Supporting Information

Synergistic Palladium/Enamine Catalysis for Asymmetric Hydrocarbon Functionalization of Unactivated Alkenes with Ketones

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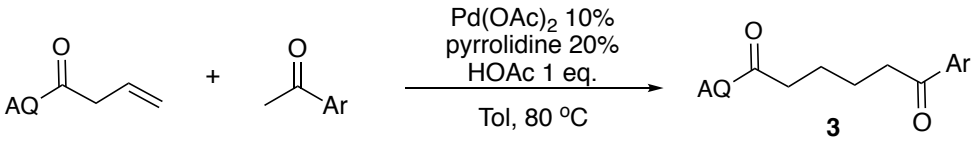
I. General Methods and Materials

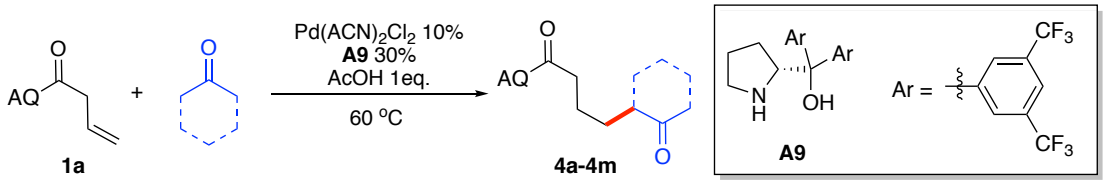
All of the reactions dealing with air and/or moisture-sensitive compounds were carried out under an atmosphere of argon using oven/flame-dried glassware and standard syringe/septa techniques. Unless otherwise noted, all commercial reagents and solvents were obtained from the commercial provider and used without further purification. ^{1}H NMR and ^{13}C NMR spectra were recorded on Varian 400 MHz spectrometers. Chemical shifts were reported relative to internal tetramethylsilane (δ 0.00 ppm) or $CDCl_3$ (δ 7.26 ppm) or DMSO (2.50 ppm) for ^{1}H and $CDCl_3$ (δ 77.16 ppm), DMSO (40.00 ppm) for ^{13}C. Flash column chromatography was performed on 230-430 mesh silica gel. Analytical thin layer chromatography was performed with precoated glass baked plates (250 μ) and visualized by fluorescence and by charring after treatment with potassium permanganate stain. HRMS were recorded on Agilent 6540 LC/QTOF spectrometer.

1.1 General procedure to synthesize 3a-3n:



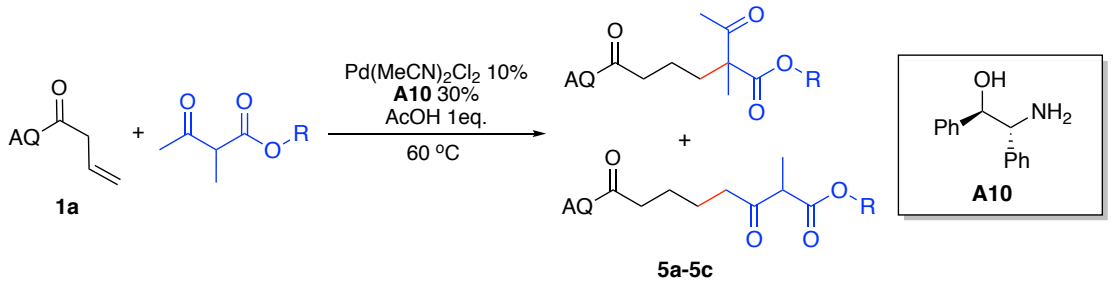
An oven-dried vial was charged with $Pd(OAc)_2$ (10 mol%, 0.02 mmol), HOAc (1 equiv., 0.2 mmol), ketone (3 equiv., 0.6 mmol) and pyrrolidine (20 mol%, 0.04 mmol). The vial was placed under vacuum and charged with Ar. Alkene (**1a**) (1 equiv., 0.2 mmol), and toluene (1M, 0.2 mL) was added into the vial sequentially under Ar atmosphere. The reaction was run under 80 °C and monitored by TLC. Once the reaction completed, the solvent was removed under vacuum, and the resulting crude mixture was loaded on a silica gel column directly and purified by flash chromatography to give desired product.

1.2 General procedure to synthesize 4a-4l:



An oven-dried vial was charged with $Pd(MeCN)_2Cl_2$ (10 mol%, 0.02 mmol), HOAc (1 equiv., 0.2 mmol), ketone (4 equiv., 0.8 mmol) and **A9** (30 mol%, 0.06 mmol). The vial was placed under vacuum and charged with Ar. Alkene (**1a**) (1 equiv., 0.2 mmol) was added into the vial sequentially under Ar atmosphere. The reaction was run under 60 °C and monitored by TLC. Once the reaction completed, the crude mixture was loaded on a silica gel column directly and purified by flash chromatography to give desired product.

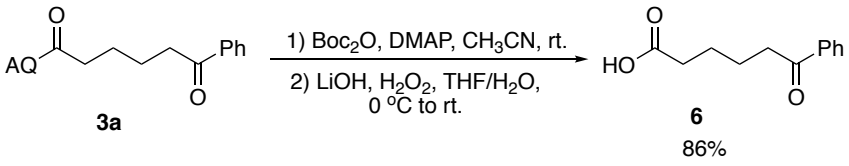
1.3 General procedure to synthesize 5a-5c:



1a **5a-5c**

An oven-dried vial was charged with $Pd(MeCN)_2Cl_2$ (10 mol%, 0.02 mmol), HOAc (1 equiv., 0.2 mmol), ketone ester (3 equiv., 0.6 mmol) and **A10** (30 mol %, 0.6 mmol). The vial was placed under vacuum and charged with Ar. Alkene (**1a**) (1 equiv., 0.2 mmol) was added into the vial sequentially under Ar atmosphere. The reaction was run under 60 °C and monitored by TLC. Once the reaction completed, the crude mixture was loaded on a silica gel column directly and purified by flash chromatography to give desired product.

1.4 Removal of directing group:[1]



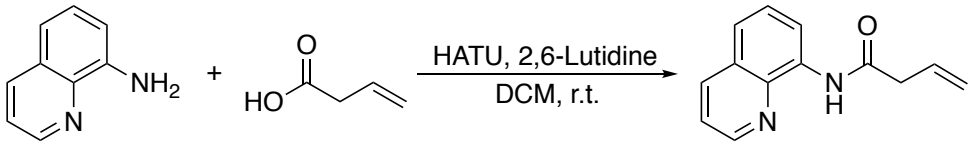
3a **6**

86%

An oven-dried flask was added compound **3a** (1 mmol), Boc_2O (4 equiv., 4 mmol), DMAP (1.5 equiv., 1.5 mmol), and dry acetonitrile (15 mL) then placed under vacuum and charged with Ar. The reaction was run under room temperature and monitored by TLC. Once the reaction completed, the crude mixture was purified by flash chromatography (Hexane: Ethyl Acetate = 3:1, R_f = 0.2) on silica gel and the product was used in the next step.

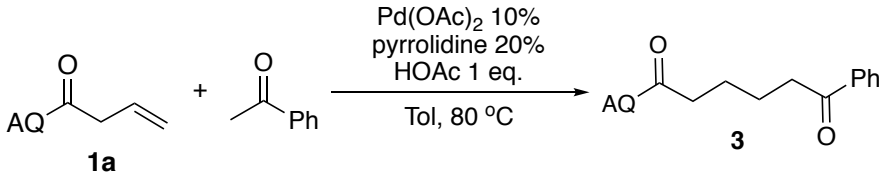
The product from the previous step was employed in THF/ H_2O (13 mL : 4.5 mL) and cooled to 0 ˚C, followed by the addition of LiOH (1.1 eq.) and H_2O_2 (9 eq.). The reaction was run at 0 ˚C until the reaction was done, then $Na_2S_2O_3$ solution (aq., 1.5 M, 10 mL) was added. The solution was washed with DCM 20 mL twice. The aqueous phase was extracted with EA (25 mL) three times. The organic phase was combined, washed with brine (20 mL) and dried with Na_2SO_4, then the solvent was evaporated under vacuum. The crude mixture was purified by flash chromatography (EA : Hexanes = 3:1, R_f = 0.32) to give the desired product **6** with 86% overall yield for two steps.

1.5 Synthesis of N(quinolin-8-yl)but-3-enamide 1a:



8-Aminoquinoline (10 mmol), vinyl acetic acid (1.3 eq., 13 mmol), and DCM (30 mL) were added in a 100 mL round bottom flask. 2,6-Lutidine (2 eq., 20 mmol) and HATU (1.3 eq., 1.3 mmol) were charged sequentially at r.t. The reaction was monitored by TLC. Upon the reaction completed, H_2O (80 mL) was added into the mixture and extracted by DCM (3*40 mL). The organic layer was combined, washed with sat. $NaHCO_3$ and brine, and then dried over Na_2SO_4. The solvent was evaporated under vacuum. The crude mixture was purified by flash chromatography (ethyl acetate: hexanes = 3:1) to give the desired product **1a** (1.87 g, 88% yield) as a yellow oil. The physical and spectroscopic data matched with literature.[2]

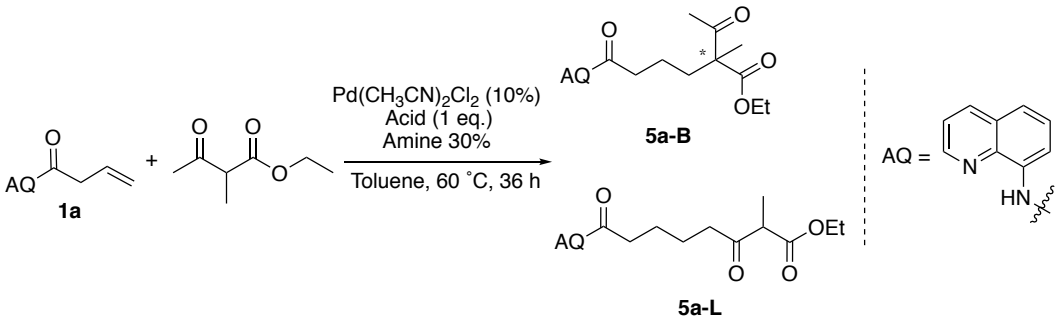
1.6 Gram-scale synthesis of 3a:

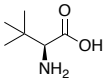
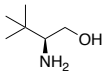
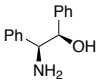
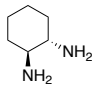
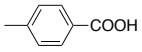
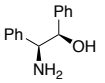
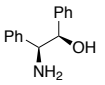
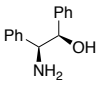
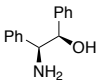
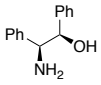


An oven-dried 25mL round-bottom flask was charged with $Pd(OAc)_2$ (10 mol%, 92 mg, 0.41 mmol), HOAc (1 equiv., 0.24 mL, 4.1 mmol), alkene (**1a**) (1 equiv., 870 mg, 4.1 mmol), acetophenone (3 equiv., 1.48 g, 12.3 mmol), pyrrolidine (20 mol%, 68 μL, 0.82

mmol) and toluene (1M, 4.1 mL). The vial was placed under vacuum and charged with Ar. The reaction was run under 80 °C and monitored by TLC. Once the reaction completed, the solvent was evaporated by vacuum and the crude mixture was purified by flash chromatography (Hexane: Ethyl Acetate = 3:1) on silica gel to give desired product **3a** (1.27 g, 94%).

II. Extensive screening of catalysts for dicarbonyl compounds:[a]

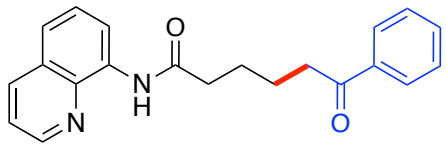


Entry	Acid	Amine/Ligand	Conv.	Yield	*ee*%	**B/L**
1	HOAc		52%	46%	<5%	86 : 14
2	HOAc		47%	43%	40%	50 : 50
3	HOAc		64%	61%	62%	47 : 53
4	HOAc		<10%	<10%	-	-
5			69%	63%	48%	43 : 57
6	HOAc (2 eq.)		62%	60%	52%	45 : 55
7[b]	HOAc		100%	99%	63%	47 : 53
8	HOAc	MOX ligand[c]	74%	70%	12%	90 : 10
9	HOAc	 and MOX ligand[c]	40%	39%	20%	74 : 26
10	HOAc	 and s-BINAP	10%	0%	-	-

Reaction conditions: [a] Reaction conditions: $Pd(CH_3CN)_2Cl_2$. (10 mol%), ligand **A9** (30 mol%), AcOH (1 eq.), 36 hours. Yield were determined by 1H NMR using 1,3,5-trimethoxybenzene as internal standard. The dr and *ee* was determined by HPLC. [b] neat. [c] *See ref 4*

III. Compounds Characterization

3a



6-oxo-6-phenyl-*N*-(quinolin-8-yl)hexanamide

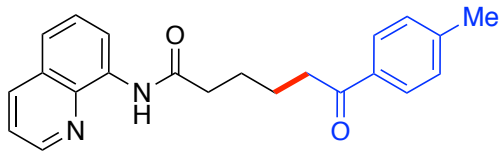
3a was prepared following the General Procedure **1.1** and purified by flash Chromatography (hexanes/ethyl acetate = 3:1, R_f = 0.21) to give white solid (62 mg, 94% yield). 36 hours. MP: 85 °C.

^{1}H NMR (400 MHz, $CDCl_3$) δ 9.83 (s, 1H), 8.96 – 8.62 (m, 2H), 8.16 (dd, *J* = 8.2, 1.8 Hz, 1H), 8.02 – 7.91 (m, 2H), 7.69 – 7.35 (m, 6H), 3.07 (t, *J* = 6.5 Hz, 2H), 2.64 (t, *J* = 6.8 Hz, 2H), 2.00 – 1.81 (m, 4H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 200.00, 171.45, 148.26, 138.39, 137.03, 136.45, 134.57, 133.10, 128.69, 128.07, 127.48, 121.61, 121.51, 116.54, 56.35, 38.35, 38.06, 25.35, 23.92.

HRMS (ESI): Calculated for $C_{21}H_{21}N_2O_2$ $(M+H)^+$: 333.1598， found: 333.1601.

3b



6-oxo-N-(quinolin-8-yl)-6-(p-tolyl)hexanamide

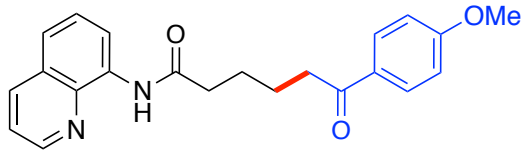
3b was prepared following the General Procedure **1.1** and purified by flash Chromatography (hexanes/ethyl acetate = 3:1, R_f = 0.29) to give white solid (66 mg, 96% yield). 36 hours. MP: 80 °C.

^{1}H NMR (400 MHz, $CDCl_3$) δ 9.82 (s, 1H), 8.78 (m, 2H), 8.15 (d, *J* = 8.2 Hz, 1H), 7.85 (d, *J* = 7.8 Hz, 2H), 7.58 – 7.38 (m, 3H), 7.23 (d, *J* = 7.8 Hz, 2H), 3.03 (t, *J* = 6.6 Hz, 2H), 2.62 (t, *J* = 6.8 Hz, 2H), 2.39 (s, 3H), 2.08 – 1.78 (m, 4H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 199.74, 171.53, 148.25, 143.82, 138.44, 136.46, 134.61, 129.36, 128.28, 128.04, 127.52, 121.70, 121.51, 116.55, 38.28, 38.13, 25.43, 24.07, 21.74.

HRMS (ESI): Calculated for $C_{22}H_{23}N_2O_2$ $(M+H)^+$: 347.1754， found: 347.1762.

3c



6-(4-methoxyphenyl)-6-oxo-N-(quinolin-8-yl)hexanamide

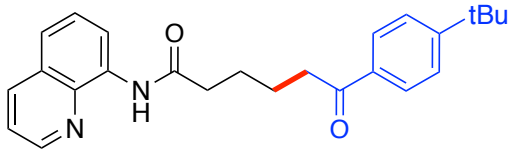
3c was prepared following the General Procedure **1.1** and purified by flash Chromatography (hexanes/ethyl acetate = 3:1, R_f = 0.13) to give white solid (68 mg, 94% yield). 36 hours. MP: 73 °C.

^{1}H NMR (400 MHz, $CDCl_3$) δ 9.81 (s, 1H), 8.82 – 8.71 (m, 2H), 8.13 (d, *J* = 8.2 Hz, 1H), 7.92 (d, *J* = 8.4 Hz, 2H), 7.57 – 7.36 (m, 3H), 6.89 (d, *J* = 8.4 Hz, 2H), 3.83 (s, 3H), 2.99 (t, *J* = 6.5 Hz, 2H), 2.61 (t, *J* = 6.8 Hz, 2H), 1.98 – 1.81 (m, 4H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 198.62, 171.50, 163.44, 148.21, 138.39, 136.42, 134.57, 130.37, 130.13, 128.00, 127.46, 121.67, 121.48, 116.49, 113.76, 55.52, 38.08, 38.00, 25.42, 24.16.

HRMS (ESI): Calculated for $C_{22}H_{22}N_2O_3$ $(M+H)^+$: 363.1703， found: 363.1707

3d



6-(4-(tert-butyl)phenyl)-6-oxo-N-(quinolin-8-yl)hexanamide

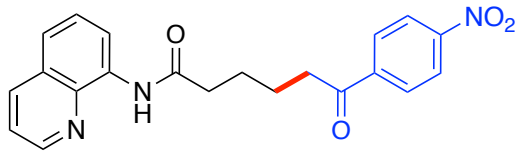
3d was prepared following the General Procedure **1.1** and purified by flash Chromatography (hexanes/ethyl acetate = 3:1, R_f = 0.36) to give white solid (72 mg, 93% yield). 36 hours. MP: 58 °C.

^{1}H NMR (400 MHz, $CDCl_3$) δ 9.83 (s, 1H), 8.79 (m, 2H), 8.19 – 8.11 (m, 1H), 7.90 (d, *J* = 8.2 Hz, 2H), 7.60 – 7.38 (m, 5H), 3.04 (t, *J* = 6.5 Hz, 2H), 2.63 (t, *J* = 6.8 Hz, 2H), 2.05 – 1.85 (m, 4H), 1.33 (s, 9H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 199.67, 171.45, 156.69, 148.18, 138.36, 136.39, 134.55, 134.44, 128.07, 127.97, 127.43, 125.55, 121.64, 121.46, 116.47, 38.23, 38.05, 35.12, 31.15, 25.37, 24.03.

HRMS (ESI): Calculated for $C_{25}H_{29}N_2O_2$ $(M+H)^+$: 389.2224，found: 389.2228.

3e



6-(4-nitrophenyl)-6-oxo-N-(quinolin-8-yl)hexanamide

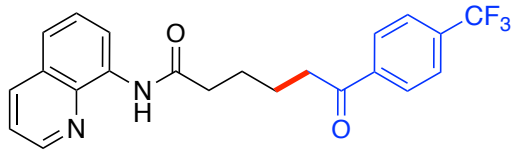
3e was prepared following the General Procedure **1.1** and purified by flash Chromatography (hexanes/ethyl acetate = 3:1, R_f = 0.13) to give yellow solid (69 mg, 91% yield). 36 hours. MP: 143 °C.

^{1}H NMR (400 MHz, $CDCl_3$) δ 9.82 (s, 1H), 8.81 (d, J = 4.1 Hz, 1H), 8.76 (d, J = 6.8 Hz, 1H), 8.27 (d, J = 8.5 Hz, 2H), 8.17 (d, J = 8.2 Hz, 1H), 8.09 (d, J = 8.4 Hz, 2H), 7.60 – 7.40 (m, 3H), 3.17 – 3.05 (m, 2H), 2.64 (d, J = 6.6 Hz, 2H), 2.00 – 1.87 (m, 4H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 198.34, 171.27, 150.32, 148.32, 148.19, 141.38, 138.37, 136.53, 134.50, 129.08, 128.03, 127.40, 123.90, 121.65, 116.46, 38.91, 37.89, 25.10, 23.59.

HRMS (ESI): Calculated for $C_{21}H_{20}N_3O_4$ $(M+H)^+$: 378.1448，found: 378.1454

3f



6-oxo-N-(quinolin-8-yl)-6-(4-(trifluoromethyl)phenyl)hexanamide

3f was prepared following the General Procedure **1.1** and purified by flash Chromatography (hexanes/ethyl acetate = 3:1, R_f = 0.27) to give white solid (73 mg, 91% yield). 36 hours. MP: 89 °C.

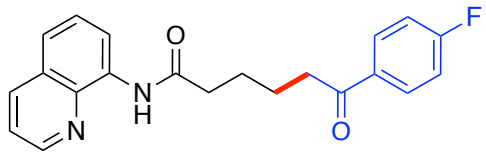
^{1}H NMR (400 MHz, $CDCl_3$) δ 9.82 (s, 1H), 8.84 – 8.69 (m, 2H), 8.16 (d, *J* = 8.3 Hz, 1H), 8.04 (d, *J* = 8.0 Hz, 2H), 7.70 (d, *J* = 8.1 Hz, 2H), 7.57 – 7.40 (m, 3H), 3.08 (t, *J* = 6.3 Hz, 2H), 2.63 (t, *J* = 6.8 Hz, 2H), 2.01 – 1.85 (m, 4H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 198.88, 171.31, 148.17, 139.59, 138.34, 136.44, 134.50, 134.26 (q, *J* = 32.6 Hz), 128.37, 127.99, 127.44, 125.65, 123.69 (q, *J* = 274.0 Hz), 121.72, 121.62, 116.45, 38.61, 37.91, 25.15, 23.64.

^{19}F NMR (376 MHz, $CDCl_3$) δ -63.16.

HRMS (ESI): Calculated for $C_{22}H_{20}N_2O_2F_3$ $(M+H)^+$: 401.1471， found: 401.1477

3g



6-(4-fluorophenyl)-6-oxo-N-(quinolin-8-yl)hexanamide

3g was prepared following the General Procedure **1.1** and purified by flash Chromatography (hexanes/ethyl acetate = 3:1, R_f = 0.20) to give white solid (64 mg, 92% yield). 36 hours. MP: 86 ºC.

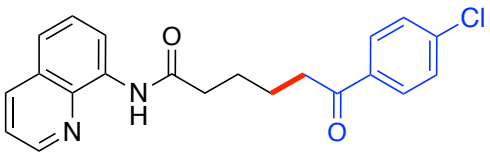
^{1}H NMR (400 MHz, $CDCl_3$) δ 9.82 (s, 1H), 8.85 – 8.71 (m, 2H), 8.16 (d, *J* = 8.2 Hz, 1H), 7.98 (dd, *J* = 8.7, 5.5 Hz, 2H), 7.58 – 7.39 (m, 3H), 7.11 (t, *J* = 8.6 Hz, 2H), 3.03 (t, *J* = 6.6 Hz, 2H), 2.63 (t, *J* = 6.8 Hz, 2H), 1.98 – 1.82 (m, 4H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 198.31, 171.37, 165.69 (d, *J* = 254.3 Hz), 148.16, 138.34, 136.40, 134.51, 133.40, 130.71 (d, *J* = 7.4 Hz), 127.97, 127.44, 121.61, 121.52 (d, *J* = 4.0 Hz), 116.44, 115.65 (d, *J* = 21.4 Hz), 38.22, 37.97, 25.26, 23.85.

^{19}F NMR (376 MHz, $CDCl_3$) δ -105.56, -105.57, -105.58, -105.60, -105.60, -105.61, -105.62, -105.63.

HRMS (ESI): Calculated for $C_{21}H_{20}N_2O_2F$ $(M+H)^+$: 351.1503， found: 351.1509

3h



6-(4-chlorophenyl)-6-oxo-N-(quinolin-8-yl)hexanamide

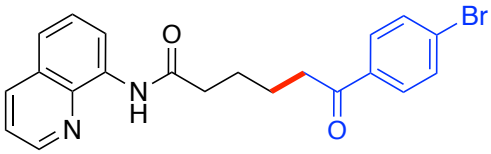
3h was prepared following the General Procedure **1.1** and purified by flash Chromatography (hexanes/ethyl acetate = 3:1, R_f = 0.21) to give white solid (68 mg, 91% yield). 36 hours. MP: 82 °C.

^{1}H NMR (400 MHz, $CDCl_3$) δ 9.82 (s, 1H), 8.84 – 8.71 (m, 2H), 8.17 (d, *J* = 8.2 Hz, 1H), 7.89 (d, *J* = 8.5 Hz, 2H), 7.58 – 7.35 (m, 5H), 3.03 (t, *J* = 6.6 Hz, 2H), 2.63 (t, *J* = 6.6 Hz, 2H), 1.97 – 1.84 (m, 4H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 198.67, 171.34, 148.27, 139.41, 138.35, 136.45, 135.28, 134.52, 129.58, 129.01, 127.98, 127.56, 121.76, 121.57, 116.54, 38.29, 37.97, 25.24, 23.80.

HRMS (ESI): Calculated for $C_{21}H_{20}N_2O_2Cl$ $(M+H)^+$: 367.1208， found: 367.1215

3i



6-(4-bromophenyl)-6-oxo-N-(quinolin-8-yl)hexanamide

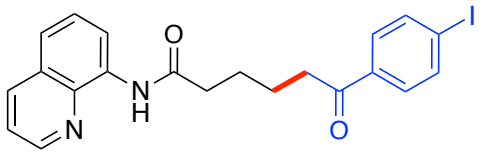
3i was prepared following the General Procedure **1.1** and purified by flash Chromatography (hexanes/ethyl acetate = 3:1, R_f = 0.26) to give white solid (75 mg, 92% yield). 36 hours. MP: 87 °C.

^{1}H NMR (400 MHz, $CDCl_3$) δ 9.81 (s, 1H), 8.92 – 8.63 (m, 2H), 8.16 (d, *J* = 7.8 Hz, 1H), 7.81 (d, *J* = 5.5 Hz, 2H), 7.62 – 7.39 (m, 4H), 3.02 (t, *J* = 5.2 Hz, 2H), 2.62 (t, *J* = 5.5 Hz, 2H), 1.97 – 1.81 (m, 4H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 198.83, 171.32, 148.21, 138.32, 135.65, 134.49, 131.83, 129.64, 128.12, 127.96, 127.43, 121.70, 121.60, 116.49, 38.25, 37.94, 25.20, 23.75.

HRMS (ESI): Calculated for $C_{21}H_{20}N_2O_2Br$ $(M+H)^+$: 411.0703， found: 411.0706

3j



6-(4-iodophenyl)-6-oxo-N-(quinolin-8-yl)hexanamide

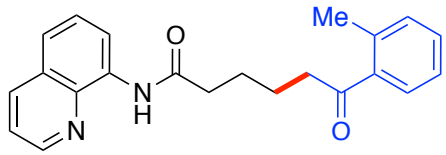
3j was prepared following the General Procedure **1.1** and purified by flash Chromatography (hexanes/ethyl acetate = 3:1, R_f = 0.21) to give white solid (48 mg, 52% yield). 36 hours. MP: 103 °C.

^{1}H NMR (400 MHz, $CDCl_3$) δ 9.82 (s, 1H), 8.91 – 8.63 (m, 2H), 8.16 (dd, J = 8.3, 1.7 Hz, 1H), 7.88 – 7.74 (m, 2H), 7.73 – 7.60 (m, 2H), 7.58 – 7.42 (m, 3H), 3.01 (t, J = 6.7 Hz, 2H), 2.63 (t, J = 6.9 Hz, 2H), 1.96 – 1.82 (m, 4H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 199.26, 171.40, 148.25, 138.42, 137.98, 136.49, 136.26, 134.56, 129.57, 128.04, 127.52, 121.72, 121.56, 116.55, 101.00, 77.16, 38.28, 38.03, 25.28, 23.83.

HRMS (ESI): Calculated for $C_{22}H_{23}N_2O_2$ $(M+H)^+$: 359.0564， found: 359.0569.

3k



6-oxo-N-(quinolin-8-yl)-6-(o-tolyl)hexanamide

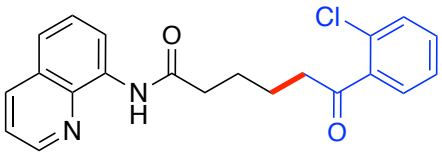
3k was prepared following the General Procedure **1.1** and purified by flash Chromatography (hexanes/ethyl acetate = 3:1, R_f = 0.27) to give white solid (62 mg, 89% yield). 36 hours. MP: 80 °C.

^{1}H NMR (400 MHz, $CDCl_3$) δ 9.82 (s, 1H), 8.83 – 8.74 (m, 2H), 8.16 (d, J = 8.2 Hz, 1H), 7.62 (d, J = 7.6 Hz, 1H), 7.58 – 7.40 (m, 3H), 7.35 (t, J = 7.4 Hz, 1H), 7.24 (t, J = 8.7 Hz, 2H), 2.98 (t, J = 6.6 Hz, 2H), 2.62 (t, J = 6.8 Hz, 2H), 2.48 (s, 3H), 1.96 – 1.81 (m, 4H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 204.24, 171.44, 148.18, 138.40, 138.18, 137.97, 136.42, 134.57, 131.99, 131.21, 128.48, 128.36, 128.01, 127.49, 125.75, 121.62, 116.47, 41.35, 38.08, 25.33, 24.05, 21.40.

HRMS (ESI): Calculated for $C_{22}H_{23}N_2O_2$ $(M+H)^+$: 347.1754， found: 347.1759.

3l



6-(2-chlorophenyl)-6-oxo-N-(quinolin-8-yl)hexanamide

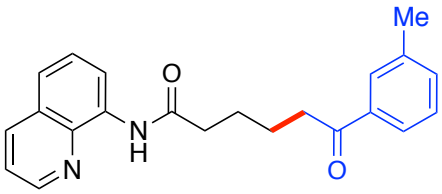
3l was prepared following the General Procedure **1.1** and purified by flash Chromatography (hexanes/ethyl acetate = 3:1, R_f = 0.26) to give white solid (60 mg, 82% yield). 36 hours. MP: 99 °C.

^{1}H NMR (400 MHz, $CDCl_3$) δ 9.82 (s, 1H), 8.85 – 8.72 (m, 2H), 8.16 (d, *J* = 8.3, 1H), 7.61 – 7.22 (m, 7H), 3.03 (t, *J* = 6.7 Hz, 2H), 2.62 (t, *J* = 6.8 Hz, 2H), 1.97 – 1.81 (m, 4H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 203.20, 171.27, 148.13, 139.57, 138.30, 136.35, 134.48, 131.56, 130.73, 130.47, 128.70, 127.92, 127.33, 126.93, 121.57, 121.49, 116.38, 42.67, 37.90, 25.09, 23.73.

HRMS (ESI): Calculated for $C_{21}H_{20}N_2O_2Cl$ $(M+H)^+$: 367.1208， found: 367.1216

3m



6-oxo-N-(quinolin-8-yl)-6-(m-tolyl)hexanamide

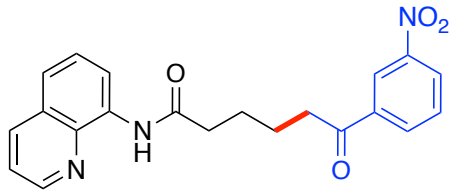
3m was prepared following the General Procedure **1.1** and purified by flash Chromatography (hexanes/ethyl acetate = 3:1, R_f = 0.27) to give white solid (65 mg, 94% yield). 36 hours. MP: 66 °C.

^{1}H NMR (400 MHz, $CDCl_3$) δ 9.82 (s, 1H), 8.90 – 8.64 (m, 2H), 8.15 (d, *J* = 8.1 Hz, 1H), 7.75 (d, *J* = 8.5 Hz, 2H), 7.58 – 7.40 (m, 3H), 7.33 (d, *J* = 8.0 Hz, 2H), 3.05 (t, *J* = 7.6 Hz, 2H), 2.62 (t, *J* = 8.0 Hz, 2H), 2.40 (s, 2H), 1.99 – 1.83 (m, 4H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 204.24, 171.44, 148.18, 138.40, 138.18, 137.97, 136.42, 134.57, 131.99, 131.21, 128.48, 128.36, 128.01, 127.49, 125.75, 121.62, 116.47, 41.35, 38.08, 25.33, 24.05, 21.40.

HRMS (ESI): Calculated for $C_{22}H_{23}N_2O_2$ $(M+H)^+$: 347.1754，found: 347.1763

3n



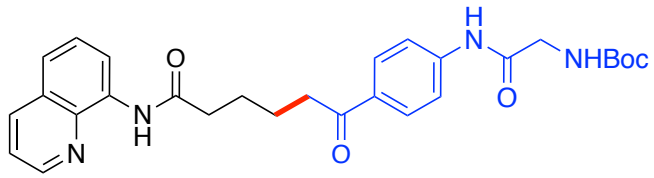
6-(3-nitrophenyl)-6-oxo-N-(quinolin-8-yl)hexanamide

3n was prepared following the General Procedure **1.1** and purified by flash Chromatography (hexanes/ethyl acetate = 3:1, R_f = 0.12) to give white solid (62 mg, 82% yield). 36 hours. MP: 165 °C.

^{1}H NMR (400 MHz, $CDCl_3$) δ 9.83 (s, 1H), 8.88 – 8.69 (m, 3H), 8.40 (d, J = 8.3 Hz, 1H), 8.28 (d, J = 7.8 Hz, 1H), 8.17 (d, J = 7.5 Hz, 1H), 7.65 (t, J = 8.0 Hz, 1H), 7.58 – 7.42 (m, 3H), 3.14 (t, J = 6.8 Hz, 2H), 2.65 (t, J = 6.4 Hz, 2H), 2.02 – 1.86 (m, 4H), 1.56 (s, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 197.64, 171.30, 148.56, 148.29, 138.41, 138.25, 136.51, 134.54, 133.69, 129.97, 128.06, 127.52, 127.37, 123.03, 121.75, 121.61, 116.55, 38.62, 37.95, 25.14, 23.58.

HRMS (ESI): Calculated for $C_{21}H_{20}N_3O_4$ $(M+H)^+$: 378.1448，found: 378.1455



3o

Tert-butyl (2-oxo-2-((4-(6-oxo-6-(quinolin-8-ylamino)hexanoyl)phenyl)amino)ethyl) carbamate

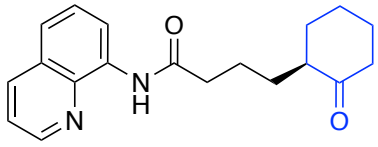
3o was prepared following the General Procedure **1.1** and purified by flash Chromatography (hexanes/ethyl acetate = 1:1, R_f = 0.1) to give white solid (96 mg, 95% yield). 36 hours. MP: 140 °C.

^{1}H NMR (400 MHz, $CDCl_3$) δ 9.82 (s, 1H), 8.94 (s, 1H), 8.82 – 8.65 (m, 2H), 8.12 (d, *J* = 8.2 Hz, 1H), 7.87 (d, *J* = 8.3 Hz, 2H), 7.59 (d, *J* = 8.3 Hz, 2H), 7.53 – 7.37 (m, 3H), 5.59 (t, *J* = 5.8 Hz, 1H), 3.97 (d, *J* = 5.9 Hz, 2H), 2.96 (t, *J* = 6.6 Hz, 2H), 2.60 (t, *J* = 6.8 Hz, 2H), 1.97 – 1.76 (m, 3H), 1.45 (s, 9H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 198.81, 171.63, 168.43, 156.72, 148.27, 142.06, 138.40, 136.44, 134.47, 132.75, 129.45, 128.01, 127.43, 121.71, 121.61, 119.19, 116.54, 80.83, 45.62, 38.08, 28.40, 25.37, 23.96.

HRMS (ESI): Calculated for $C_{28}H_{33}N_4O_5$ $(M+H)^+$: 505.2445， found: 505.2474

4a



6-cyclohexyl-6-oxo-N-(quinolin-8-yl)hexanamide

4a was prepared following the General Procedure **1.1** and purified by flash Chromatography (hexanes/ethyl acetate = 3:1, R_f = 0.31) to give yellow gum (59 mg, 95% yield). 24 hours.

^{1}H NMR (400 MHz, $CDCl_3$) δ 9.80 (s, 1H), 8.81 (dd, *J* = 4.2, 1.7 Hz, 1H), 8.77 (d, *J* = 7.2 Hz, 1H), 8.16 (dd, *J* = 8.2, 1.7 Hz, 1H), 7.60 – 7.41 (m, 3H), 2.67 – 2.49 (m, 2H), 2.45 – 2.24 (m, 3H), 2.22 – 2.12 (m, 1H), 2.10 – 1.99 (m, 1H), 1.98 – 1.75 (m, 4H), 1.72 – 1.62 (m, 2H), 1.48 – 1.30 (m, 2H).

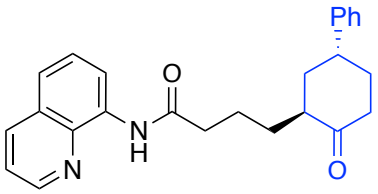
^{13}C NMR (101 MHz, $CDCl_3$) δ 213.25, 171.69, 148.27, 138.47, 136.49, 134.66, 128.07, 127.56, 121.72, 121.51, 116.56, 50.78, 42.23, 38.38, 34.09, 29.16, 28.20, 25.14, 23.43.

HRMS (ESI): Calculated for $C_{19}H_{23}N_2O_3$ $(M+H)^+$: 311.1754， found: 311.1754.

The enantiomeric excess was determined by chiral HPLC: 88% *ee*, (CHIRALPAK AS-H, hexane/*i*-PrOH = 80:20, flow rate 1 mL/min, T = 25 ˚C, 254 nm), t_R (major) = 19.317 min,

t_R (minor) = 15.009 min. The absolute configuration was assigned tentatively based on analogy.

4b



4-(2-oxo-5-phenylcyclohexyl)-N-(quinolin-8-yl)butanamide

4b was prepared following the General Procedure **1.2** and purified by flash Chromatography (hexanes/ethyl acetate = 3:1, R_f = 0.30) to give yellow gum (70 mg, 91% yield). 24 hours.

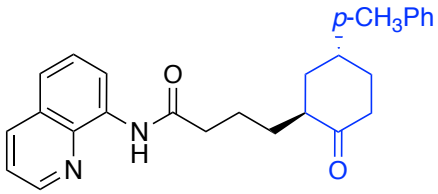
^{1}H NMR (400 MHz, $CDCl_3$) δ 9.80 (s, 1H), 8.92 – 8.64 (m, 2H), 8.23 – 8.09 (m, 1H), 7.65 – 7.38 (m, 3H), 7.35 – 7.11 (m, 5H), 3.25 – 3.05 (m, 1H), 2.69 – 2.48 (m, 4H), 2.46 – 2.31 (m, 1H), 2.28 – 2.12 (m, 2H), 2.11 – 1.61 (m, 6H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 214.04, 171.16, 148.22, 144.44, 138.36, 136.43, 128.66, 127.45, 126.82, 126.74, 121.68, 121.52, 116.49, 49.28, 43.50, 41.91, 41.38, 38.44, 38.30, 33.42, 28.74, 23.28.

