An Easy Access to Carboxylic Acids via Pd-Catalyzed Hydrocarboxylation of Olefins with HCOOLi as CO Surrogate under Mild Conditions

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Supporting Information

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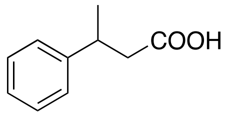
General Methods. All commercially available reagents were used without further purification unless otherwise noted. All solvents used for the reaction were purified with solvent purification system. Column chromatography was performed on silica gel (200-300 mesh). ^{1}H NMR spectra were recorded on a 400 MHz NMR spectrometer and ^{13}C NMR spectra were recorded on a 100 MHz NMR spectrometer. IR spectra were recorded on a FT-IR spectrometer. Melting points were uncorrected.

Representative procedure for hydrocarboxylation (Table 2, entry 1). To a stirred mixture of $Pd(OAc)_2$ (0.0056 g, 0.025 mmol), Xantphos (0.0145 g, 0.025 mmol), $HCOOLi{\cdot}H_2O$ (0.070 g, 1.00 mmol), and DCE (0.30 mL) in a vial (1.5 mL) were added α-methylstyrene (**1a**) (0.0591 g, 0.50 mmol) and Ac_2O (0.0511 g, 0.50 mmol) successively via syringe. The vial was purged with Ar to remove the air and tightly sealed with a septum cap. The reaction mixture was stirred at 90 ^{o}C for 24 h, cooled to rt, diluted with CH_2Cl_2 (3.0 mL), and poured into 1N aqueous NaOH (40 mL) in a separatory funnel. Upon vigorous shaking, the mixture was washed with CH_2Cl_2 (3 x 40 mL). The aqueous layer was acidified with 2N HCl (40 mL), extracted with CH_2Cl_2 (3 x 30 mL), dried over Na_2SO_4, filtered, and concentrated to give carboxylic acid **2a** as a light yellow oil (0.0739 g, 90 % yield) [for Table 2, entries 16 and 17, saturated aqueous $NaHCO_3$ (40 mL) was used instead of 1N aqueous NaOH (40 mL)].

Procedures for gram scale hydrocarboxylation reaction (Scheme 4). To a stirred mixture of $Pd(OAc)_2$ (0.1123 g, 0.50 mmol), Xantphos (0.2893 g, 0.50 mmol), and DCE (6.0 mL) in a sealed tube (50.0 mL) were added α-methylstyrene (**1a**) (1.180 g, 10.0 mmol), $HCOOLi{\cdot}H_2O$ (1.40 g, 20.0 mmol), and Ac_2O (1.020 g, 10.0 mmol) successively via syringe. The tube was purged with Ar to remove the air and tightly sealed. The reaction mixture was stirred at 90 ^{o}C for 48 h, cooled to rt, diluted with CH_2Cl_2 (6.0 mL), and poured into 1N NaOH (80 mL) in a separatory funnel. Upon vigorous shaking, the mixture was washed with CH_2Cl_2 (3 x 100 mL). The aqueous layer was acidified with 2N HCl (80 mL), extracted with CH_2Cl_2 (3 x 100 mL), dried over Na_2SO_4, filtered, and concentrated to give carboxylic acid **2a** as a light yellow oil (1.409 g, 86 % yield).

Table 2, entry 1

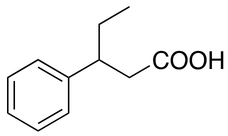


2a

Light yellow oil; IR (film) 2966, 1707, 1452 cm^{-1}; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.34-7.25 (m, 2H), 7.25-7.15 (m, 3H), 3.33-3.19 (m, 1H), 2.66 (dd, J = 15.5, 6.8 Hz, 1H), 2.56 (dd, J = 15.5, 8.2 Hz, 1H), 1.31 (d, J = 7.0 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 179.2, 145.6, 128.8, 126.9, 126.7, 42.8, 36.3, 22.0.

Wang, Y.; Ren, W.; Li, J.; Wang, H.; Shi, Y. *Org. Lett.* **2014**, *16*, 5960.
Wang, Y.; Ren, W.; Shi, Y. *Org. Biomol. Chem.* **2015**, *13*, 8416.

Table 2, entry 2

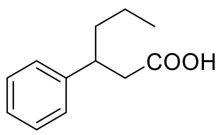


2b

Light yellow oil; IR (film) 2964, 1708 cm^{-1}; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.32-7.23 (m, 2H), 7.23-7.11 (m, 3H), 3.04-2.91 (m, 1H), 2.65 (dd, J = 15.6, 7.2 Hz, 1H), 2.59 (dd, J = 15.6, 7.9 Hz, 1H), 1.79-1.66 (m, 1H), 1.66-1.52 (m, 1H), 0.77 (t, J = 7.3 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 179.3, 143.8, 128.6, 127.7, 126.7, 43.7, 41.4, 29.3, 12.0.

Wang, Y.; Ren, W.; Li, J.; Wang, H.; Shi, Y. *Org. Lett.* **2014**, *16*, 5960.

Table 2, entry 3

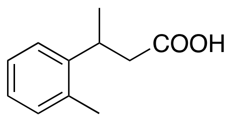


2c

Light yellow oil; IR (film) 2958, 1708 cm^{-1}; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.31-7.23 (m, 2H), 7.23-7.12 (m, 3H), 3.14-3.00 (m, 1H), 2.64 (dd, *J* = 15.6, 7.2 Hz, 1H), 2.58 (dd, *J* = 15.0, 7.3 Hz, 1H), 1.69-1.50 (m, 2H), 1.28-1.04 (m, 2H), 0.84 (t, *J* = 7.3 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 179.3, 144.0, 128.6, 127.6, 126.7, 41.8, 41.7, 38.6, 20.6, 14.1.

Estévez, M. C.; Galve, R.; Baeza, F. S.; Marco, M. P. *Anal. Chem.* **2005**, *77*, 5283.

Table 2, entry 4

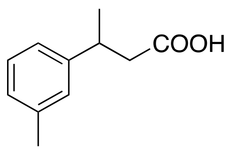


2d

White soild; mp. 44-46 °C; IR (film) 2969, 1708 cm^{-1}; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.21-7.04 (m, 4H), 3.60-3.45 (m, 1H), 2.66 (dd, *J* = 15.6, 6.3 Hz, 1H), 2.55 (dd, *J* = 15.6, 8.6 Hz, 1H), 2.36 (s, 3H), 1.26 (d, *J* = 6.9 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 179.4, 143.8, 135.5, 130.7, 126.6, 126.4, 125.1, 42.1, 31.3, 21.4, 19.6.

Wang, Y.; Ren, W.; Li, J.; Wang, H.; Shi, Y. *Org. Lett.* **2014**, *16*, 5960.
Wang, Y.; Ren, W.; Shi, Y. *Org. Biomol. Chem.* **2015**, *13*, 8416.

Table 2, entry 5

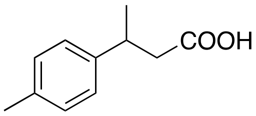


2e

Light yellow oil; IR (film) 2966, 1708 cm^{-1}; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.22-7.13 (m, 1H), 7.06-6.96 (m, 3H), 3.29-3.16 (m, 1H), 2.65 (dd, *J* = 15.5, 6.6 Hz, 1H), 2.55 (dd, *J* = 15.5, 8.4 Hz, 1H), 2.32 (s, 3H), 1.29 (d, *J* = 7.0 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 179.3, 145.6, 138.3, 128.6, 127.7, 127.5, 123.9, 42.8, 36.2, 22.0, 21.6.

Wang, Y.; Ren, W.; Li, J.; Wang, H.; Shi, Y. *Org. Lett.* **2014**, *16*, 5960.
Wang, Y.; Ren, W.; Shi, Y. *Org. Biomol. Chem.* **2015**, *13*, 8416.

Table 2, entry 6

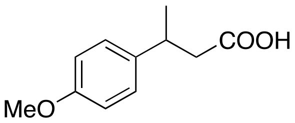


2f

White soild; mp. 86-88 ^{o}C; IR (film) 2966, 1701 cm^{-1}; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.12 (s, 4H), 3.31-3.18 (m, 1H), 2.66 (dd, *J* = 15.4, 6.8 Hz, 1H), 2.56 (dd, *J* = 15.5, 8.2 Hz, 1H), 2.32 (s, 3H), 1.30 (d, *J* = 7.0 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 178.6, 142.6, 136.2, 129.5, 126.8, 42.8, 36.0, 22.2, 21.2.

Wang, Y.; Ren, W.; Li, J.; Wang, H.; Shi, Y. *Org. Lett.* **2014**, *16*, 5960.
Wang, Y.; Ren, W.; Shi, Y. *Org. Biomol. Chem.* **2015**, *13*, 8416.

Table 2, entry 7

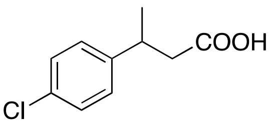


2g

Light yellow oil; IR (film) 2963, 1708 cm^{-1}; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.17 (d, *J* = 8.6 Hz, 2H), 6.87 (d, *J* = 8.7 Hz, 2H), 3.80 (s, 3H), 3.32-3.19 (m, 1H), 2.65 (dd, *J* = 15.4, 7.0 Hz, 1H), 2.57 (dd, *J* = 15.4, 8.1 Hz, 1H), 1.32 (d, *J* = 7.0 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 179.1, 158.3, 137.7, 127.8, 114.1, 55.4, 43.1, 35.5, 22.2.

Wang, Y.; Ren, W.; Li, J.; Wang, H.; Shi, Y. *Org. Lett.* **2014**, *16*, 5960.

Table 2, entry 8



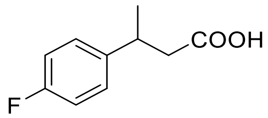
2h

White solid; mp. 89-90 ^{o}C; IR (film) 2963, 1702 cm^{-1}; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.26 (d, *J* = 8.4 Hz, 2H), 7.15 (d, *J* = 8.4 Hz, 2H), 3.30-3.18 (m, 1H), 2.62

(dd, J = 15.6, 7.2 Hz, 1H), 2.56 (dd, J = 15.6, 7.8 Hz, 1H), 1.29 (d, J = 7.0 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 178.9, 144.0, 132.4, 128.9, 128.3, 42.7, 35.8, 22.1.

Wang, Y.; Ren, W.; Li, J.; Wang, H.; Shi, Y. *Org. Lett.* **2014**, *16*, 5960.
Wang, Y.; Ren, W.; Shi, Y. *Org. Biomol. Chem.* **2015**, *13*, 8416.

Table 2, entry 9

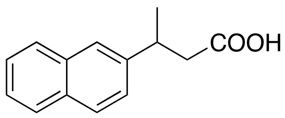


2i

White solid; mp. 63-67 °C; IR (film) 2973, 1702 cm^{-1}; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.23-7.15 (m, 2H), 7.04-6.94 (m, 2H), 3.34-3.20 (m, 1H), 2.64 (dd, J = 15.6, 7.2 Hz, 1H), 2.58 (dd, J = 15.6, 7.9 Hz, 1H), 1.31 (d, J = 7.0 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 179.1, 161.7 (d, J = 243 Hz), 141.2 (d, J = 3 Hz), 128.3 (d, J = 8 Hz), 115.5 (d, J = 21 Hz), 42.9, 35.7, 22.2.

Wang, Y.; Ren, W.; Shi, Y. *Org. Biomol. Chem.* **2015**, *13*, 8416.

Table 2, entry 10

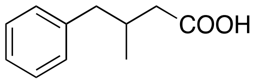


2j

White solid; mp. 106-108 °C; IR (film) 2973, 1696 cm^{-1}; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.87-7.78 (m, 3H), 7.70 (s, 1H), 7.54-7.43 (m, 2H), 7.43-7.38 (m, 1H), 3.55-3.41 (m, 1H), 2.81 (dd, J = 15.6, 6.8 Hz, 1H), 2.70 (dd, J = 15.6, 8.1 Hz, 1H), 1.43 (d, J = 6.9 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 179.1, 143.0, 133.7, 132.5, 128.5, 127.9, 127.8, 126.2, 125.7, 125.6, 125.1, 42.7, 36.4, 22.1.

Wang, Y.; Ren, W.; Li, J.; Wang, H.; Shi, Y. *Org. Lett.* **2014**, *16*, 5960.
Wang, Y.; Ren, W.; Shi, Y. *Org. Biomol. Chem.* **2015**, *13*, 8416.

Table 2, entry 11

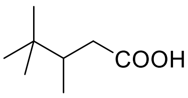


2k

Light yellow oil; IR (film) 2961, 1707 cm^{-1}; ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.31-7.23 (m, 2H), 7.23-7.11 (m, 3H), 2.63 (dd, *J* = 13.4, 6.8 Hz, 1H), 2.51 (dd, *J* = 13.4, 7.4 Hz, 1H), 2.37 (dd, *J* = 14.8, 5.5 Hz, 1H), 2.33-2.21 (m, 1H), 2.16 (dd, *J* = 14.8, 7.9 Hz, 1H), 0.97 (d, *J* = 6.5 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 180.1, 140.2, 129.4, 128.5, 126.3, 43.1, 41.0, 32.3, 19.8.

Wang, Y.; Ren, W.; Li, J.; Wang, H.; Shi, Y. *Org. Lett.* **2014**, *16*, 5960.
Wang, Y.; Ren, W.; Shi, Y. *Org. Biomol. Chem.* **2015**, *13*, 8416.

Table 2, entry 12



2l

Light yellow oil; IR (film) 2964, 1709 cm^{-1}; ^{1}H NMR (400 MHz, $CDCl_3$) δ 2.55 (dd, *J* = 14.9, 3.2 Hz, 1H), 1.99 (dd, *J* = 14.9, 10.8 Hz, 1H), 1.85-1.74 (m, 1H), 0.92 (d, *J* = 6.8 Hz, 3H), 0.88 (s, 9H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 181.4, 40.0, 37.6, 32.9, 27.3, 15.2.

Wang, Y.; Ren, W.; Shi, Y. *Org. Biomol. Chem.* **2015**, *13*, 8416.

Table 2, entry 13

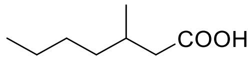
2m

Light yellow oil; IR (film) 2964, 1709 cm^{-1}; ^{1}H NMR (400 MHz, $CDCl_3$) δ 2.36 (dd, *J* = 15.0, 6.0 Hz, 1H), 2.14 (dd, *J* = 15.0, 8.2 Hz, 1H), 1.96-1.81 (m, 1H), 1.46-1.32 (m, 1H), 1.32-1.16 (m, 1H), 0.96 (d, *J* = 6.7 Hz, 3H), 0.90 (t, *J* = 7.4 Hz, 3H); ^{13}C

NMR (100 MHz, $CDCl_3$) δ 180.5, 41.5, 31.9, 29.5, 19.4, 11.5. HRMS (ESI) Calcd for $C_6H_{11}O_2$ (M-H): 115.0764; Found: 115.0765.

Troyanskii, E. I.; Svitan, I. V.; Nikishin, G. I. *Organic Chemistry* **1985**, 125.

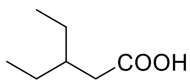
Table 2, entry 14

 **2n**

Light yellow oil; IR (film) 2959, 1709 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ 2.35 (dd, *J* = 15.0, 6.0 Hz, 1H), 2.14 (dd, *J* = 14.9, 8.2 Hz, 1H), 2.02-1.87 (m, 1H), 1.40-1.14 (m, 6H), 0.96 (d, *J* = 6.6 Hz, 3H), 0.89 (t, *J* = 6.8 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 180.4, 41.9, 36.6, 30.3, 29.3, 23.0, 19.9, 14.3. HRMS (ESI) Calcd for $C_8H_{15}O_2$ (M-H): 143.1077; Found: 143.1076.

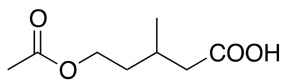
Burger, B. V.; Petersen, W. G. B. *Journal of Chemical Ecology* **2002**, *28*, 501.

Table 2, entry 15

 **2o**

Light yellow oil; IR (film) 2964, 1708 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ 2.28 (d, *J* = 7.0 Hz, 2H), 1.82-1.68 (m, 1H), 1.47-1.24 (m, 4H), 0.88 (t, *J* = 7.4 Hz, 6H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 180.8, 38.5, 37.9, 26.0, 11.0. HRMS (ESI) Calcd for $C_7H_{13}O_2$ (M-H): 129.0921; Found: 129.0922.

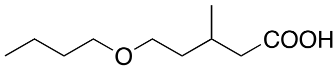
Table 2, entry 16

 **2p**

Light yellow oil; IR (film) 2964, 1739, 1710 cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$) δ 4.20-4.00 (m, 2H), 2.36 (dd, *J* = 15.2, 6.0 Hz, 1H), 2.20 (dd, *J* = 15.3, 7.8 Hz, 1H), 2.15-2.05 (m, 1H), 2.02 (s, 3H), 1.77-1.63 (m, 1H), 1.60-1.45 (m, 1H), 0.99 (d, *J* = 6.6 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 179.1, 171.5, 62.6, 41.4, 35.1, 27.3, 21.1, 19.7.

Wang, Y.; Ren, W.; Li, J.; Wang, H.; Shi, Y. *Org. Lett.* **2014**, *16*, 5960.

Table 2, entry 17

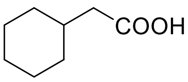


2q

Light yellow oil; IR (film) 2960, 1709 cm^{-1}; ^{1}H NMR (400 MHz, $CDCl_3$) δ 3.51-3.35 (m, 4H), 2.39 (dd, *J* = 14.8, 5.7 Hz, 1H), 2.19 (dd, *J* = 14.8, 7.9 Hz, 1H), 2.15-2.00 (m, 1H), 1.72-1.60 (m, 1H), 1.60-1.42 (m, 3H), 1.42-1.27 (m, 2H), 0.98 (d, *J* = 6.6 Hz, 3H), 0.89 (t, *J* = 7.4 Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 179.2, 71.0, 68.9, 41.7, 36.3, 31.9, 27.8, 20.1, 19.5, 14.1;

Wang, Y.; Ren, W.; Li, J.; Wang, H.; Shi, Y. *Org. Lett.* **2014**, *16*, 5960.

Table 2, entry 18

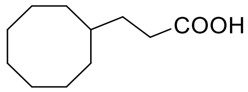


2r

Light yellow oil; IR (film) 2925, 1707 cm^{-1}; ^{1}H NMR (400 MHz, $CDCl_3$) δ 2.21 (d, *J* = 6.8 Hz, 2H), 1.87-1.56 (m, 6H), 1.36-1.20 (m, 2H), 1.20-1.06 (m, 1H), 1.06-0.84 (m, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 180.2, 42.2, 34.8, 33.2, 26.3, 26.2. HRMS (ESI) Calcd for $C_8H_{13}O_2$ (M-H): 141.0921; Found: 141.0921.

Bonaparte, A. C.; Betush, M. P.; Panseri, B. M.; Mastarone, D. J.; Murphy, R. K.; Murphree, S. S. *Org. Lett.* **2011**, *13*, 1447.

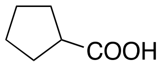
Table 2, entry 19



2s

Light yellow oil; IR (film) 2920, 1709 cm^{-1}; ^{1}H NMR (400 MHz, $CDCl_3$) δ 2.35 (t, *J* = 7.2 Hz, 2H), 1.73-1.35 (m, 15H), 1.35-1.19 (m, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 181.2, 37.0, 32.9, 32.5, 32.1, 27.4, 26.4, 25.5. HRMS (ESI) Calcd for $C_{11}H_{19}O_2$ (M-H): 183.1390; Found: 183.1390.

Table 2, entry 20



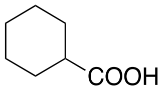
2t

Light yellow oil; IR (film) 2961, 1704 cm^{-1}; ^{1}H NMR (400 MHz, $CDCl_3$) δ 2.82-2.69 (m, 1H), 1.99-1.77 (m, 4H), 1.77-1.65 (m, 2H), 1.65-1.52 (m, 2H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 183.8, 43.9, 30.2, 26.0.

Wang, Y.; Ren, W.; Li, J.; Wang, H.; Shi, Y. *Org. Lett.* **2014**, *16*, 5960.

Wang, Y.; Ren, W.; Shi, Y. *Org. Biomol. Chem.* **2015**, *13*, 8416.

Table 2, entry 21



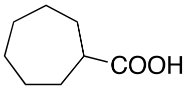
2u

Light yellow oil; IR (film) 2934, 1704 cm^{-1}; ^{1}H NMR (400 MHz, $CDCl_3$) δ 2.32 (tt, *J* = 11.2, 3.6 Hz, 1H), 1.99-1.86 (m, 2H), 1.82-1.69 (m, 2H), 1.69-1.58 (m, 1H), 1.52-1.36 (m, 2H), 1.36-1.14 (m, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 183.1, 43.2, 29.0, 25.9, 25.5.

