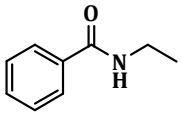
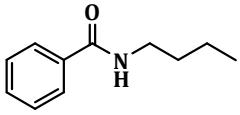
Electronic Supplementary Material (ESI) for New Journal of Chemistry.

1. General procedure

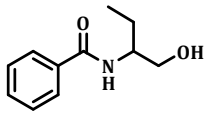
In a sealed tube, to hydrochloric salts of butylamine (1mmol), $CaCO_3$(2.2 equiv) and Fe_3O_4@SiO_2-APTMS-Cu (40 mg, 2mol%) in CH_3CN/Toluene (2 ml, in a ratio of 4/1 respectively), and 8equiv TBHP (70 wt % in H_2O) and the mixture was stirred at 80^{o}C under Ar balloon for 10 h. After end of the reaction and cooling to room temporature, 1N HCl (2.5 mL) and EtOAc (5 mL) was added. The mixture was extracted with EtOAc and the organic phase was washed with a saturated aqueous solution of $NaHCO_3$ (5 mL), brine (10 mL),dried over anhydrous Na_2SO_4, After removal the solvent under vacuum, survived the crude product, then purified by column chromatography to afford the desired product.



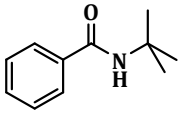
Compound **1b** was prepared according to the general procedure and purified by column chromatography (n-Hexane: EtOAc= 4:1) to give 52 % yield.
[1]**H NMR (CDCl$_3$, 200 MHz)**: δ (ppm) = 7.78-7.74 (m, 2H), 7.53-7.39 (m, 3H), 6.12-6.11 (br s, 1H), 3.56-3.45 (q, 2H, *J* = 6.7 Hz), 1.29-1.23 (t, 3H, *J* = 7.1 Hz).
Analytical data was similar to those previously reported. [2]



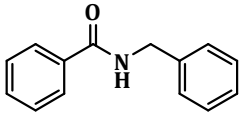
Compound **1c** was prepared according to the general procedure and purified by column chromatography (n-Hexane: EtOAc= 4:1) to give 80 % yield.
[1]**H NMR (CDCl$_3$, 200 MHz)**: δ (ppm) = 7.99-8.00 (m, 2H), 7.43-7.20 (m, 3H), 6.32 (br s, 1H), 3.40-3.42 (q, 2H, J = 6.8 Hz), 1.57-1.46 (m, 2H), 1.37-1.28 (m, 2H), 0.90-0.84 (t, 3H, J = 7.0 Hz).
Analytical data was similar to those previously reported. [3]



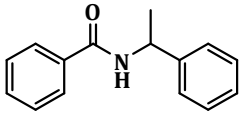
Compound **1d** was prepared according to the general procedure and purified by column chromatography (n-Hexane: EtOAc= 4:1) to give 67 % yield.
[1]**H NMR (CDCl$_3$, 200 MHz)**: δ (ppm) = 7.71-7.69 (m, 2H), 7.42-7.32 (m, 3H), 6.35 (s, 1H), 3.99 (br s, 1H), 3.73-3.60 (dd, 2H, *J* = 10.8, 2.6 Hz), 2.95-2.97 (br s, 1H), 1.51-1.67 (m, 2H), 0.95-0.93 (t, 3H, *J*=7.0Hz).
[13]C NMR (CDCl$_3$, 75 MHz): δ (ppm) = 168.3, 134.4, 131.6, 128.6, 127.0, 65.2, 53.7, 24.3, 10.7.
Analytical data was similar to those previously reported. [4]



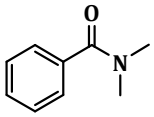
Compound **1e** was prepared according to the general procedure and purified by column chromatography (n-Hexane: EtOAc= 4:1) to give 56 % yield.
[1]**H NMR (CDCl$_3$, 200 MHz)**: δ (ppm) = 7.80-7.90 (m, 2H), 7.50-7.35 (m, 3H), 6.12 (br s, 1H),1.40 (s, 9H).
[13]C NMR (CDCl$_3$, 75 MHz): δ (ppm) = 167.7, 136.0, 131.2, 128.6, 126.8, 51.8, 29.00.
Analytical data was similar to those previously reported. [3]



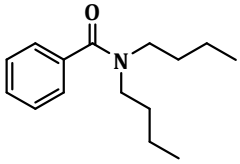
Compound **1f** was prepared according to the general procedure and purified by column chromatography (n-Hexane: EtOAc= 4:1) to give 84 % yield.
[1]**H NMR (CDCl3, 200 MHz)**: δ (ppm) = 7.81-7.66 (m, 2H), 7.51-7.26 (m, 8H), 6.39 (br s, 1H), 4.67-4.65 (d, 2H, *J* = 5.5 Hz).
Analytical data was similar to those previously reported. [5]



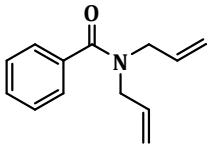
Compound **1g** was prepared according to the general procedure and purified by column chromatography (n-Hexane: EtOAc= 4:1) to give 80 % yield.
^{1}H NMR ($CDCl_3$, 200 MHz): δ (ppm) 7.80-7.78 (m, 2H), 7.54-7.30 (m, 8H), 6.34 (d, *J* = 7.0 Hz, 1H), 5.37(q, *J* = 7.2 Hz, 1H), 1.64 (d, *J* = 7.1 Hz, 3H).
^{13}C NMR ($CDCl_3$, 75 MHz): δ (ppm) = 166.6, 143.2, 134.6, 131.5, 128.7, 128.6, 127.4, 126.9, 126.3, 49.3, 21.8.
Analytical data was similar to those previously reported. [6]



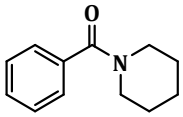
Compound **1i** was prepared according to the general procedure and purified by column chromatography (n-Hexane: EtOAc= 4:1) to give 67 % yield.
^{1}H NMR ($CDCl_3$, 200 MHz): δ (ppm) = 7.39-7.26 (m, 5H), 2.97 (s, 3H), 3.09 (s, 3H).
^{13}C NMR ($CDCl_3$, 75 MHz): δ (ppm) = 171.7, 136.5, 129.7, 128.5, 127.2, 39.7, 35.47.
Analytical data was similar to those previously reported. [7]



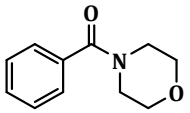
Compound **1j** was prepared according to the general procedure and purified by column chromatography (n-Hexane: EtOAc= 4:1) to give a 43 % yield.
^{1}H NMR ($CDCl_3$, 200 MHz): δ (ppm) = 7.73-7.28 (m, 5H), 3.47 (m, 2H), 3.18 (m, 2H), 1.62-1.61 (m, 2H), 1.47-1.39 (m, 2H), 1.14-0.97 (m, 4H), 0.99-097(m, 3H), 0.80-0.77 (m, 3H,).
Analytical data was similar to those previously reported. [8]



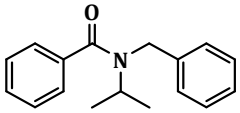
Compound **1m** was prepared according to the general procedure and purified by column chromatography (n-Hexane: EtOAc= 4:1) to give 69 % yield.
^{1}H NMR ($CDCl_3$, 200 MHz): δ (ppm) = 7.44-7.38 (s, 5H), 5.90 (br s, 1H), 5.74 (br s, 1H), 5.26-5.18 (s, 4H), 4.15 (s, 2H), 3.84 (s, 2H).
^{13}C NMR ($CDCl_3$, 75 MHz): δ (ppm) = 171.8, 136.3, 133.2, 132.8, 129.6, 128.4, 126.6, 117.6, 50.7, 46.92.
Analytical data was similar to those previously reported. [4]



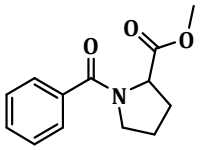
Compound **1k** was prepared according to the general procedure and purified by column chromatography (n-Hexane: EtOAc= 4:1) to give 72 % yield.
^{1}H NMR ($CDCl_3$, 200 MHz): δ (ppm) = 7.39 (s, 5H), 3.71 (s, 2H), 3.49 (s, 2H), 1.41-1.68 (m, 6H).
^{13}C NMR ($CDCl_3$, 75 MHz): δ (ppm) = 170.3, 136.5, 129.5, 128.5, 126.9, 48.8, 43.2, 26.7, 25.8, 24.8.
Analytical data was similar to those previously reported. [5]



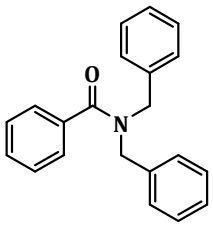
Compound **1l** was prepared according to the general procedure and purified by column chromatography (n-Hexane: EtOAc= 4:1) to give 81 % yield.
^{1}**H NMR (CDCl$_3$, 200 MHz)**: δ (ppm) = 7.40 (s, 5H), 3.70 (br s, 2H), 3.46 (br s, 2H).
^{13}**C NMR (CDCl$_3$, 75 MHz):** δ (ppm) = 170.5, 135.4, 130.0, 128.7, 127.2, 67.0.
Analytical data was similar to those previously reported. [3]



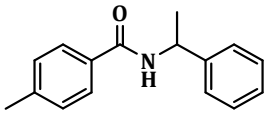
Compound **1n** was prepared according to the general procedure and purified by column chromatography (n-Hexane: EtOAc= 4:1) to give a 45 % yield.
^{1}**H NMR (CDCl$_3$, 200 MHz)**: δ (ppm) = 7.44 (m, 5H), 7.36-7.24 (m, 5H), 4.7 (br s, 2H), 4.15 (br s, 1H), 1.11 (s, 6H).
^{13}**C NMR (CDCl$_3$, 75 MHz):** δ (ppm) = 166.6, 143.1, 134.6, 131.5, 128.8, 128.6, 127.5, 127.0, 126.3, 49.2, 21.7.
Analytical data was similar to those previously reported. [4]



Compound **1o** was prepared according to the general procedure and purified by column chromatography (n-Hexane: EtOAc= 4:1) to give 78 % yield.
^{1}**H NMR (CDCl$_3$, 200 MHz)**: δ (ppm) = 7.57-7.54 (m, 2H), 7.44-7.35 (m, 3H), 4.68-4.54 (dd, 1H (79%), *J* = 7.5, 4.4 Hz), 4.32 (d, 1H (21%), *J* = 8.5 Hz), 3.79-3.68 (s, 3H (78%)), 3.54-3.52 (s, 3H (20%)), 3.68-3.42 (m, 2H), 2.32-2.27 (m,1H), 2.05-1.85 (m, 3H).
^{13}**C NMR (CDCl$_3$, 75 MHz):** δ (ppm) = 172.9, 169.8, 136.3, 130.3, 128.3, 127.4, 59.2, 52.4, 50.0, 29.5, 25.5.
Analytical data was similar to those previously reported. [6]



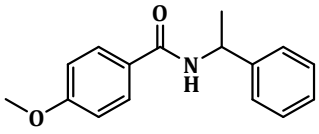
Compound **1p** was prepared according to the general procedure and purified by column chromatography (n-Hexane: EtOAc= 4:1) to give 60 % yield.
^{1}**H NMR (CDCl$_3$, 200 MHz)**: δ (ppm) = 7.52-7.27(m, 7H), 7.16 (s, 1H), 4.71 (s, 2H), 4.41 (s, 2H).
^{13}**C NMR (CDCl$_3$, 75 MHz):** δ (ppm) = 172.3, 136.9, 136.4, 136.2, 129.7, 128.8, 128.6, 128.4, 127.6, 127.0, 51.5, 46.9.
Analytical data was similar to those previously reported. [6]



Compound **1v** was prepared according to the general procedure and purified by column chromatography (n-Hexane: EtOAc= 4:1) to give 73 % yield.

[1]**H NMR (CDCl3, 200 MHz)**: δ (ppm) = 7.78-7.75 (d, 2H, *J* = 8.3 Hz), 7.46-7.26 (m, 9H), 6.30 (d, 1H, *J* = 6.8 Hz), 5.37-5.31 (m, 1H), 2.40 (s, 3H), 1.63-1.60 (d, 3H, *J* = 7.1 Hz).

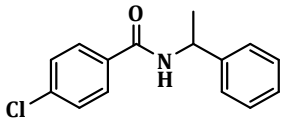
Analytical data was similar to those previously reported. [6]



Compound **1w** was prepared according to the general procedure and purified by column chromatography (n-Hexane: EtOAc= 4:1) to give 87 % yield.

[1]**H NMR (CDCl$_3$, 200 MHz)**: δ (ppm) = 7.76-7.72 (d, 2H, *J* = 9 Hz), 7.38-7.26 (m, 6H), 6.93-6.89 (m, 2H), 6.23 (d, 1H, *J* = 7.3 Hz), 5.36-5.30 (p, 1H, *J* = 6.9 Hz), 3.84 (s, 3H), 1.61-1.59 (d, 3H, *J* = 6.8 Hz).

Analytical data was similar to those previously reported. [6]



Compound **1x** was prepared according to the general procedure and purified by column chromatography (n-Hexane: EtOAc= 4:1) to give 75 % yield.

[1]**H NMR (CDCl3, 200 MHz)**: δ (ppm) = 7.72-7.68 (dd, 2H, *J* = 8.0, 1.1 Hz), 7.39-7.26 (m, 7H), 6.38-6.40 (br s, 1H), 5.33-5.28 (p, 1H, *J* = 6.8 Hz), 1.62-1.58 (d, 3H, *J* = 7).

Analytical data was similar to those previously reported. [6]

References

[1] Y. Wang, K. Yamaguchi, Mizuno, N. *Angew. Chem. Int. Ed.*, **2012**, 51, 1 – 5.

[2] W.Yoo, C. Li, *J. Am. Chem. Soc.* ***2006***, 128, 13064-13065.

[3] X.Wu, M. Sharif, A. Pews-Davtyan, P. Langer, K. Ayub, M. Beller*, Eur. J. Org. Chem.* **2013**, 2783–2787.

[4] D. Saberi, A. Heydari, *Appl. Organometal. Chem.* **2014**, 28, 101-108.

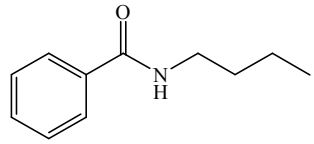
[5] S. Ch. Ghosh, S. Muthaiah, Y. Zhang, X. Xu, S. H. Hong, *Adv. Synth. Catal.* **2009**, 351, 2643 – 2649.

