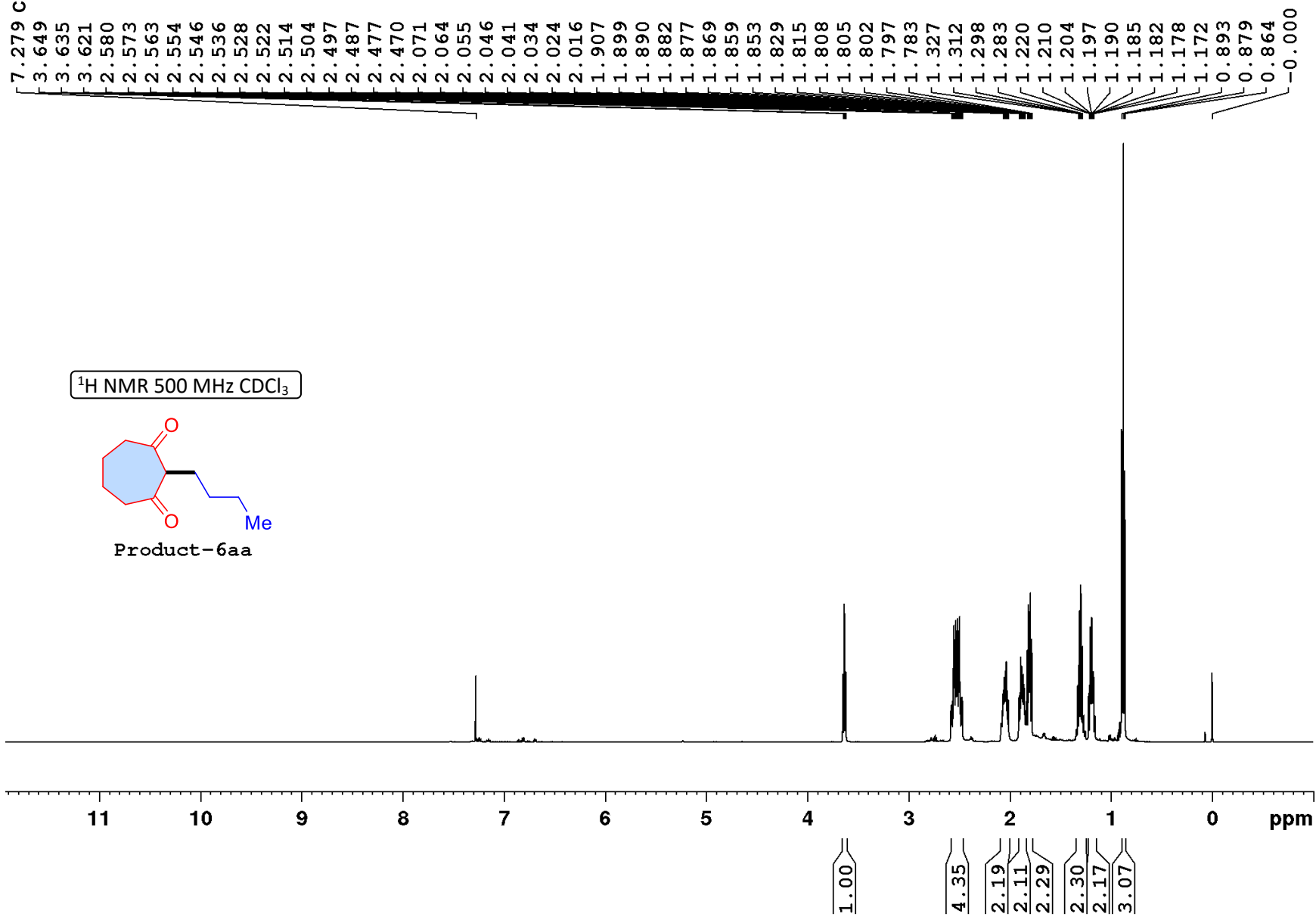


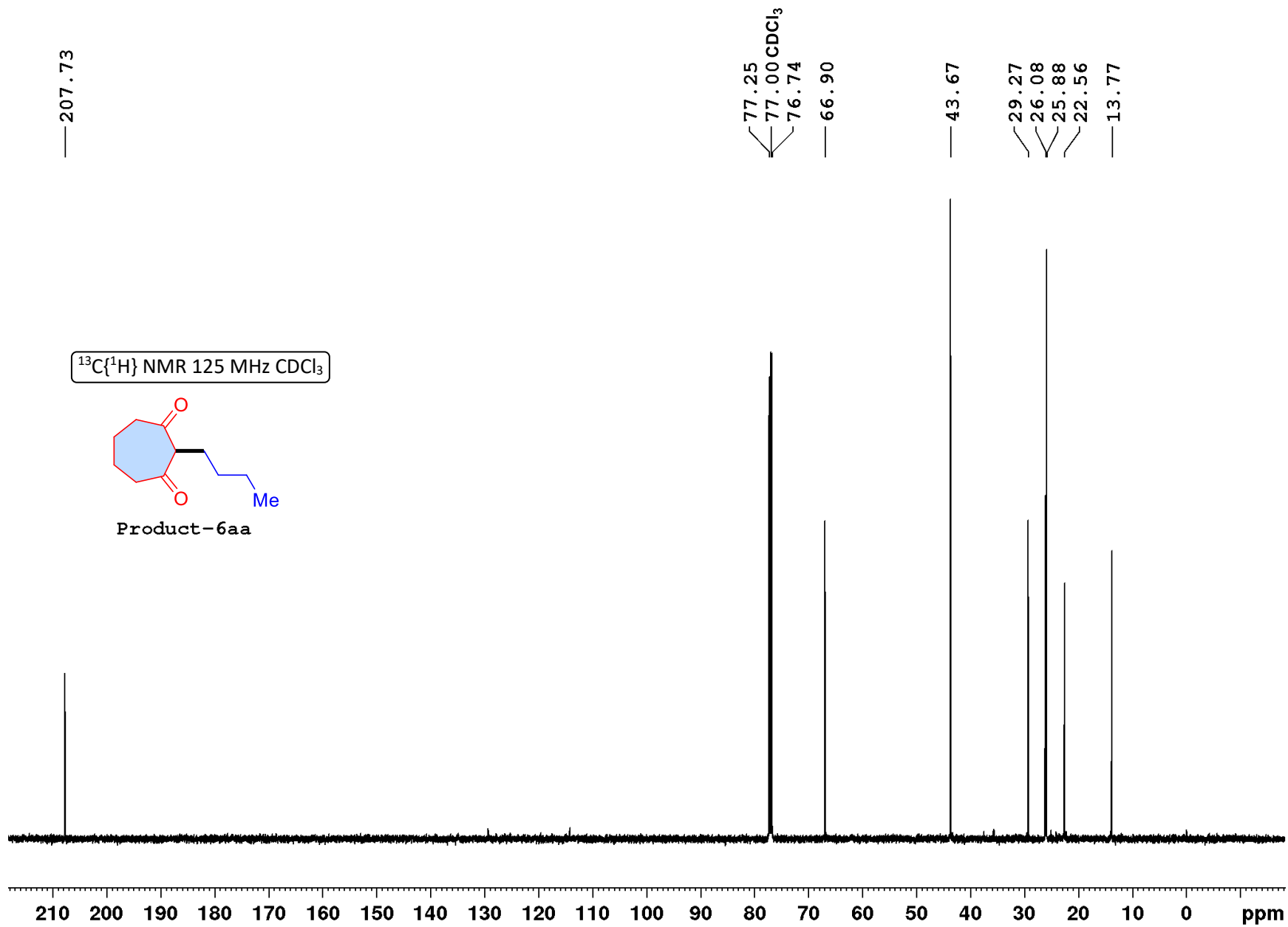
^1H NMR 500 MHz CDCl_3

^1H NMR 500 MHz CDCl_3

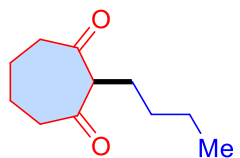


Product-6aa

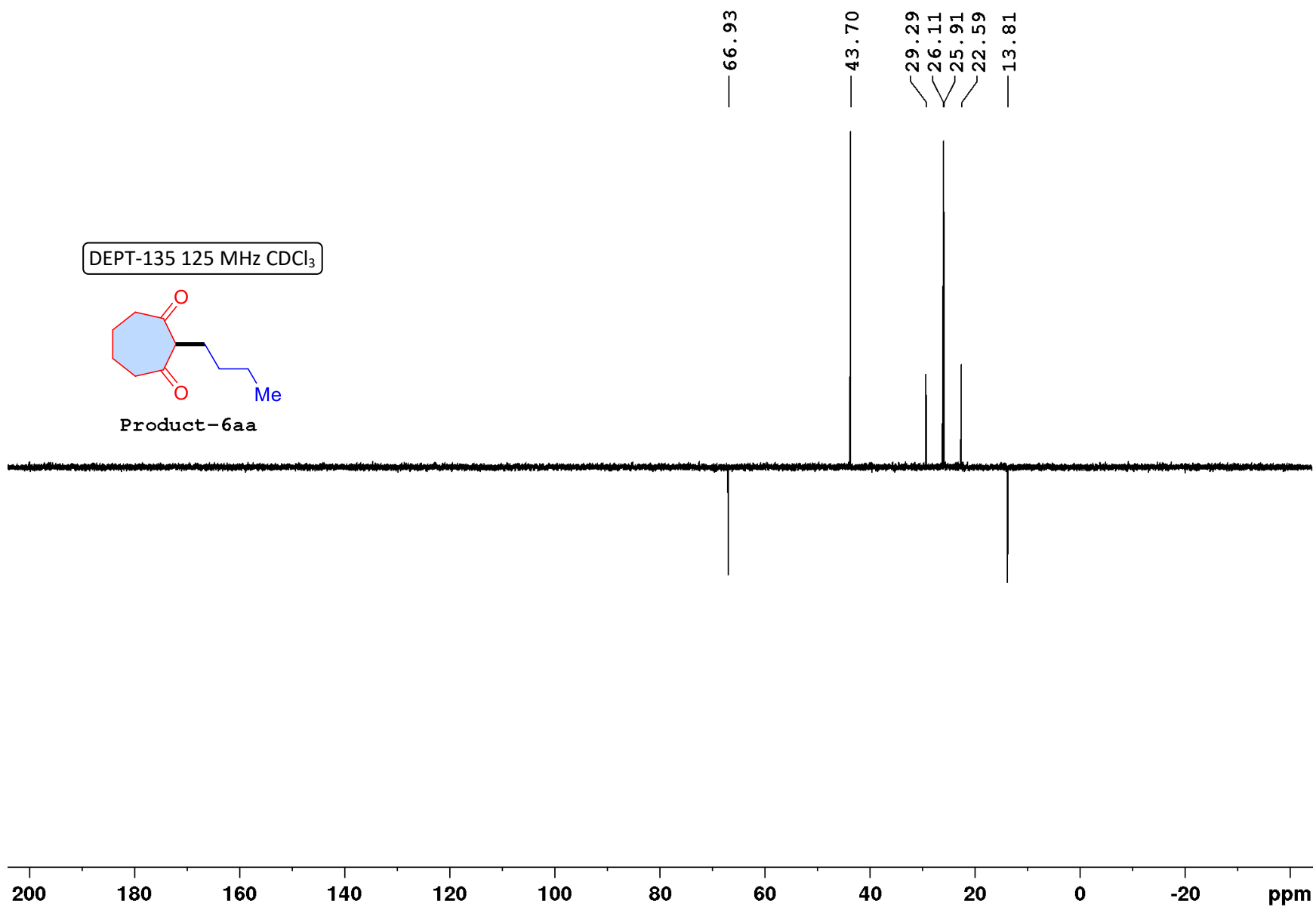




DEPT-135 125 MHz CDCl₃



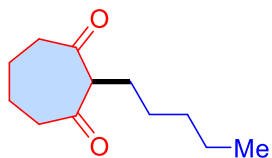
Product-6aa



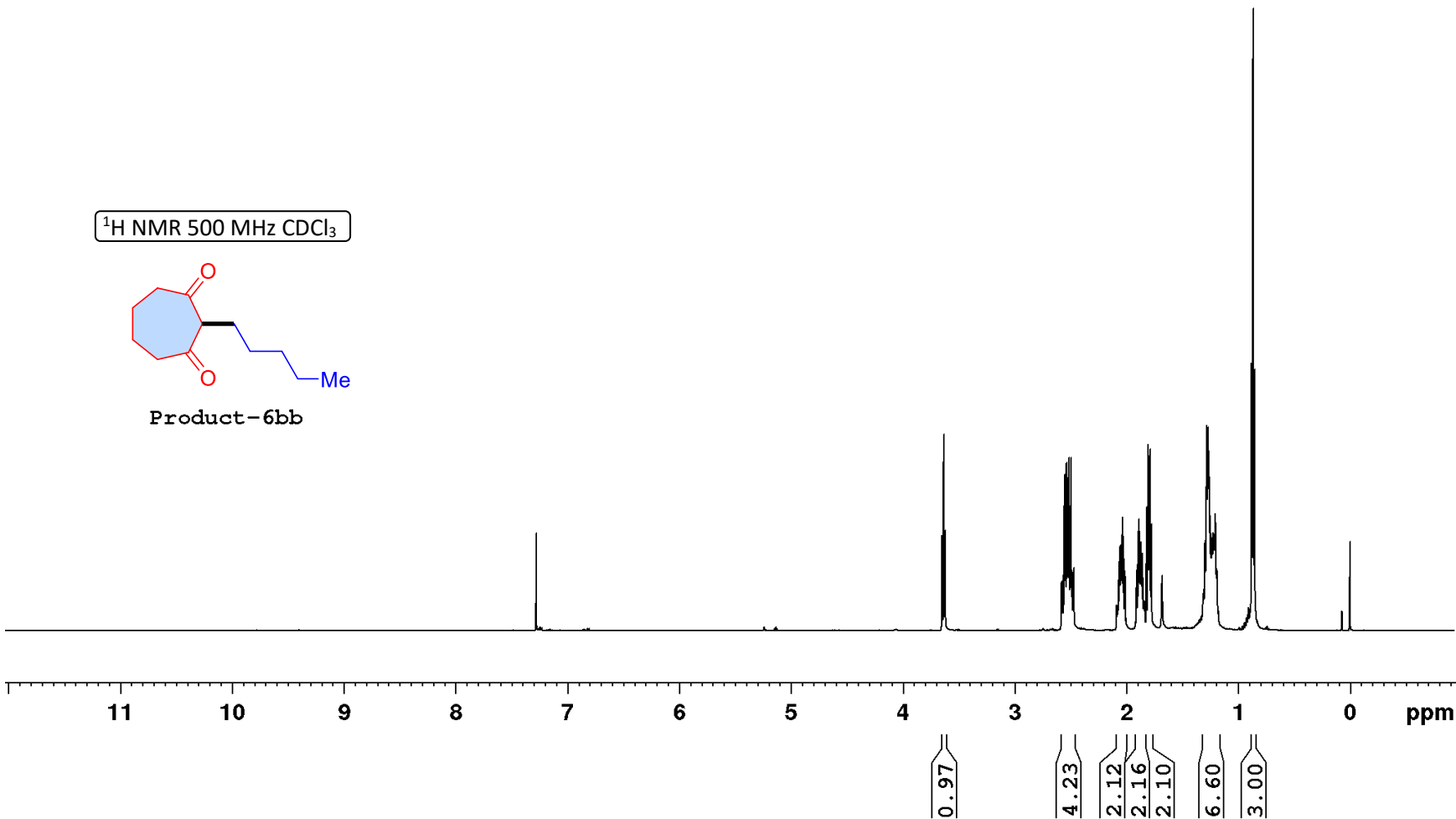
7.278 CDCl₃

3.647
3.634
3.620
2.552
2.544
2.535
2.527
2.520
2.513
2.503
2.496
2.486
2.469
2.063
2.054
2.045
2.040
2.033
2.023
1.907
1.899
1.889
1.882
1.876
1.873
1.868
1.866
1.858
1.819
1.806
1.800
1.789
1.775
1.296
1.283
1.282
1.278
1.271
1.264
1.259
1.250
1.245
1.243
1.237
1.233
1.230
1.223
1.216
1.211
1.204
1.194
1.190
0.880
0.875
0.866
0.852
-0.000

¹H NMR 500 MHz CDCl₃



Product-6bb



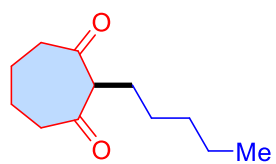
— 207.72

77.25
77.00 CDCl₃
76.74
— 66.94

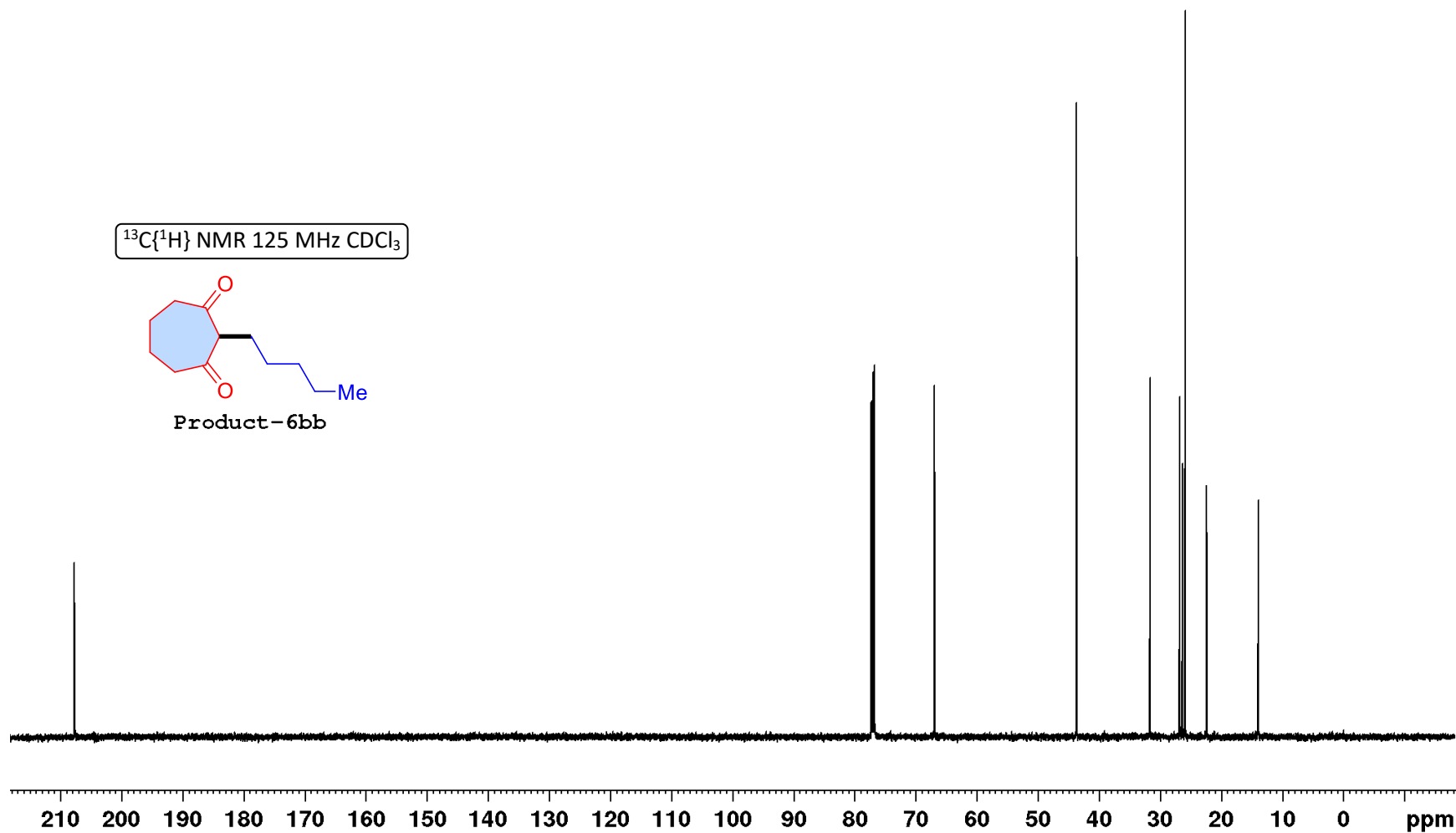
— 43.67

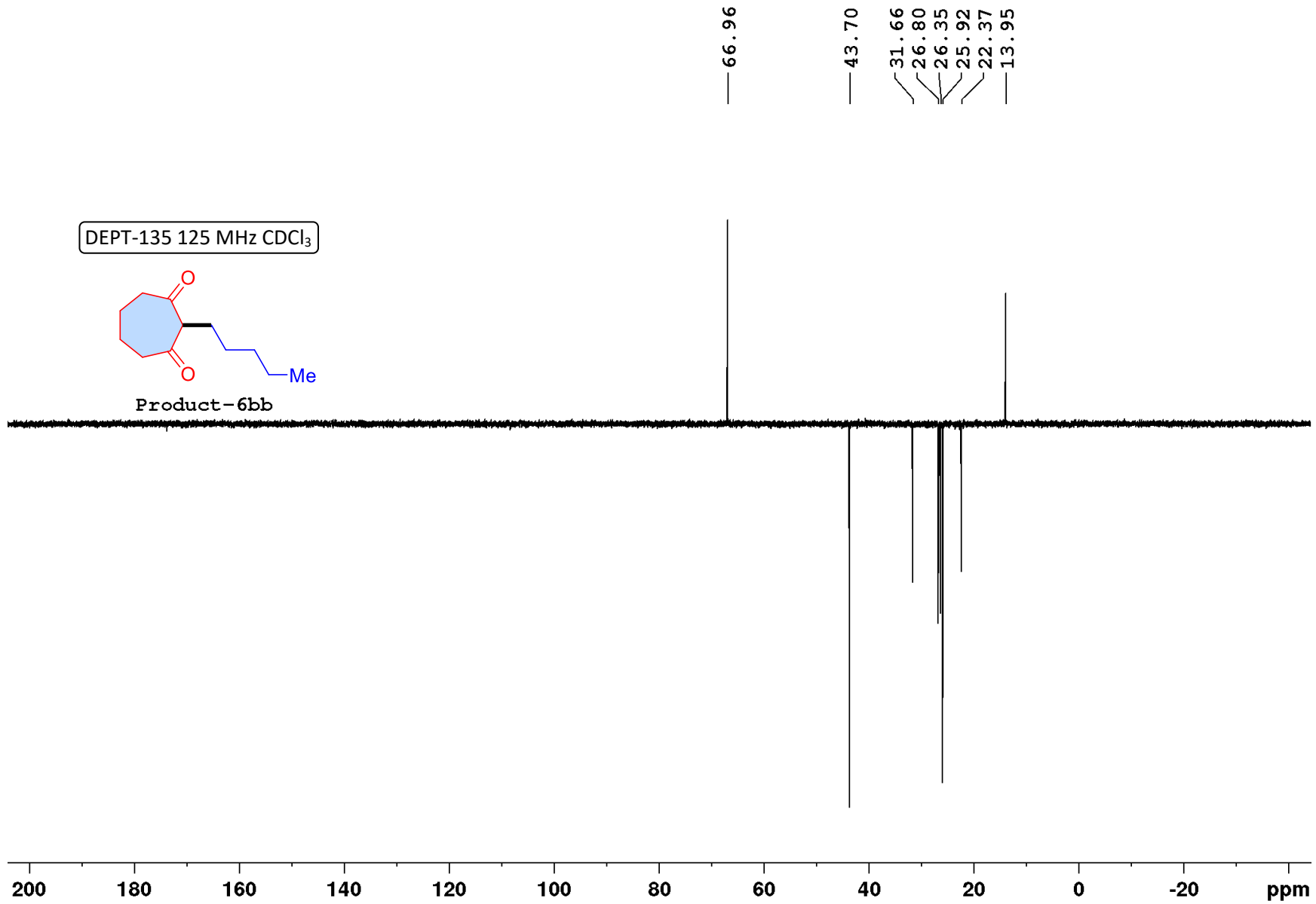
31.64
26.77
26.33
25.89
22.34
— 13.91

¹³C{¹H} NMR 125 MHz CDCl₃



Product-6bb

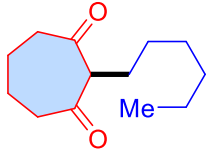




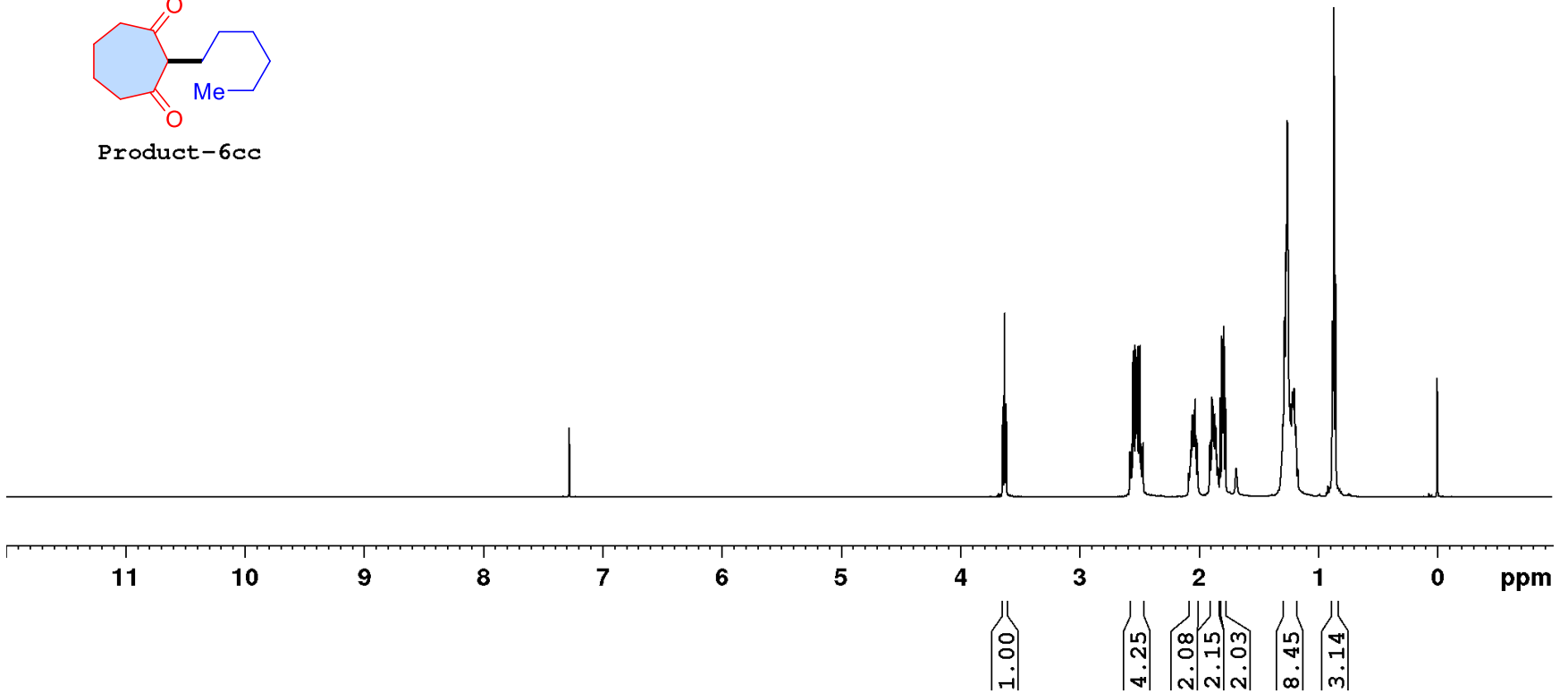
7.280 CDCl₃

3.643
3.629
3.615
2.577
2.569
2.560
2.550
2.542
2.533
2.525
2.519
2.511
2.502
2.494
2.485
2.475
2.467
2.068
2.061
2.052
2.043
2.038
2.031
2.021
2.013
2.010
1.910
1.906
1.898
1.888
1.881
1.875
1.867
1.858
1.851
1.840
1.821
1.807
1.790
1.776
1.296
1.292
1.281
1.269
1.257
1.255
1.237
1.229
1.213
1.207
1.199
1.187
1.184
0.880
0.867
0.853
-0.000

¹H NMR 500 MHz CDCl₃



Product-6cc

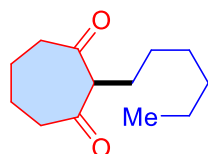


— 207.73

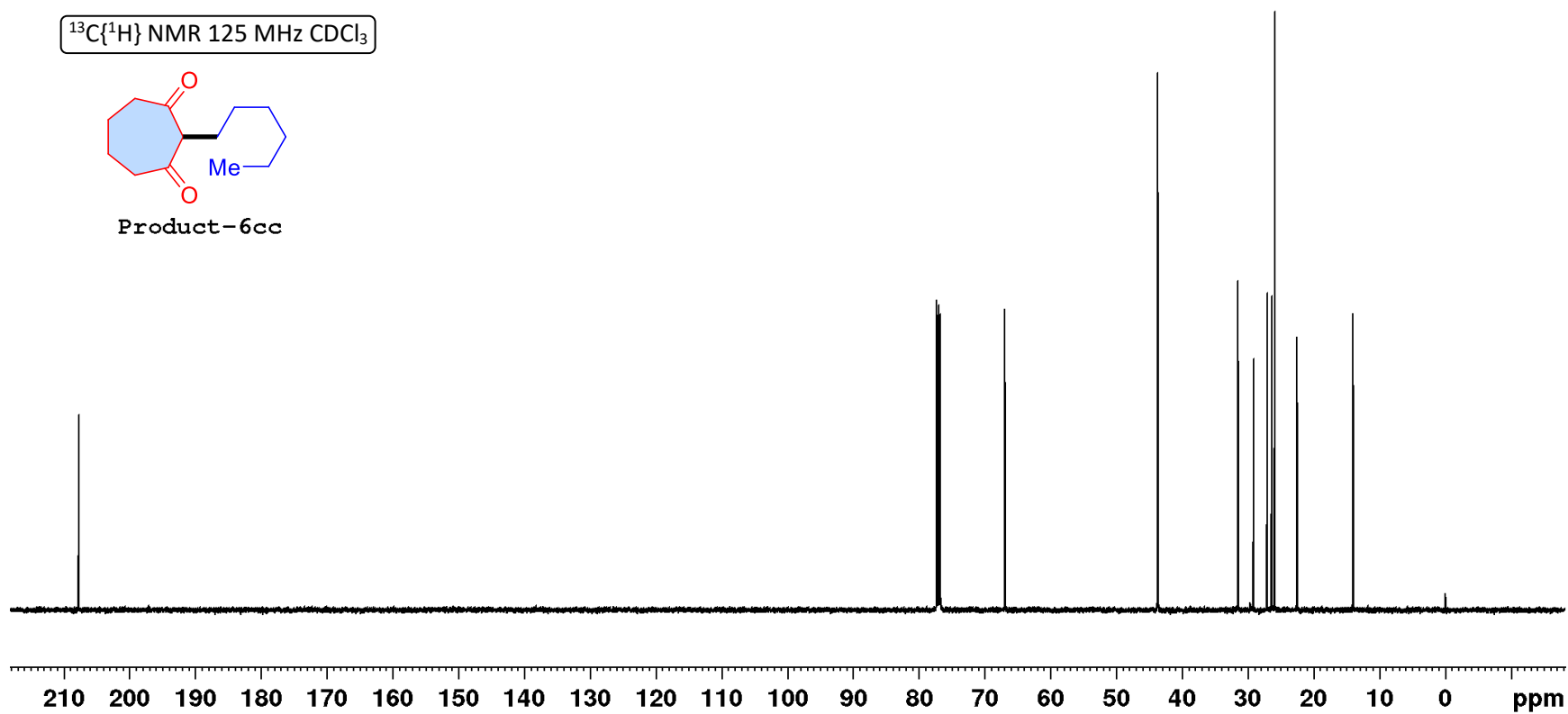
77.25
76.99 CDCl₃
76.74
— 66.92

— 43.66
31.48
29.11
27.04
26.35
25.88
22.49
— 13.97

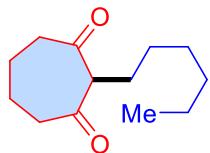
¹³C{¹H} NMR 125 MHz CDCl₃



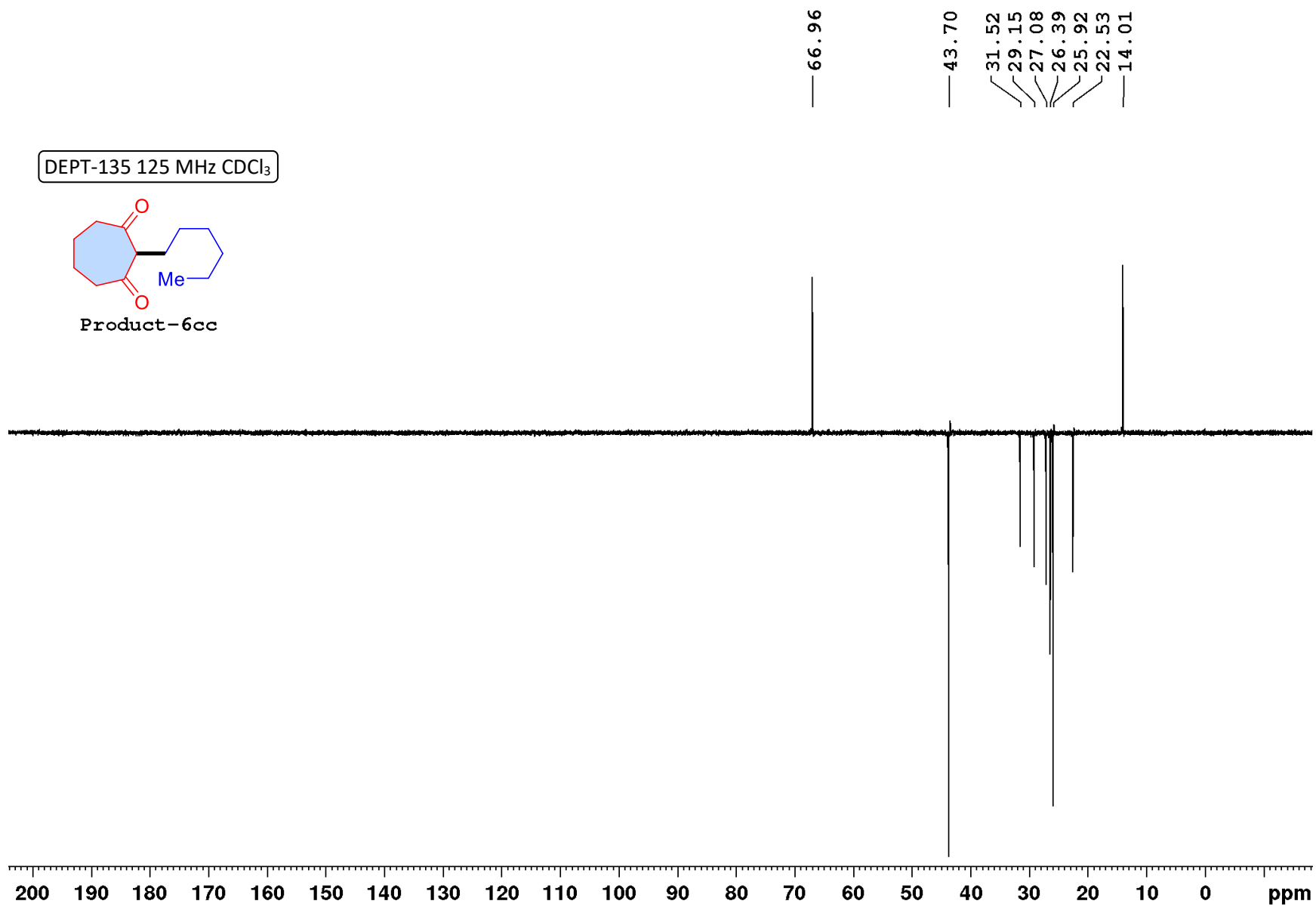
Product-6cc



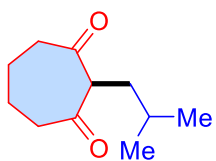
DEPT-135 125 MHz CDCl₃



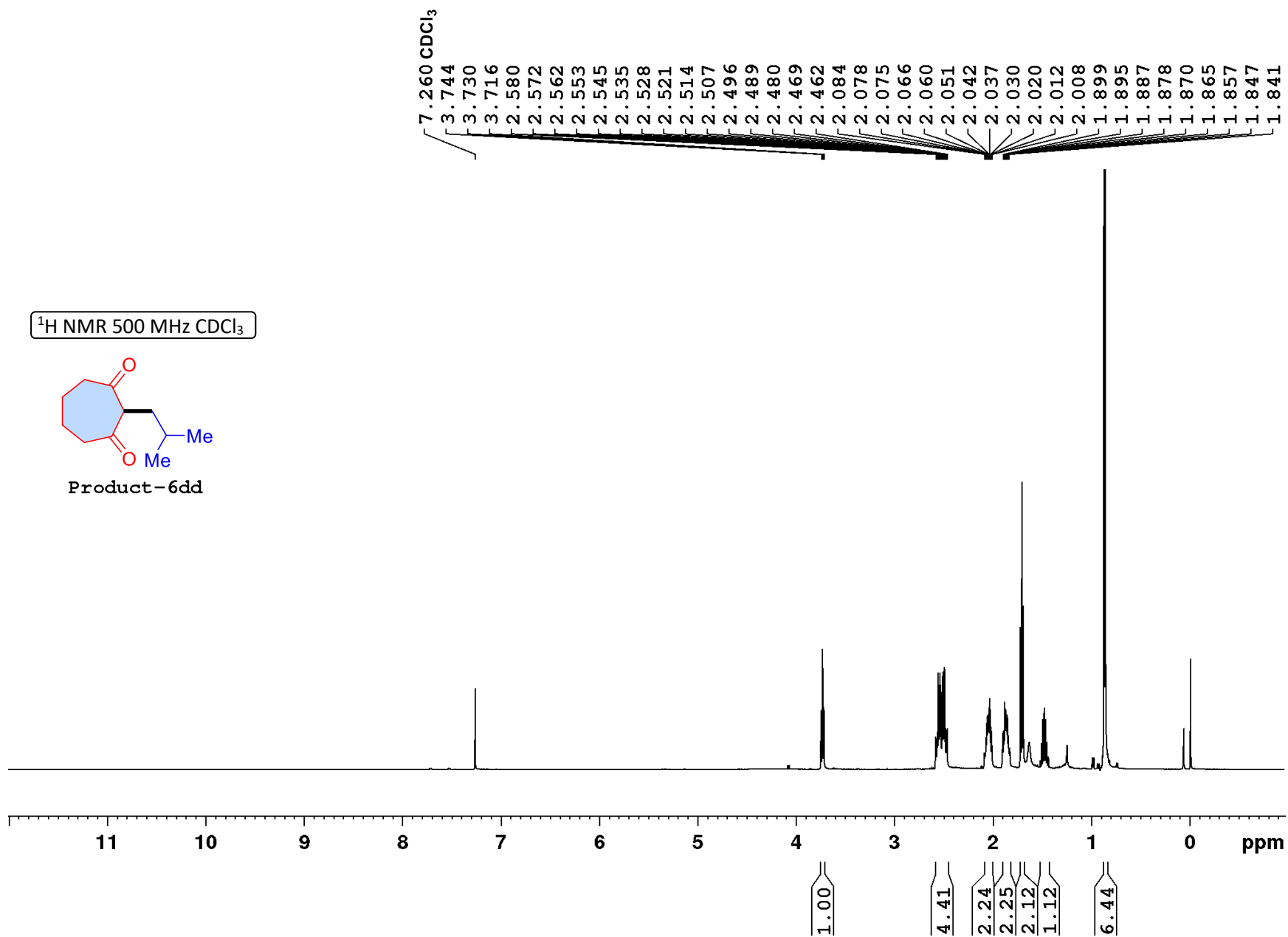
Product-6cc



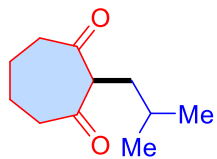
¹H NMR 500 MHz CDCl₃



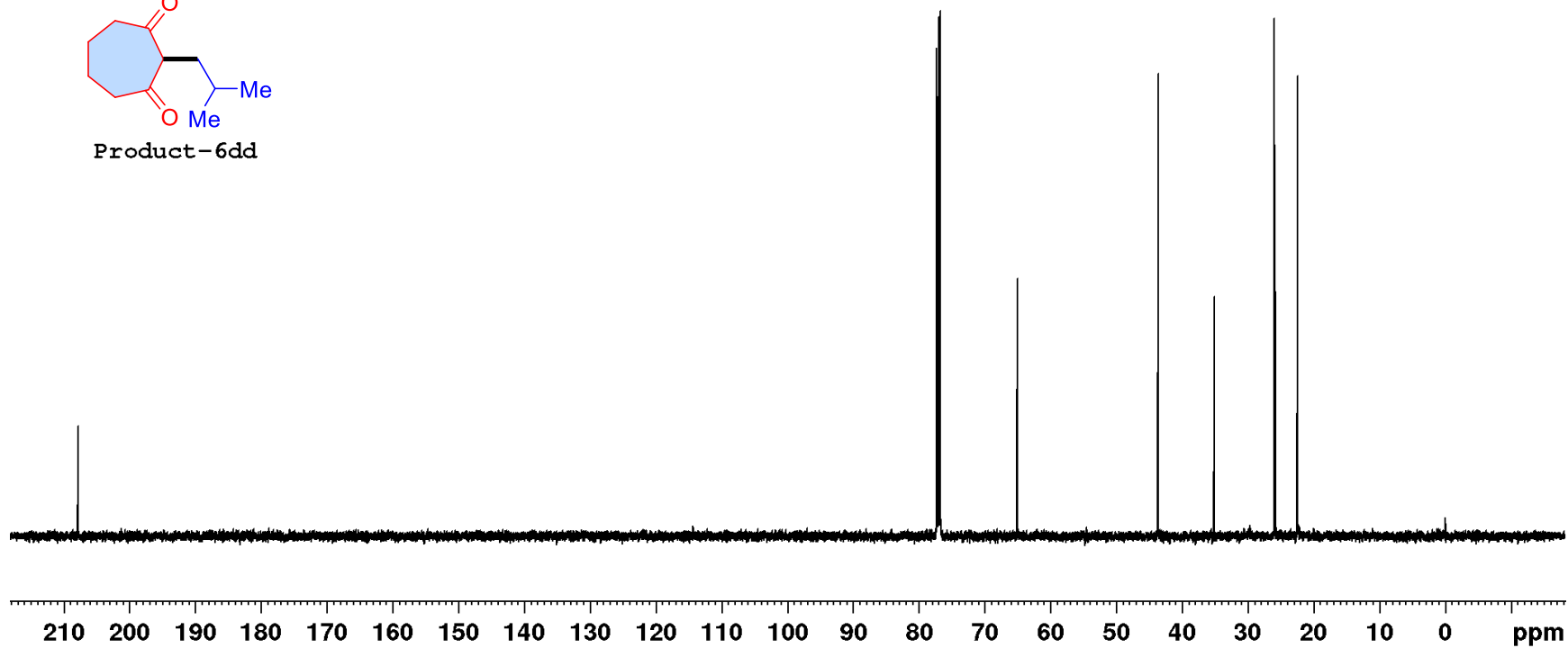
Product-6dd



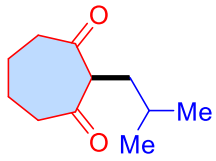
$^{13}\text{C}\{^1\text{H}\}$ NMR 125 MHz CDCl_3



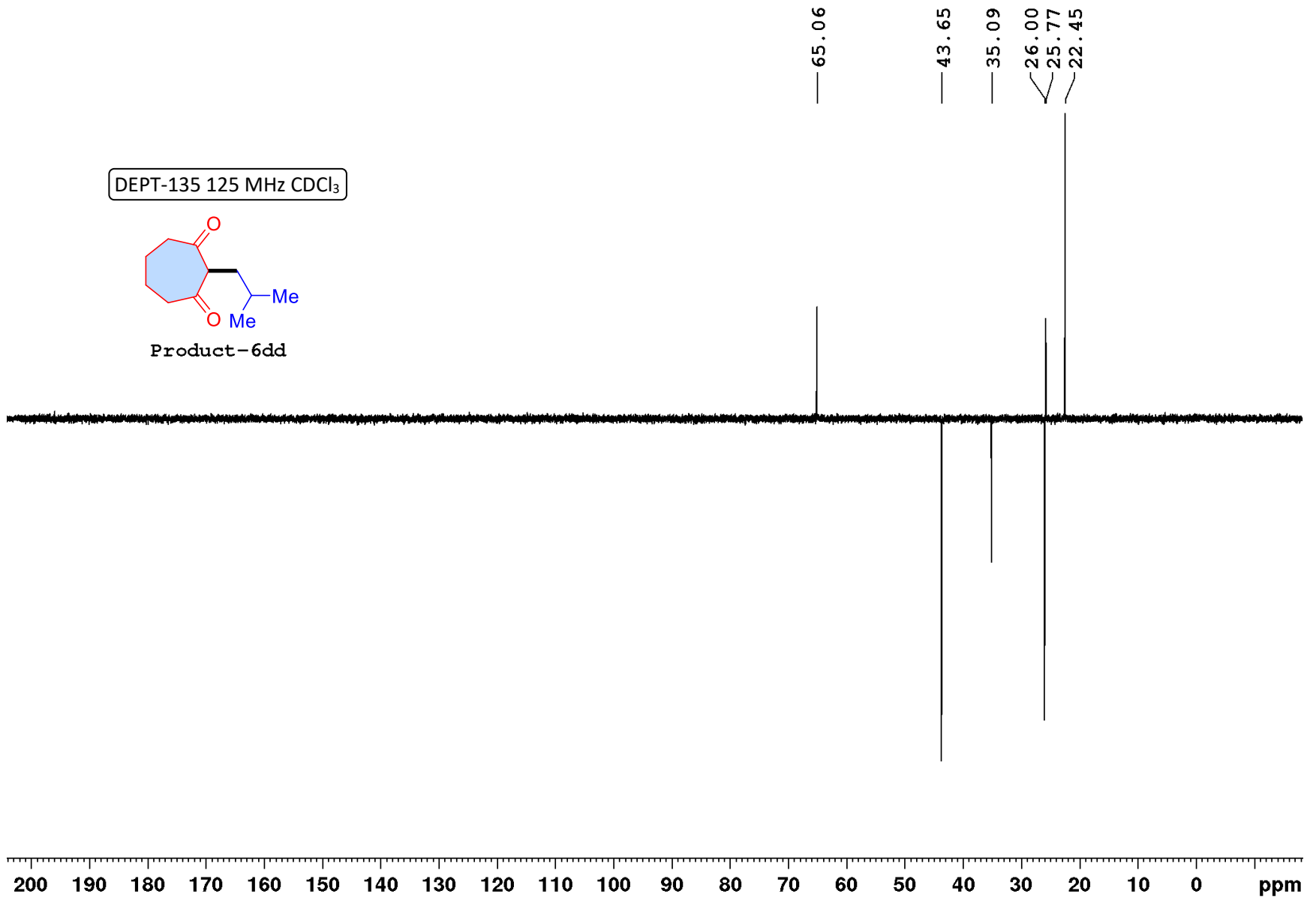
Product-6dd

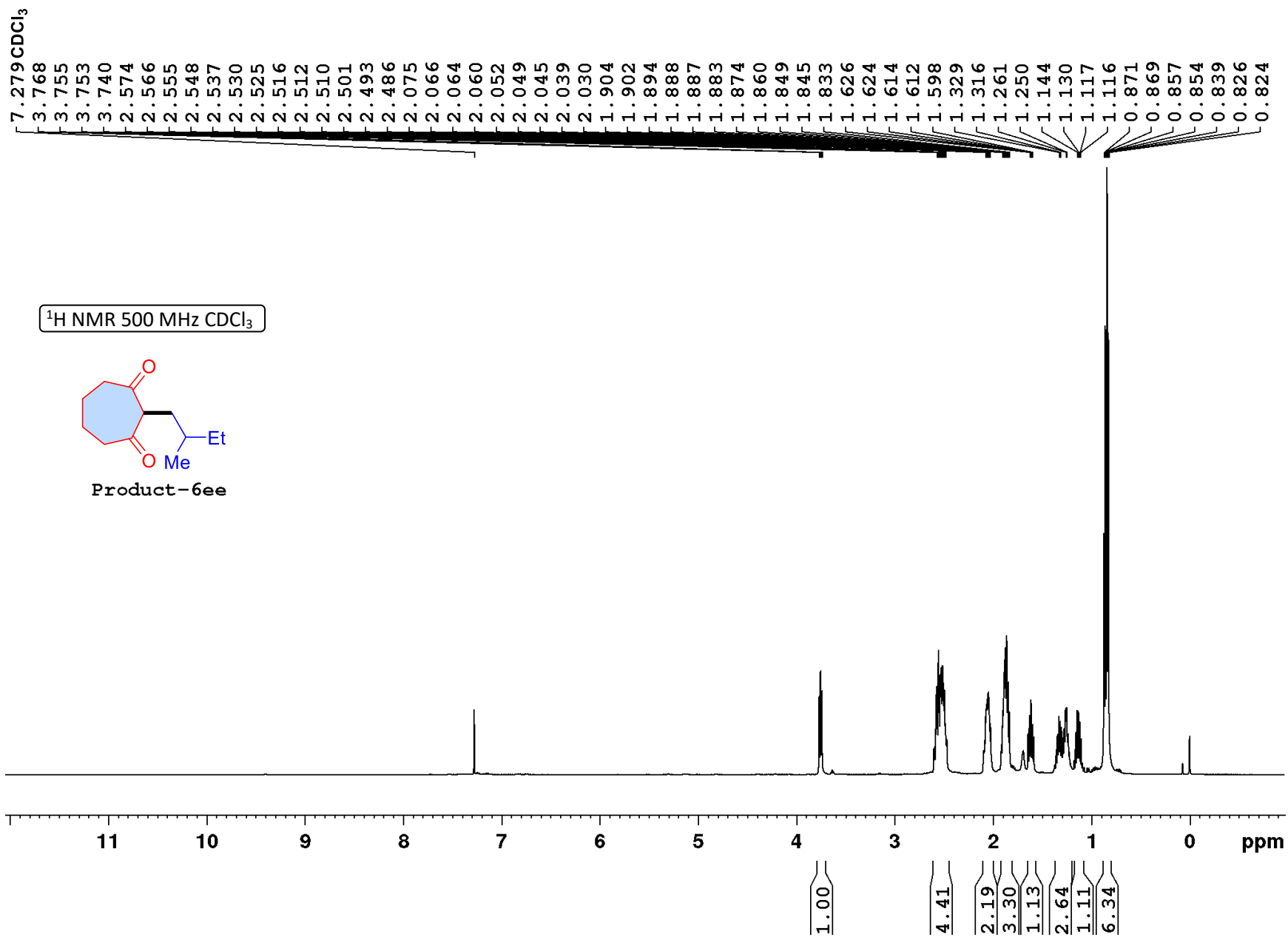


DEPT-135 125 MHz CDCl₃



Product-6dd



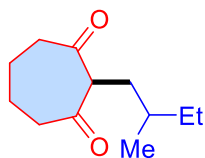


207.95
207.80

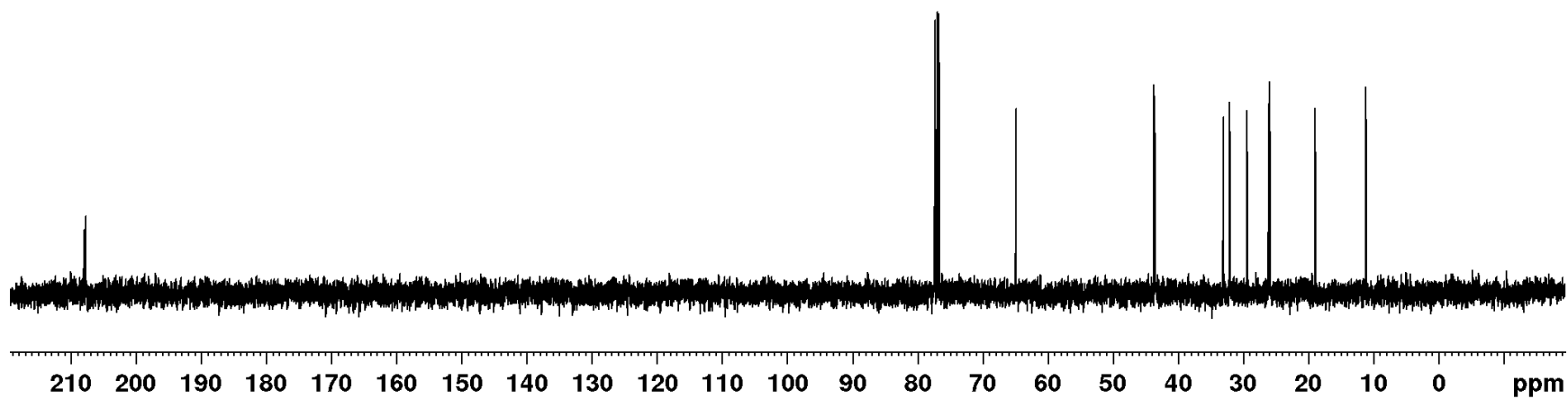
77.31
77.00 CDCl₃
76.68
64.86

43.67
43.54
33.02
32.03
29.36
26.06
25.88
18.91
11.10

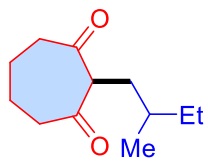
¹³C{¹H} NMR 100 MHz CDCl₃



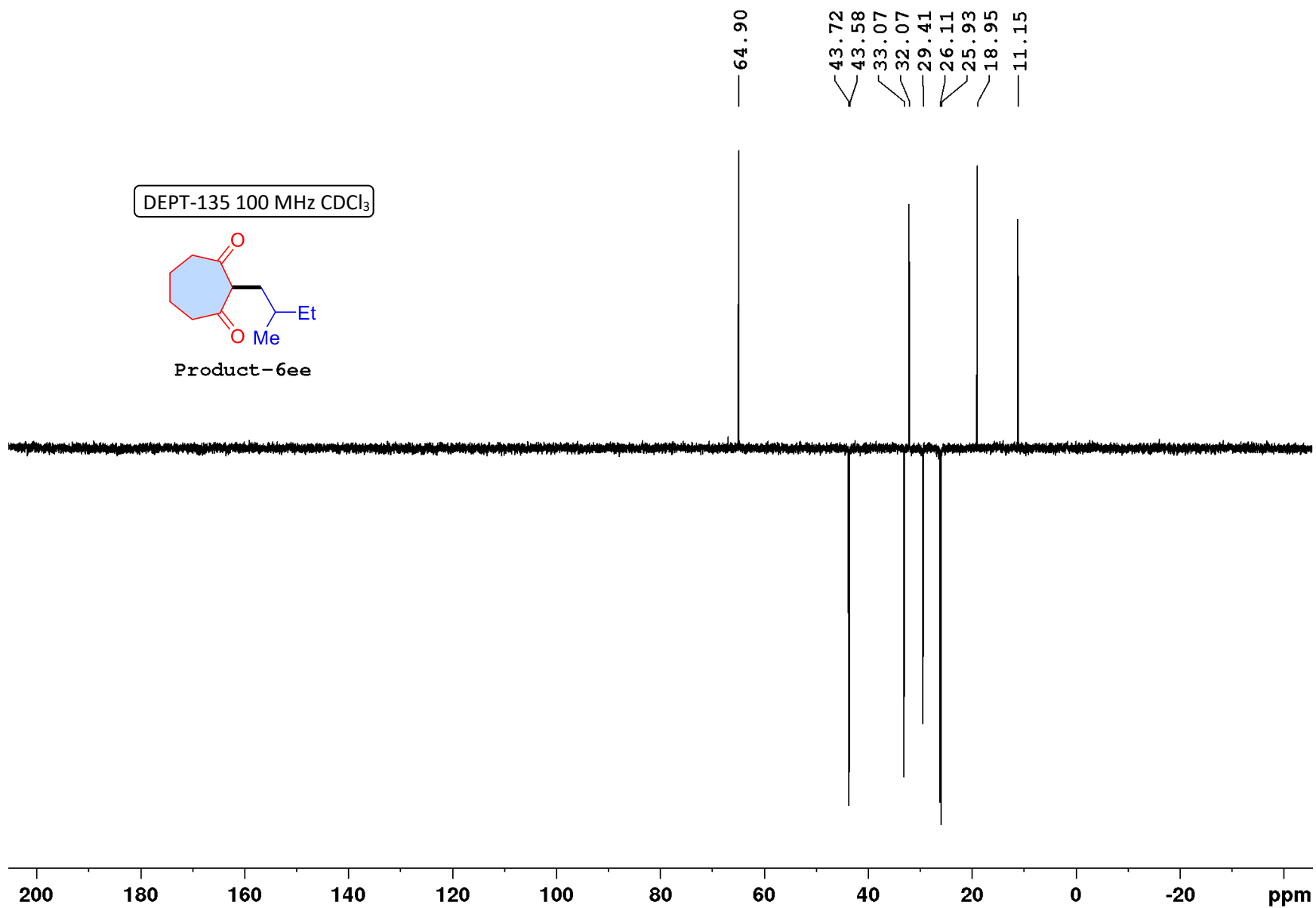
Product-6ee

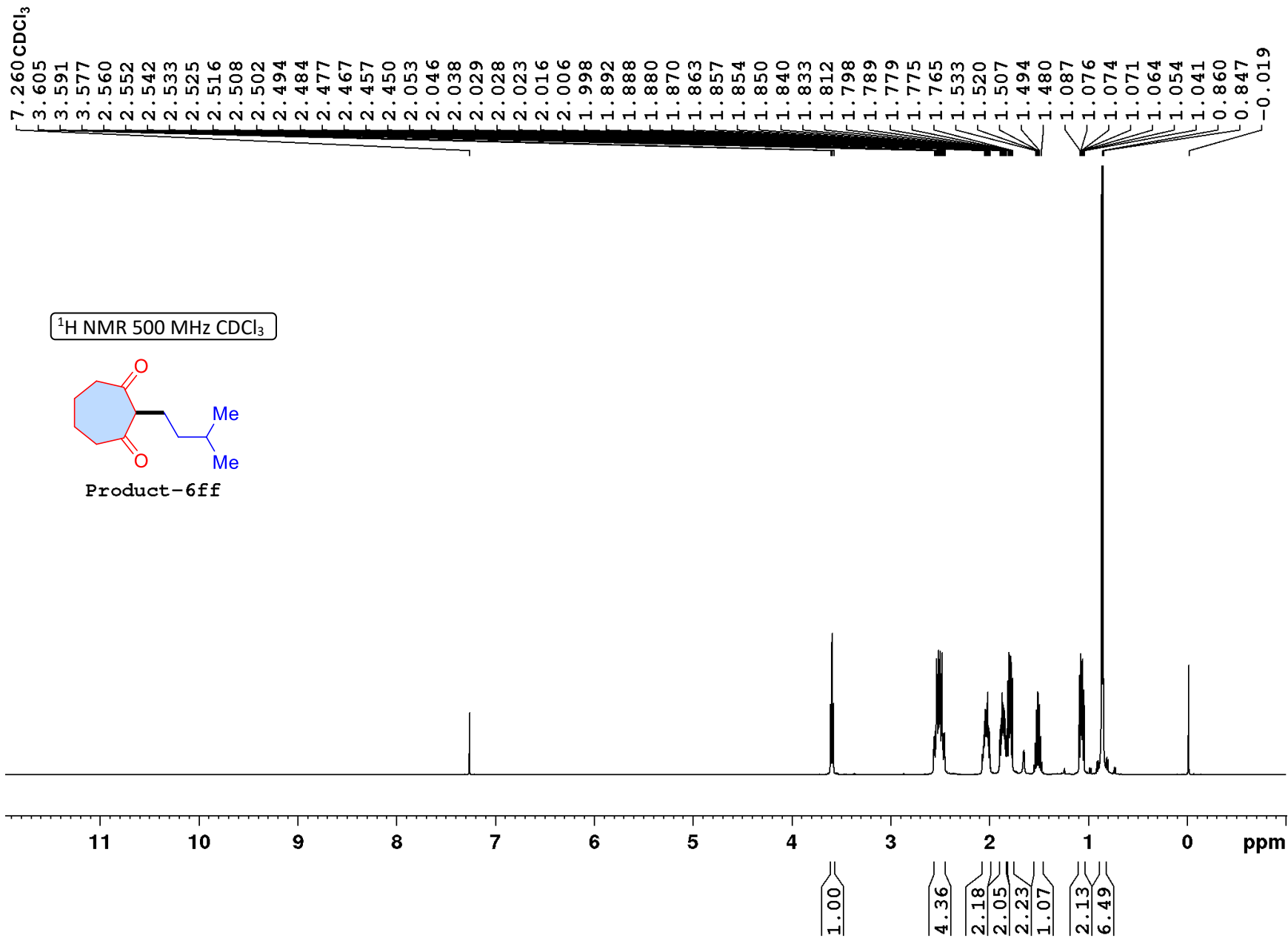


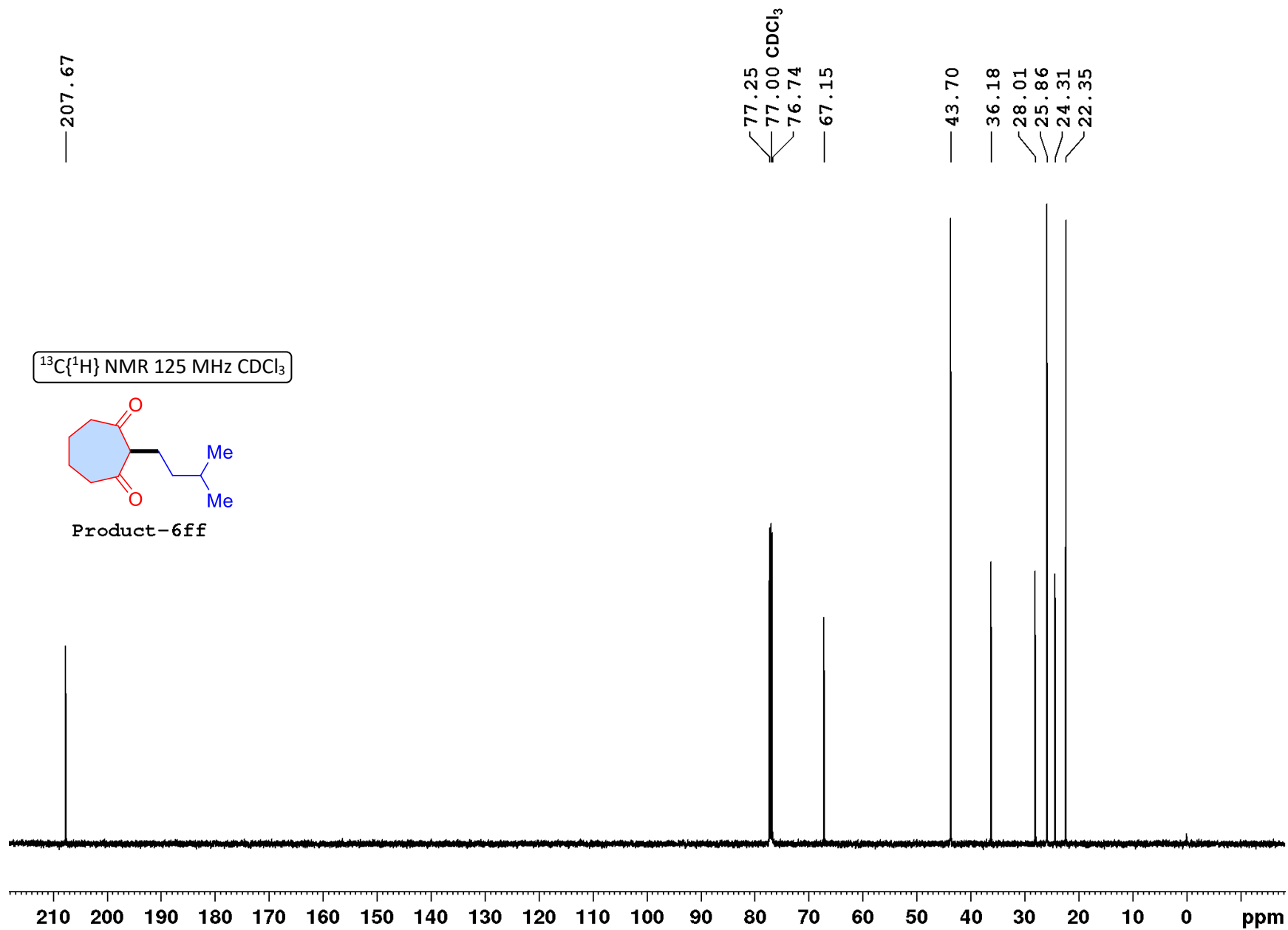
DEPT-135 100 MHz CDCl₃



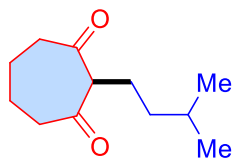
Product-6ee



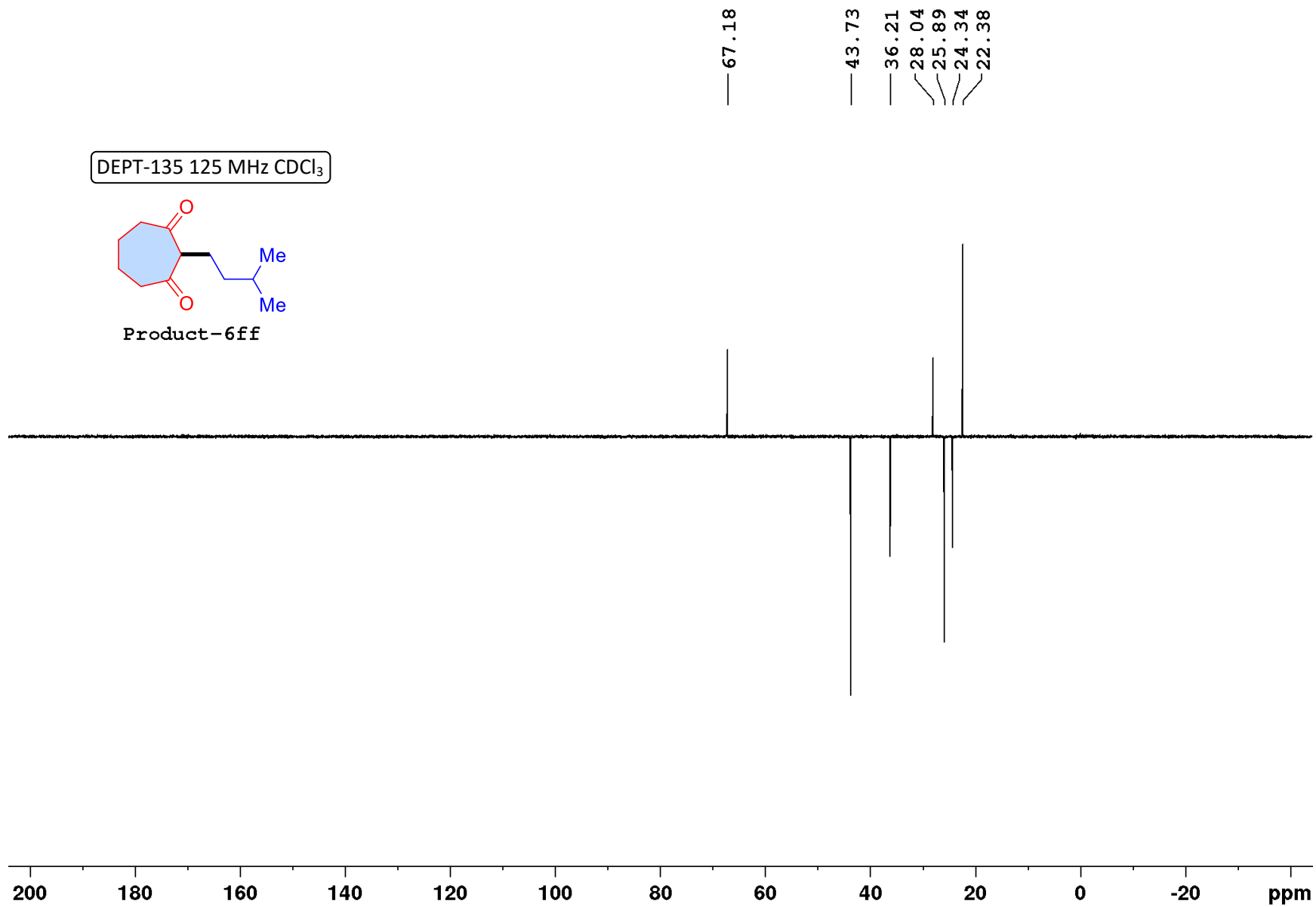




DEPT-135 125 MHz CDCl₃

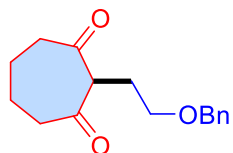


Product-6ff

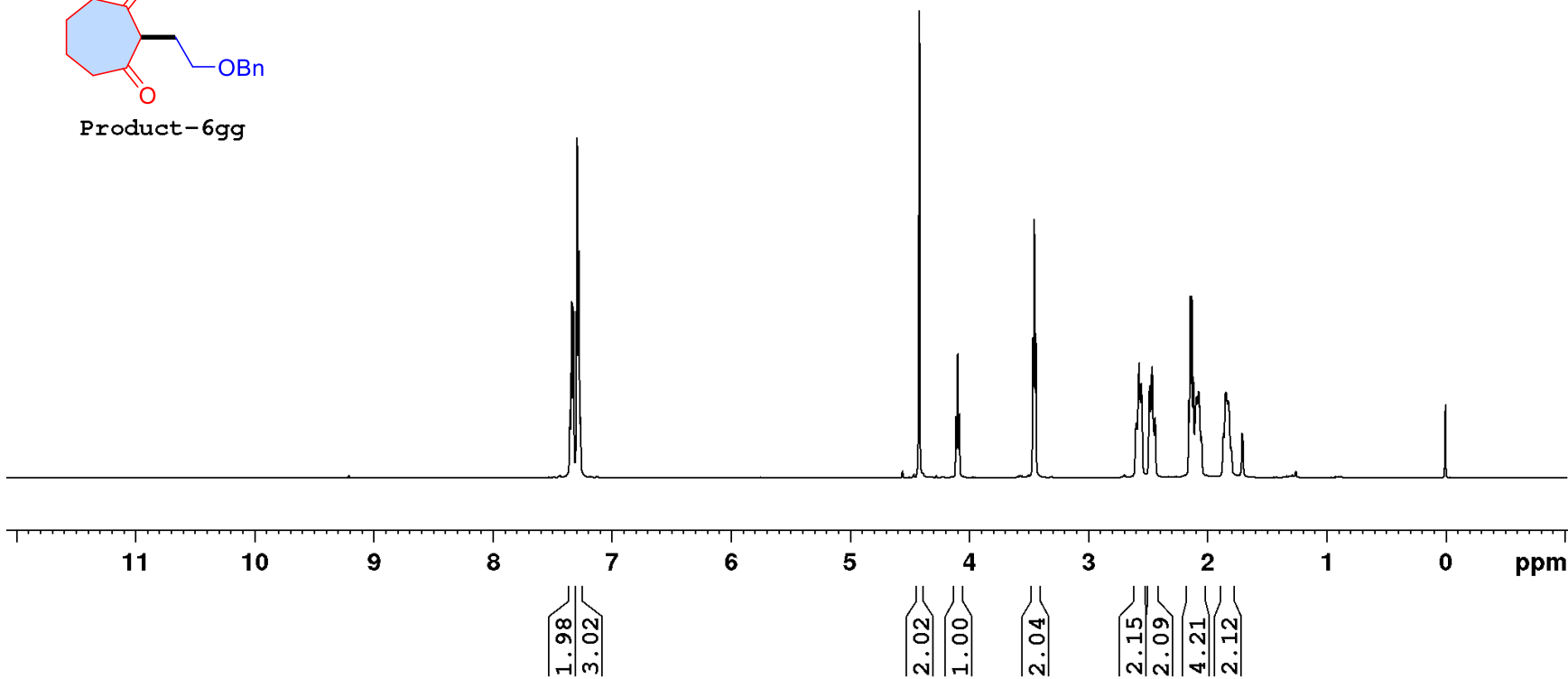


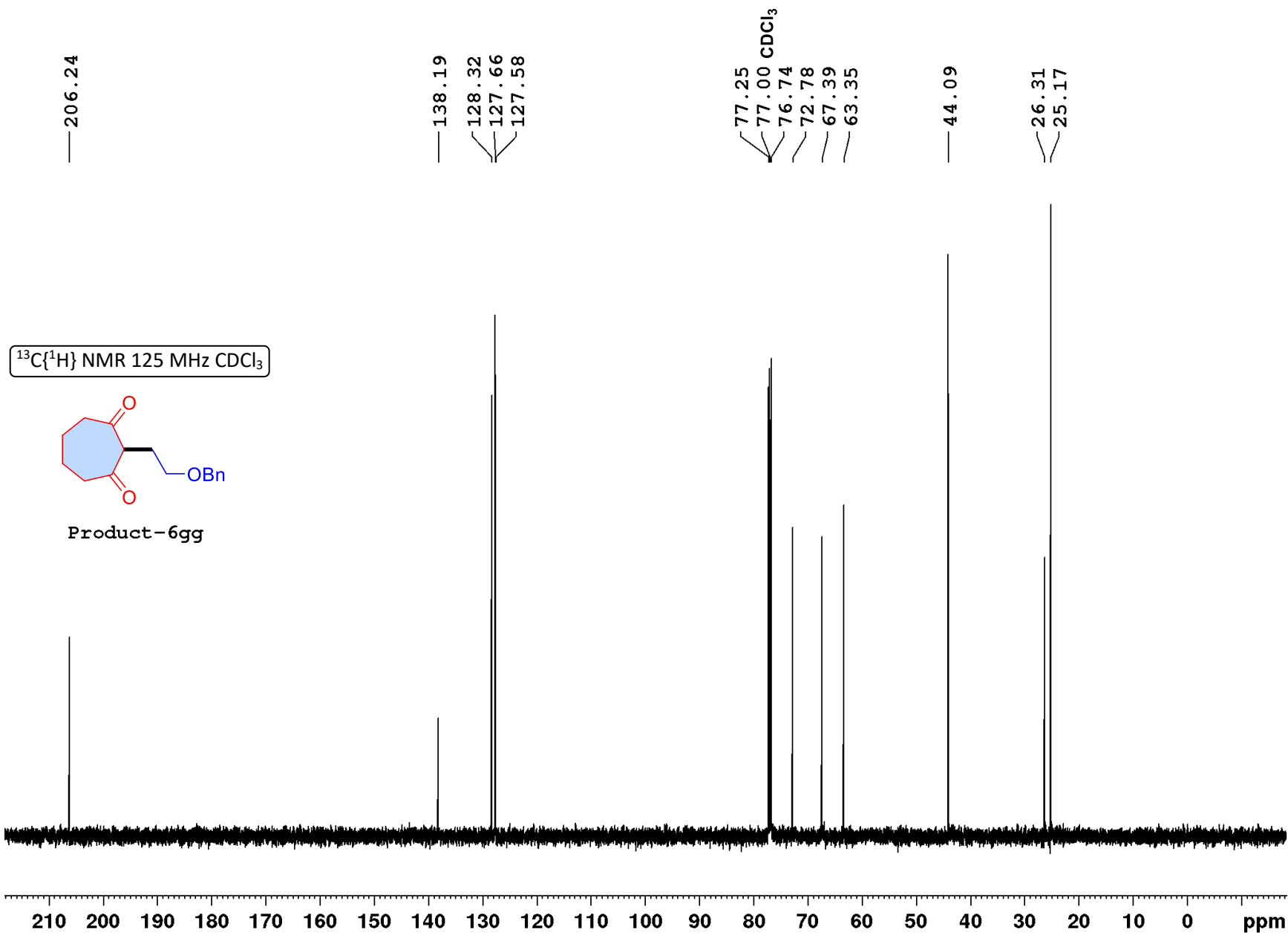
7.351
7.348
7.335
7.326
7.322
7.291
7.276
7.265 CDCl₃
4.418
4.095
3.467
3.463
3.459
3.455
3.451
3.448
3.443
3.439
3.436
2.573
2.566
2.561
2.555
2.552
2.548
2.485
2.481
2.477
2.467
2.463
2.460
2.154
2.150
2.142
2.129
2.121
2.117
2.113
2.099
2.095
2.090
2.087
2.077
2.074
2.070
2.067
2.063
1.846
1.843
1.839
1.836
1.832
1.829
1.827
1.824
1.822
1.819
1.815