Wang, Y.; Ren, W.; Li, J.; Wang, H.; Shi, Y. *Org. Lett.* **2014**, *16*, 5960.

Wang, Y.; Ren, W.; Shi, Y. *Org. Biomol. Chem.* **2015**, *13*, 8416.

Table 2, entry 22

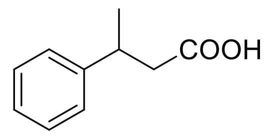


2v

Light yellow oil; IR (film) 2928, 1703 cm^{-1}; ^{1}H NMR (400 MHz, $CDCl_3$) δ 2.56-2.45 (m, 1H), 2.02-1.89 (m, 2H), 1.79-1.62 (m, 4H), 1.62-1.39 (m, 6H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 184.0, 45.0, 30.8, 28.5, 26.4.

Wang, Y.; Ren, W.; Li, J.; Wang, H.; Shi, Y. *Org. Lett.* **2014**, *16*, 5960.

Wang, Y.; Ren, W.; Shi, Y. *Org. Biomol. Chem.* **2015**, *13*, 8416.



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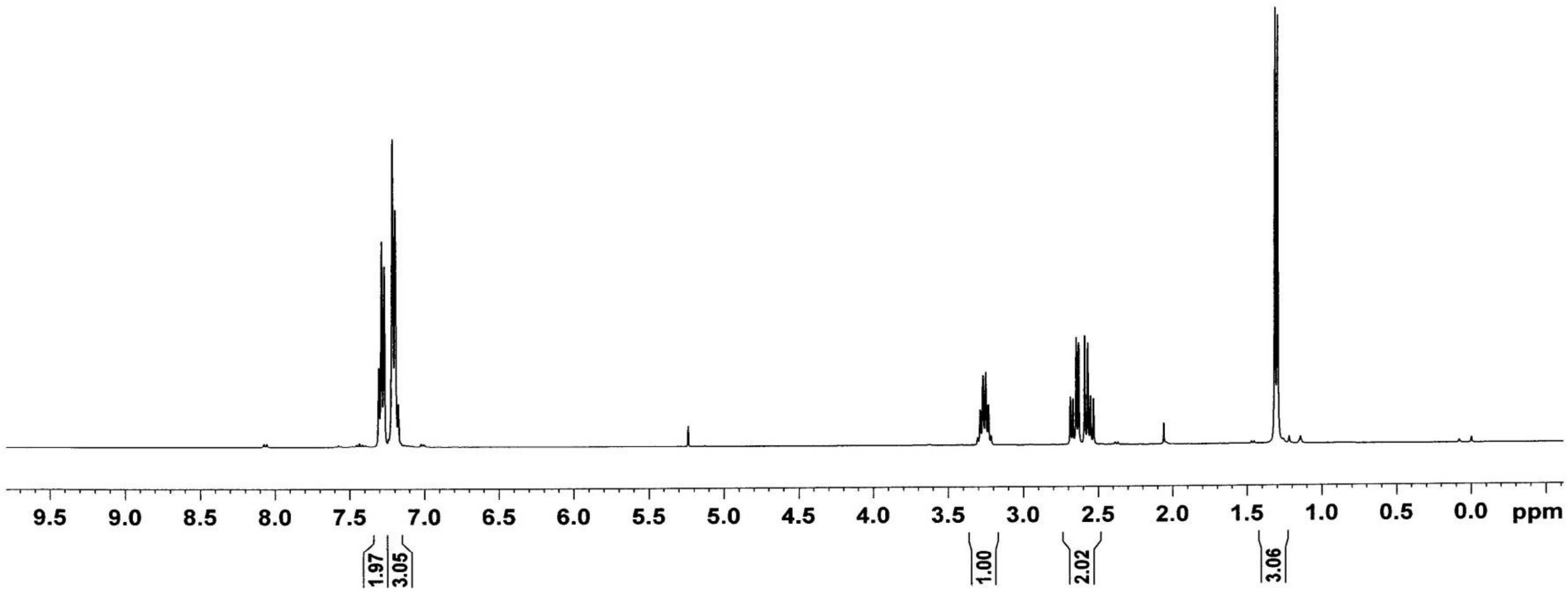


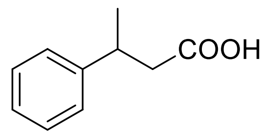
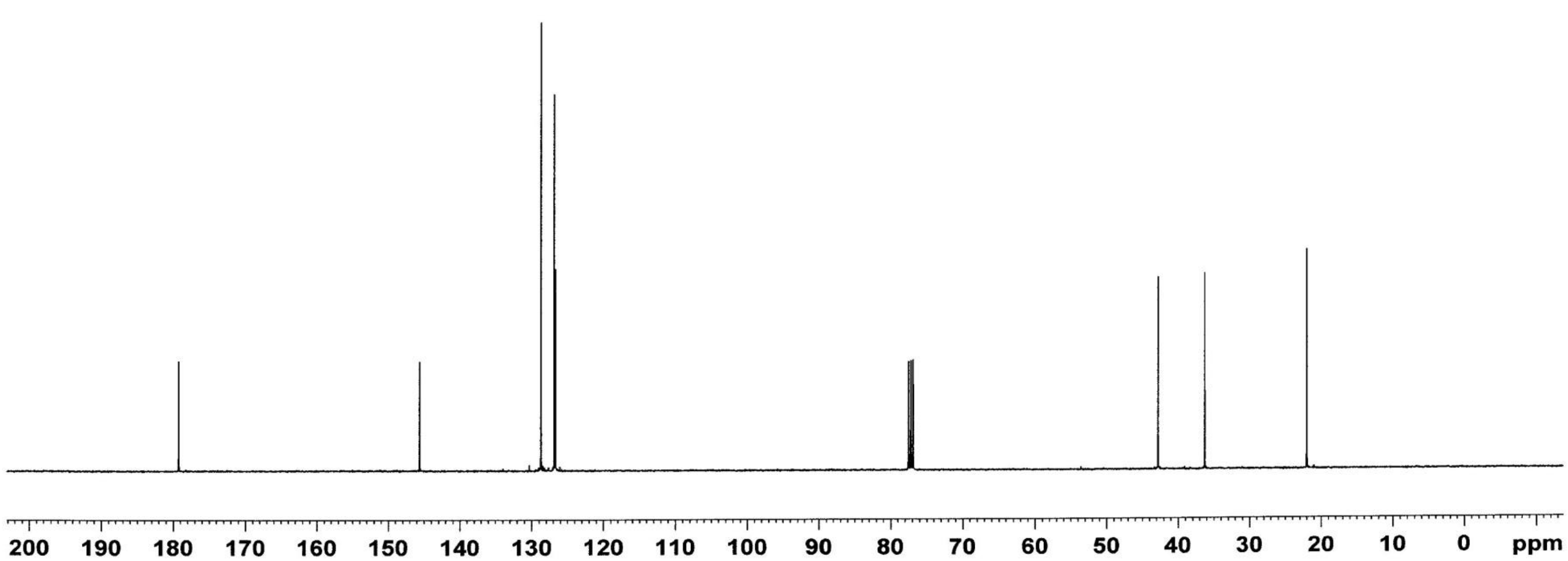
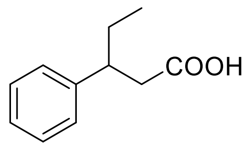


Table 2, Entry 1, **2a**





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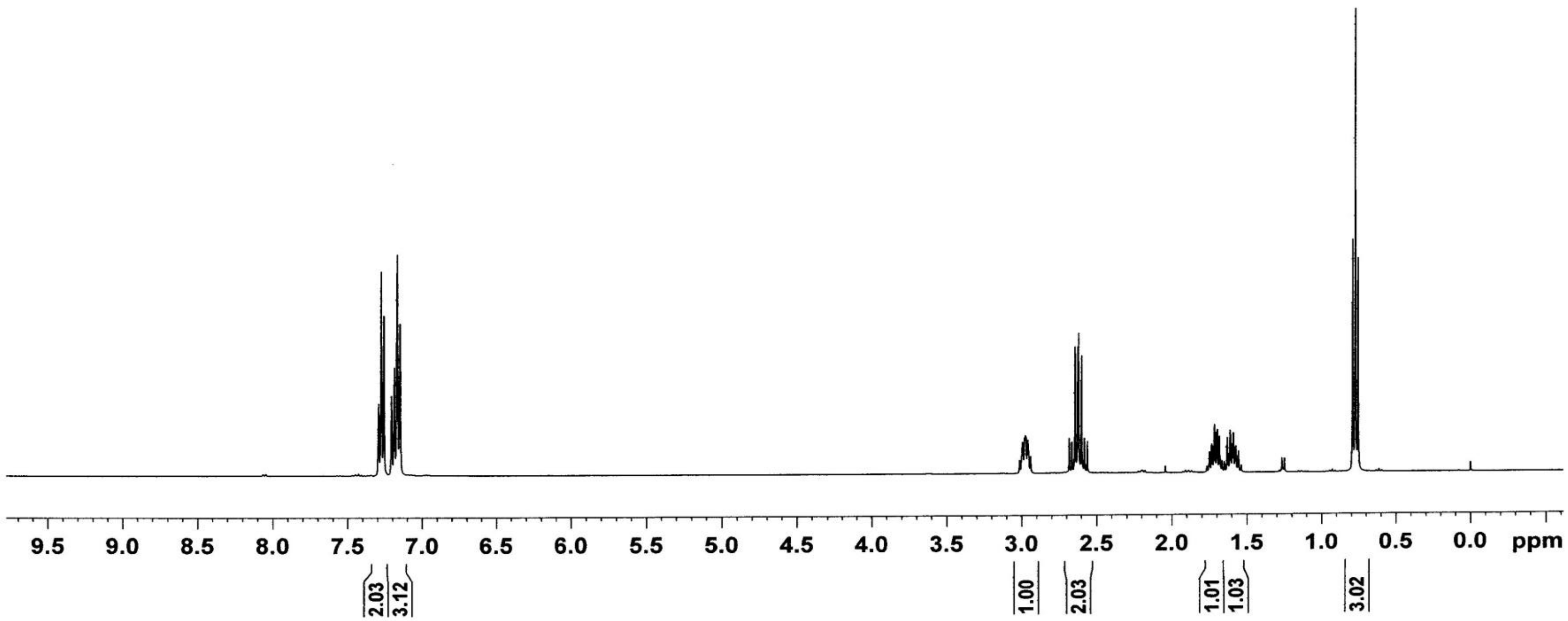

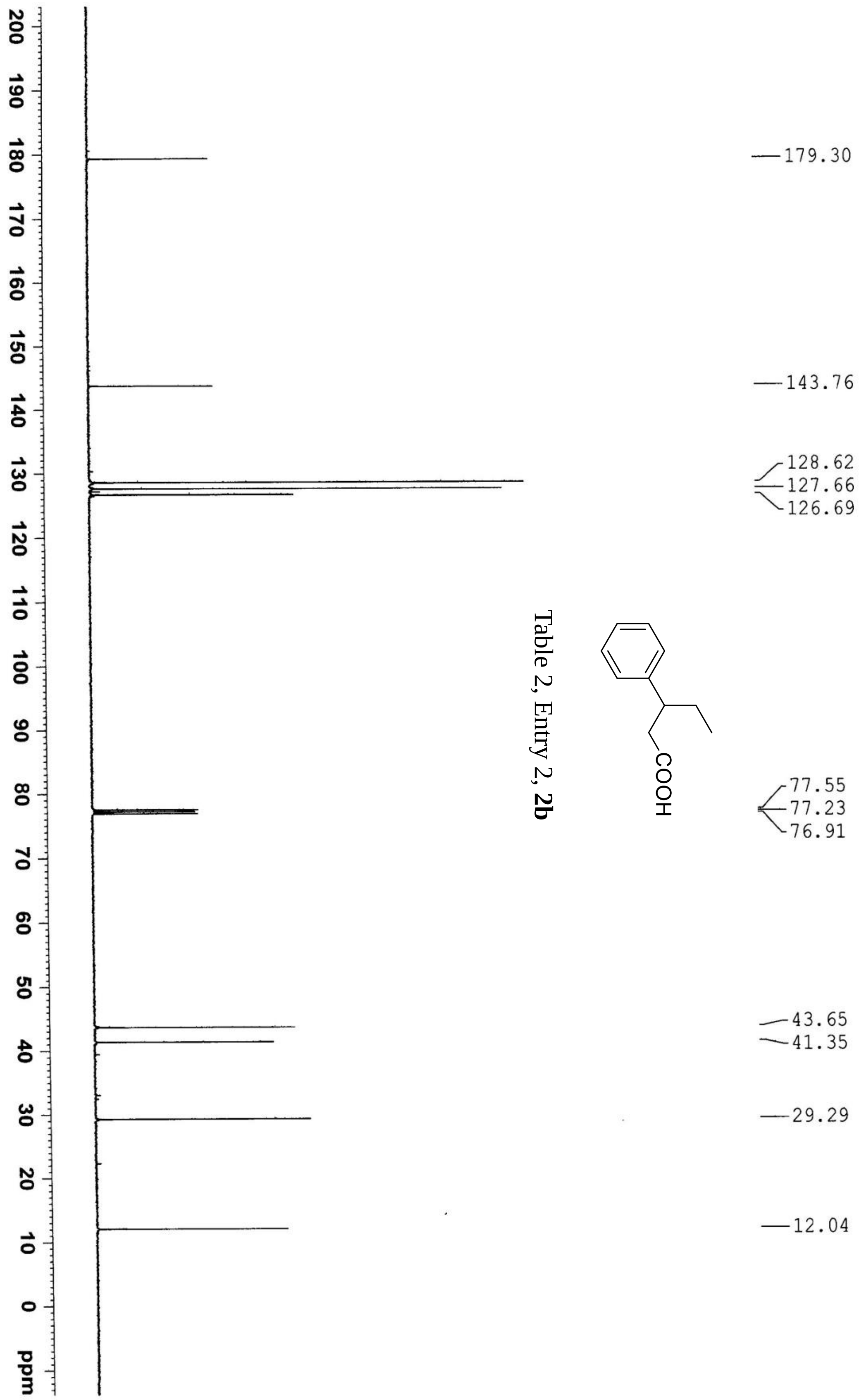

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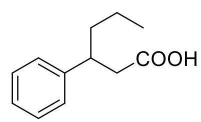

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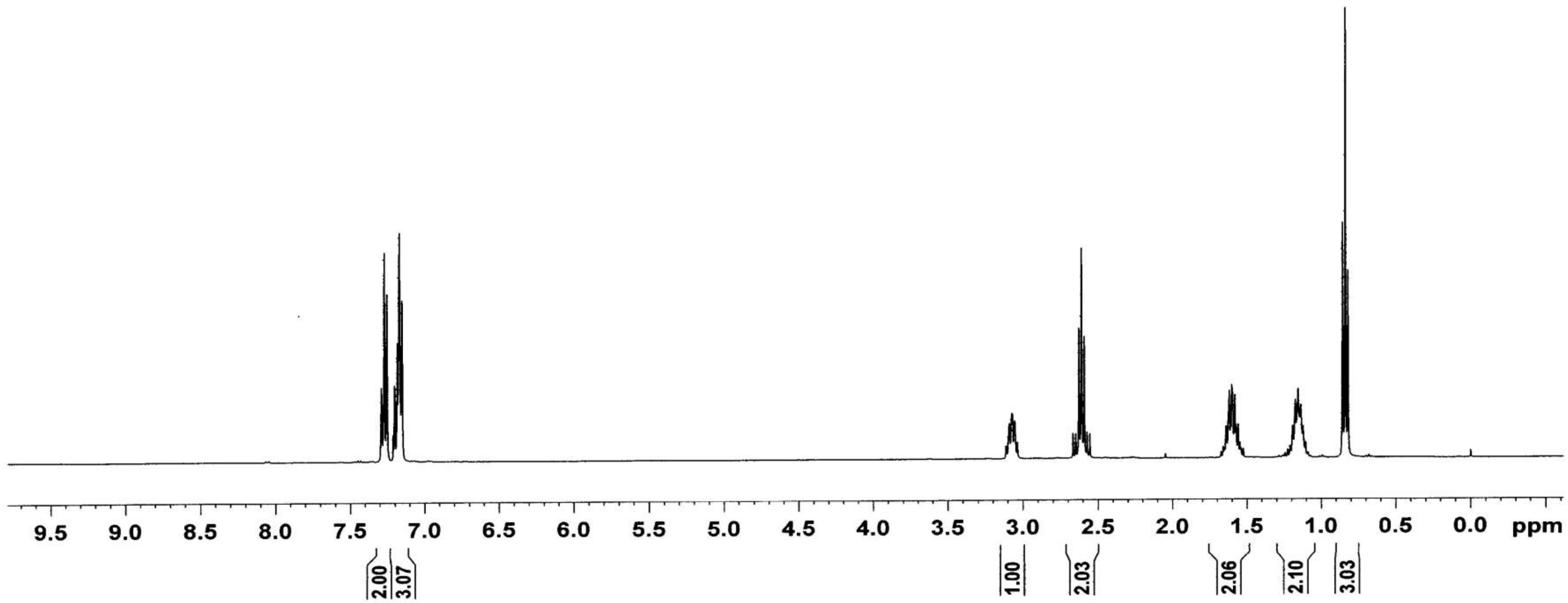

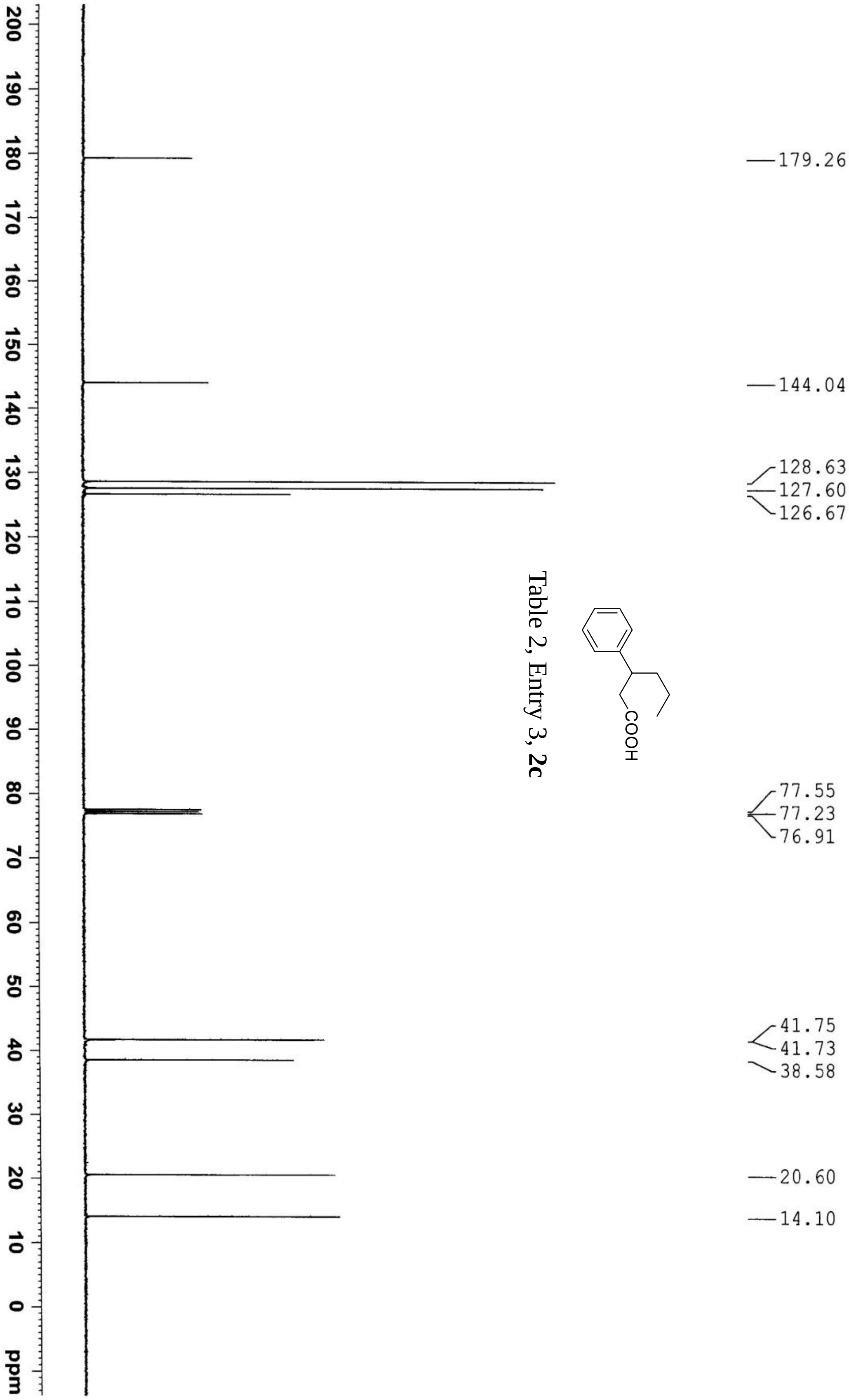

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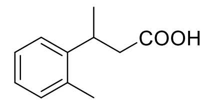