[6] X. Bantreil, C. Fleith, J. Martinez, F. Lamaty, *ChemCatChem.* **2012**, 41, 922-925.

[7] K. Xu, Y. Hu, S. Zhang, Zh. Zha, .Zh. Wang,*Chem. Eur. J.* **2012**, 18, 9793-9797.

[8] S. Wang, J. Wang, R. Guo, G. Wang, Sh. Chen, X.Yu, *Tet. Lett.* **2013**, 54, 6233–6236.

1b)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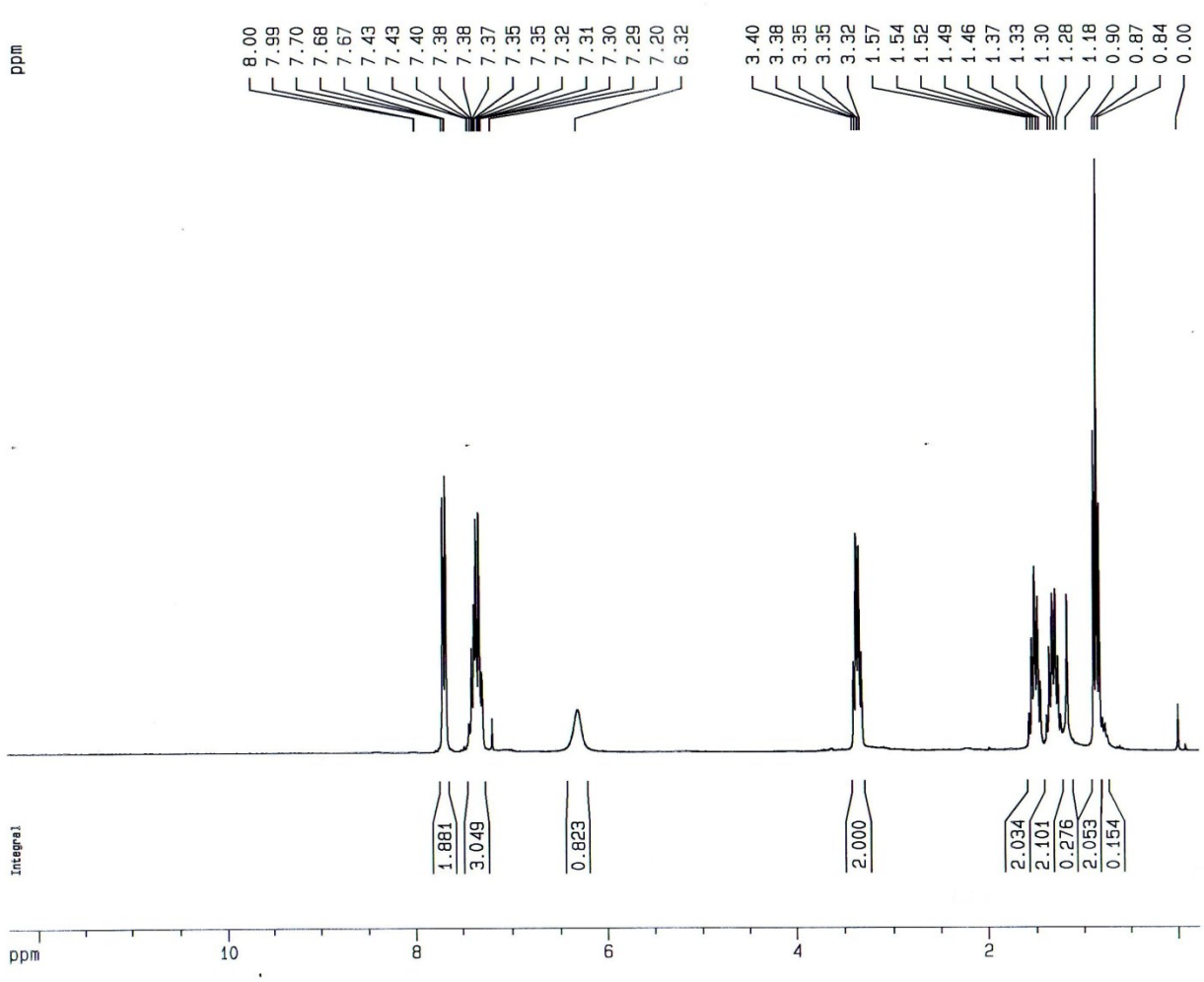
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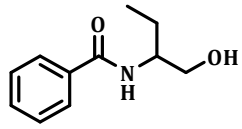
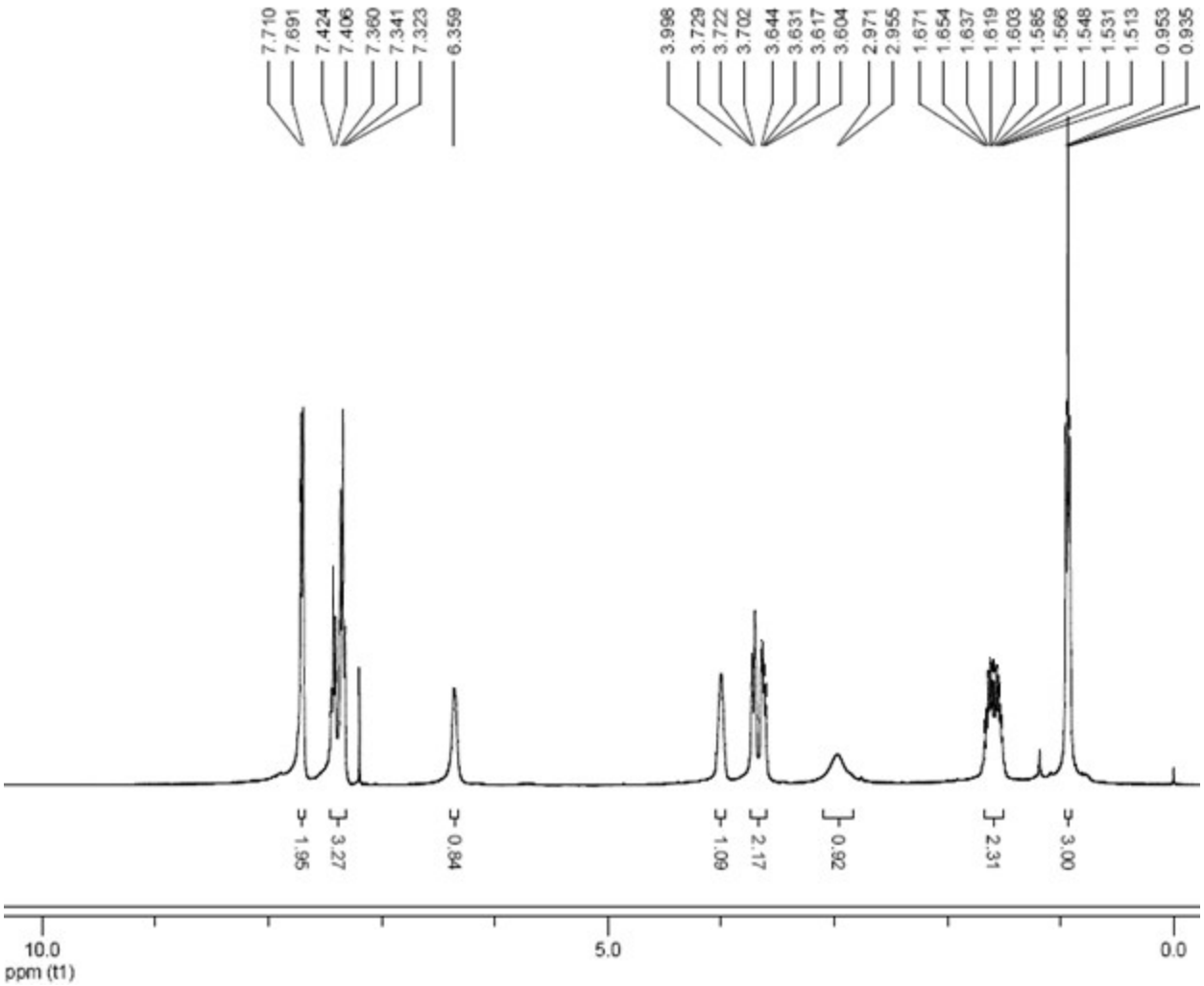
1c)


O
N
H
OH

(^{1}H-NMR)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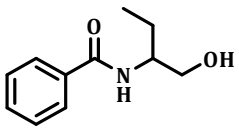
1c)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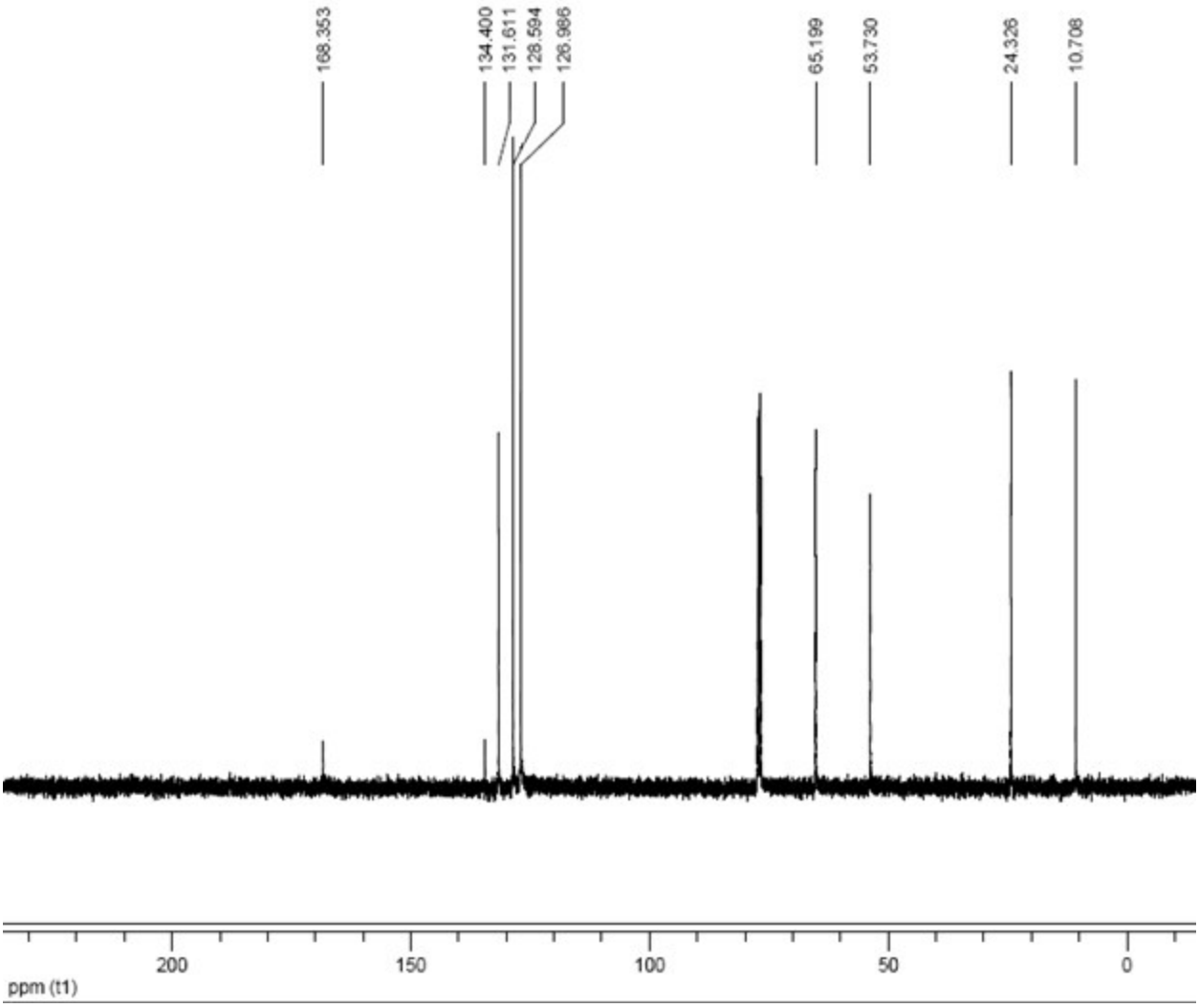
N
H
OH

(^{13}C-NMR)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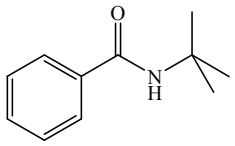
1d)



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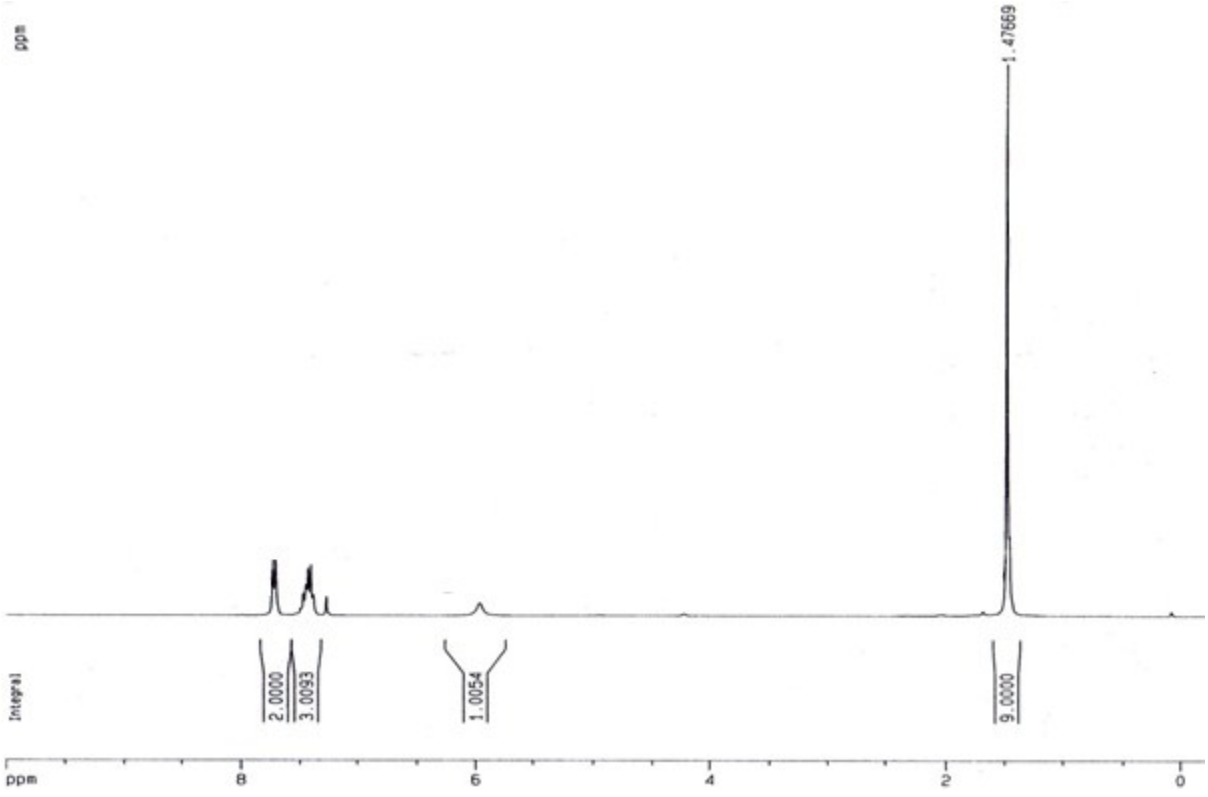
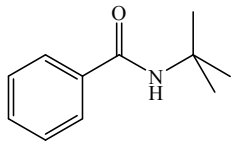


