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Supporting Information

Aerobic Photooxidative Direct Asymmetric Aldol Reactions of Benzyl Alcohols Using Water as the Solvent

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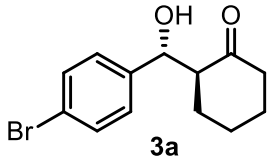
1. General Information.

All dry solvents were obtained from Kanto Kagaku Co., Ltd. Other chemicals used were of reagent grade and were obtained from Tokyo Kasei Kogyo Co., Ltd., Wako Pure Chemical Industries, Ltd., and Aldrich Chemical Co. ^{1}H NMR and ^{13}C NMR spectra were obtained on a JEOL ECA 500 at room temperature in $CDCl_3$ as a solvent (500 MHz for ^{1}H NMR and 125 MHz for ^{13}C NMR). Chemical shifts (δ) are expressed in parts per million and are internally referenced [0.00 ppm (tetramethylsilane) for ^{1}H NMR and 77.0 ppm ($CDCl_3$) for ^{13}C NMR]. The pure product was obtained by preparative TLC or flash silicagel chromatography. Preparative thin-layer chromatography (TLC) was carried out on precoated plates of silica gel (MERCK, silica gel F-254, YMC-GEL (8 nm S-25μm)). Flash column chromatography was performed with Silica Gel 60N (Kanto Chemical Co., Inc., 40−50 μm spherical, neutral).

2. General Procedure

Synthesis of (*2S, 1'R*)-2-[Hydroxy(4-bromophenyl)methyl]cyclohexan-1-one (3a) (Table 3, Entry 10): A mixture of 4-bromobenzylalcohol (**1a**, 0.3 mmol), anthraquinone-2-sodiumsulfonate monohydrate (0.03 mmol), cyclohexanone (1.5 mmol), *trans*-4-*tert*-butyldiphenylsiloxy (TBDPS)-L-proline (0.03 mmol) in H_2O (3 mL) and AcOH (0.15 mmol) as stirred under air (open) with irradiation of 23 W fluorescent lamp (Philips: mini Decorative T2 Twister EL/mdT2, 23W, 120 V, 60 Hz, 360 mA, 2700 K, Lumens: 1600) for 48 h. The reaction mixture was washed with brine (5 mL) extracted with EtOAc (20 mL × 3), dried over magnesium sulfate, and concentrated *in vacuo*. Purification of the crude product by preparative thin-layer chromatography (chloroform: methanol = 60: 1) provided (*2S, 1'R*)-2-[Hydroxy(4-bromophenyl)methyl]cyclohexan-1-one (**3a**) (60.2 mg, 71%).

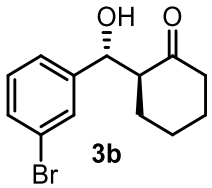
(*2S, 1'R*)-2-[Hydroxy(4-bromophenyl)methyl]cyclohexan-1-one (3a) [1,2,3,4,5] **(Table 4)**



3a

HPLC analysis chiralpak AS-H (*i*-PrOH: hexane = 2: 98, 0.5 mL/ min, 217 nm) t_{major} = 56.3 min and t_{minor} = 60.9 min. ^{1}H NMR (500 MHz, $CDCl_3$): δ 1.26-1.33 (m, 1H), 1.50-1.72 (m, 3H),1.79-1.82 (m, 1H), 2.07-2.11 (m, 1H), 2.32-2.36 (m, 1H), 2.45-2.58 (m, 2H), 4.00 (d, *J*= 2.9 Hz, 1H), 4.74 (d, *J*= 2.9, 9.2 Hz, 1H), 7.19-7.21 (d, *J*= 8.0 Hz, 2H), 7.46-7.49 (m, 2H). ^{13}C NMR (125 Hz, $CDCl_3$): δ 24.67, 27.69, 30.71, 42.64, 57.28, 74.16, 121.69, 128.71, 131.45, 139.93, 215.33.

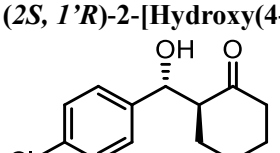
(*2S, 1'R*)-2-[Hydroxy(3-bromophenyl)methyl]cyclohexan-1-one (3b)[2] **(Table 4)**



3b

HPLC analysis chiralpak AD-H (*i*-PrOH: hexane = 10: 90, 0.5 mL/ min, 210 nm) t_{major} = 27.9 min and t_{minor} = 28.3 min. ^{1}H NMR (500 MHz, $CDCl_3$): δ 1.26-1.39 (m, 1H), 1.52-1.75 (m, 3H),1.78-1.89 (m, 1H), 2.07-2.13 (m, 1H), 2.33-2.40 (m, 1H), 2.42-2.51 (m, 1H), 2.55-2.60 (m, 1H), 4.02 (d, *J*= 2.9 Hz, 1H), 4.74 (d, *J* = 2.9, 9.2 Hz, 1H), 7.19-7.25 (m, 2H), 7.42 (m, 1H), 7.49 (m, 1H). ^{13}C NMR (125 Hz, $CDCl_3$): δ 24.65, 27.70, 30.74, 42.65, 57.22, 74.21, 122.55, 125.75, 129.87, 129.99, 130.97, 143.22, 215.30.

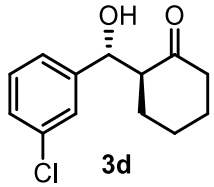
(*2S, 1'R*)-2-[Hydroxy(4-chlorophenyl)methyl]cyclohexan-1-one (3c) [1,2,4,6] **(Table 4)**



3c

HPLC analysis chiralpak AD-H (*i*-PrOH: hexane = 10: 90, 0.5 mL/ min, 254 nm) t_{minor} = 25.4 min and t_{major} = 31.7 min. ^{1}H NMR (500 MHz, $CDCl_3$): δ 1.24-1.33 (m, 1H), 1.50-1.70 (m, 3H), 1.78-1.82 (m, 1H), 2.06-2.12 (m, 1H), 2.32-2.39 (m, 1H), 2.46-2.50 (m, 1H), 2.53-2.59 (m, 1H), 4.01 (d, *J*= 2.9 Hz, 1H), 4.76 (dd, *J*= 2.3, 8.6 Hz, 1H), 7.25 (m, 2H), 7.31 (m, 2H). ^{13}C NMR (125 Hz, $CDCl_3$): δ 24.80, 27.82, 30.84, 42.77, 57.45, 74.22, 121.49, 128.63, 131.66, 139.55, 215.49.

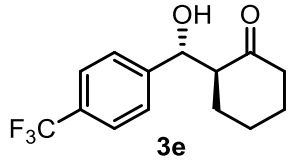
(*2S, 1'R*)-2-[Hydroxy(3-chlorophenyl)methyl]cyclohexan-1-one (3d) [2] **(Table 4)**



3d

HPLC analysis chiralpak AD-H (*i*-PrOH: hexane = 10: 90, 0.5 mL/ min, 210 nm) t_{major} = 26.4 min and t_{minor} = 29.0 min. ^{1}H NMR (500 MHz, $CDCl_3$): δ 1.25-1.35 (m, 1H), 1.51-1.72 (m, 3H), 1.73-1.87 (m, 1H), 2.06-2.13 (m, 1H), 2.32-2.41 (m, 1H), 2.45-2.50 (m, 1H), 2.55-2.61 (m, 1H), 4.04 (d, *J*= 2.3 Hz, 1H), 4.75 (d, *J*= 2.3, 10.9 Hz, 1H), 7.16-7.20 (m, 1H), 7.25-7.27 (m, 2H), 7.33 (br-s, 1H). ^{13}C NMR (125 Hz, $CDCl_3$): δ 24.61, 27.67, 30.69, 42.60, 57.18, 74.17, 125.25, 127.06, 127.98, 129.55, 134.24, 142.96, 215.24.

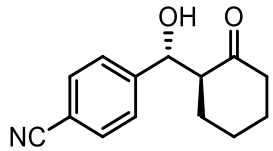
(*2S, 1'R*)-2-[Hydroxy(4-trifluoromethylphenyl)methyl]cyclohexan-1-one (3e) [3,5,6] **(Table 4)**



3e

HPLC analysis chiralpak OD-H (*i*-PrOH: hexane = 20: 80, 0.5 mL/ min, 210 nm) t_{major} = 12.4 min and t_{minor} = 13.9 min. ^{1}H NMR (500 MHz, $CDCl_3$): δ 1.33-1.38 (m, 1H), 1.51-1.72 (m, 3H), 1.80-1.83 (m, 1H), 2.09-2.13 (m, 1H), 2.33-2.40 (m, 1H), 2.48-2.62 (m, 2H), 4.04 (d, *J*= 2.9 Hz, 1H), 4.84 (dd, *J*= 2.9, 8.6 Hz, 1H), 7.45 (d, *J*= 8.6 Hz, 2H), 7.61 (d, *J*= 8.0 Hz, 2H). ^{13}C NMR (125 Hz, $CDCl_3$): δ 24.66, 27.68, 30.72, 42.65, 57.22, 74.23, 125.27, 125.30, 127.33, 130.02, 144.90, 215.15.

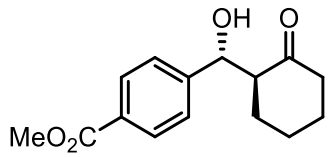
4-((*R*)-Hydroxy((*S*)-2-oxocyclohexyl)methyl)benzonitrile (3f) [1,3,4,5,6] **(Table 4)**



3f

HPLC analysis chiralpak AD-H (*i*-PrOH: hexane = 10: 90, 0.5 mL/ min, 254 nm) t_{minor}= 48.0 min and t_{major} = 61.7 min. ^{1}H NMR (500 MHz, $CDCl_3$) δ 1.31-1.39 (m, 1H), 1.51-1.71 (m, 3H), 1.78-1.84 (m, 1H), 2.09-2.14 (m, 1H), 2.33-2.40 (m, 1H), 2.48 (m, 1H), 2.50-2.59 (m, 1H), 4.09 (d, *J*= 2.9 Hz, 1H), 4.84 (dd, *J*= 2.9, 8.6 Hz, 1H), 7.45 (d, *J*= 8.0 Hz, 2H), 7.64 (d, *J*= 8.0 Hz, 2H). ^{13}C NMR (125 Hz, $CDCl_3$) δ 24.57, 27.56, 30.62, 42.57, 57.02, 74.07, 111.53, 118.80, 127.70, 132.09, 146.29, 214.81.

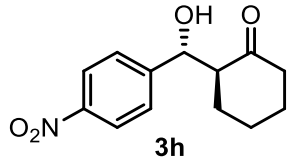
Methyl 4-((*R*)-hydroxy((*S*)-2-oxocyclohexyl)methyl)benzoate (3g)[1,4] **(Table 4)**



3g

HPLC analysis chiralpak AS-H (*i*-PrOH: hexane = 20: 80, 0.5 mL/ min, 254 nm) t_{major} = 32.5 min and t_{minor} = 51.0 min. ^{1}H NMR (500 MHz, $CDCl_3$): δ 1.30-1.37 (m, 1H), 1.51-1.71 (m, 3H), 1.79-1.81 (m, 1H), 2.08-2.12 (m, 1H), 2.34-2.37 (m, 1H), 2.48-2.50 (m, 1H), 2.57-2.63 (m, 1H), 3.92 (s, 3H), 4.03 (d, *J*= 2.9 Hz, 1H), 4.84 (dd, *J*= 2.9, 8.6 Hz, 1H), 7.40 (d, *J*= 8.0 Hz, 2H), 8.02 (d, *J*= 8.6 Hz, 2H). ^{13}C NMR (125 Hz, $CDCl_3$): δ 24.61, 27.65, 30.68, 42.60, 52.07, 57.20, 74.28, 126.95, 129.42, 129.60, 145.98, 166.80, 215.13.

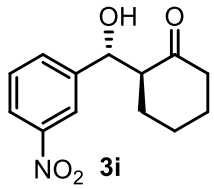
(*2S, 1'R*)-2-[Hydroxy(4-nitrophenyl)methyl]cyclohexan-1-one (3h)[1,2,3,4,5,6] **(Table 4)**



3h

HPLC analysis chiralpak OD-H (*i*-PrOH: hexane = 20: 80, 0.5 mL/ min, 254 nm) t_{major} = 17.3 min and t_{minor} = 21.6 min. ^{1}H NMR (500 MHz, $CDCl_3$): δ 1.35-1.71 (m, 4H), 1.82-1.85 (m, 1H), 2.10-2.14 (m, 1H), 2.34-2.39 (m, 1H), 2.49-2.52 (m, 1H), 2.56-2.62 (m, 1H), 4.08 (d, *J*= 2.9 Hz, 1H), 4.89 (dd, *J*= 2.9, 8.0 Hz, 1H), 7.51 (d, *J*= 8.6 Hz, 2H), 8.21 (d, *J*= 8.6 Hz, 2H). ^{13}C NMR (125 Hz, $CDCl_3$): δ 24.62, 27.59, 30.69, 42.62, 57.11, 73.95, 125.52, 127.83, 147.52, 148.30, 214.79.

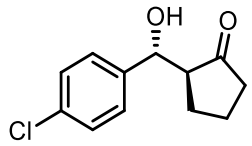
(*2S, 1'R*)-2-[Hydroxy(3-nitrophenyl)methyl]cyclohexan-1-one (3i)[1,2,3,4,5,6] **(Table 4)**



3i

HPLC analysis chiralpak AD-H (*i*-PrOH: hexane = 5: 95, 0.8 mL/ min, 254 nm) t_{major} = 37.9 min and t_{minor} = 48.5 min. ^{1}H NMR (500 MHz, $CDCl_3$): δ 1.36-1.44 (m, 1H), 1.55-1.74 (m, 3H), 1.81-1.85 (m, 1H), 2.10-2.15 (m, 1H), 2.37-2.42 (m, 1H), 2.48-2.53 (m, 1H), 2.61-2.66 (m, 1H), 4.16 (d, *J*= 2.9 Hz, 1H), 4.90 (d, *J*= 2.9, 8.6 Hz, 1H), 7.54 (t, *J*= 8.0 Hz, 1H), 7.67 (d, *J*= 7.5 Hz, 1H), 8.15-8.17 (m, 1H), 8.22 (t, *J*= 2.0 Hz, 1H). ^{13}C NMR (125 Hz, $CDCl_3$): δ 24.57, 27.56, 30.65, 42.59, 57.04, 73.93, 121.94, 122.80, 129.25, 133.18, 143.17, 148.16, 214.89.

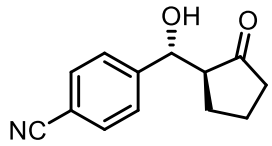
(*2S, 1'R*)-2-[Hydroxy(4-chlorophenyl)methyl]cyclopentan-1-one (3p)[7,8] **(Table 4)**



3p

The result of HPLC analysis and ^{1}H NMR data were referred to previous reports.
HPLC analysis chiralpak AD-H (*i*-PrOH: hexane = 5: 95, 1 mL/ min, 254 nm) t_{major} = 13.9 min and t_{minor} = 15.6 min. ^{1}H NMR (500 MHz, $CDCl_3$): δ 1.44-1.53 (m, 1H), 1.68-1.80 (m, 2H), 1.95-2.01 (m, 1H), 2.21-2.29 (m, 1H), 2.36-2.47 (m, 2H), 2.44-2.50 (m, 1H), 4.63 (s, 1H), 4.69 (d, *J*= 9.2 Hz, 1H), 7.27-7.30 (m, 2H), 7.31-7.33 (m, 2H). ^{13}C NMR (125 Hz, $CDCl_3$): δ 20.36, 29.91, 38.68, 52.26, 74.60, 127.89, 128.60, 133.65, 139.93, 222.87.

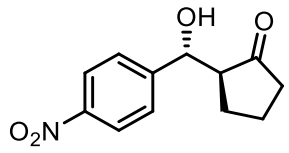
4-((*R*)-Hydroxy((*S*)-2-oxocyclopentyl)methyl)benzonitrile (3q)[7,8] **(Table 4)**



3q

The result of HPLC analysis and ^{1}H NMR data were referred to previous reports.
HPLC analysis chiralpak AD-H (*i*-PrOH: hexane = 5: 95, 1 mL/ min, 254 nm) t_{major} = 45.7 min and t_{minor} = 47.5 min. ^{1}H NMR (500 MHz, $CDCl_3$): δ 1.67-1.78 (m, 2H), 1.92-2.07 (m, 2H), 2.12-2.37 (m, 2H), 2.40-2.51 (m, 1H), 4.75 (s, 1H), 4.79 (d, *J*= 9.2 Hz, 1H), 7.46-7.49 (d, *J*= 8.6 Hz, 2H), 7.64-7.66 (d, *J*= 8.0 Hz, 2H). ^{13}C NMR (125 Hz, $CDCl_3$): δ 20.34, 26.83, 38.59, 55.04, 74.63, 111.79, 118.69, 127.22, 132.32, 146.64, 222.37.

