

Supporting Information

Diastereoselective Synthesis of Indanes and Tetralins *via* Intramolecular Friedel-Crafts Reaction

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General Experimental

All reactions were performed in standard glassware with no special precautions taken for the exclusion of moisture or air. Products were purified by flash chromatography on Merck silica gel 60 (eluent given in brackets, EtOAc refers to ethyl acetate, Hex to hexane). Yields refer to analytically pure samples. Isomer ratios were determined by GC or suitable ¹H NMR integrals of cleanly separated signals. GC: Agilent 6850. NMR: Varian Mercury 300, Varian Inova 400. ¹H NMR, CHCl₃ (7.26 ppm) as internal standard in the same solvent; ¹³C NMR: CDCl₃ (77.16 ppm) as internal standard in the same solvent; integrals in accordance with assignments, coupling constants are measured in Hz and always constitute $J_{H,H}$ coupling constants, if not otherwise noted. IR spectra: Perkin-Elmer 1760 series FT-IR as neat films on KBr plates. Low-resolution and high resolution mass spectra were obtained using electron impact ionisation (EI) and chemical ionisation (CI) techniques, or positive

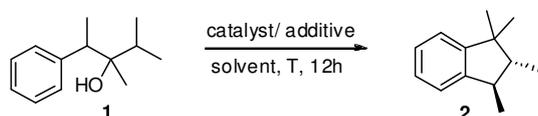
and/or negative electrospray ionisation (ES) on Finnigan SSQ or 7000 Thermo Deca XP mass spectrometers.

To highlight the relative configuration of the generated diastereomers, one out of two possible enantiomers is generally depicted, even though all products are formed as racemates.

General Procedure for the Cyclization Reaction

The alcohol (0.25 mmol) was dissolved in 0.75 mL of dichloroethane. Bu_4NPF_6 and $\text{Ca}(\text{NTf}_2)_2$ were added and the reaction was stirred at indicated temperature until complete conversion of the alcohol (monitored by GC). The reaction mixture was filtered through a short plug of silica. The crude product was purified by semi-preparative HPLC.

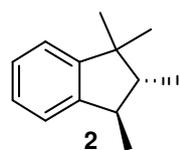
Additional Catalyst Screening for the Cyclization's Reaction Conditions



| entry | additive | solvent | yield (%) |
|-------|---|-----------------------|-----------|
| 1 | Bu_4NPF_6 | DCE | 100 |
| 2 | Bu_4NPF_4 | DCE | 50 |
| 3 | Bu_4NSbF_6 | DCE | 46 |
| 4 | $\text{PhMe}_2\text{NHB}(\text{C}_6\text{F}_5)_4$ | DCE | 0 |
| 5 | $\text{Et}_3\text{BnNPF}_6$ | DCE | 53 |
| 6 | Bu_4NPF_6 | DCM | 100 |
| 7 | Bu_4NPF_6 | Et_2O | 8 |
| 8 | Bu_4NPF_6 | Toluene | 12 |
| 9 | Bu_4NPF_6 | MeNO_2 | 91 |

Analytical data for compounds

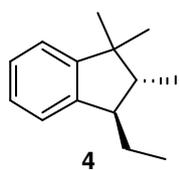
Trans-1,1,2,3-tetramethyl-2,3-dihydro-1H-indene (**2**)¹



According to the general procedure, 2,3-dimethyl-4-phenylpentan-3-ol **1** (48.1 mg, 0.25 mmol), $\text{Ca}(\text{NTf}_2)_2$ (7.5 mg, 0.0125 mmol, 5 mol%), Bu_4NPF_6 (5 mg, 0.0125 mmol, 5 mol%) were stirred in dichloroethane at 40 °C for 12h. Work-up and semi-preparative HPLC (100% hexane) afforded product **2** as a colourless oil (42.7 mg, 0.245 mmol, quant).

¹H-NMR (400 MHz; CDCl₃): δ(ppm)= 7.21 – 7.11 (m, 4H), 2.75 – 2.63 (m, 1H), 1.64 – 1.55 (m, 1H), 1.30 (d, J= 6.8 Hz, 3H), 1.28 (s, 3H), 1.07 (d, J= 6.8 Hz, 3H), 0.95 (s, 3H); ¹³C-NMR (100 MHz; CDCl₃): δ(ppm)=152.8, 146.4, 126.4, 126.2, 122.7, 121.8, 54.0, 44.6, 43.1, 26.4, 23.4, 16.7, 11.6; *m/z* (EI) (%): 174.3 (43), 121.2 (100), 297.3 (24); HRMS-ESI calcd. for C₁₃H₁₈: 174.14085, found: 174.14084; IR (KBr): ν = 3438, 2953, 1810, 1684, 1457, 1383, 1313, 1261, 1066, 753, 624, 468 cm⁻¹.

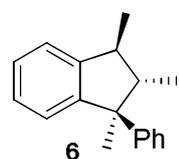
***Trans*-3-ethyl-1,1,2-trimethyl-2,3-dihydro-1H-indene (4)**



According to the general procedure, 2,3-dimethyl-4-phenylhexan-3-ol **3** (51.6 mg, 0.25 mmol), Ca(NTf₂)₂ (7.5 mg, 0.0125 mmol, 5 mol%), Bu₄NPF₆ (5 mg, 0.0125 mmol, 5 mol%) were stirred in dichloroethane at 40 °C for 20h. Work-up and semi-preparative HPLC (100% hexane) afforded product **4** as a colourless oil (33.0 mg, 0.175 mmol, 70%).

¹H-NMR (400 MHz; CDCl₃): δ(ppm)= 7.20 – 7.12 (m, 4H), 2.74 – 2.64 (m, 1H), 1.89 – 1.72 (m, 3H), 1.28 (s, 3H), 1.06 (d, J= 6.8 Hz, 3H), 0.97 (d, J= 6.8 Hz, 3H), 0.95 (s, 3H); ¹³C-NMR (100 MHz; CDCl₃): δ(ppm)=153.2, 144.9, 126.3, 126.1, 123.1, 121.9, 49.5, 49.4, 44.5, 26.7, 23.7, 23.4, 12.4, 10.9; *m/z* (EI) (%): 188.3 (52), 173.3 (39), 159.2 (30), 145.2 (52), 131.2 (42), 91.2 (49), 57.3 (100); HRMS-ESI calcd. for C₁₄H₂₀: 188.15650, found: 188.15646; IR (KBr): ν = 2959, 2867, 1726, 1457, 1381, 753 cm⁻¹.

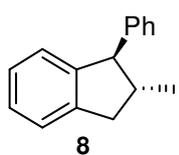
***Trans*-1,2,3-trimethyl-1-phenyl-2,3-dihydro-1H-indene (6)**



According to the general procedure, 3-methyl-2,4-diphenylpentan-3-ol **5** (63.5 mg, 0.25 mmol), Ca(NTf₂)₂ (7.5 mg, 0.0125 mmol, 5 mol%), Bu₄NPF₆ (5 mg, 0.0125 mmol, 5 mol%) were stirred in dichloroethane at 80 °C for 20h. Work-up and column chromatographic (8 / 1 hexane / diethyl ether) afforded product **6** as a colourless oil (35.4 mg, 0.15 mmol, 60%).

¹H-NMR (600 MHz; CDCl₃): δ (ppm)= 7.32 – 7.31 (m, 4H), 7.25 – 7.22 (m, 3H), 7.15 – 7.13 (m, 1H), 6.84 – 6.83 (m, 1H), 2.84 – 2.82 (m, 1H), 2.06 – 2.01 (m, 1H), 1.39 – 1.38 (m, 6H), 1.00 (d, J=7.2 Hz, 3H) ¹³C-NMR (100 MHz; CDCl₃): δ (ppm)= 152.7, 148.3, 146.9, 127.8 (2C), 127.4 (2C), 126.6, 126.4, 125.7, 124.1, 122.8, 57.3, 53.6, 43.4, 19.9, 16.9, 11.3; *m/z* (EI) (%): 236.4 (64), 221.4 (100), 207.3 (22), 192.3 (19), 178.2 (13), 143.2 (35), 128.2 (14), 105.2 (13), 91.3 (16); HRMS-ESI calcd. for C₁₈H₂₀: 236.1559, found: 236.1552; IR (KBr): ν = 3485, 3026, 2961, 2875, 1948, 1805, 1598, 1456, 1376 cm⁻¹.

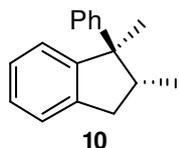
***Trans*-2-methyl-1-phenyl-2,3-dihydro-1H-indene (8)**



According to the general procedure, 2-methyl-1,3-diphenylpropan-2-ol **7** (56.6 mg, 0.25 mmol), Ca(NTf₂)₂ (7.5 mg, 0.0125 mmol, 5 mol%), Bu₄NPF₆ (5 mg, 0.0125 mmol, 5 mol%) were stirred in dichloroethane at 80 °C for 20h. Work-up and semi-preparative HPLC (100% hexane) afforded product **8** as a colourless oil (41.7 mg, 0.2 mmol, 80%).

¹H-NMR (400 MHz; CDCl₃): δ (ppm)= 7.35 – 7.31 (m, 2H), 7.28 – 7.24 (m, 2H), 7.22 – 7.16 (m, 3H), 7.13 – 7.09 (m, 1H), 6.88 – 6.85 (m, 1H), 3.80 (d, J= 9.5 Hz, 1H), 3.15 (dd, J= 15.5 Hz, 7.5 Hz, 1H), 2.65 (dd, J= 15.5 Hz, 9.5 Hz, 1H), 2.50 – 2.41 (m, 1H), 1.19 (d, J= 6.6 Hz, 3H); ¹³C-NMR (100 MHz; CDCl₃): δ (ppm)=147.1, 144.0, 143.7, 128.6 (2C), 128.4 (2C), 126.5, 126.4, 126.3, 124.8, 124.1, 59.7, 46.2, 40.3, 18.3 ; *m/z* (EI) (%): 208.0 (88), 178.8 (100); HRMS-ESI calcd. for C₁₆H₁₆: 208.12465, found: 208.12453; IR (KBr): ν = 3444, 3027, 2946, 2424, 2300, 1948, 1805, 1739, 1599, 1456, 1382, 1124, 1072, 1028, 910, 874, 808, 742, 700, 645, 530 cm⁻¹.

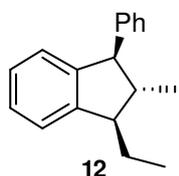
***Trans*-1,2-dimethyl-1-phenyl-2,3-dihydro-1H-indene (10)**



According to the general procedure, 2-methyl-1,3-diphenylbutan-2-ol **9** (60.1 mg, 0.25 mmol), Ca(NTf₂)₂ (7.5 mg, 0.0125 mmol, 5 mol%), Bu₄NPF₆ (5 mg, 0.0125 mmol, 5 mol%) were stirred in dichloroethane at 80 °C for 20h. Work-up and semi-preparative HPLC (100% hexane) afforded product **10** as a colourless oil (47.2 mg, 0.213 mmol, 85%).

¹H-NMR (400 MHz; CDCl₃): δ (ppm)= 7.38 – 7.08 (m, 8H), 6.91 – 6.81 (m, 1H), 3.05 (dd, J= 15.2 Hz, 7.2 Hz, 1H), 2.70 – 2.54 (m, 2H), 1.39 (s, 3H), 1.01 (d, J= 6.8 Hz, 3H); ¹³C-NMR (100 MHz; CDCl₃): δ (ppm)=153.0, 148.5, 142.7, 127.8, 127.3, 126.3, 125.8, 124.4, 54.3, 48.6, 38.6, 19.9, 13.6; *m/z* (EI) (%): 222.3 (57), 207.2 (100), 193.2 (33), 178.2 (54), 129.1 (40), 91.1 (23); HRMS-ESI calcd. for C₁₇H₁₈: 222.14030, found: 222.13968; IR (KBr): ν = 3440, 3028, 2959, 1804, 1675, 1599, 1456, 1382, 1311, 1256, 1151, 1027, 746, 701, 598, 547 cm⁻¹.

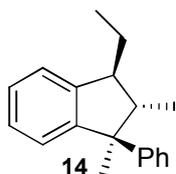
***Trans*-1-ethyl-2-methyl-3-phenyl-2,3-dihydro-1H-indene (12)**



According to the general procedure, 2-methyl-1,3-diphenylpentan-2-ol **11** (63.6 mg, 0.25 mmol), Ca(NTf₂)₂ (7.5 mg, 0.0125 mmol, 5 mol%), Bu₄NPF₆ (5 mg, 0.0125 mmol, 5 mol%) were stirred in dichloroethane at 80 °C for 20h. Work-up and semi-preparative HPLC (100% hexane) afforded product **12** as a colourless oil (36.0 mg, 0.153 mmol, 61%).

¹H-NMR (400 MHz; CDCl₃): δ (ppm)= 7.36 – 7.08 (m, 8H), 6.86 – 6.81 (m, 1H), 3.74 (d, J= 9.7 Hz, 1H), 2.80 – 2.75 (m, 1H), 2.13 – 2.05 (m, 1H), 2.00 – 1.81 (m, 2H), 1.18 (d, J= 6.5 Hz, 3H), 1.01 (t, J= 7.4 Hz, 3H); ¹³C-NMR (100 MHz; CDCl₃): δ (ppm)=146.7, 146.6, 144.3, 128.8 (2C), 128.3 (2C), 126.5, 126.4, 126.3, 124.6, 123.0, 59.0, 51.8, 50.6, 24.3, 17.3, 10.8 ; *m/z* (EI) (%): 236.4 (84), 207.4 (100), 178.3 (41), 129.3 (75), 91.3 (43); HRMS-ESI calcd. for C₁₈H₂₀: 236.15595, found: 236.15564; IR (KBr): ν = 3437, 3028, 2922, 2864, 1737, 1587, 1456, 1383, 1068, 876, 744, 700 cm⁻¹.

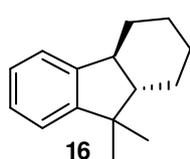
***Trans*-3-ethyl-1,2-dimethyl-1-phenyl-2,3-dihydro-1H-indene (14)**



According to the general procedure, 3-methyl-2,4-diphenylhexan-3-ol **13** (67 mg, 0.25 mmol), Ca(NTf₂)₂ (7.5 mg, 0.0125 mmol, 5 mol%), Bu₄NPF₆ (5 mg, 0.0125 mmol, 5 mol%) were stirred in dichloroethane at 80 °C for 20h. Work-up and semi-preparative HPLC (100% hexane) afforded product **14** as a colourless oil (45.0 mg, 0.18 mmol, 72%).

¹H-NMR (600 MHz; CDCl₃): δ (ppm)= 7.30 – 7.11 (m, 7H), 7.13 – 7.11 (m, 1H), 6.83 – 6.81 (m, 1H), 2.85 – 2.82 (m, 1H), 2.25 – 2.22 (m, 1H), 1.91 – 1.86 (m, 2H), 1.37 (s, 3H), 1.00 – 0.97(m, 6H); ¹³C-NMR (100 MHz; CDCl₃): δ (ppm)= 153.1, 148.9, 145.3, 127.9, 127.8, 127.4 (2C), 126.5, 126.3, 125.7, 124.2, 123.2, 53.5, 52.6, 49.6, 23.3, 20.3, 12.2, 10.6; *m/z* (EI) (%): 250.4 (76), 235.3 (100), 221.3 (76), 209.3 (14), 207.3 (13), 192.3 (22), 178.2 (24), 173.3 (27), 143.2 (46); 105.2 (50), 91.2 (34); HRMS-ESI calcd. for C₁₉H₂₂: 250.1716, found: 250.1716; IR (KBr): ν = 3439, 3060, 2963, 2872, 1950, 1806, 1598, 1458, 1380 cm⁻¹.

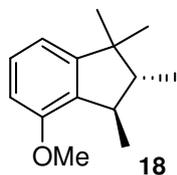
***Trans*-9,9-dimethyl-1,2,3,4,4a,9,9a-heptahydro-4aH-fluorene (16)**



According to the general procedure, 1-isopropyl-2-phenylcyclohexanol **15** (54.6 mg, 0.25 mmol), Ca(NTf₂)₂ (7.5 mg, 0.0125 mmol, 5 mol%), Bu₄NPF₆ (5 mg, 0.0125 mmol, 5 mol%) were stirred in dichloroethane at 80 °C for 20h or at 40 °C for 48h. Work-up and semi-preparative HPLC (100% hexane) afforded product **16** as a colourless oil (38.6 mg, 0.193 mmol, 77%).

¹H-NMR (400 MHz; CDCl₃): δ(ppm)= 7.14 – 7.01 (m, 4H), 2.45 – 2.38 (m, 1H), 2.19 – 2.14 (m, 1H), 1.75 – 1.65 (m, 2H), 1.61 – 1.52 (m, 1H), 1.36 – 1.27 (m, 1H), 1.20 (s, 3H), 1.20 – 1.10 (m, 4H), 0.90 (s, 3H); ¹³C-NMR (100 MHz; CDCl₃): δ(ppm)=153.4, 145.4, 126.3, 126.0, 121.9, 121.7, 59.5, 50.9, 46.5, 43.6, 40.9, 29.4, 26.7, 26.5, 26.0, 25.6, 21.9; *m/z* (EI) (%): 200.1 (21), 185.1 (77), 143.1 (29), 129.1 (58), 105.1 (36), 91.2 (100), 83.1 (79), 71.3 (52), 57.4 (78), 55.3 (50); HRMS-ESI calcd. for C₁₅H₂₀: 200.15595, found: 200.15597; IR (KBr): ν= 3437, 2924, 2856, 1834, 1678, 1454, 1385, 1257, 1068, 750, 610 cm⁻¹.

***Trans*-4-methoxy-1,1,2,3-tetramethyl-2,3-dihydro-1H-indene (18)¹**

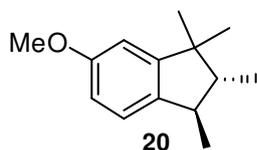


According to the general procedure, 2-(2-methoxyphenyl)-3,4-dimethylpentan-3-ol **17** (55.6 mg, 0.25 mmol), Ca(NTf₂)₂ (7.5 mg, 0.0125 mmol, 5 mol%), Bu₄NPF₆ (5 mg, 0.0125 mmol, 5 mol%) were stirred in dichloroethane at 80 °C for 2h. Work-up and semi-preparative HPLC (hexane/ethyl acetate = 20/1) afforded product **18** as a colourless oil (38.8 mg, 0.19 mmol, 76%).

¹H-NMR (400 MHz; CDCl₃): δ(ppm)= 7.20 – 7.14 (m, 1H), 6.80 – 6.77 (m, 1H), 6.71 – 6.68 (m, 1H), 3.81 (s, 3H), 2.82 – 2.74 (m, 1H), 1.66 – 1.60 (m, 1H), 1.41 (d, J= 6.7 Hz, 3H), 1.28 (s, 3H), 1.05 (d, J= 6.9 Hz, 3H), 0.92 (s, 3H); ¹³C-NMR (100 MHz; CDCl₃): δ(ppm)=156.8, 155.1, 132.7, 127.9, 114.6, 108.7, 55.1, 53.8, 45.0, 43.2, 26.9, 24.0, 17.7, 11.8; *m/z* (EI) (%): 204.1 (40), 189.1 (100);

HRMS-ESI calcd. for C₁₄H₂₁ [M + H]: 205.15869, found: 205.15840; IR (KBr): ν = 3451, 2953, 2872, 1732, 1588, 1460, 1381, 1259, 1058, 877, 780, 734, 673, 609 cm⁻¹.

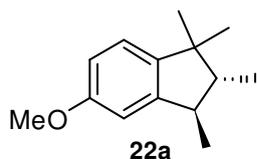
Trans-6-methoxy-1,1,2,3-tetramethyl-2,3-dihydro-1H-indene (20)



According to the general procedure, 2-(4-methoxyphenyl)-3,4-dimethylpentan-3-ol **19** (55.6 mg, 0.25 mmol), Ca(NTf₂)₂ (7.5 mg, 0.0125 mmol, 5 mol%), Bu₄NPF₆ (5 mg, 0.0125 mmol, 5 mol%) were stirred in dichloroethane at 80 °C for 1h. Work-up and semi-preparative HPLC (hexane/ethyl acetate = 20/1) afforded product **20** as a colourless oil (38.3 mg, 0.188 mmol, 75%).

¹H-NMR (400 MHz; CDCl₃): δ (ppm)= 7.06 – 7.02 (m, 1H), 6.74 – 6.69 (m, 2H), 3.81 (s, 3H), 2.66 – 2.59 (m, 1H), 1.61 – 1.55 (m, 1H), 1.27 (d, J= 6.7 Hz, 3H), 1.26 (s, 3H), 1.05 (d, J= 6.9 Hz, 3H), 0.94 (s, 3H); ¹³C-NMR (100 MHz; CDCl₃): δ (ppm)=158.9, 154.4, 138.7, 123.3, 111.5, 107.9, 55.4, 54.5, 44.7, 42.5, 26.3, 23.4, 17.0, 11.6 ; *m/z* (EI) (%): 204.1 (43), 189.1 (100); HRMS-ESI calcd. for C₁₄H₂₁ [M + H]: 205.15869, found: 205.15871; IR (KBr): ν = 2956, 2868, 1712, 1611, 1486, 1375, 1322, 1280, 1215, 1089, 1049, 964, 937, 895, 866, 846, 811, 759, 729, 696 cm⁻¹.

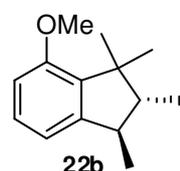
Trans-5-methoxy-1,1,2,3-tetramethyl-2,3-dihydro-1H-indene (22a)



According to the general procedure, 2-(3-methoxyphenyl)-3,4-dimethylpentan-3-ol **21** (55.6 mg, 0.25 mmol), Ca(NTf₂)₂ (7.5 mg, 0.0125 mmol, 5 mol%), Bu₄NPF₆ (5 mg, 0.0125 mmol, 5 mol%) were stirred in dichloroethane at 80 °C for 2h. Work-up and semi-preparative HPLC (hexane/ethyl acetate = 20/1) afforded product **22a** as a colourless oil (27.6 mg, 0.135 mmol, 54%).

¹H-NMR (400 MHz; CDCl₃): δ (ppm)= 7.06 – 7.03 (m, 1H), 6.76 – 6.72 (m, 1H), 6.72 – 6.68 (m, 1H), 3.80 (s, 3H), 2.70 – 2.63 (m, 1H), 1.62 – 1.56 (m, 1H), 1.29 (d, J= 6.7 Hz, 3H), 1.26 (s, 3H), 1.05 (d, J= 6.9 Hz, 3H), 0.93 (s, 3H); ¹³C-NMR (100 MHz; CDCl₃): δ (ppm)=158.7, 148.0, 145.1, 122.4, 112.0, 109.0, 55.4, 54.4, 43.9, 43.2, 26.7, 23.6, 16.7, 11.7; *m/z* (EI) (%): 204.1 (28), 189.1 (100); HRMS-ESI calcd. for C₁₄H₂₁ [M + H]: 205.15869, found: 205.15863; IR (KBr): ν = 3450, 2926, 2864, 2421, 2151, 1732, 1609, 1455, 1385, 1242, 1031, 874, 819, 657, 611 cm⁻¹.

Trans-7-methoxy-1,1,2,3-tetramethyl-2,3-dihydro-1H-indene (22b)

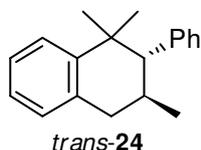


According to the general procedure, 2-(3-methoxyphenyl)-3,4-dimethylpentan-3-ol **21** (55.6 mg, 0.25 mmol), Ca(NTf₂)₂ (7.5 mg, 0.0125 mmol, 5 mol%), Bu₄NPF₆ (5 mg, 0.0125 mmol, 5 mol%) were stirred in dichloroethane at 80 °C for 2h. Work-up and semi-preparative HPLC (hexane/ethyl acetate = 20/1) afforded product **22b** as a colourless oil (11.2 mg, 0.06 mmol, 22%).

¹H-NMR (400 MHz; CDCl₃): δ (ppm)= 7.17 – 7.13 (m, 1H), 6.79 – 6.76 (m, 1H), 6.72 – 6.69 (m, 1H), 3.81 (s, 3H), 2.66 – 2.59 (m, 1H), 1.60 – 1.55 (m, 1H), 1.40 (s, 3H), 1.29 (d, J= 6.7 Hz, 3H), 1.03 (d, J= 6.9 Hz, 3H), 1.01 (s, 3H); ¹³C-NMR (100 MHz; CDCl₃): δ (ppm)=156.4, 148.5, 138.6, 127.6, 116.6, 108.8, 55.1, 54.0, 45.3, 43.6, 26.4, 20.3, 17.0, 10.0; *m/z* (EI) (%): 204.1 (33), 189.1 (100);

HRMS-ESI calcd. for $C_{14}H_{21}$ [M + H]: 205.15869, found: 205.15866; IR (KBr): $\nu = 3448, 2953, 2867, 2513, 2115, 1733, 1586, 1457, 1384, 1260, 1072, 1026, 875, 785, 741, 612\text{ cm}^{-1}$.

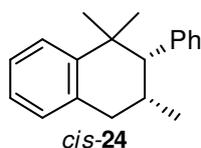
***Trans*-1,1,3-trimethyl-2-phenyl-1,2,3,4-tetrahydronaphthalene (*trans*-24)**



According to the general procedure, 2,4-dimethyl-1,3-diphenylpentan-2-ol **23** (67.1 mg, 0.25 mmol), $Ca(NTf_2)_2$ (7.5 mg, 0.0125 mmol, 5 mol%), Bu_4NPF_6 (5 mg, 0.0125 mmol, 5 mol%) were stirred in dichloroethane at 80 °C for 20h. Work-up and semi-preparative HPLC (100% hexane) afforded product *trans*-**24** as a colourless oil (22.5 mg, 0.09 mmol, 36%).

1H -NMR (400 MHz; $CDCl_3$): δ (ppm)= 7.44 – 7.04 (m, 9H), 3.01 (dd, $J = 5.0\text{ Hz}, 16.5\text{ Hz}$, 1H), 2.65 (dd, $J = 11.3\text{ Hz}, 16.5\text{ Hz}$, 1H), 2.56 – 2.47 (m, 1H), 2.47 – 2.35 (m, 1H), 1.21 (s, 3H), 1.13 (s, 3H), 0.79 (d, $J = 6.3\text{ Hz}$, 3H); ^{13}C -NMR (100 MHz; $CDCl_3$): δ (ppm)=146.2, 141.1, 135.3, 128.5 (2C), 127.3, 126.9 (2C), 126.0, 125.8, 125.4 (2C), 99.3, 40.1, 38.5, 29.3, 28.5, 27.9, 21.4 ; m/z (EI) (%): 250.4 (82), 235.4 (25), 159.4 (30), 132.3 (100), 117.3 (79), 115.3 (37), 105.3 (24), 91.3 (50); HRMS-ESI calcd. for $C_{19}H_{22}$: 250.17160, found: 250.17133; IR (KBr): $\nu = 3058, 2964, 2891, 1722, 1487, 1453, 1377, 1262, 1233, 1155, 1085, 1035, 916, 873, 794, 761, 710\text{ cm}^{-1}$.

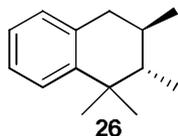
***Cis*-1,1,3-trimethyl-2-phenyl-1,2,3,4-tetrahydronaphthalene (*cis*-24)**



According to the general procedure, 2,4-dimethyl-1,3-diphenylpentan-2-ol **23** (67.1 mg, 0.25 mmol), $Ca(NTf_2)_2$ (7.5 mg, 0.0125 mmol, 5 mol%), Bu_4NPF_6 (5 mg, 0.0125 mmol, 5 mol%) were stirred in dichloroethane at 80 °C for 20h. Work-up and semi-preparative HPLC (100% hexane) afforded product *cis*-**24** as a colourless oil (15.0 mg, 0.06 mmol, 24%).

1H -NMR (400 MHz; $CDCl_3$): δ (ppm)= 7.37 – 7.06 (m, 7H), 6.89 – 6.85 (m, 2H), 2.74 – 2.66 (m, 2H), 2.65 – 2.57 (m, 1H), 2.57 – 2.50 (m, 1H), 1.43 (s, 3H), 1.16 (s, 3H), 0.76 (d, $J = 6.5\text{ Hz}$, 3H); ^{13}C -NMR (100 MHz; $CDCl_3$): δ (ppm)=145.4, 140.3, 136.3, 130.3, 128.6, 127.4, (3C), 126.2 (2C), 125.9, 125.3, 58.5, 38.1, 36.5, 34.2, 28.5, 27.8, 20.4 ; m/z (EI) (%): 250.4 (78), 235.4 (47), 159.3 (23), 132.2 (100), 117.2 (53), 105.2 (32), 91.2 (36); HRMS-ESI calcd. for $C_{19}H_{22}$: 250.17160, found: 250.17105; IR (KBr): $\nu = 3441, 3023, 2958, 1949, 1731, 1599, 1453, 1380, 1326, 1156, 1035, 755, 707\text{ cm}^{-1}$.

***Trans*-1,1,2,3-tetramethyl-1,2,3,4-tetrahydronaphthalene (**26**)**

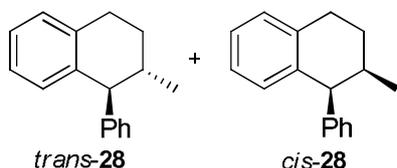


According to the general procedure, 2,3,4-trimethyl-1-phenylpentan-3-ol **25** (51.5 mg, 0.25 mmol), $Ca(NTf_2)_2$ (7.5 mg, 0.0125 mmol, 5 mol%), Bu_4NPF_6 (5 mg, 0.0125 mmol, 5 mol%) were stirred in dichloroethane at 40 °C for 20h. Work-up and semi-preparative HPLC (100% hexane) afforded product **26** as *trans/cis* (90/10) mixture (45.0 mg, 0.24 mmol, 96%).

1H -NMR (600 MHz; $CDCl_3$): δ (ppm) = 7.36 – 7.31 (m, 1H), 7.15 – 7.13 (m, 1H), 7.08 – 7.02 (m, 2H), 2.64 (dd, $J = 5.4\text{ Hz}, 16.8\text{ Hz}$, 1H), 2.53 – 2.46 (m, 1H), 2.38 – 2.33 (m, 1H), 1.54 – 1.51 (m, 1H), 1.34 (s, 3H), 1.27 (s, 3H), 1.04 (d, $J = 6.6\text{ Hz}$, 3H), 0.77 (d, $J = 7.2\text{ Hz}$, 3H); ^{13}C -NMR (100 MHz; $CDCl_3$): δ (ppm)= 144.5, 135.6, 128.7, 126.7, 125.8, 125.1, 44.2, 40.1, 34.2, 33.9, 27.9, 27.8, 19.7,

8.7; m/z (EI) (%): 188.3 (39), 173.3 (100), 131.2 (73), 117.2 (43), 91 (57), 57 (72); HRMS-ESI calcd. for $C_{14}H_{20}$: 188.1559, found: 188.1560; IR (KBr): $\nu = 3471, 3060, 2967, 2920, 2873, 1487, 1453, 1381, 757, 727\text{ cm}^{-1}$.

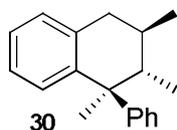
Trans-2-methyl-1-phenyl-1,2,3,4-tetrahydronaphthalene (28)²



According to the general procedure, 2-methyl-1,4-diphenylbutan-2-ol **27** (60.0 mg, 0.25 mmol), $Ca(NTf_2)_2$ (7.5 mg, 0.0125 mmol, 5 mol%), Bu_4NPF_6 (5 mg, 0.0125 mmol, 5 mol%) were stirred in dichloroethane at 40 °C for 20h. Work-up and semi-preparative HPLC (100% hexane) afforded product **28** as a inseparable *trans/cis* (77/23) mixture (50.0 mg, 0.22 mmol, 91%).

1H -NMR (600 MHz; $CDCl_3$): δ (ppm) = 7.31 – 6.94 (m, 16H), 6.94 (d, $J = 7.2$ Hz, 1H), 6.72 (d, $J = 7.8$ Hz, 1H), 4.11 (d, $J = 5.4$ Hz, 1H), 3.60 (d, $J = 9.6$ Hz, 1H), 3.04 – 2.87 (m, 4H), 2.00 – 1.97 (m, 4H), 1.63-1.56 (m, 2H), 0.94 (d, $J = 6.6$ Hz, 3H), 0.82 (d, $J = 6.6$ Hz, 3H); ^{13}C -NMR (100 MHz; $CDCl_3$): δ (ppm) = 146.4, 143.2, 140.0, 139.8, 137.0, 136.8, 130.0, 130.4, 130.2, 129.9, 129.4, 128.8, 128.5, 128.3, 128.1, 127.4, 126.6, 125.9, 125.8 (2C), 125.6, 125.5, 54.2, 50.2, 37.4, 33.0, 29.0, 25.8, 20.5, 19.5.; m/z (EI) (%): 222.1 (100), 180.1 (100), 131.2 (65), 179.1 (79), 178.1 (26); HRMS-ESI calcd. for $C_{17}H_{18}$: 222.1403, found: 222.1407; IR (KBr): $\nu = 3469, 3059, 3023, 2920, 2923, 2871, 1599, 1490, 1452, 1377, 743, 702\text{ cm}^{-1}$.

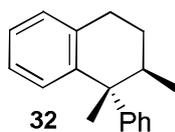
Trans-1,2,3-trimethyl-1-phenyl-1,2,3,4-tetrahydronaphthalene (30)



According to the general procedure, 2,3-dimethyl-1,4-diphenylpentan-3-ol **29** (67.0 mg, 0.25 mmol), $Ca(NTf_2)_2$ (7.5 mg, 0.0125 mmol, 5 mol%), Bu_4NPF_6 (5 mg, 0.0125 mmol, 5 mol%) were stirred in dichloroethane at 40 °C for 20h. Work-up and semi-preparative HPLC (100% hexane) afforded product **30** as a colourless oil (42.0 mg, 0.18 mmol, 70%).

1H -NMR (600 MHz; $CDCl_3$): δ (ppm) = 7.29 – 7.17 (m, 5H), 7.08 – 7.02 (m, 2H), 6.97 – 6.89 (m, 1H), 6.61 – 6.59 (m, 1H), 2.92 (dd, $J = 4.8$ Hz, 16.8 Hz, 1H), 2.72 – 2.68 (m, 1H), 1.98 – 1.92 (m, 1H), 1.89 – 1.83 (m, 1H), 1.51 (s, 3H), 1.07 (d, $J = 6.6$ Hz, 3H), 0.75 (d, $J = 6.6$ Hz, 3H); ^{13}C -NMR (100 MHz; $CDCl_3$): δ (ppm) = 150.8, 147.2, 136.0, 130.3, 128.2 (2C), 128.1, 127.5 (2C), 125.5, 125.4, 125.2, 48.2, 47.3, 39.9, 30.8, 22.9, 20.1, 12.9; m/z (EI) (%): 250.1 (42), 235.0 (18), 193.0 (69), 178.7 (100), 105.0 (13), 91.1 (11); HRMS-ESI calcd. for $C_{19}H_{22}$: 250.1716, found: 250.1723; IR (KBr): $\nu = 3057, 3021, 2970, 1946, 1804, 1596, 1489, 1377\text{ cm}^{-1}$.

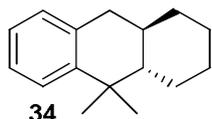
Trans-1,2-dimethyl-1-phenyl-1,2,3,4-tetrahydronaphthalene (32)²



According to the general procedure, 3-methyl-1,4-diphenylpentan-3-ol **31** (63.5 mg, 0.25 mmol), $Ca(NTf_2)_2$ (7.5 mg, 0.0125 mmol, 5 mol%), Bu_4NPF_6 (5 mg, 0.0125 mmol, 5 mol%) were stirred in dichloroethane at 80 °C for 20h. Work-up and column chromatographic (8/ 1 hexane/ diethyl ether) afforded product **32** as a colourless oil (41.3 mg, 0.17 mmol, 70%).

