

Fe-catalyzed one-pot synthesis of 1,3- and 1,3,5-substituted pyrazoles from hydrazones and vicinal diols

Niranjan Panda,* and Ashis Kumar Jena

Department of Chemistry

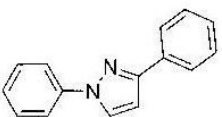
National Institute of Technology, Rourkela-769008, Odisha, India

Email: npanda@nitrkl.ac.in

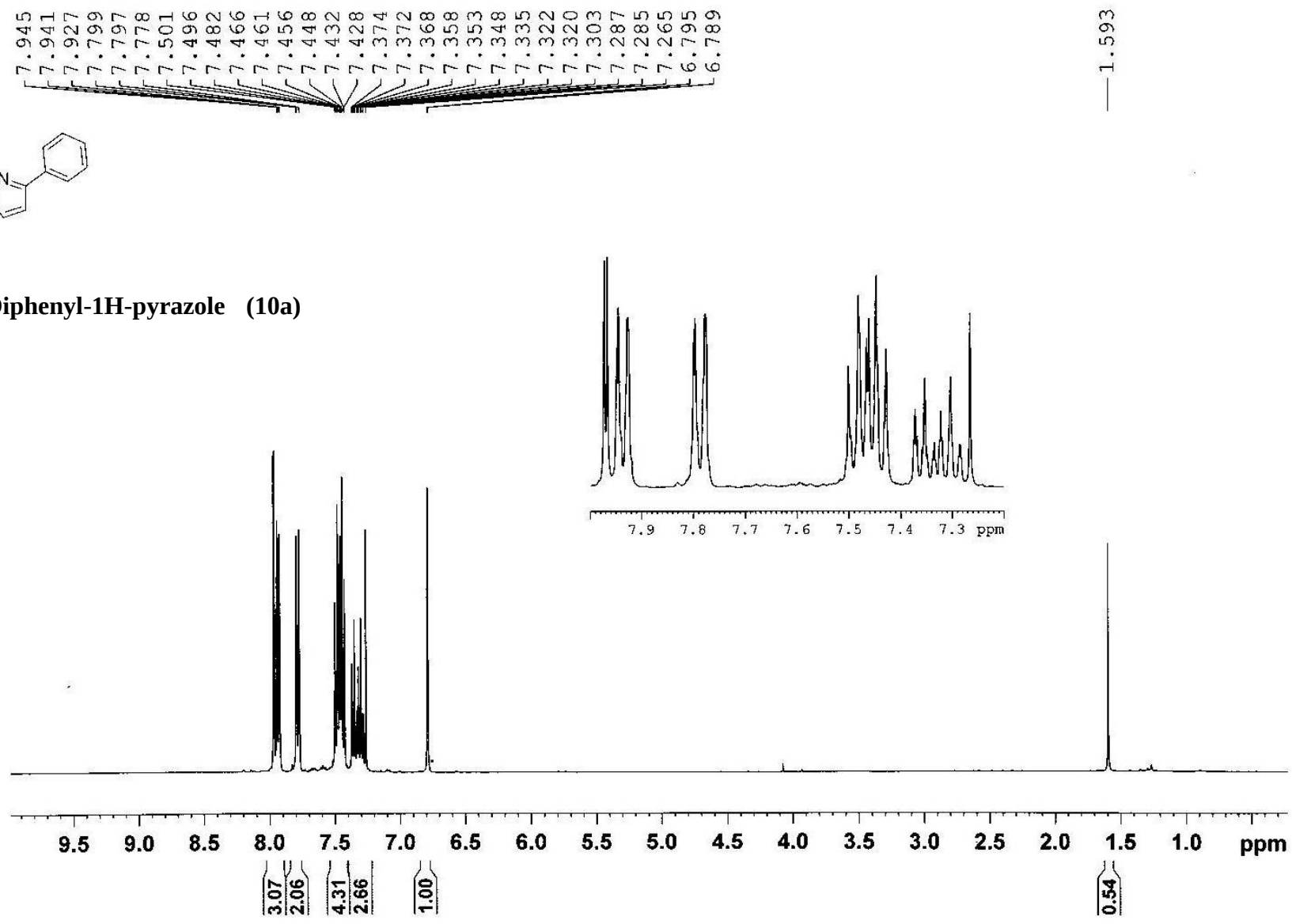
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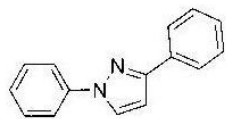
NMR spectra of synthesized compounds

S 2-S 49

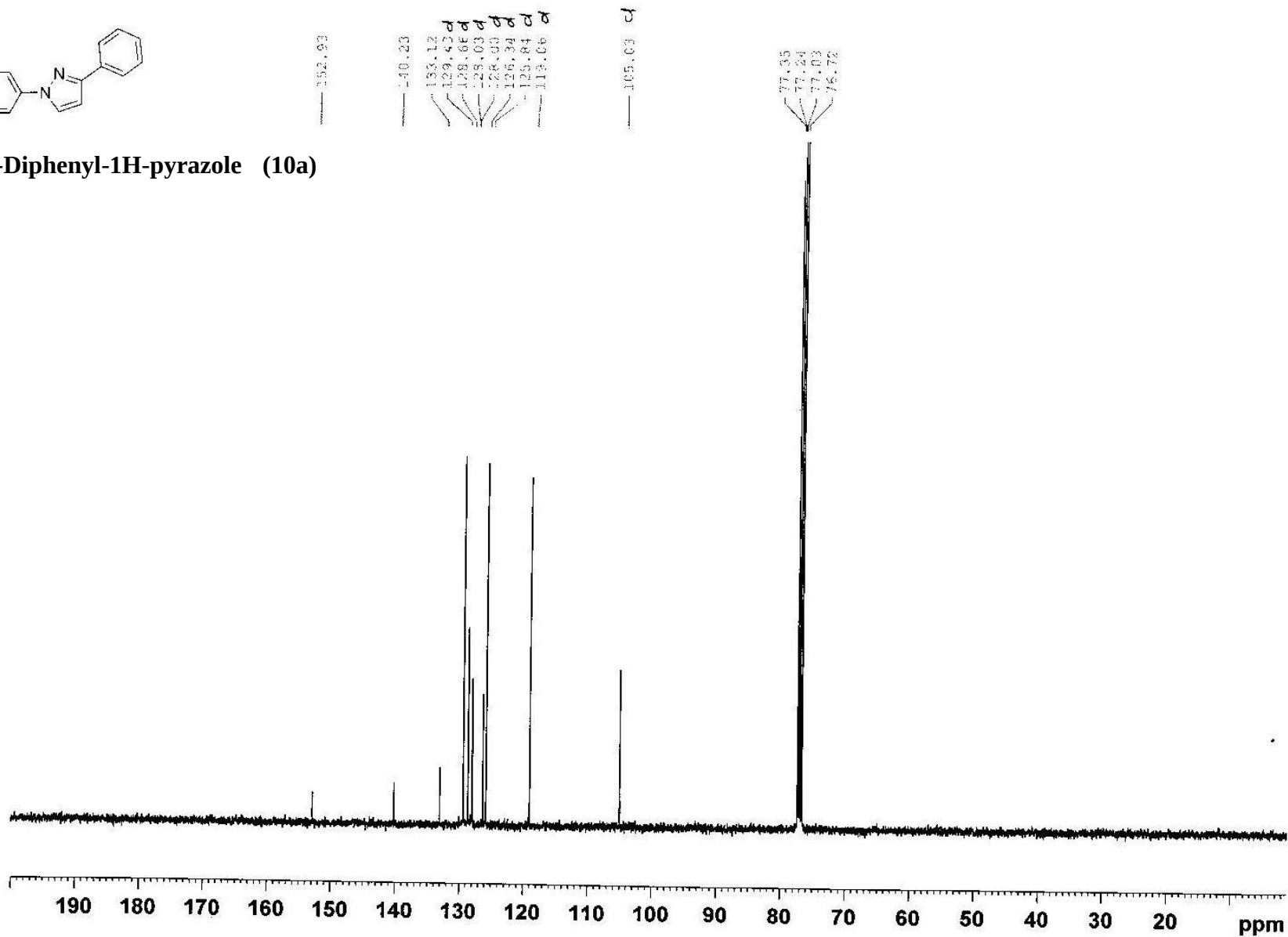


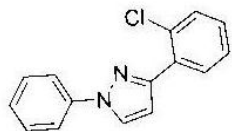
1,3-Diphenyl-1H-pyrazole (10a)





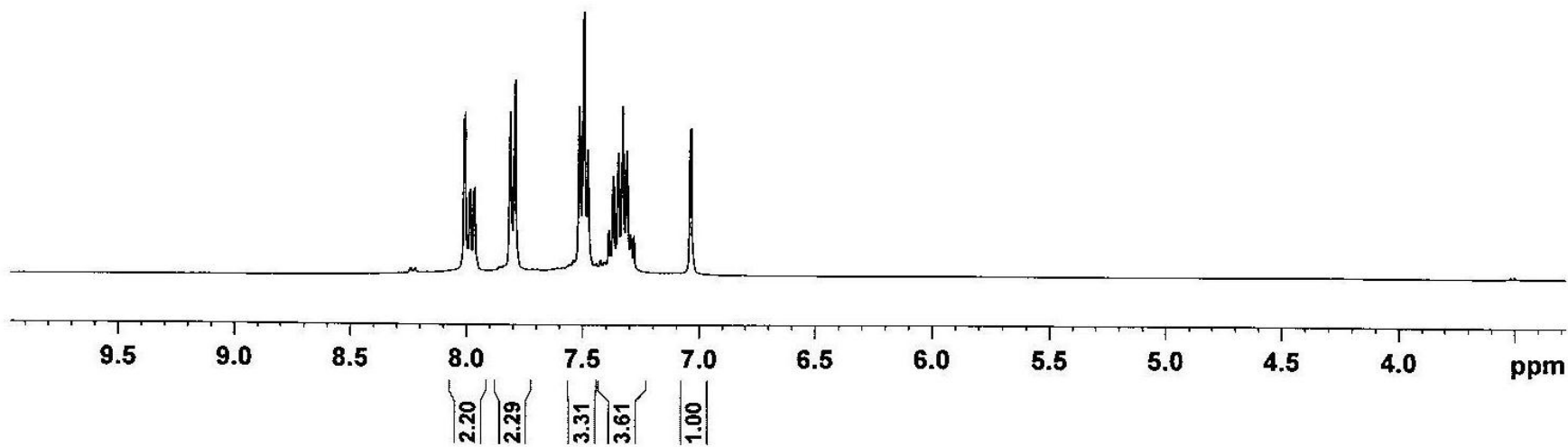
1,3-Diphenyl-1H-pyrazole (10a)



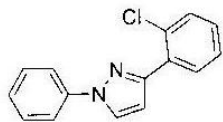


3-(2-chlorophenyl)-1-phenyl-1H-pyrazole (10b)

8.011
8.005
7.987
7.983
7.968
7.964
7.811
7.791
7.514
7.495
7.476
7.387
7.370
7.348
7.329
7.313
7.310
7.295
7.291
7.282
7.040
7.035



NP-AKJ-1048-13C



150.66

140.10

132.43

132.12

130.77

130.33

129.44

129.05

127.13

126.89

126.52

119.15

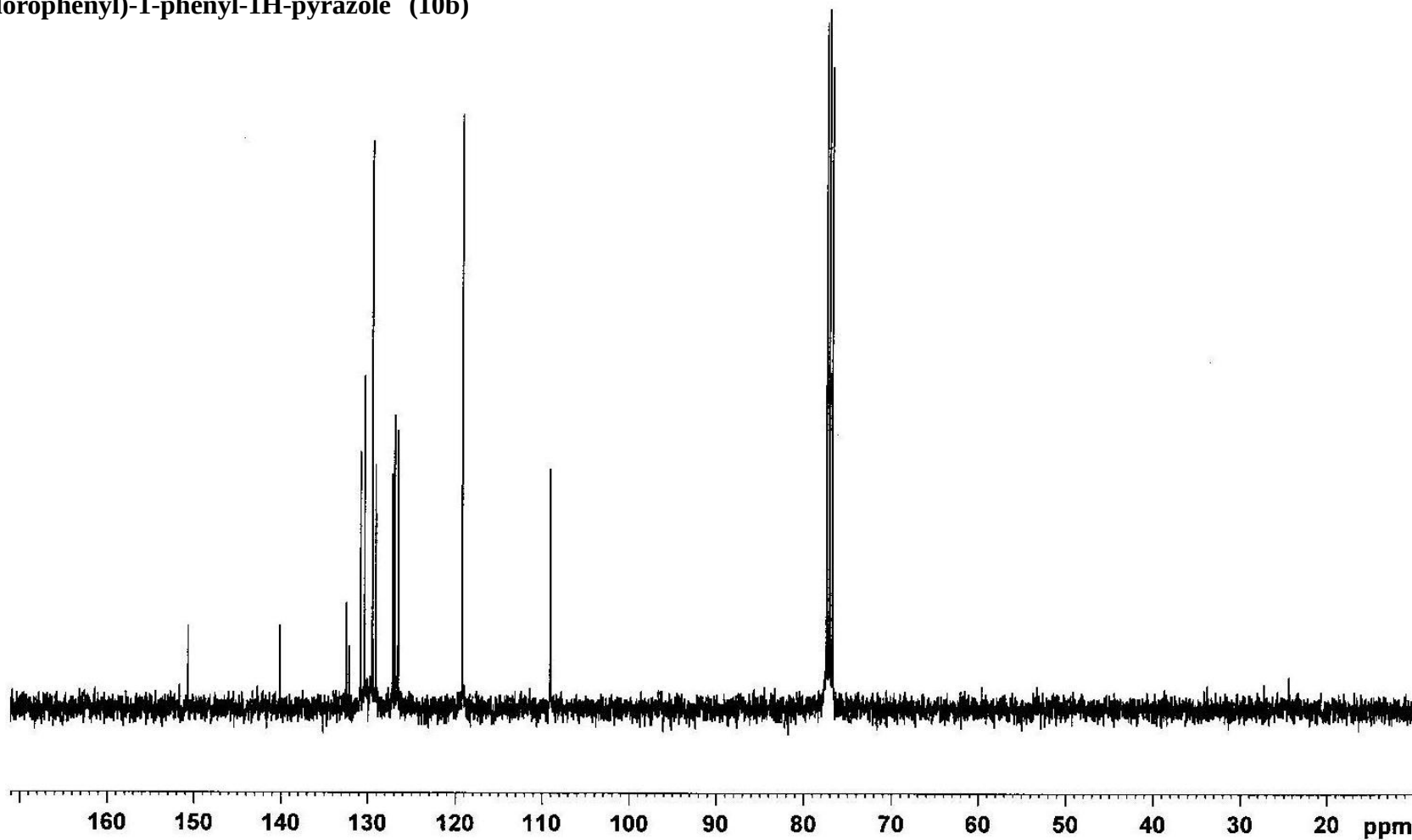
109.03

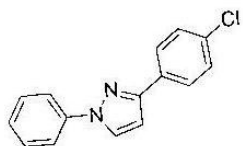
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77.04

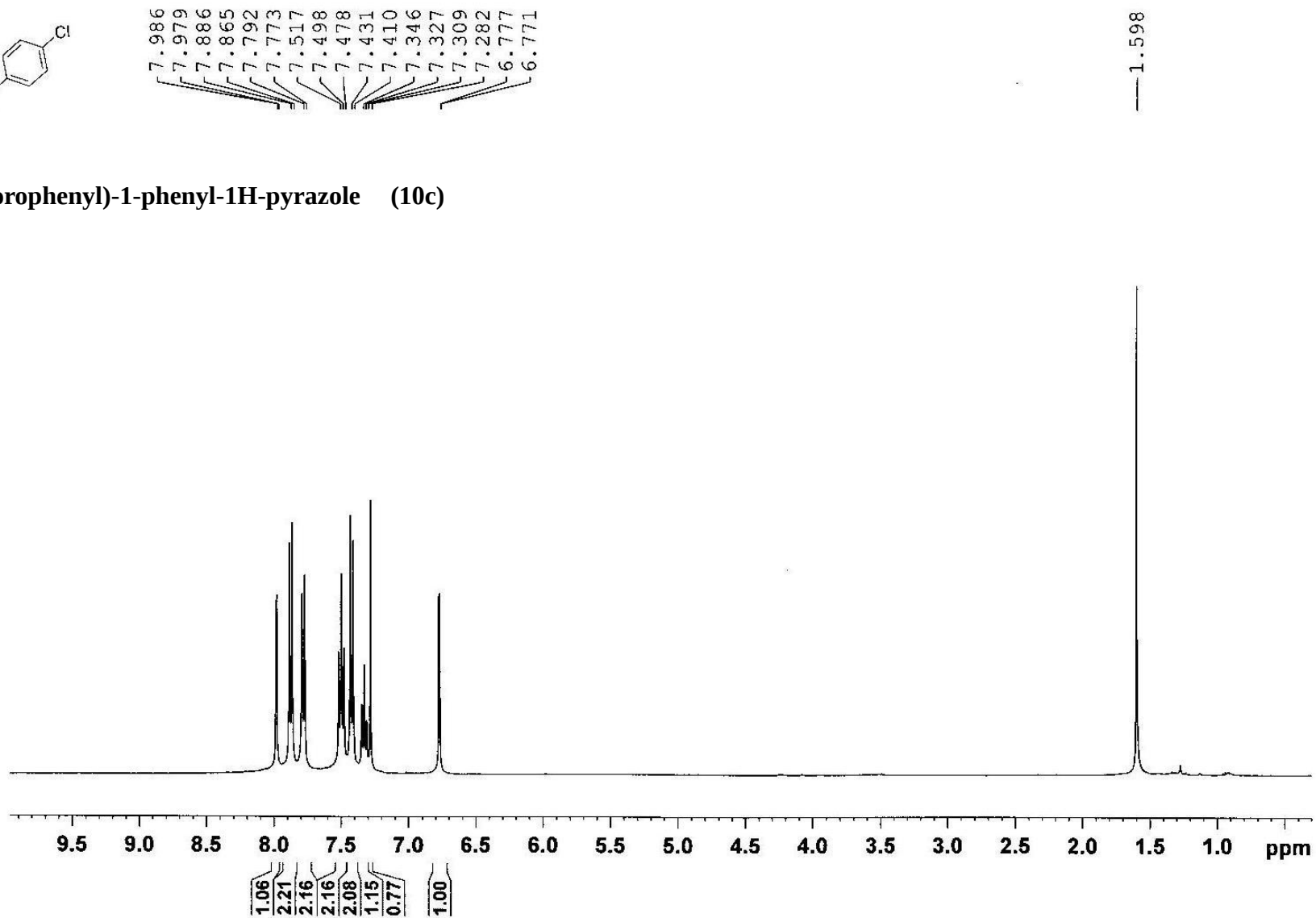
76.72

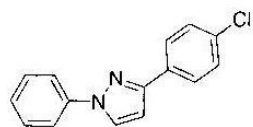
3-(2-chlorophenyl)-1-phenyl-1H-pyrazole (10b)



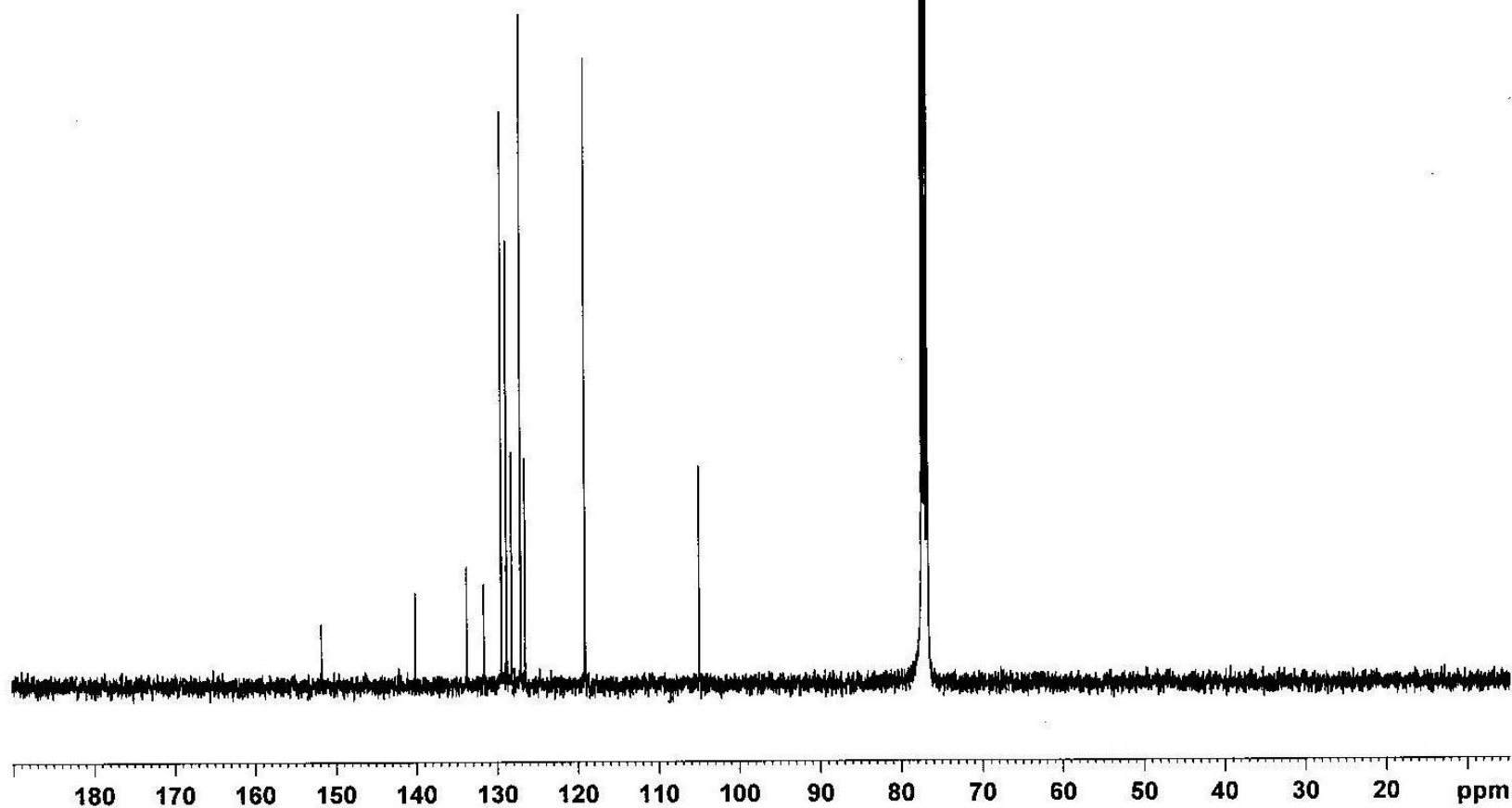


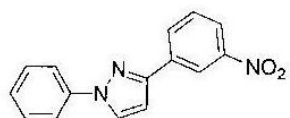
3-(4-chlorophenyl)-1-phenyl-1H-pyrazole (10c)



