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"Nitrogen-philic" Cyclization of Acyl Radicals onto N=C Bond. New Synthesis of 2-Pyrrolidinones by Radical Carbonylation/Annulation Method

Supporting Information

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Experimental Procedure and Spectral Data for Products **2a-2j**

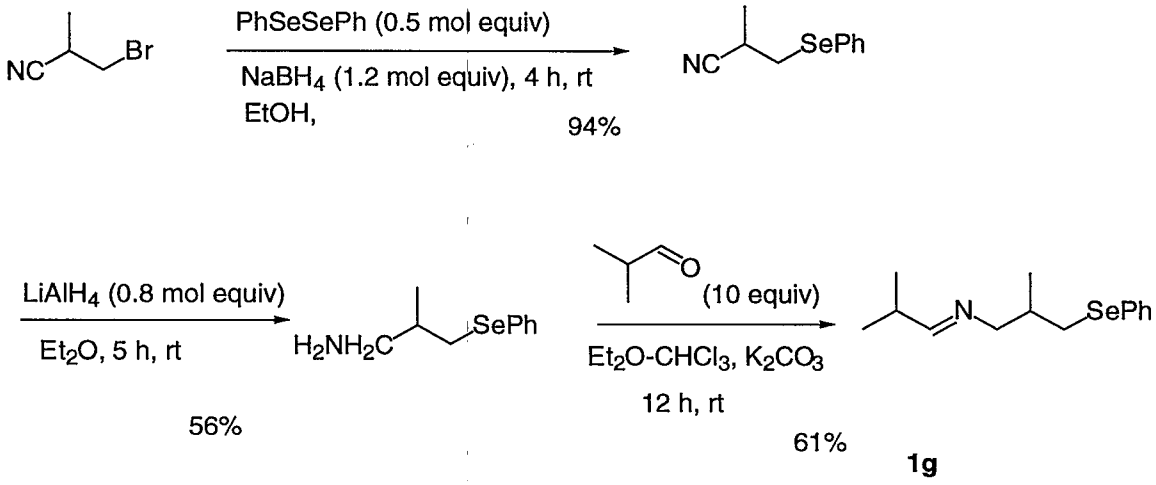
General Methods. ^{1}H NMR spectra were recorded with a JEOL JNM-GX67S (270 MHz) spectrometer and a Bruker AM600 (600 MHz) spectrometer. Chemical shifts are reported in parts per million (δ) downfield from internal TMS. ^{13}C NMR spectra were recorded with a JEOL JNM-GX67S (68MHz) spectrometer. Infrared spectra were recorded with a HITACHI 270-30 Infrared Spectrometer. Both conventional and high resolution mass spectra were recorded with a JEOL JMS-DX303HF spectrometer. The ratios of compounds were assayed with a Shimadzu GC-17A gas chromatography equipped with Supelco fused silica capillary column DB-1. The products were purified by flash chromatography on silica gel (Fuji Silysia BW-300) and, if necessary, were further purified by recycling preparative HPLC (JAI, JAIGEL-1H) equipped with a GPC column.

Preparation of 3-Bromo-*N*-cyclohexylmethylidenepropylamine (1a). HBr salt of 3-bromo-1-propylamine (29.46 g, 135 mmol) was treated with 1N NaOH (50 mL) and the mixture was extracted into benzene (50 mL x 5). To the combined benzene solutions was added a 100 mL benzene solution of cyclohexanecarboxaldehyde (17 mL, 140 mmol) dropwise. Then the solution was heated to reflux for two hours and during the reflux water was trapped by a Dean-Stark tube. The benzene solution was concentrated in vacuo and the vacuum distillation of the resulting residue gave 19.7 g (63%) of **1a** (72-74°C, 0.15 mmHg): ^{1}H-NMR ($CDCl_3$, 270 MHz) δ 1.21-1.33 (m, 3H), 1.68-1.81 (m, 3H), 2.11-2.16 (m, 3H), 3.38-3.50 (m, 4H), 7.57 (d, 1H, J = 5.0 Hz); ^{13}C-NMR ($CDCl_3$, 68 MHz) δ 25.42 (t), 25.98 (t), 29.70 (t), 31.54 (t), 34.00 (t), 43.46 (d), 58.51 (t), 170.51 (d); HRMS calcd for $C_{10}H_{18}NBr$ m/z 232.0623, found: 232.0686.

Bromoalkyl imines **1b**, **1c**, **1d**, and **1j** were prepared by a similar procedure in the yields of 65-72% and **1e** was prepared according to the Warkentin's report (reference 4c). Selected Spectral Data: **1b**: ^{1}H-NMR ($CDCl_3$, 270 MHz) δ 1.48-1.62 (m, 2H), 1.85-1.91 (m, 2H), 2.15 (tt, 4H, J = 6.3, 6.3 Hz)), 2.45 (bs, 1H), 3.41 (t, 2H, J = 6.3 Hz), 3.52 (t, 2H, J = 6.3 Hz), 5.70 (m,

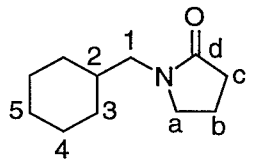
2H), 7.67 (d, 1H, J = 5.0 Hz); ^{13}C-NMR ($CDCl_3$, 68 MHz) δ 25.13 (t), 25.62 (t), 27.91 (t), 31.50 (t), 32.94 (t), 39.19 (d), 58.47 (t), 125.34 (d), 126.99 (d), 169.64 (d); HRMS calcd for $C_{10}H_{16}NBr$ m/z 229.0466, found: 229.0466. **1c**: ^{1}H-NMR ($CDCl_3$, 270 MHz) δ 2.25 (tt, 2H, J = 6.3, 6.3 Hz), 3.45 (t, 2H, J = 6.3 Hz), 3.75 (t, 2H, J = 6.3 Hz),7.40-7.43 (m, 3H), 7.71-7.74 (m, 2H), ^{13}C-NMR ($CDCl_3$, 68 MHz) δ 31.56 (t), 33.17 (t), 58.65 (t), 127.92 (d), 128.43 (d), 130.55 (d), 135.90 (s), 161.81 (d); HRMS calcd for $C_{10}H_{18}NBr$ m/z 231.0623, found: 232.0686 (M + 1). **1d**: ^{1}H-NMR ($CDCl_3$, 270 MHz) δ 0.86-0.92 (m, 4H), 1.27-1.50 (m, 8H), 2.15 (tt, 4H, J = 6.3, 6.3 Hz)), 3.43 (t, 2H, J = 6.3 Hz), 3.53 (t, 2H, J = 6.3 Hz), 7.46 (d, 1H, J = 6.9 Hz); ^{13}C-NMR ($CDCl_3$, 68 MHz) δ 11.29 (q), 13.66 (q), 22.41 (t), 25.02 (t), 29.02 (t), 31.16 (t), 31.50 (t), 32.62 (t), 46.35 (d), 58.08 (t), 170.35 (d); HRMS calcd for $C_{11}H_{22}NBr$ m/z 247.0936, found: 247.0950. **1i**: ^{1}H-NMR ($CDCl_3$, 270 MHz) δ 1.04-1.10 (m, 3H), 1.30-1.59 (m, 2H), 1.68 (s, 3H), 1.72 (s, 3H), 1.95-2.03 (m, 2H), 2.09-2.19 (m, 2H), 2.27-2.37 (m, 1H), 3.41 (td, 2H, J = 6.3, 1.7 Hz), 3.49 (t, 2H, J = 6.3 Hz), 5.07-5.12 (m, 1H), 7.55 (dd, 2H, J = 6.3, 1.7 Hz); ^{13}C-NMR ($CDCl_3$, 68 MHz) δ 17.37 (q), 17.68 (q), 25.62 (t), 25.71 (q), 31.55 (t), 33.01 (t), 34.18 (t), 39.08 (d), 58.49 (t), 124.02 (d), 131.82 (s), 170.89 (d); HRMS calcd for $C_{12}H_{22}NBr$ m/z 259.0936, found: 260.1026.

Phenylselenenylimines **1f**, **1g**, and **1h** were prepared from cyanobromides via three steps according to the following Scheme depicted for the case of **1g** (see reference 5b).

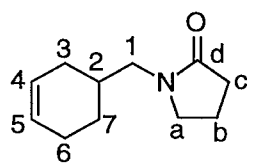


Scheme. Preparation of Phenylseleno Imine **1g**

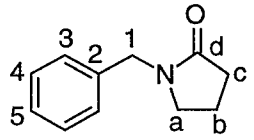
Typical Procedure: *N*-Cyclohexylmethyl-2-pyrrolidinone (2a). A magnetic stirring bar, AIBN (8.2 mg, 0.05 mmol), benzene (50 mL), Bu_3SnH (274.9 mg, 0.94 mmol), and imine **1a** (178.7 mg, 0.77 mmol) were placed in a 100-mL stainless steel autoclave lined with glass liner. The autoclave was closed, purged twice with carbon monoxide, pressurized with 80 atm of CO and then heated at 80 °C for 2 h. Excess CO was discharged at room temperature. The solvent was removed under reduced pressure, and the residue was dissolved in Et_2O (30 mL). The ethereal solution was treated with aqueous KF (10 mL) for 2 hours, and the resultant precipitate of Bu_3SnF was removed by vacuum filtration. The two liquid layers were separated, and aqueous layer was extracted with Et_2O (5 x 20 mL). The combined organic layers were dried ($MgSO_4$) and concentrated. The residue was purified by flash chromatography on silica gel (hexane/EtOAc = 2/8 eluant). The major fraction (R_f = 0.23) eluted from the column contained 113.3 mg (81 %) of product **2a**: ^{1}H-NMR ($CDCl_3$, 270 MHz) δ 0.90-0.97 (m, 2 H, H-3 or H-4), 1.16-1.38 (m, 3 H, , H-5, H-3 or H-4), 1.61-1.71 (m, 6 H, H-2, H-5, H-3 or H-4), 1.96-2.07 (tt, 2 H, J = 8.0, 7.0 Hz, H-b), 2.40 (t, 2 H, J = 8.0 Hz, H-c), 3.11 (d, 2 H, J = 7.0 Hz, H-1), 3.37 (t, 2 H, J = 7.0 Hz, H-a); ^{13}C-NMR ($CDCl_3$, 68 MHz) δ 18.10 (t, C-b), 25.79 (t), 26.40 (t), 30.75 (t), 31.11 (t, C-c), 35.92 (d, C-2), 47.94 (t, C-a), 48.93 (t, C-1), 175.20 (s, C-d); EIMS (relative intensity) m/z 181 (M^+, 13), 99 (57), 98 (100), 86 (52), 70 (31), 42 (18), 41 (48); IR(neat) 2928, 2856, 1692, 1450, 1286 cm^{-1}; HRMS calcd for $C_{11}H_{19}NO$ m/z 181.1467, found: 181.1459.



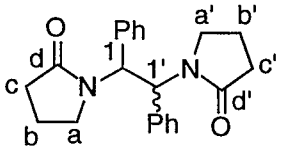
***N*-(Cyclohexen-4-ylmethyl)-2-pyrrolidinone (2b):** ^{1}H-NMR ($CDCl_3$, 270 MHz) δ 1.18-1.35 (m, 1 H, H-3, 6 or 7), 1.69-2.08 (m, 8 H, H-2, H-3, H-6, H-7, H-b), 2.41 (t, 2 H, J = 7.3 Hz, H-c), 3.20 (d, 2 H, J = 7.3 Hz, H-1), 3.39 (t, 2 H, J = 7.3 Hz, H-a), 5.66 (m, 2 H, H-5); ^{13}C-NMR ($CDCl_3$, 68 MHz) δ 18.10 (t, C-b), 24.64 (t), 26.29 (t), 26.40 (t), 31.07 (t, C-c), 32.04 (d, C-2), 47.85 (t, C-a), 48.16 (t, C-1), 125.59 (d, C-4 or C-5), 127.08 (d, C-4 or C-5), 175.25 (s, C-d); EIMS (relative intensity) m/z 179 (M^+, 29), 99 (87), 98 (100), 78 (21), 70 (24), 41 (47); IR(neat) 2920, 1688, 1442, 1288, 652 cm^{-1}; HRMS calcd for $C_{11}H_{17}NO$ m/z 179.1310, found: 179.1318.



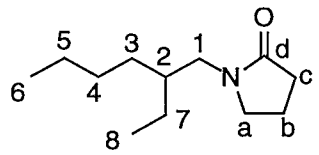
***N*-Benzyl-2-pyrrolidinone (2c)**: ^{1}H-NMR ($CDCl_3$, 270 MHz) δ 1.99 (quint, 2 H, J = 7.6 Hz, H-b), 2.45 (t, 2 H, J = 7.6 Hz, H-c), 3.27 (t, 2 H, J = 7.6 Hz, H-a), 4.45 (s, 2 H, H-1), 7.23-7.26 (m, 5 H, H-3, H-4, H-5); ^{13}C-NMR ($CDCl_3$, 68 MHz) δ 17.67 (t, C-b), 30.89 (t, C-c), 46.56 (t, C-a, C-1), 127.48 (d), 128.05 (d), 128.61 (d), 136.51 (s, C-2), 174.91 (s, C-d); EIMS (relative intensity) m/z 175 (M^+, 56), 146 (36), 104 (37), 91 (100), 84 (35), 65 (38), 41 (44); IR(neat) 1686, 1426, 1290, 1266, 702 cm^{-1}; HRMS calcd for $C_{11}H_{13}NO$ m/z 175.0997, found: 175.0994; Anal. Calcd for $C_{11}H_{13}NO$: C, 75.40; H, 7.48; N, 8.00. Found: C, 75.62; H, 7.48; N, 7.70.