¹H NMR 500 MHz CDCl₃

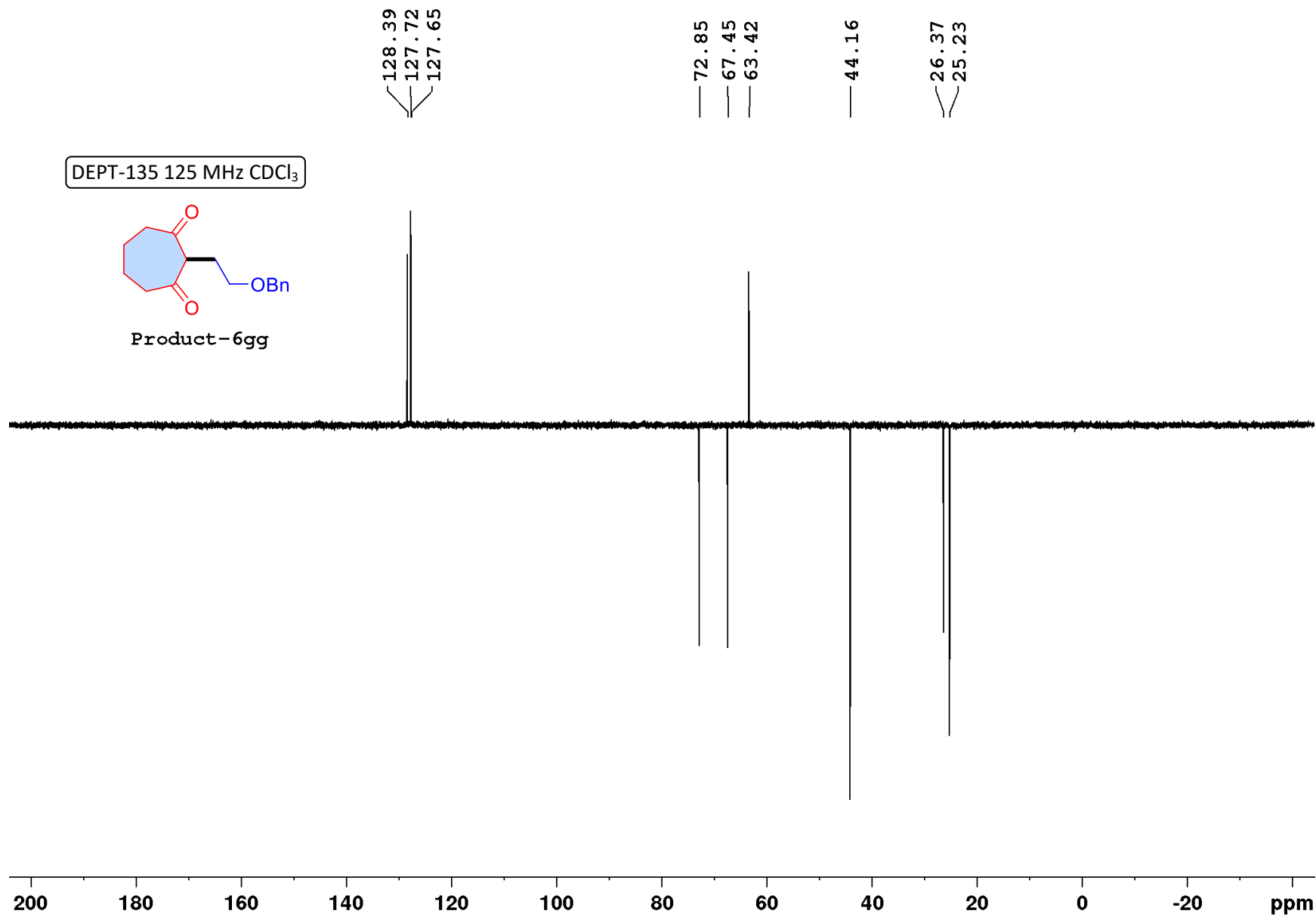
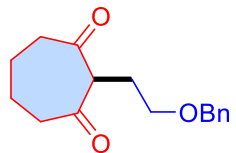


Product-6gg



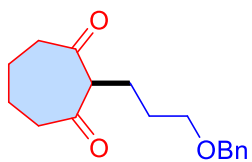


DEPT-135 125 MHz CDCl₃

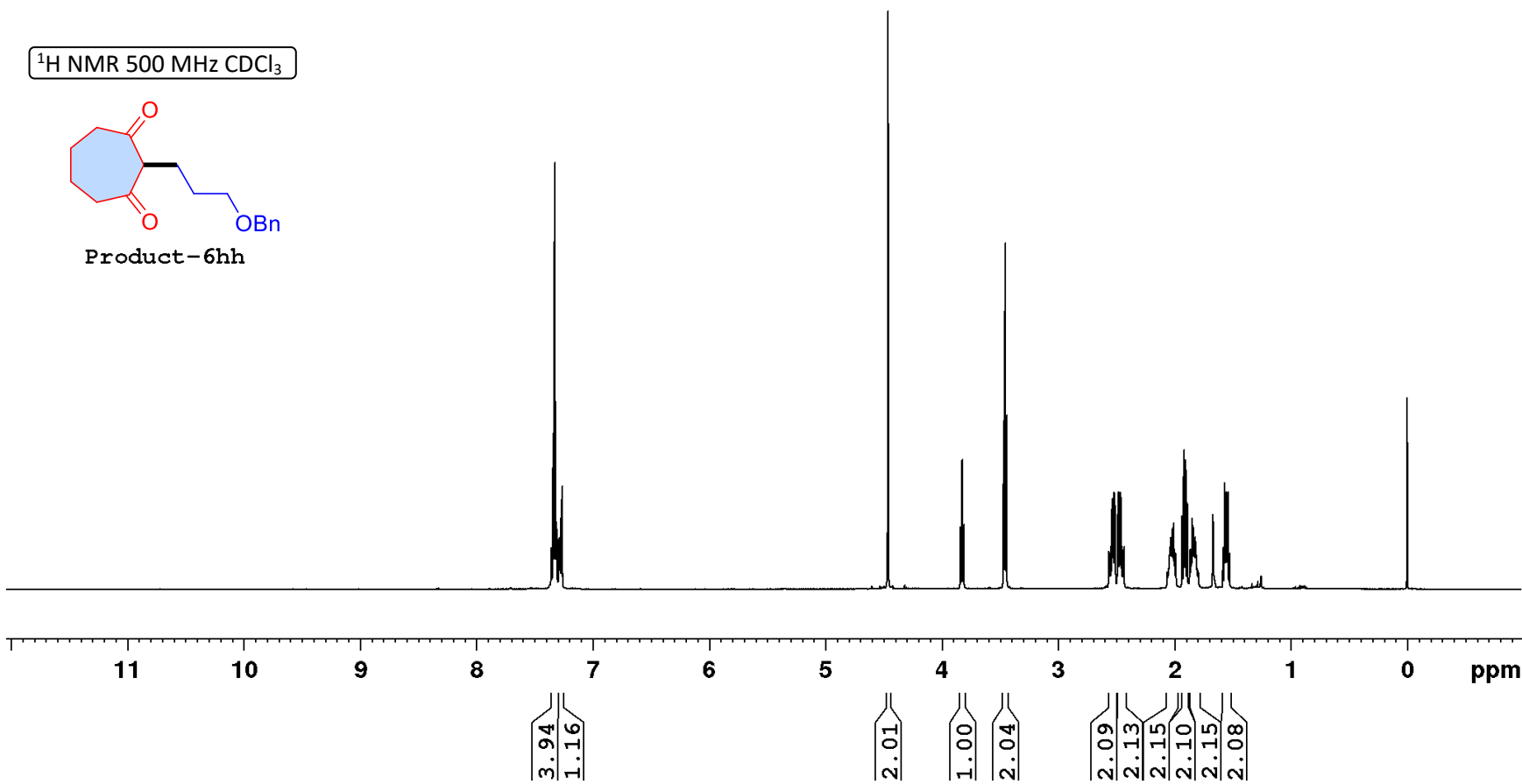


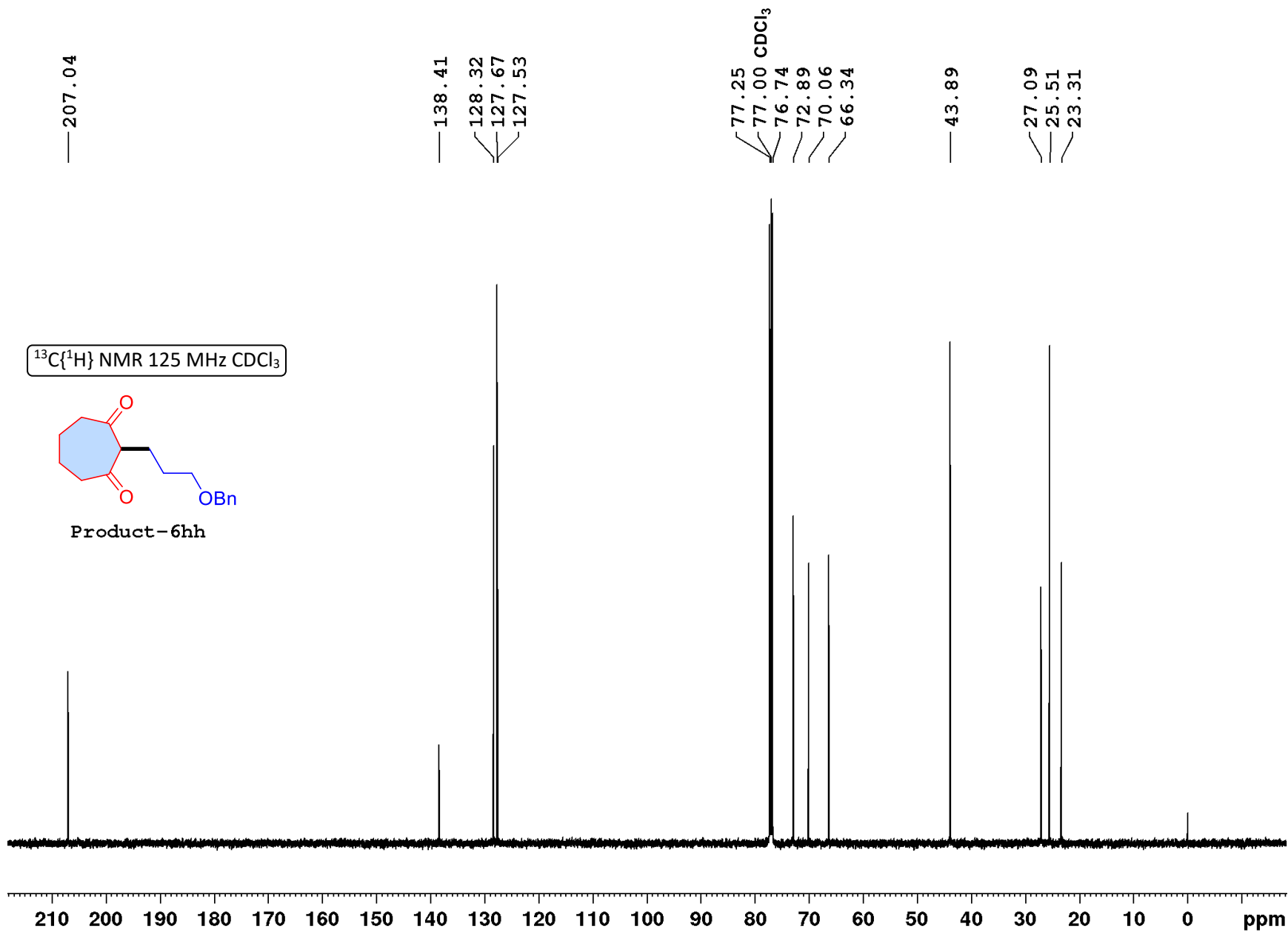
7.356
7.344
7.341
7.339
7.334
7.328
7.324
7.312
7.294
7.290
7.276
7.265 CDCl₃
4.462
3.839
3.825
3.811
3.468
3.456
3.444
2.545
2.535
2.527
2.517
2.509
2.486
2.479
2.469
2.461
2.451
2.434
2.039
2.030
2.021
2.015
2.008
1.998
1.933
1.919
1.914
1.907
1.903
1.889
1.863
1.856
1.846
1.839
1.833
1.824
1.822
1.815
1.582
1.569
1.566
1.563
1.557
1.554
1.551
1.539

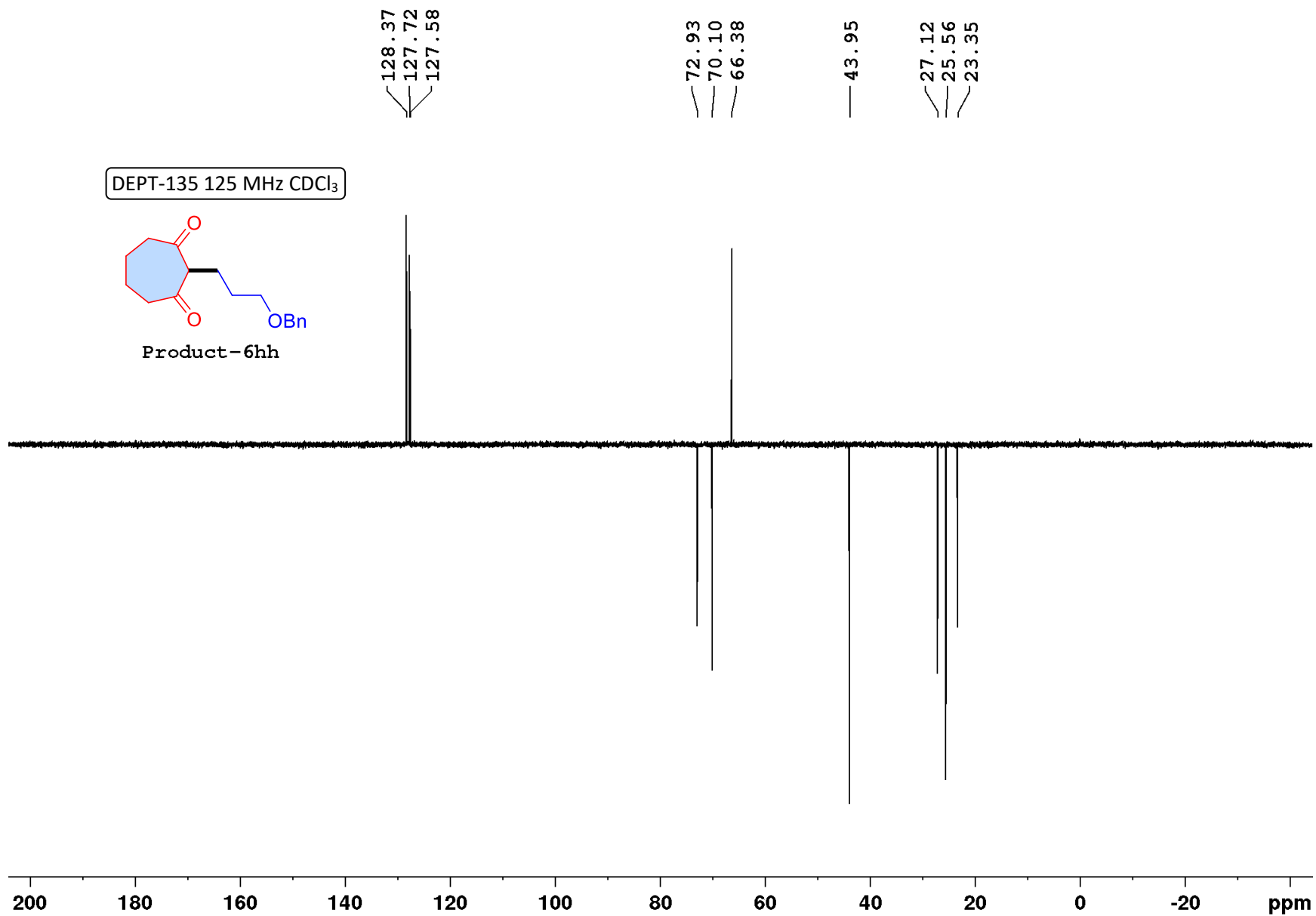
¹H NMR 500 MHz CDCl₃

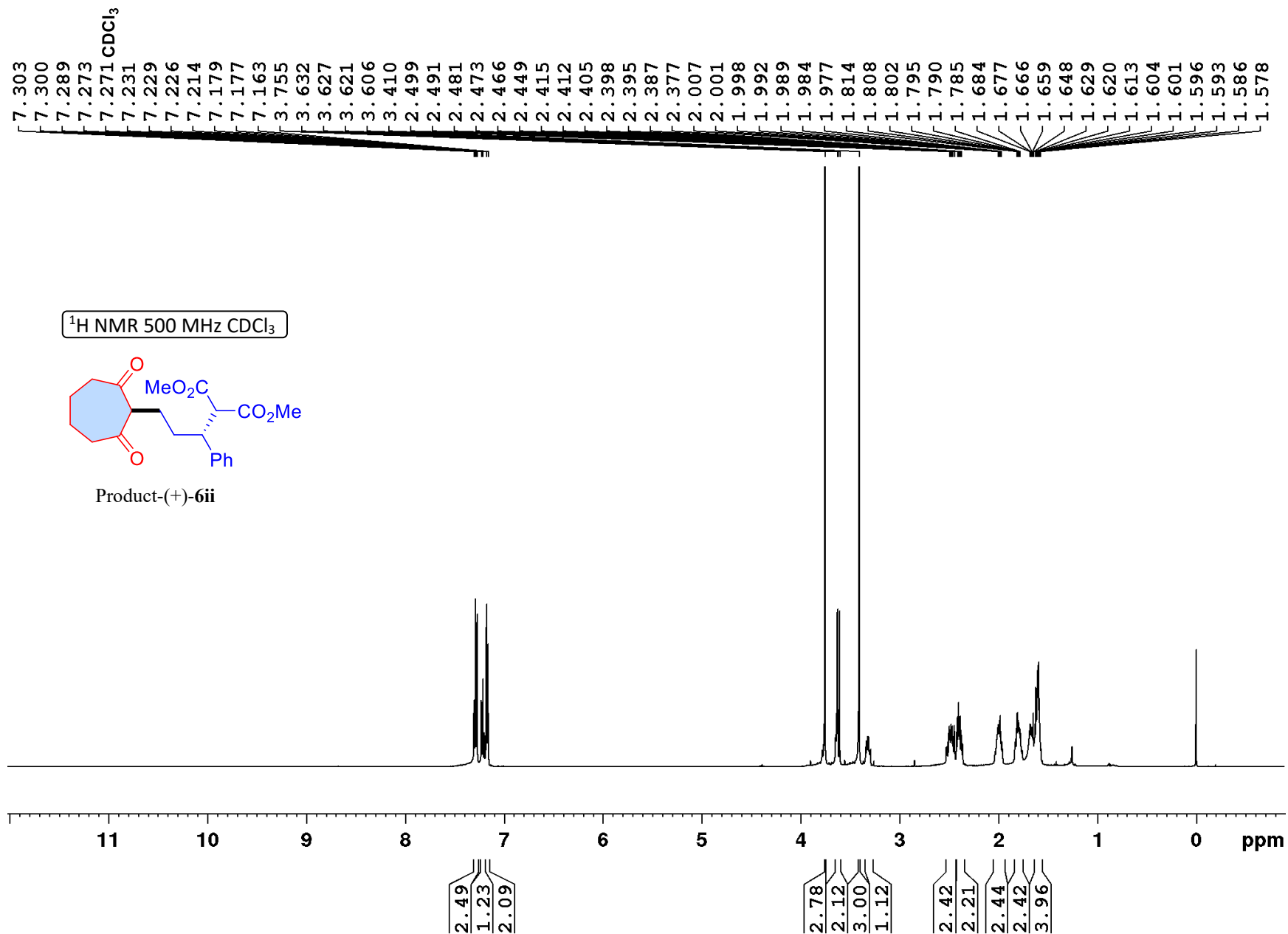


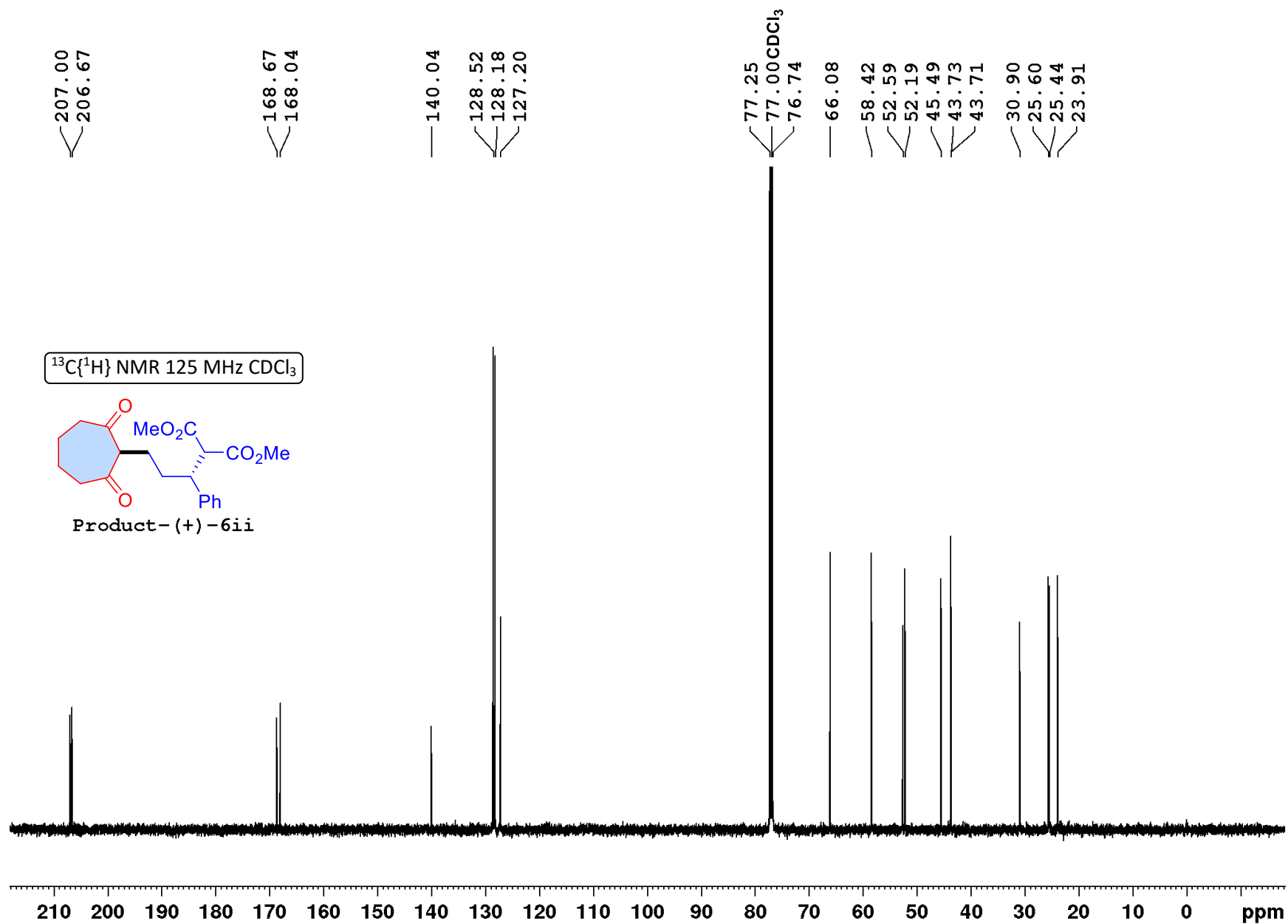
Product-6hh

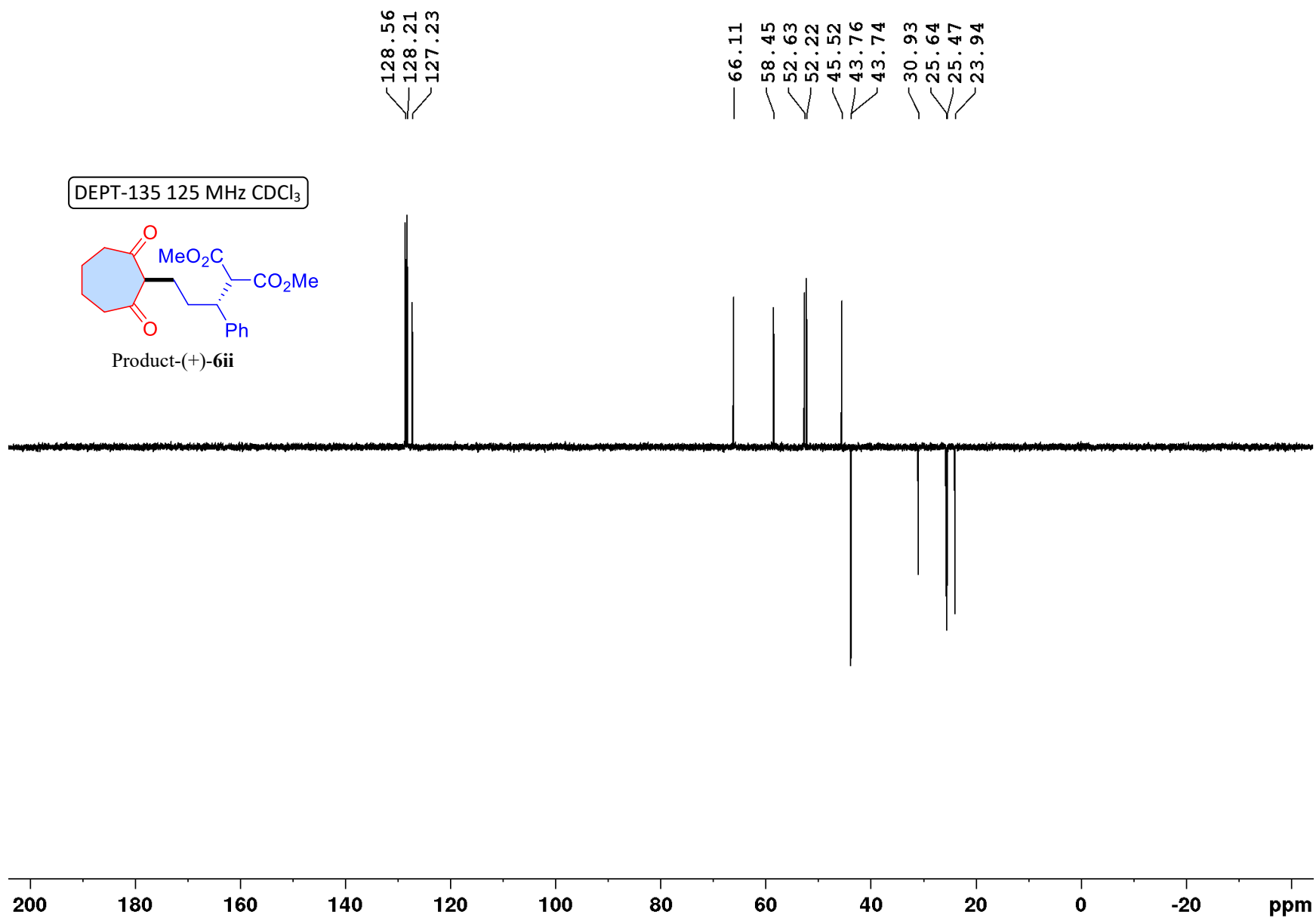






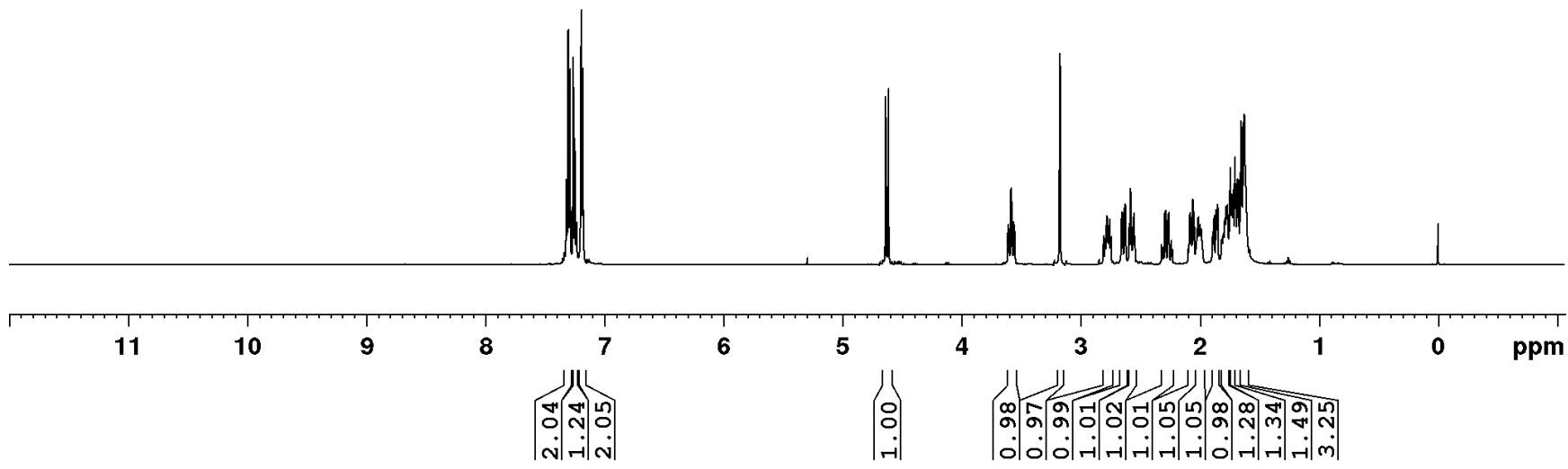
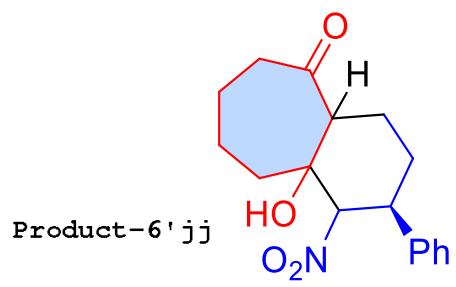


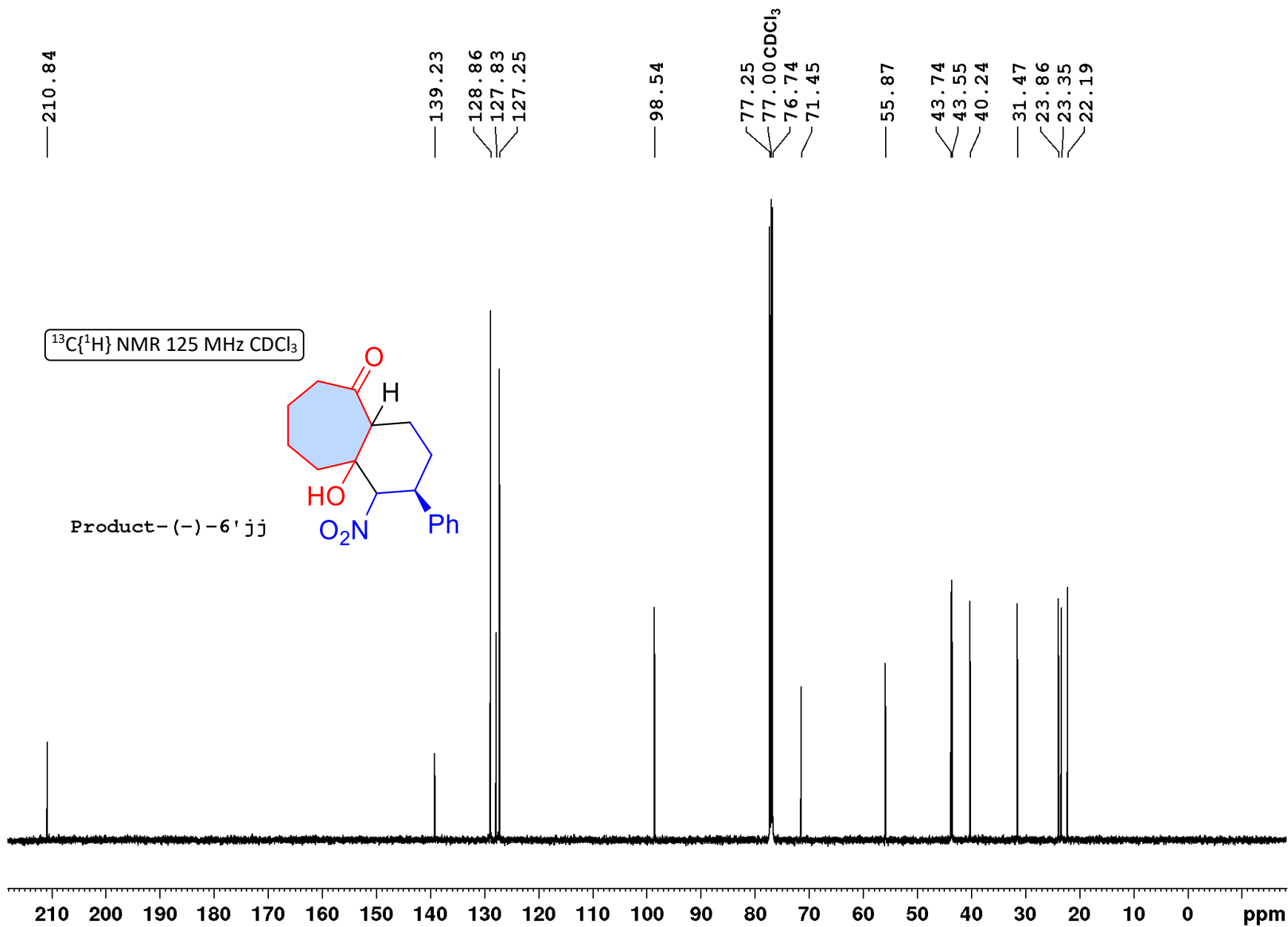


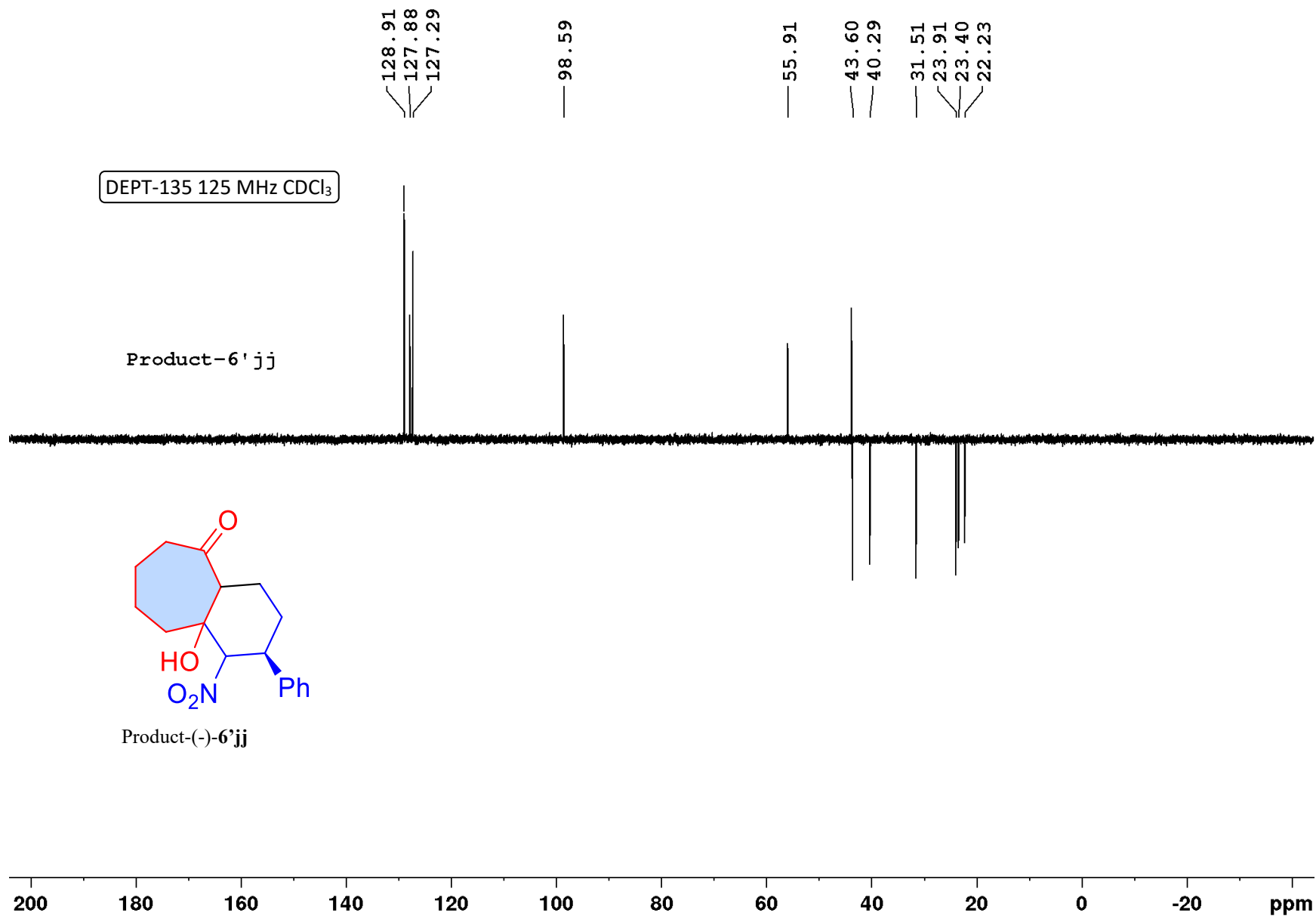


7.319
7.316
7.305
7.290
7.263 CDCl₃
7.253
7.249
7.199
7.196
7.182
4.639
4.615
3.586
3.579
3.562
3.177
3.174
2.779
2.757
2.655
2.651
2.630
2.625
2.582
2.554
2.293
2.285
2.267
2.259
2.085
2.080
2.058
2.053
2.012
1.879
1.862
1.850
1.789
1.787
1.779
1.770
1.767
1.748
1.744
1.734
1.728
1.720
1.715
1.706
1.699
1.686
1.677
1.660
1.652
1.643
1.633
1.629
1.626

¹H NMR 500 MHz CDCl₃



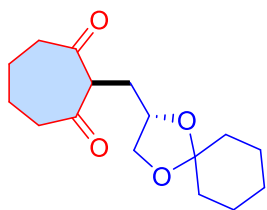




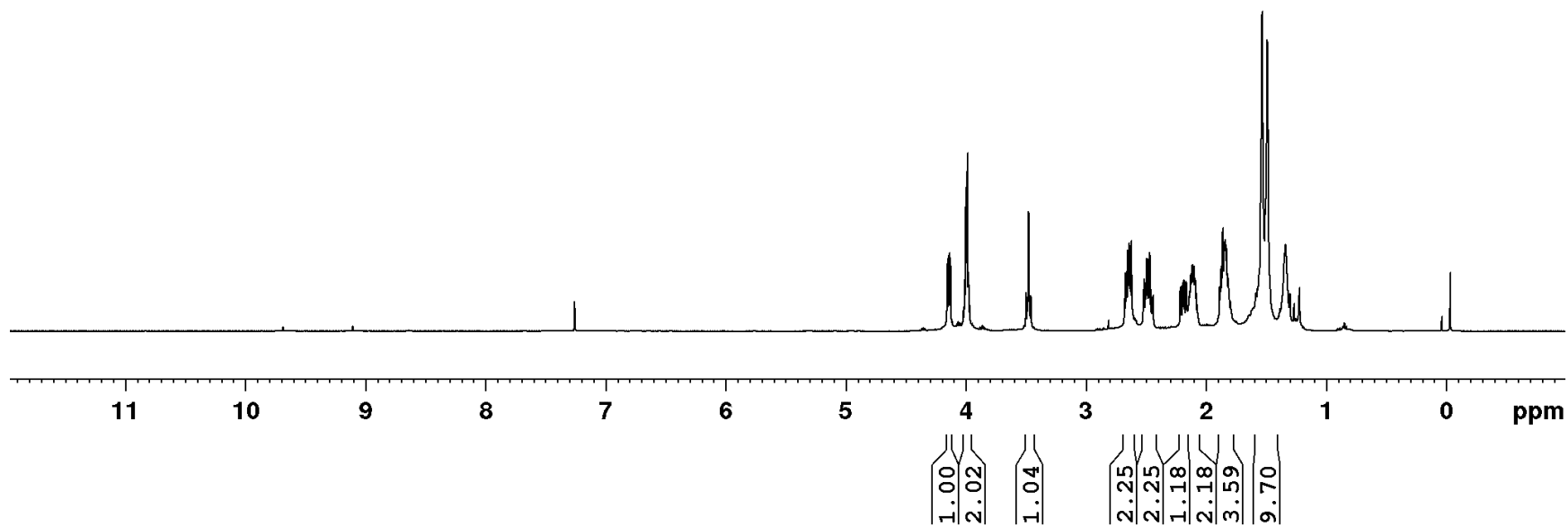
CDCl₃

7.260
4.155
4.145
4.138
4.128
4.008
4.000
3.996
3.992
3.987
3.980
3.976
3.498
3.488
3.485
3.479
3.477
3.471
3.467
3.458
2.678
2.669
2.661
2.652
2.641
2.632
2.623
2.616
2.521
2.513
2.504
2.495
2.486
2.476
2.468
2.458
2.447
2.440
2.214
2.208
2.198
2.191
2.186
2.179
2.169
2.163
2.142
2.133
2.123
2.114
2.109
2.100
2.097
2.090
2.083
2.080
1.887
1.878
1.870
1.867
1.862
1.860
1.855
1.849
1.845
1.841
1.837
1.831
1.825
1.820
1.812
1.807
1.532
1.490

¹H NMR 500 MHz CDCl₃



Product-(+)-**6kk**



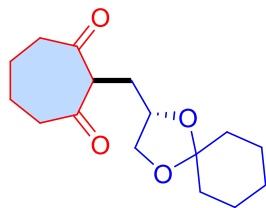
205.87
205.77

109.54

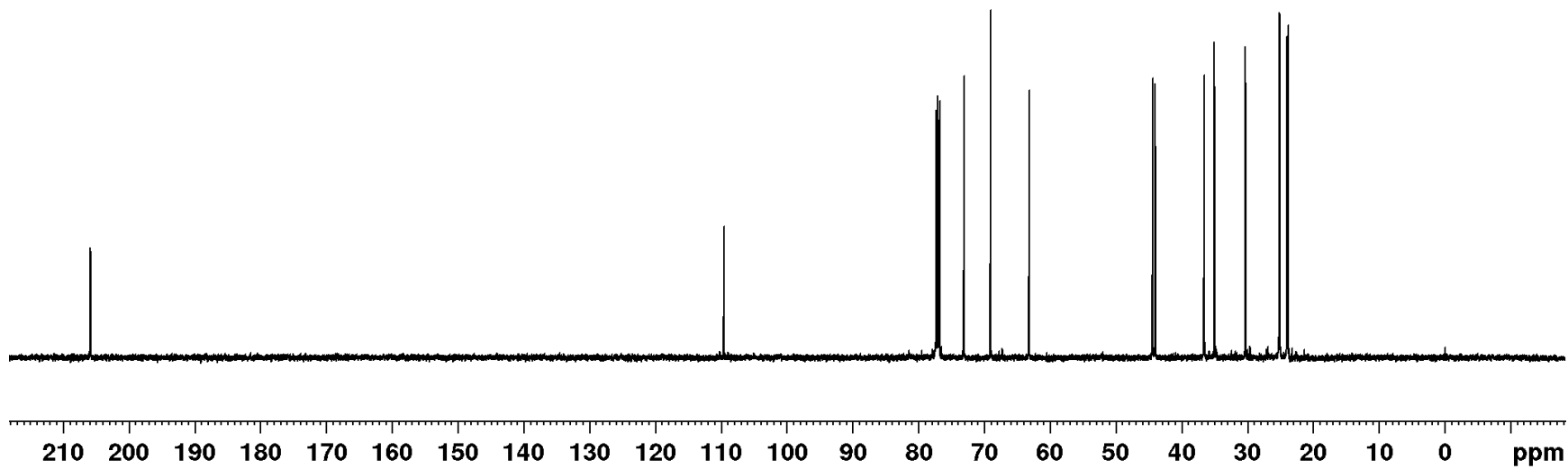
77.25
77.00 CDCl₃
76.74
73.05
68.97
63.13

44.37
43.96
36.52
34.97
30.25
25.11
25.08
25.01
23.96
23.79

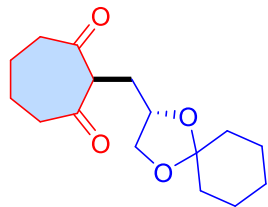
¹³C{¹H} NMR 125 MHz CDCl₃



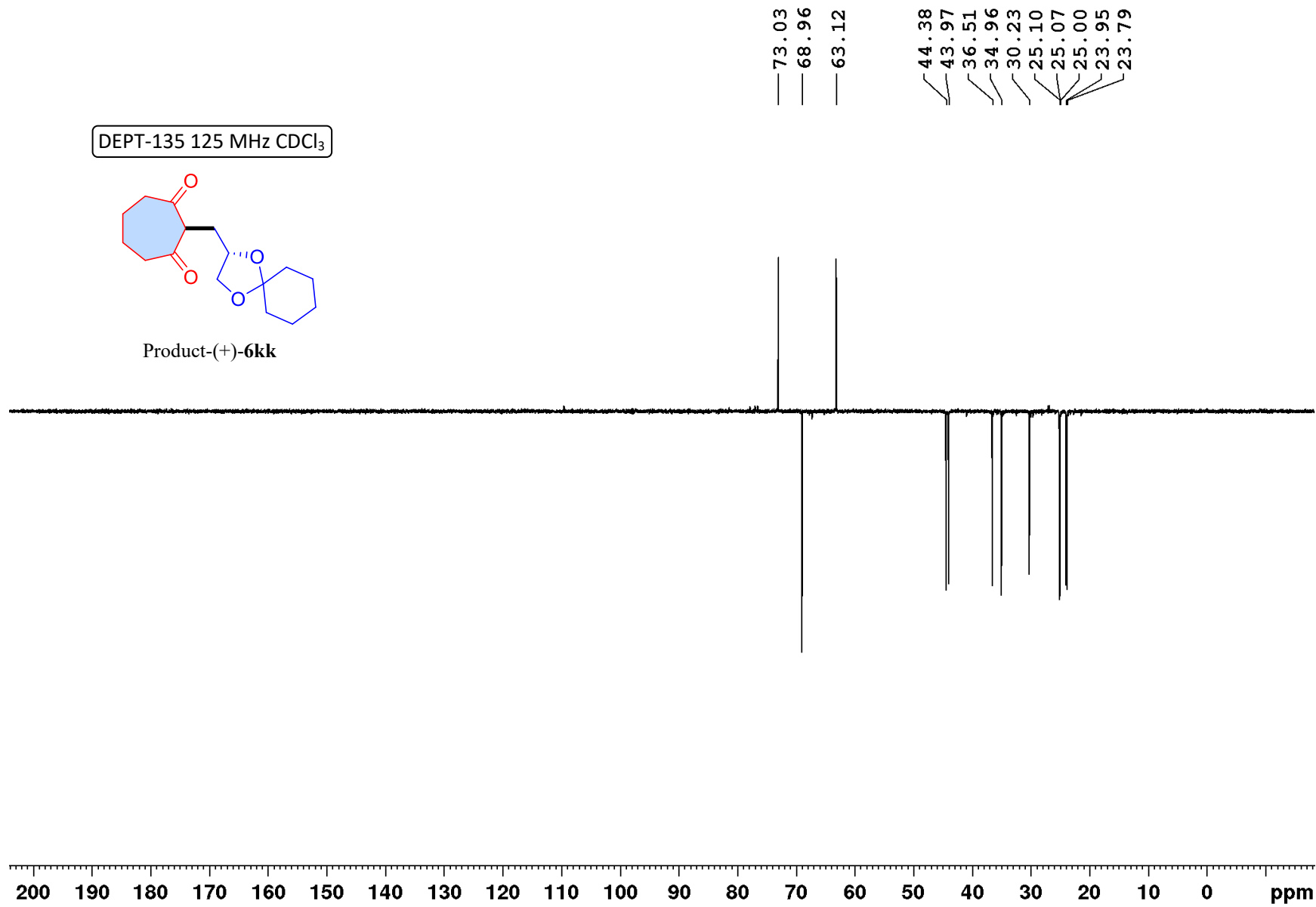
Product-(+)-6kk



DEPT-135 125 MHz CDCl₃



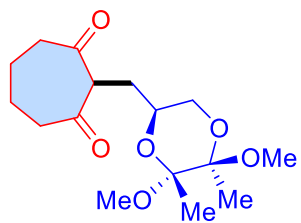
Product-(+)-6kk



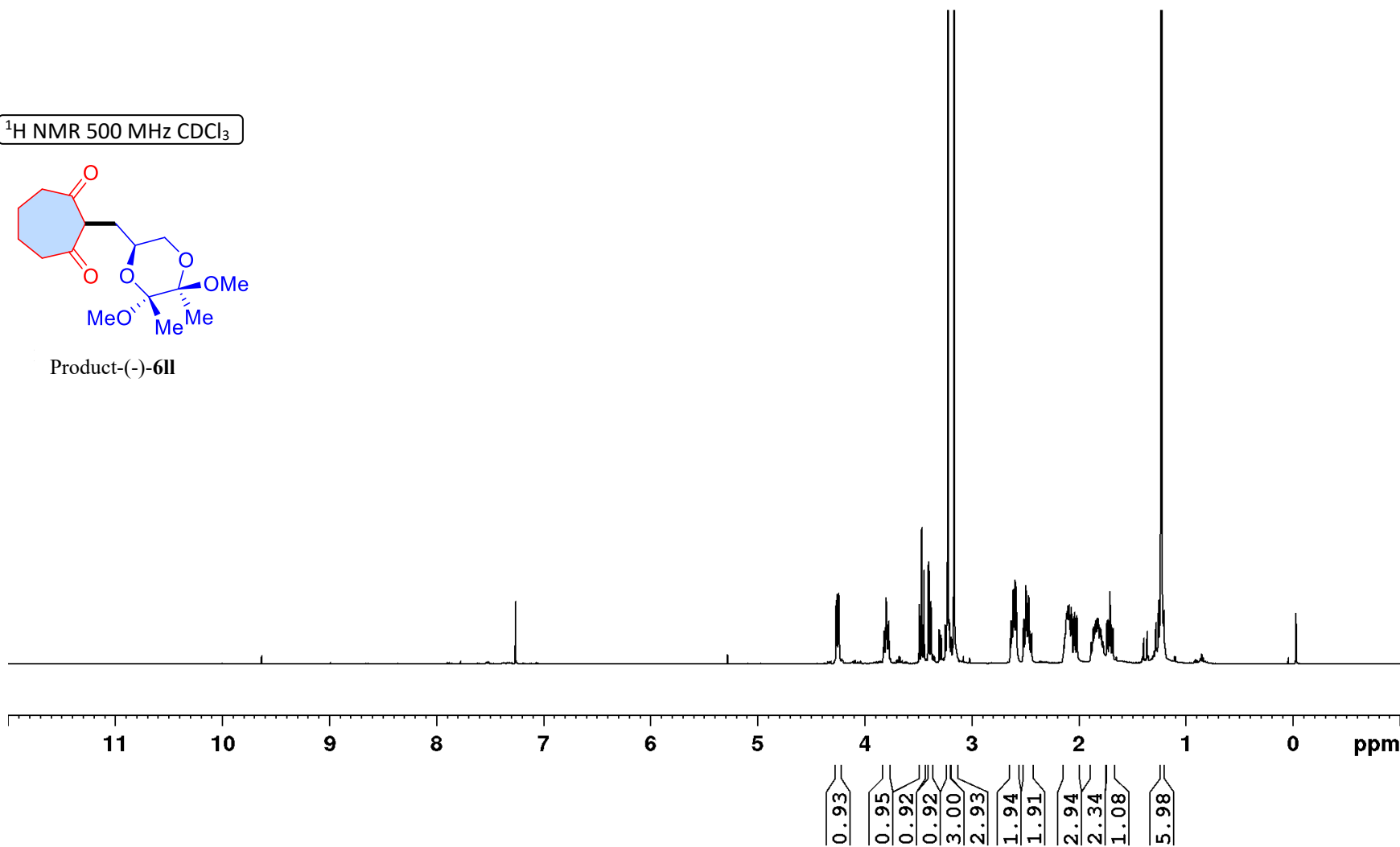
7.260 CDCl₃

4.264
4.255
4.245
4.236
3.797
3.790
3.776
3.488
3.466
3.444
3.404
3.397
3.381
3.375
3.221
3.163
2.630
2.620
2.610
2.606
2.601
2.592
2.584
2.576
2.509
2.500
2.492
2.485
2.481
2.473
2.466
2.114
2.107
2.098
2.089
2.081
2.066
2.060
2.048
2.041
2.038
2.031
2.019
2.012
1.846
1.841
1.835
1.828
1.820
1.810
1.735
1.726
1.715
1.706
1.697
1.231
1.225

¹H NMR 500 MHz CDCl₃



Product(-)-6II



205.57
205.47

99.03
97.94

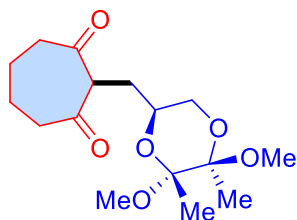
77.25
77.00
76.74
CDCl₃

64.46
63.41
61.91

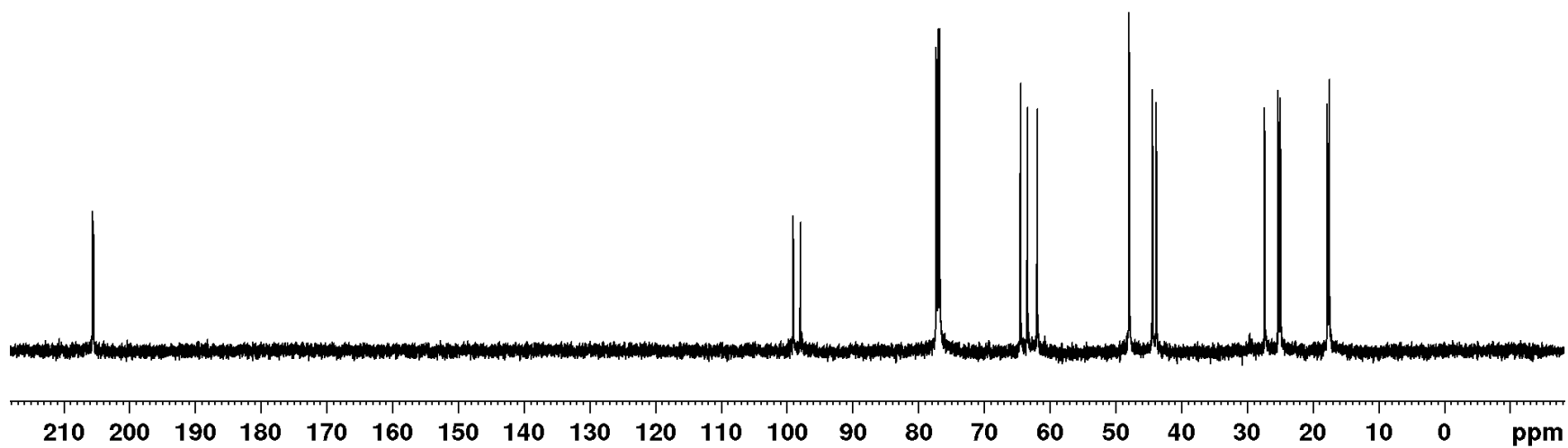
47.95
47.92
44.41
43.81

27.32
25.25
24.95
17.78
17.48

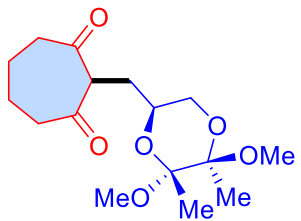
¹³C{¹H} NMR 125 MHz CDCl₃



Product(-)-6II

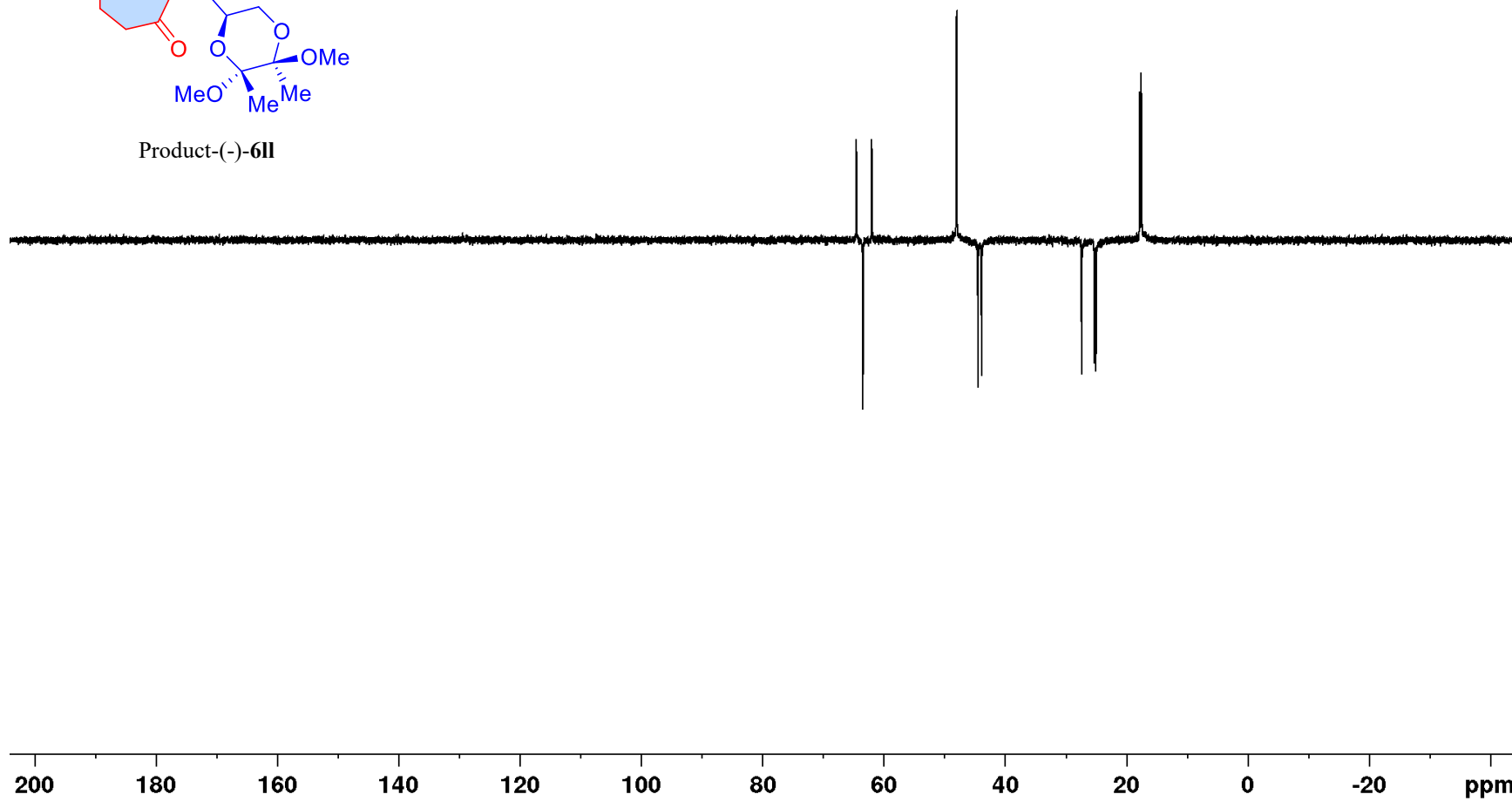


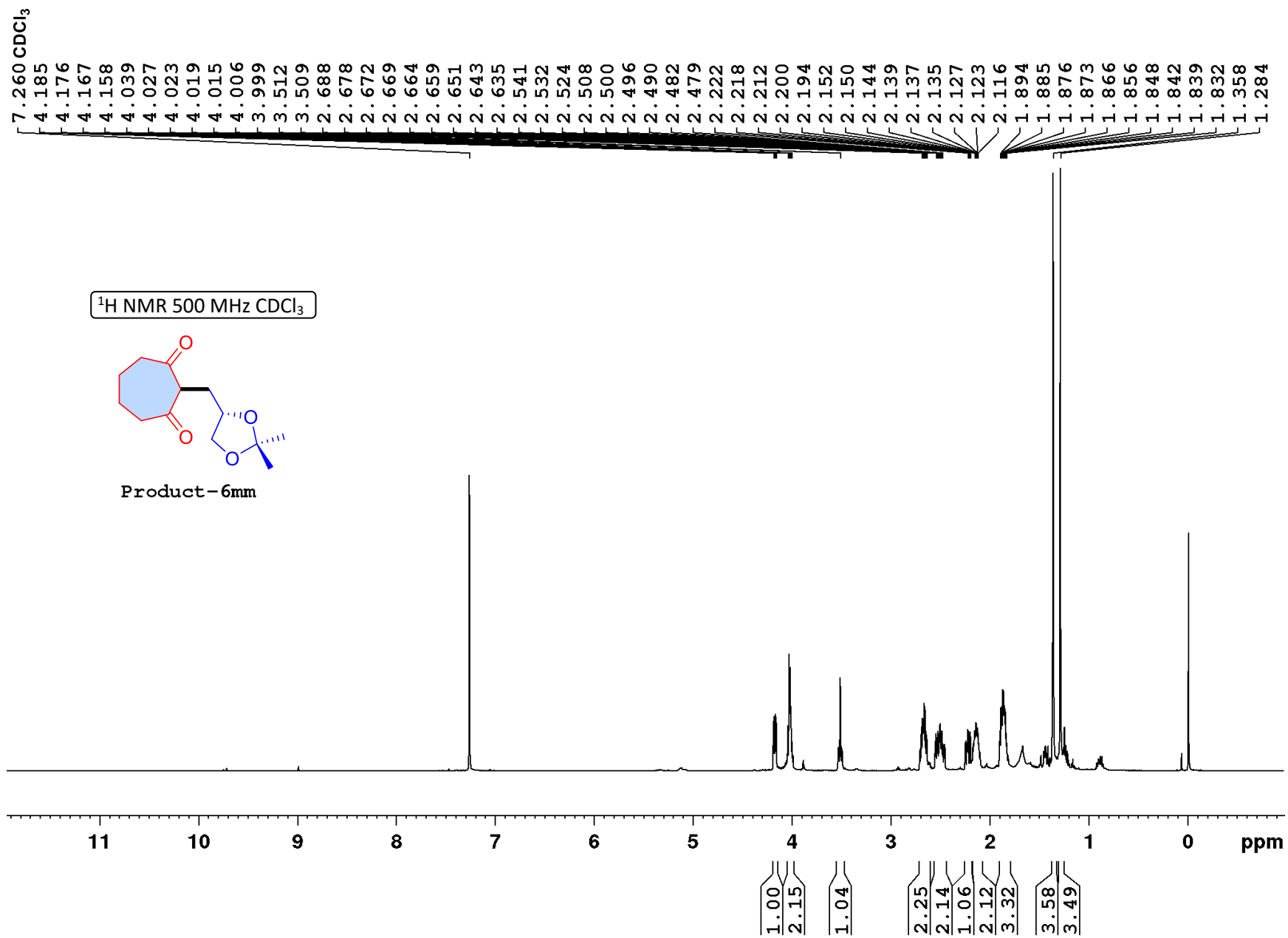
DEPT-135 125 MHz CDCl₃



Product-(-)-6II

64.50
63.45
61.95
48.00
47.97
44.45
43.86
27.36
25.29
24.99
17.82
17.52





205.91
205.66

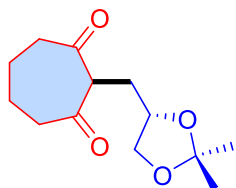
109.01

77.25
76.99 CDCl₃
76.74
73.40
69.33
62.99

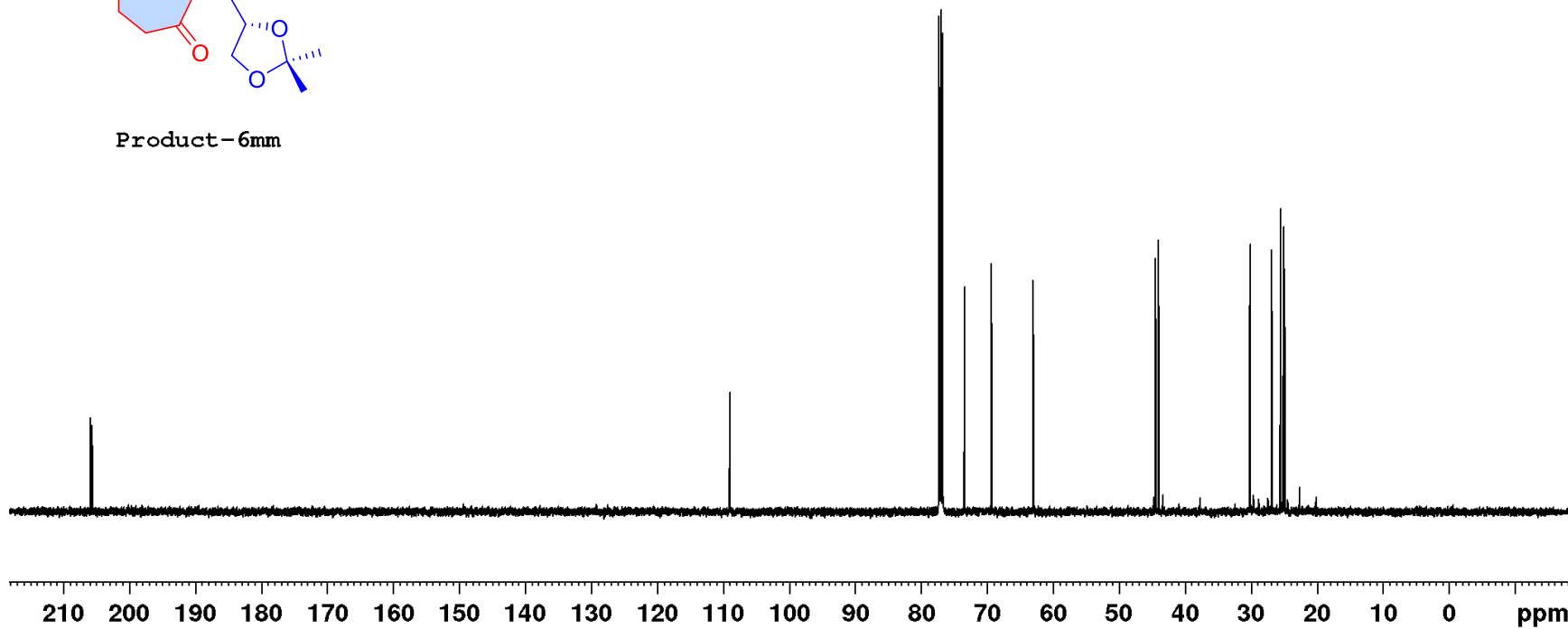
44.45
44.00

30.14
26.84
25.51
25.08
24.88

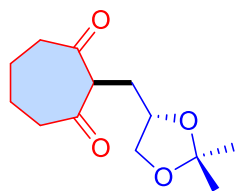
¹³C{¹H} NMR 125 MHz CDCl₃



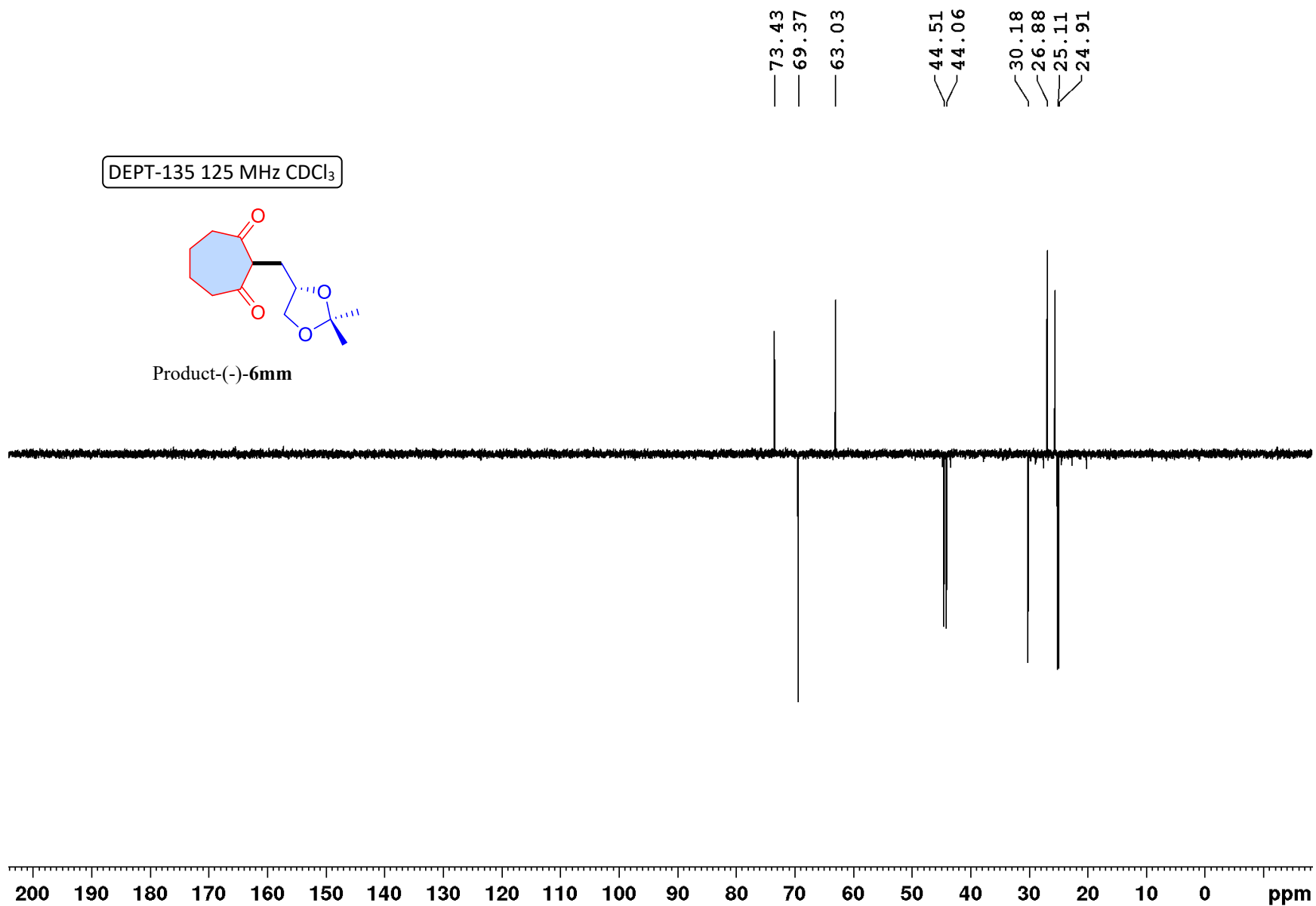
Product-6mm



DEPT-135 125 MHz CDCl₃



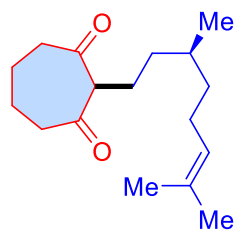
Product-(-)-6mm



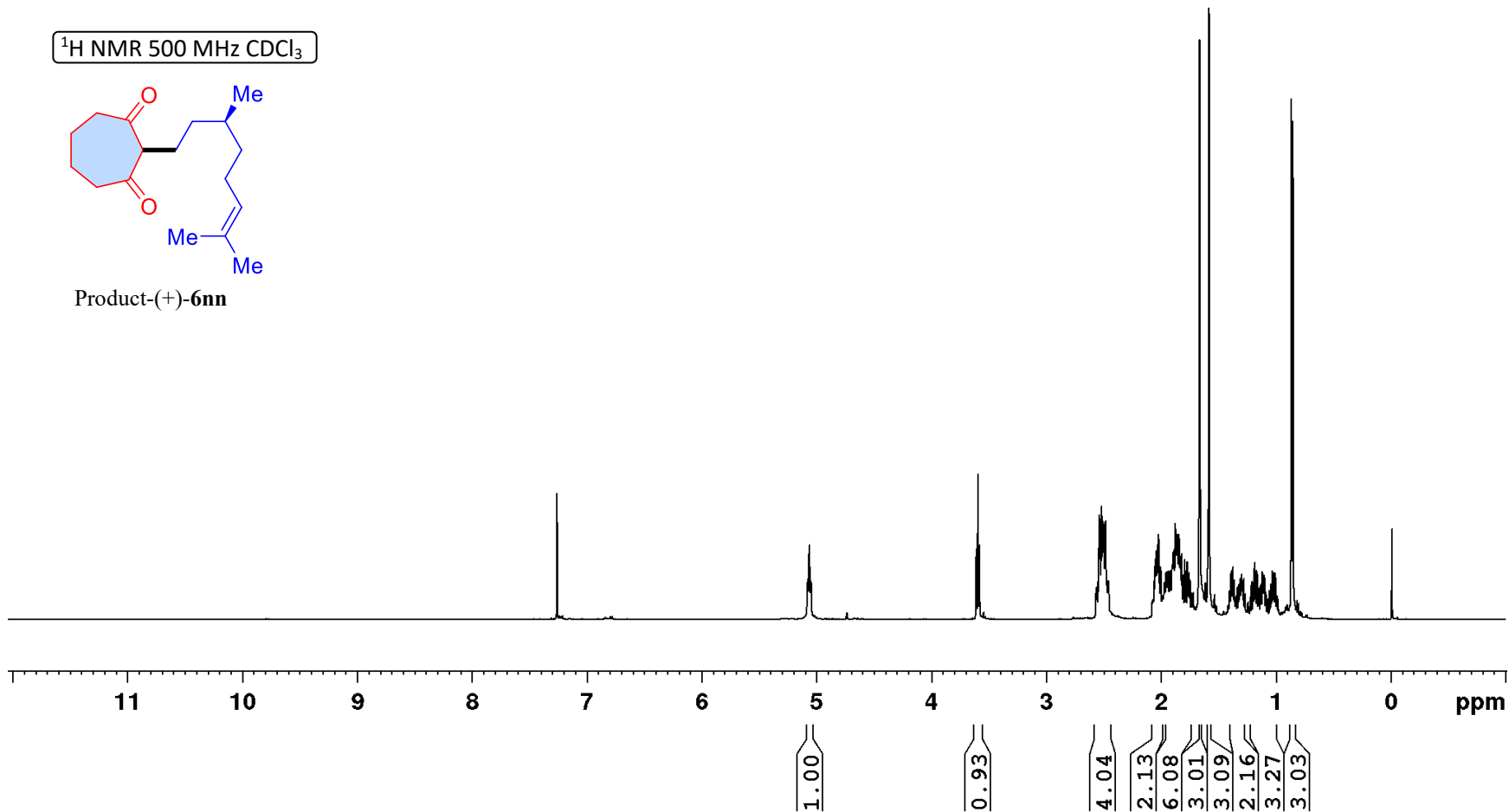
7.260 CDCl₃

5.063
5.061
5.058
3.607
3.593
3.579
2.537
2.529
2.519
2.511
2.504
2.499
2.482
2.050
2.042
2.034
2.028
2.020
2.010
2.002
1.954
1.936
1.919
1.901
1.896
1.891
1.884
1.874
1.868
1.860
1.858
1.854
1.844
1.835
1.830
1.826
1.818
1.793
1.783
1.770
1.760
1.757
1.662
1.580
1.388
1.374
1.297
1.184
1.172
1.161
1.116
1.029
1.027
1.016
1.004
0.863
0.849