HRMS (ESI): Calculated for $C_{25}H_{27}N_2O_2$ $(M+H)^+$: 387.2067， found: 387.2086.

The enantiomeric excess was determined by chiral HPLC: **Major**: 93% *ee*, **Minor**: 73% *ee* (CHIRALPAK AS-H, hexane/*i*-PrOH = 85/15, flow rate 1 mL/min, T = 25 ˚C, 254 nm), **Minor**: t_R (major) = 19.853 min, t_R (minor) = 34.417 min; **Major**: t_R (major) = 40.780 min, t_R (minor) = 60.310 min; **dr**: 3.5/1. The absolute configuration was determined based on the comparison of the literature.[3]

4c



4-(2-oxo-5-(p-tolyl)cyclohexyl)-N-(quinolin-8-yl)butanamide

4c was prepared following the General Procedure **1.2** and purified by flash Chromatography (hexanes/ethyl acetate = 3:1, R_f = 0.30) to give yellow gum (77 mg, 96% yield). 24 hours.

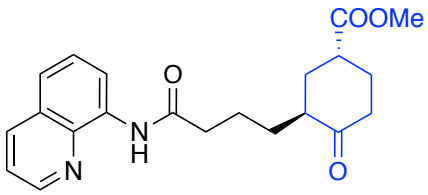
^{1}H NMR (400 MHz, $CDCl_3$) δ 9.80 (s, 1H), 8.92 – 8.64 (m, 2H), 8.23 – 8.09 (m, 1H), 7.65 – 7.38 (m, 3H), 7.35 – 7.11 (m, 5H), 3.25 – 3.05 (m, 1H), 2.69 – 2.48 (m, 4H), 2.46 – 2.31 (m, 1H), 2.28 – 2.12 (m, 2H), 2.11 – 1.61 (m, 6H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 213.93, 171.04, 148.10, 141.27, 138.22, 136.30, 135.88, 134.41, 129.22, 127.87, 127.31, 126.57, 121.57, 121.41, 116.37, 49.15, 38.44, 38.34, 37.48, 36.83, 33.38, 30.65, 23.18, 20.95.

HRMS (ESI): Calculated for $C_{26}H_{29}N_2O_2$ $(M+H)^+$: 401.2224， found: 401.2247.

The enantiomeric excess was determined by chiral HPLC: **Major**: 93% *ee*, **Minor**: 70% *ee* (CHIRALPAK OJ-H, hexane/*i*-PrOH = 70:30, flow rate 1 mL/min, T = 25 ˚C, 254 nm), **Major**: t_R (major) = 25.653 min, t_R (minor) = 41.974 min; **Minor**: t_R (major) = 33.155 min, t_R (minor) = 57.709 min; **dr**: 8.2/1. The absolute configuration was determined based on the comparison of the literature.[3]

4d



Methyl 4-oxo-3-(4-oxo-4-(quinolin-8-ylamino)butyl)cyclohexane-1-carboxylate

4d was prepared following the General Procedure **1.2** and purified by flash Chromatography (hexanes/ethyl acetate = 2:1, R_f = 0.17) to give yellow gum (70 mg, 95% yield). 24 hours.

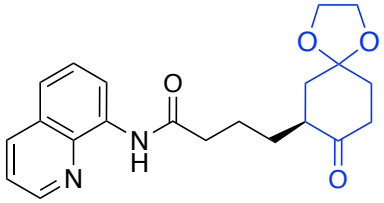
^{1}H NMR (400 MHz, $CDCl_3$) δ 9.80 (s, 1H), 8.86 – 8.72 (m, 2H), 8.16 (dd, J = 8.2, 1.7 Hz, 1H), 7.59 – 7.41 (m, 3H), 3.75 (s, 3H), 2.94 – 2.80 (m, 1H), 2.66 – 2.26 (m, 7H), 2.04 – 1.95 (m, 1H), 1.93 – 1.71 (m, 4H), 1.50 – 1.37 (m, 1H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 212.21, 174.80, 171.45, 148.27, 138.46, 136.50, 134.62, 128.07, 127.54, 121.73, 121.55, 116.57, 52.18, 47.49, 38.69, 38.36, 38.07, 34.28, 29.30, 28.76, 23.19.

HRMS (ESI): Calculated for $C_{21}H_{25}N_2O_4$ $(M+H)^+$: 369.1809， found: 369.1829.

The enantiomeric excess was determined by chiral HPLC: **Major**: 96% *ee*, **Minor**: 43% *ee* (CHIRALPAK AS-H, hexane/*i*-PrOH = 82/18, flow rate 1 mL/min, T = 25 ˚C, 254 nm), **Minor**: t_R (major) = 45.983 min, t_R (minor) = 105.002 min; **Major**: t_R (major) = 66.030 min, t_R (minor) = 59.002 min; **dr**: 2.6/1. The absolute configuration was determined based on the comparison of the literature.[3]

4e



4-(8-oxo-1,4-dioxaspiro[4.5]decan-7-yl)-N-(quinolin-8-yl)butanamide

4e was prepared following the General Procedure **1.2** and purified by flash Chromatography (hexanes/ethyl acetate = 3:1, R_f = 0.17) to give yellow gum (65 mg, 88% yield). 24 hours.

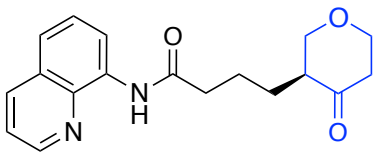
^{1}H NMR (400 MHz, $CDCl_3$) δ 9.80 (s, 1H), 8.88 – 8.69 (m, 2H), 8.16 (dd, *J* = 8.3, 1.6 Hz, 1H), 7.58 – 7.42 (m, 3H), 4.12 – 3.90 (m, 4H), 2.76 – 2.48 (m, 4H), 2.43 – 2.32 (m, 1H), 2.22 – 2.12 (m, 1H), 2.09 – 1.87 (m, 3H), 1.87 – 1.69 (m, 3H), 1.41 – 1.30 (m, 1H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 211.41, 171.51, 148.21, 138.39, 136.42, 134.58, 128.00, 127.47, 121.67, 121.47, 116.49, 107.46, 64.84, 64.68, 46.32, 40.60, 38.36, 38.21, 34.85, 28.62, 23.12.

HRMS (ESI): Calculated for $C_{21}H_{25}N_2O_4$ $(M+H)^+$: 369.1809， found: 369.1826.

The enantiomeric excess was determined by chiral HPLC: 87% *ee*, (CHIRALPAK OJ-H, hexane/*i*-PrOH = 90:10, flow rate 1 mL/min, T = 25 ˚C, 254 nm), t_R (major) = 104.713 min, t_R (minor) = 117.955 min. The absolute configuration was assigned tentatively based on analogy.

4f



4-(4-oxotetrahydro-2H-pyran-3-yl)-N-(quinolin-8-yl)butanamide

4f was prepared following the General Procedure **1.2** and purified by flash Chromatography (hexanes/ethyl acetate = 1:1, R_f = 0.26) to give yellow solid (56 mg, 90% yield). 24 hours. MP: 108 °C.

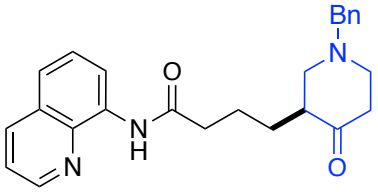
^{1}H NMR (400 MHz, $CDCl_3$) δ 9.80 (s, 1H), 8.85 – 8.68 (m, 2H), 8.15 (d, *J* = 8.2 Hz, 1H), 7.58 – 7.37 (m, 3H), 4.26 – 4.09 (m, 2H), 3.75 (td, *J* = 10.8, 3.7 Hz, 1H), 3.46 (t, *J* = 10.4 Hz, 1H), 2.68 – 2.50 (m, 4H), 2.43 – 2.37 (m, 1H), 1.99 – 1.75 (m, 3H), 1.43 – 1.30 (m, 1H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 208.24, 171.17, 148.18, 138.38, 136.47, 136.43, 134.51, 128.01, 127.46, 121.63, 116.48, 72.75, 68.75, 51.58, 42.55, 38.01, 25.41, 23.19.

HRMS (ESI): Calculated for $C_{18}H_{21}N_2O_3$ $(M+H)^+$: 313.1547， found: 313.1565.

The enantiomeric excess was determined by chiral HPLC: 88% *ee*, (CHIRALPAK OJ-H, hexane/*i*-PrOH = 70:30, flow rate 1 mL/min, T = 25 ˚C, 254 nm), t_R (major) = 35.458 min, t_R (minor) = 43.327 min. The absolute configuration was assigned tentatively based on analogy.

4g



4-(1-benzyl-4-oxopiperidin-3-yl)-N-(quinolin-8-yl)butanamide

4g was prepared following the General Procedure **1.2** and purified by flash Chromatography (hexanes/ethyl acetate = 2:1, R_f = 0.17) to give yellow gum (58 mg, 72% yield). 24 hours.

^{1}H NMR (400 MHz, $CDCl_3$) δ 9.78 (s, 1H), 8.84 – 8.68 (m, 2H), 8.13 (d, *J* = 8.1 Hz, 1H), 7.56 – 7.39 (m, 3H), 7.38 – 7.20 (m, 5H), 3.64 (d, *J* = 13.2 Hz, 1H), 3.54 (d, *J* = 13.2 Hz,

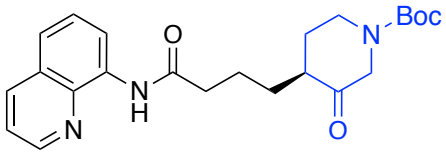
1H), 3.14 – 3.04 (m, 1H), 3.02 – 2.92 (m, 1H), 2.65 – 2.49 (m, 4H), 2.48 – 2.32 (m, 2H), 2.25 (t, J = 10.6 Hz, 1H), 1.99 – 1.84 (m, 1H), 1.84 – 1.71 (m, 2H), 1.44 – 1.31 (m, 1H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 210.72, 171.43, 148.24, 138.42, 138.20, 136.47, 136.43, 134.59, 128.96, 128.50, 128.03, 127.45, 121.75, 121.63, 121.50, 116.53, 61.96, 59.03, 58.95, 53.61, 49.79, 41.11, 38.20, 27.11, 23.34.

HRMS (ESI): Calculated for $C_{25}H_{28}N_3O_2$ $(M+H)^+$: 402.2176， found: 402.2196.

The enantiomeric excess was determined by chiral HPLC: 0% *ee*, (CHIRALPAK OJ-H, hexane/*i*-PrOH = 75:25, flow rate 1 mL/min, T = 25 ˚C, 254 nm), t_R = 33.561 min, t_R = 51.758 min.

4h



Tert-butyl 3-oxo-4-(4-oxo-4-(quinolin-8-ylamino)butyl)piperidine-1-carboxylate

4h was prepared following the General Procedure **1.2** and purified by flash Chromatography (hexanes/ethyl acetate = 2:1, R_f = 0.15) to give yellow gum (66 mg, 80% yield). 24 hours.

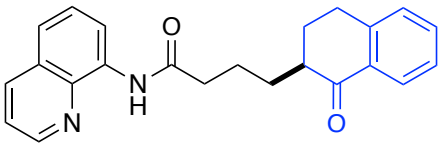
^{1}H NMR (400 MHz, $CDCl_3$) δ 9.80 (s, 1H), 8.85 – 8.70 (m, 2H), 8.16 (d, J = 8.2 Hz, 1H), 7.58 – 7.41 (m, 3H), 4.80 -4.39 (m, 1H), 4.27 – 3.86 (m, 1H), 3.27 – 3.02 (s, 1H), 2.76 – 2.55 (m, 2H), 2.53 – 2.37 (m, 2H), 2.06 – 1.73 (m, 7H), 1.47 (s, 9H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 208.64, 148.39, 148.11, 138.41, 136.44, 134.53, 128.03, 127.66, 127.30, 121.88, 121.54, 116.66, 116.41, 80.61, 37.31, 36.96, 30.42, 28.57, 28.39, 23.37, 23.29, 21.82.

HRMS (ESI): Calculated for $C_{23}H_{30}N_3O_4$ $(M+H)^+$: 412.2231， found: 412.2252.

The enantiomeric excess was determined by chiral HPLC: 47% *ee*, (CHIRALPAK OD-H, hexane/*i*-PrOH = 85:15, flow rate 1 mL/min, T = 25 ˚C, 254 nm), t_R (minor) = 30.184 min, t_R (major) = 34.668 min. The absolute configuration was assigned tentatively based on analogy.

4i



Tert-butyl 3-oxo-4-(4-oxo-4-(quinolin-8-ylamino)butyl)piperidine-1-carboxylate

4i was prepared following the General Procedure **1.2** and purified by flash Chromatography (hexanes/ethyl acetate = 3:1, R_f = 0.27) to give white solid (68 mg, 95% yield). 24 hours. MP: 103 °C.

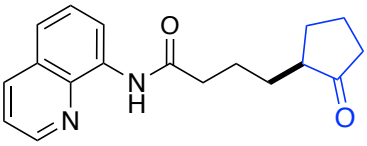
^{1}H NMR (400 MHz, $CDCl_3$) δ 9.83 (s, 1H), 8.87 – 8.71 (m, 2H), 8.15 (d, *J* = 8.2 Hz, 1H), 8.02 (d, *J* = 7.8 Hz, 1H), 7.58 – 7.40 (m, 4H), 7.26 (dt, *J* = 21.0, 7.6 Hz, 2H), 3.07 – 2.93 (m, 5H), 2.72 – 2.48 (m, 3H), 2.36 – 2.25 (m, 1H), 2.15 - 2.05 (m, 1H), 2.03 - 1.84(m, 3H), 1.73 – 1.61 (m, 1H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 200.15, 171.61, 148.27, 144.10, 138.47, 136.47, 134.65, 133.29, 132.62, 128.81, 128.06, 127.56, 126.69, 121.69, 121.52, 116.56, 47.58, 38.35, 29.26, 28.64, 28.44, 23.28.

HRMS (ESI): Calculated for $C_{23}H_{23}N_3O_2$ $(M+H)^+$: 359.1754， found: 359.1767.

The enantiomeric excess was determined by chiral HPLC: 0% *ee*, (CHIRALPAK OD-H, hexane/*i*-PrOH = 80:20, flow rate 1 mL/min, T = 25 ˚C, 254 nm), t_R = 50.978 min, t_R = 70.594 min

4j



Tert-butyl 3-oxo-4-(4-oxo-4-(quinolin-8-ylamino)butyl)piperidine-1-carboxylate

4j was prepared following the General Procedure **1.2** and purified by flash Chromatography (hexanes/ethyl acetate = 3:1, R_f = 0.31) to give yellow gum (55 mg, 92% yield). 24 hours.

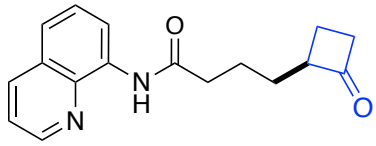
^{1}H NMR (400 MHz, $CDCl_3$) δ 9.80 (s, 1H), 8.85 – 8.72 (m, 2H), 8.16 (d, *J* = 8.3 Hz, 1H), 7.57 – 7.42 (m, 3H), 2.66 – 2.50 (m, 2H), 2.37 – 2.22 (m, 2H), 2.18 – 1.96 (m, 3H), 1.95 – 1.71 (m, 4H), 1.61 – 1.52 (m, 1H), 1.49 – 1.35 (m, 1H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 221.17, 171.43, 148.23, 138.41, 136.46, 134.57, 128.03, 127.49, 121.69, 121.52, 116.52, 49.15, 38.22, 38.17, 29.65, 29.43, 23.75, 20.85.

HRMS (ESI): Calculated for $C_{18}H_{21}N_2O_2$ $(M+H)^+$: 297.1598，found: 297.1597.

The enantiomeric excess was determined by chiral HPLC: 0% *ee*, (CHIRALPAK OD-H, hexane/*i*-PrOH = 80:20, flow rate 1 mL/min, T = 25 ˚C, 254 nm), t_R = 16.946 min, t_R = 23.041 min

4k



4-(2-oxocyclobutyl)-N-(quinolin-8-yl)butanamide

4k was prepared following the General Procedure **1.2** and purified by flash Chromatography (hexanes/ethyl acetate = 3:1, R_f = 0.31) to give yellow gum (54 mg, 95% yield). 24 hours.

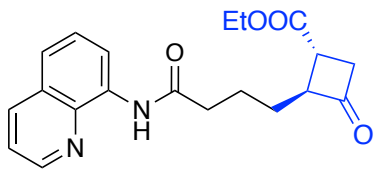
^{1}H NMR (400 MHz, $CDCl_3$) δ 9.81 (s, 1H), 8.86 – 8.71 (m, 2H), 8.16 (d, *J* = 8.2 Hz, 1H), 7.59 – 7.40 (m, 3H), 3.43 – 3.29 (m, 1H), 3.12-2.99 (m, 1H), 2.96 – 2.84 (m, 1H), 2.66 – 2.50 (m, 2H), 2.30 – 2.15 (m, 1H), 1.97 - 1.77 (m, 3H), 1.76 – 1.64 (m, 2H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 211.82, 171.31, 148.24, 138.45, 136.50, 134.57, 128.07, 127.52, 121.79, 121.68, 116.54, 60.42, 60.36, 44.67, 37.87, 29.19, 23.26, 17.02.

HRMS (ESI): Calculated for $C_{17}H_{19}N_2O_2$ $(M+H)^+$: 283.1441，found: 283.1447.

The enantiomeric excess was determined by chiral HPLC: 0% *ee*, (CHIRALPAK AS-H, hexane/*i*-PrOH = 80/20, flow rate 1 mL/min, T = 25 ˚C, 254 nm), t_R (major) = 18.859 min, t_R (minor) = 25.859 min.

4l



Ethyl 3-oxo-2-(4-oxo-4-(quinolin-8-ylamino)butyl)cyclobutane-1-carboxylate

4l was prepared following the General Procedure **1.2** and purified by flash Chromatography (hexanes/ethyl acetate = 2:1, R_f = 0.16) to give yellow gum (51 mg, 72% yield). 24 hours.

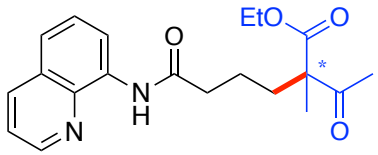
^{1}H NMR (400 MHz, $CDCl_3$) δ 9.78 (s, 1H), 8.83 – 8.68 (m, 2H), 8.15 (d, *J* = 8.2 Hz, 1H), 7.56 – 7.39 (m, 3H), 4.20 (q, *J* = 7.1 Hz, 2H), 3.65 – 3.56 (m, 1H), 3.38 (ddd, *J* = 17.4, 7.8, 3.1 Hz, 1H), 3.10 (ddd, *J* = 17.4, 8.8, 2.4 Hz, 1H), 2.90 (q, *J* = 8.0 Hz, 1H), 2.65 – 2.48 (m, 2H), 1.97 – 1.81 (m, 3H), 1.78 – 1.65 (m, 1H), 1.27 (t, *J* = 7.1 Hz, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 206.18, 173.77, 170.92, 148.18, 138.30, 136.39, 134.45, 127.95, 127.36, 121.66, 121.50, 116.39, 64.99, 61.36, 53.55, 48.32, 37.46, 34.34, 28.21, 22.73, 14.20.

HRMS (ESI): Calculated for $C_{20}H_{23}N_2O_4$ $(M+H)^+$: 355.1652， found: 355.1674.

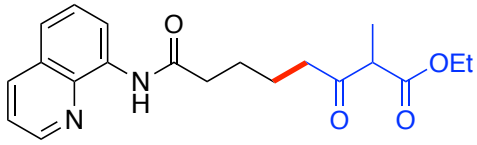
The enantiomeric excess was determined by chiral HPLC: 45% *ee*, (CHIRALPAK OD-H, hexane/*i*-PrOH = 85:15, flow rate 1 mL/min, T = 25 ˚C, 254 nm), t_R (minor) = 40.124 min, t_R (major) = 44.126 min. The absolute configuration was assigned tentatively based on analogy.

5a-B



Ethyl 2-acetyl-2-methyl-6-oxo-6-(quinolin-8-ylamino)hexanoate

5a-L



Ethyl 2-methyl-3,8-dioxo-8-(quinolin-8-ylamino)octanoate

5a-B and **5a-L** were prepared following the General Procedure **1.3** and purified by flash Chromatography as an inseparable mixture with 47:53 ratio. Hexanes/ethyl acetate = 3:1, R_f = 0.33. Yellow gum (68 mg, 95% yield). 36 hours.

^{1}H NMR (400 MHz, $CDCl_3$) δ 9.80 (s, 1H), 8.87 – 8.71 (m, 2H), 8.17 (d, *J* = 8.2 Hz, 1H), 7.59 – 7.40 (m, 3H), 4.26 – 4.11 (m, 2H), 3.57 – 3.47 (m, 0.5H), 2.74 – 2.52 (m, 3H), 2.18

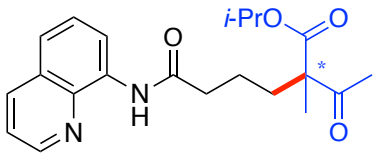
(s, 1H), 2.07 – 1.65 (m, 4H), 1.57 (s, 1H), 1.40 (s, 1H), 1.34 (d, J = 7.2 Hz, 2H), 1.26 (t, J = 7.2 Hz, 3H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 205.67, 172.92, 171.36, 170.96, 170.67, 148.24, 138.41, 136.48, 134.56, 128.04, 127.50, 121.72, 121.55, 116.52, 61.47, 59.68, 52.98, 41.20, 38.09, 37.95, 34.37, 26.27, 25.06, 23.22, 20.45, 18.92, 14.21, 12.90.

HRMS (ESI): Calculated for $C_{20}H_{24}N_2O_4$ $(M+H)^+$: 357.1809， found: 357.1831.

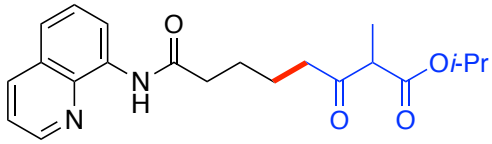
The enantiomeric excess was determined by chiral HPLC: **5a-B**: 63% *ee*, (CHIRALPAK OD-H, hexane/*i*-PrOH = 90:10, flow rate 1 mL/min, T = 25 ˚C, 254 nm), t_R (major) = 38.724 min, t_R (minor) = 44.544 min. **5a-L**: t_R = 54.610 min. **5a-B**:**5a-L** = 47:53.

5b-B



Isopropyl 2-acetyl-2-methyl-6-oxo-6-(quinolin-8-ylamino)hexanoate

5b-L



Isopropyl 2-methyl-3,8-dioxo-8-(quinolin-8-ylamino)octanoate

5b-B and **5b-L** were prepared following the General Procedure **1.3** and purified by flash Chromatography as an inseparable mixture with 52:48 ratio. Hexanes/ethyl acetate = 3:1, R_f = 0.28. Yellow gum (70 mg, 95% yield). 36 hours.

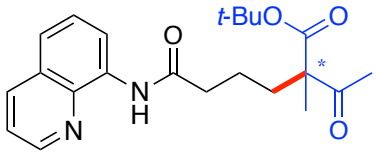
^{1}H NMR (400 MHz, $CDCl_3$) δ 9.78 (s, 1H), 8.86 – 8.71 (m, 2H), 8.16 (dd, J = 8.3, 1.6 Hz, 1H), 7.59 – 7.39 (m, 3H), 5.13 – 4.97 (dp, J = 12.4, 6.3 Hz, 2H), 3.48 (q, J = 7.1 Hz, 0.5H), 2.73 – 2.49 (m, 3H), 2.17 (s, 1.5H), 2.06 – 1.58 (m, 5H), 1.38 (s, 1.5H), 1.32 (d, J = 7.1 Hz, 1.5H), 1.24 (t, J = 5.4, 2.6 Hz, 6H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 205.45, 205.35, 172.12, 171.10, 170.71, 169.96, 148.01, 138.11, 136.22, 134.33, 134.30, 127.78, 127.18, 121.50, 121.34, 116.24, 68.75, 59.45, 52.91, 40.95, 37.83, 37.68, 34.07, 26.00, 24.85, 23.01, 21.56, 21.45, 20.17, 18.63, 12.61.

HRMS (ESI): Calculated for $C_{21}H_{27}N_2O_4$ $(M+H)^+$: 371.1965， found: 357.1987.

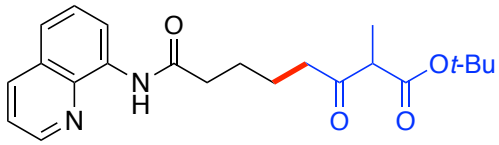
The enantiomeric excess was determined by chiral HPLC: **5b-B**: 74% *ee*, (CHIRALPAK OD-H, hexane/*i*-PrOH = 92:08, flow rate 1 mL/min, T = 25 ˚C, 254 nm), t_R (major) = 30.231 min, t_R (minor) = 36.600 min. **5b-L**: t_R = 41.909 min. **5b-B**:**5b-L** = 52:48.

5c-B



Tert-butyl 2-acetyl-2-methyl-6-oxo-6-(quinolin-8-ylamino)hexanoate

5c-L



Tert-butyl 2-methyl-3,8-dioxo-8-(quinolin-8-ylamino)octanoate

5c-B and **5c-L** were prepared following the General Procedure **1.3** and purified by flash Chromatography as an inseparable mixture with 51:49 ratio. Hexanes/ethyl acetate = 3:1, R_f = 0.26. Yellow gum (73 mg, 95% yield). 36 hours.

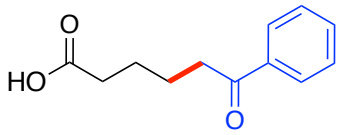
^{1}H NMR (400 MHz, $CDCl_3$) δ 9.79 (s, 1H), 8.85 – 8.71 (m, 2H), 8.16 (d, J = 8.2 Hz, 1H), 7.59 – 7.40 (m, 3H), 3.43 (q, J = 7.1 Hz, 0.5H), 2.73 – 2.50 (m, 3H), 2.17 (s, 1.6H), 2.02 – 1.67 (m, 4H), 1.46 (s, 4.5H), 1.45 (s, 4.5H), 1.35 (s, 1.5H), 1.29 (d, J = 7.1 Hz, 1.5H).

^{13}C NMR (101 MHz, $CDCl_3$) δ 215.60, 171.15, 148.12, 138.27, 136.33, 134.43, 127.90, 127.35, 121.58, 121.40, 116.38, 48.88, 41.29, 38.43, 37.57, 32.37, 31.48, 30.79, 27.41, 26.80, 23.22.

HRMS (ESI): Calculated for $C_{22}H_{28}NaN_2O_4$ $(M+Na)^+$: 407.1941， found: 407.1941.

The enantiomeric excess was determined by chiral HPLC: **5c-B**: 74% *ee*, (CHIRALPAK OJ-H, hexane/*i*-PrOH = 95:05, flow rate 1 mL/min, T = 25 ˚C, 254 nm), t_R (major) = 31.039 min, t_R (minor) = 41.822 min. **5c-L**: t_R = 54.620 min, t_R = 66.851 min. **5c-B**:**5c-L** = 51:49

6



6-oxo-6-phenylhexanoic acid

6 were prepared following the General Procedure **1.4** and purified by flash Chromatography. White solid (177 mg, 86% yield). MP: 70 °C.[5]

^{1}H NMR (400 MHz, $CDCl_3$) δ 7.96 (d, *J* = 7.3 Hz, 1H), 7.56 (t, *J* = 7.4 Hz, 1H), 7.46 (t, *J* = 7.5 Hz, 1H), 3.01 (t, *J* = 7.0 Hz, 1H), 2.43 (t, *J* = 7.1 Hz, 1H), 1.87 – 1.68 (m, 2H).

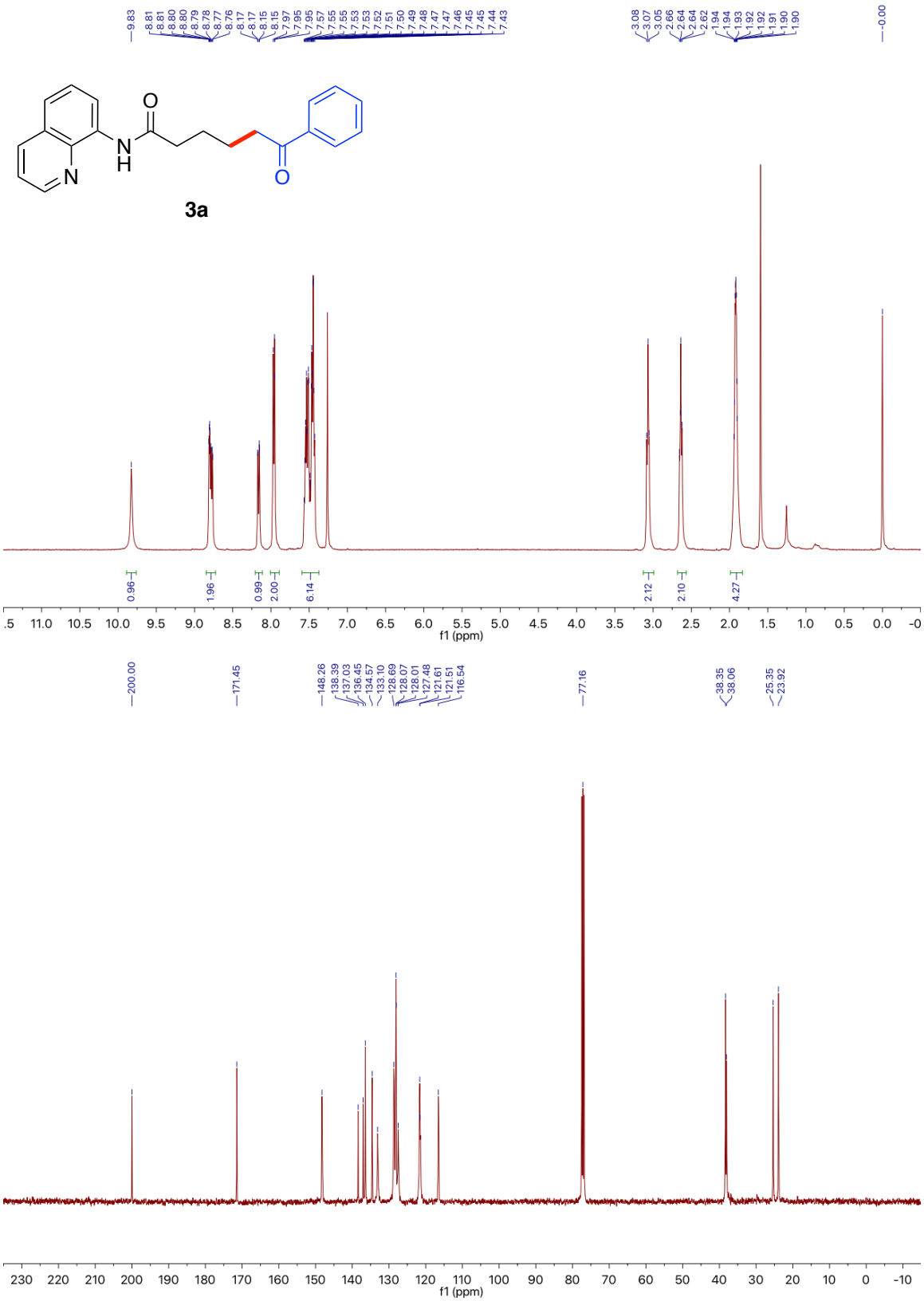
^{13}C NMR (101 MHz, $CDCl_3$) δ 200.00, 179.67, 136.91, 133.11, 128.65, 128.22, 128.08, 38.12, 33.95, 24.34, 23.59.

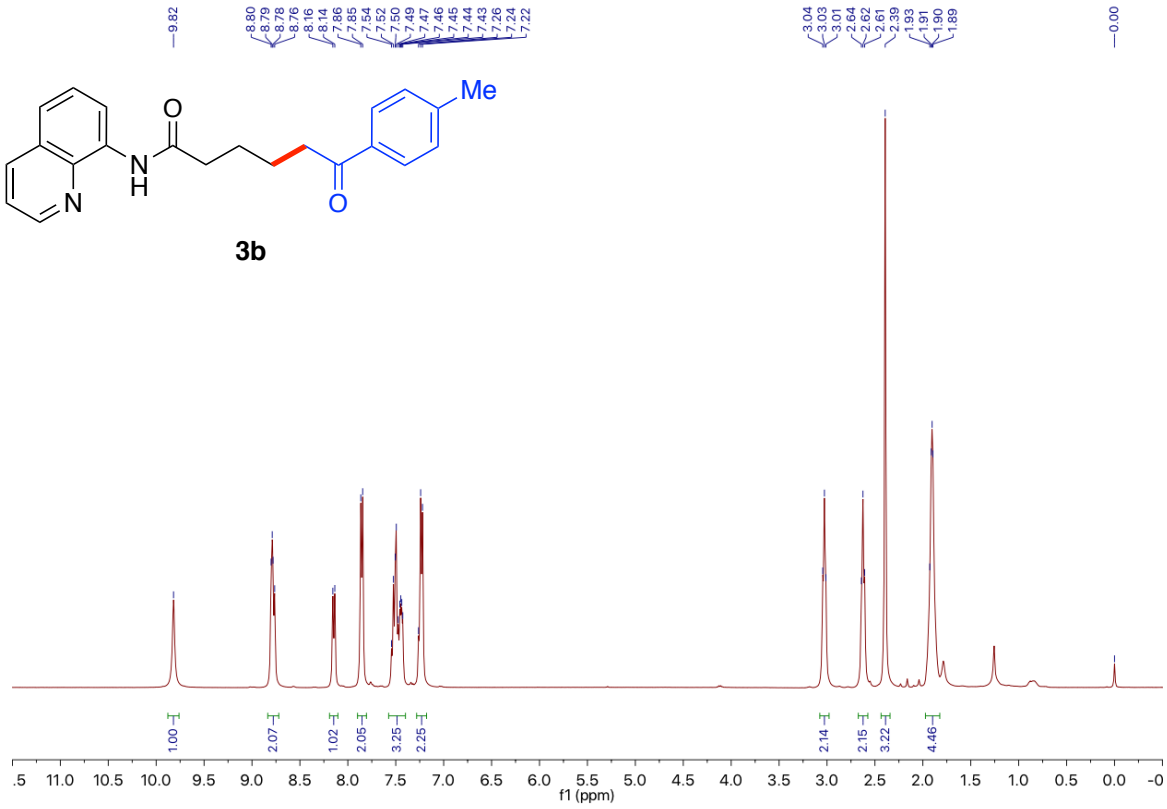
HRMS (ESI): Calculated for $C_{25}H_{28}N_3O_2$ $(M+H)^+$: 207.1016， found: 207.1017.

Reference:

1. Y. Feng and G. Chen, *Angew. Chem., Int. Ed.*, 2010, **49**, 958-961.
2. J. A. Gurak, K. S. Yang, Z. Liu and K. M. Engle, *J. Am. Chem. Soc.*, 2016, **138**, 5805-5808.
3. H. Shen, L. Zhang, S. Chen, J. Feng, B. Zhang, Y. Zhang, X. Zhang, Y. Wu and L. Gong, *ACS Catal.,* 2019, **9**, 791-797.
4. (*a*) H. Wang, Z. Bai, T. Jiao, Z. Deng, H. Tong, G. He, Q. Peng and G. Chen, *J. Am. Chem. Soc.,* 2018, **140**, 3542−3546; (*b*) Z. Liu, X. Li, T. Zeng and K. M. Engle, *ACS Catal.,* 2019, **9**, 3260-3265.
5. Reported MP: 66-68°C. Y.-S. Hon, S.-W. Lin, L. Lu and Y.-J. Chen, *Tetrahedron*, 1995, **51**, 5019.