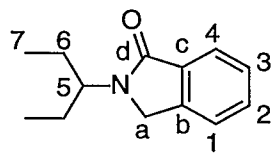
1, 1'-Bis-(*N*-phenylmethyl-2-pyrrolidinone) (2c'): Hexane/EtOAc (7:3), MeOH was used as the eluant to give each product as a colorless solid: major isomer (more polar): ^{1}H-NMR ($CDCl_3$, 270 MHz) δ 1.79-1.94 (m, 4 H, H-b, H-b'), 2.33-2.39 (m, 4 H, H-c, H-c'), 2.85-2.94 (m, 2 H, H-a, H-a'), 3.67-3.76 (m, 2 H, H-a, H-a'), 6.08 (s, 2 H, H-1, H-1'), 7.13-7.31 (m, 10 H, Ph-H); ^{13}C-NMR ($CDCl_3$, 68 MHz) δ 18.08 (t, C-b, C-b'), 31.48 (t, C-c, C-c'), 43.25 (t, C-a, C-a'), 53.06 (d, C-1, C-1'), 127.87 (d, Ph), 128.61 (d, Ph), 128.89 (d, Ph), 135.72 (s, Ph), 175.06 (s, C-d, C-d'); EIMS (relative intensity) m/z 175 (13), 174 (100), 131 (16), 91 (12), 69 (18), 41 (32); IR (KBr) 1684, 1426, 1288, 1270, 702 cm^{-1}; HRMS calcd for $C_{22}H_{24}N_2O_2$ m/z 348.1837, found: 348.1910; Anal. Calcd for $C_{22}H_{24}N_2O_2$: C, 75.83; H, 6.94; N, 8.04. Found: C, 75.43; H, 6.97; N, 7.99., minor isomer (less polar): ^{1}H-NMR ($CDCl_3$, 270 MHz) δ 1.48-1.78 (m, 4 H, H-b, H-b'), 1.95-2.21 (m, 4 H, H-c, H-c'), 3.10-3.22 (m, 4 H, H-a, H-a'), 6.08 (s, 2 H, H-1, H-1'), 7.27-7.56 (m, 10 H, Ph-H); ^{13}C-NMR ($CDCl_3$, 68 MHz) δ 17.79 (t, C-b, C-b'), 30.74 (t, C-c, C-c'), 42.19 (t, C-a, C-a'), 52.94 (d, C-1, C-1'), 128.12 (d, Ph), 128.28 (d, Ph), 128.75 (d, Ph), 135.89 (s, Ph), 174.52 (s, C-d, C-d'); EIMS (relative intensity) m/z 175 (12), 174 (100), 131 (13), 91 (13), 69 (16), 41 (33); IR(KBr) 1668, 1426, 1422, 1280, 1182, 696 cm^{-1}; HRMS calcd for $C_{22}H_{24}N_2O_2$ m/z 348.1837, found: 349.1923.



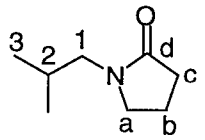
***N*-(2-Ethylhexyl)-2-pyrrolidinone (2d)**: ^{1}H-NMR ($CDCl_3$, 270 MHz) δ 0.86-0.94 (m, 6 H, H-6, H-8), 1.29-1.33 (m, 8 H, H-3, H-4, H-5, H-7), 1.61 (m, 1 H, H-2), 2.05 (q, 2 H, J = 7.3 Hz, H-b), 2.42 (t, 2 H, J = 7.3 Hz, H-c), 3.13-3.28 (m, 2 H, H-1), 3.38 (t, 2 H, J = 7.3 Hz, H-a); ^{13}C-NMR ($CDCl_3$, 68 MHz) δ 10.58 (q, C-6 or C-8), 14.09 (q, C-6 or C-8), 18.08 (t, C-b), 23.05 (t, C-5), 23.86 (t, C-7), 28.70 (t, C-4), 30.58 (t, C-3), 31.16 (t, C-c), 37.12 (d, C-2), 46.36 (t, C-1), 47.56 (t, C-a), 175.20 (s, C-d); EIMS (relative intensity) m/z 197 (M^+, 7), 99 (38), 98 (100), 86 (15), 70 (18), 43 (10), 42 (12), 41 (35); IR(neat) 2964, 2932, 1692 cm^{-1}; HRMS calcd for $C_{12}H_{23}NO$ m/z 197.1780, found: 198.1861; Anal. Calcd for $C_{12}H_{23}NO$: C, 73.00; H, 11.70; N, 7.10. Found: C, 72.92; H, 11.82; N, 7.23.



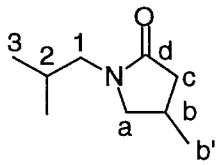
***N*-(1-Ethylpropyl)-2-phthalimidine (2e)**: ^{1}H-NMR ($CDCl_3$, 270 MHz) δ 0.87 (t, 6 H, J = 7.3 Hz, H-7), 1.52-1.75 (m, 4 H, H-6), 4.20-4.23 (m, 1 H, H-5), 4.25 (s, 2 H, H-a), 7.43-7.56 (m, 3 H, H-2, H-3, H-1 or H-4), 7.85-7.88 (m, 1 H, H-1 or H-4); ^{13}C-NMR ($CDCl_3$, 68 MHz) δ 11.31 (q, C-7), 26.88 (t, C-6), 45.32 (t, C-a), 54.83 (d, C-5), 123.11 (d), 124.13 (d), 128.34 (d), 131.43 (d), 133.51 (s, C-b or C-c), 141.56 (s, C-b or C-c), 169.58 (s, C-d); EIMS (relative intensity) m/z 203 (M^+, 4), 175 (16), 174 (100), 134 (7), 132 (6), 119 (5), 91 (8); IR(neat) 1676, 1452, 1410, 1214, 730 cm^{-1}; HRMS calcd for $C_{13}H_{17}NO$ m/z 203.1310, found: 203.1319.



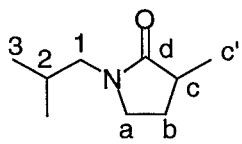
***N*-(2-Methylpropyl)-2-pyrrolidinone (2f)**: ^{1}H-NMR ($CDCl_3$, 270 MHz) δ 0.89 (d, 6 H, J = 6.6 Hz, H-3), 1.91 (t of septet, 1 H, J = 6.6, 7.3 Hz, H-2), 2.01 (tt, 2 H, J = 7.3, 7.9 Hz, H-b), 2.40 (t, 2 H, J = 7.9, Hz, H-c), 3.08 (d, 2 H, J = 7.3 Hz, H-1), 3.37 (t, 2 H, J = 7.3 Hz, H-a); ^{13}C-NMR ($CDCl_3$, 68 MHz) δ 17.92 (t, C-b), 19.86 (q, C-3), 26.45 (d, C-2), 30.93 (t, C-c), 47.55 (t, C-a), 49.96 (t, C-1), 175.06 (t, C-d); EIMS (relative intensity) m/z 141 (M^+, 28), 126 (11), 98 (100), 70 (31), 69 (11), 41 (12); IR(neat) 1674, 1462, 1274 cm^{-1}; HRMS calcd for $C_8H_{15}NO$ m/z 141.1154, found: 141.1142.



***N*-(2-Methylpropyl)-4-methyl-2-pyrrolidinone (2g)**: ^{1}H-NMR ($CDCl_3$, 270 MHz) δ 0.89 (d, 6 H, *J* = 6.6 Hz, H-3), 1.13 (d, 3 H, *J* = 6.6 Hz, H-b'), 1.90 (t of septet, 1 H, *J* = 6.9, 6.6 Hz, H-2), 2.04 (dd, 1 H, *J* = 16.0, 6.3 Hz, H-c), 2.43 (ddqdd, 1 H, *J* = 8.6, 7.6, 6.6, 6.3, 5.6 Hz, H-b), 2.56 (dd, 1 H, *J* = 16.0, 8.6 Hz, H-c), 2.95 (dd, 1 H, *J* = 9.6, 5.6 Hz, H-a), 3.07 (d, 2 H, *J* = 6.9 Hz, H-1), 3.48 (dd, 1 H, *J* = 9.6, 7.6 Hz, H-a); ^{13}C-NMR ($CDCl_3$, 68 MHz) δ 20.11 (q, C-3), 20.16 (q, C-3'), 20.22 (q, C-b'), 26.65 (d, C-2), 26.78 (d, C-b), 39.68 (t, C-c), 50.12 (t, C-1), 55.22 (t, C-a), 174.84 (s, C-d); EIMS (relative intensity) m/z 155 (M^+, 25), 113 (11), 112 (100), 84 (25), 83 (14); IR(neat) 2924, 1650, 1572, 1452, 1264 cm^{-1}; HRMS calcd for $C_9H_{17}NO$ m/z 155.1310, found: 155.1316.

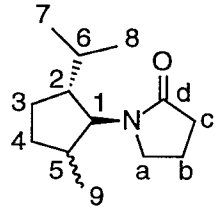


***N*-(2-Methylpropyl)-3-methyl-2-pyrrolidinone (2h)**: ^{1}H-NMR ($CDCl_3$, 600 MHz) δ 0.89 (dd, 6 H, *J* = 6.6, 0.6 Hz, H-3), 1.22 (d, 3 H, *J* = 7.2 Hz, H-c'), 1.63 (dq, 1 H, *J* = 12.6, 8.4 Hz, H-b), 1.86-1.95 (9-lines-m, 1 H, *J* = 6.6 ~ 7.8 Hz, H-2), 2.21-2.27 (m, 1 H, H-b), 2.50 (tq, 1 H, *J* = 8.4, 7.2 Hz, H-c), 3.08 (dd, 1 H, *J* = 13.2, 7.8 Hz, H-1), 3.09 (dd, 1 H, *J* = 13.2, 7.8 Hz, H-1), 3.26-3.33 (m, 2 H H-a); ^{13}C-NMR ($CDCl_3$, 68 MHz) δ 16.91 (q, C-c'), 20.45 (q, C-3), 27.06 (d, C-2), 27.82 (t, C-b), 37.29 (d, C-c), 46.15 (t, C-a), 50.69 (t, C-1), 178.02 (s, C-d); EIMS (relative intensity) m/z 155 (M^+, 40), 140 (12), 113 (13), 112(100), 100 (11), 84 (77), 55 (11), 42 (13); IR(neat) 2932, 2876, 1680, 1456, 1432 cm^{-1}; HRMS calcd for $C_9H_{17}NO$ m/z 155.1310, found: 155.1313.

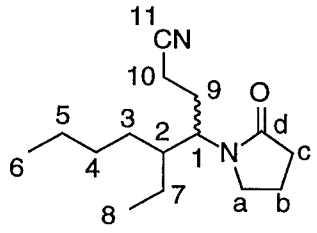


***N*-(2-Isopropyl-5-methylcyclopentyl)-2-pyrrolidinone (2i)**: Hexane/EtOAc (5:5) was used as the eluant to give a colorless oil as a mixture of two diasteroisomers (major:minor = 78:22 based on ^{1}H-NMR). :^{1}H-NMR (C_6D_6, 270 MHz) (signals for minor isomer are in square brackets) δ 0.84-0.98 (m, 10 H, H-7, H-8, H-9, H-3 or H-4), 1.05-1.36 (m, 3 H, H-b, H-3 or H-4),

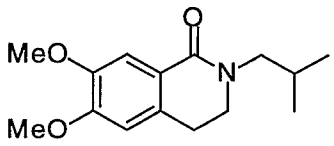
1.44-1.80 (m, 4 H, H-2, H-3, H-4, H-5), 1.91-2.09 (m, 2 H, H-c), 2.62-2.77 (m, 2 H, H-a), 4.40 (dd, 1 H, J = 2.3, 7.4 Hz, H-1) [3.95 (dd, 1 H, J = 9.6, 9.6 Hz, H-1)]; ^{13}C-NMR (C_6D_6, 68 MHz) (signals for minor isomer are in square brackets) δ 18.54 (t, C-b) [17.52 (t, C-b)], 21.73 (q, C-9) [19.14 (q, C-9)], 22.23 (q, C-7 or C-8) [20.77 (q, C-7 or C-8)], 22.57 (q, C-7 or C-8) [24.62 (q, C-7 or C-8)], 28.81 (d, C-6) [30.31 (d, C-6)], 31.11 (t, C-c) [30.39 (t, C-c)], 31.16 (t, C-3 or C-4) [31.90 (t, C-3 or C-4)], 33.14 (t, C-3 or C-4) [36.60 (t, C-3 or C-4)], 37.92 (d, C-5) [42.59 (d, C-5)], 46.47 (t, C-a) [46.04 (t, C-a)], 50.73 (d, C-2) [50.73 (d, C-2)], 60.05 (d, C-1) [61.67 (d, C-1)], 174.98 (s, C-d) [175.24 (s, C-d)]; EIMS (relative intensity) major isomer: m/z 209 (M^+, 7), 98 (22), 86 (100), 81 (14), 55 (12), 43 (11), 41 (40), minor isomer: m/z 209 (M^+, 10), 166 (13), 98 (60), 86 (100), 81 (45), 55 (33), 41 (70); IR(neat) a mixture of two isomers: 3308, 2960, 1702, 1428 cm^{-1}; HRMS (signals for minor isomer are in square brackets) calcd for $C_{13}H_{23}NO$ m/z 209.1780, found: 209.1781 [209.1795].



