

Supporting Information  
for

**CH Activation and CH<sub>2</sub> Double Activation of Indolines by Radical Translocation:  
Understanding the Chemistry of the Indolinyl Radical.**

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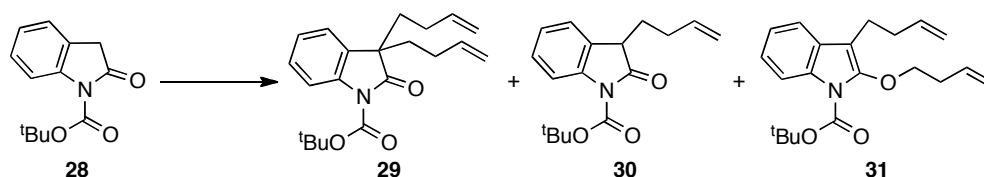
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Commercial reagents were used without further purification unless indicated otherwise. All reactions were carried out in oven-dried glassware under an inert atmosphere of argon. Toluene, THF and diethyl ether were freshly distilled from a purple solution of sodium and benzophenone. Dichloromethane and chloroform were freshly distilled from  $\text{CaH}_2$ . Flash column chromatography was carried out on silica gel (60A Particle Size 30–70 micron) with the solvent system used given in parentheses. Chromatographic purification of organotin-containing reaction mixtures was performed using the  $\text{K}_2\text{CO}_3$ -silica method (10% w/w anhydrous potassium carbonate in silica gel).<sup>[1]</sup> Melting points were recorded on a Reichert Austria apparatus and are uncorrected. Infrared spectra were recorded neat as a film or as a compressed solid using the ATR/golden gate method. Absorption maxima ( $\nu_{\text{max}}$ ) are described as s (strong), m (medium) and w (weak) and are quoted in wavenumbers ( $\text{cm}^{-1}$ ).  $^1\text{H}$  NMR spectra were recorded on either a Bruker AV-300 (300 MHz) or DPX-400 (400 MHz) spectrometer operating at 298 K. Chemical shifts are quoted in parts per million downfield of tetramethylsilane with residual solvent as the internal standard. Assignments were made on the basis of chemical shift, coupling constants, aided in some cases by COSY, HMQC, HMBC and comparison of spectra with that of related compounds. Resonances are described as s (singlet), d (doublet), t (triplet), q (quartet), sept. (septet), app. (apparent) and br. (broad). Coupling constants ( $J$ ) are reported in hertz and are round to the nearest 0.1 Hz. ESI mass spectra were recorded using a VG Platform Quadrupole Electrospray Ionisation mass spectrometer, measuring mono-isotopic masses (mode: ES+ or ES-). EI and CI were measured on a Thermoquest Trace MS.  $m/z$  values are reported with their percentage abundance relative to the most intense signal. Values for the most abundant isotope combination are reported.

## EXPERIMENTAL PROCEDURES

### Preparation and Radical Reaction of Indoline 1a

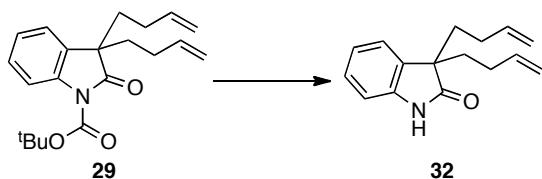
***tert*-Butyl 3,3-di-but-3-enyl-2-oxo-2,3-dihydro-indole-1-carboxylate (29), *tert*-butyl 3-but-3-enyl-2-oxo-2,3-dihydro-indole-1-carboxylate (30) and *tert*-butyl 3-but-3-enyl-2-but-3-enyloxy-indole-1-carboxylate (31)**



To a solution of Boc-oxindole **28**<sup>[2]</sup> (1.50 g, 6.43 mmol) in DMF (130 mL) at 0 °C was added sodium hydride (60% in mineral oil, 770 mg, 19.3 mmol). After 1 h, 4-bromo-1-butene (1.96 mL, 19.29 mmol) was added dropwise over 5 min. After a further 4 h at 0 °C and 3 h at RT, water (200 mL) was added. The reaction mixture was extracted with diethyl ether (2 × 100 mL) then the combined organic phases were washed with water (3 × 100 mL) and brine (200 mL), dried ( $\text{MgSO}_4$ ), and concentrated *in vacuo*. Purification by column chromatography (10% diethyl ether in petroleum ether) afforded firstly **31** as a colourless oil (55 mg, 0.16 mmol 3%)  $\nu_{\text{max}}$  3081 (w), 2970 (w), 2929 (w), 2852 (w), 1727 (m), 1618 (m), 1458 (s);  $\delta_{\text{H}}$  (300 MHz,  $\text{CDCl}_3$ ) 8.04 (1H, m, ArH), 7.44 (1H, m, ArH), 7.26–7.20 (2H, m, 2 × ArH), 6.03–5.84 (2H, m, 2 × CH=CH<sub>2</sub>), 5.25–4.97 (4H, m, 2 × CH=CH<sub>2</sub>), 4.13 (2H, t,  $J=6.9$  Hz,  $\text{OCH}_2\text{CH}_2\text{CH}=\text{CH}_2$ ), 2.67–2.60 (2H, m,  $\text{CH}_2\text{CH}_2\text{CH}=\text{CH}_2$ ), 2.60 (2H, app. qt,  $J=6.9$ , 1.3 Hz,  $\text{OCH}_2\text{CH}_2\text{CH}=\text{CH}_2$ ), 2.46–2.36 (2H, m,  $\text{CH}_2\text{CH}_2\text{CH}=\text{CH}_2$ ), 1.70 (9H, s,  $\text{C}(\text{CH}_3)_3$ );  $\delta_{\text{C}}$  (75 MHz,  $\text{CDCl}_3$ ) 149.5 (C=O), 147.7 (C), 138.5 (CH), 134.4 (CH), 132.1 (C), 128.3 (C), 123.3 (CH), 122.7 (CH), 118.4 (CH), 117.5 (CH<sub>2</sub>), 115.4 (CH), 115.1 (CH<sub>2</sub>), 105.3 (C), 83.7 (C), 75.6 (CH<sub>2</sub>), 34.4 (CH<sub>2</sub>), 33.9 (CH<sub>2</sub>), 28.5 (3 ×

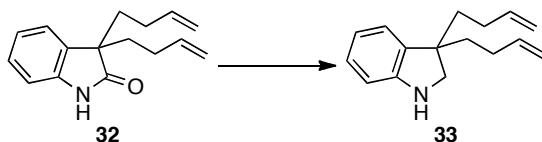
CH<sub>3</sub>), 22.6 (CH<sub>2</sub>); **LRMS (ES<sup>+</sup>)** 706 ([2M+Na]<sup>+</sup>, 40%), 364 ([M+Na]<sup>+</sup>, 70%), 342 ([M+H]<sup>+</sup>, 20%), 286 ([M-<sup>t</sup>Bu+H]<sup>+</sup>, 100%), then secondly **29** as a colourless oil (960 mg, 2.82 mmol, 44%) **v**<sub>max</sub> 3072 (w), 2978 (w), 2933 (w), 2909 (w), 2848 (w), 1973 (w), 1763 (m), 1727 (s); **δ**<sub>H</sub> (300 MHz, CDCl<sub>3</sub>) 7.83 (1H, d, *J*=8.1 Hz, *ArH*), 7.31 (1H, ddd, *J*=8.1, 7.4, 1.8 Hz, *ArH*), 7.20 (1H, app. td, *J*=7.4, 1.0 Hz, *ArH*), 7.16 (1H, ddd, *J*=7.4, 1.8, 1.0 Hz, *ArH*), 5.64 (2H, m, 2 × CH=CH<sub>2</sub>), 4.90–4.80 (4H, m, 2 × CH=CH<sub>2</sub>), 2.14–2.00 (2H, m, 2 × CHH), 1.90–1.67 (6H, m, 2 × CHH and 4 × CHH), 1.65 (9H, s, OC(CH<sub>3</sub>)<sub>3</sub>); **δ**<sub>C</sub> (75 MHz, CDCl<sub>3</sub>) 178.4 (C=O), 149.1 (C=O), 140.0 (C), 137.3 (2 × CH), 130.6 (C), 128.1 (CH), 124.5 (CH), 122.6 (CH), 114.9 (2 × CH<sub>2</sub>), 114.9 (CH), 84.2 (C), 52.8 (C), 38.1 (2 × CH<sub>2</sub>), 28.6 (2 × CH<sub>2</sub>), 28.1 (3 × CH<sub>3</sub>); **LRMS (ES<sup>+</sup>)** 706 ([2M+Na]<sup>+</sup>, 100%), 364 ([M+Na]<sup>+</sup>, 30%), 286 ([M-<sup>t</sup>Bu+H]<sup>+</sup>, 50%); **HRMS** C<sub>21</sub>H<sub>27</sub>NNaO<sub>3</sub> [M+Na]<sup>+</sup> requires 364.1883; found: 364.1875, and then finally **30** as a colourless oil (380 mg, 1.31 mmol, 20%) **v**<sub>max</sub> 3077 (w), 2978 (w), 2925 (w), 1793 (m), 1764 (s), 1727 (s); **δ**<sub>H</sub> (300 MHz, CDCl<sub>3</sub>) 7.82 (1H, d, *J*=8.4 Hz, *ArH*), 7.35–7.22 (2H, m, 2 × *ArH*), 7.16 (1H, app. dt, *J*=7.3, 1.1 Hz, *ArH*), 5.80 (1H, m, CH=CH<sub>2</sub>), 4.94–5.06 (2H, m, CH=CH<sub>2</sub>), 3.58 (1H, t, *J*=5.5 Hz, CHCH<sub>2</sub>CH<sub>2</sub>CH=CH<sub>2</sub>), 2.24–2.04 (4H, m, CHCH<sub>2</sub>CH<sub>2</sub>CH=CH<sub>2</sub>), 1.65 (9H, s, CO<sub>2</sub>C(CH<sub>3</sub>)<sub>3</sub>); **δ**<sub>C</sub> (75 MHz, CDCl<sub>3</sub>) 176.1 (C=O), 149.3 (C=O), 140.2 (C), 137.2 (CH), 128.1 (CH), 127.8 (C), 124.2 (CH), 123.6 (CH), 115.7 (CH<sub>2</sub>), 114.9 (CH), 84.2 (C), 45.2 (CH), 30.4 (CH<sub>2</sub>), 29.8 (CH<sub>2</sub>), 28.1 (3 × CH<sub>3</sub>); **LRMS (ES<sup>+</sup>)** 560 (100%), 310 ([M+Na]<sup>+</sup>, 20%), 232 ([M-<sup>t</sup>Bu+H]<sup>+</sup>, 70%); **HRMS** C<sub>17</sub>H<sub>21</sub>NNaO<sub>3</sub> [M+Na]<sup>+</sup> requires 310.1414; found: 310.1419.

### 3,3-Di-but-3-enyl-1,3-dihydro-indol-2-one (32)



To a solution of oxindole **29** (950 mg, 2.78 mmol) in dichloromethane (50 mL) at 0 °C was added TFA (2.5 mL). The reaction mixture was allowed to warm to RT and after 16 h was concentrated *in vacuo* to afford the *title compound* as a yellow oil (670 mg, 2.78 mmol, 100%) **v**<sub>max</sub> 3162 (w), 3085 (w), 2974 (w), 2929 (w), 2844 (w), 1709 (s), 1668 (s), 1642 (s), 1619 (s); **δ**<sub>H</sub> (300 MHz, CDCl<sub>3</sub>) 9.25 (1H, br. s, *NH*), 7.29 (1H, ddd, *J*=7.7, 7.1, 1.8 Hz, *ArH*), 7.25–7.20 (2H, m, 2 × *ArH*), 7.15 (1H, app. dt, *J*=7.1, 1.0 Hz, *ArH*), 5.66 (2H, ddt, *J*=16.1, 11.1, 6.3 Hz, 2 × CH<sub>2</sub>=CH), 4.95–4.83 (4H, m, 2 × CH<sub>2</sub>=CH), 2.11–1.60 (8H, m, 2 × CH<sub>2</sub>=CHCH<sub>2</sub>CH<sub>2</sub>); **δ**<sub>C</sub> (75 MHz, CDCl<sub>3</sub>) 184.8 (C=O), 140.2 (C), 137.2 (2 × CH), 132.1 (C), 128.2 (CH), 123.6 (CH), 123.2 (CH), 115.1 (2 × CH<sub>2</sub>), 110.6 (CH), 54.0 (C), 36.9 (2 × CH<sub>2</sub>), 28.4 (2 × CH<sub>2</sub>); **LRMS (CI)** 242 ([M+H]<sup>+</sup>, 100%), 187 ([M-CH<sub>2</sub>CH<sub>2</sub>CHCH<sub>2</sub>]<sup>+</sup>, 75%), 146 (70%), 130 (10%), 117 (15%); **HRMS** C<sub>16</sub>H<sub>19</sub>NNaO [M+Na]<sup>+</sup> requires 264.1359; found: 264.1357.

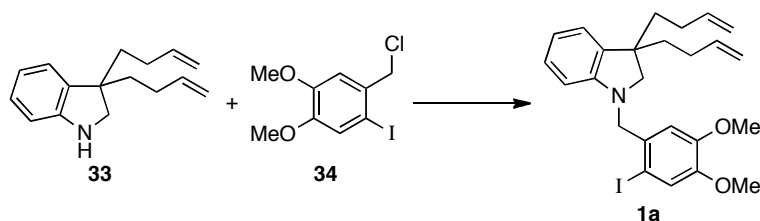
### 3,3-Dibut-3-enyl-2,3-dihydro-1H-indole (33)



To a solution of LiAlH<sub>4</sub> (1.0 M solution in THF, 7.71 mL, 7.71 mmol) at 0 °C and diluted with THF (80 mL) was added a solution of oxindole **32** (620 mg, 2.57 mmol) in THF (20 mL) dropwise over 20 min. The reaction mixture was heated to 70 °C for 16 h then cooled to 0 °C and water (100 mL) added cautiously. Following extraction with diethyl ether (3 × 50 mL), the combined organic phases were washed with brine (200 mL), dried (MgSO<sub>4</sub>) and concentrated *in vacuo* to afford the *title compound* as a brown oil (520 mg, 2.27 mmol, 88%) **v**<sub>max</sub>

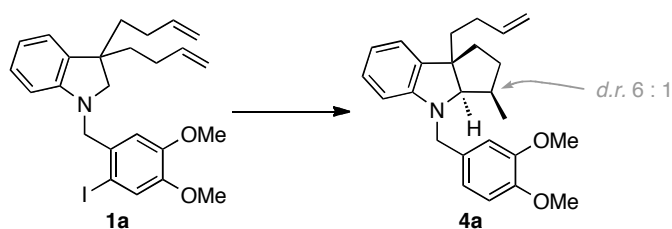
3391 (w), 3072 (w), 2983 (w), 2921 (w), 2844 (w), 1642 (m), 1607 (m), 1487 (m), 1462 (m);  $\delta_{\text{H}}$  (300 MHz,  $\text{CDCl}_3$ ) 7.05 (1H, app. td,  $J=7.7, 1.3$  Hz, ArH), 7.00 (1H, dd,  $J=7.3, 0.7$  Hz, ArH), 6.74 (1H, app. td,  $J=7.3, 1.3$  Hz, ArH), 6.64 (1H, d,  $J=7.7$  Hz, ArH), 5.80 (2H, ddt,  $J=17.1, 10.3, 6.4$  Hz,  $2 \times \text{CH}=\text{CH}_2$ ), 5.05–4.96 (2H, m,  $2 \times \text{CH}=\text{CHH}$ ), 4.93 (2H, d with fine splitting,  $J=10.3$  Hz,  $2 \times \text{CH}=\text{CHH}$ ), 3.41 (2H, s,  $\text{NCH}_2$ ), 2.19–2.03 (2H, m,  $2 \times \text{CHH}$ ), 2.01–1.86 (2H, m,  $2 \times \text{CHH}$ ), 1.86–1.64 (4H, m,  $2 \times \text{CH}_2\text{CH}_2\text{CH}=\text{CH}_2$ );  $\delta_{\text{C}}$  (75 MHz,  $\text{CDCl}_3$ ) 151.2 (C), 138.9 ( $2 \times \text{CH}$ ), 134.8 (C), 127.5 (CH), 123.3 (CH), 118.4 (CH), 114.2 ( $2 \times \text{CH}_2$ ), 109.5 (CH), 57.3 ( $\text{CH}_2$ ), 48.5 (C), 38.1 ( $2 \times \text{CH}_2$ ), 28.8 ( $2 \times \text{CH}_2$ ); **LRMS (CI)** 228 ( $[\text{M}+\text{H}]^+$ , 70%), 172 ( $[\text{M}-\text{CH}_2\text{CH}_2\text{CHCH}_2]^+$ , 50%), 130 ( $[\text{M}-(\text{CH}_2\text{CH}_2\text{CHCH}_2)-(\text{CH}_2\text{CHCH}_2)]^+$ , 100%), 117 (10%); **HRMS**  $\text{C}_{16}\text{H}_{22}\text{N}$   $[\text{M}+\text{H}]^+$  requires 228.1747; found: 228.1746.

### 3,3-Dibut-3-enyl-1-(2-iodo-4,5-dimethoxybenzyl)-2,3-dihydro-1H-indole (1a)



A solution of indoline **33** (300 mg, 1.32 mmol), benzyl chloride **34**<sup>[3]</sup> (620 mg, 1.98 mmol),  $\text{K}_2\text{CO}_3$  (1.13 g, 8.18 mmol) and KI (330 mg, 1.98 mmol) in acetone (30 mL) was heated at reflux for 16 h then cooled and concentrated *in vacuo*. The residue was partitioned between water (30 mL) and diethyl ether (30 mL). The aqueous phase was extracted with diethyl ether ( $2 \times 30$  mL) then the combined organic phases were washed with brine (80 mL), dried ( $\text{MgSO}_4$ ) and concentrated *in vacuo*. Purification by column chromatography (5% diethyl ether in petroleum ether) afforded the *title compound* as a yellow oil (530 mg, 1.04 mmol, 79%)  $\nu_{\text{max}}$  3072 (w), 2995 (w), 2929 (w), 2905 (w), 2884 (w), 1638 (w), 1603 (m), 1497 (s), 1459 (s);  $\delta_{\text{H}}$  (300 MHz,  $\text{CDCl}_3$ ) 7.30 (1H, s, ArH), 7.09 (1H, app. td,  $J=7.7, 1.1$  Hz, ArH), 7.01 (1H, dd,  $J=7.3, 0.7$  Hz, ArH), 6.95 (1H, s, ArH), 6.73 (1H, app. td,  $J=7.3, 1.1$  Hz, ArH), 6.45 (1H, d,  $J=7.7$  Hz, ArH), 5.80 (2H, ddt,  $J=17.0, 10.4, 6.3$  Hz,  $2 \times \text{CH}=\text{CH}_2$ ), 5.04–4.88 (4H, m,  $2 \times \text{CH}=\text{CH}_2$ ), 4.21 (2H, s,  $\text{NCH}_2\text{Ar}$ ), 3.89 (3H, s,  $\text{OCH}_3$ ), 3.76 (3H, s,  $\text{OCH}_3$ ), 3.26 (2H, s,  $\text{NCH}_2$ ), 2.23–2.06 (2H, m,  $2 \times \text{CHH}$ ), 2.02–1.88 (2H, m,  $2 \times \text{CHH}$ ), 1.87–1.64 (4H, m,  $4 \times \text{CHH}$ );  $\delta_{\text{C}}$  (75 MHz,  $\text{CDCl}_3$ ) 151.7 (C), 149.6 (C), 148.6 (C), 138.7 ( $2 \times \text{CH}$ ), 135.0 (C), 132.6 (C), 127.7 (CH), 123.0 (CH), 121.7 (CH), 117.7 (CH), 114.3 ( $2 \times \text{CH}_2$ ), 111.6 (CH), 106.8 (CH), 86.1 (C), 63.8 ( $\text{CH}_2$ ), 57.9 ( $\text{CH}_2$ ), 56.2 ( $\text{CH}_3$ ), 55.8 ( $\text{CH}_3$ ), 47.0 (C), 38.5 ( $2 \times \text{CH}_2$ ), 28.9 ( $2 \times \text{CH}_2$ ); **LRMS (ES<sup>+</sup>)** 526 ( $[\text{M}+\text{Na}]^+$ , 25%), 504 ( $[\text{M}+\text{H}]^+$ , 100%); **HRMS**  $\text{C}_{25}\text{H}_{31}\text{INO}_2$   $[\text{M}+\text{H}]^+$  requires 504.1394; found: 504.1390.

### 8b-But-3-enyl-4-(3,4-dimethoxybenzyl)-3-methyl-1,2,3,3a,4,8b-hexahydrocyclopenta[b]indole (4a)

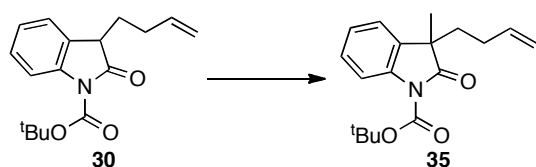


A solution of **1a** (200 mg, 0.40 mmol), tributyltin hydride (0.24 mL, 0.87 mmol) and VAZO (20 mg, 0.08 mmol) in toluene (20 mL) was heated at reflux for 4 h, then cooled and concentrated *in vacuo*. Purification by column chromatography (10% w/w anhydrous  $\text{K}_2\text{CO}_3$ -silica; 10% diethyl ether in petroleum ether) afforded the *title compound* as a brown oil (120 mg, 0.31 mmol, 76%), as a 6:1 mixture of diastereoisomers  $\nu_{\text{max}}$  3077 (w), 3003

(w), 2929 (m), 2856 (m), 2827 (m), 1601 (s), 1513 (s), 1485 (s), 1461 (s);  $\delta_{\text{H}}$  (400 MHz,  $\text{CDCl}_3$ ) Major diastereoisomer 7.48 (1H, app. td,  $J=7.9, 1.1$  Hz, ArH), 7.43 (1H, dd,  $J=7.3, 1.1$  Hz, ArH), 7.34–7.28 (3H, m, 3  $\times$  ArH), 7.13 (1H, app. td,  $J=7.3, 0.6$  Hz, ArH), 6.87 (1H, d,  $J=7.9$  Hz, ArH), 6.16 (1H, ddt,  $J=16.7, 10.7, 6.1$  Hz,  $\text{CH}_2=\text{CH}$ ), 5.39–5.31 (2H, m,  $\text{CH}_2=\text{CH}$ ), 5.04 (1H, d,  $J=15.9$  Hz, NCHAr), 4.65 (1H, d,  $J=15.9$  Hz, NCHAr), 4.34 (3H, s,  $\text{OCH}_3$ ), 4.25 (3H, s,  $\text{OCH}_3$ ), 4.11 (1H, d,  $J=5.8$  Hz, NCH), 2.59–2.46 (2H, m,  $\text{CH}_2=\text{CHCH}_2\text{CH}_2$ ), 2.45–2.35 (2H, m,  $\text{CH}_2=\text{CHCH}_2\text{CH}_2$ ), 2.34–2.02 (4H, m,  $\text{CH}_3\text{CHCH}_2\text{CH}_2\text{C}$ ), 1.82 (1H, m,  $\text{CH}_3\text{CHCH}_2\text{CH}_2\text{C}$ ), 1.57 (3H, d,  $J=6.9$  Hz,  $\text{CH}_3\text{CHCH}_2\text{CH}_2\text{C}$ );  $\delta_{\text{C}}$  (100 MHz,  $\text{CDCl}_3$ ) Major diastereoisomer 153.2 (C), 148.9 (C), 148.0 (C), 138.8 (CH), 136.3 (C), 131.2 (C), 127.3 (CH), 122.8 (CH), 119.8 (CH), 117.1 (CH), 113.9 ( $\text{CH}_2$ ), 111.0 (CH), 110.9 (CH), 107.0 (CH), 75.0 (CH), 56.9 (C), 55.8 ( $\text{CH}_3$ ), 55.7 ( $\text{CH}_3$ ), 53.3 ( $\text{CH}_2$ ), 41.5 (CH), 40.9 ( $\text{CH}_2$ ), 40.6 ( $\text{CH}_2$ ), 32.6 ( $\text{CH}_2$ ), 30.1 ( $\text{CH}_2$ ), 14.9 ( $\text{CH}_3$ ), Additional signals attributed to the minor diastereoisomer; LRMS (CI) 378 ( $[\text{M}+\text{H}]^+$ , 30%), 151 ( $[\text{M}-\text{CH}_2\text{Ar}]^+$ , 100%); HRMS  $\text{C}_{25}\text{H}_{32}\text{NO}_2$   $[\text{M}+\text{H}]^+$  requires 378.2428; found: 378.2428.

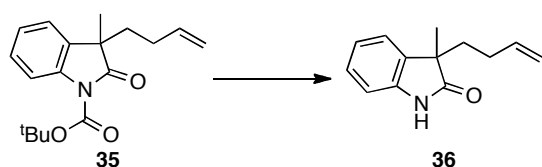
### An Analogous Radical Reaction Mediated By Tris(trimethylsilyl)silane

#### **tert-Butyl-3-but-3-enyl-3-methyl-2-oxo-2,3-dihydroindole-1-carboxylate (35)**



To a solution of Boc-oxindole **30** (300 mg, 1.04 mmol) in DMF (30 mL) at 0 °C was added sodium hydride (60% in mineral oil, 63 mg, 1.57 mmol). After 1.5 h, methyl iodide (0.1 mL, 1.57 mmol) was added cautiously and the reaction mixture warmed to RT for 4 h. Water (50 mL) was added and the reaction mixture extracted with diethyl ether (2  $\times$  40 mL). The combined organic phases were washed with water (4  $\times$  40 mL) and brine (100 mL), dried ( $\text{MgSO}_4$ ) and concentrated *in vacuo*. Purification by column chromatography (5% diethyl ether in petroleum ether) afforded the *title compound* as a colourless oil (130 mg, 0.42 mmol, 41%)  $\nu_{\text{max}}$  2974 (w), 2933 (w), 1789 (w), 1764 (m), 1727 (s), 1646 (w), 1610 (w), 1479 (m);  $\delta_{\text{H}}$  (300 MHz,  $\text{CDCl}_3$ ) 7.85 (1H, d,  $J=8.4$  Hz, ArH), 7.31 (1H, m, ArH), 7.21–7.16 (2H, m, 2  $\times$  ArH), 5.66 (1H, ddt,  $J=17.6, 9.6, 6.4$  Hz,  $\text{CH}=\text{CH}_2$ ), 4.91–4.82 (2H, m,  $\text{CH}=\text{CH}_2$ ), 2.08 (1H, m,  $\text{CH}_2\text{CHHCH}=\text{CH}_2$ ), 1.90–1.68 (3H, m,  $\text{CH}_2\text{CHHCH}=\text{CH}_2$ ), 1.66 (9H, s,  $\text{C}(\text{CH}_3)_3$ ), 1.43 (3H, s,  $\text{CH}_3$ );  $\delta_{\text{C}}$  (75 MHz,  $\text{CDCl}_3$ ) 179.1 (C=O), 149.3 (C=O), 139.2 (C), 137.3 (CH), 132.6 (C), 128.0 (CH), 124.5 (CH), 122.4 (CH), 115.0 (CH), 114.9 ( $\text{CH}_2$ ), 84.2 (C), 48.5 (C), 38.4 ( $\text{CH}_2$ ), 28.9 ( $\text{CH}_2$ ), 28.1 (3  $\times$   $\text{CH}_3$ ), 24.9 ( $\text{CH}_3$ ); LRMS ( $\text{ES}^+$ ) 626 ( $[\text{2M}+\text{Na}]^+$ , 100%), 324 ( $[\text{M}+\text{Na}]^+$ , 30%), 246 ( $[\text{M}-\text{tBu}]^+$ , 80%); HRMS  $\text{C}_{18}\text{H}_{23}\text{NNaO}_3$   $[\text{M}+\text{Na}]^+$  requires 324.1570; found: 324.1566.

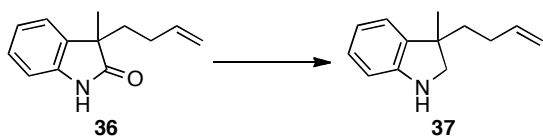
#### **3-But-3-enyl-3-methyl-1,3-dihydroindol-2-one (36)**



To a solution of oxindole **35** (130 mg, 0.42 mmol,) in dichloromethane (30 mL) at 0 °C was added TFA (1.5 mL). The reaction mixture was warmed to RT and after 16 h was concentrated *in vacuo* to afford the *title compound* as a yellow oil (83 mg, 0.41 mmol, 98%)  $\nu_{\text{max}}$  3220 (br. w), 3072 (w), 3023 (w), 2974 (w), 2925 (w), 2844 (w), 1700 (s), 1620 (m), 1471 (s);  $\delta_{\text{H}}$  (300 MHz,  $\text{CDCl}_3$ ) 8.63 (1H, br. s, NH), 7.23 (1H, app. td,  $J=7.7, 1.2$  Hz, ArH), 7.18 (1H, dd,  $J=7.5, 1.2$  Hz, ArH), 7.09 (1H, app. td,  $J=7.5, 0.7$  Hz, ArH), 6.94 (1H, d,  $J=7.7$  Hz, ArH), 5.68 (1H, m,  $\text{CH}=\text{CH}_2$ ), 4.96–4.84 (2H, m,  $\text{CH}=\text{CH}_2$ ), 2.13–1.61 (4H, m,  $\text{CH}_2\text{CH}_2\text{CH}=\text{CH}_2$ ), 1.42 (3H, s,  $\text{CH}_3$ );  $\delta_{\text{C}}$  (75 MHz,

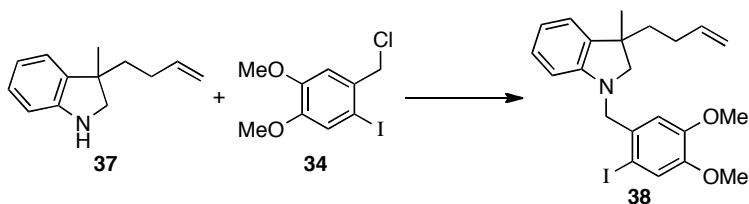
**CDCl<sub>3</sub>**) 157.7 (C=O), 140.2 (C), 137.7 (CH), 134.5 (C), 128.1 (CH), 123.2 (CH), 123.1 (CH), 115.1 (CH<sub>2</sub>), 110.2 (CH), 47.2 (C), 37.5 (CH<sub>2</sub>), 29.0 (CH<sub>2</sub>), 24.0 (CH<sub>3</sub>); **LRMS (CI)** 202 ([M+H]<sup>+</sup>, 90%), 147 ([M-CH<sub>2</sub>CH<sub>2</sub>CHCH<sub>2</sub>]<sup>+</sup>, 100%), 117 (10%), 91 (5%); **HRMS (ES<sup>+</sup>)** C<sub>13</sub>H<sub>15</sub>NNaO [M+Na]<sup>+</sup> requires 224.1046; found: 224.1044.

### 3-But-3-enyl-3-methyl-2,3-dihydro-1H-indole (37)



A solution of LiAlH<sub>4</sub> (1.0 M solution in THF, 1.23 mmol, 1.23 mL) was diluted with THF (10 mL) and cooled to 0 °C. A solution of oxindole **36** (0.41 mmol, 83 mg) in THF (2 mL) was added dropwise over 5 min and the reaction mixture heated to 70 °C for 20 h, then cooled to 0 °C. Water (20 mL) was added and the reaction mixture was extracted with diethyl ether (3 × 20 mL). The combined organic phases were washed with brine (50 mL), dried (MgSO<sub>4</sub>), and concentrated *in vacuo* to afford the *title compound* as a yellow oil (75 mg, 0.40 mmol, 98%) **ν**<sub>max</sub> 3387 (w), 2958 (m), 2922 (m), 2856 (m), 1642 (w), 1605 (m), 1487 (m), 1462 (m); **δ**<sub>H</sub> (300 MHz, CDCl<sub>3</sub>) 7.08–7.00 (2H, m, 2 × ArH), 6.75 (1H, app. td, *J*=7.5, 1.0 Hz, ArH), 6.65 (1H, app. dt, *J*=7.5, 0.8 Hz, ArH), 5.81 (1H, ddt, *J*=17.0, 10.3, 6.5 Hz, CH=CH<sub>2</sub>), 5.01 (1H, app. dq, *J*=17.0, 1.8 Hz, CH=CHH), 4.93 (1H, app. ddt, *J*=10.3, 1.8, 1.3 Hz, CH=CHH), 3.44 (1H, d, *J*=8.9 Hz, NCHH), 3.28 (1H, d, *J*=8.9 Hz, NCHH), 2.22–1.89 (2H, m, 2 × CHH), 1.82–1.62 (2H, m, 2 × CHH), 1.33 (3H, s, CH<sub>3</sub>); **δ**<sub>C</sub> (75 MHz, CDCl<sub>3</sub>) 150.8 (C), 139.2 (CH), 137.1 (C), 127.6 (CH), 122.8 (CH), 118.8 (CH), 114.3 (CH<sub>2</sub>), 109.8 (CH), 59.6 (CH<sub>2</sub>), 45.2 (C), 40.0 (CH<sub>2</sub>), 29.3 (CH<sub>2</sub>), 26.0 (CH<sub>3</sub>); **LRMS (CI)** 188 ([M+H]<sup>+</sup>, 100%), 172 (10%), 132 ([M-CH<sub>2</sub>CH<sub>2</sub>CH=CH<sub>2</sub>]<sup>+</sup>, 100%), 144 (15%), 117 (15%); **HRMS (ES<sup>+</sup>)** C<sub>13</sub>H<sub>18</sub>N [M+H]<sup>+</sup> requires 188.1434; found: 188.1433.

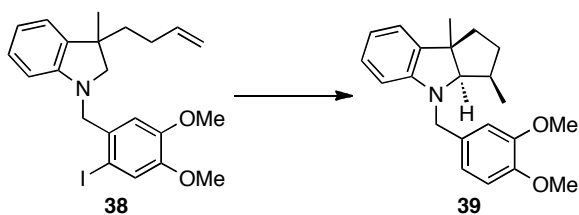
### 3-But-3-enyl-1-(2-iodo-4,5-dimethoxybenzyl)-3-methyl-2,3-dihydro-1H-indole (38)



A solution of indoline **37** (60 mg, 0.32 mmol), benzyl chloride **34**<sup>[3]</sup> (83 mg, 0.27 mmol) and K<sub>2</sub>CO<sub>3</sub> (230 mg, 1.67 mmol) in acetone (20 mL) was heated at reflux for 16 h then cooled and concentrated *in vacuo*. The residue was partitioned between water (50 mL) and diethyl ether (50 mL). The aqueous phase was extracted with diethyl ether (2 × 30 mL) then the combined organic phases were washed with brine (100 mL), dried (MgSO<sub>4</sub>) and concentrated *in vacuo*. Purification by column chromatography (5% diethyl ether in petroleum ether) afforded the *title compound* as a yellow oil (63 mg, 0.14 mmol, 50%) **ν**<sub>max</sub> 3387 (br. w), 2958 (w), 2929 (w), 2827 (w), 1716 (w), 1638 (w), 1605 (m), 1498 (s); **δ**<sub>H</sub> (300 MHz, CDCl<sub>3</sub>) 7.29 (1H, s, ArH), 7.09 (1H, app. td, *J*=7.7, 1.2 Hz, ArH), 7.04 (1H, dd, *J*=7.4, 1.2 Hz, ArH), 6.97 (1H, s, ArH), 6.74 (1H, app. td, *J*=7.4, 0.9 Hz, ArH), 6.48 (1H, d, *J*=7.7 Hz, ArH), 5.79 (1H, ddt, *J*=16.9, 10.3, 6.6 Hz, CH=CH<sub>2</sub>), 5.03–4.88 (2H, m, CH=CH<sub>2</sub>), 4.26 (1H, d, *J*=15.4 Hz, NCHHAr), 4.13 (1H, d, *J*=15.4 Hz, NCHHAr), 3.89 (3H, s, OCH<sub>3</sub>), 3.78 (3H, s, OCH<sub>3</sub>), 3.30 (1H, d, *J*=8.8 Hz, NCHH), 3.10 (1H, d, *J*=8.8 Hz, NCHH), 2.17 (1H, m, CH<sub>2</sub>CHHCH=CH<sub>2</sub>), 1.95 (1H, m, CH<sub>2</sub>CHHCH=CH<sub>2</sub>), 1.82–1.64 (2H, m, CH<sub>2</sub>CH<sub>2</sub>CH=CH<sub>2</sub>), 1.35 (3H, s, CH<sub>3</sub>); **δ**<sub>C</sub> (75 MHz, CDCl<sub>3</sub>) 151.5 (C), 149.9 (C), 149.0 (C), 139.2 (CH), 137.5 (C), 133.0 (C), 127.9 (CH), 122.7 (CH), 122.1 (CH), 118.2 (CH), 114.5 (CH<sub>2</sub>), 112.1 (CH), 107.3 (CH), 86.6 (C), 66.2 (CH<sub>2</sub>), 58.1 (CH<sub>2</sub>), 56.6 (CH<sub>3</sub>), 56.2 (CH<sub>3</sub>), 43.9 (C), 40.5 (CH<sub>2</sub>),

29.6 (CH<sub>2</sub>), 26.3 (CH<sub>3</sub>); **LRMS (ES<sup>+</sup>)** 486 ([M+Na]<sup>+</sup>, 20%), 464 ([M+H]<sup>+</sup>, 100%); **HRMS** C<sub>22</sub>H<sub>27</sub>INO<sub>2</sub> [M+H]<sup>+</sup> requires 464.1081; found: 464.1085.

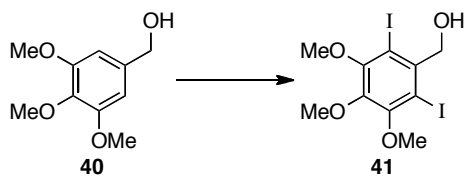
#### 4-(3,4-Dimethoxybenzyl)-3,8b-dimethyl-1,2,3,3a,4,8b-hexahydrocyclopenta-[b]indole (39)



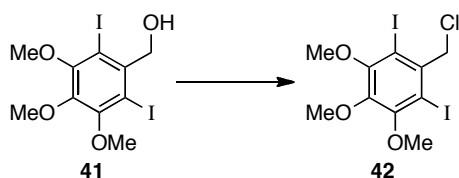
A solution of **38** (60 mg, 0.13 mmol), TTMSS (0.29 mmol, 88  $\mu$ L) and VAZO (0.03 mmol, 6 mg) in toluene (20 mL) was heated at reflux for 16 h, then cooled and concentrated *in vacuo*. Purification by column chromatography (50% CHCl<sub>3</sub> in petroleum ether) afforded the *title compound* as a brown oil (27 mg, 0.08 mmol, 62%), contaminated with ~10% silicon residues  **$\nu_{\max}$**  2945 (w), 2930 (w), 2892 (w), 2854 (w), 1697 (w), 1599 (w), 1512 (w);  **$\delta_{\text{H}}$  (300 MHz, CDCl<sub>3</sub>)** 7.02–6.94 (2H, m, 2  $\times$  ArH), 6.82–6.76 (3H, m, 3  $\times$  ArH), 6.65 (1H, app. td,  $J=7.3, 0.9$  Hz, ArH), 6.32 (1H, d,  $J=7.8$  Hz, ArH), 4.52 (1H, d,  $J=16.2$  Hz, NCHHAr), 4.19 (1H, d,  $J=16.2$  Hz, NCHHAr), 3.86 (3H, s, OCH<sub>3</sub>), 3.78 (3H, s, OCH<sub>3</sub>), 3.53 (1H, d,  $J=5.5$  Hz, NCH), 2.17–1.84 (3H, m, NCHCH), 1.73–1.57 (2H, m, CH(CH<sub>3</sub>)), 1.36 (3H, s, CCH<sub>3</sub>), 1.08 (3H, d,  $J=6.9$  Hz, NCHCH(CH<sub>3</sub>)CH<sub>2</sub>CH<sub>2</sub>);  **$\delta_{\text{C}}$  (75 MHz, CDCl<sub>3</sub>)** 153.2 (C), 149.2 (C), 148.0 (C), 138.8 (C), 131.9 (C), 127.5 (CH), 122.5 (CH), 119.4 (CH), 117.6 (CH), 111.3 (CH), 110.6 (CH), 107.4 (CH), 79.4 (NCH), 56.1 (CH<sub>3</sub>), 55.9 (CH<sub>3</sub>), 53.9 (CH<sub>2</sub>), 53.2 (C), 42.4 (CH<sub>2</sub>), 41.5 (CH), 33.6 (CH<sub>2</sub>), 29.3 (CH<sub>3</sub>), 15.1 (CH<sub>3</sub>).

#### Preparation and Radical Reaction of Indoline 1b

##### (2,6-Diiodo-3,4,5-trimethoxyphenyl)-methanol (41)

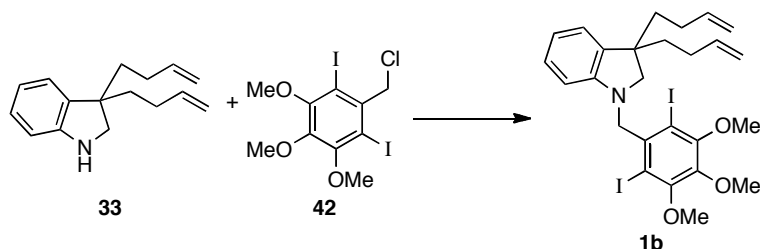


To a solution of 3,4,5-trimethoxybenzyl alcohol **40** (200 mg, 1.01 mmol) in chloroform (20 mL) at 0  $^{\circ}$ C was added silver trifluoroacetate (560 mg, 2.53 mmol). To this suspension was added a solution of iodine (640 mg, 2.53 mmol) in chloroform (100 mL) dropwise over 1 h. The reaction mixture was allowed to warm to RT and after 16 h was filtered. The filtrate was washed with saturated solution of sodium thiosulfate (100 mL) then the organic phases were dried (MgSO<sub>4</sub>) and concentrated *in vacuo* to afford the *title compound* as a yellow oil (450 mg, 1.01 mmol, 99%)  **$\nu_{\max}$**  3506 (w), 3387 (w), 2999 (w), 2929 (w), 2880 (w), 2840 (w), 1459 (m), 1438 (m), 1398 (m), 1370 (m);  **$\delta_{\text{H}}$  (300 MHz, CDCl<sub>3</sub>)** 5.06 (2H, s, CH<sub>2</sub>OH), 3.83 (3H, s, OCH<sub>3</sub>), 3.81 (6H, s, 2  $\times$  OCH<sub>3</sub>), 2.40 (1H, br. s, OH);  **$\delta_{\text{C}}$  (75 MHz, CDCl<sub>3</sub>)** 154.2 (2  $\times$  C), 145.0 (C), 139.7 (C), 92.9 (2  $\times$  C), 75.0 (CH<sub>2</sub>), 61.3 (CH<sub>3</sub>), 61.0 (2  $\times$  CH<sub>3</sub>); **LRMS (EI)** 450 ([M]<sup>+</sup>, 100%), 433 (20%), 324 (15%); **HRMS (ES<sup>+</sup>)** C<sub>10</sub>H<sub>12</sub>I<sub>2</sub>NaO<sub>4</sub> [M+Na]<sup>+</sup> requires 472.8717; found: 472.8721.



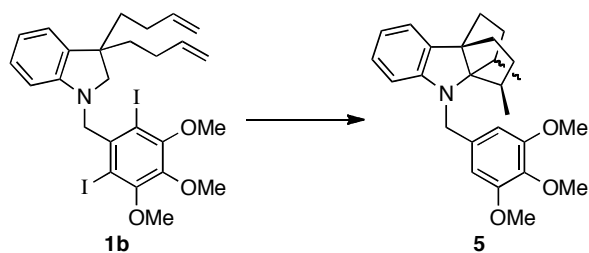
To a solution of benzyl alcohol **41** (400 mg, 0.89 mmol) in DCM (40 mL) at 0 °C was added thionyl chloride (0.07 mL, 0.89 mmol) dropwise over 5 min. The reaction mixture was warmed to RT and after 16 h was concentrated *in vacuo* to afford the *title compound* as a yellow oil (420 mg, 0.89 mmol, 100%)  $\nu_{\max}$  3003 (w), 2966 (w), 2933 (w), 2856 (w), 1456 (s), 1399 (s), 1371 (s), 1315 (s);  $\delta_{\text{H}}$  (300 MHz,  $\text{CDCl}_3$ ) 5.13 (2H, s,  $\text{ClCH}_2\text{Ar}$ ), 3.92 (3H, s,  $\text{OCH}_3$ ), 3.89 (6H, s,  $2 \times \text{OCH}_3$ );  $\delta_{\text{C}}$  (75 MHz,  $\text{CDCl}_3$ ) 154.7 ( $2 \times \text{C}$ ), 145.4 (C), 137.2 (C), 93.0 ( $2 \times \text{C}$ ), 61.4 ( $\text{CH}_3$ ), 61.1 ( $2 \times \text{CH}_3$ ), 58.2 ( $\text{CH}_2$ ); **LRMS (EI)** 468 ( $[\text{M}]^+$ , 90%), 434 ( $[\text{M}-\text{Cl}]^+$ , 100%), 419 (10%), 291 (20%), 277 (15%); **HRMS**  $\text{C}_{10}\text{H}_{11}\text{ClI}_2\text{O}_3$   $[\text{M}]^+$  requires 467.8486; found: 467.8494.

### 3,3-Dibut-3-enyl-1-(2,6-diiodo-3,4,5-trimethoxybenzyl)-2,3-dihydro-1H-indole (**1b**)



A solution of indoline **33** (400 mg, 1.76 mmol), benzyl chloride **42** (690 mg, 1.47 mmol),  $\text{K}_2\text{CO}_3$  (1.26 g, 9.11 mmol) and KI (240 mg, 1.47 mmol) in acetone (50 mL) was heated at reflux for 16 h then cooled and concentrated *in vacuo*. The residue was partitioned between water (40 mL) and diethyl ether (40 mL). The aqueous phase was extracted with diethyl ether ( $2 \times 40$  mL) then the combined organic phases were washed with brine (100 mL), dried ( $\text{MgSO}_4$ ) and concentrated *in vacuo*. Purification by column chromatography (2% diethyl ether in petroleum ether) afforded the *title compound* as a light brown solid (440 mg, 0.67 mmol, 46%) **MP** 79–81 °C (EtOAc in hexanes);  $\nu_{\max}$  3064 (w), 3007 (w), 2962 (w), 2933 (w), 2909 (w), 2852 (w), 1634 (w), 1603 (m), 1491 (s), 1456 (s);  $\delta_{\text{H}}$  (300 MHz,  $\text{CDCl}_3$ ) 7.15 (1H, app. td,  $J=7.7, 1.1$  Hz,  $\text{ArH}$ ), 6.98 (1H, dd,  $J=7.3, 1.1$  Hz,  $\text{ArH}$ ), 6.75–6.67 (2H, m,  $2 \times \text{ArH}$ ), 5.76 (2H, ddt,  $J=16.9, 10.3, 6.4$  Hz,  $2 \times \text{CH}=\text{CH}_2$ ), 5.00–4.85 (4H, m,  $2 \times \text{CH}=\text{CH}_2$ ), 4.71 (2H, s,  $\text{NCH}_2\text{Ar}$ ), 3.96 (3H, s,  $\text{OCH}_3$ ), 3.92 (6H, s,  $2 \times \text{OCH}_3$ ), 3.07 (2H, s,  $\text{NCH}_2$ ), 2.13–1.97 (2H, m,  $2 \times \text{CHH}$ ), 1.95–1.80 (2H, m,  $2 \times \text{CHH}$ ), 1.79–1.57 (4H, m,  $4 \times \text{CHH}$ );  $\delta_{\text{C}}$  (75 MHz,  $\text{CDCl}_3$ ) 154.2 ( $2 \times \text{C}$ ), 151.4 (C), 144.8 (C), 139.4 ( $2 \times \text{CH}$ ), 136.8 (C), 135.7 (C), 127.8 (CH), 123.3 (CH), 117.8 (CH), 114.4 ( $2 \times \text{CH}_2$ ), 107.5 (CH), 94.3 ( $2 \times \text{C}$ ), 62.0 ( $2 \times \text{CH}_2$ ), 61.4 ( $\text{CH}_3$ ), 61.1 ( $2 \times \text{CH}_3$ ), 47.1 (C), 38.5 ( $2 \times \text{CH}_2$ ), 29.3 ( $2 \times \text{CH}_2$ ); **LRMS (ES<sup>+</sup>)** 682 ( $[\text{M}+\text{Na}]^+$ , 10%), 660 ( $[\text{M}+\text{H}]^+$ , 100%); **HRMS**  $\text{C}_{26}\text{H}_{32}\text{I}_2\text{NO}_3$   $[\text{M}+\text{H}]^+$  requires 660.0466; found: 660.0469; **CHN** Found: C 47.46, H 4.73, N 2.02;  $\text{C}_{26}\text{H}_{31}\text{I}_2\text{NO}_3$  requires C 47.36, H 4.74, N 2.12.

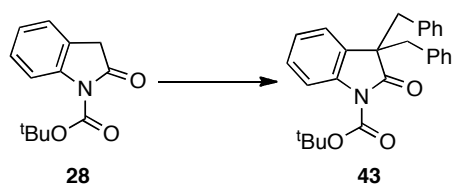




A solution of **1b** (300 mg, 0.46 mmol), tributyltin hydride (0.55 mL, 2.02 mmol,) and VAZO (23 mg, 0.09 mmol) in toluene (20 mL) was heated at reflux for 16 h, then cooled and concentrated *in vacuo*. Purification by column chromatography (10% w/w anhydrous K<sub>2</sub>CO<sub>3</sub>-silica; 5–10% diethyl ether in petroleum ether) afforded the *title compound* as a white solid (170 mg, 0.41 mmol, 90%) as a 1:1 mixture of diastereoisomers  $\nu_{\max}$  2933 (m), 2868 (w), 2848 (w), 1687 (m), 1588 (m), 1499 (m);  $\delta_{\text{H}}$  (300 MHz, CDCl<sub>3</sub>) 7.04 (1H, dd, *J*=7.3, 1.0 Hz, *ArH*), 7.05 (1H, dd, *J*=7.3, 1.0 Hz, *ArH*), 6.92 (1H, app. td, *J*=7.7, 1.4 Hz, *ArH*), 6.91 (1H, app. td, *J*=7.7, 1.4 Hz, *ArH*), 6.63 (1H+1H, app. tt, *J*=7.3, 1.0 Hz, *ArH*), 6.57 (1H+1H, br. s, *ArH*), 6.53 (1H+1H, br. s, *ArH*), 6.01 (1H, d, *J*=7.6 Hz, *ArH*), 5.95 (1H, d, *J*=7.6 Hz, *ArH*), 4.72 (1H, d, *J*=16.8 Hz, *NCHHAr*), 4.44 (1H+1H, s, *NCHHAr*), 4.25 (1H, d, *J*=16.8 Hz, *NCHAr*), 3.87 (3H, s, OCH<sub>3</sub>), 3.86 (3H, s, OCH<sub>3</sub>), 3.79 (6H, s, 2 × OCH<sub>3</sub>), 3.78 (6H, s, 2 × OCH<sub>3</sub>), 2.19–1.97 (4H+4H, m, 2 × 2 × *CH* and *CHH*), 1.94–1.76 (2H+2H, m, 2 × 2 × *CHH*), 1.75–1.57 (2H+2H, m, 2 × 2 × *CHH*), 1.54–1.32 (2H+2H, m, 2 × 2 × *CHH*), 1.26 (3H, d, *J*=6.9 Hz, *CHCH*<sub>3</sub>), 1.11 (3H, d, *J*=6.9 Hz, *CHCH*<sub>3</sub>), 0.92 (3H+3H, d, *J*=7.0 Hz, 2 × *CHCH*<sub>3</sub>);  $\delta_{\text{C}}$  (75 MHz, CDCl<sub>3</sub>) 153.4 (2 × C), 152.6+151.8 (C), 138.5+137.9 (C), 135.3 (C), 135.1 (C), 127.2+127.2 (CH), 122.7+122.5 (CH), 117.3+117.0 (CH), 107.5 (CH), 105.7 (CH), 103.8+103.7 (CH), 91.4+87.4 (C), 67.5+64.3 (C), 61.1 (CH<sub>3</sub>), 56.3+56.2 (2 × CH<sub>3</sub>), 52.8+50.8 (CH<sub>2</sub>), 44.0+43.6 (2 × CH), 41.5+41.1+40.1 (2 × CH<sub>2</sub>), 35.0+34.3+33.8 (2 × CH<sub>2</sub>), 16.4+15.2+15.1 (2 × CH<sub>3</sub>); **LRMS (ES<sup>+</sup>)** 408 ([*M*+*H*]<sup>+</sup>, 50%), 228 [*M*-CH<sub>2</sub>*Ar*+*H*]<sup>+</sup> (100%); **HRMS** C<sub>26</sub>H<sub>33</sub>NNaO<sub>3</sub> [*M*+*Na*]<sup>+</sup> requires 430.2353; found: 430.2349.

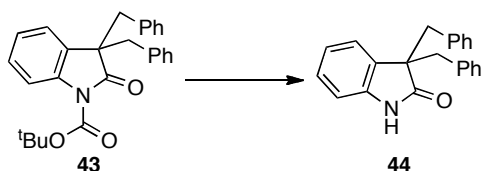
### Preparation and Radical Reaction of Indoline 6

#### *tert*-Butyl-3,3-dibenzyl-2-oxo-2,3-dihydroindole-1-carboxylate (43)



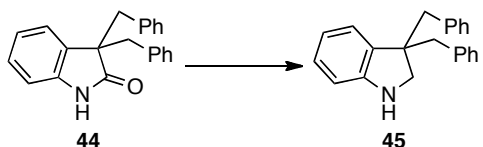
To a solution of Boc-oxindole **28**<sup>[2]</sup> (1.48 g, 6.35 mmol) in DMF (100 mL) at 0 °C was added sodium hydride (60% in mineral oil, 640 mg, 15.9 mmol) followed after 2 h by benzyl bromide (2.27 mL, 19.05 mmol). The reaction mixture warmed to RT and after 16 h water (100 mL) and diethyl ether (100 mL) were added. The aqueous phase was extracted with diethyl ether (100 mL) and the combined organic phases were washed with water (3 × 200 mL) and brine (200 mL), dried (MgSO<sub>4</sub>) and concentrated *in vacuo*. Purification by column chromatography (5–10% diethyl ether in petroleum ether) afforded the *title compound* as a yellow oil (1.50 g, 3.62 mmol, 57%)  $\nu_{\max}$  3085(w), 3064 (w), 3032 (w), 2987 (w), 2913 (w), 1785 (m), 1762 (s), 1728 (s);  $\delta_{\text{H}}$  (400 MHz, CDCl<sub>3</sub>) 7.39 (1H, m, *ArH*), 7.20 (1H, m, *ArH*), 7.16–7.10 (3H, m, 3 × *ArH*), 7.10–7.03 (5H, m, 5 × *ArH*), 6.93–6.86 (4H, m, 4 × *ArH*), 3.38 (2H, d, *J*=13.1 Hz, 2 × *CHHAr*), 3.18 (2H, d, *J*=13.1 Hz, 2 × *CHHAr*), 1.51 (9H, s, C(CH<sub>3</sub>)<sub>3</sub>);  $\delta_{\text{C}}$  (100 MHz, CDCl<sub>3</sub>) 177.5 (C=O), 148.5 (C=O), 139.8 (C), 135.4 (2 × C), 130.0 (4 × CH), 129.0 (C), 128.0 (CH), 127.7 (4 × CH), 126.6 (2 × CH), 124.1 (CH), 123.5 (CH), 114.6 (CH), 83.6 (C), 56.4 (C), 44.3 (2 × CH<sub>2</sub>), 28.0 (3 × CH<sub>3</sub>); **LRMS (ES<sup>+</sup>)** 849 ([2*M*+*Na*]<sup>+</sup>, 100%), 436 ([*M*+*Na*]<sup>+</sup>, 50%); **HRMS** C<sub>27</sub>H<sub>27</sub>NNaO<sub>3</sub> [*M*+*Na*]<sup>+</sup> requires 436.1883; found: 436.1877.

### 3,3-Dibenzyl-1,3-dihydroindol-2-one (**44**)<sup>[4]</sup>



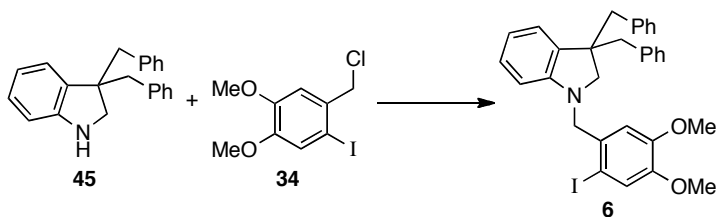
To a solution of *N*-Boc oxindole **43** (1.50 g, 3.62 mmol) in dichloromethane (200 mL) at 0 °C was added TFA (10 mL). After 4 h at RT the reaction mixture was concentrated *in vacuo* to afford the title compound as a white solid (1.02 g, 3.26 mmol, 90%)  $\nu_{\max}$  3142 (w), 3077 (w), 2023 (w), 2938 (w), 2913 (w), 2880 (w), 2856 (w), 2823 (w), 1713 (s), 1667 (m);  $\delta_{\text{H}}$  (300 MHz,  $\text{CDCl}_3$ ) 8.62 (1H, br. s, NH), 7.28 (1H, m, ArH), 7.19–7.02 (8H, m, 8  $\times$  ArH), 6.98–6.87 (4H, m, 4  $\times$  ArH), 6.56 (1H, m, ArH), 3.37 (2H, d,  $J=13.2$  Hz, 2  $\times$  CHHPh), 3.27 (2H, d,  $J=13.2$  Hz, 2  $\times$  CHHPh);  $\delta_{\text{C}}$  (75 MHz,  $\text{CDCl}_3$ ) 183.4 (C=O), 139.8 (C), 135.1 (2  $\times$  C), 130.7 (C), 129.9 (4  $\times$  CH), 128.2 (CH), 127.8 (4  $\times$  CH), 126.8 (2  $\times$  CH), 124.6 (CH), 122.8 (CH), 110.4 (CH), 57.6 (C), 43.3 (2  $\times$  CH<sub>2</sub>); LRMS (CI) 313 ( $[\text{M}]^+$ , 100%), 222 ( $[\text{M}-\text{CH}_2\text{Ph}]^+$ , 100%), 204 (35%), 91 (75%).

### 3,3-Dibenzyl-2,3-dihydro-1*H*-indole (**45**)



A solution of  $\text{LiAlH}_4$  (1.0 M solution in THF, 9.78 mL, 9.78 mmol) was diluted with THF (100 mL) and cooled to 0 °C. A solution of oxindole **44** (1.02 g, 3.26 mmol) in THF (20 mL) was added dropwise over 20 min and the reaction mixture was then heated to 70 °C for 16 h, then cooled to 0 °C. Water (200 mL) was added and the reaction mixture extracted with diethyl ether (3  $\times$  70 mL). The combined organic phases were washed with brine (200 mL), dried ( $\text{MgSO}_4$ ) and concentrated *in vacuo*. Purification by column chromatography (20% diethyl ether in petroleum ether) afforded the *title compound* as a brown oil (570 mg, 1.91 mmol, 60%)  $\nu_{\max}$  3386 (m), 3081(w), 3052 (w), 3019 (w), 2917 (w), 2852 (w), 1605 (m), 1487 (s), 1462 (m), 1453 (m);  $\delta_{\text{H}}$  (300 MHz,  $\text{CDCl}_3$ ) 7.24–7.17 (6H, m, 6  $\times$  ArH), 7.09–6.94 (6H, m, 6  $\times$  ArH), 6.77 (1H, app. td,  $J=7.3$ , 0.9 Hz, ArH), 6.53 (1H, d,  $J=7.8$  Hz, ArH), 3.43 (2H, s,  $\text{NHCH}_2$ ), 3.10 (2H, d,  $J=13.4$  Hz, 2  $\times$  CHHAr), 3.00 (2H, d,  $J=13.5$  Hz, 2  $\times$  CHHAr);  $\delta_{\text{C}}$  (75 MHz,  $\text{CDCl}_3$ ) 151.7 (C), 138.6 (2  $\times$  C), 134.6 (C), 131.0 (4  $\times$  CH), 128.1 (4  $\times$  CH), 126.5 (3  $\times$  CH), 124.6 (CH), 118.7 (CH), 110.5 (CH), 55.6 (CH<sub>2</sub>), 51.5 (C), 45.1 (2  $\times$  CH<sub>2</sub>); LRMS ( $\text{ES}^+$ ) 300 ( $[\text{M}+\text{H}]^+$ , 100%); HRMS  $\text{C}_{22}\text{H}_{22}\text{N}$   $[\text{M}+\text{H}]^+$  requires 300.1747; found: 300.1742.