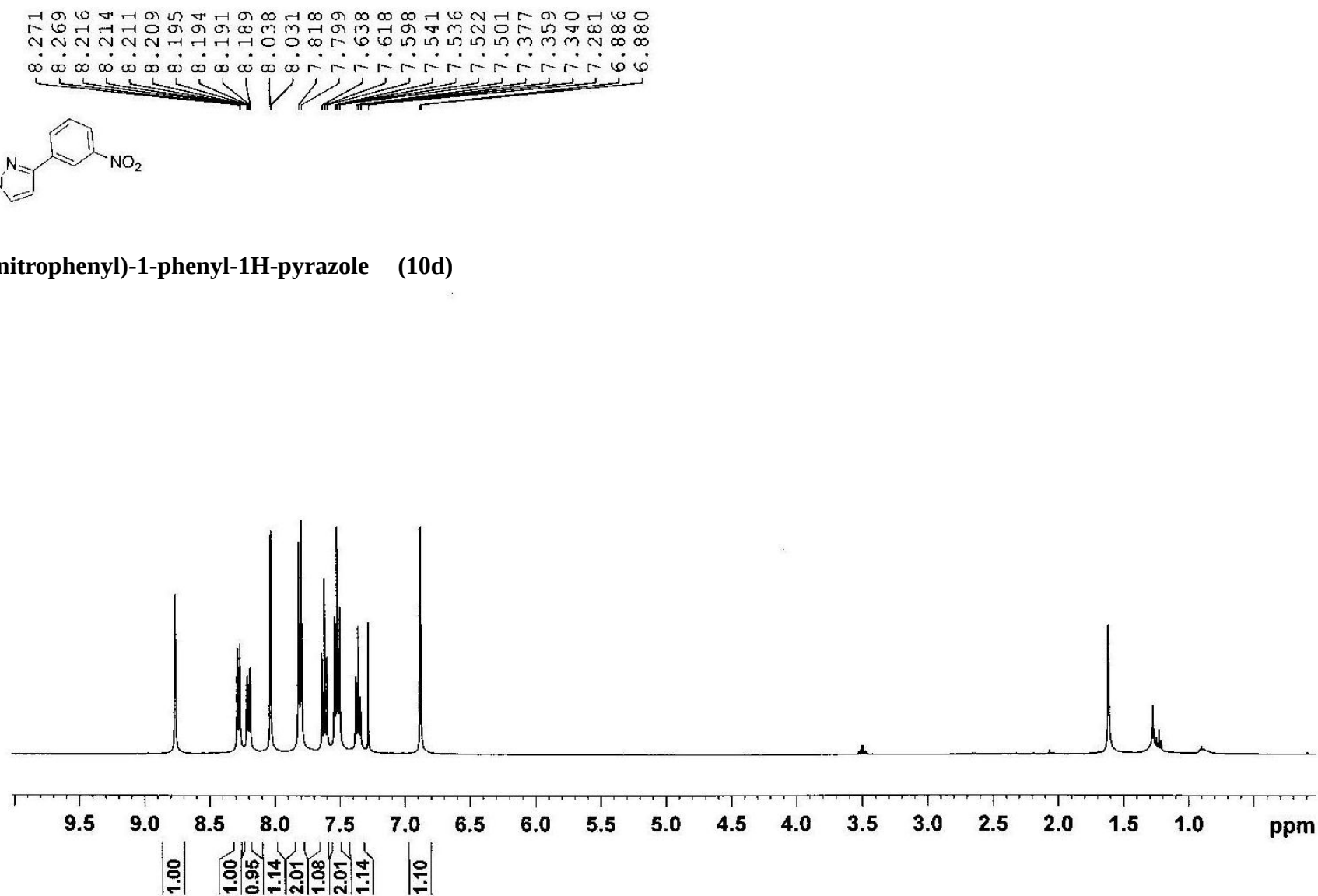


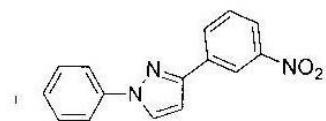
3-(4-chlorophenyl)-1-phenyl-1H-pyrazole (10c)





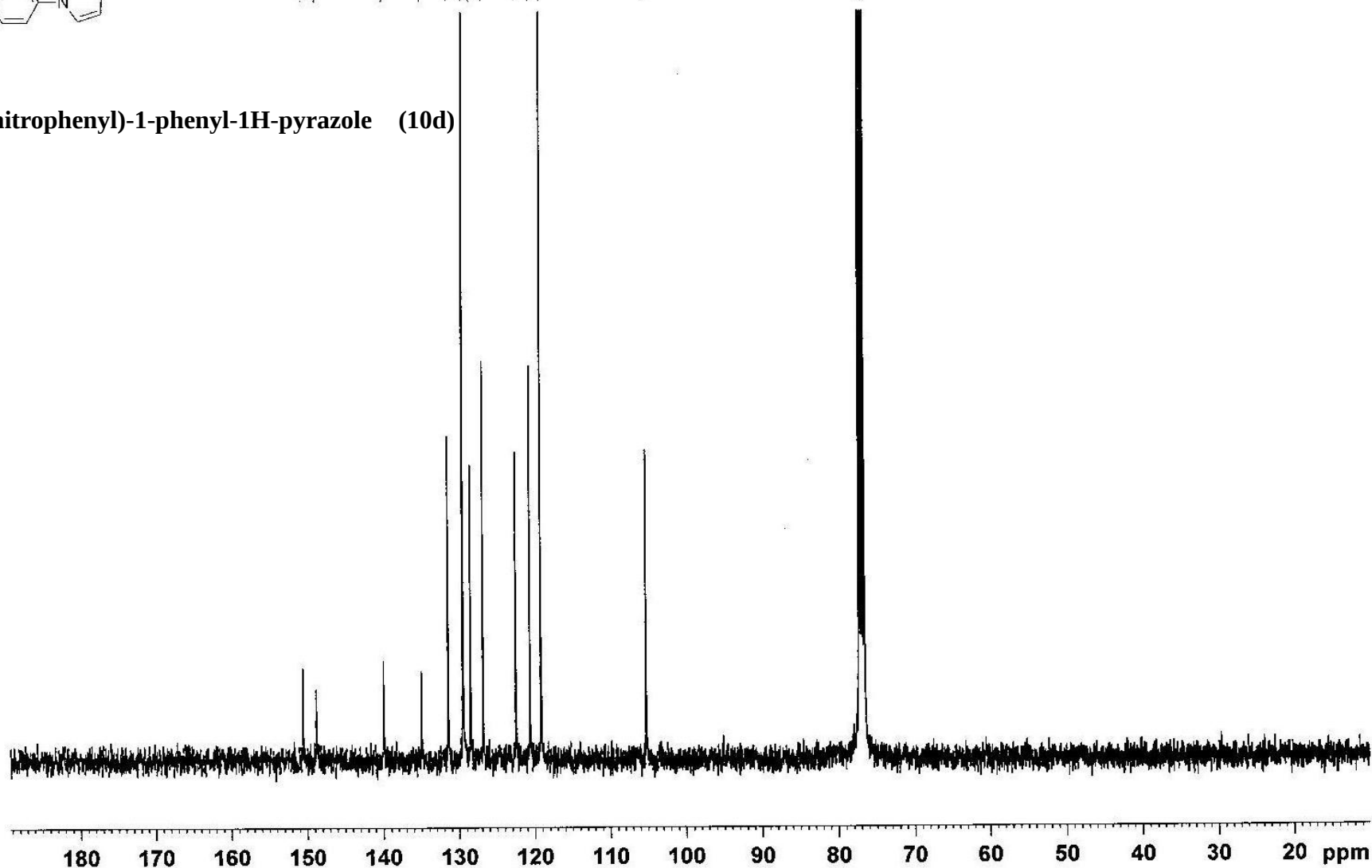
3-(3-nitrophenyl)-1-phenyl-1H-pyrazole (10d)

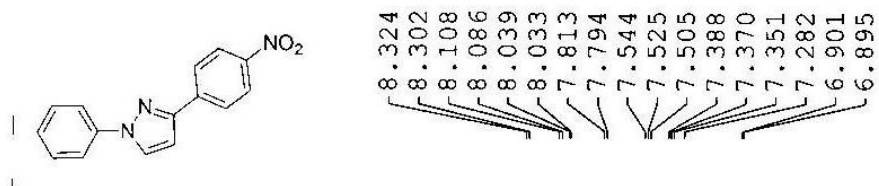




150.56
 148.79
 139.95
 135.01
 131.47
 129.50
 128.50
 126.85
 122.49
 120.62
 119.19
 105.26
 77.30
 76.88
 76.66

3-(3-nitrophenyl)-1-phenyl-1H-pyrazole (10d)

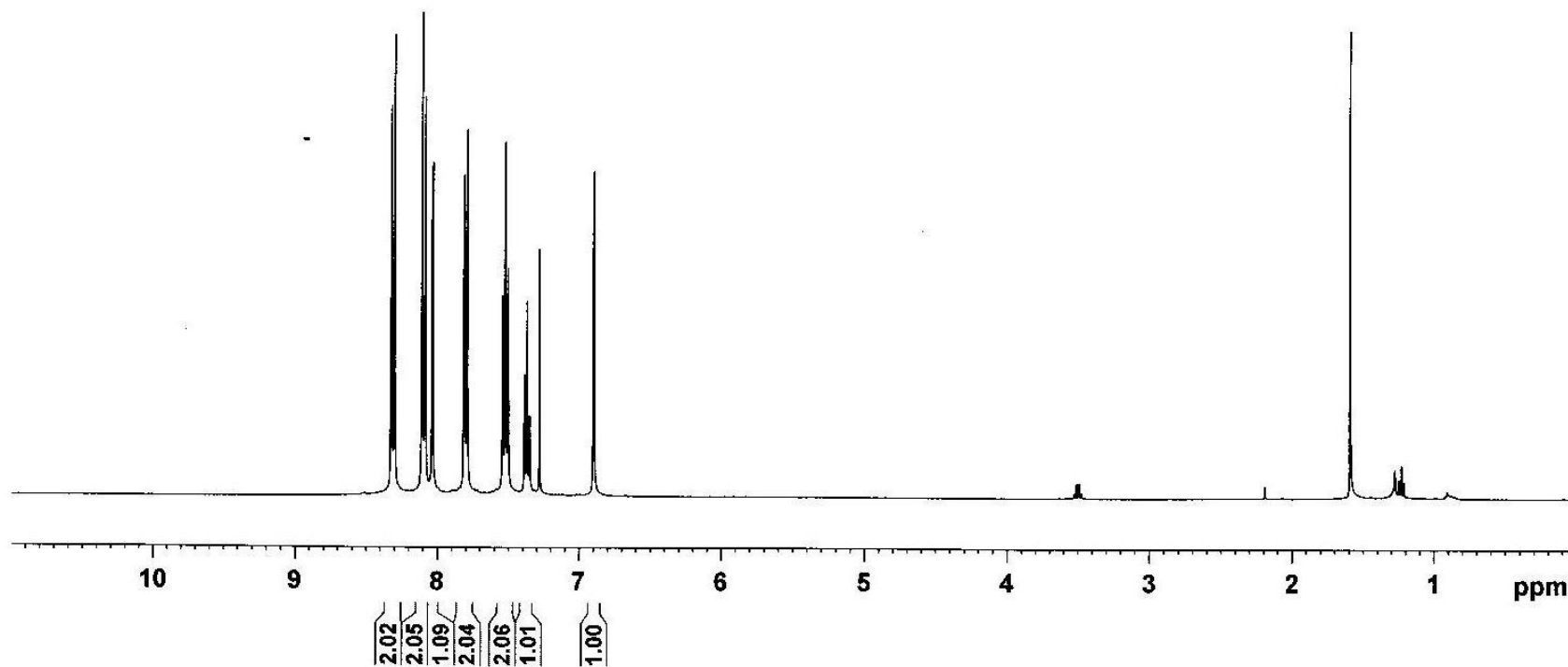


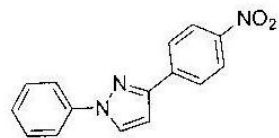


8.324
8.302
8.108
8.086
8.039
8.033
7.813
7.794
7.544
7.525
7.505
7.388
7.370
7.351
7.282
6.901
6.895

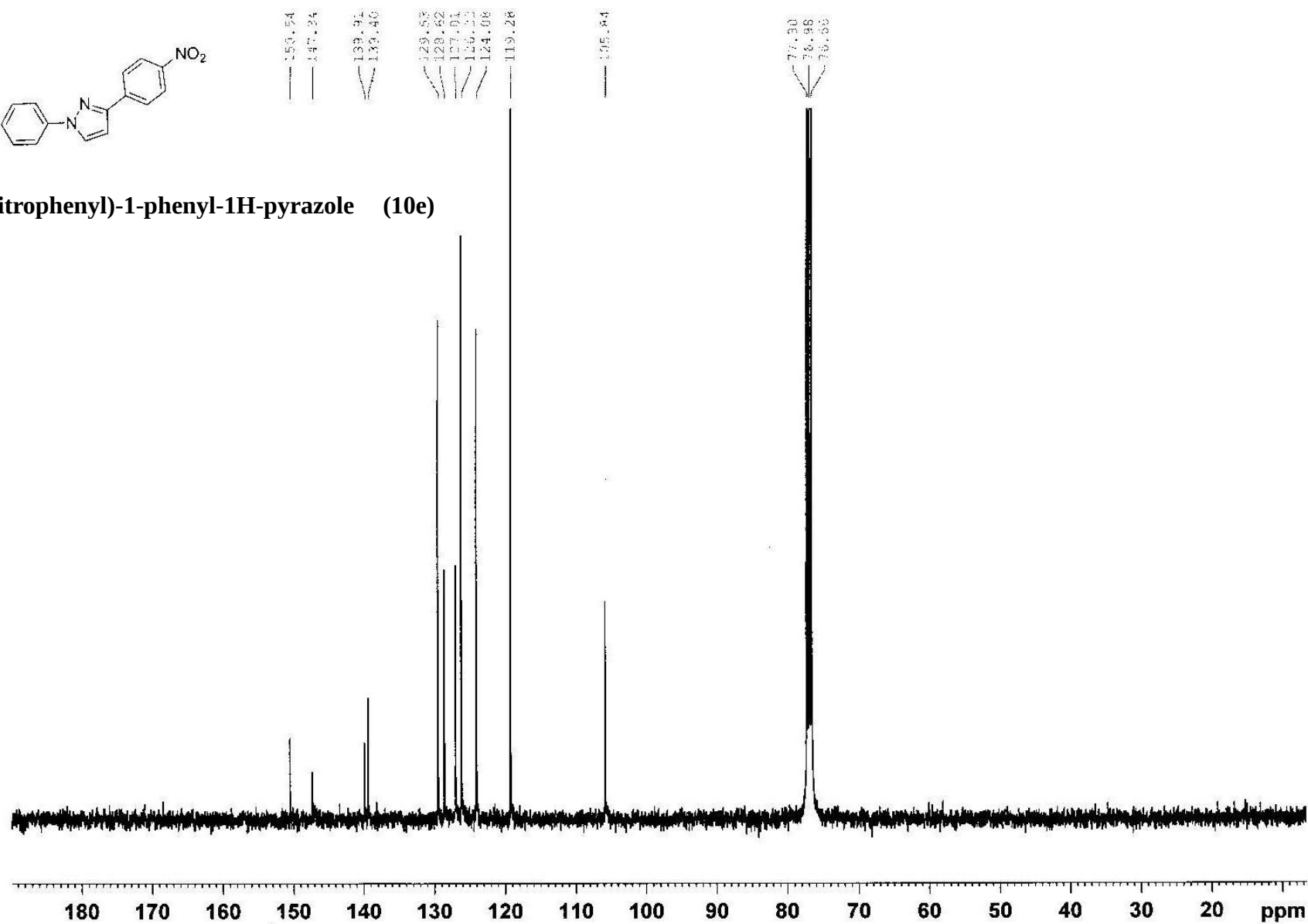
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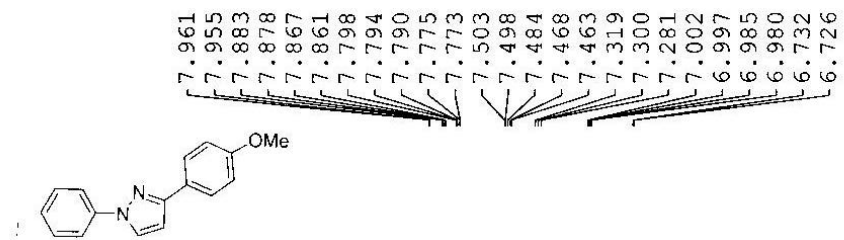
3-(4-nitrophenyl)-1-phenyl-1H-pyrazole (10e)



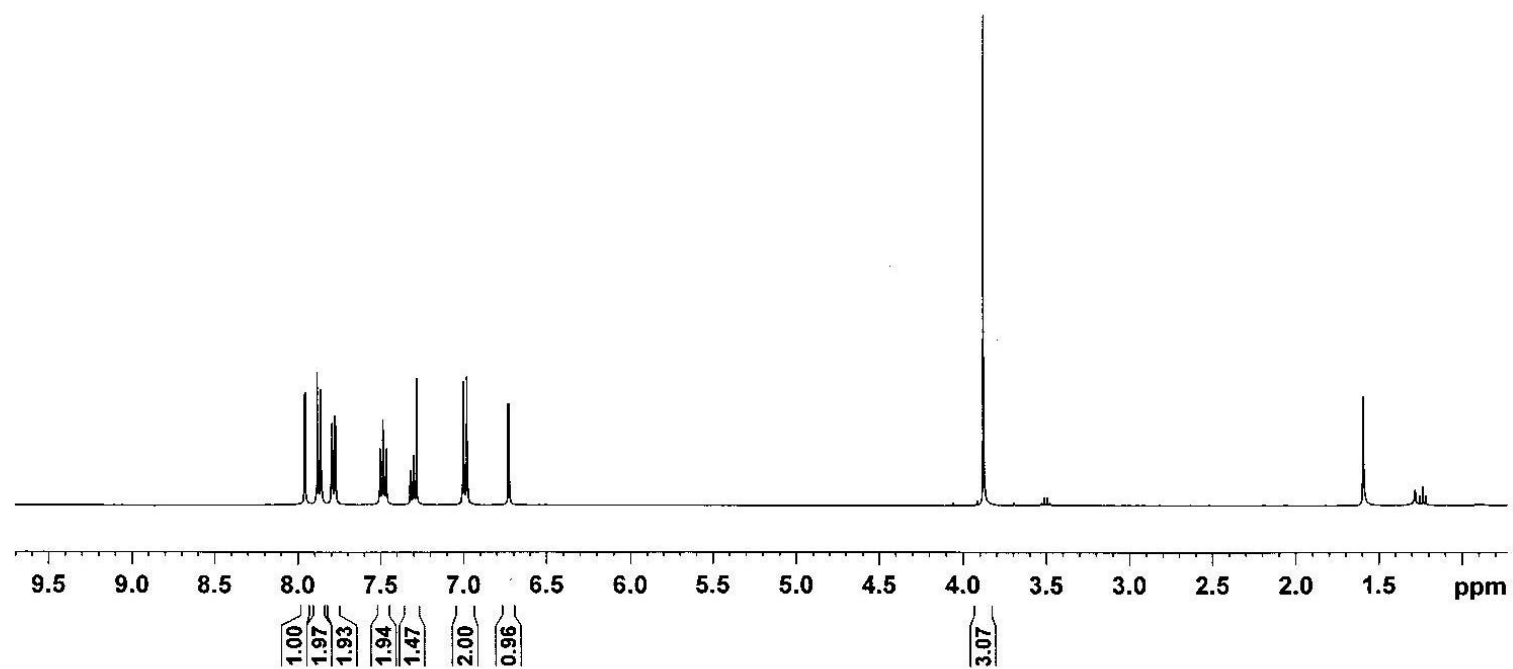


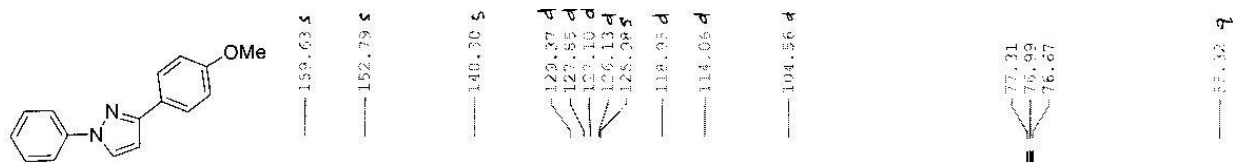
3-(4-nitrophenyl)-1-phenyl-1H-pyrazole (10e)