(*2S, 1'R*)-2-[Hydroxy(4-nitrophenyl)methyl]cyclopentan-1-one (3r)[1,2,3,5,6] **(Table 4)**



3r

HPLC analysis chiralpak AD-H (*i*-PrOH: hexane = 5: 95, 1 mL/ min, 265 nm) t_{major} = 40.3 min and t_{minor} = 43.0 min.
^{1}H NMR (500 MHz, $CDCl_3$): δ 1.53-1.60 (m, 1H), 1.70-1.80 (m, 2H), 2.00-2.05 (m, 1H), 2.24-2.32 (m, 1H), 2.36-2.42 (m, 1H), 2.44-2.50 (m, 1H), 4.79 (s, 1H), 4.85 (d, *J*= 8.6 Hz, 1H), 7.53-7.55 (d, *J*= 1.7, 8.6 Hz, 2H), 8.21-8.23 (m, 2H).
^{13}C NMR (125 Hz, $CDCl_3$): δ 20.30, 26.75, 38.54, 55.00, 74.33, 123.65, 127.29, 147.52, 148.60, 222.24.

3. References

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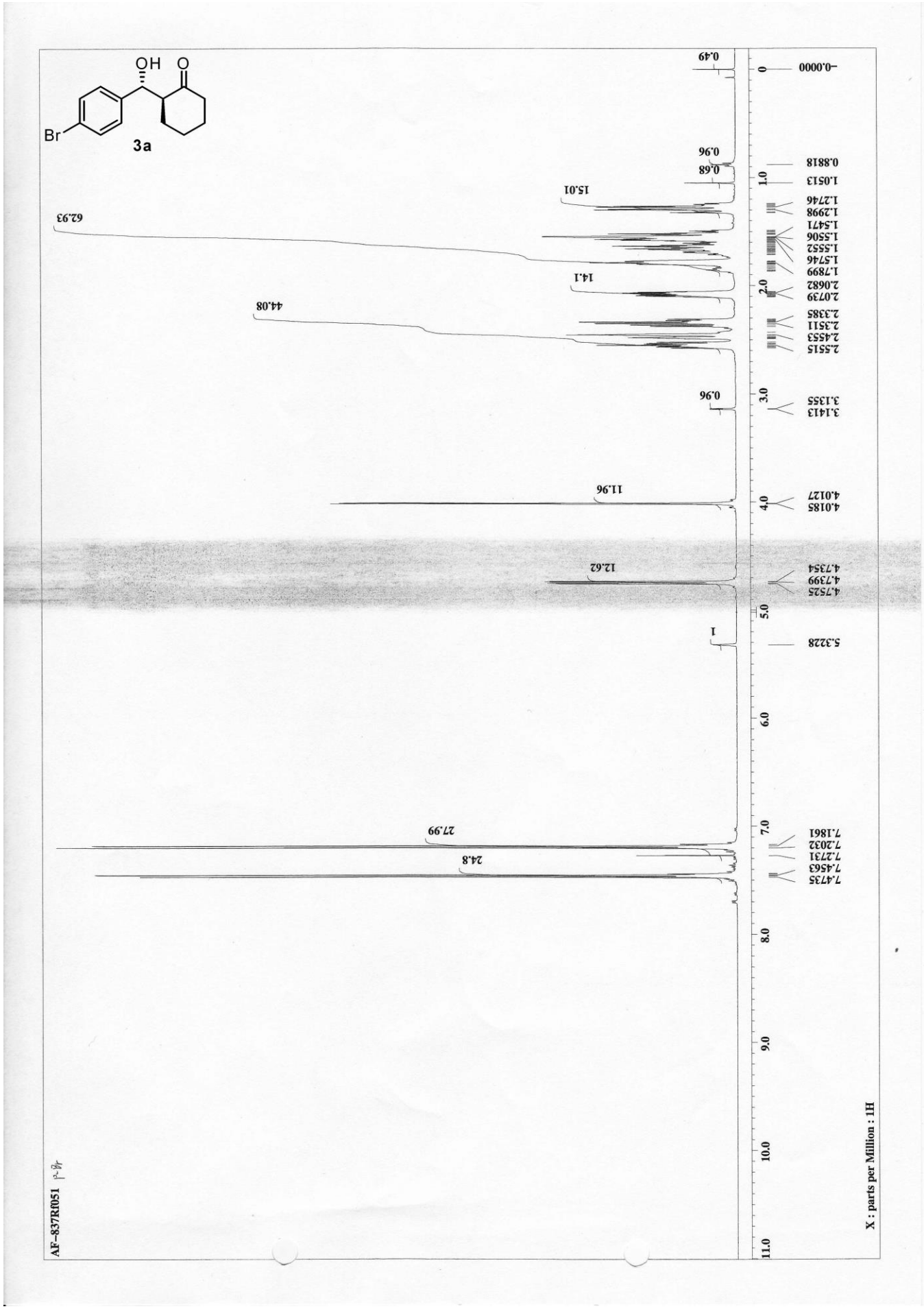
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Br