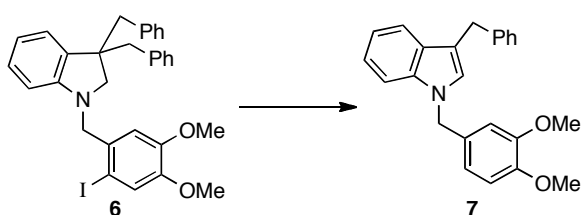
### 3,3-Dibenzyl-1-(2-iodo-4,5-dimethoxybenzyl)-2,3-dihydro-1*H*-indole (**6**)



A solution of indoline **45** (250 mg, 0.84 mmol), benzyl chloride **34**<sup>[3]</sup> (390 mg, 1.25 mmol),  $\text{K}_2\text{CO}_3$  (700 mg, 5.04 mmol) and KI (210 mg, 1.25 mmol) in acetone (60 mL) was heated at reflux for 16 h then cooled to RT and concentrated *in vacuo*. The residue was partitioned between water (50 mL) and diethyl ether (50 mL). The aqueous phase was extracted with diethyl ether (2  $\times$  50 mL), then the combined organic phases were washed

with brine (200 mL), dried ( $\text{MgSO}_4$ ) and concentrated *in vacuo*. Purification by column chromatography (5% diethyl ether in petroleum ether) afforded the *title compound* as a brown oil (370 mg, 0.64 mmol, 76%)  $\nu_{\text{max}}$  3064 (w), 3023 (w), 2999 (w), 2909 (w), 2848 (w), 1711 (s), 1601 (m), 1496 (s);  $\delta_{\text{H}}$  (400 MHz,  $\text{CDCl}_3$ ) 7.24 (1H, s, ArH), 7.23–7.16 (6H, m, 6  $\times$  ArH), 7.08 (1H, app. td,  $J=7.6, 1.2$  Hz, ArH), 7.00–6.95 (4H, m, 4  $\times$  ArH), 6.91 (1H, dd,  $J=7.3, 0.9$  Hz, ArH), 6.71 (1H, app. t,  $J=7.4$  Hz, ArH), 6.69 (1H, s, ArH), 6.37 (1H, d,  $J=7.8$  Hz, ArH), 3.98 (2H, s,  $\text{NCH}_2\text{Ar}$ ), 3.87 (3H, s,  $\text{OCH}_3$ ), 3.65 (3H, s,  $\text{OCH}_3$ ), 3.27 (2H, s,  $\text{NCH}_2$ ), 3.09 (2H, d,  $J=13.5$  Hz, 2  $\times$  CHHAr), 2.98 (2H, d,  $J=13.5$  Hz, 2  $\times$  CHHAr);  $\delta_{\text{C}}$  (100 MHz,  $\text{CDCl}_3$ ) 151.6 (C), 149.5 (C), 148.6 (C), 138.0 (2  $\times$  C), 134.3 (C), 132.6 (C), 130.7 (4  $\times$  CH), 127.9 (CH), 127.8 (4  $\times$  CH), 126.2 (2  $\times$  CH), 124.2 (CH), 121.7 (CH), 117.3 (CH), 112.1 (CH), 107.3 (CH), 86.4 (C), 61.8 ( $\text{CH}_2$ ), 57.8 ( $\text{CH}_2$ ), 56.2 ( $\text{CH}_3$ ), 56.0 ( $\text{CH}_3$ ), 49.9 (C), 44.3 (2  $\times$   $\text{CH}_2$ ); LRMS ( $\text{ES}^+$ ) 598 ( $[\text{M}+\text{Na}]^+$ , 30%), 576 ( $[\text{M}+\text{H}]^+$ , 100%); HRMS  $\text{C}_{31}\text{H}_{31}\text{INO}_2$   $[\text{M}+\text{H}]^+$  requires 576.1394; found: 576.1389.

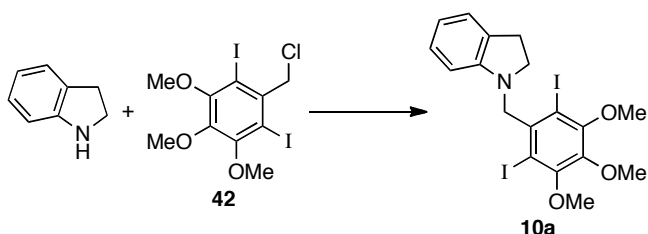
### 3-Benzyl-1-(3,4-dimethoxybenzyl)-1H-indole (7)



A solution of **6** (350 mg, 0.61 mmol), tributyltin hydride (0.36 mL, 1.34 mmol) and VAZO (0.12 mmol, 30 mg) in toluene (25 mL) was heated at reflux for 16 h, then cooled and concentrated *in vacuo*. Purification by column chromatography (10% w/w anhydrous  $\text{K}_2\text{CO}_3$ -silica; 5% diethyl ether in petroleum ether) afforded the *title compound* as a brown oil (210 mg, 0.58 mmol, 95%)  $\nu_{\text{max}}$  3052 (w), 3027 (w), 2999 (w), 2933 (w), 2901 (w), 2823 (w), 1514 (s), 1463 (m), 1452 (m);  $\delta_{\text{H}}$  (400 MHz,  $\text{CDCl}_3$ ) 7.60 (1H, dd,  $J=7.8, 0.9$  Hz, ArH), 7.38–7.31 (4H, m, 4  $\times$  ArH), 7.26–7.21 (3H, m, 3  $\times$  ArH), 7.14 (1H, ddd,  $J=7.8, 6.9, 1.0$  Hz, ArH), 6.93 (1H, s, ArH), 6.86 (1H, d,  $J=8.1$  Hz, ArH), 6.75 (1H, dd,  $J=8.1, 1.9$  Hz, ArH), 6.71 (1H, d,  $J=1.9$  Hz, ArH), 5.27 (2H, s,  $\text{CH}_2\text{Ar}$ ), 4.20 (2H, s,  $\text{NCH}_2\text{Ar}$ ), 3.92 (3H, s,  $\text{OCH}_3$ ), 3.83 (3H, s,  $\text{OCH}_3$ );  $\delta_{\text{C}}$  (100 MHz,  $\text{CDCl}_3$ ) 149.3 (C), 148.5 (C), 141.4 (C), 136.9 (C), 130.2 (2  $\times$  C), 128.6 (2  $\times$  CH), 128.3 (2  $\times$  CH), 126.4 (CH), 125.8 (CH), 121.7 (CH), 119.3 (CH), 119.2 (CH), 119.0 (CH), 114.8 (C), 111.3 (CH), 110.1 (CH), 109.6 (CH), 55.9 ( $\text{CH}_3$ ), 55.8 ( $\text{CH}_3$ ), 49.7 ( $\text{CH}_2$ ), 31.5 ( $\text{CH}_2$ ); LRMS ( $\text{ES}^+$ ) 258 ( $[\text{M}+\text{H}]^+$ , 100%); HRMS  $\text{C}_{24}\text{H}_{24}\text{NO}_2$   $[\text{M}+\text{H}]^+$  requires 358.1802; found: 358.1804.

### Preparation and Radical Reaction of Indoline 10a

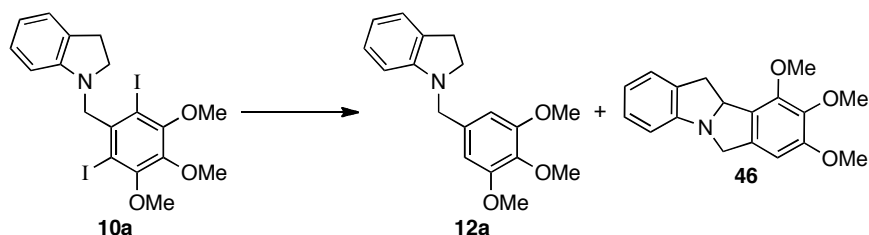
#### 1-(2,6-Diiodo-3,4,5-trimethoxy-benzyl)indoline (10a)



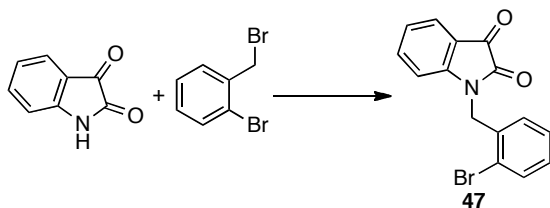
A solution of indoline (46 mg, 0.39 mmol), benzyl chloride **42** (272 mg, 0.58 mmol),  $\text{K}_2\text{CO}_3$  (323 mg, 2.34 mmol) and KI (96 mg, 0.58 mmol) in acetone (40 mL) was heated at reflux for 16 h. The reaction mixture was cooled to RT and partitioned between water (60 mL) and diethyl ether (60 mL). The aqueous phase was extracted with diethyl ether (2  $\times$  40 mL) then the combined organic phases were washed with brine (100 mL), dried ( $\text{MgSO}_4$ ) and concentrated *in vacuo*. Purification by column chromatography (10% diethyl ether in petroleum ether)

afforded the *title compound* as a brown oil (196 mg, 0.25 mmol, 41%)  $\nu_{\max}$  2932 (w), 2848 (w), 2362 (w), 1606 (m), 1487 (m), 1458 (s), 1402 (s), 1371 (s), 1355 (w), 1309 (m), 1279 (w), 1251 (w), 1213 (w), 1161 (w);  $\delta_{\text{H}}$  (400 MHz,  $\text{CDCl}_3$ ) 7.18–7.09 (2H, m, 2  $\times$  ArH), 6.76 (1H, d,  $J=7.7$  Hz, ArH), 6.70 (1H, app. td,  $J=7.4, 0.9$  Hz, ArH), 4.69 (2H, s,  $\text{NCH}_2\text{Ar}$ ), 3.94 (3H, s,  $\text{CH}_3$ ), 3.91 (6H, s, 2  $\times$   $\text{CH}_3$ ), 3.27 (2H, t,  $J=8.2$  Hz,  $\text{CH}_2\text{CH}_2$ ), 2.90 (2H, t,  $J=8.2$  Hz,  $\text{CH}_2\text{CH}_2$ );  $\delta_{\text{C}}$  (100 MHz,  $\text{CDCl}_3$ ) 153.8 (2  $\times$  C), 151.6 (C), 144.3 (C), 136.5 (C), 130.1 (C), 127.1 (CH), 124.4 (CH), 117.7 (CH), 107.4 (CH), 94.1 (2  $\times$  C), 62.2 ( $\text{CH}_2$ ), 61.0 ( $\text{CH}_3$ ), 60.8 (2  $\times$   $\text{CH}_3$ ), 52.4 ( $\text{CH}_2$ ), 28.5 ( $\text{CH}_2$ ).

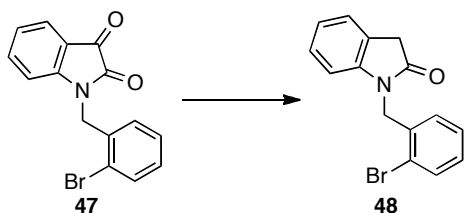
**1-(3,4,5-Trimethoxybenzyl)indoline (12a) and 8,9,10-trimethoxy-10b,11-dihydro-6H-isoindolo[2,1-a]indole (46)**<sup>[5]</sup>



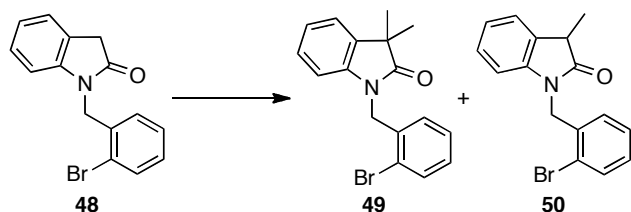
A solution of **10a** (106 mg, 0.19 mmol), tributyltin hydride (0.23 mL, 0.84 mmol) and VAZO (9 mg, 0.04 mmol) in toluene (6 mL) was heated at reflux for 18 h, then cooled and concentrated *in vacuo*. Purification by column chromatography (10% w/w anhydrous  $\text{K}_2\text{CO}_3$ -silica; 20% diethyl ether in petroleum ether) afforded firstly **12a**, as a colourless oil (54 mg, 0.18 mmol, 95%)  $\nu_{\max}$  2923 (w), 2837 (w), 1590 (m), 1504 (m), 1487 (m), 1456 (m), 1419 (m), 1377 (w), 1357 (w), 1327 (m), 1270 (w), 1228 (m), 1181 (w), 1122 (s), 1008 (m);  $\delta_{\text{H}}$  (300 MHz,  $\text{CDCl}_3$ ) 7.16–7.03 (2H, m, 2  $\times$  ArH), 6.71 (1H, app. td,  $J=7.4, 0.9$  Hz, ArH), 6.63 (2H, s, ArH), 6.55 (1H, d,  $J=7.6$  Hz, ArH), 4.19 (2H, s,  $\text{NCH}_2\text{Ar}$ ), 3.88–3.87 (3H, s,  $\text{OCH}_3$ ), 3.86 (6H, s, 2  $\times$   $\text{OCH}_3$ ), 3.33 (2H, t,  $J=8.3$  Hz,  $\text{NCH}_2\text{CH}_2$ ), 3.01 (2H, t,  $J=8.3$  Hz,  $\text{NCH}_2\text{CH}_2$ );  $\delta_{\text{C}}$  (75 MHz,  $\text{CDCl}_3$ ) 153.3 (2  $\times$  C), 152.5 (C), 136.9 (C), 134.3 (C), 130.0 (C), 127.3 (CH), 124.5 (CH), 117.9 (CH), 107.2 (CH), 104.5 (2  $\times$  CH), 60.8 ( $\text{CH}_3$ ), 56.1 (2  $\times$   $\text{CH}_3$ ), 54.3 ( $\text{CH}_2$ ), 53.8 ( $\text{CH}_2$ ), 28.5 ( $\text{CH}_2$ ); **LRMS (ES<sup>+</sup>)** 299 ( $[\text{M}]^+$ , 13%); **HRMS**  $\text{C}_{18}\text{H}_{21}\text{NNaO}_3$   $[\text{M}+\text{Na}]^+$  requires 322.1414; found: 322.1414, and then finally **46** as a pale yellow oil (3 mg, 0.01 mmol, 5%)  $\nu_{\max}$  2927 (w), 1589 (w), 1463 (w), 1412 (w), 1332 (w), 1259 (w), 1238 (w), 1190 (w), 1106 (w), 1079 (w), 1047 (w), 1022 (w), 1004 (w), 963 (w), 926 (w), 836 (w), 760 (w), 742 (w);  $\delta_{\text{H}}$  (300 MHz,  $\text{CDCl}_3$ ) 7.13 (1H, app. t,  $J=8.0$  Hz, ArH), 7.11 (1H, d,  $J=8.0$  Hz, ArH), 6.81 (1H, app. t,  $J=7.3$  Hz, ArH), 6.80 (1H, d,  $J=7.3$  Hz, ArH), 6.52 (1H, s, ArH), 5.33 (1H, br. d,  $J=9.4$  Hz, NCH), 4.58 (1H, dd,  $J=14.5, 1.2$  Hz, NCHHAr), 4.44 (1H, d,  $J=14.5$  Hz, NCHHAr), 4.00 (3H, s,  $\text{ArOCH}_3$ ), 3.85 (3H, s,  $\text{ArOCH}_3$ ), 3.83 (3H, s,  $\text{ArOCH}_3$ ), 3.58 (1H, dd,  $J=16.2, 3.8$  Hz, ArCHH), 3.48 (1H, dd,  $J=16.2, 9.4$  Hz, ArCHH);  $\delta_{\text{C}}$  (75 MHz,  $\text{CDCl}_3$ ) 154.5 (C), 154.3 (C), 149.5 (C), 141.0 (C), 135.4 (C), 130.6 (C), 127.7 (CH), 127.6 (C), 124.9 (CH), 120.7 (CH), 112.1 (CH), 101.4 (CH), 69.0 (CH), 61.2 ( $\text{CH}_3$ ), 60.7 ( $\text{CH}_3$ ), 59.9 ( $\text{CH}_2$ ), 56.4 ( $\text{CH}_3$ ), 34.6 ( $\text{CH}_2$ ); **LRMS (CI)** 298 ( $[\text{M}+\text{H}]^+$ , 100%); **HRMS**  $\text{C}_{18}\text{H}_{20}\text{NO}_3$   $[\text{M}+\text{H}]^+$  requires 298.1438; found: 298.1434.

**1-(2-Bromobenzyl)-1H-indole-2,3-dione (47)**

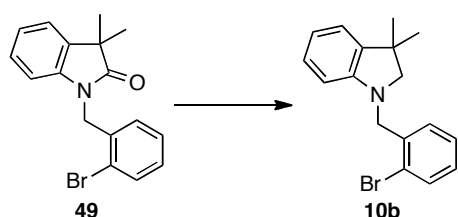
To a solution of isatin (2.00 g, 13.6 mmol) in MeCN (100 mL) was added  $K_2CO_3$  (3.76 g, 27.2 mmol) and KI (230 mg, 1.36 mmol). After 45 min, 2-bromobenzyl bromide (3.40 g, 13.6 mmol) in MeCN (30 mL) was added dropwise over 30 min. After 17 h ethyl acetate (100 mL) and water (100 mL) were added and the phases separated. The aqueous phase was extracted with ethyl acetate (3 × 100 mL) then the combined organic phases were washed with brine (100 mL), dried ( $MgSO_4$ ) and the solvent removed *in vacuo* to afford the *title compound* as an orange solid (4.19 g, 13.3 mmol, 98%) **MP** 180–182 °C (EtOH);  $\nu_{max}$  3334 (w), 3097 (w), 1735 (s), 1643 (m), 1610 (s), 1530 (m);  $\delta_H$  (300 MHz,  $CDCl_3$ ) 7.67–7.50 (2H, m, 2 × ArH), 7.43 (1H, app. td,  $J=7.8$ , 1.3 Hz, ArH), 7.26–6.95 (4H, m, 4 × ArH), 6.67 (1H, d,  $J=7.7$  Hz, ArH), 4.98 (2H, s,  $NCH_2Ar$ );  $\delta_C$  (75 MHz,  $CDCl_3$ ) 182.9 (C=O), 158.5 (C=O), 150.5 (C), 138.5 (CH), 133.3 (CH), 129.6 (CH), 128.1 (CH), 128.0 (CH), 125.5 (CH), 124.1 (CH), 122.8 (C), 117.7 (C), 111.2 (CH), 44.0 ( $CH_2$ ), *one quaternary signal was not discretely observed*; **LRMS (ES<sup>+</sup>)** 338 ( $[M+Na]^+$ , 100%); **HRMS**  $C_{15}H_{10}BrNNaO_2$   $[M+Na]^+$  requires 337.9793; found: 337.9787.

**1-(2-Bromobenzyl)-1,3-dihydroindol-2-one (48)**

A suspension of **47** (3.28 g, 10.4 mmol) in hydrazine monohydrate (20 mL) was heated at reflux for 2 h, then cooled to RT and poured into ice water (100 mL). Following extraction with ethyl acetate (4 × 100 mL), the combined organic phases were washed with brine (100 mL), dried ( $MgSO_4$ ) and the solvent removed *in vacuo* to afford the *title compound* as an orange solid (2.83 g, 9.37 mmol, 90%) **MP** 102–104 °C (EtOH);  $\nu_{max}$  3057 (w), 1710 (s), 1615 (m), 1489 (m), 1466 (m), 1440 (w);  $\delta_H$  (300 MHz,  $CDCl_3$ ) 7.52 (1H, dd,  $J=7.7$ , 1.1 Hz, ArH), 7.22 (1H, d,  $J=7.6$  Hz, ArH), 7.17–7.02 (3H, m, 3 × ArH), 7.01–6.92 (2H, m, 2 × ArH), 6.59 (1H, d,  $J=7.8$  Hz, ArH), 4.95 (2H, s,  $CH_2$ ), 3.61 (2H, s,  $CH_2$ );  $\delta_C$  (75 MHz,  $CDCl_3$ ) 175.3 (C=O), 144.0 (C), 134.5 (C), 132.9 (CH), 129.0 (CH), 128.0 (CH), 127.8 (CH), 127.7 (CH), 124.5 (CH), 124.3 (C), 122.8 (C), 122.7 (CH), 109.2 (CH), 43.8 ( $CH_2$ ), 35.8 ( $CH_2$ ); **LRMS (ES<sup>+</sup>)** 324 ( $[M+Na]^+$ , 100%); **HRMS**  $C_{15}H_{12}BrNNaO$   $[M+Na]^+$  requires 323.9999; found: 323.9994.

**1-(2-Bromobenzyl)-3,3-dimethylindolin-2-one (49) and 1-(2-bromobenzyl)-3-methylindolin-2-one (50)**

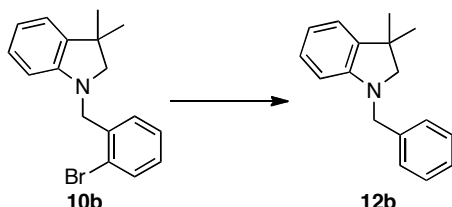
To a solution of **48** (287 mg, 0.95 mmol) in DMF (12 mL) was added NaH (60% in mineral oil, 95 mg, 2.38 mmol). After 2 h, methyl iodide (0.15 mL, 2.38 mmol) in DMF (2 mL) was added dropwise over 10 min. After 16 h water (20 mL) and ethyl acetate (20 mL) were added. The aqueous phase was separated and extracted with ethyl acetate (2 × 20 mL) then the combined organic phases were washed with water (60 mL) and brine (60 mL), dried (MgSO<sub>4</sub>) and concentrated *in vacuo*. Purification by column chromatography (10–30% diethyl ether in petroleum ether) afforded firstly **49** as an orange oil (126 mg, 0.38 mmol, 40%)  $\nu_{\max}$  3057 (w), 2967 (w), 2926 (w), 2866 (w), 1708 (s), 1612 (s), 1569 (w), 1488 (m), 1468 (m), 1458 (m), 1439 (m), 1383 (m), 1348 (s), 1308 (w), 1274 (w), 1192 (m), 1173 (m), 1120 (m);  $\delta_{\text{H}}$  (300 MHz, CDCl<sub>3</sub>) 7.51 (1H, dd,  $J=7.7, 1.2$  Hz, *ArH*), 7.19–7.00 (4H, m, 4 × *ArH*), 6.97 (1H, app. td,  $J=7.4, 0.8$  Hz, *ArH*), 6.90 (1H, dd,  $J=7.4, 1.2$  Hz, *ArH*), 6.58 (1H, d,  $J=7.7$  Hz, *ArH*), 4.93 (2H, s, NCH<sub>2</sub>Ar), 1.39 (6H, s, 2 × CH<sub>3</sub>);  $\delta_{\text{C}}$  (75 MHz, CDCl<sub>3</sub>) 181.5 (C=O), 141.4 (C), 135.6 (C), 134.7 (C), 132.9 (CH), 128.9 (CH), 127.7 (CH), 127.7 (CH), 127.5 (CH), 122.8 (C), 122.7 (CH), 122.4 (CH), 109.1 (CH), 44.3 (C), 43.5 (CH<sub>2</sub>), 24.6 (2 × CH<sub>3</sub>); **LRMS (ES<sup>+</sup>)** 393 ([M+Na+MeCN]<sup>+</sup>, 36%); **HRMS** C<sub>17</sub>H<sub>16</sub>BrNNaO [M+Na]<sup>+</sup> requires 352.0307; found: 352.0313, then **50** as an orange oil (31 mg, 0.10 mmol, 11%)  $\nu_{\max}$  3025 (br. m), 3093 (w), 2961 (m), 2931 (w), 2874 (w), 2359 (w), 1698 (s), 1619 (s), 1598 (w), 1486 (m), 1470 (s), 1387 (w), 1369 (w), 1345 (m), 1318 (w), 1297 (w), 1265 (w), 1222 (m), 1202 (w), 1117 (w), 1097 (w), 1078 (w), 1019 (w);  $\delta_{\text{H}}$  (300 MHz, CDCl<sub>3</sub>) 7.60 (1H, dd,  $J=7.7, 1.4$  Hz, *ArH*), 7.29 (1H, d,  $J=7.4$  Hz, *ArH*), 7.24–7.00 (5H, m, 5 × *ArH*), 6.67 (1H, d,  $J=7.7$  Hz, *ArH*), 5.02 (2H, s, NCH<sub>2</sub>Ar), 3.60 (1H, q,  $J=7.6$  Hz, CHCH<sub>3</sub>), 1.58 (3H, d,  $J=7.6$  Hz, CH<sub>3</sub>);  $\delta_{\text{C}}$  (75 MHz, CDCl<sub>3</sub>) 178.8 (C=O), 142.7 (C), 134.5 (C), 132.9 (CH), 130.5 (C), 129.0 (CH), 127.9 (CH), 127.8 (CH), 127.6 (CH), 123.6 (CH), 122.8 (C), 122.7 (CH), 109.0 (CH), 43.7 (CH<sub>2</sub>), 40.6 (CH), 15.7 (CH<sub>3</sub>); **LRMS (ES<sup>+</sup>)** 379 ([M+Na+MeCN]<sup>+</sup>, 10%); **HRMS** C<sub>16</sub>H<sub>15</sub>BrNO [M+H]<sup>+</sup> requires 316.0332; found: 316.0335.

**1-(2-Bromobenzyl)-3,3-dimethylindoline (10b)**

To a solution of **49** (126 mg, 0.38 mmol) in toluene (5 mL) at –78 °C was added AlH<sub>3</sub> (0.5 M in toluene, 1.52 mL, 0.76 mmol) dropwise over 10 min. After 20 min the reaction mixture was warmed to RT for 3 h and then cooled to 0 °C. Methanol (2 mL) then 1 M HCl (2 mL) were added cautiously followed after 10 min by saturated NaHCO<sub>3</sub> (to pH ~10). The aqueous phase was separated and extracted with ethyl acetate (3 × 20 mL). The combined organic phases were then washed with brine (60 mL), dried (MgSO<sub>4</sub>) and concentrated *in vacuo*. Purification by column chromatography (5% chloroform in petroleum ether) afforded the *title compound* as a yellow oil (87 mg, 0.28 mmol, 74%)  $\nu_{\max}$  3048 (w), 2955 (w), 2917 (w), 2860 (w), 2820 (w), 1605 (m), 1567 (w), 1486 (s), 1456 (m), 1439 (m), 1361 (w), 1345 (w), 1302 (w), 1263 (br. m), 1196 (w), 1157 (w), 1116 (w);  $\delta_{\text{H}}$  (400 MHz, CDCl<sub>3</sub>) 7.64 (1H, dd,  $J=7.8, 1.3$  Hz, *ArH*), 7.49 (1H, dd,  $J=7.6, 1.5$  Hz, *ArH*), 7.34 (1H, app. td,

$J=7.5, 1.3$  Hz, *ArH*), 7.20 (1H, app. td,  $J=7.8, 1.5$  Hz, *ArH*), 7.15–7.09 (2H, m, 2 × *ArH*), 6.79 (1H, app. td,  $J=7.6, 1.0$  Hz, *ArH*), 6.49 (1H, d,  $J=7.6$  Hz, *ArH*), 4.38 (2H, s,  $NCH_2Ar$ ), 3.26 (2H, s,  $NCH_2$ ), 1.40 (6H, s, 2 ×  $CH_3$ );  **$\delta_c$  (100 MHz,  $CDCl_3$ )** 150.7 (C), 138.7 (C), 137.5 (C), 132.7 (CH), 129.2 (CH), 128.5 (CH), 127.4 (2 × CH), 123.4 (C), 121.7 (CH), 117.8 (CH), 106.8 (CH), 68.2 ( $CH_2$ ), 53.4 ( $CH_2$ ), 40.4 (C), 27.6 (2 ×  $CH_3$ ); **LRMS ( $ES^+$ )** 316 ( $[M+H]^+$ , 100%).

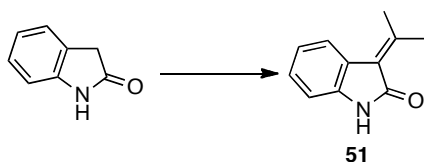
### 1-Benzyl-3,3-dimethylindoline (12b)



A solution of **10b** (87 mg, 0.28 mmol), tributyltin hydride (0.17 mL, 0.62 mmol) and VAZO (15 mg, 0.06 mmol) in toluene (9 mL) was heated at reflux for 18 h, then cooled and concentrated *in vacuo*. Purification by column chromatography (10% w/w anhydrous  $K_2CO_3$ -silica; 5% chloroform in petroleum ether) afforded the *title compound* as a colourless oil (66 mg, 0.28 mmol, 100%)  **$\nu_{max}$**  3025 (w), 2956 (w), 2922 (w), 2860 (w), 2803 (w), 1605 (m), 1486 (m), 1453 (m), 1361 (m), 1297 (w), 1260 (m), 1194 (m), 1157 (m), 1117 (w);  **$\delta_H$  (300 MHz,  $CDCl_3$ )** 7.33–7.10 (5H, m, 5 × *ArH*), 7.03–6.91 (2H, m, 2 × *ArH*), 6.62 (1H, app. td,  $J=7.3, 0.9$  Hz, *ArH*), 6.41 (1H, d,  $J=7.8$  Hz, *ArH*), 4.18 (2H, s,  $NCH_2Ph$ ), 3.00 (2H, s,  $NCH_2$ ), 1.22 (6H, s, 2 ×  $CH_3$ );  **$\delta_c$  (75 MHz,  $CDCl_3$ )** 151.1 (C), 138.9 (C), 138.6 (C), 128.4 (2 × CH), 127.7 (2 × CH), 127.4 (CH), 127.0 (CH), 121.7 (CH), 117.7 (CH), 106.9 (CH), 67.8 ( $CH_2$ ), 53.0 ( $CH_2$ ), 40.2 (C), 27.54 (2 ×  $CH_3$ ); **LRMS ( $ES^+$ )** 238 ( $[M+H]^+$ , 28%); **HRMS**  $C_{17}H_{20}N$   $[M+H]^+$  requires 238.1590; found: 238.1590.

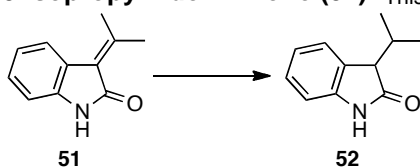
### Preparation and Radical Reaction of Indoline 10c

#### 3-(Propan-2-ylidene)indolin-2-one (51)<sup>[6]</sup>



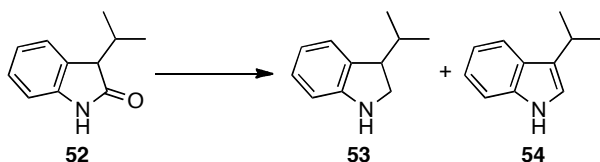
A solution of oxindole (1.00 g, 7.51 mmol), piperidine (1.49 mL, 15.02 mmol) and acetone (0.61 mL, 8.26 mmol) in ethanol (8 mL) was heated at reflux for 2.5 h, then cooled to room temperature. The resulting precipitate was collected by filtration, washed with cold ethanol (2 × 10 mL) and dried *in vacuo* to afford the title compound as a yellow solid (870 mg, 5.03 mmol, 67%) **MP** 191–193 °C (EtOH), Lit.<sup>[14]</sup> 189–191 °C (EtOH);  **$\nu_{max}$**  3139 (w), 3100 (w), 3076 (w), 3024 (w), 2893 (w), 2837 (w), 2699 (w), 2360 (w), 2341 (w), 1691 (s), 1627 (w), 1614 (m), 1587 (w), 1556 (w), 1489 (w), 1466 (m);  **$\delta_H$  (300 MHz,  $CDCl_3$ )** 8.62 (1H, br. s, *NH*), 7.52 (1H, d,  $J=7.7$  Hz, *ArH*), 7.19 (1H, app. t,  $J=7.7$  Hz, *ArH*), 7.02 (1H, app. td,  $J=7.7, 1.1$  Hz, *ArH*), 6.89 (1H, d,  $J=7.7$  Hz, *ArH*), 2.63 (3H, s,  $CH_3$ ), 2.39 (3H, s,  $CH_3$ );  **$\delta_c$  (75 MHz,  $CDCl_3$ )** 169.7 (C=O), 155.5 (C), 139.4 (C), 127.5 (CH), 124.3 (C), 123.7 (CH), 123.0 (C), 121.5 (CH), 109.3 (CH), 25.2 ( $CH_3$ ), 23.1 ( $CH_3$ ); **LRMS (CI)** 173 ( $[M]^+$ , 100%), 158 ( $[M-CH_3]^+$ , 90%), 130 ( $[M-C(CH_3)_2]^+$ , 21%).

### 3-Isopropylindolin-2-one (**52**)



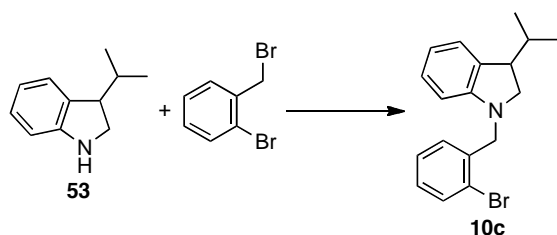
To **51** (400 mg, 2.31 mmol) and Pd/C (40 mg) was added MeOH:DCM (1:1, 25 mL). The mixture was degassed with argon then stirred vigorously under an atmosphere of H<sub>2</sub> for 4 h. The reaction mixture was purged of H<sub>2</sub> by flushing with argon, then filtered (Celite®) and washed with DCM (2 × 30 mL). The solvent was removed *in vacuo* to afford the title compound as a pale yellow solid (404 mg, 2.31 mmol, 100%) **MP** 141–143 °C (EtOH), Lit.<sup>[6]</sup> 108–109 °C (EtOAc/hexane);  $\nu_{\max}$  3057 (w), 2925 (w), 2851 (w), 1712 (s), 1613 (m), 1569 (w), 1488 (m), 1466 (m), 1440 (m), 1375 (m), 1349 (m), 1311 (w), 1265 (w), 1203 (m), 1169 (m), 1102 (w);  $\delta_{\text{H}}$  (300 MHz, CDCl<sub>3</sub>) 8.76 (1H, br. s, NH), 7.26 (1H, d, *J*=8.0 Hz, ArH), 7.22 (1H, t, *J*=7.7 Hz, ArH), 7.02 (1H, app. td, *J*=7.6, 0.9 Hz, ArH), 6.90 (1H, d, *J*=7.7 Hz, ArH), 3.41 (1H, d, *J*=3.5 Hz, CHC=O), 2.52 (1H, sept. d, *J*=7.0, 3.5 Hz, CH(CH<sub>3</sub>)<sub>2</sub>), 1.14 (3H, d, *J*=7.0 Hz, CH<sub>3</sub>), 0.93 (3H, d, *J*=7.0 Hz, CH<sub>3</sub>);  $\delta_{\text{C}}$  (75 MHz, CDCl<sub>3</sub>) 180.0 (C=O), 142.0 (C), 128.3 (C), 127.8 (CH), 124.6 (CH), 122.0 (CH), 109.5 (CH), 52.1 (CH), 30.7 (CH), 19.8 (CH<sub>3</sub>), 17.9 (CH<sub>3</sub>); **LRMS (EI)** 175 ([M]<sup>+</sup>, 23%), 133 ([M-C(CH<sub>3</sub>)<sub>2</sub>]<sup>+</sup>, 100%).

### 3-Isopropylindoline (**53**)<sup>[8]</sup> and 3-isopropyl-1H-indole (**54**)<sup>[9]</sup>



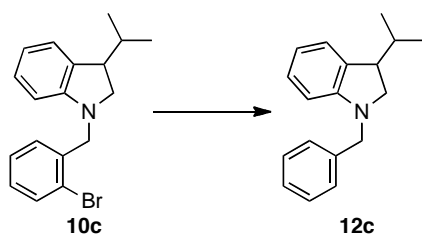
To a solution of **52** (250 mg, 1.43 mmol) in THF (15 mL) at 0 °C was added BH<sub>3</sub>·DMS (10 M, 0.54 mL, 5.42 mmol) dropwise over 5 min. The reaction mixture was allowed to warm to RT and after 16 h water (20 mL) was added cautiously and followed after 30 min by diethyl ether (20 mL). The aqueous phase was separated and extracted with diethyl ether (20 mL) then the combined organic phases were washed with water (50 mL) and brine (50 mL), dried (MgSO<sub>4</sub>) and concentrated *in vacuo*. Purification by column chromatography (5% diethyl ether in petroleum ether) afforded firstly **54** as a colourless oil (60 mg, 0.38 mmol, 27%)  $\nu_{\max}$  3412 (br. m), 3055 (w), 2957 (m), 2868 (w), 2360 (w), 1619 (w), 1485 (w), 1456 (m), 1418 (w), 1382 (w), 1362 (w), 1338 (w), 1242 (w), 1226 (w), 1150 (w), 1097 (w);  $\delta_{\text{H}}$  (300 MHz, CDCl<sub>3</sub>) 7.71 (1H, br. s, NH), 7.65 (1H, dd, *J*=7.8, 0.5 Hz, ArH), 7.28 (1H, d, *J*=7.8 Hz, ArH), 7.20–7.05 (2H, m, 2 × ArH), 6.87 (1H, d, *J*=2.2 Hz, ArH), 3.20 (1H, spt, *J*=6.8 Hz, CH(CH<sub>3</sub>)<sub>2</sub>), 1.34 (6H, d, *J*=6.8 Hz, 2 × CH<sub>3</sub>);  $\delta_{\text{C}}$  (75 MHz, CDCl<sub>3</sub>) 136.5 (C), 126.7 (C), 123.9 (C), 121.8 (CH), 119.3 (CH), 119.2 (CH), 118.9 (CH), 111.1 (CH), 25.4 (CH), 23.3 (2 × CH<sub>3</sub>); **LRMS (EI)** 159 ([M]<sup>+</sup>, 29%), 144 ([M-CH<sub>3</sub>]<sup>+</sup>, 100%) and then **53** as a colourless oil (76 mg, 0.47 mmol, 33%)  $\nu_{\max}$  3381 (w), 3031 (w), 2956 (m), 2926 (w), 2869 (m), 2360 (w), 1606 (m), 1487 (m), 1460 (m), 1385 (w), 1366 (w), 1313 (w), 1246 (m), 1151 (w), 1103 (w);  $\delta_{\text{H}}$  (300 MHz, CDCl<sub>3</sub>) 7.14 (1H, d, *J*=7.3 Hz, ArH), 7.06 (1H, app. t, *J*=7.6 Hz, ArH), 6.75 (1H, app. t, *J*=7.4 Hz, ArH), 6.66 (1H, d, *J*=7.7 Hz, ArH), 3.60 (1H, app. t, *J*=9.2 Hz, CHCHH), 3.50 (1H, br. s, NH), 3.40 (1H, dd, *J*=9.2, 6.3 Hz, CHCHH), 3.26 (1H, ddd, *J*=9.2, 6.3, 5.6 Hz, CHCH<sub>2</sub>), 2.08 (1H, sept. d, *J*=6.8, 5.6 Hz, CH(CH<sub>3</sub>)<sub>2</sub>), 1.03 (3H, d, *J*=6.8 Hz, CH<sub>3</sub>), 0.93 (3H, d, *J*=6.8 Hz, CH<sub>3</sub>);  $\delta_{\text{C}}$  (75 MHz, CDCl<sub>3</sub>) 151.9 (C), 131.7 (C), 127.3 (CH), 124.7 (CH), 118.2 (CH), 109.5 (CH), 49.2 (CH<sub>2</sub>), 48.3 (CH), 30.9 (CH), 20.4 (CH<sub>3</sub>), 18.5 (CH<sub>3</sub>); **LRMS (ES<sup>+</sup>)** 162 ([M+H]<sup>+</sup>, 40%).





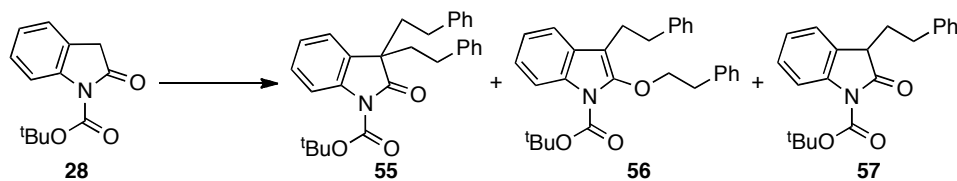
To a solution of **53** (76 mg, 0.47 mmol) in MeCN (8 mL) at RT was added  $K_2CO_3$  (130 mg, 0.94 mmol) and KI (8 mg, 0.05 mmol). After 1 h, 2-bromobenzyl bromide (118 mg, 0.47 mmol) in MeCN (2 mL) was added dropwise over 10 min. After 12 h ethyl acetate (10 mL) and water (10 mL) were added. The aqueous phase was separated and extracted with ethyl acetate (3 × 10 mL). The combined organic phases were then washed with brine (20 mL), dried ( $MgSO_4$ ) and concentrated *in vacuo*. Purification by column chromatography (0–1% chloroform in petroleum ether) afforded the *title compound* as a colourless oil (96 mg, 0.29 mmol, 62%)  $\nu_{max}$  3049 (w), 2955 (w), 2923 (w), 2868 (w), 1603 (m), 1567 (w), 1489 (m), 1459 (m), 1439 (m), 1384 (w), 1346 (m), 1305 (w), 1257 (m), 1156 (m), 1106 (w), 1044 (w);  $\delta_H$  (300 MHz,  $CDCl_3$ ) 7.62 (1H, d,  $J=7.9$  Hz, ArH), 7.44 (1H, d,  $J=7.6$  Hz, ArH), 7.31 (1H, app. t,  $J=7.5$  Hz, ArH), 7.22–7.04 (3H, m, 3 × ArH), 6.72 (1H, app. t,  $J=7.4$  Hz, ArH), 6.43 (1H, d,  $J=7.8$  Hz, ArH), 4.38 (1H, d,  $J=16.5$  Hz, NCHHAr), 4.31 (1H, d,  $J=16.5$  Hz, NCHHAr), 3.55–3.41 (1H, m, CHCH<sub>2</sub>), 3.37–3.20 (2H, m, CHCH<sub>2</sub>), 2.18–1.96 (1H, m, CH(CH<sub>3</sub>)<sub>2</sub>), 1.03 (3H, d,  $J=6.8$  Hz, CH<sub>3</sub>), 0.94 (3H, d,  $J=6.8$  Hz, CH<sub>3</sub>);  $\delta_C$  (75 MHz,  $CDCl_3$ ) 152.5 (C), 137.5 (C), 132.7 (CH), 132.0 (C), 129.1 (CH), 128.4 (CH), 127.5 (CH), 127.4 (CH), 124.5 (CH), 123.3 (C), 117.3 (CH), 106.5 (CH), 56.2 (CH<sub>2</sub>), 53.9 (CH<sub>2</sub>), 46.9 (CH), 31.1 (CH), 20.4 (CH<sub>3</sub>), 18.6 (CH<sub>3</sub>); LRMS ( $ES^+$ ) 330 ( $[M+H]^+$ , 79%); HRMS  $C_{18}H_{21}BrN$   $[M+H]^+$  requires 330.0852; found: 330.0859.

### 1-Benzyl-3-isopropylindoline (12c)

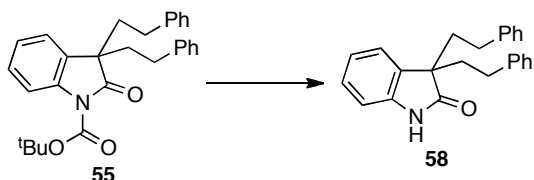


A solution of **10c** (96 mg, 0.29 mmol), tributyltin hydride (0.17 mL, 0.64 mmol) and VAZO (15 mg, 0.06 mmol) in toluene (8 mL) was heated at reflux for 18 h, then cooled and concentrated *in vacuo*. Purification by column chromatography (10% w/w anhydrous  $K_2CO_3$ -silica; 10% chloroform in petroleum ether) afforded the *title compound* as a pale yellow oil (70 mg, 0.28 mmol, 97%)  $\nu_{max}$  3027 (w), 2955 (w), 2924 (w), 2869 (w), 2825 (w), 2361 (w), 1603 (m), 1490 (s), 1454 (s), 1384 (w), 1358 (w), 1309 (w), 1242 (m), 1202 (w), 1173 (w), 1154 (w), 1104 (w);  $\delta_H$  (300 MHz,  $CDCl_3$ ) 7.31–7.11 (5H, m, 5 × ArH), 7.05–6.93 (2H, m, 2 × ArH), 6.59 (1H, app. td,  $J=7.4, 1.0$  Hz, ArH), 6.39 (1H, d,  $J=7.7$  Hz, ArH), 4.21 (1H, d,  $J=15.1$  Hz, NCHHPh), 4.13 (1H, d,  $J=15.1$  Hz, NCHHPh), 3.25 (1H, app. t,  $J=11.0$  Hz, CHCH<sub>2</sub>), 3.14–3.04 (2H, m, CHCH<sub>2</sub>), 1.95 (1H, sept. d,  $J=6.8, 5.2$  Hz, CH(CH<sub>3</sub>)<sub>2</sub>), 0.89 (3H, d,  $J=6.8$  Hz, CH<sub>3</sub>), 0.79 (3H, d,  $J=6.8$  Hz, CH<sub>3</sub>);  $\delta_C$  (75 MHz,  $CDCl_3$ ) 152.8 (C), 138.7 (C), 132.2 (C), 128.4 (2 × CH), 127.7 (2 × CH), 127.5 (CH), 127.0 (CH), 124.5 (CH), 117.1 (CH), 106.6 (CH), 55.7 (CH<sub>2</sub>), 53.4 (CH<sub>2</sub>), 46.8 (CH), 31.0 (CH), 20.4 (CH<sub>3</sub>), 18.5 (CH<sub>3</sub>); LRMS ( $ES^+$ ) 252 ( $[M+H]^+$ , 100%).

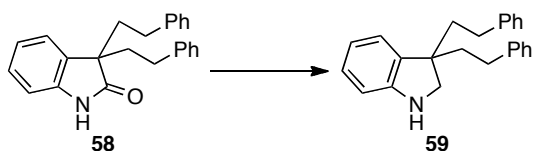
**tert-Butyl 2-oxo-3,3-diphenethyl-2,3-dihydroindole-1-carboxylate (55), tert-butyl 3-phenethyl-2-phenethyloxyindole-1-carboxylate (56) and tert-butyl 2-oxo-3-phenethyl-2,3-dihydroindole-1-carboxylate (57).**



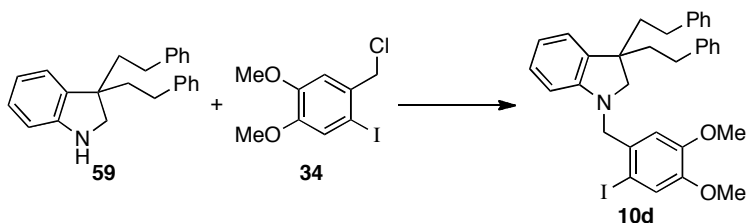
To a solution of Boc-oxindole **28**<sup>[2]</sup> (1.00 g, 4.29 mmol) in DMF (100 mL) at 0 °C was added NaH (60% in mineral oil, 430 mg, 10.7 mmol). After 1 h, 2-phenylethylbromide (1.5 mL, 10.7 mmol) was added and the reaction mixture warmed to RT. After 16 h, water (100 mL) and ethyl acetate (100 mL) were added. The aqueous phase was separated and extracted with ethyl acetate (2 × 100 mL). The combined organic phases were washed with water (4 × 60 mL) and brine (150 mL), then dried (MgSO<sub>4</sub>) and concentrated *in vacuo*. Purification by column chromatography (10% diethyl ether in petroleum ether) afforded firstly **55** as a clear oil (790 mg, 1.79 mmol, 42%)  $\nu_{\max}$  3088 (w), 3054 (w), 3032 (w), 2979 (w), 2930 (w), 2858 (w), 1792 (m), 1763 (s), 1727 (s);  $\delta_{\text{H}}$  (300 MHz, CDCl<sub>3</sub>) 7.89 (1H, d, *J*=8.1 Hz, *ArH*), 7.37–7.09 (9H, m, 9 × *ArH*), 7.06–6.98 (4H, m, 4 × *ArH*), 2.47–2.27 (4H, m, 2 × CH<sub>2</sub>CH<sub>2</sub>Ph), 2.25–1.98 (4H, m, 2 × CH<sub>2</sub>CH<sub>2</sub>Ph), 1.67 (9H, s, OC(CH<sub>3</sub>)<sub>3</sub>);  $\delta_{\text{C}}$  (75 MHz, CDCl<sub>3</sub>) 178.3 (C=O), 149.3 (C=O), 141.2 (2 × C), 140.3 (C), 130.7 (C), 128.5 (8 × CH), 126.2 (3 × CH), 124.9 (CH), 122.8 (CH), 115.3 (CH), 84.5 (C), 53.4 (C), 40.9 (2 × CH<sub>2</sub>), 30.8 (2 × CH<sub>2</sub>), 28.3 (3 × CH<sub>3</sub>); **LRMS (ES<sup>+</sup>)** 906 ([2M+Na]<sup>+</sup>, 100%), 464 ([M+Na]<sup>+</sup>, 50%); **HRMS** C<sub>29</sub>H<sub>31</sub>NNaO<sub>3</sub> [M+Na]<sup>+</sup> requires 464.2196; found: 464.2190, then secondly **56** as a clear oil (290 mg, 0.67 mmol, 16%)  $\nu_{\max}$  3066 (w), 3028 (w), 2979 (w), 2930 (w), 1726 (s), 1625 (m), 1591 (m), 1572 (m);  $\delta_{\text{H}}$  (300 MHz, CDCl<sub>3</sub>) 7.99 (1H, dd, *J*=6.8, 1.6 Hz, *ArH*), 7.36 (1H, dd, *J*=6.6, 2.1 Hz, *ArH*), 7.32–6.99 (12H, m, 12 × *ArH*), 4.04 (2H, t, *J*=7.1 Hz, OCH<sub>2</sub>CH<sub>2</sub>Ph), 3.05 (2H, t, *J*=7.1 Hz, OCH<sub>2</sub>CH<sub>2</sub>Ph), 2.86–2.77 (2H, m, CH<sub>2</sub>CH<sub>2</sub>Ph), 2.76–2.67 (2H, m, CH<sub>2</sub>CH<sub>2</sub>Ph), 1.63 (9H, s, COOC(CH<sub>3</sub>)<sub>3</sub>);  $\delta_{\text{C}}$  (75 MHz, CDCl<sub>3</sub>) 149.5 (C=O), 147.6 (C), 142.1 (C), 138.1 (C), 132.1 (C), 129.3 (2 × CH), 128.6 (4 × CH), 128.5 (2 × CH), 128.1 (C), 126.7 (CH), 126.1 (CH), 123.4 (CH), 122.7 (CH), 118.4 (CH), 115.5 (CH), 105.2 (C), 83.7 (C), 76.9 (CH<sub>2</sub>), 36.5 (CH<sub>2</sub>), 35.9 (CH<sub>2</sub>), 28.5 (3 × CH<sub>3</sub>), 25.1 (CH<sub>2</sub>); **LRMS (ES<sup>+</sup>)** 906 ([2M+Na]<sup>+</sup>, 20%), 464 ([M+Na]<sup>+</sup>, 100%); **HRMS** C<sub>29</sub>H<sub>31</sub>NNaO<sub>3</sub> [M+Na]<sup>+</sup> requires 464.2196; found: 464.2185, and then finally **57** as a yellow oil (160 mg, 0.48 mmol, 11%)  $\nu_{\max}$  3085 (w), 3058 (w), 3028 (w), 2983 (w), 2933 (w), 2858 (w), 1792 (m), 1762 (m), 1727 (s), 1607 (w);  $\delta_{\text{H}}$  (300 MHz, CDCl<sub>3</sub>) 7.86 (1H, d, *J*=8.1 Hz, *ArH*), 7.39–7.15 (8H, m, 8 × *ArH*), 3.61 (1H, t, *J*=5.9 Hz, CHCH<sub>2</sub>CH<sub>2</sub>Ph), 2.86–2.64 (2H, m, CH<sub>2</sub>CH<sub>2</sub>Ph), 2.45–2.24 (2H, m, CH<sub>2</sub>CH<sub>2</sub>Ph), 1.68 (9H, s, C(CH<sub>3</sub>)<sub>3</sub>);  $\delta_{\text{C}}$  (75 MHz, CDCl<sub>3</sub>) 176.1 (C=O), 149.4 (C=O), 141.0 (C), 140.4 (C), 128.7 (2 × CH), 128.6 (2 × CH), 128.3 (CH), 127.9 (C), 126.3 (CH), 124.5 (CH), 123.7 (CH), 115.1 (CH), 84.4 (C), 45.4 (CH), 33.0 (CH<sub>2</sub>), 31.9 (CH<sub>2</sub>), 28.3 (3 × CH<sub>3</sub>); **LRMS (ES<sup>+</sup>)** 697 ([2M+Na]<sup>+</sup>, 100%), 360 ([M+Na]<sup>+</sup>, 40%); **HRMS** C<sub>21</sub>H<sub>23</sub>NNaO<sub>3</sub> [M+Na]<sup>+</sup> requires 360.1570; found: 360.1576.

**3,3-Diphenethyl-1,3-dihydroindol-2-one (58)**

To a solution of oxindole **55** (780 mg, 1.77 mmol) in dichloromethane (40 mL) at 0 °C was added TFA (2.0 mL). The reaction mixture was warmed to RT, then after 6 h the solvent was removed *in vacuo* to afford the *title compound* as a brown oil (600 mg, 1.76 mmol, 99%)  $\nu_{\max}$  3247 (w), 3081 (w), 3066 (w), 3032 (w), 2949 (w), 2915 (w), 2858 (w), 1777 (m), 1699 (m), 1620 (m), 1603 (m), 1471 (m);  $\delta_{\text{H}}$  (300 MHz,  $\text{CDCl}_3$ ) 9.80 (1H, br. s, NH), 7.40–7.12 (9H, m, 9  $\times$  ArH), 7.09–6.98 (5H, m, 5  $\times$  ArH), 2.48–2.05 (8H, m, 2  $\times$   $\text{CH}_2\text{CH}_2\text{Ph}$ );  $\delta_{\text{C}}$  (75 MHz,  $\text{CDCl}_3$ ) 185.1 (C=O), 140.9 (2  $\times$  C), 140.5 (C), 132.1 (C), 128.7 (CH), 128.5 (8  $\times$  CH), 126.3 (2  $\times$  CH), 124.2 (CH), 123.4 (CH), 111.1 (CH), 54.6 (C), 39.7 (2  $\times$   $\text{CH}_2$ ), 30.7 (2  $\times$   $\text{CH}_2$ ); **LRMS (ES<sup>+</sup>)** 364 ([M+Na]<sup>+</sup>, 100%); **HRMS**  $\text{C}_{24}\text{H}_{24}\text{NO}$  [M+H]<sup>+</sup> requires 342.1852; found: 342.1860.

**3,3-Diphenethyl-2,3-dihydro-1H-indole (59)**

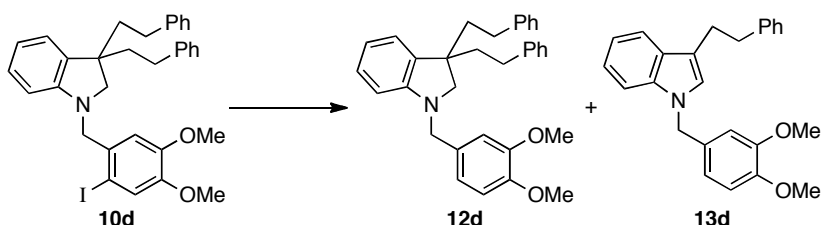
To a solution of **58** (800 mg, 2.34 mmol) in THF (20 mL) at 0 °C was added  $\text{LiAlH}_4$  (1.0 M solution in THF, 4.7 mL, 4.69 mmol) dropwise over 5 min. The reaction mixture was heated to 60 °C for 16 h, then cooled to 0 °C and water (50 mL) and diethyl ether (50 mL) were added. The aqueous phase was separated and extracted with diethyl ether (2  $\times$  50 mL), then the combined organic phases were washed with brine (100 mL), dried ( $\text{MgSO}_4$ ) and the solvent removed *in vacuo* to afford the *title compound* as a brown oil (520 mg, 1.58 mmol, 68%)  $\nu_{\max}$  3387 (w), 3081 (w), 3058 (w), 3028 (w), 2922 (w), 2850 (w), 1599 (m), 1487 (m);  $\delta_{\text{H}}$  (300 MHz,  $\text{CDCl}_3$ ) 7.32–7.23 (4H, m, 4  $\times$  ArH), 7.22–7.06 (8H, m, 8  $\times$  ArH), 6.79 (1H, app. td,  $J=7.4, 0.6$  Hz, ArH), 6.69 (1H, d,  $J=7.6$  Hz, ArH), 3.55 (2H, s,  $\text{NHCH}_2$ ), 2.70 (2H, app. td,  $J=12.8, 5.2$  Hz, 2  $\times$   $\text{CH}_2\text{CHHPh}$ ), 2.51 (2H, app. td,  $J=12.8, 5.0$  Hz, 2  $\times$   $\text{CH}_2\text{CHHPh}$ ), 2.10 (2H, ddd,  $J=13.5, 12.3, 5.2$  Hz, 2  $\times$   $\text{CHHCH}_2\text{Ph}$ ), 1.98 (2H, ddd,  $J=13.5, 12.5, 5.0$  Hz, 2  $\times$   $\text{CHHCH}_2\text{Ph}$ );  $\delta_{\text{C}}$  (75 MHz,  $\text{CDCl}_3$ ) 151.5 (C), 142.8 (2  $\times$  C), 134.8 (C), 128.5 (4  $\times$  CH), 128.5 (4  $\times$  CH), 127.9 (CH), 125.9 (2  $\times$  CH), 123.5 (CH), 118.7 (CH), 109.8 (CH), 57.4 ( $\text{CH}_2$ ), 49.2 (C), 41.4 (2  $\times$   $\text{CH}_2$ ), 31.2 (2  $\times$   $\text{CH}_2$ ); **LRMS (ES<sup>+</sup>)** 328 ([M+H]<sup>+</sup>, 100%); **HRMS**  $\text{C}_{24}\text{H}_{26}\text{N}$  [M+H]<sup>+</sup> requires 328.2060; found: 328.2052.

**1-(2-Iodo-4,5-dimethoxybenzyl)-3,3-diphenethyl-2,3-dihydro-1H-indole (10d)**

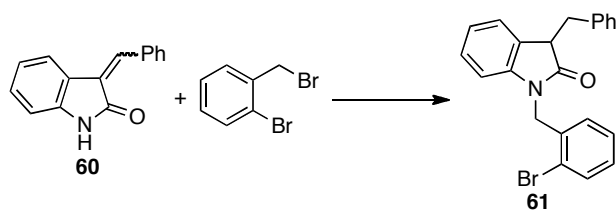
A solution of indoline **59** (310 mg, 0.93 mmol), benzyl chloride **34**<sup>[3]</sup> (350 mg, 1.12 mmol),  $\text{K}_2\text{CO}_3$  (770 mg, 5.58 mmol) and KI (150 mg, 0.93 mmol) in acetone (40 mL) was heated at reflux for 16 h. The reaction mixture was then cooled to RT and partitioned between water (50 mL) and diethyl ether (50 mL). The aqueous phase was extracted with diethyl ether (2  $\times$  30 mL), then the combined organic phases were washed with brine

(100 mL), dried ( $\text{MgSO}_4$ ) and concentrated *in vacuo*. Purification by column chromatography (5–25% diethyl ether in petroleum ether) afforded the *title compound* as a brown oil (320 mg, 0.53 mmol, 57%)  $\nu_{\text{max}}$  3081 (w), 3062 (w), 3024 (w), 3002 (w), 2922 (w), 2835 (w), 1602 (m), 1495 (s), 1454 (s), 1435 (m);  $\delta_{\text{H}}$  (400 MHz,  $\text{CDCl}_3$ ) 7.31–7.23 (6H, m,  $6 \times \text{ArH}$ ), 7.21–7.08 (7H, m,  $7 \times \text{ArH}$ ), 6.96 (1H, s,  $\text{ArH}$ ), 6.77 (1H, app. t,  $J=7.4$  Hz,  $\text{ArH}$ ), 6.51 (1H, d,  $J=7.8$  Hz,  $\text{ArH}$ ), 4.25 (2H, s,  $\text{NCH}_2\text{Ar}$ ), 3.89 (3H, s,  $\text{OCH}_3$ ), 3.69 (3H, s,  $\text{OCH}_3$ ), 3.37 (2H, s,  $\text{NCH}_2$ ), 2.70 (2H, app. td,  $J=12.9, 5.0$  Hz,  $2 \times \text{CH}_2\text{CHHPh}$ ), 2.50 (2H, app. td,  $J=12.9, 4.7$  Hz,  $2 \times \text{CH}_2\text{CHHPh}$ ), 2.09 (2H, app. td,  $J=12.9, 5.0$  Hz,  $2 \times \text{CHHCH}_2\text{Ph}$ ), 1.98 (2H, ddd,  $J=13.2, 12.9, 4.7$  Hz,  $2 \times \text{CHHCH}_2\text{Ph}$ );  $\delta_{\text{C}}$  (100 MHz,  $\text{CDCl}_3$ ) 151.9 (C), 149.7 (C), 148.8 (C), 142.7 ( $2 \times \text{C}$ ), 135.1 (C), 132.8 (C), 128.6 ( $4 \times \text{CH}$ ), 128.4 ( $4 \times \text{CH}$ ), 128.1 (CH), 126.0 ( $2 \times \text{CH}$ ), 123.2 (CH), 122.0 (CH), 118.1 (CH), 112.0 (CH), 107.2 (CH), 86.5 (C), 63.8 ( $\text{CH}_2$ ), 58.1 ( $\text{CH}_2$ ), 56.4 ( $\text{CH}_3$ ), 56.0 ( $\text{CH}_3$ ), 47.7 (C), 41.7 ( $2 \times \text{CH}_2$ ), 31.3 ( $2 \times \text{CH}_2$ ); **LRMS ( $\text{ES}^+$ )** 626 ( $[\text{M}+\text{Na}]^+$ , 90%), 604 ( $[\text{M}+\text{H}]^+$ , 100%); **HRMS**  $\text{C}_{33}\text{H}_{35}\text{INO}_2$   $[\text{M}+\text{H}]^+$  requires 604.1707; found: 604.1694.

