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Supporting Information

Graphene Oxide: A Convenient Metal-Free Carbocatalyst for Facilitating Amidation of Esters with Amines

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Characterization of Graphene Oxide (GO):

GO was synthesized from natural graphite powder by following improved hummer's method. [1] Next, synthesized GO was thoroughly characterized by various spectral techniques **(Fig. S1A-S1F)**.

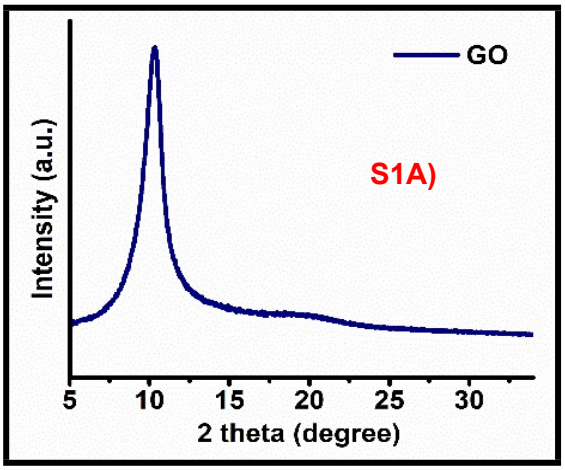


Figure S1A: X-ray diffraction pattern of GO;

The X-ray diffraction (XRD) pattern of GO exhibited a characteristic peak at 9.8° with intercalation distance of 0.90 nm **(Fig. S1A).**[2]

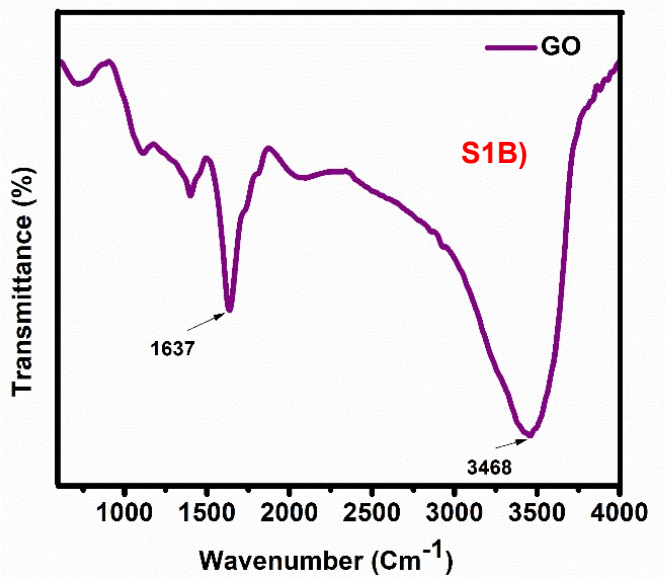


Figure S1B: FTIR spectra of GO;

The Fourier transform infrared spectra of the synthesized GO showed peaks at 3468, 1637, and 1050 cm^{-1} indicating the presence of hydroxy (-OH) carbonyl (-C=O) carboxyl (-COOH) epoxy(-O-) respectively **(Fig. S1B).**[1] In overall, the GO surface contains four different oxygenated functional groups on graphene sheets.

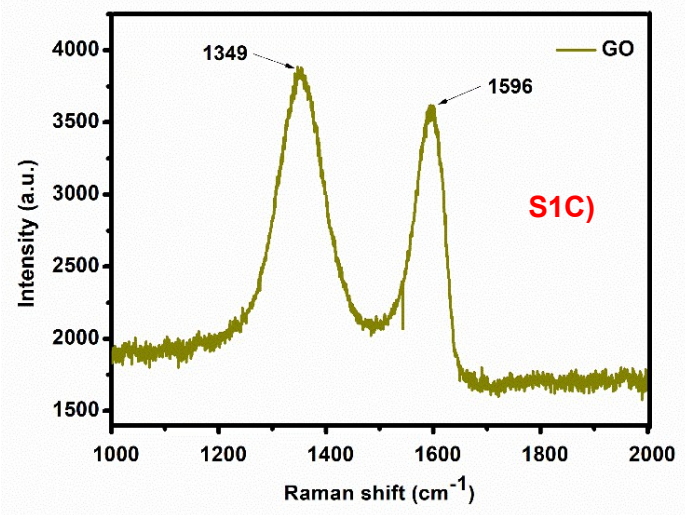


Figure S1C: Raman spectra of GO;

The synthesized GO was further analyzed by Raman analysis (**Fig. S1C)** as it is used to monitor the 2D, G ("graphenic") and D ("defects") bands present in the carbonaceous material. A D-band at 1349.0 cm^{-1} demonstrating defects in the graphene sheet and a G-band at 1596.0 cm^{-1} correspondings to the C–C bond stretching which is common to a sp^2 carbon network. The relative intensity ratio (I_D/I_G) of GO was also calculated. The calculated I_D/I_G value was found to be 1.06, which is due to randomness in the π-network of the graphene sheet. [1]

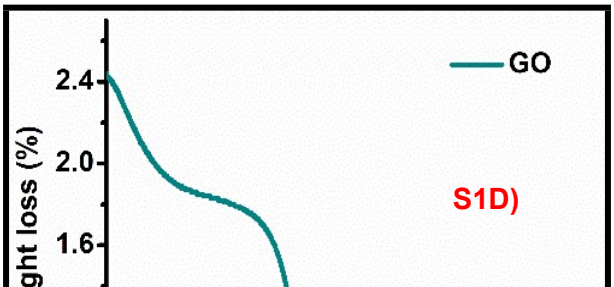


Figure S1D: Thermogravimetric analysis (TGA) of GO;

The thermogravimetric analysis (TGA) is depicted in **Fig S1D** was recorded under a nitrogen atmosphere. The thermogram reveals initial weight loss (~10%) at a temperature around 100°C due to the vaporization of the water molecules. The second weight loss (~85%) in the range of 180-200°C is due to decomposition of different oxygenated functionalities present on GO sheet.[3]

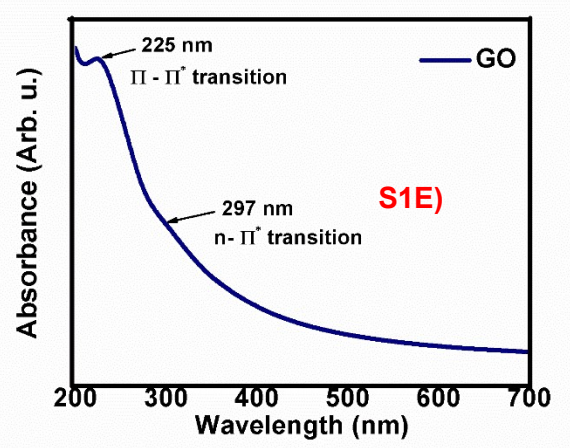


Figure S1E: UV−visible spectra of GO;

The UV-visible spectra of GO display two absorption peaks, a characteristic peak at 225 nm is due to π–π* transitions of aromatic C−C bonds and a peak at 297 nm ascribed to n−π* transitions of carbonyl **(Fig. 1E).** [3]

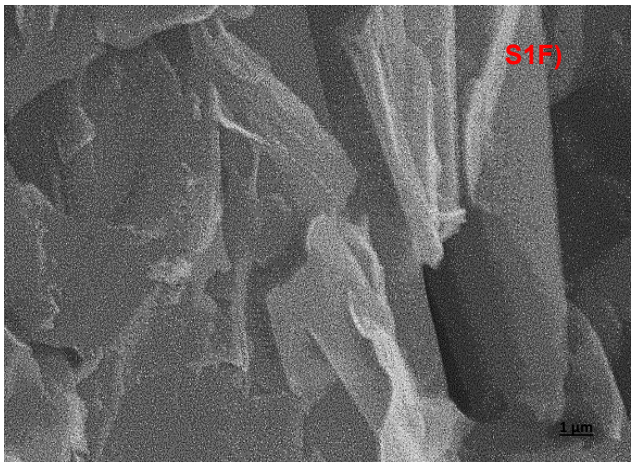


Figure S1F: Scanning electron microscopy (SEM),

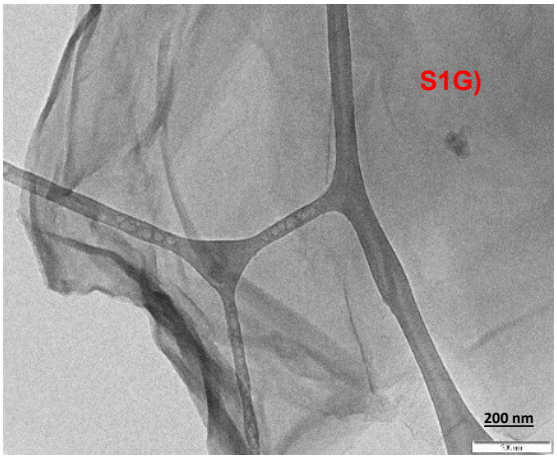


Figure S1G: transmission electron microscopy (TEM)

The Scanning electron microscopy (SEM) analysis showed wrinkled and crumpled structure due to the presence of sp^3 carbon atoms associated with oxygen functionalities and various defects in the basal plane of GO **(Fig. S1F).**[3] The transmission electron microscopy (TEM) analysis showed a layered sheet of GO (**Fig. S1G)**.[4] From the above analysis results, it can be concluded that GO is successfully synthesized from Natural graphite powder.

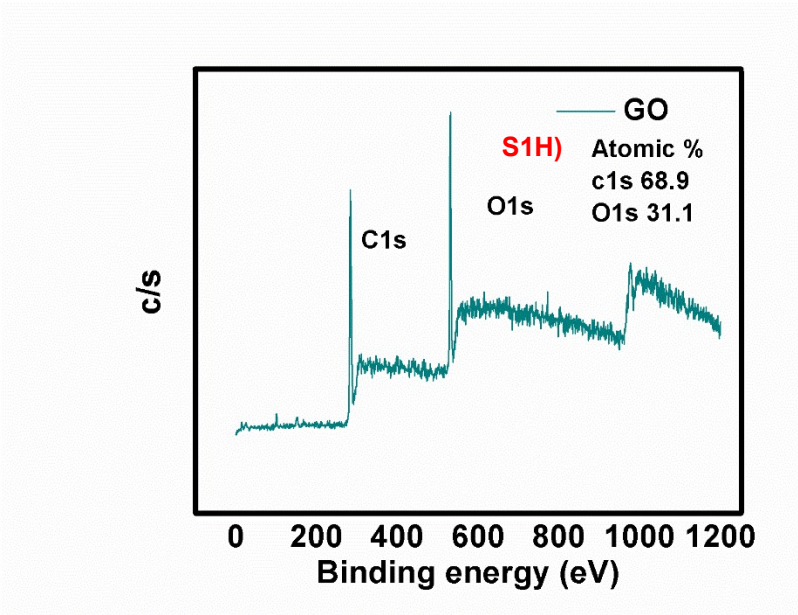


Figure S1H: XPS Survey spectrum of GO;

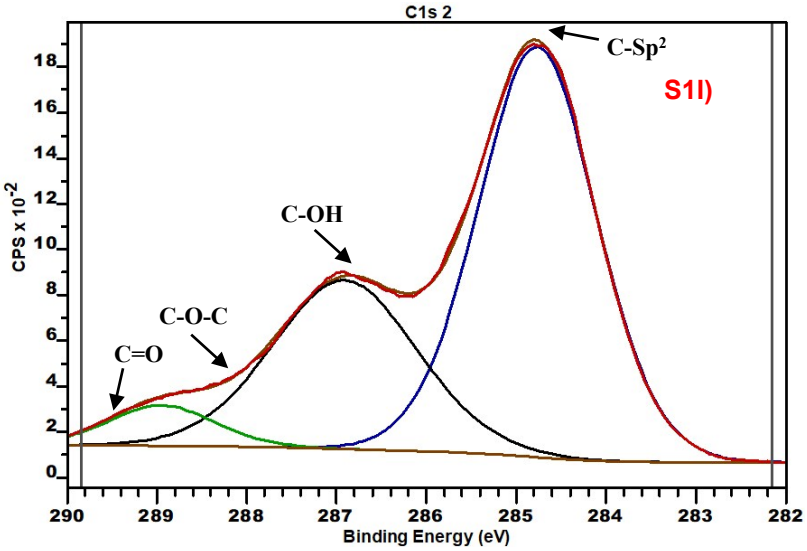


Figure S1I: C1s XPS Spectrum of recovered GO

X-ray photoelectron spectroscopy (XPS) survey spectrum of GO displayed two prominent peaks at 284.6 and 532.2, which corresponds to C1s and O1s respectively confirming the oxidation of graphite to GO **(Fig. S1H).** [5]In C1s core level spectrum of GO peak at 284.6 corresponds to sp^2 hybridized carbon and other components at 286.6, 287.8, and 288.6 eV is due to hydroxyl (C–OH), epoxide (C–O–C) and carboxyl (HO–C=O) groups, respectively**(Fig. S1I).**[3]

Spectral data of the compounds:

1. ***N*-Benzyl benzamide (3a)**:

   White crystals. Yield: 133 mg, 95%. MP: 106-108°C (lit[6] 108-109°C).

   ^{1}H NMR (500 MHz, $CDCl_3$) δ 7.79 (d, J = 7.5 Hz, 2H), 7.50 (t, J = 7.3 Hz, 1H), 7.43 (t, J = 7.6 Hz, 2H), 7.39 – 7.27 (m, 5H), 6.41 (s, 1H), 4.65 (d, J = 5.6 Hz, 2H).

2. **4-Chloro-*N*-benzyl benzamide (3b):**

   White solid. 125 mg, 94%. MP:159-161 °C (lit[7] 161-163 °C).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.76 (d, *J* = 8.8 Hz, 2H), 7.34 – 7.28 (m, 5H), 6.91 (d, *J* = 8.2 Hz, 2H), 6.38 (s, 1H), 4.63 (d, *J* = 5.3 Hz, 2H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 166.90, 162.25, 138.39, 128.78, 127.94, 127.59, 126.63, 113.79, 44.10.

3. **4-Nitro-*N*-benzyl benzamide (3c):**

Off white solid. 115 mg, 95%. MP:140-141 °C (lit[8] 137-138 °C).

1H NMR (500 MHz, CDCl3) δ 8.29 (d, J = 8.8 Hz, 1H), 7.95 (d, J = 8.9 Hz, 2H), 7.62 (d, J = 8.7 Hz, 1H), 7.42 – 7.30 (m, 5H), 6.66 (d, J = 8.7 Hz, 1H), 4.67 (d, J = 5.5 Hz, 2H).

4. **4-Hydroxy-*N*-benzyl benzamide (3d):**

Buff solid. 111 mg, 82%. MP: 152-154°C (lit[7] 157-163 °C).

5. **4-Methoxy-*N*-benzyl benzamide (3e):**

White solid. 115 mg, 87%. MP: 121-122°C (lit[9] 119-121 °C).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.76 (d, *J* = 8.8 Hz, 2H), 7.36 (d, *J* = 4.4 Hz, 4H), 7.30 (dd, *J* = 8.9, 4.5 Hz, 1H), 6.92 (m, 2H), 6.30 (s, 1H), 4.64 (d, *J* = 5.6 Hz, 2H), 3.85 (s, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 164.56, 138.38, 128.80, 128.76, 127.95, 127.61, 126.64, 113.80, 55.43, 44.12.

6. **4-Amino-*N*-benzyl benzamide (3f):**

Buff solid. Yield: 106 mg, 78%. MP: 88-90 °C (lit[10] 89-91°C)

7. **2-Amino-*N*-benzyl benzamide (3g):**

White crystal. Yield: 103 mg, 76%. MP: 122-123 °C (lit[11] 121-123°C)

^{1}H NMR (300 MHz, DMSO) δ 8.87 (t, *J* = 5.6 Hz, 1H), 7.66 (d, *J* = 7.6 Hz, 1H), 7.35 (m, 5H), 7.20 (t, *J* = 7.8 Hz, 1H), 6.80 (d, *J* = 8.1 Hz, 1H), 6.60 (d, *J* = 7.4 Hz, 1H), 6.55 (d, *J* = 6.2 Hz, 2H), 4.52 (d, *J* = 5.9 Hz, 2H).

^{13}C NMR (75 MHz, DMSO) δ 168.93, 149.82, 139.95, 131.78, 128.16, 127.14, 126.62, 116.46, 114.57, 42.23.

8. 2-Hydroxy-*N*-benzyl benzamide (3h):

White crystal. 107 mg, 79%. MP:134-136°C (lit[10] 137 °C).

^{1}H NMR (300 MHz, DMSO) δ 12.53 (s, 1H), 9.36 (t, J = 5.8 Hz, 1H), 7.93 – 7.87 (m, 1H), 7.45 – 7.22 (m, 6H), 6.90 (t, J = 7.4 Hz, 2H), 4.52 (d, J = 6.0 Hz, 2H).

^{13}C NMR (75 MHz, DMSO) δ 168.88, 160.00, 138.93, 133.77, 128.34, 127.73, 127.22, 126.89, 118.63, 117.37, 115.13, 42.29.

9. *N*^{1},*N*^{3},*N*^{5}- tribenzylbenzene-1,3,5-tricarboxamide (3i):

Buff solid. Yield:176 mg, 92%. MP: above 300°C (lit[12] 319°C).

^{1}H NMR (400 MHz, DMSO) δ 9.28 (t, *J* = 5.8 Hz, 3H), 8.51 (s, 3H), 7.34 (d, *J* = 4.4 Hz, 12H), 7.25 (m, 3H), 4.50 (d, *J* = 5.8 Hz, 6H).

^{13}C NMR (100 MHz, DMSO) δ 165.92, 139.85, 135.36, 129.23, 128.77, 127.84, 127.30, 43.30.

10. N-benzyl-2-phenylacetamide (3j):

White crystals. Yield:130 mg, 96%. MP: 124-125 °C (lit[13] 124-125 °C).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.37 – 7.11 (m, 10H), 5.64 (s, 1H), 4.40 (d, *J* = 5.4 Hz, 2H), 3.62 (s, 2H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 170.87, 138.13, 134.77, 129.48, 129.09, 128.68, 127.50, 127.45, 127.44, 43.87, 43.60.

11. N-benzyl-2-(4-methoxyphenyl)acetamide (3k):

White solid. Yield:143 mg, 92%. MP: 134-135 °C (lit[14] 134-135 °C).

12. N-benzyl-2-(o-tolyl)acetamide (3l):

White solid. Yield:130 mg, 97%. MP: 108-110°C (lit[15] 110 °C).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.32 – 7.14 (m, 9H), 5.61 (s, 1H), 4.41 (d, *J* = 5.9 Hz, 2H), 3.65 (s, 2H), 2.28 (s, 3H).

^{13}C NMR (100 MHz, DMSO) δ 165.94, 133.44, 132.50, 128.44, 126.12, 125.81, 123.90, 123.18, 122.67, 121.94, 38.74, 37.15, 14.75.

13. N-benzyl-2-(2-chlorophenyl)acetamide (3m):

White solid. Yield:119 mg, 91%. MP: 120-122 °C

14. N-benzyl-2-(naphthalen-1-yl)acetamide (3n)

White solid. Yield:128 mg, 94%. MP: 156-158 °C

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.03 – 7.97 (m, 1H), 7.88 (dd, *J* = 7.0, 2.3 Hz, 1H), 7.81 (d, *J* = 7.5 Hz, 1H), 7.59 – 7.49 (m, 2H), 7.47 – 7.38 (m, 2H), 7.22 – 7.14 (m, 3H), 7.00 (dd, *J* = 6.8, 2.5 Hz, 2H), 5.62 (s, 1H), 4.35 (d, *J* = 5.9 Hz, 2H), 4.09 (s, 2H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 170.87, 138.05, 134.01, 132.07, 130.99, 128.84, 128.61, 128.51, 128.45, 127.28, 127.25, 126.86, 126.27, 125.66, 123.90, 43.38, 41.92.

15. *N*-benzyl-2-hydroxy-2-phenylacetamide (3o):

Buff solid. Yield: 109 mg, 82%. MP:133-134 °C (lit[7] 134-135[16] °C).

^{1}H NMR (300 MHz, DMSO) δ 8.57 (t, J = 6.1 Hz, 1H), 7.48 – 7.41 (m, 2H), 7.37 – 7.19 (m, 8H), 6.24 (d, J = 4.1 Hz, 1H), 4.98 (d, J = 3.1 Hz, 1H), 4.28 (d, J = 6.1 Hz, 2H).

^{13}C NMR (75 MHz, DMSO) δ 172.21, 141.28, 139.55, 128.11, 127.89, 127.35, 127.07, 126.61, 126.51, 73.53, 41.70.

16. *N*-benzylcinnamamide (3p):

White solid. 151mg, 89%. MP:109-111 °C (lit[17]108-110°C).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.68 (d, *J* = 15.6 Hz, 1H), 7.50 (dd, *J* = 7.3, 2.2 Hz, 2H), 7.38 (m, 8H), 6.40 (d, *J* = 15.6 Hz, 1H), 5.86 (s, 1H), 4.59 (d, *J* = 5.7 Hz, 2H).

17. *N*-(2-(benzylamino)-2-oxoethyl)benzamide (3q):

Buff solid. 137mg, 94%. MP: 158-159°C (lit[18] 158 °C).

^{1}H NMR (400 MHz, DMSO) δ 8.80 (t, *J* = 5.6 Hz, 1H), 8.45 (d, *J* = 5.5 Hz, 1H), 7.92-7,87 (t, 2H), 7.57-7.52 (m, 3H), 7.34-7.22 (m, 5H), 4.31 (d, *J* = 5.9 Hz, 2H), 3.93 (d, *J* = 5.9 Hz, 2H).

^{13}C NMR (100 MHz, DMSO) δ 169.49, 166.96, 139.94, 134.50, 131.78, 128.71, 128.68, 127.86, 127.63, 127.17, 43.22, 42.49.

18. *N*^{1},*N*^{4}-dibenzylsuccinamide (3r):

White solid. Yield: 182mg, 93%. MP: 210-212 °C (lit[6] 212-212.5 °C).

^{1}H NMR (300 MHz, DMSO) δ 8.38 (t, *J* = 5.8 Hz, 2H), 7.31-7.22 (m, 11H), 4.27 (d, *J* = 5.9 Hz, 4H), 2.43 (s, 4H).

^{13}C NMR (75 MHz, DMSO) δ 171.32, 139.58, 128.19, 127.10, 126.62, 41.98, 30.71.

19. *N*-benzyl-2-(2-formylphenoxy)acetamide (3s):

Buff solid. Yield: 170mg, 76%. MP: 69°C

^{1}H NMR (300 MHz, $CDCl_3$) δ 10.13 (s, 1H), 7.97 (s, 1H), 7.76 (dd, J = 7.5, 1.3 Hz, 1H), 7.60 (dd, J = 11.4, 4.3 Hz, 1H), 7.18 (t, J = 7.5 Hz, 2H), 6.94 (d, J = 8.3 Hz, 1H), 4.64 (s, 2H), 4.60 (d, J = 6.0 Hz, 2H).

^{13}C NMR (75 MHz, $CDCl_3$) δ 190.13, 167.43, 157.84, 137.86, 136.11, 134.03, 128.72, 127.65, 125.03, 122.05, 113.13, 67.66, 43.10.

20. *N*-(4-Methoxybenzyl) acetamide (3t):

White crystals. Yield: 227 mg, 95%. MP: 96-98°C (lit[12] 95°C).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.19 (d, *J* = 8.3 Hz, 2H), 6.85 (d, *J* = 8.2 Hz, 2H), 5.66 (s, 1H), 4.35 (d, *J* = 5.2 Hz, 2H), 3.78 (s, 3H), 1.99 (s, 3H).

21. *N*-Benzylformamide (3u):

White crystals. Yield:196 mg, 96%. MP: 62-63°C (lit[6] 61-63 °C).

1H NMR (500 MHz, cdcl3) δ 8.22 (s, 1H), 7.36-7.21 (m, 5H), 5.87 (s, 1H), 4.45 (d, J = 5.8 Hz, 2H).

22. *N*-benzylbutyramide (3v):

Off white solid. Yield: 155 mg, 98%. MP: 49-51°C (lit[19] 47-48°C).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.36 – 7.25 (m, 5H), 5.82 (s, 1H), 4.43 (d, *J* = 5.7 Hz, 2H), 2.19 (t, *J* = 7.5 Hz, 2H), 1.72 – 1.67 (m, 2H), 0.95 (t, *J* = 7.4 Hz, 3H).

^{13}C NMR (100 MHz, DMSO) δ 168.10, 133.69, 123.96, 123.08, 122.75, 38.82, 33.95, 14.44, 9.06.

23. *N*-benzylisobutyramide (3w):

White crystal. Yield: 159 mg, 96%. MP: 85-86 °C (lit[20] 84-86°C).

24. *N*-benzyl-2,2,2-trifluoroacetamide (3x):

White crystals. Yield: 150 mg, 95%. MP: 96-98°C (lit[10] 95°C).

^{1}H NMR (400 MHz, DMSO) δ 10.03 (s, 1H), 7.38 (m, 5H), 4.39 (d, *J* = 6.0 Hz, 2H).

^{13}C NMR (100 MHz, DMSO) δ 156.66, 137.94, 129.30, 128.99, 127.82, 117.93, 43.02.

25. *N*-(2-Methoxybenzyl) benzamide (5a):

White crystals. Yield:137mg, 94%. MP: 78-80 °C (lit[21] 77°C).

26. *N*-(4-Methoxybenzyl) benzamide (5b):

White crystals. Yield: 171mg, 95%. MP: 94-95°C (lit[22] 94-96°C).

27. *N*-(4-Methylbenzyl) benzamide (5c):

White solid. Yield: 182mg, 94%. MP: 136-137 °C (lit[22] 138-140°C).

28. *N*-(4-Tertbutylbenzyl) benzamide (5d):

White solid. Yield: 191mg, 93%. MP:108-110 °C (lit[23] 105-106 °C).

29. *N*-(4-Fluorobenzyl) benzamide (5e):

White crystals. Yield: 188mg, 81%. MP: 113-115°C (lit[23] 114-116 °C).

30. (S)-N-(1-Phenylethyl) benzamide (5f):

White crystals. Yield: 189 mg, 79%. MP: 116-118°C (lit[23] 116°C).

^{1}H NMR (500 MHz, $CDCl_3$) δ 7.78 (d, *J* = 7.3 Hz, 2H), 7.50 (t, *J* = 7.4 Hz, 1H), 7.46 – 7.35 (m, 6H), 7.29 (t, *J* = 7.1 Hz, 1H), 6.31 (s, 1H), 5.35 (p, *J* = 7.1 Hz, 1H), 1.62 (d, *J* = 6.9 Hz, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 166.61, 143.15, 134.60, 131.48, 128.66, 127.47, 126.95, 126.28, 49.22, 21.73.

31. *N*-Octylbenzamide (5g):

White crystals. 114mg, 95%. MP: 40-42 °C (lit[24]39-41 °C).

^{1}H NMR (500 MHz, CDCl3) δ 7.76 – 7.73 (m, 2H), 7.49 – 7.45 (m, 1H), 7.43 – 7.38 (m, 2H), 6.16 (s, 1H), 3.43 (td, J = 7.2, 5.8 Hz, 2H), 1.60 (dt, J = 14.9, 7.4 Hz, 2H), 1.39 – 1.28 (m, 6H), 1.28 – 1.21 (m, 4H), 0.87 (t, J = 7.0 Hz, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 167.61, 134.88, 131.24, 128.47, 126.91, 40.15, 31.80, 29.68, 29.31, 29.23, 27.04, 22.64, 14.09.

32. *N*-Butylbenzamide (5h):

Yellow liquid.129 mg, 91%. MP:38-39 °C (lit[10]39 °C).

33. N-(tert-butyl)benzamide (5i):

White crystals. Yield: 176mg, 67%. MP: 101-103°C (lit[10] 102 °C).

^{1}H NMR (300 MHz, DMSO) δ 7.87 (d, J = 7.7 Hz, 2H), 7.31 (d, J = 7.0 Hz, 3H), 1.25 (s, 9H).

^{13}C NMR (75 MHz, DMSO) δ 169.24, 129.27, 128.91, 127.30, 49.97, 27.81.

34. *N*-(2-hydroxyethyl)benzamide (5j):

White solid. Yield: 125mg, 88%. MP: 60-61°C (lit[25] 60-62 °C).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.75 (d, *J* = 6.3 Hz, 2H), 7.46 (d, *J* = 3.8 Hz, 1H), 7.39 (d, *J* = 6.9 Hz, 2H), 6.80 (s, 1H), 3.79 (s, 2H), 3.59 (s, 2H), 3.06 (s, 1H).

35. *N*-Cyclohexylbenzamide (5k):

White solid. Yield: 152 mg, 89%. MP: 151-153°C (lit[26] 153-155 °C).

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.75 (d, *J* = 7.3 Hz, 2H), 7.48 (d, *J* = 6.7 Hz, 1H), 7.47 – 7.37 (m, 2H), 5.95 (s, 1H), 3.98 (s, 1H), 2.03 – 2.06 (m, 2H), 1.80 – 1.69 (m, 2H), 1.39 – 1.45 (m, 2H), 1.31 – 1.15 (m, 4H).

^{13}C NMR (100 MHz, DMSO) δ 161.88, 130.39, 126.50, 123.78, 122.07, 43.92, 28.52, 20.85, 20.17.

36. N-cyclopropylbenzamide (5l):

White solid. Yield: 135 mg, 79%. MP: 93-95 °C (lit[27] 92-94 °C).

^{1}H NMR (400 MHz, DMSO) δ 8.18 (s, 1H), 7.58 (s, 2H), 7.27-7.21 (d, 3H), 2.61 (s, 1H), 0.46 (s, 2H), 0.34 (s, 2H).

37. *N*-(4-Nitrobenzyl) formamide (5m):

White solid. Yield: 276 mg, 72%. MP: 122-123 °C.

^{1}H NMR (400 MHz, DMSO) δ 8.63 (s, 1H), 8.16 (s, 1H), 8.08 (d, J = 6.2 Hz, 2H), 7.73 – 7.58 (m, 2H), 4.40 (d, J = 6.1 Hz, 2H).

38. *N*-(4-Cyanobenzyl) formamide (5n):

White crystals. Yield: 256 mg, 76%. MP: 126-127°C (lit[12] 127°C).

^{1}H NMR (500 MHz, $CDCl_3$) δ 8.32 (s, 1H), 7.62 (d, J = 6.7 Hz, 2H), 7.39 (d, J = 8.0 Hz, 2H), 5.98 (s, 1H), 4.54 (d, J = 6.3 Hz, 2H).

39. Morpholino(phenyl)methanethione (5o):

Buff solid. Yield: 184 mg, 69%. MP: 73-75°C (lit[28] 73-74.2 °C).

40. 2-phenyl-1-(pyrrolidin-1-yl)ethan-1-one (5p):

Yellow oil. Yield: 145 mg, 79%. MP: 45-47 °C (lit[29]47-48°C).

^{1}H NMR (400 MHz, CDCl3) δ 7.28 (dq, J = 8.5, 7.2 Hz, 5H), 3.66 (s, 2H), 3.47 – 3.40, 4H), 1.92 (m, 2H), 1.83 (m, 2H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 169.68, 134.89, 128.97, 128.60, 126.72, 46.92, 45.98, 42.27, 26.14, 24.35.

41. 4-(2-hydroxyethyl)piperazin-1-yl)(phenyl)methanone (5q):

Yellow oil. Yield: 205 mg, 76%.

^{1}H NMR (300 MHz, DMSO) δ 7.40 (ddd, J = 9.7, 7.0, 3.2 Hz, 5H), 3.42 – 3.20 (m, 4H), 2.57 – 2.28 (m, 8H).

^{13}C NMR (75 MHz, DMSO) δ 168.87, 135.89, 129.42, 128.37, 126.81, 59.95, 58.35, 53.62.

42. piperazine-1,4-diylbis(phenylmethanone (5r):

Buff solid. Yield: 422 mg, 81%.

^{1}H NMR (300 MHz, DMSO) δ 7.90-7.43 (m, 10H), 3.50 (s, 8H).

^{13}C NMR (75 MHz, DMSO) δ 169.23, 135.53, 129.65, 128.42, 126.98, 47.11, 41.52.

43. *N*-benzyl-N-methyl-2-phenylacetamide (5s):

Yellow oil. Yield: 167 mg, 87%.

^{1}H NMR[30] (400 MHz, $CDCl_3$, mixture of rotamers in a ratio of 3†:2‡) δ 7.42-7.22‡† (m, 9H, ArH), 7.10† (d, J = 7.3 Hz, 1.2H, ArH), 7.08‡ (d, J = 7.3 Hz, 0.8H, ArH), 4.61† (s,

1.14H, CH_2), 4.52‡ (s, 0.9H, CH_2), 3.78† (s, 1.2H, CH_2), 3.75‡ (s, 0.8H, CH_2), 2.95‡ (s, 1.19H, CH_3), 2.90† (s, 1.74H, CH_3)

^{13}C NMR (100 MHz, CDCl3, mixture of rotamers in a ratio of 3:2) δ 171.52, 171.17, 137.31, 136.50, 135.11, 134.97, 128.94, 128.85, 128.80, 128.73 128.70, 128.59, 128.08, 127.67, 127.37, 126.86, 126.81, 126.40, 53.68, 50.99, 41.24, 40.89, 35.24, 34.05.

44. *N*,*N*-Dibenzylformamide (5t)

Pale yellow solid. Yield: 167 mg, 84%. MP: 51-52 °C (lit[13] 50-53 °C).

^{1}H NMR (400 MHz, CDCl3) δ 7.50 (d, J = 4.5 Hz, 1H), 7.39 – 7.28 (m, 8H), 7.15 (s, 1H), 4.70 (s, 2H), 4.40 (s, 2H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 172.29, 136.17, 129.68, 128.74, 128.51, 128.51, 127.67, 127.06, 126.90, 51.55, 46.85.

45. *N*-Phenylbenzamide (5u):

White crystals. Yield: 185 mg, 71%. MP: 164-166°C (lit[10] 162-164 °C).

^{1}H NMR (500 MHz, $CDCl_3$) δ 7.91 – 7.86 (m, 2H), 7.84 (s, 1H), 7.65 (d, *J* = 7.7 Hz, 2H), 7.56 (t, *J* = 7.4 Hz, 1H), 7.50 (t, *J* = 7.4 Hz, 2H), 7.38 (t, *J* = 8.0 Hz, 2H), 7.16 (t, *J* = 7.4 Hz, 1H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 165.77, 137.93, 135.02, 131.87, 129.12, 128.81, 127.03, 124.60, 120.22.

46. *N*-Phenylacetamide (5v):

White crystals. Yield:201 mg, 76%. MP: 113-114 °C (lit[6] 112-113 °C).

^{1}H NMR (500 MHz, DMSO) δ 9.90 (s, 1H), 7.56 (d, *J* = 7.6 Hz, 2H), 7.30 – 7.24 (m, 2H), 7.01 (t, *J* = 7.4 Hz, 1H), 2.03 (s, 3H).

^{13}C NMR (100 MHz, DMSO) δ 167.96, 153.56, 131.49, 121.25, 115.44, 24.20.

47. *N*-(4-Hydroxyphenyl) acetamide (5w):

White crystals. Yield:392 mg, 72%. MP: 169-170 °C (lit[14] 169-170 °C).

48. *N*,*N*-Diphenylformamide (5x):

Buff solid. Yield: 63 mg, 52%. MP:70-72 °C (lit[10] 71-73°C).

^{1}H NMR (300 MHz, $CDCl_3$) δ 8.67 (s, 1H), 7.40 (ddd, *J* = 7.3, 6.1, 3.1 Hz, 4H), 7.35 – 7.24 (m, 4H), 7.18 (s, 2H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 161.67, 142.03, 139.63, 129.65, 129.13, 127.00, 126.81, 126.07, 125.07.

49. *N*-benzylpicolinamide(7a):

Buff solid. Yield: 167 mg, 91%. MP: 87-88°C (lit[13] 87-90 °C).

50. *N*-benzylnicotinamide (7b):

Buff solid. Yield: 163 mg, 92%. MP: 71-73°C (lit[31] 70-72°C).

^{1}H NMR (400 MHz, DMSO) δ 9.27 (t, *J* = 5.5 Hz, 1H), 9.06 (d, *J* = 1.4 Hz, 1H), 8.72 (d, *J* = 4.7 Hz, 1H), 8.24 (m, 1H), 7.52 (dd, *J* = 7.9, 4.8 Hz, 1H), 7.34 (d, *J* = 4.4 Hz, 4H), 7.26 (dd, *J* = 8.7, 4.5 Hz, 1H), 4.52 (d, *J* = 6.0 Hz, 2H).

^{13}C NMR (100 MHz, DMSO) δ 165.29, 152.39, 148.89, 139.75, 135.49, 130.26, 128.81, 127.74, 127.32, 123.97, 43.10.

51. *N*-isobutylpiconamide (7c):

White solid. Yield: 187 mg, 72%. MP: 52-54°C (lit[32] 54.5-55.5 °C).

^{1}H NMR (400 MHz, CDCl3) δ 8.54 (d, J = 4.7 Hz, 1H), 8.20 (d, J = 7.8 Hz, 1H), 7.84 (td, J = 7.7, 1.7 Hz, 2H), 7.41 (ddd, J = 7.5, 4.8, 1.1 Hz, 1H), 4.15 – 4.05 (m, 1H), 1.61 (p, J = 7.3 Hz, 2H), 1.25 (d, J = 6.6 Hz, 3H), 0.97 (t, J = 7.4 Hz, 3H).

^{13}C NMR (100 MHz, $CDCl_3$) δ 163.60, 150.21, 147.95, 137.33, 125.98, 122.22, 46.66, 29.80, 20.51.

52. N-benzylfuran-2-carboxamide (7d):

Buff solid. Yield: 154 mg, 91%. MP: 108-109°C (lit[31] 108-110°C).

^{1}H NMR (300 MHz, $CDCl_3$) δ 7.42 – 7.35 (m, 5H), 7.29 (dd, J = 11.2, 6.1 Hz, 2H), 7.15 (d, J = 3.2 Hz, 1H), 6.53 – 6.48 (m, 1H), 4.62 (d, J = 5.9 Hz, 2H).

^{13}C NMR (75 MHz, $CDCl_3$) δ 158.26, 147.90, 143.88, 137.99, 129.39, 128.34, 127.64, 114.43, 112.19, 43.18.

53. pyrrolidin-2-one (9):

Colorless liquid. Yield:154 mg, 76%.

^{1}H NMR (300 MHz, CDCl3) δ 7.65 (s, 1H), 3.41 (d, J = 5.9 Hz, 2H), 2.30 (dd, J = 7.3, 6.4 Hz, 2H), 2.24 – 2.03 (m, 2H).

^{13}C NMR (75 MHz, $CDCl_3$) δ 179.77, 42.49, 30.32, 20.72.

54. Tert-butyl (S)-(1-(benzylamino)-1-oxopropan-2-yl)carbamate (11)

White solid. Yield: 175mg, 84%. MP: 129-130°C.