¹H NMR 500 MHz CDCl₃



Product-(+)-6nn



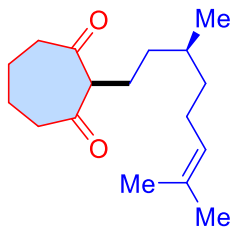
207.68
207.66

131.10
124.75

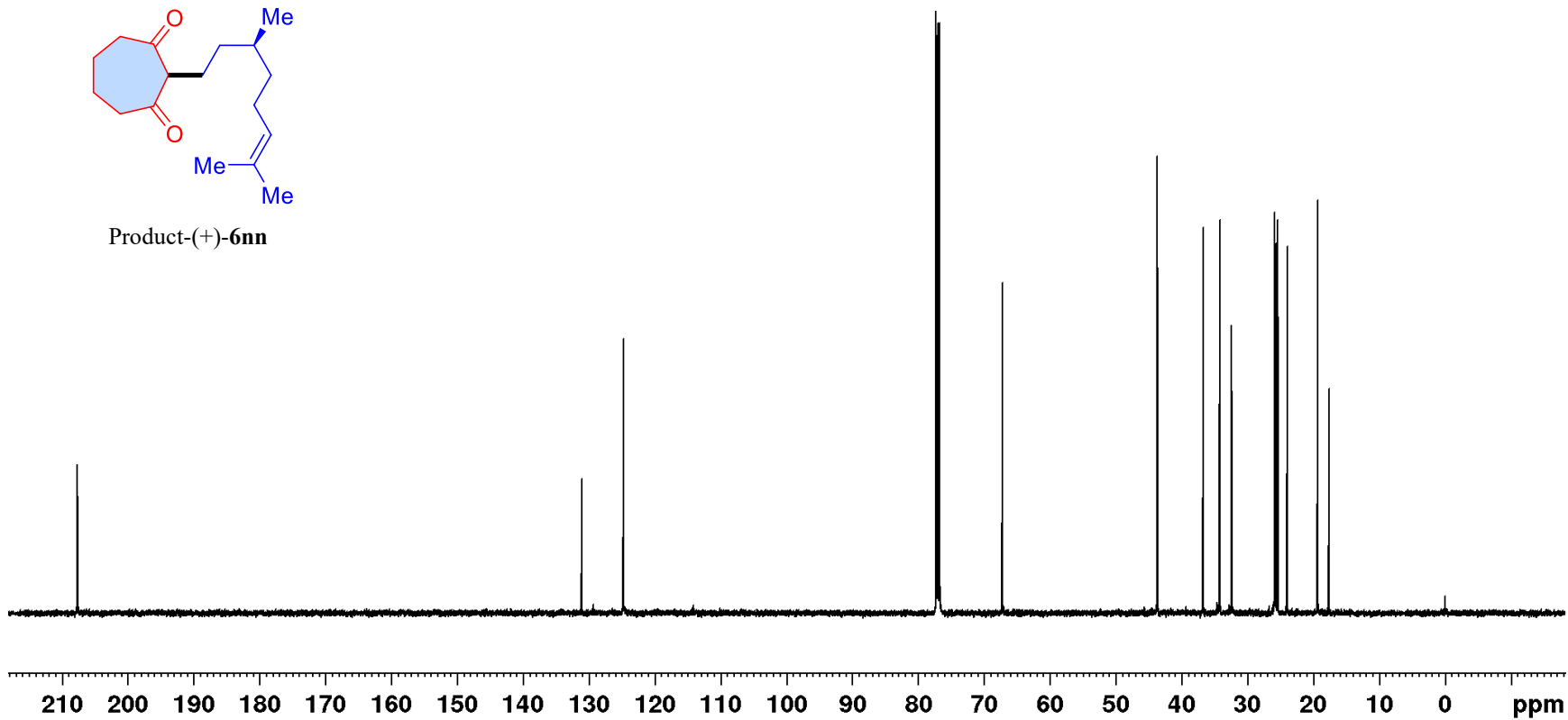
77.25
76.99 CDCl₃
76.74
67.20

43.70
36.72
34.20
32.38
25.87
25.84
25.67
25.40
23.95
19.32
17.60

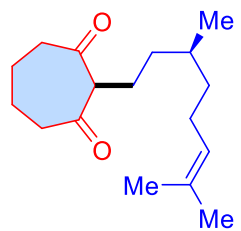
¹³C{¹H} NMR 125 MHz CDCl₃



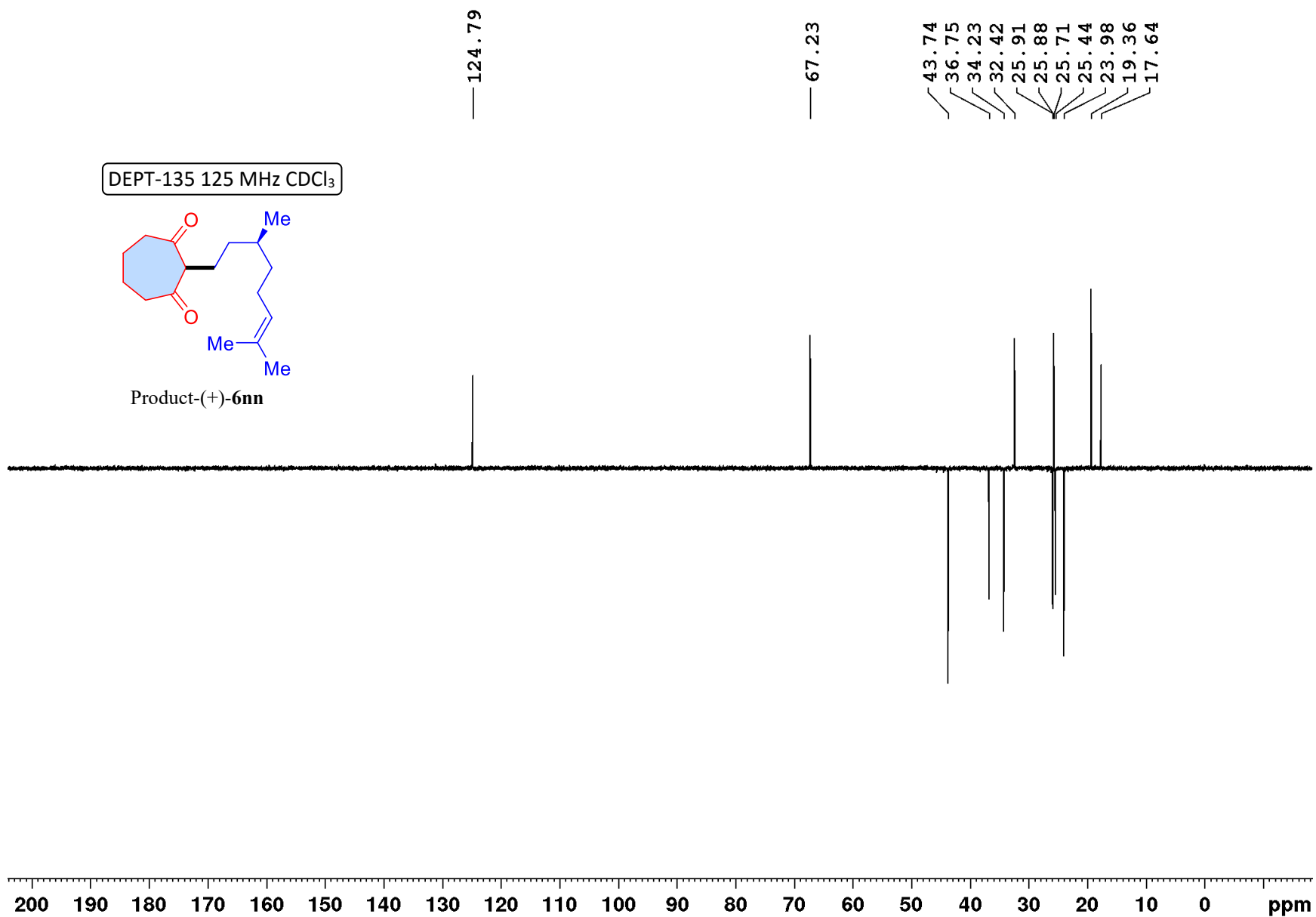
Product-(+)-6nn

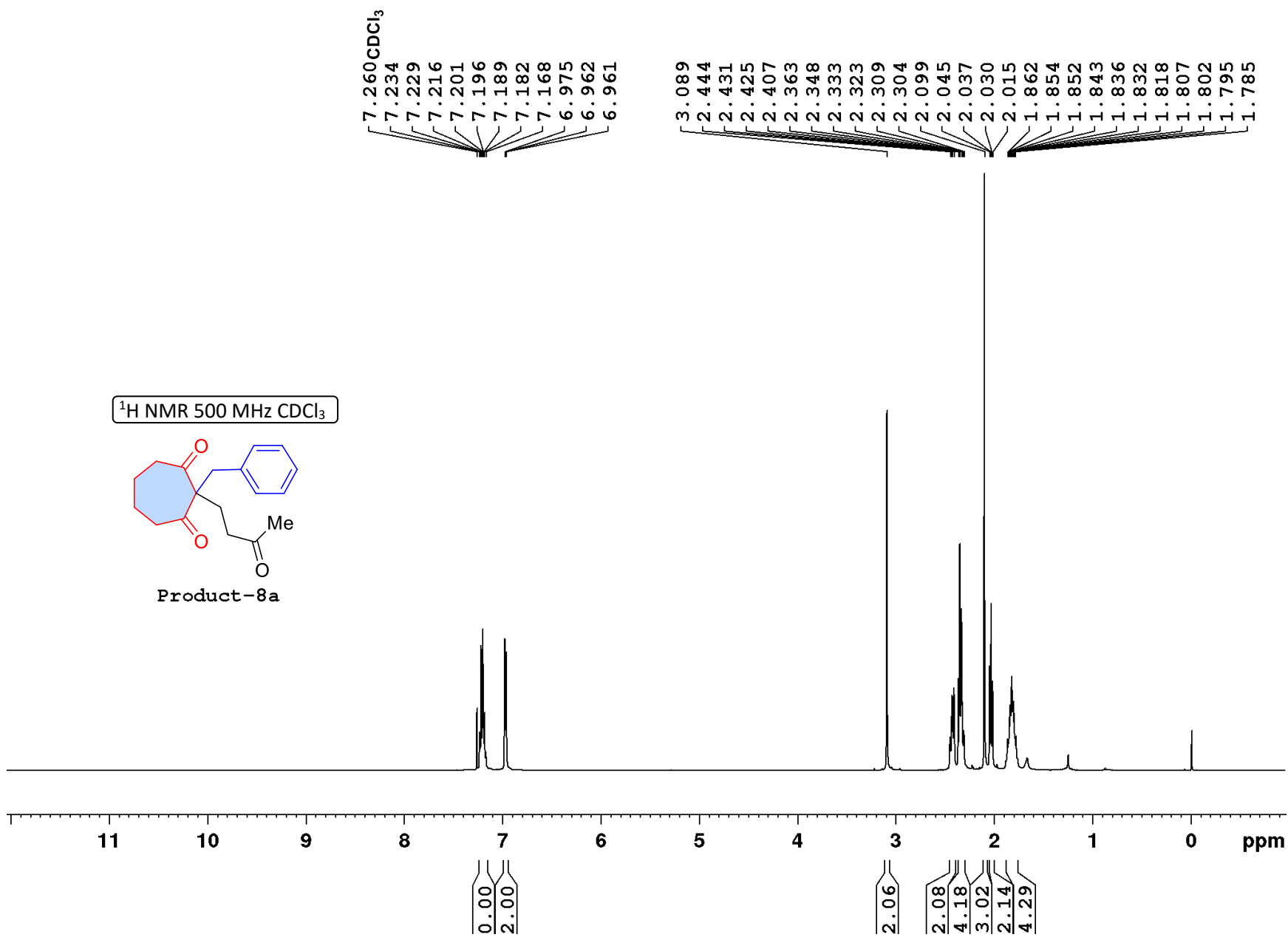


DEPT-135 125 MHz CDCl₃



Product-(+)-6nn





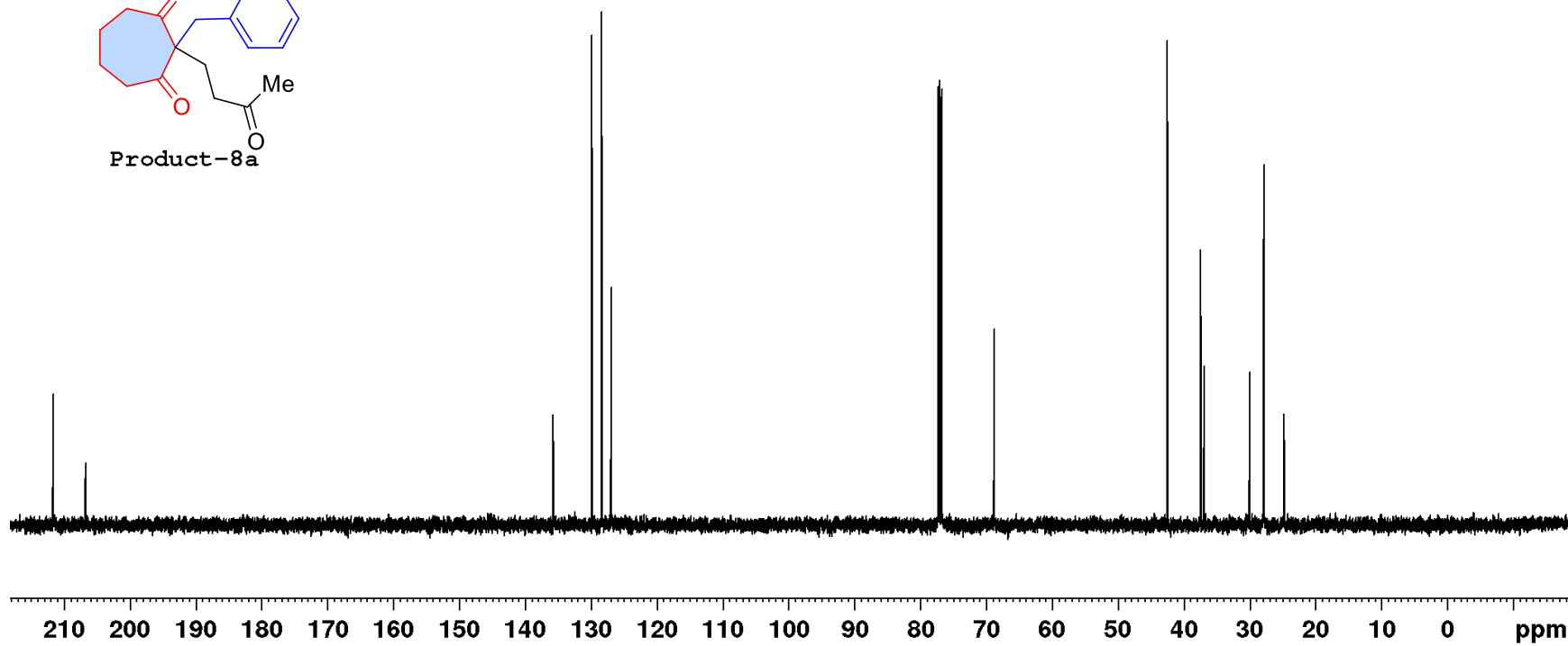
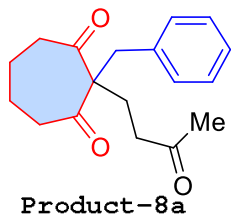
— 211.65
— 206.75

— 135.76
— 129.86
— 128.38
— 126.94

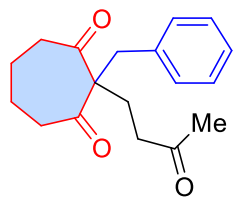
77.25
77.00 CDCl₃
76.74
— 68.79

— 42.46
— 37.44
— 36.92
— 29.96
— 27.82
— 24.79

¹³C{¹H} NMR 125 MHz CDCl₃



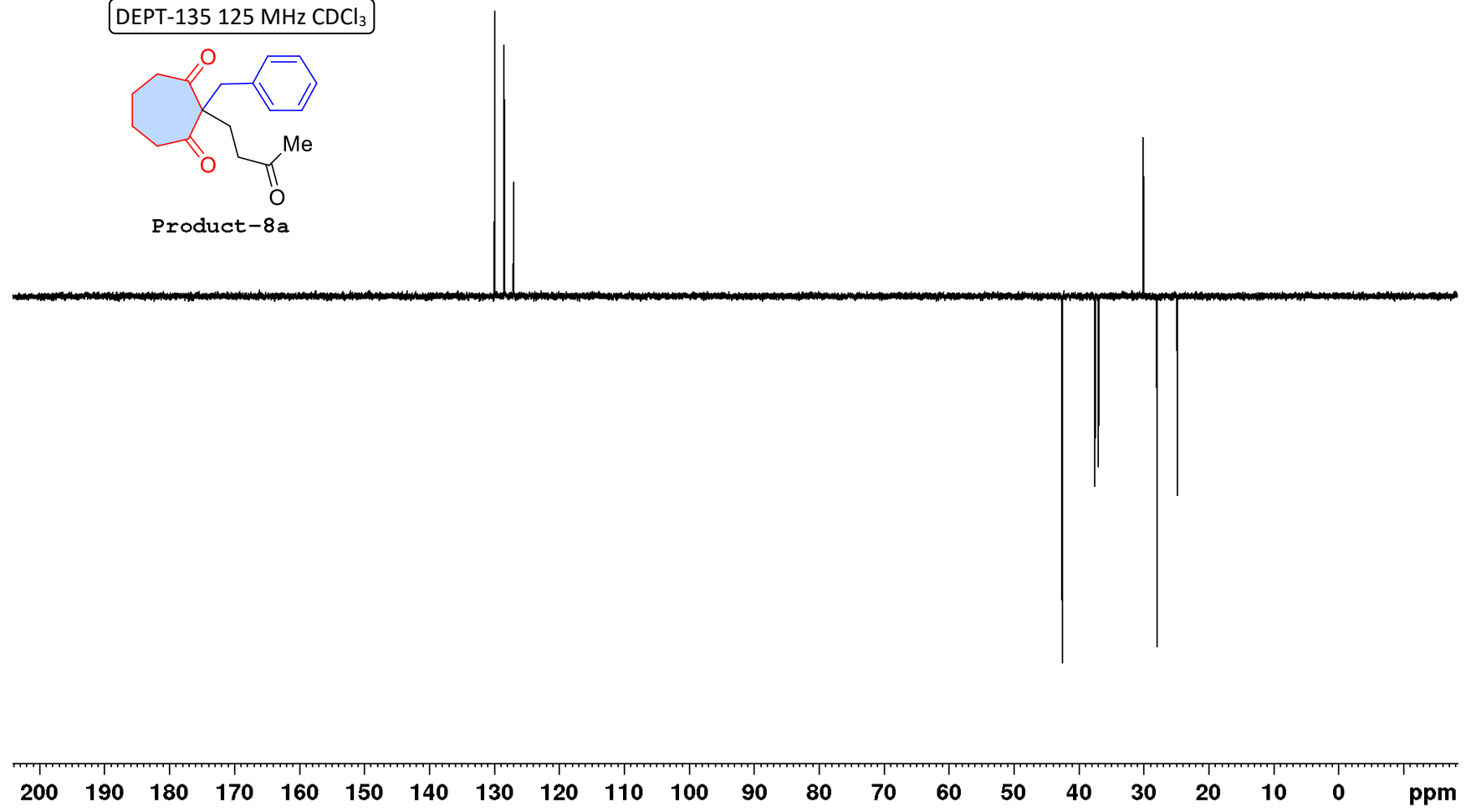
DEPT-135 125 MHz CDCl₃



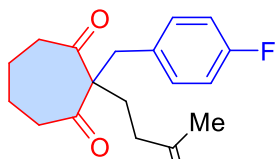
Product-8a

129.91
128.44
126.99

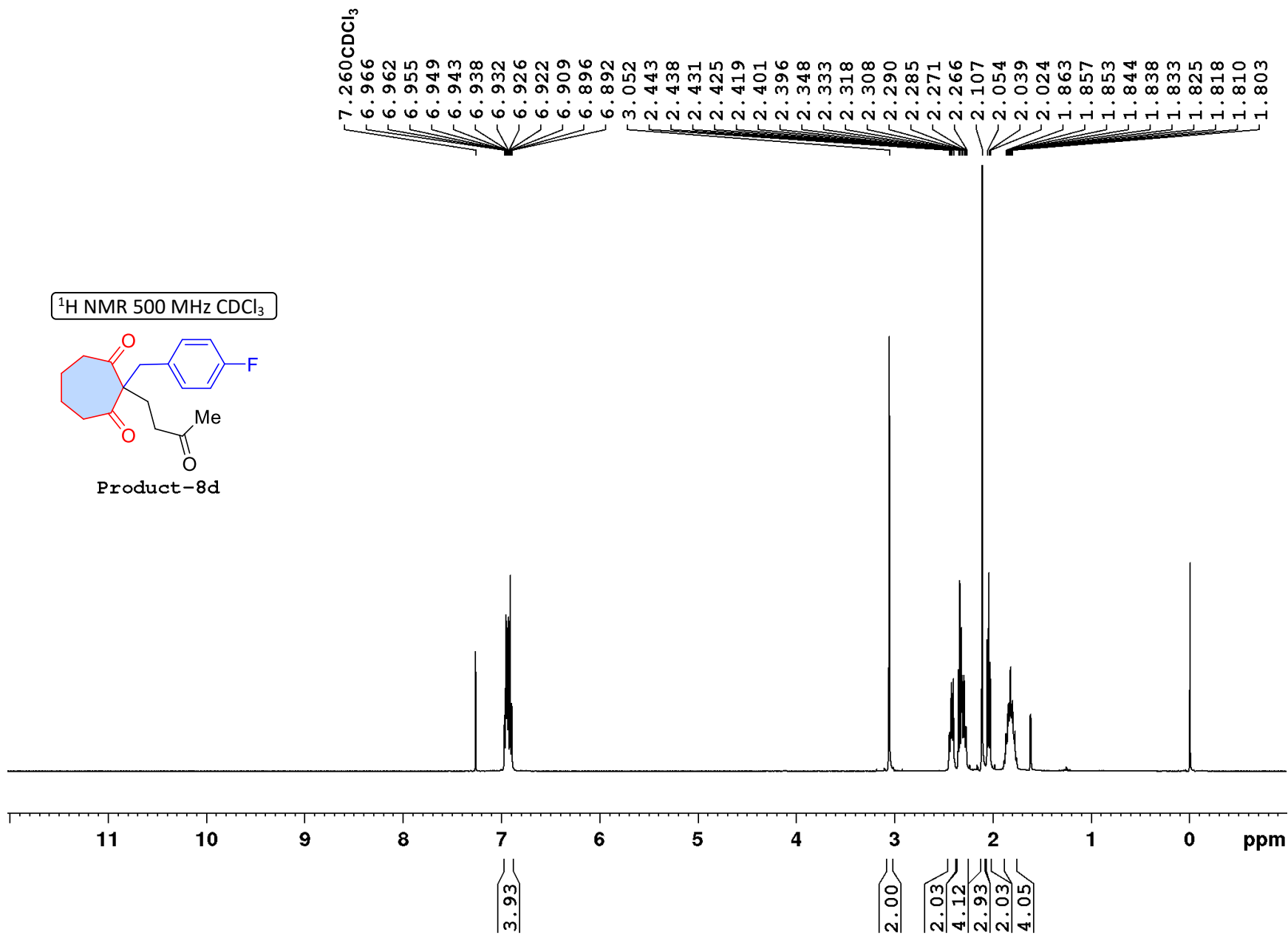
42.51
37.49
36.94
30.03
27.89
24.78



¹H NMR 500 MHz CDCl₃



Product-8d



— 211.59
— 206.62

— 162.87
— 160.88

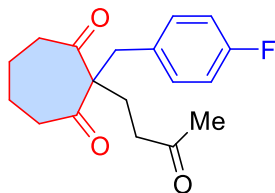
— 131.51
— 131.49
— 131.44
— 131.38

— 115.38
— 115.21

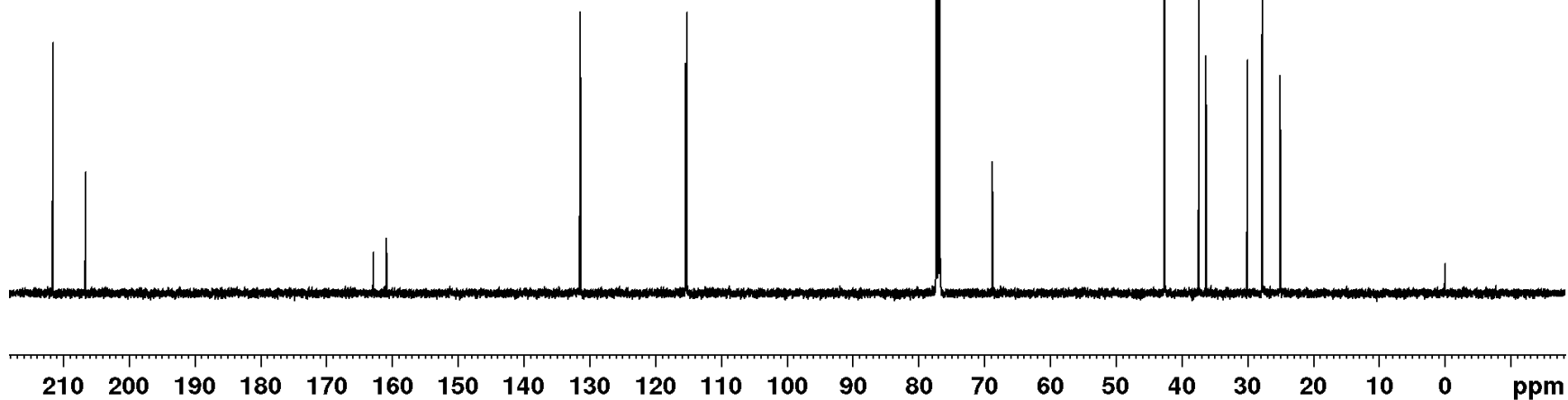
— 77.24
— 76.99
— 76.74
— 68.74
CDCl₃

— 42.59
— 37.37
— 36.27
— 29.99
— 27.72
— 25.04

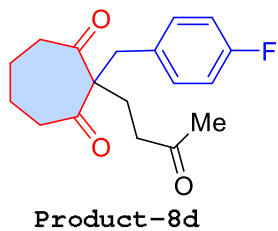
¹³C{¹H} NMR 125 MHz CDCl₃



Product-8d



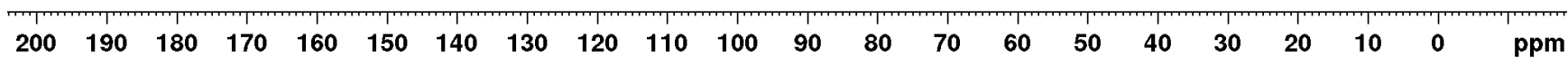
DEPT-135 125 MHz CDCl₃



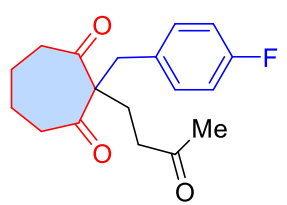
131.47
131.41

115.42
115.25

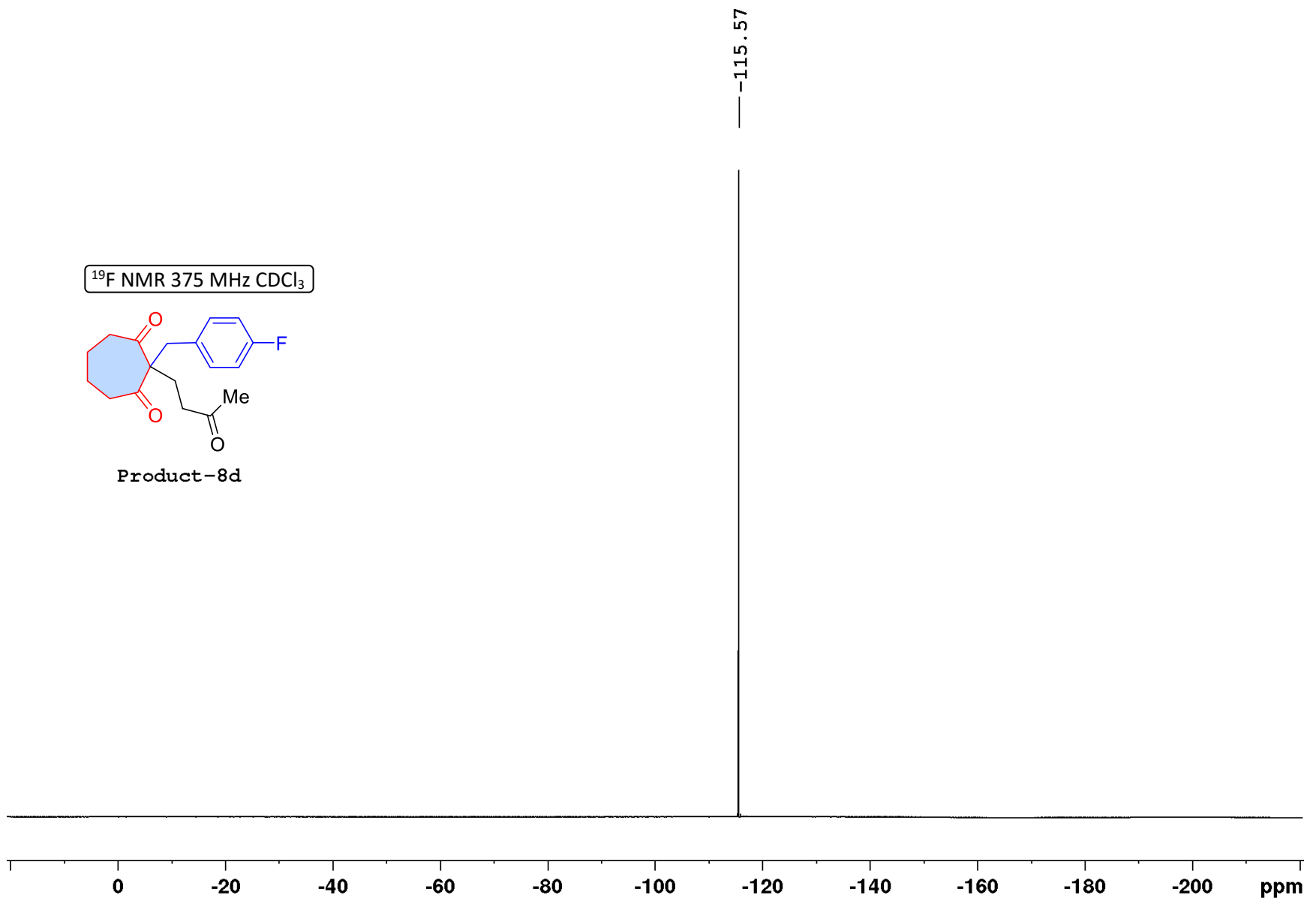
42.63
37.40
36.28
30.05
27.77
25.04



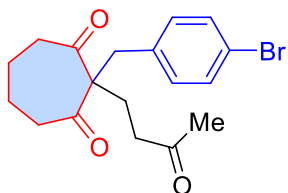
¹⁹F NMR 375 MHz CDCl₃



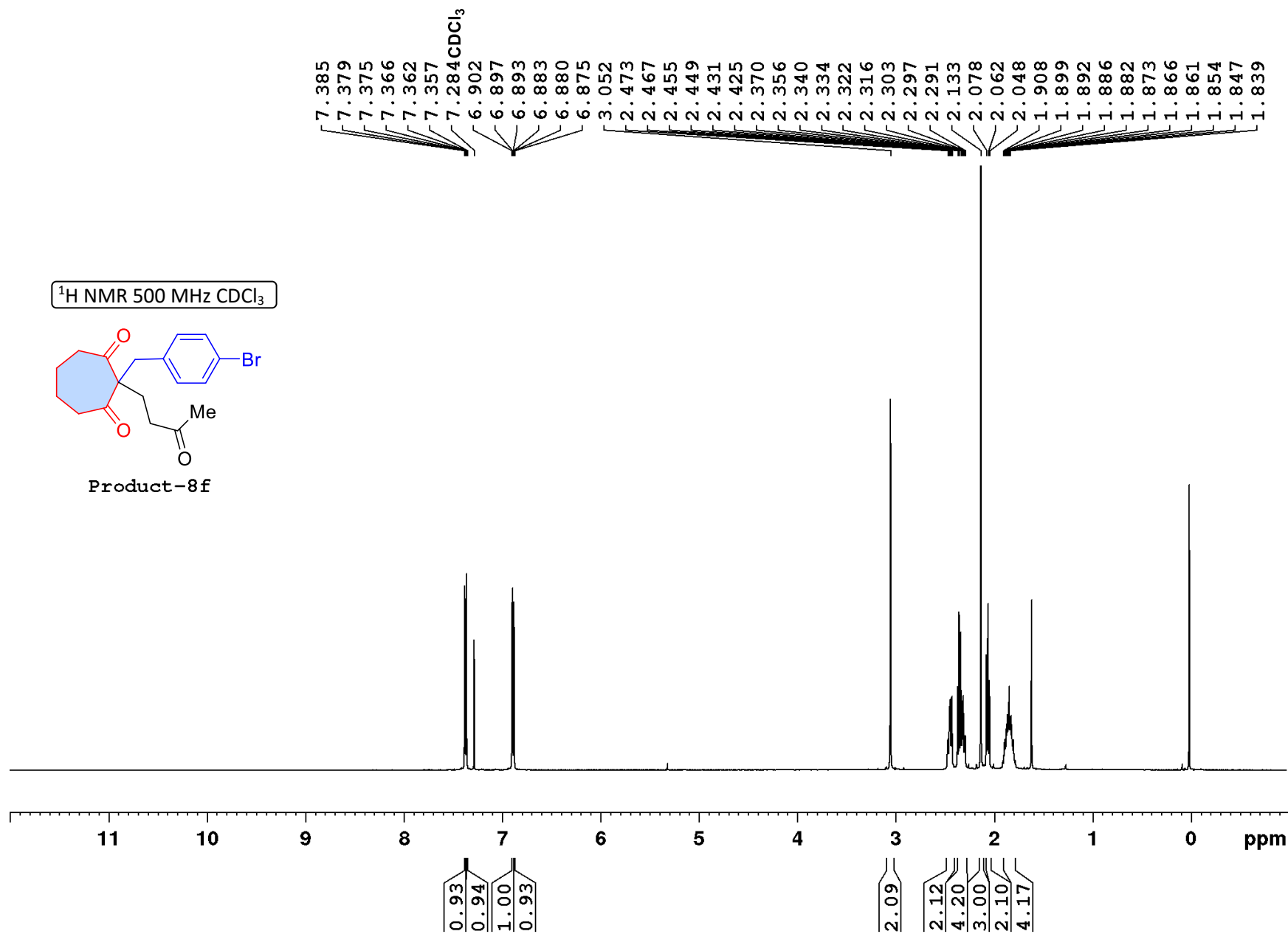
Product-8d

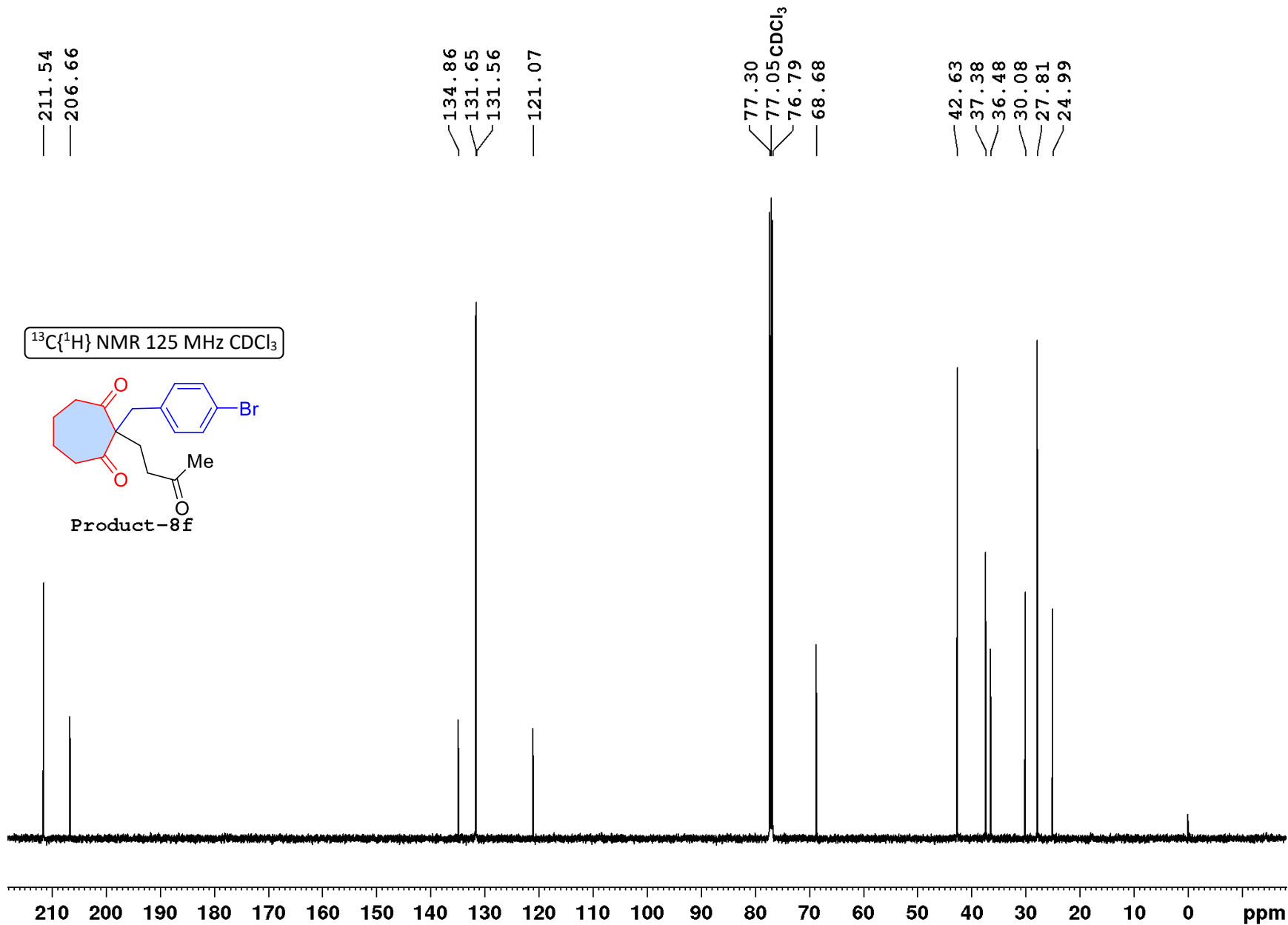


¹H NMR 500 MHz CDCl₃

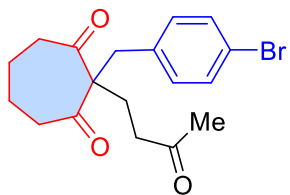


Product-8f





DEPT-135 125 MHz CDCl₃

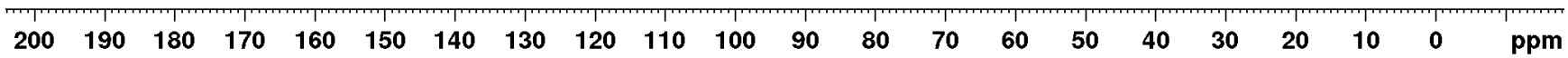


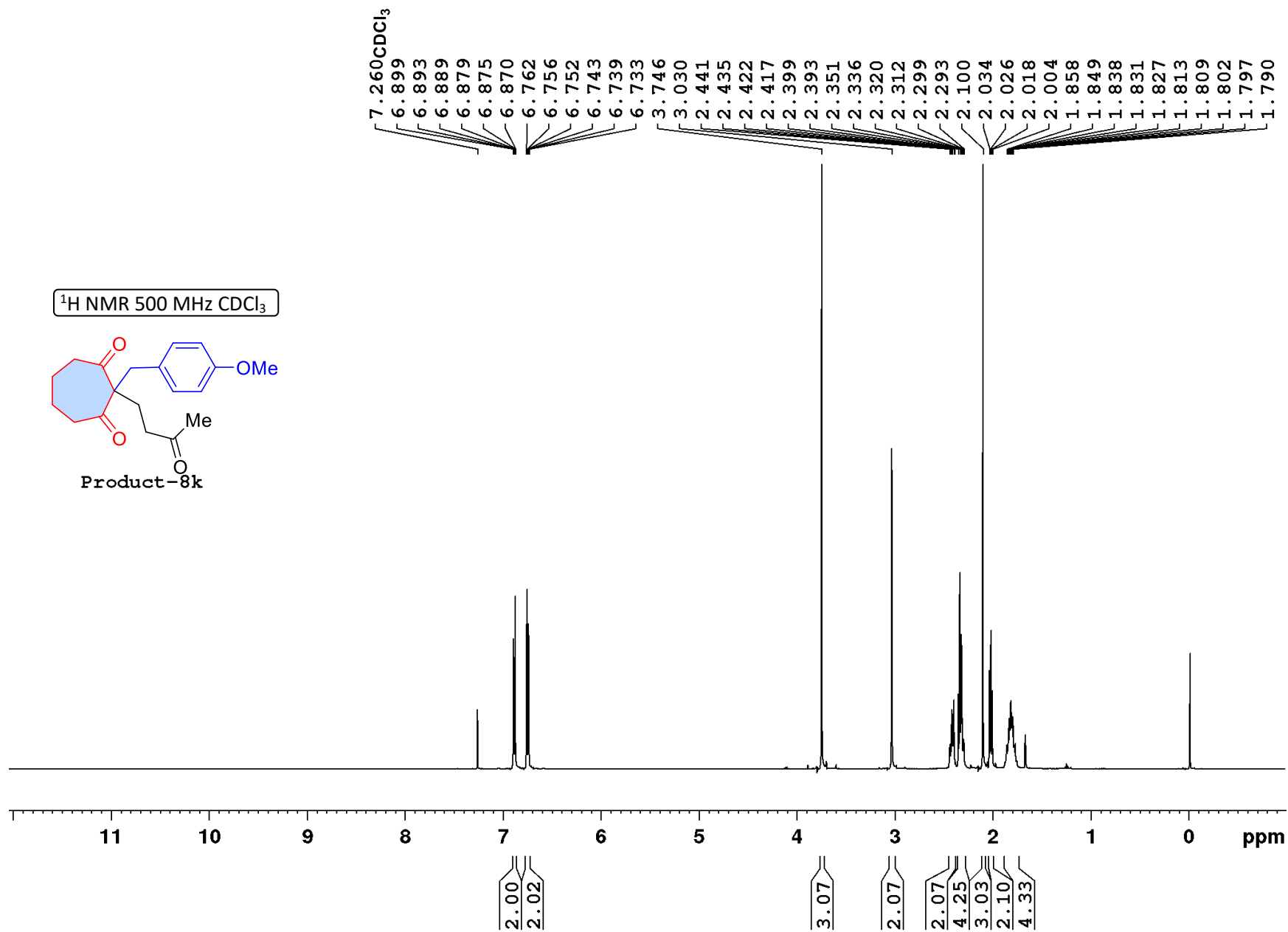
Product-8f

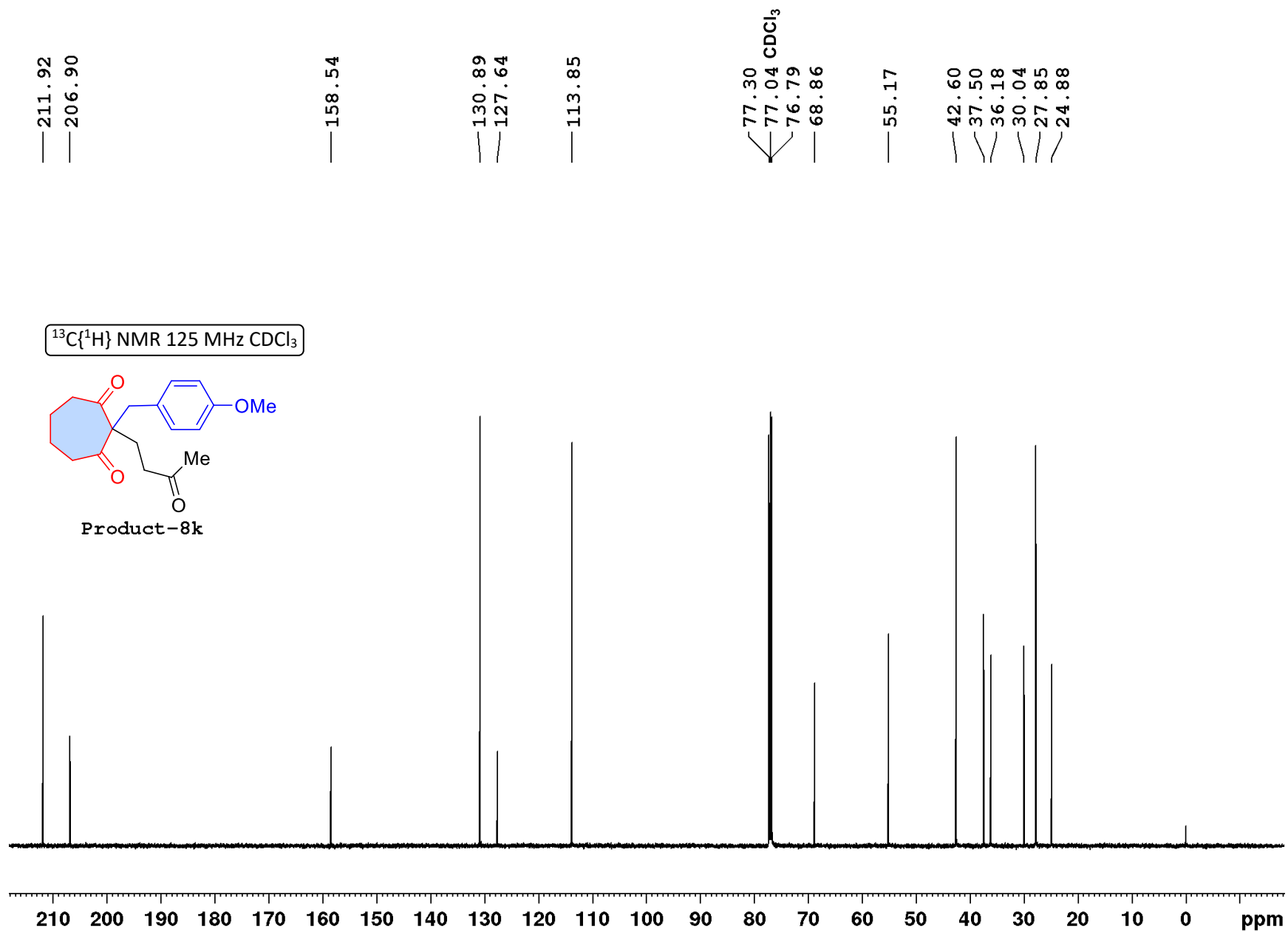
131.65
131.56

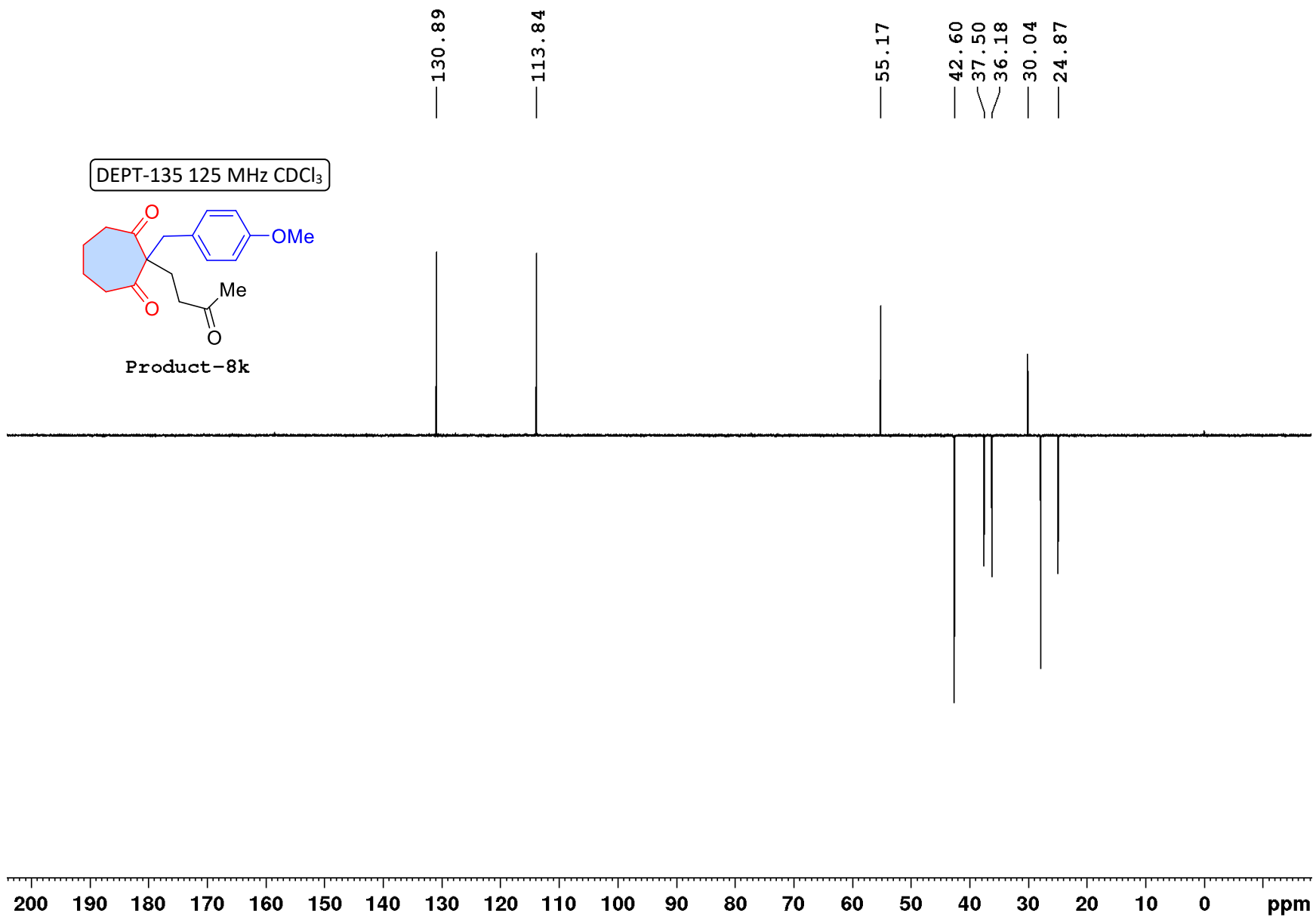
42.77
42.63
37.38
36.47
30.09
27.81
24.98

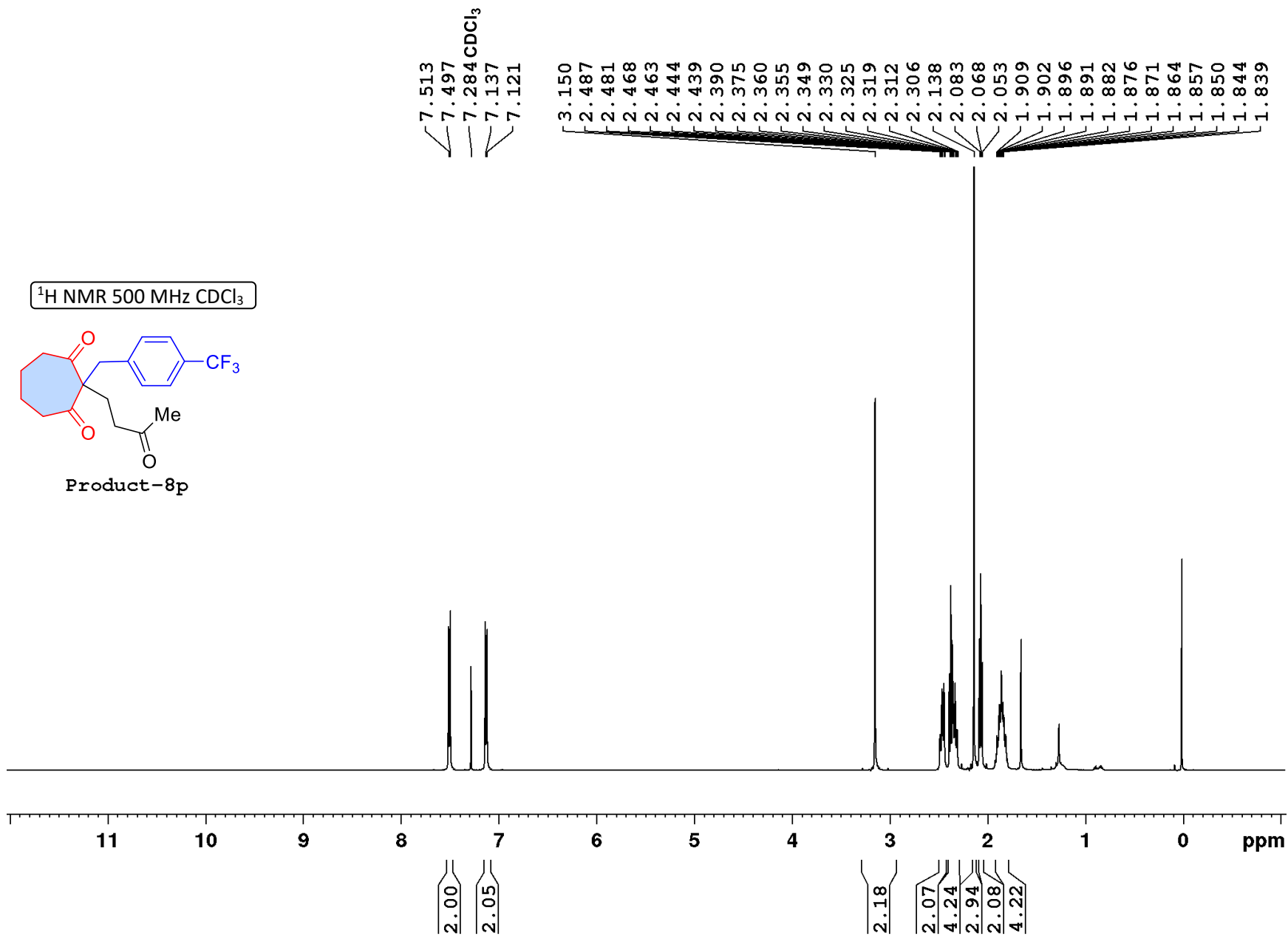
— 0.01



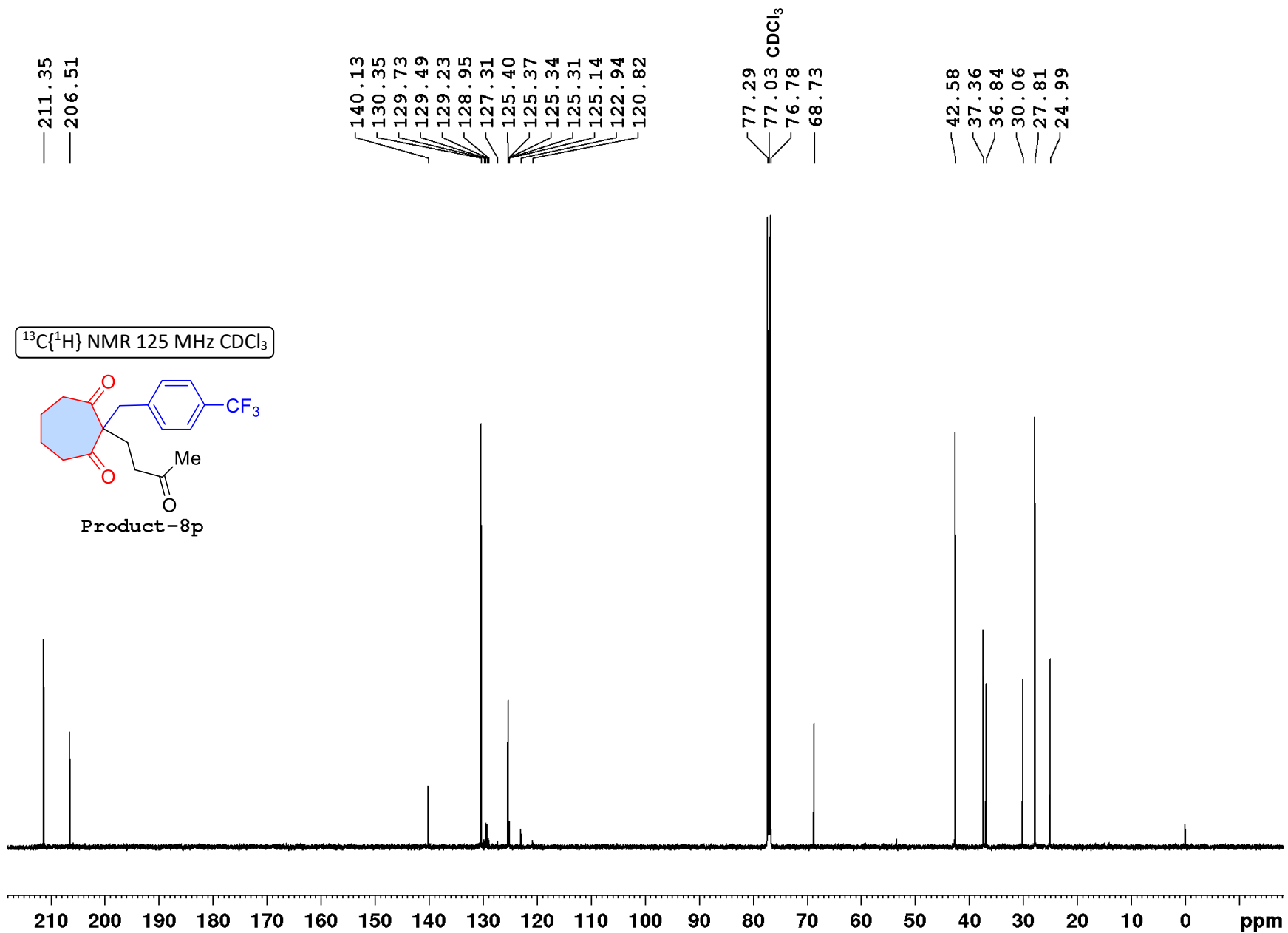
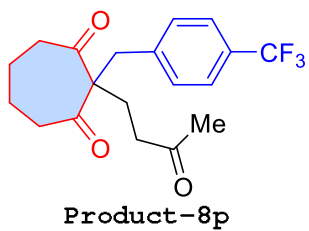


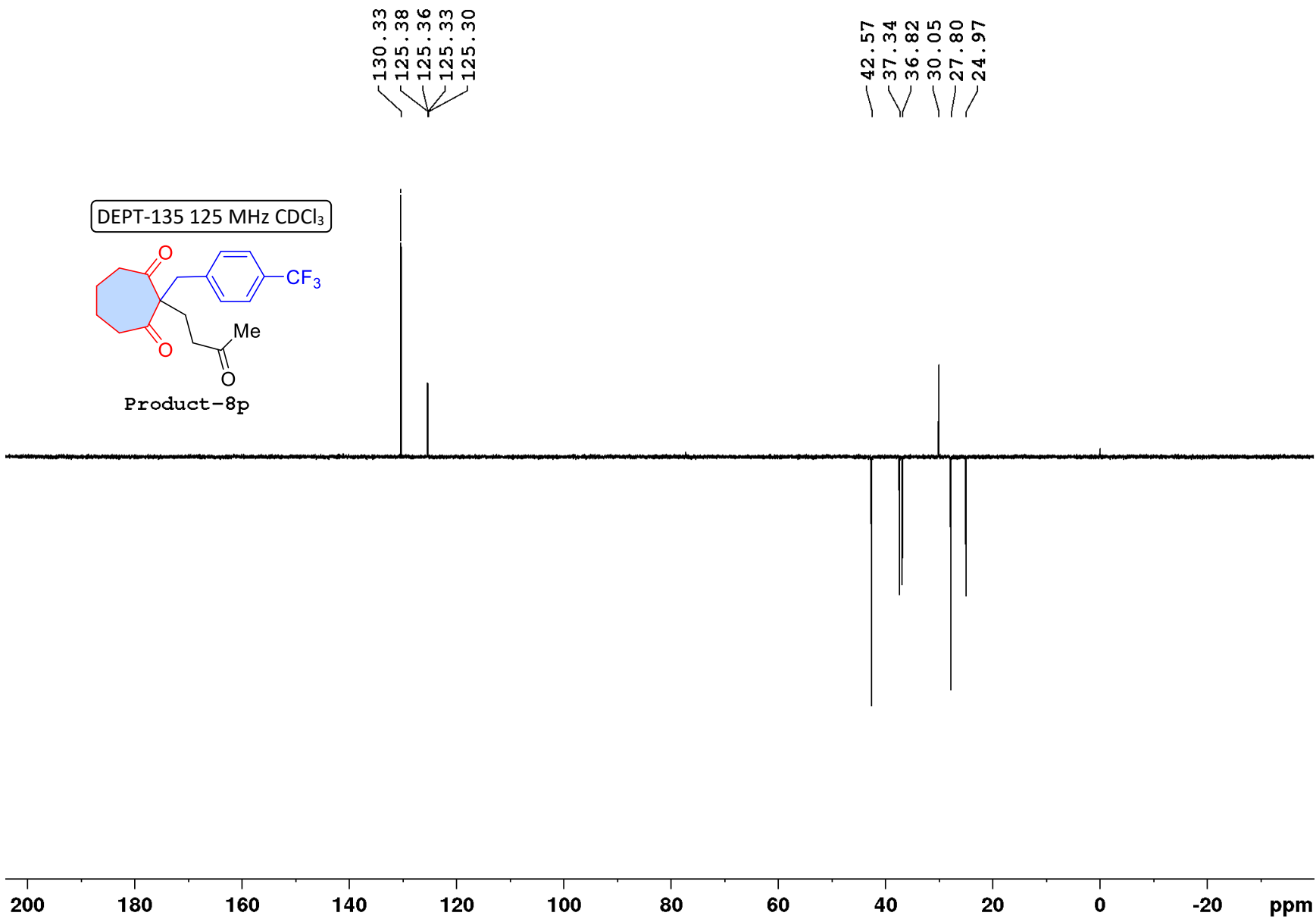


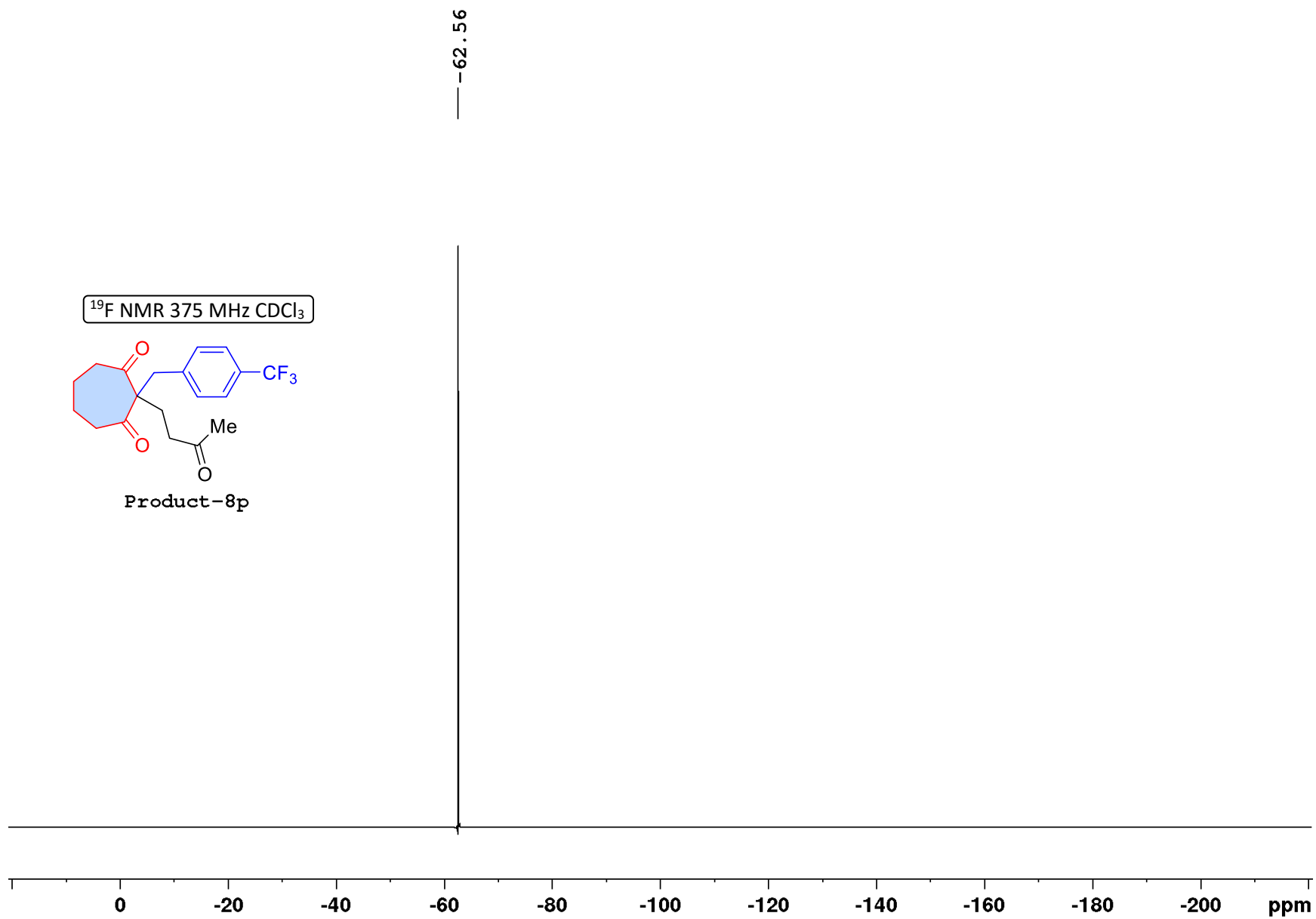




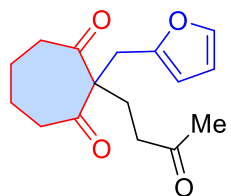
$^{13}\text{C}\{^1\text{H}\}$ NMR 125 MHz CDCl_3