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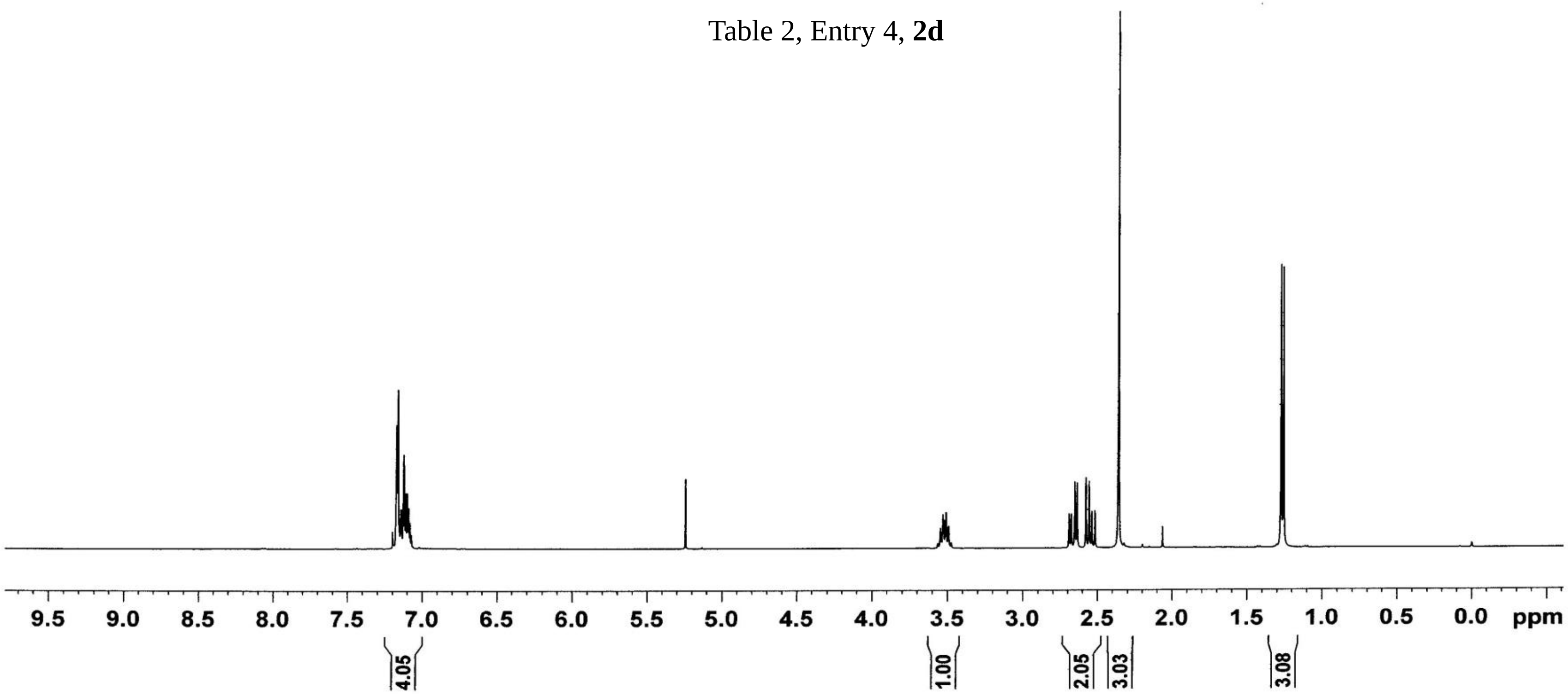

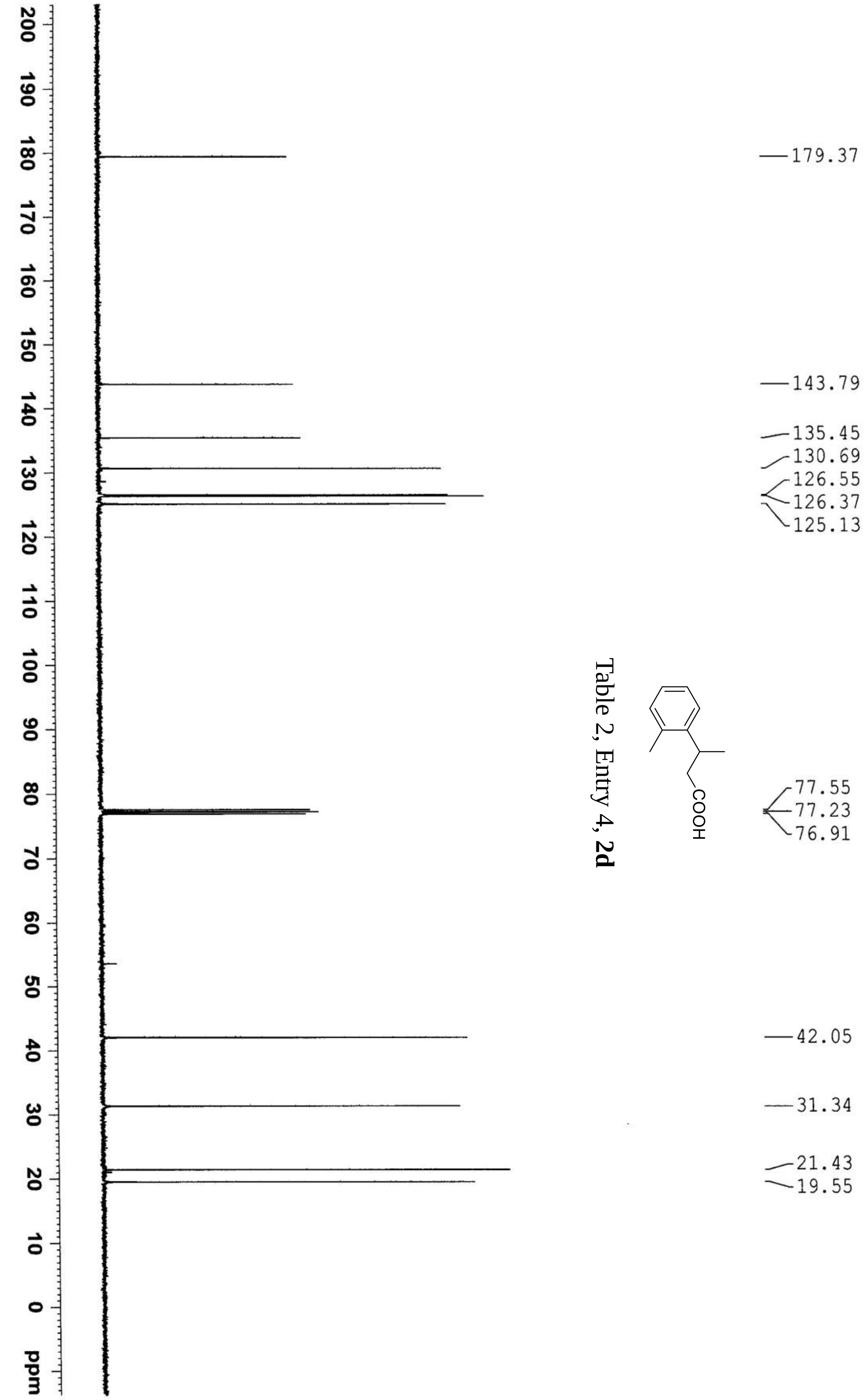

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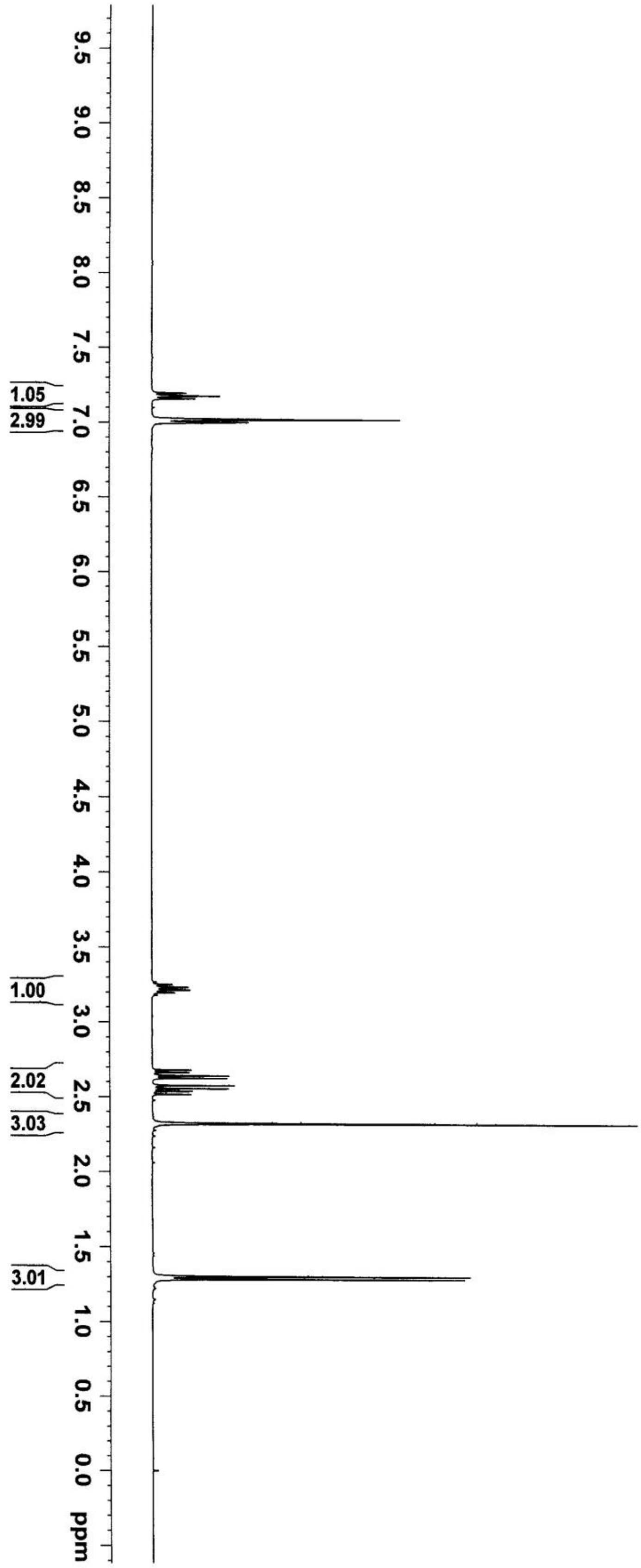

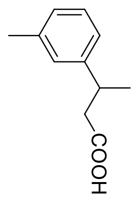

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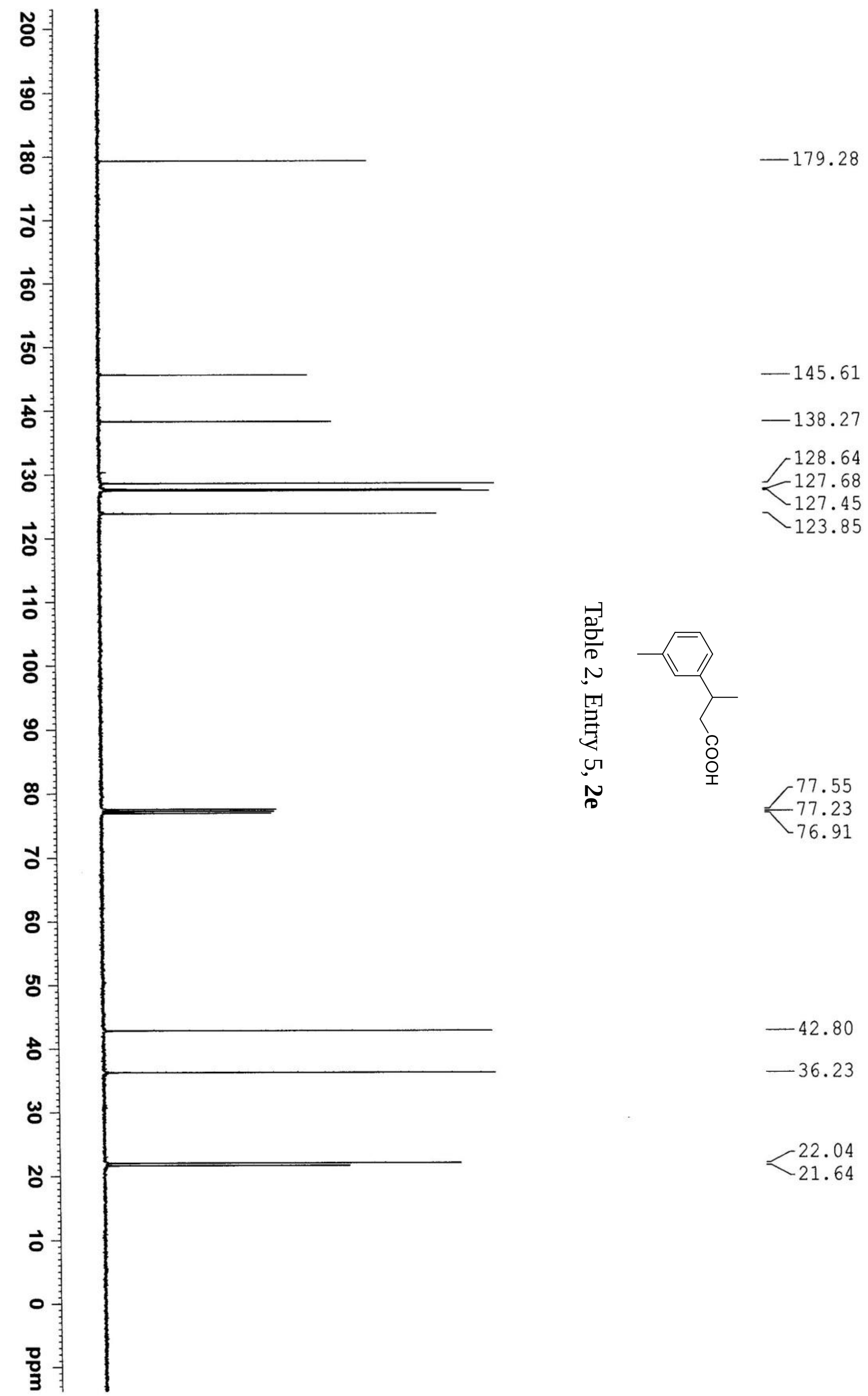

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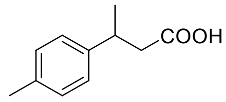
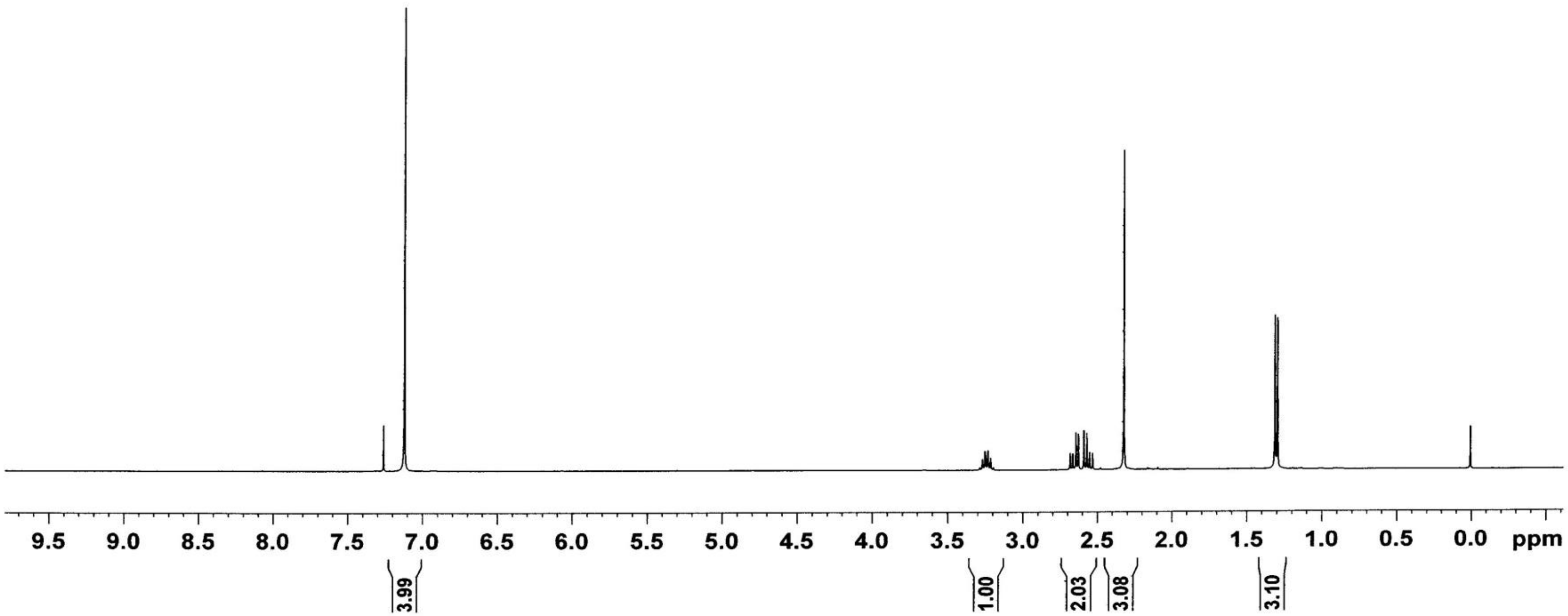
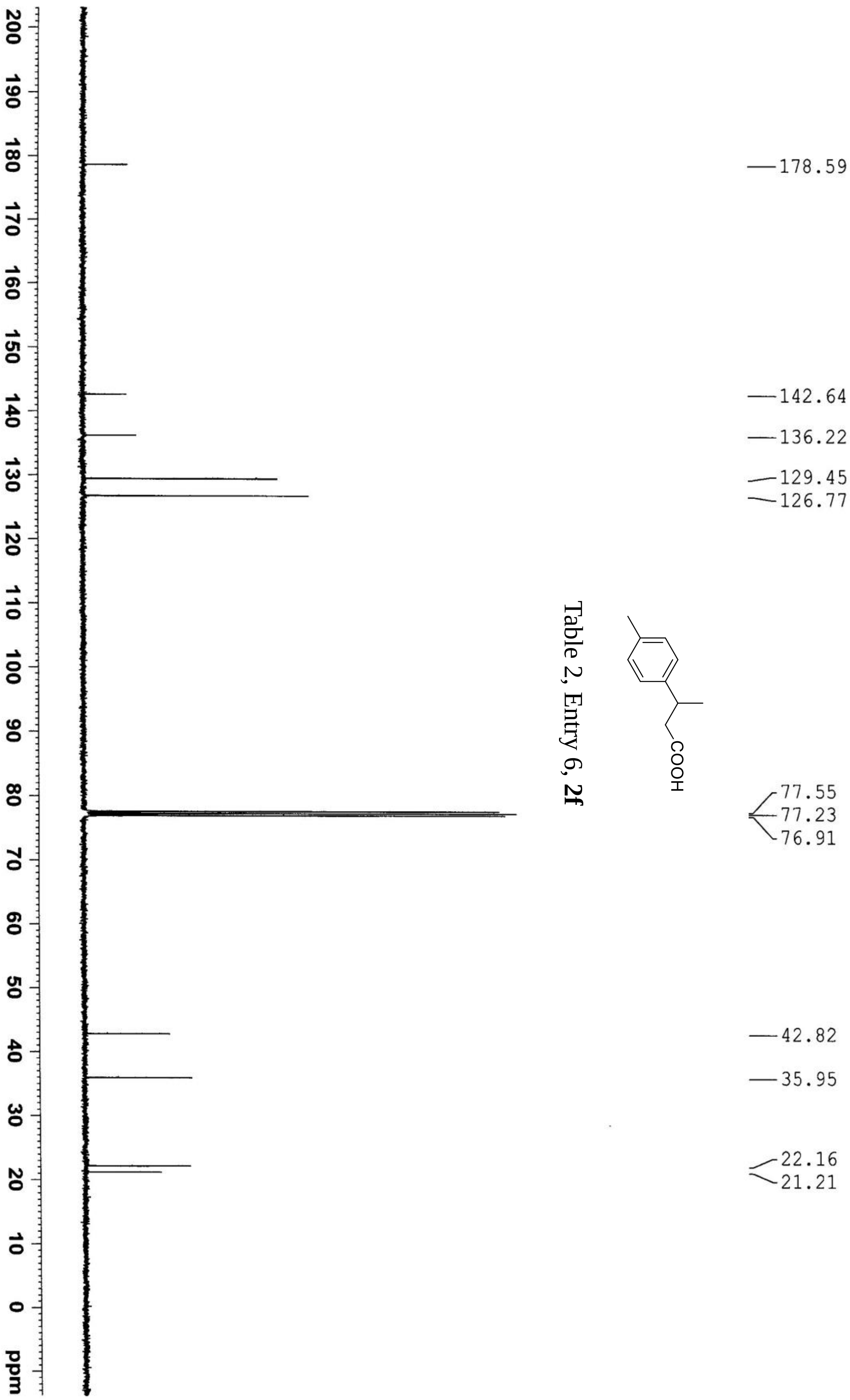