^{1}H NMR (400 MHz, DMSO) δ 8.37 (s, 1H), 7.26 – 7.22 (m, 5H), 6.95 (d, J = 7.2 Hz, 1H), 4.25 (d, J = 5.8 Hz, 2H), 4.19 – 4.13 (m, 1H), 1.28 (s, 9H), 1.19 (d, J = 6.2 Hz, 3H).

55. Tert-butyl (S)-(1-(benzylamino)-1-oxo-3-phenylpropan-2-yl)carbamate (13)

White solid. Yield: 179 mg, 79%. MP 136–139 °C (lit[13] 134–135 °C).

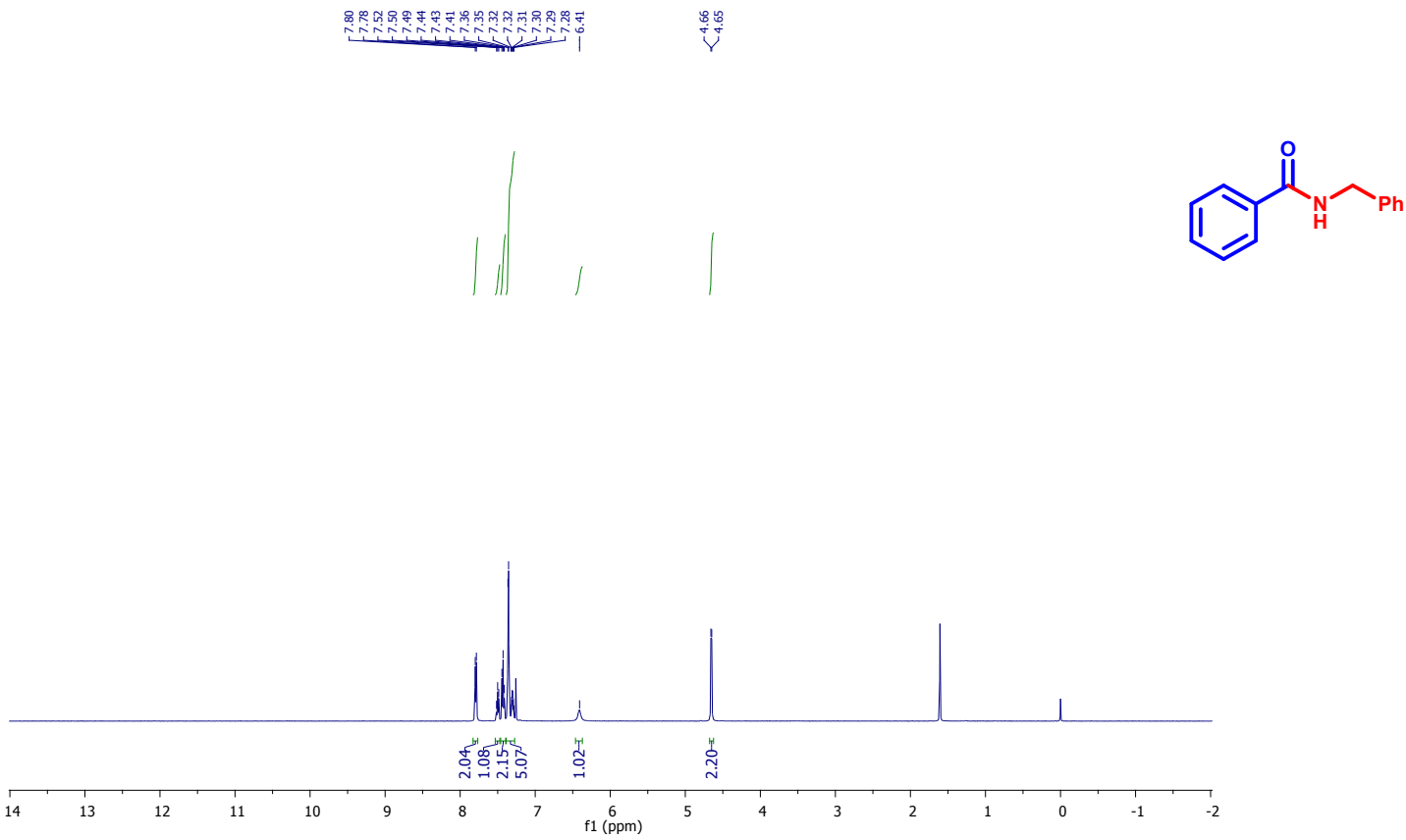
^{1}H NMR (400 MHz, DMSO) δ 8.42 (d, J = 6.0 Hz, 1H), 7.30- 7.18 (m, 10H), 6.98 (d, J = 5.8 Hz, 1H), 4.28 (d, J = 5.6 Hz, 2H), 4.20-4.16 (m, 1H), 3.99 (t, J = 7.0 Hz, 1H), 3.82 (s, 1H), 1.31 (s, 9H).

56. Tert-butyl 2-(benzylcarbamoyl)pyrrolidine-1-carboxylate (15)

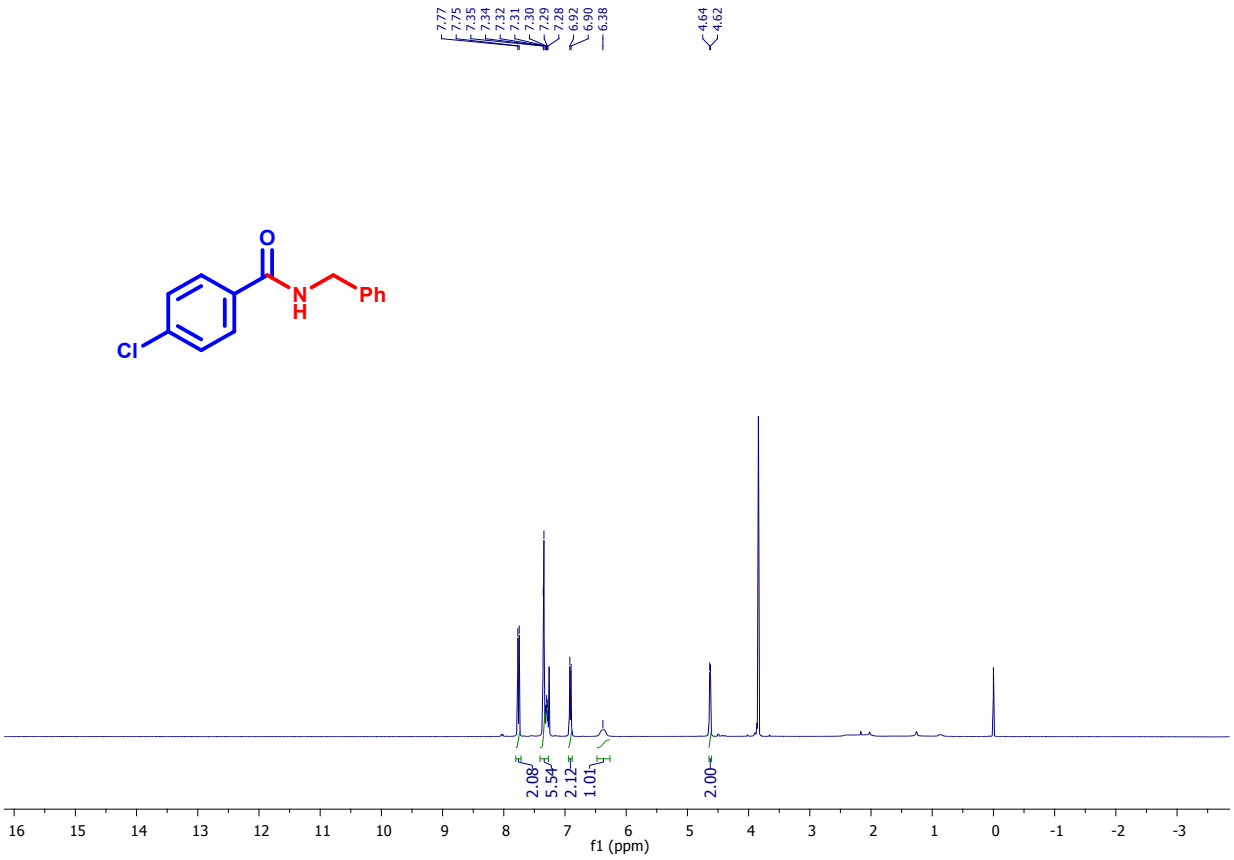
White solid. Yield: 189 mg, 91%. MP: 130–131 °C (lit[13] 129–131 °C).

^{1}H NMR (400 MHz, DMSO) δ 8.33 (d, J = 4.9 Hz, 1H), 7.33 – 7.14 (m, 5H), 4.34 – 4.26 (m, 1H), 4.12 (d, J = 5.1 Hz, 2H), 3.30- 3.26 (m, 2H), 2.31 – 1.93 (m, 2H), 1.78- 1.74 (m, 2H), 1.39 (s, 3H), 1.25 (s, 6H).

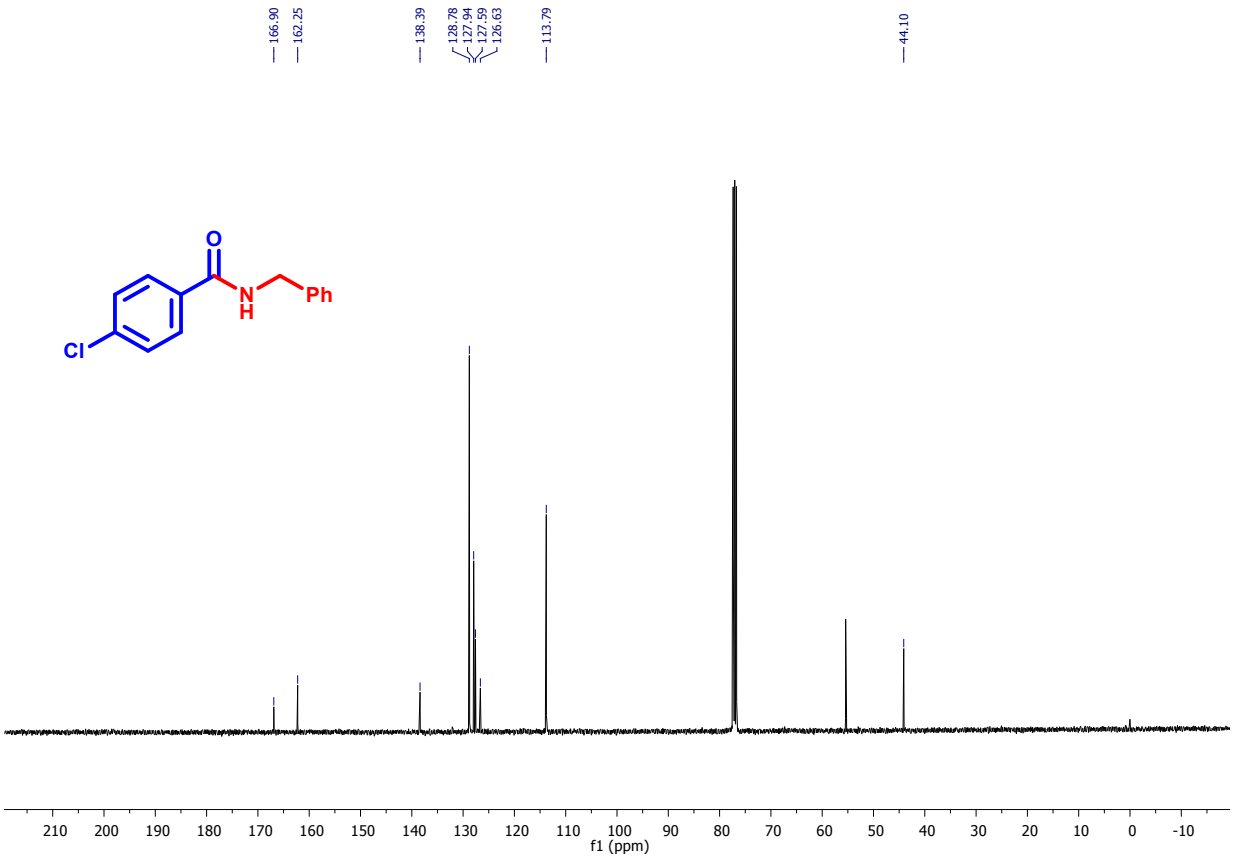
Copies of ^{1}H, ^{13}C NMR and GC-MS spectra



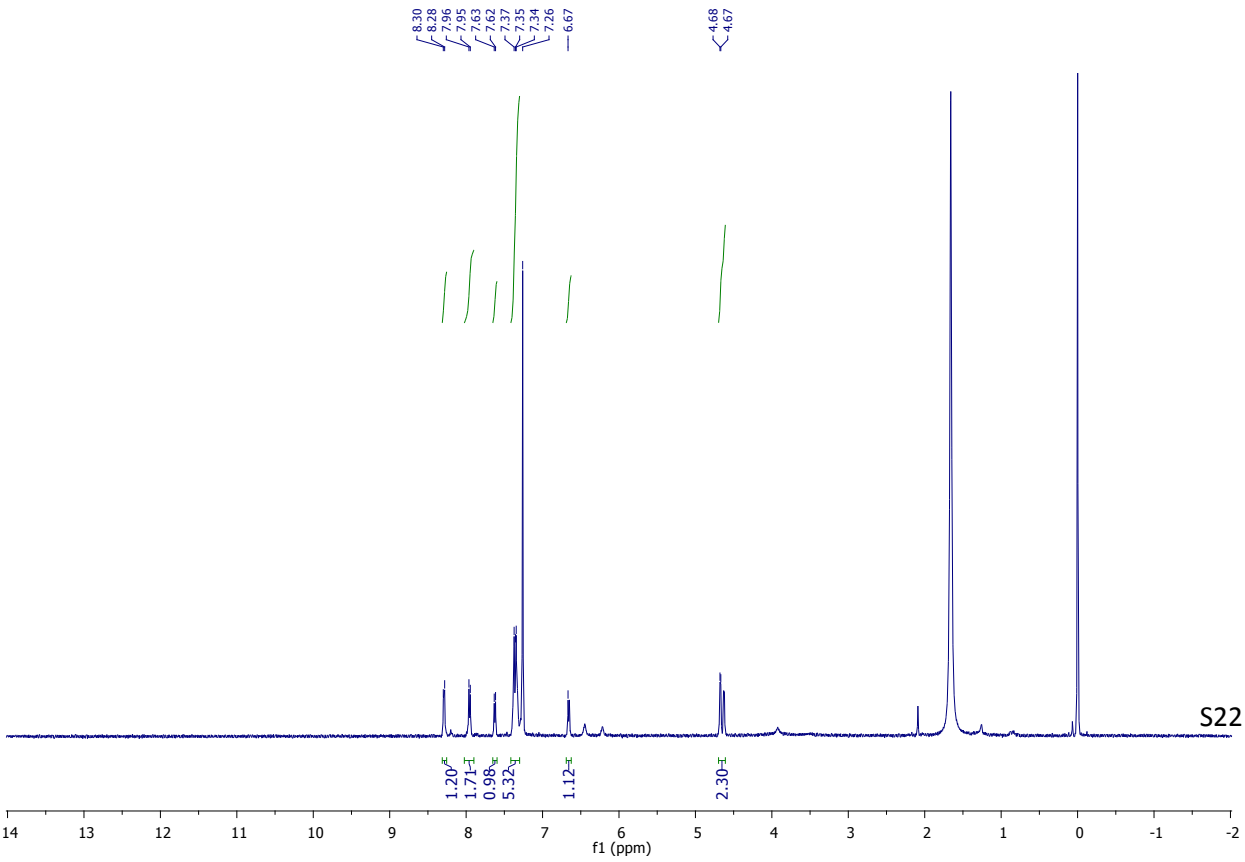
^{1}H NMR of N-Benzyl benzamide (3a)

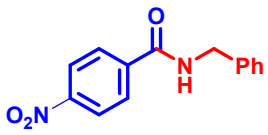


^{1}H NMR of N-benzyl 4-Chlorobenzamide (3b)

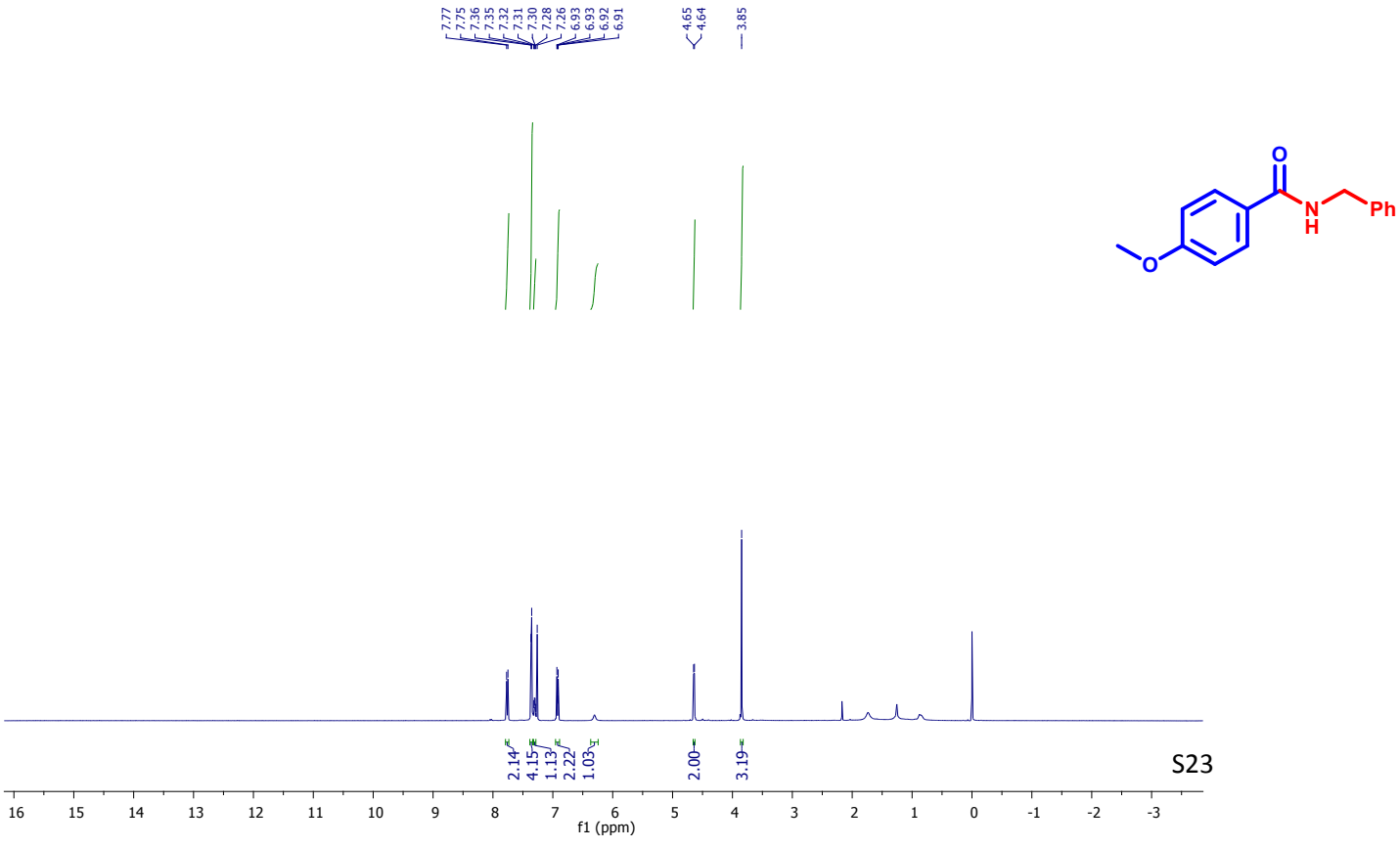


^{13}C NMR of N-benzyl 4-Chlorobenzamide (3b)

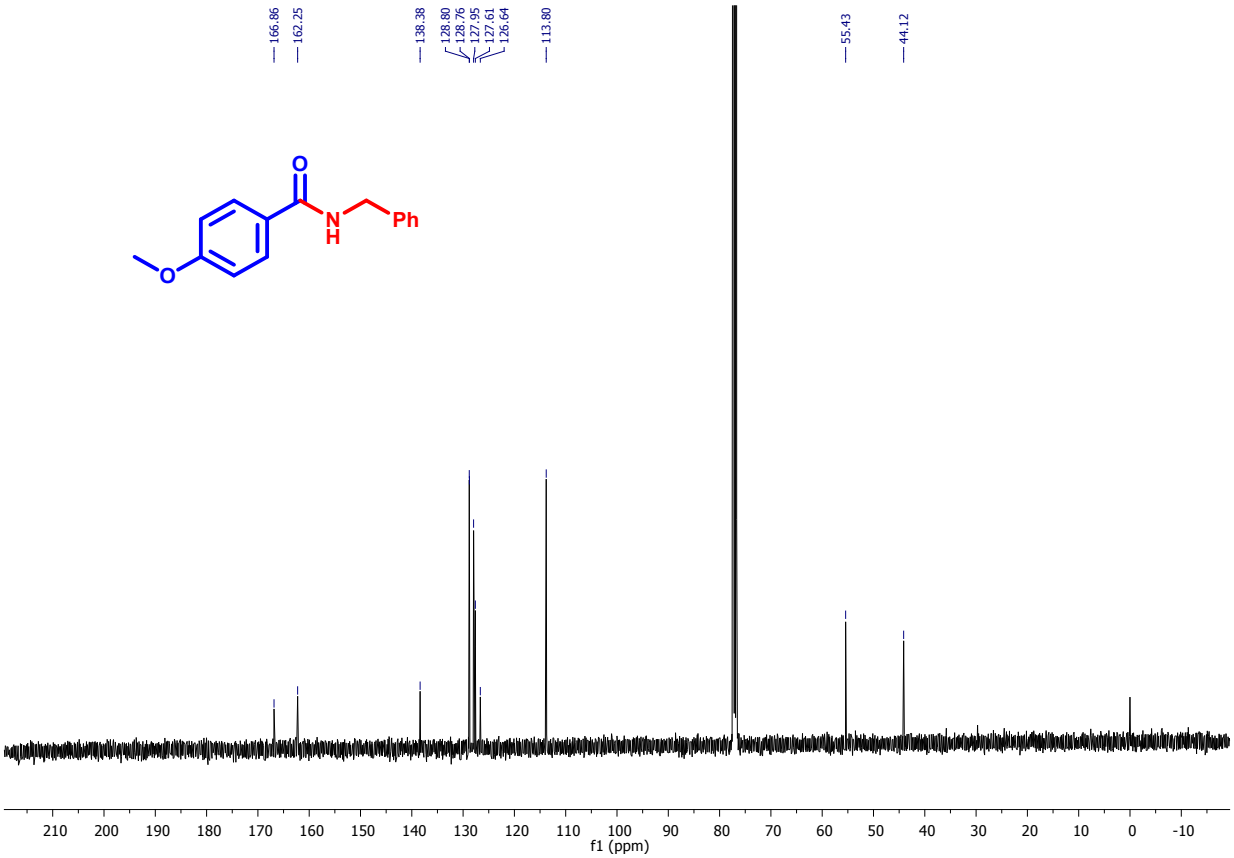




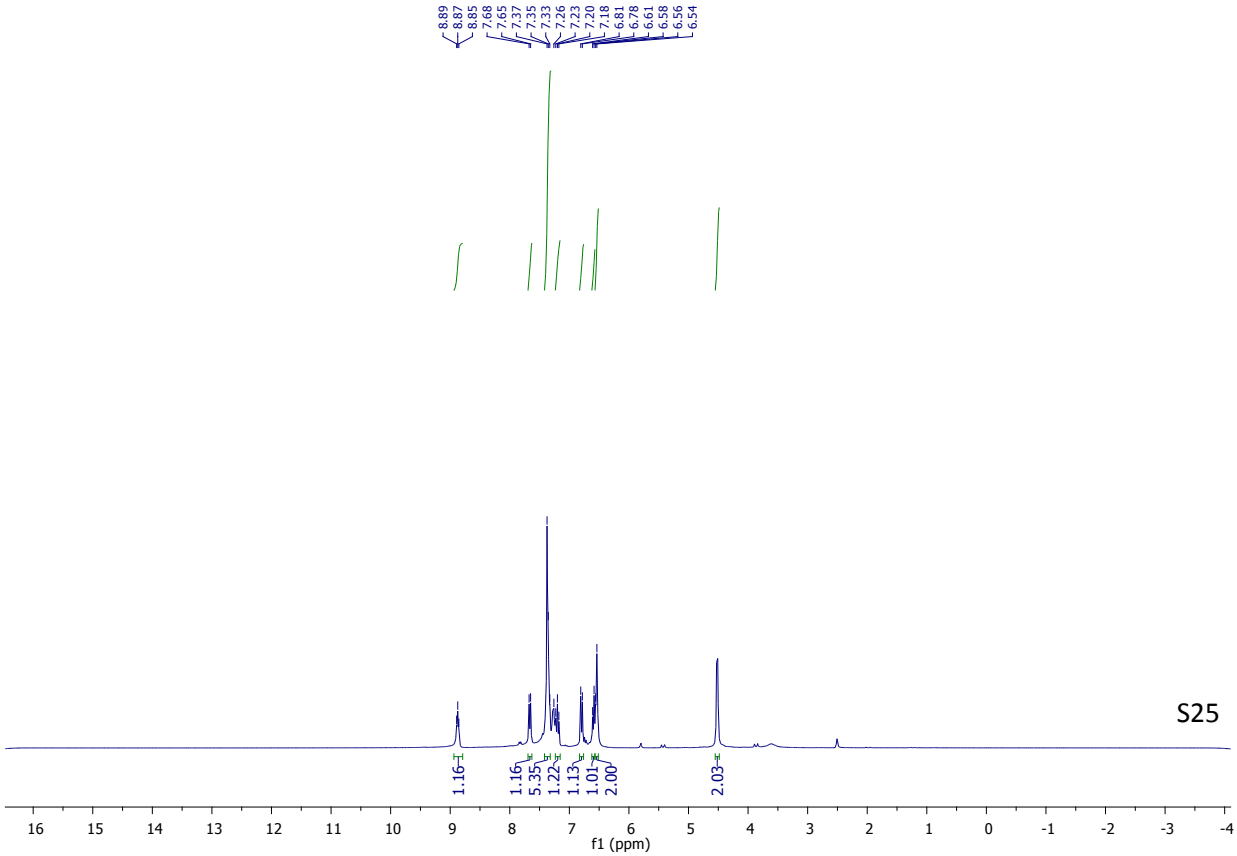
^{1}H NMR of N-benzyl 4-Nitrobenzamide (3c)

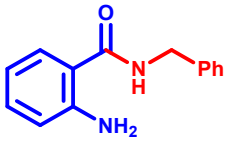


^{1}H NMR of N-benzyl 4-Methoxybenzamide (3e)

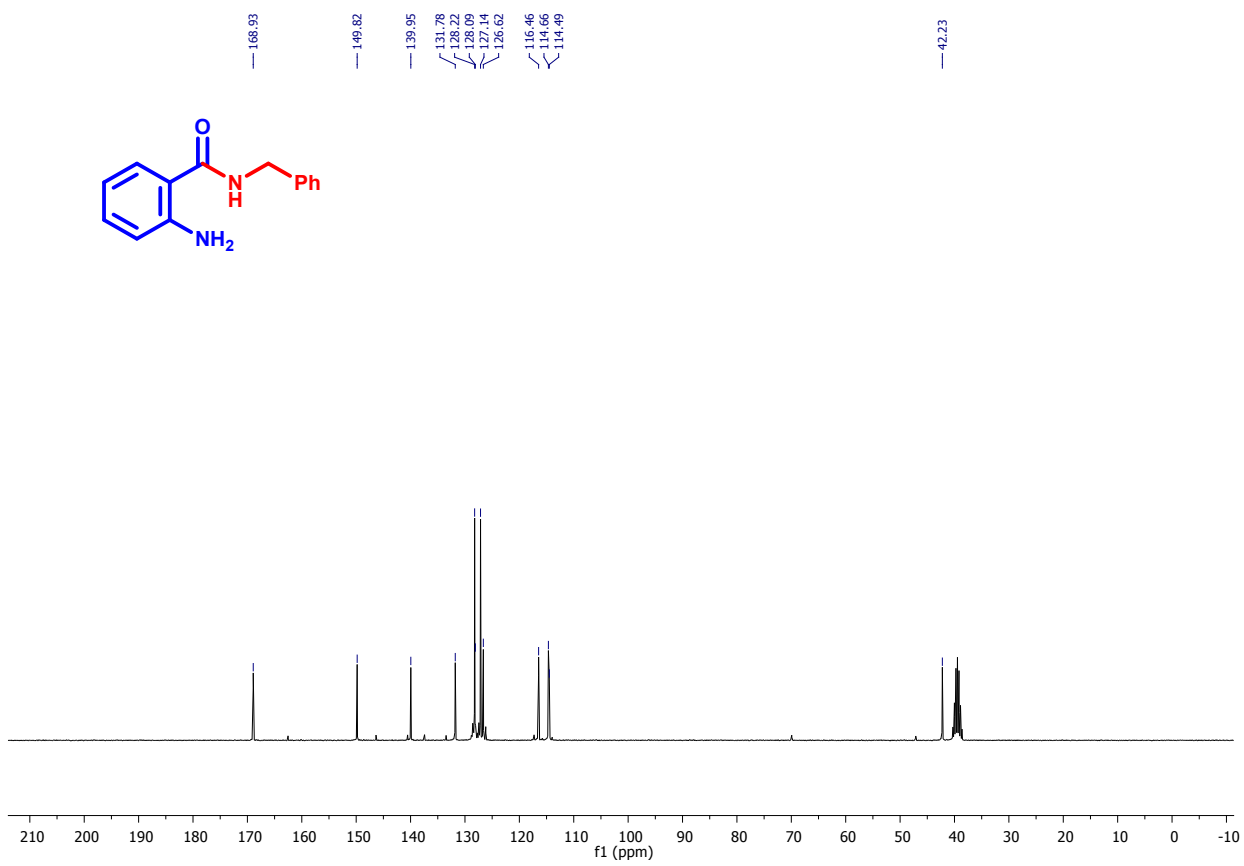


^{13}C NMR of N-benzyl 4-Methoxybenzamide (3e)

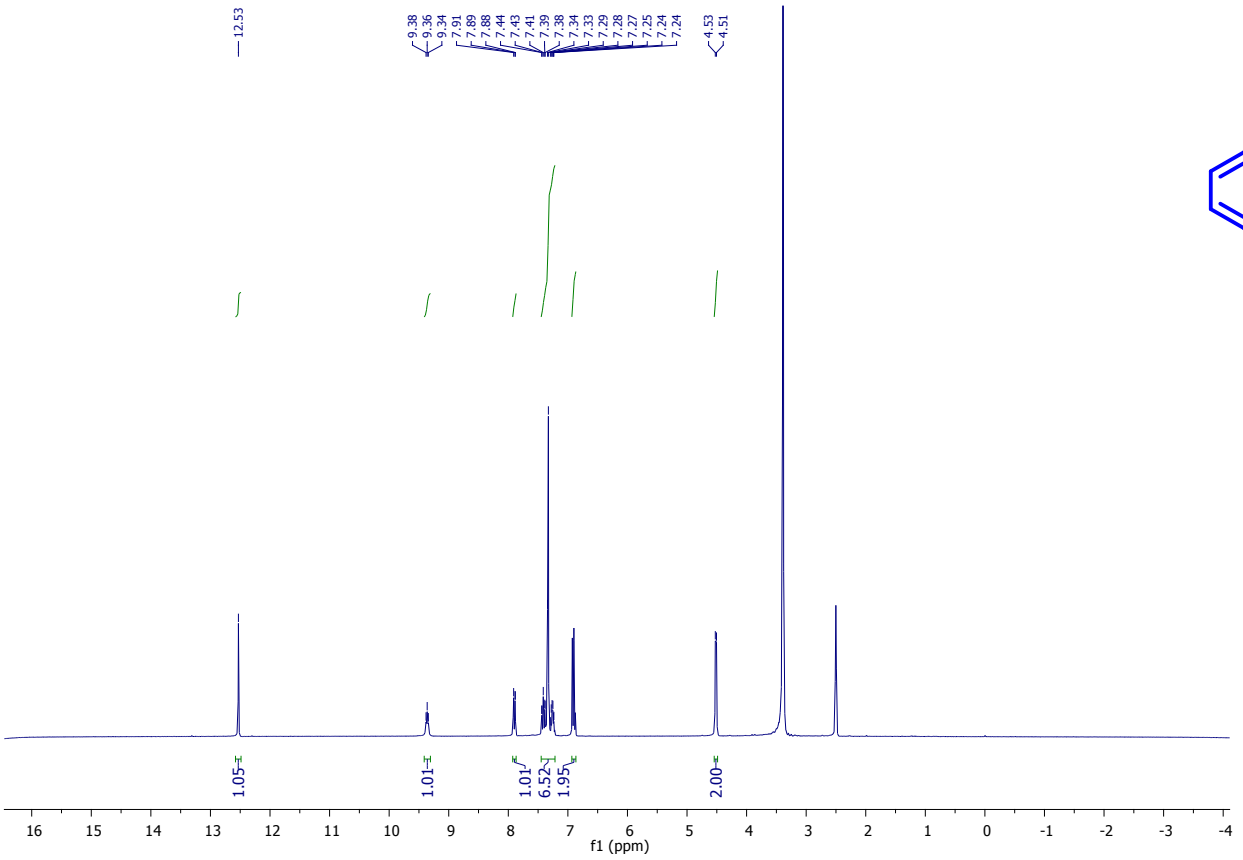


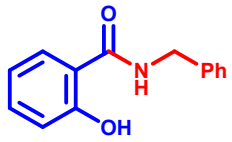


^{1}H NMR of 2-Amino-N-benzyl benzamide (3g)

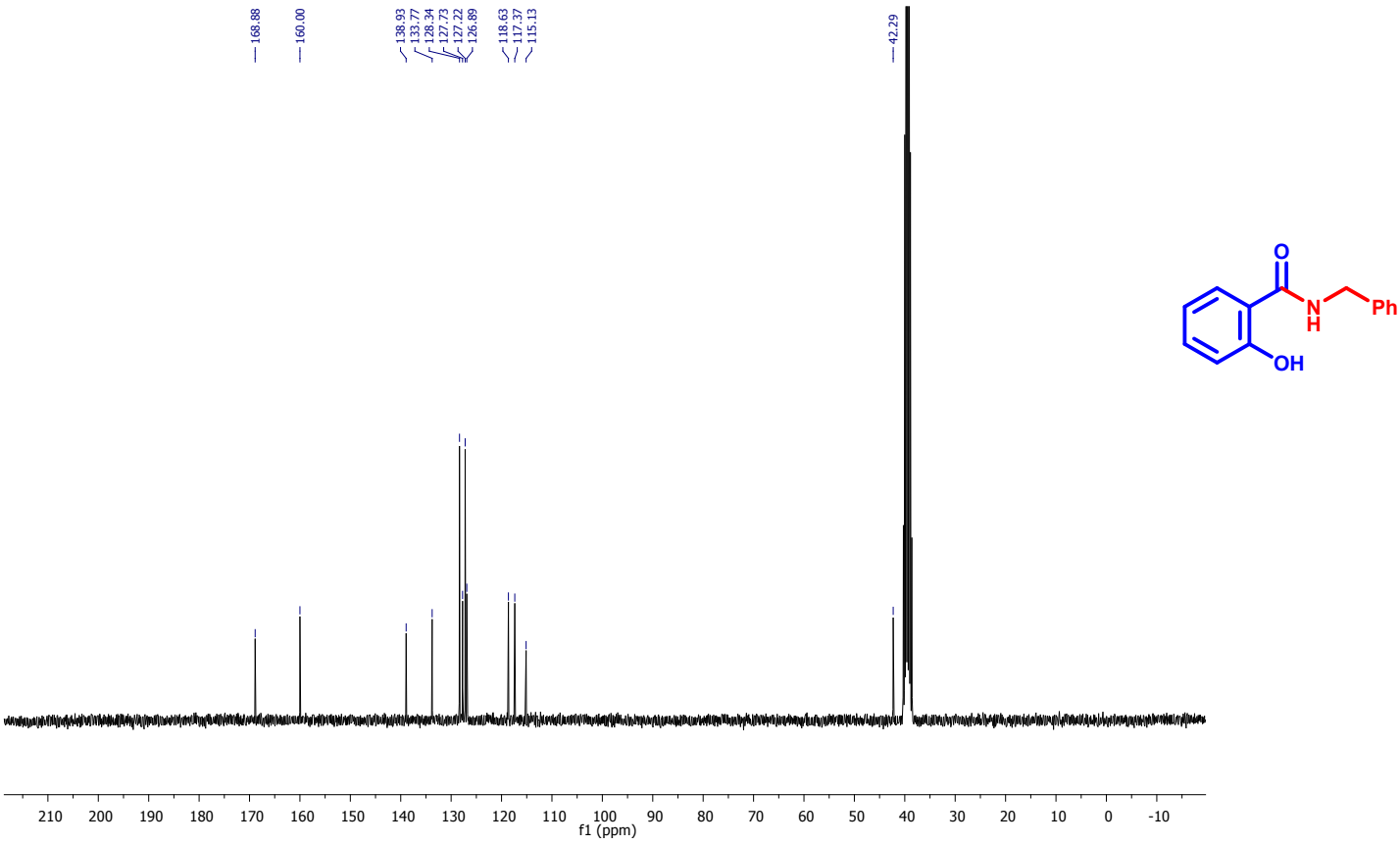

168.93
149.82
139.95
131.78
128.22
128.09
127.14
126.62
116.46
114.66
114.49
42.23
O
N
H
Ph
NH2
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)

^{13}C NMR of 2-Amino-N-benzyl benzamide (3g)