$^1\text{H-NMR}$ (600 MHz; CDCl_3): δ (ppm) = 7.29 – 7.25 (m, 2H), 7.23 – 7.18 (m, 3H), 7.12 – 7.08 (m, 2H), 7.02 – 7.00 (m, 1H), 6.74 (d, J = 7.8, 1H), 3.05 – 3.00 (m, 1H), 2.95 – 2.90 (m, 1H), 2.23 – 2.17 (m, 1H), 1.80 – 1.75 (m, 2H), 1.55 (s, 3H), 0.82 (d, J = 7.2 Hz, 3H), $^{13}\text{C-NMR}$ (100 MHz; CDCl_3): δ (ppm) = 150.8, 146.5, 136.1, 130.1, 128.5, 128.0 (2C), 127.5 (2C), 125.6, 125.4, 125.3, 46.9, 41.2, 29.6, 27.3, 22.7, 16.2; m/z (EI) (%): 236.3 (100), 221.3 (85), 193.2 (55), 179.2 (99), 159.2 (21), 143.2 (14), 105.1 (14), 91.2 (15), 83.0 (21); HRMS-ESI calcd. for $\text{C}_{18}\text{H}_{20}$: 236.1559, found: 236.1563; IR (KBr): ν = 3056, 3021, 2926, 1949, 1807, 1596, 1486, 1377 cm^{-1} .

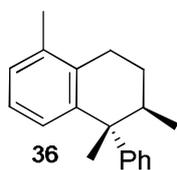
***Trans*-9,9-dimethyl-1,2,3,4,4a,9,9a,10-octahydroanthracene (34)**



According to the general procedure, 2-benzyl-1-isopropylcyclohexanol **33** (58.0 mg, 0.25 mmol), $\text{Ca}(\text{NTf}_2)_2$ (7.5 mg, 0.0125 mmol, 5 mol%), Bu_4NPF_6 (5 mg, 0.0125 mmol, 5 mol%) were stirred in dichloroethane at 40 °C for 20h. Work-up and semi-preparative HPLC (100% hexane) afforded product **34** as a colourless oil (43.0 mg, 0.2 mmol, 81%).

$^1\text{H-NMR}$ (600 MHz; CDCl_3): δ (ppm) = 7.30 (d, J = 7.8 Hz, 1H), 7.14 – 7.08 (m, 3H), 3.04 – 2.99 (m, 1H), 2.59 (dd, J = 7.2 Hz, 18 Hz, 1H), 2.51 – 2.48 (m, 1H), 1.77 – 1.44 (m, 9H), 1.34 (s, 3H), 1.24 (s, 3H), $^{13}\text{C-NMR}$ (100 MHz; CDCl_3): δ (ppm) = 144.6, 135.1, 128.9, 128.5, 125.6, 125.1, 47.6, 37.4, 34.6, 31.2, 29.4, 28.3, 27.2, 26.7, 22.5, 20.0; m/z (EI) (%): 214.2 (29), 199.1 (100), 143.2 (16), 131.1 (29); HRMS-ESI calcd. for $\text{C}_{16}\text{H}_{22}$: 214.1716, found: 214.1718; IR (KBr): ν = 3458, 3058, 2923, 2856, 1450, 1382, 1039, 756 cm^{-1} .

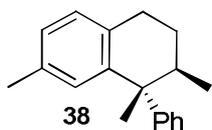
***Trans*-1,2,5-trimethyl-1-phenyl-1,2,3,4-tetrahydronaphthalene (36)**



According to the general procedure, 3-methyl-4-phenyl-1-*o*-tolylpentan-3-ol **35** (67.0 mg, 0.25 mmol), $\text{Ca}(\text{NTf}_2)_2$ (7.5 mg, 0.0125 mmol, 5 mol%), Bu_4NPF_6 (5 mg, 0.0125 mmol, 5 mol%) were stirred in dichloroethane at 40 °C for 20h. Work-up and semi-preparative HPLC (100% hexane) afforded product **36** as a colourless oil (44.0 mg, 0.17 mmol, 70%).

$^1\text{H-NMR}$ (600 MHz; CDCl_3): δ (ppm) = 7.26 – 7.23 (m, 2H), 7.18 – 7.15 (m, 3H), 6.98 – 6.91 (m, 2H), 6.59 (d, J = 7.8 Hz, 1H), 2.85 – 2.71 (m, 2H), 2.27 (s, 3H), 2.18 – 2.14 (m, 1H), 1.84 – 1.74 (m, 2H), 1.52 (s, 3H), 0.79 (d, J = 6.6 Hz, 3H). $^{13}\text{C-NMR}$ (100 MHz; CDCl_3): δ (ppm) = 151.1, 146.4, 135.6, 134.8, 129.4, 128.0 (2C), 127.5 (2C), 126.8, 125.3, 125.2, 47.0, 40.5, 27.1, 26.8, 22.8, 19.9, 16.2; m/z (EI) (%): 250.1 (100), 235.1 (93), 207.1 (35), 193.1 (66), 105.1 (26); HRMS-ESI calcd. for $\text{C}_{19}\text{H}_{22}$: 250.1716, found: 250.1718; IR (KBr): ν = 3468, 3057, 3022, 2967, 2925, 2874, 1593, 1491, 1459, 1377, 1029, 781, 745, 725, 701 cm^{-1} .

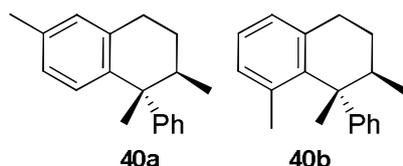
***Trans*-1,2,7-trimethyl-1-phenyl-1,2,3,4-tetrahydronaphthalene (38)**



According to the general procedure, 3-methyl-4-phenyl-1-*p*-tolylpentan-3-ol **37** (67.0 mg, 0.25 mmol), $\text{Ca}(\text{NTf}_2)_2$ (7.5 mg, 0.0125 mmol, 5 mol%), Bu_4NPF_6 (5 mg, 0.0125 mmol, 5 mol%) were stirred in dichloroethane at 40 °C for 20h. Work-up and semi-preparative HPLC (100% hexane) afforded product **38** as a colourless oil (50.0 mg, 0.2 mmol, 80%).

¹H-NMR (600 MHz; CDCl₃): δ (ppm) = 7.27 – 7.16 (m, 5H), 7.04 – 6.99 (m, 1H), 6.90 – 6.89 (m, 1H), 6.53 (s, 1H), 2.97 – 2.92 (m, 1H), 2.88 – 2.84 (m, 1H), 2.14 (s, 4H), 1.75– 1.69 (m, 2H), 1.52 (s, 3H), 0.79 (d, J= 6.6 Hz, 3H). ¹³C-NMR (100 MHz; CDCl₃): δ (ppm)= 150.9, 146.2, 134.8, 133.1, 130.4, 128.4 (2C), 128.1 (2C), 127.5, 126.3, 125.3, 46.9, 41.3, 29.2, 27.4, 22.8, 21.0, 16.1; *m/z* (EI) (%): 250.1 (92), 235.1 (83), 207.1 (47), 193.1 (100), 105.1 (20); HRMS-ESI calcd. for C₁₉H₂₂: 250.1716, found: 250.1718; IR (KBr): ν = 3020, 2962, 2923, 2325 2095, 1935, 1601, 1496, 1446, 1375, 1027, 804, 750, 700 cm⁻¹.

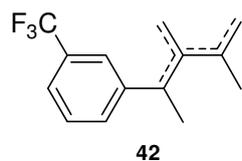
Trans-1,2,6-trimethyl-1-phenyl-1,2,3,4-tetrahydronaphthalene (40)



According to the general procedure, 33-methyl-4-phenyl-1-m-tolylpentan-3-ol **39** (67.0 mg, 0.25 mmol), Ca(NTf₂)₂ (7.5 mg, 0.0125 mmol, 5 mol%), Bu₄NPF₆ (5 mg, 0.0125 mmol, 5 mol%) were stirred in dichloroethane at 40 °C for 20h. Work-up and semi-preparative HPLC (100% hexane) afforded a mixture 67/ 33 of product **40a** and **40b** as a colourless oil (50.0 mg, 0.2 mmol, 81%).

¹H-NMR (600 MHz; CDCl₃): δ (ppm) = 7.27 – 6.89 (m, 14H), 6.81 (d, J= 7.8, 1H), 6.60 (d, J= 8.4, 1H), 3.00-2.81 (m, 4H), 2.29 (s, 3H), 2.26 (s, 3H), 2.19 – 2.10 (m, 1H), 1.87 – 1.82 (m, 1H), 1.74 – 1.69 (m, 2H), 1.59 – 1.55 (m, 2H), 1.54 (s, 3H), 1.51 (s, 3H), 0.78 (d, J= 6.6 Hz, 3H), 0.66 (d, J= 7.2 Hz, 3H). ¹³C-NMR (100 MHz; CDCl₃): δ (ppm)= 150.9, 147.1, 143.6, 142.3, 136.5, 136.0, 134.7, 130.0, 129.0, 128.0, 127.5, 126.8, 126.6, 125.3, 46.6, 45.6, 41.3, 40.5, 29.8, 28.5, 27.4, 27.1, 22.7, 20.8, 17.9, 16.2; *m/z* (EI) (%): 250.1 (92), 235.1 (83), 207.1 (47), 193.1 (100), 105.1 (20); HRMS-ESI calcd. for C₁₉H₂₂: 250.1716, found: 250.1718; IR (KBr): ν = 2925, 1602, 1494, 1452, 1376, 1031, 819, 752, 701 cm⁻¹.

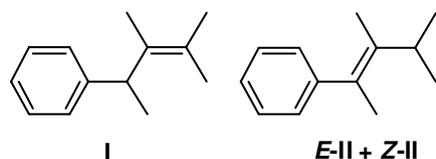
1-(3,4-dimethylpenten-2-yl)-3-(trifluoromethyl)benzenes (42)



According to the general procedure, 2,3-dimethyl-4-(3-(trifluoromethyl)phenyl)pentan-3-ol **41** (65.1 mg, 0.25 mmol), Ca(NTf₂)₂ (7.5 mg, 0.0125 mmol, 5 mol%), Bu₄NPF₆ (5 mg, 0.0125 mmol, 5 mol%) were stirred in dichloroethane at 80 °C for 20 h. Work-up and semi-preparative HPLC (hexane/ethyl acetate = 20/1) afforded an inseparable mixture of olefinic intermediates **42** as a colourless oil (44.2 mg, 0.183 mmol, 73%).

¹H-NMR (400 MHz; CDCl₃): δ(ppm)= 7.46 – 7.181 (m), 2.98 (quin, J= 6.5 Hz), 2.75 – 2.65 (m), 2.43 (quin, J= 6.5 Hz), 1.96 – 1.93 (m), 1.91 – 1.88 (m), 1.67 – 1.65 (m), 1.43 – 1.39 (m), 1.31 (d, J= 7.1 Hz), 1.28 (s), 1.06 (d, J= 7.1 Hz), 1.03 (d, J= 6.5 Hz), 0.94 (s), 0.87 (d, J = 7.1 Hz).

Intermediates: (3,4-dimethylpent-3-en-2-yl)benzene (I) and (3,4-dimethylpent-2-en-2-yl)benzene (E-II + Z-II)



According to the general procedure, 2,3-dimethyl-4-phenylpentan-3-ol **1** (48.1 mg, 0.25 mmol), Ca(NTf₂)₂ (7.5 mg, 0.0125 mmol, 5 mol%), Bu₄NPF₆ (5 mg, 0.0125 mmol, 5 mol%) were stirred in dichloroethane at 40 °C for 1h30. Work-up and semi-

preparative HPLC (100% hexane) afforded intermediates **I** and **II** (along with traces of **III** and **IV**).

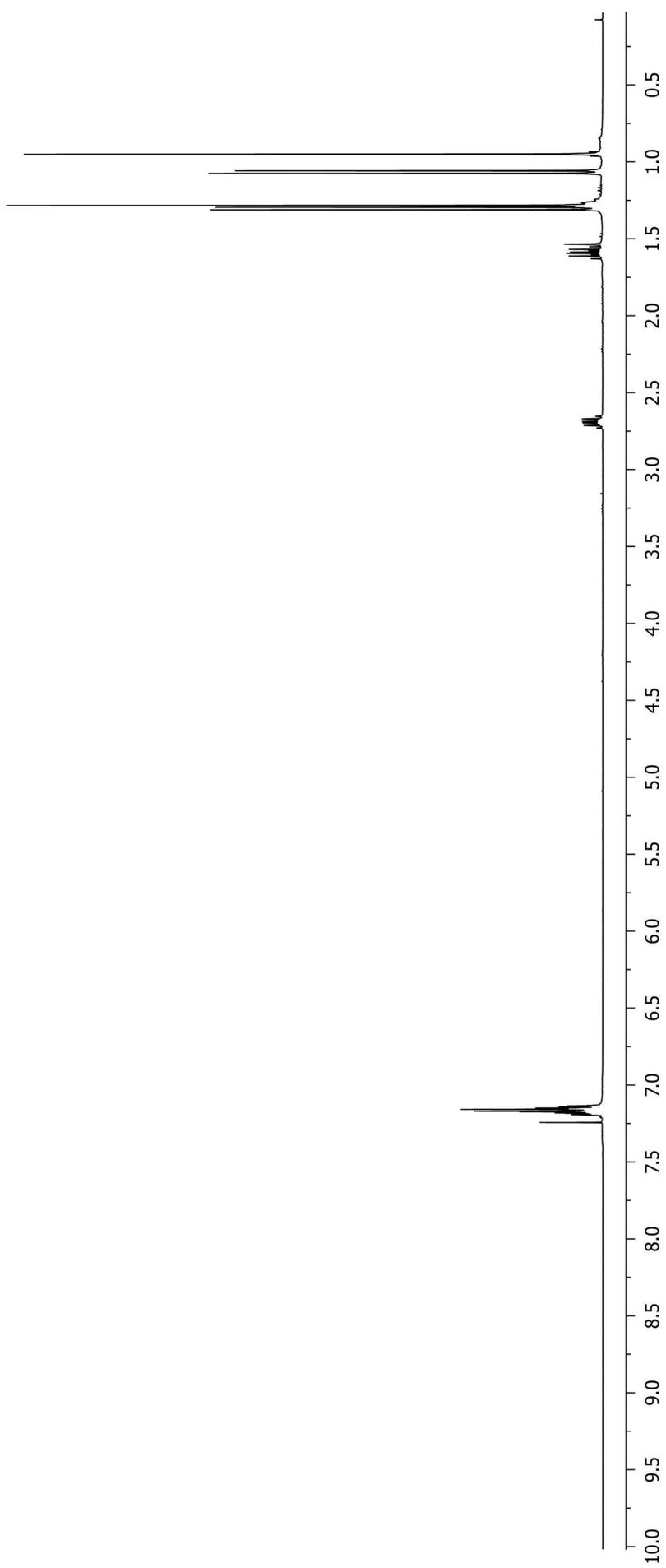
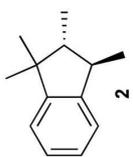
I: $^1\text{H-NMR}$ (400 MHz; CDCl_3): δ (ppm)= 7.34 – 7.11 (m, 5H), 4.11 (q, $J= 7.1$ Hz, 1H), 1.82 (s, 3H), 1.68 (s, 3H), 1.37 (s, 3H), 1.31 (d, $J= 7.1$ Hz, 3H).

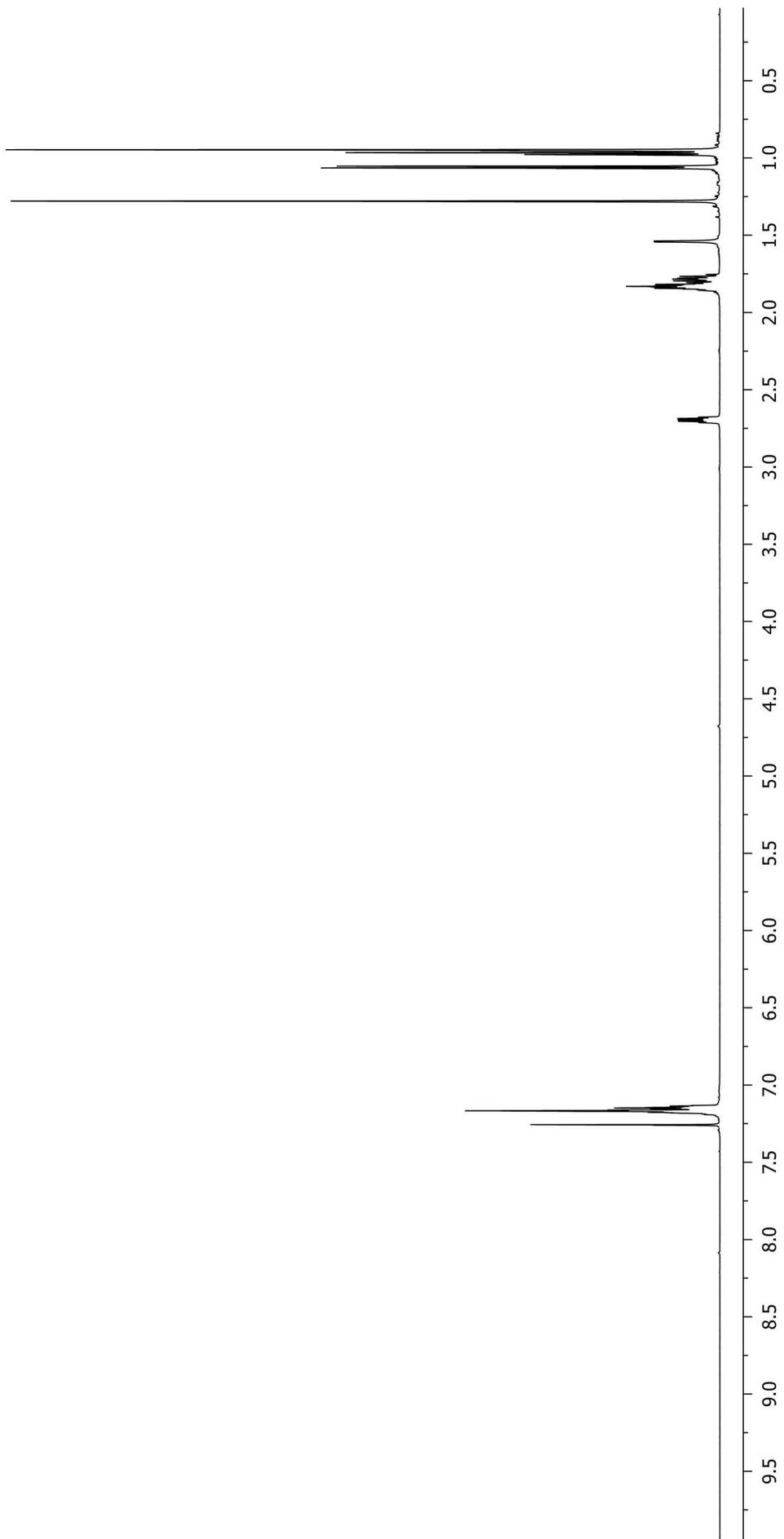
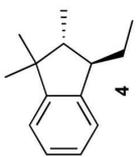
E-II + Z-II: $^1\text{H-NMR}$ (400 MHz; CDCl_3): δ (ppm)= 3.01 – 2.83 (m, 10H), 2.92 (sep, $J= 6.9$ Hz, 1H), 2.48 (sep, $J= 6.8$ Hz, 1H), 1.89 (s, 3H), 1.84 (s, 3H), 1.60 (s, 3H), 1.36 (s, 3H), 0.97 (d, $J= 6.7$ Hz, 3H), 0.89 (d, $J= 6.9$ Hz, 3H).

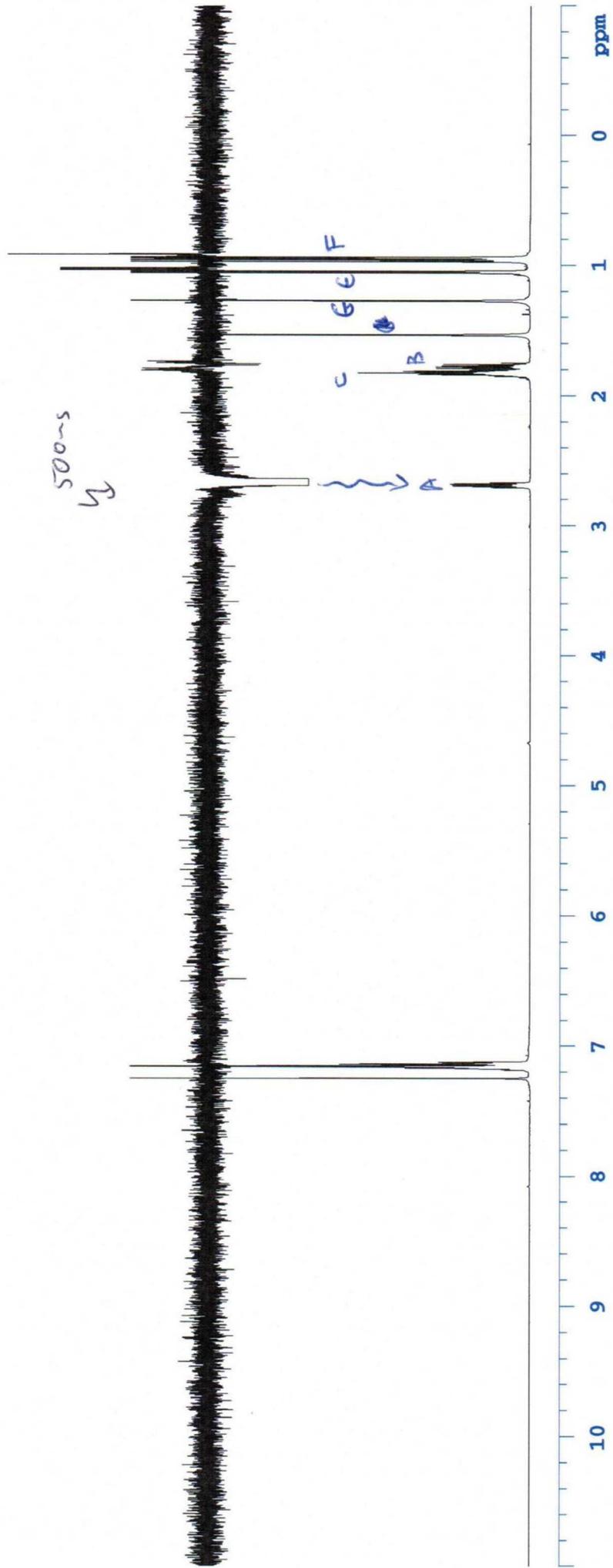
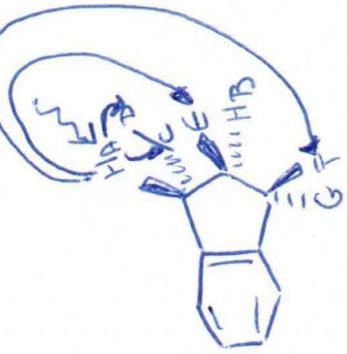
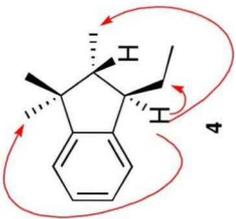
Literature

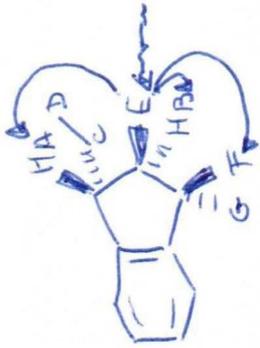
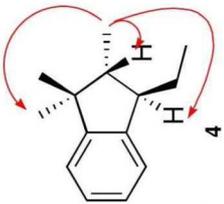
[1] Blum, R.; Giovannini, E.; Hengartner, U.; Vallat, G. *Helv. Chim. Acta*, **2002**, 85, 1827-1840.

[2] Mühlthau, F.; Bach, T. *Synthesis*, **2005**, 19, 3428.

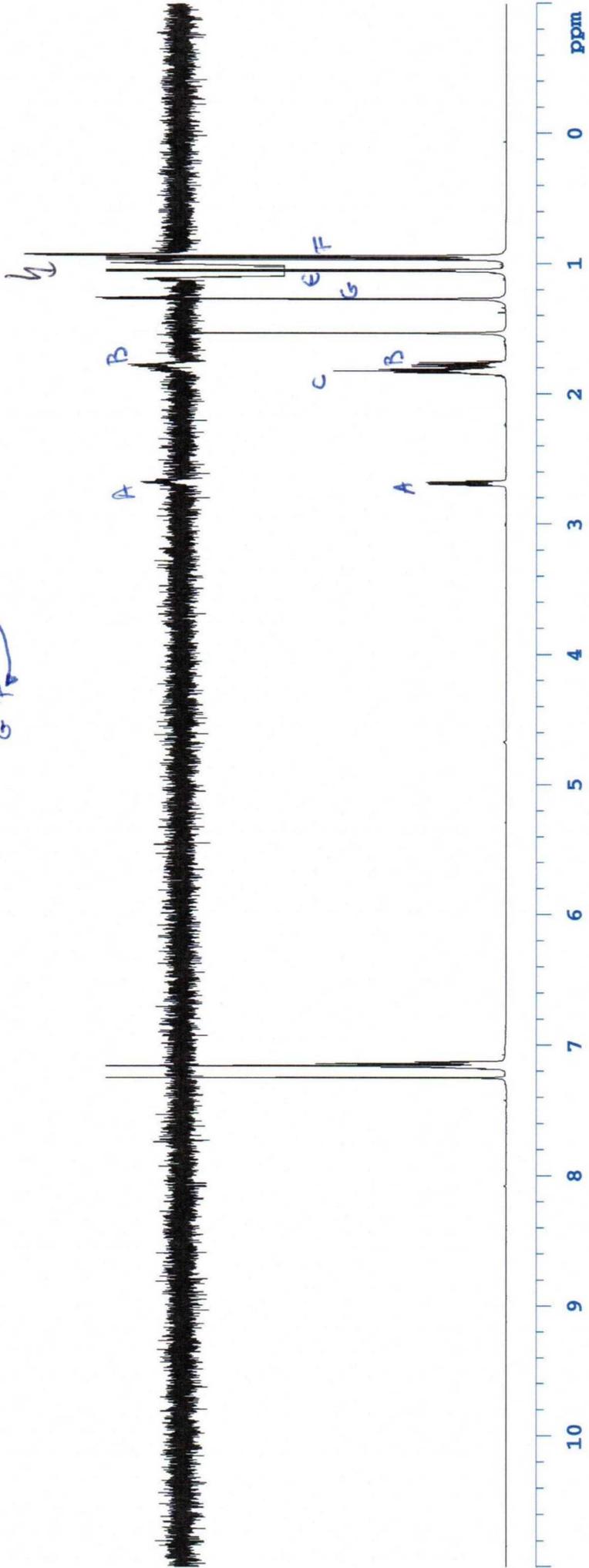


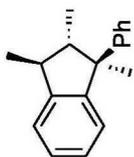




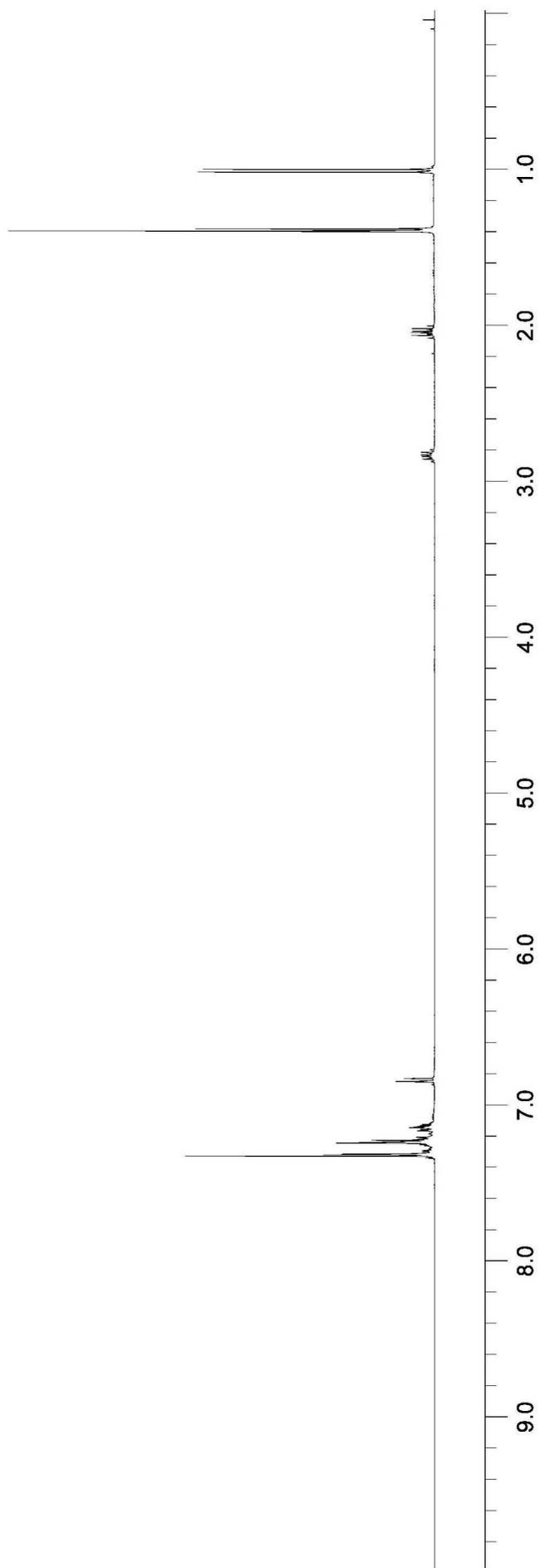


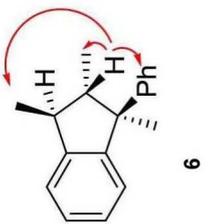
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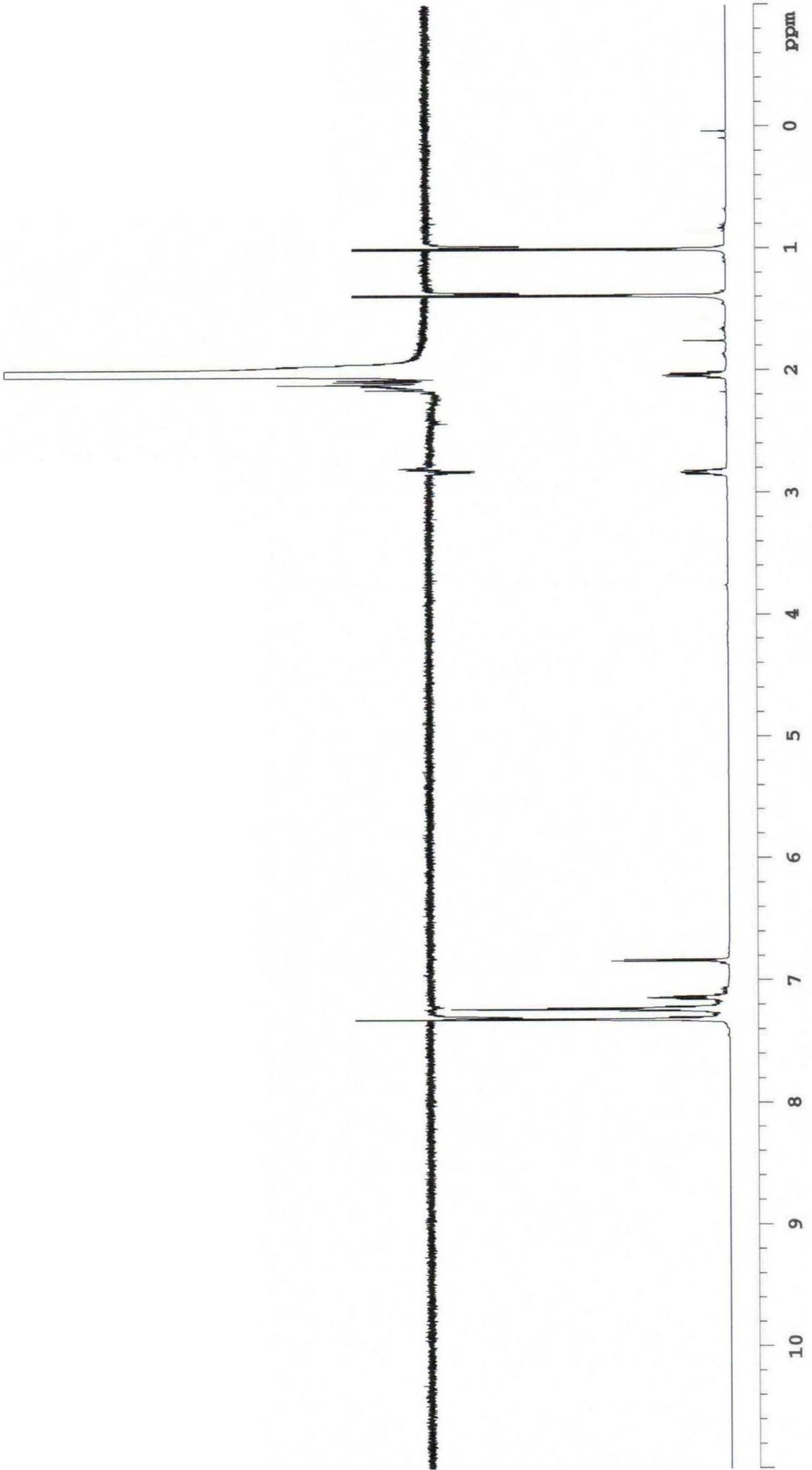


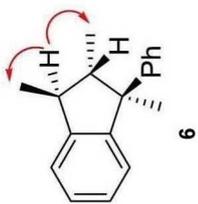
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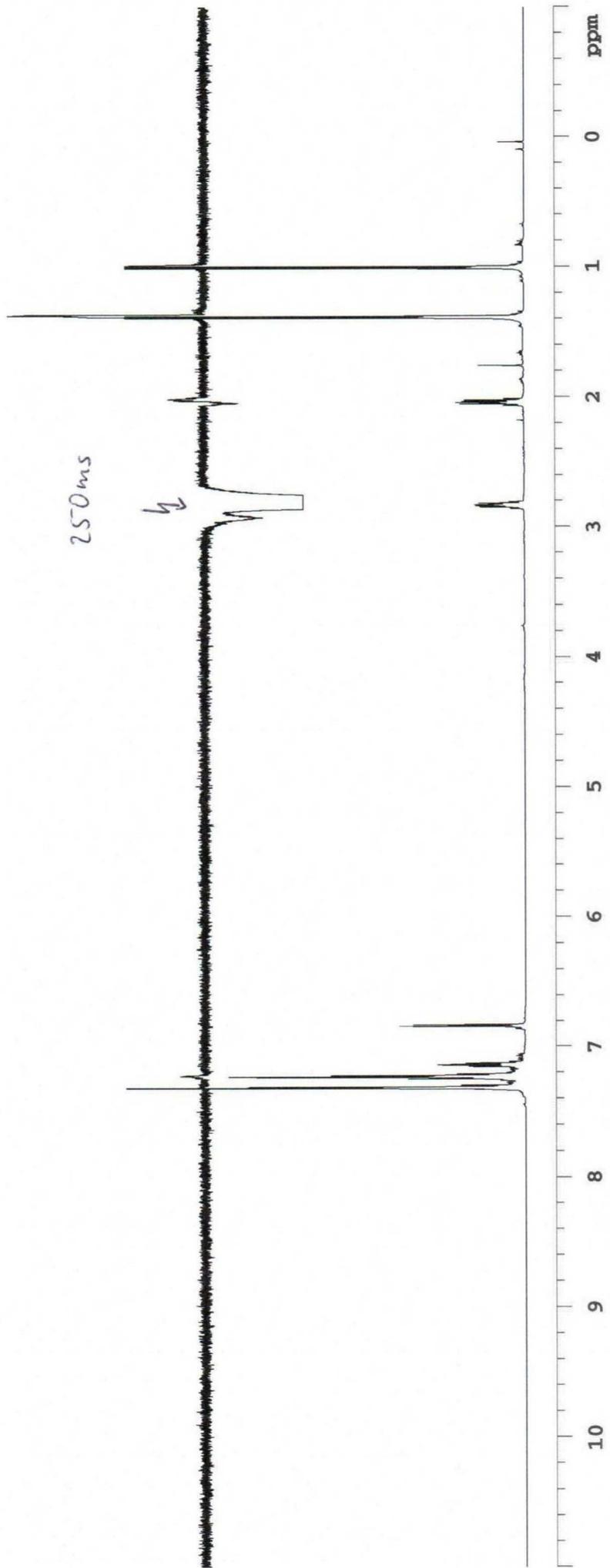