1d)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N
H

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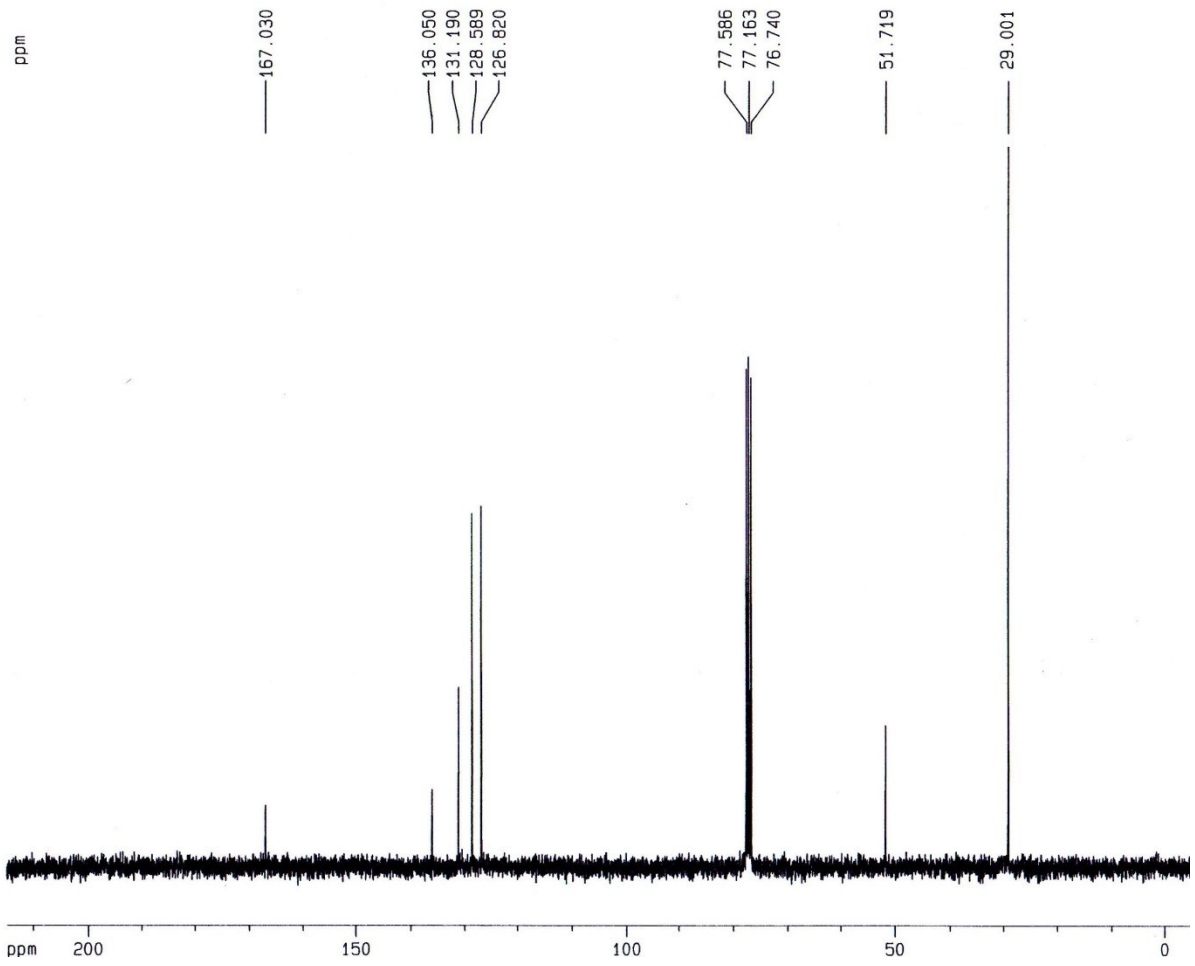
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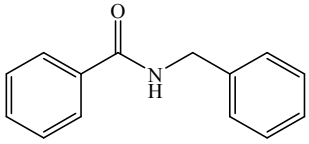
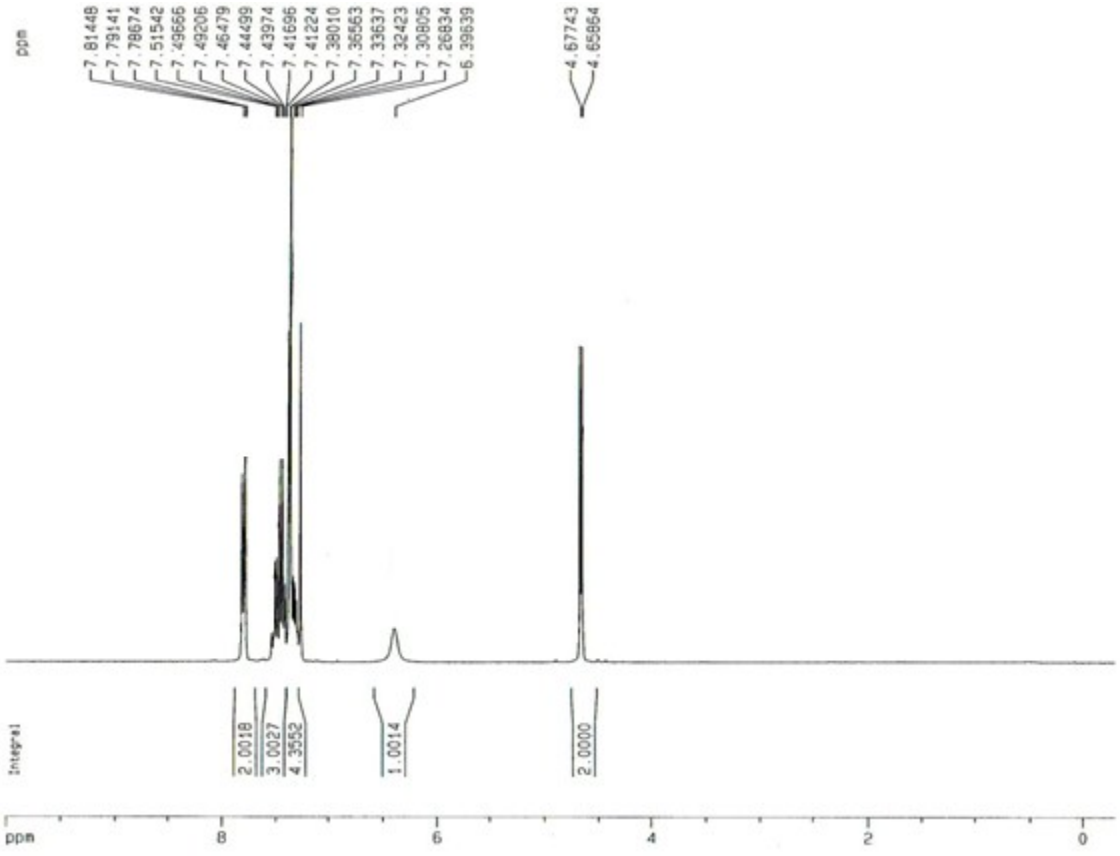
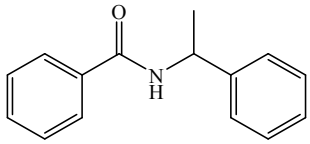
1e)


O
N
H

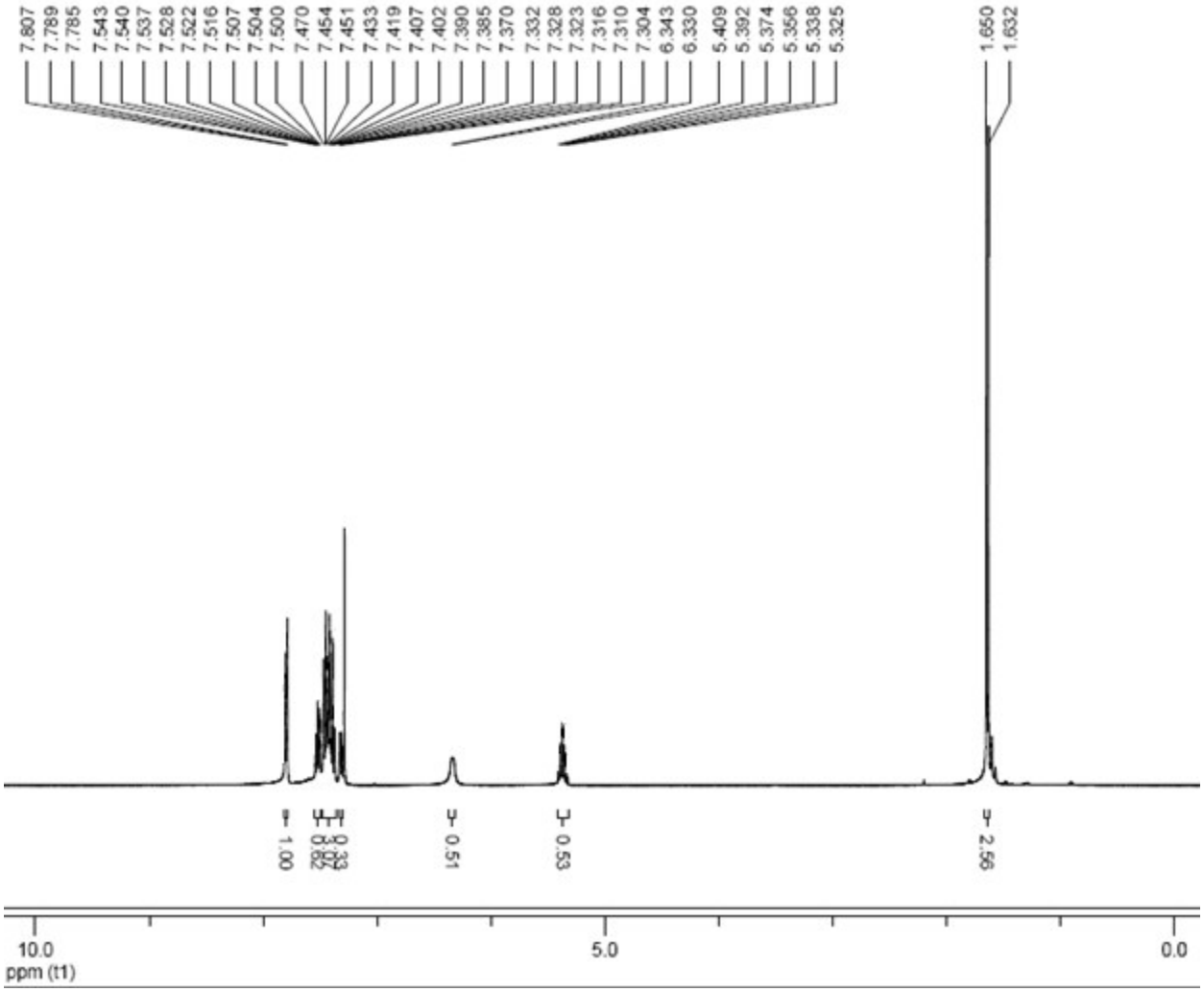
(^{1}H-NMR)


ppm
7.81448
7.79141
7.78674
7.51542
7.49666
7.49206
7.46479
7.44499
7.43974
7.41696
7.41224
7.38010
7.35563
7.33637
7.32423
7.30805
7.26834
6.39639
4.67743
4.65864
Integral
2.0018
3.0027
4.3552
1.0014
2.0000
ppm
8
6
4
2
0

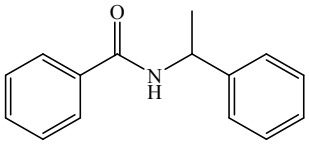
1f)