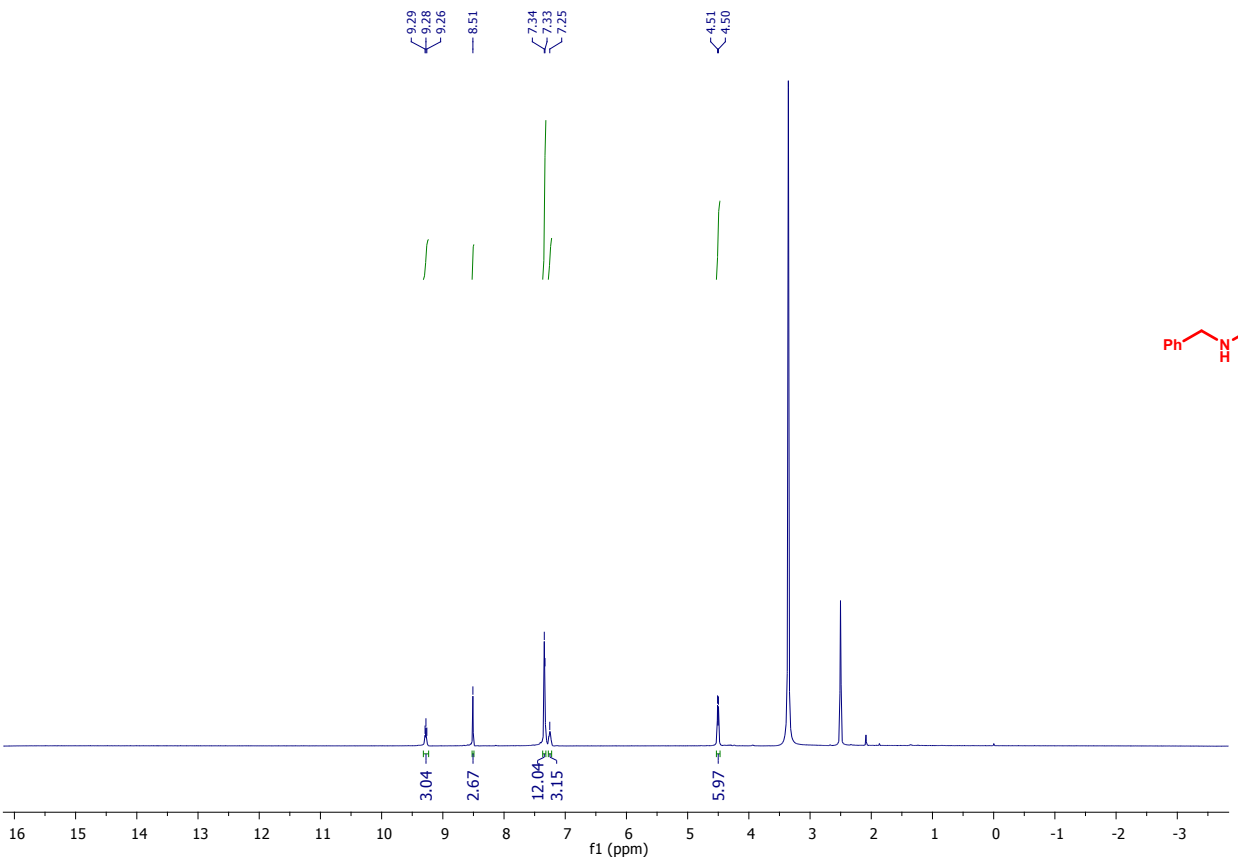




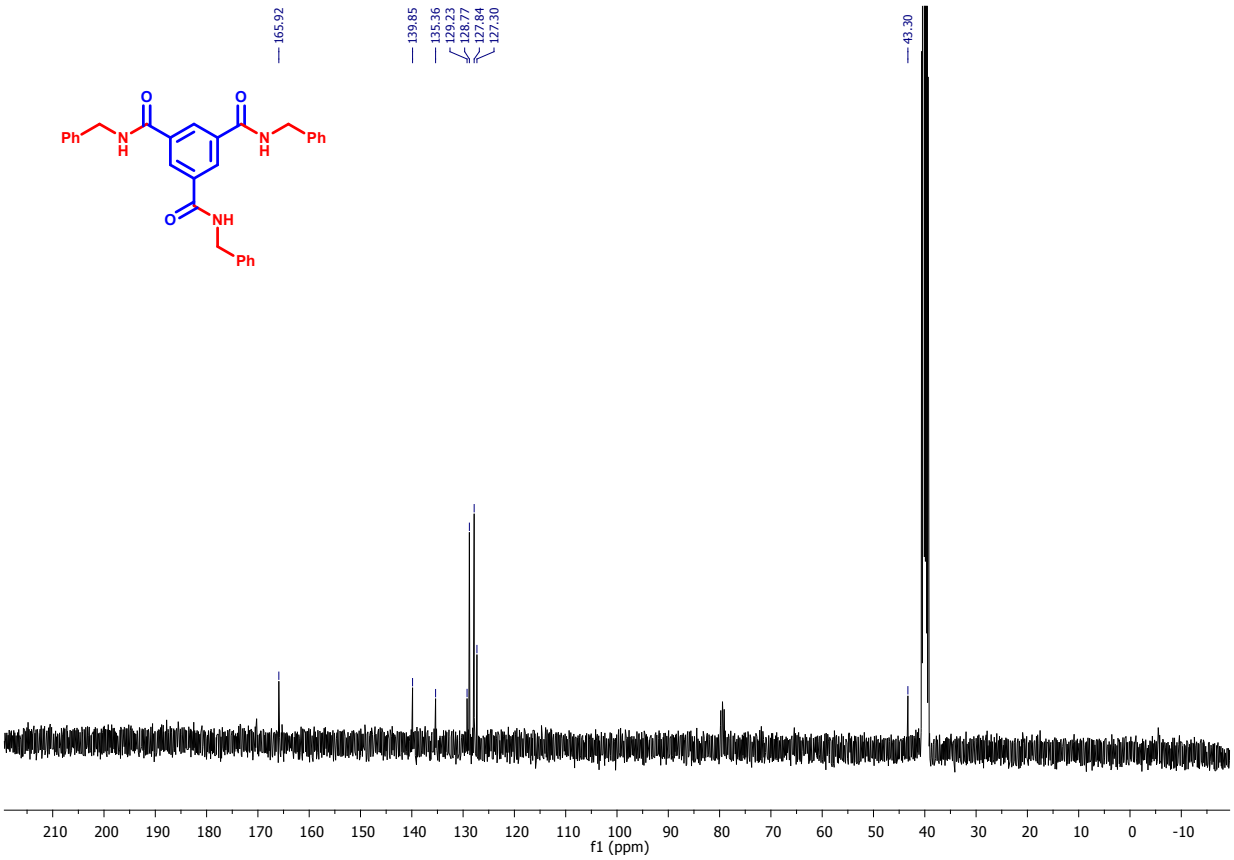
^{1}H NMR of 2-hydroxy-N-benzyl benzamide (3h)



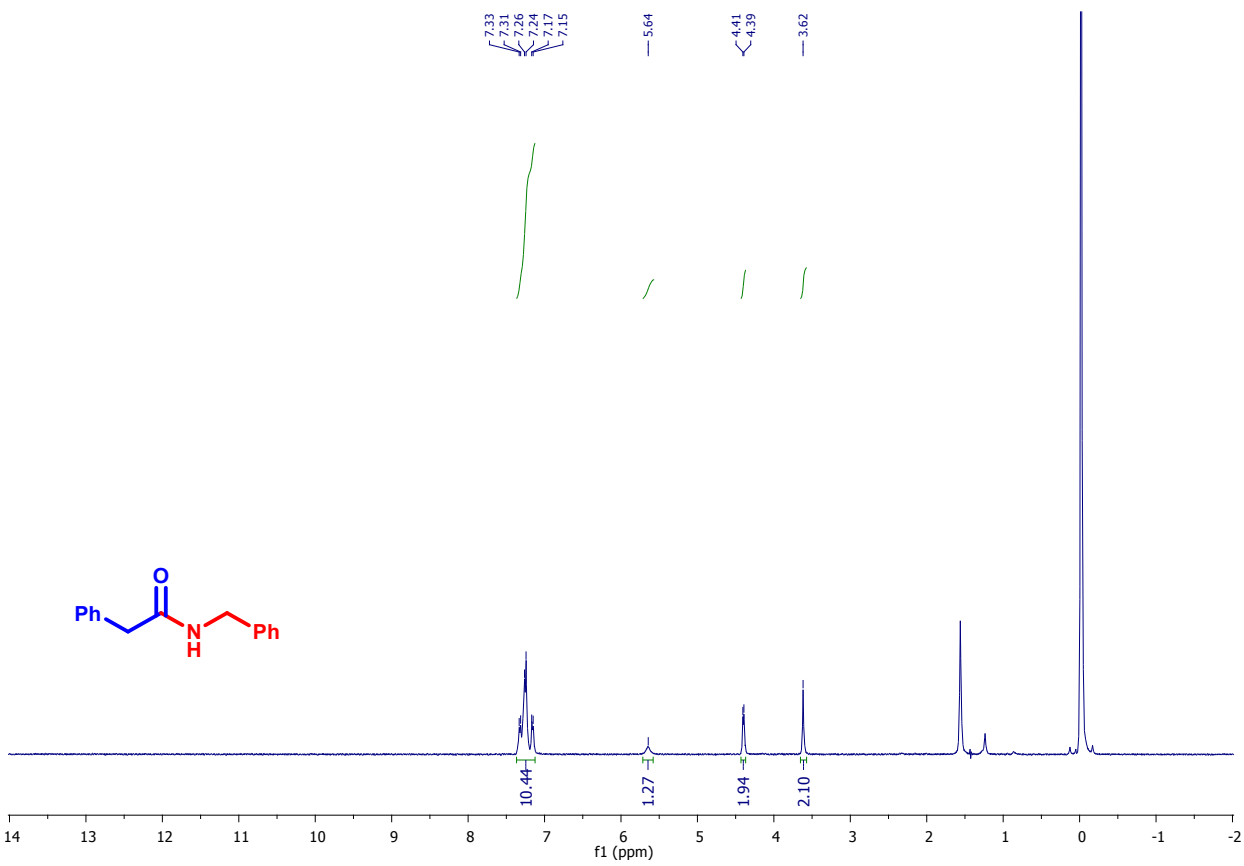
^{13}C NMR of 2-Hydroxy-N-benzyl benzamide (3h)



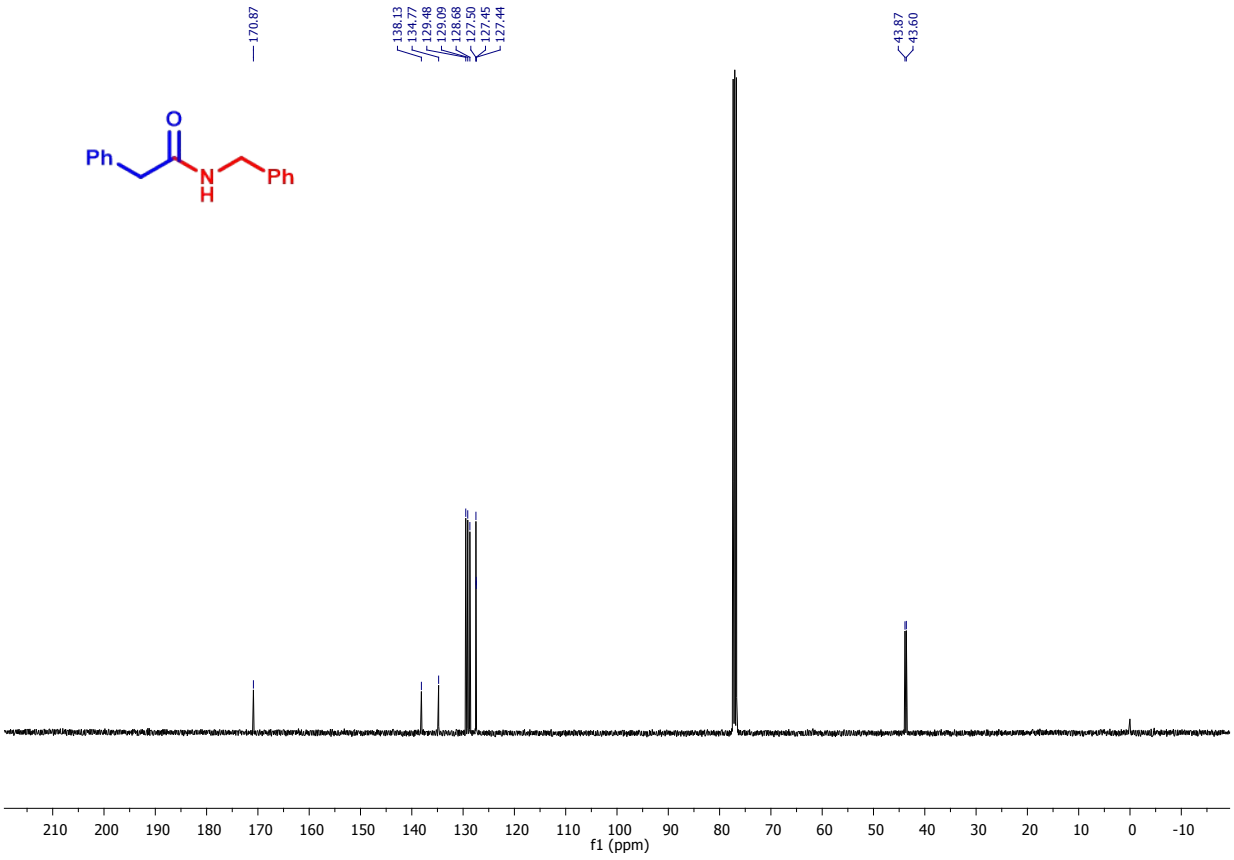
^{1}H NMR of N^{1},N^{3},N^{5}-tribenzylbenzene-1,3,5-tricarboxamide (3i)



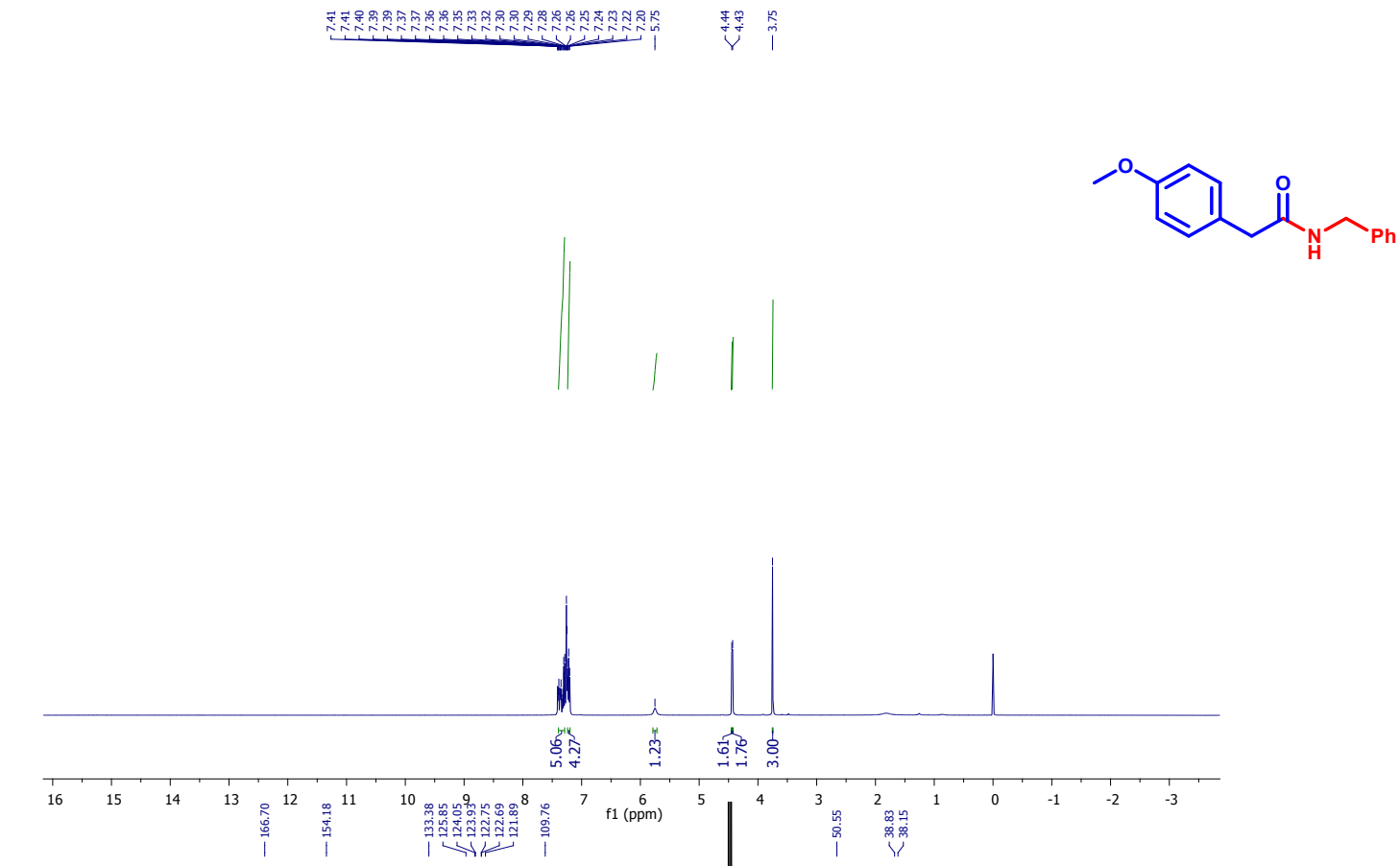
^{13}C NMR of N^{1},N^{3},N^{5}-tribenzylbenzene-1,3,5-tricarboxamide (3i)



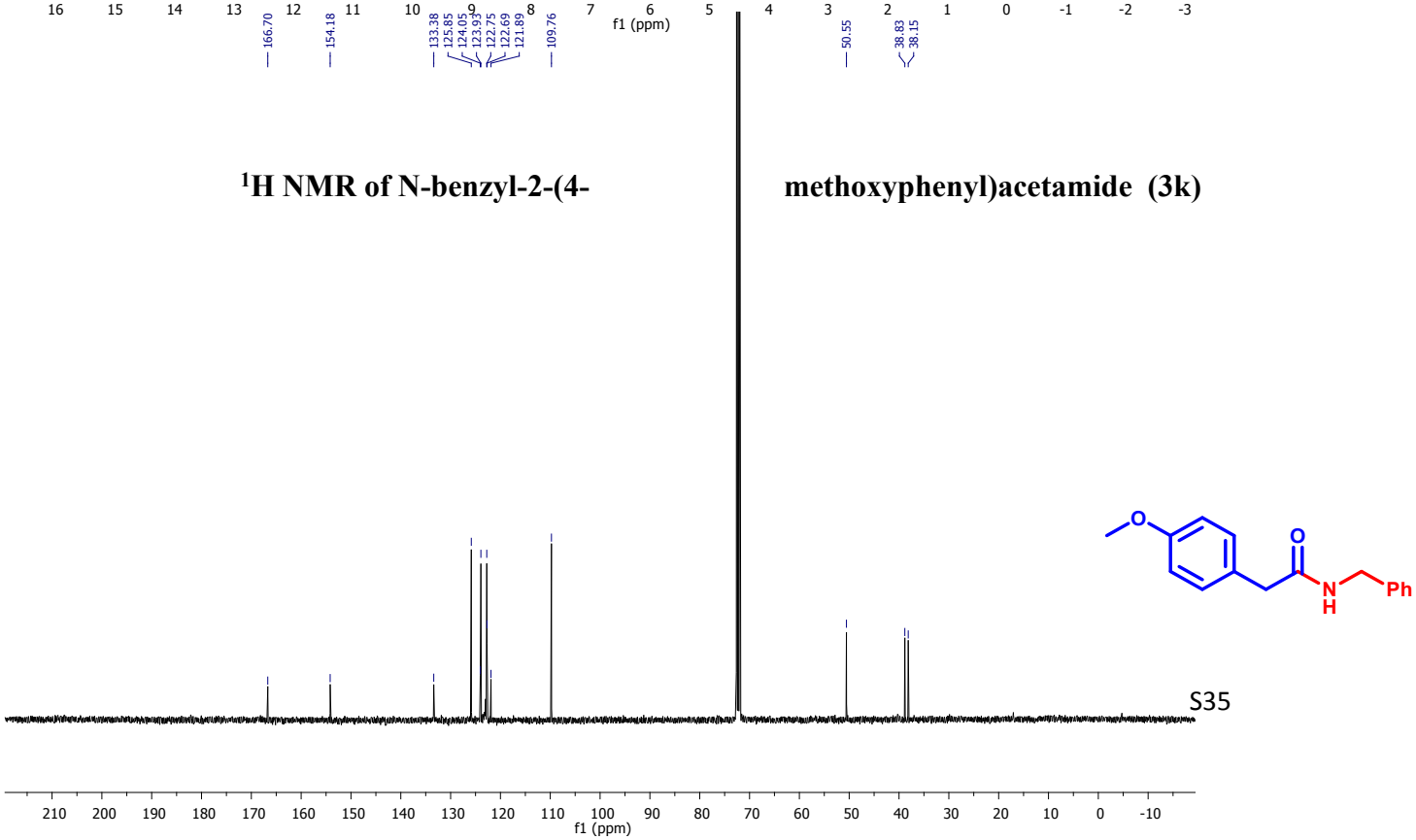
^{1}H NMR of *N*-benzyl-2-phenylacetamide (3j)



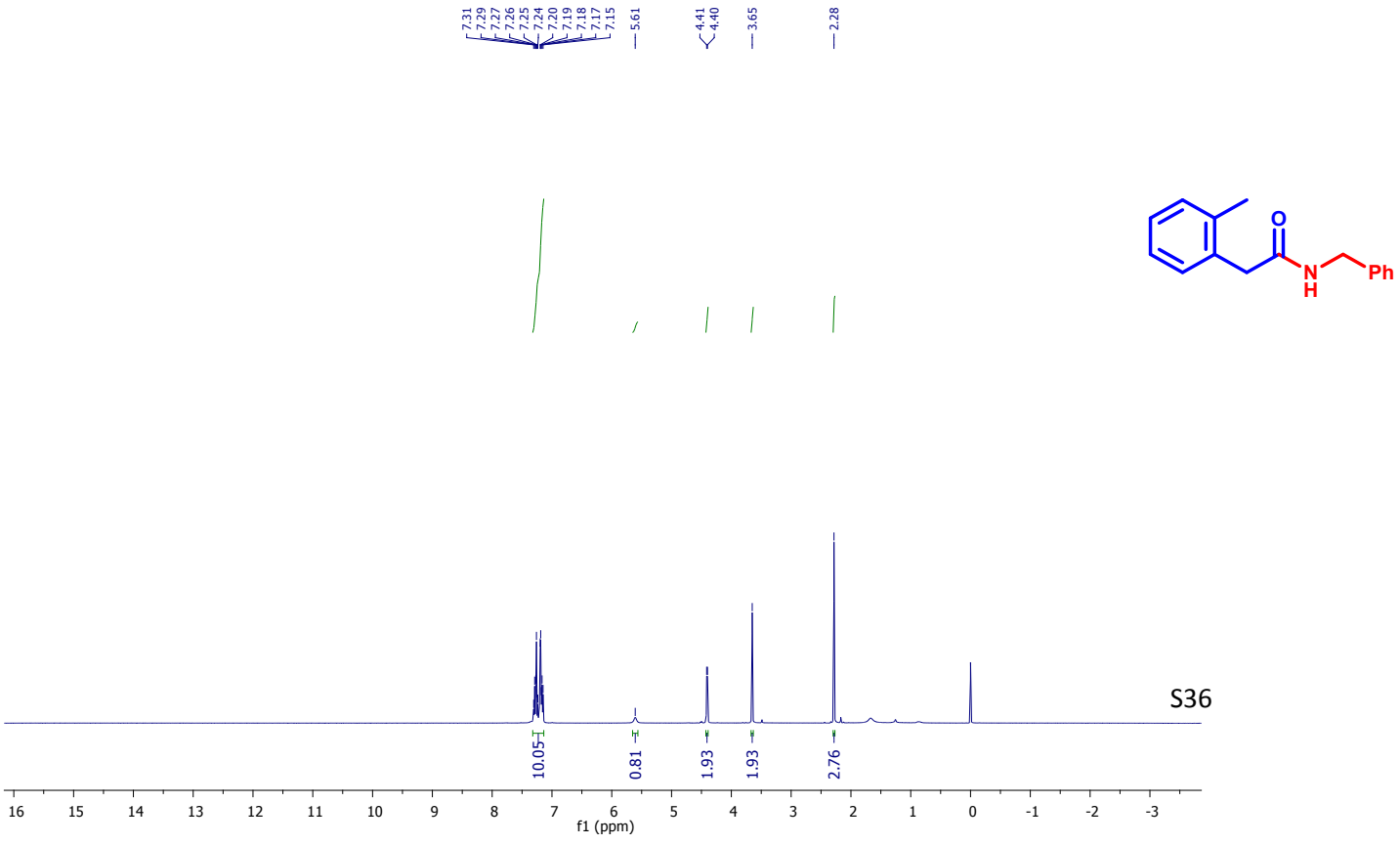
^{13}C NMR of *N*-benzyl-2-phenylacetamide (3j)



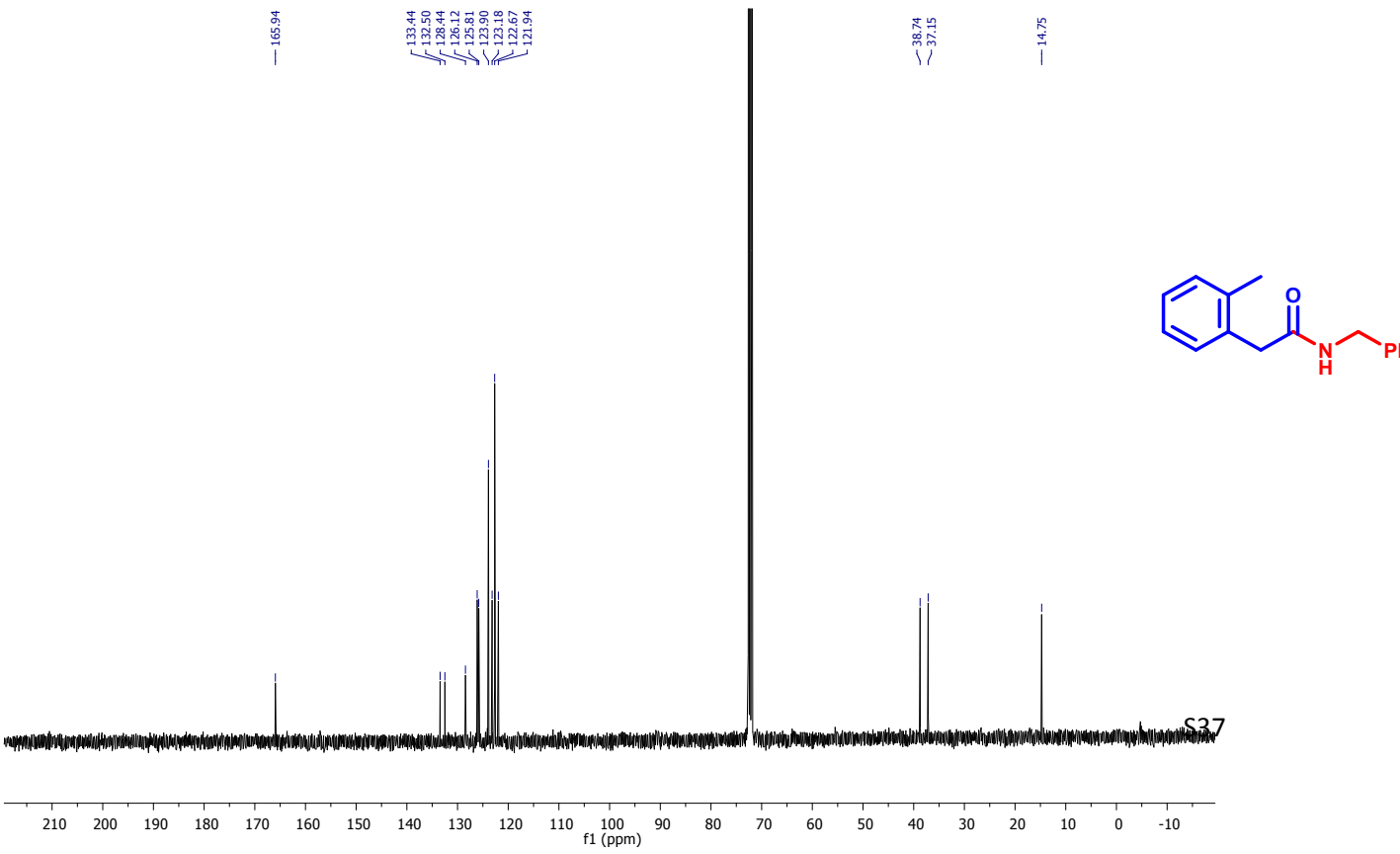
^{1}H NMR of N-benzyl-2-(4-methoxyphenyl)acetamide (3k)



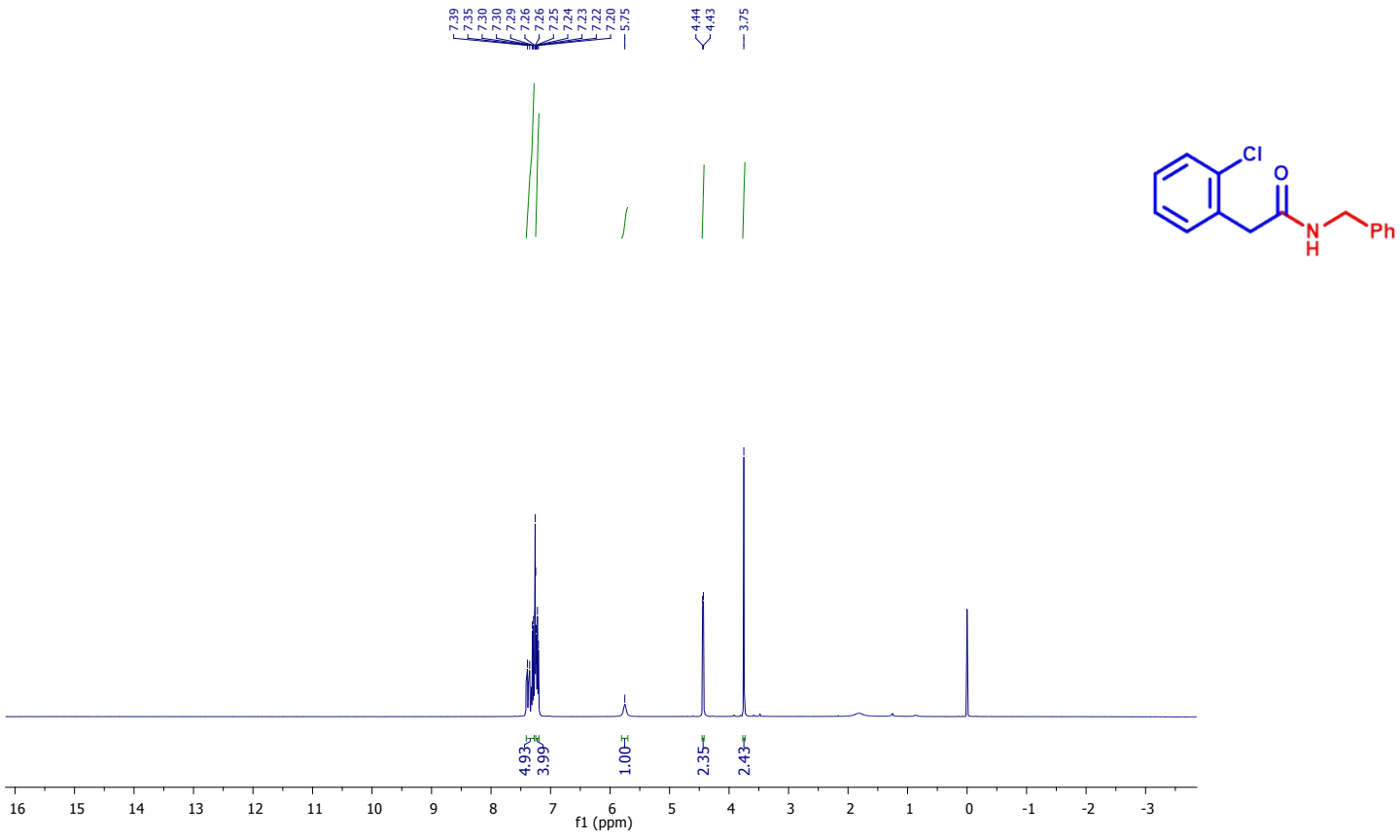
^{13}C NMR of N-benzyl-2-(4-methoxyphenyl)acetamide (3k)



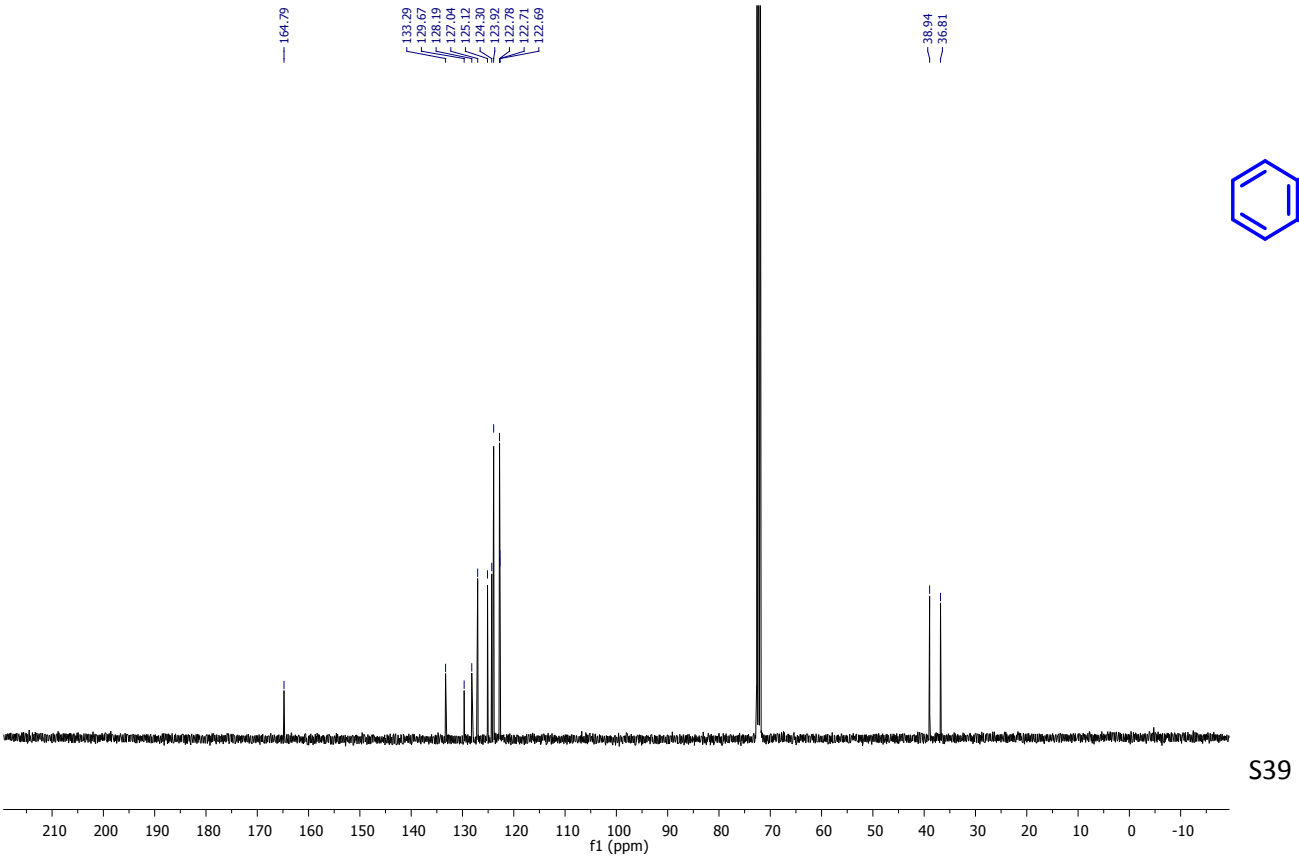
^{1}H NMR of N-benzyl-2-(o-tolyl)acetamide (3l)



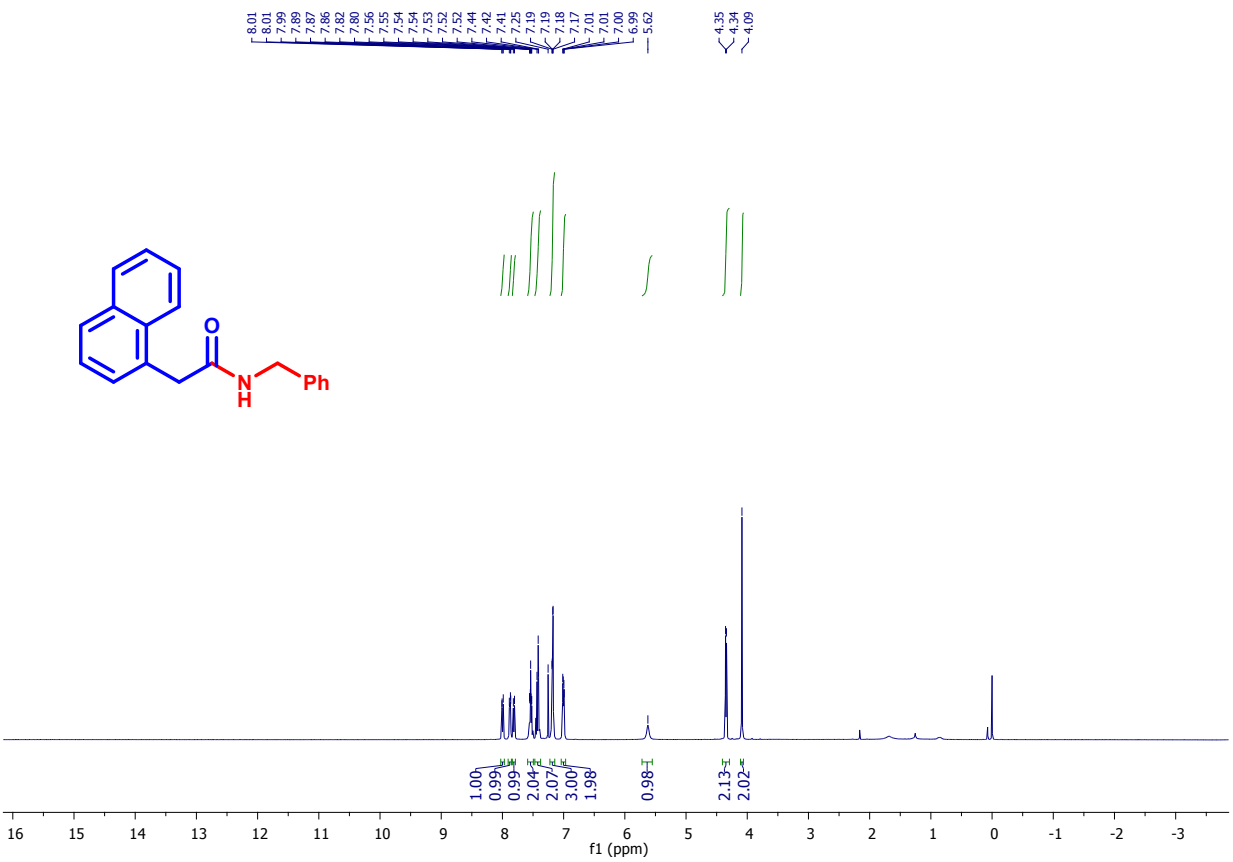
^{13}C NMR of N-benzyl-2-(o-tolyl)acetamide (3l)