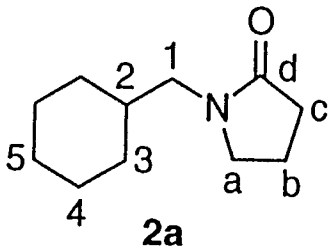
***N*-[1-(2-Cyanoethyl)-2-ethylhexyl]-2-pyrrolidinone (2j)**: Hexane/EtOAc (8:2) was used as the eluant to give a colorless oil as a mixture of two diasteroisomers (major:minor = 53:47 based on GC). :^{1}H-NMR ($CDCl_3$, 270 MHz) δ 0.84-0.91 (m, 6 H, H-6, H-8), 1.14-1.53 (m, 9 H, H-2, H-3, H-4, H-5, H-7), 1.77-1.82 (m, 1 H, H-9), 1.97-2.45 (m, 7 H, H-b, H-c, H-9, H-10), 3.23-3.32 (m, 2 H, H-a), 3.93-3.97 (m, 1 H, H-1); ^{13}C-NMR (C_6D_6, 68 MHz) (signals for minor isomer are in square brackets) δ 18.54 (t, C-b) [17.52 (t, C-b)], 21.73 (q, C-9) [19.14 (q, C-9)], 22.23 (q, C-7 or C-8) [20.77 (q, C-7 or C-8)], 22.57 (q, C-7 or C-8) [24.62 (q, C-7 or C-8)], 28.81 (d, C-6) [30.31 (d, C-6)], 31.11 (t, C-c) [30.39 (t, C-c)], 31.16 (t, C-3 or C-4) [31.90 (t, C-3 or C-4)], 33.14 (t, C-3 or C-4) [36.60 (t, C-3 or C-4)], 37.92 (d, C-5) [42.59 (d, C-5)], 46.47 (t, C-a) [46.04 (t, C-a)], 50.73 (d, C-2) [50.73 (d, C-2)], 60.05 (d, C-1) [61.67 (d, C-1)], 174.98 (s, C-d) [175.24 (s, C-d)]; EIMS (relative intensity) major isomer: m/z 250 (M^+, 1), 151 (100), 124 (41), 86 (13), 69 (17), 41 (57) minor isomer: m/z 250 (M^+, 1), 151 (100), 124 (43), 86 (15), 69 (17), 41 (64); IR(neat): 2948, 1672, 1422, 1282 cm^{-1}; HRMS (signals for minor isomer are in square brackets) calcd for $C_{15}H_{26}N_2O$ m/z 250.2045, found: 250.2047 [250.2041].



***N*-(2-Methylpropyl)-3,4-dihydroxy-6,7-dimethoxy-1(2H)-isoquinolinone:** ^{1}H-NMR ($CDCl_3$, 270 MHz) δ 0.94 (d, 6 H, J = 7 Hz), 2.02 (m, 1H), 2.91 (t, 2H, J = 6.7 Hz), 3.36 (d, 2H, J = 7.6 Hz), 3.52 (t, 2H, J = 6.7 Hz), 3.90 (s, 3H), 3.91 (s, 3H), 6.64 (s, 1H), 7.60 (s, 3H); ^{13}C-NMR ($CDCl_3$, 68 MHz) δ 20.04, 27.15, 27.62, 46.70, 54.56, 55.83, 109.04, 110.41, 122.10, 131.38, 147.73, 151.41, 164.37; EIMS (relative intensity) m/z 263 (M^+, 20), 220 (100), 207 (28), 105 (19), 77 (16); IR(neat) 2936, 1635, 1600, 1456, 1338, 1272, 1092, 1012, 740 cm^{-1}.