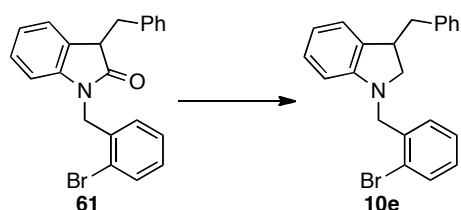
**1-(3,4-Dimethoxybenzyl)-3,3-diphenethyl-2,3-dihydro-1H-indole (12d) and 1-(3,4-dimethoxybenzyl)-3-phenethyl-1H-indole (13d)**



A solution of **10d** (80 mg, 0.13 mmol), tributyltin hydride (0.290 mmol, 0.08 mL) and VAZO (0.003 mmol, 6 mg) in toluene (10 mL) was heated at reflux for 3 h, then cooled and concentrated *in vacuo*. Purification by column chromatography (10% w/w anhydrous  $\text{K}_2\text{CO}_3$ -silica; 5% diethyl ether in petroleum ether) afforded firstly **12d** as a colourless oil (28 mg, 0.059 mmol, 45%)  $\nu_{\text{max}}$  3054 (w), 3028 (w), 2930 (w), 2835 (w), 1603 (m), 1513 (m), 1489 (m), 1455 (m);  $\delta_{\text{H}}$  (300 MHz,  $\text{CDCl}_3$ ) 7.65–7.56 (5H, m,  $5 \times \text{ArH}$ ), 7.55–7.41 (8H, m,  $8 \times \text{ArH}$ ), 7.26 (1H, d,  $J=7.0$  Hz,  $\text{ArH}$ ), 7.21 (1H, app. t,  $J=8.9$  Hz,  $\text{ArH}$ ), 7.10 (1H, app. t,  $J=7.3$  Hz,  $\text{ArH}$ ), 6.92 (1H, d,  $J=7.8$  Hz,  $\text{ArH}$ ), 4.61 (2H, s,  $\text{NCH}_2\text{Ar}$ ), 4.24 (3H, s,  $\text{OCH}_3$ ), 4.16 (3H, s,  $\text{OCH}_3$ ), 3.63 (2H, s,  $\text{NCH}_2$ ), 3.00 (2H, app. td,  $J=12.8, 5.2$  Hz,  $2 \times \text{CH}_2\text{CHHPh}$ ), 2.82 (2H, app. td,  $J=12.8, 4.9$  Hz,  $2 \times \text{CH}_2\text{CHHPh}$ ), 2.40 (2H, ddd,  $J=13.4, 12.8, 5.2$  Hz,  $2 \times \text{CHHCH}_2\text{Ph}$ ), 2.29 (2H, ddd,  $J=13.4, 12.8, 4.9$  Hz,  $2 \times \text{CHHCH}_2\text{Ph}$ );  $\delta_{\text{C}}$  (75 MHz,  $\text{CDCl}_3$ ) 152.3 (C), 149.3 (C), 148.3 (C), 142.8 ( $2 \times \text{C}$ ), 135.3 (C), 131.2 (C), 128.5 ( $4 \times \text{CH}$ ), 128.5 ( $4 \times \text{CH}$ ), 128.0 (CH), 125.9 ( $2 \times \text{CH}$ ), 123.3 (CH), 120.0 (CH), 117.8 (CH), 111.3 (CH), 110.9 (CH), 107.0 (CH), 63.4 ( $\text{CH}_2$ ), 56.1 ( $\text{CH}_3$ ), 56.0 ( $\text{CH}_3$ ), 53.0 ( $\text{CH}_2$ ), 47.5 (C), 41.6 ( $2 \times \text{CH}_2$ ), 31.2 ( $2 \times \text{CH}_2$ ); **LRMS ( $\text{ES}^+$ )** 500 ( $[\text{M}+\text{Na}]^+$ , 30%), 478 ( $[\text{M}+\text{H}]^+$ , 100%); **HRMS**  $\text{C}_{33}\text{H}_{35}\text{NNaO}_2$   $[\text{M}+\text{Na}]^+$  requires 500.2560; found: 500.2561, then secondly **13d** as a colourless oil (3 mg, 0.008 mmol, 6%)  $\nu_{\text{max}}$  3058 (w), 3024 (w), 2998 (w), 2933 (w), 2854 (w), 1607 (w), 1514 (m), 1463 (m), 1453 (m);  $\delta_{\text{H}}$  (300 MHz,  $\text{CDCl}_3$ ) 7.63 (1H, d,  $J=7.5$  Hz,  $\text{ArH}$ ), 7.32–7.08 (9H, m,  $9 \times \text{ArH}$ ), 6.83 (1H, s,  $\text{ArH}$ ), 6.79 (1H, d,  $J=8.0$  Hz,  $\text{ArH}$ ), 6.67 (1H, app. t,  $J=2.3$  Hz,  $\text{ArH}$ ), 5.19 (2H, s,  $\text{NCH}_2\text{Ar}$ ), 3.86 (3H, s,  $\text{OCH}_3$ ), 3.79 (3H, s,  $\text{OCH}_3$ ), 3.12–2.98 (4H, m,  $\text{CH}_2\text{CH}_2\text{Ph}$ );  $\delta_{\text{C}}$  (75 MHz,  $\text{CDCl}_3$ ) 142.6 (C), 136.9 (C), 132.8 (C), 131.2 (C), 130.4 (C), 128.7 ( $2 \times \text{CH}$ ), 128.5 ( $2 \times \text{CH}$ ), 128.0 (C), 126.0 (CH), 125.6 (CH), 121.8 (CH), 119.5 (CH), 119.2 (CH), 119.1 (CH), 111.5 (CH), 110.5 (CH) 109.8 (CH), 56.1 ( $\text{CH}_3$ ), 56.1 ( $\text{CH}_3$ ), 49.9 ( $\text{CH}_2$ ), 36.9 ( $\text{CH}_2$ ), 27.5 ( $\text{CH}_2$ ), *one quaternary signal was not discretely observed*.

**3-Benzyl-1-(2-bromobenzyl)indolin-2-one (61)**

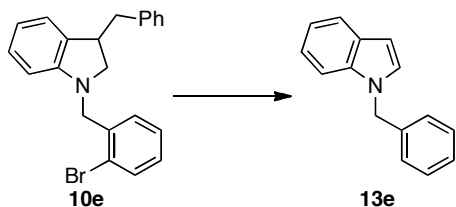
To a solution of **60**<sup>[10]</sup> (1.00 g, 4.52 mmol) in DMF (10 mL) was added sodium hydride (60% in mineral oil, 199 mg, 4.97 mmol). After 15 min, 2-bromobenzyl bromide (1.24 g, 4.97 mmol) in DMF (2 mL) was added dropwise over 5 min. After 16 h the reaction mixture was quenched with water (10 mL) and extracted with MTBE (2 × 10 mL). The combined organic phases were dried (MgSO<sub>4</sub>) and the solvent removed *in vacuo* to afford a yellow oil (1.76 g, quant.) which was diluted with acetic acid (7 mL). Zn dust (1.73 g, 0.026 g-atom) and conc. HCl (0.05 mL) were then added. After 16 h the reaction mixture was filtered through Celite<sup>®</sup> with additional ethyl acetate. The filtrate was washed with saturated NaHCO<sub>3</sub> (2 × 20 mL) and brine (20 mL), then dried (MgSO<sub>4</sub>) and concentrated *in vacuo*. Purification by column chromatography (10% diethyl ether in petroleum ether) afforded the *title compound* as a white solid (1.13 g, 2.88 mmol, 64%) **MP** 160–163 °C;  **$\nu_{\max}$**  3059 (w), 3030 (w), 2921 (w), 2853 (w), 2248 (w), 1708 (s), 1613 (m), 1569 (w), 1488 (m), 1466 (m), 1454 (w), 1440 (m), 1422 (w), 1381 (w), 1360 (m), 1310 (w), 1268 (w), 1216 (w), 1026 (m), 907 (m), 747 (s), 725 (s), 698 (s);  **$\delta_{\text{H}}$**  (400 MHz, CDCl<sub>3</sub>) 7.58 (1H, dd, *J*=7.9, 1.3 Hz, *ArH*), 7.41–7.22 (3H, m, 3 × *ArH*), 7.21–7.13 (4H, m, 4 × *ArH*), 7.10 (1H, app. td, *J*=7.6, 1.7 Hz, *ArH*), 7.07–6.98 (2H, m, 2 × *ArH*), 6.52 (1H, d, *J*=7.8 Hz, *ArH*), 6.22 (1H, dd, *J*=7.7, 0.8 Hz, *ArH*), 5.15 (1H, d, *J*=16.9 Hz, NCHHAr), 4.76 (1H, d, *J*=16.9 Hz, NCHHAr), 3.96 (1H, dd, *J*=7.4, 4.3 Hz, CHCH<sub>2</sub>Ph), 3.56 (1H, dd, *J*=13.6, 4.3 Hz, CHCHHPh), 3.30 (1H, dd, *J*=13.6, 7.4 Hz, CHCHHPh);  **$\delta_{\text{C}}$**  (100 MHz, CDCl<sub>3</sub>) 176.8 (C=O), 143.1 (C), 137.0 (C), 133.9 (C), 132.6 (CH), 129.7 (2 × CH), 128.6 (CH), 128.2 (2 × CH), 128.0 (CH), 127.9 (C), 127.7 (CH), 127.2 (CH), 126.6 (CH), 124.4 (CH), 122.5 (C), 122.3 (CH), 108.9 (CH), 47.1 (CH), 43.5 (CH<sub>2</sub>), 36.2 (CH<sub>2</sub>); **LRMS (ES<sup>+</sup>)** 455 ([M+Na+MeCN]<sup>+</sup>, 100%); **HRMS** C<sub>22</sub>H<sub>19</sub>BrNO [M+H]<sup>+</sup> requires 392.0645; found: 392.0640.

**3-Benzyl-1-(2-bromobenzyl)-2,3-dihydro-1H-indole (10e)**

To a solution of **61** (100 mg, 0.25 mmol) in toluene (3 mL) at –78 °C was added AlH<sub>3</sub> (0.5 M in toluene, 1.0 mL, 0.50 mmol) dropwise over 5 min. After 20 min the reaction mixture was warmed to RT for 4 h and then cooled to 0 °C. Methanol (1.5 mL) then 1 M HCl (1.5 mL) were added cautiously followed after 10 min by saturated NaHCO<sub>3</sub> (to pH ~10). The aqueous phase was separated and extracted with ethyl acetate (3 × 10 mL). The combined organic phases were washed with brine (30 mL), dried (MgSO<sub>4</sub>) and the solvent removed *in vacuo* to afford the *title compound* as a pale yellow oil (28 mg, 0.074 mmol, 30%)  **$\nu_{\max}$**  3025 (w), 2916 (w), 2825 (w), 1604 (m), 1567 (w), 1487 (m), 1458 (w), 1439 (w);  **$\delta_{\text{H}}$**  (300 MHz, CDCl<sub>3</sub>) 7.61 (1H, dd, *J*=7.9, 1.1 Hz, *ArH*), 7.42–7.21 (7H, m, 7 × *ArH*), 7.21–7.09 (2H, m, 2 × *ArH*), 7.05 (1H, d, *J*=7.2 Hz, *ArH*), 6.74 (1H, app. t, *J*=7.3 Hz, *ArH*), 6.48 (1H, d, *J*=7.8 Hz, *ArH*), 4.37 (1H, d, *J*=16.3 Hz, NCHHAr), 4.30 (1H, d, *J*=16.3 Hz, NCHHAr), 3.74–3.57 (1H, m, NCH<sub>2</sub>CH), 3.49 (1H, app. t, *J*=8.7 Hz, NCHHCH), 3.29–3.10 (2H, m, NCHHCH and CHCHHPh),

2.90 (1H, dd,  $J=13.6, 9.1$  Hz, CHCH(Ar)),  $\delta_{\text{C}}$  (75 MHz, CDCl<sub>3</sub>) 139.9 (C), 137.4 (C), 132.7 (CH), 129.1 (CH), 129.0 (2 × CH), 128.5 (CH), 128.4 (2 × CH), 127.8 (CH), 127.4 (CH), 126.2 (CH), 123.9 (CH), 123.3 (C), 117.6 (CH), 106.9 (CH), 59.5 (CH<sub>2</sub>), 53.6 (CH<sub>2</sub>), 42.3 (CH), 40.5 (CH<sub>2</sub>), one quaternary signal was not discretely observed; LRMS (ES<sup>+</sup>) 378 ([M+H]<sup>+</sup>, 100%).

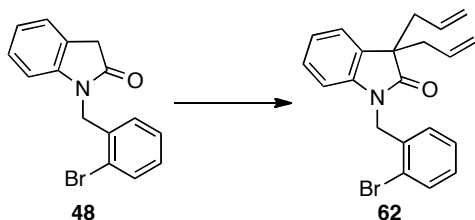
### 1-Benzyl-1H-indole (13e)<sup>[11]</sup>



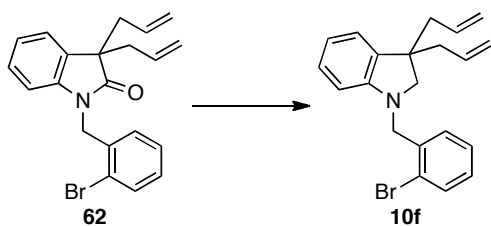
A solution of **10e** (60 mg, 0.16 mmol), tributyltin hydride (0.1 mL, 0.35 mmol) and VAZO (0.007 g, 0.03 mmol) in toluene (5 mL) was heated at reflux for 64 h then cooled to RT and an additional charge of tributyltin hydride (0.1 mL, 0.35 mmol) and VAZO (7 mg, 0.03 mmol) added. After a further 1 h at reflux, the reaction mixture was cooled and concentrated *in vacuo*. Purification by column chromatography (10% w/w anhydrous K<sub>2</sub>CO<sub>3</sub>-silica; 5% DCM in petroleum ether) afforded the title compound as a colourless oil (19 mg, 0.092 mmol, 58%)  $\nu_{\text{max}}$  3029 (w), 2919 (w), 1612 (w), 1511 (w), 1495 (w), 1484 (w), 1463 (m);  $\delta_{\text{H}}$  (300 MHz, CDCl<sub>3</sub>) 7.66 (1H, dd,  $J=7.9, 1.0$  Hz, ArH), 7.36–7.22 (4H, m, 4 × ArH), 7.21–7.06 (5H, m, 5 × ArH), 6.56 (1H, d,  $J=3.2$  Hz, ArH), 5.32 (2H, s, NCH<sub>2</sub>Ar);  $\delta_{\text{C}}$  (75 MHz, CDCl<sub>3</sub>) 137.7 (2 × C), 136.5 (C), 128.9 (2 × CH), 128.4 (CH), 127.8 (CH), 126.9 (2 × CH), 121.9 (CH), 121.1 (CH), 119.7 (CH), 109.9 (CH), 101.9 (CH), 50.3 (CH<sub>2</sub>); LRMS (ES<sup>+</sup>) 360 (100%), 208 ([M+H]<sup>+</sup>, 24%).

## Preparation and Radical Reaction of Indoline 10f

### 3,3-Diallyl-1-(2-bromobenzyl)indolin-2-one (62)

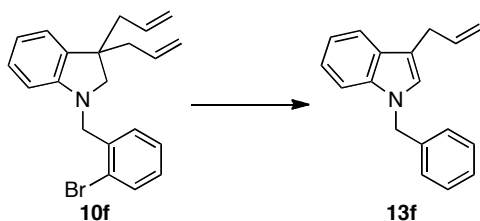


To a solution of **48** (1.00 g, 3.31 mmol) in DMF (50 mL) was added NaH (60% in mineral oil, 331 mg, 8.28 mmol). After 2 h, allyl bromide (0.72 mL, 8.28 mmol) in DMF (10 mL) was added dropwise over 15 min. After a further 16 h, water (75 mL) and ethyl acetate (75 mL) were added and the phases separated. The aqueous phase was extracted with ethyl acetate (2 × 75 mL), and the combined organic phases were washed with water (250 mL) and brine (250 mL) then dried (MgSO<sub>4</sub>) and concentrated *in vacuo*. Purification by column chromatography (25–50% DCM in petroleum ether) afforded the *title compound* as a yellow solid (922 mg, 2.41 mmol, 73%) MP 118–121 °C;  $\nu_{\text{max}}$  3057 (w), 2905 (w), 1700 (s), 1641 (w), 1614 (m), 1568 (w), 1490 (m), 1466 (s), 1440 (m), 1383 (m), 1366 (m), 1349 (m);  $\delta_{\text{H}}$  (300 MHz, CDCl<sub>3</sub>) 7.62–7.55 (1H, m, ArH), 7.29–7.02 (6H, m, 6 × ArH), 6.62 (1H, app. dq,  $J=7.7, 0.6$  Hz, ArH), 5.57–5.41 (2H, m, 2 × CH<sub>2</sub>CH=CH<sub>2</sub>), 5.06 (2H, ddt,  $J=17.0, 2.0, 1.0$ , Hz, 2 × CH<sub>2</sub>CH=CHH), 4.98 (2H, ddt,  $J=10.0, 2.0, 1.0$  Hz, 2 × CH<sub>2</sub>CH=CHH), 4.99 (2H, d,  $J=0.5$  Hz, NCH<sub>2</sub>Ar), 2.75–2.58 (4H, m, 2 × CH<sub>2</sub>CH=CH<sub>2</sub>); LRMS (ES<sup>+</sup>) 785 ([2M+Na]<sup>+</sup>, 29%), 404 ([M+Na]<sup>+</sup>, 100%); HRMS C<sub>21</sub>H<sub>21</sub>BrNO [M+H]<sup>+</sup> requires 382.0801; found: 382.0808.



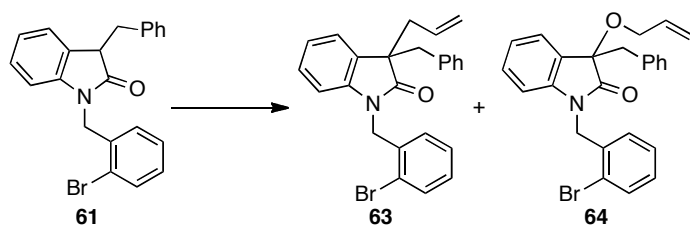
To a solution of **62** (113 mg, 0.30 mmol) in toluene (3 mL) at  $-78\text{ }^{\circ}\text{C}$  was added  $\text{AlH}_3$  (0.5 M in toluene, 1.2 mL, 0.60 mmol) dropwise over 5 min. After 20 min the reaction mixture was warmed to RT for 4 h and then cooled to  $0\text{ }^{\circ}\text{C}$ . Methanol (1.5 mL) then 1 M HCl (1.5 mL) were added cautiously followed after 10 min by saturated  $\text{NaHCO}_3$  (to pH  $\sim 10$ ). The aqueous phase was separated and extracted with ethyl acetate ( $3 \times 10\text{ mL}$ ). The combined organic phases were washed with brine (30 mL), then dried ( $\text{MgSO}_4$ ) and the solvent removed *in vacuo* to afford the *title compound* as a yellow oil (105 mg, 0.29 mmol, 97%)  $\nu_{\text{max}}$  3676 (w), 3647 (w), 3628 (w), 3071 (w), 2976 (w), 2913 (w), 2838 (w), 2359 (m), 2341 (m), 2194 (w), 2177 (w), 2158 (m), 2035 (w), 2012 (w), 1969 (w), 1942 (w), 1716 (w), 1698 (w), 1605 (m), 1489 (s), 1459 (m), 1439 (m);  $\delta_{\text{H}}$  (300 MHz,  $\text{CDCl}_3$ ) 7.48 (1H, dd,  $J=7.9, 1.1\text{ Hz}$ , *ArH*), 7.32 (1H, dd,  $J=7.6, 1.5\text{ Hz}$ , *ArH*), 7.18 (1H, app. td,  $J=7.5, 1.1\text{ Hz}$ , *ArH*), 7.04 (1H, app. td,  $J=7.6, 1.8\text{ Hz}$ , *ArH*), 7.01–6.90 (2H, m,  $2 \times \text{ArH}$ ), 6.61 (1H, app. td,  $J=7.4, 1.0\text{ Hz}$ , *ArH*), 6.31 (1H, d,  $J=7.9\text{ Hz}$ , *ArH*), 5.76–5.53 (2H, m,  $2 \times \text{CH}_2\text{CH}=\text{CH}_2$ ), 5.03–4.92 (4H, m,  $2 \times \text{CH}_2\text{CH}=\text{CH}_2$ ), 4.22 (2H, s,  $\text{NCH}_2\text{Ar}$ ), 3.17 (2H, s,  $\text{NCH}_2\text{C}$ ), 2.45–2.28 (4H, m,  $2 \times \text{CH}_2\text{CH}=\text{CH}_2$ );  $\delta_{\text{C}}$  (75 MHz,  $\text{CDCl}_3$ ) 151.6 (C), 137.4 (C), 134.7 (C), 134.6 ( $2 \times \text{CH}$ ), 132.7 (CH), 129.2 (CH), 128.5 (CH), 127.8 (CH), 127.4 (CH), 123.3 (C), 123.2 (CH), 117.8 ( $2 \times \text{CH}_2$ ), 117.4 (CH), 106.6 (CH), 63.0 ( $\text{CH}_2$ ), 53.41 ( $\text{CH}_2$ ), 47.0 (C), 43.0 ( $2 \times \text{CH}_2$ ); **LRMS ( $\text{ES}^+$ )** 368 ( $[\text{M}+\text{H}]^+$ , 100%); **HRMS**  $\text{C}_{21}\text{H}_{23}\text{BrN}$   $[\text{M}+\text{H}]^+$  requires 368.1008; found: 368.1014.

### 3-Allyl-1-benzyl-1H-indole (13f)<sup>[12]</sup>



A solution of **10f** (51 mg, 0.14 mmol), tributyltin hydride (0.08 mL, 0.31 mmol) and VAZO (7 mg, 0.03 mmol) in toluene (4 mL) was heated at reflux for 18 h, then cooled to RT and concentrated *in vacuo*. Purification by column chromatography (10% w/w anhydrous  $\text{K}_2\text{CO}_3$ -silica; 0–25% DCM in petroleum ether) afforded the *title compound* as a colourless oil (30 mg, 0.12 mmol, 86%)  $\nu_{\text{max}}$  3058 (w), 3029 (w), 2917 (w), 1715 (w), 1670 (w), 1638 (w), 1604 (m), 1553 (w), 1494 (w), 1481 (w), 1465 (m), 1453 (m), 1439 (w), 1392 (w), 1356 (m), 1352 (m), 1298 (w);  $\delta_{\text{H}}$  (300 MHz,  $\text{CDCl}_3$ ) 7.63 (1H, d,  $J=7.7\text{ Hz}$ , *ArH*), 7.36–7.24 (4H, m,  $4 \times \text{ArH}$ ), 7.18 (1H, app. td,  $J=7.5, 1.1\text{ Hz}$ , *ArH*), 7.15–7.07 (3H, m,  $3 \times \text{ArH}$ ), 6.93 (1H, s, *ArH*), 6.09 (1H, ddt,  $J=16.9, 10.2, 6.4\text{ Hz}$ ,  $\text{CH}_2\text{CH}=\text{CH}_2$ ), 5.29 (2H, s,  $\text{CH}_2\text{Ph}$ ), 5.24–5.02 (2H, m,  $\text{CH}_2\text{CH}=\text{CH}_2$ ), 3.55 (2H, dd,  $J=6.4, 0.9\text{ Hz}$ ,  $\text{CH}_2\text{CH}=\text{CH}_2$ );  $\delta_{\text{C}}$  (75 MHz,  $\text{CDCl}_3$ ) 137.7 (C), 137.4 (CH), 128.7 ( $2 \times \text{CH}$ ), 128.1 (C), 127.5 (CH), 126.8 ( $2 \times \text{CH}$ ), 125.9 (CH), 121.7 (CH), 119.2 (CH), 118.9 (CH), 115.1 ( $\text{CH}_2$ ), 113.6 (C), 109.6 (CH), 49.9 ( $\text{CH}_2$ ), 29.8 ( $\text{CH}_2$ ), *one quaternary signal was not discretely observed*.

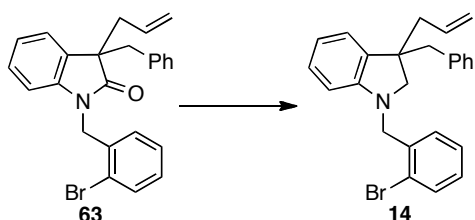
### 3-Allyl-3-benzyl-1-(2-bromobenzyl)indolin-2-one (**63**) and 3-(oxyallyl)-3-benzyl-1-(2-bromobenzyl)indolin-2-one (**64**)



To a solution of **61** (188 mg, 0.48 mmol) in DMF (13 mL) at 0 °C was added sodium hydride (60% in mineral oil, 29 mg, 0.72 mmol). After 1.5 h, allyl bromide (0.06 mL, 0.72 mmol) in DMF (2 mL) was added dropwise over 10 min. After 16 h at RT water (20 mL) and ethyl acetate (10 mL) was added. The aqueous phase was separated and extracted with ethyl acetate (2 × 10 mL). The organic phases were combined, washed with water (3 × 10 mL) and brine (20 mL), dried (MgSO<sub>4</sub>) and concentrated *in vacuo*. Purification by column chromatography (40% DCM in petroleum ether) afforded firstly **63** as a pale yellow oil (60 mg, 0.14 mmol, 29%)  $\nu_{\max}$  3059 (w), 3031 (w), 2915 (w), 2849 (w), 2362 (w), 2247 (w), 1709 (s), 1640 (w), 1612 (m), 1569 (w), 1489 (m), 1466 (m), 1455 (w), 1439 (m), 1382 (m), 1364 (m), 1349 (m), 1309 (w), 1269 (w), 1226 (w), 1198 (w);  $\delta_{\text{H}}$  (400 MHz, CDCl<sub>3</sub>) 7.51 (1H, dd,  $J=7.8, 1.3$  Hz, ArH), 7.41–7.34 (1H, m, ArH), 7.20–7.14 (1H, m, ArH), 7.14–7.05 (4H, m, 4 × ArH), 7.02 (1H, app. td,  $J=7.5, 1.5$  Hz, ArH), 6.92 (2H, d,  $J=7.0$  Hz, 2 × ArH), 6.85 (1H, app. td,  $J=7.5, 1.5$  Hz, ArH), 6.36–6.31 (1H, m, ArH), 5.76 (1H, d,  $J=8.0$  Hz, ArH), 5.53 (1H, ddt,  $J=17.2, 9.9, 7.3$  Hz, CH=CH<sub>2</sub>), 5.11 (1H, dd,  $J=17.2, 2.0$  Hz, CH=CHH), 5.00 (1H, dd,  $J=9.9, 2.0$  Hz, CH=CHH), 4.99 (1H, d,  $J=17.4$  Hz, NCHHAr), 4.60 (1H, d,  $J=17.4$  Hz, NCHHAr), 3.30 (1H, d,  $J=13.1$  Hz, CHHPh), 3.20 (1H, d,  $J=13.1$  Hz, CHHPh), 2.82 (1H, dd,  $J=13.6, 8.0$  Hz, CHHCH=CH<sub>2</sub>), 2.76 (1H, dd,  $J=13.6, 7.0$  Hz, CHHCH=CH<sub>2</sub>);  $\delta_{\text{C}}$  (100 MHz, CDCl<sub>3</sub>) 178.4 (C=O), 142.7 (C), 136.0 (C), 133.9 (C), 132.5 (CH), 132.2 (CH), 130.6 (C), 130.2 (2 × CH), 128.4 (CH), 128.0 (CH), 127.9 (2 × CH), 127.6 (CH), 127.2 (CH), 126.6 (CH), 123.7 (CH), 122.3 (C), 122.3 (CH), 119.2 (CH<sub>2</sub>), 108.9 (CH), 54.9 (C), 43.5 (CH<sub>2</sub>), 43.0 (CH<sub>2</sub>), 42.4 (CH<sub>2</sub>); LRMS (ES<sup>+</sup>) 495 ([M+Na+MeCN]<sup>+</sup>, 13%), 454 ([M+Na]<sup>+</sup>, 2%); HRMS C<sub>25</sub>H<sub>22</sub>BrNNaO [M+Na]<sup>+</sup> requires 454.0777; found: 454.0793, then **64** as a colourless oil (44 mg, 0.10 mmol, 21%)  $\nu_{\max}$  3059 (w), 3030 (w), 2921 (w), 2853 (w), 1724 (s), 1612 (s), 1569 (w), 1487 (m), 1466 (s), 1440 (m), 1423 (w), 1378 (w), 1352 (m), 1304 (w), 1277 (w), 1199 (w), 1170 (m);  $\delta_{\text{H}}$  (400 MHz, CDCl<sub>3</sub>) 7.52 (1H, dd,  $J=8.0, 1.0$  Hz, ArH), 7.39 (1H, dd,  $J=7.3, 1.3$  Hz, ArH), 7.24–7.14 (3H, m, 3 × ArH), 7.11 (2H, app. t,  $J=7.5$  Hz, 2 × ArH), 7.04 (1H, td,  $J=7.5, 1.5$  Hz, ArH), 6.94 (2H, d,  $J=7.5$  Hz, 2 × ArH), 6.88 (1H, app. td,  $J=7.5, 1.0$  Hz, ArH), 6.36 (1H, d,  $J=7.0$  Hz, ArH), 5.92 (1H, ddt,  $J=17.2, 10.4, 5.7$  Hz, CH=CH<sub>2</sub>), 5.73 (1H, d,  $J=7.5$  Hz, ArH), 5.24 (1H, app. dq,  $J=17.2, 1.5$  Hz, CH=CHH), 5.15 (1H, app. dq,  $J=10.4, 1.5$  Hz, CH=CHH), 5.06 (1H, d,  $J=17.1$  Hz, NCHHAr), 4.56 (1H, d,  $J=17.1$  Hz, NCHHAr), 3.82 (1H, ddt,  $J=11.6, 5.7, 1.4$  Hz, OCHHCH=CH<sub>2</sub>), 3.69 (1H, ddt,  $J=11.6, 5.7, 1.4$  Hz, OCHHCH=CH<sub>2</sub>), 3.46 (1H, d,  $J=12.6$  Hz, CHHPh), 3.41 (1H, d,  $J=12.6$  Hz, CHHPh);  $\delta_{\text{C}}$  (100 MHz, CDCl<sub>3</sub>) 175.7 (C=O), 143.1 (C), 134.1 (CH), 133.7 (C), 133.6 (C), 132.6 (CH), 130.8 (2 × CH), 130.0 (CH), 128.6 (CH), 128.0 (2 × CH), 127.8 (CH), 127.1 (CH), 126.9 (CH), 126.5 (C), 124.8 (CH), 123.0 (CH), 122.3 (C), 117.4 (CH<sub>2</sub>), 109.4 (CH), 83.5 (C), 66.7 (CH<sub>2</sub>), 43.9 (CH<sub>2</sub>), 43.8 (CH<sub>2</sub>); LRMS (ES<sup>+</sup>) 511 ([M+Na+MeCN]<sup>+</sup>, 37%), 470 ([M+Na]<sup>+</sup>, 33%); HRMS C<sub>25</sub>H<sub>22</sub>BrNNaO<sub>2</sub> [M+Na]<sup>+</sup> requires 470.0726; found: 470.0726.

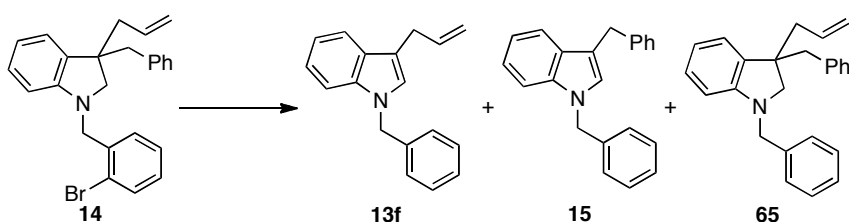


3-Allyl-3-benzyl-1-(2-bromophenyl)indoline (14)



To a solution of **63** (60 mg, 0.14 mmol) in toluene (2 mL) at  $-78^{\circ}\text{C}$  was added  $\text{AlH}_3$  (0.5 M in toluene, 0.56 mL, 0.28 mmol) dropwise over 5 min. After 20 min the reaction mixture was warmed to RT for 4 h and then cooled to  $0^{\circ}\text{C}$ . Methanol (1 mL) then 1 M HCl (1 mL) were added cautiously followed after 10 min by saturated  $\text{NaHCO}_3$  (to pH  $\sim 10$ ). The aqueous phase was separated and extracted with ethyl acetate ( $3 \times 10$  mL). The combined organic phases were then washed with brine (30 mL), dried ( $\text{MgSO}_4$ ) and concentrated *in vacuo*. Purification by column chromatography (10%–40% chloroform in petroleum ether) afforded the *title compound* as a yellow oil (41 mg, 0.10 mmol, 71%)  $\nu_{\text{max}}$  3061 (w), 3026 (w), 2916 (w), 2849 (w), 1698 (w), 1638 (w), 1604 (s), 1567 (w), 1489 (s), 1459 (m), 1439 (s), 1346 (w), 1263 (m), 1198 (w), 1158 (w), 1111 (w);  $\delta_{\text{H}}$  (400 MHz,  $\text{CDCl}_3$ ) 7.55 (1H, dd,  $J=7.8, 1.4$  Hz, ArH), 7.26–7.18 (3H, m,  $3 \times$  ArH), 7.17 (1H, dd,  $J=7.5, 1.4$  Hz, ArH), 7.12 (1H, dd,  $J=7.7, 1.8$  Hz, ArH), 7.08 (1H, app. td,  $J=7.7, 1.3$  Hz, ArH), 6.99–6.93 (3H, m,  $3 \times$  ArH), 6.90 (1H, dd,  $J=7.6, 1.8$  Hz, ArH), 6.72 (1H, app. td,  $J=7.4, 0.9$  Hz, ArH), 6.31 (1H, d,  $J=7.8$  Hz, ArH), 5.87–5.73 (1H, m,  $\text{CH}=\text{CH}_2$ ), 5.13–5.11 (1H, m,  $\text{CH}=\text{CHH}$ ), 5.09 (1H, ddt,  $J=7.2, 2.2, 1.1$  Hz,  $\text{CH}=\text{CHH}$ ), 4.28 (1H, d,  $J=16.6$  Hz,  $\text{NCHHAr}$ ), 4.15 (1H, d,  $J=16.6$  Hz,  $\text{NCHHAr}$ ), 3.40 (1H, d,  $J=9.0$  Hz,  $\text{NCHH}$ ), 3.24 (1H, d,  $J=9.0$  Hz,  $\text{NCHH}$ ), 2.99 (1H, d,  $J=13.3$  Hz,  $\text{CHHPh}$ ), 2.93 (1H, d,  $J=13.3$  Hz,  $\text{CHHPh}$ ), 2.56 (1H, ddt,  $J=14.0, 7.0, 1.4$  Hz,  $\text{CHHCH}=\text{CH}_2$ ), 2.51 (1H, ddt,  $J=14.0, 8.0, 1.1$  Hz,  $\text{CHHCH}=\text{CH}_2$ );  $\delta_{\text{C}}$  (100 MHz,  $\text{CDCl}_3$ ) 151.8 (C) 138.0 (C) 137.4 (C) 134.8 (CH) 134.5 (C) 132.5 (CH) 130.5 ( $2 \times$  CH) 129.0 (CH) 128.3 (CH) 127.9 (CH) 127.8 ( $2 \times$  CH) 127.4 (CH) 126.2 (CH) 123.5 (CH) 123.1 (C) 118.0 ( $\text{CH}_2$ ) 117.3 (CH) 106.7 (CH) 62.6 ( $\text{CH}_2$ ) 53.5 ( $\text{CH}_2$ ) 48.3 (C) 45.2 ( $\text{CH}_2$ ) 42.7 ( $\text{CH}_2$ ); LRMS ( $\text{ES}^+$ ) 418 ( $[\text{M}+\text{H}]^+$ , 30%); HRMS  $\text{C}_{25}\text{H}_{25}\text{BrN}$   $[\text{M}+\text{H}]^+$  requires 418.1165; found: 418.1166.

3-Allyl-1-benzyl-1*H*-indole (**13f**)<sup>[12]</sup> and 1,3-dibenzylindole (**15**)<sup>[9]</sup> and 3-allyl-1,3-dibenzylindoline (**65**)

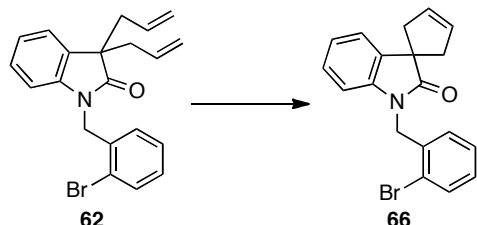


A solution of **14** (41 mg, 0.10 mmol), tributyltin hydride (0.06 mL, 0.22 mmol) and VAZO (5 mg, 0.02 mmol) in toluene (3 mL) were heated at reflux for 18 h, then cooled and concentrated *in vacuo*. Purification by column chromatography (10% w/w anhydrous  $\text{K}_2\text{CO}_3$ -silica; 0–1% chloroform in petroleum ether) afforded an inseparable mixture of **13f**, **15** and **65** (10:5:2) as a colourless oil (13 mg, 0.048 mmol, 48%)  $\nu_{\text{max}}$  3059 (w), 3028 (w), 2917 (w), 2852 (w), 2358 (w), 2336 (w), 1638 (w), 1604 (w), 1553 (w), 1495 (w), 1481 (w), 1466 (m), 1453 (m), 1439 (w), 1392 (w), 1357 (m), 1332 (m), 1299 (w), 1260 (w), 1203 (w), 1173 (w), 1126 (w), 1106 (w), 1075 (w);  $\delta_{\text{H}}$  (400 MHz,  $\text{CDCl}_3$ ) Peaks attributed to **13f** 7.60 (1H, d,  $J=7.6$  Hz, ArH), 7.35–6.98 (8H, m,  $8 \times$  ArH), 6.90 (1H, s, ArH), 6.06 (1H, ddt,  $J=17.0, 10.2, 6.4$  Hz,  $\text{CH}_2\text{CH}=\text{CH}_2$ ), 5.26 (2H, s,  $\text{CH}_2\text{Ar}$ ), 5.19–5.01 (2H, m,  $\text{CH}_2\text{CH}=\text{CH}_2$ ), 3.51 (2H, d,  $J=6.4$  Hz,  $\text{CH}_2\text{CH}=\text{CH}_2$ ); Peaks attributed to **15** 7.33–6.80 (15H, m,  $15 \times$  ArH), 5.27 (2H, s,  $\text{NCH}_2\text{Ph}$ ), 4.11 (2H, s,  $\text{CCH}_2\text{Ph}$ ); Peaks attributed to **65** 7.51 (1H, d,  $J=7.6, 1.4$  Hz, ArH), 7.33–6.80 (11H, m,  $11 \times$  ArH), 6.66 (1H, app. t,  $J=7.4$  Hz, ArH), 6.38 (1H, d,  $J=7.6$  Hz, ArH), 5.80–5.66 (1H, m,  $\text{CH}=\text{CH}_2$ ),

4.23 (1H, d,  $J=15.7$  Hz,  $\text{NCH}_2\text{Ar}$ ), 4.05 (1H, d,  $J=15.7$  Hz,  $\text{NCH}_2\text{Ar}$ ), 3.24 (1H, d,  $J=9.1$  Hz,  $\text{NCH}_2\text{H}$ ), 3.07 (1H, d,  $J=9.1$  Hz,  $\text{NCH}_2\text{H}$ ), 2.90 (1H, s,  $\text{CCH}_2\text{Ph}$ ), 2.52–2.38 (2H, m,  $\text{CH}_2\text{CH}=\text{CH}_2$ ); **LRMS (ES<sup>+</sup>)** 340 ( $[\mathbf{65}+\text{H}]^+$ , 100%), 298 ( $[\mathbf{15}+\text{H}]^+$ , 20%), 248 ( $[\mathbf{13f}+\text{H}]^+$ , 20%).

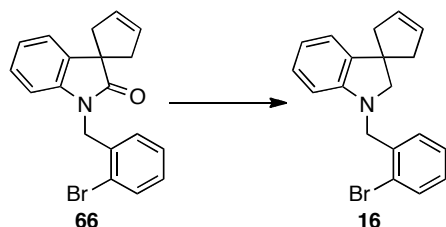
### Preparation and Radical Reaction of Indoline 16

#### 1'-(2-Bromobenzyl)spirocyclopent-3-ene-1,3'-indolin-2'-one (**66**)



A solution of **62** (77 mg, 0.20 mmol) and Hoveyda-Grubbs' II catalyst (3 mg, 0.004 mmol in toluene (2 mL) was heated at reflux for 22 h, then cooled to RT and concentrated *in vacuo*. Purification by column chromatography (10% diethyl ether in petroleum ether) afforded the *title compound* as a pale brown oil (62 mg, 0.175 mmol, 88%)  $\nu_{\text{max}}$  3056 (w), 2921 (w), 2842 (w), 1714 (s), 1610 (m), 1569 (w), 1486 (m), 1466 (m), 1440 (m), 1381 (m), 1349 (m), 1308 (w), 1268 (w), 1206 (m), 1160 (w);  $\delta_{\text{H}}$  (400 MHz,  $\text{CDCl}_3$ ) 7.61 (1H, dd,  $J=7.9$ , 1.1 Hz,  $\text{ArH}$ ), 7.31 (1H, dd,  $J=7.4$ , 0.8 Hz,  $\text{ArH}$ ), 7.21 (1H, app. td,  $J=7.4$ , 1.1 Hz,  $\text{ArH}$ ), 7.18–7.11 (2H, m,  $2 \times \text{ArH}$ ), 7.06–6.97 (2H, m,  $2 \times \text{ArH}$ ), 6.66 (1H, d,  $J=7.5$  Hz,  $\text{ArH}$ ), 5.89 (2H, s,  $\text{CH}_2\text{CH}=\text{CH}$ ), 5.04 (2H, s,  $\text{NCH}_2\text{Ar}$ ), 3.12 (2H, d,  $J=14.6$  Hz,  $2 \times \text{CHHCH}=\text{CH}$ ), 2.71 (2H, d,  $J=14.6$  Hz,  $2 \times \text{CHHCH}=\text{CH}$ );  $\delta_{\text{C}}$  (100 MHz,  $\text{CDCl}_3$ ) 181.6 (C=O), 141.3 (C), 137.2 (C), 134.6 (C), 132.9 (CH), 128.9 (CH), 128.9 ( $2 \times \text{CH}$ ), 127.8 (CH), 127.7 (CH), 127.6 (CH), 123.1 (CH), 122.8 (C), 121.8 (CH), 108.9 (CH), 52.2 (C), 45.2 ( $2 \times \text{CH}_2$ ), 43.8 ( $\text{CH}_2$ ); **LRMS (ES<sup>+</sup>)** 417 ( $[\text{M}+\text{Na}+\text{MeCN}]^+$ , 28%); **HRMS**  $\text{C}_{19}\text{H}_{16}\text{BrNNaO}$   $[\text{M}+\text{Na}]^+$  requires 376.0307; found: 376.0313.

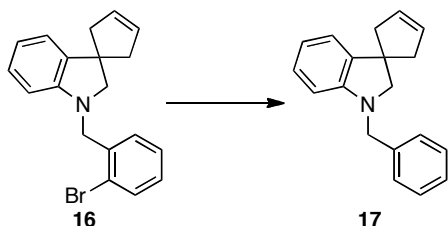
#### 1'-(2-Bromobenzyl)spirocyclopent-3-ene-1,3'-indoline (**16**)



To a solution of **66** (62 mg, 0.18 mmol) in toluene (2 mL) at  $-78$  °C was added  $\text{AlH}_3$  (0.5 M in toluene, 0.72 mL, 0.36 mmol) dropwise over 5 min. After 20 min the reaction mixture was warmed to RT for 4 h and then cooled to 0 °C. Methanol (1 mL) then 1 M HCl (1 mL) were added cautiously followed after 10 min by saturated  $\text{NaHCO}_3$  (to pH  $\sim 10$ ). The aqueous phase was separated and extracted with ethyl acetate ( $3 \times 10$  mL). The combined organic phases were washed with brine (30 mL), then dried ( $\text{MgSO}_4$ ) and concentrated *in vacuo* to afford the *title compound* as a yellow oil (60 mg, 0.176 mmol, 98%)  $\nu_{\text{max}}$  3050 (w), 2917 (w), 2838 (w), 1604 (m), 1567 (w), 1485 (s), 1459 (m), 1439 (m), 1344 (m), 1260 (m), 1024 (m), 738 (s);  $\delta_{\text{H}}$  (300 MHz,  $\text{CDCl}_3$ ) 7.60 (1H, dd,  $J=7.9$ , 1.0 Hz,  $\text{ArH}$ ), 7.47 (1H, dd,  $J=7.6$ , 0.8 Hz,  $\text{ArH}$ ), 7.31 (1H, app. td,  $J=7.5$ , 1.2 Hz,  $\text{ArH}$ ), 7.20–7.13 (2H, m,  $2 \times \text{ArH}$ ), 7.10 (1H, app. td,  $J=7.7$ , 1.3 Hz,  $\text{ArH}$ ), 6.74 (1H, app. td,  $J=7.4$ , 0.9 Hz,  $\text{ArH}$ ), 6.48 (1H, d,  $J=7.9$  Hz,  $\text{ArH}$ ), 5.76 (2H, s,  $\text{CH}_2\text{CH}=\text{CH}$ ), 4.34 (2H, s,  $\text{NCH}_2\text{Ar}$ ), 3.38 (2H, s,  $\text{NCH}_2$ ), 2.76 (2H, d,  $J=15.2$  Hz,  $2 \times \text{CHHCH}=\text{CH}$ ), 2.65 (2H, d,  $J=15.2$  Hz,  $2 \times \text{CHHCH}=\text{CH}$ );  $\delta_{\text{C}}$  (75 MHz,  $\text{CDCl}_3$ ) 151.3 (C), 138.1 (C), 137.5 (C), 132.8 (CH), 129.3 ( $3 \times \text{CH}$ ), 128.5 (CH), 127.6 (CH), 127.4 (CH), 123.4 (C), 121.8 (CH), 118.1 (CH), 106.9

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(CH), 69.5 (CH<sub>2</sub>), 53.5 (CH<sub>2</sub>), 50.0 (C), 46.8 (2 × CH<sub>2</sub>); **LRMS (ES<sup>+</sup>)** 340 ([M+H]<sup>+</sup>, 100%); **HRMS** C<sub>19</sub>H<sub>19</sub>BrN [M+H]<sup>+</sup> requires 340.0695; found: 340.0690.

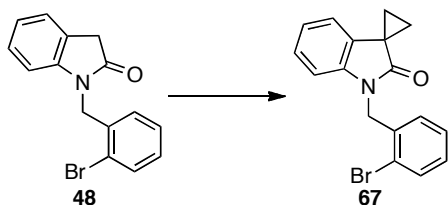
### 1'-Benzylspirocyclopent-3-ene-1,3'-indoline (17)



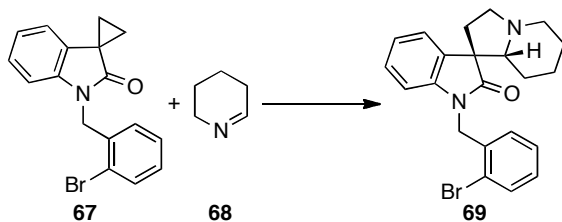
A solution of **16** (137 mg, 0.40 mmol), tributyltin hydride (0.24 mL, 0.88 mmol) and VAZO (20 mg, 0.08 mmol) in toluene (10 mL) was heated at reflux for 18 h, then cooled to RT and concentrated *in vacuo*. Purification by column chromatography (10% w/w anhydrous K<sub>2</sub>CO<sub>3</sub>-silica; 0–2% diethyl ether in petroleum ether) afforded the *title compound* as a colourless oil (61 mg, 0.23 mmol, 58%) **v<sub>max</sub>** 3051 (w), 3026 (w), 2918 (br. w), 2839 (w), 1716 (w), 1678 (w), 1603 (m), 1485 (s), 1459 (m), 1453 (m), 1437 (m), 1375 (w), 1357 (m), 1330 (w), 1311 (w), 1294 (w), 1260 (m), 1202 (w), 1155 (m); **δ<sub>H</sub>** (400 MHz, CDCl<sub>3</sub>) 7.40–7.32 (3H, m, 3 × ArH), 7.31–7.26 (2 H, m, 2 × ArH), 7.15–7.05 (2H, m, 2 × ArH), 6.72 (1H, app. td, J=7.4, 0.9 Hz, ArH), 6.55 (1H, d, J=7.8 Hz, ArH), 5.73 (2H, s, CH=CH), 4.27 (2H, s, NCH<sub>2</sub>Ph), 3.25 (2H, s, NCH<sub>2</sub>), 2.75–2.67 (2H, m, CH<sub>2</sub>CHCH), 2.64–2.56 (2H, m, CH<sub>2</sub>CHCH); **δ<sub>C</sub>** (100 MHz, CDCl<sub>3</sub>) 151.6 (C), 138.5 (2 × C), 129.3 (2 × CH), 128.5 (2 × CH), 127.9 (2 × CH), 127.5 (CH), 127.1 (CH), 121.8 (CH), 118.1 (CH), 107.1 (CH), 69.0 (CH<sub>2</sub>), 53.3 (CH<sub>2</sub>), 49.8 (C), 46.7 (2 × CH<sub>2</sub>); **LRMS (ES<sup>+</sup>)** 262 ([M+H]<sup>+</sup>, 68%); **HRMS** C<sub>19</sub>H<sub>20</sub>N [M+H]<sup>+</sup> requires 262.1590; found: 262.1592.

### Preparation and Radical Reaction of Indoline 18

#### 1'-(2-Bromobenzyl)-spirocyclopropane-1,3'-indol-2'-one (67)

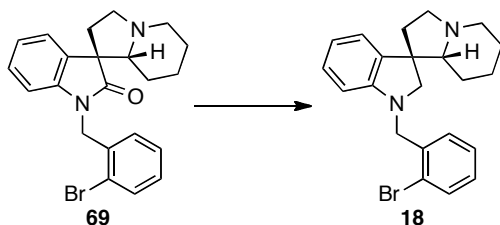


To a solution of **48** (3.53 g, 11.7 mmol) in DMF (50 mL) at 0 °C was added NaH (60% in mineral oil, 1.03 g, 25.7 mmol). After 1 h at 0 °C, 1,2-dibromoethane (4.0 mL, 46.7 mmol) was added dropwise over 5 min. The reaction mixture was warmed to RT and after 72 h water (100 mL) and ethyl acetate (100 mL) were added. The aqueous phase was separated and extracted with ethyl acetate (100 mL). The combined organic phases and washed with water (4 × 100 mL) and brine (200 mL), then dried (MgSO<sub>4</sub>) and concentrated *in vacuo*. Purification by column chromatography (10% ethyl acetate in hexanes) gave firstly the *title compound* as a red solid (2.39 g, 7.27 mmol, 62%) **MP** 115–117 °C (EtOAc); **v<sub>max</sub>** 3058 (w), 2990 (w), 2930 (w), 1708 (s), 1614 (m); **δ<sub>H</sub>** (300 MHz, CDCl<sub>3</sub>) 7.61 (1H, dd, J=7.8, 1.2 Hz, ArH), 7.25–7.00 (5H, m, 5 × ArH), 6.90 (1H, d, J=7.3 Hz, ArH), 6.75 (1H, d, J=7.7 Hz, ArH), 5.11 (2H, s, NCH<sub>2</sub>Ar), 1.94–1.76 (2H, m, CHHCCH), 1.70–1.51 (2H, m, CHHCCH); **δ<sub>C</sub>** (75 MHz, CDCl<sub>3</sub>) 177.4 (C=O), 142.5 (C), 135.0 (C), 133.0 (CH), 130.8 (C), 129.1 (CH), 127.9 (CH), 127.0 (CH), 122.8 (C), 122.4 (CH), 118.5 (CH), 109.2 (CH), 44.3 (CH<sub>2</sub>), 27.3 (C), 19.7 (2 × CH<sub>2</sub>) *one CH signal was not discretely observed*; **LRMS (ES<sup>+</sup>)** 350 ([M+Na]<sup>+</sup>, 100%); **HRMS** C<sub>17</sub>H<sub>14</sub>BrNNO [M+Na]<sup>+</sup> requires 350.0156; found: 350.0151; **CHN** Found: C 61.52, H 4.26, N 4.28; C<sub>17</sub>H<sub>14</sub>BrNO requires C 62.21, H 4.30, N 4.27; and recovered starting material (110 mg, 0.35 mmol, 3%).



A solution of cyclopropane **67** (100 mg, 0.3 mmol), imine **68** (67 mg, 0.27 mmol) and  $\text{MgI}_2$  (36 mg, 0.13 mmol) in THF (2 mL) was degassed for 30 min. The reaction vessel was then heated under microwave irradiation (150 W, 125 °C) for 5 h. After cooling to RT water (10 mL) and ethyl acetate (10 mL) were added. The aqueous phase was separated and extracted with ethyl acetate (2 × 10 mL), then the combined organic phases were washed with brine (20 mL), dried ( $\text{MgSO}_4$ ) and concentrated *in vacuo*. Purification by column chromatography (10–40% ethyl acetate in hexane) afforded the *title compound* as a colourless oil (82 mg, 0.2 mmol, 74 %)  $\nu_{\text{max}}$  2931 (m), 2855 (w), 2793 (w), 1716 (s), 1612 (m);  $\delta_{\text{H}}$  (300 MHz,  $\text{CDCl}_3$ ) 7.52 (1H, dd,  $J=7.8, 1.4$  Hz, ArH), 7.40 (1H, d,  $J=7.4$  Hz, ArH), 7.16–7.01 (3H, m, 3 × ArH), 6.98 (1H, app. td,  $J=7.5, 1.1$  Hz, ArH), 6.89 (1H, dd,  $J=7.5, 1.7$  Hz, ArH), 6.56 (1H, d,  $J=7.5$  Hz, ArH), 5.03 (1H, d,  $J=16.7$  Hz, NCHHAr), 4.85 (1H, d,  $J=16.7$  Hz, NCHHAr), 3.34–3.20 (1H, m, NCHH), 3.15 (1H, app. d,  $J=10.6$  Hz, NCHH), 2.55–2.39 (2H, m, NCH<sub>2</sub>), 2.39–2.28 (1H, m, NCH), 2.11–1.93 (2H, m, 2 × CHH), 1.68–1.47 (2H, m, 2 × CHH), 1.46–1.26 (1H, m, CHH), 1.25–1.01 (3H, m, 3 × CHH);  $\delta_{\text{C}}$  (75 MHz,  $\text{CDCl}_3$ ) 179.9 (C=O), 141.9 (C), 134.7 (C), 133.5 (C), 133.0 (2 × CH), 128.9 (CH), 127.7 (CH), 127.6 (CH), 125.0 (CH), 122.8 (C), 122.6 (CH), 108.7 (CH), 72.1 (CH), 56.6 (C), 54.2 (CH<sub>2</sub>), 53.6 (CH<sub>2</sub>), 43.9 (CH<sub>2</sub>), 35.1 (CH<sub>2</sub>), 26.5 (CH<sub>2</sub>), 25.1 (CH<sub>2</sub>), 23.7 (CH<sub>2</sub>); LRMS ( $\text{ES}^+$ ) 411 ( $[\text{M}+\text{H}]^+$ , 99%); HRMS  $\text{C}_{22}\text{H}_{24}\text{BrN}_2\text{O}$   $[\text{M}+\text{H}]^+$  requires 411.1067; found: 411.1066.

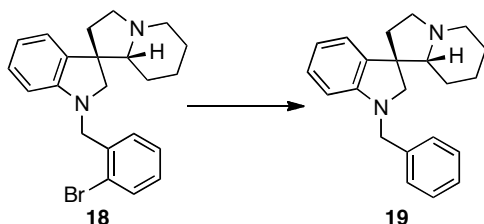
**(1'S,8a'R)-1-(2-Bromobenzyl)-3',5',6',7',8',8a'-hexahydro-2'H-spiro[indoline-3,1'-indolizine] (18)**



To a solution of **69** (80 mg, 0.19 mmol) in toluene (2 mL) at –78 °C was added  $\text{AlH}_3$  (0.5 M in toluene, 0.96 mL, 0.48 mmol) dropwise over 5 min. After 20 min the reaction mixture was warmed to RT and after a further 4 h was cooled to 0 °C. Methanol (1 mL), then 1 M HCl (1 mL) were added dropwise, followed after 10 min by saturated  $\text{NaHCO}_3$  (to pH ~10) and ethyl acetate (10 mL). The aqueous phase was extracted with ethyl acetate (2 × 10 mL) then the combined organics were washed with brine (30 mL), dried ( $\text{MgSO}_4$ ) and concentrated *in vacuo*. Purification by column chromatography (25%–40% ethyl acetate in hexanes) afforded the *title compound* as a colourless oil (49 mg, 0.12 mmol, 63%)  $\nu_{\text{max}}$  3047 (w), 2928 (m), 2852 (w), 2781 (w), 1716 (w), 1604 (m), 1568 (w), 1486 (m), 1460 (m), 1440 (m), 1380 (w), 1343 (m), 1261 (w), 1152 (m), 1108 (w), 1087 (w), 1044 (w), 1024 (m);  $\delta_{\text{H}}$  (400 MHz,  $\text{CDCl}_3$ ) 7.57 (1H, d,  $J=7.8$  Hz, ArH), 7.37 (1H, d,  $J=7.5$  Hz, ArH), 7.30–7.22 (2H, m, 2 × ArH), 7.13 (1H, app. td,  $J=7.6, 1.1$  Hz, ArH), 7.05 (1H, app. td,  $J=7.6, 1.1$  Hz, ArH), 6.71 (1H, app. t,  $J=7.1$  Hz, ArH), 6.41 (1H, d,  $J=7.7$  Hz, ArH), 4.36 (1H, d,  $J=16.1$  Hz, NCHHAr), 4.20 (1H, d,  $J=16.1$  Hz, NCHHAr), 3.39 (1H, d,  $J=9.0$  Hz, NCHH), 3.33 (1H, d,  $J=9.0$  Hz, NCHH), 3.24–3.05 (2H, m, 2 × NCHH), 2.27–2.11 (2H, m, 2 × NCHH), 1.99–1.85 (2H, m, CHH and NCH), 1.80 (1H, d,  $J=10.6$  Hz, CHH), 1.68 (1H, d,  $J=12.8$  Hz, CHH), 1.60–1.37 (3H, m, 3 × CHH), 1.15 (1H, qt,  $J=12.9, 4.0$  Hz, CHH), 1.02–0.82 (1H, m, CHH);  $\delta_{\text{C}}$  (100 MHz,  $\text{CDCl}_3$ ) 150.7 (C), 136.5 (C), 134.8 (C), 131.8 (CH), 128.3 (CH), 127.5 (CH), 126.4 (2 × CH), 124.0

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 (CH), 122.5 (C), 116.9 (CH), 105.7 (CH), 73.4 (CH), 65.0 (CH), 53.1 (CH), 53.0 (CH<sub>2</sub>), 52.8 (CH<sub>2</sub>), 51.5 (C), 37.2 (CH<sub>2</sub>), 25.4 (CH<sub>2</sub>), 24.3 (CH<sub>2</sub>), 23.2 (CH<sub>2</sub>); **LRMS (ES<sup>+</sup>)** 397 ([M+H]<sup>+</sup>, 100%).

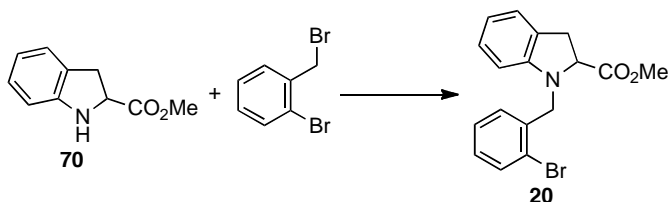
**(1'S,8a'R)-1-Benzyl-3',5',6',7',8',8a'-hexahydro-2'H-spiro[indoline-3,1'-indolizine] (19)**<sup>[13]</sup>



A solution of **18** (35 mg, 0.09 mmol), tributyltin hydride (0.05 mL, 0.20 mmol) and VAZO (5 mg, 0.02 mmol) in toluene (4 mL) was heated at reflux for 18 h, then cooled and concentrated *in vacuo*. Purification by column chromatography (10% w/w anhydrous K<sub>2</sub>CO<sub>3</sub>-silica; 25% ethyl acetate in hexanes) afforded the title compound as a colourless oil (25 mg, 0.08 mmol, 89%) **ν**<sub>max</sub> 3029 (w), 2931 (m), 2854 (w), 2360 (w), 1712 (w), 1603 (m), 1487 (m), 1453 (m), 1359 (w), 1259 (m), 1152 (w), 1075 (w), 1046 (w), 1026 (w); **δ**<sub>H</sub> (300 MHz, CDCl<sub>3</sub>) 7.34–7.16 (6H, m, 6 × ArH), 7.01 (1H, app. td, *J*=7.6, 1.3 Hz, ArH), 6.65 (1H, app. td, *J*=7.4, 0.9 Hz, ArH), 6.43 (1H, d, *J*=7.8 Hz, ArH), 4.26 (1H, d, *J*=14.9 Hz, NCHHPh), 4.08 (1H, d, *J*=14.9 Hz, NCHHPh), 3.23 (1H, d, *J*=9.1 Hz, NCHH), 3.15 (1H, d, *J*=9.1 Hz, NCHH), 3.13–3.00 (2H, m, 2 × NCHH), 2.19–2.00 (2H, m, 2 × NCHH), 1.92–1.29 (7H, m, 6 × CHH and NCH), 1.09 (1H, app. qt, *J*=12.7, 4.0 Hz, CHH), 0.97–0.77 (1H, m, CHH); **δ**<sub>C</sub> (75 MHz, CDCl<sub>3</sub>) 152.0 (C), 138.6 (C), 136.0 (C), 128.5 (2 × CH), 127.8 (2 × CH), 127.4 (CH), 127.0 (CH), 125.0 (CH), 117.7 (CH), 106.7 (CH), 74.4 (CH), 65.5 (CH<sub>2</sub>), 54.1 (CH<sub>2</sub>), 53.9 (CH<sub>2</sub>), 53.5 (CH<sub>2</sub>), 52.3 (C), 38.1 (CH<sub>2</sub>), 26.4 (CH<sub>2</sub>), 25.3 (CH<sub>2</sub>), 24.2 (CH<sub>2</sub>); **LRMS (ES<sup>+</sup>)** 319 ([M+H]<sup>+</sup>, 100%).