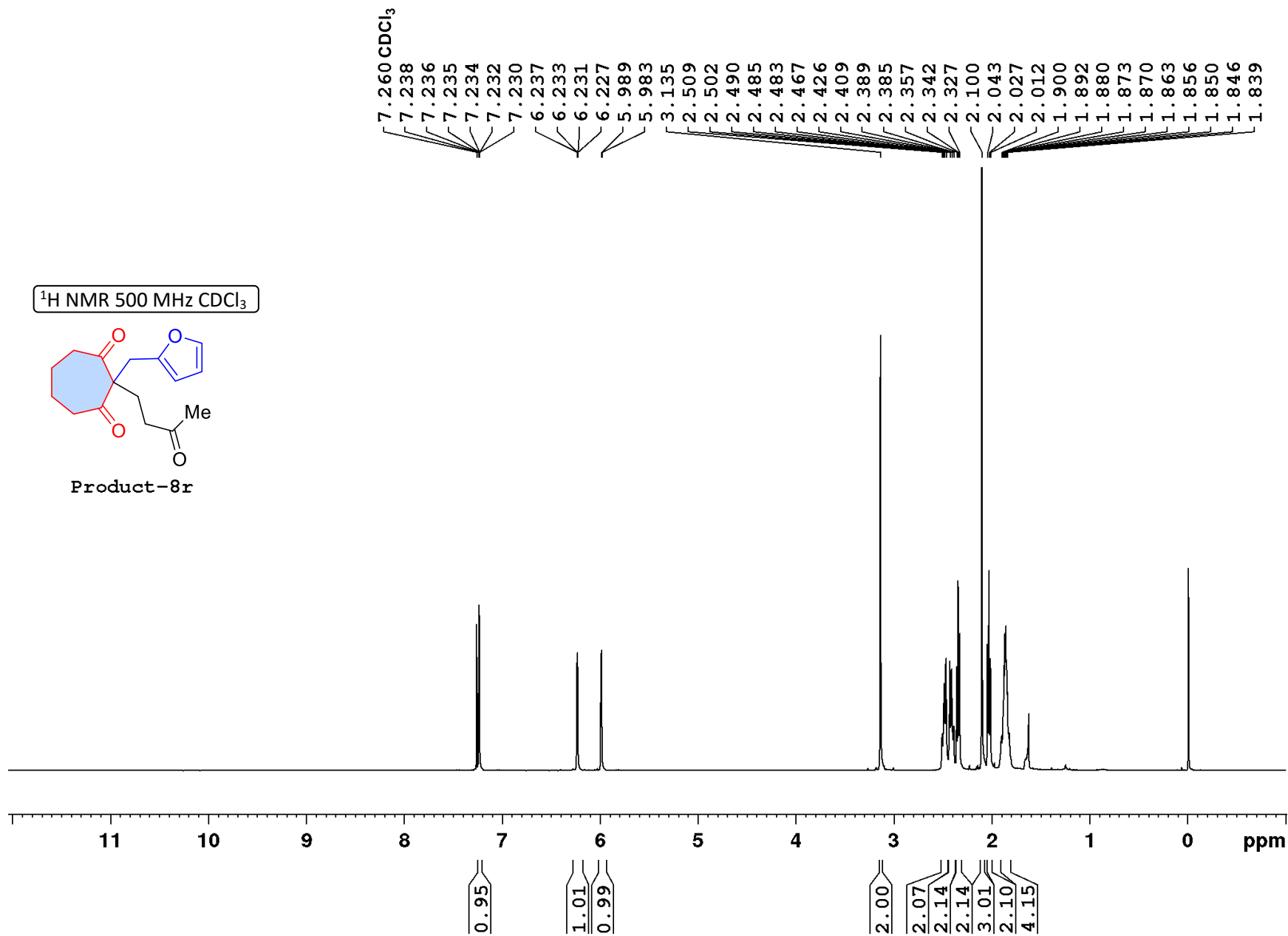


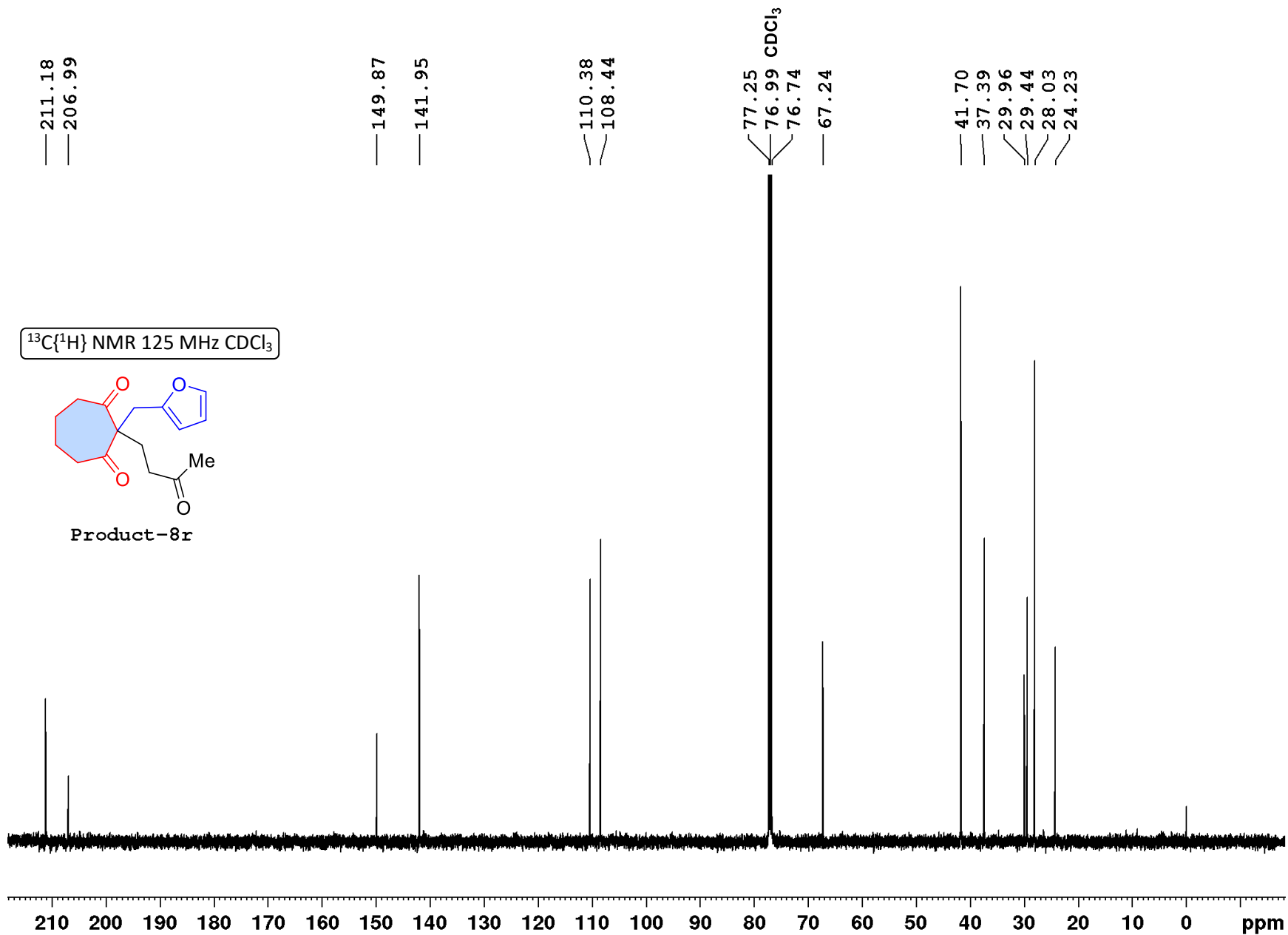


¹H NMR 500 MHz CDCl₃

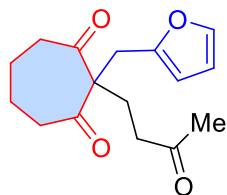


Product-8r





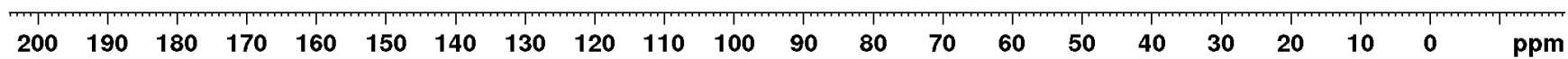
DEPT-135 125 MHz CDCl₃



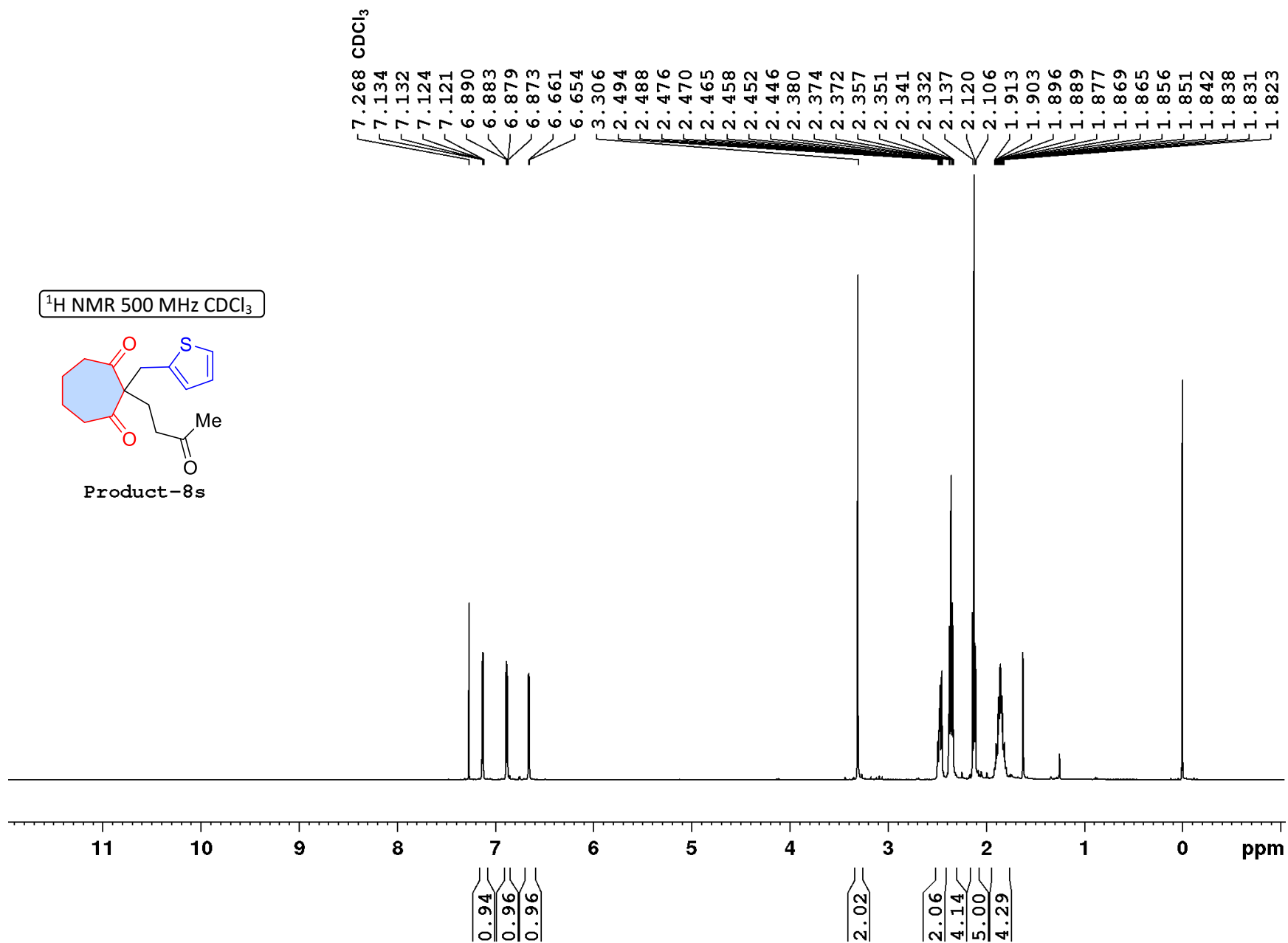
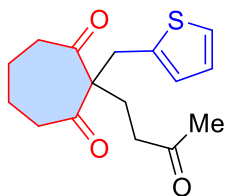
— 142.01

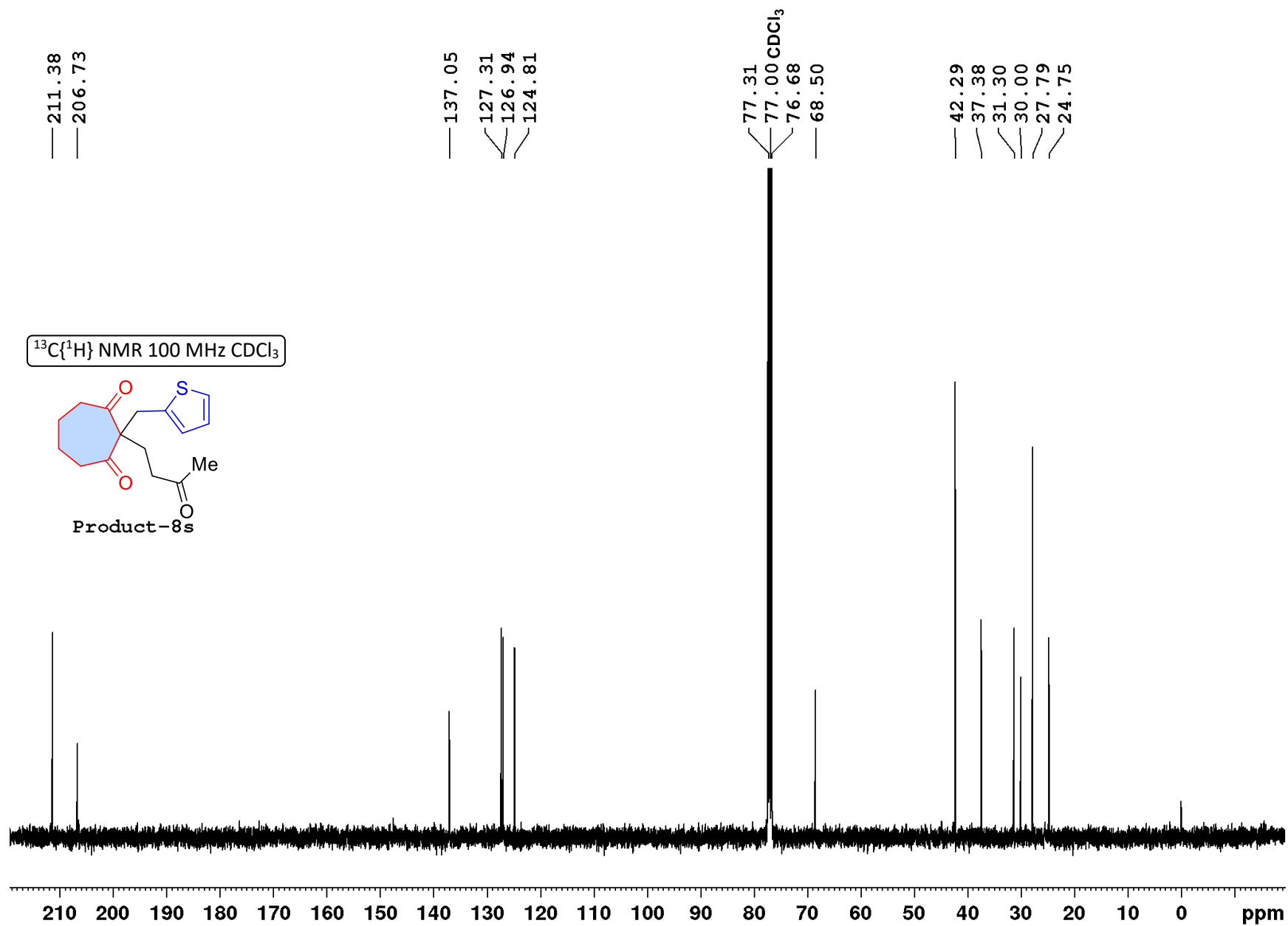
— 110.42
— 108.48

— 41.74
— 37.43
— 30.02
— 29.46
— 28.09
— 24.23

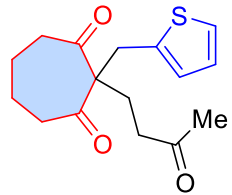


^1H NMR 500 MHz CDCl_3





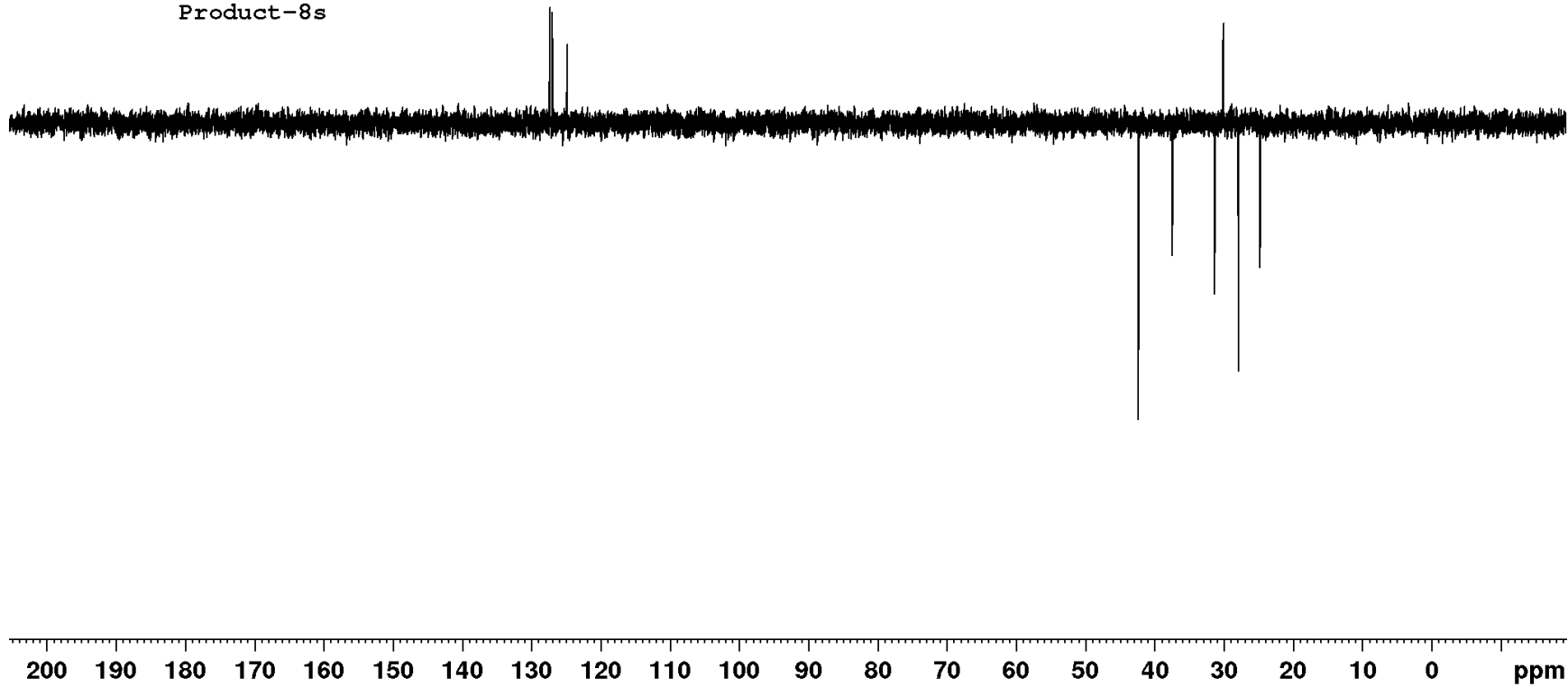
DEPT-135 100 MHz CDCl₃



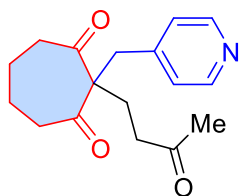
Product-8s

127.35
126.98
124.85

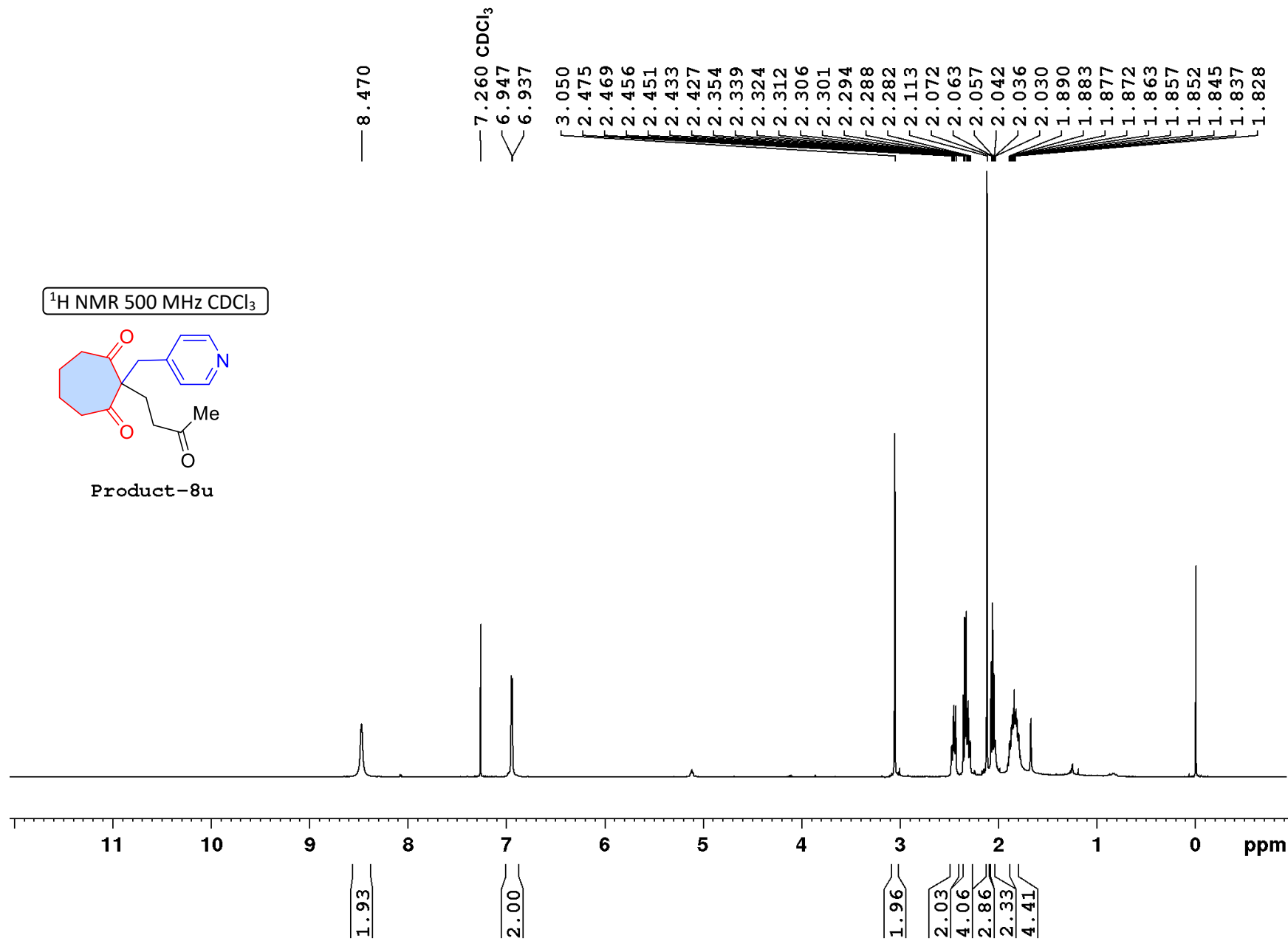
42.32
37.41
31.30
30.07
27.85
24.73

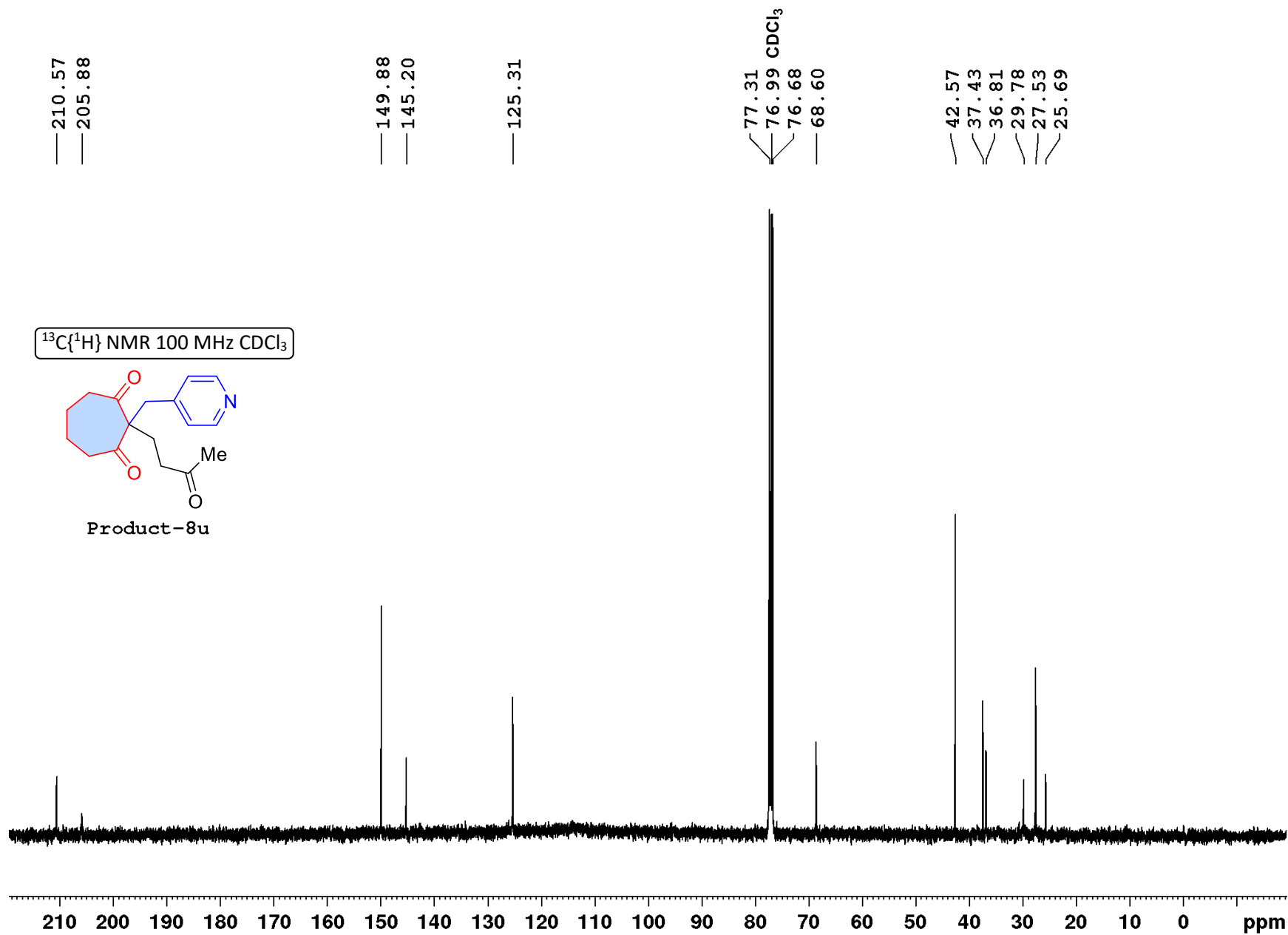


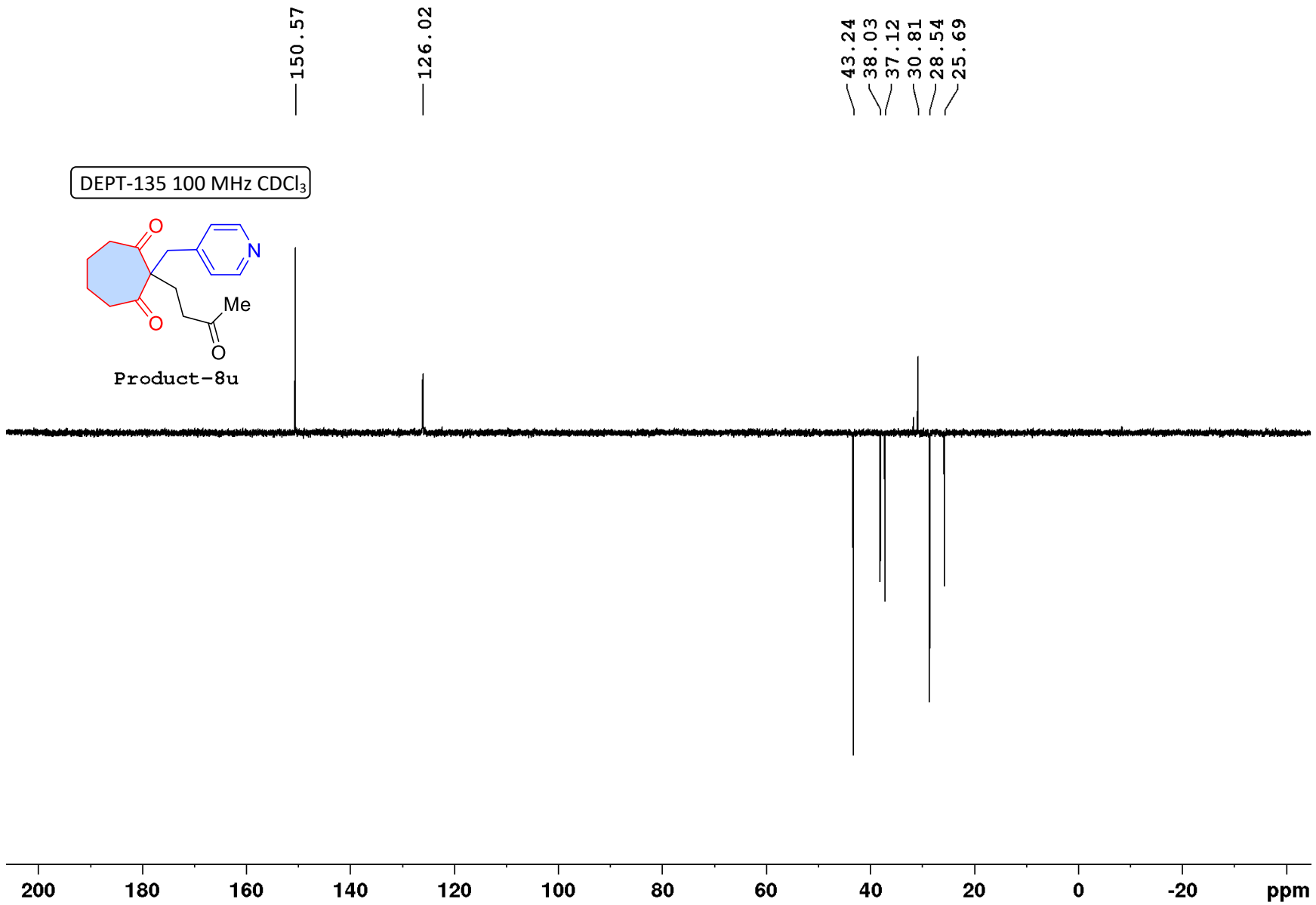
¹H NMR 500 MHz CDCl₃

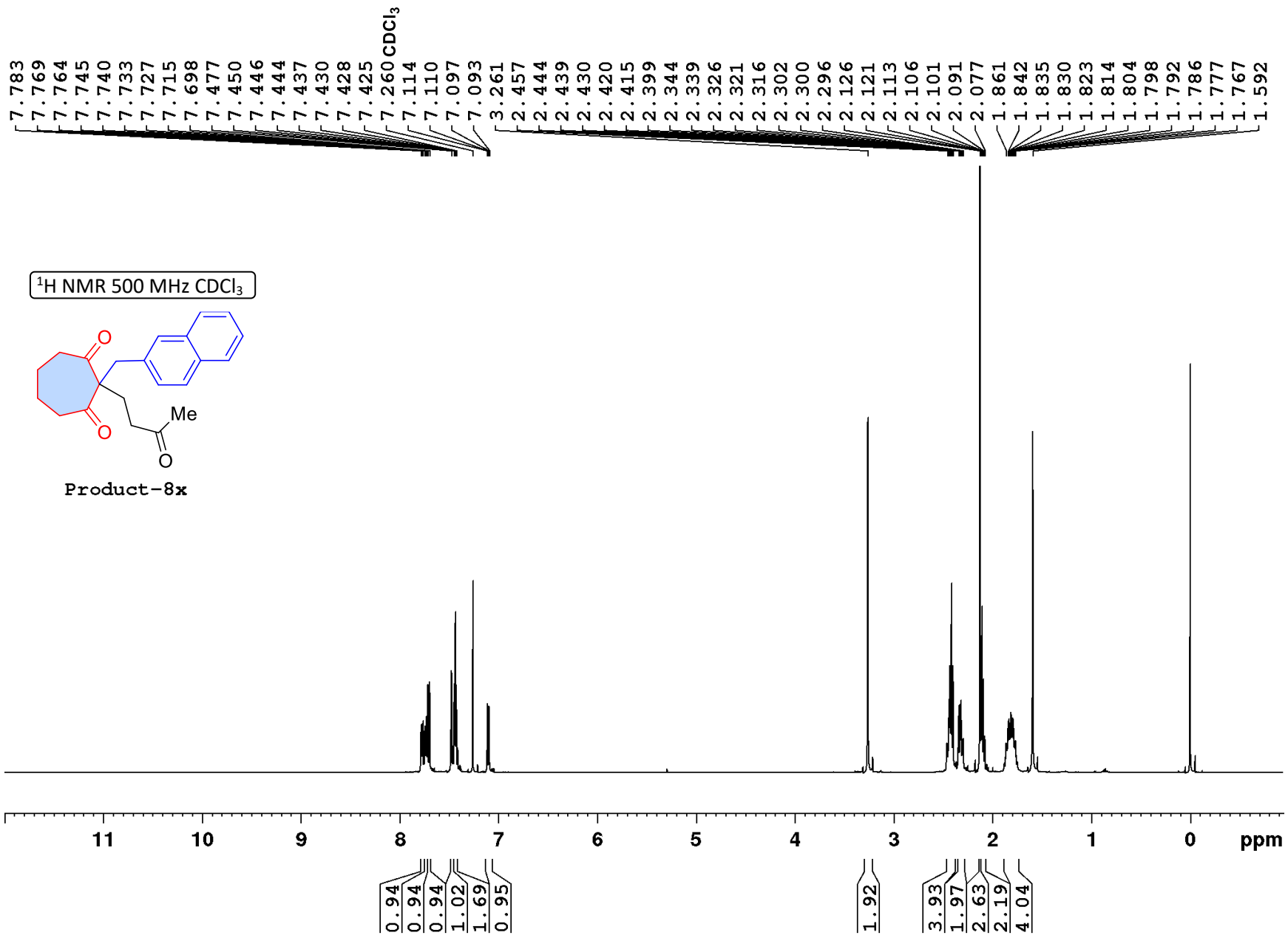


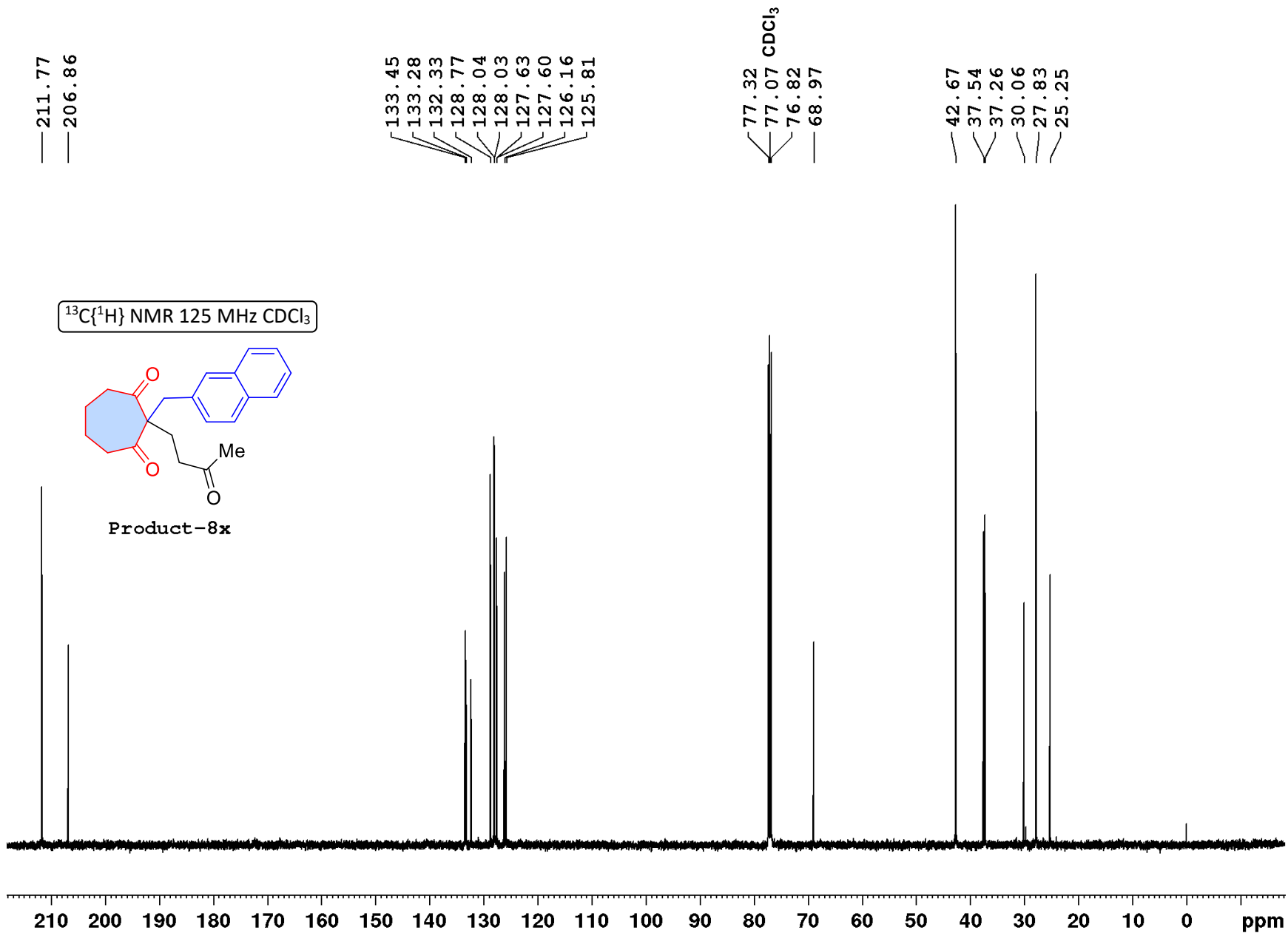
Product-8u



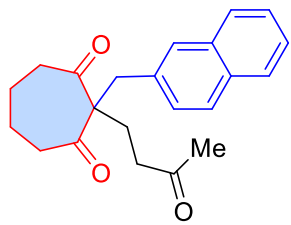








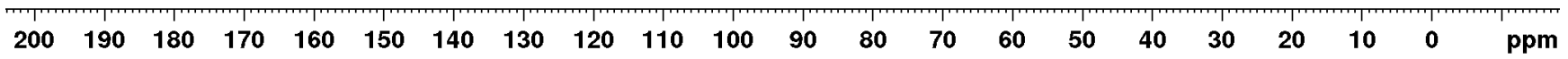
DEPT-135 125 MHz CDCl₃



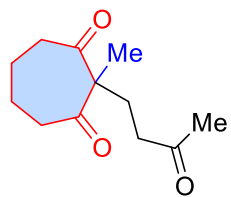
Product-8x

128.77
128.04
128.02
127.63
127.60
126.16
125.81

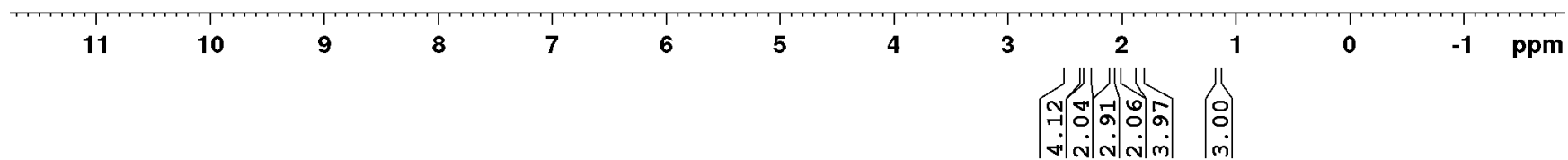
42.86
42.67
37.54
37.26
30.07
28.03
27.84
25.24



¹H NMR 500 MHz CDCl₃



Product-800



7.260 CDCl₃

2.478
2.467
2.459
2.455
2.452
2.445
2.436
2.433
2.431
2.423
2.417
2.415
2.410
2.408
2.392
2.388
2.322
2.307
2.292
2.088
2.053
2.046
2.037
2.022
1.853
1.848
1.843
1.153

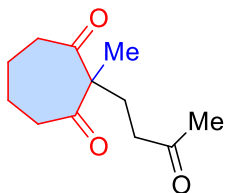
— 212.28
— 207.12

77.31
77.00
76.68
CDCl₃

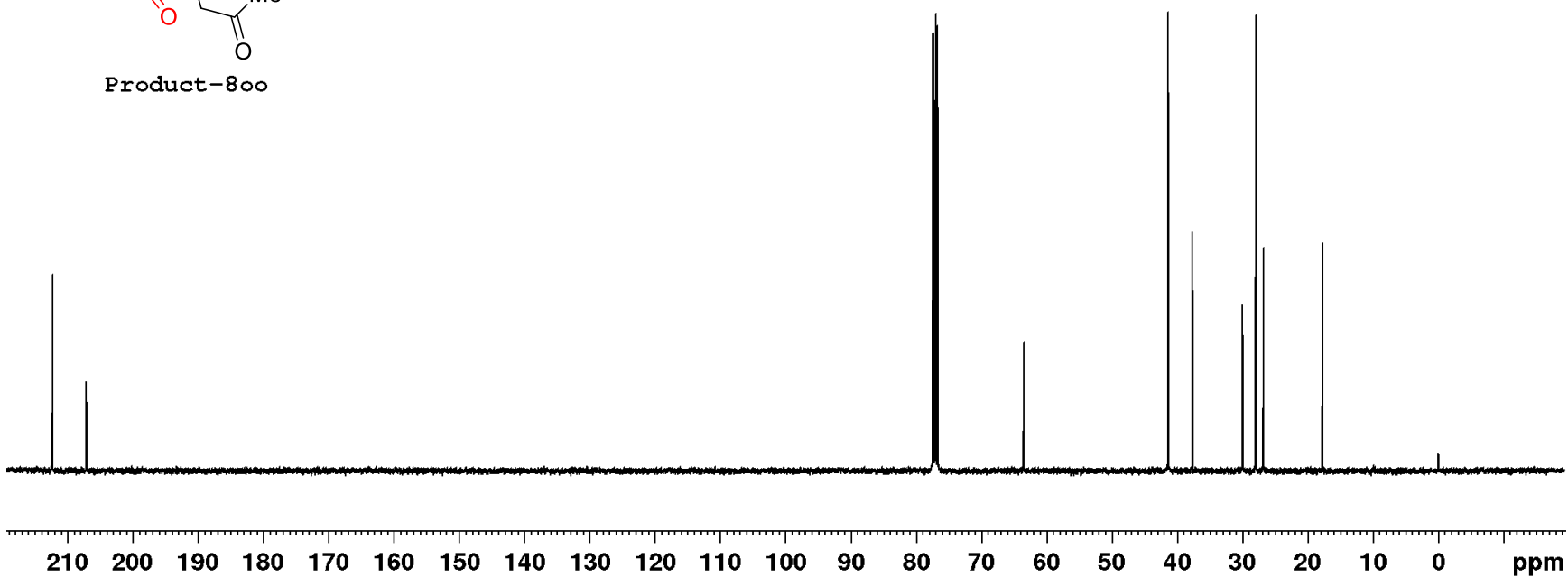
— 63.49

— 41.32
— 37.64
— 29.93
— 27.92
— 26.74
— 17.67

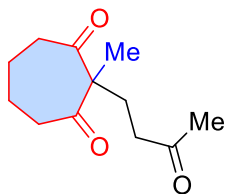
¹³C{¹H} NMR 100 MHz CDCl₃



Product-800

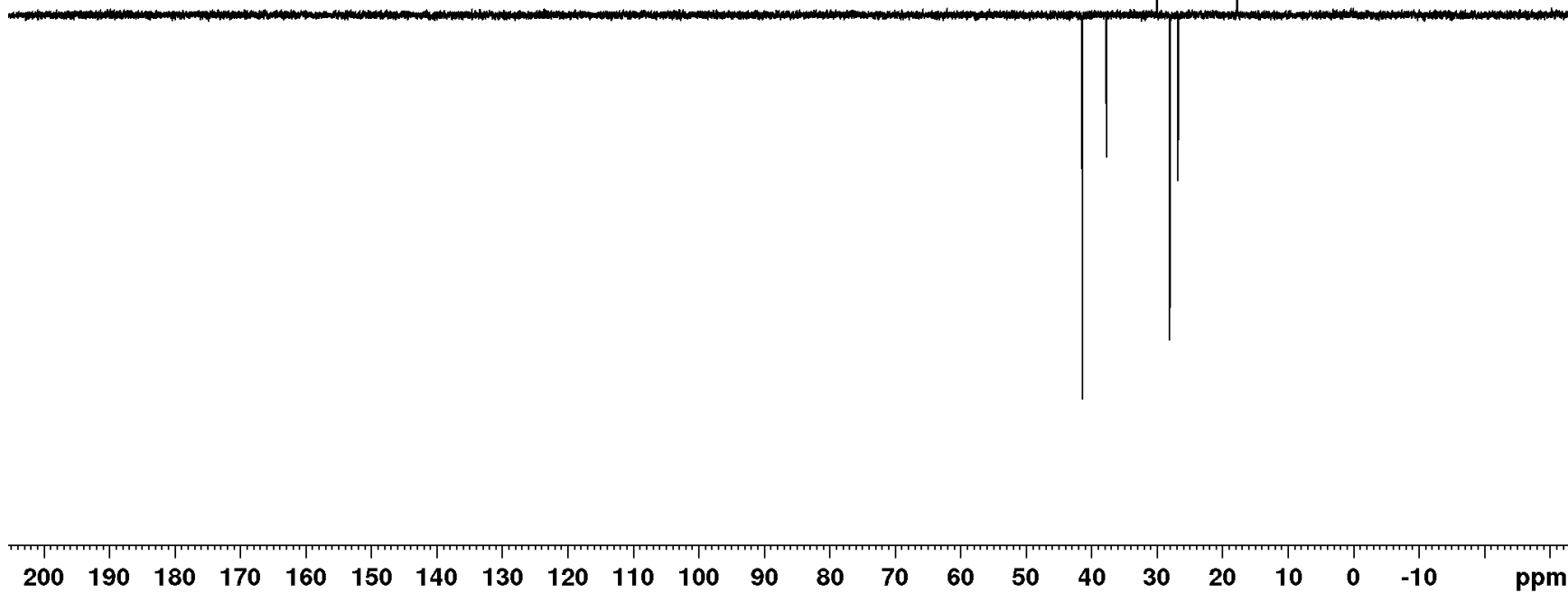


DEPT-135 100 MHz CDCl₃

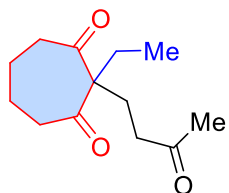


Product-800

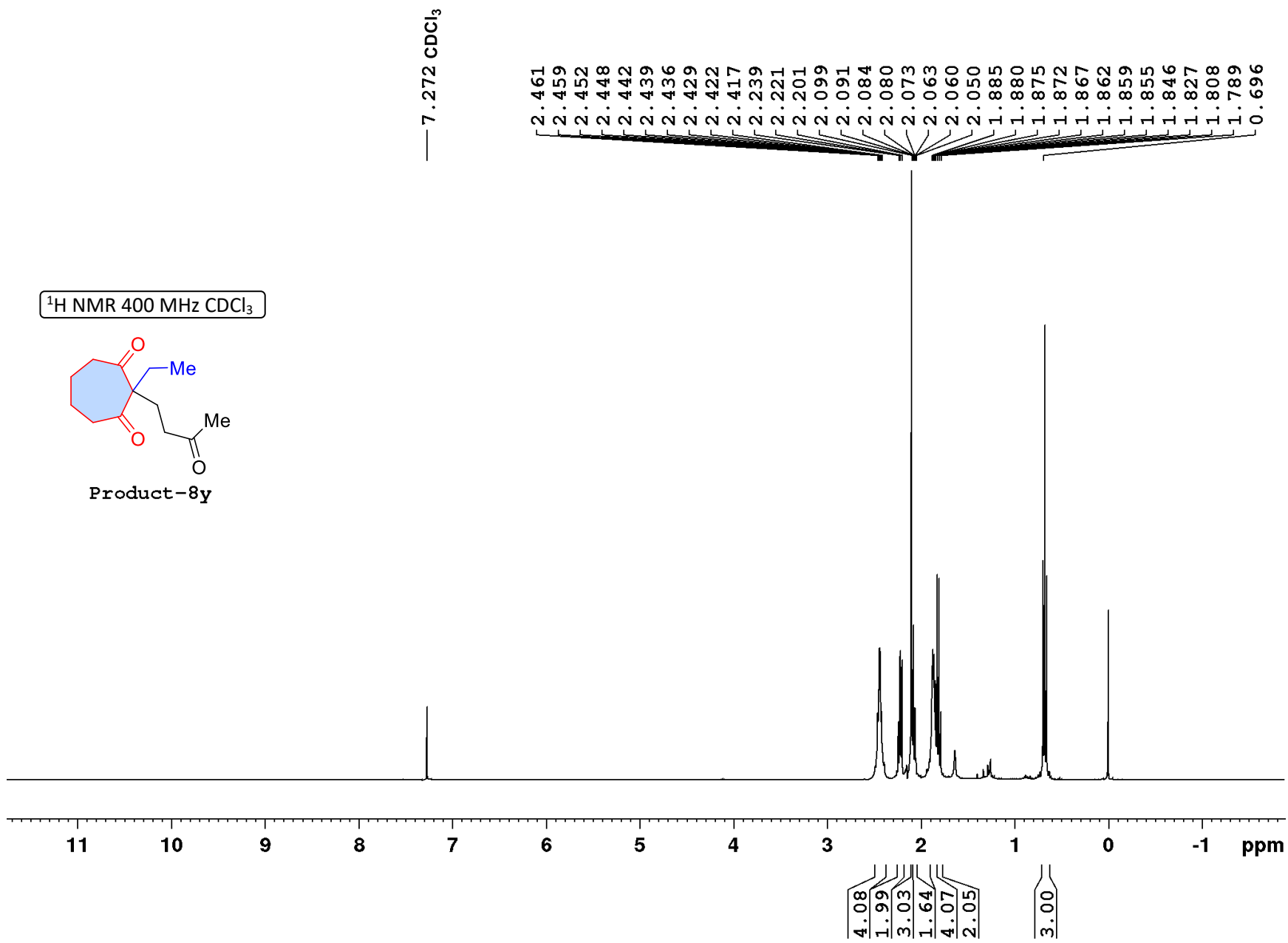
41.37
37.68
30.01
27.99
26.76
17.71

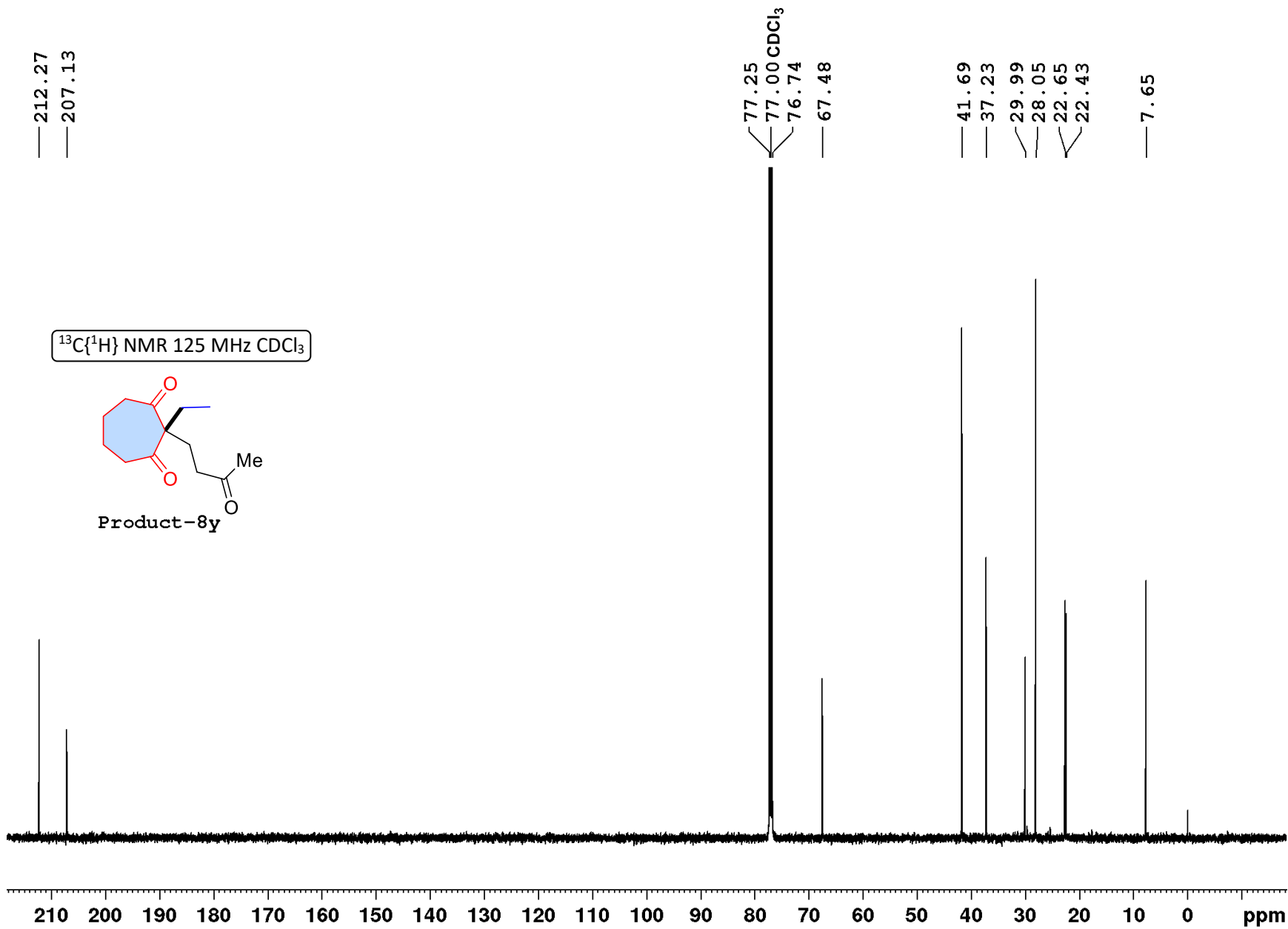


¹H NMR 400 MHz CDCl₃

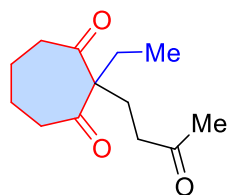


Product-8y





DEPT-135 100 MHz CDCl₃



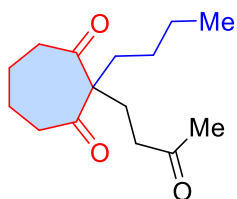
Product-9y

41.72
37.26
30.03
28.08
22.67
22.45
7.68

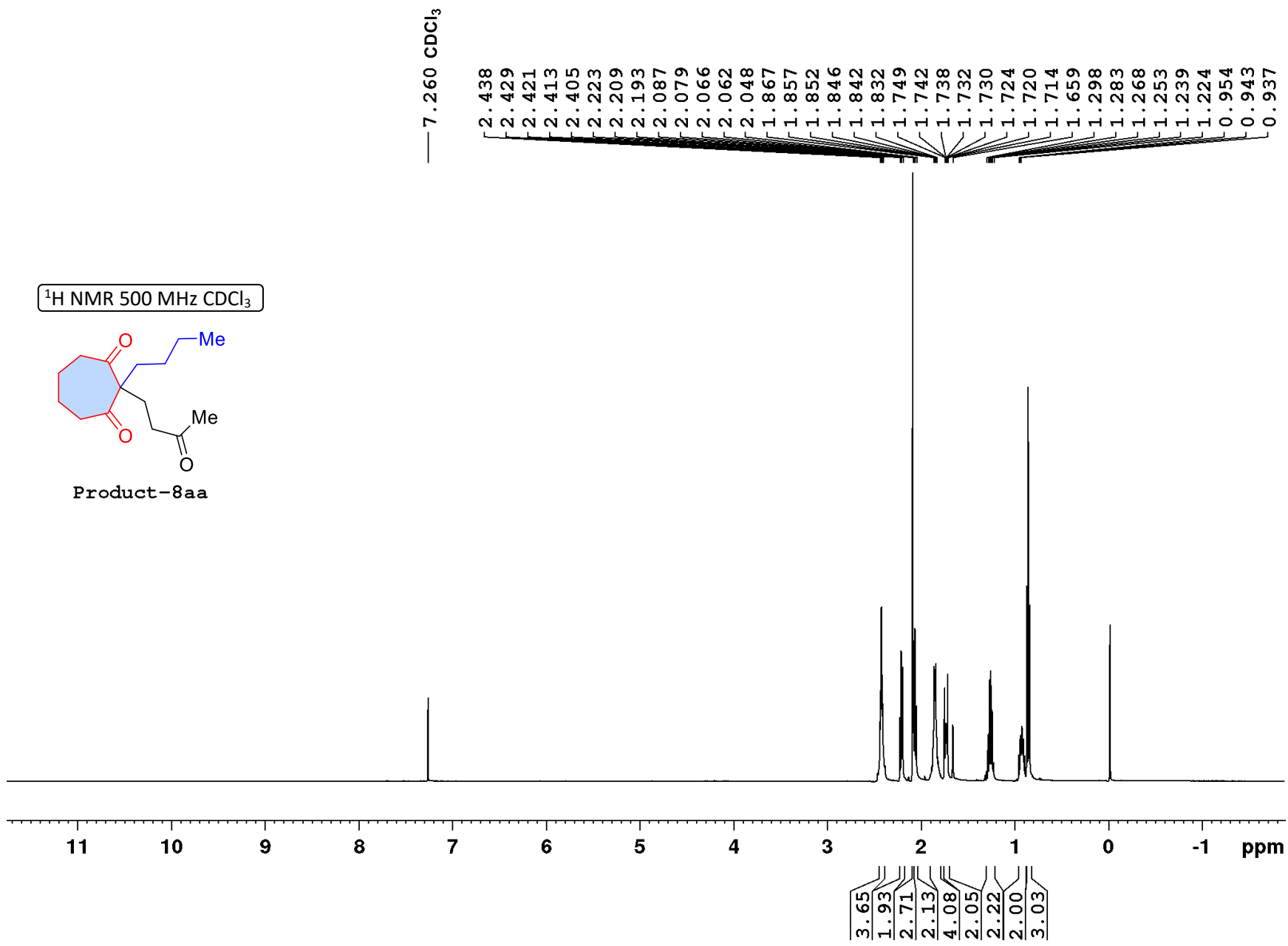


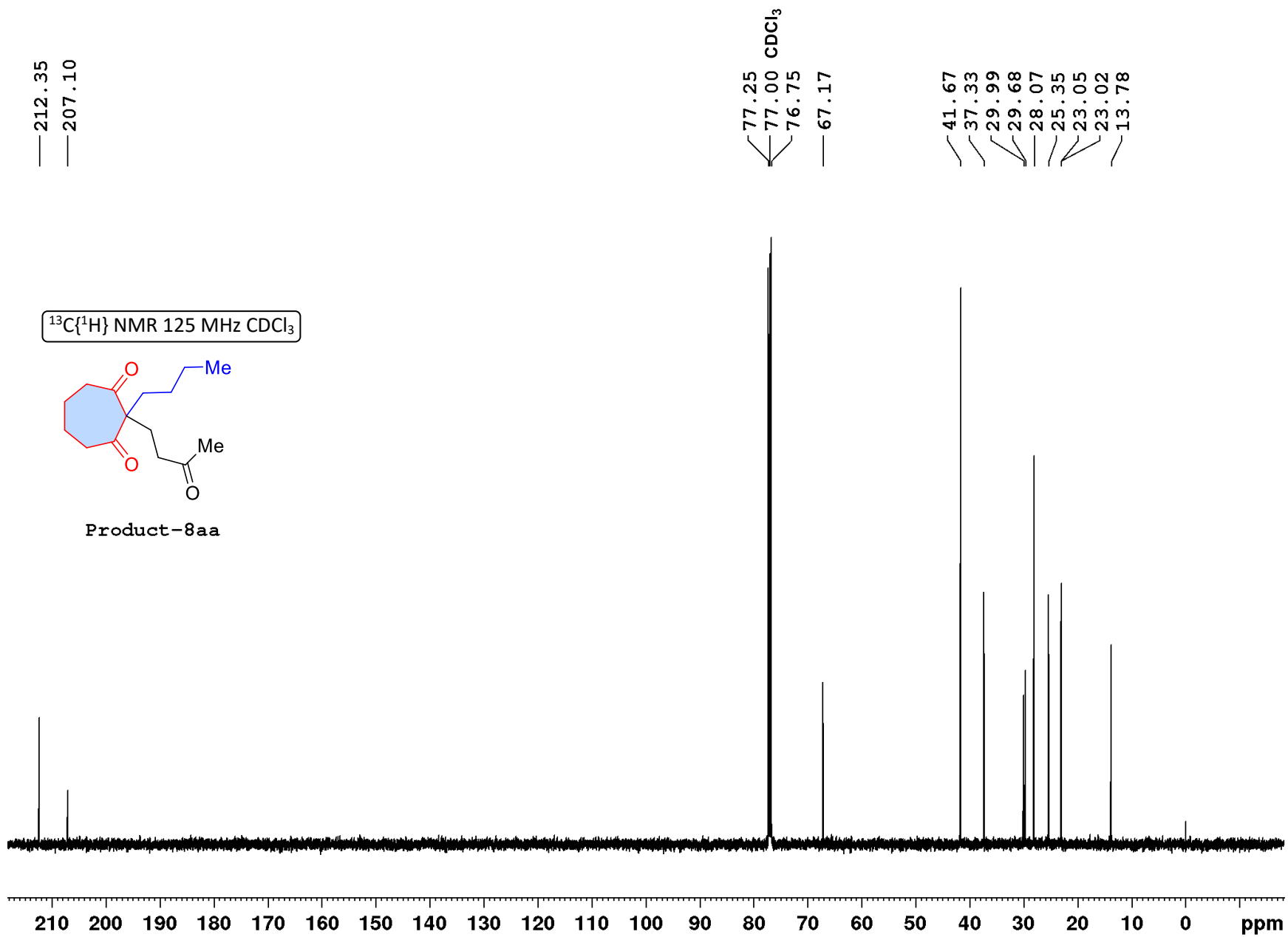
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10 ppm

¹H NMR 500 MHz CDCl₃

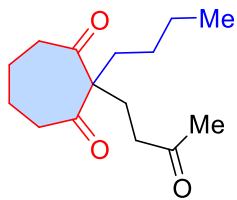


Product-8aa



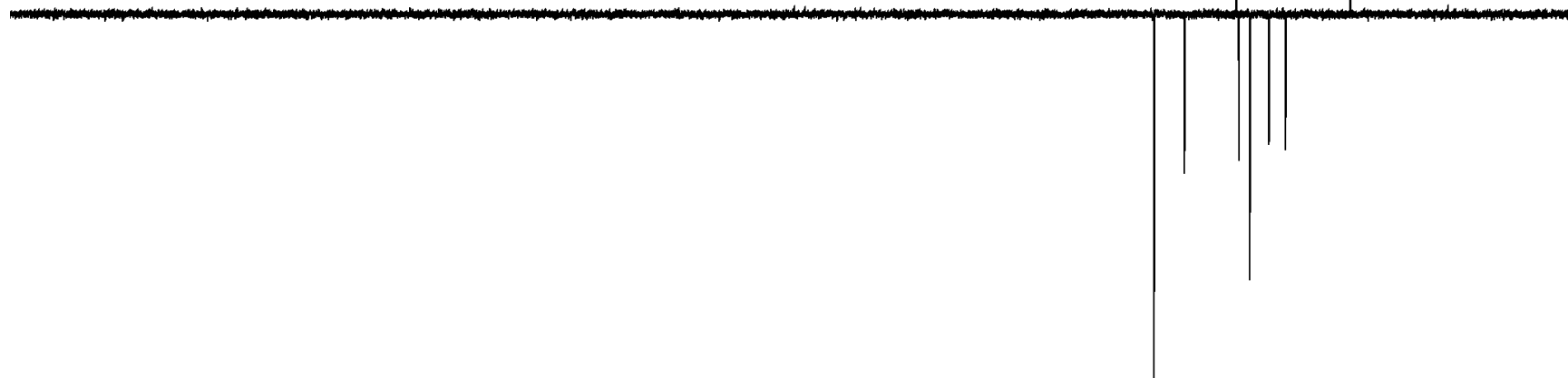


DEPT-135 125 MHz CDCl₃



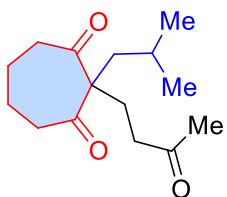
Product-8aa

41.70
37.36
30.05
29.68
28.12
25.38
23.05
13.83

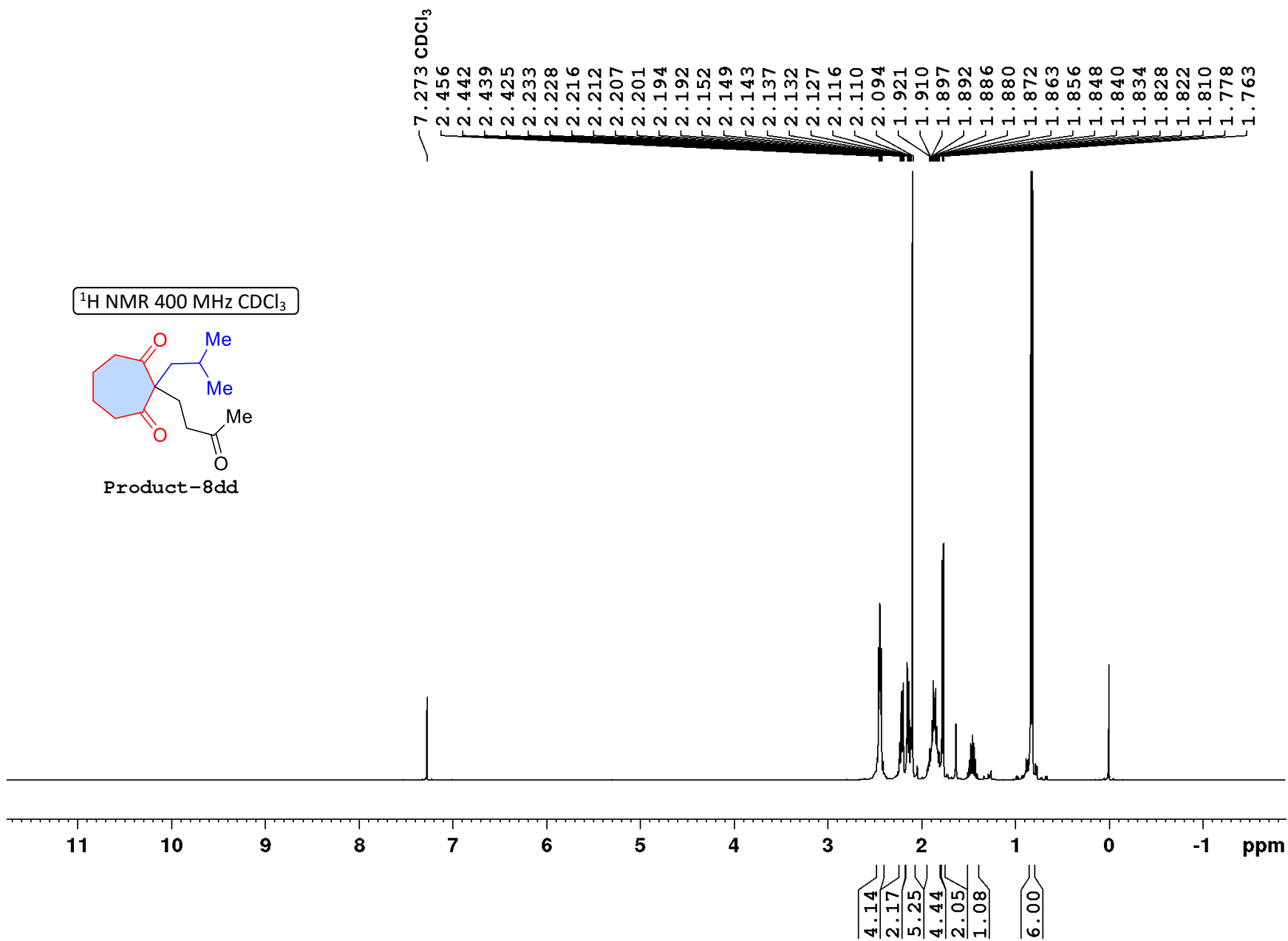


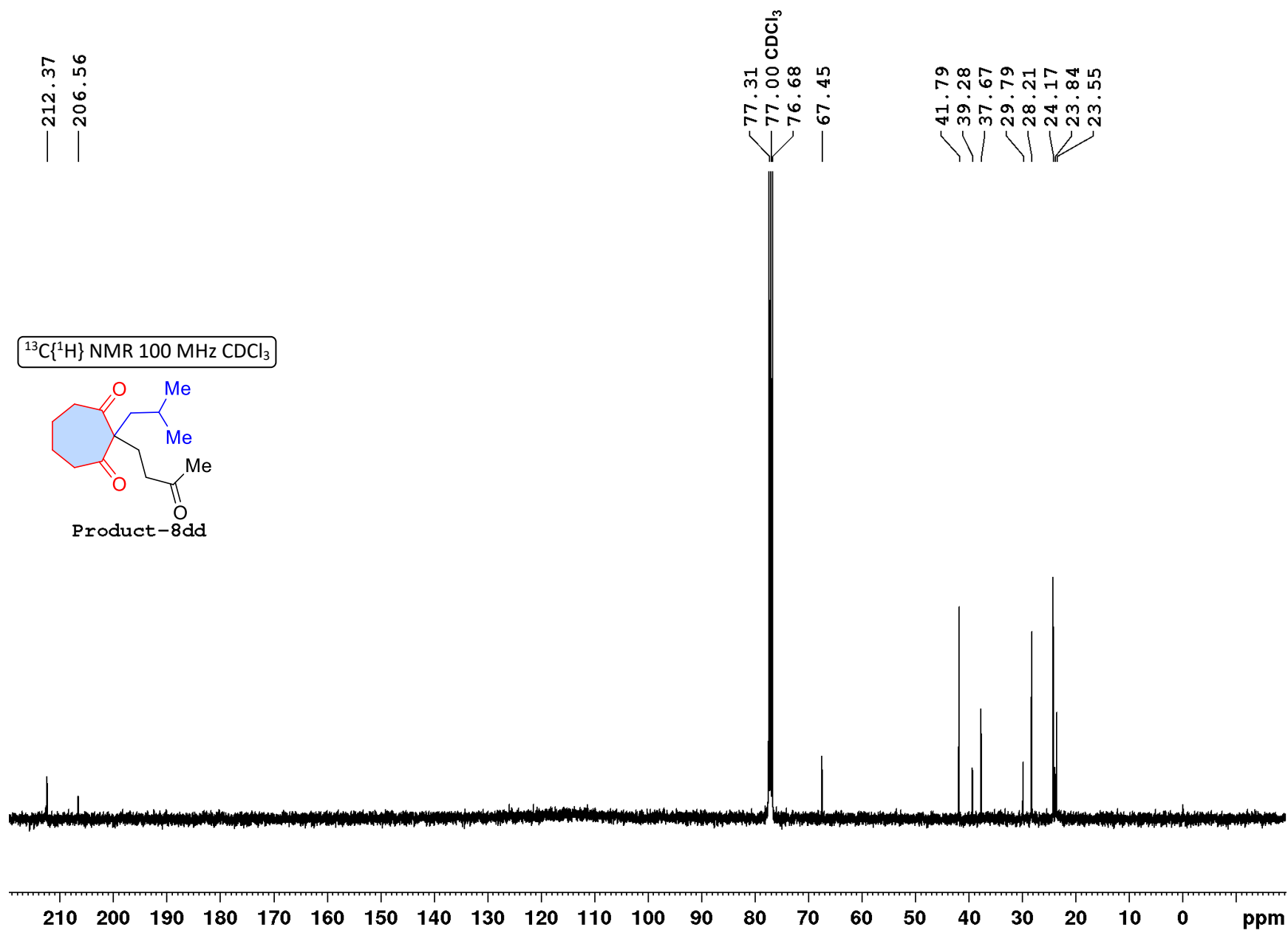
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 ppm