Table 2, Entry 6, **2f**





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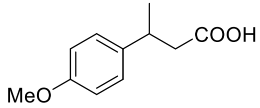

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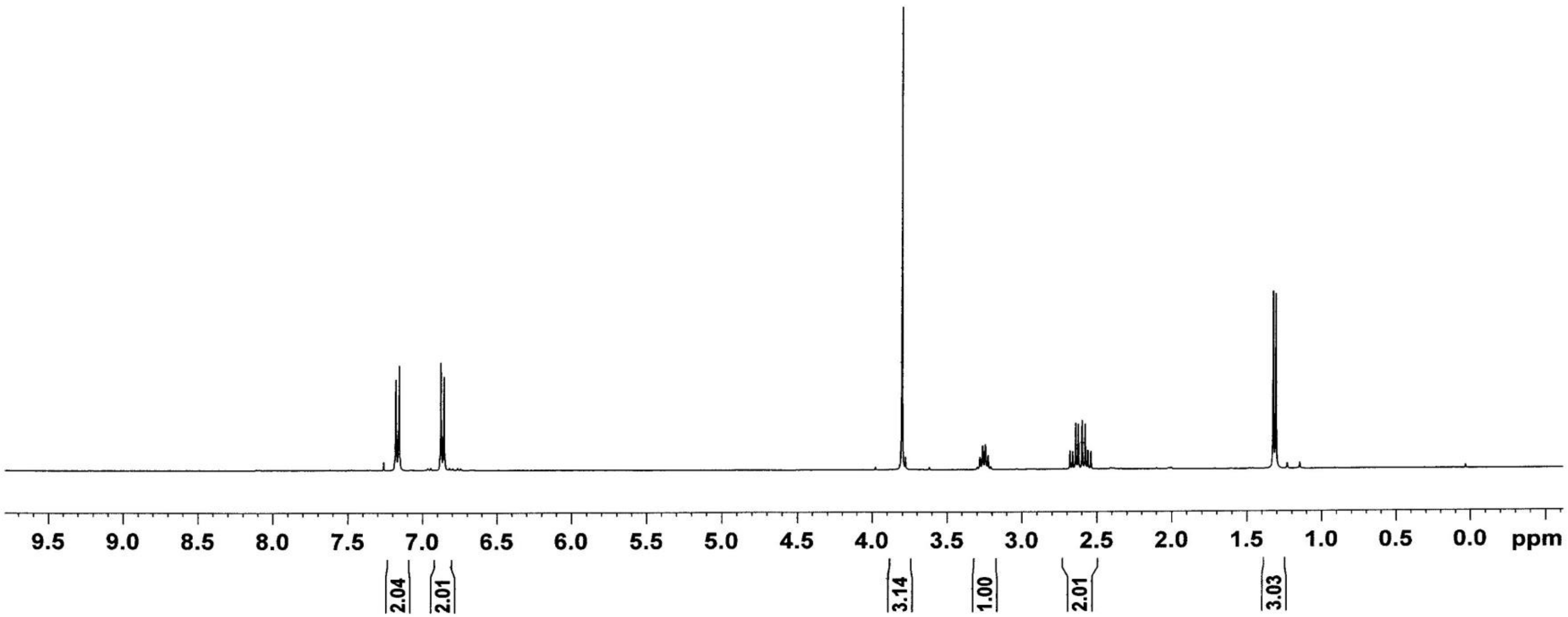

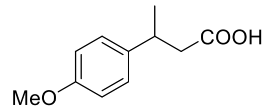

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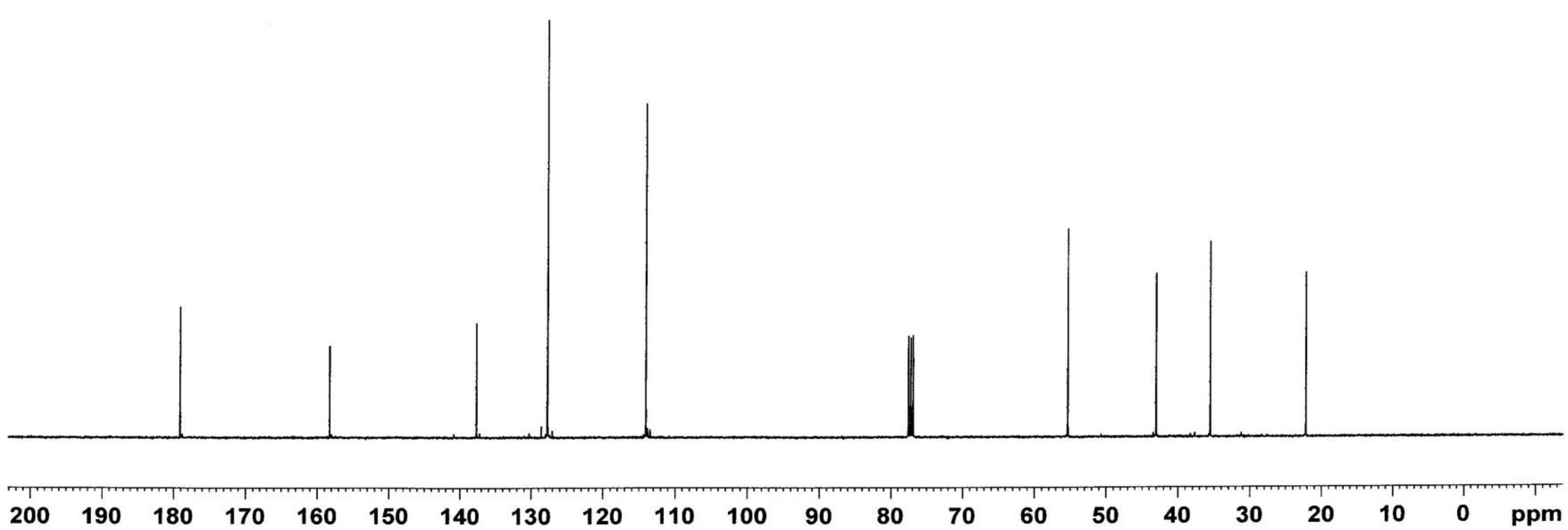


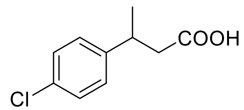
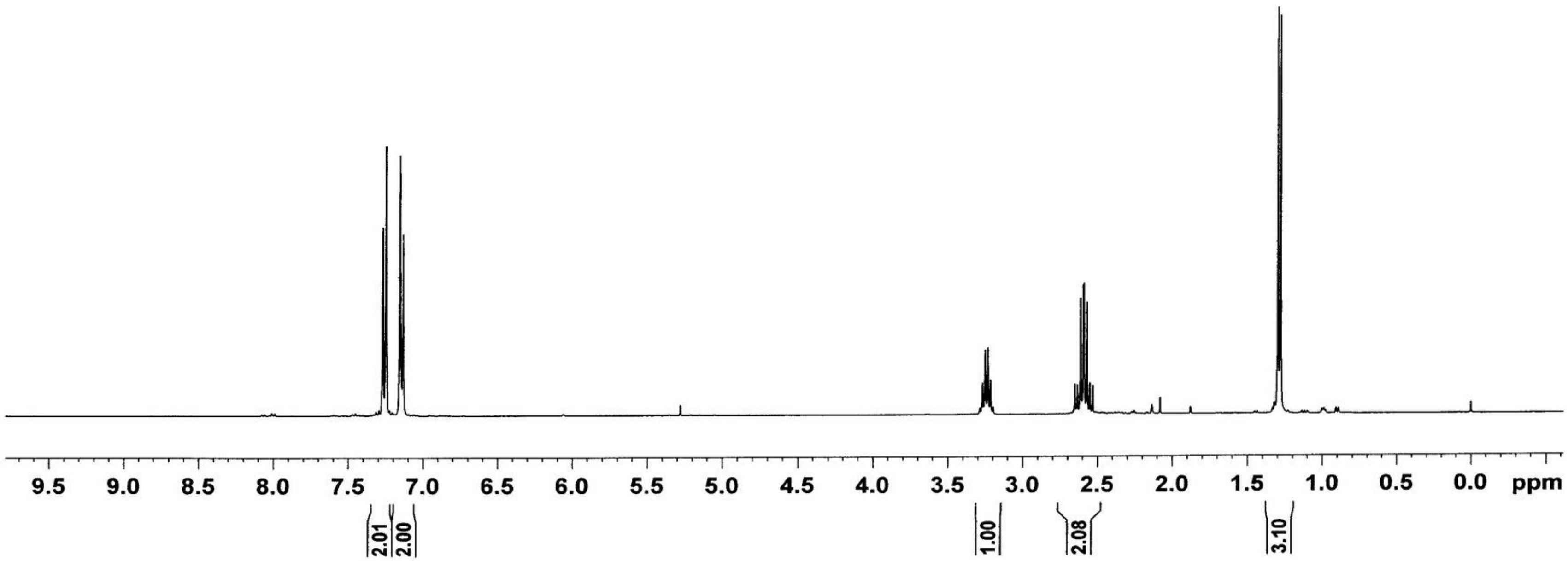
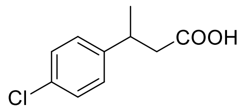


Table 2, Entry 8, **2h**





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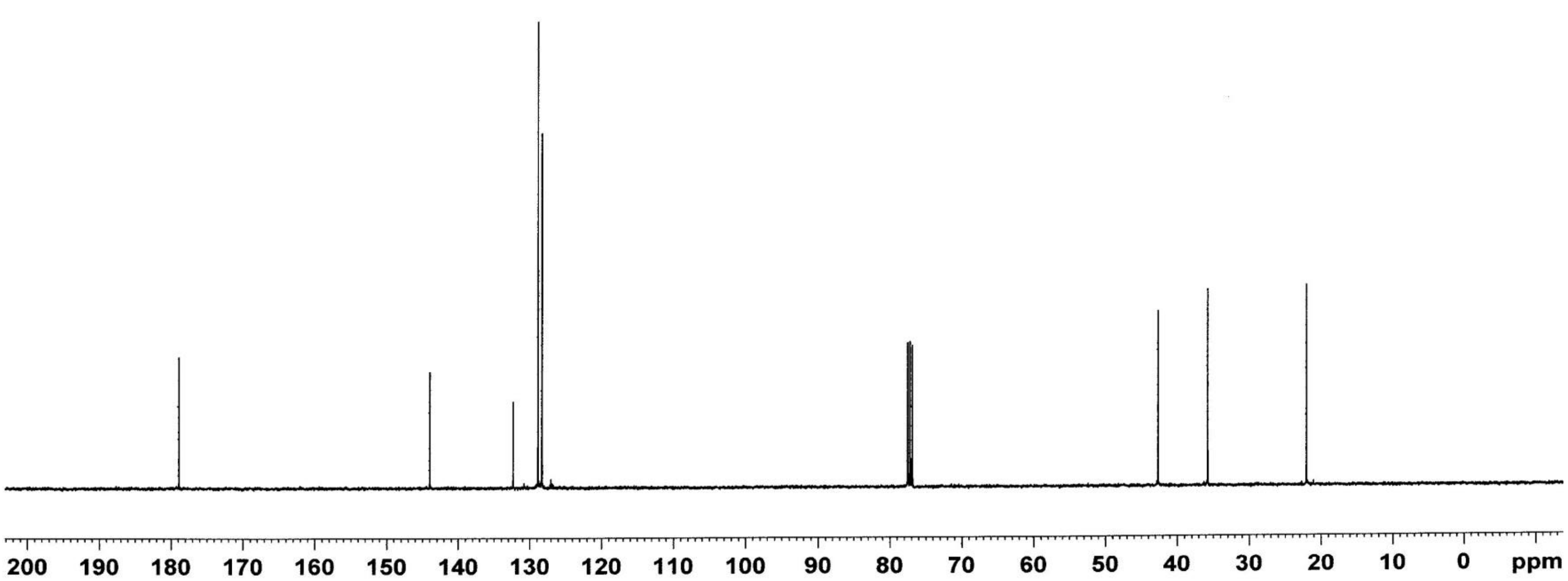


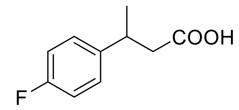
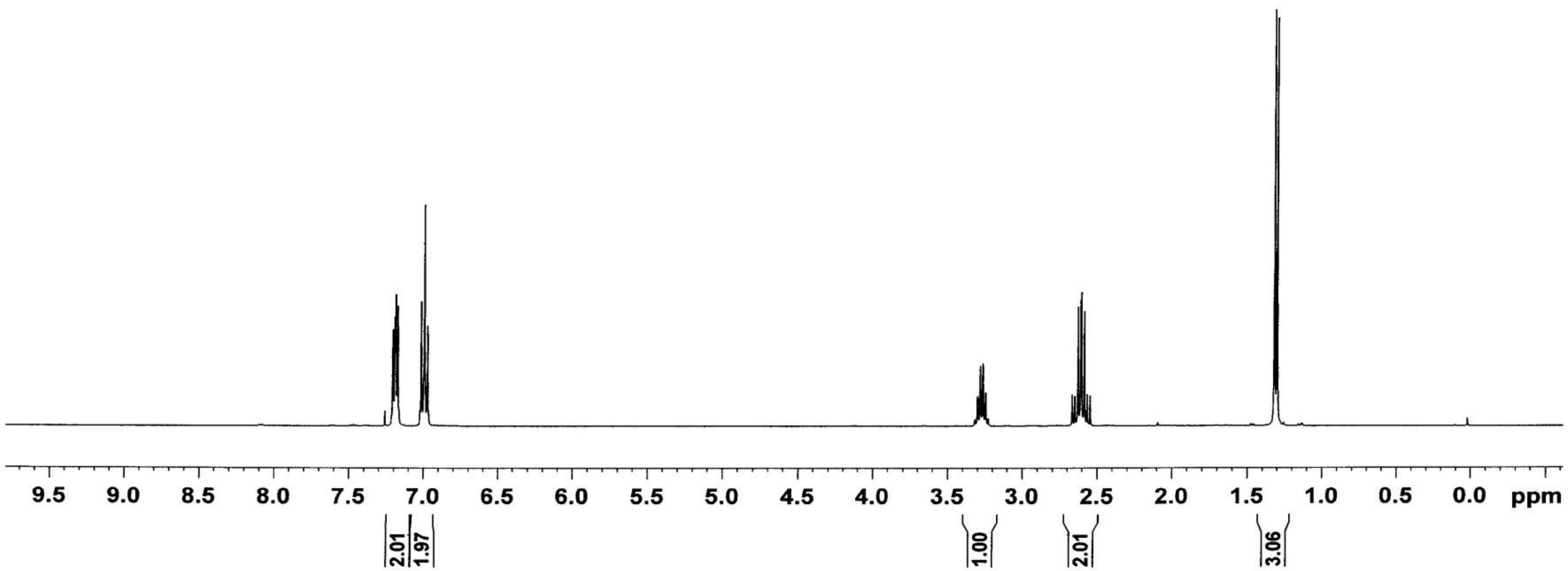
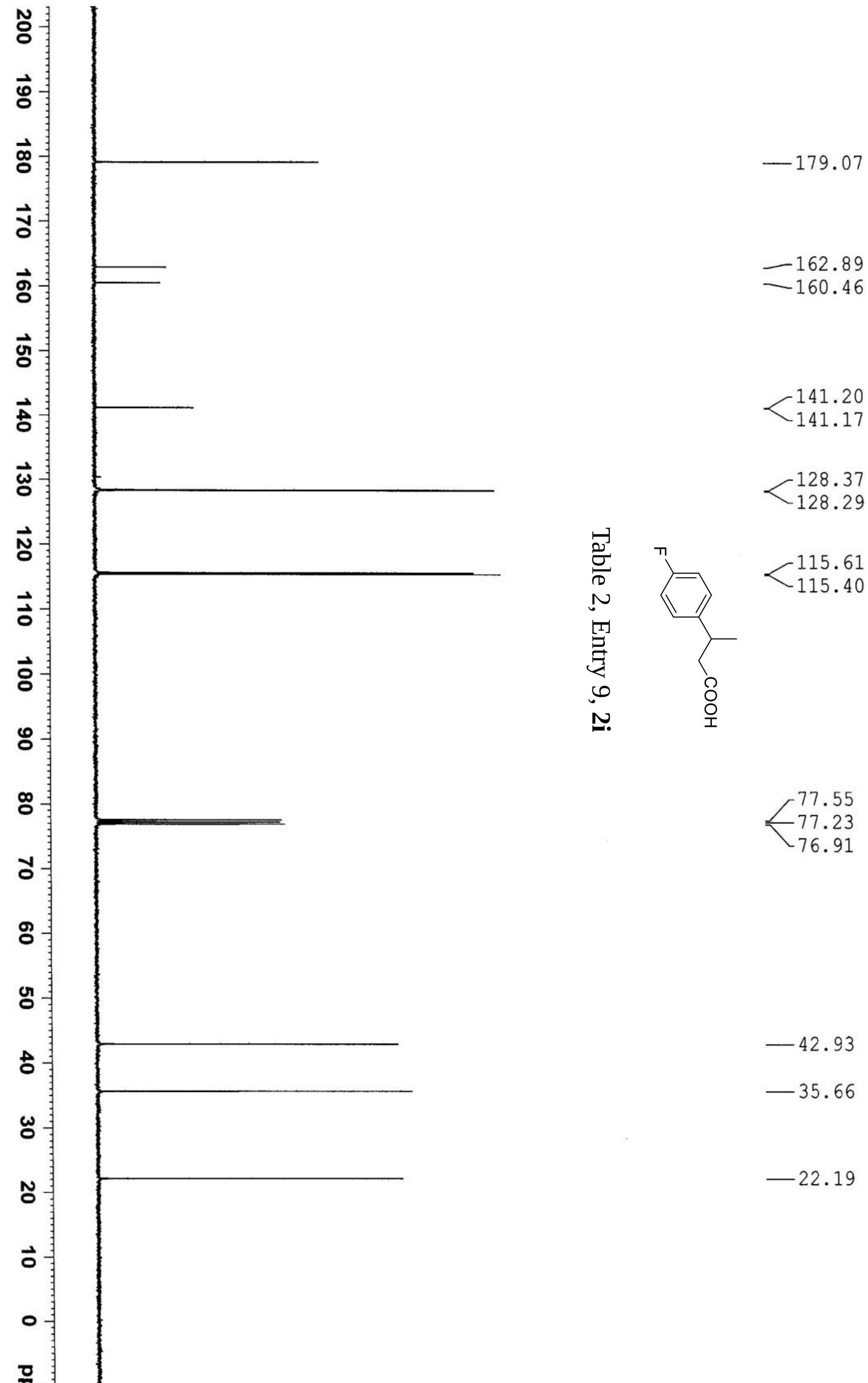


Table 2, Entry 9, **2i**





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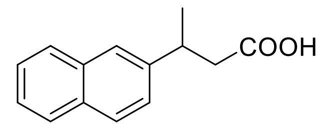

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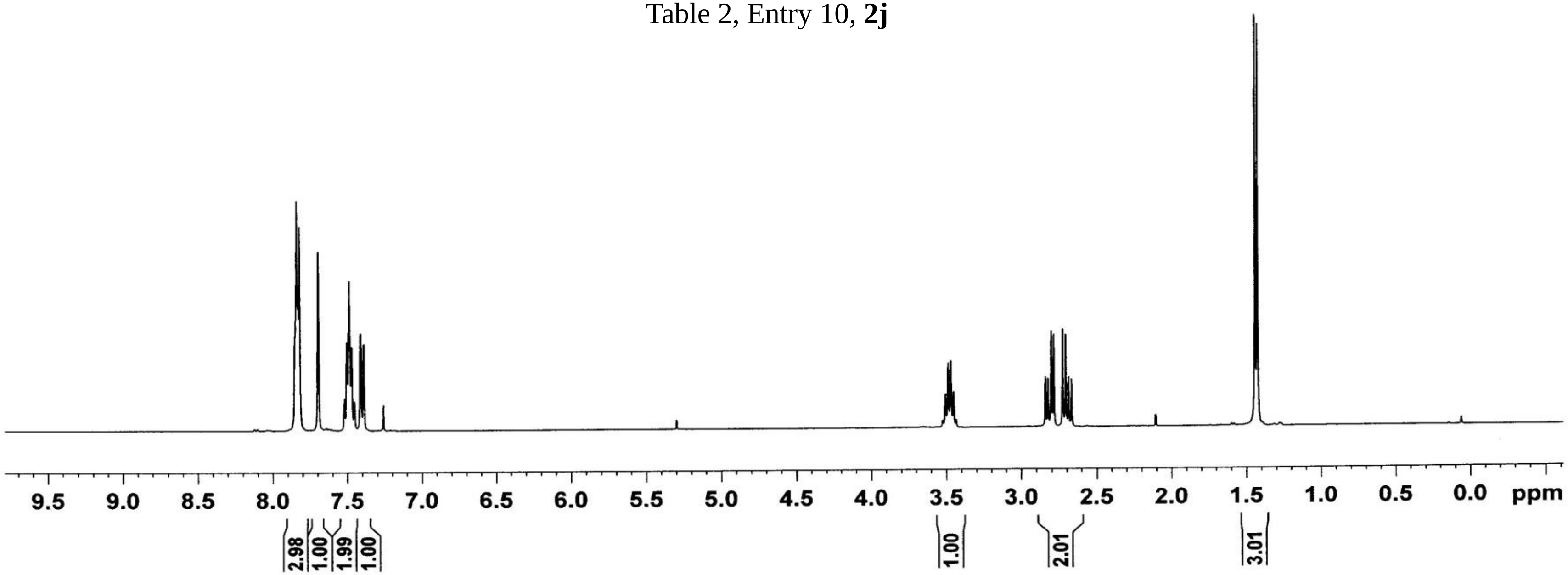