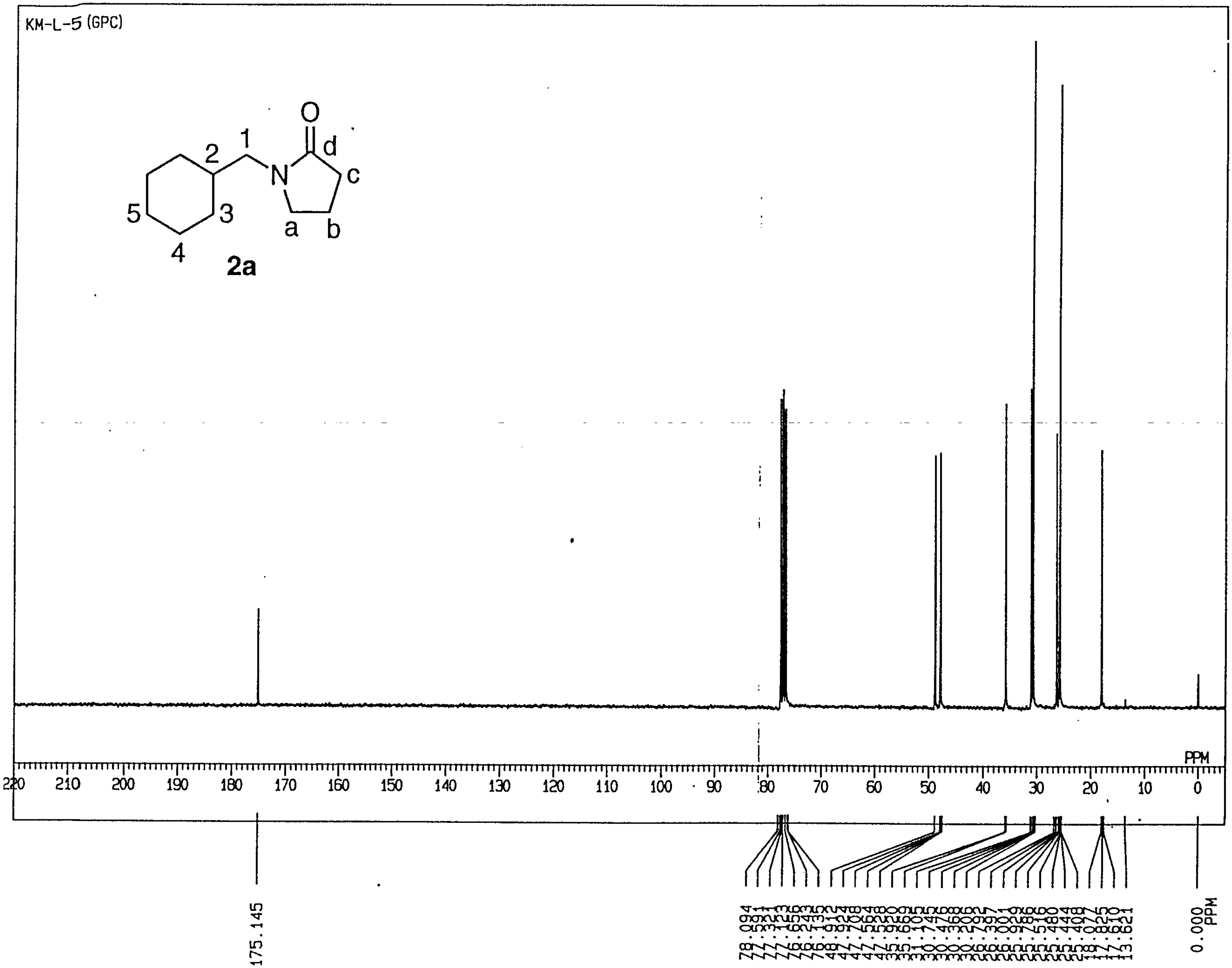


KM-L-5-2, FR. 16-42

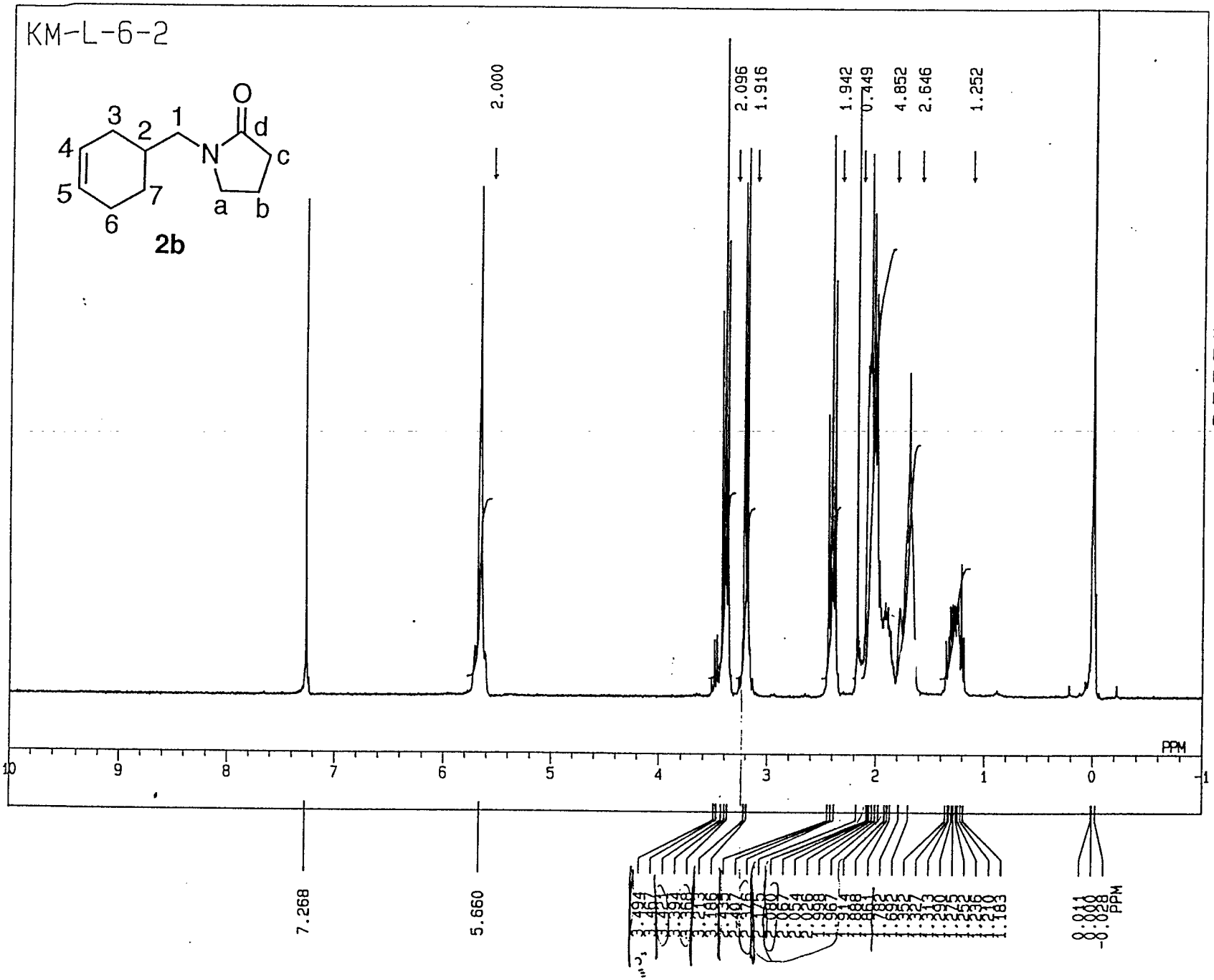


2a

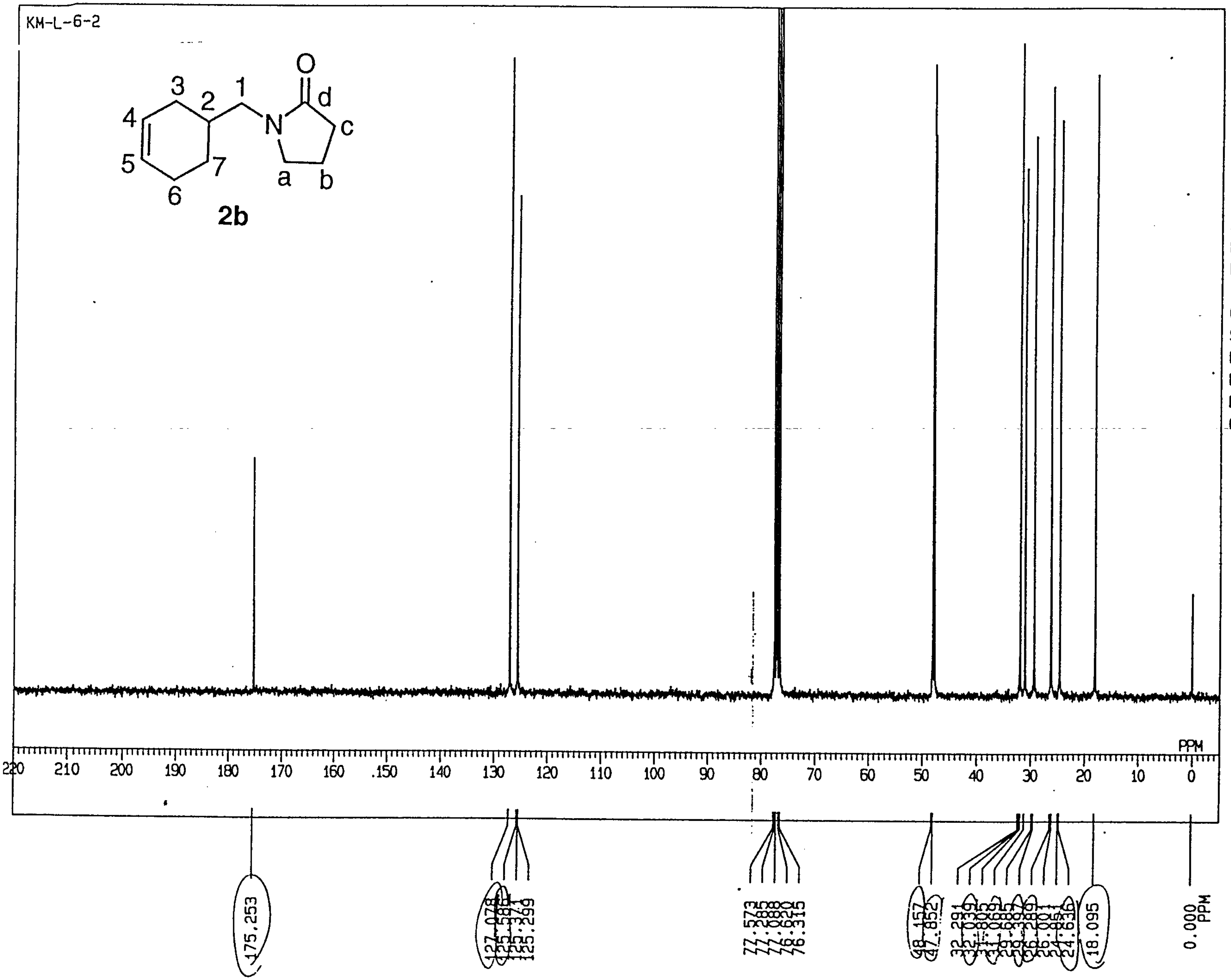
16-FEB-95 22: 47: 20
DFILE SAVING
OBNUC 1H
EXMOD NON
OFR 270.05 MHz
OBSET 112.00 kHz
OBFIN 5800.0 Hz
POINT 32768
FREQU 5405.4 Hz
SCANS 32
ACQTM 3.031 sec
PD 10.000 sec
PW1 4.7 us
IRNUC 1H
CTEMP 20.7 c
SLVNT CDCL3
EXREF 0.00 ppm
BF 0.10 Hz
RGAIN 18
OPERATOR : _____



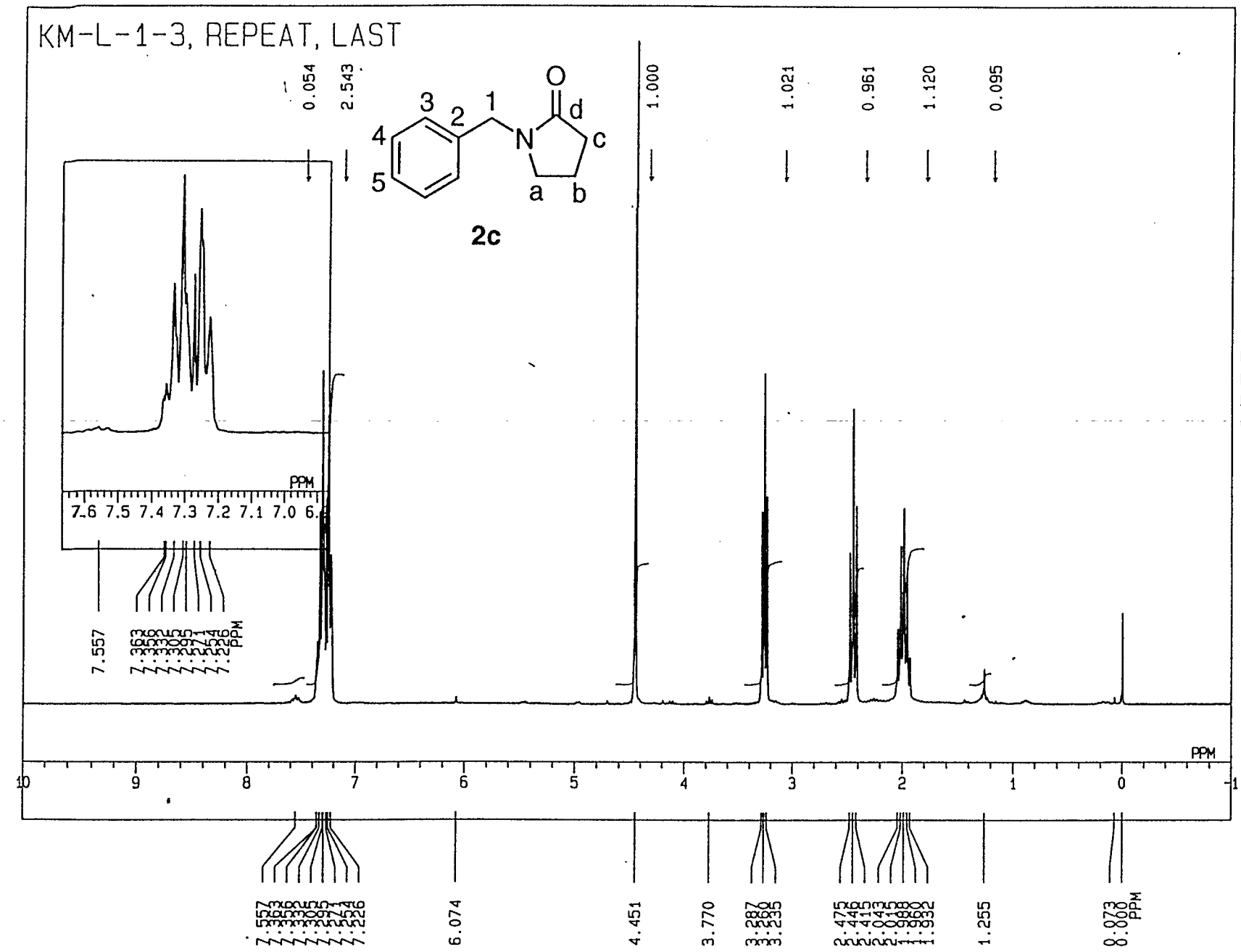
27-FEB-95 04:07:05
DFILE Q13C
OBNUC 13C
EXMOD BCM
OFR 67.80 MHz
OBSET 135.00 kHz
OBFIN 5200.0 Hz
POINT 32768
FREQU 20000.0 Hz
SCANS 2892
ACQTM 0.819 sec
PD 2.181 sec
PW1 4.0 us
IRNUC 1H
CTEMP 21.7 c
SLVNT CDCL3
EXREF 0.00 ppm
BF 1.50 Hz
RGAIN 32
OPERATOR :

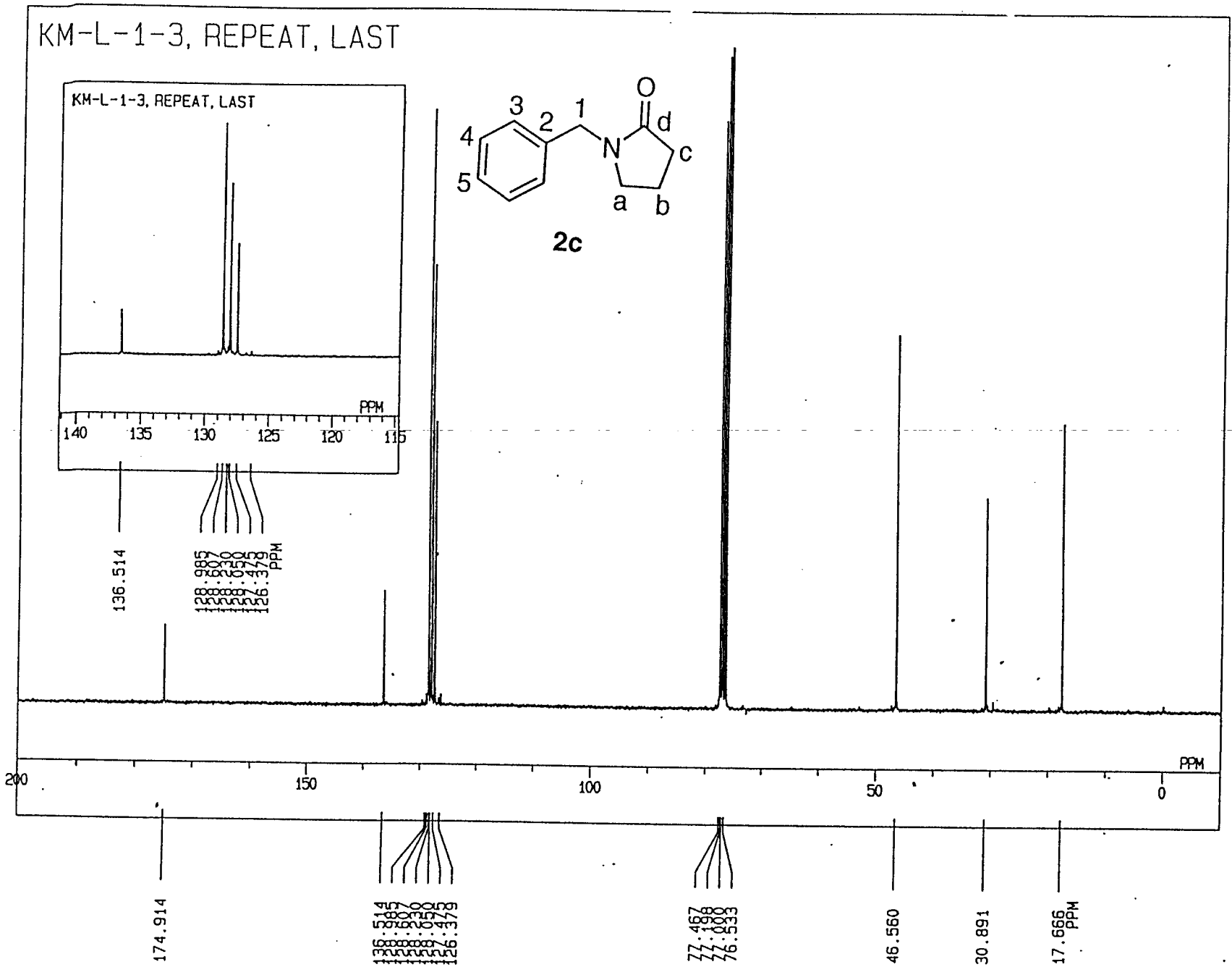


02-MAR-95 21:58:19
OFILE SAVING
OBNUC 1H
EXMOD NON
OFR 270.05 MHz
OBSET 112.00 kHz
OBFIN 5800.0 Hz
POINT 32768
FREQU 5405.4 Hz
SCANS 32
ACQTM 3.031 sec
PD 10.000 sec
PW1 4.7 us
IRNUC 1H
CTEMP 21.1 c
SLVNT CDCL3
EXREF 0.00 ppm
BF 0.10 Hz
RGAIN 19
OPERATOR : _____



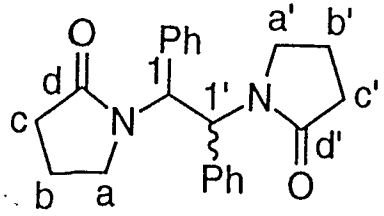
03-MAR-95 05:03:34
DFILE Q13C
OBNUC 13C
EXMOD BCM
OFR 67.80 MHz
OBSET 135.00 kHz
OBFIN 5200.0 Hz
POINT 32768
FREQU 20000.0 Hz
SCANS 3685
ACQTM 0.819 sec
PD 2.181 sec
PW1 4.0 us
IRNUC 1H
CTEMP 21.5 c
SLVNT CDCL3
EXREF 0.00 ppm
BF 1.50 Hz
RGAIN 32
OPERATOR :


KM-L-1-3, REPEAT, LAST
2c
04-OCT-95 17:01:23
DFILE SAVING
OBNUC 1H
EXMOD NON
OFR 270.05 MHz
OBSET 112.00 kHz
OBFIN 5800.0 Hz
POINT 32768
FREQU 5405.4 Hz
SCANS 16
ACQTM 3.031 sec
PD 3.969 sec
PW1 4.7 us
IRNUC 1H
CTEMP 23.7 c
SLVNT CDCL3
EXREF 0.00 ppm
BF 0.10 Hz
RGAIN 16
OPERATOR :
PPM



04-OCT-95 22:37:59
DFILE SAVING
OBNUC 13C
EXMOD BCM
OFR 67.80 MHz
OBSET 135.00 kHz
OBFIN 5200.0 Hz
POINT 32768
FREQU 20000.0 Hz
SCANS 7786
ACQTM 0.819 sec
PD 4.000 sec
PW1 4.0 us
IRNUC 1H
CTEMP 0.0 c
SLVNT CDCL3
EXREF 77.00 ppm
BF 1.22 Hz
RGAIN 18
OPERATOR :