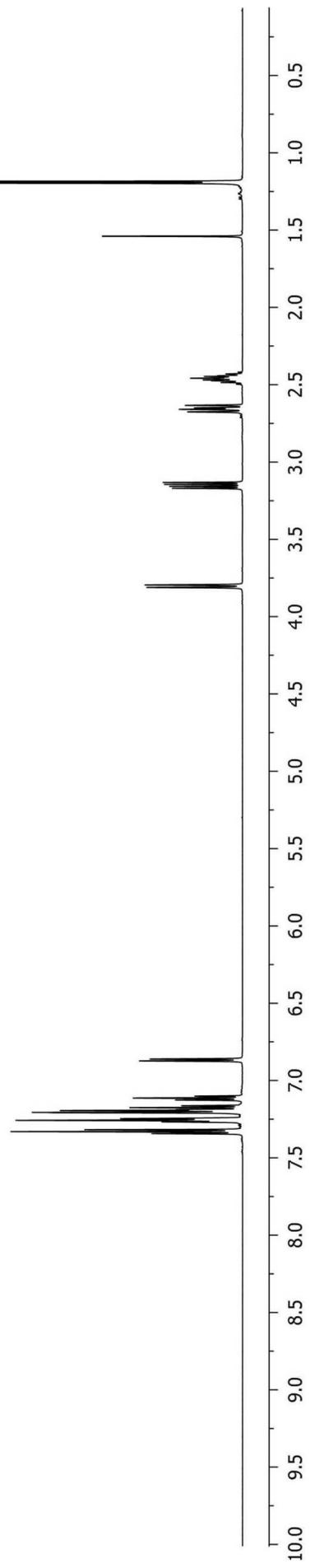
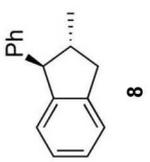
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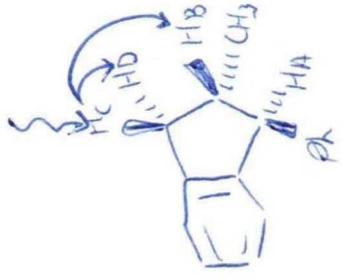
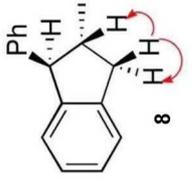




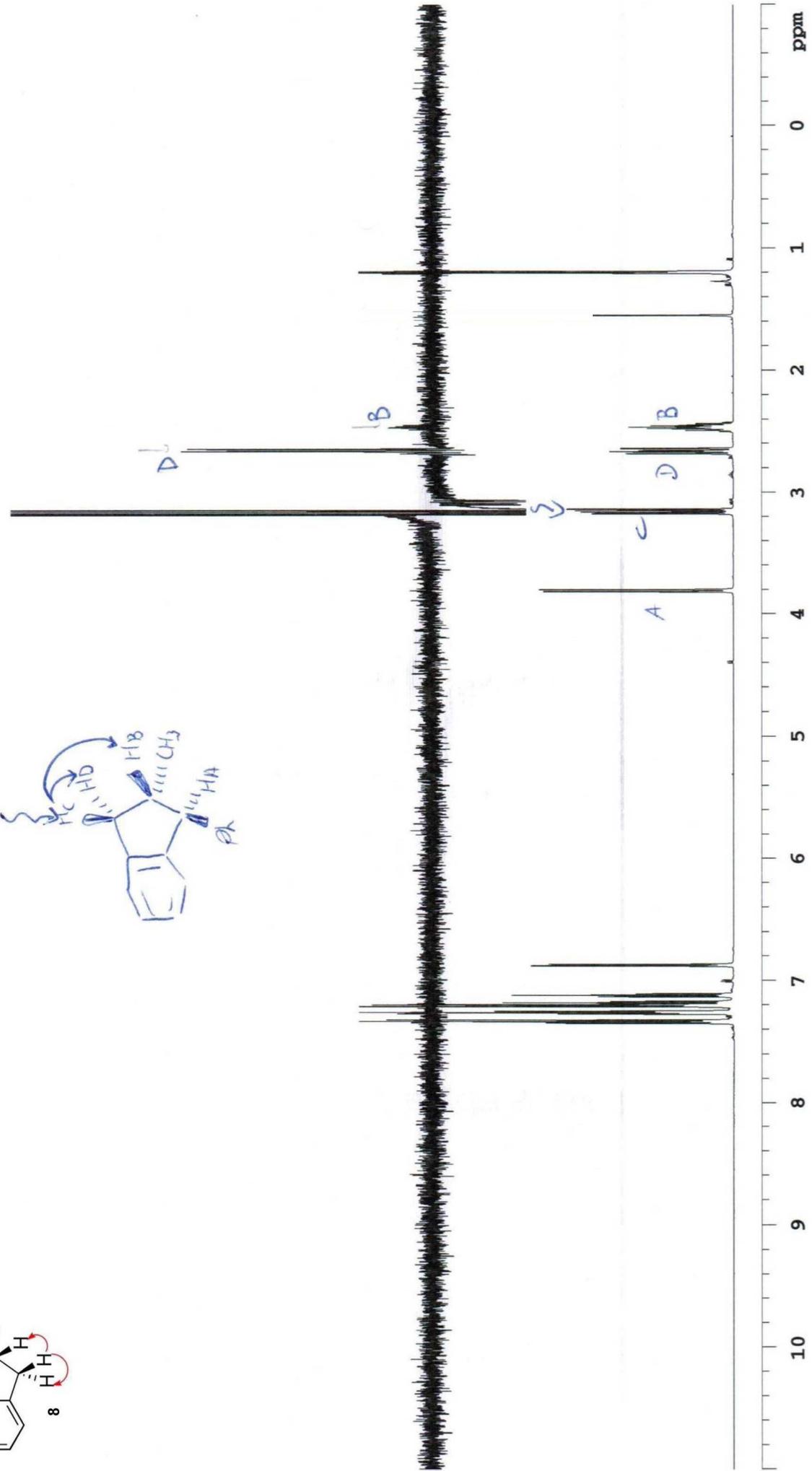
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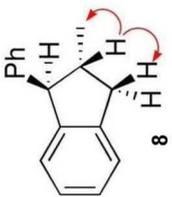




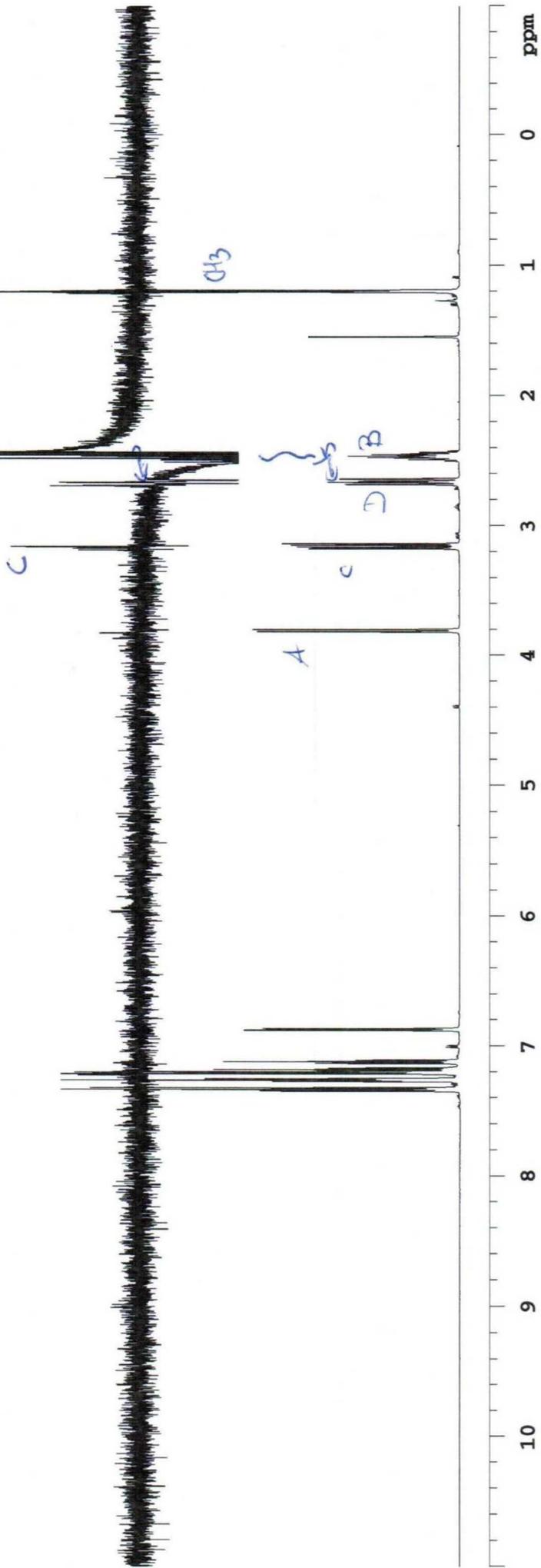


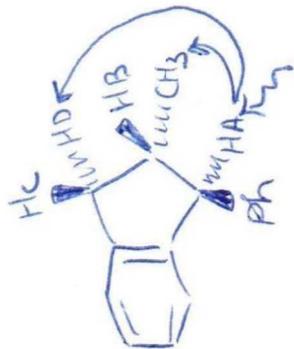
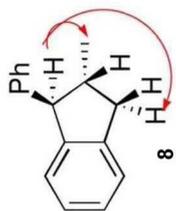
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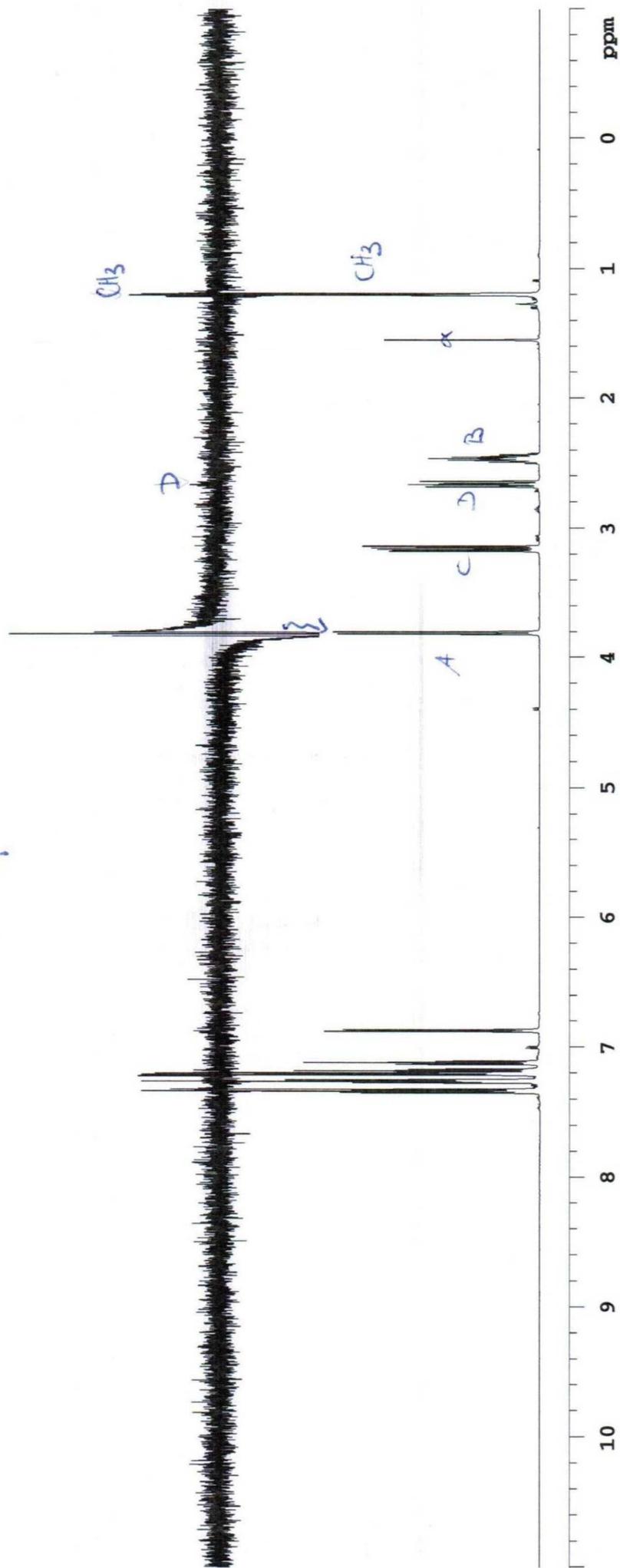
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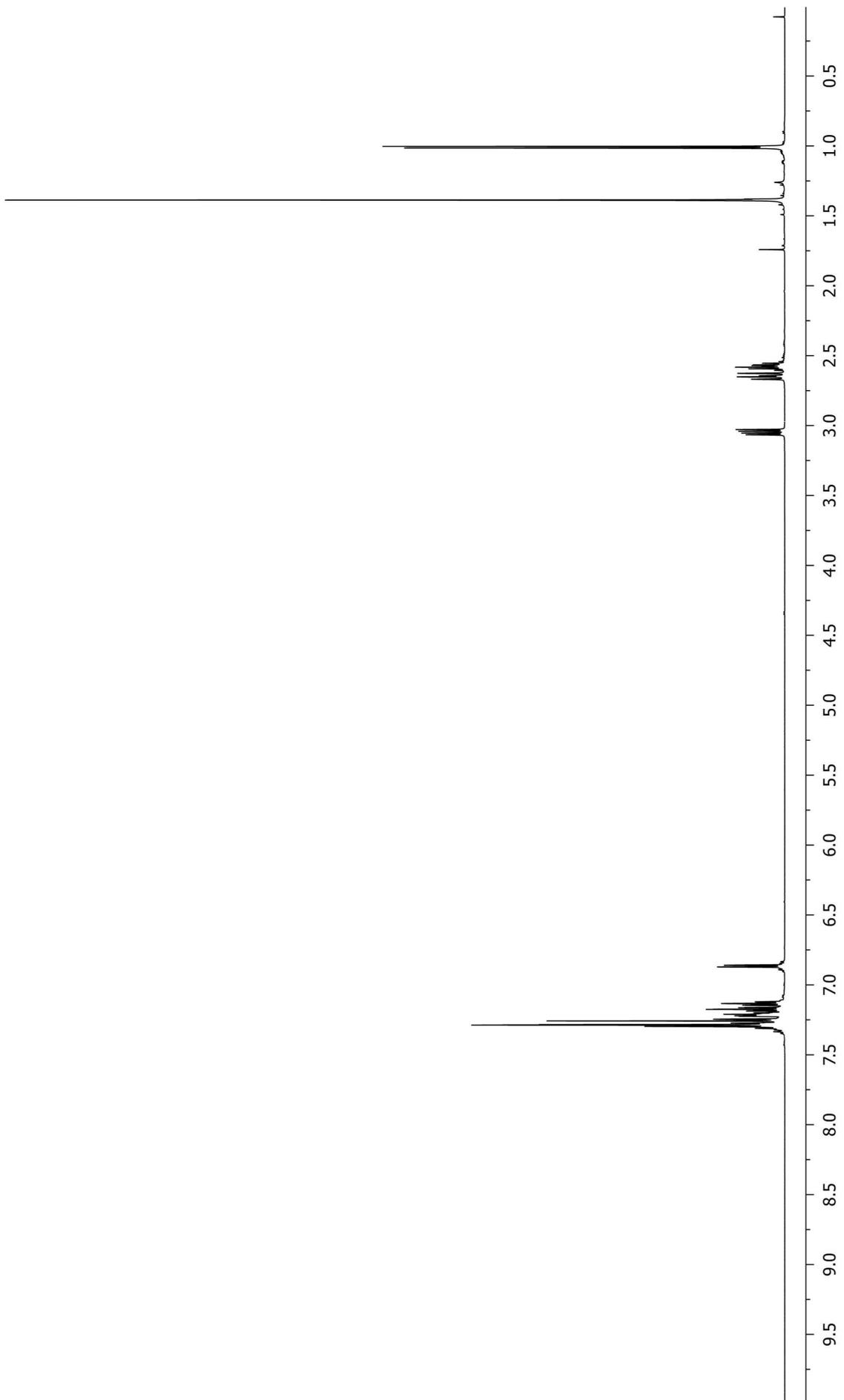
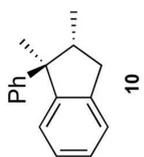


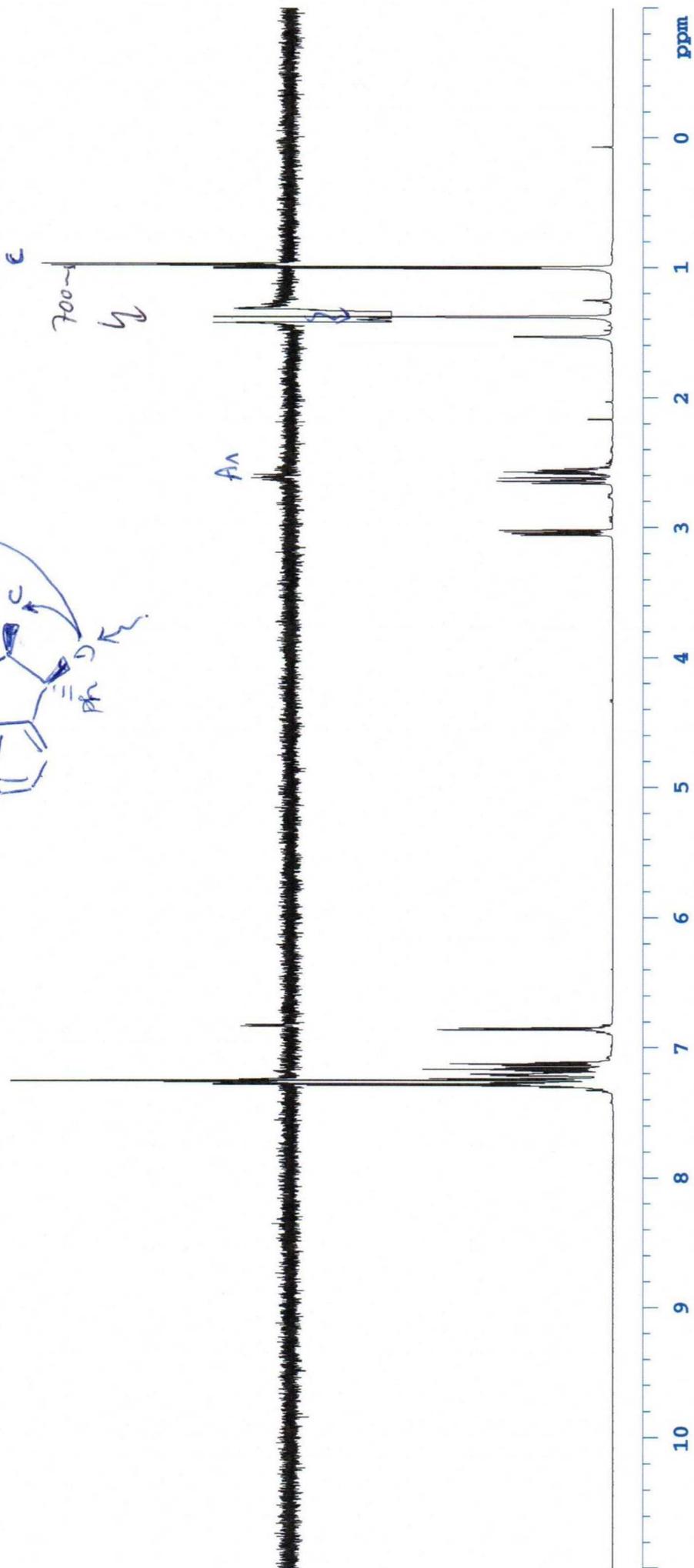
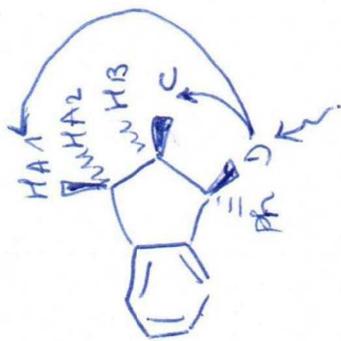
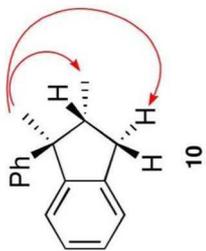


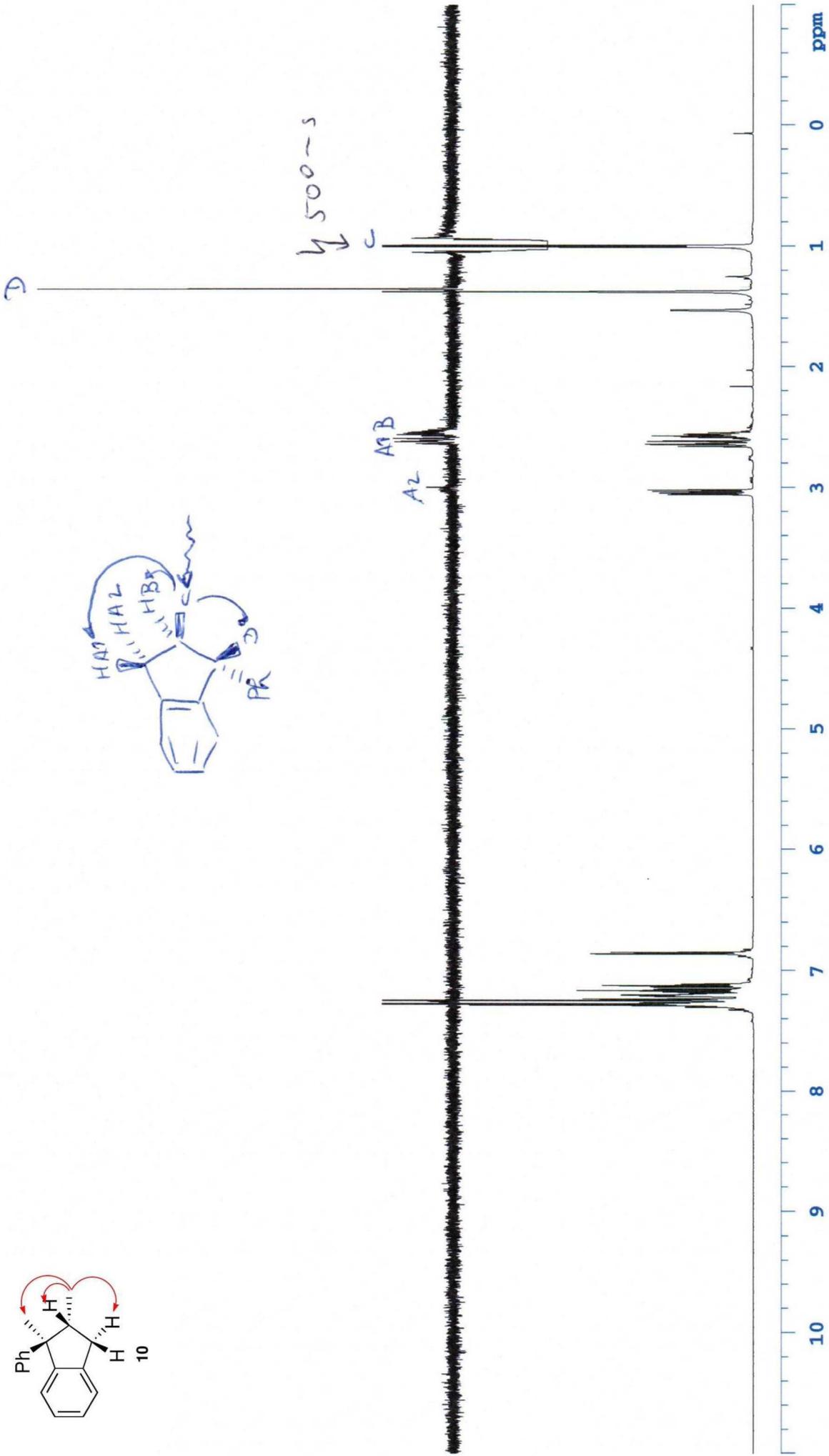
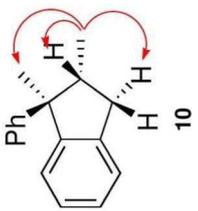
A → CH₃
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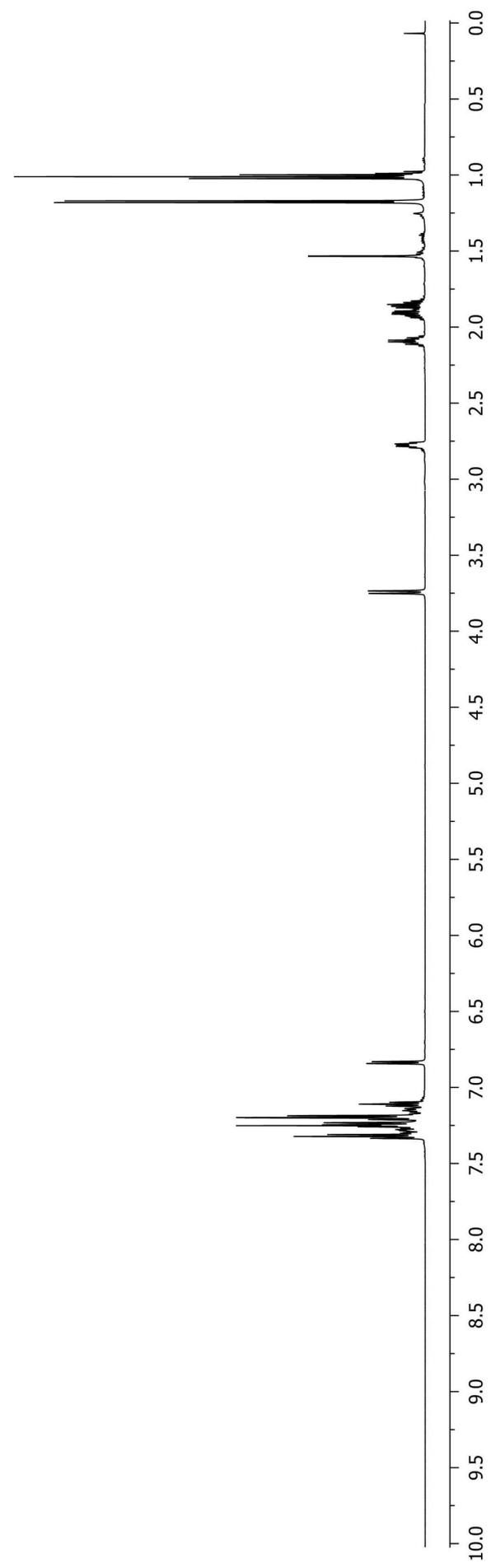
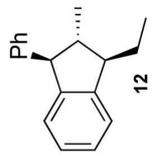
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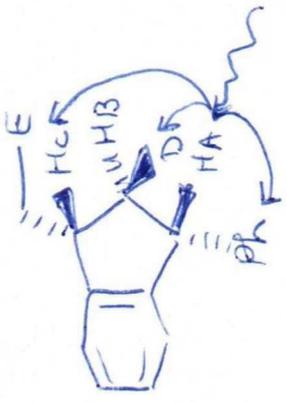
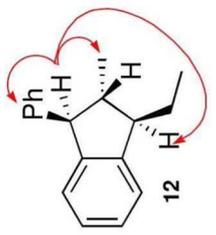




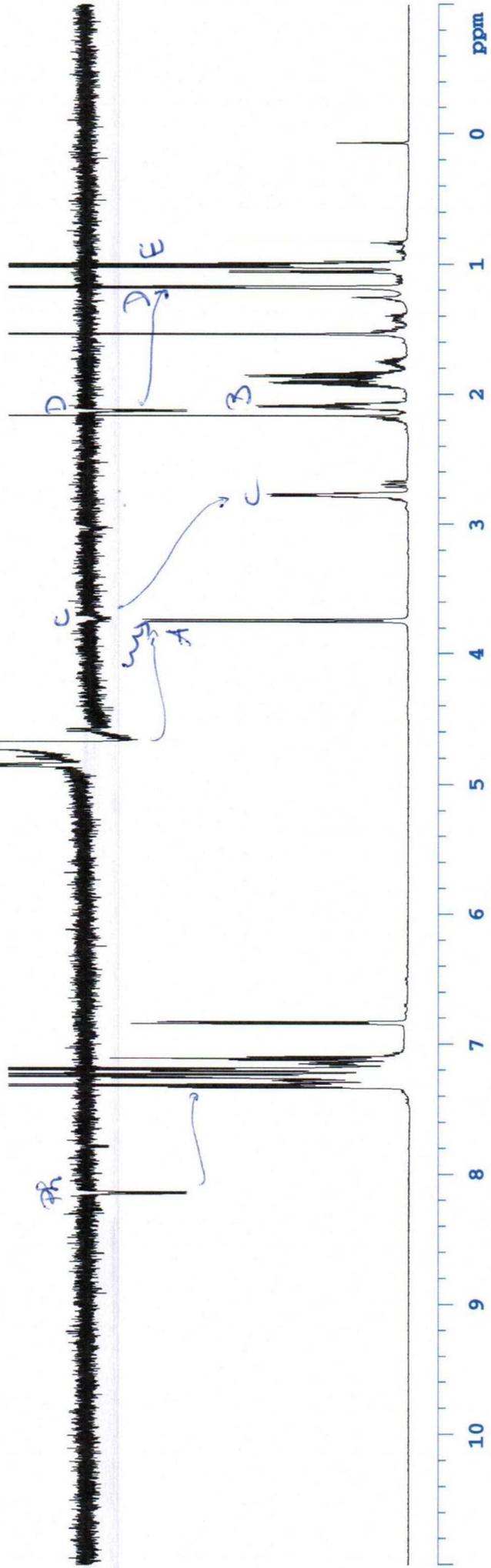


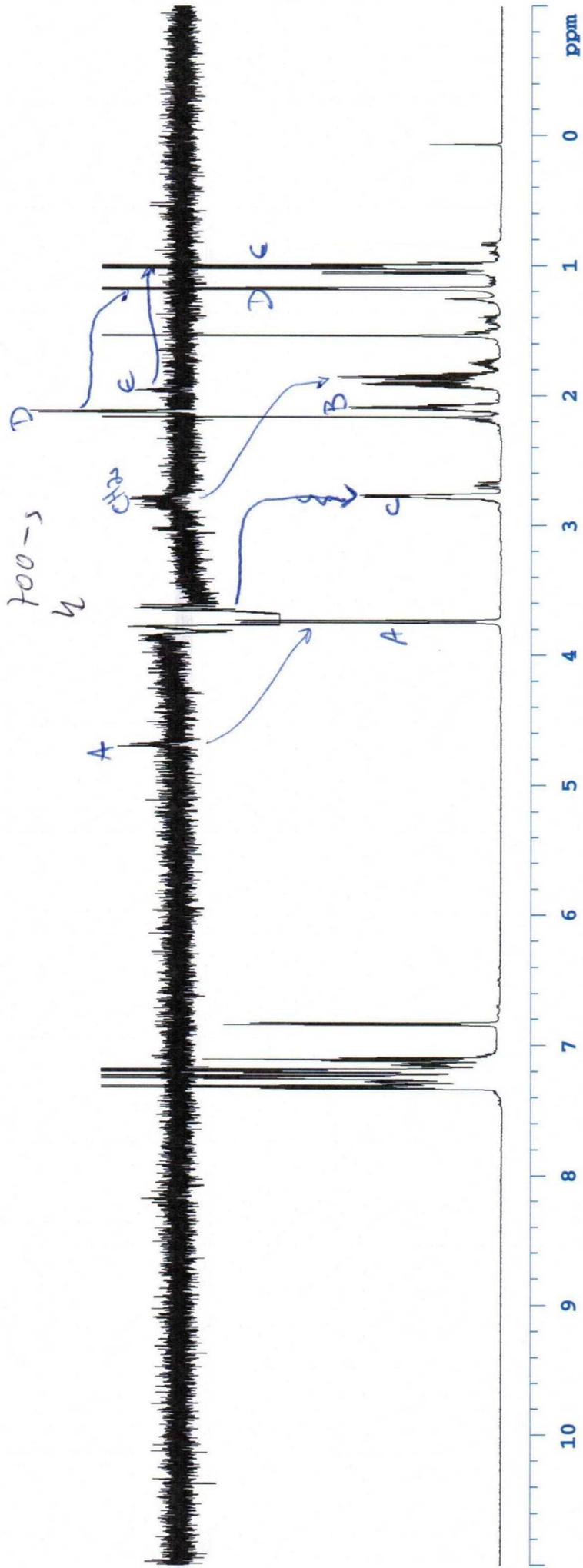
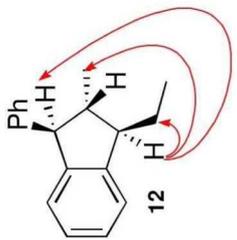


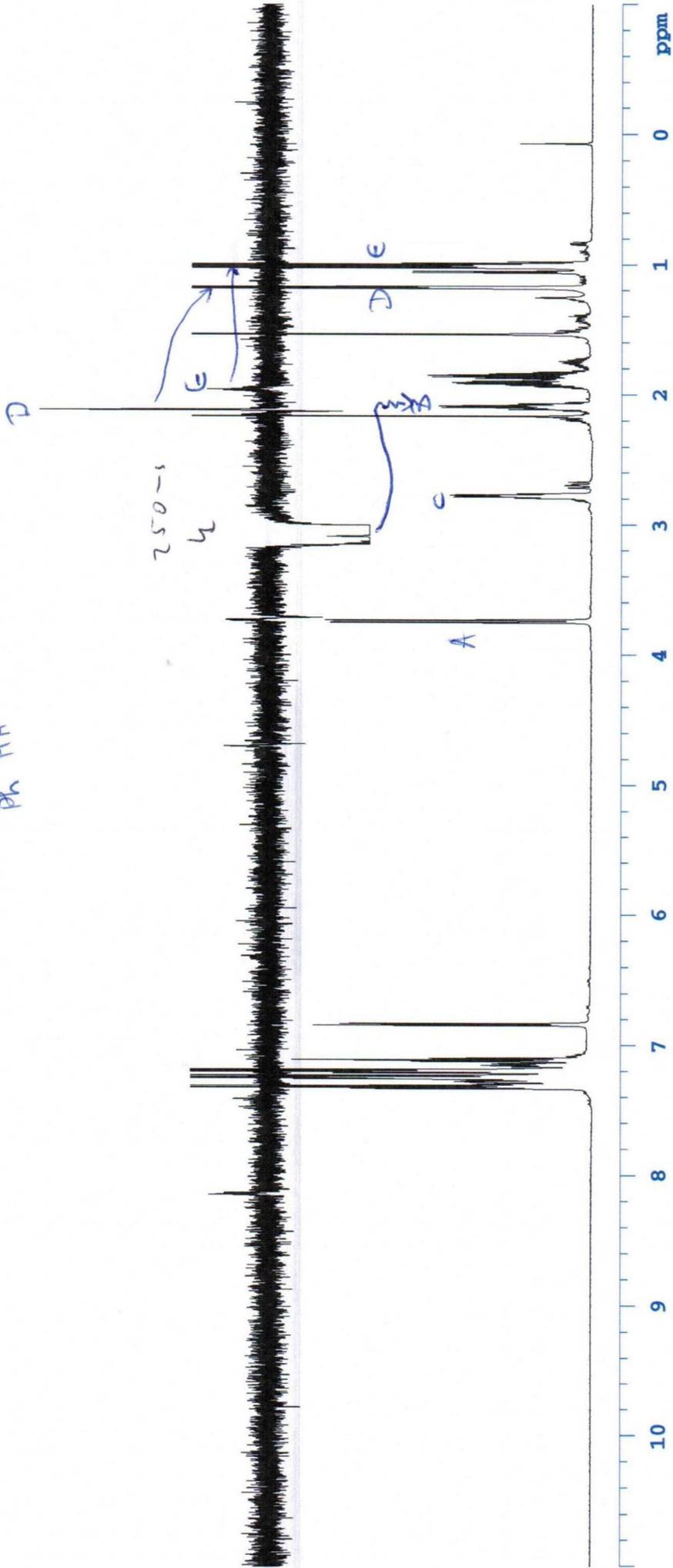
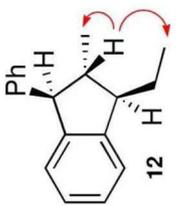