¹H NMR 400 MHz CDCl₃

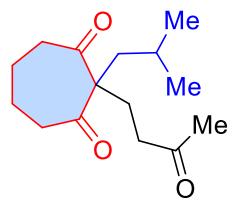


Product-8dd



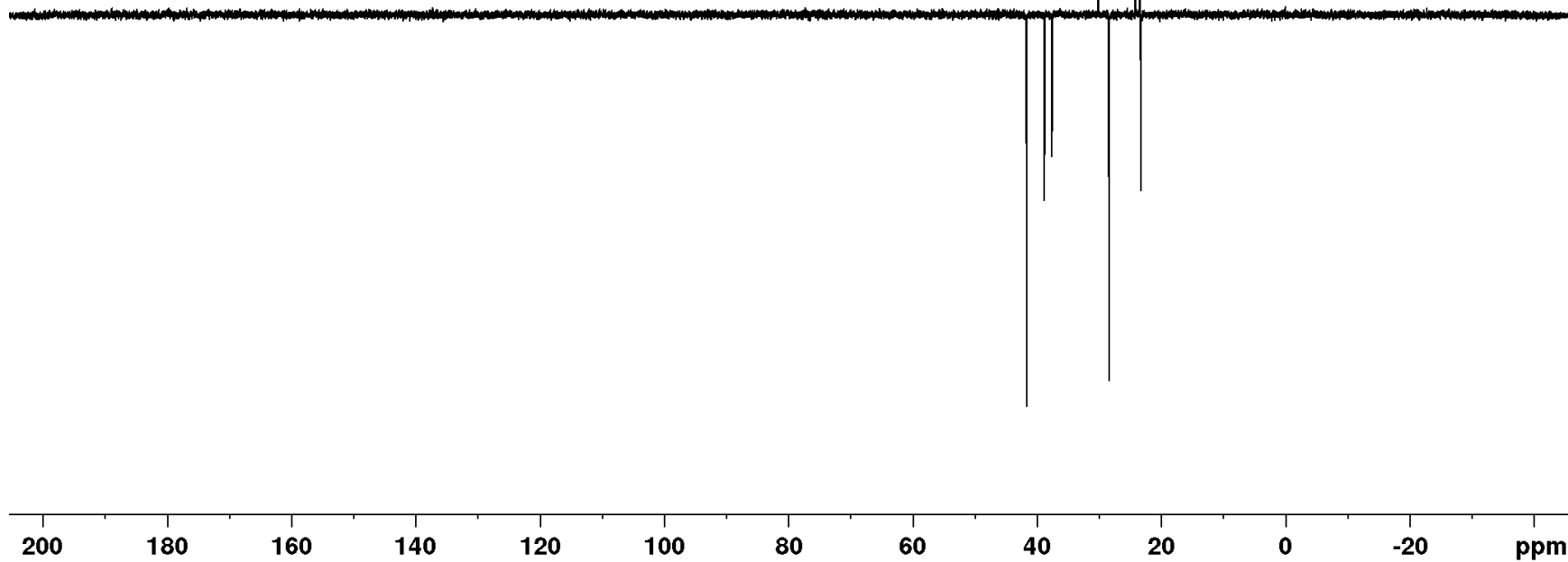


DEPT-135 100 MHz CDCl₃

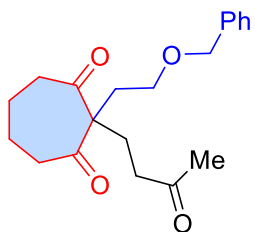


Product-8dd

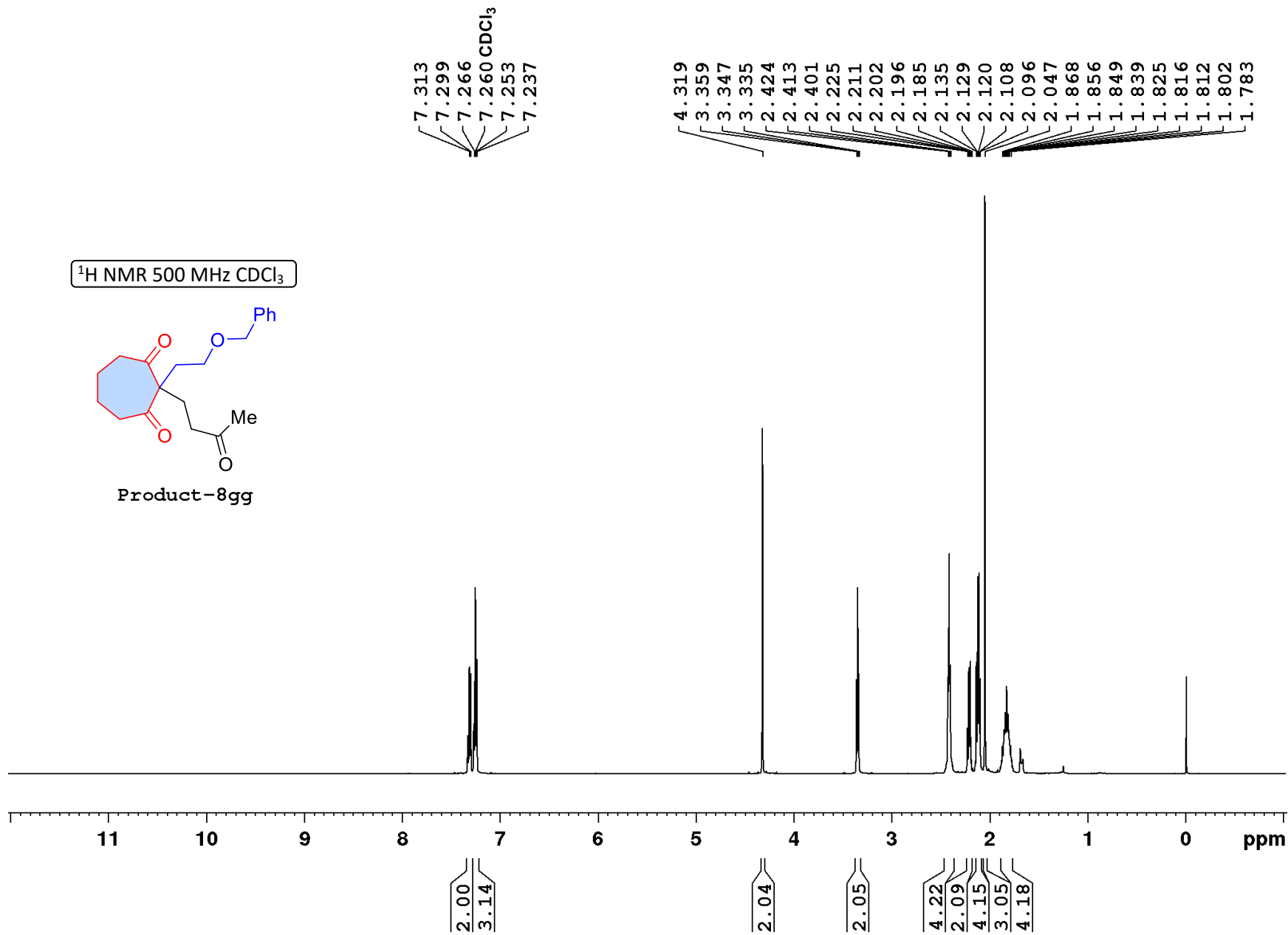
41.64
38.77
37.53
30.03
28.38
24.14
23.42
23.23

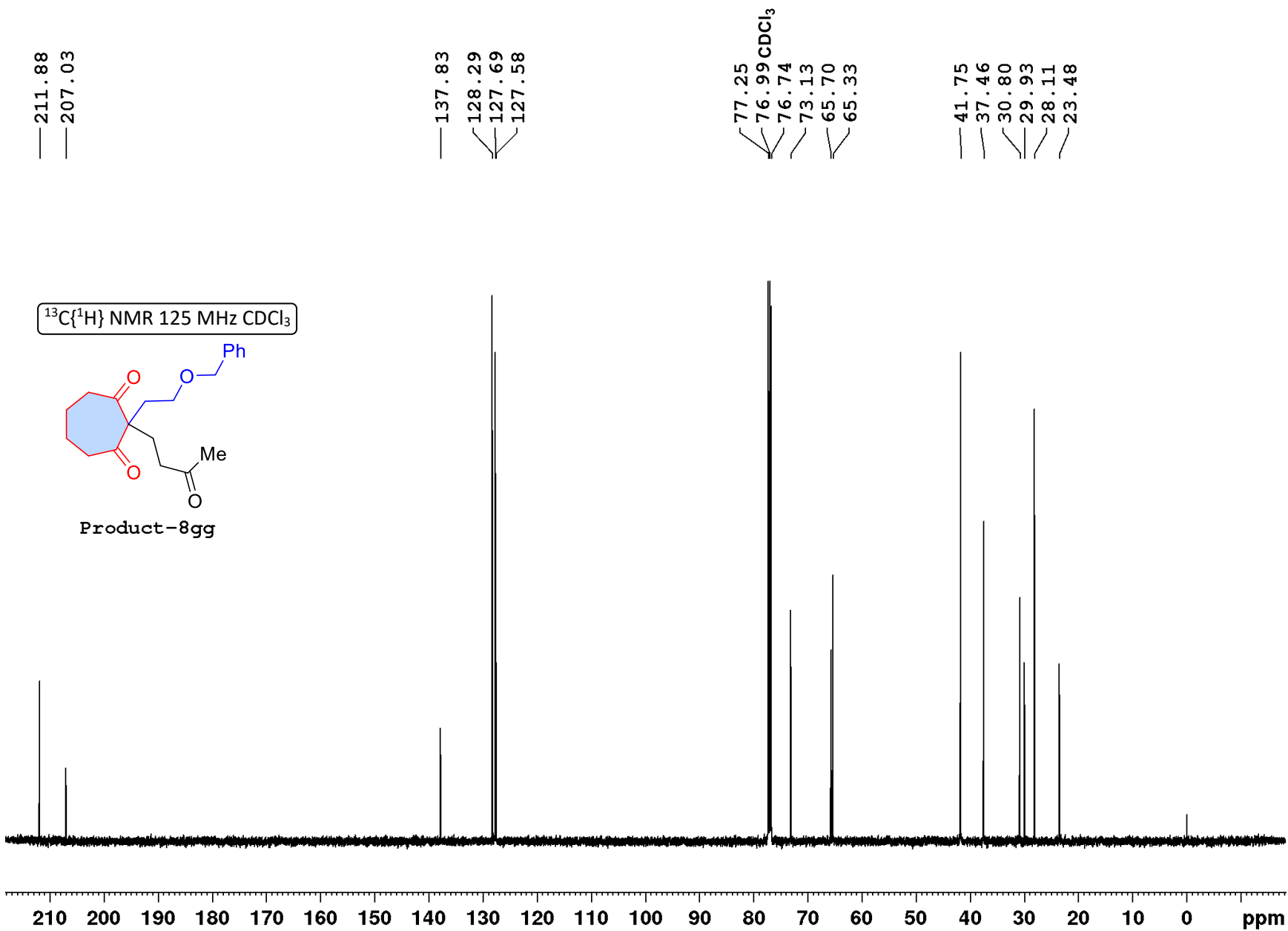


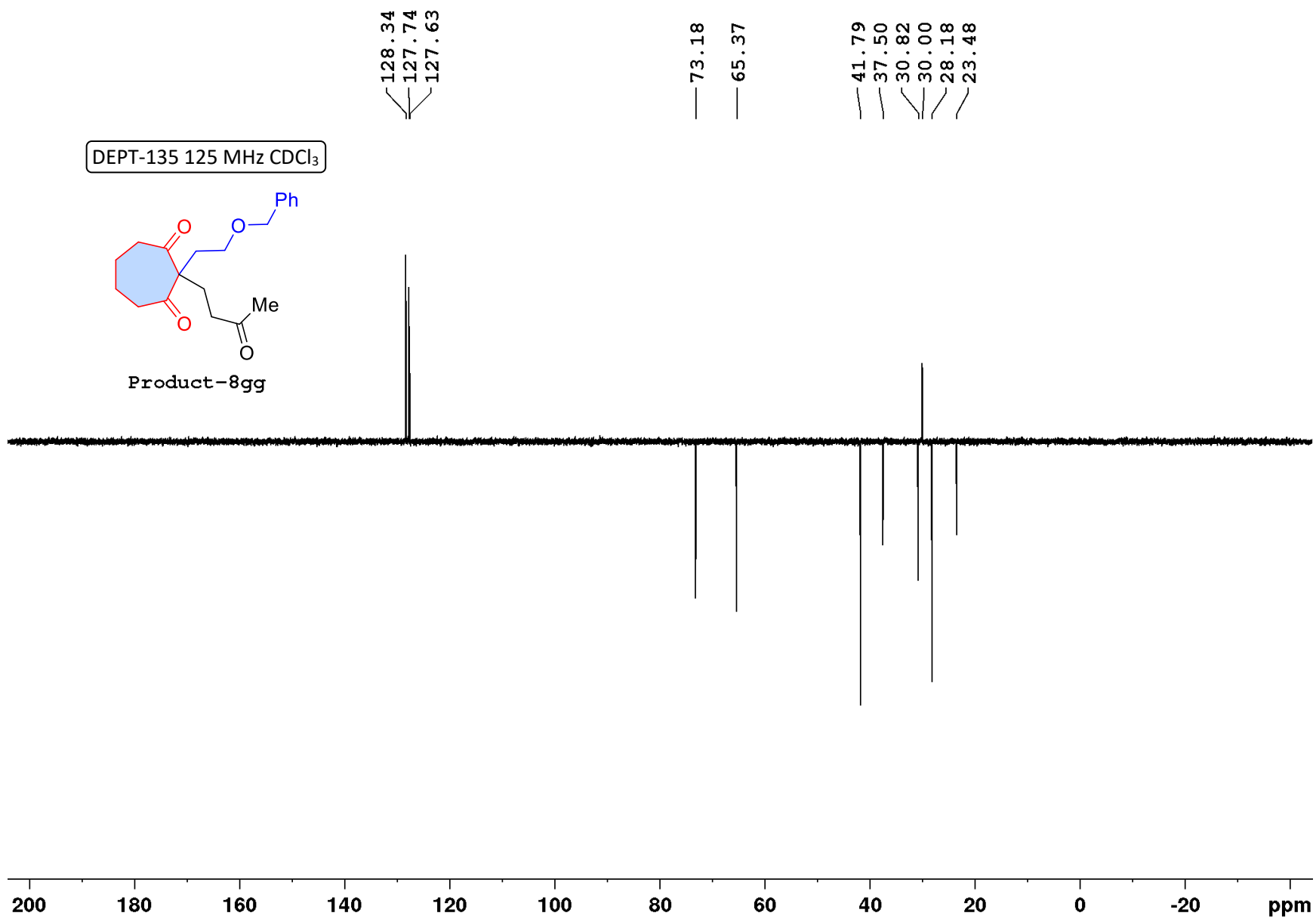
¹H NMR 500 MHz CDCl₃



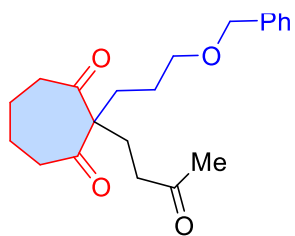
Product-8gg



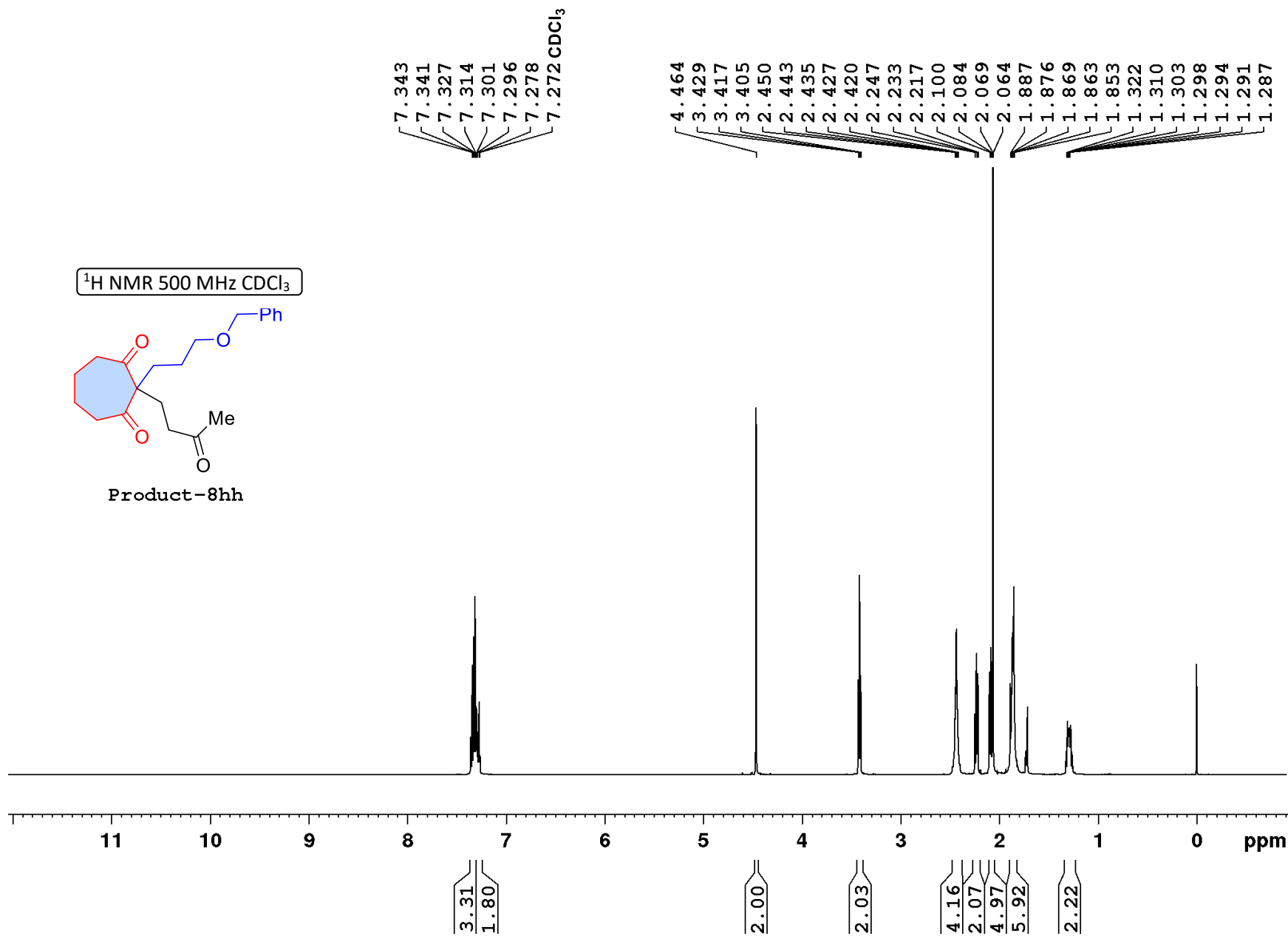




¹H NMR 500 MHz CDCl₃



Product-8hh



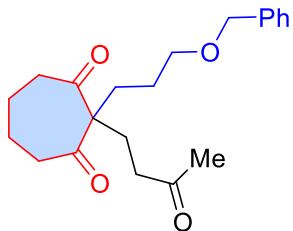
— 212.12
— 207.08

— 138.32
— 128.31
— 127.50

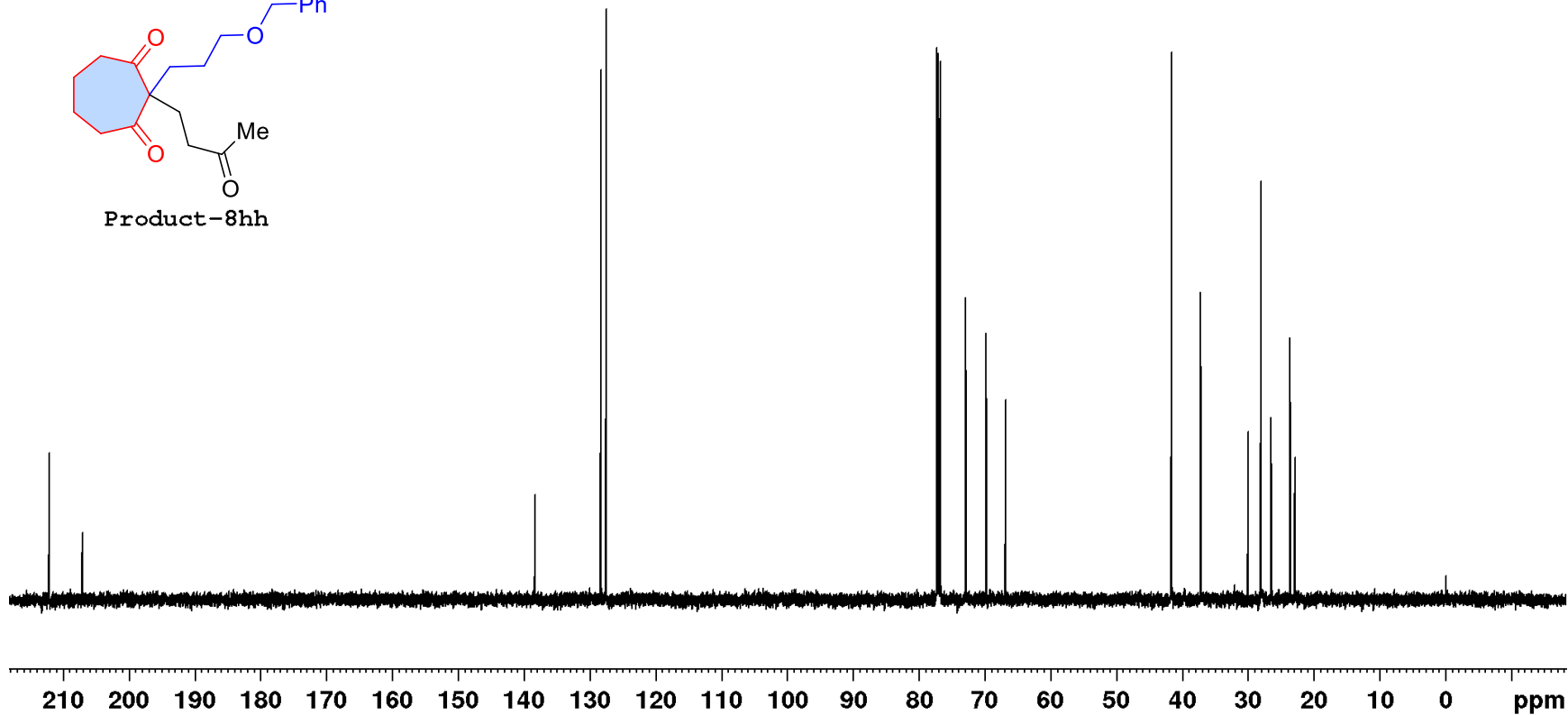
77.25
76.99 CDCl₃
76.74
72.87
69.79
66.81

— 41.60
— 37.18
— 29.95
— 28.03
— 26.48
— 23.62
— 22.87

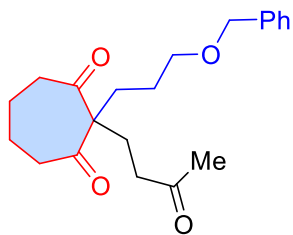
¹³C{¹H} NMR 125 MHz CDCl₃



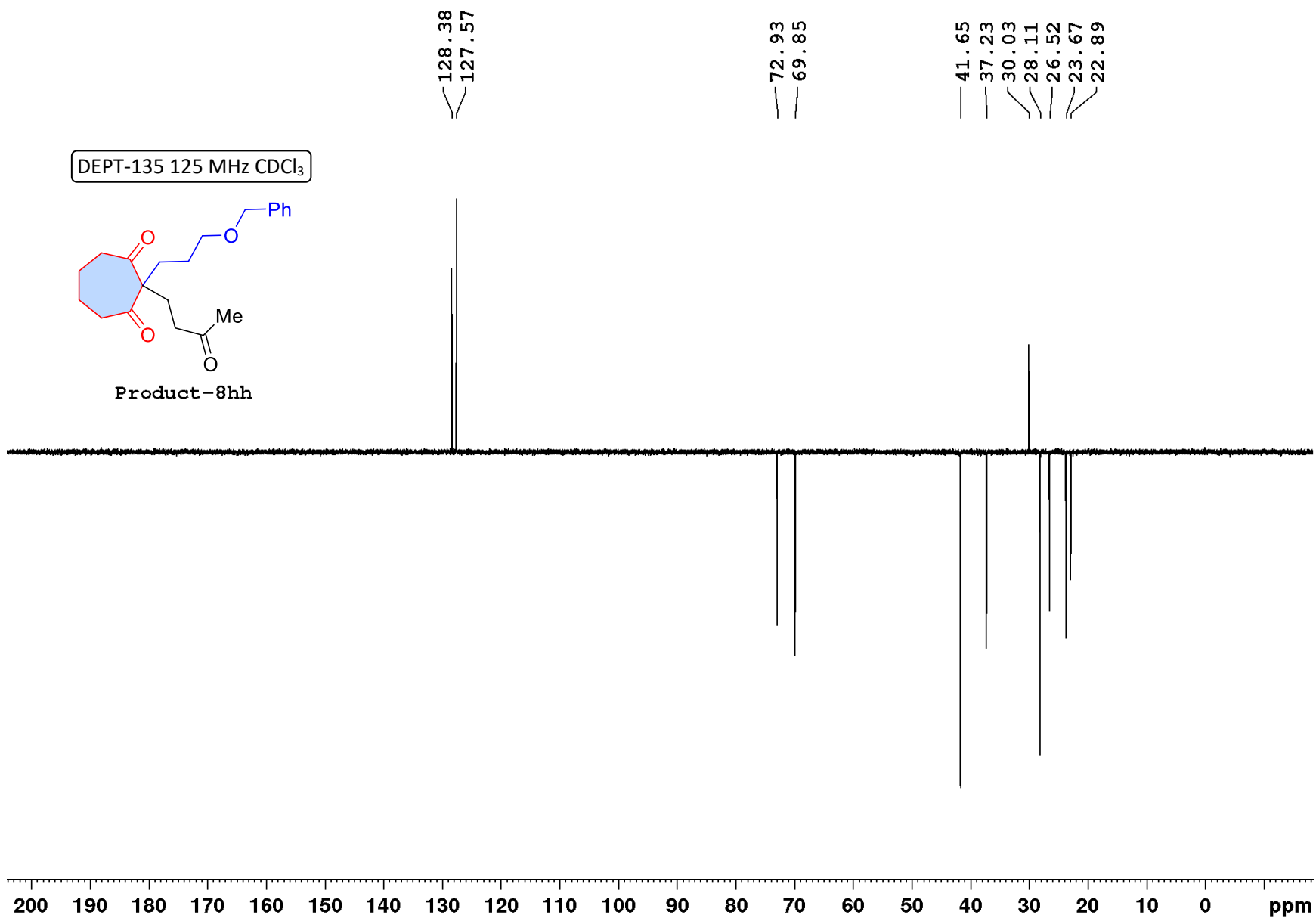
Product-8hh



DEPT-135 125 MHz CDCl₃

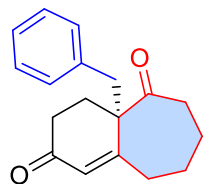


Product-8hh

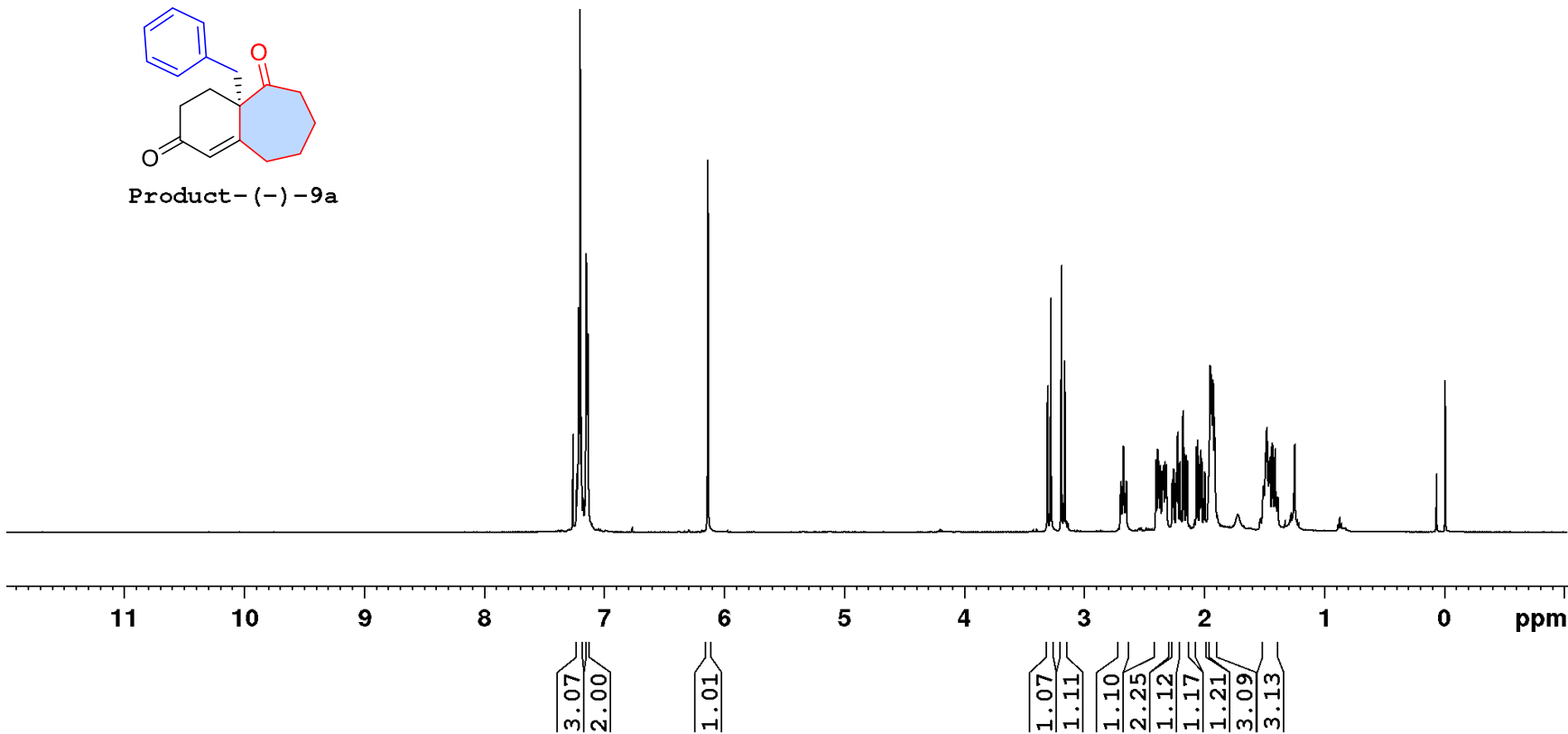


7.260 CDCl₃
 7.213
 7.210
 7.203
 7.199
 7.196
 7.189
 7.187
 7.150
 7.145
 7.141
 7.134
 7.131
 6.135
 3.303
 3.276
 3.188
 3.161
 2.673
 2.671
 2.399
 2.386
 2.376
 2.326
 2.221
 2.218
 2.201
 2.175
 2.164
 2.149
 2.138
 2.063
 2.051
 2.029
 2.025
 2.018
 1.952
 1.948
 1.941
 1.937
 1.933
 1.929
 1.926
 1.923
 1.915
 1.910
 1.488
 1.485
 1.477
 1.473
 1.459
 1.456
 1.452
 1.434
 1.431
 1.428
 1.410
 1.406

¹H NMR 500 MHz CDCl₃



Product (-)-9a



—211.15

—197.58

—165.14

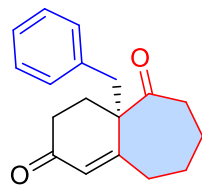
137.35
130.62
130.28
128.30
126.85

77.25
76.99 CDCl₃
76.74

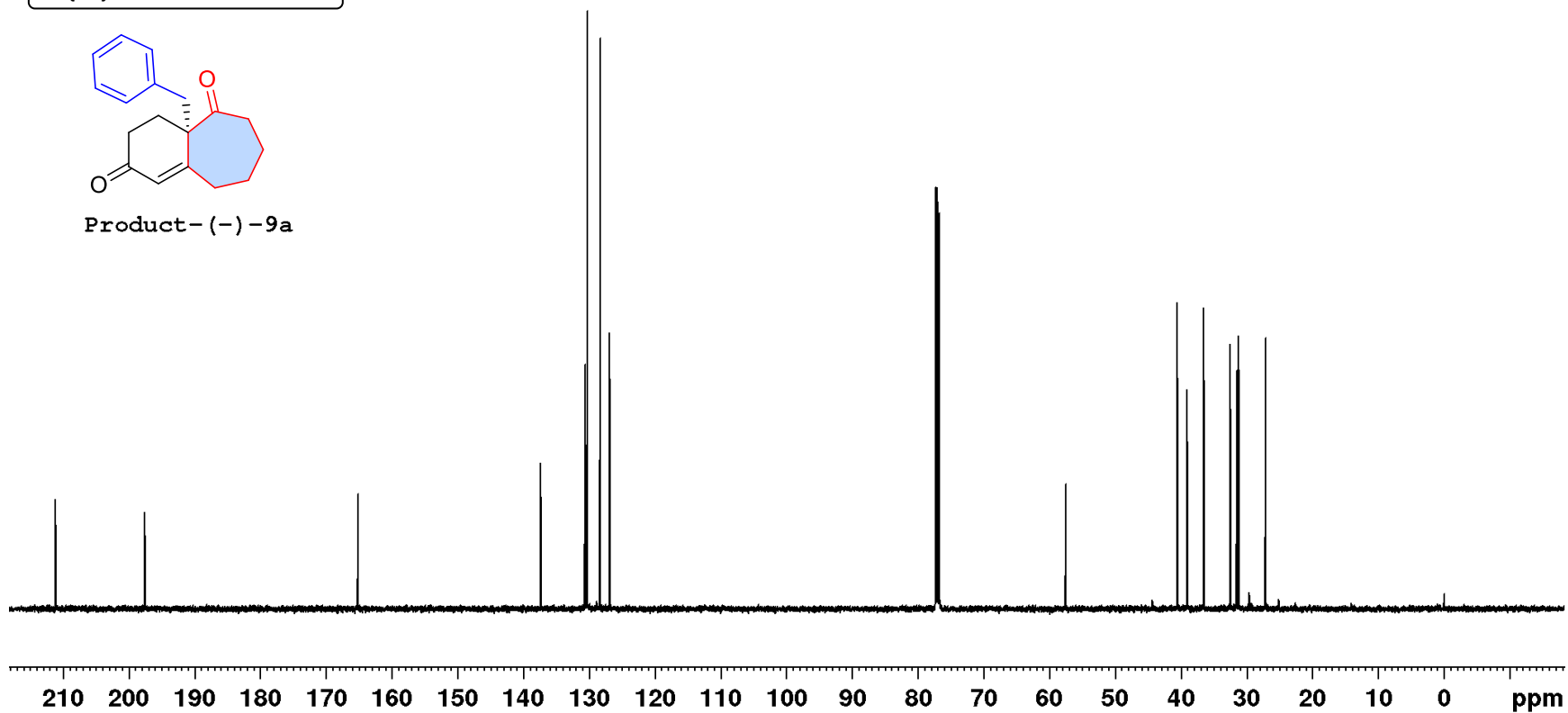
—57.49

40.54
39.03
36.49
32.49
31.48
31.17
27.09

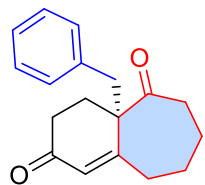
¹³C{¹H} NMR 125 MHz CDCl₃



Product-(-)-9a



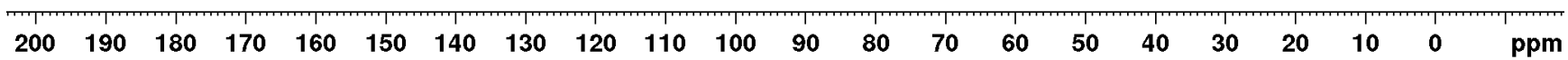
DEPT-135 125 MHz CDCl₃



Product-(-)-9a

130.67
130.32
128.36
126.91

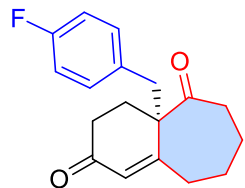
40.60
39.06
36.55
32.54
31.54
31.21
27.16



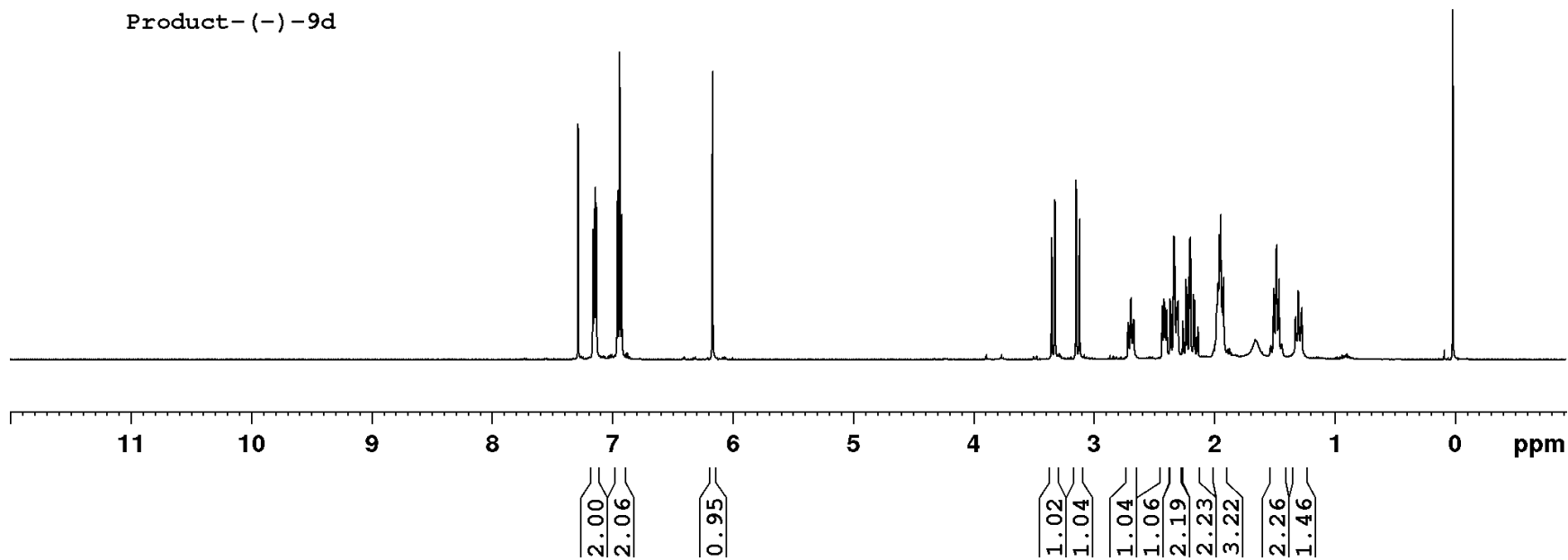
7.284CDCl₃

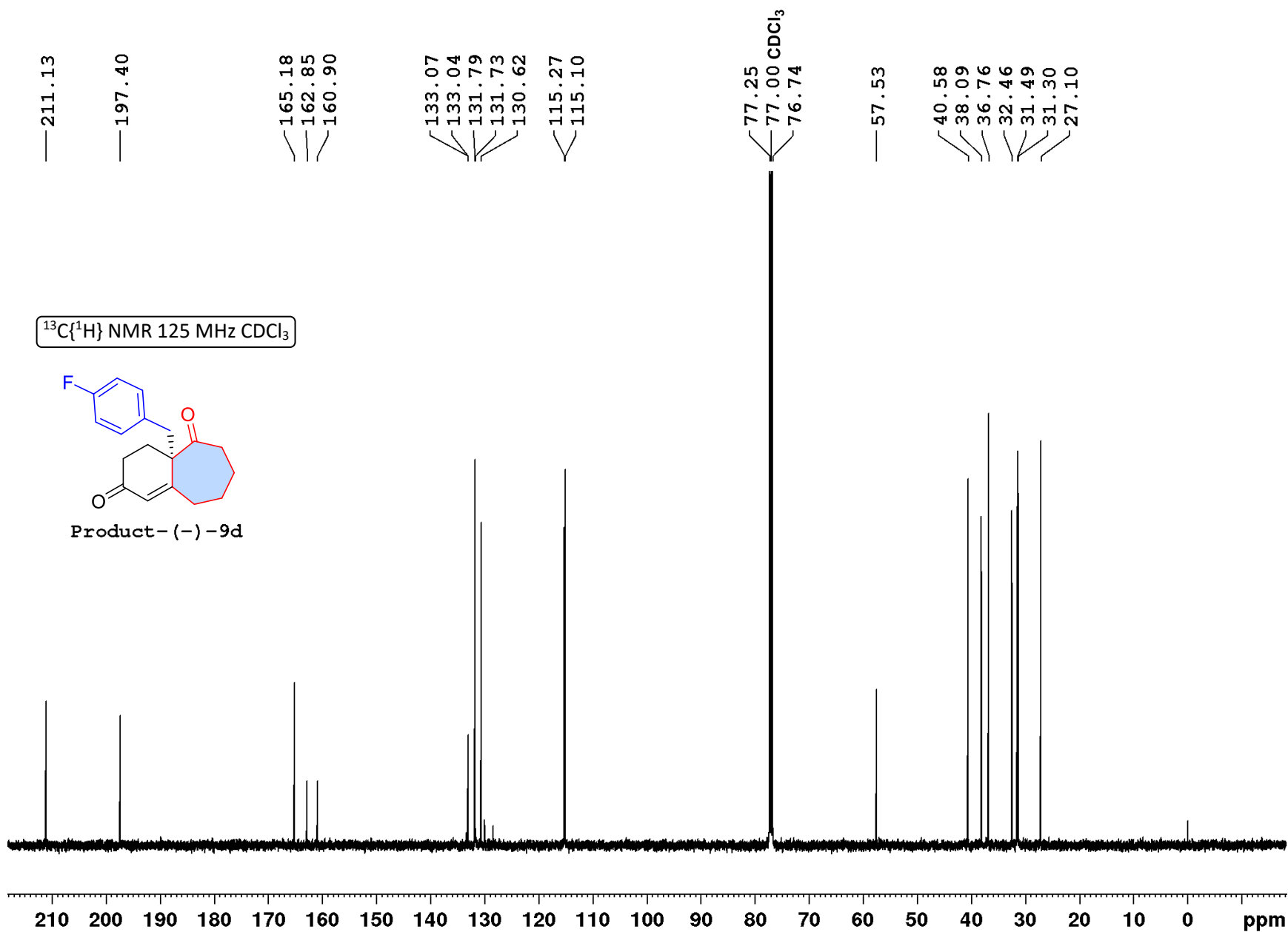
7.162
7.151
7.144
7.138
7.133
6.956
6.943
6.939
6.935
6.922
6.167
3.349
3.322
3.146
3.119
2.690
2.687
2.430
2.416
2.407
2.393
2.365
2.361
2.356
2.336
2.333
2.323
2.311
2.301
2.233
2.223
2.206
2.202
2.198
2.193
2.171
2.166
2.160
1.977
1.974
1.969
1.966
1.955
1.950
1.945
1.941
1.930
1.925
1.919
1.504
1.485
1.481
1.461
1.301
1.296
1.276
1.271