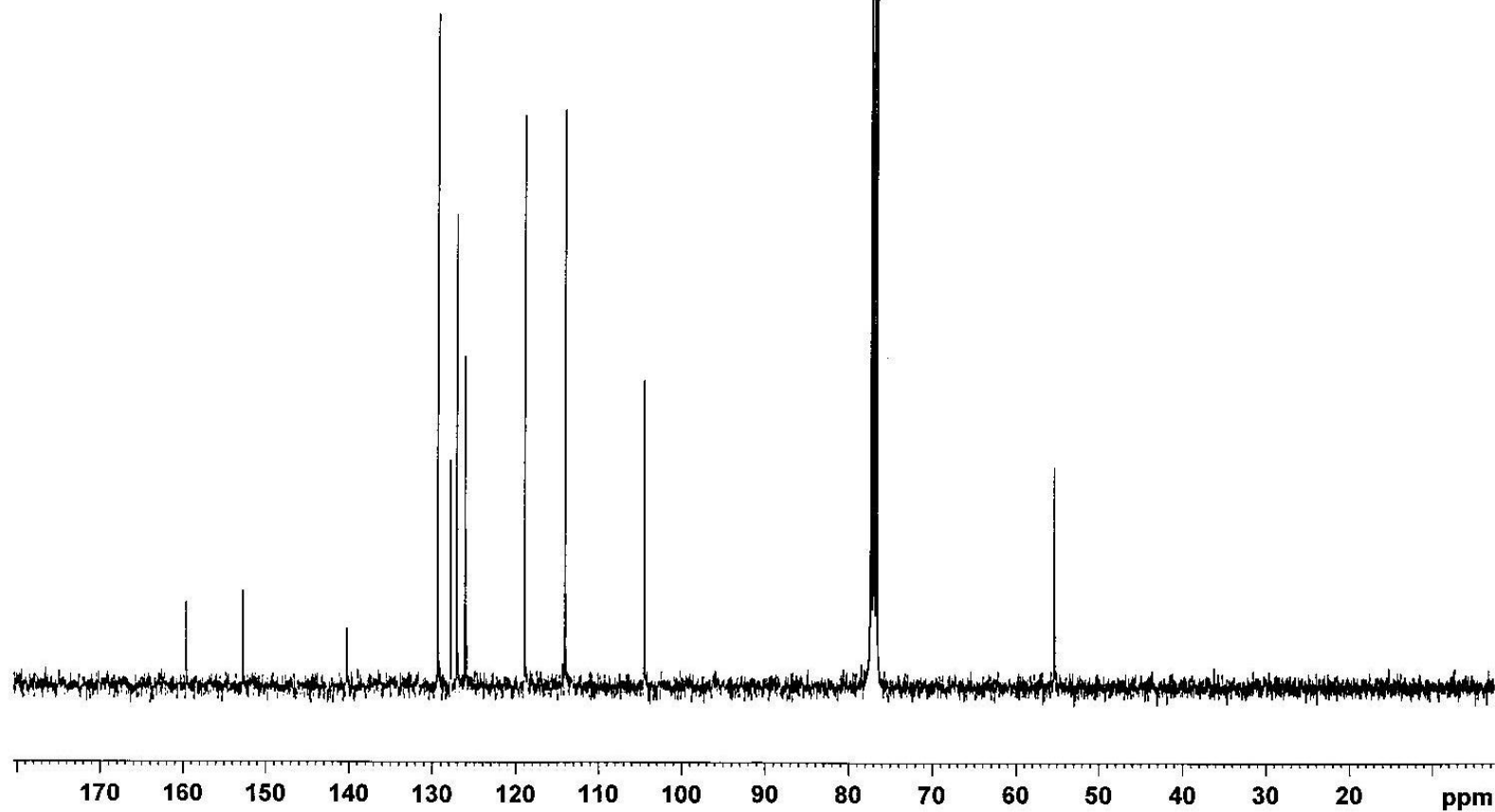


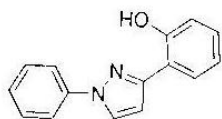
3-(4-methoxyphenyl)-1-phenyl-1H-pyrazole (10f)





3-(4-methoxyphenyl)-1-phenyl-1H-pyrazole (10f)

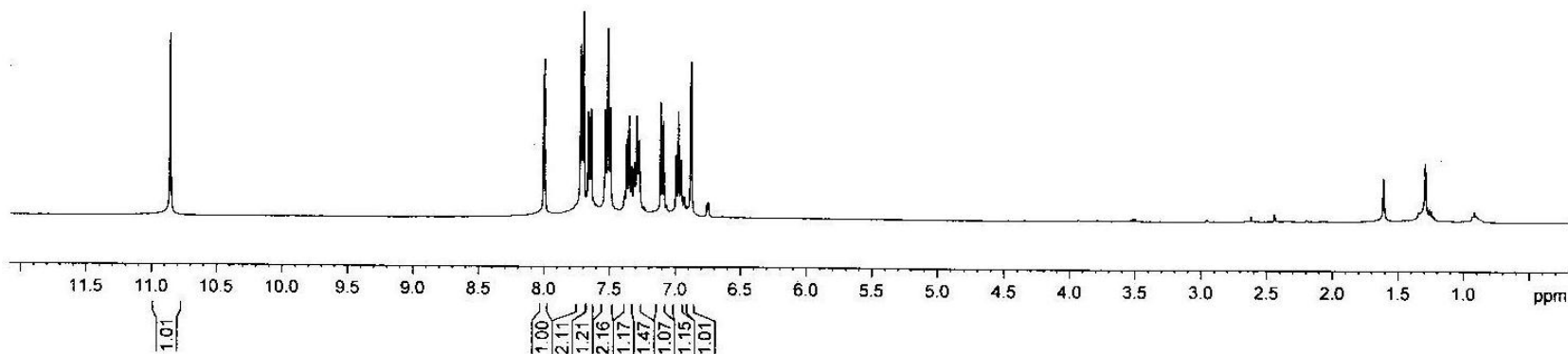


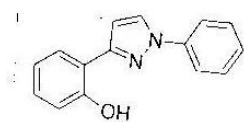


10.870

8.003
7.996
7.719
7.699
7.659
7.639
7.533
7.514
7.494
7.370
7.352
7.334
7.312
7.294
7.281
7.276
7.274
7.113
7.093
6.997
6.978
6.959
6.885
6.879

2-(1-phenyl-1H-pyrazol-3-yl)phenol (10g)





156.02
152.94

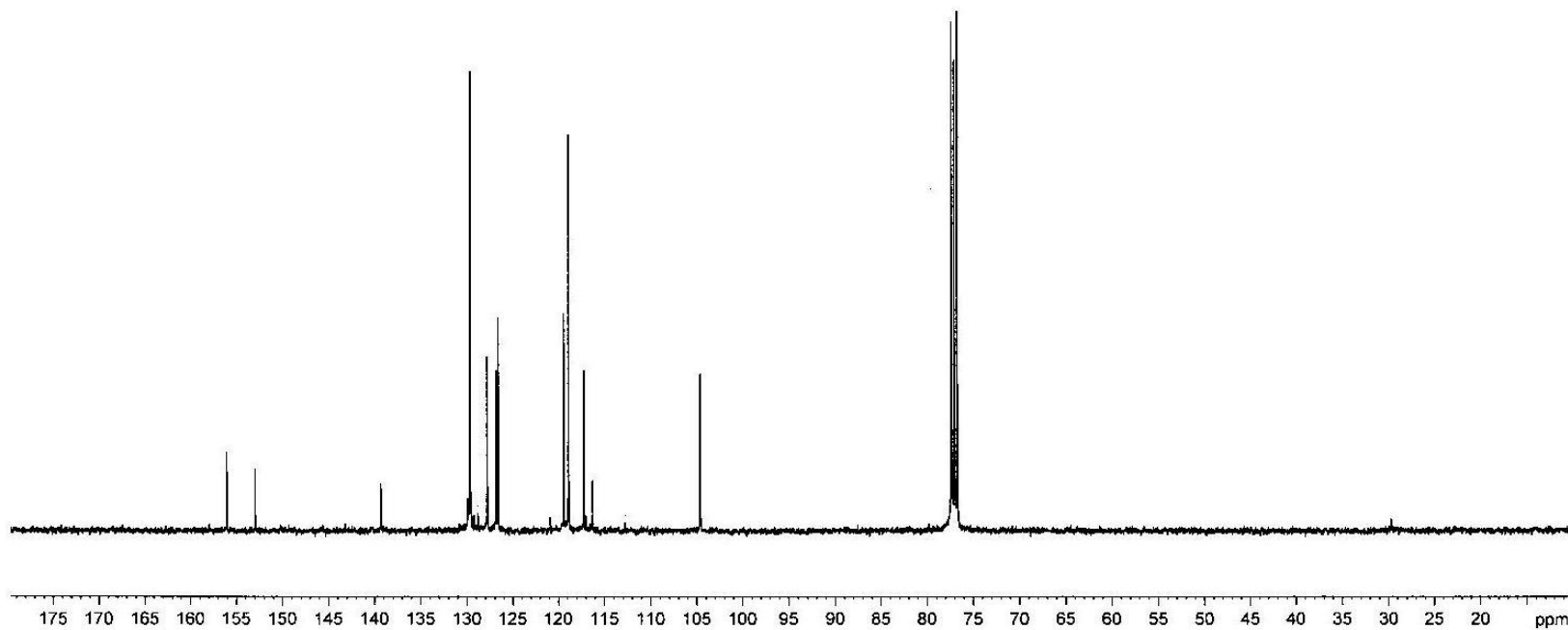
139.28

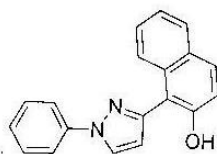
129.67
129.62
127.77
126.81
126.59
119.38
118.86
117.20
116.25

104.59

77.35
77.03
76.71

2-(1-phenyl-1H-pyrazol-3-yl)phenol (10g)

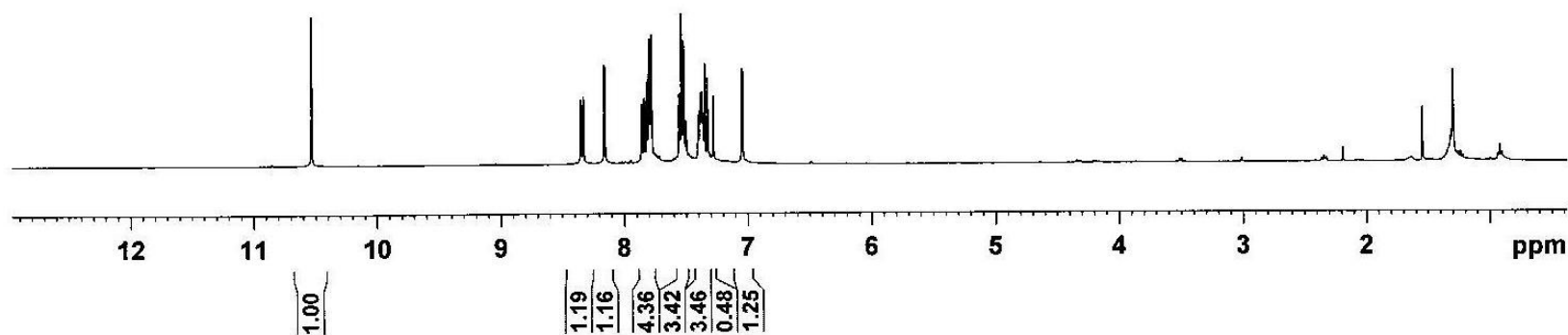




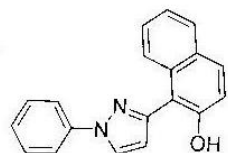
— 10.533

8.350
8.328
8.160
8.154
7.859
7.838
7.816
7.799
7.795
7.780
7.557
7.537
7.518
7.499
7.403
7.384
7.373
7.350
7.327
7.281
7.048
7.042

1-(1-phenyl-1H-pyrazol-3-yl)naphthalen-2-ol (10h)



NP-AKJ-1046-13C



153.73

150.45

139.44

132.01

130.42

129.63

129.02

128.70

127.91

126.86

126.75

123.80

123.03

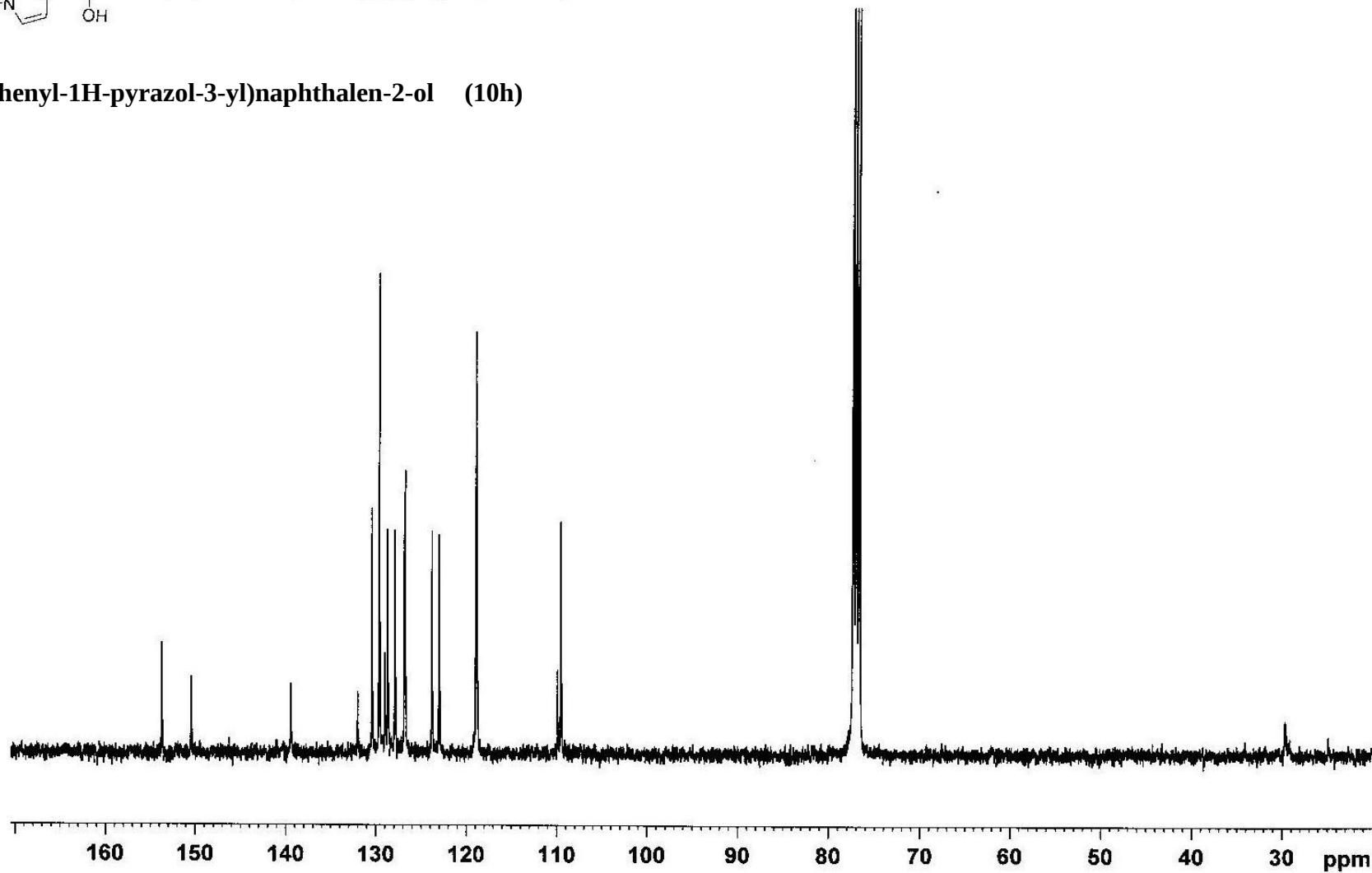
118.94

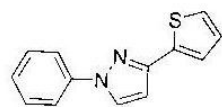
118.81

109.89

109.54

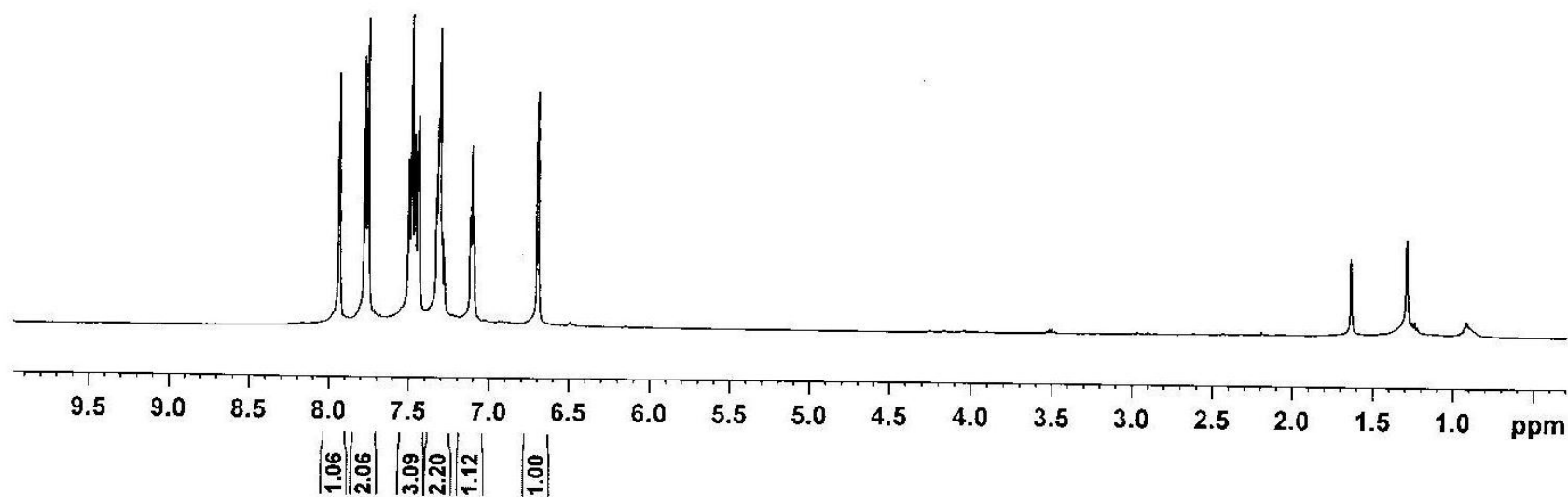
1-(1-phenyl-1H-pyrazol-3-yl)naphthalen-2-ol (10h)

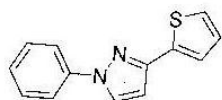




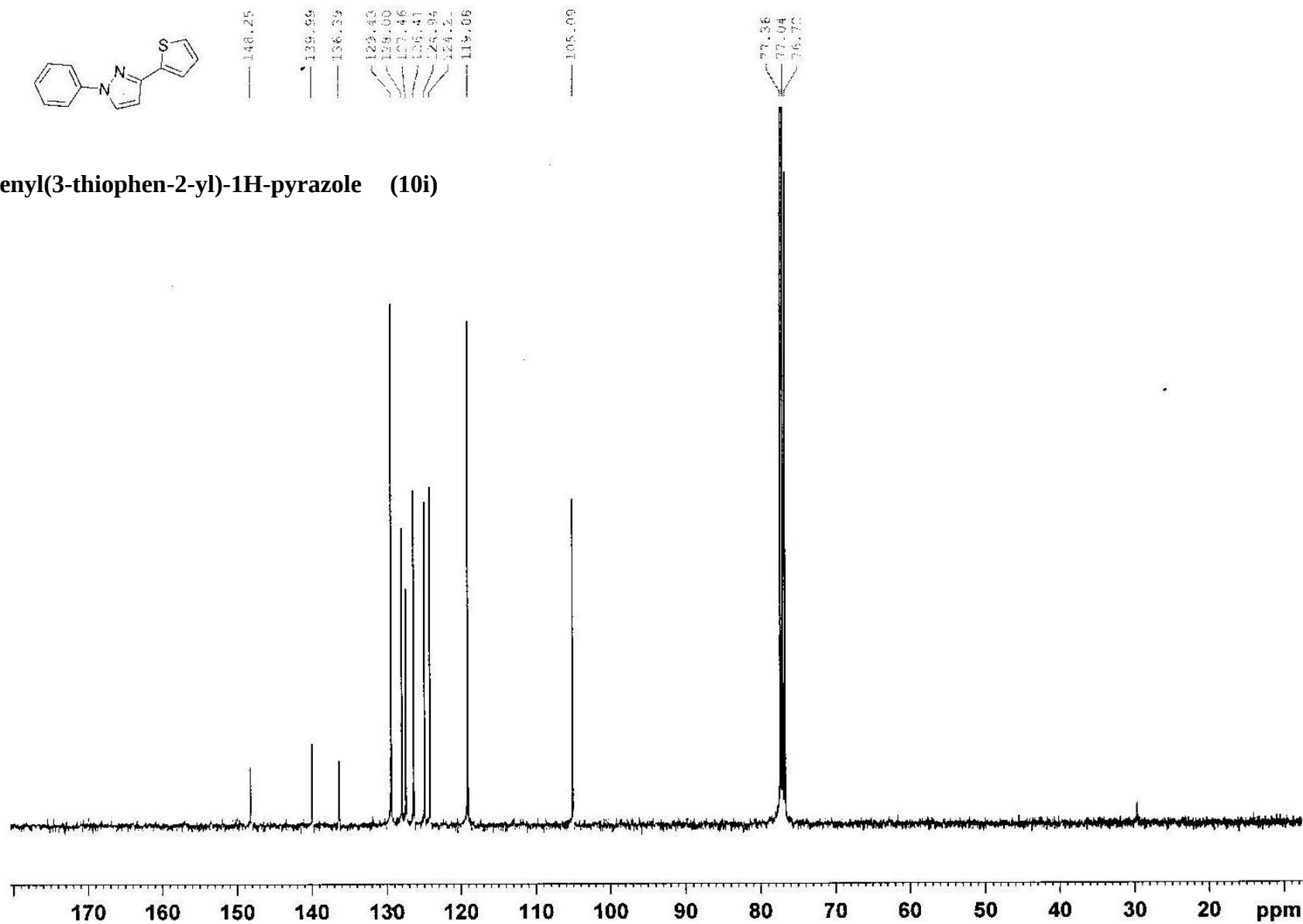
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7.758
7.503
7.484
7.465
7.448
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7.283
7.122
7.121
7.110
7.101
6.704
6.698