O
N
H

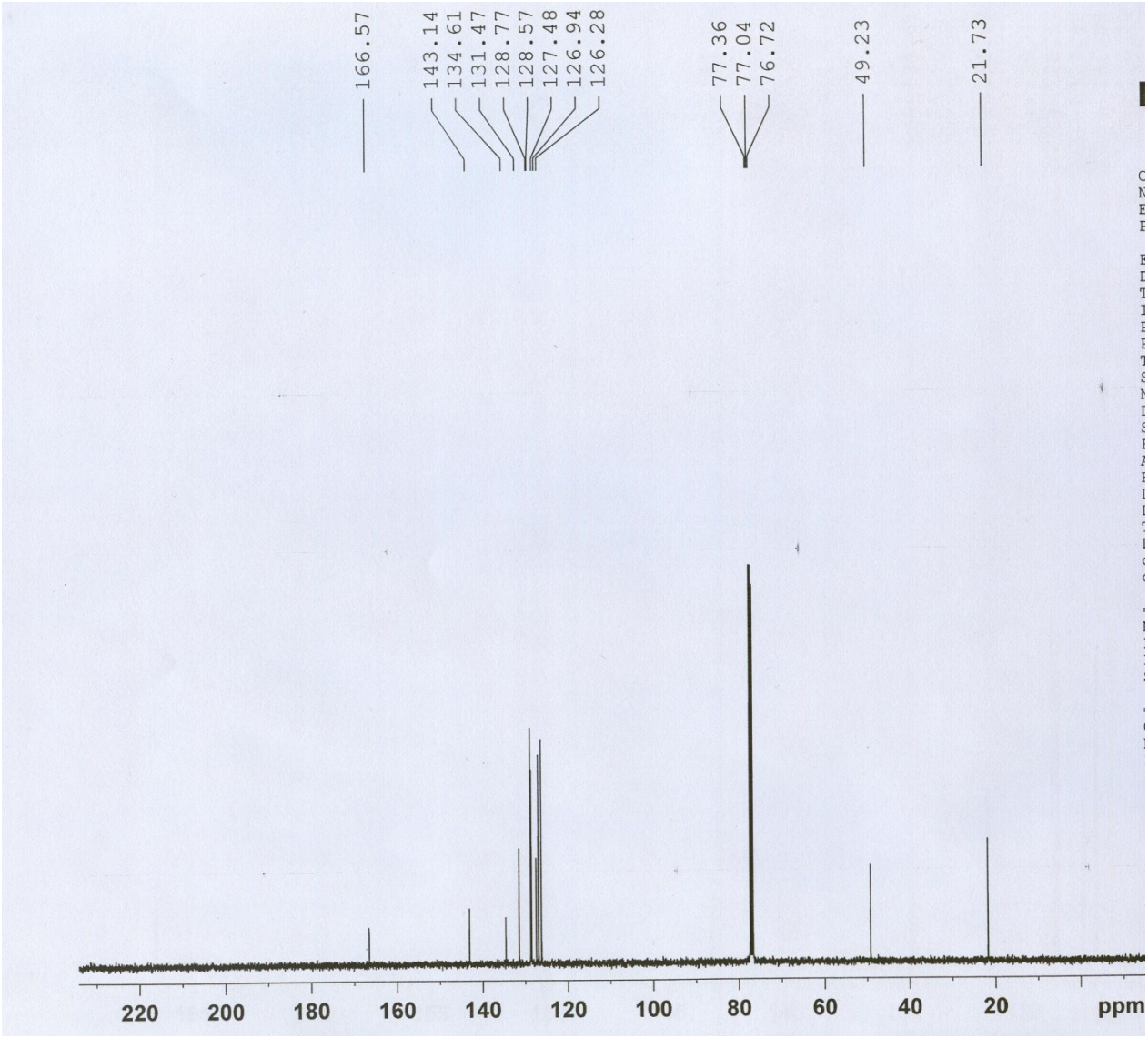
(^{1}H-NMR)


7.807
7.789
7.785
7.543
7.540
7.537
7.528
7.522
7.516
7.507
7.504
7.500
7.470
7.454
7.451
7.433
7.419
7.407
7.402
7.390
7.385
7.370
7.332
7.328
7.323
7.316
7.310
7.304
6.343
6.330
5.409
5.392
5.374
5.356
5.338
5.325
1.650
1.632
1.00
2.82
0.83
0.51
0.53
2.56
10.0
ppm (t1)
5.0
0.0

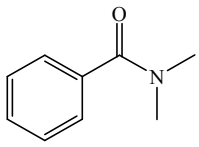
1f)


O
N
H

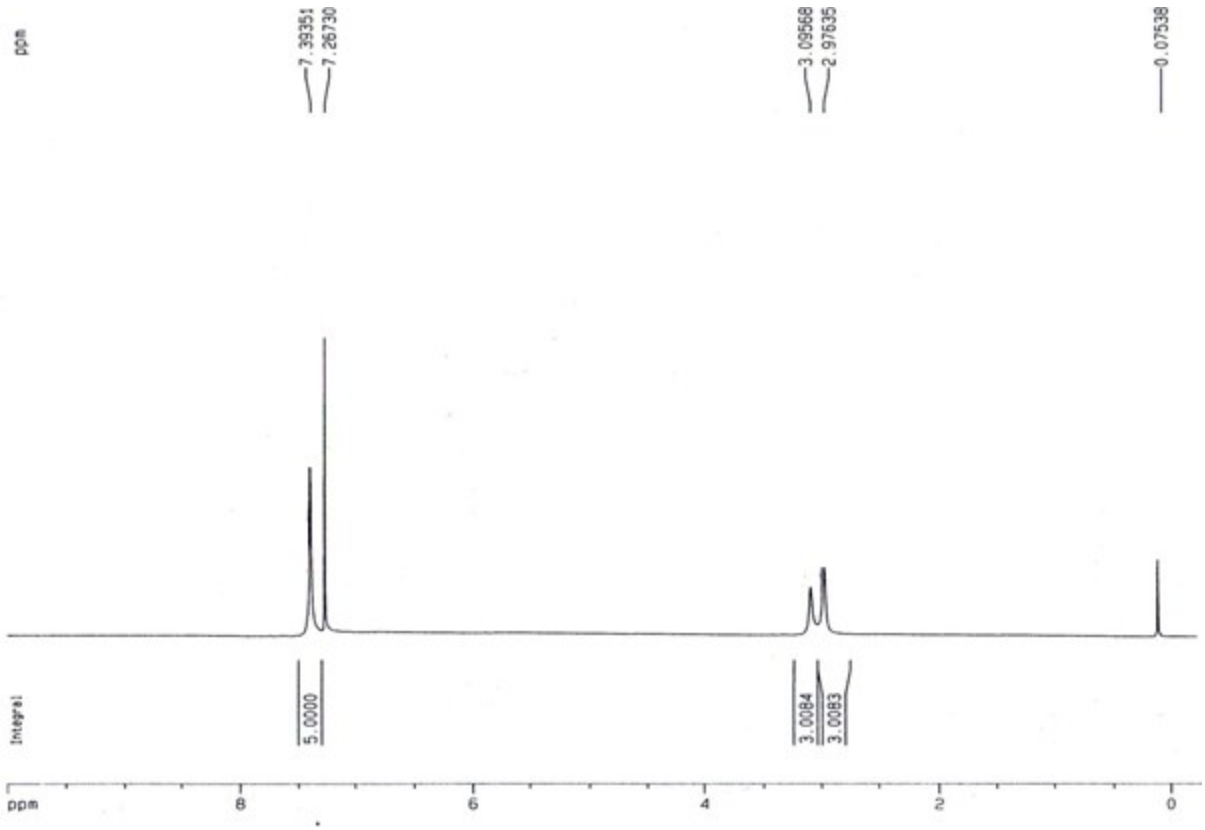
(C-NMR)


166.57
143.14
134.61
131.47
128.77
128.57
127.48
126.94
126.28
77.36
77.04
76.72
49.23
21.73
220
200
180
160
140
120
100
80
60
40
20
ppm

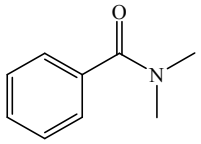
1h)


O
N

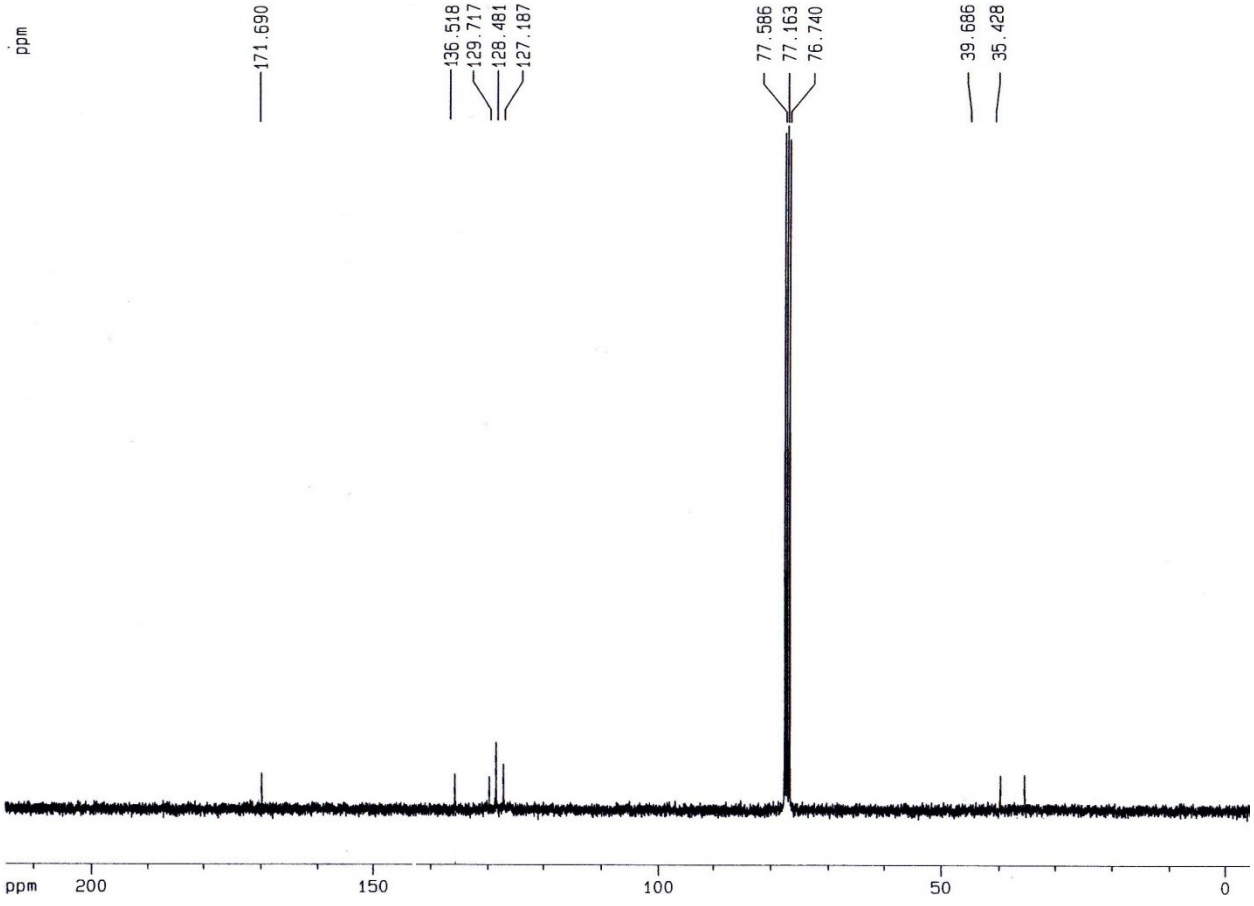
(^{1}H-NMR)


ppm
7.39351
7.26730
3.09568
2.97635
0.07538
Integral
5.0000
3.0084
3.0083
ppm
8
6
4
2
0

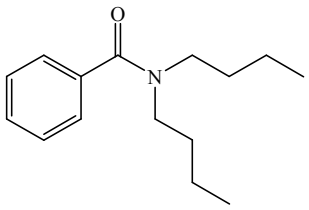
1h)


O
N

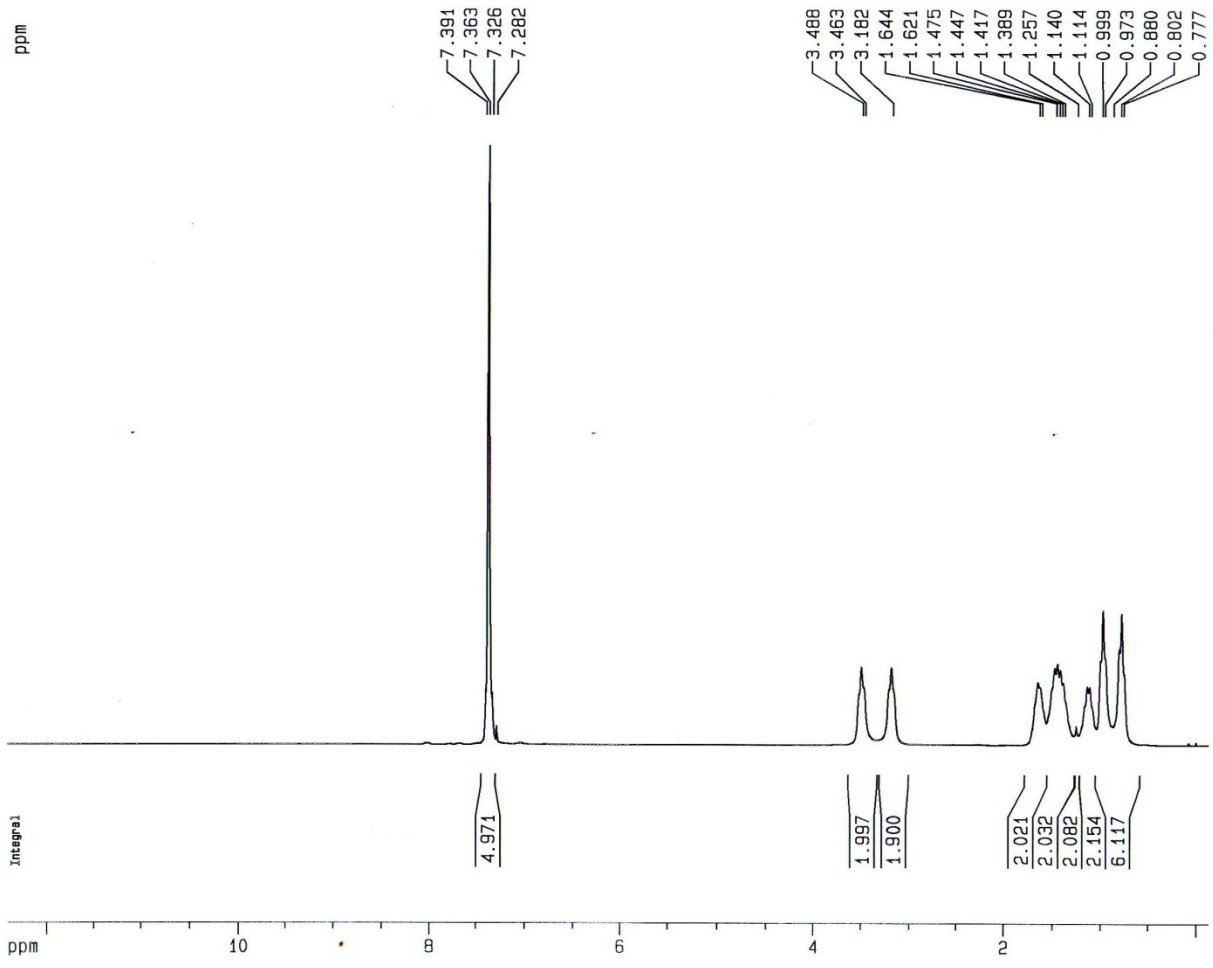
(^{13}C-NMR)


ppm
171.690
136.518
129.717
128.481
127.187
77.586
77.163
76.740
39.686
35.428
ppm
200
150
100
50
0