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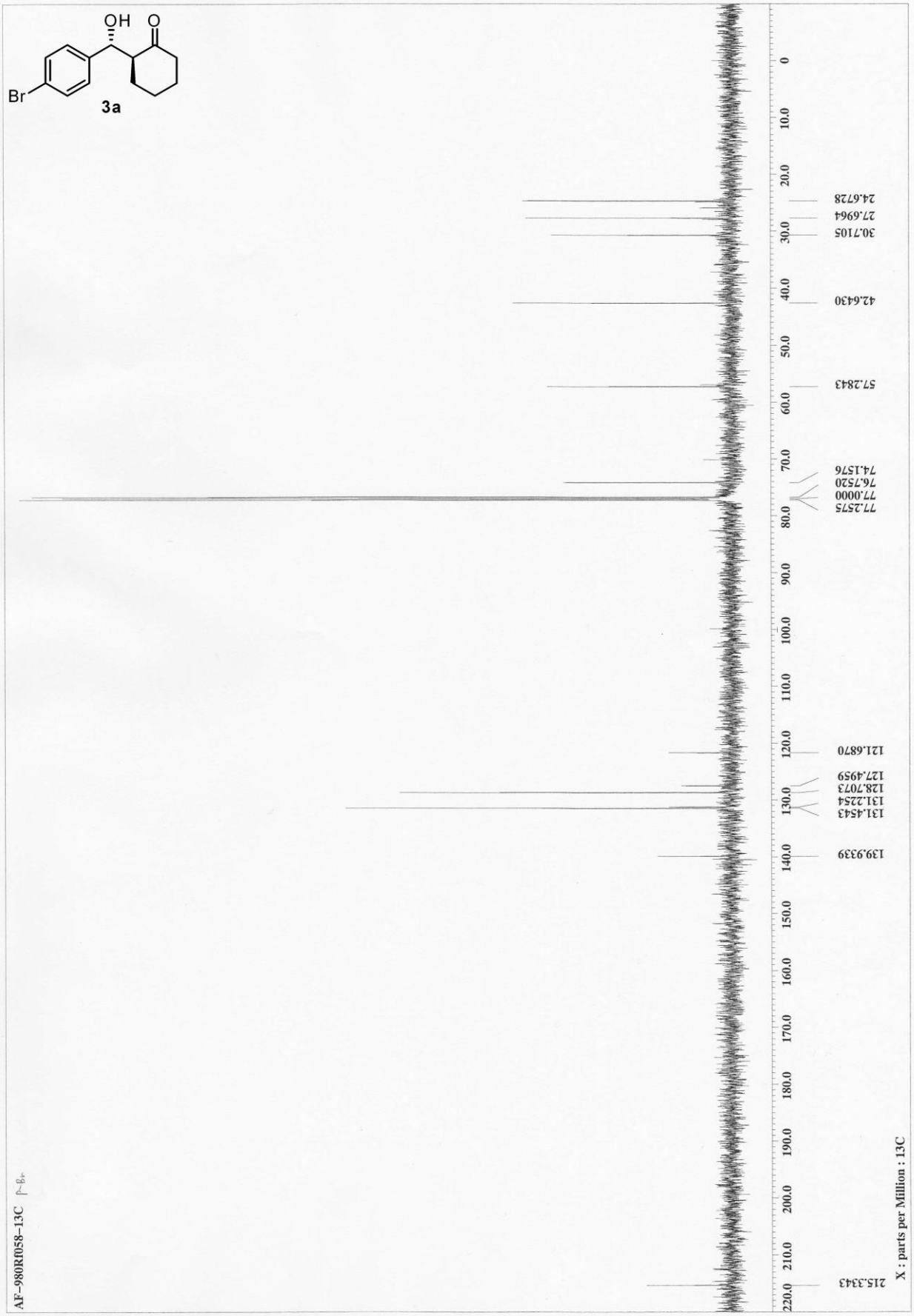
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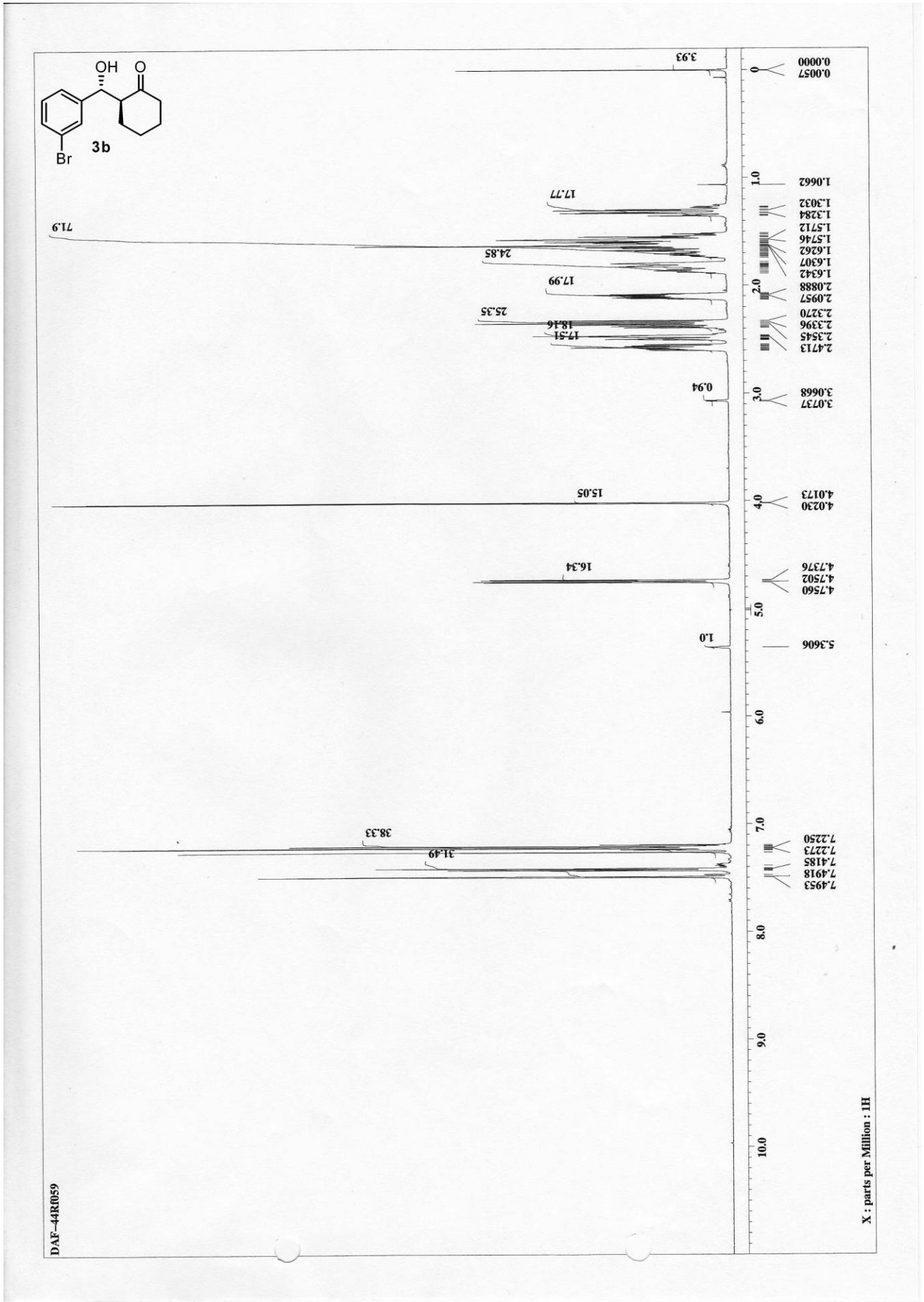
X : parts per Million : 13C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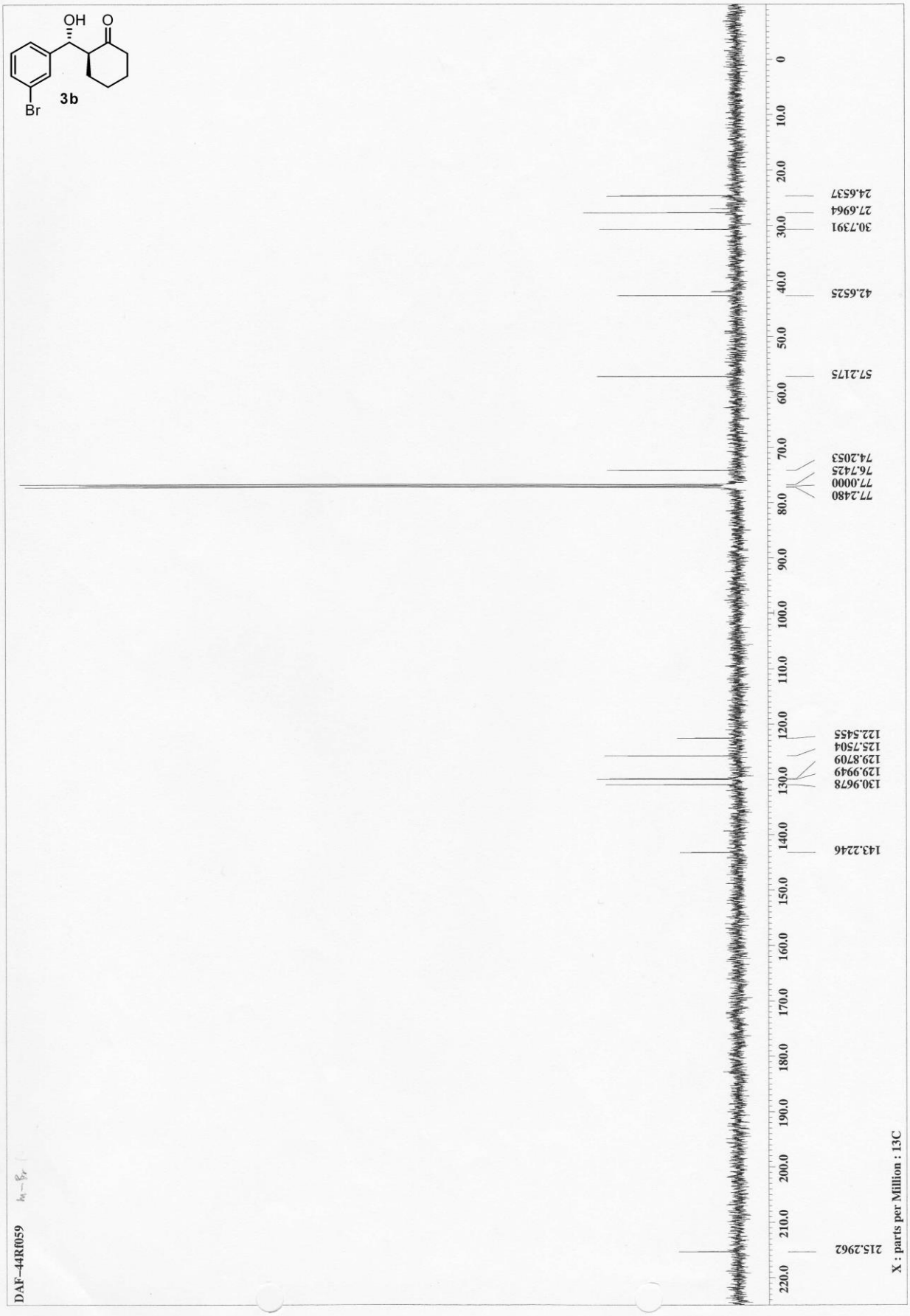
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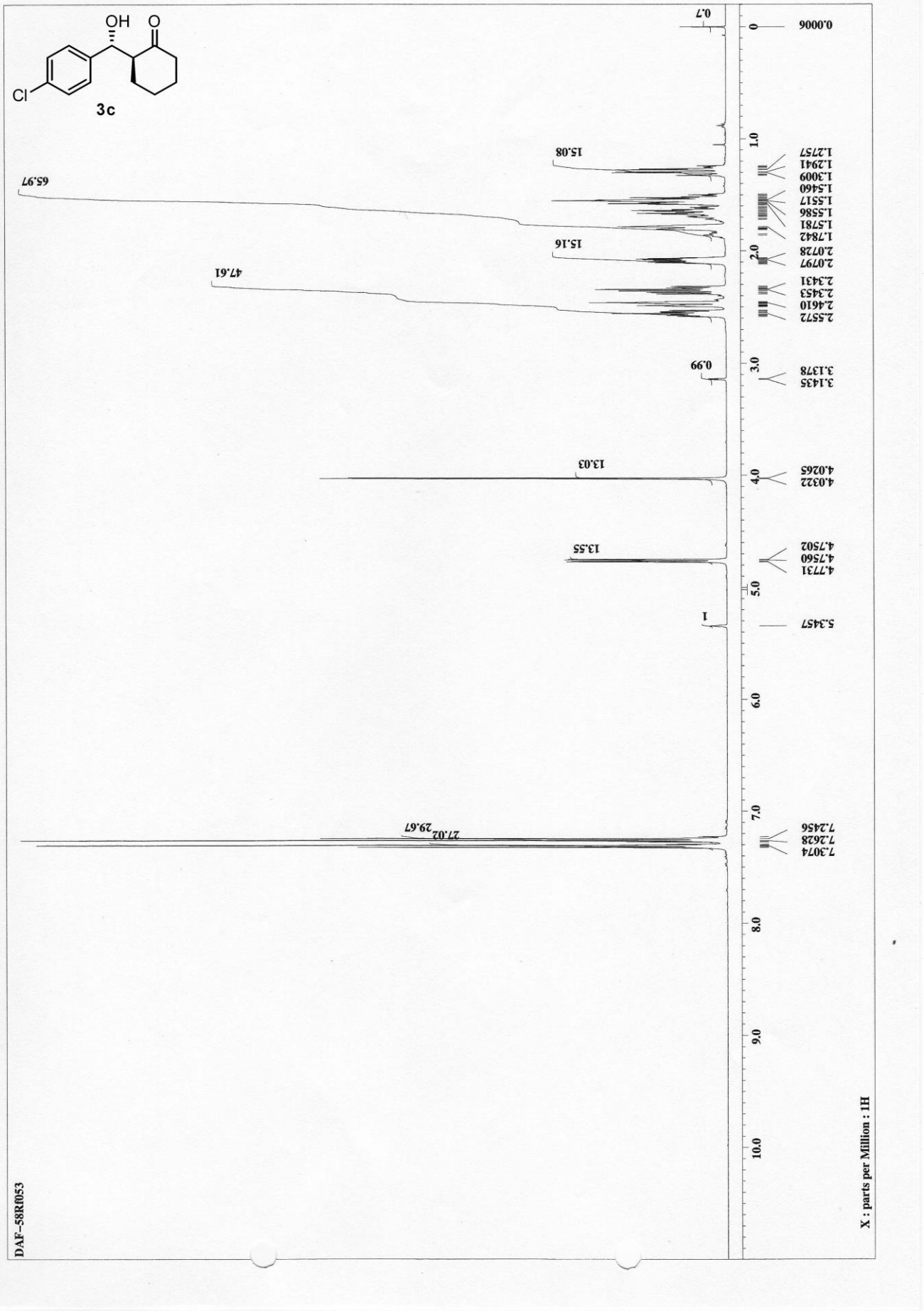
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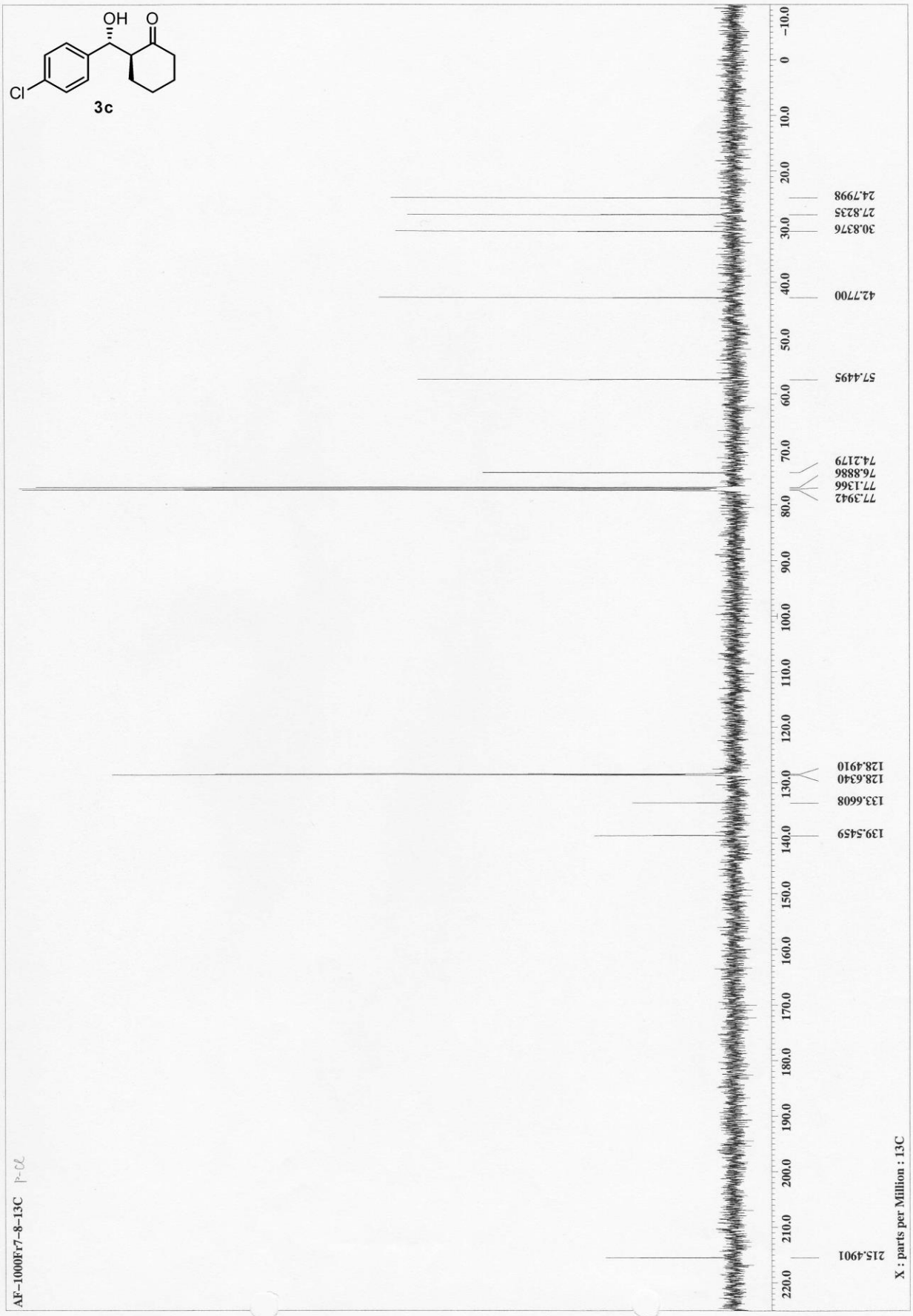
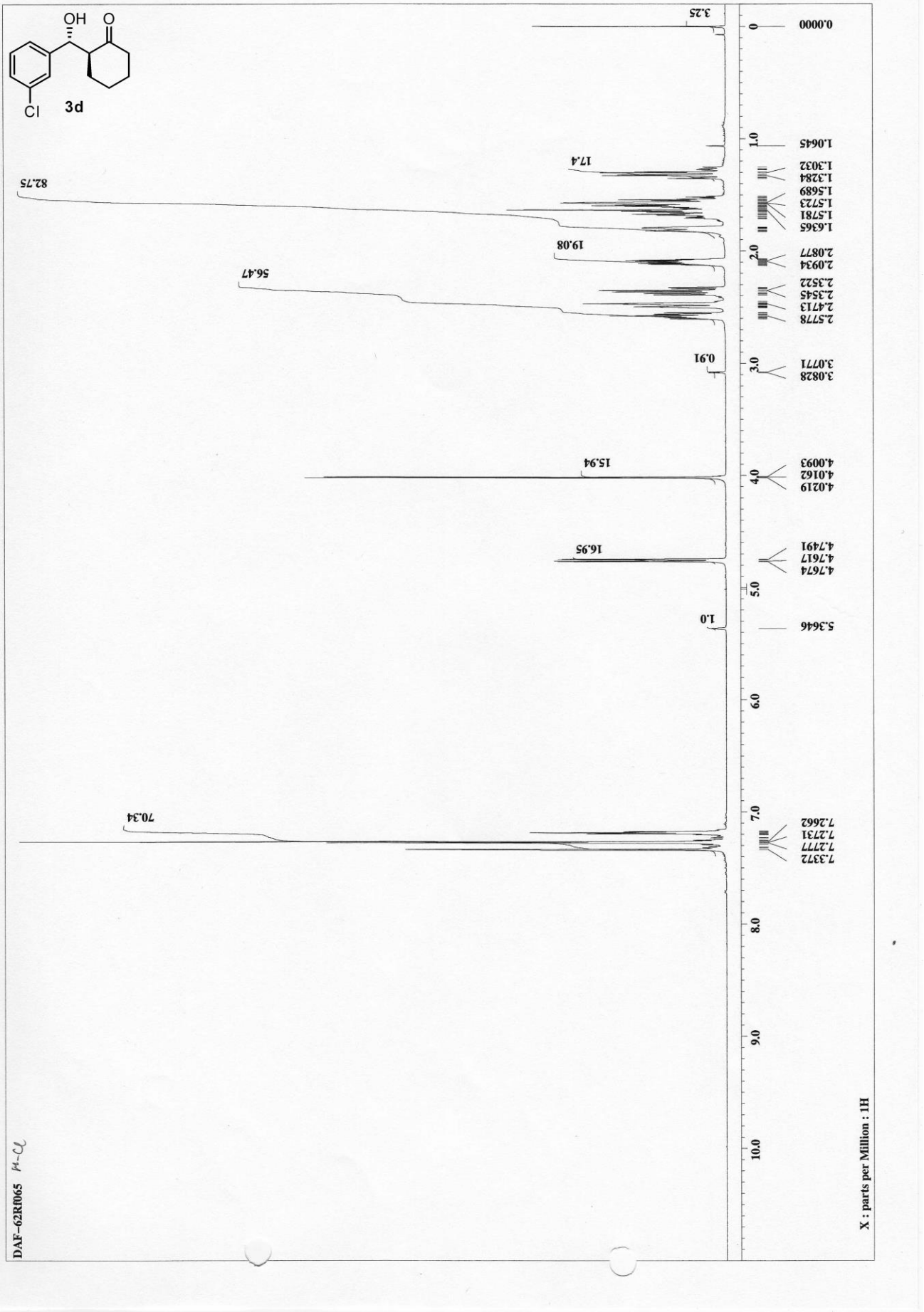
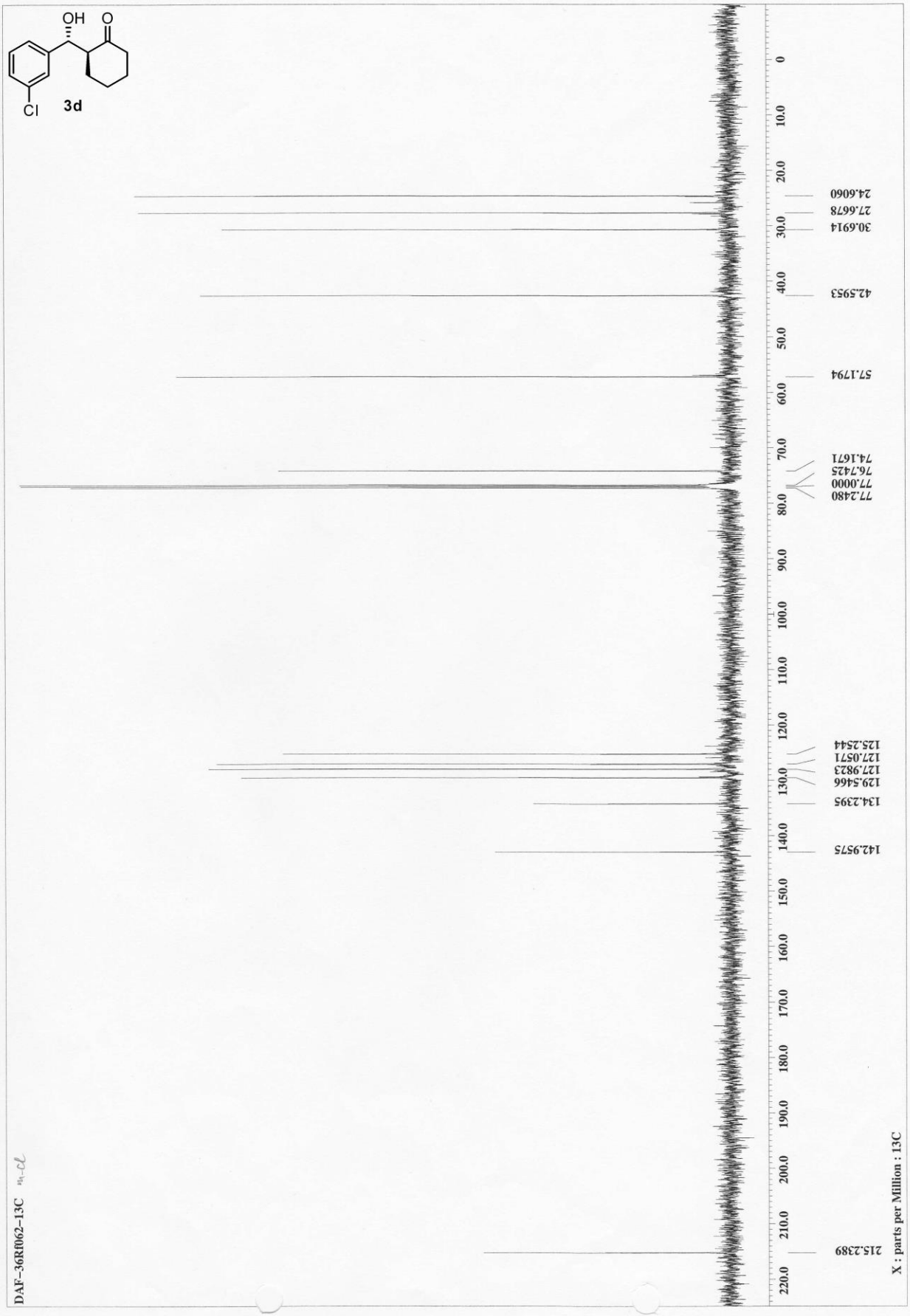
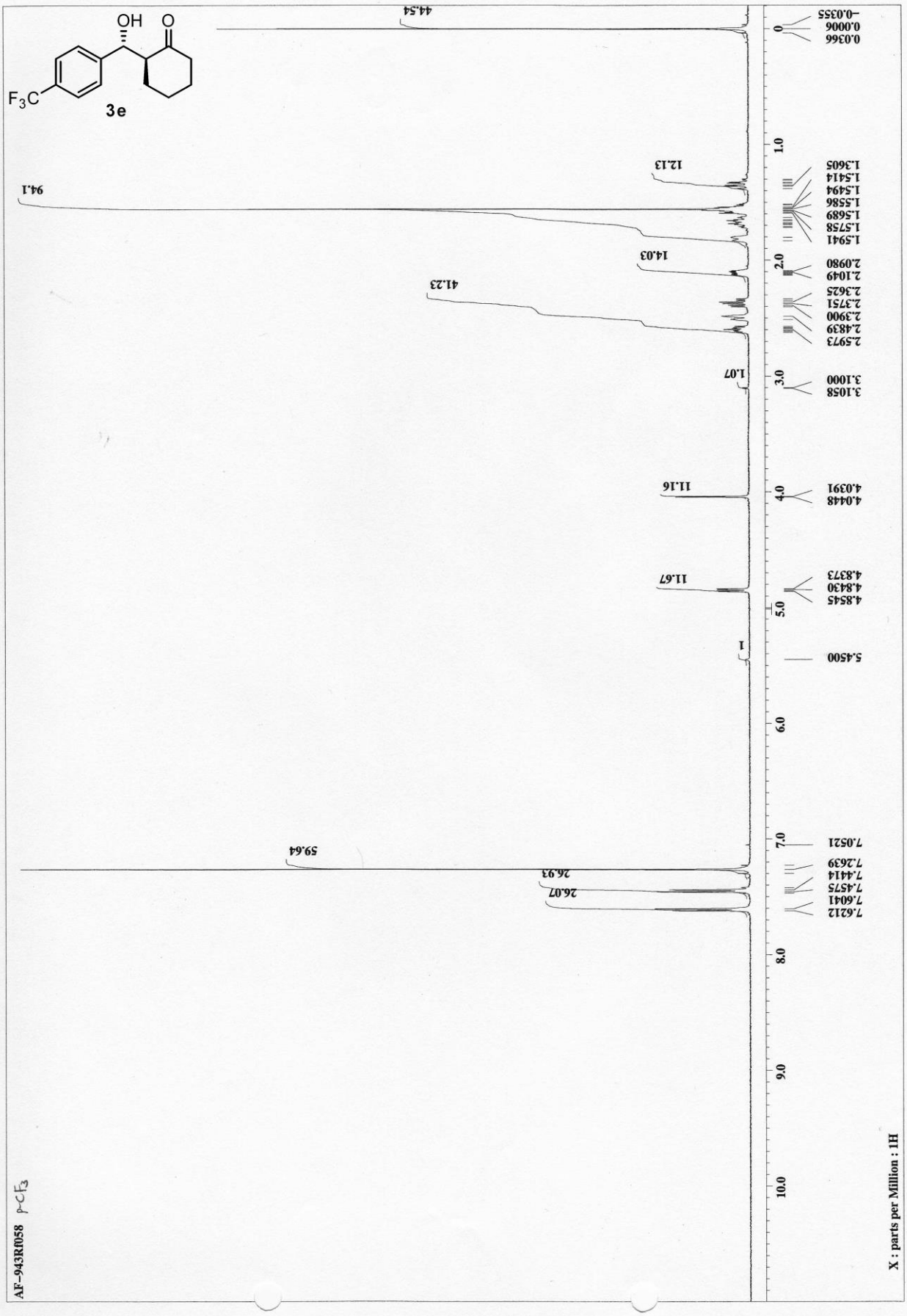
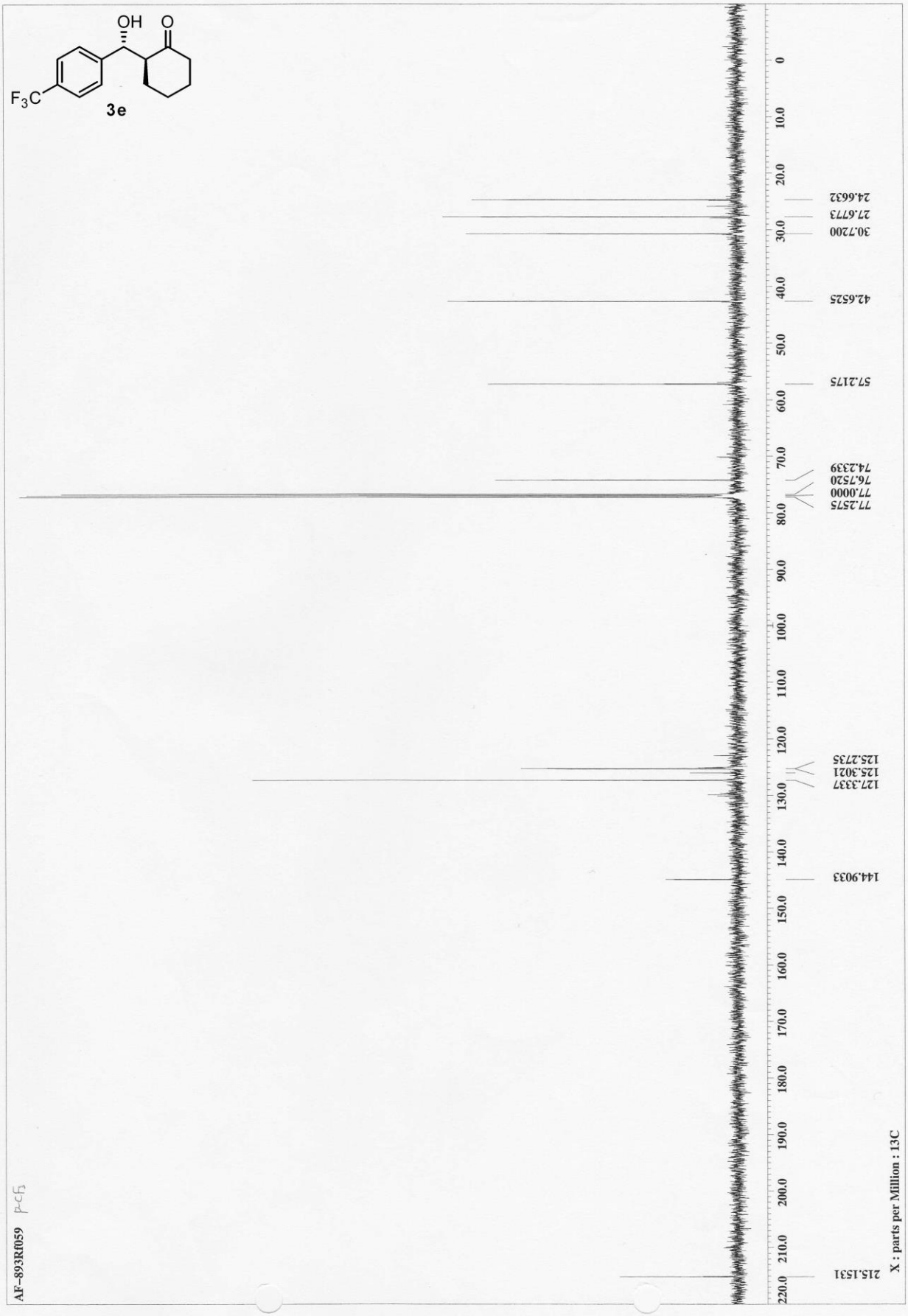
O
Cl
3c
DAF-58Rf053
X : parts per Million : 1H