IV. NMR Spectra




9.82
8.80
8.79
8.78
8.76
8.16
8.14
7.86
7.85
7.54
7.52
7.50
7.49
7.47
7.46
7.45
7.44
7.43
7.26
7.24
7.22
3.04
3.03
3.01
2.64
2.62
2.61
2.39
1.93
1.91
1.90
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O
N
H
N
O
Me
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2.05
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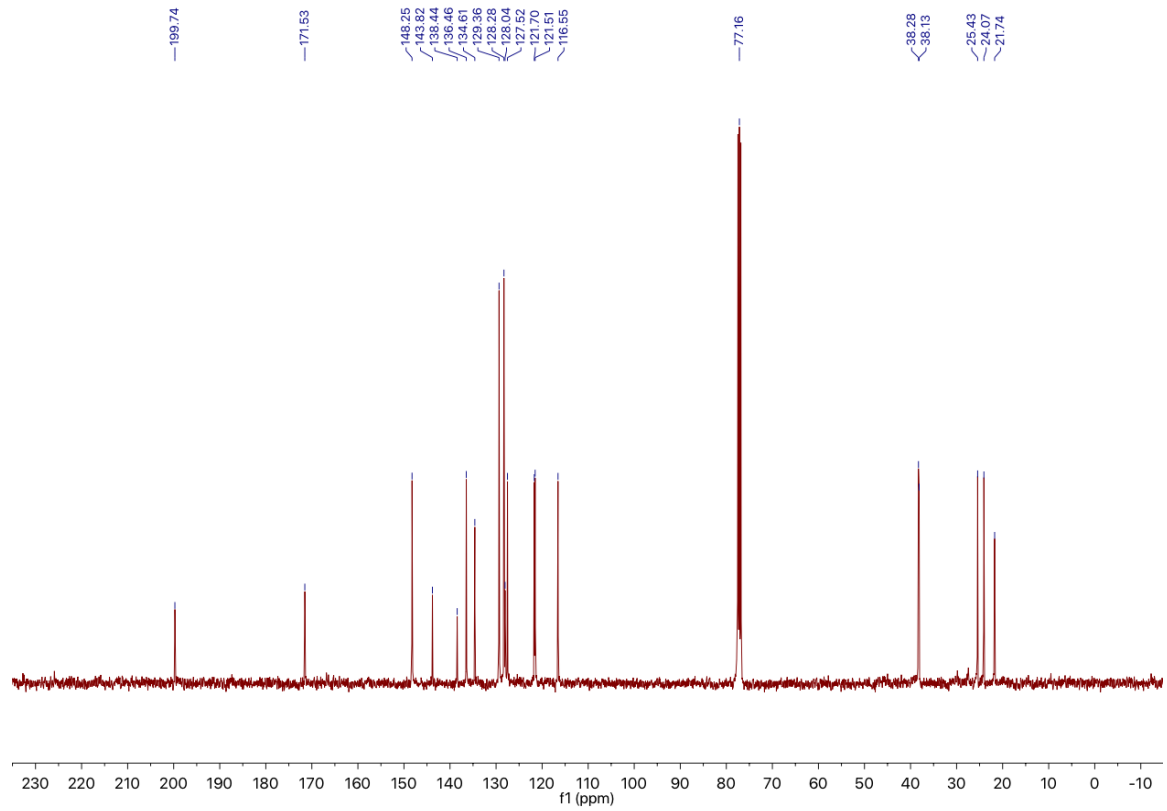
2.25
2.14
2.15
3.22
4.46
f1 (ppm)

3b


199.74
171.53
148.25
143.82
138.44
136.46
134.61
129.36
128.28
128.04
127.52
121.70
121.51
116.55
77.16
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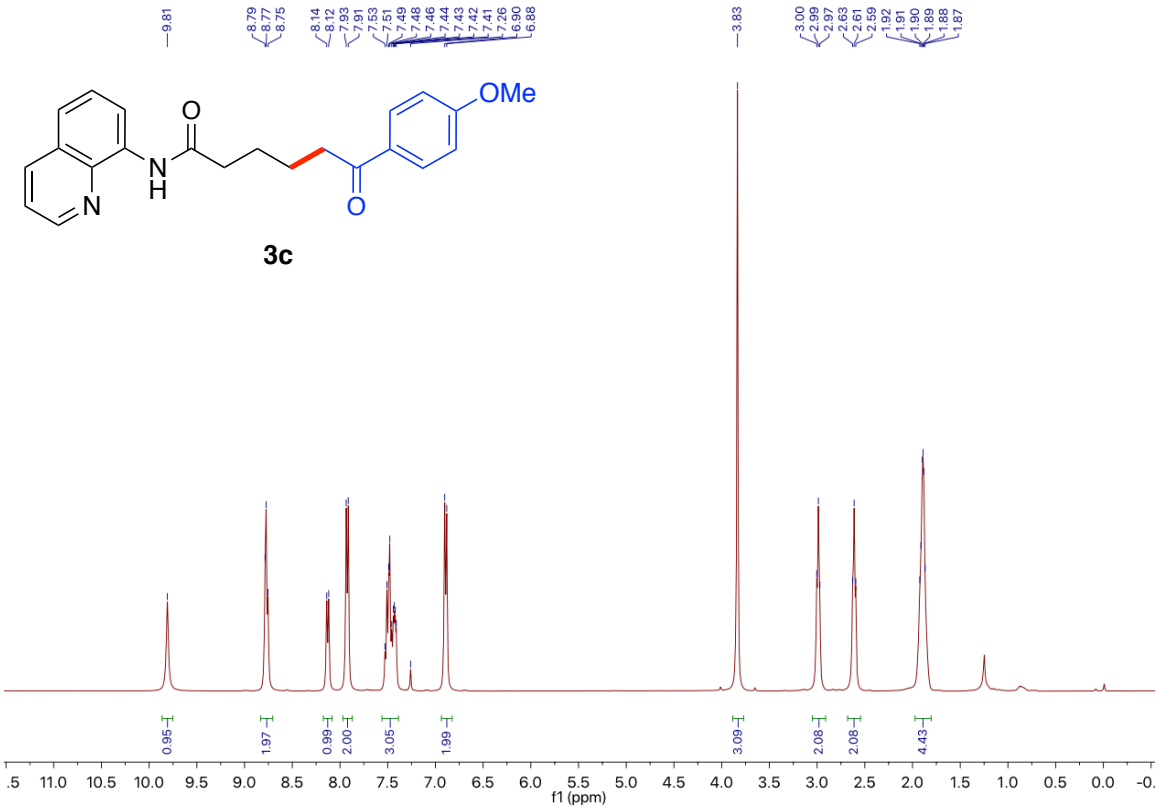
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7.43
7.42
7.41
7.26
6.90
6.88
3.83
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2.99
2.97
2.63
2.61
2.59
1.92
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1.90
1.89
1.88
1.87
OMe
O
N
H
N
O
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2.08
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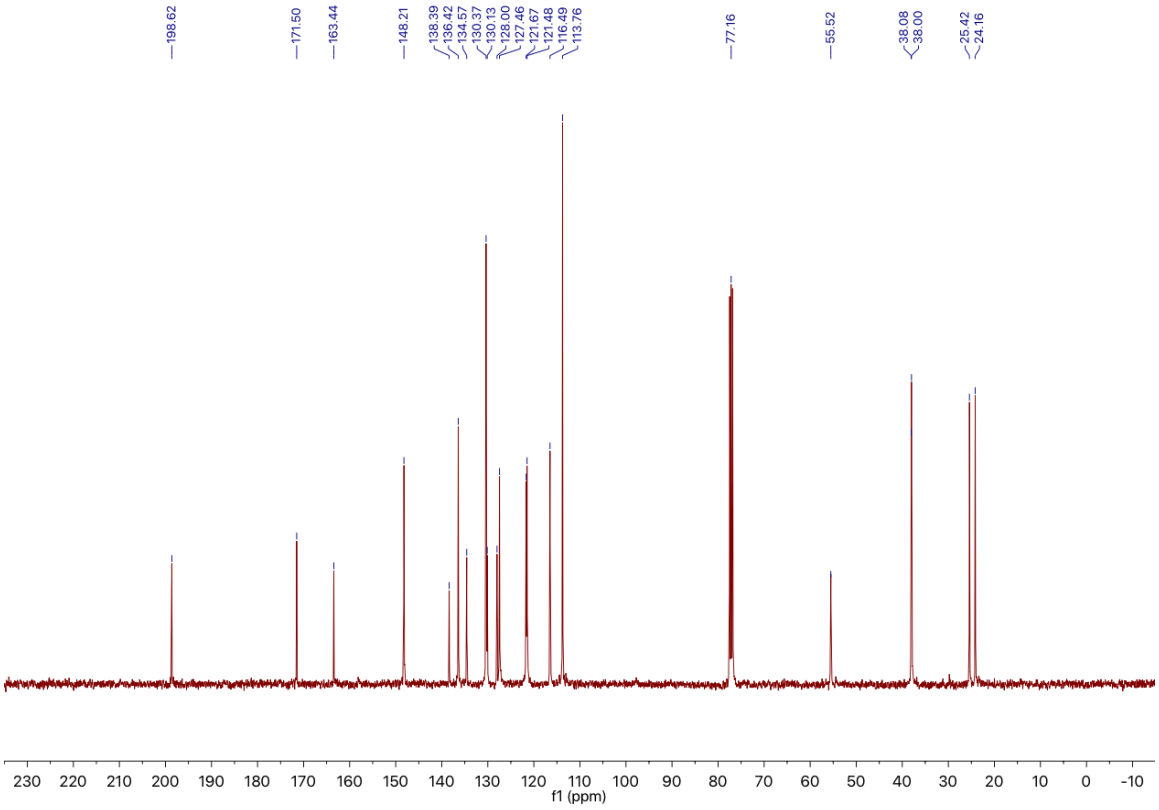
f1 (ppm)

3c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38.00
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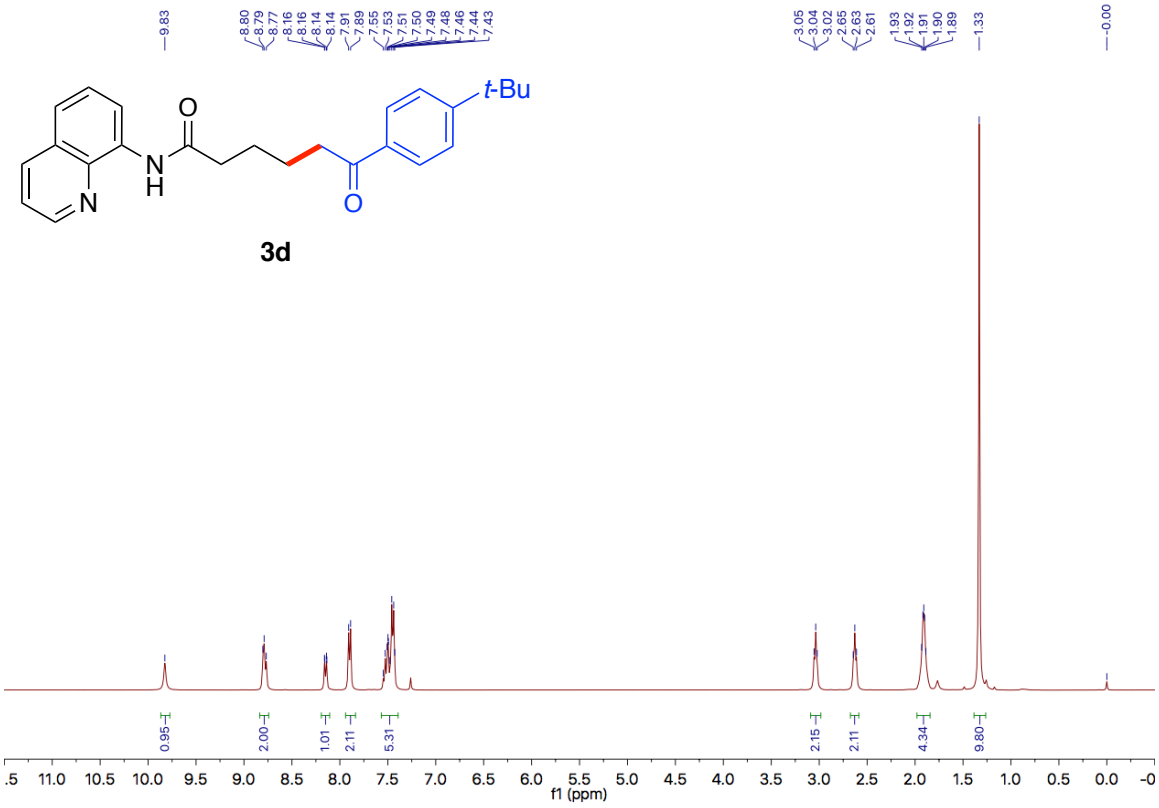
24.16
f1 (ppm)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7.50
7.49
7.48
7.46
7.44
7.43
3.05
3.04
3.02
2.65
2.63
2.61
1.93
1.92
1.91
1.90
1.89
1.33
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t-Bu
O
N
H
N
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2.11
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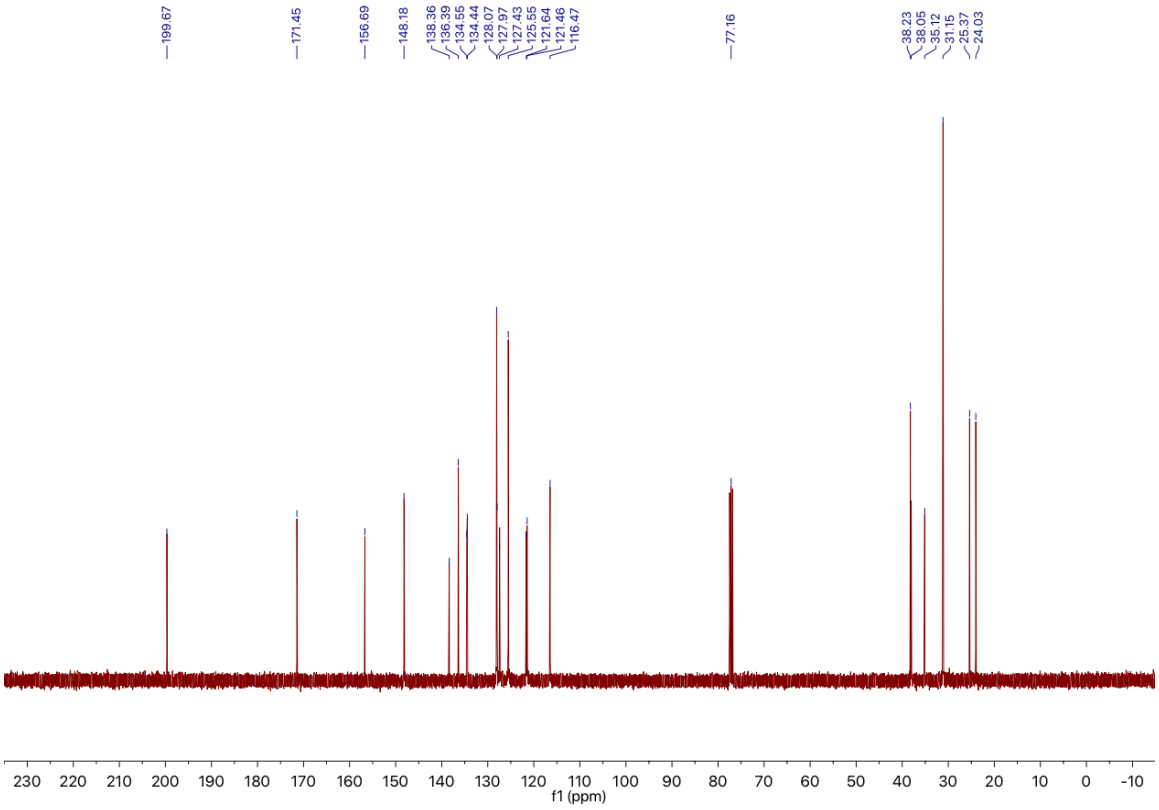
f1 (ppm)

3d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31.15
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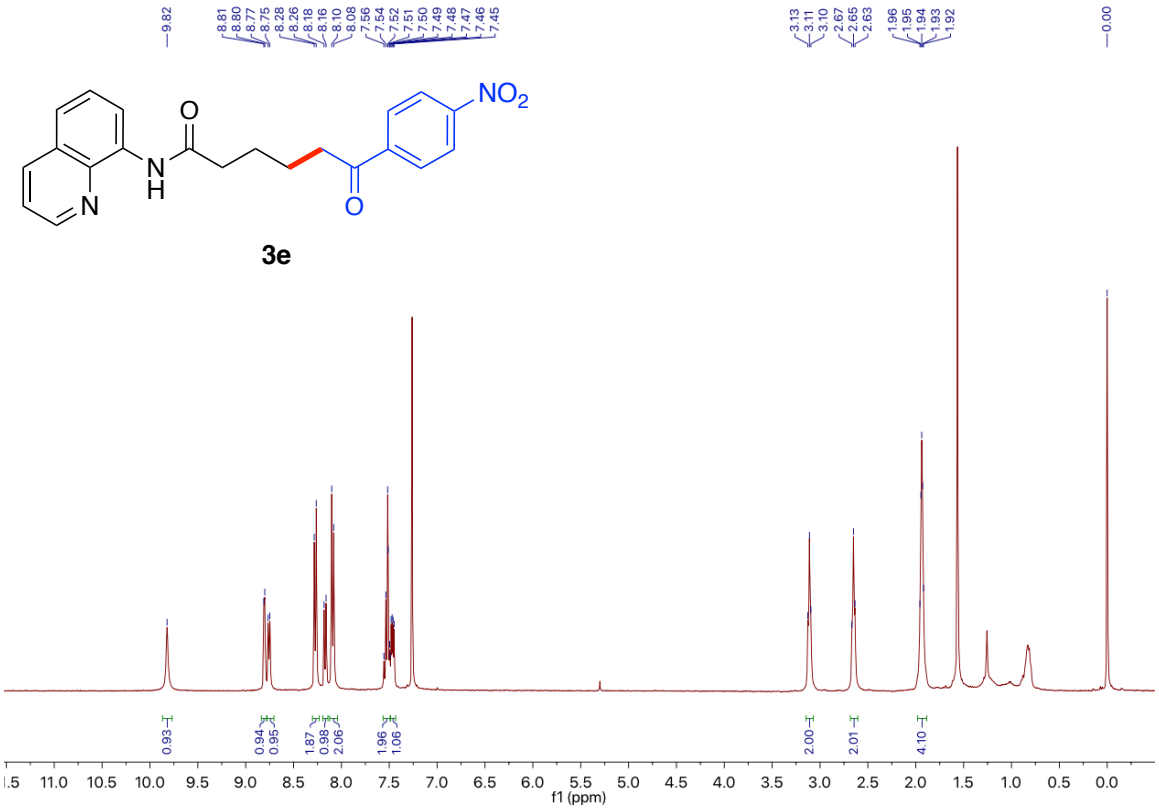
24.03
f1 (ppm)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7.48
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7.46
7.45
3.13
3.11
3.10
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2.63
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1.95
1.94
1.93
1.92
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NO2
O
N
H
N
O
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1.96
1.06
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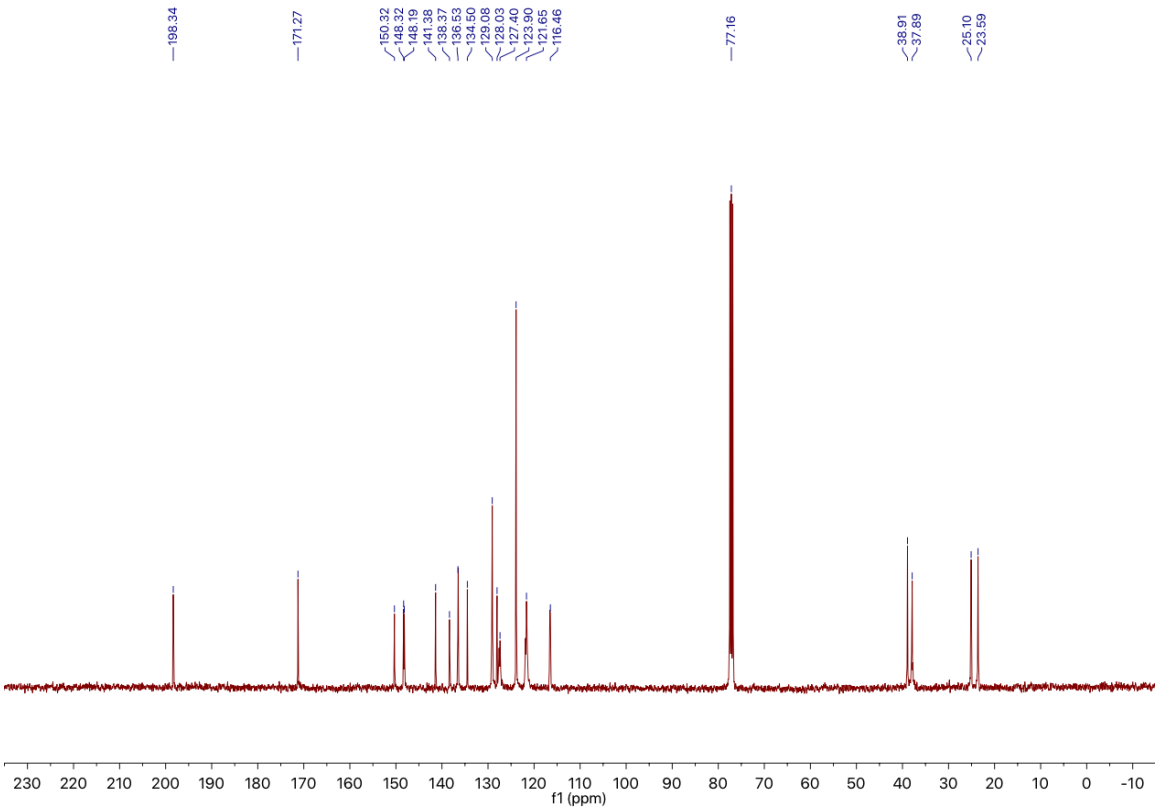
2.01
4.10
f1 (ppm)

3e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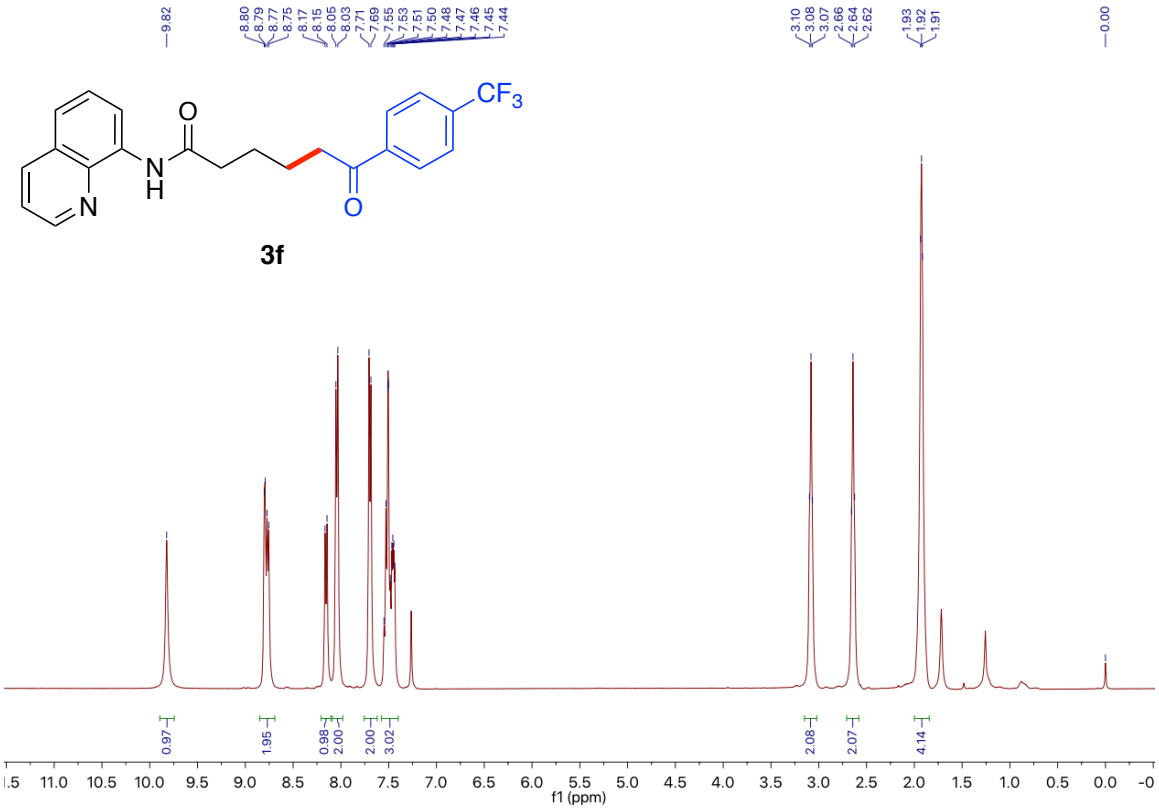
37.89
25.10
23.59
f1 (ppm)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7.48
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7.46
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7.44
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3.07
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2.62
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1.92
1.91
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O
N
H
N
O
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2.00
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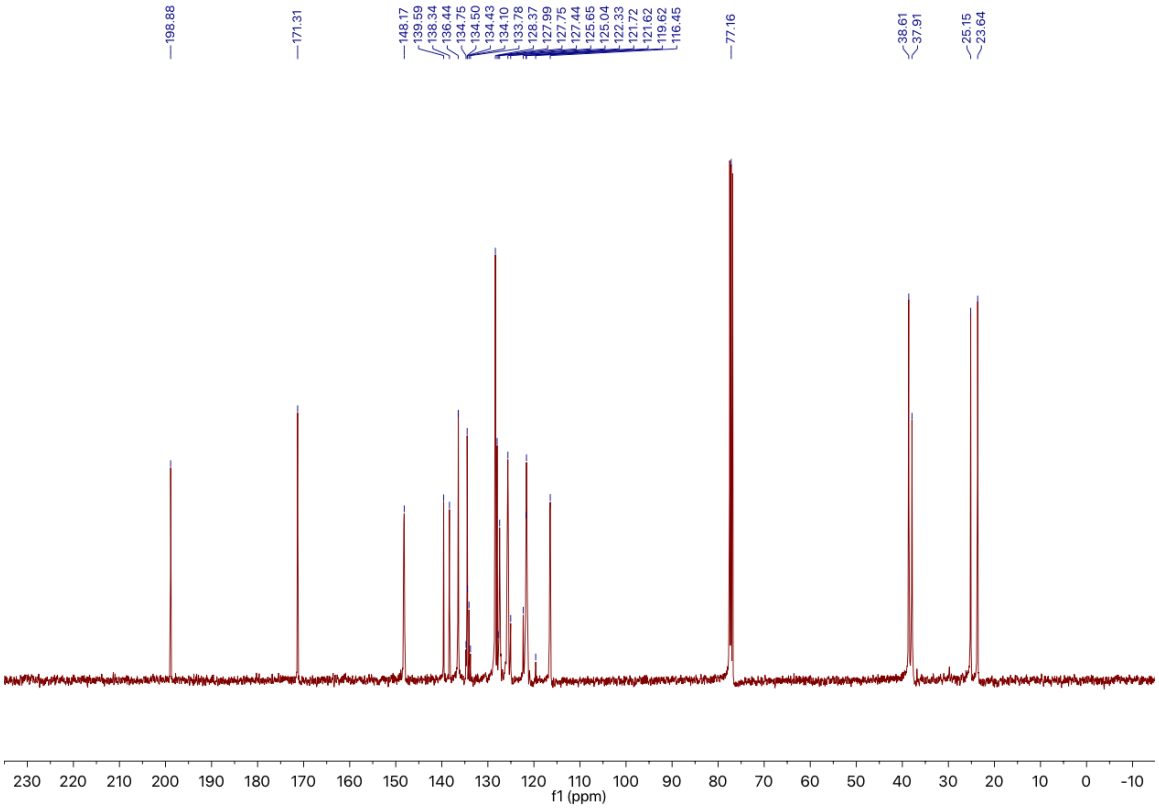
2.08
2.07
4.14
f1 (ppm)

3f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127.44
125.65
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23.64
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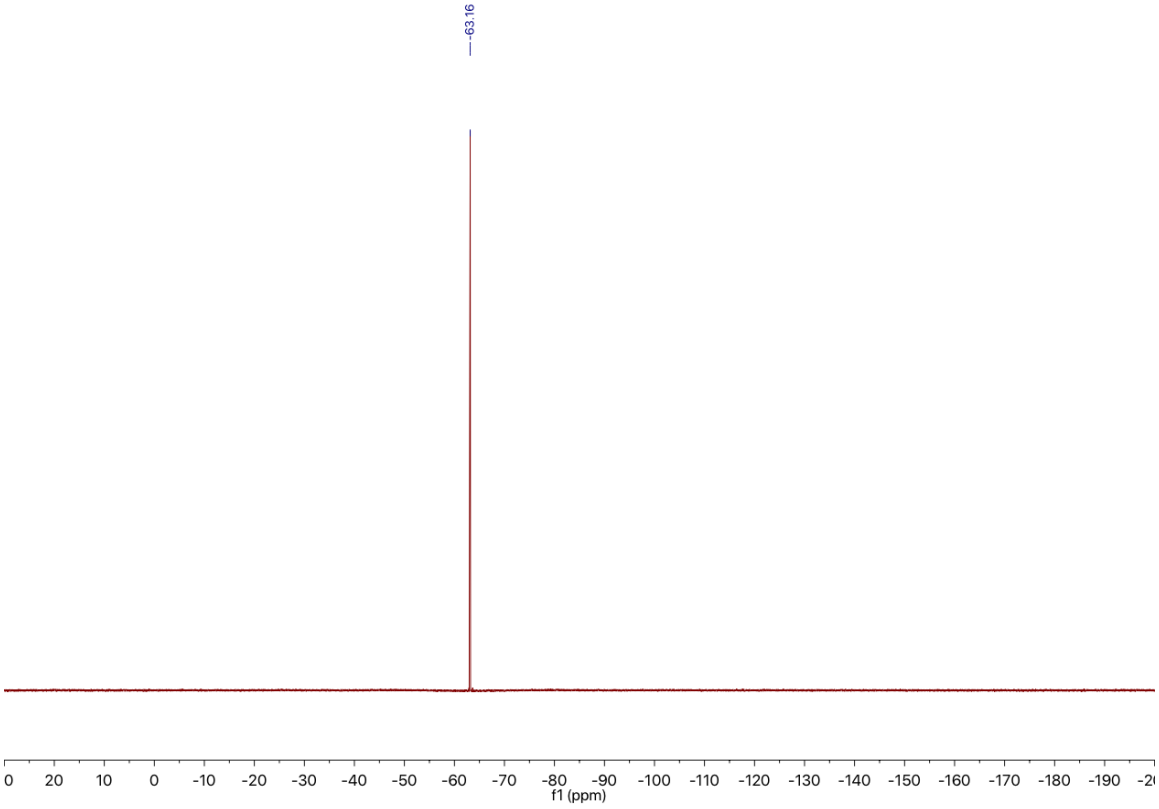
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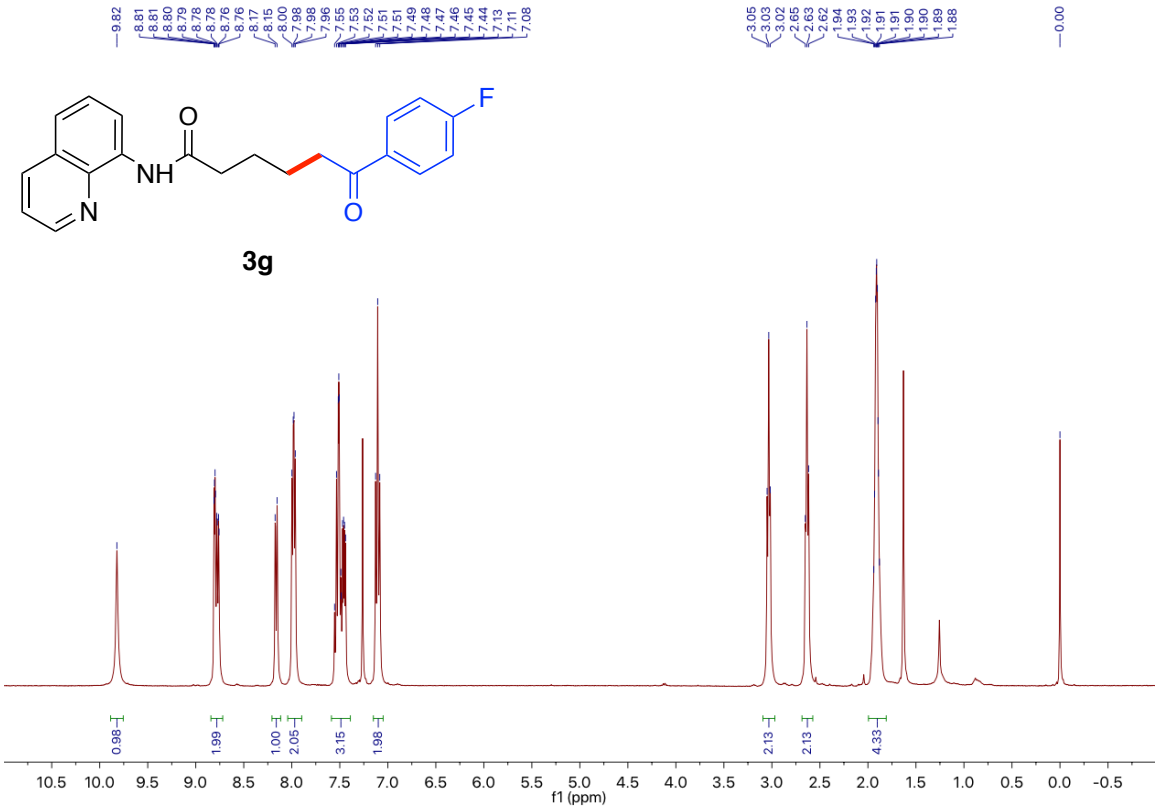
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7.46
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7.44
7.13
7.11
7.08
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3.03
3.02
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2.63
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1.90
1.89
1.88
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O
NH
N
O
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0.98
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1.00
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3.15
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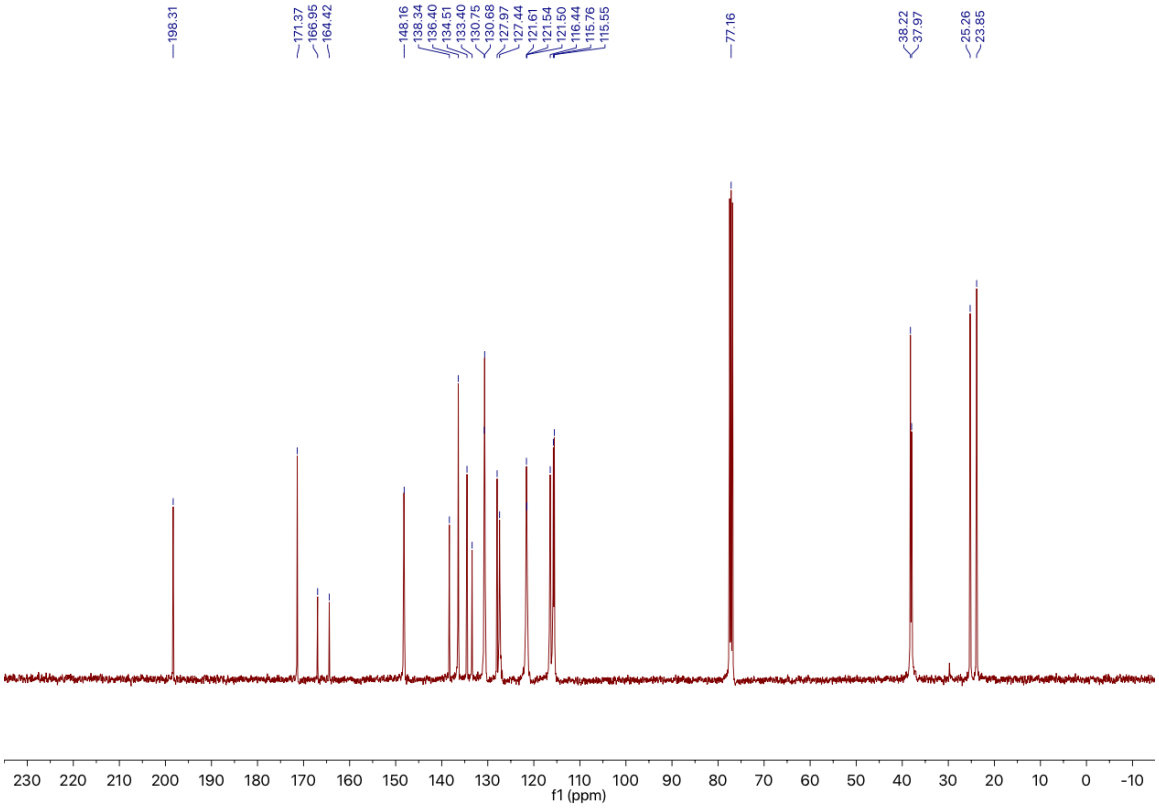
2.13
2.13
4.33
f1 (ppm)