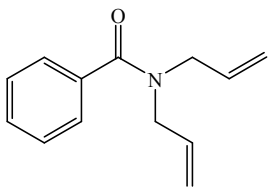
1i)



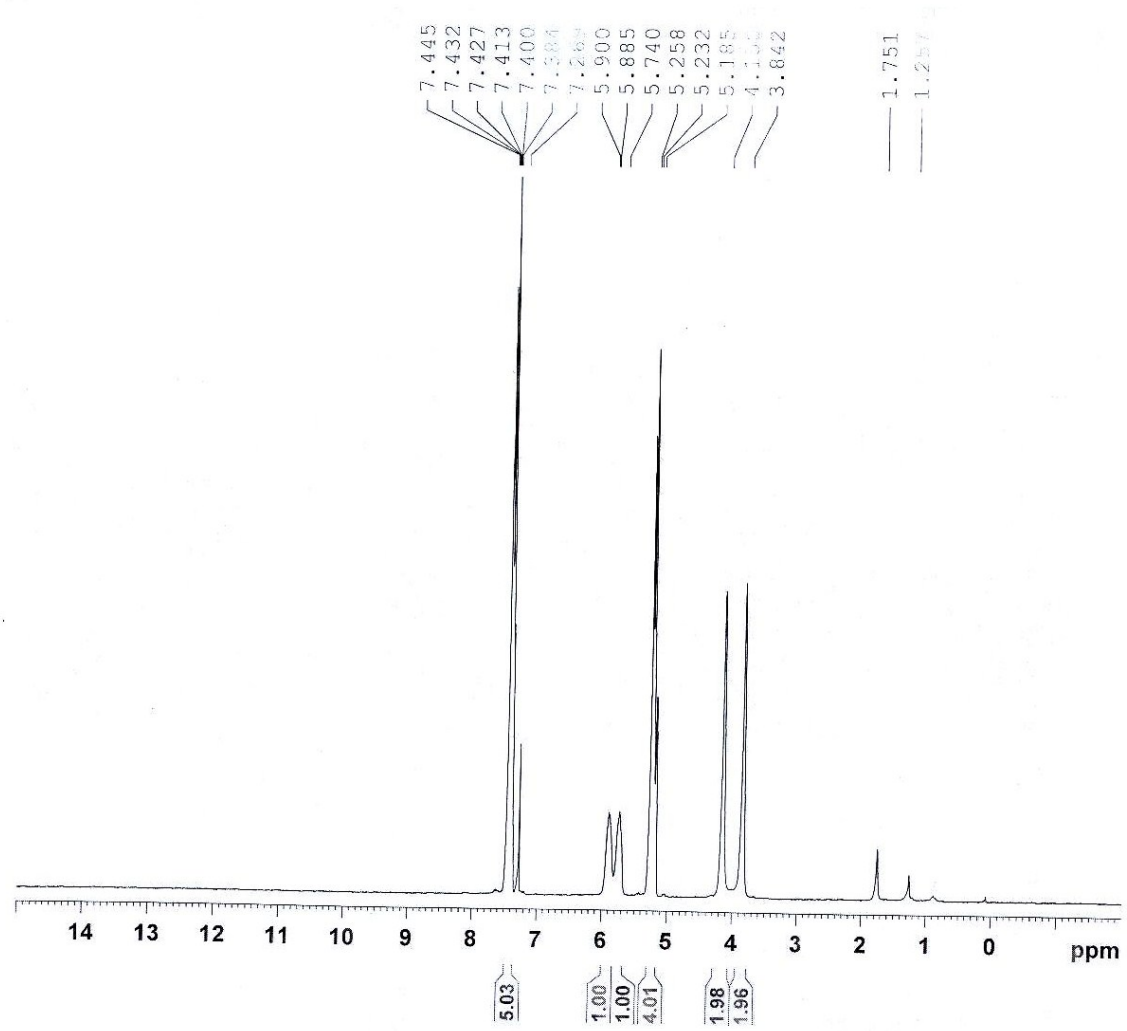
(^{1}H-NMR)


ppm
7.391
7.363
7.326
7.282
3.488
3.463
3.182
1.644
1.621
1.475
1.447
1.417
1.389
1.257
1.140
1.114
0.999
0.973
0.880
0.802
0.777
Integral
4.971
1.997
1.900
2.021
2.032
2.082
2.154
6.117
ppm
10
8
6
4
2

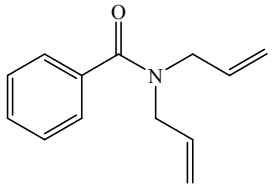
1j)



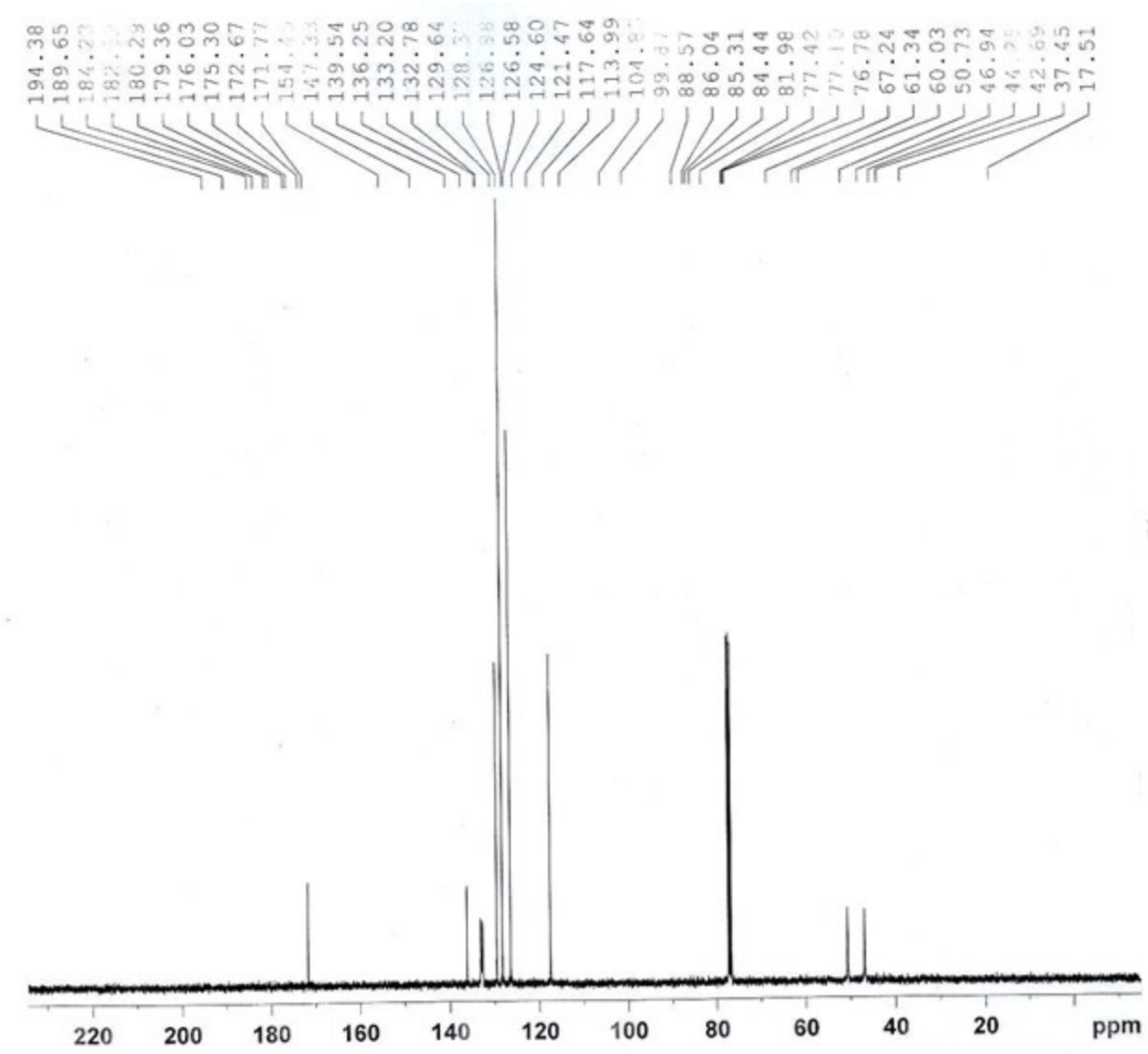
(^{1}H-NMR)


7.445
7.432
7.427
7.413
7.400
5.900
5.885
5.740
5.258
5.232
3.842
1.751
14 13 12 11 10 9 8 7 6 5 4 3 2 1 0 ppm
5.03
1.00
1.00
4.01
1.98
1.96

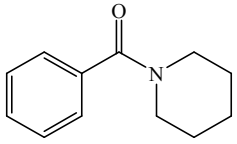
1j)


O
N

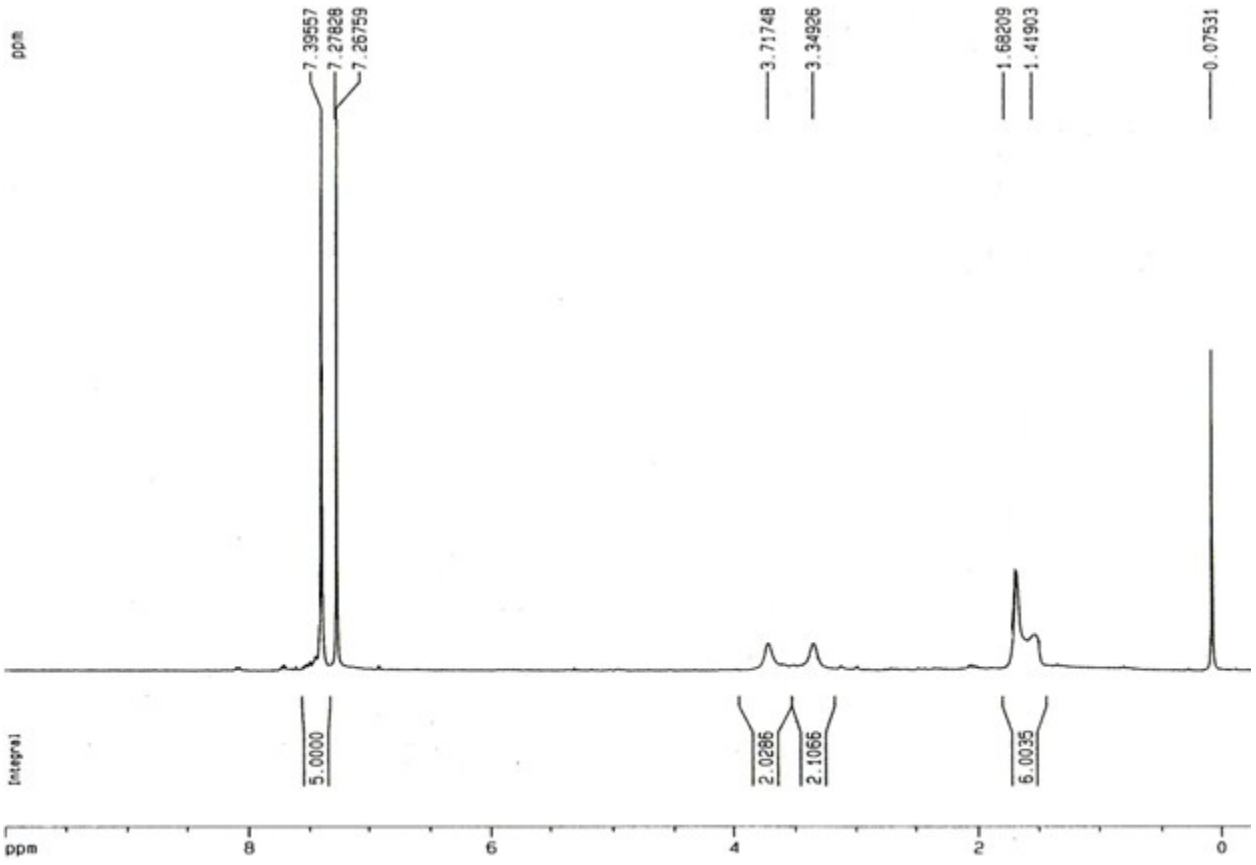
(^{13}C-NMR)



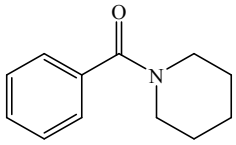
1k)