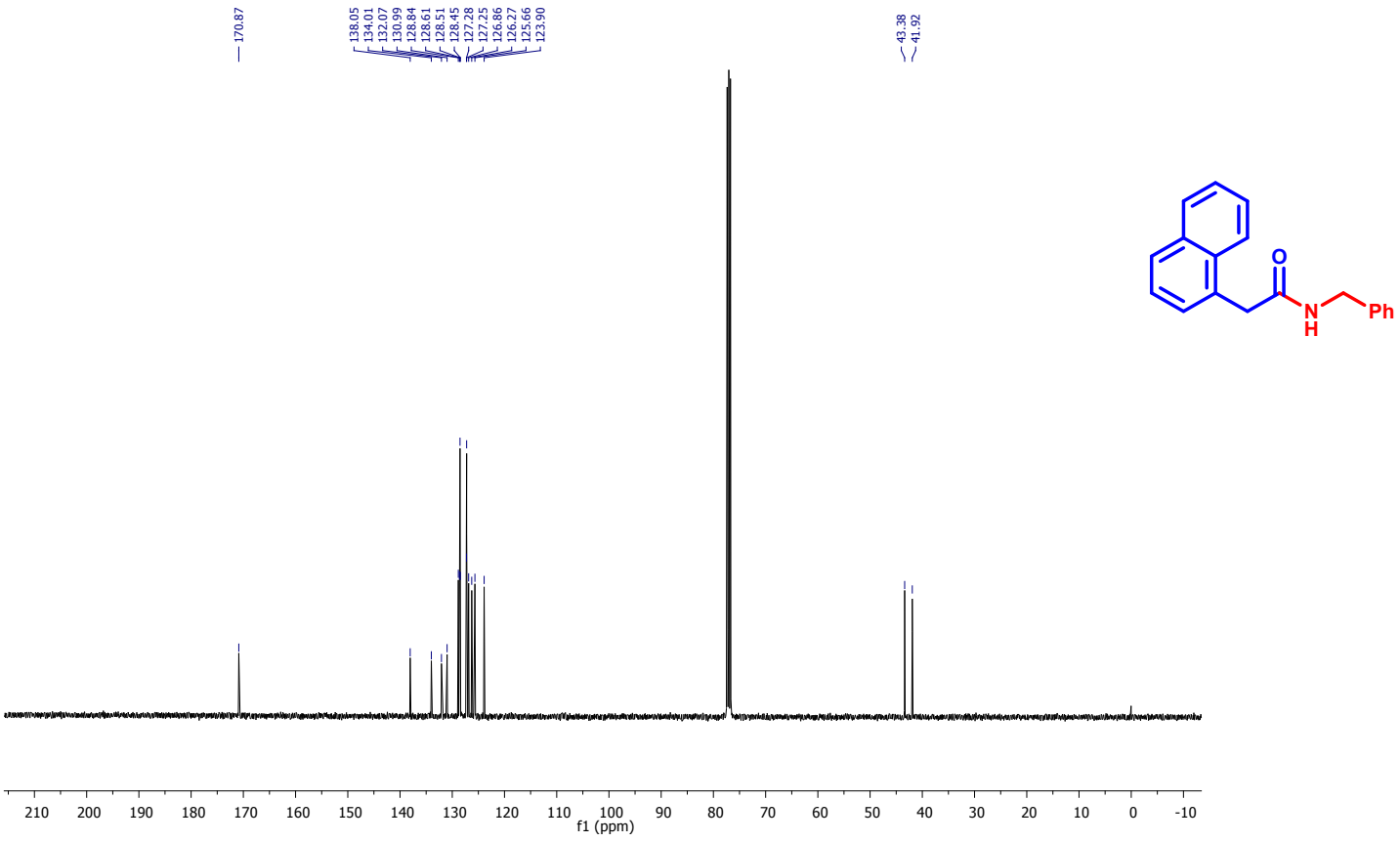
^{13}C NMR of N-benzyl-2-(2-chlorophenyl)acetamide (3m)



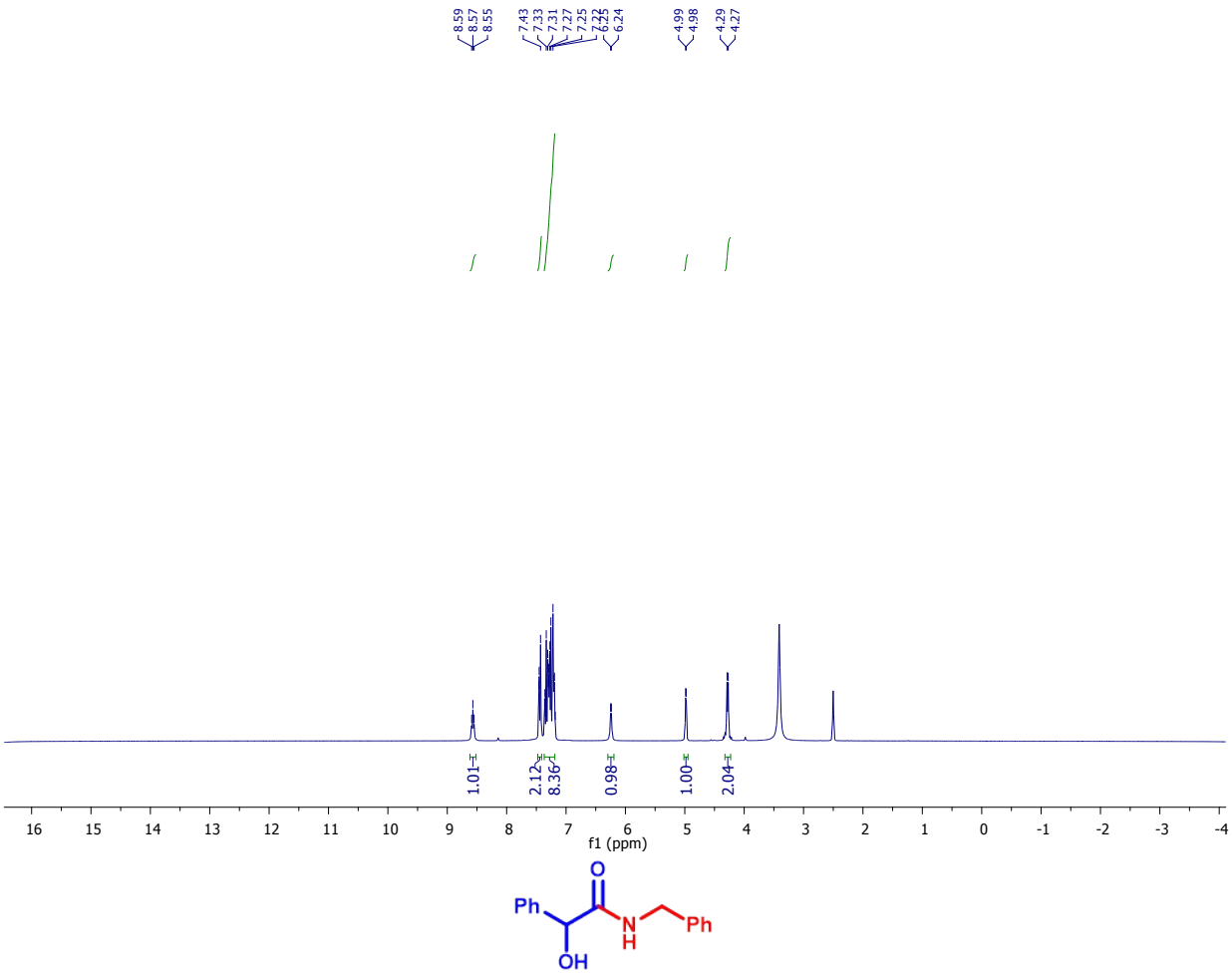
^{13}C NMR of N-benzyl-2-(2-chlorophenyl)acetamide (3m)



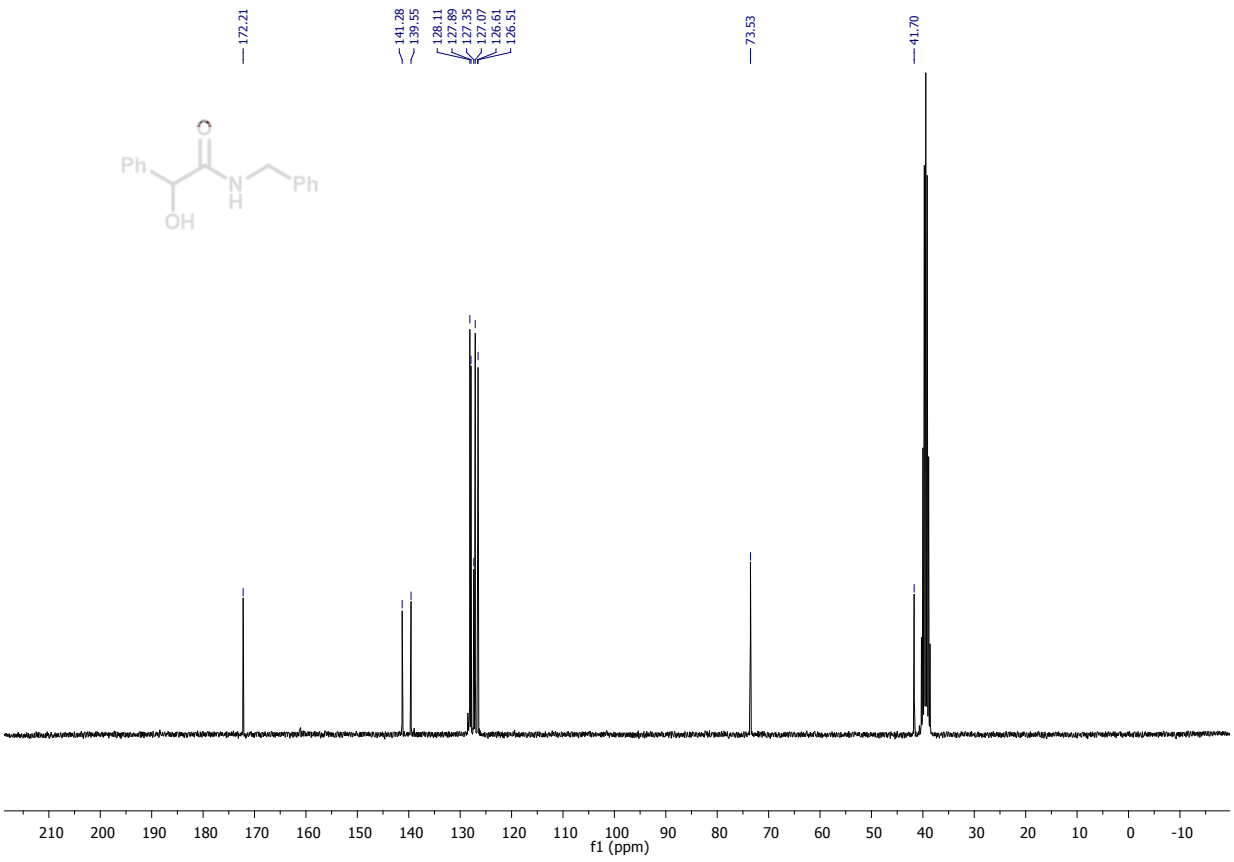
^{1}H NMR of N-benzyl-2-(naphthalen-1-yl)acetamide (3n)



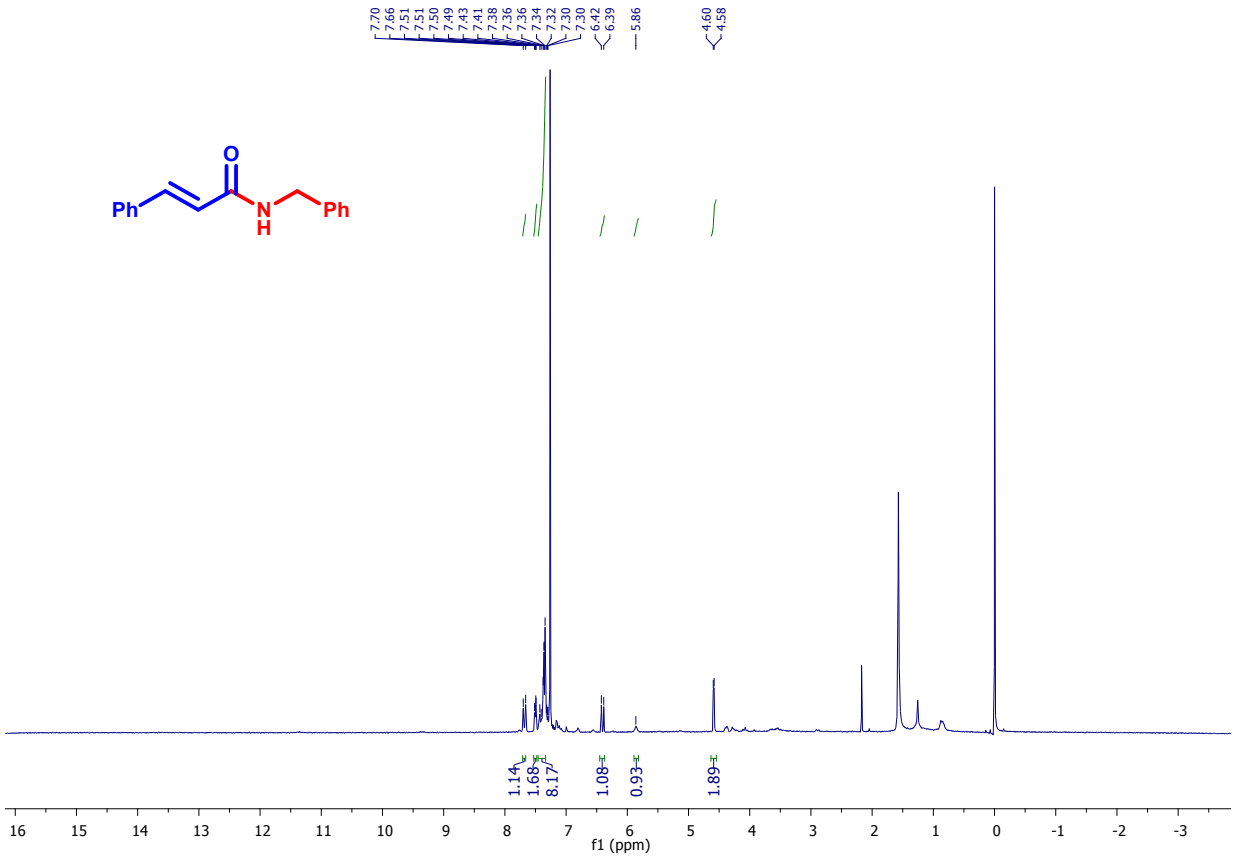
^{13}C NMR of N-benzyl-2-(naphthalen-1-yl)acetamide (3n)



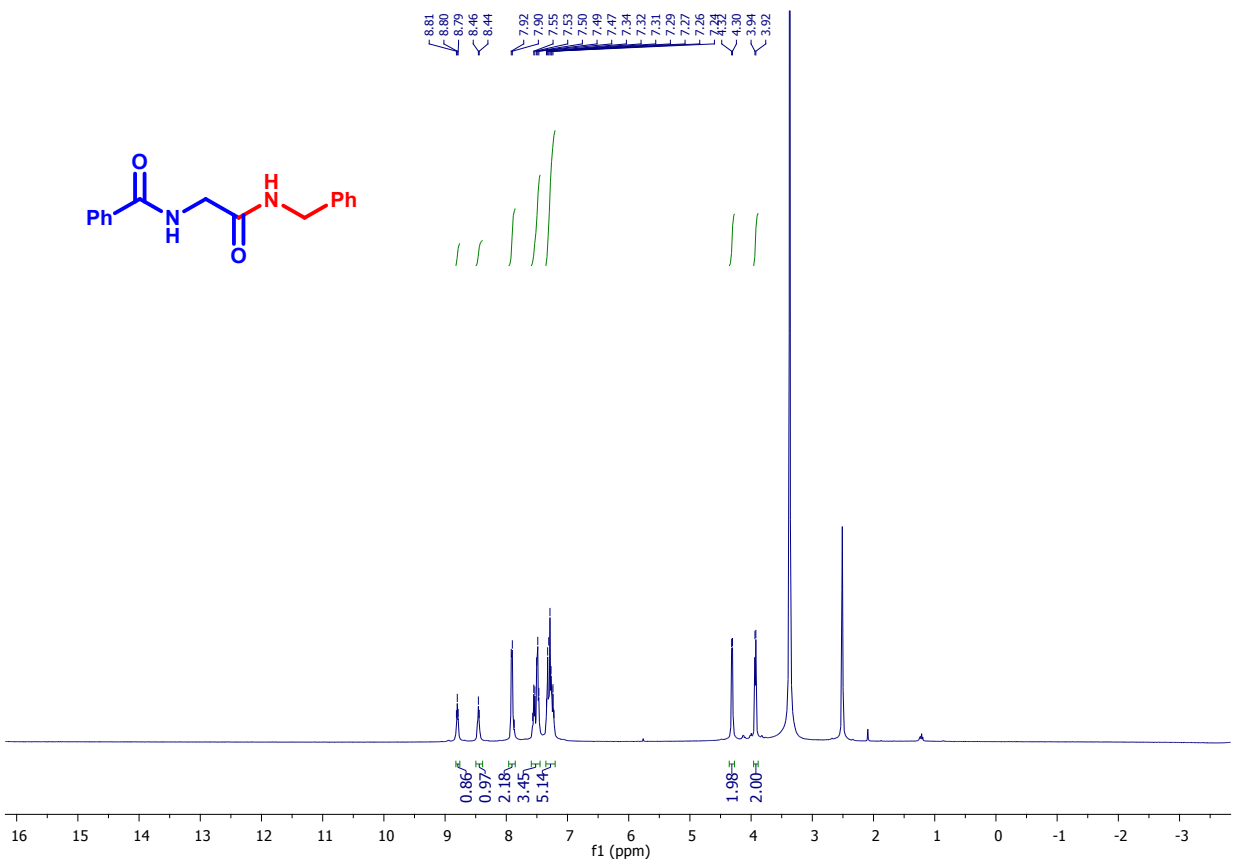
^{1}H NMR of N-benzyl-2-hydroxy-2-phenylacetamide (3o)



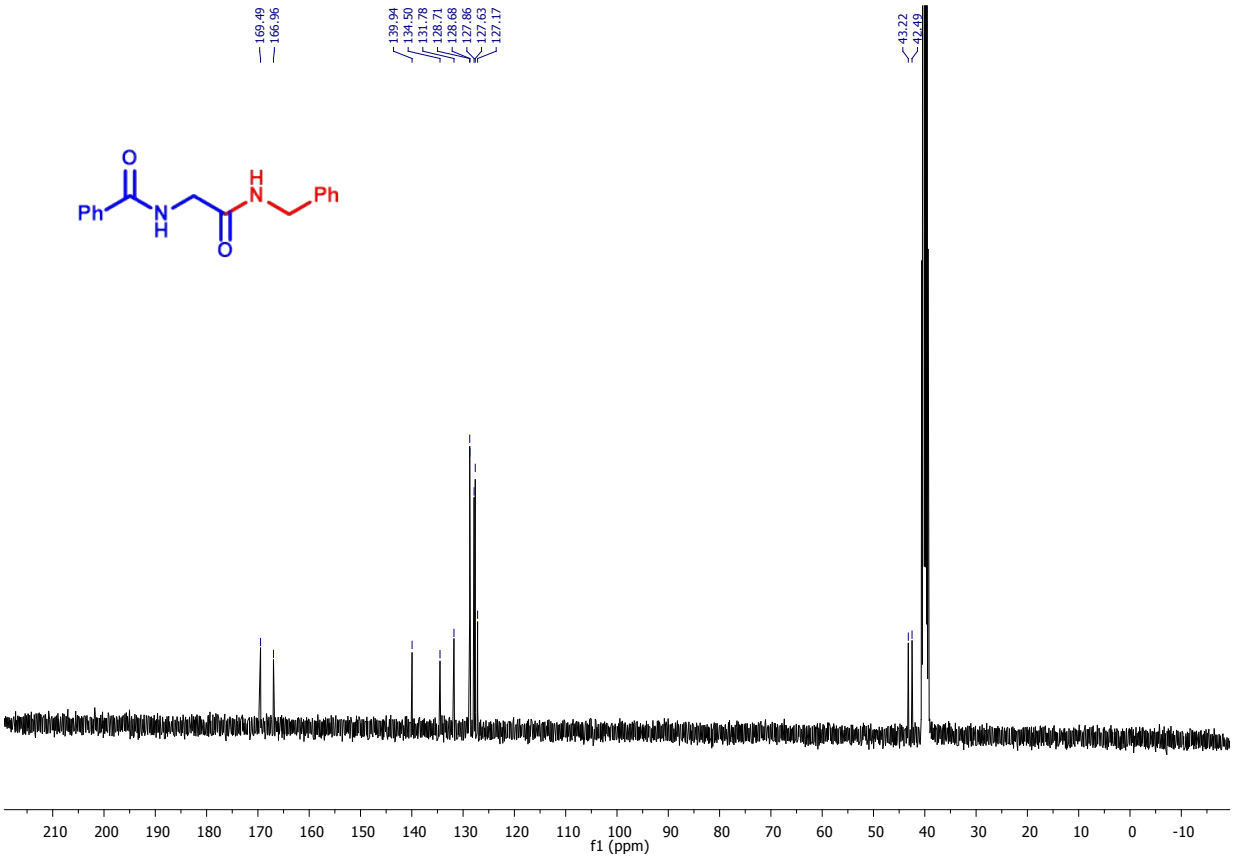
^{13}C NMR of N-benzyl-2-hydroxy-2-phenylacetamide (3o)



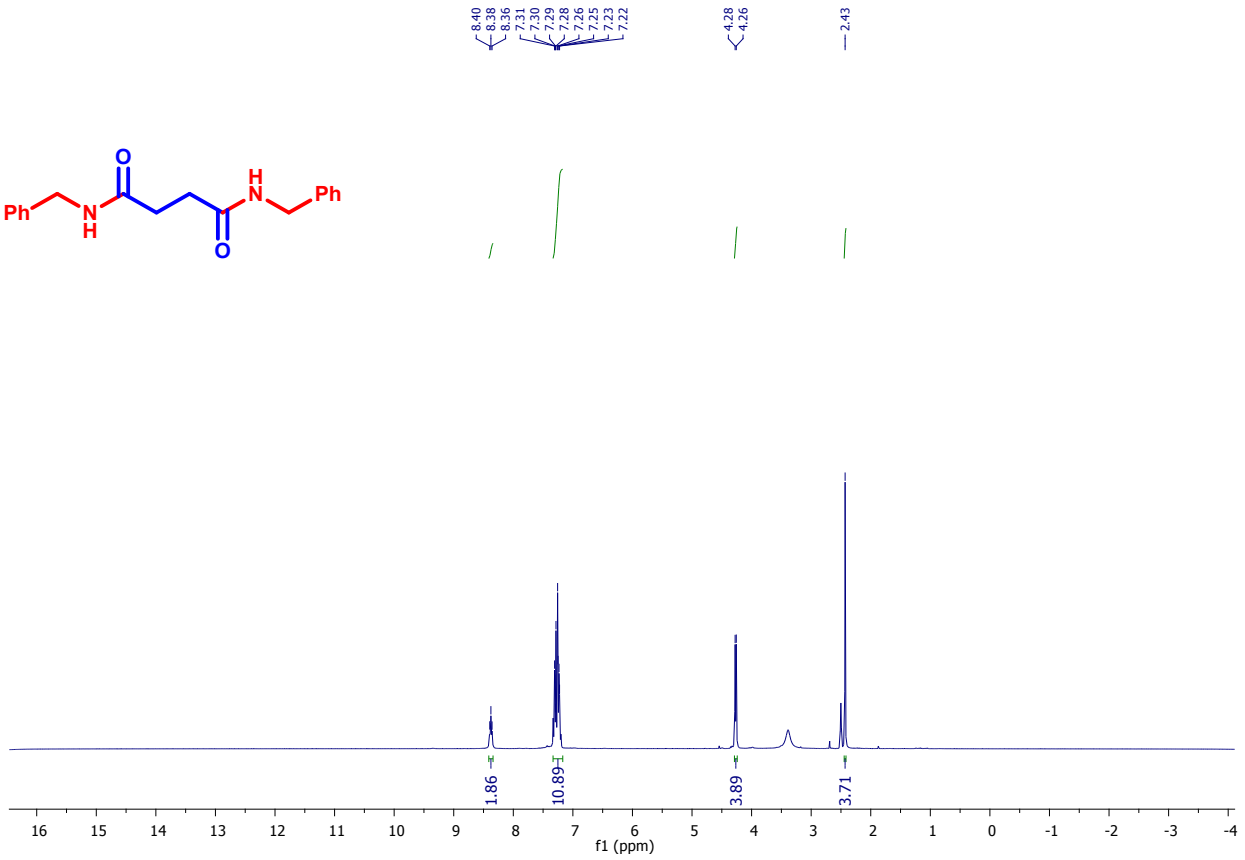
^{1}H NMR of *N*-benzylcinnamamide (3p)



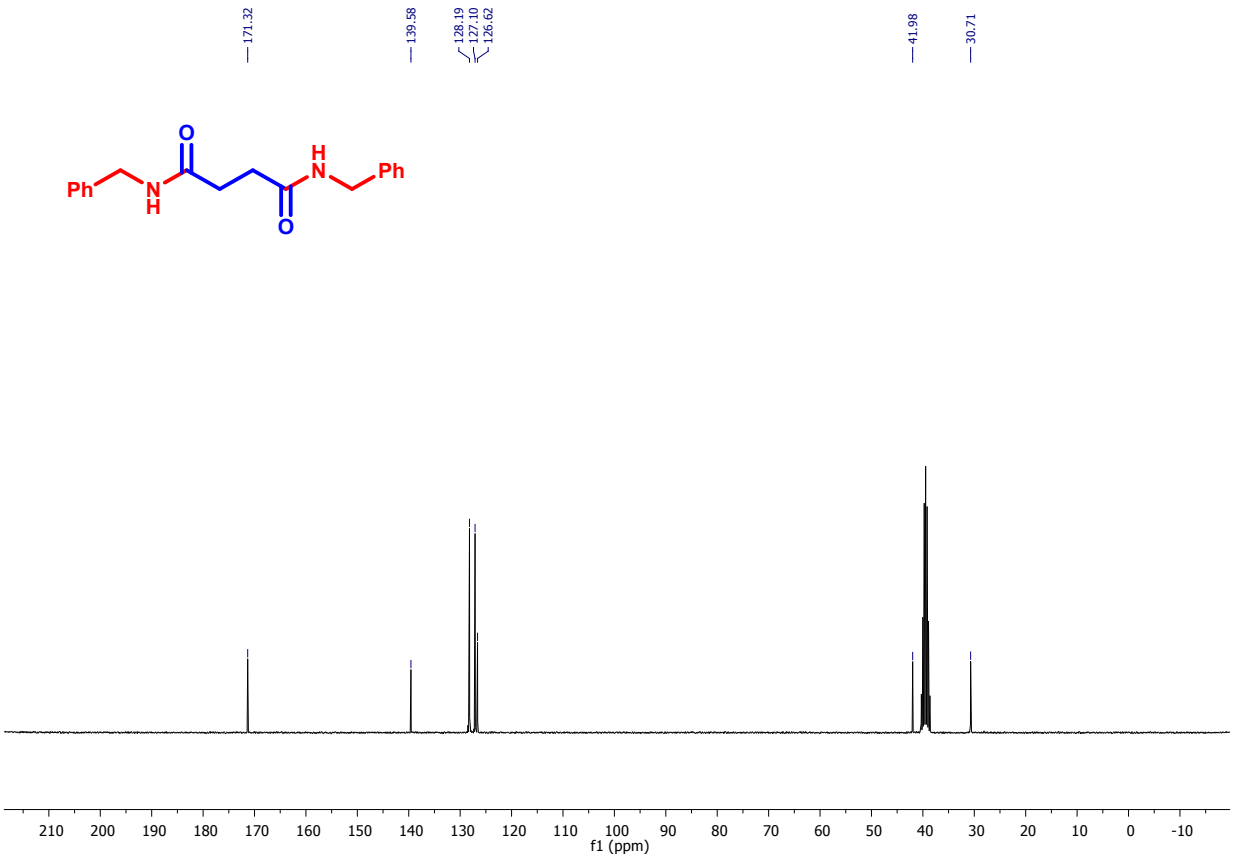
^{1}H NMR of N-(2-(benzylamino)-2-oxoethyl)benzamide (3q)



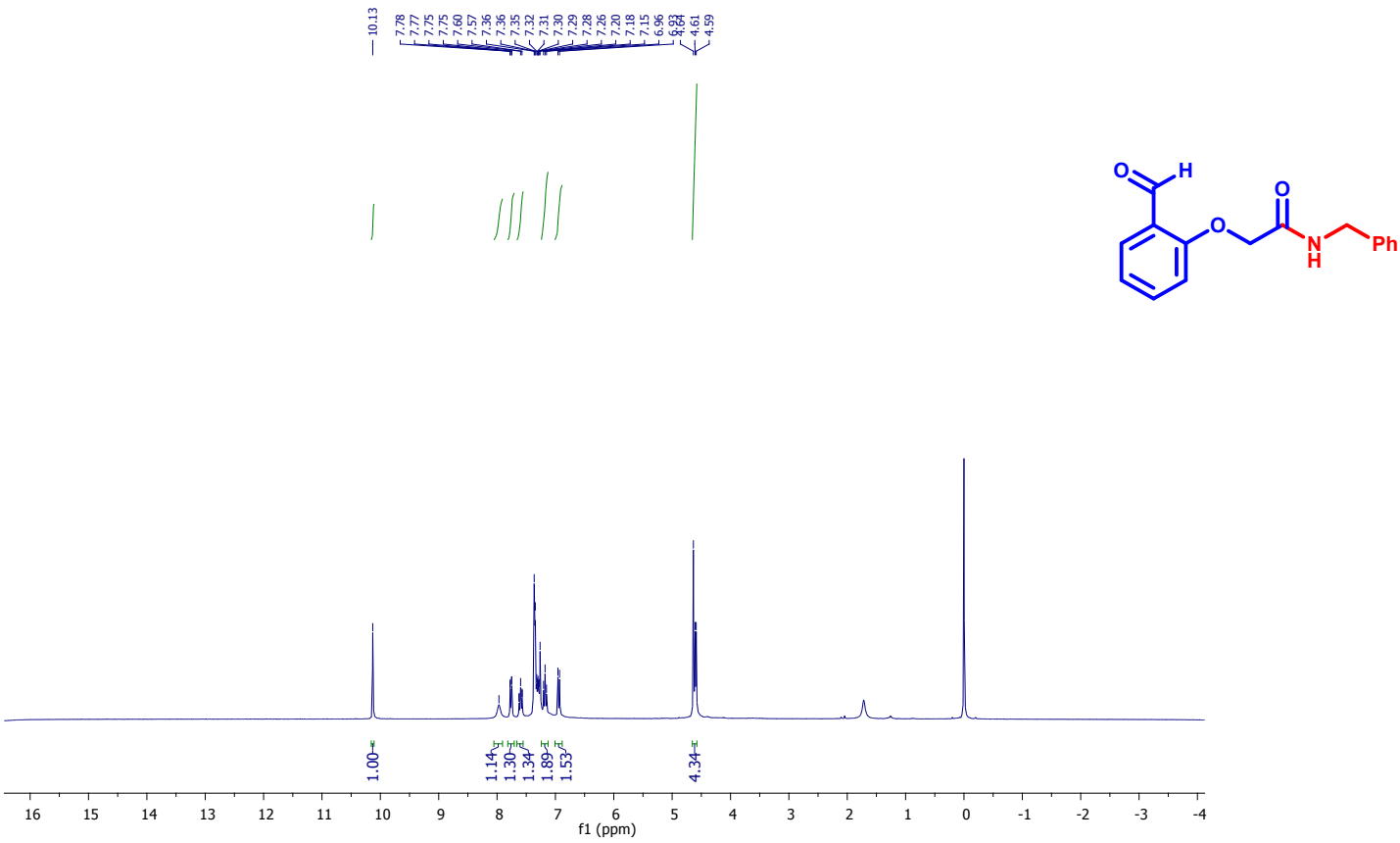
^{13}C NMR of N-(2-(benzylamino)-2-oxoethyl)benzamide (3q)



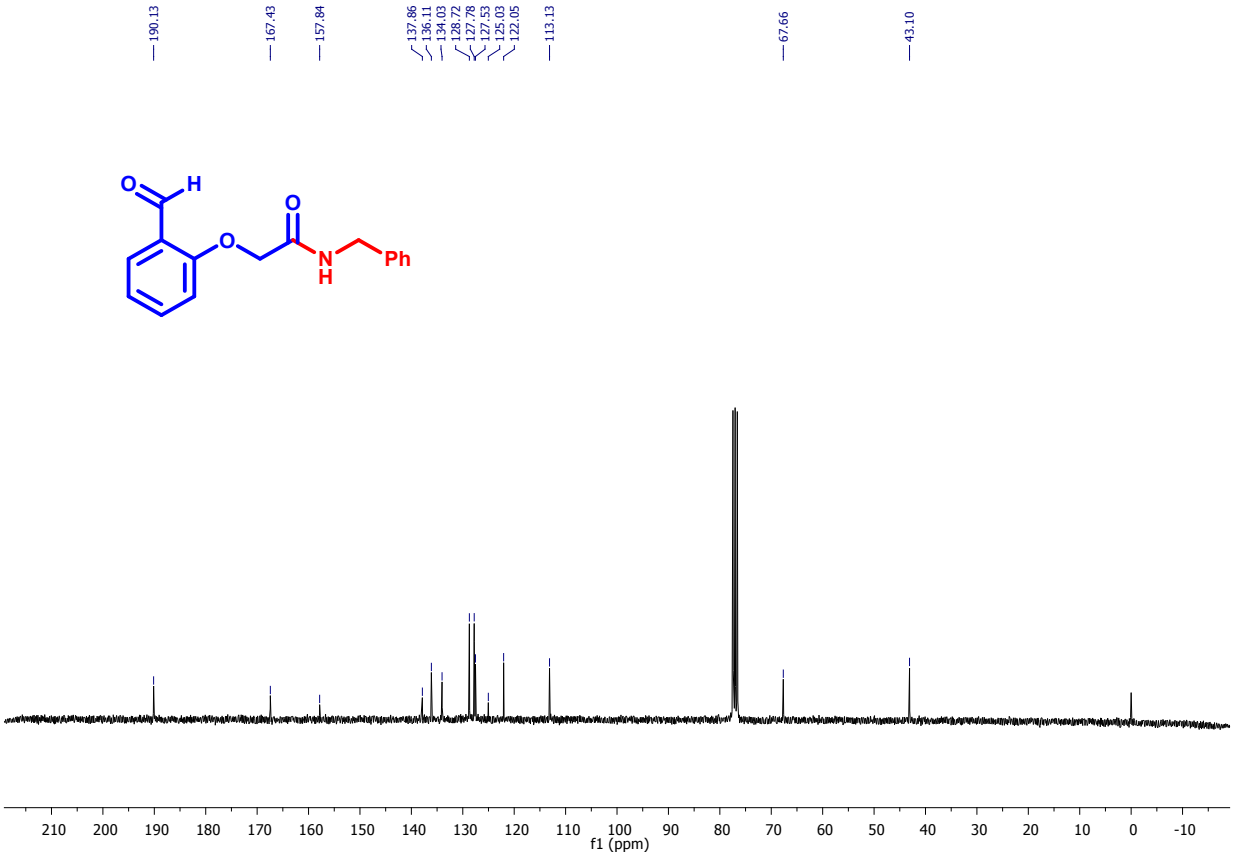
^{1}H NMR of *N1*,*N4*-dibenzylsuccinamide (3r)



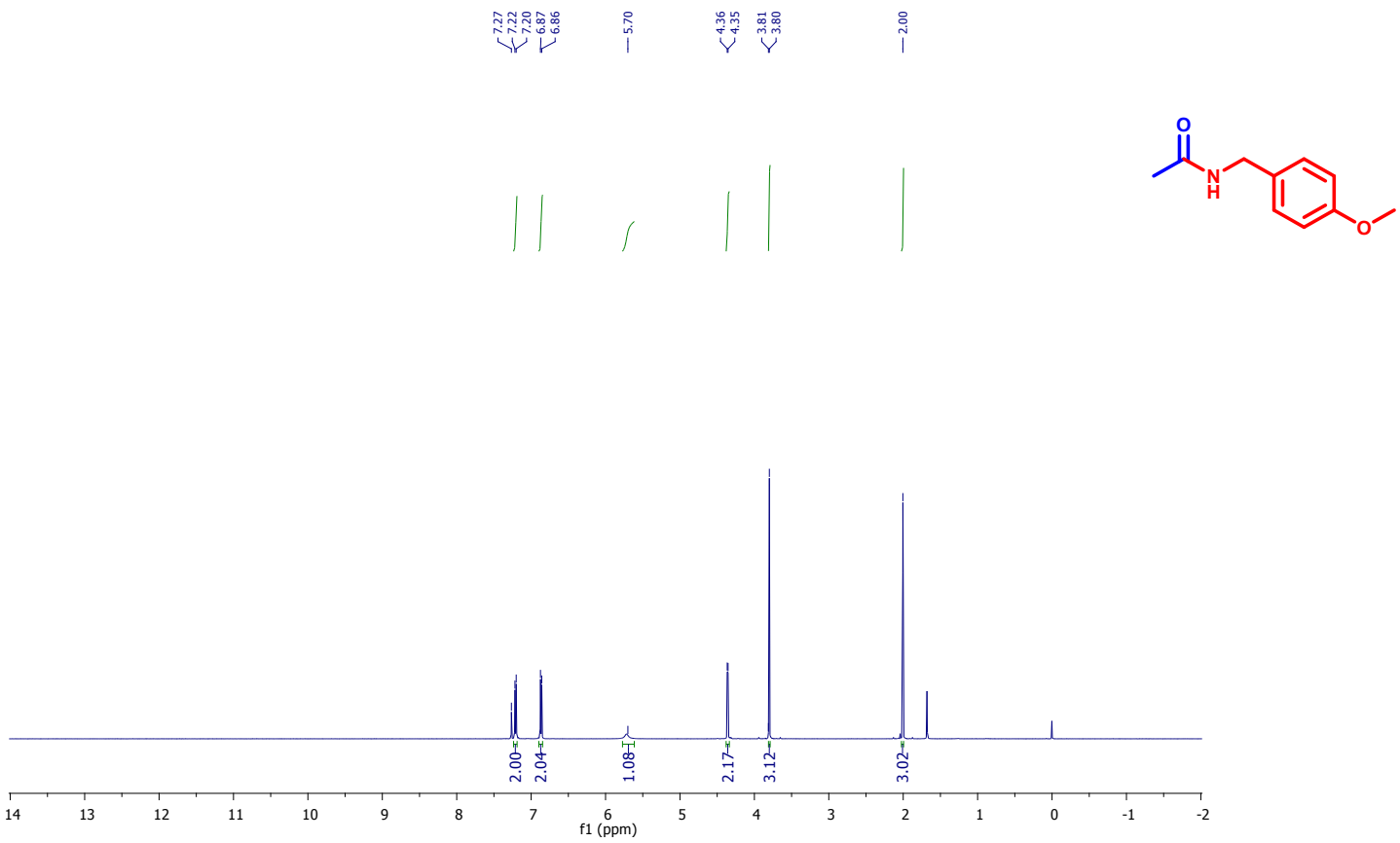
^{13}C NMR of N1,N4-dibenzylsuccinamide (3r)