3g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127.44
121.61
121.54
121.50
116.44
115.76
115.55
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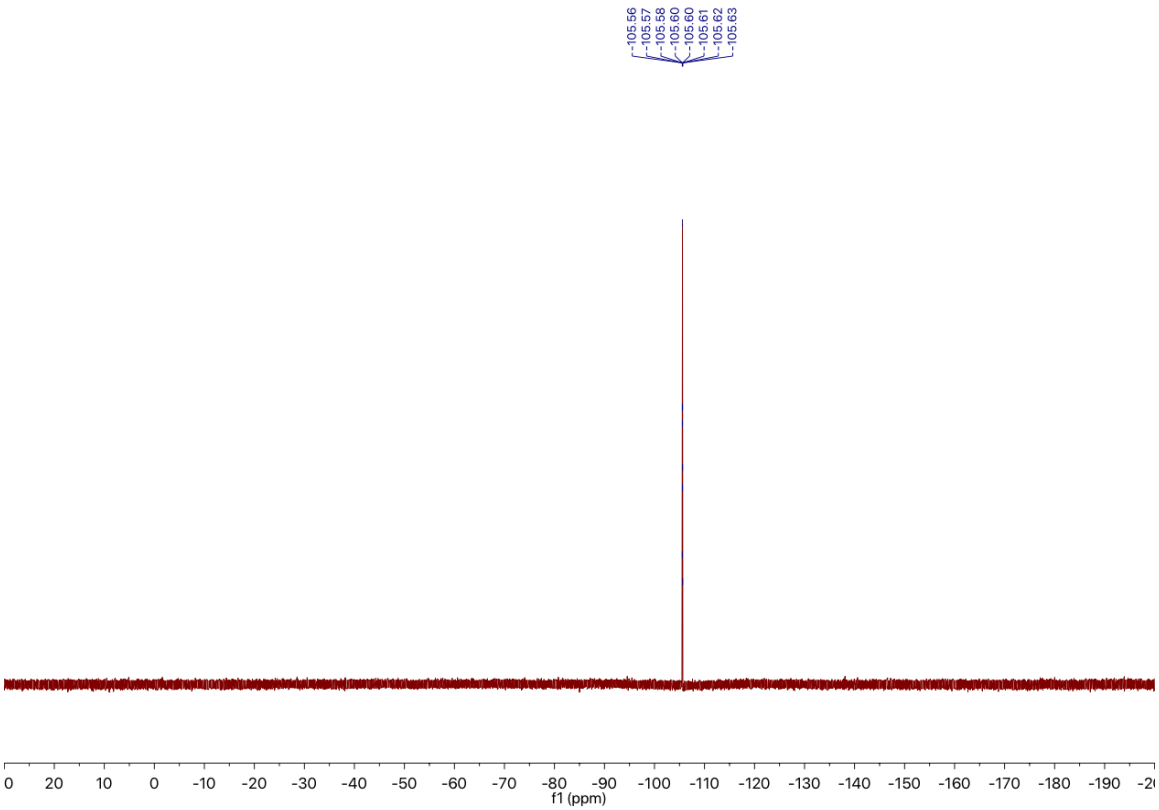
37.97
25.26
23.85
230 220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
f1 (ppm)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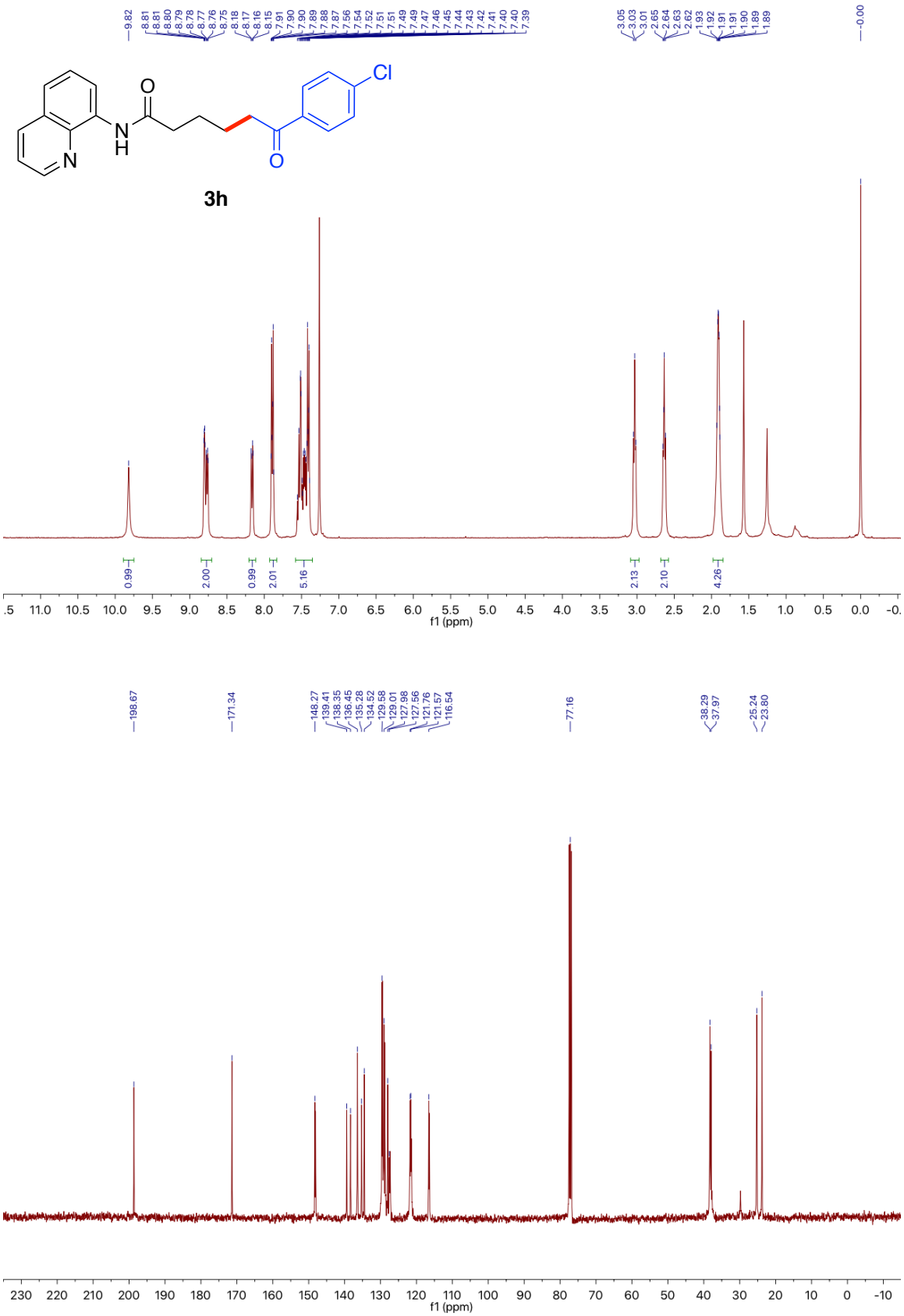
-105.63
0 20 10 0 -10 -20 -30 -40 -50 -60 -70 -80 -90 -100 -110 -120 -130 -140 -150 -160 -170 -180 -190
f1 (ppm)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7.39
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2.64
2.63
2.62
1.93
1.92
1.91
1.91
1.90
1.89
1.89
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O
N
H
N
O
Cl
3h
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2.00
0.99
2.01
5.16
2.13
2.10
4.26
f1 (ppm)
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171.34
148.27
139.41
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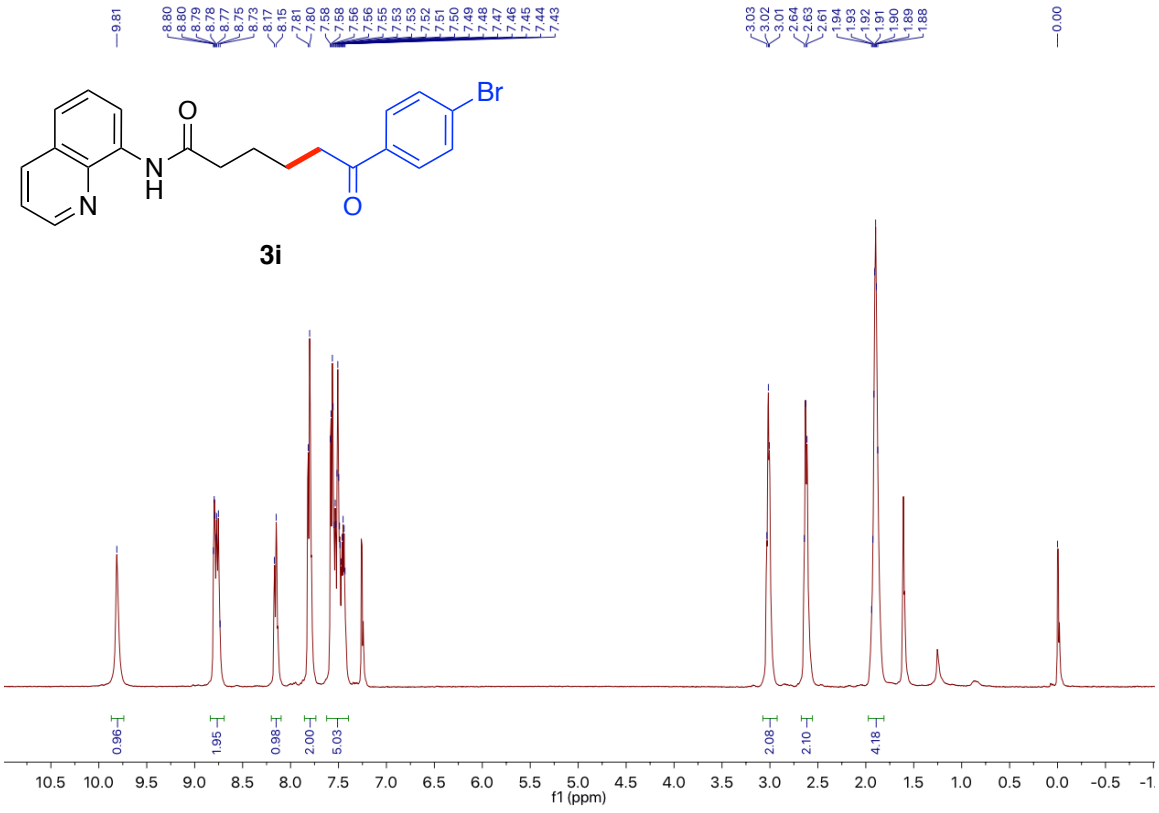
23.80
f1 (ppm)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7.46
7.45
7.44
7.43
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1.90
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1.88
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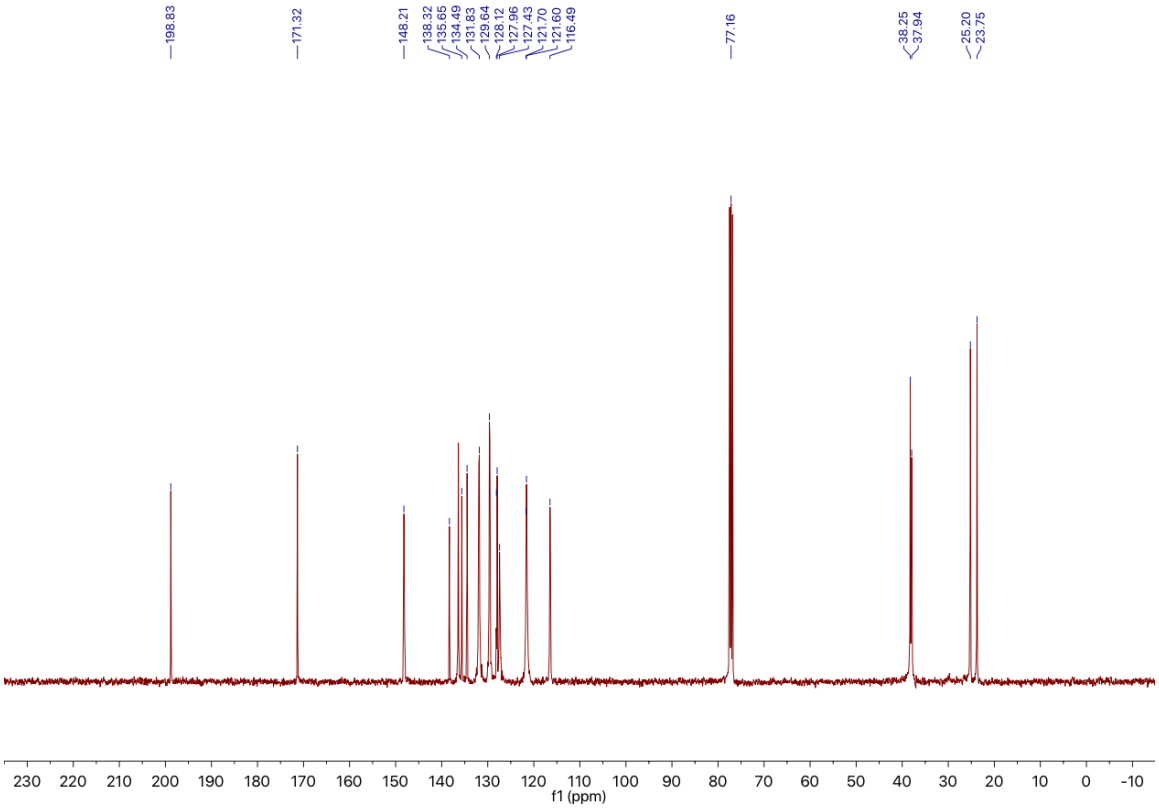
f1 (ppm)

3i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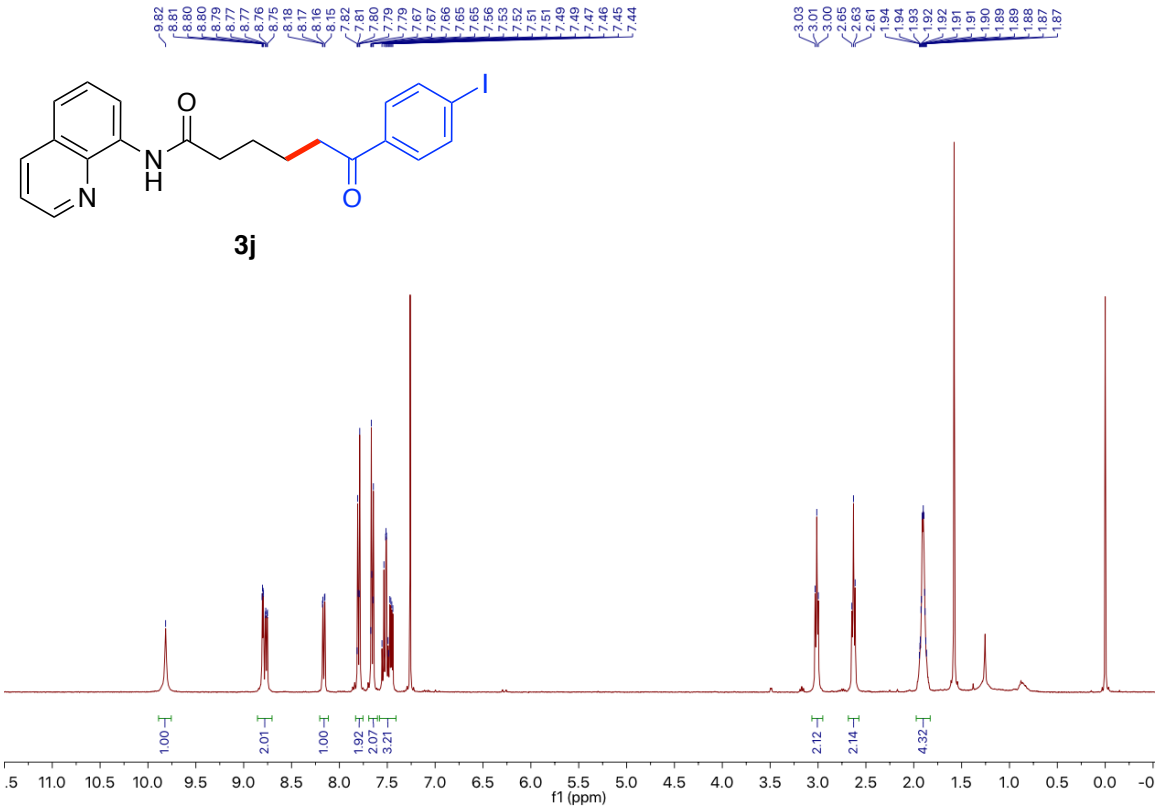
23.75
f1 (ppm)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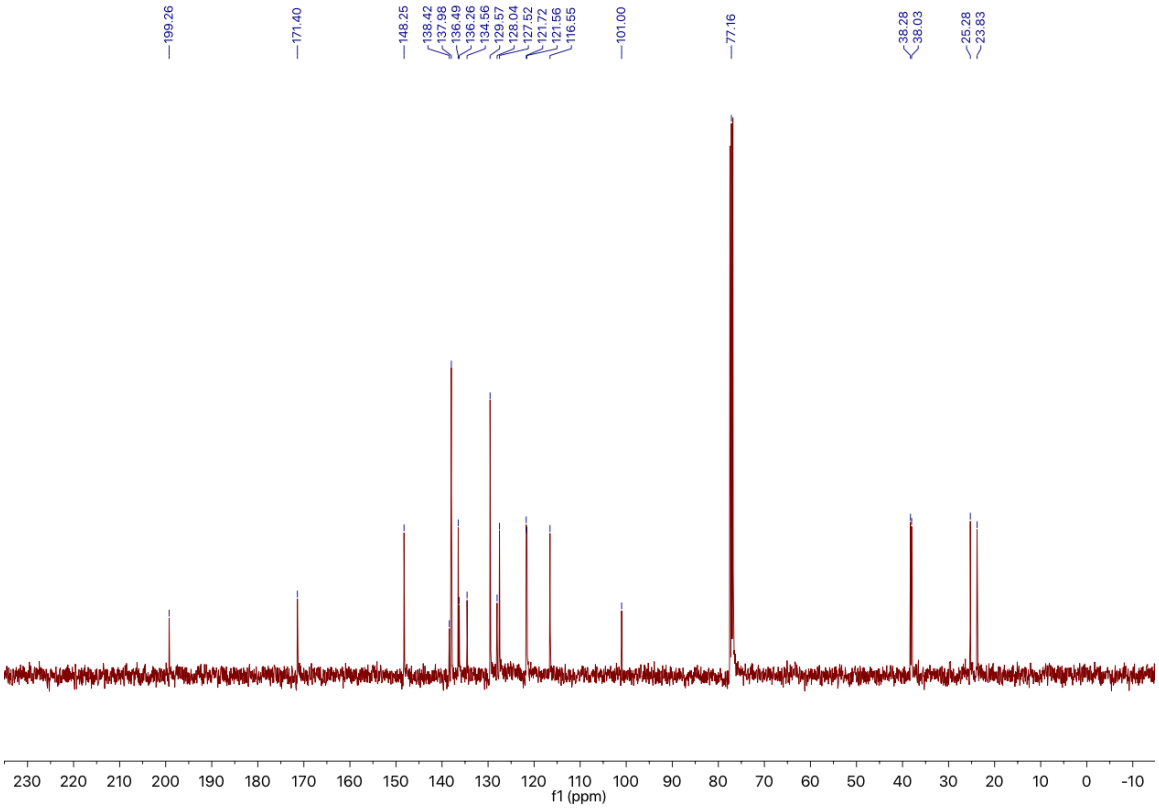
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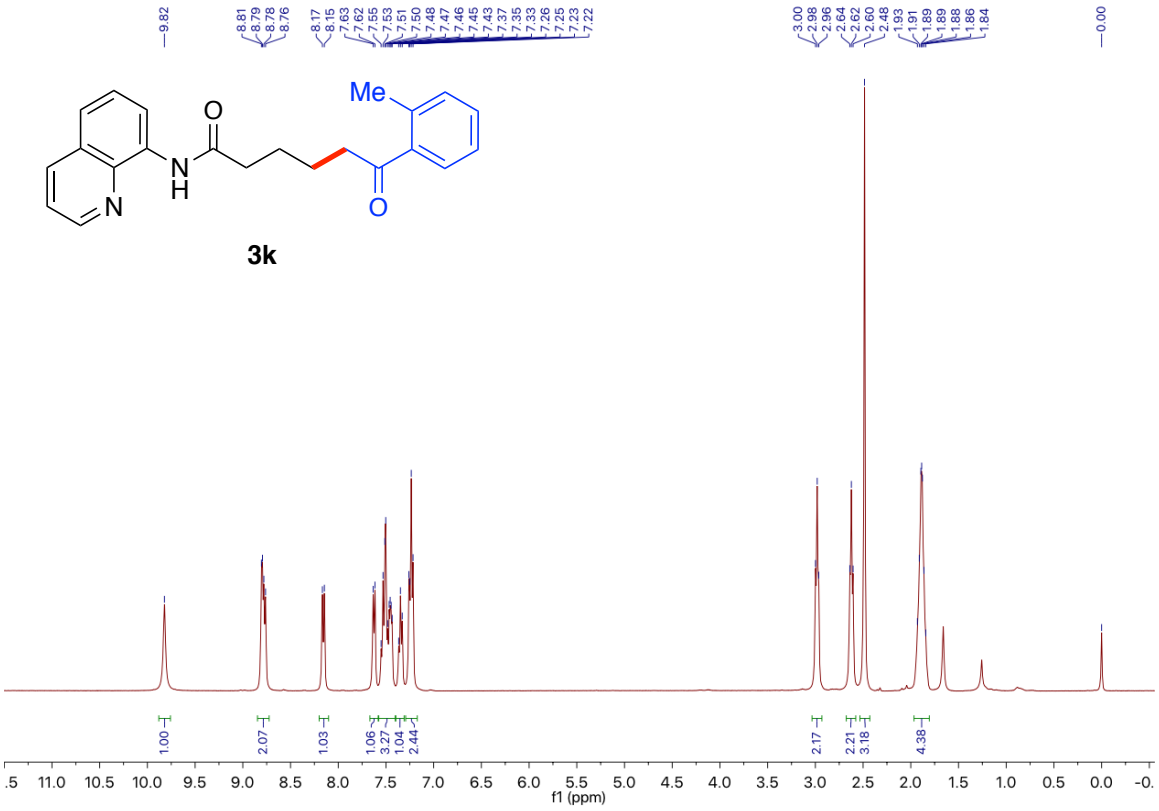
23.83
f1 (ppm)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O
3k
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2.21
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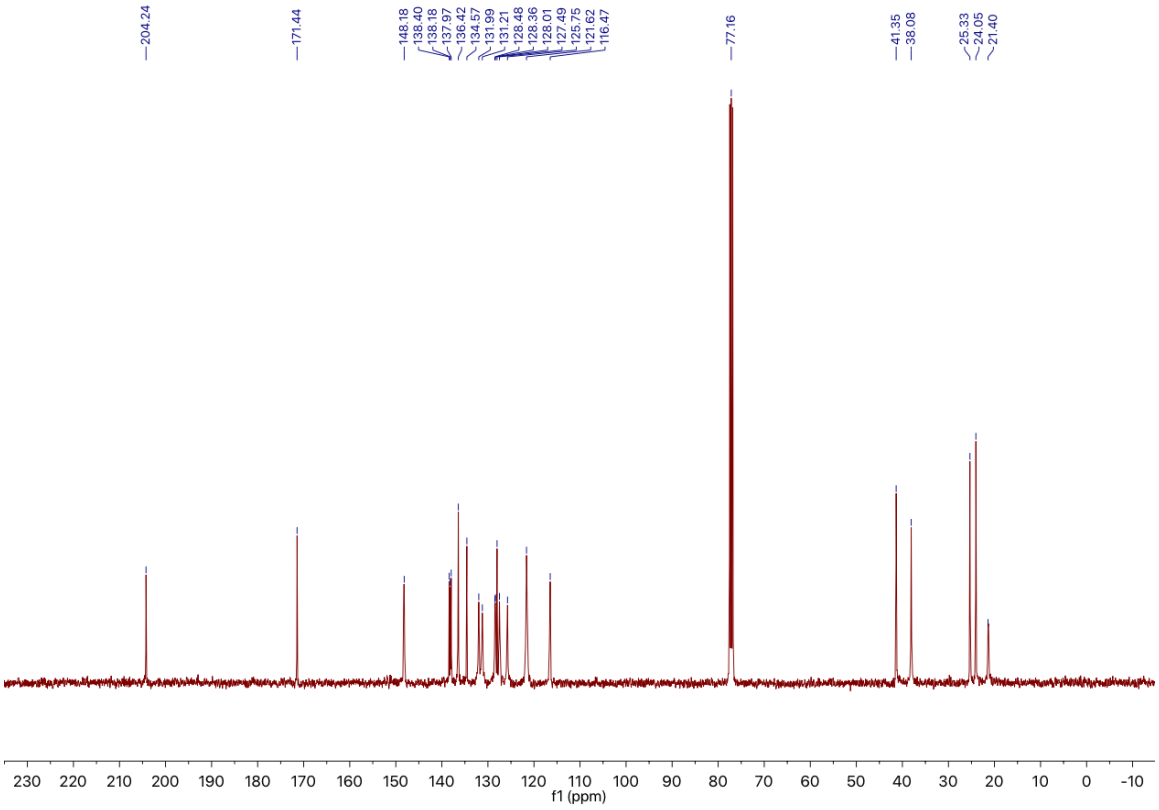
4.38
f1 (ppm)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41.35
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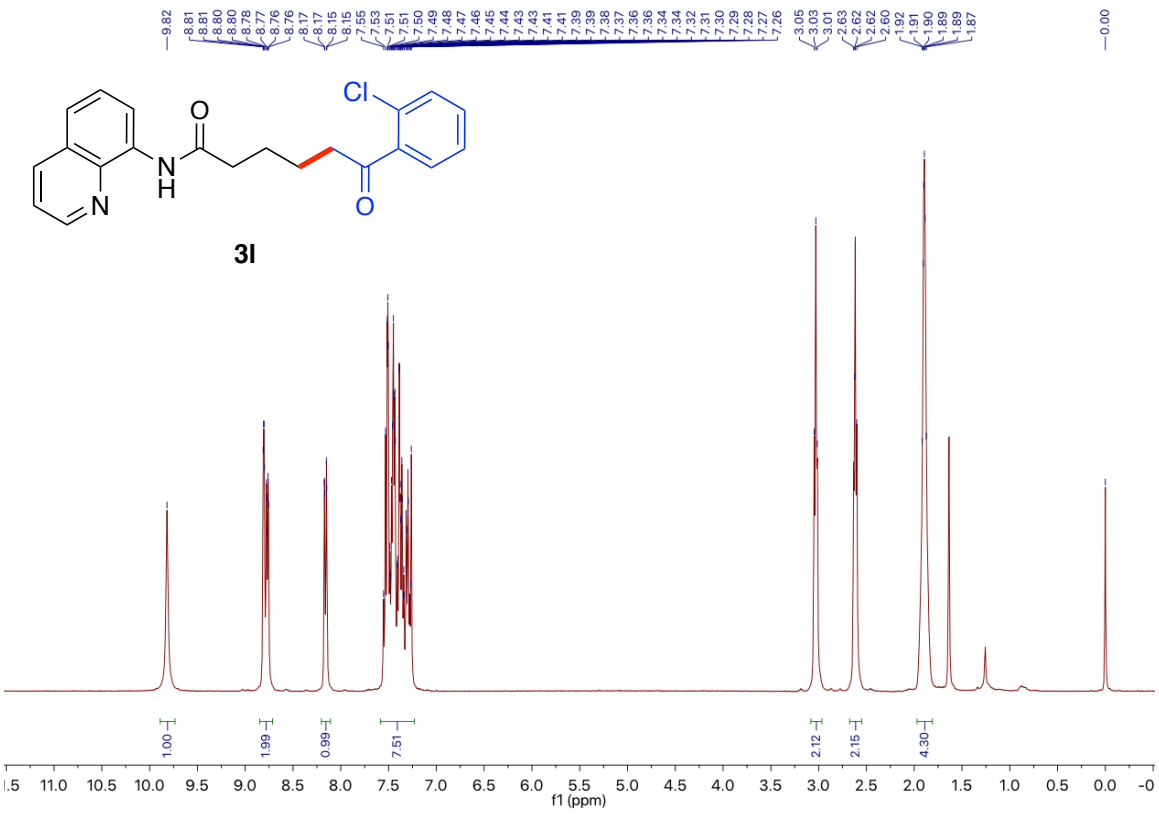
21.40
f1 (ppm)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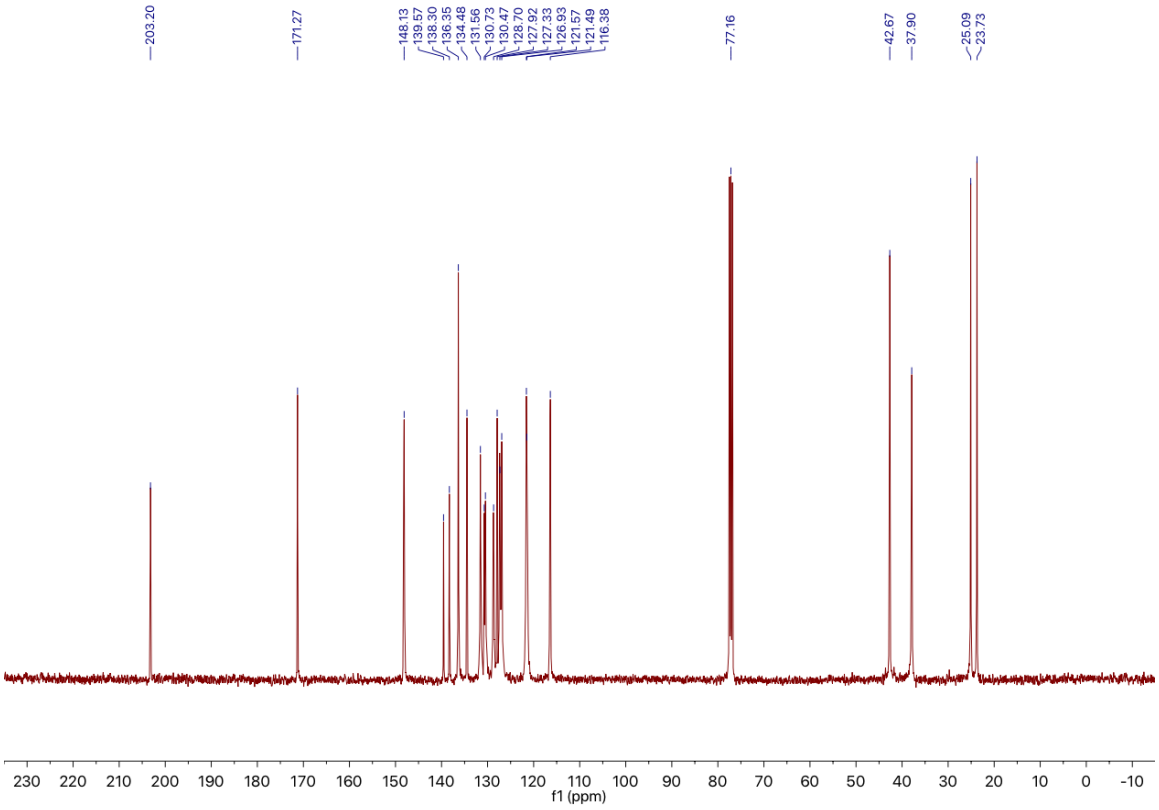
f1 (ppm)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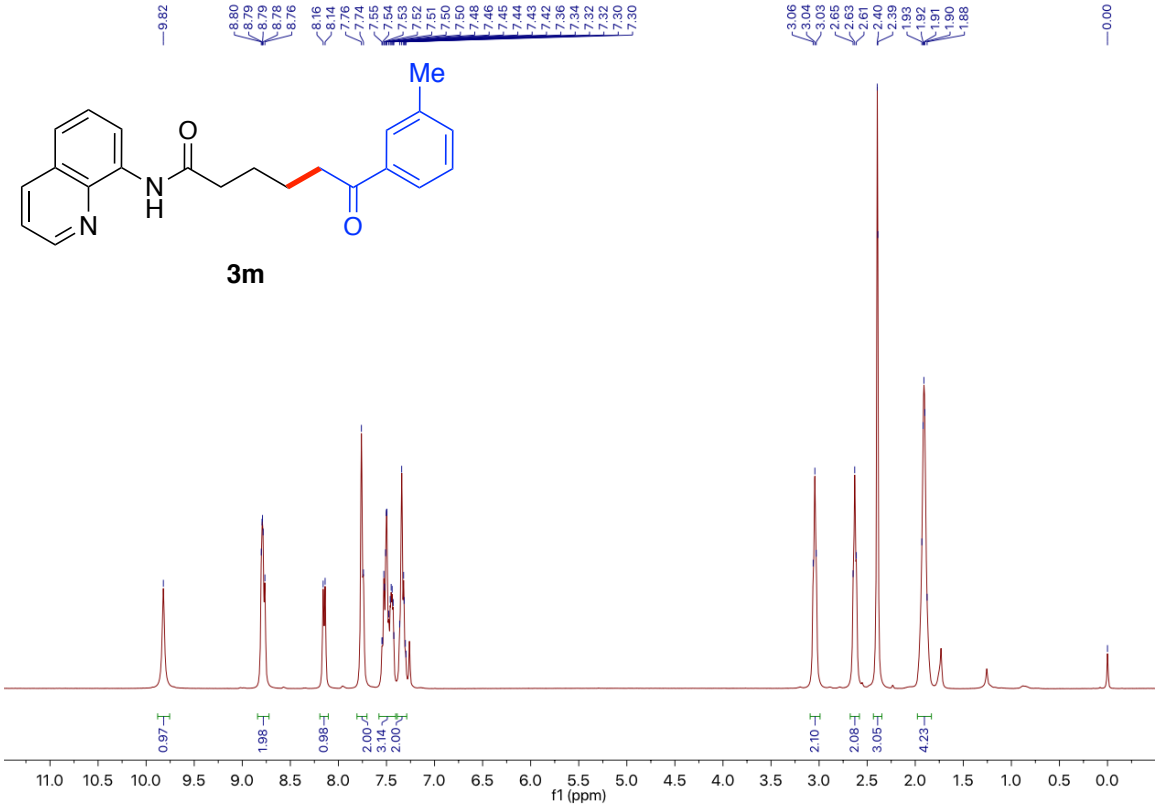
37.90
25.09
23.73
f1 (ppm)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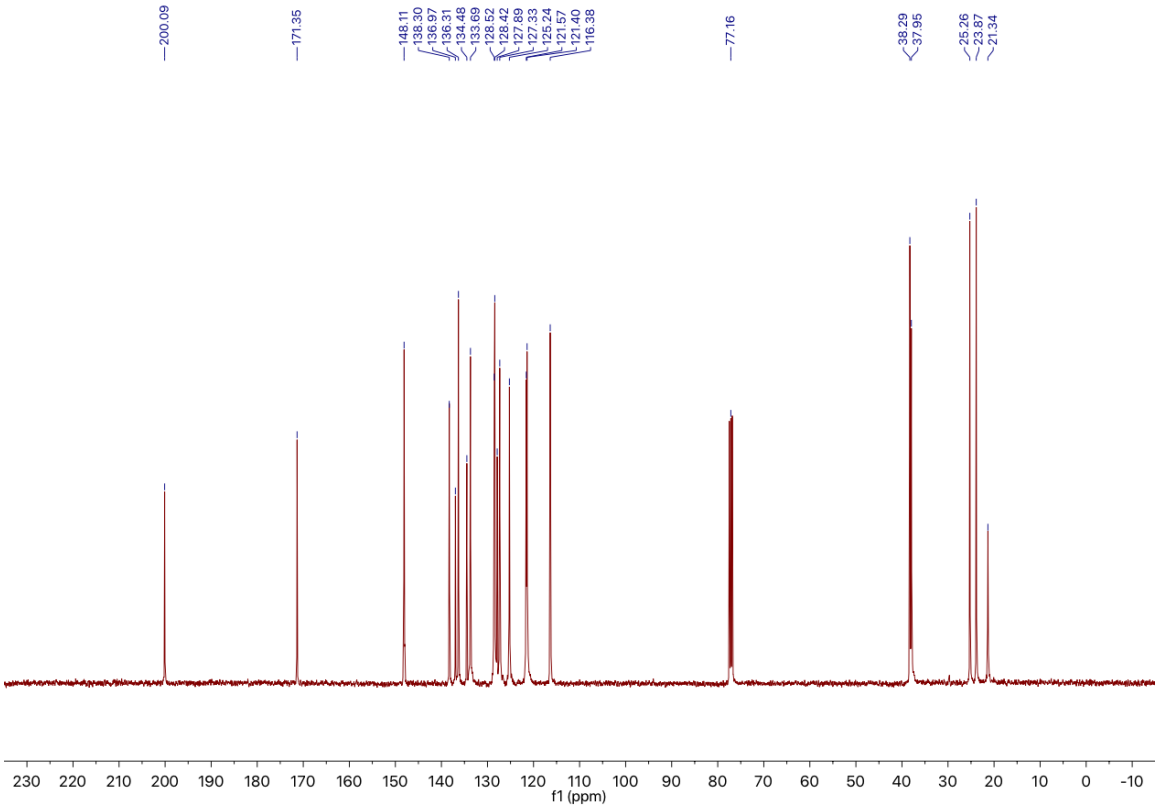
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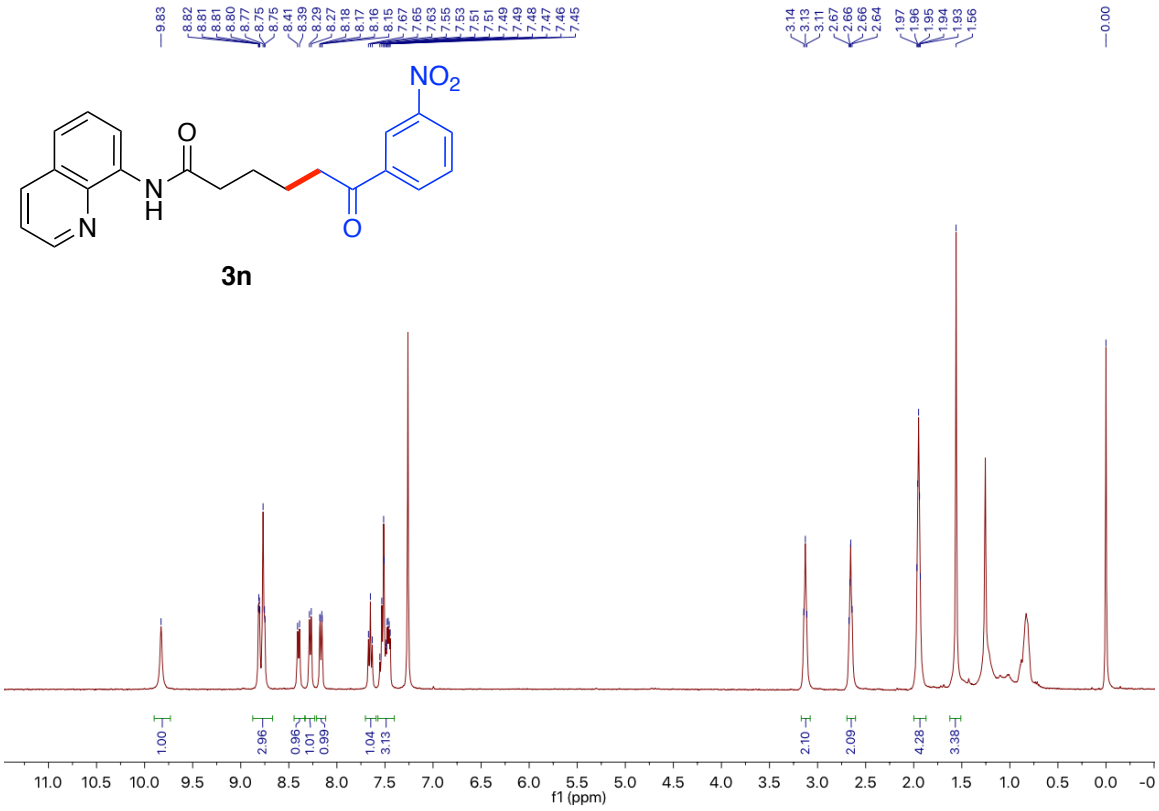
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7.45
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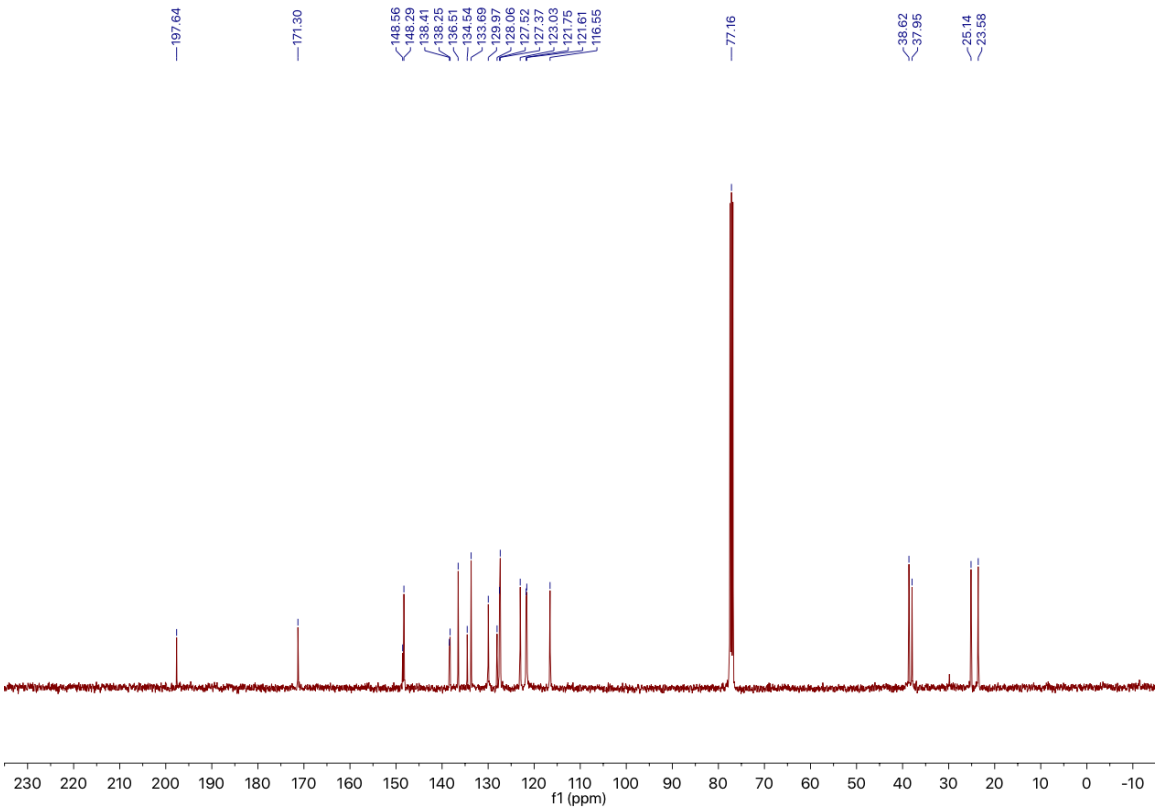
f1 (ppm)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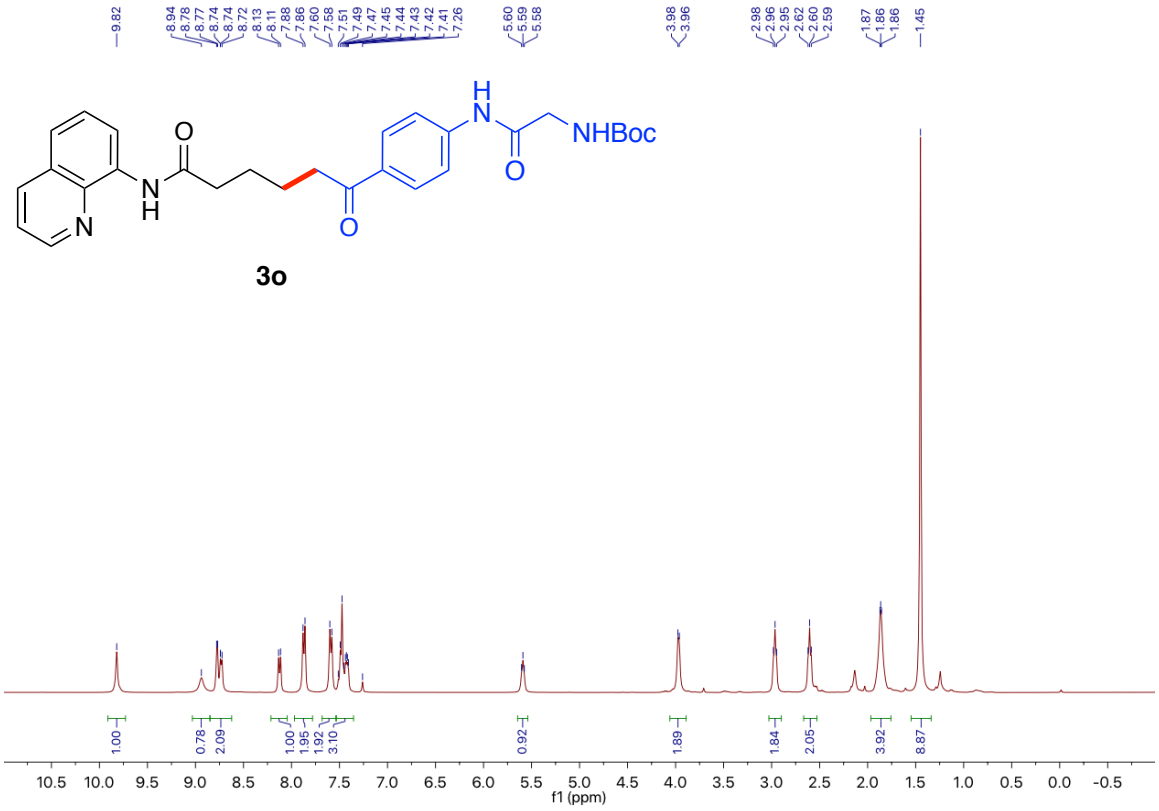
25.14
23.58
f1 (ppm)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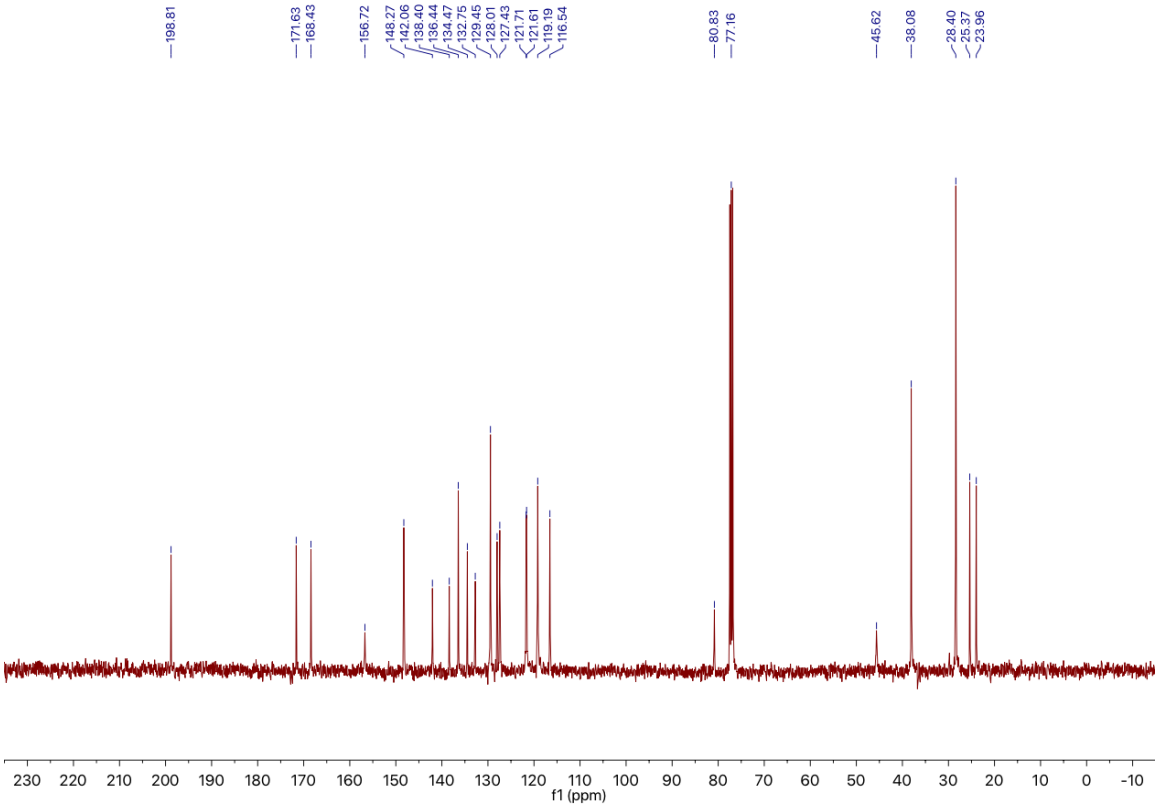
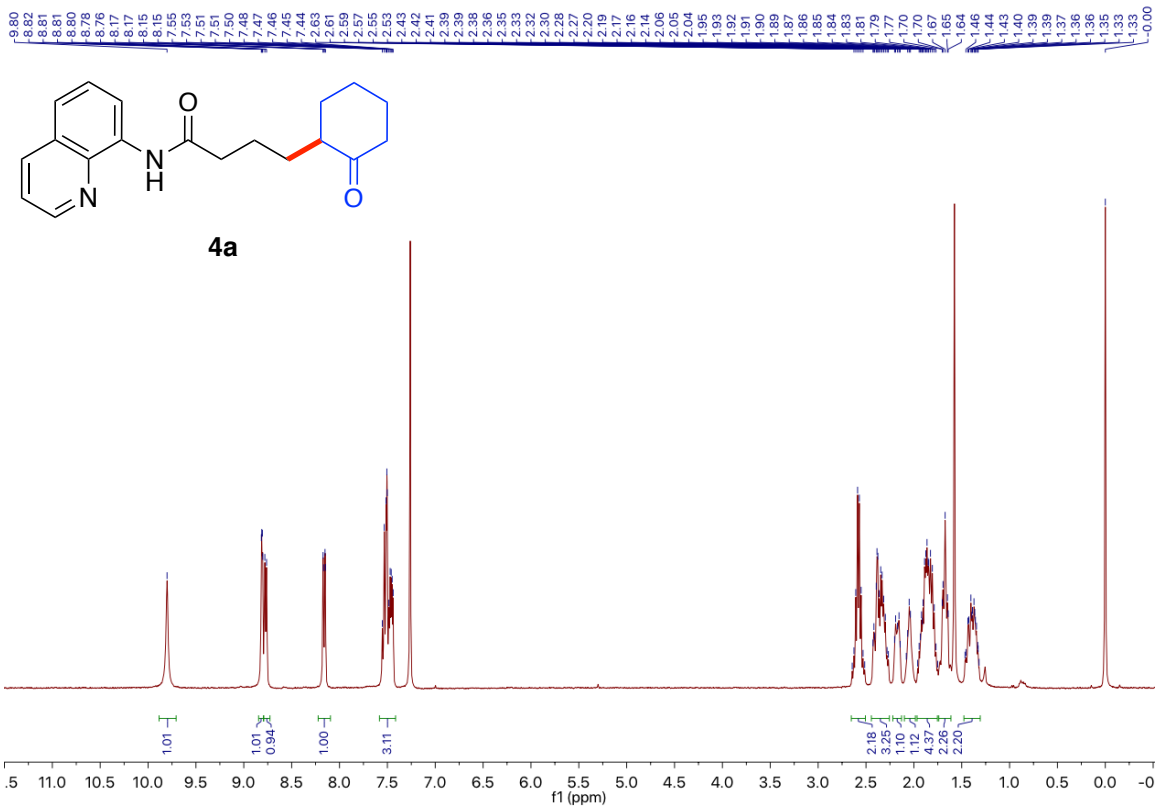
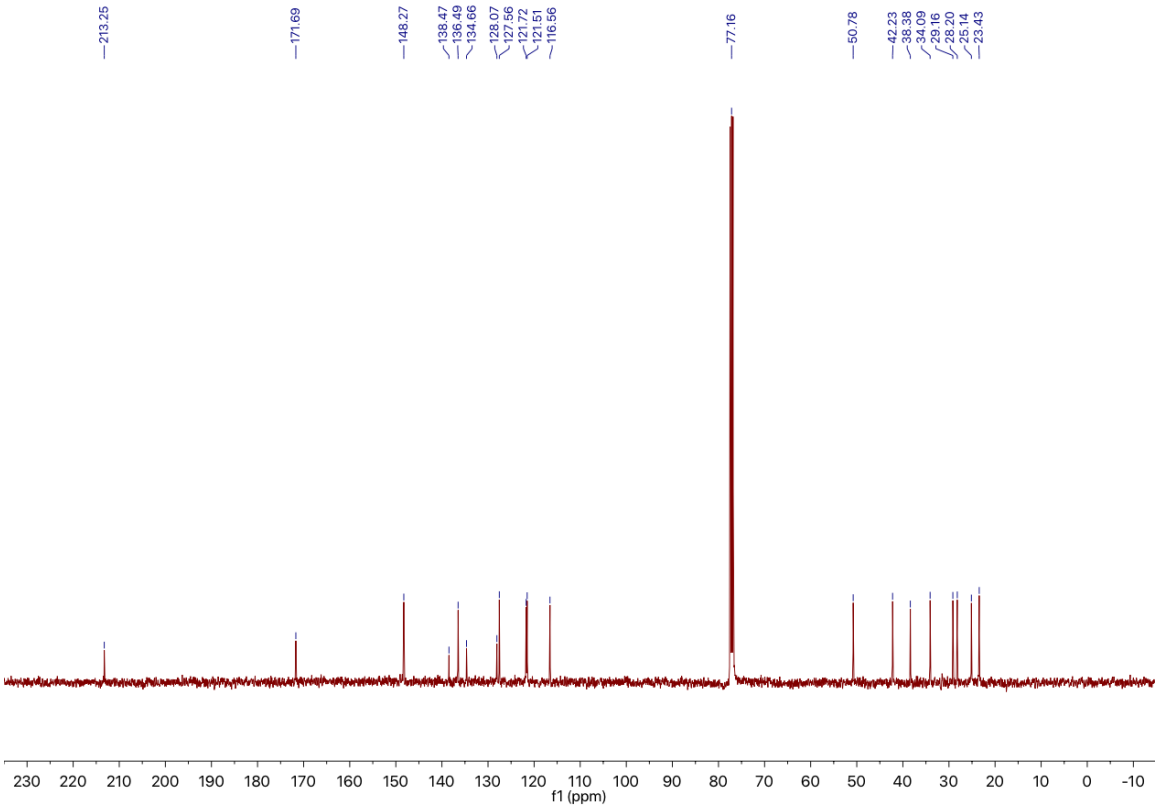
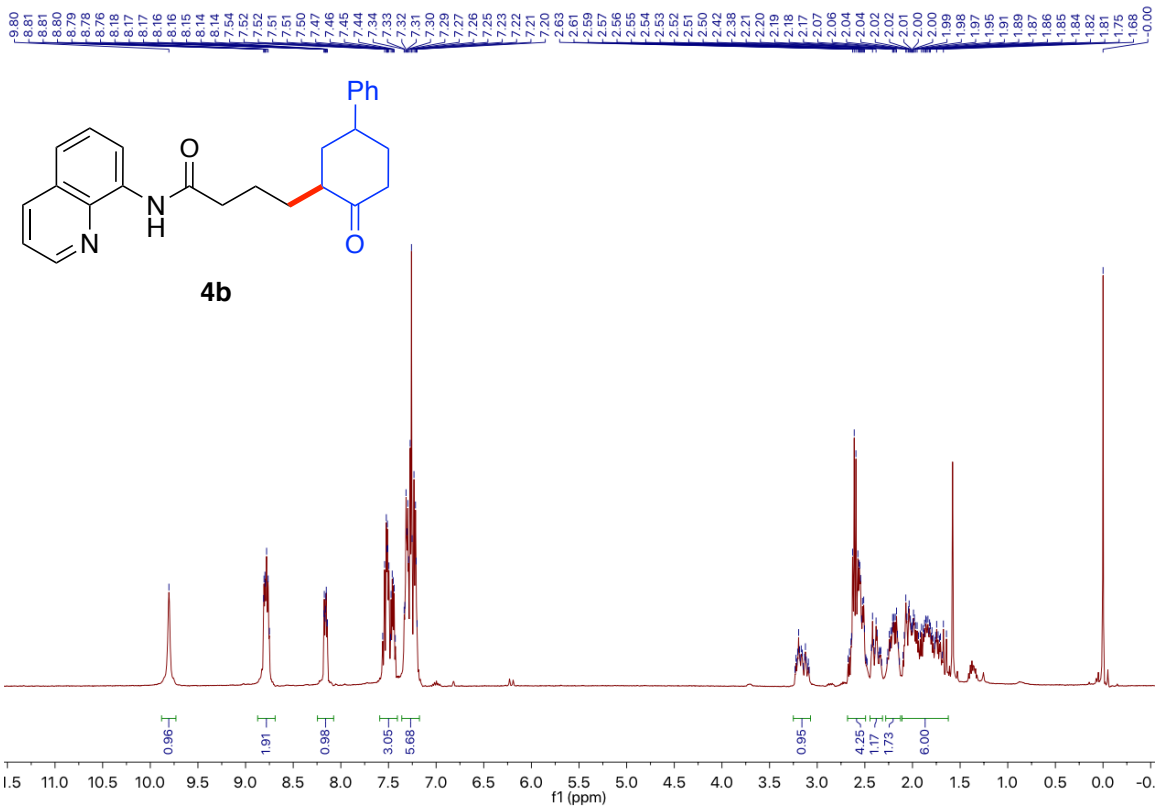
N
O
NHBoc
1.00
0.78
2.09
1.00
1.95
1.92
3.10
0.92
1.89
1.84
2.05
3.92
8.87
f1 (ppm)