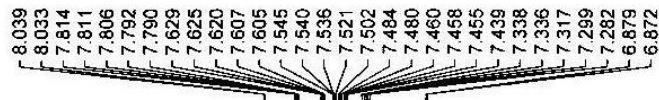
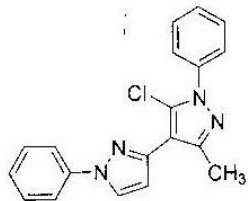
1-phenyl(3-thiophen-2-yl)-1H-pyrazole (10i)



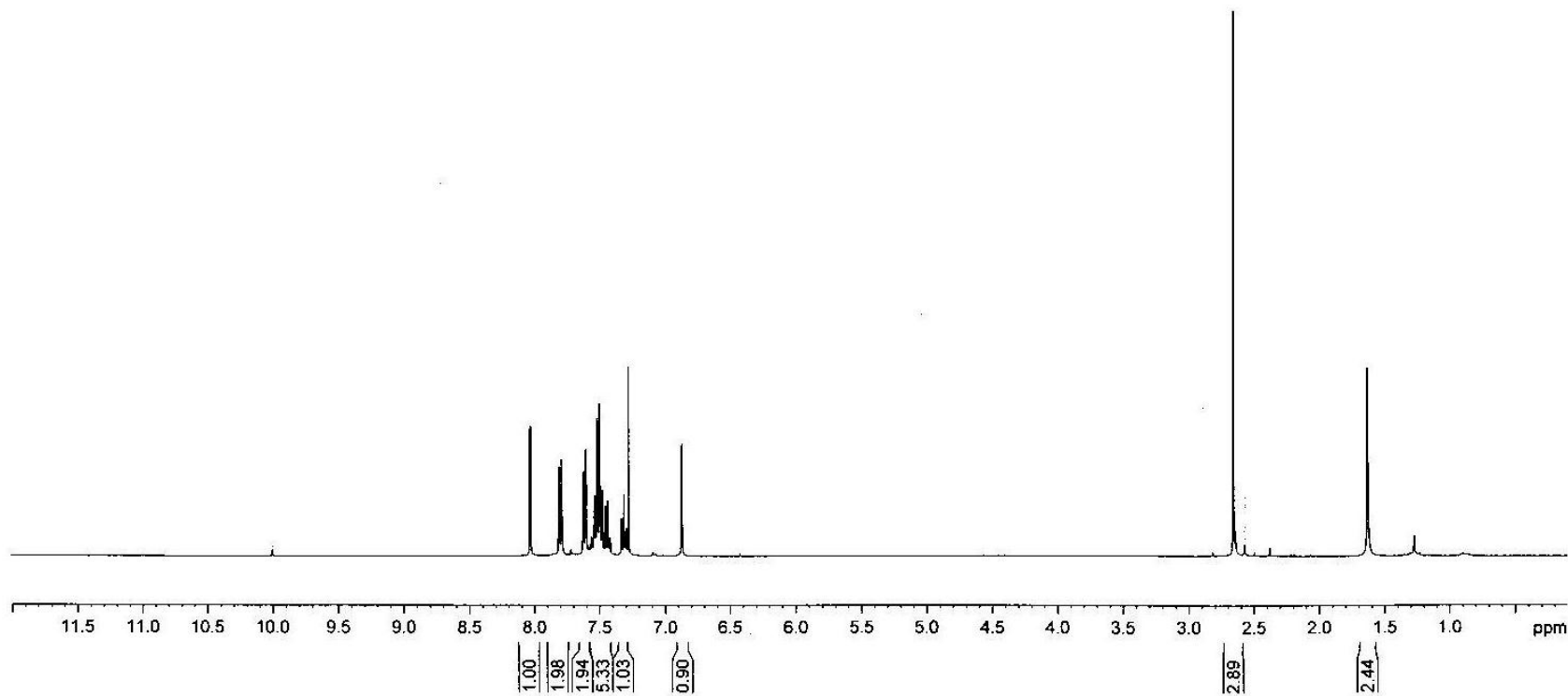


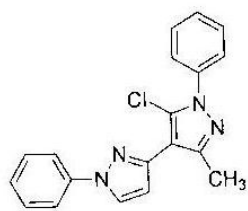
1-phenyl(3-thiophen-2-yl)-1H-pyrazole (10i)



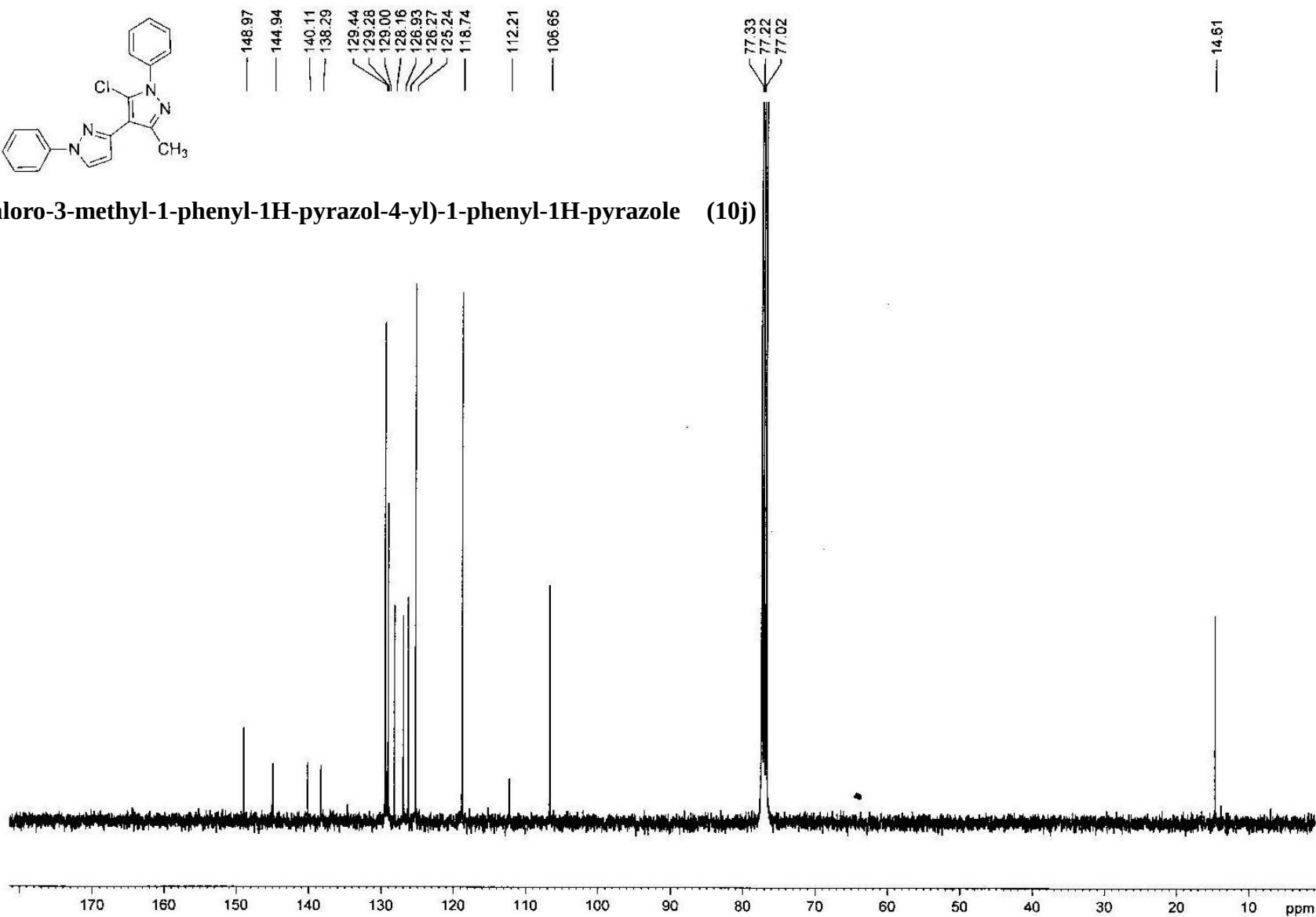


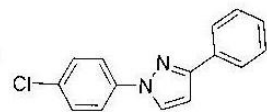
3-(5-chloro-3-methyl-1-phenyl-1H-pyrazol-4-yl)-1-phenyl-1H-pyrazole (10j)





3-(5-chloro-3-methyl-1-phenyl-1H-pyrazol-4-yl)-1-phenyl-1H-pyrazole (10j)

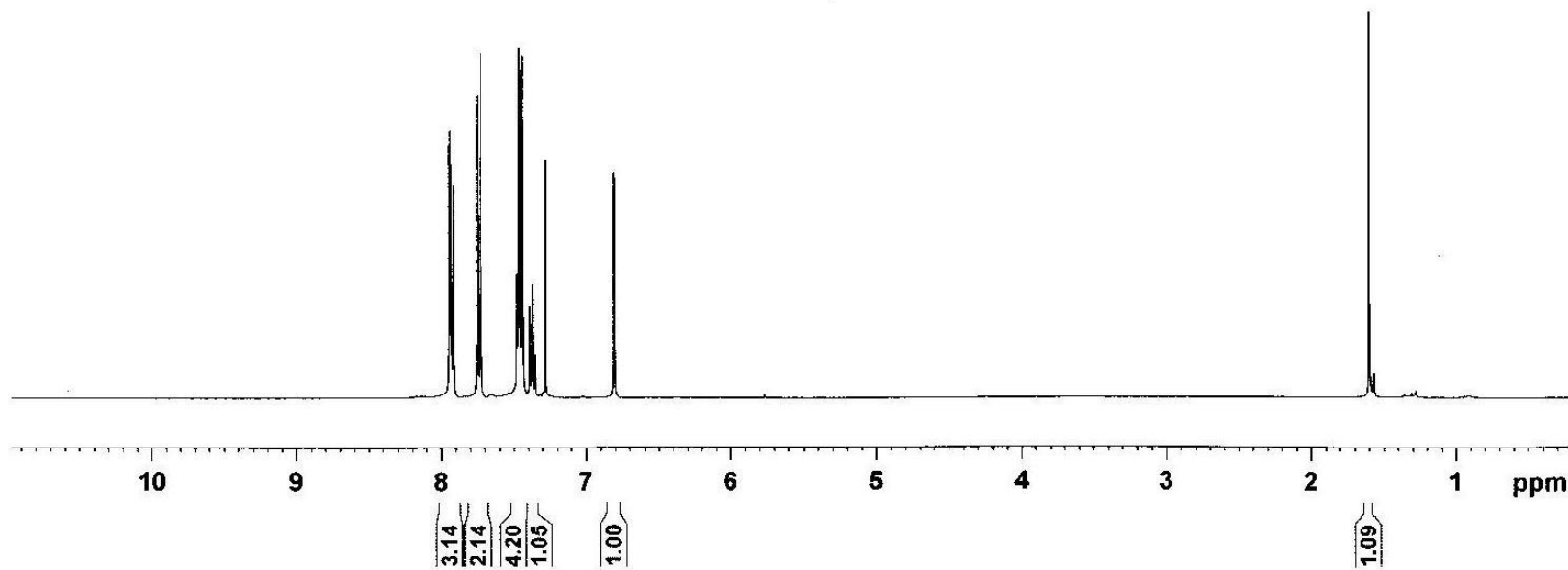


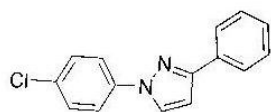


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7.944
7.941
7.937
7.933
7.919
7.918
7.755
7.750
7.738
7.733
7.479
7.475
7.467
7.462
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6.813
6.807

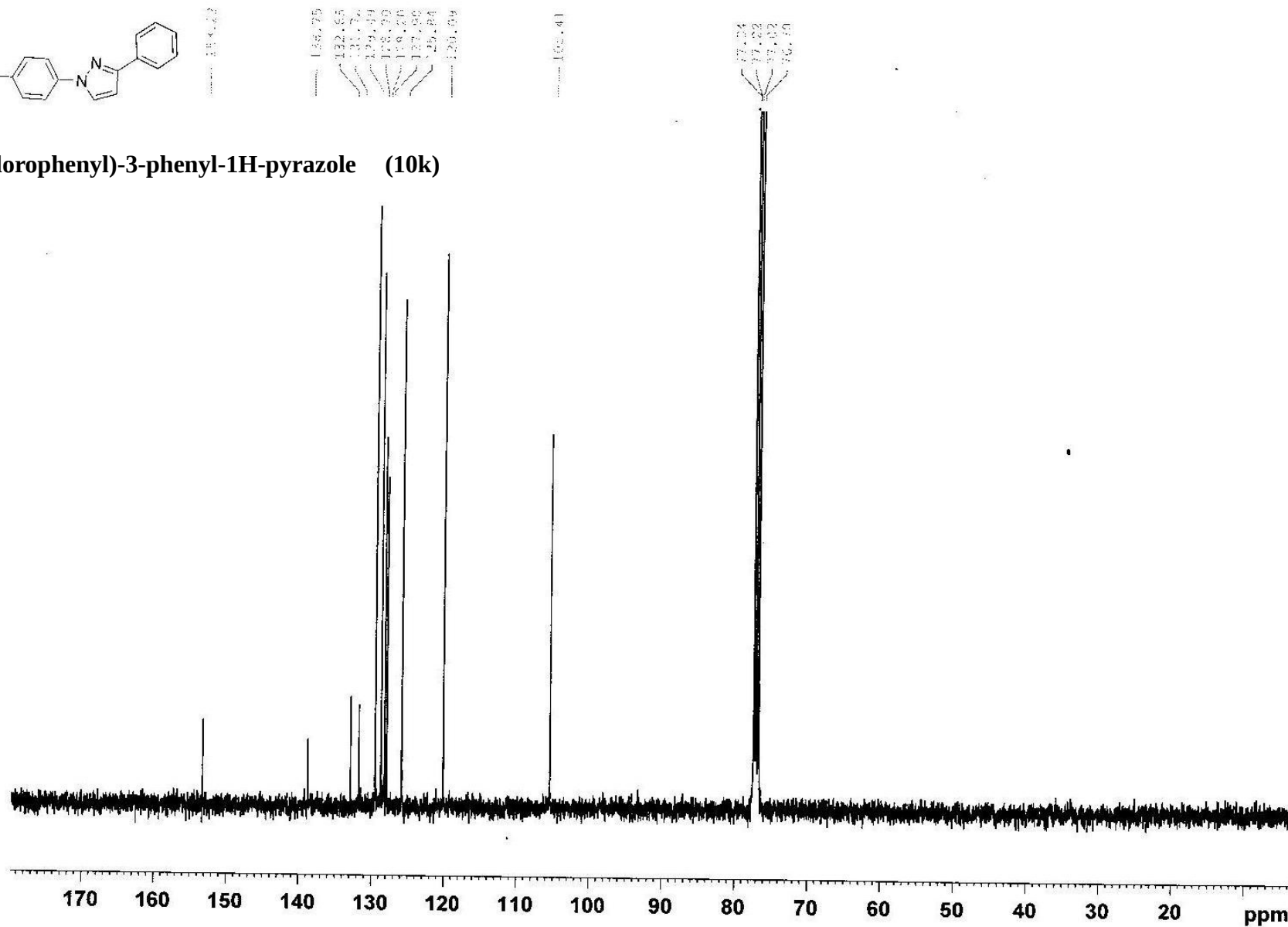
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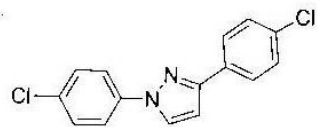
1-(4-chlorophenyl)-3-phenyl-1H-pyrazole (10k)





1-(4-chlorophenyl)-3-phenyl-1H-pyrazole (10k)

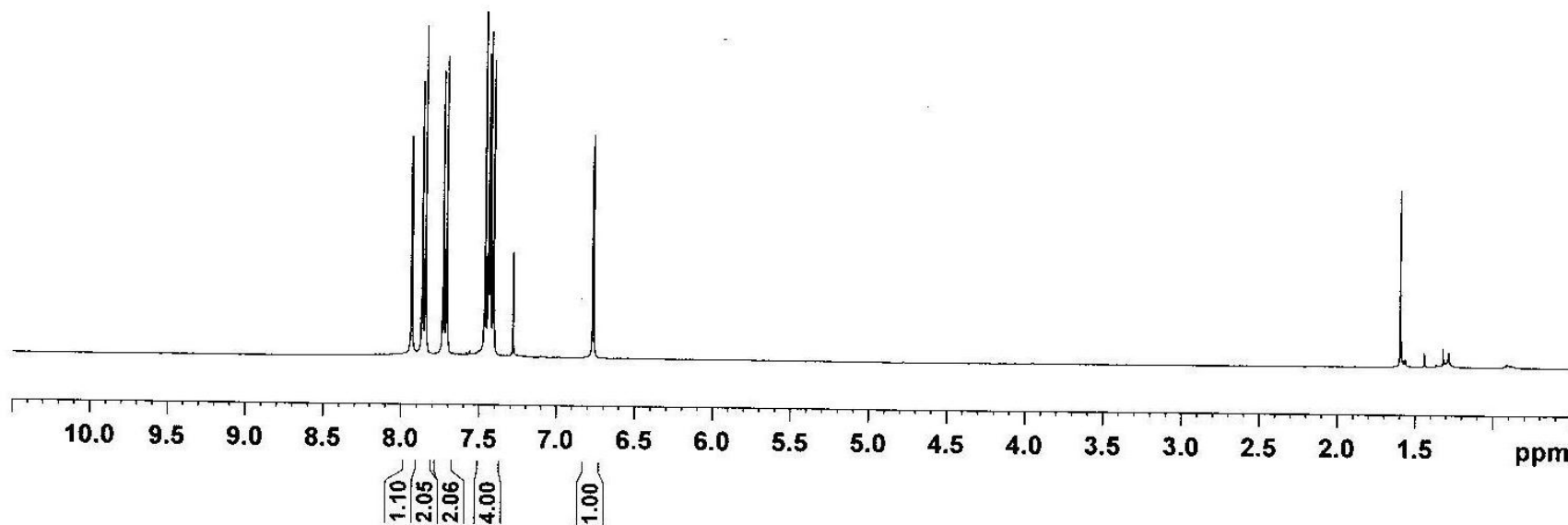


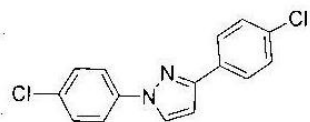


7.937
7.931
7.872
7.866
7.861
7.849
7.845
7.838
7.740
7.733
7.728
7.716
7.711
7.704
7.473
7.465
7.460
7.448
7.443
7.438
7.432
7.427
7.415
7.410
7.404
7.282
6.771
6.765

— 1.597

1,3-bis(4-chlorophenyl)-1H-pyrazole (10l)





156.63

136.43

134.93

134.24

134.12

133.92

134.36

134.09

133.93

128.19

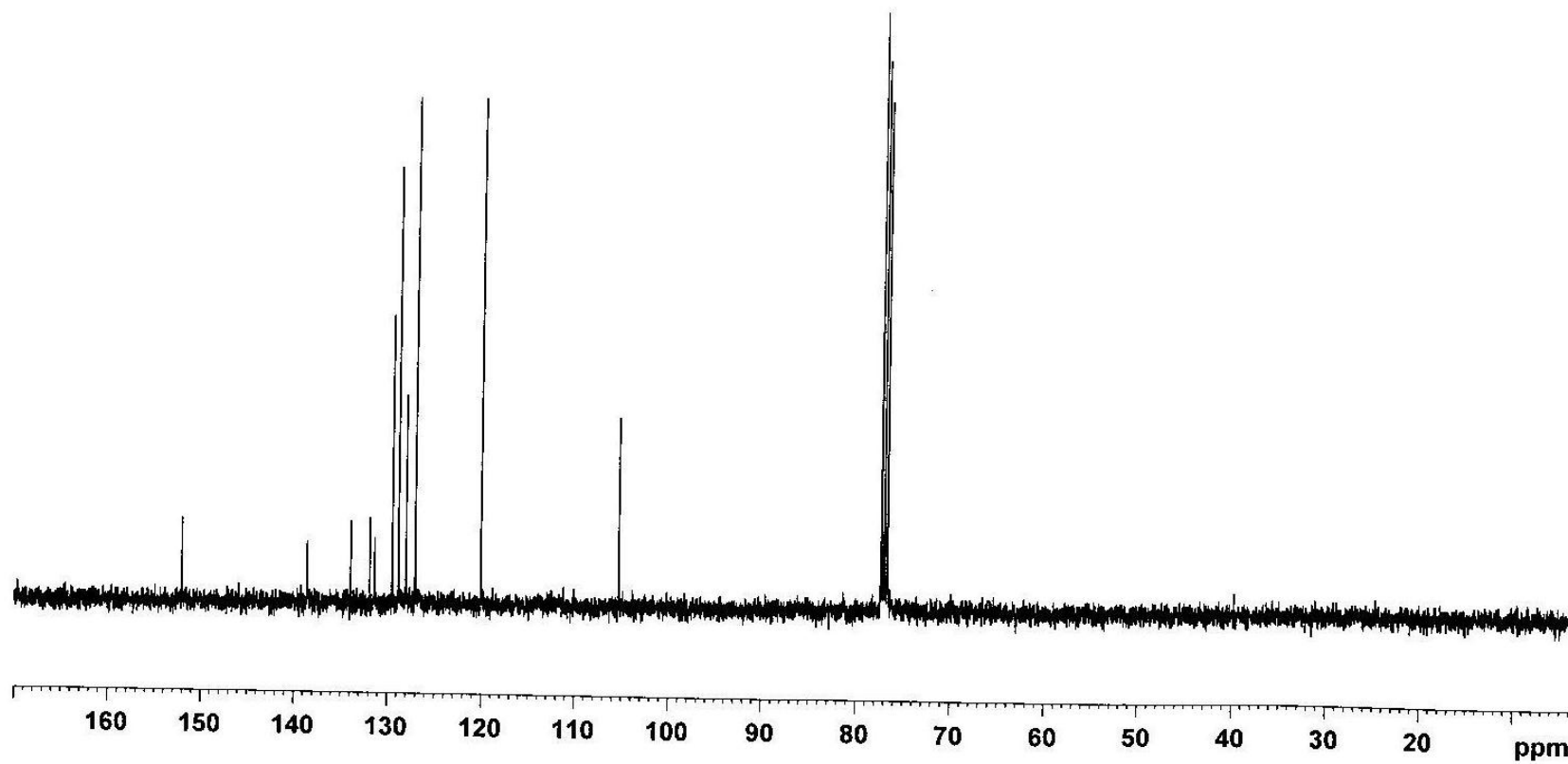
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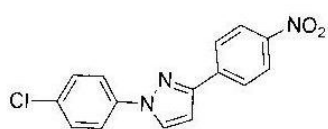
77.33

