Electronic Supplementary Material (ESI) for ChemComm.

Supporting Information

p-Selective (sp^2)-C-H Functionalization for Acylation/Alkylation Reaction using Organic Photoredox Catalysis

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Supplementary Material

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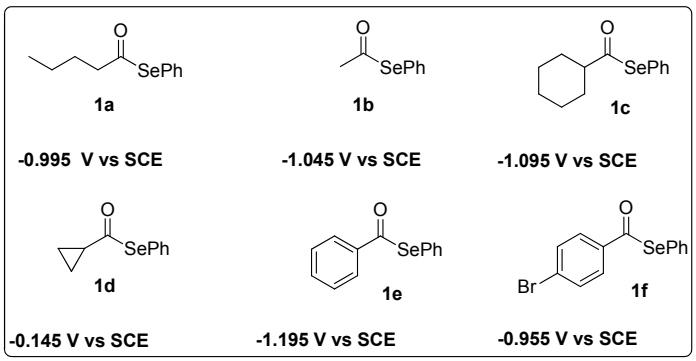
General Information:

Moisture sensitive reactions were performed under argon atmosphere and sensitive reagents were added via syringe and cannula techniques. All glass wares were washed with detergent, rinsed with acetone and dried in an oven at 125 °C prior to use. Commercial reagents and solvents were purified according to procedures prescribed in Perrin's handbook[1] and stored over 4A^{o} molecular sieves. Starting materials were prepared according to literature procedures. 9,10-Dimethoxyanthracene (DMA) was synthesized according to literature procedure. Reactions were monitored by thin layer chromatography (TLC) which were performed on silica

gel coated aluminium plates (MERCK, 60F254) and visualized by UV fluorescence and/or by staining with iodine, alcoholic solution of phosphomolybodic acid and ninhydrin. Column chromatography (CC) was performed on silica gel of mesh type 60–120, 100–200, 230–400 obtained from S. D. Fine Chemical Co. India or SRL India.

Infra-Red (IR) spectra were recorded on a Perkin-Elmer FT-IR Spectrometer. Nuclear Magnetic Resonance (NMR) spectra were recorded on a BRUKER 400 ULTRA SHIELD (400 MHz for ^{1}H and 101 MHz for ^{13}C, respectively) instrument using deuterated solvent. Chemical shifts are reported in ppm. Proton coupling constants (*J*) are reported as absolute values in Hz and multiplicity (br, broadened; s, singlet; d, doublet; t, triplet; dd, doublet of doublet; dt, doublet of triplet; td, triplet of doublet; qd, quartet of doublet; dq, doublet of quartet; p, pictet; m, multiplet). Data for ^{13}C NMR spectra are described in terms of chemical shift (δ in ppm) relative to the central line of $CDCl_3$ (δ 77.16). High resolution mass (HRMS) spectra were performed on Agilent Technologies 6530 Accurate-Mass Q-TOF LC/MS using electron spray ionization (ESI) technique.[2] Gas chromatography (GC) was performed on Agilent 7890B GC and 5977A MSD equipped with a split-mode capillary injection system and flame-ionization detectors using an Agilent HP-1 column (30 m, 0.32 mm ID).

Cyclic voltammetric studies were performed on a BAS Epsilon electrochemical workstation in acetonitrile with 0.1 M *tetra-n*-butylammonium hexafluorophosphate ($TBAPF_6$) as the supporting electrolyte. The working electrode was a BAS Pt-disk electrode, the reference electrode was Ag/AgCl, and the auxiliary electrode was a Pt wire. The potentials are reported in electron volts (eV). The oxidation potential and the excitation energy values of DMA were taken as such from literature.[3] The reduction potentials of a series of alkylphenylselenides are already reported previously by our group[4] which ranges from –0.29 eV to –1.0 eV. The reduction potential of a series of acylphenylselenides are given below.



Evaluation of Thermodynamic Parameters

The thermodynamic feasibility of ET between excited state of DMA and Se-phenyl pentaneselenoate was established by estimating Gibbs free energy change (ΔGet) for electron transfer using oxidation potential of donor (D) and reduction potential of acceptor (A) through Weller equation (eq.1).[5]

$\Delta G DS^{+\cdot}\ AS^{-\cdot} = E_{1/2}^{ox.}$ (D) - $E_{1/2}^{red.}$ (A) – $E_{exc.}$ of D ……Eq. 1
$E_{1/2}^{ox.}$ of D = Oxidation potential of DMA
$E_{1/2}^{red.}$ of A = Reduction potential of Se-phenyl pentaneselenoate (**-0.995 V vs SCE**)
$E_{exc.}$ of D = Singlet state excitation energy of DMA

$\Delta G DS^{+\cdot}\ AS^{-\cdot}$ = 0.935 V – (-0.995 V) – 74 kcalM^{-1}
$\Delta G DS^{+\cdot}\ AS^{-\cdot}$ = -29.49 kcalM^{-1}

Similarly, ET feasibility from Naphthalene to $DMA^{+\cdot}$ was evaluated by estimating ΔG_{et} employing the Eq.1.

- $\Delta G_{et} = E_{1/2}^{ox.} - E_{1/2}^{red.}$
$E_{1/2}^{ox.}$ = Oxidation potential of Naphthalene
$E_{1/2}^{red.}$ = Reduction potential of $DMA^{+\cdot}$
- ΔG_{et} = 1.54 V – 28.81 kcalM^{-1}
- ΔG_{et} = 35.51 kcal/M-1 – 28.81 kcalM^{-1}
-ΔG_{et} = 6.7 kcalM^{-1}

Similarly, ET feasibility from Anisole to $DMA^{+\cdot}$ was evaluated by estimating ΔG_{et} employing the Eq.1.

- $\Delta G_{et} = E_{1/2}^{ox.} - E_{1/2}^{red.}$
$E_{1/2}^{ox.}$ = Oxidation potential of Anisole
$E_{1/2}^{red.}$ = Reduction potential of $DMA^{+\cdot}$
- ΔG_{et} = 1.76 V – 28.81 kcalM^{-1}
- ΔG_{et} = 40.58 kcal/M-1 – 28.81 kcalM^{-1}
-ΔG_{et} = 11.77 kcalM^{-1}

Similarly, ET feasibility from Toluene to $DMA^{+\cdot}$ was evaluated by estimating ΔG_{et} employing the Eq.1.

- $\Delta G_{et} = E_{1/2}^{ox.} - E_{1/2}^{red.}$
$E_{1/2}^{ox.}$ = Oxidation potential of Toluene
$E_{1/2}^{red.}$ = Reduction potential of $DMA^{+\cdot}$
- ΔG_{et} = 1.98 V – 28.81 kcalM^{-1}
- ΔG_{et} = 44.66 kcal/M-1 – 28.81 kcalM^{-1}
-ΔG_{et} = 15.85 kcalM^{-1}

DFT Calculation

1. Result and discussion:

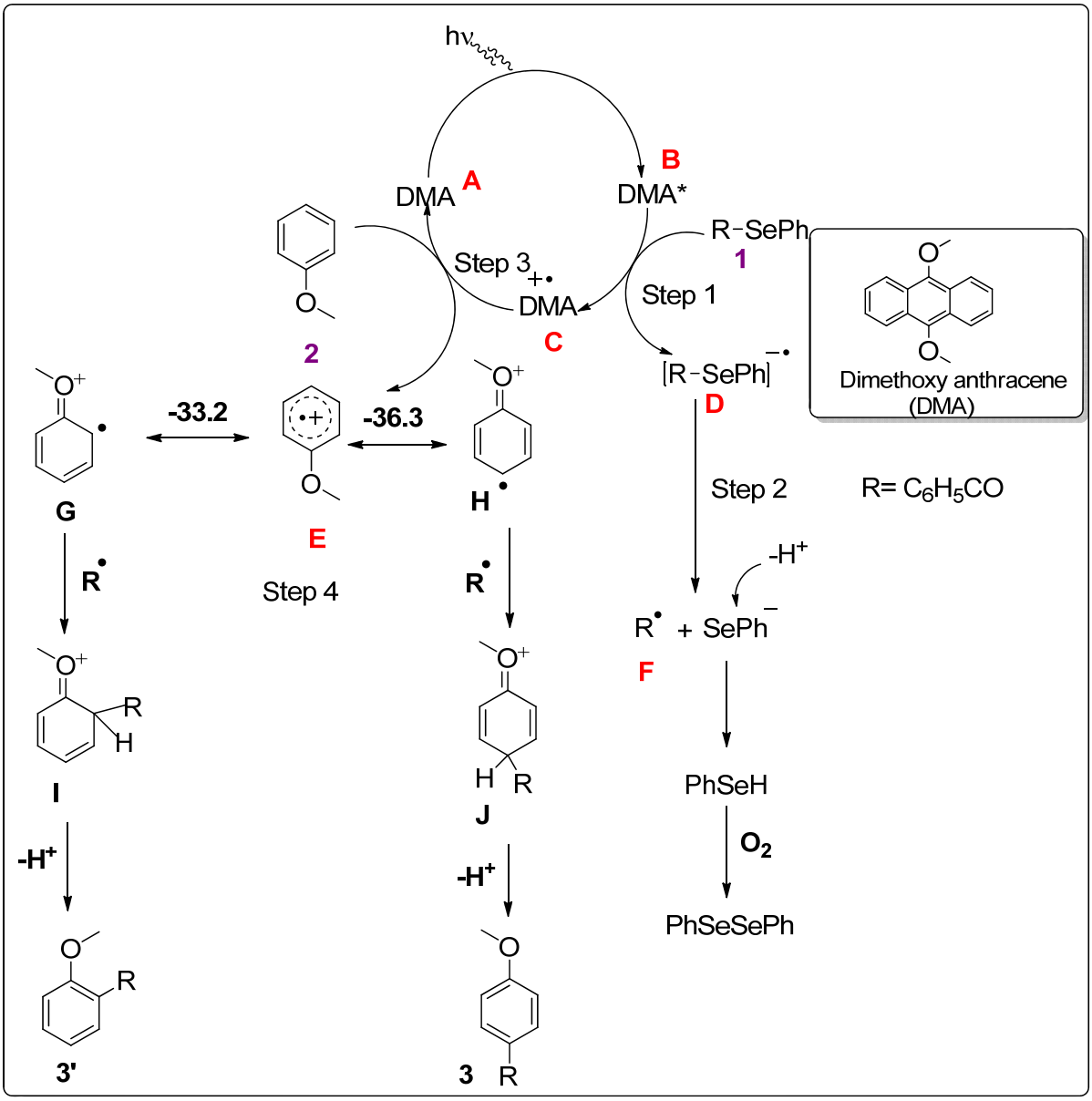


Figure S1. Mechanistic details for the acylation reaction. All ΔG values are in kcal/mol.

In this mechanism, as shown as Step 3, the DMA radical cation (**C**) is neutralized by one electron transfer from **2** to generate radical cation (**E**), which can lead to the formation of two possible radical cationic species, **G** and **H.** The attack of acyl radical (**F**) on the radical cationic species **G** and **H** to form the cationic species **I** and **J** (Step 4). This is where the differentiation occurs, leading to either the *para* product (starting from **E**) or the *ortho*. It is seen that the formation of the cationic species **J** is more favourable by 3.1 kcal/mol, which indicates that the *para* product would be the preferred one. Furthermore, in addition to the thermodynamics, we

have also attempted to obtain the barrier at this important step for the formation of the *para* product from **J** to **3**, as well as from **I** to **3'**. Since the transition states for this could not be obtained, an estimate of the barriers has been obtained from a linear scan of the reaction coordinate. The reaction profiles are shown in Figure S4 and Figure S5 below. Since H^+ is a proton and therefore does not have any electrons, we cannot directly find the electronic energy of H^+. Therefore, in order to calculate the effective reaction (loss of H^+), we have added H_3O^+ and H_2O in the aromatization reaction step.

They, too, indicate that the *para* product would be preferred ($\Delta G^{\#}$ = 8.0 kcal/mol) over the *ortho* ($\Delta G^{\#}$ =10.2 kcal/mol). This result therefore corroborates the experimental observations.

In order to understand the observed and calculated preference for the *para* product over the *ortho* product, we have done Mulliken atomic spin density calculations (see Figure S2 below), from which the spin densities on the different atoms in the radical cation (**E**) have been evaluated. The analysis shows that the spin density on the *para* carbon is maximum (0.49), which suggests that the incoming radical (acyl or alkyl radical) will attack on the *para* carbon, and, therefore, that the *para* product would be preferred ($\Delta G^{\#}$ = 8.0 kcal/mol) over the *ortho.*

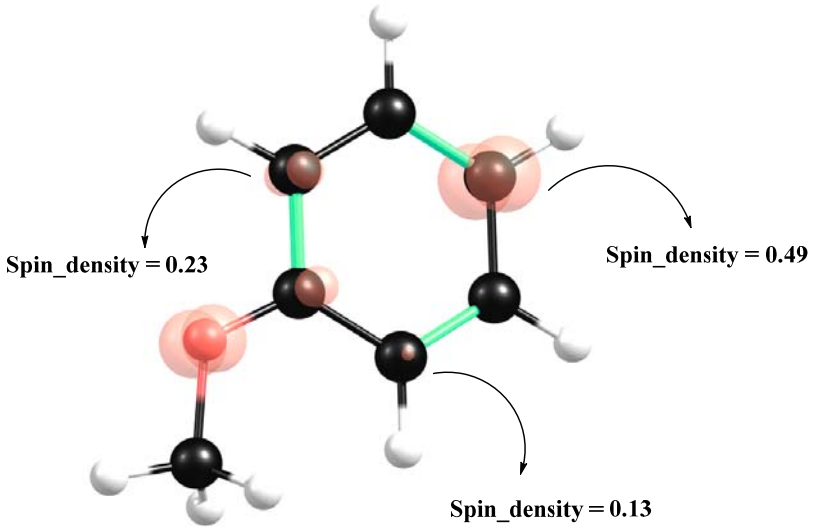


Figure S2. Spin density for ortho and para carbon on radical cation **(E)**.

Similar calculations have also been done for the alkylation reaction, and the results are shown in the Figures S3, S6 and S7 below. While the reaction mechanism remain the same, the overall energetics (obtained by the addition of all the steps) show less favourability in comparison to the acylation process. This explains why the experiments find the acylation to be more facile.

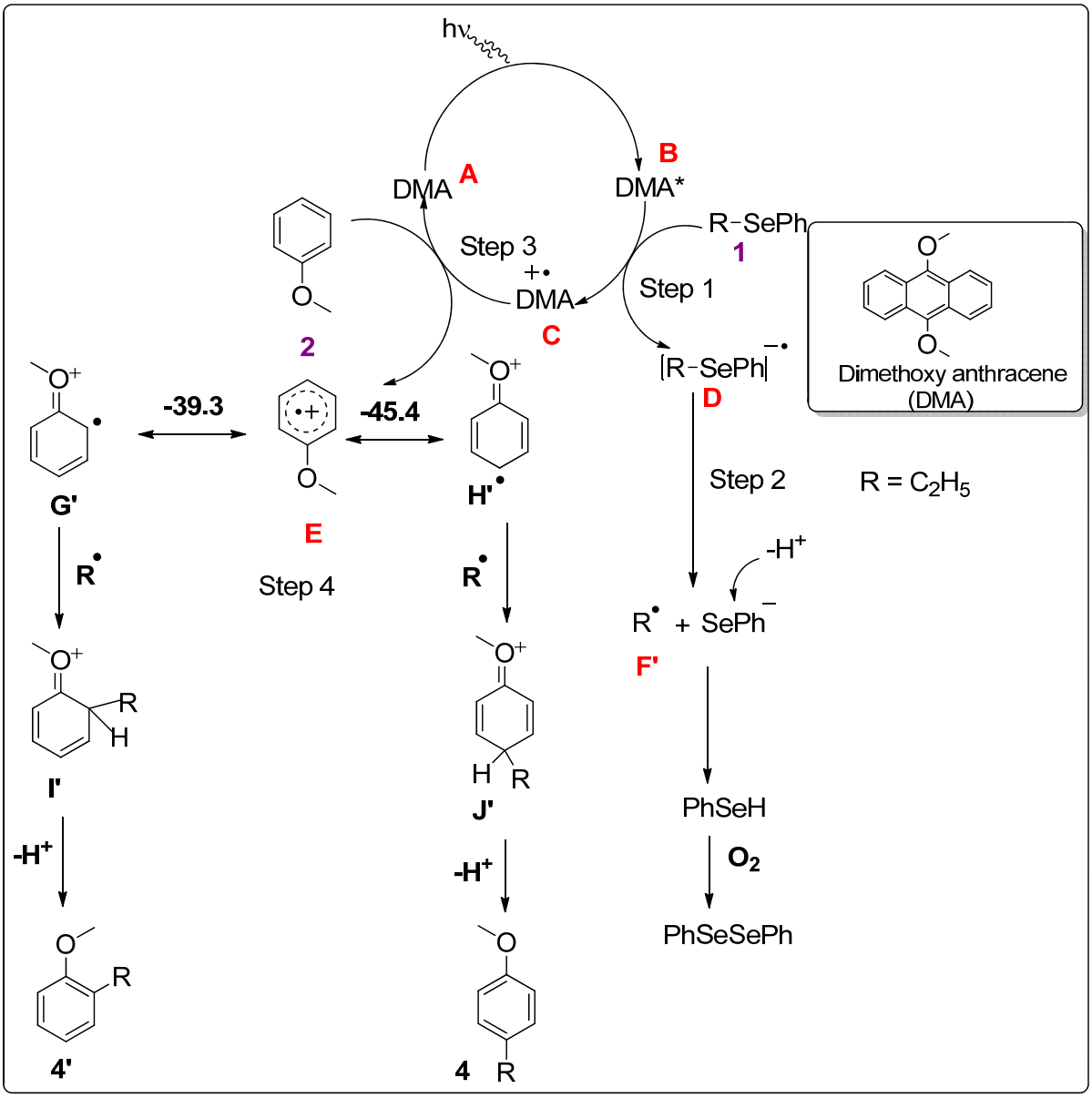


Figure S3. The mechanism for the alkylation process. All ΔG values are in kcal/mol.

The calculation of the aromatization step in the Figures S4 to S7 has been done for the sake of completion.

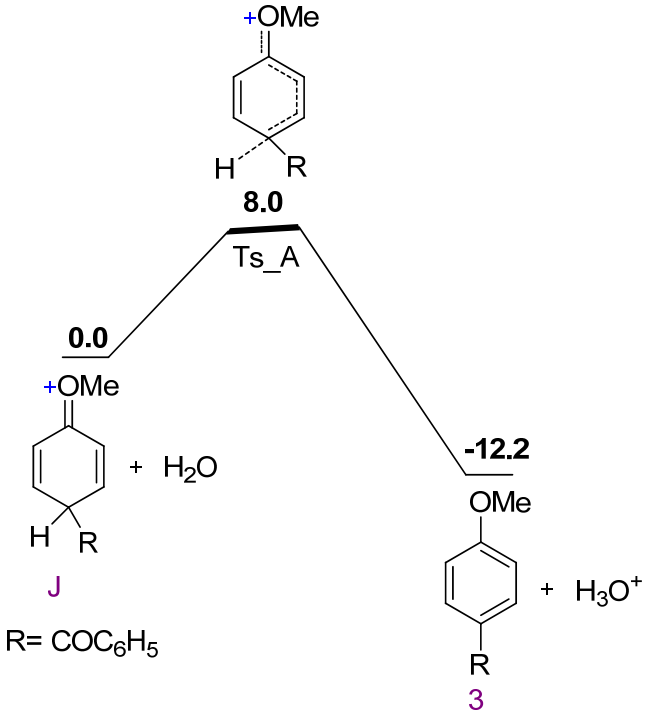


Figure S4. The free energy profile (ΔG in kcal/mol) for formation of product **3** in acylation process.

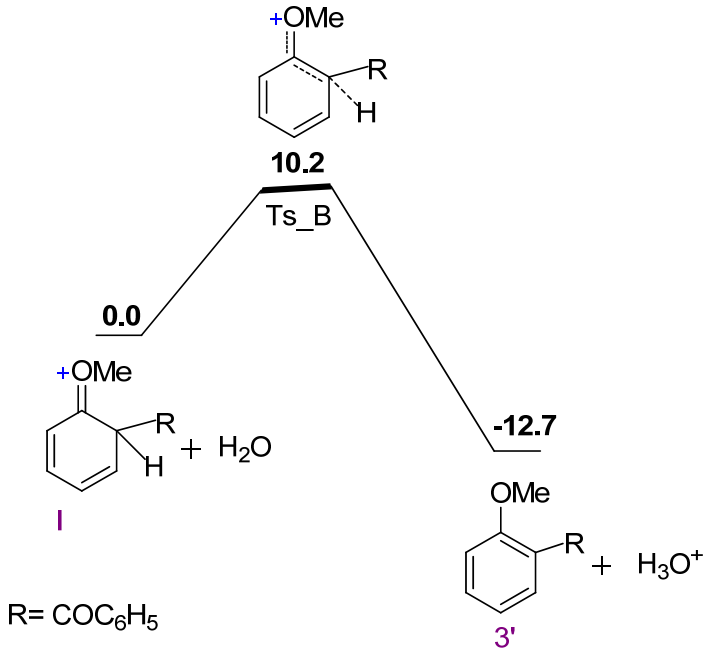


Figure S5. The free energy profile (ΔG in kcal/mol) for formation of product **3**' in acylation process.

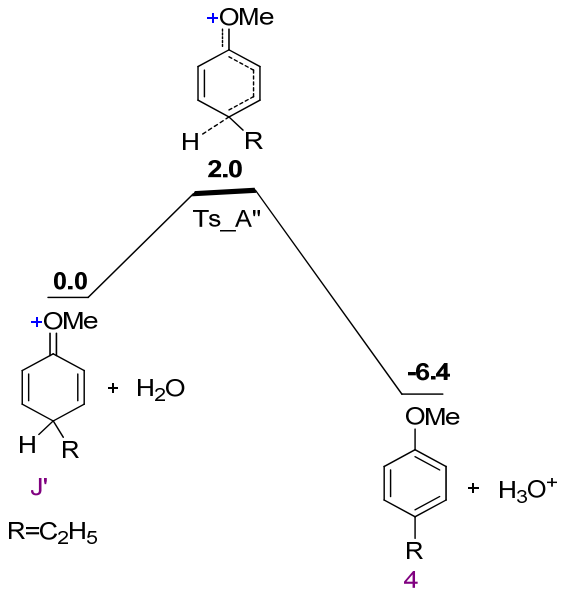


Figure S6. The free energy profile (ΔG in kcal/mol) for formation of product **4**in alkylation process.

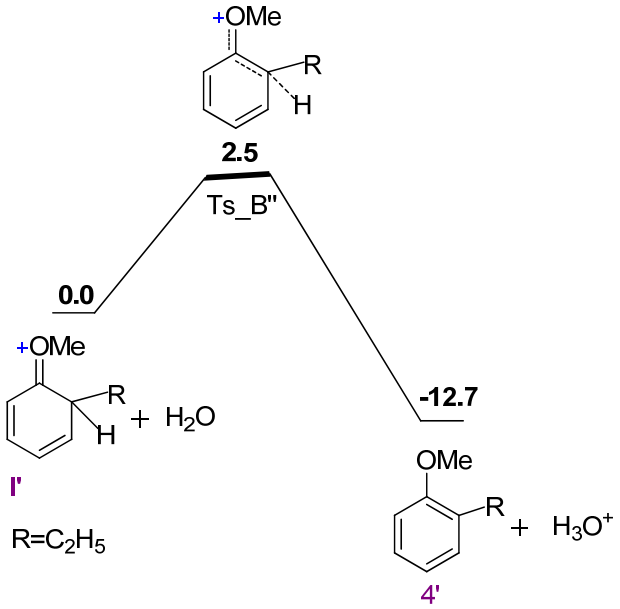


Figure S7. The free energy profile (ΔG in kcal/mol) for formation of product **4'** in alkylation process.

2. Computational Details

The geometry optimizations were conducted employing density functional theory (DFT), with the Turbo mole 7.0 suite of programs.[6] The M06-2X[7] functional was used for the geometry

optimization calculations. The triple-ζ basis set, augmented by a polarization function (Turbo mole basis set TZVP), was used for all the atoms. Solvent effects were accounted for as follows: we have done full geometry optimizations of all intermediates calculations using the COSMO[8] model. The solvent used in this study is acetonitrile ($\varepsilon = 37.5$). The contributions of internal energy and entropy were obtained from frequency calculations done on the DFT structures: thus, the energies reported in the figures are the ΔG values, in kcal/mol. The charge analysis was done with the Mulliken[9] method.

The xyz coordinate for optimized geometry

DMA

32

C	-7.746094	-3.958407	-0.037961
C	-6.386099	-3.958455	-0.037826
C	-5.660782	-2.727506	-0.045325
C	-6.387071	-1.496619	-0.052810
C	-7.815681	-1.539268	-0.056025
C	-8.470978	-2.730822	-0.048113
C	-4.263793	-2.692242	-0.040438
C	-5.681470	-0.291057	-0.052045
C	-4.284719	-0.255906	-0.047031
C	-3.558348	-1.486753	-0.042379
C	-2.129665	-1.443894	-0.035344
H	-1.583103	-2.377404	-0.024562
C	-1.474580	-0.252507	-0.029355
C	-2.199429	0.975033	-0.031566
C	-3.559280	0.975303	-0.041321
H	-8.290338	-4.893668	-0.025477

H	-5.830187	-4.886431	-0.020609
H	-8.362282	-0.605923	-0.054637
H	-9.552927	-2.755533	-0.044524
H	-0.392513	-0.227679	-0.017991
H	-1.655247	1.910546	-0.020740
H	-4.115185	1.903266	-0.033633
O	-3.568062	-3.866721	-0.010910
O	-6.377811	0.883368	-0.033448
C	-6.684066	1.449096	-1.309307
H	-7.764361	1.560828	-1.393772
H	-6.211018	2.427659	-1.387790
H	-6.323204	0.807855	-2.114013
C	-3.251684	-4.437969	-1.281909
H	-2.170421	-4.545292	-1.359841
H	-3.719938	-5.418965	-1.357590
H	-3.610959	-3.802863	-2.092216

4

25

C	-0.086447	-0.000012	0.179831
C	0.066932	-0.000156	1.563576
C	1.341501	-0.000174	2.113621
C	2.459002	-0.000090	1.286688
C	2.307332	0.000033	-0.096100
C	1.038557	0.000100	-0.649146
H	-0.793790	-0.000381	2.220829
H	1.461703	-0.000296	3.188205
H	3.450398	-0.000108	1.719713
H	3.176288	0.000076	-0.741009
H	0.902600	0.000250	-1.722223

C	-1.410932	-0.000204	-0.503966
O	-1.502073	-0.001314	-1.700536
Se	-2.984218	0.001713	0.647574
C	-4.465547	0.000586	-0.598589
C	-5.714168	0.000179	0.028595
C	-6.878064	-0.000226	-0.727618
C	-6.812544	-0.000311	-2.116394
C	-5.571475	0.000005	-2.735895
C	-4.394870	0.000529	-1.990675
H	-5.783665	0.000274	1.109921
H	-7.836917	-0.000540	-0.226156
H	-7.718942	-0.000622	-2.707809
H	-5.505537	-0.000087	-3.816621
H	-3.447459	0.000772	-2.499806

DMA

32

C	-7.585998	-4.126877	0.082949
C	-6.216637	-4.044593	-0.000003
C	-5.582682	-2.800645	-0.215393
C	-6.385666	-1.631578	-0.261638
C	-7.787921	-1.746761	-0.217576
C	-8.377598	-2.977119	-0.050755
C	-4.170925	-2.644103	-0.336609
C	-5.772752	-0.341641	-0.355897
C	-4.361858	-0.183931	-0.222966
C	-3.558718	-1.353916	-0.250417
C	-2.156773	-1.239116	-0.196231
H	-1.552528	-2.132383	-0.252441
C	-1.567534	-0.007670	-0.036590

C	-2.359557	1.143575	0.079665
C	-3.728289	1.061423	-0.014394
H	-8.053762	-5.086070	0.259028
H	-5.634439	-4.941268	0.132351
H	-8.392391	-0.854715	-0.287306
H	-9.455208	-3.056415	-0.003829
H	-0.490251	0.071451	0.018302
H	-1.892988	2.104197	0.250953
H	-4.310029	1.959975	0.104482
O	-3.319106	-3.632206	-0.476013
O	-6.624697	0.642609	-0.515748
C	-6.340693	1.875115	-1.188945
H	-7.233854	2.103485	-1.762825
H	-6.166360	2.660955	-0.458495
H	-5.486712	1.763503	-1.853204
C	-3.596136	-4.861051	-1.159194
H	-2.698788	-5.084753	-1.728478
H	-3.774662	-5.651493	-0.434754
H	-4.445780	-4.746913	-1.828536

D

25

C	-4.058081	-1.122457	0.763288
C	-3.027899	-1.804692	0.126950
C	-2.076481	-1.105778	-0.613977
C	-2.173582	0.278721	-0.719151
C	-3.208631	0.959902	-0.084993
C	-4.148808	0.261359	0.662062
H	-4.785857	-1.670506	1.349442
H	-2.949858	-2.878707	0.229593

H	-1.428136	0.830575	-1.276777
H	-3.269304	2.038308	-0.162954
H	-4.944054	0.792878	1.169930
Se	-0.568383	-2.032673	1.379072
C	0.344362	-2.251047	0.420423
O	-0.336363	-1.942110	1.410975
C	1.670153	-2.737558	0.448238
C	2.443145	-3.107864	-0.689377
C	2.299295	-2.866583	1.730971
C	3.736987	-3.563865	-0.545587
H	2.012898	-3.030819	-1.681314
C	3.591059	-3.324304	1.847759
H	1.731224	-2.592406	2.610491
C	4.338868	-3.681886	0.715653
H	4.298513	-3.837145	-1.431163
H	4.034092	-3.409181	2.834189
H	5.353877	-4.041478	0.814091

F

13

C	-0.002645	0.000299	0.056727
C	0.016810	0.000171	1.448301
C	1.229858	-0.000168	2.120335
C	2.415935	-0.000062	1.396525
C	2.398361	-0.000014	0.001898
C	1.190310	0.000083	-0.676804
H	-0.922727	0.000273	1.985402
H	1.248176	-0.000432	3.201505
H	3.362427	-0.000013	1.921315
H	3.329976	0.000028	-0.548999

H 1.165458 0.000112 -1.759460
C -1.317347 0.000827 -0.608898
O -1.579338 -0.001102 -1.759475
2
16
C 0.002296 -0.000021 0.053345
C 0.021951 0.000003 1.449781
C 1.230489 0.000034 2.121695
C 2.431996 0.000006 1.414454
C 2.403102 0.000020 0.028269
C 1.194209 0.000036 -0.664689
H -0.920835 -0.000077 1.981605
H 1.235191 0.000099 3.204112
H 3.375232 -0.000054 1.942864
H 3.327168 0.000004 -0.535188
H 1.195569 0.000059 -1.745407
O -1.228477 -0.000118 -0.518269
C -1.312931 -0.000014 -1.930438
H -2.371686 0.000126 -2.173421
H -0.845195 0.891625 -2.353237
H -0.845413 -0.891729 -2.353312
E
16
C -0.125242 0.000002 0.051129
C -0.036890 -0.000159 1.458569
C 1.187814 0.000178 2.049557
C 2.361966 0.000026 1.227885
C 2.276410 0.000215 -0.196411
C 1.036522 -0.000128 -0.760734

H	-0.935100	-0.000011	2.058324
H	1.328831	0.000184	3.121832
O	3.475373	-0.000205	1.885510
H	3.170457	0.000178	-0.803476
H	0.931969	-0.000161	-1.836209
H	-1.096855	-0.000013	-0.421545
C	4.750815	-0.000069	1.219386
H	5.488375	-0.000151	2.013788
H	4.843985	-0.897133	0.611178
H	4.843890	0.897247	0.611504

H

29

C	0.014334	0.942140	0.439010
C	0.196081	0.053833	1.608007
C	1.480933	-0.688104	1.644277
C	2.355739	-0.632236	0.633438
C	2.060986	0.183234	-0.506458
C	0.897157	1.011983	-0.569642
C	-0.961062	-0.992141	1.633345
O	-1.623129	-1.140692	0.639757
O	2.923985	0.110846	-1.453182
C	-1.177195	-1.798643	2.856313
C	-2.024626	-2.904799	2.749099
C	-2.271452	-3.692914	3.858595
C	-1.678572	-3.377584	5.078276
C	-0.834987	-2.279021	5.187722
C	-0.580358	-1.488552	4.076561
H	3.279841	-1.192216	0.624885
H	1.688360	-1.310201	2.505336

H	-0.891081	1.534943	0.404966
H	0.726944	1.656566	-1.419124
H	-0.376306	-2.035289	6.136049
H	-1.876932	-3.991890	5.946288
H	-2.923702	-4.551957	3.776474
H	-2.475799	-3.133880	1.792589
H	0.070109	-0.629352	4.177885
H	0.099458	0.661517	2.517233
C	2.768274	0.853046	-2.678917
H	3.626779	0.586209	-3.283485
H	1.846297	0.552433	-3.172132
H	2.770611	1.918934	-2.462996

3

28

C	-0.107926	0.731213	0.377866
C	0.286578	0.038220	1.519730
C	1.543695	-0.564133	1.573168
C	2.396210	-0.486573	0.483997
C	2.007215	0.218576	-0.651237
C	0.761491	0.833119	-0.700994
C	-0.552959	-0.000212	2.752653
O	-0.008876	0.100054	3.837656
C	-2.018939	-0.180088	2.670294
C	-2.785169	0.149746	3.787865
C	-4.146186	-0.093721	3.820682
C	-4.749048	-0.695092	2.714418
C	-3.993373	-1.030124	1.587871
C	-2.640010	-0.770708	1.565706
O	-6.058917	-0.996390	2.648742

C	-6.867110	-0.766127	3.790533
H	-4.489707	-1.506872	0.753421
H	-2.057966	-1.059894	0.700873
H	-2.299849	0.598376	4.644657
H	-4.719749	0.171782	4.696997
H	0.466621	1.394322	-1.577706
H	2.679464	0.292536	-1.496071
H	3.365385	-0.965452	0.522562
H	1.838565	-1.090957	2.472118
H	-1.075613	1.215365	0.344341
H	-7.866513	-1.094915	3.521879
H	-6.507938	-1.344935	4.643225
H	-6.891107	0.293765	4.049074

3’

28

C	0.404345	1.200102	0.406237
C	0.716835	0.630561	1.647916
C	1.671867	-0.381227	1.711525
C	2.280688	-0.859879	0.561793
C	1.943102	-0.303109	-0.665495
C	1.013008	0.724968	-0.753496
C	0.161796	1.148472	2.936939
O	0.922281	1.278699	3.876918
C	-1.289261	1.439557	3.129605
C	-2.272073	0.888379	2.311508
C	-3.612862	1.100626	2.602451
C	-3.974554	1.876786	3.698307
C	-2.995188	2.440835	4.510086
C	-1.656773	2.215620	4.230637

H	0.785524	1.165084	-1.713695
O	-0.443990	2.246430	0.433937
H	1.929085	-0.787677	2.681493
H	3.016032	-1.650710	0.622800
H	-4.377196	0.659590	1.976577
H	-5.020917	2.040341	3.923365
H	-3.275977	3.045961	5.362434
H	-0.884859	2.635239	4.862626
H	-1.989170	0.284551	1.458643
H	2.418295	-0.657285	-1.571074
C	-0.923122	2.775324	-0.787159
H	-1.649353	3.536640	-0.517544
H	-0.116104	3.232059	-1.363383
H	-1.410352	2.001068	-1.383284

PhSeH

13

C	-0.015912	0.000101	0.146869
C	0.060344	0.000032	1.538214
C	1.301182	-0.000043	2.163757
C	2.469601	-0.000039	1.411416
C	2.388903	0.000007	0.024066
C	1.152378	0.000063	-0.611688
H	-0.842562	-0.000050	2.136346
H	1.350453	-0.000065	3.245152
H	3.433548	-0.000061	1.902604
H	3.292330	0.000013	-0.572610
H	1.106977	0.000181	-1.693144
Se	-1.764020	0.000411	0.656487
H	-1.269320	-0.000552	-2.036994

PhSeSePh

24

C	0.942557	-0.000817	-0.837272
C	-0.195152	-0.001070	-0.052199
C	-0.082383	-0.000224	1.332407
C	1.165549	0.000559	1.922685
C	2.309759	0.000668	1.140812
C	2.191691	0.000140	-0.234617
Se	-2.005836	-0.003327	0.717251
H	-0.961028	-0.000329	1.951500
H	1.242276	0.001167	2.994124
H	3.279958	0.001144	1.601378
H	3.070094	0.000369	-0.853053
H	0.890771	-0.001401	-1.907571
Se	-1.604298	0.000492	3.056653
C	-3.415594	0.000219	-3.720314
C	-3.529918	0.000202	-5.104788
C	-4.778644	0.000283	-5.693637
C	-5.921887	0.000197	-4.910465
C	-5.802311	0.000220	-3.535210
C	-4.552429	0.000255	-2.934011
H	-2.652048	0.000078	-5.724935
H	-4.856569	0.000412	-6.764968
H	-6.892672	0.000087	-5.369916
H	-6.679927	0.000221	-2.915690
H	-4.499600	0.000453	-1.863792

H_3O^+

4

O	0.082566	0.000184	-0.017347

H -0.093385 -0.000064 0.936760
H 0.996722 -0.000056 -0.342365
H -0.655917 -0.000064 -0.646713
Ethyl_radical
7
C -0.008973 -0.000046 0.124757
H -0.126836 0.000073 1.199222
C 1.346748 -0.000001 -0.484387
H 1.297825 0.000022 -1.572423
H 1.929466 0.875285 -0.175482
H 1.929463 -0.875308 -0.175552
H -0.899393 -0.000024 -0.486444
a
22
C -0.002134 -0.048713 -0.000202
C -0.072704 0.241589 1.356907
C 1.105610 0.306989 2.098860
C 2.347763 0.091461 1.518470
C 2.392338 -0.194465 0.150295
C 1.237763 -0.264087 -0.604577
H -1.021997 0.417703 1.842849
H 1.043896 0.533451 3.157174
C 3.608011 0.090977 2.341307
H 3.350411 -0.365278 -0.328175
H 1.268764 -0.485319 -1.664086
O -1.082687 -0.138860 -0.818497
C -2.366154 0.029046 -0.249543
H -3.077961 -0.098694 -1.060389
H -2.555949 -0.721503 0.520210

H	-2.481290	1.026843	0.179805
H	4.407967	0.585251	1.785319
H	3.444705	0.667574	3.253589
C	4.041020	-1.331811	2.701326
H	4.944509	-1.325482	3.311643
H	3.251981	-1.840420	3.258744
H	4.241692	-1.911931	1.798672

b

22

C	0.267313	-0.257944	-0.153813
C	0.078161	0.183137	1.166631
C	1.149698	0.293885	2.046357
C	2.431361	-0.036915	1.611177
C	2.639908	-0.473735	0.314066
C	1.554923	-0.579898	-0.555042
O	-1.203546	0.476622	1.502474
C	-1.469452	0.974424	2.797394
H	0.998889	0.630173	3.062562
H	3.261237	0.050301	2.300833
H	1.710307	-0.924224	-1.571108
H	-2.534154	1.190188	2.826724
H	-1.229574	0.234107	3.563035
H	-0.909110	1.891978	2.990426
H	3.633838	-0.734318	-0.024014
C	-0.906361	-0.345744	-1.092902
H	-1.729639	-0.862400	-0.595205
C	-1.389074	1.030068	-1.560933
H	-0.619538	-0.947203	-1.956932
H	-2.241768	0.930600	-2.234116

H	-1.693664	1.638552	-0.709757
H	-0.594546	1.555678	-2.093307

H’

23

C	0.107887	0.016111	0.024509
C	0.230630	-0.090959	1.444516
C	1.447004	0.010957	1.999460
C	2.668632	0.180452	1.190069
C	2.429052	0.456573	-0.236719
C	1.216752	0.340954	-0.812423
H	-0.669528	-0.271086	2.015539
H	1.559163	-0.078291	3.072259
H	3.296836	0.966052	1.623767
H	3.293743	0.687760	-0.847911
H	1.082072	0.479085	-1.874694
O	-1.078941	-0.196443	-0.430515
C	-1.363458	-0.169049	-1.840519
H	-2.419624	-0.397965	-1.920196
H	-1.158429	0.820784	-2.241589
H	-0.770885	-0.927925	-2.347968
C	3.522734	-1.138177	1.248531
C	3.828595	-1.592144	2.667366
H	2.974467	-1.914799	0.712487
H	4.444607	-0.945034	0.700753
H	4.535246	-2.421300	2.637310
H	4.271238	-0.786775	3.255008
H	2.931751	-1.941410	3.178978

G’

23

C	0.251341	0.162110	0.083233
C	0.342323	-0.209011	1.466694
C	1.528849	-0.307088	2.129802
C	2.716751	-0.006868	1.436085
C	2.718921	0.086516	-0.037666
C	1.377570	0.338351	-0.623144
H	-0.573028	-0.393309	2.014995
C	3.131740	-1.346820	-0.588968
C	4.513440	-1.835670	-0.186907
H	1.584901	-0.521140	3.187638
O	3.774556	0.102209	2.161986
H	3.450141	0.800593	-0.413803
H	1.355255	0.578232	-1.678462
H	-0.722302	0.287729	-0.366395
H	2.368088	-2.052925	-0.262226
H	3.067923	-1.265938	-1.672357
H	4.692131	-2.796883	-0.670347
H	5.296673	-1.151404	-0.511146
H	4.601902	-1.996982	0.887666
C	5.066256	0.566525	1.722513
H	5.315931	1.404662	2.365563
H	5.770077	-0.245666	1.877415
H	5.064656	0.872628	0.682839

GC-MS Analysis

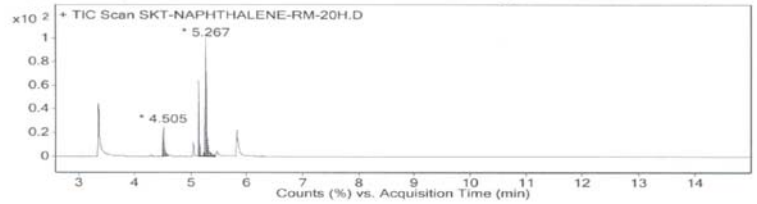
GC-MS analysis of reaction of 1a with 2a

Qualitative Analysis Report

Data Filename	SKT-NAPHTHALENE-RM-20H.D	**Sample Name**	SKT-NAPHTHALENE-RM-20H
Sample Type		**Position**	51
Instrument Name	GCMS	**User Name**	
Acq Method	BC15.M	**Acquired Time**	8/13/2017 10:56:39 AM
IRM Calibration Status	Not Applicable	**DA Method**	BC15.M
Comment			
Expected Barcode		**Sample Amount**	
Dual Inj Vol	1	**TuneName**	atune.u
TunePath	D:\MassHunter\GCMS\1\5977 \	**MSFirmwareVersion**	6.00.18
OperatorName		**RunCompletedFlag**	True

User Chromatograms

Fragmentor Voltage **Collision Energy** 0 **Ionization Mode** Unspecified



Integration Peak List

Peak	RT	Height	Area	Area Sum Percent
1	4.505	2538783.31	4293762.54	15.82
2	5.267	10082798.19	22843487.41	84.18

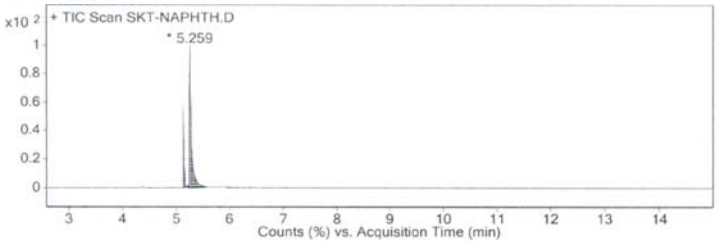
--- End Of Report ---

Qualitative Analysis Report

Data Filename	SKT-NAPHTH.D	**Sample Name**	SKT-NAPHTH
Sample Type		**Position**	51
Instrument Name	GCMS	**User Name**	
Acq Method	BC15.M	**Acquired Time**	8/15/2017 5:44:31 PM
IRM Calibration Status	Not Applicable	**DA Method**	BC15.M
Comment			
Expected Barcode		**Sample Amount**	
Dual Inj Vol	1	**TuneName**	atune.u
TunePath	D:\MassHunter\GCMS\1\5977 \	**MSFirmwareVersion**	6.00.18
OperatorName		**RunCompletedFlag**	True

User Chromatograms

Fragmentor Voltage **Collision Energy** 0 **Ionization Mode** Unspecified



Integration Peak List

Peak	RT	Height	Area	Area Sum Percent
1	5.142	3892802.76	4229466.58	21.09
2	5.259	6798090.87	15828163.31	78.91

--- End Of Report ---

GC-MS analysis of reaction of 1a with 2c

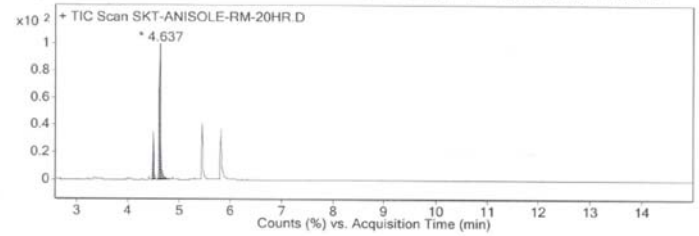
Qualitative Analysis Report

Data Filename	SKT-ANISOLE-RM-20HR.D	**Sample Name**	SKT-ANISOLE-RM-20HR
Sample Type		**Position**	61
Instrument Name	GCMS	**User Name**	
Acq Method	BC15.M	**Acquired Time**	8/13/2017 8:39:11 PM
IRM Calibration Status	Not Applicable	**DA Method**	BC15.M
Comment			

Expected Barcode		**Sample Amount**	
Dual Inj Vol	1	**TuneName**	atune.u
TunePath	D:\MassHunter\GCMS\1\5977 \	**MSFirmwareVersion**	6.00.18
OperatorName		**RunCompletedFlag**	True

User Chromatograms

Fragmentor Voltage **Collision Energy** 0 **Ionization Mode** Unspecified



Integration Peak List

Peak	RT	Height	Area	Area Sum Percent
1	4.498	4344888.15	4854366.84	14.32
2	4.637	12269381.29	29045860.91	85.68

--- End Of Report ---

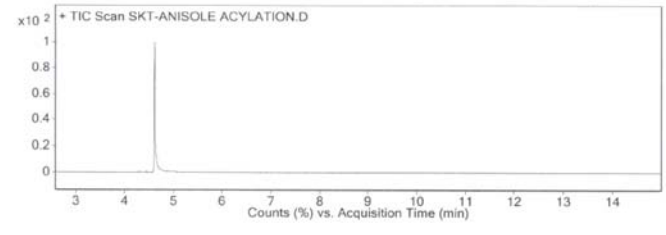
Qualitative Analysis Report

Data Filename	SKT-ANISOLE ACYLATION.D	**Sample Name**	SKT-ANISOLE ACYLATION
Sample Type		**Position**	32
Instrument Name	GCMS	**User Name**	
Acq Method	BC15.M	**Acquired Time**	8/15/2017 12:05:34 AM
IRM Calibration Status	Not Applicable	**DA Method**	BC15.M
Comment			

Expected Barcode		**Sample Amount**	
Dual Inj Vol	1	**TuneName**	atune.u
TunePath	D:\MassHunter\GCMS\1\5977 \	**MSFirmwareVersion**	6.00.18
OperatorName		**RunCompletedFlag**	True

User Chromatograms

Fragmentor Voltage **Collision Energy** 0 **Ionization Mode** Unspecified



--- End Of Report ---

GC-MS analysis of reaction of 1a with 2g

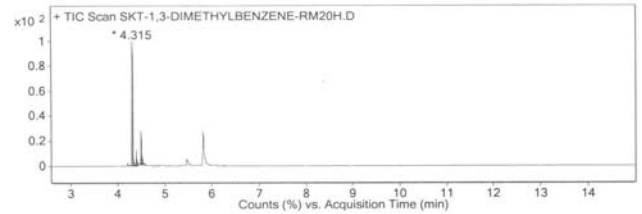
Qualitative Analysis Report

Data Filename	SKT-1,3-DIMETHYLBENZENE-RM20H.D	**Sample Name**	SKT-1,3-DIMETHYLBENZENE-RM20H
Sample Type		**Position**	52
Instrument Name	GCMS	**User Name**	
Acq Method	BC15.M	**Acquired Time**	8/13/2017 11:45:54 AM
IRM Calibration Status	Not Applicable	**DA Method**	BC15.M
Comment			

Expected Barcode		**Sample Amount**	
Dual Inj Vol	1	**TuneName**	atune.u
TunePath	D:\MassHunter\GCMS\1\5977\	**MSFirmwareVersion**	6.00.18
OperatorName		**RunCompletedFlag**	True

User Chromatograms

Fragmentor Voltage **Collision Energy** 0 **Ionization Mode** Unspecified



Integration Peak List

Peak	RT	Height	Area	Area Sum Percent
1	4.315	11222779.01	16511443.45	78.85
2	4.498	3008603.92	4429372.92	21.15

--- End Of Report ---

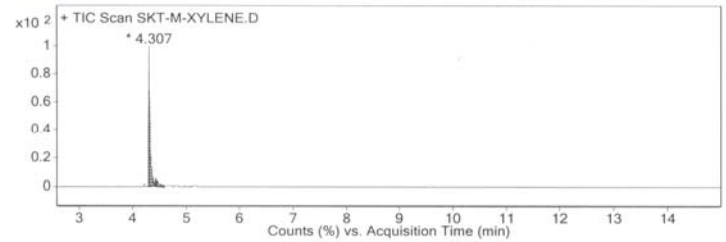
Qualitative Analysis Report

Data Filename	SKT-M-XYLENE.D	**Sample Name**	SKT-M-XYLENE
Sample Type		**Position**	52
Instrument Name	GCMS	**User Name**	
Acq Method	BC15.M	**Acquired Time**	8/15/2017 6:09:11 PM
IRM Calibration Status	Not Applicable	**DA Method**	BC15.M
Comment			

Expected Barcode		**Sample Amount**	
Dual Inj Vol	1	**TuneName**	atune.u
TunePath	D:\MassHunter\GCMS\1\5977\	**MSFirmwareVersion**	6.00.18
OperatorName		**RunCompletedFlag**	True

User Chromatograms

Fragmentor Voltage **Collision Energy** 0 **Ionization Mode** Unspecified



Integration Peak List

Peak	RT	Height	Area	Area Sum Percent
1	4.307	10301634.14	17239520.16	88.7
2	4.432	540234.99	2195581.62	11.3

--- End Of Report ---

GC-MS analysis of reaction of 1a with 2e

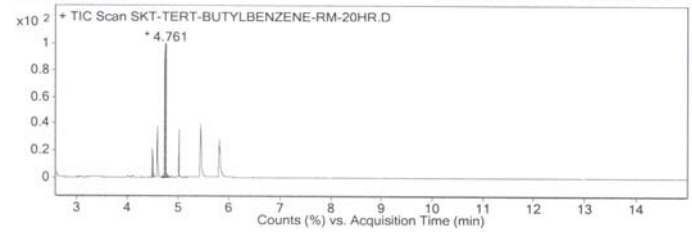
Qualitative Analysis Report

Data Filename	SKT-TERT-BUTYLBENZENE-RM-20HR.D	**Sample Name**	SKT-TERT-BUTYLBENZENE-RM-20HR
Sample Type		**Position**	62
Instrument Name	GCMS	**User Name**	
Acq Method	BC15.M	**Acquired Time**	8/13/2017 9:03:58 PM
IRM Calibration Status	Not Applicable	**DA Method**	BC15.M
Comment			

Expected Barcode		**Sample Amount**	
Dual Inj Vol	1	**TuneName**	atune.u
TunePath	D:\MassHunter\GCMS\1\5977\	**MSFirmwareVersion**	6.00.18
OperatorName		**RunCompletedFlag**	True

User Chromatograms

Fragmentor Voltage **Collision Energy** 0 **Ionization Mode** Unspecified



Integration Peak List

Peak	RT	Height	Area	Area Sum Percent
1	4.498	2765617.33	2855599.8	9.02
2	4.761	13004330.24	28804164.27	90.98

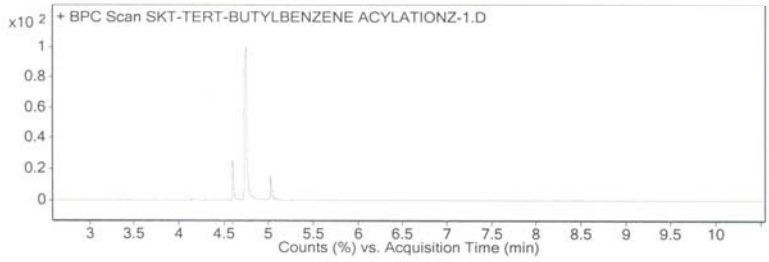
--- End Of Report ---

Qualitative Analysis Report

Data Filename	SKT-TERT-BUTYLBENZENE ACYLATIONZ-1.D	**Sample Name**	Unavailable
Sample Type	Unavailable	**Position**	Unavailable
Instrument Name	Unavailable	**User Name**	Unavailable
Acq Method		**Acquired Time**	Unavailable
IRM Calibration Status	Not Applicable	**DA Method**	BC15.M
Comment	Sample information is unavailable		

User Chromatograms

Fragmentor Voltage **Collision Energy** 0 **Ionization Mode** Unspecified



--- End Of Report ---

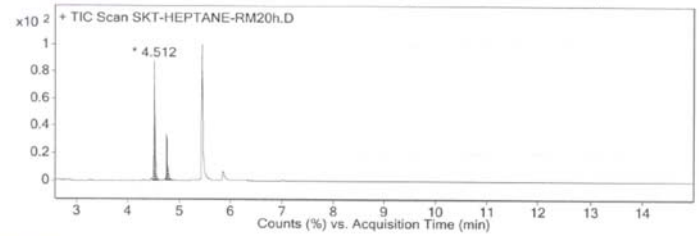
GC-MS analysis of reaction of 4c with 2c

Qualitative Analysis Report

Data Filename	SKT-HEPTANE-RM20h.D	**Sample Name**	SKT-HEPTANE-RM20h
Sample Type		**Position**	56
Instrument Name	GCMS	**User Name**	
Acq Method	BC15.M	**Acquired Time**	8/18/2017 2:29:38 AM
IRM Calibration Status	Not Applicable	**DA Method**	BC15.M
Comment			
Expected Barcode		**Sample Amount**	
Dual Inj Vol	1	**TuneName**	atune.u
TunePath	D:\MassHunter\GCMS\1\5977\	**MSFirmwareVersion**	6.00.18
OperatorName		**RunCompletedFlag**	True

User Chromatograms

Fragmentor Voltage **Collision Energy** 0 **Ionization Mode** Unspecified



Integration Peak List

Peak	RT	Height	Area	Area Sum Percent
1	4.512	9590363.82	12649164.88	69.18
2	4.754	3701712.29	5636385.01	30.82

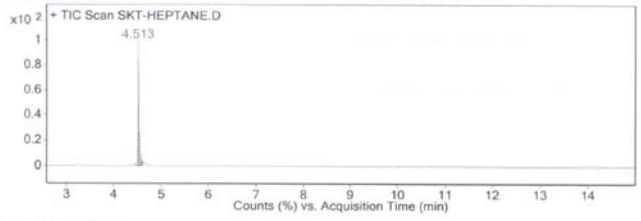
--- End Of Report ---

Qualitative Analysis Report

Data Filename	SKT-HEPTANE.D	**Sample Name**	SKT-HEPTANE
Sample Type		**Position**	53
Instrument Name	GCMS	**User Name**	
Acq Method	BC15.M	**Acquired Time**	8/17/2017 8:54:25 PM
IRM Calibration Status	Not Applicable	**DA Method**	BC15.M
Comment			
Expected Barcode		**Sample Amount**	
Dual Inj Vol	1	**TuneName**	atune.u
TunePath	D:\MassHunter\GCMS\1\5977\	**MSFirmwareVersion**	6.00.18
OperatorName		**RunCompletedFlag**	True

User Chromatograms

Fragmentor Voltage **Collision Energy** 0 **Ionization Mode** Unspecified



Integration Peak List

Peak	RT	Height	Area	Area Sum Percent
1	4.513	9677542.69	16216244.18	100

--- End Of Report ---

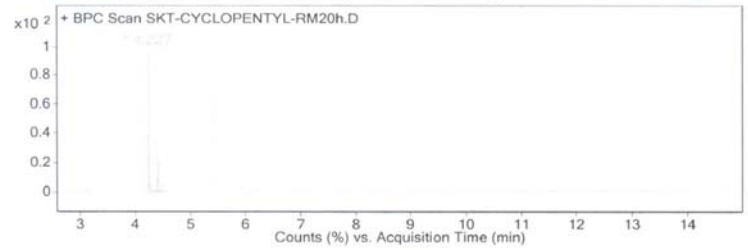
GC-MS analysis of reaction of 4b with 2c

Qualitative Analysis Report

Data Filename	SKT-CYCLOPENTYL-RM20h.D	**Sample Name**	Unavailable
Sample Type	Unavailable	**Position**	Unavailable
Instrument Name	Unavailable	**User Name**	Unavailable
Acq Method		**Acquired Time**	Unavailable
IRM Calibration Status	Not Applicable	**DA Method**	BC15.M
Comment	Sample information is unavailable		

User Chromatograms

Fragmentor Voltage **Collision Energy** 0 **Ionization Mode** Unspecified



Integration Peak List

Peak	RT	Height	Area	Area Sum Percent
1	4.227	1415369.56	2196387.05	66.63
2	4.403	493028.32	1100051.57	33.37

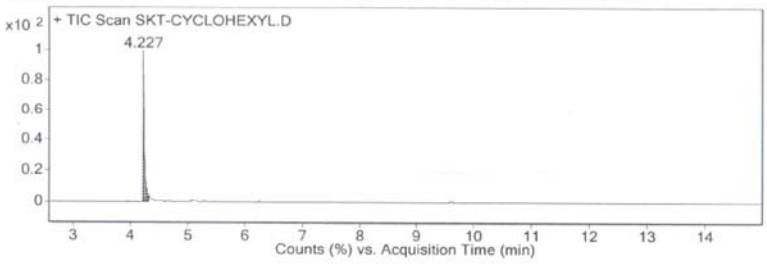
--- End Of Report ---

Qualitative Analysis Report

Data Filename	SKT-CYCLOHEXYL.D	**Sample Name**	SKT-CYCLOHEXYL
Sample Type		**Position**	51
Instrument Name	GCMS	**User Name**	
Acq Method	BC15.M	**Acquired Time**	8/17/2017 6:51:00 PM
IRM Calibration Status	Not Applicable	**DA Method**	BC15.M
Comment			
Expected Barcode		**Sample Amount**	
Dual Inj Vol	1	**TuneName**	atune.u
TunePath	D:\MassHunter\GCMS\1\5977\	**MSFirmwareVersion**	6.00.18
OperatorName		**RunCompletedFlag**	True

User Chromatograms

Fragmentor Voltage **Collision Energy** 0 **Ionization Mode** Unspecified



Integration Peak List

Peak	RT	Height	Area	Area Sum Percent
1	4.227	10784964.66	17037034.65	100

--- End Of Report ---

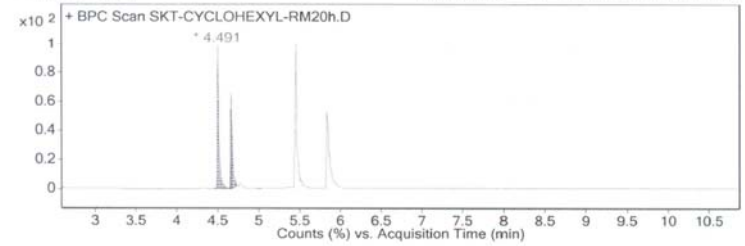
GC-MS analysis of reaction of 4d with 2c

Qualitative Analysis Report

Data Filename	SKT-CYCLOHEXYL-RM20h.D	**Sample Name**	Unavailable
Sample Type	Unavailable	**Position**	Unavailable
Instrument Name	Unavailable	**User Name**	Unavailable
Acq Method		**Acquired Time**	Unavailable
IRM Calibration Status	Not Applicable	**DA Method**	BC15.M
Comment	Sample information is unavailable		

User Chromatograms

Fragmentor Voltage **Collision Energy** 0 **Ionization Mode** Unspecified



Integration Peak List

Peak	RT	Height	Area	Area Sum Percent
1	4.491	793613.22	1241255.21	62.96
2	4.659	527860.85	730234.92	37.04

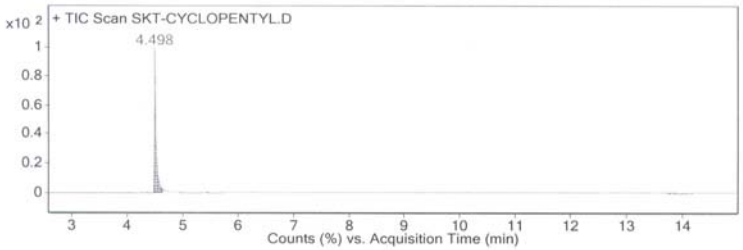
--- End Of Report ---

Qualitative Analysis Report

Data Filename	SKT-CYCLOPENTYL.D	**Sample Name**	SKT-CYCLOPENTYL
Sample Type		**Position**	52
Instrument Name	GCMS	**User Name**	
Acq Method	BC15.M	**Acquired Time**	8/17/2017 7:15:42 PM
IRM Calibration Status	Not Applicable	**DA Method**	BC15.M
Comment			
Expected Barcode		**Sample Amount**	
Dual Inj Vol	1	**TuneName**	atune.u
TunePath	D:\MassHunter\GCMS\1\5977\	**MSFirmwareVersion**	6.00.18
OperatorName		**RunCompletedFlag**	True

User Chromatograms

Fragmentor Voltage **Collision Energy** 0 **Ionization Mode** Unspecified

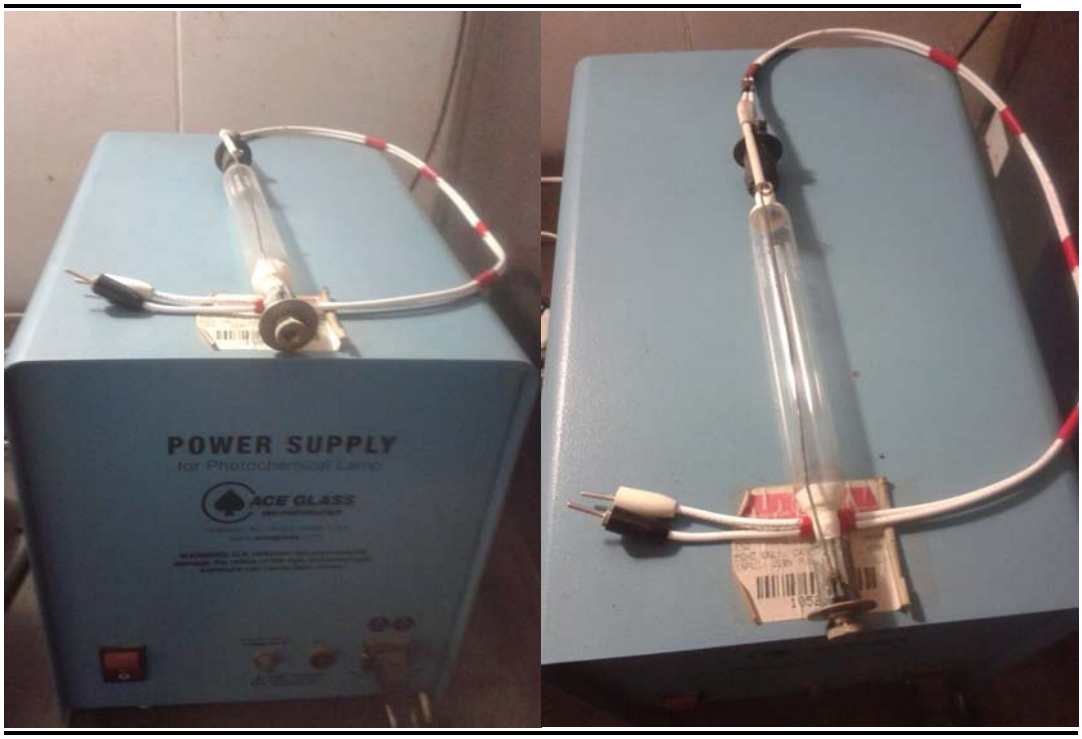


Integration Peak List

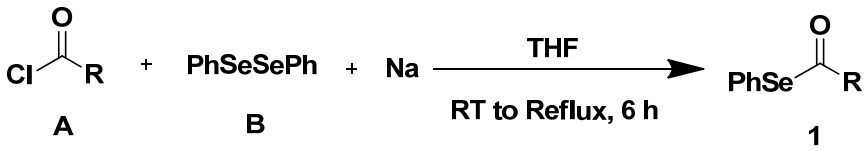
Peak	RT	Height	Area	Area Sum Percent
1	4.498	4012264.99	8172814.6	100

--- End Of Report ---

Picture of Photochemical Lamp:

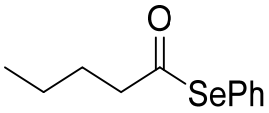


General procedure for the synthesis of Acylphenylselenides (1a-1f)[10]



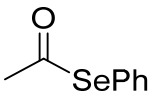
An argon purged solution of diphenyldiselenide (**B**) (3.12 g, 10.0 mmol) in tetrahydrofuran (50 mL) was treated with sodium metal (460 mg, 20.0 mmol) and the resulting mixture was refluxed for 4 hours. The slurry was cooled to 0 °C, treated with acyl chloride (**A**) (2.42 mL, 20.0 mmol), and refluxed for 1 hour. After cooling to 0 °C, methanol (10 mL) was added carefully to quench unreacted sodium and the mixture was poured into ice-water (40 mL), extracted with Et_2O (2 x 50 mL). The combined extracts were washed with brine, dried over Na_2SO_4, and concentrated under reduced pressure. The residue was purified by flash chromatography over silica gel with EtOAc/hexane to afford the title acylphenylselenides **1**.

Se-phenyl pentaneselenoate (1a)



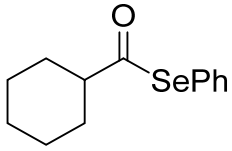
R_f = 0.60 (SiO_2, ethyl acetate/hexane, 1:49); yellow liquid (58%);
^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.53–7.50 (m, 2H), 7.40–7.36 (m, 3H), 2.71 (t, *J* = 7.5 Hz, 2H), 1.69 (dt, *J* = 15.0, 7.5 Hz, 2H), 1.40 (dq, *J* = 14.6, 7.4 Hz, 2H), 0.93 (t, *J* = 7.4 Hz, 3H);
^{13}C NMR ($CDCl_3$, 101 MHz): δ 200.5, 135.9, 129.4, 128.9, 126.7, 47.4, 27.5, 22.1, 13.8.

Se-phenyl ethaneselenoate (1b)



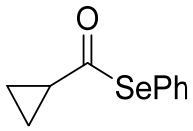
R_f = 0.60 (SiO_2, ethyl acetate/hexane, 1:49); yellow liquid (50%);
^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.55–7.53 (m, 2H), 7.42–7.38 (m, 3H), 2.47 (s, 3H);
^{13}C NMR ($CDCl_3$, 101 MHz): δ 196.8, 135.8, 129.5, 129.0, 126.8, 34.1.

Se-phenyl cyclohexanecarboselenoate (1c)



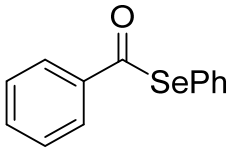
R_f = 0.60 (SiO_2, ethyl acetate/hexane, 1:49); yellow liquid (52%);
^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.52–7.50 (m, 2H), 7.40–7.36 (m, 3H), 2.65 (tt, *J*=11.3, 3.6 Hz, 1H), 2.03 (dd, *J*=13.1, 2.7 Hz, 2H), 1.85–1.81 (m, 2H), 1.69–1.67 (m, 1H), 1.53 (qd, *J* = 12.0, 3.2 Hz, 2H), 1.35–1.23 (m, 3H);
^{13}C NMR ($CDCl_3$, 101 MHz): δ 203.9, 136.0, 129.3, 128.8, 126.5, 56.1, 29.4, 25.7, 25.5.

Se-phenyl cyclopropanecarboselenoate (1d)



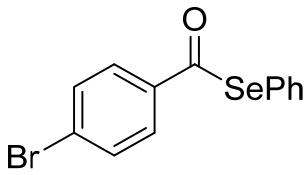
R_f = 0.60 (SiO_2, ethyl acetate/hexane, 1:49); yellow liquid (53%);
^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.58–7.53 (m, 2H), 7.41–7.37 (m, 3H), 2.24–2.18 (m, 1H), 1.29–1.25 (m, 3H), 1.06–1.01 (m, 2H);
^{13}C NMR ($CDCl_3$, 101 MHz): δ 200.1, 135.9, 129.4, 128.9, 126.6, 25.6, 11.7.

Se-phenyl benzoselenoate (1e)



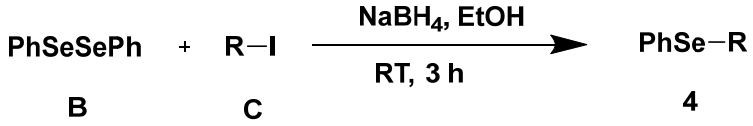
R_f = 0.70 (SiO_2, ethyl acetate/hexane, 1:49); yellow solid (58%);
^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.97–7.95 (m, 2H), 7.65–7.61 (m, 3H), 7.52–7.42 (m, 5H);
^{13}C NMR ($CDCl_3$, 101 MHz): δ 193.4, 138.6, 136.4, 134.0, 129.5, 129.5, 129.1, 127.5, 125.9.

Se-phenyl 4-bromobenzoselenoate (1f)



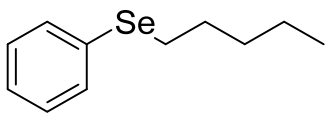
R_f = 0.80 (SiO_2, ethyl acetate/hexane, 1:49); white solid (60%);
^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.81 (d, *J*=8.4 Hz, 2H), 7.65–7.58 (m, 4H), 7.47–7.41 (m, 3H);
^{13}C NMR ($CDCl_3$, 101 MHz): δ 192.5, 137.39, 136.4, 132.3, 129.5, 129.3, 129.1, 128.8, 125.5.

General procedure for the synthesis of alkylphenylselenide (4a-4f)[11]



Two neck 100 mL R B flask fitted with a reflux condenser, a rubber septum and a magnetic bead was charged with PhSeSePh (**B**) (2.5 g, 8.0 mmol). Dry ethanol (50 mL) was introduced into the flask by syringe and allowed to stir for 10 min under dry nitrogen atmosphere. Septum was replaced with solid addition funnel containing $NaBH_4$ (0.61 g, 16 mmol), which was added to the contents slowly. Pale yellow solution was decolourized to a clear solution indicating the formation of phenyl selenyl anion. Solid addition funnel was replaced with septum again and alkyl halide (**C**) (1.75g, 16 mmol) was added dropwise to the reaction mixture. After the addition was completed, contents were refluxed for 3 h. Ethanol was removed under reduced pressure, quenched with 15% dil HCl to dissolve the solid concentrate and was extracted with 50 mL of ether. The combined organic layer was washed with $NaHCO_3$, H_2O and brine solution respectively. Ether layer was separated out and dried over anhydrous Na_2SO_4. The solvent was removed under reduced pressure and the crude product was purified by column chromatography on silica gel.

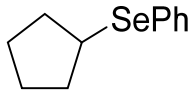
Pentyl(phenyl)selane (4a)



R_f = 0.80 (SiO_2, ethyl acetate/hexane, 1:49); yellow liquid (91%);

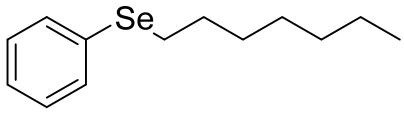
^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.52–7.49 (m, 2H), 7.30–7.22 (m, 3H), 2.94 (t, *J*=7.5 Hz, 2H), 1.77–1.70 (m, 2H), 1.42–1.35 (m, 4H), 0.91 (t, *J*=7.2 Hz, 3H);
^{13}C NMR ($CDCl_3$, 101 MHz): δ 132.4, 130.8, 129.1, 126.6, 32.1, 29.9, 27.9, 22.3, 14.1.

Cyclopentyl(phenyl)selane (4b)



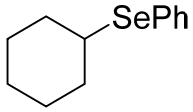
R_f = 0.80 (SiO_2, ethyl acetate/hexane, 1:49); yellow liquid (89%);
^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.56–7.54 (m, 2H), 7.27–7.26 (m, 3H), 3.68–3.62 (m, 1H), 2.07 (dt, *J*=11.7, 5.8 Hz, 2H), 1.80–1.67 (m, 4H), 1.64–1.56 (m, 2H);
^{13}C NMR ($CDCl_3$, 101 MHz): δ 133.6, 131.2, 128.9, 126.9, 41.9, 34.7, 25.0.

Heptyl(phenyl)selane (4c)



R_f = 0.70 (SiO_2, ethyl acetate/hexane, 1:49); yellow liquid (88%);
^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.52–7.50 (m, 2H), 7.30–7.24 (m, 3H), 2.94 (t, *J*=7.5 Hz, 2H), 1.77–1.69 (m, 2H), 1.47–1.37 (m, 2H), 1.32–1.29 (m, 6H), 0.90 (t, *J*=6.2 Hz, 3H);
^{13}C NMR ($CDCl_3$, 101 MHz): δ 132.5, 130.9, 129.1, 126.7, 31.8, 30.3, 29.9, 28.9, 28.1, 22.7, 14.2.

Cyclohexyl (phenyl)selane (4d)



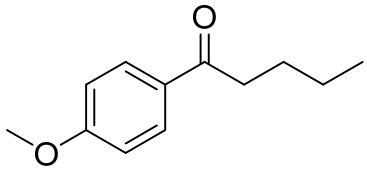
R_f = 0.80 (SiO_2, ethyl acetate/hexane, 1:49); yellow liquid (91%);
^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.57–7.54 (m, 2H), 7.29–7.25 (m, 3H), 3.26 (tt, *J*=10.8, 3.7 Hz, 1H), 2.05–1.01 (m, 2H), 1.77–1.73 (m, 2H), 1.62–1.62 (m, 1H), 1.54–1.50 (m, 2H), 1.35–1.27 (m, 3H);
^{13}C NMR ($CDCl_3$, 101 MHz): δ 134.8, 129.5, 128.9, 127.3, 43.5, 34.4, 27.0, 25.9.

General procedure for photoredox catalysis:

A mixture of **1** or **4** (acyl/alkyl phenyl selenide, 0.3 g, 1.15 mmol), naphthalene (**2**, .294 g, 2.30 mmol) and a catalytic amount of 9,10-dimethoxyanthracene (DMA) (0.041 g, 0.172 mmol) in acetonitrile (500 mL) was irradiated in the argon atmosphere utilizing visible-light (410 nm), obtained by using a combination of Pyrex and a $CuSO_4$:NH_3 solution filter[12] from a 450-W Hanovia medium pressure mercury lamp[13] in a specially designed double walled photoreactor. Progress of the reaction was monitored by following the disappearance of **1/4** by GC and HPLC (C18 reverse phase, ACN: H_2O/75:25). After 15-20 h of photo-irradiation, when almost all of the **1** or **4** was consumed, the solvent was removed by distillation under reduced pressure. After evaporation of the solvent, the mixture was purified by silica gel column chromatography to give respective acylated/alkylated products **3** or **5** along with diphenyl diselenide. The yield was calculated based on the consumption of starting **1**or **4.**

Characterization of products:

1-(4-Methoxyphenyl)pentan-1-one (3b)



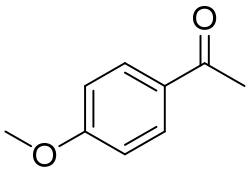
R_f = 0.40 (SiO2, ethyl acetate/hexane, 1:9); yellow liquid (89%);

^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.94 (d, *J*=8.9 Hz, 2H), 6.92 (d, *J*=8.9 Hz, 2H), 3.86 (s, 3H), 2.91 (t, *J*=7.5 Hz, 2H), 1.70 (p, *J*=7.5 Hz, 2H), 1.42–1.35 (m, 2H), 0.94 (t, *J*=7.3 Hz, 3H);

^{13}C NMR ($CDCl_3$, 101 MHz): δ 199.4, 163.4, 130.4, 130.3, 113.8, 55.6, 38.2, 26.9, 22.7, 14.1;

HRMS (ESI) *m/z* calcd. for $C_{12}H_{16}O_2[M+H]^+$ 193.1223, found 193.1228.

1-(4-Methoxyphenyl)ethan-1-one (3n)



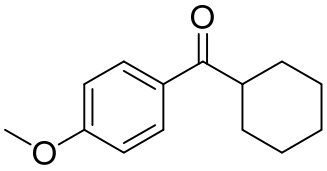
R_f = 0.40 (SiO_2, ethyl acetate/hexane, 1:9); white solid (84%);

^1H NMR ($CDCl_3$, 400 MHz): δ 7.93 (d, *J* = 8.9 Hz, 2H), 6.92 (d, *J* = 8.9 Hz, 2H), 3.86 (s, 3H), 2.55 (s, 3H);

^{13}C NMR ($CDCl_3$, 101 MHz): δ 196.6, 163.2, 130.2, 129.9, 113.4, 55.1, 25.9;

HRMS (ESI) *m/z* calcd. for $C_9H_{10}O_2[M+H]^+$ 151.0754, found 151.0755.

Cyclohexyl(4-methoxyphenyl)methanone (3y)



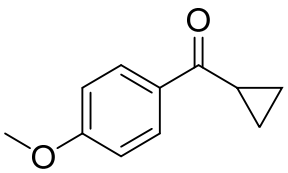
R_f = 0.40 (SiO_2, ethyl acetate/hexane, 1:9); white solid (85%);

^1H NMR ($CDCl_3$, 400 MHz): δ 7.94 (d, *J*=8.8 Hz, 2H), 6.93 (d, *J*=8.8 Hz, 2H), 3.86 (s, 3H), 3.21 (ddd, *J*=11.5, 7.4, 3.0 Hz, 1H), 1.85 (t, *J*=10.2 Hz, 4H), 1.73 (d, *J*=12.4 Hz, 1H), 1.54–1.25 (m, 5H);

^{13}C NMR ($CDCl_3$, 101 MHz): δ 202.4, 163.25, 130.5, 129.3, 113.7, 55.4, 45.3, 29.6, 26.0, 25.9;

HRMS (ESI) *m/z* calcd. for $C_{14}H_{19}O_2[M+H]^+$ 219.1380, found 218.1387.

Cyclopropyl(4-methoxyphenyl)methanone (3aj)



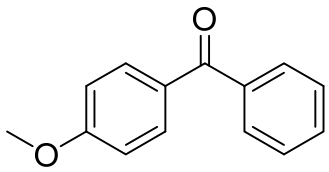
R_f = 0.40 (SiO_2, ethyl acetate/hexane, 1:9); white solid (81%);

^{1}H NMR ($CDCl_3$, 400 MHz): δ 8.01 (d, *J*=8.8 Hz, 2H), 6.95 (d, *J*=8.8 Hz, 2H), 3.87 (s, 3H), 2.63 (ddd, *J*=12.2, 7.9, 4.5 Hz, 1H), 1.21 (dt, *J*=7.2, 3.6 Hz, 2H), 1.00 (dt, *J*=11.0, 3.4 Hz, 2H);

^{13}C NMR ($CDCl_3$, 101 MHz): δ 199.1, 163.4, 131.1, 130.3, 113.7, 55.5, 16.7, 11.3;

HRMS (ESI) *m/z* calcd. for $C_{11}H_{12}O_2[M+H]^+$ 177.0910, found 177.0916.

(4-Methoxyphenyl)(phenyl)methanone (3au)



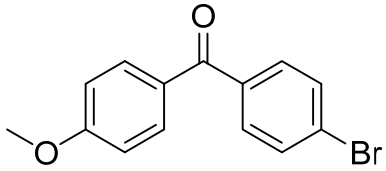
R_f = 0.50 (SiO_2, ethyl acetate/hexane, 1:9); white solid (87%);

^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.83 (d, *J*=8.3 Hz, 2H), 7.76 (d, *J*=7.5 Hz, 2H), 7.57 (t, *J*=7.2 Hz, 1H), 7.47 (t, *J*=7.4 Hz, 2H), 6.97 (d, *J*=8.3 Hz, 2H), 3.89 (s, 3H);

^{13}C NMR ($CDCl_3$, 101 MHz): δ 195.5, 163.3, 138.3, 132.5, 131.9, 130.1, 129.7, 128.2, 113.6, 55.4;

HRMS (ESI) *m/z* calcd. for $C_{14}H_{12}O_2[M+H]^+$ 213.0910, found 213.0914.

(4-Bromophenyl)(4-methoxyphenyl)methanone (3af')



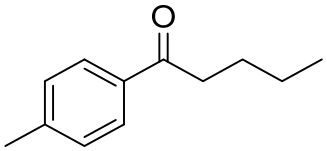
R_f = 0.60 (SiO_2, ethyl acetate/hexane, 1:9); white solid (85%);

^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.80 (d, *J*=8.6 Hz, 2H), 7.62 (s, 4H), 6.97 (d, *J*=8.6 Hz, 2H), 3.89 (s, 3H);

^{13}C NMR ($CDCl_3$, 101 MHz): δ 194.4, 163.5, 137.2, 132.5, 131.6, 131.5, 129.8, 126.9, 113.8, 55.6;

HRMS (ESI) *m/z* calcd. for $C_{14}H_{11}BrO_2[M+H]^+$ 291.0015, found 219.0020.

1-(p-Tolyl)pentan-1-one (3c)



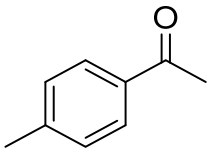
R_f = 0.40 (SiO_2, ethyl acetate/hexane, 1:19); colorless liquid (83%);

^1H NMR ($CDCl_3$, 400 MHz): δ 7.88 (d, *J*=8.1 Hz, 2H), 7.27 (d, *J*=8.1 Hz, 2H), 2.96 (t, *J*=7.4 Hz, 2H), 2.43 (s, 3H), 1.73 (dq, *J*=15.2, 7.5 Hz, 2H), 1.45–1.39 (m, 2H), 0.97 (t, *J*=7.3 Hz, 3H);

^{13}C NMR ($CDCl_3$, 101 MHz): δ 200.1, 143.5, 134.6, 129.2, 128.1, 38.1, 26.5, 22.5, 21.5, 13.9;

HRMS (ESI) *m/z* calcd. for $C_{12}H_{16}O[M+H]^+$ 177.1274, found 177.1270.

1-(p-Tolyl)ethan-1-one (3o)



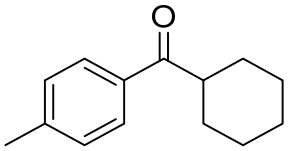
R_f = 0.40 (SiO_2, ethyl acetate/hexane, 1:19); yellow liquid (81%);

^1H NMR ($CDCl_3$, 400 MHz): δ 7.87 (d, *J*=8.1 Hz, 2H), 7.27 (d, *J*=8.1 Hz, 2H), 2.59 (s, 3H), 2.42 (s, 3H);

^{13}C NMR ($CDCl_3$, 101 MHz): δ 197.4, 143.6, 134.6, 129.0, 128.2, 26.2, 21.3;

HRMS (ESI) *m/z* calcd. for $C_9H_{10}O[M+H]^+$ 135.0804, found 135.0805.

Cyclohexyl(p-tolyl)methanone (3z)



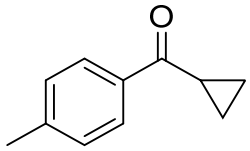
R_f = 0.40 (SiO_2, ethyl acetate/hexane, 1:19); white solid (84%);

^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.87 (d, *J*=8.1 Hz, 2H), 7.27 (d, *J*=8.1 Hz, 2H), 3.28–3.22 (m, 1H), 2.42 (s, 3H), 1.87 (t, *J*=12.9 Hz, 4H), 1.75 (d, *J*=12.5 Hz, 1H), 1.56–1.23 (m, 5H);

^{13}C NMR ($CDCl_3$, 101 MHz): δ 203.6, 143.5, 133.7, 129.3, 128.5, 45.6, 29.6, 26.1, 25.9, 21.7;

HRMS (ESI) *m/z* calcd. for $C_{14}H_{18}O[M+H]^+$ 203.1430, found 203.1437.