**Preparation and Radical Reaction of Indoline 20**

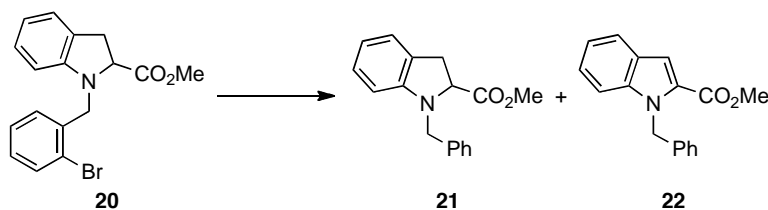
**Methyl 1-(2-bromobenzyl)indoline-2-carboxylate (20)**



To a solution of **70**<sup>[14]</sup> (500 mg, 2.82 mmol) in MeCN (40 mL) was added K<sub>2</sub>CO<sub>3</sub> (780 mg, 5.64 mmol) and KI (46 mg, 0.28 mmol). After 1 h, 2-bromobenzyl bromide (705 mg, 2.82 mmol) in MeCN (20 mL) was added dropwise over 30 min. After 12 h ethyl acetate (50 mL) and water (50 mL) were added. The aqueous phase was separated and extracted with ethyl acetate (3 × 50 mL) then the combined organic phases were then washed with brine (100 mL), dried (MgSO<sub>4</sub>) and concentrated *in vacuo*. Purification by column chromatography (5% diethyl ether in petroleum ether) afforded the *title compound* as a pale brown oil (592 mg, 1.71 mmol, 61%) **ν**<sub>max</sub> 3053 (w), 3028 (w), 2950 (w), 2914 (w), 2850 (w), 1745 (s), 1607 (m), 1568 (w), 1485 (s), 1462 (m), 1439 (m), 1388 (w), 1347 (m), 1317 (w), 1262 (m), 1197 (s), 1168 (s), 1088 (w), 1060 (w), 1044 (w), 1024 (m), 1002 (w); **δ**<sub>H</sub> (300 MHz, CDCl<sub>3</sub>) 7.59 (1H, dd, *J*=8.0, 1.0 Hz, ArH), 7.48 (1H, dd, *J*=7.7, 0.9 Hz, ArH), 7.28 (1H, app. td, *J*=7.4, 1.0 Hz, ArH), 7.16 (1H, dd, *J*=7.8, 1.6 Hz, ArH), 7.12 (1H, t, *J*=8.0 Hz, ArH), 7.06 (1H, app. t, *J*=7.8 Hz, ArH), 6.73 (1H, app. t, *J*=7.4 Hz, ArH), 6.34 (1H, d, *J*=7.7 Hz, ArH), 4.47 (2H, s, NCH<sub>2</sub>Ar), 4.39 (1H, dd, *J*=10.3, 8.0 Hz, CHCHH), 3.68 (3H, s, OCH<sub>3</sub>), 3.48 (1H, dd, *J*=16.1, 10.3 Hz, CHCHH), 3.27 (1H, dd, *J*=16.1, 8.0 Hz, CHCHH); **δ**<sub>C</sub> (75 MHz, CDCl<sub>3</sub>) 173.2 (C=O), 151.0 (C), 136.9 (C), 132.6 (CH), 129.2 (CH), 128.6 (CH), 127.8 (CH), 127.5 (CH), 126.7 (C), 124.1 (CH), 123.1 (C), 118.3 (CH), 107.0 (CH), 66.1 (CH<sub>3</sub>), 52.9 (CH<sub>2</sub>), 52.1

(CH), 33.6 (CH<sub>2</sub>); **LRMS (EI)** 267 ([M-CO<sub>2</sub>Me-Br]<sup>+</sup>, 75%), **HRMS** C<sub>17</sub>H<sub>15</sub>BrNO<sub>2</sub> [M+H]<sup>+</sup> requires 346.0437; found: 346.0432.

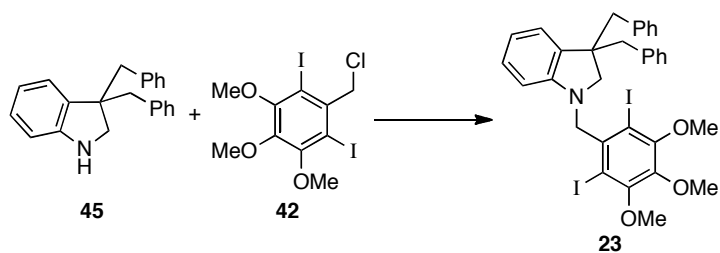
### Methyl 1-benzylindoline-2-carboxylate (**21**) and methyl 1-benzyl-1*H*-indole-2-carboxylate (**22**)



A solution of **20** (569 mg, 1.64 mmol), tributyltin hydride (0.97 mL, 3.61 mmol) and VAZO (81 mg, 0.33 mmol) in toluene (50 mL) was heated at reflux for 18 h, then cooled and concentrated *in vacuo*. Purification by column chromatography (10% w/w anhydrous K<sub>2</sub>CO<sub>3</sub>-silica; 2–5% diethyl ether in petroleum ether) afforded firstly **22** as a colourless oil (102 mg, 0.38 mmol, 24%)  $\nu_{\max}$  3062 (w), 3031 (w), 2946 (w), 2857 (w), 1706 (s), 1614 (w), 1605 (w), 1518 (m), 1496 (w), 1480 (w), 1452 (m), 1434 (m), 1404 (w), 1353 (m), 1319 (m), 1248 (s), 1191 (s), 1163 (m), 1138 (m), 1118 (w), 1095 (m), 1076(w);  $\delta_{\text{H}}$  (300 MHz, CDCl<sub>3</sub>) 7.76 (1H, d, *J*=8.1 Hz, Ar*H*), 7.44 (1H, s, Ar*H*), 7.41 (1H, d, *J*=8.1 Hz, Ar*H*), 7.36 (1H, dd, *J*=6.6, 1.1 Hz, Ar*H*), 7.28 (1H, d, *J*=7.5 Hz, Ar*H*), 7.33–7.17 (3H, m, 3 × Ar*H*), 7.10 (2H, m, 2 × Ar*H*), 5.89 (2H, s, NCH<sub>2</sub>Ph), 3.91 (3H, s, OCH<sub>3</sub>);  $\delta_{\text{C}}$  (75 MHz, CDCl<sub>3</sub>) 162.3 (C=O), 139.5 (C), 138.2 (C), 128.5 (2 × CH), 127.3 (CH), 127.1 (C), 126.2 (2 × CH), 126.1 (C), 125.3 (CH), 122.7 (CH), 120.8 (CH), 111.1 (CH), 110.8 (CH), 51.61 (CH<sub>3</sub>) 47.79 (CH<sub>2</sub>); **LRMS (EI)** 265 ([M]<sup>+</sup>, 57%), 233 ([M-MeOH]<sup>+</sup>, 12%), 206 ([M-CO<sub>2</sub>Me]<sup>+</sup>, 6%), 188 ([M-Ph]<sup>+</sup>, 4%), 115 ([M-CO<sub>2</sub>Me-Ph]<sup>+</sup>, 5%), 91 ([Bn]<sup>+</sup>, 100%); **HRMS** C<sub>17</sub>H<sub>15</sub>NNaO<sub>2</sub> [M+Na]<sup>+</sup> requires 288.0995; found: 288.0994, and then **21** as a pale yellow oil (290 mg, 1.09 mmol, 67%)  $\nu_{\max}$  3053 (w), 3027 (w), 2950 (w), 2849 (w), 1733 (s), 1605 (m), 1484 (s), 1461 (m), 1453 (m), 1435 (m), 1385 (w), 1351 (m), 1319 (w), 1265 (m), 1195 (s), 1156 (s), 1088 (w), 1076 (w), 1022 (m), 1000 (m);  $\delta_{\text{H}}$  (300 MHz, CDCl<sub>3</sub>) 7.32–7.14 (5H, m, 5 × Ar*H*), 7.02–6.93 (2H, m, 2 × Ar*H*), 6.62 (1H, app. td, *J*=7.4, 0.7 Hz, Ar*H*), 6.39 (1H, d, *J*=7.8 Hz, Ar*H*), 4.44 (1H, d, *J*=15.4 Hz, NCHHPh), 4.25 (1H, d, *J*=15.4 Hz, NCHHPh), 4.19 (1H, dd, *J*=10.3, 8.1 Hz, CHCHH), 3.59 (3H, s, OCH<sub>3</sub>), 3.31 (1H, dd, *J*=15.9, 10.3 Hz, CHCHH), 3.12 (1H, dd, *J*=15.9, 8.1 Hz, CHCHH);  $\delta_{\text{C}}$  (75 MHz, CDCl<sub>3</sub>) 173.3 (C=O), 151.3 (C), 137.7 (C), 128.4 (2 × CH), 127.8 (2 × CH), 127.7 (CH), 127.2 (CH), 126.8 (C), 124.1 (CH), 118.1 (CH), 107.2 (CH), 65.2 (CH), 52.1 (CH<sub>2</sub>), 52.0 (CH<sub>3</sub>), 33.4 (CH<sub>2</sub>); **LRMS (EI)** 267 ([M]<sup>+</sup>, 25%), 208 ([M-CO<sub>2</sub>Me]<sup>+</sup>, 54%), 117 ([M-CO<sub>2</sub>Me-Bn]<sup>+</sup>, 17%), 91 ([Bn]<sup>+</sup>, 100%); **HRMS** C<sub>17</sub>H<sub>17</sub>NNaO<sub>2</sub> [M+Na]<sup>+</sup> requires 290.1151; found: 290.1156.

### Preparation and Radical Reaction of Indoline **23**

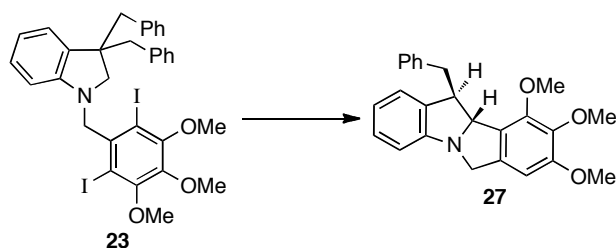
#### 3,3-Dibenzyl-1-(2,6-diiodo-3,4,5-trimethoxybenzyl)-2,3-dihydro-1*H*-indole (**23**)



A solution of indoline **45** (250 mg, 0.84 mmol), benzyl chloride **42** (590 mg, 1.25 mmol), K<sub>2</sub>CO<sub>3</sub> (700 mg, 5.04 mmol) and KI (210 mg, 1.25 mmol) in acetone (60 mL) was heated at reflux for 16 h then cooled to RT and concentrated *in vacuo*. Water (50 mL) and diethyl ether (50 mL) were added and the aqueous phase separated and extracted with diethyl ether (2 × 50 mL). The combined organic phases were washed with brine (200 mL),

dried ( $\text{MgSO}_4$ ) and concentrated *in vacuo*. Purification by column chromatography (5% diethyl ether in petroleum ether) afforded the *title compound* as a cream solid (510 mg, 0.70 mmol, 83%) **MP** 96–99 °C (EtOAc in hexanes);  $\nu_{\text{max}}$  3027 (w), 3003 (w), 2925 (w), 2848 (w), 1602 (m), 1487 (m), 1455 (s);  $\delta_{\text{H}}$  (400 MHz,  $\text{CDCl}_3$ ) 7.20–7.10 (7H, m, 7  $\times$  ArH), 6.95 (4H, app. dd,  $J=6.7$ , 2.9 Hz, 4  $\times$  ArH), 6.85 (1H, dd,  $J=7.3$ , 0.6 Hz, ArH), 6.69 (2H, app. dt,  $J=8.5$ , 7.3, 1.1 Hz, 2  $\times$  ArH), 4.60 (2H, s,  $\text{NCH}_2\text{Ar}$ ), 3.97 (3H, s,  $\text{OCH}_3$ ), 3.91 (6H, s, 2  $\times$   $\text{OCH}_3$ ), 3.05 (2H, s,  $\text{NCH}_2$ ), 2.98 (2H, d,  $J=13.5$  Hz, 2  $\times$   $\text{CHHPh}$ ), 2.87 (2H, d,  $J=13.5$  Hz, 2  $\times$   $\text{CHHPh}$ );  $\delta_{\text{C}}$  (100 MHz,  $\text{CDCl}_3$ ) 154.0 (C), 150.8 (2  $\times$  C), 144.6 (C), 138.4 (2  $\times$  C), 136.8 (C), 134.9 (C), 131.1 (4  $\times$  CH), 127.9 (4  $\times$  CH), 127.7 (CH), 126.3 (2  $\times$  CH), 124.2 (CH), 117.4 (CH), 107.6 (CH), 94.3 (2  $\times$  C), 61.6 ( $\text{CH}_2$ ), 61.2 ( $\text{CH}_3$ ), 61.0 (2  $\times$   $\text{CH}_3$ ), 60.0 ( $\text{CH}_2$ ), 49.8 (C), 43.2 (2  $\times$   $\text{CH}_2$ ); **LRMS (ES<sup>+</sup>)** 732 ( $[\text{M}+\text{H}]^+$ , 100%); **HRMS**  $\text{C}_{32}\text{H}_{32}\text{I}_2\text{NO}_3$   $[\text{M}+\text{H}]^+$  requires 732.0466; found: 732.0467.

### 11-Benzyl-8,9,10-trimethoxy-10b,11-dihydro-6H-isoindolo[2,1-a]indole (27)



A solution of **23** (500 mg, 0.68 mmol), tributyltin hydride (3.01 mmol, 0.81 mL) and VAZO (0.14 mmol, 33 mg) in toluene (40 mL) was heated at reflux for 16 h, then cooled and concentrated *in vacuo*. Purification by column chromatography (10% w/w anhydrous  $\text{K}_2\text{CO}_3$ -silica; 5% diethyl ether in petroleum ether) afforded the *title compound* as a colourless oil (160 mg, 0.40 mmol, 60%)  $\nu_{\text{max}}$  3032 (w), 2995 (w), 2938 (w), 2856 (w), 1597 (w);  $\delta_{\text{H}}$  (400 MHz,  $\text{CDCl}_3$ ) 7.42–7.36 (4H, m, 4  $\times$  ArH), 7.31 (1H, m, ArH), 7.17 (1H, app. dt,  $J=7.5$ , 1.3 Hz, ArH), 6.87–6.80 (2H, m, 2  $\times$  ArH), 6.78 (1H, ddd,  $J=7.9$ , 7.2, 0.8 Hz, ArH), 6.51 (1H, s, ArH), 5.06 (1H, br. s, NCH), 4.55 (1H, dd,  $J=14.6$ , 1.3 Hz, NCHH), 4.48 (1H, d,  $J=14.6$  Hz, NCHH), 4.18 (1H, br. dt,  $J=7.5$ , 1.9 Hz,  $\text{CHCH}_2\text{Ph}$ ), 3.83 (3H, s,  $\text{OCH}_3$ ), 3.82 (3H, s,  $\text{OCH}_3$ ), 3.70 (3H, s,  $\text{OCH}_3$ ), 3.16 (1H, dd,  $J=13.3$ , 8.2 Hz,  $\text{CHCHHPh}$ ), 3.07 (1H, dd,  $J=13.3$ , 7.3 Hz,  $\text{CHCHHPh}$ );  $\delta_{\text{C}}$  (100 MHz,  $\text{CDCl}_3$ ) 154.1 (C), 154.1 (C), 149.5 (C), 140.9 (C), 140.0 (C), 135.0 (C), 134.0 (C), 129.7 (2  $\times$  CH), 128.2 (2  $\times$  CH), 127.8 (CH), 127.1 (C), 126.1 (CH), 124.8 (CH), 120.3 (CH), 112.0 (CH), 101.3 (CH), 74.7 (CH), 60.8 ( $\text{CH}_3$ ), 60.3 ( $\text{CH}_3$ ), 59.4 ( $\text{NCH}_2$ ), 56.1 ( $\text{CH}_3$ ), 48.1 (CH), 43.2 ( $\text{CH}_2$ ); **LRMS (CI)** 388 ( $[\text{M}+\text{H}]^+$ , 80%), 296 ( $[\text{M}-\text{CH}_2\text{Ph}]^+$ , 100%), 280 (15%), 195 (20%), 167 (20%), 91 (30%); **HRMS (ES<sup>+</sup>)**  $\text{C}_{25}\text{H}_{26}\text{NO}_3$   $[\text{M}+\text{H}]^+$  requires 388.1907; found: 388.1901.

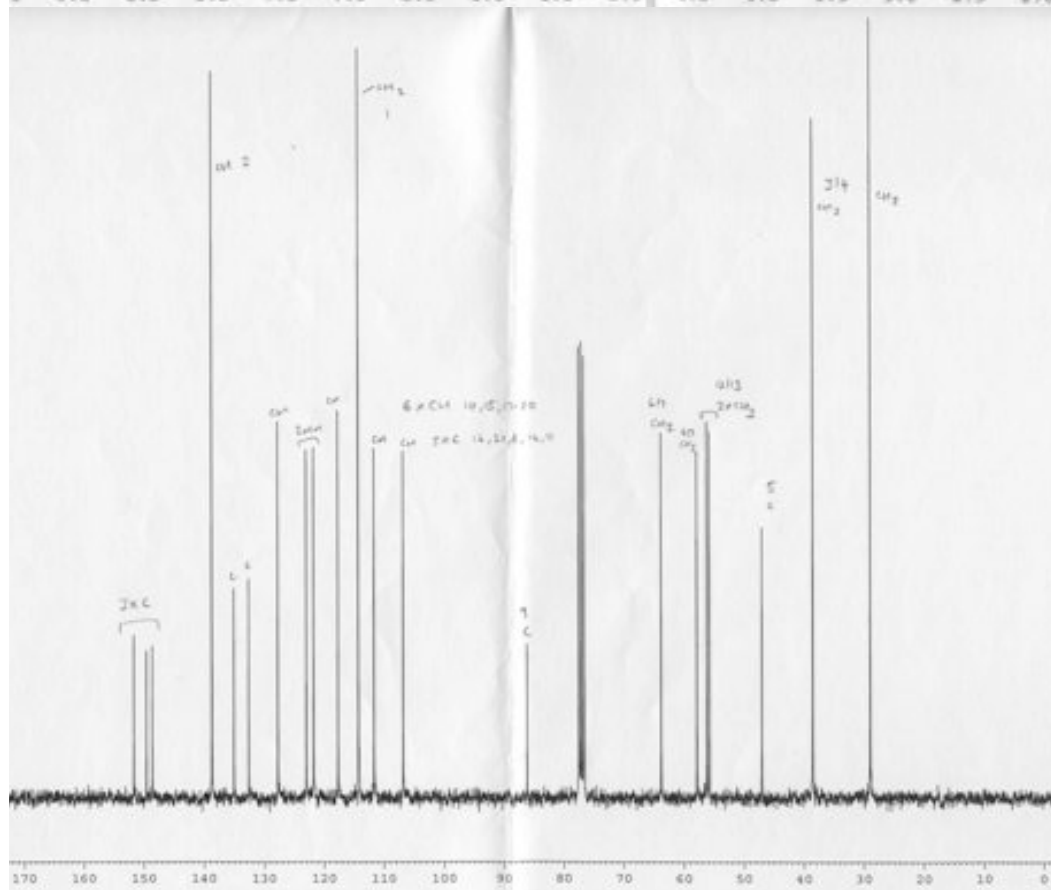
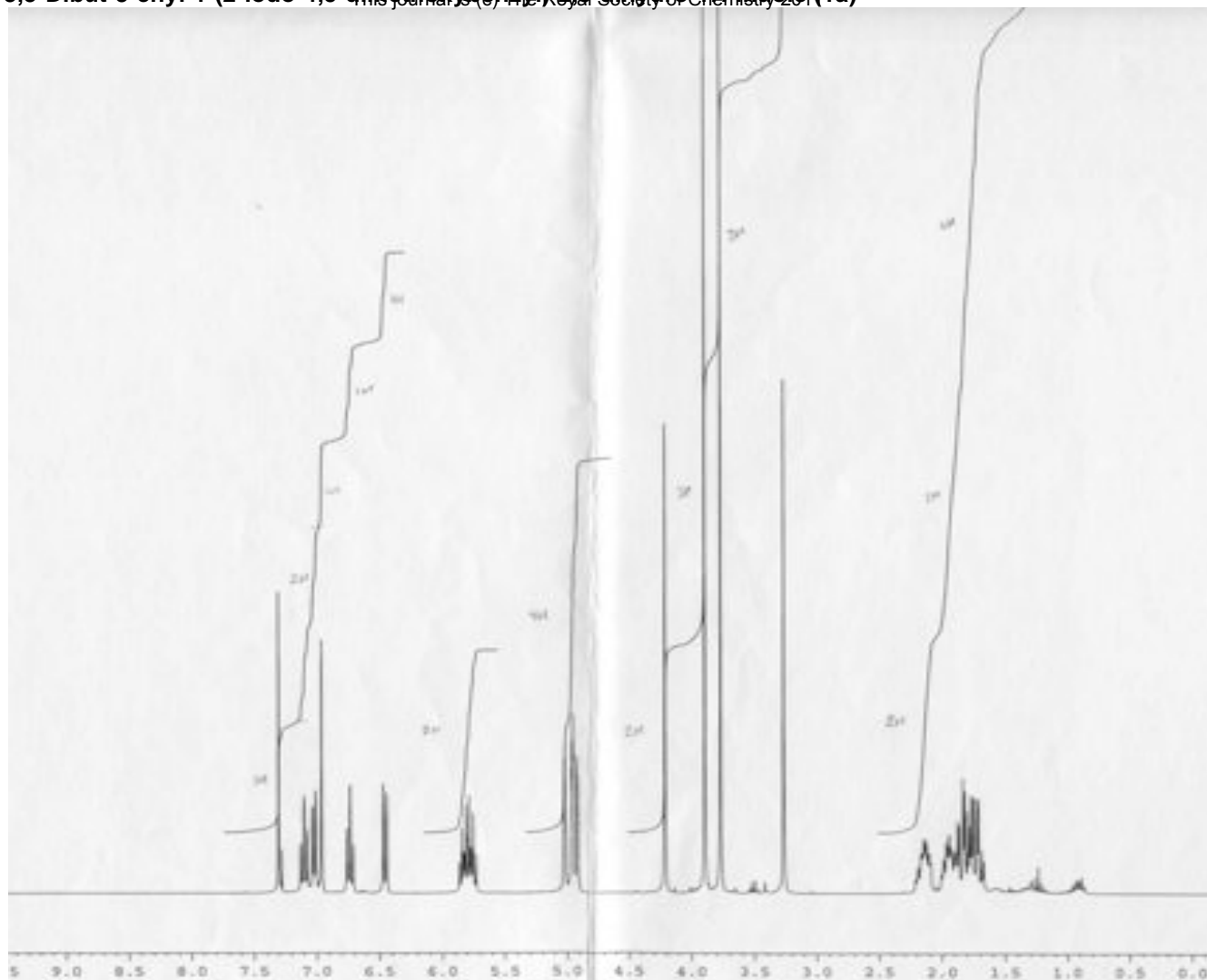
### REFERENCES FOR SUPPORTING INFORMATION

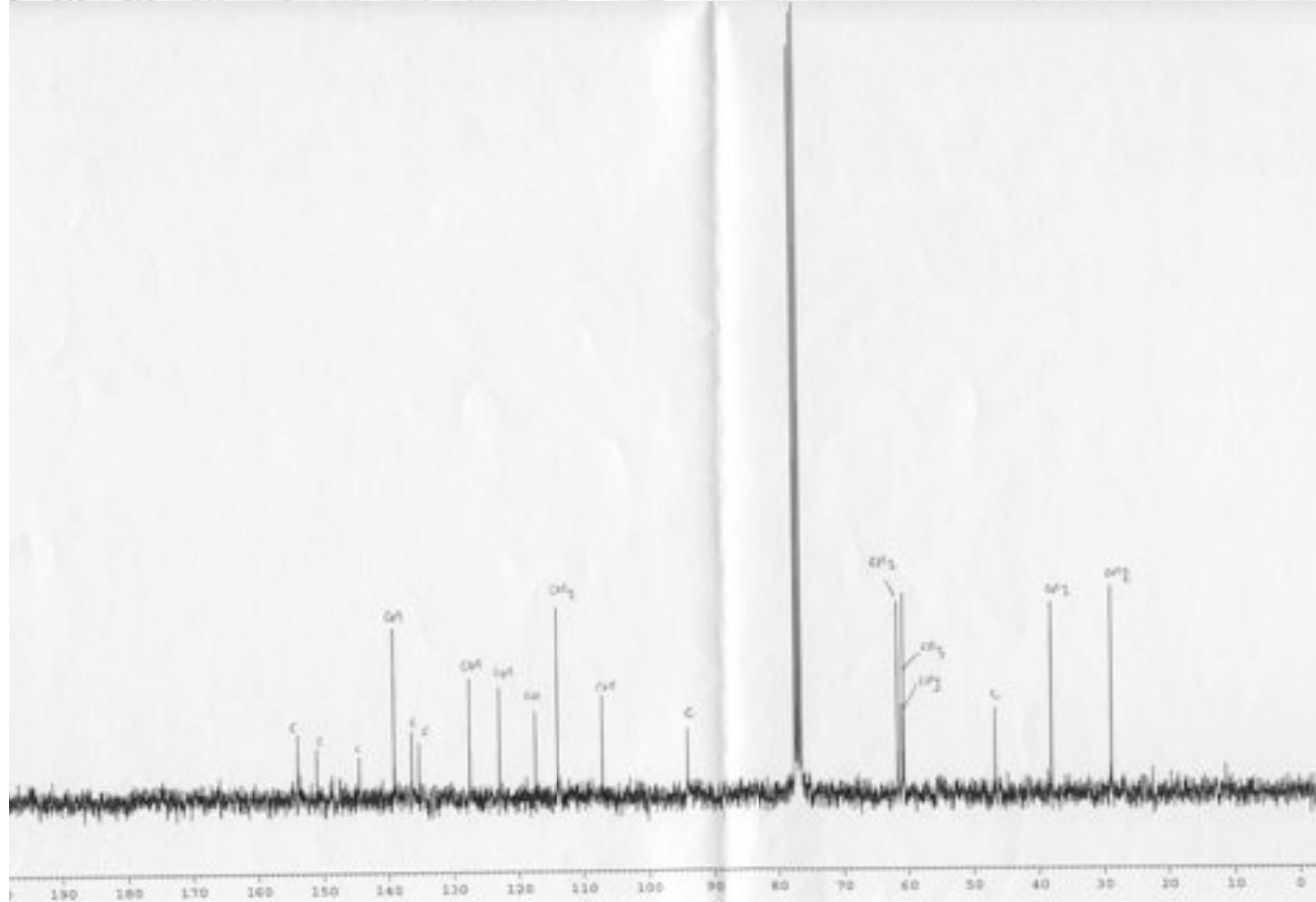
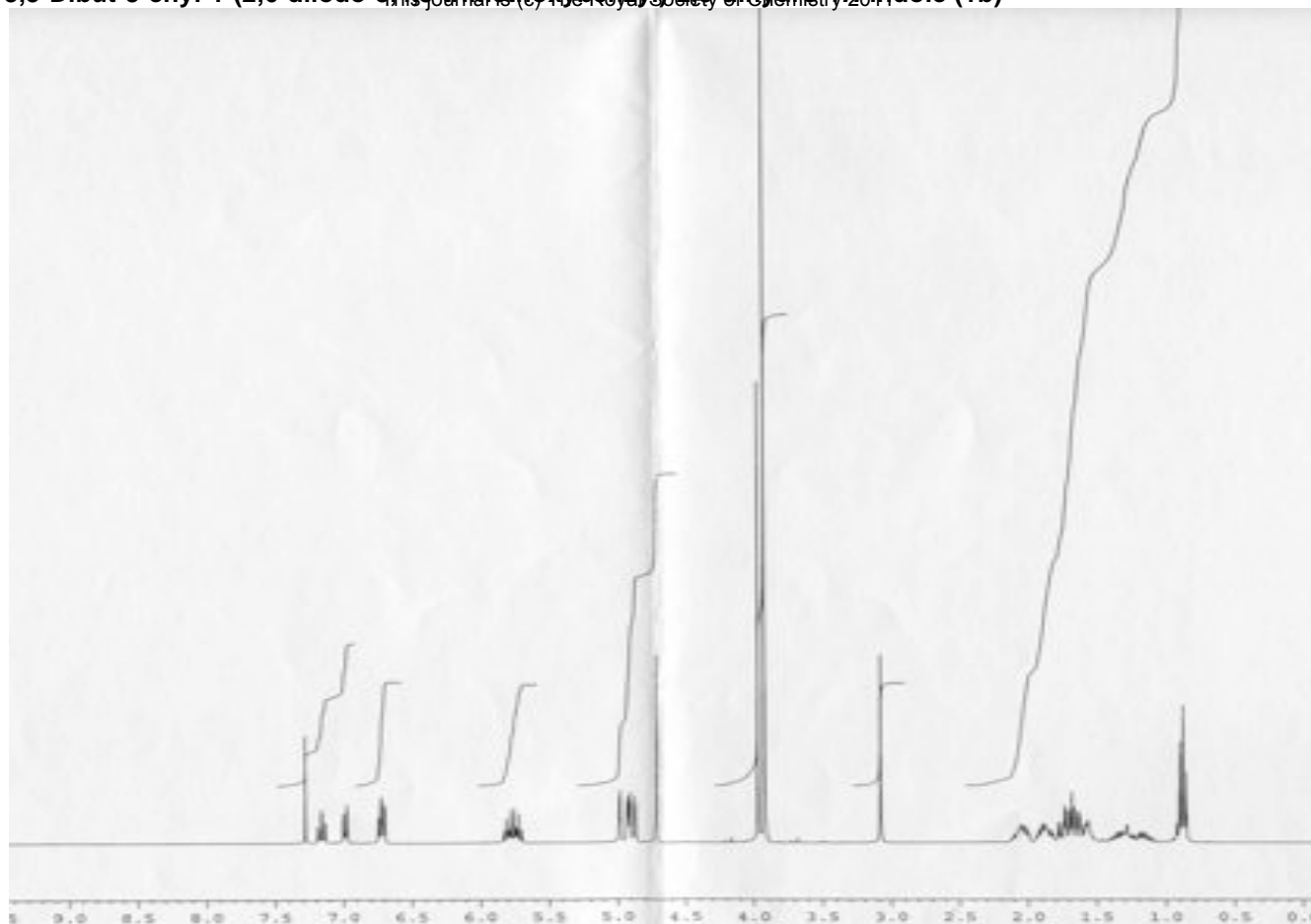
- [1] D. C. Harrowven, D. P. Curran, S. L. Kostiuik, I. L. Wallis-Guy, S. Whiting, K. J. Stenning, B. Tang, E. Packard, L. Nanson, *Chem. Commun.*, 2010, **46**, 6335–6337.
- [2] W. G. Rajeswaran, L. A. Cohen, *Tetrahedron*, 1998, **54**, 11375–11380.
- [3] S. A. Ahmad-Junan, D. A. Whiting, *J. Chem. Soc., Perkin Trans. 1*, 1992, 675–678.
- [4] A. S. Kende, J. C. Hodges, *Synth. Commun.*, 1982, **12**, 1–10.
- [5] S. R. Flanagan, D. C. Harrowven, M. Bradley, *Tetrahedron Lett.*, 2003, **44**, 1795–1798.
- [6] J. Spencer, B. Z. Chowdhry, S. Hamid, A. P. Mendham, L. Male, S. J. Coles, M. B. Hursthouse, *Acta Cryst.*, 2010, **C66**, 071–078.
- [7] T. Jensen, R. Madsen, *J. Org. Chem.*, 2009, **74**, 3990–3992.

- [8] A. T. Vu, S. T. Cohn, P. Zhang, C. Y. Kim, P. E. Maboney, J. A. Bray, G. H. Johnston, E. J. Koury, S. A. Cosmi, D. C. Deecher, V. A. Smith, J. E. Harrison, L. Leventhal, G. T. Whiteside, J. D. Kennedy, E. J. Trybulski, *J. Med. Chem.*, 2010, **53**, 2051–2062.
- [9] B. Cardillo, G. Casnati, A. Pochini, A. Ricca, *Tetrahedron*, 1967, **23**, 3771–3783.
- [10] A. Huang, J. J. Kodanko, L. E. Overman, *J. Am. Chem. Soc.*, 2004, **126**, 14043–14053.
- [11] J. Bergman, P.-O. Norrby, P. Sand, *Tetrahedron*, 1990, **46**, 6113–6124.
- [12] I. Usui, S. Schmidt, M. Keller, B. Breit, *Org. Lett.*, 2008, **10**, 1207–1210.
- [13] P. B. Alper, C. Meyers, A. Lerchner, D. R. Siegel, E. M. Carreira, *Angew. Chem. Int. Ed.*, 1999, **38**, 3186–3189.
- [14] S. Alatorre-Santamaría, M. Rodríguez-Mata, V. Gotor-Fernández, M. Carlos de Mattos, F. J. Sayago, A. I. Jiménez, C. Cativiela, V. Gotor, *Tetrahedron: Asymm.*, 2008, **19**, 1714–1719.

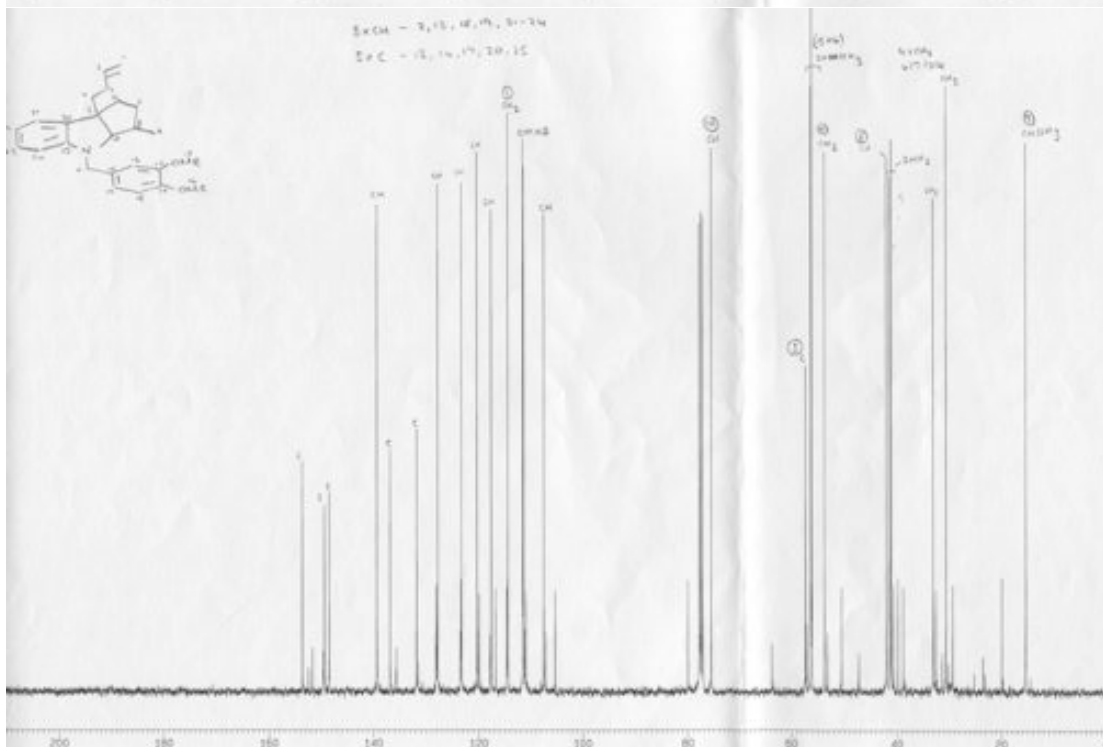
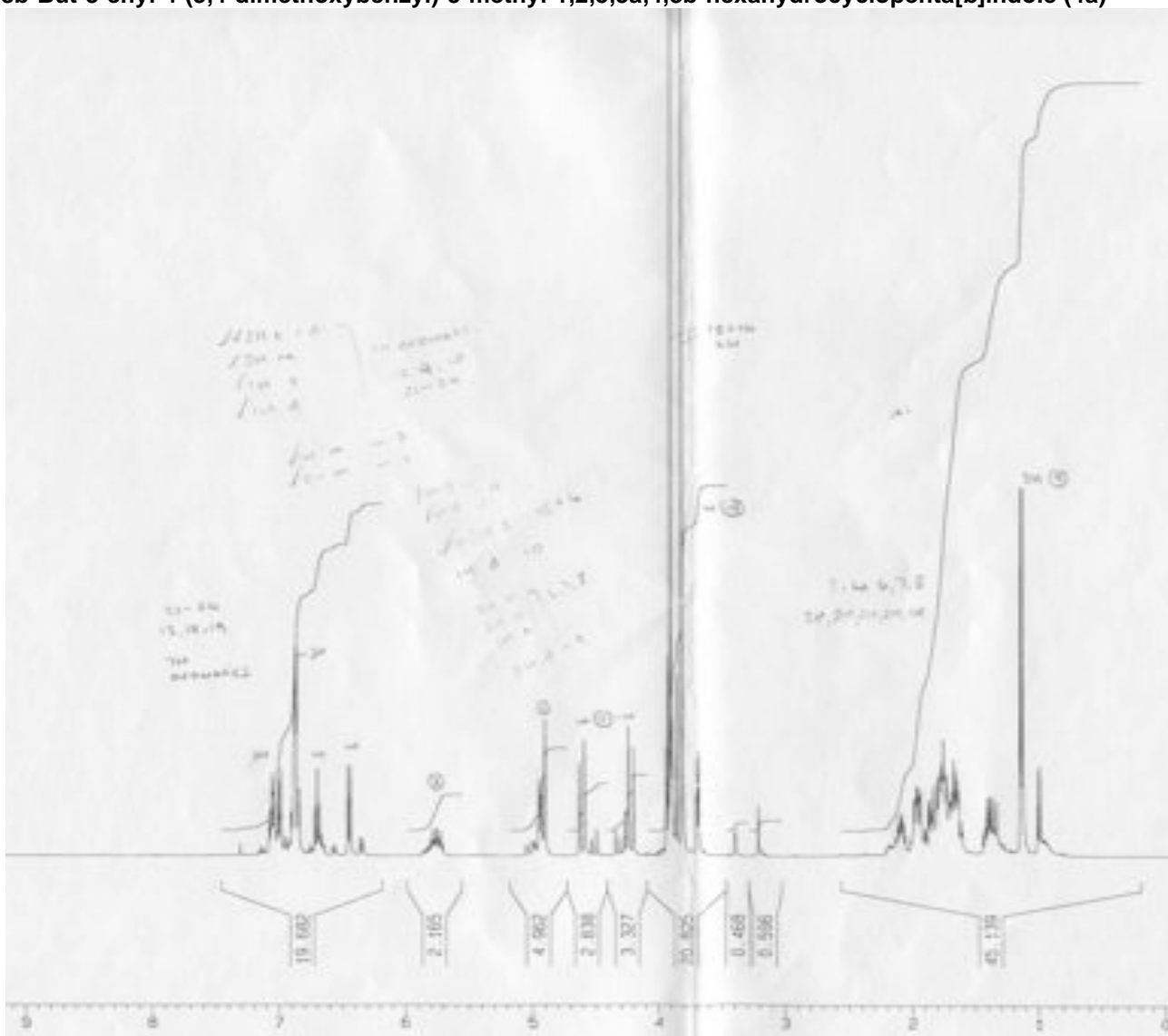


3,3-Dibut-3-enyl-1-(2-iodo-4,5-dimethoxybenzyl)-2,3-dihydro-1H-indole (1a)



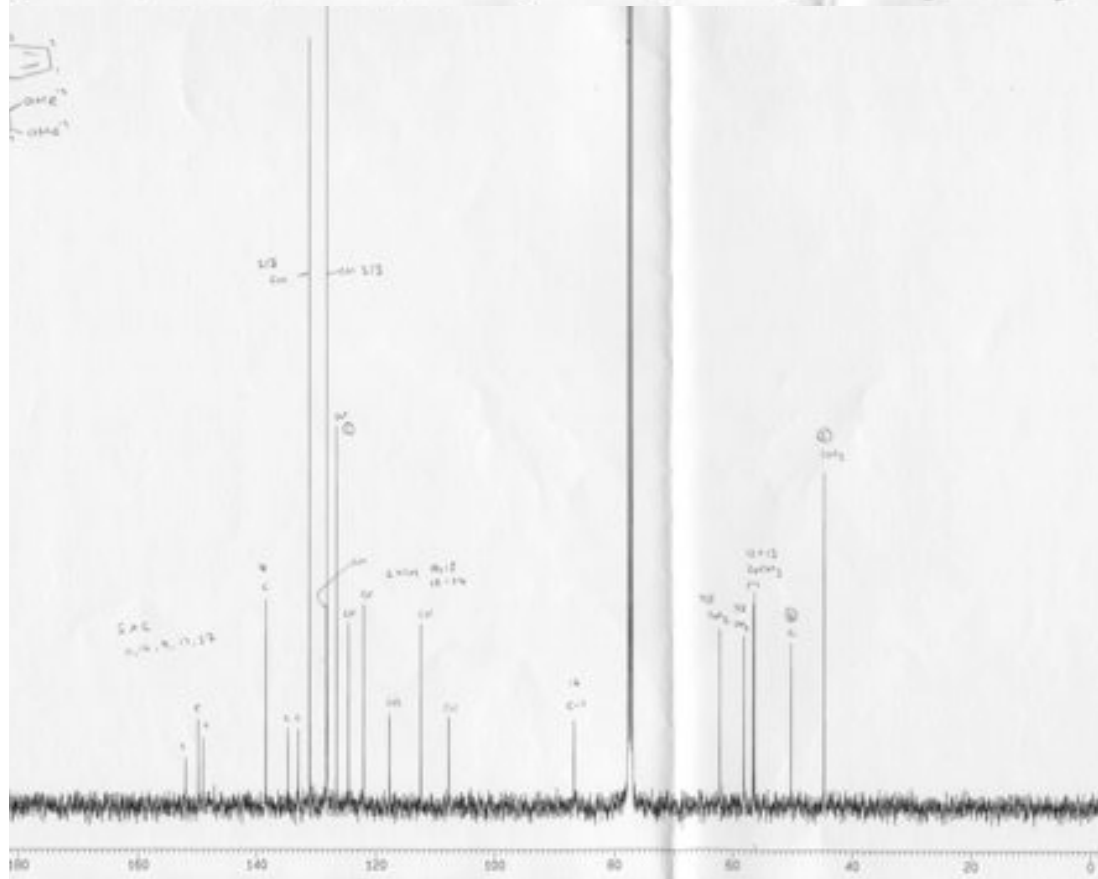
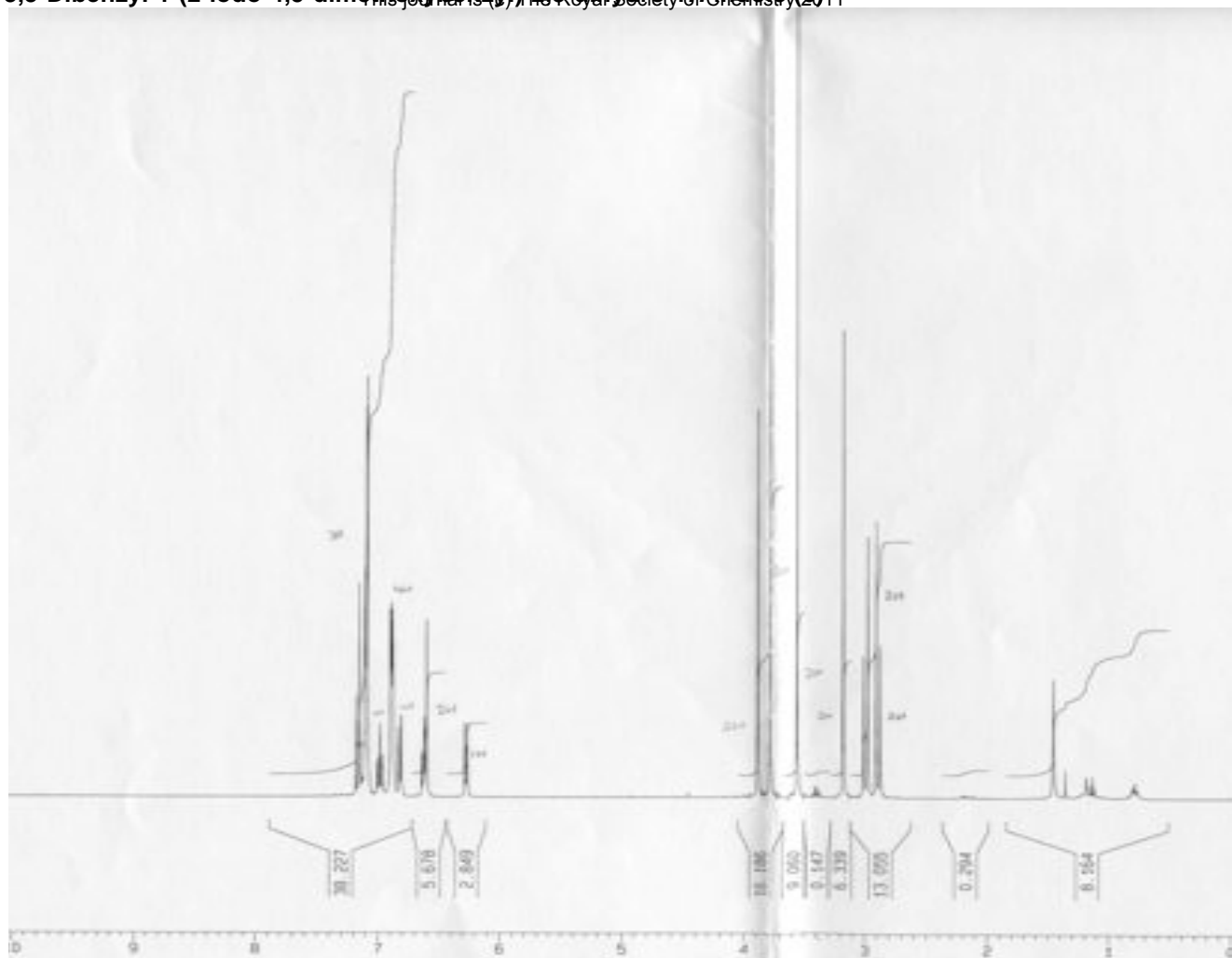


**8b-But-3-enyl-4-(3,4-dimethoxybenzyl)-3-methyl-1,2,3,3a,4,8b-hexahydrocyclopenta[b]indole (4a)**



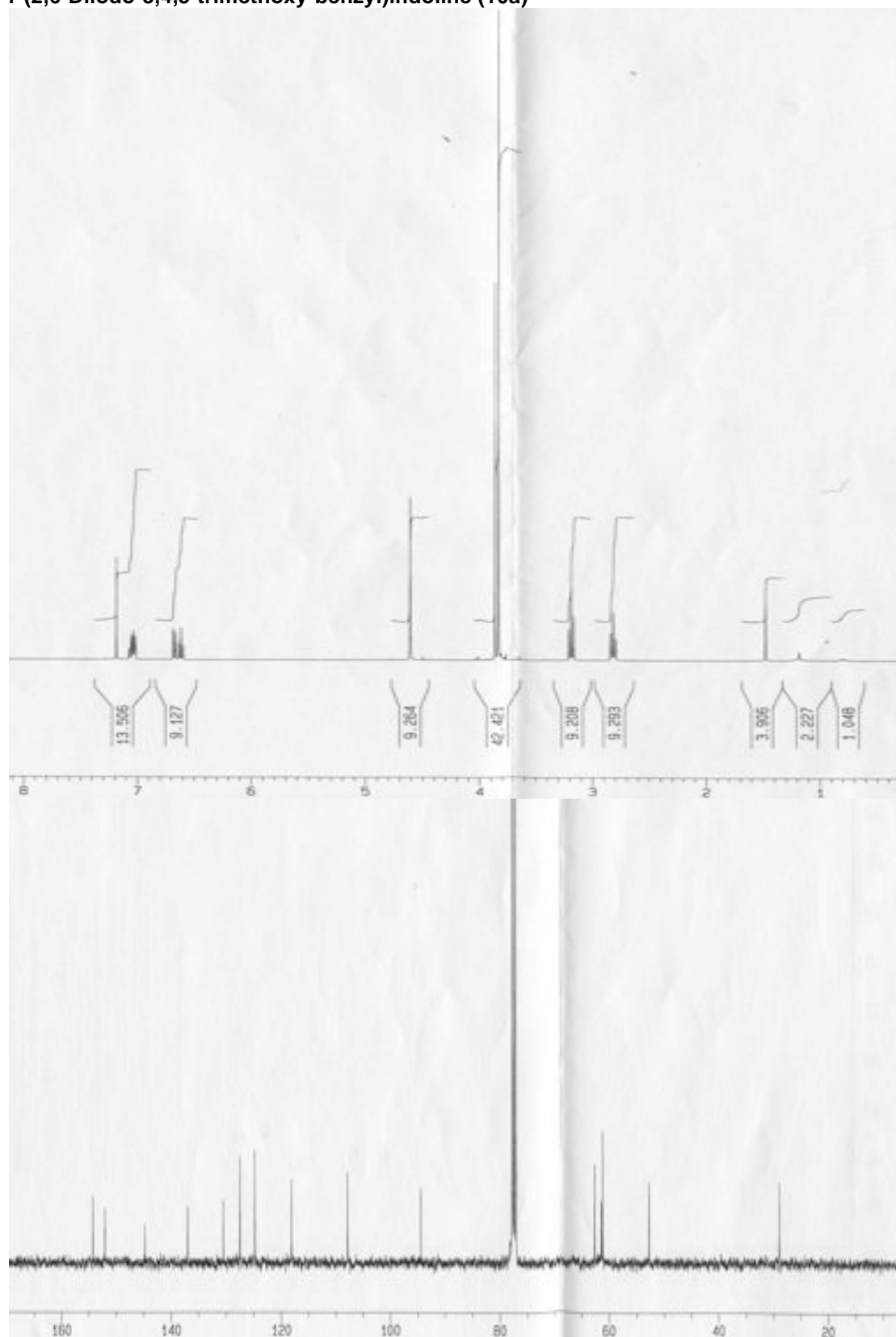


3,3-Dibenzyl-1-(2-iodo-4,5-dimethoxybenzyl)-2,3-dihydro-1H-indole (6)





**1-(2,6-Diiodo-3,4,5-trimethoxy-benzyl)indoline (10a)**

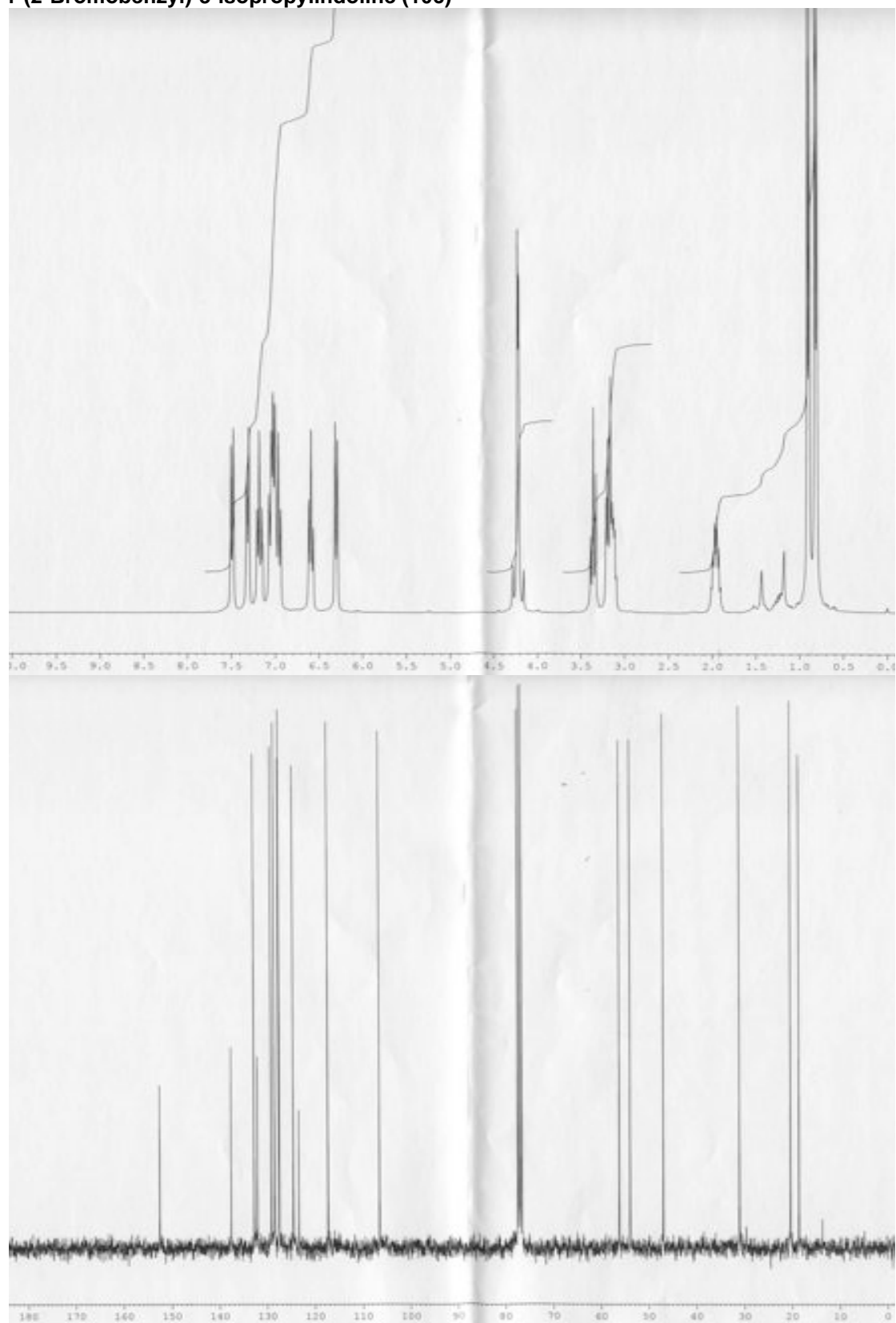


**1-(2-Bromobenzyl)-3,3-dimethylindoline (10b)**

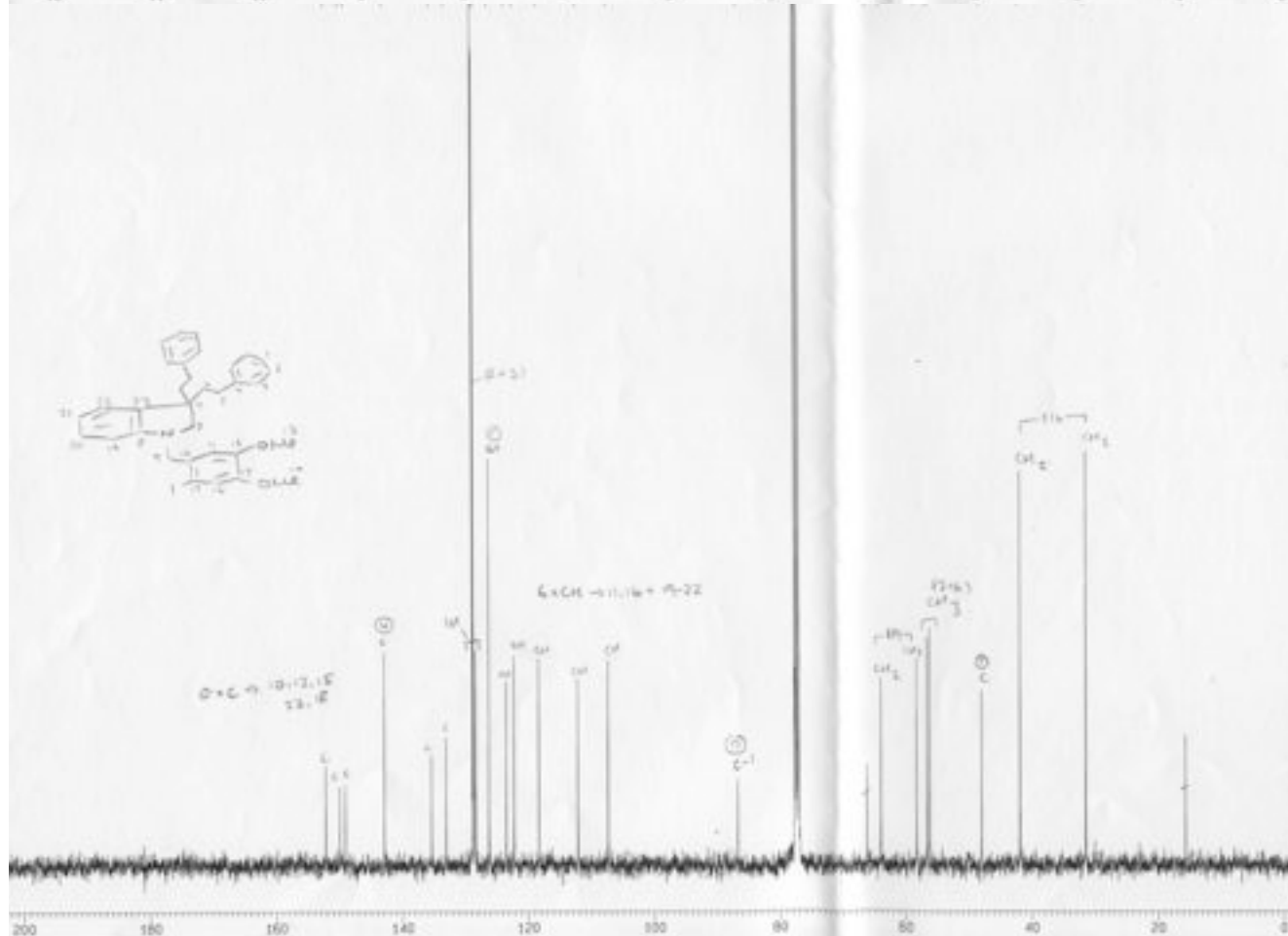
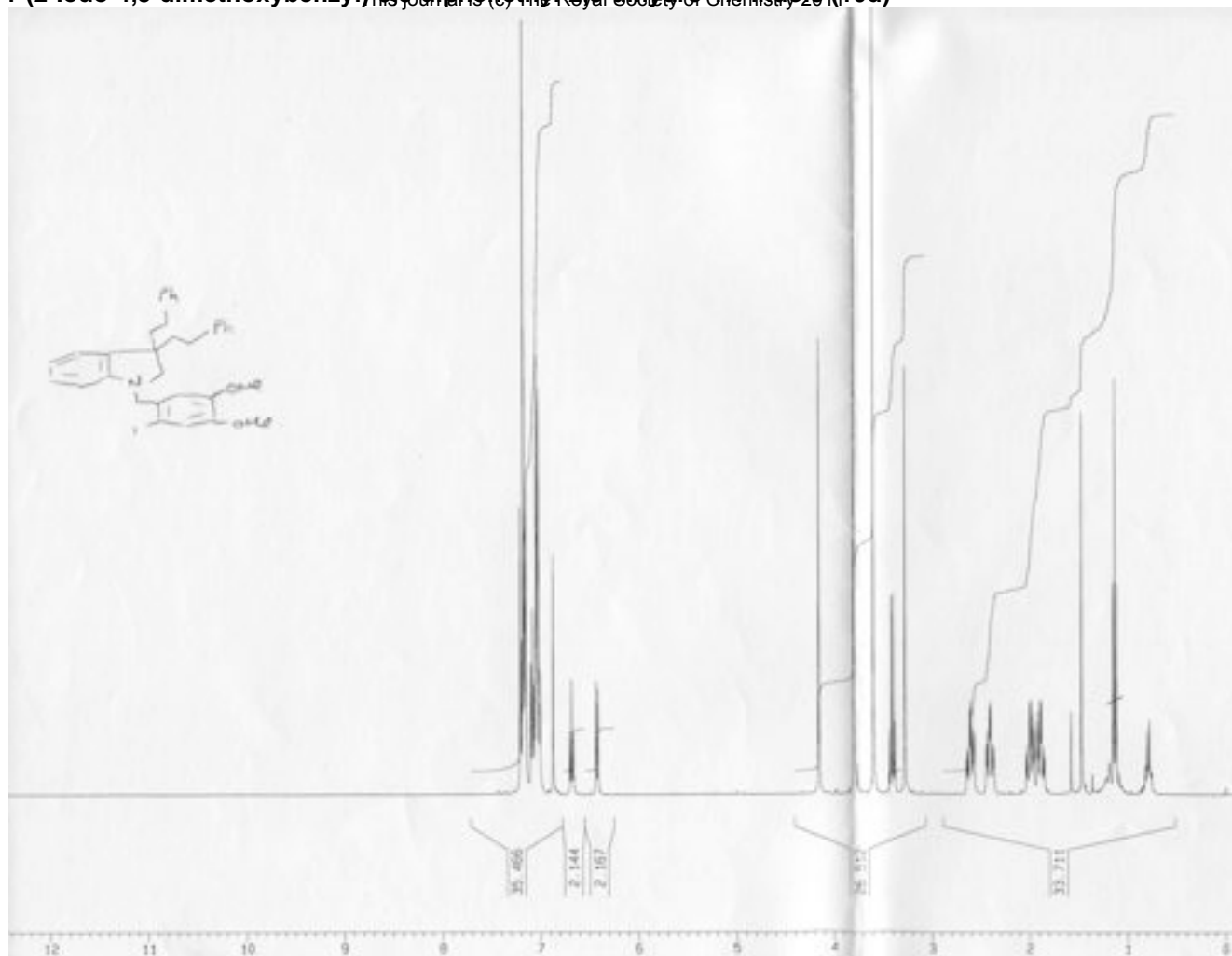