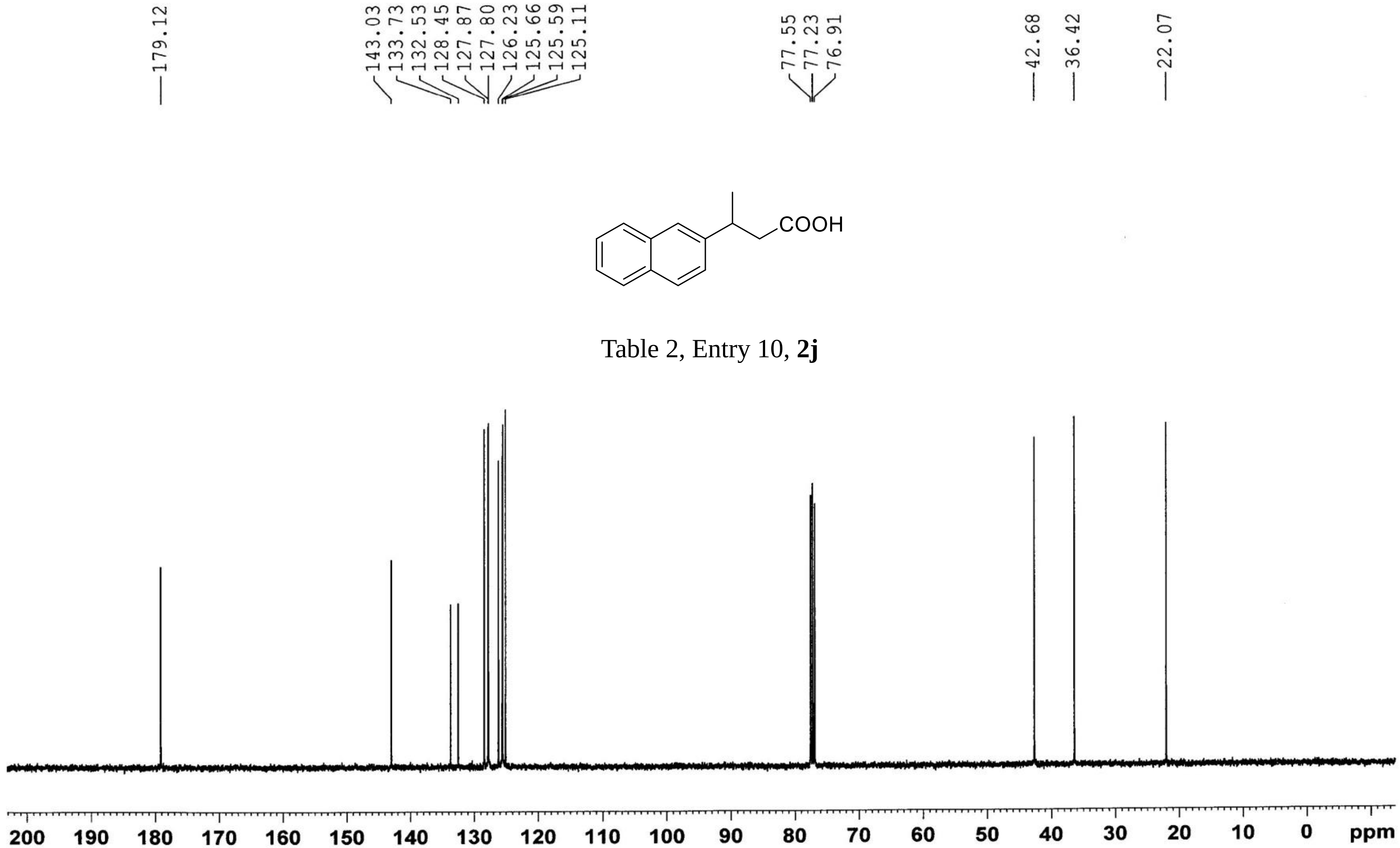

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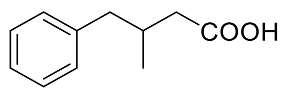

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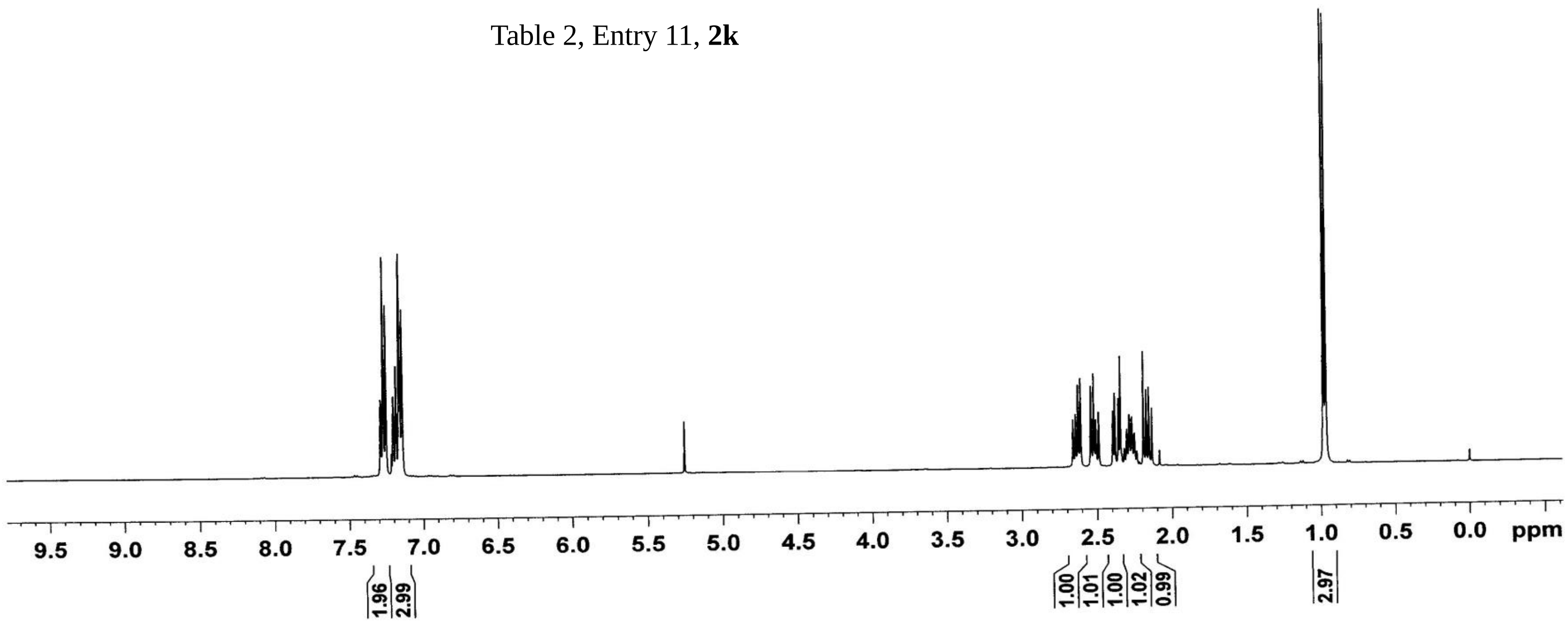

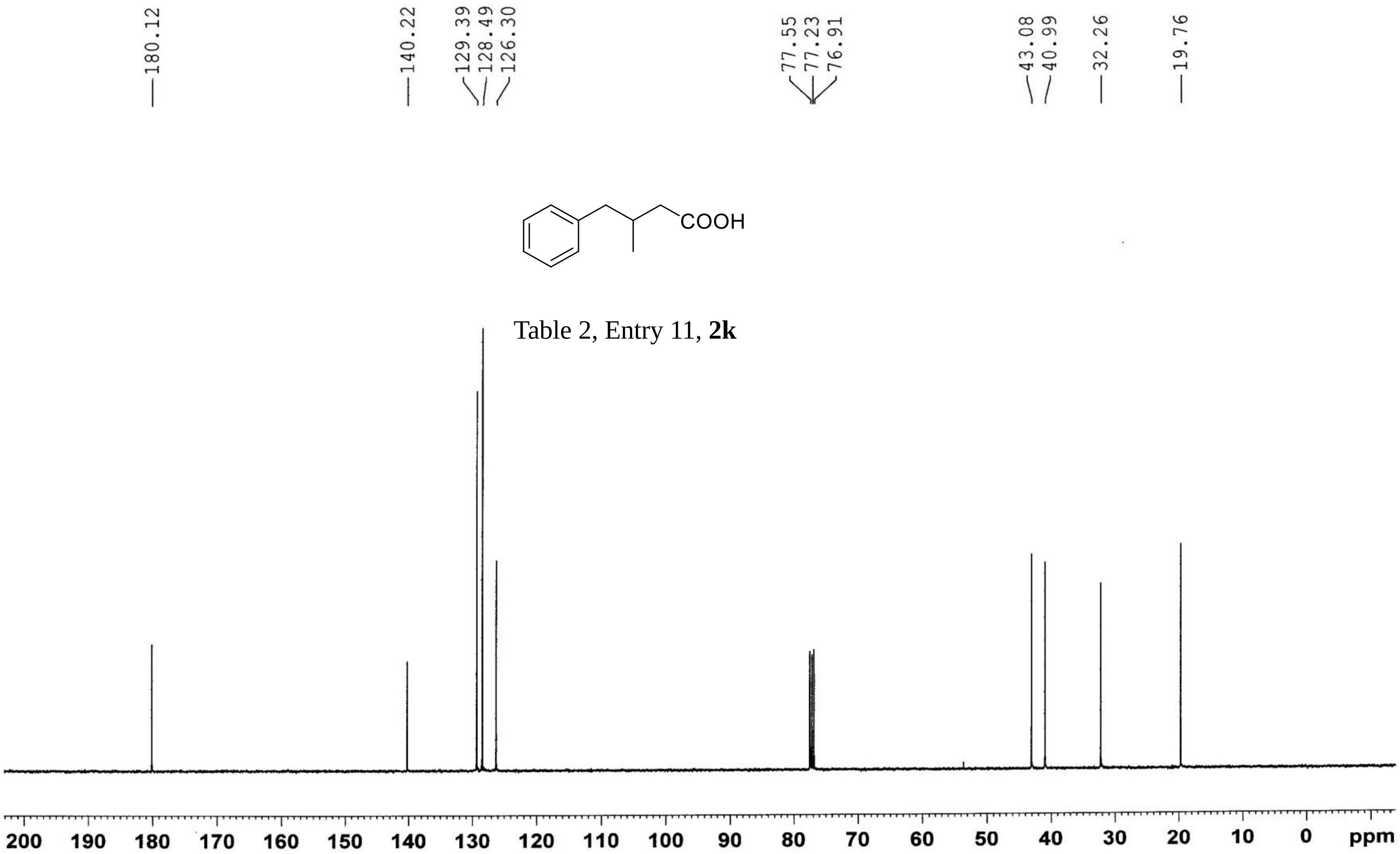

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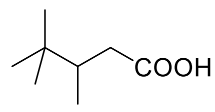

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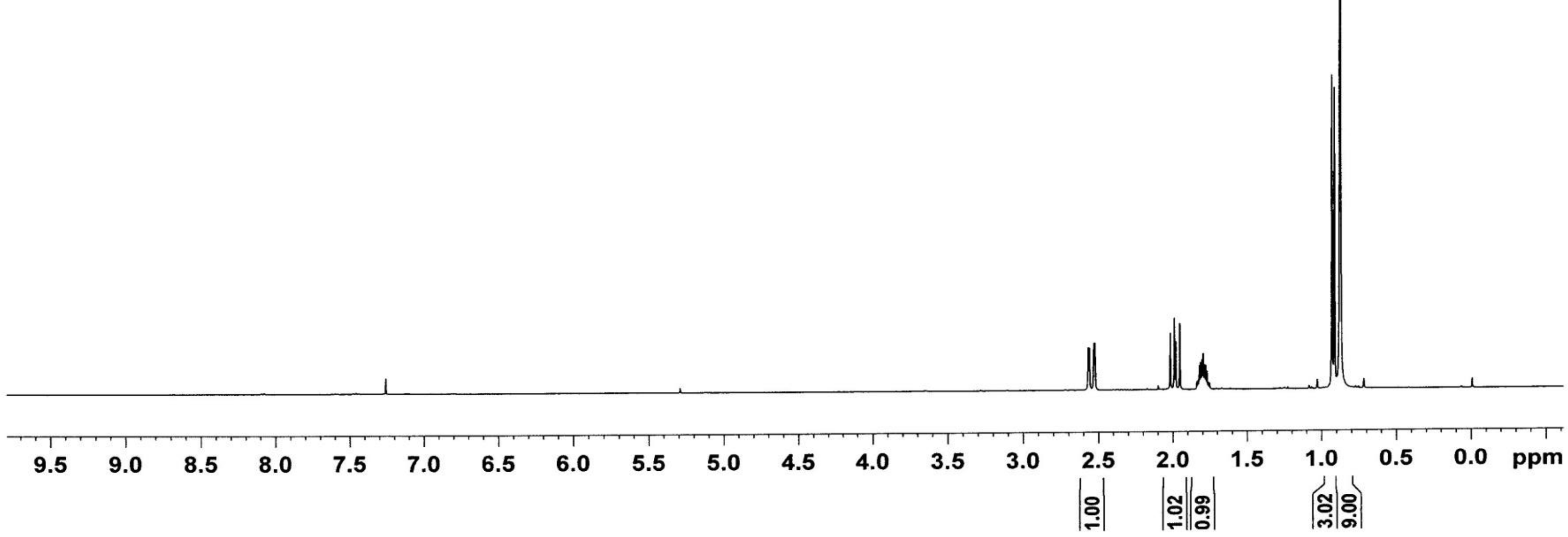

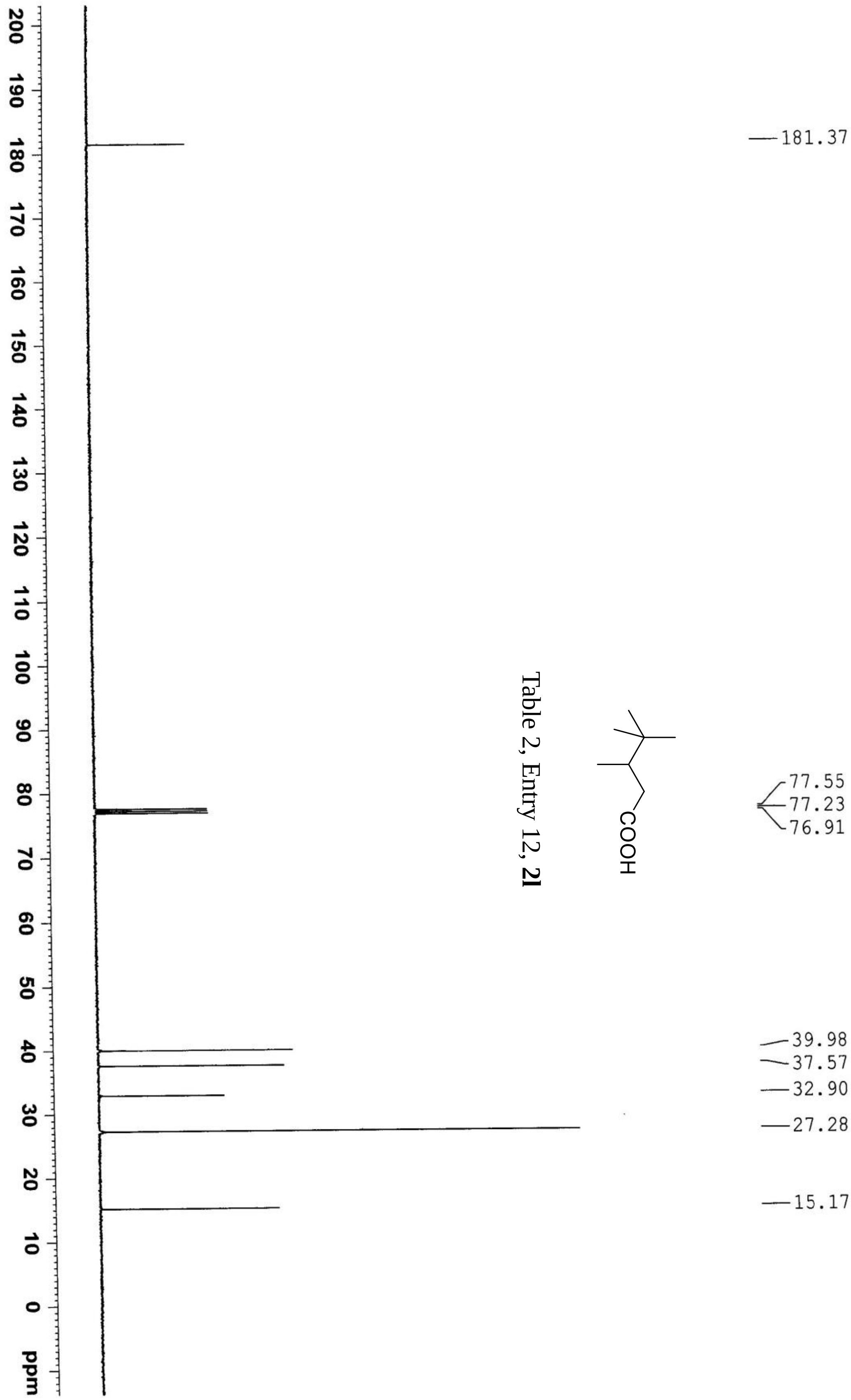

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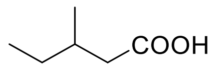

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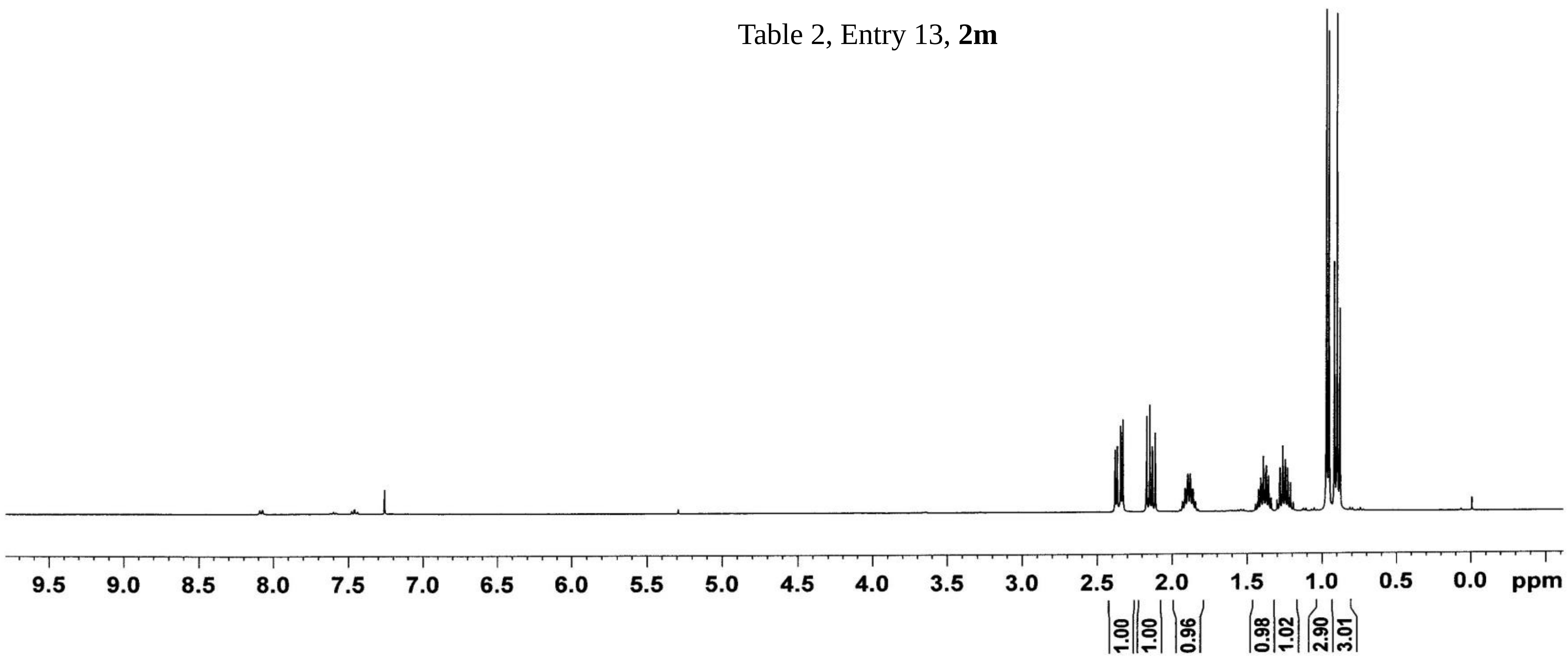