Cyclopropyl(p-tolyl)methanone (3ak)



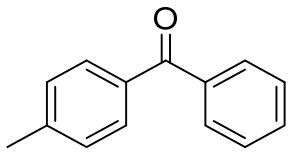
R_f = 0.30 (SiO_2, ethyl acetate/hexane, 1:19); reddish solid (80%);

^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.92 (d, *J*=8.1 Hz, 2H), 7.27 (d, *J*=8.1 Hz, 2H), 2.66 (ddd, *J*=12.4, 7.9, 4.6 Hz, 1H), 2.42 (s, 3H), 1.22 (dt, *J*=7.4, 3.6 Hz, 2H), 1.02 (dt, *J*=11.2, 3.4 Hz, 2H);

^{13}C NMR ($CDCl_3$, 101 MHz): δ 200.3, 143.5, 135.6, 129.3, 128.2, 21.7, 17.0, 11.6;

HRMS (ESI) *m/z* calcd. for $C_{11}H_{12}O[M+H]^+$ 161.0961, found 161.0966.

Phenyl(p-tolyl)methanone (3av)



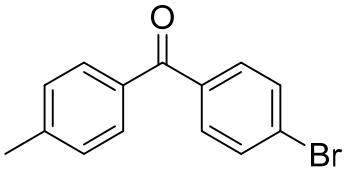
R_f = 0.60 (SiO_2, ethyl acetate/hexane, 1:19); yellow liquid (83%);

^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.78 (d, *J*=7.1 Hz, 2H), 7.72 (d, *J*=8.0 Hz, 2H), 7.58 (t, *J*=7.4 Hz, 1H), 7.47 (t, *J*=7.5 Hz, 2H), 7.27 (dd, *J*=9.1, 4.0 Hz, 2H), 2.44 (s, 3H);

^{13}C NMR ($CDCl_3$, 101 MHz): δ 196.6, 143.3, 138.1, 135.0, 132.3, 130.4, 130.0, 129.1, 128.3, 21.7;

HRMS (ESI) *m/z* calcd. for $C_{14}H_{12}O[M+H]^+$ 197.0961, found 197.0966.

(4-Bromophenyl)(p-tolyl)methanone (3ag')



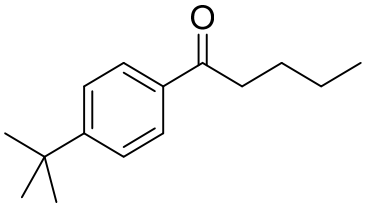
R_f = 0.70 (SiO_2, ethyl acetate/hexane, 1:19); white solid (78%);

^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.70–7.62 (m, 6H), 7.30 (dd, *J*=10.8, 3.9 Hz, 2H), 2.44 (s, 3H);

^{13}C NMR ($CDCl_3$, 101 MHz): δ 195.4, 143.7, 136.8, 134.6, 131.7, 131.6, 130.3, 129.2, 127.28, 21.8;

HRMS (ESI) *m/z* calcd. for $C_{14}H_{11}BrO[M+H]^+$ 275.0066, found 277.0047.

1-(4-(Tert-butyl)phenyl)pentan-1-one (3e)



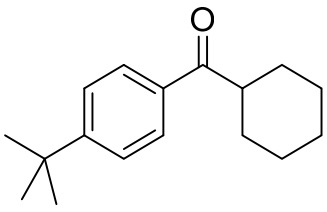
R_f = 0.50 (SiO_2, ethyl acetate/hexane, 1:19); yellow liquid (88%);

^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.90 (d, *J*=8.4 Hz, 2H), 7.47 (d, *J*=8.4 Hz, 2H), 2.94 (t, *J*=7.4 Hz, 2H), 1.75–1.69 (m, 2H), 1.41–1.39 (m, 2H), 1.34 (s, 9H), 0.95 (t, *J*=7.3 Hz, 3H);

^{13}C NMR ($CDCl_3$, 101 MHz): δ 199.9, 156.4, 134.5, 128.0, 125.4, 38.1, 34.9, 31.0, 26.5, 22.5, 13.9;

HRMS (ESI) *m/z* calcd. for $C_{15}H_{22}O[M+H]^+$ 219.1743, found 219.1741.

(4-(Tert-butyl)phenyl)(cyclohexyl)methanone (3aa)



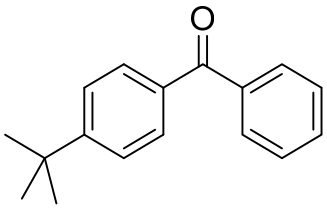
R_f = 0.50 (SiO_2, ethyl acetate/hexane, 1:19); yellow liquid (81%);

^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.89 (d, *J*=8.3 Hz, 2H), 7.47 (d, *J*=8.3 Hz, 2H), 3.28–3.28 (m, 1H), 1.90–1.72 (m, 5H), 1.45 (dt, *J*=25.4, 19.3 Hz, 4H), 1.34 (s, 9H), 1.28–1.23 (m, 1H);

^{13}C NMR ($CDCl_3$, 101 MHz): δ 203.5, 156.4, 133.8, 128.3, 125.6, 45.6, 35.1, 31.2, 29.6, 26.1, 25.9;

HRMS (ESI) *m/z* calcd. for $C_{17}H_{24}O[M+H]^+$ 245.1900, found 245.1895.

(4-(Tert-butyl)phenyl)(phenyl)methanone (3aw)



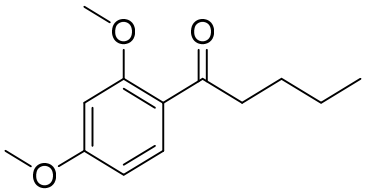
R_f = 0.70 (SiO_2, ethyl acetate/hexane, 1:19); yellow liquid (80%);

^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.79 (dd, *J*=15.9, 7.8 Hz, 4H), 7.58 (t, *J*=7.3 Hz, 1H), 7.51–7.46 (m, 4H), 1.37 (s, 9H);

^{13}C NMR ($CDCl_3$, 101 MHz): δ 196.5, 156.3, 138.0, 134.9, 132.3, 130.2, 130.1, 128.3, 125.3, 35.2, 31.2;

HRMS (ESI) *m/z* calcd. for $C_{17}H_{18}O[M+H]^+$ 239.1430, found 239.1425.

1-(2,4-Dimethoxyphenyl)pentan-1-one (3f)



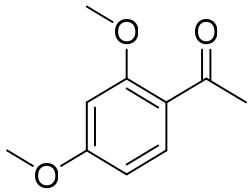
R_f = 0.40 (SiO_2, ethyl acetate/hexane, 1:4); white solid (82%);

^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.77 (d, *J*=8.7 Hz, 1H), 6.53–6.51 (m, 1H), 6.45 (d, *J*=2.2 Hz, 1H), 3.88 (s, 3H), 3.84 (s, 3H), 2.92 (t, *J*=7.4 Hz, 2H), 1.67–1.60 (m, 2H), 1.41 – 1.32 (m, 2H), 0.92 (t, *J*=7.3 Hz, 3H);

^{13}C NMR ($CDCl_3$, 101 MHz): δ 200.9, 164.2, 160.6, 132.6, 121.4, 105.1, 98.3, 55.5, 55.4, 43.4, 26.8, 22.6, 14.0;

HRMS (ESI) *m/z* calcd. for $C_{13}H_{18}O_3[M+H]^+$ 223.1329, found 223.1326.

1-(2,4-Dimethoxyphenyl)ethan-1-one (3q)



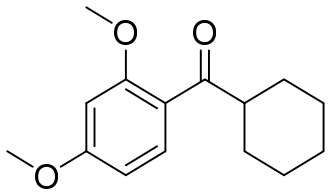
R_f = 0.30 (SiO_2, ethyl acetate/hexane, 1:4); reddish solid (77%);

^1H NMR ($CDCl_3$, 400 MHz): δ 7.82 (d, *J*=8.7 Hz, 1H), 6.54–6.44 (m, 2H), 3.88 (s, 3H), 3.84 (s, 3H), 2.56 (s, 3H);

^{13}C NMR ($CDCl_3$, 101 MHz): δ 197.2, 164.4, 160.9, 132.2, 120.7, 105.0, 97.9, 55.2, 55.1, 31.5;

HRMS (ESI) *m/z* calcd. for $C_{10}H_{12}O_3[M+H]^+$ 181.0859, found 181.0850.

Cyclohexyl(2,4-dimethoxyphenyl)methanone (3ab)



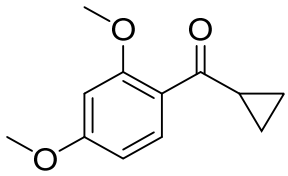
R_f = 0.40 (SiO_2, ethyl acetate/hexane, 1:4); yellow liquid (81%);

^1H NMR ($CDCl_3$, 400 MHz): δ 7.65 (d, *J*=8.6 Hz, 1H), 6.51 (dd, *J*=8.6, 2.2 Hz, 1H), 6.44 (d, *J*=2.2 Hz, 1H), 3.87 (s, 3H), 3.84 (s, 3H), 3.23 (ddd, *J*=11.0, 7.1, 3.2 Hz, 1H), 1.89–1.86 (m, 2H), 1.80–1.77 (m, 2H), 1.70 – 1.66 (m, 1H), 1.42–1.21 (m, 5H);

^{13}C NMR ($CDCl_3$, 101 MHz): δ 204.9, 163.8, 159.9, 132.4, 121.4, 105.0, 98.3, 55.5, 55.4, 49.7, 29.1, 26.2, 26.1;

HRMS (ESI) *m/z* calcd. for $C_{15}H_{20}O_3[M+H]^+$ 249.1485, found 249.1483.

Cyclopropyl(2,4-dimethoxyphenyl)methanone (3am)



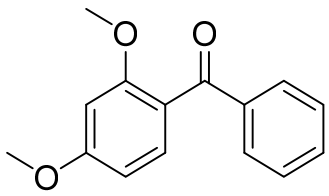
R_f = 0.30 (SiO_2, ethyl acetate/hexane, 1:4); reddish liquid (76%);

^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.68 (d, *J*=8.6 Hz, 1H), 6.53–6.48 (m, 2H), 3.88 (s, 3H), 3.85 (s, 3H), 2.83–2.76 (m, 1H), 1.20–1.17 (m, 2H), 0.93 (td, *J*=6.7, 3.3 Hz, 2H);

^{13}C NMR ($CDCl_3$, 101 MHz): δ 201.3, 164.1, 160.6, 132.3, 122.5, 104.9, 98.7, 55.8, 55.6, 21.0, 11.9;

HRMS (ESI) *m/z* calcd. for $C_{12}H_{14}O_3[M+H]^+$ 207.1016, found 207.1006.

(2,4-Dimethoxyphenyl)(phenyl)methanone (3ax)



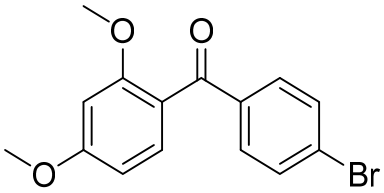
R_f = 0.60 (SiO_2, ethyl acetate/hexane, 1:4); white solid (82%);

^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.77 (d, *J*=8.2 Hz, 2H), 7.55–7.43 (m, 1H), 7.41 (t, *J*=7.2 Hz, 3H), 6.58 – 6.52 (m, 2H), 3.88 (s, 3H), 3.70 (s, 3H);

^{13}C NMR ($CDCl_3$, 101 MHz): δ 195.6, 163.5, 159.7, 138.9, 132.4, 132.2, 129.7, 128.1, 121.6, 104.7, 98.9, 55.6, 55.6;

HRMS (ESI) *m/z* calcd. for $C_{15}H_{14}O_3[M+H]^+$ 243.1016, found 243.1015.

(4-Bromophenyl)(2,4-dimethoxyphenyl)methanone (3al')



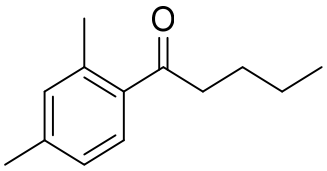
R_f = 0.70 (SiO_2, ethyl acetate/hexane, 1:4); white solid (84%);

^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.64–7.60 (m, 2H), 7.56–7.52 (m, 2H), 7.40 (d, *J*=8.5 Hz, 1H), 6.55 (dd, *J*=8.5, 2.3 Hz, 1H), 6.49 (d, *J*=2.2 Hz, 1H), 3.86 (s, 3H), 3.68 (s, 3H);

^{13}C NMR ($CDCl_3$, 101 MHz): δ 194.6, 163.8, 159.7, 137.8, 132.4, 131.4, 131.2, 127.4, 121.1, 104.9, 98.9, 55.7, 55.6;

HRMS (ESI) *m/z* calcd. for $C_{15}H_{13}BrO_3[M+H]^+$ 321.0121, found 321.0120.

1-(2,4-dimethylphenyl)pentan-1-one (3g)



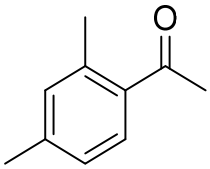
R_f = 0.50 (SiO_2, ethyl acetate/hexane, 1:19); colorless liquid (77%);

^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.57 (d, *J*=8.3 Hz, 1H), 7.05 (s, 2H), 2.87 (t, *J*=7.4 Hz, 2H), 2.48 (s, 3H), 2.35 (s, 3H), 1.68 (dd, *J*=14.9, 7.4 Hz, 2H), 1.38 (dq, *J*=14.6, 7.3 Hz, 2H), 0.93 (t, *J*=7.3 Hz, 3H);

^{13}C NMR ($CDCl_3$, 101 MHz): δ 204.2, 141.6, 138.5, 135.3, 132.9, 128.9, 126.3, 41.1, 26.8, 22.6, 21.5, 21.4, 14.0;

HRMS (ESI) *m/z* calcd. for $C_{13}H_{18}O[M+H]^+$ 191.1430, found 191.1426.

1-(2,4-Dimethylphenyl)ethan-1-one (3r)



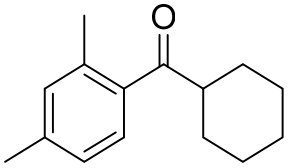
R_f = 0.40 (SiO_2, ethyl acetate/hexane, 1:19); yellow liquid (75%);

^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.63 (d, *J*=8.3 Hz, 1H), 7.06 (d, *J*=7.2 Hz, 2H), 2.56 (s, 3H), 2.52 (s, 3H), 2.35 (s, 3H);

^{13}C NMR ($CDCl_3$, 101 MHz): δ 200.7, 142.0, 138.8, 134.6, 132.8, 129.9, 126.3, 29.1, 21.7, 21.2;

HRMS (ESI) *m/z* calcd. for $C_{10}H_{12}O[M+H]^+$ 149.0961, found 149.0965.

Cyclohexyl(2,4-dimethylphenyl)methanone (3ac)



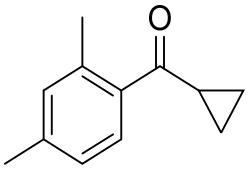
R_f = 0.50 (SiO_2, ethyl acetate/hexane, 1:19); yellow liquid (79%);

^1H NMR ($CDCl_3$, 400 MHz): δ 7.45 (d, *J* = 8.4 Hz, 1H), 7.04 (d, *J* = 7.0 Hz, 2H), 3.08–3.01 (m, 1H), 2.40 (s, 3H), 2.34 (s, 3H), 1.82 (dd, *J*=22.2, 8.5 Hz, 4H), 1.70 (d, *J*=10.9 Hz, 1H), 1.47–1.19 (m, 5H);

^{13}C NMR ($CDCl_3$, 101 MHz): δ 207.9, 140.9, 137.9, 135.7, 132.5, 127.9, 126.1, 48.5, 28.9, 25.9, 25.8, 21.3, 20.9;

HRMS (ESI) *m/z* calcd. for $C_{15}H_{20}O[M+H]^+$ 217.1587, found 217.1577.

Cyclopropyl(2,4-dimethylphenyl)methanone (3an)



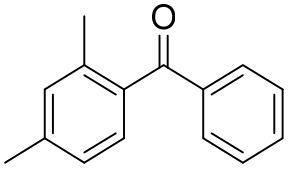
R_f = 0.50 (SiO_2, ethyl acetate/hexane, 1:19); yellow liquid (74%);

^1H NMR ($CDCl_3$, 400 MHz): δ 7.67 (d, *J*=7.8 Hz, 1H), 7.09–7.05 (m, 2H), 2.46 (s, 3H), 2.42 (dd, *J*=7.8, 4.5 Hz, 1H), 2.35 (s, 3H), 1.22 (dt, *J*=7.5, 3.6 Hz, 2H), 1.00 (td, *J*=7.0, 3.5 Hz, 2H);

^{13}C NMR ($CDCl_3$, 101 MHz): δ 204.4, 141.4, 137.4, 136.8, 132.4, 128.9, 126.3, 21.4, 20.9, 20.5, 11.8;

HRMS (ESI) *m/z* calcd. for $C_{12}H_{14}O[M+H]^+$ 175.1117, found 175.1112.

(2,4-Dimethylphenyl)(phenyl)methanone (3ay)



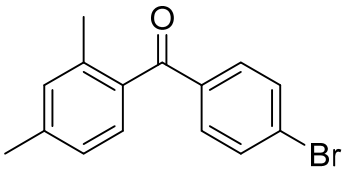
R_f = 0.70 (SiO_2, ethyl acetate/hexane, 1:19); white solid (80%);

^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.79 (d, *J*=7.3 Hz, 2H), 7.57 (t, *J*=7.4 Hz, 1H), 7.44 (t, *J*=7.6 Hz, 2H), 7.25 (dd, *J*=10.2, 3.9 Hz, 1H), 7.11 (s, 1H), 7.05 (d, *J*=7.7 Hz, 1H), 2.38 (s, 3H), 2.33 (s, 3H);

^{13}C NMR ($CDCl_3$, 101 MHz): δ 198.6, 140.7, 138.3, 137.3, 135.7, 132.9, 131.9, 130.2, 129.3, 128.4, 125.9, 21.4, 20.2;

HRMS (ESI) *m/z* calcd. for $C_{15}H_{14}O[M+H]^+$ 211.1117, found 211.1113.

(4-Bromophenyl)(2,4-dimethylphenyl)methanone (3aj')



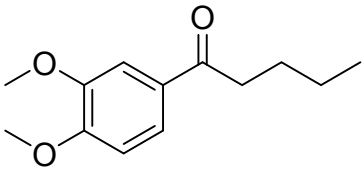
R_f = 0.80 (SiO_2, ethyl acetate/hexane, 1:19); white solid (81%);

^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.65 (d, *J*=8.2 Hz, 2H), 7.59 (d, *J*=8.4 Hz, 2H), 7.20 (d, *J*=7.7 Hz, 1H), 7.11 (s, 1H), 7.05 (d, *J*=7.8 Hz, 1H), 2.38 (s, 3H), 2.32 (s, 3H);

^{13}C NMR ($CDCl_3$, 101 MHz): δ 197.3, 141.0, 137.4, 137.1, 135.1, 132.1, 131.7, 131.6, 129.25, 128.1, 125.9, 21.4, 20.1;

HRMS (ESI) *m/z* calcd. for $C_{15}H_{13}BrO[M+H]^+$ 289.0223, found 291.0222.

1-(3,4-Dimethoxyphenyl)pentan-1-one (3h)



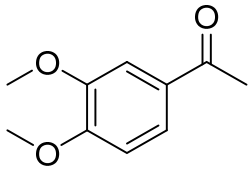
R_f = 0.40 (SiO_2, ethyl acetate/hexane, 1:4); yellow liquid (90%);

^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.54 (dd, *J*=8.4, 1.8 Hz, 1H), 7.50 (d, *J*=1.9 Hz, 1H), 6.85 (dd, *J*=8.4, 1.5 Hz, 1H), 3.90 (s, 3H), 3.89 (s, 3H), 2.90–2.86 (m, 2H), 1.69–1.66 (m, 2H), 1.40–1.34 (m, 2H), 0.91 (t, *J*=7.3, 1.5 Hz, 3H);

^{13}C NMR ($CDCl_3$, 101 MHz): δ 199.3, 153.2, 149.1, 130.4, 122.7, 110.3, 110.0, 56.1, 55.9, 37.9, 26.9, 22.6, 13.9;

HRMS (ESI) *m/z* calcd. for $C_{13}H_{18}O_3[M+H]^+$ 223.1329, found 233.1325.

1-(3,4-Dimethoxyphenyl)ethan-1-one (3s)



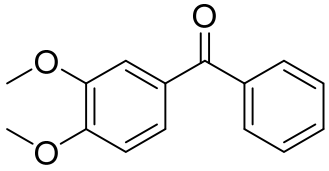
R_f = 0.40 (SiO_2, ethyl acetate/hexane, 1:4); yellow liquid (88%);

^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.56–7.53 (m, 1H), 7.49 (d, *J*=1.9 Hz, 1H), 6.86 (d, *J*=8.4 Hz, 1H), 3.91 (s, 3H), 3.90 (s, 3H), 2.53 (s, 3H);

^{13}C NMR ($CDCl_3$, 101 MHz): δ 196.8, 153.4, 149.1, 130.6, 123.3, 110.2, 110.1, 56.1, 56.0, 26.2;

HRMS (ESI) *m/z* calcd. for $C_{10}H_{12}O_3[M+H]^+$ 181.0859, found 181.0859.

(3,4-Dimethoxyphenyl)(phenyl)methanone (3az)



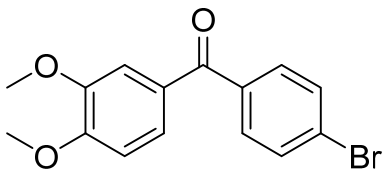
R_f = 0.50 (SiO_2, ethyl acetate/hexane, 1:4); white solid (89%);

^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.77–7.75 (m, 2H), 7.57 – 7.50 (m, 1H), 7.49–7.45 (m, 3H), 7.39–7.36 (m, 1H), 6.89 (d, *J*=8.4 Hz, 1H), 3.96 (s, 3H), 3.94 (s, 3H);

^{13}C NMR ($CDCl_3$, 101 MHz): δ 195.7, 153.2, 149.2, 138.4, 132.0, 130.4, 129.8, 128.3, 125.6, 112.3, 109.9, 56.2, 56.2;

HRMS (ESI) *m/z* calcd. for $C_{15}H_{14}O_3[M+H]^+$ 243.1016, found 243.1020.

(4-Bromophenyl)(3,4-dimethoxyphenyl)methanone (3ak')



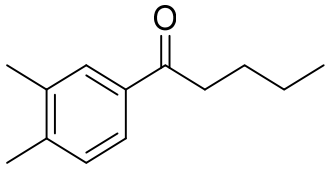
R_f = 0.60 (SiO_2, ethyl acetate/hexane, 1:4); white solid (86%);

^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.64–7.59 (m, 4H), 7.45 (d, *J*=1.5 Hz, 1H), 7.34–7.31 (m, 1H), 6.88 (d, *J*=8.3 Hz, 1H), 3.95 (s, 3H), 3.93 (s, 3H);

^{13}C NMR ($CDCl_3$, 101 MHz): δ 194.5, 153.4, 149.3, 137.1, 131.6, 131.4, 129.9, 126.9, 125.45, 112.2, 109.9, 56.2, 56.2;

HRMS (ESI) *m/z* calcd. for $C_{15}H_{13}BrO_3[M+H]^+$ 321.0121, found 321.0123.

1-(3,4-Dimethylphenyl)pentan-1-one) (3i)



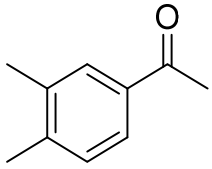
R_f = 0.50 (SiO_2, ethyl acetate/hexane, 1:19); yellow liquid (84%);

^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.73 (s, 1H), 7.69 (d, *J*=7.7 Hz, 1H), 7.20 (d, *J*=7.8 Hz, 1H), 2.93 (t, *J*=7.5 Hz, 2H), 2.31 (s, 6H), 1.71 (dd, *J*=15.0, 7.4 Hz, 2H), 1.43–1.37 (m, 2H), 0.95 (t, *J*=7.3 Hz, 3H);

^{13}C NMR ($CDCl_3$, 101 MHz): δ 200.2, 142.1, 136.7, 134.9, 129.6, 129.1, 125.7, 38.1, 26.6, 22.4, 19.8, 19.6, 13.9;

HRMS (ESI) *m/z* calcd. for $C_{13}H_{18}O[M+H]^+$ 191.1430, found 191.1425.

1-(3,4-Dimethylphenyl)ethan-1-one) (3t)



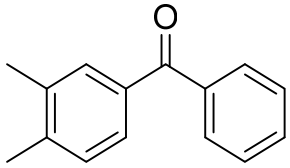
R_f = 0.40 (SiO_2, ethyl acetate/hexane, 1:19); yellow liquid (87%);

^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.73 (s, 1H), 7.69 (d, *J*=7.7 Hz, 1H), 7.21 (d, *J*=7.8 Hz, 1H), 2.57 (s, 3H), 2.32 (s, 6H);

^{13}C NMR ($CDCl_3$, 101 MHz): δ 197.7, 142.3, 136.6, 135.0, 129.6, 129.2, 125.9, 26.3, 19.7, 19.5;

HRMS (ESI) *m/z* calcd. for $C_{10}H_{12}O[M+H]^+$ 149.0961, found 149.0955.

(3,4-Dimethylphenyl)(phenyl)methanone) (3aa')



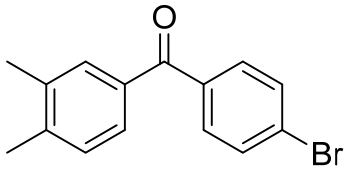
R_f = 0.70 (SiO_2, ethyl acetate/hexane, 1:19); white solid (85%);

^1H NMR ($CDCl_3$, 400 MHz): δ 7.78 (d, *J*=7.1 Hz, 2H), 7.62 (s, 1H), 7.59–7.45 (m, 4H), 7.24 (dd, *J*=12.4, 3.9 Hz, 1H), 2.35 (s, 3H), 2.33 (s, 3H);

^{13}C NMR ($CDCl_3$, 101 MHz): δ 196.7, 142.0, 138.2, 136.9, 135.4, 132.1, 131.2, 129.9, 129.5, 128.2, 128.1, 20.0, 19.8;

HRMS (ESI) *m/z* calcd. for $C_{15}H_{14}O[M+H]^+$ 211.1117, found 211.1106.

(4-Bromophenyl)(3,4-dimethylphenyl)methanone) (3al')



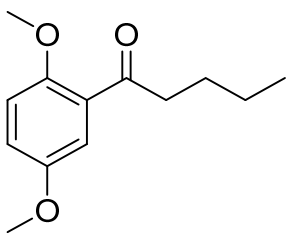
R_f = 0.70 (SiO_2, ethyl acetate/hexane, 1:19); yellow solid (84%);

^1H NMR ($CDCl_3$, 400 MHz): δ 7.67–7.58 (m, 5H), 7.50 (d, *J*=7.5 Hz, 1H), 7.24–7.22 (m, 1H), 2.35 (s, 3H), 2.33 (s, 3H);

^{13}C NMR ($CDCl_3$, 101 MHz): δ 195.6, 142.4, 137.0, 136.9, 135.0, 131.6, 131.6, 131.2, 129.68, 127.9, 127.2, 20.1, 19.9;

HRMS (ESI) *m/z* calcd. for $C_{15}H_{13}BrO[M+H]^+$ 289.0223, found 289.0213.

1-(2,5-Dimethoxyphenyl)pentan-1-one (3j)



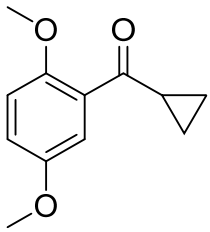
R_f = 0.40 (SiO_2, ethyl acetate/hexane, 1:4); yellow liquid (86%);

^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.21 (d, *J*=3.2 Hz, 1H), 7.00 (dd, *J*=9.0, 3.2 Hz, 1H), 6.89 (d, *J*=9.0 Hz, 1H), 3.85 (s, 3H), 3.78 (s, 3H), 2.96 (t, *J*=7.4 Hz, 2H), 1.68–1.61 (m, 2H), 1.41–1.32 (m, 2H), 0.92 (t, *J*=7.3 Hz, 3H);

^{13}C NMR ($CDCl_3$, 101 MHz): δ 202.9, 153.5, 152.9, 129.0, 119.5, 114.0, 113.1, 56.1, 55.8, 43.5, 26.6, 22.6, 14.0;

HRMS (ESI) *m/z* calcd. for $C_{13}H_{18}O_3[M+H]^+$ 223.1329, found 233.1327.

Cyclopropyl(2,5-dimethoxyphenyl)methanone (3aq)



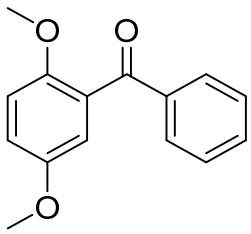
R_f = 0.40 (SiO_2, ethyl acetate-hexane, 1:4); reddish liquid (84%);

^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.13 (d, *J*=2.9 Hz, 1H), 6.99 (dd, *J*=8.9, 2.9 Hz, 1H), 6.91 (d, *J*=9.0 Hz, 1H), 3.85 (s, 3H), 3.77 (s, 3H), 2.80–2.74 (m, 1H), 1.24–1.20 (m, 2H), 0.98 (dd, *J*=7.5, 3.5 Hz, 2H);

^{13}C NMR ($CDCl_3$, 101 MHz): δ 203.2, 153.5, 152.9, 129.9, 119.3, 113.9, 113.5, 56.5, 55.9, 21.6, 12.4;

HRMS (ESI) *m/z* calcd. for $C_{12}H_{14}O_3[M+H]^+$ 207.1016, found 207.1008.

(2,5-Dimethoxyphenyl)(phenyl)methanone (3ab')



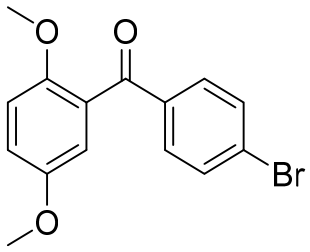
R_f = 0.60 (SiO_2, ethyl acetate/hexane, 1:4); white solid (89%);

^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.82 (dd, *J*=8.4, 1.0 Hz, 2H), 7.60–7.50 (m, 1H), 7.43 (t, *J*=7.6 Hz, 2H), 7.01 (dd, *J*=9.0, 3.0 Hz, 1H), 6.99–6.92 (m, 2H), 3.78 (s, 3H), 3.66 (s, 3H);

^{13}C NMR ($CDCl_3$, 101 MHz): δ 196.3, 153.6, 151.6, 137.8, 133.1, 129.9, 129.7, 128.6, 117.5, 114.6, 113.3, 56.5, 55.9;

HRMS (ESI) *m/z* calcd. for $C_{15}H_{14}O_3[M+H]^+$ 243.1016, found 243.1019.

(4-Bromophenyl)(2,5-dimethoxyphenyl)methanone (3am')



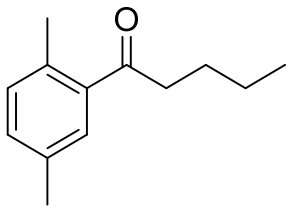
R_f = 0.70 (SiO_2, ethyl acetate/hexane, 1:4); white solid (84%);

^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.67 (d, *J*=8.4 Hz, 2H), 7.56 (d, *J*=8.4 Hz, 2H), 7.02 (dd, *J*=9.0, 3.1 Hz, 1H), 6.92 (dd, *J*=6.0, 2.9 Hz, 2H), 3.78 (s, 3H), 3.65 (s, 3H);

^{13}C NMR ($CDCl_3$, 101 MHz): δ 195.2, 153.7, 151.6, 136.8, 131.7, 131.4, 128.9, 128.2, 117.9, 114.6, 113.2, 56.4, 55.9;

HRMS (ESI) *m/z* calcd. for $C_{15}H_{13}BrO_3[M+H]^+$ 321.0121, found 321.0122.

1-(2,5-Dimethylphenyl)pentan-1-one (3k)



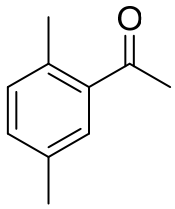
R_f = 0.50 (SiO_2, ethyl acetate/hexane, 1:19); colorless liquid (82%);

^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.40 (s, 1H), 7.14 (dd, *J*=19.4, 7.7 Hz, 2H), 2.87 (t, *J*=7.4 Hz, 2H), 2.43 (s, 3H), 2.36 (s, 3H), 1.71–1.64 (m, 2H), 1.43–1.36 (m, 2H), 0.94 (t, *J*=7.3 Hz, 3H);

^{13}C NMR ($CDCl_3$, 101 MHz): δ 205.1, 138.4, 135.1, 134.5, 131.7, 131.7, 128.8, 41.4, 26.5, 22.5, 20.9, 20.7, 13.9;

HRMS (ESI) *m/z* calcd. for $C_{13}H_{18}O[M+H]^+$ 191.1430, found 191.1426.

1-(2,5-Dimethylphenyl)ethan-1-one (3v)



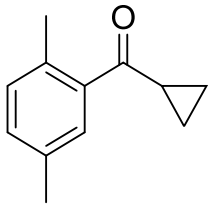
R_f = 0.40 (SiO_2, ethyl acetate/hexane, 1:19); yellow liquid (80%);

^1H NMR ($CDCl_3$, 400 MHz): δ 7.51 (s, 1H), 7.21 (d, *J*=7.5 Hz, 1H), 7.15 (d, *J*=7.7 Hz, 1H), 2.59 (s, 3H), 2.50 (s, 3H), 2.39 (s, 3H);

^{13}C NMR ($CDCl_3$, 101 MHz): δ 201.6, 137.6, 135.1, 132.2, 131.9, 129.9, 29.4, 21.0, 20.8;

HRMS (ESI) *m/z* calcd. for $C_{10}H_{12}O[M+H]^+$ 149.0961, found 149.0964.

Cyclopropyl(2,5-dimethylphenyl)methanone (3ar)



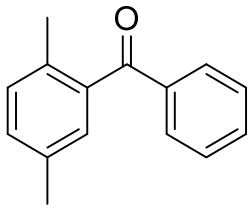
R_f = 0.40 (SiO_2, ethyl acetate/hexane, 1:19); yellow liquid (81%);

^1H NMR ($CDCl_3$, 400 MHz): δ 7.50 (s, 1H), 7.14 (dd, *J*=19.4, 7.7 Hz, 2H), 2.44–2.39 (m, 4H), 2.37 (s, 3H), 1.25 (dd, *J*=7.5, 3.9 Hz, 2H), 1.03 (td, *J*=6.7, 3.2 Hz, 2H);

^{13}C NMR ($CDCl_3$, 101 MHz): δ 205.4, 139.8, 135.2, 133.7, 131.6, 131.4, 128.9, 20.9, 20.8, 20.3, 12.0;

HRMS (ESI) *m/z* calcd. for $C_{12}H_{14}O[M+H]^+$ 175.1117, found 175.1111.

(2,5-Dimethylphenyl)(phenyl)methanone (3ac')



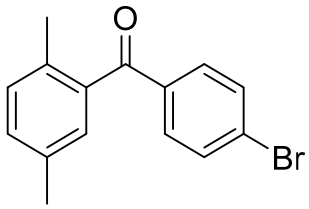
R_f = 0.70 (SiO_2, ethyl acetate/hexane, 1:19); colorless liquid (91%);

^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.80 (d, *J*=7.3 Hz, 2H), 7.58 (t, *J*=7.3 Hz, 1H), 7.46 (t, *J*=7.6 Hz, 2H), 7.21–7.16 (m, 2H), 7.12 (s, 1H), 2.33 (s, 3H), 2.26 (s, 3H);

^{13}C NMR ($CDCl_3$, 101 MHz): δ 198.9, 138.7, 137.9, 134.9, 133.6, 133.1, 131.0, 130.9, 130.2, 128.9, 128.5, 77.5, 77.2, 76.8, 20.9, 19.6;

HRMS (ESI) *m/z* calcd. for $C_{15}H_{14}O[M+H]^+$ 211.1117, found 211.1111.

(4-Bromophenyl)(2,5-dimethylphenyl)methanone (3an')



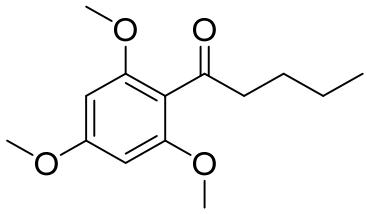
R_f = 0.80 (SiO_2, ethyl acetate/hexane, 1:19); colorless sticky liquid (81%);

^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.66 (d, *J*=8.3 Hz, 2H), 7.60 (d, *J*=8.5 Hz, 2H), 7.22–7.16 (m, 2H), 7.09 (s, 1H), 2.33 (s, 3H), 2.26 (s, 3H);

^{13}C NMR ($CDCl_3$, 101 MHz): δ 197.8, 138.1, 136.7, 135.0, 133.7, 131.9, 131.7, 131.3, 131.1, 128.9, 128.4, 20.9, 19.6;

HRMS (ESI) *m/z* calcd. for $C_{15}H_{13}BrO[M+H]^+$ 289.0223, found 289.0219.

1-(2,4,6-Trimethoxyphenyl)pentan-1-one (3l')



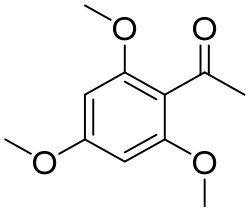
R_f = 0.40 (SiO_2, ethyl acetate/hexane, 1:4); light yellow liquid (88%);

^{1}H NMR ($CDCl_3$, 400 MHz): δ 6.08 (s, 2H), 3.79 (s, 3H), 3.74 (s, 6H), 2.70 (t, *J*=7.4 Hz, 2H), 1.64–1.57 (m, 2H), 1.33 (dq, *J*=14.6, 7.3 Hz, 2H), 0.88 (t, *J*=7.3 Hz, 3H);

^{13}C NMR ($CDCl_3$, 101 MHz): δ 204.9, 162.1, 157.9, 113.6, 90.5, 55.7, 55.4, 44.6, 25.9, 22.3, 13.9;

HRMS (ESI) *m/z* calcd. for $C_{14}H_{20}O_4[M+H]^+$ 253.1434, found 253.1429.

1-(2,4,6-Trimethoxyphenyl)ethan-1-one (3w)



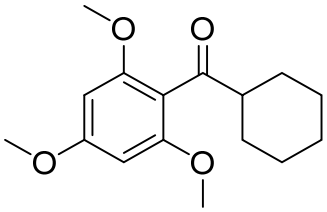
R_f = 0.40 (SiO_2, ethyl acetate/hexane, 1:4); white solid (87%);

^1H NMR ($CDCl_3$, 400 MHz): δ 6.10 (s, 2H), 3.82 (s, 3H), 3.79 (s, 6H), 2.45 (s, 3H);

^{13}C NMR ($CDCl_3$, 101 MHz): δ 201.7, 162.4, 158.4, 113.8, 90.7, 55.8, 55.4, 32.5;

HRMS (ESI) *m/z* calcd. for $C_{11}H_{14}O_4[M+H]^+$ 211.0965, found 211.0957.

Cyclohexyl(2,4,6-trimethoxyphenyl)methanone (3ah)



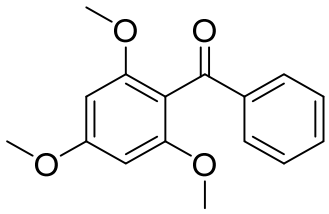
R_f = 0.40 (SiO_2, ethyl acetate/hexane, 1:4); white solid (85%);

^1H NMR ($CDCl_3$, 400 MHz): δ 6.10 (s, 2H), 3.81 (s, 3H), 3.76 (s, 6H), 2.73–2.68 (m, 1H), 1.89 (d, *J*=11.8 Hz, 2H), 1.75 (s, 2H), 1.62 (d, *J*=13.1 Hz, 2H), 1.43–1.28 (m, 2H), 1.25–1.18 (m, 2H);

^{13}C NMR ($CDCl_3$, 101 MHz): δ 208.1, 161.9, 158.0, 113.4, 90.6, 55.8, 55.4, 51.9, 28.1, 26.1, 25.9;

HRMS (ESI) *m/z* calcd. for $C_{16}H_{22}O_4[M+H]^+$ 279.1591, found 279.1597.

Phenyl(2,4,6-trimethoxyphenyl)methanone (3ad')



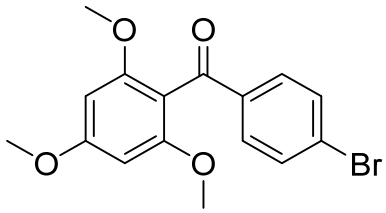
R_f = 0.50 (SiO_2, ethyl acetate/hexane, 1:4); white solid (88%);

^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.84 (d, *J*=7.7 Hz, 2H), 7.53 (t, *J*=6.9 Hz, 1H), 7.41 (t, *J*=7.4 Hz, 2H), 6.18 (s, 2H), 3.87 (s, 3H), 3.69 (s, 6H);

^{13}C NMR ($CDCl_3$, 101 MHz): δ 194.9, 162.5, 158.8, 138.3, 132.9, 129.4, 128.3, 111.0, 90.8, 55.8, 55.5;

HRMS (ESI) *m/z* calcd. for $C_{16}H_{16}O_4[M+H]^+$ 273.1121, found 273.1125.

(4-Bromophenyl)(2,4,6-trimethoxyphenyl)methanone (3ao')



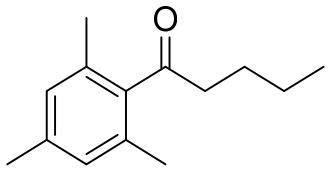
R_f = 0.50 (SiO_2, ethyl acetate/hexane, 1:4); white solid (83%);

^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.69 (d, *J*=8.1 Hz, 2H), 7.54 (d, *J*=8.2 Hz, 2H), 6.16 (s, 2H), 3.86 (s, 3H), 3.69 (s, 6H);

^{13}C NMR ($CDCl_3$, 101 MHz): δ 193.9, 162.8, 158.9, 137.3, 131.7, 131.0, 128.1, 110.5, 90.9, 55.9, 55.6;

HRMS (ESI) *m/z* calcd. for $C_{16}H_{15}BrO_4[M+H]^+$ 351.0226, found 351.0229.

1-Mesitylpentan-1-one (3m)



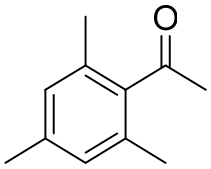
R_f = 0.60 (SiO_2, ethyl acetate/hexane, 1:19); yellow liquid (87%);

^{1}H NMR ($CDCl_3$, 400 MHz): δ 6.83 (s, 2H), 2.69 (t, *J*=2.6 Hz, 2H), 2.28 (s, 3H), 2.19 (s, 6H), 1.70–1.67 (m, 2H), 1.41–1.37 (m, 2H), 0.94 (t, *J*=7.0 Hz, 3H);

^{13}C NMR ($CDCl_3$, 101 MHz): δ δ 210.9, 140.0, 138.2, 132.5, 128.5, 44.6, 25.6, 22.5, 21.0, 19.1, 13.9;

HRMS (ESI) *m/z* calcd. for $C_{14}H_{20}O[M+H]^+$ 205.1587, found 205.1577.

1-Mesitylethan-1-one (3x)



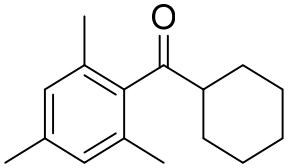
R_f = 0.50 (SiO_2, ethyl acetate/hexane, 1:19); yellow liquid (84%);

^{1}H NMR ($CDCl_3$, 400 MHz): δ 6.84 (s, 2H), 2.46 (s, 3H), 2.28 (s, 3H), 2.22 (s, 6H);

^{13}C NMR ($CDCl_3$, 101 MHz): δ 207.9, 139.8, 138.0, 132.1, 128.4, 31.9, 20.8, 18.9;

HRMS (ESI) *m/z* calcd. for $C_{11}H_{14}O[M+H]^+$ 163.1117, found 163.1113.

Cyclohexyl(mesityl)methanone (3ai)



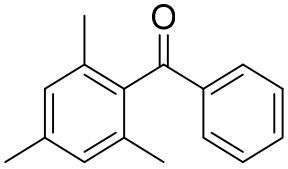
R_f = 0.60 (SiO_2, ethyl acetate/hexane, 1:19); yellow liquid (81%);

^{1}H NMR ($CDCl_3$, 400 MHz): δ 6.83 (s, 2H), 2.71–2.65 (m, 1H), 2.28 (s, 3H), 2.19 (s, 6H), 1.94–1.69 (m, 5H), 1.43–1.38 (m, 2H), 1.25 (d, *J* = 9.2 Hz, 3H);

^{13}C NMR ($CDCl_3$, 101 MHz): δ 213.40, 139.22, 138.16, 133.24, 128.57, 52.26, 28.25, 25.91, 20.98, 19.63;

HRMS (ESI) *m/z* calcd. for $C_{16}H_{22}O[M+H]^+$ 231.1743, found 231.1736.

Mesityl(phenyl)methanone (3ae')



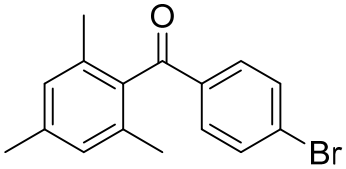
R_f = 0.80 (SiO_2, ethyl acetate/hexane, 1:19); colorless liquid (86%);

^1H NMR ($CDCl_3$, 400 MHz): δ 7.80 (d, *J*=7.8 Hz, 2H), 7.57 (t, *J*=7.2 Hz, 1H), 7.44 (t, *J*=7.6 Hz, 2H), 6.90 (s, 2H), 2.34 (s, 3H), 2.08 (s, 6H);

^{13}C NMR ($CDCl_3$, 101 MHz): δ 200.5, 138.4, 137.4, 136.9, 134.1, 133.5, 129.3, 128.8, 128.3, 21.1, 19.3;

HRMS (ESI) *m/z* calcd. for $C_{16}H_{16}O[M+H]^+$ 225.1274, found 225.1264.

(4-Bromophenyl)(mesityl)methanone (3ap')



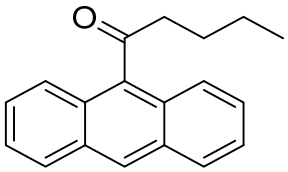
R_f = 0.80 (SiO_2, ethyl acetate/hexane, 1:19); yellow sticky liquid (81%);

^1H NMR ($CDCl_3$, 400 MHz): δ 7.66 (d, *J*=8.4 Hz, 2H), 7.58 (d, *J*=8.6 Hz, 2H), 6.90 (s, 2H), 2.33 (s, 3H), 2.07 (s, 6H);

^{13}C NMR ($CDCl_3$, 101 MHz): δ 199.8, 138.9, 136.3, 136.1, 134.2, 132.3, 130.9, 129.0, 128.5, 21.3, 19.4;

HRMS (ESI) *m/z* calcd. for $C_{16}H_{15}BrO[M+H]^+$ 303.0379, found 303.0374.

1-(Anthracen-9-yl)pentan-1-one (3aq')



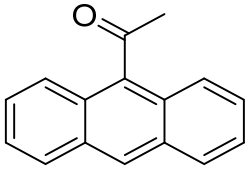
R_f = 0.50 (SiO_2, ethyl acetate/hexane, 1:19); reddish solid (86%);

^{1}H NMR ($CDCl_3$, 400 MHz): δ 8.47 (s, 1H), 8.02 (dd, *J*=7.1, 2.5 Hz, 2H), 7.81 (dd, *J*=7.0, 2.3 Hz, 2H), 7.53–7.46 (m, 4H), 3.07 (t, *J*=7.5 Hz, 2H), 1.89 (dt, *J*=15.2, 7.5 Hz, 2H), 1.52–1.46 (m, 2H), 0.98 (t, *J*=7.3 Hz, 3H);

^{13}C NMR ($CDCl_3$, 101 MHz): δ 210.9, 137.0, 131.2, 128.9, 128.2, 127.1, 126.8, 125.6, 124.5, 46.3, 26.1, 22.6, 14.1;

HRMS (ESI) *m/z* calcd. for $C_{19}H_{18}O[M+H]^+$ 263.1430, found 263.1426.

1-(Anthracen-9-yl)ethan-1-one (3ar')



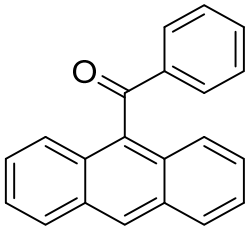
R_f = 0.40 (SiO_2, ethyl acetate/hexane, 1:19); yellow solid (83%);

^{1}H NMR ($CDCl_3$, 400 MHz): δ 9.48 (s, 1H), 8.45 (s, 1H), 8.17 (d, *J*=8.5 Hz, 1H), 8.11 – 8.05 (m, 1H), 8.00 (td, *J*=7.0, 2.1 Hz, 2H), 7.53–7.45 (m, 3H), 2.81 (s, 3H);

^{13}C NMR ($CDCl_3$, 101 MHz): δ 201.7, 135.0, 134.1, 133.2, 132.1, 131.7, 129.8, 129.4, 127.9, 127.8, 127.1, 126.3, 126.7, 125.9, 123.6, 29.9;

HRMS (ESI) *m/z* calcd. for $C_{16}H_{12}O[M+H]^+$ 221.0961, found 221.0959.

Anthracen-9-yl(phenyl)methanone (3as')



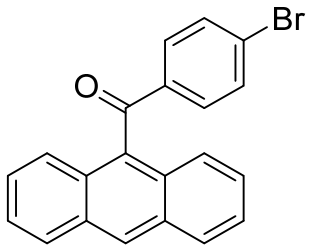
R_f = 0.70 (SiO_2, ethyl acetate/hexane, 1:19); yellow solid (88%);

^{1}H NMR ($CDCl_3$, 400 MHz): δ 8.57 (s, 1H), 8.07 (d, *J*=8.4 Hz, 2H), 7.82 (d, *J*=8.1 Hz, 2H), 7.72 (d, *J*=8.7 Hz, 2H), 7.58 (t, *J*=6.8 Hz, 1H), 7.49–7.46 (m, 2H), 7.43–7.37 (m, 4H);

^{13}C NMR ($CDCl_3$, 101 MHz): δ 200.3, 138.3, 134.2, 134.1, 131.2, 130.2, 128.9, 128.5, 128.5, 126.7, 125.6, 125.5;

HRMS (ESI) *m/z* calcd. for $C_{21}H_{14}O[M+H]^+$ 283.1117, found 238.1109.

Anthracen-9-yl(4-bromophenyl)methanone (3at')



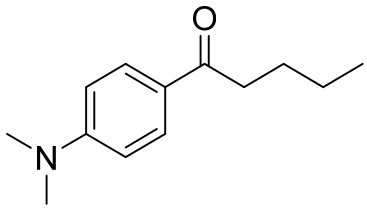
R_f = 0.80 (SiO_2, ethyl acetate/hexane, 1:19); white solid (81%);

^{1}H NMR ($CDCl_3$, 400 MHz): δ 8.58 (s, 1H), 8.07 (d, *J*=8.5 Hz, 2H), 7.70–7.66 (m, 4H), 7.56–7.54 (m, 2H), 7.51–7.47 (m, 2H), 7.43–7.39 (m, 2H);

^{13}C NMR ($CDCl_3$, 101 MHz): δ 199.3, 137.0, 133.4, 132.4, 131.6, 131.2, 129.6, 128.9, 128.8, 128.7, 126.9, 125.7, 125.2;

HRMS (ESI) *m/z* calcd. for $C_{21}H_{13}BrO[M+H]^+$ 361.0223, found 361.0223.

1-(4-(Dimethylamino)phenyl)pentan-1-one (3au')



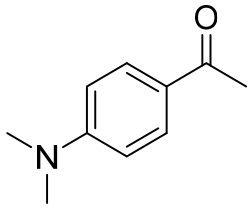
R_f = 0.60 (SiO_2, ethyl acetate/hexane, 1:9); yellow solid (89%);

^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.88 (d, *J*=8.9 Hz, 2H), 6.65 (d, *J*=8.9 Hz, 2H), 3.05 (s, 6H), 2.87 (t, *J*=7.5 Hz, 2H), 1.70 (dt, *J*=15.2, 7.5 Hz, 2H), 1.40 (dq, *J*=14.7, 7.4 Hz, 2H), 0.94 (t, *J*=7.3 Hz, 3H);

^{13}C NMR ($CDCl_3$, 101 MHz): δ 198.9, 153.3, 130.3, 125.1, 110.7, 40.0, 37.7, 27.3, 22.7, 14.0;

HRMS (ESI) *m/z* calcd. for $C_{13}H_{19}NO[M+H]^+$ 206.1539, found 206.1537.

1-(4-(dimethylamino)phenyl)ethan-1-one (3av')



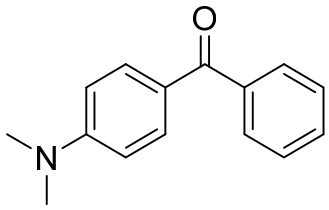
R_f = 0.40 (SiO_2, ethyl acetate/hexane, 1:9); blackish solid (86%);

^1H NMR ($CDCl_3$, 400 MHz): δ 7.87 (d, *J*=8.9 Hz, 2H), 6.65 (d, *J*=8.9 Hz, 2H), 3.05 (s, 6H), 2.51 (s, 3H);

^{13}C NMR ($CDCl_3$, 101 MHz): δ 196.4, 153.4, 130.5, 125.3, 110.6, 40.0, 26.0;

HRMS (ESI) *m/z* calcd. for $C_{10}H_{13}NO[M+H]^+$ 164.1070, found 164.1078.

(4-(Dimethylamino)phenyl)(phenyl)methanone (3aw')



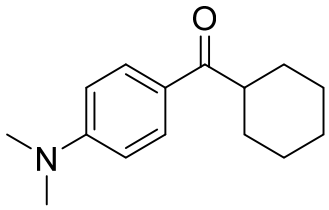
R_f = 0.70 (SiO_2, ethyl acetate/hexane, 1:9); yellow solid (88%);

^1H NMR ($CDCl_3$, 400 MHz): δ 7.80 (d, *J*=9.0 Hz, 2H), 7.72 (d, *J*=6.9 Hz, 2H), 7.52 (t, *J*=6.7 Hz, 1H), 7.45 (t, *J*=7.3 Hz, 2H), 6.68 (d, *J*=9.0 Hz, 2H), 3.07 (s, 6H);

^{13}C NMR ($CDCl_3$, 101 MHz): δ 195.3, 153.4, 139.4, 132.9, 131.2, 129.6, 128.1, 124.8, 110.64, 40.2;

HRMS (ESI) *m/z* calcd. for $C_{15}H_{15}NO[M+H]^+$ 226.1226, found 266.1229.

Cyclohexyl(4-(dimethylamino)phenyl)methanone (3ax')



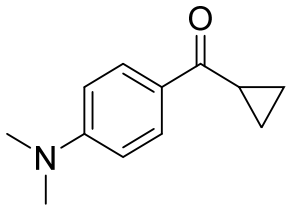
R_f = 0.50 (SiO_2, ethyl acetate/hexane, 1:9); yellow solid (88%);

^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.88 (d, *J*=9.0 Hz, 2H), 6.66 (d, *J*=9.0 Hz, 2H), 3.20 (tt, *J*=11.5, 3.0 Hz, 1H), 3.05 (s, 6H), 1.84 (dd, *J*=9.6, 2.2 Hz, 4H), 1.72 (d, *J*=13.4 Hz, 1H), 1.55–1.25 (m, 5H);

^{13}C NMR ($CDCl_3$, 101 MHz): δ 202.2, 153.3, 130.5, 124.2, 110.8, 45.0, 40.1, 29.8, 26.1;

HRMS (ESI) *m/z* calcd. for $C_{15}H_{21}NO[M+H]^+$ 232.1696, found 232.1692.

Cyclopropyl(4-(dimethylamino)phenyl)methanone (3ay')



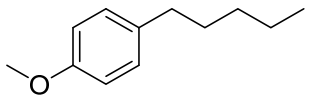
R_f = 0.40 (SiO_2, ethyl acetate/hexane, 1:9); yellow solid (81%);

^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.96 (d, *J*=8.9 Hz, 2H), 6.67 (d, *J*=8.9 Hz, 2H), 3.06 (s, 6H), 2.65–2.59 (m, 1H), 1.19–1.15 (m, 2H), 0.96–0.91 (m, 2H);

^{13}C NMR ($CDCl_3$, 101 MHz): δ 198.5, 153.4, 130.3, 126.0, 110.8, 40.2, 16.2, 10.7;

HRMS (ESI) *m/z* calcd. for $C_{12}H_{16}NO[M+H]^+$ 190.1226, found 190.1224.

1-Methoxy-4-pentylbenzene (5a)

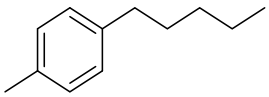


R_f = 0.80 (SiO_2, ethyl acetate/hexane, 1:9); colorless liquid (65%);

^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.13 (d, *J*=8.6 Hz, 2H), 6.85 (d, *J*=8.6 Hz, 2H), 3.81 (s, 3H), 2.57 (t, *J*=7.6 Hz, 2H), 1.63–1.59 (m, 2H), 1.39–1.32 (m, 4H), 0.92 (t, *J*=6.8 Hz, 3H);

^{13}C NMR ($CDCl_3$, 101 MHz): δ 157.7, 135.2, 129.4, 113.8, 55.3, 35.2, 31.6, 22.7, 14.2;

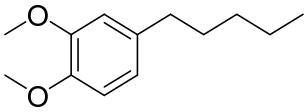
1-methyl-4-pentylbenzene (5b)



R_f = 0.70 (SiO_2, ethyl acetate-hexane, 1:19); colorless liquid (60%);

^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.21–7.03 (m, 4H), 2.60 (t, *J*=7.7 Hz, 2H), 2.35 (s, 3H), 1.67–1.60 (m, 2H), 1.34 (dd, *J*=14.0, 10.8 Hz, 4H), 0.93 (t, *J*=6.7 Hz, 3H);
^{13}C NMR ($CDCl_3$, 101 MHz): δ 140.0, 135.1, 129.1, 128.4, 35.7, 31.7, 31.5, 22.7, 21.1, 14.2;

1,2-dimethoxy-4-pentylbenzene (5c)

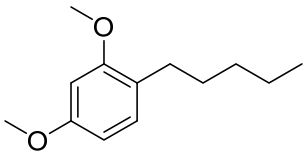


R_f = 0.50 (SiO_2, ethyl acetate/hexane, 1:9); colorless liquid (72%);

^{1}H NMR ($CDCl_3$, 400 MHz): δ 6.79 (d, *J*=8.6 Hz, 1H), 6.72 (d, *J*=6.6 Hz, 2H), 3.88 (s, 3H), 3.86 (s, 3H), 2.55 (t, *J*=7.7 Hz, 2H), 1.64–1.56 (m, 2H), 1.37–1.30 (m, 4H), 0.90 (t, *J*=6.8 Hz, 3H);

^{13}C NMR ($CDCl_3$, 101 MHz): δ 148.8, 147.1, 135.7, 120.2, 111.8, 111.2, 56.0, 55.9, 35.7, 31.6, 31.53, 22.7, 14.2;
HRMS (ESI) *m/z* calcd. for $C_{13}H_{20}O_2[M+H]^+$ 209.1536, found 209.1535.

2,4-dimethoxy-1-pentylbenzene (5d)



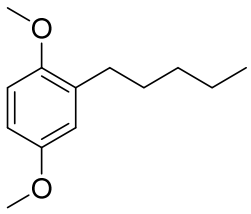
R_f = 0.60 (SiO_2, ethyl acetate/hexane, 1:9); colorless liquid (73%);

^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.02 (d, *J*=8.1 Hz, 1H), 6.47–6.43 (m, 2H), 3.82 (s, 6H), 2.53 (t, *J*=7.6 Hz, 2H), 1.60–1.53 (m, 2H), 1.39–1.32 (m, 4H), 0.89 (t, *J*=6.8 Hz, 3H);

^{13}C NMR ($CDCl_3$, 101 MHz): δ 159.0, 158.4, 129.9, 123.8, 103.7, 98.5, 55.4, 55.3, 31.9, 29.9, 29.6, 22.7, 14.2;

HRMS (ESI) *m/z* calcd. for $C_{13}H_{20}O_2[M+H]^+$ 209.1536, found 209.1529.

1,4-dimethoxy-2-pentylbenzene (5e)



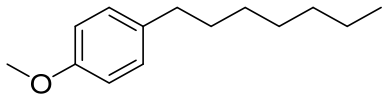
R_f = 0.50 (SiO_2, ethyl acetate/hexane, 1:9); colorless liquid (70%);

^{1}H NMR ($CDCl_3$, 400 MHz): δ 6.78 (dd, *J*=9.1, 5.9 Hz, 2H), 6.71 (dd, *J*=8.7, 3.0 Hz, 1H), 3.80 (s, 3H), 3.79 (s, 3H), 2.61 (t, *J*=7.8 Hz, 2H), 1.67–1.57 (m, 2H), 1.38–1.33 (m, 4H), 0.93 (t, *J*=6.8 Hz, 3H);

^{13}C NMR ($CDCl_3$, 101 MHz): δ 153.5, 151.9, 132.8, 116.3, 111.3, 110.6, 56.0, 55.7, 31.9, 30.4, 29.7, 22.7, 14.2;

HRMS (ESI) *m/z* calcd. for $C_{13}H_{20}O_2[M+H]^+$ 209.1536, found 209.1535.

1-Heptyl-4-methoxybenzene (5f)

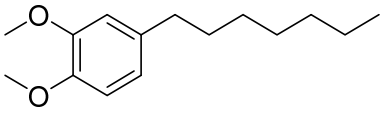


R_f = 0.80 (SiO_2, ethyl acetate/hexane, 1:9); colorless liquid (68%);

^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.11 (d, *J*=8.6 Hz, 2H), 6.84 (d, *J*=8.6 Hz, 2H), 3.80 (s, 3H), 2.56 (t, *J*=7.6 Hz, 2H), 1.59 (m, *J*=6.8 Hz, 2H), 1.31 (m, *J*=8.0, 4.8 Hz, 8H), 0.90 (t, *J*=6.8 Hz, 3H);

^{13}C NMR ($CDCl_3$, 101 MHz): δ 157.7, 135.2, 129.4, 113.75, 55.4, 35.2, 31.9, 31.9, 29.4, 29.4, 22.8, 14.3;

4-Heptyl-1,2-dimethoxybenzene (5g)



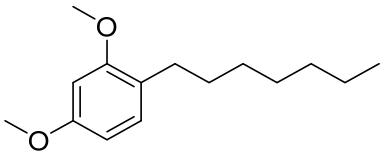
R_f = 0.60 (SiO_2, ethyl acetate/hexane, 1:9); colorless liquid (75%);

^{1}H NMR ($CDCl_3$, 400 MHz): δ 6.79 (d, *J*=8.6 Hz, 1H), 6.72 (d, *J*=6.1 Hz, 2H), 3.88 (s, 3H), 3.86 (s, 3H), 2.55 (t, *J*=7.7 Hz, 2H), 1.60 (dd, *J*=12.3, 5.2 Hz, 2H), 1.32-1.28 (m, 8H), 0.89 (t, *J*=6.6 Hz, 3H);

^{13}C NMR ($CDCl_3$, 101 MHz): δ 148.8, 147.1, 135.7, 120.2, 111.8, 111.2, 56.0, 55.9, 35.7, 31.9, 31.83, 29.4, 29.3, 22.8, 14.2;

HRMS (ESI) *m/z* calcd. for $C_{15}H_{24}O_2[M+H]^+$ 237.1849, found 237.1850.

1-Heptyl-2,4-dimethoxybenzene (5h)



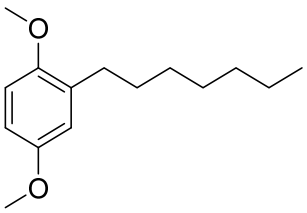
R_f = 0.50 (SiO_2, ethyl acetate/hexane, 1:9); colorless liquid (75%);

^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.04 (d, *J*=8.1 Hz, 1H), 6.53–6.35 (m, 2H), 3.81 (s, 6H), 2.55 (t, *J*=7.7 Hz, 2H), 1.57–1.54 (m, 2H), 1.34–1.30 (m, 8H), 0.91 (t, *J*=6.7 Hz, 3H);

^{13}C NMR ($CDCl_3$, 101 MHz): δ 159.0, 158.4, 129.9, 123.9, 103.8, 98.6, 55.4, 55.4, 32.0, 30.3, 29.7, 29.6, 29.4, 22.8, 14.3;

HRMS (ESI) *m/z* calcd. for $C_{15}H_{24}O_2[M+H]^+$ 237.1849, found 237.1849.

2-Heptyl-1,4-dimethoxybenzene (5i)



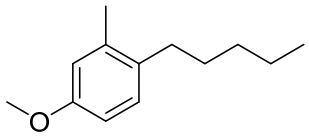
R_f = 0.50 (SiO_2, ethyl acetate/hexane, 1:9); colorless liquid (75%);

^{1}H NMR ($CDCl_3$, 400 MHz): δ 6.77 (dd, *J*=10.4, 5.7 Hz, 2H), 6.70 (dd, *J*=8.7, 2.8 Hz, 1H), 3.79 (s, 3H), 3.78 (s, 3H), 2.60 (t, *J*=7.7 Hz, 2H), 1.60 (dd, *J*=12.7, 5.9 Hz, 2H), 1.33 (d, *J*=16.2 Hz, 8H), 0.90 (t, *J*=7.0 Hz, 3H);

^{13}C NMR ($CDCl_3$, 101 MHz): δ 153.6, 151.9, 132.8, 116.4, 111.3, 110.6, 56.1, 55.7, 32.0, 30.4, 30.0, 29.7, 29.4, 22.8, 14.3;

HRMS (ESI) *m/z* calcd. for $C_{15}H_{24}O_2[M+H]^+$ 237.1849, found 237.1846.

4-Methoxy-2-methyl-1-pentylbenzene (5j)

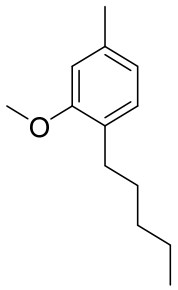


R_f = 0.60 (SiO_2, ethyl acetate/hexane, 1:9); colorless liquid (37%);

^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.08 (d, *J*=8.2 Hz, 1H), 6.77–6.73 (m, 2H), 3.81 (s, 3H), 2.57 (t, *J*=7.8 Hz, 2H), 2.33 (s, 3H), 1.65–1.58 (m, 2H), 1.44–1.40 (m, 4H), 0.96 (t, *J*=6.5 Hz, 3H);

^{13}C NMR ($CDCl_3$, 101 MHz): δ 157.7, 137.2, 133.5, 129.8, 115.9, 111.0, 55.3, 32.6, 31.9, 30.4, 22.7, 19.7, 14.2;

2-Methoxy-4-methyl-1-pentylbenzene (5k)

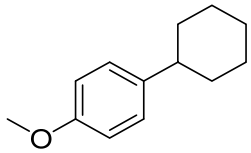


R_f = 0.70 (SiO_2, ethyl acetate/hexane, 1:9); colorless liquid (38%);

^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.05 (d, *J* = 7.4 Hz, 1H), 6.74–6.70 (m, 2H), 3.84 (s, 3H), 2.60 (t, *J*=7.7 Hz, 2H), 2.37 (s, 3H), 1.60 (dt, *J*=12.3, 6.3 Hz, 2H), 1.38–1.36 (m, 4H), 0.93 (t, *J*=6.6 Hz, 3H);

^{13}C NMR ($CDCl_3$, 101 MHz): δ 157.5, 136.6, 129.7, 128.4, 120.9, 111.4, 55.4, 31.9, 29.9, 22.7, 21.6, 14.2;

1-Cyclohexyl-4-methoxybenzene (5l)

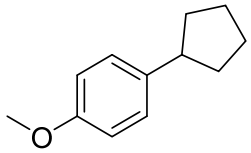


R_f = 0.50 (SiO_2, ethyl acetate/hexane, 1:9); white solid (58%);

^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.16 (d, *J*=8.5 Hz, 2H), 6.87 (d, *J*=8.6 Hz, 2H), 3.81 (s, 3H), 2.48–2.46 (m, 1H), 1.90–1.76 (m, 5H), 1.47–1.26 (m, 5H);

^{13}C NMR ($CDCl_3$, 101 MHz): δ 157.8, 140.5, 127.7, 113.8, 55.3, 43.8, 34.9, 27.1, 26.3;

1-Cyclopentyl-4-methoxybenzene (5m)



R_f = 0.60 (SiO_2, ethyl acetate/hexane, 1:9); colorless liquid (55%);

^{1}H NMR ($CDCl_3$, 400 MHz): δ 7.20 (d, *J*=8.6 Hz, 2H), 6.87 (d, *J*=8.6 Hz, 2H), 3.82 (s, 3H), 3.02–2.93 (m, 1H), 2.08–2.07 (m, 2H), 1.87–1.79 (m, 2H), 1.75–1.70 (m, 2H), 1.58 (td, *J* = 16.9, 9.2 Hz, 2H);

^{13}C NMR ($CDCl_3$, 101 MHz): δ 157.8, 138.7, 128.0, 113.8, 55.4, 45.3, 34.8, 25.6;

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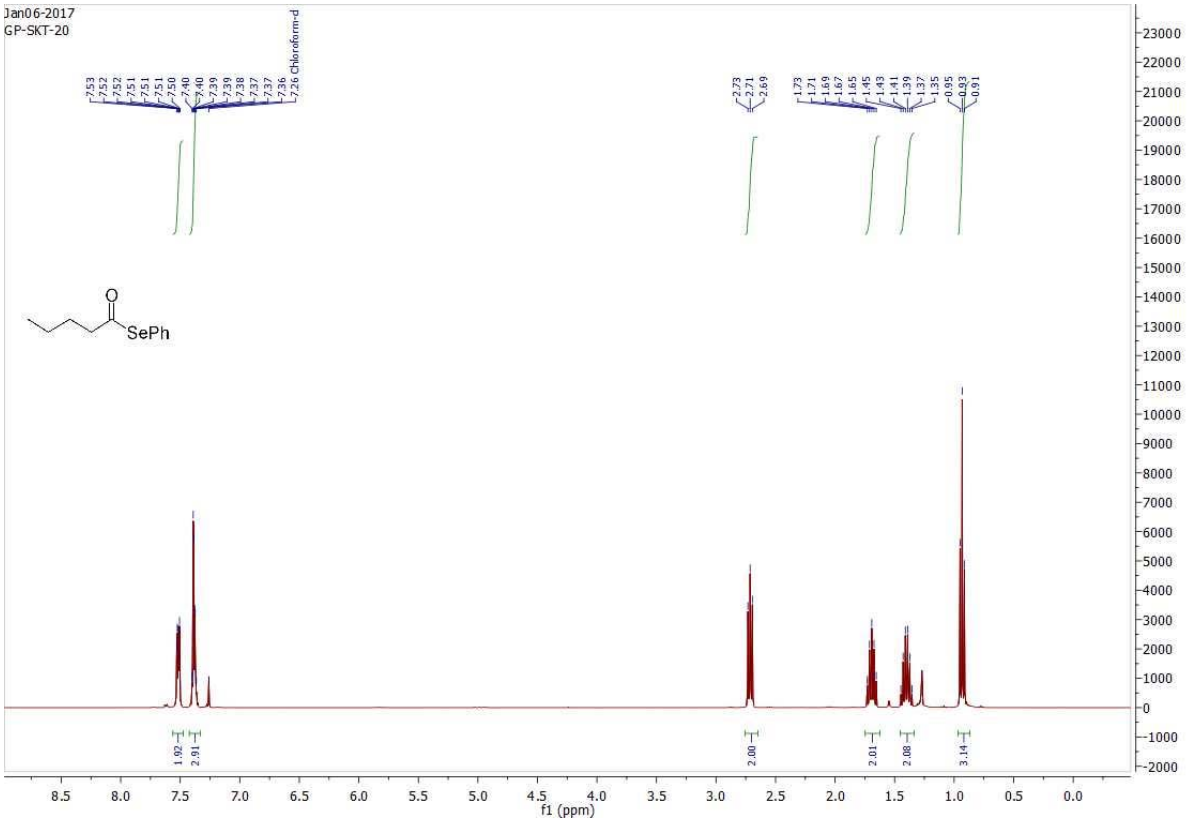
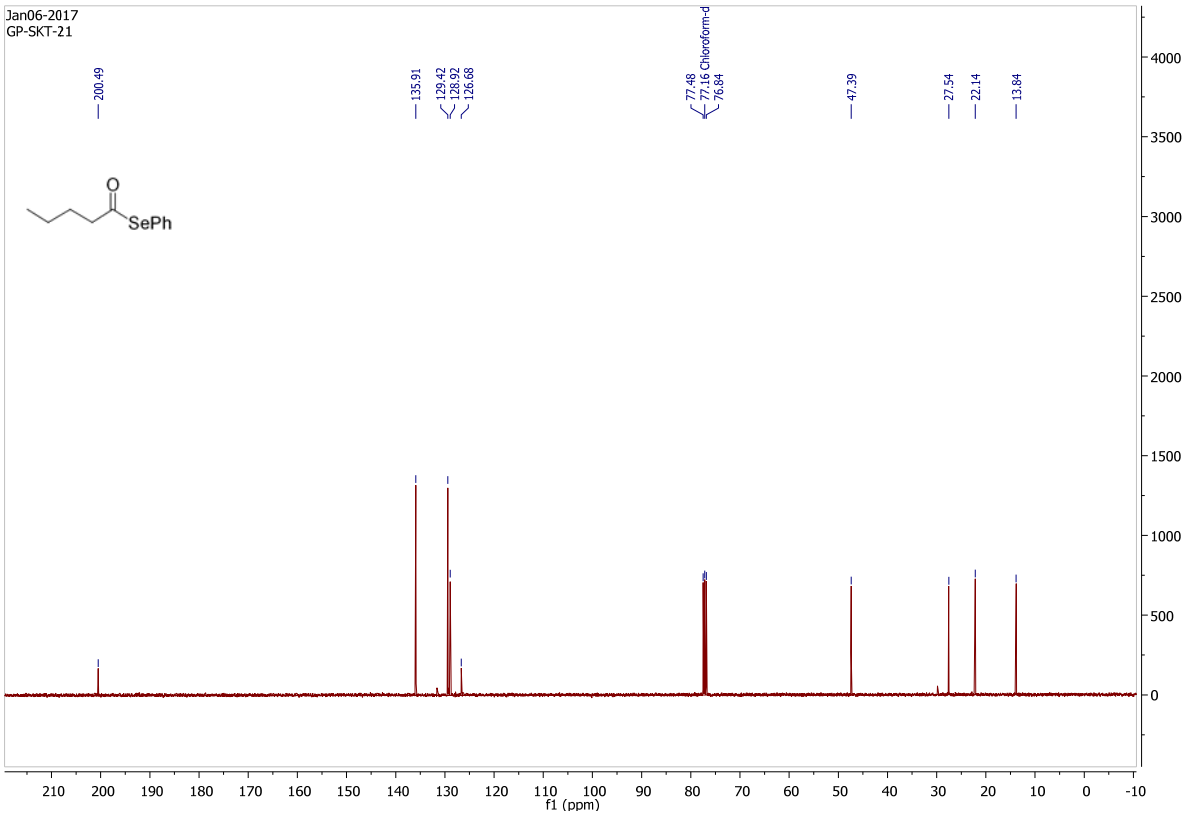
13. This setup was used in the absence of a commercially available LED source in this wavelength range. Any lamp emitting at 410 nm with appropriate intensity (ca.6.0×1015 photons per second) can be used.