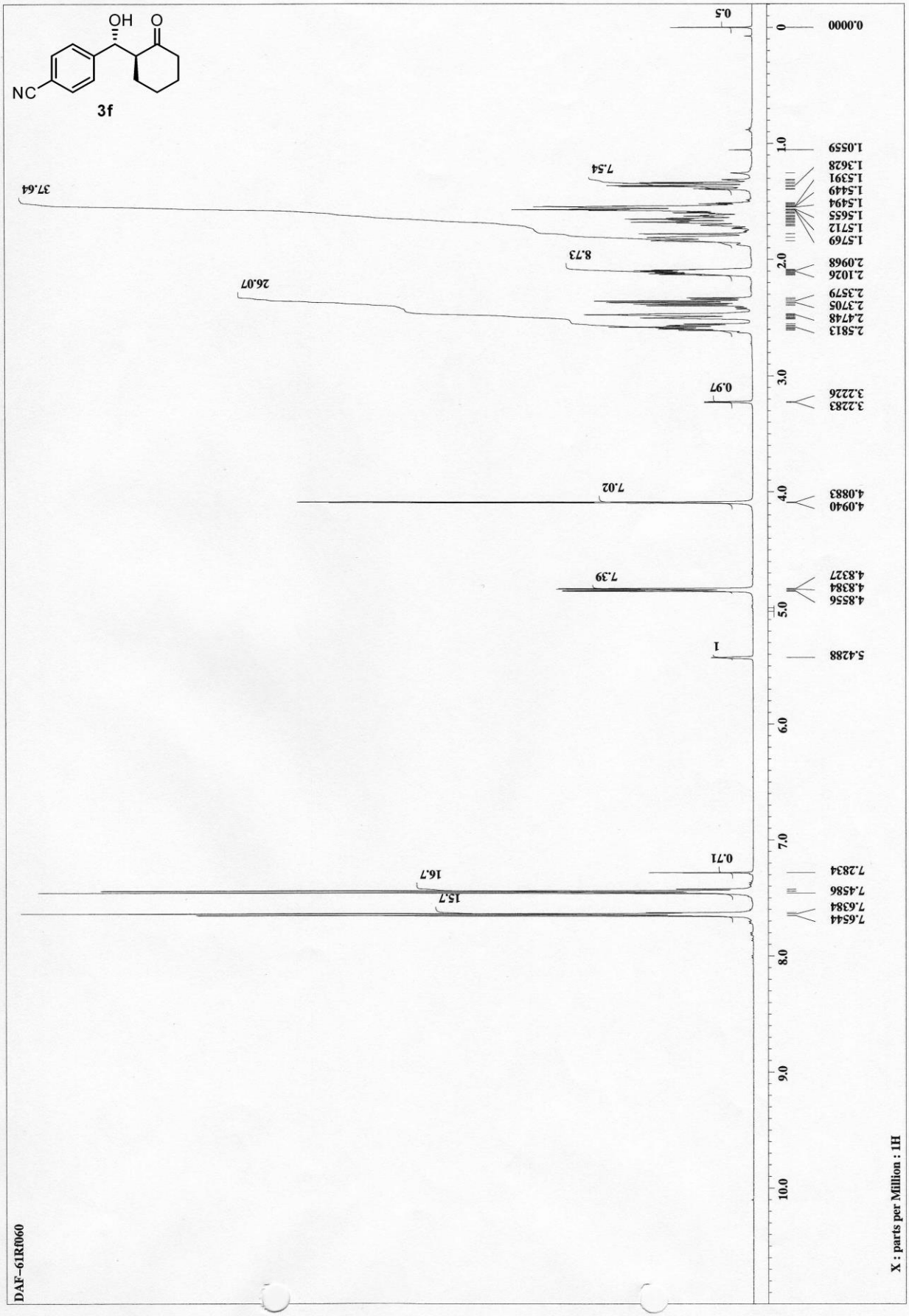

OH
O
Cl
3c
AF-1000Fr7-8-13C p-Cl
215.4901
139.5459
133.6608
128.6340
128.4910
77.3942
77.1366
76.8886
74.2179
57.4495
42.7700
30.8376
27.8235
24.7998
X : parts per Million : 13C

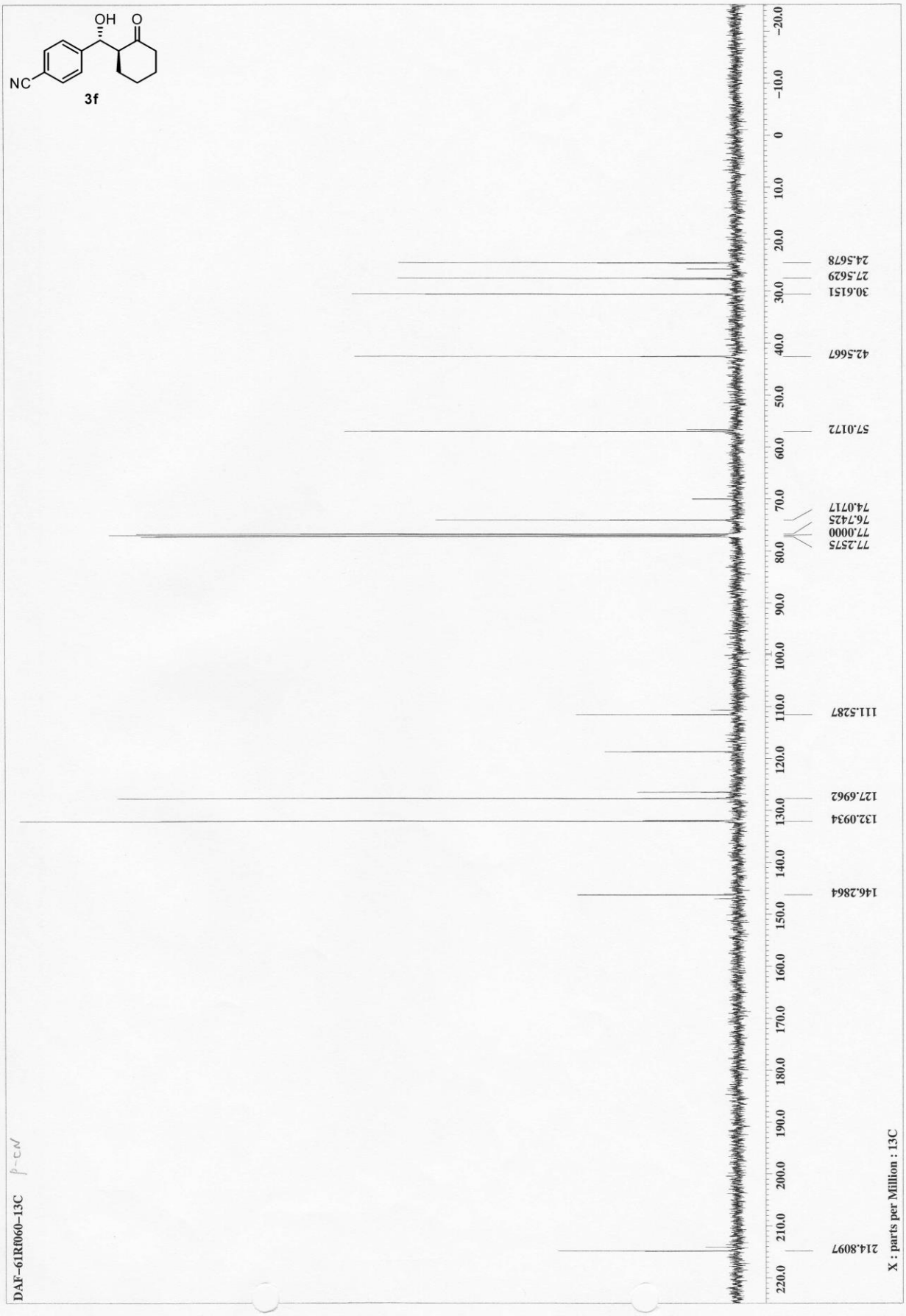

OH
O
Cl
3d
DAF-62Rf065
X : parts per Million : 1H

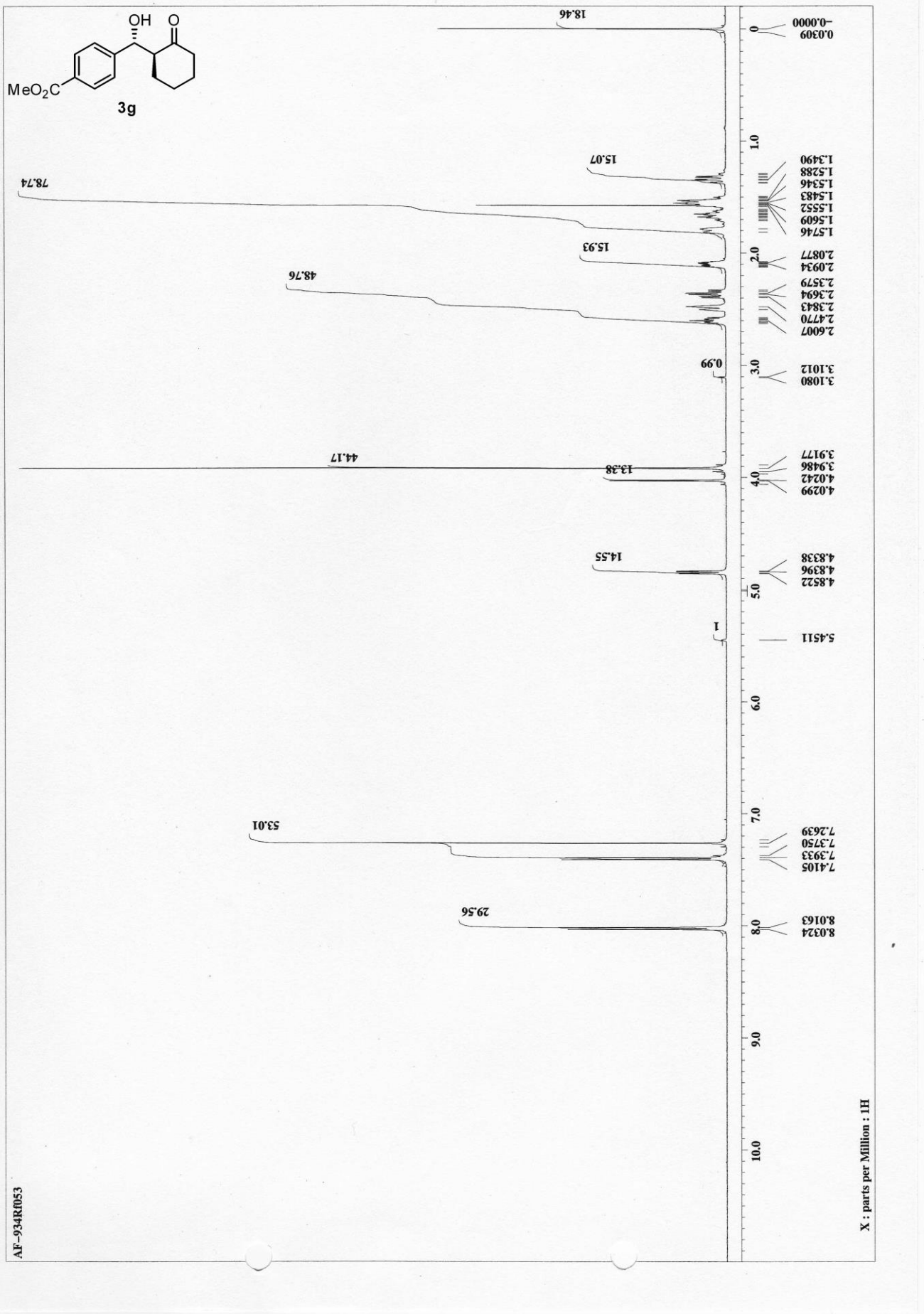

OH
O
Cl
3d
DAF-36R062-13C
m-Cl
0
10.0
20.0
24.6060
27.6678
30.6914
40.0
42.5953
50.0
57.1794
60.0
70.0
74.1671
76.7425
77.0000
77.2480
80.0
90.0
100.0
110.0
120.0
125.2544
127.0571
127.9823
129.5466
130.0
134.2395
140.0
142.9575
150.0
160.0
170.0
180.0
190.0
200.0
210.0
215.2389
220.0
X : parts per Million : 13C