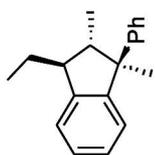


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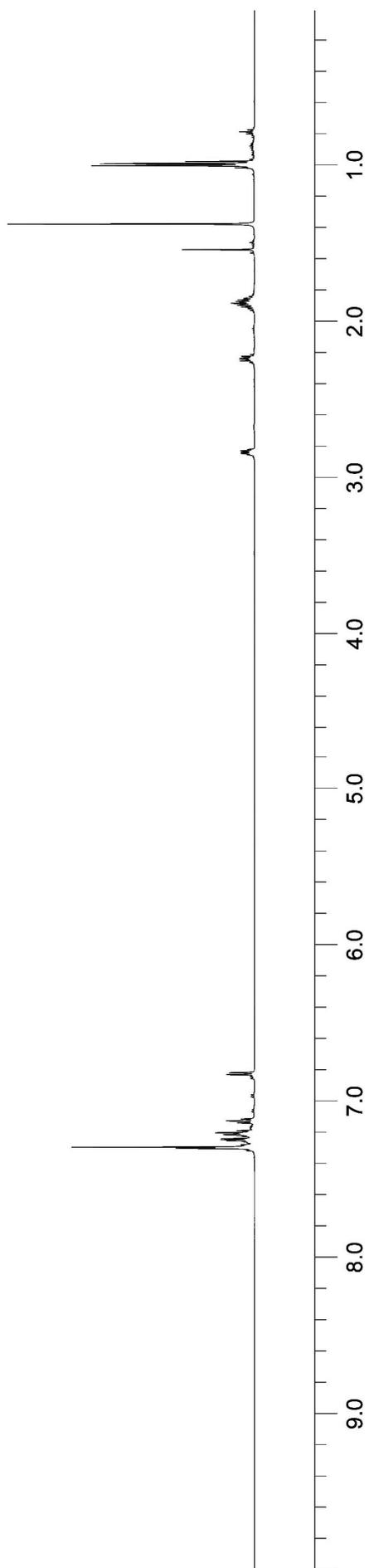


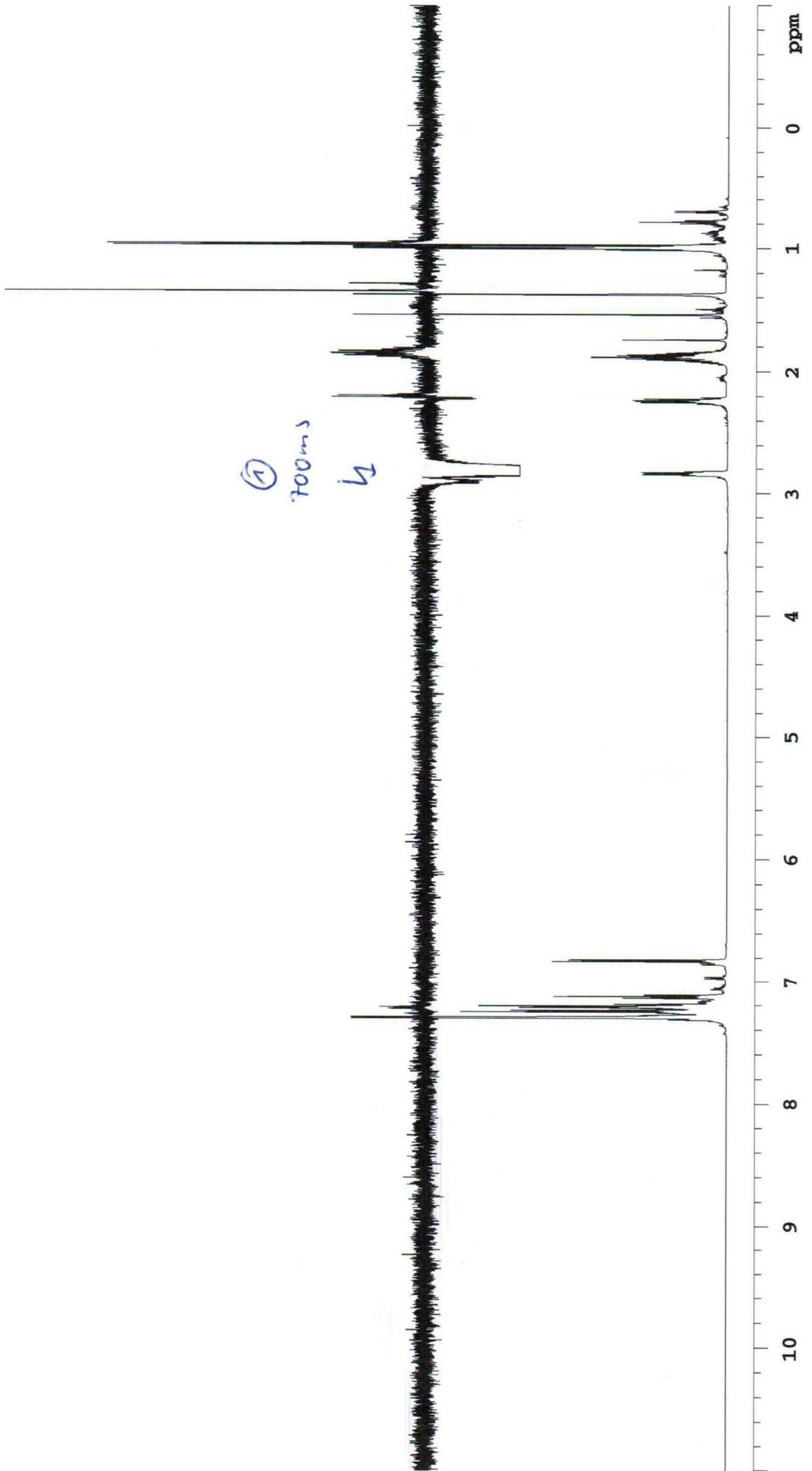
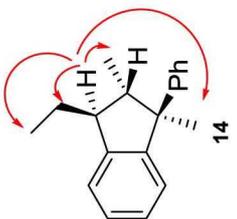


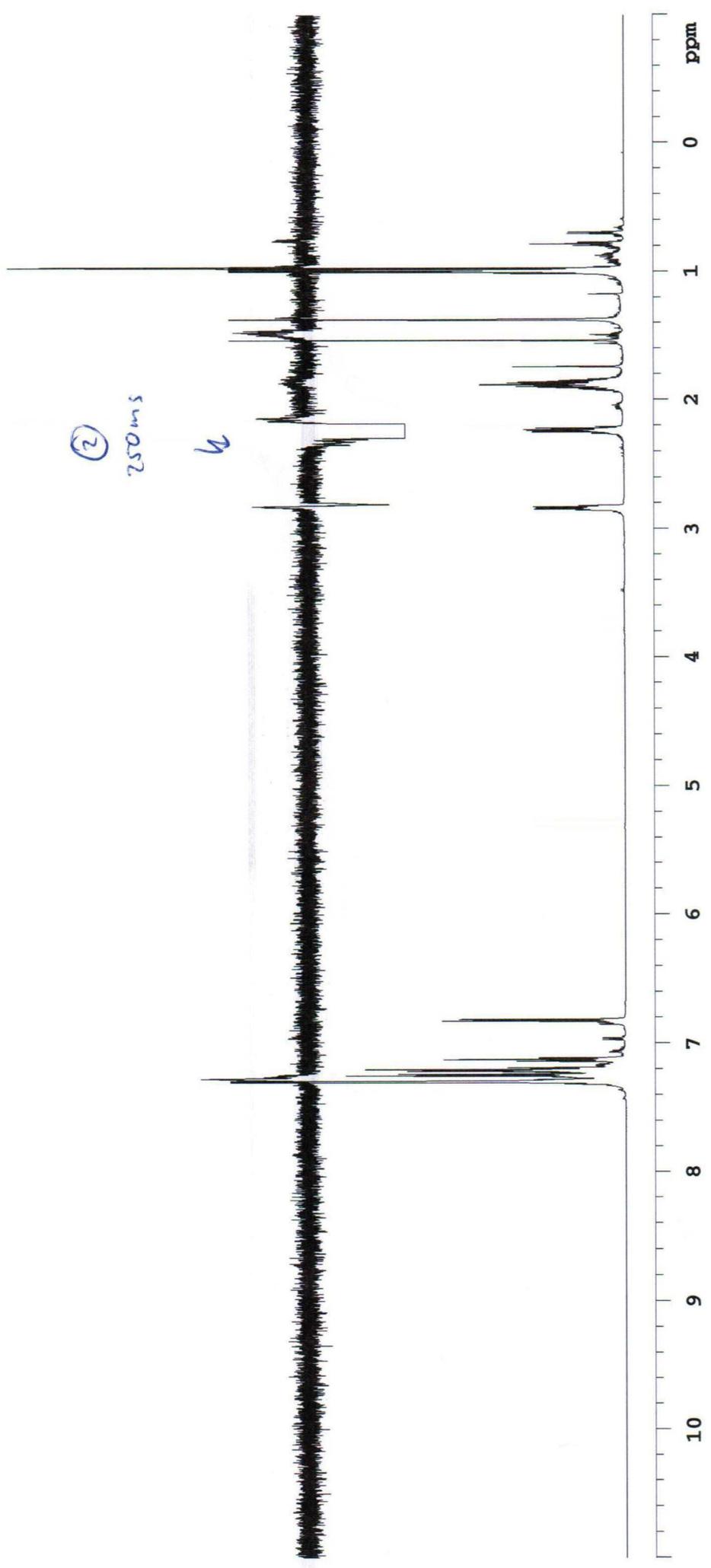
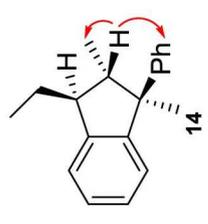


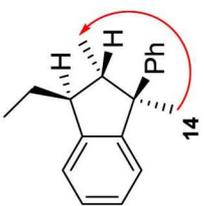


14

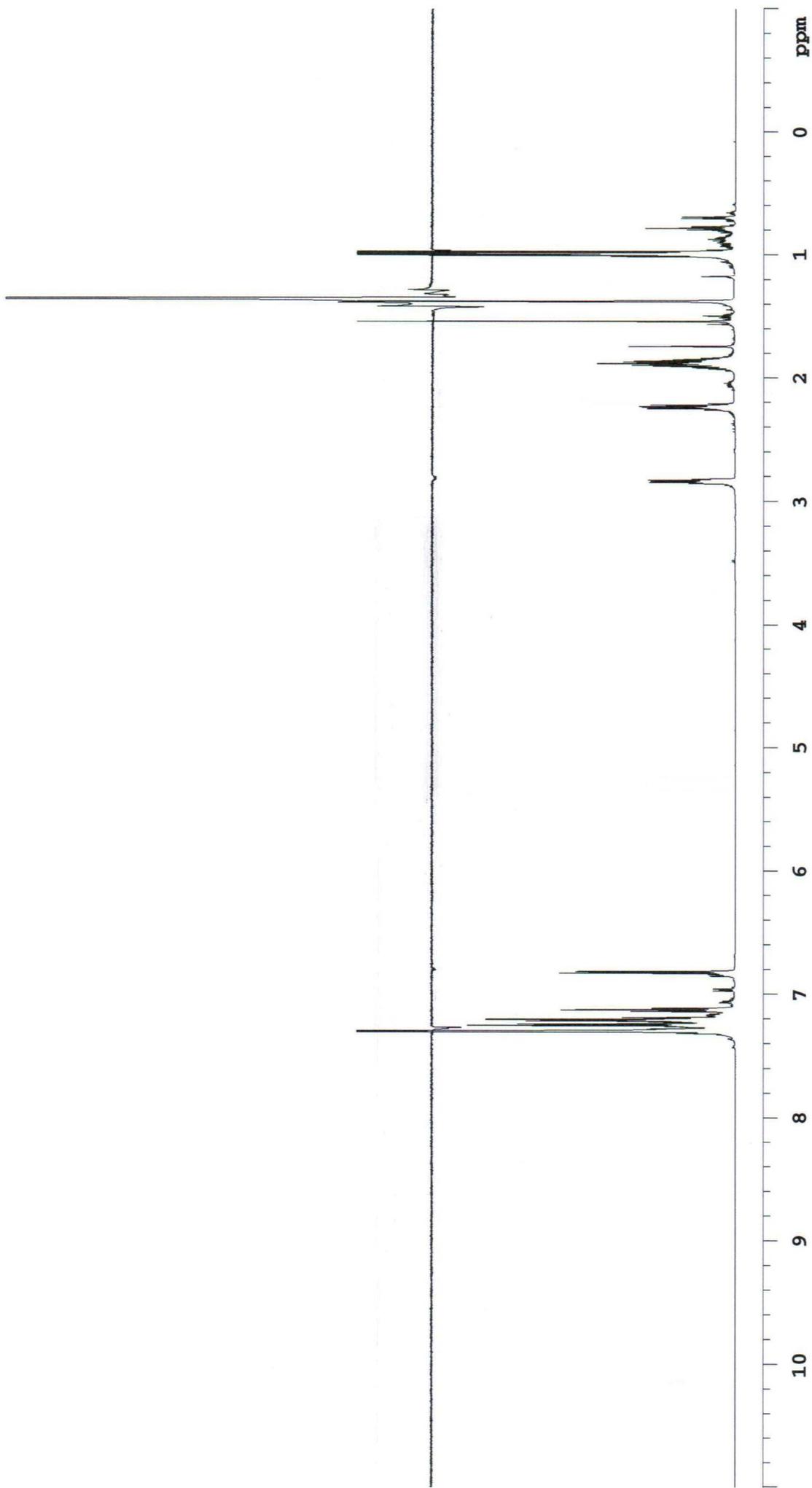


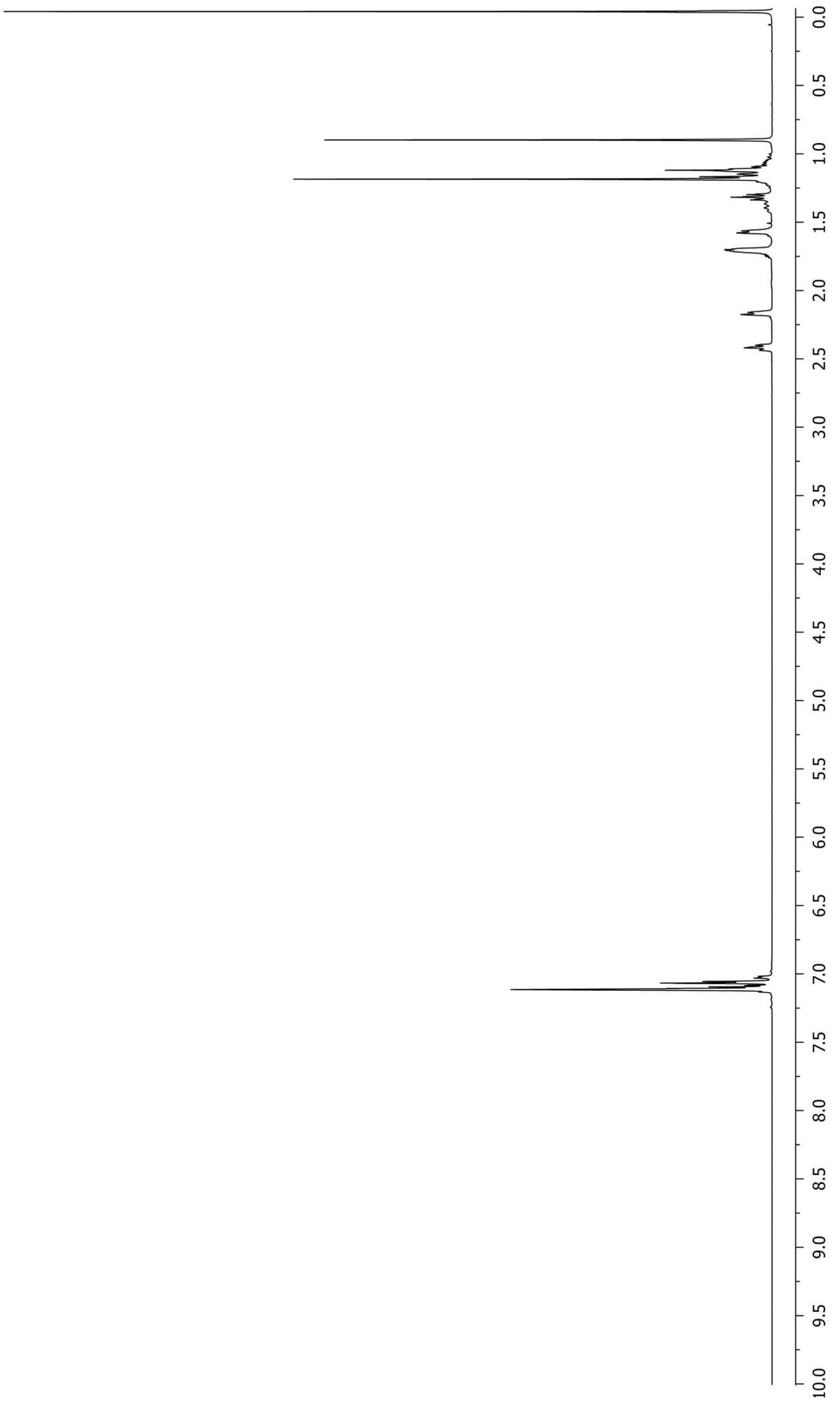
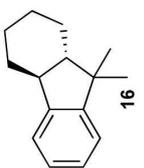


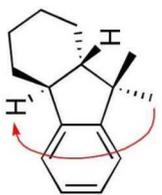




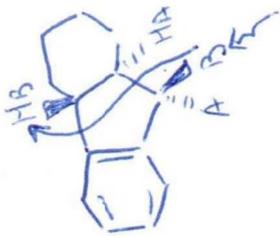
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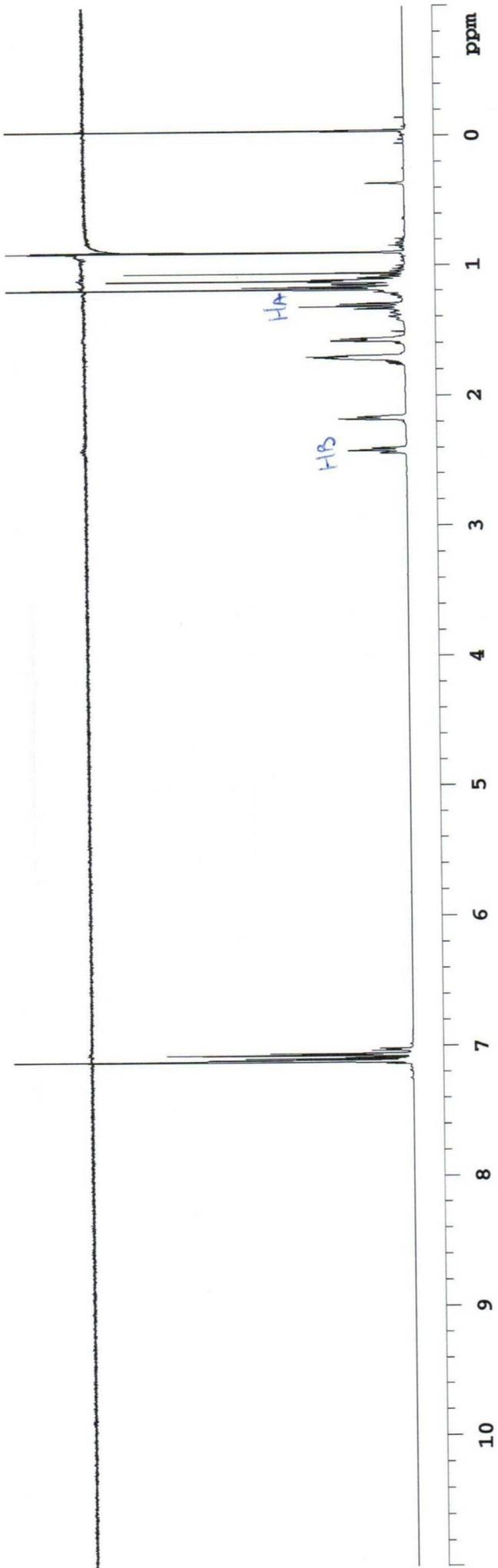


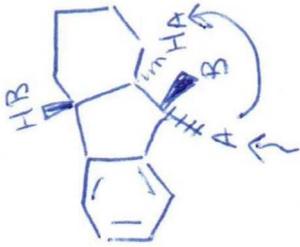
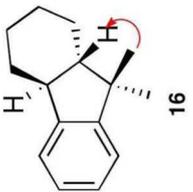


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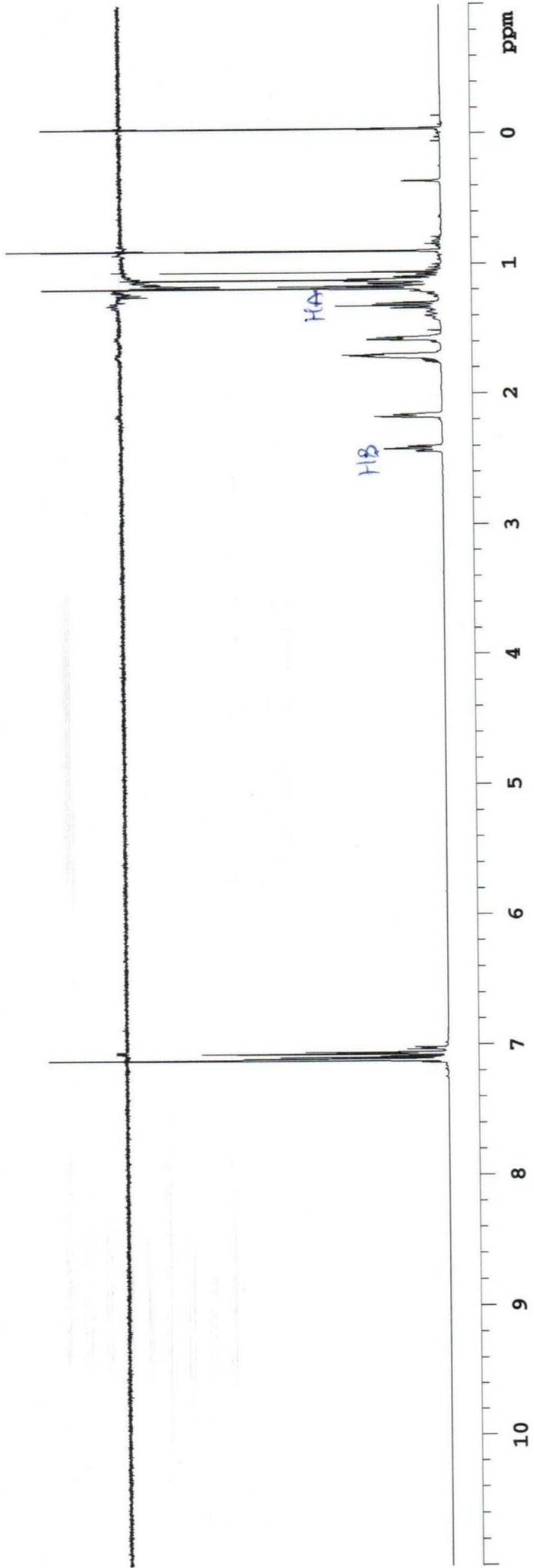


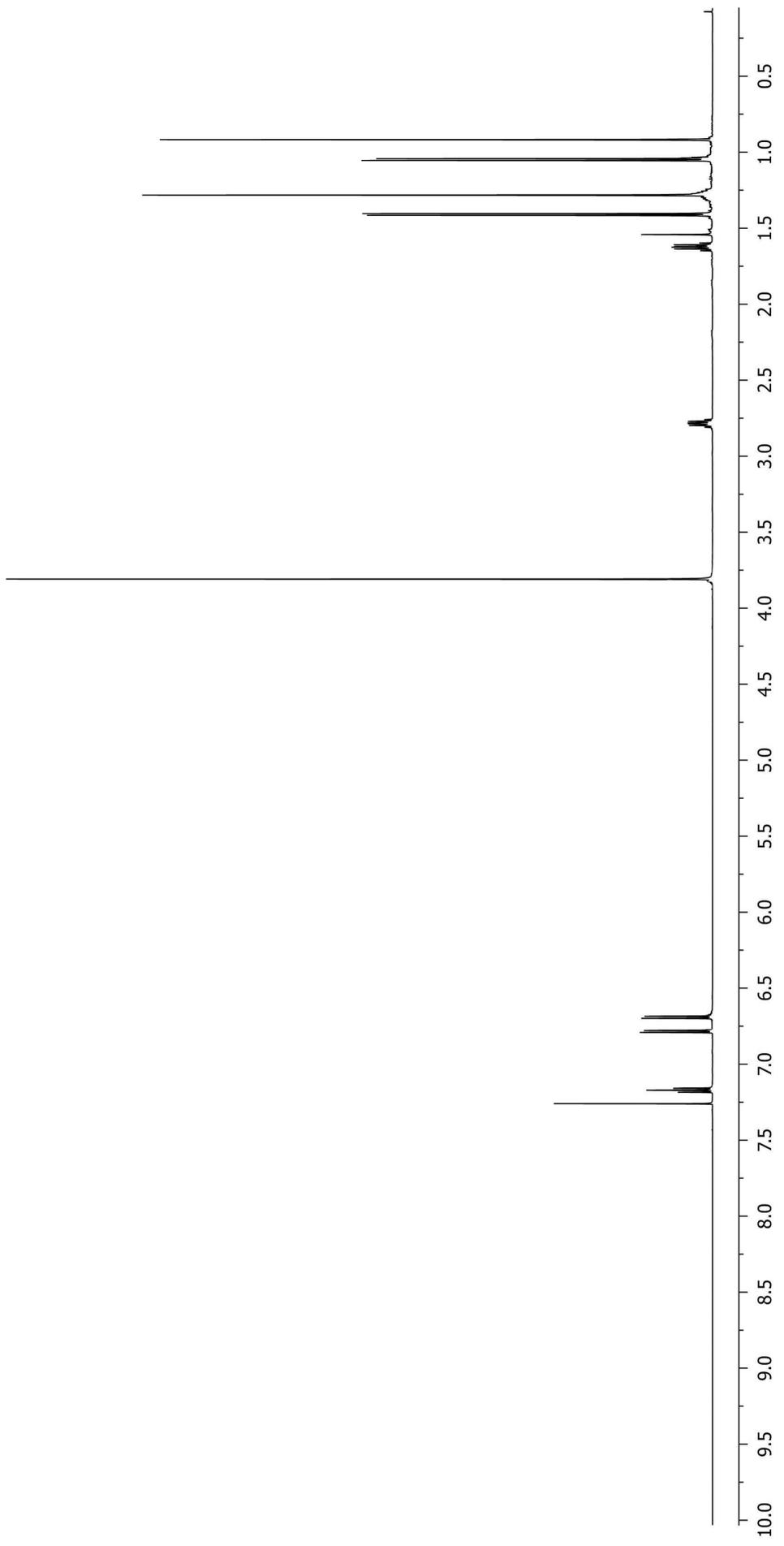
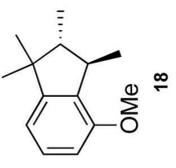
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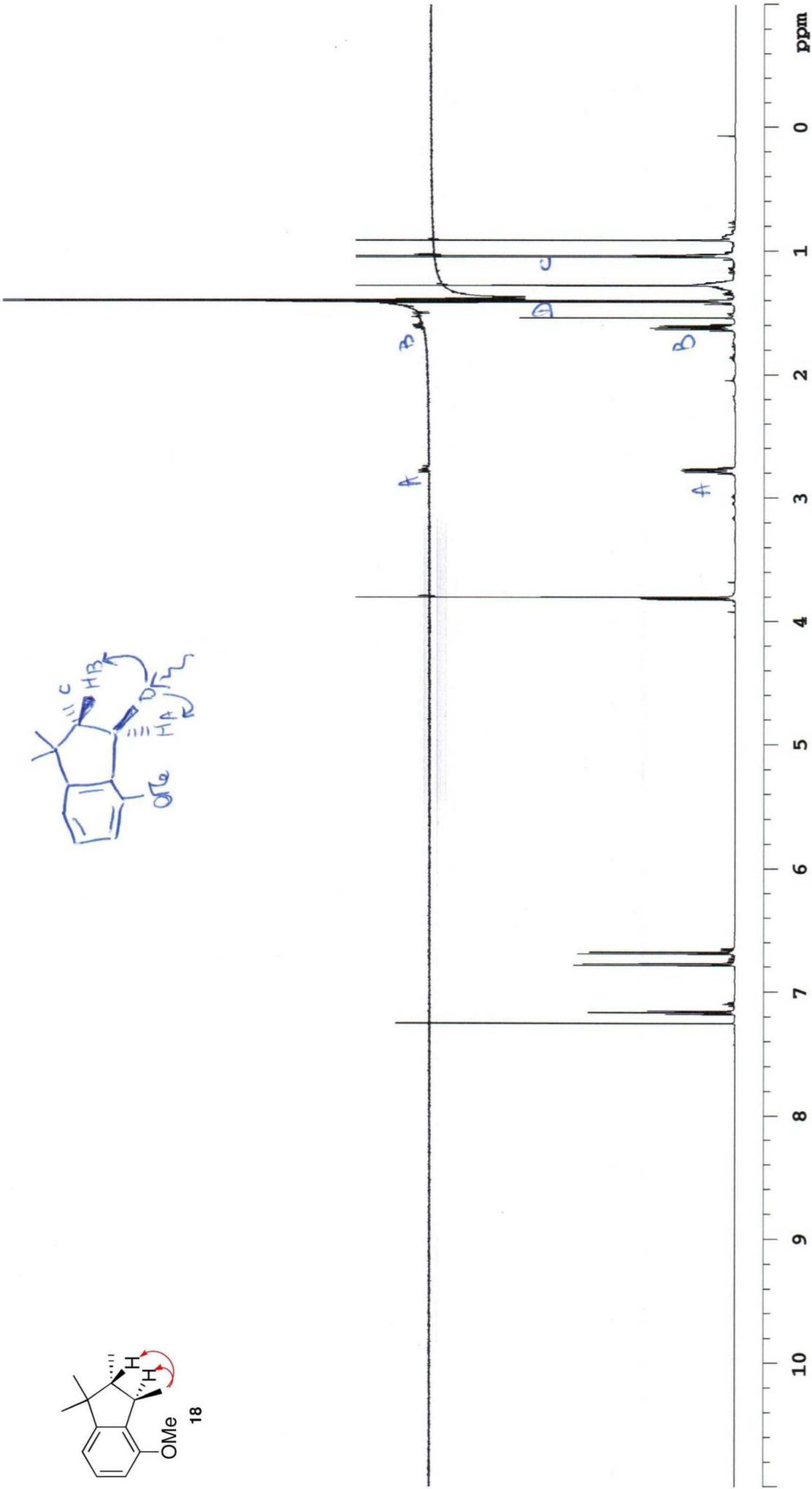
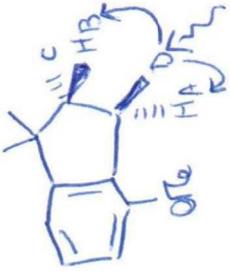
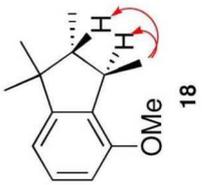