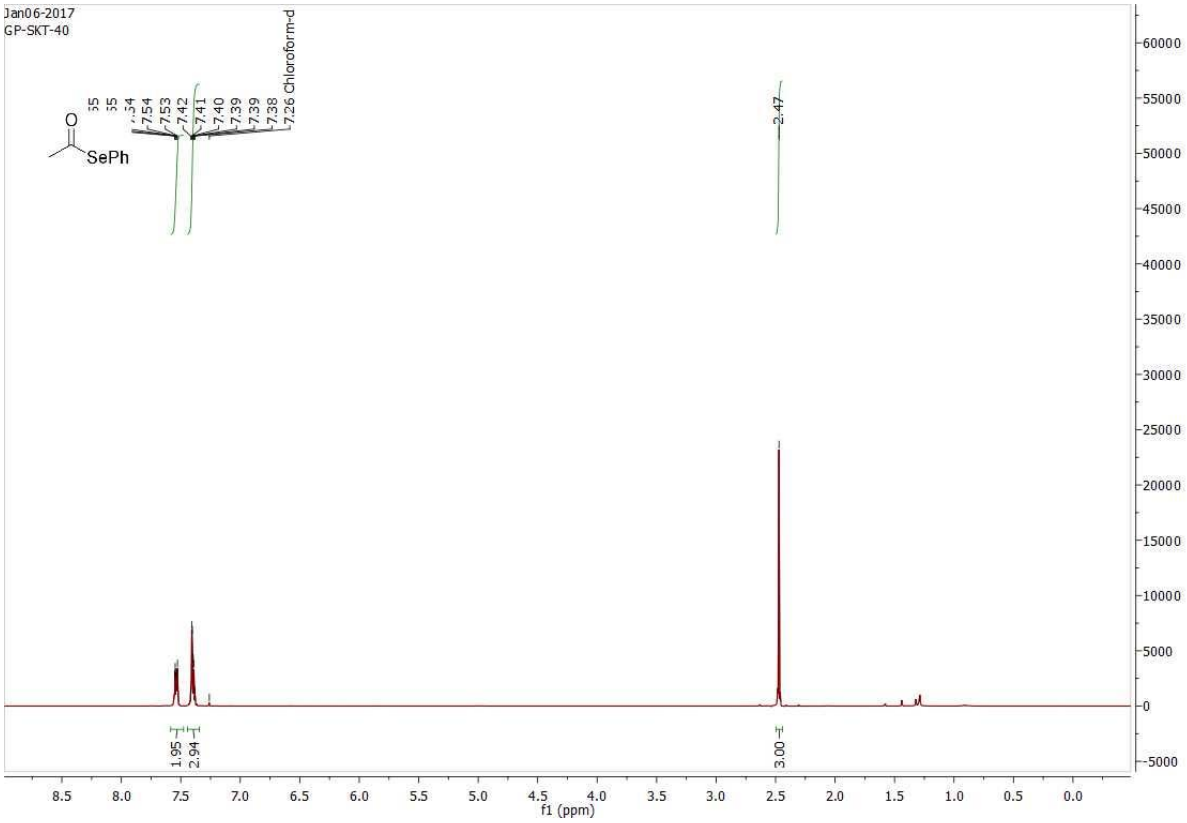
^{1}H and ^{13}C spectra of Starting Material

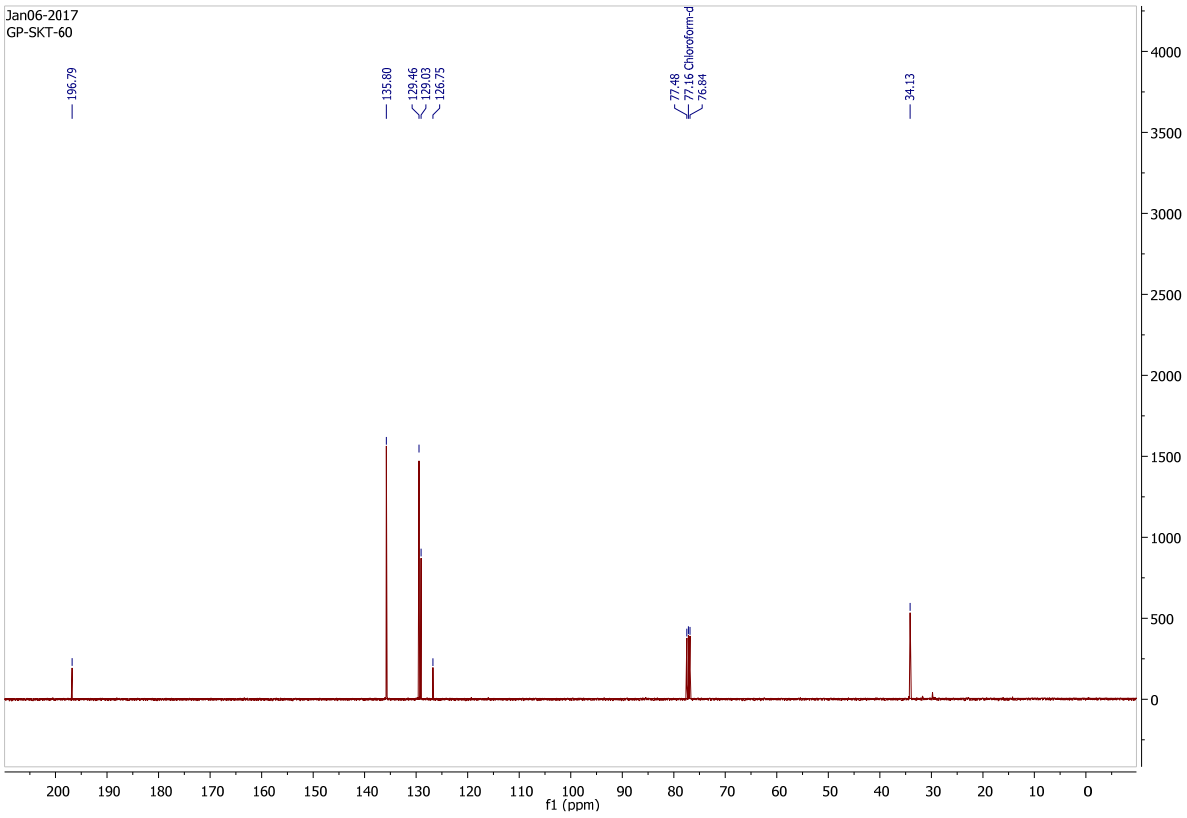
^{1}H and ^{13}C spectra of Se-phenyl pentaneselenoate (1a)



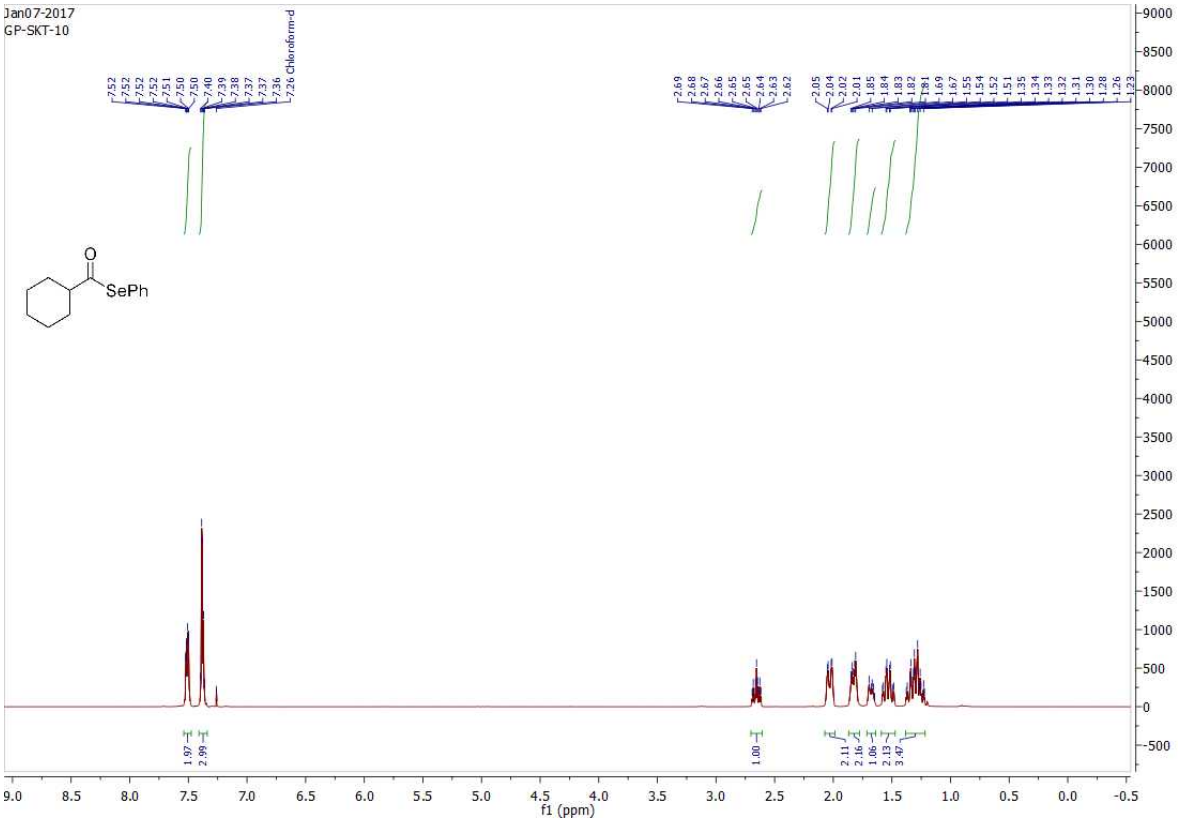


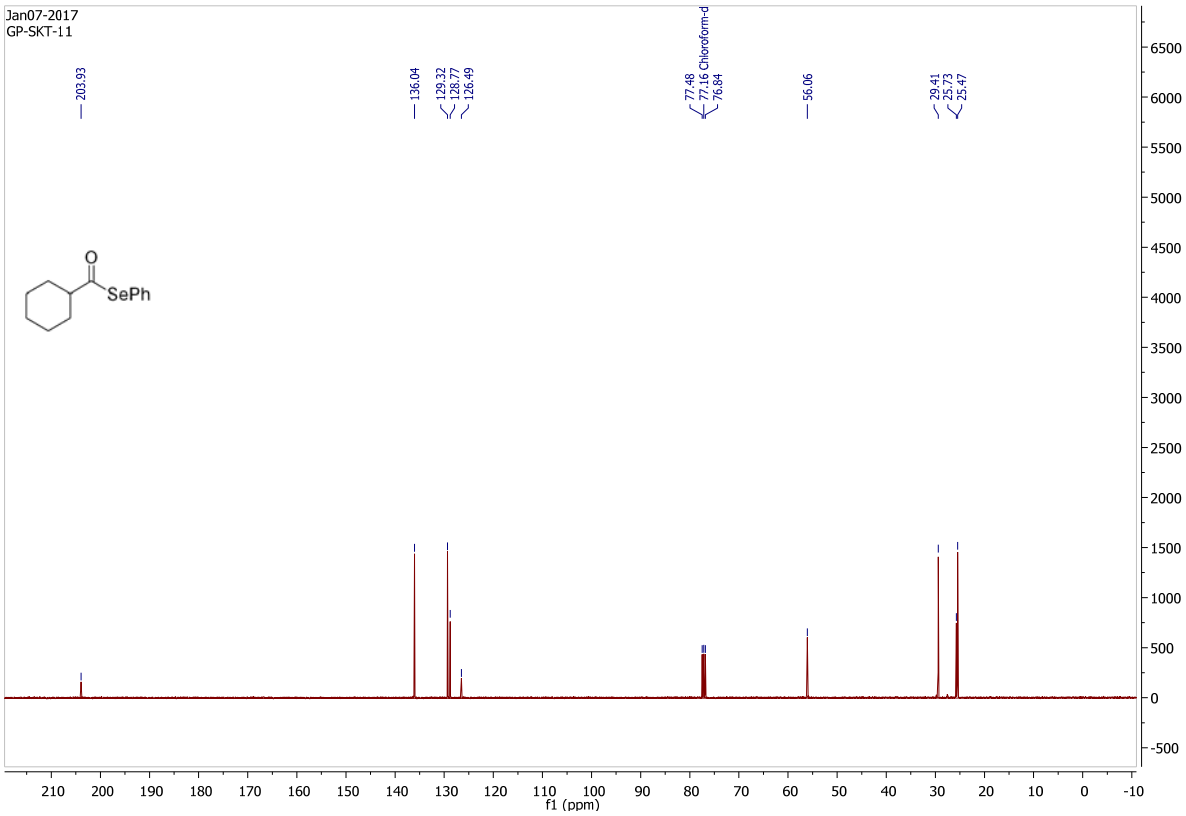
^{1}H and ^{13}C spectra of Se-phenyl ethaneselenoate (1b)



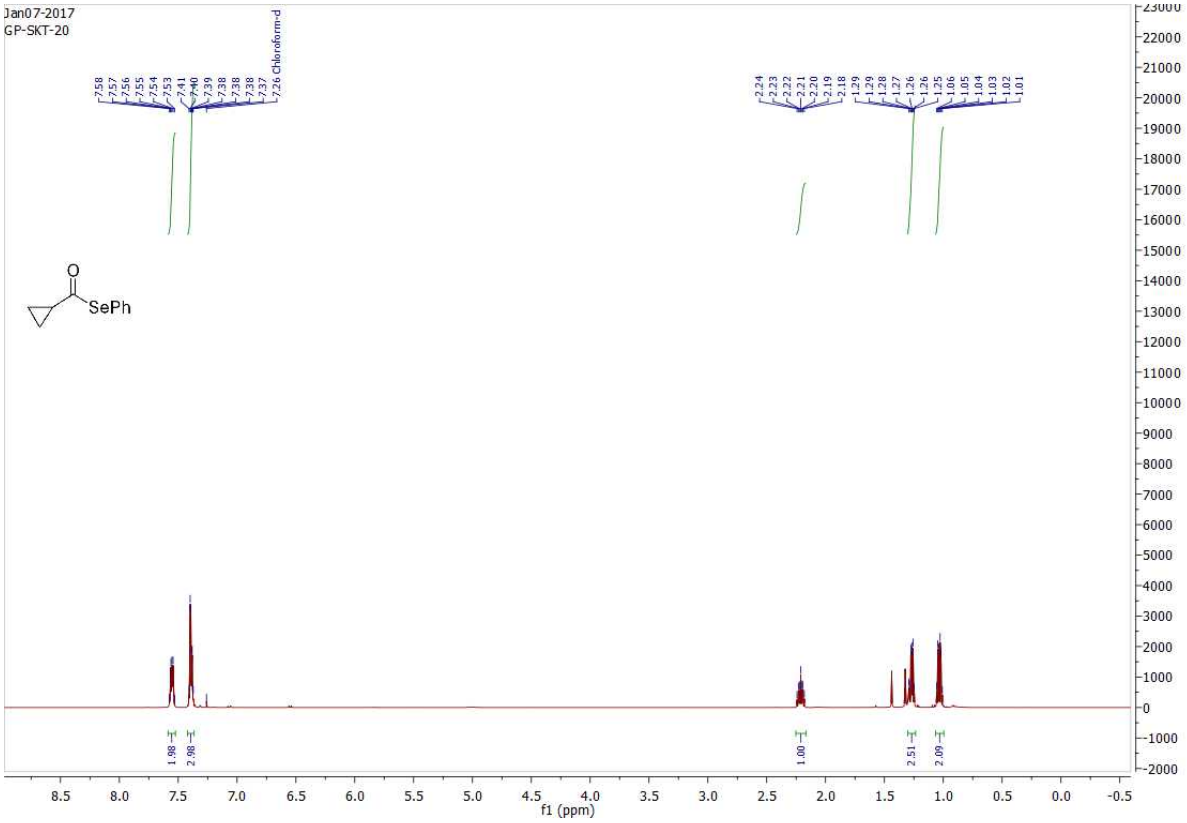


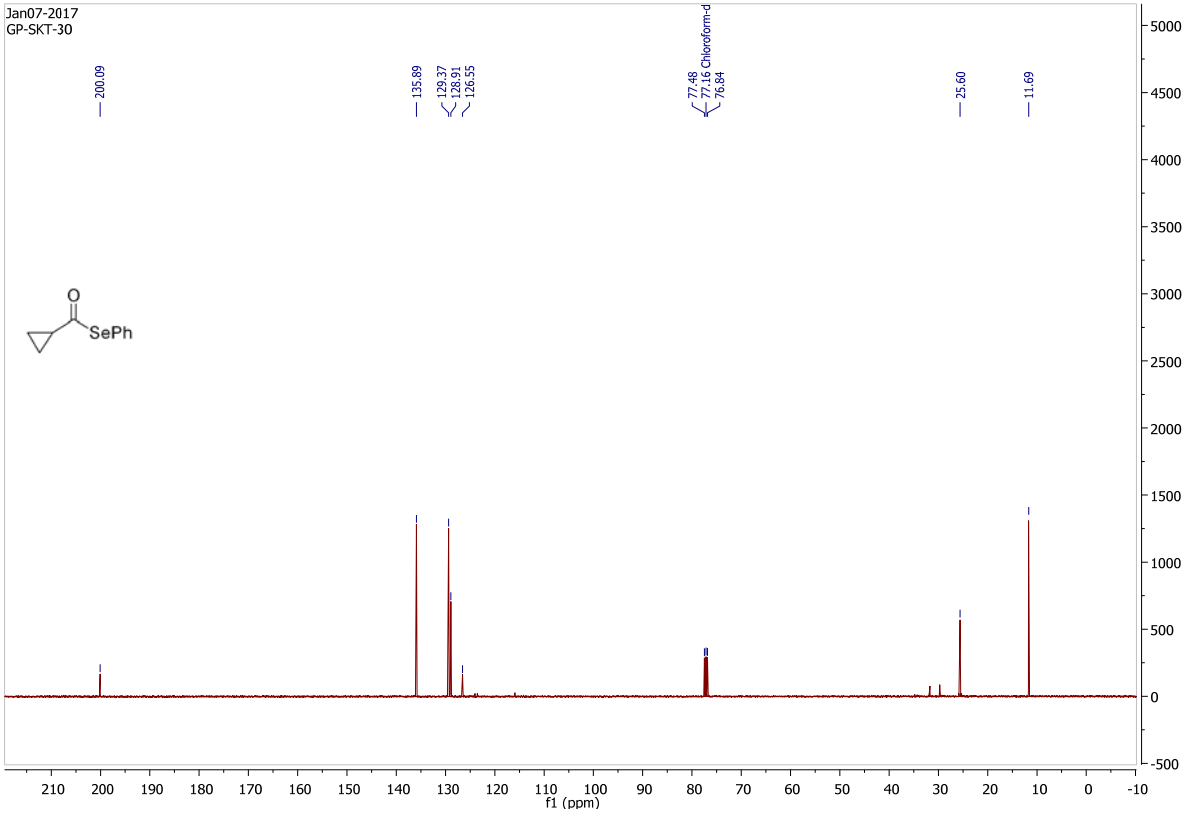
^{1}H and ^{13}C spectra of Se-phenyl cyclohexanecarboselenoate (1c)



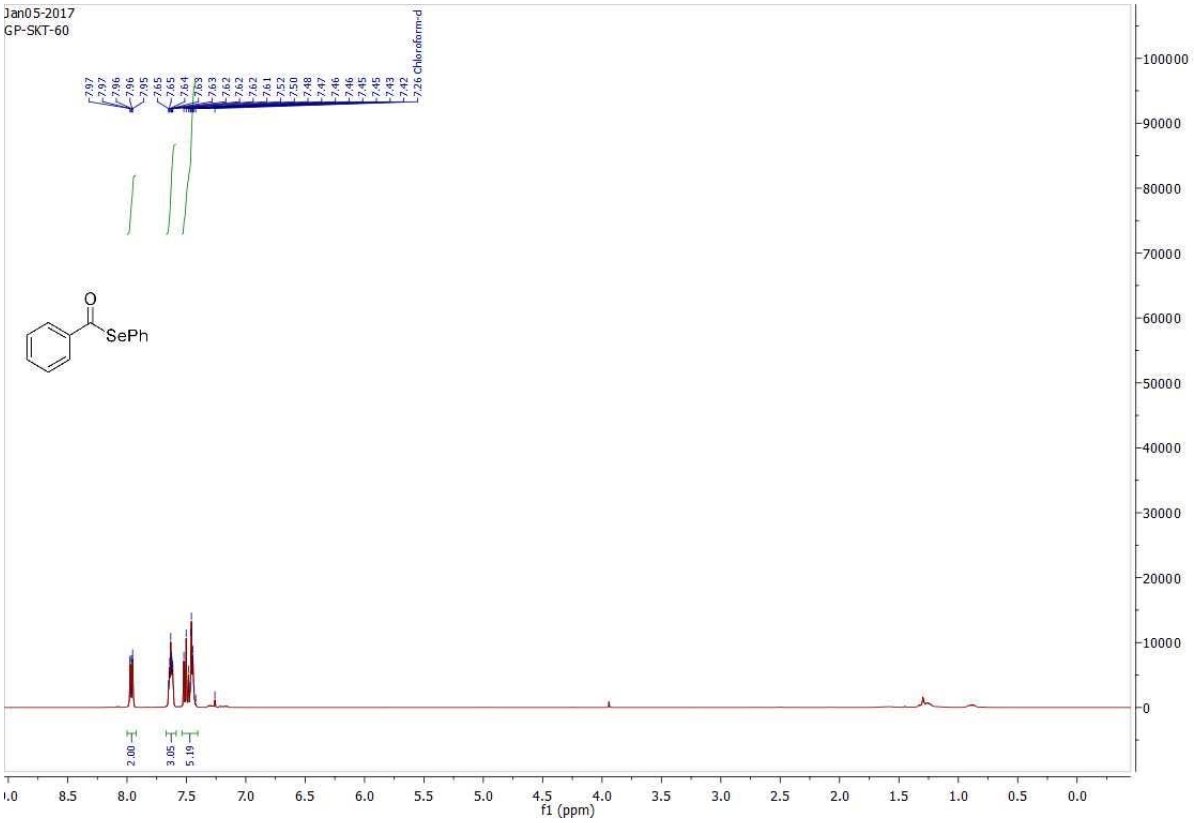


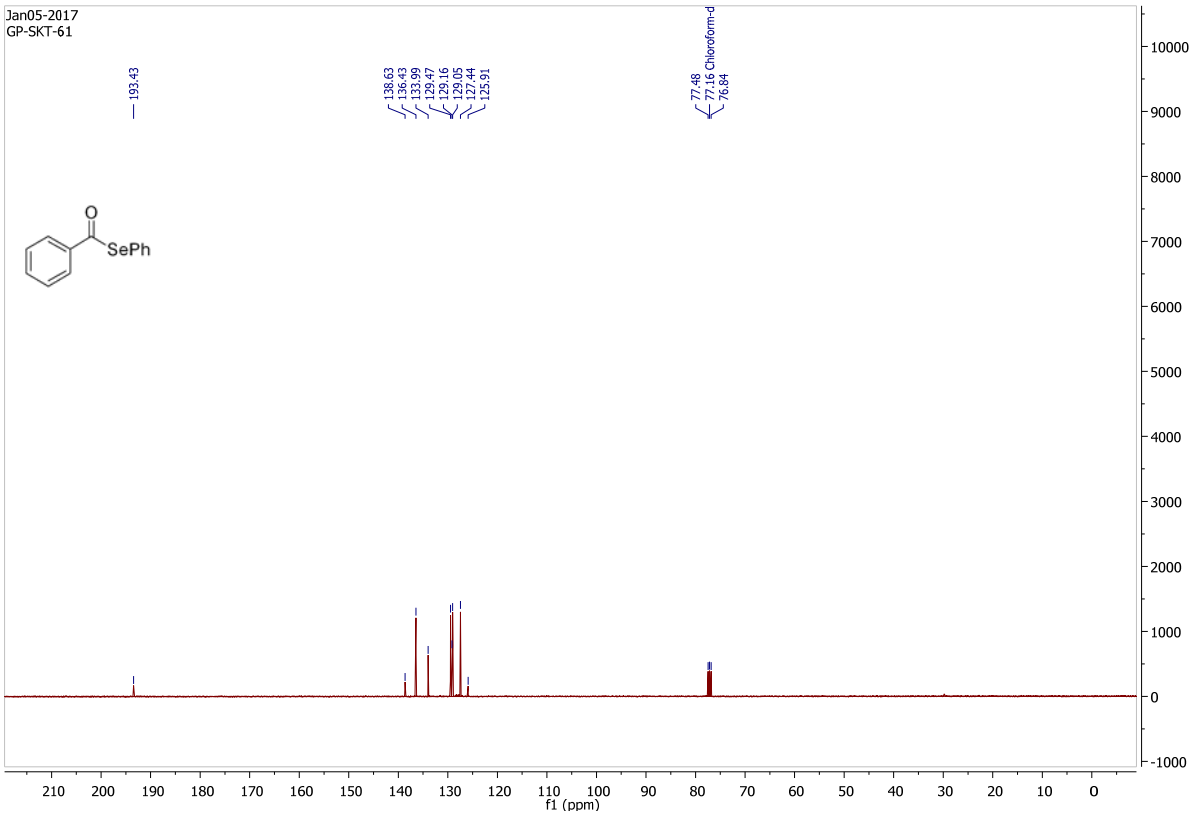
^{1}H and ^{13}C spectra of Se-phenyl cyclopropanecarboselenoate (1d)



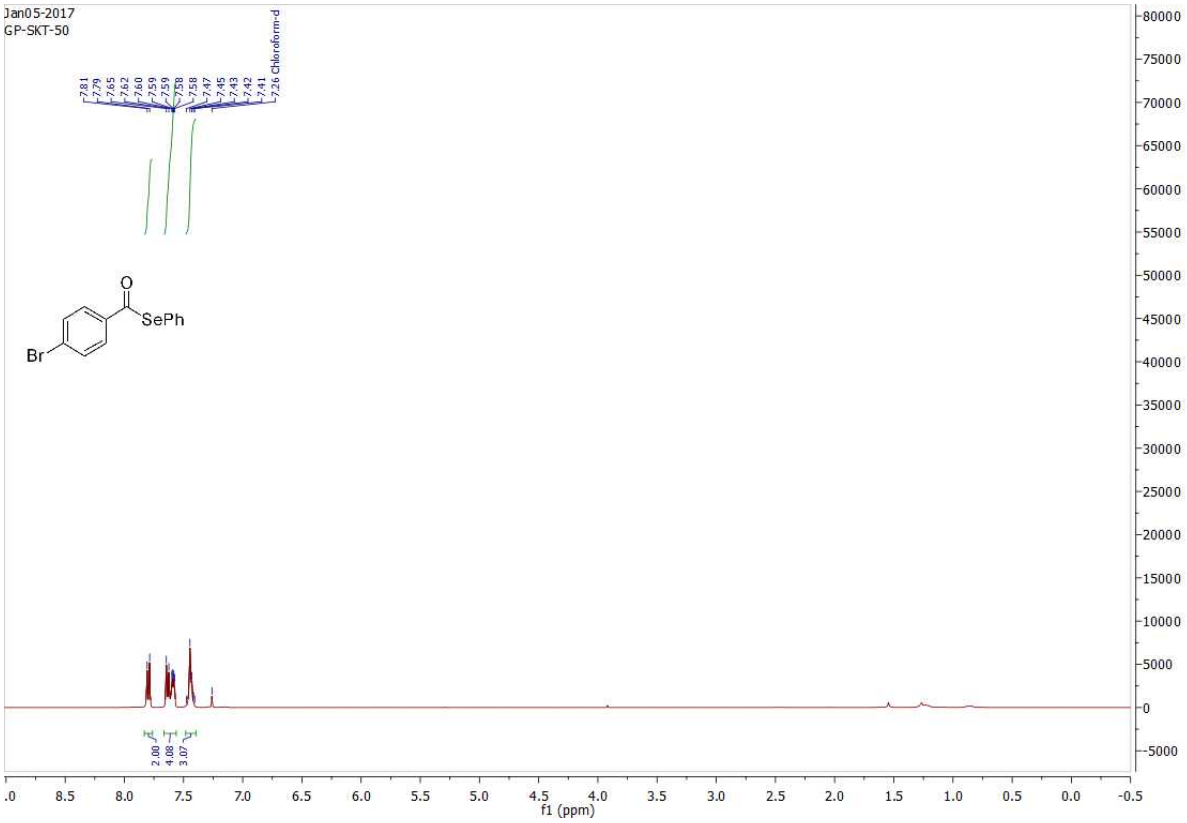


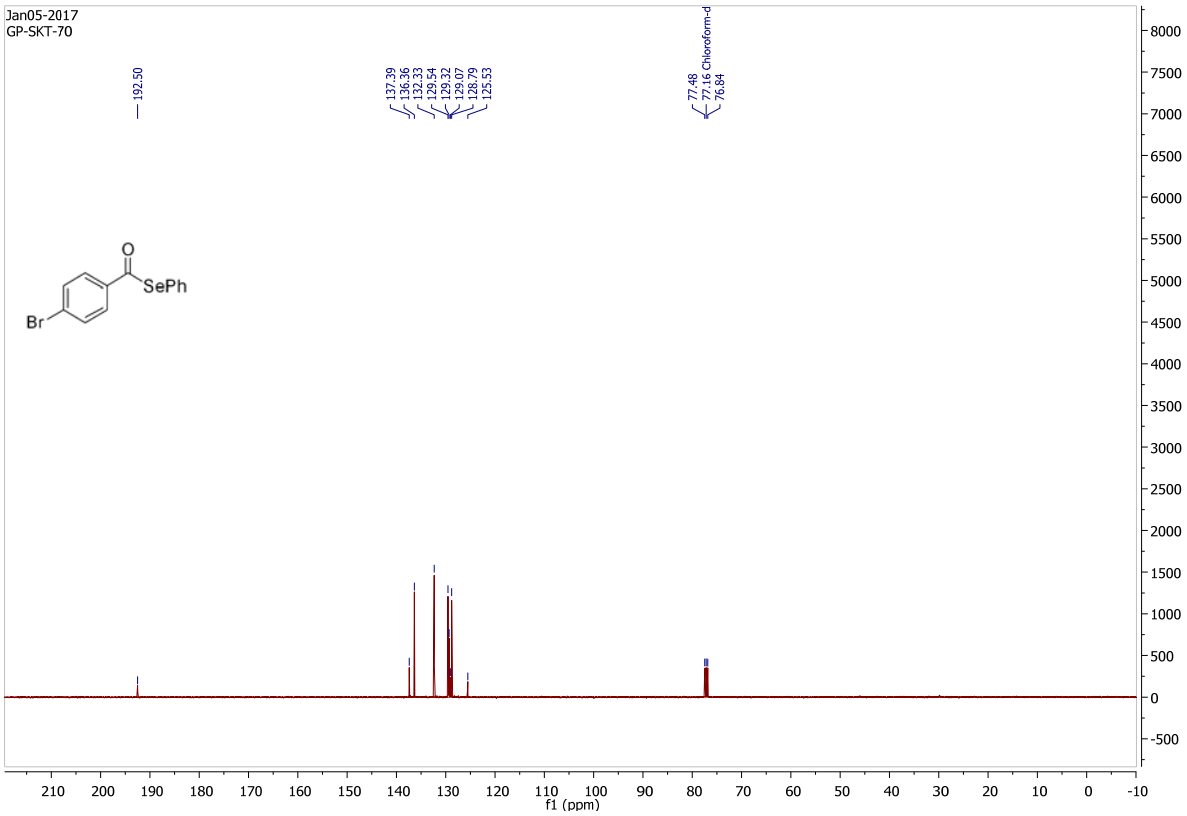
^{1}H and ^{13}C spectra of Se-phenyl benzoselenoate (1e)



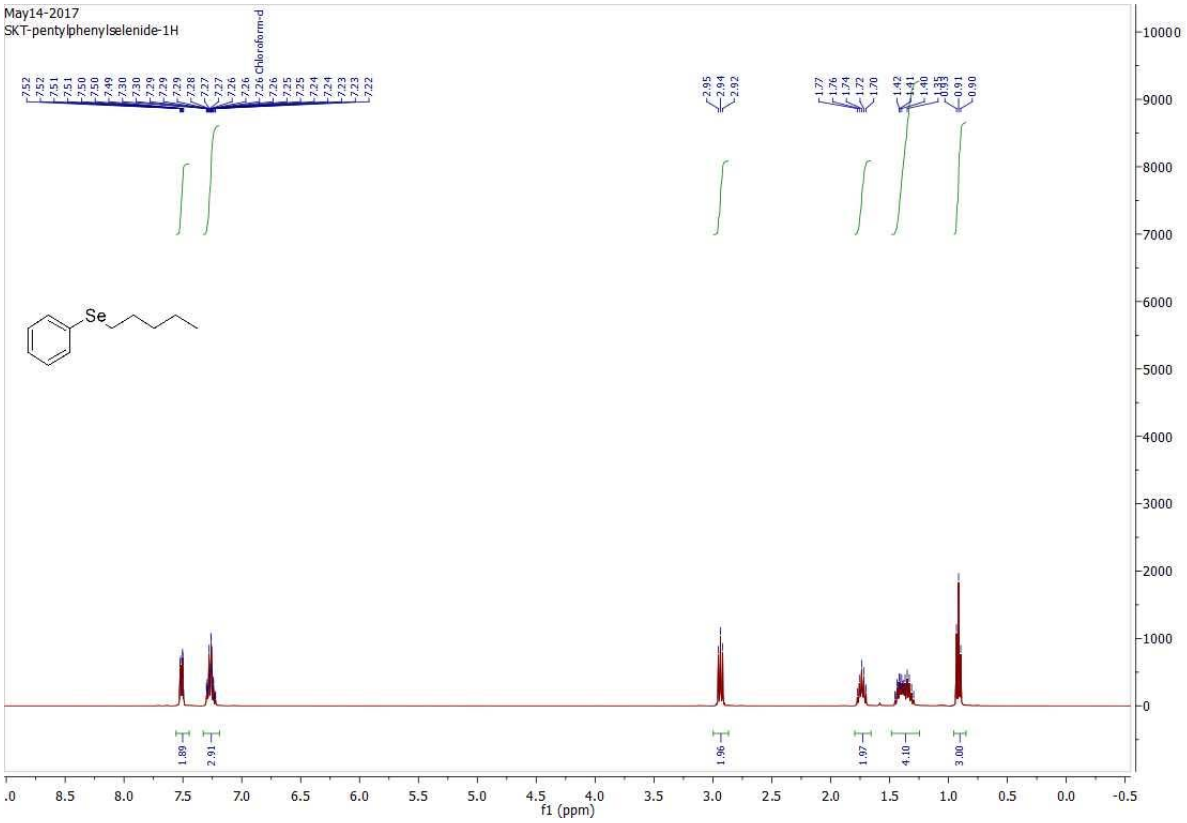


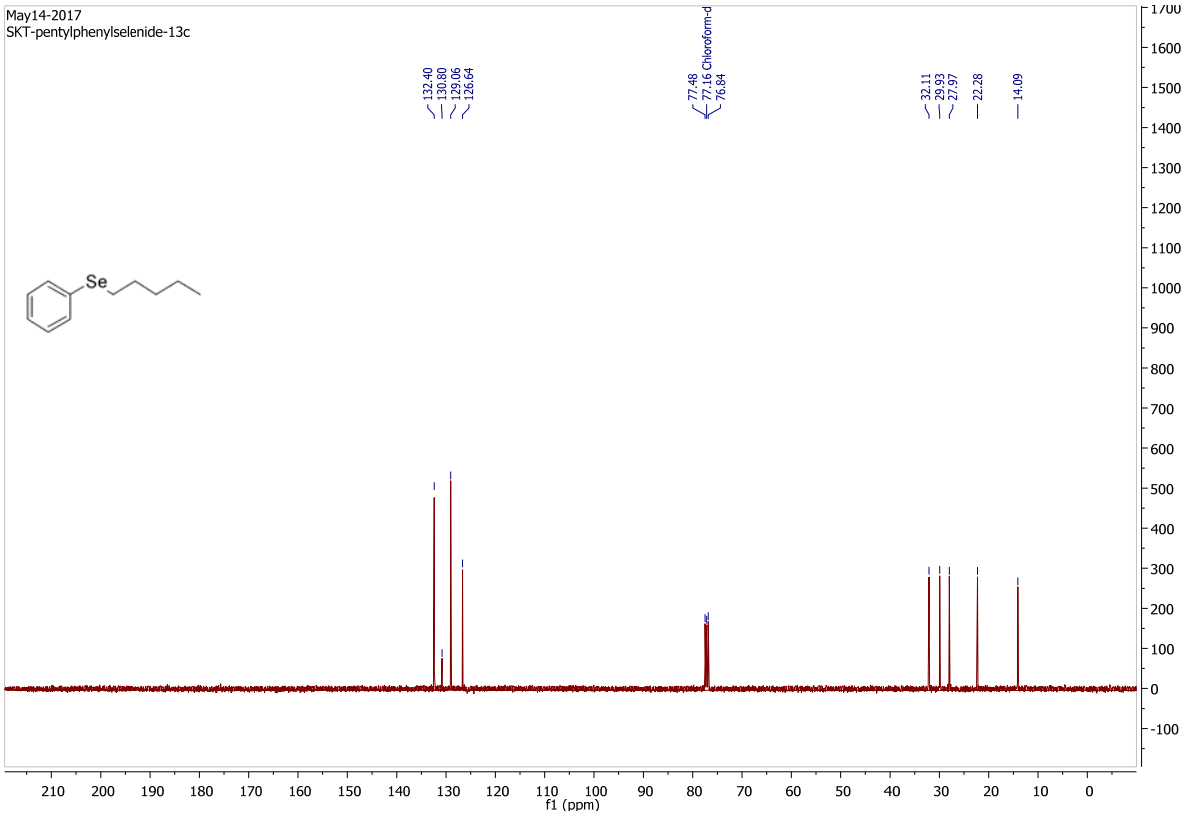
^{1}H and ^{13}C spectra of Se-phenyl 4-bromobenzoselenoate (1f)



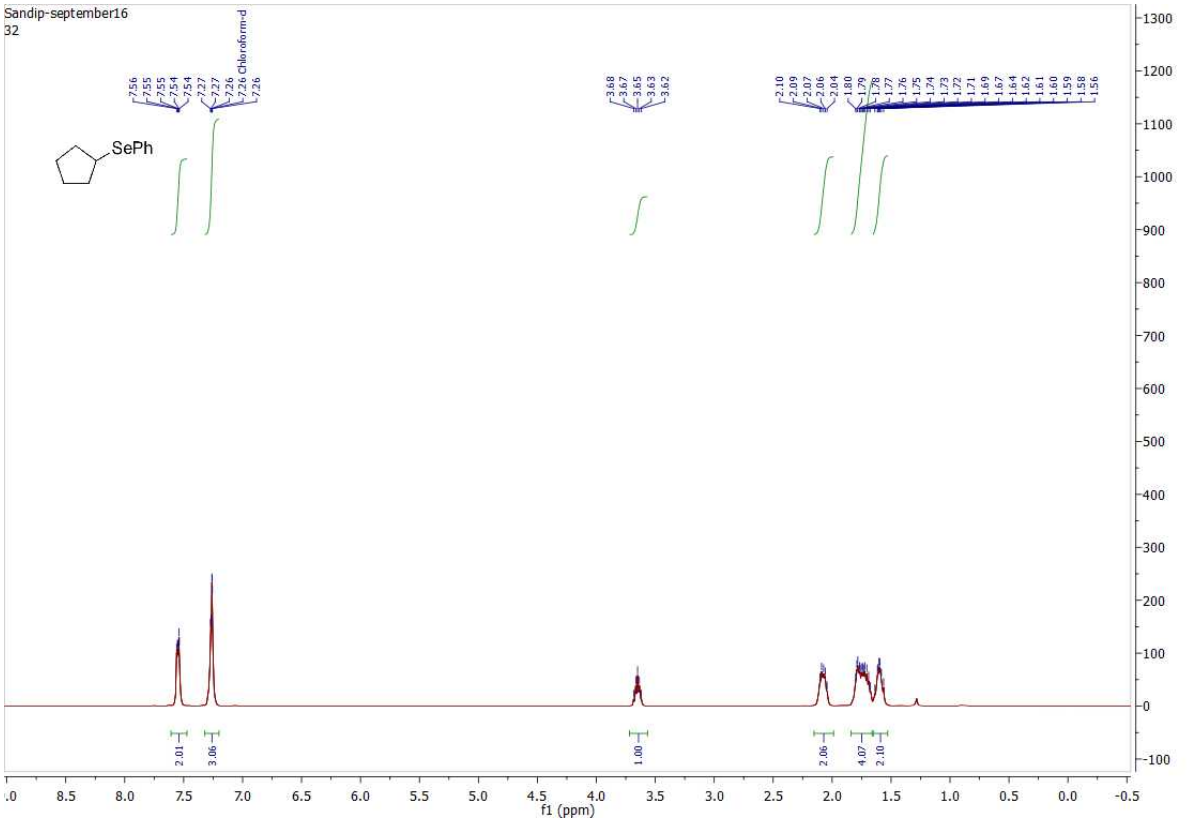


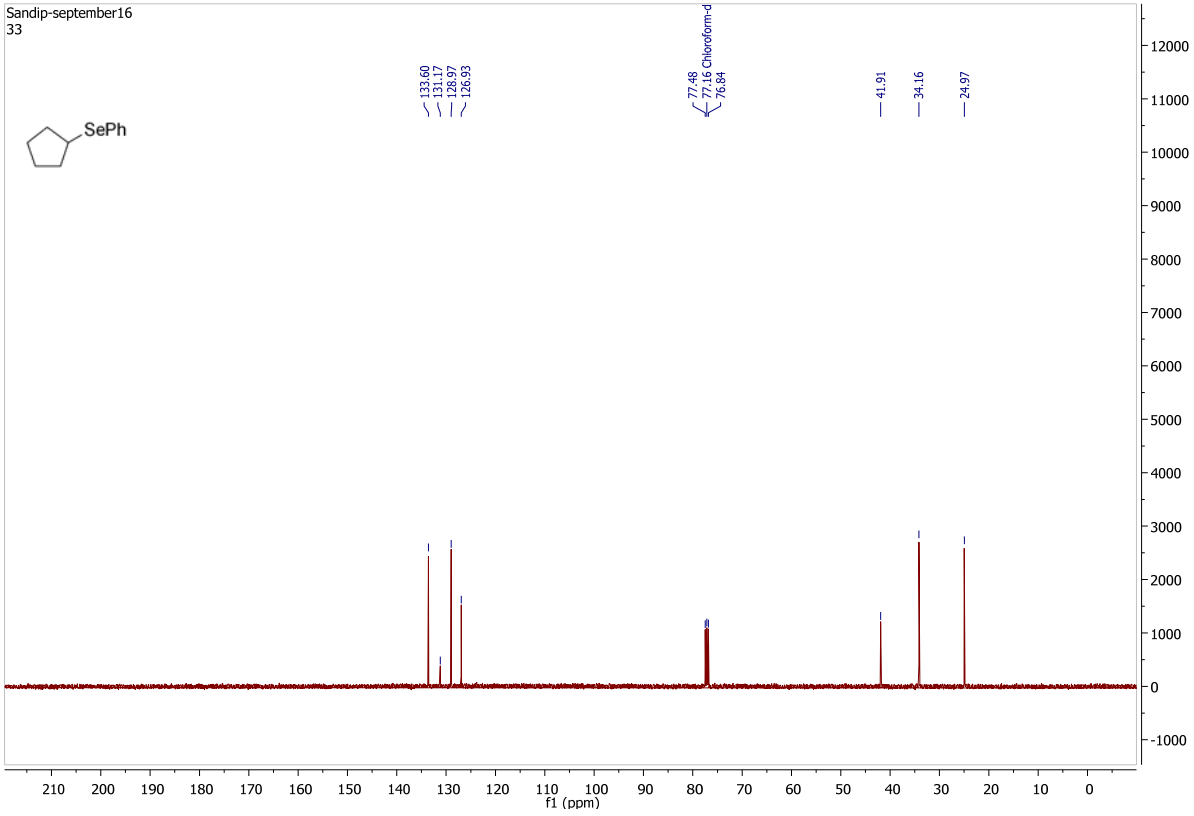
^{1}H and ^{13}C spectra of Pentyl(phenyl)selane (4a)



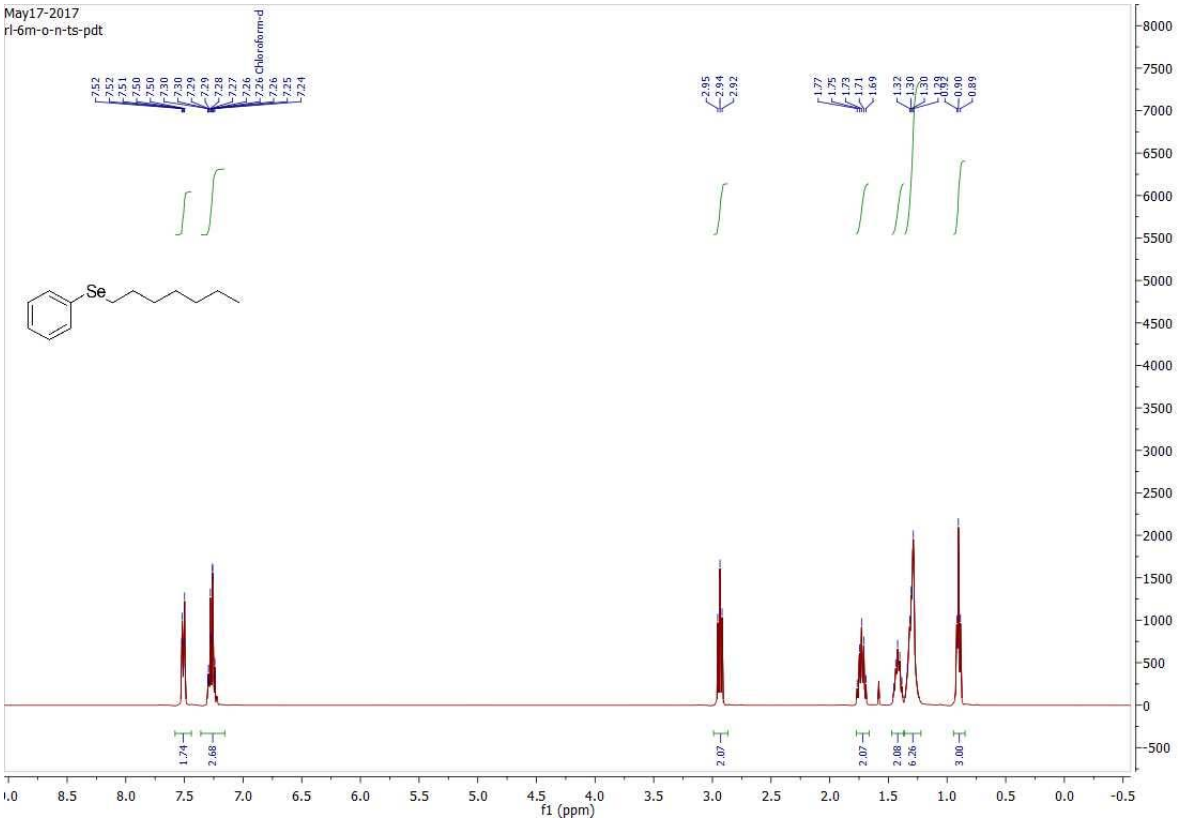


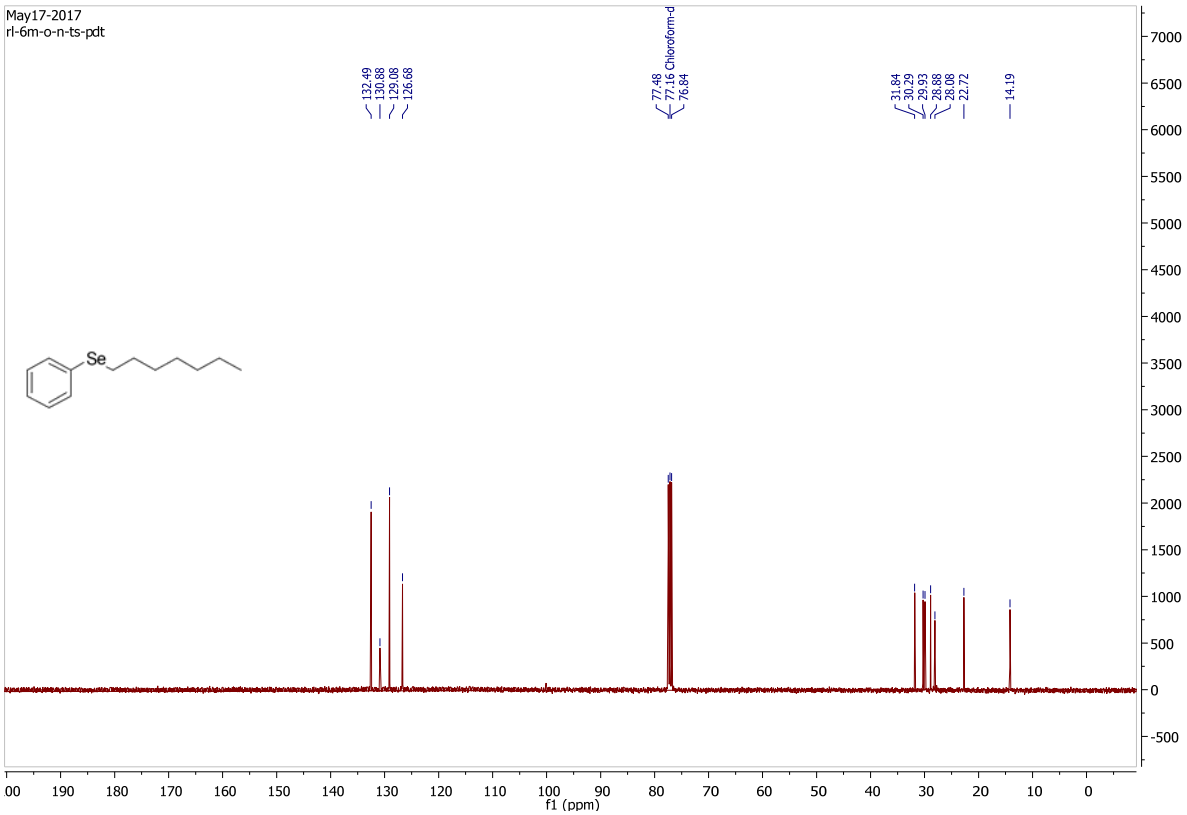
^{1}H and ^{13}C spectra of cyclopentyl(phenyl)selane (4b)



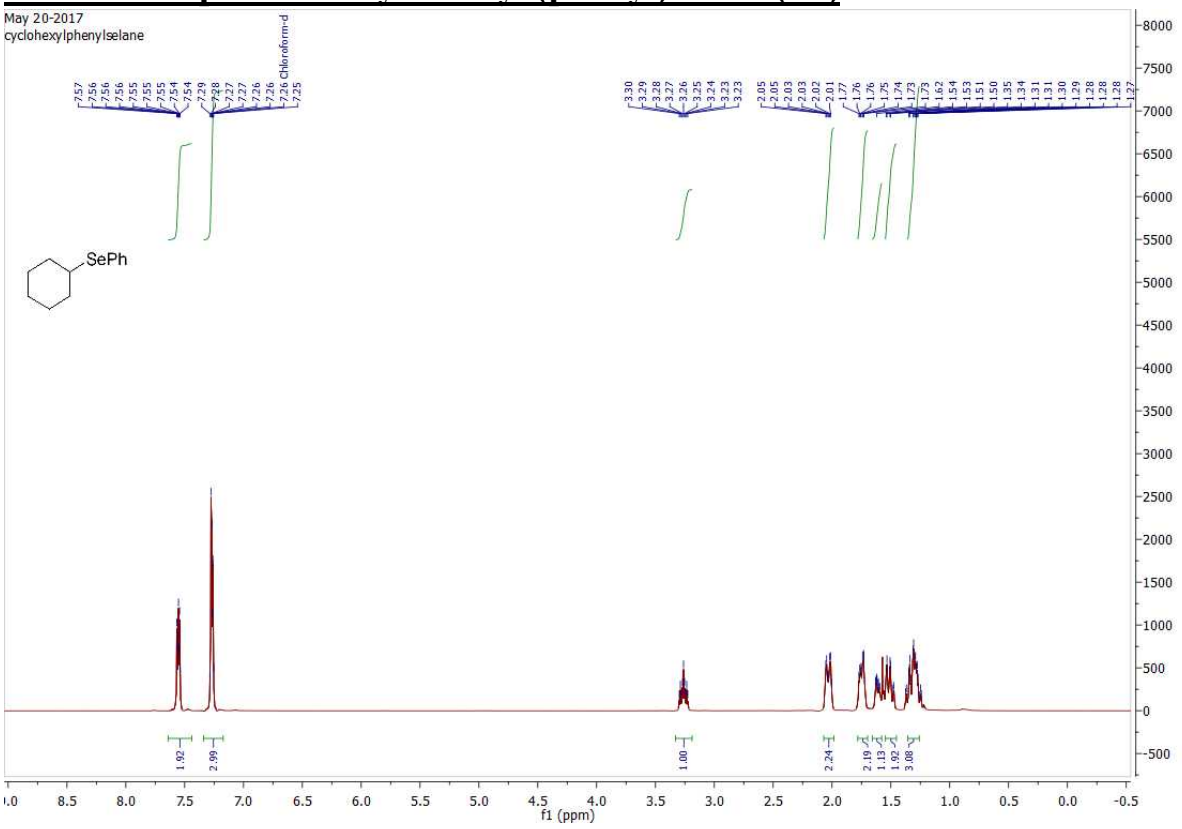


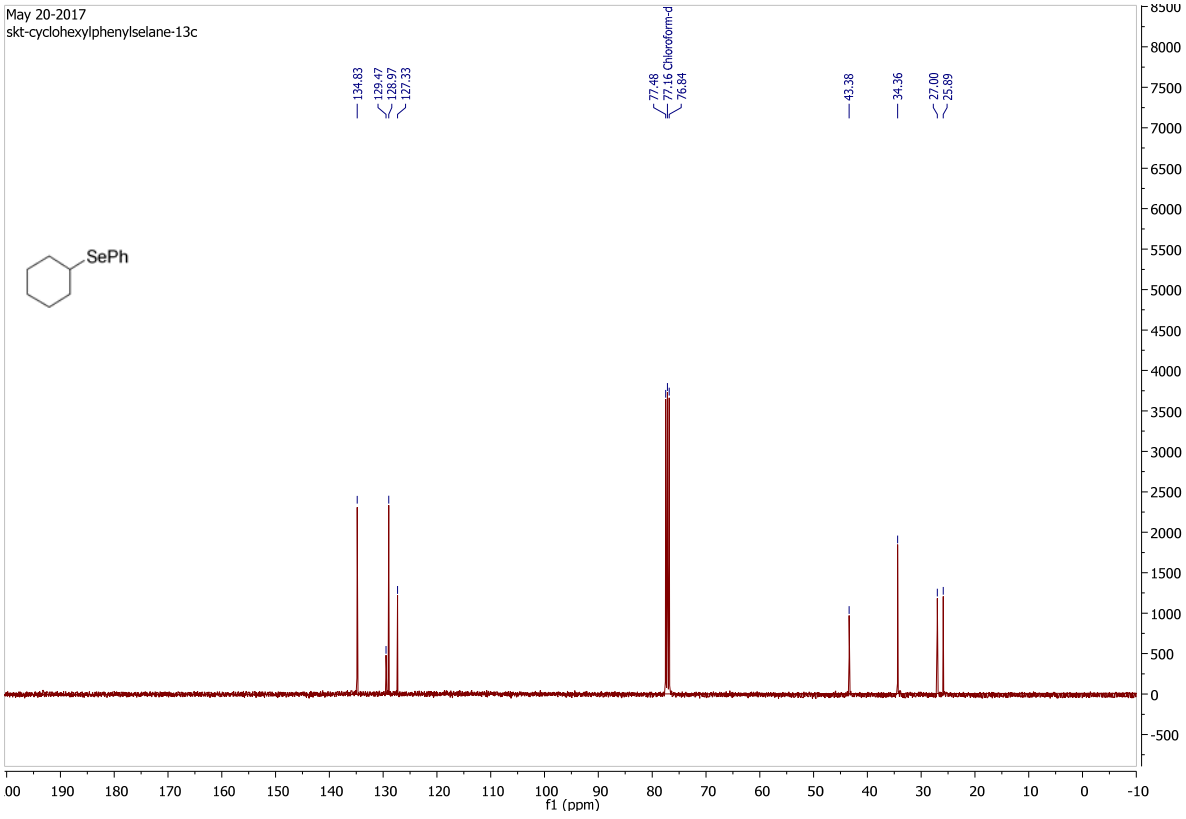
^{1}H and ^{13}C spectra of Heptyl(phenyl)selane (4c)





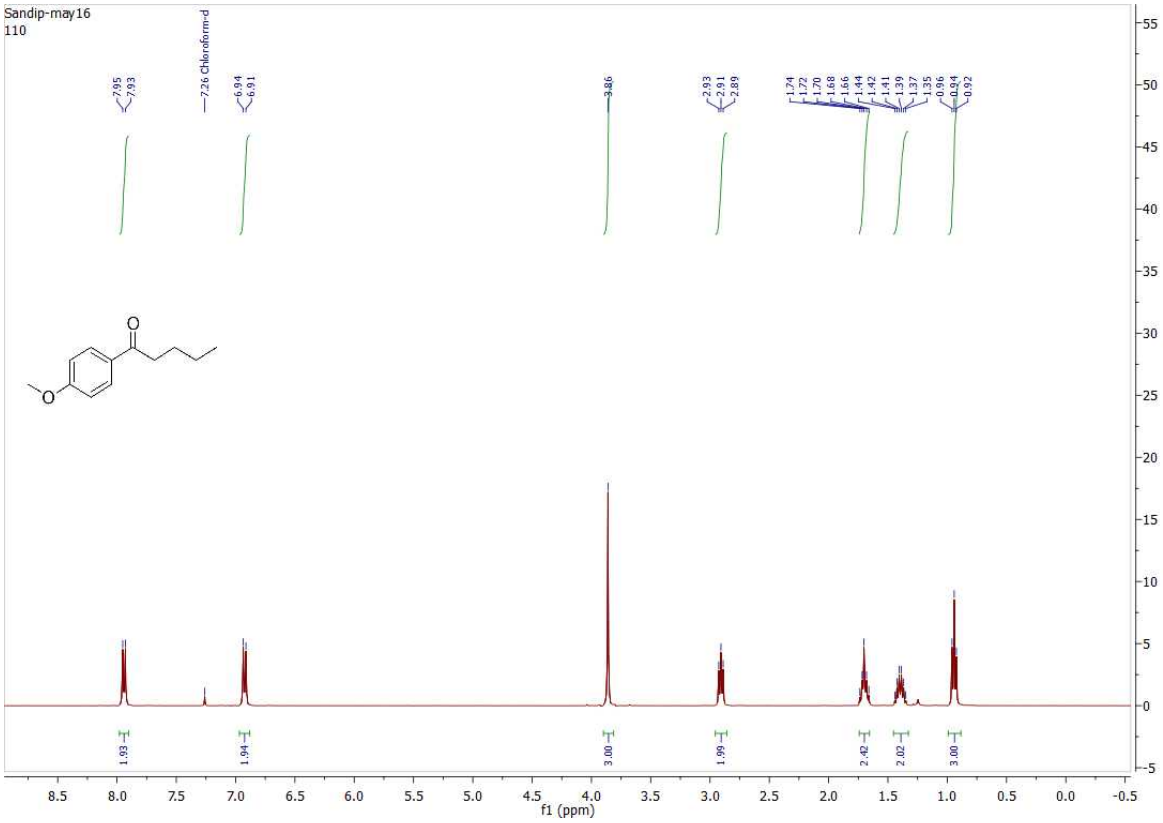
^{1}H and ^{13}C spectra of Cyclohexyl (phenyl)selane (4d)

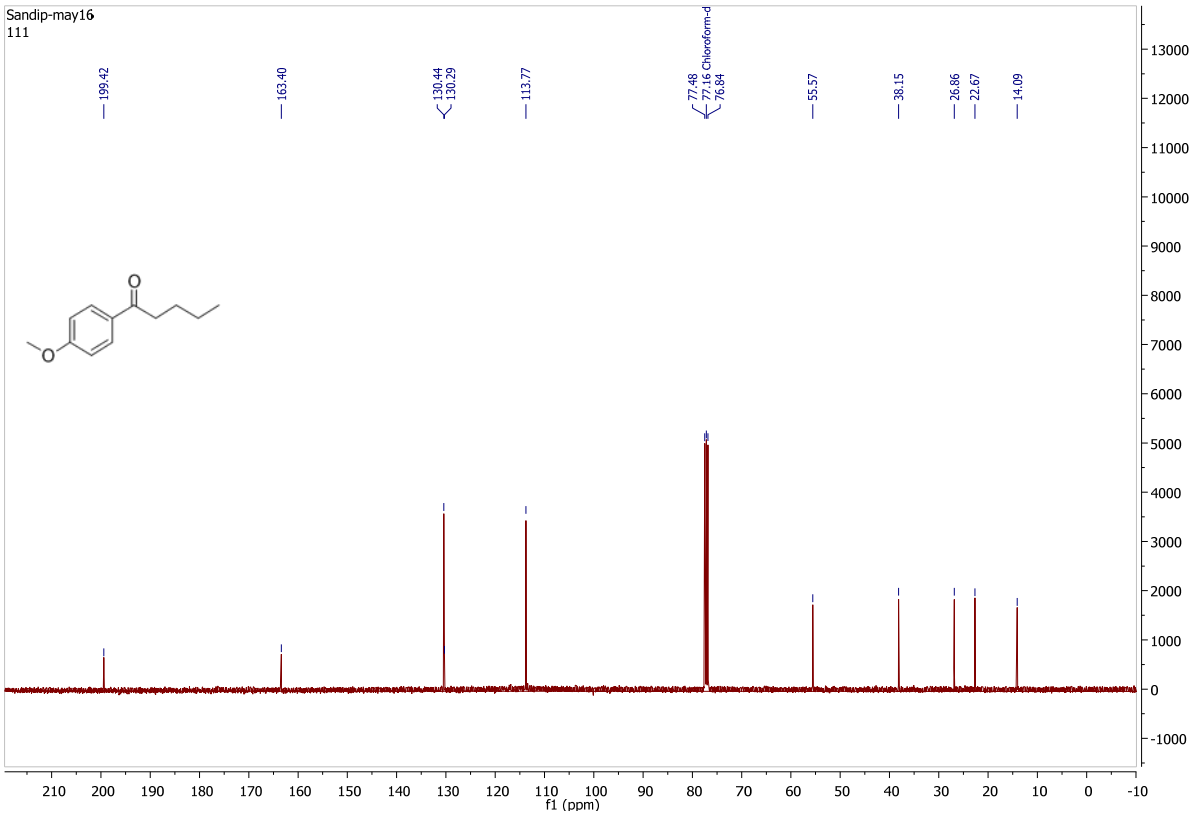




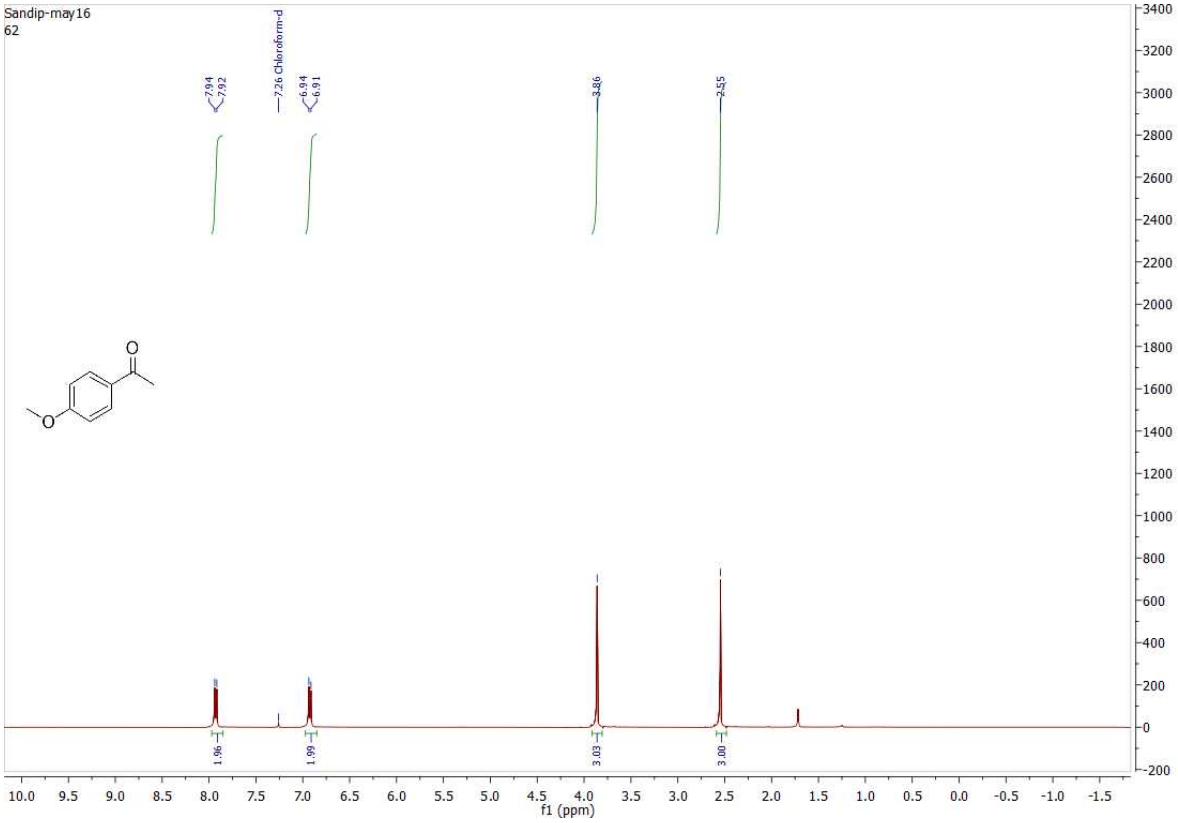
^{1}H and ^{13}C spectra of Products

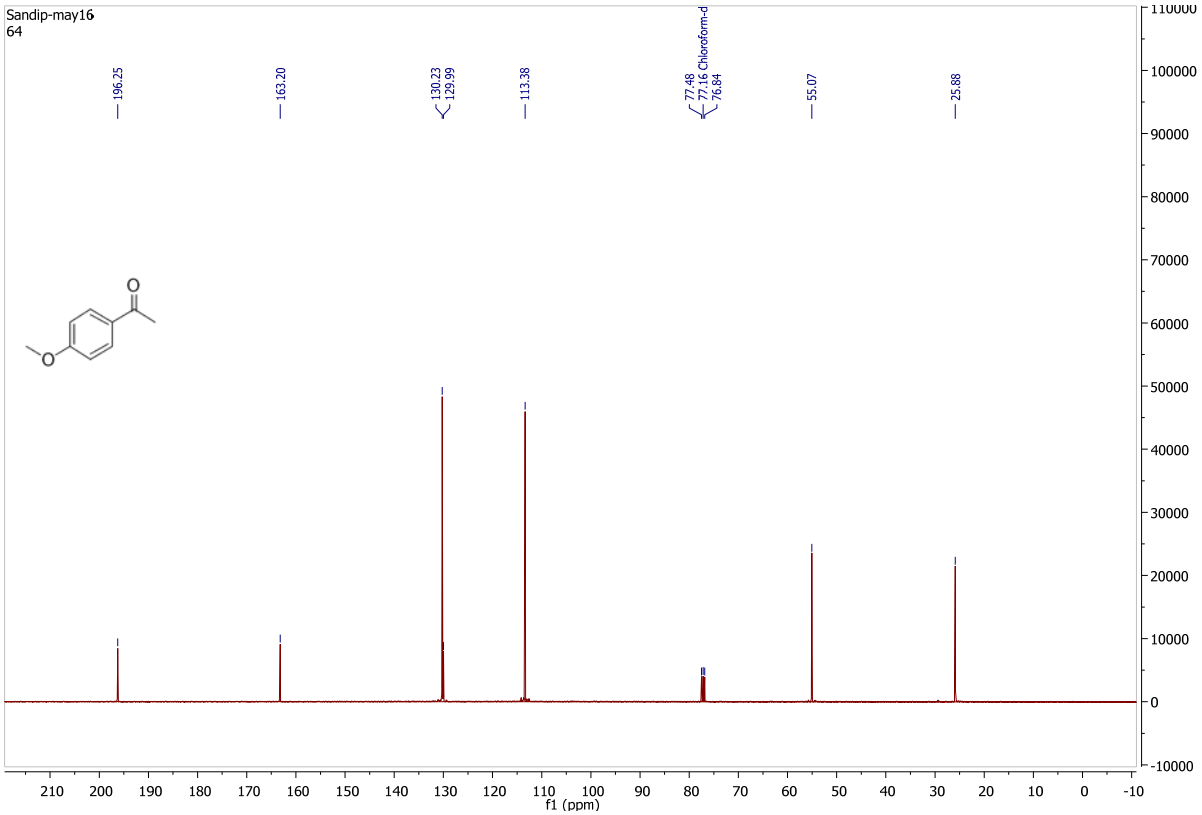
^{1}H and ^{13}C spectra of 1-(4-Methoxyphenyl)pentan-1-one (3b)



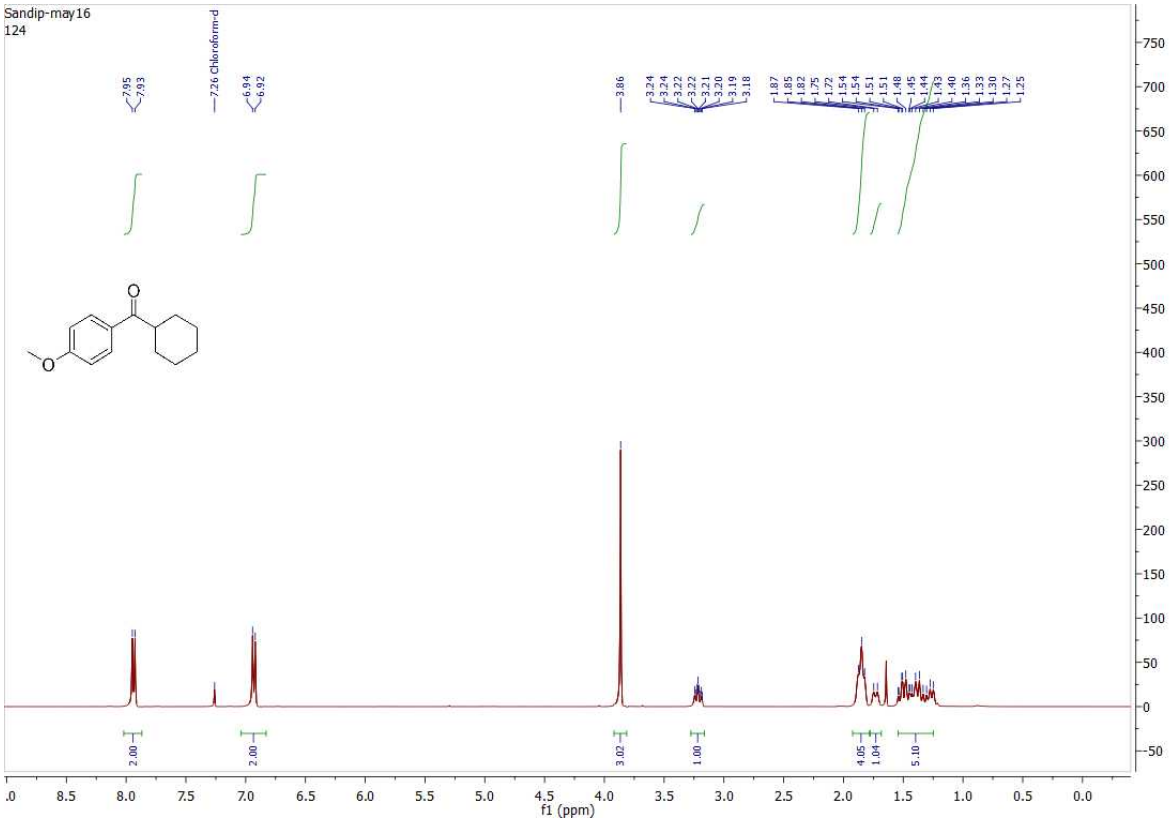


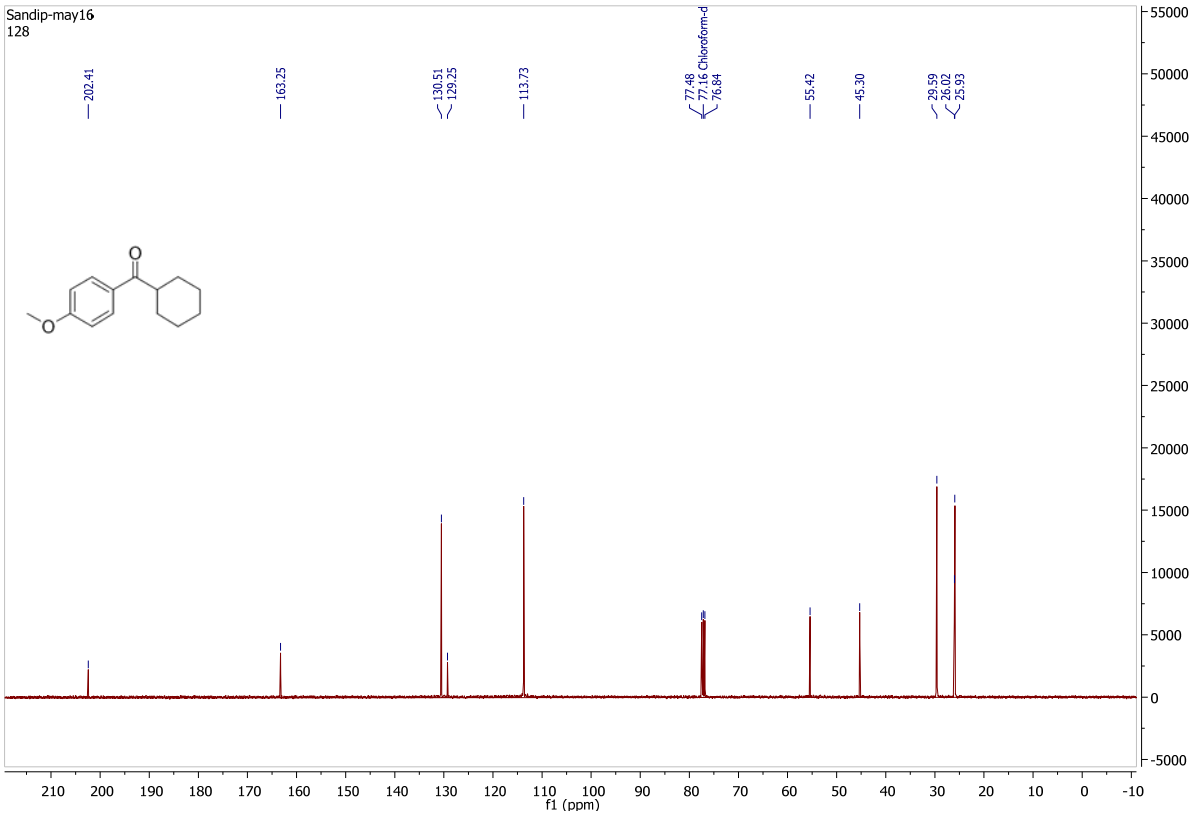
^{1}H and ^{13}C spectra of 1-(4-Methoxyphenyl)ethan-1-one (3n)



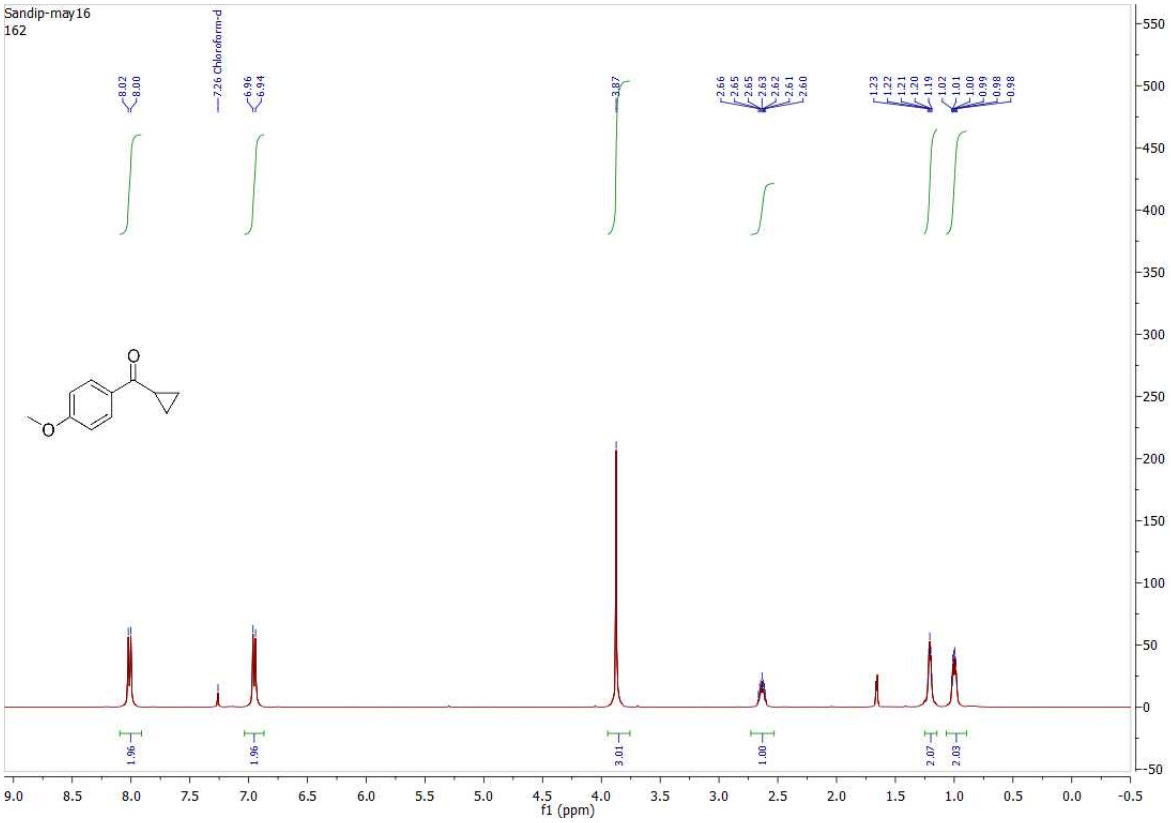


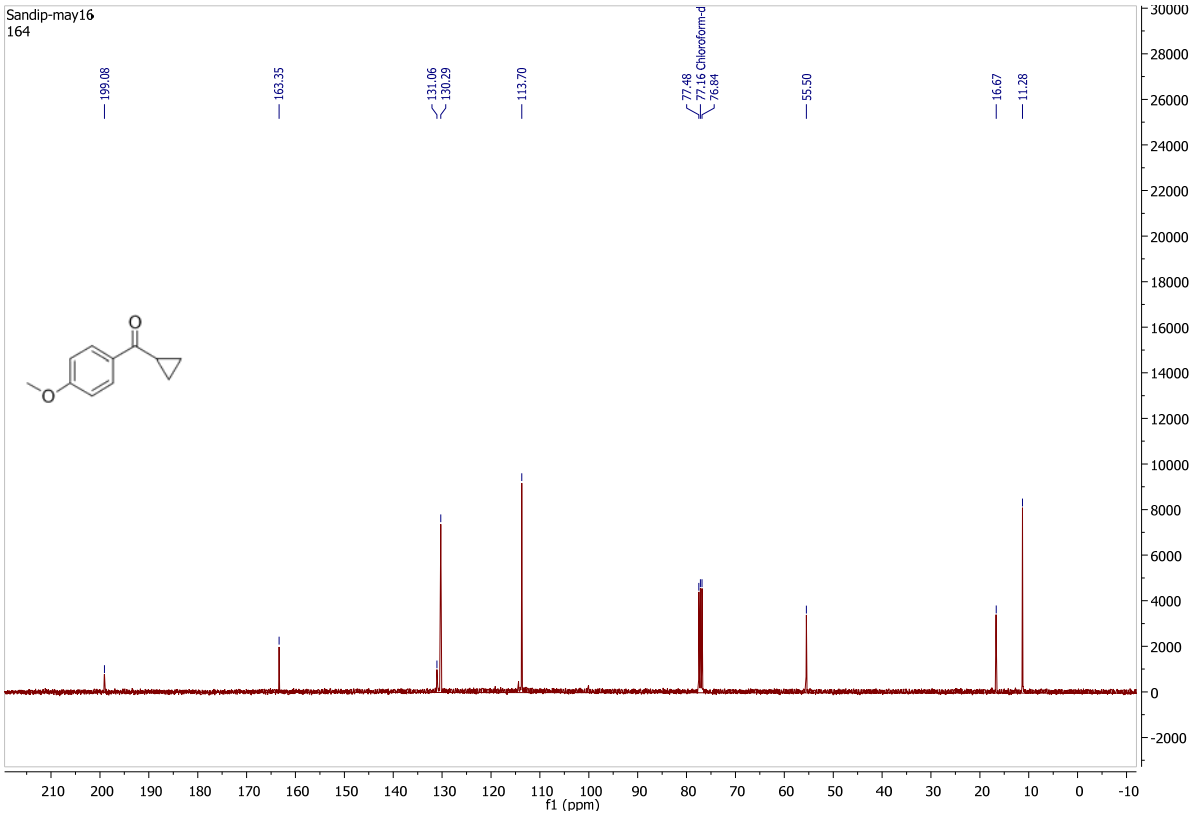
^{1}H and ^{13}C spectra of Cyclohexyl(4-methoxyphenyl)methanone (3y)



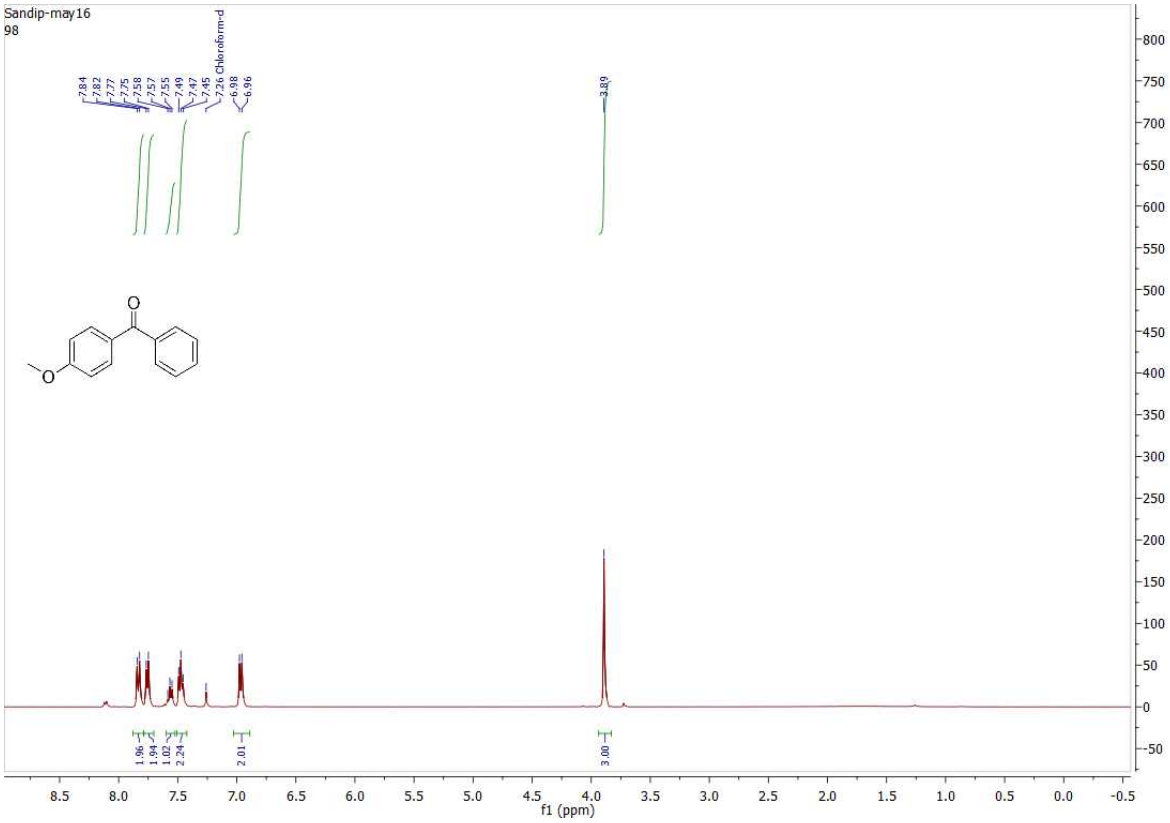


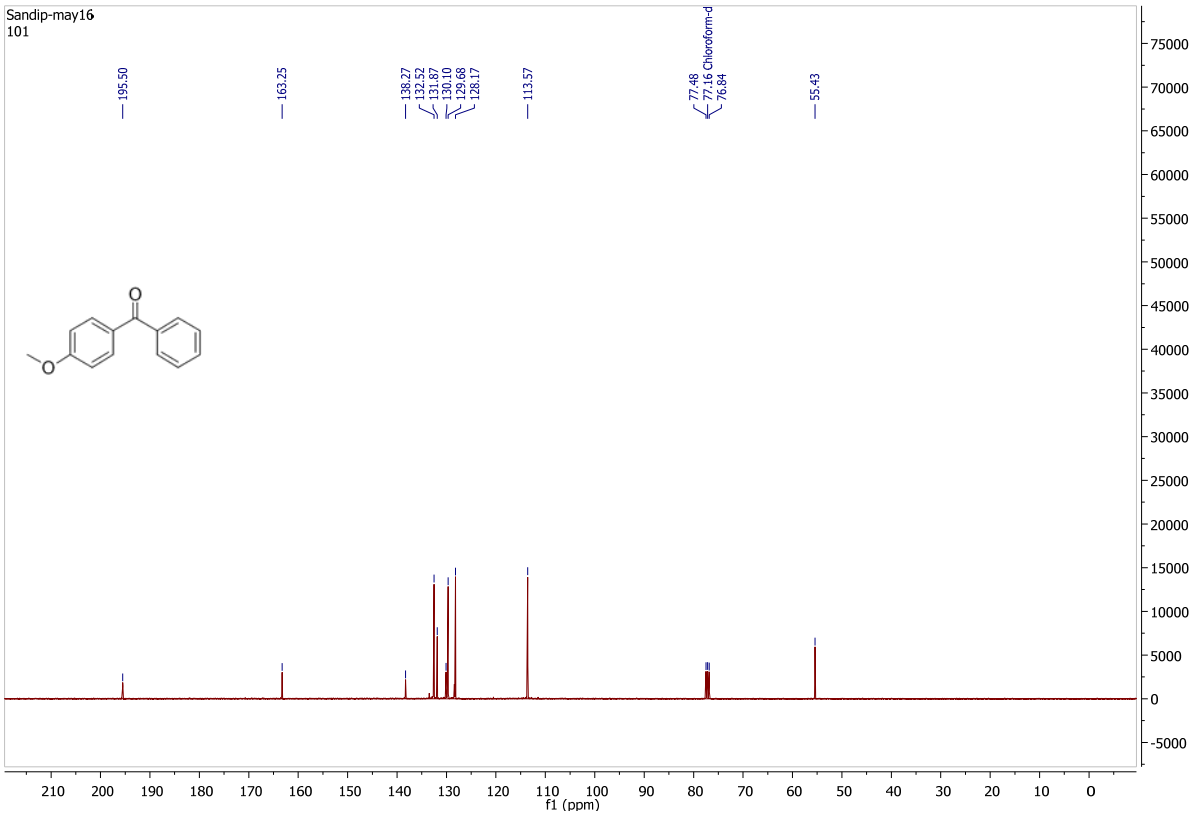
^{1}H and ^{13}C spectra of Cyclopropyl(4-methoxyphenyl)methanone (3aj)



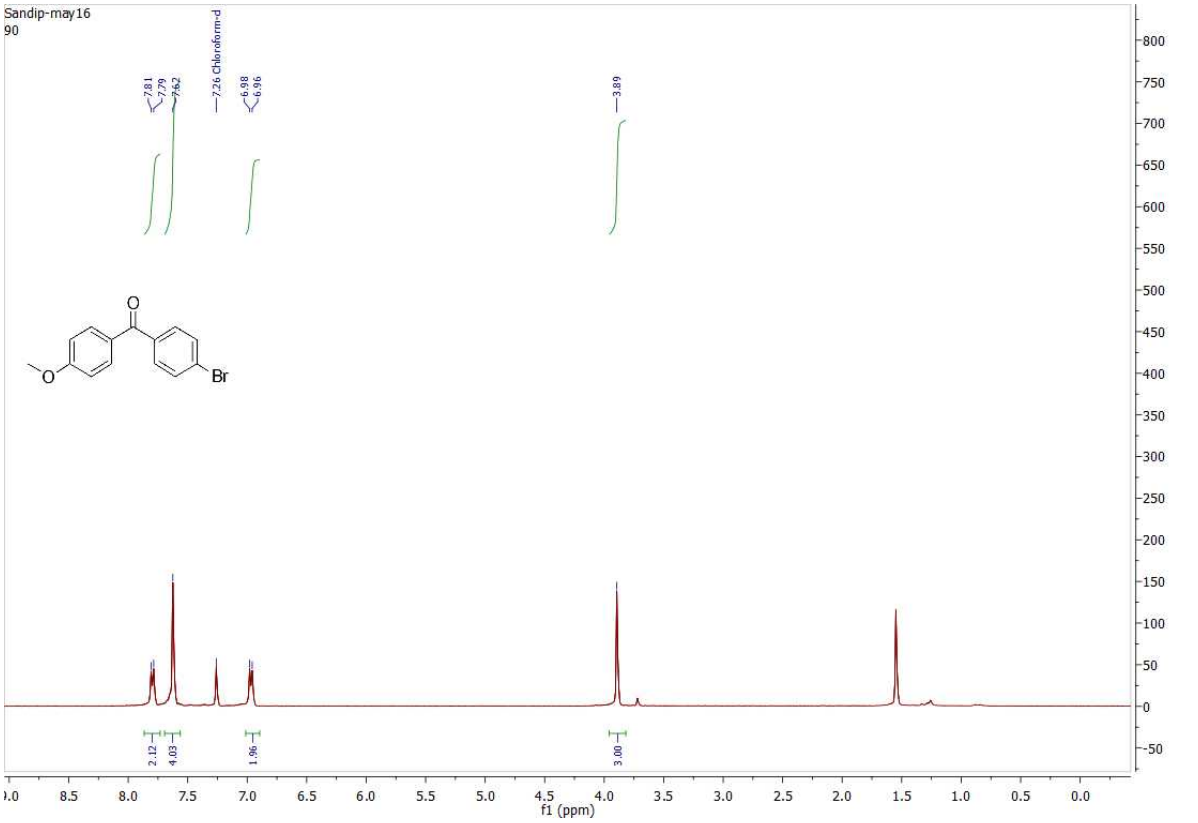


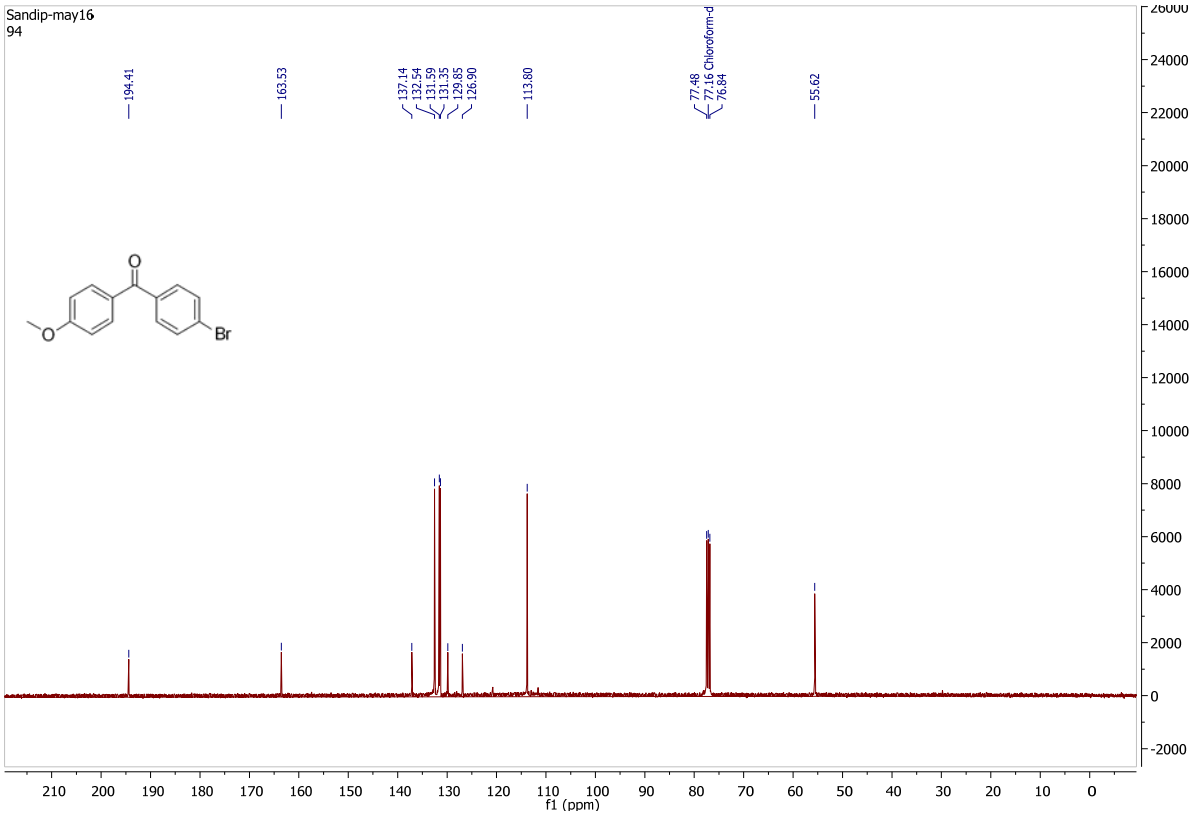
^{1}H and ^{13}C spectra of (4-Methoxyphenyl)(phenyl)methanone (3au)