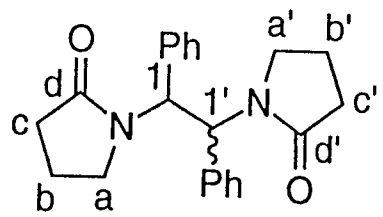
KM-L-1-10, MeOH; Fr.: 2, GPC.1



(more polar isomer)

13-NOV-95 21:40:54
DFILE SAVING
OBNUC 1H
EXMOD NON
OFR 270.05 MHz
OBSET 112.00 kHz
OBFIN 5800.0 Hz
POINT 32768
FREQU 5405.4 Hz
SCANS 16
ACQTM 3.031 sec
PD 3.969 sec
PW1 4.7 us
IRNUC 1H
CTEMP 19.9 c
SLVNT CDCL3
EXREF 0.00 ppm
BF 0.10 Hz
RGAIN 21
OPERATOR : _____

KM-L-1-10, MeOH; Fr:2, GPC:1

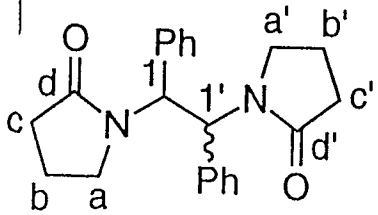


2c' (more polar isomer)

13-NOV-95 23:51:48
DFILE SAVING
OBNUC 13C
EXMOD BCM
OFR 67.80 MHz
OBSET 135.00 kHz
OBFIN 5200.0 Hz
POINT 32768
FREQU 20000.0 Hz
SCANS 6153
ACQTM 0.819 sec
PD 4.000 sec
PW1 4.0 us
IRNUC 1H
CTEMP 0.0 c
SLVNT CDCL3
EXREF 0.00 ppm
BF 1.22 Hz
RGAIN 18
OPERATOR : _____

Fr. 30 ~,

KM-L-1-11~14, X (GPC)

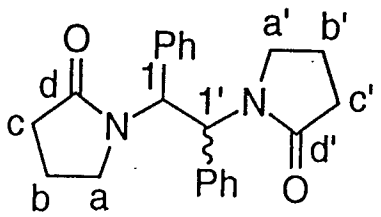


2 c' (less polar isomer)

25-NOV-95 02: 03: 47
DFILE SAVING
OBNUC 1H
EXMOD NON
OFR 270.05 MHz
OBSET 112.00 kHz
OBFIN 5800.0 Hz
POINT 32768
FREQU 5405.4 Hz
SCANS 32
ACQTM 3.031 sec
PD 10.000 sec
PW1 4.7 us
IRNUC 1H
CTEMP 18.9 c
SLVNT CDCL3
EXREF 0.00 ppm
BF 0.10 Hz
RGAIN 17
OPERATOR : _____

S17

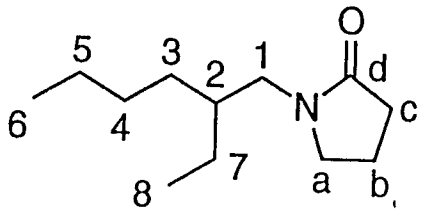
KM-L-1-11~14, X (GPC)



2c' (less polar isomer)

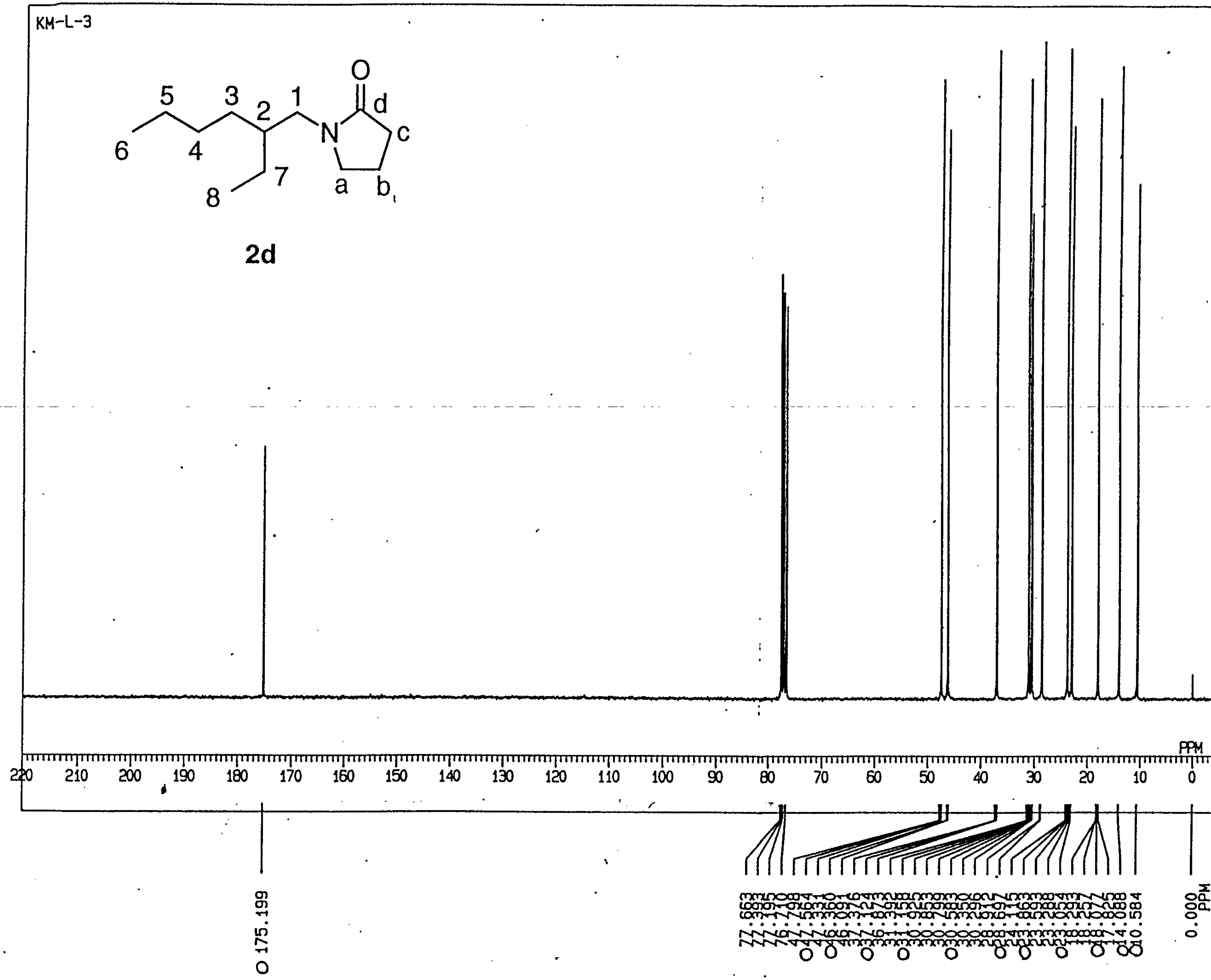
25-NOV-95 11:29:54
DFILE SAVING
OBNUC 13C
EXMOD BCM
OFR 67.80 MHz
OBSET 135.00 kHz
OBFIN 5200.0 Hz
POINT 32768
FREQU 20000.0 Hz
SCANS 770
ACQTM 0.819 sec
PD 4.000 sec
PW1 4.0 us
IRNUC 1H
CTEMP 0.0 c
SLVNT CDCL3
EXREF 0.00 ppm
BF 1.22 Hz
RGAIN 18
OPERATOR : _____