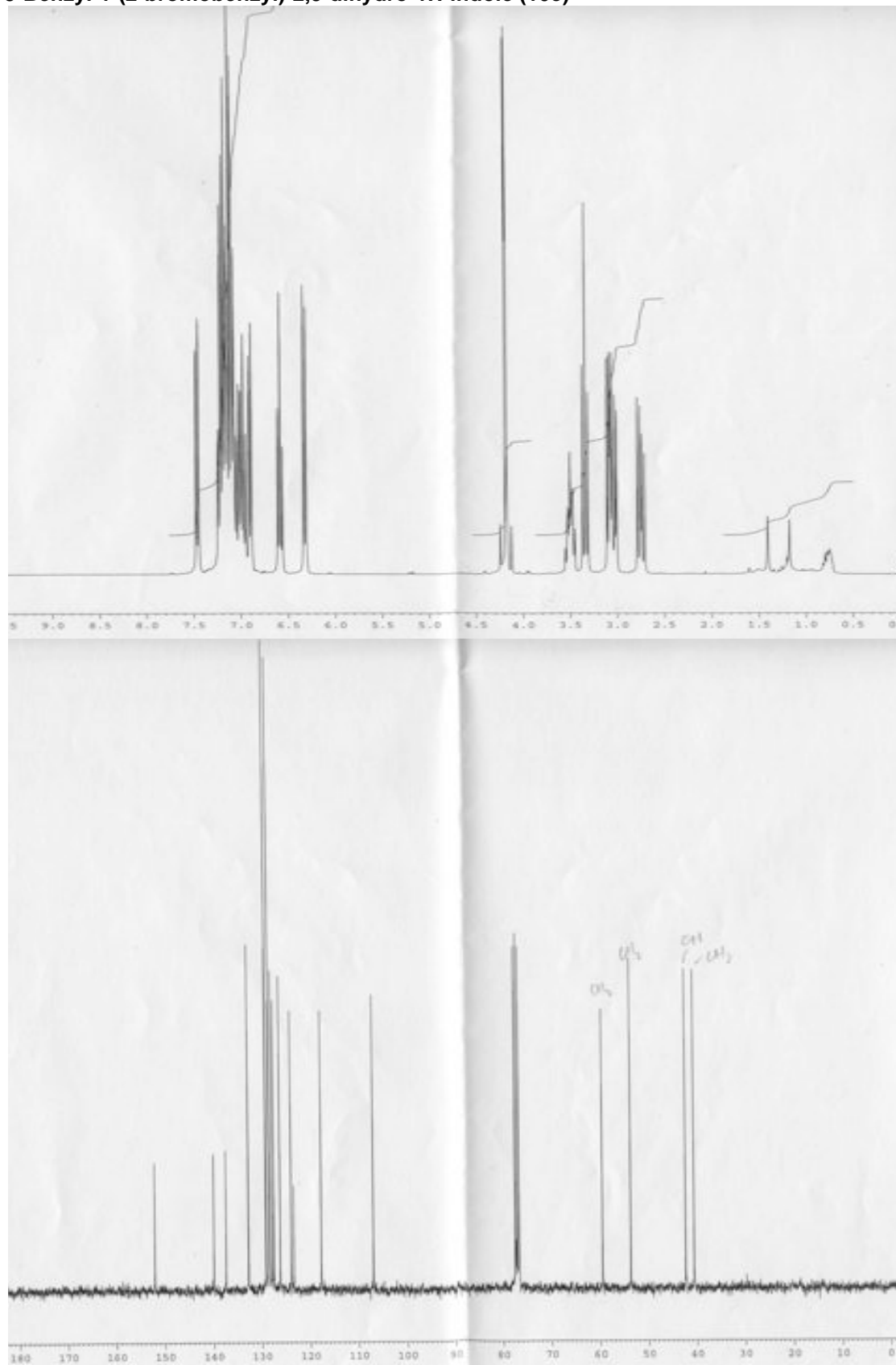
**1-(2-Bromobenzyl)-3-isopropylindoline (10c)**



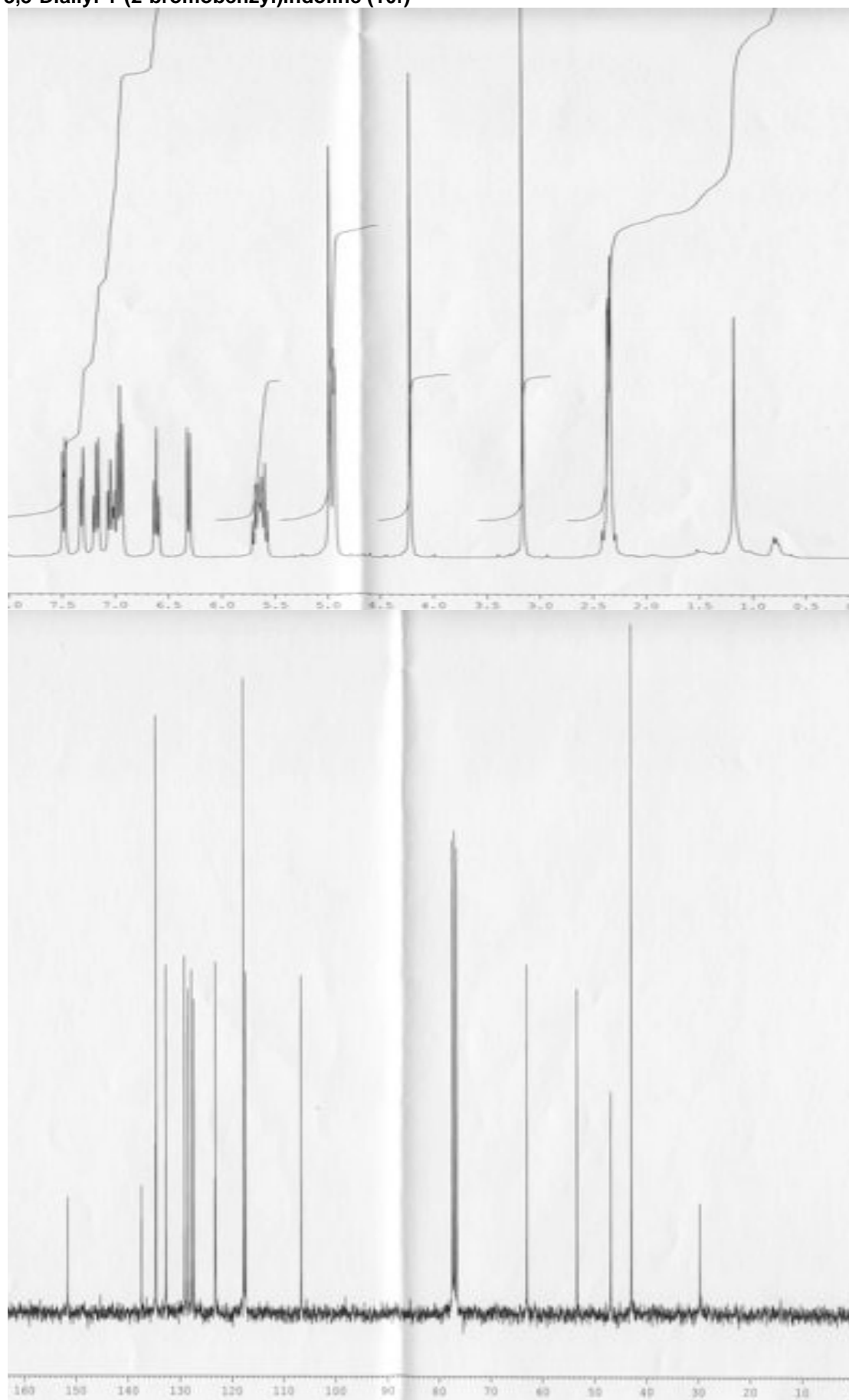
1-(2-Iodo-4,5-dimethoxybenzyl)-3,3-diphenyl-2,3-dihydro-1H-indole (10d)



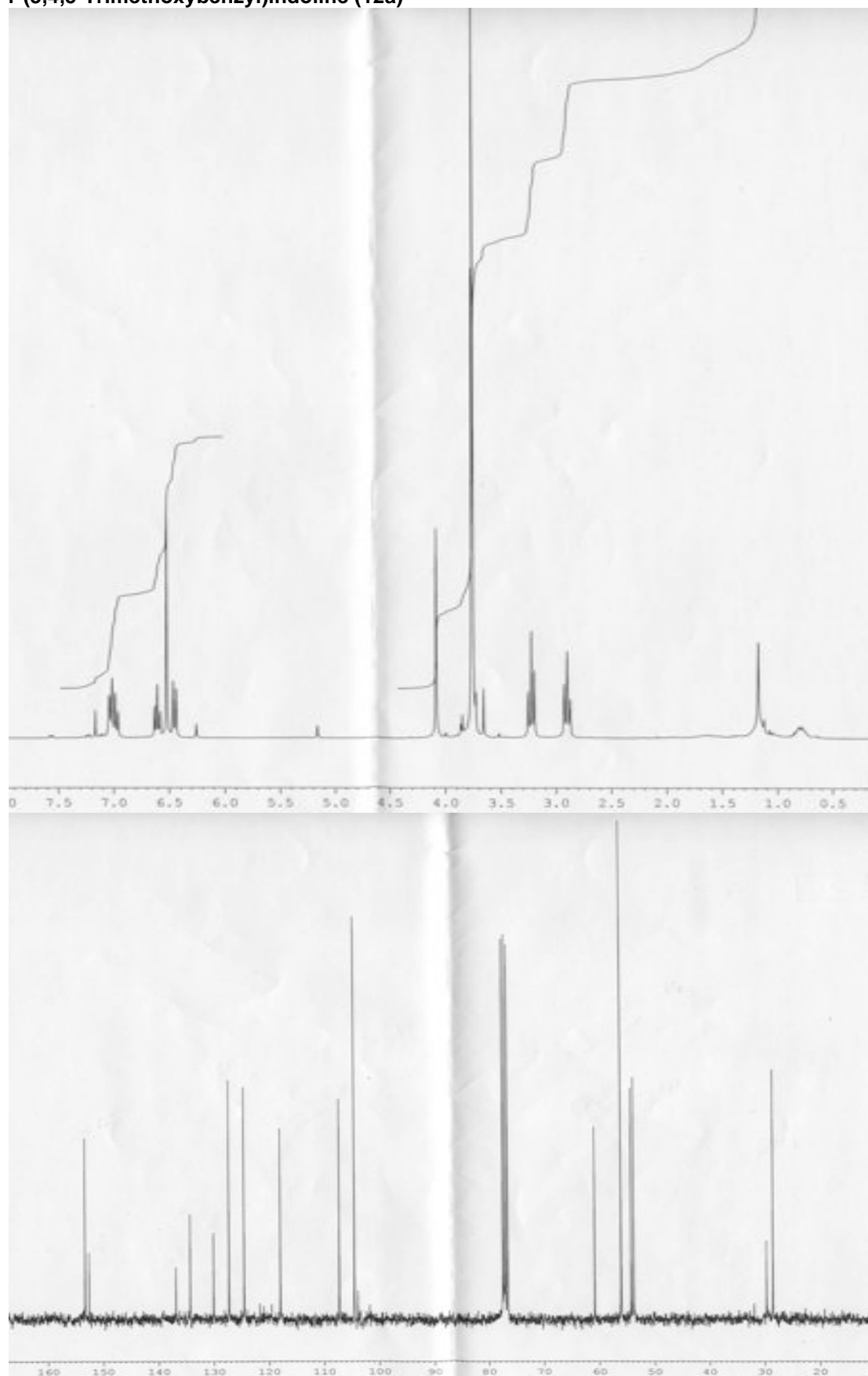
**3-Benzyl-1-(2-bromobenzyl)-2,3-dihydro-1H-indole (10e)**



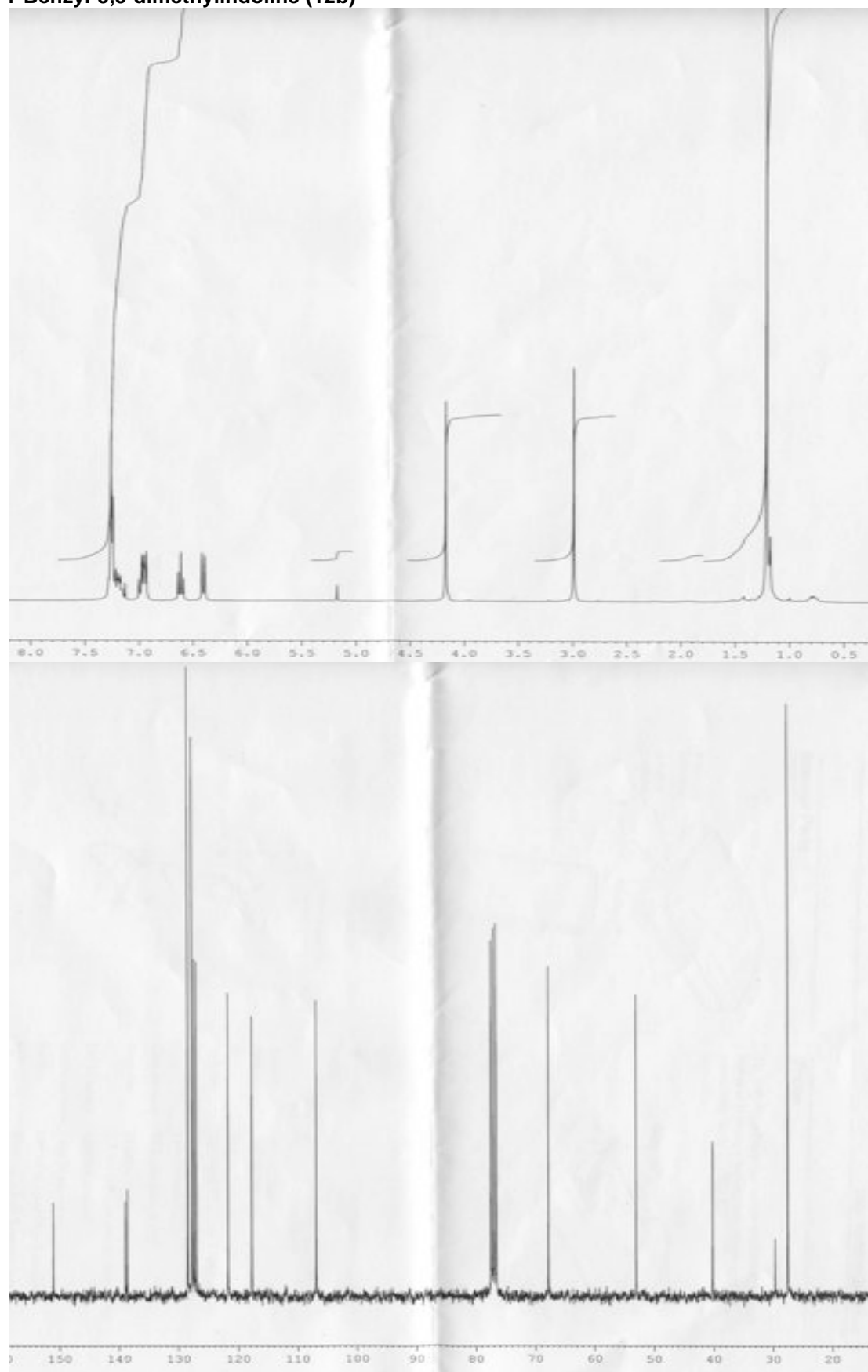
**3,3-Diallyl-1-(2-bromobenzyl)indoline (10f)**



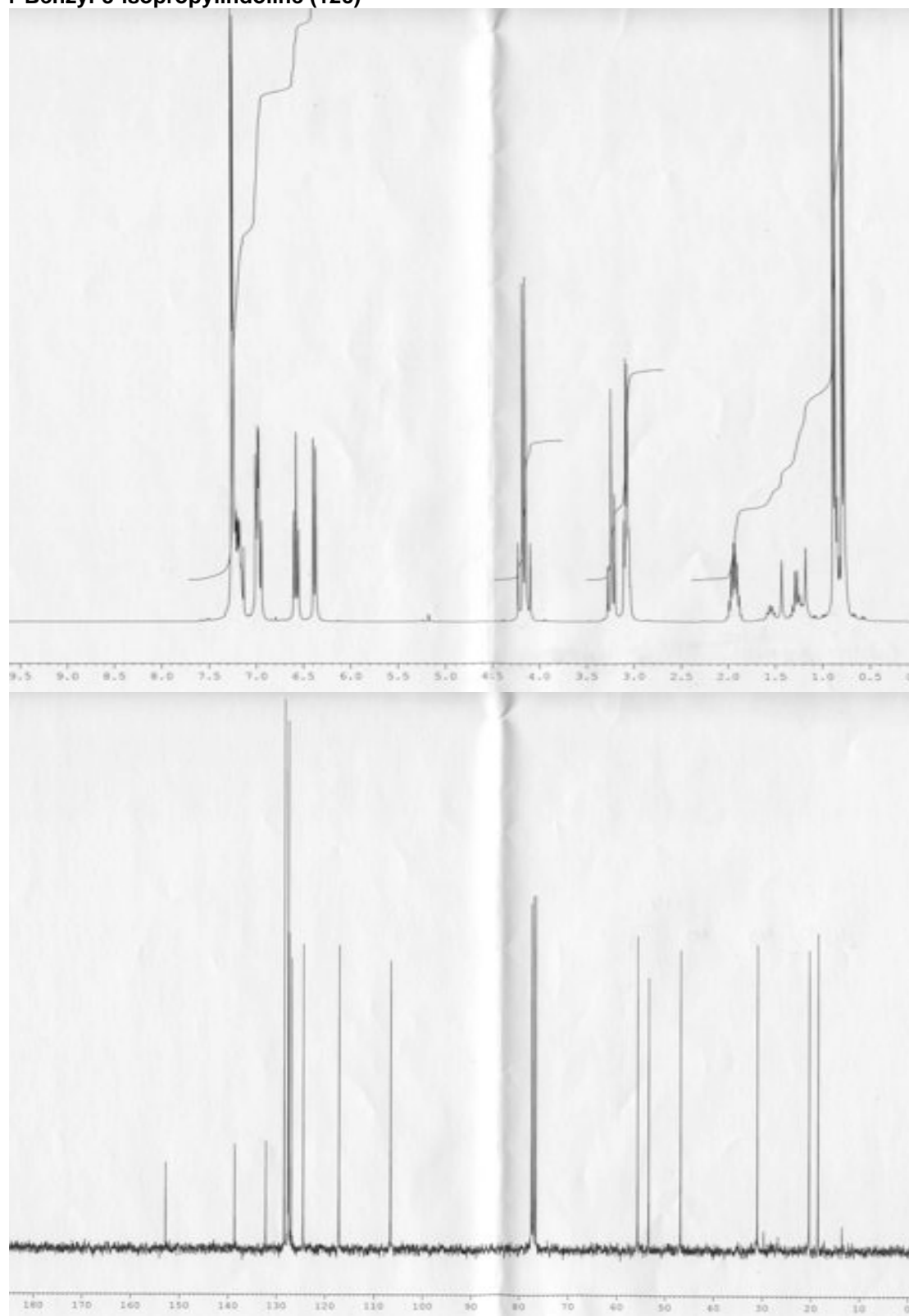
**1-(3,4,5-Trimethoxybenzyl)indoline (12a)**



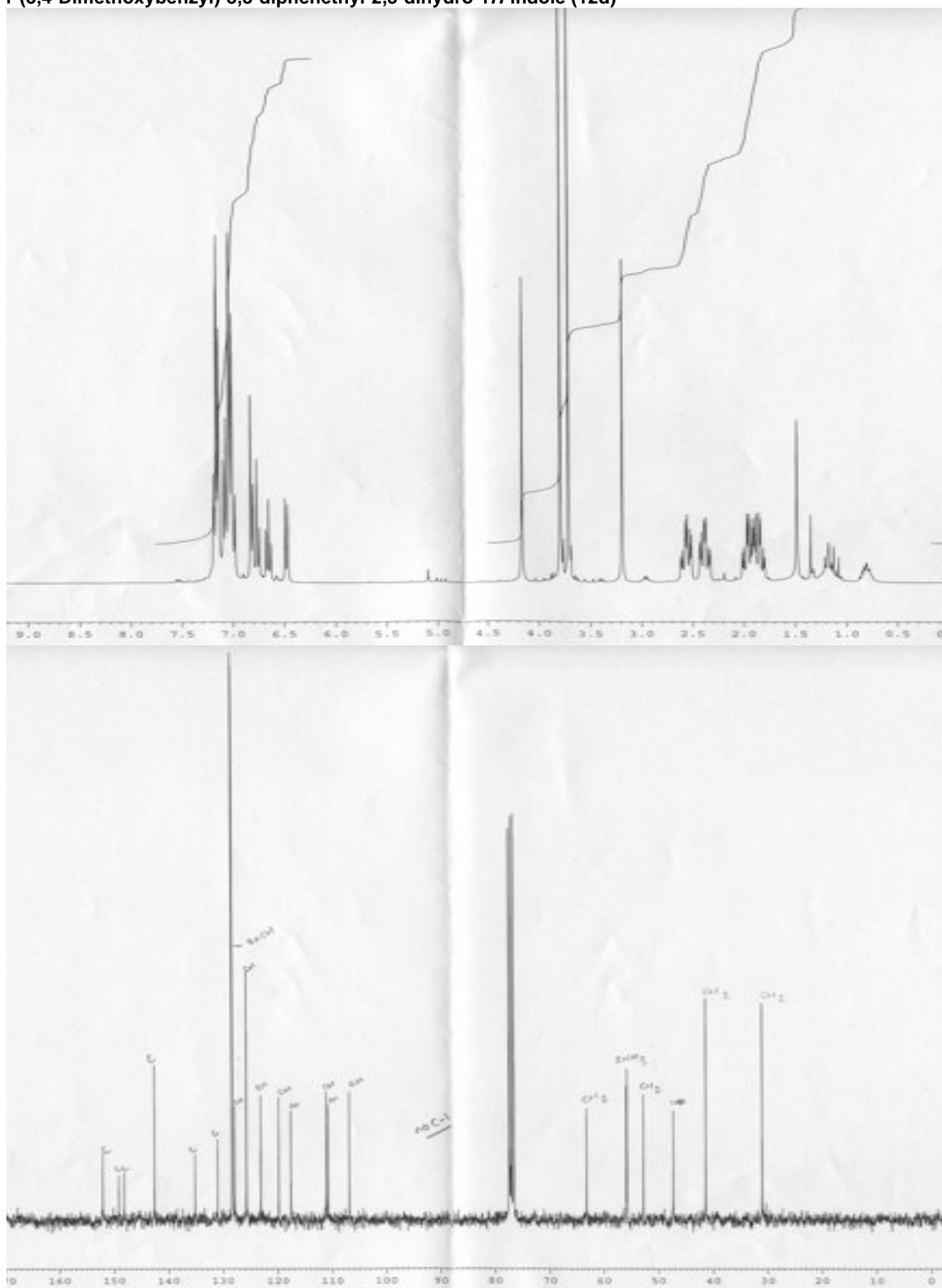
**1-Benzyl-3,3-dimethylindoline (12b)**



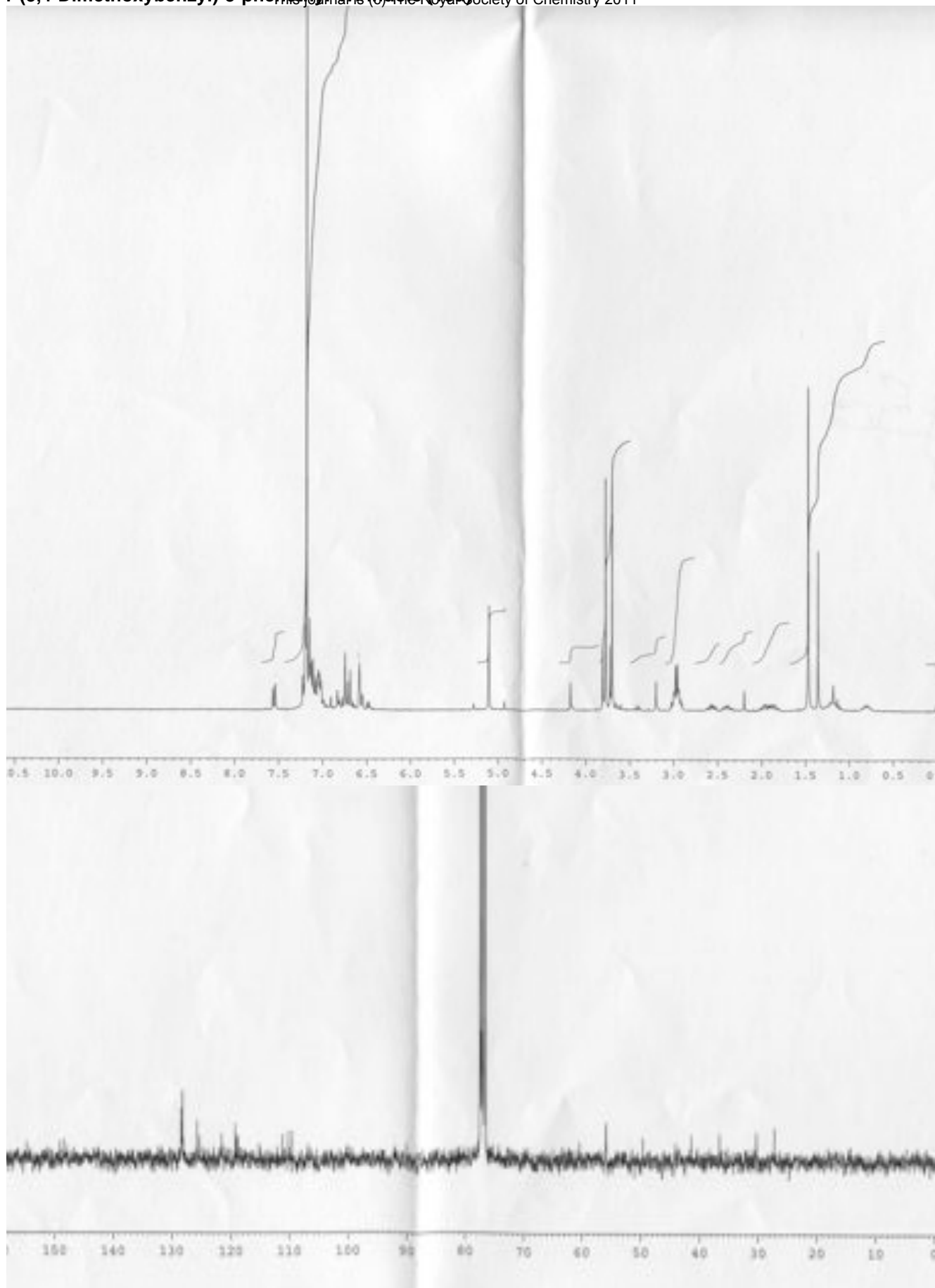
**1-Benzyl-3-isopropylindoline (12c)**



**1-(3,4-Dimethoxybenzyl)-3,3-diphenethyl-2,3-dihydro-1H-indole (12d)**

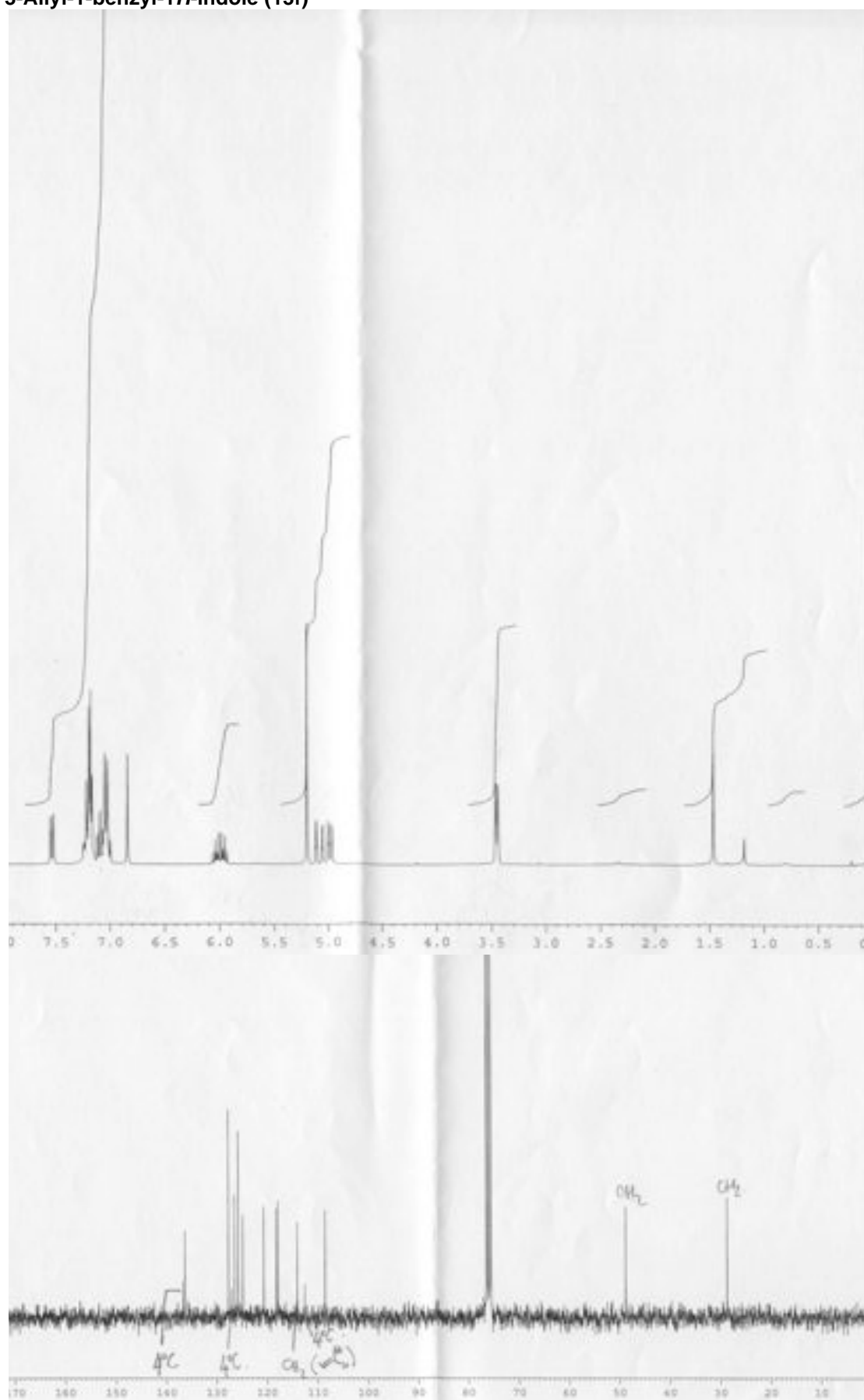




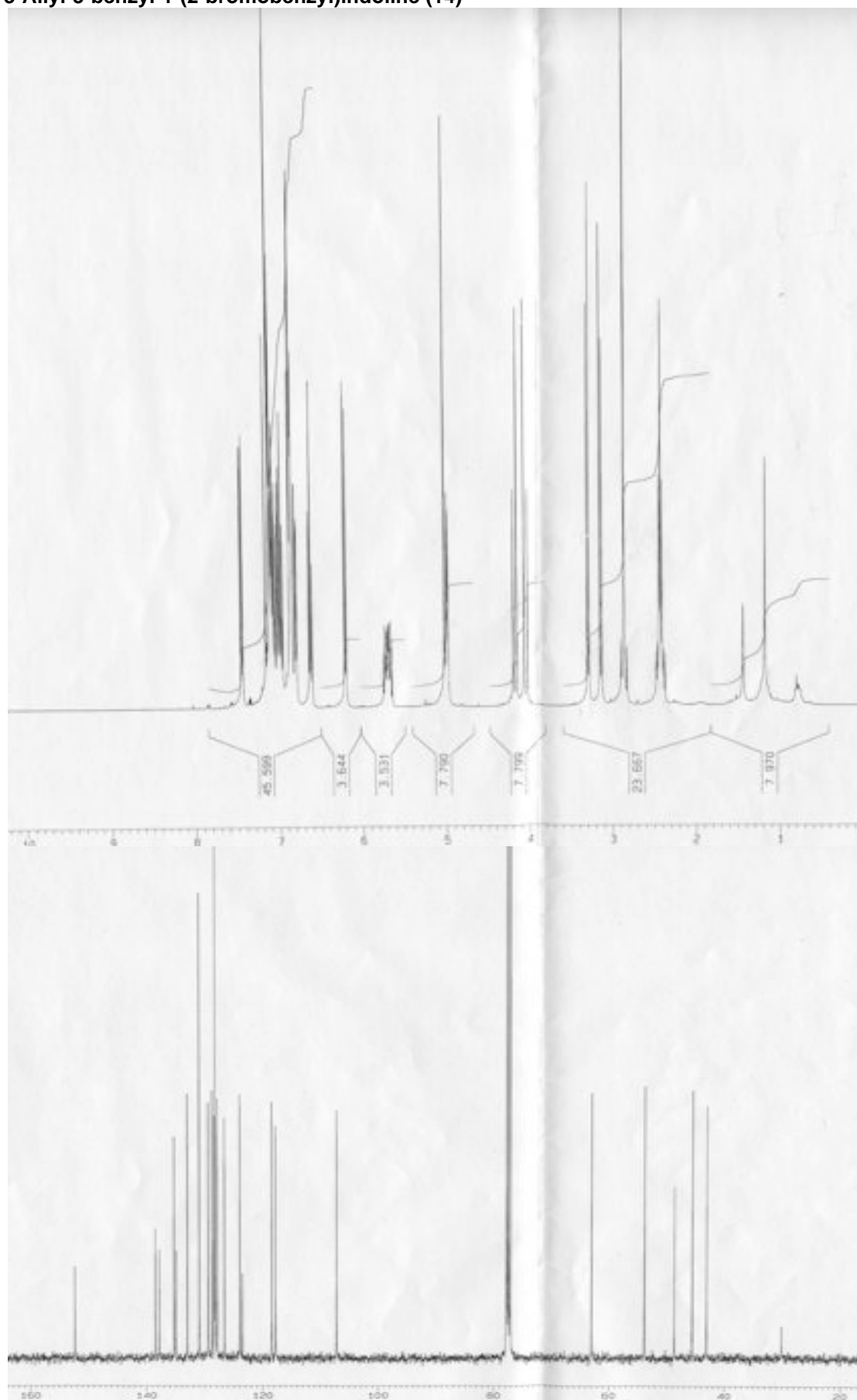




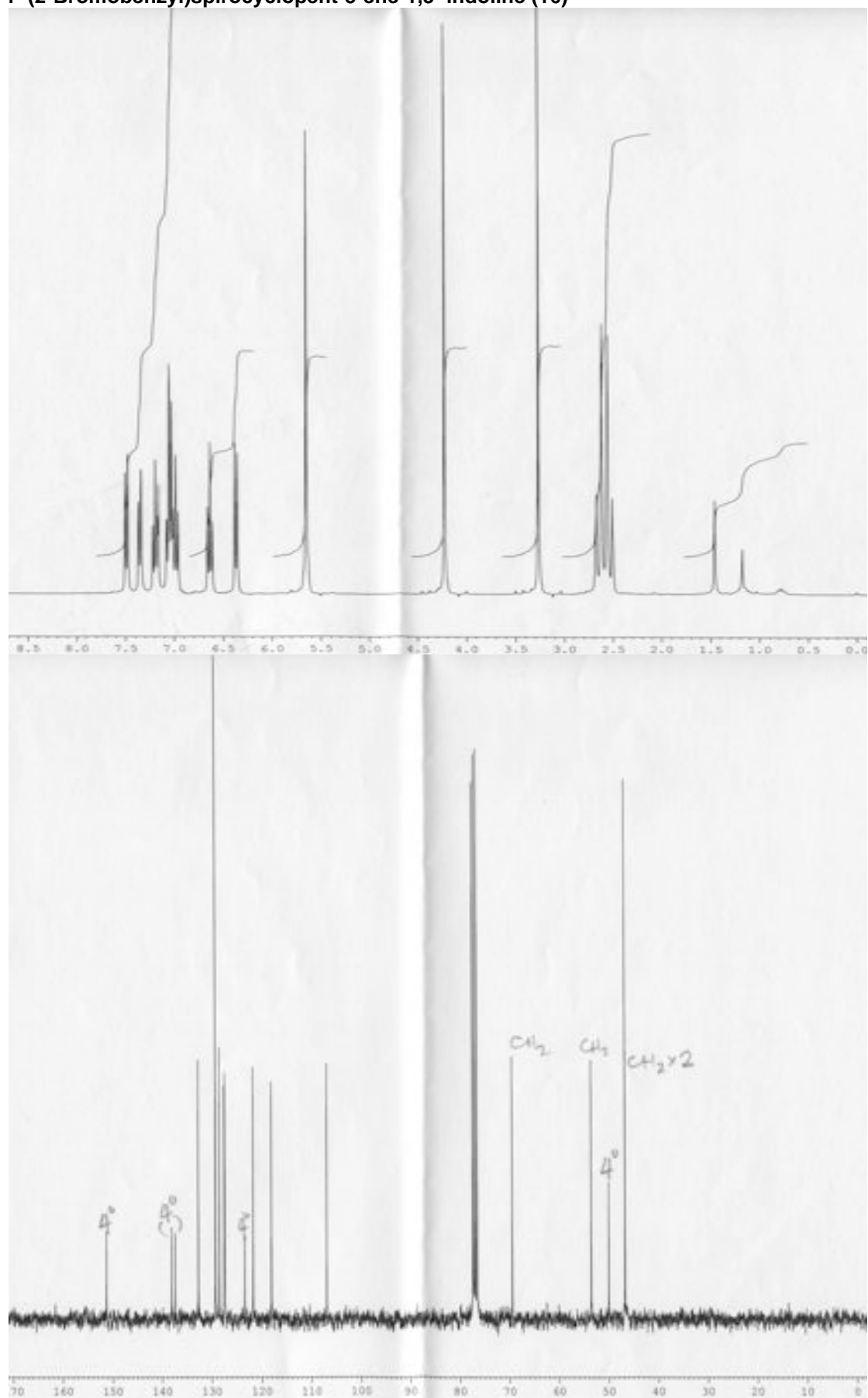
**3-Allyl-1-benzyl-1H-indole (13f)**



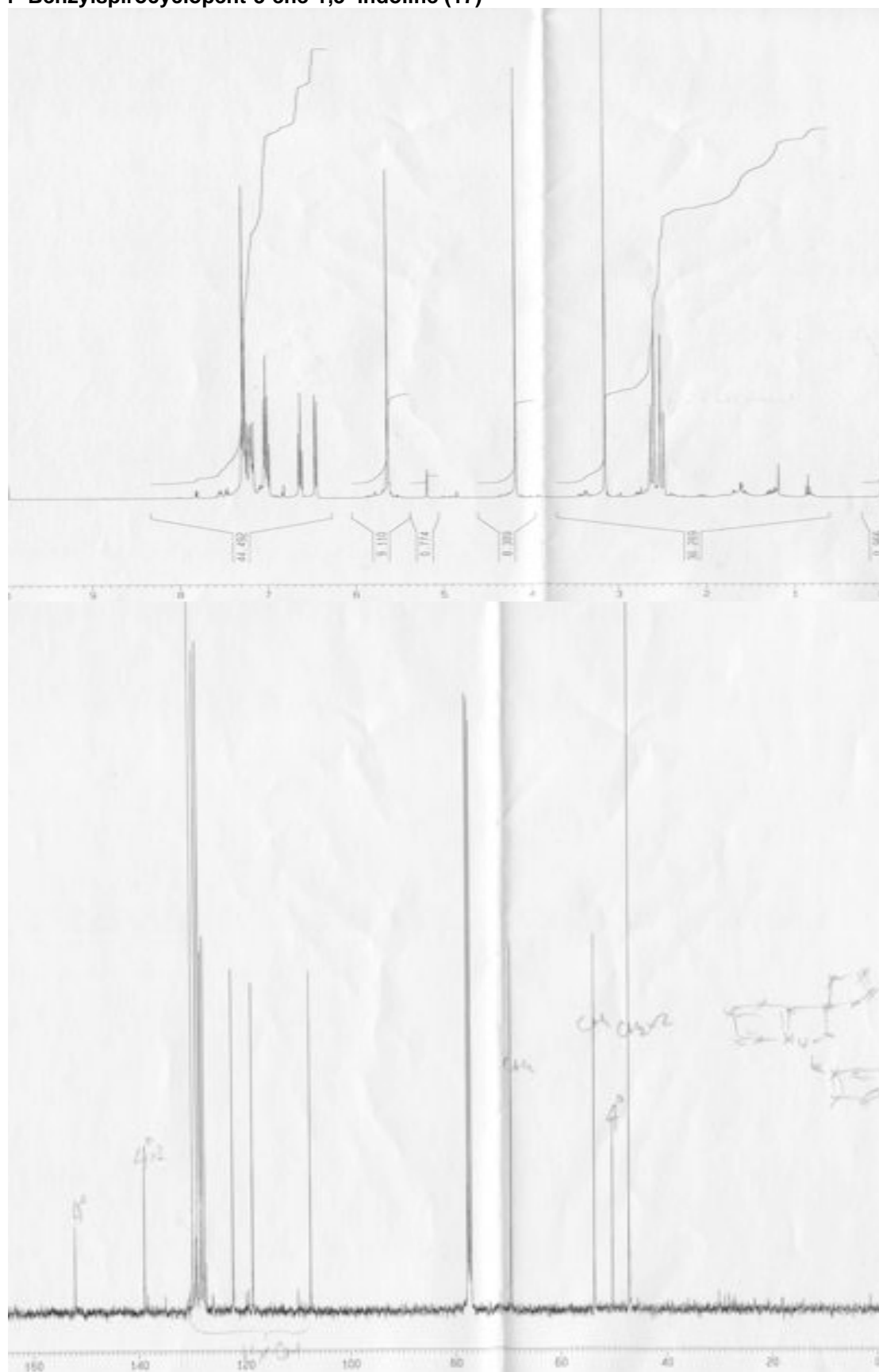
**3-Allyl-3-benzyl-1-(2-bromobenzyl)indoline (14)**



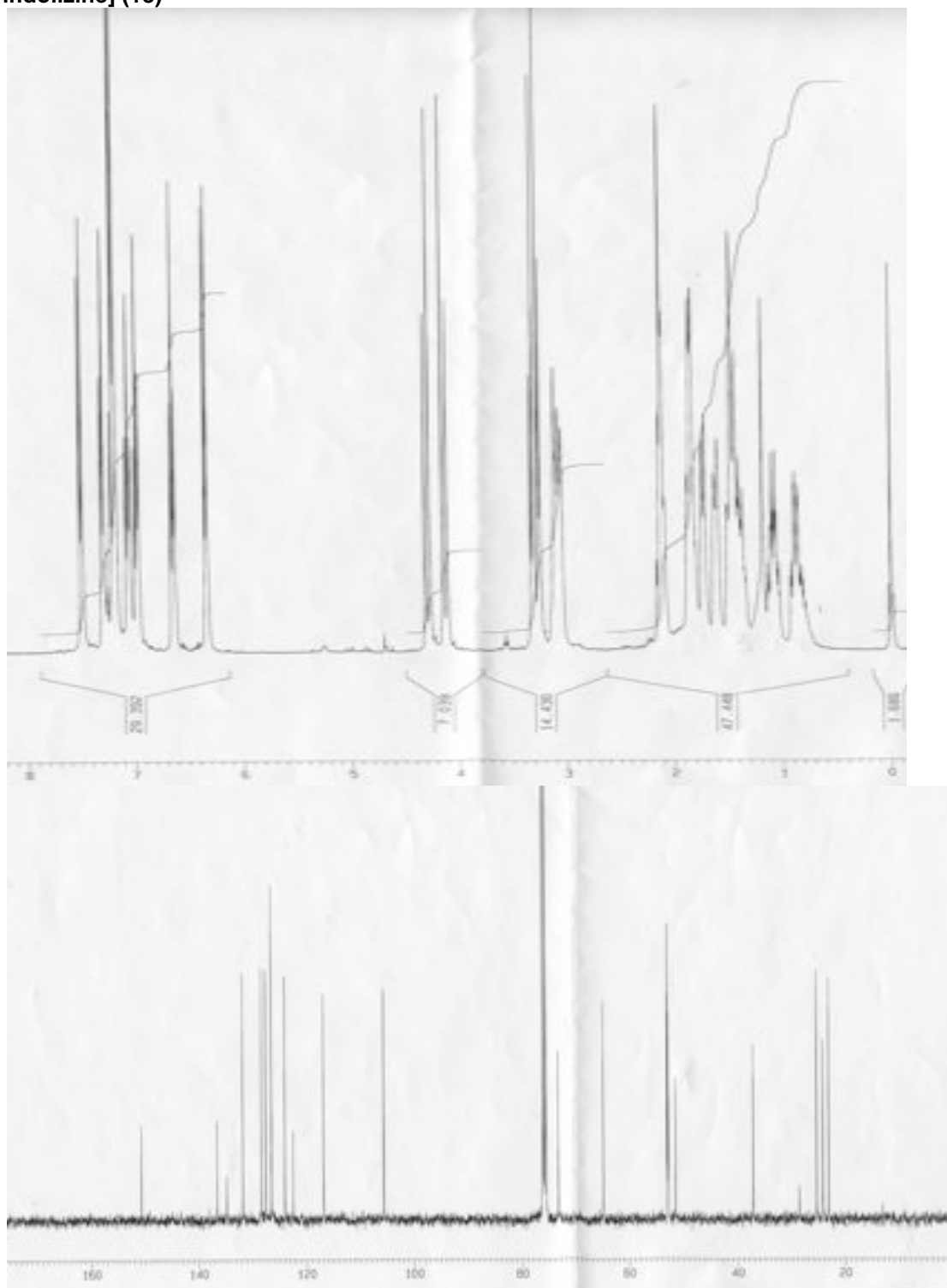
**1'-(2-Bromobenzyl)spirocyclopent-3-ene-1,3'-indoline (16)**



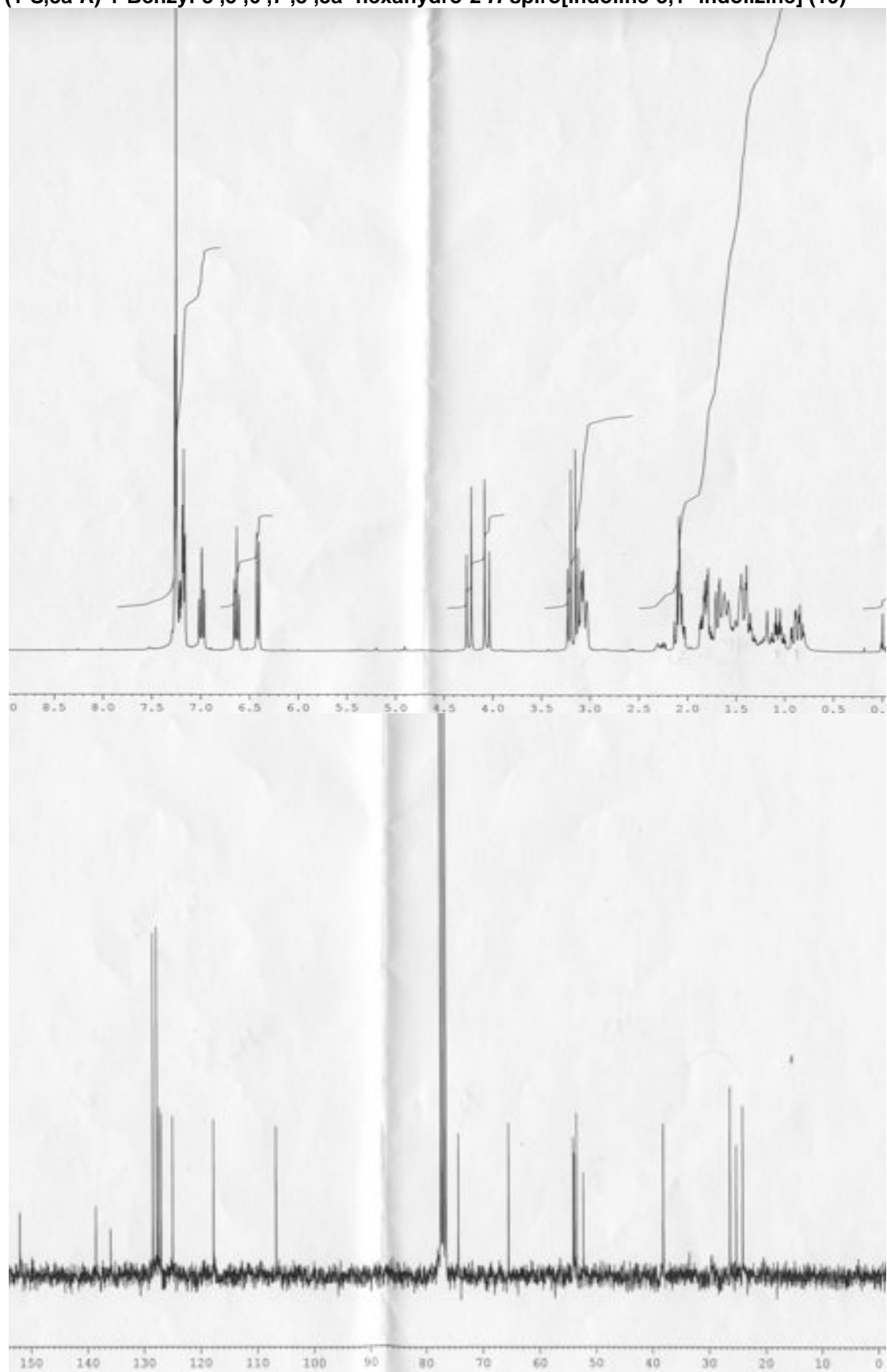
**1'-Benzylspirocyclopent-3-ene-1,3'-indoline (17)**



**(1'*S*,8*a'**R*)-1-(2-Bromobenzyl)-3',5',6',7',8',8*a'*-hexahydro-2'*H*-spiro[indoline-3,1'-indolizine] (18)**

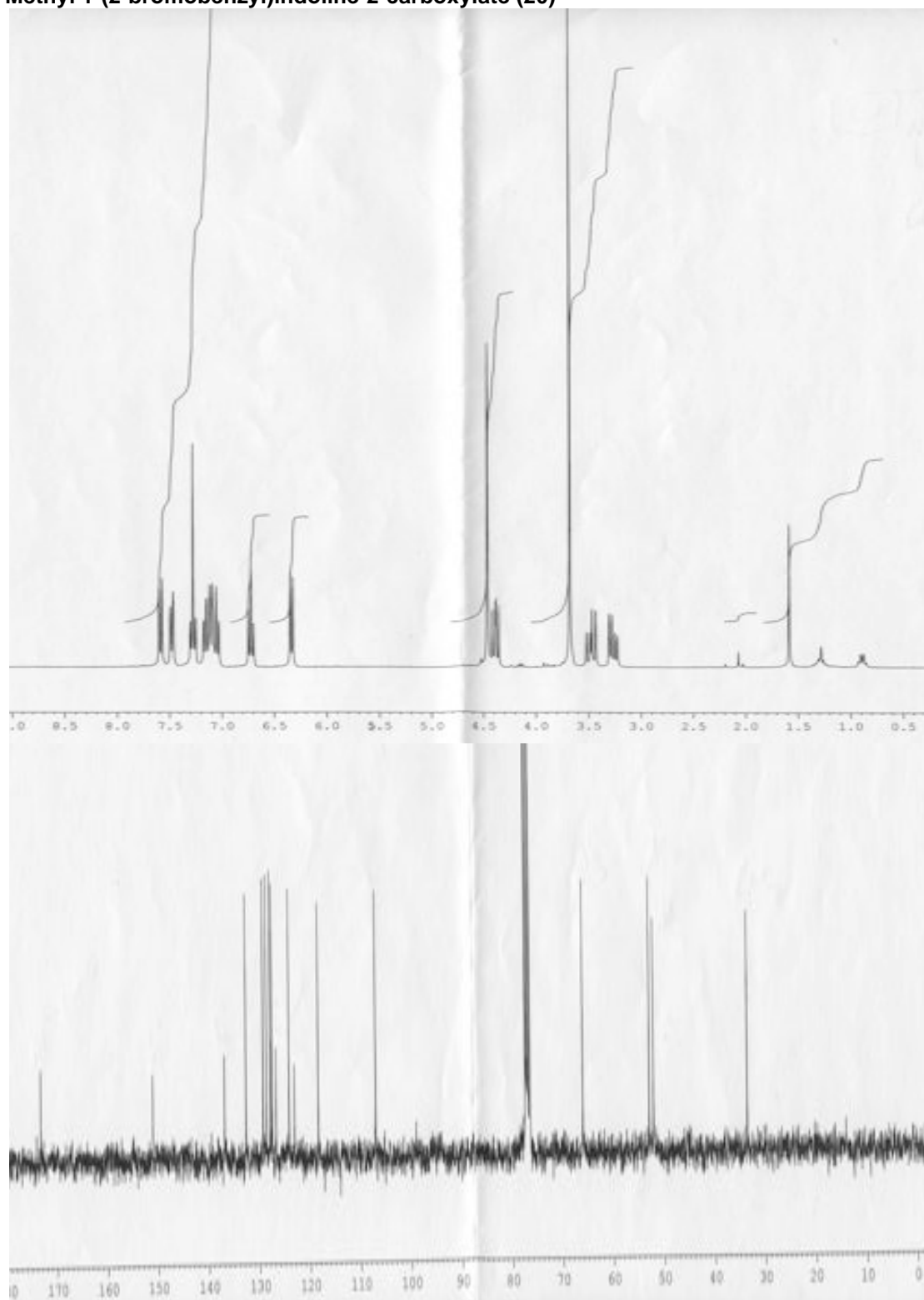


**(1'*S*,8*a*'*R*)-1-Benzyl-3',5',6',7',8',8*a*'-hexahydro-2'*H*-spiro[indoline-3,1'-indolizine] (19)**

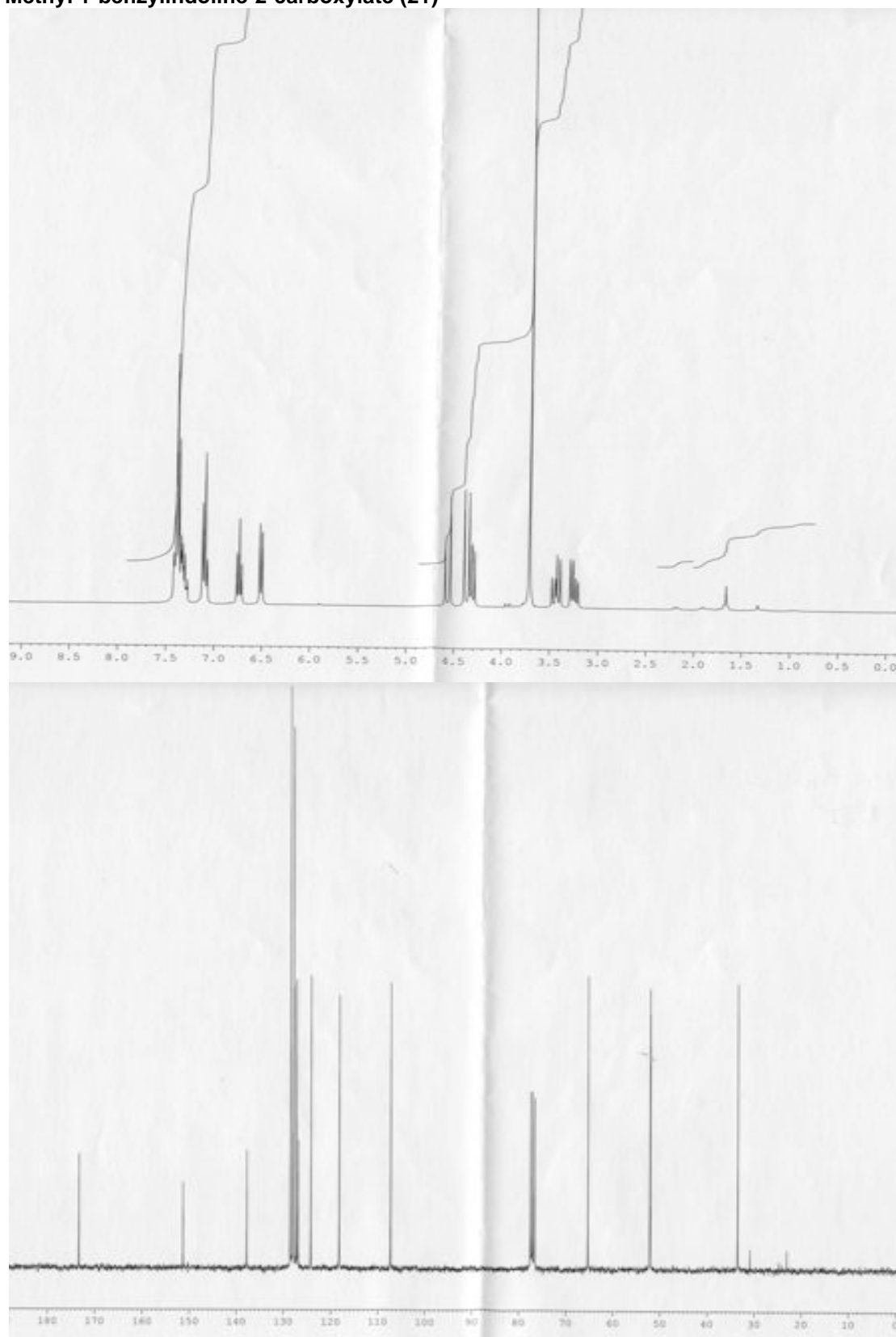




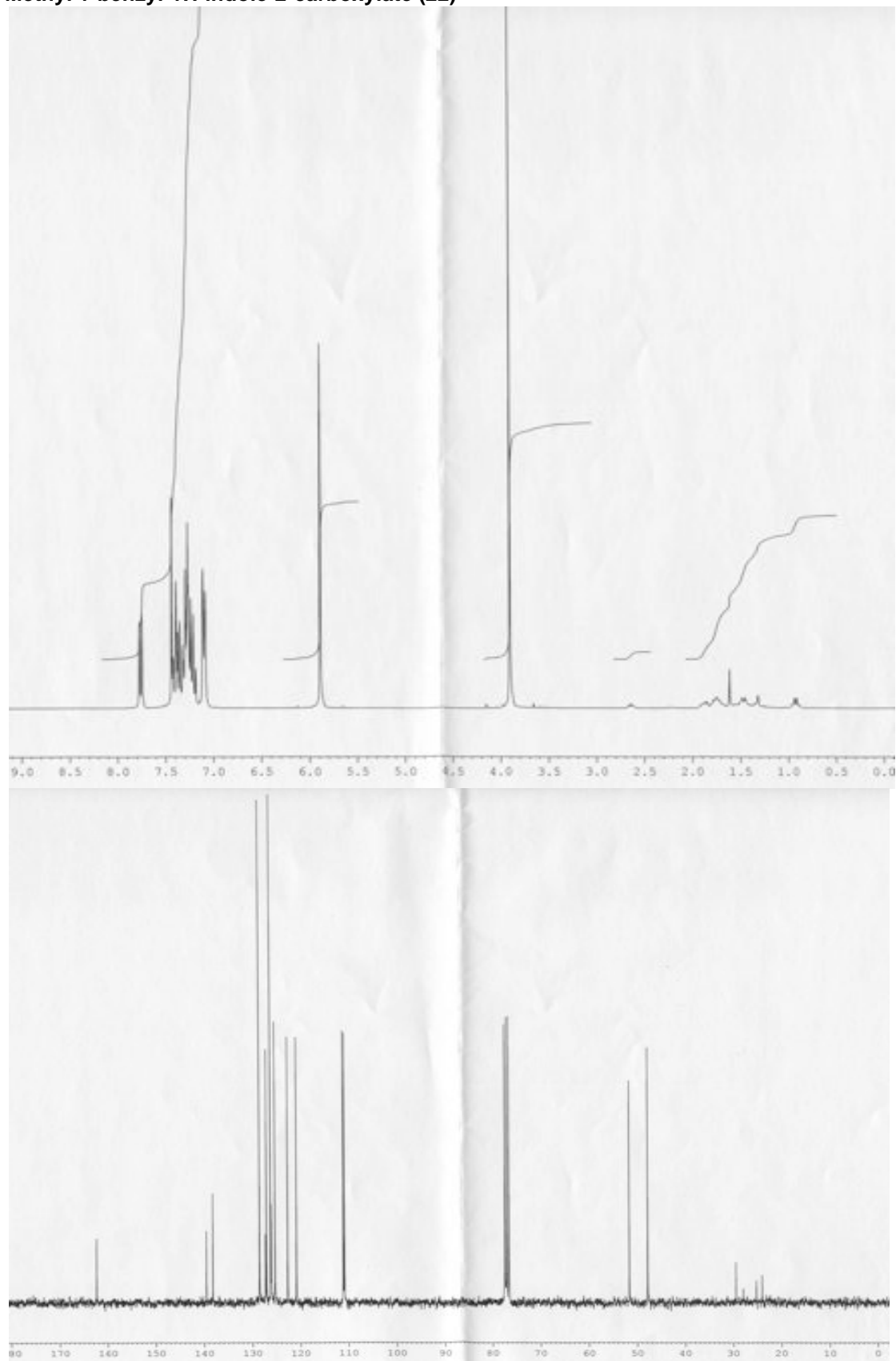
**Methyl 1-(2-bromobenzyl)indoline-2-carboxylate (20)**