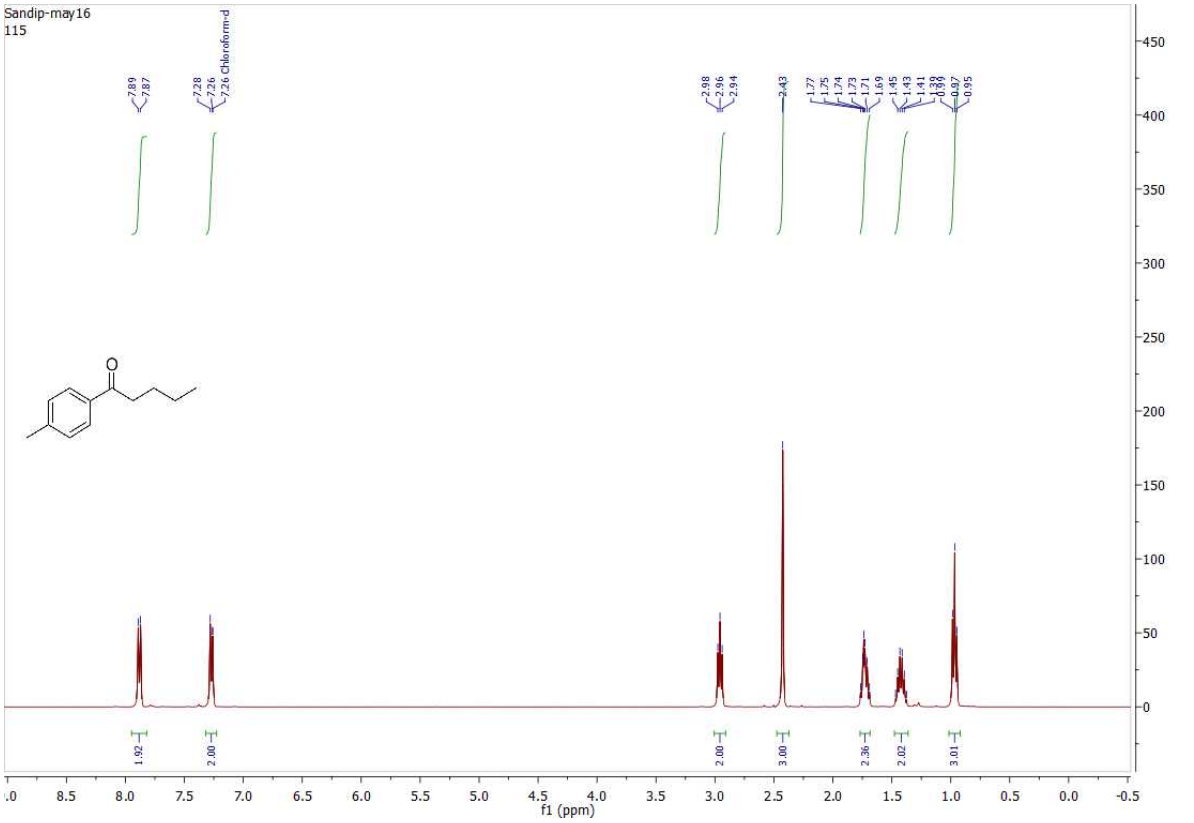


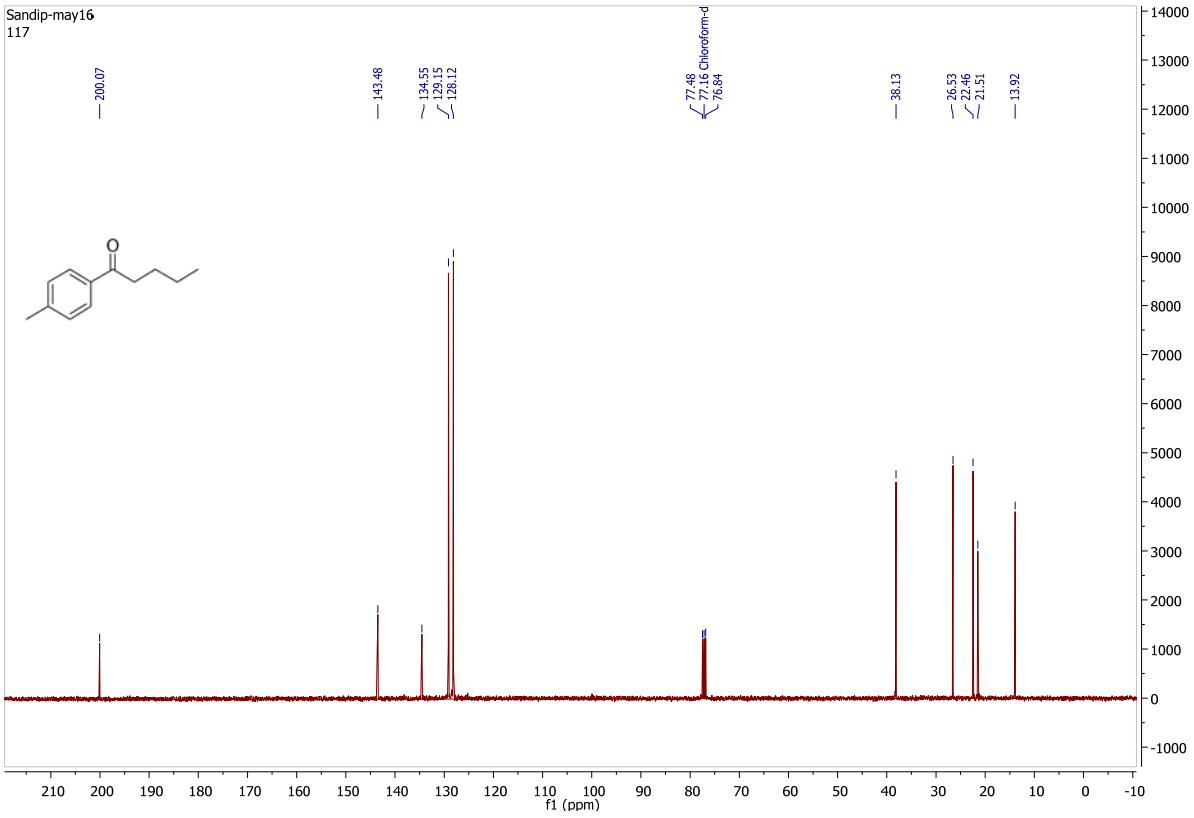
^{1}H and ^{13}C spectra of (4-Bromophenyl)(4-methoxyphenyl)methanone (3af')



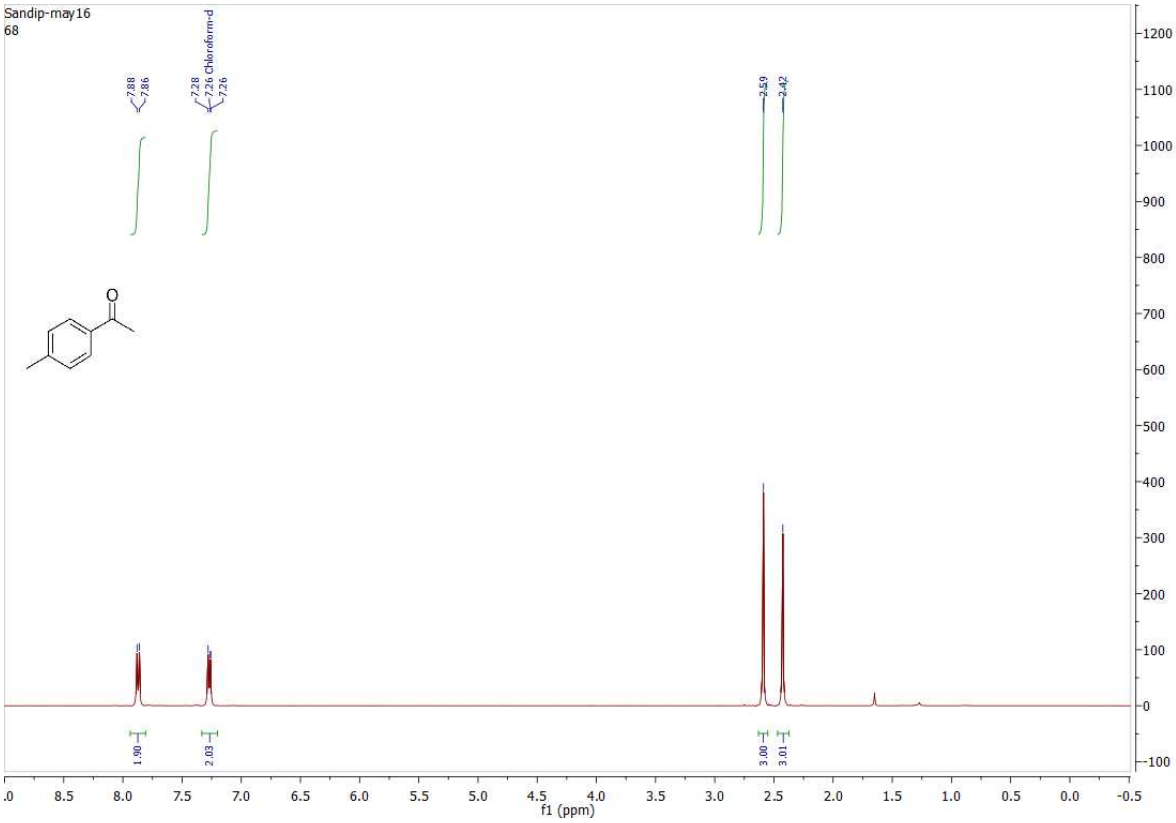


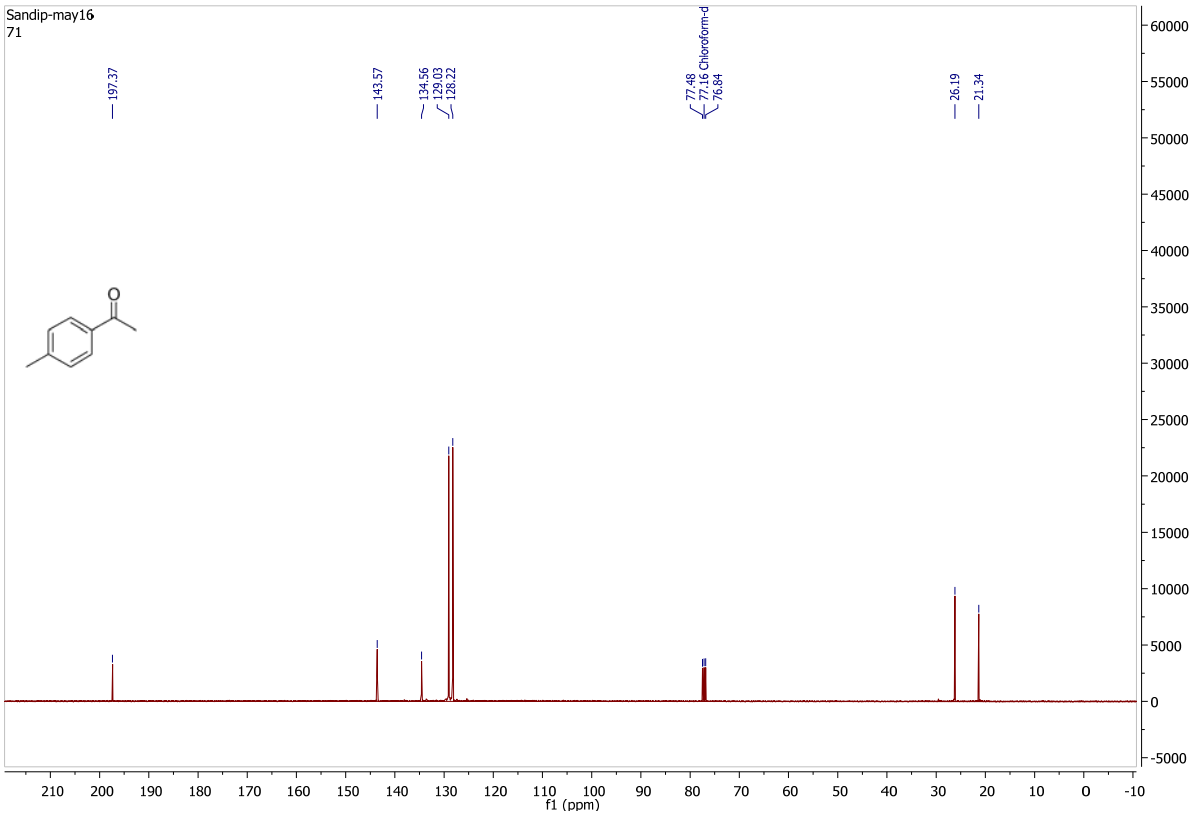
^{1}H and ^{13}C spectra of 1-(p-Tolyl)pentan-1-one (3c)



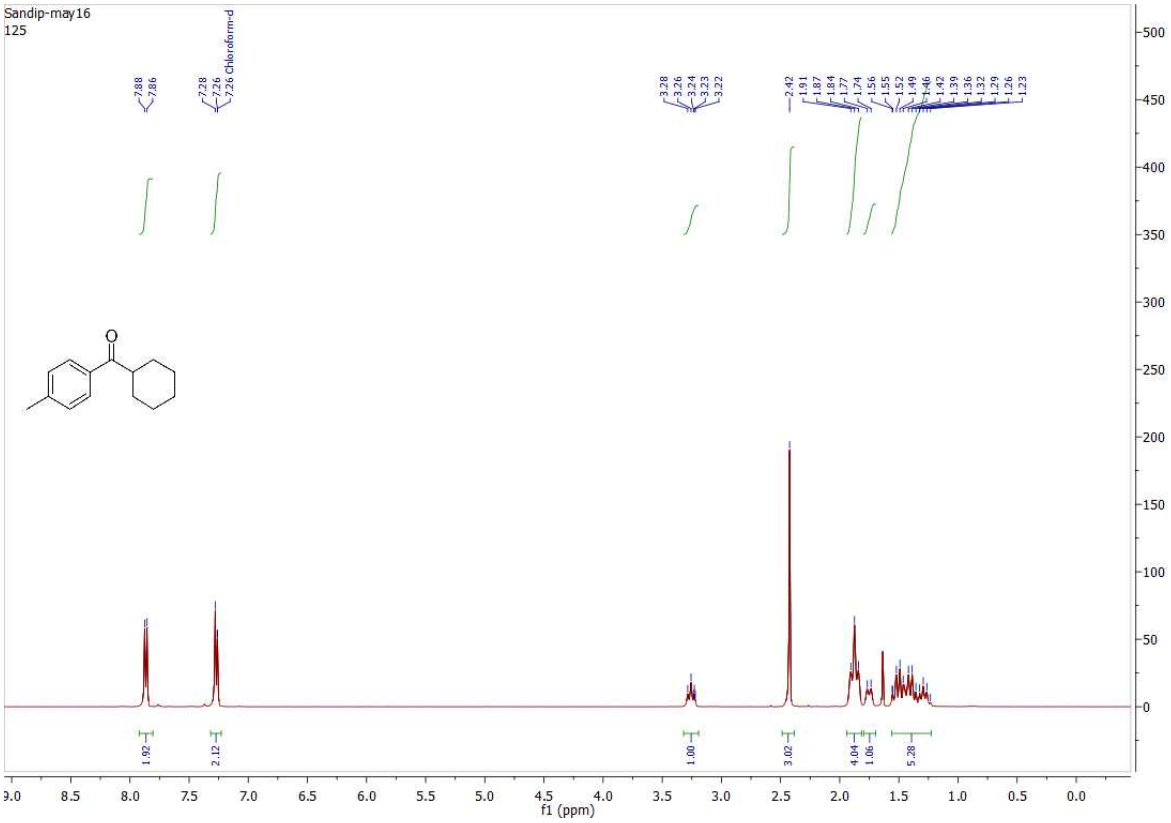


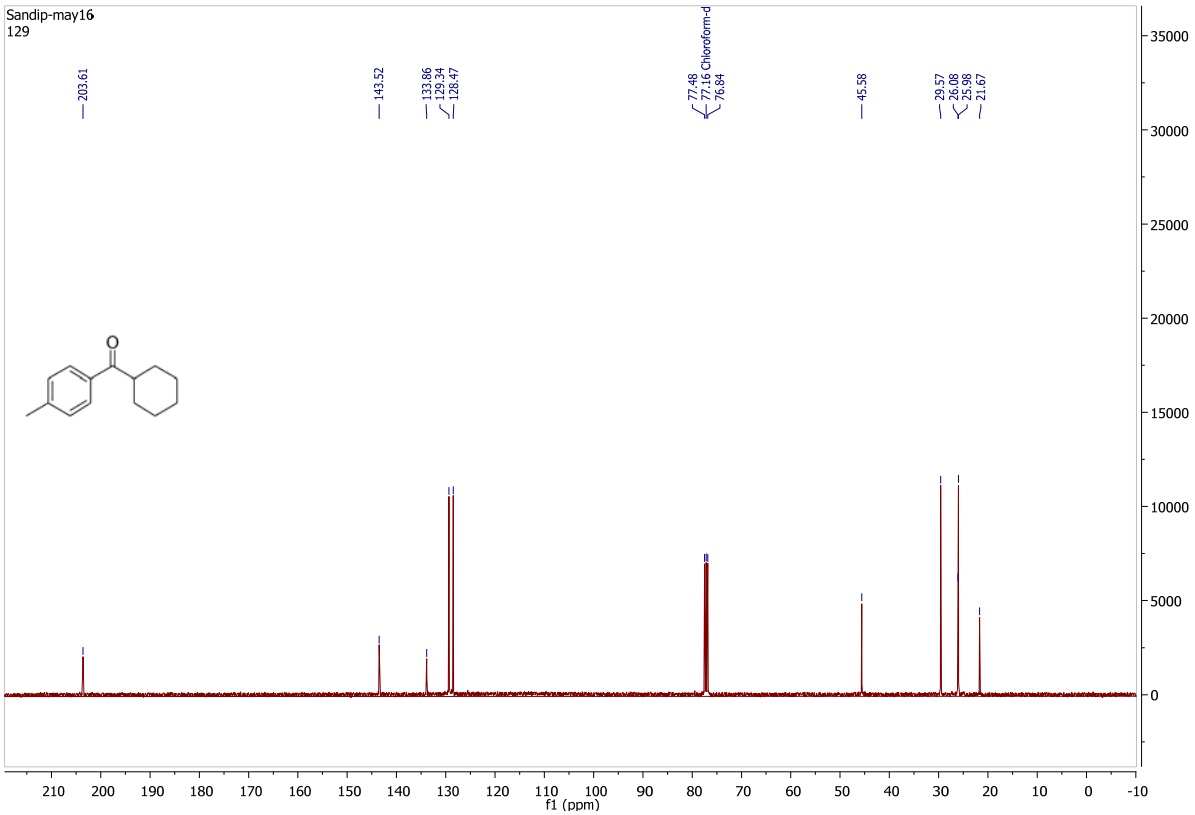
^{1}H and ^{13}C spectra of 1-(p-Tolyl)ethan-1-one (3o)



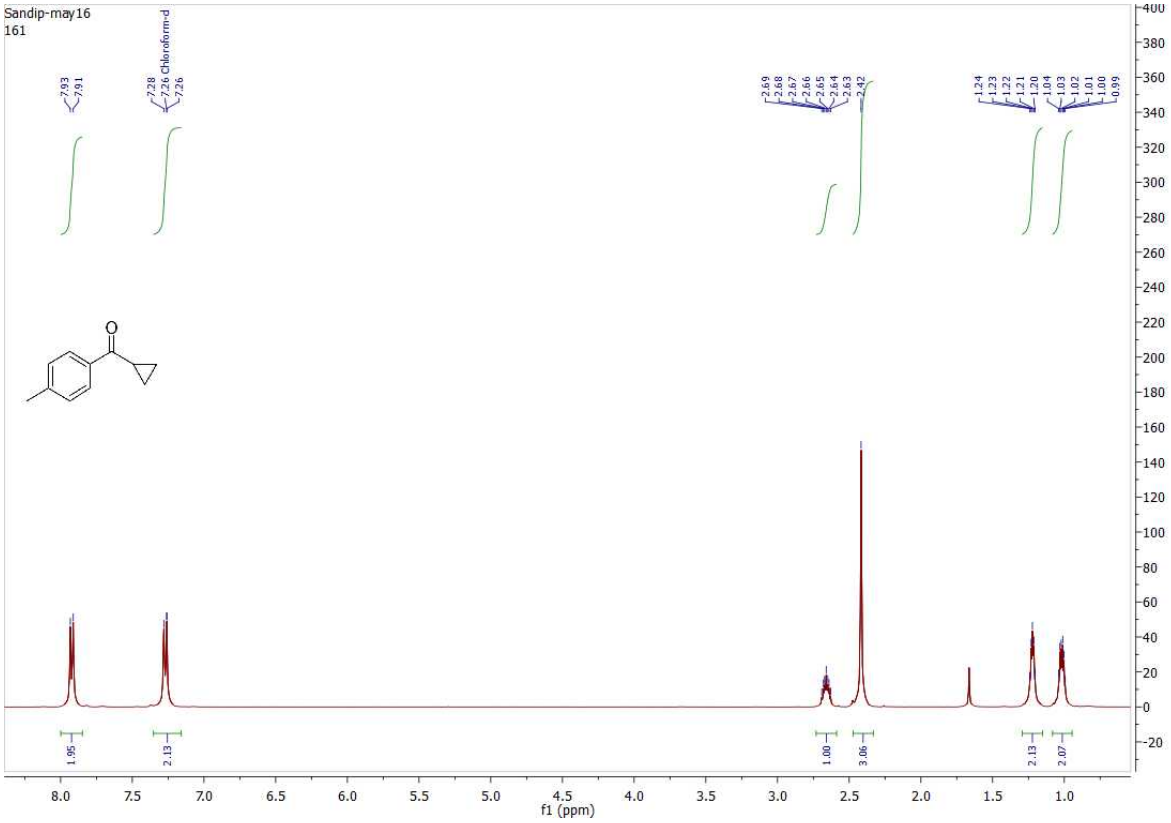


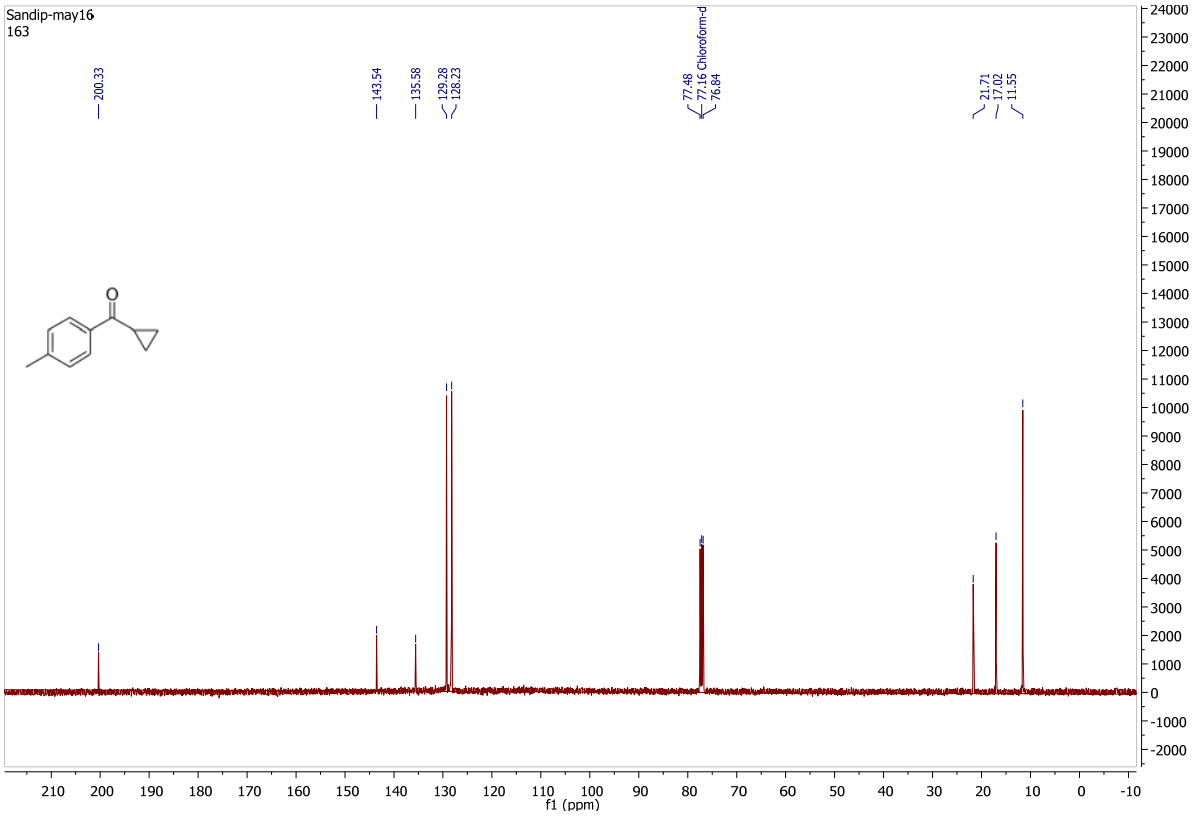
^{1}H and ^{13}C spectra of Cyclohexyl(p-tolyl)methanone (3z)



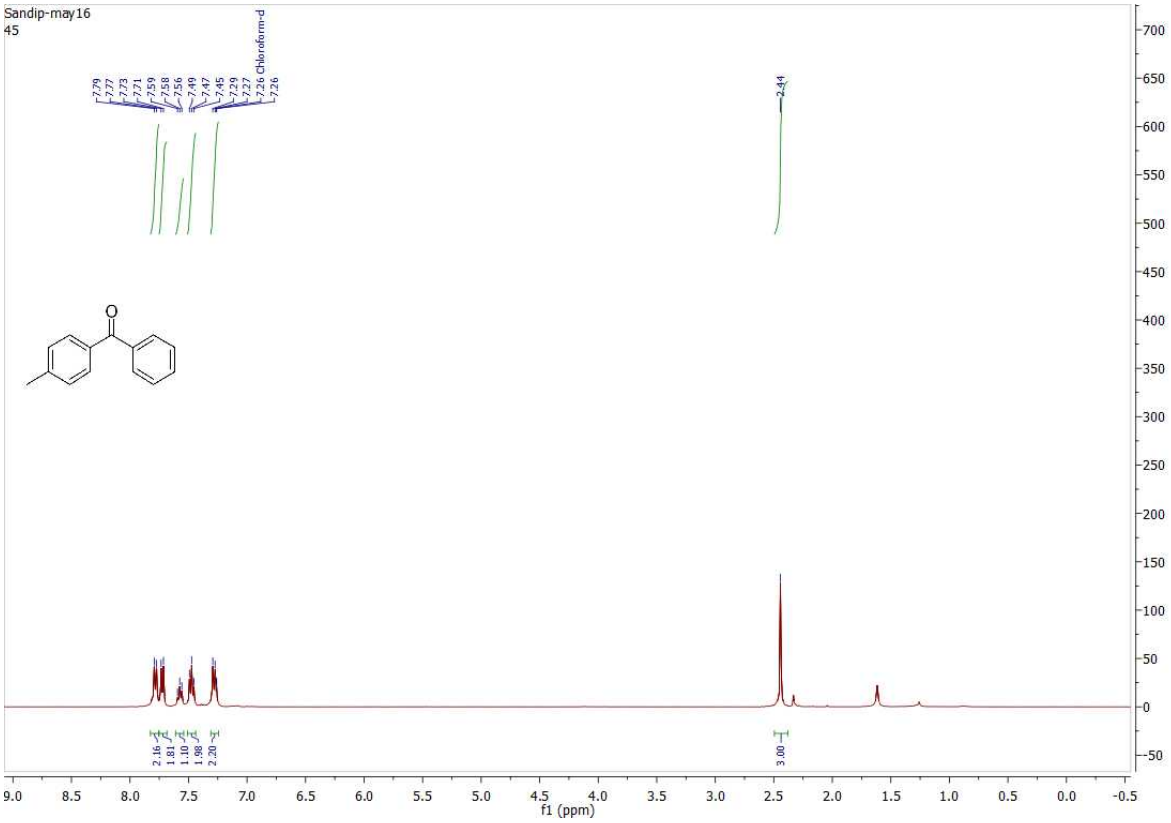


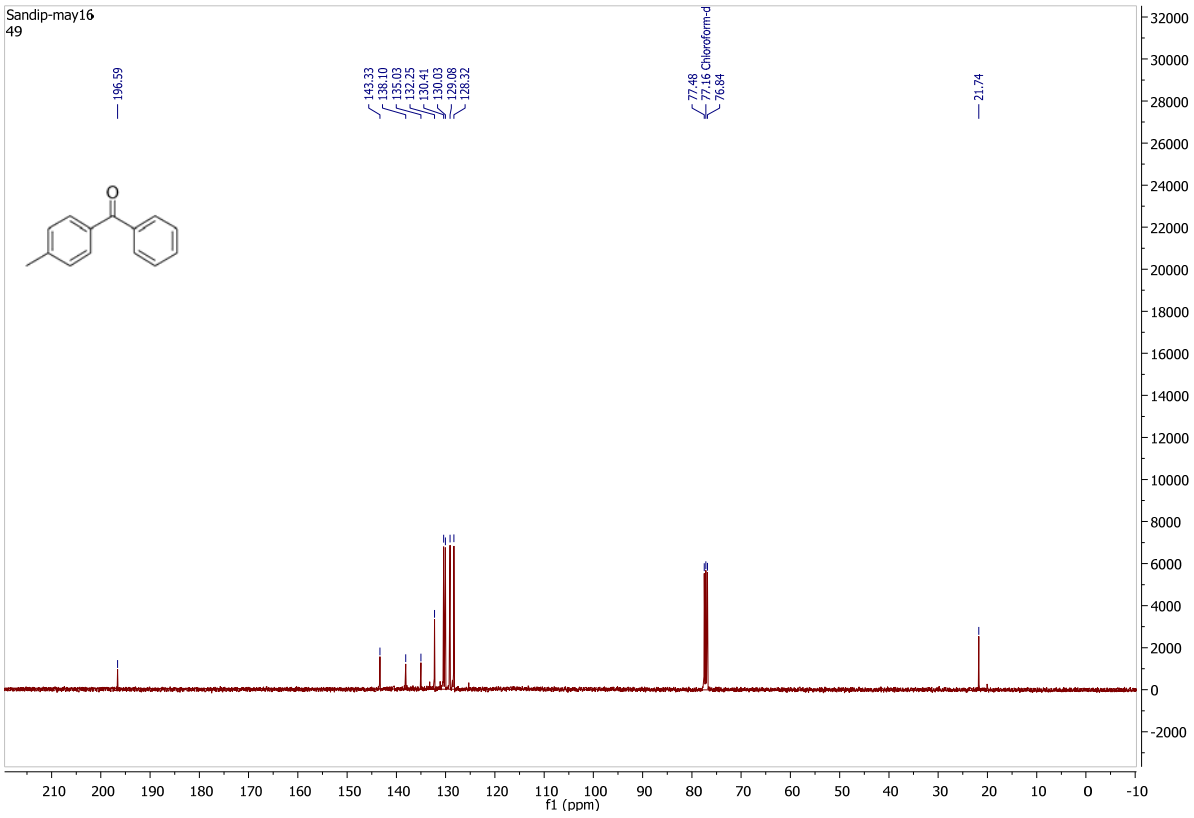
^{1}H and ^{13}C spectra of Cyclopropyl(p-tolyl)methanone (3ak)



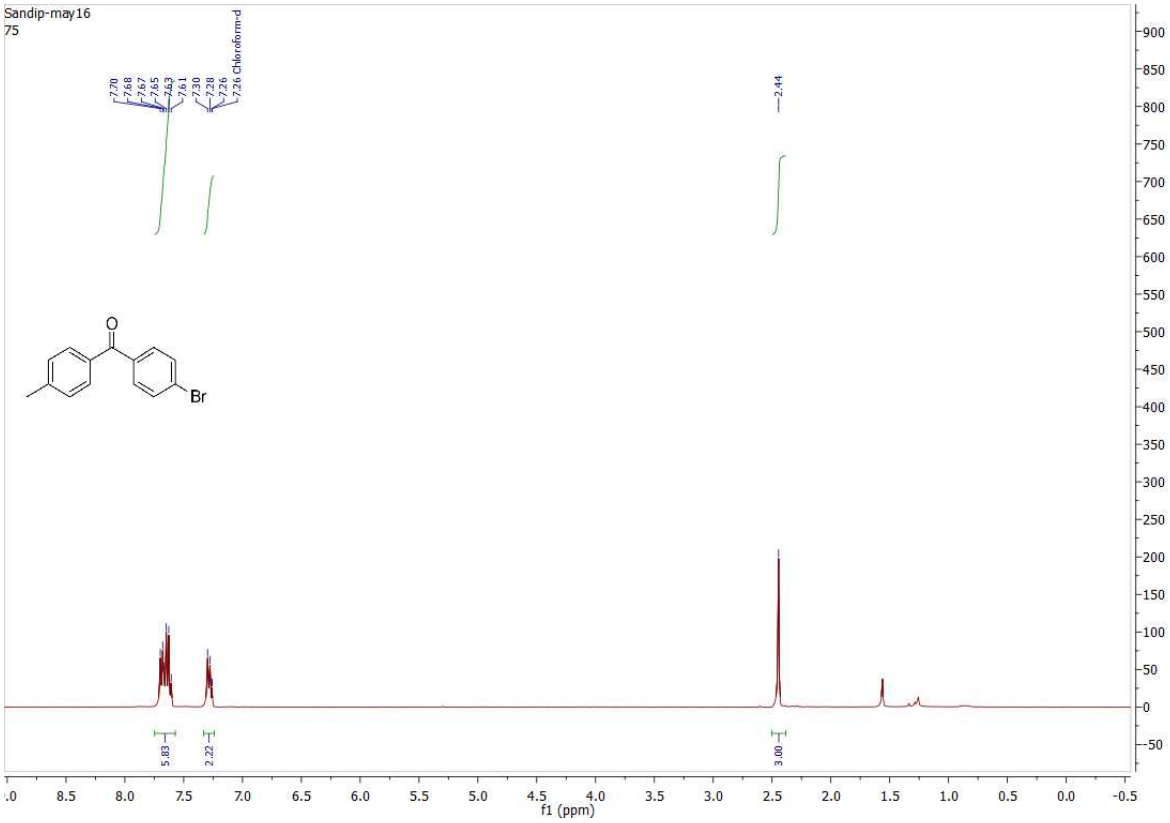


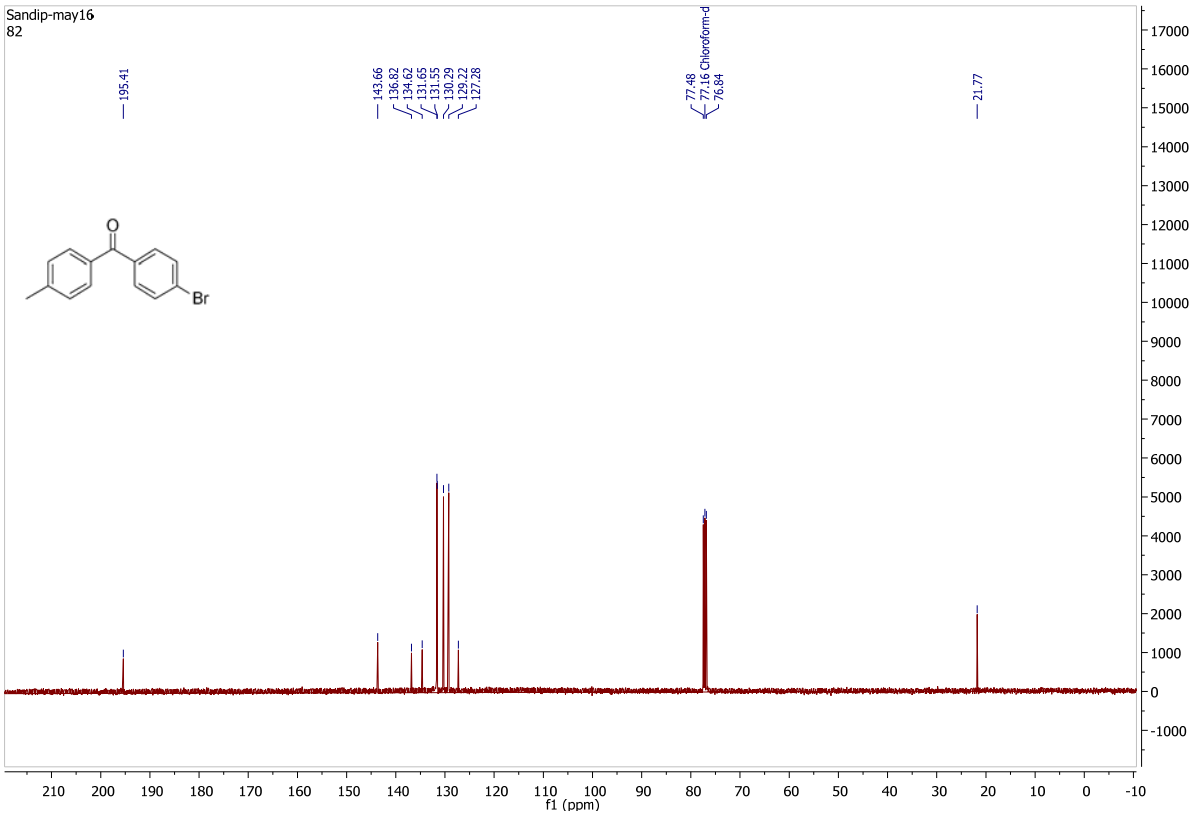
^{1}H and ^{13}C spectra of Phenyl(p-tolyl)methanone (3av)



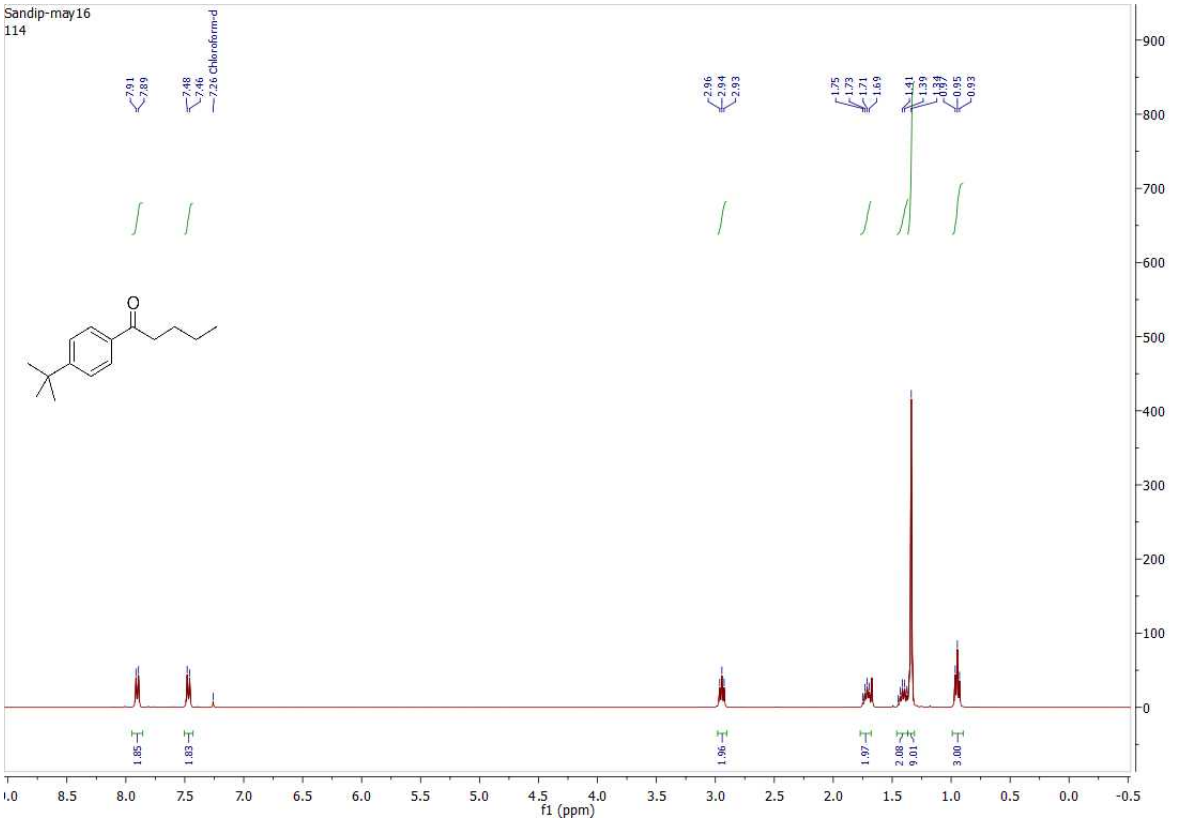


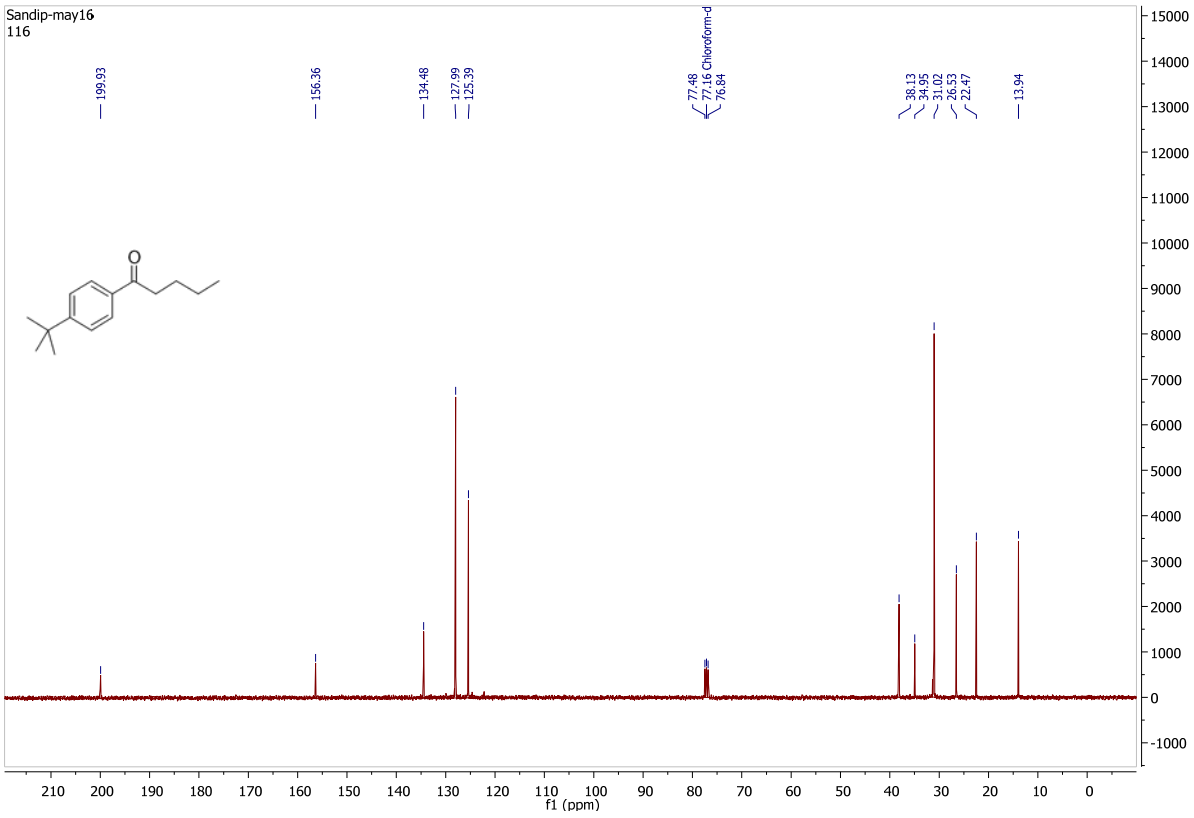
^{1}H and ^{13}C spectra of (4-Bromophenyl)(p-tolyl)methanone (3ag')



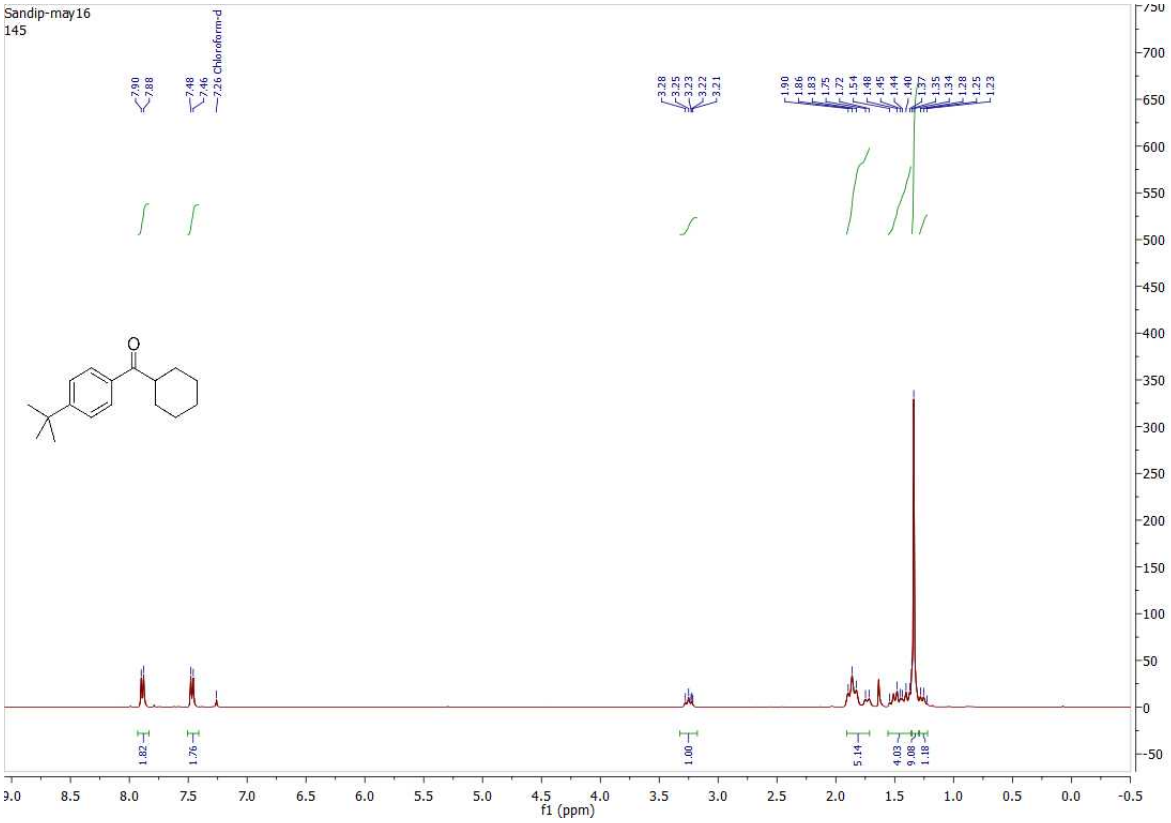


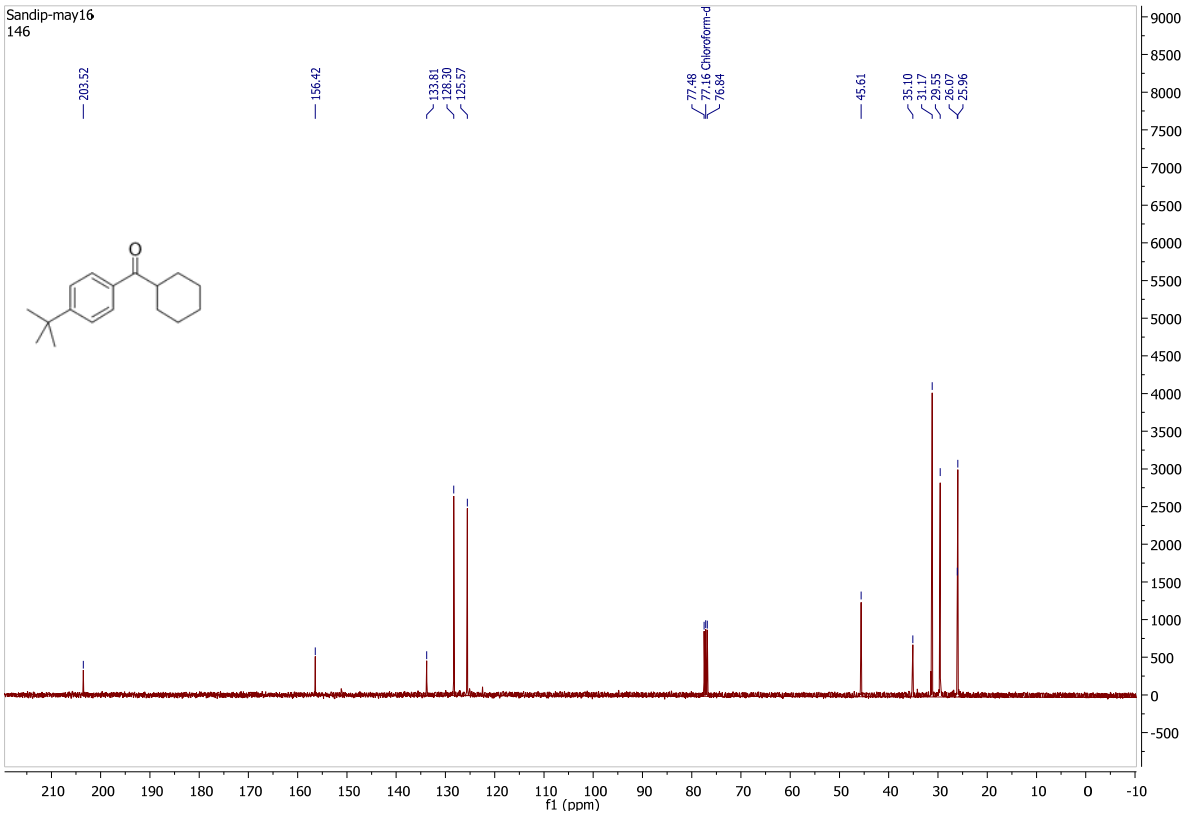
^{1}H and ^{13}C spectra of 1-(4-(Tert-butyl)phenyl)pentan-1-one (3e)



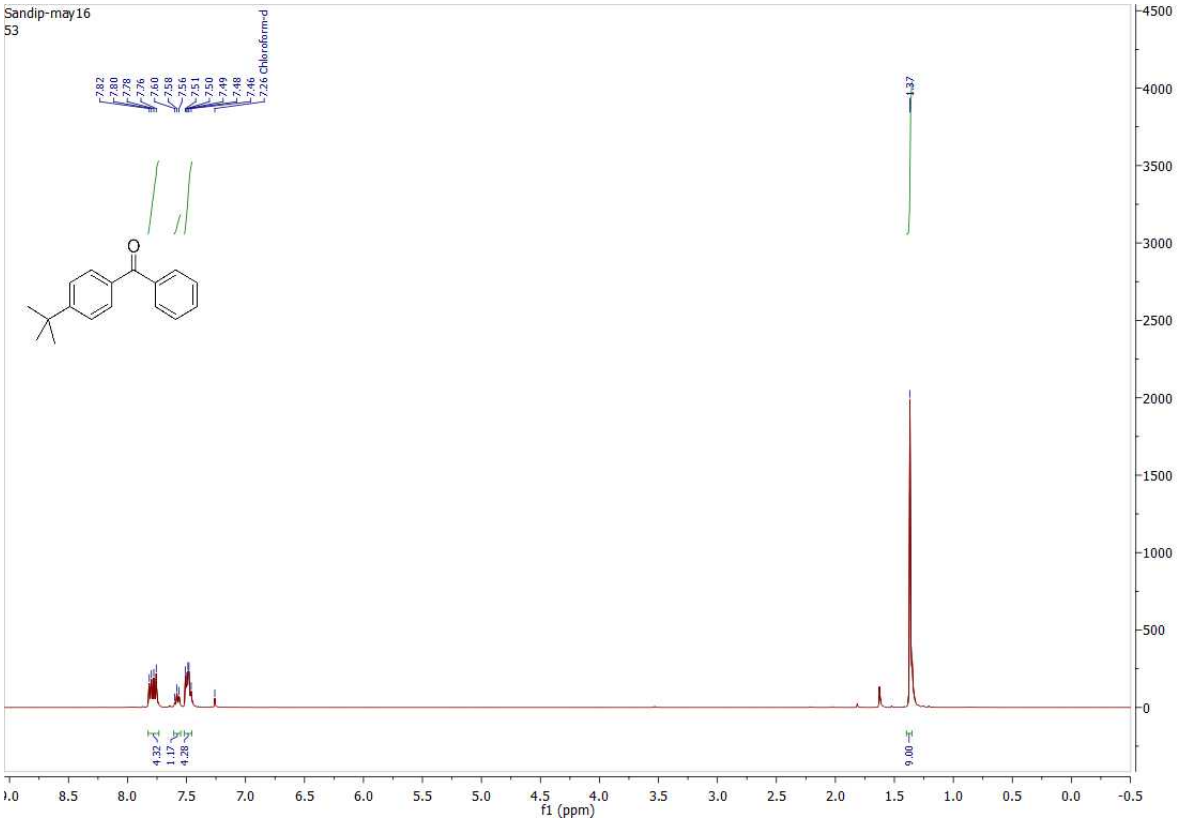


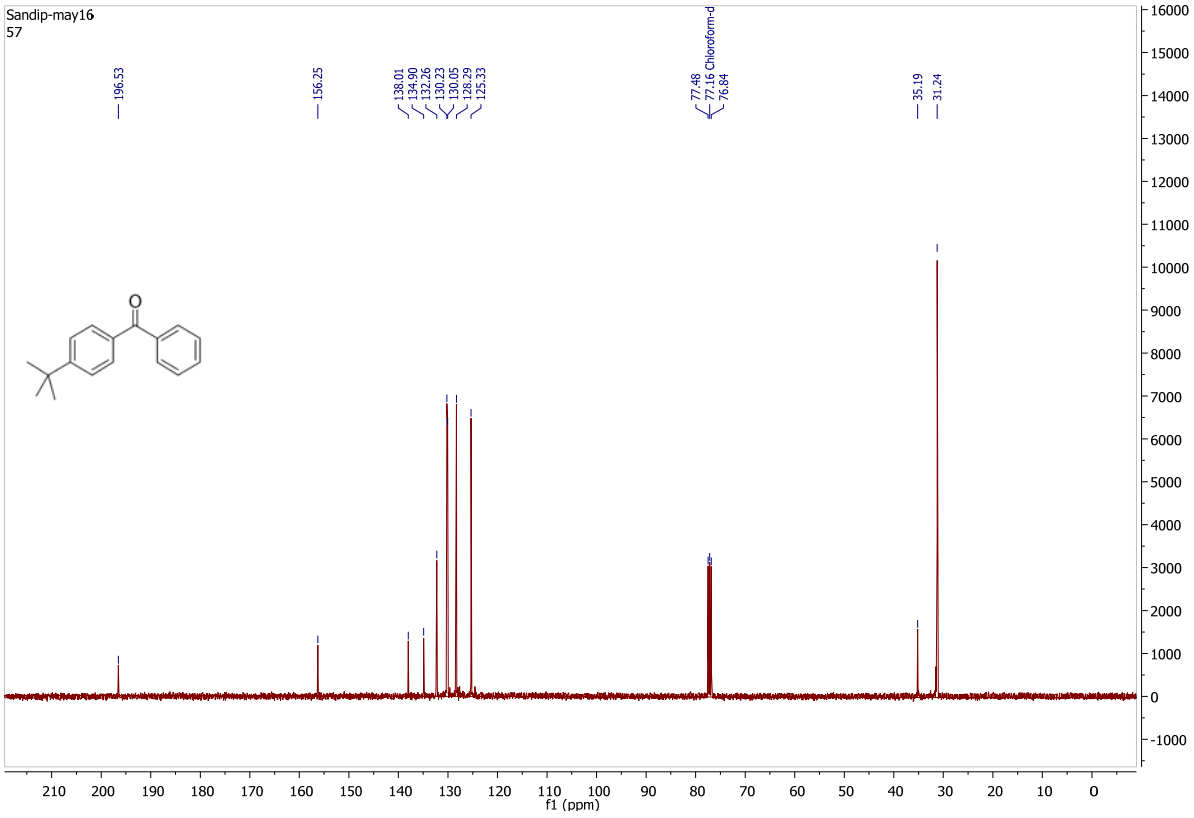
^{1}H and ^{13}C spectra of (4-(Tert-butyl)phenyl)(cyclohexyl)methanone (3aa)



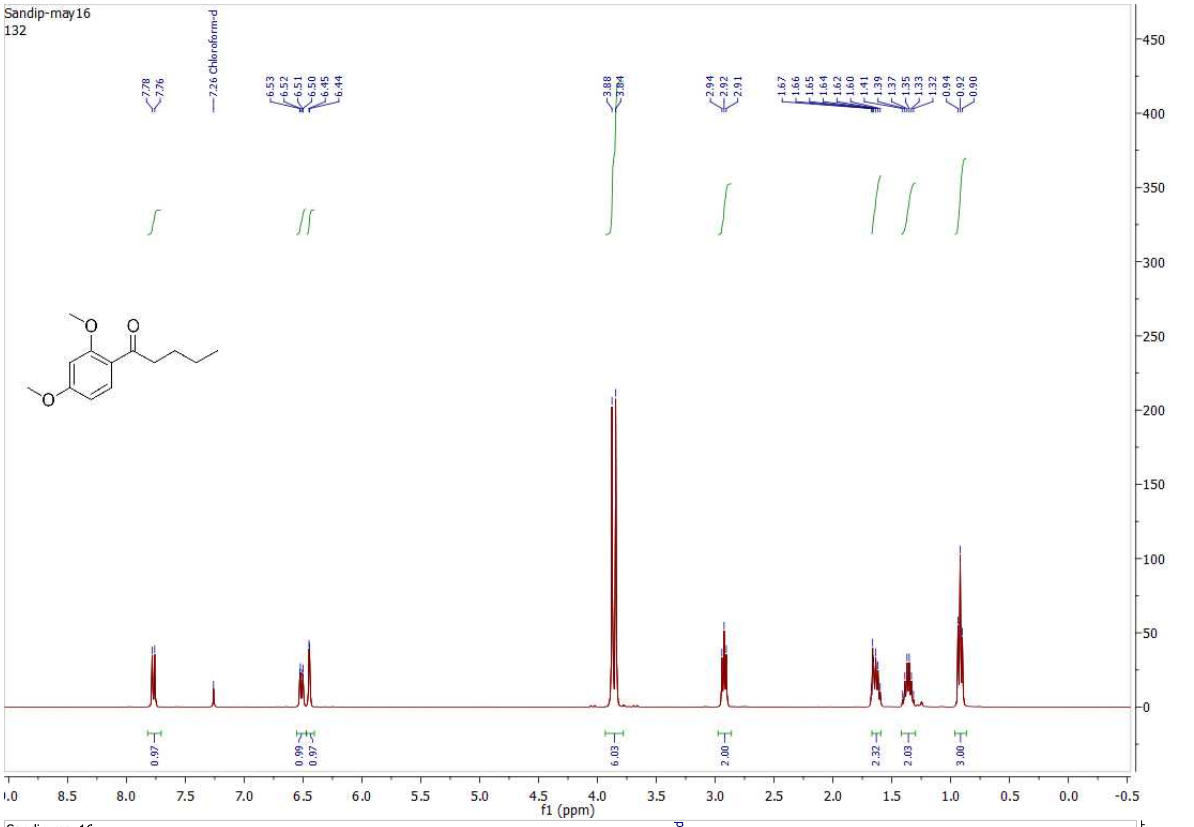


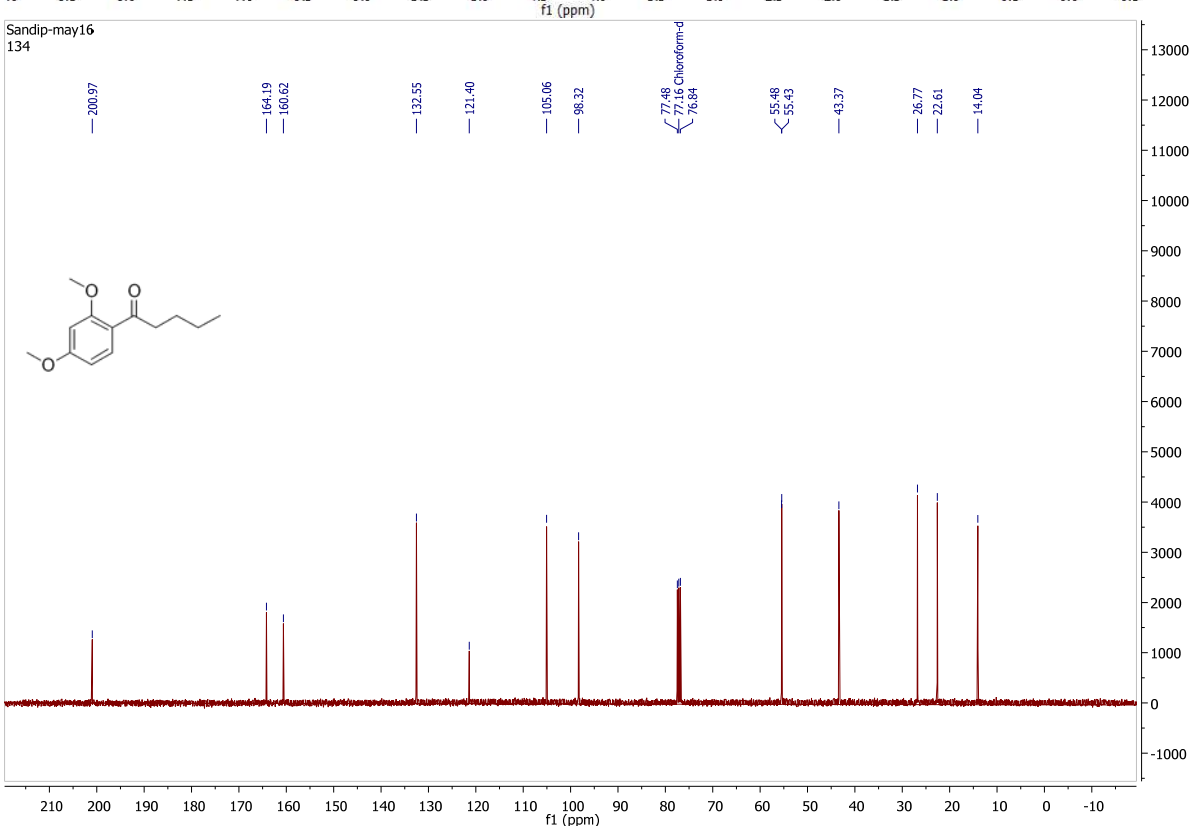
^{1}H and ^{13}C spectra of (4-(Tert-butyl)phenyl)(phenyl)methanone (3aw)



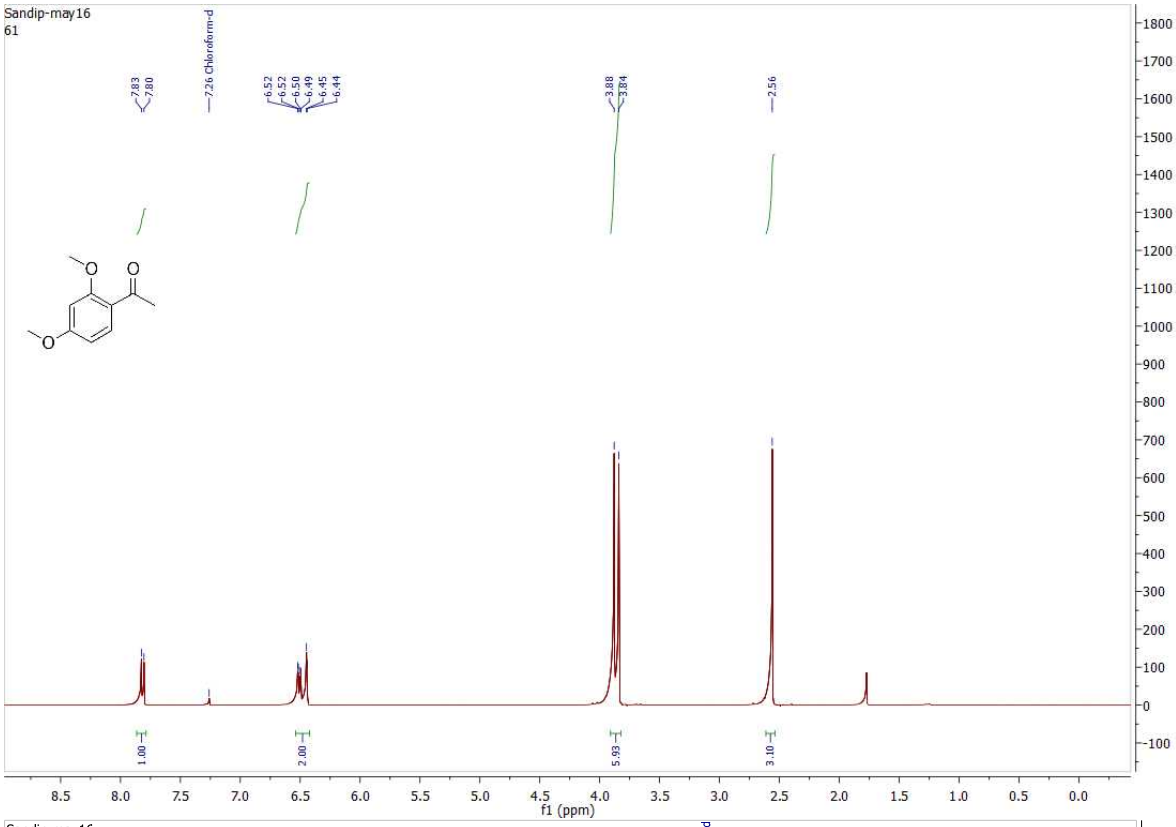


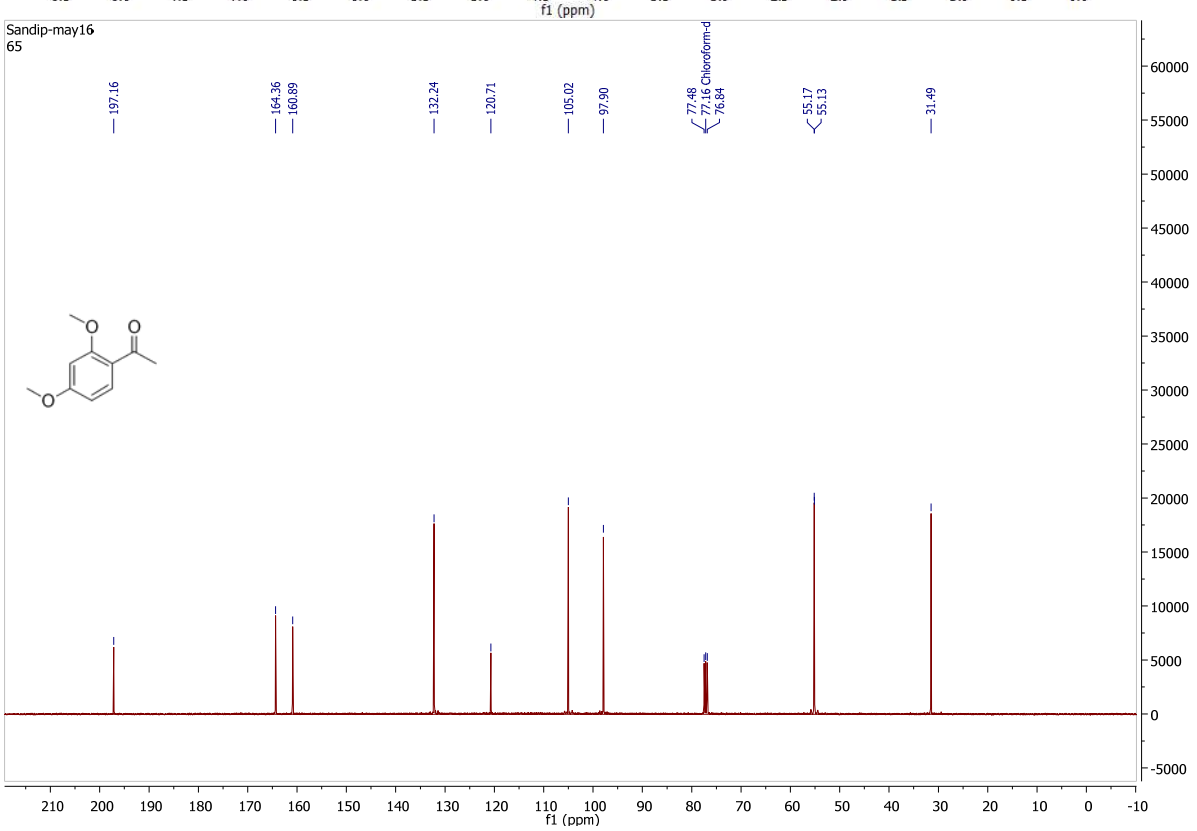
^{1}H and ^{13}C spectra of 1-(2,4-Dimethoxyphenyl)pentan-1-one (3f)



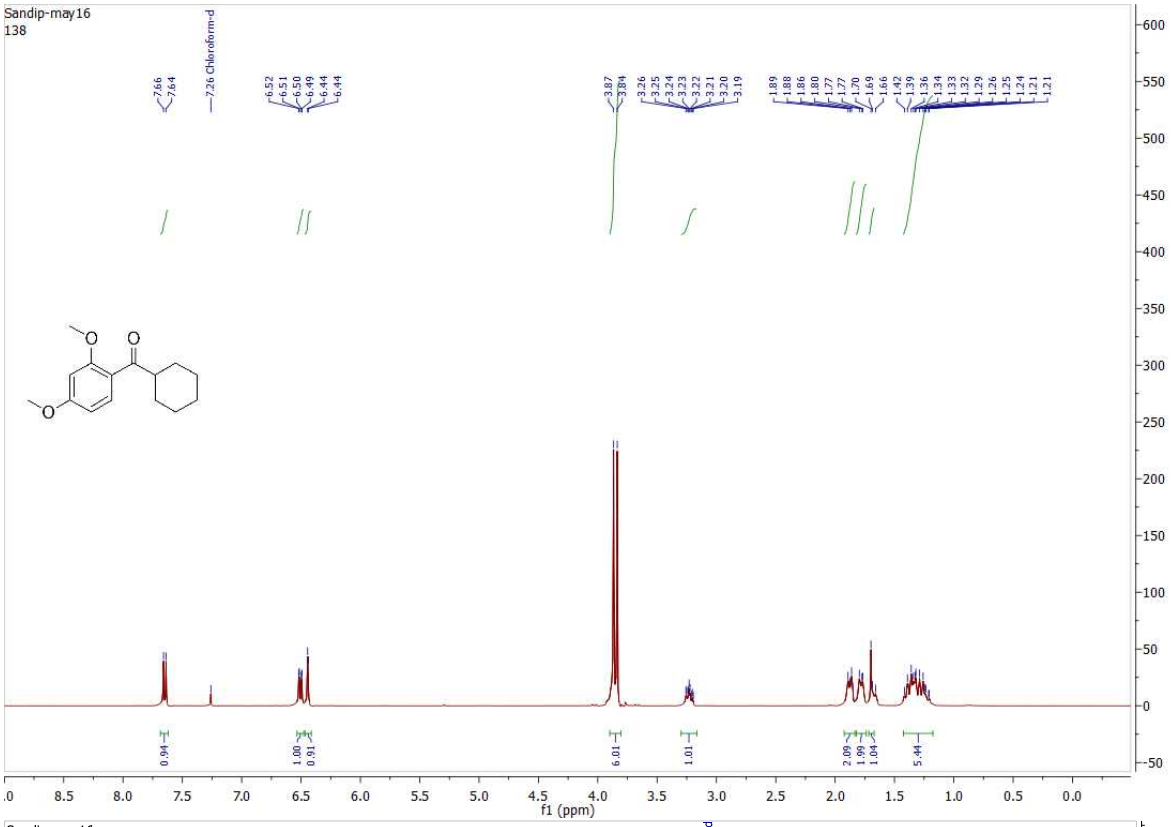


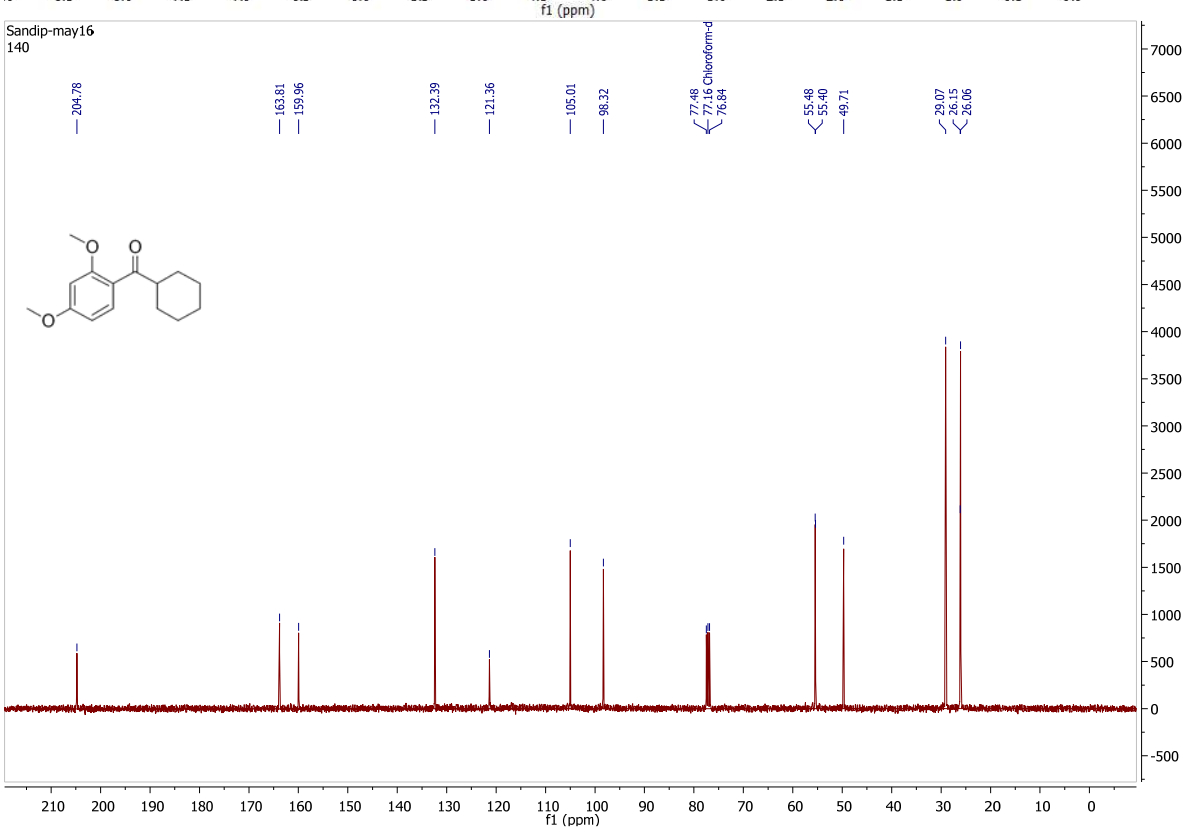
^{1}H and ^{13}C spectra of 1-(2,4-Dimethoxyphenyl)ethan-1-one (3q)



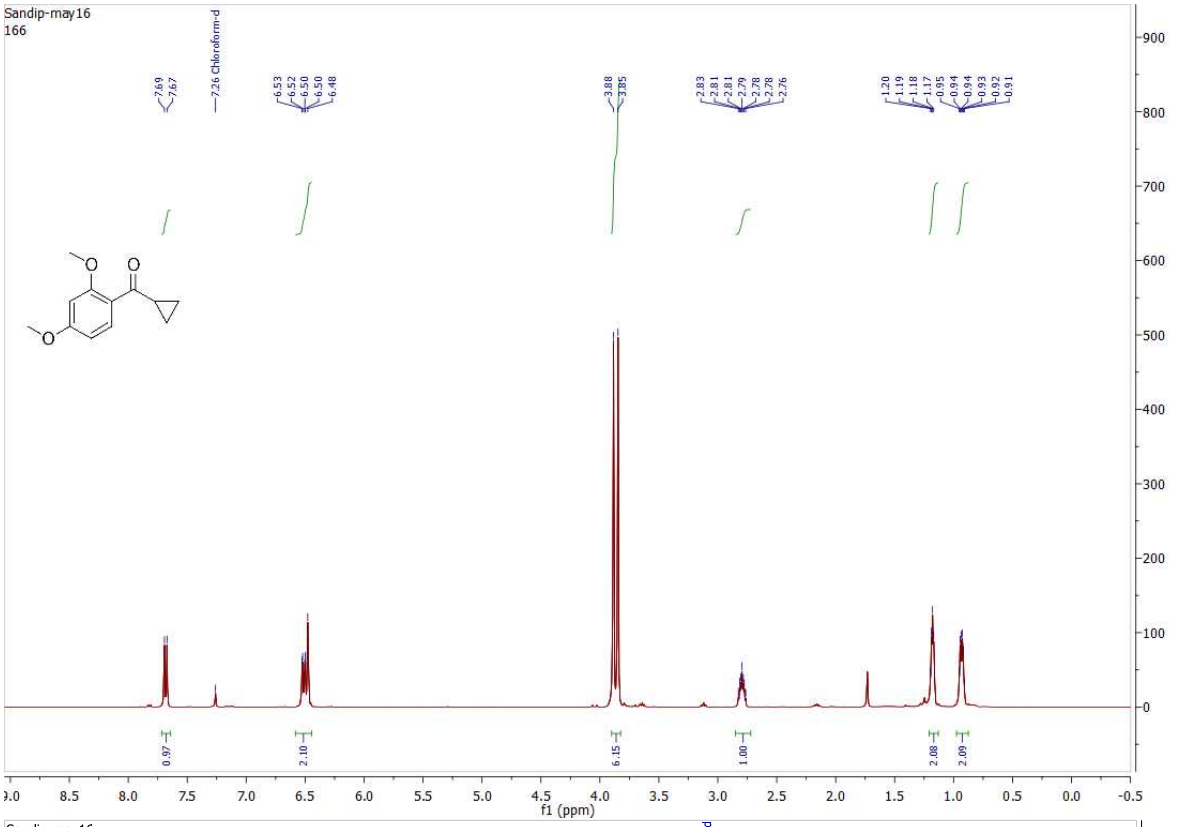


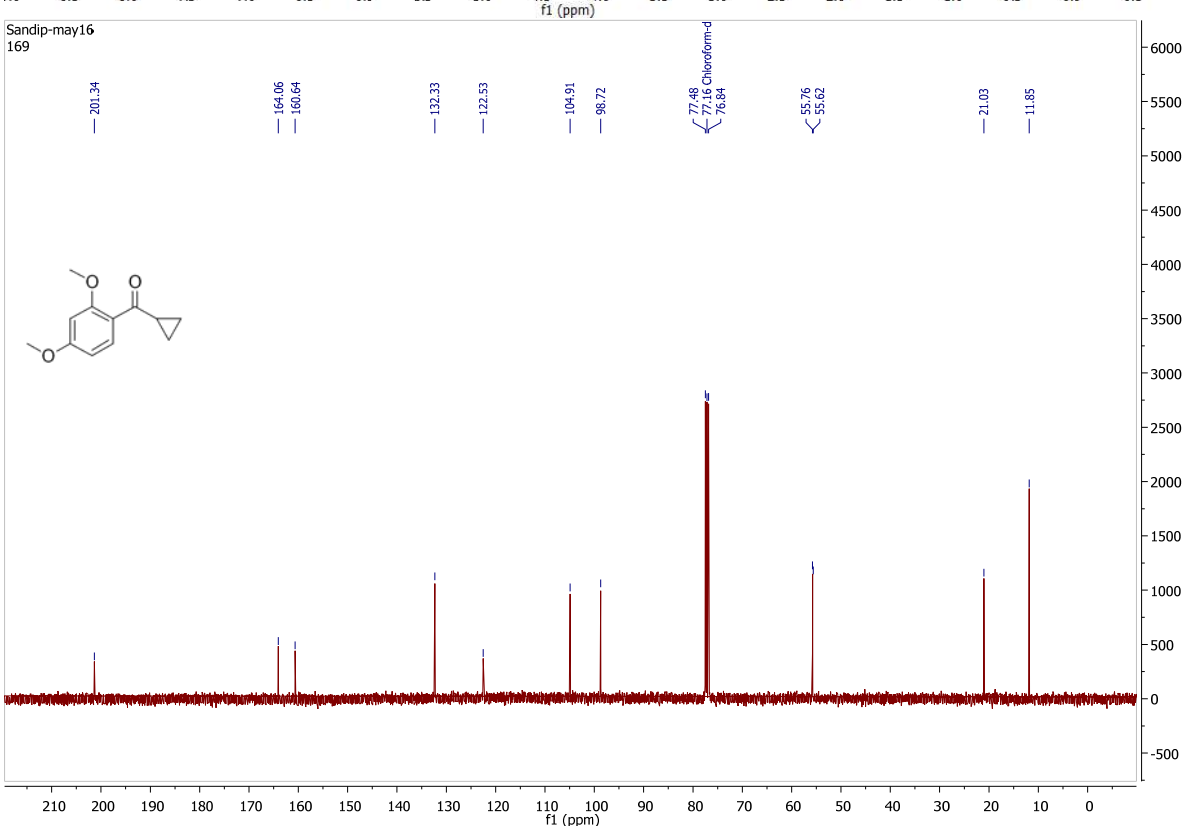
^{1}H and ^{13}C spectra of Cyclohexyl(2,4-dimethoxyphenyl)methanone (3ab)