KM-L-3

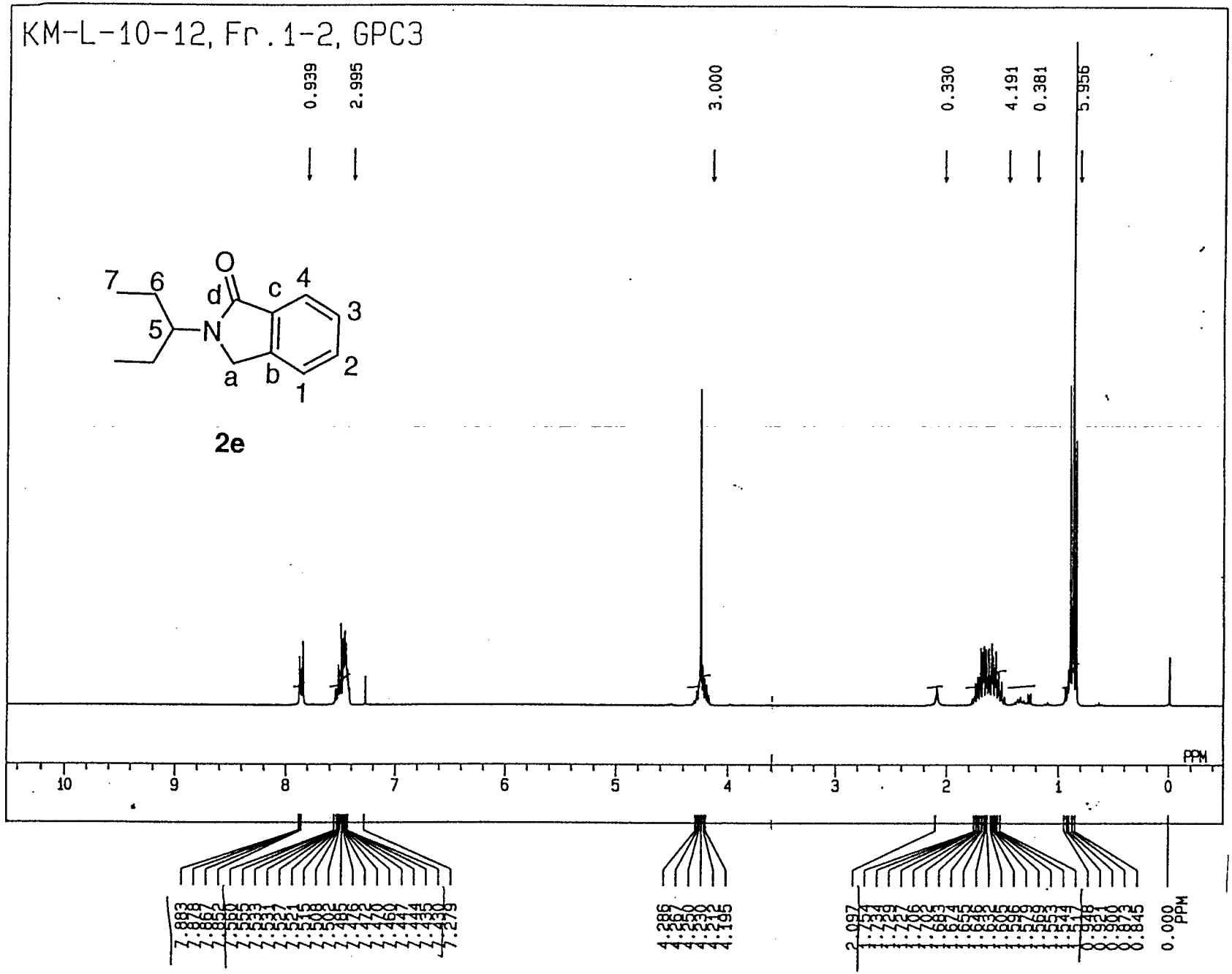


2d

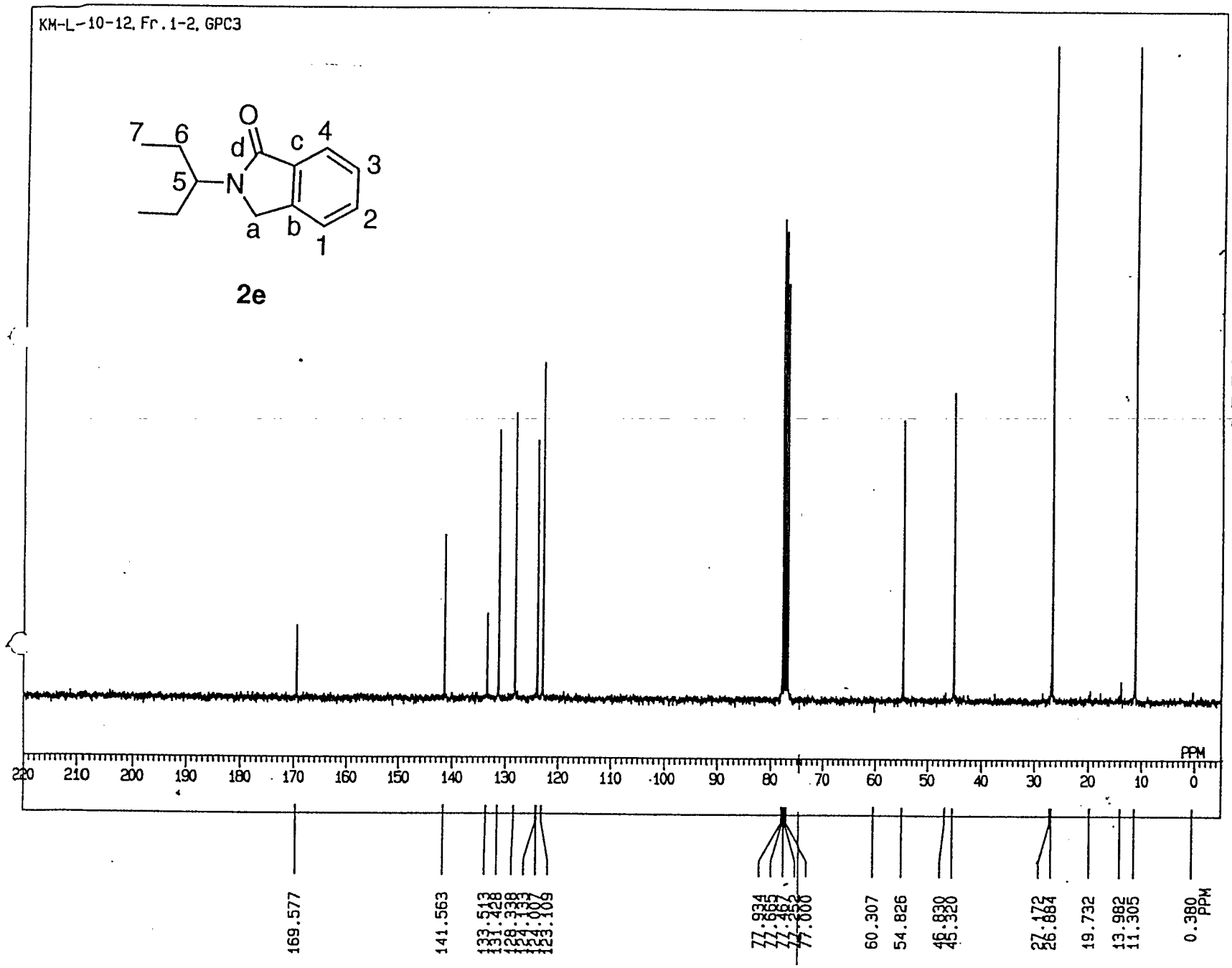
19-JAN-96 21:32:15
DFILE SAVING
OBNUC 1H
EXMOD NON
OFR 270.05 MHz
OBSET 112.00 kHz
OBFIN 5800.0 Hz
POINT 32768
FREQU 5405.4 Hz
SCANS 48
ACQTM 3.031 sec
PD 10.000 sec
PW1 4.7 us
IRNUC 1H
CTEMP 20.1 c
SLVNT CDCL3
EXREF 0.00 ppm
BF 0.10 Hz
RGAIN 12
OPERATOR : _____



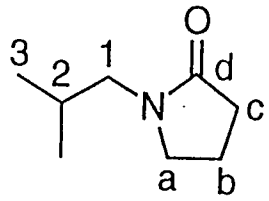
?3-JAN-96 04: 48: 39
DFILE Q13C
OBNUC 13C
EXMOD BCM
OFR 67.80 MHz
OBSET 135.00 kHz
OBFIN 5200.0 Hz
POINT 32768
FREQU 20000.0 Hz
SCANS 4290
ACQTM 0.819 sec
PD 2.181 sec
PW1 4.0 us
IRNUC 1H
CTEMP 20.6 c
SLVNT CDCL3
EXREF 0.00 ppm
BF 1.50 Hz
RGAIN 32
OPERATOR : ________



31-OCT-97 02:04:29
DFILE SAVING
OBNUC 1H
EXMOD NON
OFR 270.05 MHz
OBSET 112.00 kHz
OBFIN 5800.0 Hz
POINT 32768
FREQU 5405.4 Hz
SCANS 100
ACQTM 3.031 sec
PD 3.969 sec
PW1 4.7 us
IRNUC 1H
CTEMP 23.3 c
SLVNT CDCL3
EXREF 0.00 ppm
BF 0.10 Hz
RGAIN 15
OPERATOR: _____


KM-L-10-12, Fr.1-2, GPC3
31-OCT-97 03:32:54
DFILE Q13C
OBNUC 13C
EXMOD BCM
OFR 67.80 MHz
OBSET 135.00 kHz
OBFIN 5200.0 Hz
POINT 32768
FREQU 20000.0 Hz
SCANS 1184
ACQTM 0.819 sec
PD 2.181 sec
PW1 4.0 us
IRNUC 1H
CTEMP 23.9 c
SLVNT CDCL3
EXREF 77.00 ppm
BF 1.50 Hz
RGAIN 32
OPERATOR :
O
d
c
4
7
6
3
5
N
2
a
b
1
2e
PPM
220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
169.577
141.563
133.513
131.428
128.338
124.007
123.109
77.934
77.665
77.382
77.000
60.307
54.826
46.830
45.320
27.172
26.884
19.732
13.982
11.305
0.380
PPM

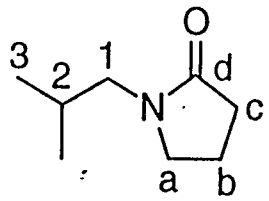
KM-L-16-5, Fr.24-30



2f

30-JUN-97 15:32:55
DFILE SAVING
OBNUC 1H
EXMOD NON
OFR 270.05 MHz
OBSET 112.00 kHz
OBFIN 5800.0 Hz
POINT 32768
FREQU 5405.4 Hz
SCANS 16
ACQTM 3.031 sec
PD 3.969 sec
PW1 4.7 us
IRNUC 1H
CTEMP 25.6 c
SLVNT CDCL3
EXREF 0.00 ppm
BF 0.10 Hz
RGAIN 15
OPERATOR :

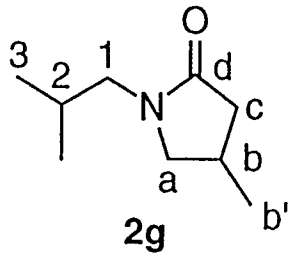
KM-L-16-6, Fr.2



2f

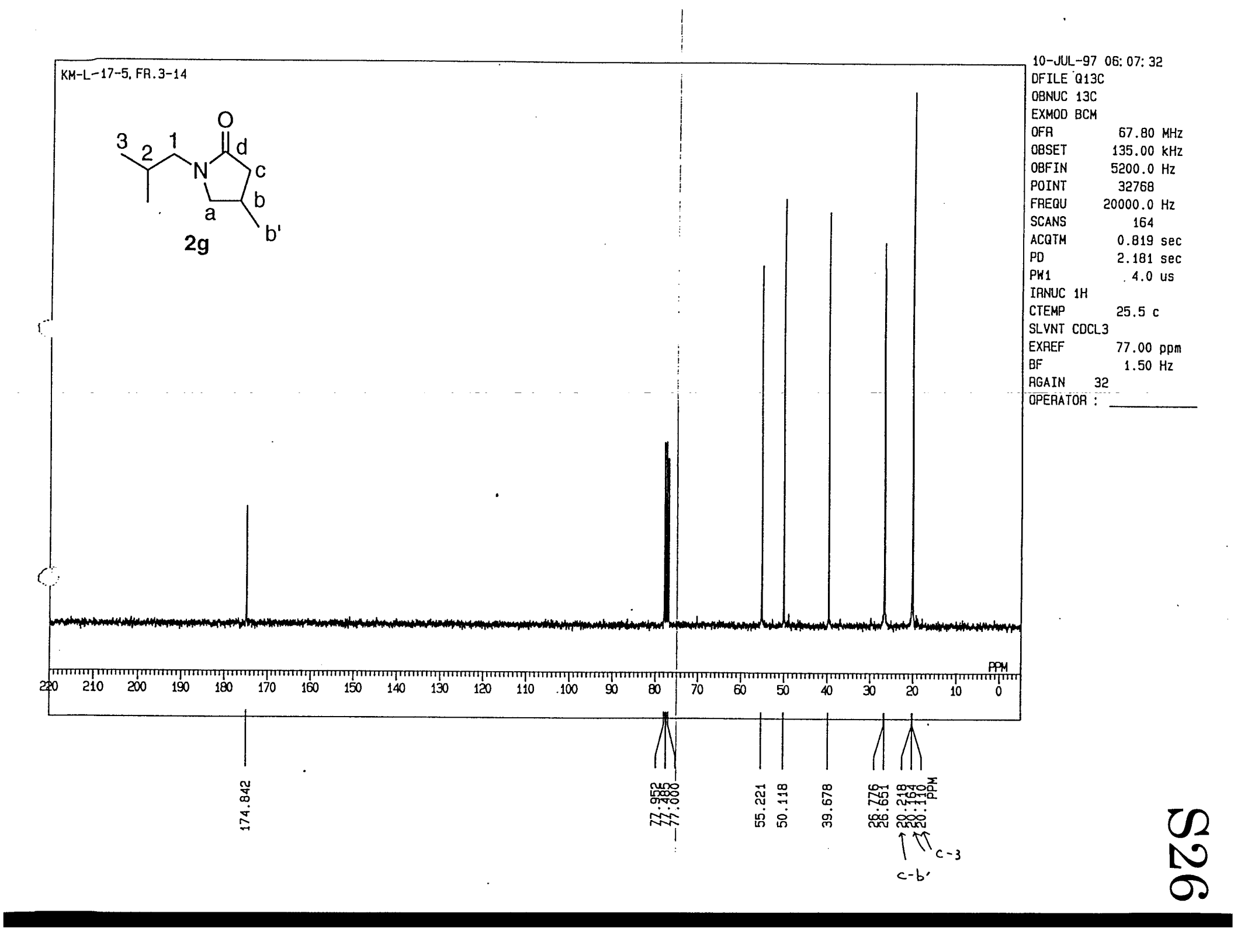
04-JUL-97 02:19:59
DFILE SAVING
OBNUC 13C
EXMOD BCM
OFR 67.80 MHz
OBSET 135.00 kHz
OBFIN 5200.0 Hz
POINT 32768
FREQU 20000.0 Hz
SCANS 936
ACQTM 0.819 sec
PD 4.000 sec
PW1 4.0 us
IRNUC 1H
CTEMP 0.0 c
SLVNT CDCL3
EXREF 77.00 ppm
BF 1.22 Hz
RGAIN 18
OPERATOR :

KM-L-17-5, FR.4



2g

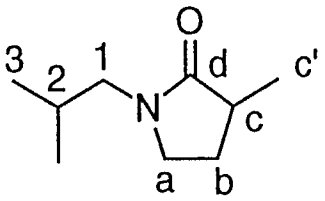
10-JUL-97 03: 44: 07
DFILE SAVING
OBNUC 1H
EXMOD NON
OFR 270.05 MHz
OBSET 112.00 kHz
OBFIN 5800.0 Hz
POINT 32768
FREQU 5405.4 Hz
SCANS 16
ACQTM 3.031 sec
PD 3.969 sec
PW1 4.7 us
IRNUC 1H
CTEMP 24.6 c
SLVNT CDCL3
EXREF 0.00 ppm
BF 0.10 Hz
RGAIN 14
OPERATOR : _____


KM-L-17-5, FR.3-14
2g
10-JUL-97 06:07:32
DFILE Q13C
OBNUC 13C
EXMOD BCM
OFR 67.80 MHz
OBSET 135.00 kHz
OBFIN 5200.0 Hz
POINT 32768
FREQU 20000.0 Hz
SCANS 164
ACQTM 0.819 sec
PD 2.181 sec
PW1 4.0 us
IRNUC 1H
CTEMP 25.5 c
SLVNT CDCL3
EXREF 77.00 ppm
BF 1.50 Hz
RGAIN 32
OPERATOR :
PPM
174.842
77.952
77.485
77.000
55.221
50.118
39.678
28.776
28.651
20.218
20.164
20.110
c-3
c-b'