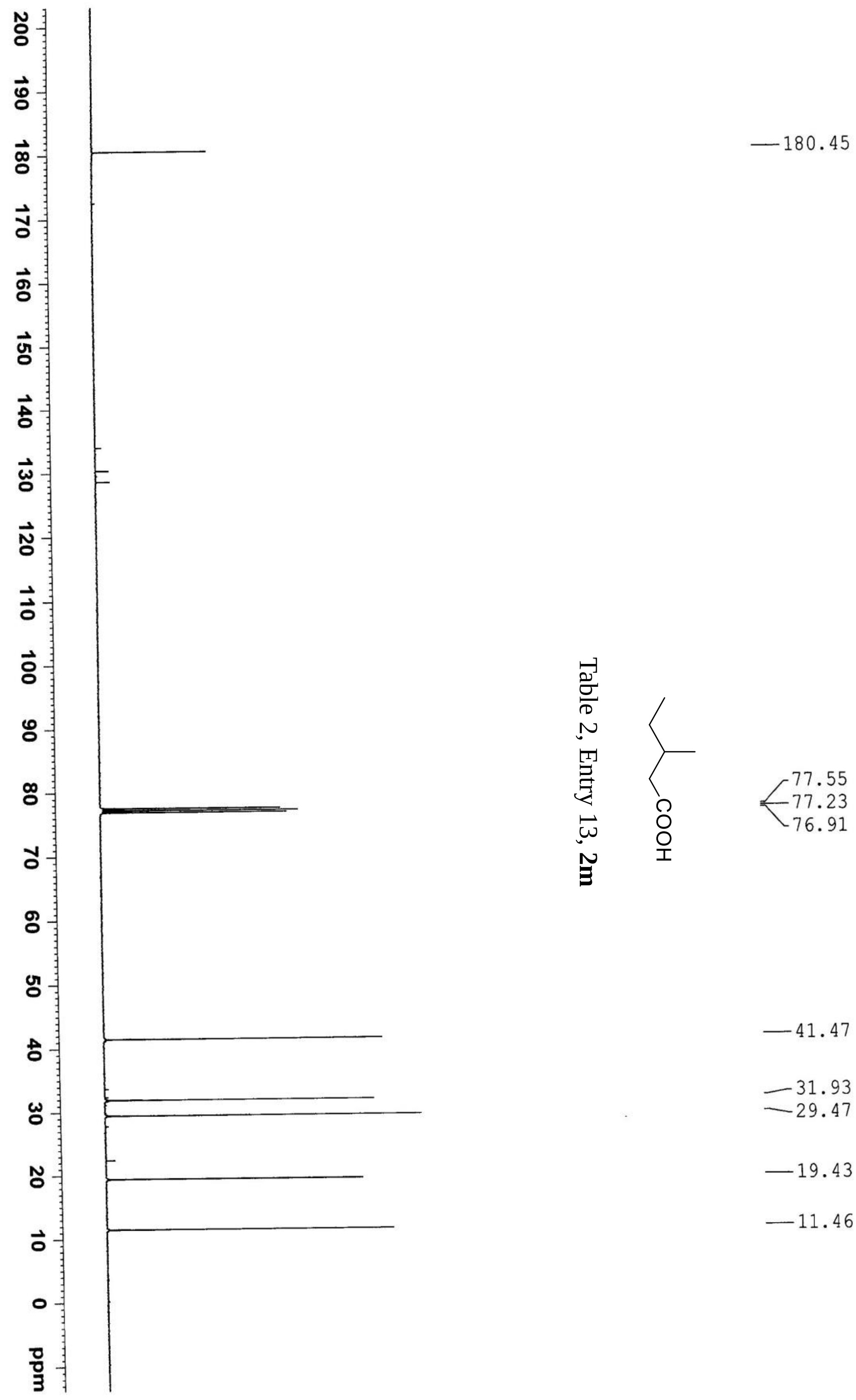

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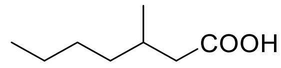

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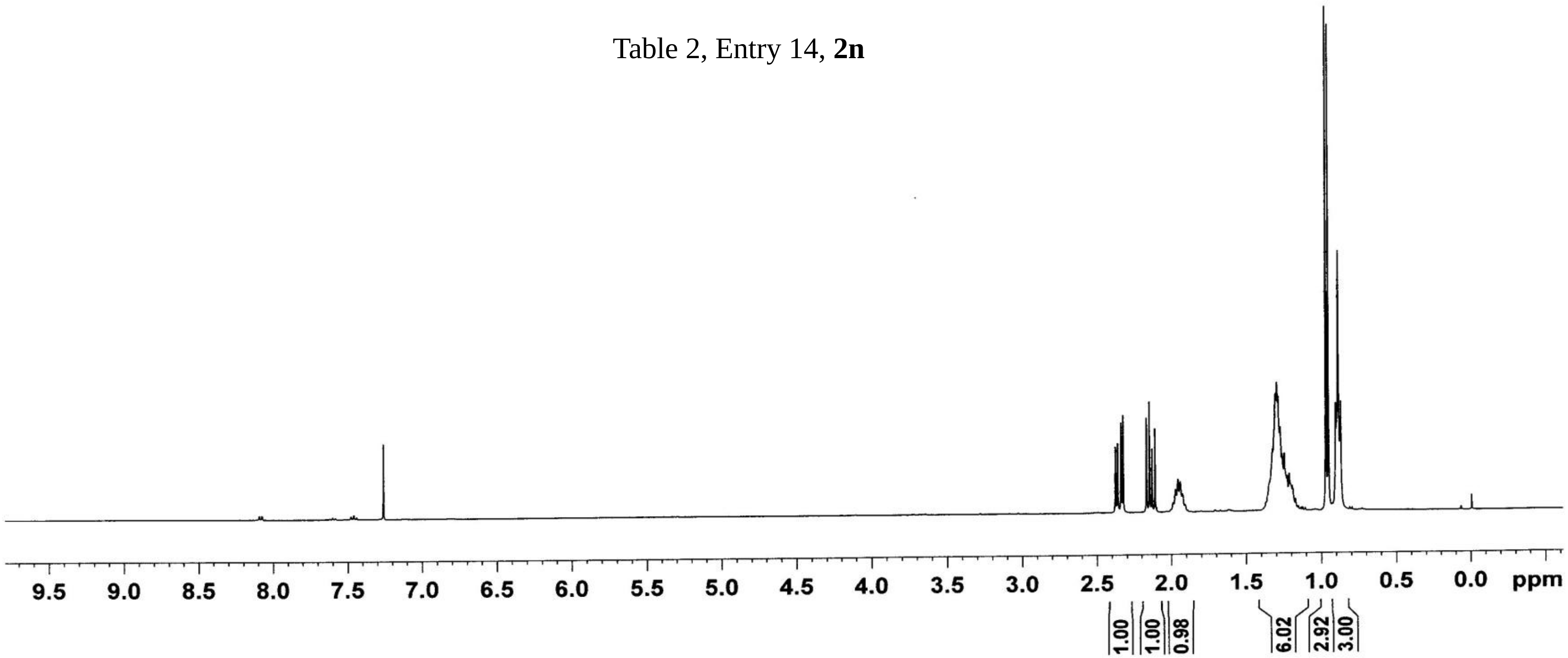

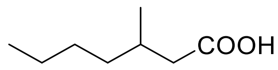

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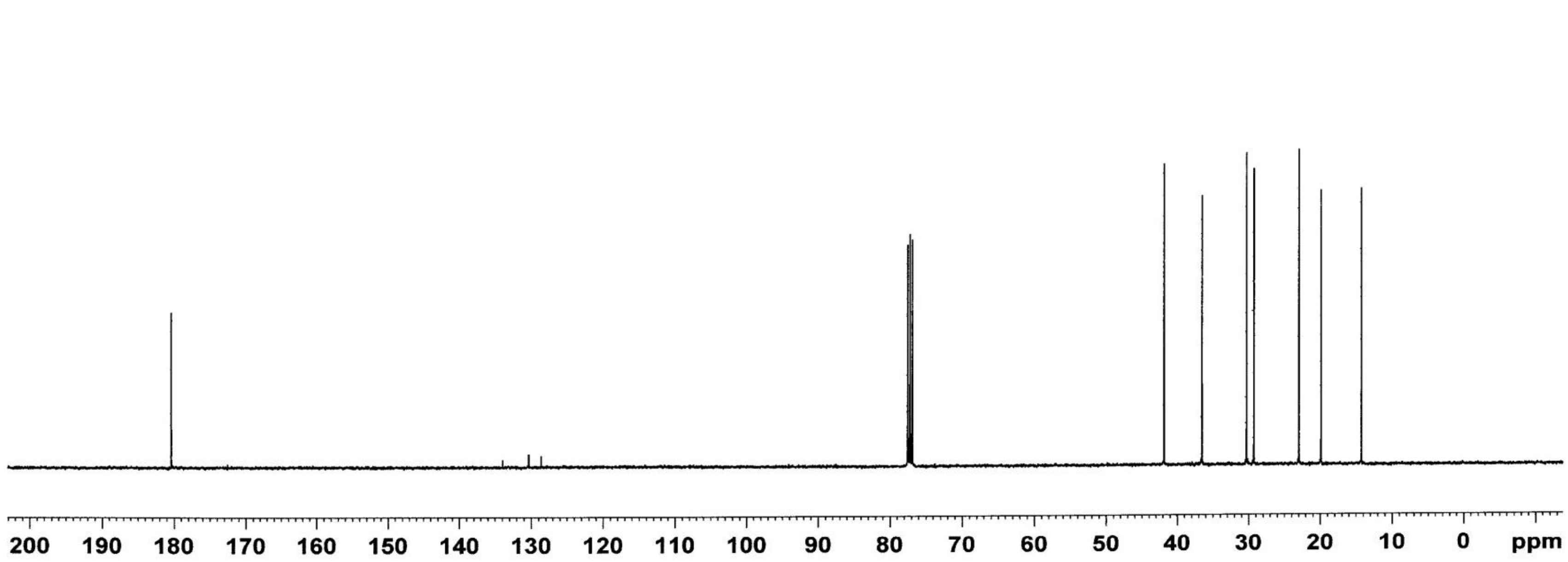

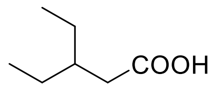

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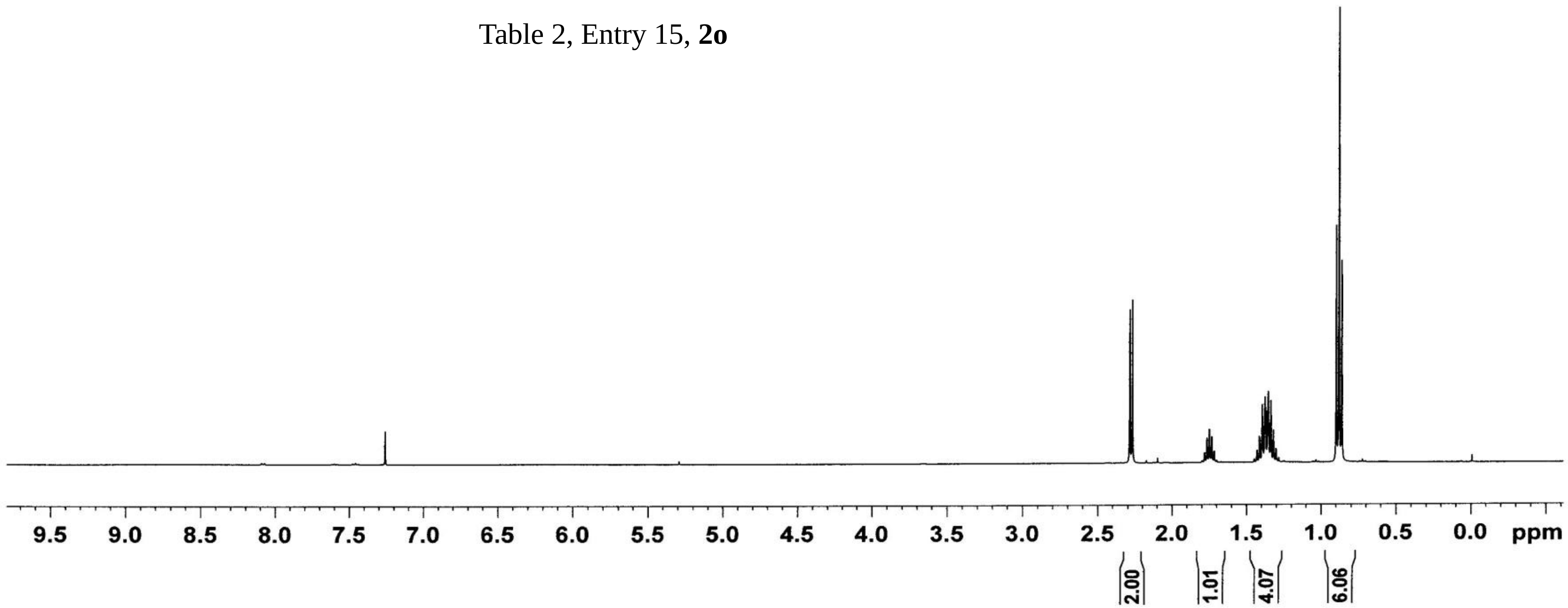

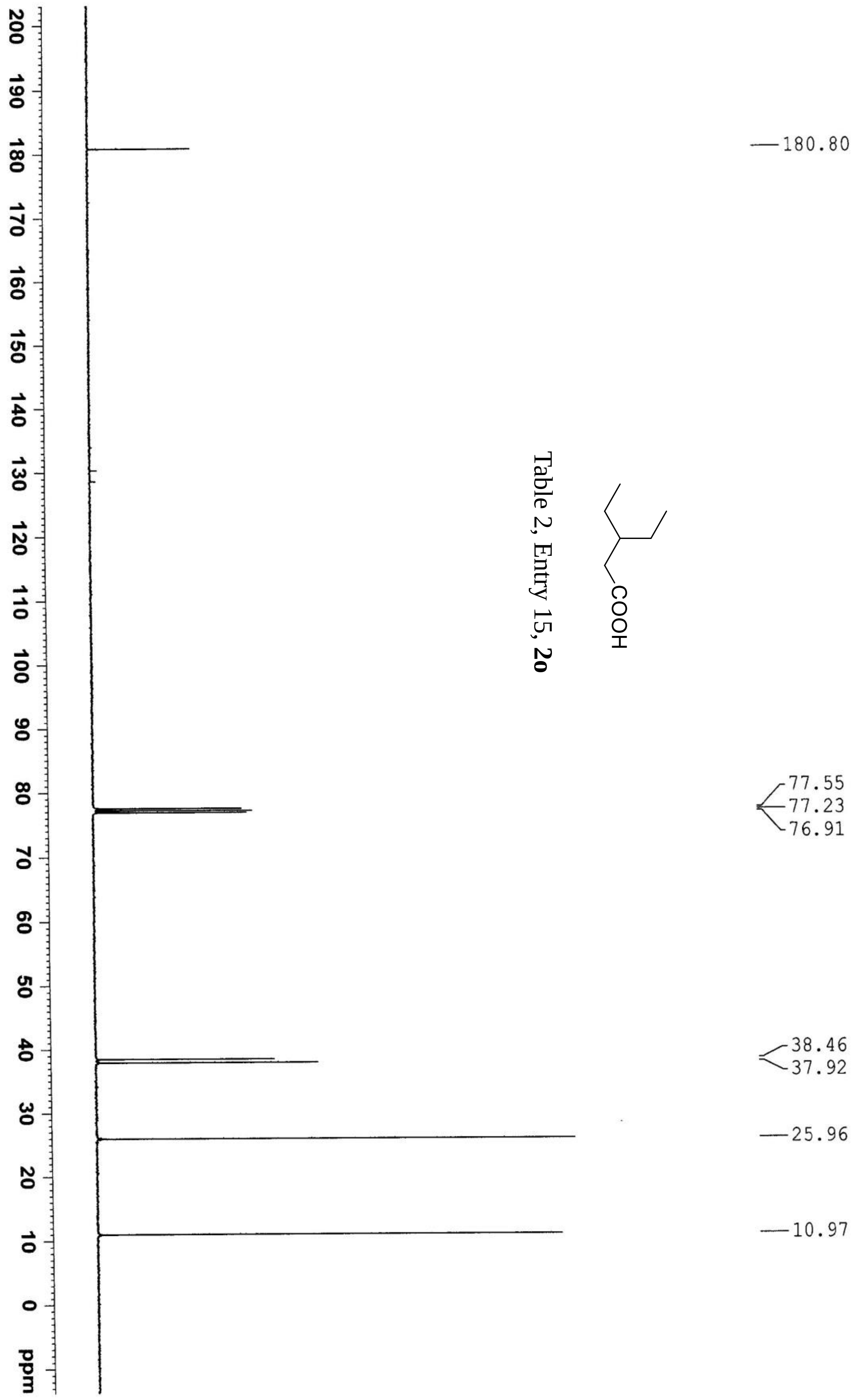

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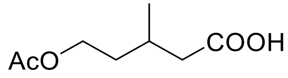

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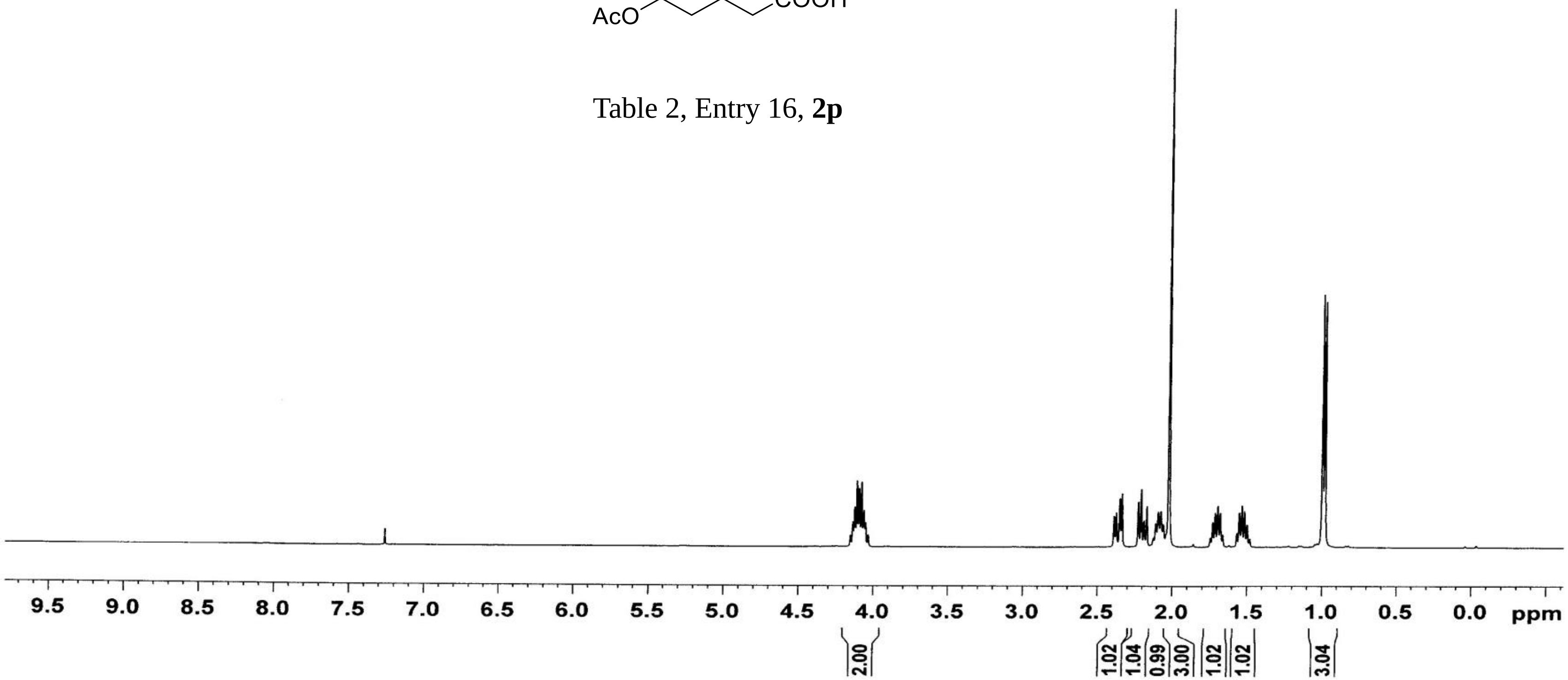