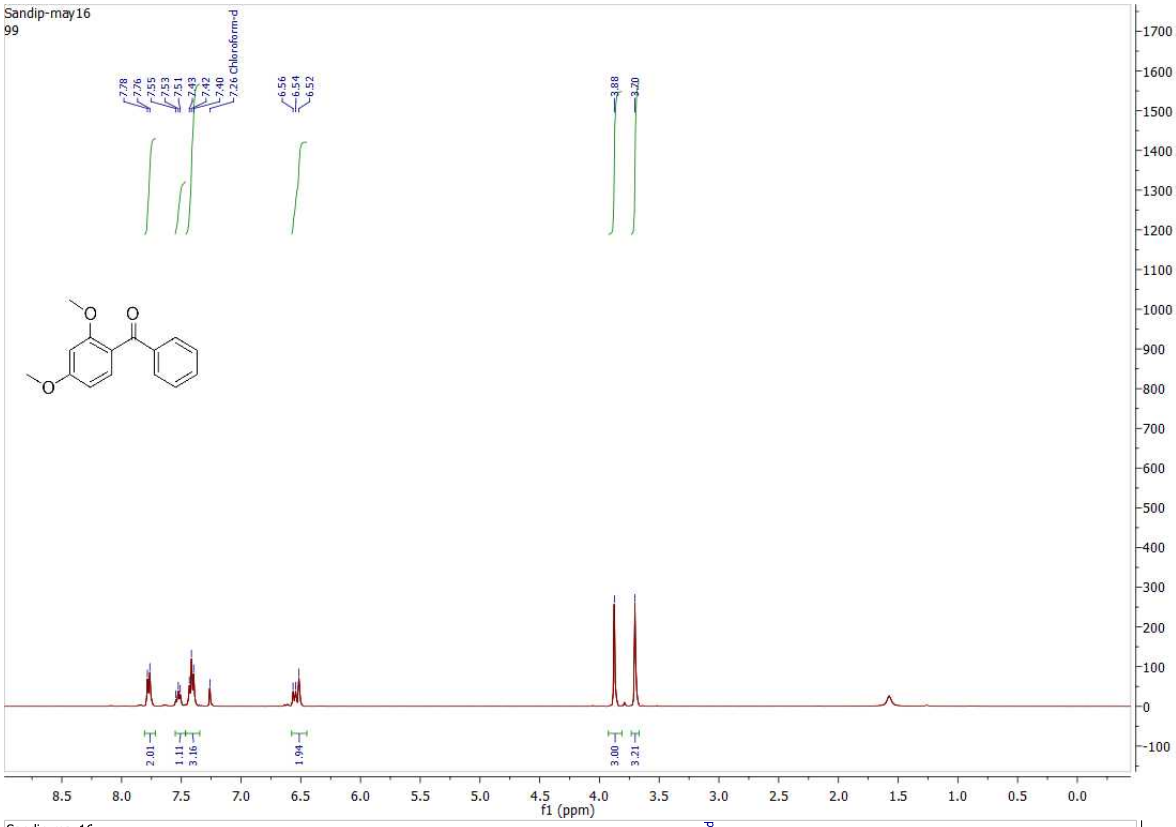


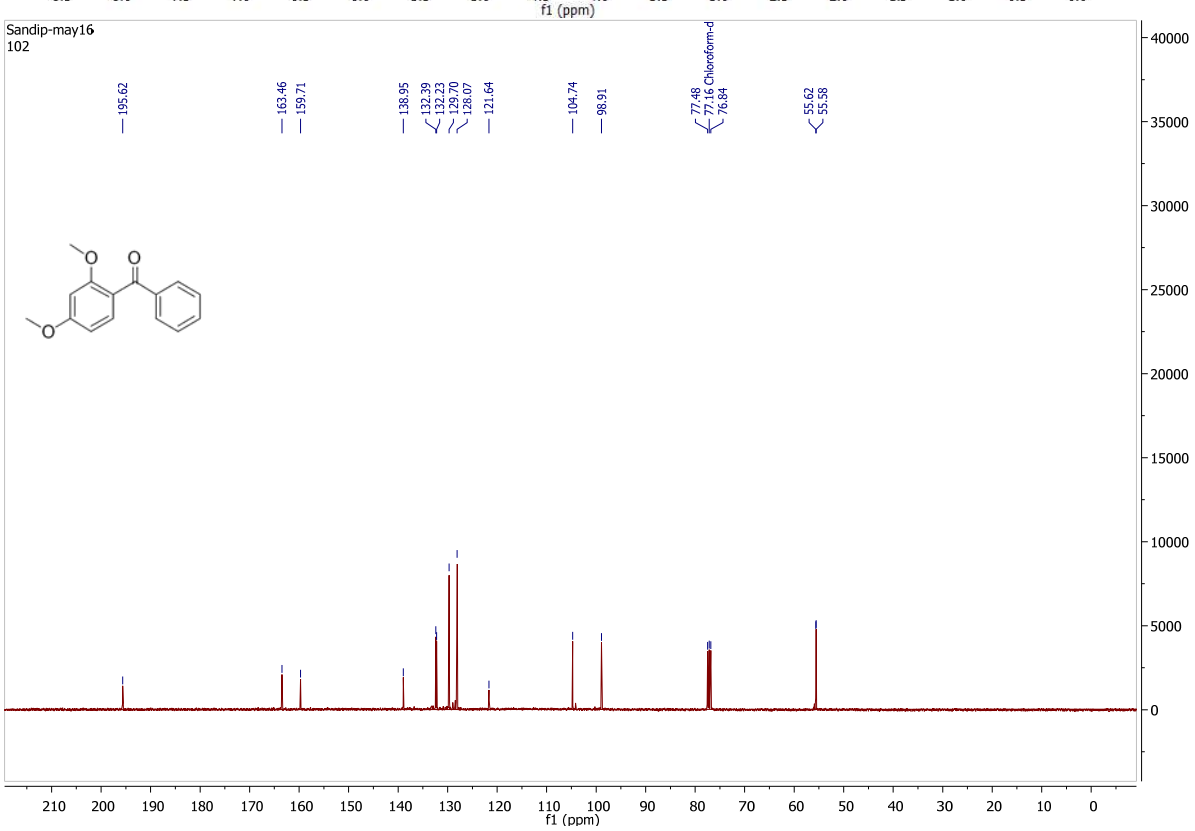
^{1}H and ^{13}C spectra of Cyclopropyl(2,4-dimethoxyphenyl)methanone (3am)



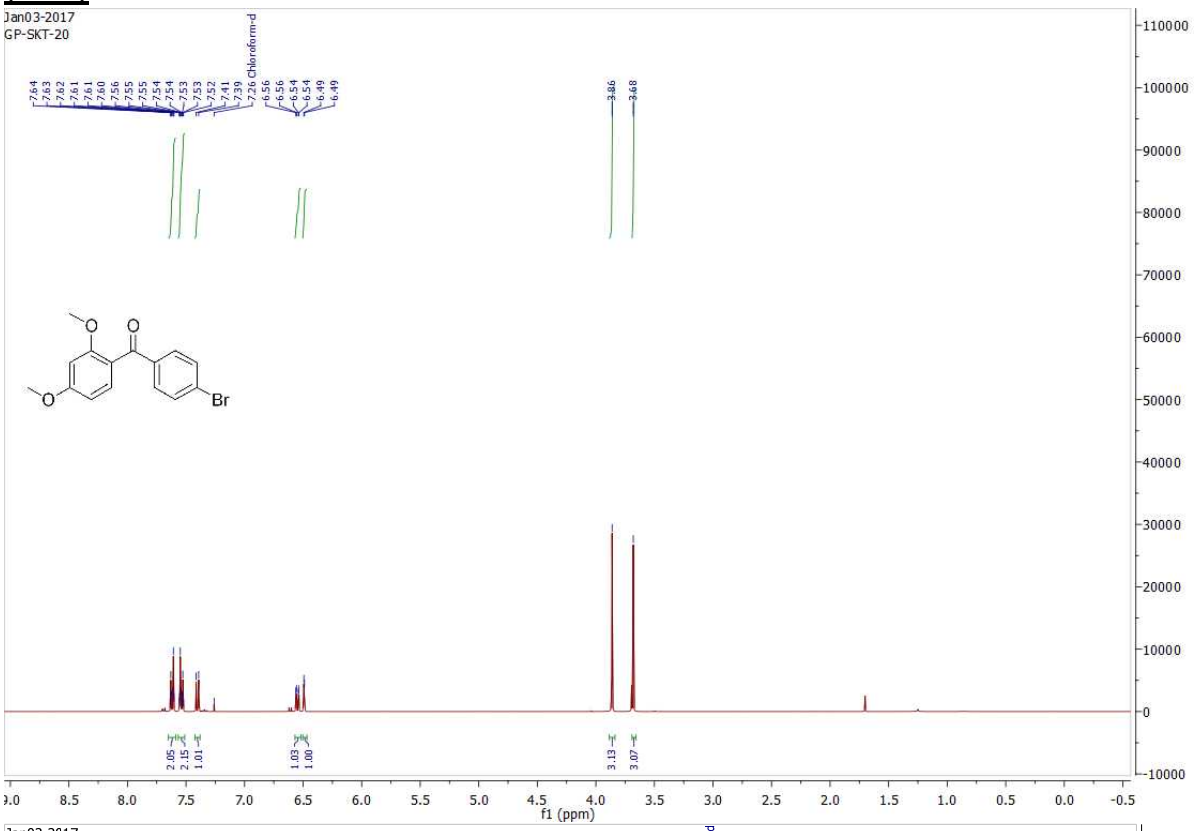


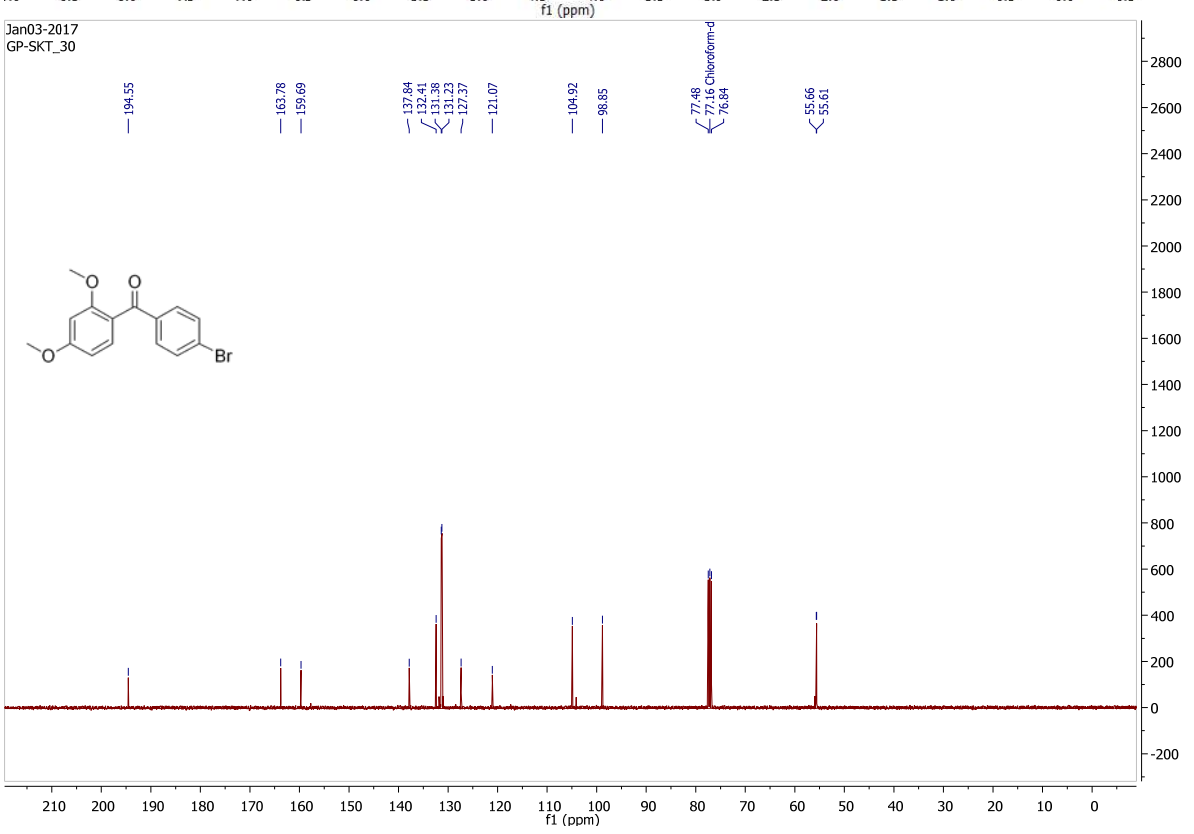
^{1}H and ^{13}C spectra of (2,4-Dimethoxyphenyl)(phenyl)methanone (3ax)



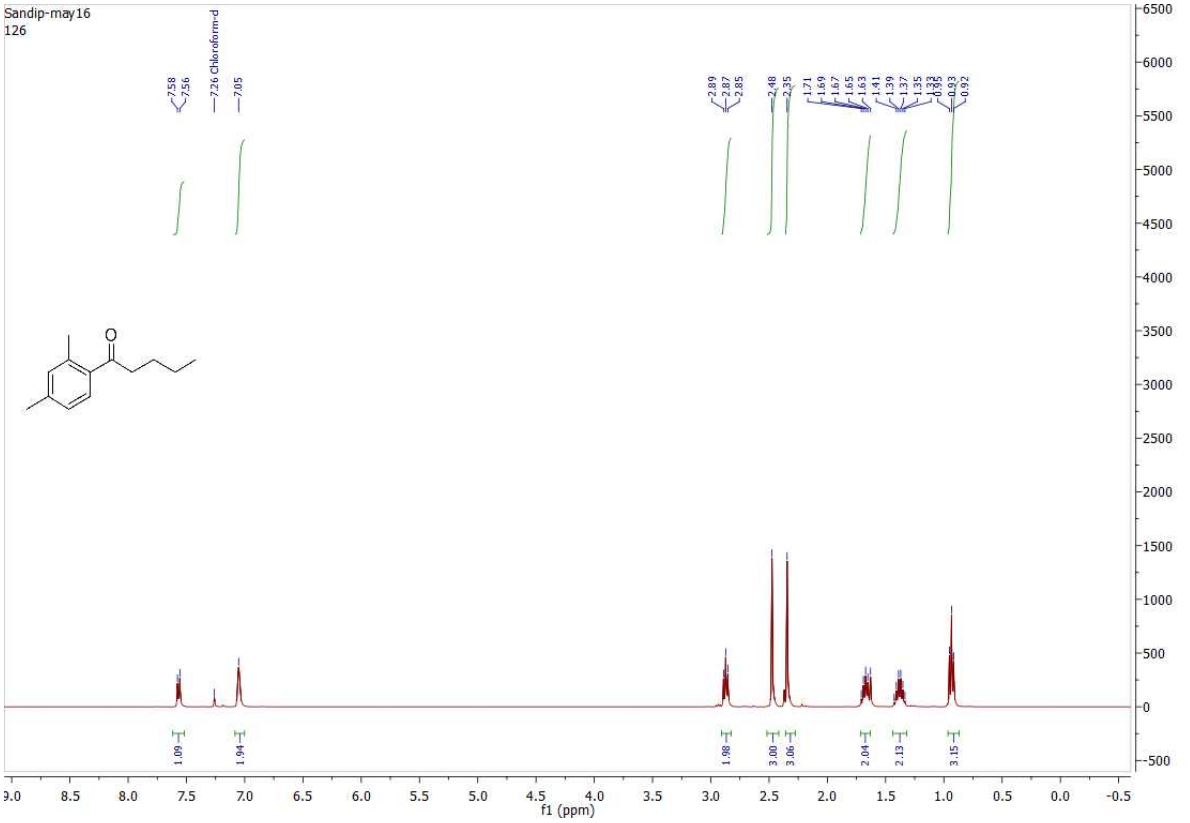


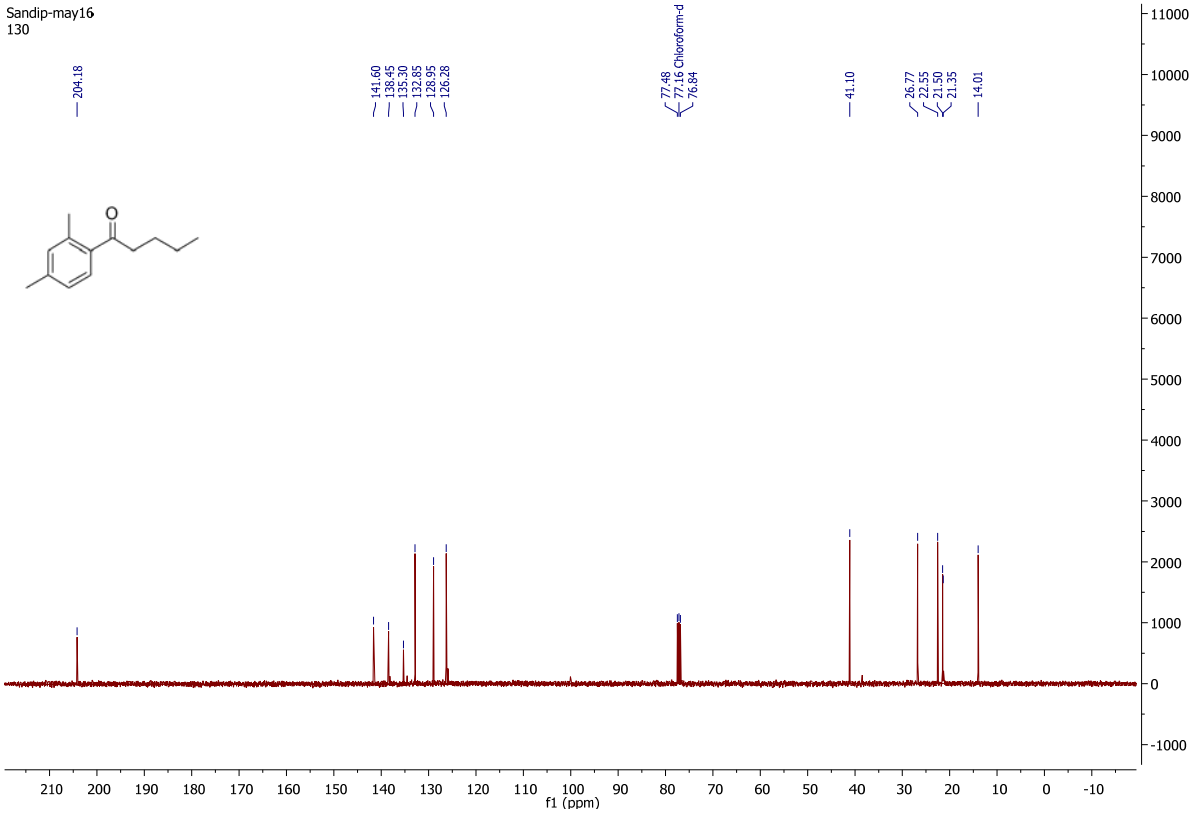
^{1}H and ^{13}C spectra of (4-Bromophenyl)(2,4-dimethoxyphenyl)methanone (3al')



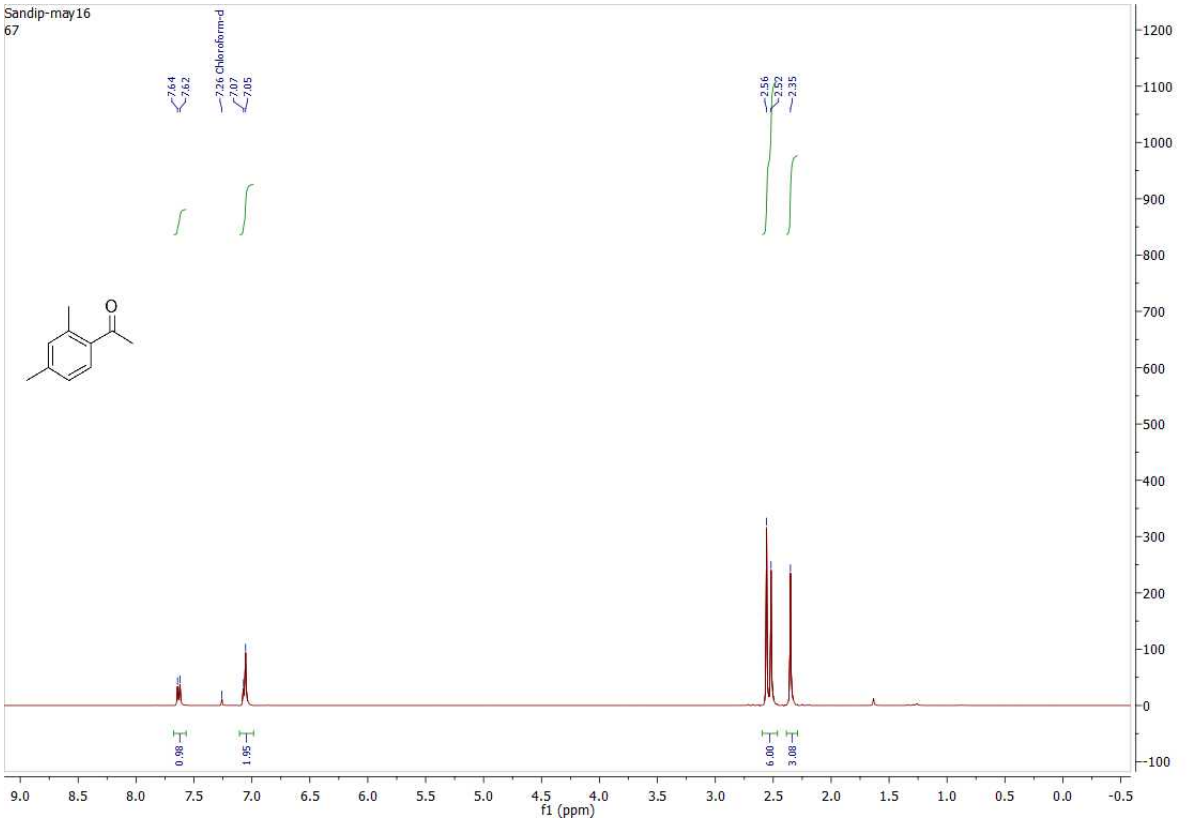


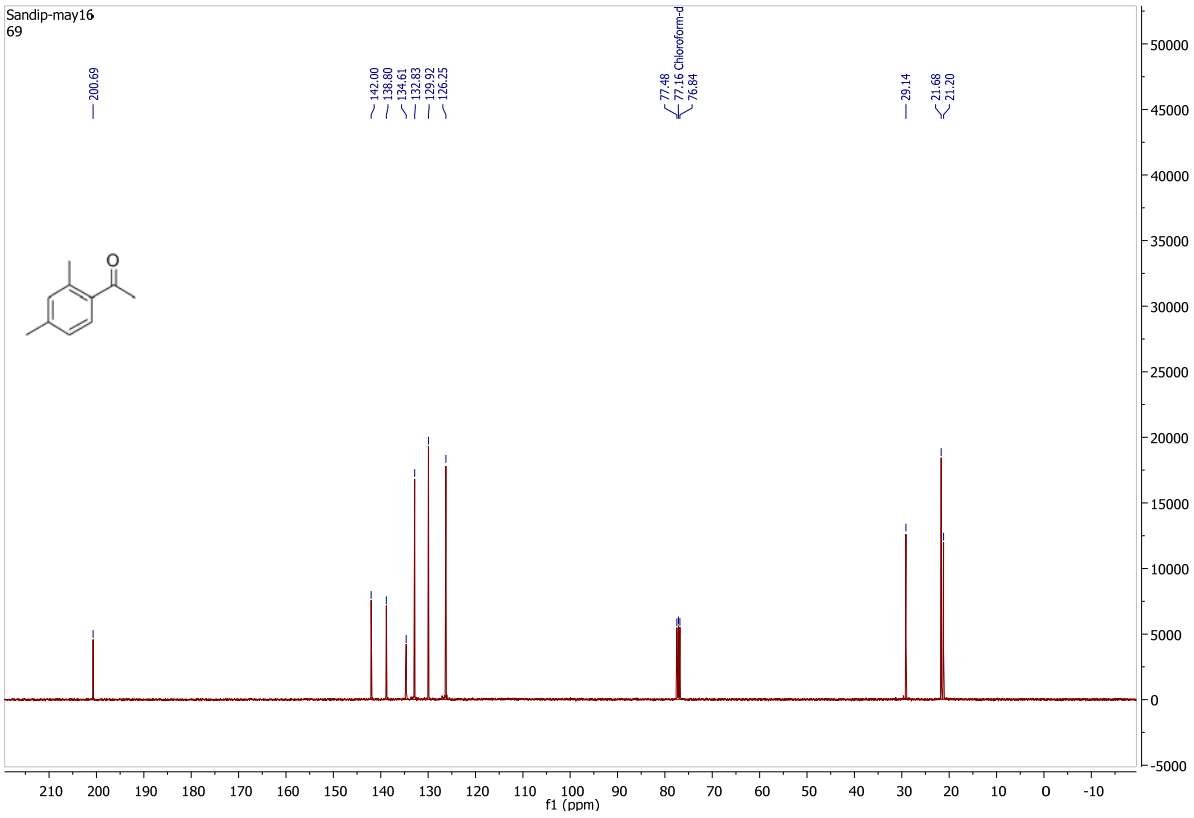
^{1}H and ^{13}C spectra of 1-(2,4-dimethylphenyl)pentan-1-one (3g)



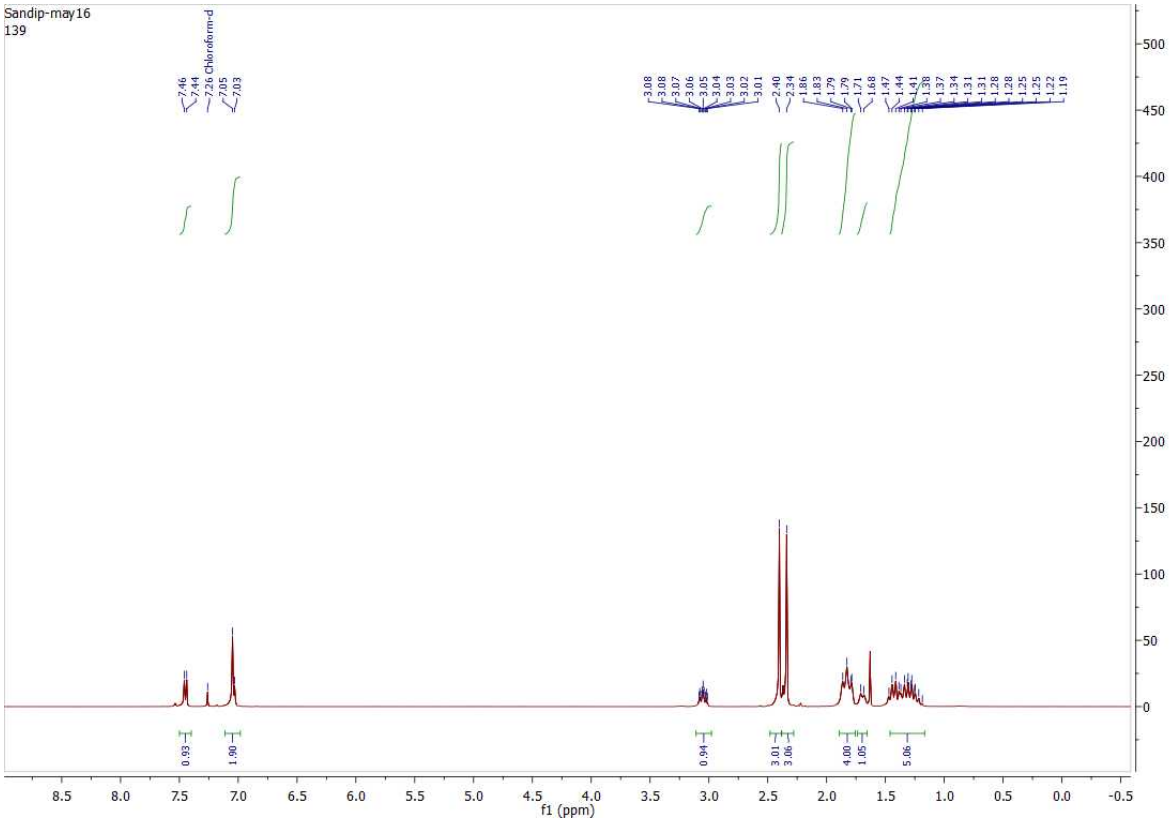


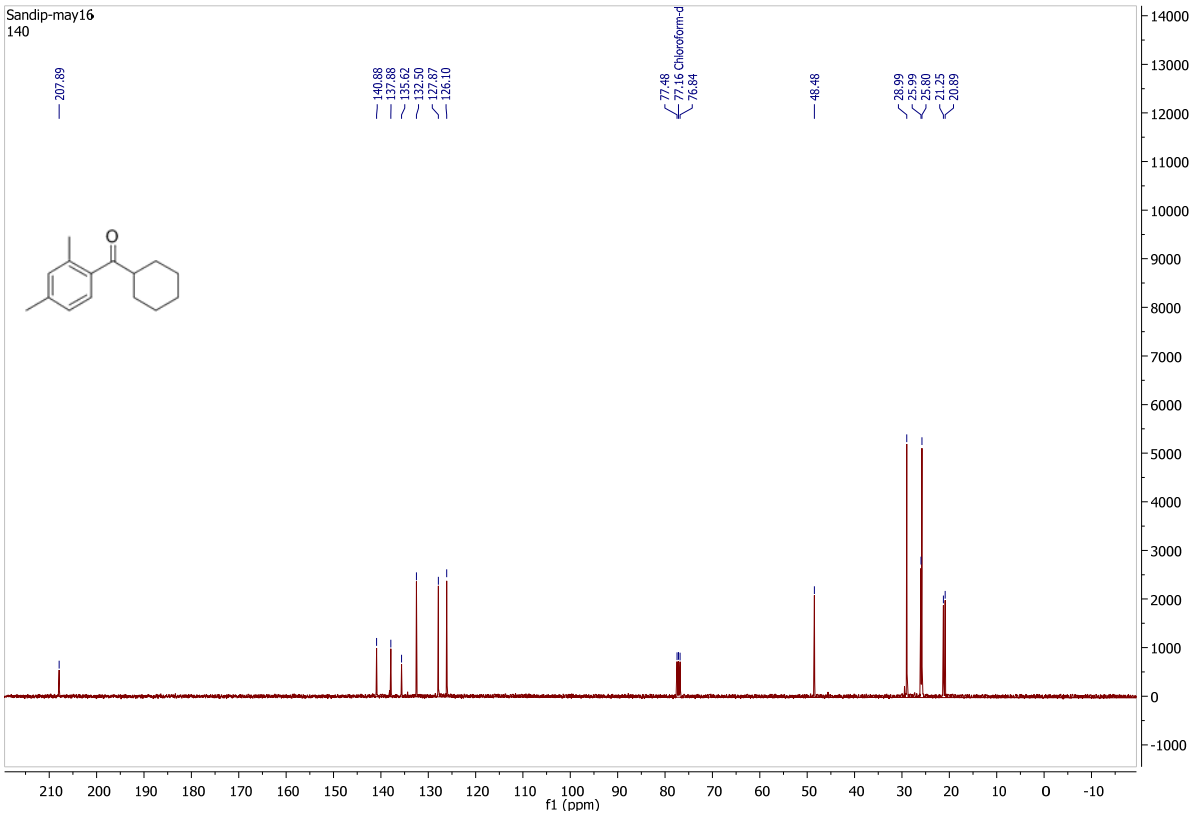
^{1}H and ^{13}C spectra of 1-(2,4-Dimethylphenyl)ethan-1-one (3r)



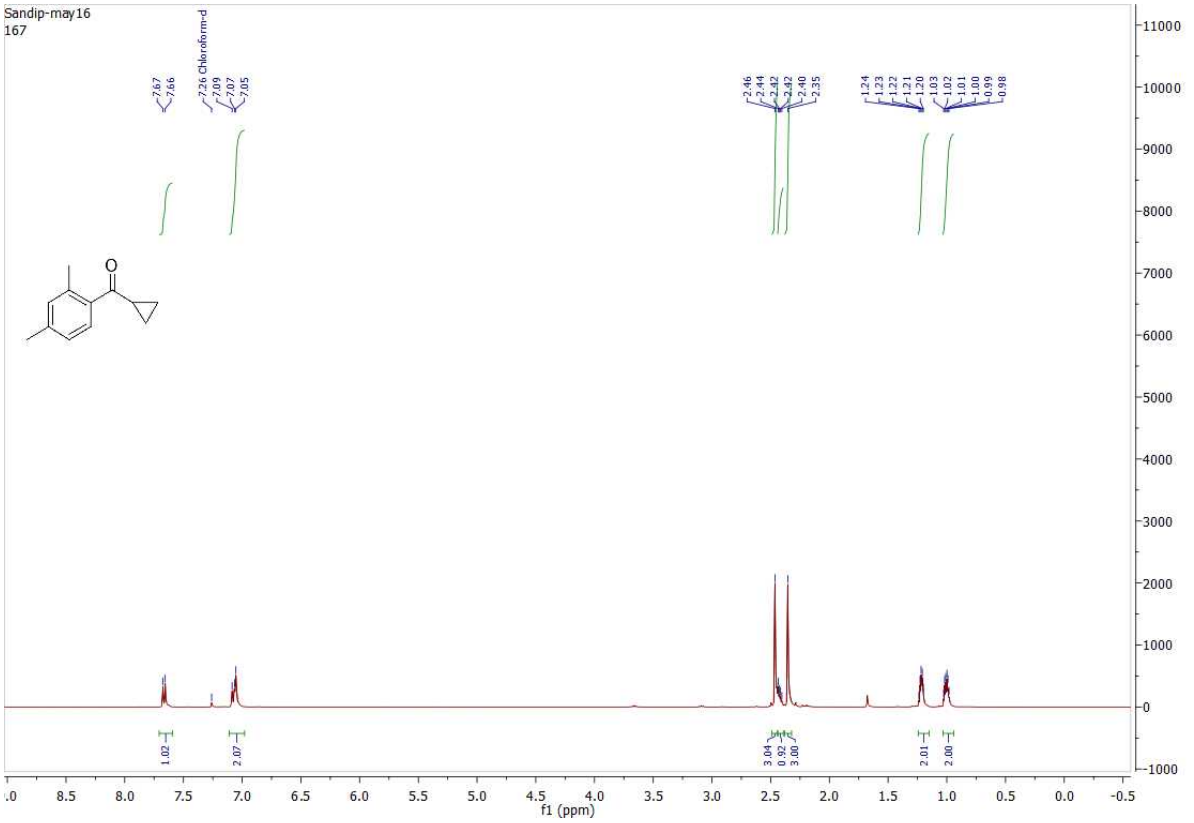


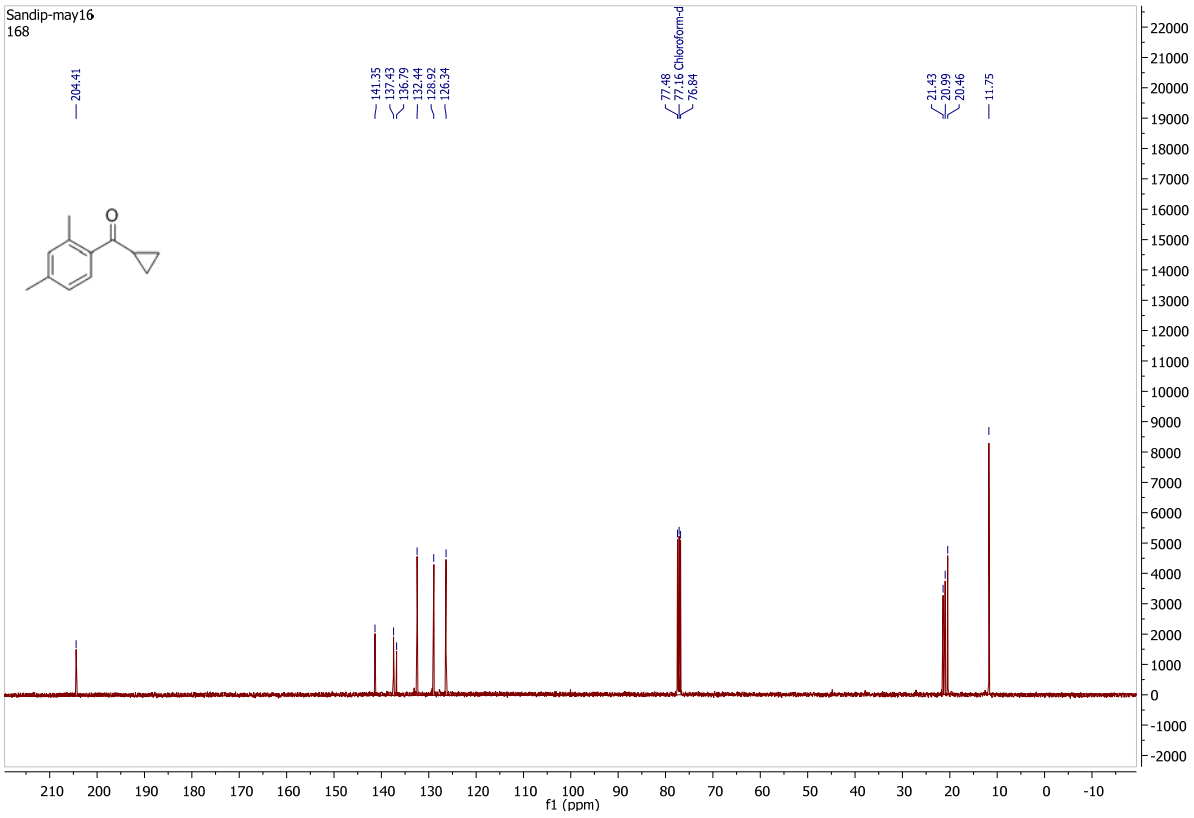
^{1}H and ^{13}C spectra of Cyclohexyl(2,4-dimethylphenyl)methanone (3ac)



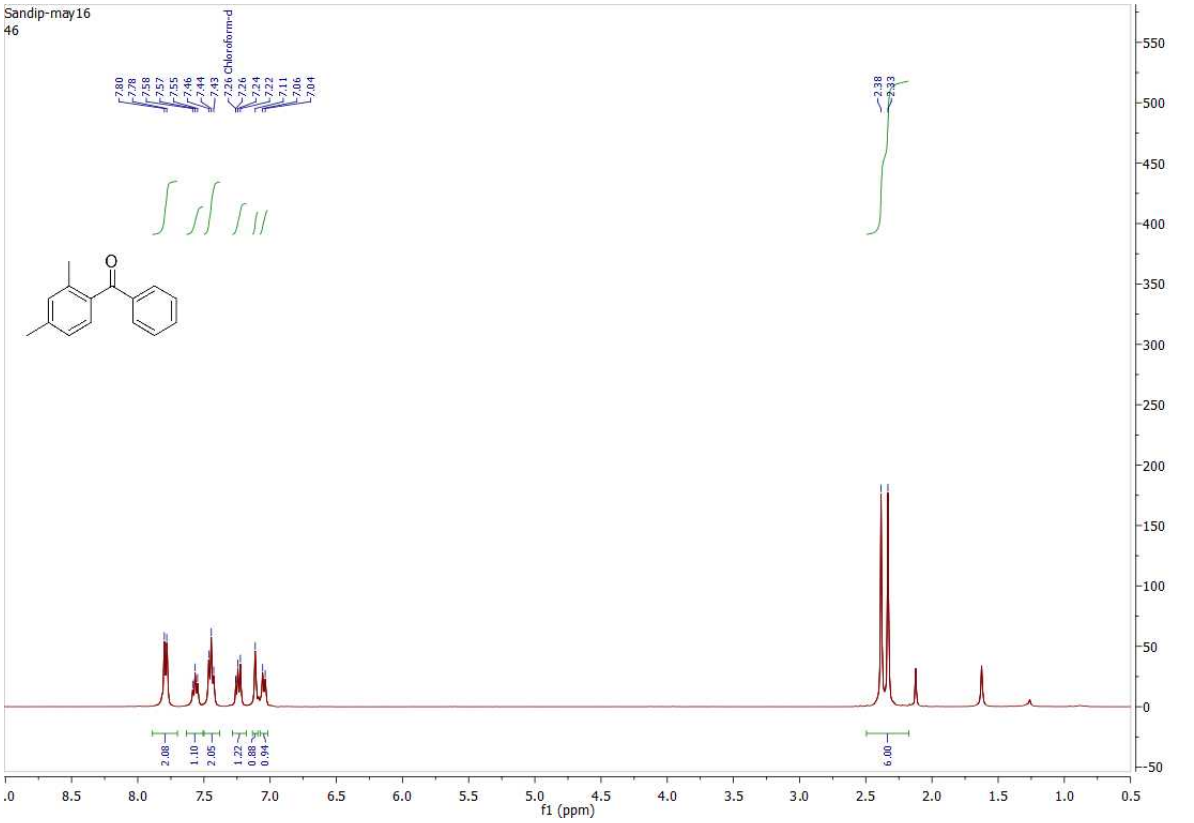


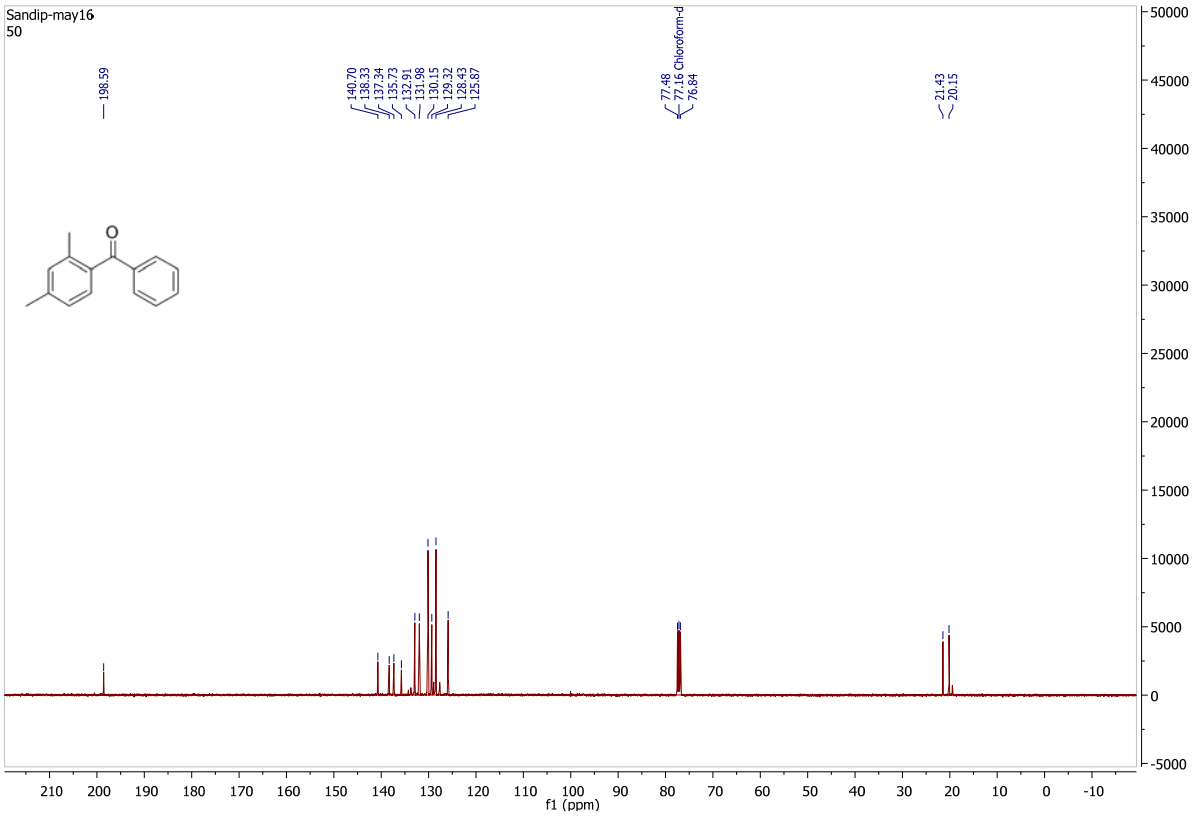
^{1}H and ^{13}C spectra of Cyclopropyl(2,4-dimethylphenyl)methanone (3an)



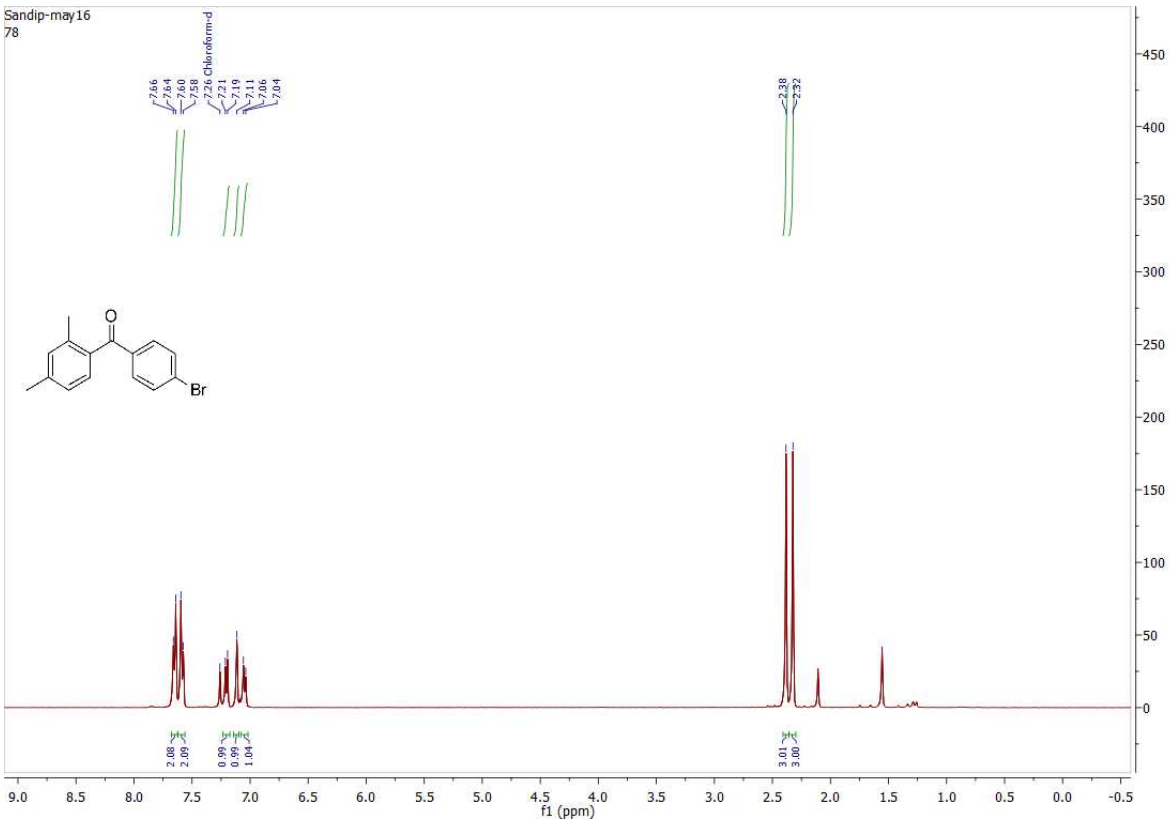


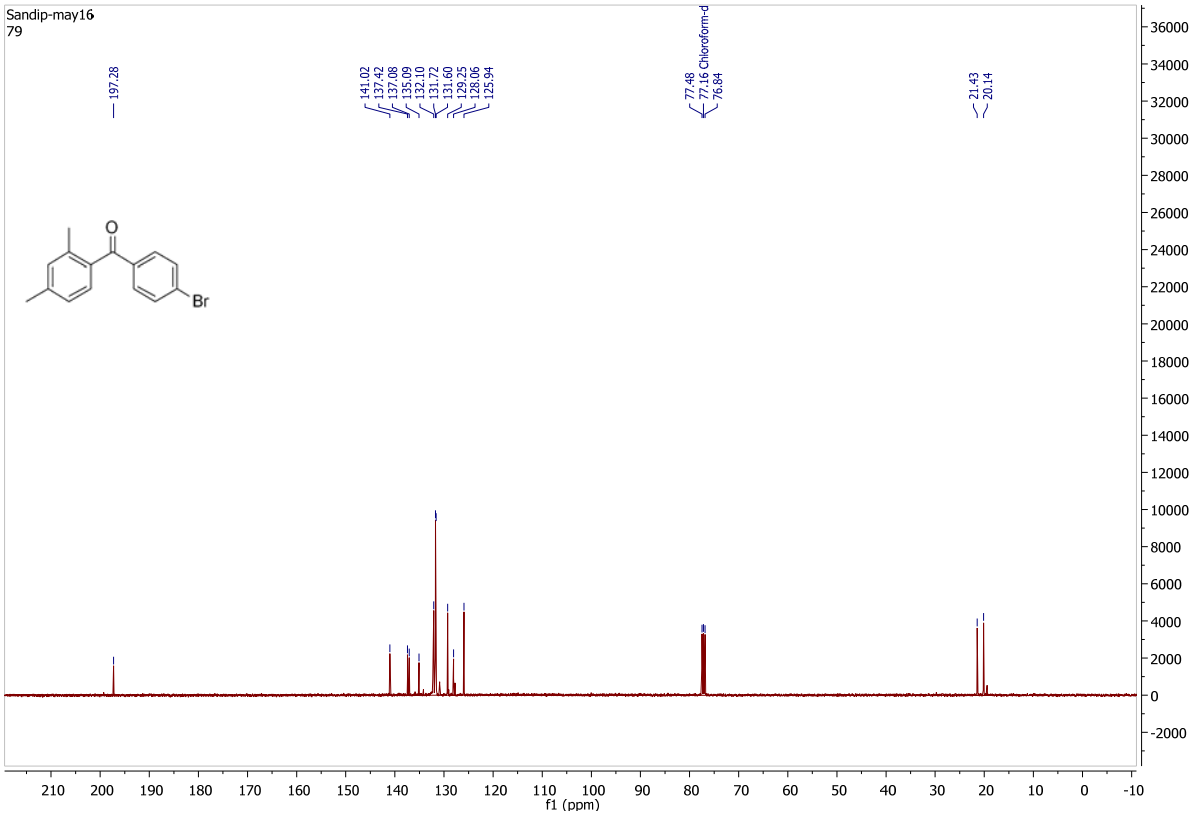
^{1}H and ^{13}C spectra of (2,4-Dimethylphenyl)(phenyl)methanone (3ay)



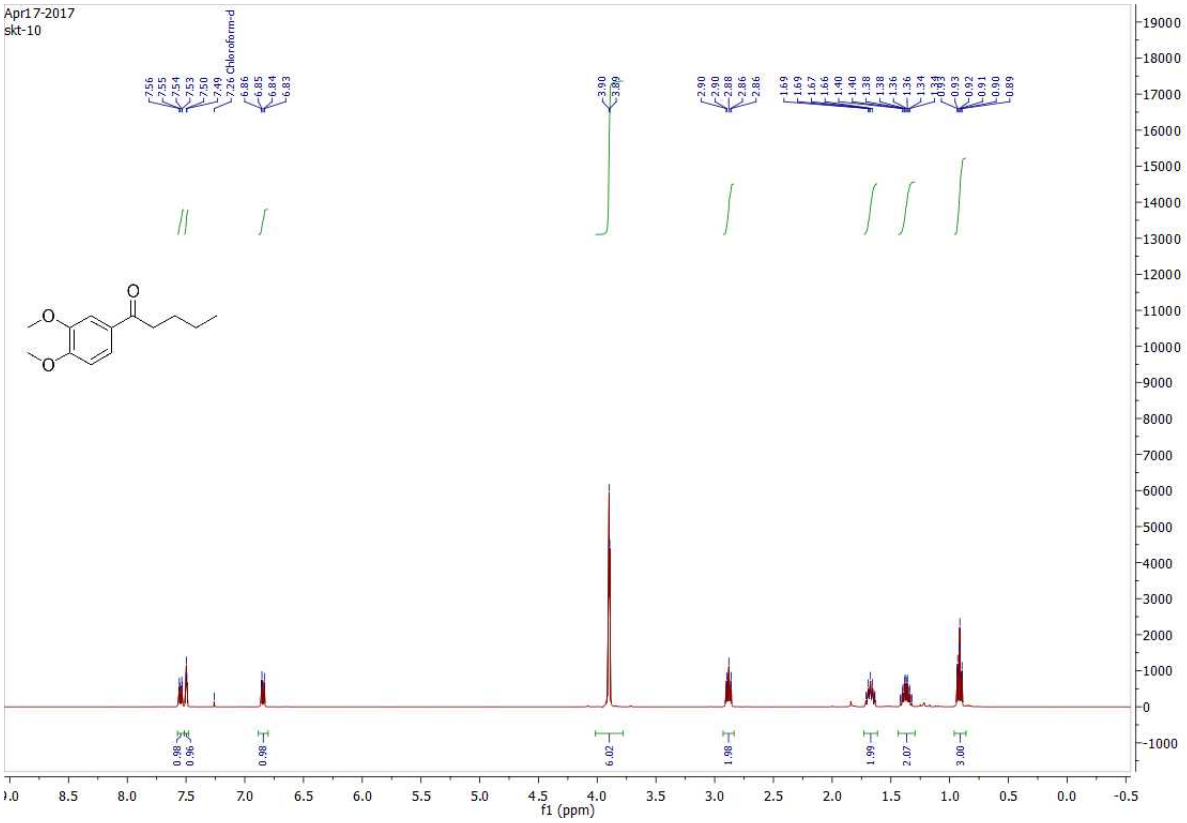


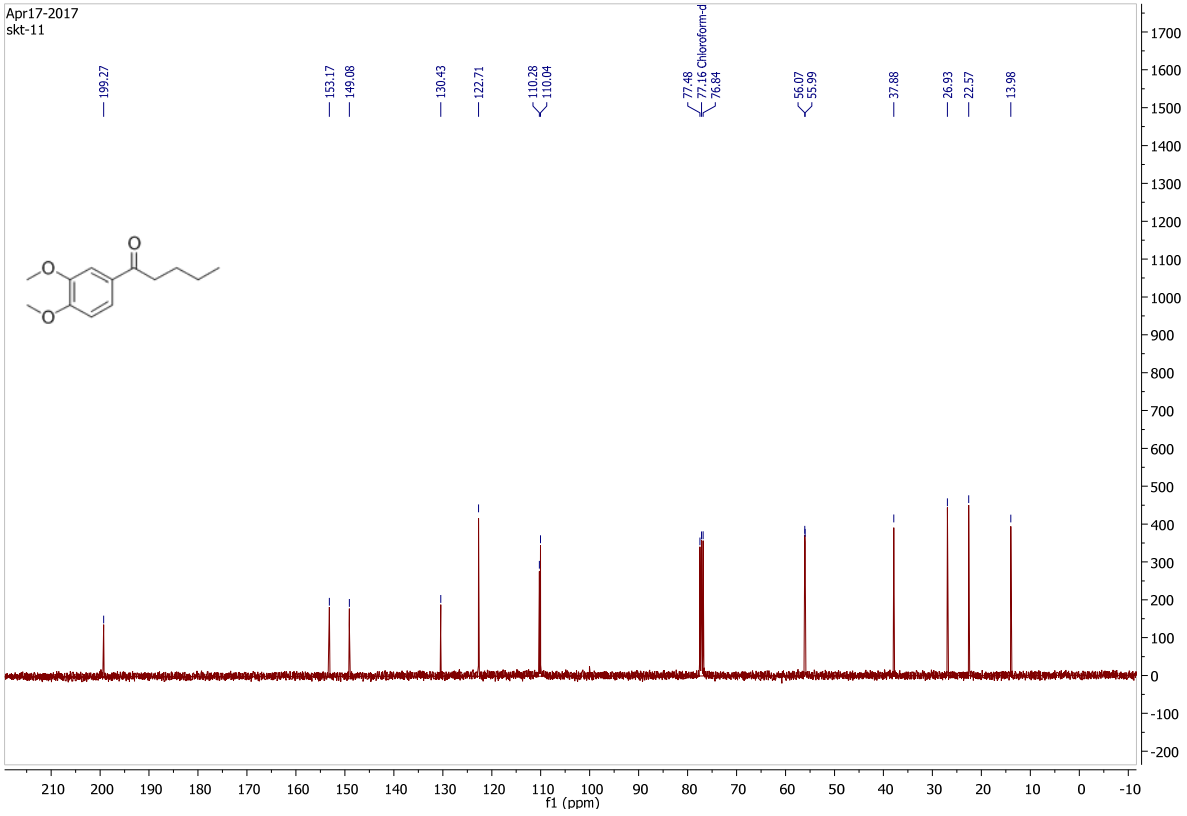
^{1}H and ^{13}C spectra of (4-Bromophenyl)(2,4-dimethylphenyl)methanone (3aj')



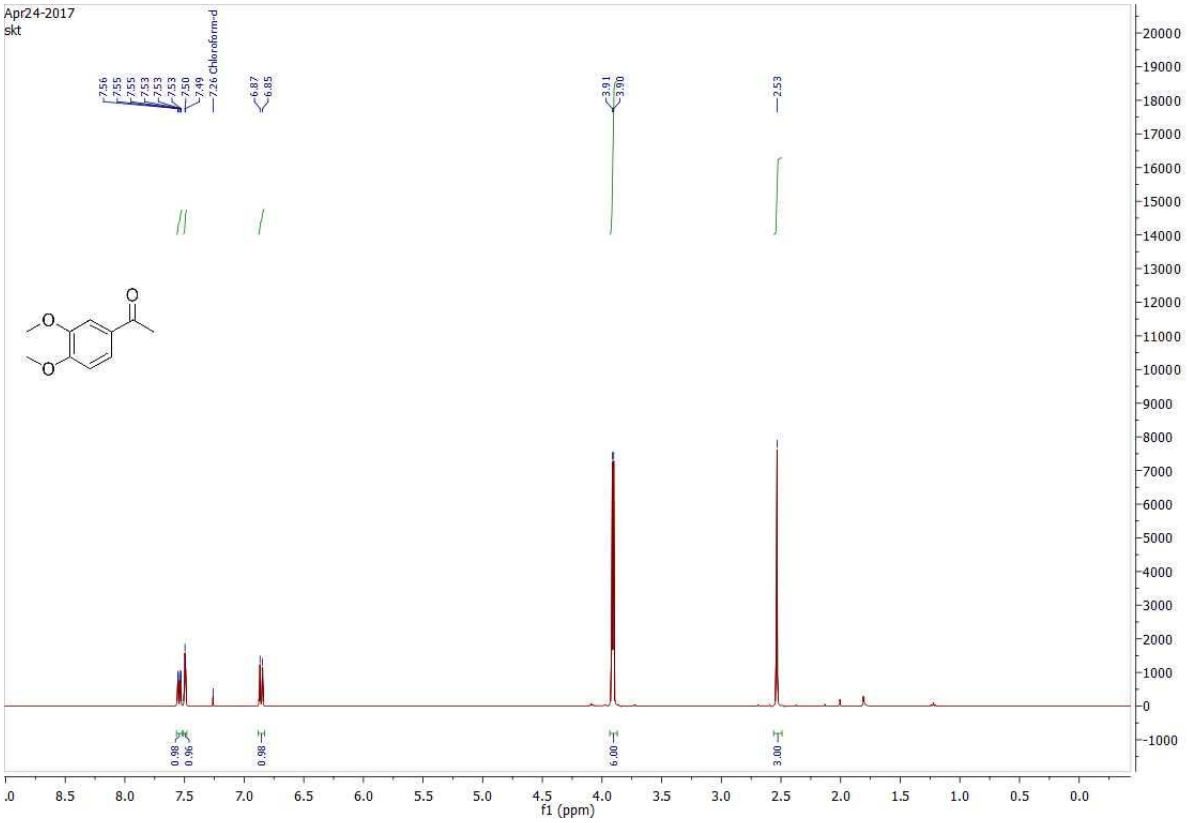


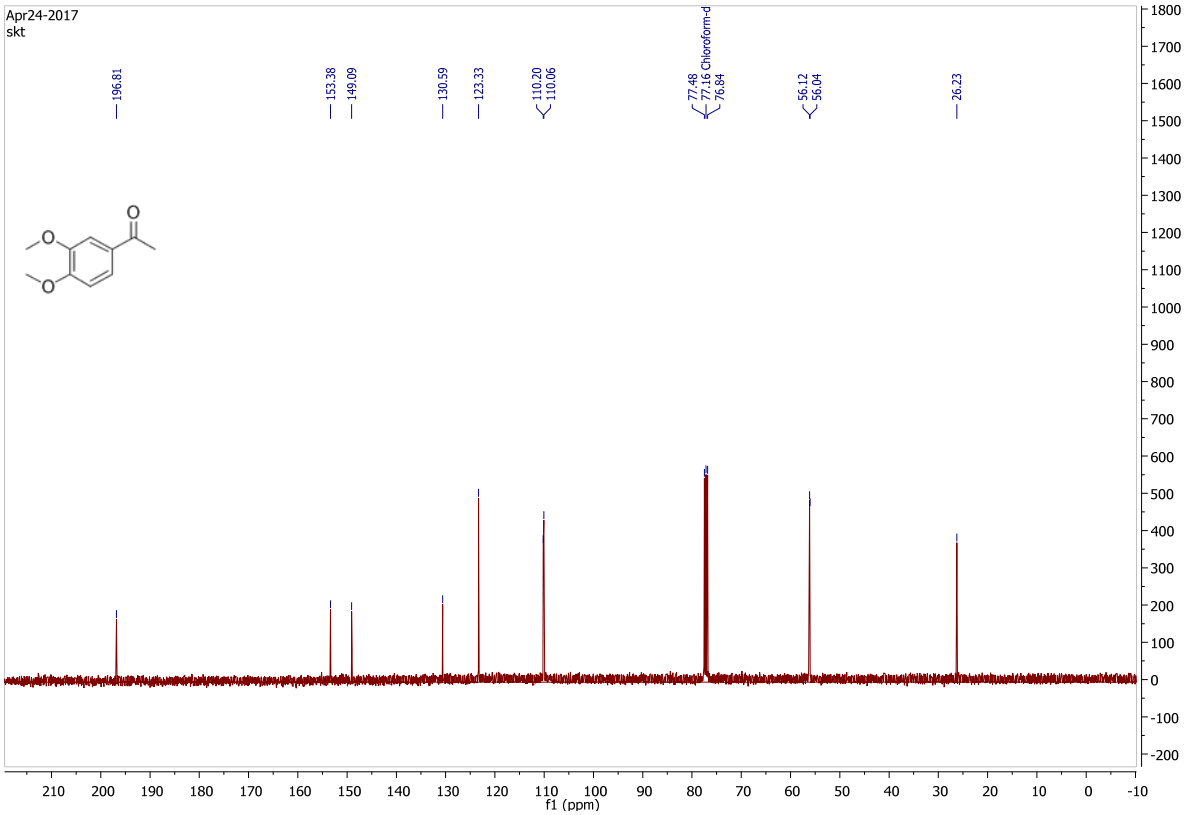
^{1}H and ^{13}C spectra of 1-(3,4-Dimethoxyphenyl)pentan-1-one (3h)



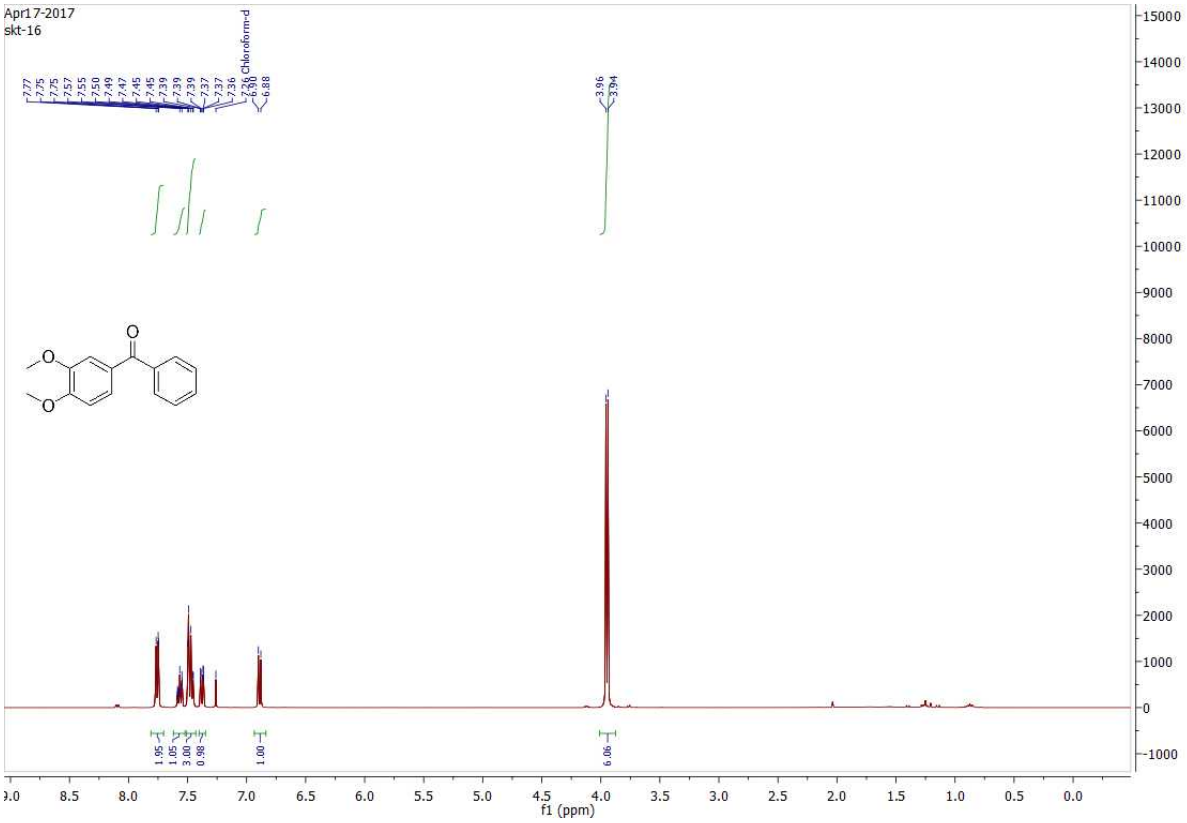


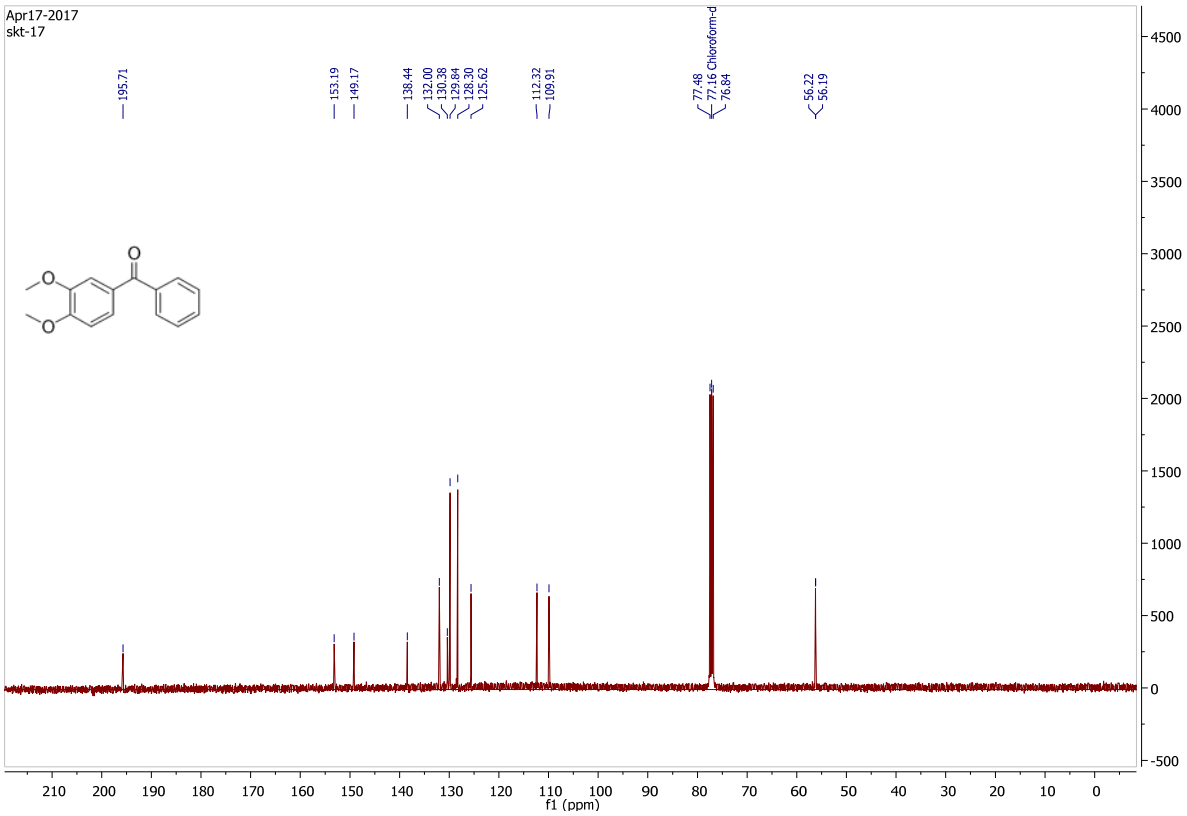
^{1}H and ^{13}C spectra of 1-(3,4-Dimethoxyphenyl)ethan-1-one (3s)



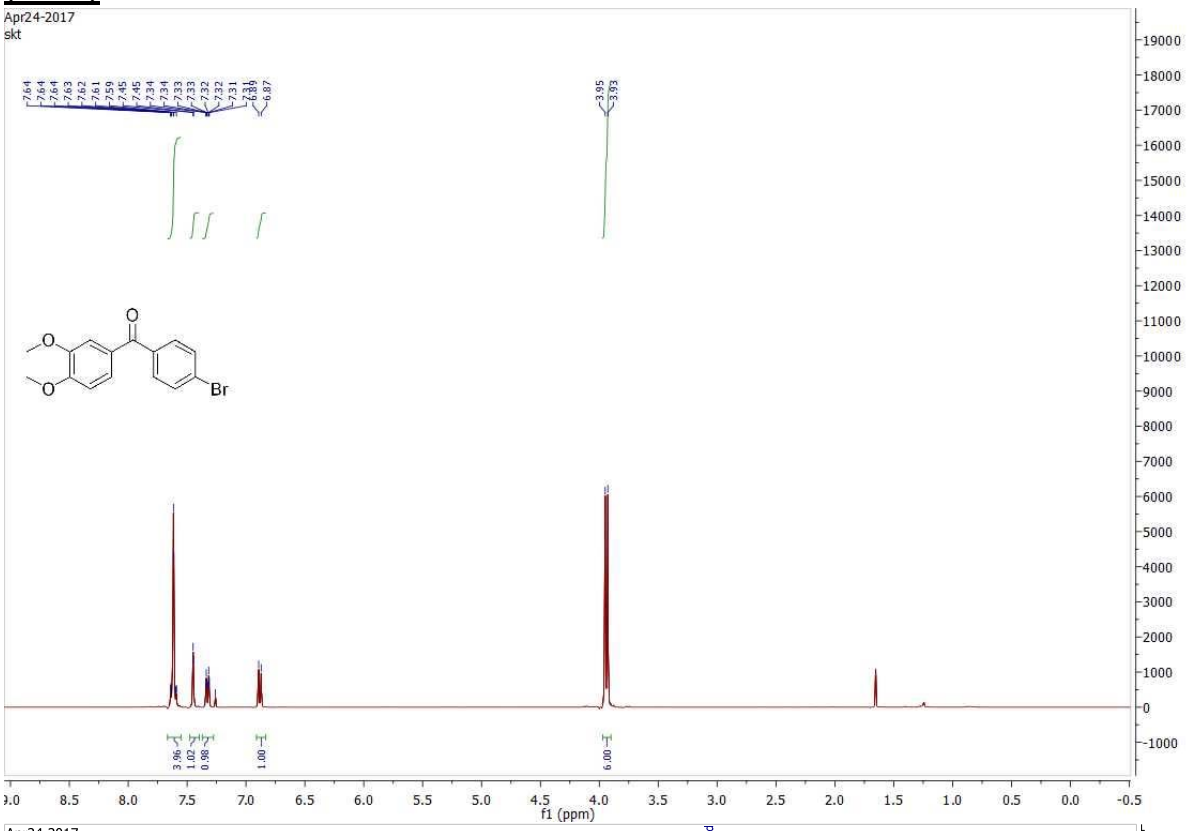


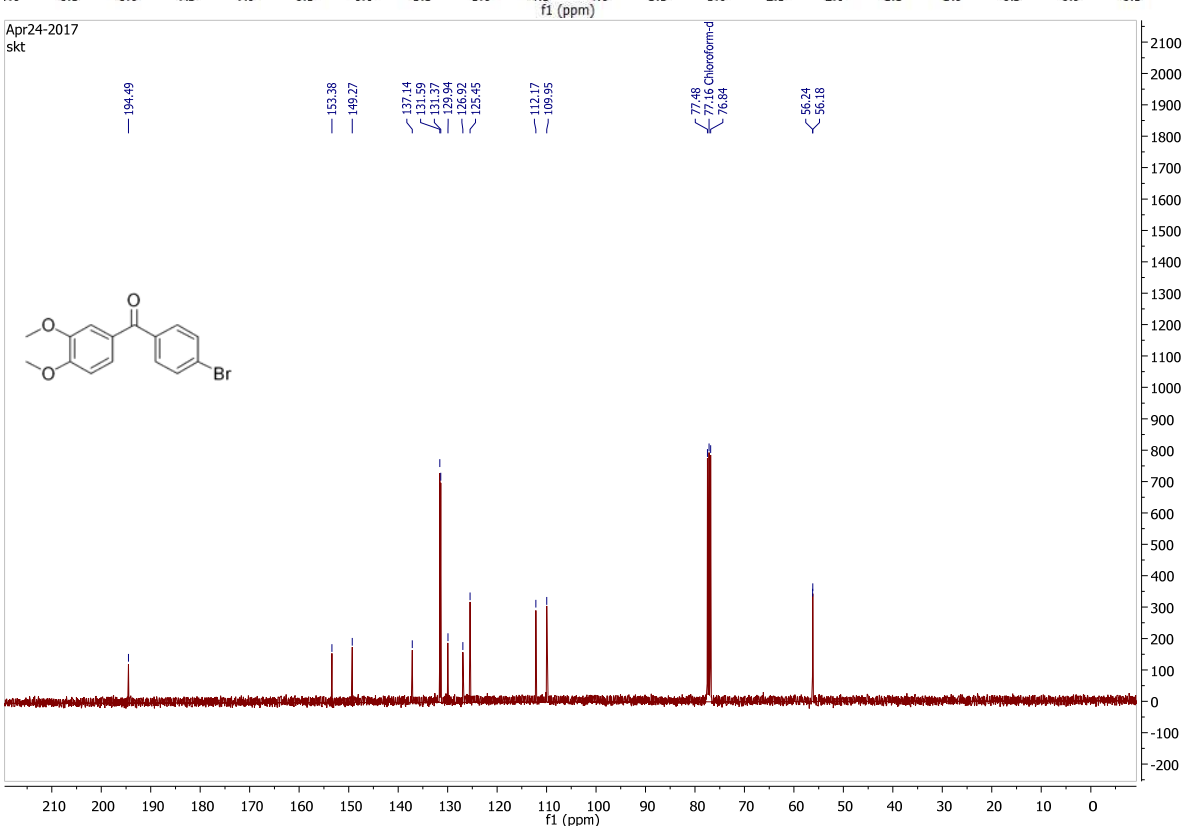
^{1}H and ^{13}C spectra of (3,4-Dimethoxyphenyl)(phenyl)methanone (3az)



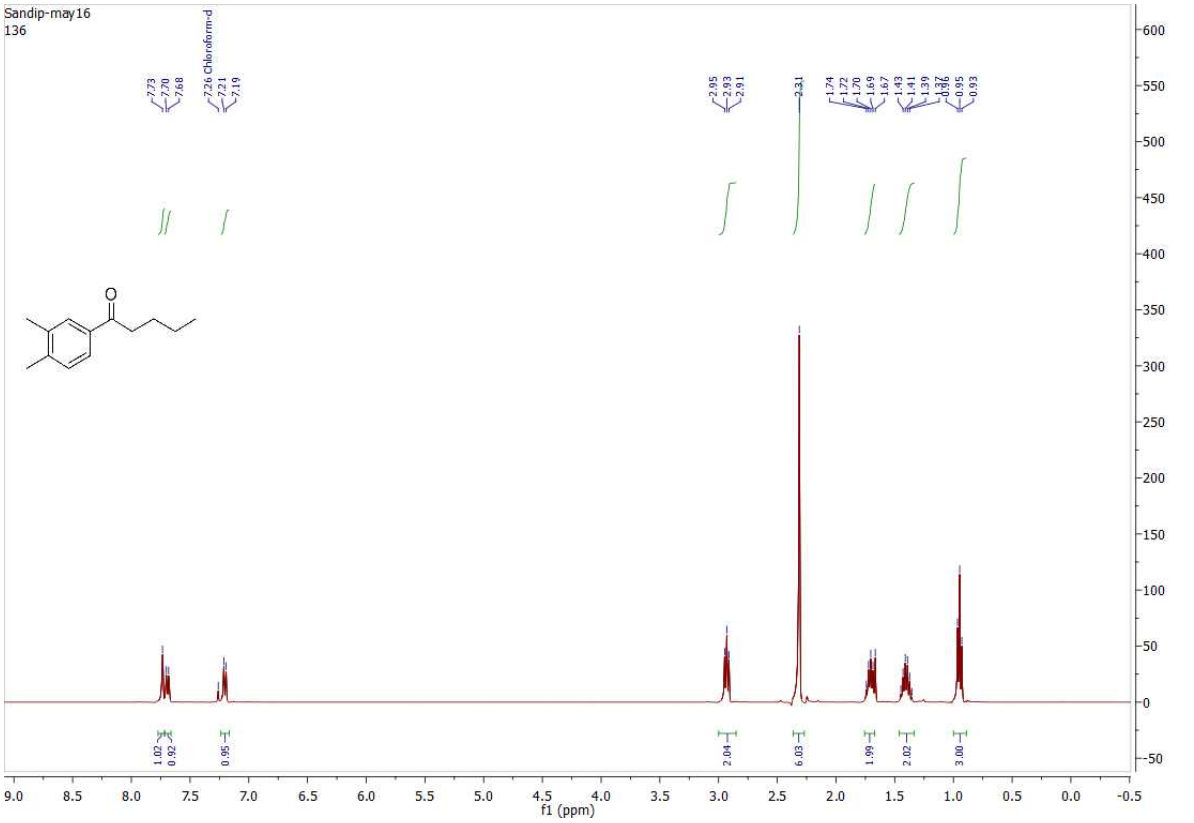


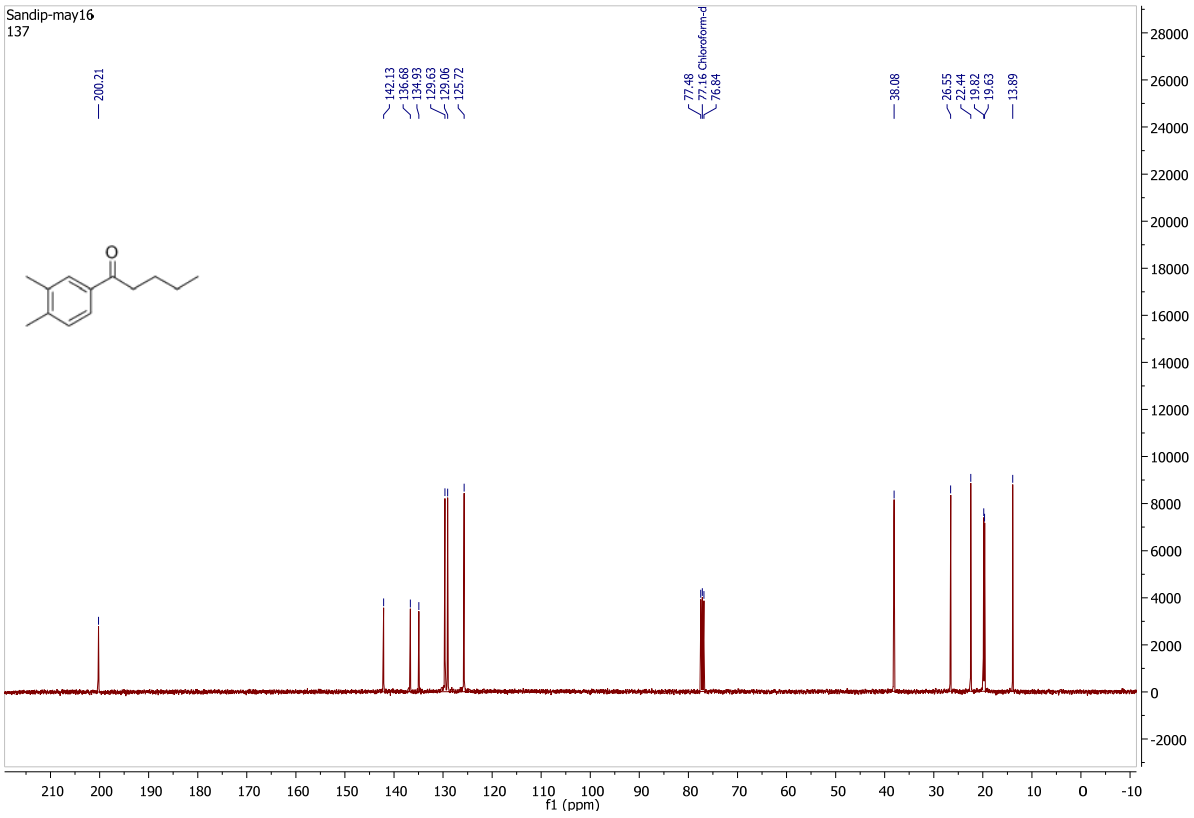
^{1}H and ^{13}C spectra of (4-Bromophenyl)(3,4-dimethoxyphenyl)methanone (3ak')