77.01

76.63

1,3-bis(4-chlorophenyl)-1H-pyrazole (10l)

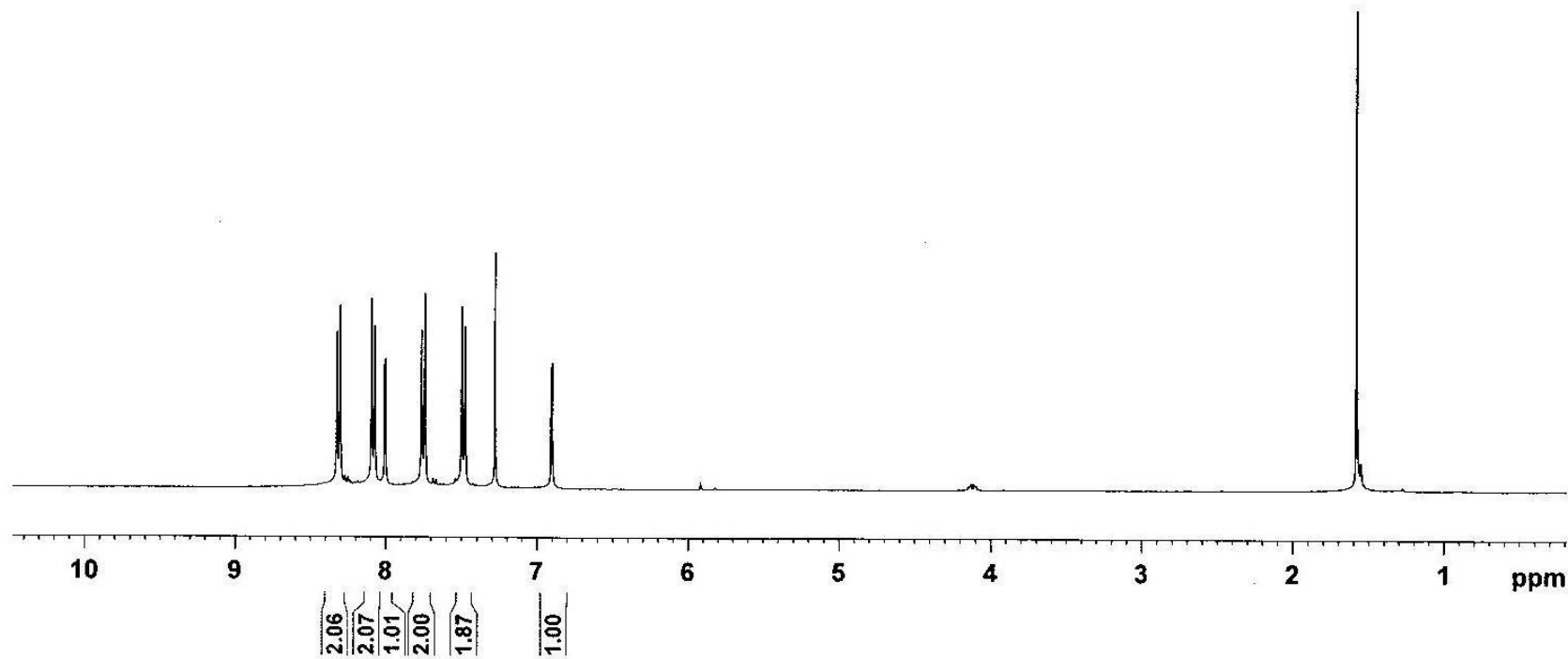




8.326
8.304
8.095
8.073
8.008
8.002
7.763
7.742
7.500
7.478
7.282
6.908
6.902

—1.583

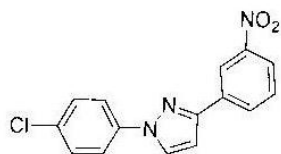
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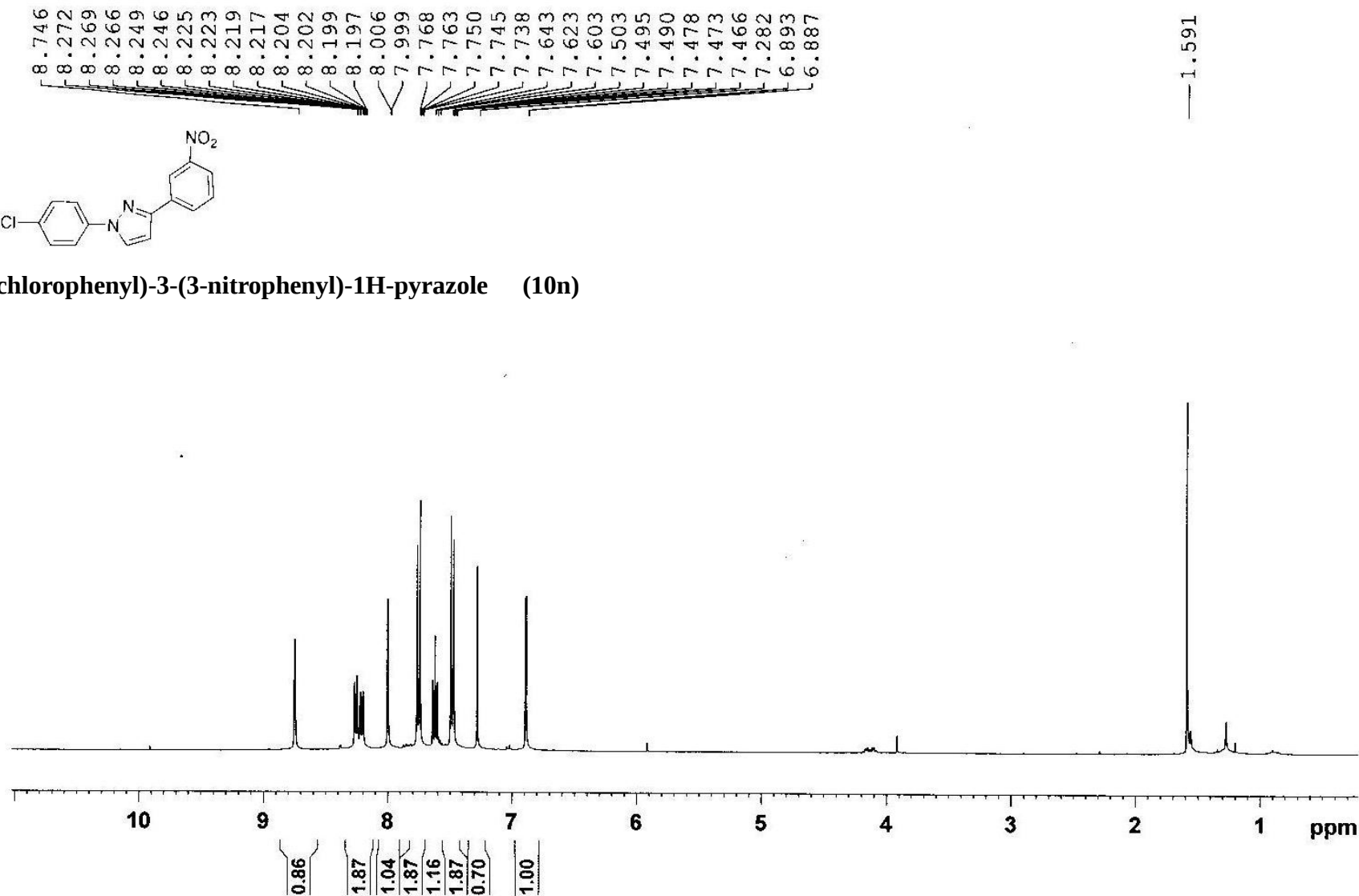


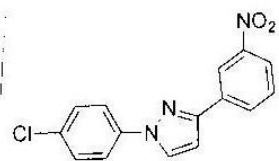
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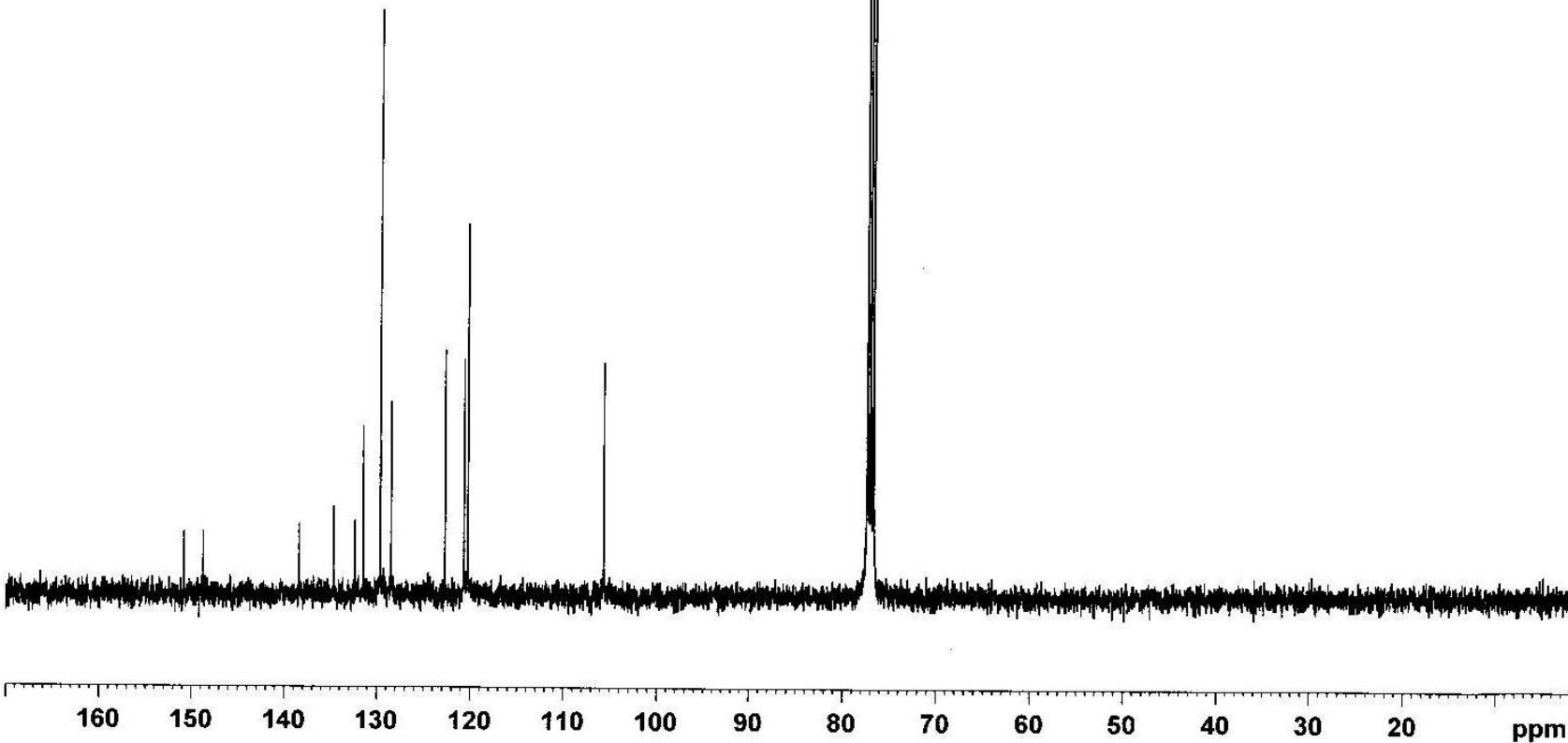


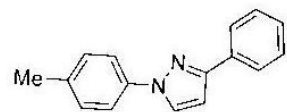
1-(4-chlorophenyl)-3-(3-nitrophenyl)-1H-pyrazole (10n)



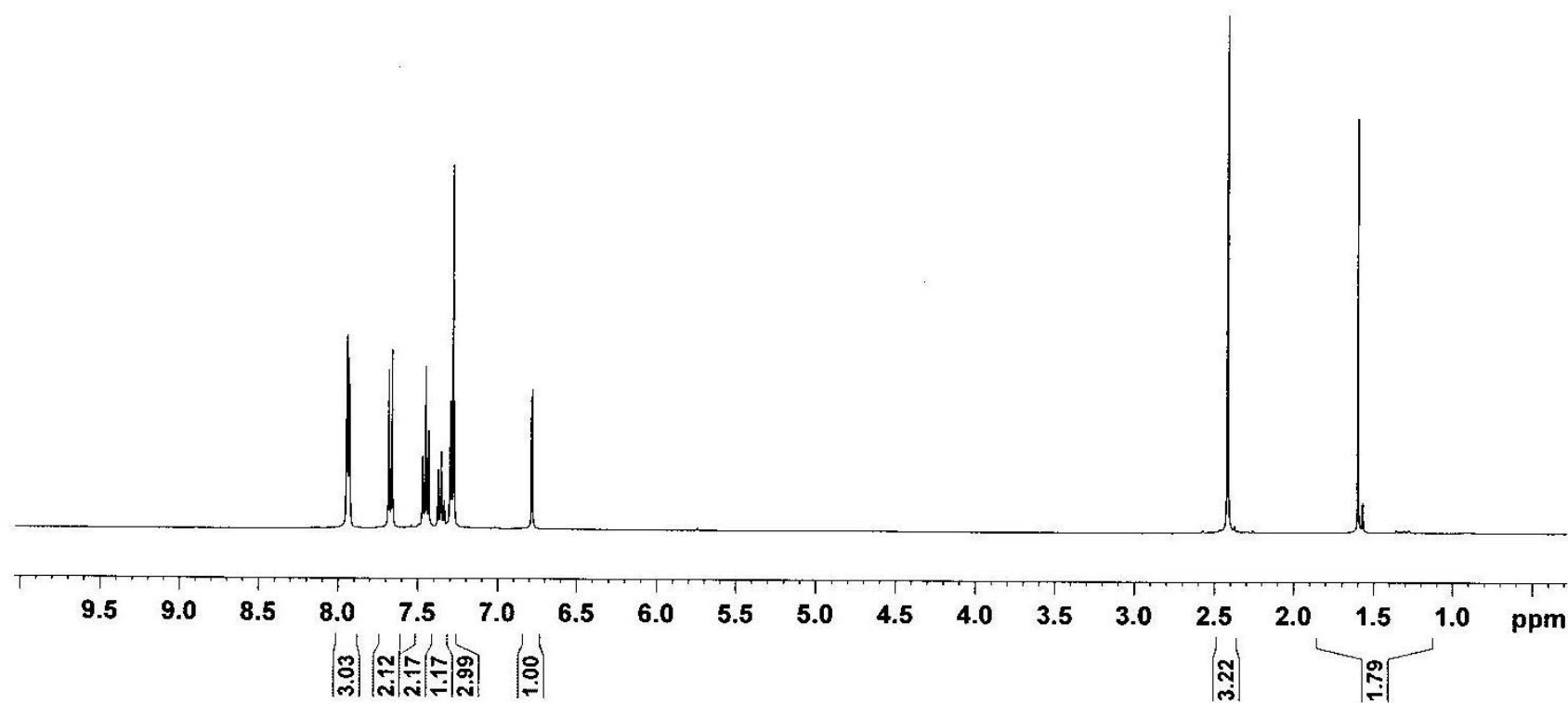


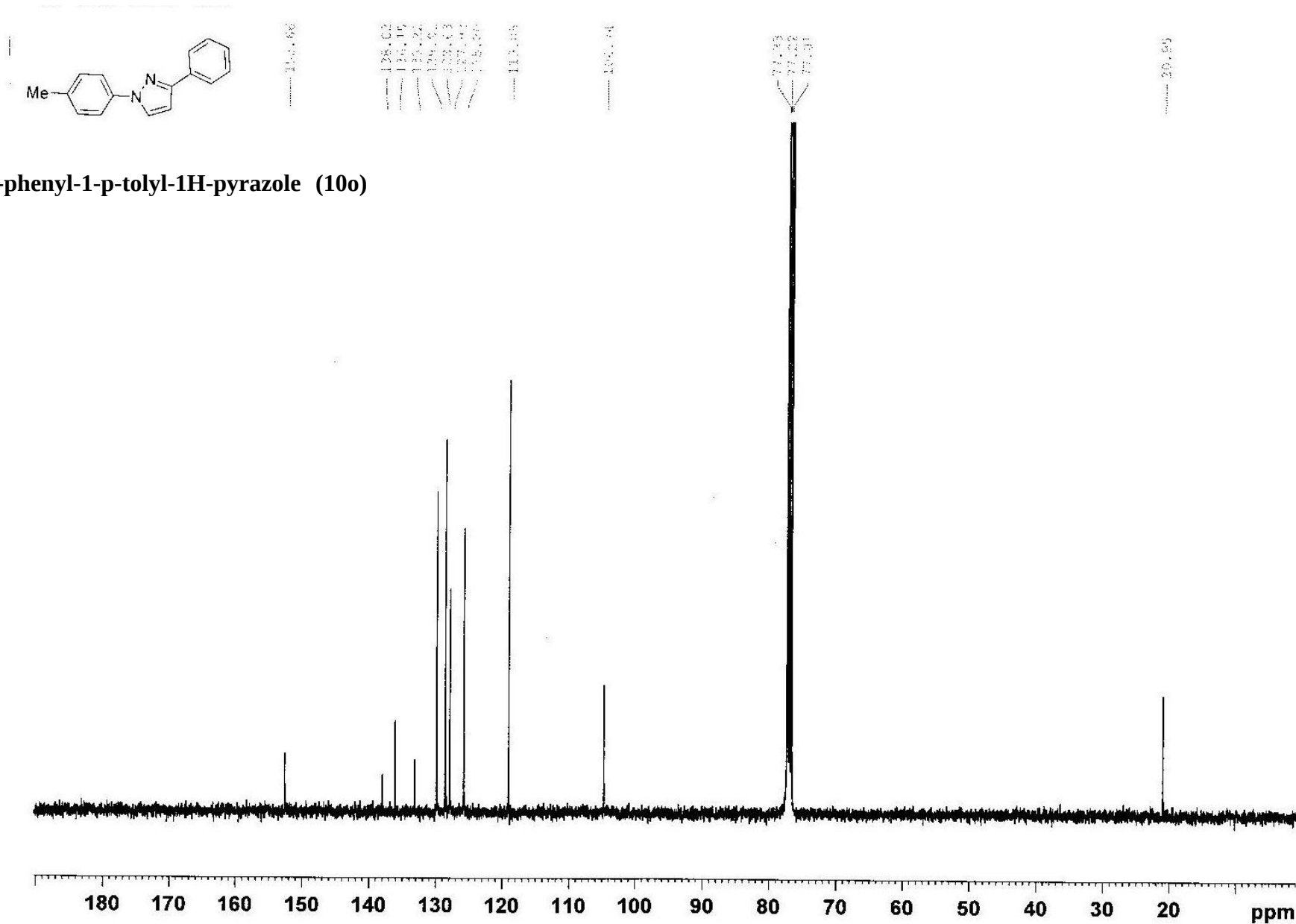
1-(4-chlorophenyl)-3-(3-nitrophenyl)-1H-pyrazole (10n)

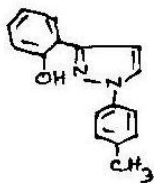




3-phenyl-1-p-tolyl-1H-pyrazole (10o)