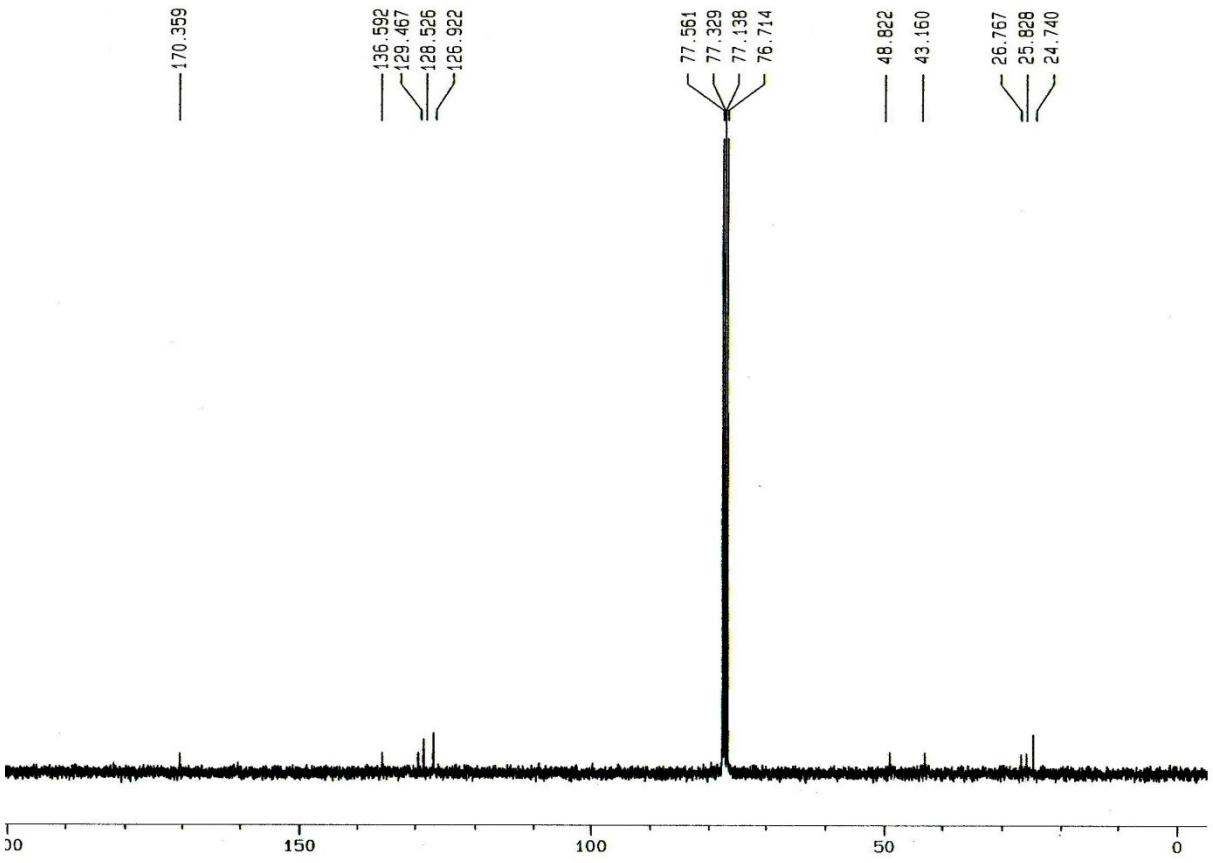
(^{1}H-NMR)


ppm
7.39557
7.27828
7.26759
3.71748
3.34926
1.68209
1.41903
0.07531
Integral
5.0000
2.0286
2.1066
6.0035
ppm
8
6
4
2
0

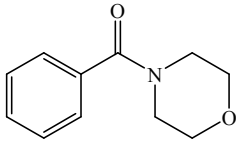
1j)


O
N

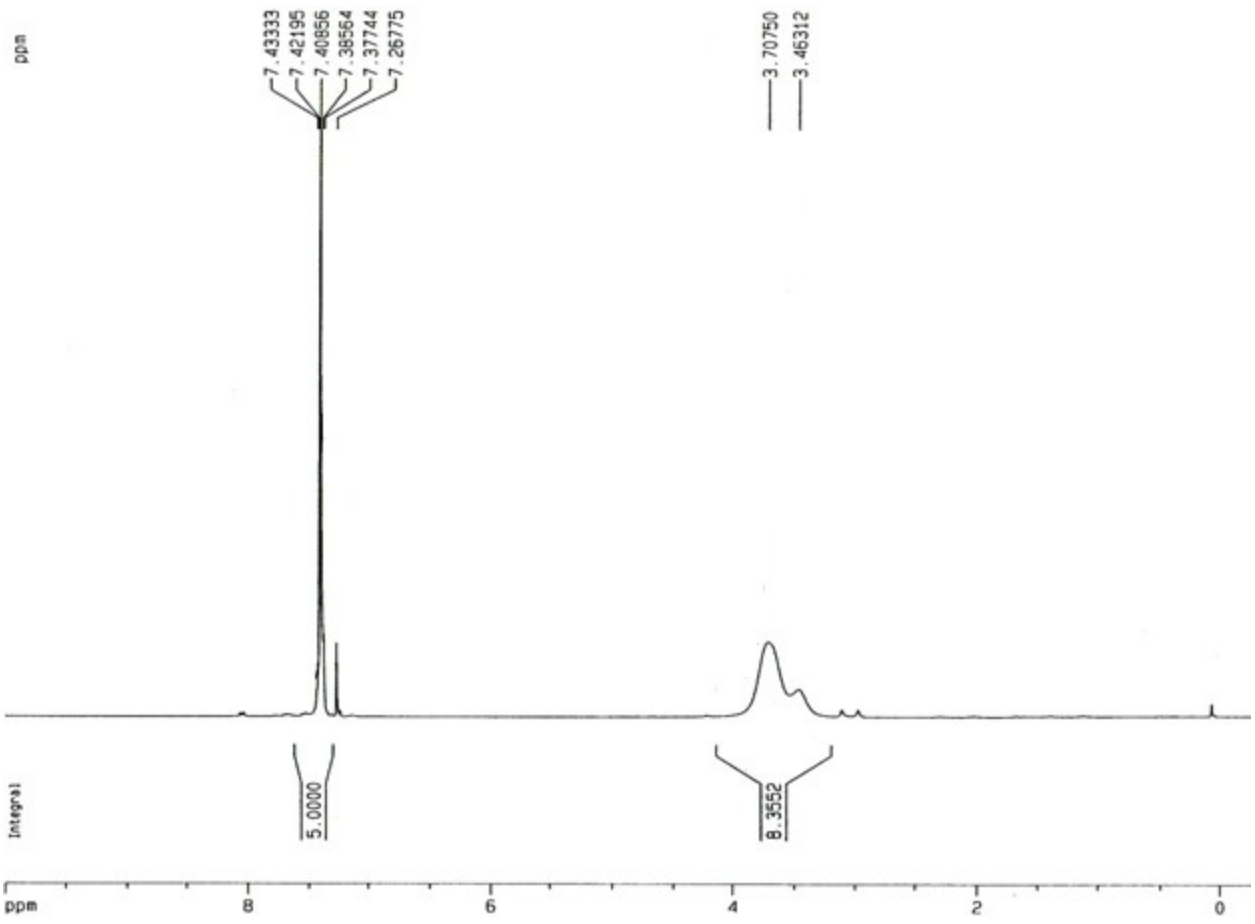
(^{13}C-NMR)


170.359
136.592
129.467
128.526
126.922
77.561
77.329
77.138
76.714
48.822
43.160
26.767
25.828
24.740
150
100
50
0

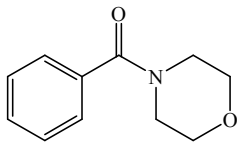
1l)


O
N
O

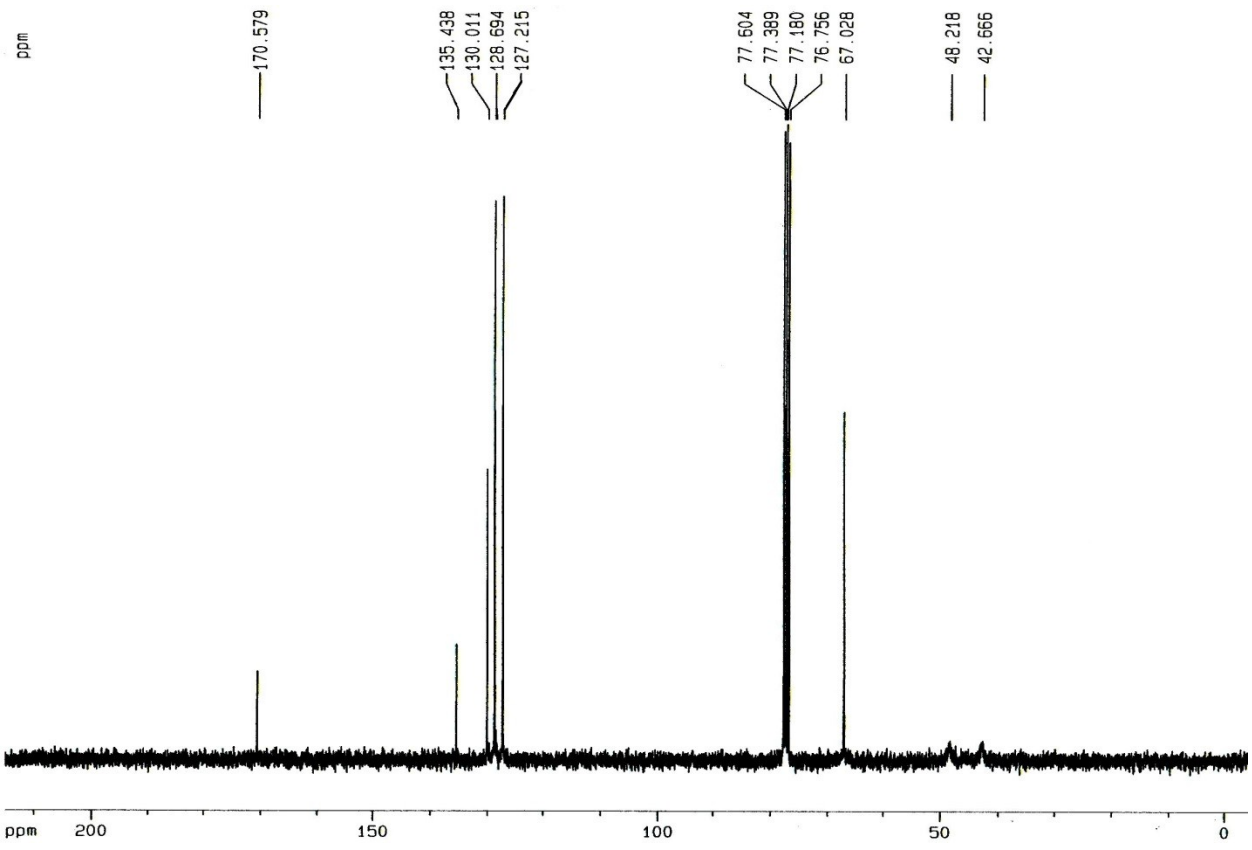
(^{1}H-NMR)


ppm
7.43333
7.42195
7.40856
7.38564
7.37744
7.26775
3.70750
3.46312
Integral
5.0000
8.3552
ppm
8
6
4
2
0

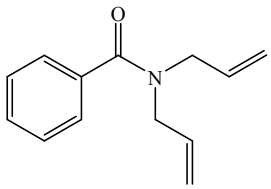
1l)


O
N
O

(^{13}C-NMR)

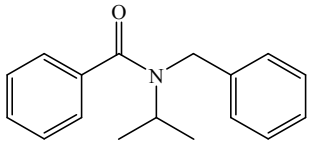

ppm
170.579
135.438
130.011
128.694
127.215
77.604
77.389
77.180
76.756
67.028
48.218
42.666
ppm
200
150
100
50
0

1m)

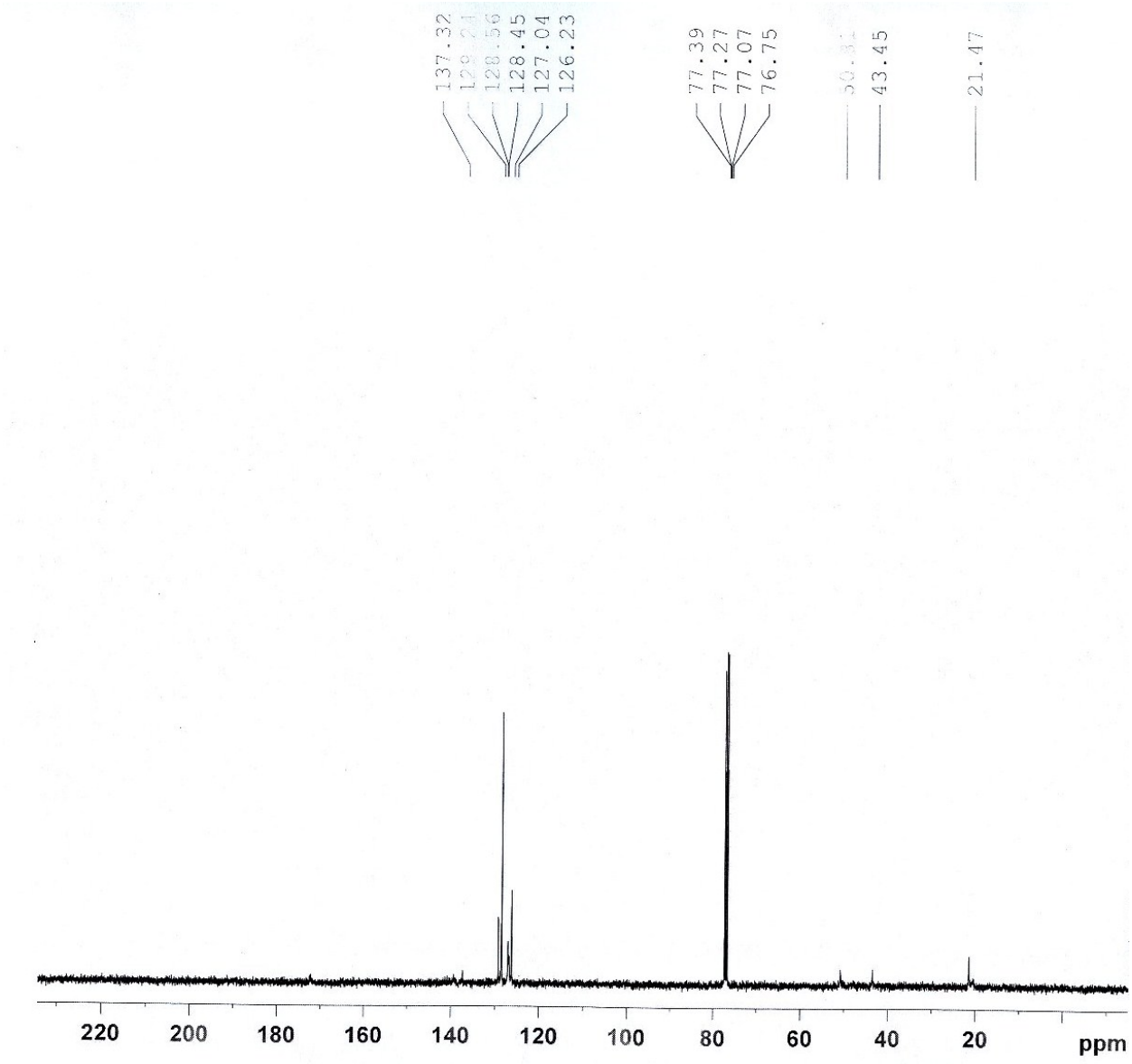

O
N

(^{1}H-NMR)

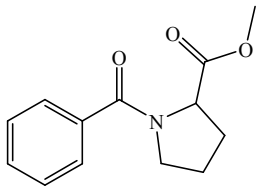
1m)