¹H NMR 500 MHz CDCl₃

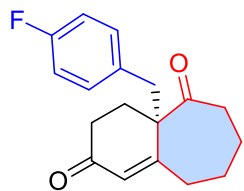


Product-(-)-9d





DEPT-135 125 MHz CDCl₃

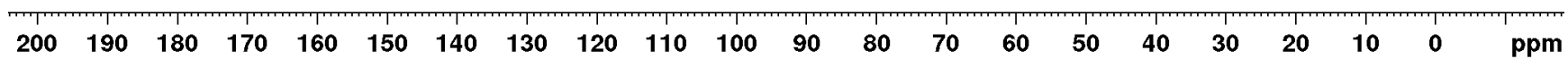


Product-(-)-9d

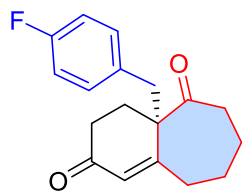
131.83
131.77
130.66

115.32
115.15

40.62
38.12
36.81
32.50
31.54
31.33
27.16

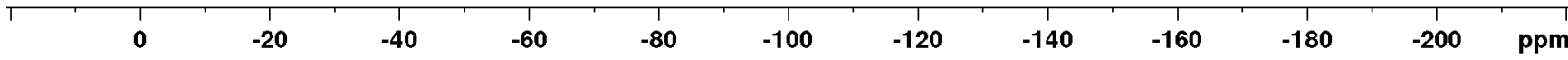


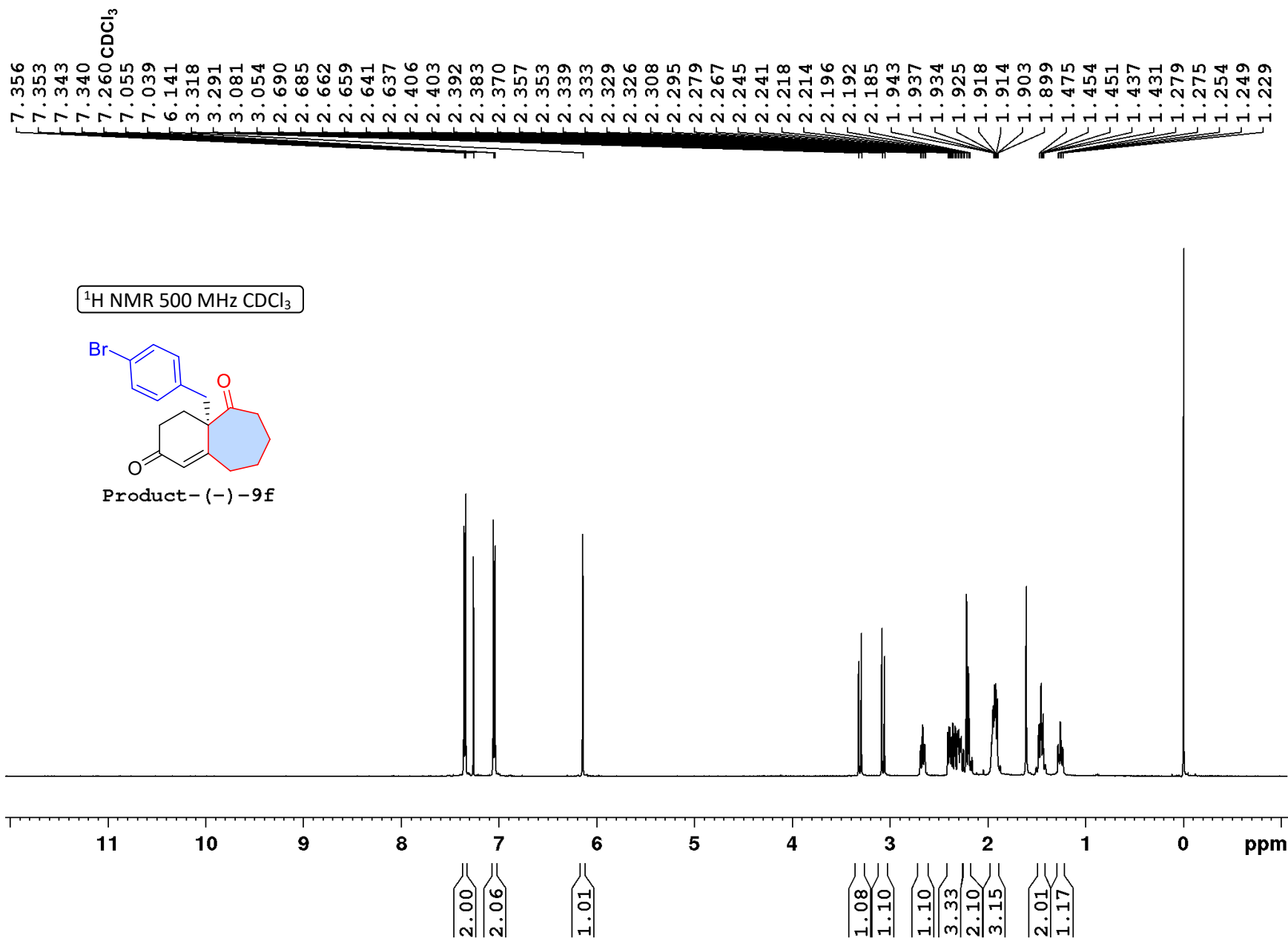
¹⁹F NMR 375 MHz CDCl₃

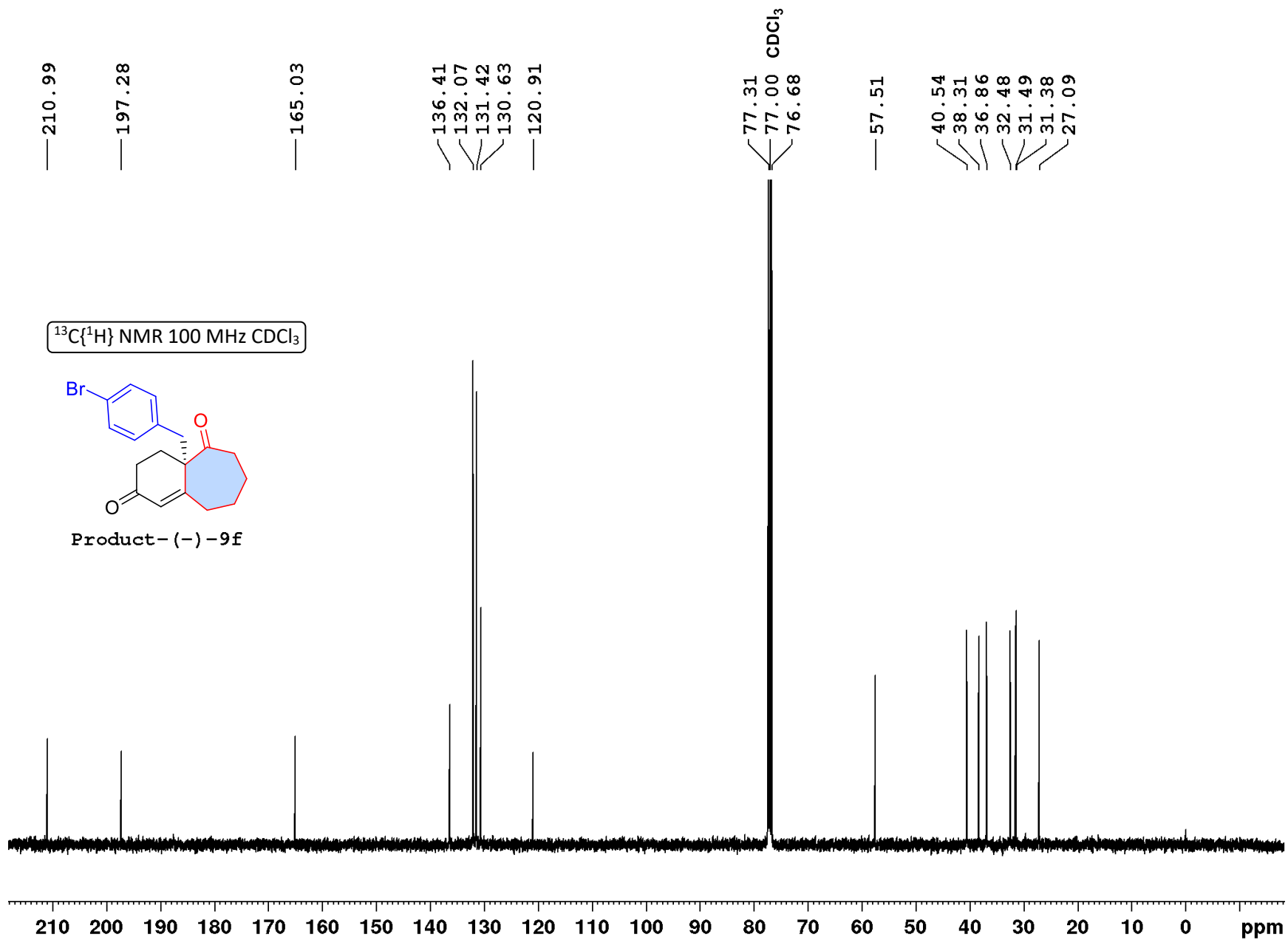


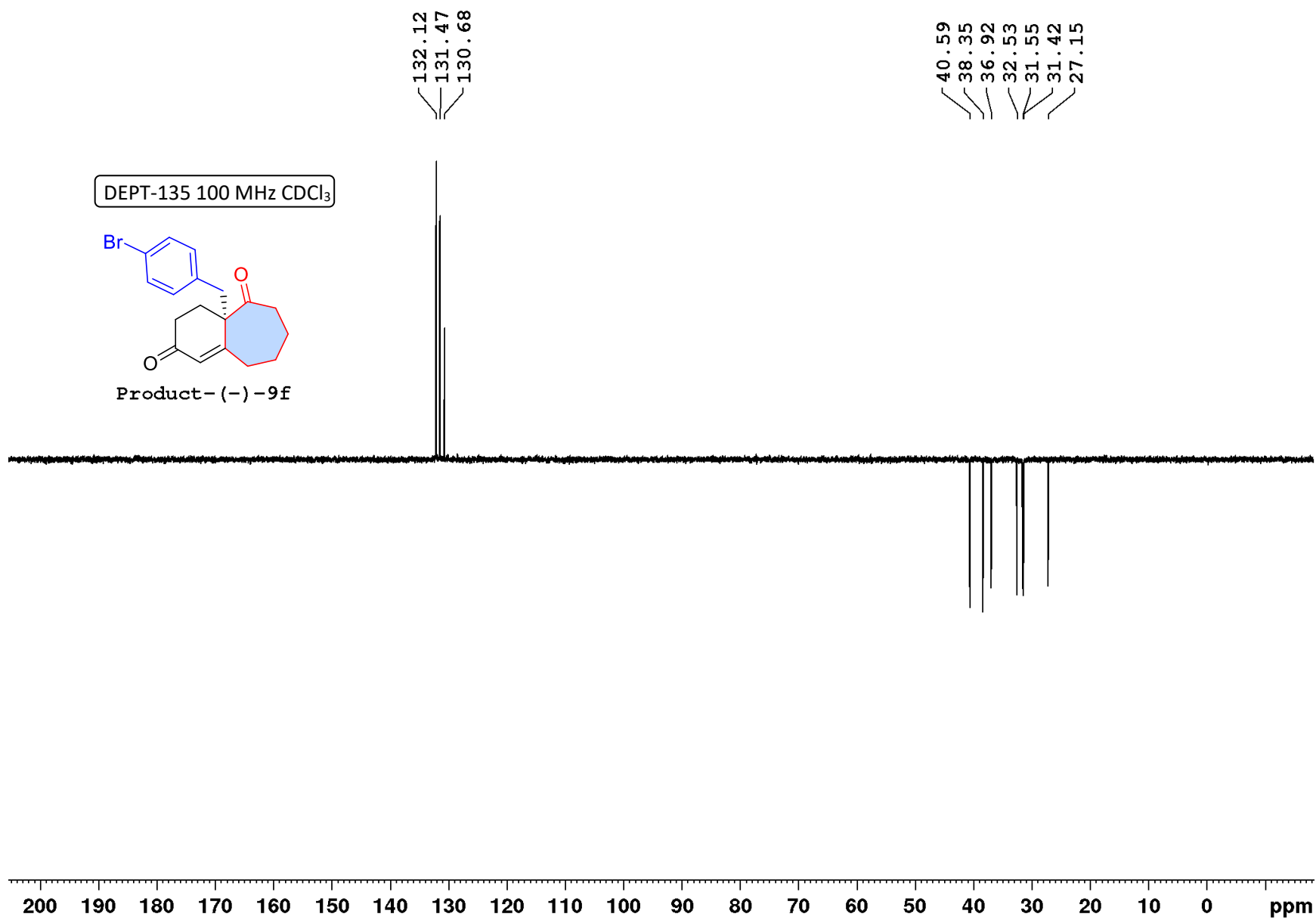
Product-(-)-9d

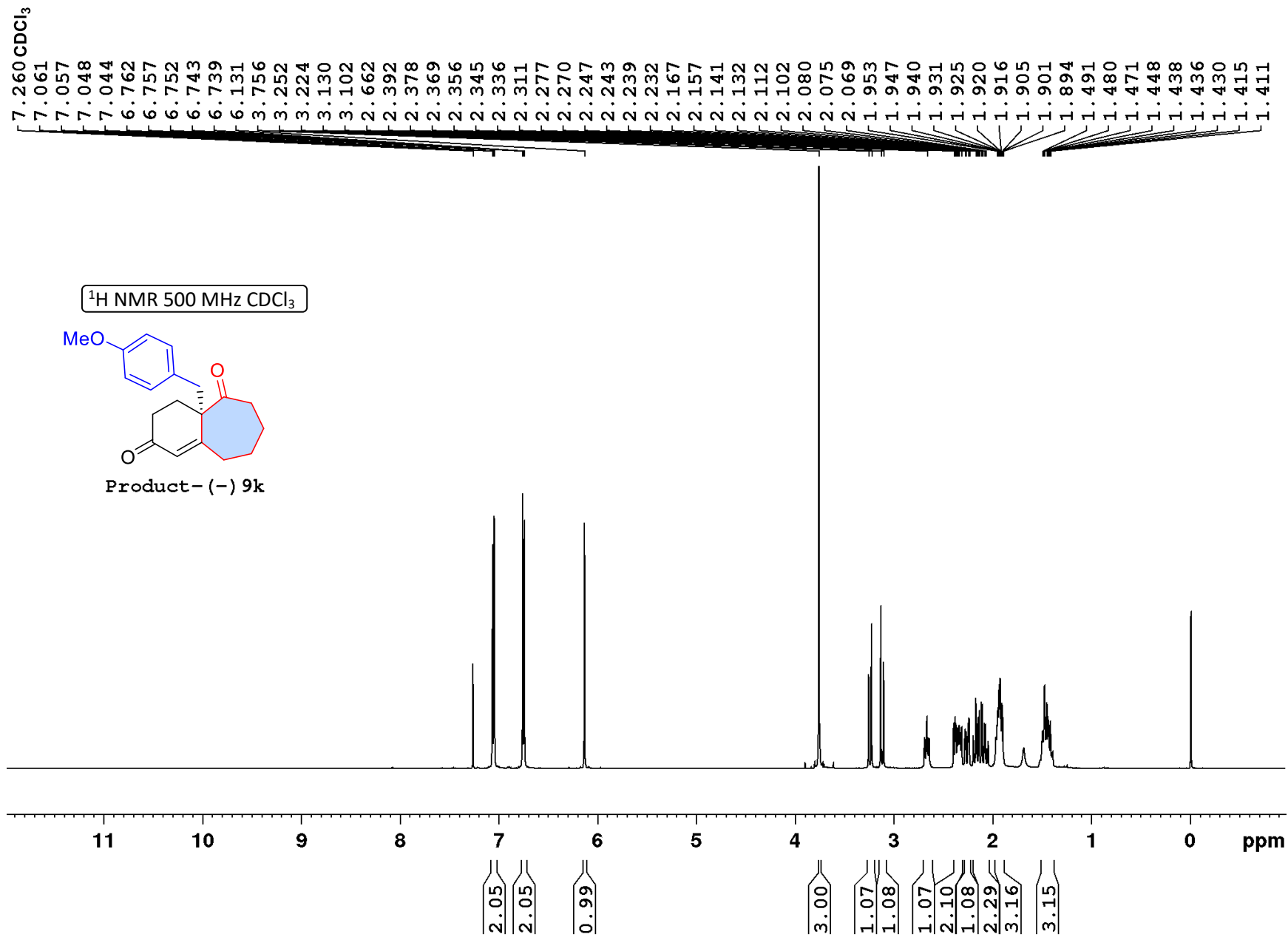
-115.71

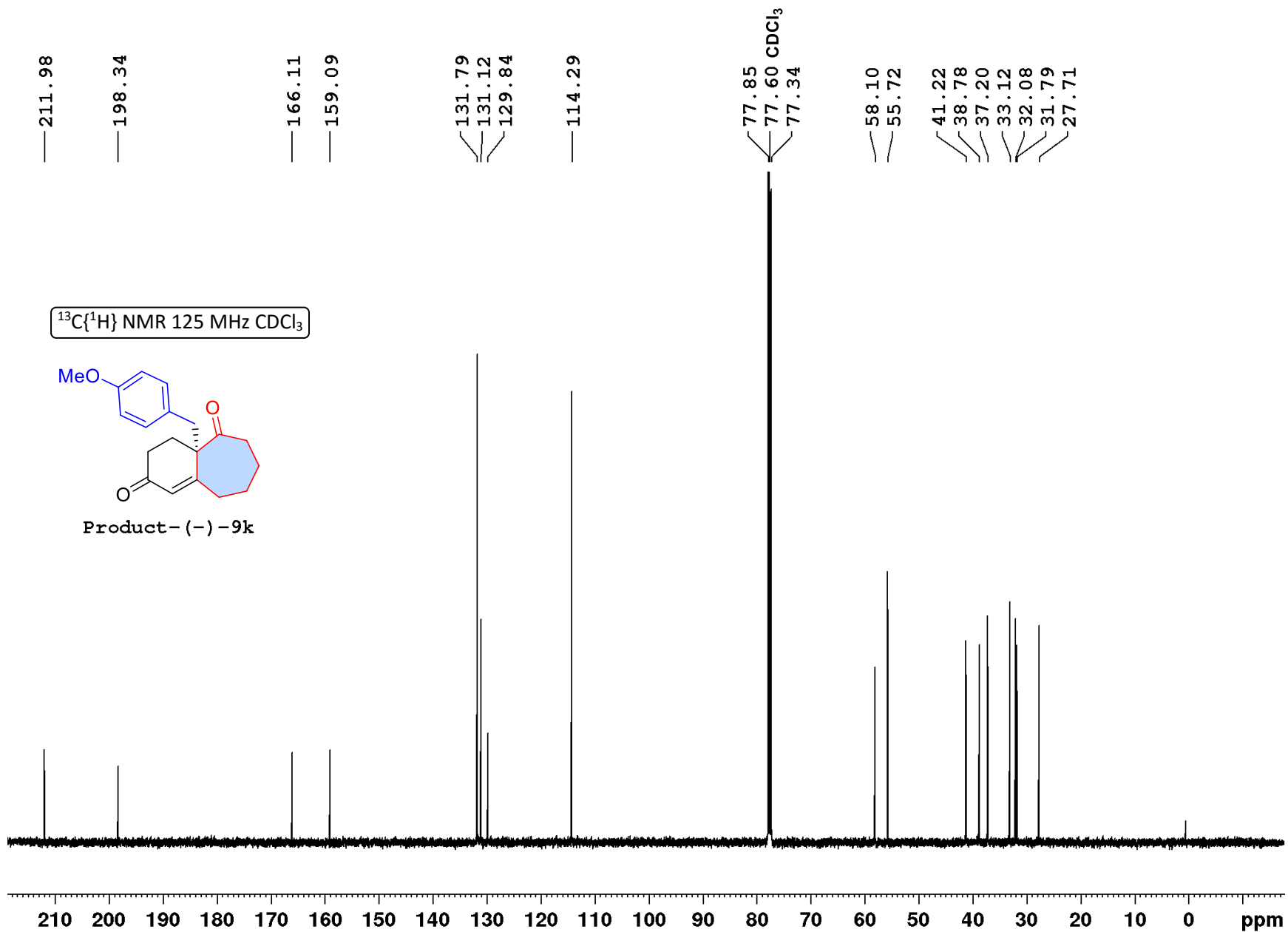




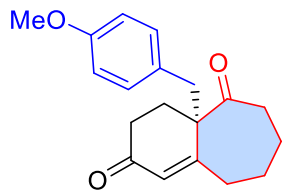




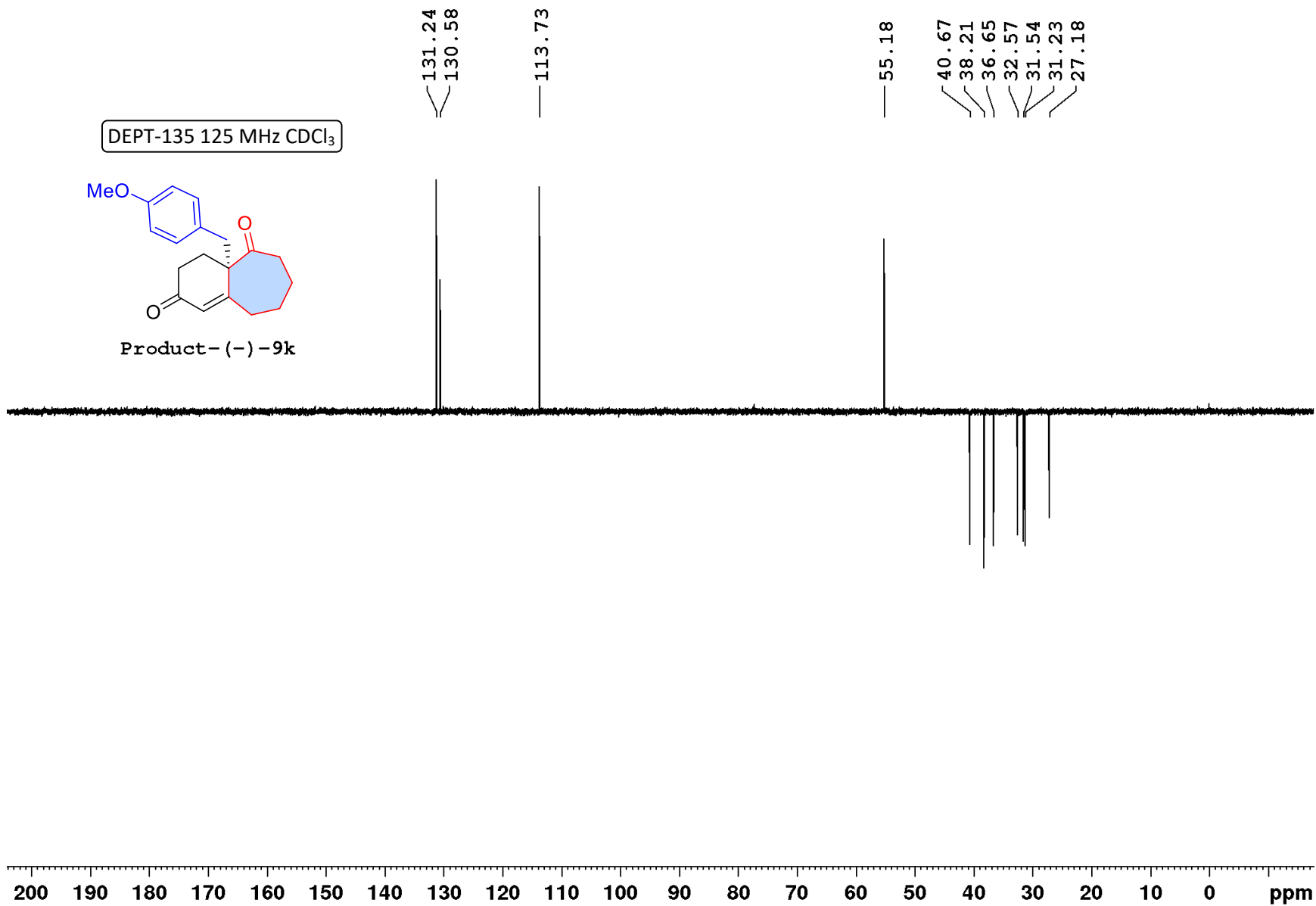


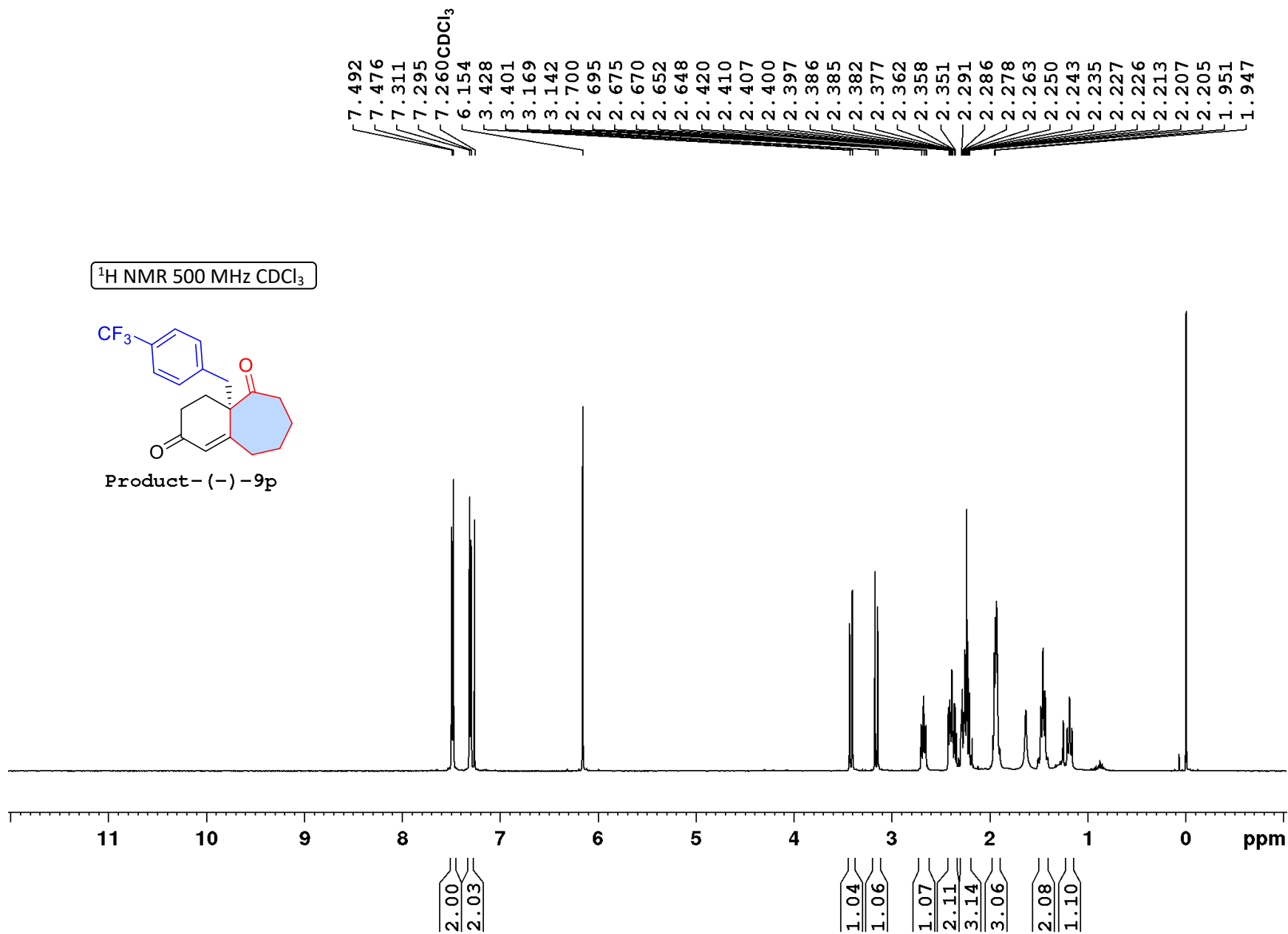


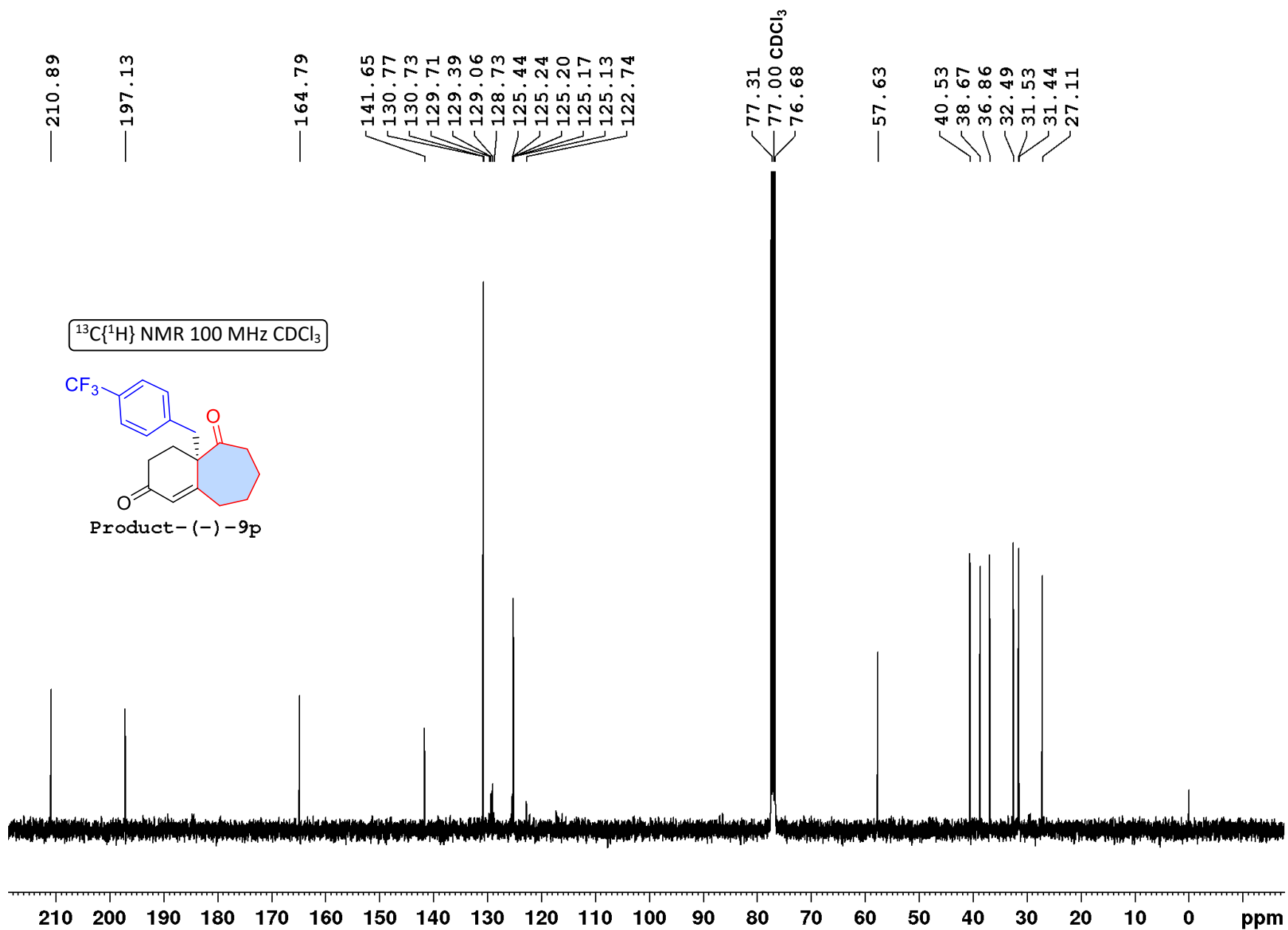
DEPT-135 125 MHz CDCl₃

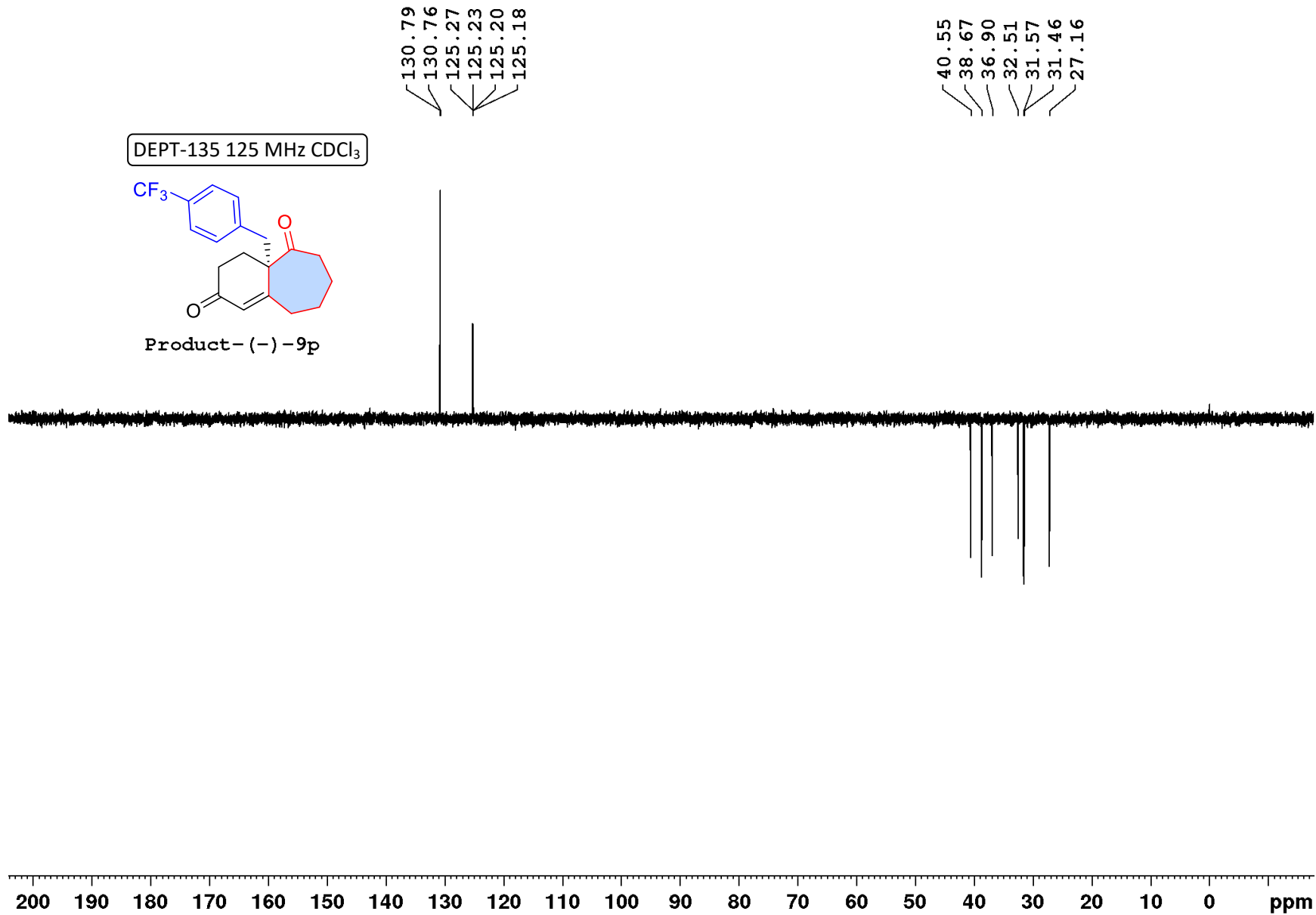


Product - (-) -9k

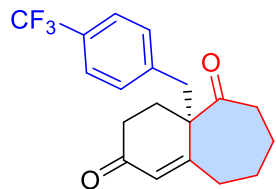






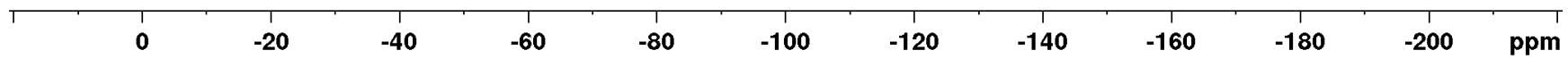


^{19}F NMR 375 MHz CDCl_3



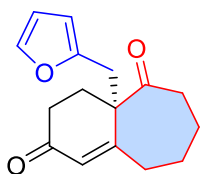
Product - (-)-9p

-62.42

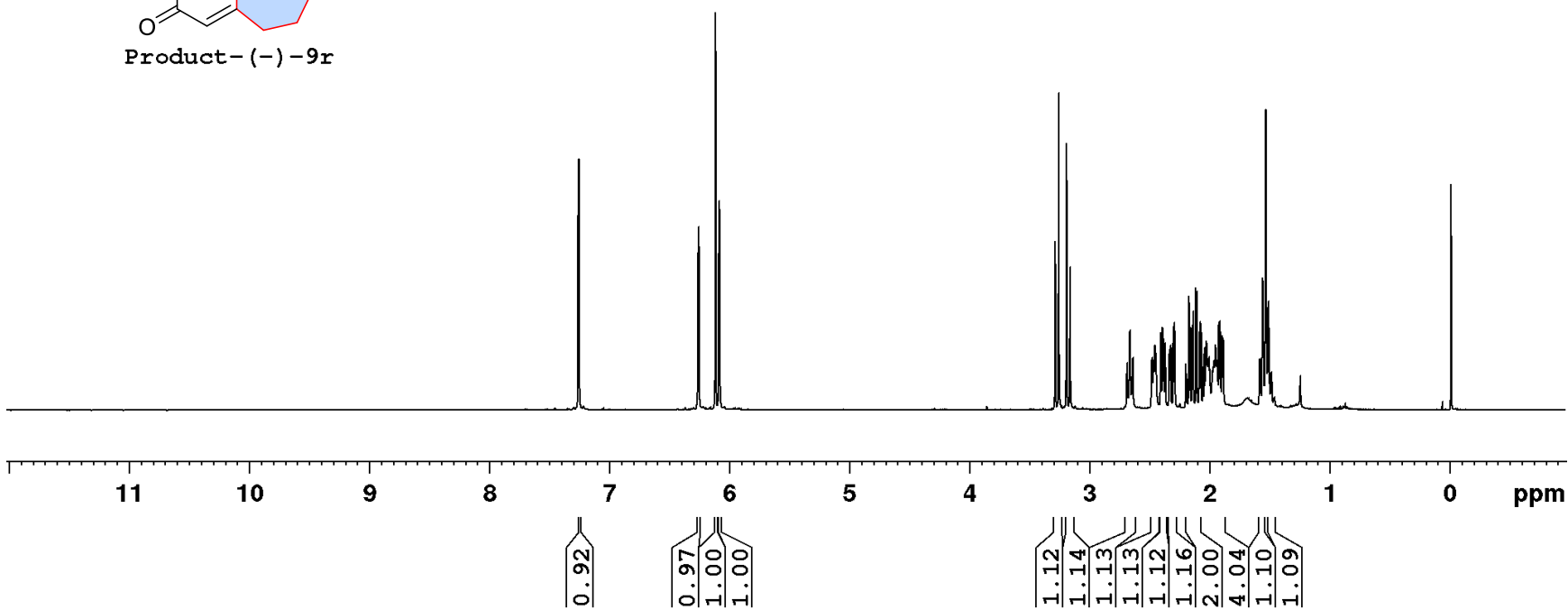


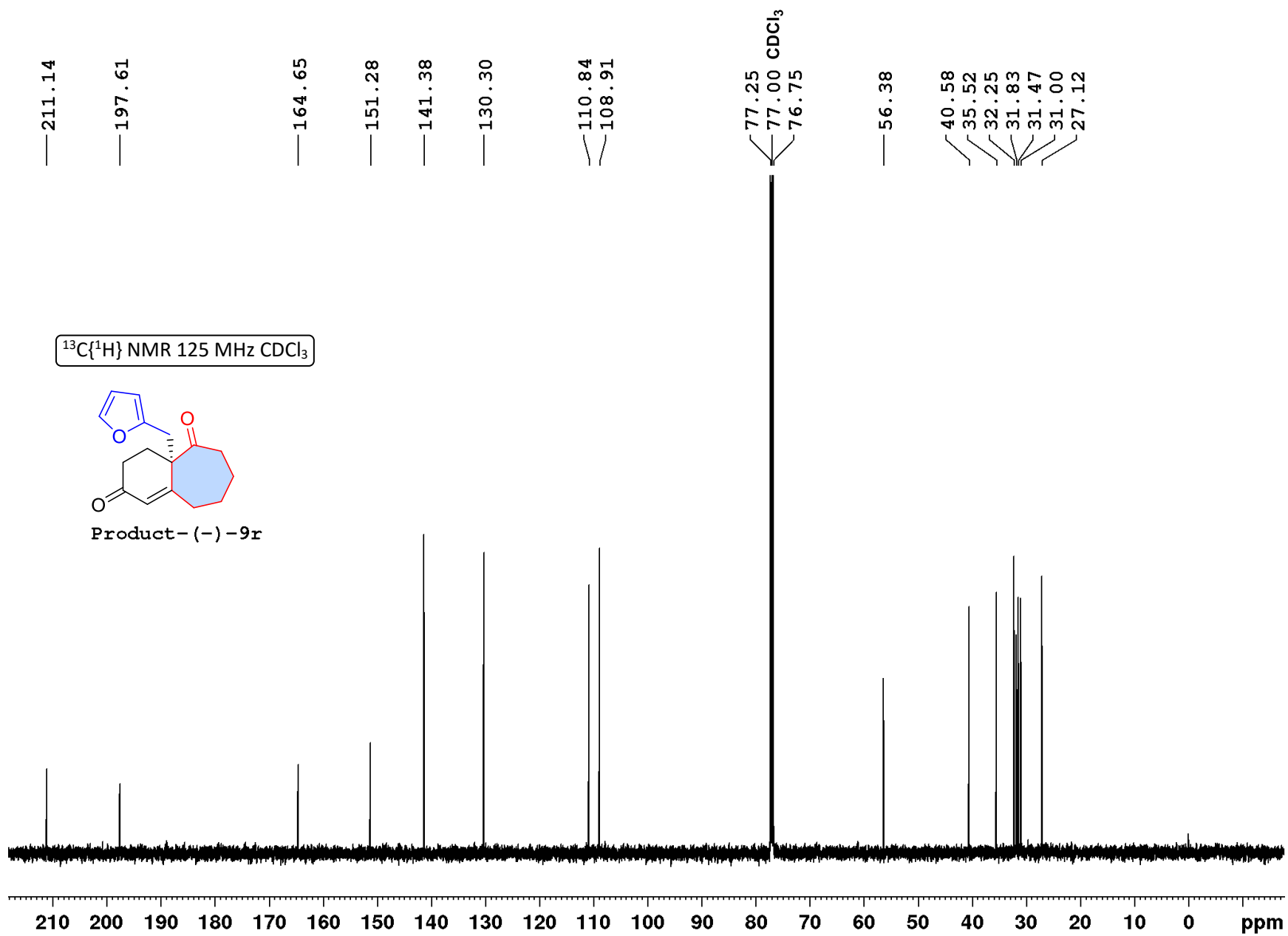
7.260 CDCl₃
 7.256
 7.254
 7.252
 7.251
 6.262
 6.259
 6.256
 6.252
 6.115
 6.086
 6.080
 3.285
 3.255
 3.191
 3.161
 2.665
 2.663
 2.660
 2.454
 2.405
 2.392
 2.382
 2.369
 2.332
 2.327
 2.321
 2.303
 2.297
 2.295
 2.287
 2.171
 2.161
 2.144
 2.135
 2.113
 2.104
 2.080
 2.077
 2.069
 2.043
 2.033
 2.026
 2.022
 1.950
 1.924
 1.917
 1.913
 1.907
 1.897
 1.892
 1.886
 1.882
 1.556
 1.552
 1.515
 1.509
 1.505

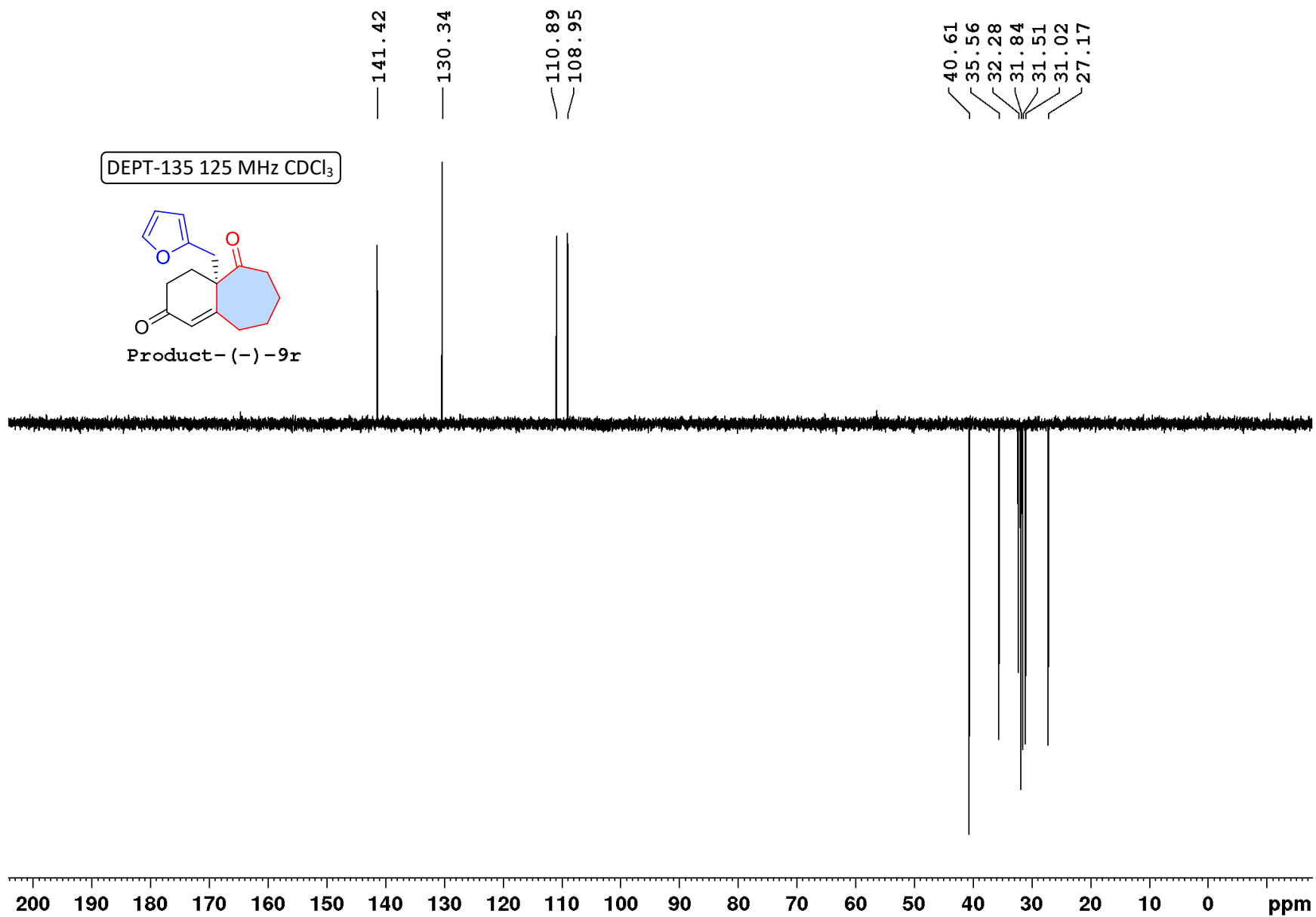
¹H NMR 500 MHz CDCl₃



Product-(-)-9r



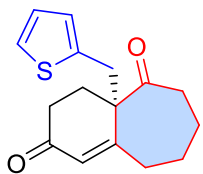




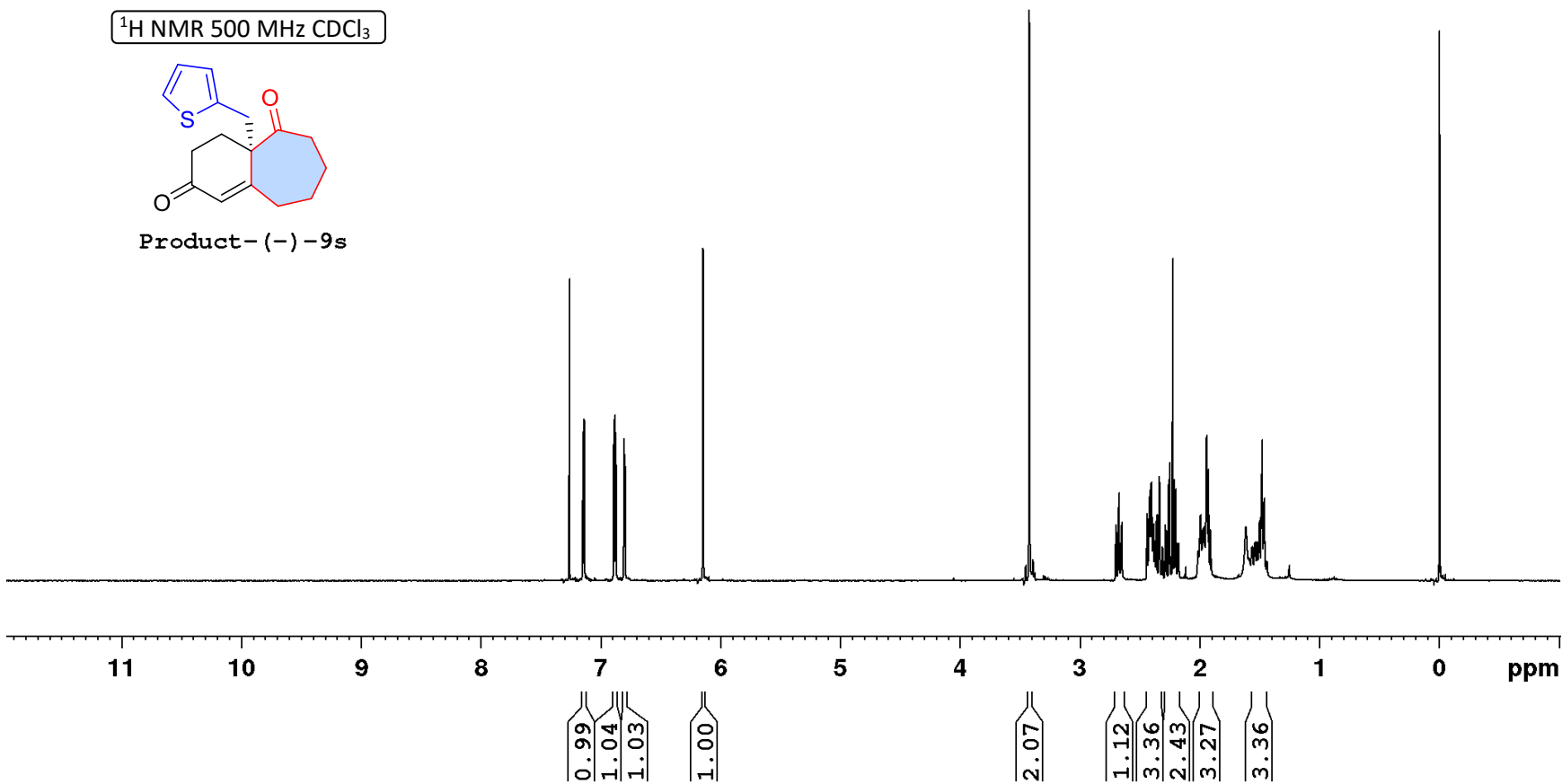
7.260 CDCl₃

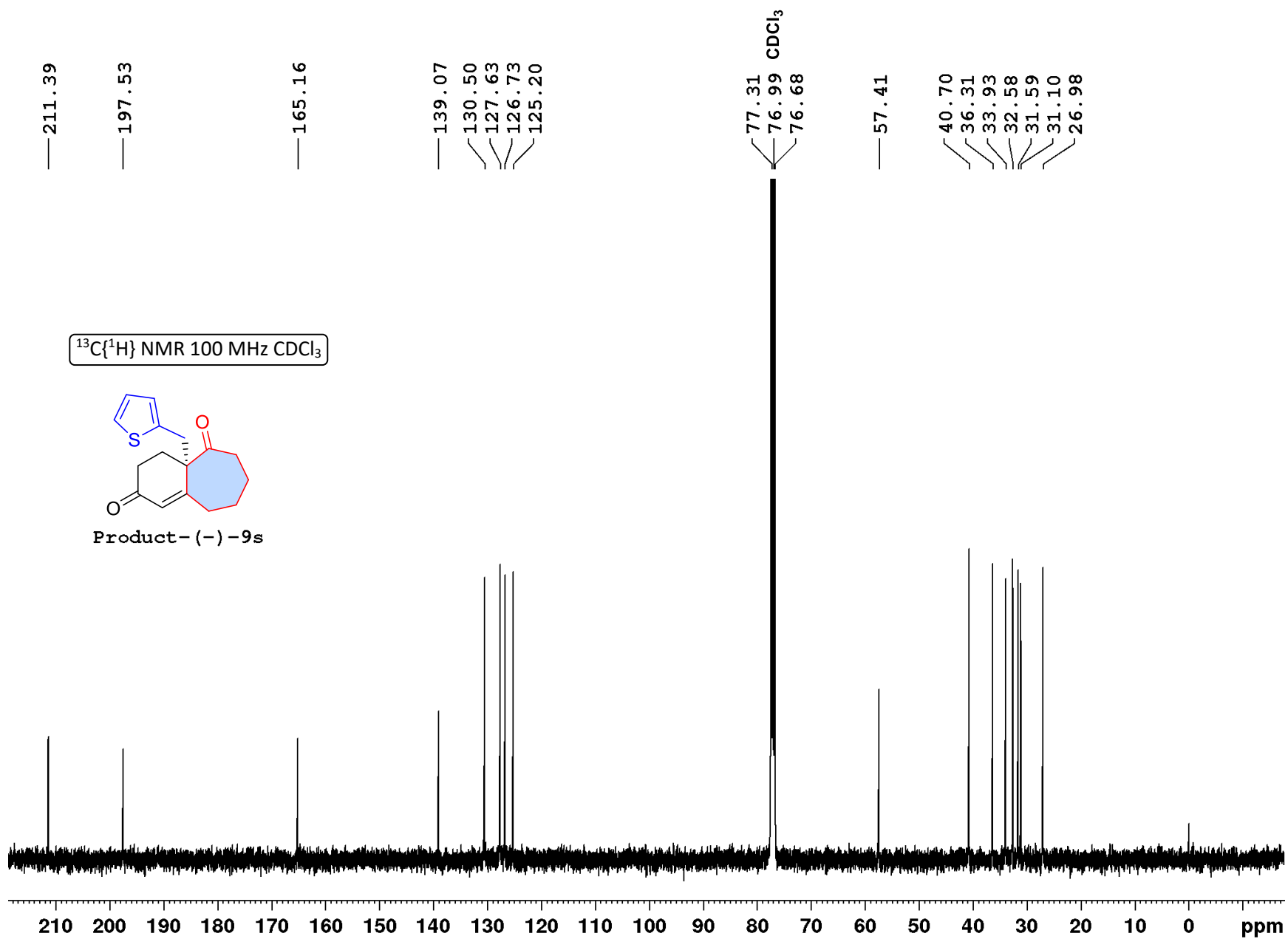
7.147
7.144
7.136
7.134
6.889
6.882
6.879
6.872
6.803
6.797
6.143
3.419
2.693
2.674
2.671
2.669
2.651
2.645
2.435
2.423
2.419
2.413
2.403
2.400
2.396
2.382
2.357
2.338
2.333
2.329
2.282
2.272
2.256
2.246
2.223
2.207
2.197
1.990
1.971
1.965
1.944
1.940
1.934
1.924
1.918
1.909
1.498
1.496
1.494
1.485
1.481
1.476
1.471
1.464
1.462
1.458
1.456

¹H NMR 500 MHz CDCl₃

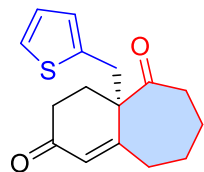


Product-(-)-9s





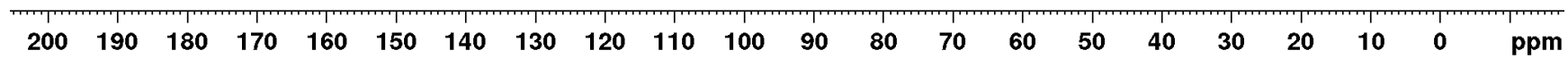
DEPT-135 100 MHz CDCl₃



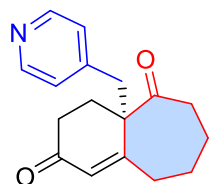
Product-(-)-9s

130.53
127.66
126.76
125.25

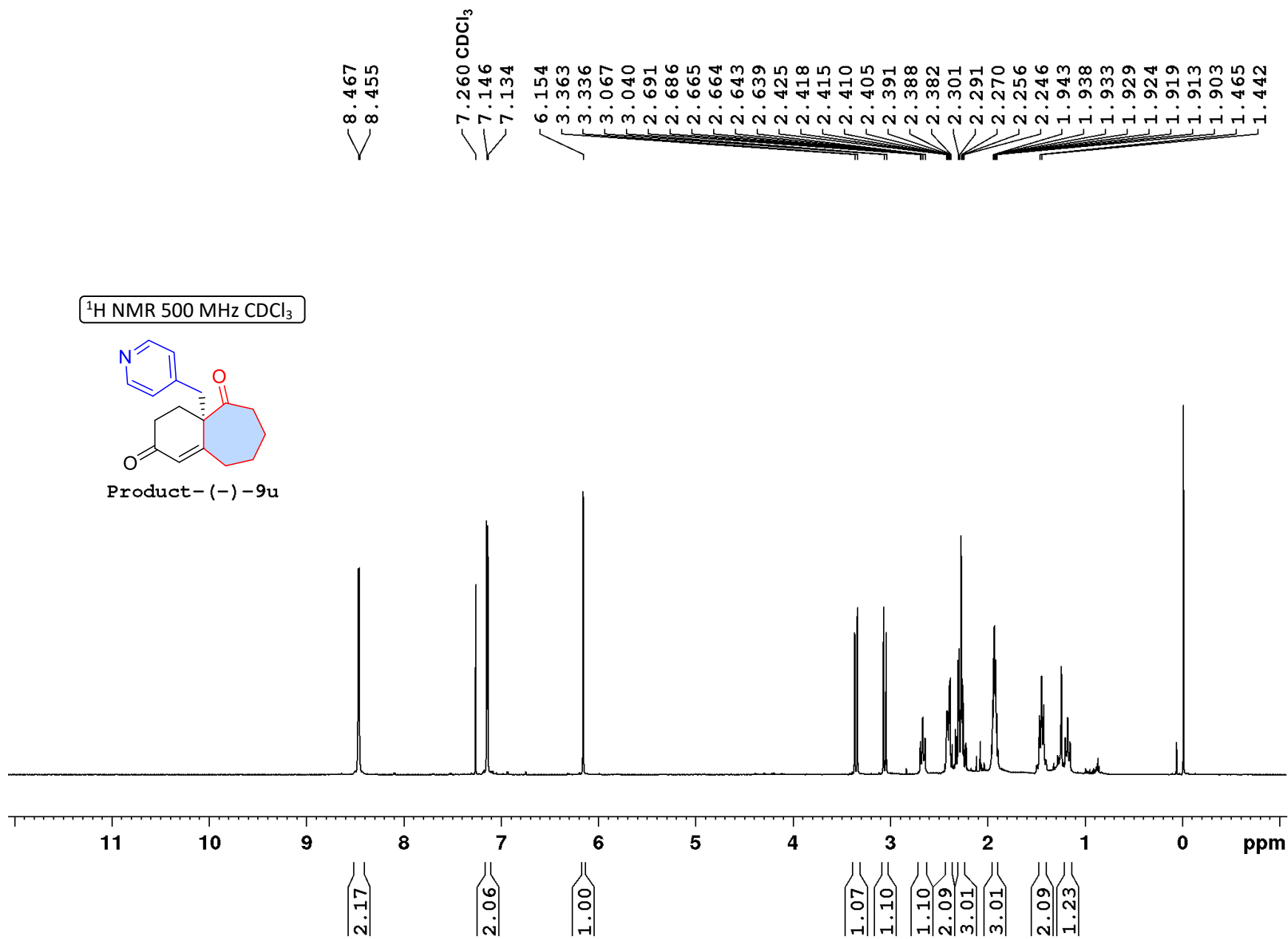
40.73
36.34
33.95
32.61
31.63
31.12
27.03

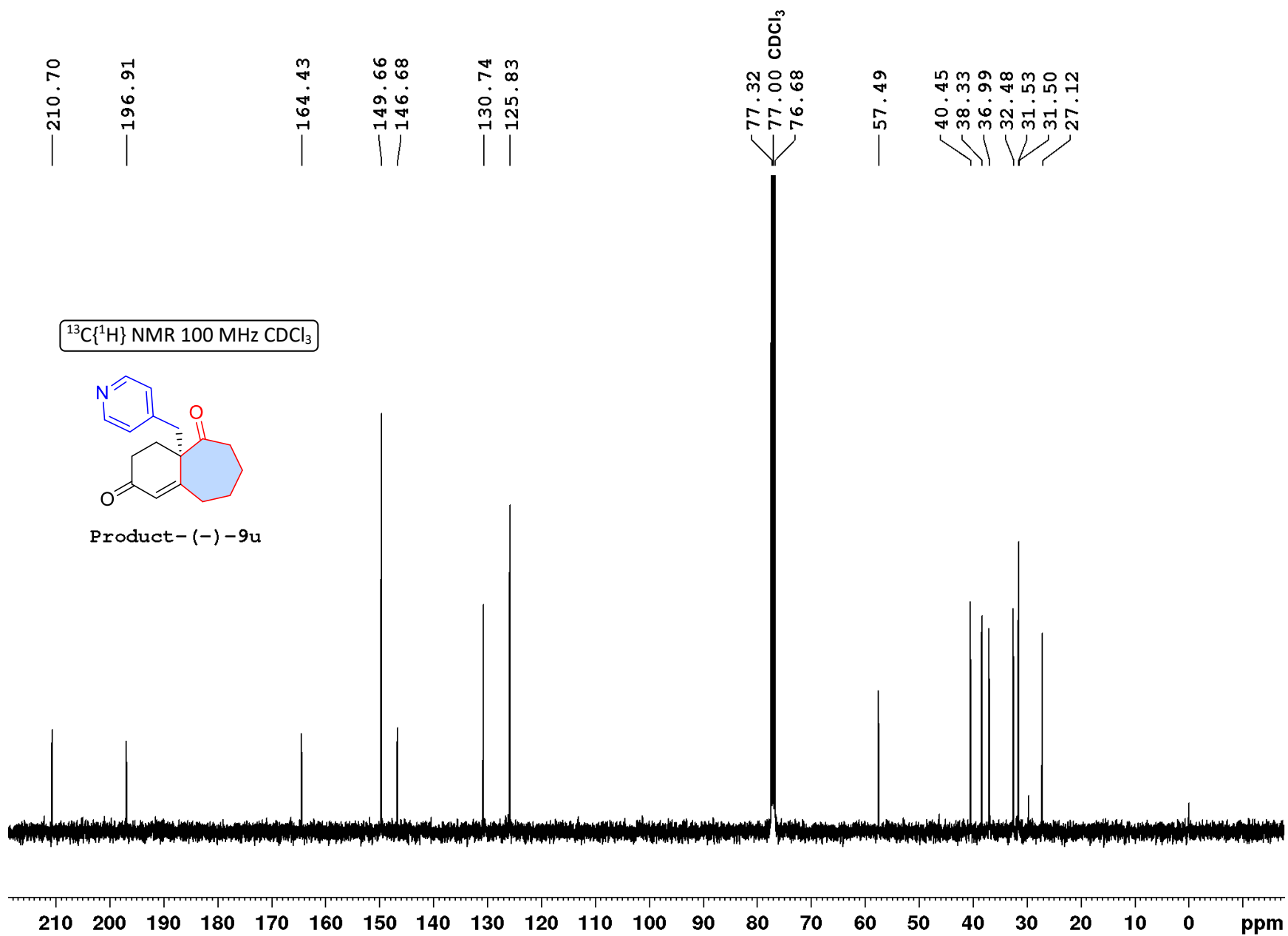


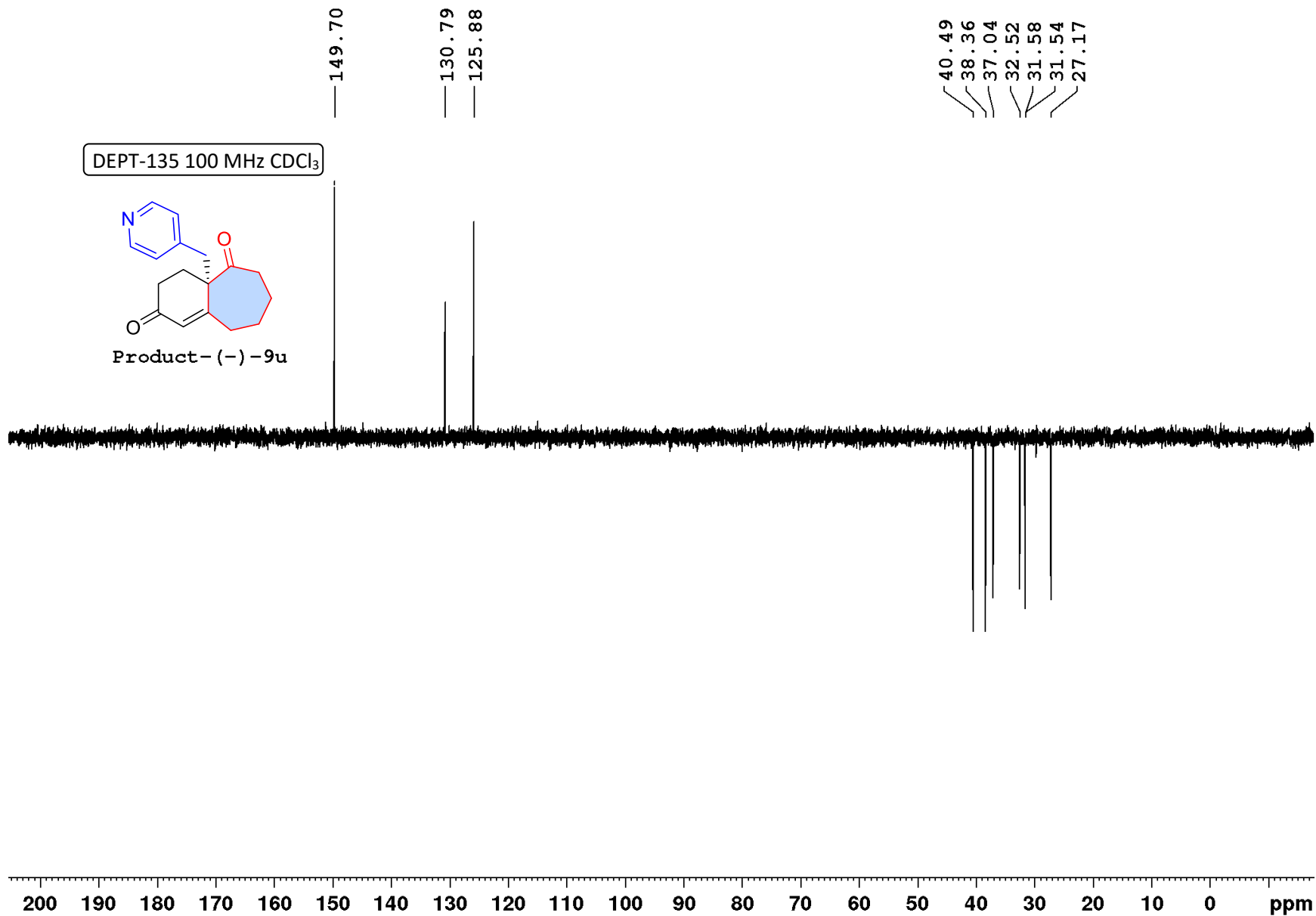
¹H NMR 500 MHz CDCl₃



Product-(-)-9u

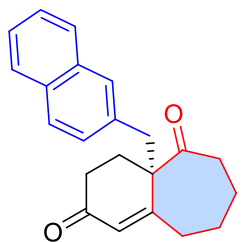




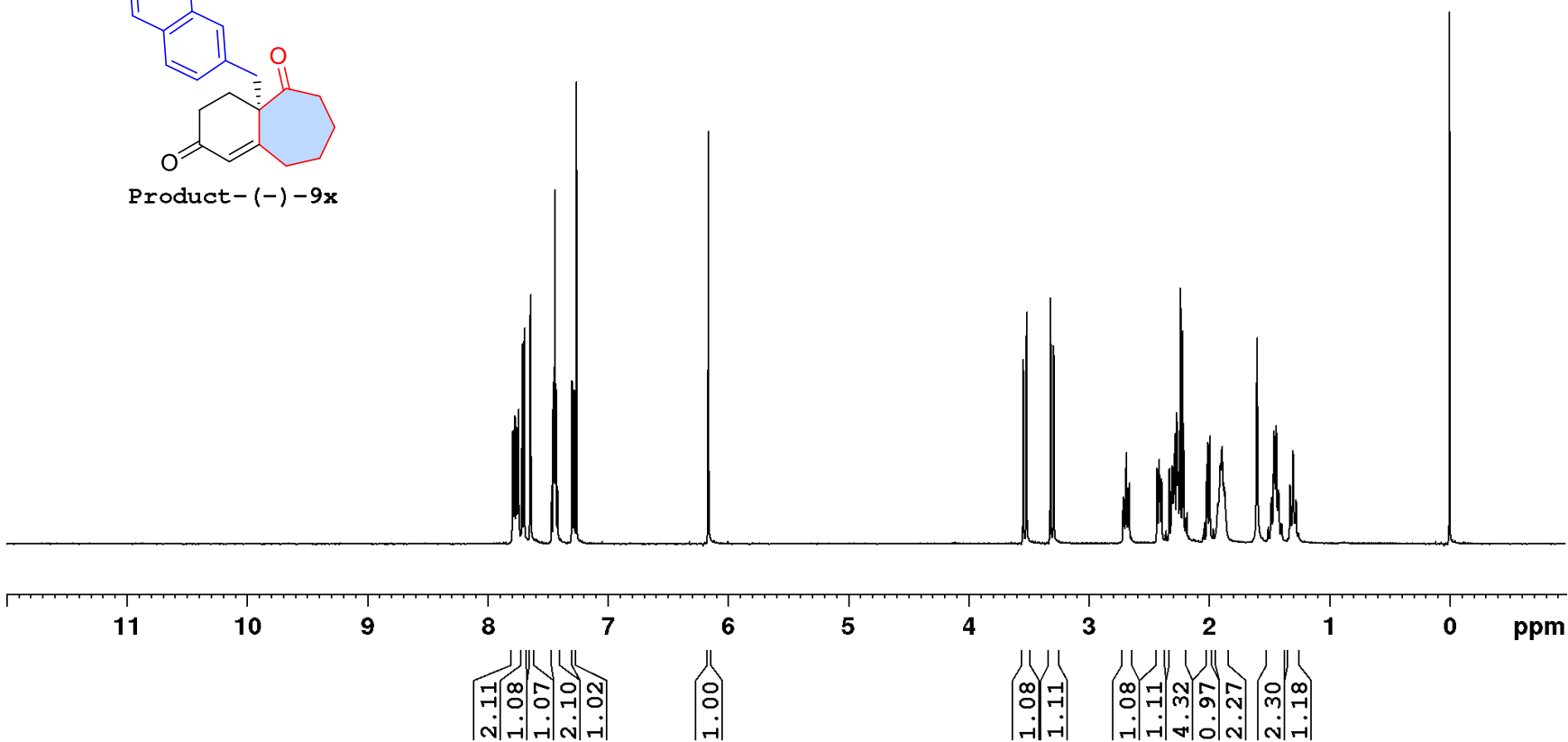


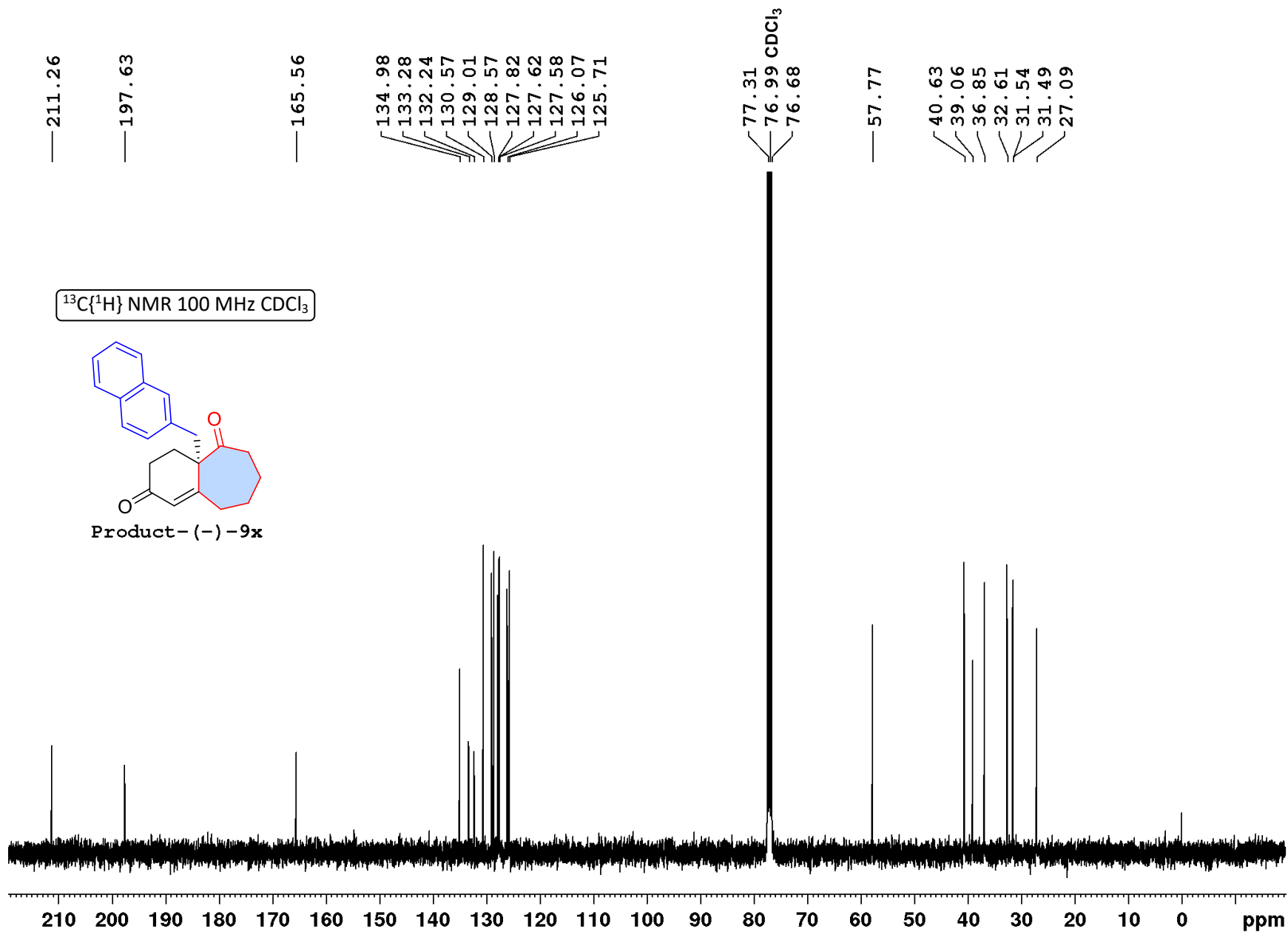
7.789
7.776
7.771
7.761
7.756
7.743
7.711
7.694
7.643
7.454
7.451
7.447
7.441
7.435
7.431
7.428
7.298
7.294
7.281
7.278
7.260 CDCl₃
6.163
3.544
3.517
3.318
3.291
2.689
2.686
2.431
2.417
2.331
2.327
2.309
2.304
2.301
2.283
2.268
2.263
2.242
2.238
2.234
2.220
2.216
2.208
2.013
2.008
1.997
1.994
1.905
1.901
1.898
1.892
1.888
1.599
1.459
1.440
1.302
1.297

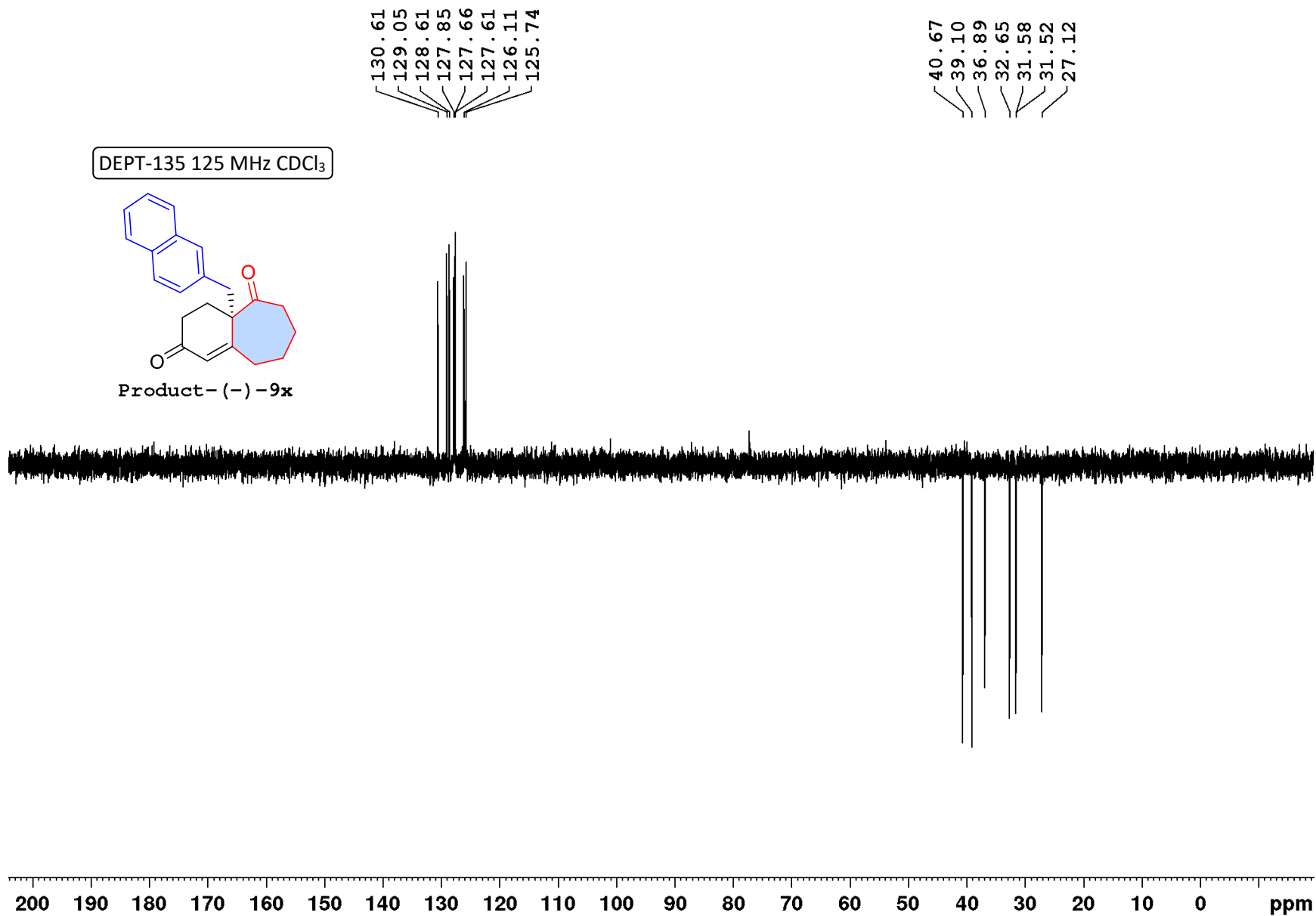
¹H NMR 500 MHz CDCl₃

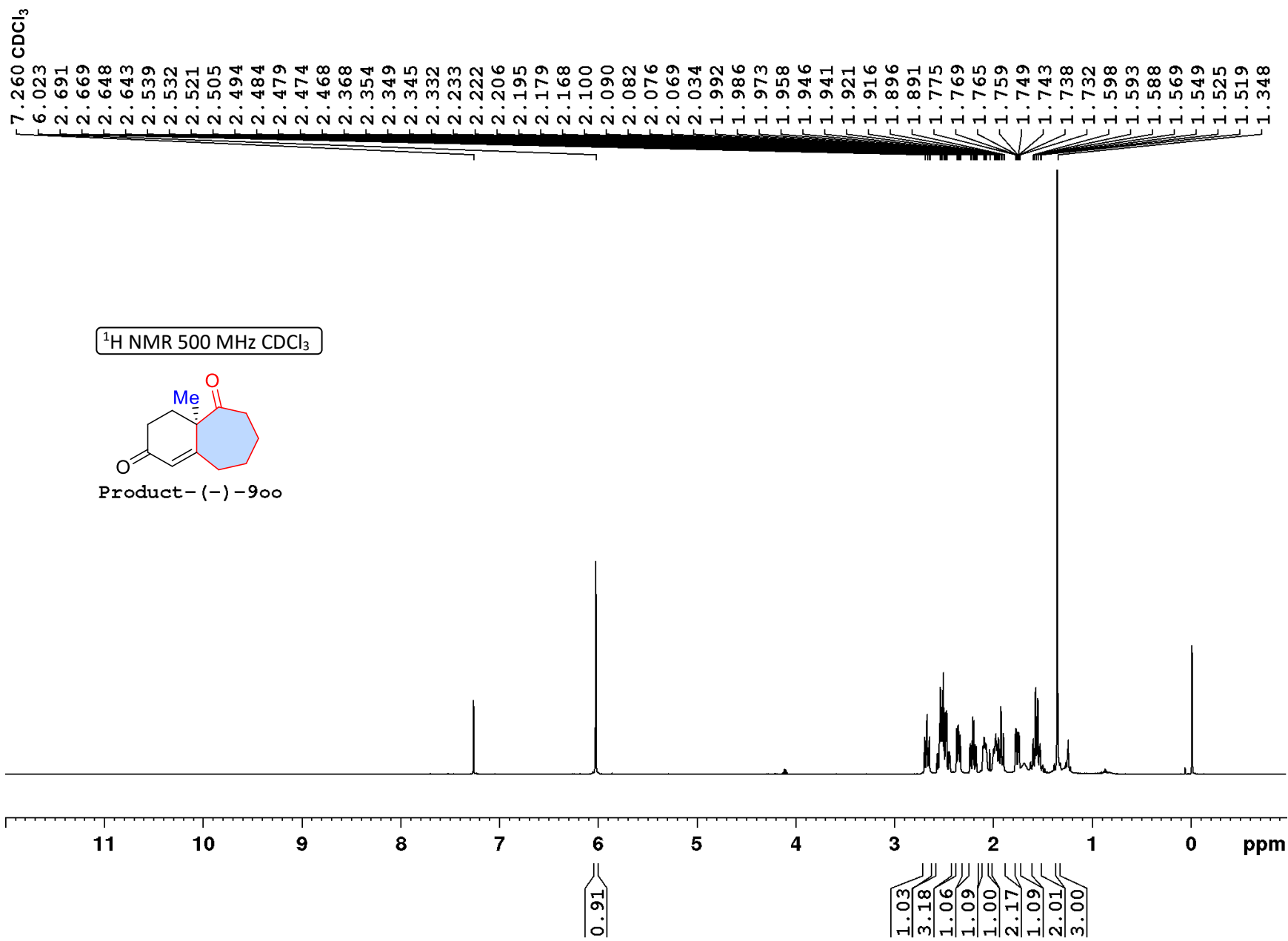


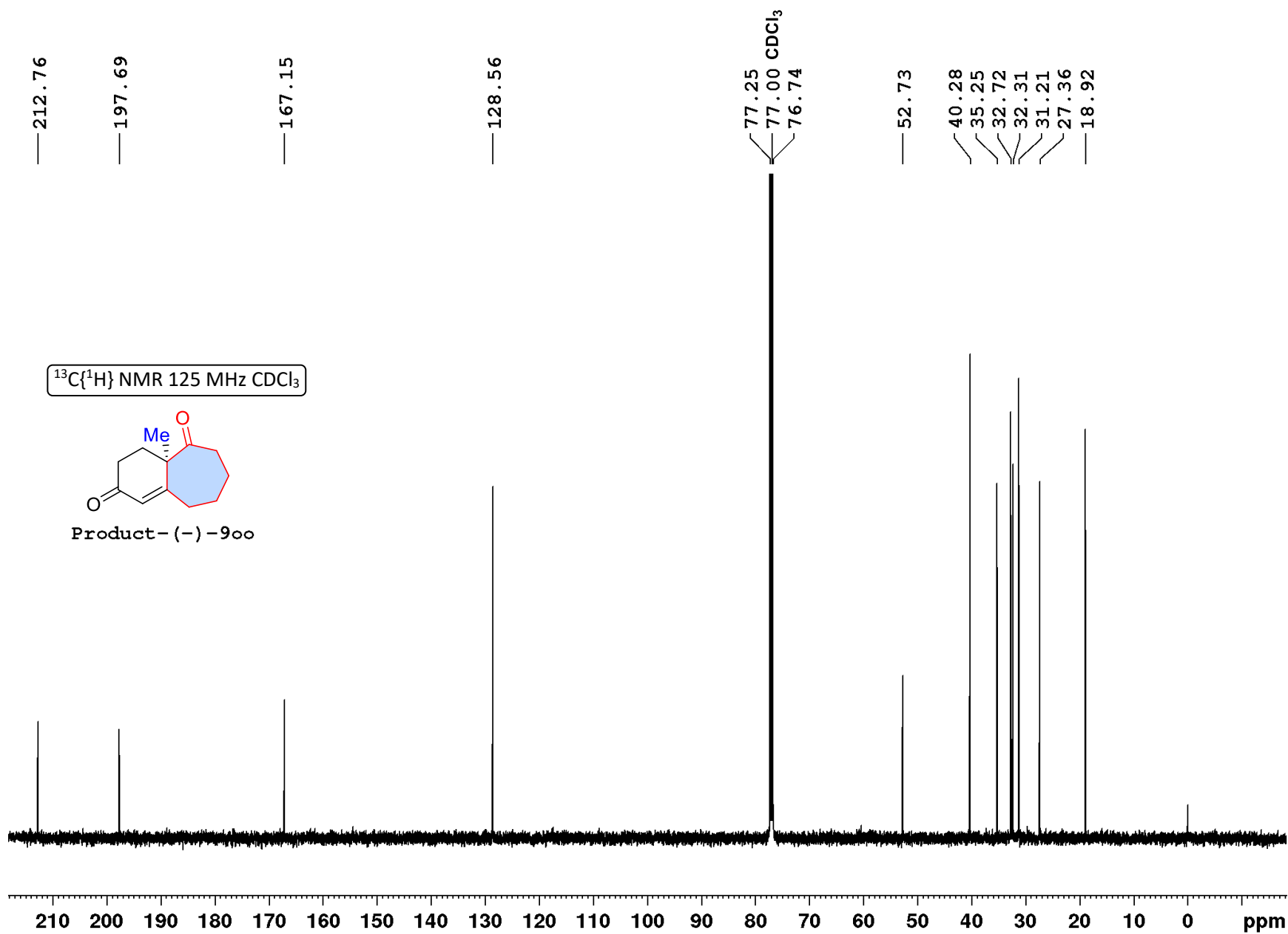
Product-(-)-9x

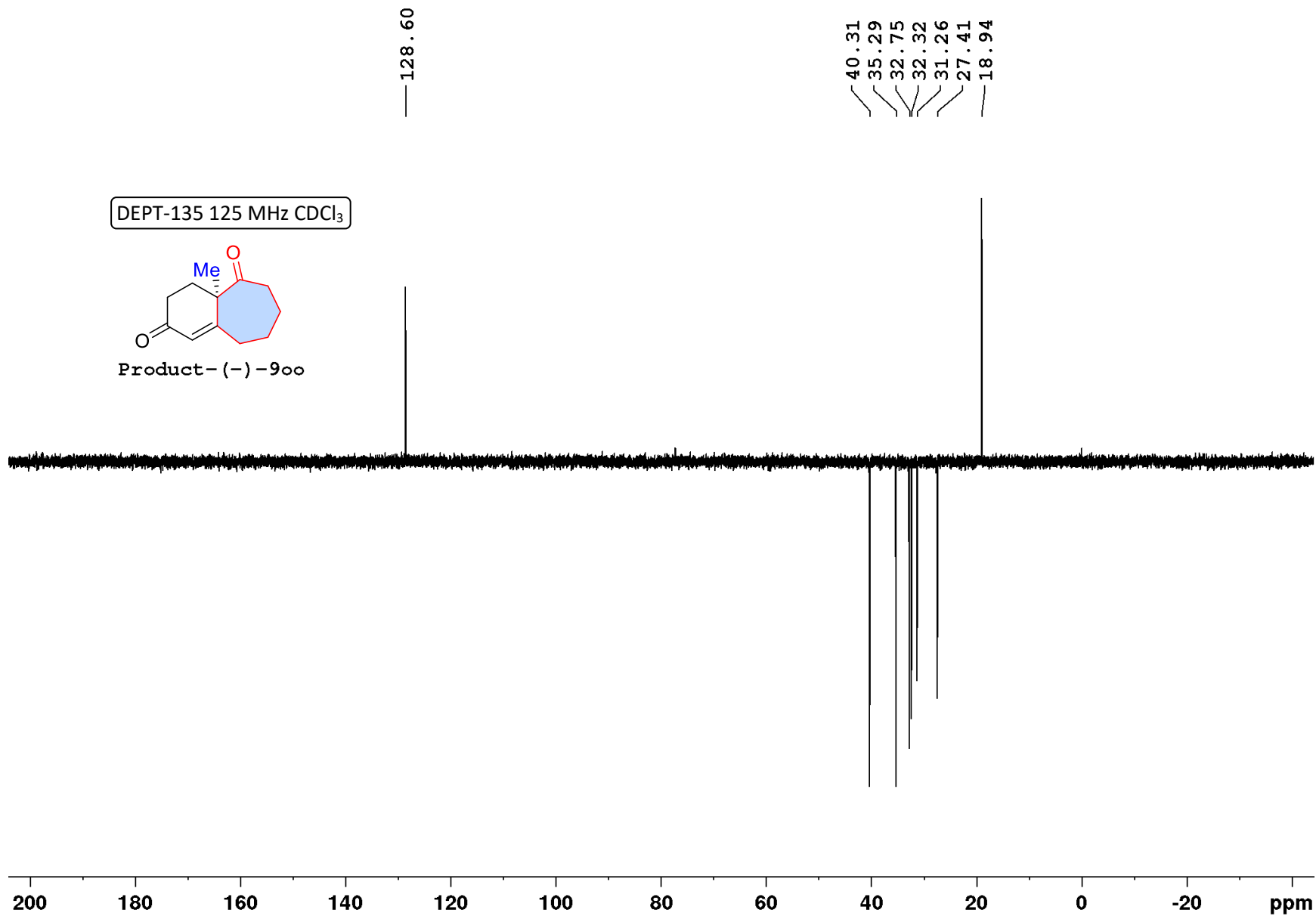


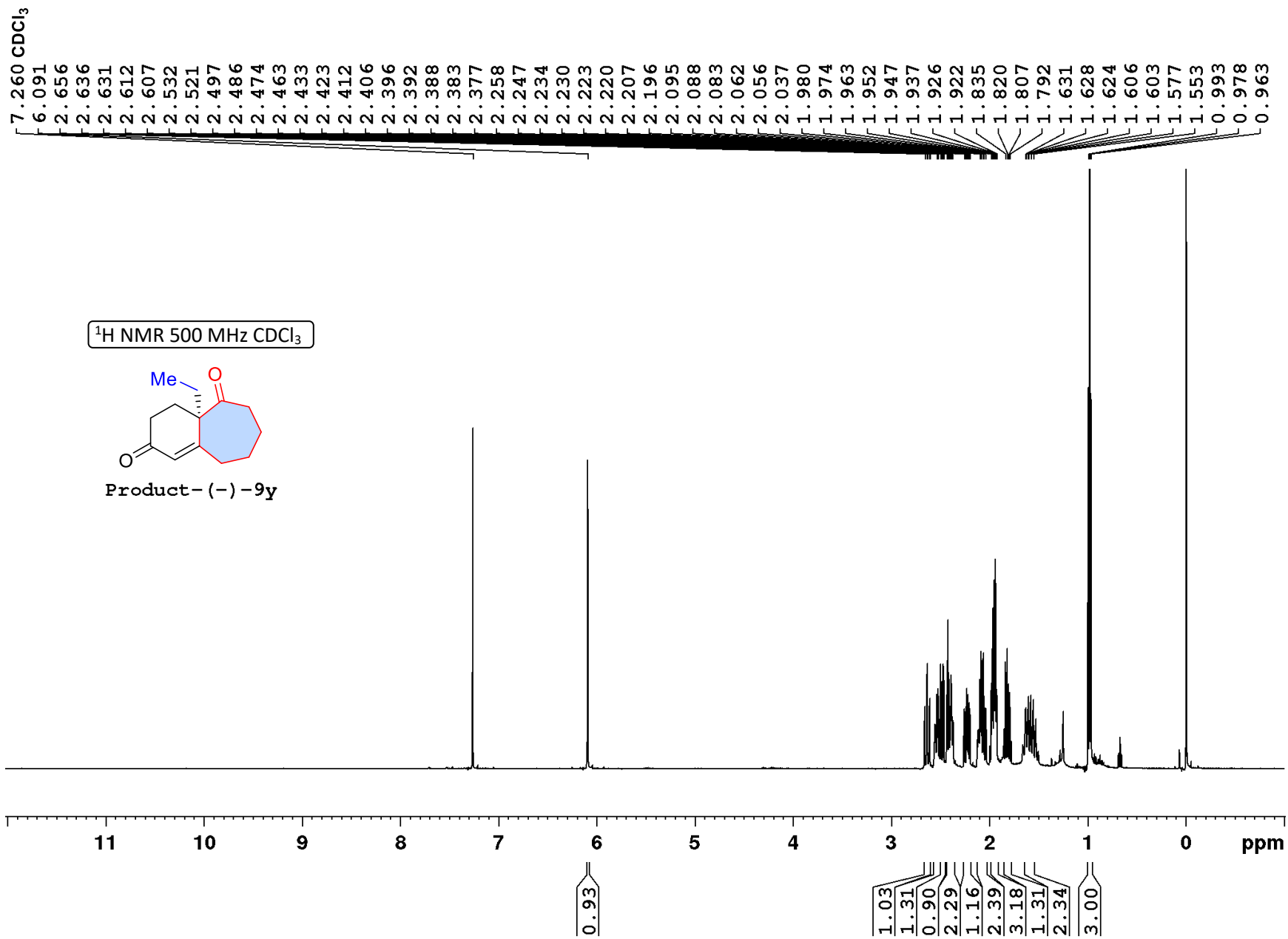


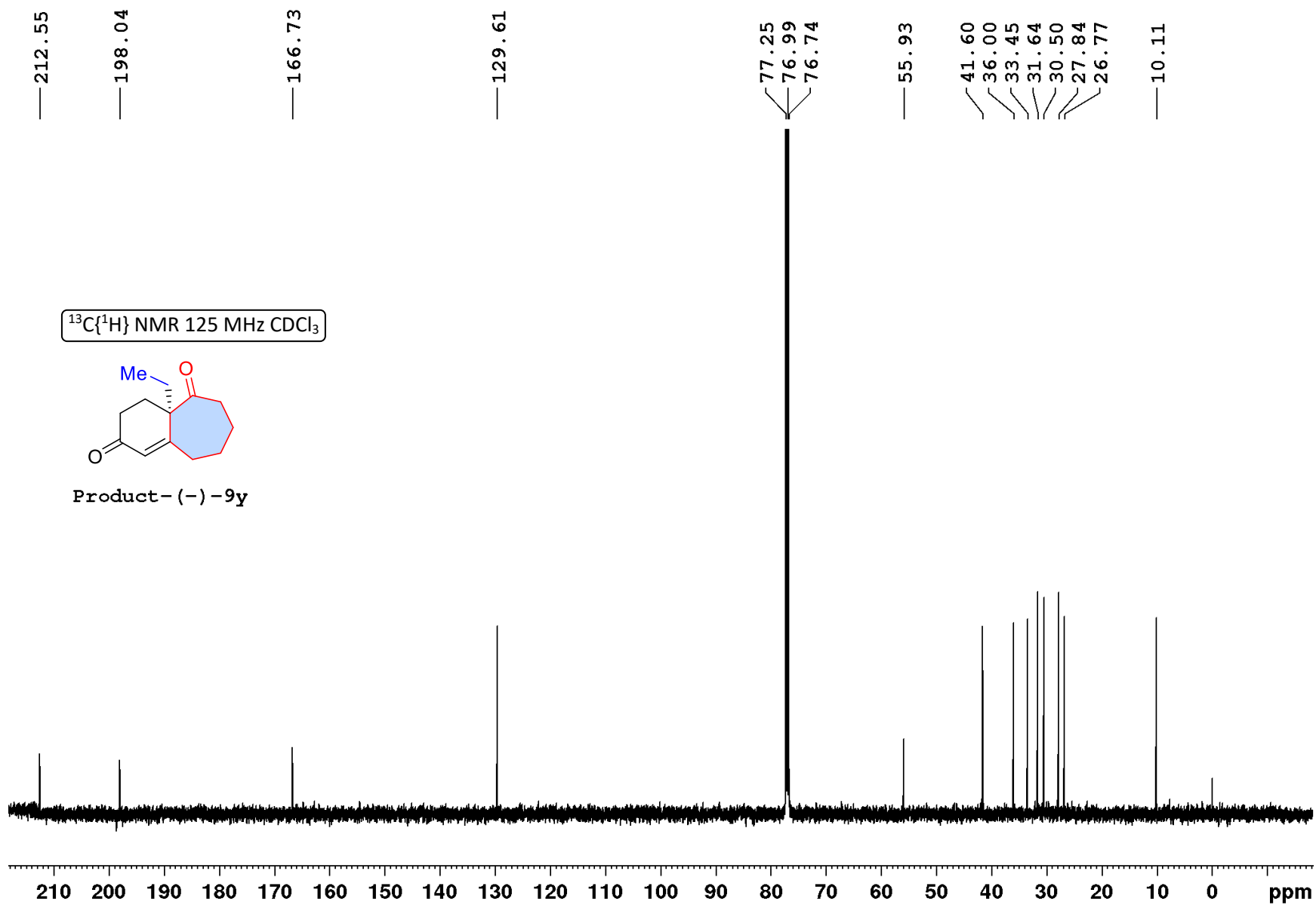


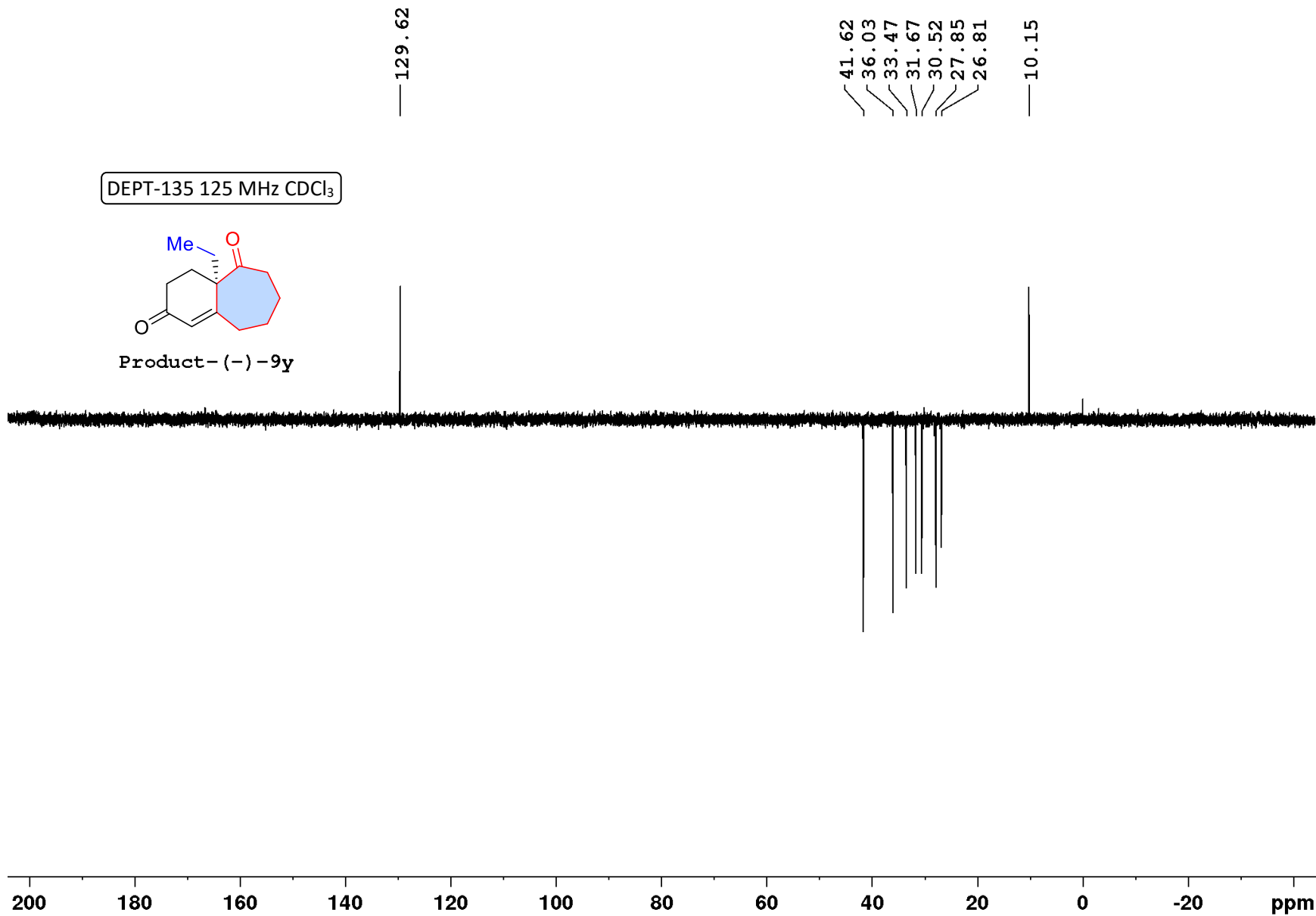








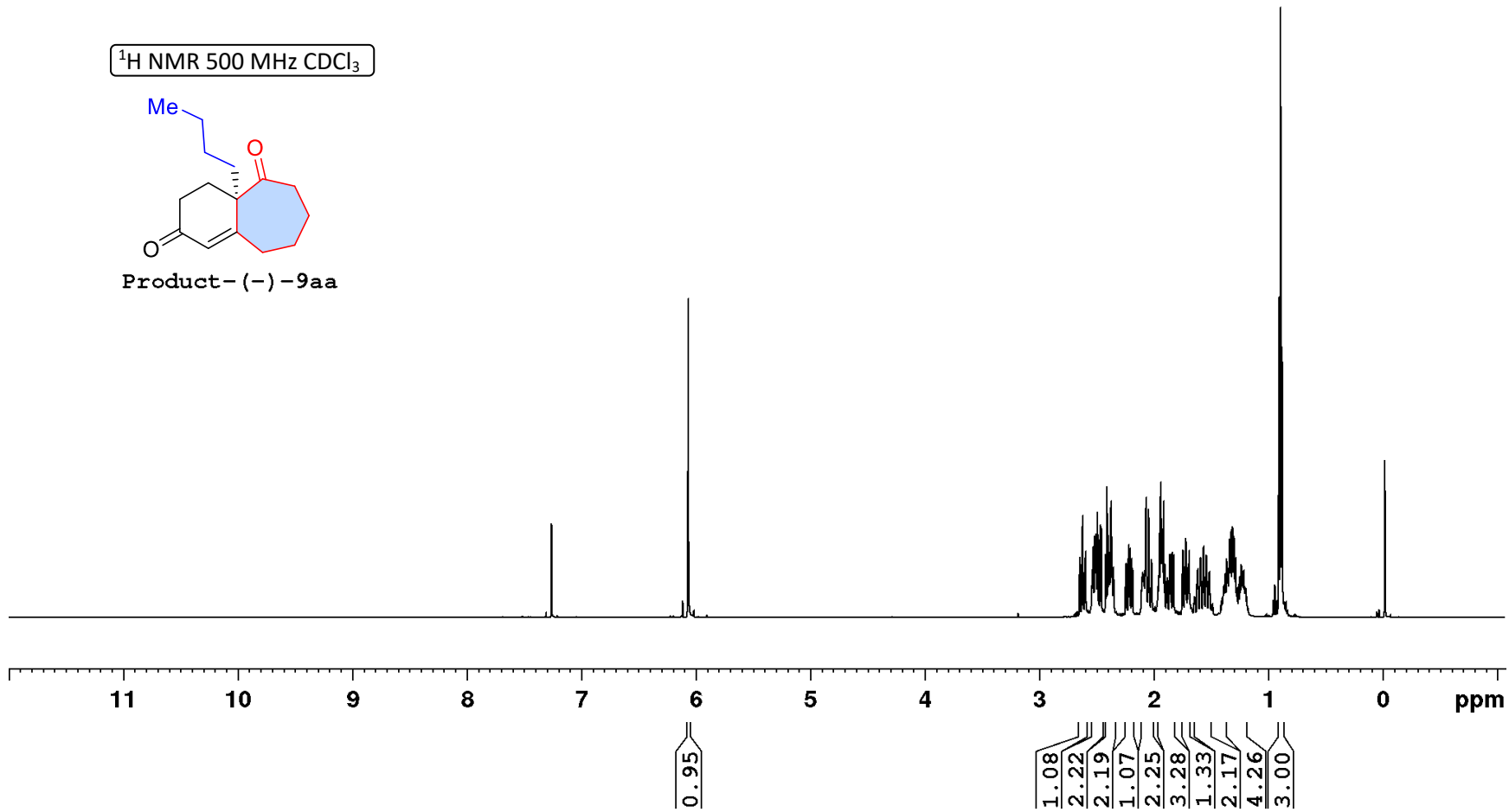
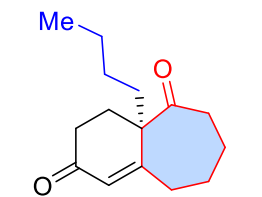