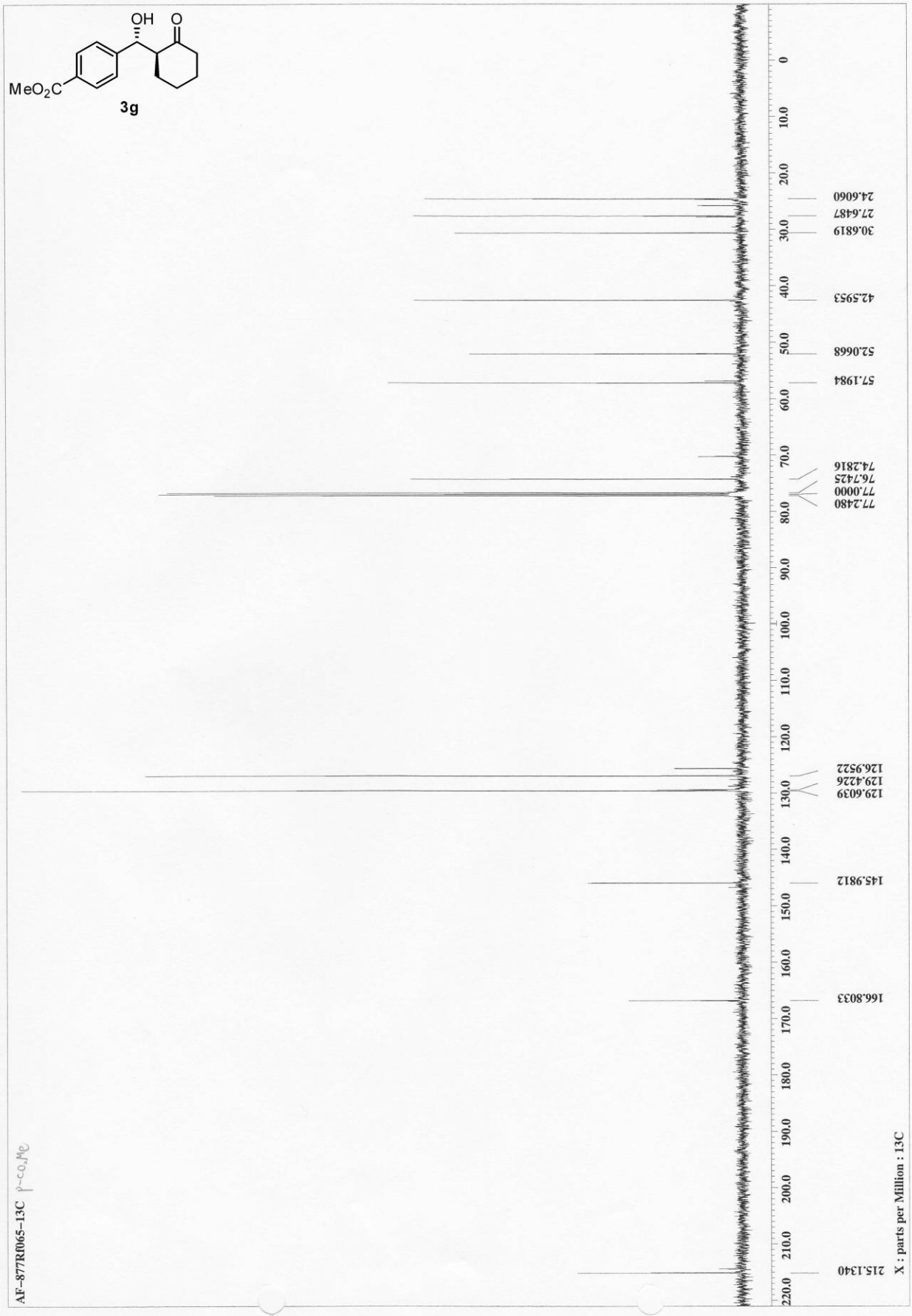

OH
O
F3C
3e
AF-943R0058 p-CF3
X : parts per Million : 1H

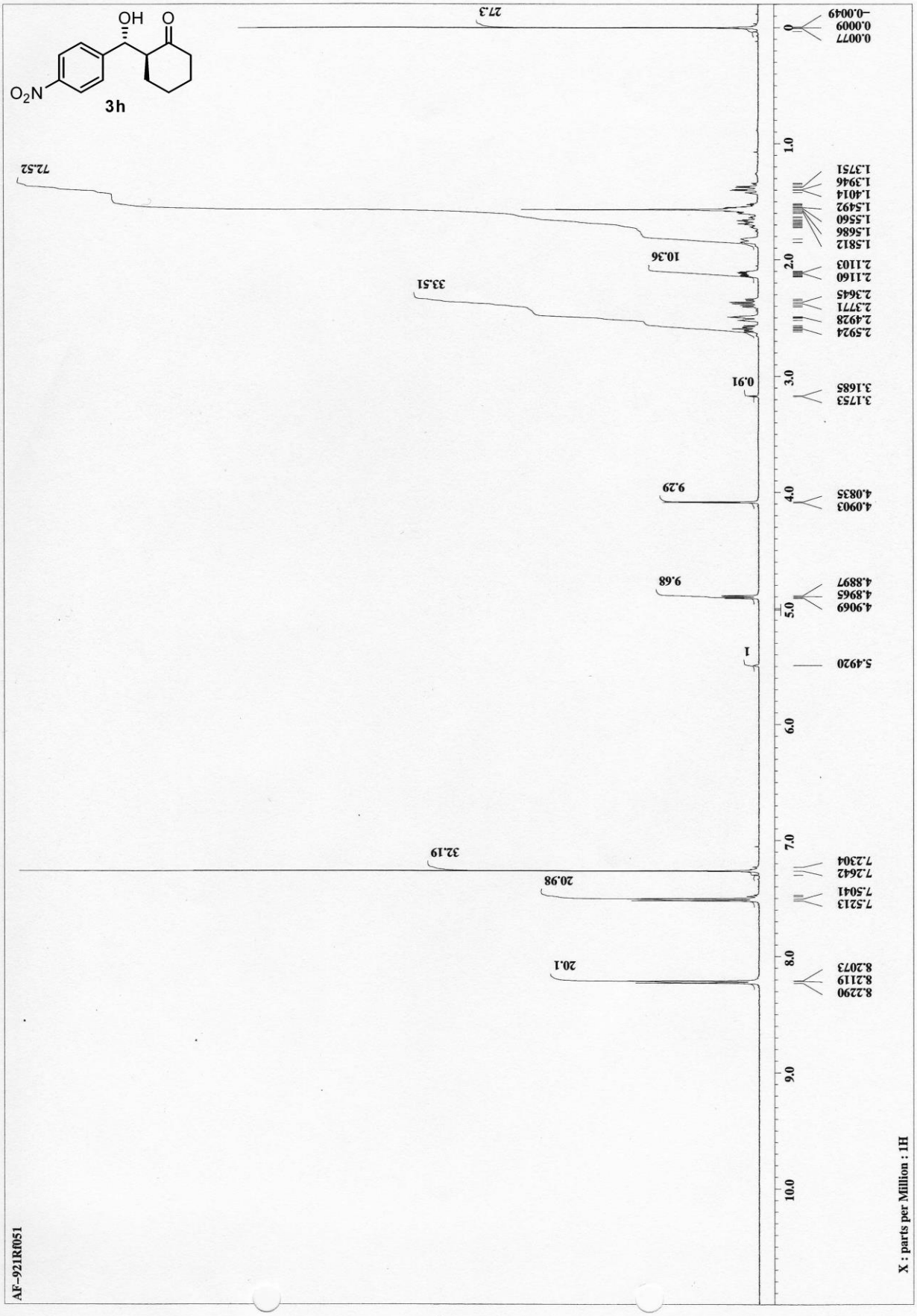

OH
O
F3C
3e
AF-893R0059
X : parts per Million : 13C
215.1531
144.9033
127.3337
125.3021
125.2735
77.2575
77.0000
76.7520
74.2339
57.2175
42.6525
30.7200
27.6773
24.6632

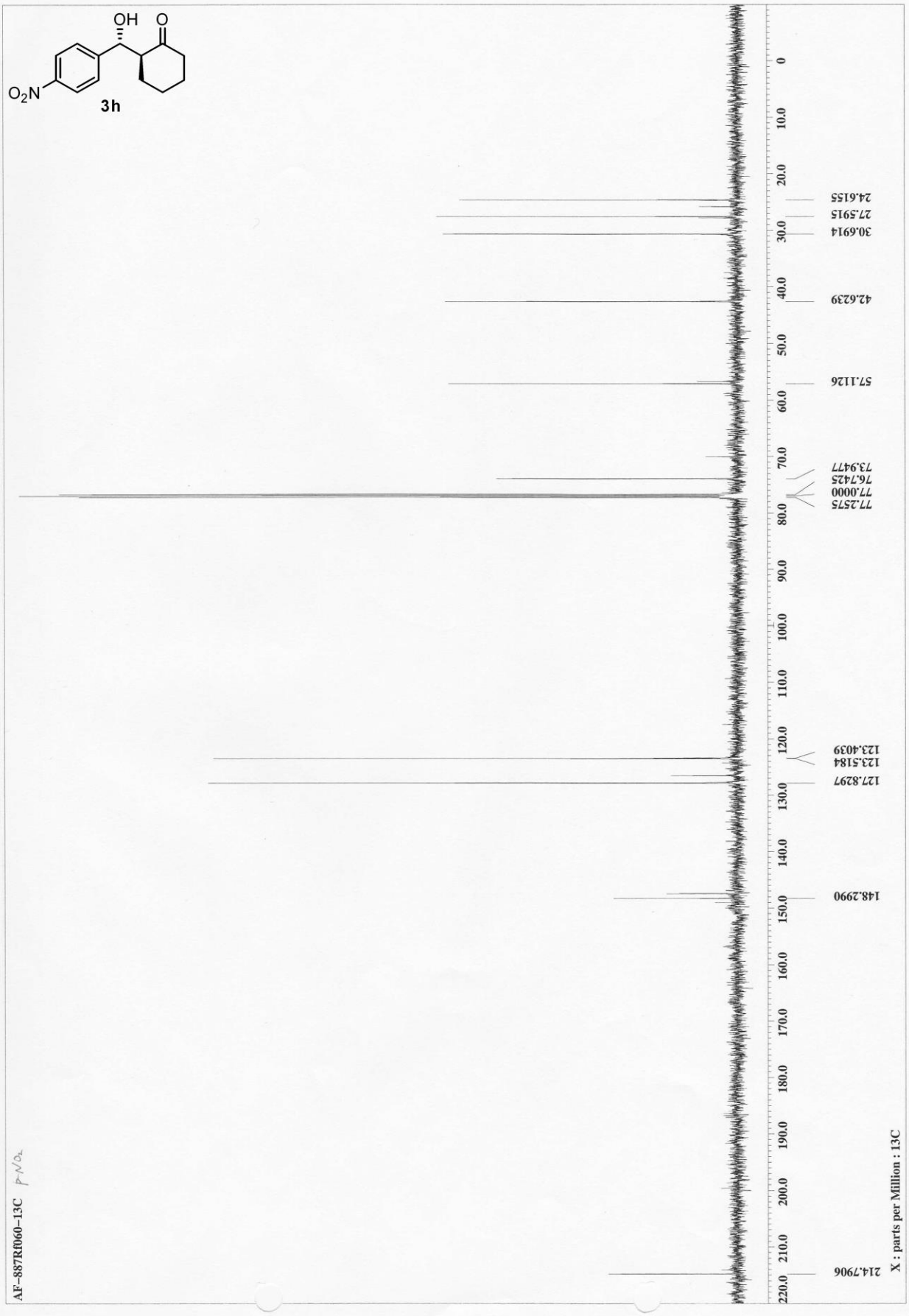

OH
O
NC
3f
DAF-61Rf060
X : parts per Million : 1H
0.5
7.54
37.64
8.73
26.07
0.97
7.02
7.39
1
0.71
16.7
15.7
0.0000
1.0559
1.3628
1.5391
1.5449
1.5494
1.5655
1.5712
1.5769
2.0968
2.1026
2.3579
2.3705
2.4748
2.5813
3.2226
3.2283
4.0883
4.0940
4.8327
4.8384
4.8556
5.4288
7.2834
7.4586
7.6384
7.6544


OH
O
NC
3f
DAF-61Rf060-13C
p-CN
24.5678
27.5629
30.6151
42.5667
57.0172
74.0717
76.7425
77.0000
77.2575
111.5287
127.6962
132.0934
146.2864
214.8097
X : parts per Million : 13C