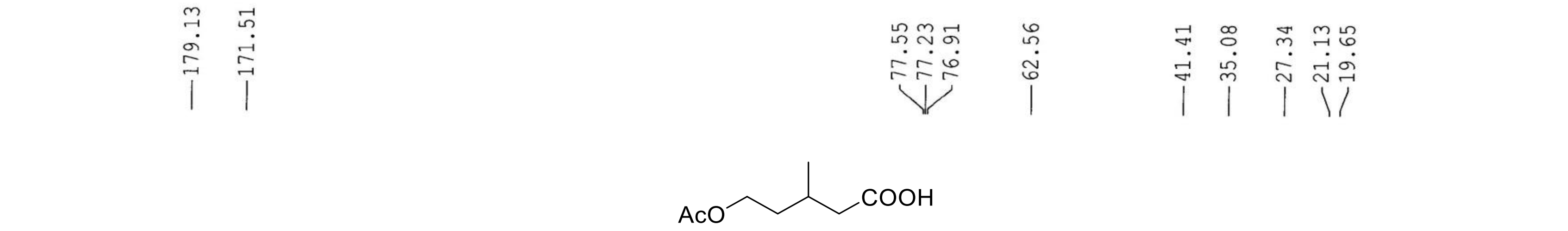

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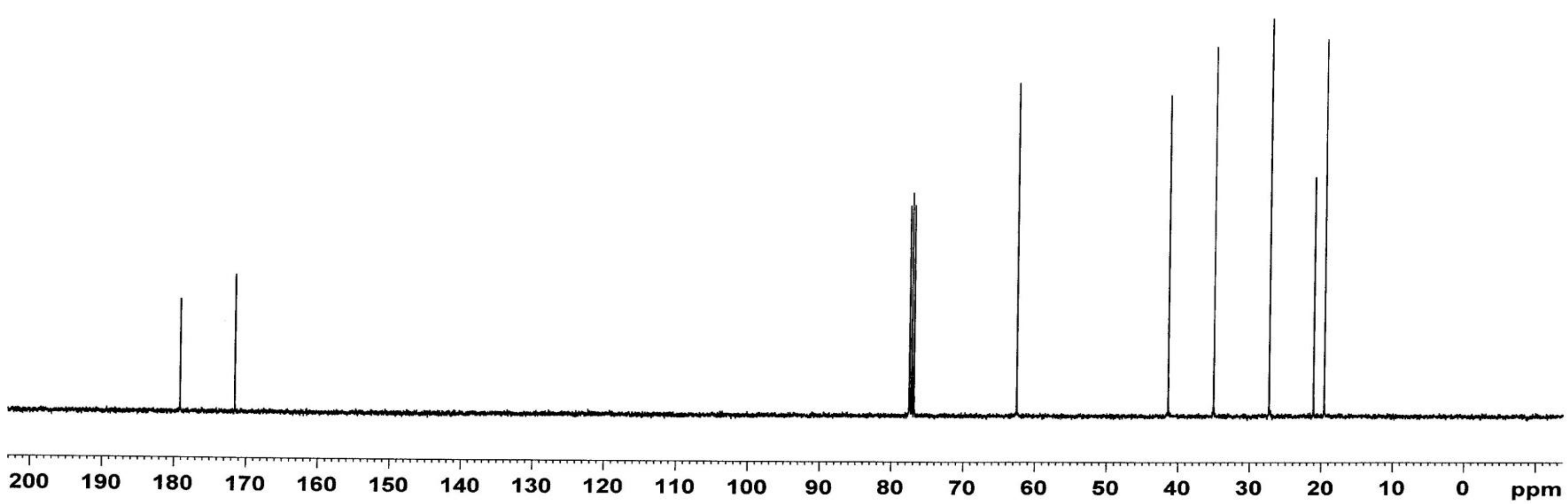

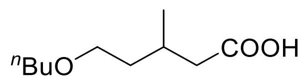

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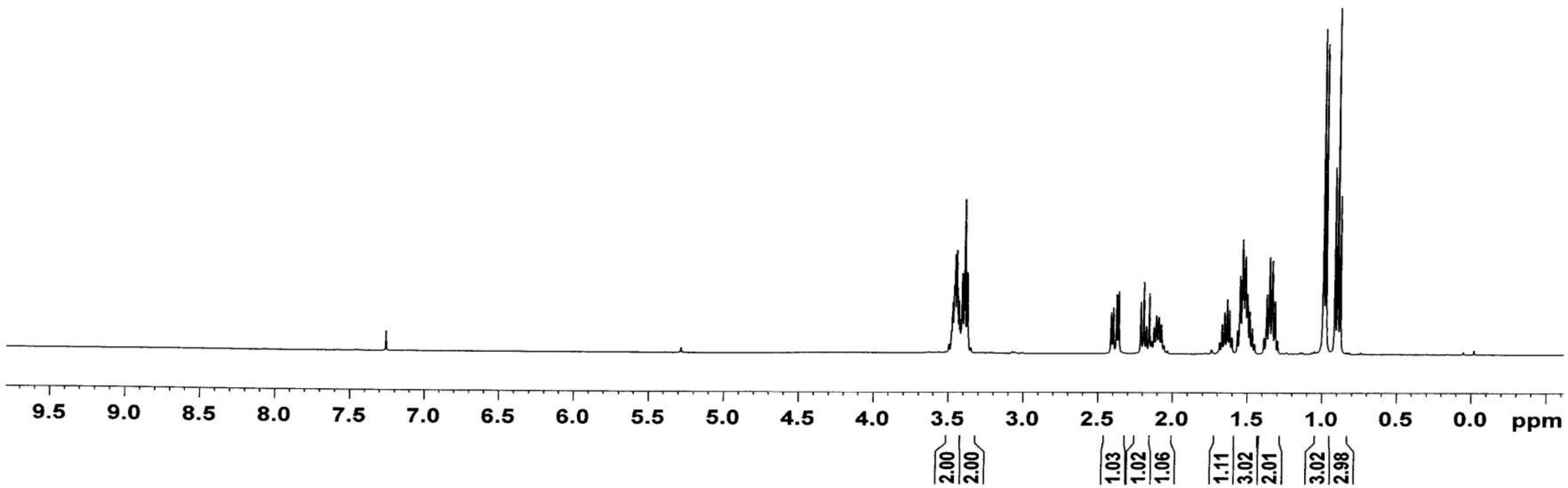

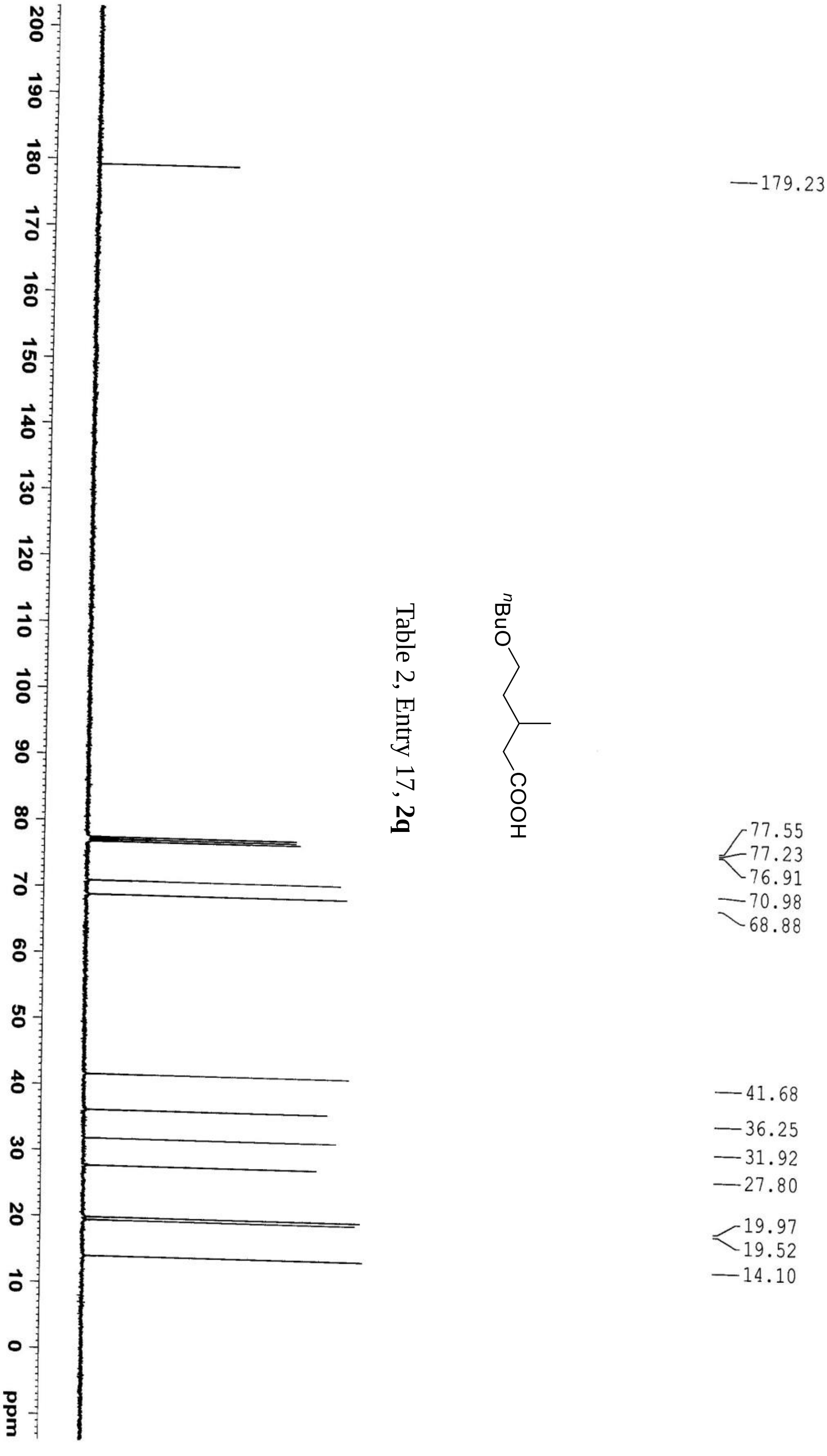

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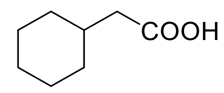

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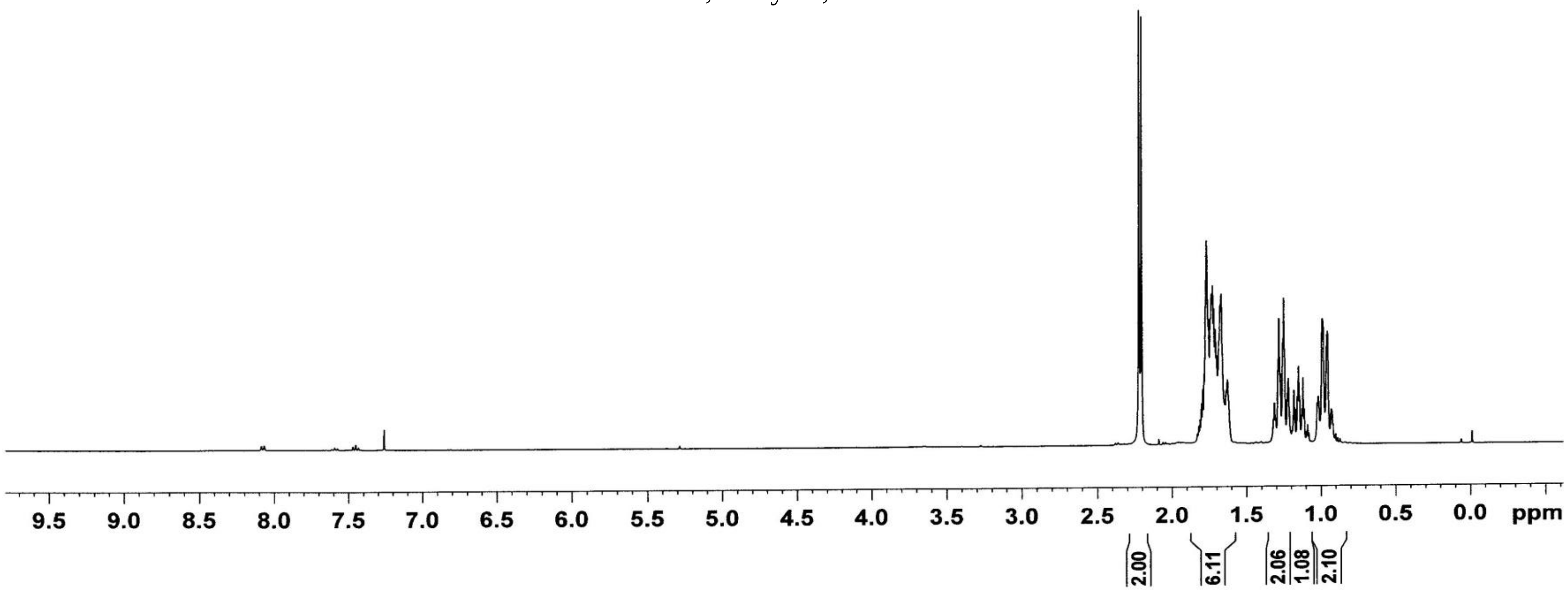

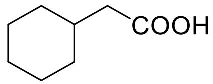

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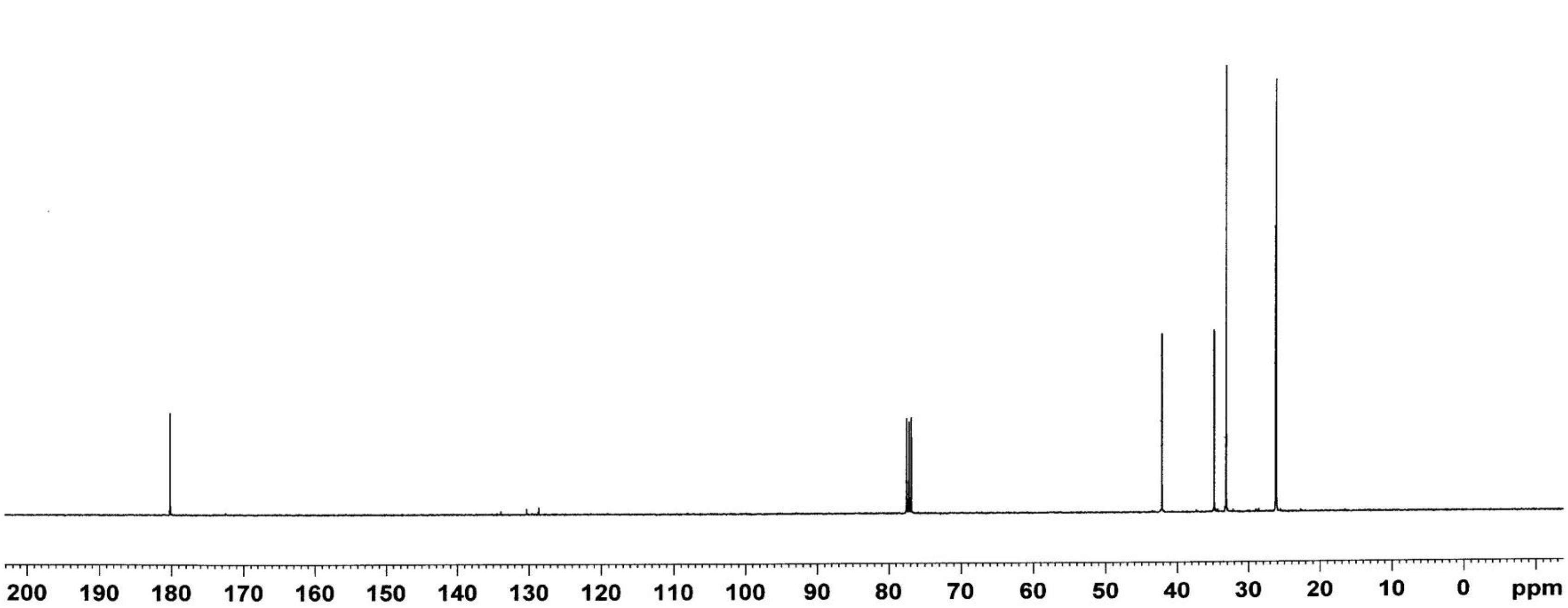

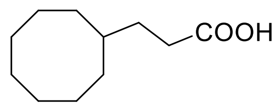

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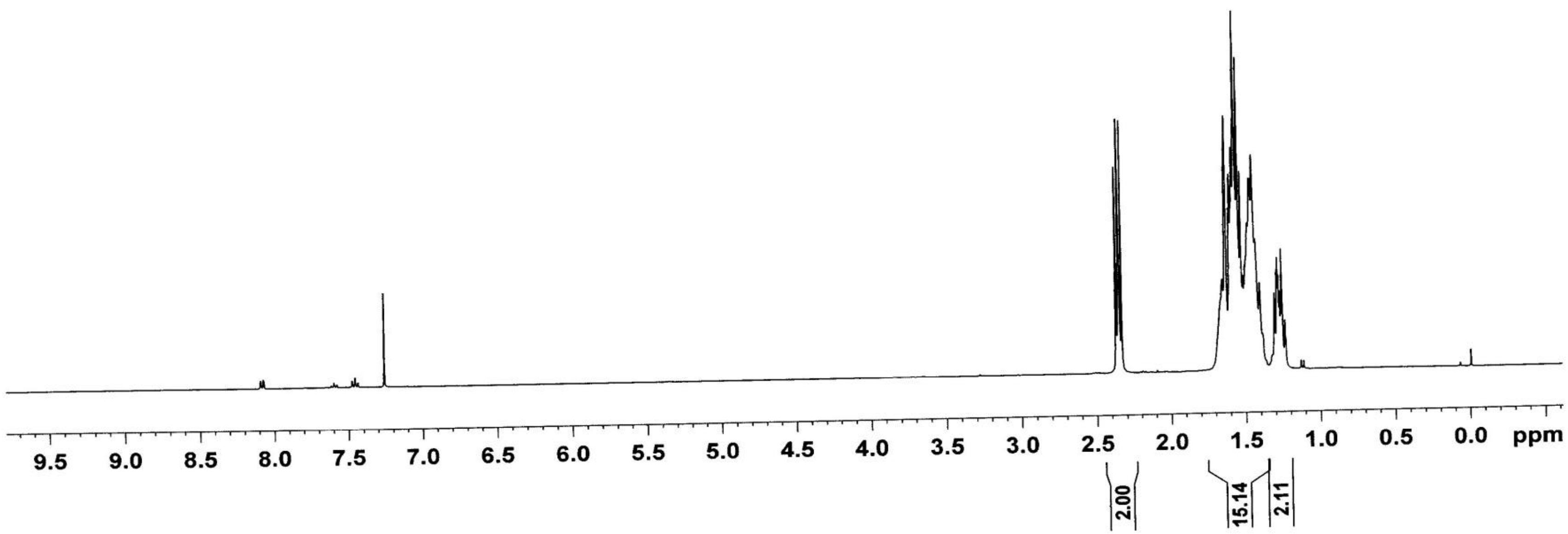