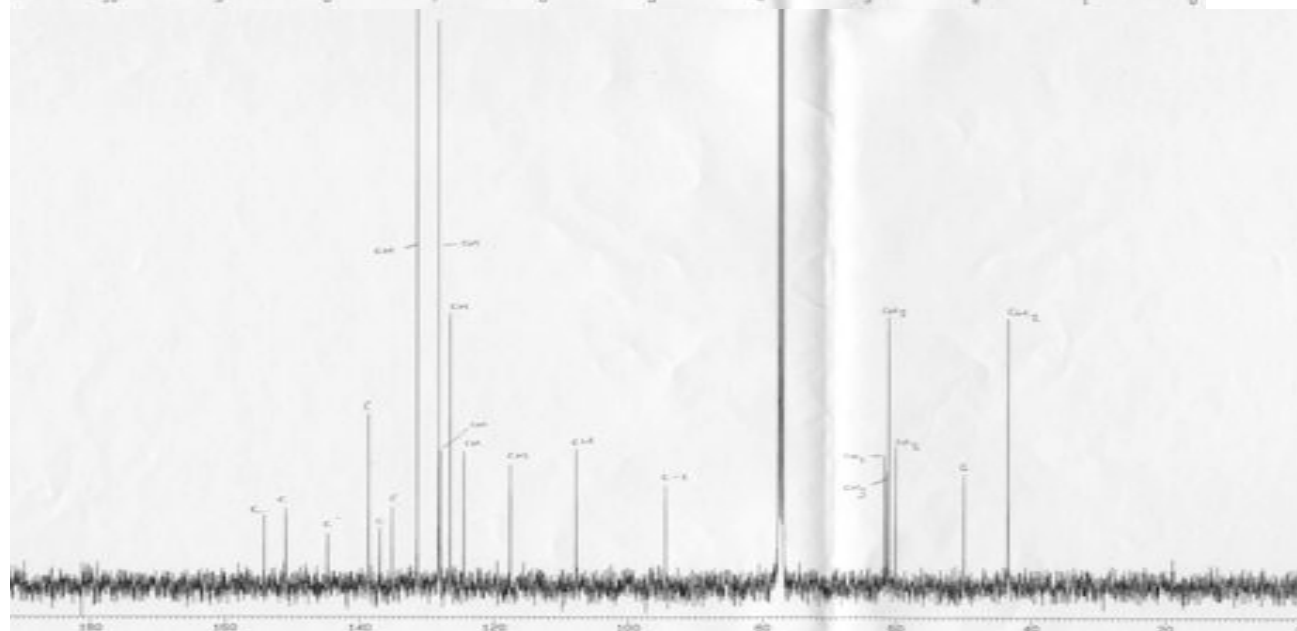
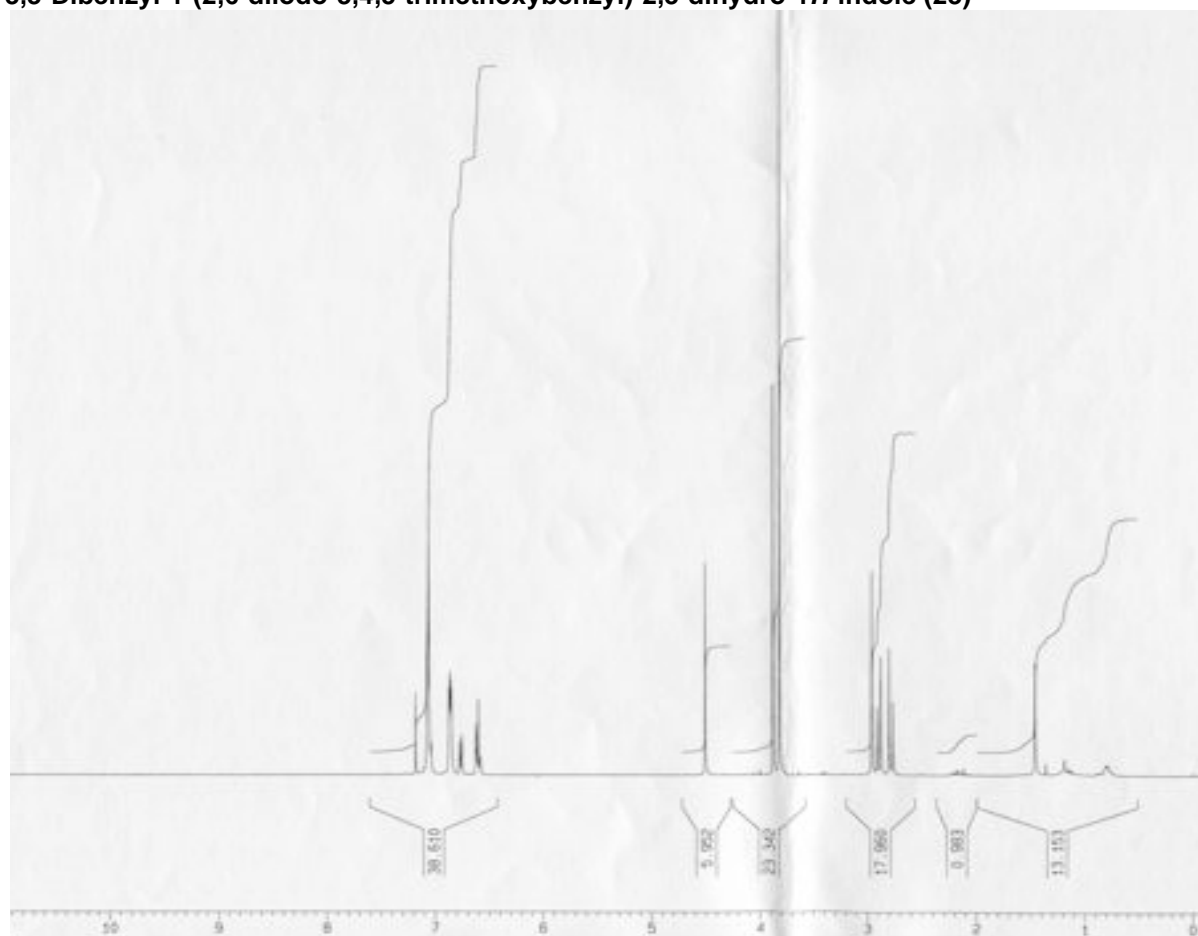
**Methyl 1-benzylindoline-2-carboxylate (21)**



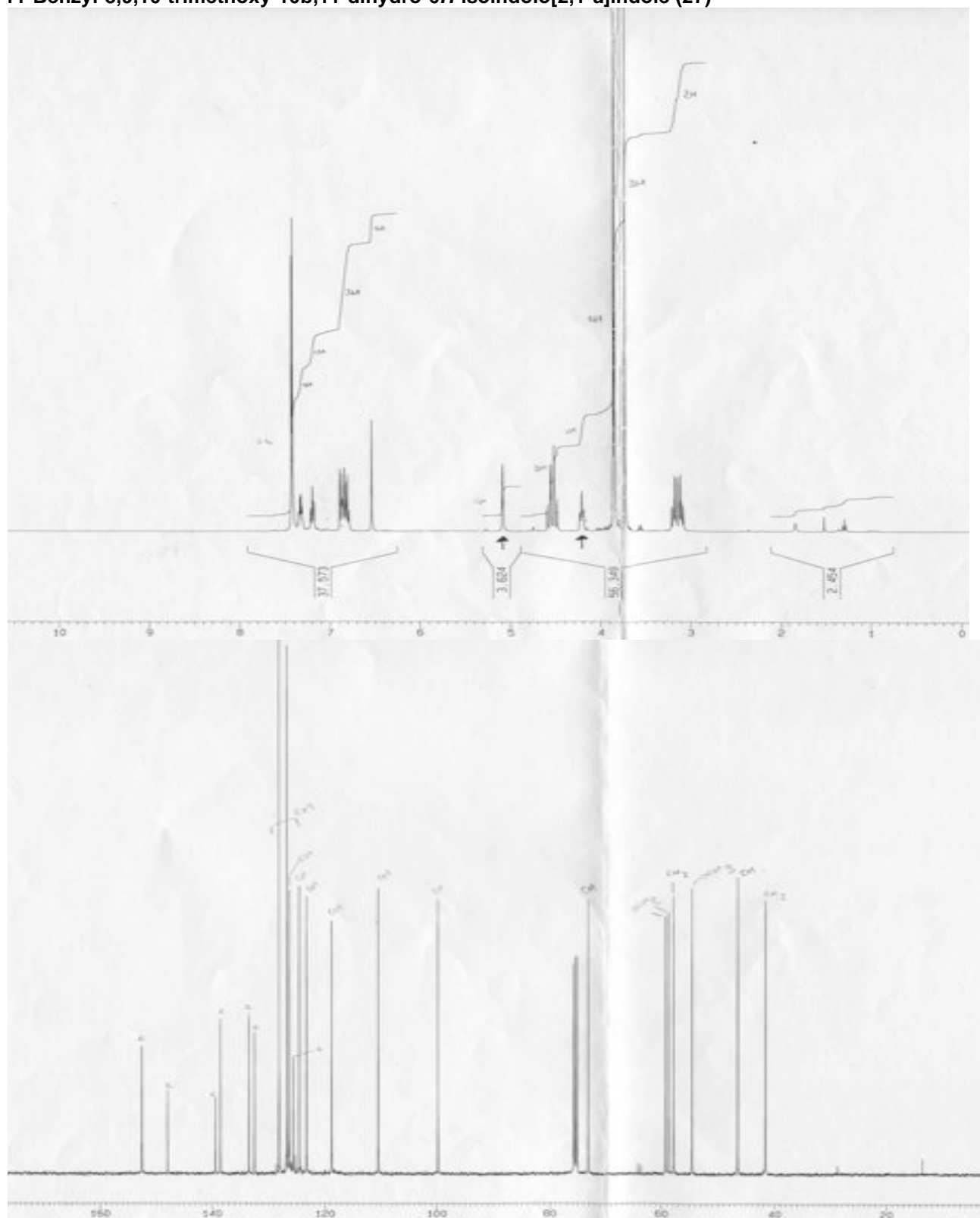
**Methyl 1-benzyl-1*H*-indole-2-carboxylate (22)**

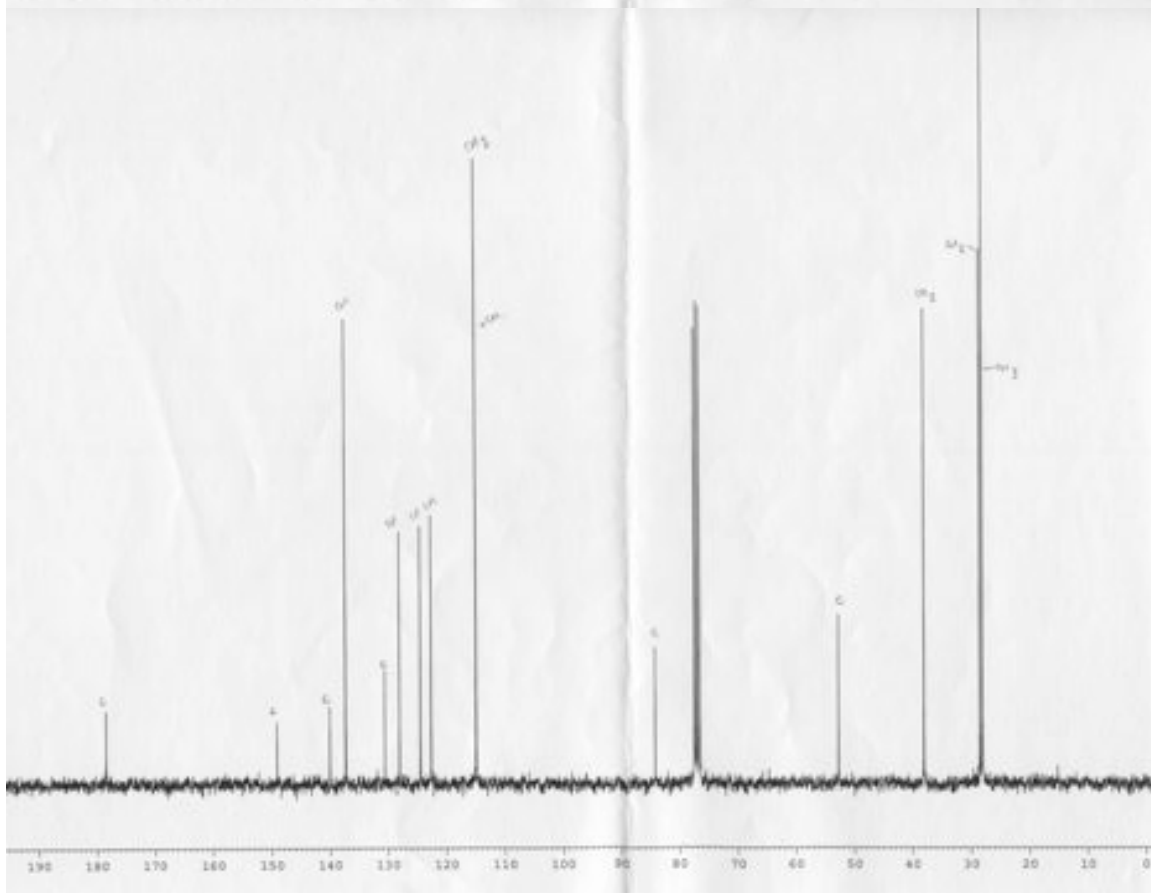
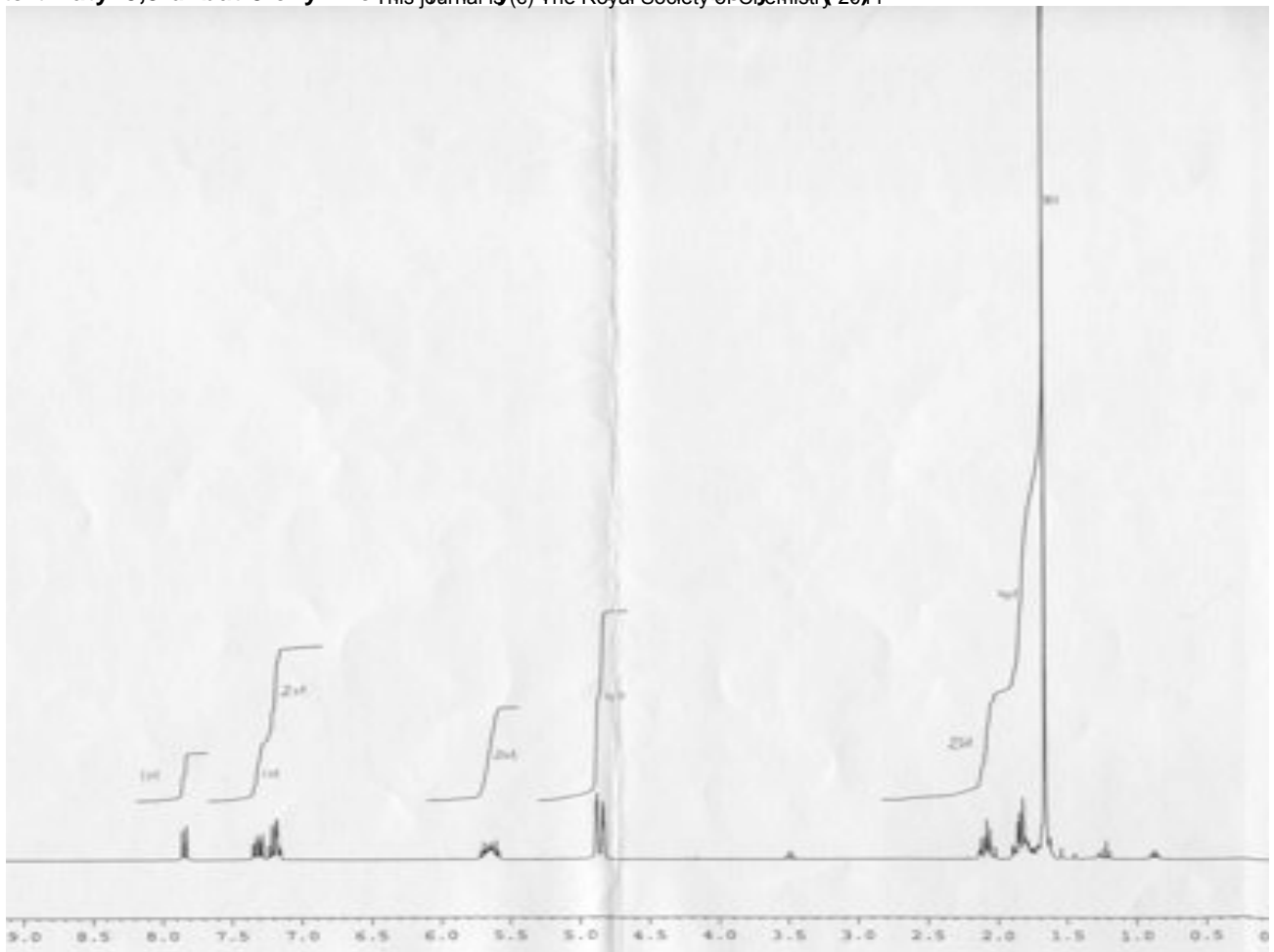


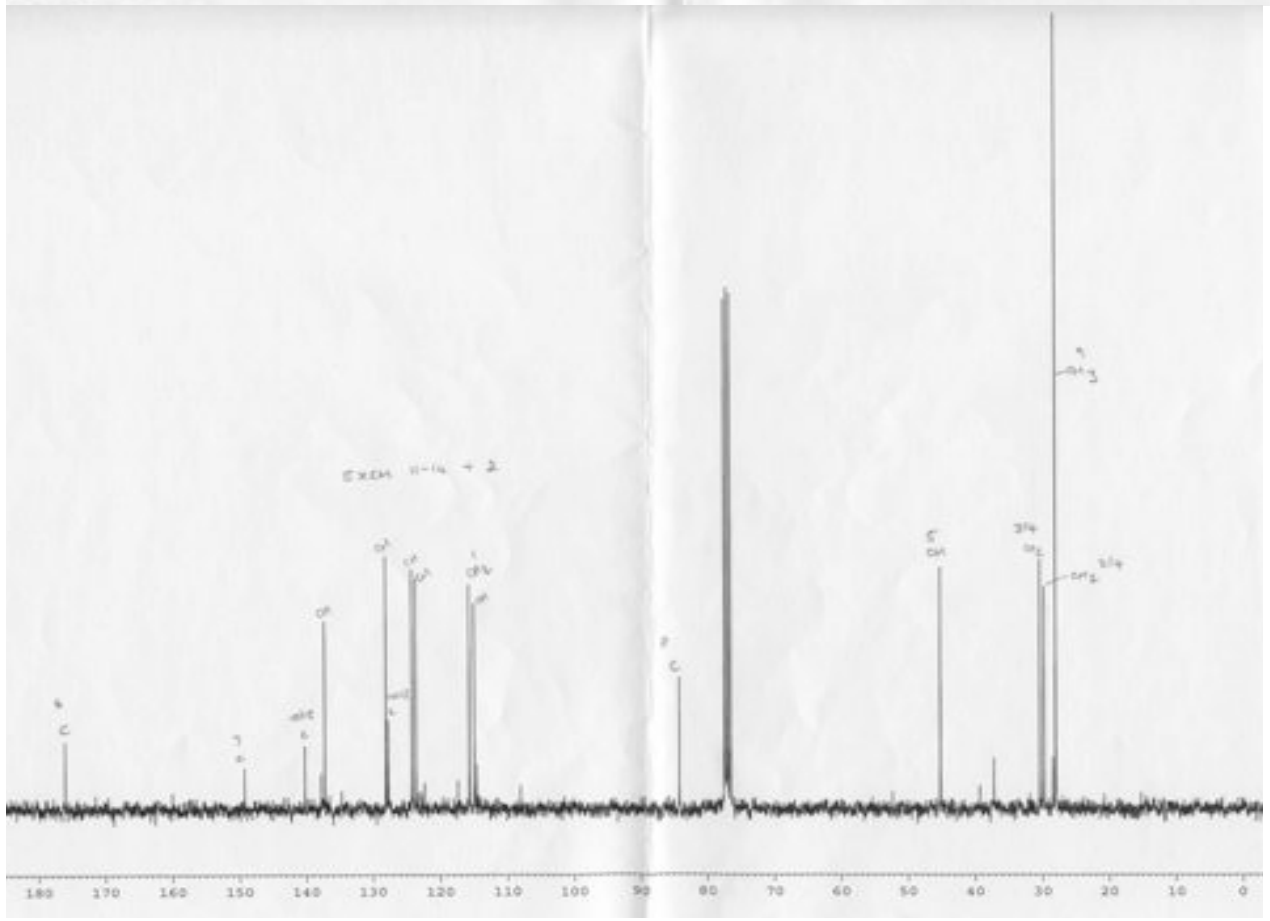
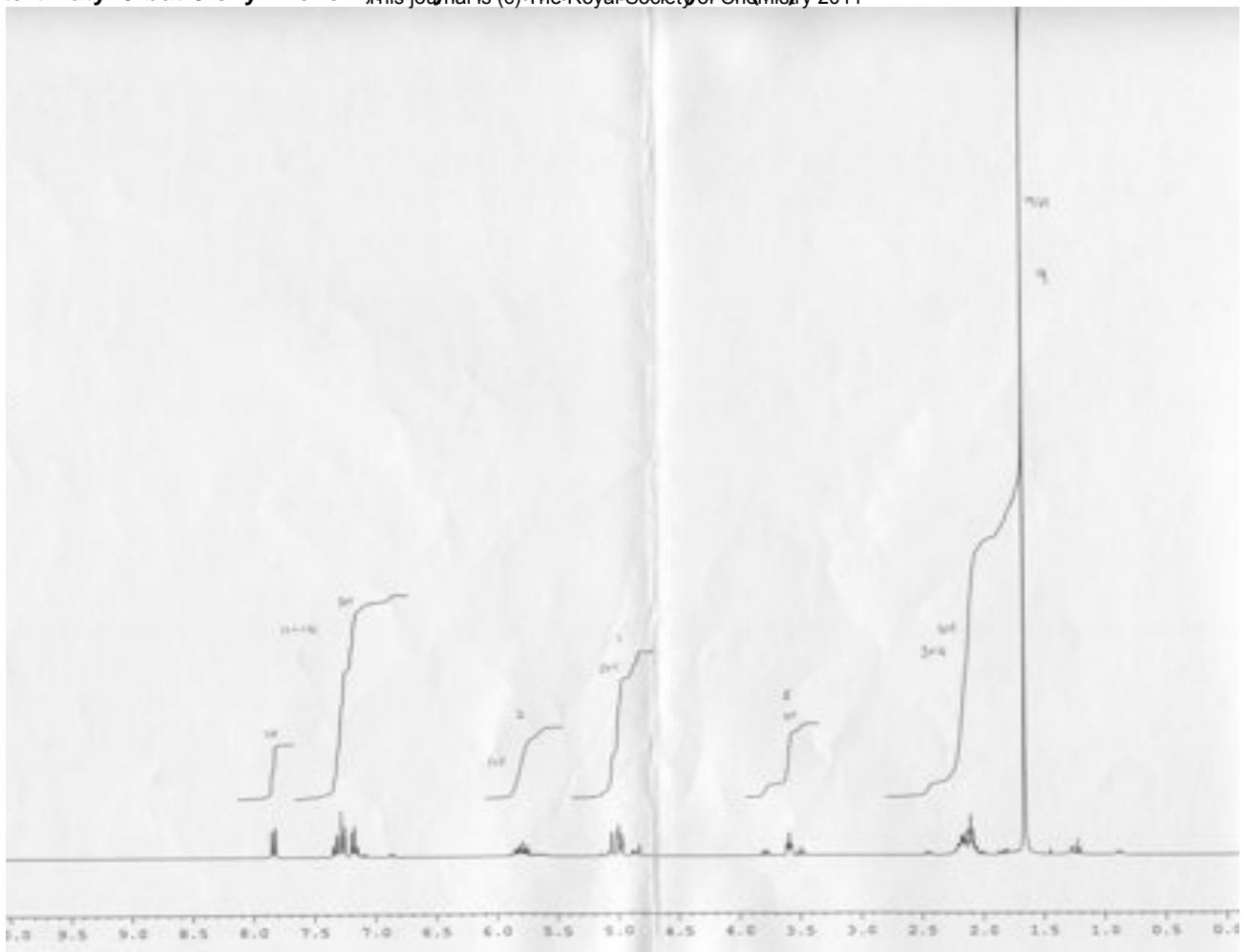
**3,3-Dibenzyl-1-(2,6-diiodo-3,4,5-trimethoxybenzyl)-2,3-dihydro-1H-indole (23)**

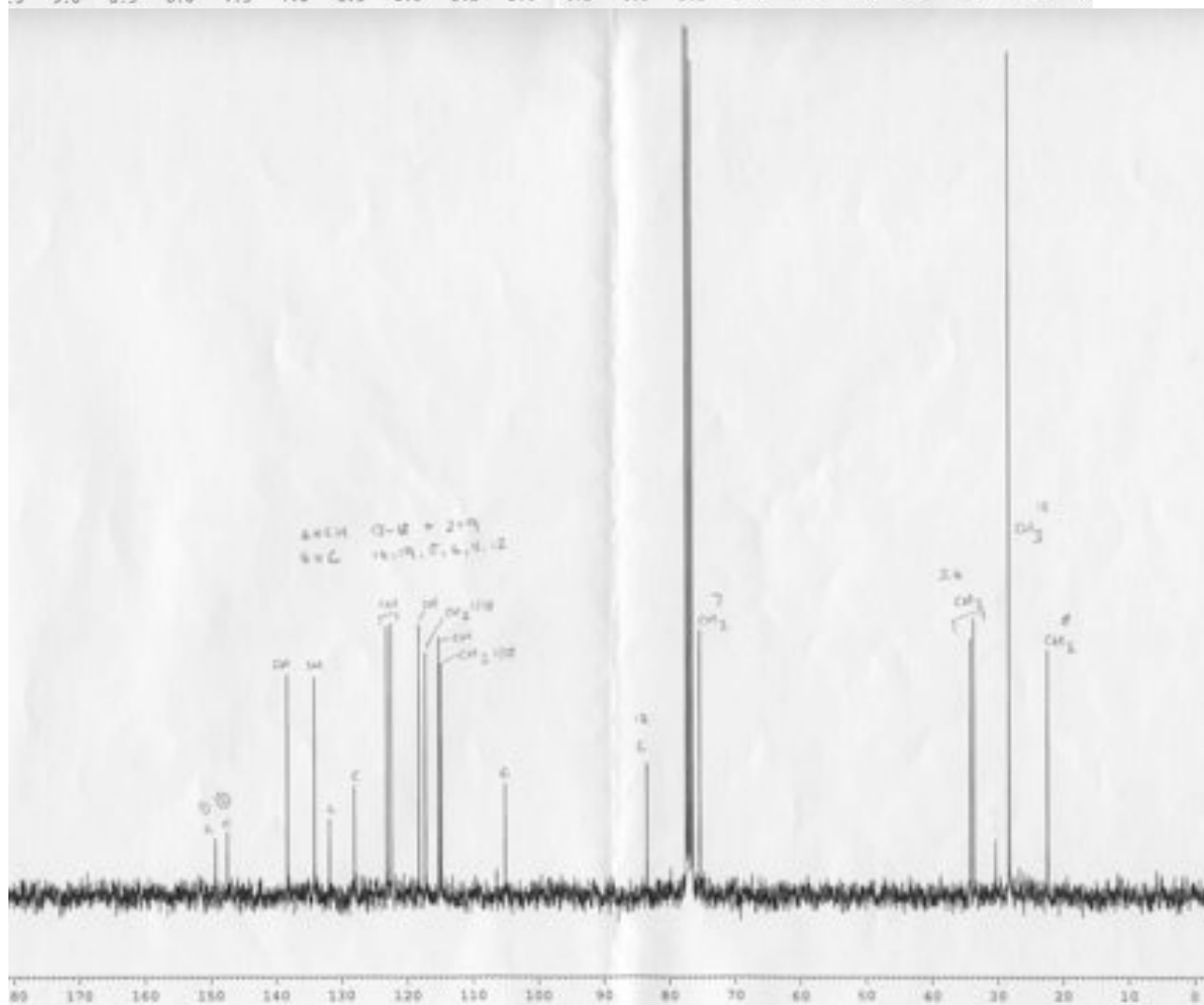
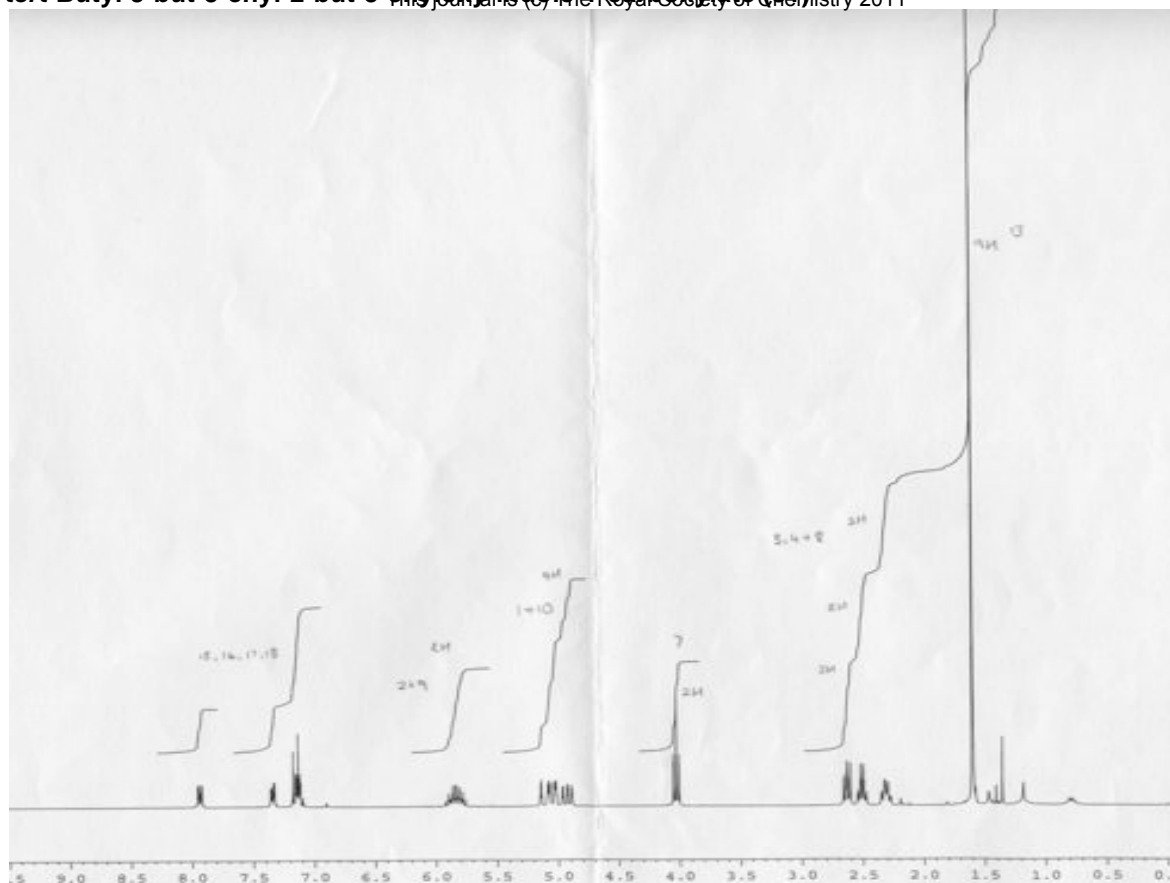


**11-Benzyl-8,9,10-trimethoxy-10b,11-dihydro-6H-isoindolo[2,1-a]indole (27)**

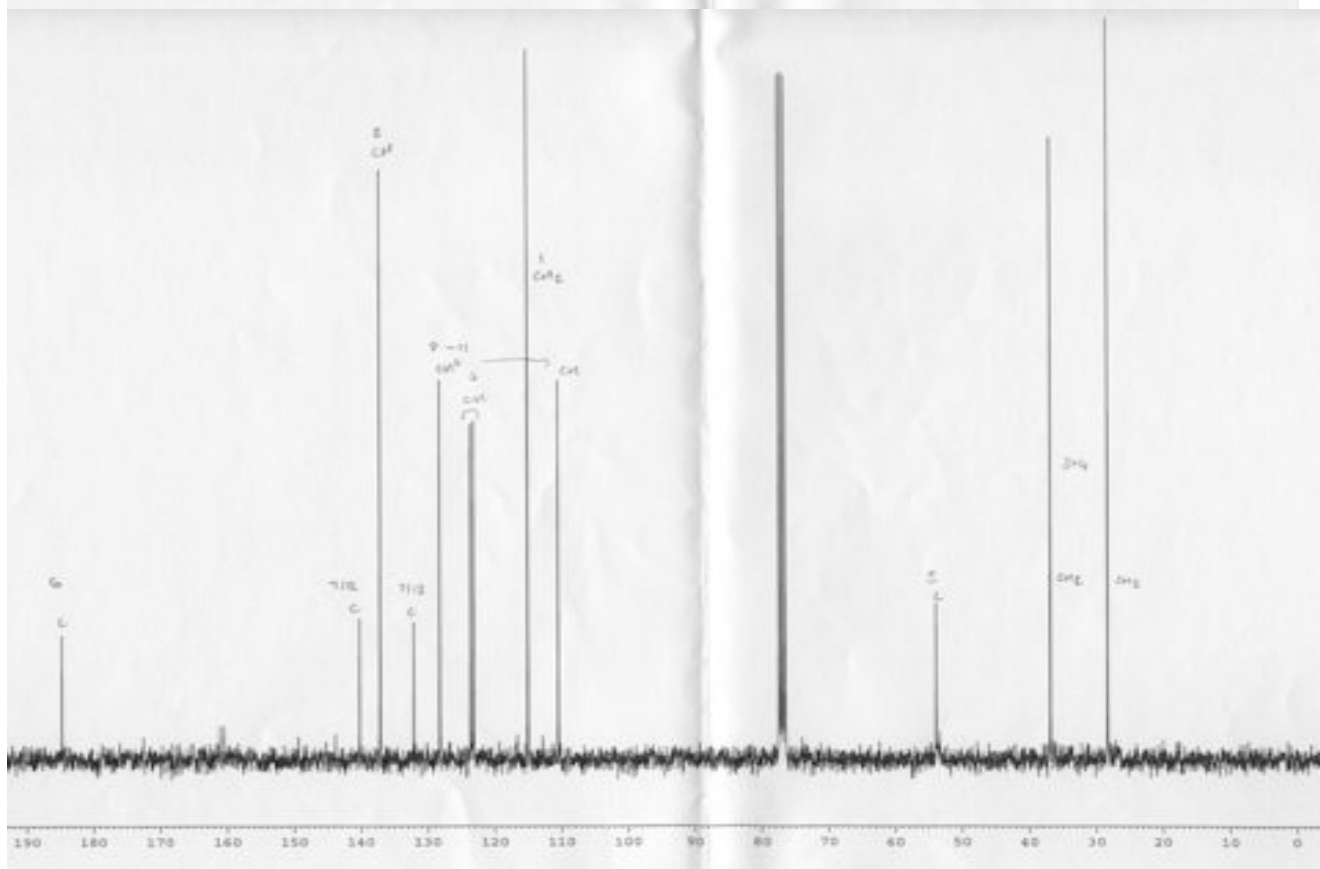
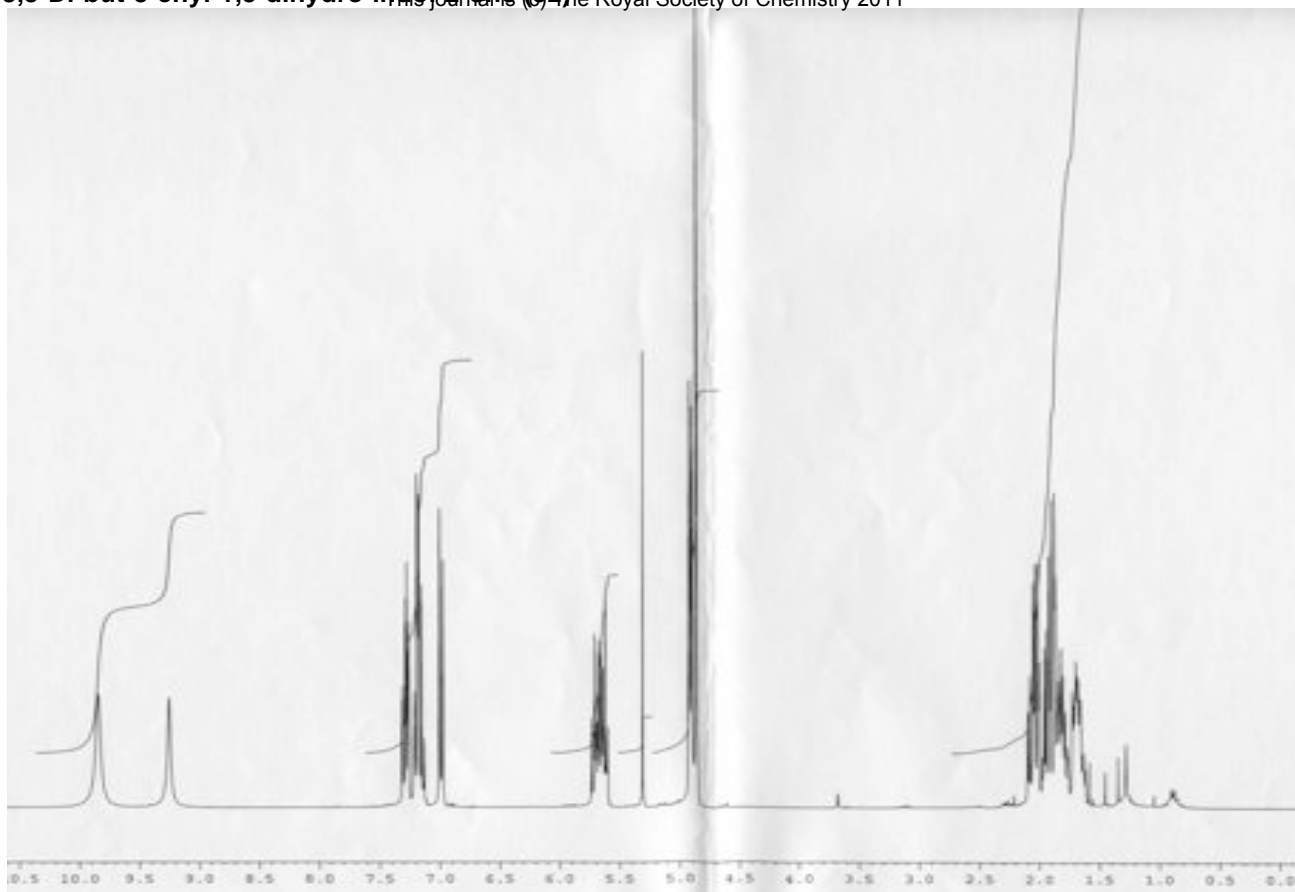


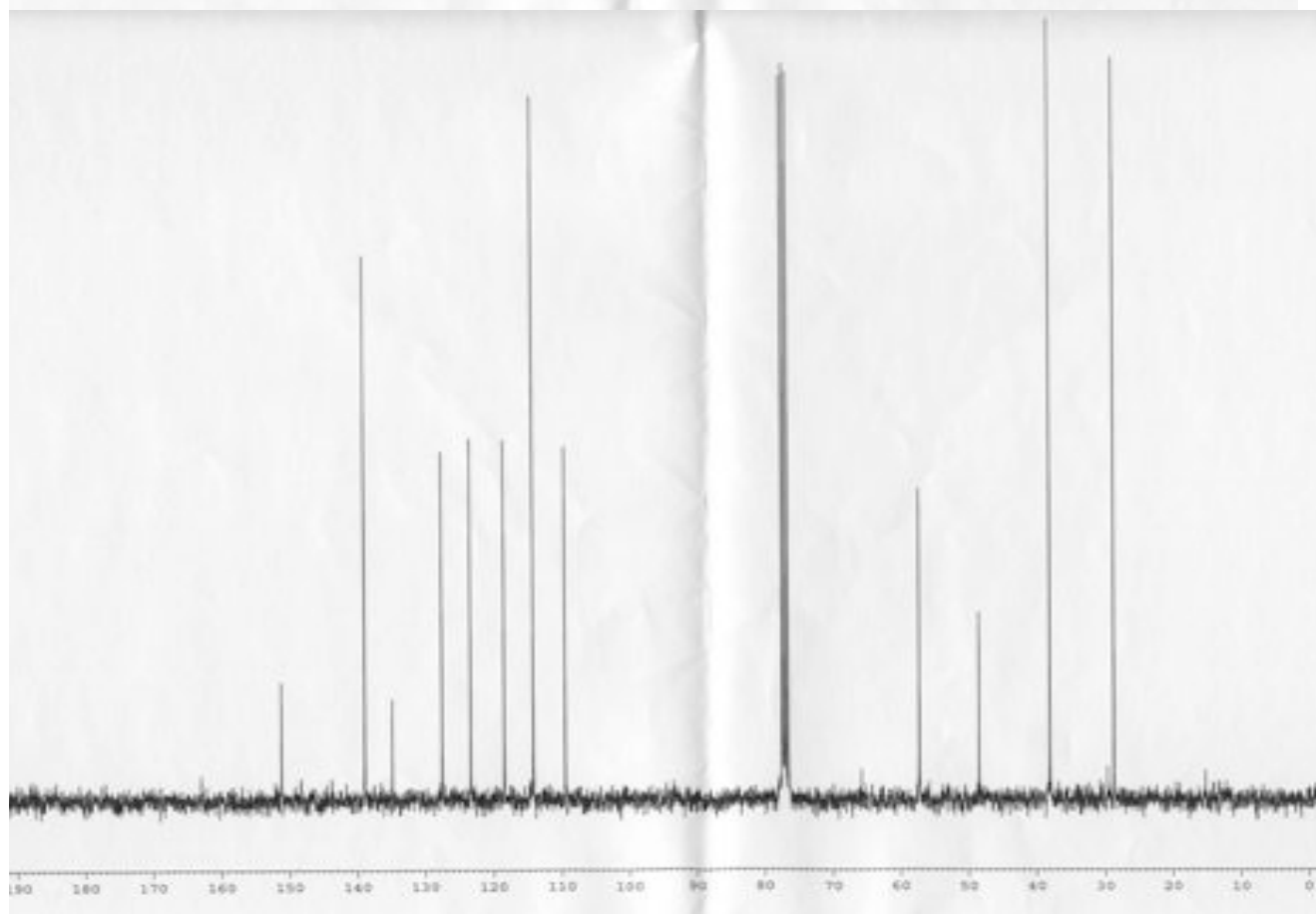
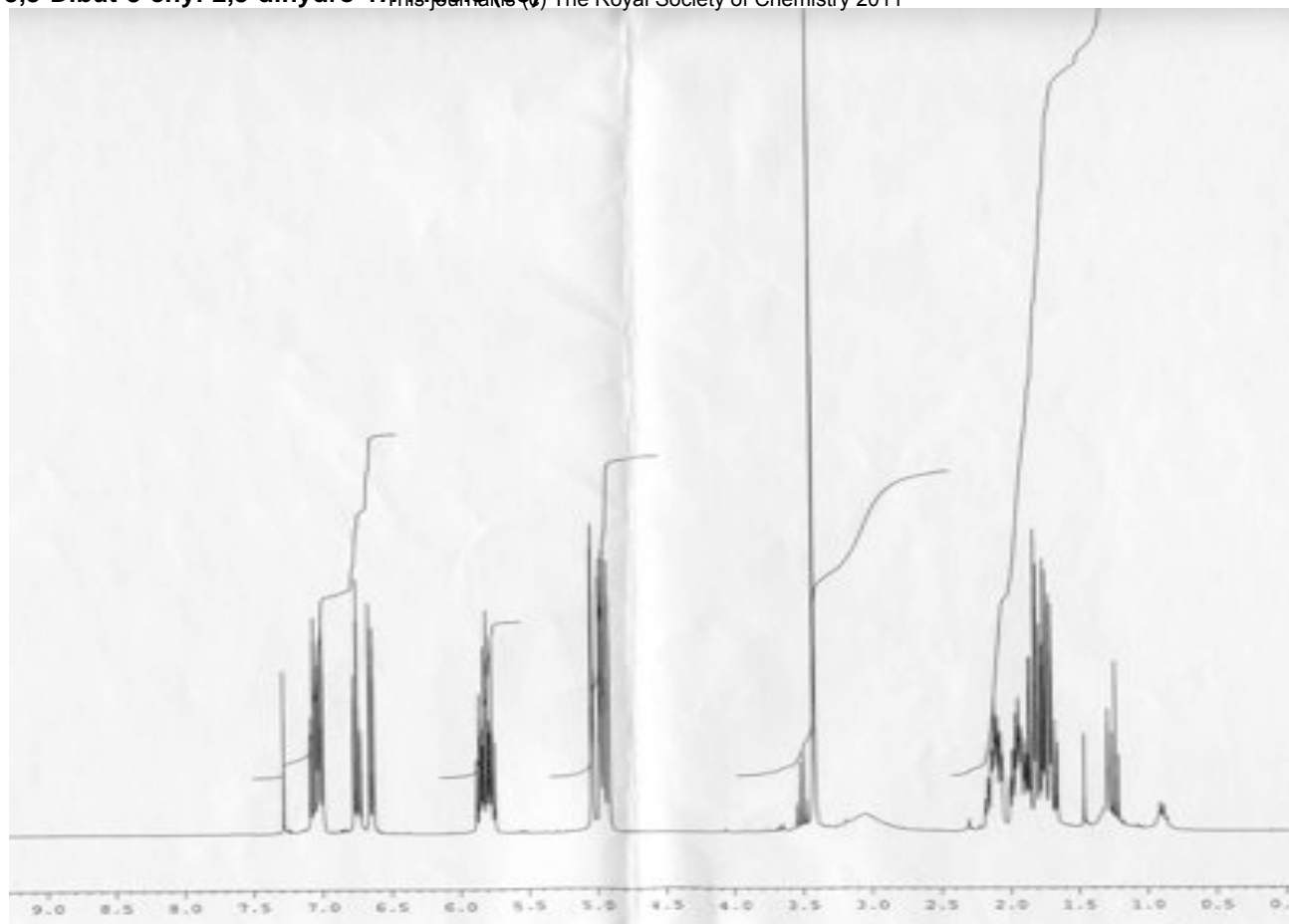


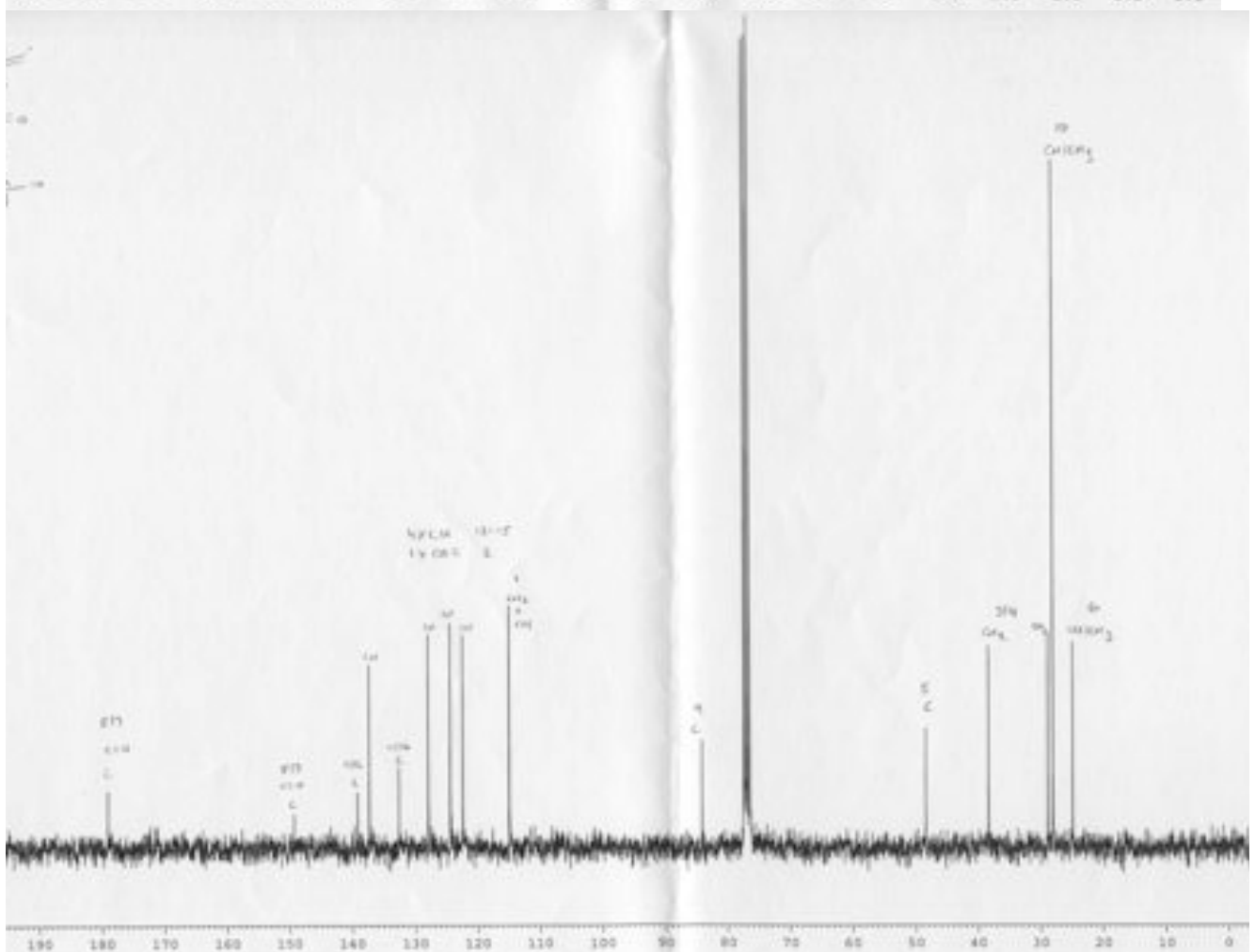
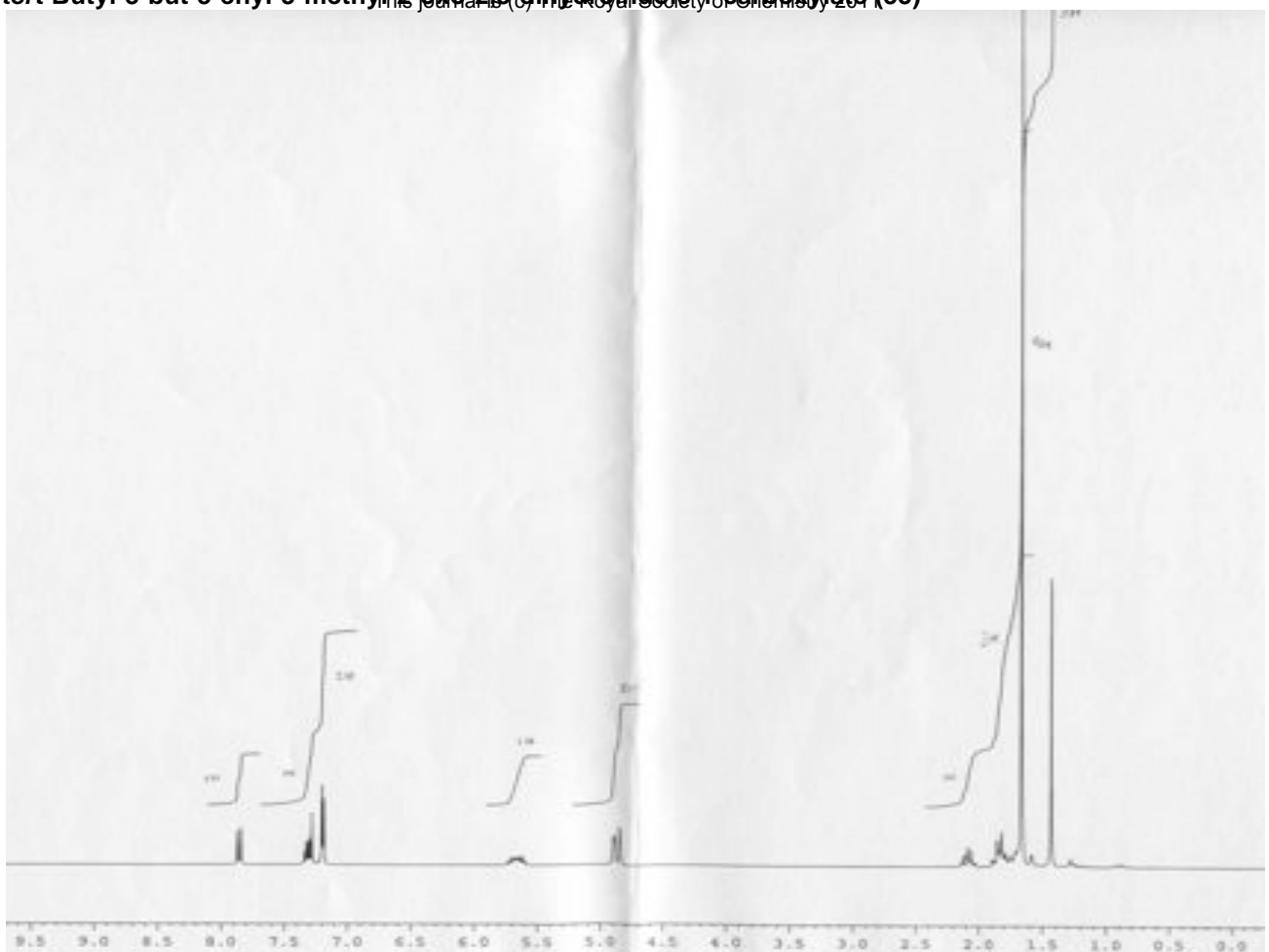




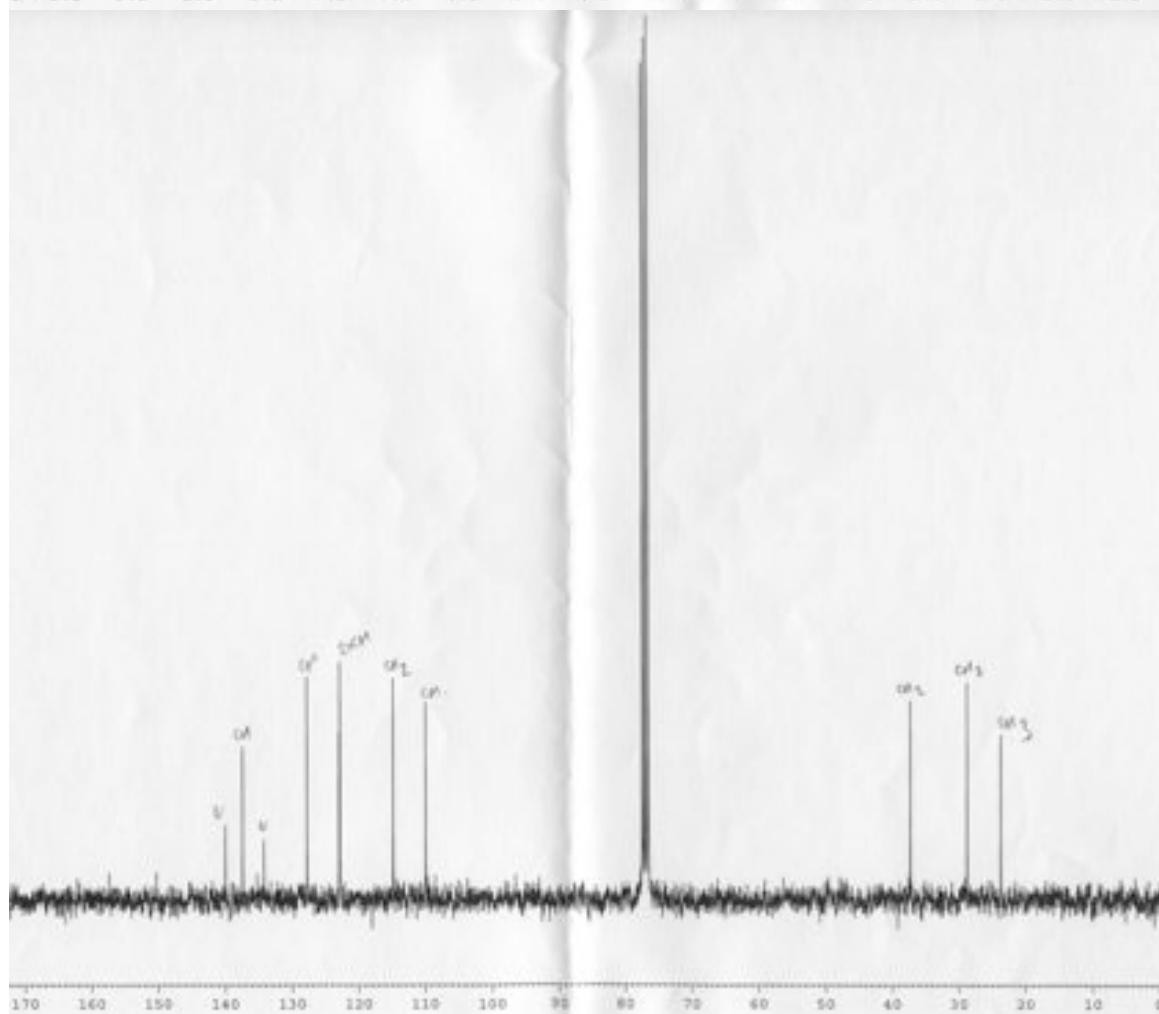
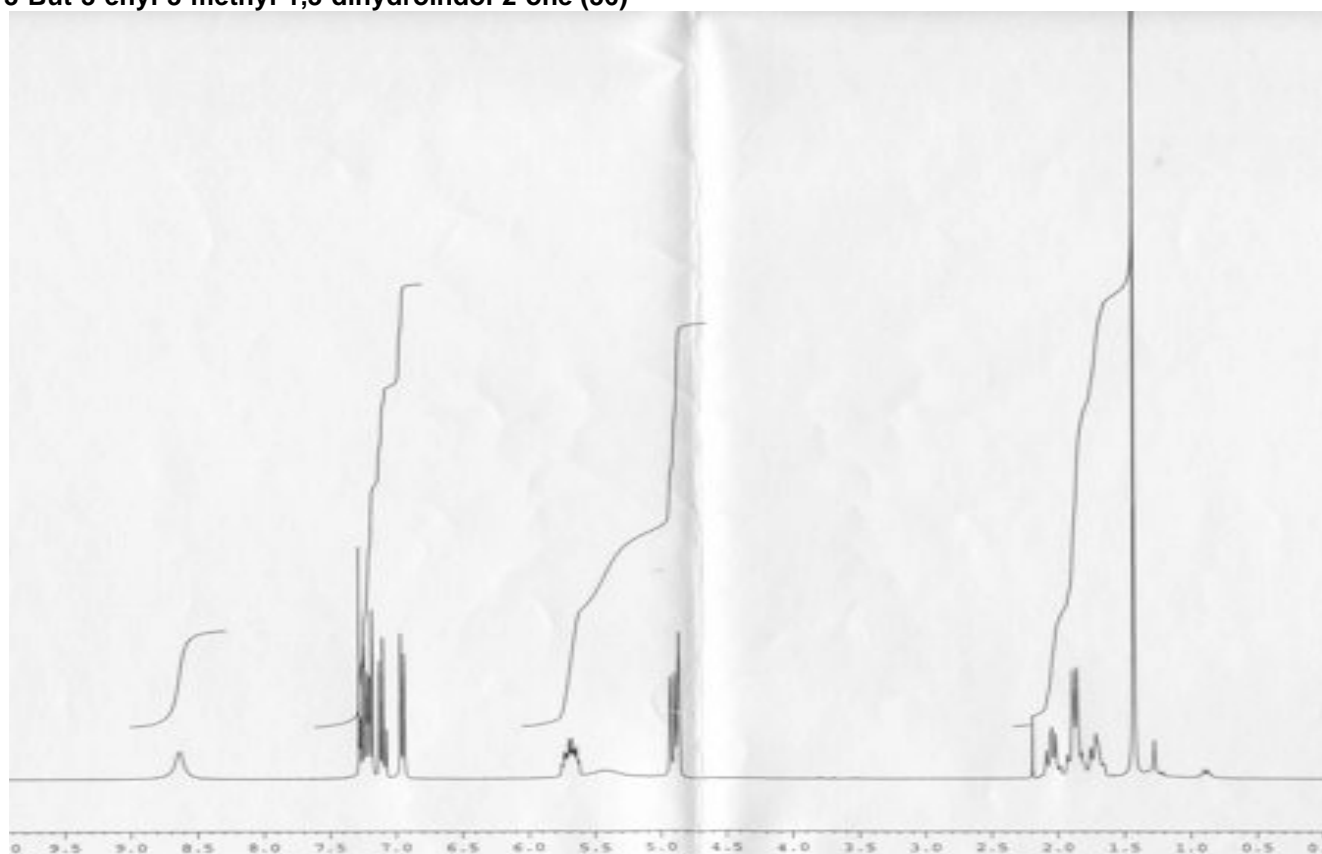