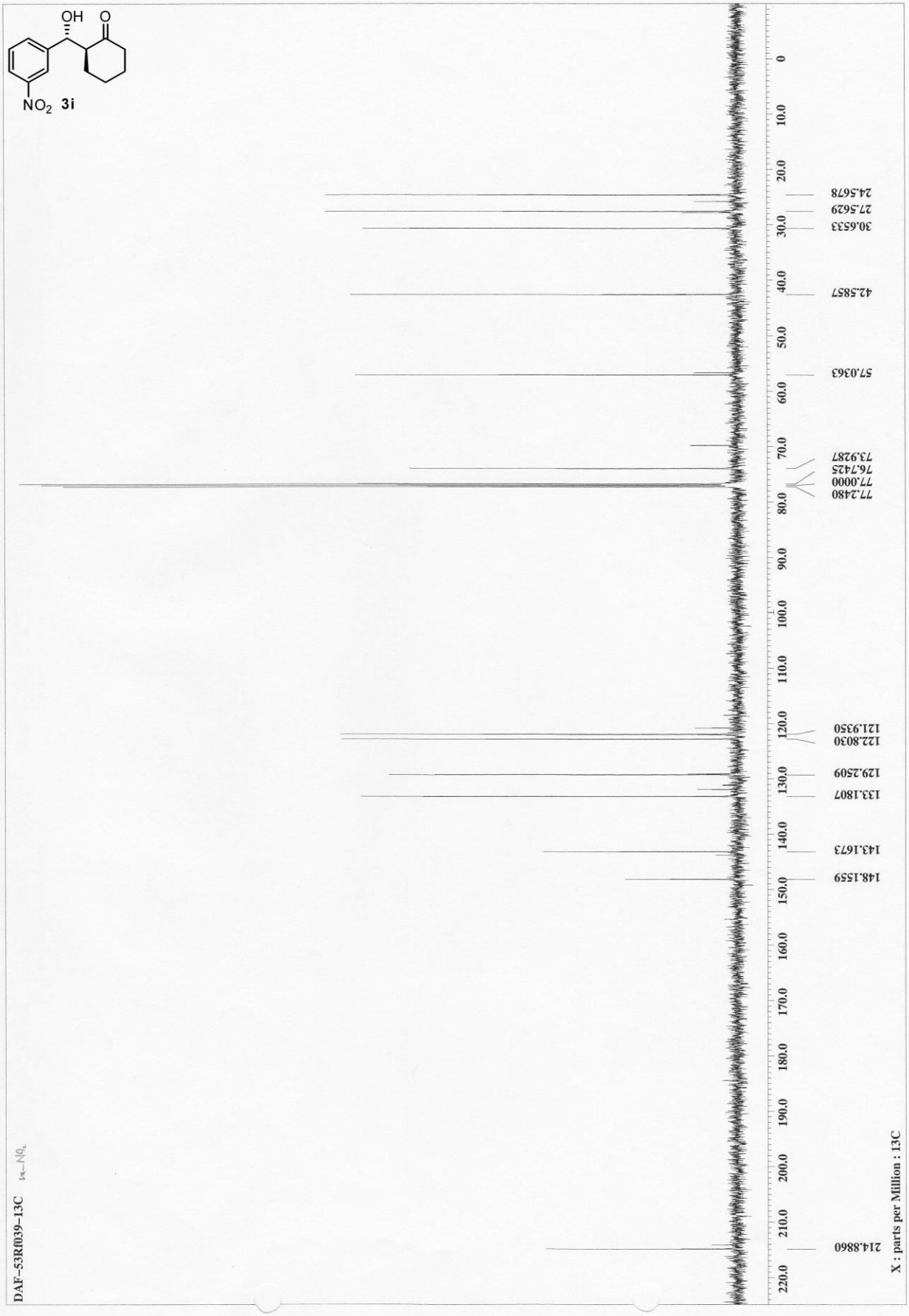

OH
O
MeO2C
3g
AF-934R053
X : parts per Million : 1H

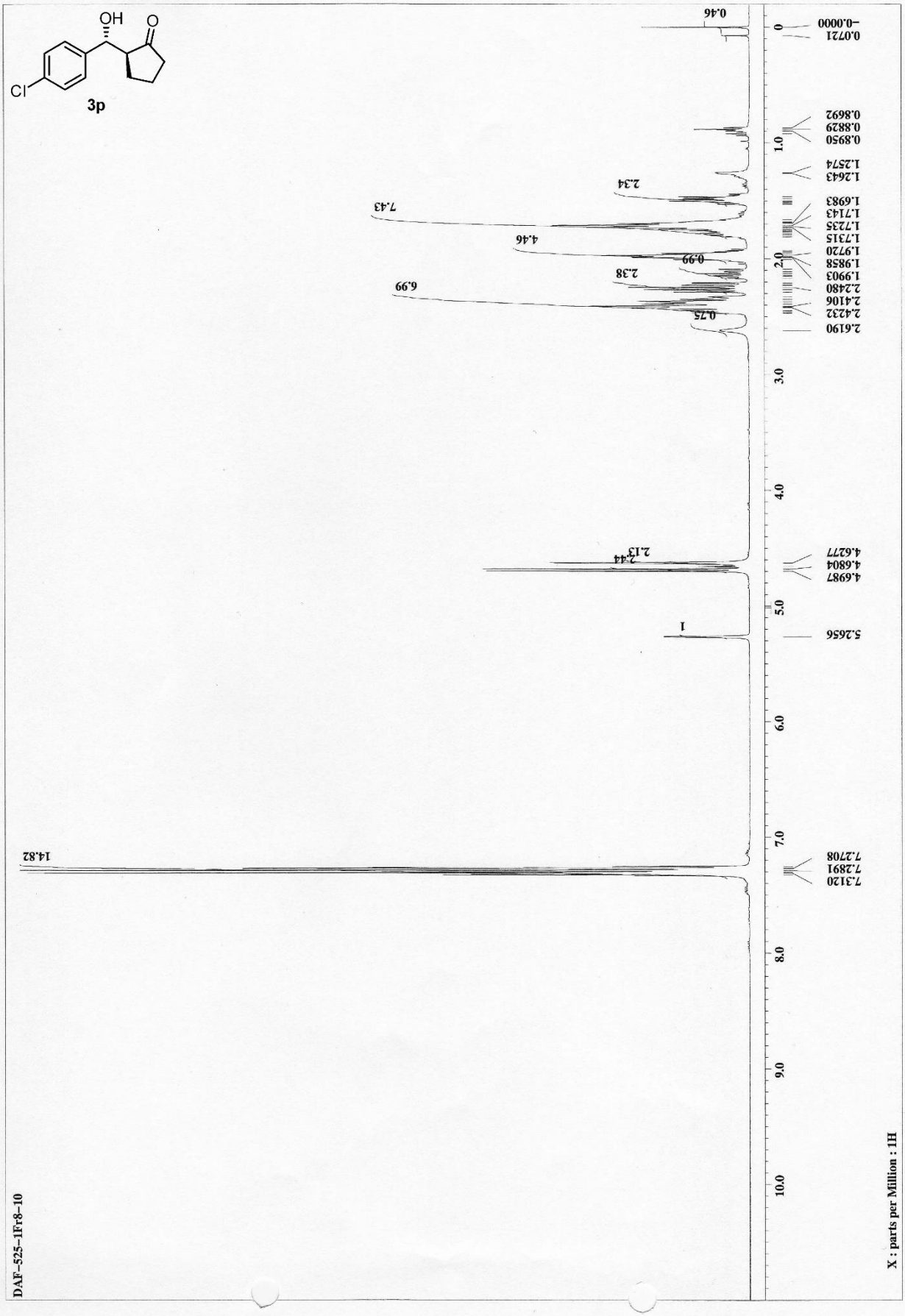

OH
O
MeO2C
3g
AF-877R065-13C p-co2Me
X : parts per Million : 13C
24.6060
27.6487
30.6819
42.5953
52.0668
57.1984
74.2816
76.7425
77.0000
77.2480
126.9522
129.4226
129.6039
145.9812
166.8033
215.1340

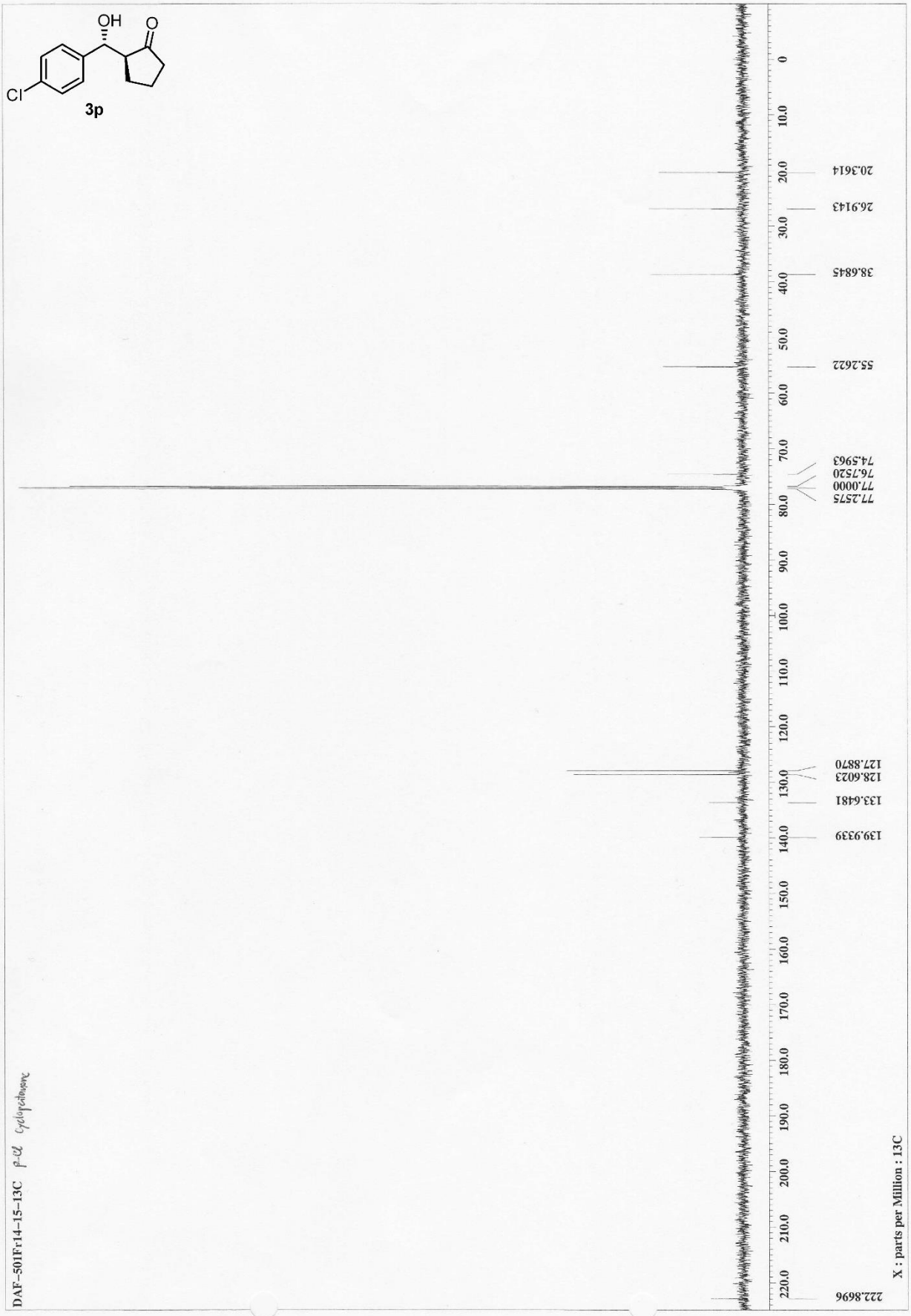

OH
O
O_2N
3h
AF-921RM051
X : parts per Million : 1H


OH
O
O2N
3h
AF-887R060-13C
p-NO2
214.7906
148.2990
127.8297
123.5184
123.4039
77.2575
77.0000
76.7425
73.9477
57.1126
42.6239
30.6914
27.5915
24.6155
X : parts per Million : 13C

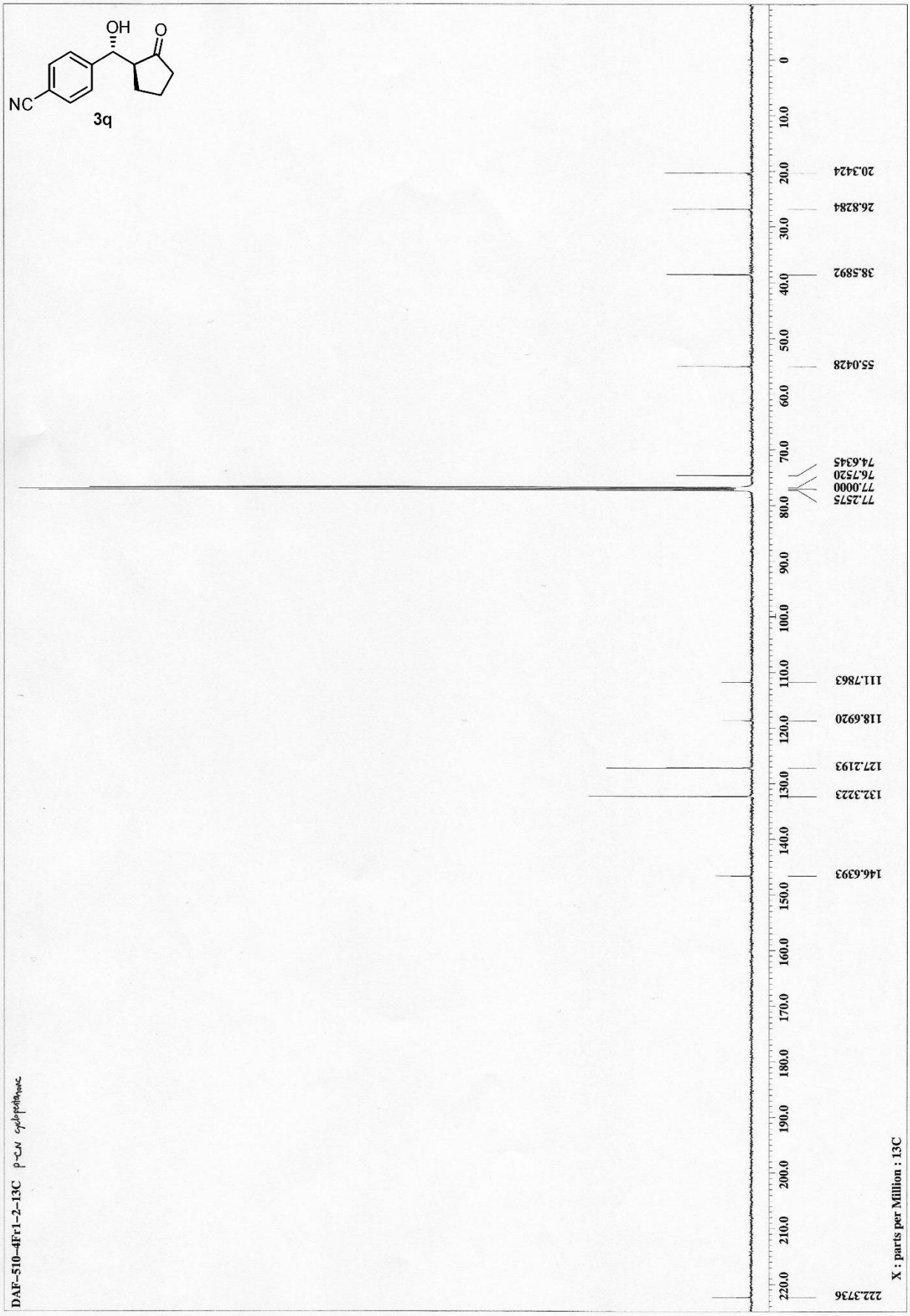
OH
O
NO2
3i
DAF-53R039
X : parts per Million : 1H
0.0000
1.0582
1.4029
1.4097
1.5643
1.5712
1.5838
1.5907
1.5987
2.1094
2.1163
2.3763
2.3786
2.3912
2.4919
2.6362
3.2535
3.2592
4.1559
4.1616
4.8934
4.8991
4.9163
5.4820
7.2811
7.5365
7.6705
7.6854
8.2133
8.2179
8.2213
0.69
0.25
49.27
9.87
29.64
0.98
8.14
8.53
1.0
1.03
9.37
9.33
17.14

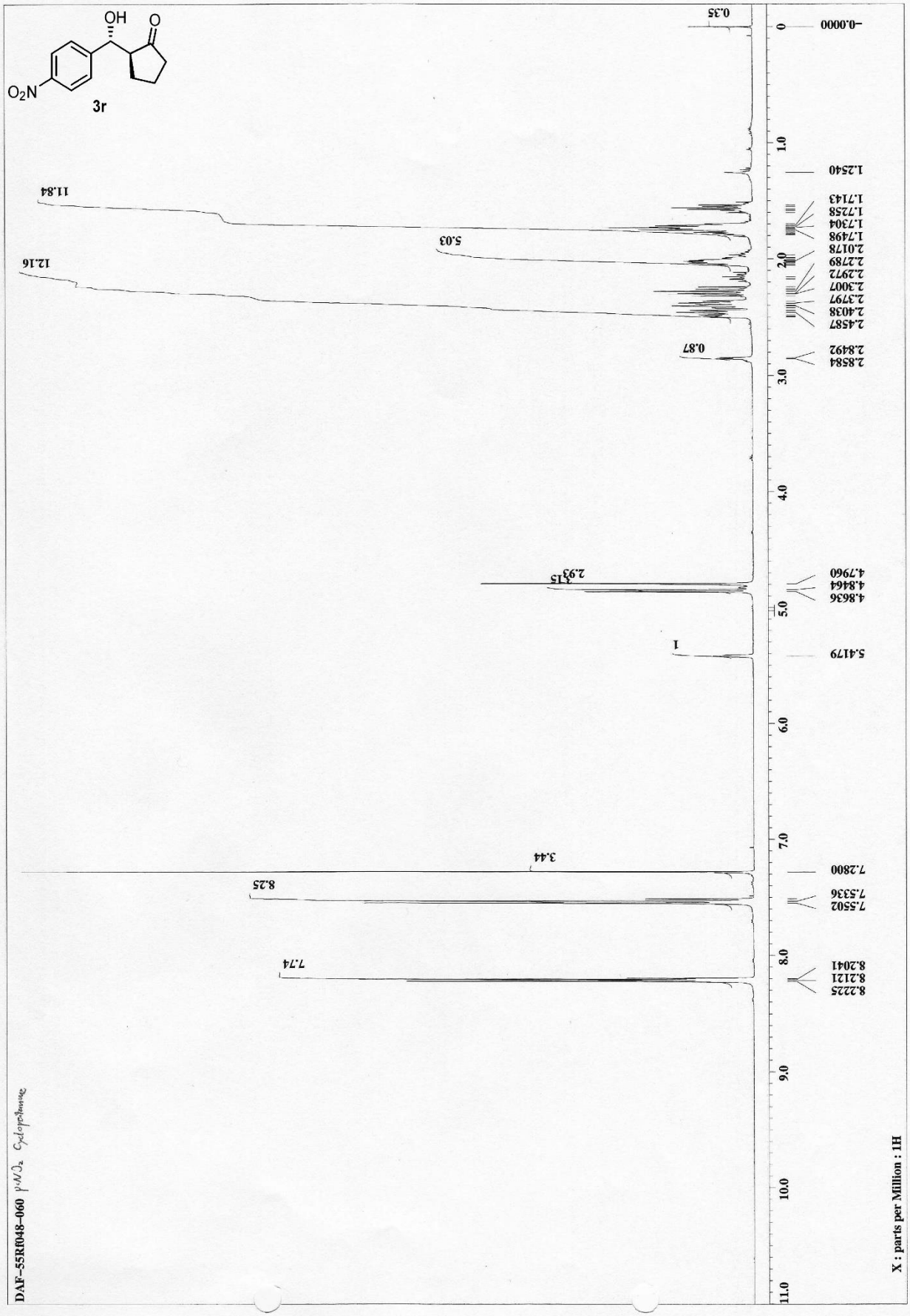

OH
O
NO2 3i
DAF-53Rf039-13C
24.5678
27.5629
30.6533
42.5857
57.0363
73.9287
76.7425
77.0000
77.2480
121.9350
122.8030
129.2509
133.1807
143.1673
148.1559
214.8860
X : parts per Million : 13C