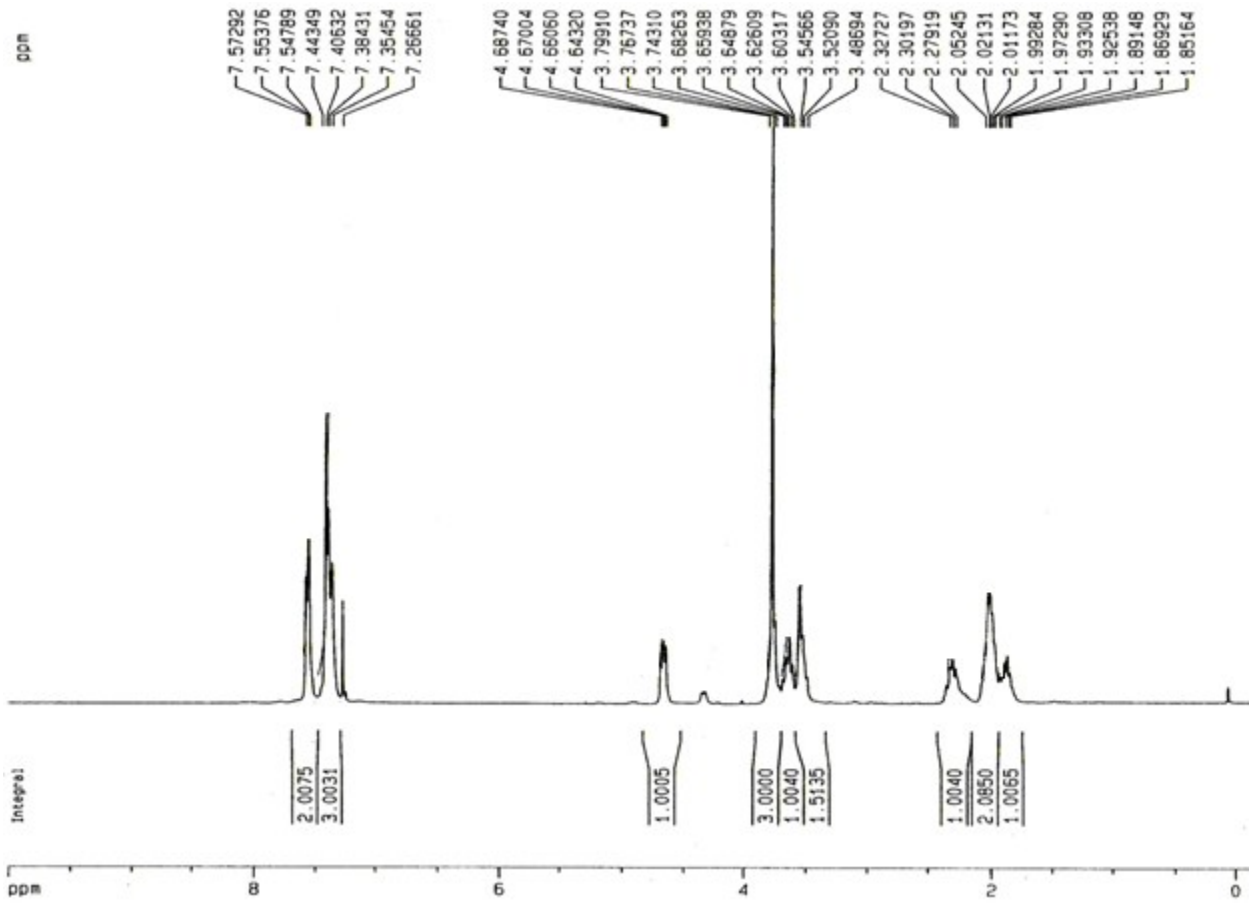
(^{13}C-NMR)


137.32
128.45
127.04
126.23
77.39
77.27
77.07
76.75
43.45
21.47
220
200
180
160
140
120
100
80
60
40
20
ppm

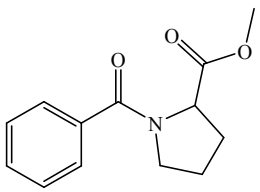
1n)


O
O
O
N

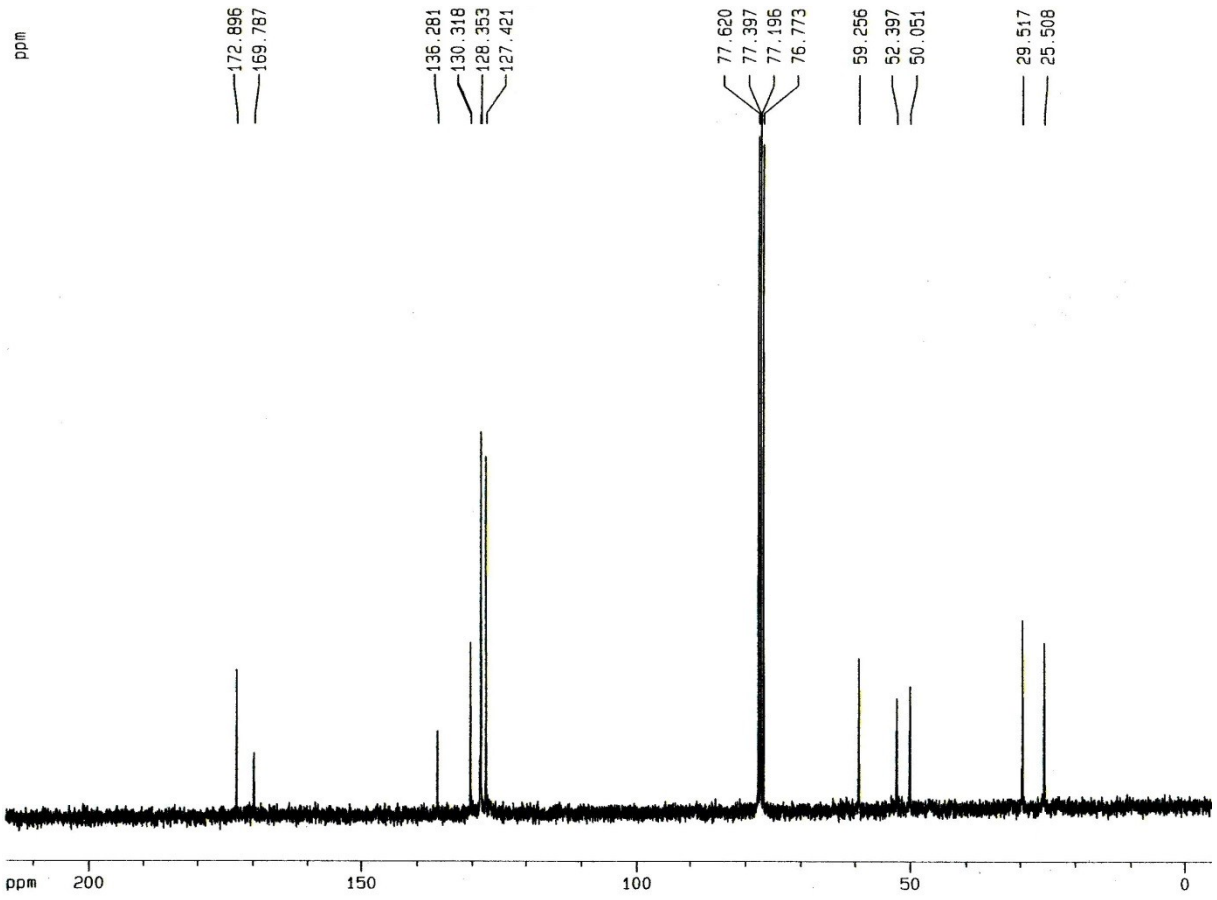
(^{1}H-NMR)


ppm
7.57292
7.55376
7.54789
7.44349
7.40632
7.38431
7.35454
7.26661
4.68740
4.67004
4.66060
4.64320
3.79910
3.76737
3.74310
3.68263
3.65938
3.64879
3.62609
3.60317
3.54566
3.52090
3.48694
2.32727
2.30197
2.27919
2.05245
2.02131
2.01173
1.99284
1.97290
1.93308
1.92538
1.89148
1.86929
1.85164
Integral
2.0075
3.0031
1.0005
3.0000
1.0040
1.5135
1.0040
2.0850
1.0065
ppm
8
6
4
2
0

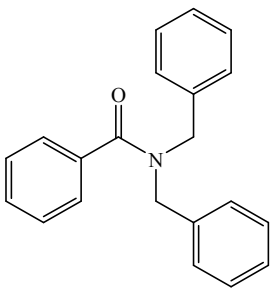
1n)


O
O
O
N

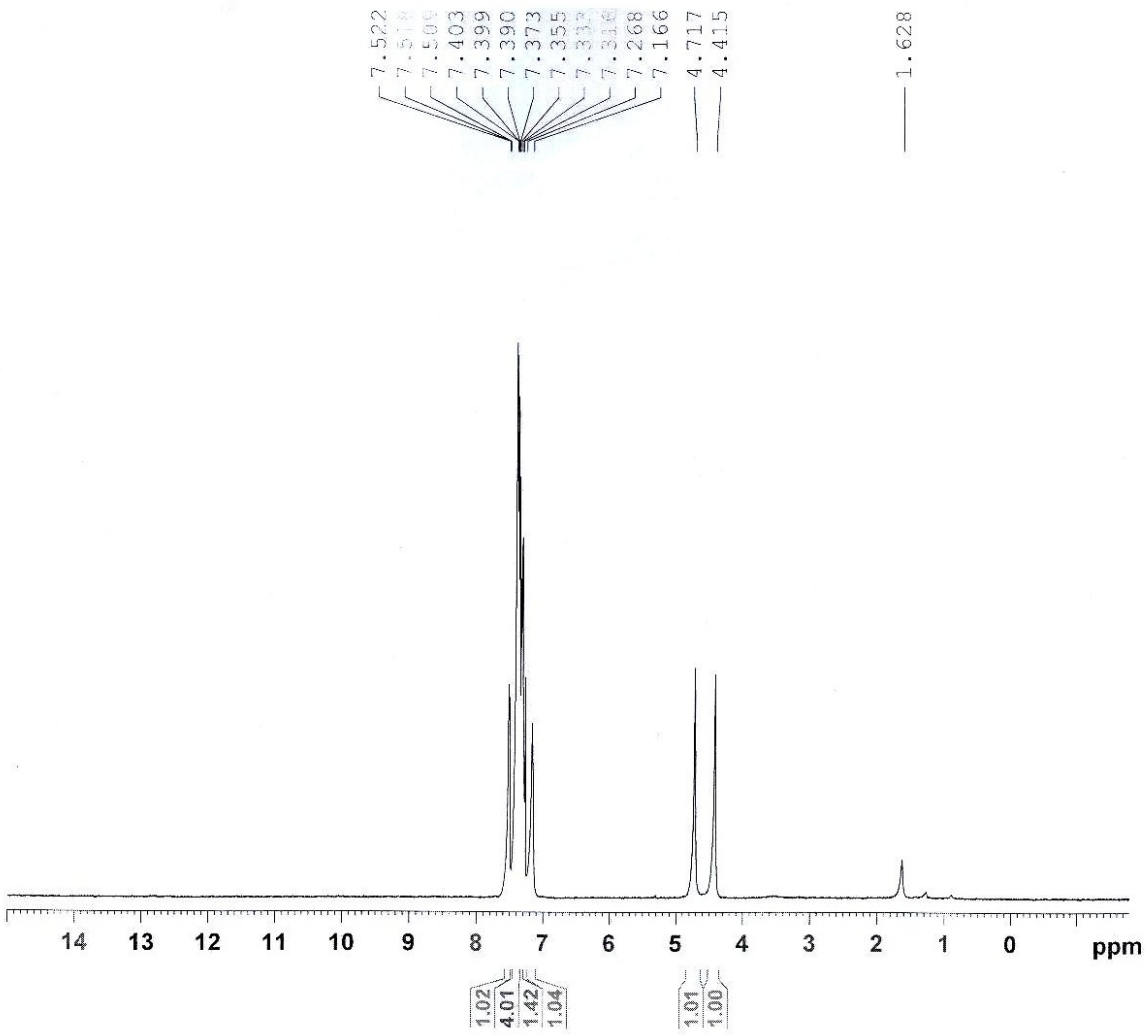
(^{13}C-NMR)



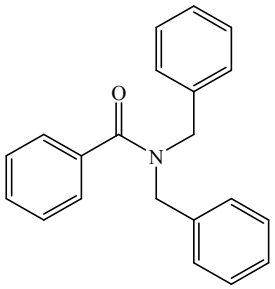
1o)