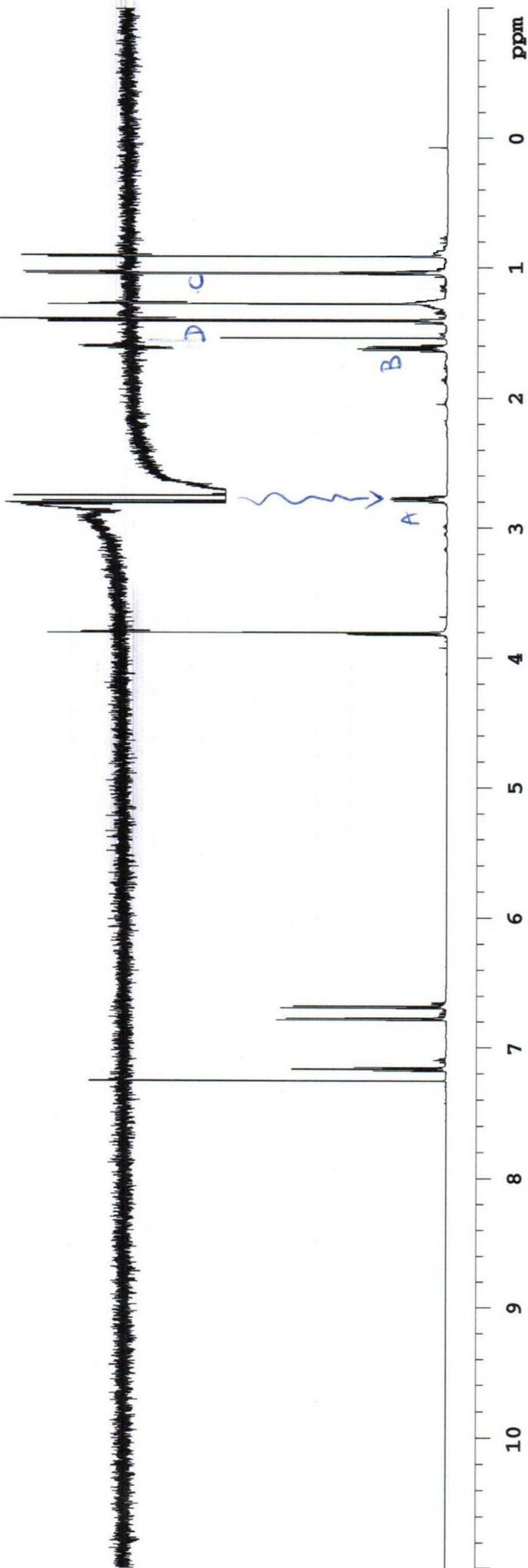
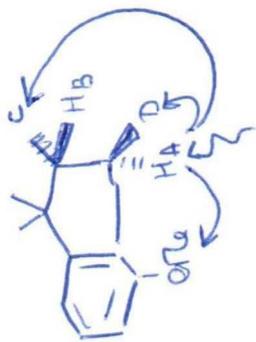
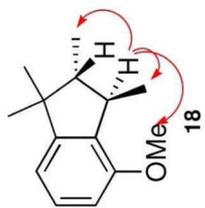
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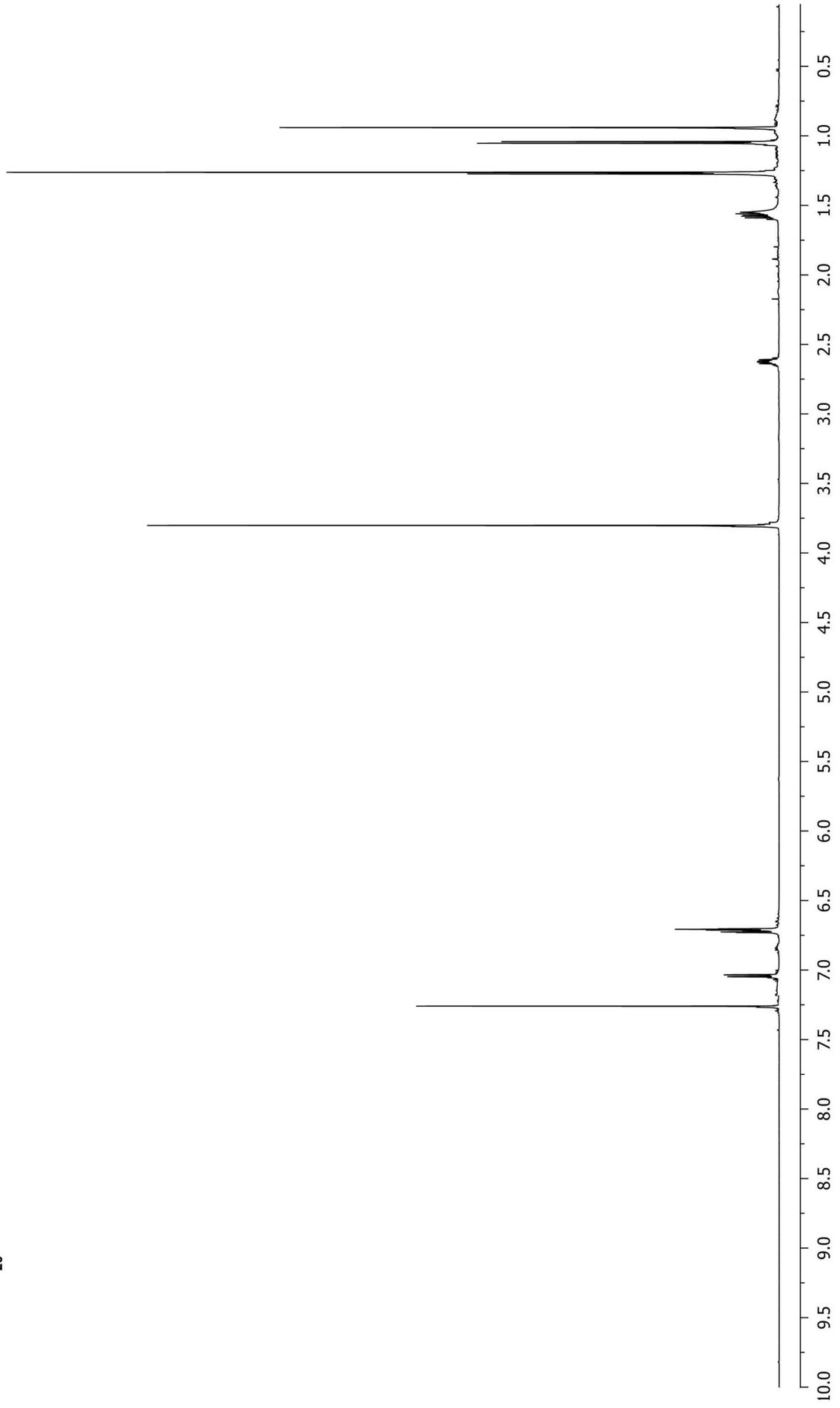
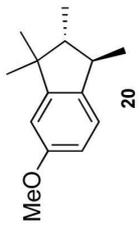


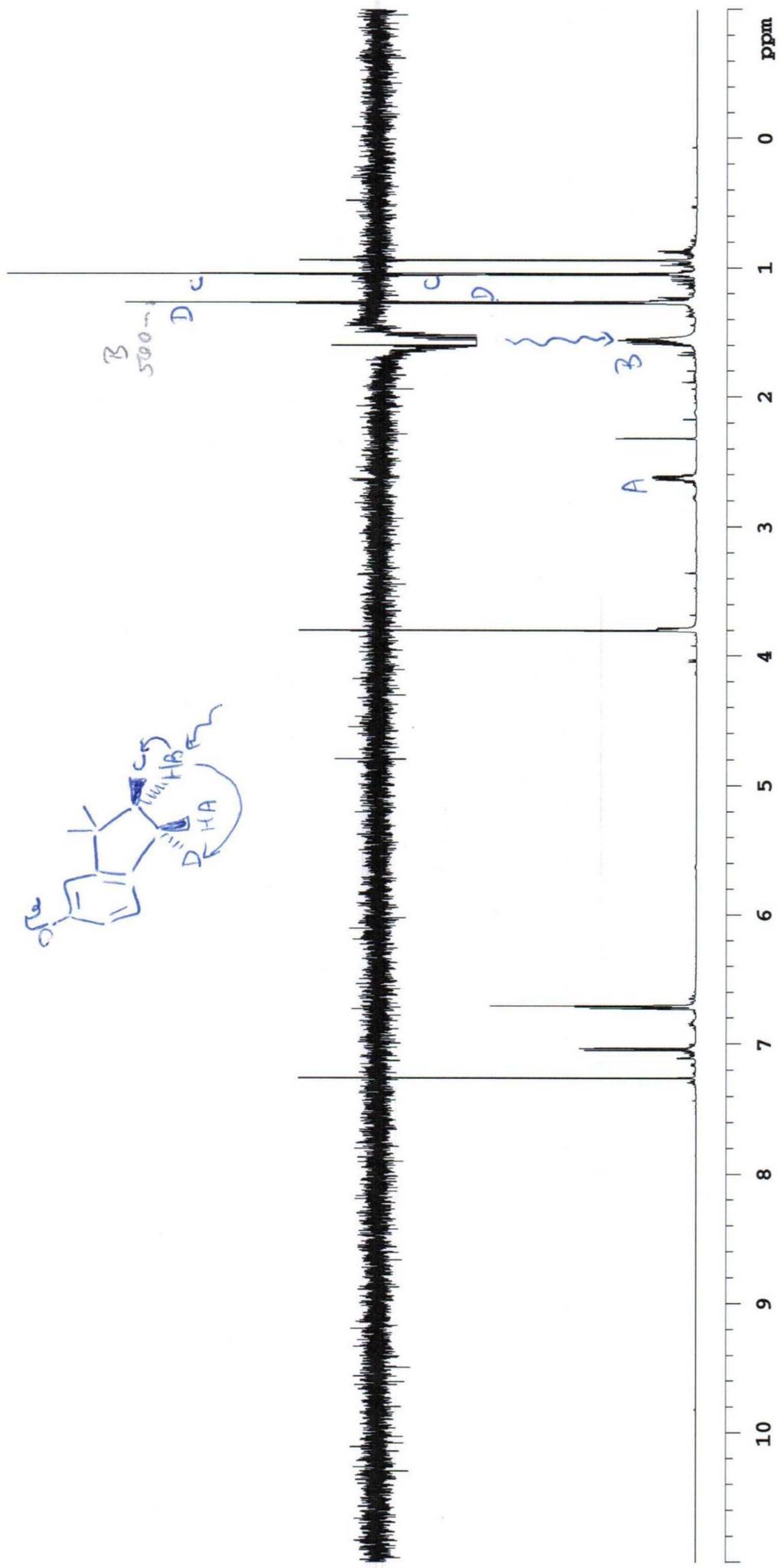
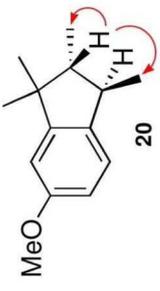


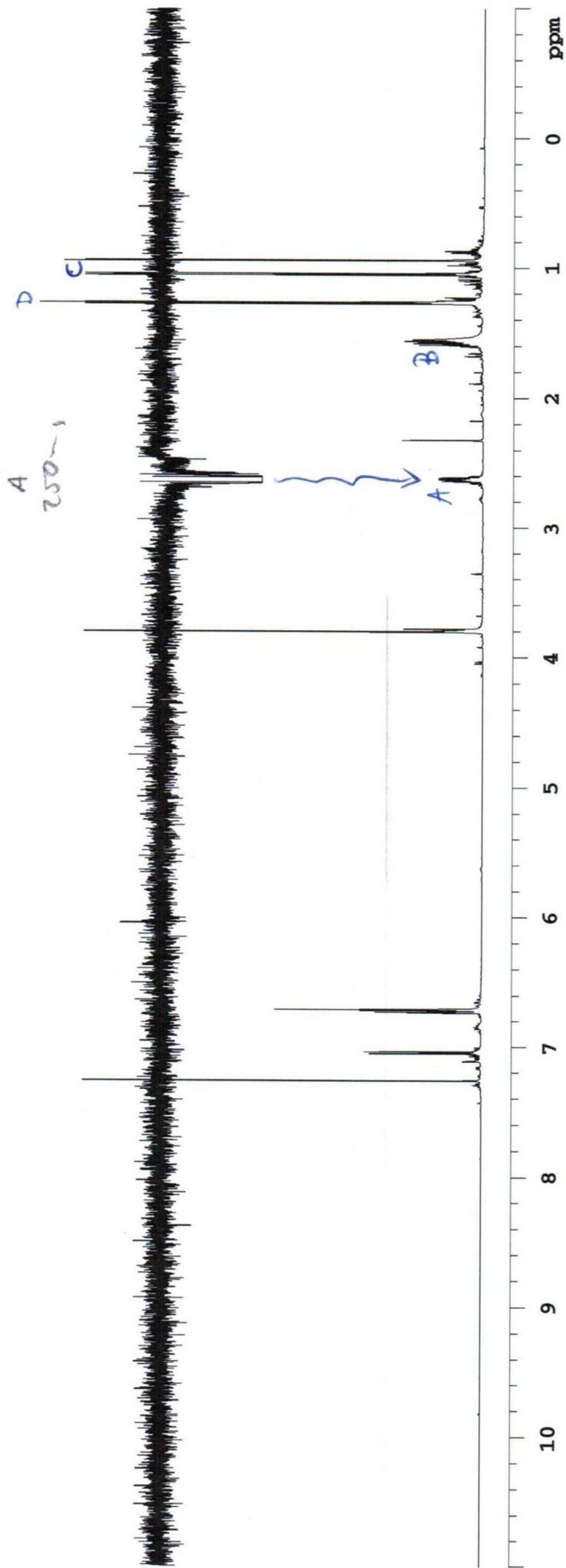
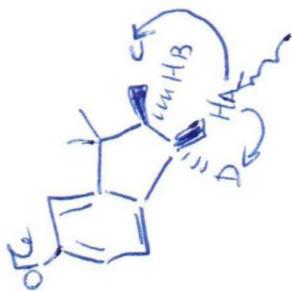
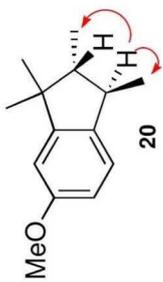


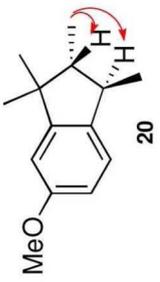
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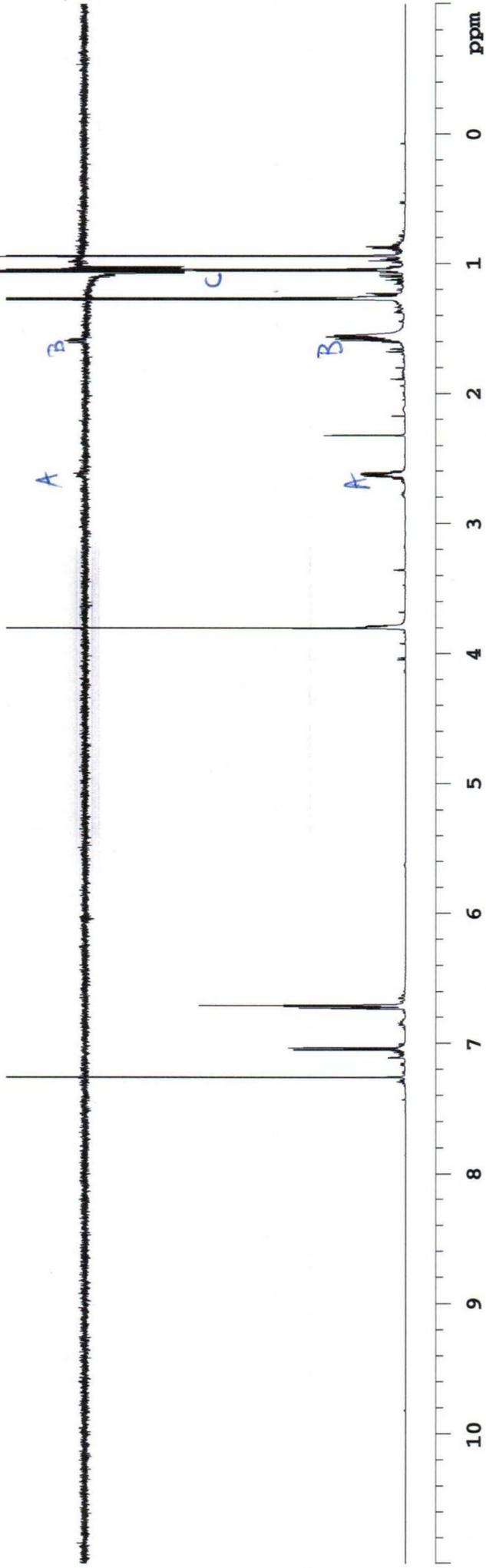


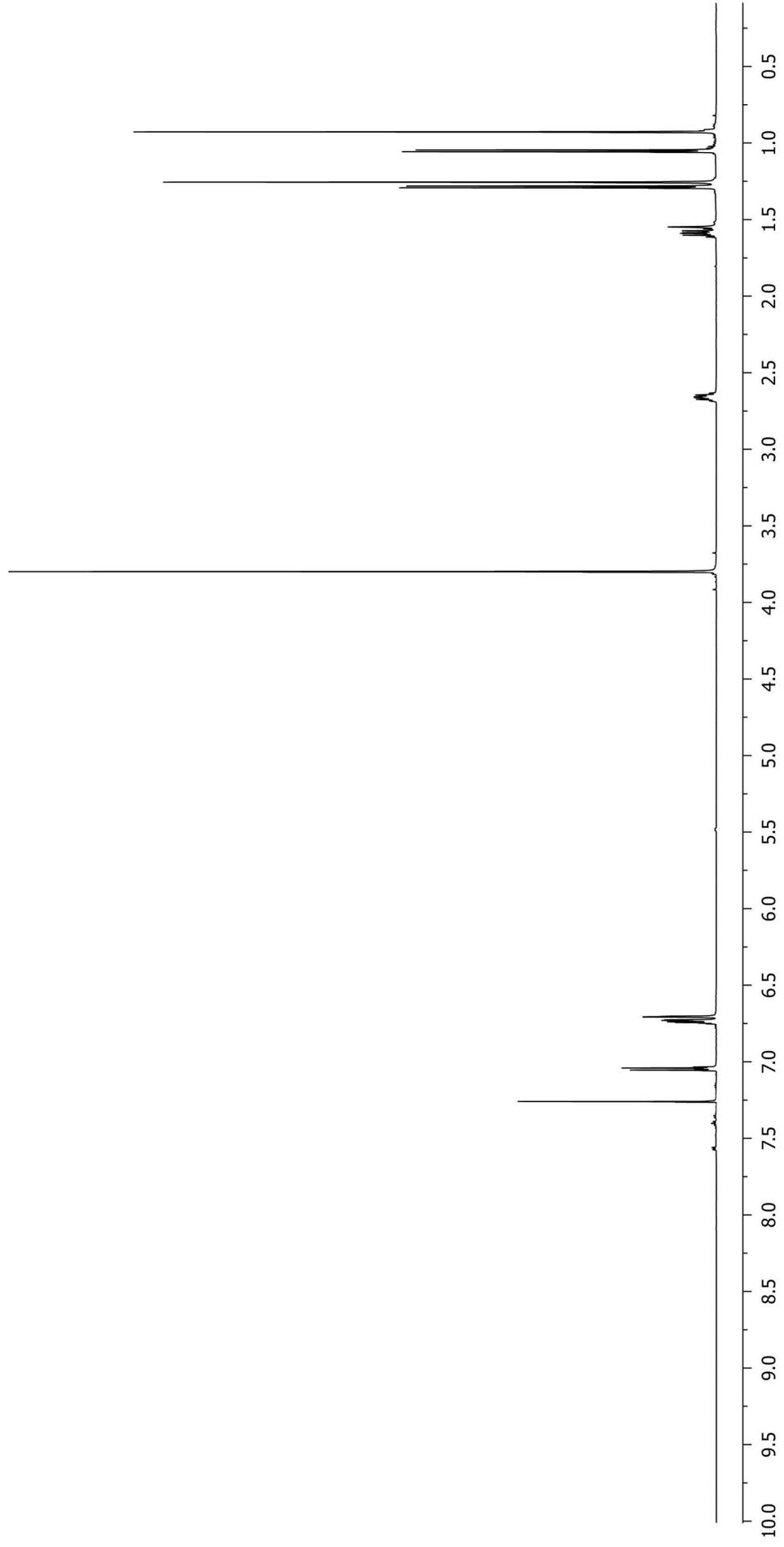
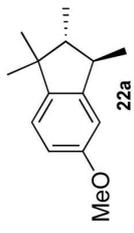


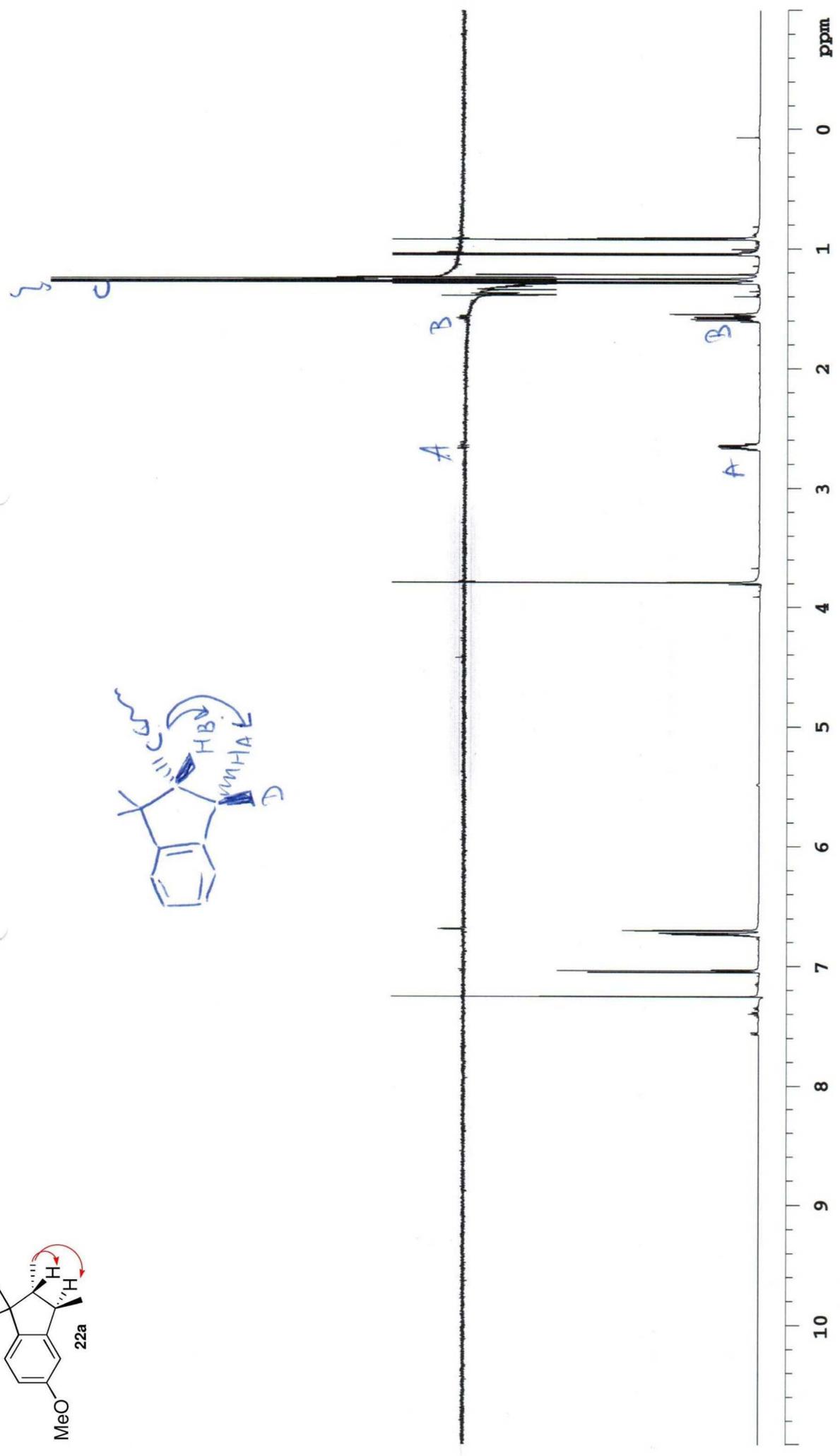
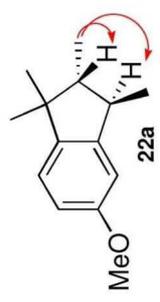


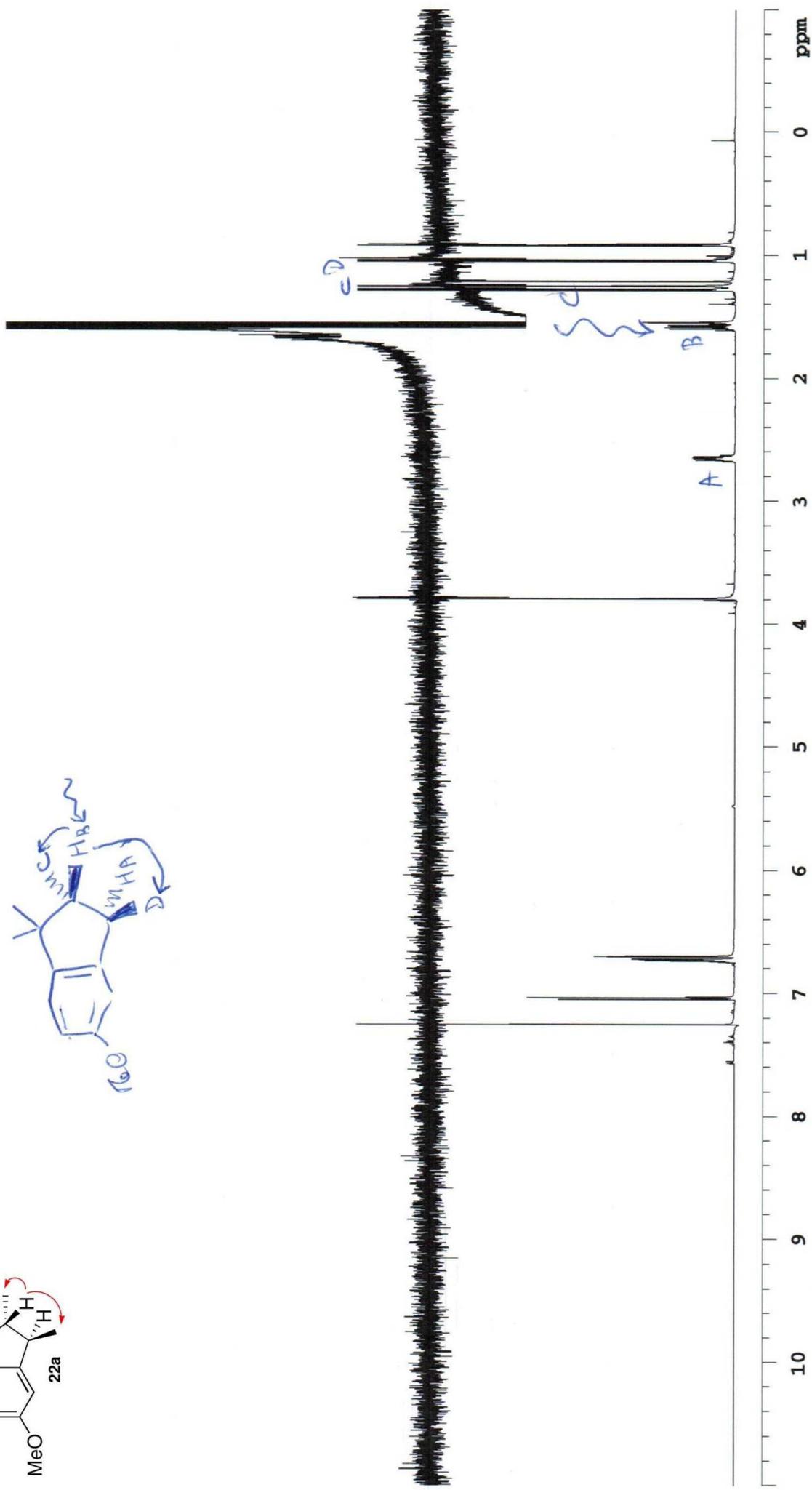
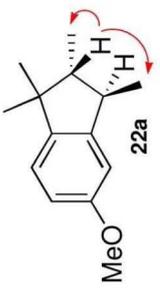


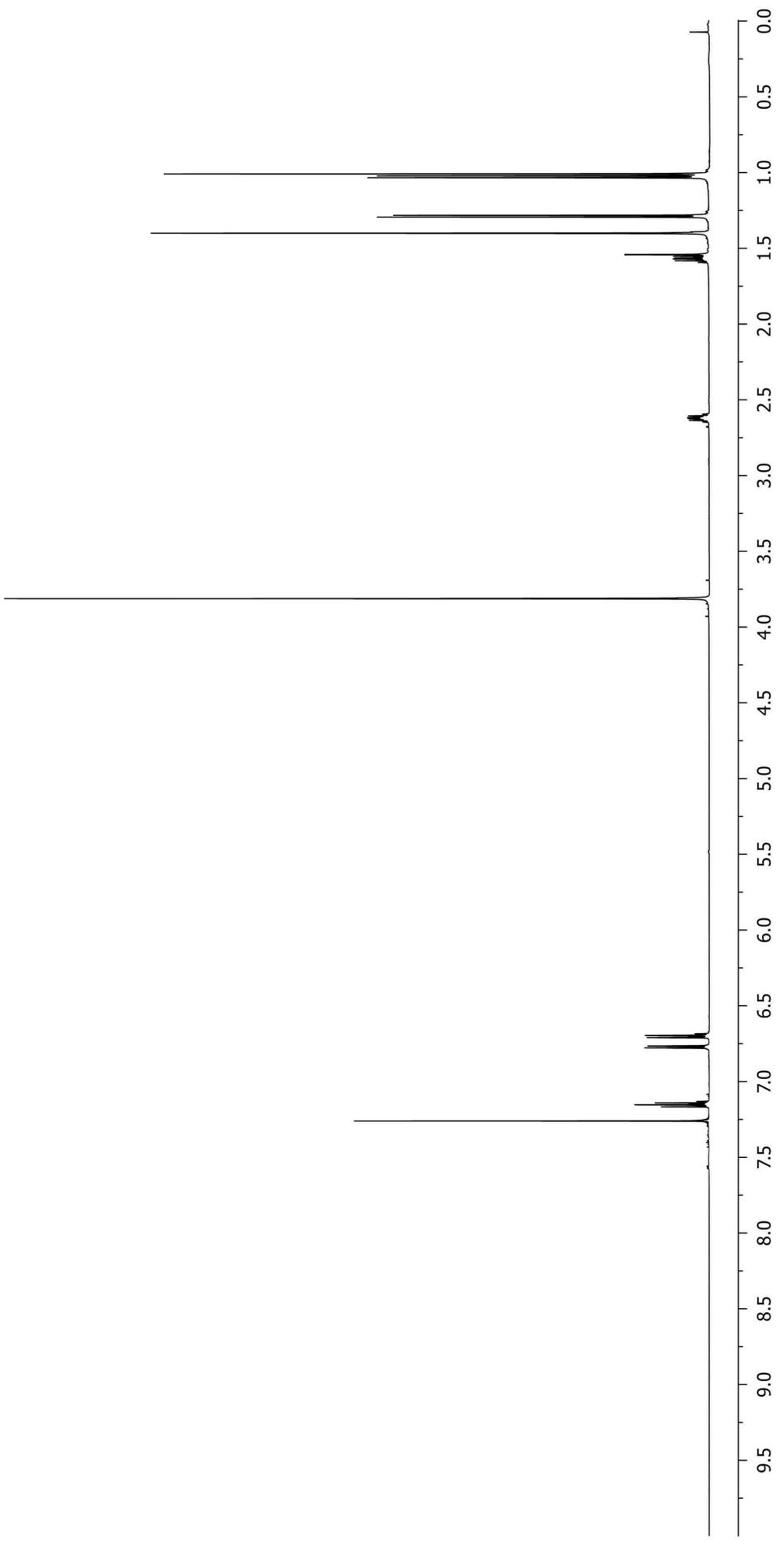
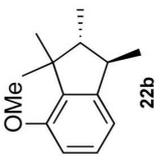
C
500-

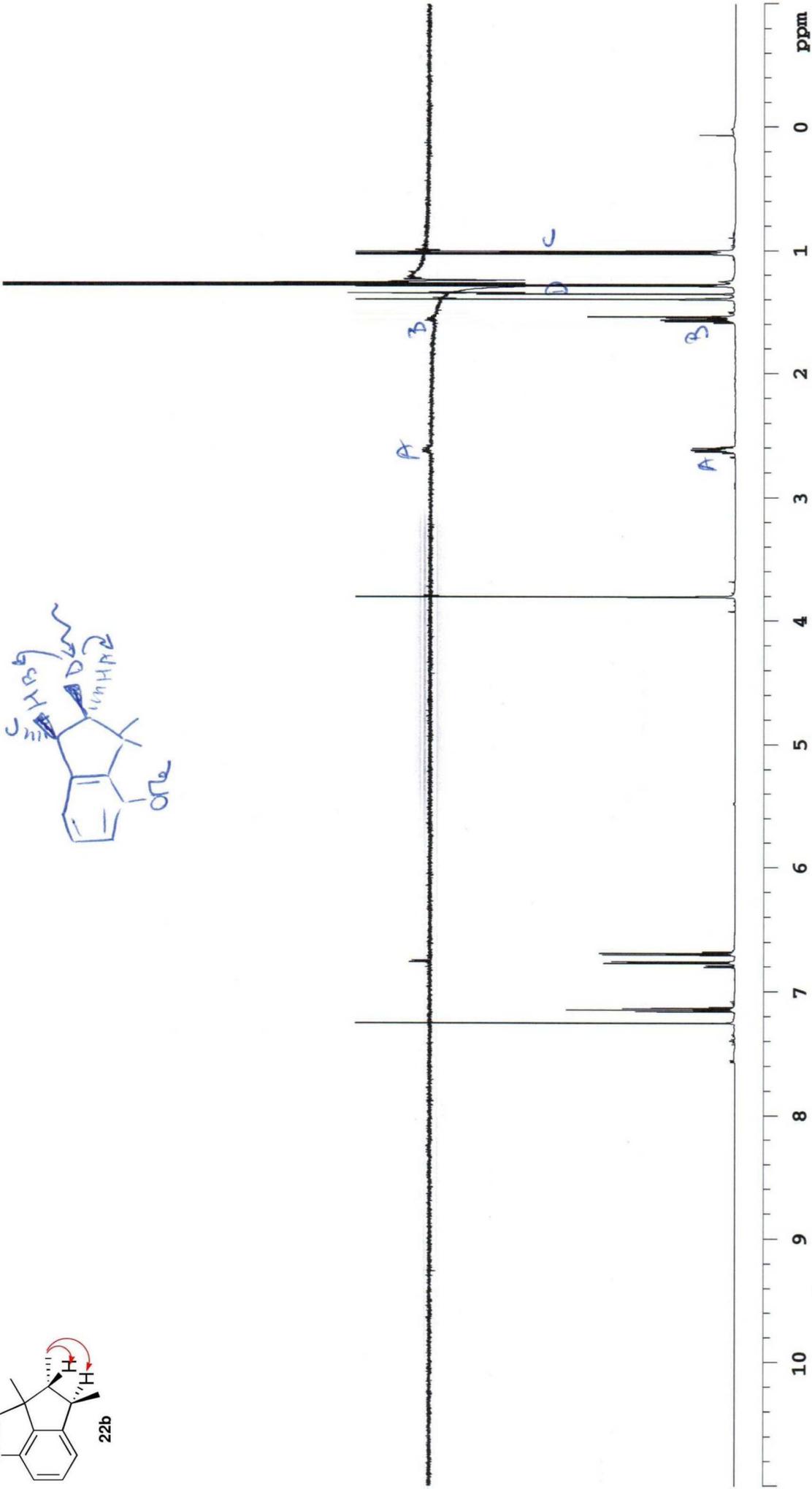
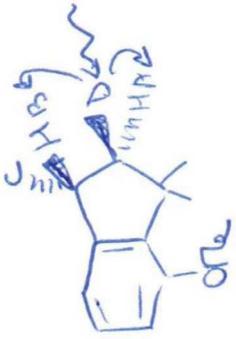
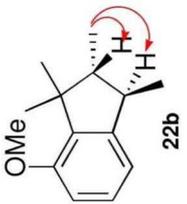


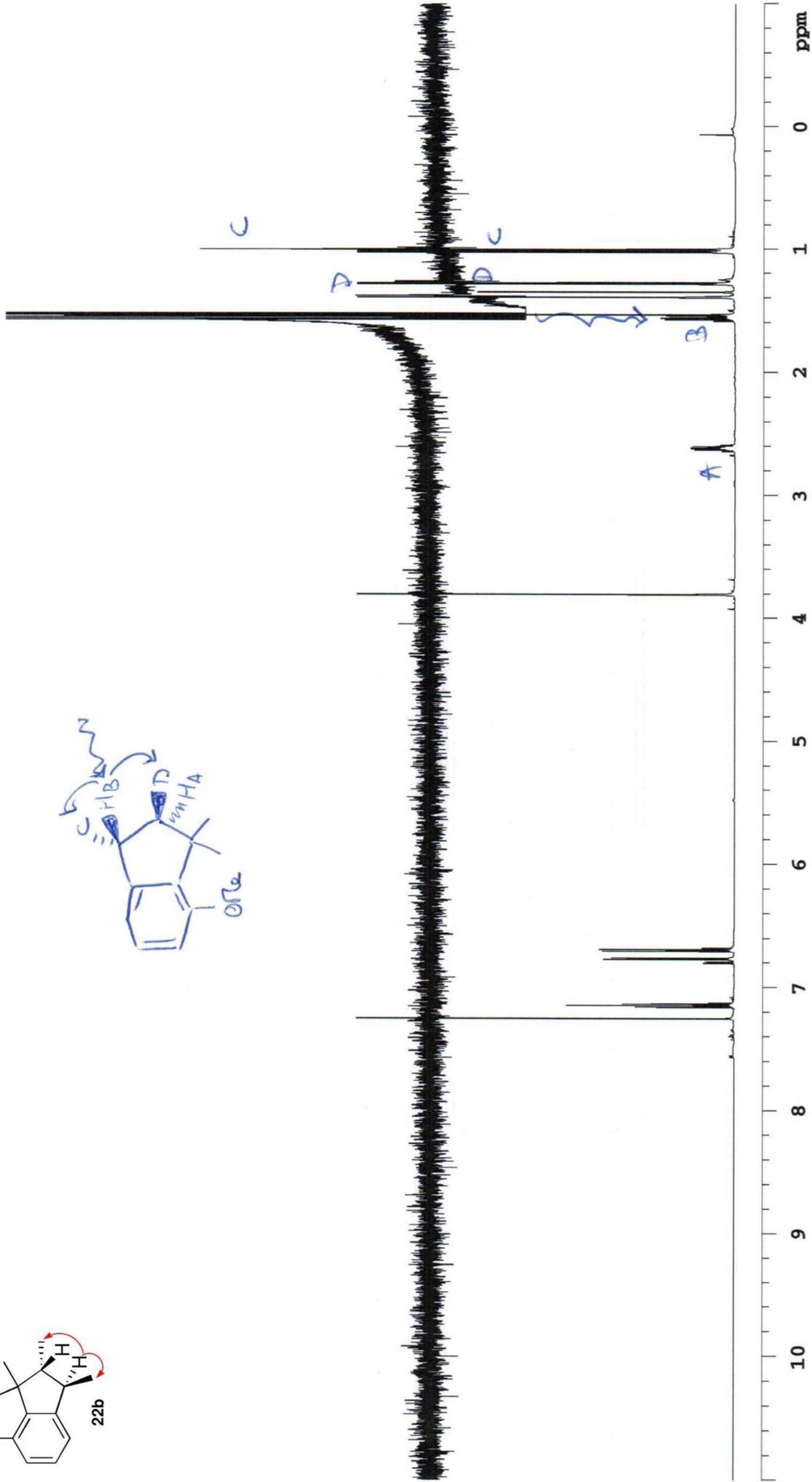
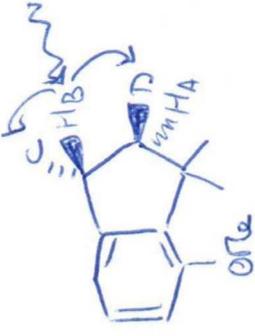
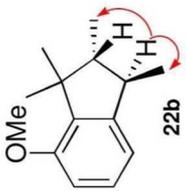