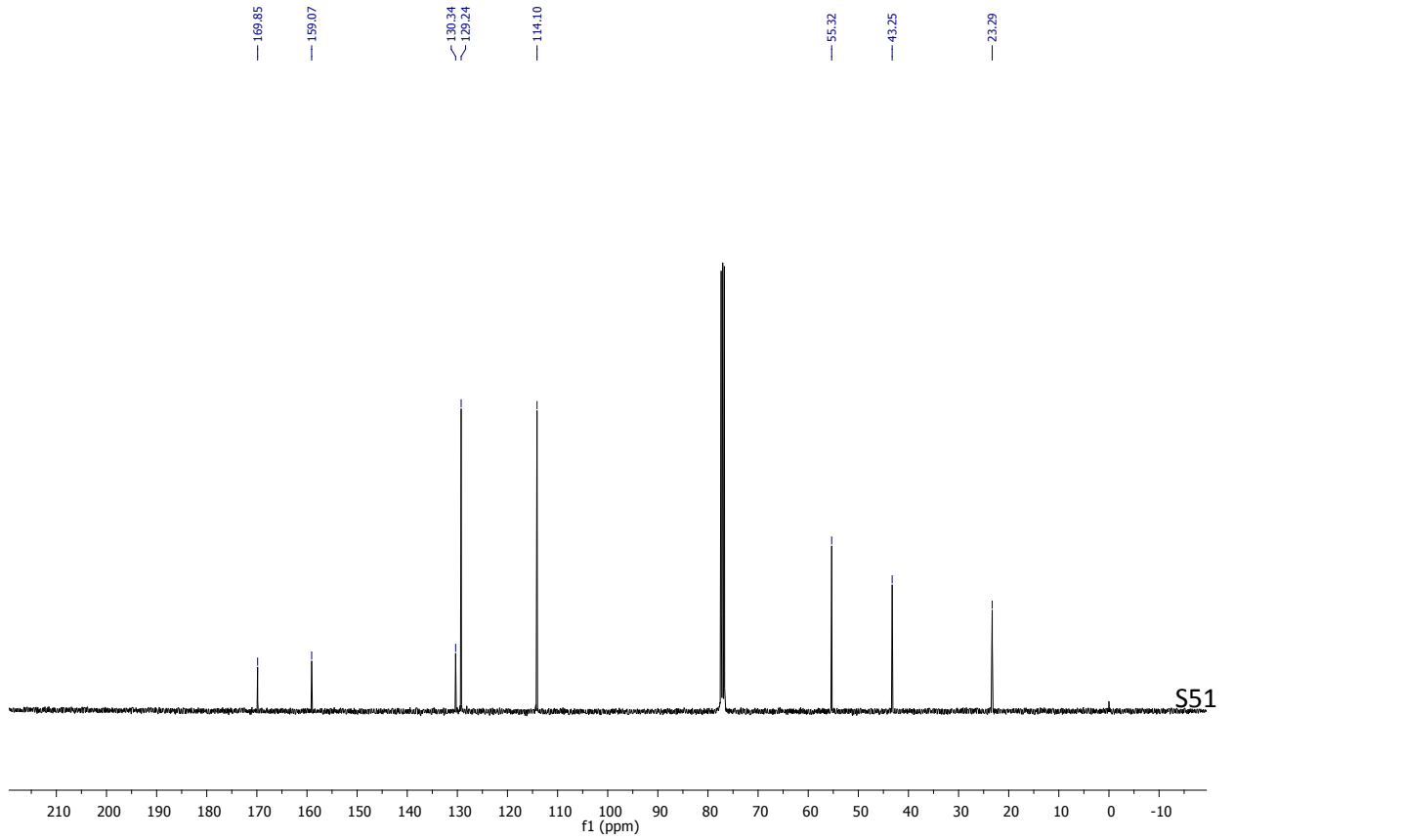
^{1}H NMR of N-benzyl-2-(2-formylphenoxy)acetamide (3s)

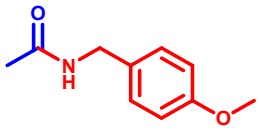


^{13}C NMR of N-benzyl-2-(2-formylphenoxy)acetamide (3s)

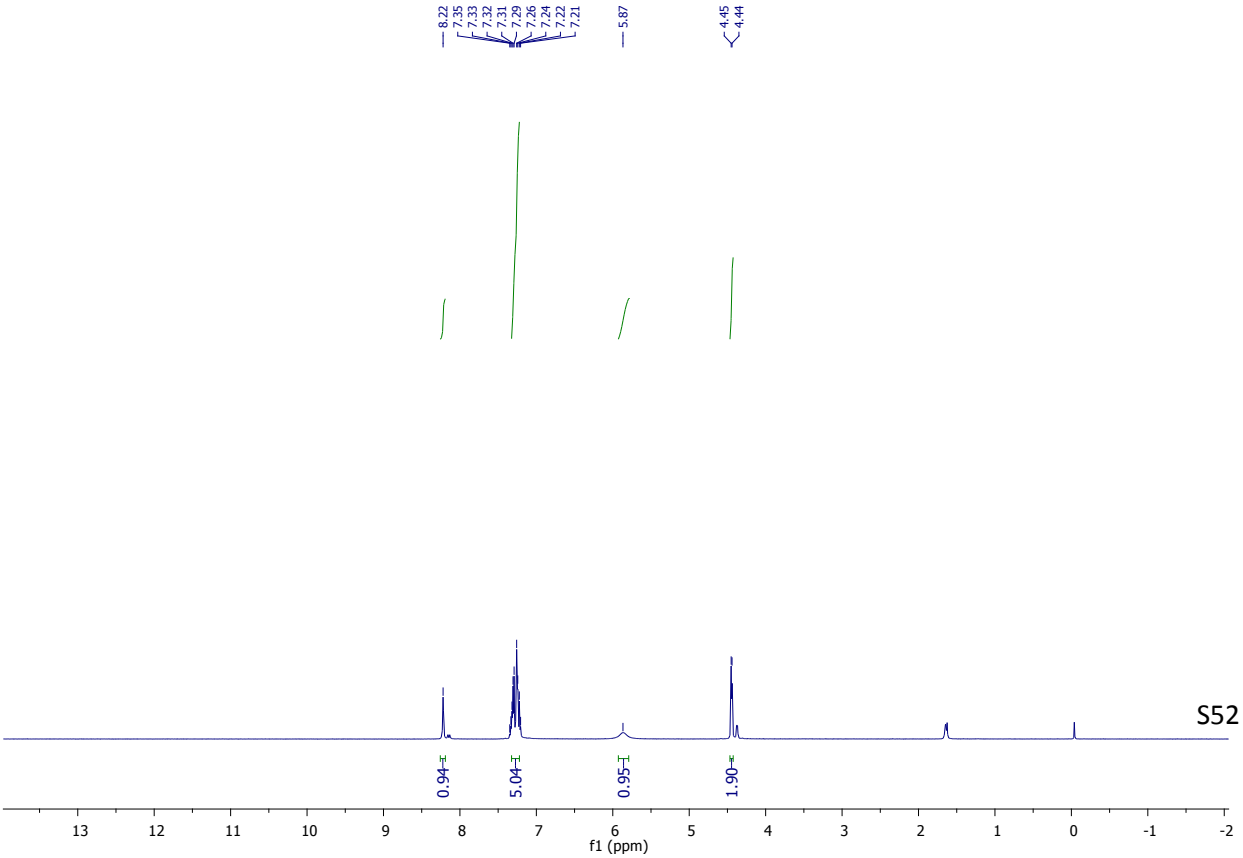


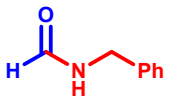
^{1}H NMR of N-(4-Methoxybenzyl) acetamide (3t)



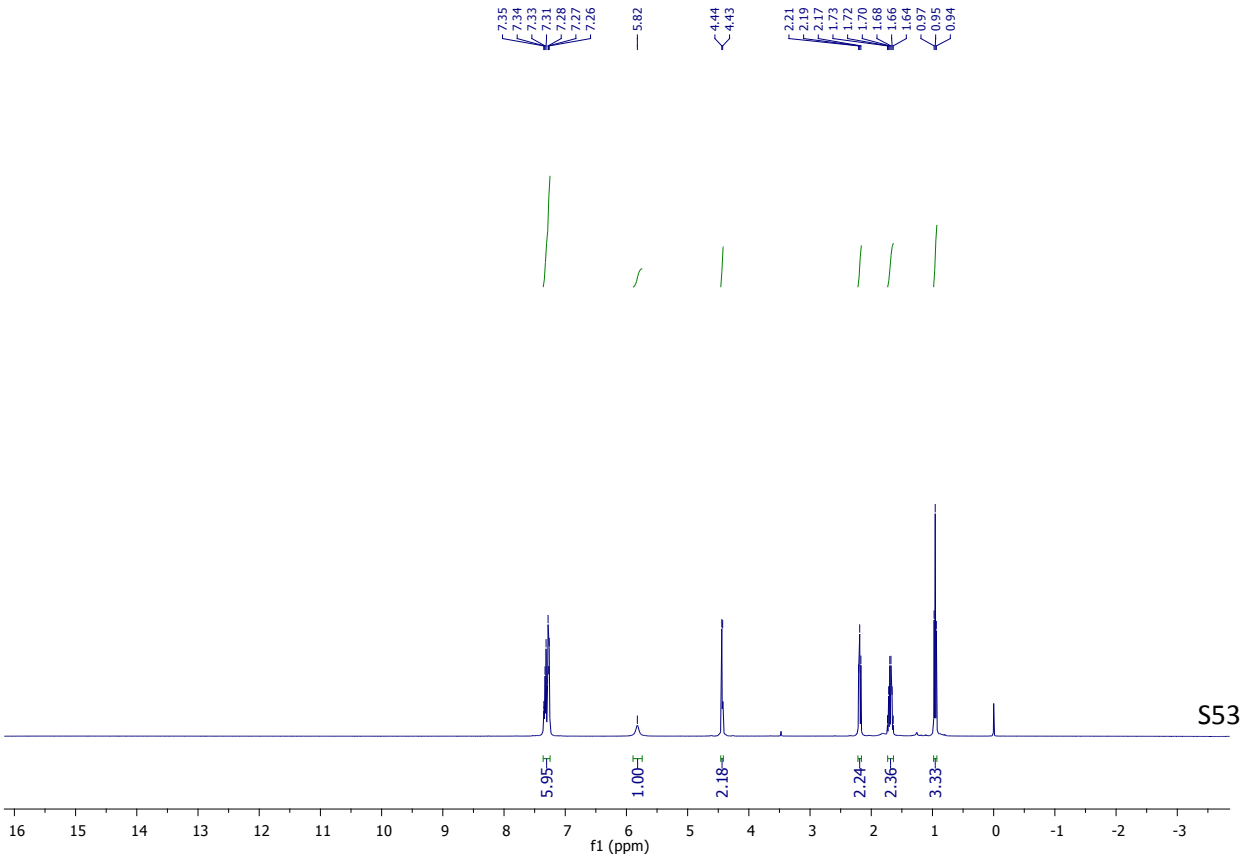


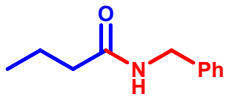
^{13}C NMR of N-(4-Methoxybenzyl) acetamide (3t)



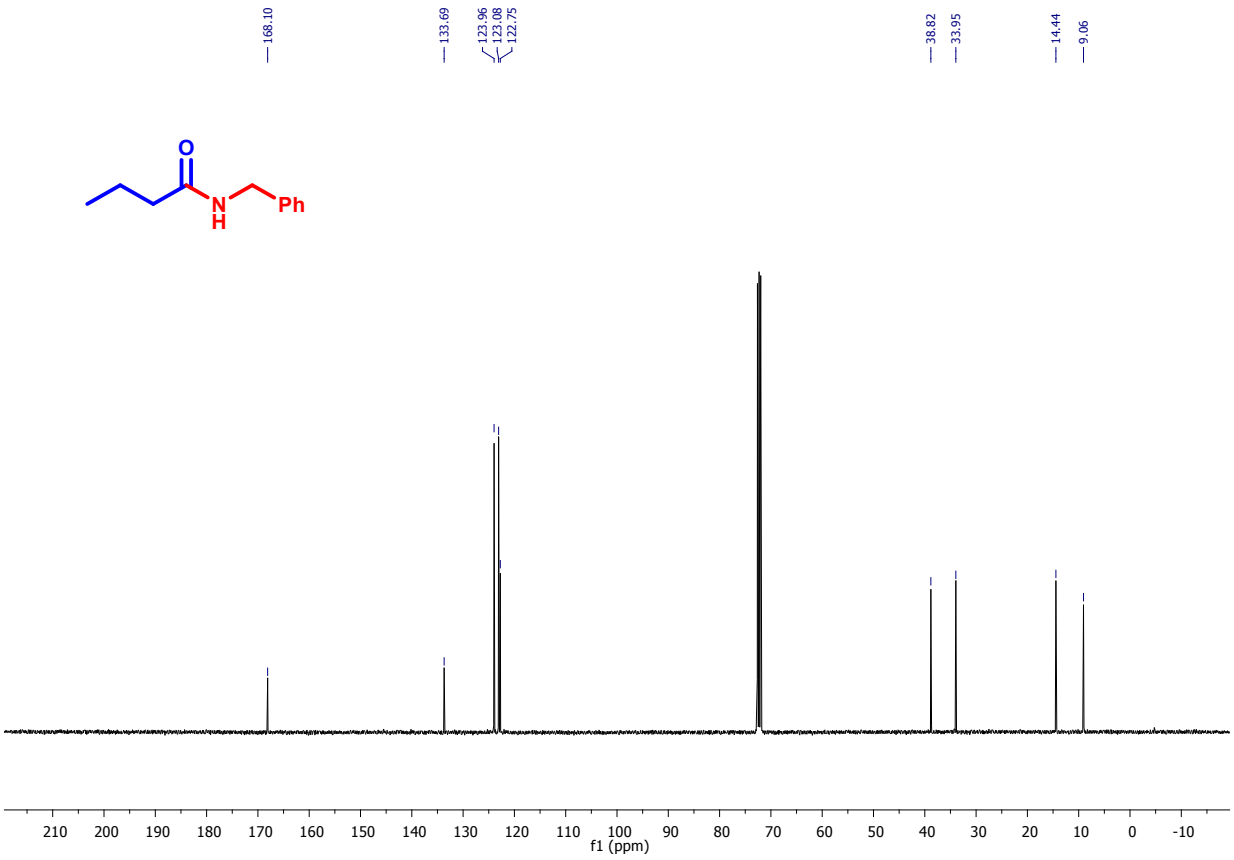


^{1}H NMR of N-Benzylformamide (3u)

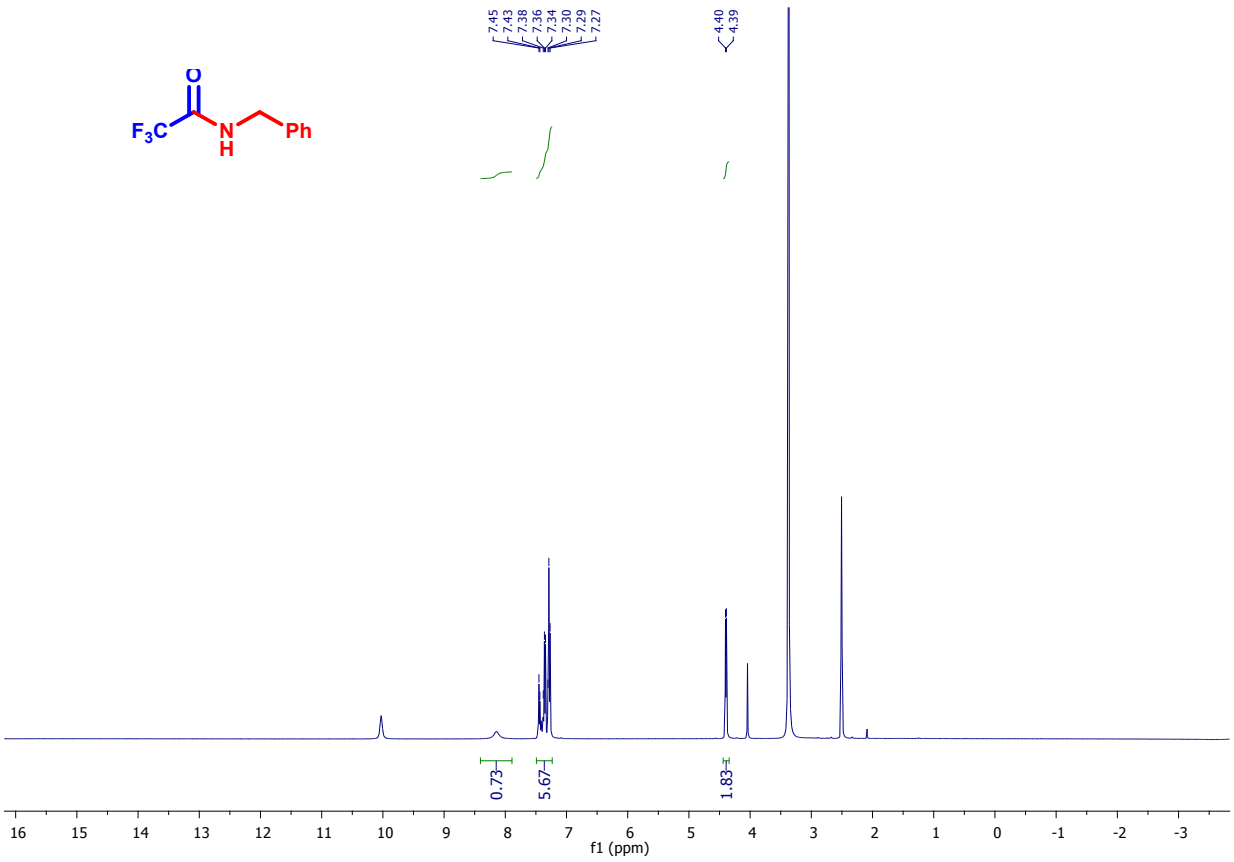




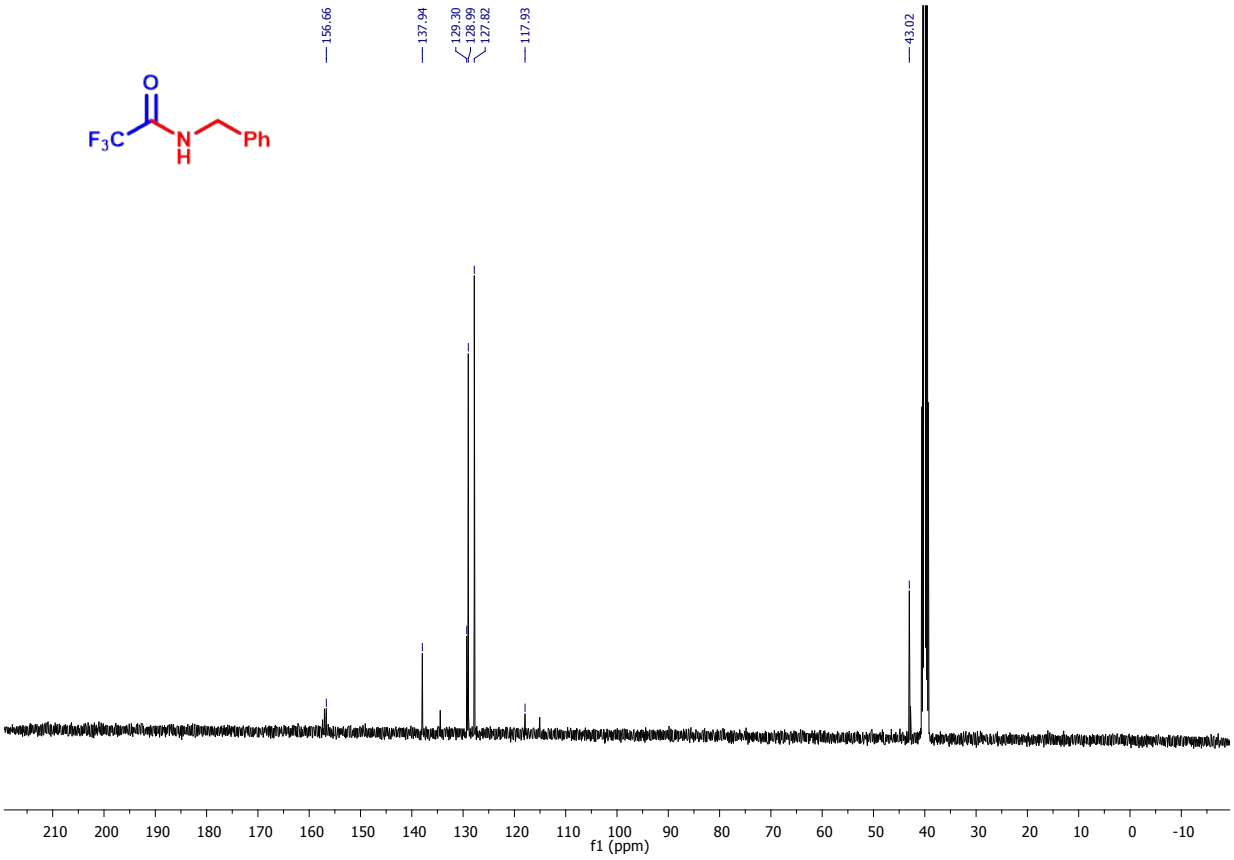
^{1}H NMR of N-benzylbutyramide (3v)



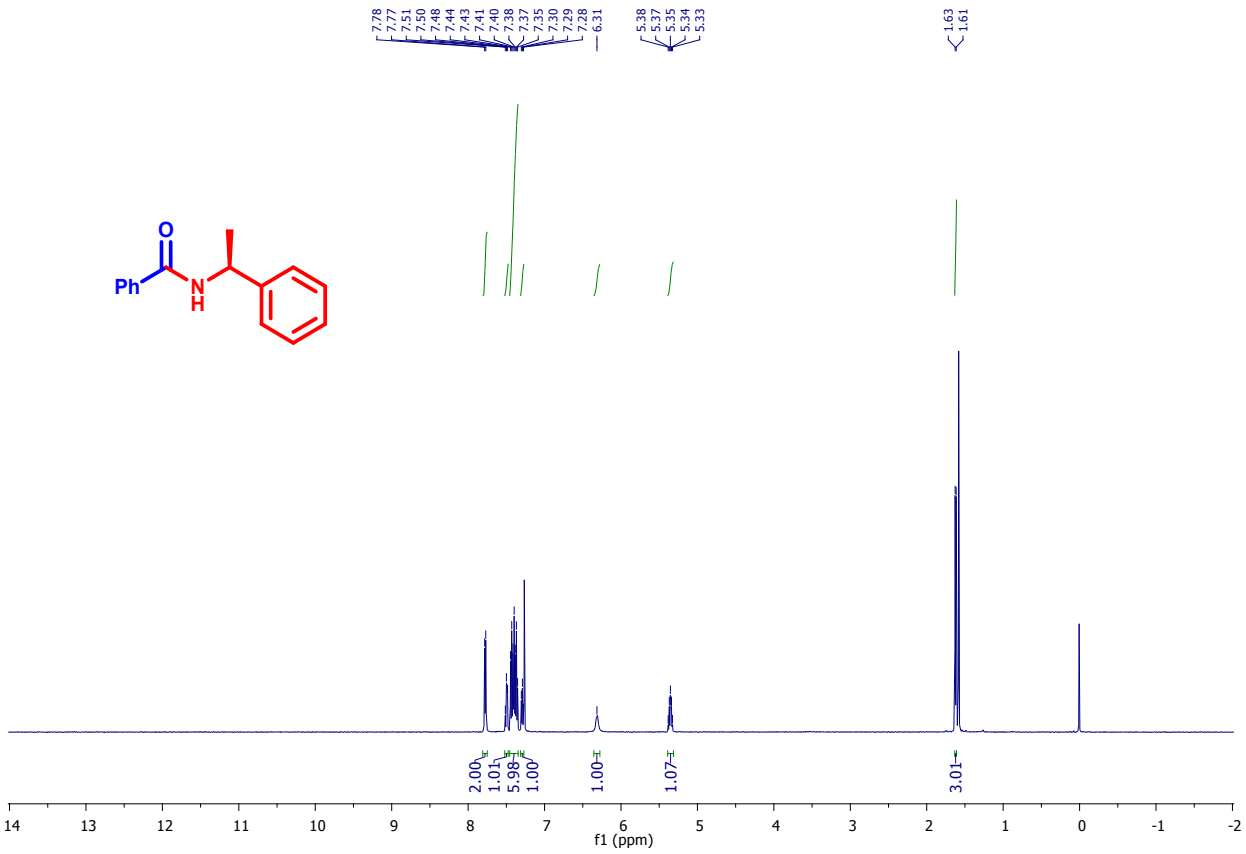
^{13}C NMR of N-benzylbutyramide (3v)



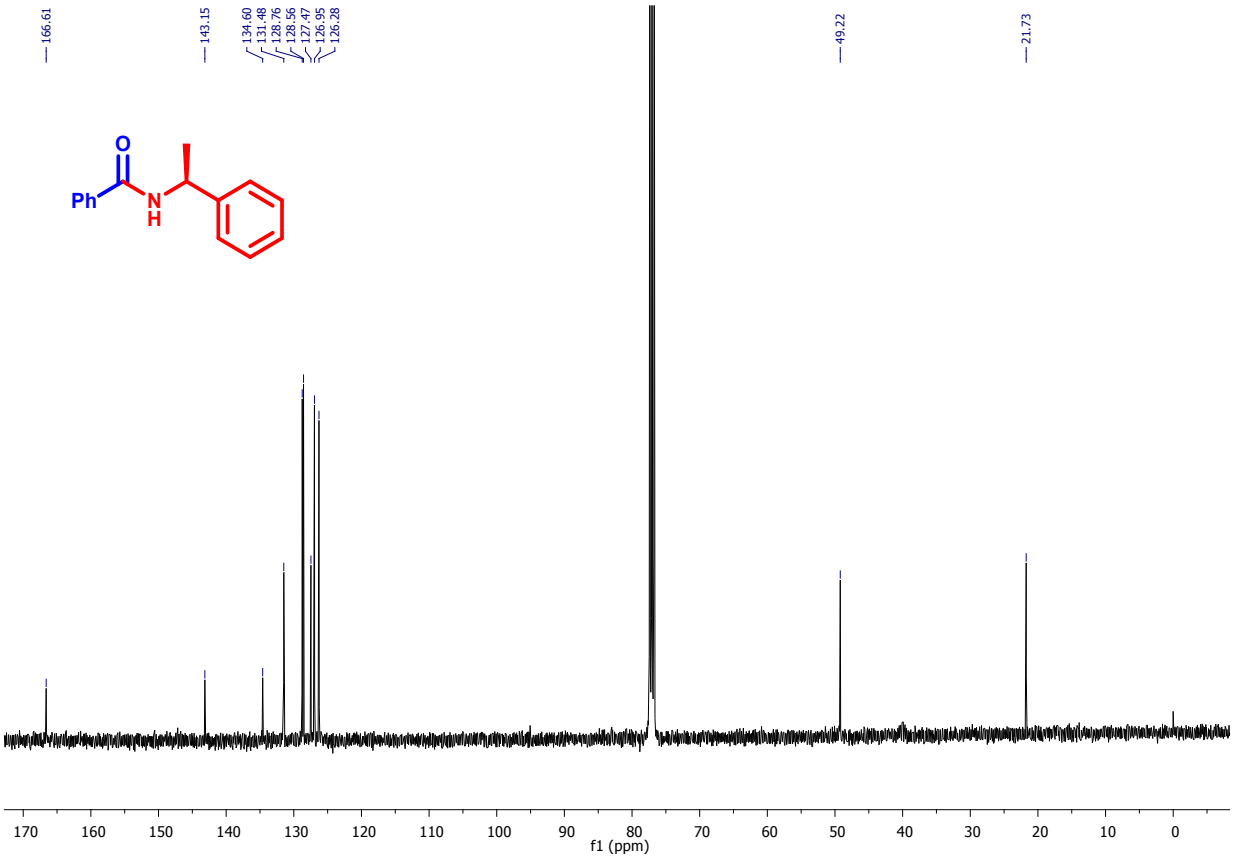
^{1}H NMR of *N*-benzyl-2,2,2-trifluoroacetamide (3x)



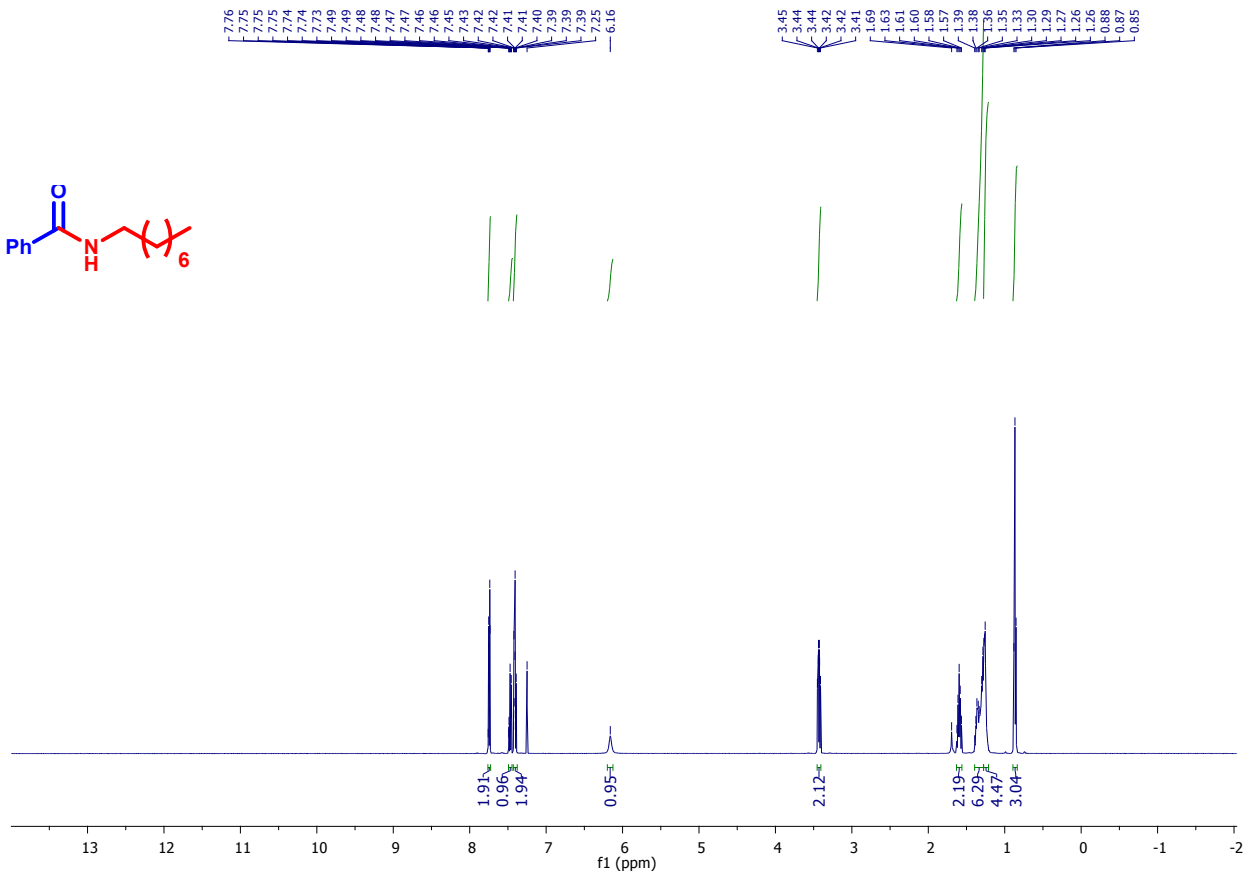
^{13}C NMR of *N*-benzyl-2,2,2-trifluoroacetamide (3x)



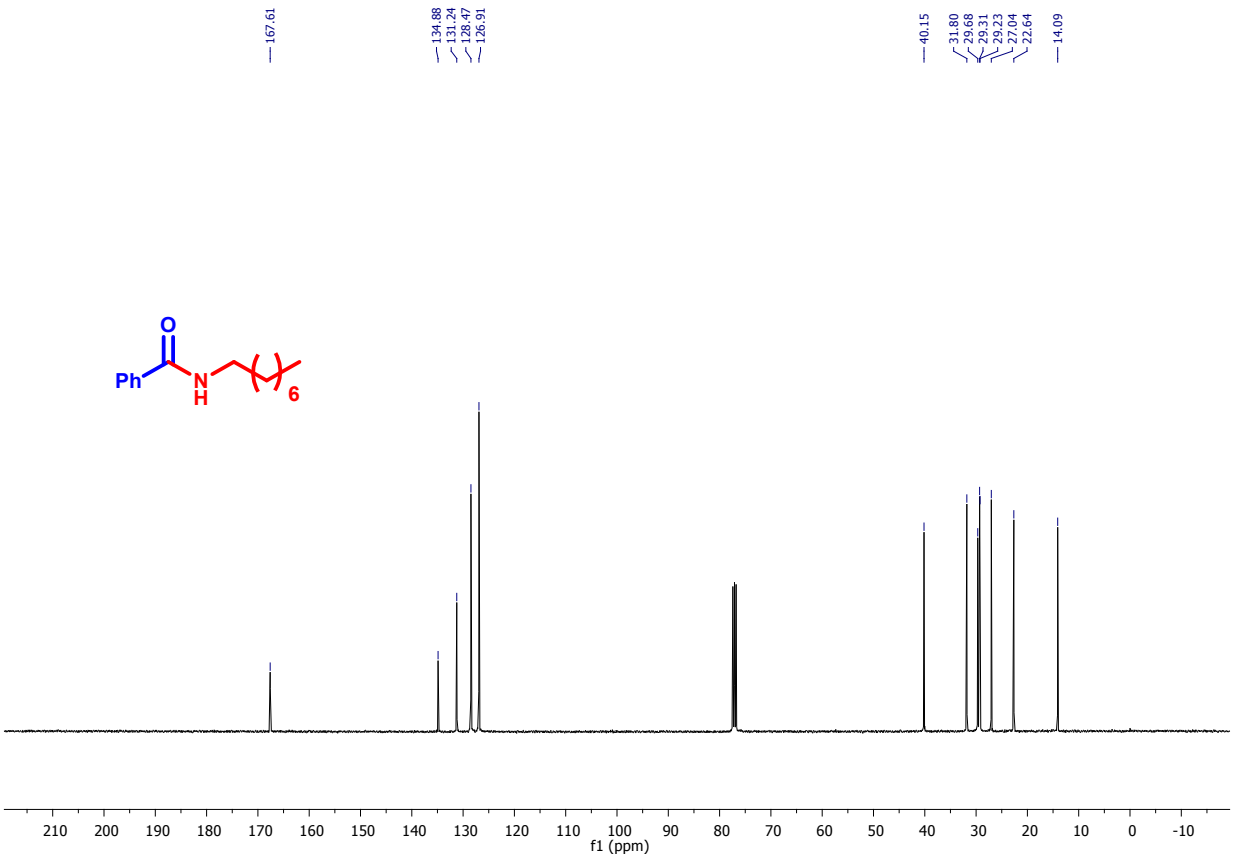
^{1}H NMR of (S)-N-(1-Phenylethyl) benzamide (5f)



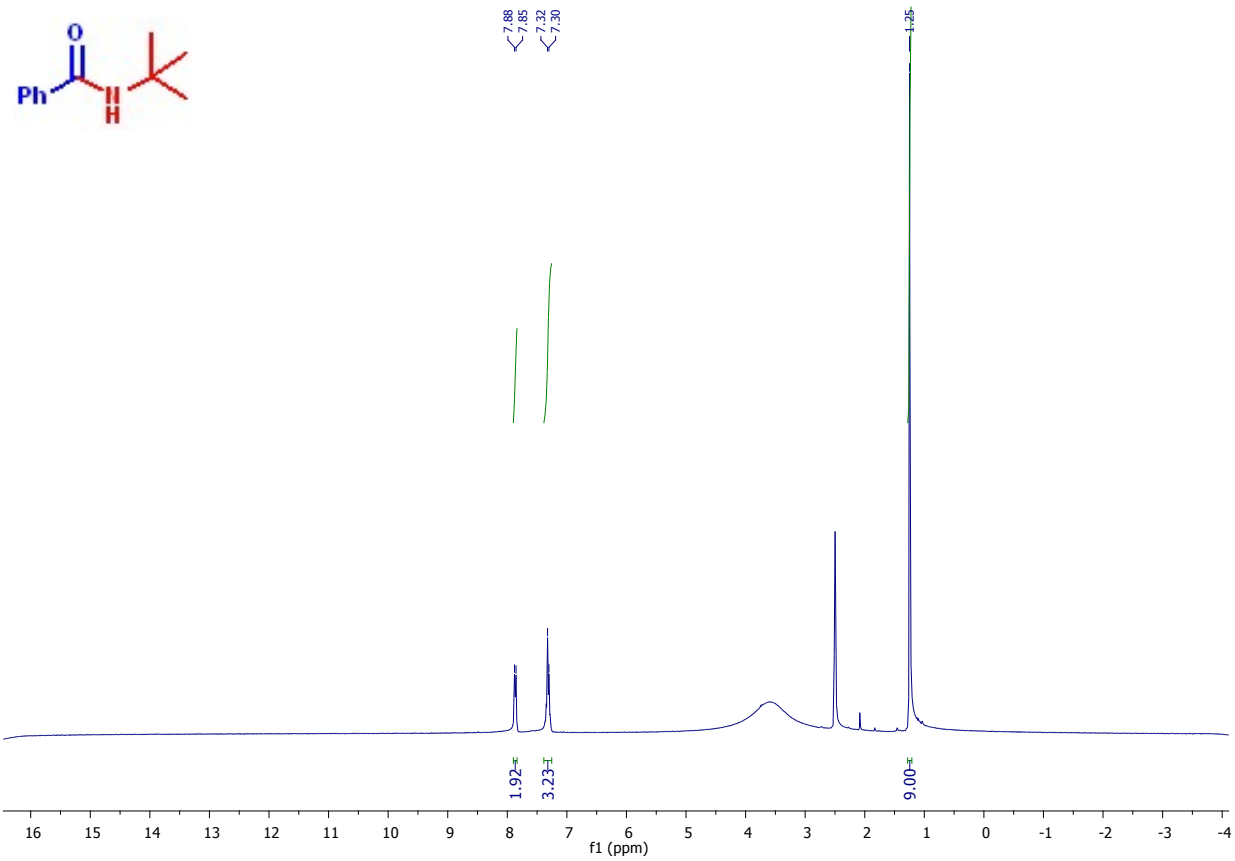
^{13}C NMR of (S)-N-(1-Phenylethyl) benzamide (5f)