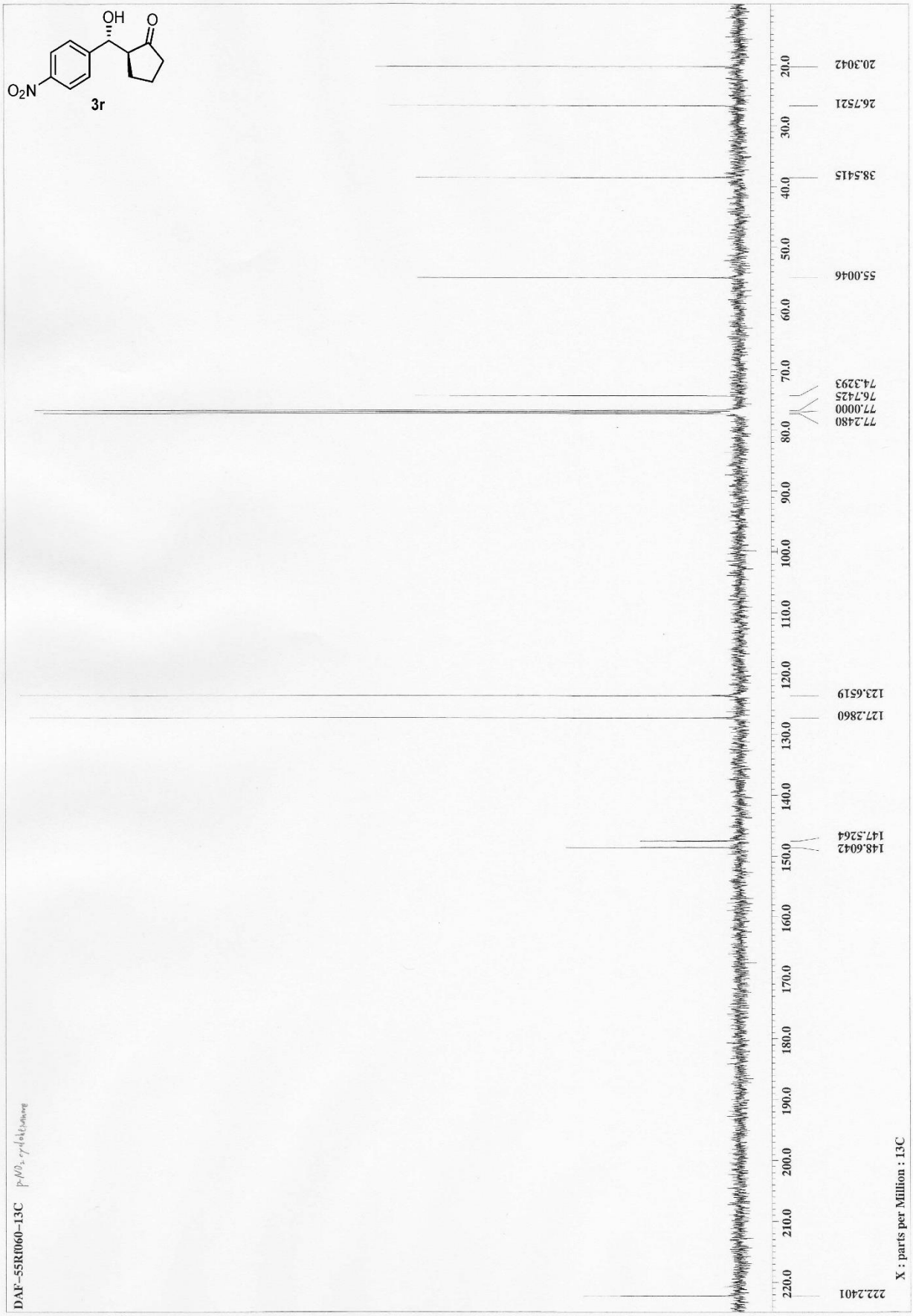

OH
O
Cl
3p
DAF-525-1Fr8-10
X : parts per Million : 1H


OH
O
Cl
3p
DAF-501Fr14-15-13C
20.3614
26.9143
38.6845
55.2622
74.5963
76.7520
77.0000
77.2575
127.8870
128.6023
133.6481
139.9339
222.8696
X : parts per Million : 13C

OH
O
NC
3q
DAF-510-4Fr1-6
X : parts per Million : 1H
0.0006
1.2540
1.6857
1.6937
1.7075
1.7212
1.7269
1.7373
2.0178
2.3568
2.3808
2.4358
2.4530
2.6820
2.6923
4.7491
4.7777
4.7949
5.3664
7.2719
7.4689
7.4850
7.6361
7.6453
7.6613
6.75
6.89
2.85
I
2.23
0.91
5.44
1.69
2.02
3.79
7.36
1.38
0.57

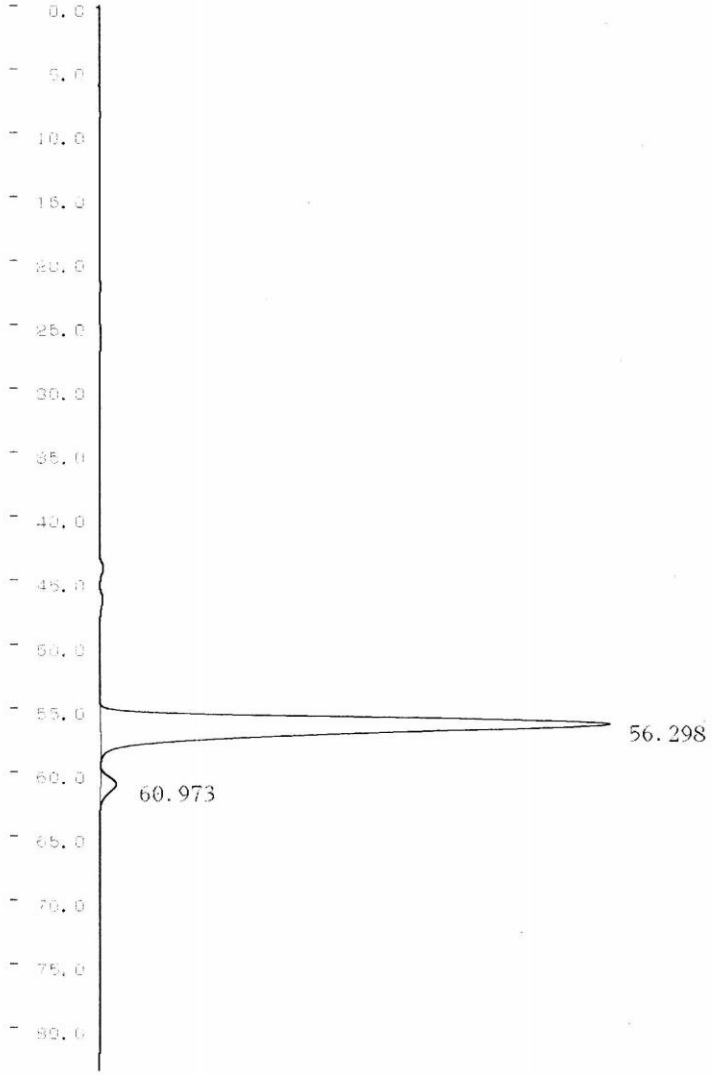

OH
O
NC
3q
DAF-510-4Fr1-2-13C p-CN cyclopentanone
222.3736
146.6393
132.3223
127.2193
118.6920
111.7863
77.2575
77.0000
76.7520
74.6345
55.0428
38.5892
26.8284
20.3424
X : parts per Million : 13C

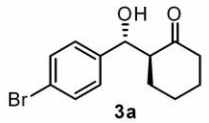

OH
O
O2N
3r
DAF-55RR048-060 pNO2 Cyclopentenone
X : parts per Million : 1H
0.35
11.84
5.03
12.16
0.87
2.93
1
3.44
8.25
7.74
-0.0000
1.2540
1.7143
1.7258
1.7304
1.7498
2.0178
2.2789
2.2972
2.3007
2.3797
2.4038
2.4587
2.8492
2.8584
4.7960
4.8464
4.8636
5.4179
7.2800
7.5336
7.5502
8.2041
8.2121
8.2225


OH
O
O2N
3r
DAF-55RI060-13C
p-NO2 cyclobutanone
20.3042
26.7521
38.5415
55.0046
74.3293
76.7425
77.0000
77.2480
123.6519
127.2860
147.5264
148.6042
222.2401
X : parts per Million : 13C

AF-837 Rf 0.51

C-RSA CHROMATOPAC CH-1 Report No.=5 DATA=1:@CHRM1.C00 13/10/02 17:49:10





3a

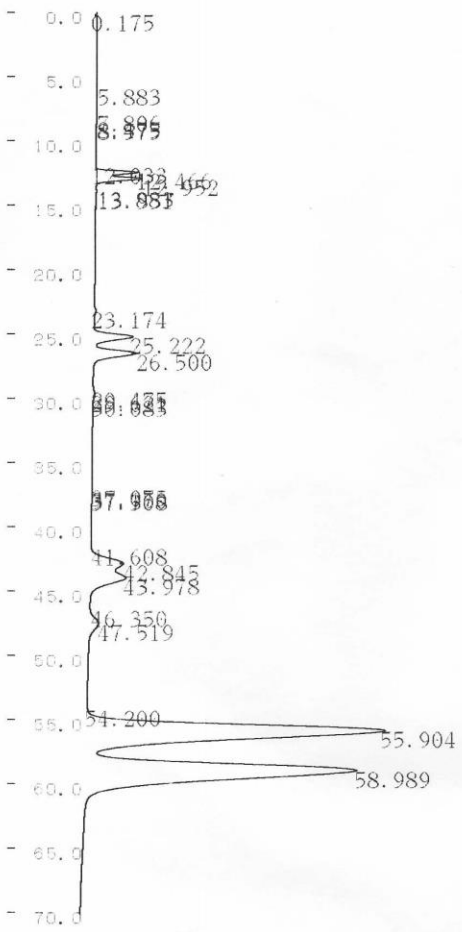
** CALCULATION REPORT **

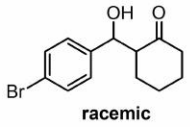
CH	PKNO	TIME	AREA	HEIGHT	MK	IDNO	CONC	NAME
1	1	56.298	6088209	72411			97.1749	
	2	60.973	176996	2176			2.8251	
		TOTAL	6265205	74587			100	

$100 \times \frac{94.3498}{100} = 94\%$ ee

AP-815 Fr. 11-13 AS-H Hexane : IPrOH = 98 : 2

C-R8A CHROMATOPAC CH=1 DATA=1:@CHRM1.C00 ATTEN= 7 SPEED= 2.0





racemic

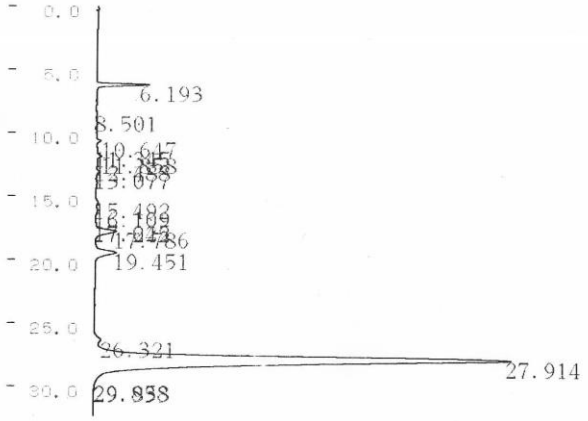
C-R8A CHROMATOPAC CH=1 Report No.=1 DATA=1:@CHRM1.C00 13/09/12 23:20:40

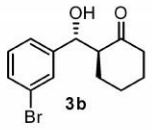
** CALCULATION REPORT **

CH	PKNO	TIME	AREA	HEIGHT	MK	IDNO	CONC	NAME
1	7	12.466	119630	6089	V		1.5017	
	8	12.952	138796	6736	V		1.7423	
	11	23.174	5810	211			0.0733	
	12	25.222	192532	5604			2.4169	
	13	26.5	226014	6169	V		2.8372	
	21	42.845	272874	4657	V		3.4255	
	22	43.978	317331	5092	V		3.9835	
	24	47.519	87543	1338	V		1.0989	
	27	55.904	3315884	42686	V		41.6252	
	28	58.989	3289601	38677	V		41.2953	
		TOTAL	7966044	117258			100	

DAF-4A-Rf059

C-R8A CHROMATOPAC CH=1 DATA=1:@CHRM1.C00 ATTEN= 7 SPEED= 2.0





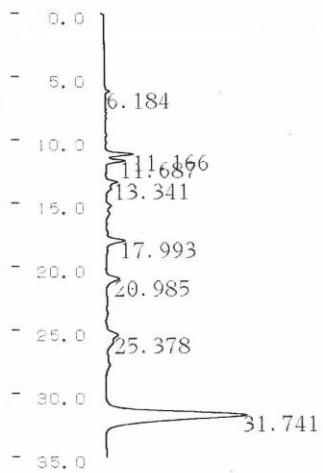
C-R8A CHROMATOPAC CH=1 Report No.=6 DATA=1:@CHRM1.C00 14/04/29 18:21:24

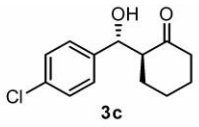
** CALCULATION REPORT **

CH	PKNO	TIME	AREA	HEIGHT	MK	IDNO	CONC	NAME
1	1	6.193	88694	7596			3.0318	
	3	10.647	10229	660			0.3496	
	5	11.858	11198	624	V		0.3828	
	7	13.077	7731	454			0.2643	
	8	15.492	8922	433			0.305	
	9	16.109	7111	337	V		0.2431	
	12	17.786	78251	3041	V		2.6748	
	13	19.451	88779	3043			3.0347	
	14	26.321	32131	963			1.0983	
	15	27.914	2592417	59546	SV		88.6156	
		TOTAL	2925463	76696			100	