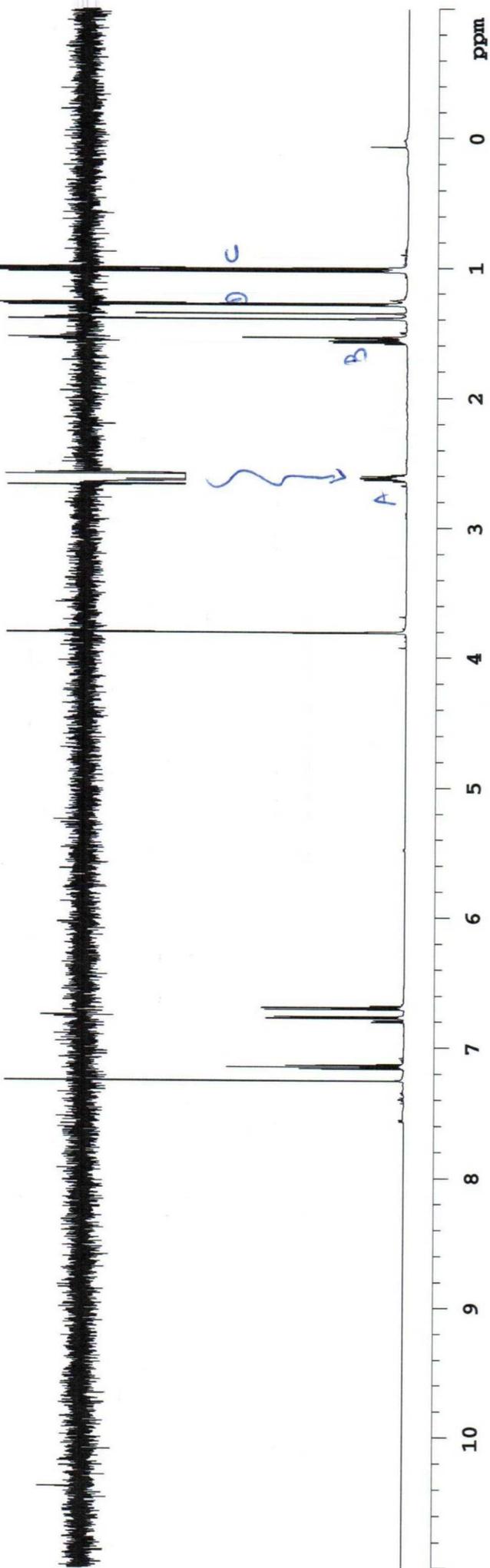
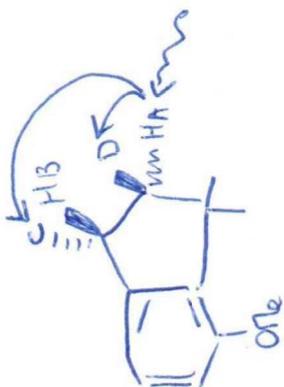
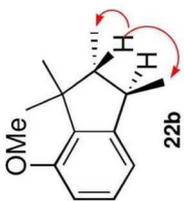


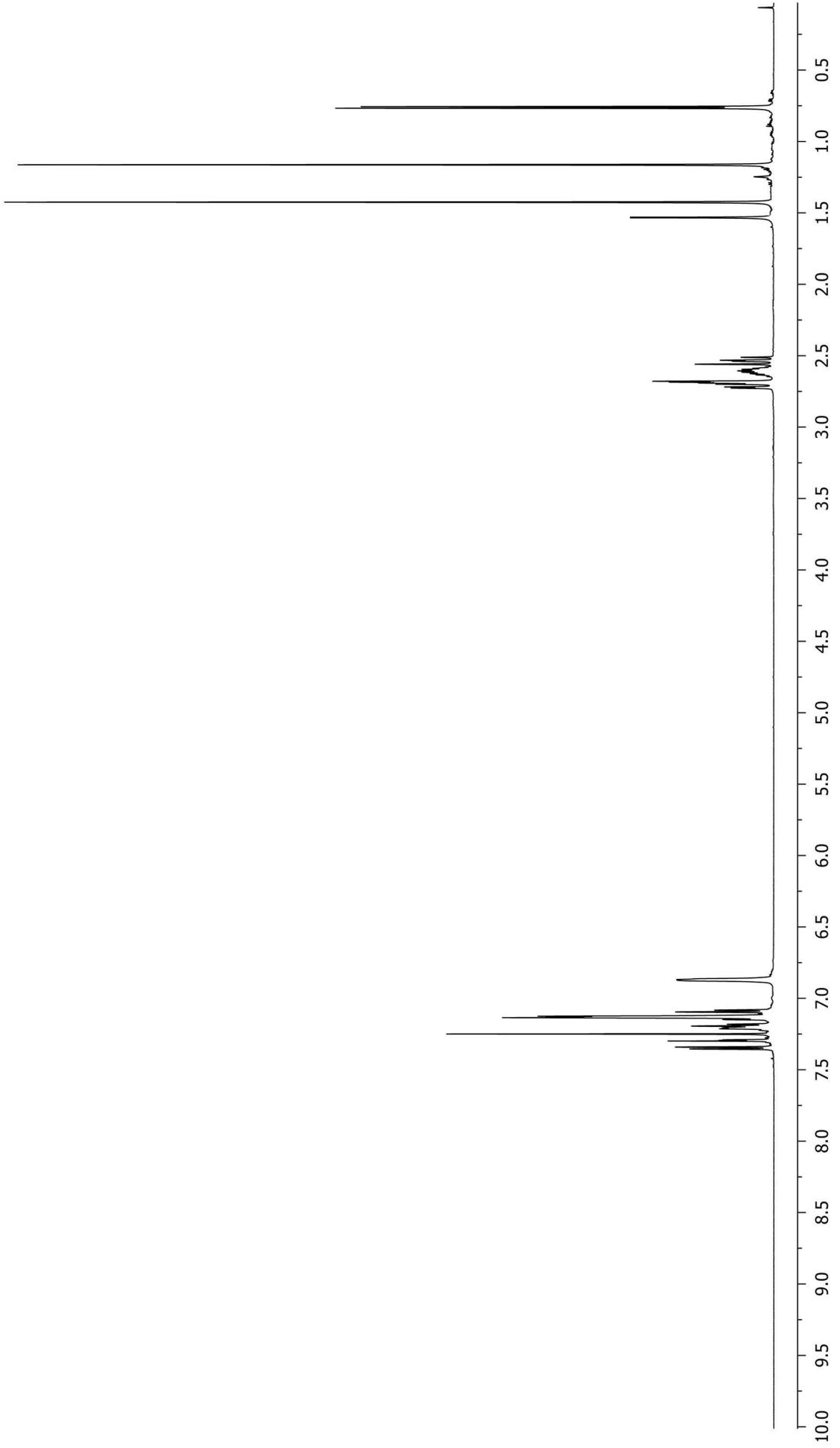
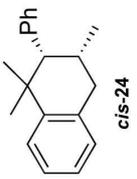


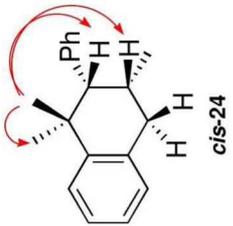




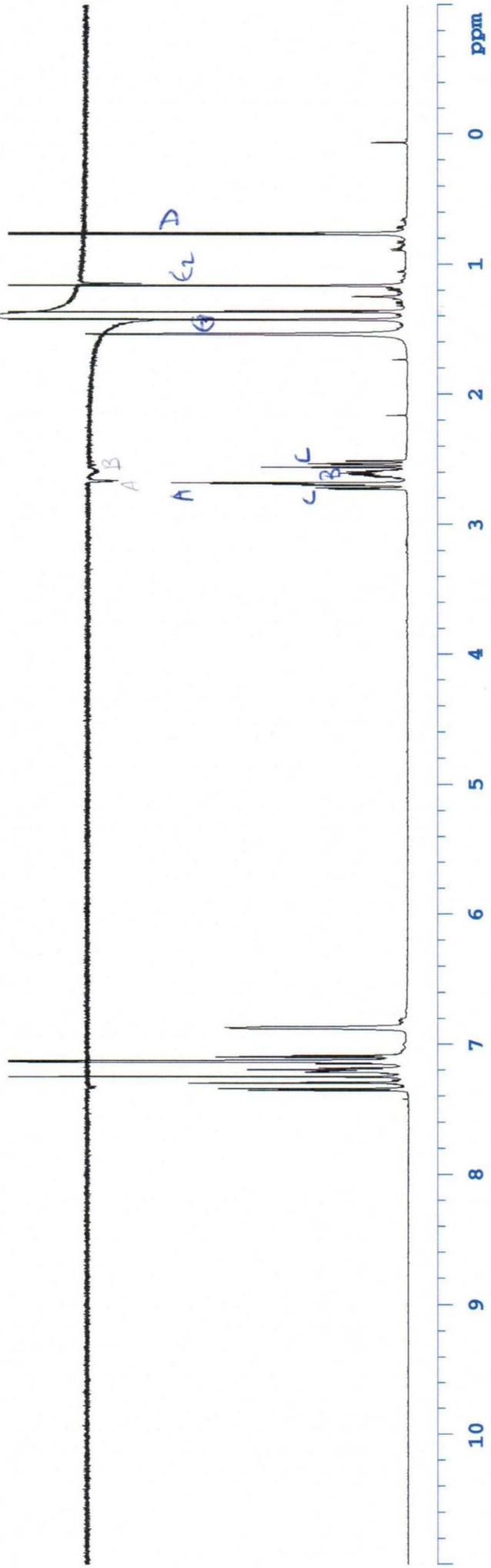


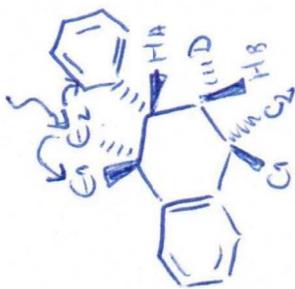
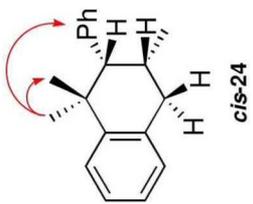






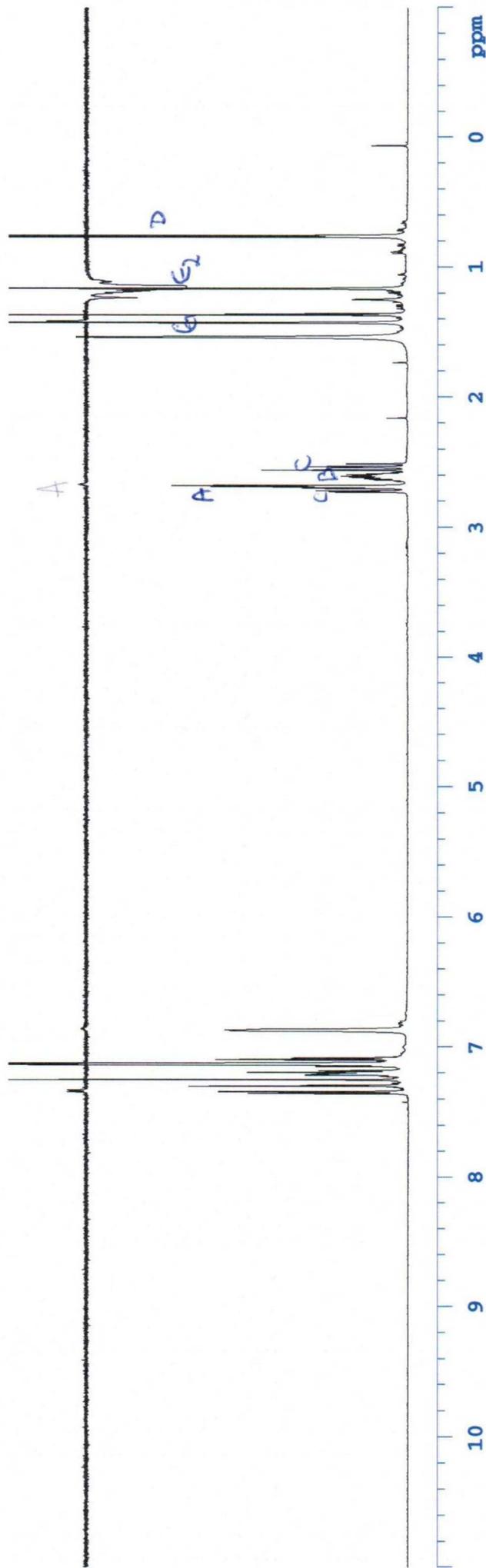
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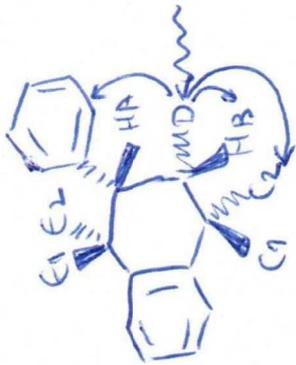
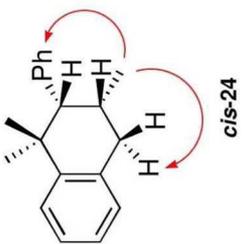




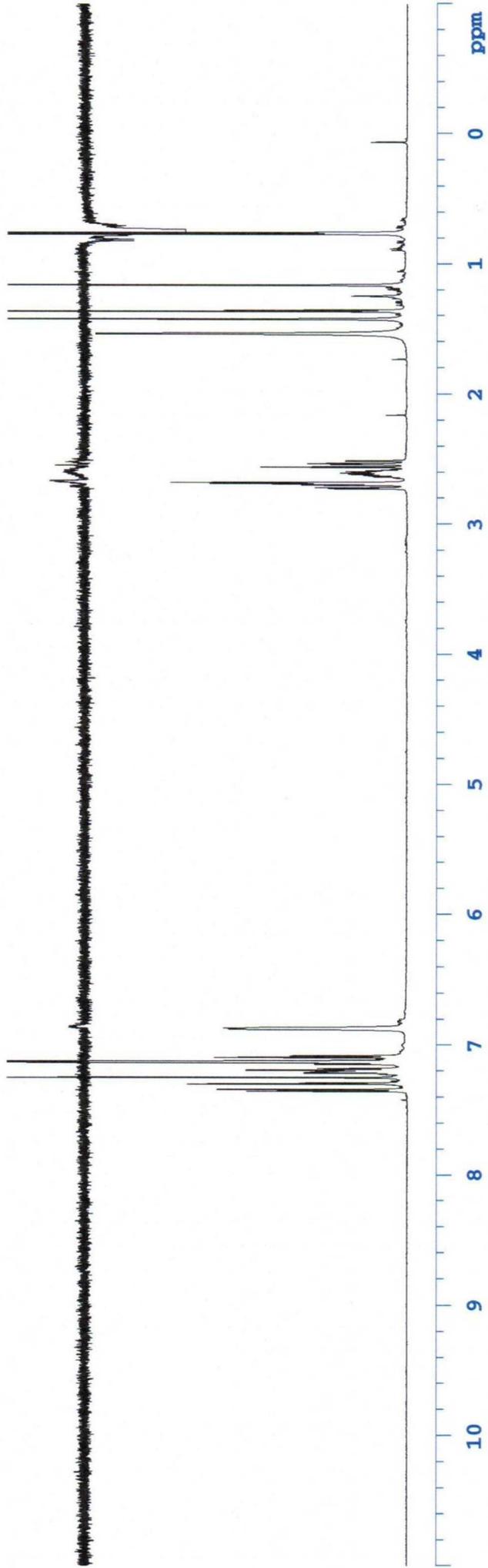
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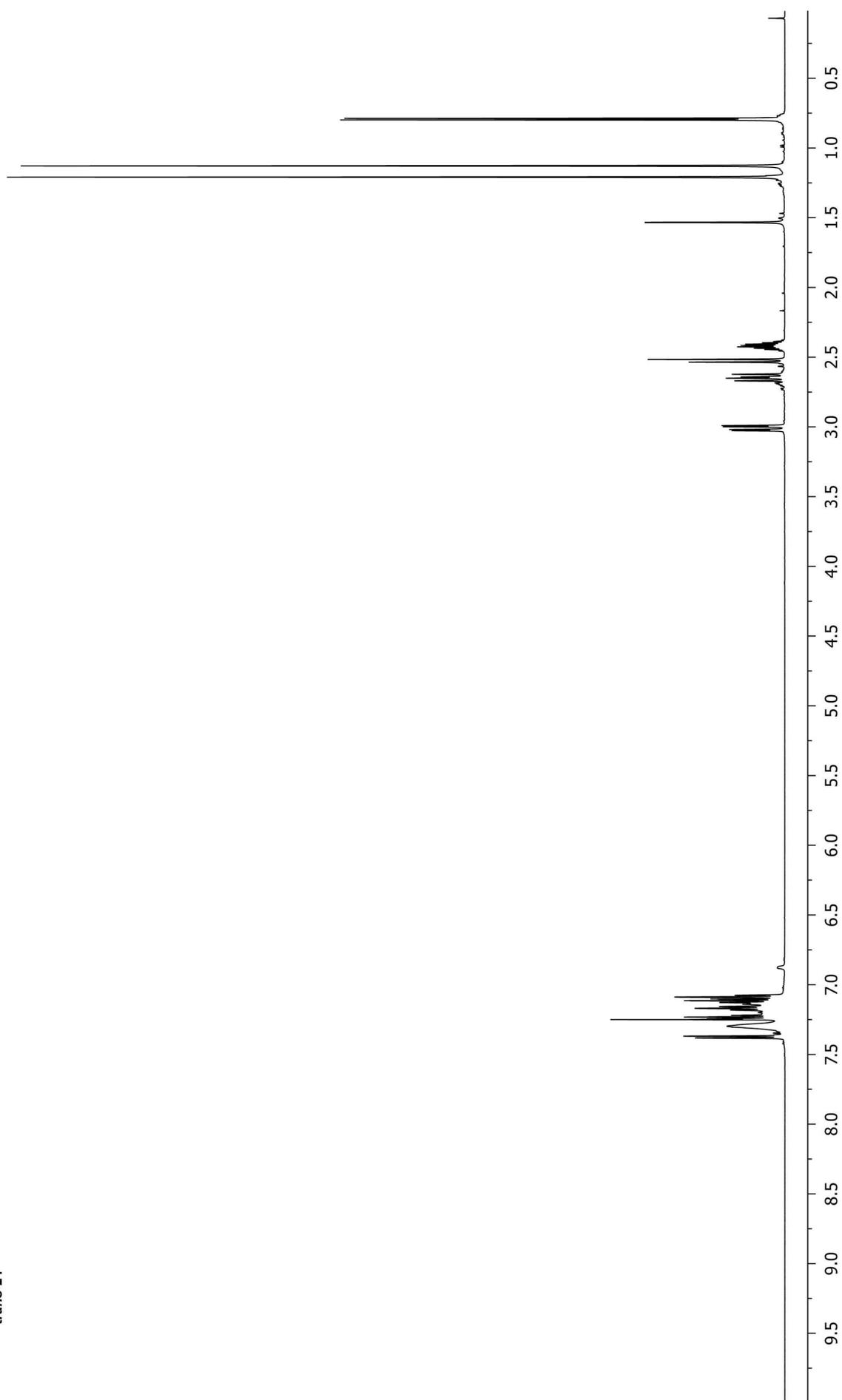
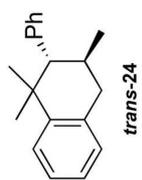
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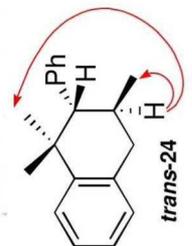




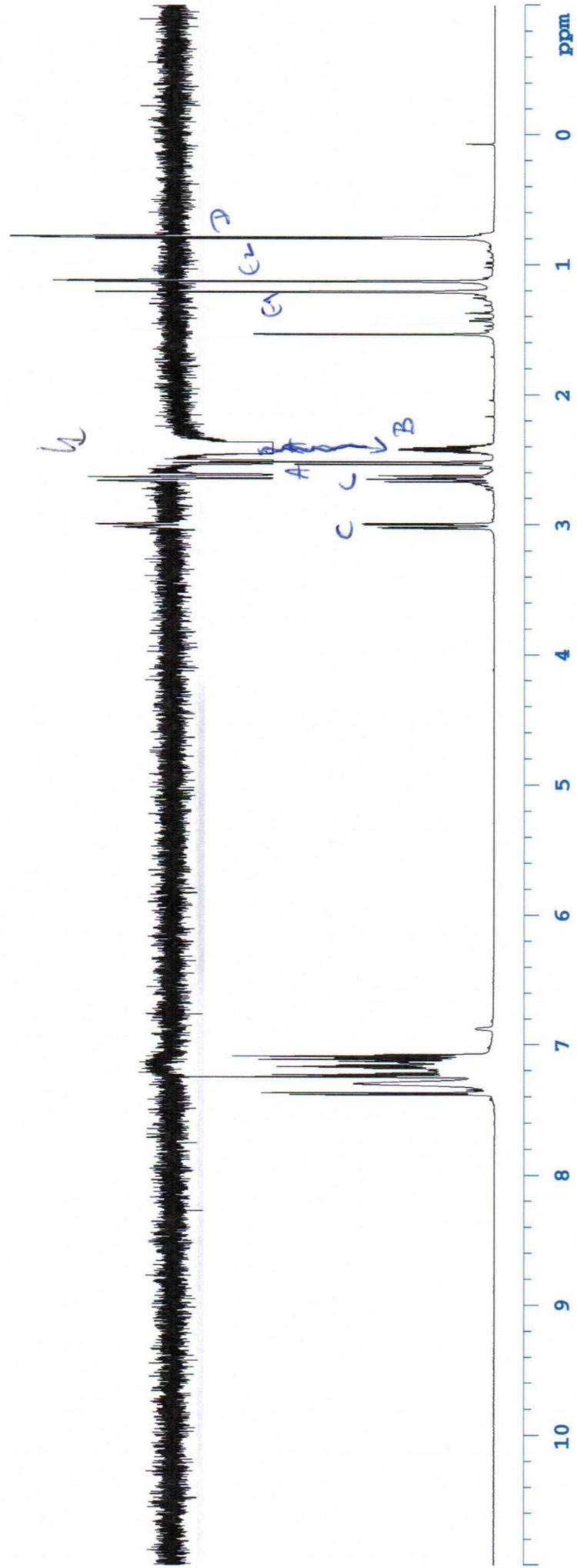
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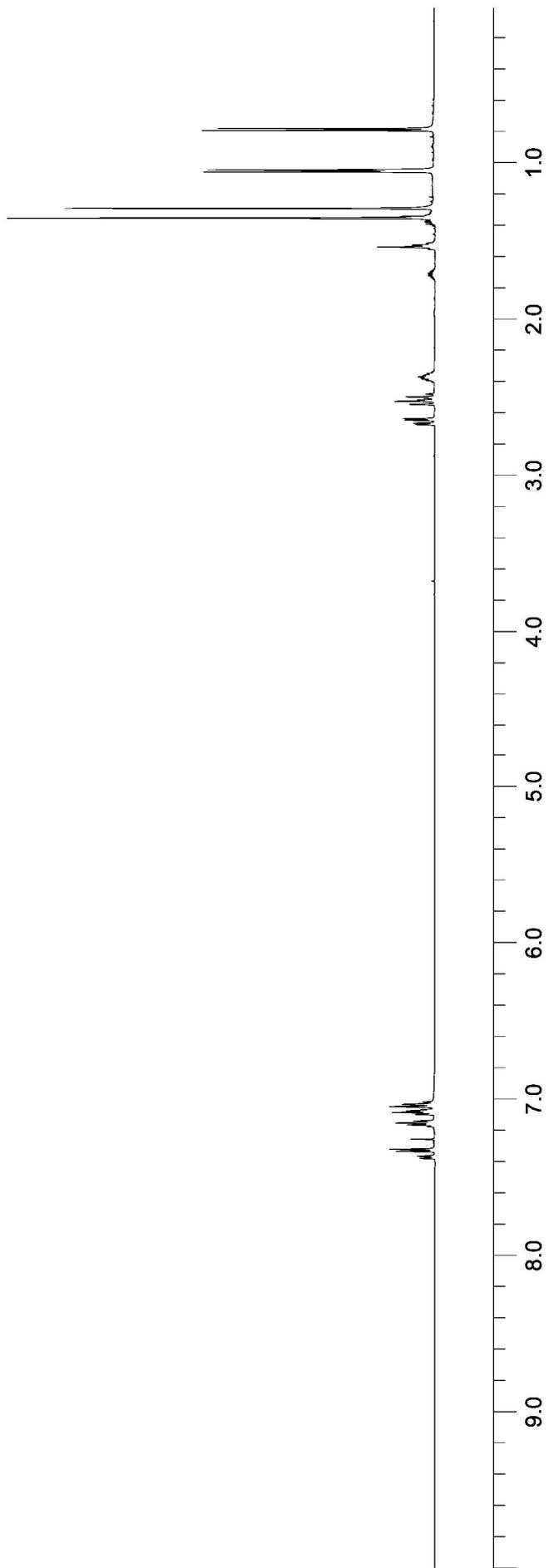


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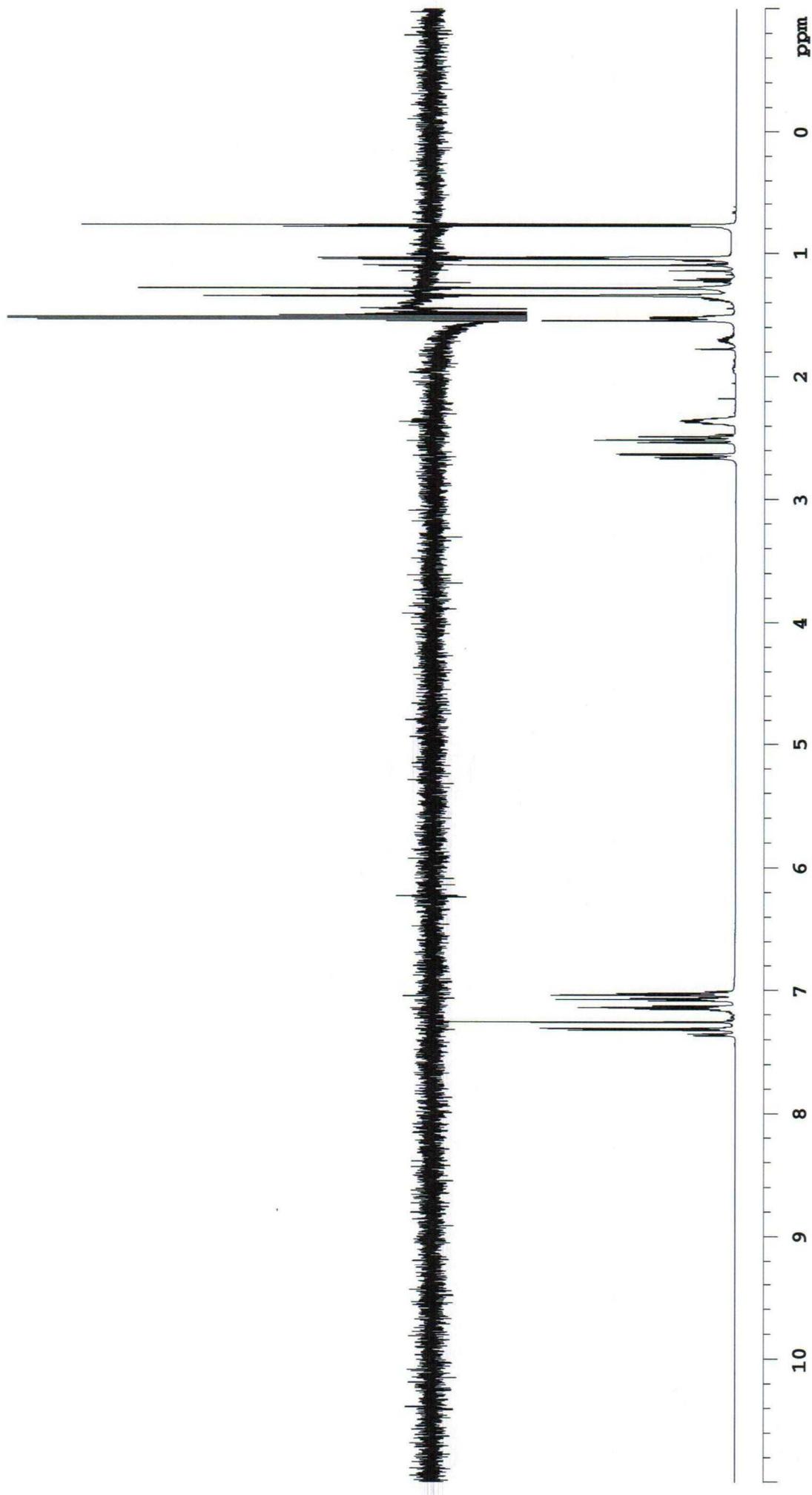
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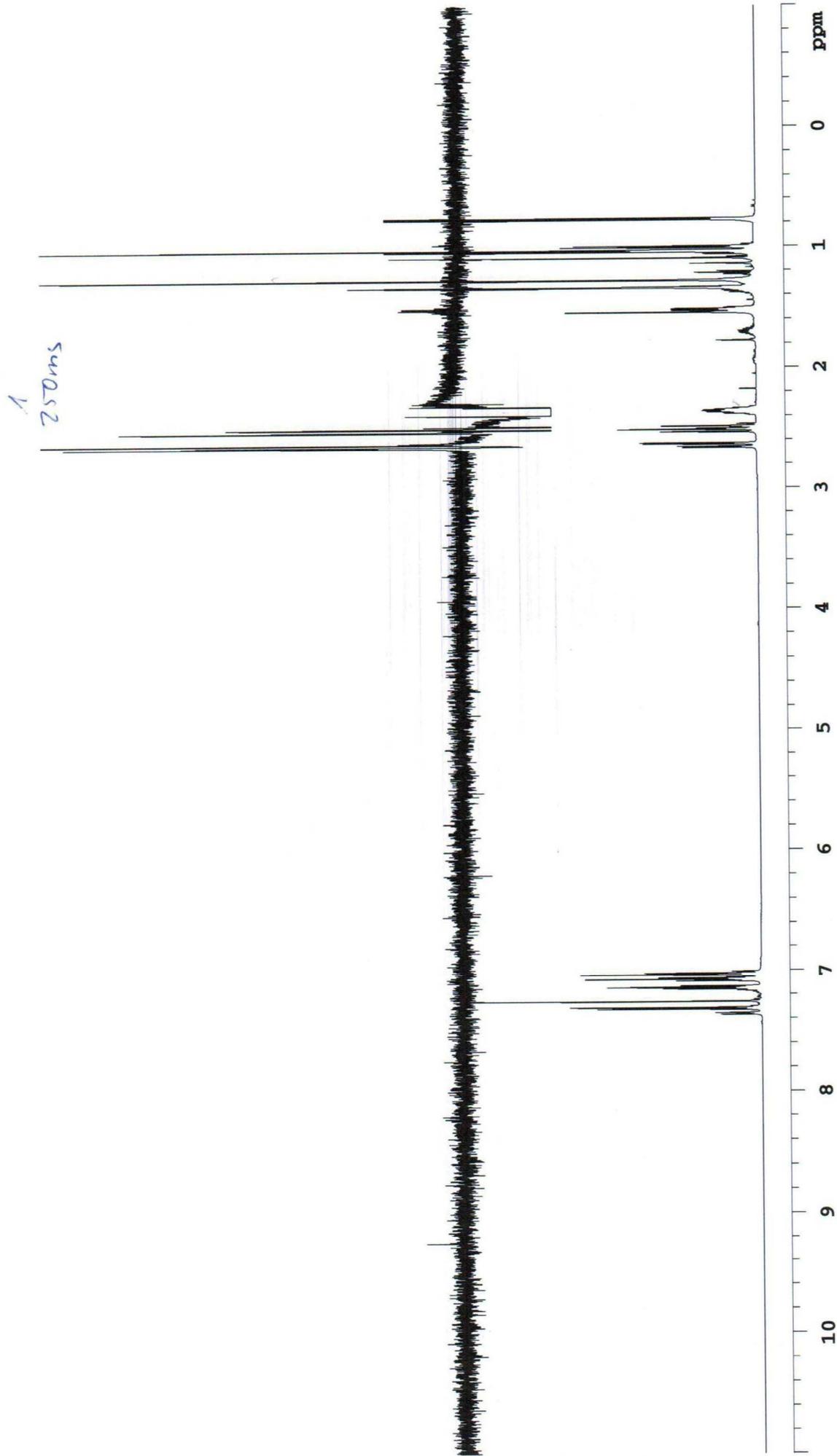
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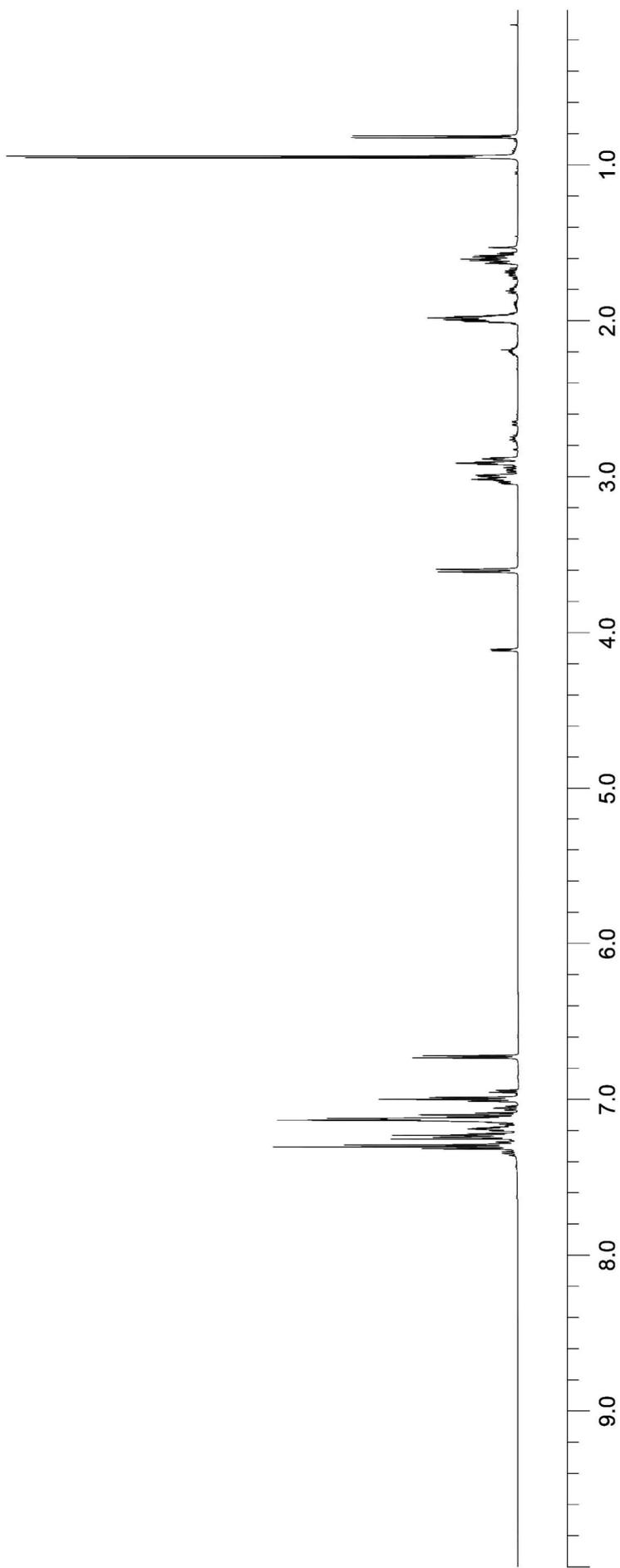
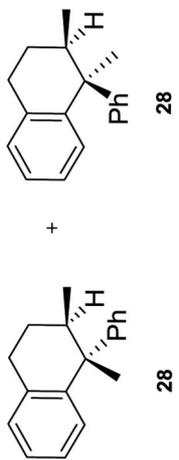
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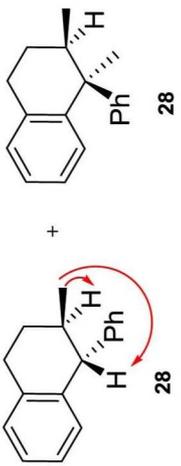