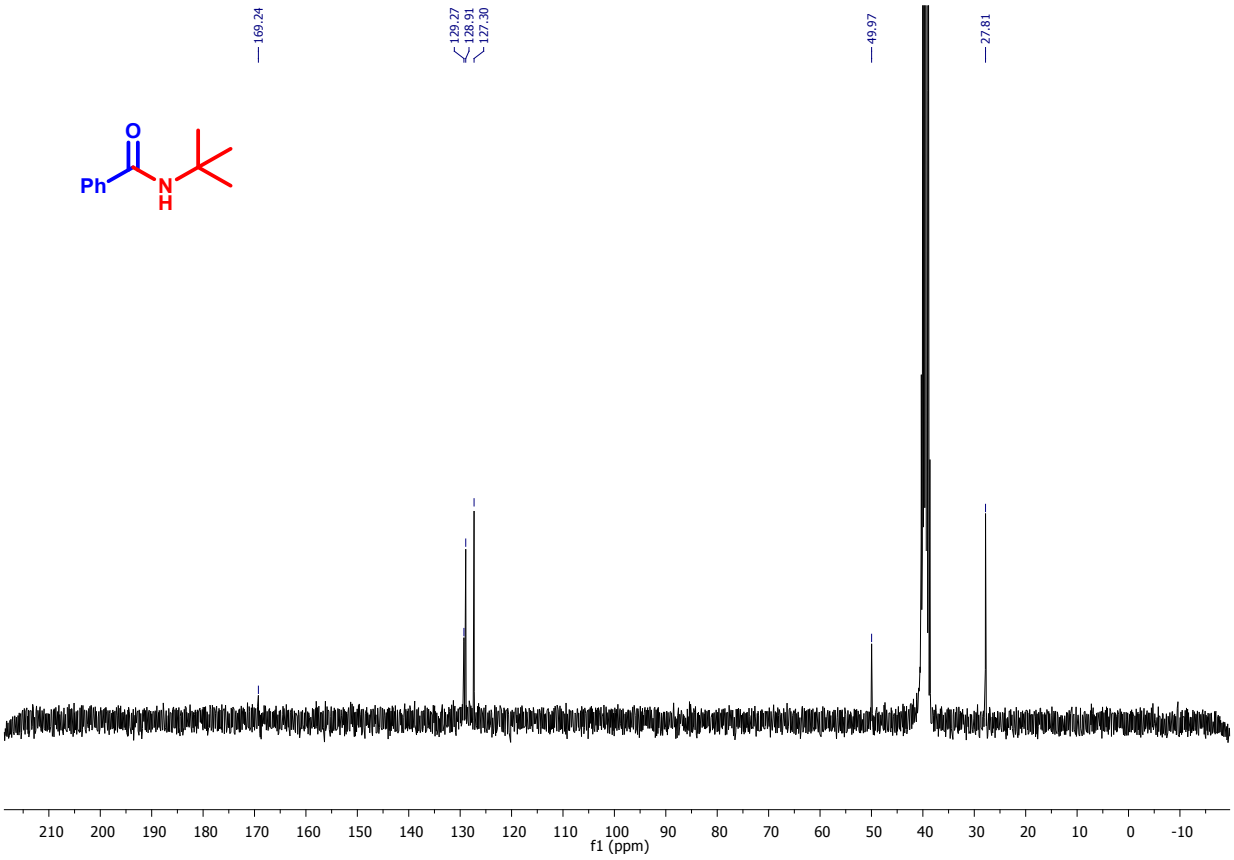
^{1}H NMR of N-Octylbenzamide(5g)


167.61
134.88
131.24
128.47
126.91
40.15
31.80
29.68
29.31
29.23
27.04
22.64
14.09
O
Ph
N
H
6
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

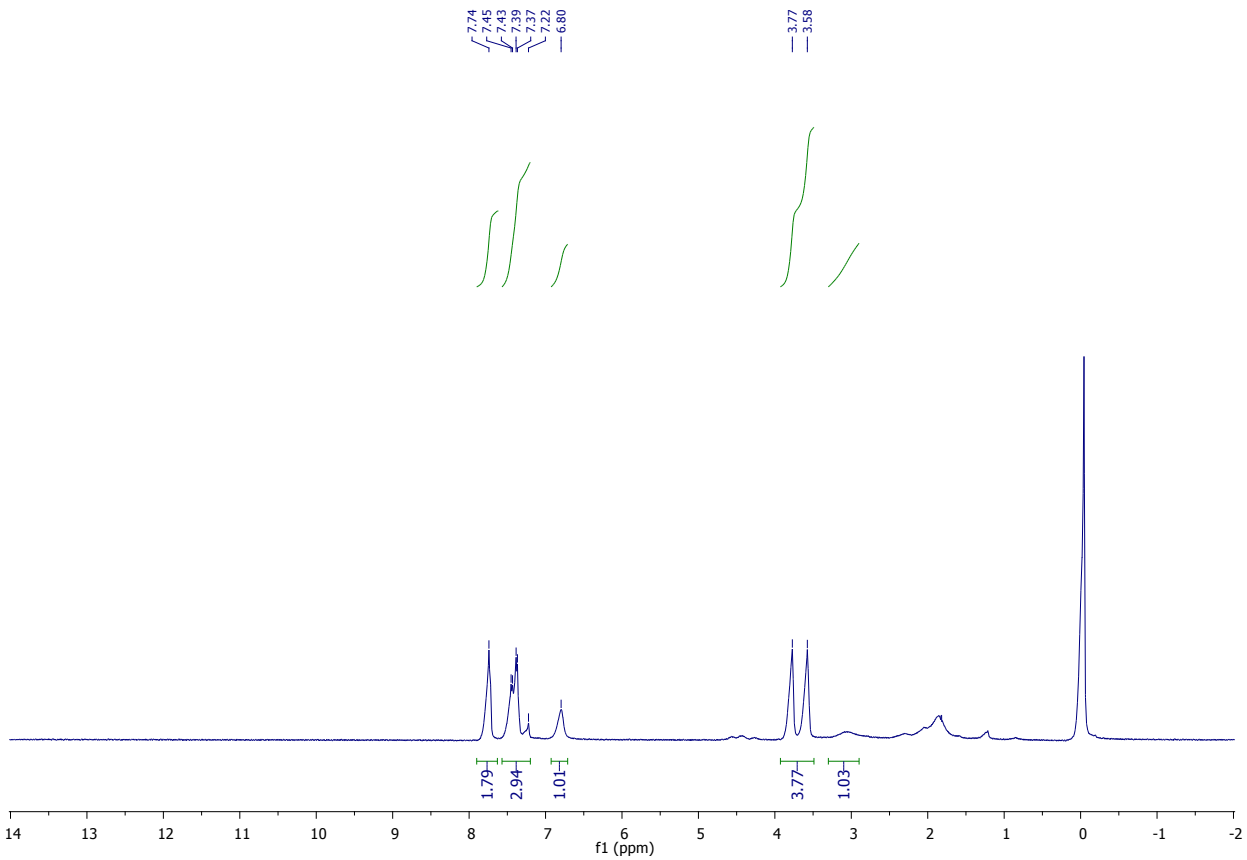
^{13}C NMR of N-Octylbenzamide (5g)



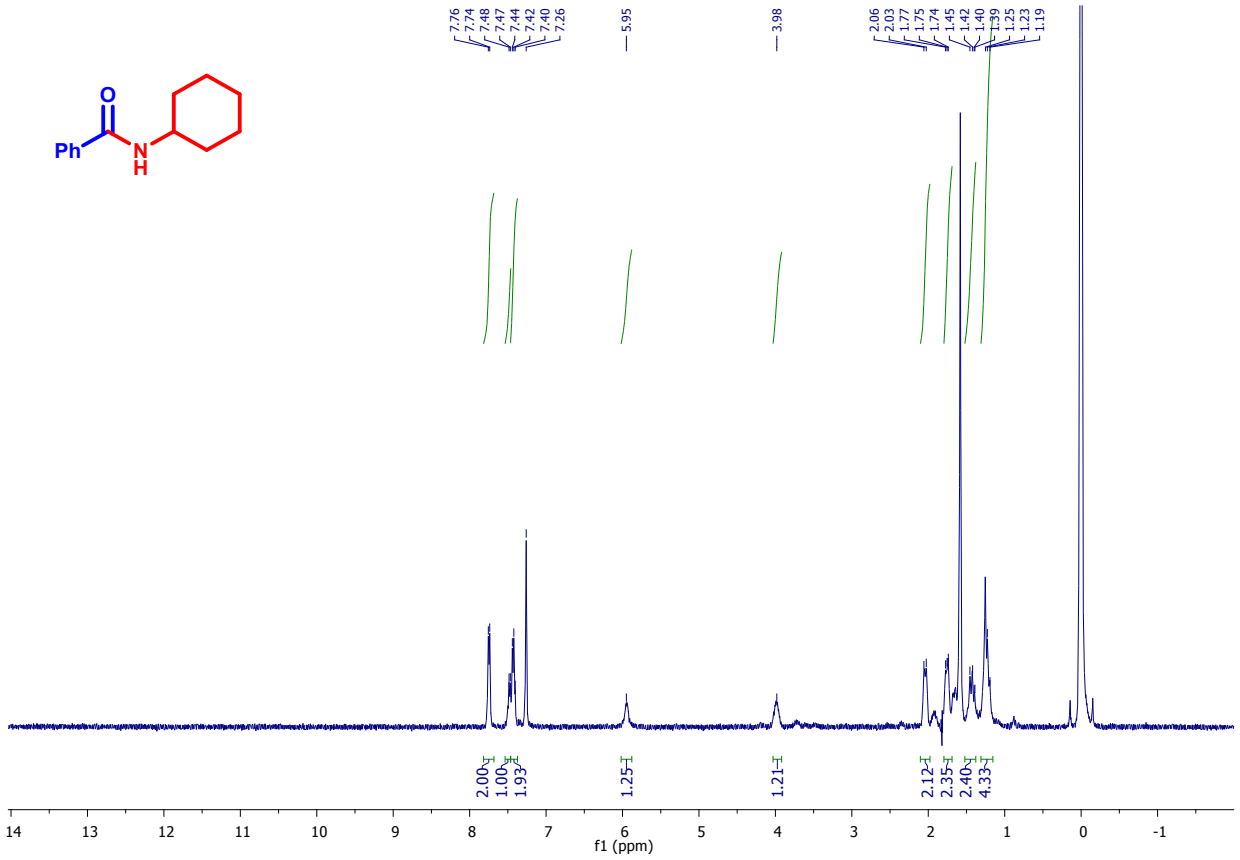
^{1}H NMR of N-(tert-butyl)benzamide (5i)



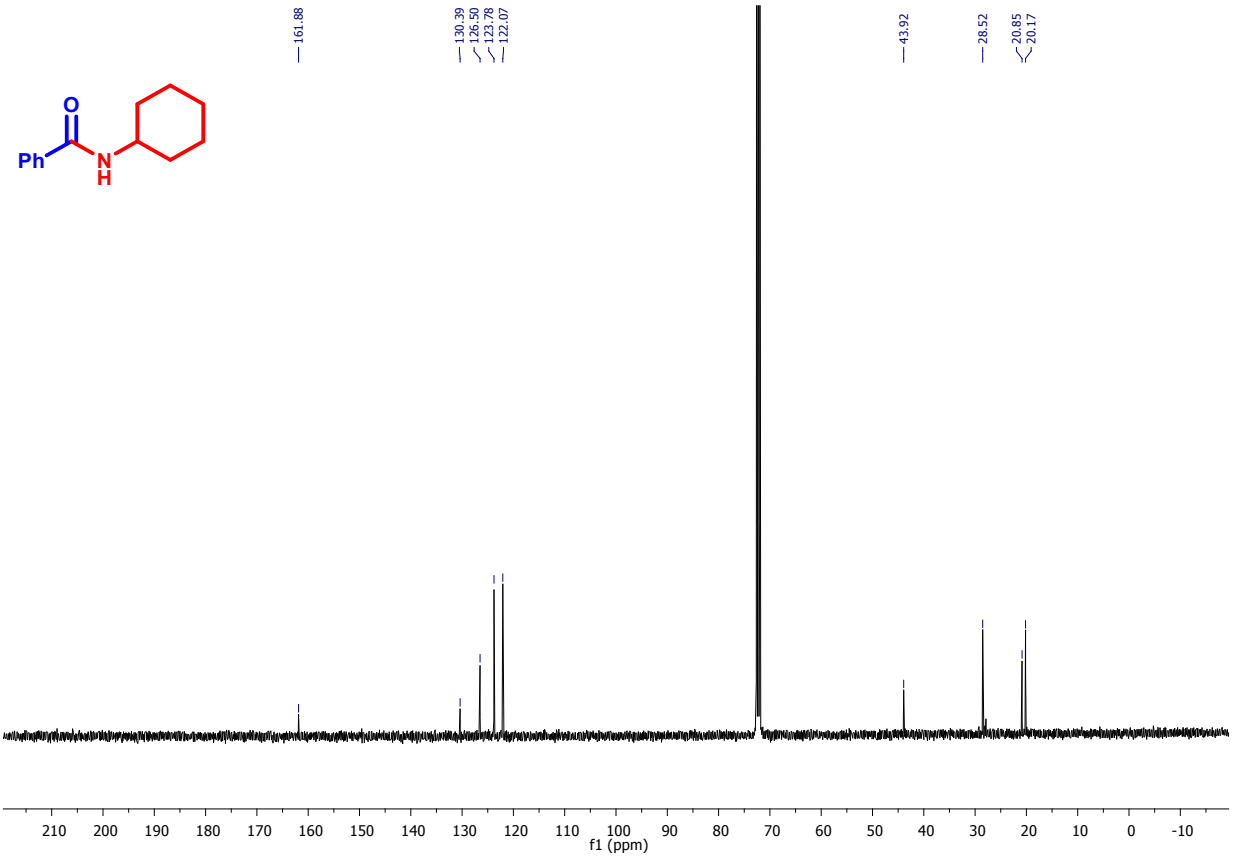
^{13}C NMR of N-(tert-butyl)benzamide (5i)



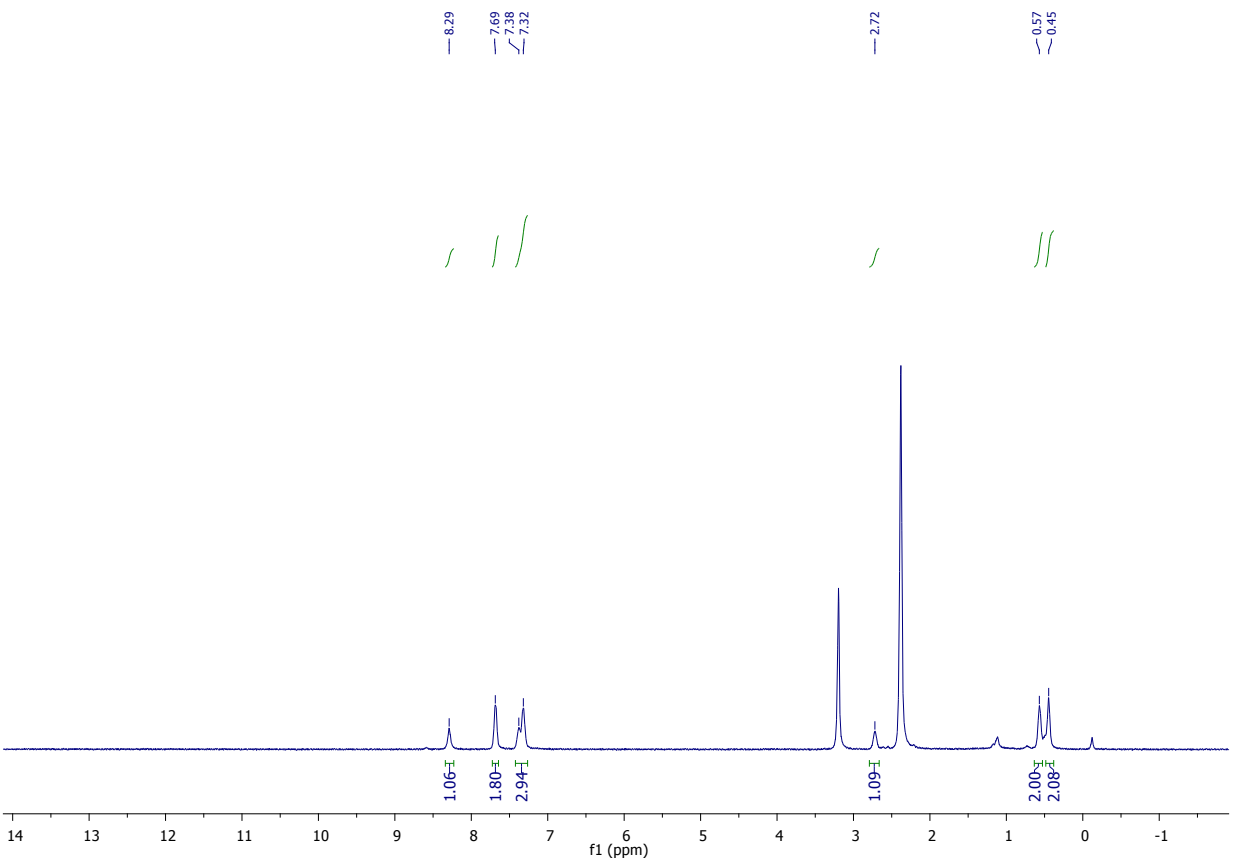
^{1}H NMR of N-(2-hydroxyethyl)benzamide (5j)



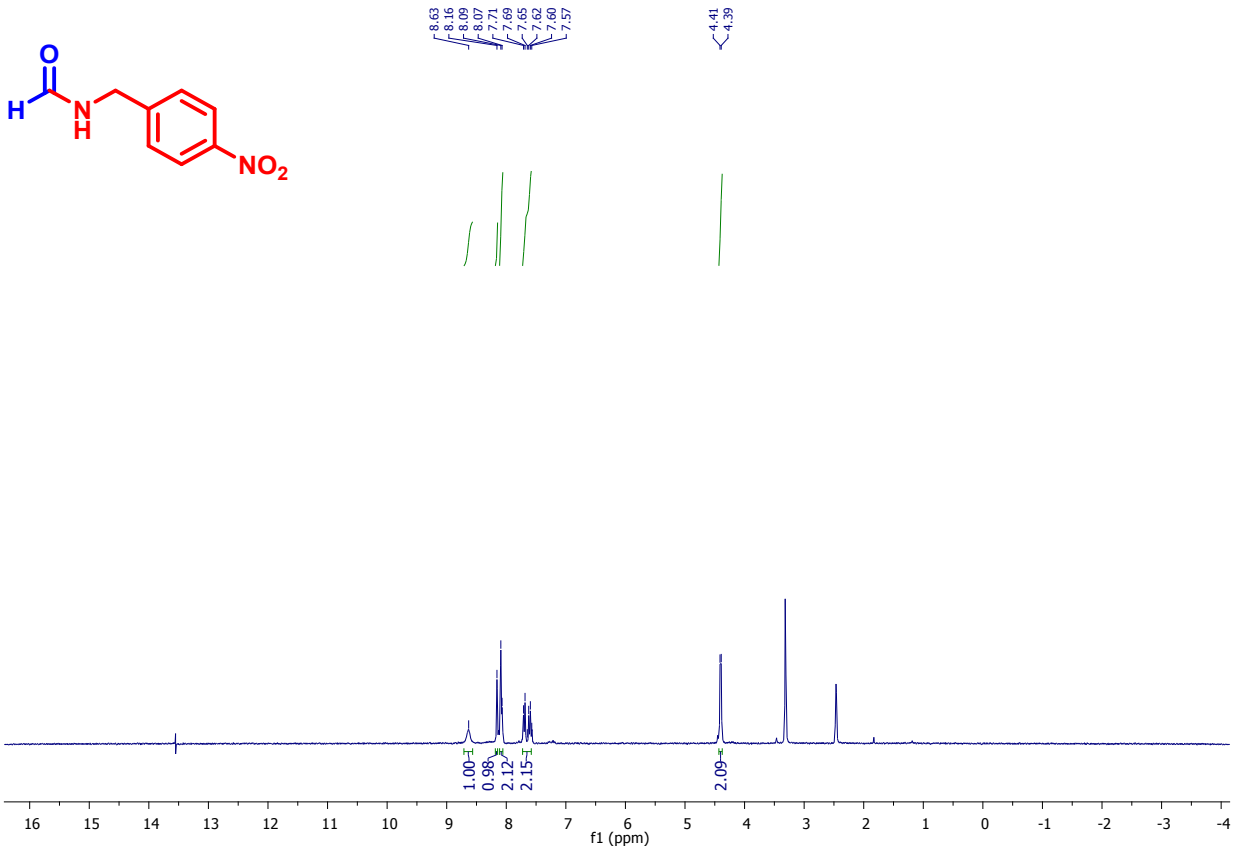
^{1}H NMR of N-Cyclohexylbenzamide (5k)



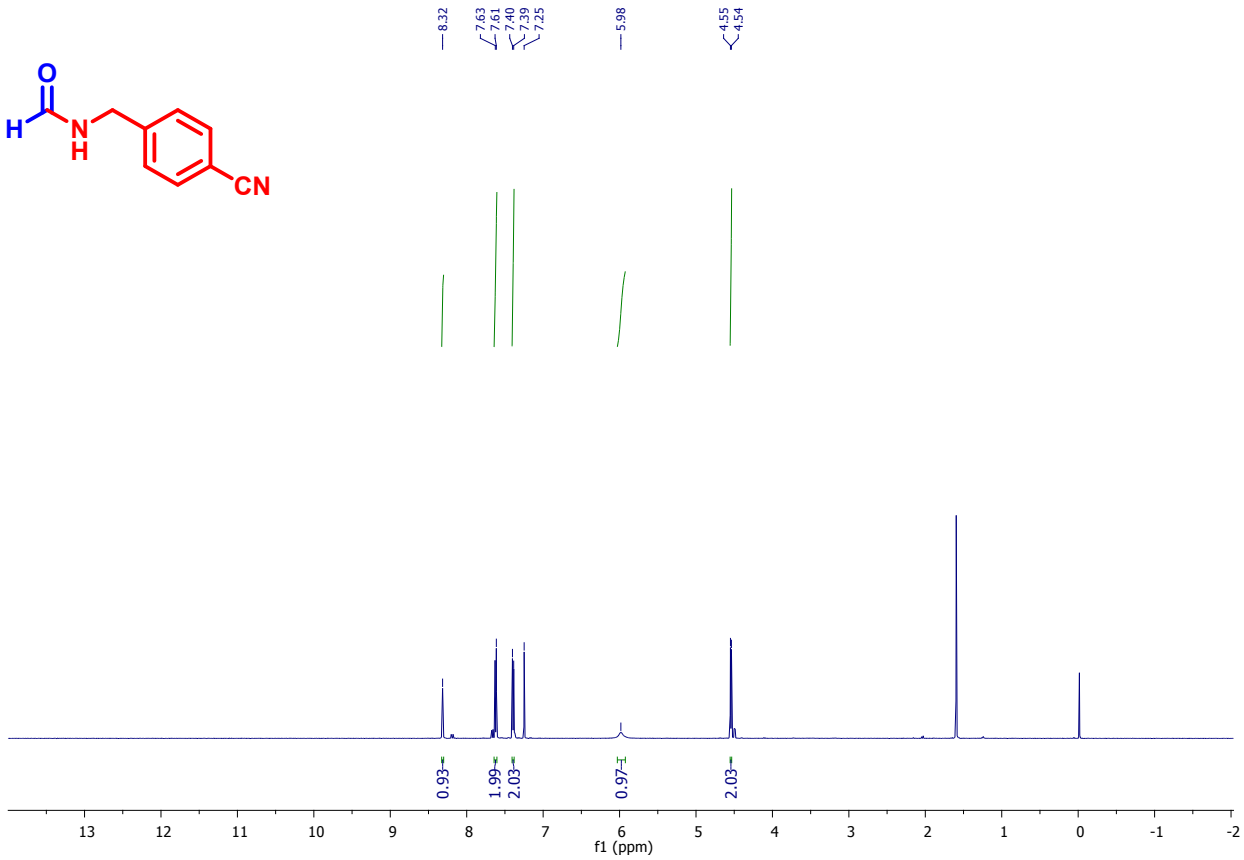
^{13}C NMR of N-Cyclohexylbenzamide (5k)



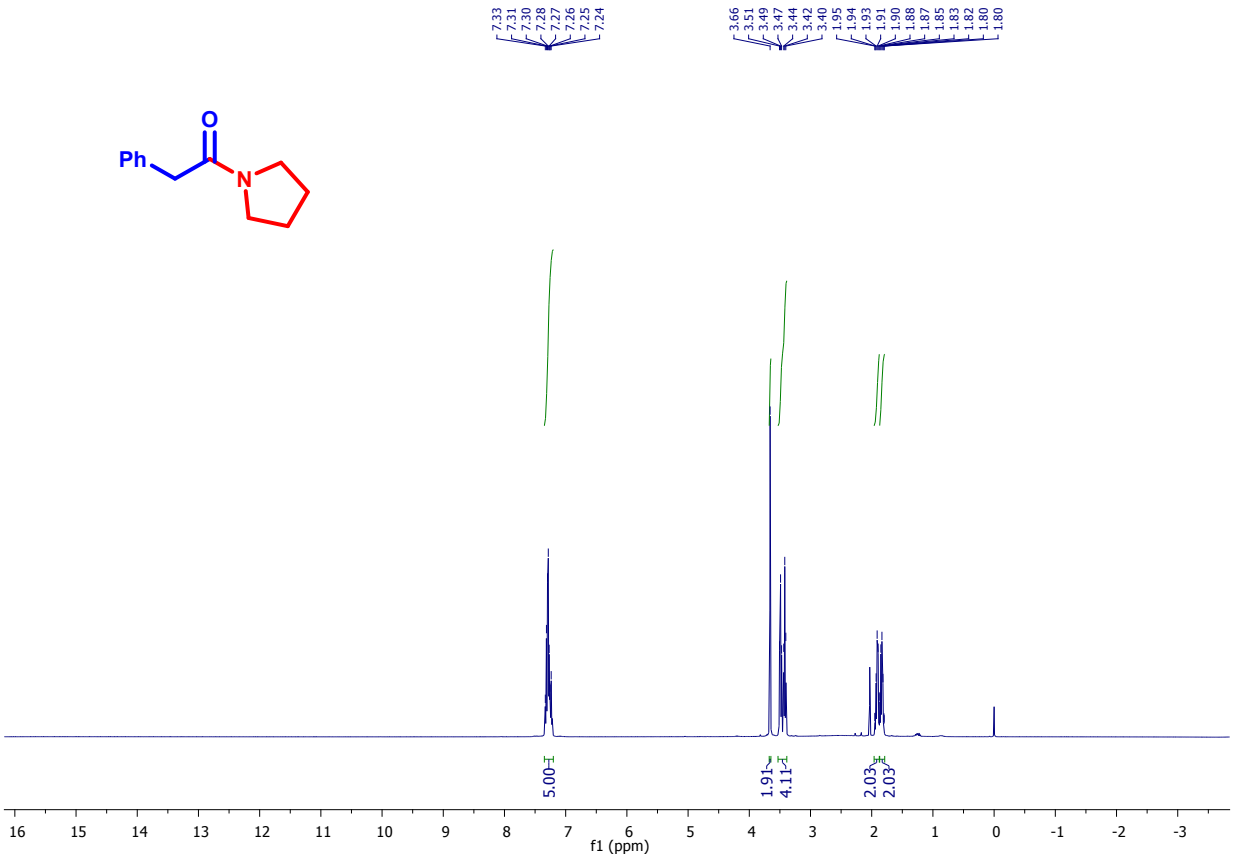
^{1}H NMR of N-Cyclopropylbenzamide (5l)



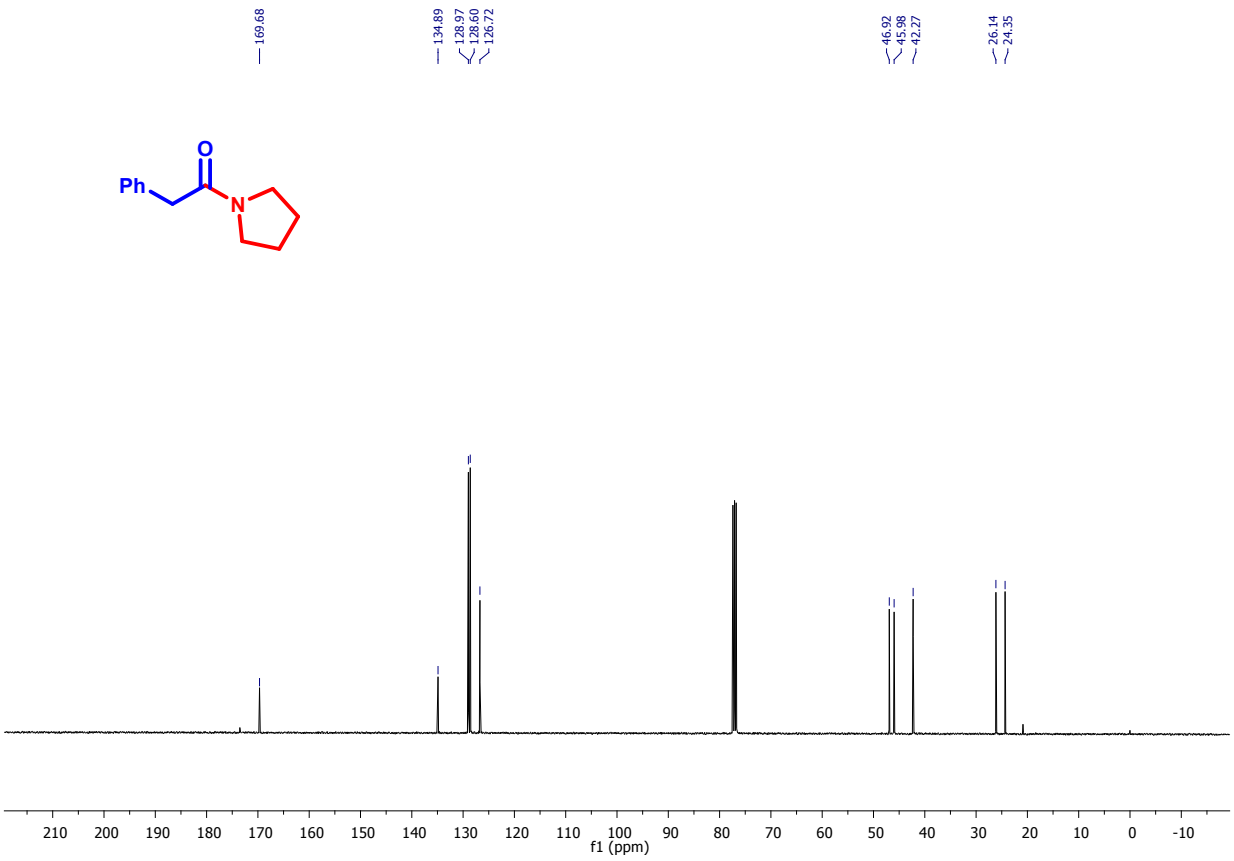
^{1}H NMR of N-(4-Nitrobenzyl) formamide (5m)



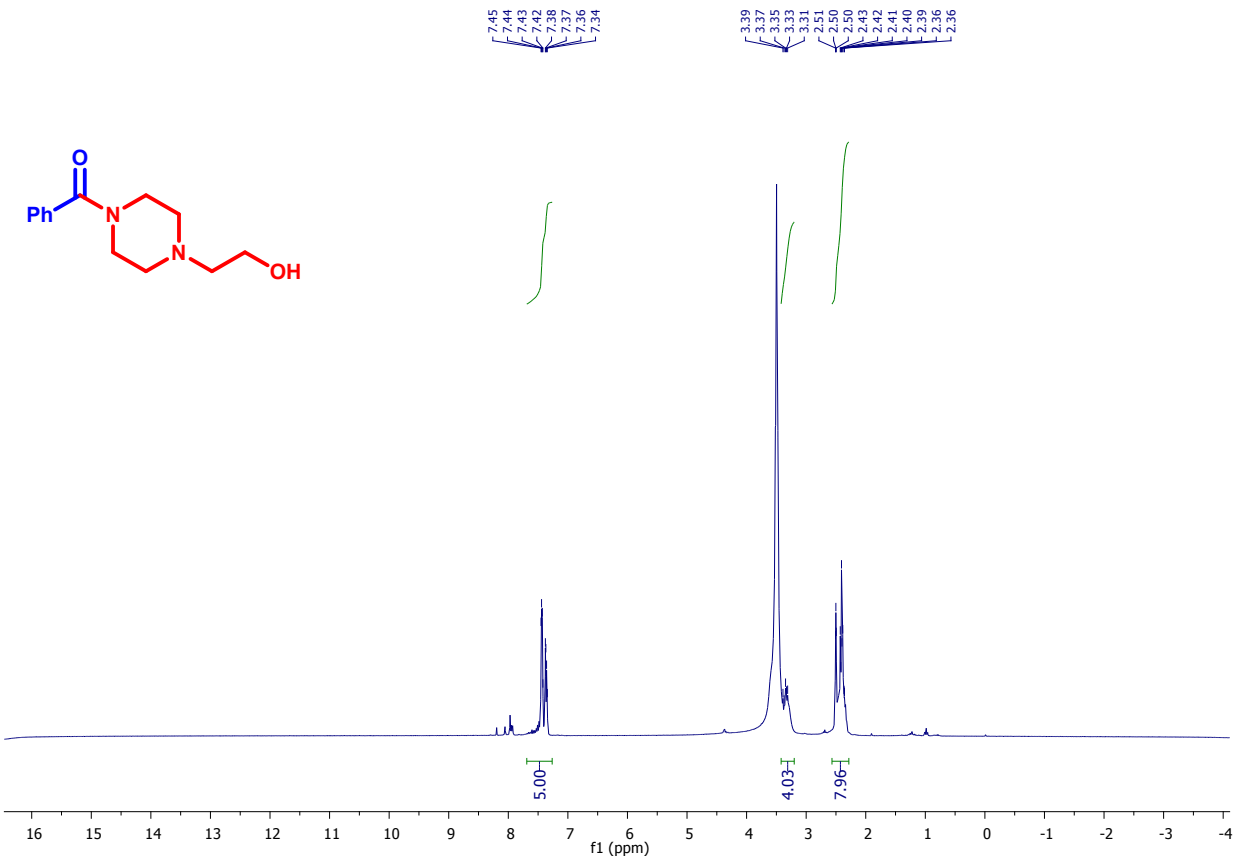
^{1}H NMR of N-(4-Cyanobenzyl) formamide (5n)



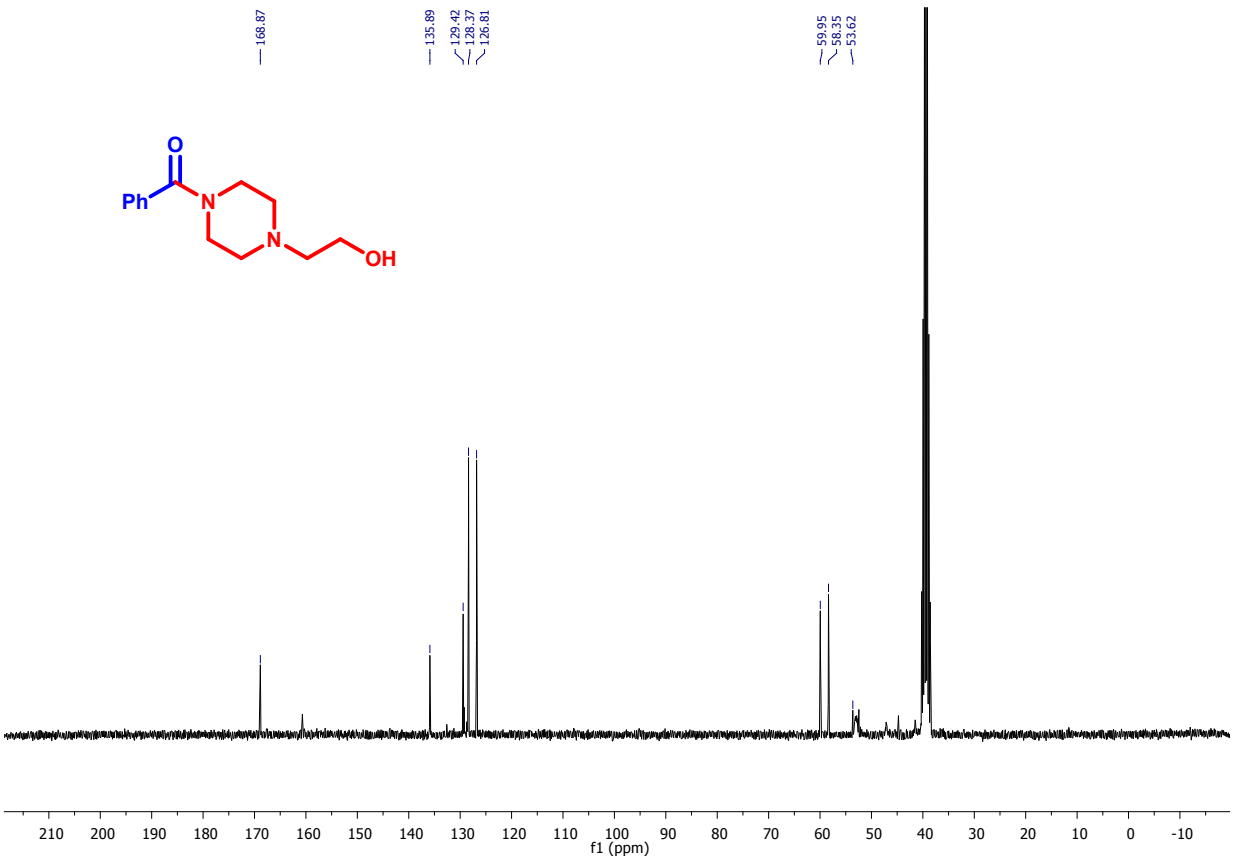
^{1}H NMR of 2-phenyl-1-(pyrrolidin-1-yl)ethan-1-one (5p)