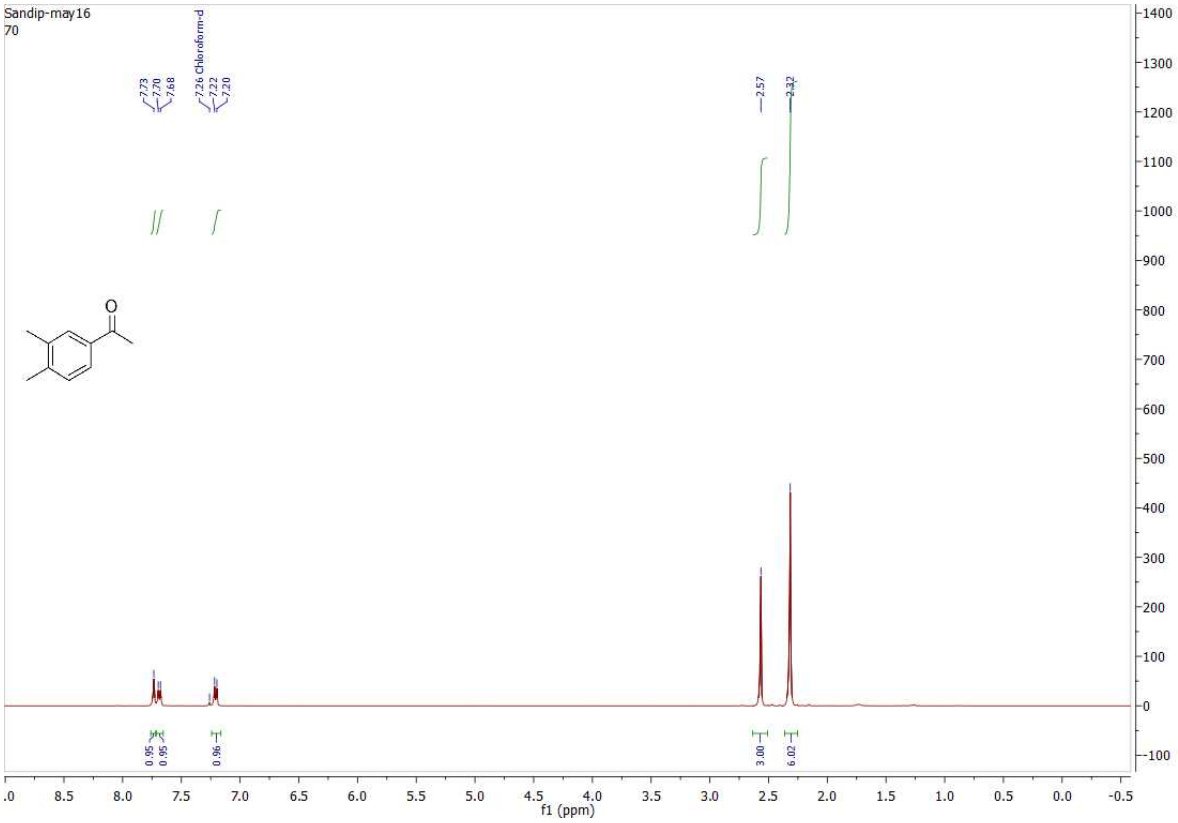


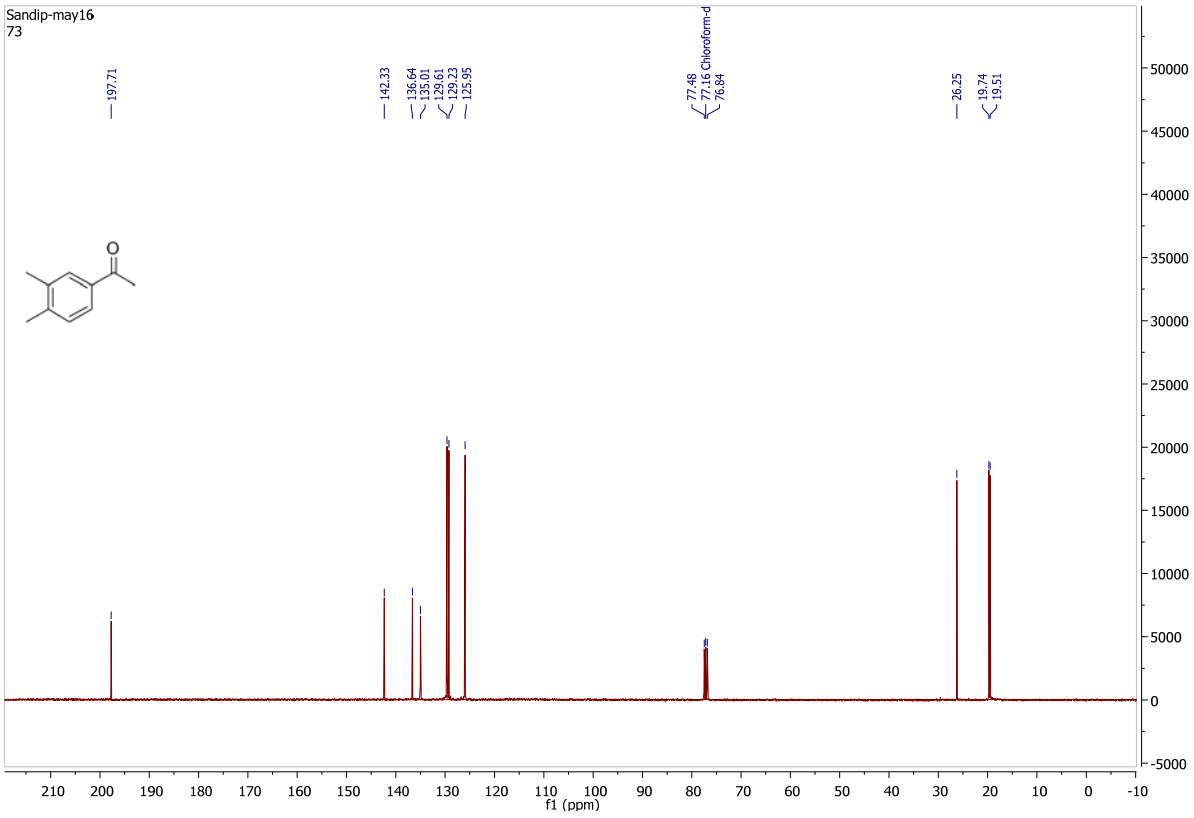
^{1}H and ^{13}C spectra of 1-(3,4-Dimethylphenyl)pentan-1-one) (3i)



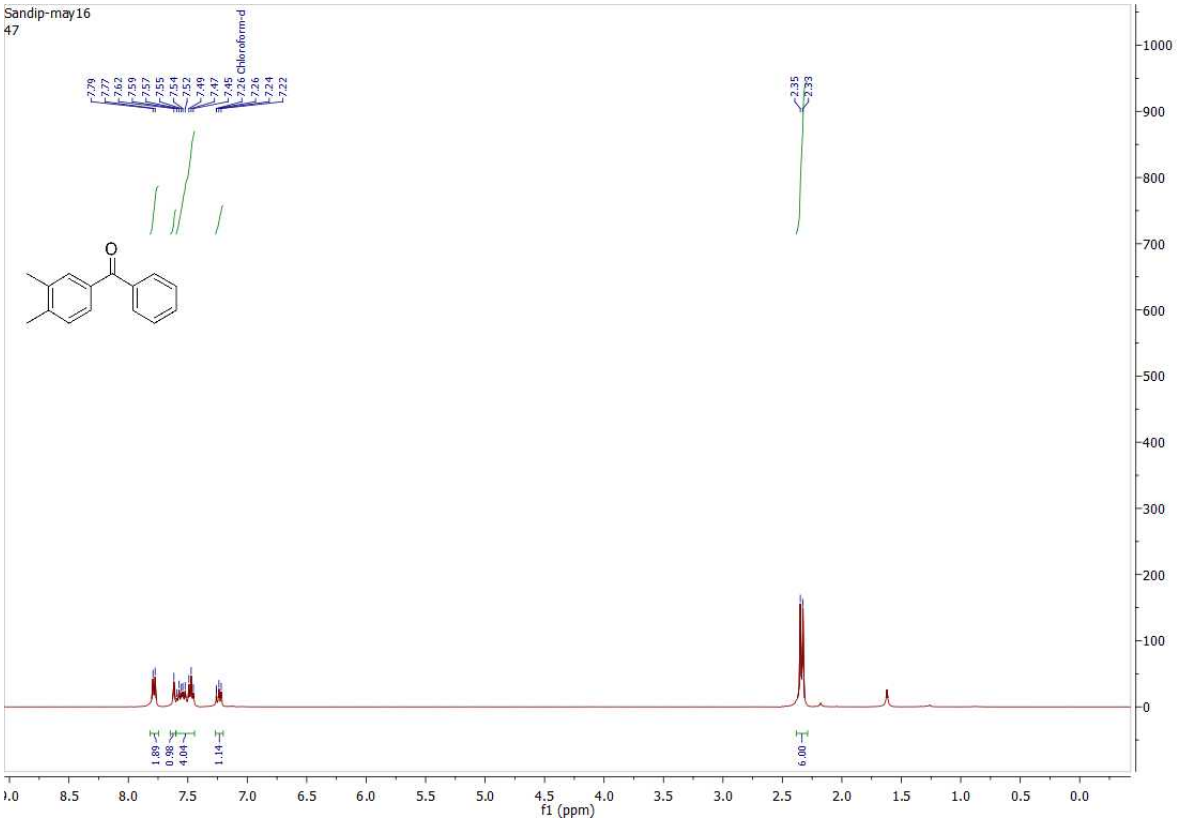


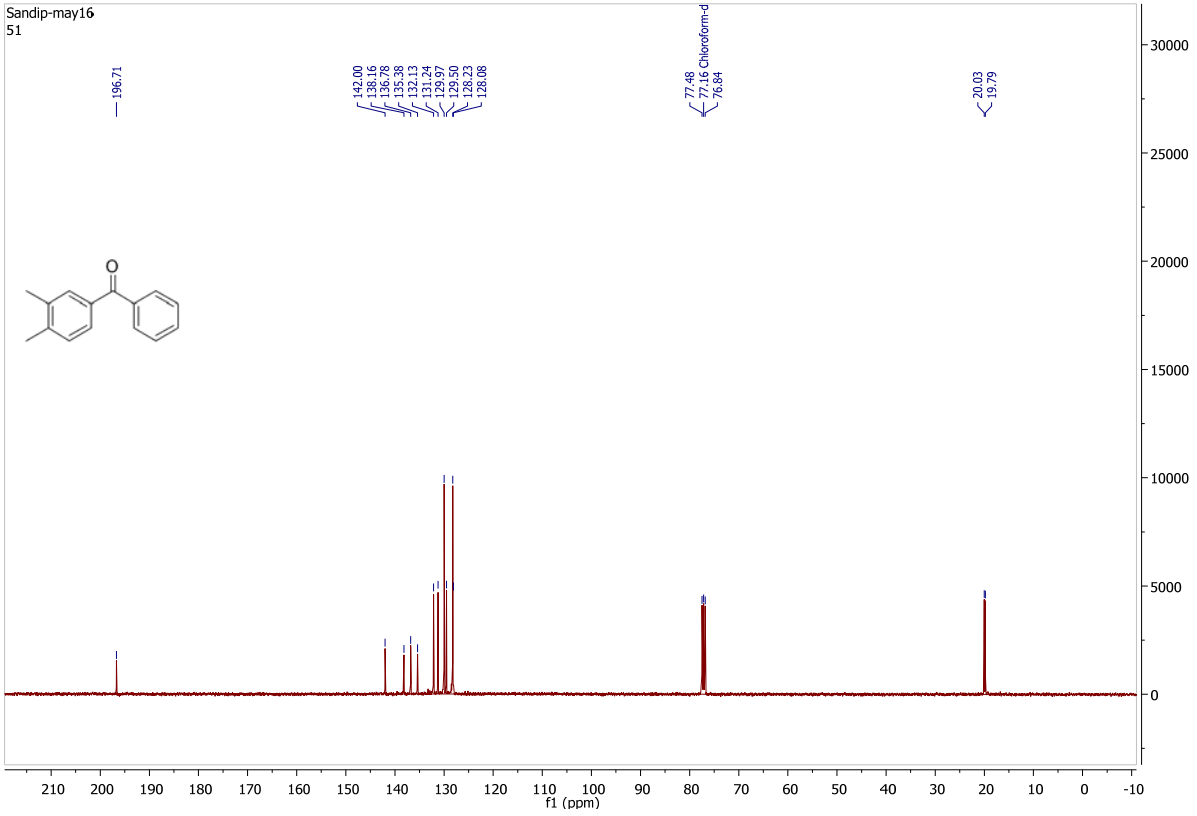
^{1}H and ^{13}C spectra of 1-(3,4-Dimethylphenyl)ethan-1-one) (3t)



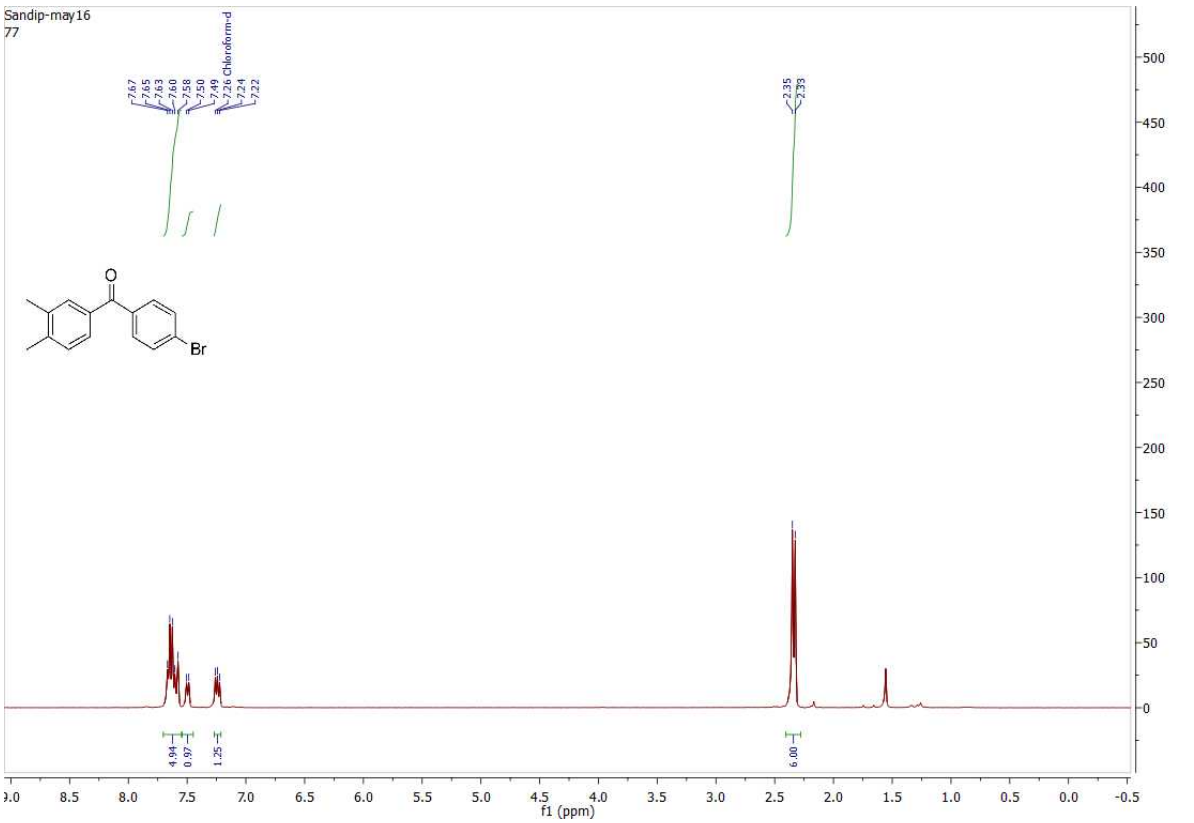


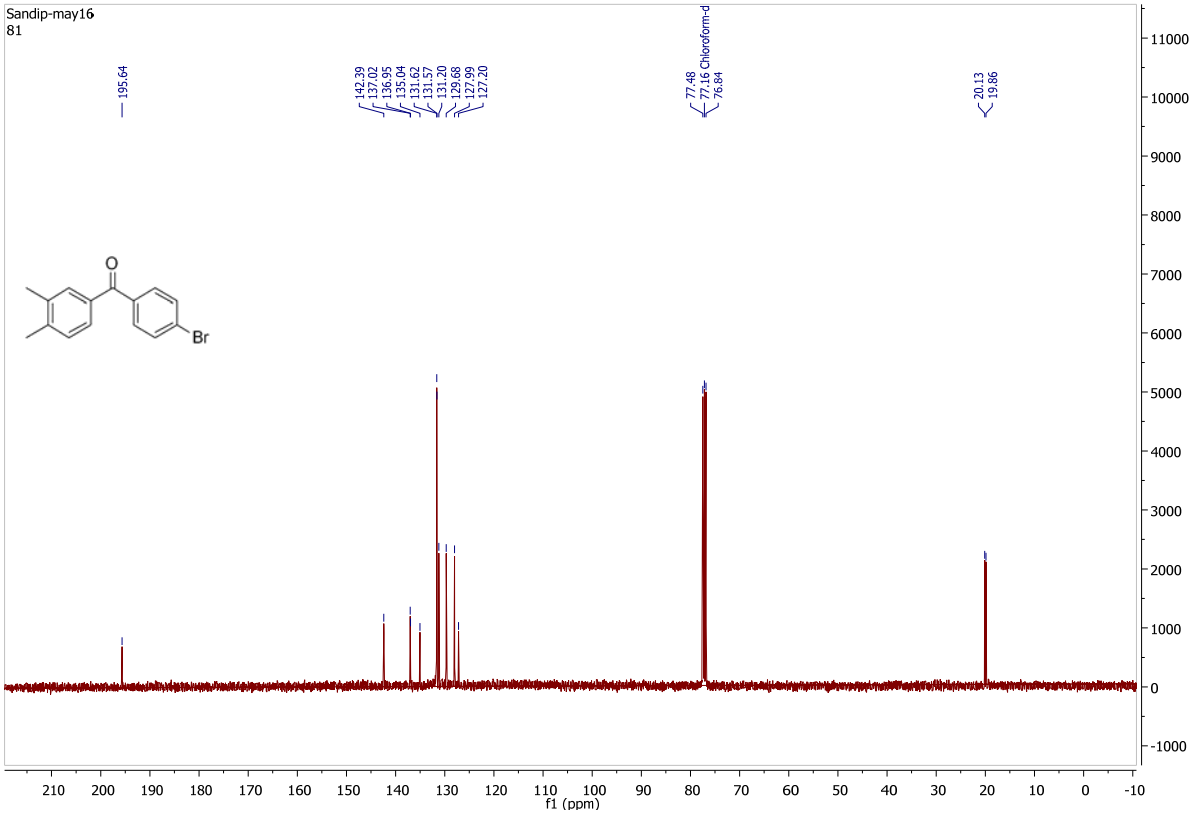
^{1}H and ^{13}C spectra of (3,4-Dimethylphenyl)(phenyl)methanone) (3aa')



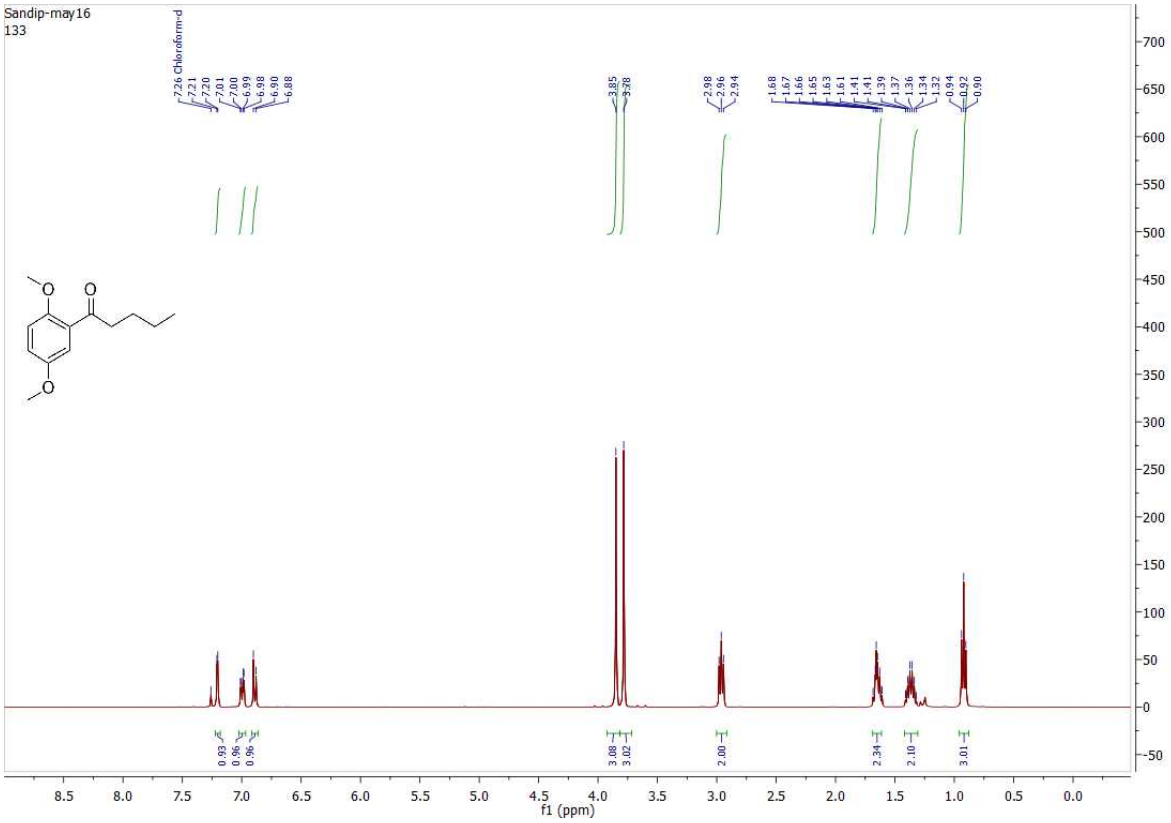


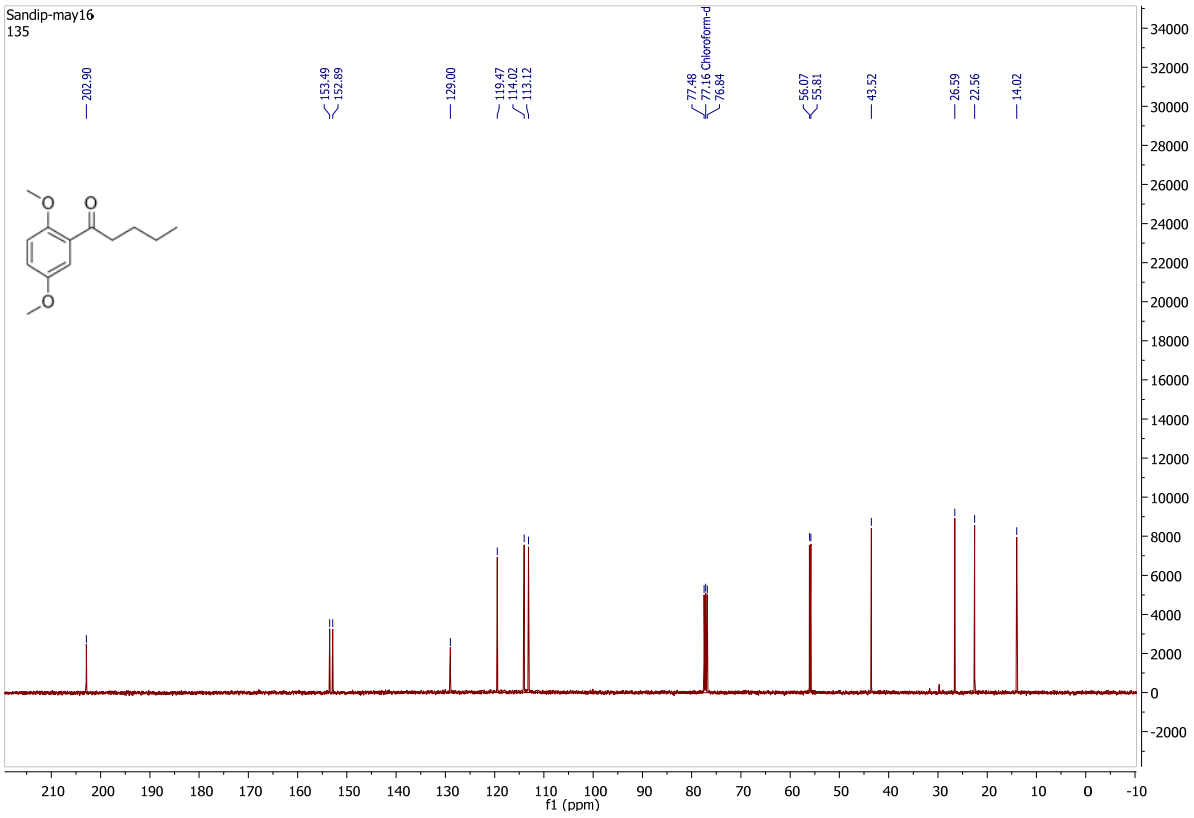
^{1}H and ^{13}C spectra of (4-Bromophenyl)(3,4-dimethylphenyl)methanone) (3al')



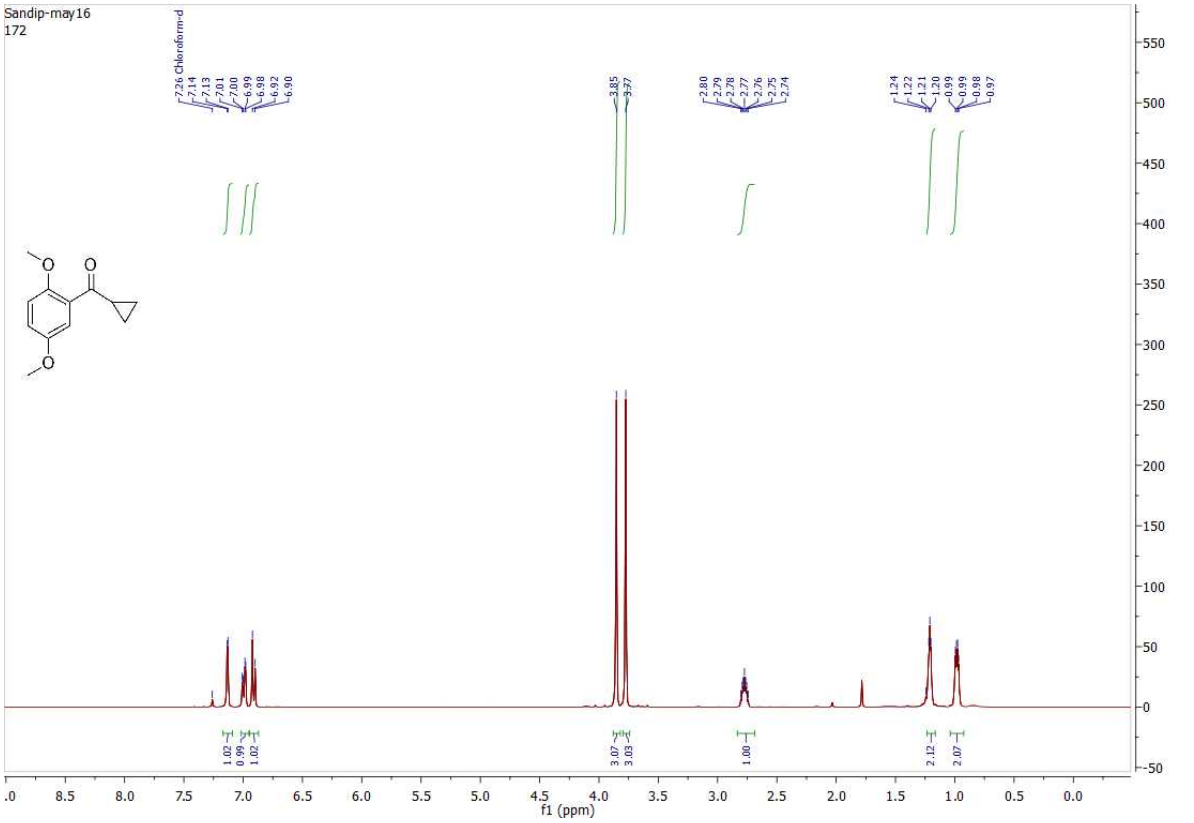


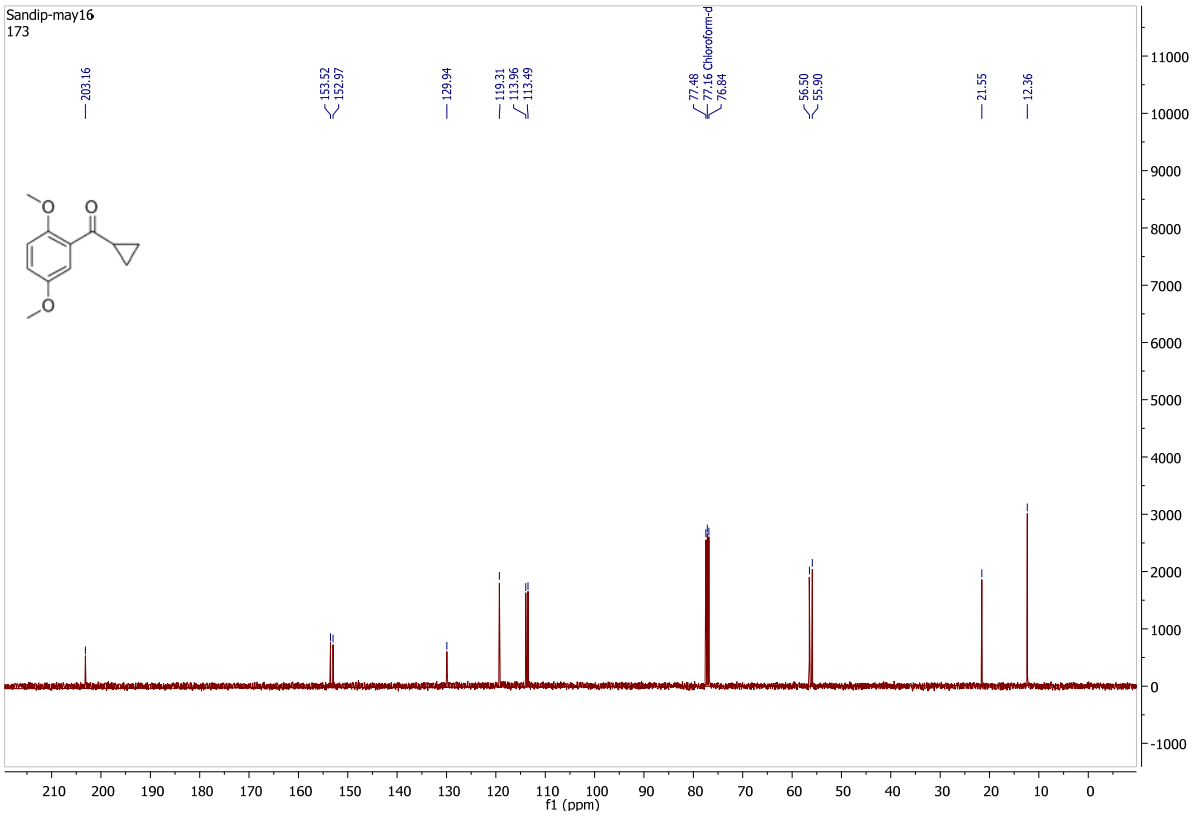
^{1}H and ^{13}C spectra of 1-(2,5-Dimethoxyphenyl)pentan-1-one (3j)



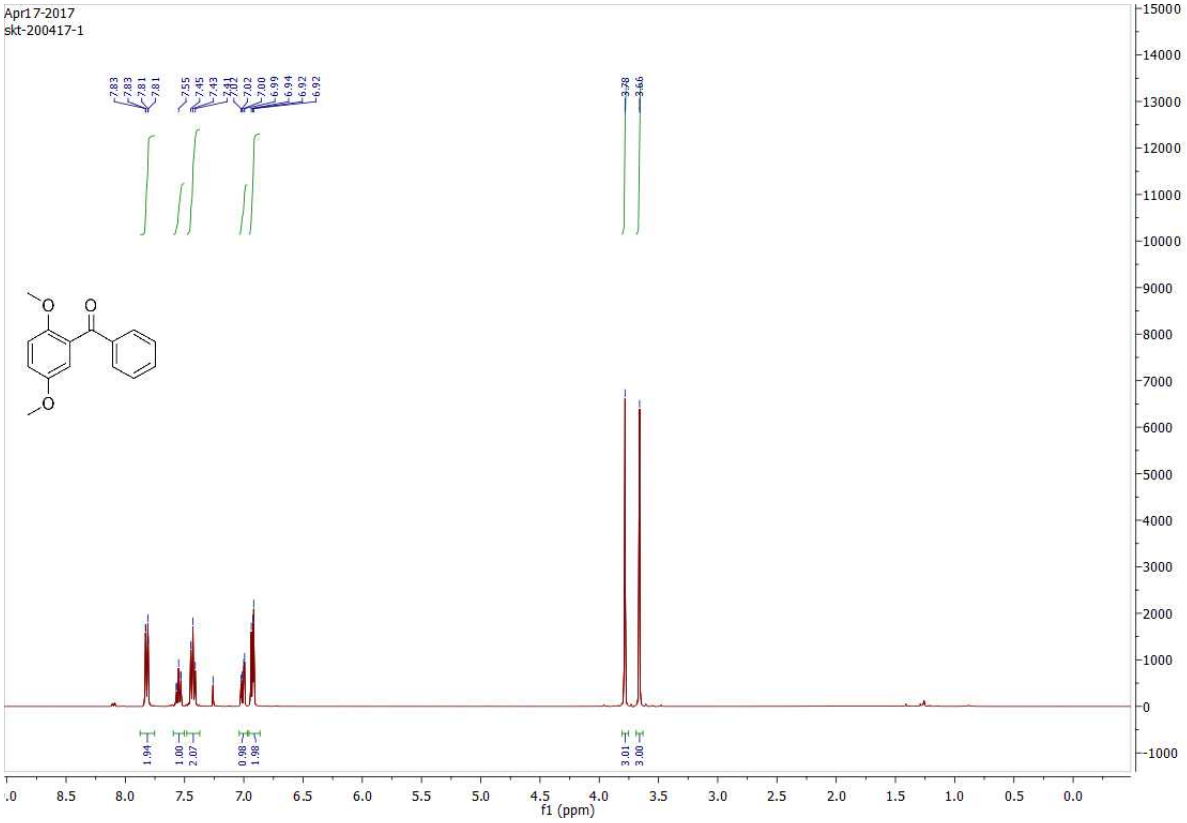


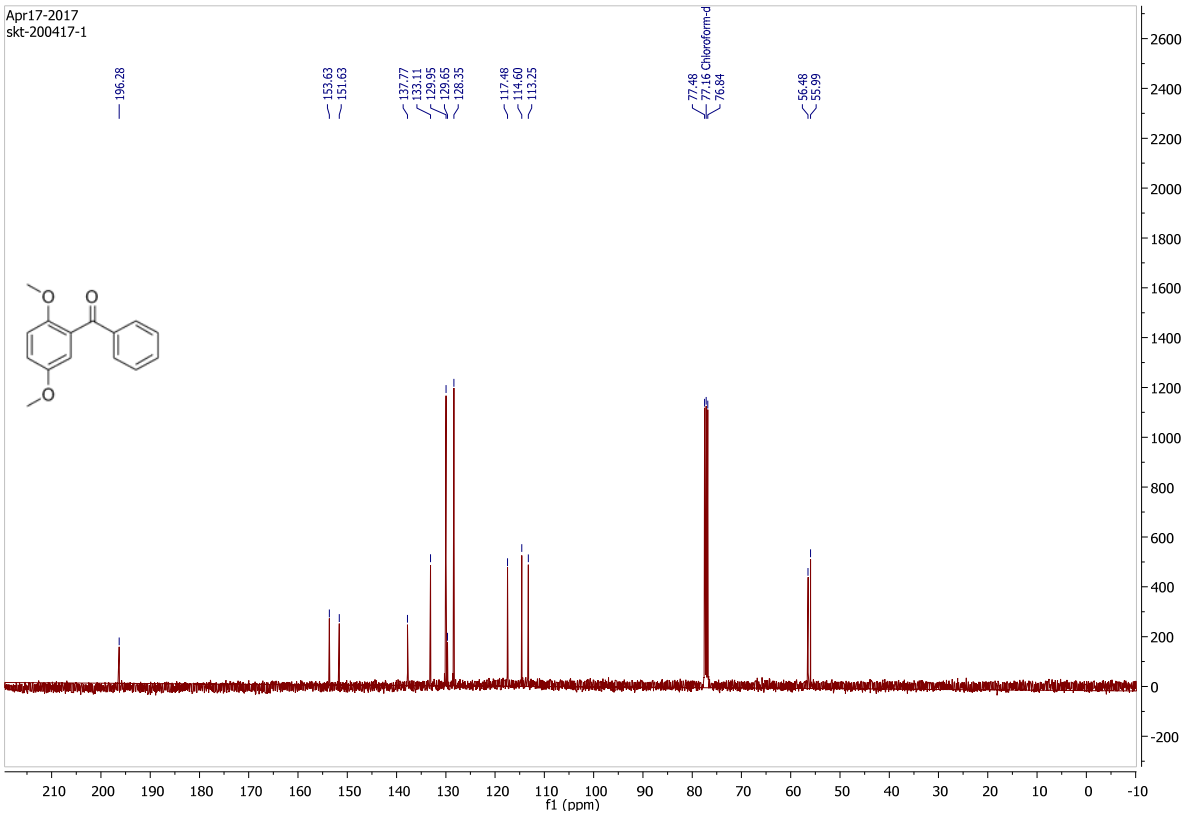
^{1}H and ^{13}C spectra of Cyclopropyl(2,5-dimethoxyphenyl)methanone (3aq)



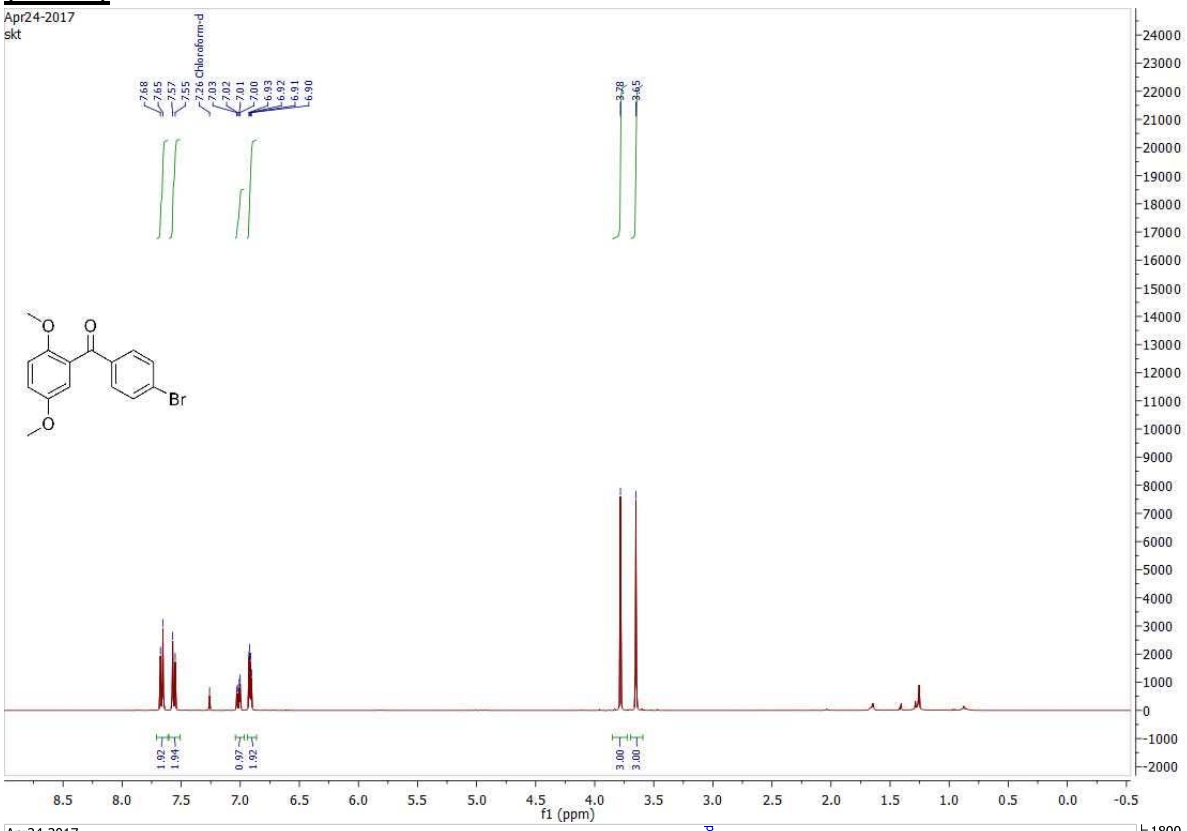


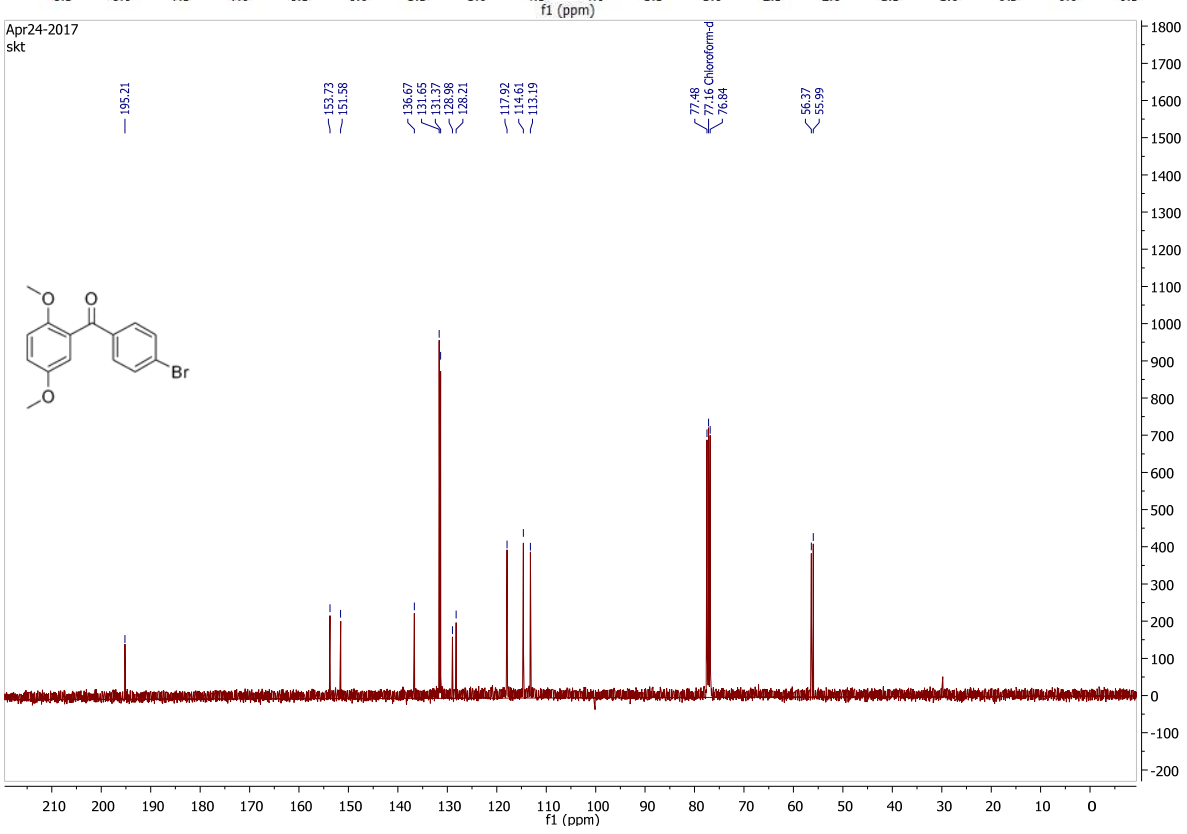
^{1}H and ^{13}C spectra of (2,5-Dimethoxyphenyl)(phenyl)methanone (3ab')



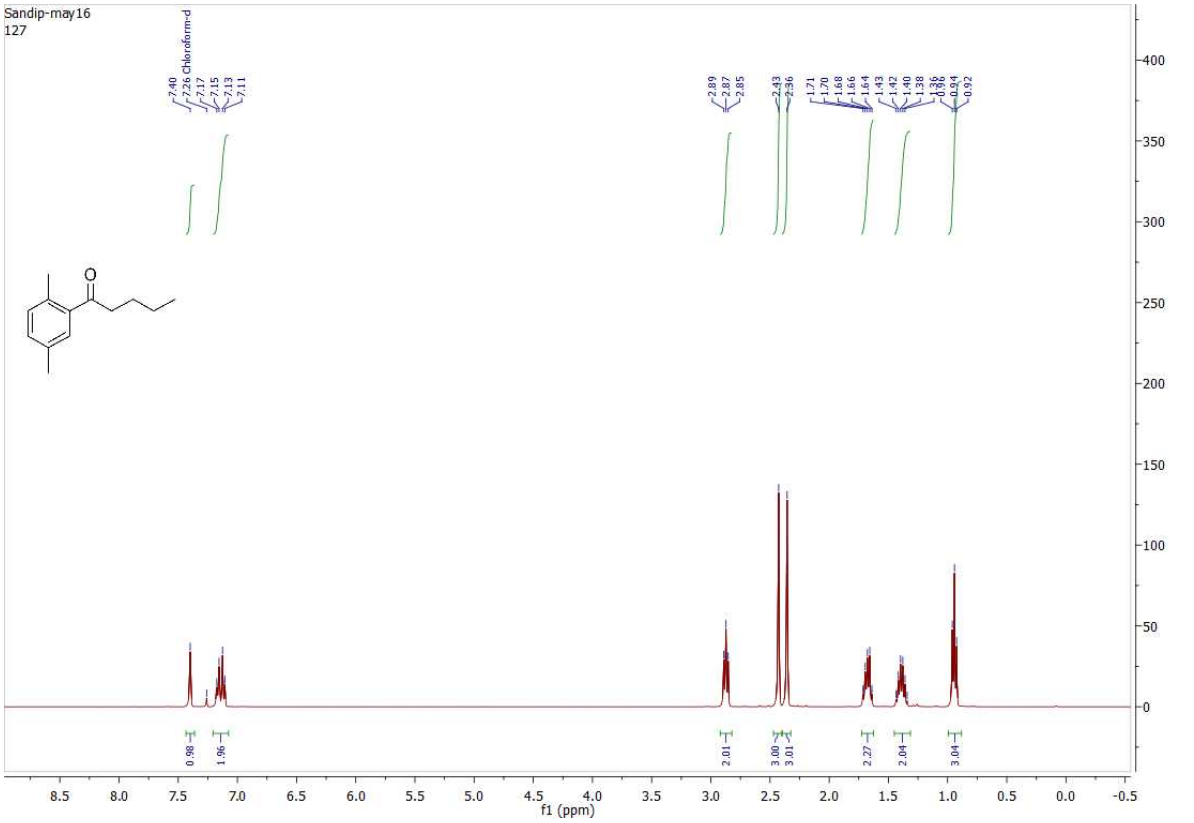


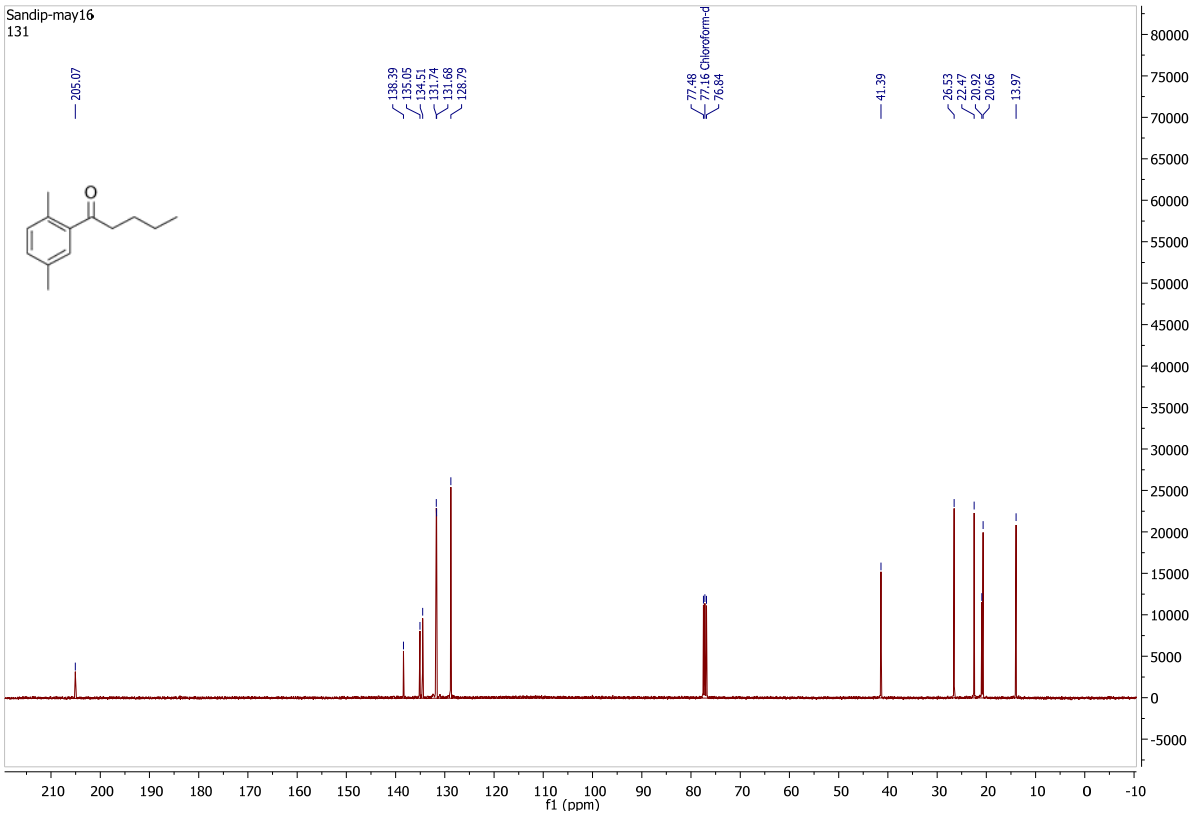
^{1}H and ^{13}C spectra of (4-Bromophenyl)(2,5-dimethoxyphenyl)methanone (3am')



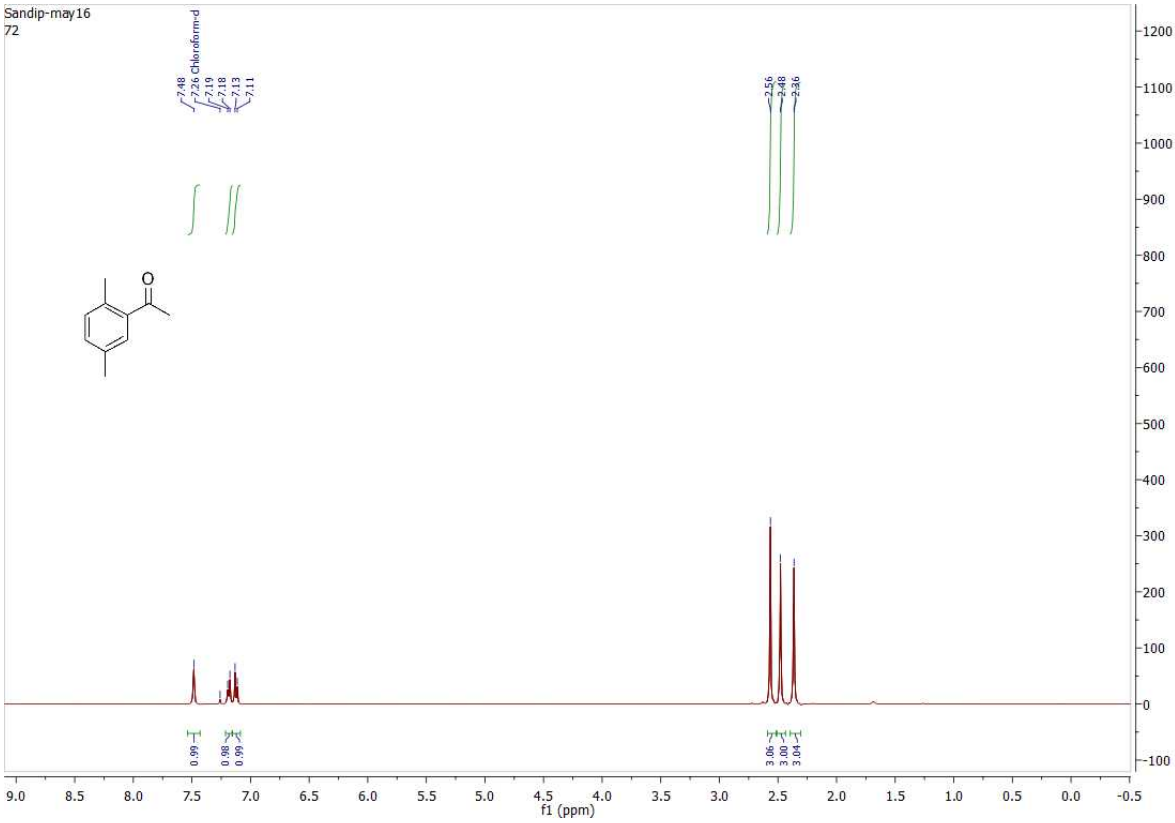


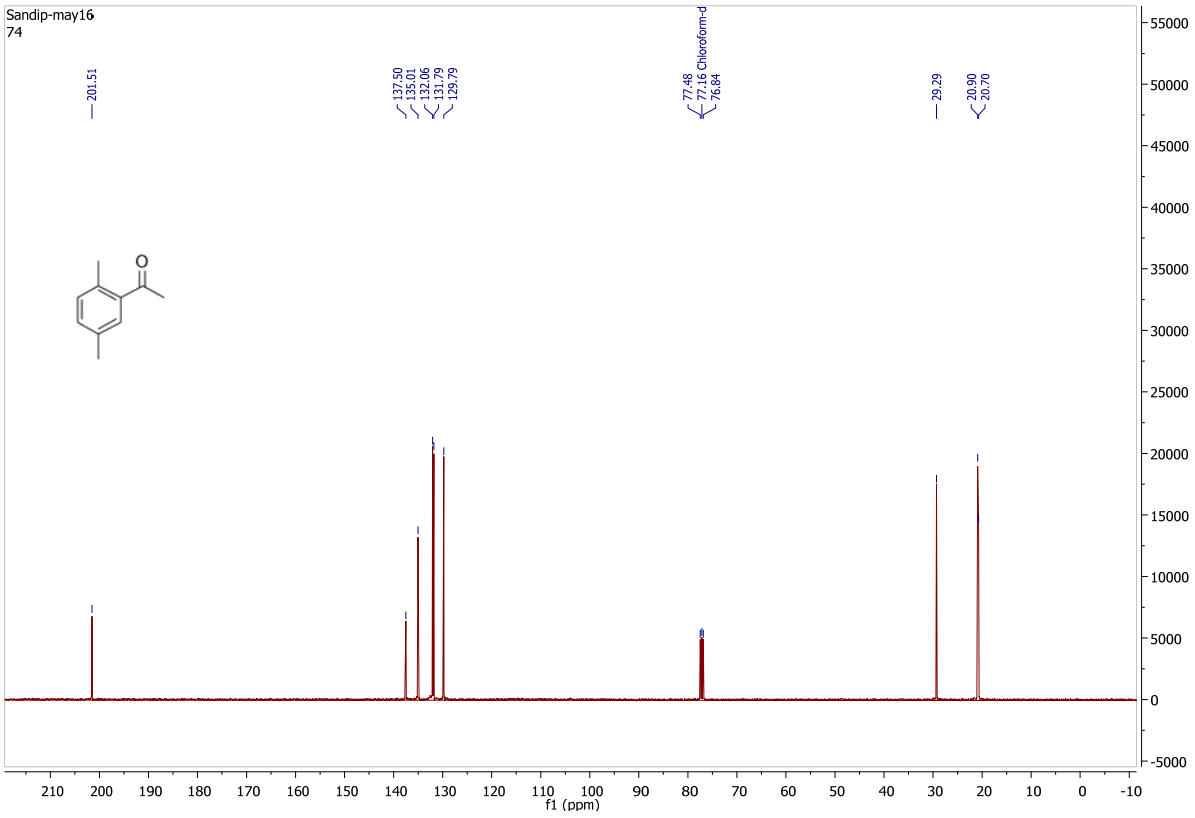
^{1}H and ^{13}C spectra of 1-(2,5-Dimethylphenyl)pentan-1-one (3k)



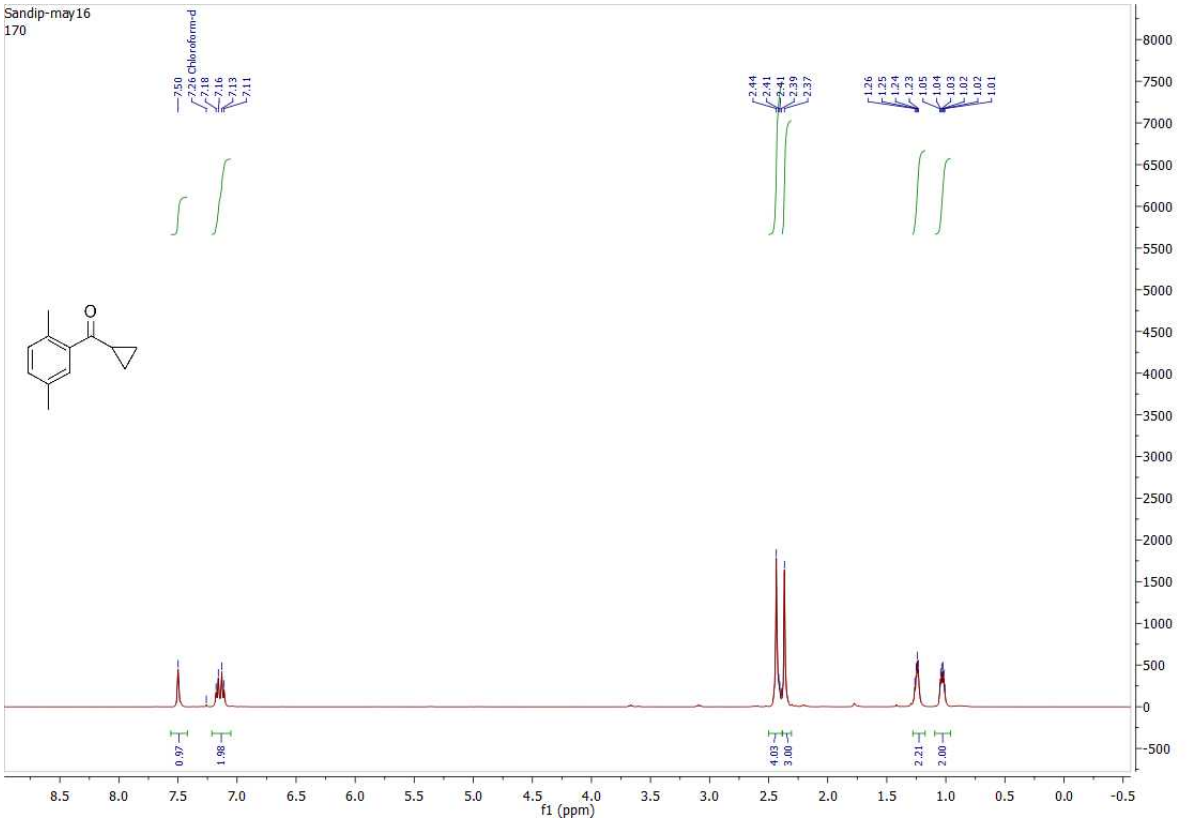


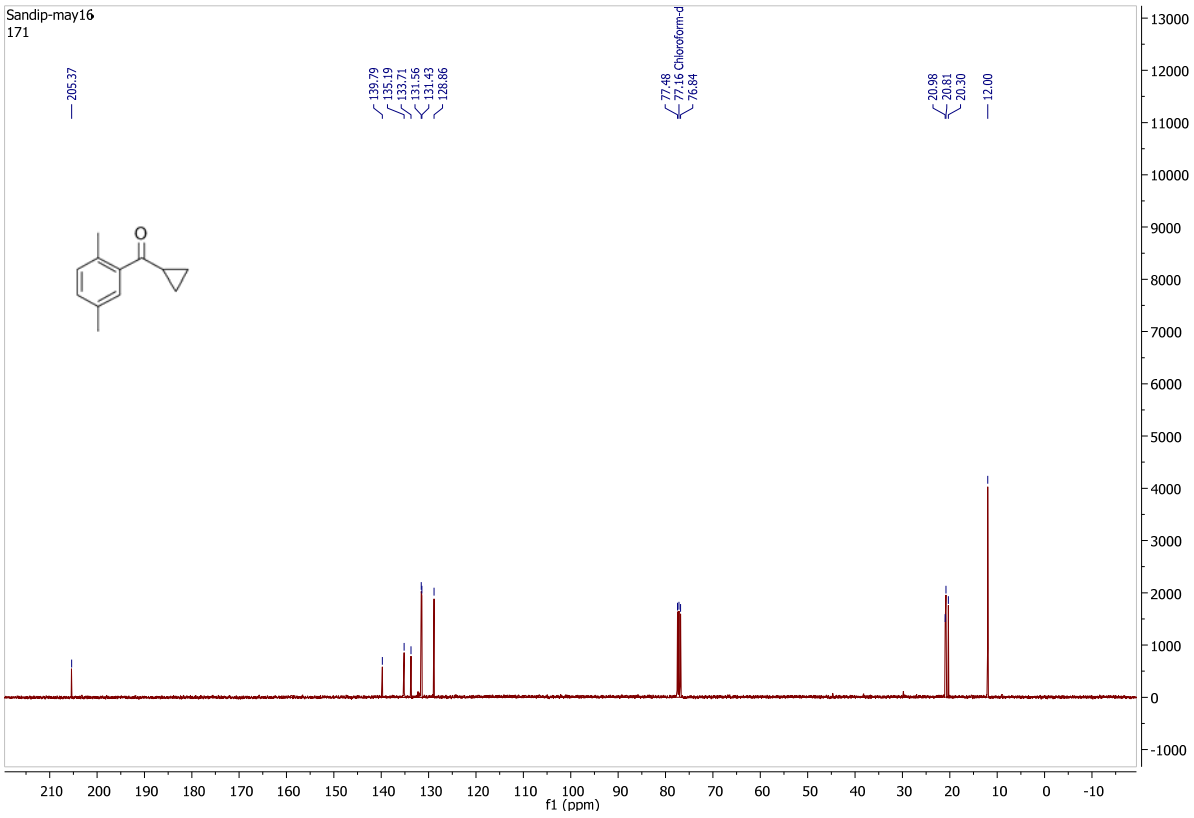
^{1}H and ^{13}C spectra of 1-(2,5-Dimethylphenyl)ethan-1-one (3v)



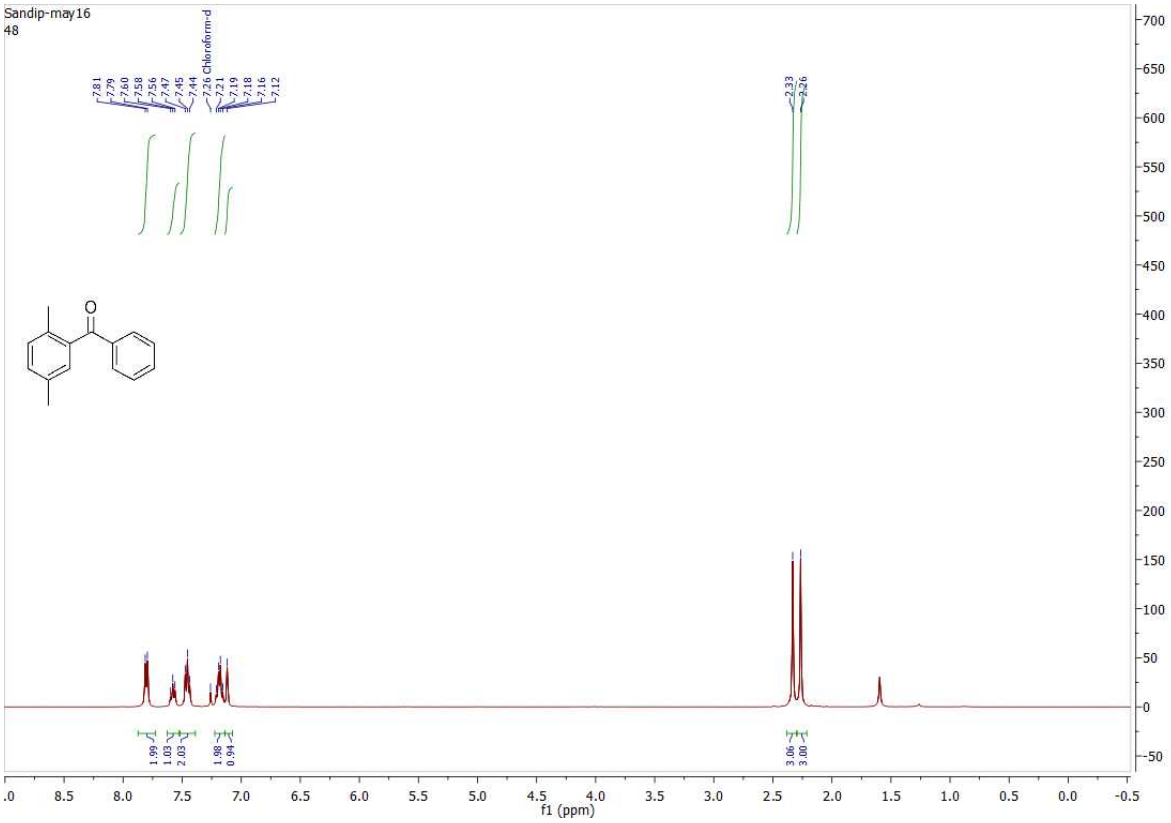


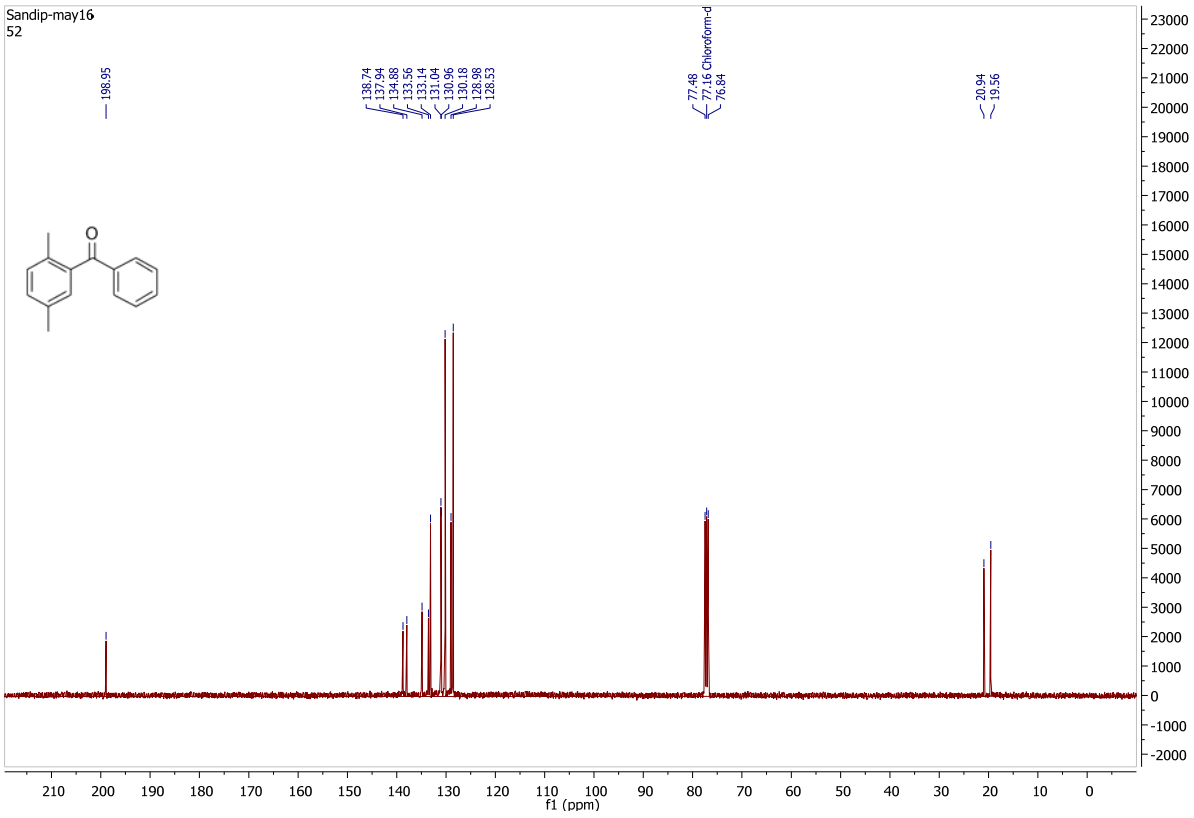
^{1}H and ^{13}C spectra of Cyclopropyl(2,5-dimethylphenyl)methanone (3ar)



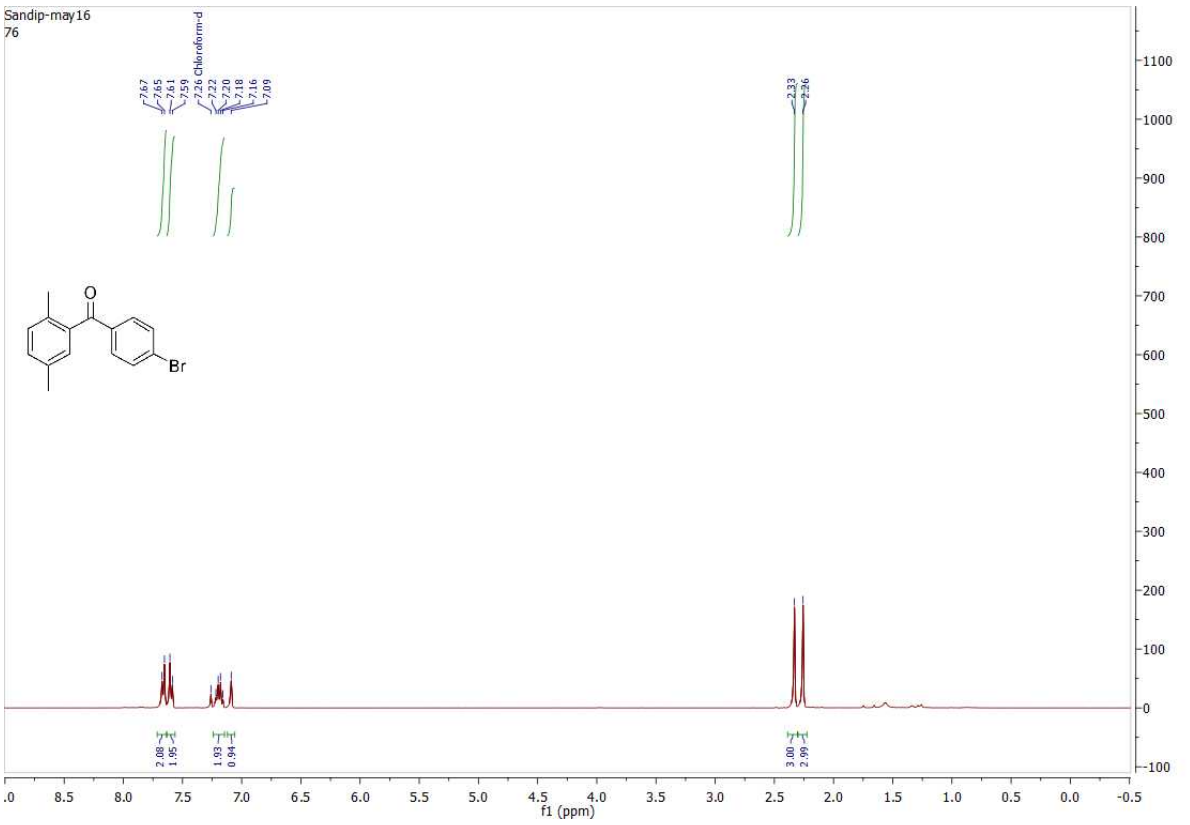


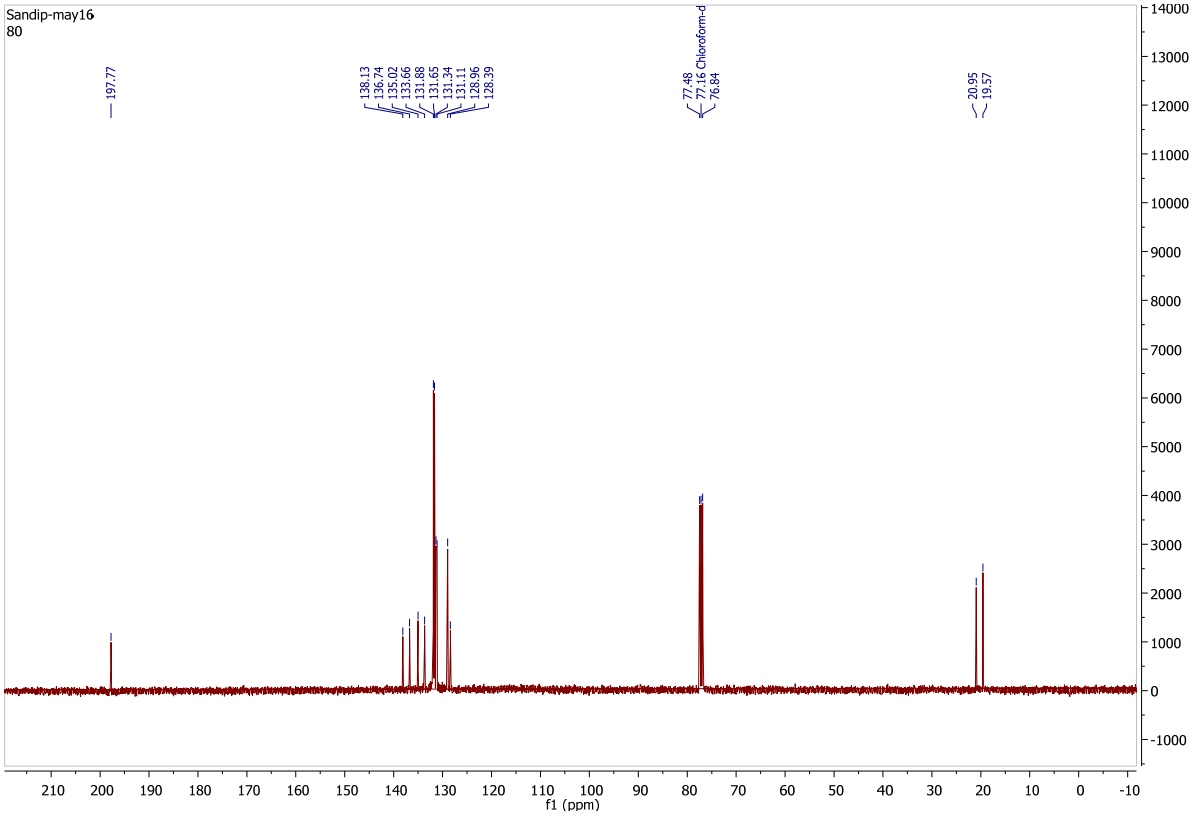
^{1}H and ^{13}C spectra of (2,5-Dimethylphenyl)(phenyl)methanone (3ac')



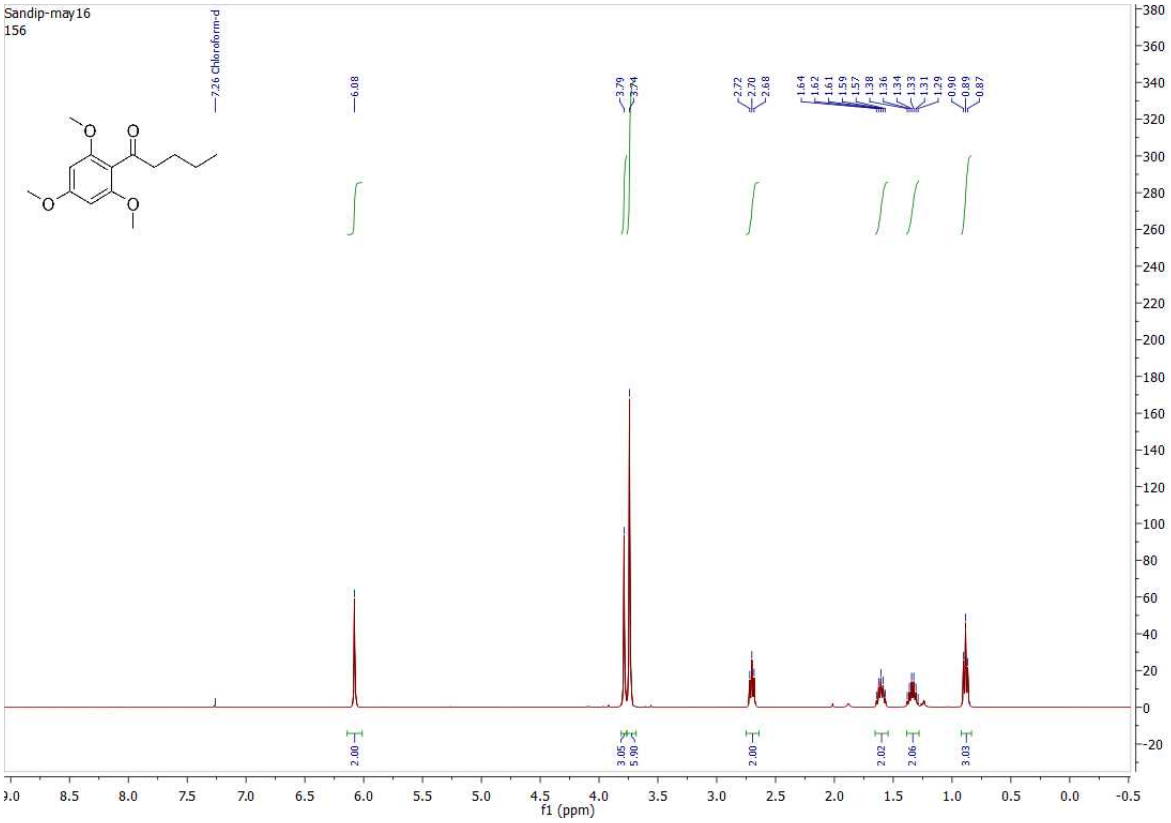


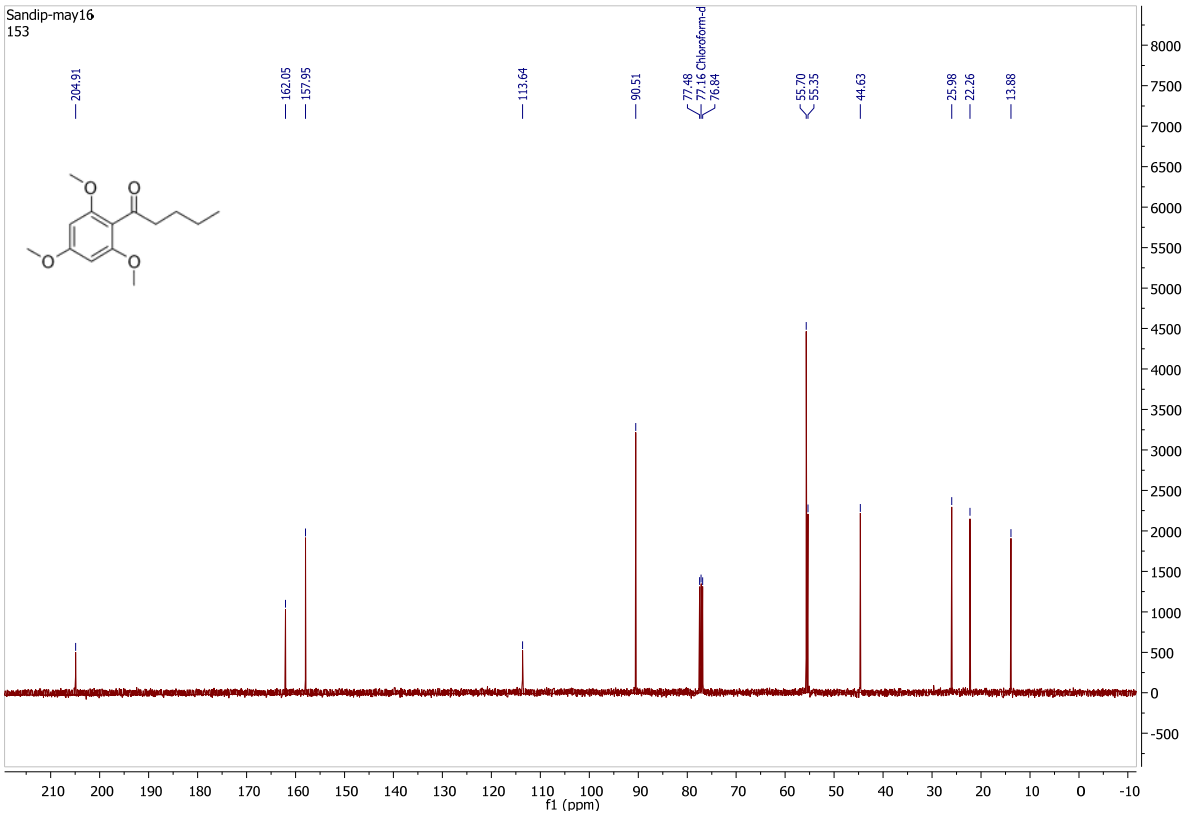
^{1}H and ^{13}C spectra of (4-Bromophenyl)(2,5-dimethylphenyl)methanone (3an')



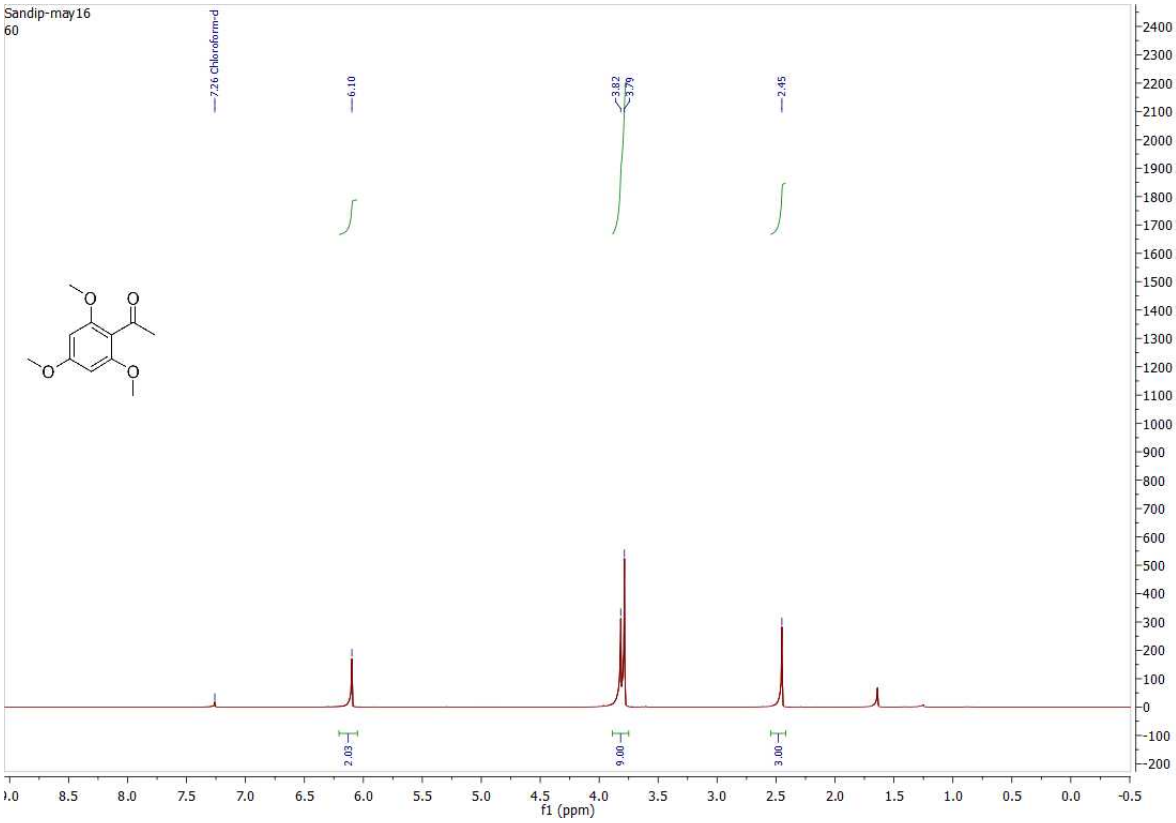


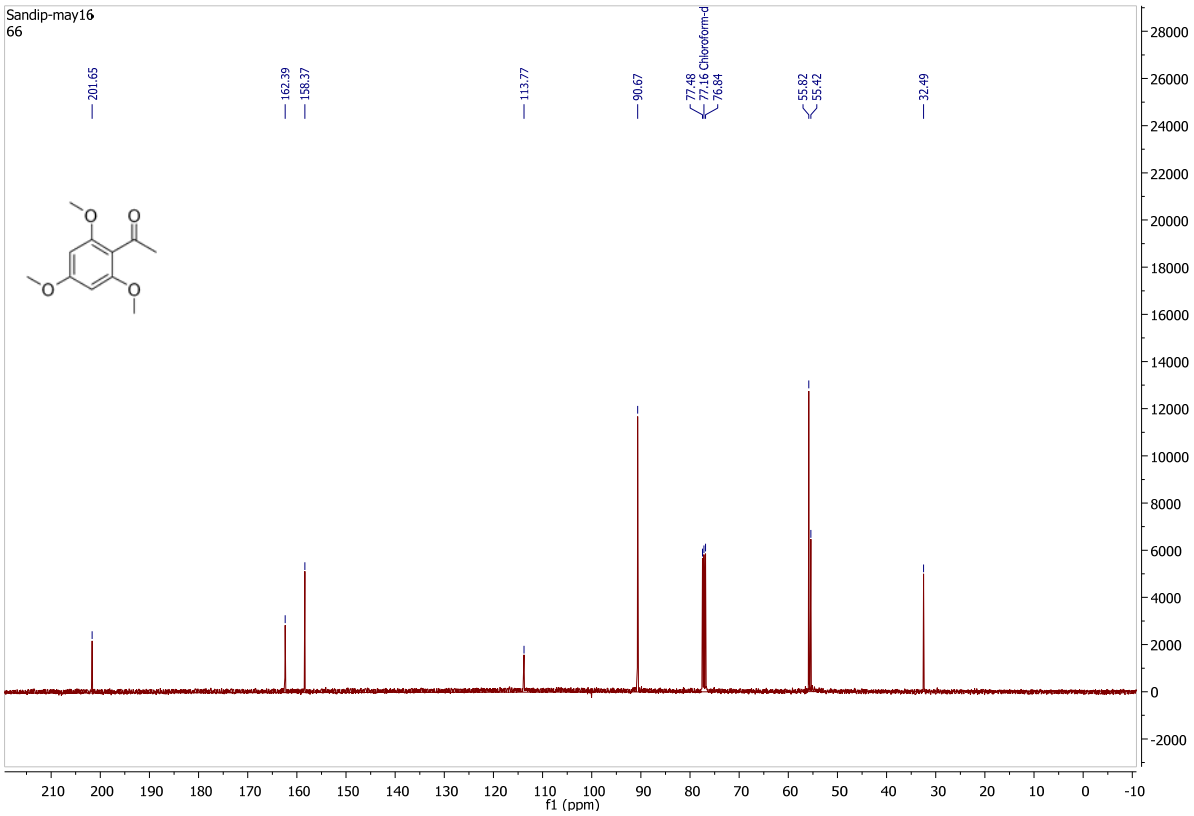
^{1}H and ^{13}C spectra of 1-(2,4,6-Trimethoxyphenyl)pentan-1-one (3l')