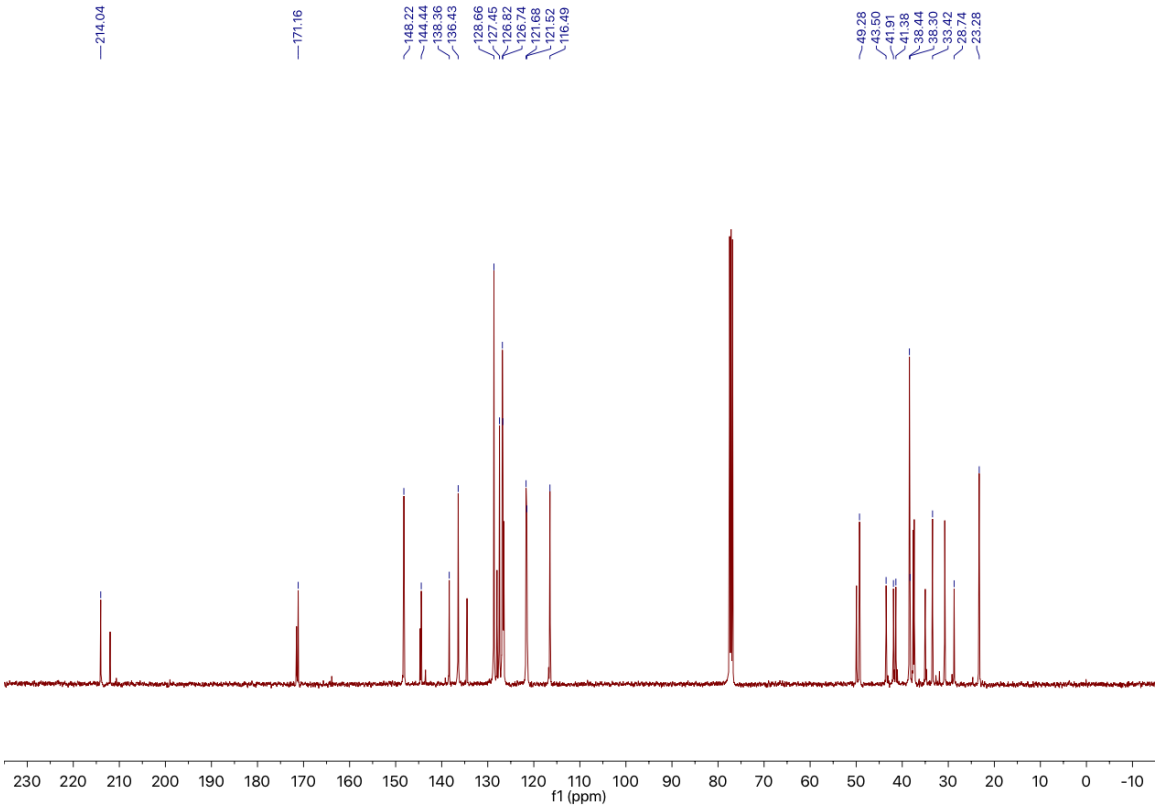
3o

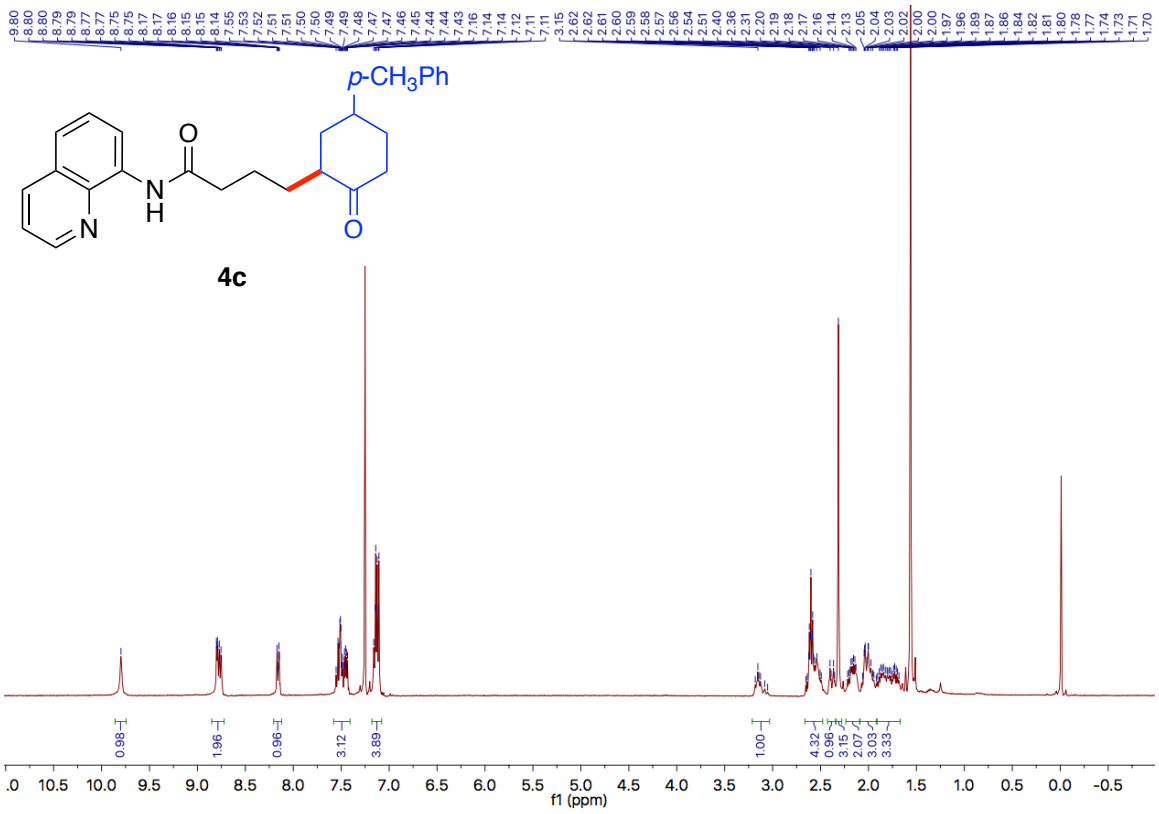

198.81
171.63
168.43
156.72
148.27
142.06
138.40
136.44
134.47
132.75
129.45
128.01
127.43
121.71
121.61
119.19
116.54
80.83
77.16
45.62
38.08
28.40
25.37
23.96
f1 (ppm)

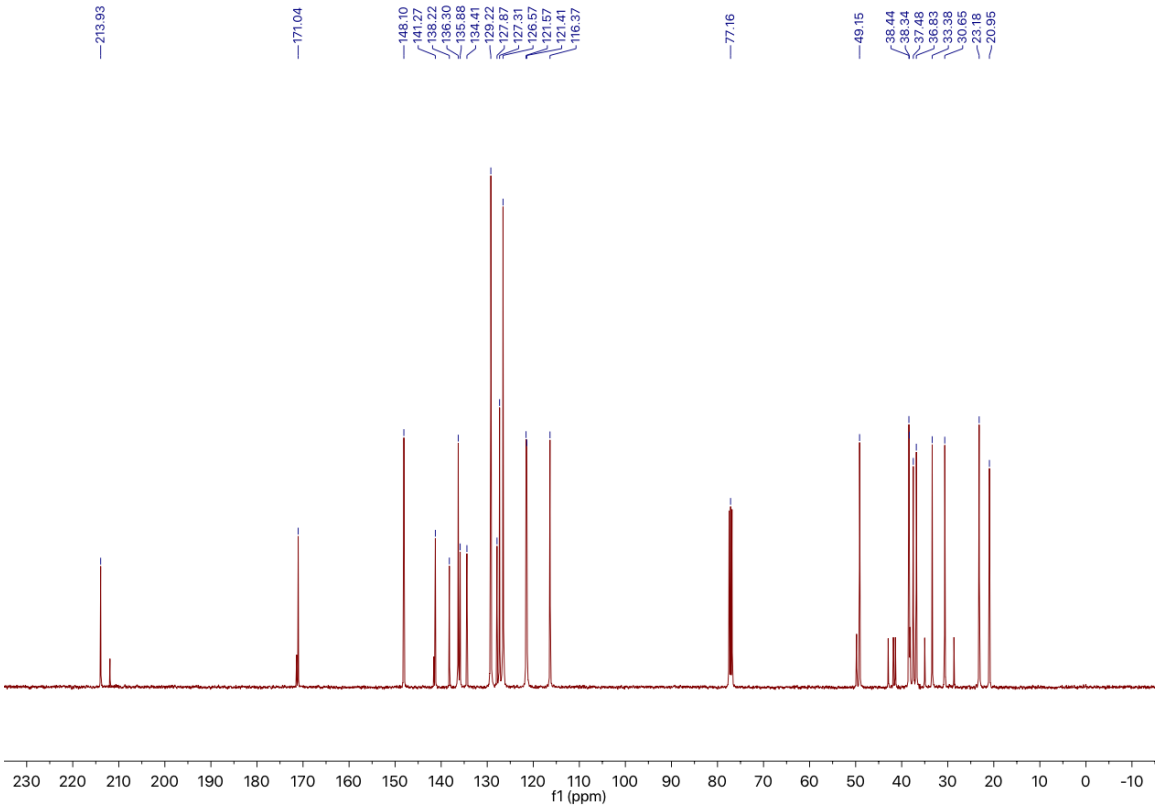

O
N
H
N
O
4a
f1 (ppm)

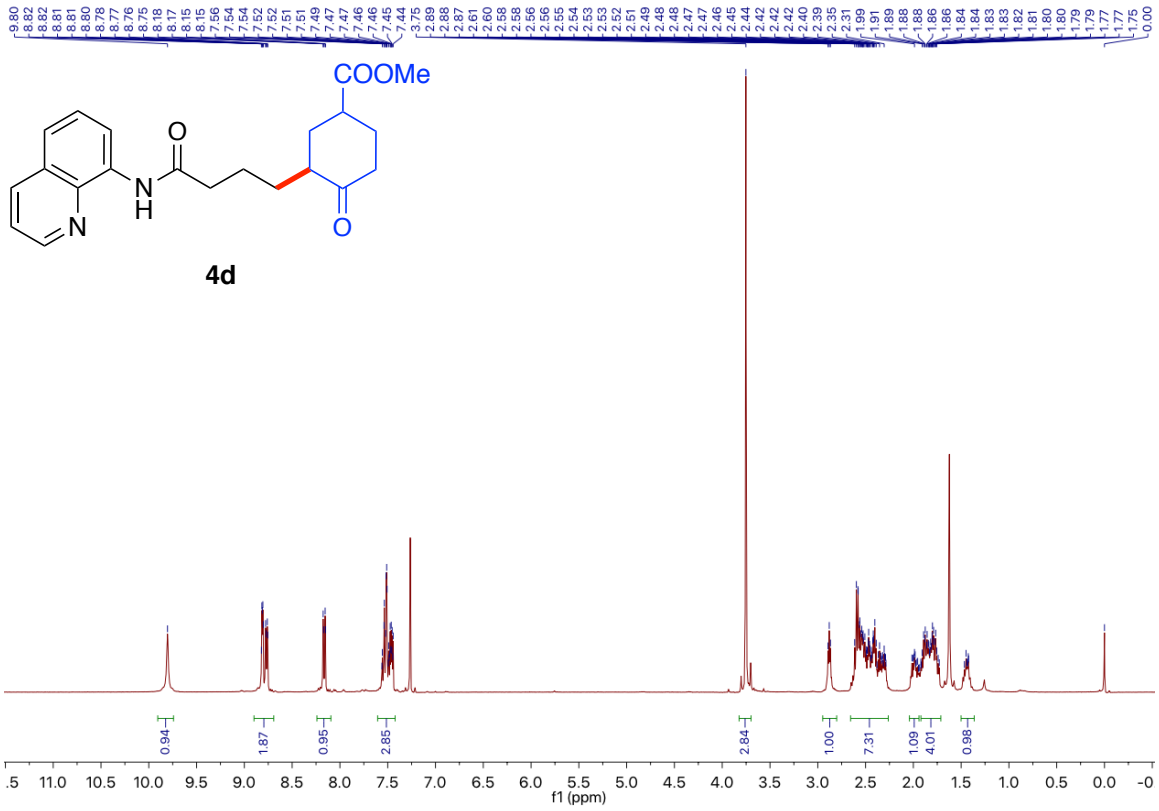

f1 (ppm)

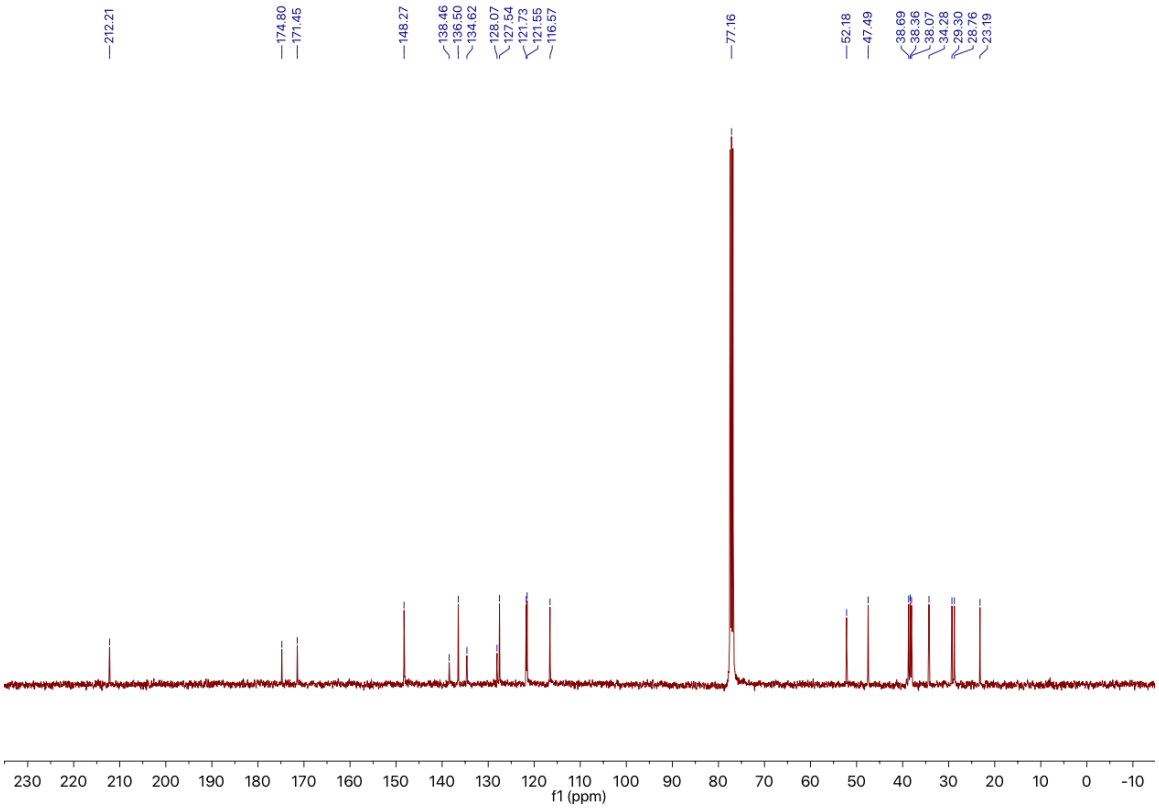

Ph
O
N
H
N
O
4b
f1 (ppm)


214.04
171.16
148.22
144.44
138.36
136.43
128.66
127.45
126.82
126.74
121.68
121.52
116.49
49.28
43.50
41.91
41.38
38.44
38.30
33.42
28.74
23.28
f1 (ppm)


p-CH3Ph
O
N
H
N
O
4c
f1 (ppm)


213.93
171.04
148.10
141.27
138.22
136.30
135.88
134.41
129.22
127.87
127.31
126.57
121.57
121.41
116.37
77.16
49.15
38.44
38.34
37.48
36.83
33.38
30.65
23.18
20.95
f1 (ppm)


COOMe
O
N
H
N
O
4d
0.94
1.87
0.95
2.85
2.84
1.00
7.31
1.09
4.01
0.98
f1 (ppm)


212.21
174.80
171.45
148.27
138.46
136.50
134.62
128.07
127.54
121.73
121.55
116.57
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38.69
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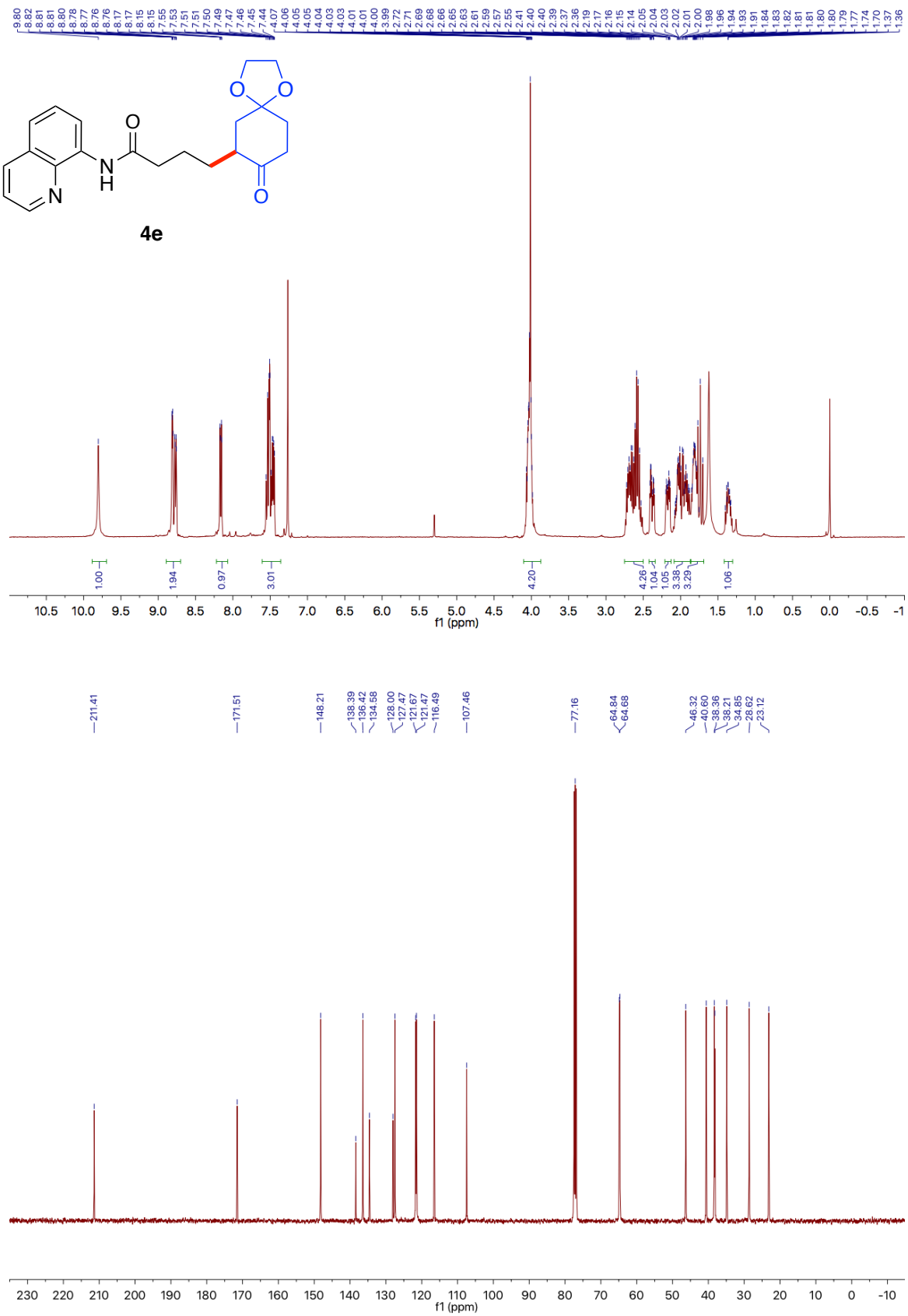
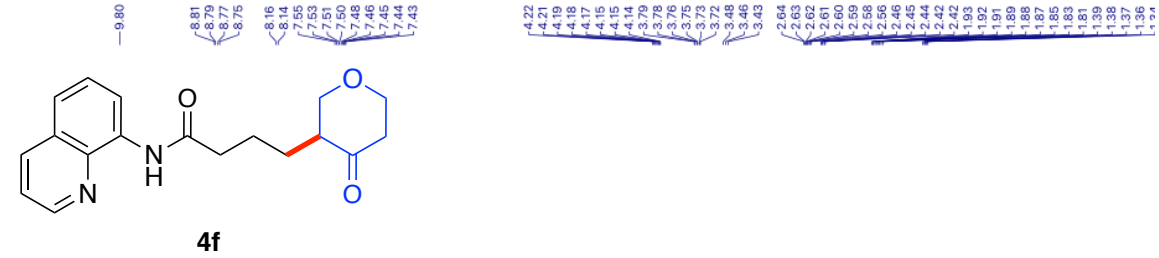
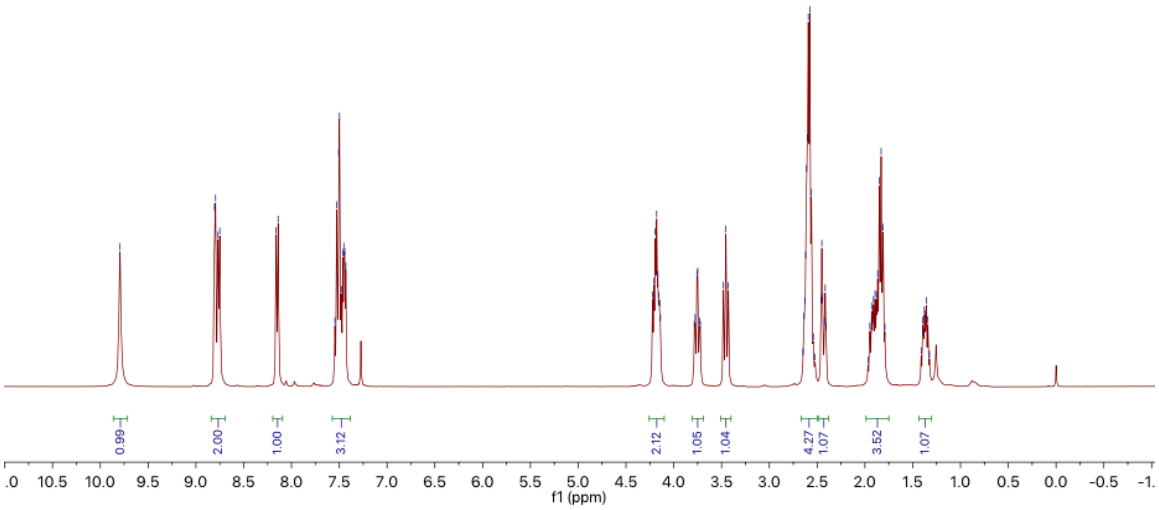
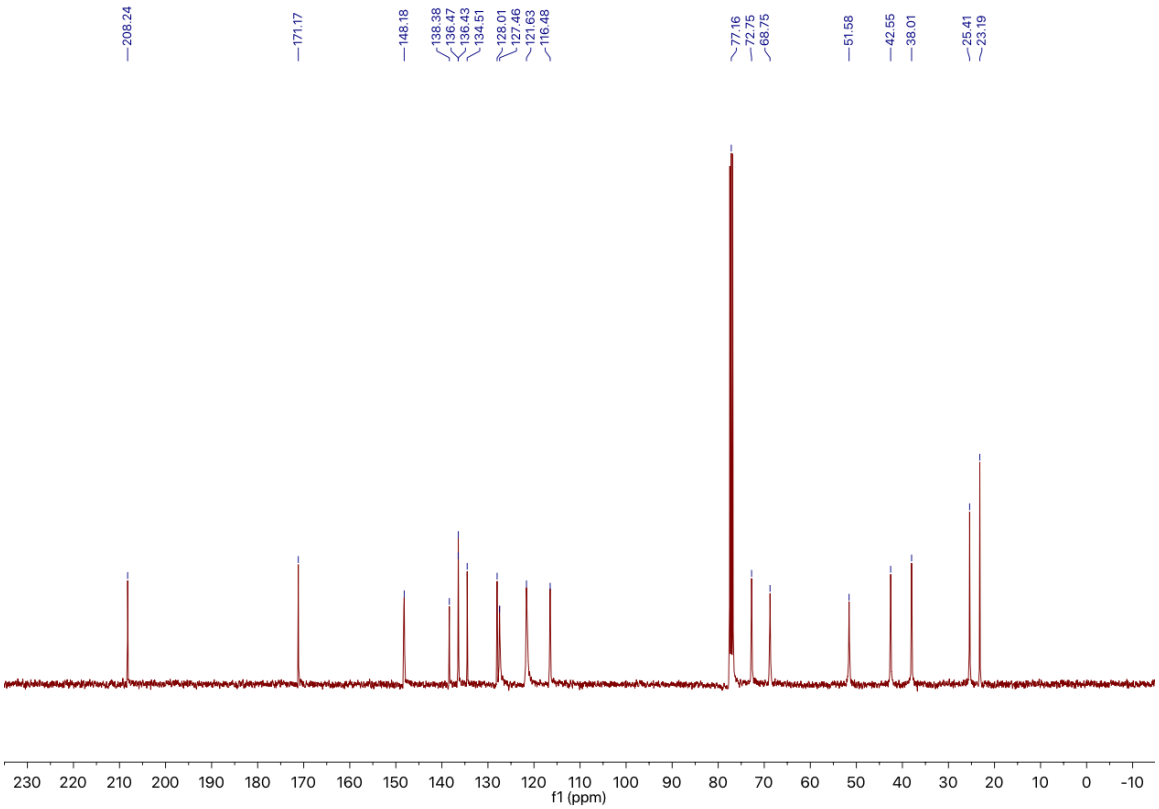
29.30
28.76
23.19
f1 (ppm)