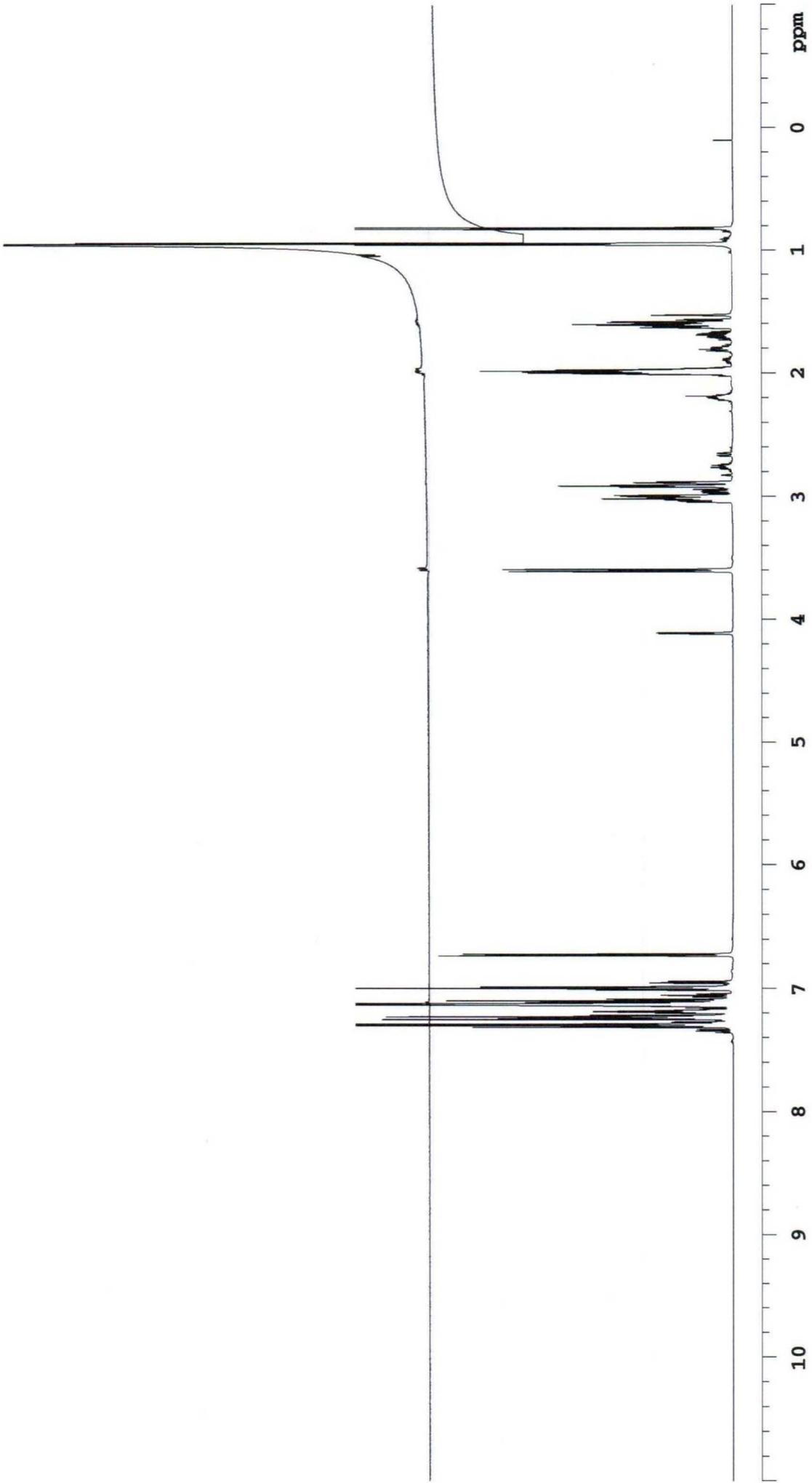
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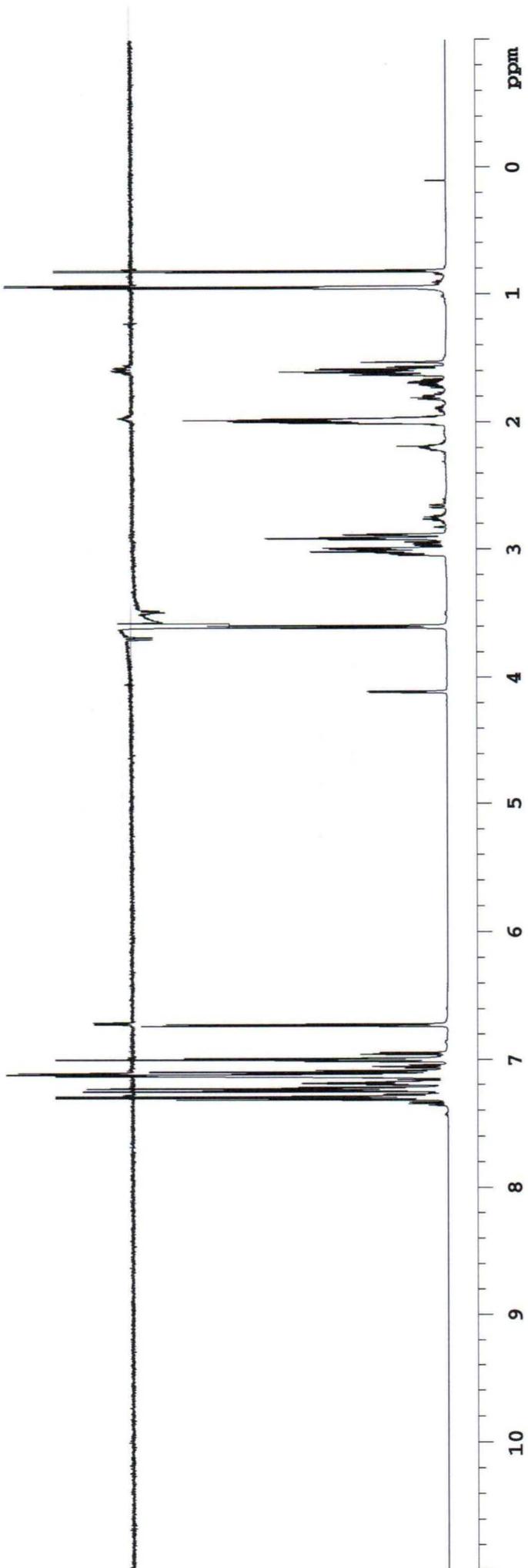
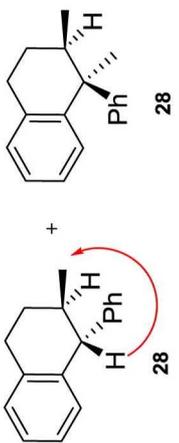


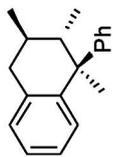




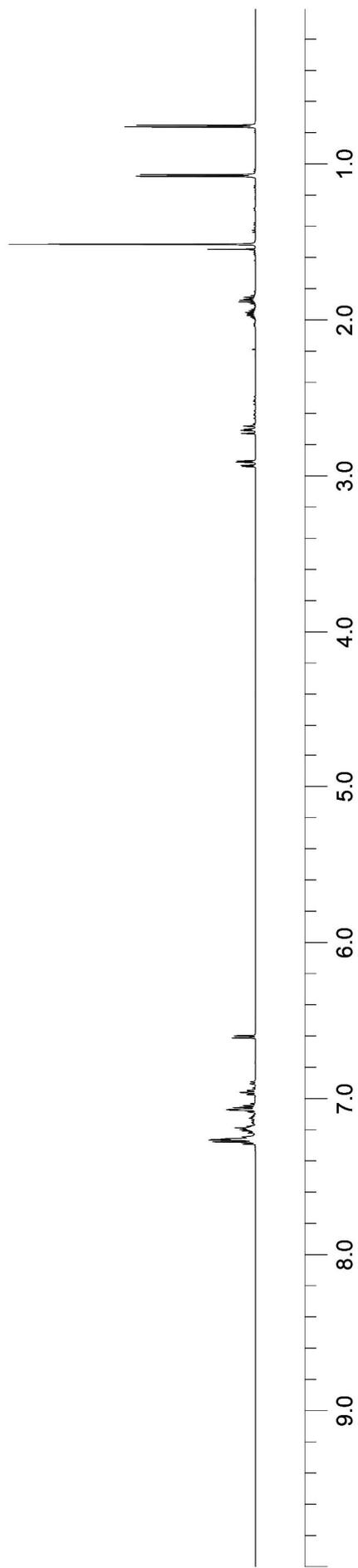
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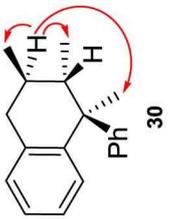




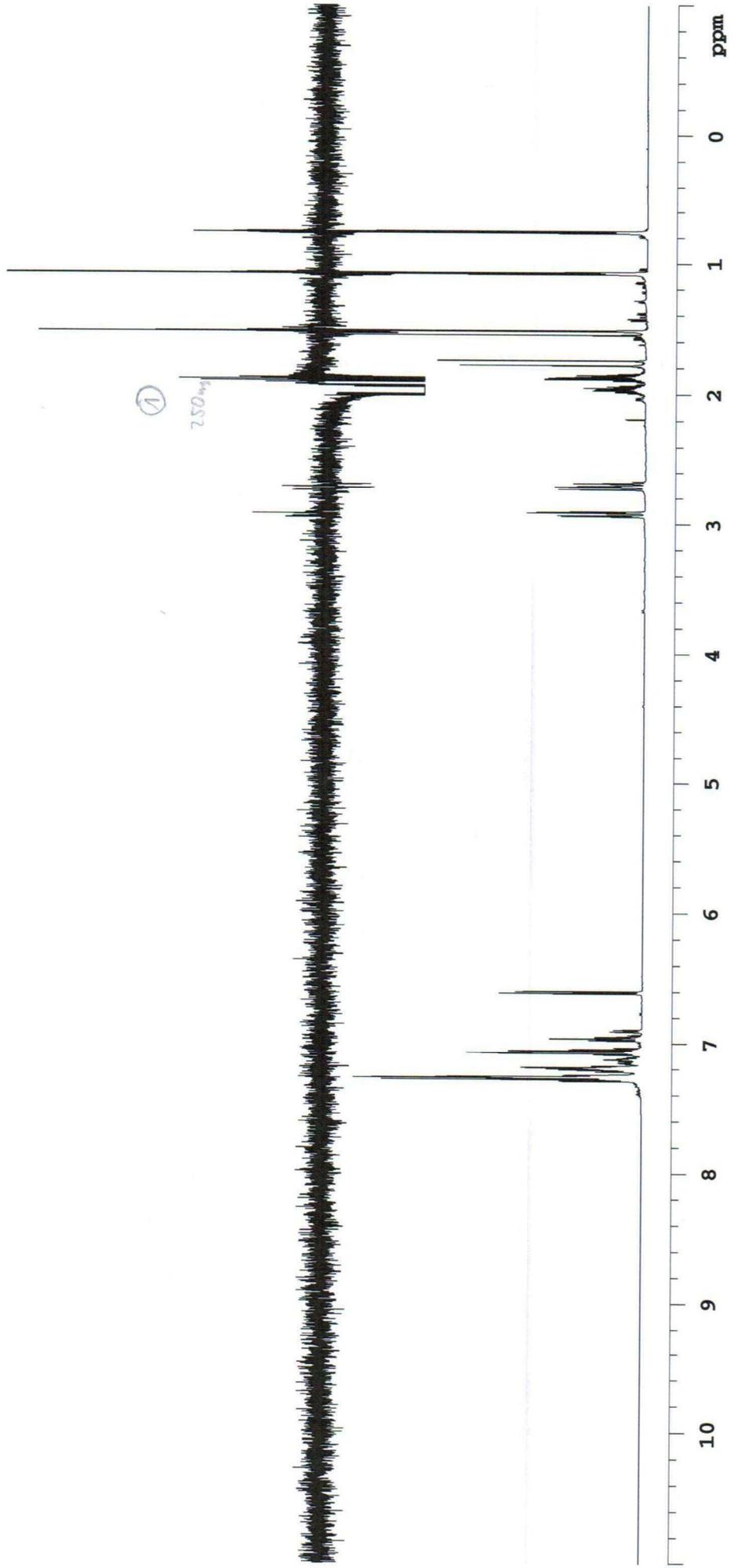


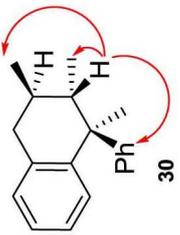
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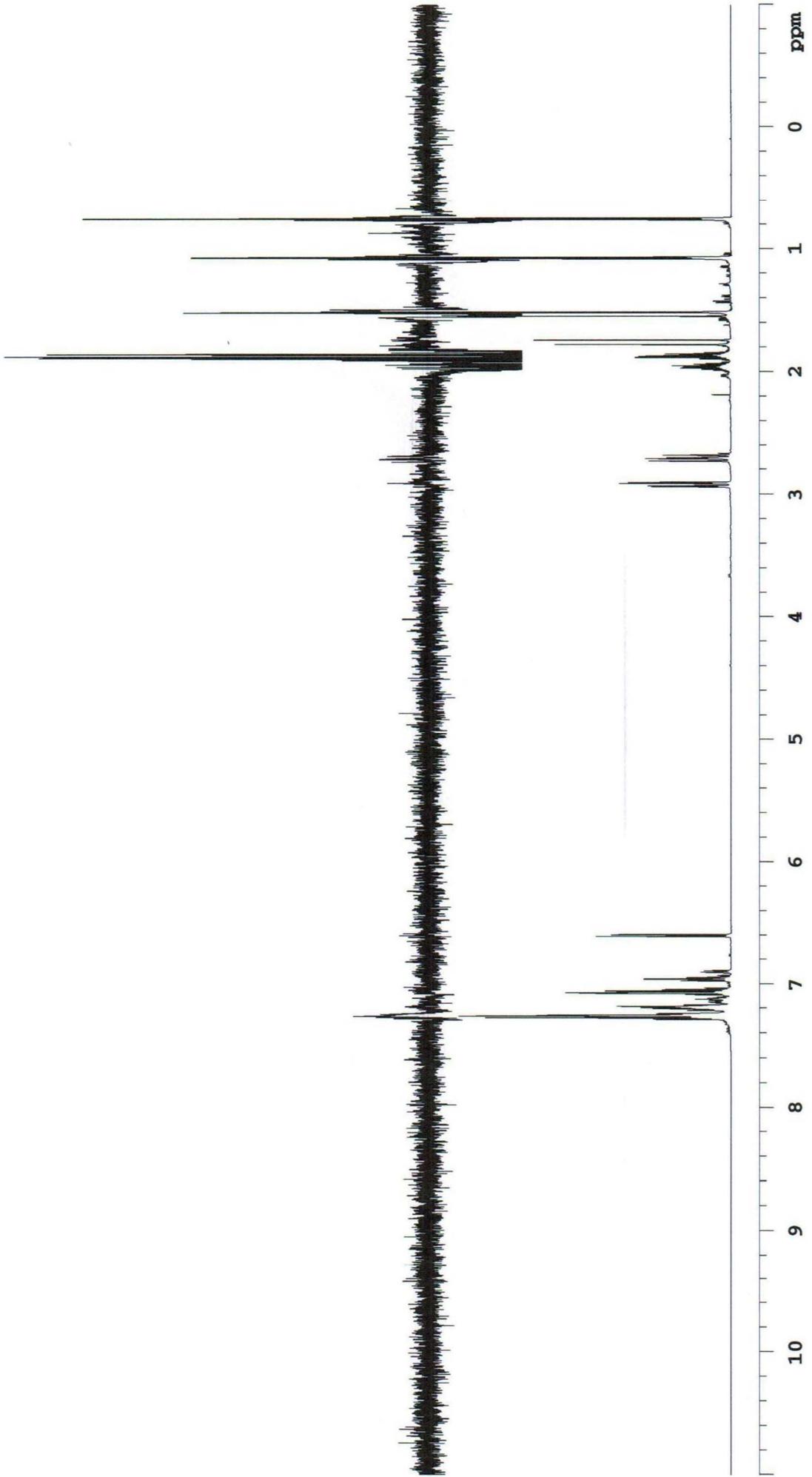


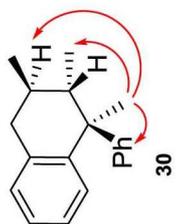
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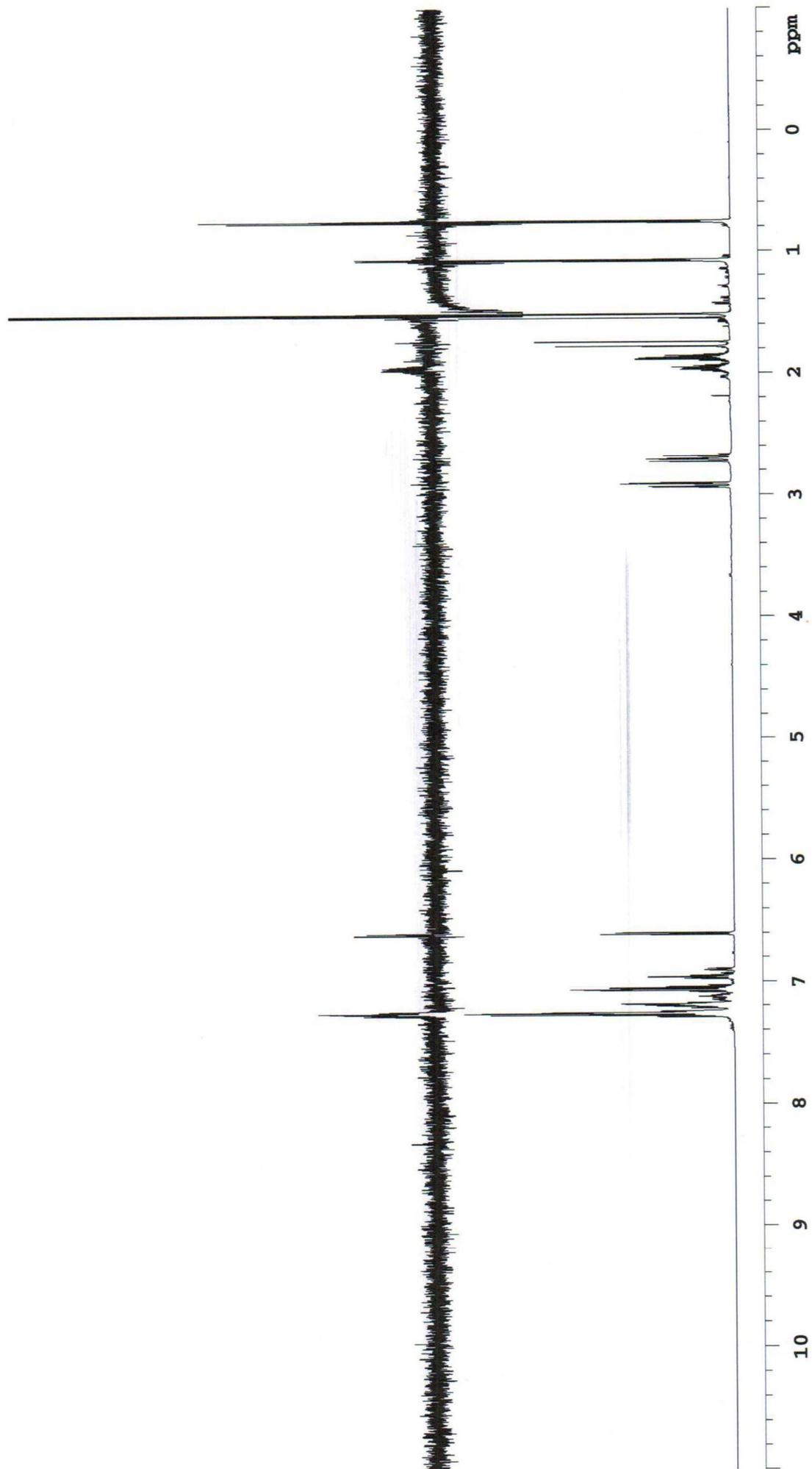


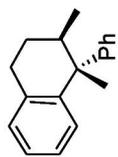
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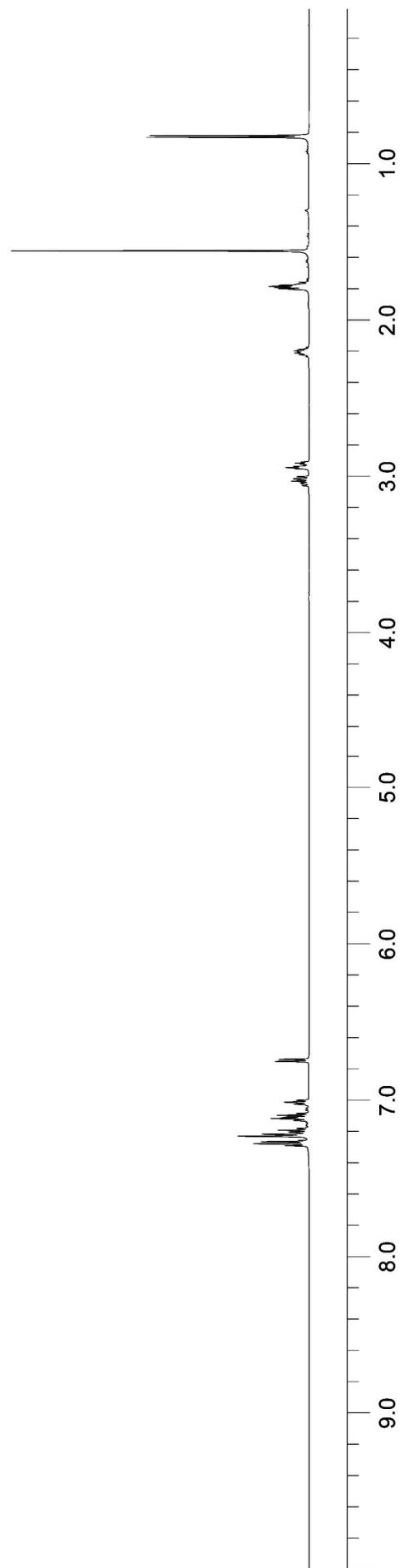


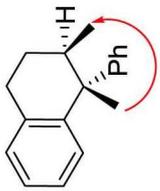
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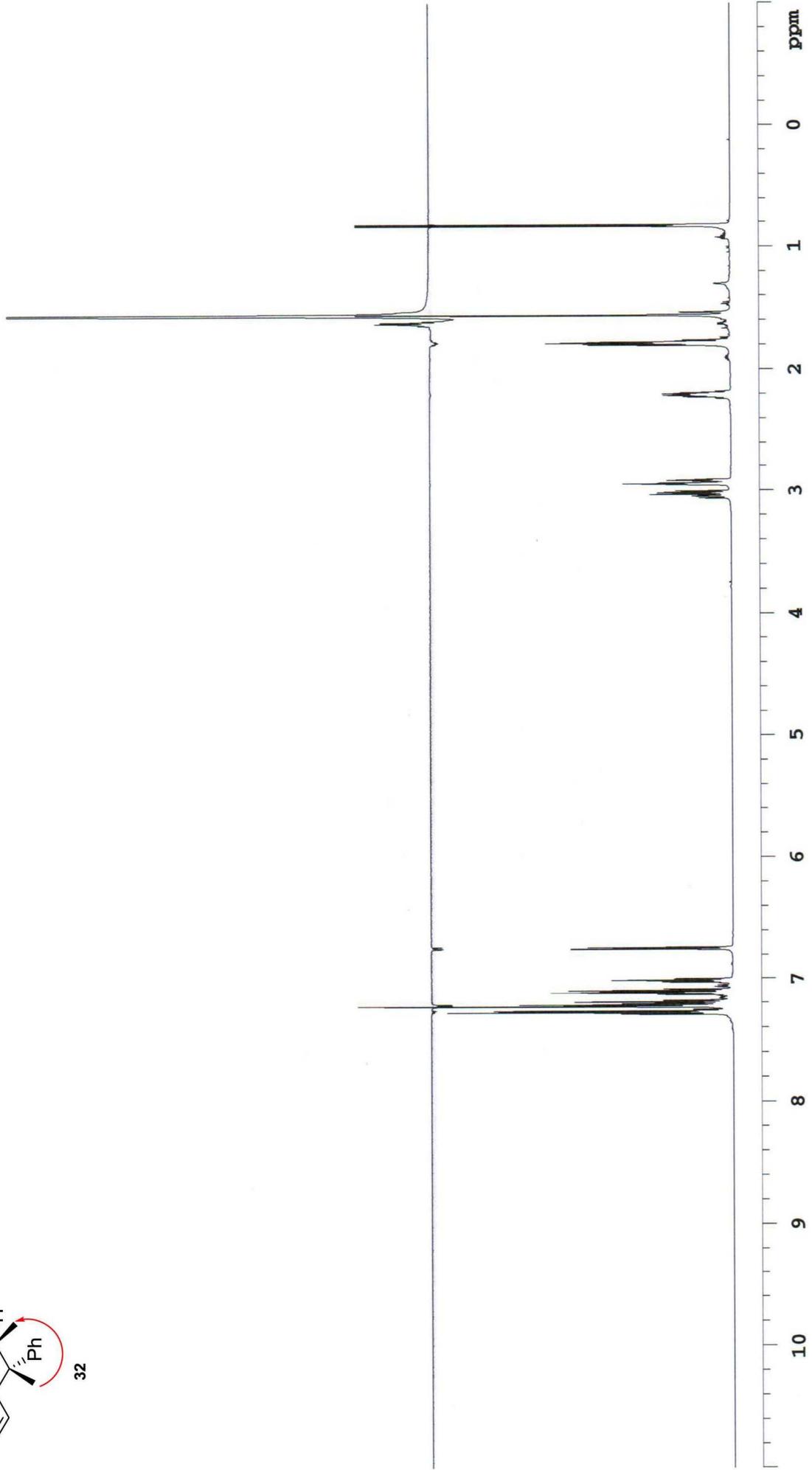
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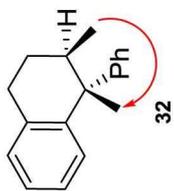




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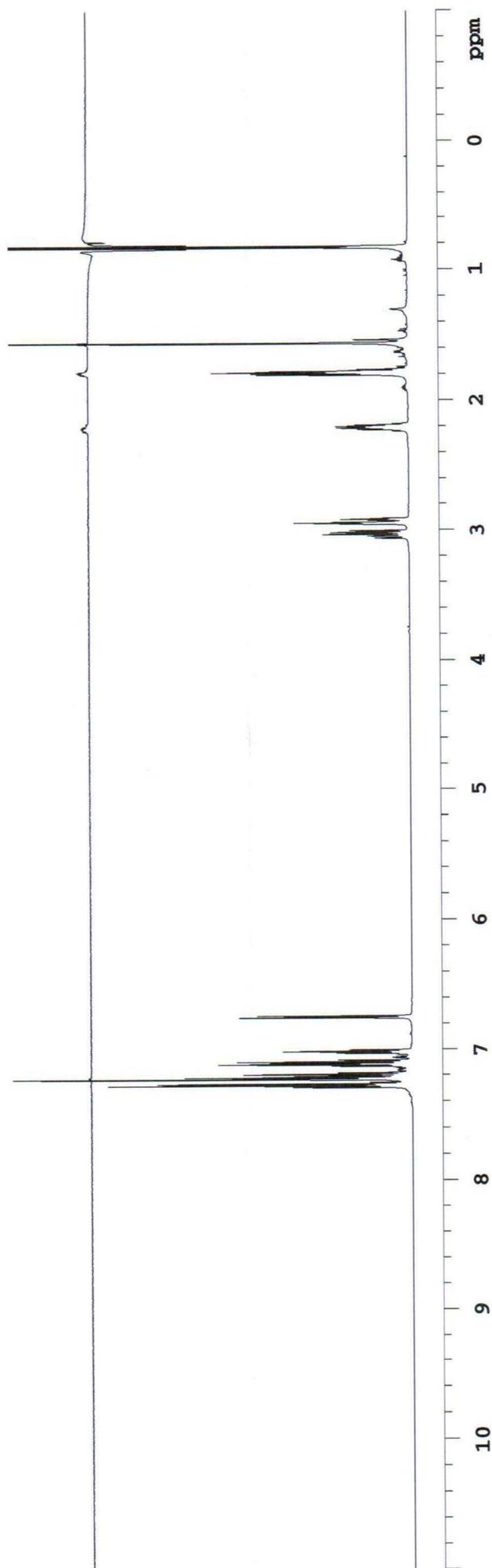
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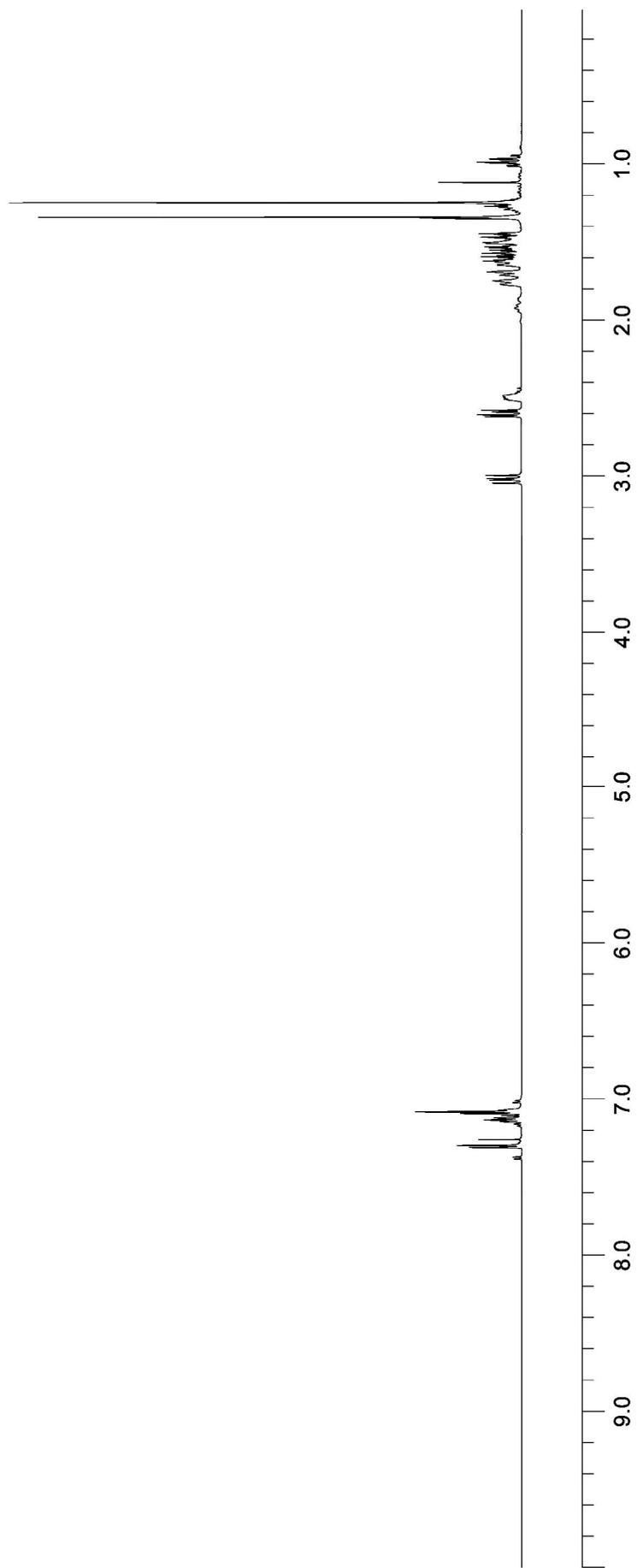
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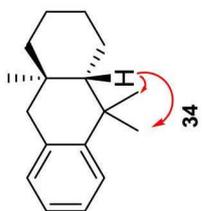
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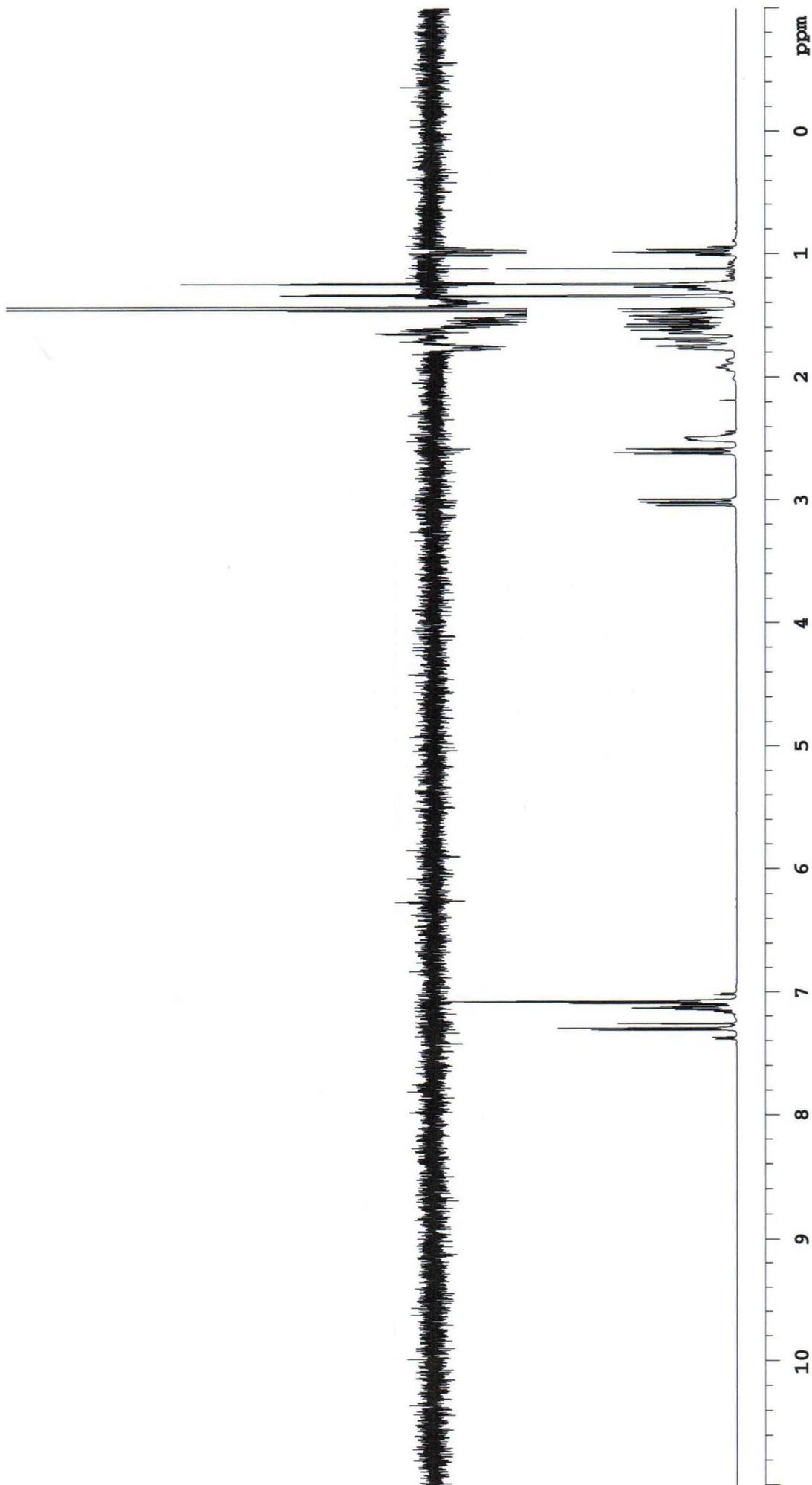