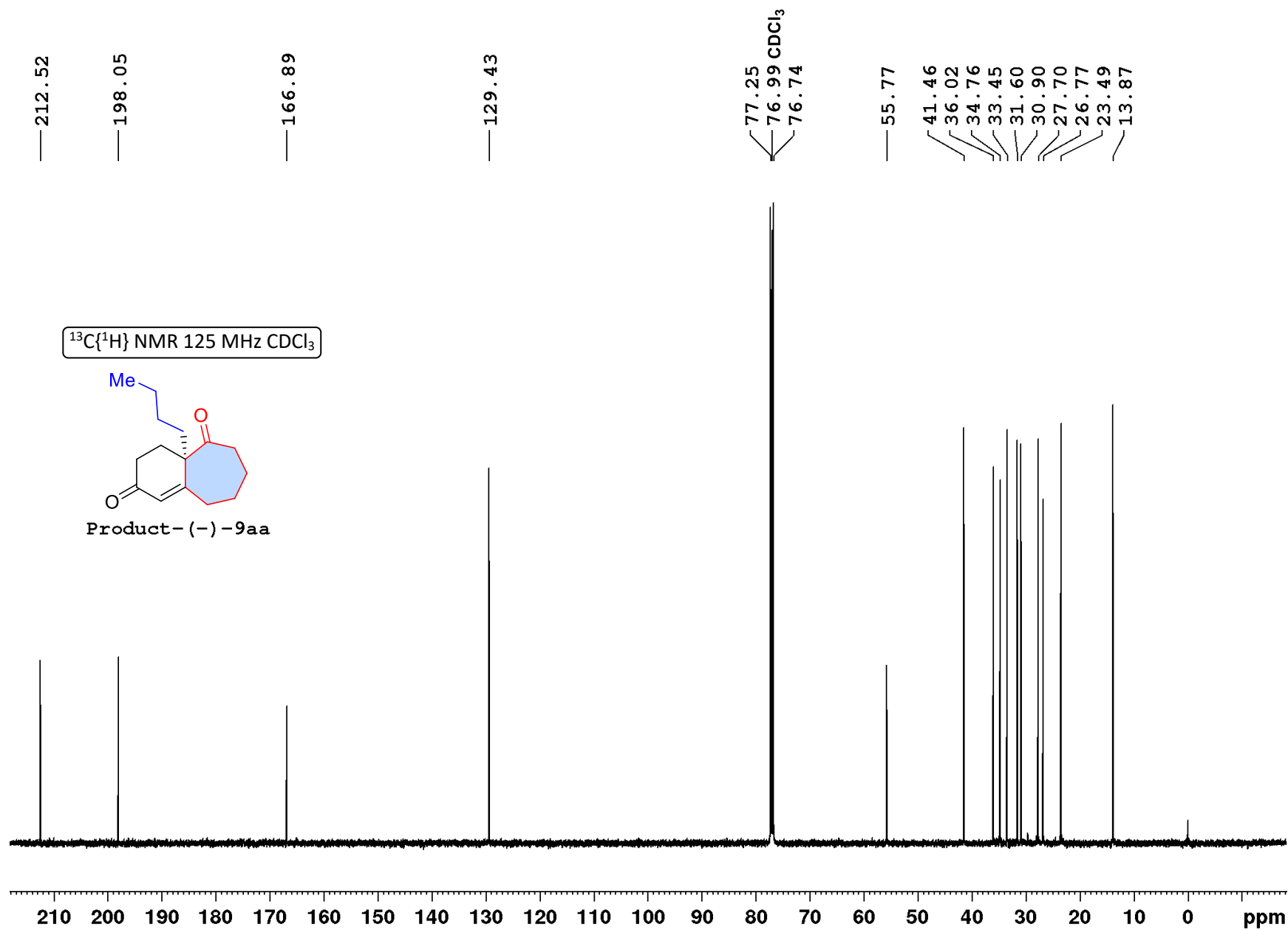


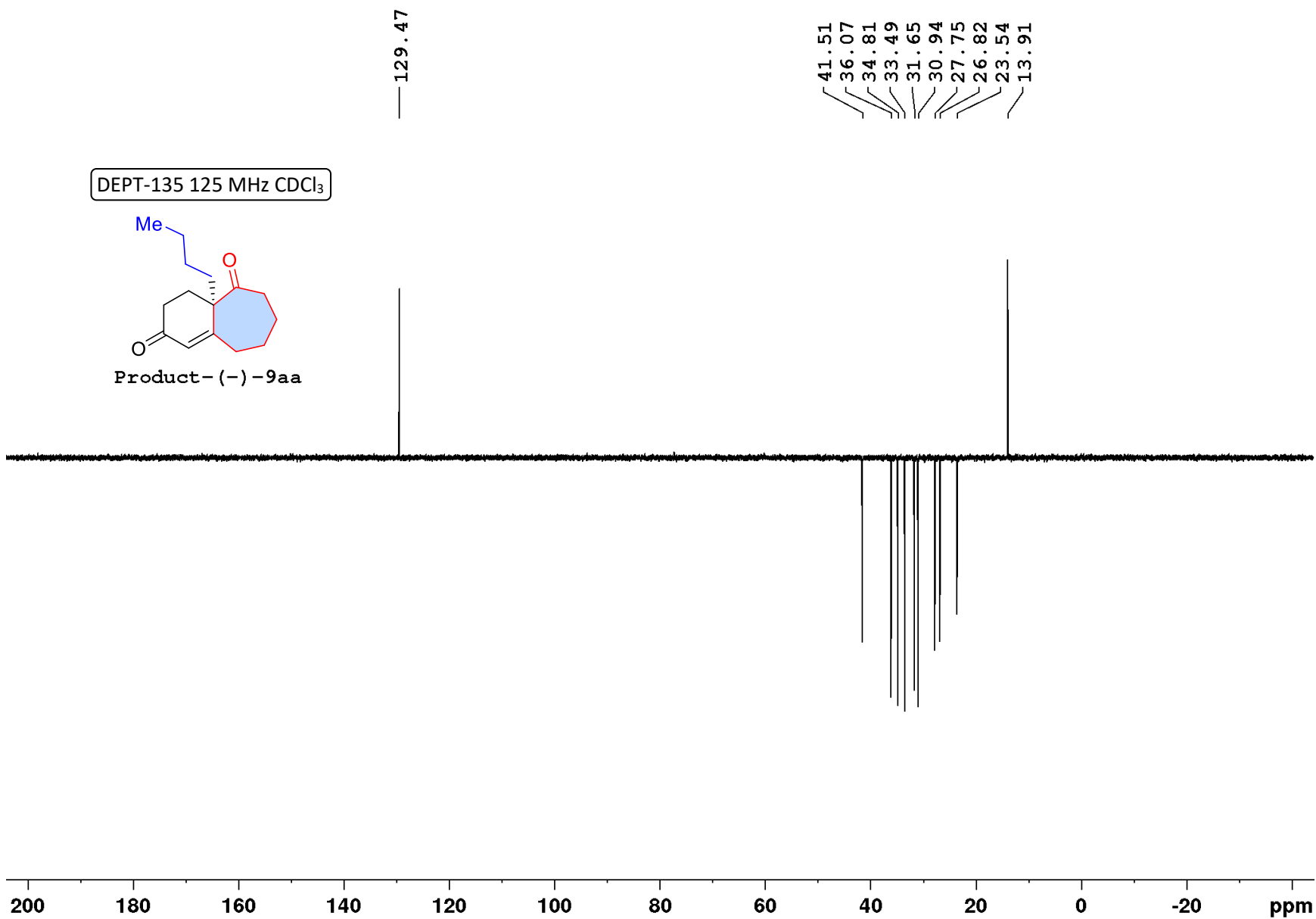
7.260 CDCl₃

6.066
2.644
2.625
2.620
2.600
2.595
2.528
2.517
2.504
2.493
2.482
2.469
2.458
2.420
2.410
2.399
2.390
2.374
2.364
2.219
2.208
2.196
2.068
2.047
2.041
2.022
1.952
1.941
1.931
1.925
1.914
1.860
1.854
1.851
1.836
1.827
1.745
1.720
1.717
1.692
1.592
1.565
1.541
1.365
1.338
1.330
1.324
1.317
1.312
1.309
1.303
1.300
1.298
1.286
0.908
0.893
0.879

¹H NMR 500 MHz CDCl₃



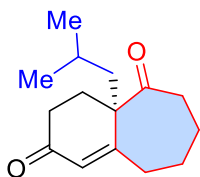




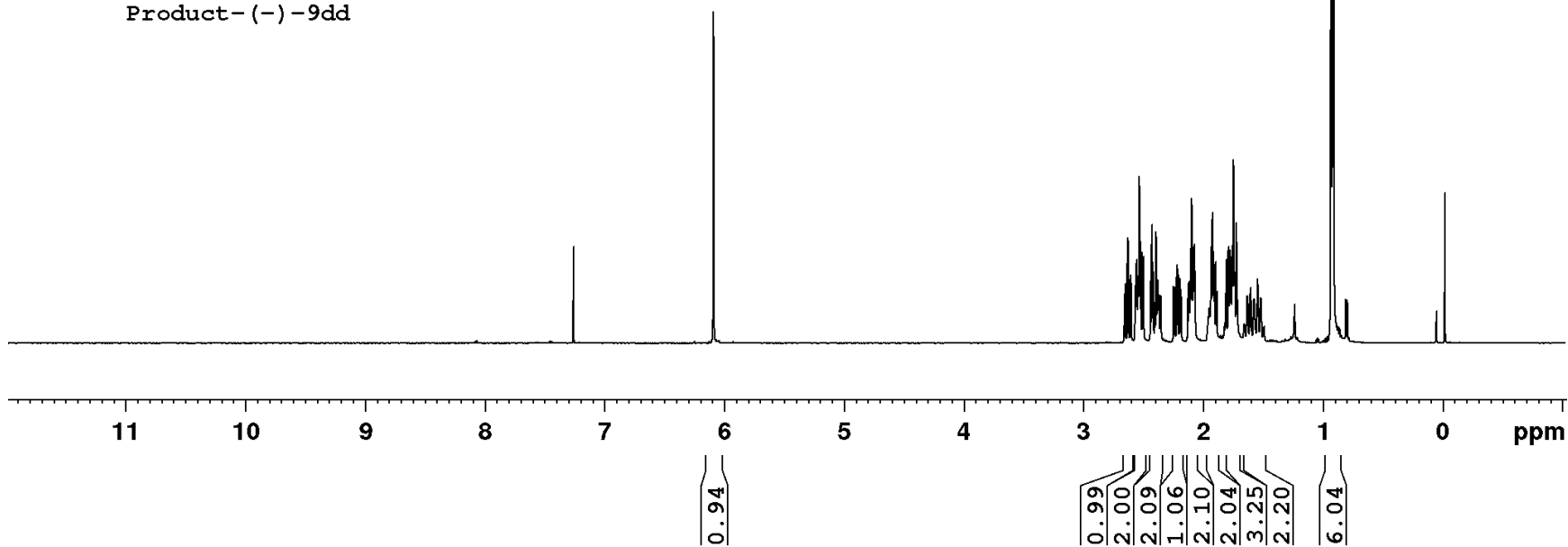
7.260 CDCl₃

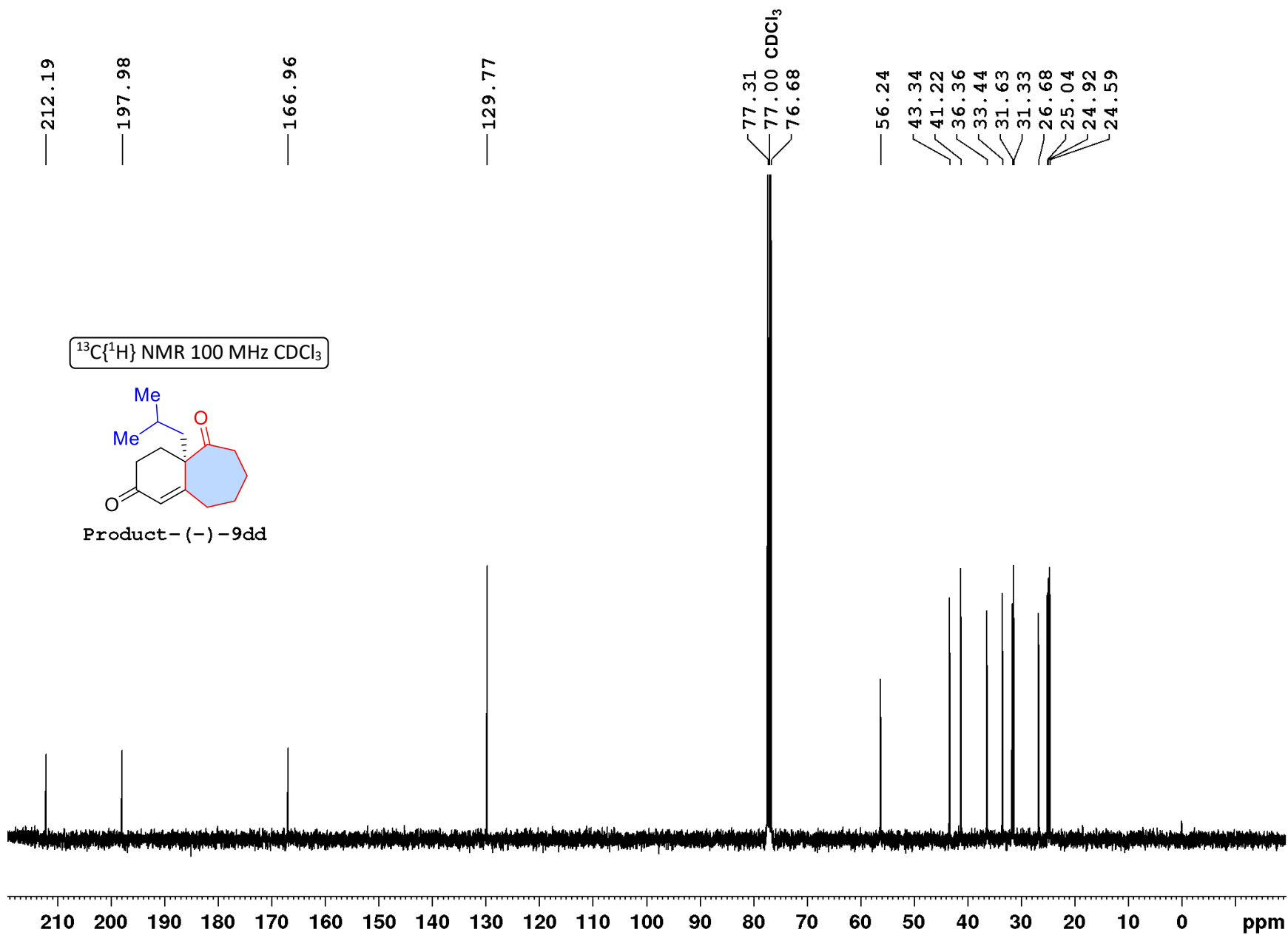
6.089
2.651
2.631
2.627
2.607
2.602
2.567
2.556
2.543
2.532
2.521
2.507
2.497
2.438
2.428
2.418
2.393
2.382
2.381
2.379
2.246
2.236
2.222
2.219
2.211
2.208
2.195
2.184
2.119
2.104
2.097
2.094
2.082
2.074
2.068
1.931
1.921
1.911
1.904
1.894
1.884
1.806
1.789
1.783
1.774
1.758
1.753
1.746
1.742
1.735
1.732
1.722
1.603
1.544
0.932
0.920
0.908

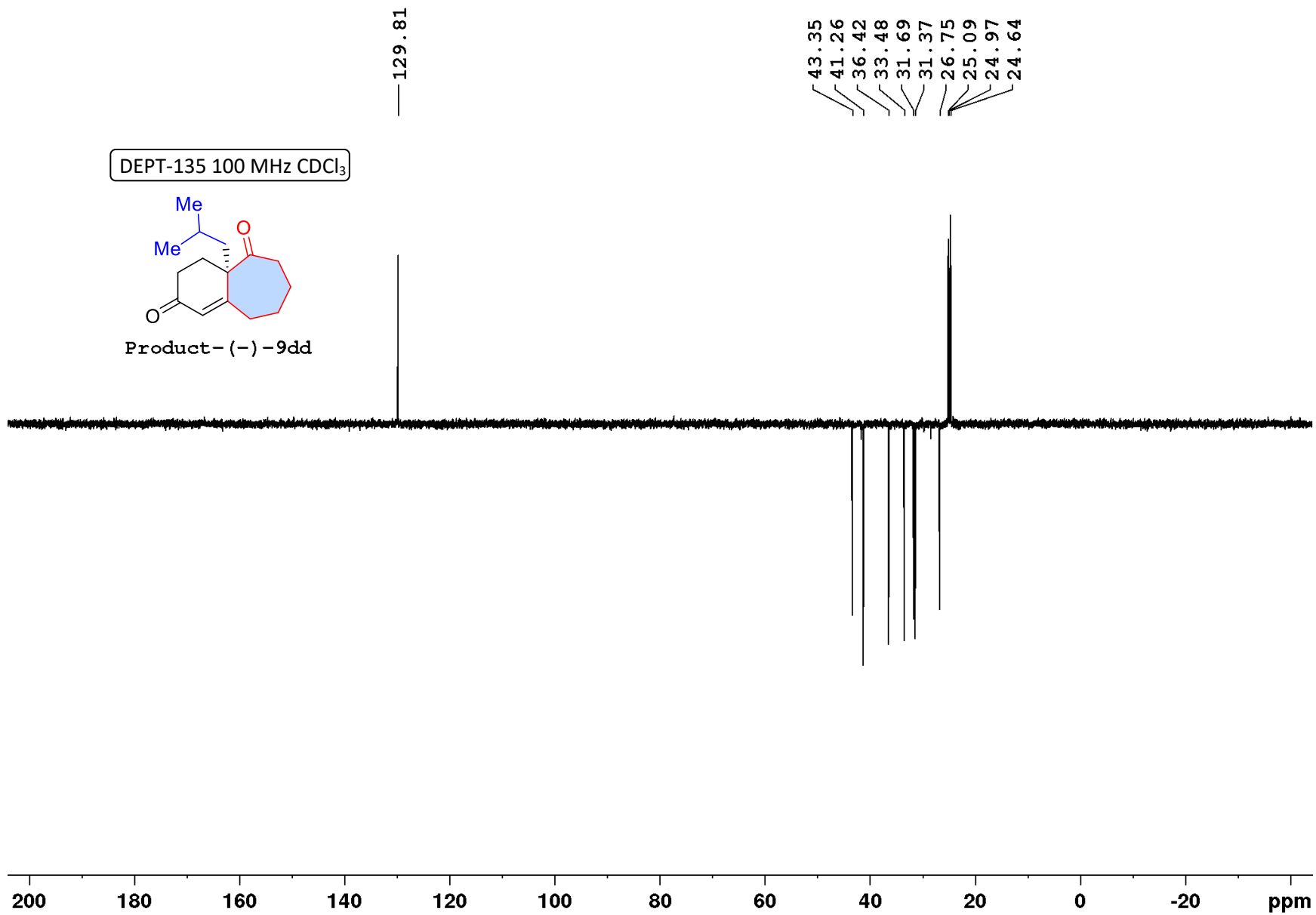
¹H NMR 500 MHz CDCl₃



Product-(-)-9dd

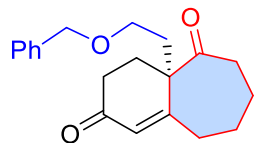




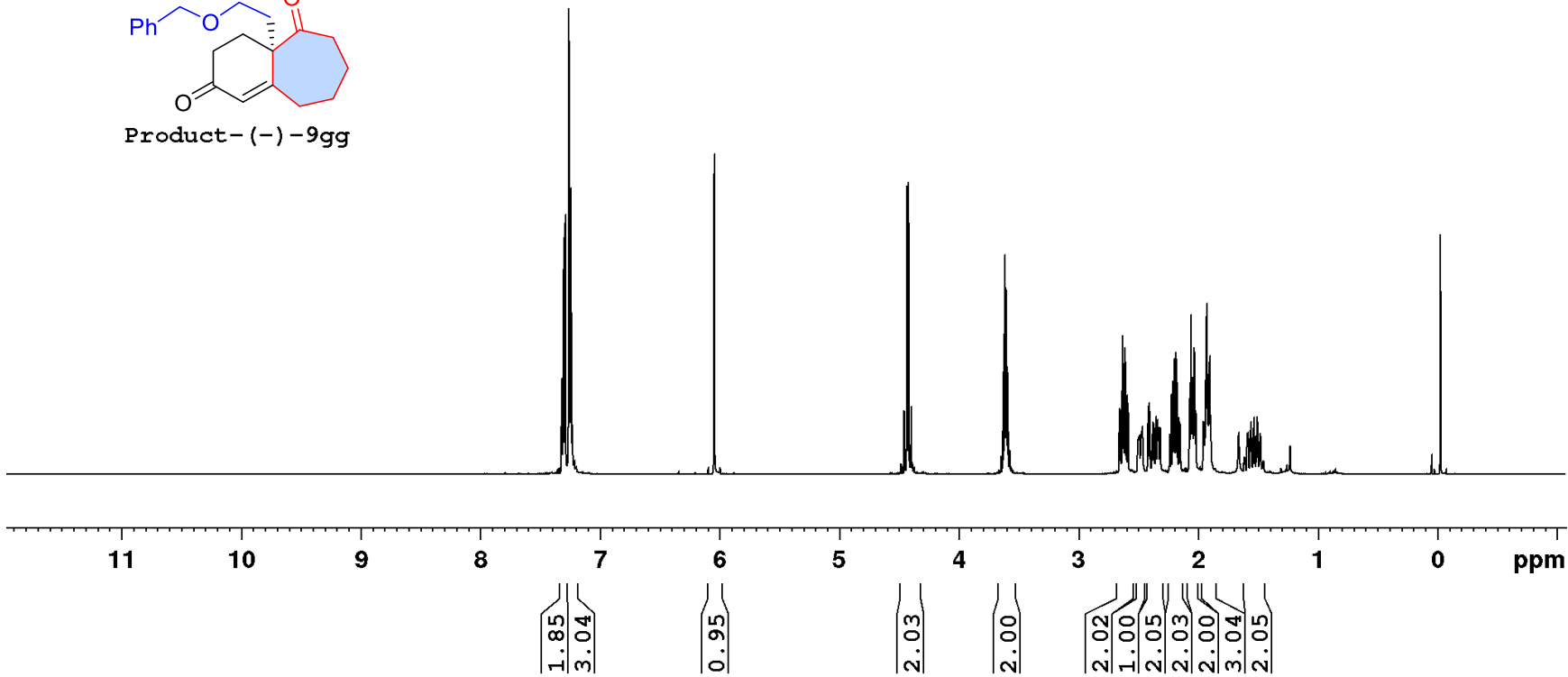


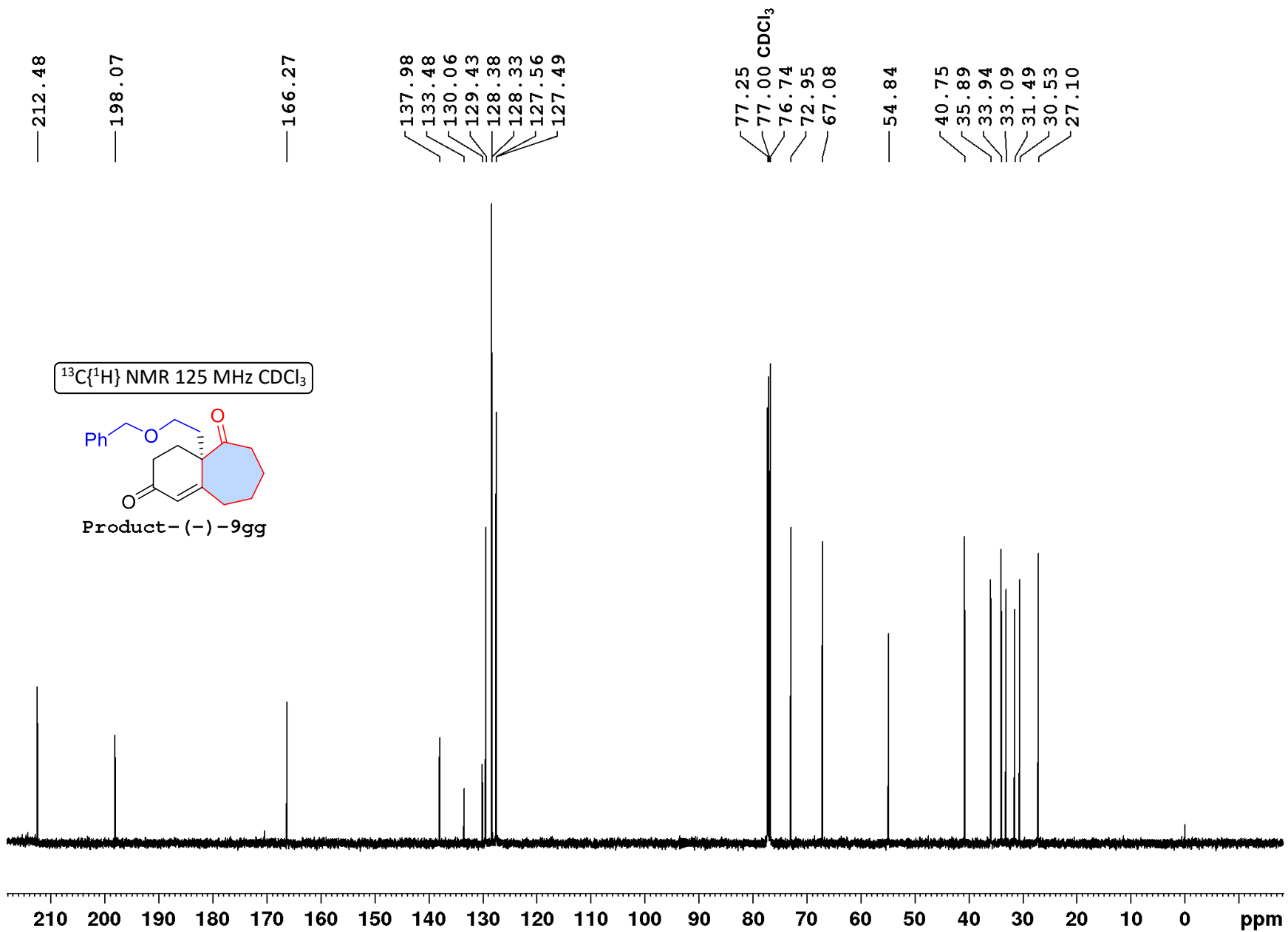
7.319
7.309
7.304
7.302
7.295
7.290
7.260CDCl₃
7.254
7.245
7.240
6.044
4.457
4.433
4.420
4.397
3.627
3.618
3.614
3.606
3.602
3.593
2.656
2.653
2.645
2.633
2.629
2.620
2.610
2.604
2.594
2.584
2.411
2.409
2.401
2.352
2.224
2.211
2.207
2.200
2.195
2.183
2.174
2.158
2.072
2.059
2.047
2.043
2.030
2.017
1.937
1.931
1.926
1.918
1.909
1.906
1.902
1.891
1.505

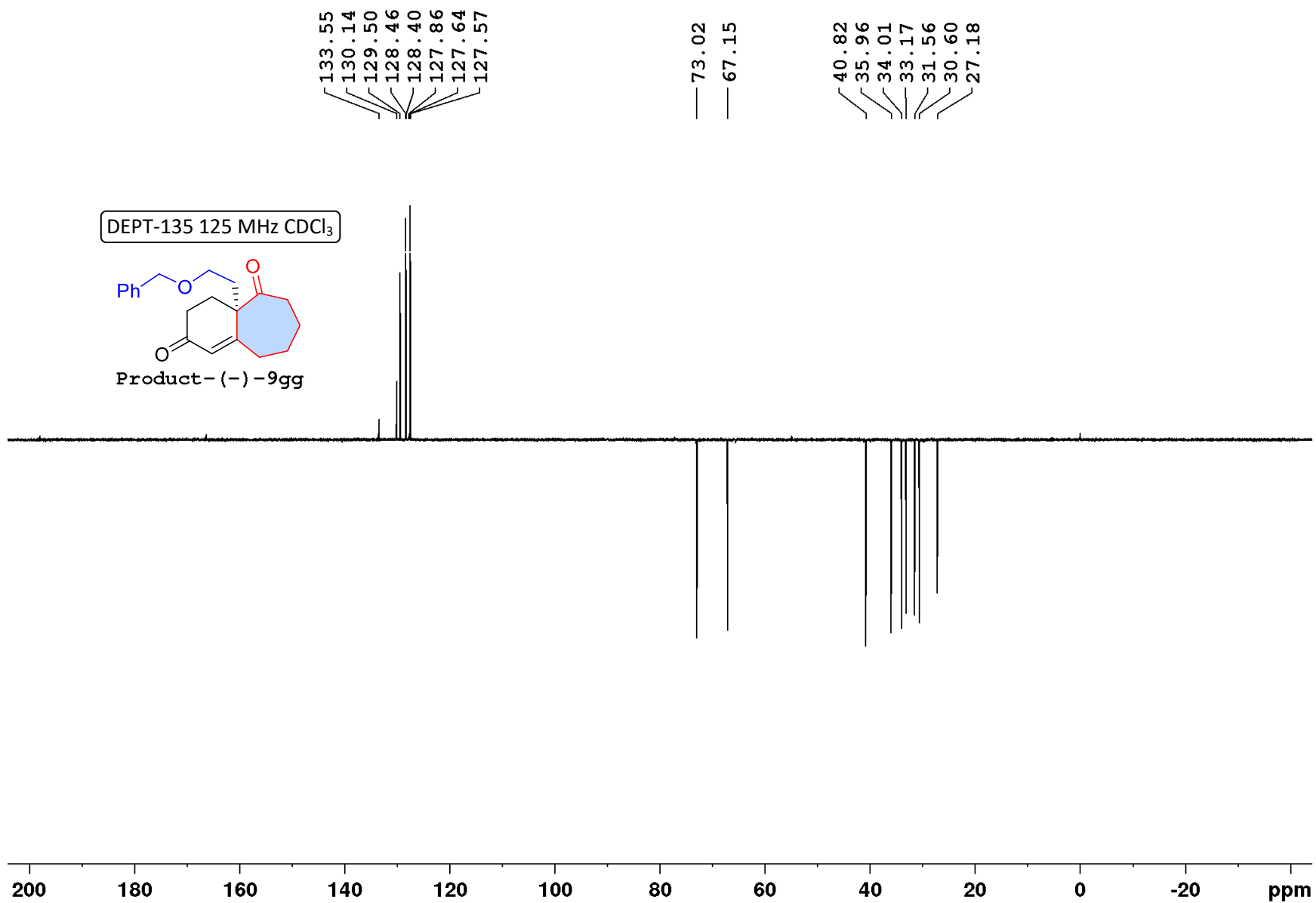
¹H NMR 500 MHz CDCl₃

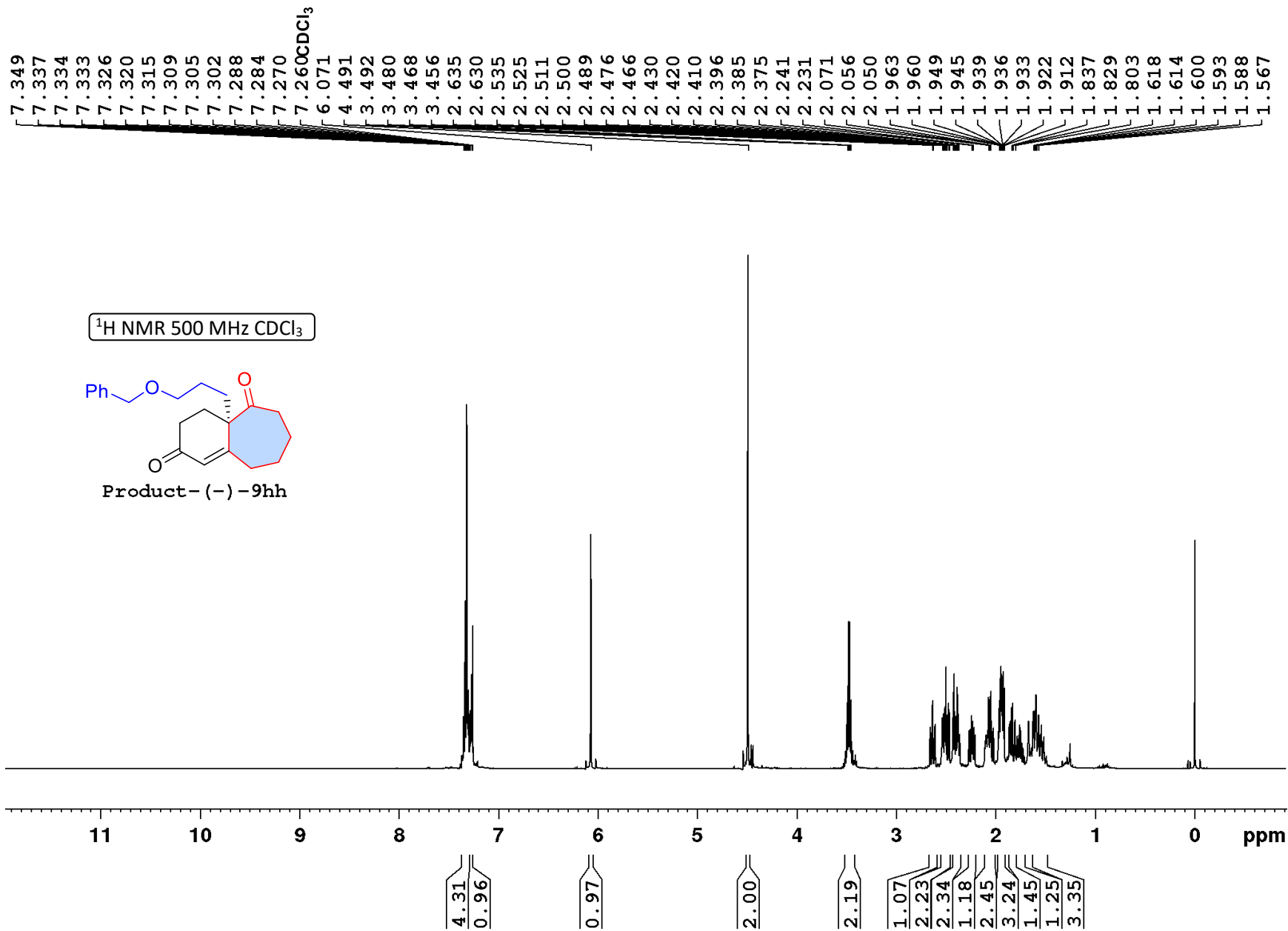


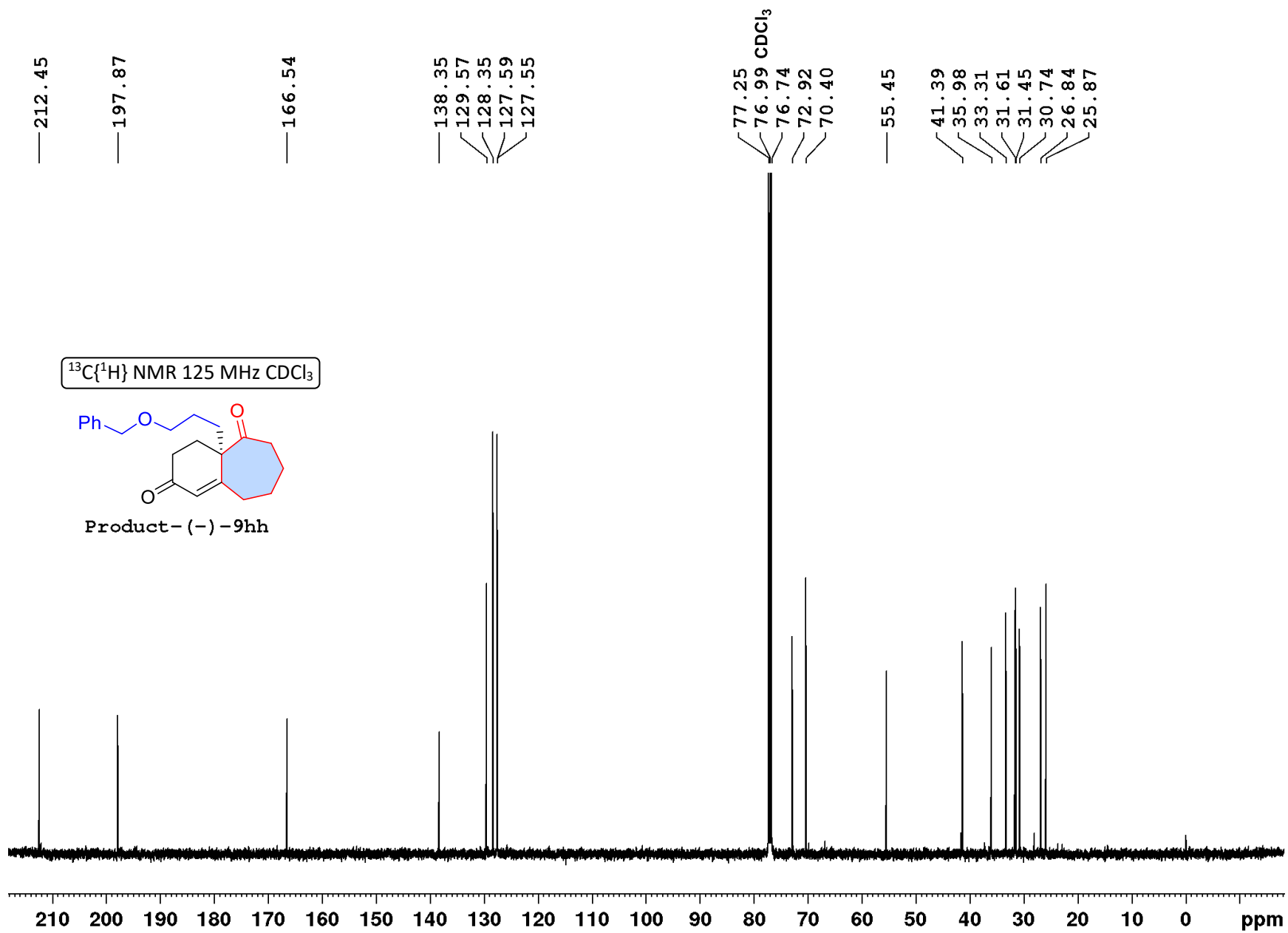
Product- (-)-9gg

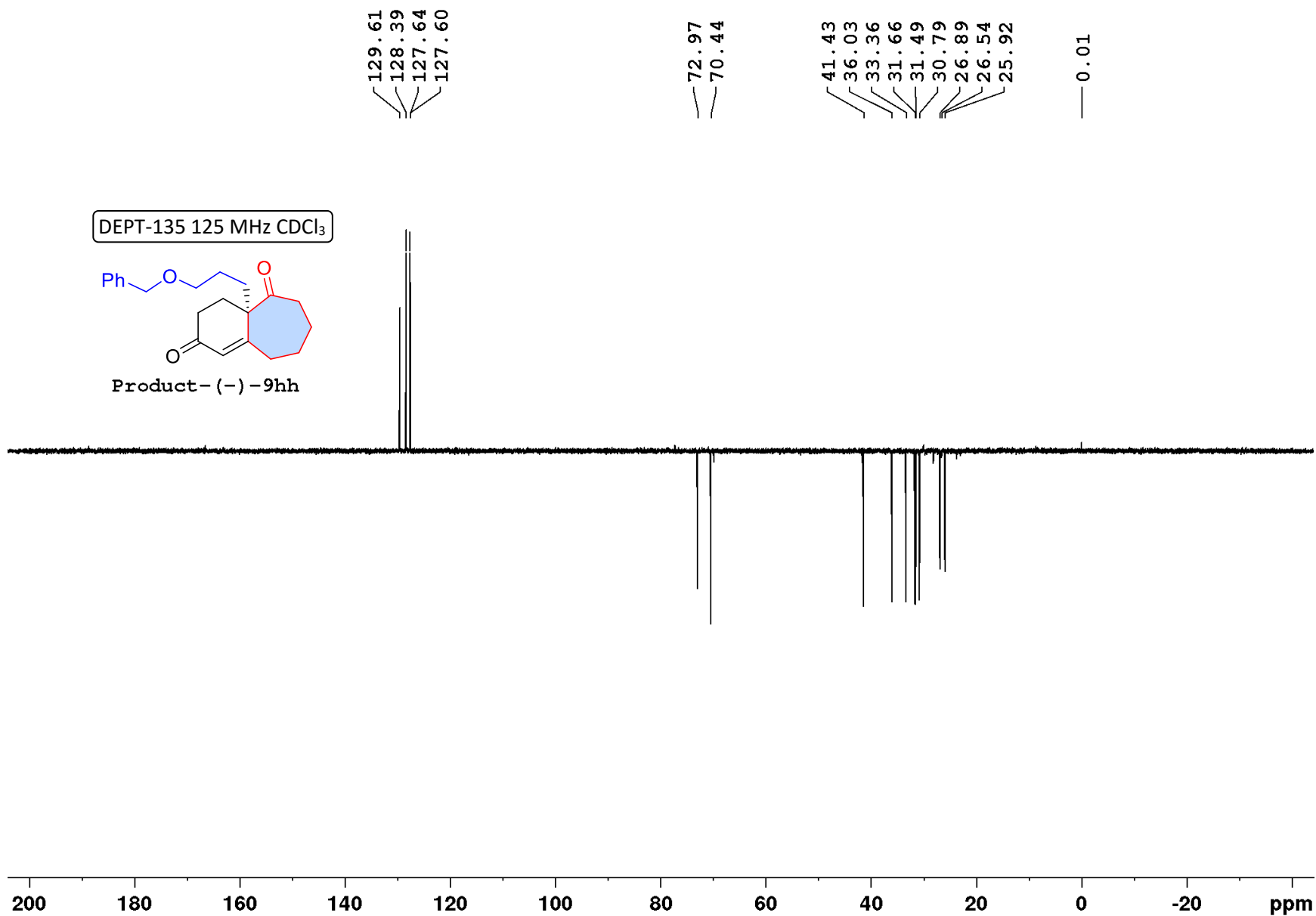




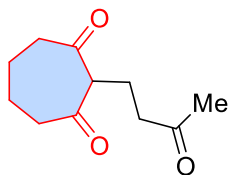




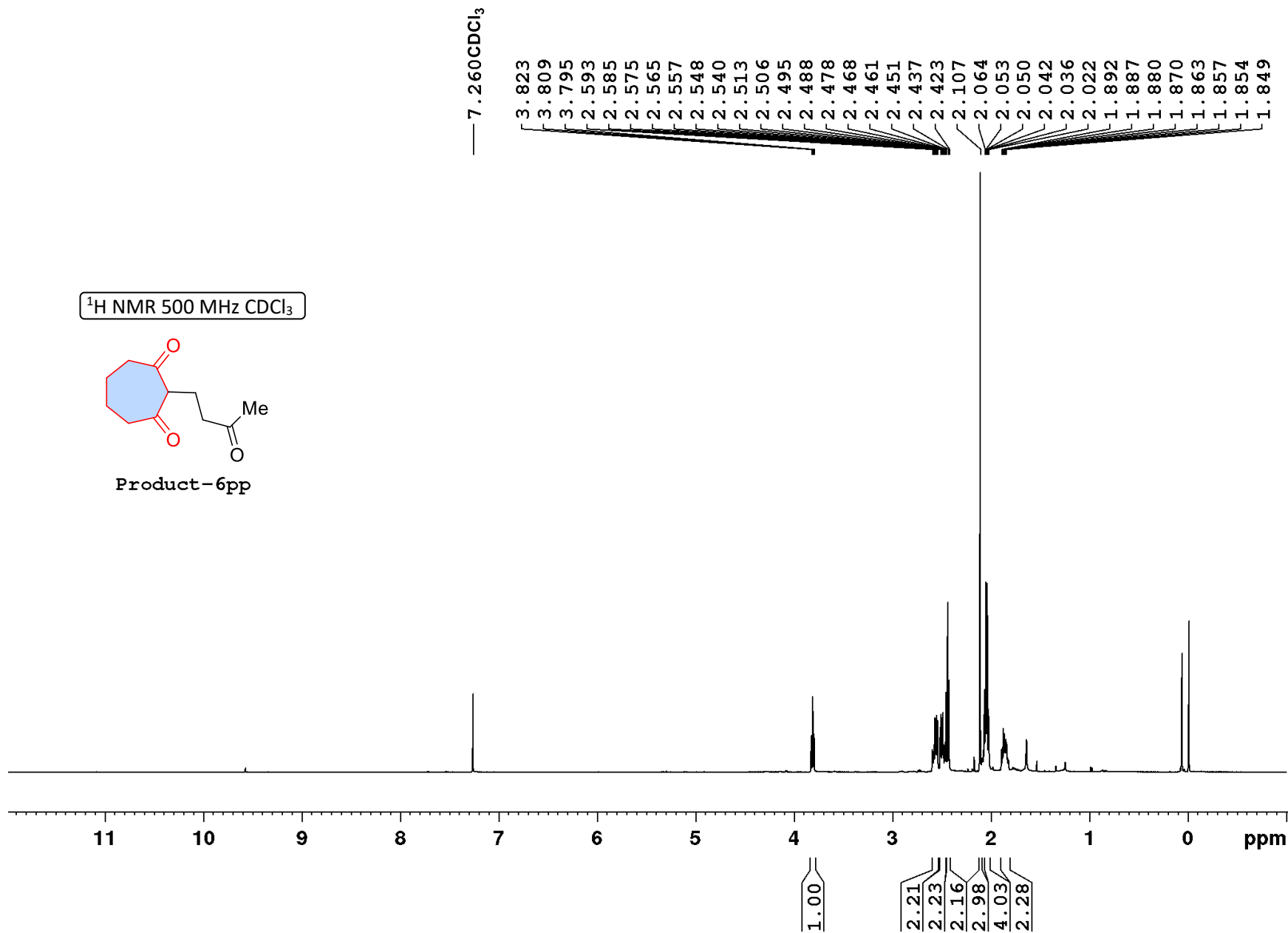


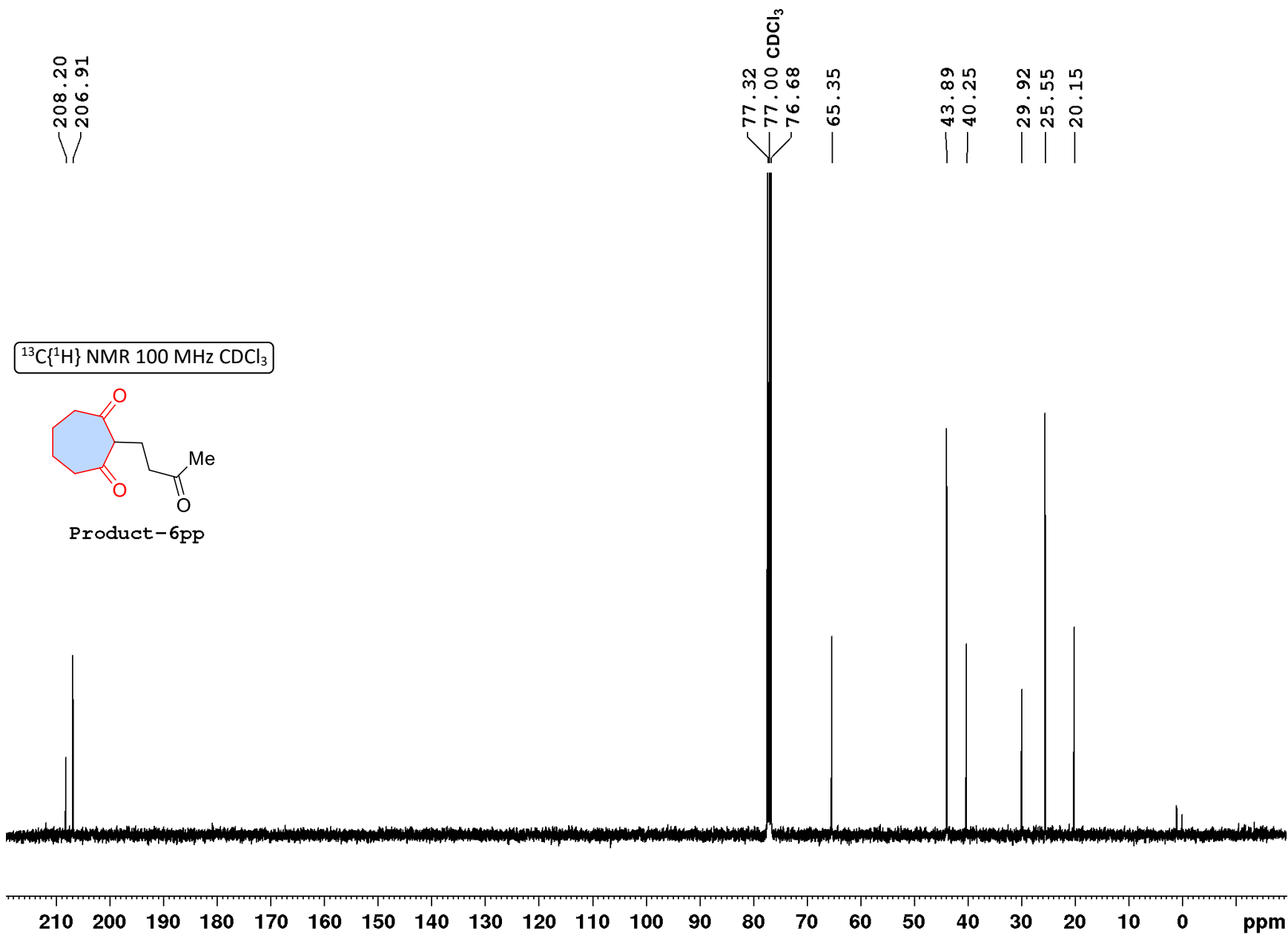


^1H NMR 500 MHz CDCl_3

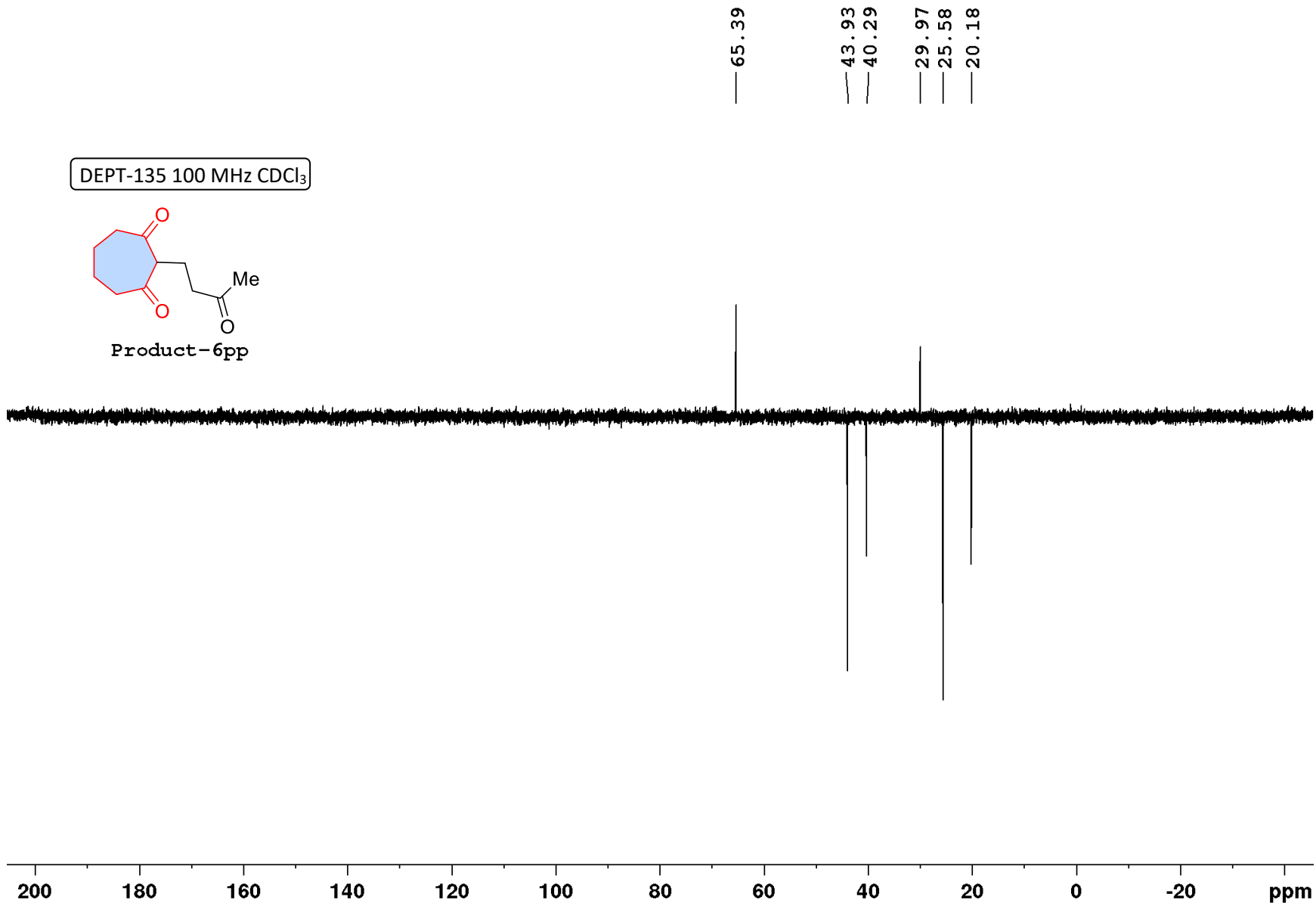
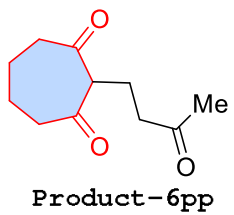


Product-6pp

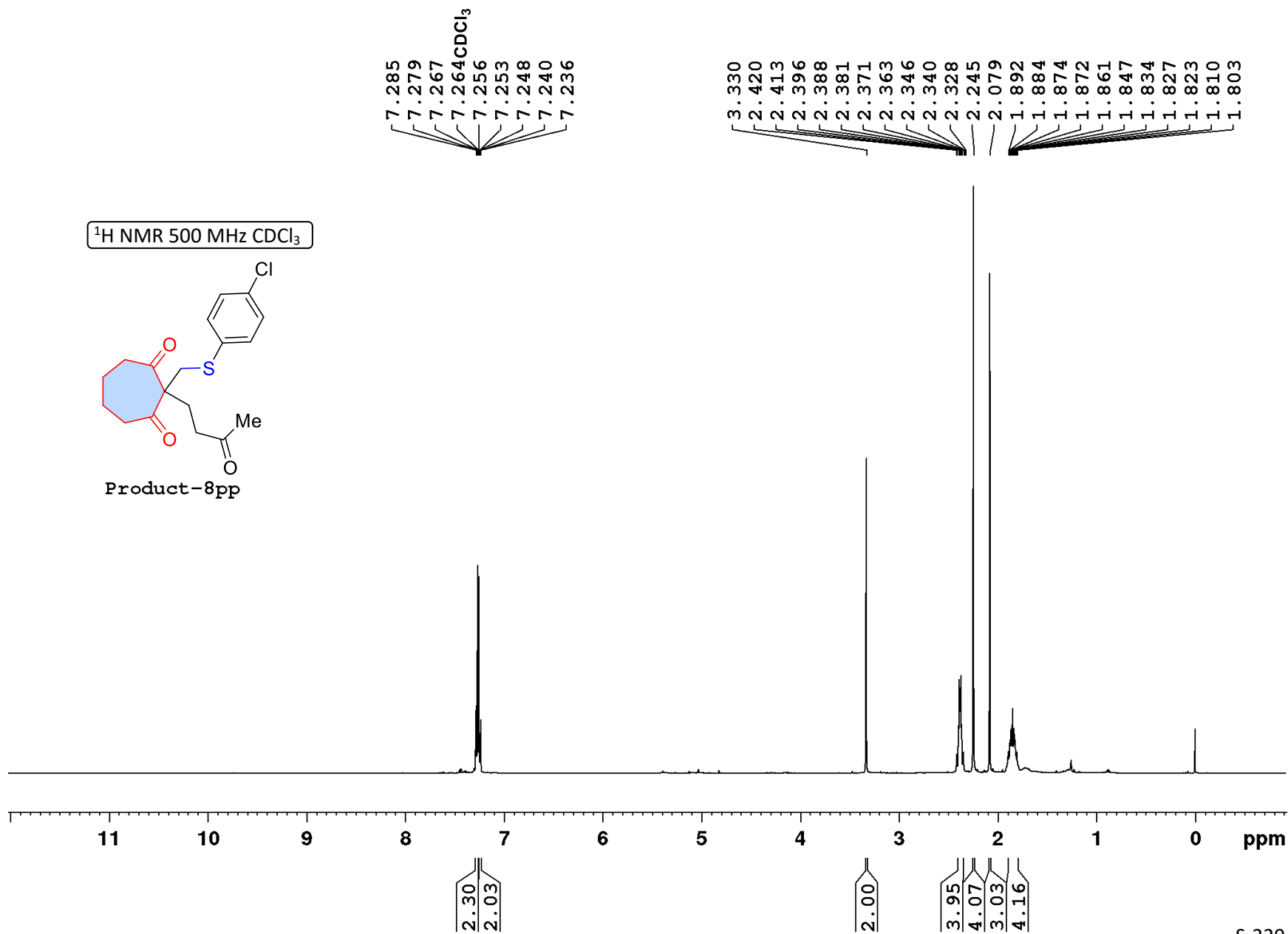
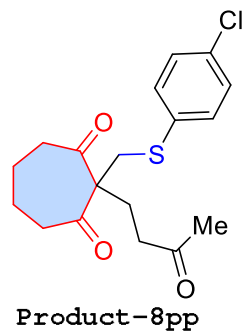


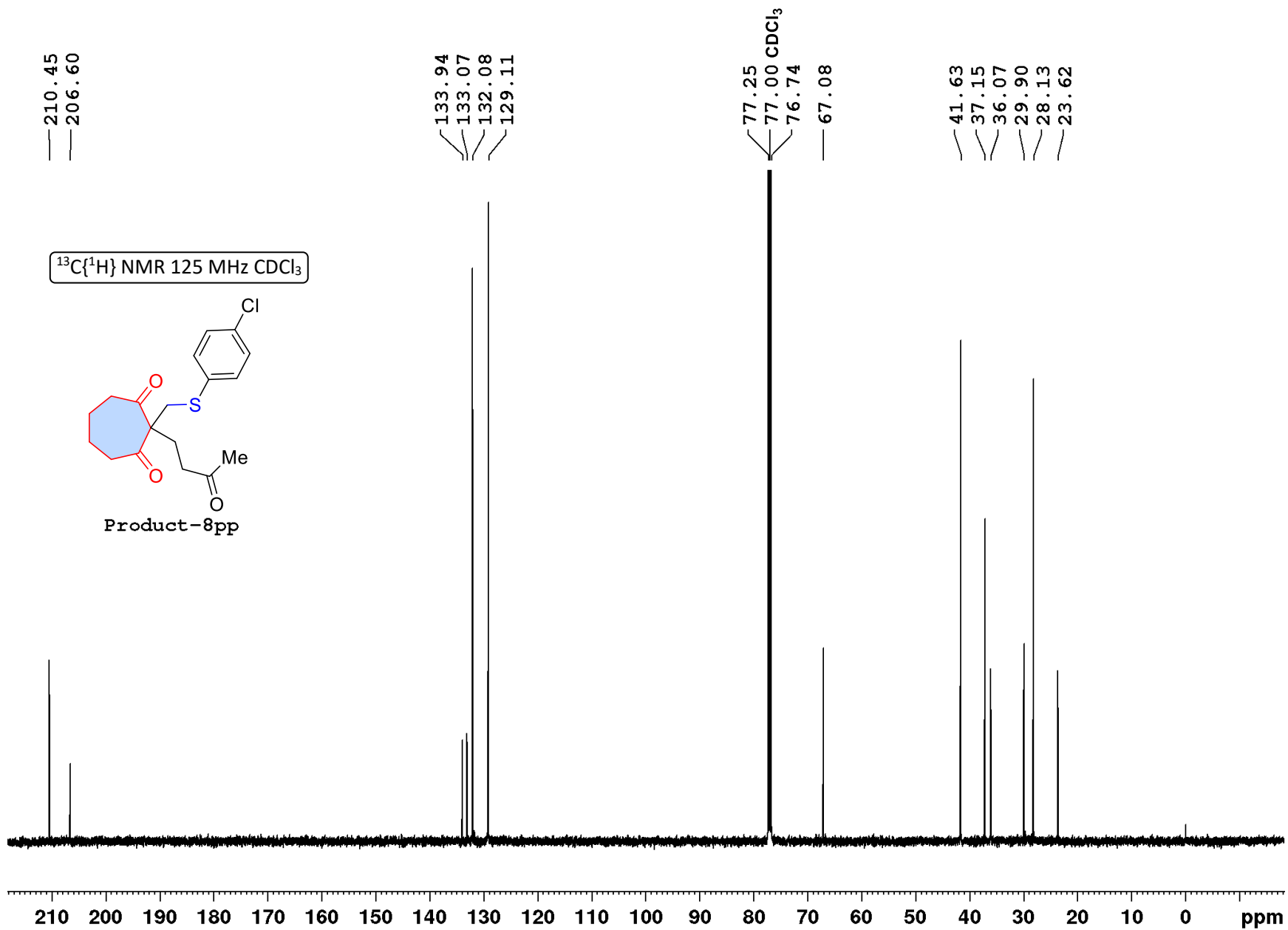


DEPT-135 100 MHz CDCl₃

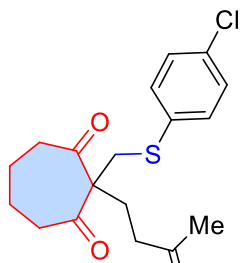


¹H NMR 500 MHz CDCl₃





DEPT-135 125 MHz CDCl₃



Product-8pp

132.12
129.16

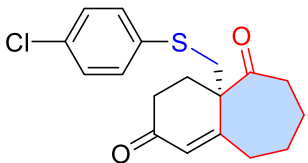
41.68
37.19
36.09
29.97
28.19
23.63



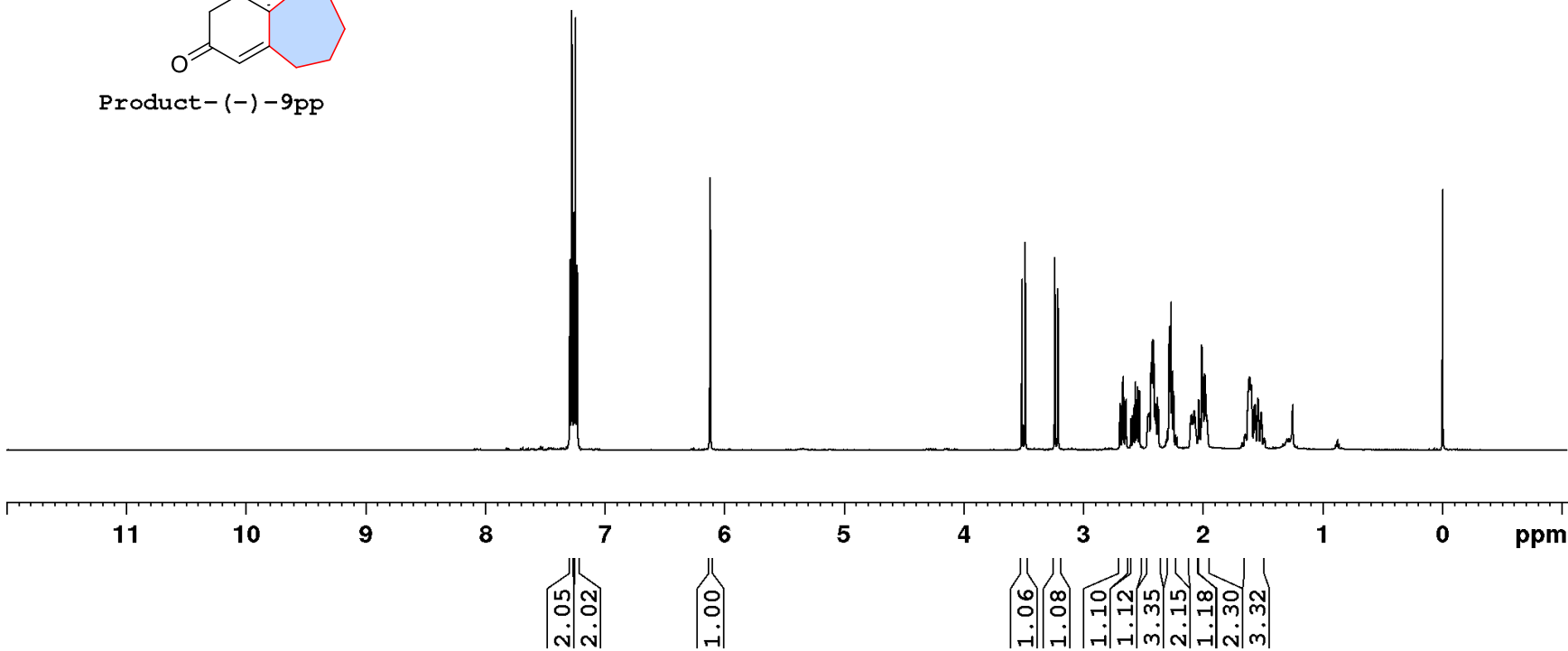
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 ppm

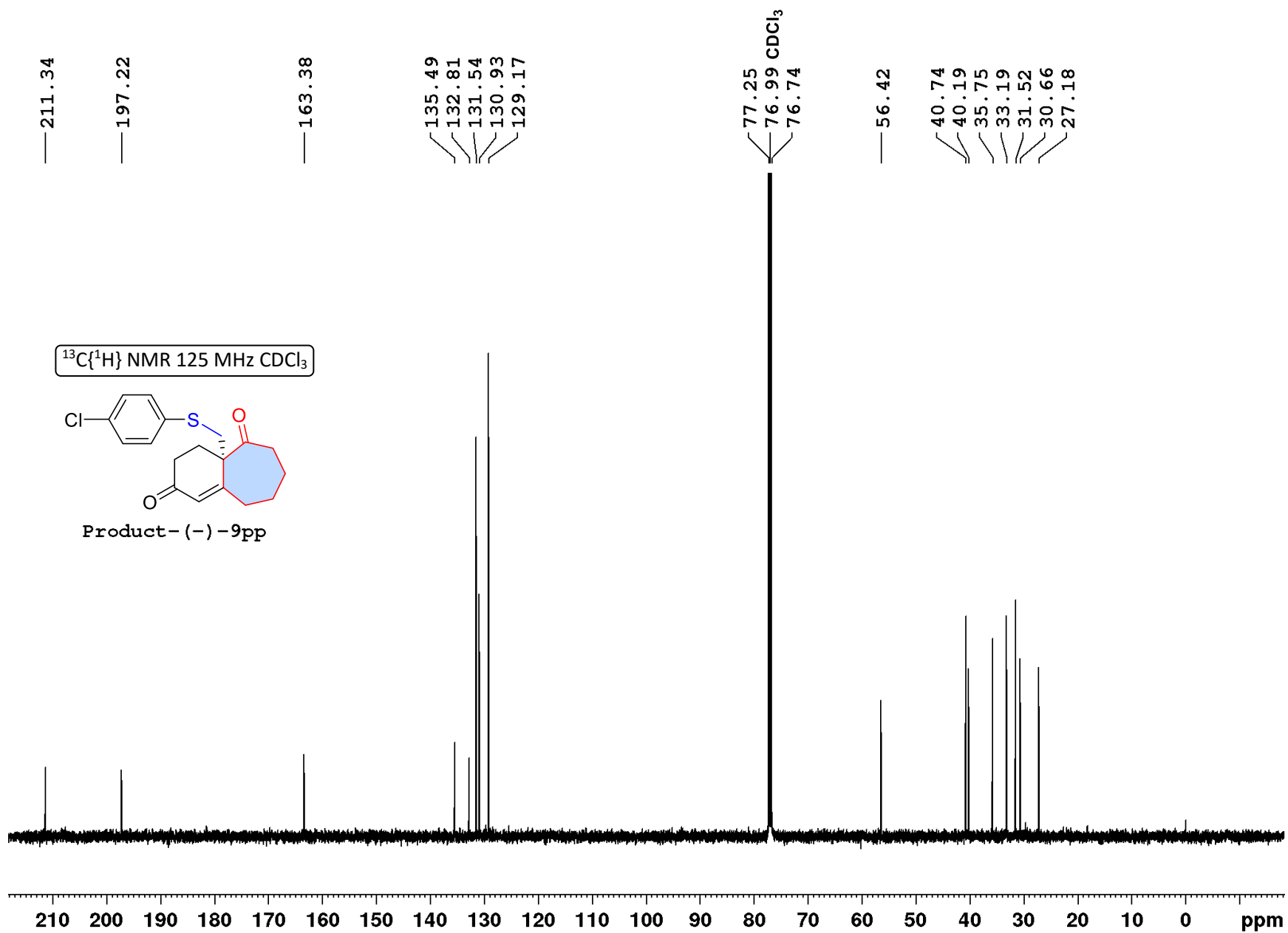
7.291
7.278
7.274
7.269
7.260CDCl₃
7.246
7.242
7.229
6.118
3.511
3.484
3.236
3.210
2.687
2.668
2.664
2.644
2.639
2.577
2.564
2.551
2.542
2.528
2.430
2.422
2.418
2.414
2.412
2.404
2.395
2.377
2.368
2.279
2.277
2.271
2.266
2.258
2.254
2.243
2.070
2.032
2.007
2.001
1.981
1.976
1.625
1.621
1.618
1.613
1.607
1.600
1.597
1.593
1.568
1.564
1.561
1.537
1.511