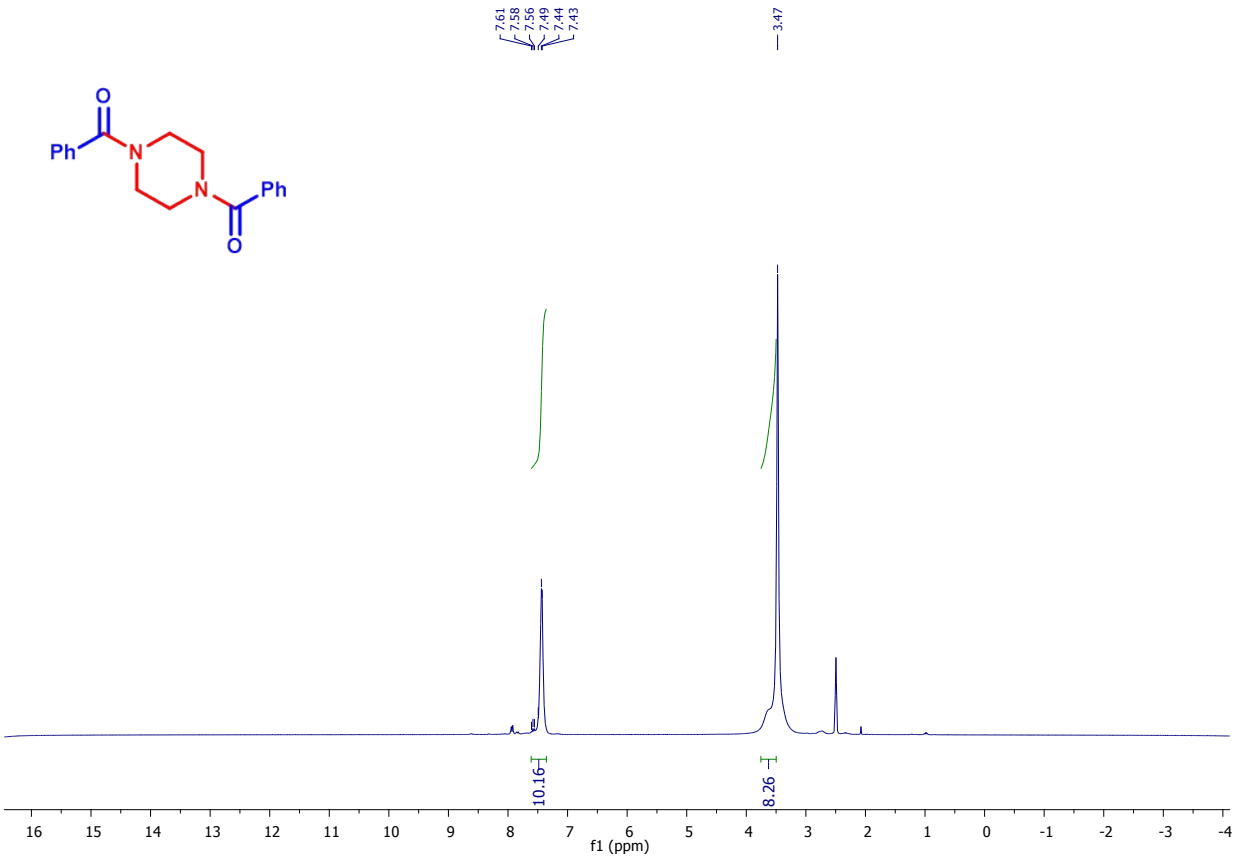
^{13}C NMR of 2-phenyl-1-(pyrrolidin-1-yl)ethan-1-one (5p)



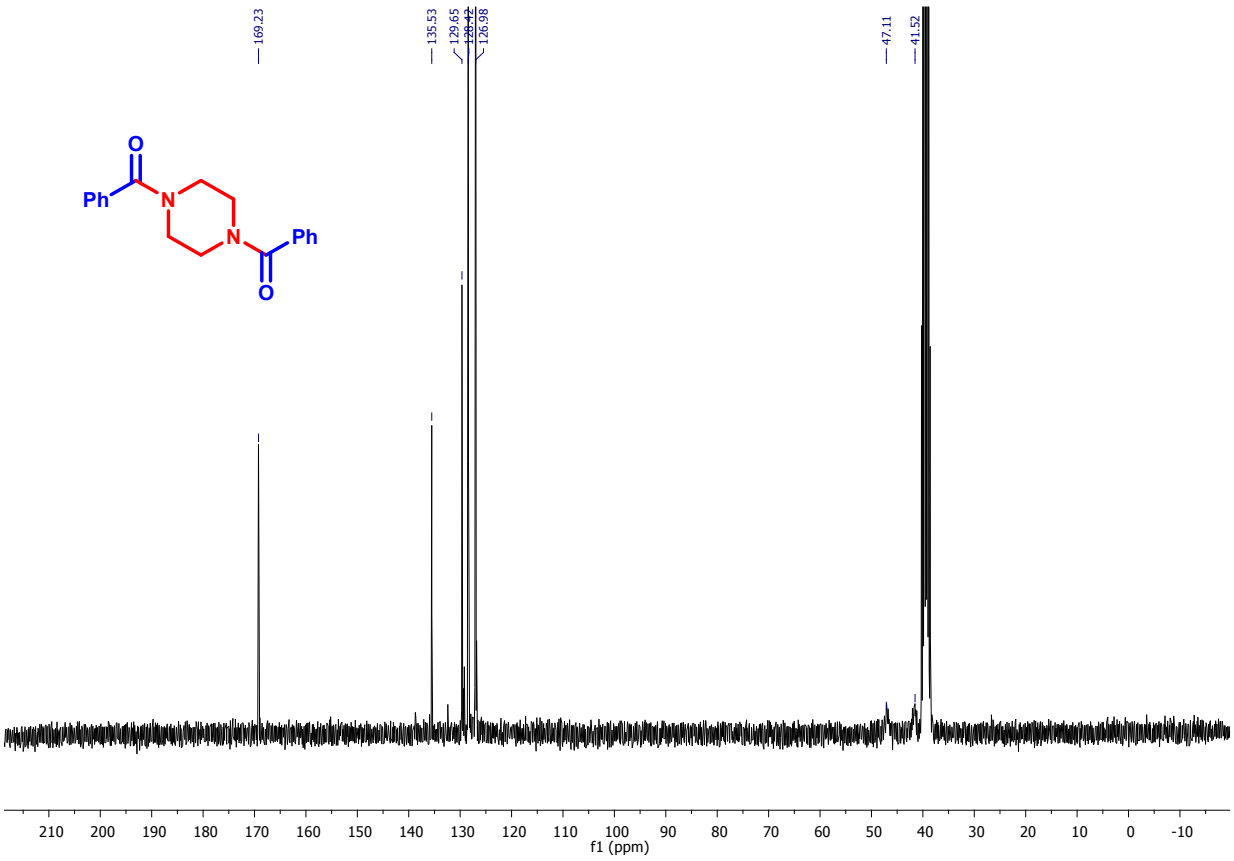
^{1}H NMR of (4-(2-hydroxyethyl)piperazin-1-yl)(phenyl)methanone (5q)



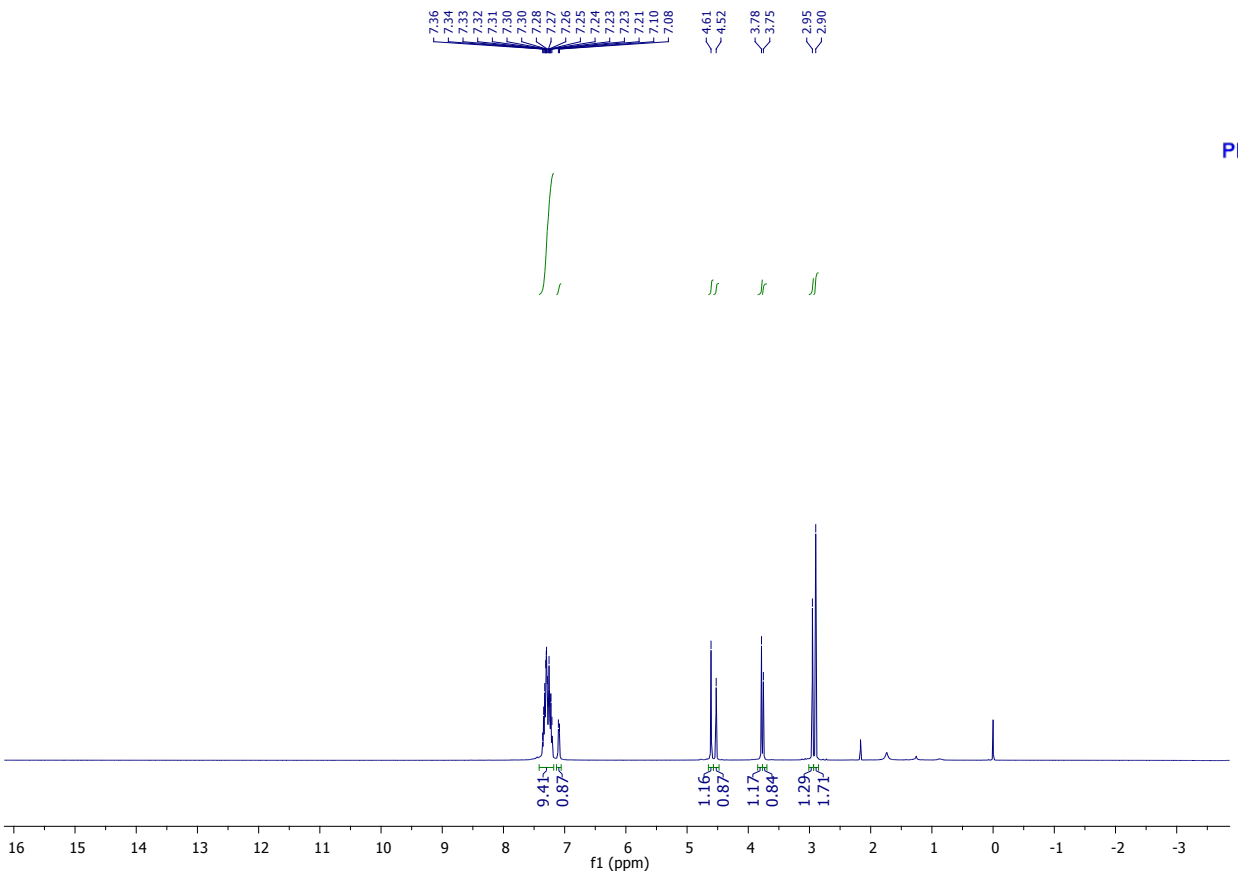
^{13}C NMR of (4-(2-hydroxyethyl)piperazin-1-yl)(phenyl)methanone (5q)



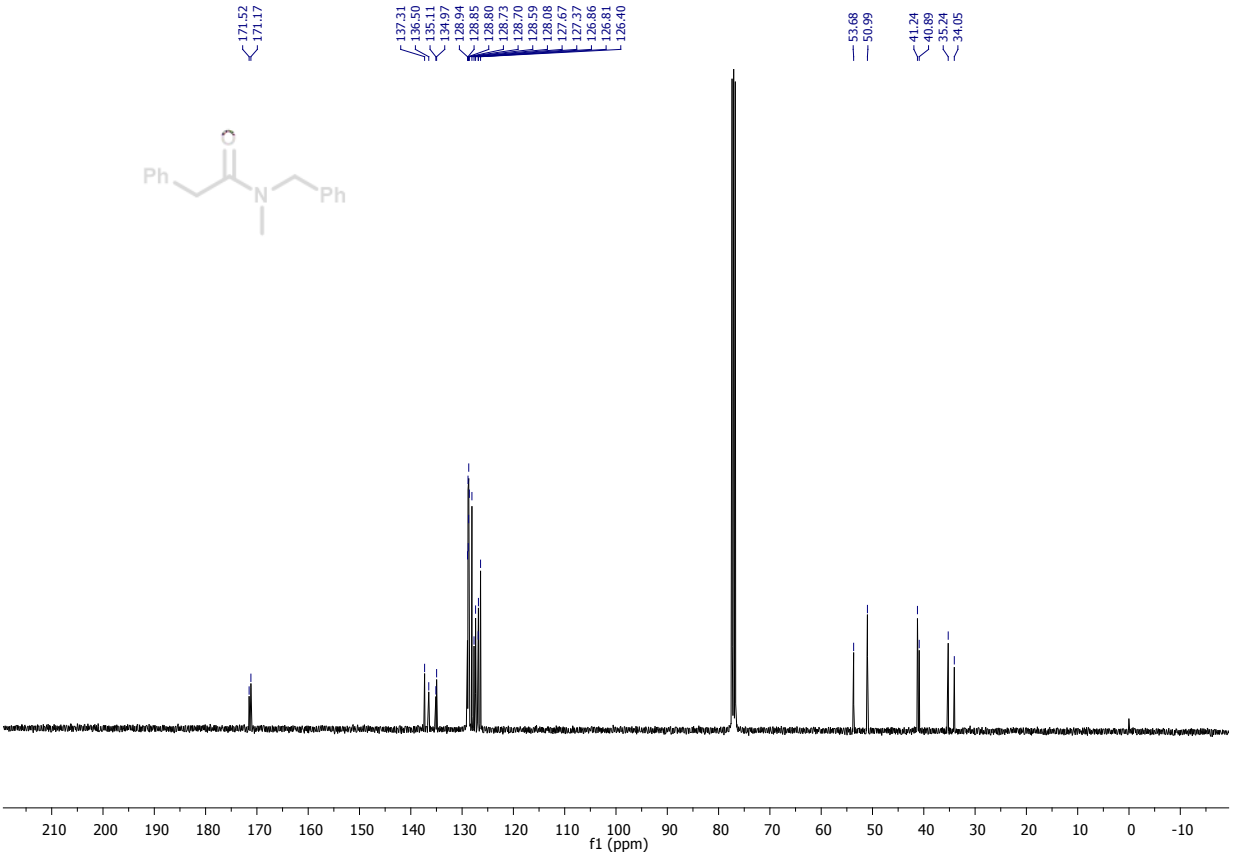
^{1}H NMR of piperazine-1,4-diylbis(phenylmethanone) (5r)



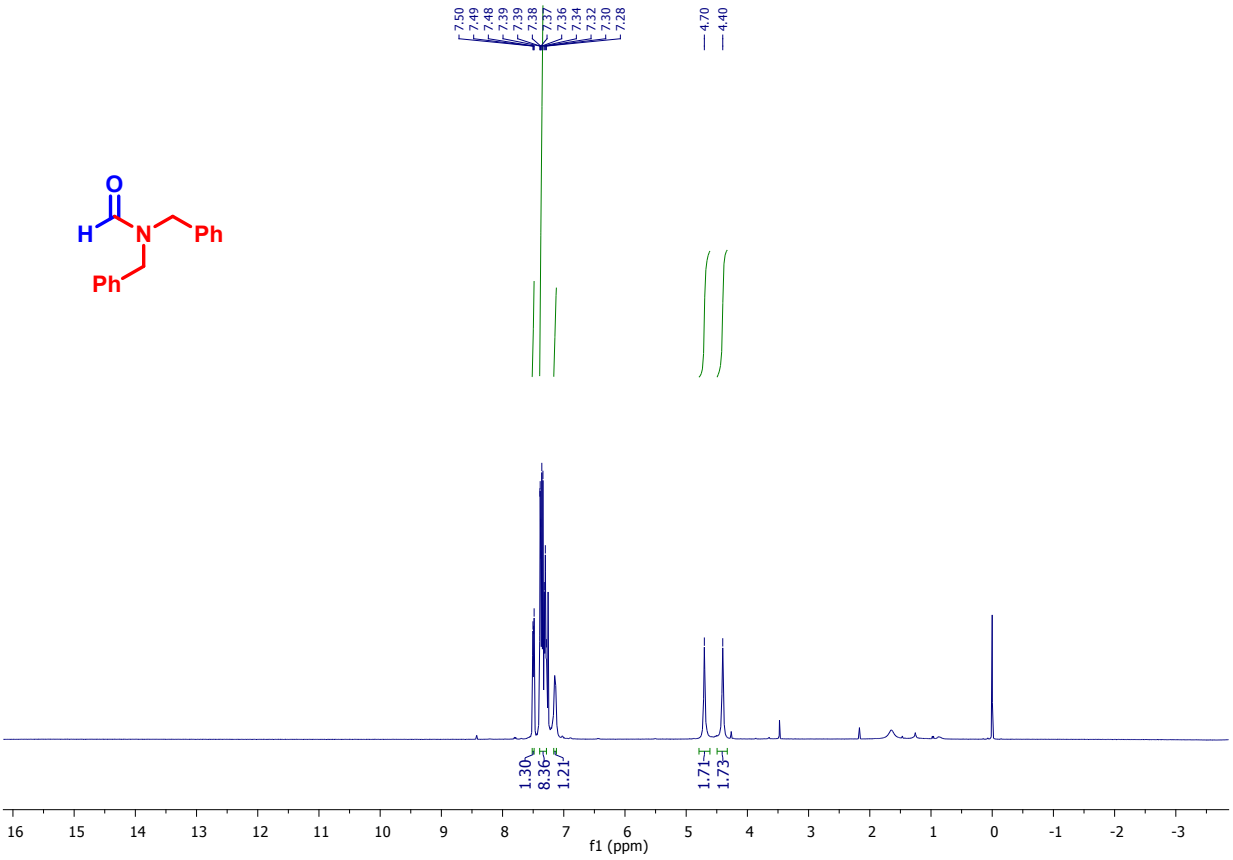
^{13}C NMR of piperazine-1,4-diylbis(phenylmethanone) (5r)



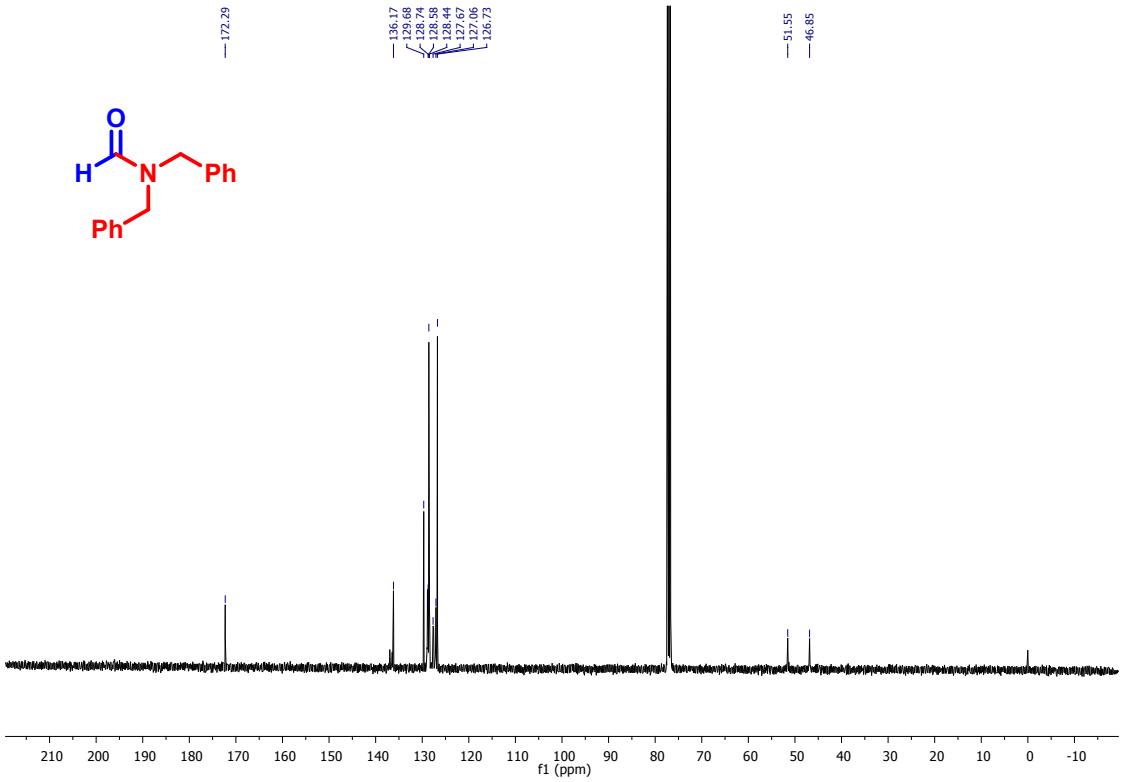
^{1}H NMR of N-benzyl-N-methyl-2-phenylacetamide (5s)



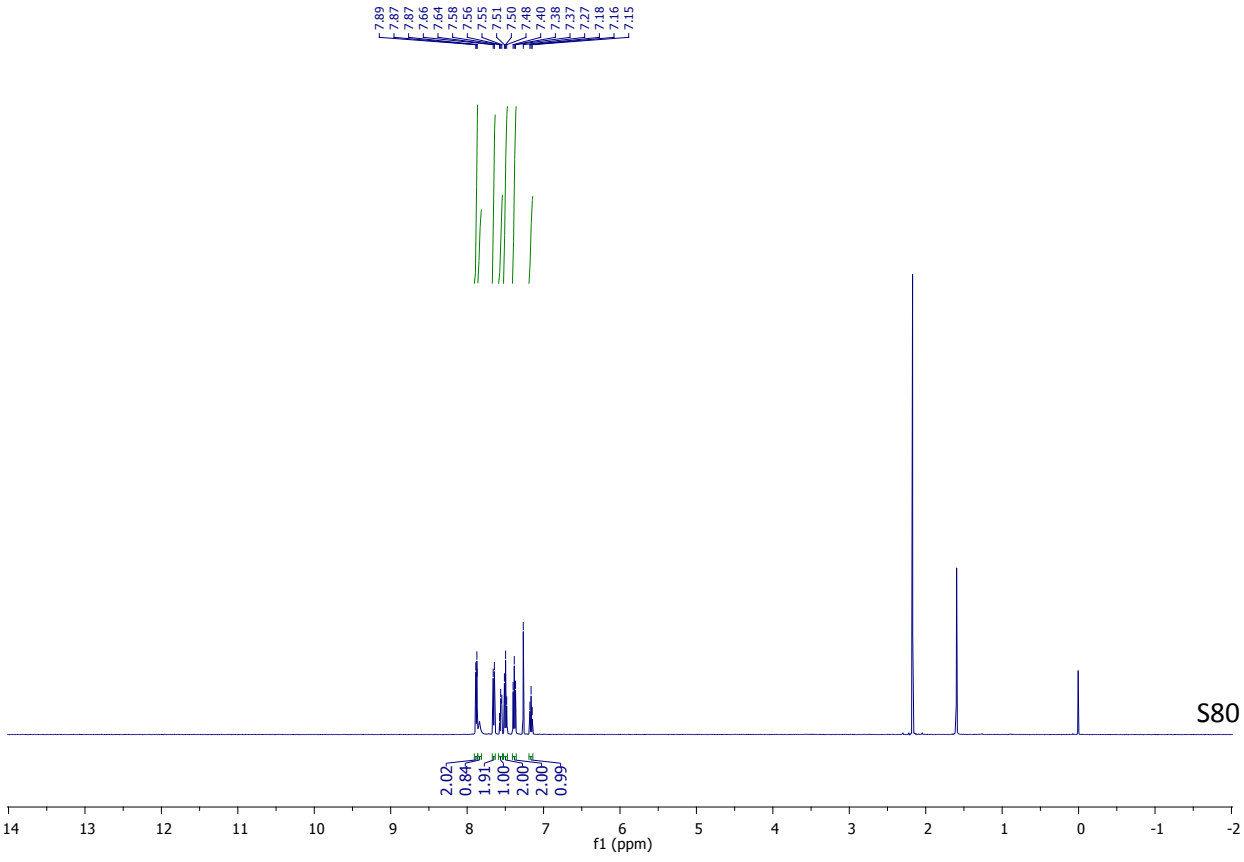
^{13}C NMR of N-benzyl-N-methyl-2-phenylacetamide (5s)

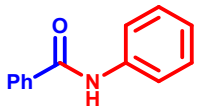


^{1}H NMR of N,N-dibenzylformamide (5t)

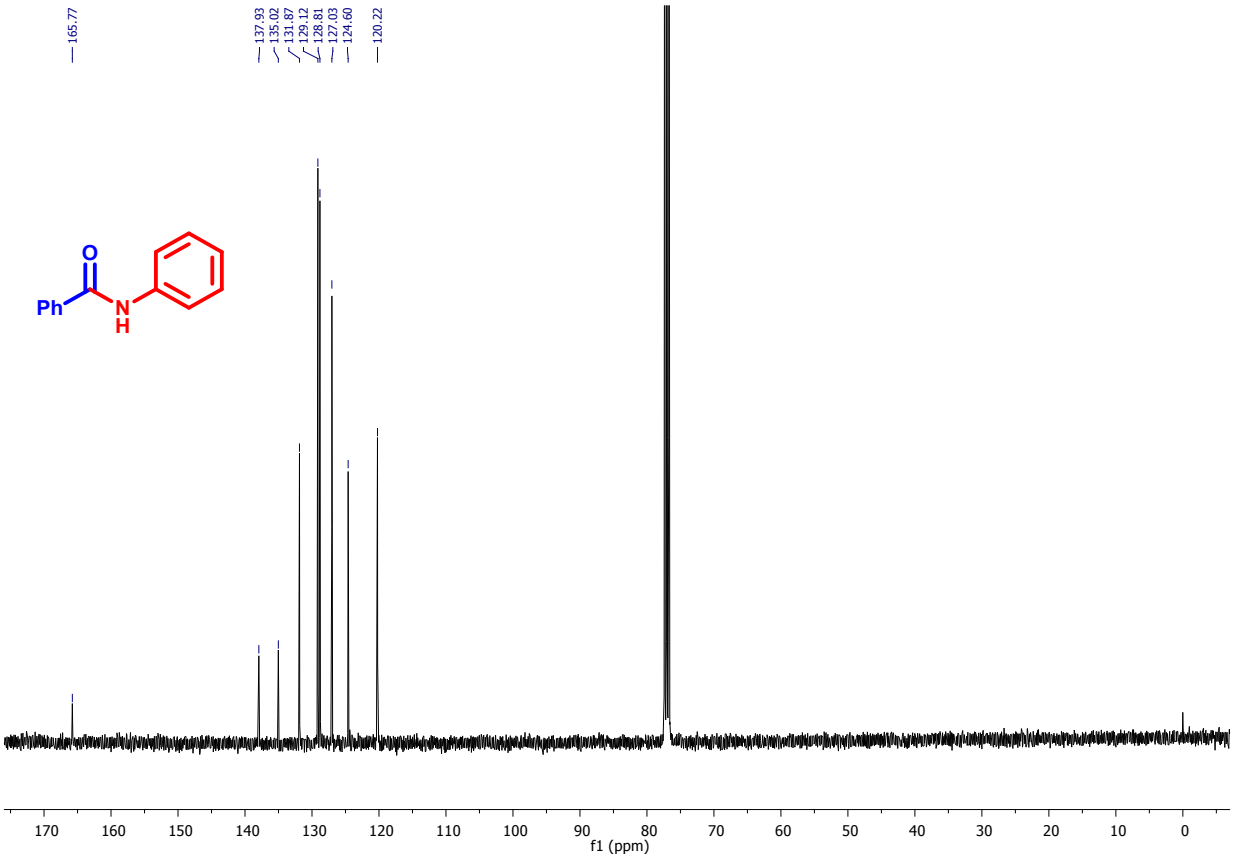


^{13}C NMR of N,N-dibenzylformamide (5t)

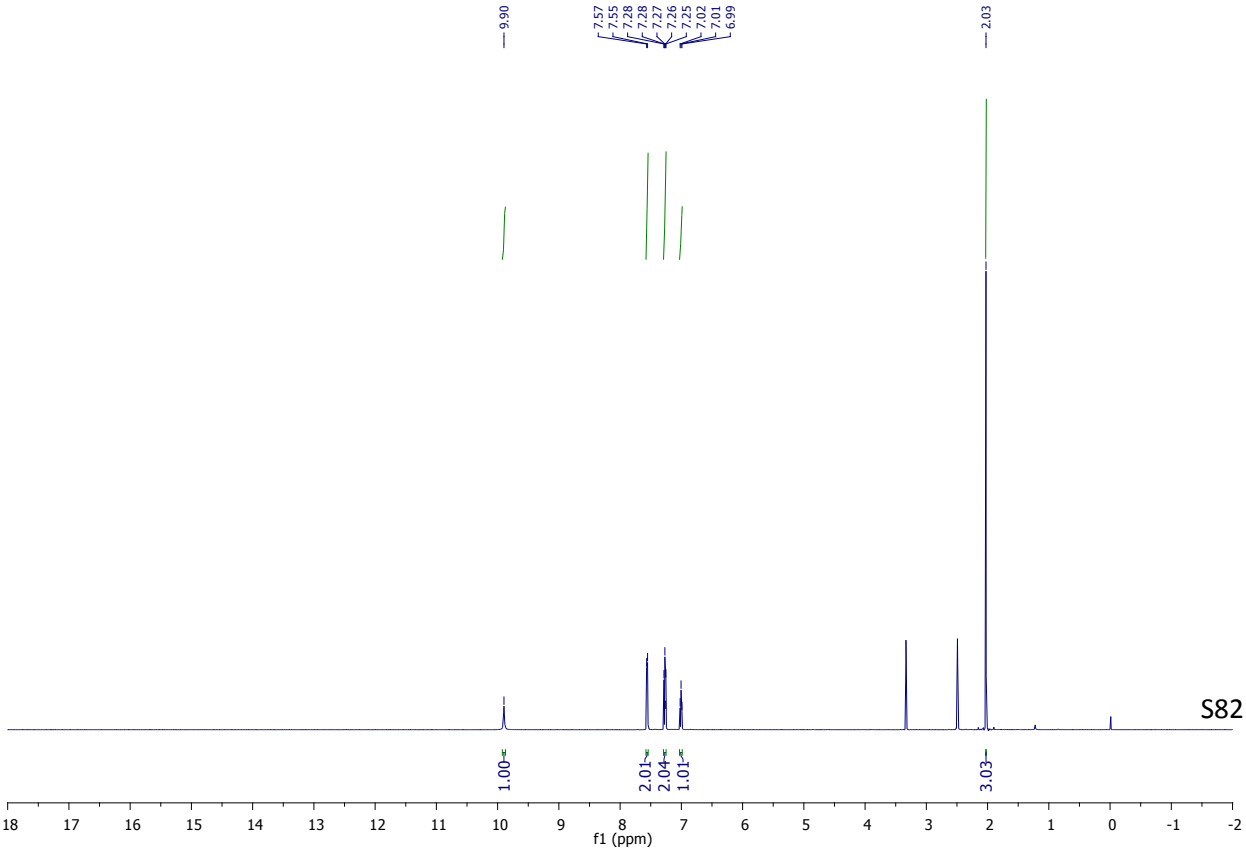


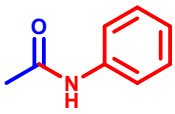


^{1}H NMR of N-Phenylbenzamide (5u)

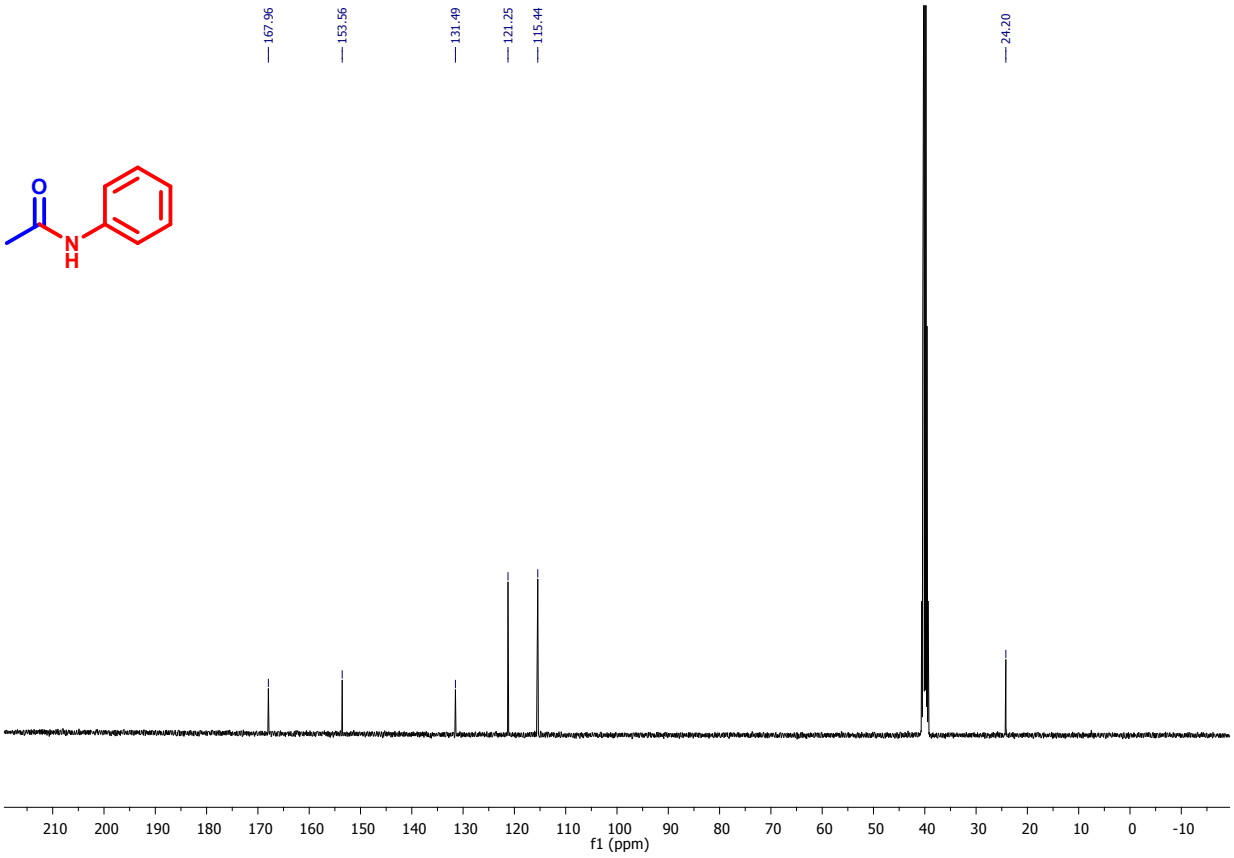


^{13}C NMR of N-Phenylbenzamide (5u)

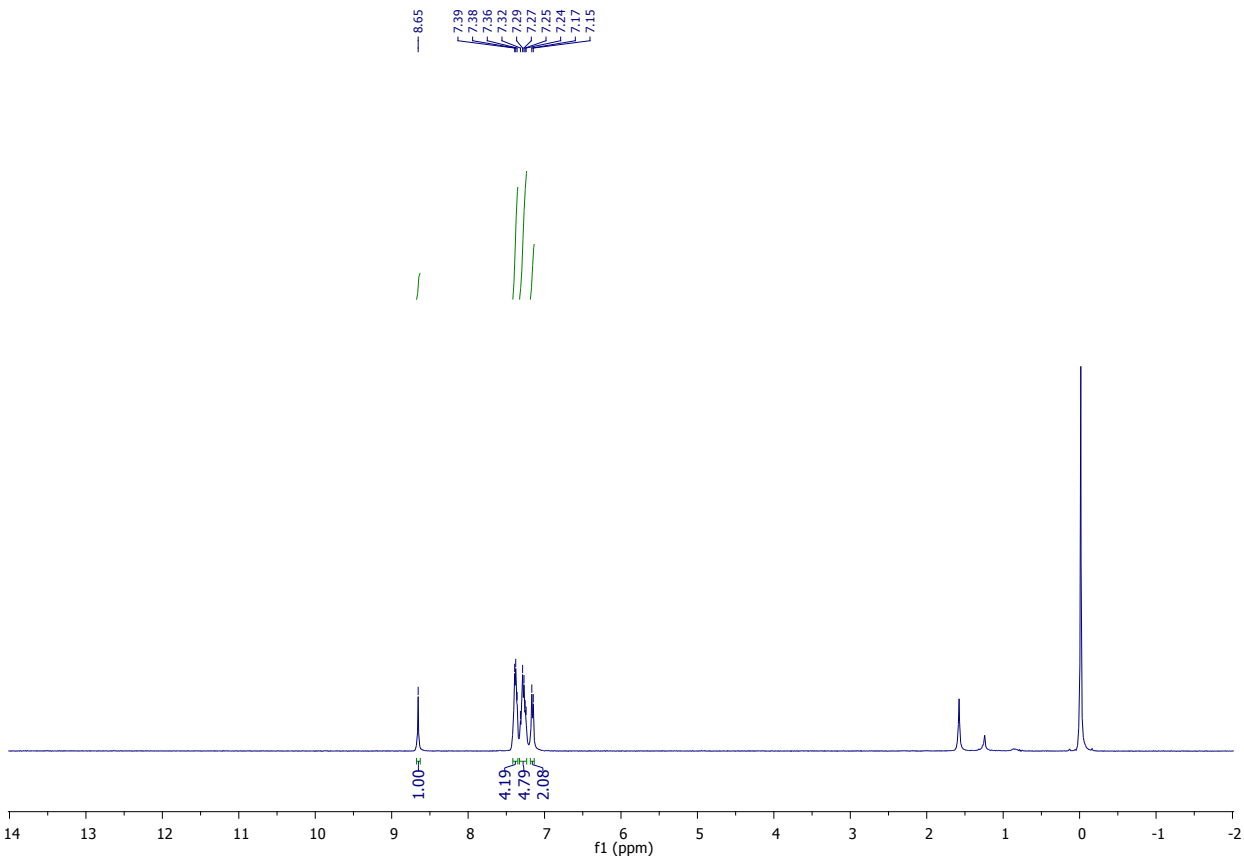




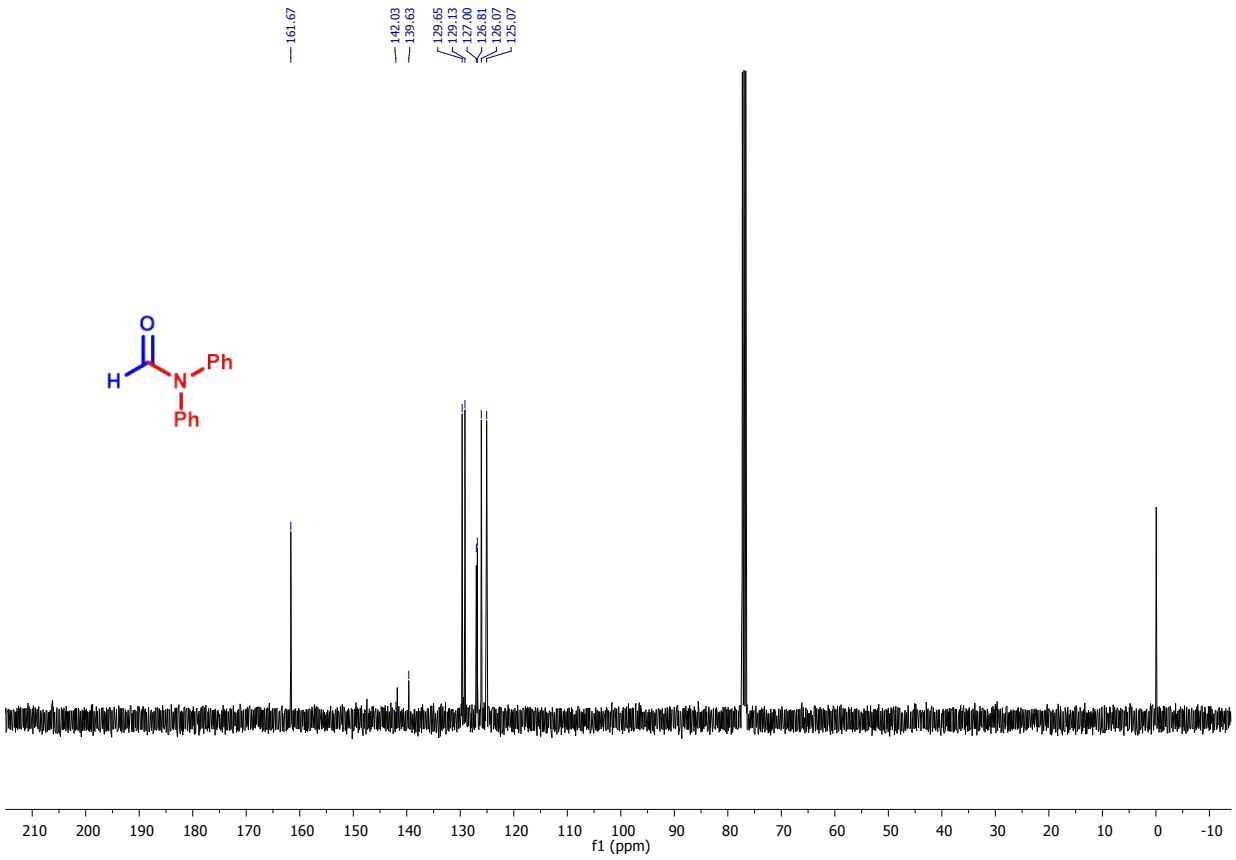
^{1}H NMR of N-Phenylacetamide (5v)