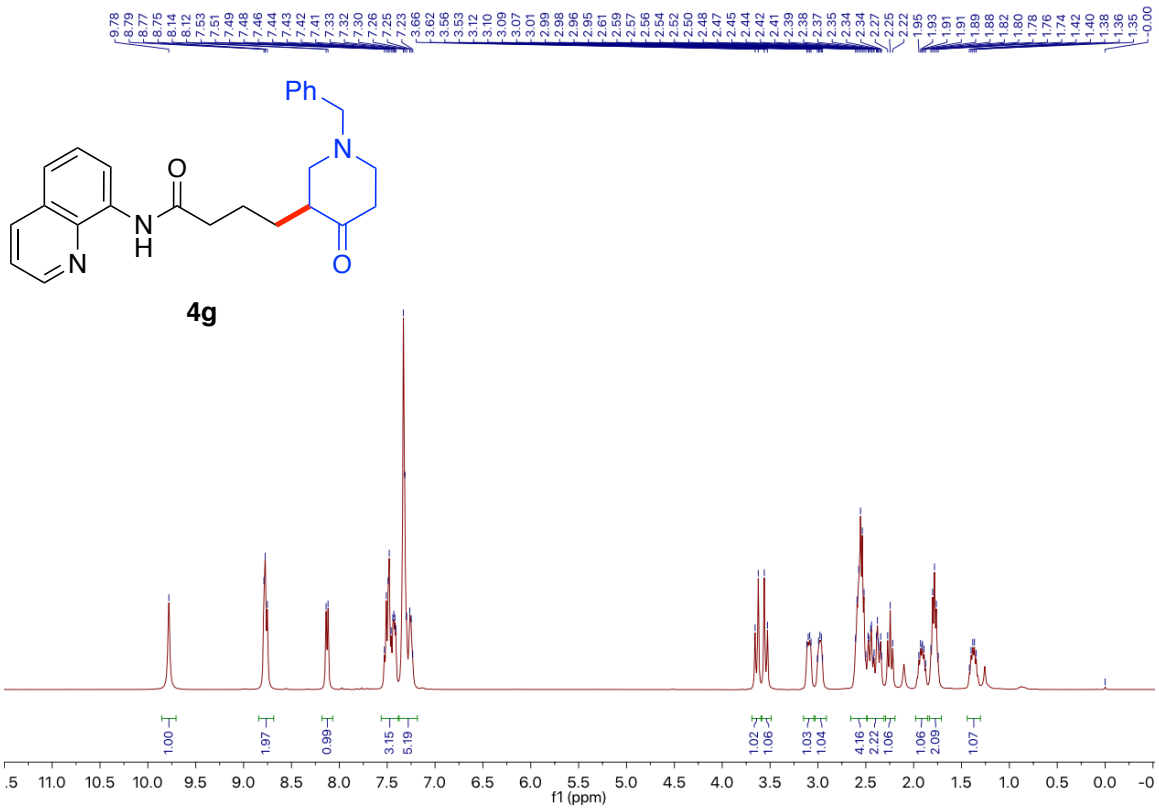

4e
f1 (ppm)
f1 (ppm)



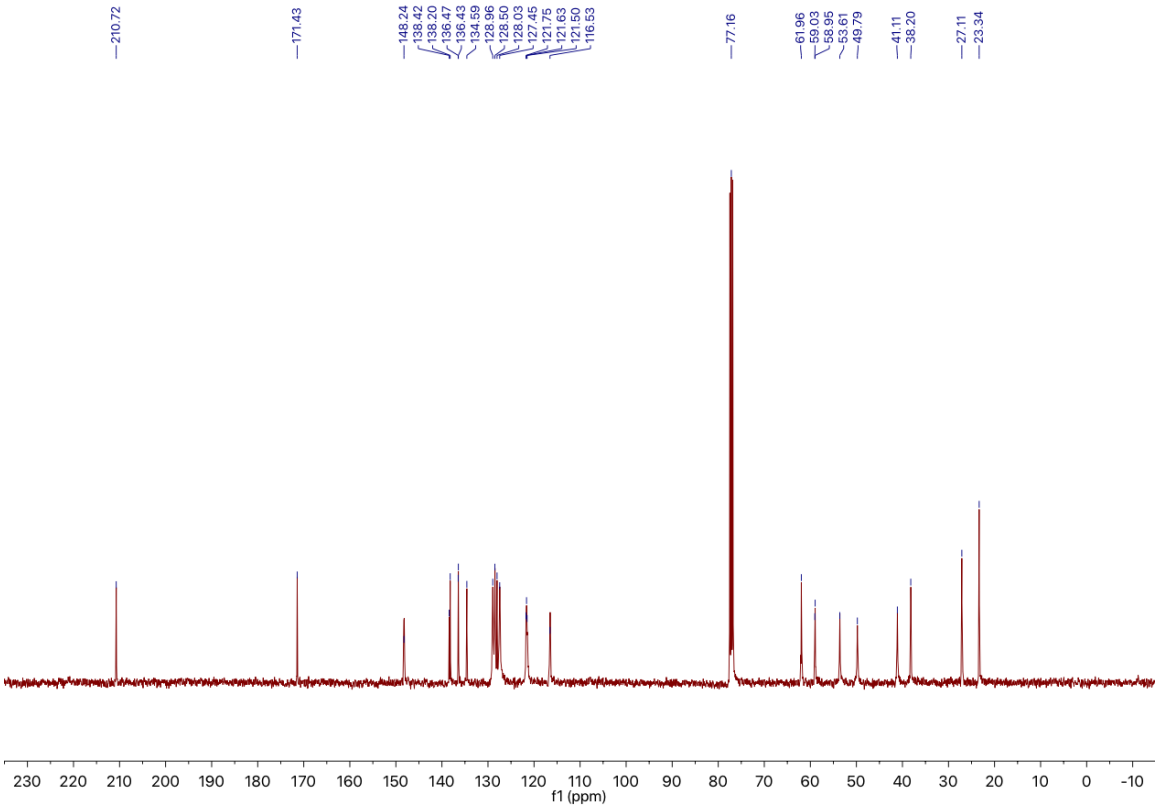
4f

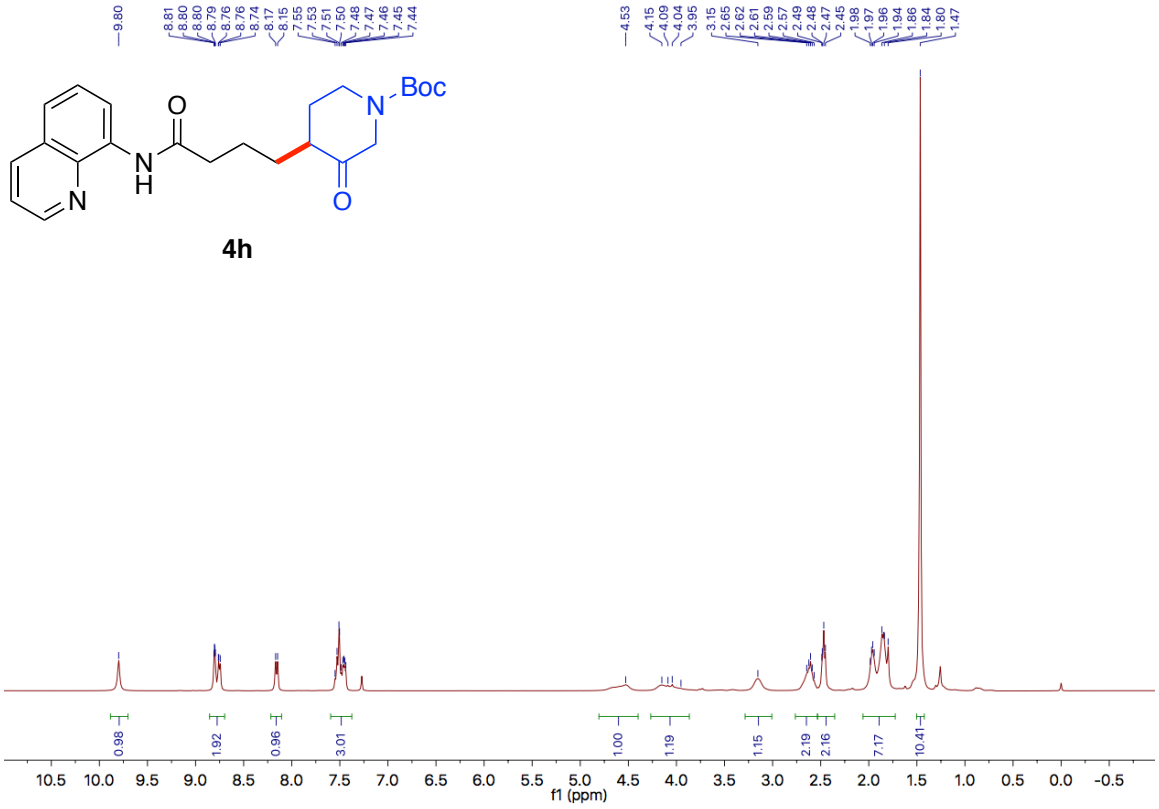




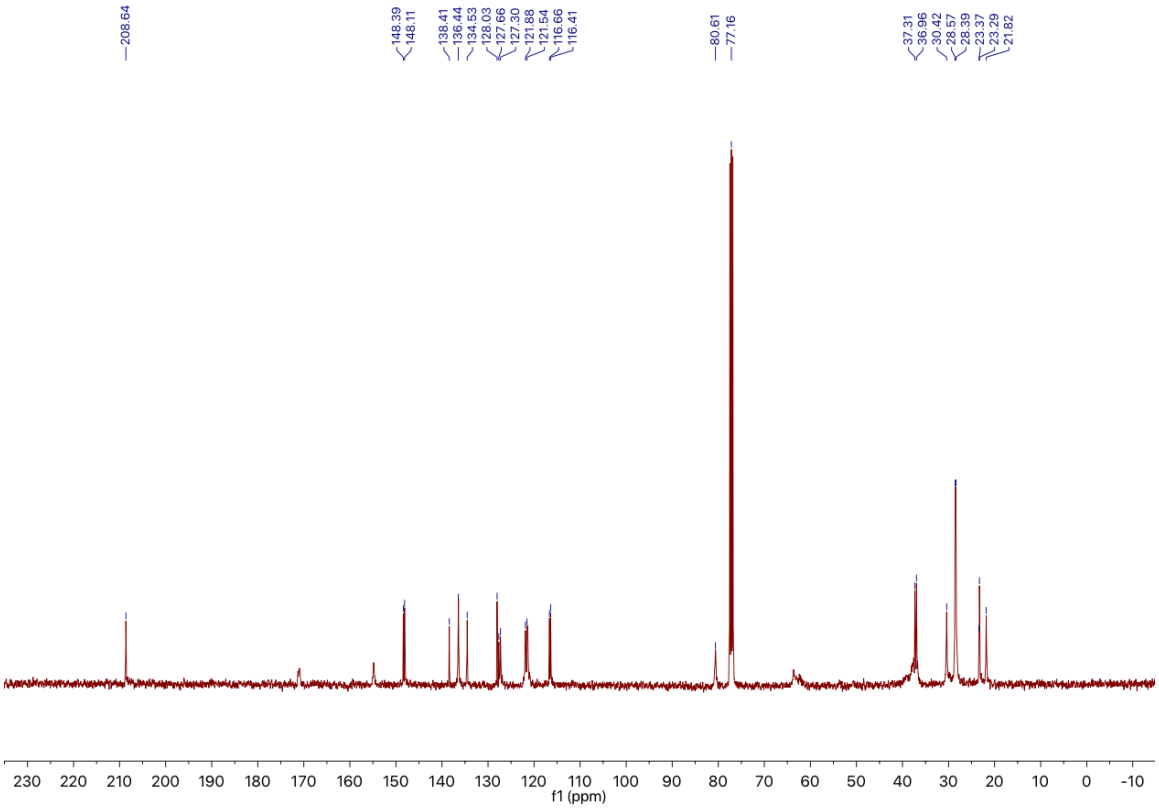


4g




9.80
8.81
8.80
8.80
8.79
8.78
8.76
8.74
8.17
8.15
7.55
7.53
7.51
7.50
7.48
7.47
7.46
7.45
7.44
4.53
4.15
4.09
4.04
3.95
3.15
2.65
2.62
2.61
2.59
2.57
2.49
2.48
2.47
2.45
1.98
1.97
1.96
1.94
1.86
1.84
1.80
1.47
Boc
O
N
H
N
O
N
0.98
1.92
0.96
3.01
1.00
1.19
1.15
2.19
2.16
7.17
10.41
f1 (ppm)

4h


208.64
148.39
148.11
138.41
136.44
134.53
128.03
127.66
127.30
121.88
121.54
116.66
116.41
80.61
77.16
37.31
36.96
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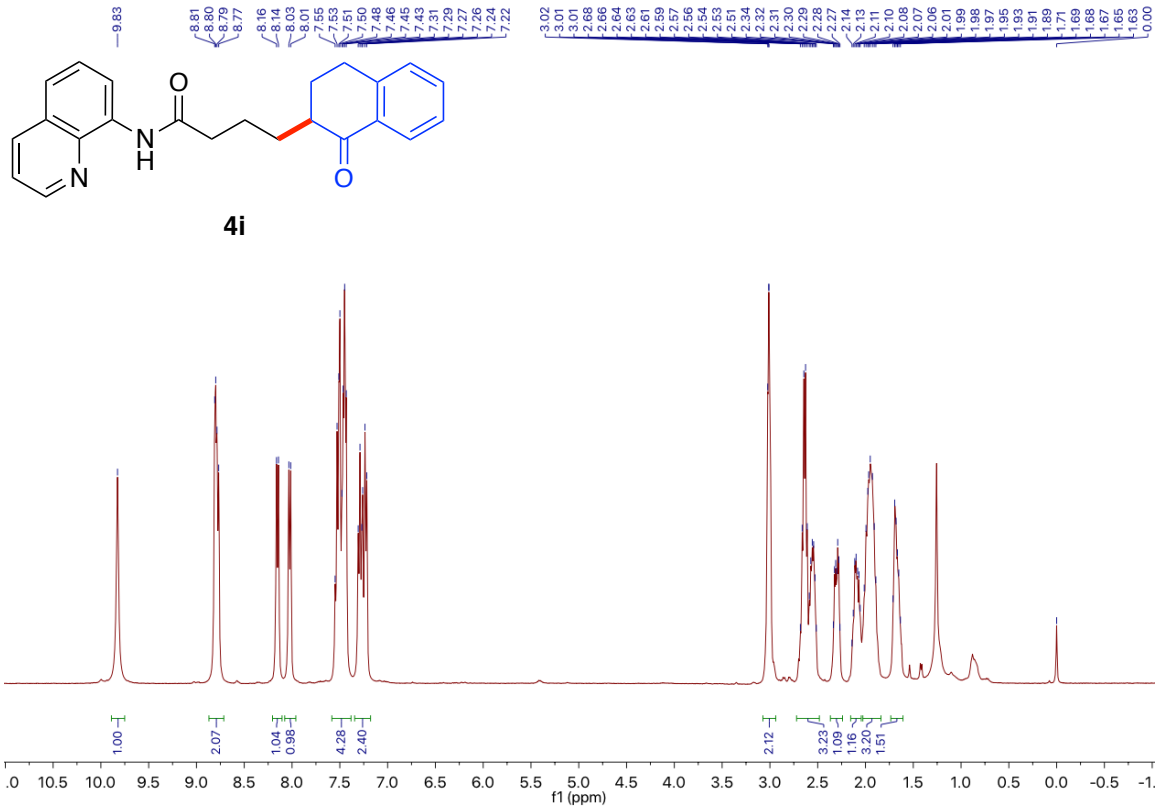
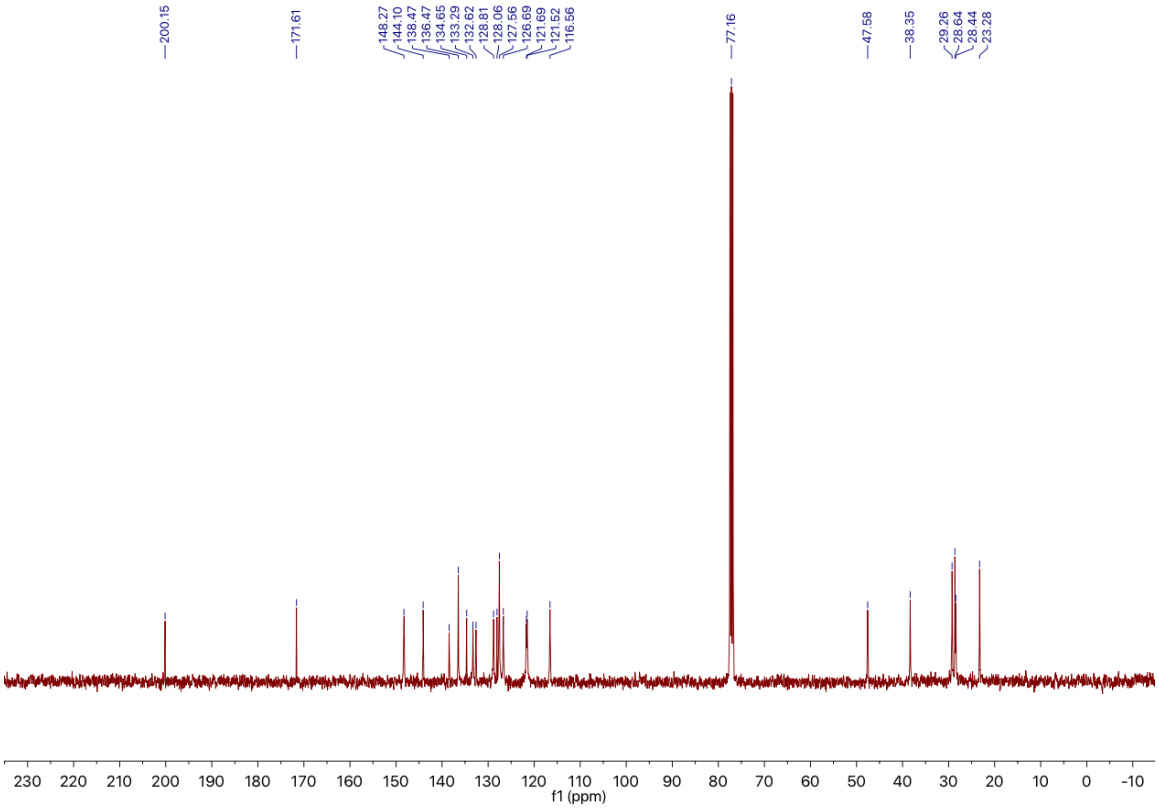
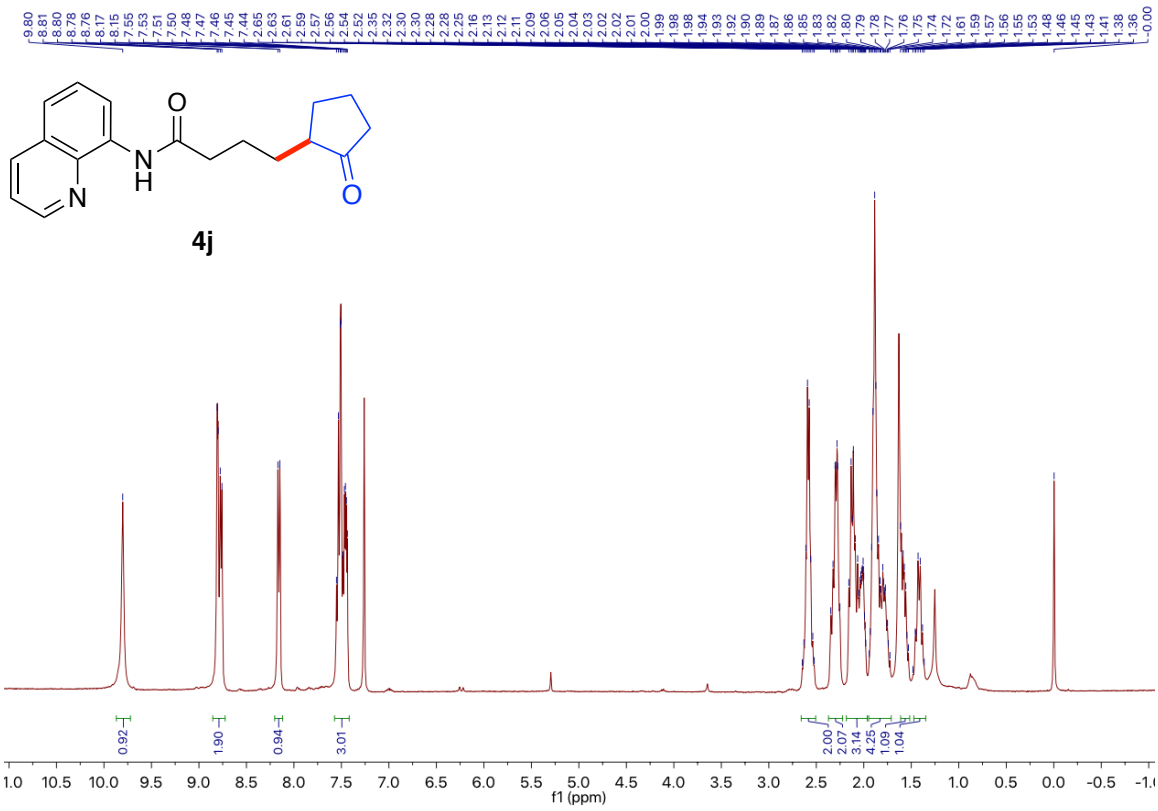
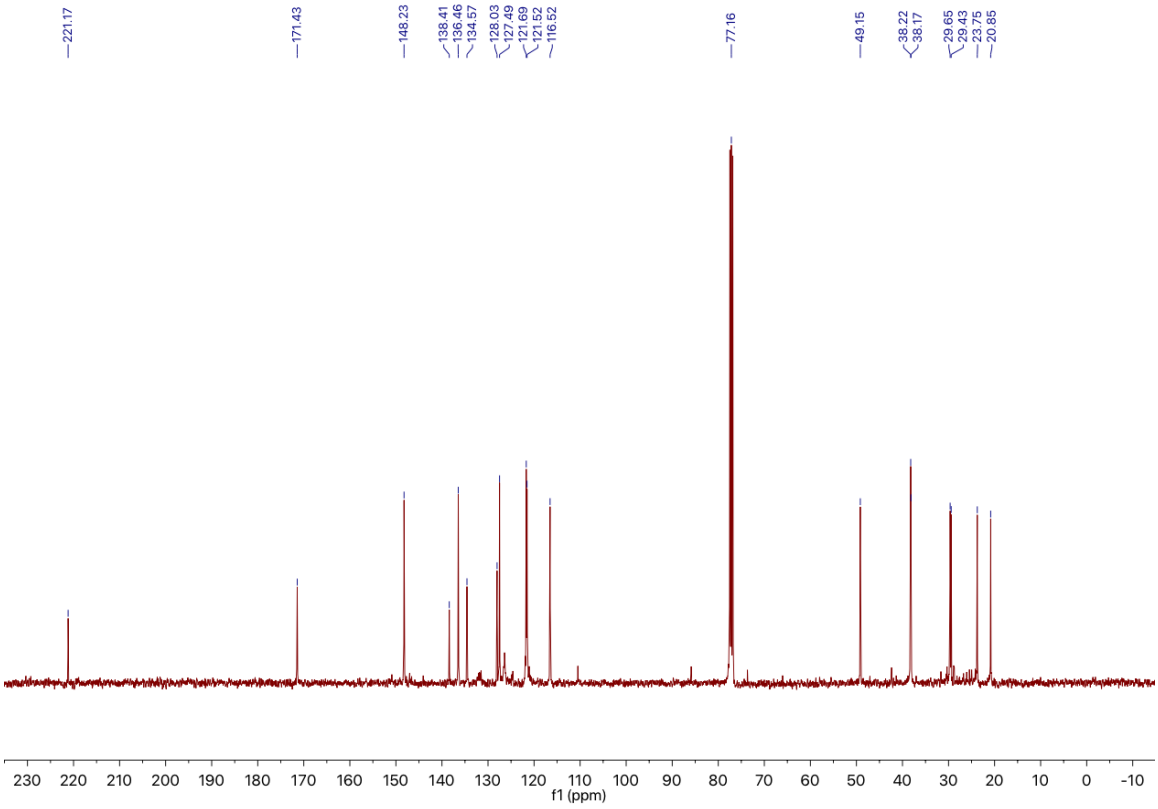
28.57
28.39
23.37
23.29
21.82
f1 (ppm)

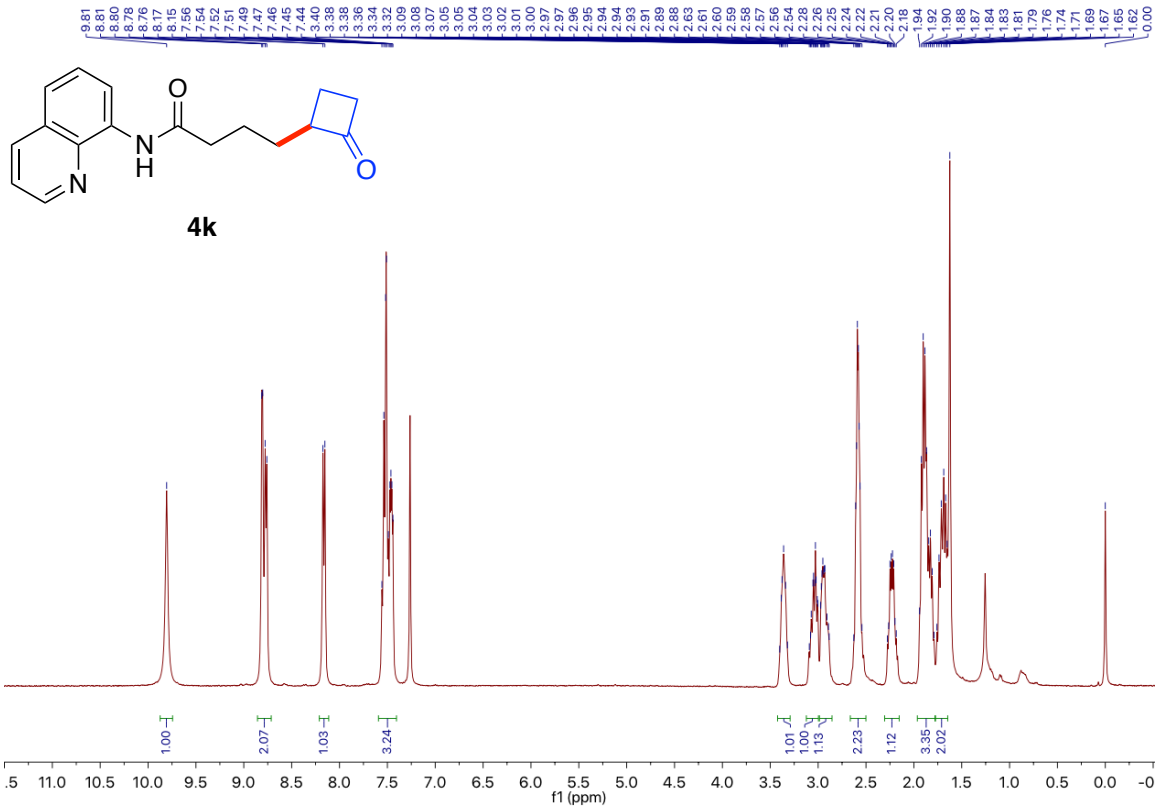

9.83
8.81
8.80
8.79
8.77
8.16
8.14
8.03
8.01
7.55
7.53
7.51
7.50
7.48
7.46
7.45
7.43
7.31
7.29
7.27
7.26
7.24
7.22
3.02
3.01
3.01
2.68
2.66
2.64
2.63
2.61
2.59
2.57
2.56
2.54
2.53
2.51
2.34
2.32
2.31
2.30
2.29
2.28
2.27
2.14
2.13
2.11
2.10
2.08
2.07
2.06
2.01
1.99
1.98
1.97
1.95
1.93
1.91
1.89
1.71
1.69
1.68
1.67
1.65
1.63
0.00
O
N
H
N
O
1.00
2.07
1.04
0.98
4.28
2.40
2.12
3.23
1.09
1.16
3.20
1.51
f1 (ppm)

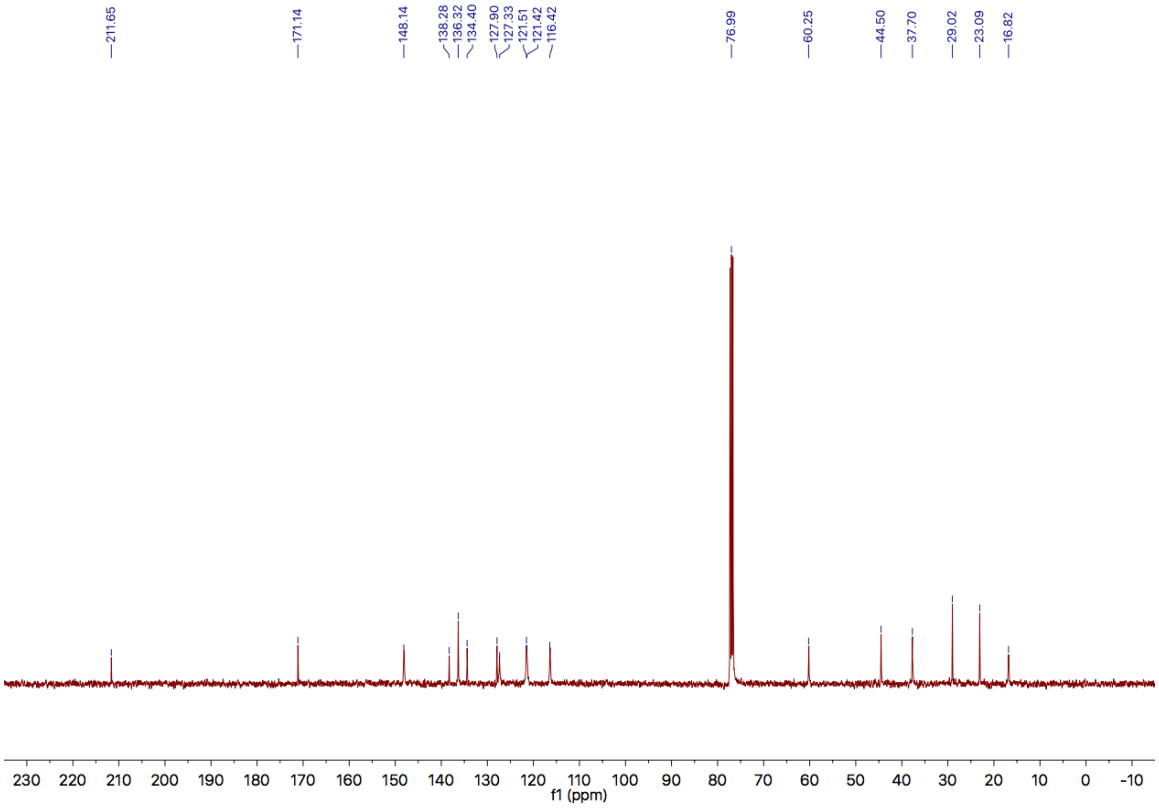
4i

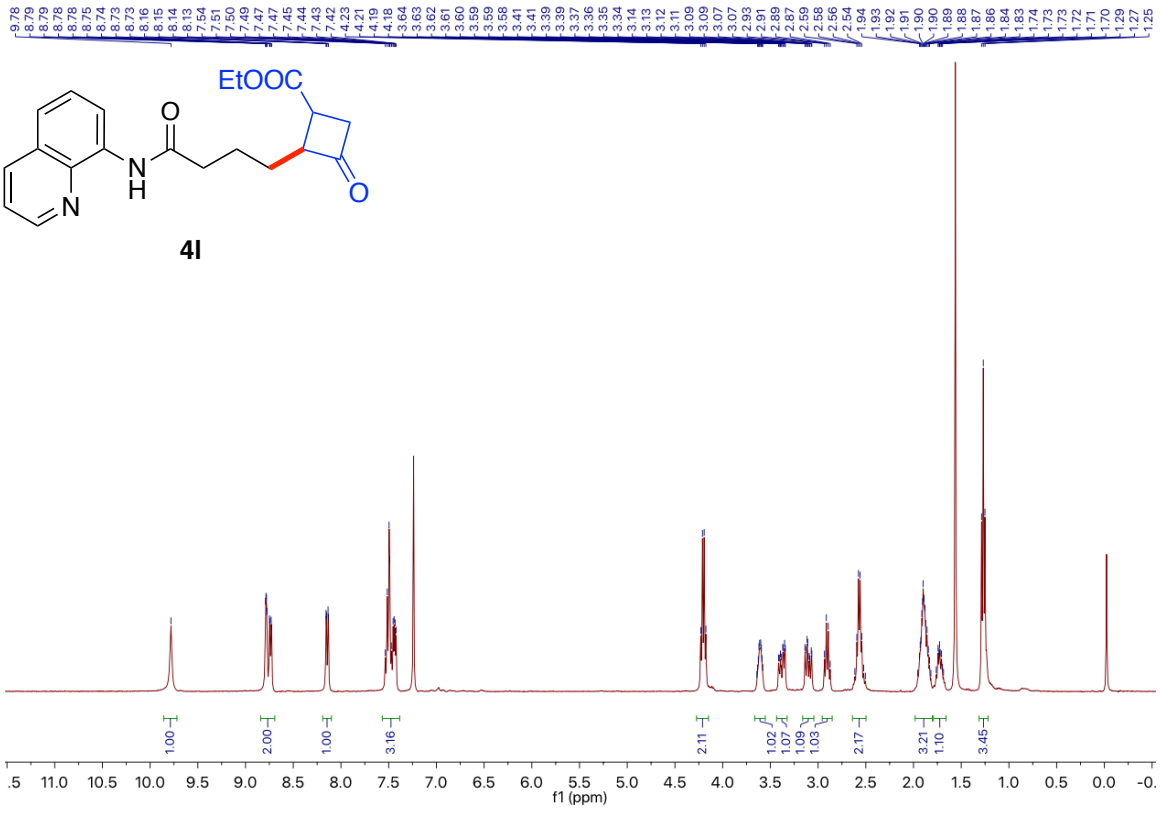

200.15
171.61
148.27
144.10
138.47
136.47
134.65
133.29
132.62
128.81
128.06
127.56
126.69
121.69
121.52
116.56
77.16
47.58
38.35
29.26
28.64
28.44
23.28
f1 (ppm)


O
N
H
N
O
4j
f1 (ppm)

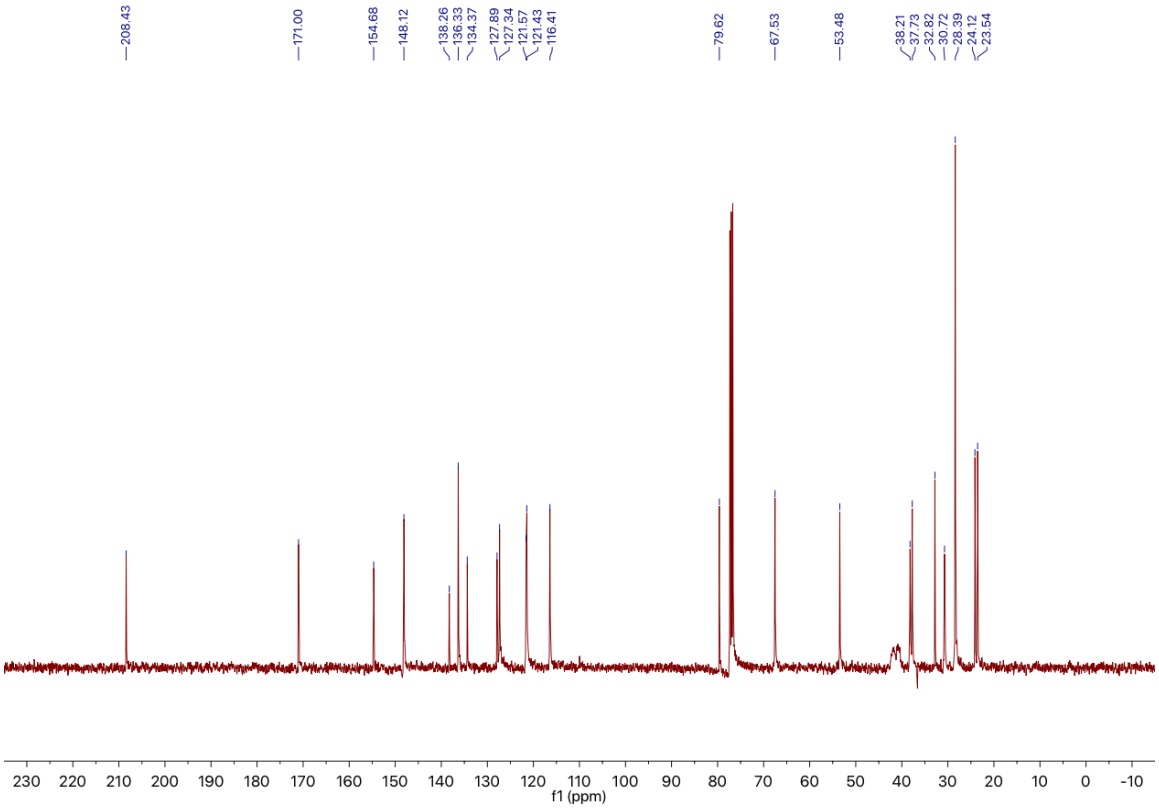

f1 (ppm)