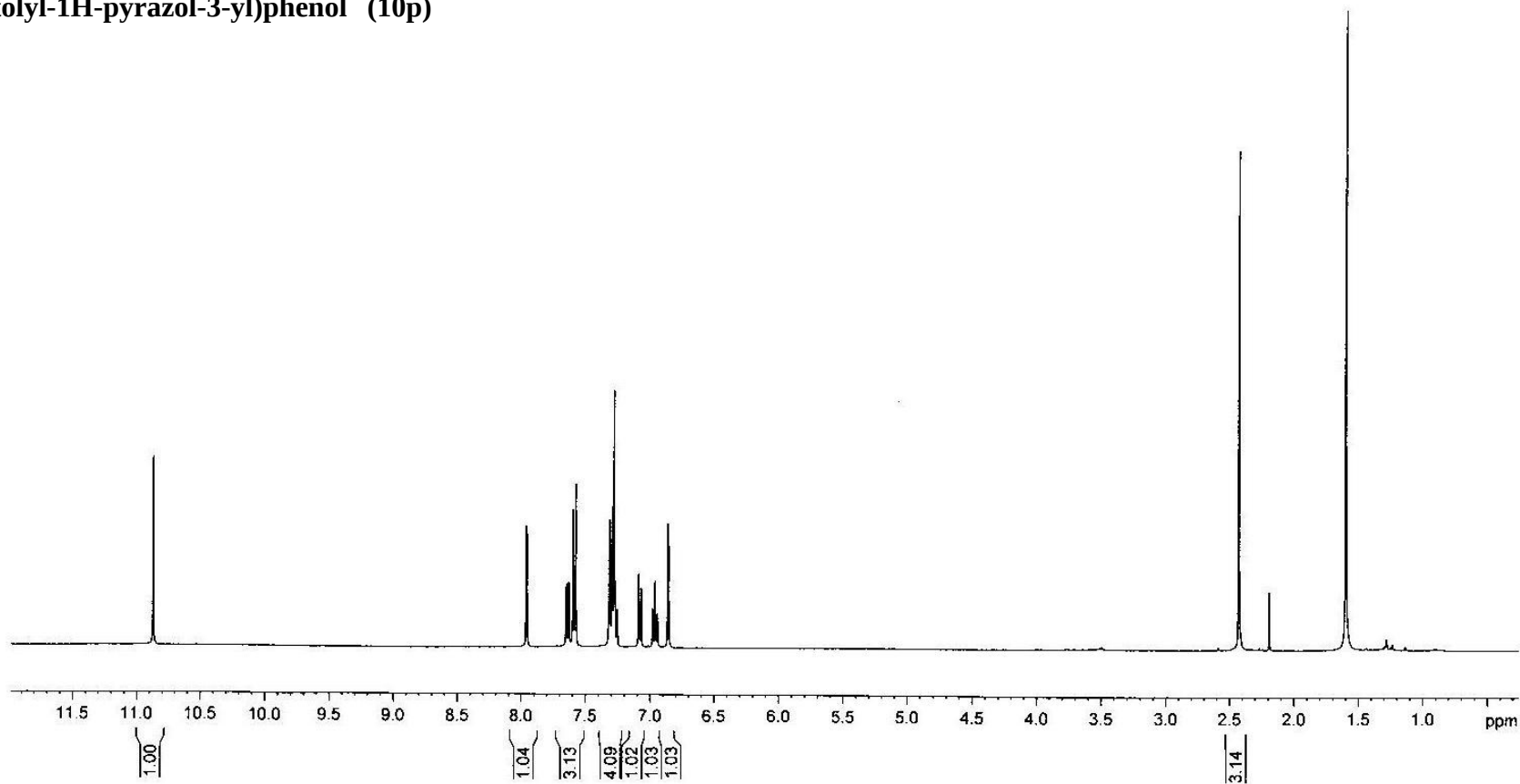
10.871

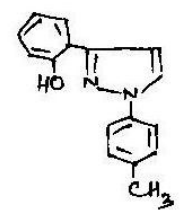
7.962
7.955
7.651
7.648
7.632
7.628
7.597
7.576
7.316
7.295
7.282
7.274
7.256
7.253
7.092
7.072
7.071
6.983
6.982
6.963
6.946
6.944
6.864
6.858

2.428

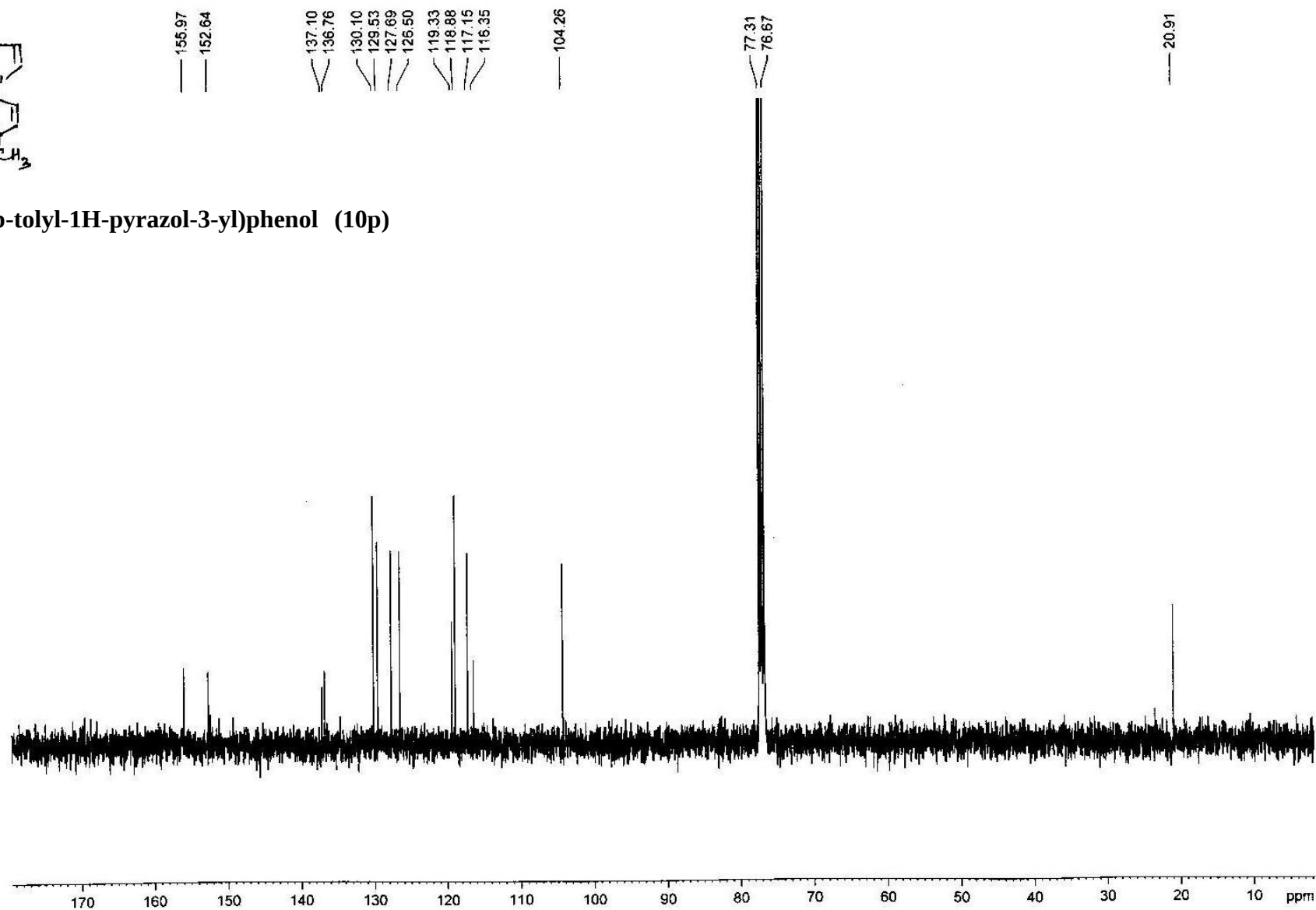
1.598

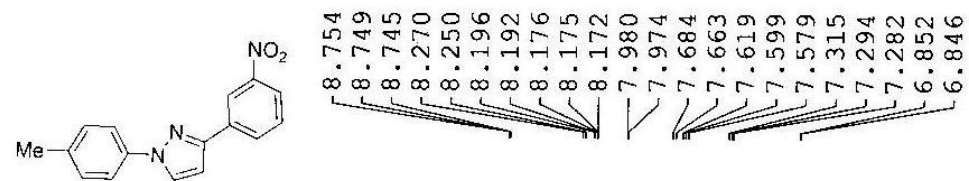
2-(1-p-tolyl-1H-pyrazol-3-yl)phenol (10p)



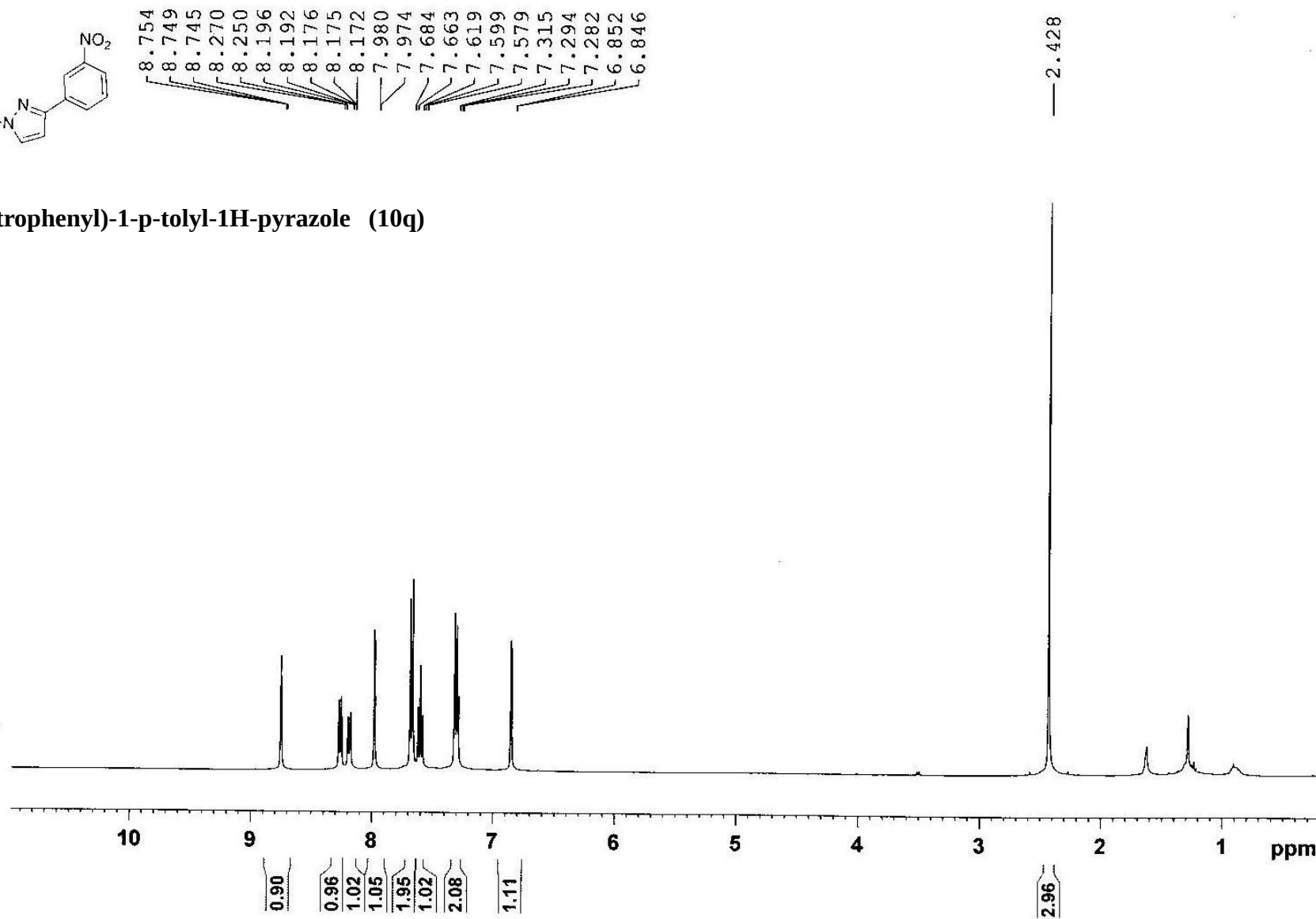


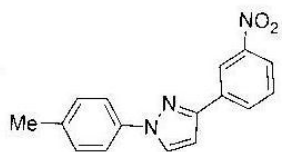
2-(1-p-tolyl-1H-pyrazol-3-yl)phenol (10p)





3-(3-nitrophenyl)-1-p-tolyl-1H-pyrazole (10q)





150.5
146.0

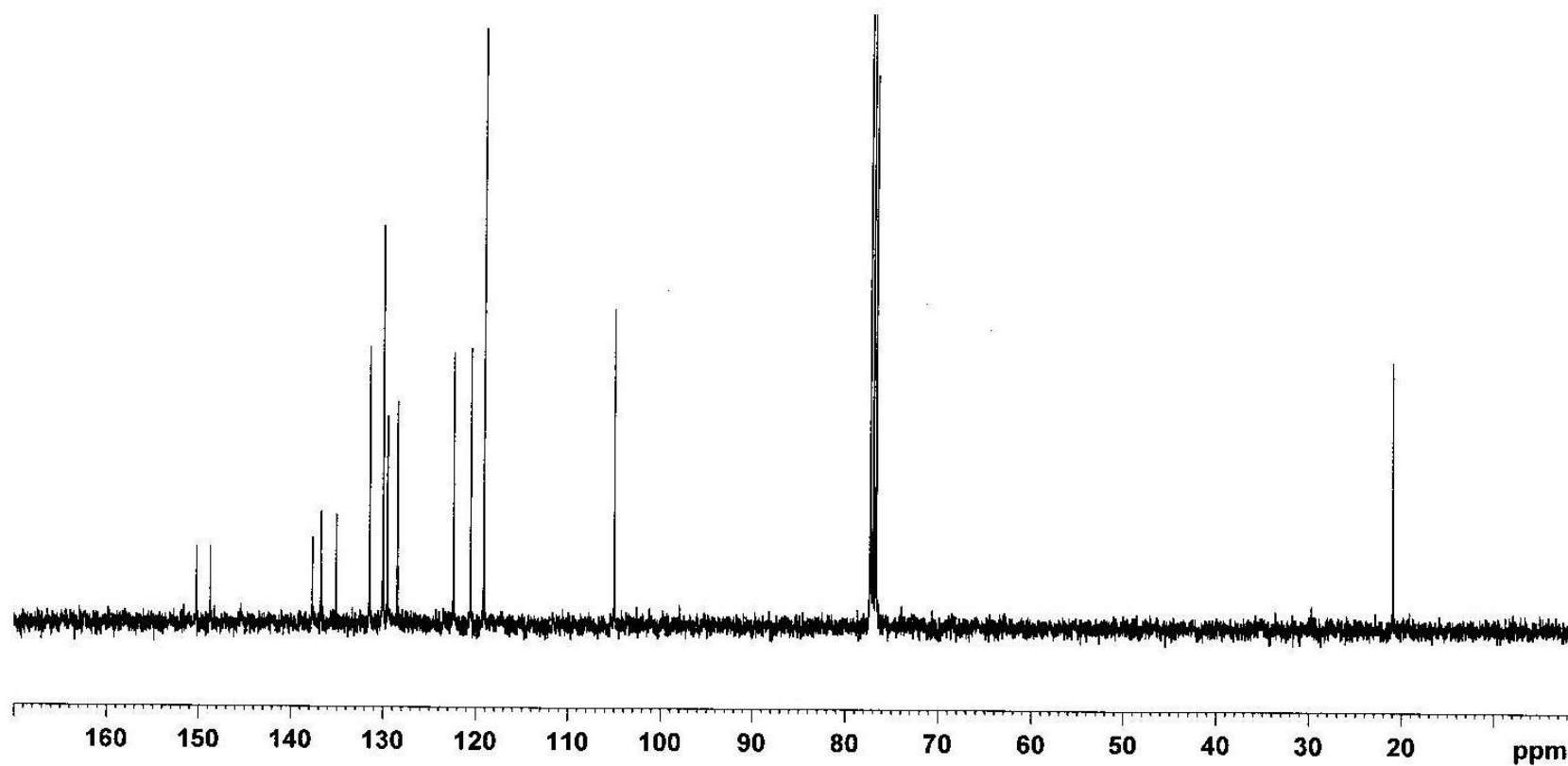
131.73
131.72
131.09
131.07
130.02
129.94
129.45
122.4
122.4
120.13

105.0

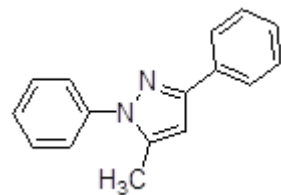
77.47
77.00
76.50

20.55

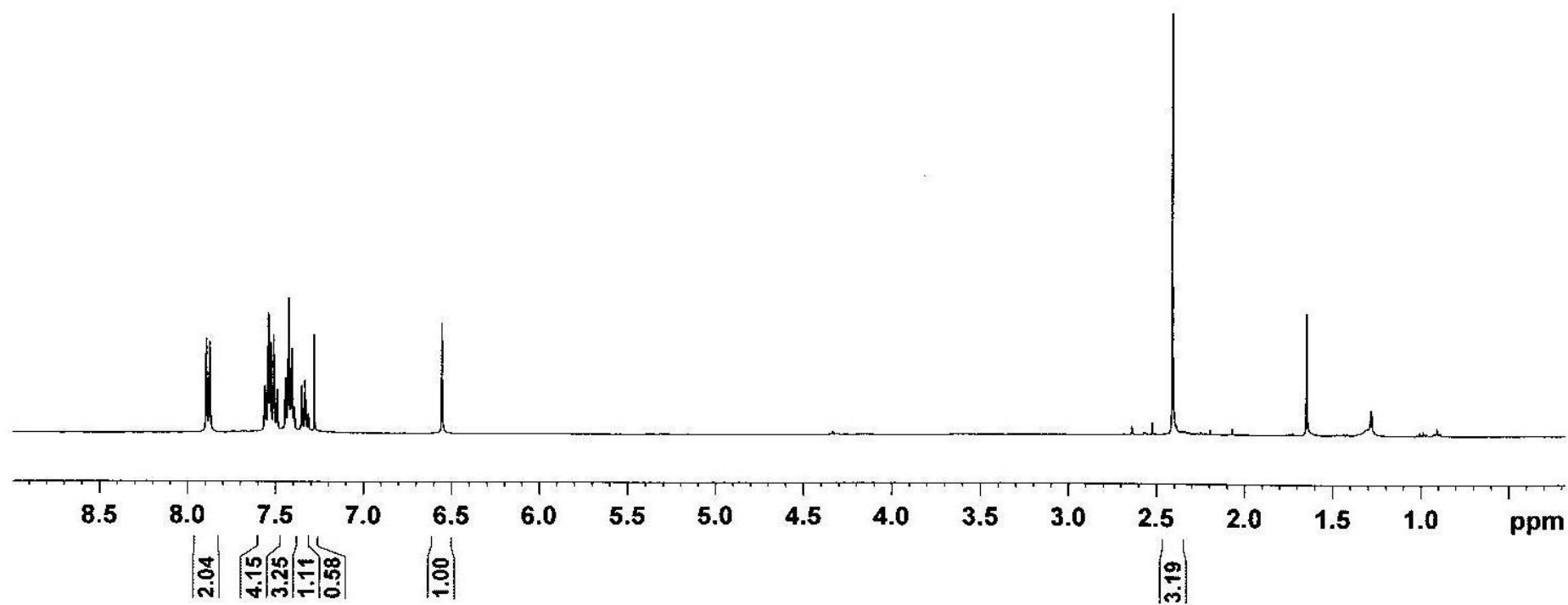
3-(3-nitrophenyl)-1-p-tolyl-1H-pyrazole (10q)



7.566
7.561
7.549
7.543
7.541
7.536
7.530
7.516
7.512
7.507
7.492
7.445
7.434
7.430
7.427
7.418
7.412
7.408
7.353
7.334
7.282
6.556

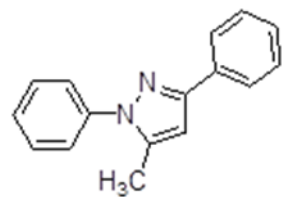


5-methyl-1,3-diphenyl-1H-pyrazole (11a)

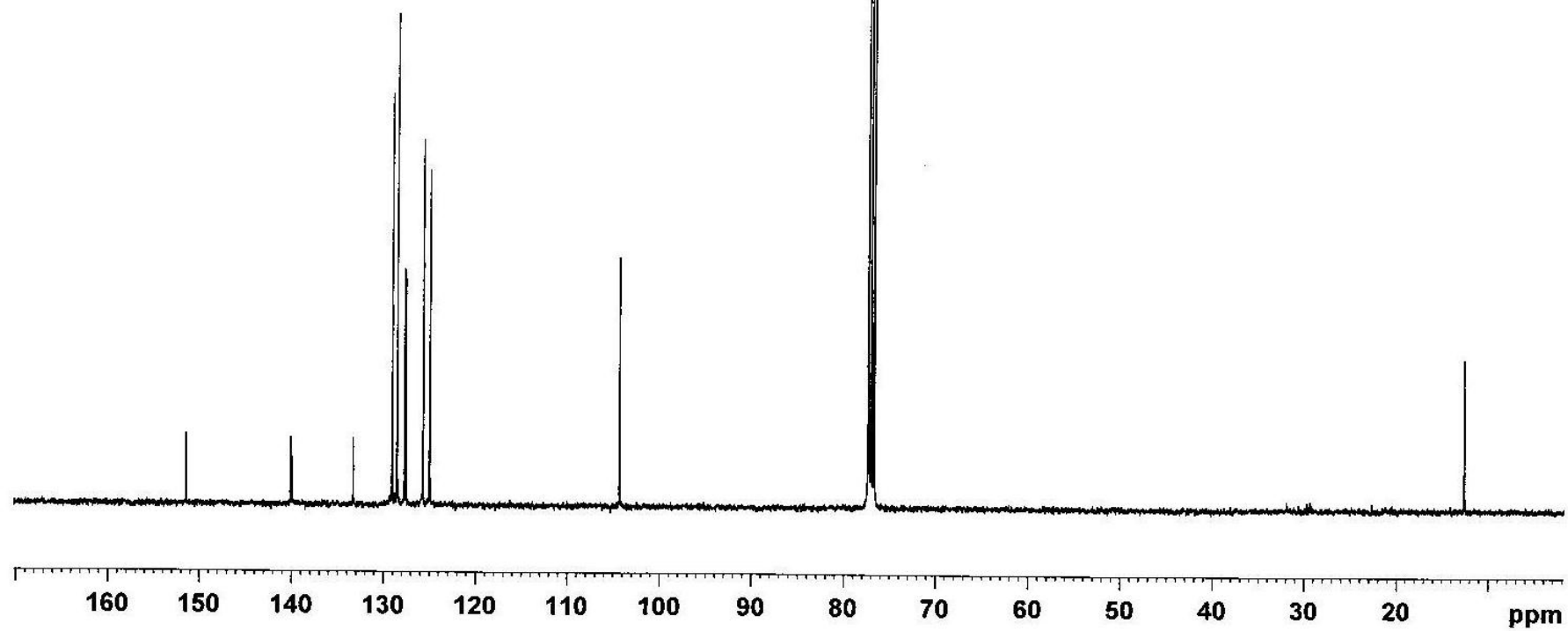


—2.413

—1.654

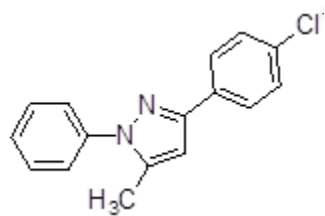


5-methyl-1,3-diphenyl-1H-pyrazole (11a)