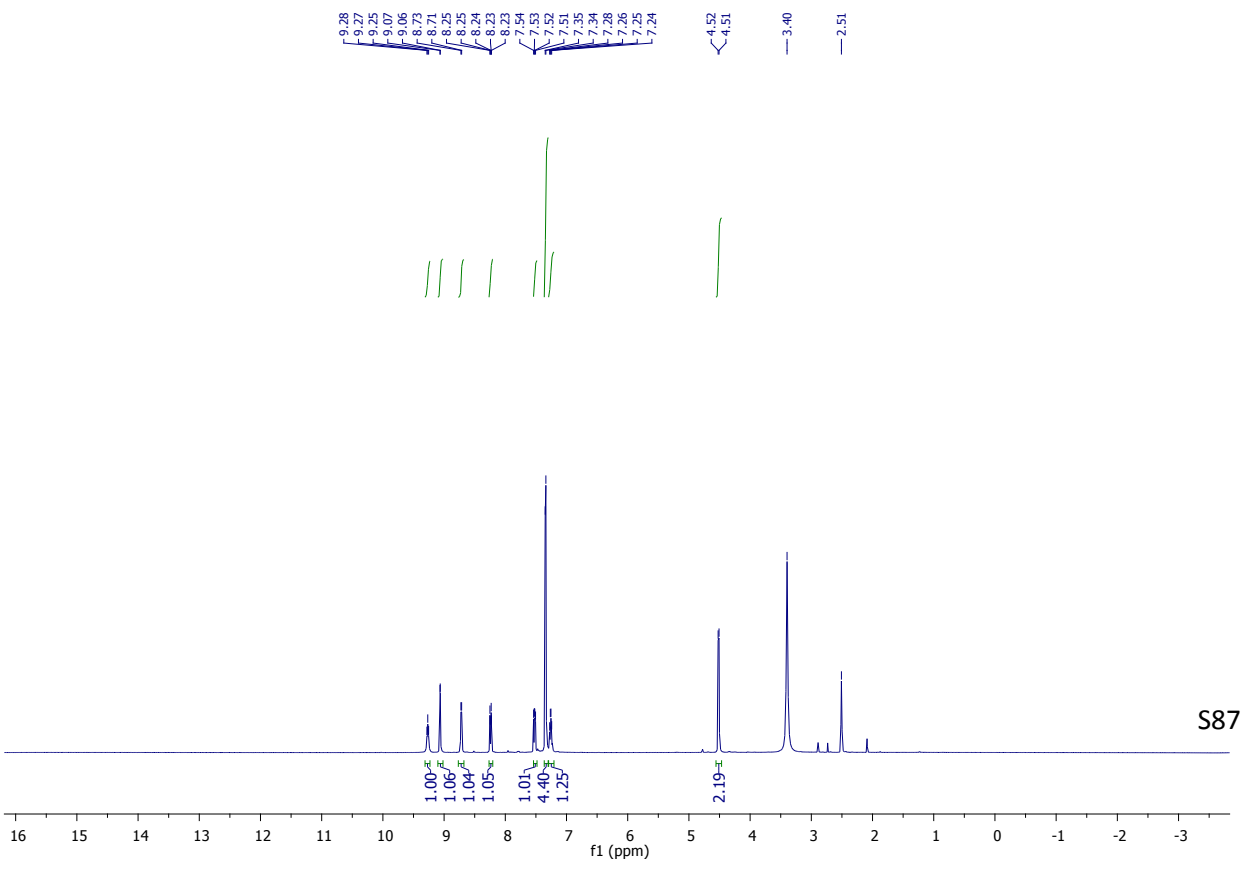
^{13}C NMR of N-Phenylacetamide (5v)

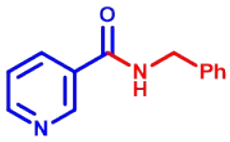


^{1}H NMR of N,N-Diphenylformamide (5x)

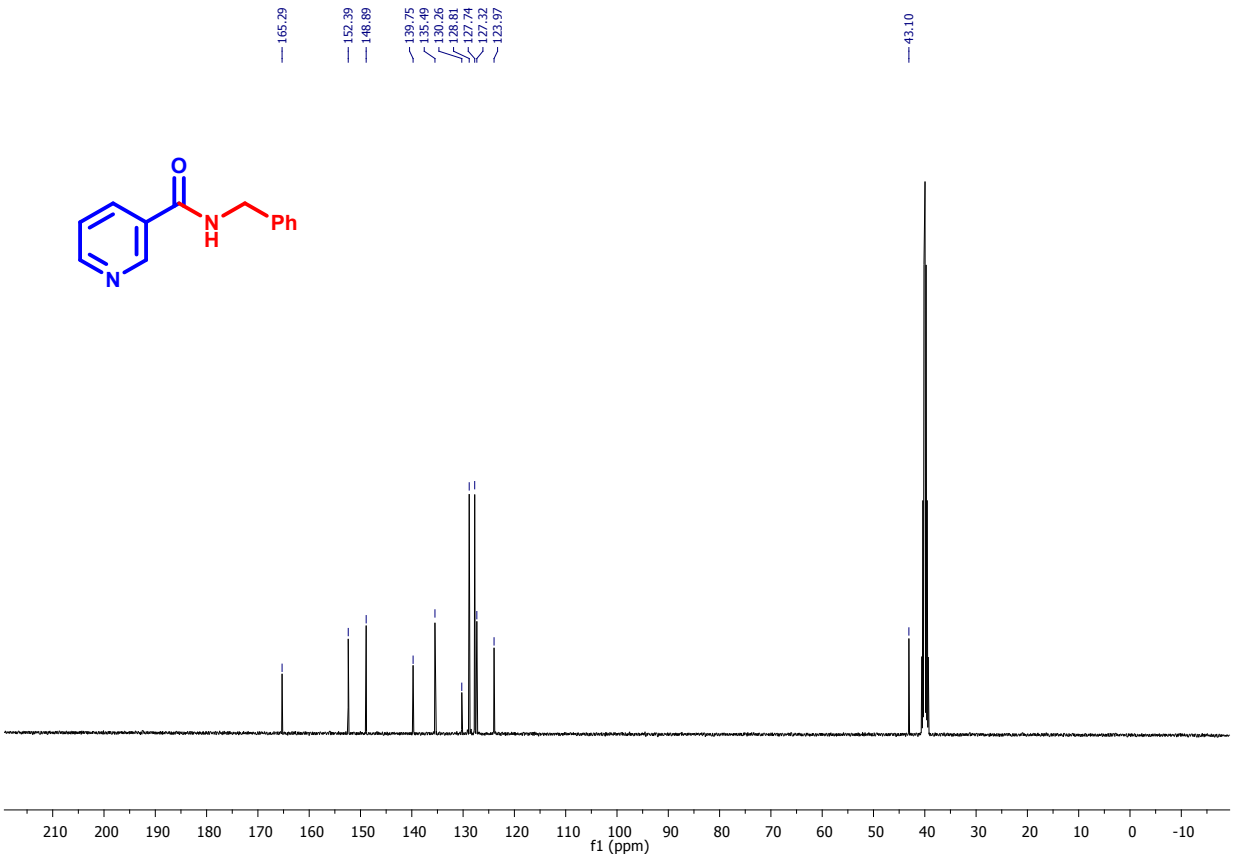

161.67
142.03
139.63
129.65
129.13
127.00
126.81
126.07
125.07
O
H
N
Ph
Ph
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)

^{13}C NMR of N,N-Diphenylformamide (5x)

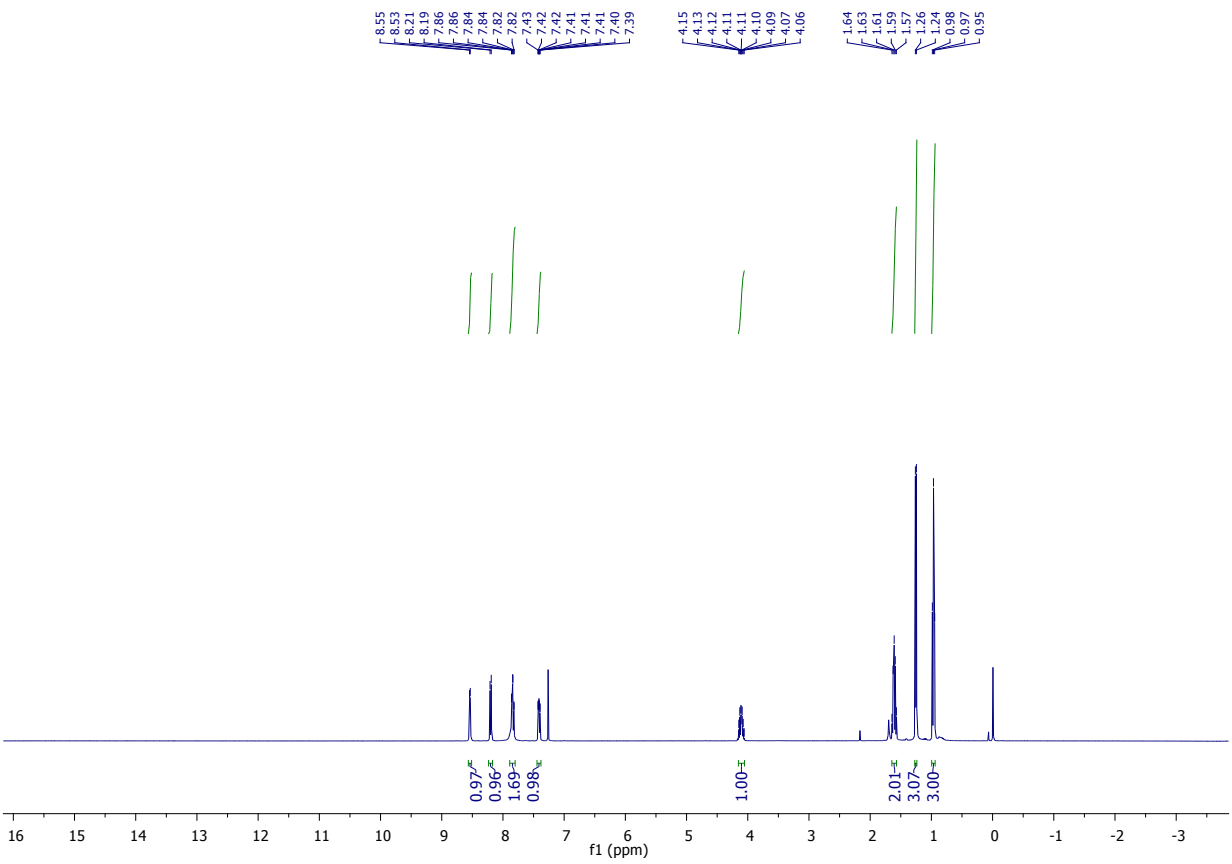




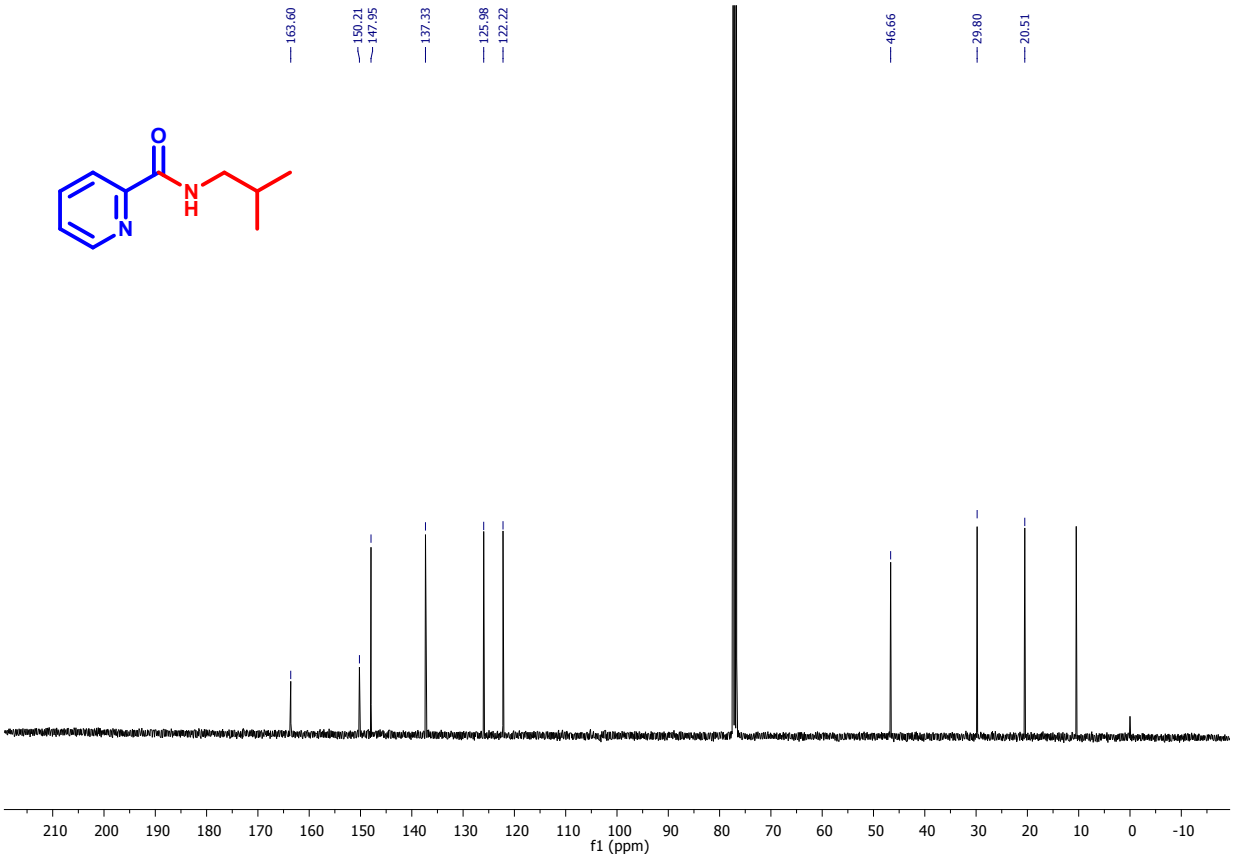
^{1}H NMR of N-benzylnicotinamide (7b)



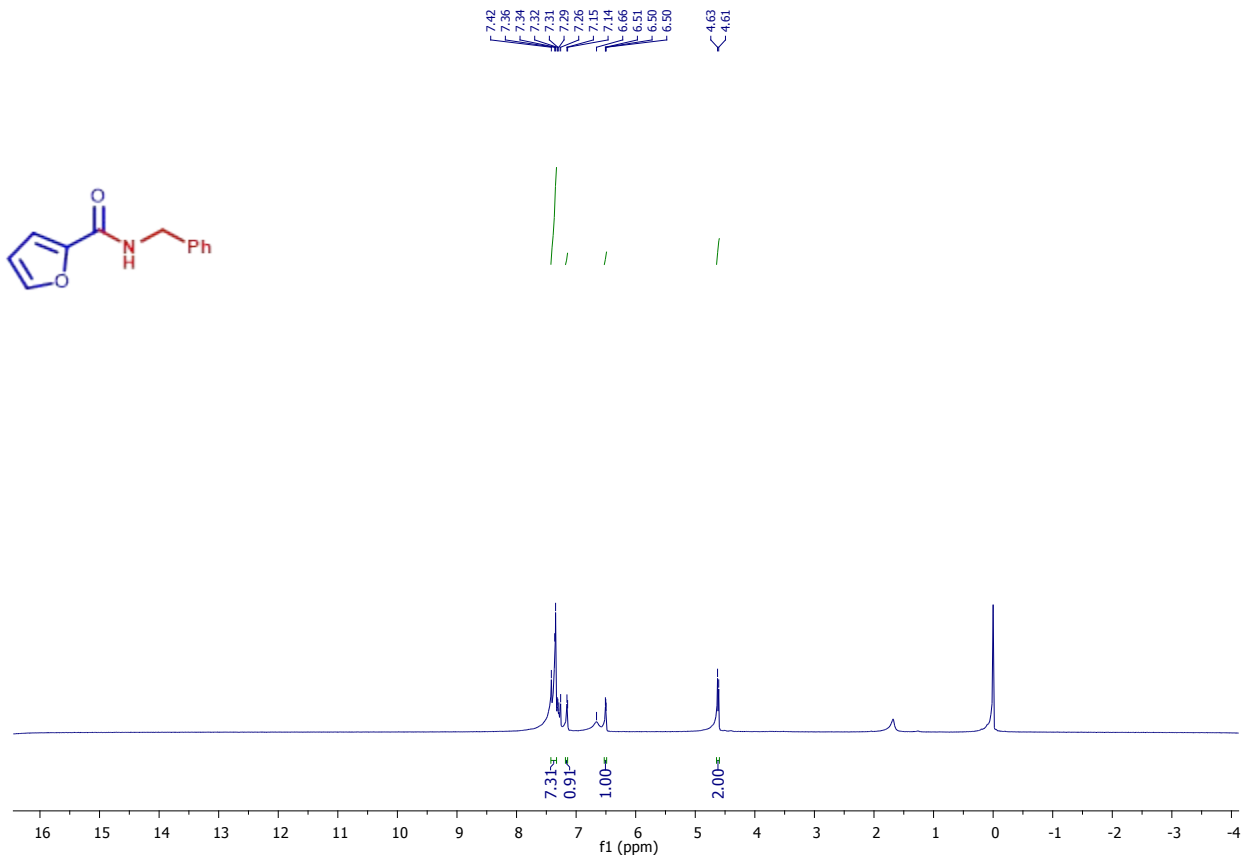
^{13}C NMR of N-benzylnicotinamide (7b)



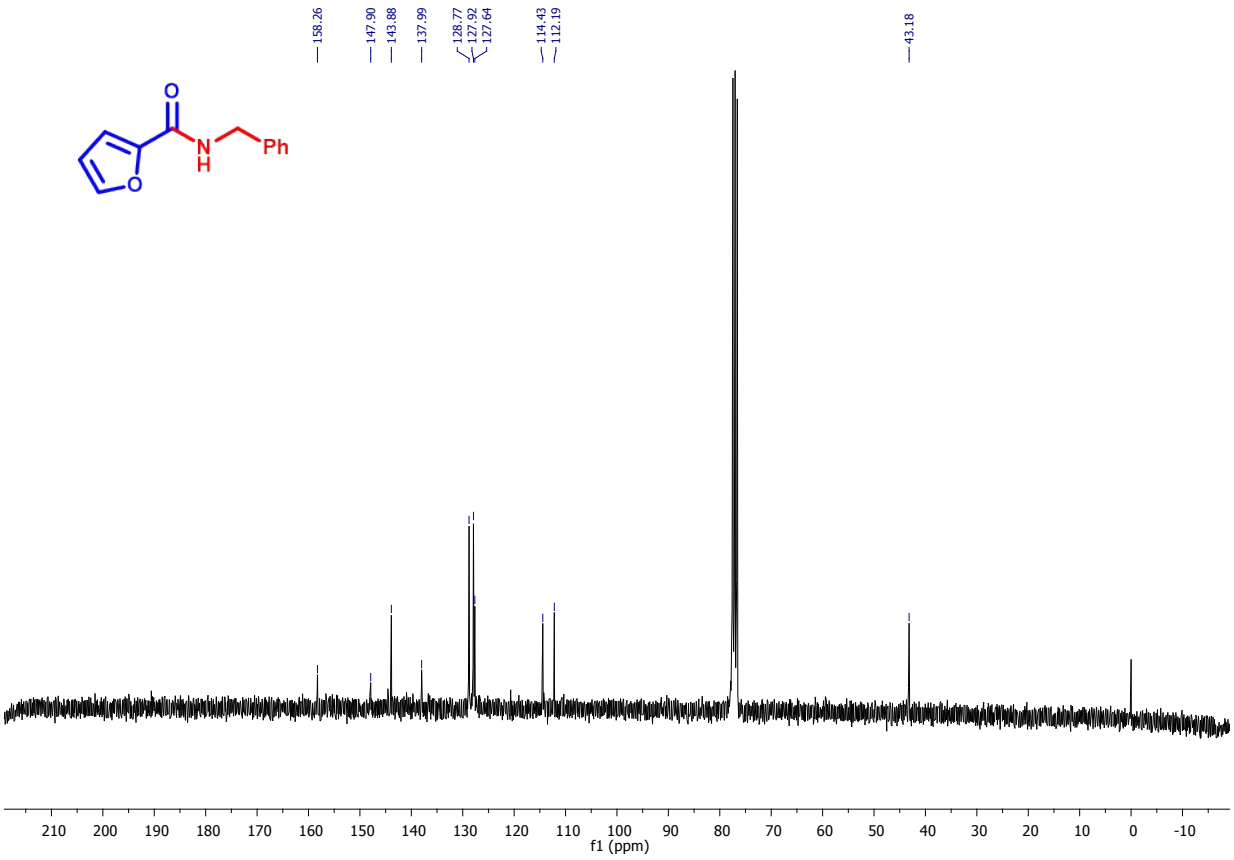
^{1}H NMR of *N*-Isobutylpicolinamide (7c)



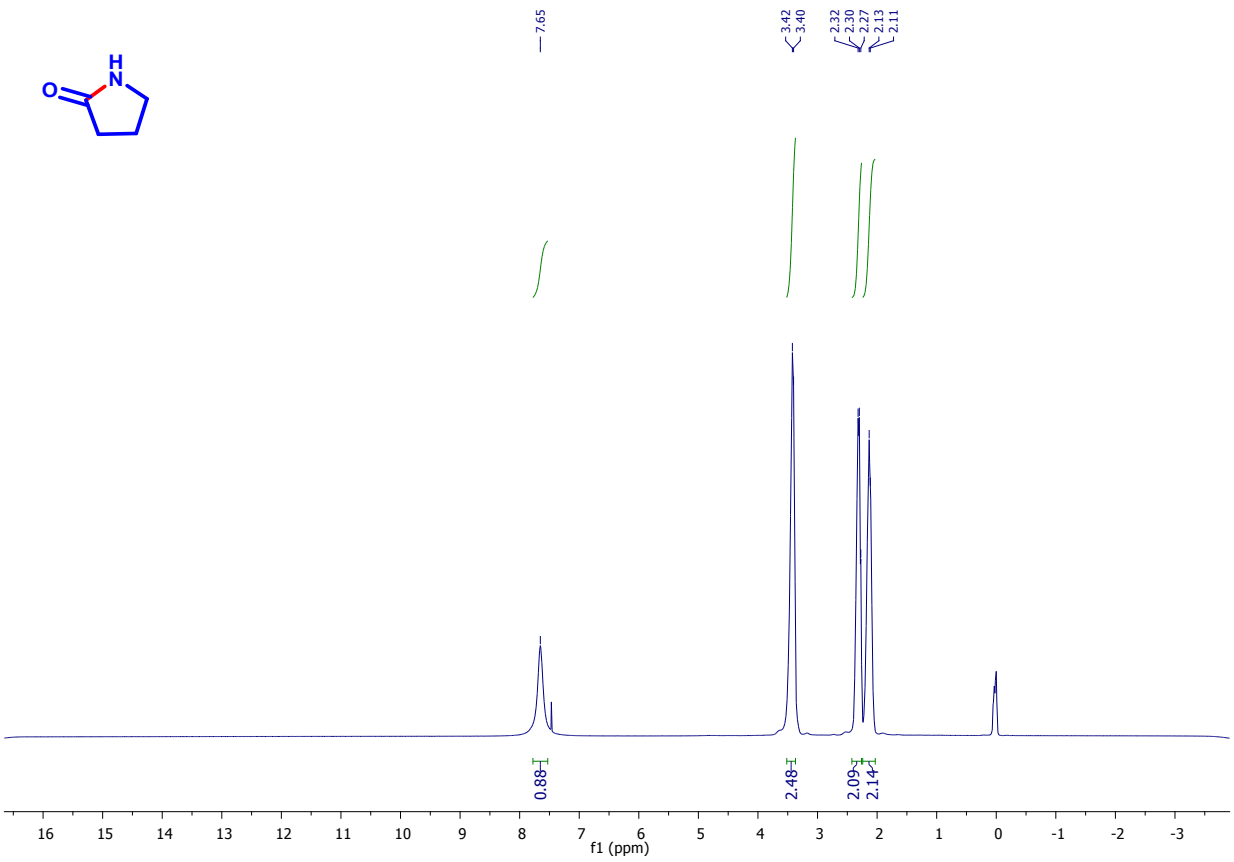
^{13}C NMR of *N*-Isobutylpicolinamide (7c)



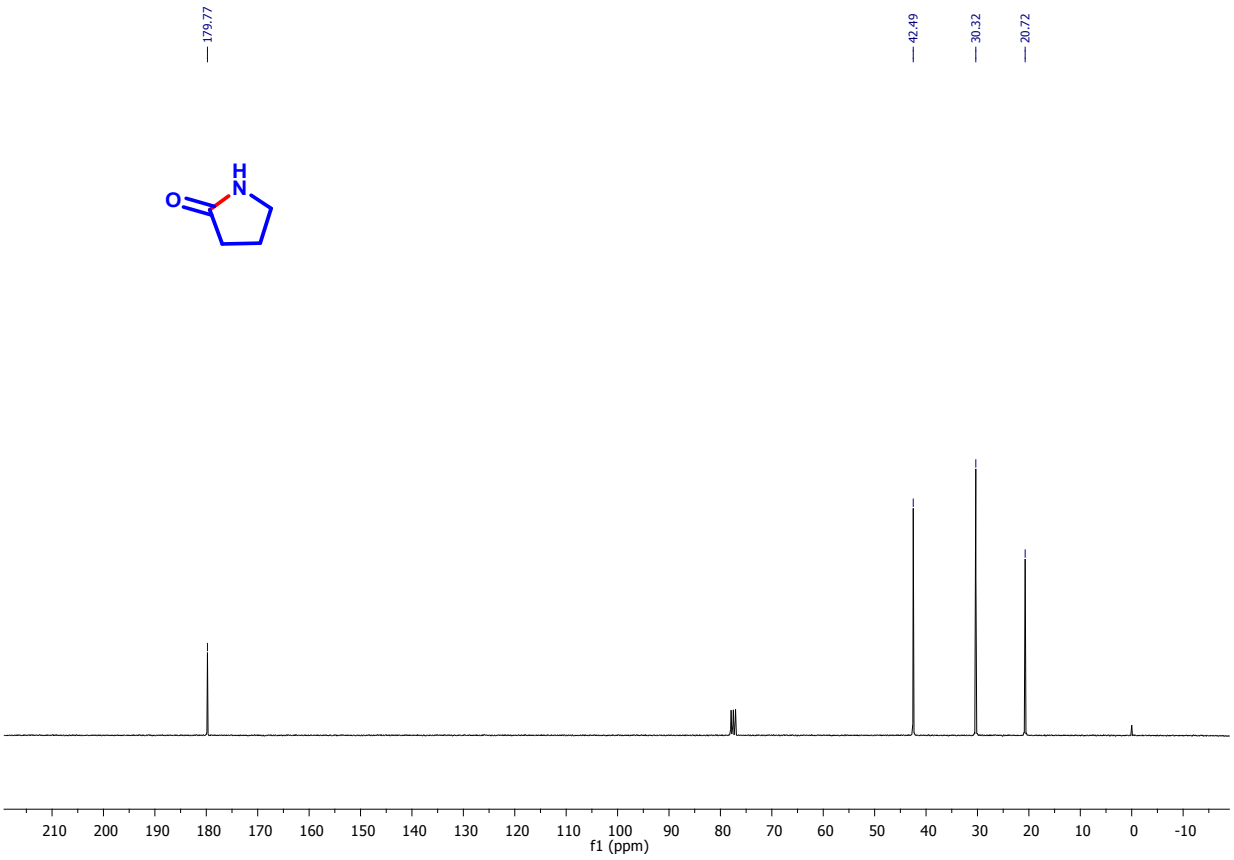
^{1}H NMR of N-benzylfuran-2-carboxamide (7d)



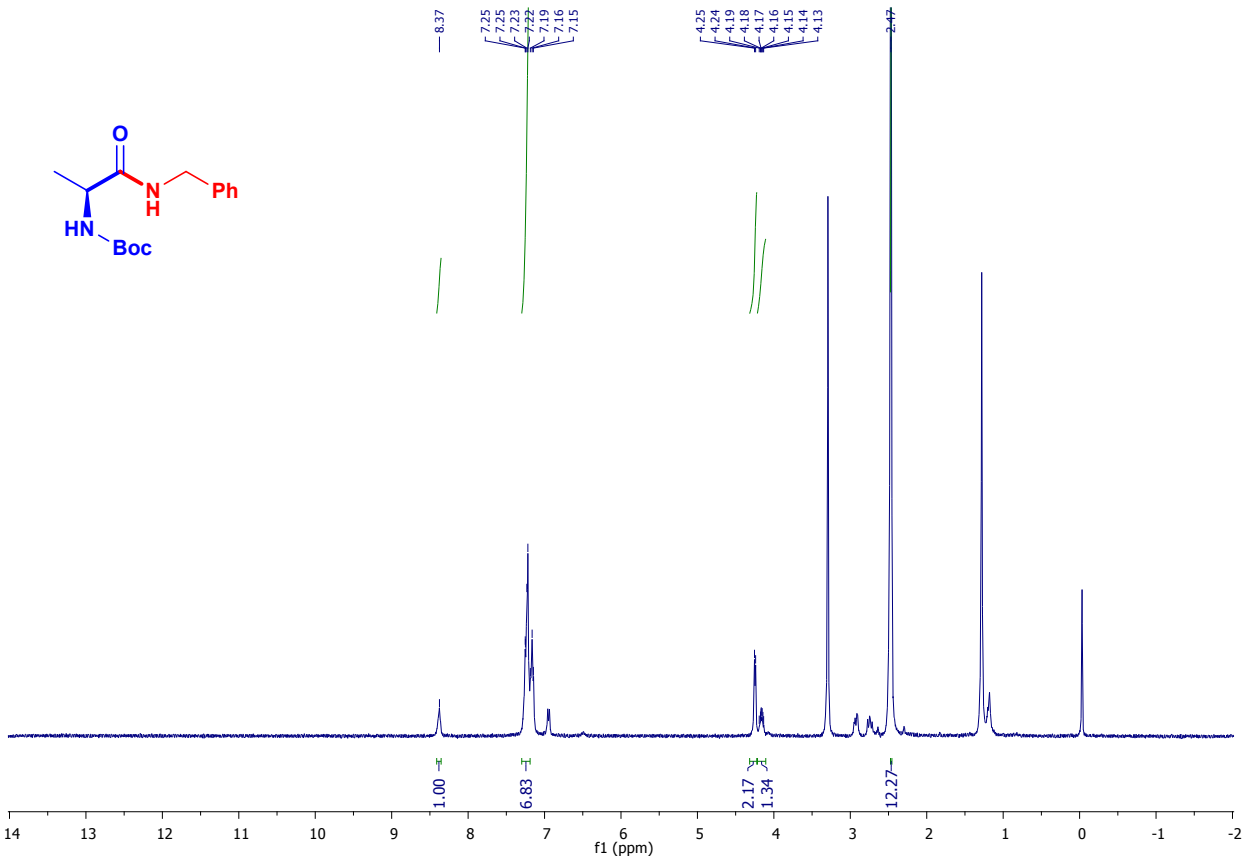
^{13}C NMR of N-benzylfuran-2-carboxamide (7d)



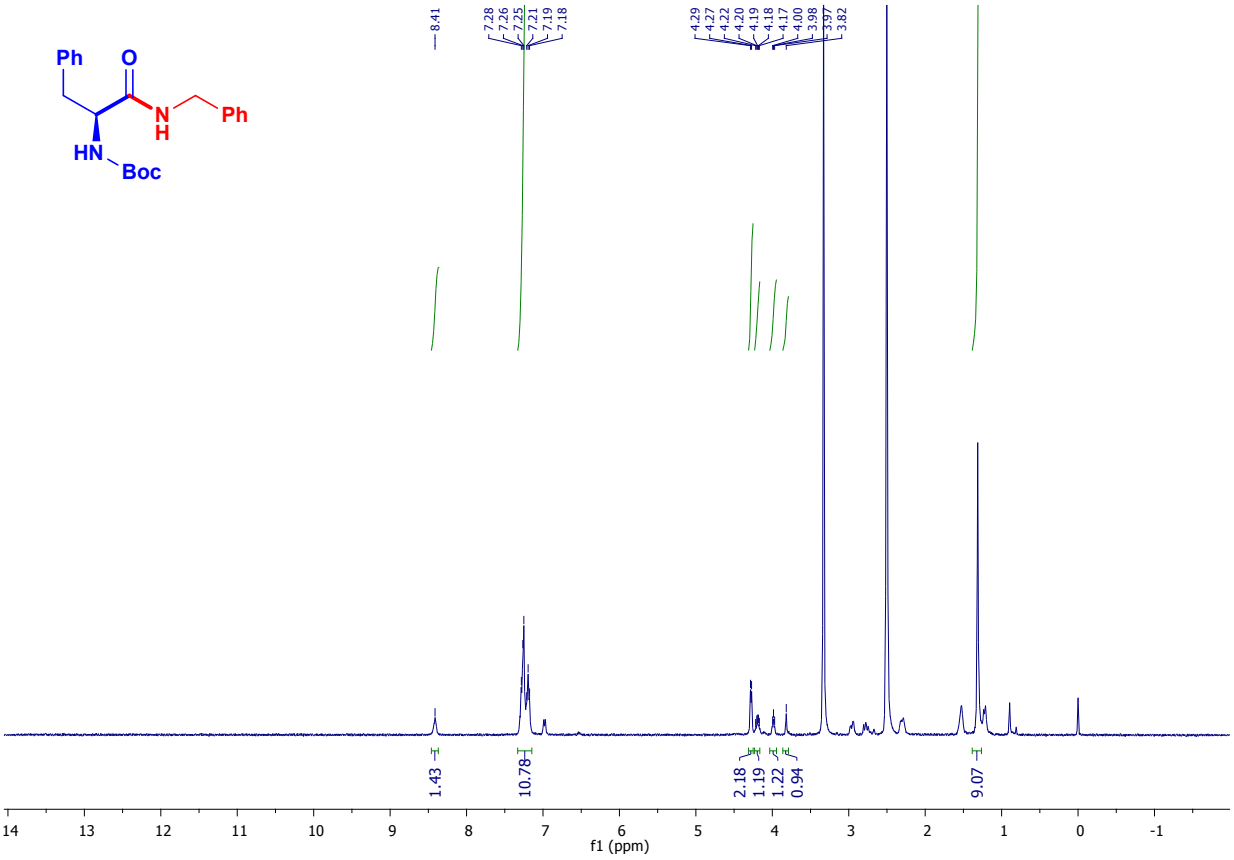
^{1}H NMR of pyrrolidin-2-one (9)



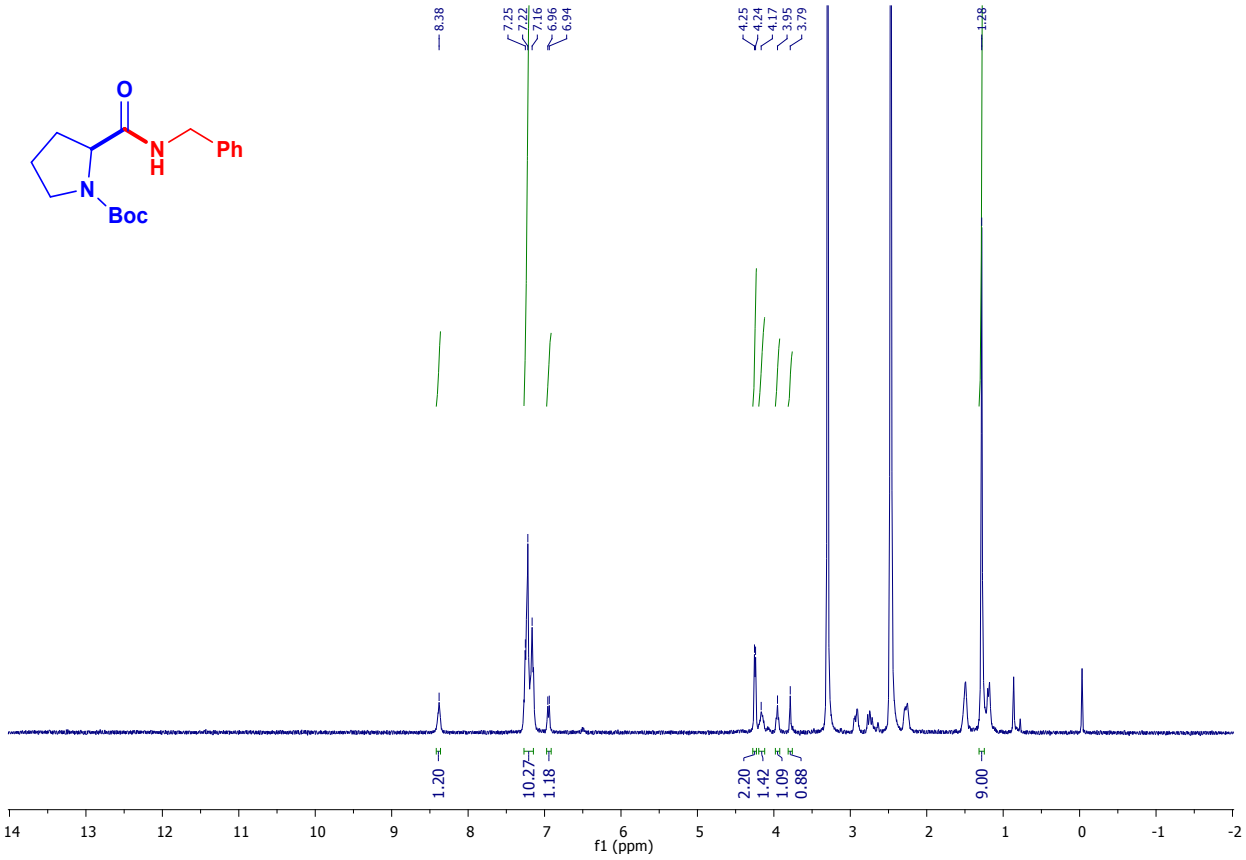
^{13}C NMR of pyrrolidin-2-one (9)



^{1}H NMR of tert-butyl (S)-(1-(benzylamino)-1-oxopropan-2-yl)carbamate (11)



^{1}H NMR of tert-butyl (S)-(1-(benzylamino)-1-oxo-3-phenylpropan-2-yl)carbamate (13)



^{1}H NMR of Tert-butyl 2-(benzylcarbamoyl)pyrrolidine-1-carboxylate (15)

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