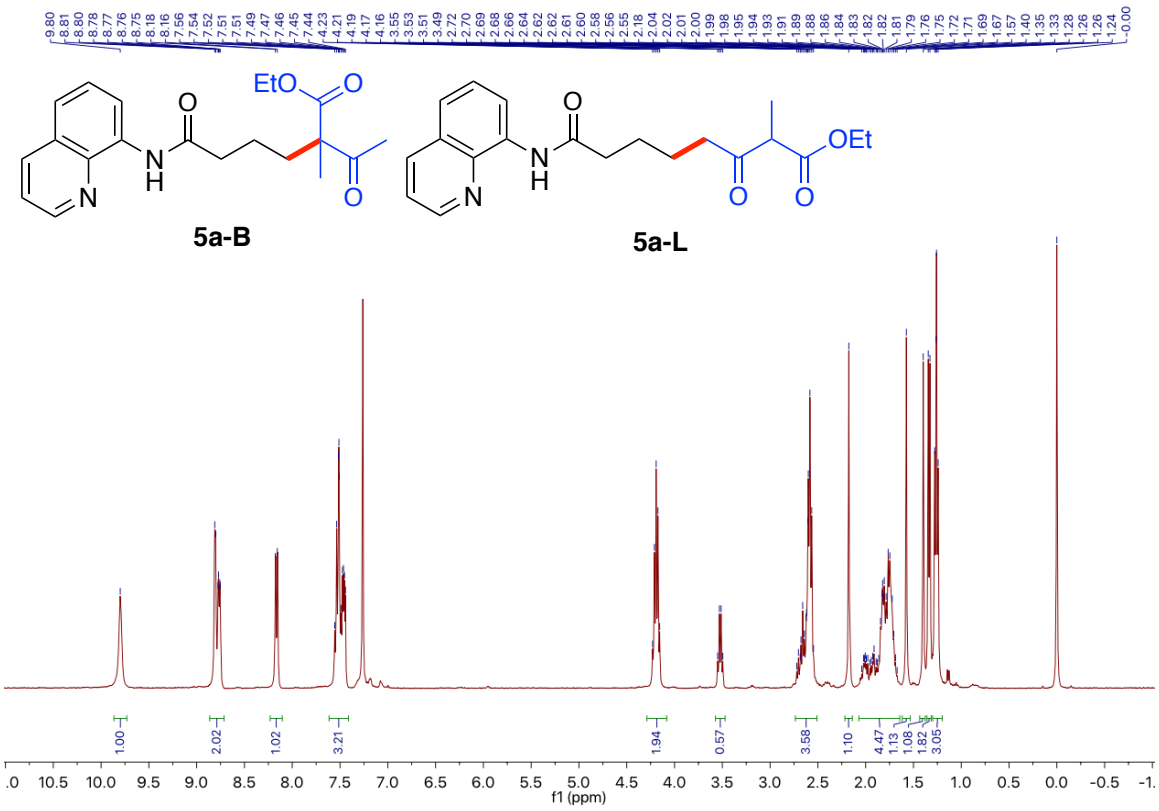

9.81 8.81 8.80 8.78 8.76 8.17 8.15 7.56 7.54 7.52 7.51 7.49 7.47 7.46 7.45 7.44 7.40 3.38 3.36 3.34 3.32 3.09 3.08 3.07 3.05 3.05 3.04 3.03 3.02 3.01 3.00 2.97 2.97 2.96 2.95 2.94 2.94 2.93 2.91 2.89 2.88 2.63 2.61 2.60 2.59 2.58 2.57 2.56 2.54 2.28 2.26 2.25 2.24 2.22 2.21 2.20 2.18 1.94 1.92 1.90 1.88 1.87 1.84 1.83 1.81 1.79 1.76 1.74 1.71 1.69 1.67 1.65 1.62 0.00
O
N
H
N
O
4k
1.00 2.07 1.03 3.24 1.01 1.00 1.13 2.23 1.12 3.35 2.02
f1 (ppm)

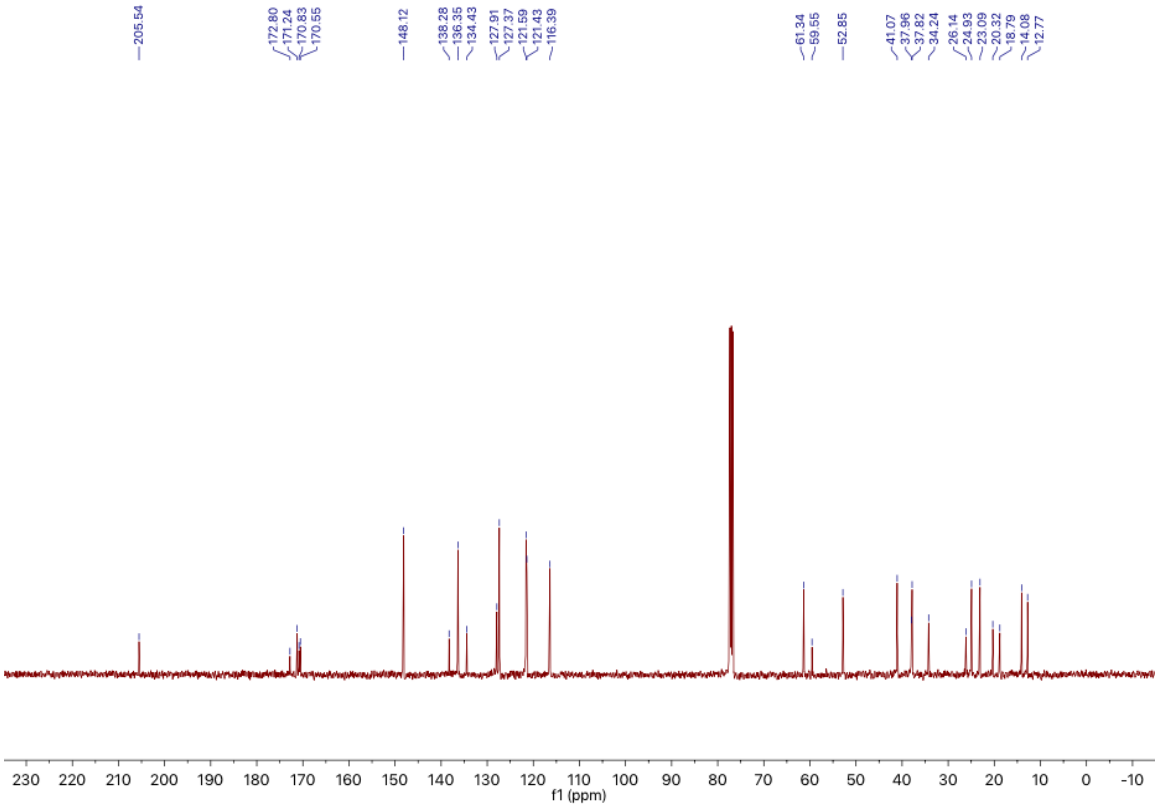

211.65 171.14 148.14 138.28 136.32 134.40 127.90 127.33 121.51 121.42 116.42 76.99 60.25 44.50 37.70 29.02 23.09 16.82
f1 (ppm)

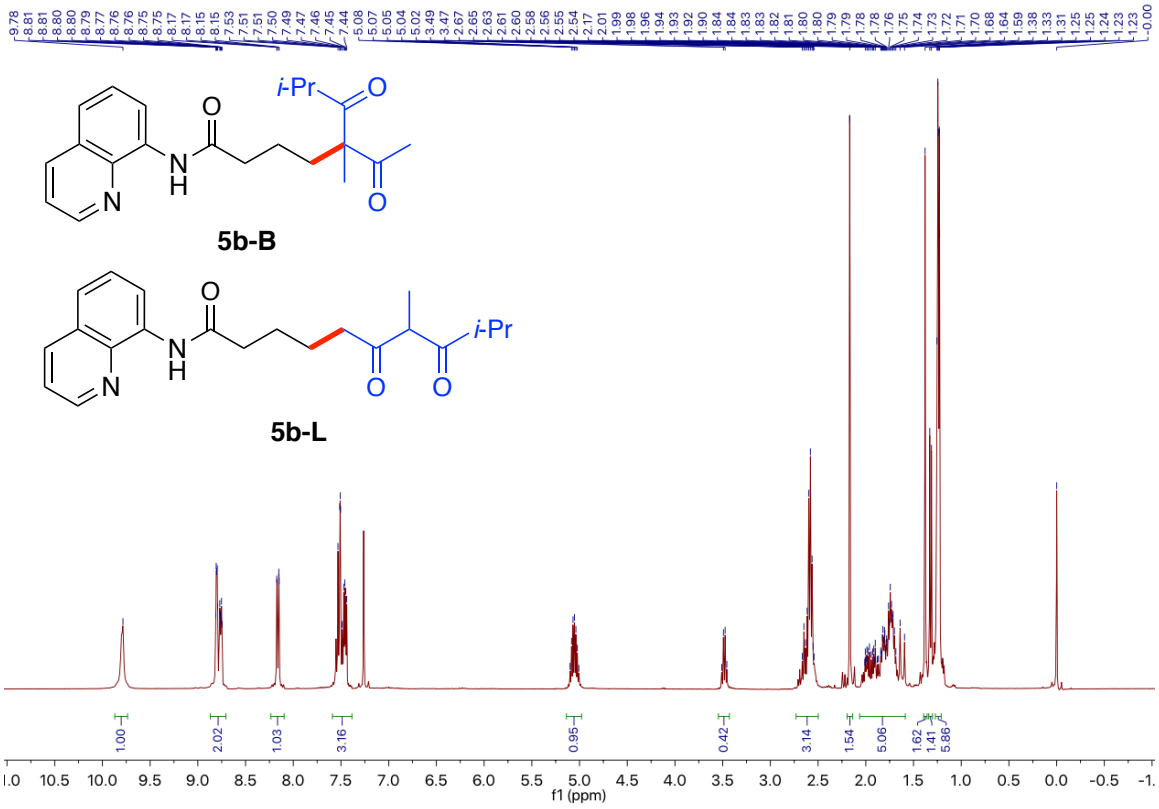


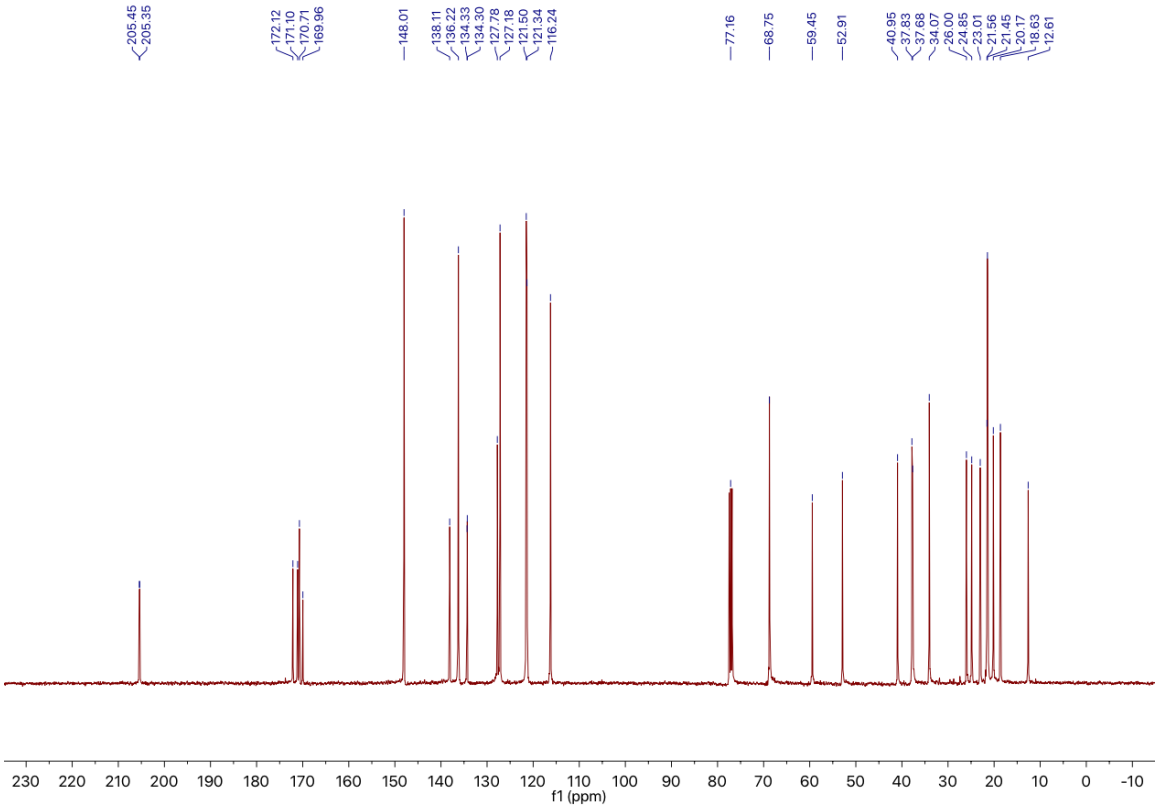
4l

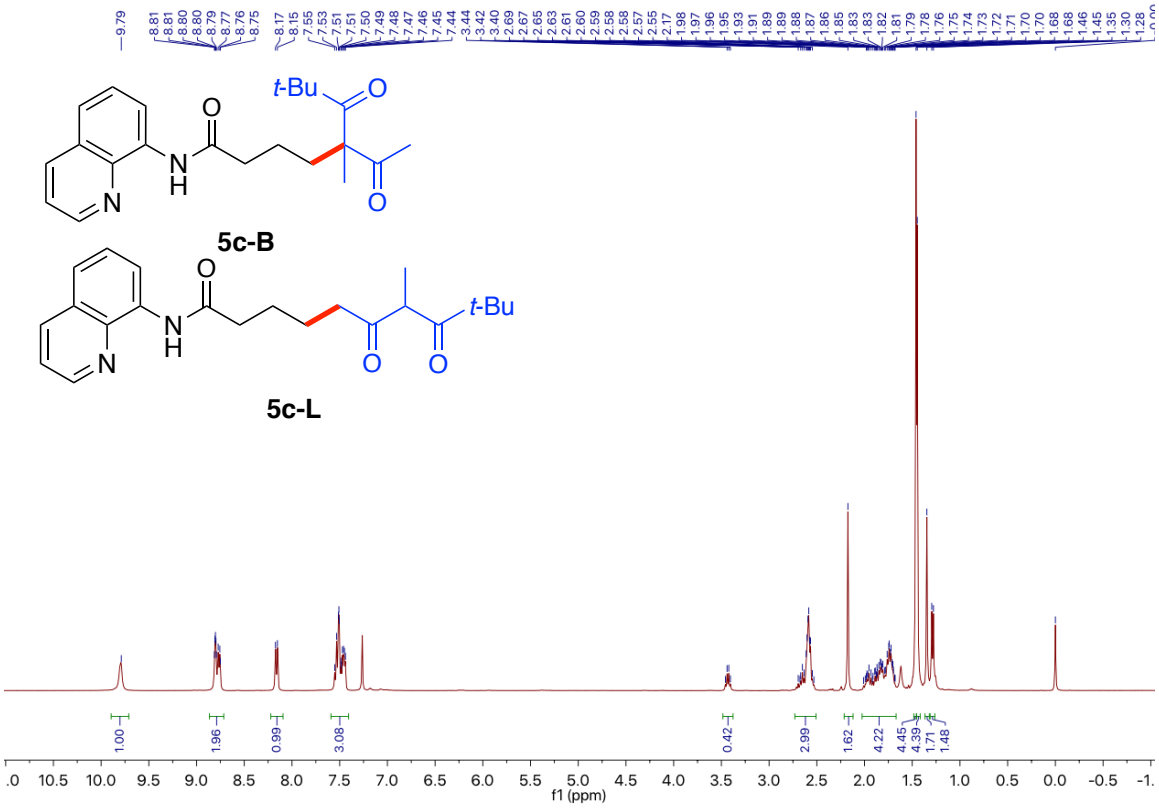


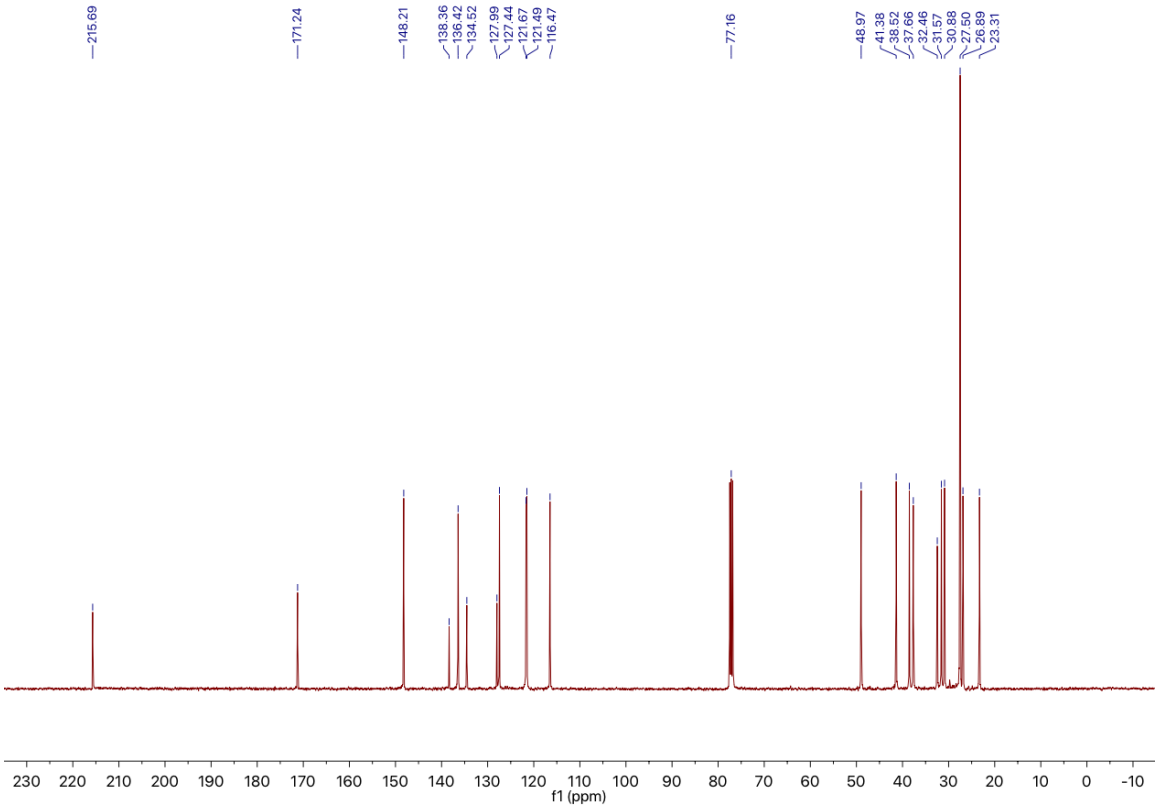

EtO
O
O
N
H
N
O
O
5a-B
O
N
H
N
OEt
O
O
5a-L
f1 (ppm)


f1 (ppm)


i-Pr
O
N
H
N
O
O
5b-B
i-Pr
O
N
H
N
O
O
5b-L
1.00
2.02
1.03
3.16
0.95
0.42
3.14
1.54
5.06
1.62
1.41
5.86
f1 (ppm)

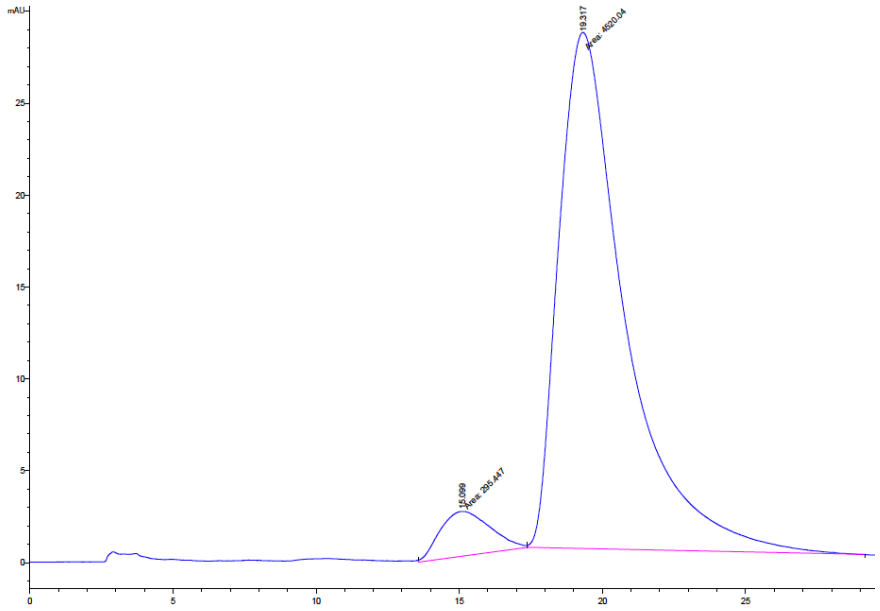

205.45
205.35
172.12
171.10
170.71
169.96
148.01
138.11
136.22
134.33
134.30
127.78
127.18
121.50
121.34
116.24
77.16
68.75
59.45
52.91
40.95
37.83
37.68
34.07
26.00
24.85
23.01
21.56
21.45
20.17
18.63
12.61
f1 (ppm)


5c-B
5c-L
f1 (ppm)

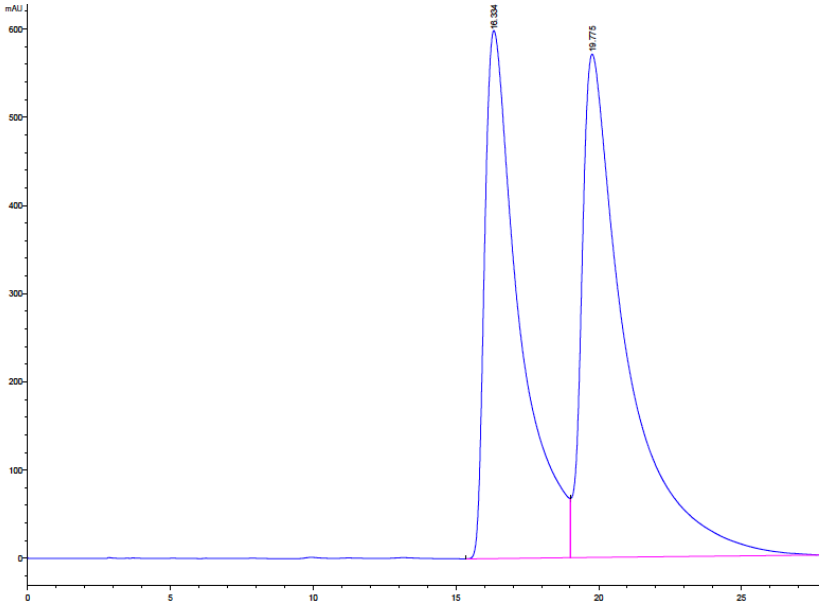

f1 (ppm)

V. HPLC Spectra for Products

4a

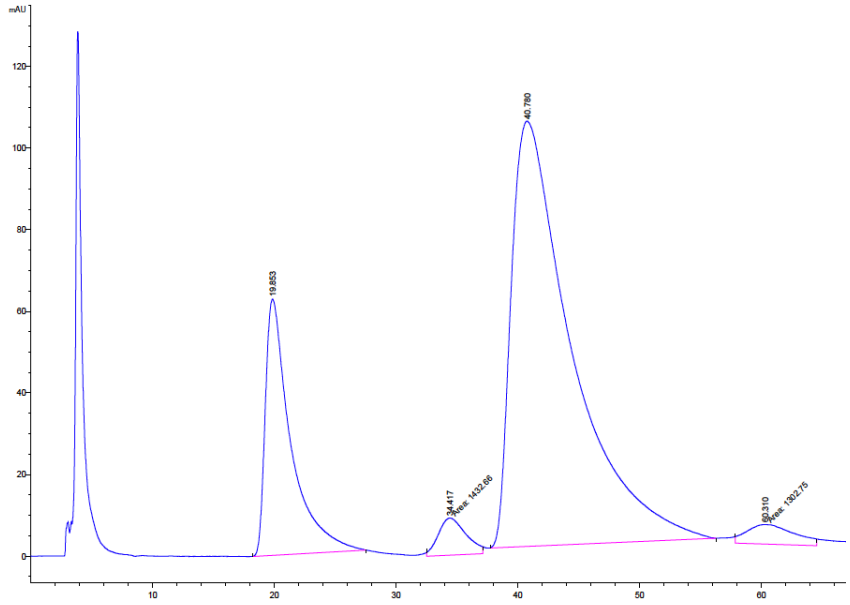


Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	15.099	MM	2.0182	295.44681	2.43985	6.1354
2	19.317	MM	2.6832	4520.03564	28.07619	93.8646

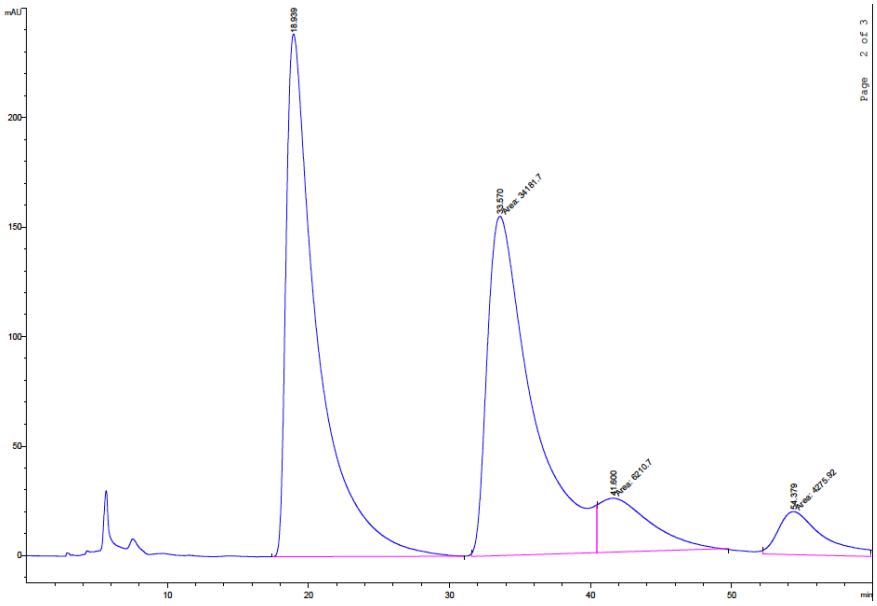


Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	16.334	BV	1.2126	5.07116e4	598.45721	45.2385
2	19.775	VBA	1.4951	6.13868e4	570.60626	54.7615

4b

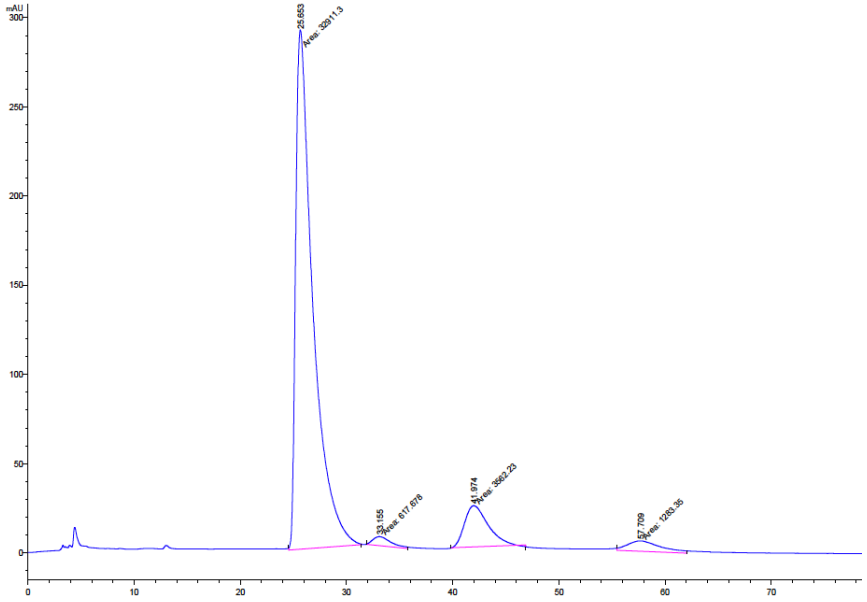


Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	19.853	BB	1.9268	9143.08691	62.78939	19.2081
2	34.417	MM	2.6245	1432.65552	9.09793	3.0098
3	40.780	BB	4.0204	3.57216e4	104.17704	75.0452
4	60.310	MM	4.5405	1302.74634	4.78200	2.7369

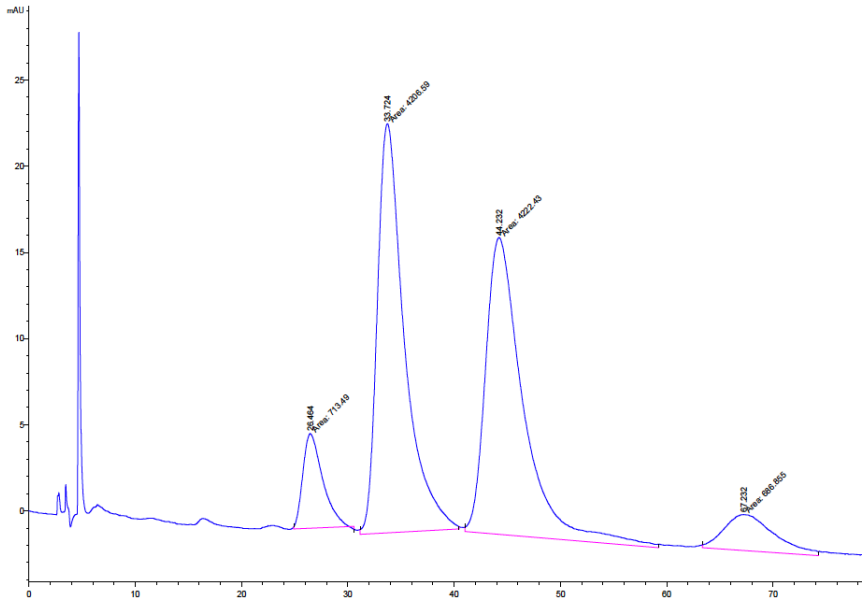


Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	18.939	BB	2.1181	3.67376e4	238.62573	45.1289
2	33.570	MF	3.6768	3.41817e4	154.94432	41.9892
3	41.600	FM	4.2137	6210.69824	24.56542	7.6293
4	54.379	MM	3.6251	4275.92139	19.65880	5.2526

4c

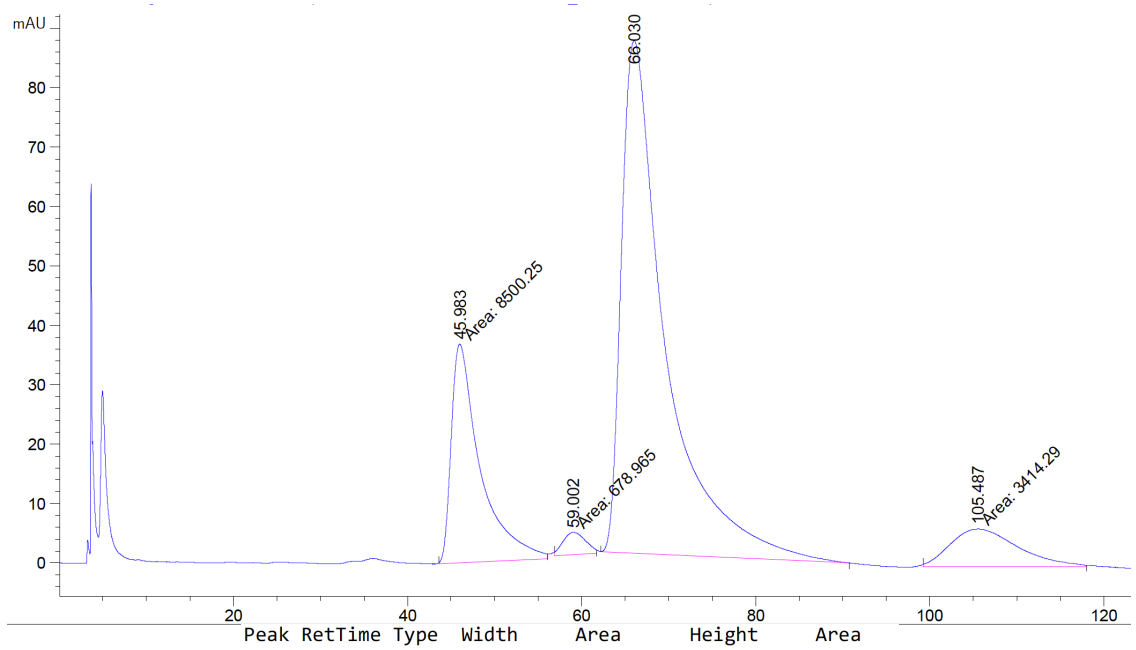


Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	25.653	MM	1.8849	3.29113e4	291.01071	85.7633
2	33.155	MM	1.9911	617.67767	5.17026	1.6096
3	41.974	MM	2.5722	3562.23413	23.08173	9.2828
4	57.709	MM	3.6836	1283.35498	5.80666	3.3443

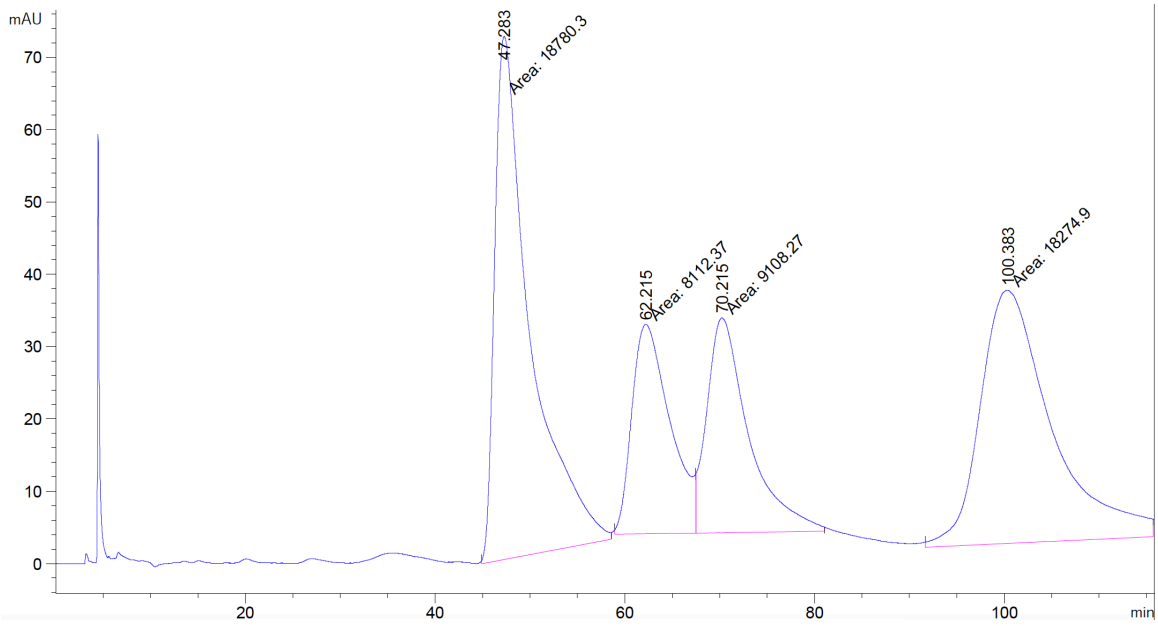


Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	26.464	MM	2.1690	713.48975	5.48249	7.2588
2	33.724	MM	2.9541	4206.59375	23.73303	42.7962
3	44.232	MM	4.0851	4222.42822	17.22681	42.9573
4	67.232	MM	5.5084	686.85498	2.07821	6.9878

4d

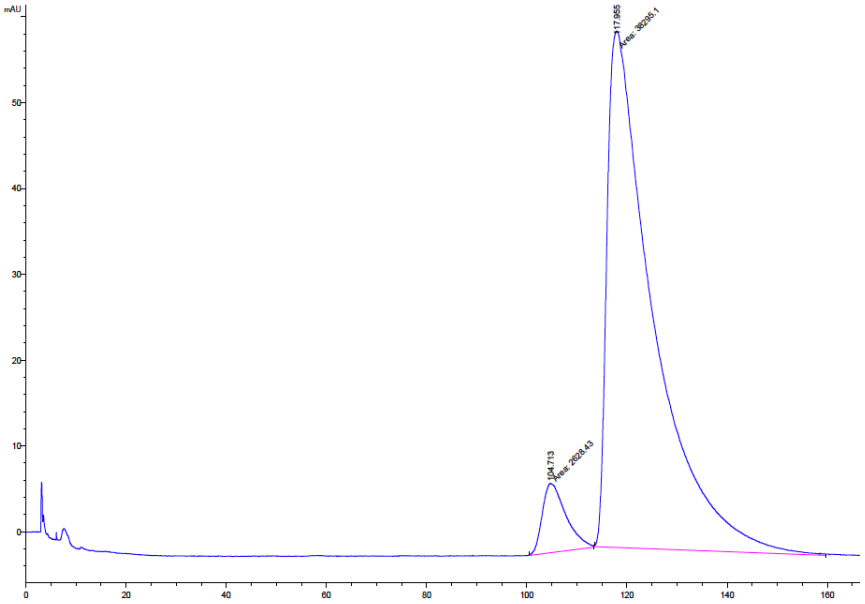


Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	45.983	MM	3.8450	8500.24902	36.84522	19.8117
2	59.002	MM	3.0006	678.96515	3.77122	1.5825
3	66.030	BB	4.1124	3.03118e4	86.28606	70.6481
4	105.487	MM	8.9702	3414.28979	6.34379	7.9577