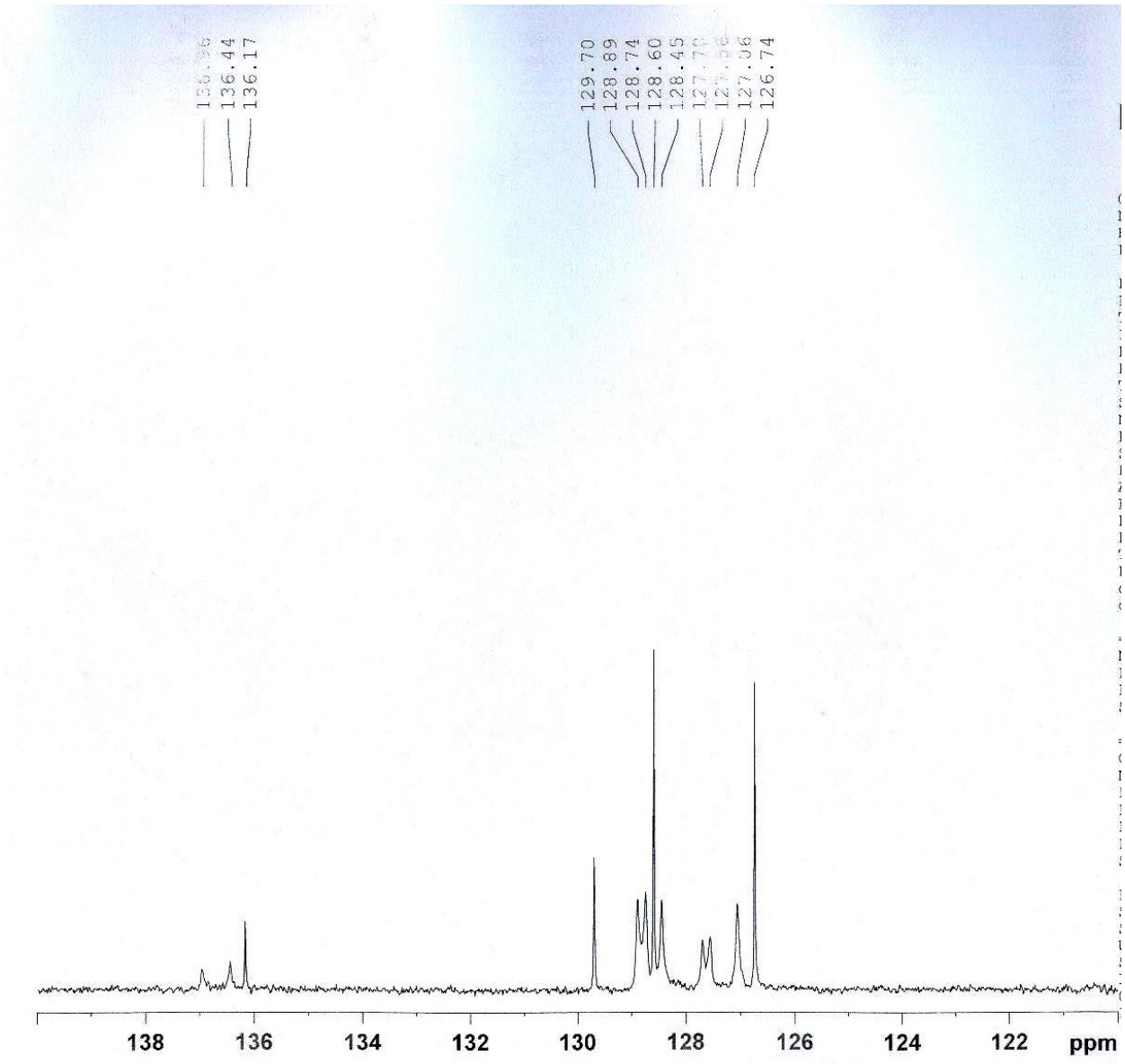
(^{1}H-NMR)


7.522
7.403
7.399
7.390
7.373
7.355
7.268
7.166
4.717
4.415
1.628
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
ppm
1.02
4.01
1.42
1.04
1.01
1.00

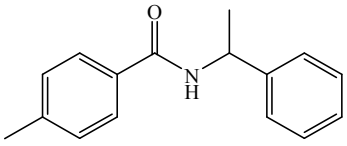
1o)


O
N

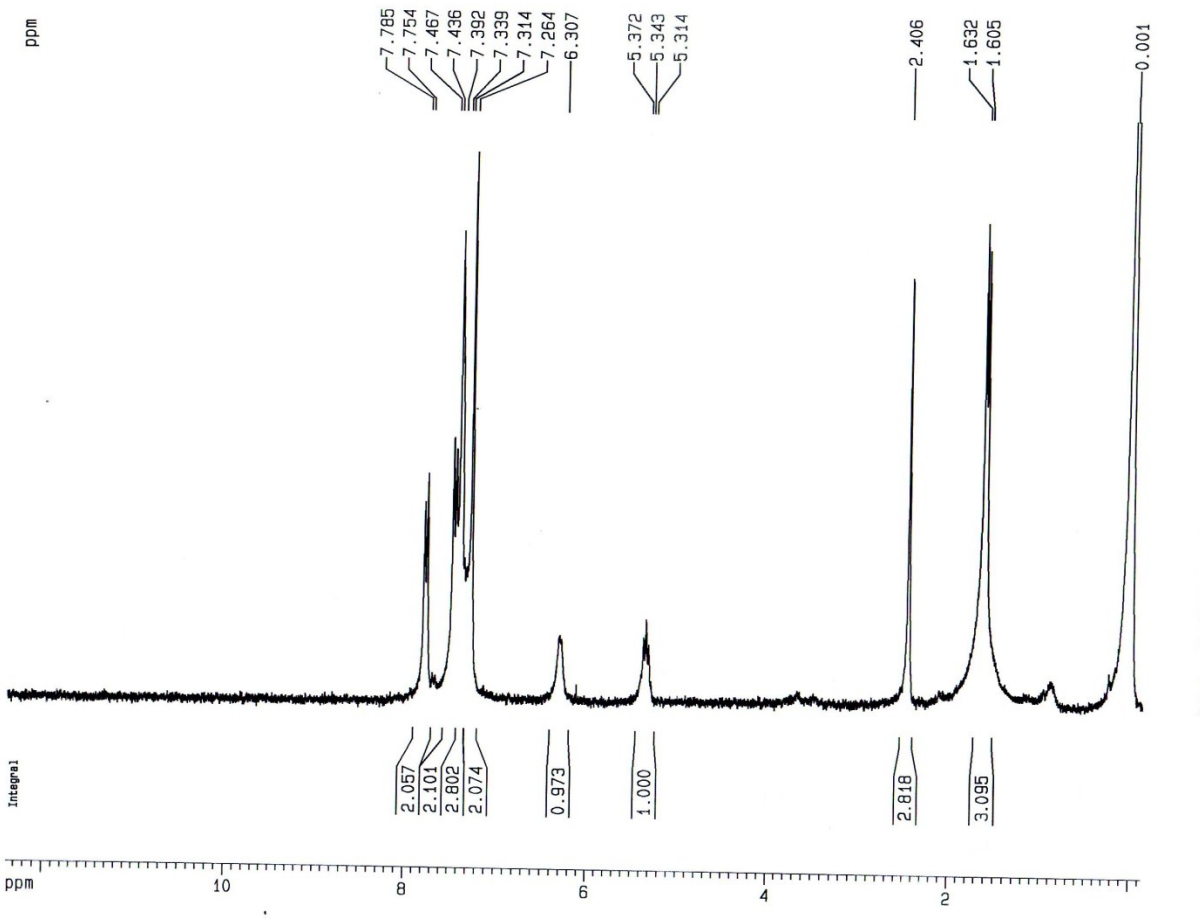
(^{13}C-NMR)


136.44
136.17
129.70
128.89
128.74
128.60
128.45
127.06
126.74
138
136
134
132
130
128
126
124
122
ppm

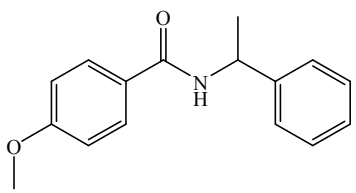
1p)


O
N
H

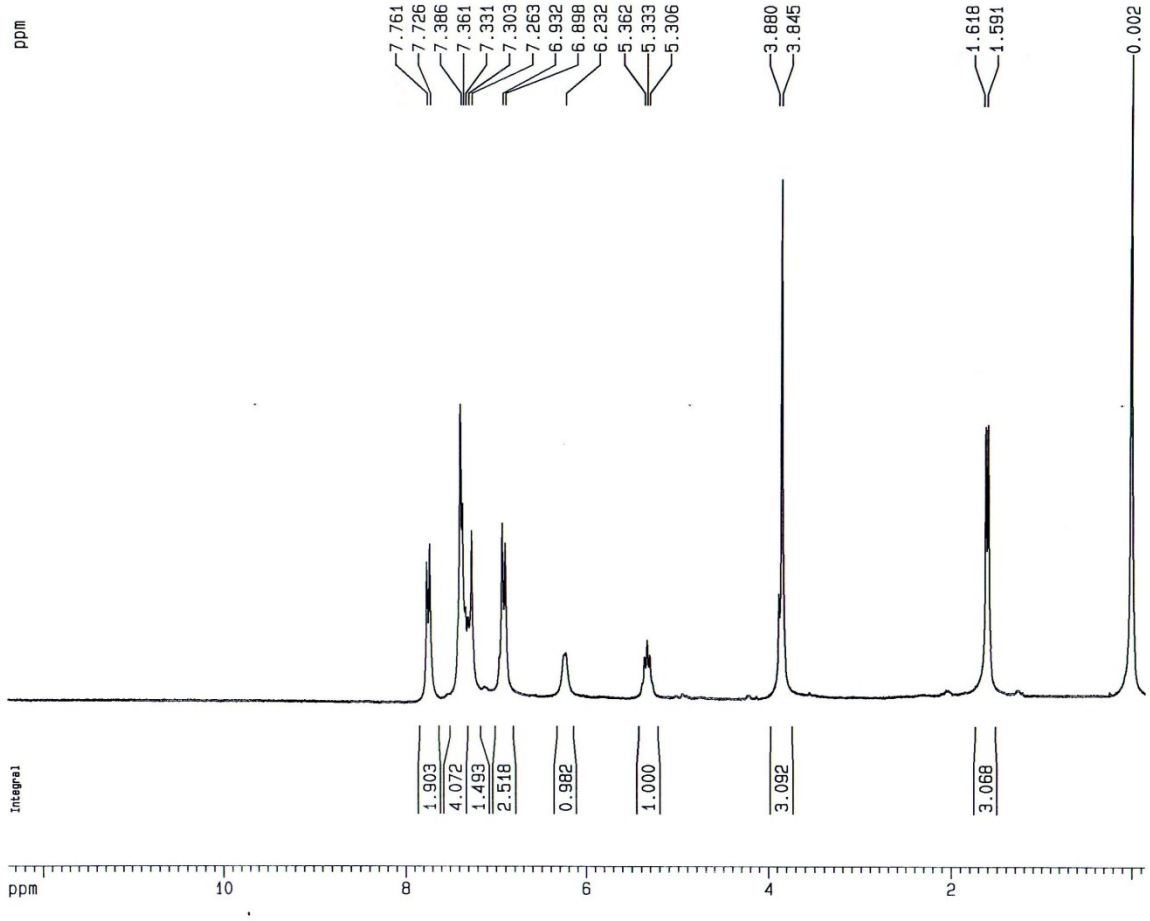
(^{1}H-NMR)


ppm
7.785
7.754
7.467
7.436
7.392
7.339
7.314
7.264
6.307
5.372
5.343
5.314
2.406
1.632
1.605
0.001
Integral
2.057
2.101
2.802
2.074
0.973
1.000
2.818
3.095
ppm
10
8
6
4
2

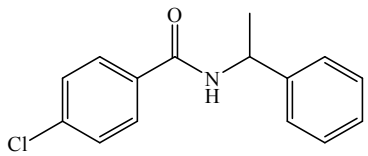
1q)


O
N
H
O

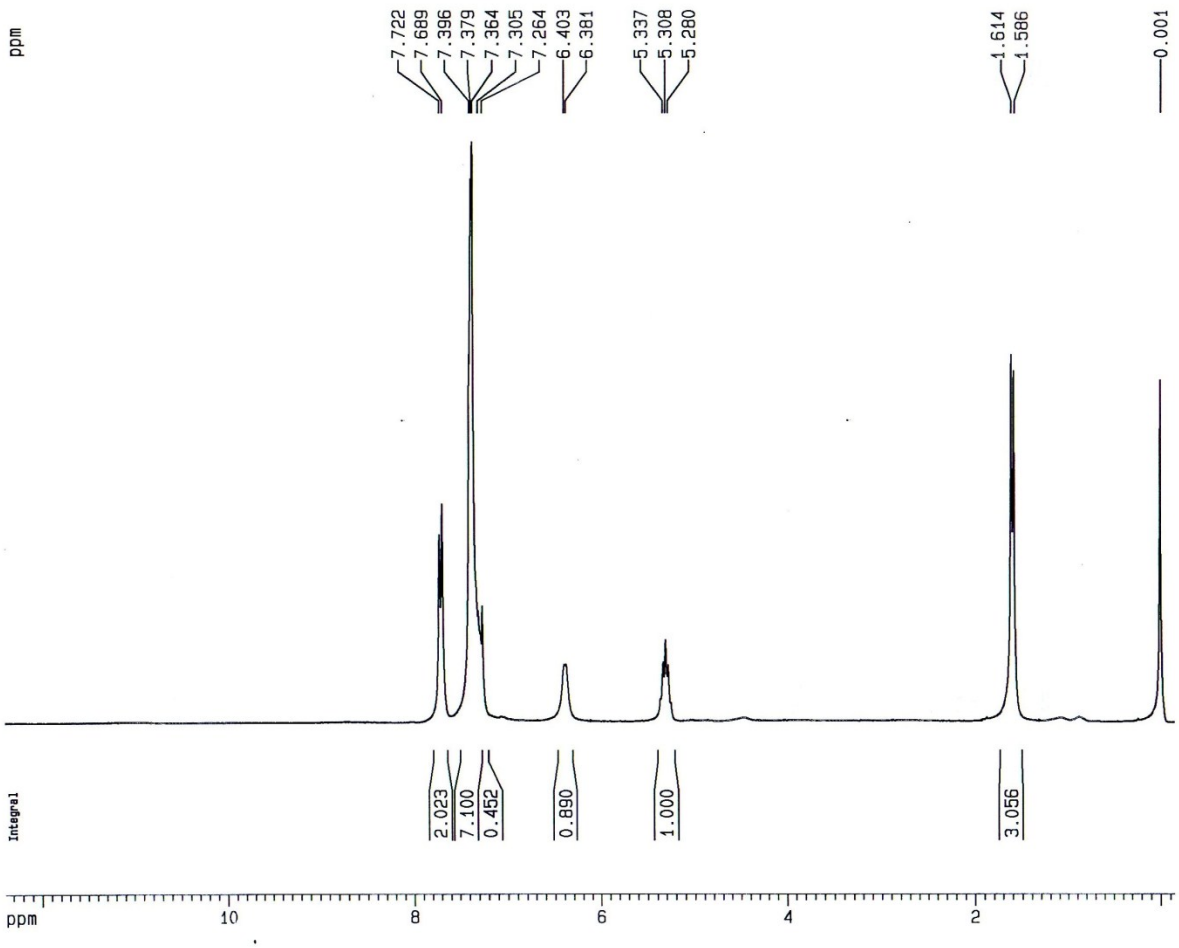
(^{1}H-NMR)



1r)



(^{1}H-NMR)


ppm
7.722
7.689
7.396
7.379
7.364
7.305
7.264
6.403
6.381
5.337
5.308
5.280
1.614
1.586
0.001
Integral
2.023
7.100
0.452
0.890
1.000
3.056
ppm
10
8
6
4
2