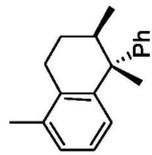
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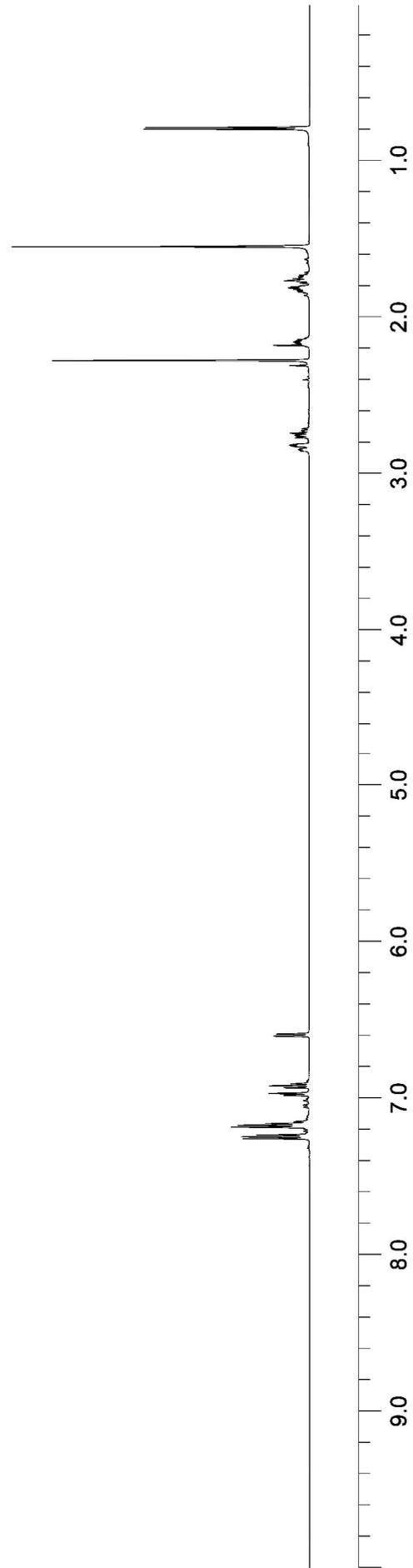


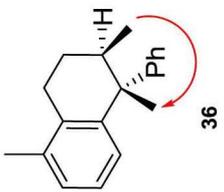
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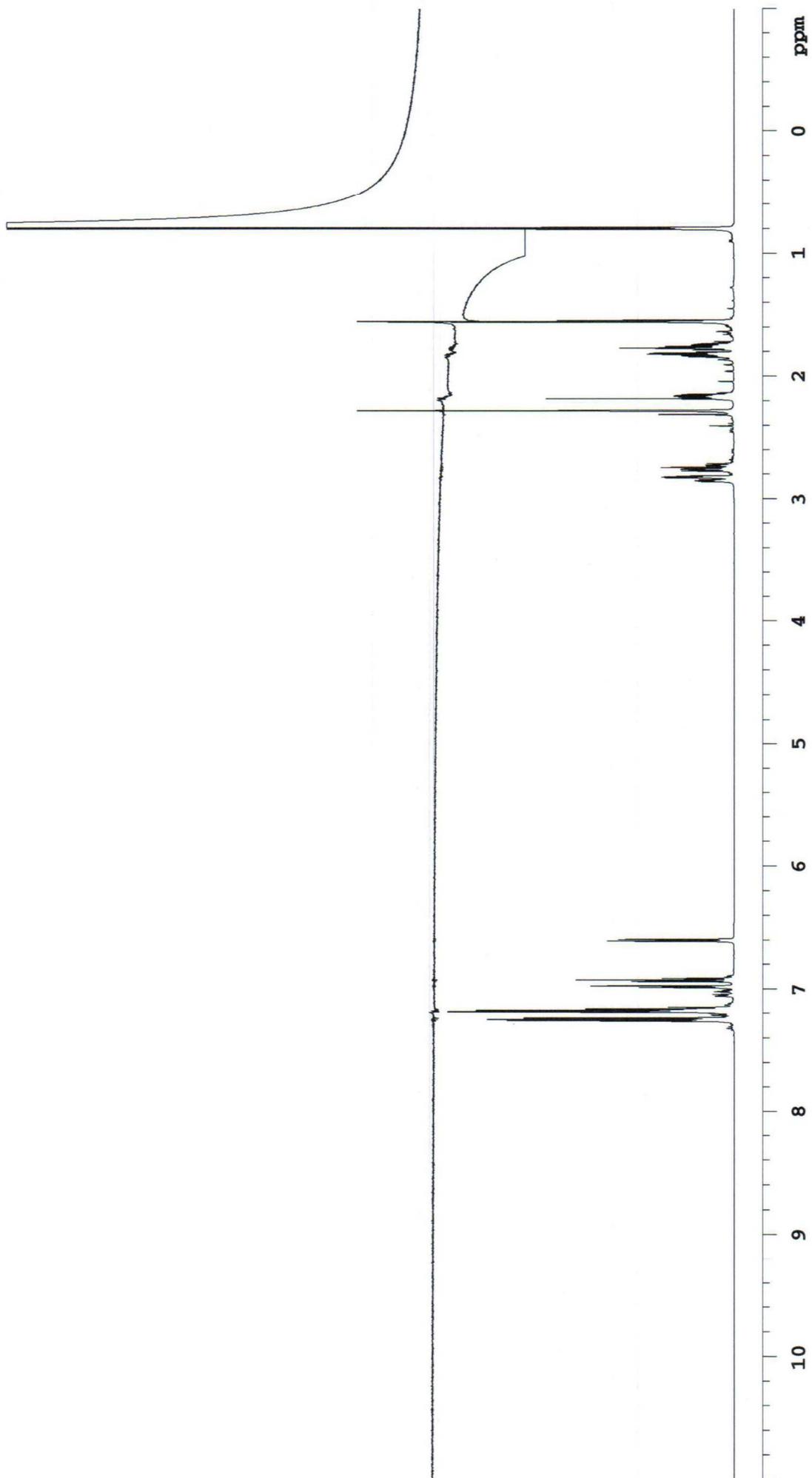


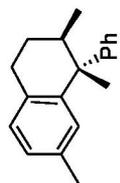
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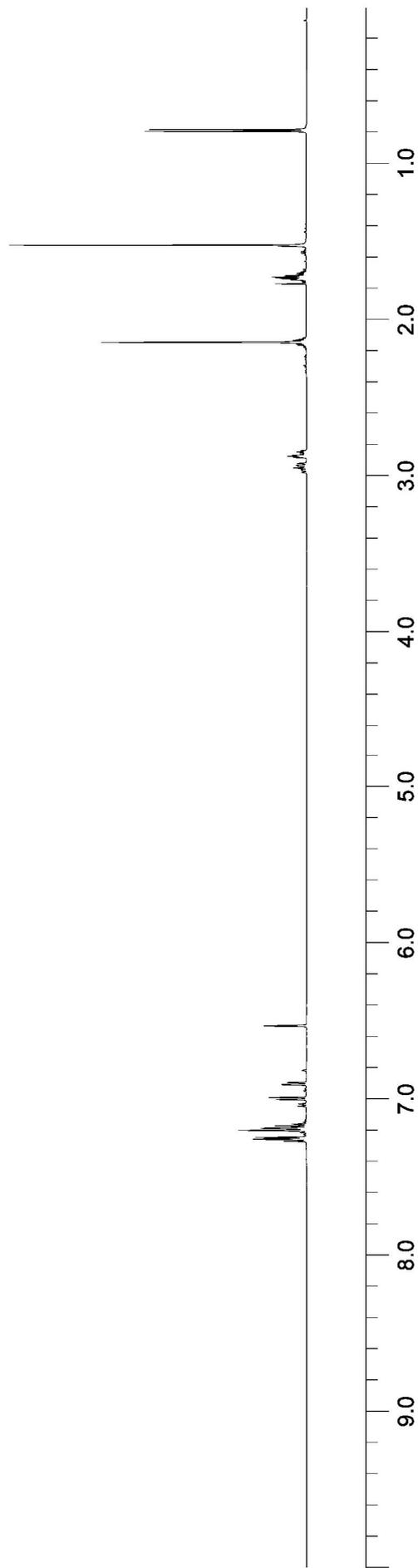


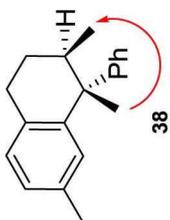
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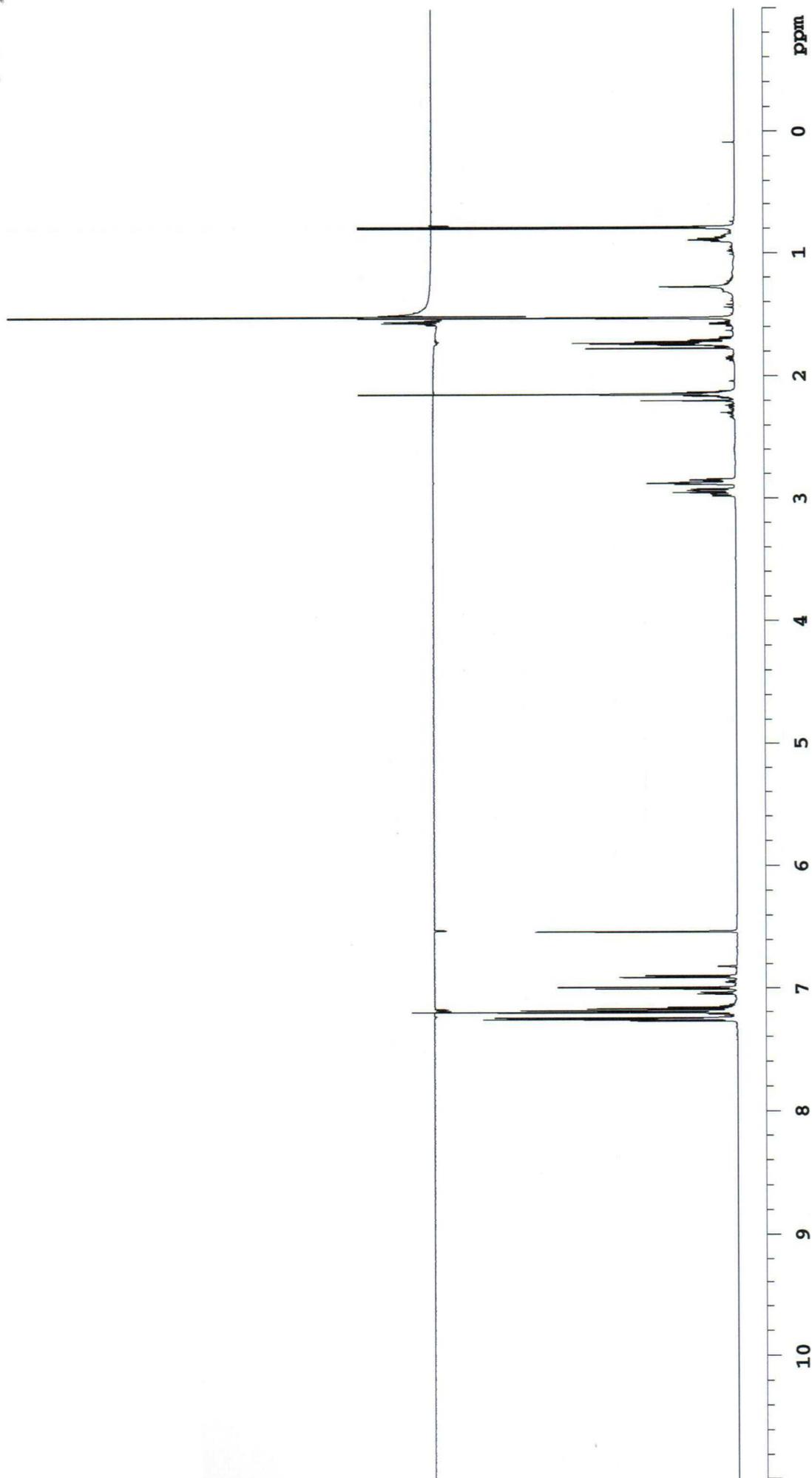


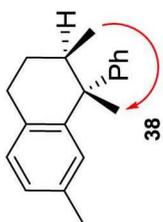
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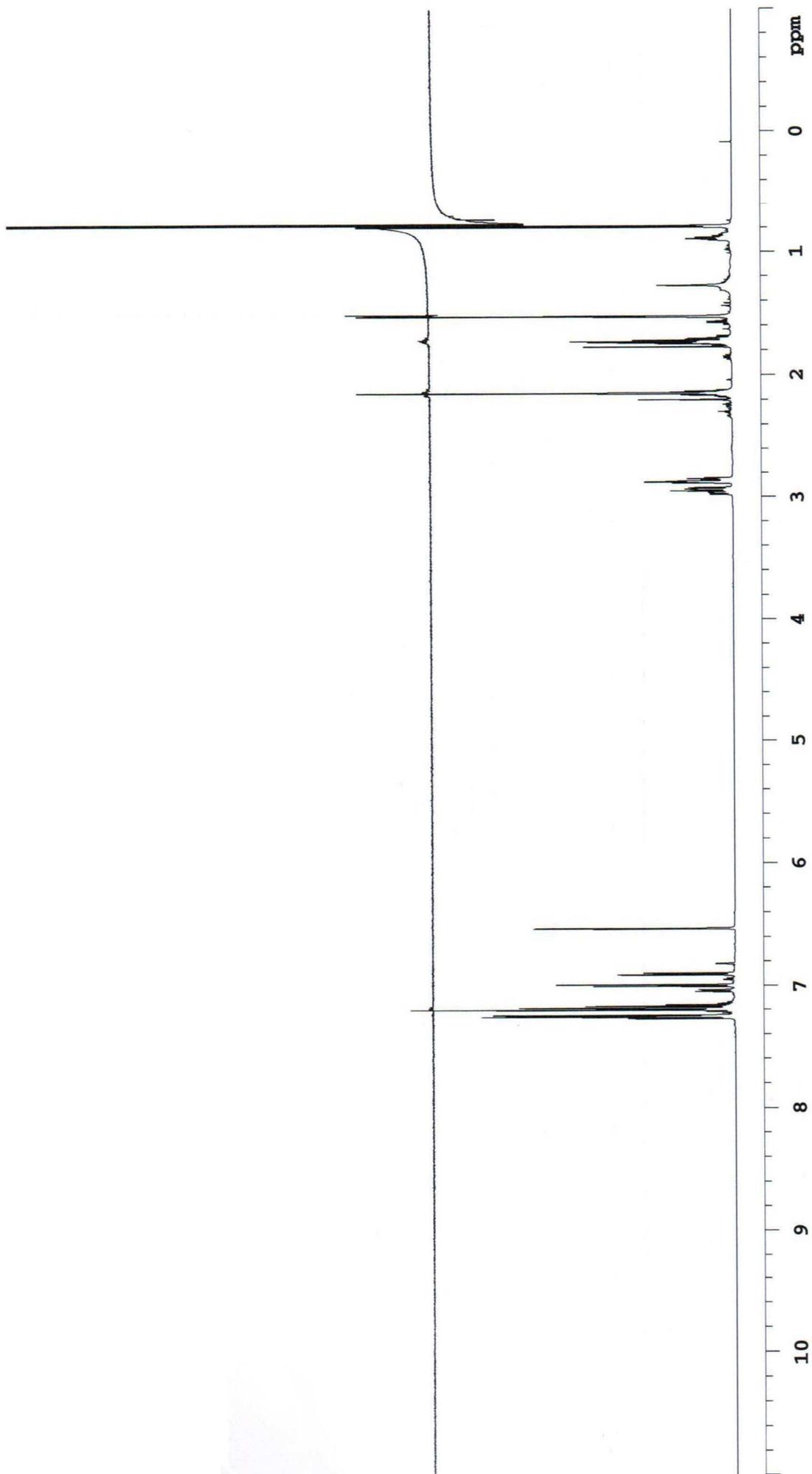


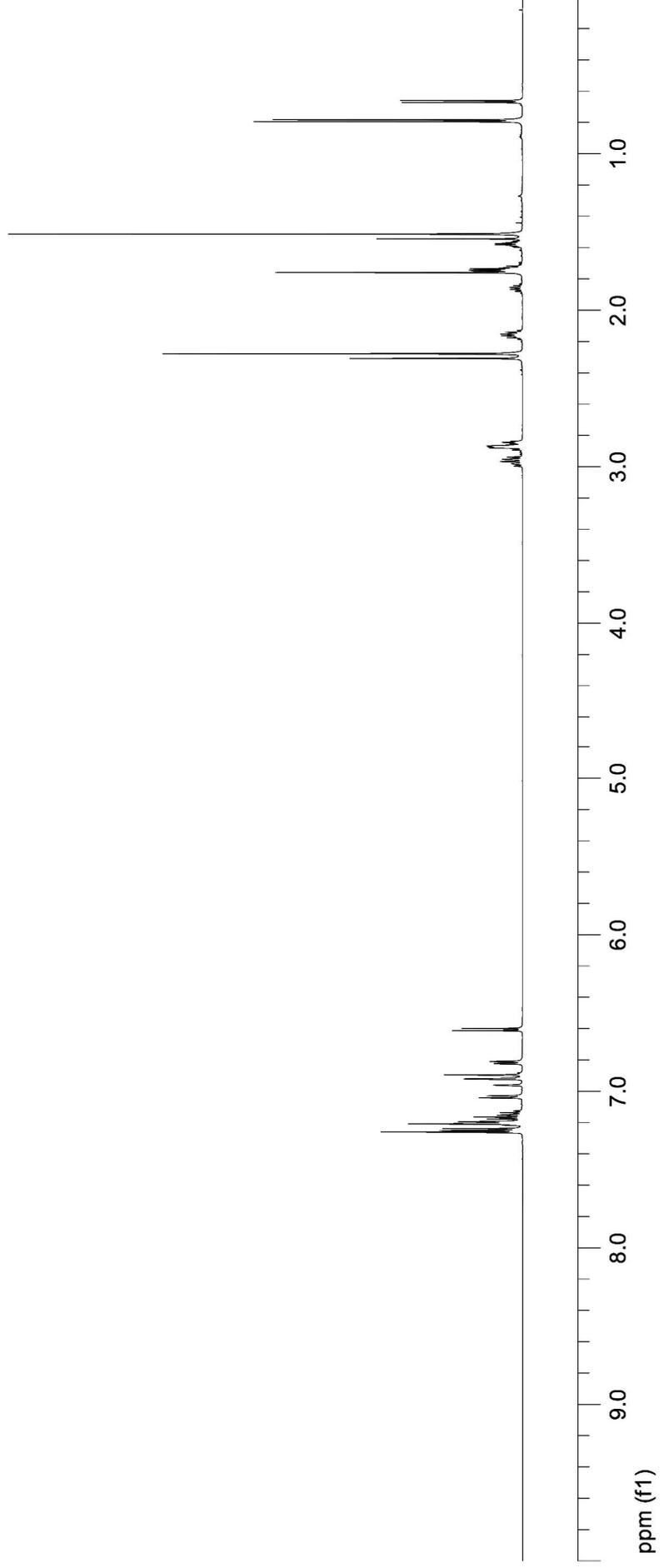
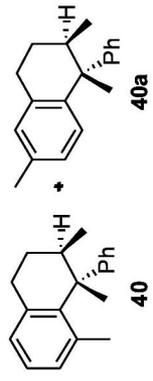
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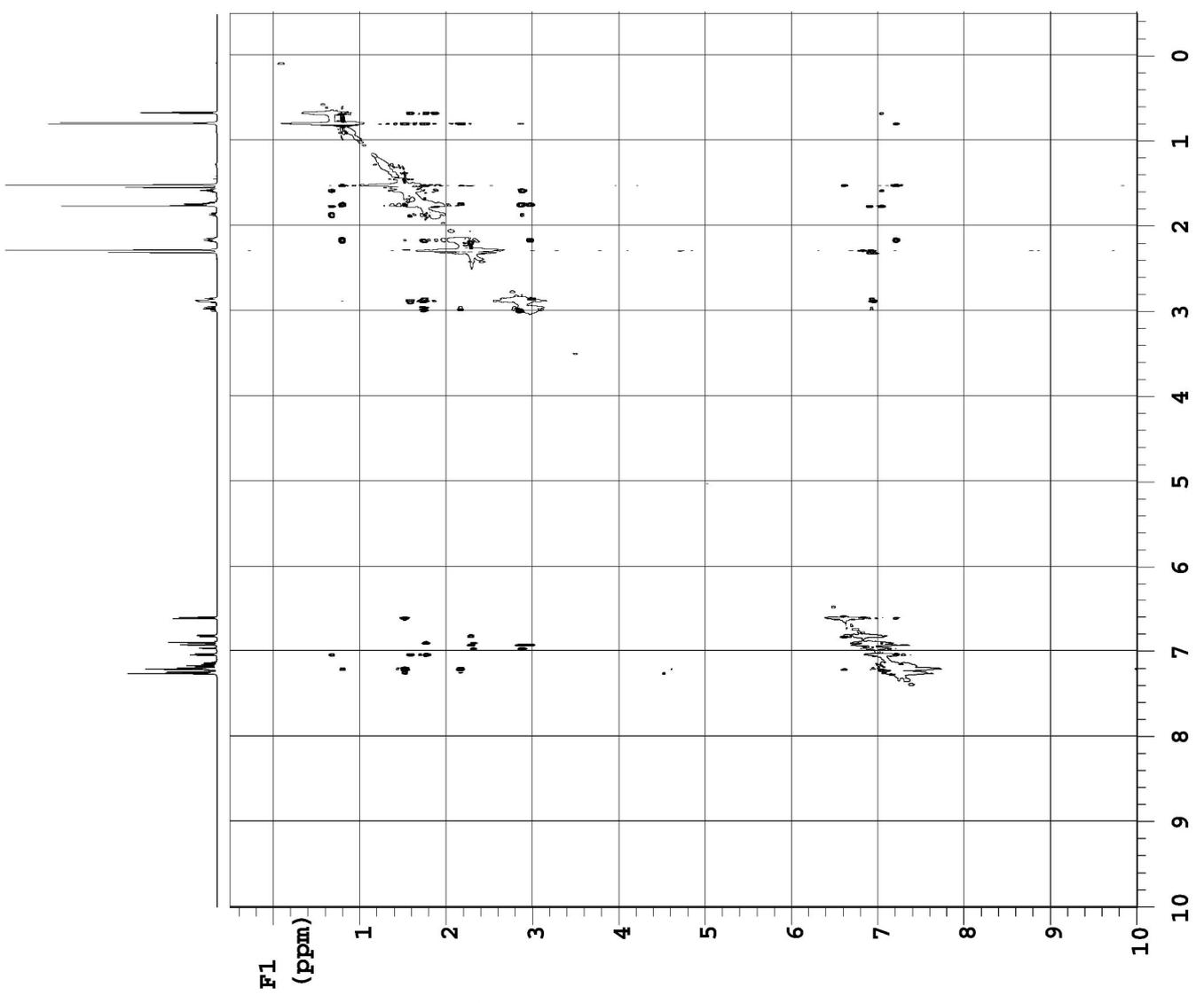
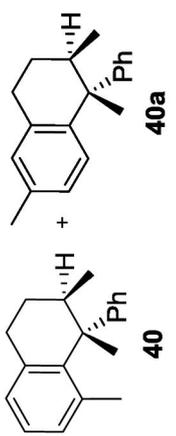


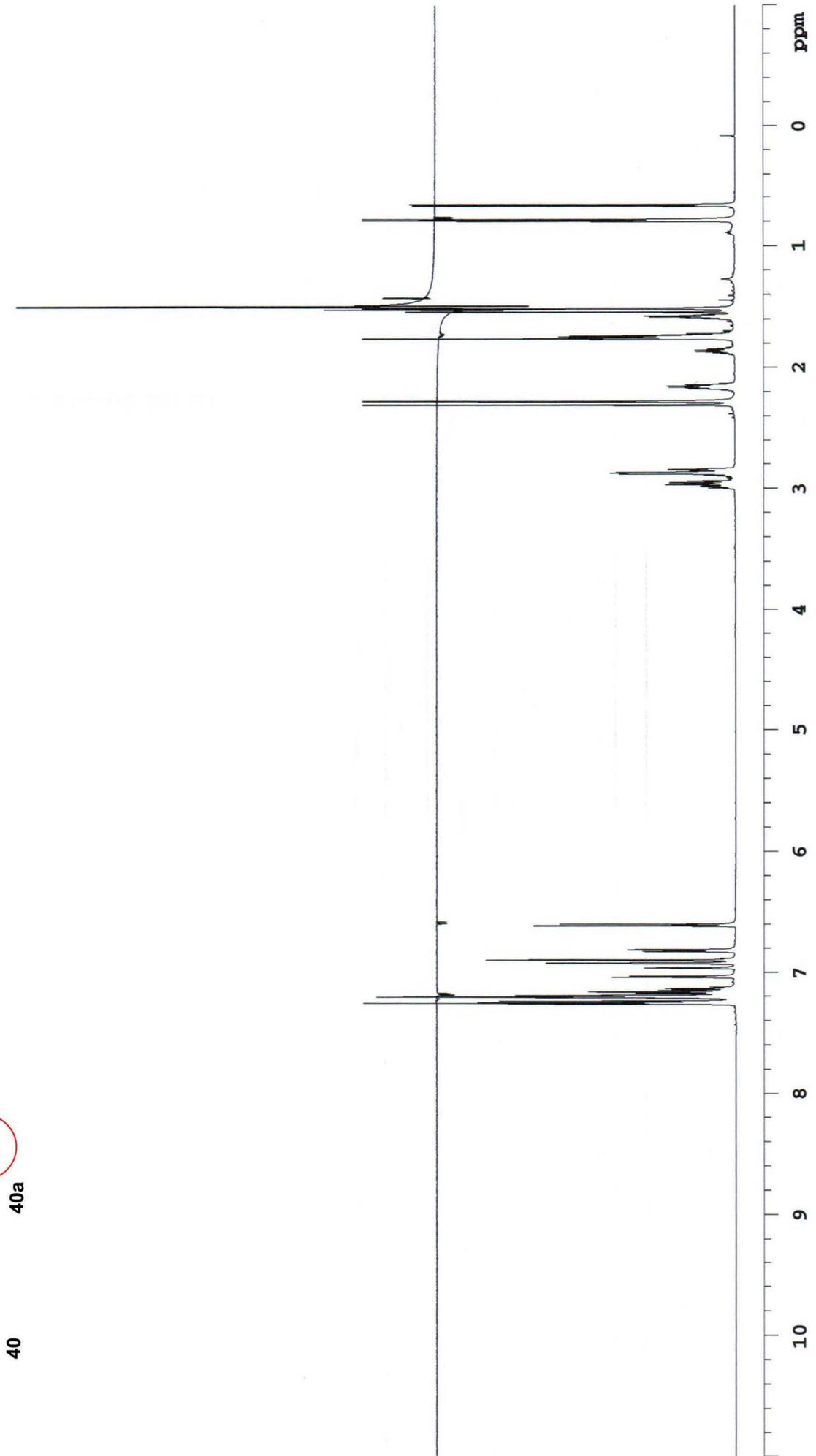
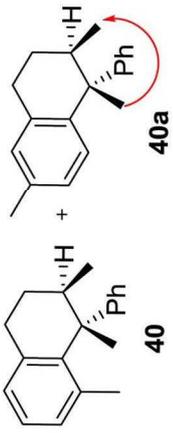


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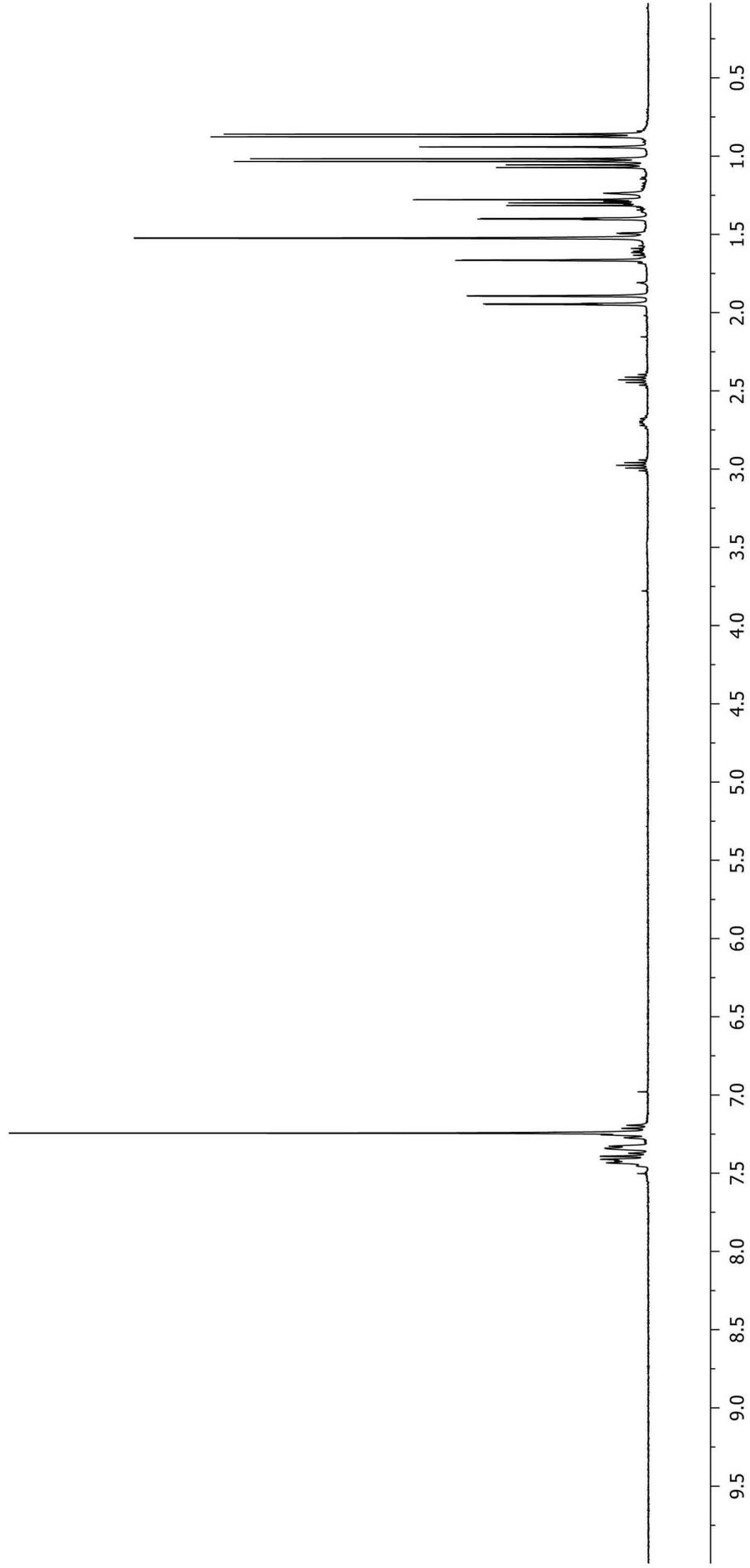
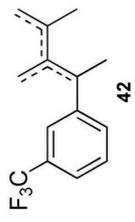


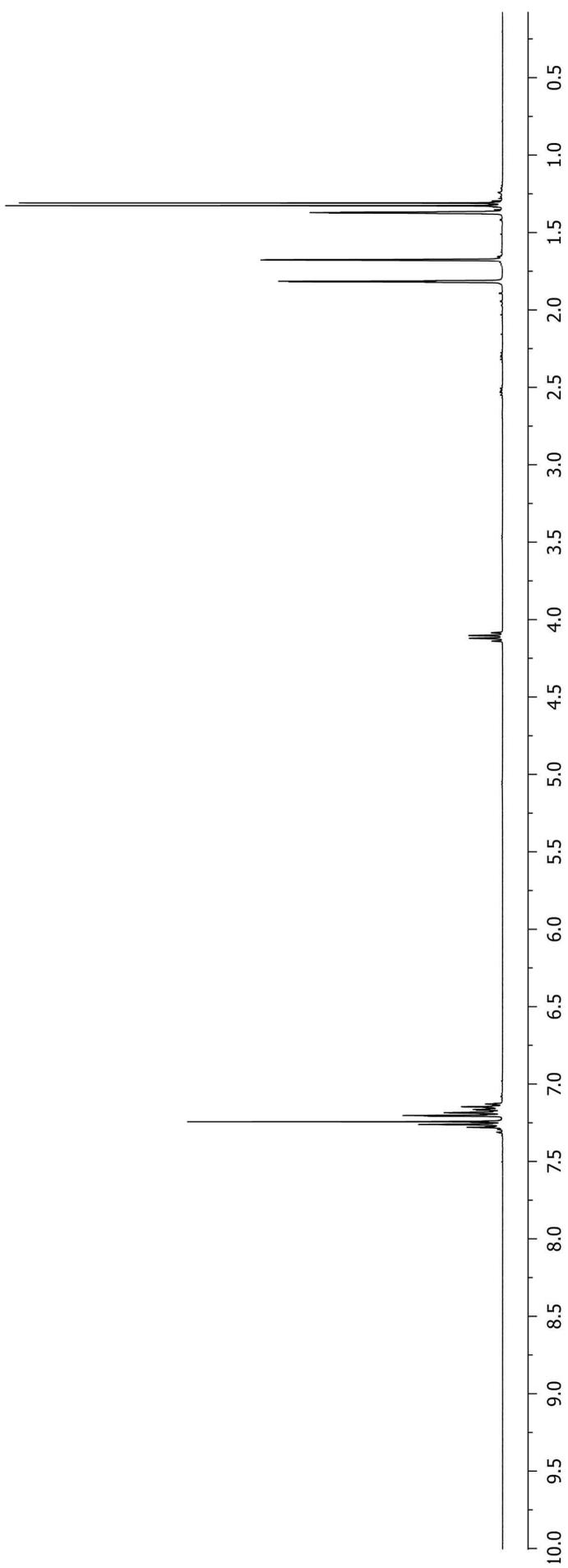
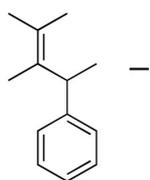


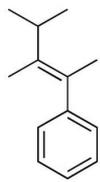




3
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E-II + Z-II