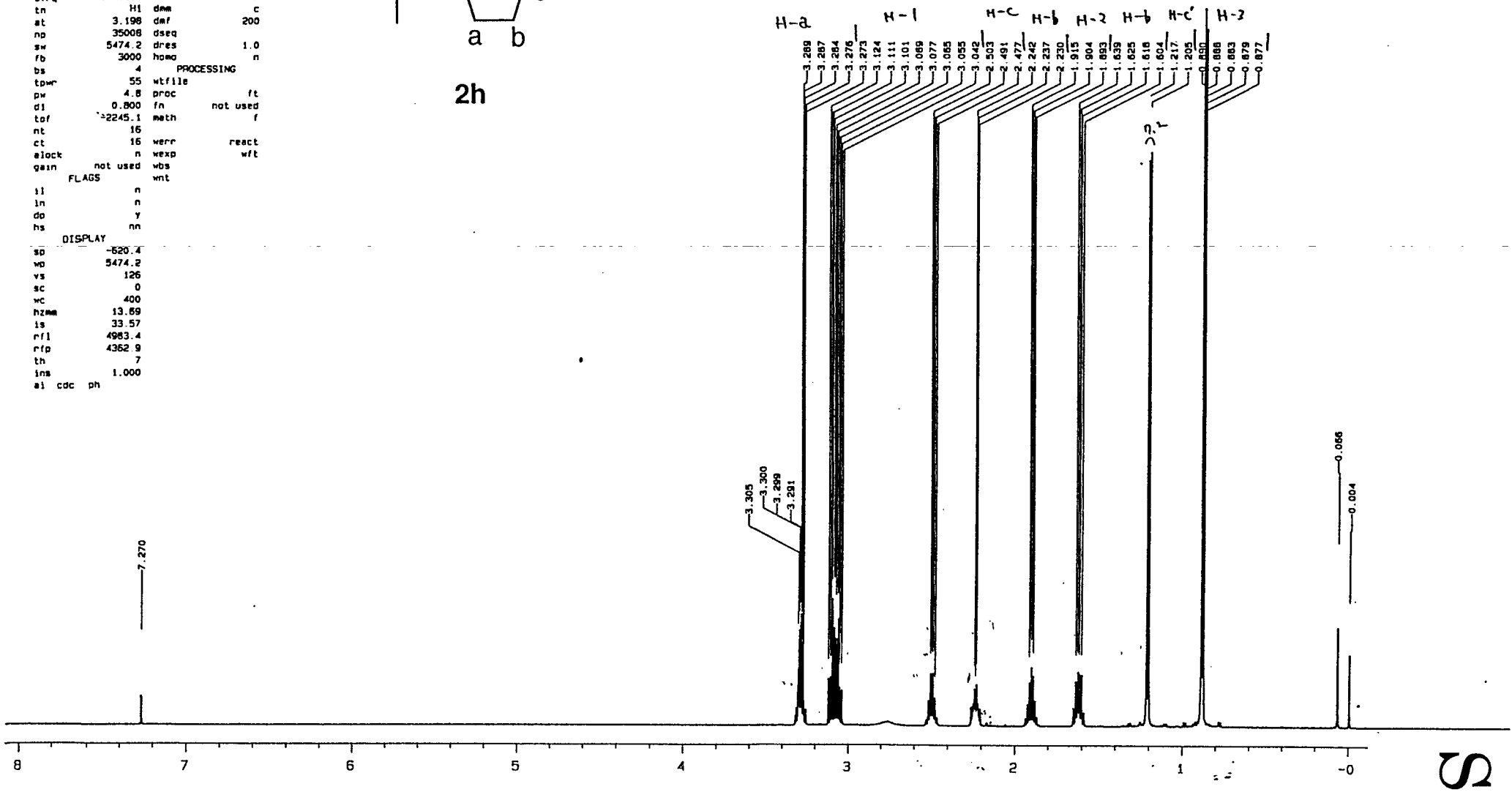
KM-L-31-4, Fr. 11

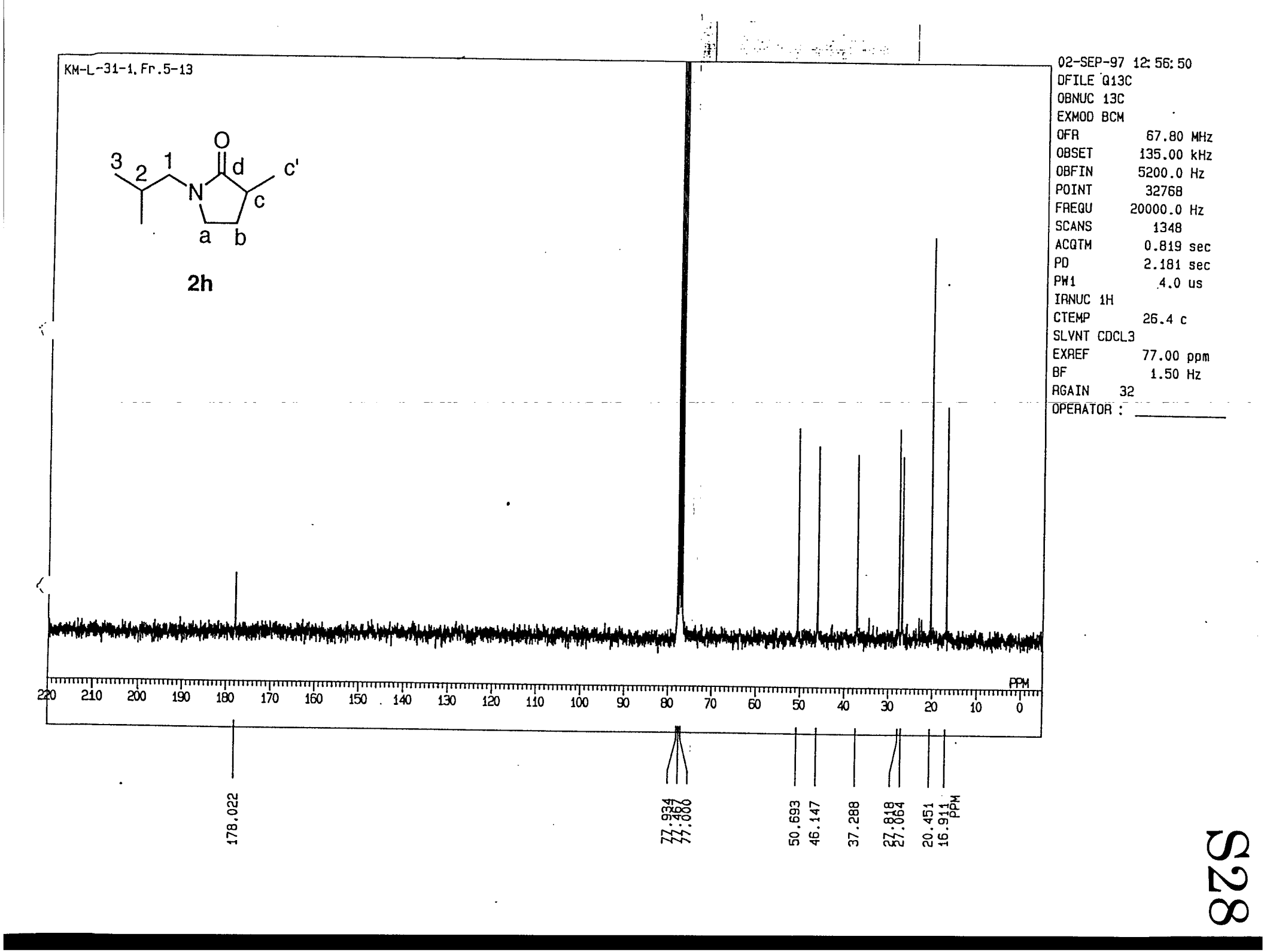
exp3 s2pul

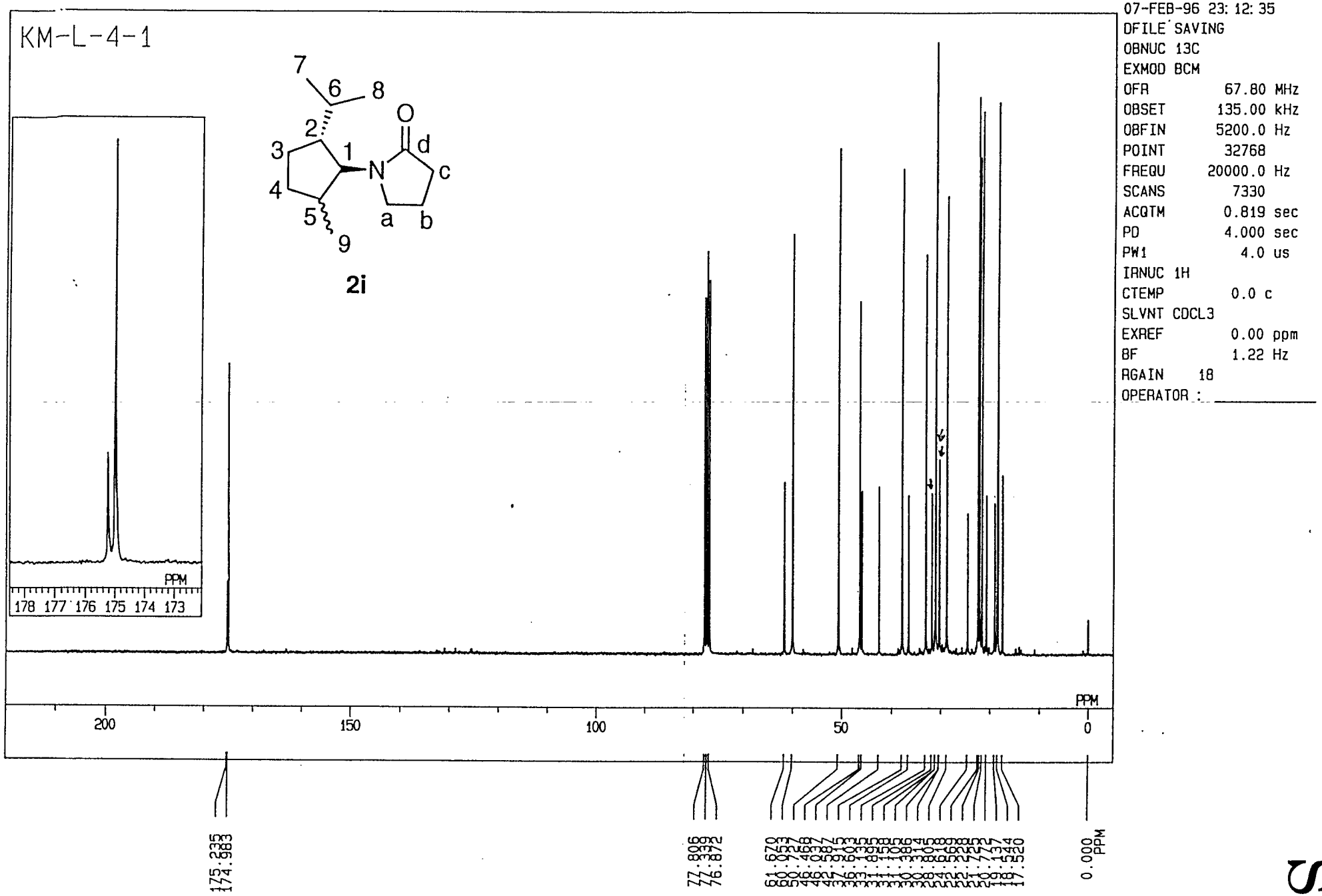
SAMPLE		DEC. & VT	
date	Dec 20 97	dfrq	600.133
solvent	CDCl3	dn	H1
file	exp	dpwr	18
ACQUISITION		dof	0
sfrq	600.130	dm	nnn
tn	H1	dmm	c
at	3.198	dmf	200
np	35008	dseq	
sw	5474.2	dres	1.0
fb	3000	homo	n
bs	4	PROCESSING	
tpwr	55	wtfile	
pw	4.8	proc	ft
d1	0.800	fn	not used
tof	2245.1	math	f
nt	16		
ct	16	werr	react
alock	n	wexp	wft
gain	not used	wbs	
FLAGS		wnt	
il	n		
in	n		
dp	y		
hs	nn		
DISPLAY			
sp	-620.4		
wp	5474.2		
vs	126		
sc	0		
wc	400		
hzmm	13.69		
is	33.57		
rfl	4983.4		
rfp	4362.9		
th	7		
ins	1.000		
ai cdc ph			