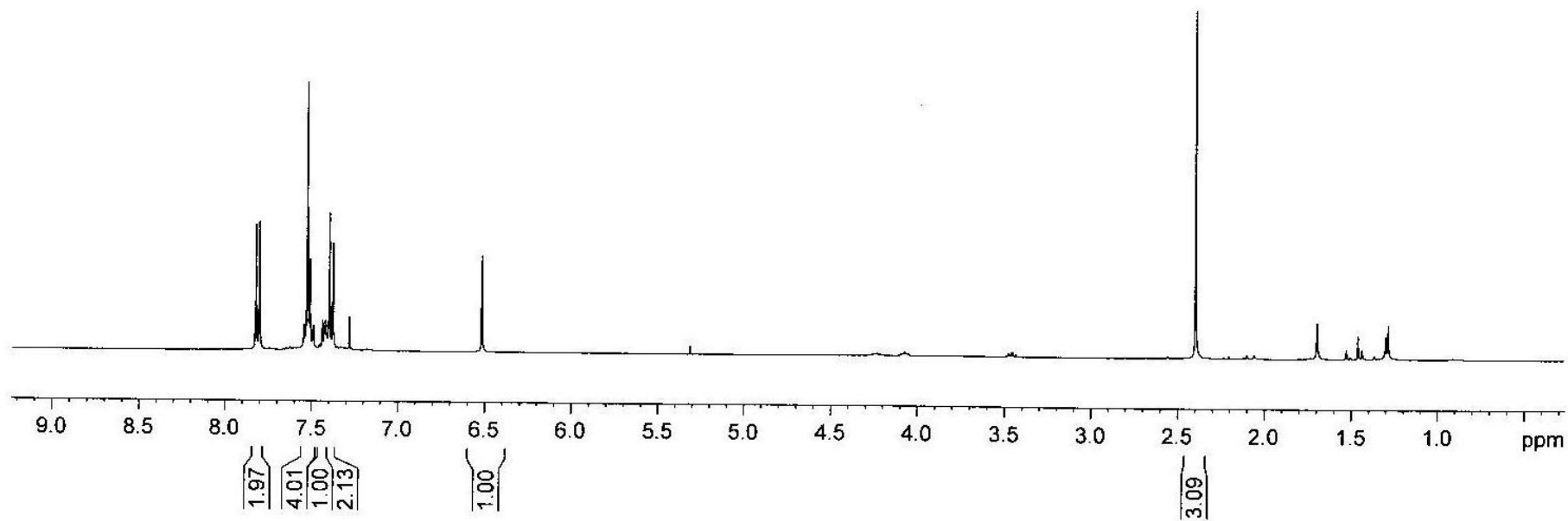


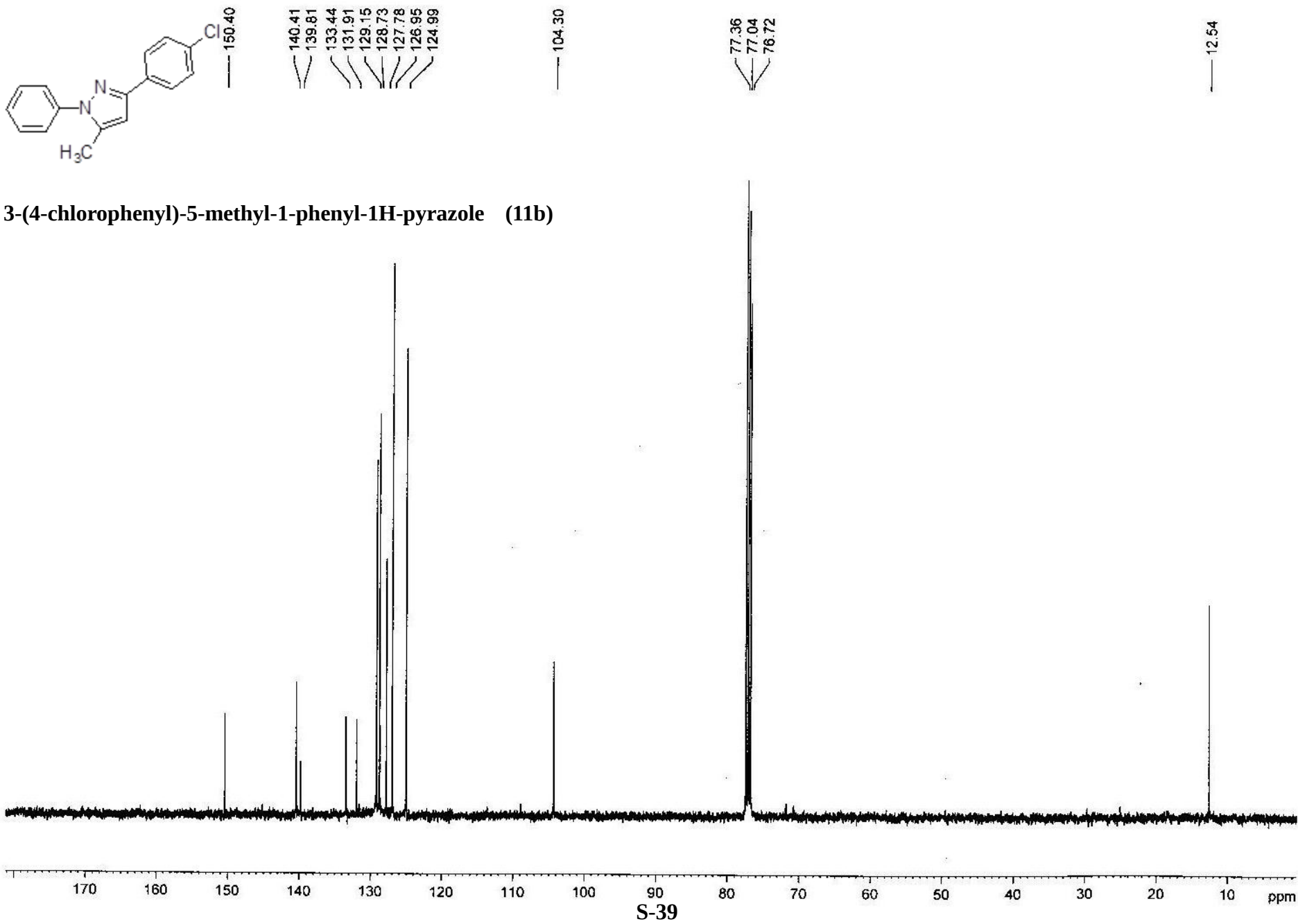
7.806
7.801
7.795
7.544
7.538
7.528
7.523
7.512
7.506
7.491
7.442
7.436
7.429
7.427
7.424
7.420
7.416
7.405
7.399
7.394
7.382
7.377
7.371
7.282
6.516

— 2.399

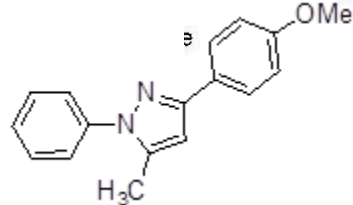


3-(4-chlorophenyl)-5-methyl-1-phenyl-1H-pyrazole (11b)

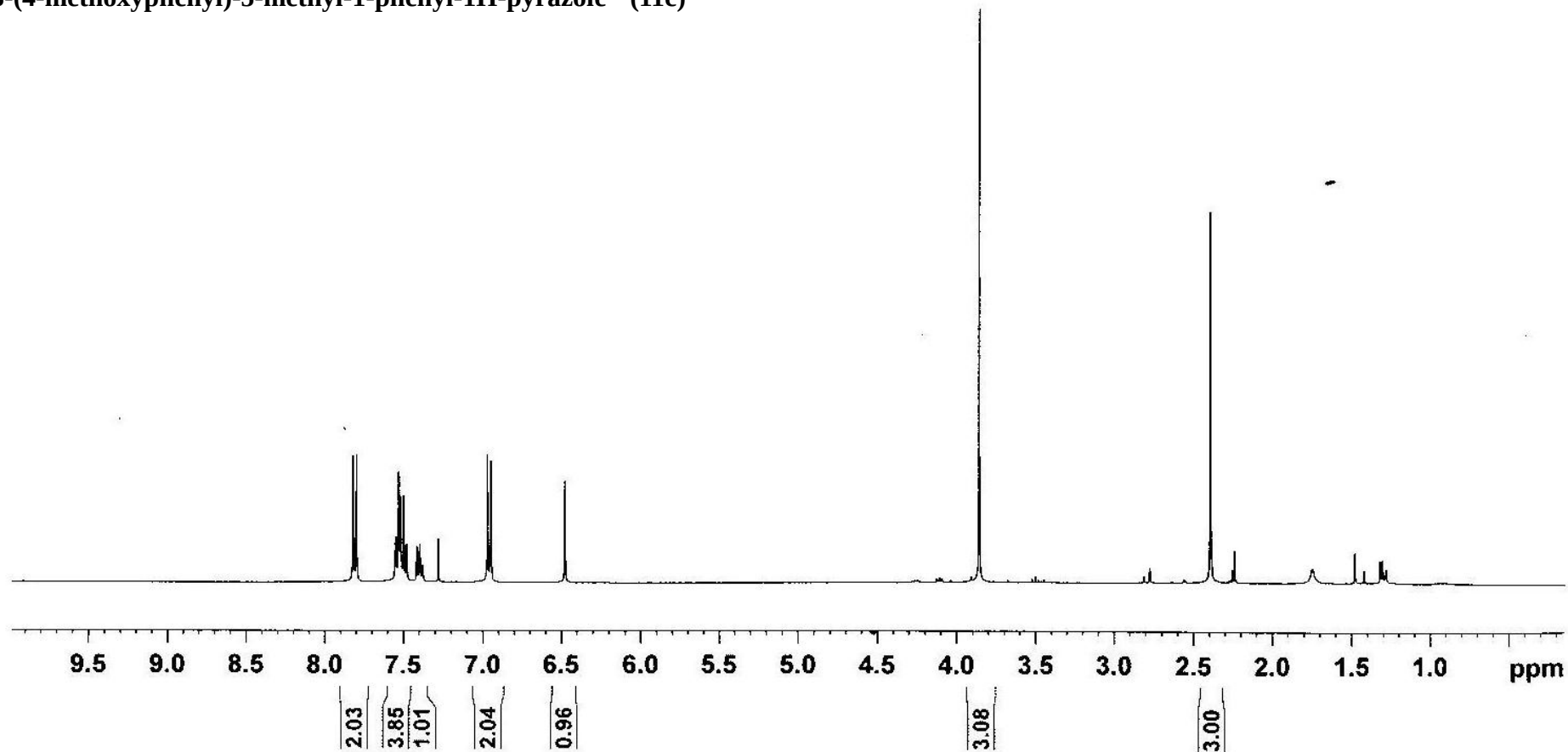




7.817
7.805
7.799
7.793
7.754
7.550
7.545
7.532
7.529
7.525
7.519
7.513
7.500
7.496
7.484
7.480
7.419
7.415
7.411
7.403
7.398
7.392
7.380
7.282
6.979
6.972
6.968
6.955
6.950
6.943
6.479

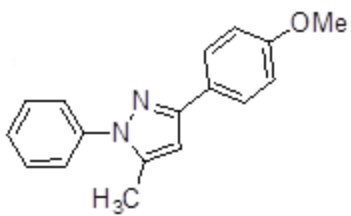


3-(4-methoxyphenyl)-5-methyl-1-phenyl-1H-pyrazole (11c)

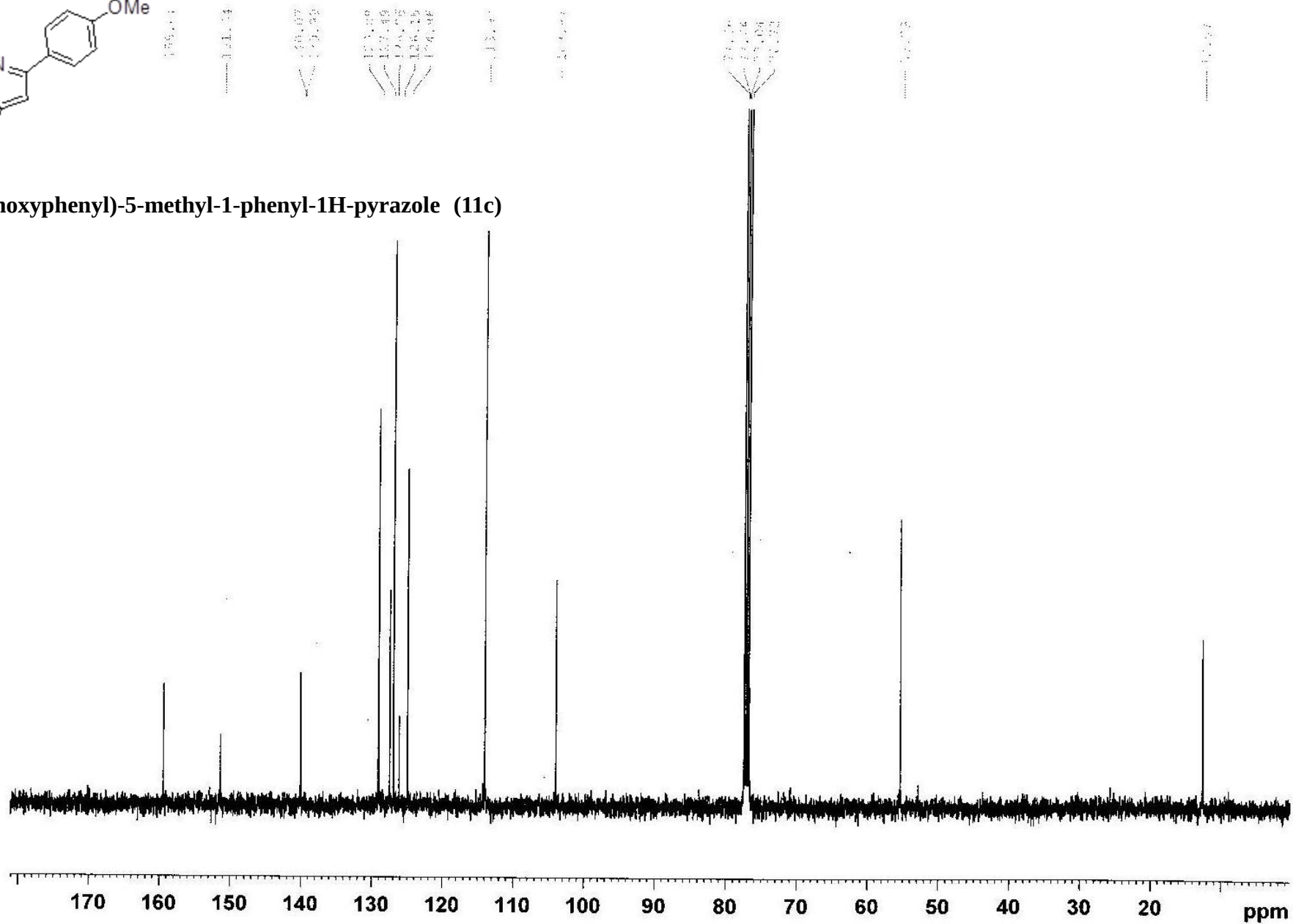


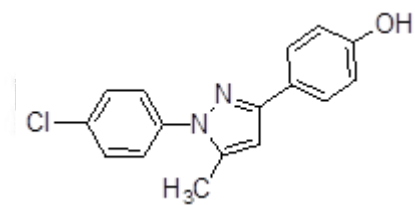
— 3.859

— 2.393



3-(4-methoxyphenyl)-5-methyl-1-phenyl-1H-pyrazole (11c)

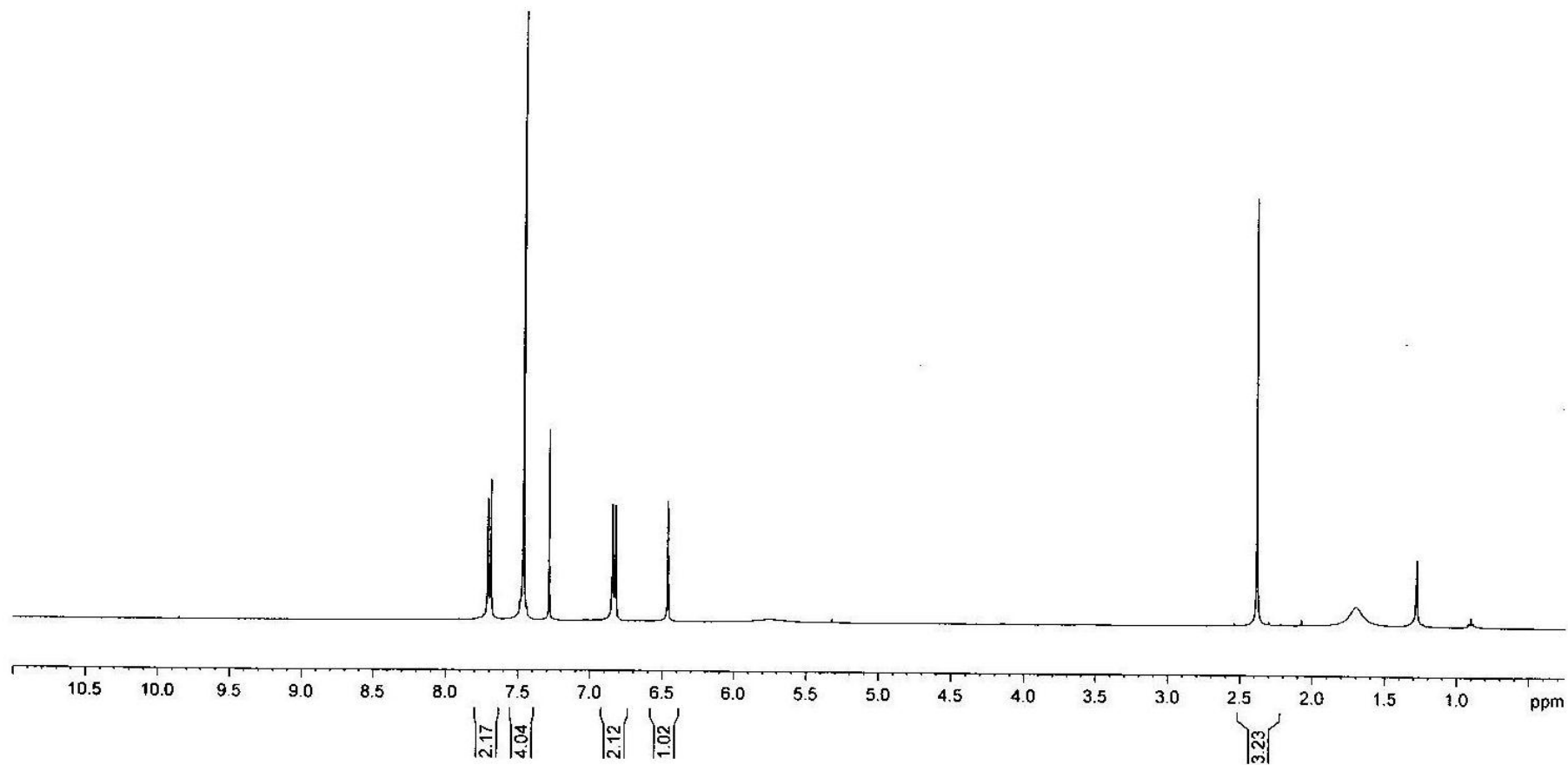


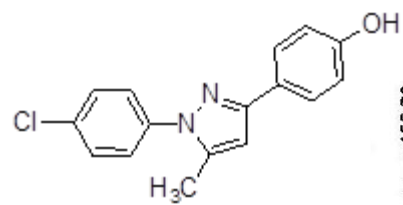


7.708
7.686
7.462
7.281
6.844
6.822
6.462

2.380

4-(1-(4-chlorophenyl)-5-methyl-1H-pyrazol-3-yl)phenol (11d)