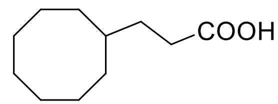
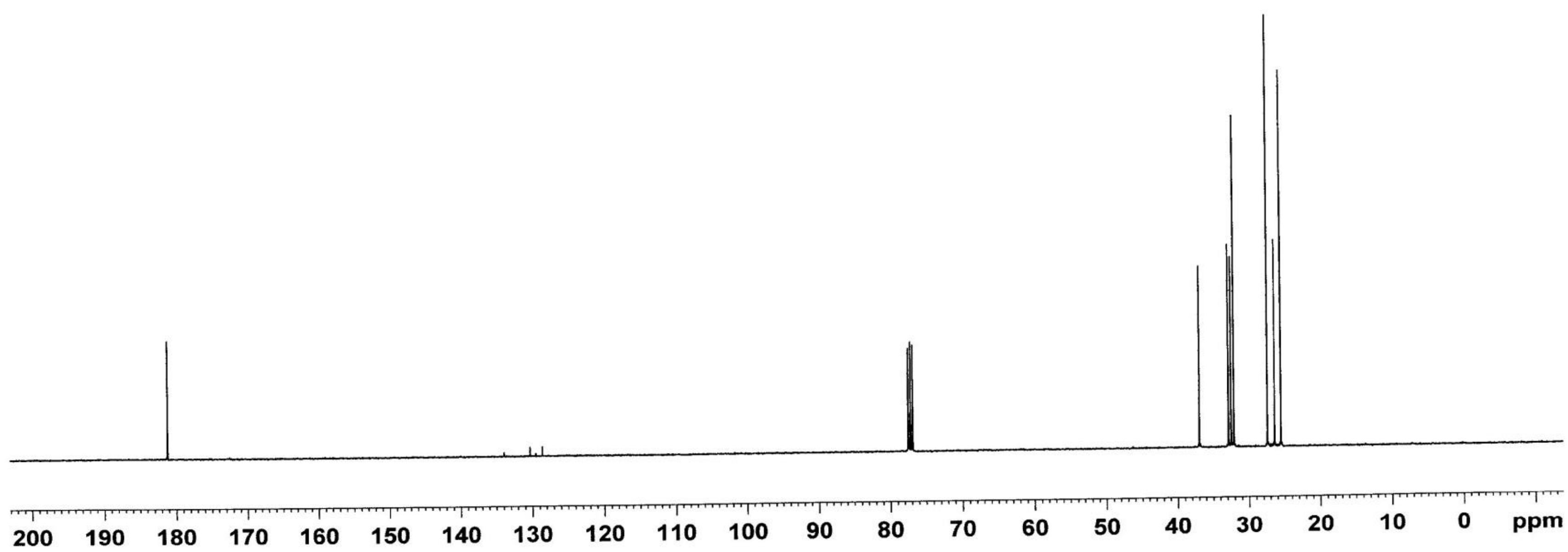
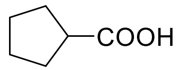


Table 2, Entry 19, **2s**





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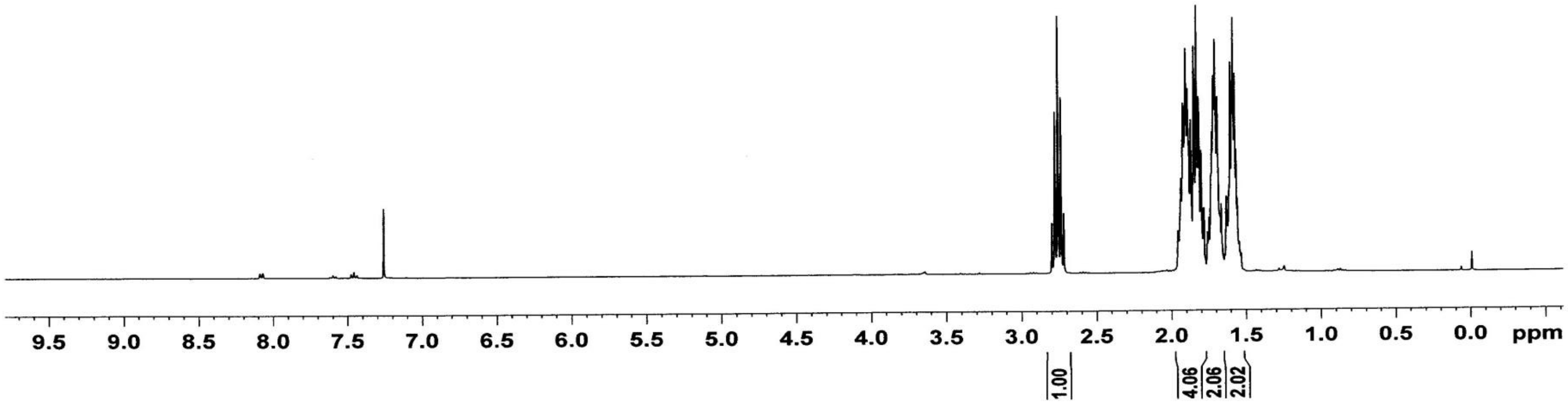


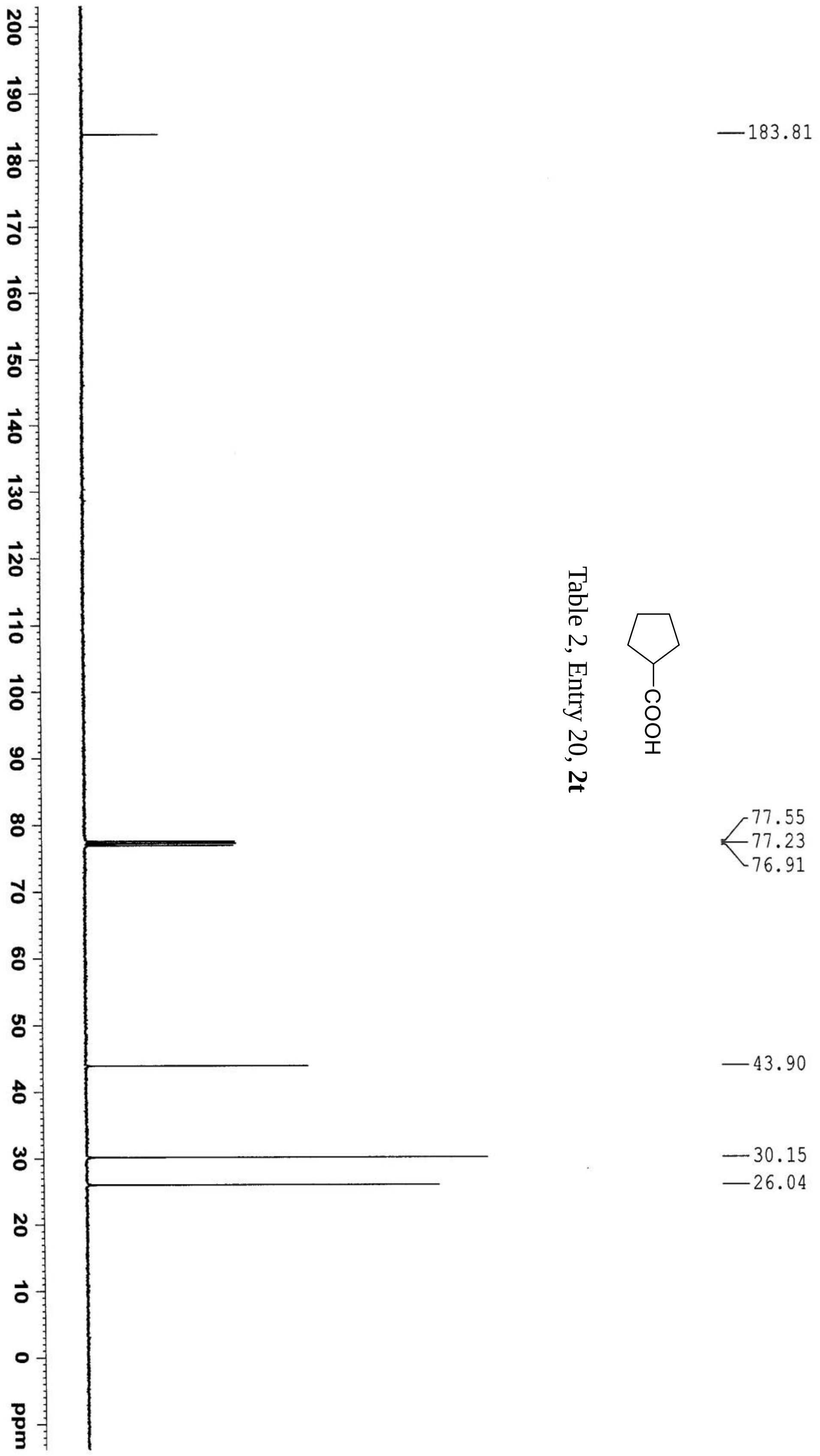


Table 2, Entry 20, **2t**

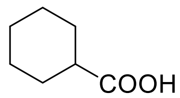
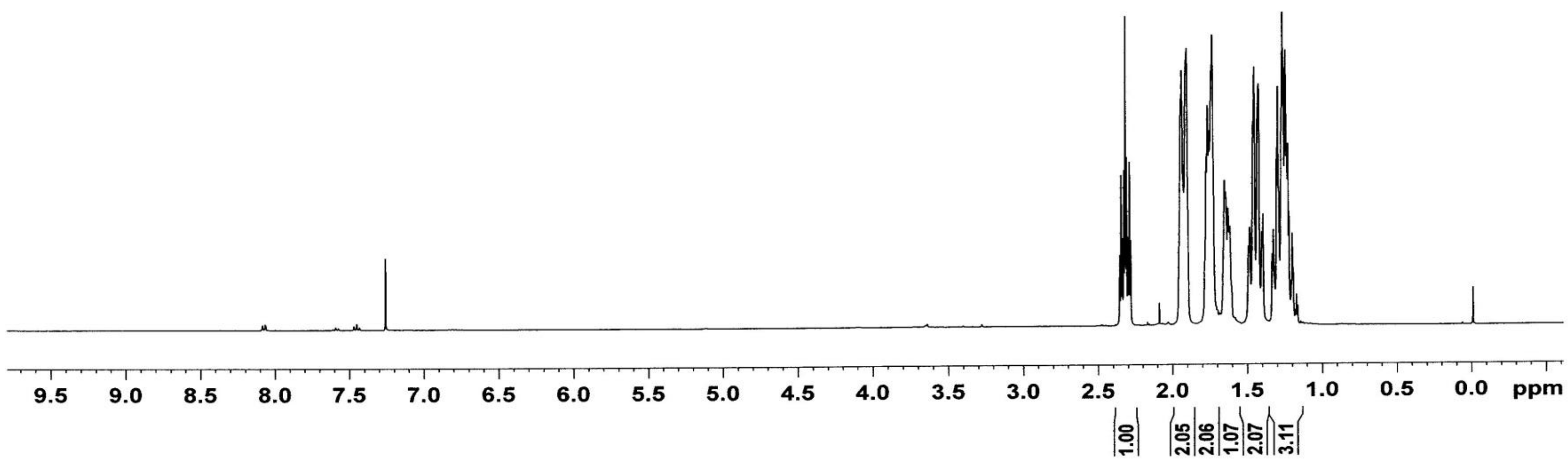
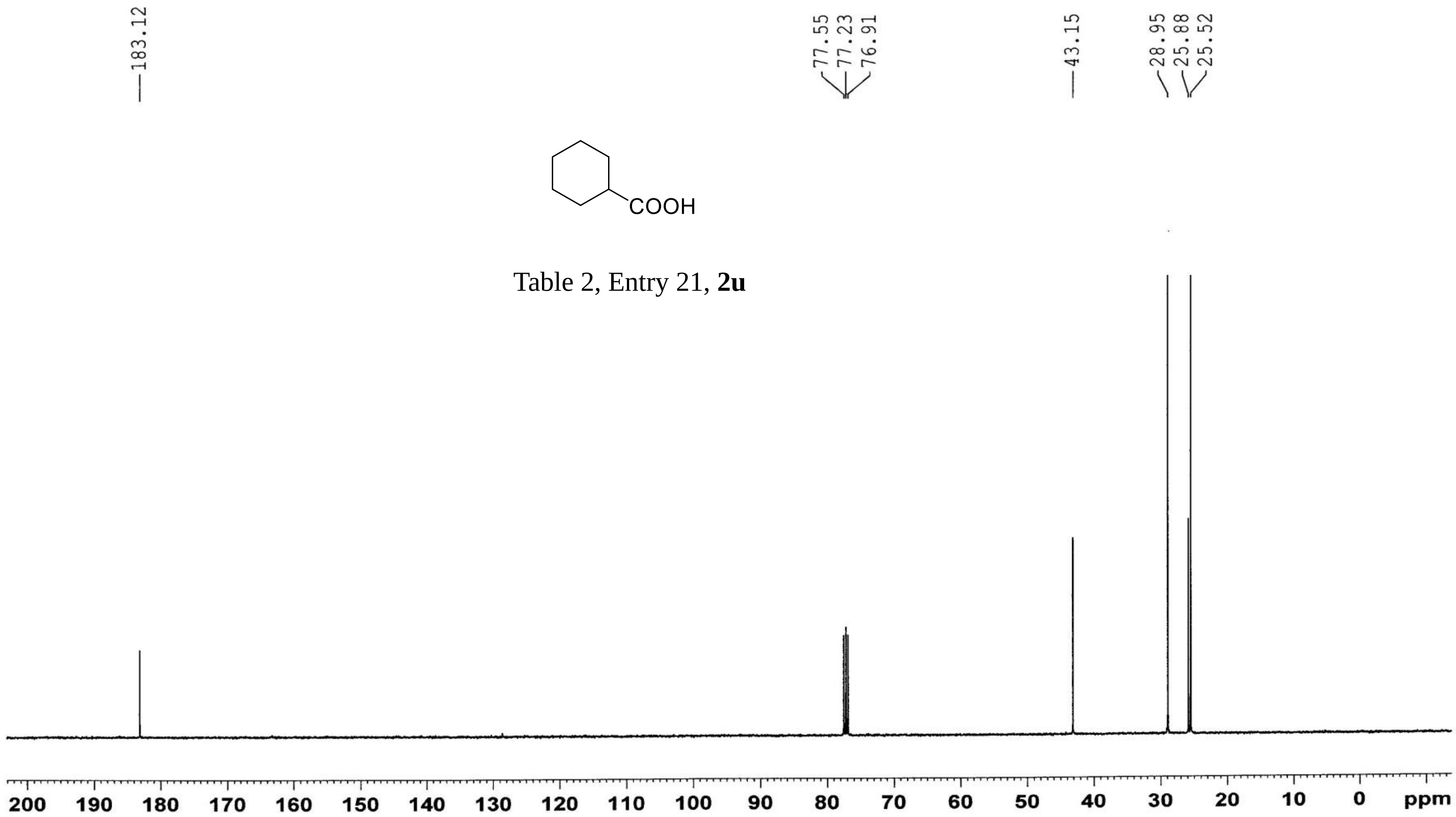


Table 2, Entry 21, **2u**





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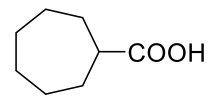
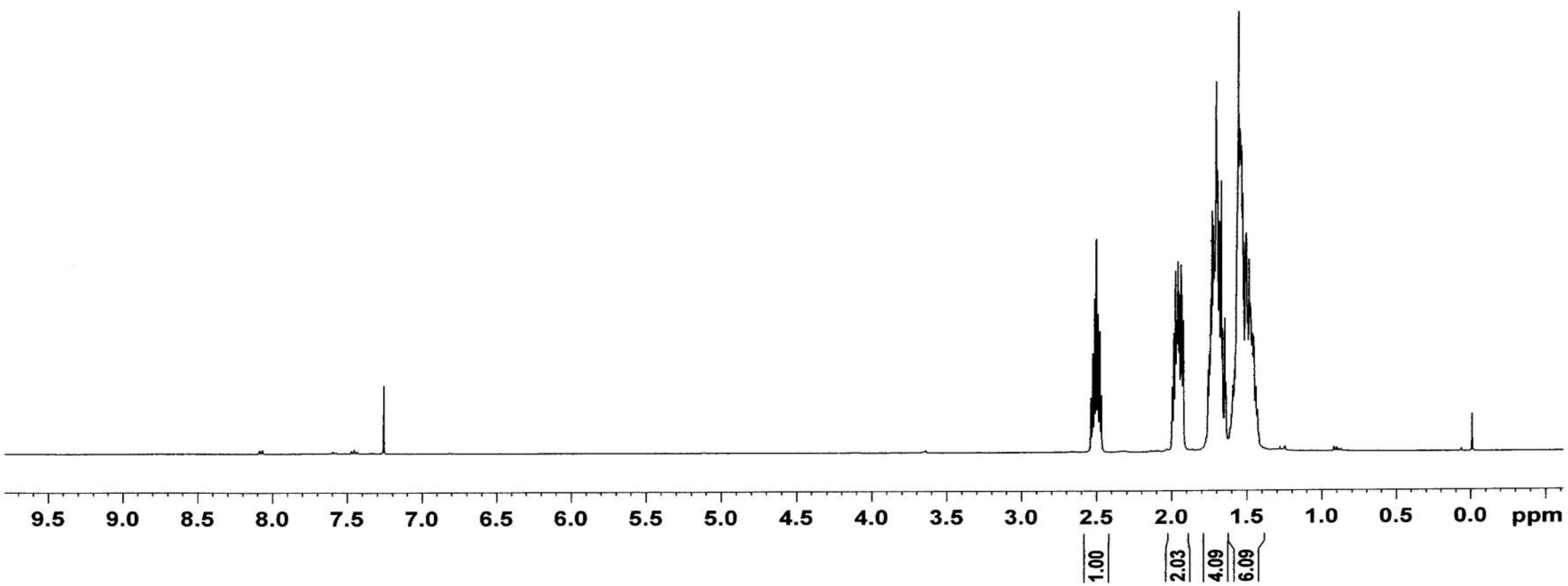


Table 2, Entry 22, **2v**



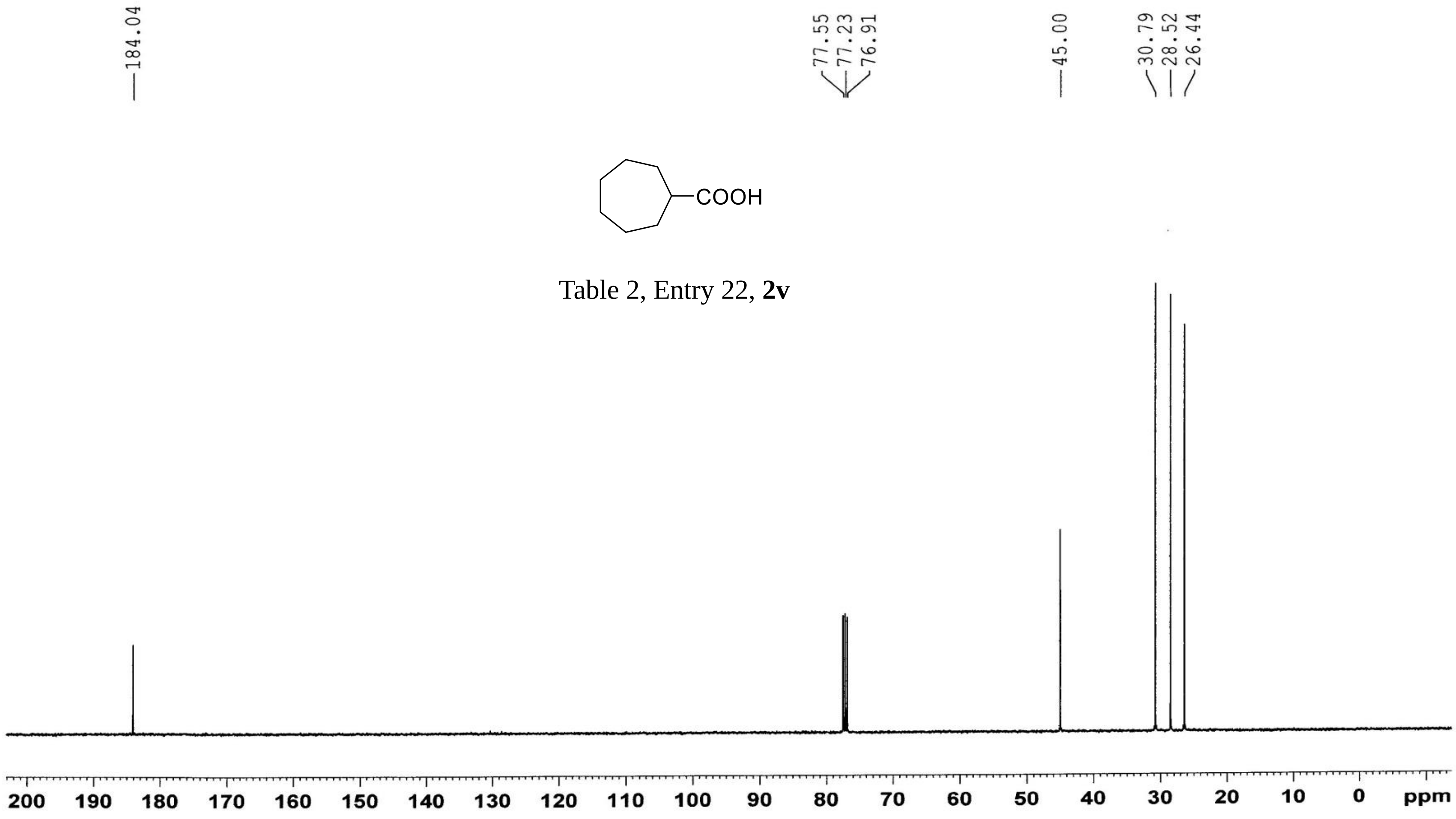


Table 2, Entry 22, **2v**