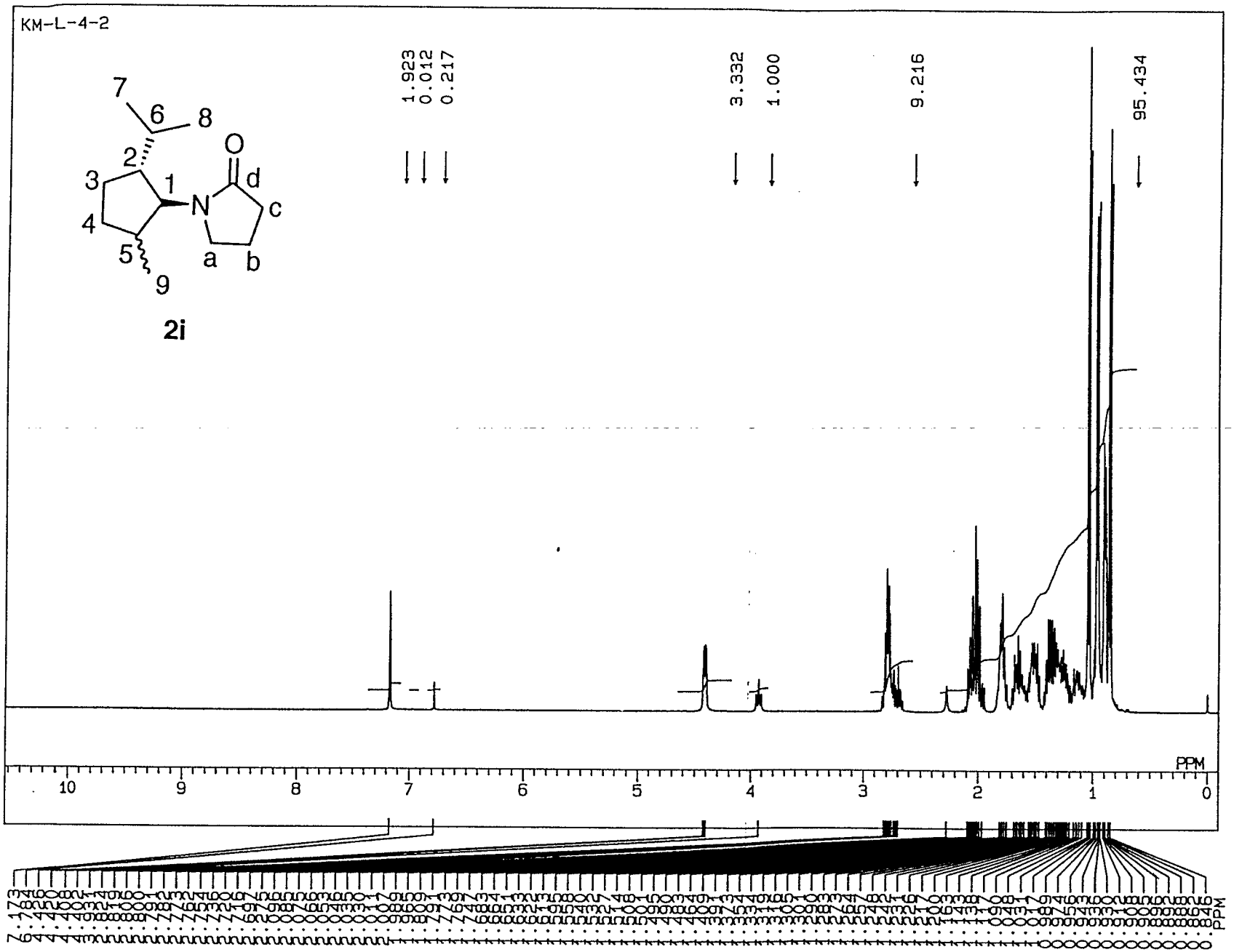


2h



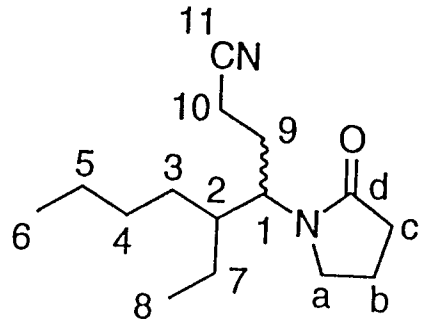

KM-L-31-1. Fr.5-13
2h
02-SEP-97 12:56:50
DFILE Q13C
OBNUC 13C
EXMOD BCM
OFR 67.80 MHz
OBSET 135.00 kHz
OBFIN 5200.0 Hz
POINT 32768
FREQU 20000.0 Hz
SCANS 1348
ACQTM 0.819 sec
PD 2.181 sec
PW1 4.0 us
IRNUC 1H
CTEMP 26.4 c
SLVNT CDCL3
EXREF 77.00 ppm
BF 1.50 Hz
RGAIN 32
OPERATOR :
PPM
178.022
77.934
77.467
77.000
50.693
46.147
37.288
27.818
27.064
20.451
16.911


KM-L-4-1
2i
07-FEB-96 23: 12: 35
DFILE SAVING
OBNUC 13C
EXMOD BCM
OFR 67.80 MHz
OBSET 135.00 kHz
OBFIN 5200.0 Hz
POINT 32768
FREQU 20000.0 Hz
SCANS 7330
ACQTM 0.819 sec
PD 4.000 sec
PW1 4.0 us
IRNUC 1H
CTEMP 0.0 c
SLVNT CDCL3
EXREF 0.00 ppm
BF 1.22 Hz
RGAIN 18
OPERATOR :
PPM
178 177 176 175 174 173
200
150
100
50
0
PPM
175.235
174.983
77.606
76.872
0.000
PPM



08-MAR-96 12:56:01
DFILE Q1H
COMNT KM-L-4-2
EXMOD SGNON
OBNUC 1H
OBFIN 10492.9 Hz
POINT 32768
FREQU 12019.2 Hz
SCANS 16
ACQTM 1.363 sec
PD 3.637 sec
PW1 7.7 us
IRFIN 10300.0 Hz
IRATN 15
IRAPW 60 us
TEMP. 27.0 c
SLVNT C6D6
EXREF 0.00 ppm
BF 0.37 Hz
RGAIN 6
XE 4249.5640 Hz
XS -81.3550 Hz

KM-L-35-3, Fr.EtOAc100%



2j

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03-FEB-98 08:24:01
DFILE SAVING
OBNUC 13C
EXMOD BCM
OFR          67.80 MHz
OBSET       135.00 kHz
OBFIN        5200.0 Hz
POINT         32768
FREQU       20000.0 Hz
SCANS           161
ACQTM         0.819 sec
PD            4.000 sec
PW1             4.0 us
IRNUC 1H
CTEMP           0.0 c
SLVNT CDCL3
EXREF         77.00 ppm
BF             1.22 Hz
RGAIN    18
OPERATOR :
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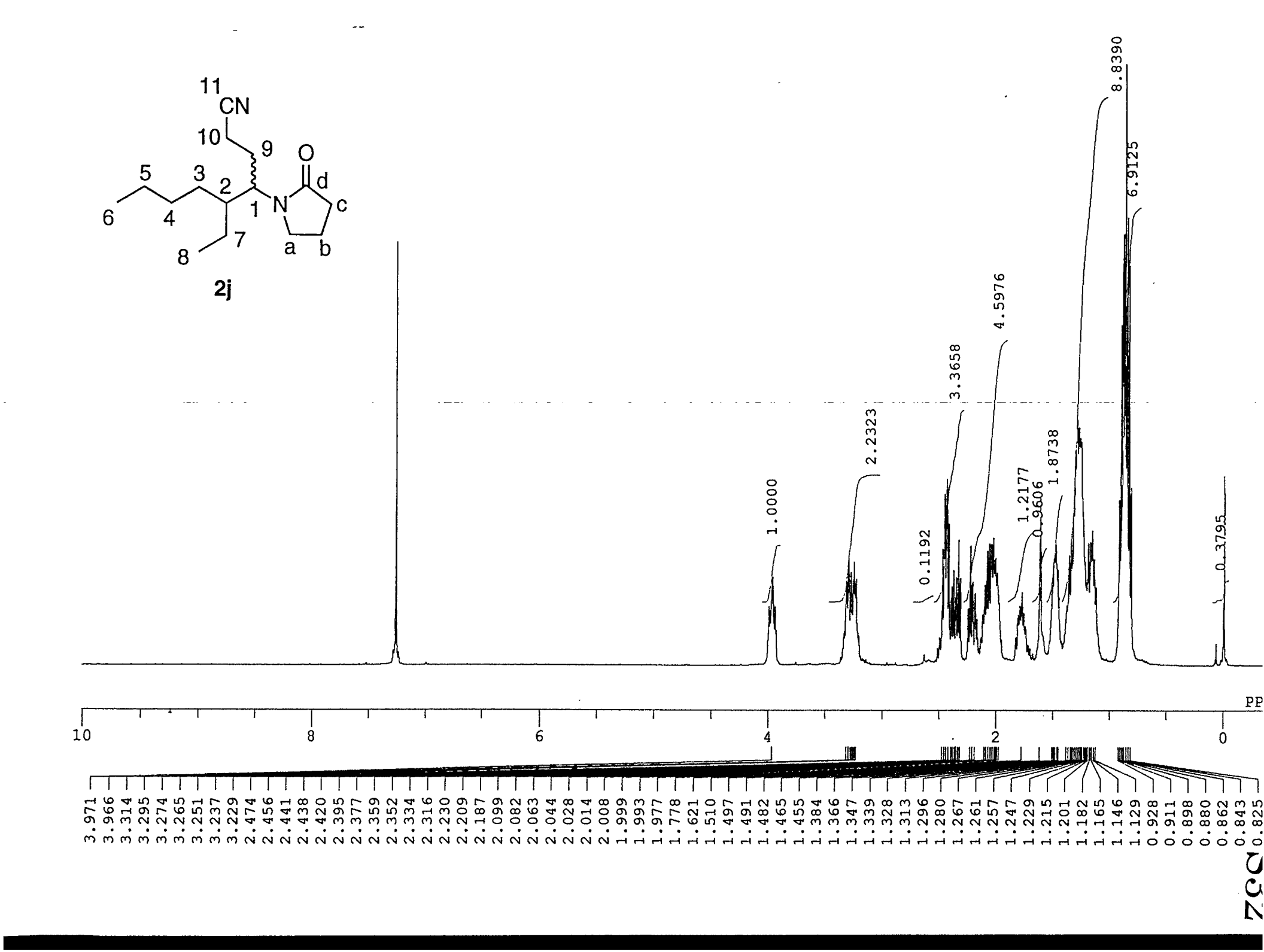
11
CN
10
9
O
5
3
2
d
6
4
1
N
c
7
a
b
8
2j
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6.9125
4.5976
3.3658
2.2323
1.0000
0.1192
1.2177
0.9606
1.8738
0.3795
PP
10
8
6
4
2
0
3.971
3.966
3.314
3.295
3.274
3.265
3.251
3.237
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2.474
2.456
2.441
2.438
2.420
2.395
2.377
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2.352
2.334
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2.230
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2.099
2.082
2.063
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1.229
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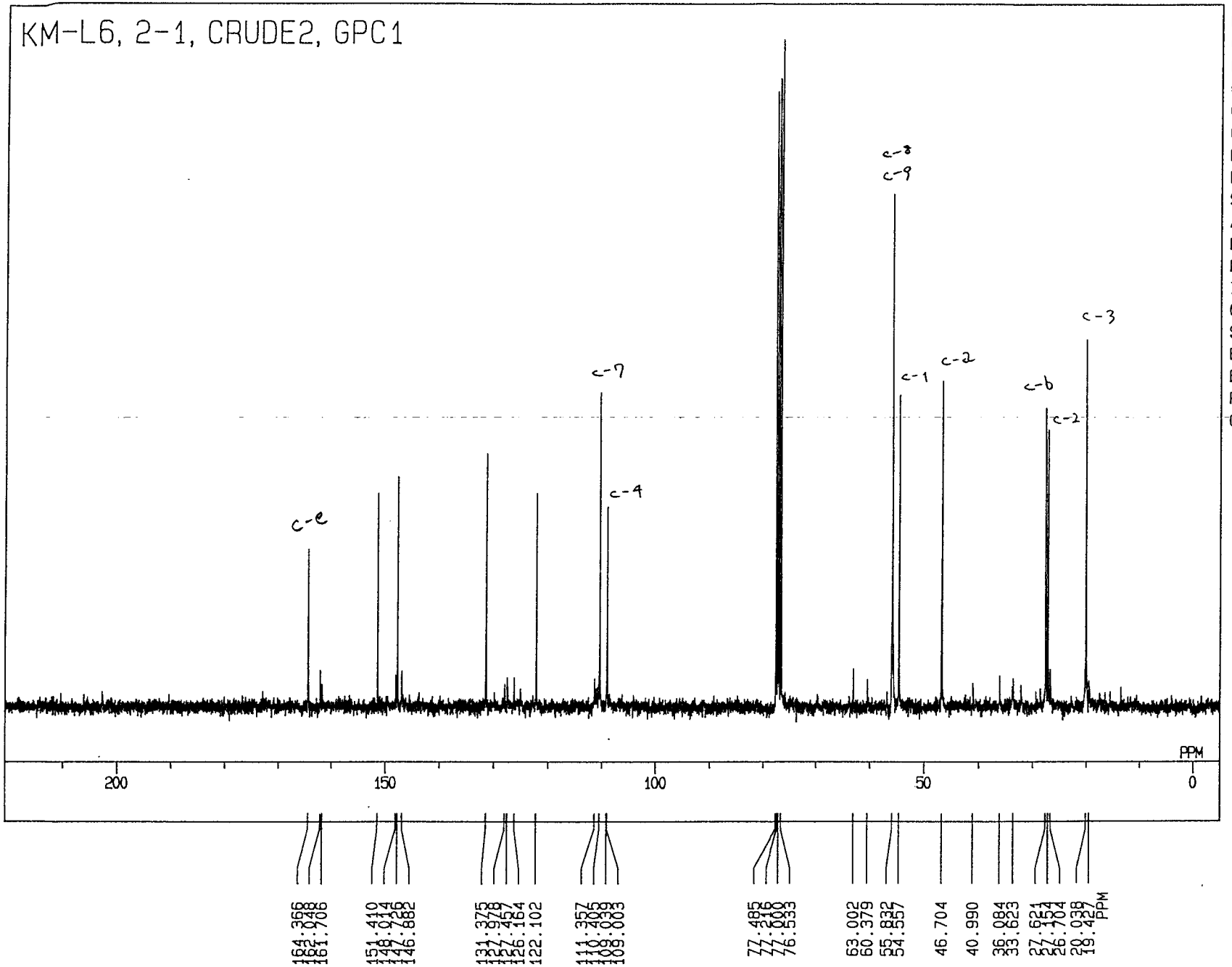
0.825



13-FEB-98 01:08:38
OFILE SAVING
OBNUC 13C
EXMOD BCM
OFR 67.80 MHz
OBSET 135.00 kHz
OBFIN 5200.0 Hz
POINT 32768
FREQU 20000.0 Hz
SCANS 358
ACQTM 0.819 sec
PD 4.000 sec
PW1 4.0 us
IRNUC 1H
CTEMP 24.0 c
SLVNT CDCL3
EXREF 77.00 ppm
BF 1.22 Hz
RGAIN 32
OPERATOR :