— 155.78

— 151.77

— 140.23

— 138.32

— 133.29

— 129.25

— 127.22

— 126.09

— 125.69

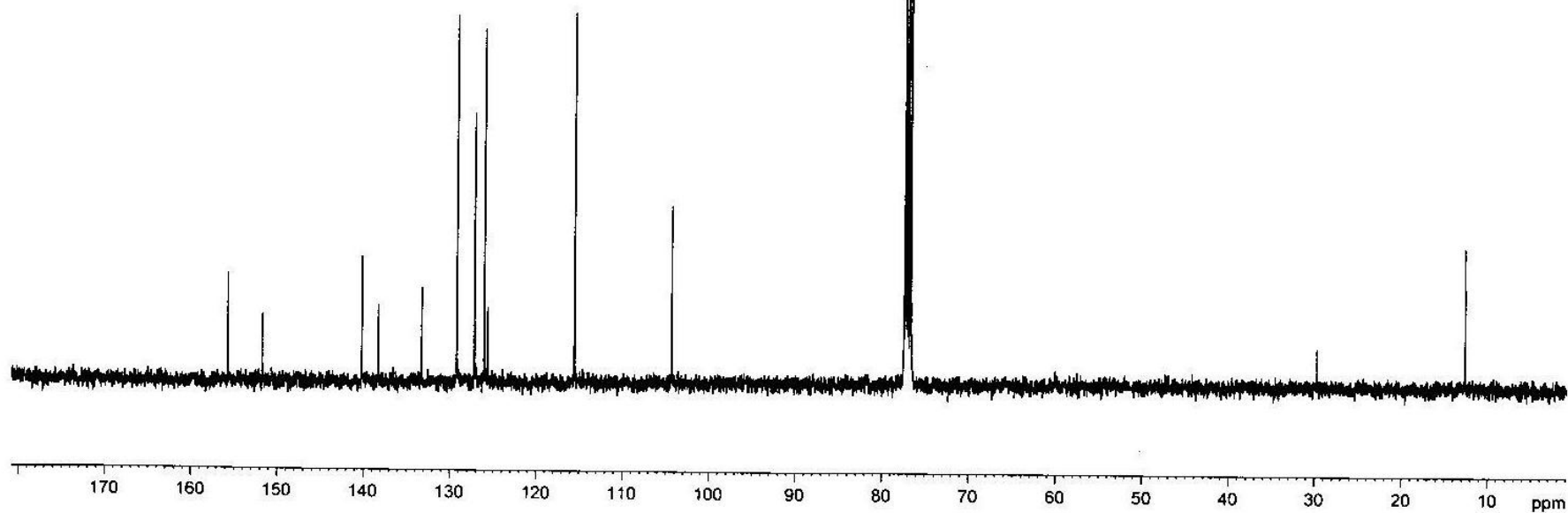
— 115.56

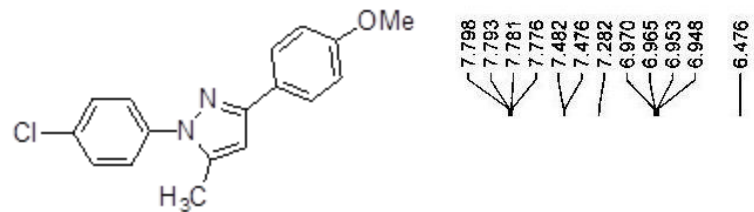
— 104.38

— 77.22

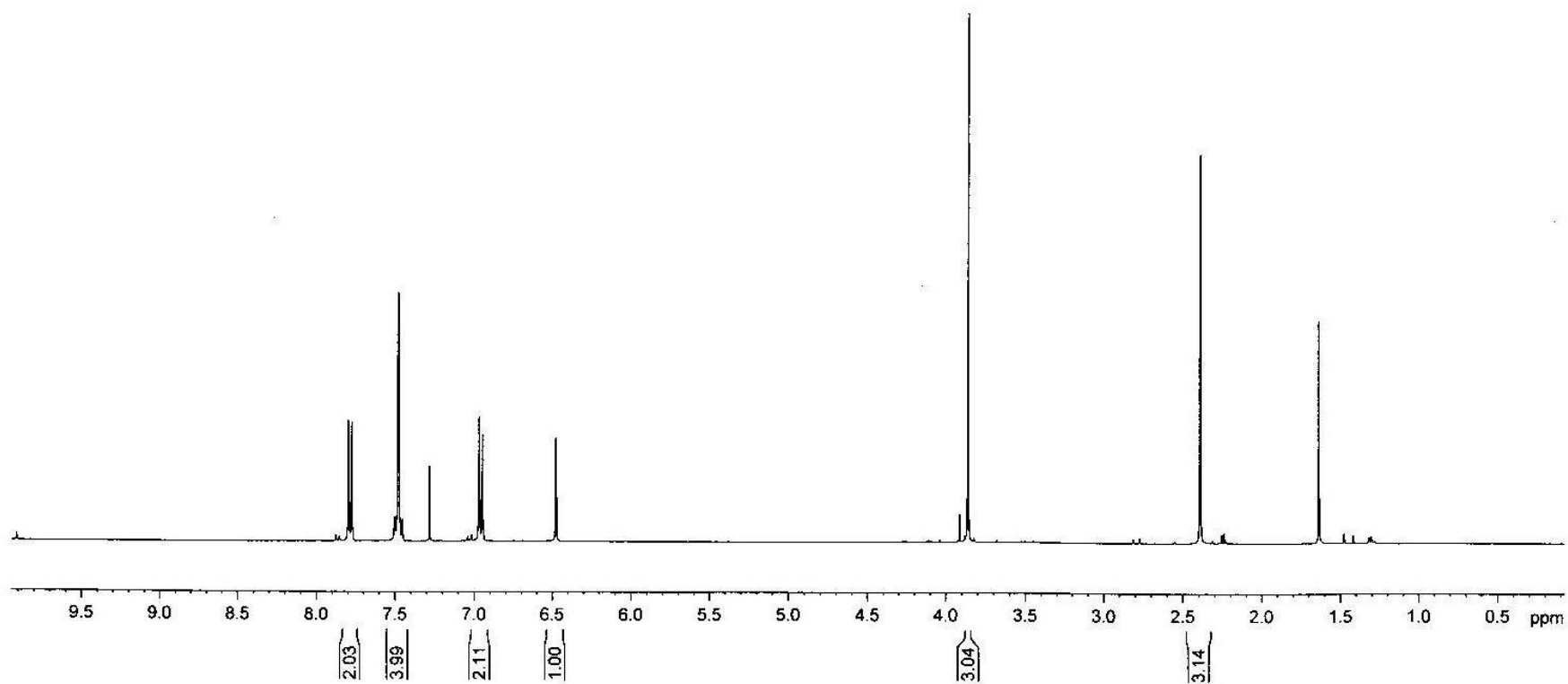
— 12.57

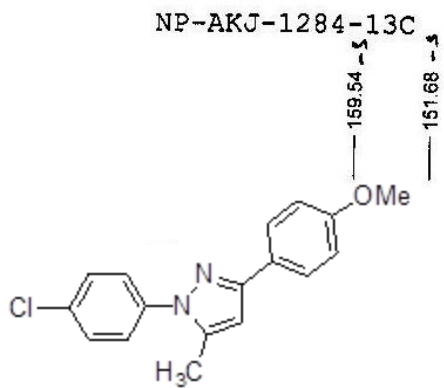
4-(1-(4-chlorophenyl)-5-methyl-1H-pyrazol-3-yl)phenol (11d)





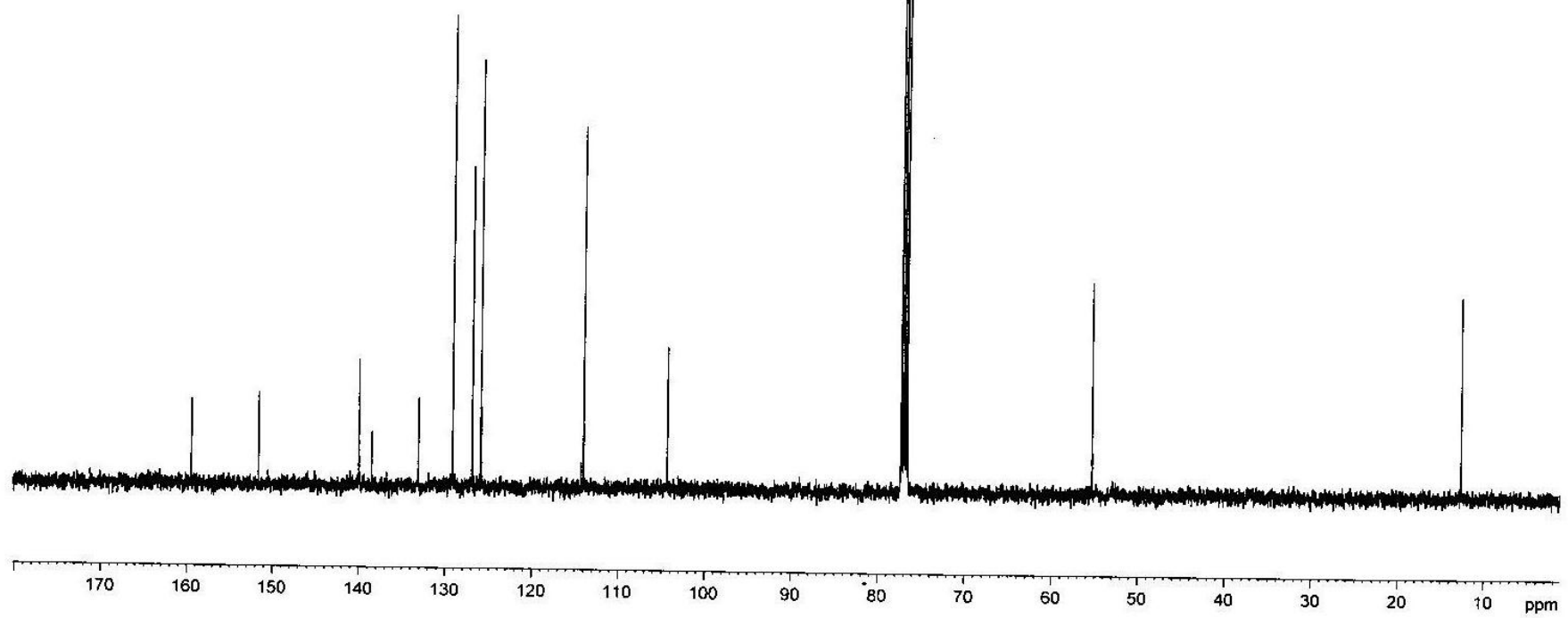
1-(4-chlorophenyl)-3-(4-methoxyphenyl)-5-methyl-1H-pyrazole (11e)

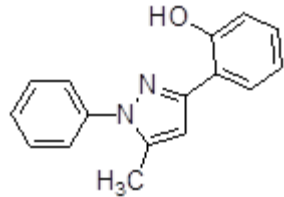




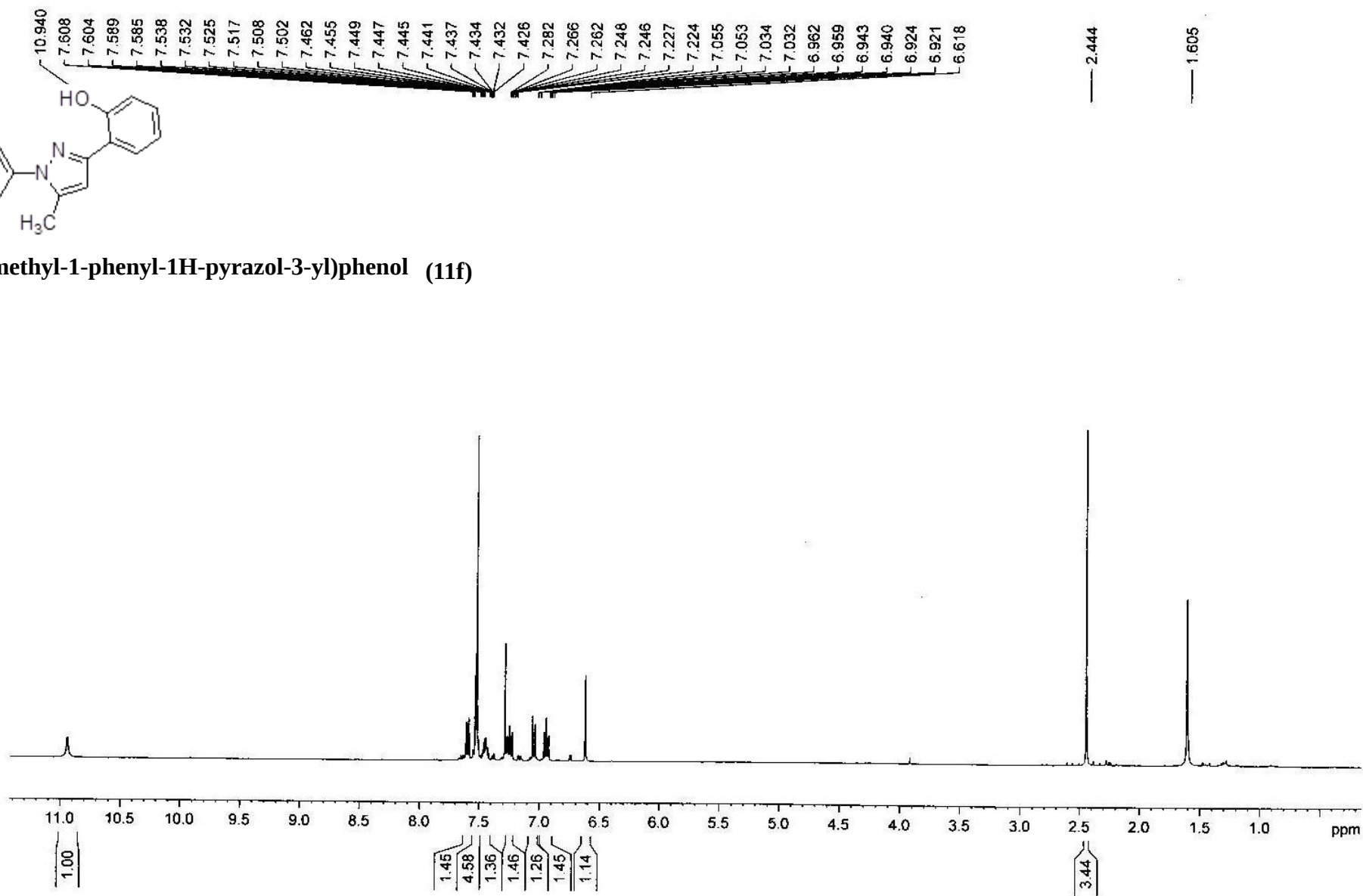
140.06 - s
138.56 - s
159.54 - s
151.68 - s
133.13 s
129.21 - d
126.97 - d
125.97 - d
125.93 s
114.02 - d
104.38 - d
77.32
77.21
77.01
76.69
55.29 - q
12.59 - q

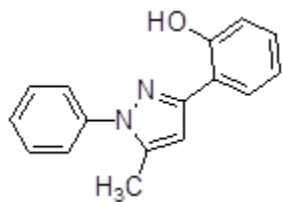
1-(4-chlorophenyl)-3-(4-methoxyphenyl)-5-methyl-1H-pyrazole (11e)





2-(5-methyl-1-phenyl-1H-pyrazol-3-yl)phenol (11f)





156.17

151.67

139.91

139.18

129.25

129.19

127.91

126.36

124.63

119.16

117.08

116.45

103.81

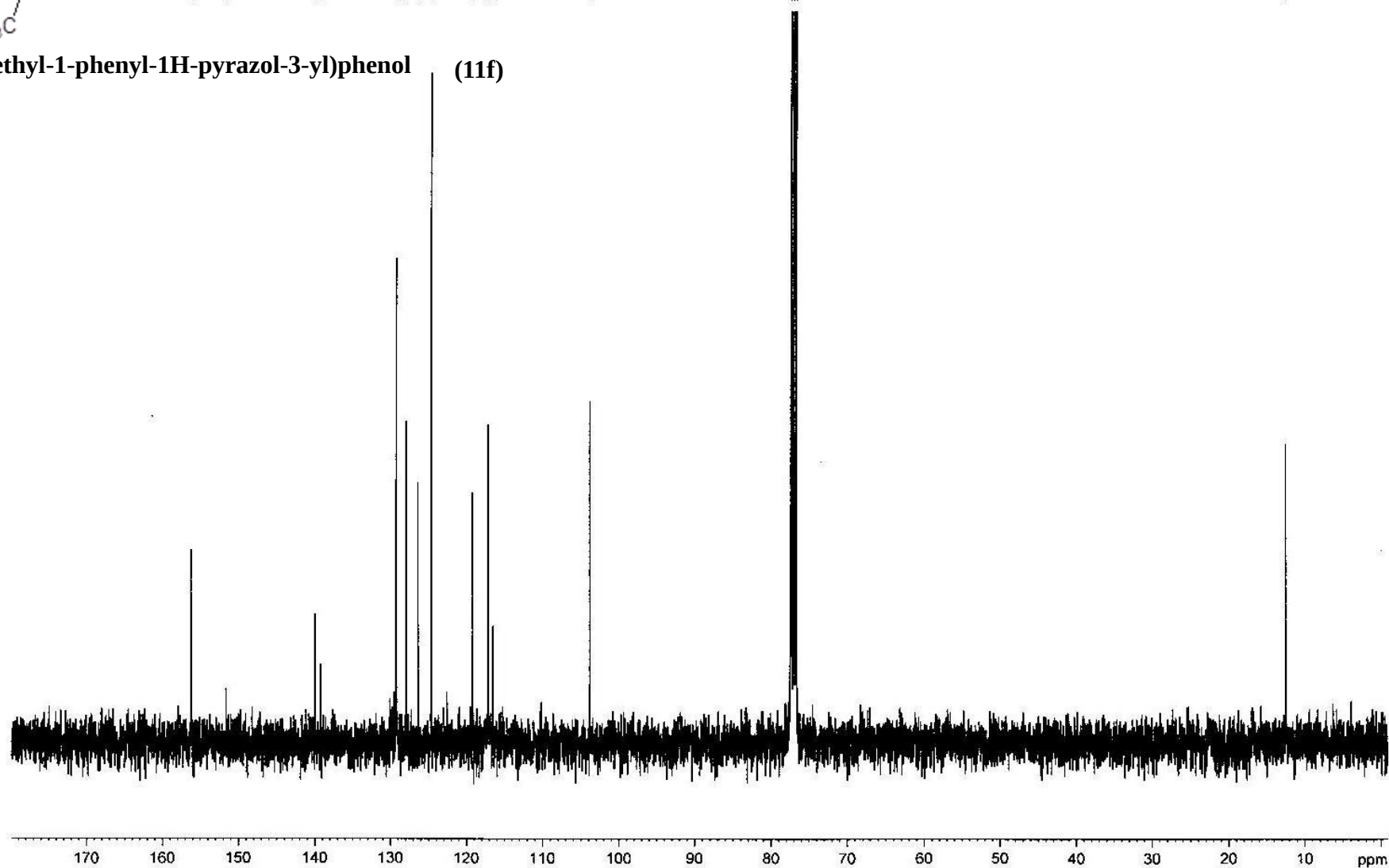
77.32

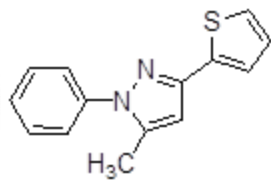
77.00

76.68

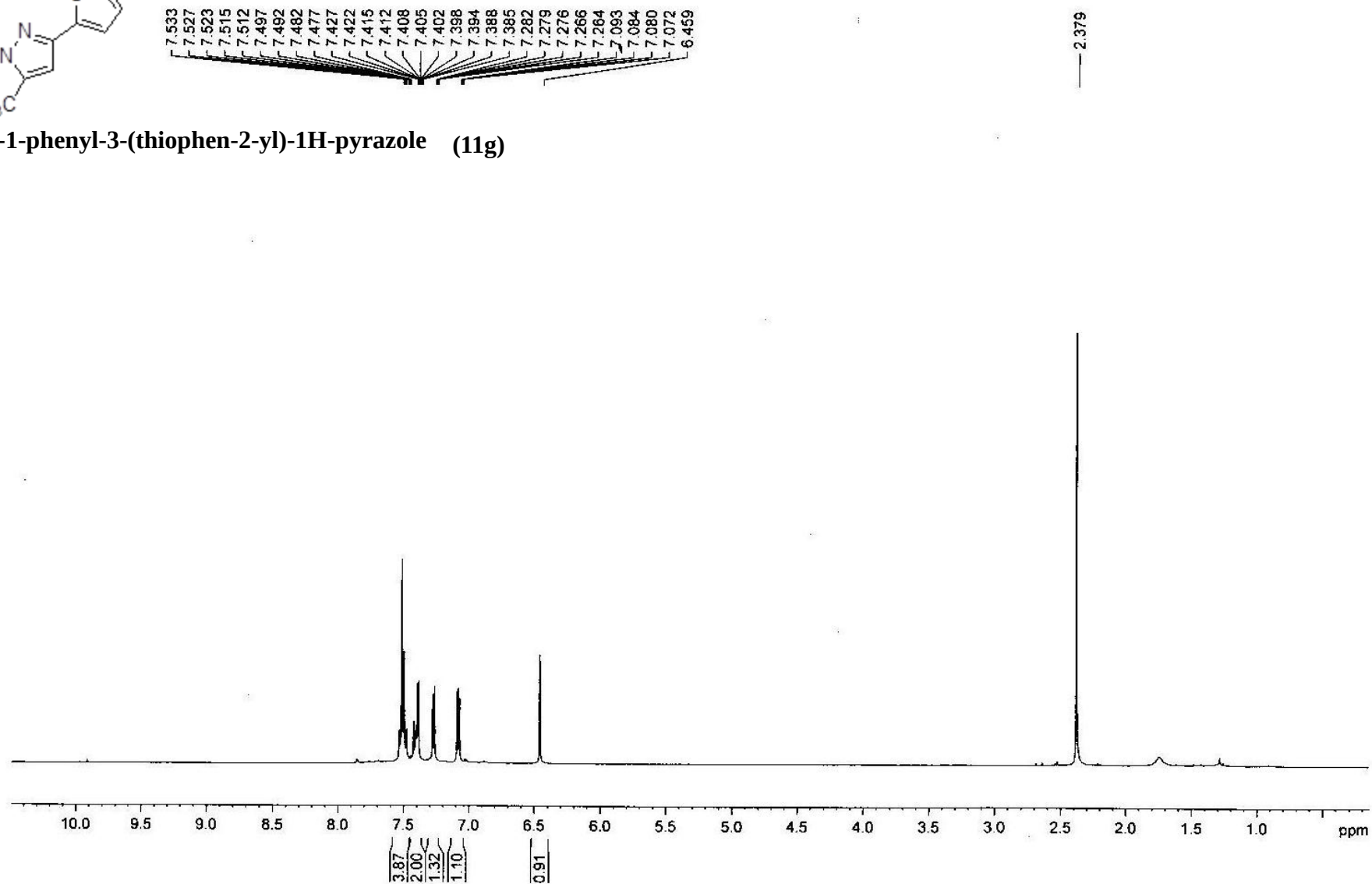
12.41

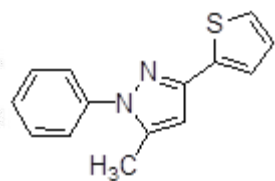
2-(5-methyl-1-phenyl-1H-pyrazol-3-yl)phenol (11f)





5-methyl-1-phenyl-3-(thiophen-2-yl)-1H-pyrazole (11g)





146.85

140.25

139.64

136.64

129.11

127.73

127.40

125.08

124.54

123.81

104.39

77.36

77.04

76.73

12.50

5-methyl-1-phenyl-3-(thiophen-2-yl)-1H-pyrazole (11g)