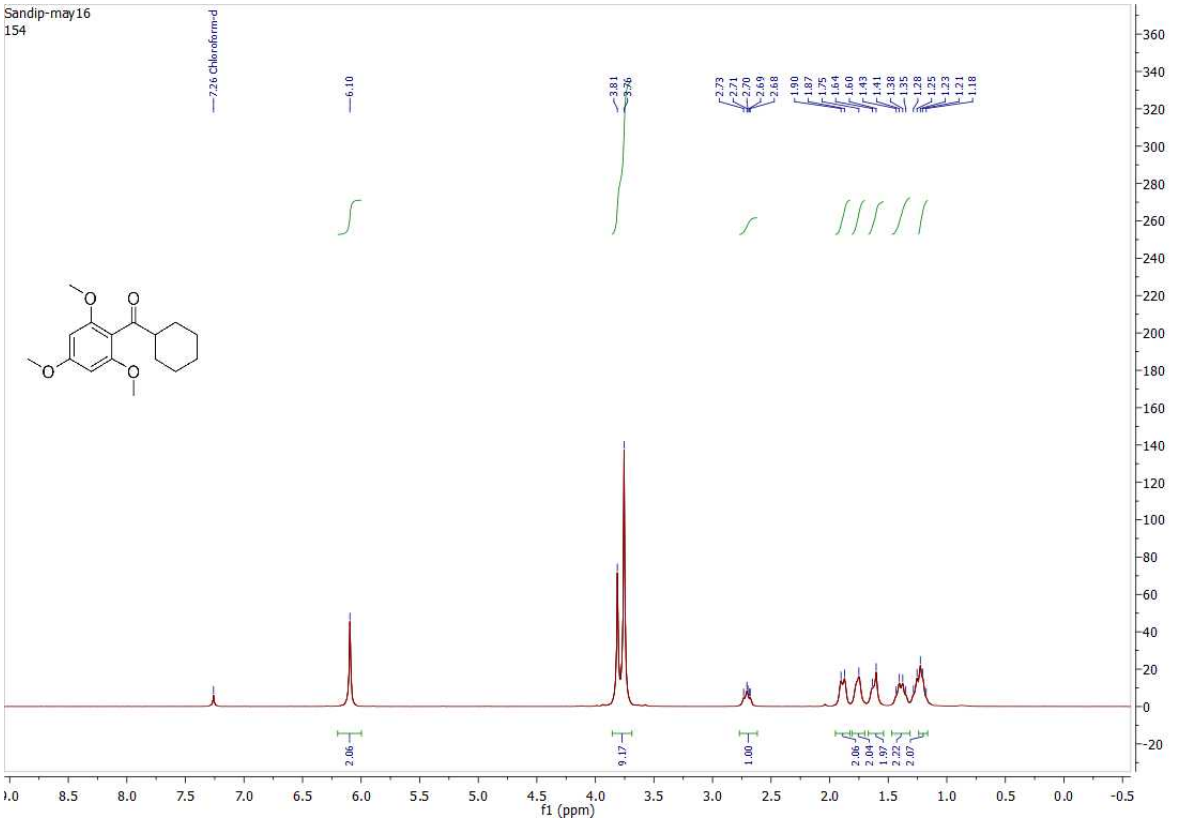


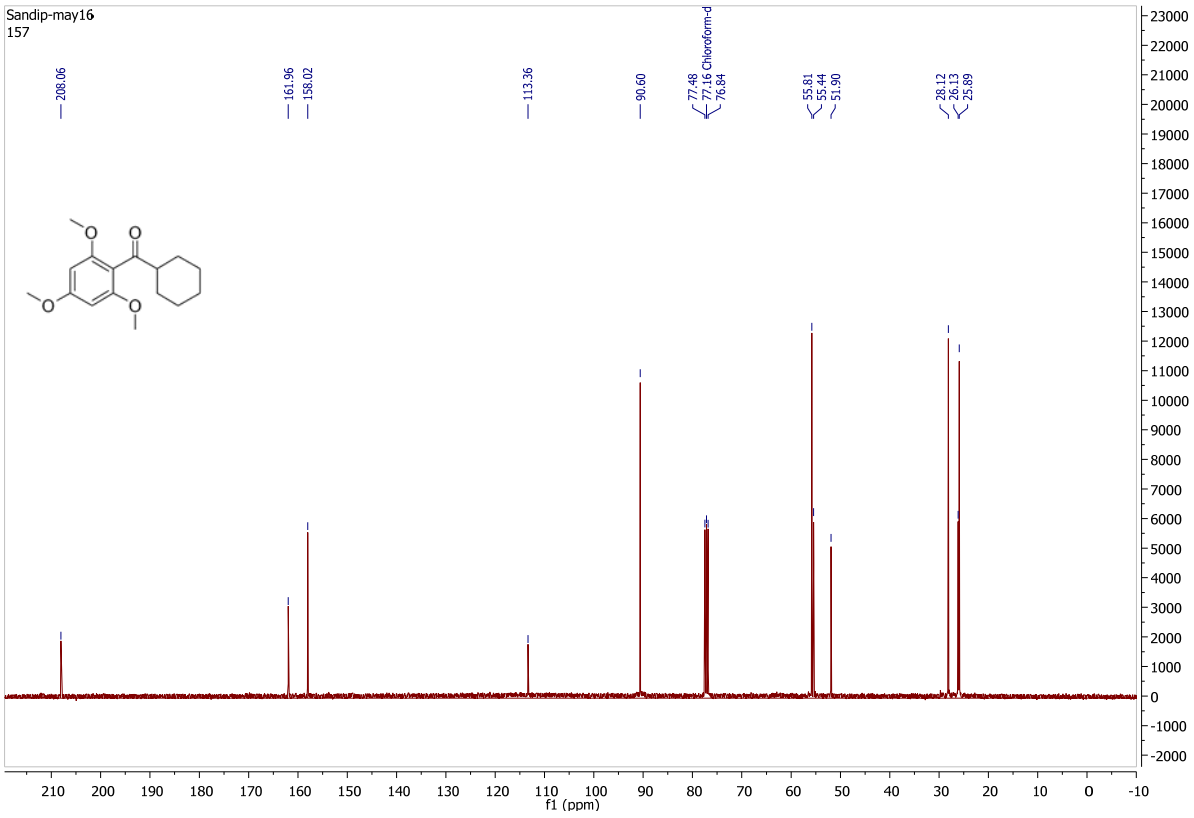
^{1}H and ^{13}C spectra of 1-(2,4,6-Trimethoxyphenyl)ethan-1-one (3w)



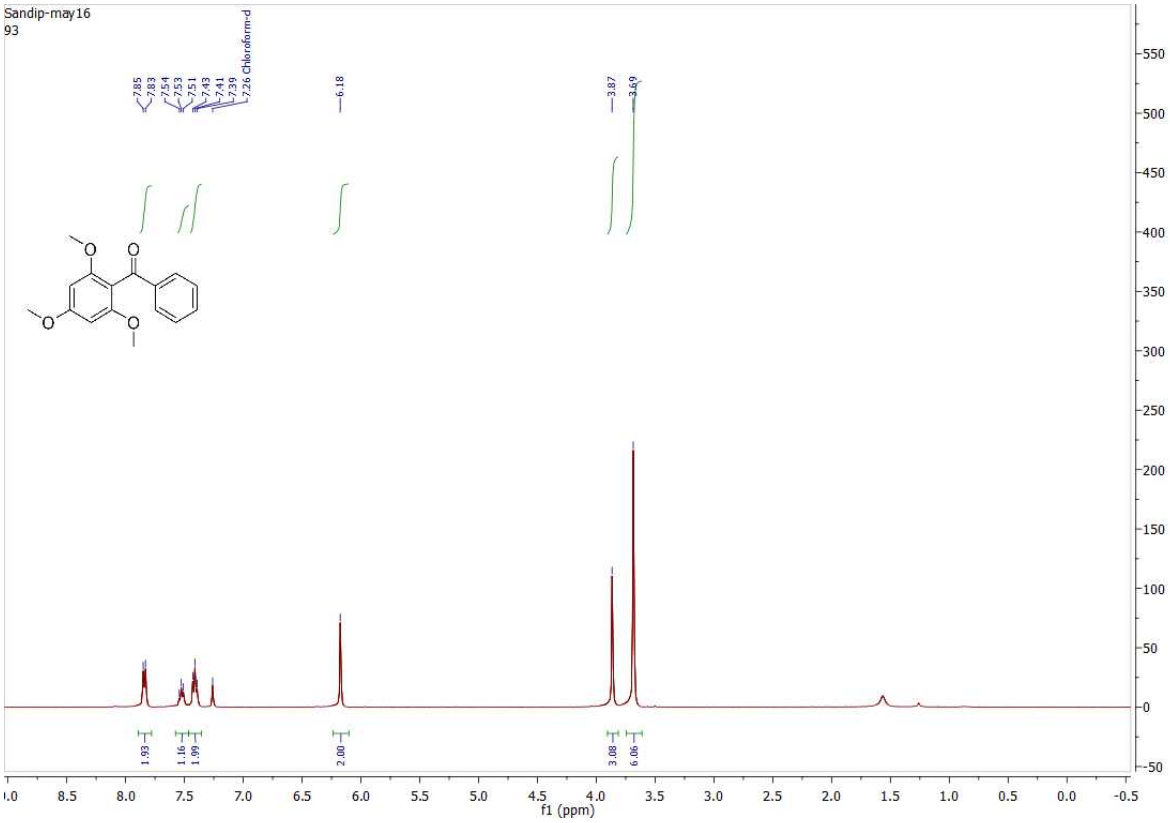


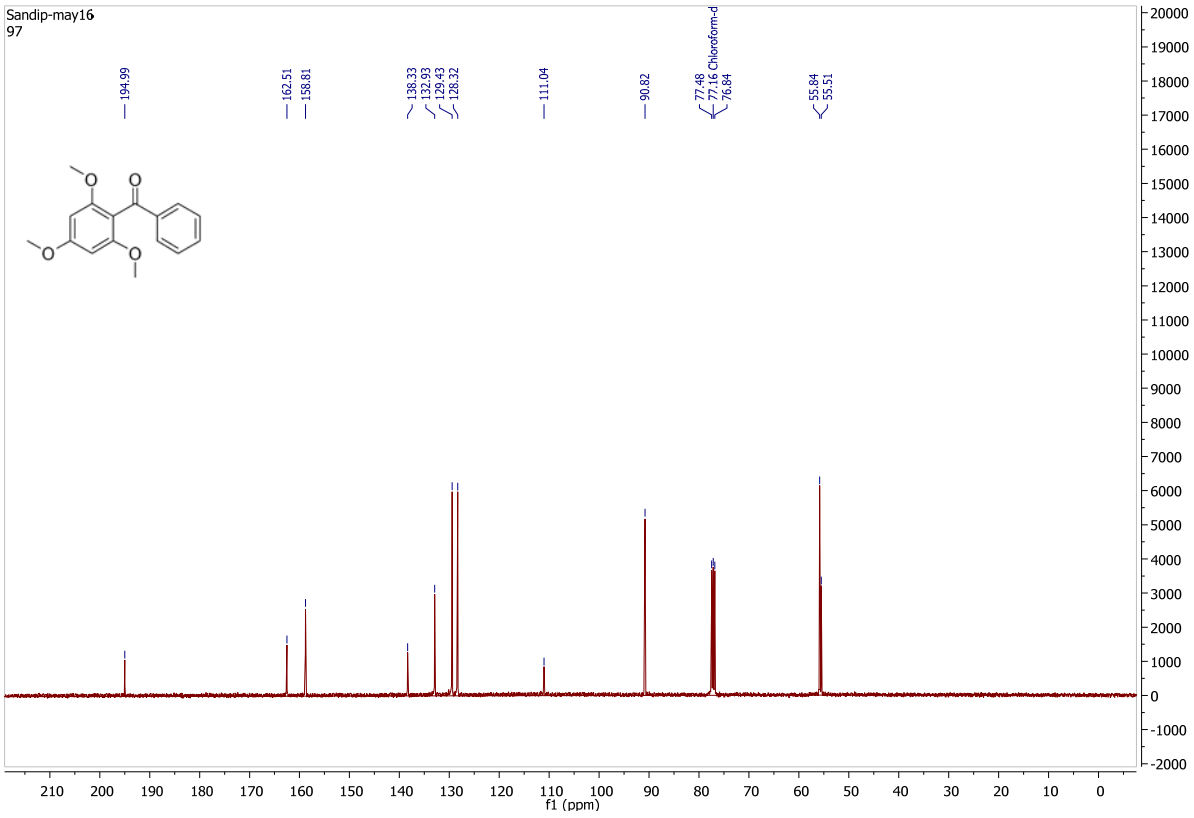
^{1}H and ^{13}C spectra of Cyclohexyl(2,4,6-trimethoxyphenyl)methanone (3ah)



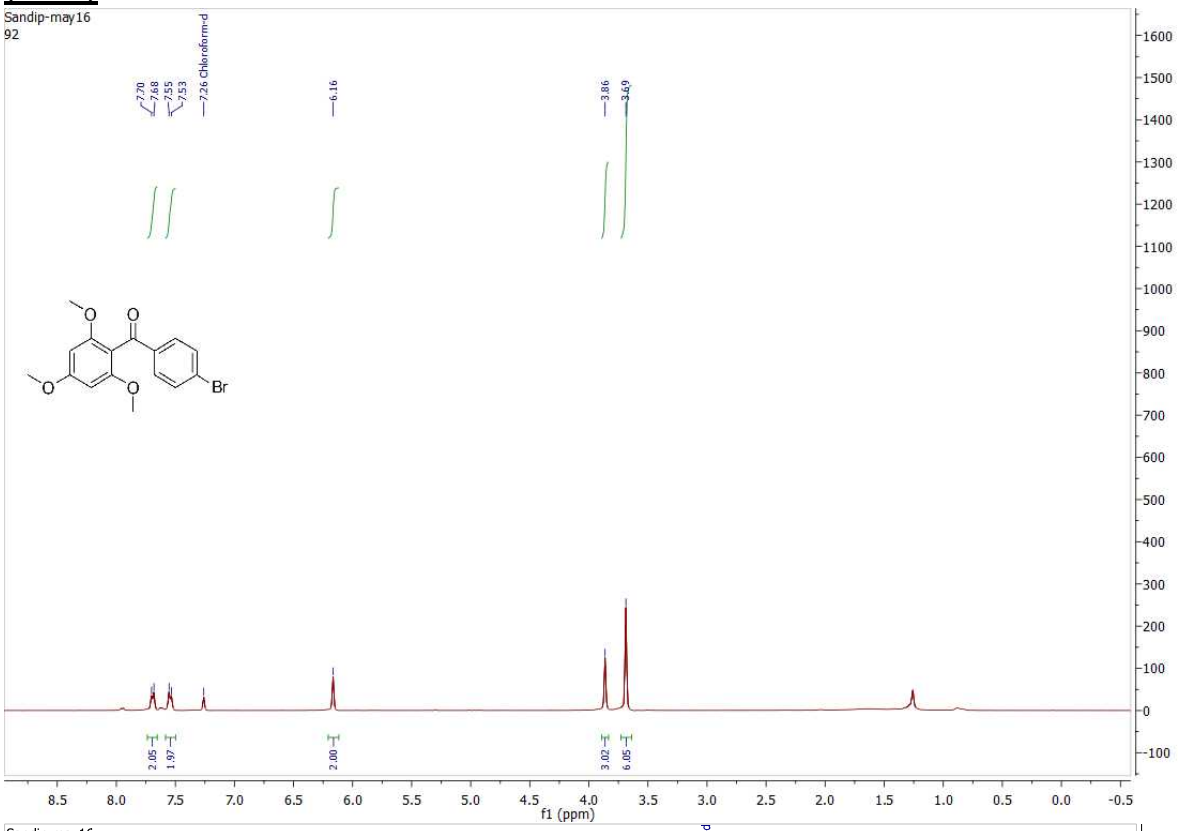


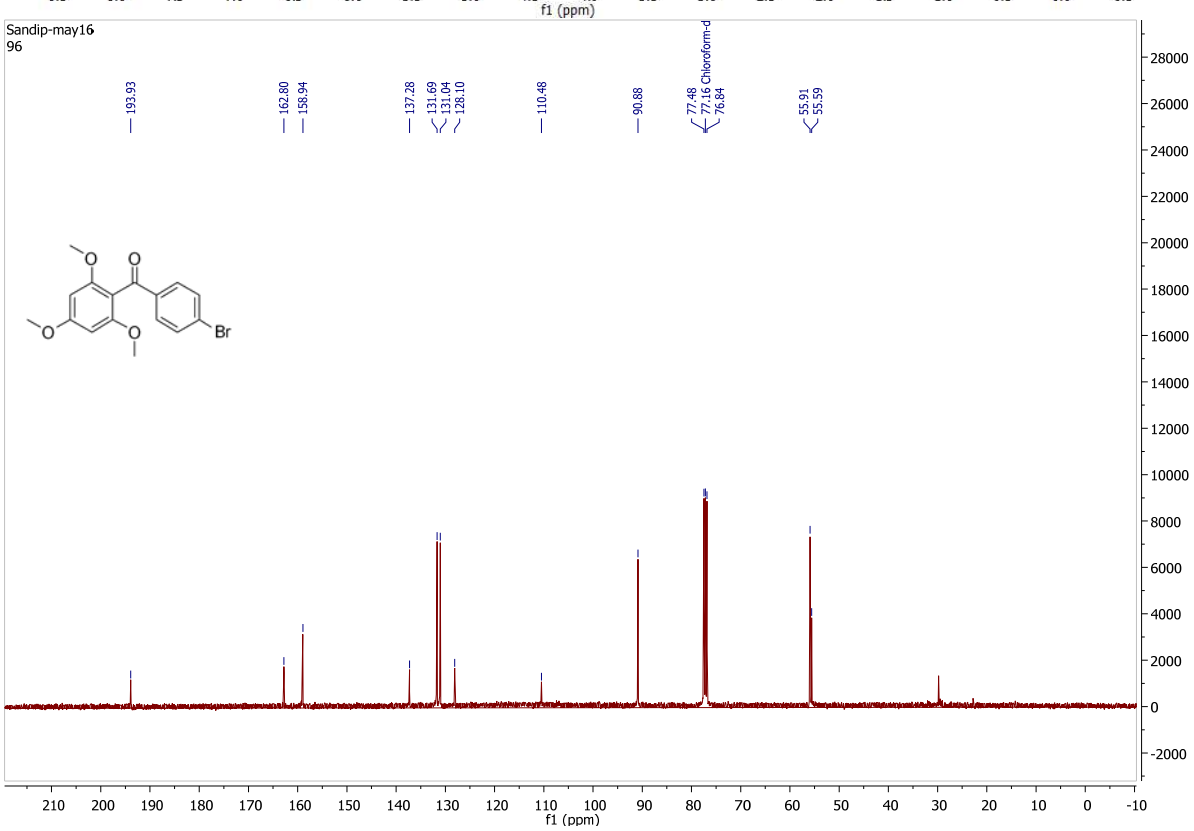
^{1}H and ^{13}C spectra of Phenyl(2,4,6-trimethoxyphenyl)methanone (3ad')



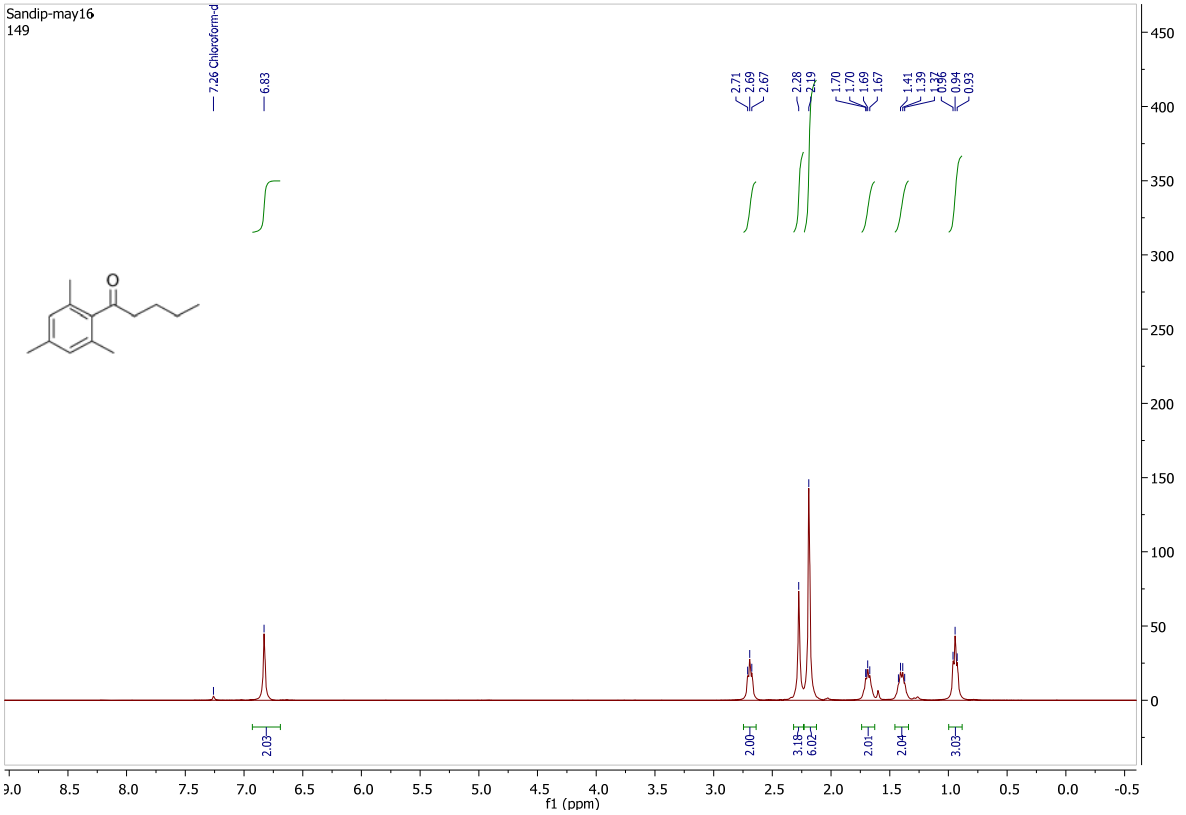


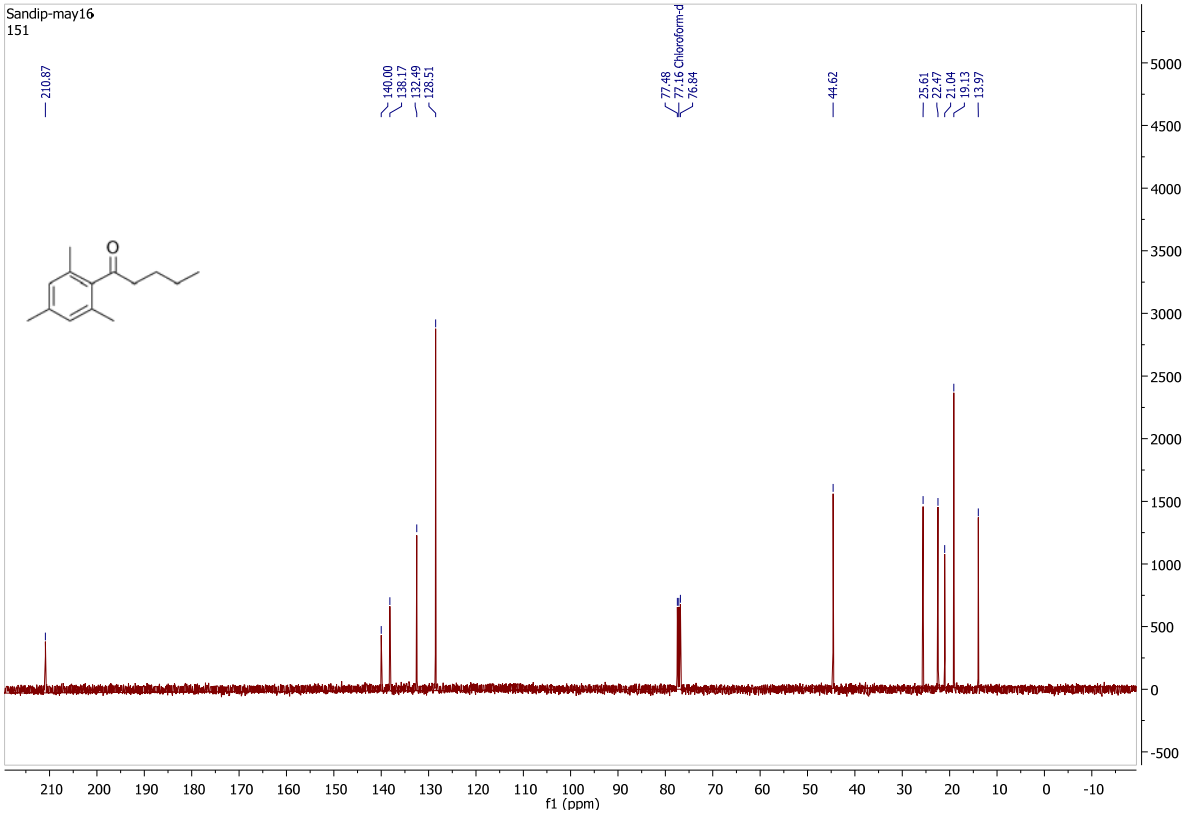
^{1}H and ^{13}C spectra of (4-Bromophenyl)(2,4,6-trimethoxyphenyl)methanone (3ao')



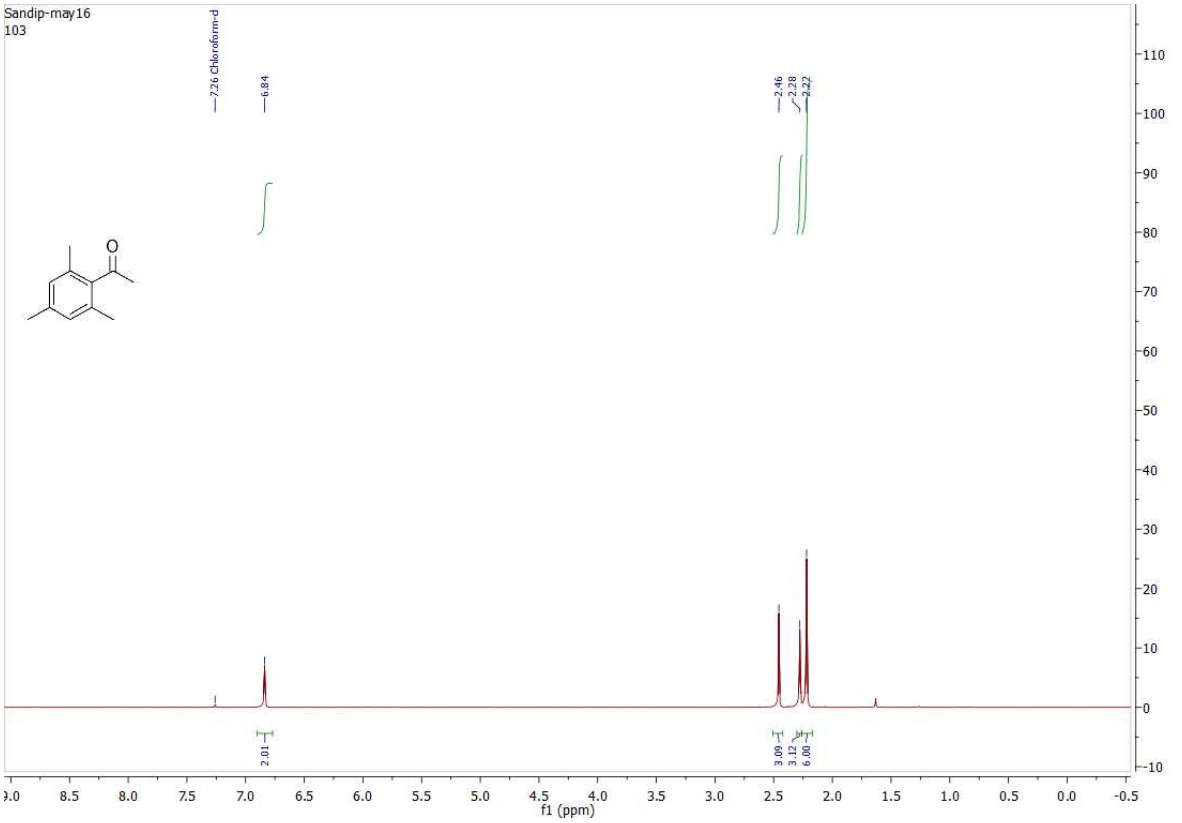


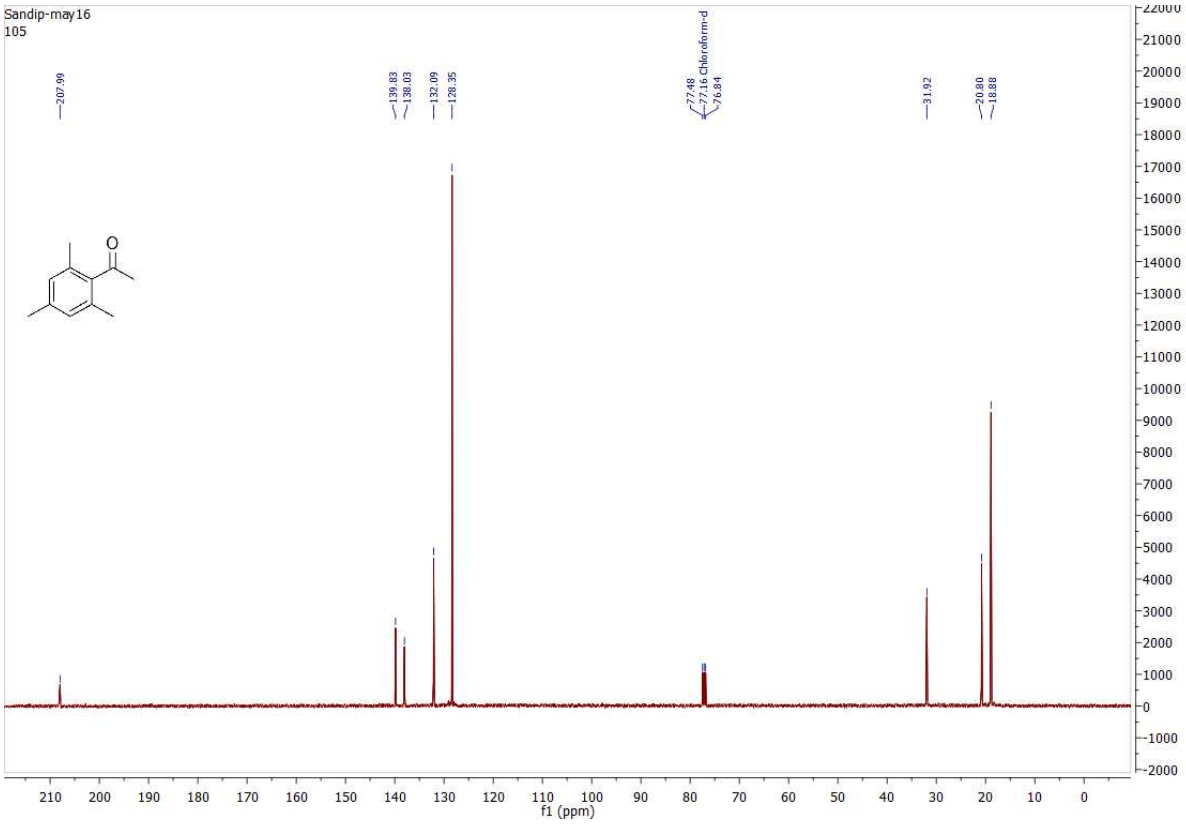
^{1}H and ^{13}C spectra of 1-Mesitylpentan-1-one (3m)



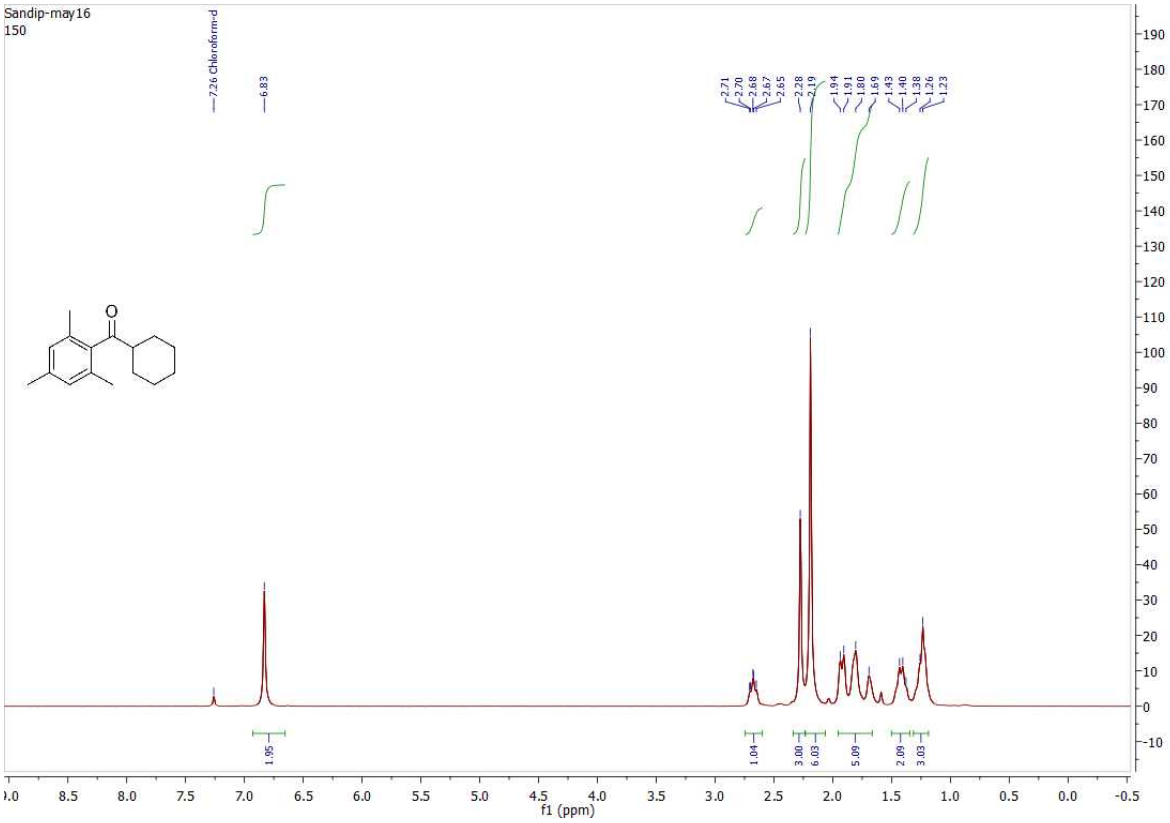


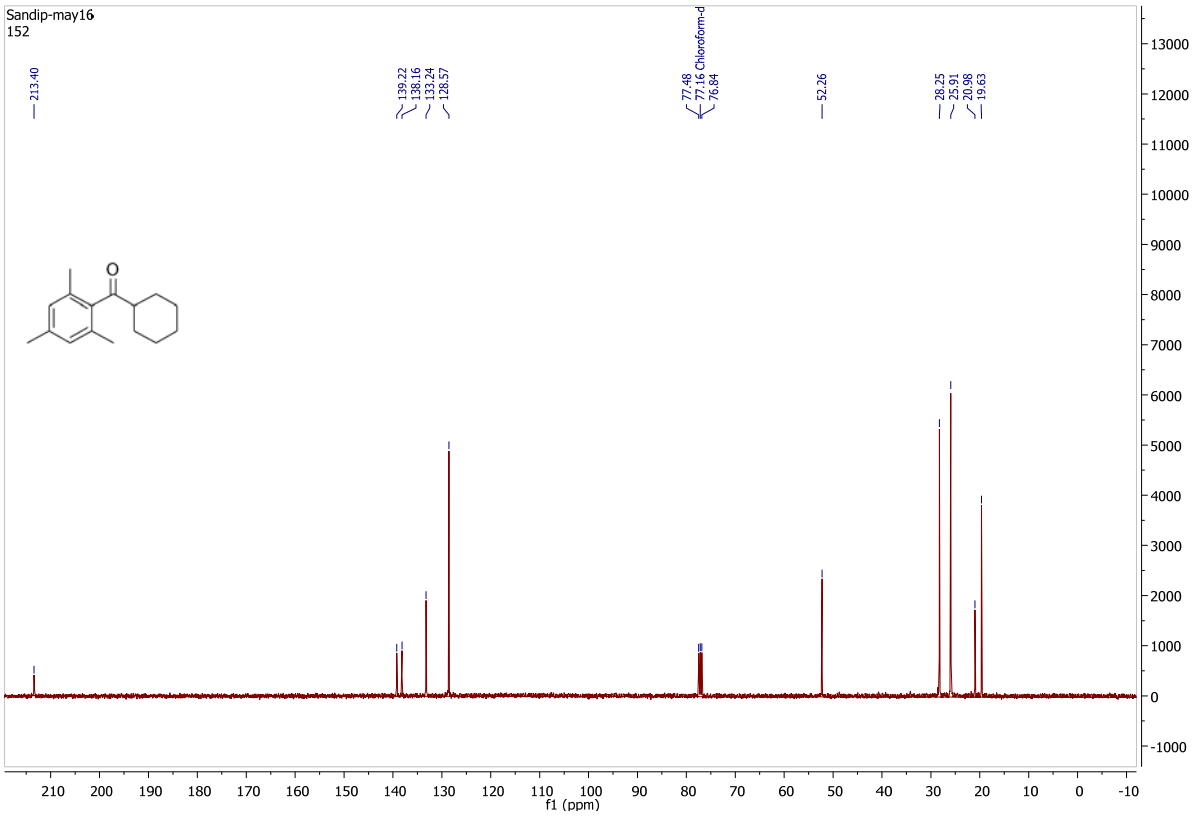
^{1}H and ^{13}C spectra of 1-Mesitylethan-1-one (3x)



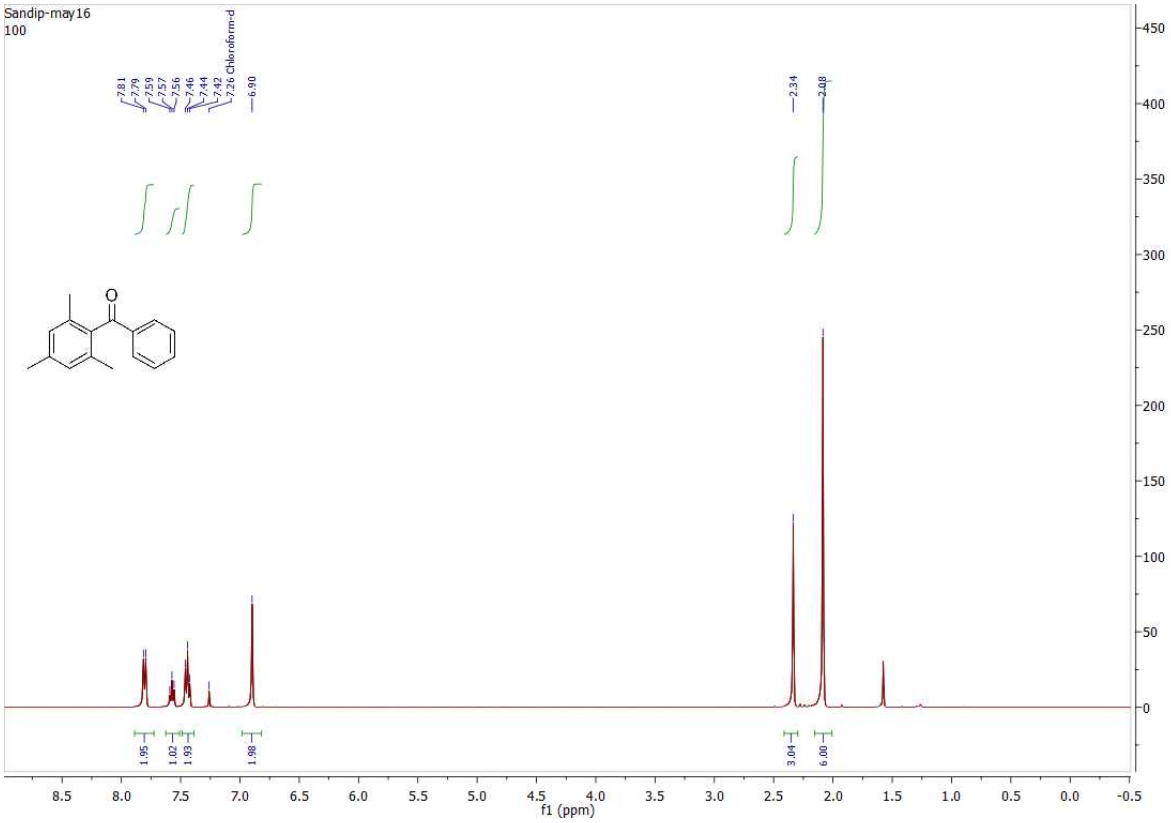


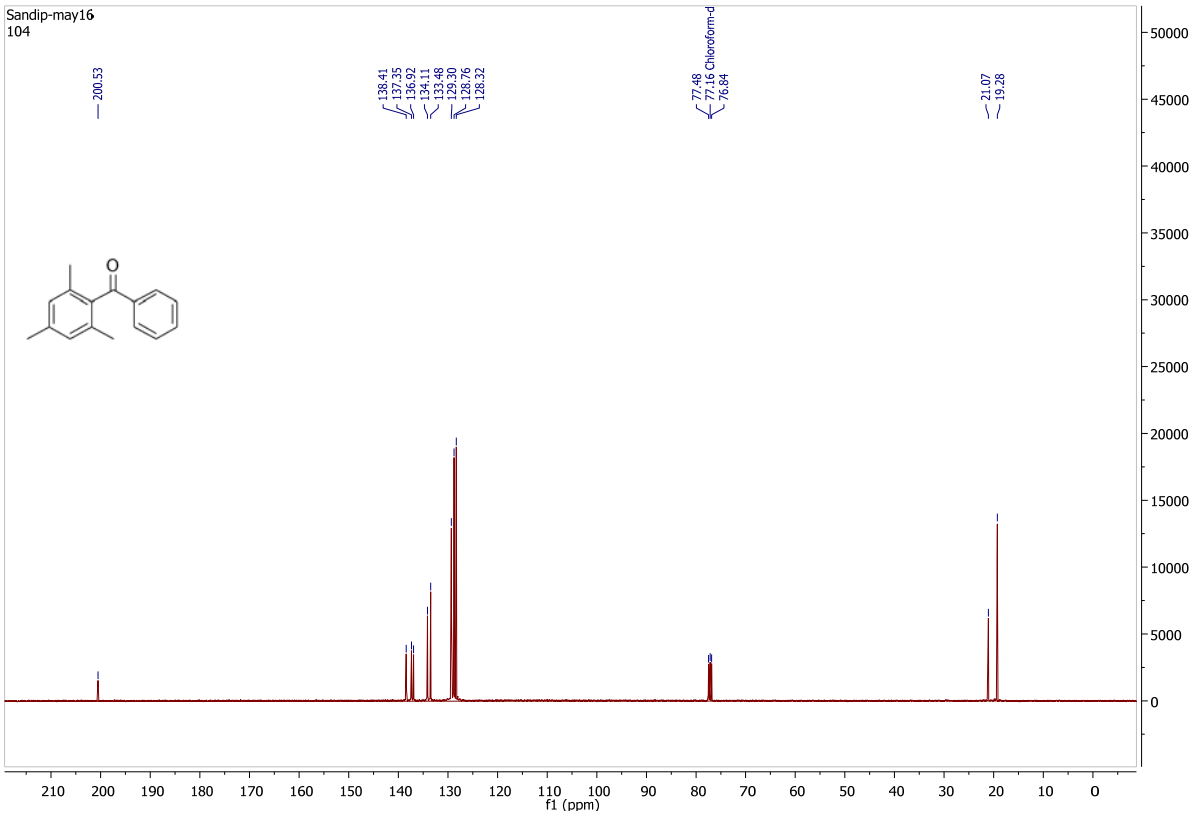
^{1}H and ^{13}C spectra of Cyclohexyl(mesityl)methanone (3ai)



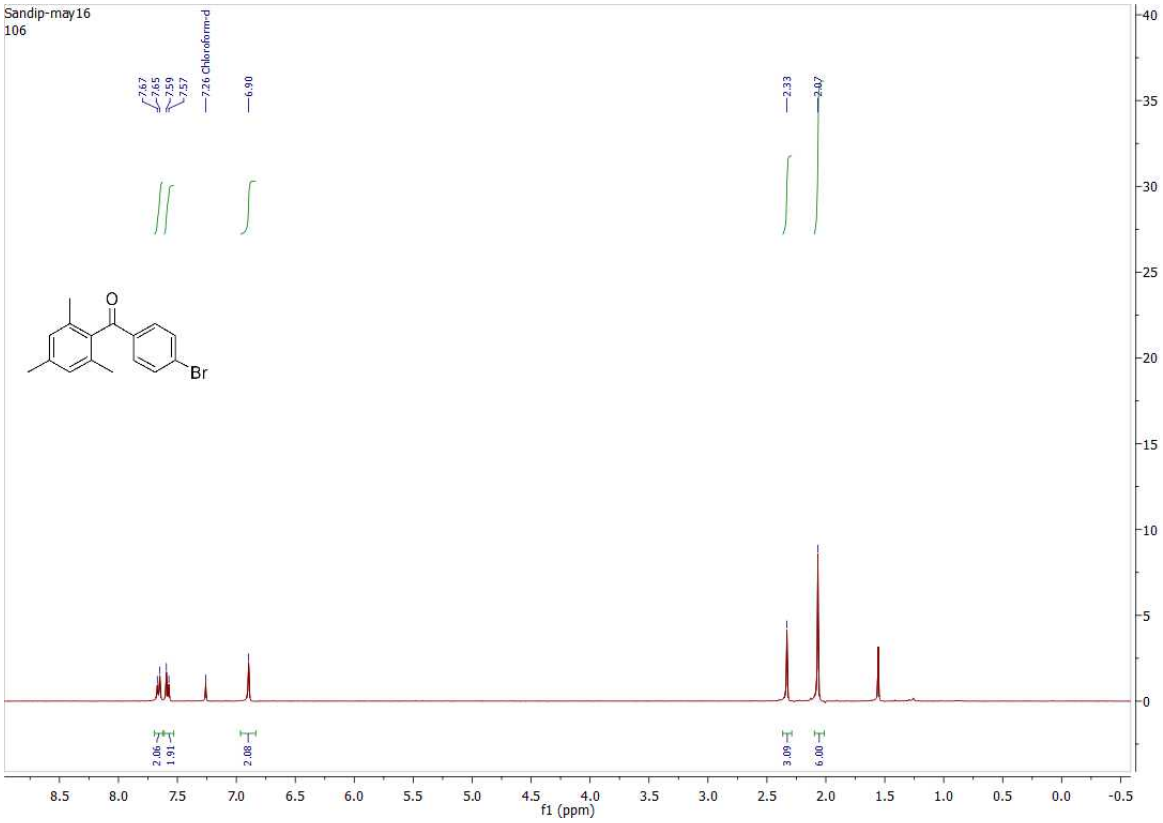


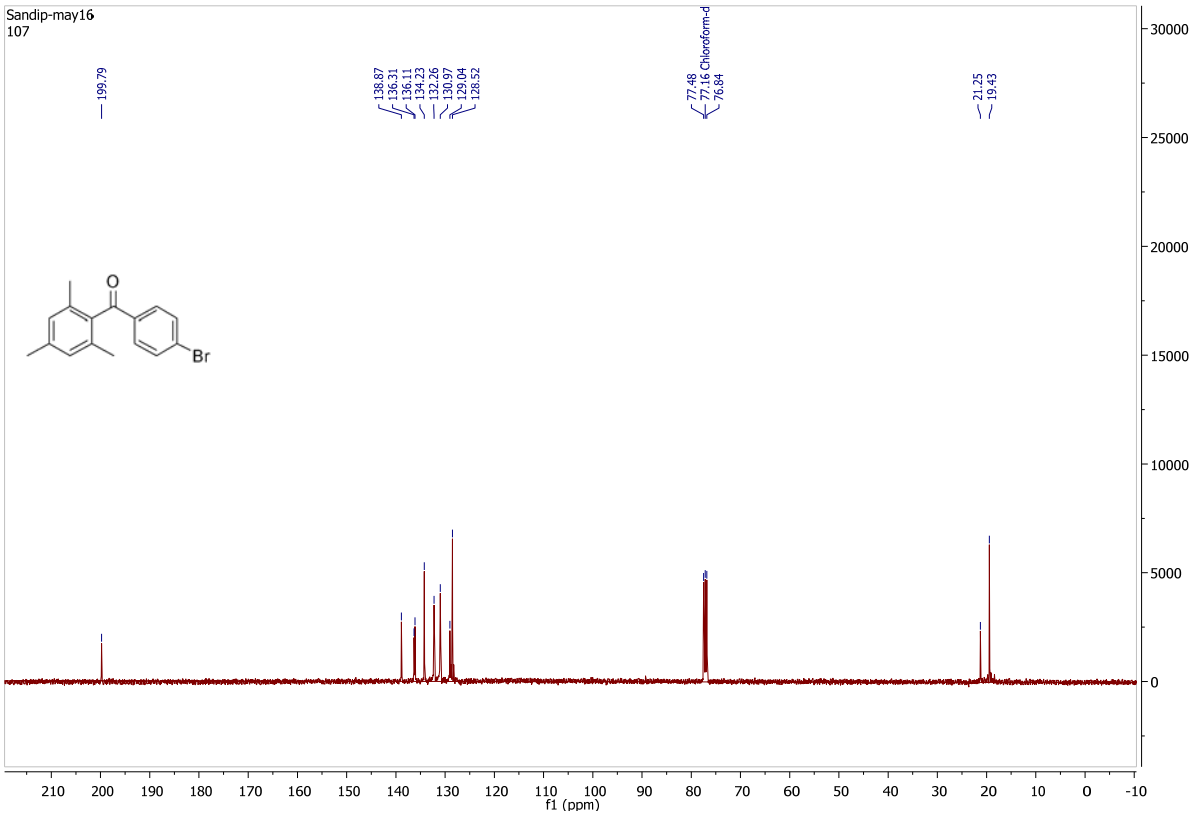
^{1}H and ^{13}C spectra of Mesityl(phenyl)methanone (3ae')



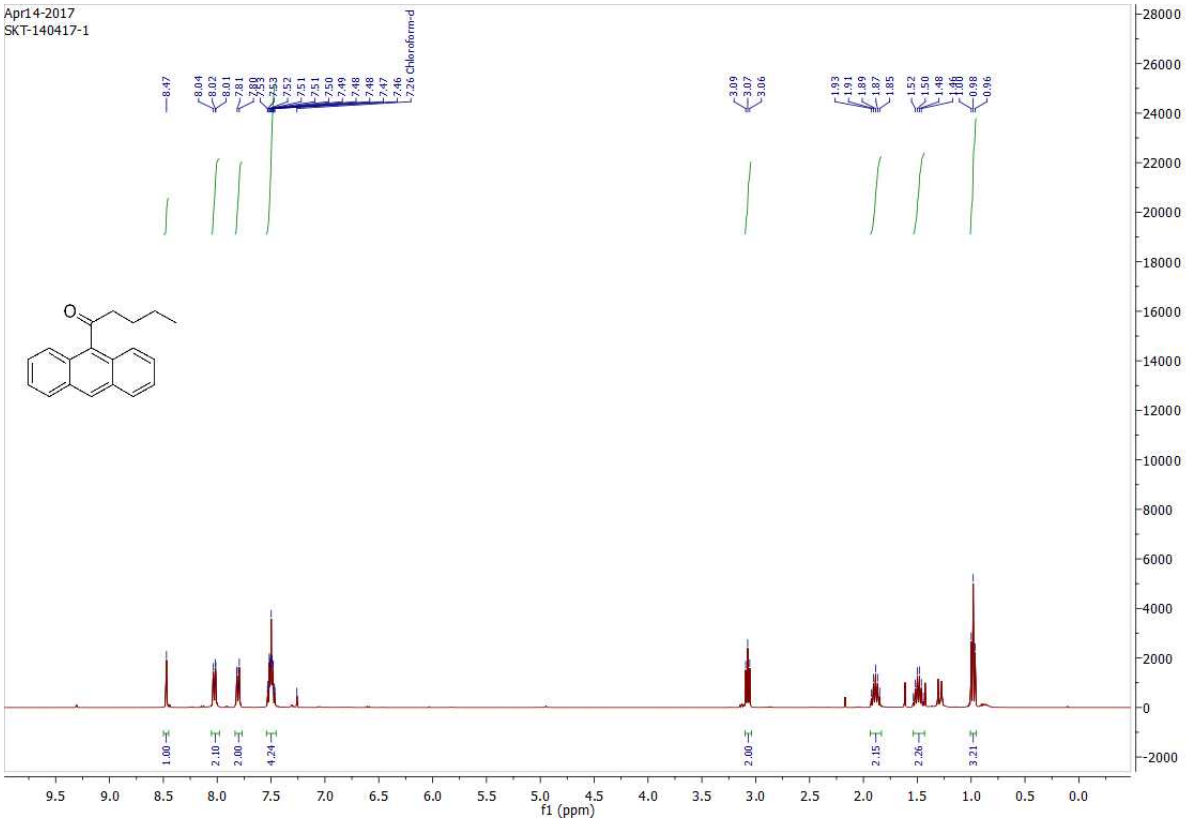


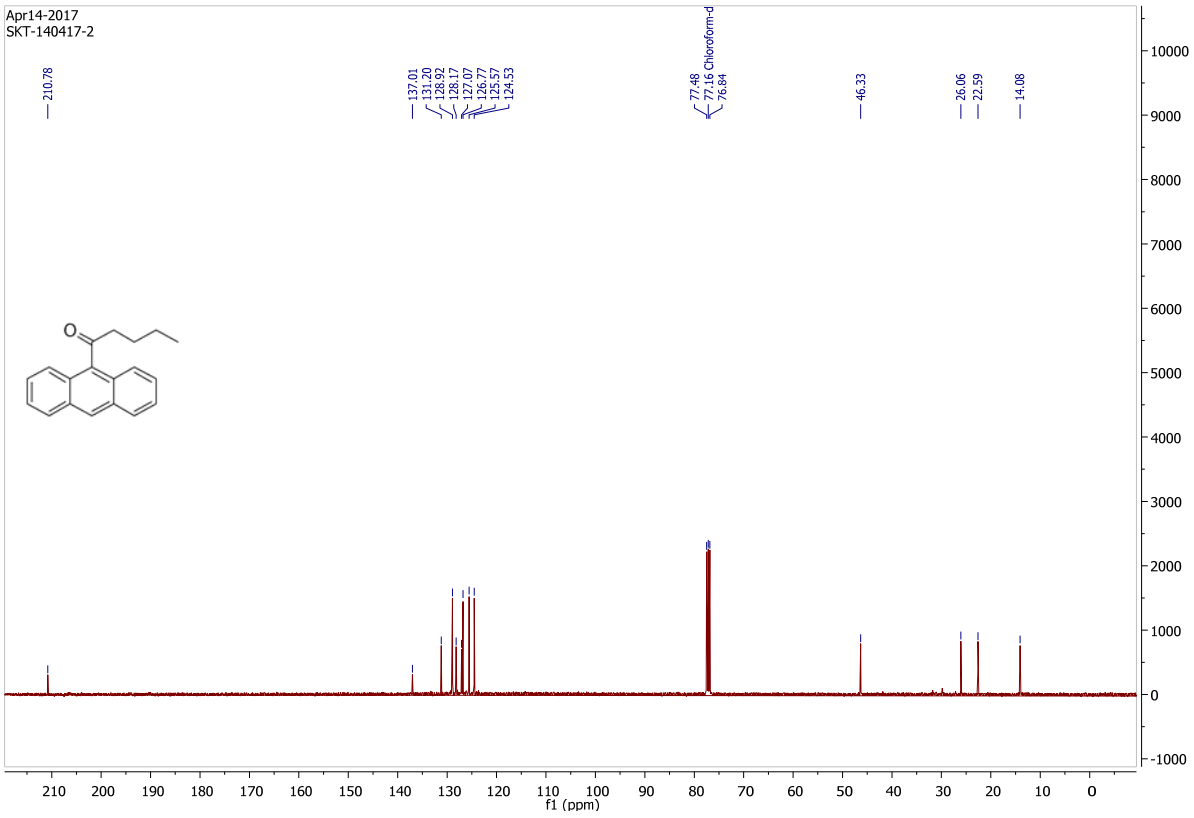
^{1}H and ^{13}C spectra of (4-Bromophenyl)(mesityl)methanone (3ap')



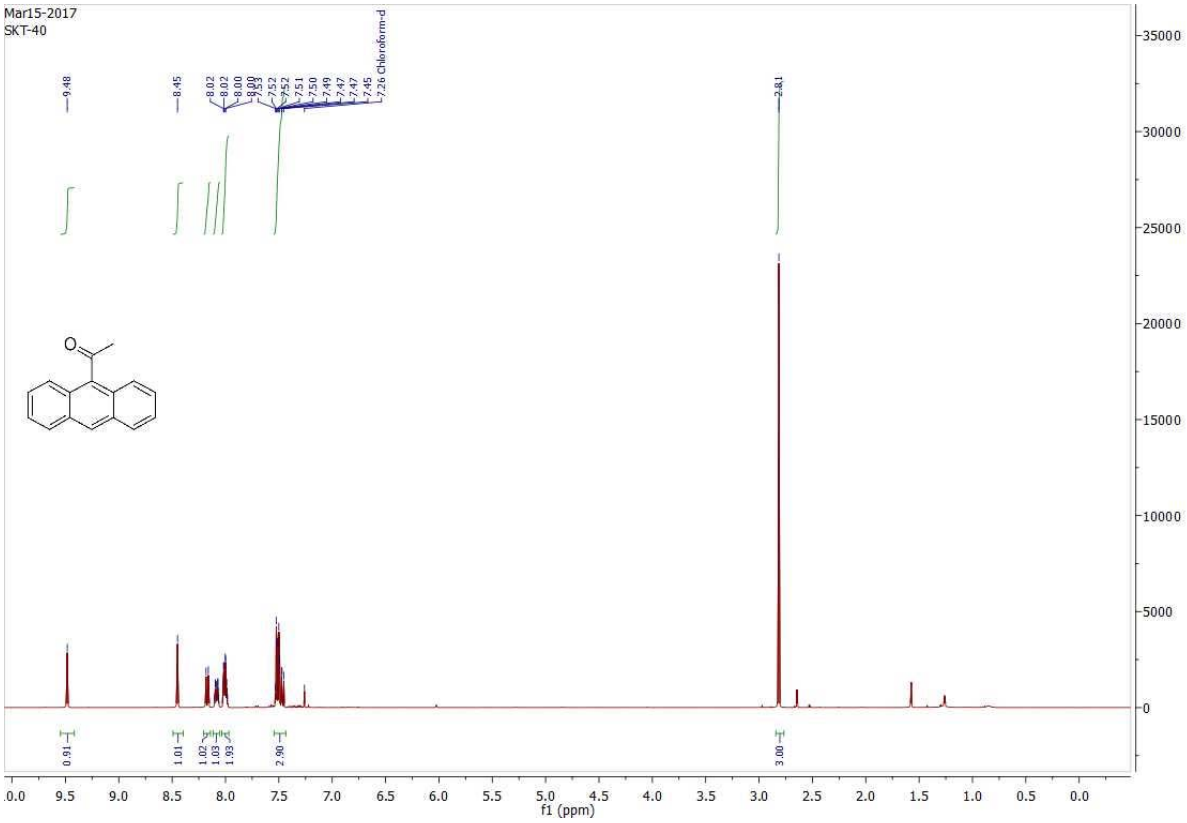


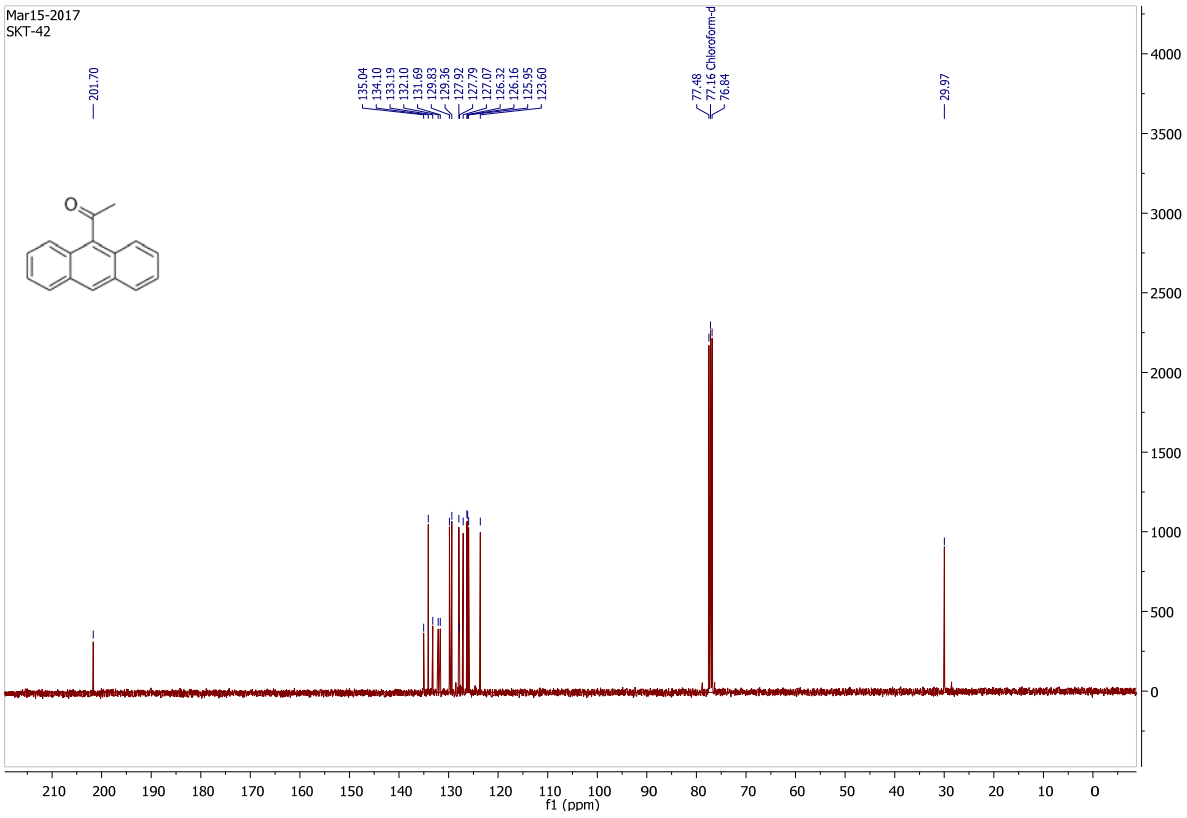
^{1}H and ^{13}C spectra of 1-(Anthracen-9-yl)pentan-1-one (3aq')



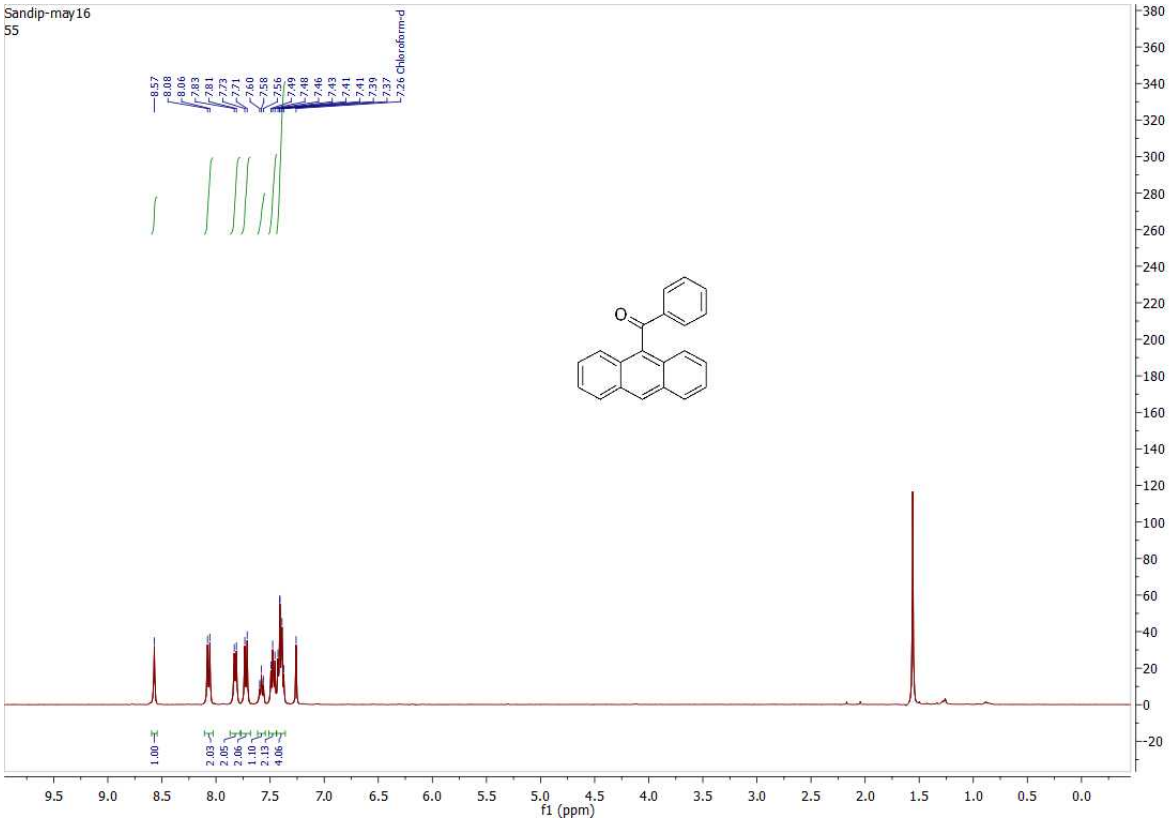


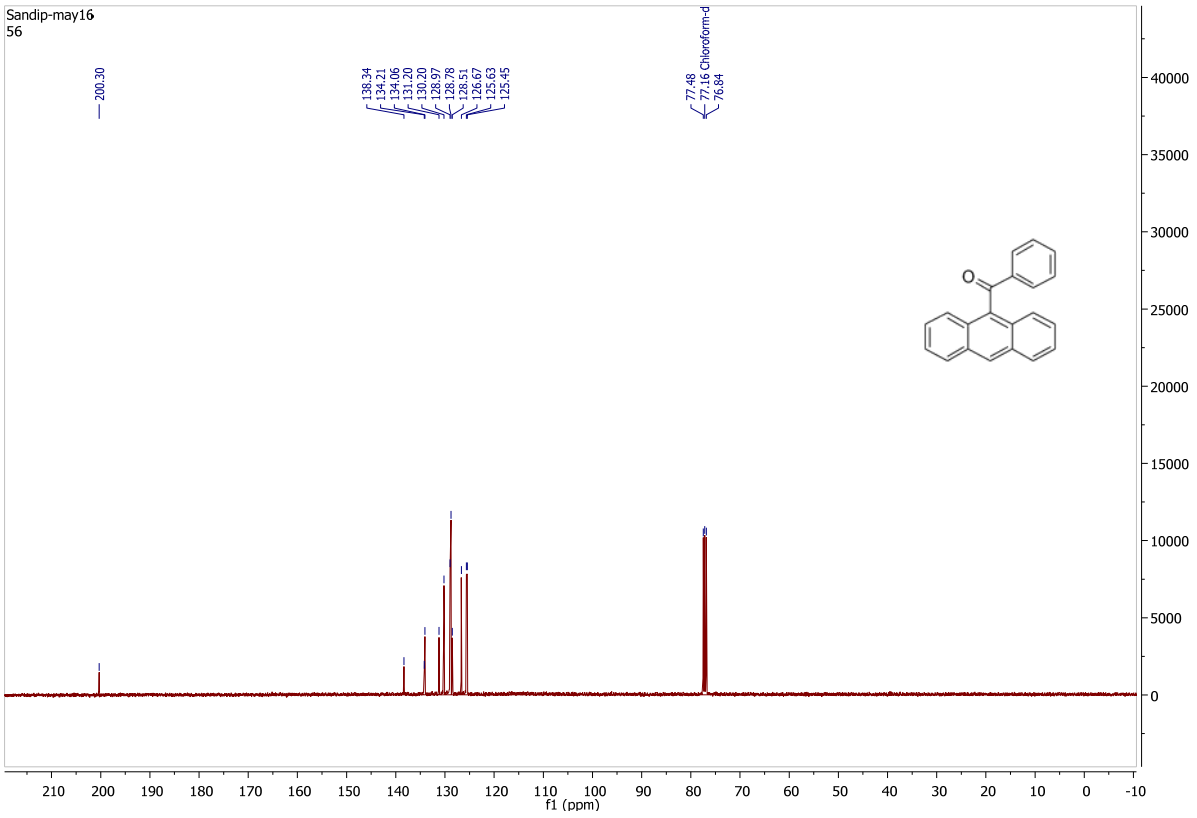
^{1}H and ^{13}C spectra of 1-(Anthracen-9-yl)ethan-1-one (3ar')



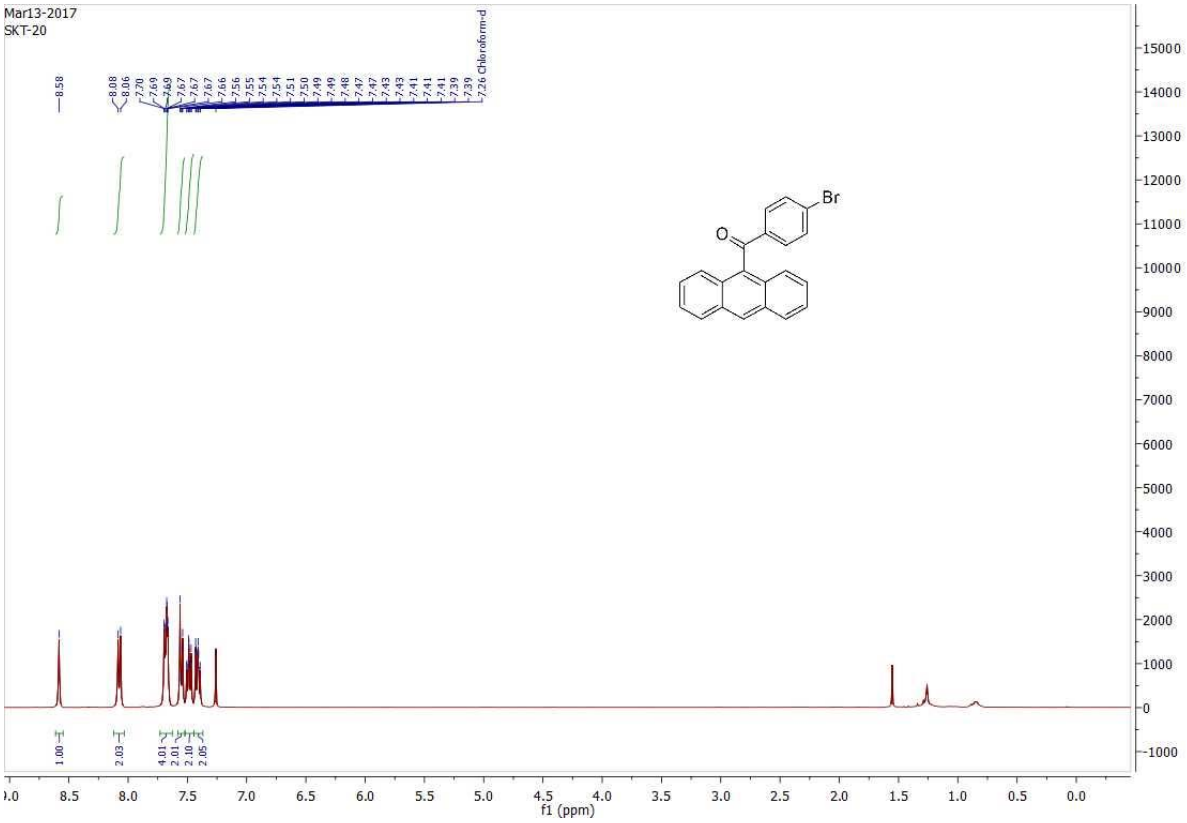


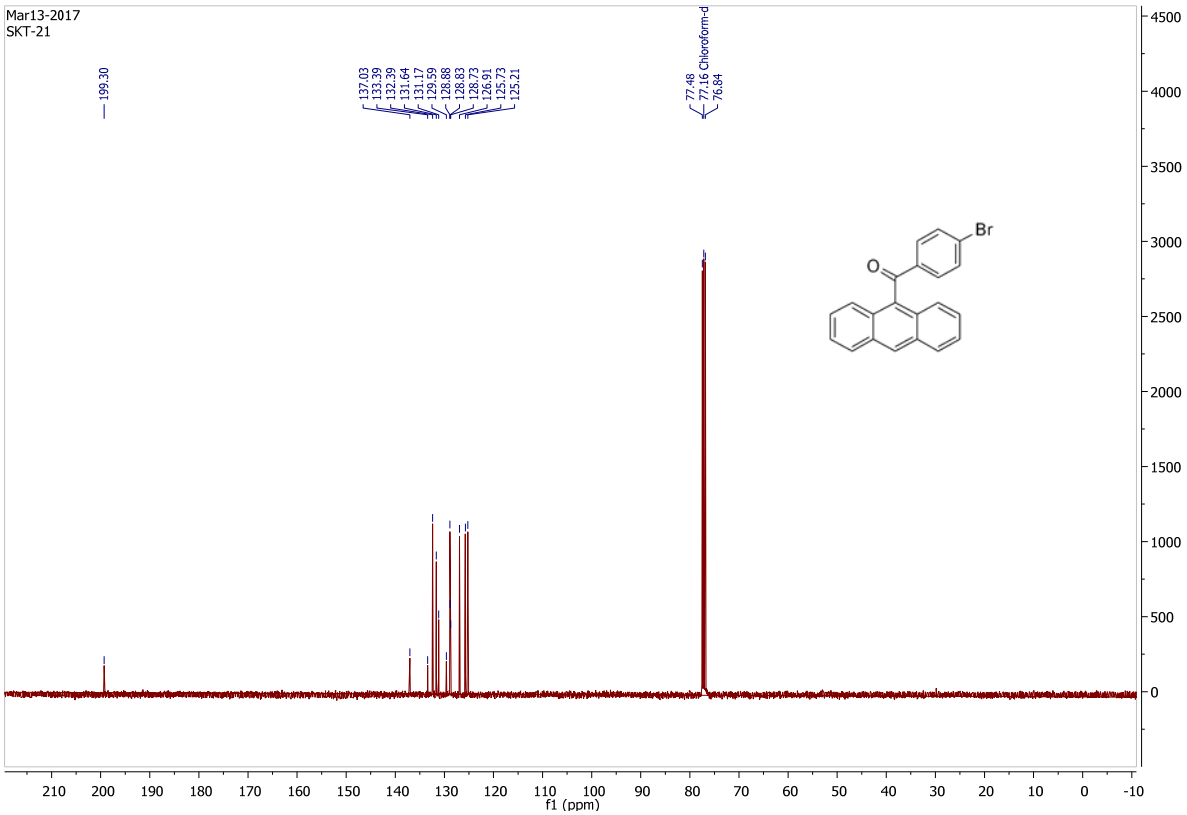
^{1}H and ^{13}C spectra of Anthracen-9-yl(phenyl)methanone (3as')



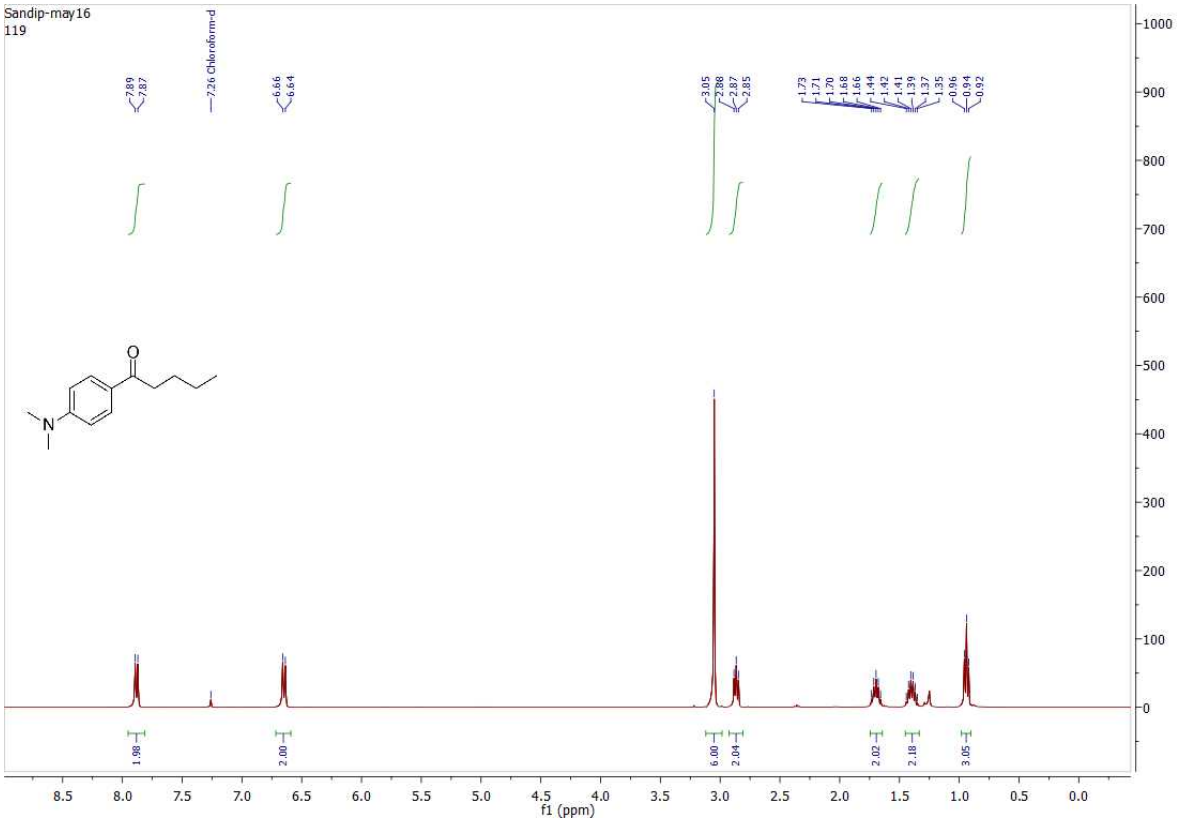


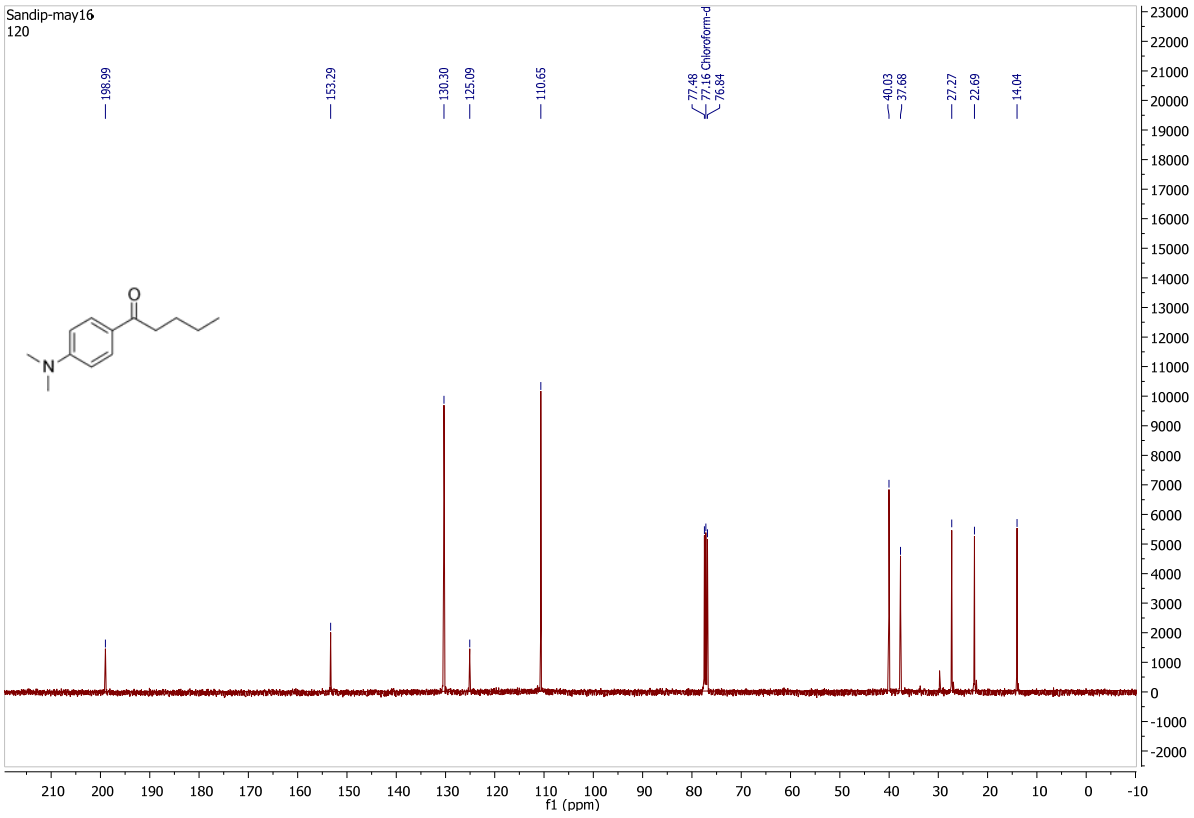
^{1}H and ^{13}C spectra of Anthracen-9-yl(4-bromophenyl)methanone (3at')