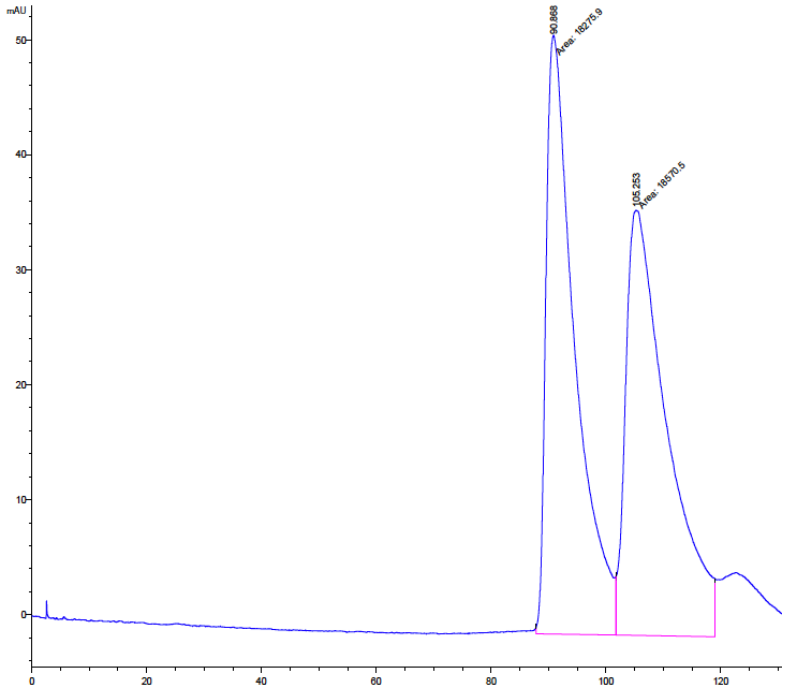


Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	47.283	MM	4.3284	1.87803e4	72.31415	34.6016
2	62.215	MF	4.6690	8112.36768	28.95816	14.9466
3	70.215	FM	5.1089	9108.27344	29.71374	16.7815
4	100.383	MM	8.6913	1.82749e4	35.04455	33.6704

4e

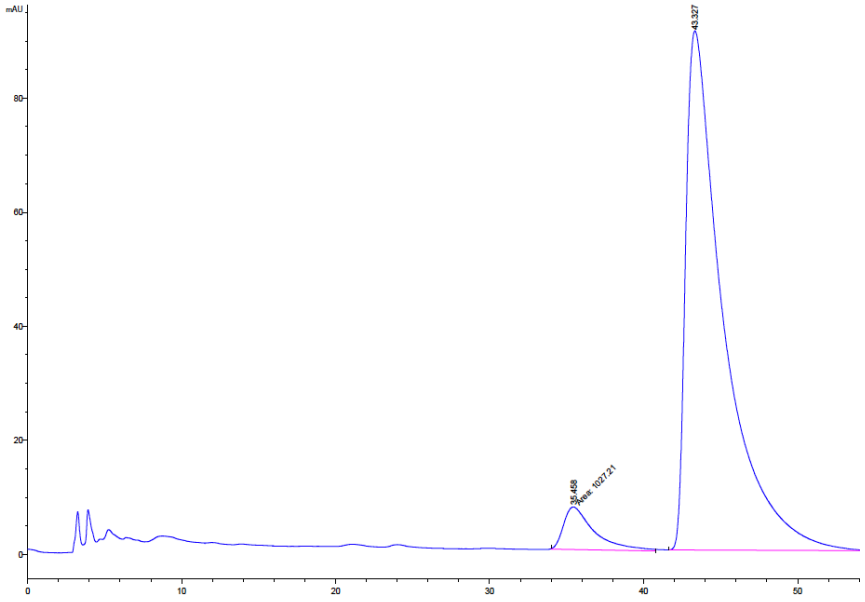


Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	104.713	MM	5.4283	2628.42627	8.07008	6.4228
2	117.955	MM	10.6149	3.82951e4	60.12783	93.5772

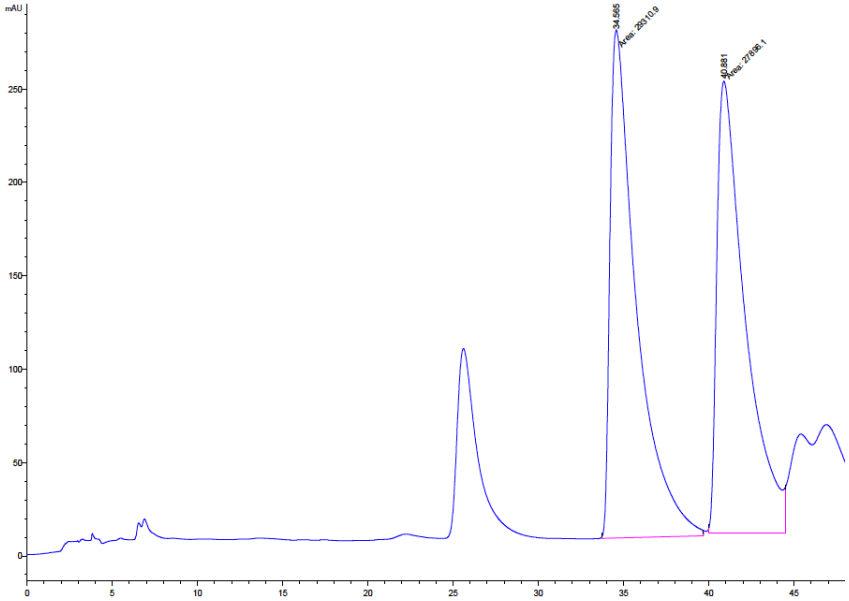


Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	90.868	MF	5.8046	1.80359e4	51.78663	49.1644
2	105.253	FM	8.4595	1.86490e4	36.74181	50.8356

4f

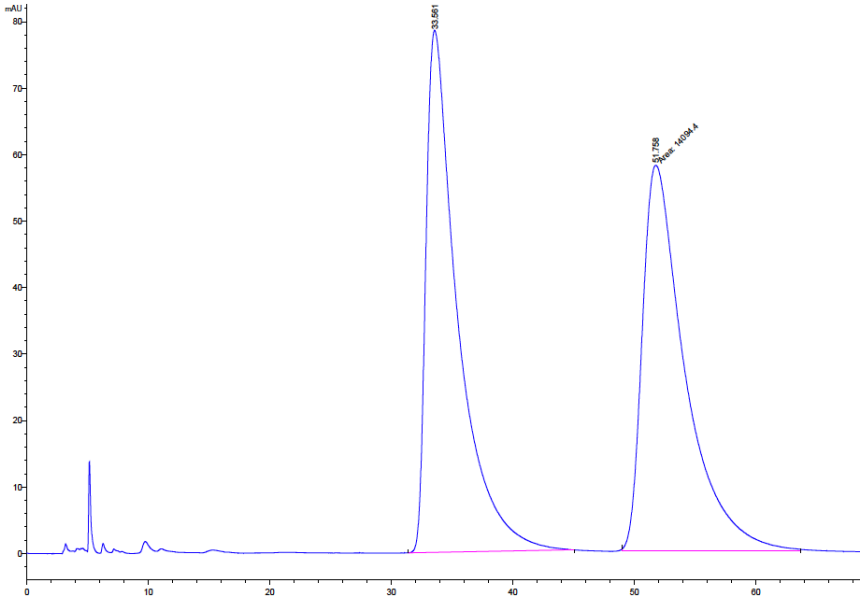


Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	35.458	MM	2.2995	1027.20728	7.44506	6.2198
2	43.327	BB	2.3473	1.54878e4	91.01455	93.7802

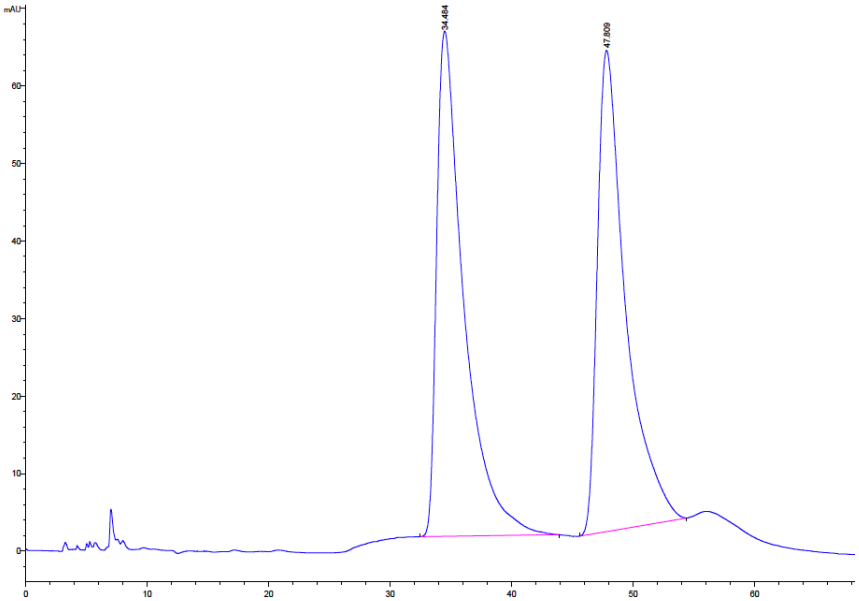


Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	34.565	MM	1.7962	2.93109e4	271.96533	51.2365
2	40.881	MM	1.9221	2.78961e4	241.89000	48.7635

4g

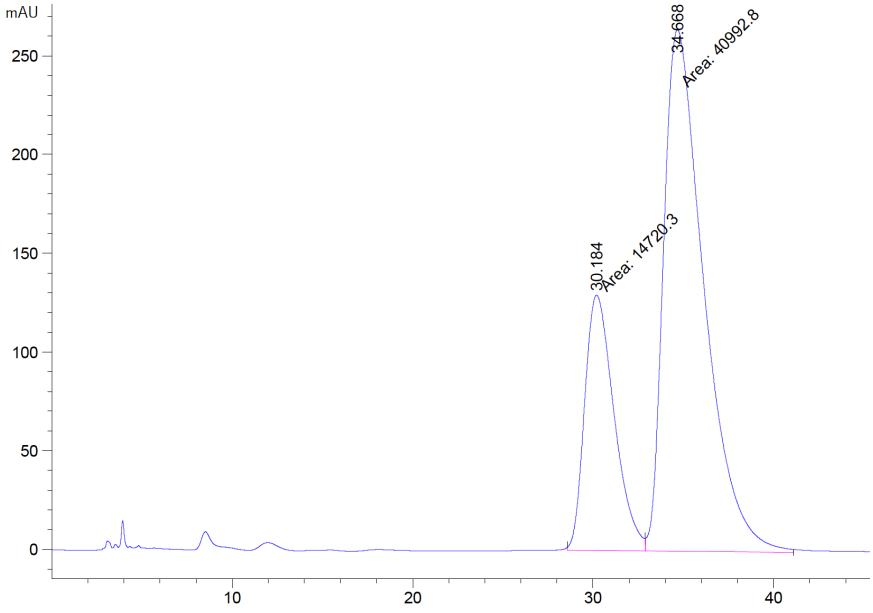


Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	33.561	BB	2.4744	1.42057e4	78.53018	50.1967
2	51.758	MM	4.0522	1.40944e4	57.96939	49.8033

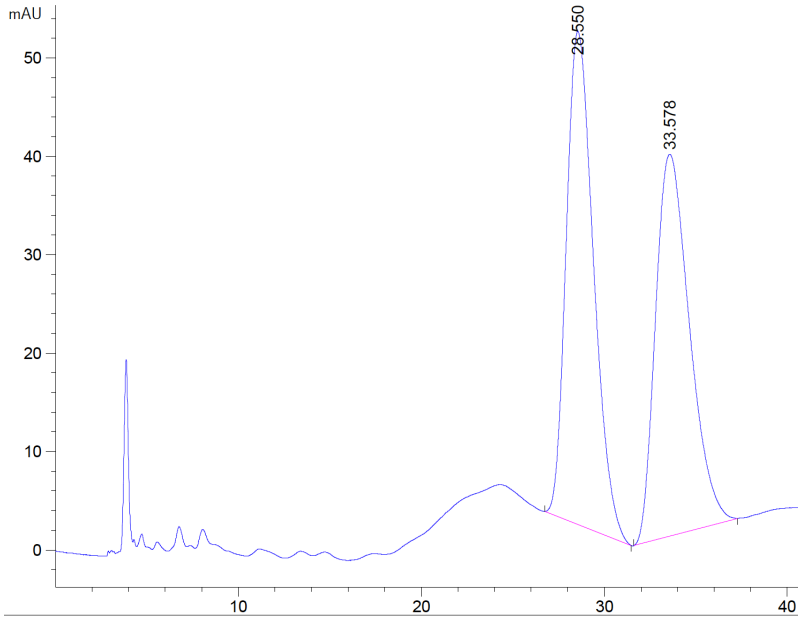


Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	34.484	BB	2.1750	1.01627e4	65.18038	50.2135
2	47.809	BB	2.2691	1.00763e4	62.09762	49.7865

4h

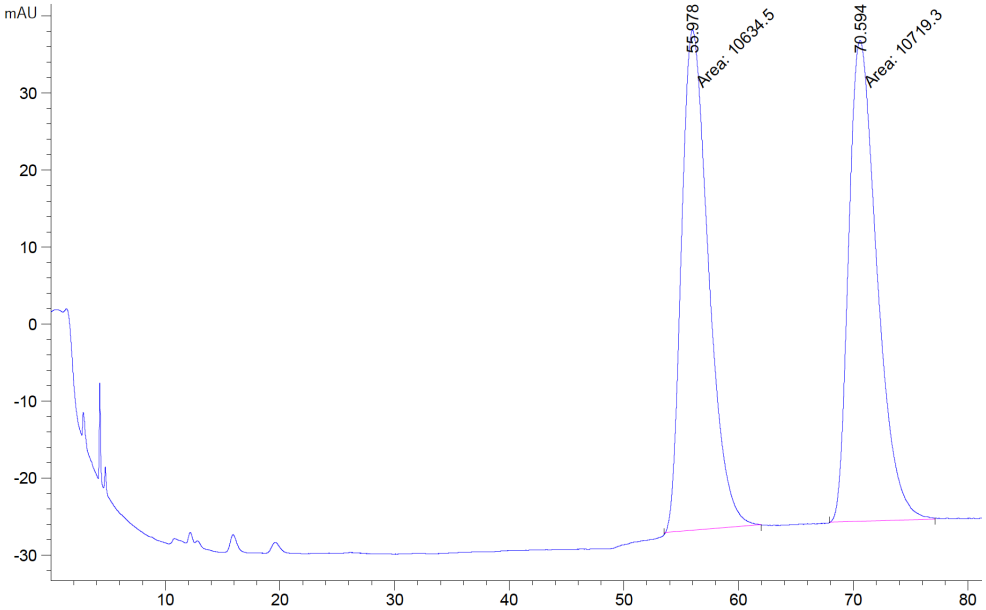


Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	30.184	MF	1.8963	1.47203e4	129.37396	26.4216
2	34.668	FM	2.5873	4.09928e4	264.06158	73.5784

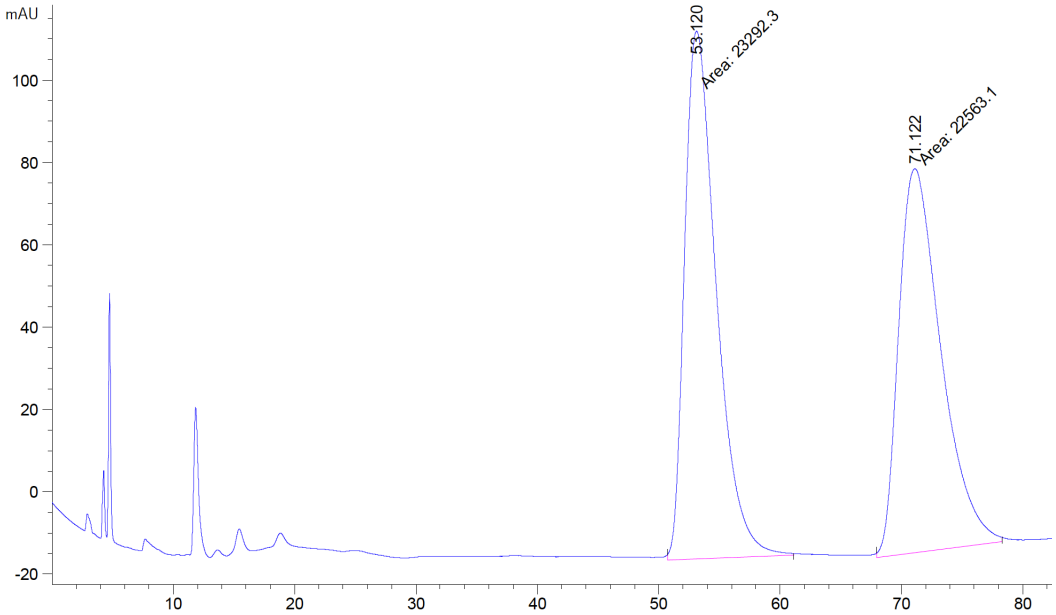


Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	28.550	BB	1.5488	5198.08984	50.08681	50.9248
2	33.578	BB	1.8639	5009.29980	38.80861	49.0752

4i

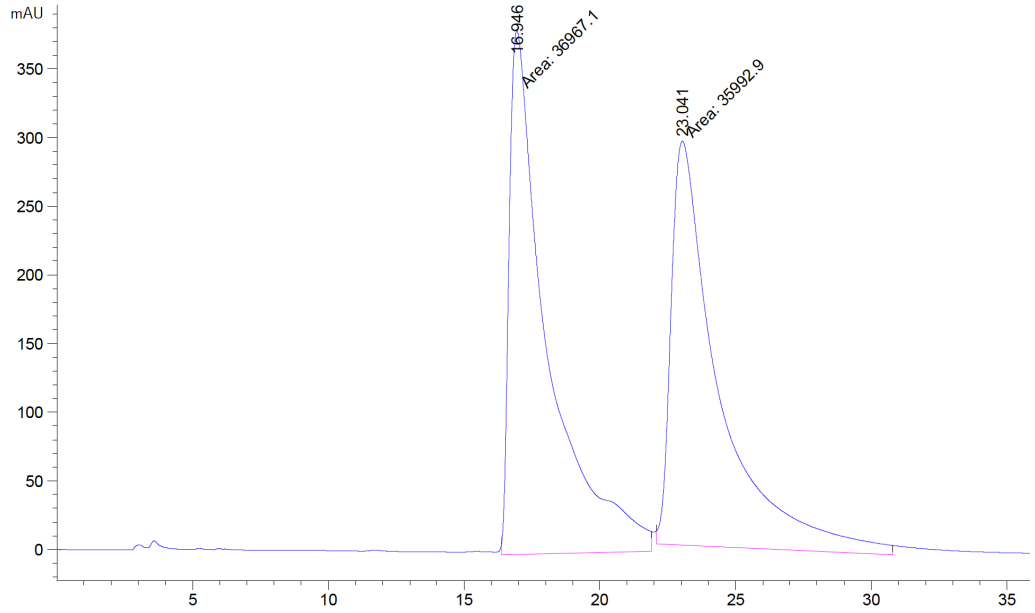


Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	55.978	MM	2.7289	1.06345e4	64.95023	49.8015
2	70.594	MM	2.8614	1.07193e4	62.43624	50.1985

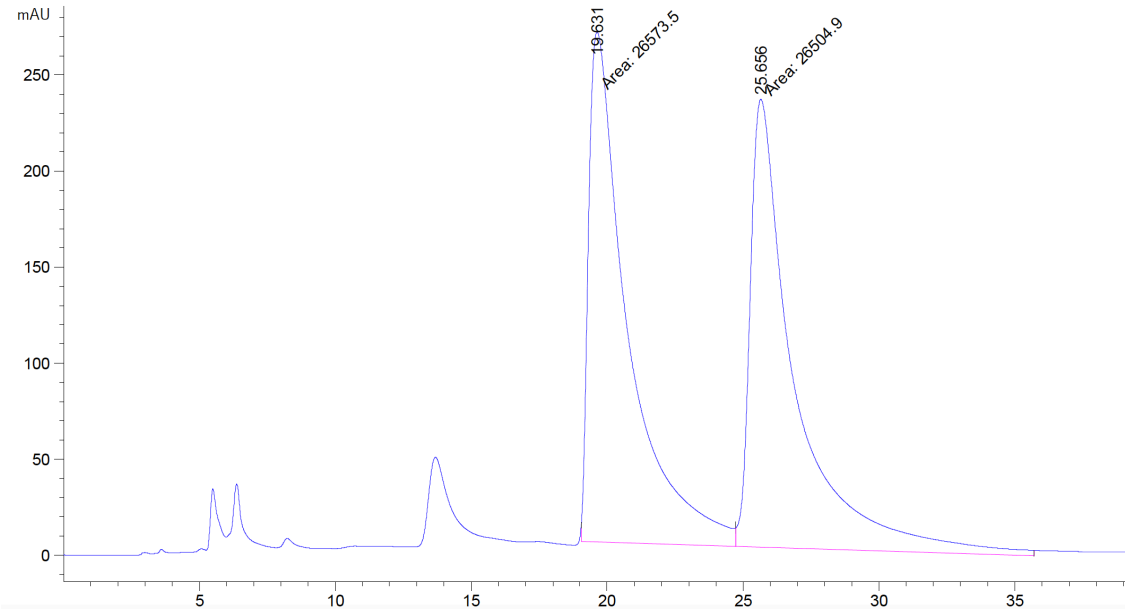


Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	53.120	MM	3.0277	2.32923e4	128.21948	50.7951
2	71.122	MM	4.0324	2.25631e4	93.25620	49.2049

4j

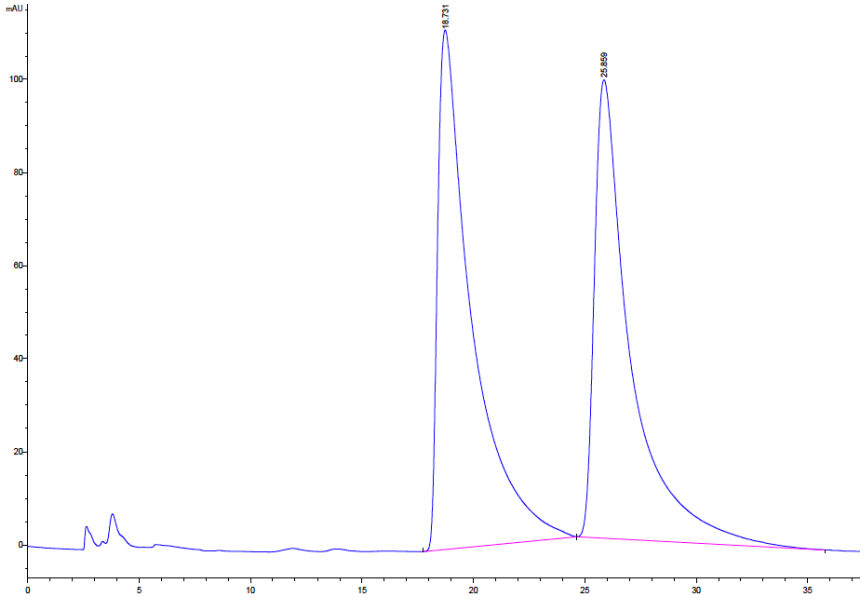


Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	16.946	MM	1.6148	3.69671e4	381.54535	50.6676
2	23.041	MM	2.0383	3.59929e4	294.29819	49.3324

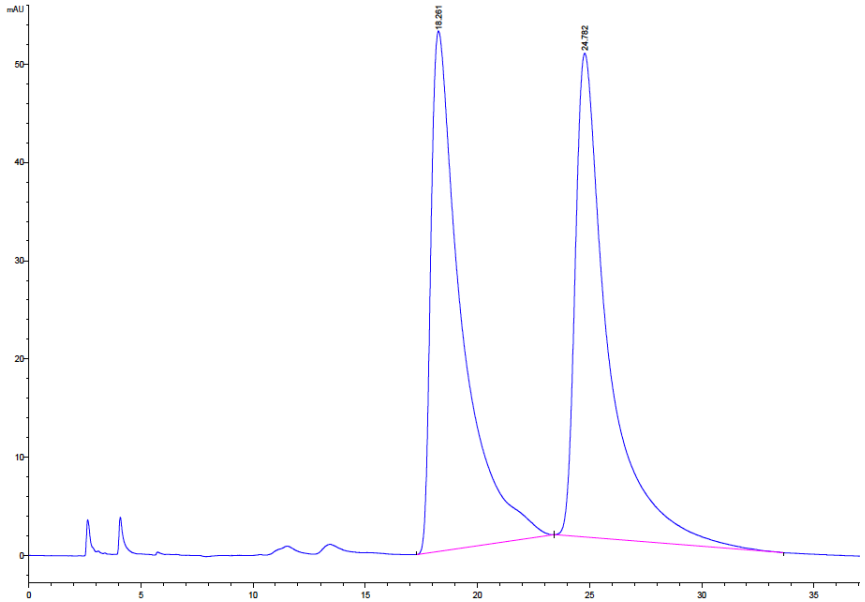


Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	19.631	MF	1.6675	2.65735e4	265.60947	50.0646
2	25.656	FM	1.8938	2.65049e4	233.25410	49.9354

4k

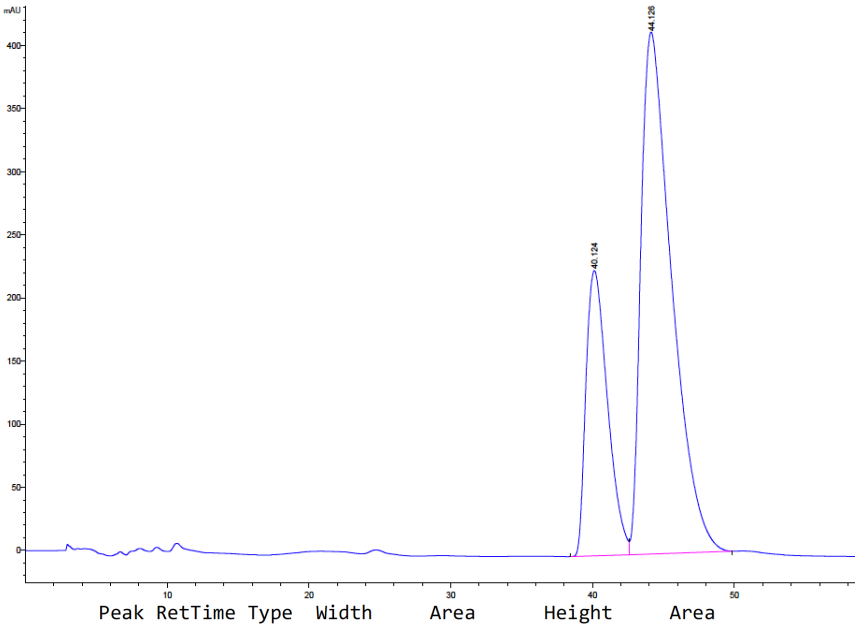


Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	18.731	BB	1.4632	1.18689e4	111.55849	51.7532
2	25.859	BB	1.5688	1.10648e4	98.48472	48.2468

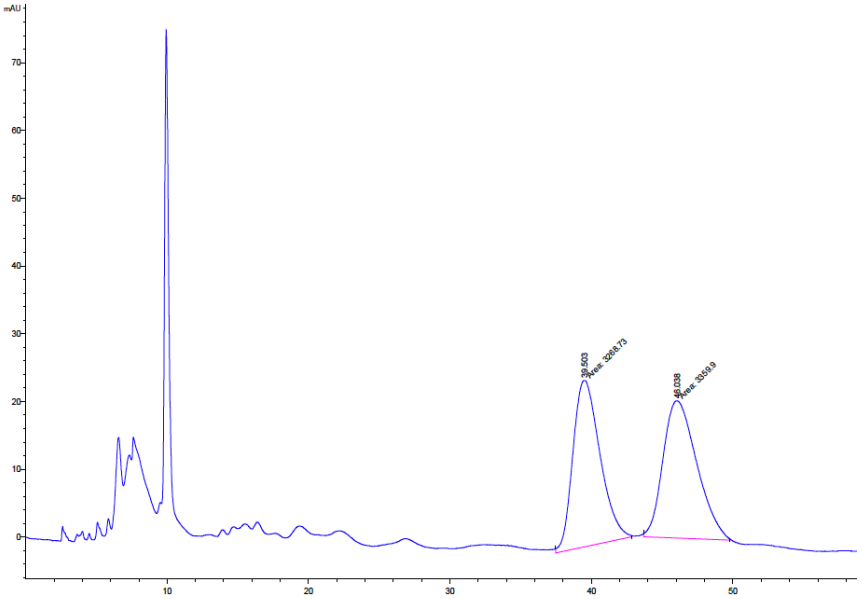


Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	18.261	BB	1.3325	5076.03223	52.94718	50.4602
2	24.782	BB	1.4289	4983.43848	49.23272	49.5398

4l

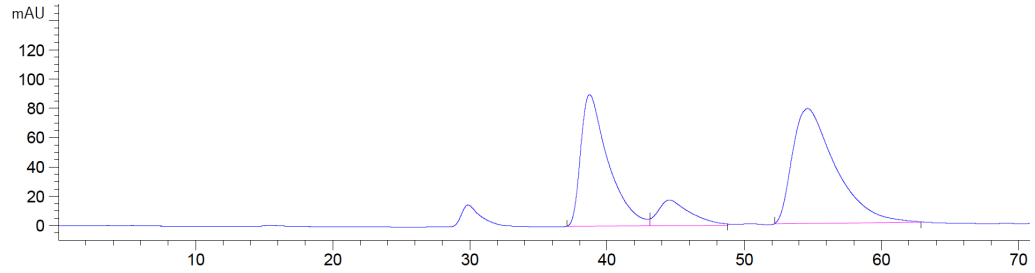


Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	40.124	BV	1.6434	2.38883e4	225.95178	27.6646
2	44.126	VB	2.2352	6.24613e4	413.28030	72.3354

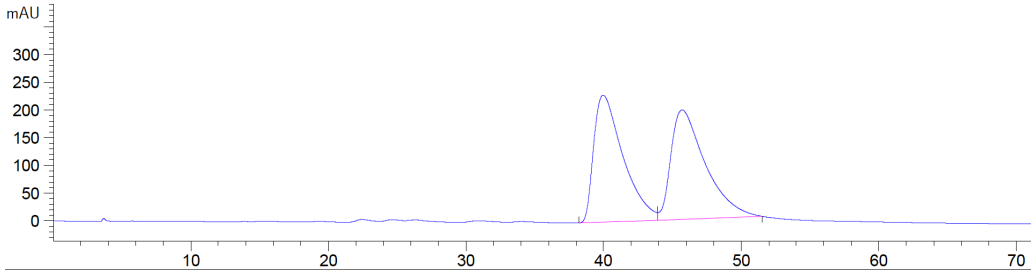


Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	39.503	MM	2.2188	3268.73022	24.55355	49.3123
2	46.038	MM	2.7663	3359.90063	20.24293	50.6877

5a-B & 5a-L

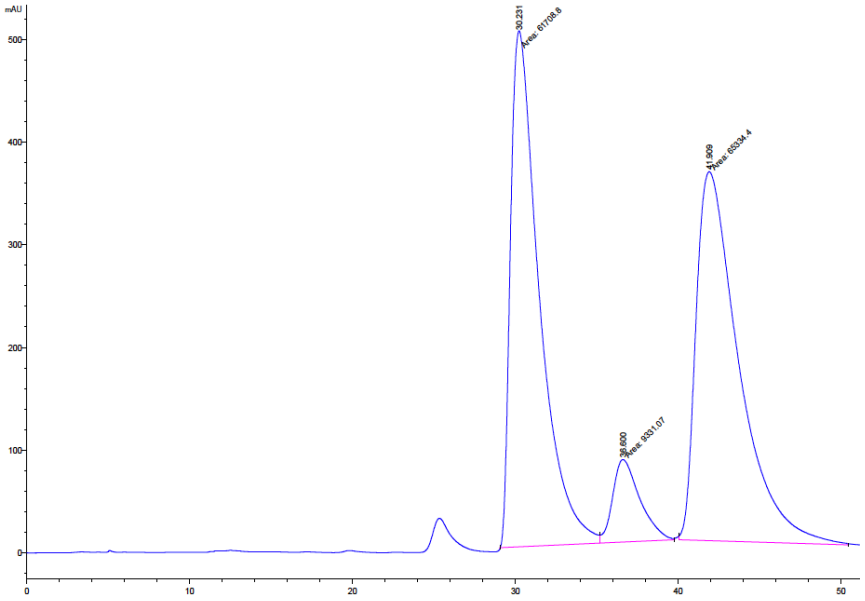


Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Area %
1	38.724	MF	2.3311	1.25832e4	38.6477
2	44.544	FM	2.7008	2830.08936	8.6923
3	54.610	MM	3.6371	1.71454e4	52.6600

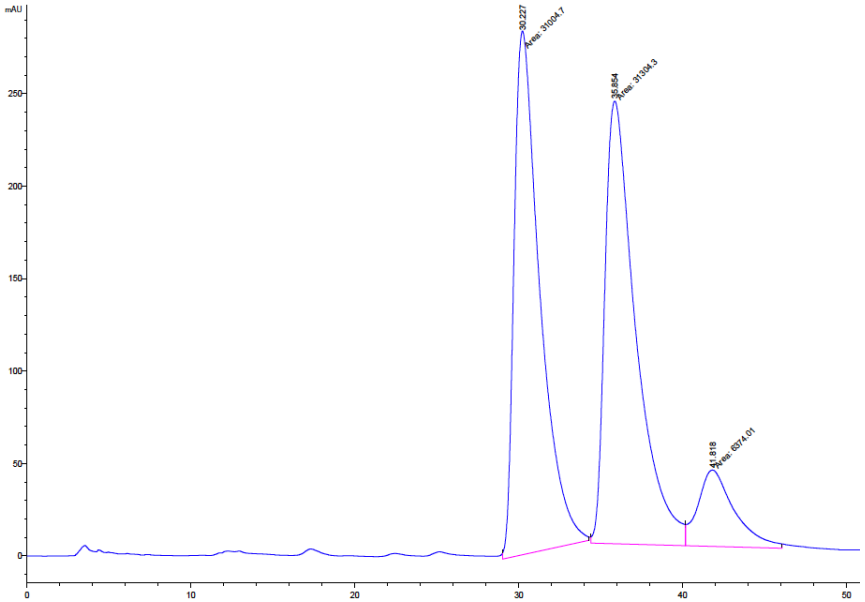


Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Area %
1	39.964	BB	2.1645	3.39747e4	49.6709
2	45.714	BB	2.5028	3.44250e4	50.3291

5b-B & 5b-L

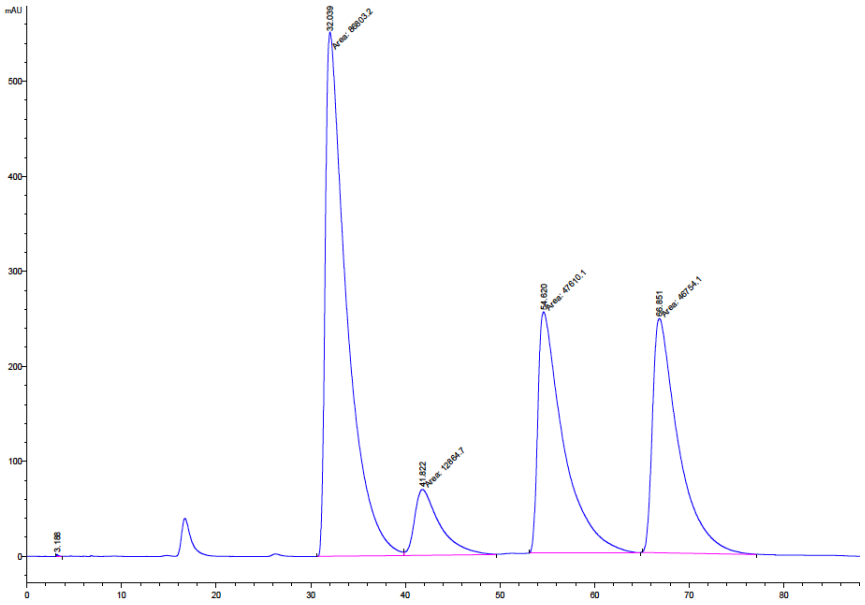


Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	30.231	MF T	2.0475	6.17088e4	502.31943	45.4972
2	36.600	FM T	1.9355	9331.06641	80.34985	6.8797
3	41.909	MM	3.0131	6.45923e4	357.28226	47.6231

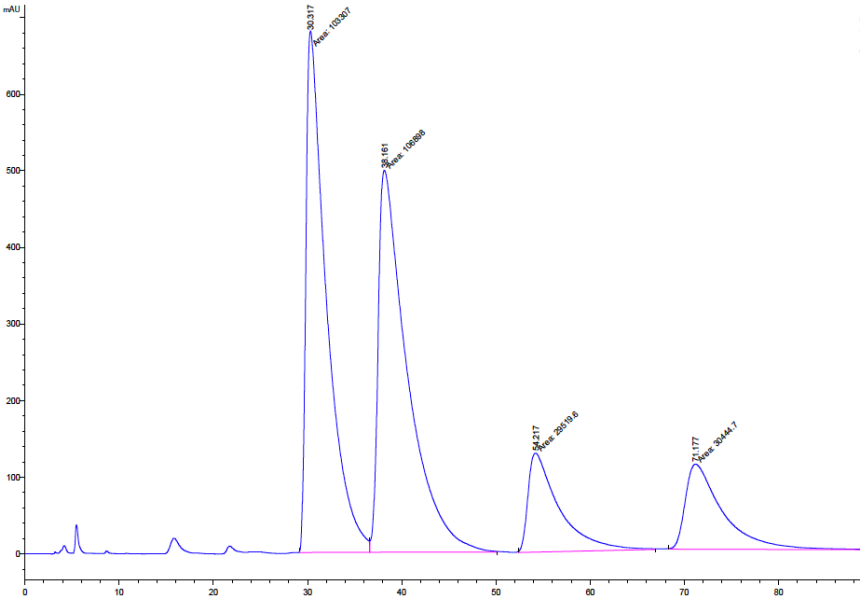


Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	30.227	MM	1.8257	3.10047e4	283.03580	45.1417
2	35.854	MF	2.1806	3.13043e4	239.26634	45.5780
3	41.818	FM	2.5733	6374.00684	41.28370	9.2803

5c-B & 5c-L



Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Area %
1	32.039	MF	2.6227	8.68032e4	44.7365
2	41.822	FM	3.0935	1.28647e4	6.6302
3	54.620	MM	3.1261	4.76101e4	24.5372
4	66.851	MM	3.1580	4.67541e4	24.0961



Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Area %
1	30.317	MF	2.5296	1.03307e5	38.2378
2	38.161	FM	3.5726	1.06898e5	39.5671
3	54.217	MM	3.8122	2.95196e4	10.9263
4	71.177	MM	4.5691	3.04447e4	11.2688