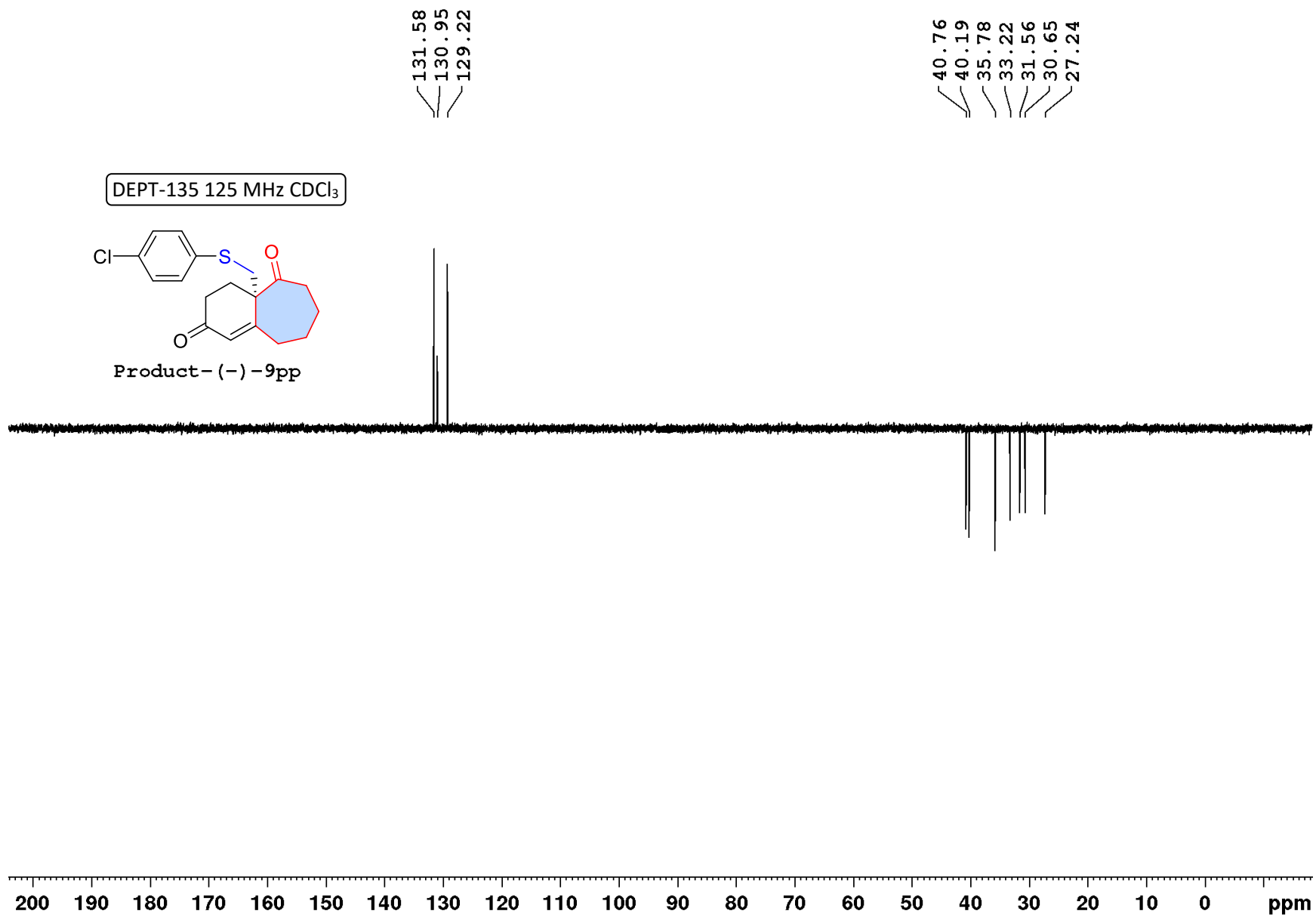
¹H NMR 500 MHz CDCl₃



Product - (-) -9pp



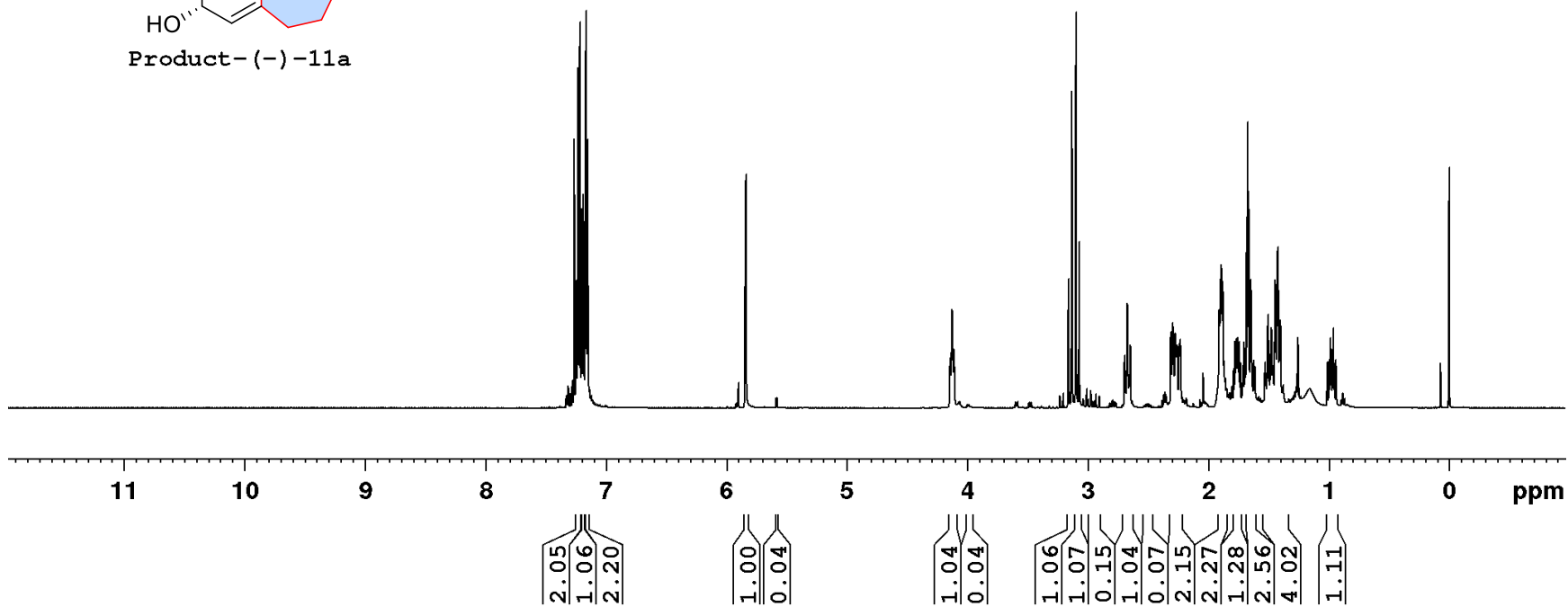
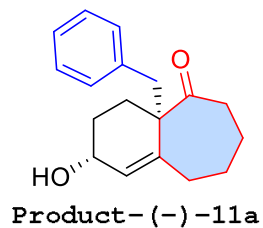


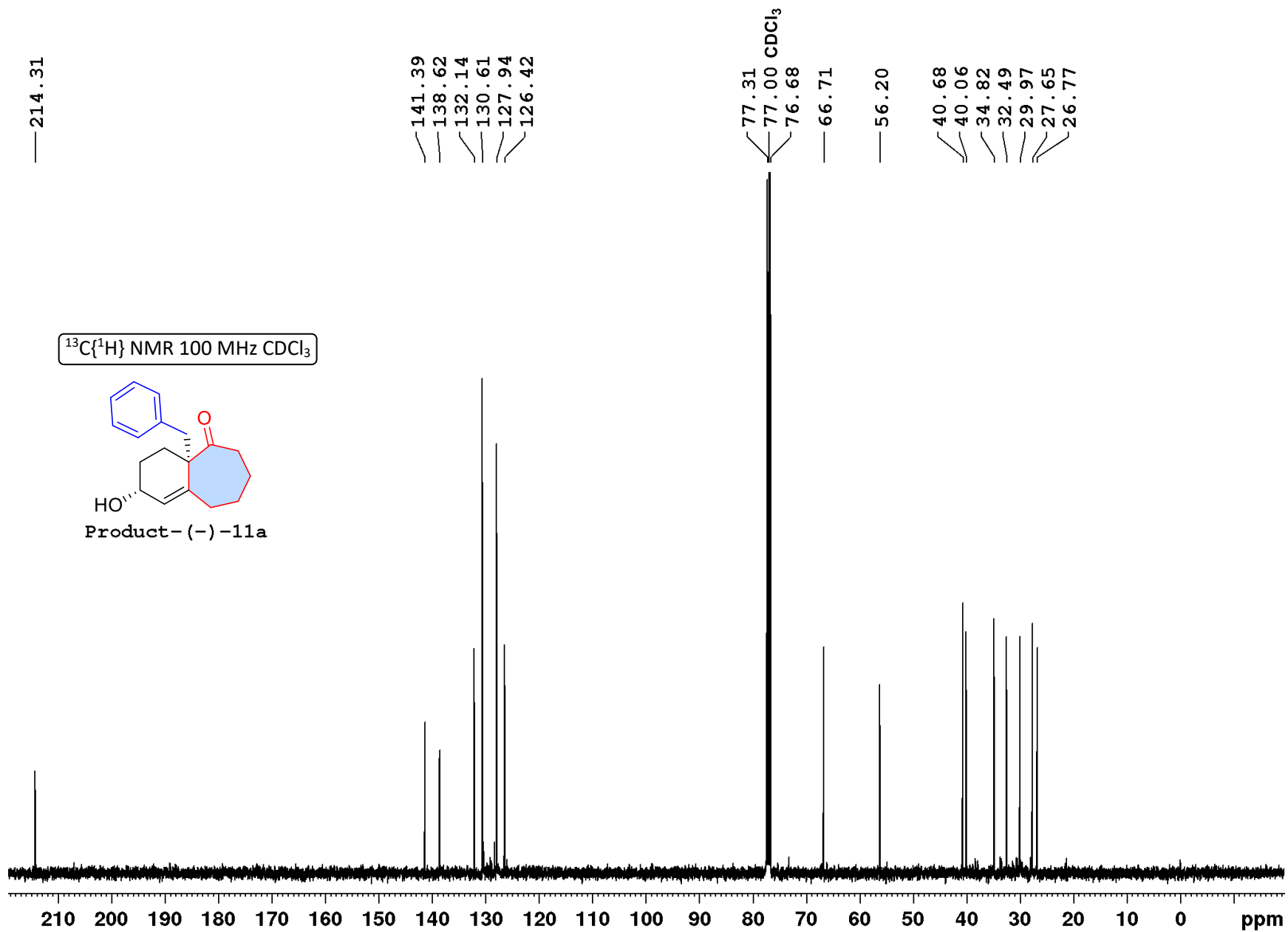


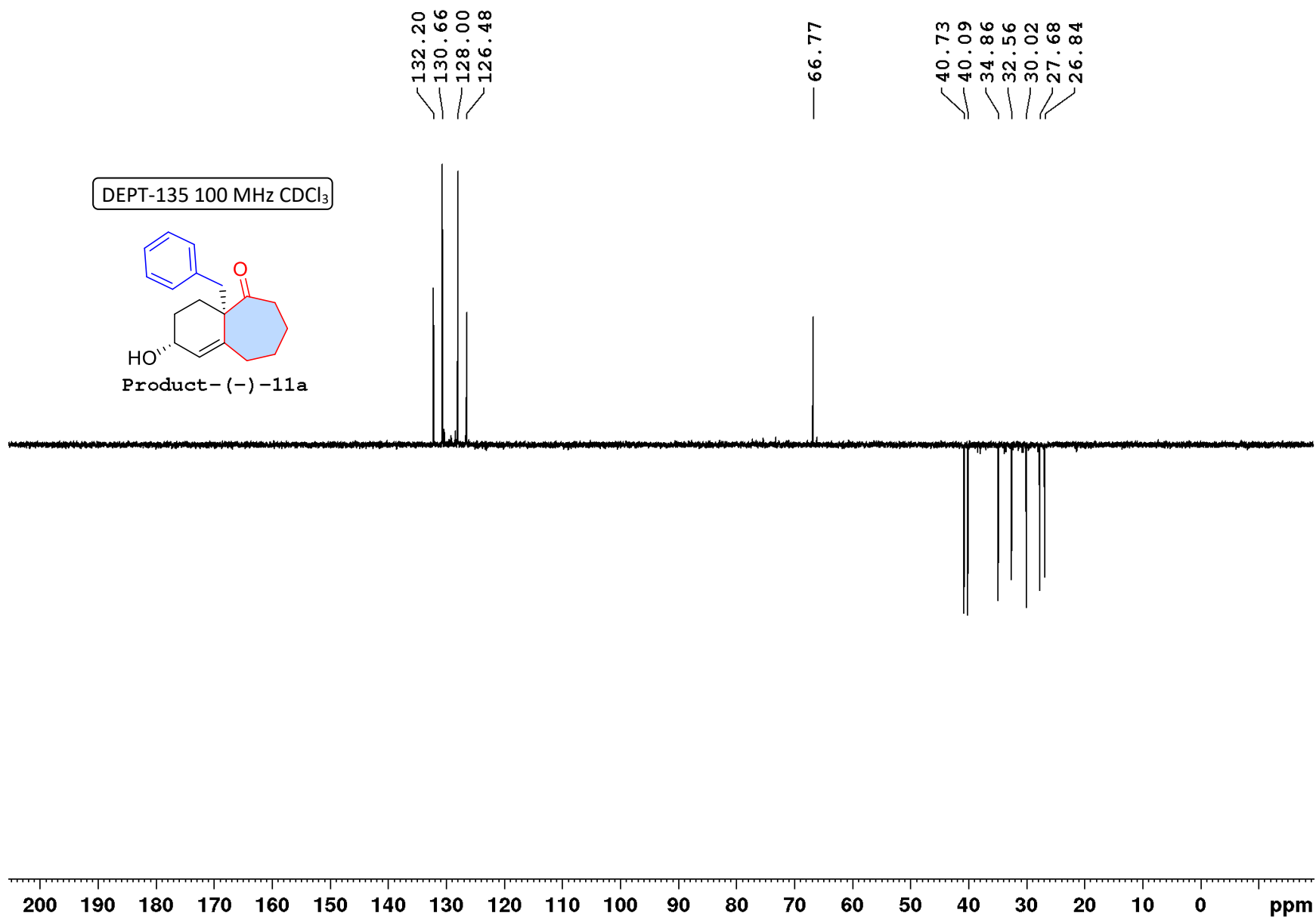
7.263 CDCl₃

7.245
7.232
7.228
7.220
7.217
7.216
7.201
7.198
7.187
7.168
7.165
7.152
5.842
5.837
4.126
3.160
3.133
3.098
3.070
2.675
2.671
2.667
2.310
2.297
2.294
2.288
2.275
2.273
1.908
1.905
1.902
1.898
1.894
1.893
1.890
1.885
1.879
1.875
1.753
1.683
1.673
1.664
1.648
1.640
1.504
1.500
1.478
1.474
1.445
1.443
1.438
1.426
1.423
1.421
1.418
1.402
0.961

¹H NMR 500 MHz CDCl₃

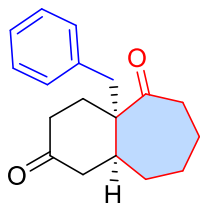




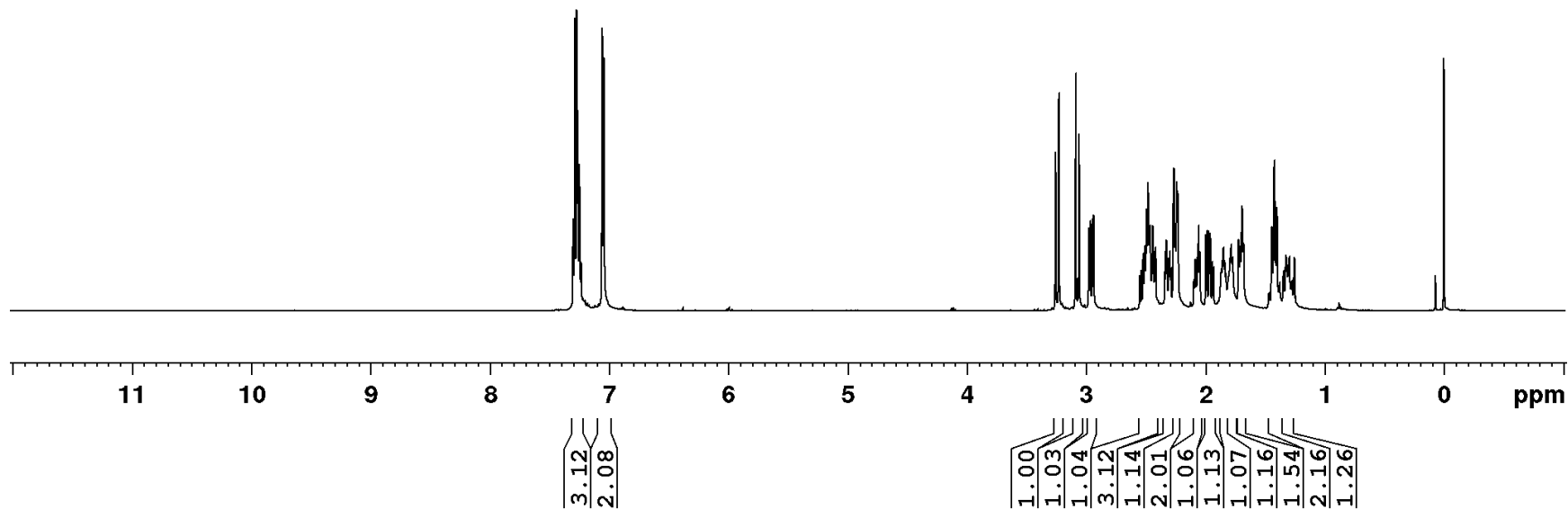


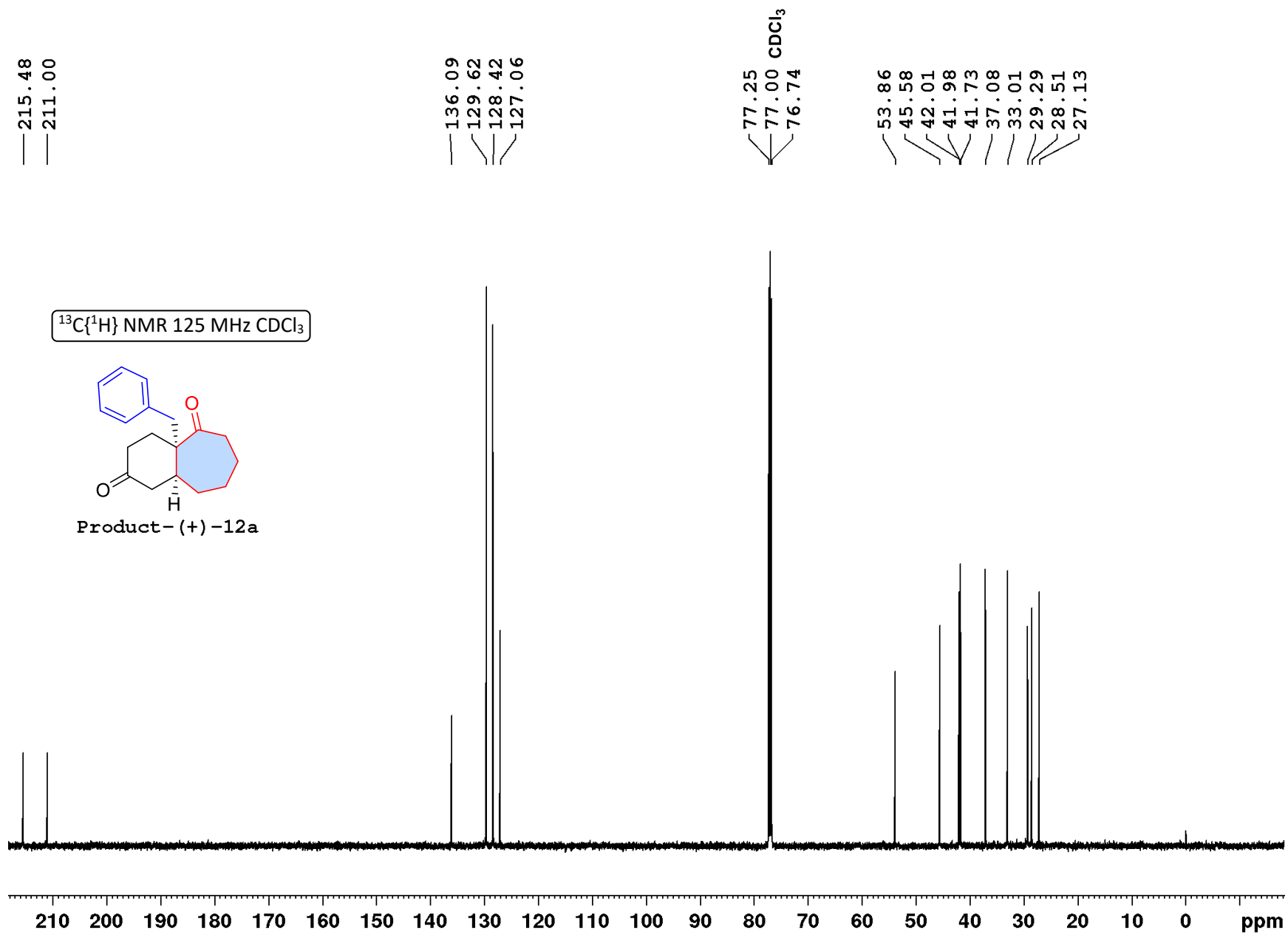
7.305
 7.301
 7.287
 7.284
 7.276
 7.273
 7.269
 7.267
 7.264
 7.261CDCl₃
 7.255
 7.250
 7.060
 7.057
 7.053
 7.044
 3.257
 3.229
 3.088
 3.060
 2.978
 2.966
 2.949
 2.937
 2.508
 2.496
 2.494
 2.482
 2.469
 2.463
 2.445
 2.440
 2.331
 2.328
 2.327
 2.270
 2.266
 2.263
 2.259
 2.251
 2.242
 2.237
 2.234
 2.230
 2.056
 1.997
 1.987
 1.972
 1.962
 1.848
 1.784
 1.722
 1.709
 1.694
 1.680
 1.443
 1.420
 1.401

¹H NMR 500 MHz CDCl₃

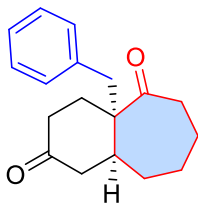


Product-(+)-12a





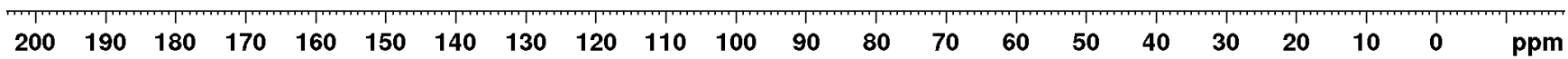
DEPT-135 125 MHz CDCl₃



Product-(+)-12a

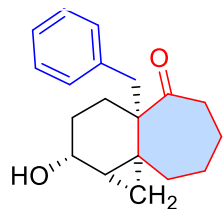
129.68
128.48
127.11

45.64
42.08
42.04
41.79
37.14
33.06
29.34
28.57
27.18

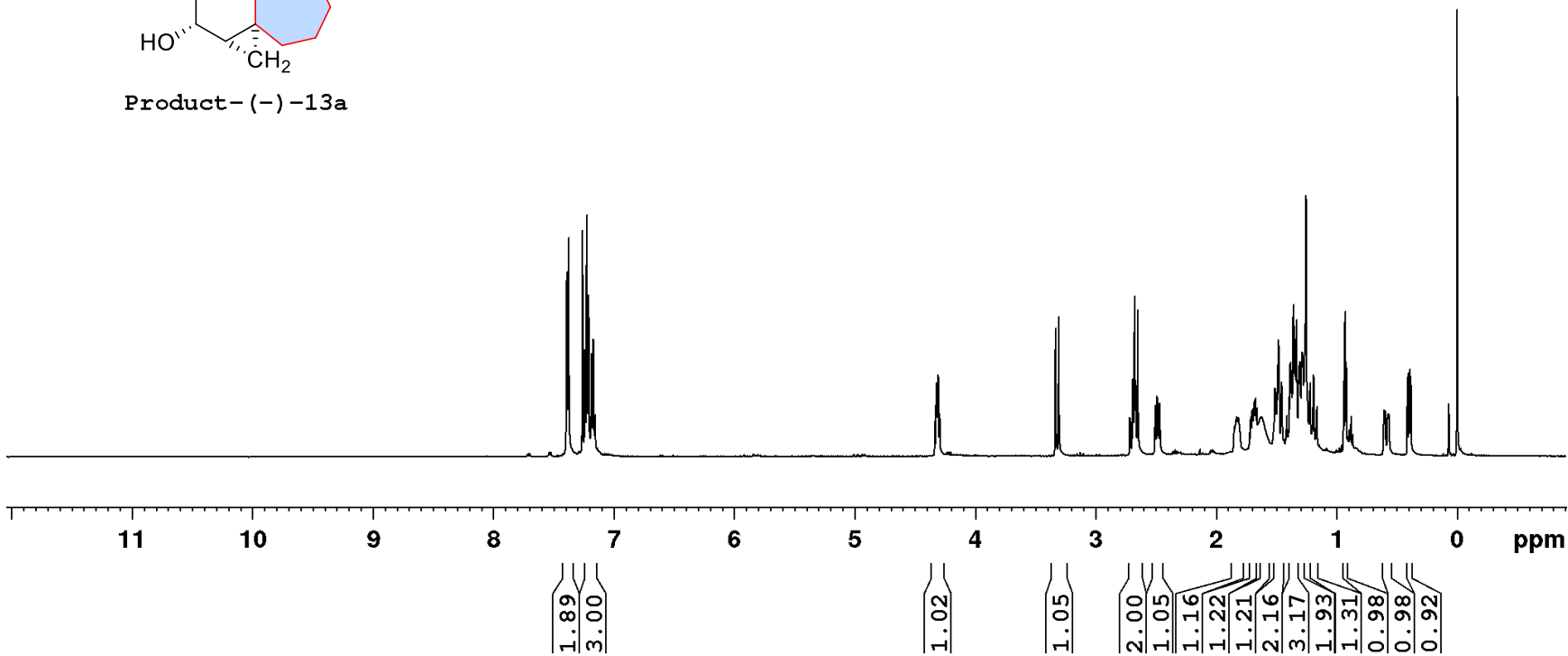


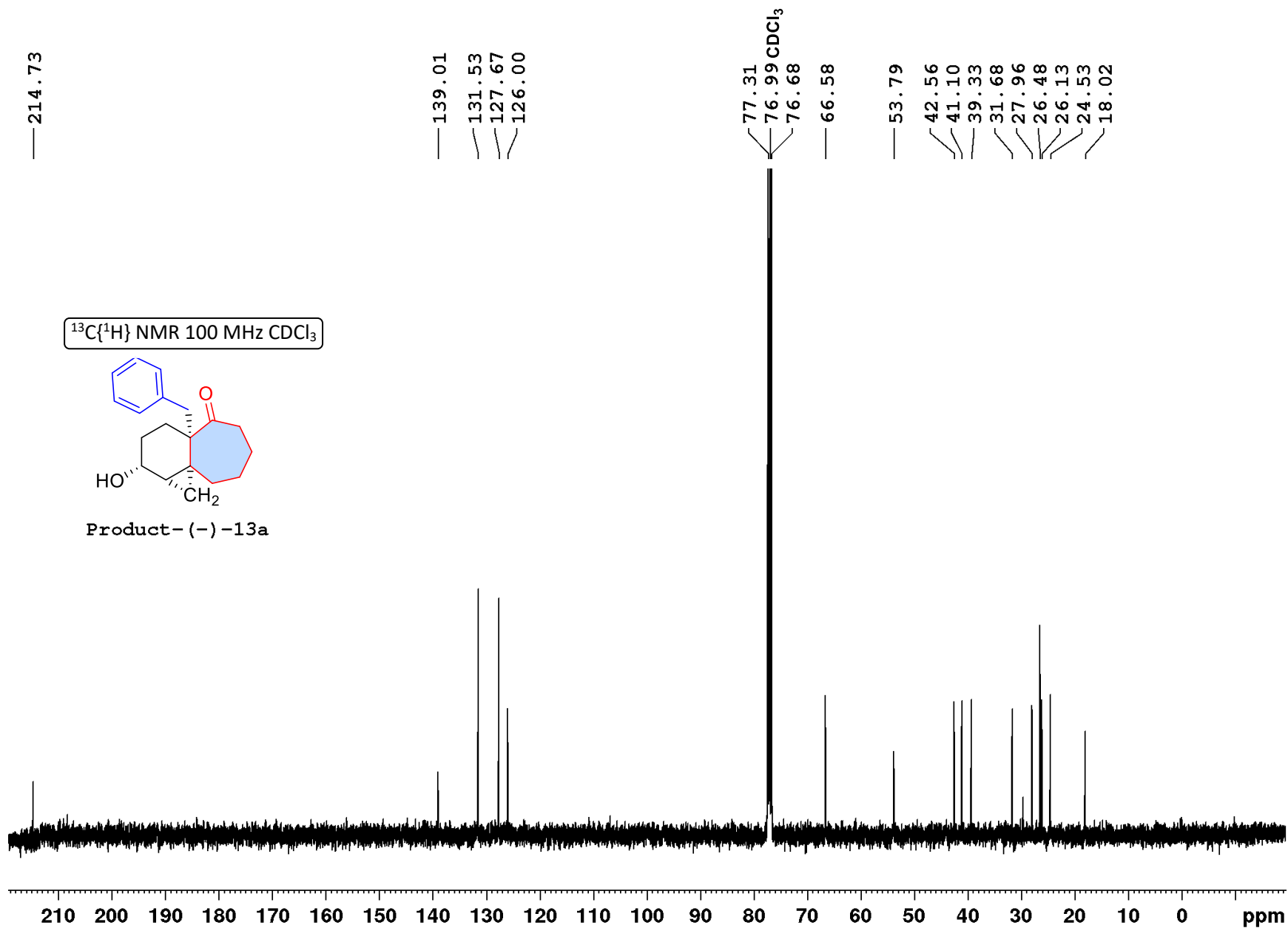
7.390
7.375
7.260 CDCl₃
7.239
7.225
7.209
7.184
7.169
4.321
4.316
4.311
4.305
3.331
3.305
2.692
2.689
2.675
2.667
2.663
2.648
2.488
2.484
2.481
2.466
1.680
1.671
1.509
1.501
1.486
1.479
1.472
1.458
1.449
1.392
1.385
1.379
1.371
1.356
1.350
1.340
1.330
1.312
1.305
1.296
1.289
1.283
1.278
1.221
1.217
1.191
1.186
0.938
0.928
0.917
0.409
0.399
0.392
0.381

¹H NMR 500 MHz CDCl₃

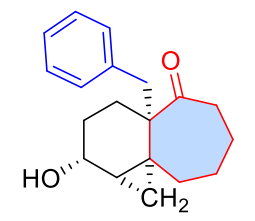


Product-(-)-13a





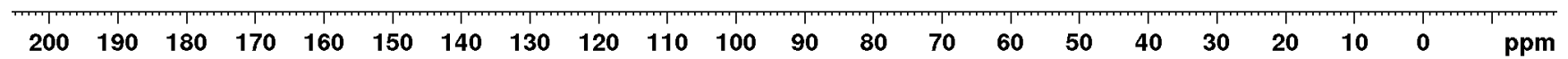
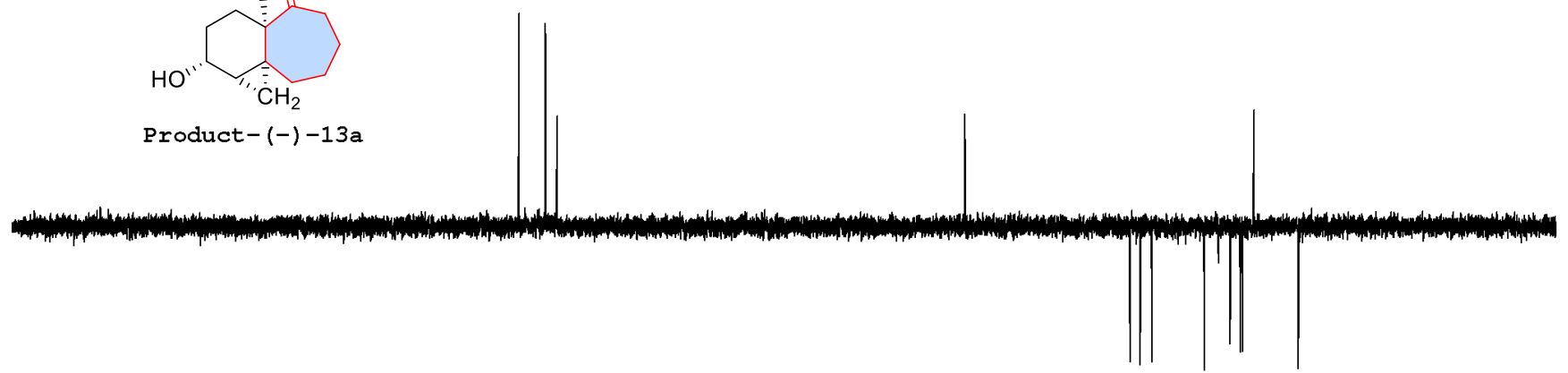
DEPT-135 100 MHz CDCl₃



131.56
127.71
126.04

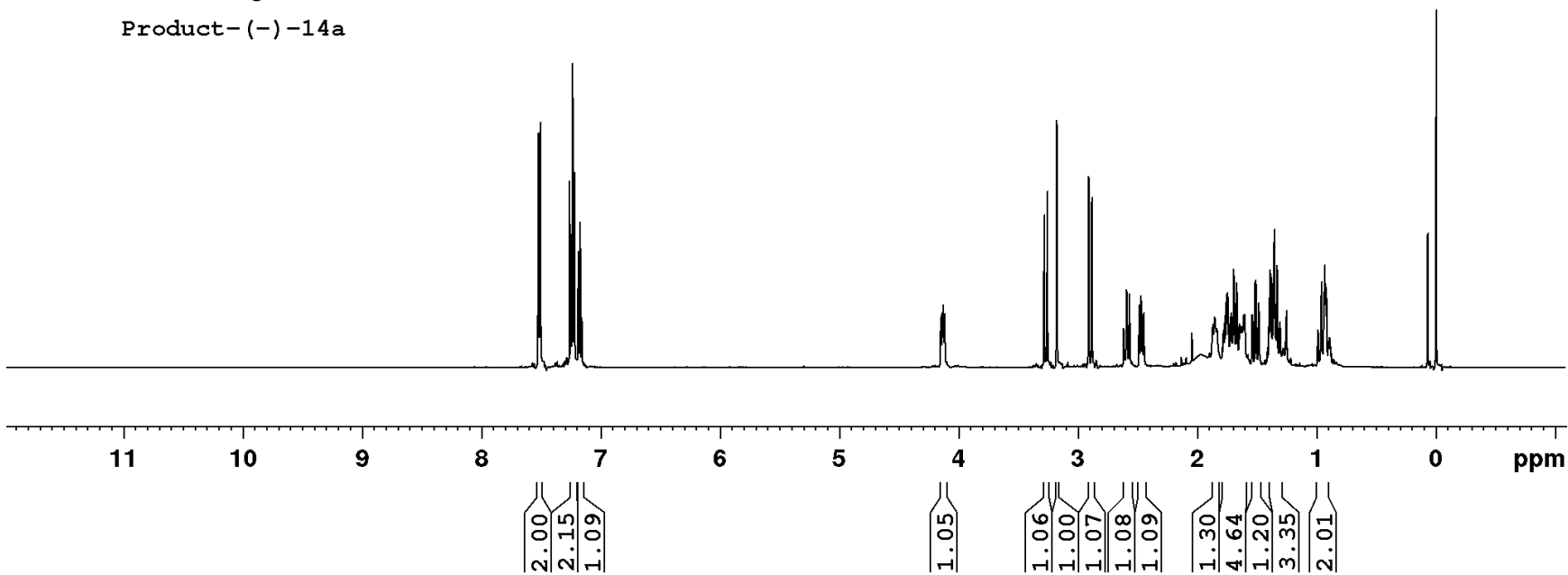
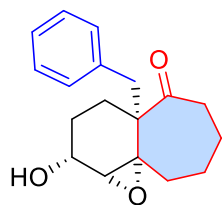
66.64

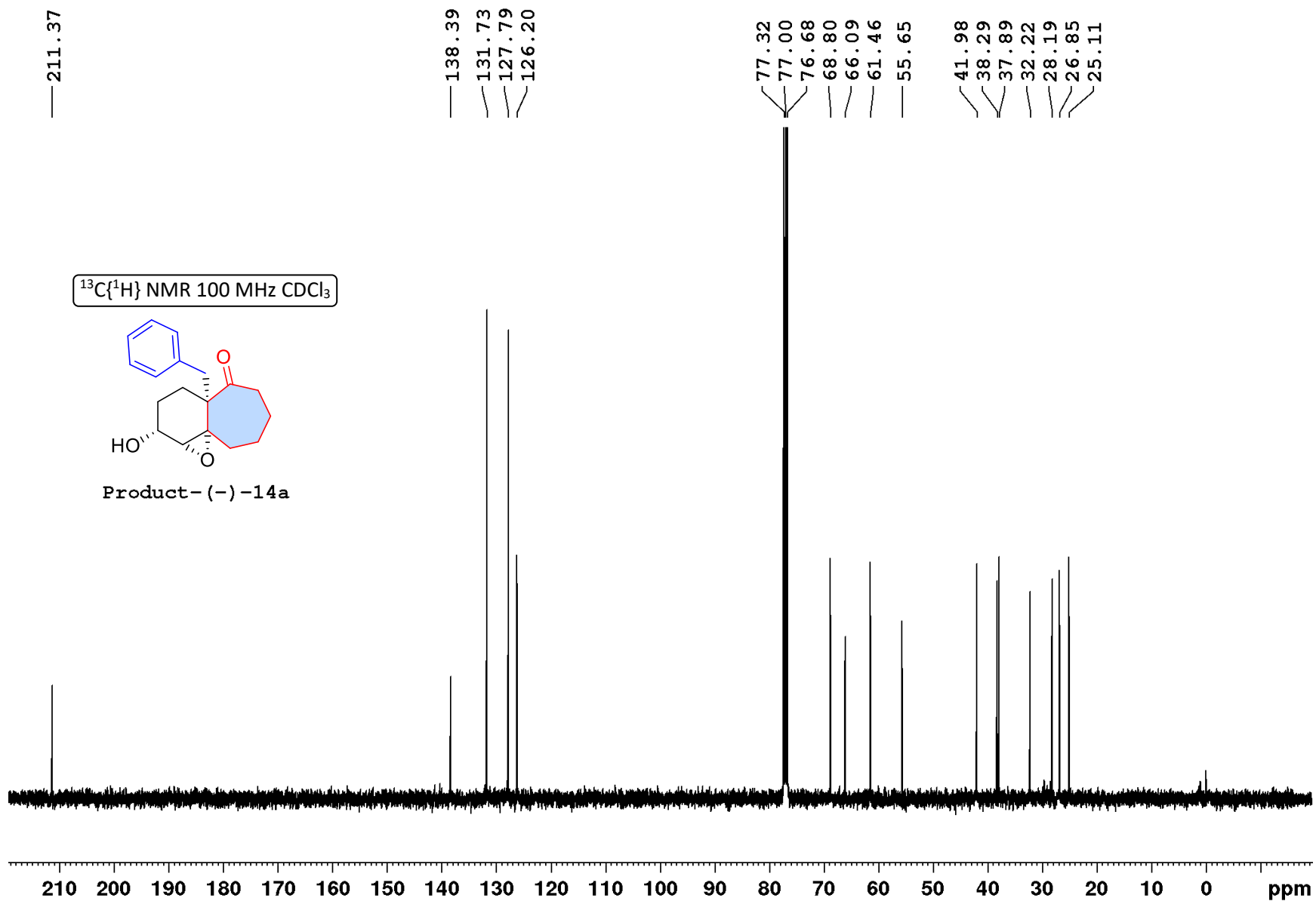
42.58
41.11
39.37
31.73
28.00
26.50
26.18
24.55
18.07



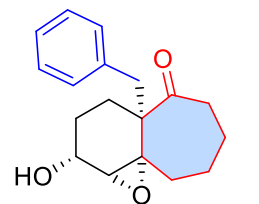
7.523
7.520
7.506
7.260 CDCl₃
7.249
7.235
7.232
7.222
7.219
7.188
7.186
7.183
7.171
4.134
4.125
4.114
3.280
3.254
3.175
2.907
2.880
2.589
2.587
2.566
2.482
2.469
2.446
1.752
1.751
1.743
1.742
1.712
1.692
1.686
1.672
1.666
1.606
1.539
1.511
1.504
1.484
1.477
1.394
1.387
1.385
1.379
1.359
1.356
1.351
1.334
1.328
0.959
0.954
0.936
0.930
0.923
0.919
0.912

¹H NMR 500 MHz CDCl₃





DEPT-135 100 MHz CDCl₃



Product-(-)-14a

131.77
127.84
126.25

68.84
61.50

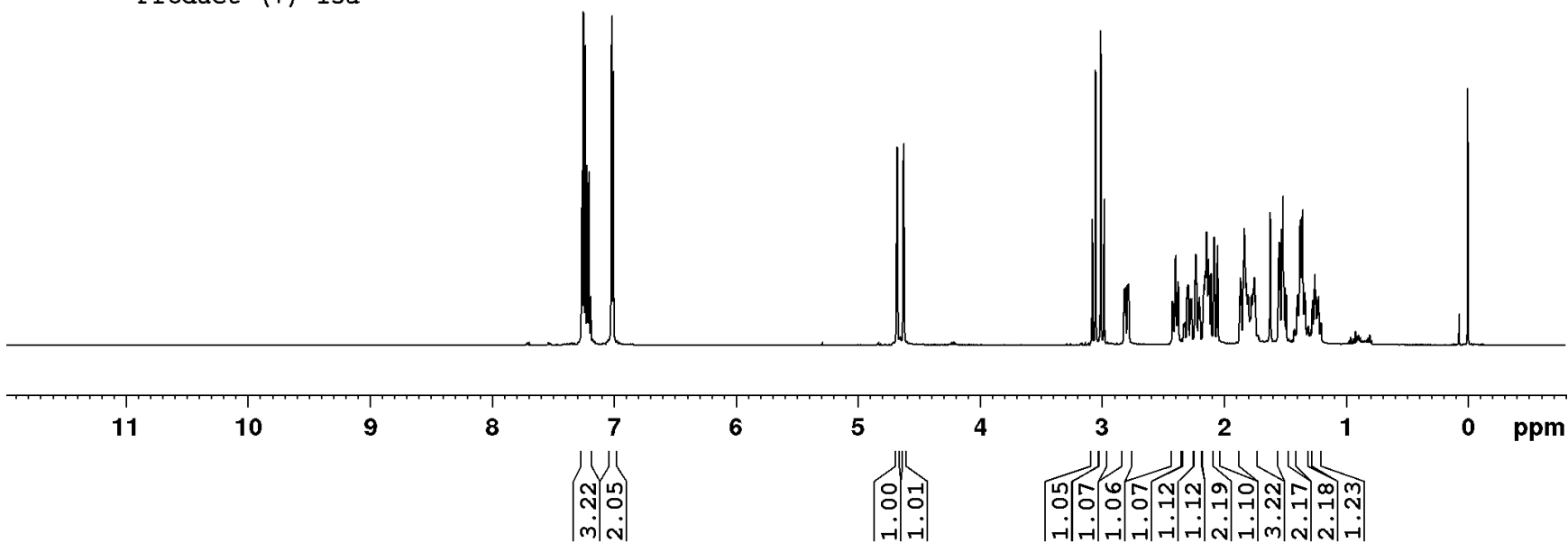
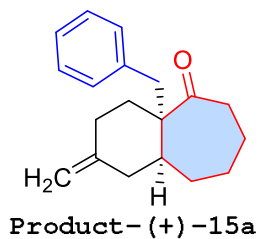
42.02
38.34
37.92
32.27
28.23
26.90
25.13

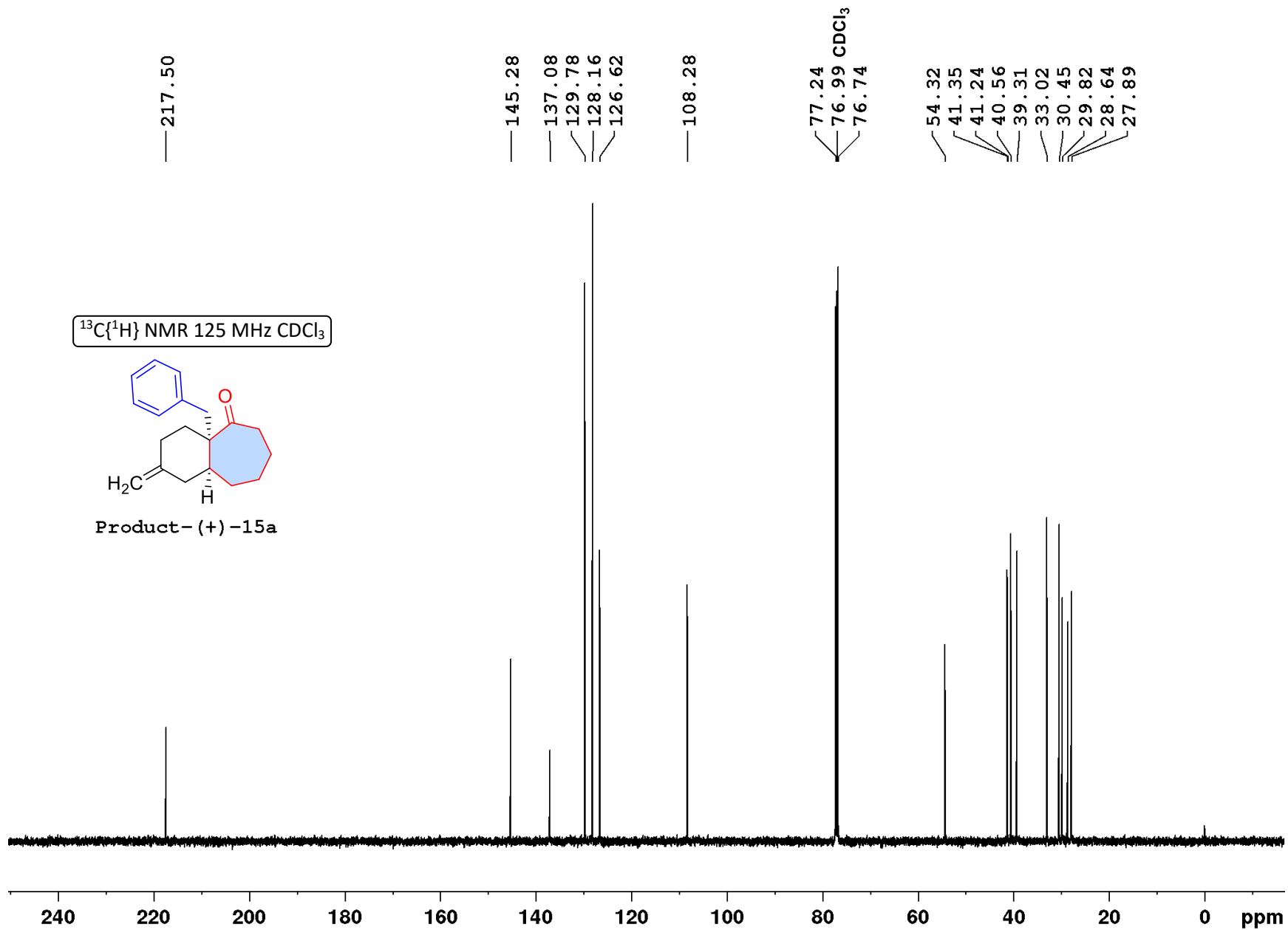


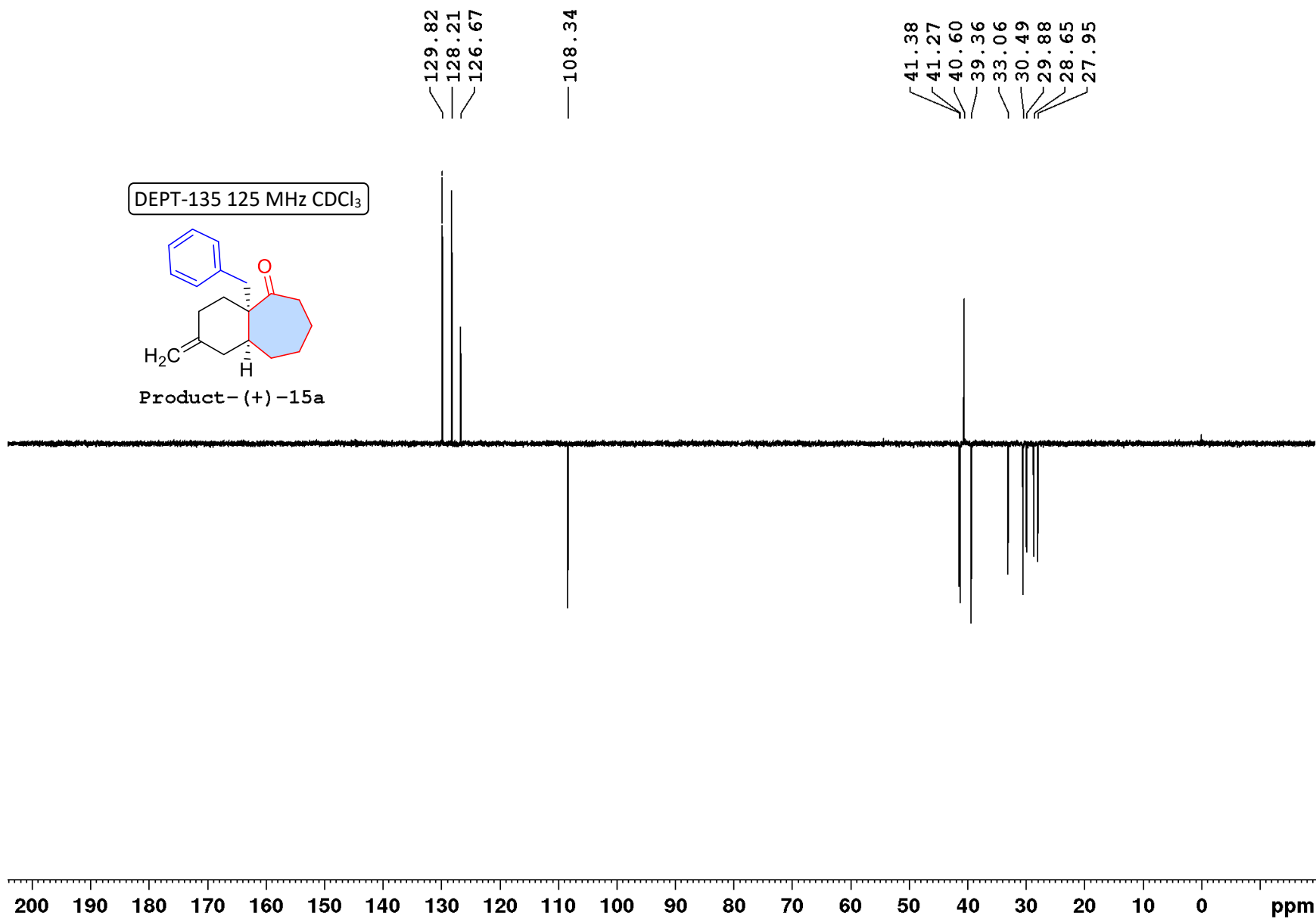
200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 ppm

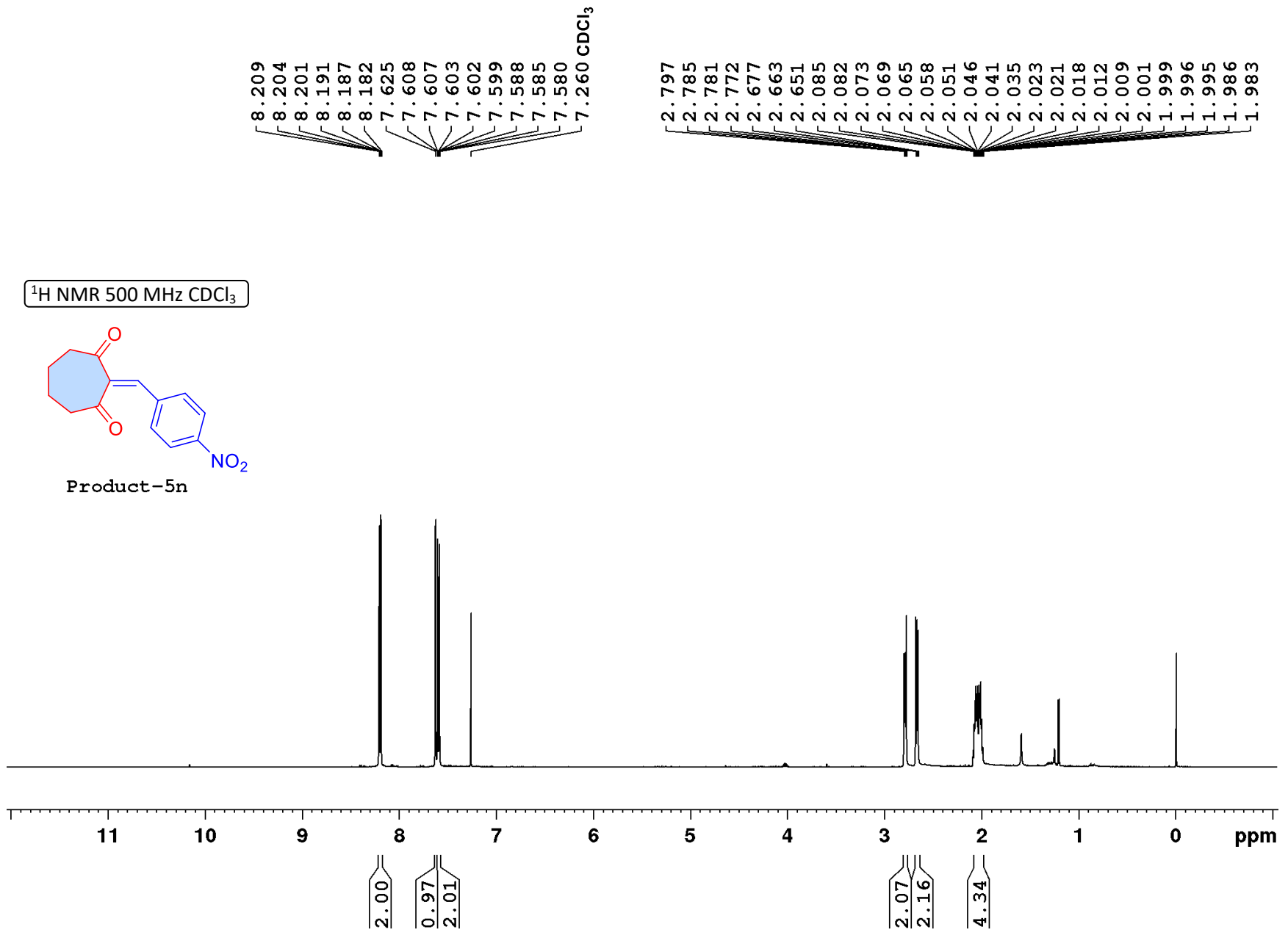
7.266
7.263
7.258CDCl₃
7.249
7.246
7.237
7.234
7.222
7.219
7.216
7.205
7.021
7.018
7.014
7.005
4.680
4.677
4.626
4.622
3.078
3.051
3.008
2.981
2.400
2.396
2.375
2.233
2.229
2.224
2.151
2.142
2.139
2.127
2.124
2.119
2.104
2.083
2.079
2.074
2.056
2.052
2.047
1.862
1.833
1.830
1.828
1.817
1.749
1.553
1.550
1.543
1.525
1.515
1.508
1.374
1.364
1.356
1.254

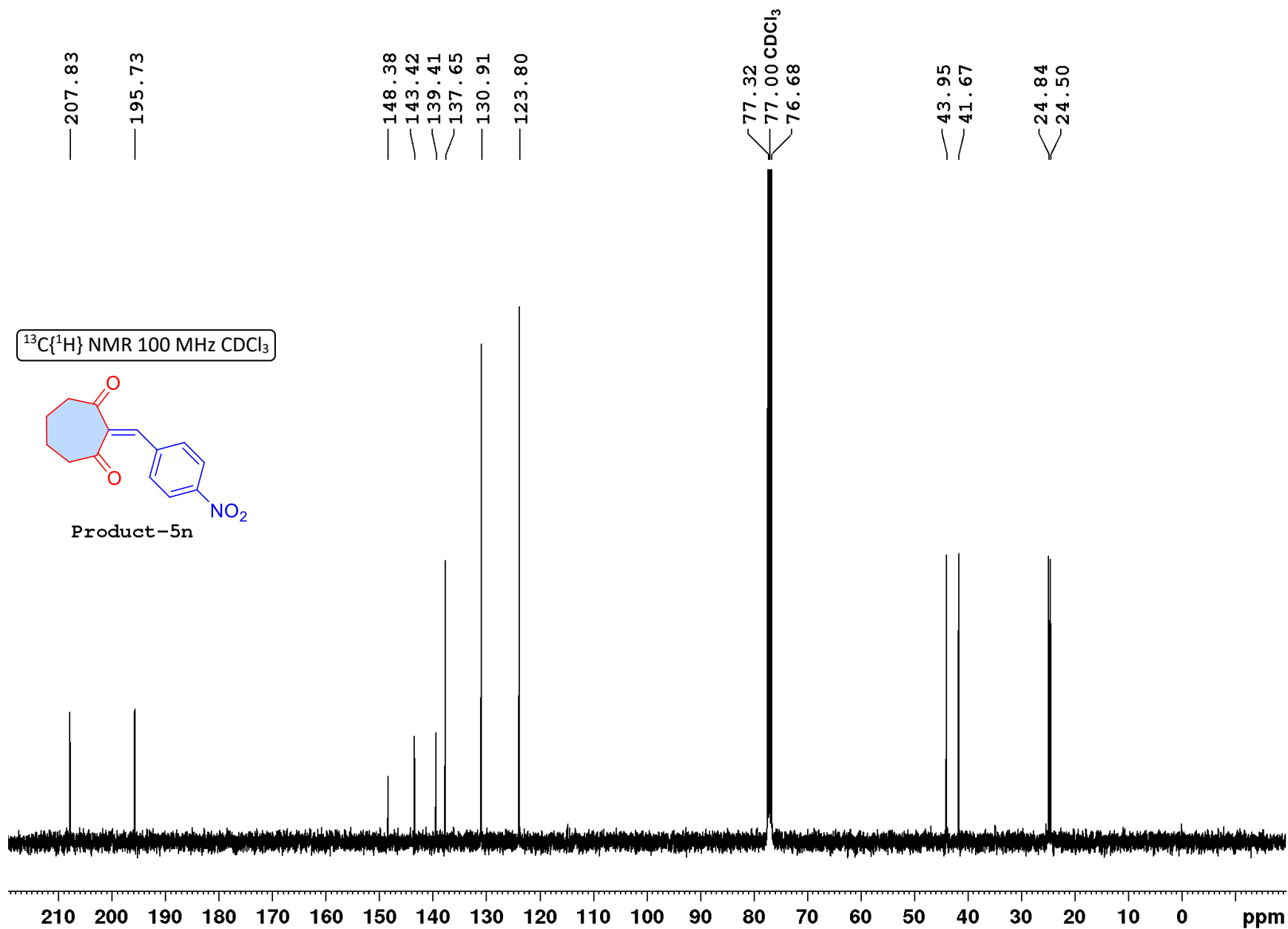
¹H NMR 500 MHz CDCl₃



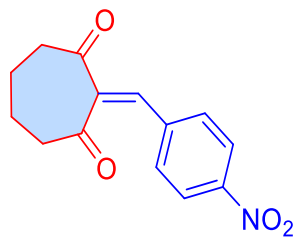








DEPT-135 100 MHz CDCl₃



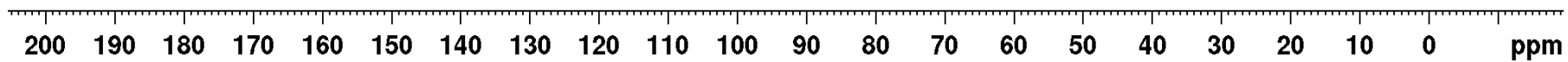
137.688

130.945

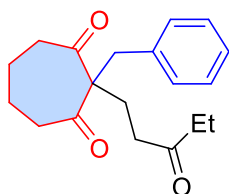
123.837

43.977
41.703

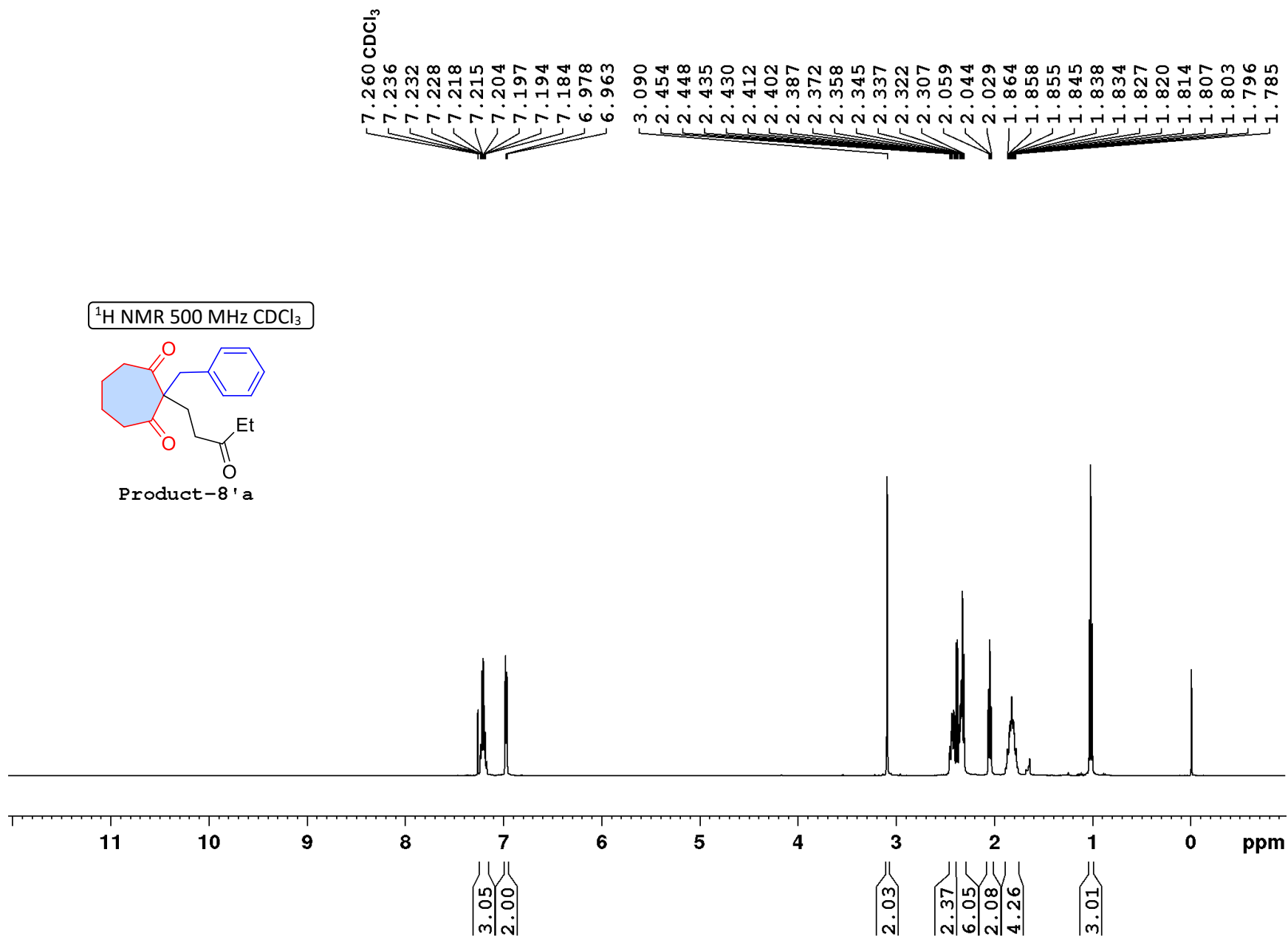
24.867
24.529

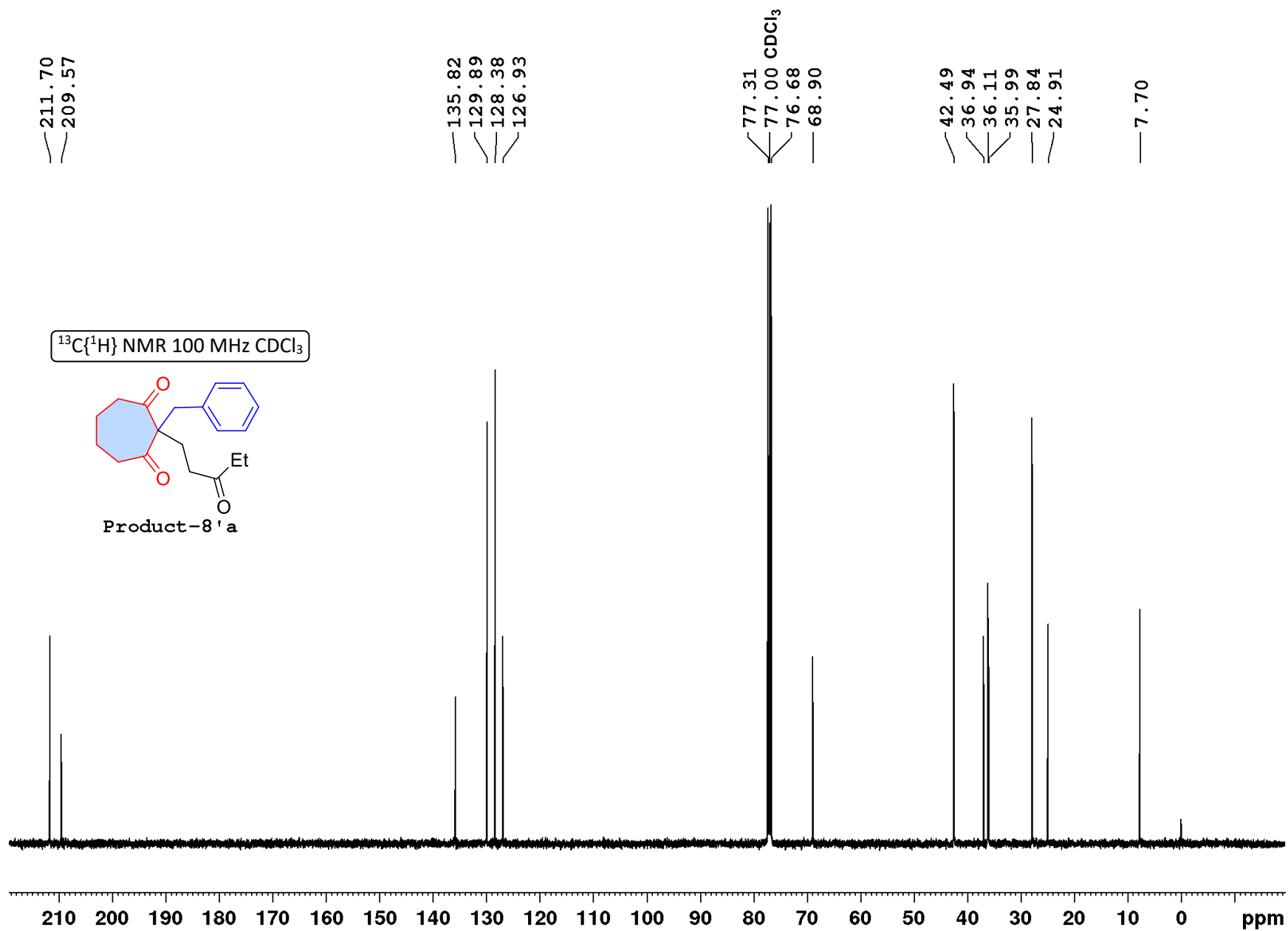


¹H NMR 500 MHz CDCl₃

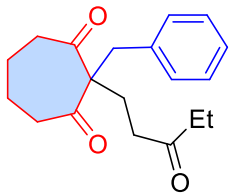


Product-8'a

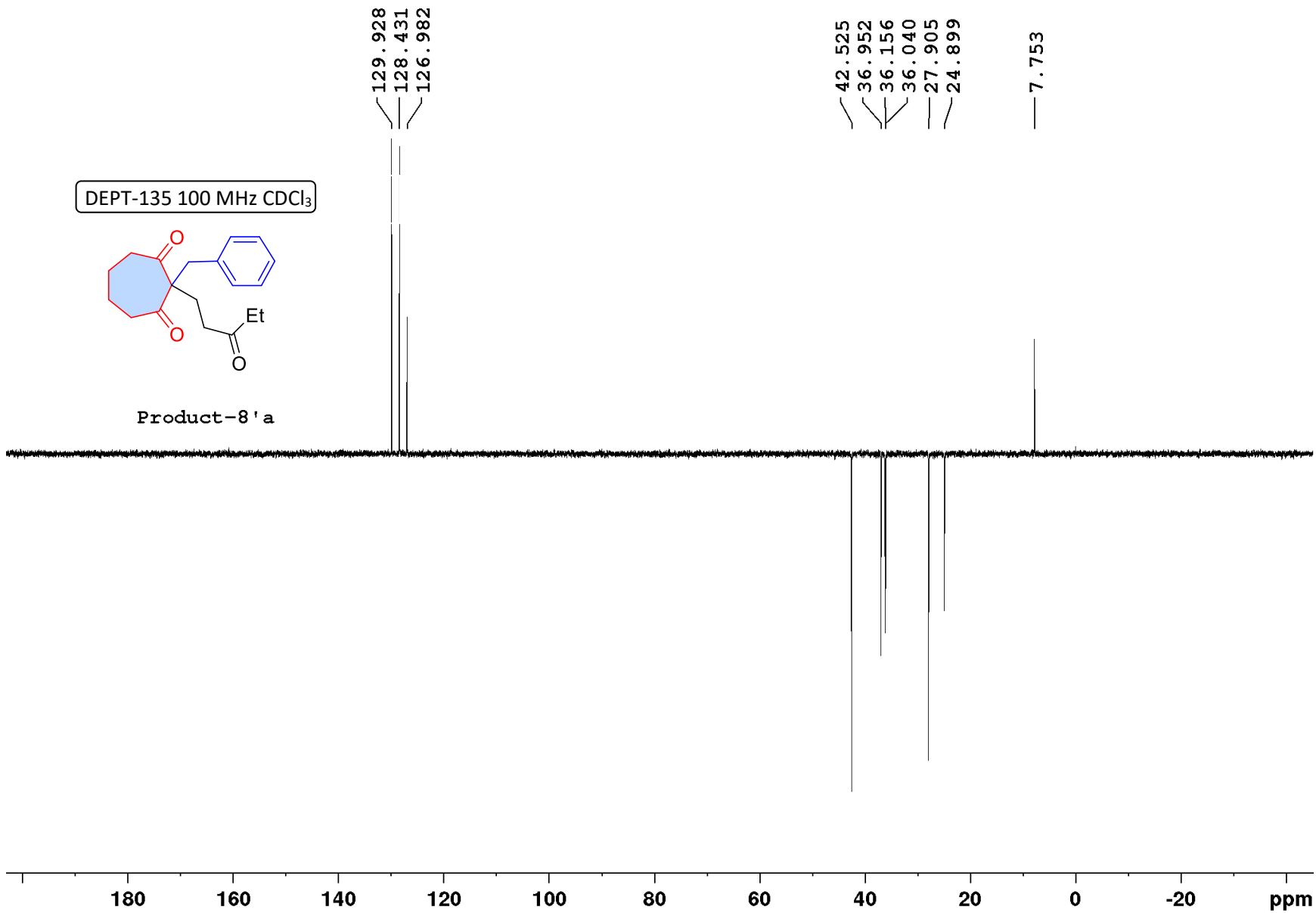




DEPT-135 100 MHz CDCl₃



Product-8'a



7.260 CDCl₃