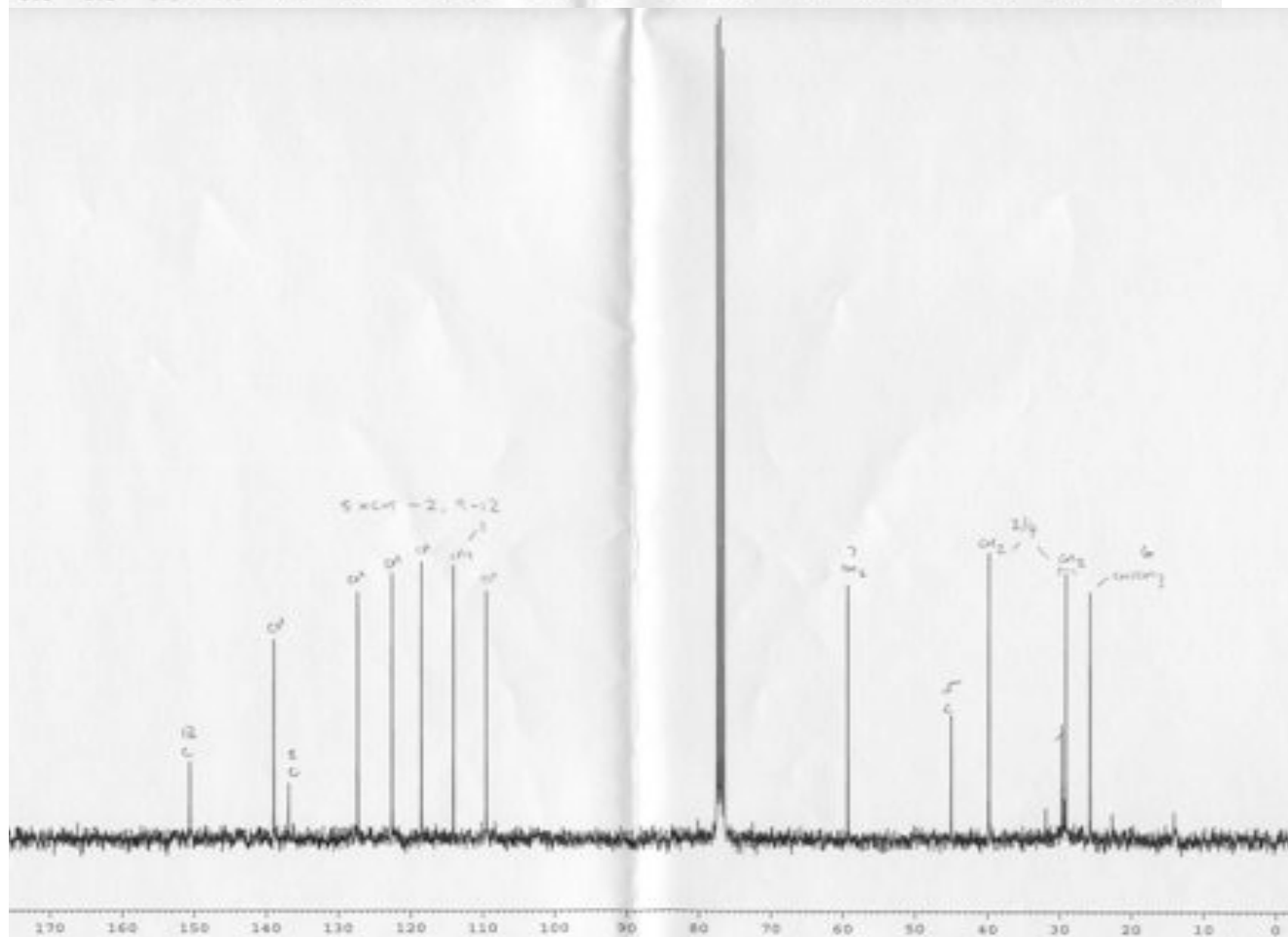
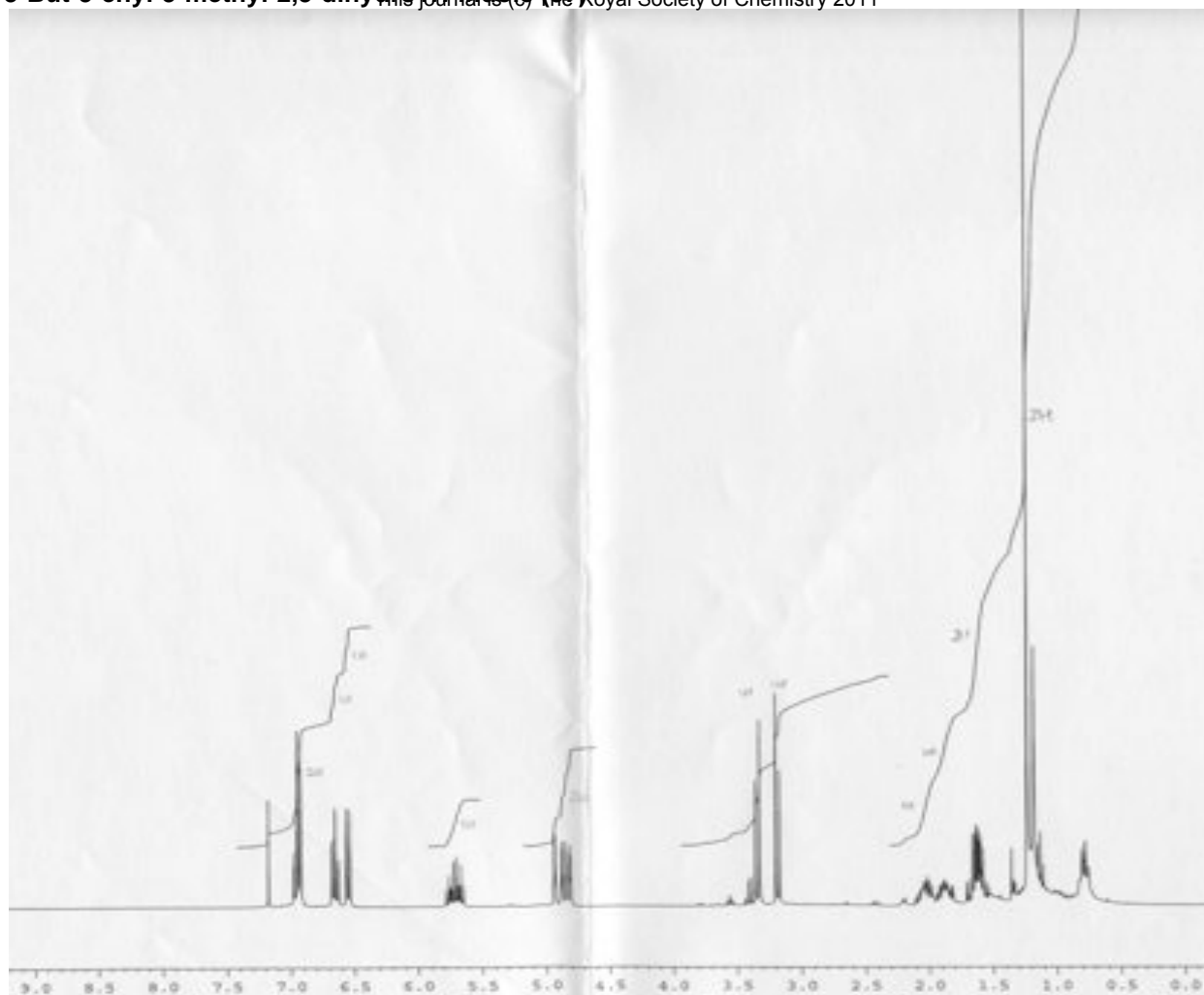




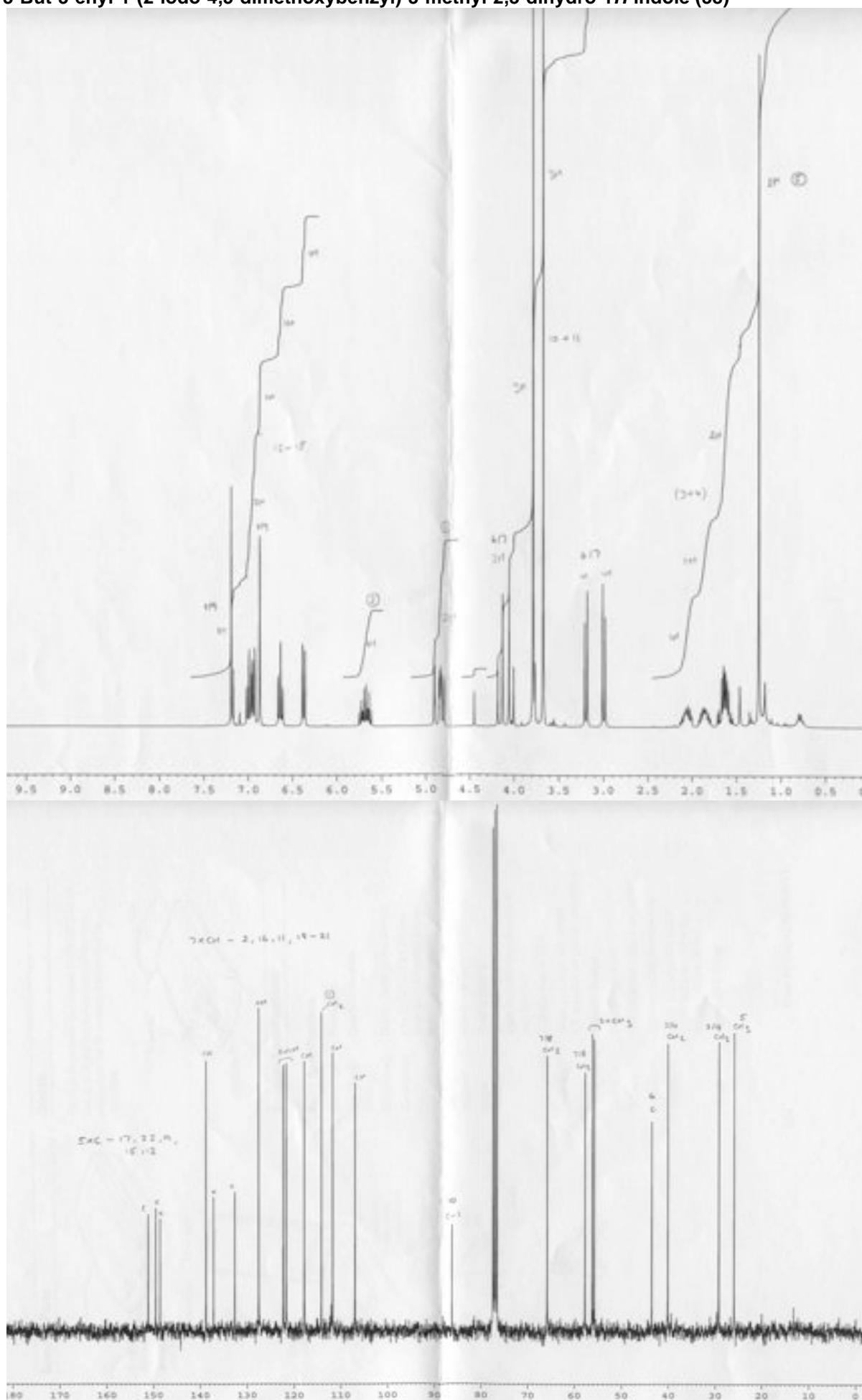


**3-But-3-enyl-3-methyl-1,3-dihydroindol-2-one (36)**

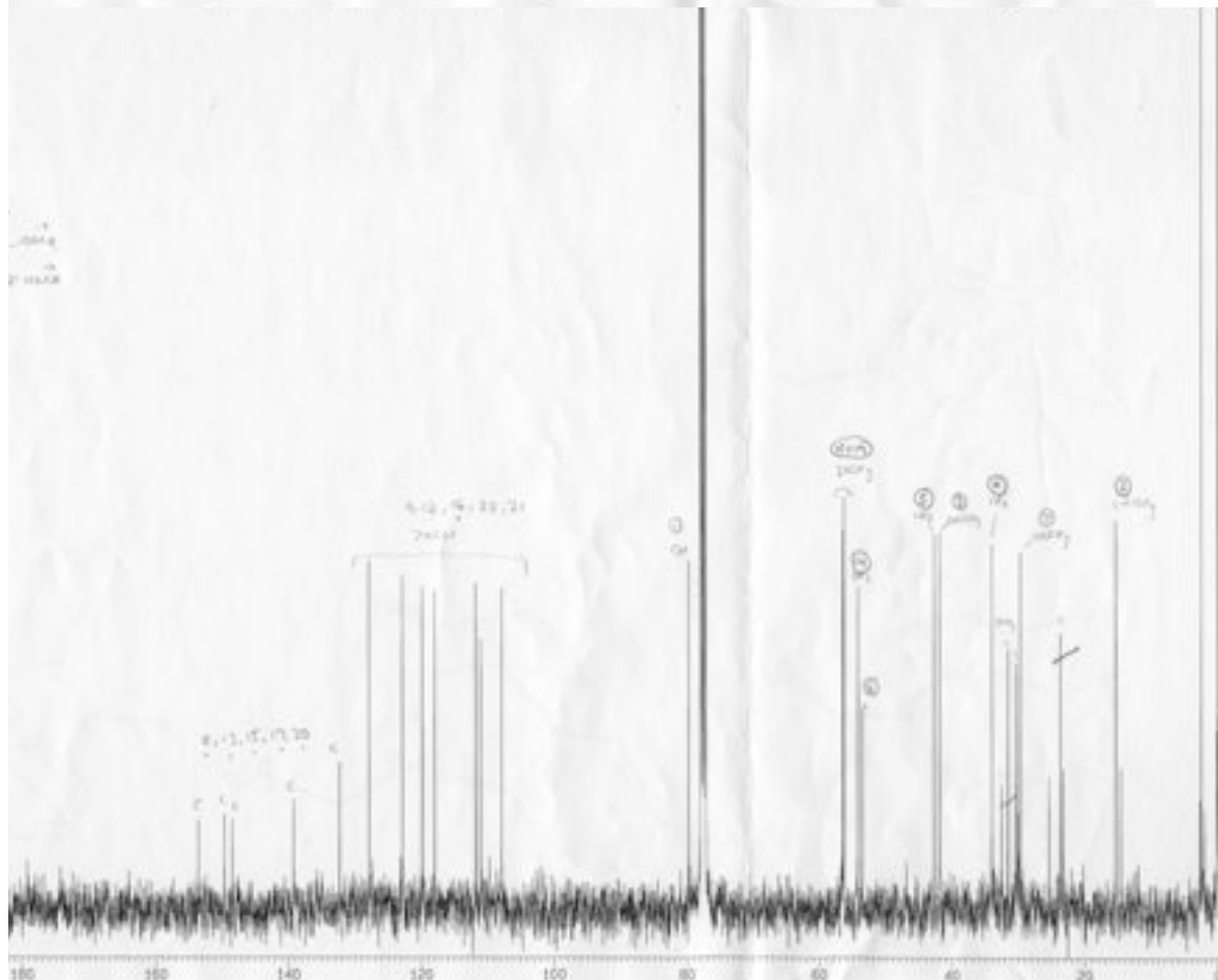
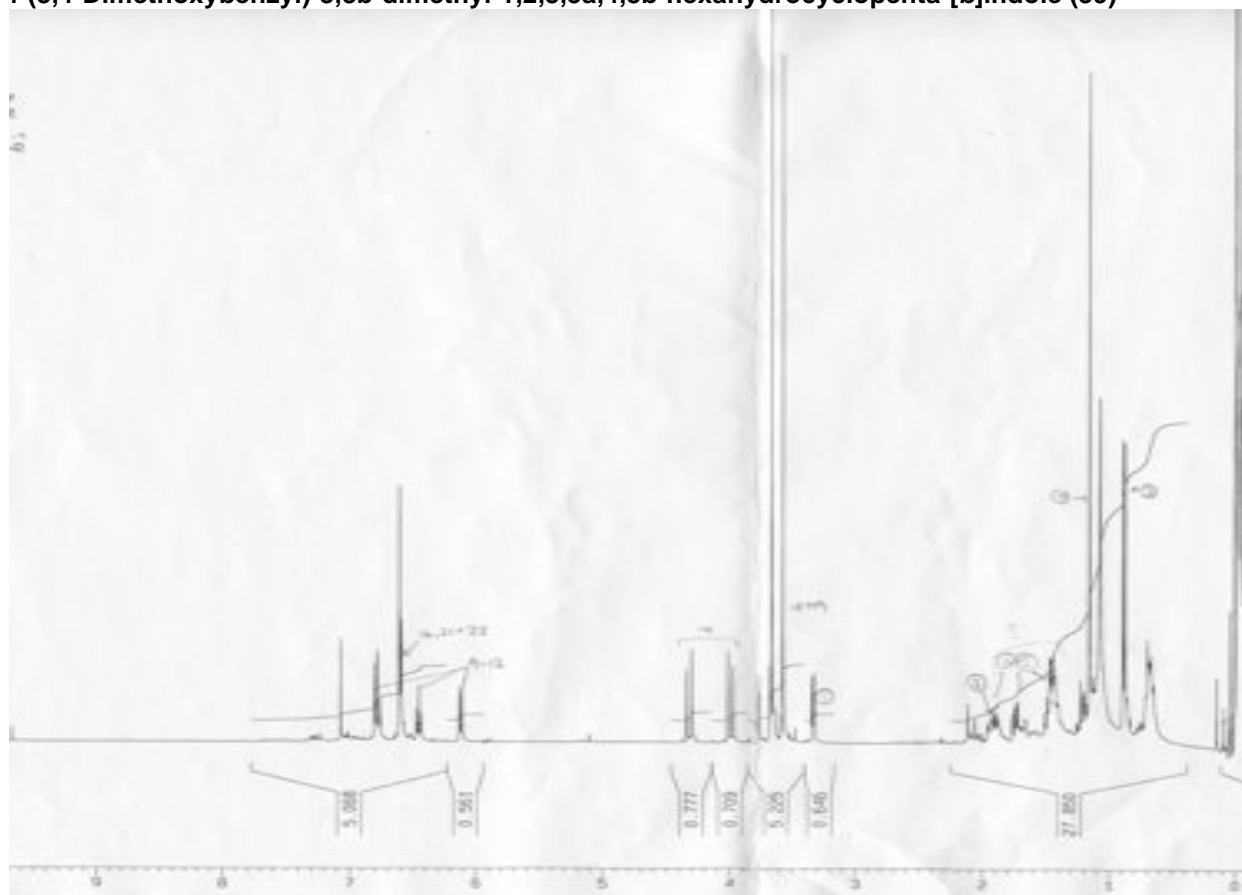




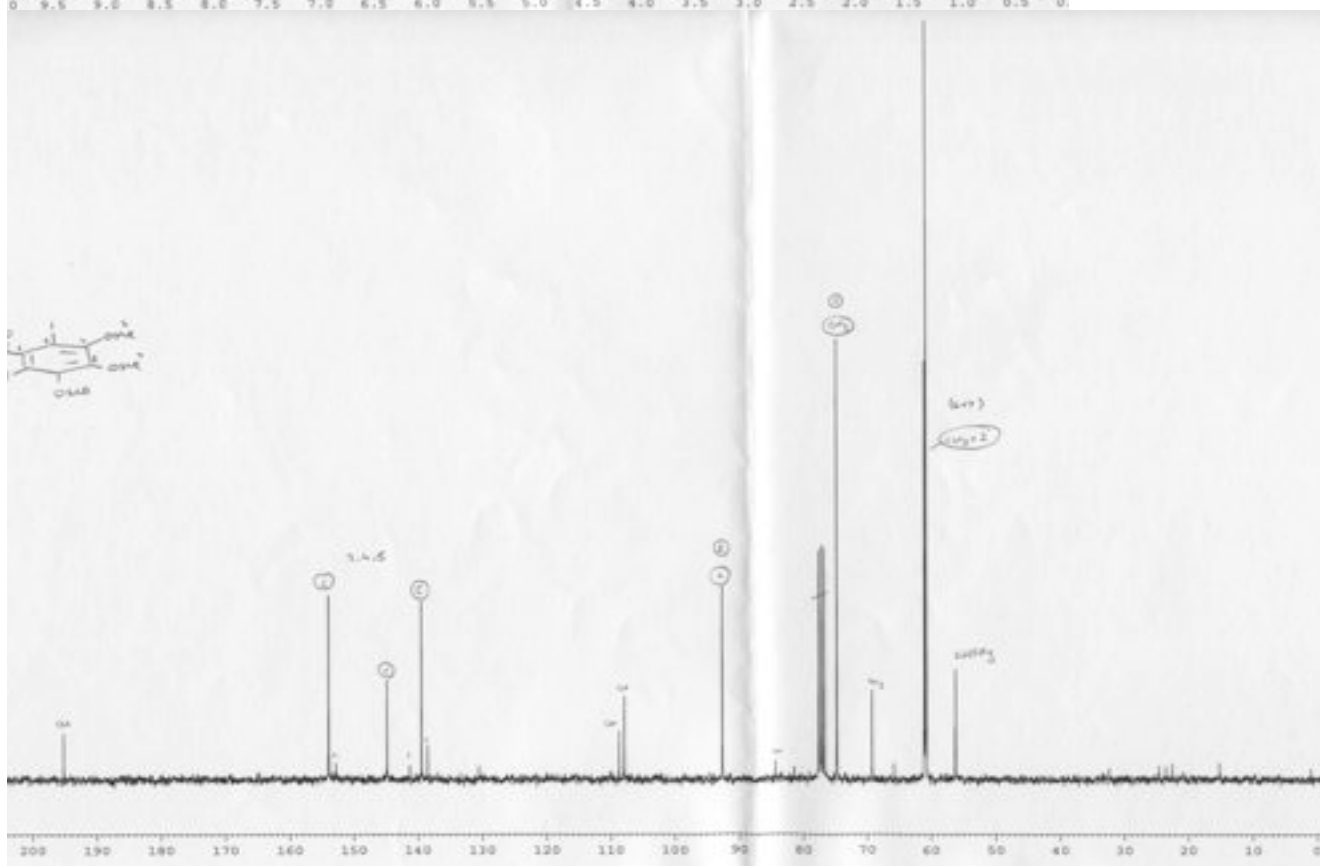
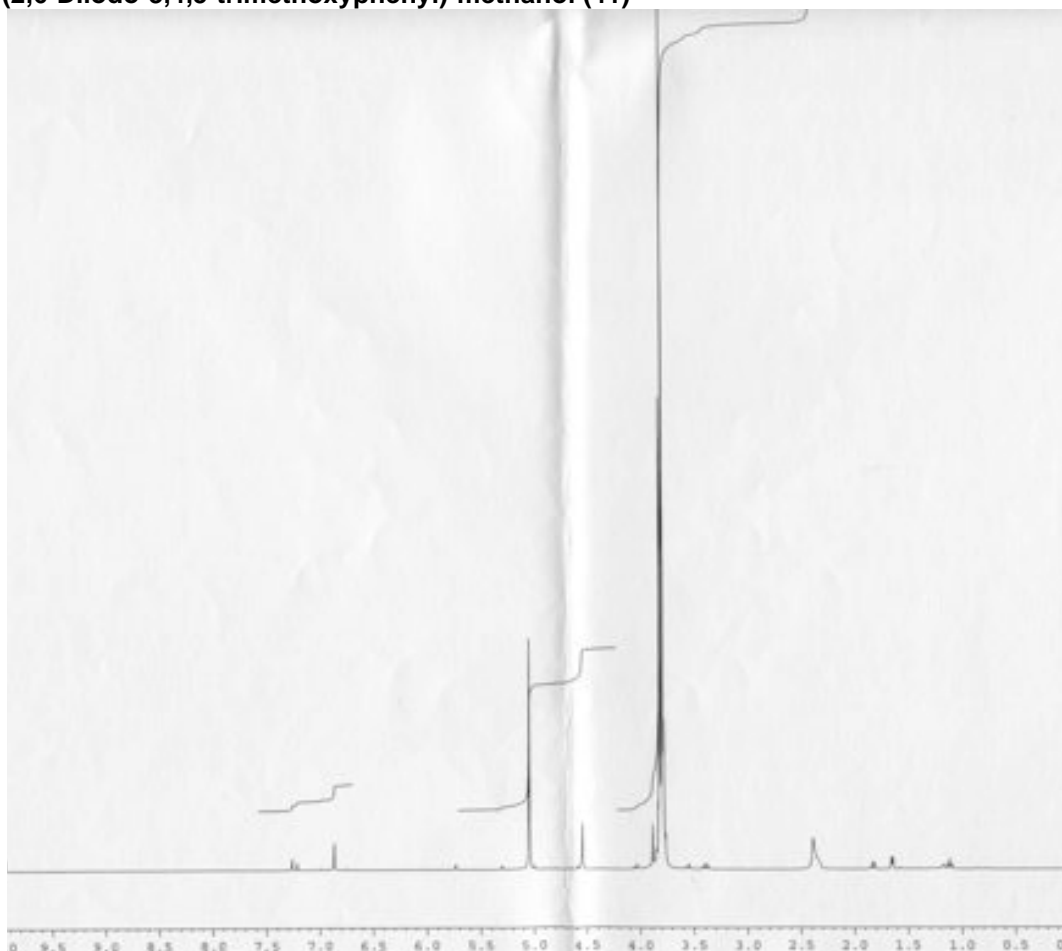
**3-But-3-enyl-1-(2-iodo-4,5-dimethoxybenzyl)-3-methyl-2,3-dihydro-1H-indole (38)**



4-(3,4-Dimethoxybenzyl)-3,8b-dimethyl-1,2,3,3a,4,8b-hexahydrocyclopenta-[b]indole (39)

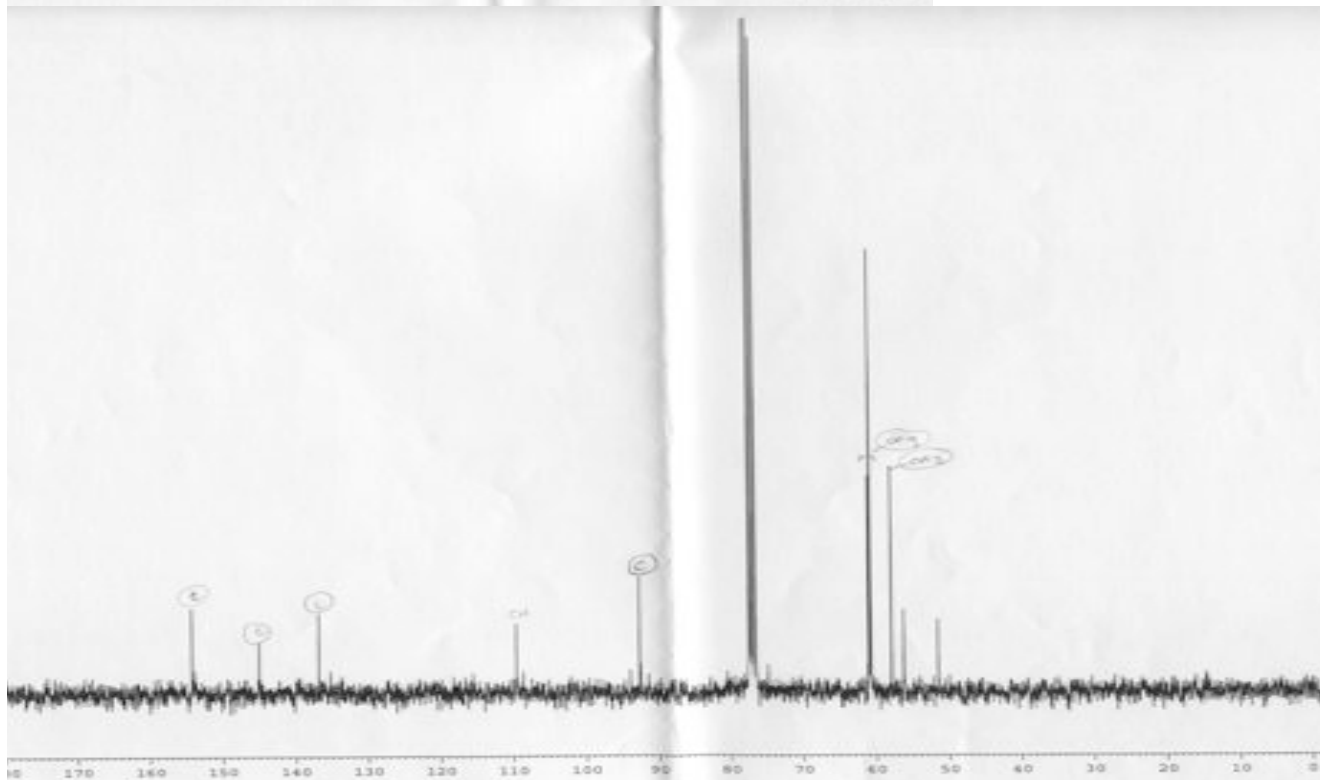
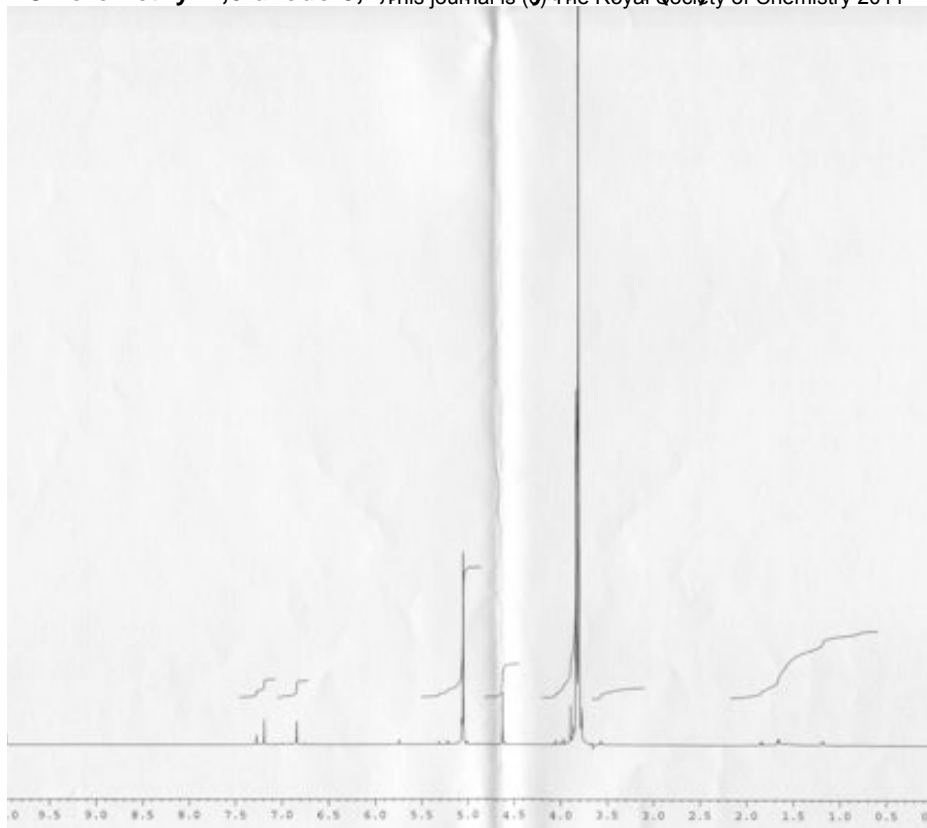


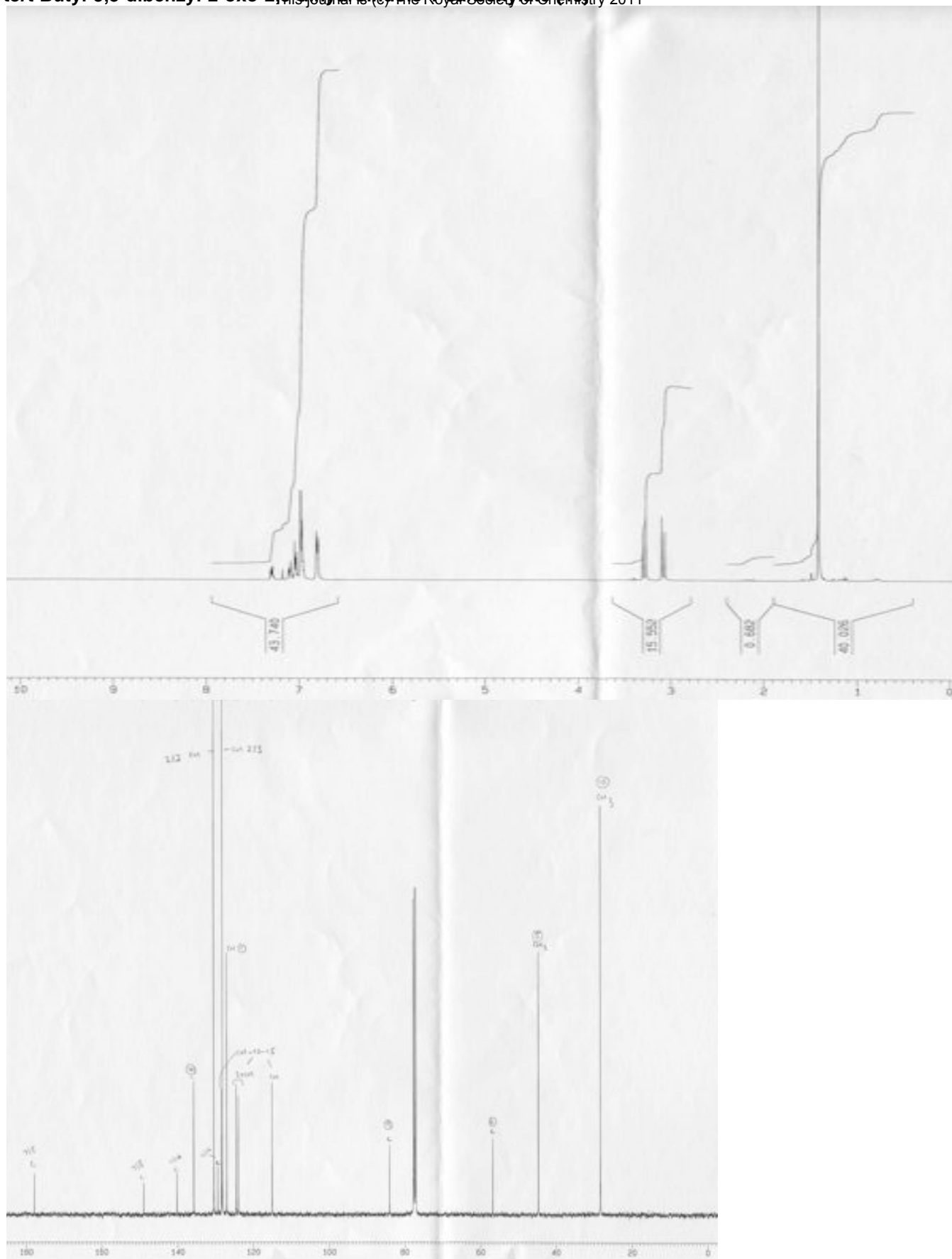
**(2,6-Diiodo-3,4,5-trimethoxyphenyl)-methanol (41)**





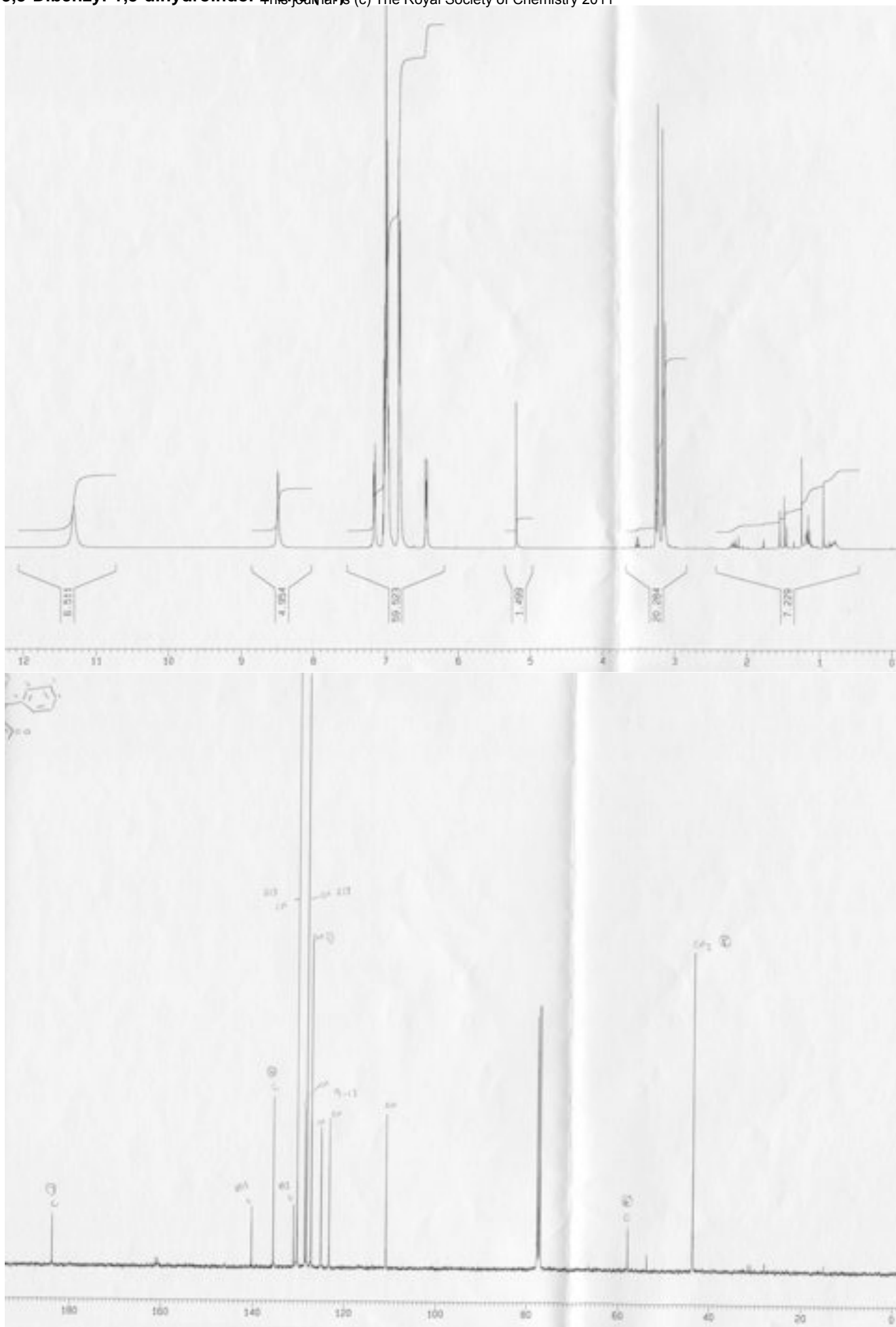
1-Chloromethyl-2,6-diiodo-3,4,5-trimethoxybenzene (42)

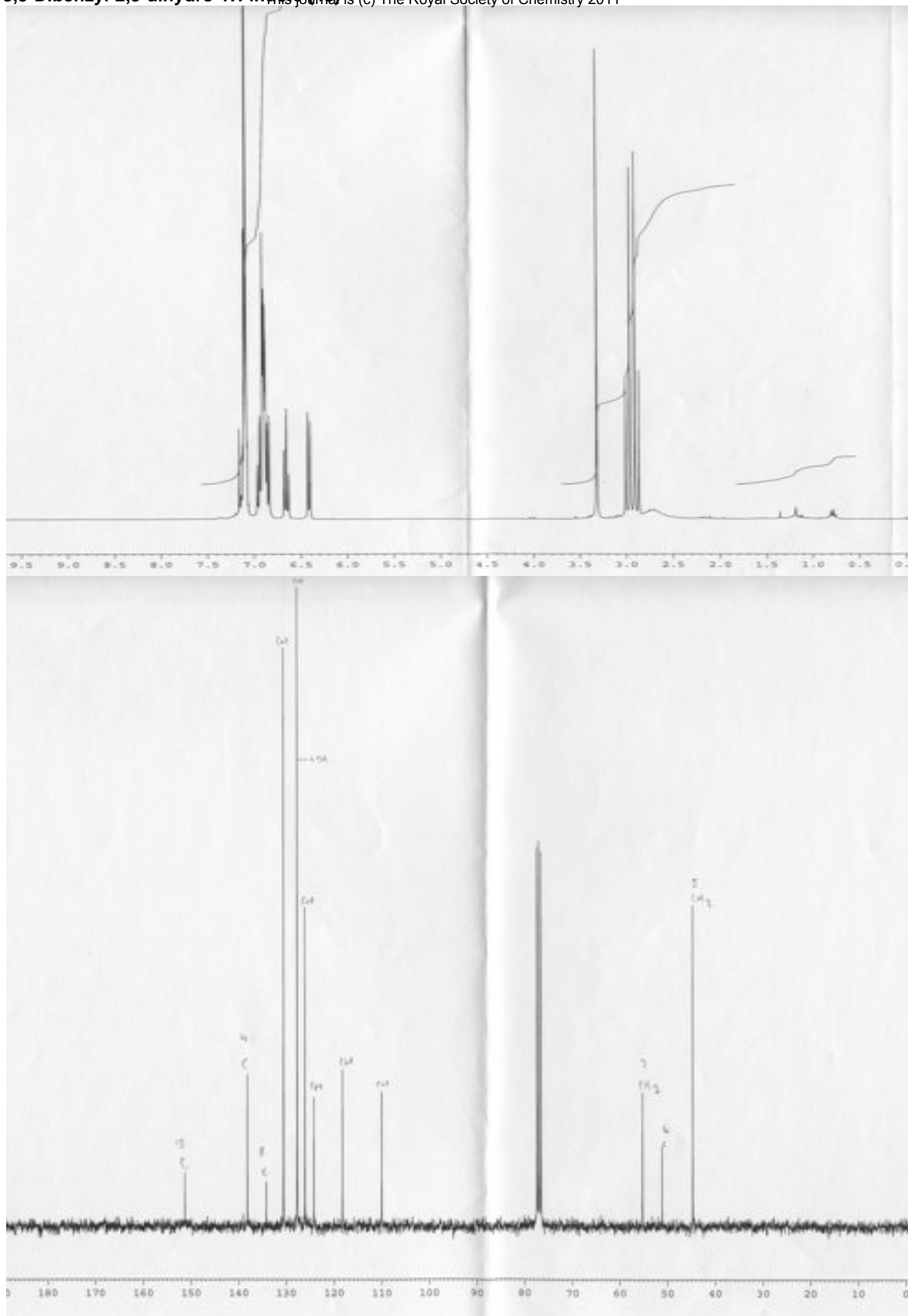


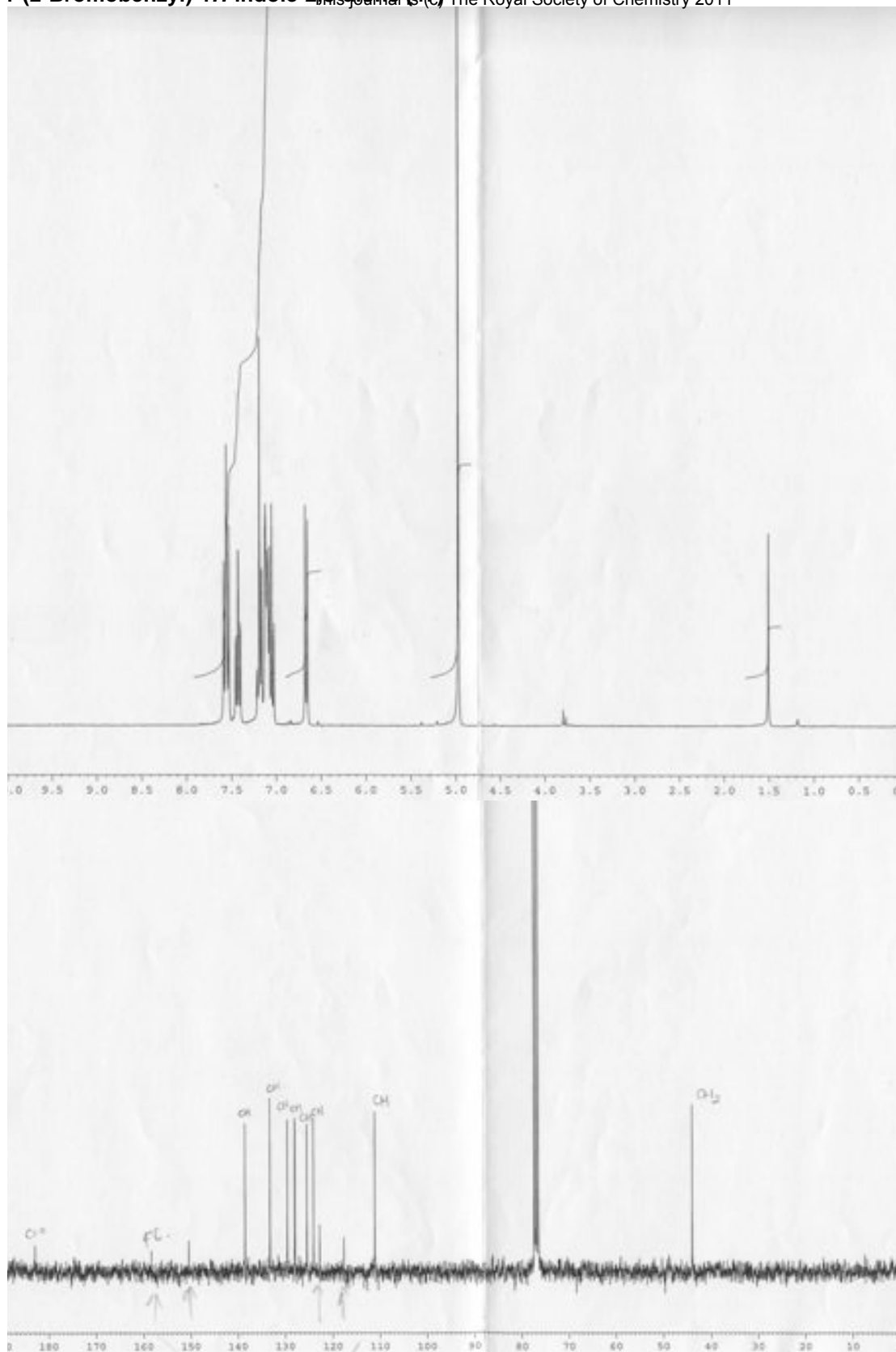


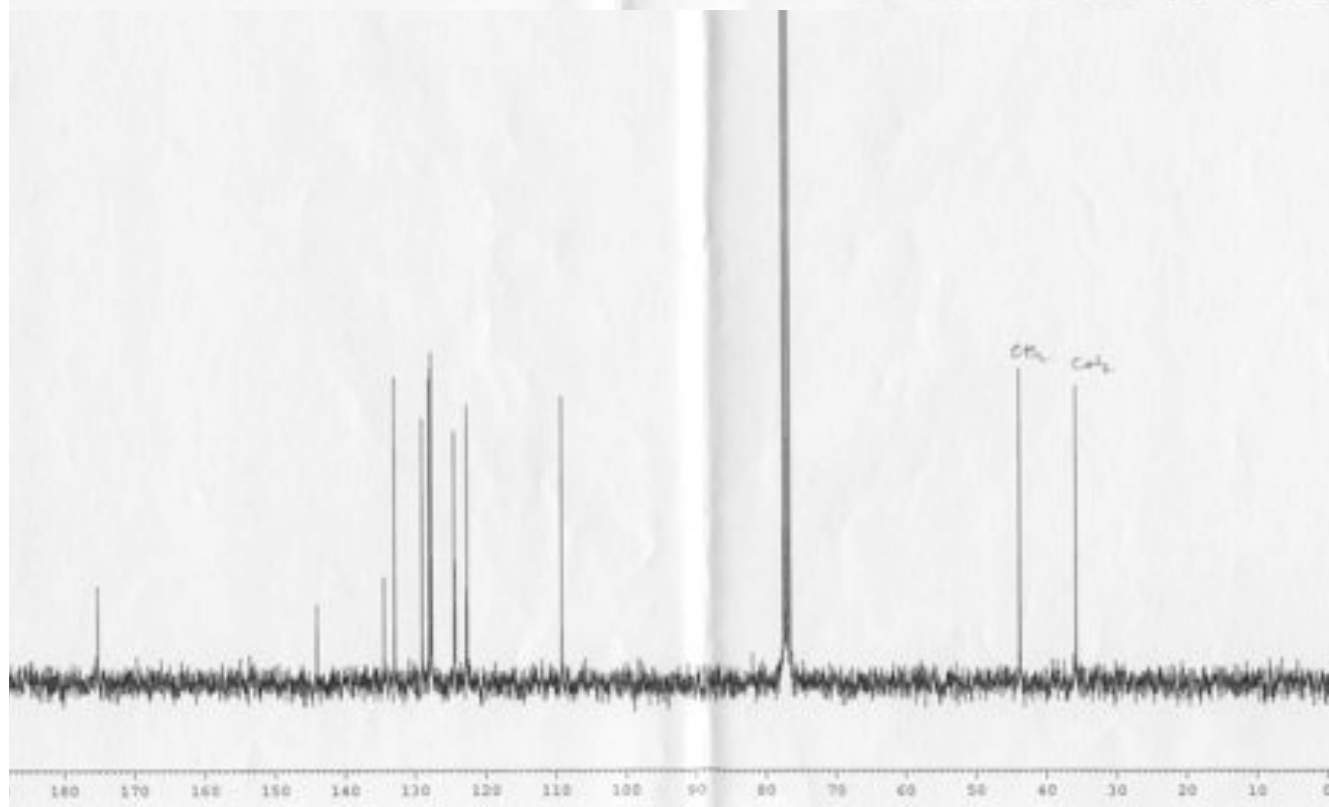
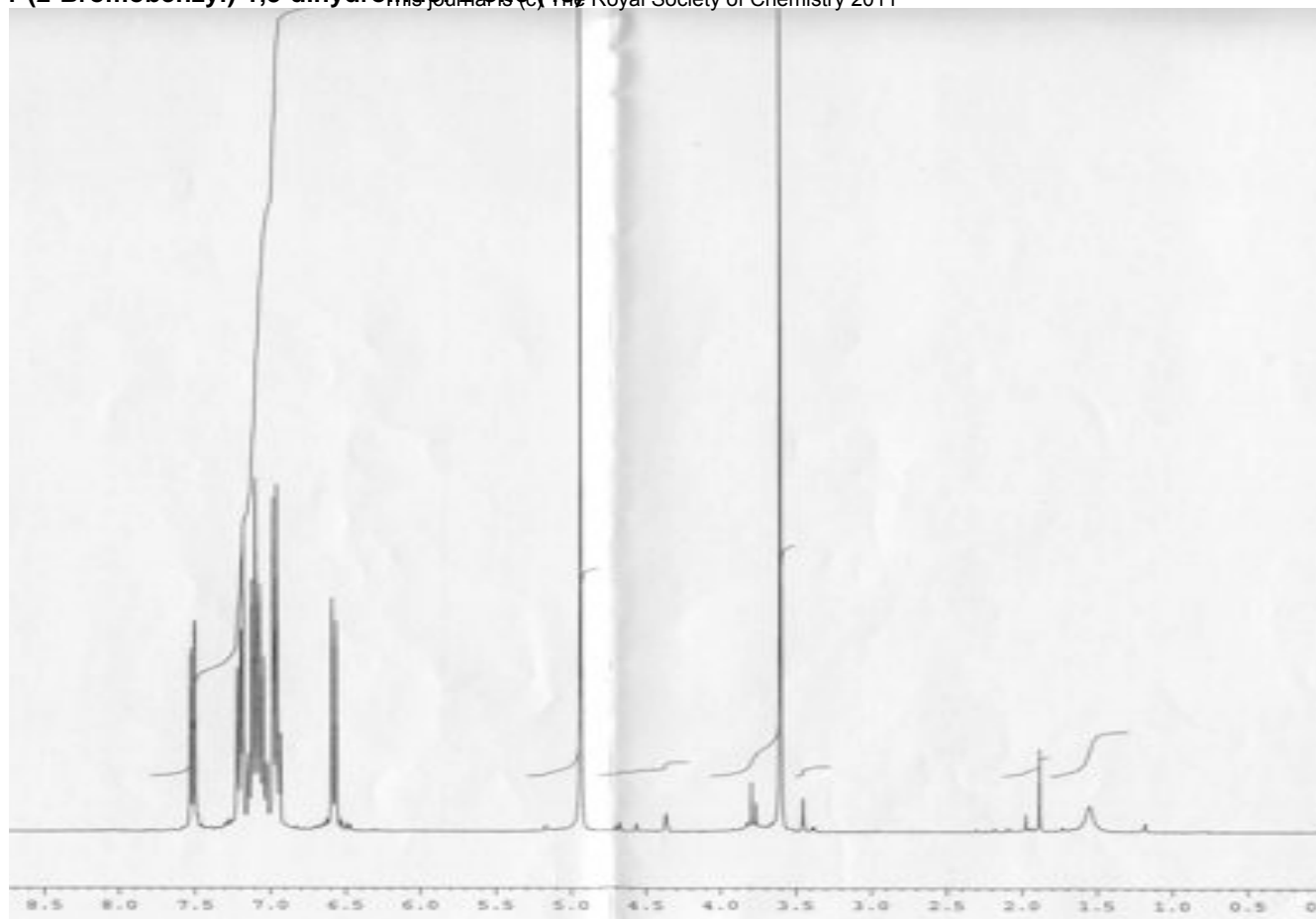
**3,3-Dibenzyl-1,3-dihydroindol-2-one (44)**

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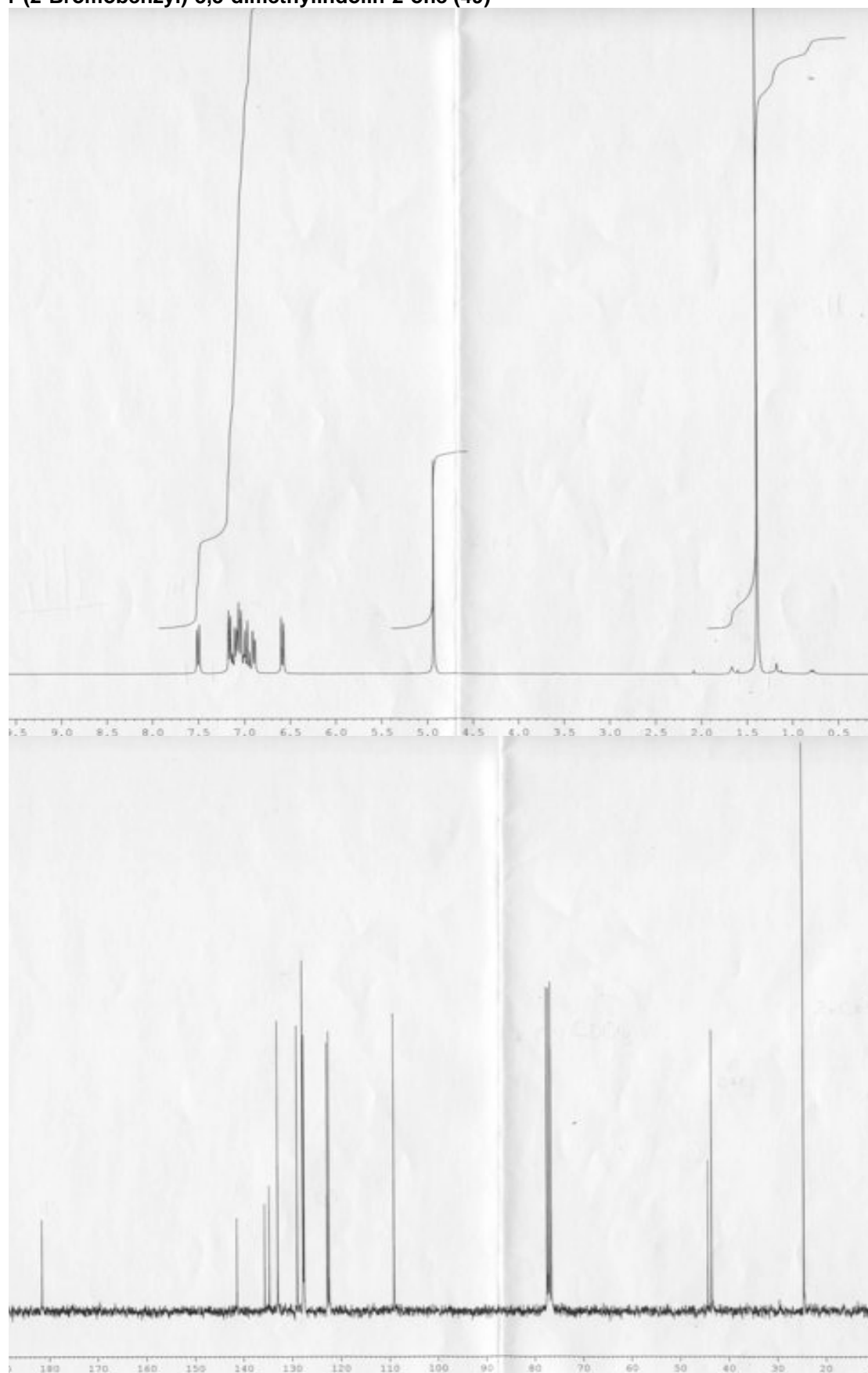