DAF-58 RF053

C-R8A CHROMATOPAC CH=1 DATA=1:@CHRM1.C00 ATTEN= 5 SPEED= 2.0





3c

C-R8A CHROMATOPAC CH=1 Report No.=3 DATA=1:@CHRM1.C00 14/05/14 17:00:34

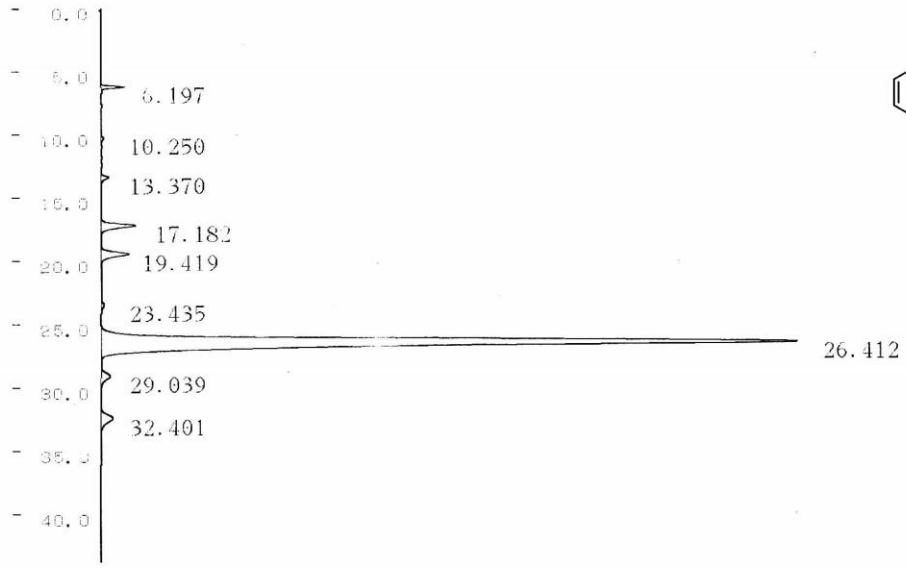
** CALCULATION REPORT **

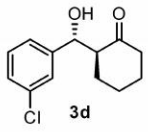
CH	PKNO	TIME	AREA	HEIGHT	MK	IDNO	CONC	NAME
1	2	11.166	15762	957			5.5285	
	3	11.687	11259	680	V		3.949	
	5	17.993	13799	602			4.84	
	6	20.985	12305	446			4.3159	
	7	25.378	5993	249			2.102	
	8	31.741	225987	4909			79.2647	
		TOTAL	285104	7843			100	

$\frac{79.1627}{81.3667} \times 100 \fallingdotseq 95\%$ ee

DAF-62 RT0.65

C-R8A CHROMATOPAC CH=1 Report No.=11 DATA=1:@CHRM1.C00 14/05/14 22:52:38





3d

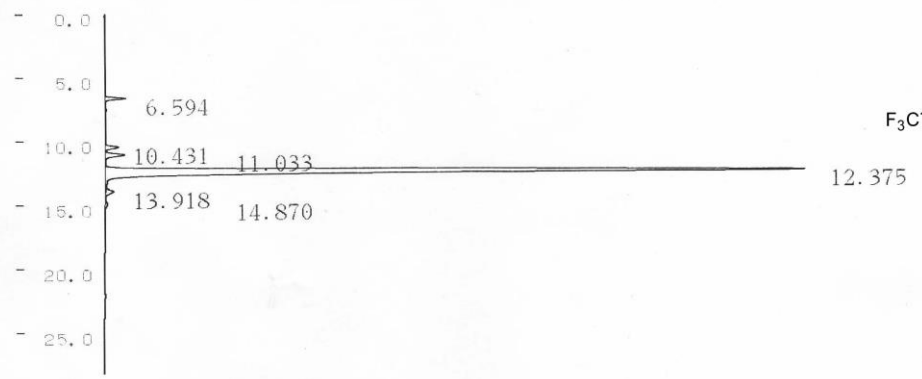
** CALCULATION REPORT **

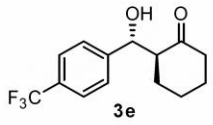
CH	PKNO	TIME	AREA	HEIGHT	MK	IDNO	CONC	NAME
1	2	6.197	79489	6759	V		0.9175	
	6	10.25	11817	776			0.1364	
	11	13.37	43880	2254	V		0.5065	
	14	17.182	236698	9763			2.732	
	16	19.419	220794	7951			2.5484	
	18	23.435	27572	898			0.3182	
	19	26.412	7781720	198763			89.8176	
	21	29.039	102918	2615	V		1.1879	
	22	32.401	159027	3473			1.8355	
		TOTAL	8663912	233252			100	

$\frac{88.6297}{91.0055} \times 100 \fallingdotseq 97\%\ ee$

AF-944 RF0.56

C-R8A CHROMATOPAC CH=1 Report No.=4 DATA=1:@CHRM1.C00 14/01/20 12:14:20





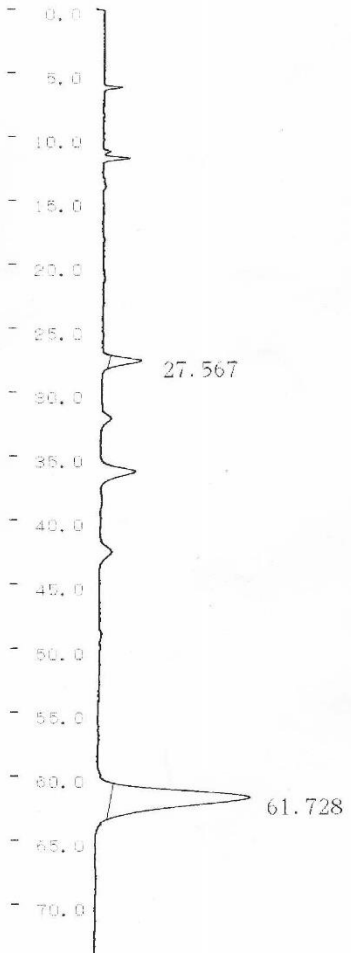
** CALCULATION REPORT **

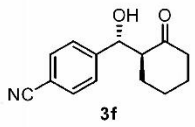
CH	PKNO	TIME	AREA	HEIGHT	MK	IDNO	CONC	NAME
1	11	6.594	67702	5816	SV		1.593	
	17	10.431	60374	3871			1.4205	
	18	11.033	94644	5552	V		2.2269	
	19	12.375	3959636	198622	SV		93.1665	
	22	13.918	48950	2289	T		1.1517	
	23	14.87	18759	837			0.4414	
		TOTAL	4250063	216987			100	

$\frac{92.0148}{94.3182} \times 100 = 97.56\%_{ee}$

DAF-61 Rf0.60

C-R8A CHROMATOPAC CH=1 Report No.=6 DATA=1:@CHRM1.C00 14/05/14 19:44:28

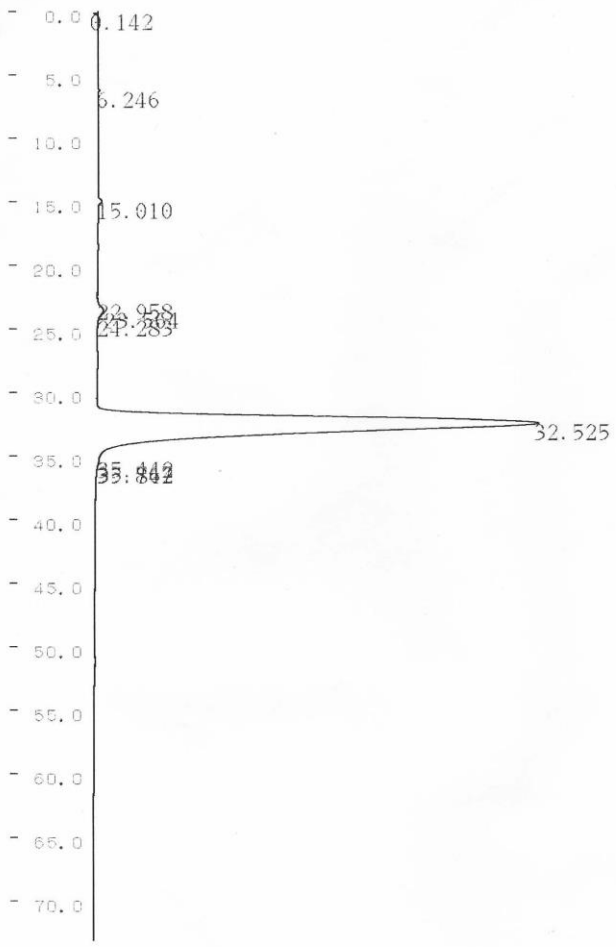


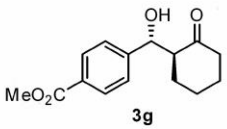


3f

AF-934 Fr 19,20

C-R8A CHROMATOPAC CH=1 DATA=1:@CHRM1.C00 ATTEN= 6 SPEED= 2.0





3g

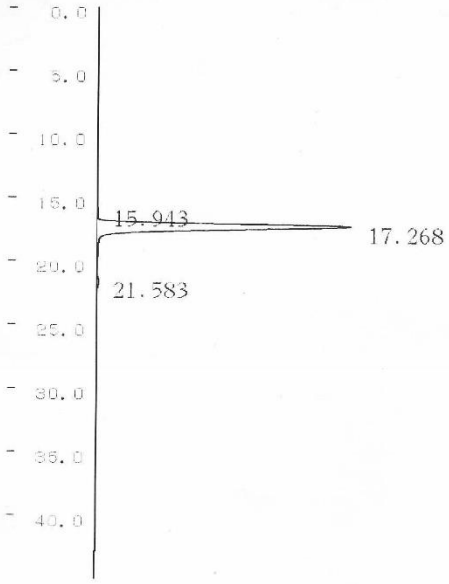
C-R8A CHROMATOPAC CH=1 Report No.=4 DATA=1:@CHRM1.C00 14/01/07 12:49:46

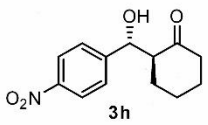
** CALCULATION REPORT **

CH	PKNO	TIME	AREA	HEIGHT	MK	IDNO	CONC	NAME
1	3	15.01	7246	290			0.2713	
	5	23.564	20833	440	V		0.78	
	7	32.525	2642694	31565	S		98.9487	
		TOTAL	2670772	32296			100	

AF-921 RF051

C-RSA CHROMATOPAC CH-1 Report No.-2 DATA=1:@CHRM1.C00 13/10/09 15:32:28





3h

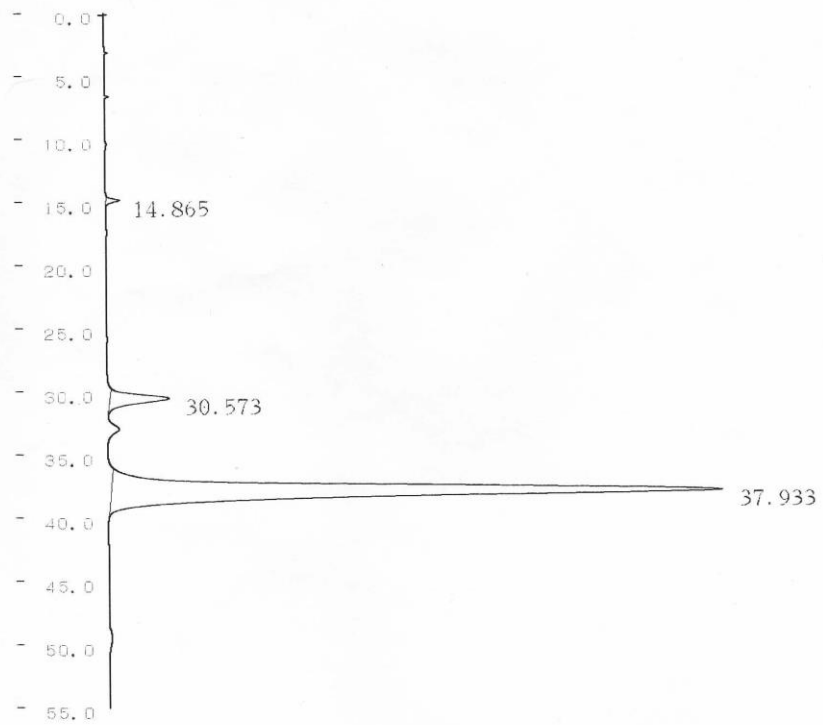
** CALCULATION REPORT **

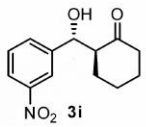
CH	PKNO	TIME	AREA	HEIGHT	MK	IDNO	CONC	NAME
1	4	15.943	21155	696			0.4392	
	5	17.268	4747165	146162	SV		98.5603	
	7	21.583	48187	1216			1.0005	
		TOTAL	4816507	148074			100	

97.5598 / 99.5608 ×100 ≒ 98%

DAE-53 RT 0.47

C-R8A CHROMATOPAC CH=1 Report No.=2 DATA=1:@CHRM1.C00 14/05/06 15:19:24





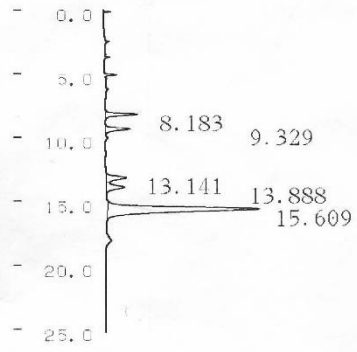
3i

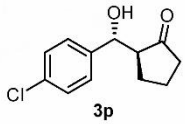
** CALCULATION REPORT **

CH	PKNO	TIME	AREA	HEIGHT	MK	IDNO	CONC	NAME
1	3	14.865	9173	470			0.6378	
	4	30.573	95158	2096			6.6374	
	5	37.933	1333547	21738			92.7248	
		TOTAL	1438178	24304			100	

DAF-5P1 F-18-15

C-R8A CHROMATOPAC CH=1 Report No.=8 DATA=1:@CHRM1.C00 14/12/29 14:41:52





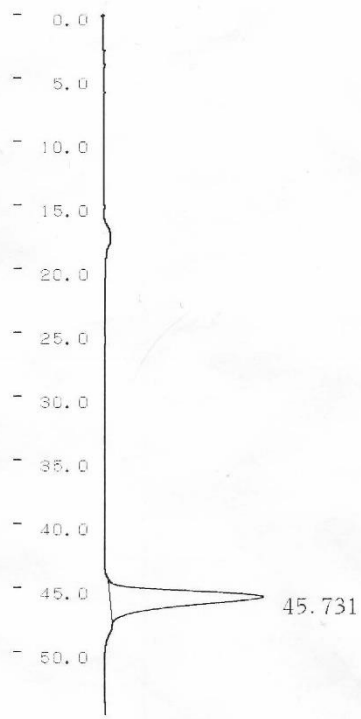
3p

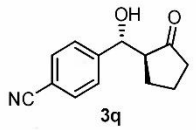
** CALCULATION REPORT **

CH	PKNO	TIME	AREA	HEIGHT	MK	IDNO	CONC	NAME
1	6	8.183	14825	1141			7.3472	
	7	9.329	13492	882			6.6862	
	8	13.141	14264	707			7.0689	
	9	13.888	14468	638	V		7.1701	
	10	15.609	144733	5419			71.7275	
		TOTAL	201782	8788			100	

DAF-570-4Fr1-2

C-R8A CHROMATOPAC CH=1 Report No.=5 DATA=1:@CHRM1.C00 15/01/04 20:16:56





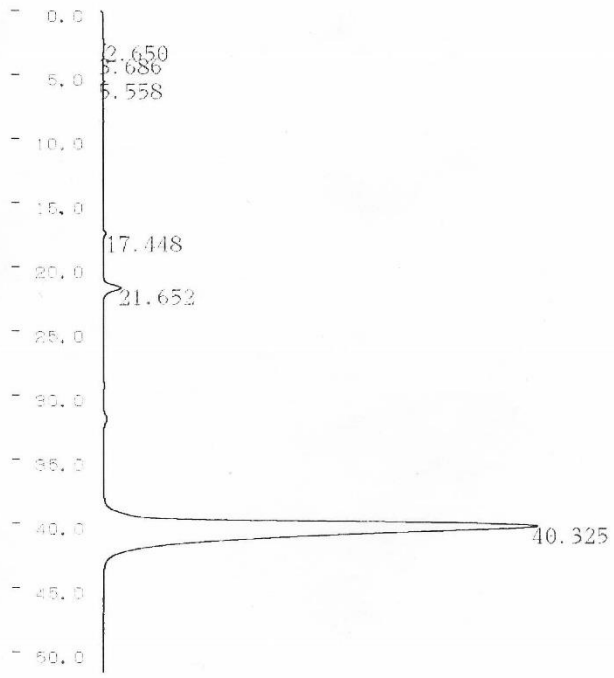
3q

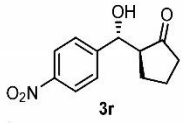
** CALCULATION REPORT **

CH	PKNO	TIME	AREA	HEIGHT	MK	IDNO	CONC	NAME
1	4	45.731	827652	10986			100	
		TOTAL	827652	10986			100	

DAF-55RP0.60

C-R8A CHROMATOPAC CH=1 DATA=1:@CHRM1.C00 ATTEN= 6 SPEED= 2.0





3r

C-R8A CHROMATOPAC CH=1 Report No.-5 DATA=1:@CHRM1.C00 14/05/06 18:49:18

** CALCULATION REPORT **

CH	PKNO	TIME	AREA	HEIGHT	MK	IDNO	CONC	NAME
1	5	21.652	41561	1200			1.7344	
	6	40.325	2354668	30725			98.2656	
		TOTAL	2396229	31925			100	

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