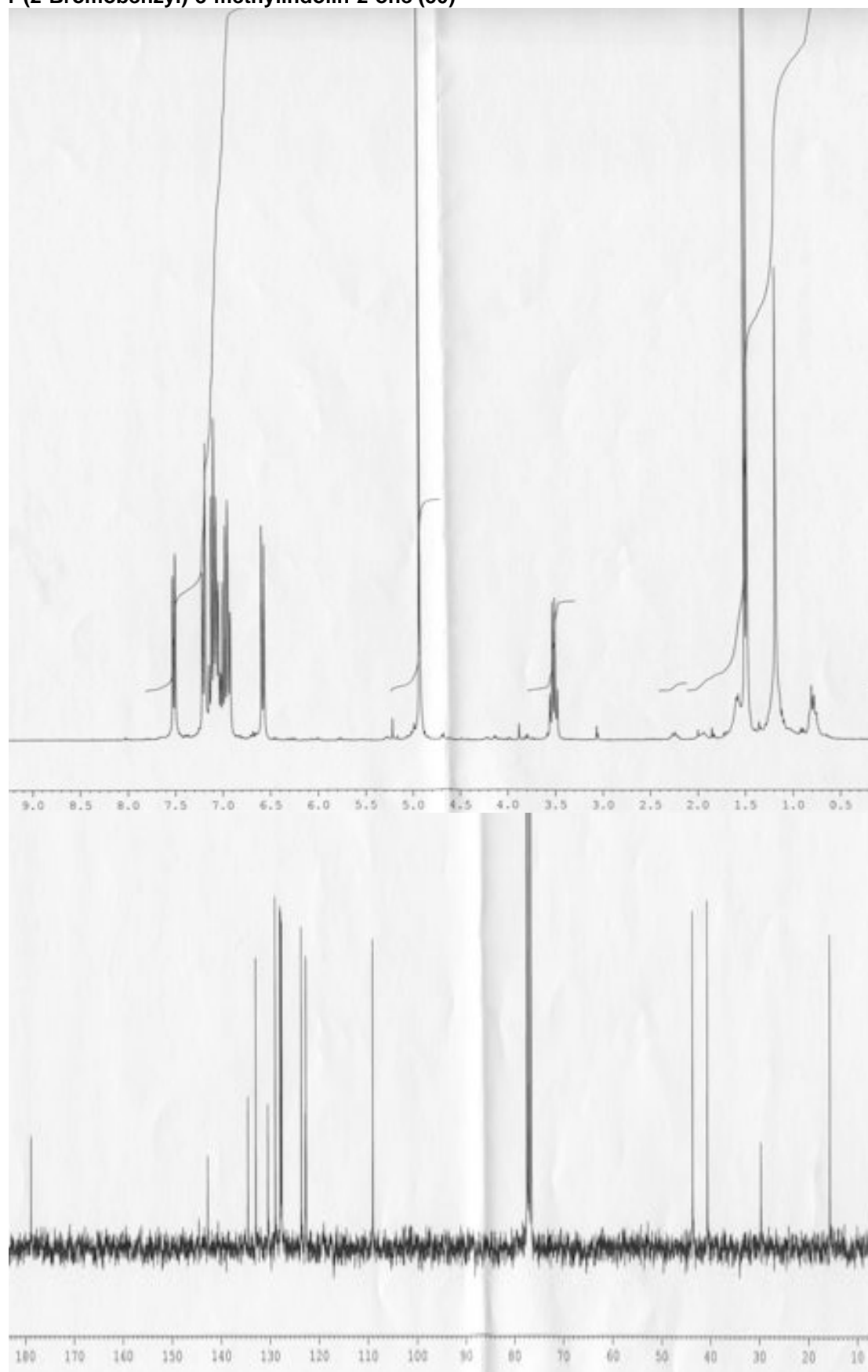




**1-(2-Bromobenzyl)-3,3-dimethylindolin-2-one (49)**

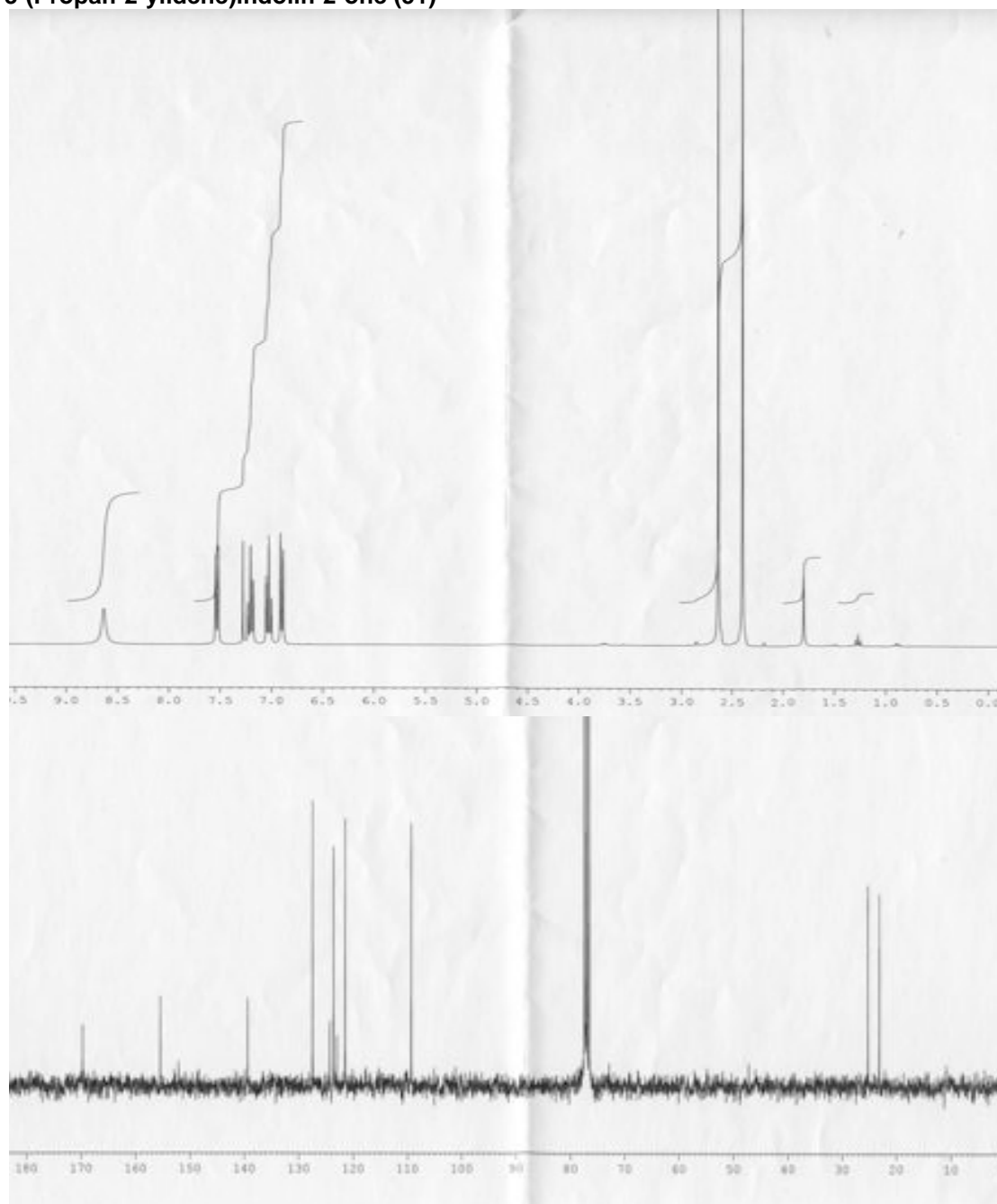


**1-(2-Bromobenzyl)-3-methylindolin-2-one (50)**

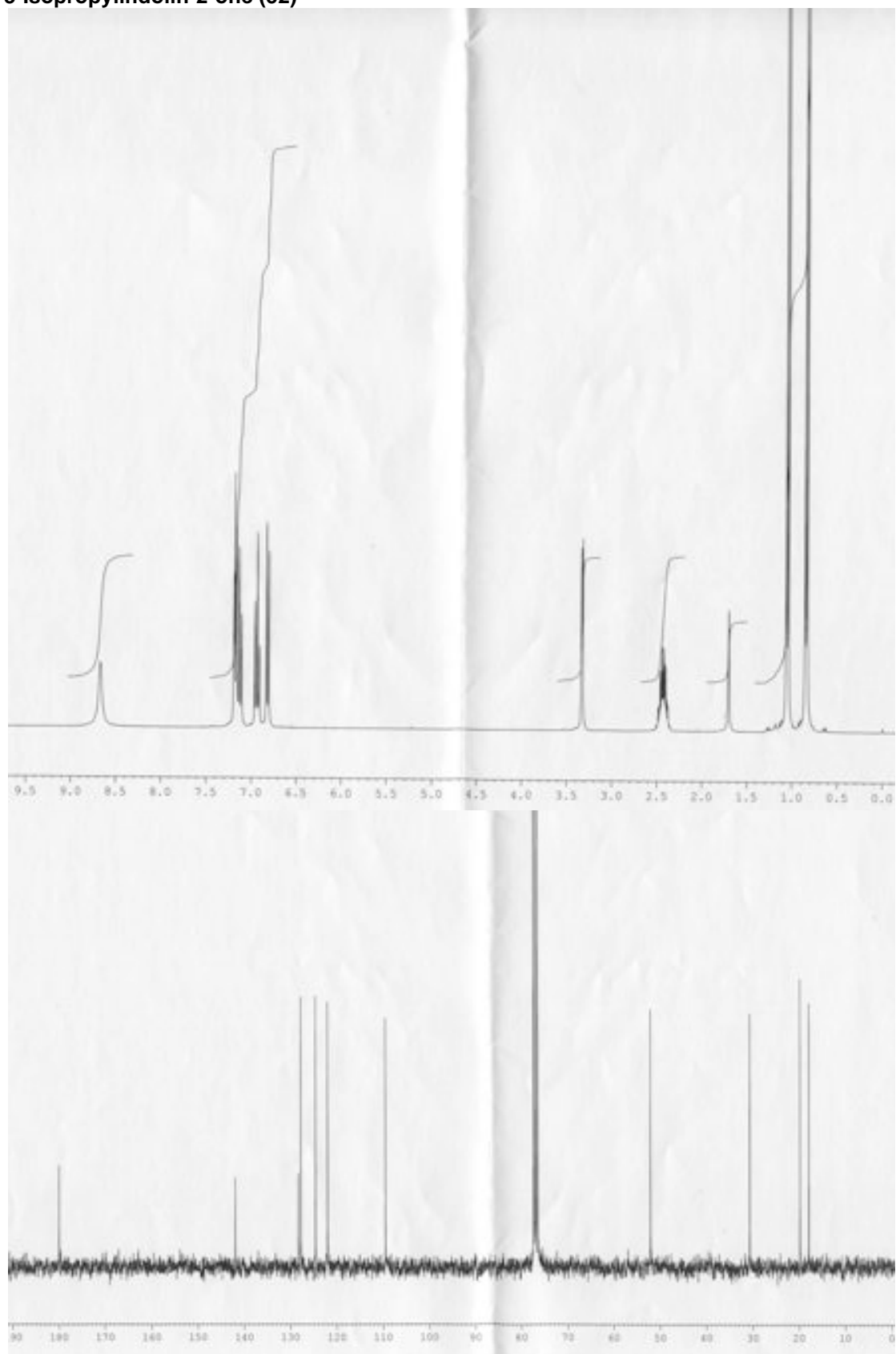




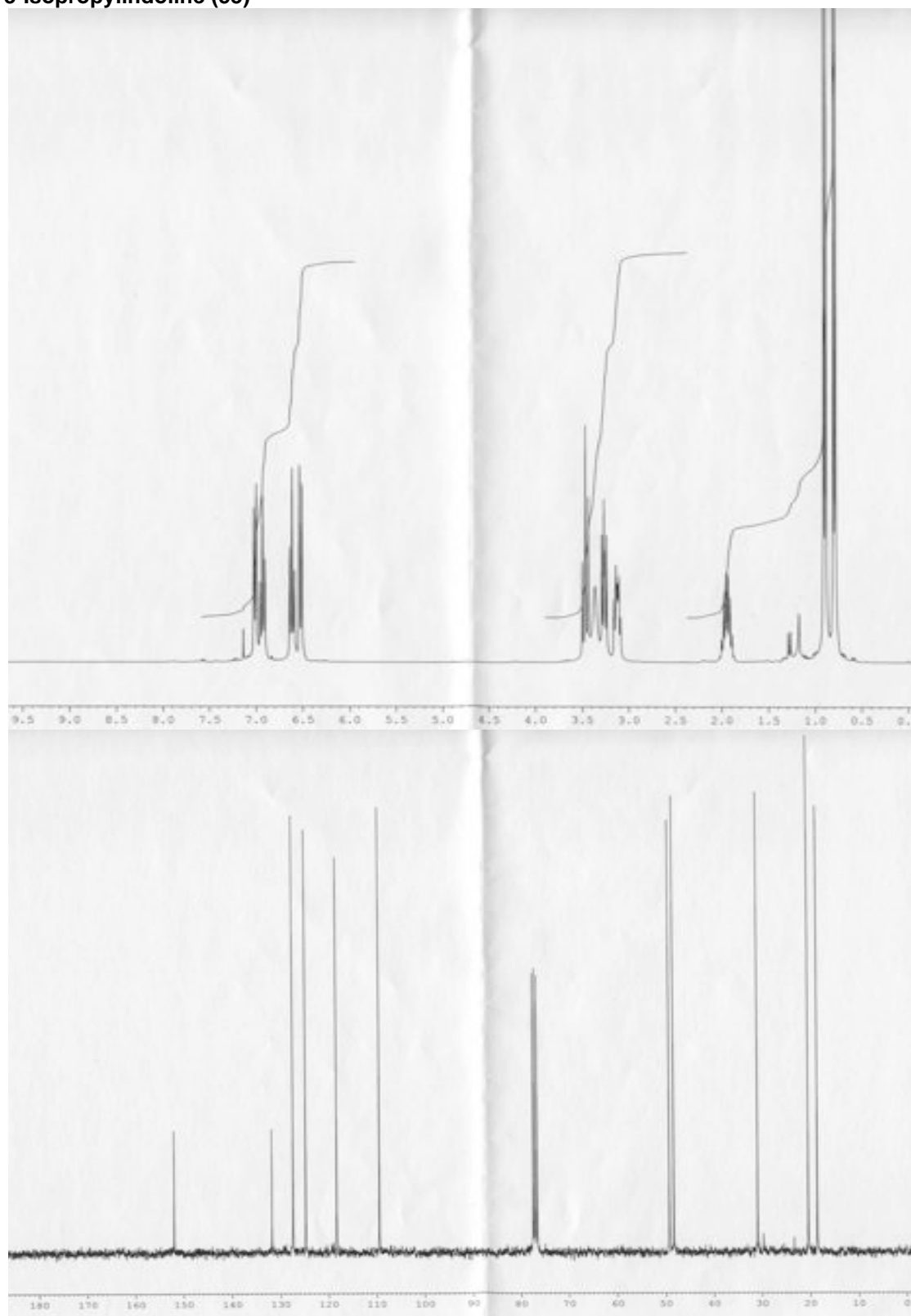
**3-(Propan-2-ylidene)indolin-2-one (51)**



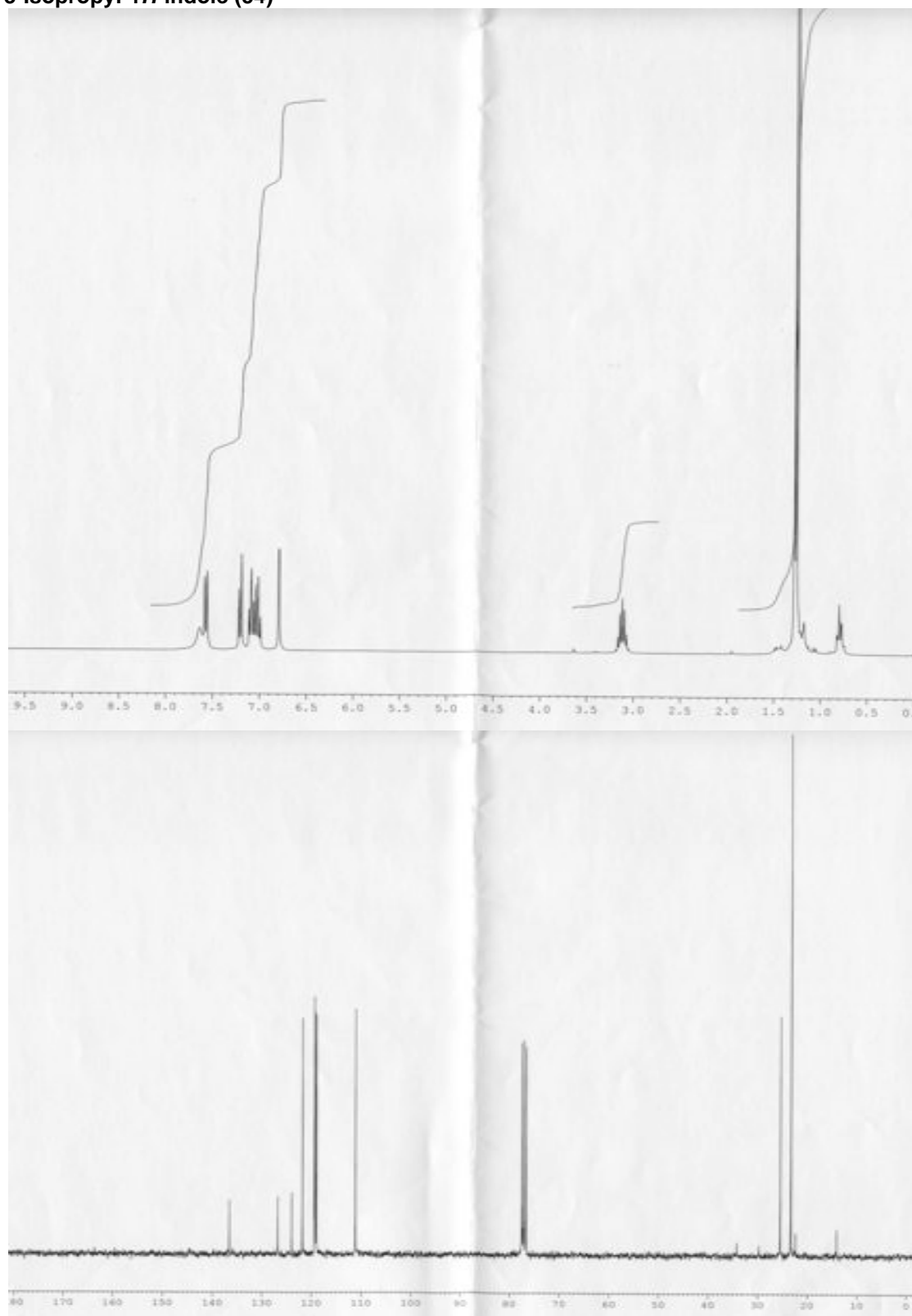
**3-Isopropylindolin-2-one (52)**

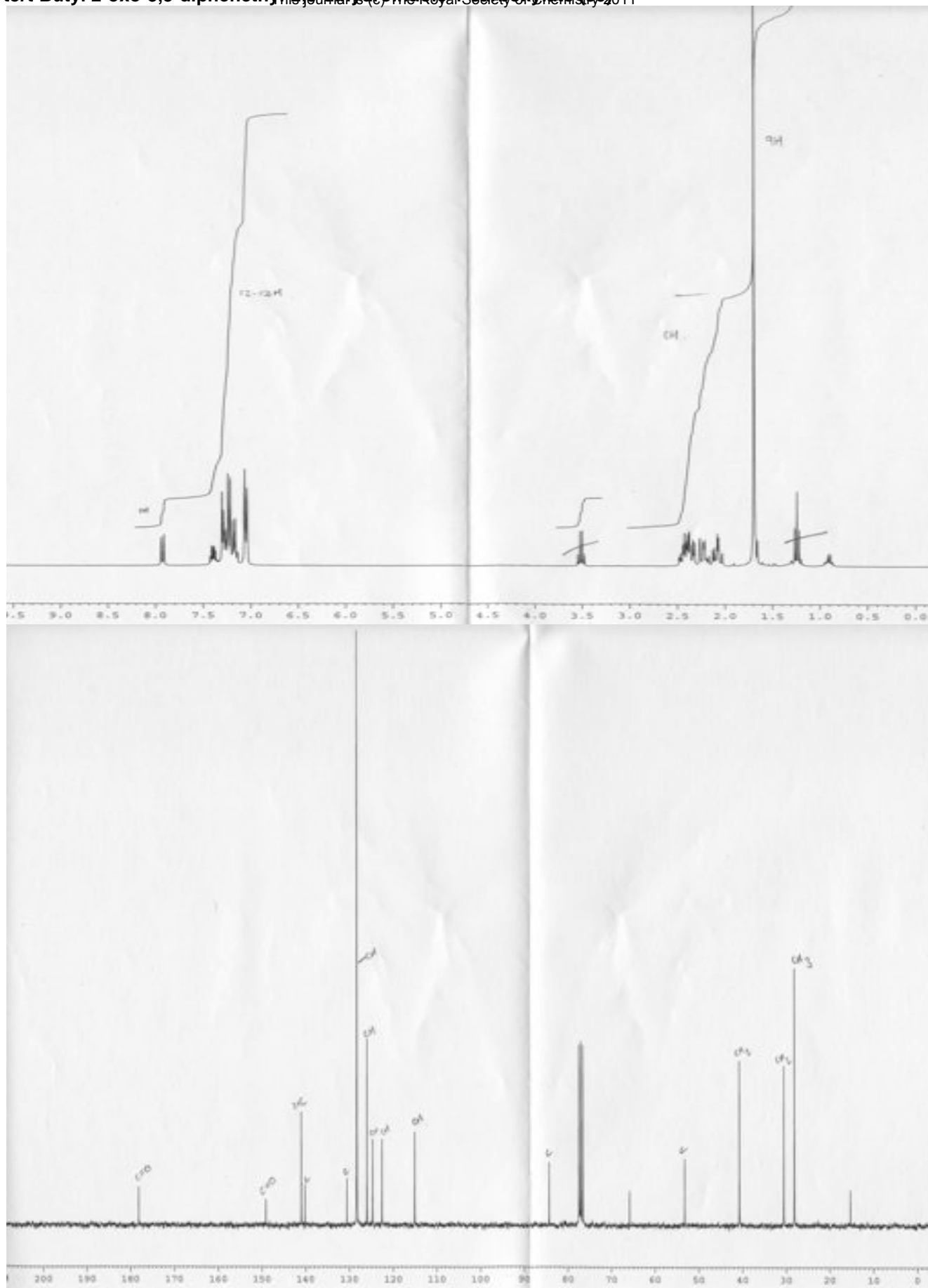


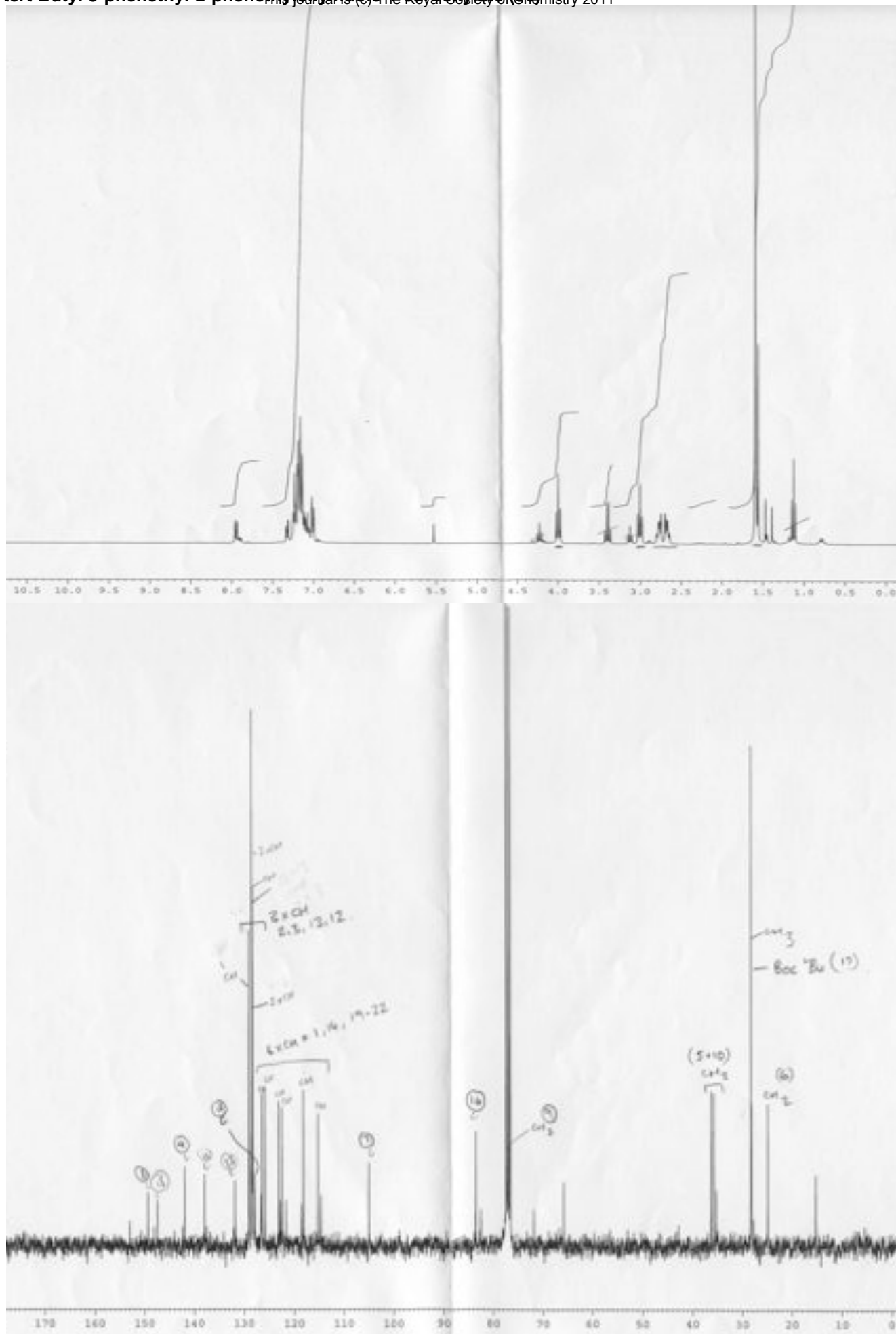
**3-Isopropylindoline (53)**



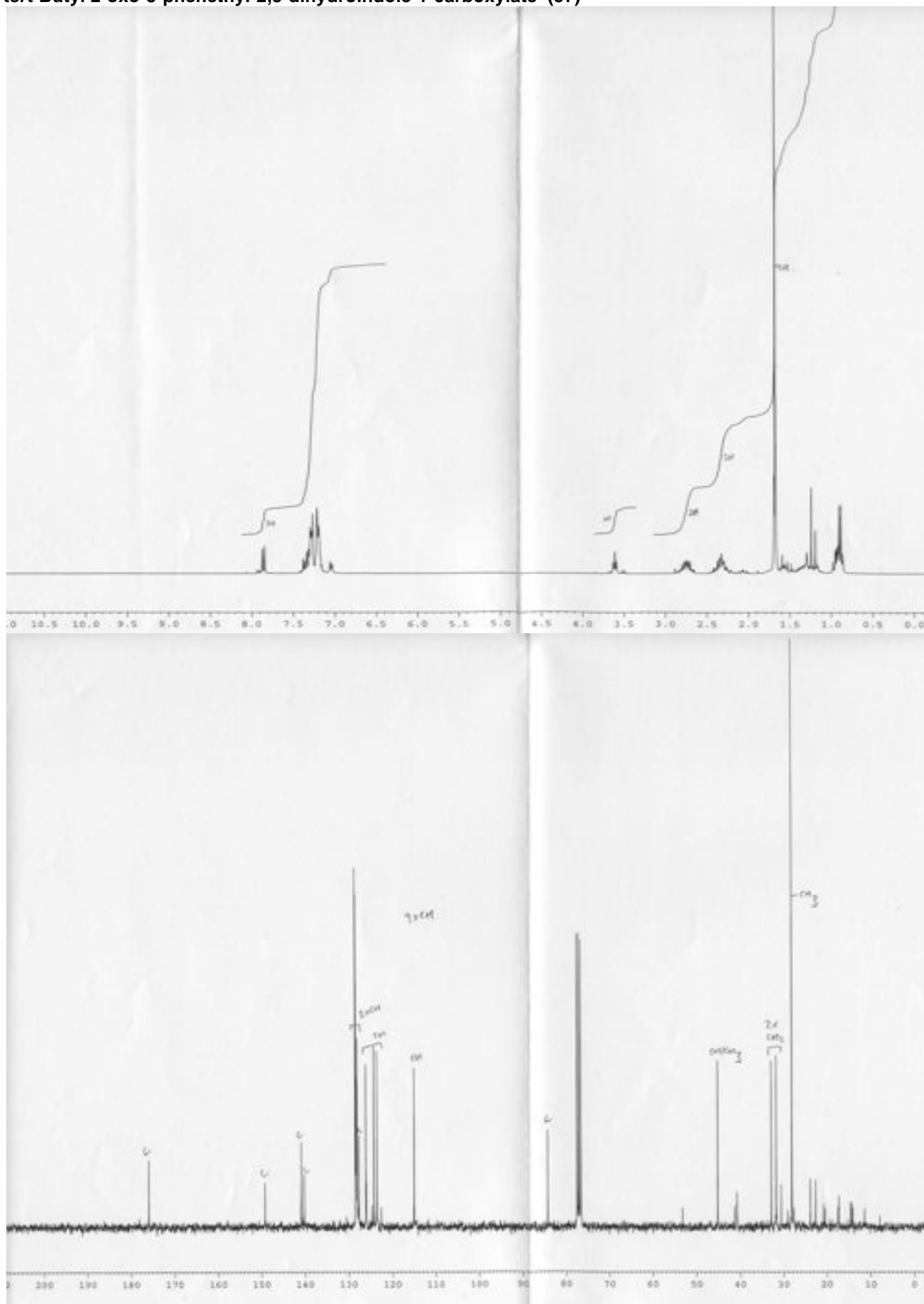
**3-Isopropyl-1*H*-indole (54)**

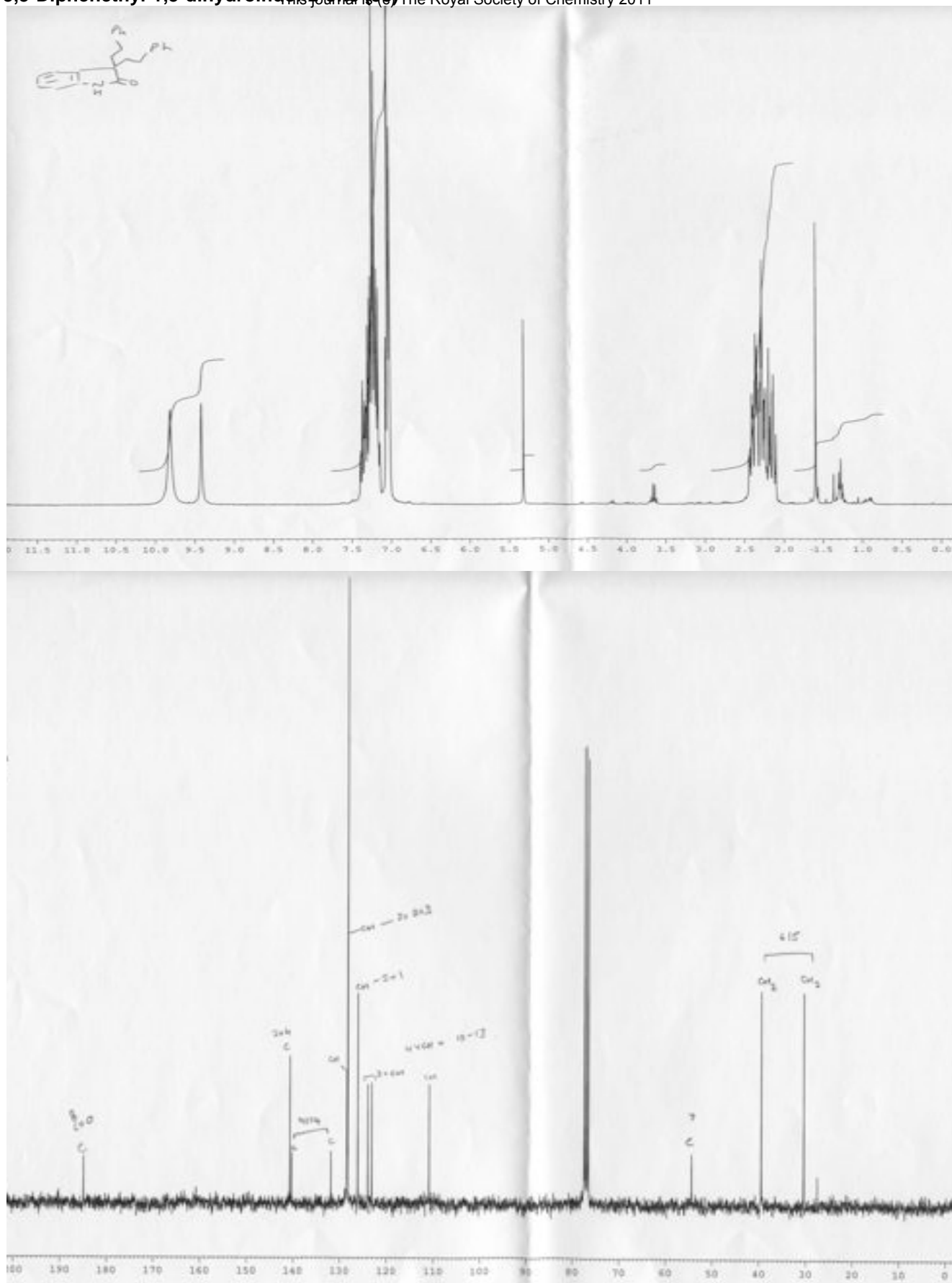




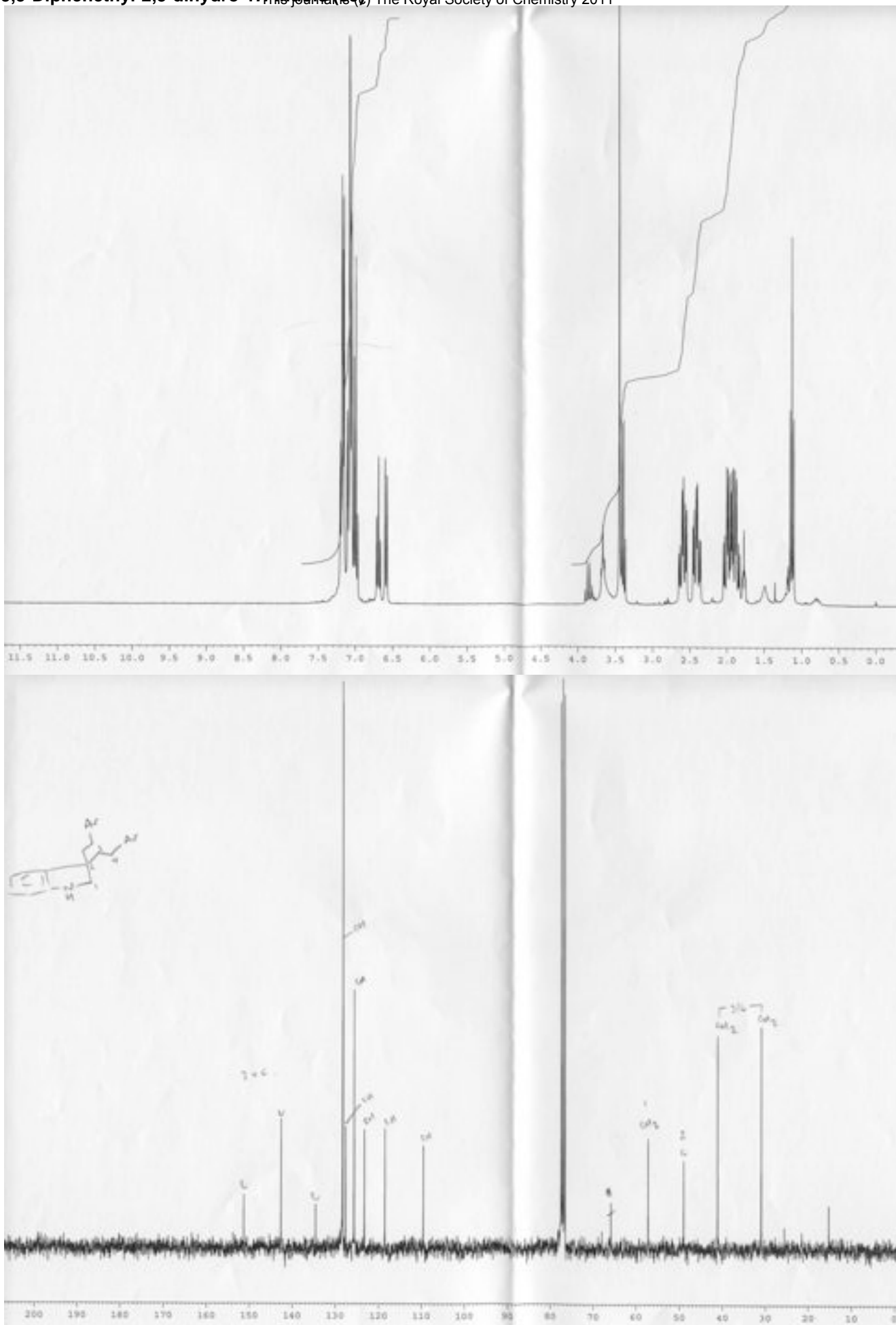


***tert*-Butyl 2-oxo-3-phenethyl-2,3-dihydroindole-1-carboxylate (57)**

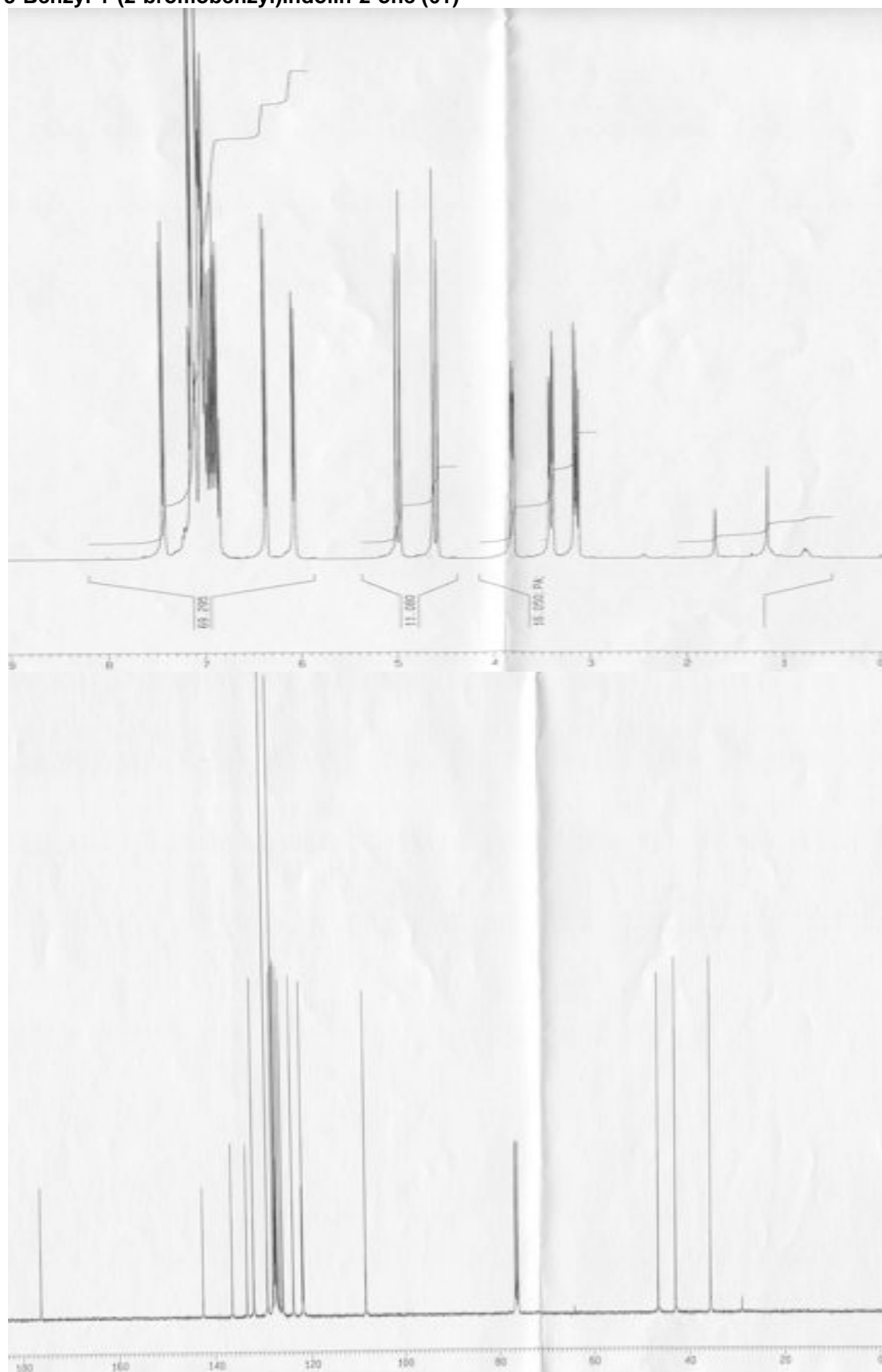




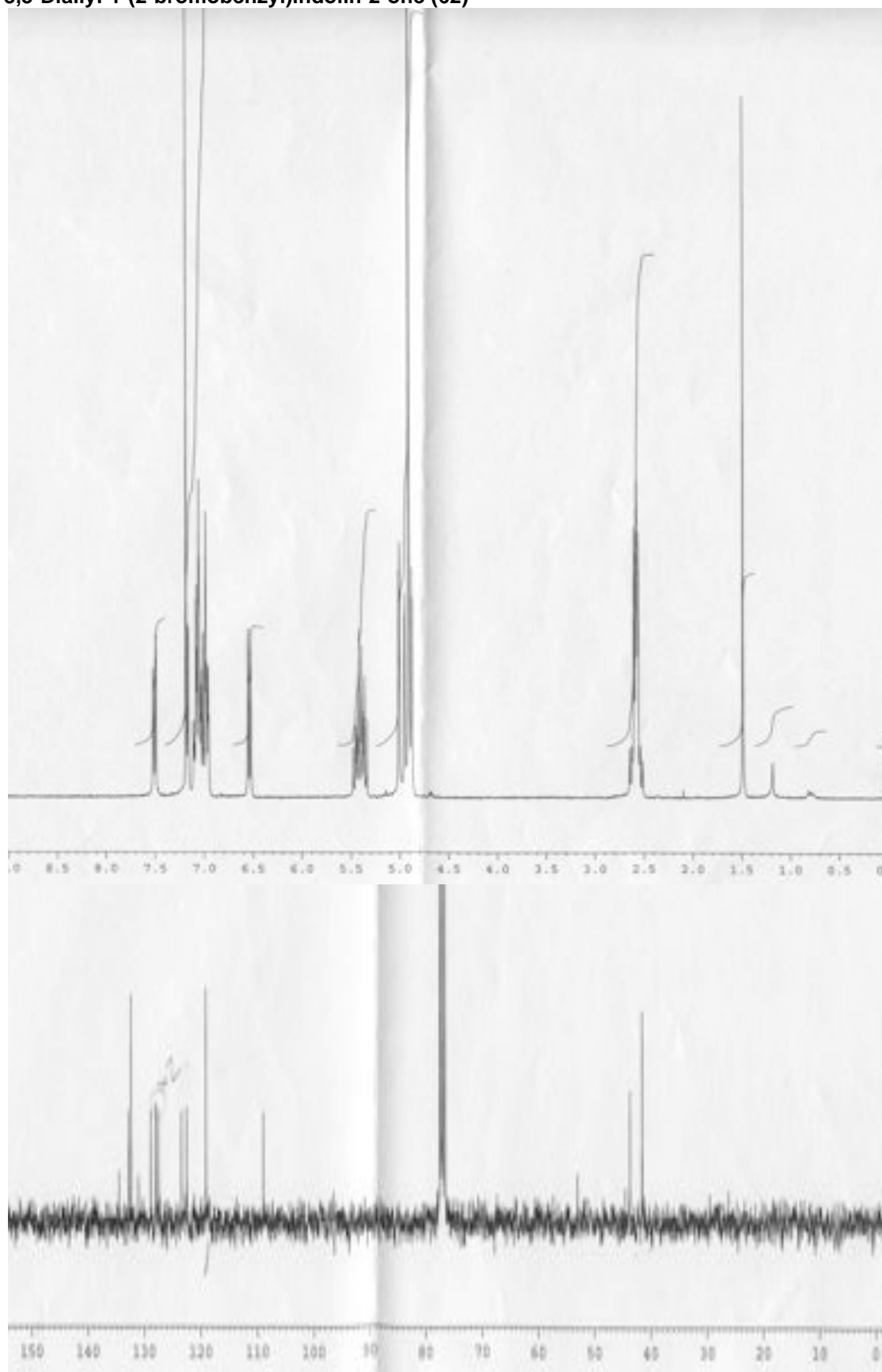




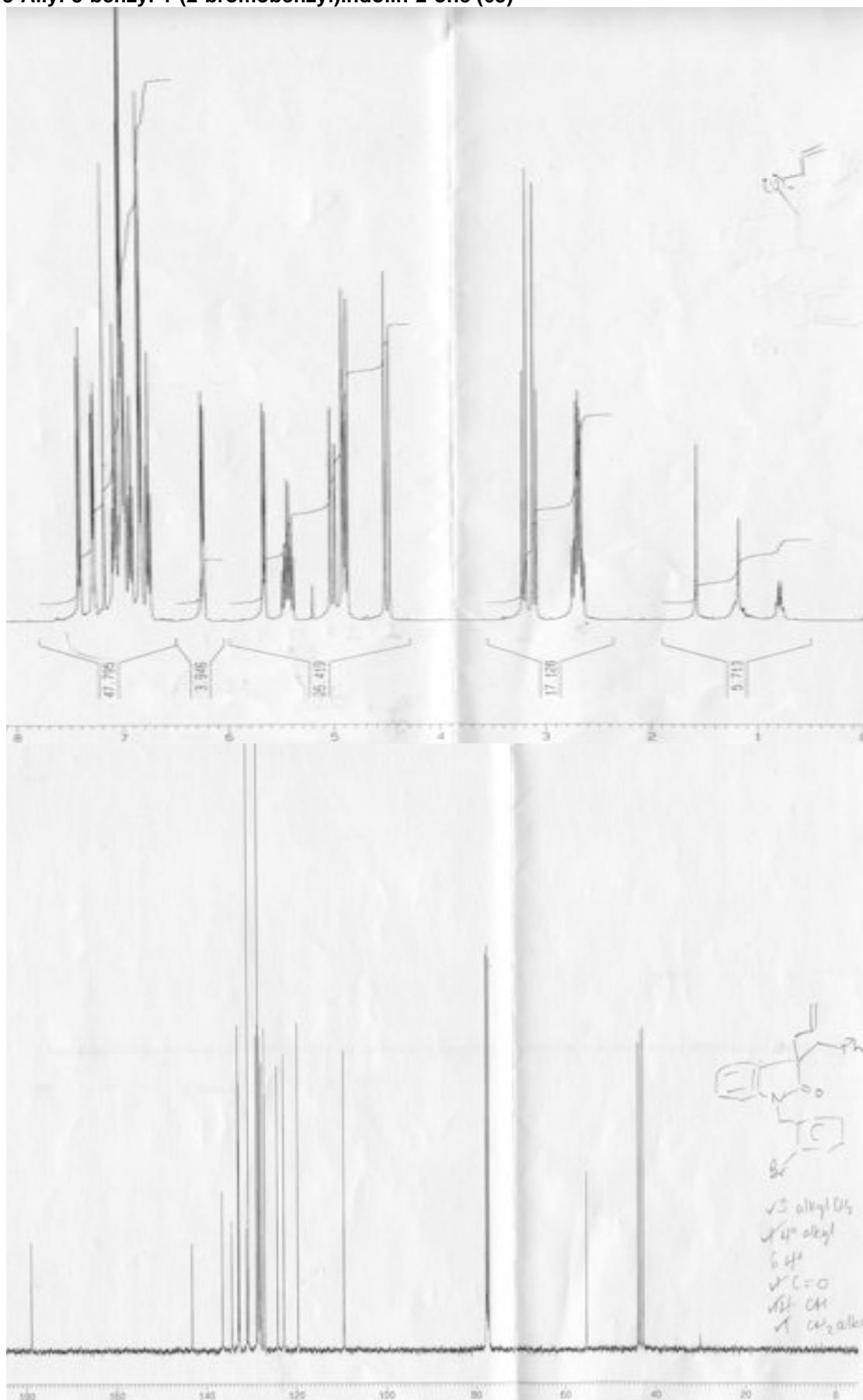
**3-Benzyl-1-(2-bromobenzyl)indolin-2-one (61)**



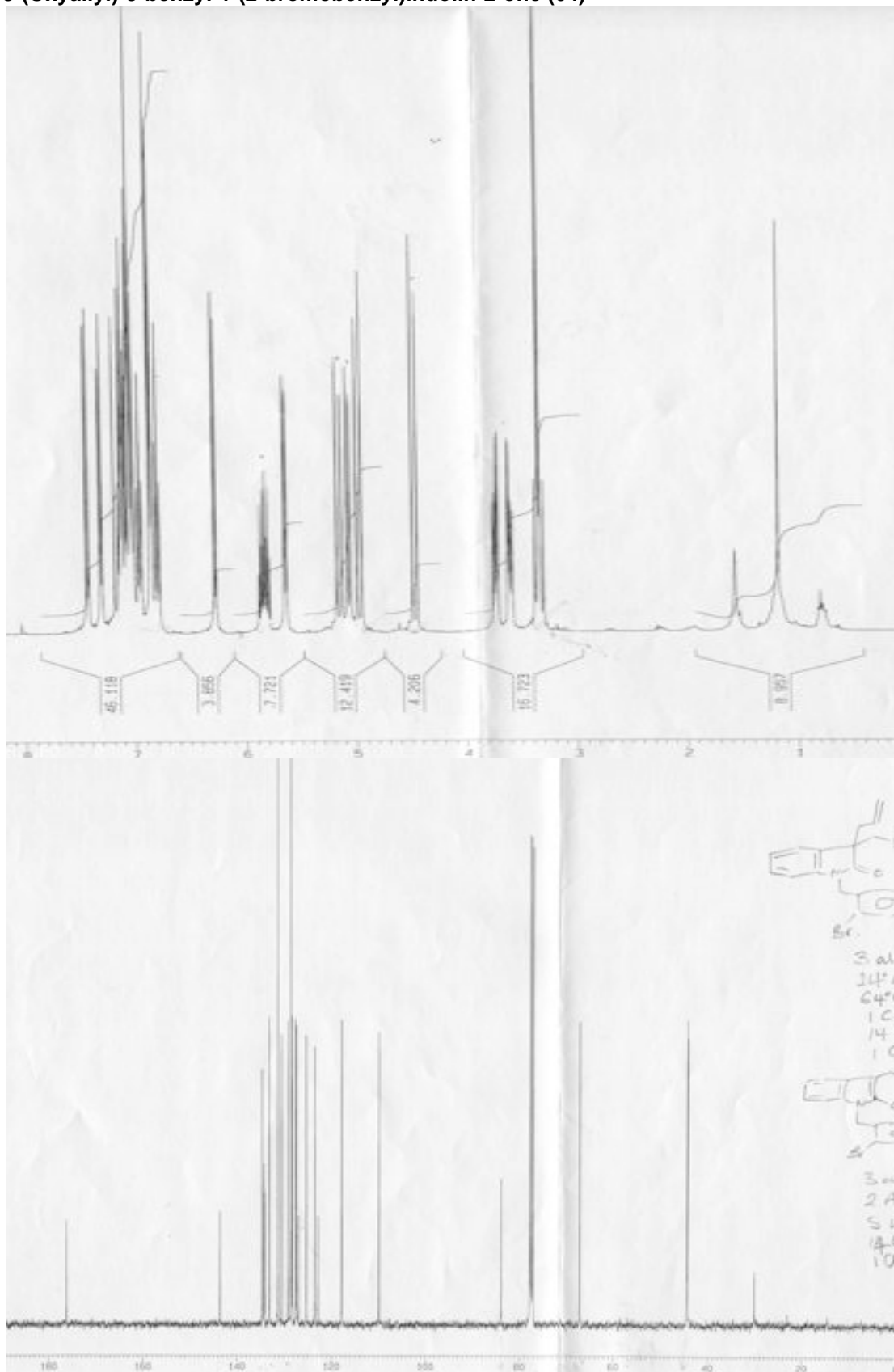
**3,3-Diallyl-1-(2-bromobenzyl)indolin-2-one (62)**



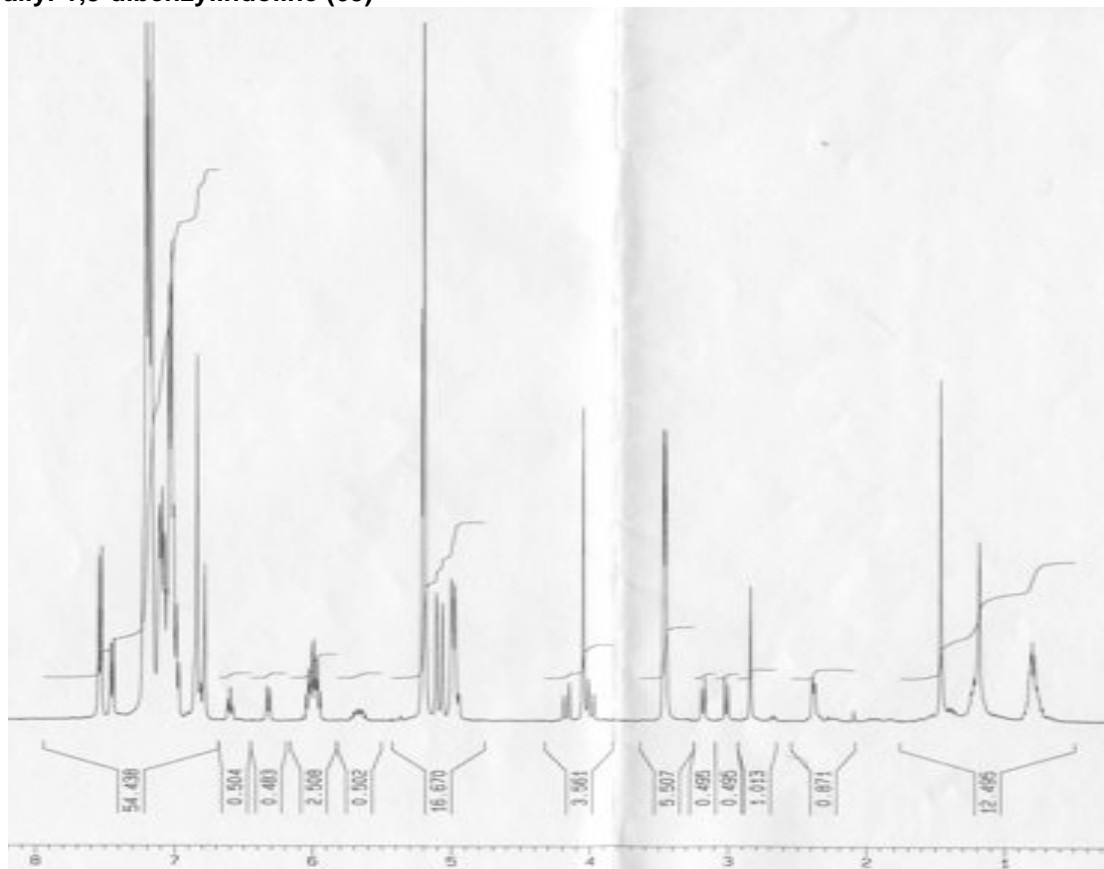
**3-Allyl-3-benzyl-1-(2-bromobenzyl)indolin-2-one (63)**



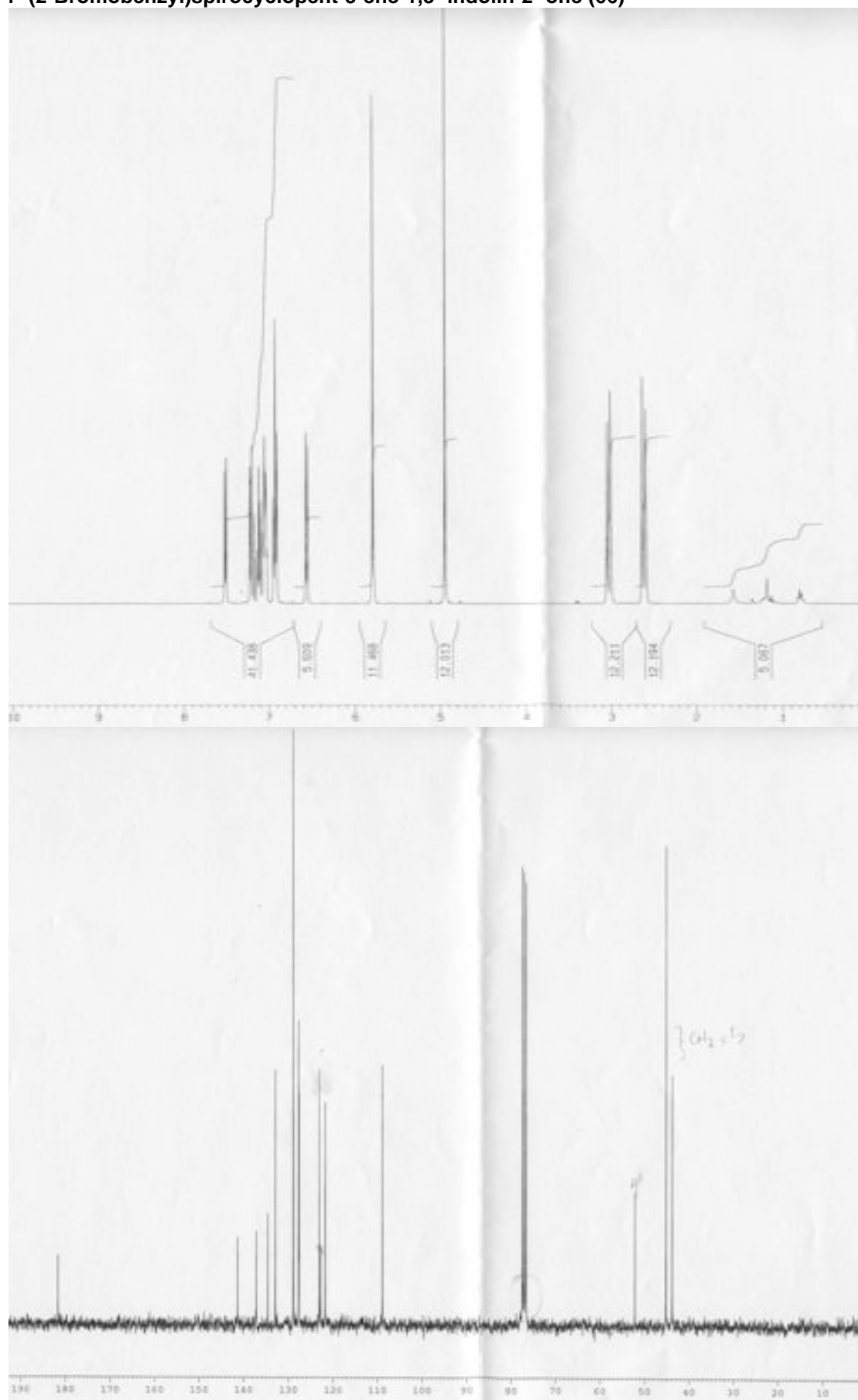
**3-(Oxyallyl)-3-benzyl-1-(2-bromobenzyl)indolin-2-one (64)**



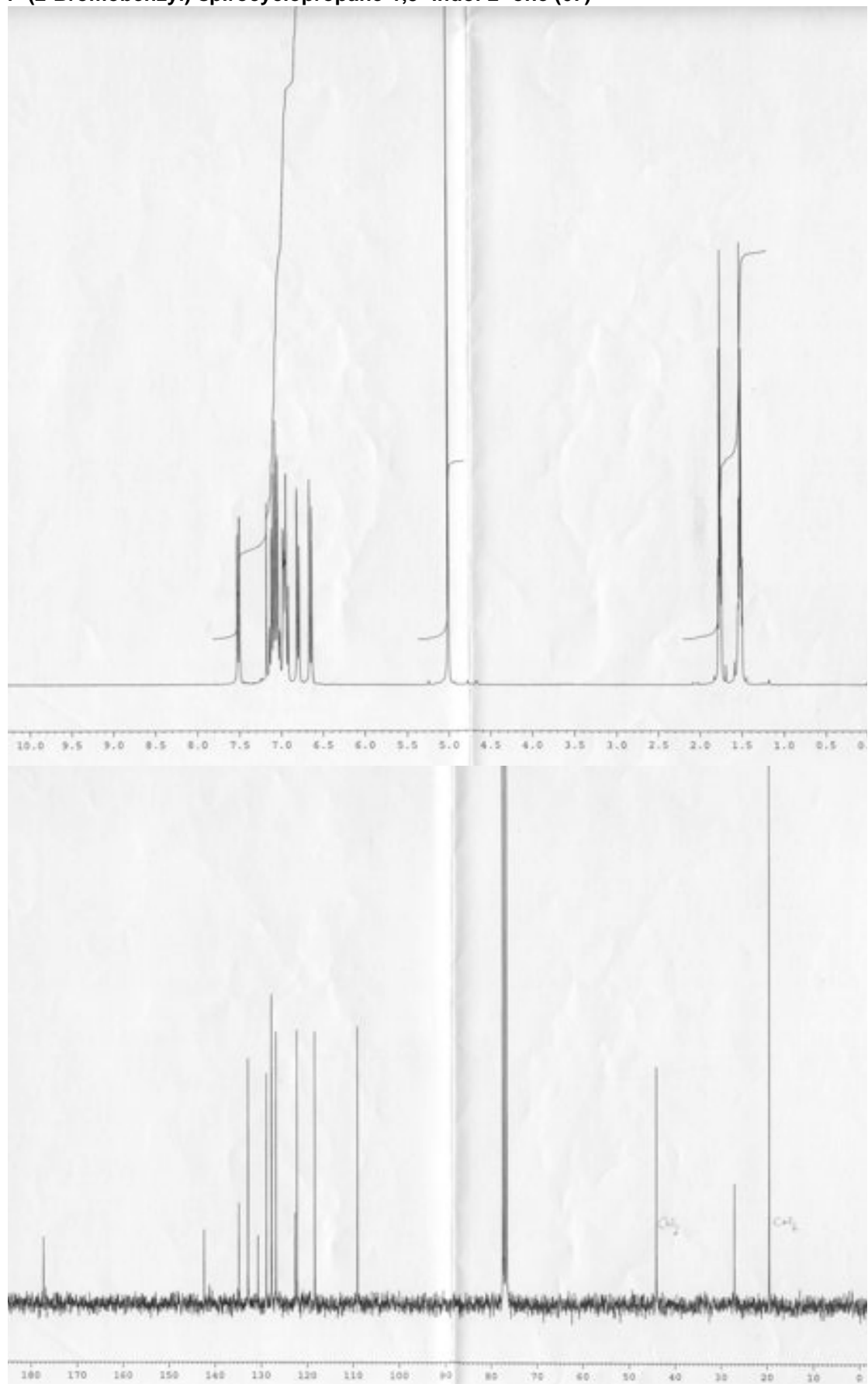
**Inseparable mixture of 3-Allyl-1-benzyl-1*H*-indole (13f), 1,3-dibenzylindole (15) and 3-allyl-1,3-dibenzylindoline (65)**



**1'-(2-Bromobenzyl)spirocyclopent-3-ene-1,3'-indolin-2'-one (66)**



**1'-(2-Bromobenzyl)-spirocyclopropane-1,3'-indol-2'-one (67)**





**1-(2-Bromobenzyl)octahydrospiro[indolizine-1,3-indol-2-one] (69)**