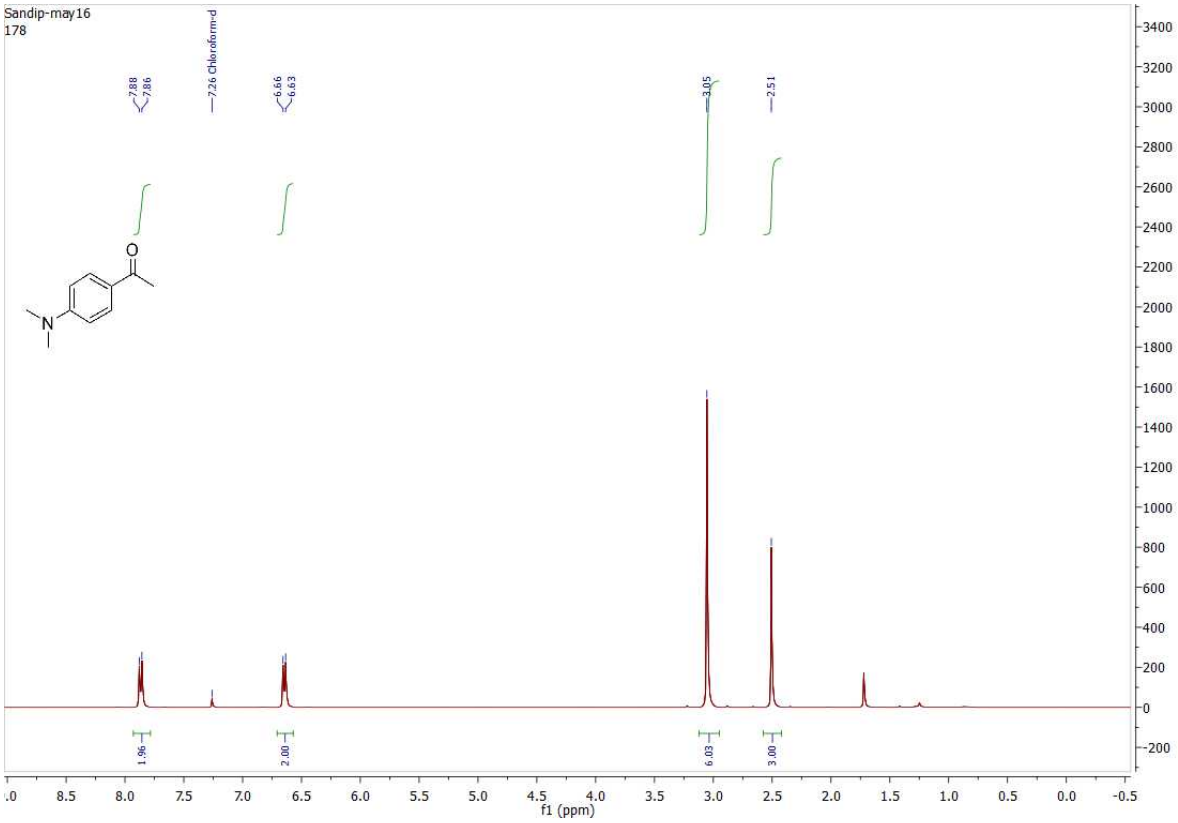


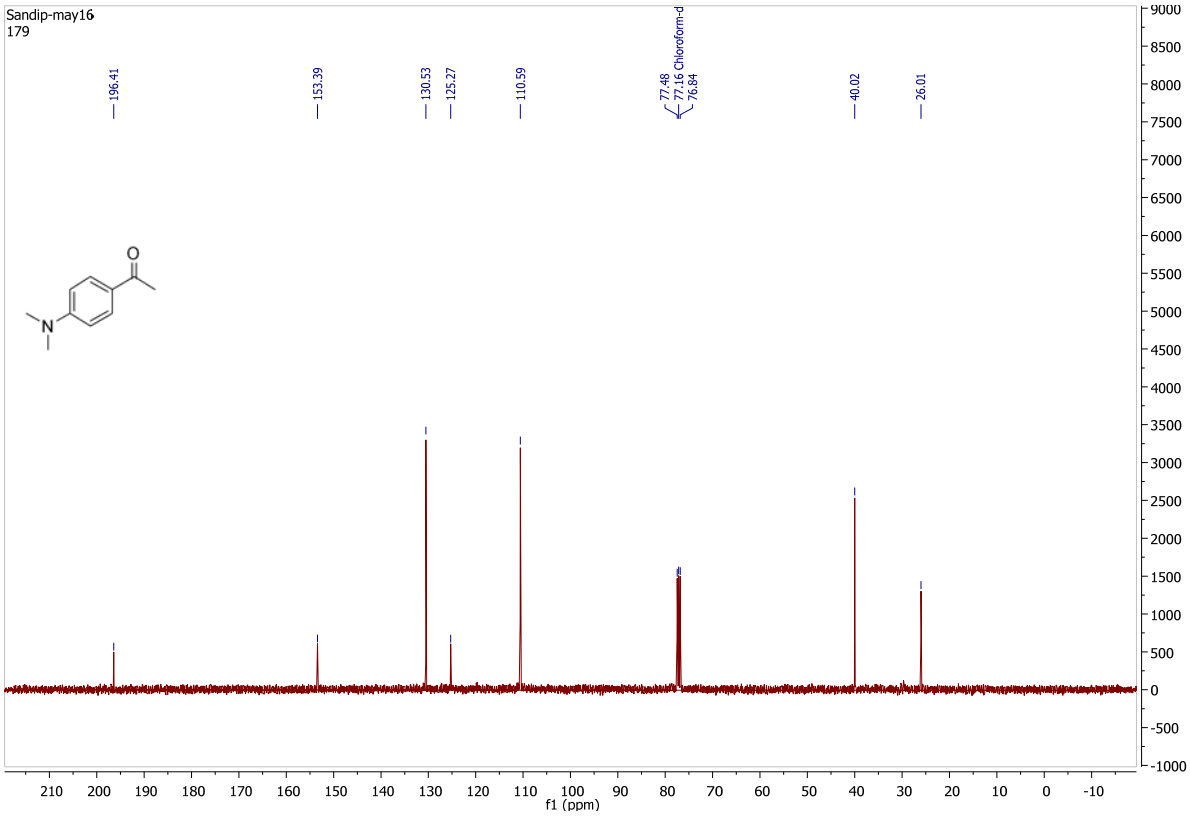
^{1}H and ^{13}C spectra of 1-(4-(Dimethylamino)phenyl)pentan-1-one (3au')



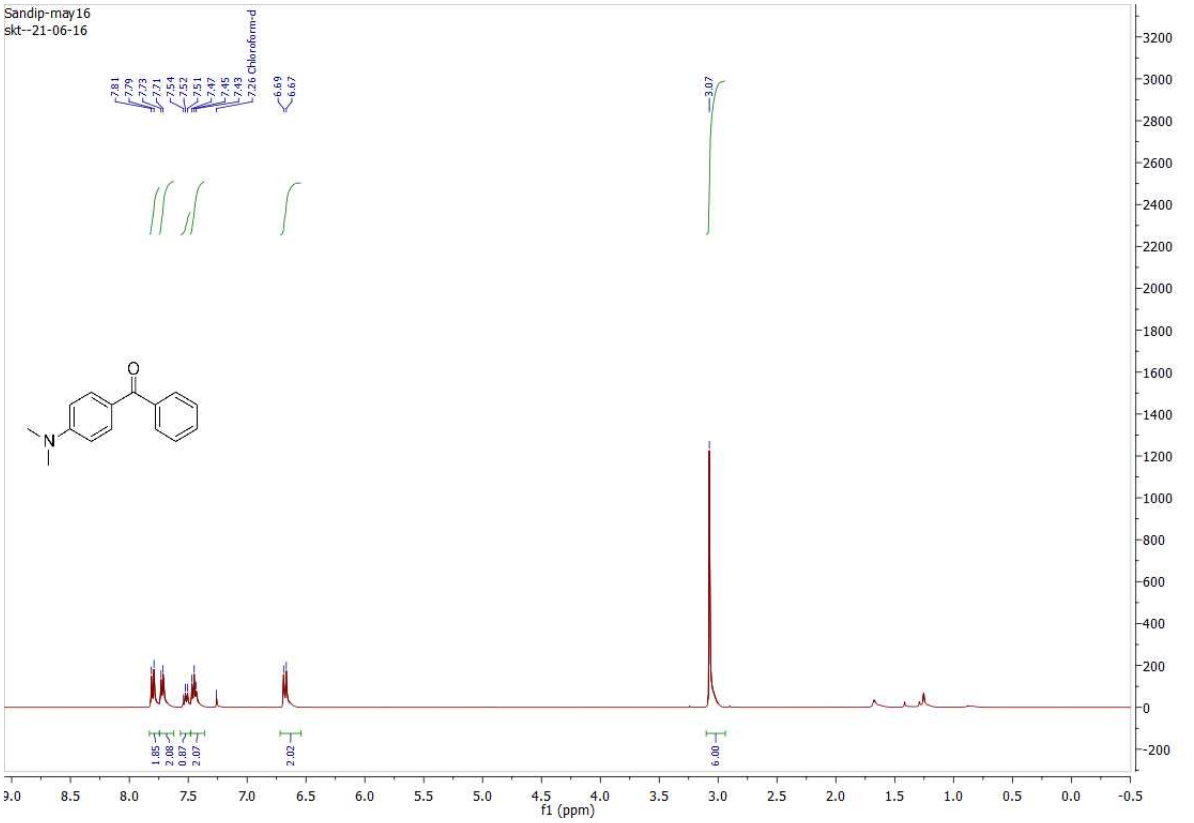


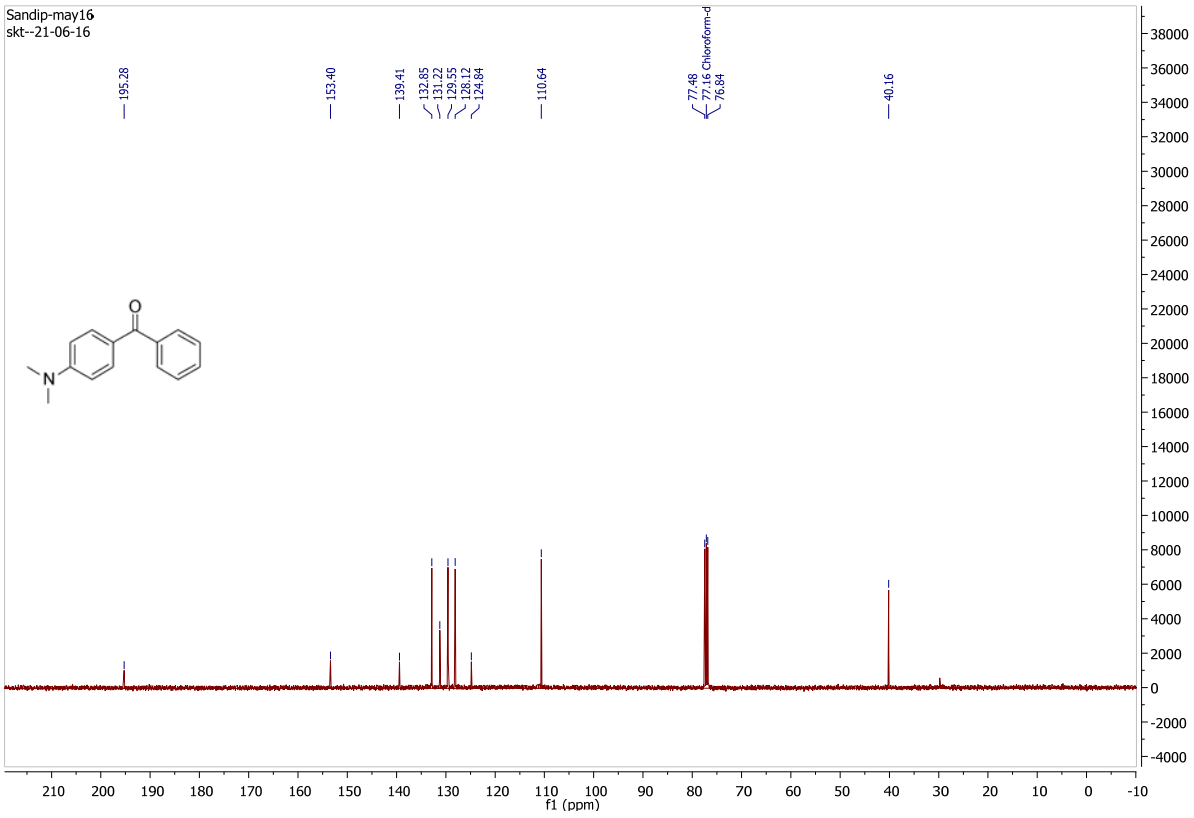
^{1}H and ^{13}C spectra of 1-(4-(dimethylamino)phenyl)ethan-1-one (3av')



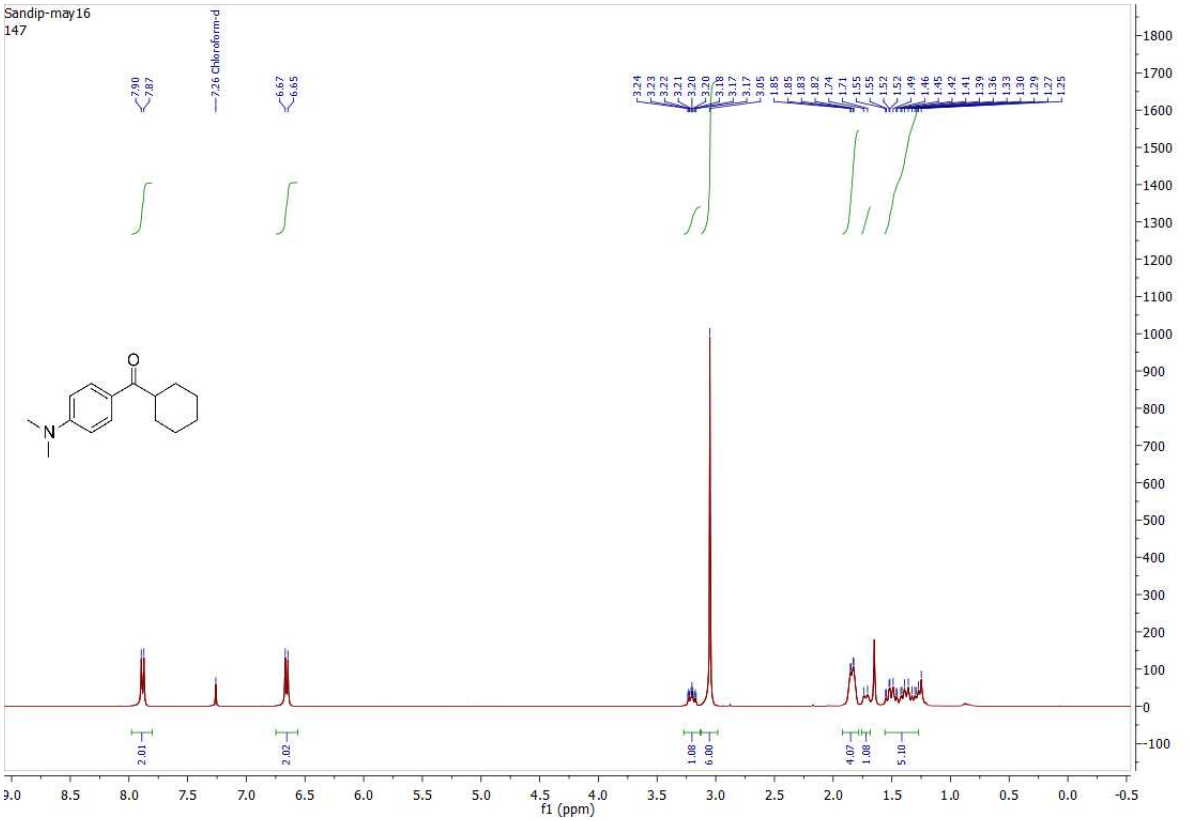


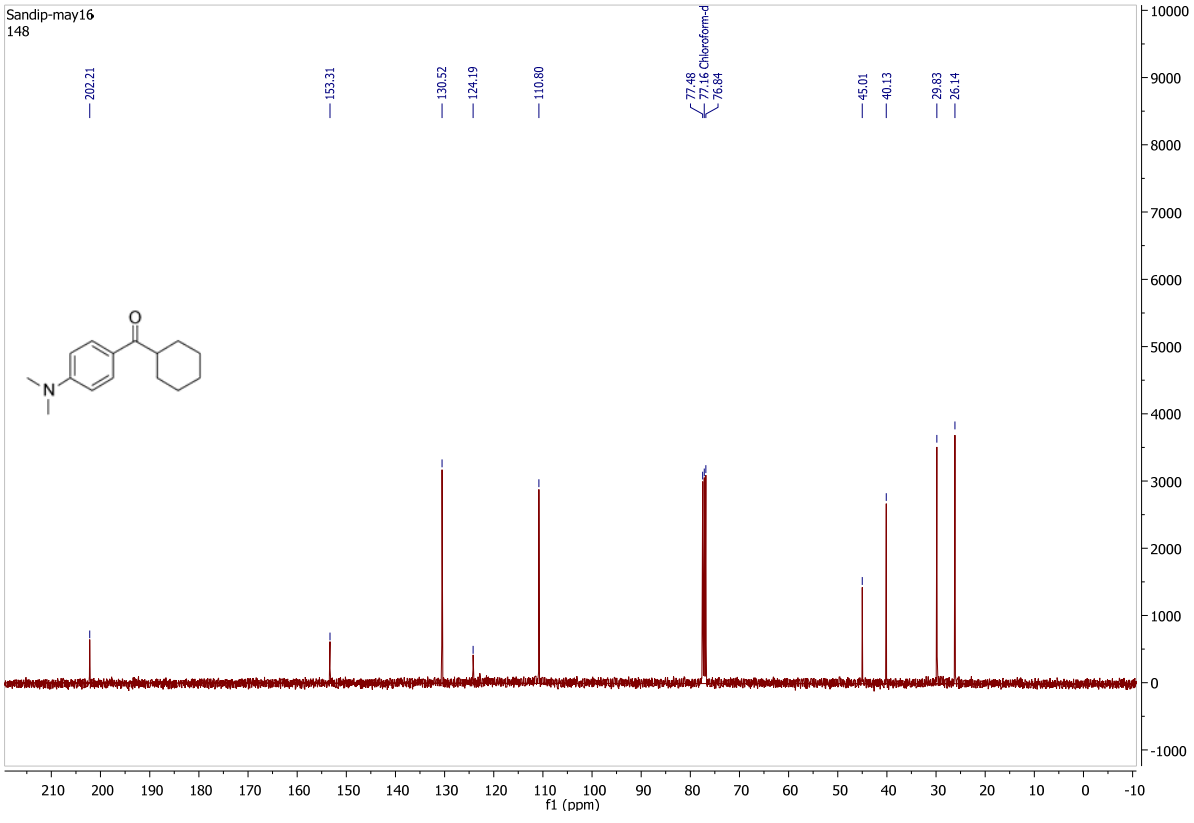
^{1}H and ^{13}C spectra of (4-(Dimethylamino)phenyl)(phenyl)methanone (3aw')



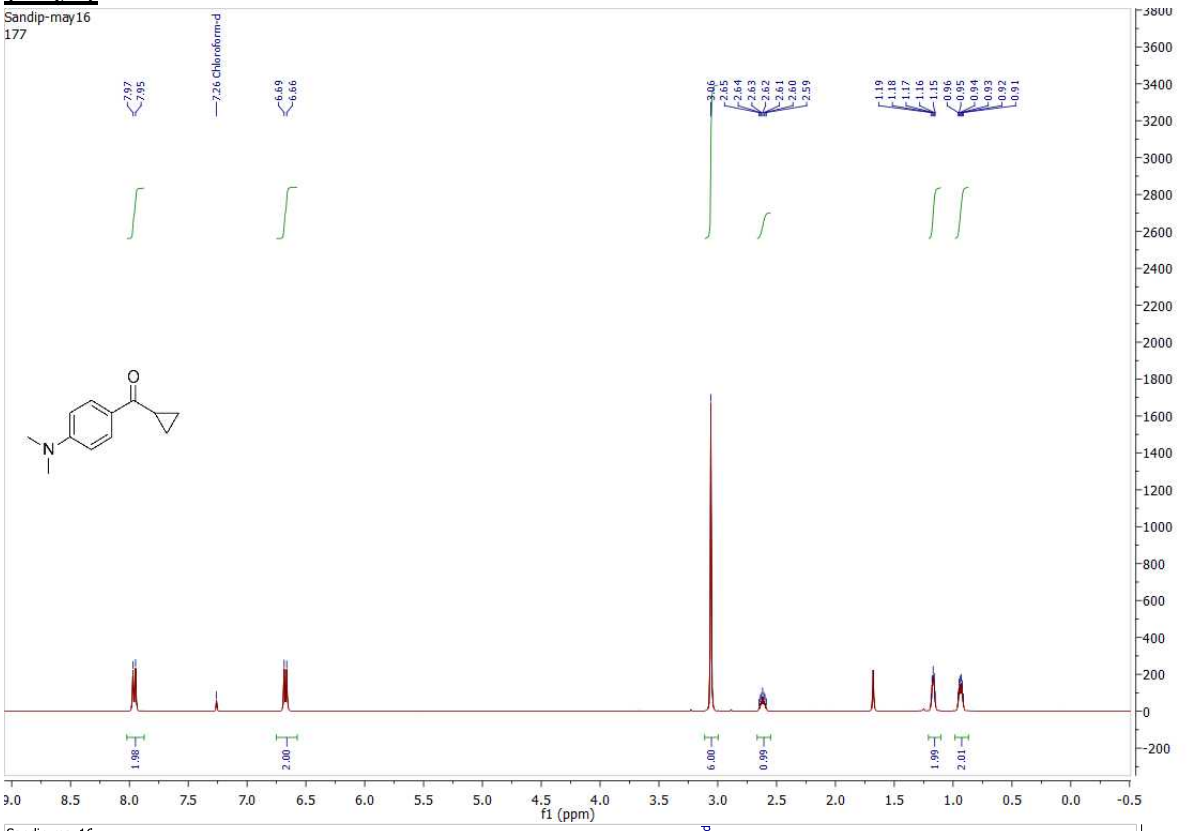


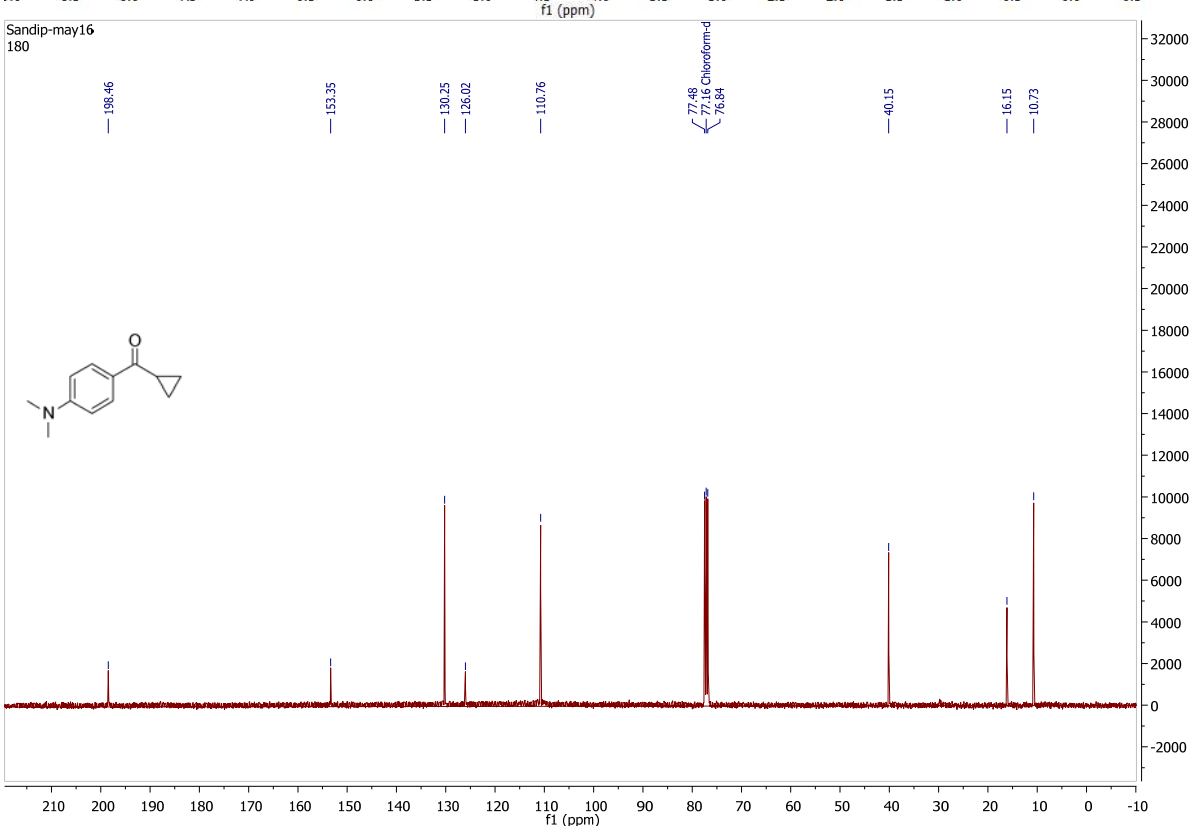
^{1}H and ^{13}C spectra of Cyclohexyl(4-(dimethylamino)phenyl)methanone (3ax')



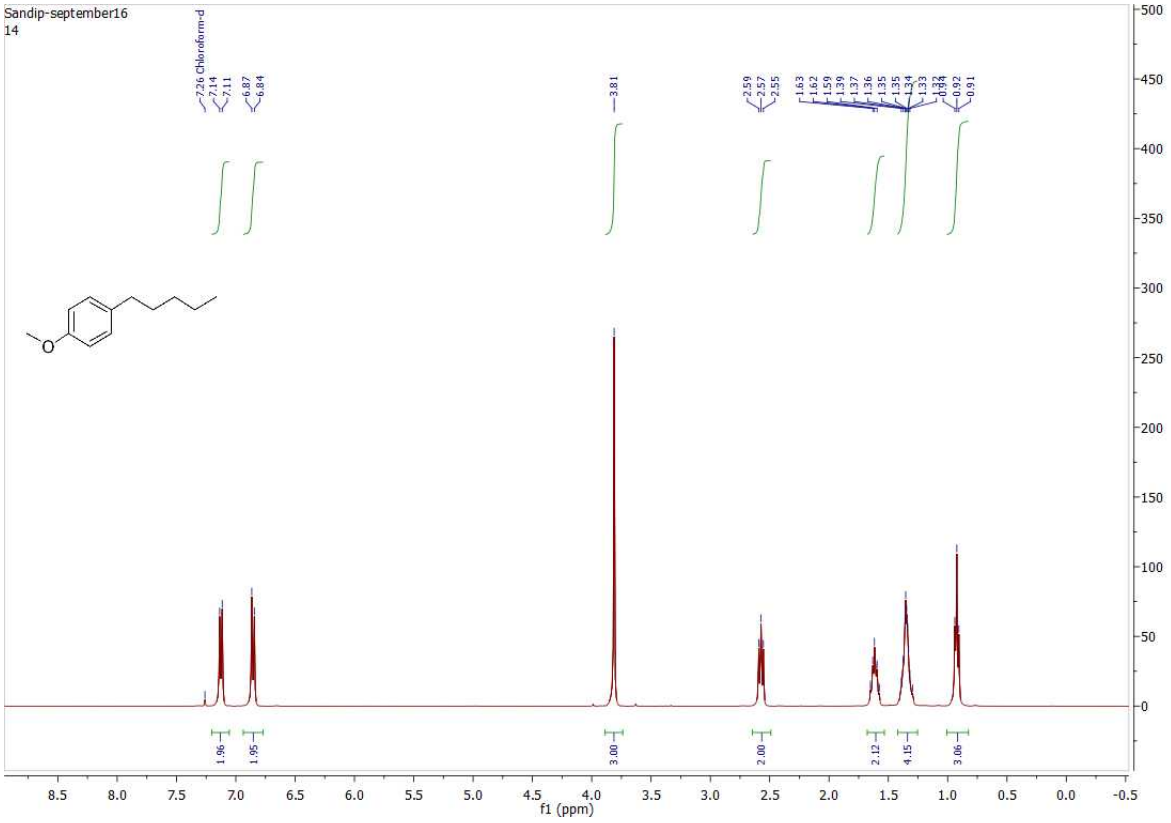


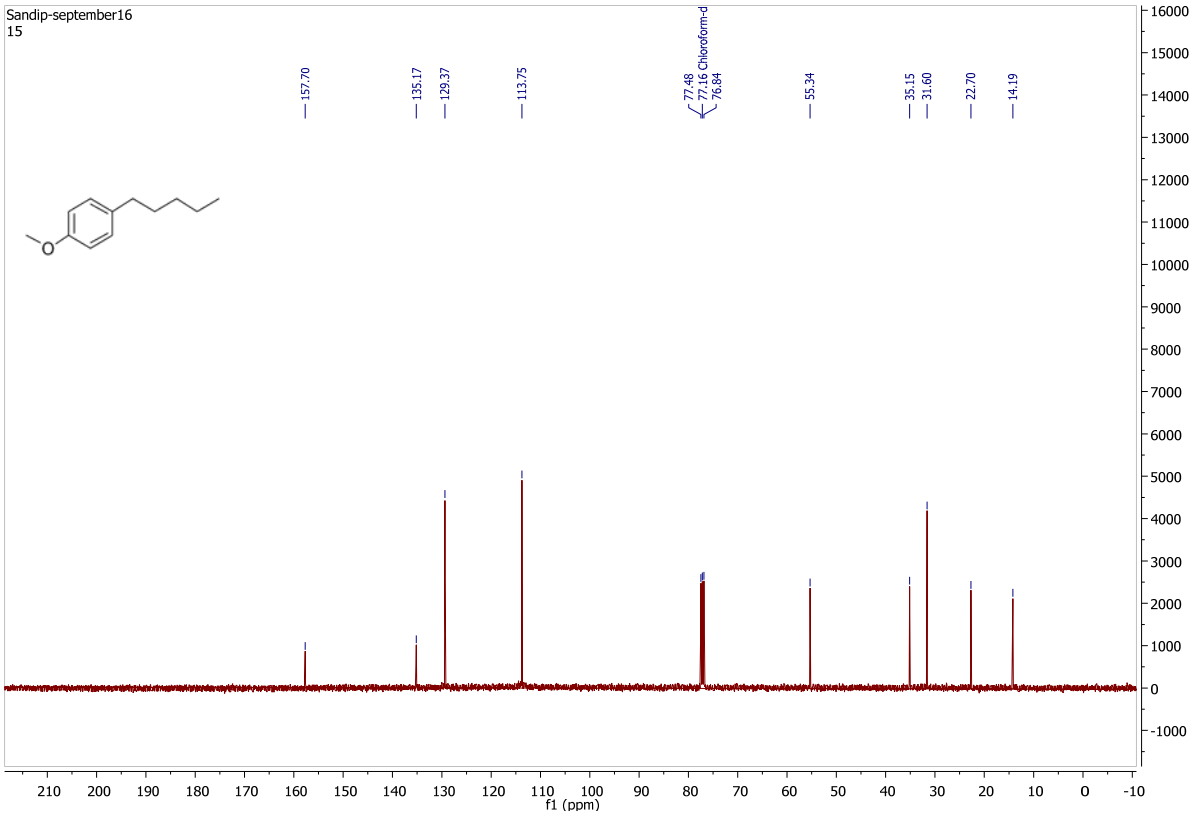
^{1}H and ^{13}C spectra of Cyclopropyl(4-(dimethylamino)phenyl)methanone (3ay')



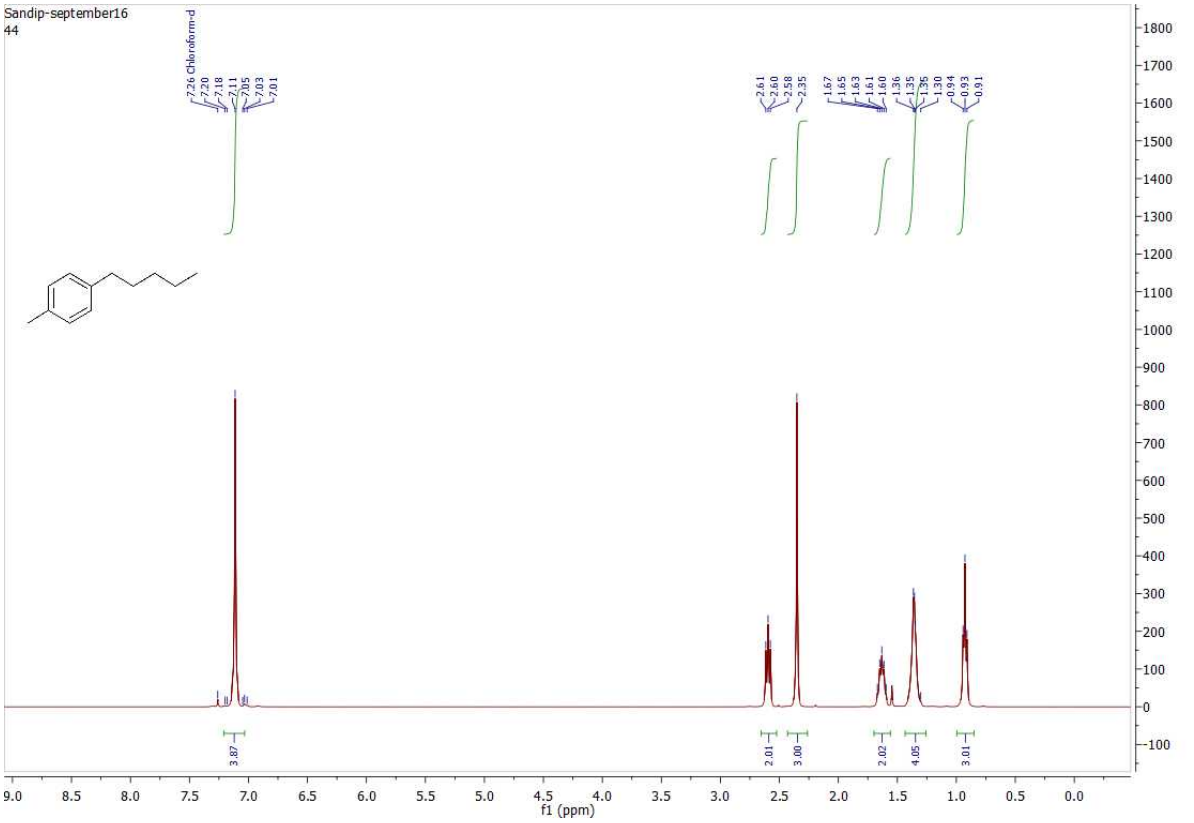


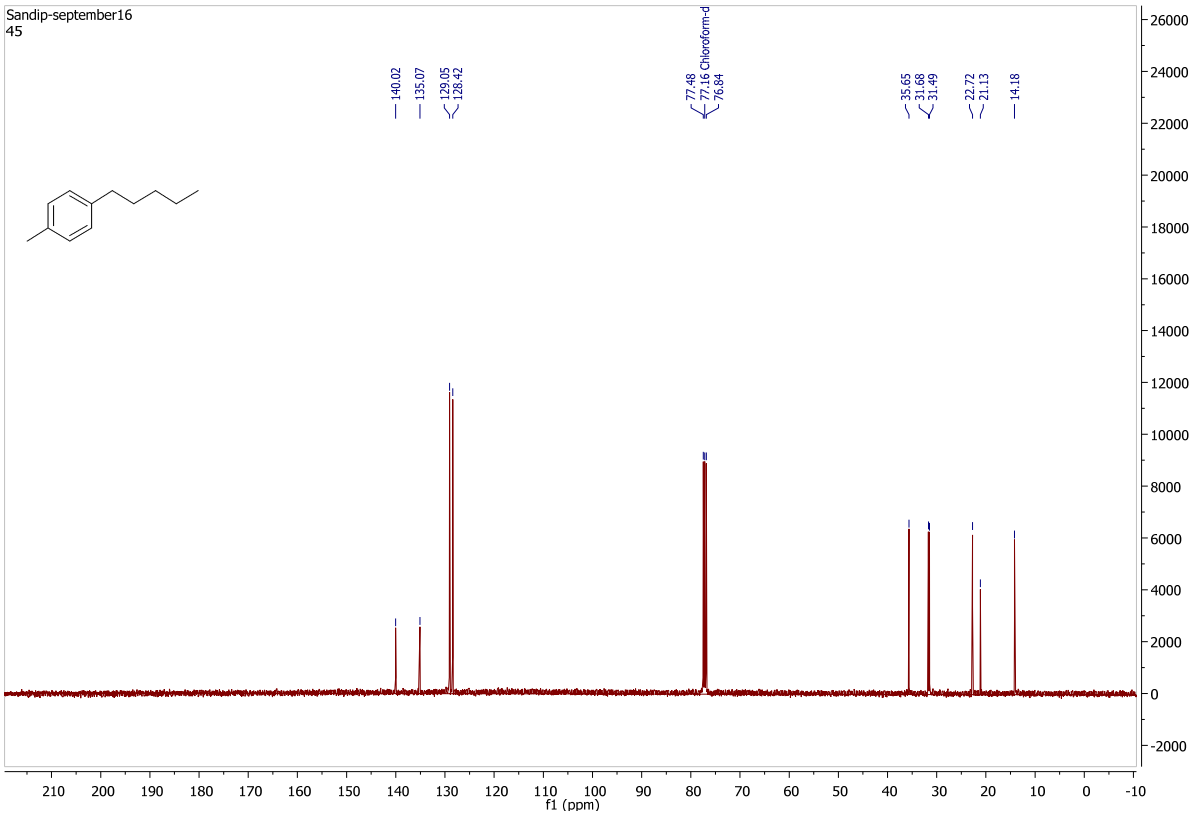
^{1}H and ^{13}C spectra of 1-methoxy-4-pentylbenzene (5a)



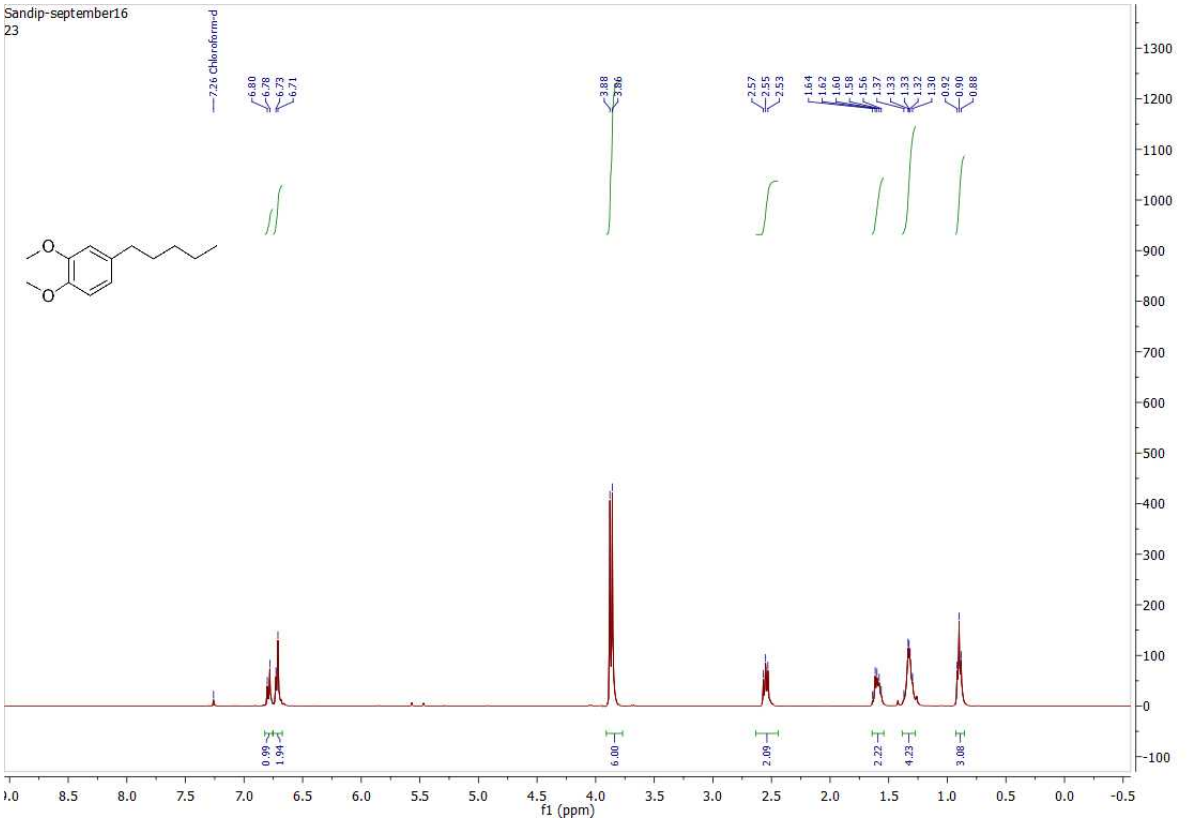


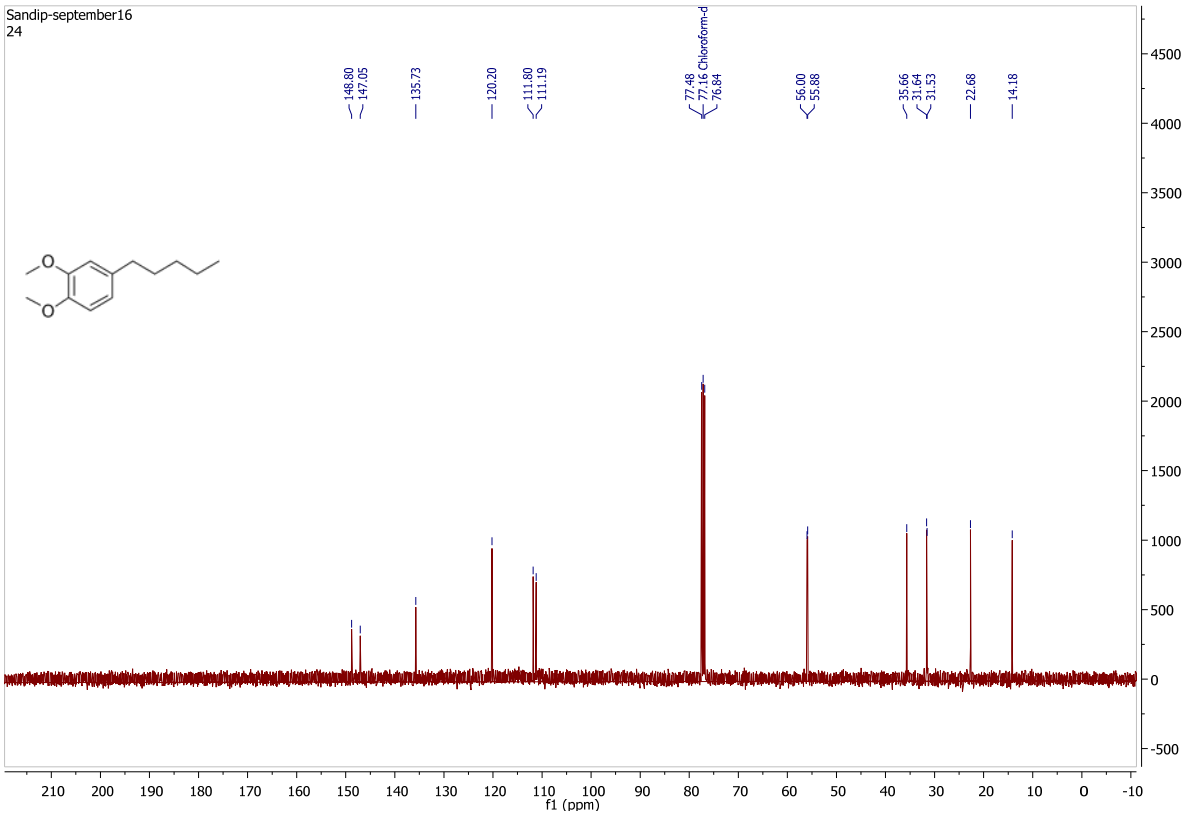
^{1}H and ^{13}C spectra of 1-methyl-4-pentylbenzene (5b)



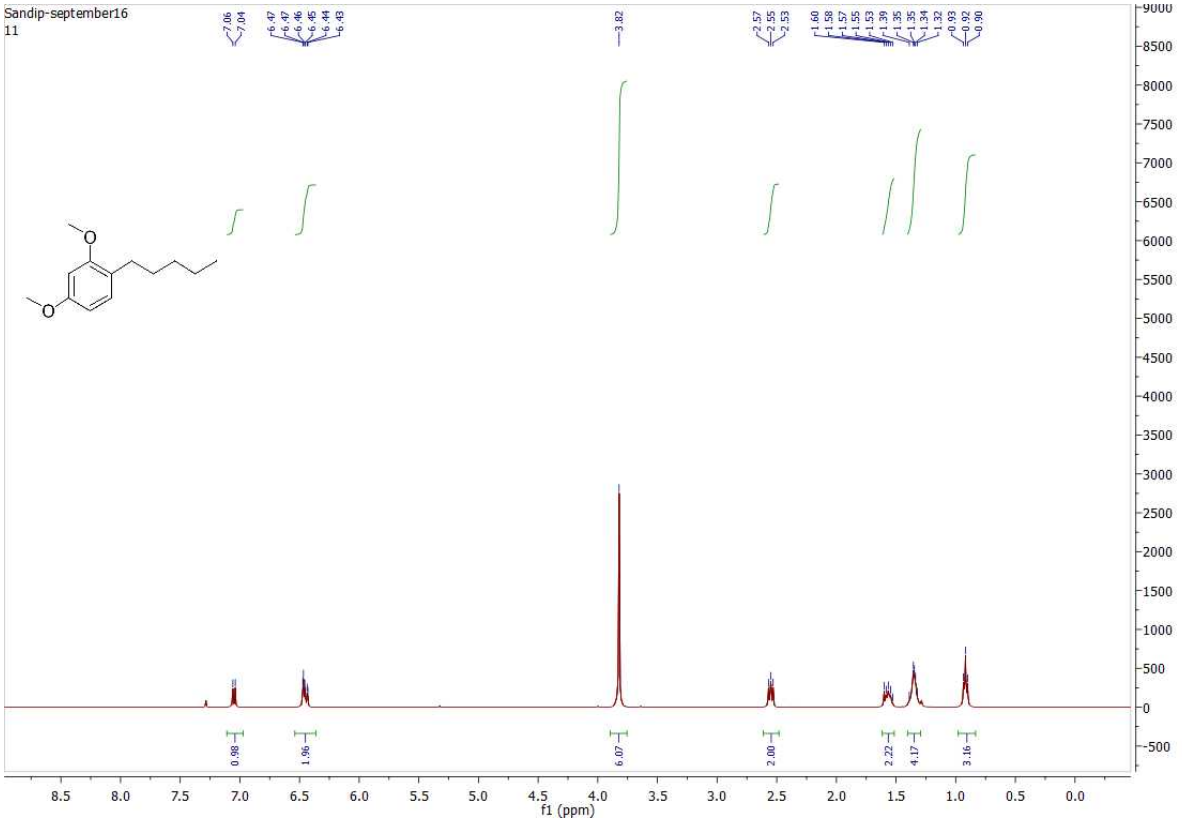


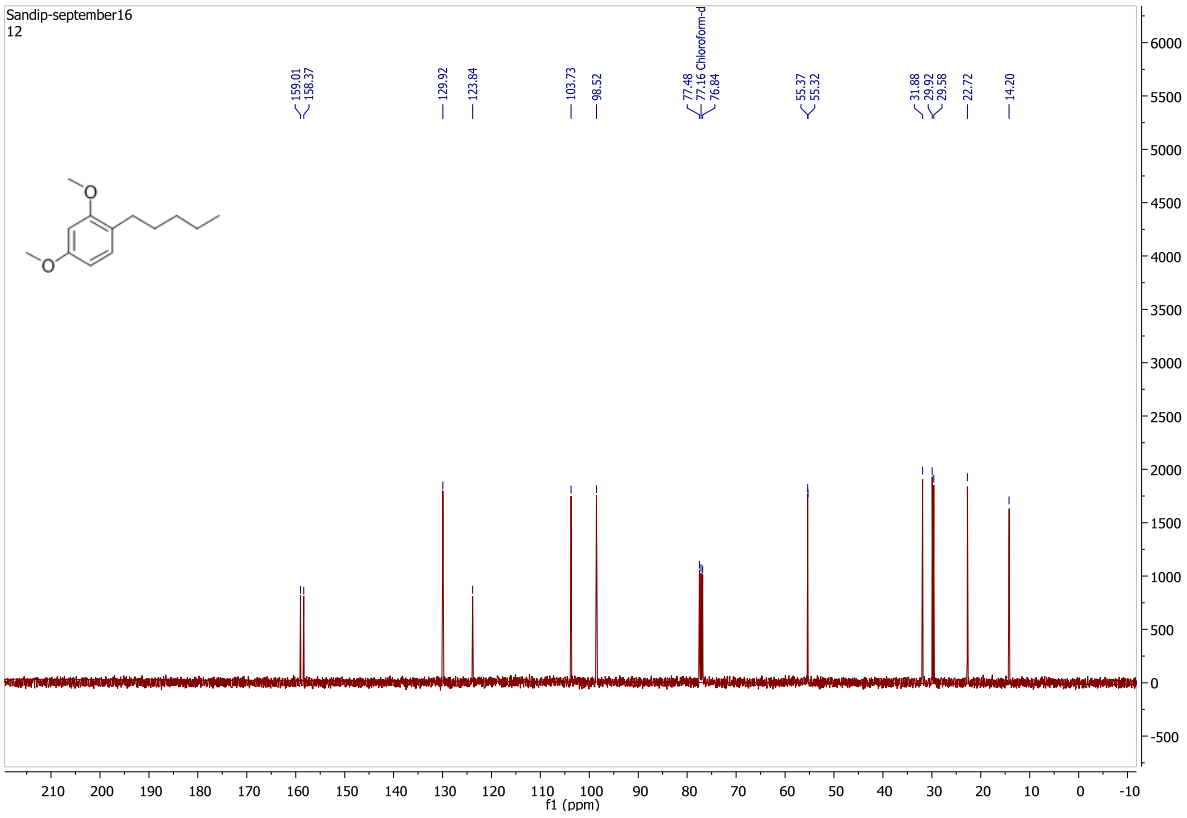
^{1}H and ^{13}C spectra of 1,2-dimethoxy-4-pentylbenzene (5c)



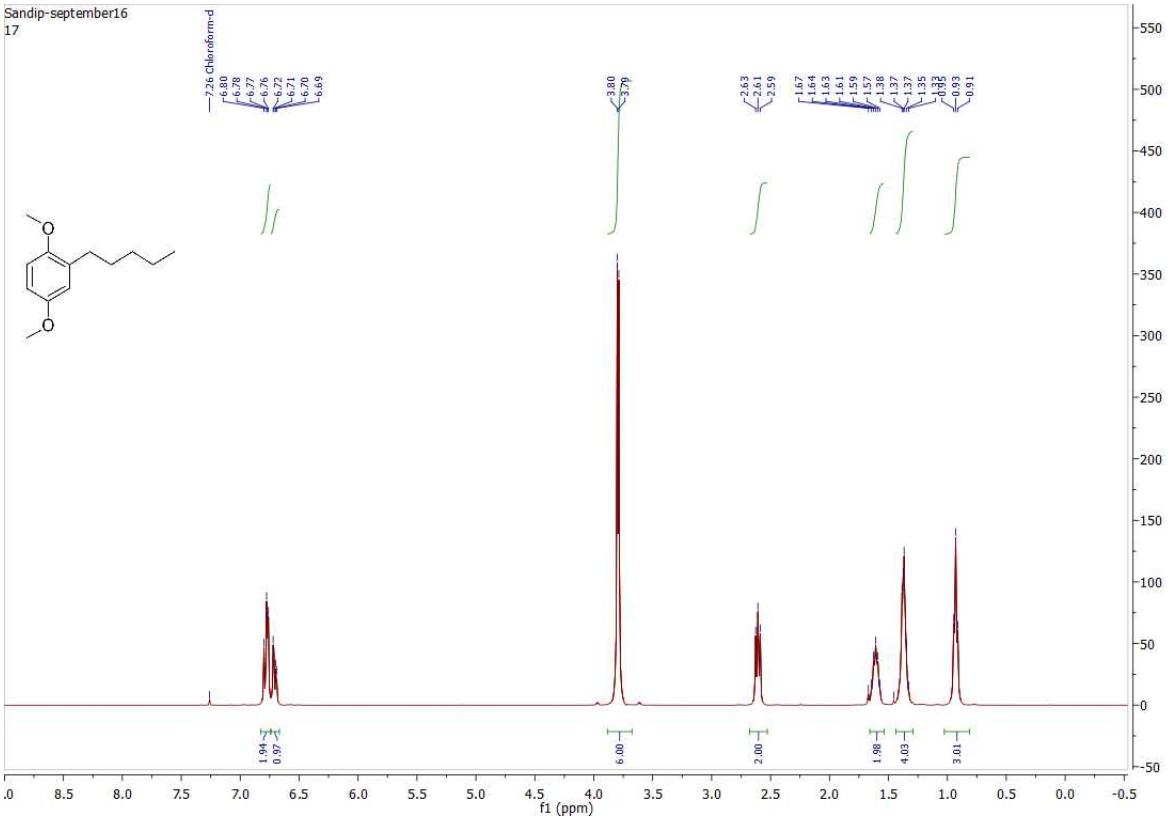


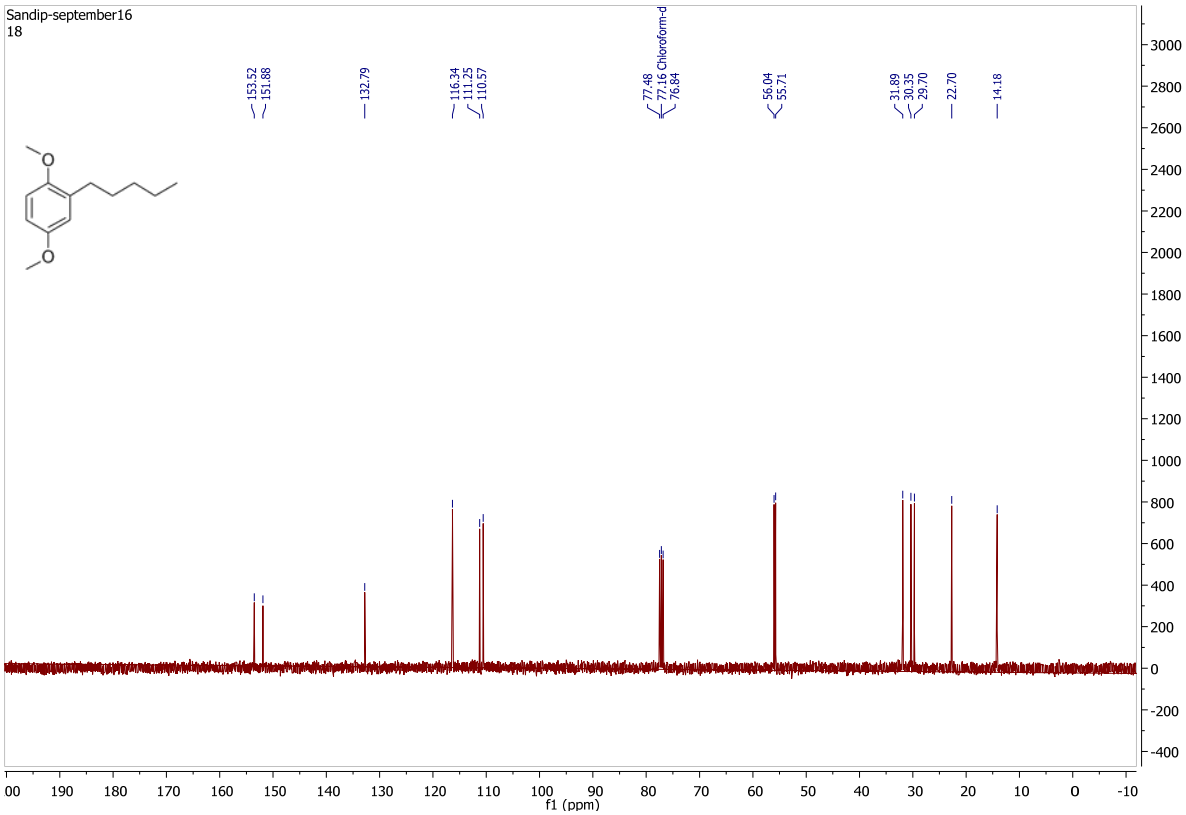
^{1}H and ^{13}C spectra of 2,4-dimethoxy-1-pentylbenzene (5d)



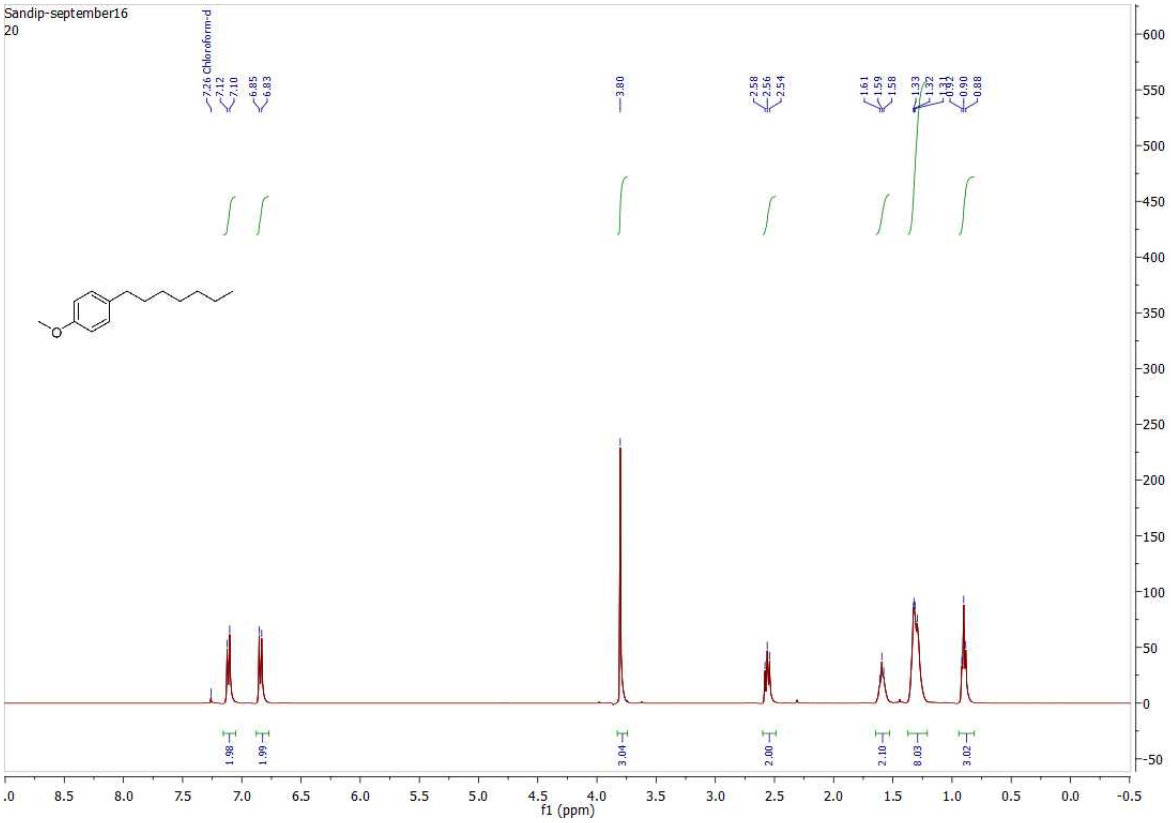


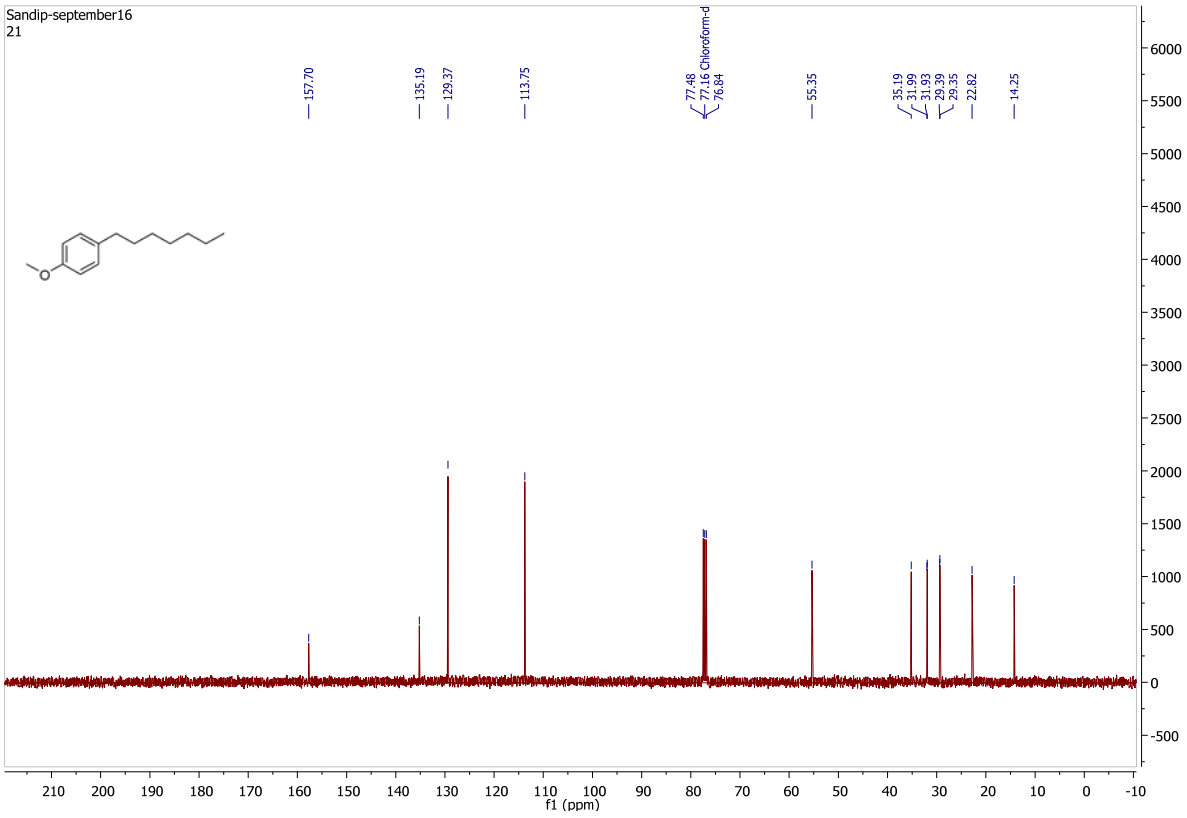
^{1}H and ^{13}C spectra of 1,4-dimethoxy-2-pentylbenzene (5e)



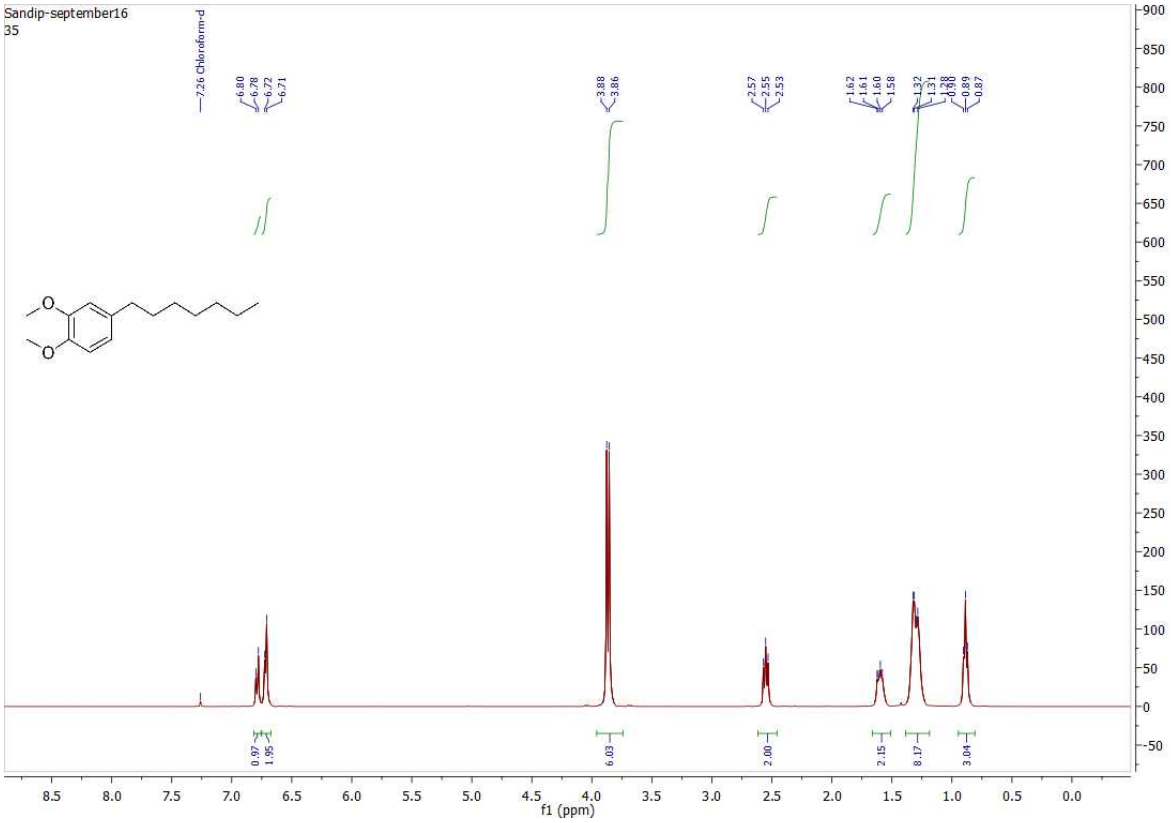


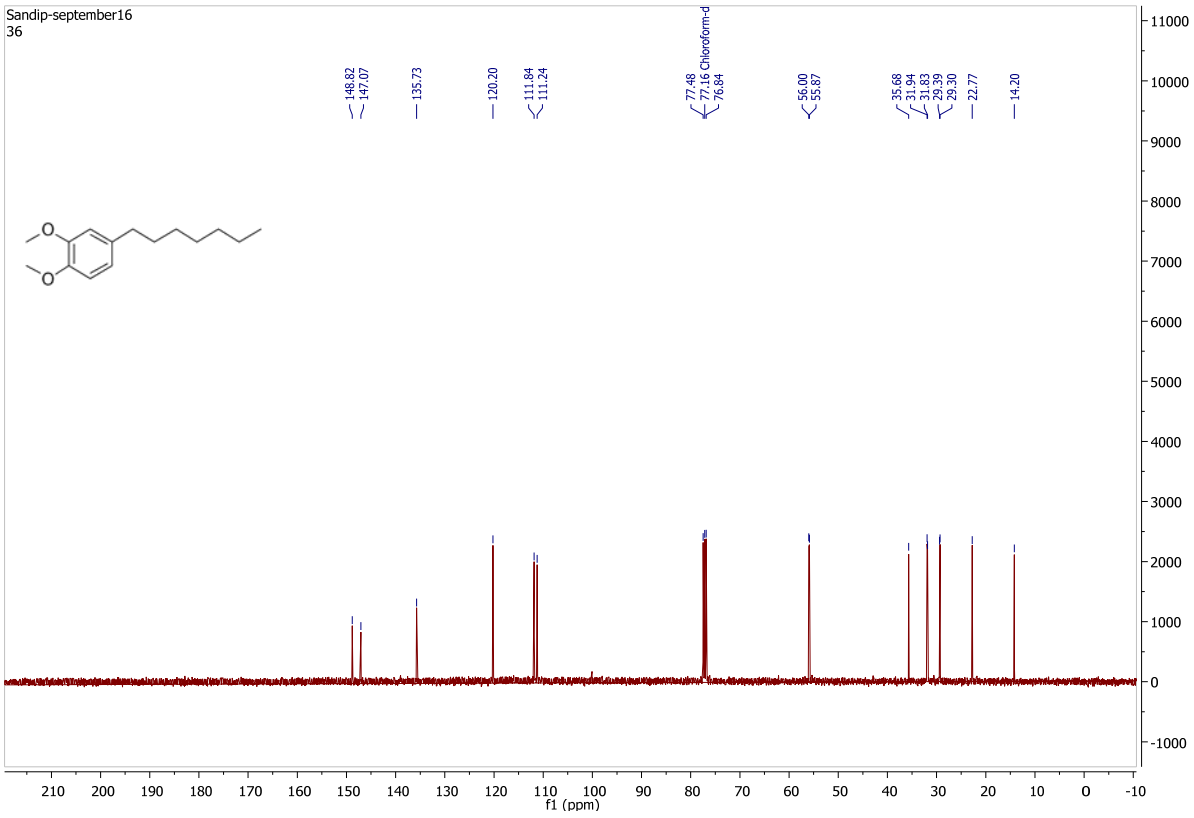
^{1}H and ^{13}C spectra of 1-Heptyl-4-methoxybenzene (5f)



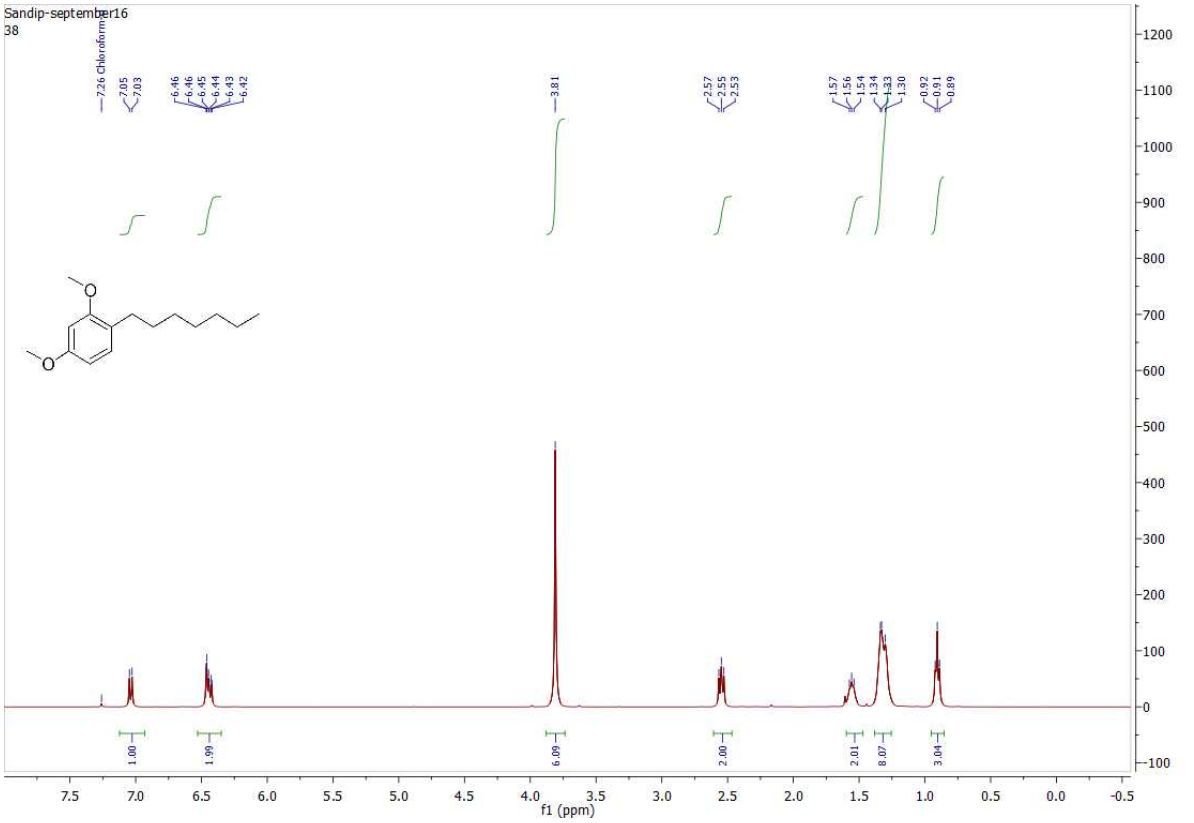


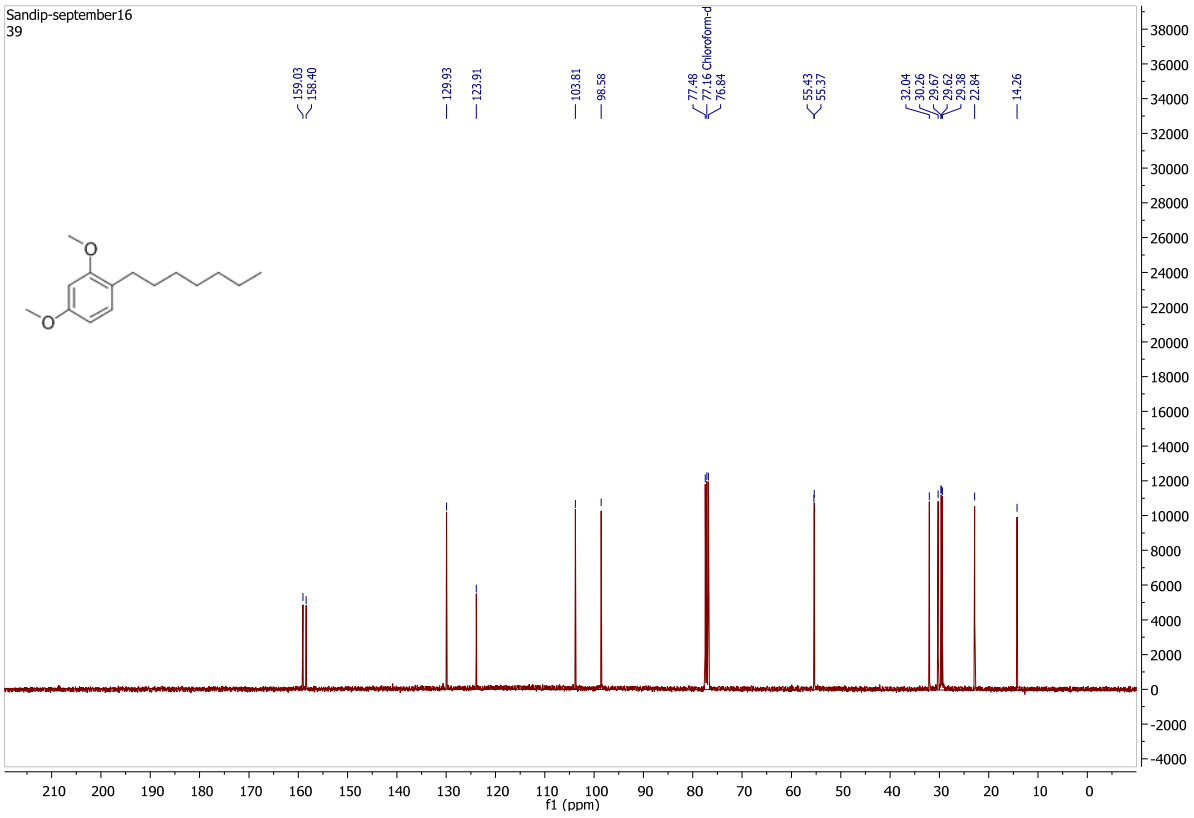
^{1}H and ^{13}C spectra of 4-heptyl-1,2-dimethoxybenzene (5g)



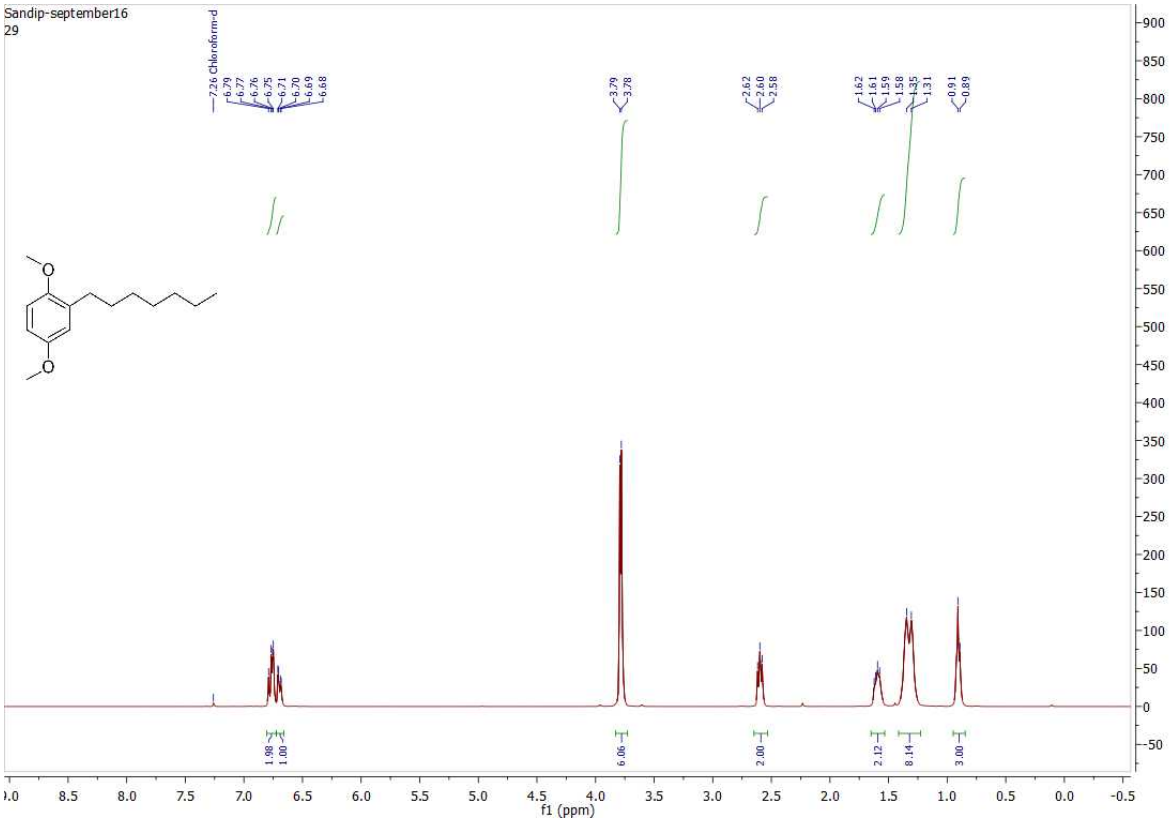


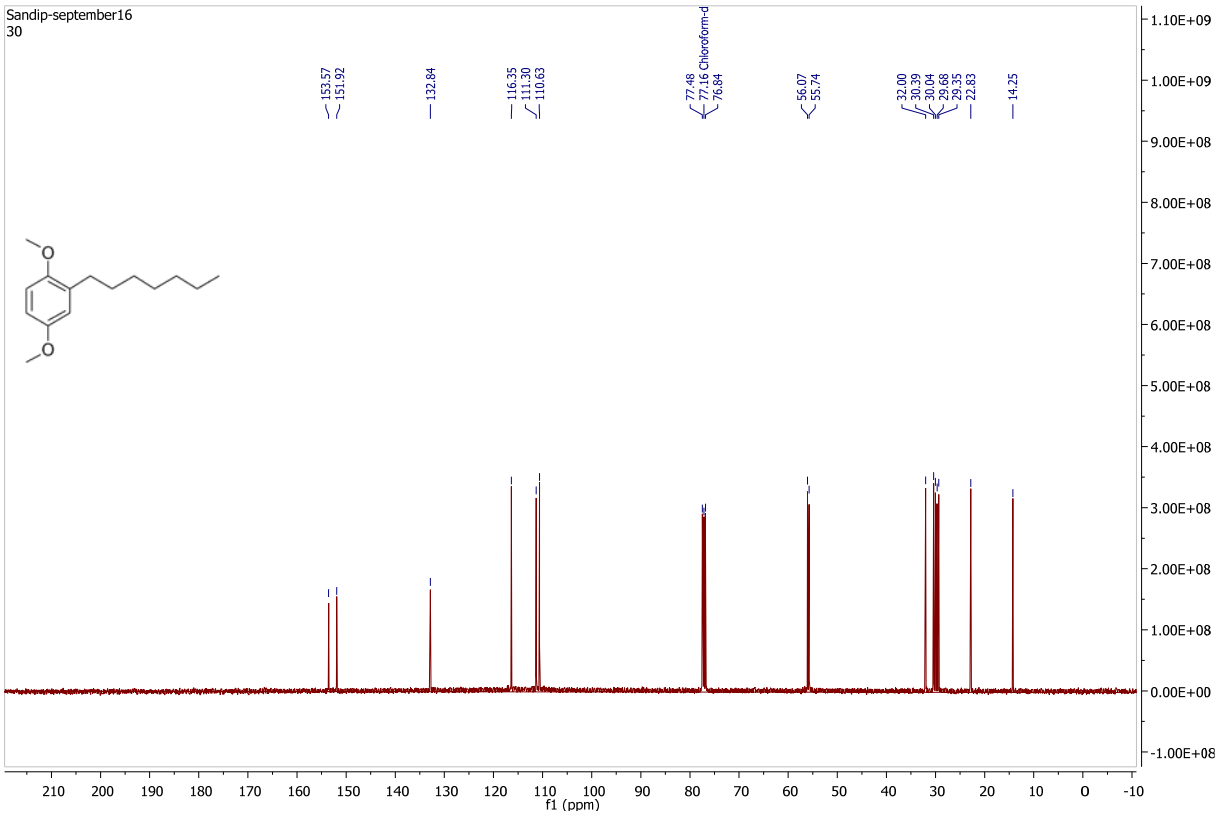
^{1}H and ^{13}C spectra of 1-heptyl-2,4-dimethoxybenzene (5h)



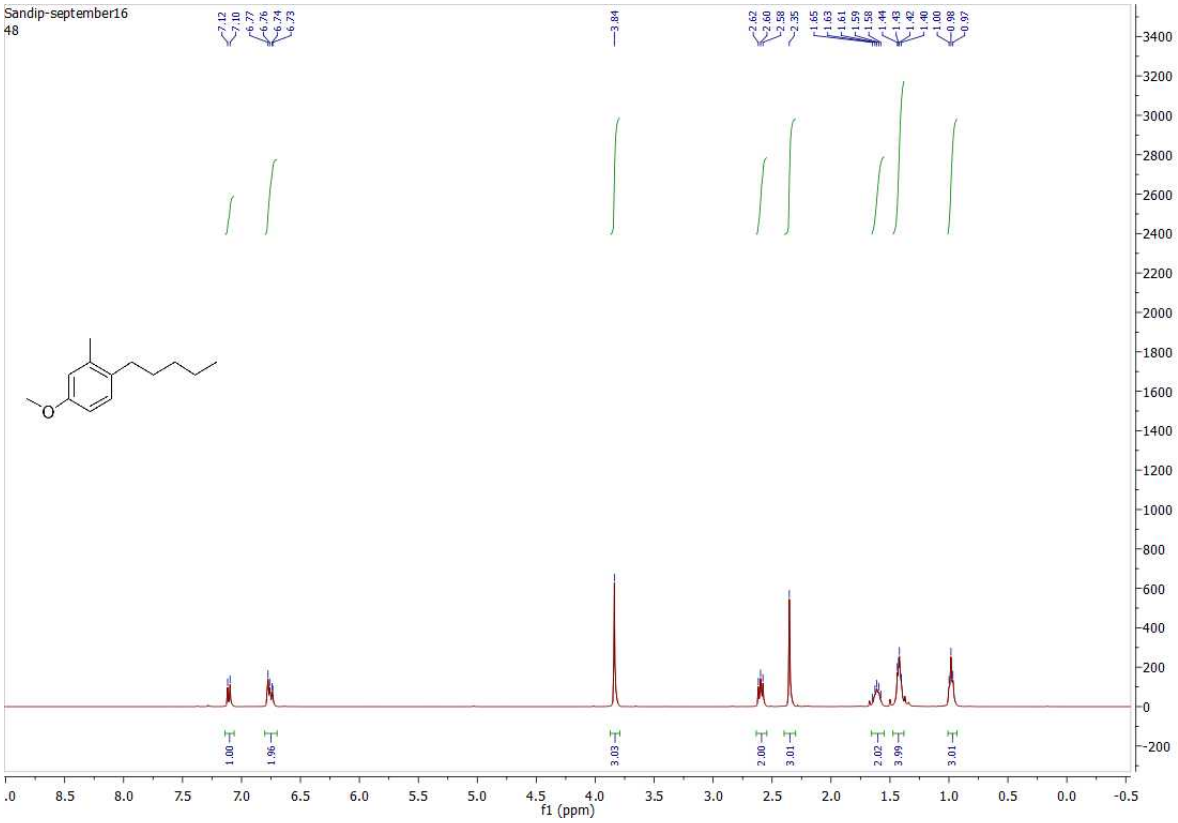


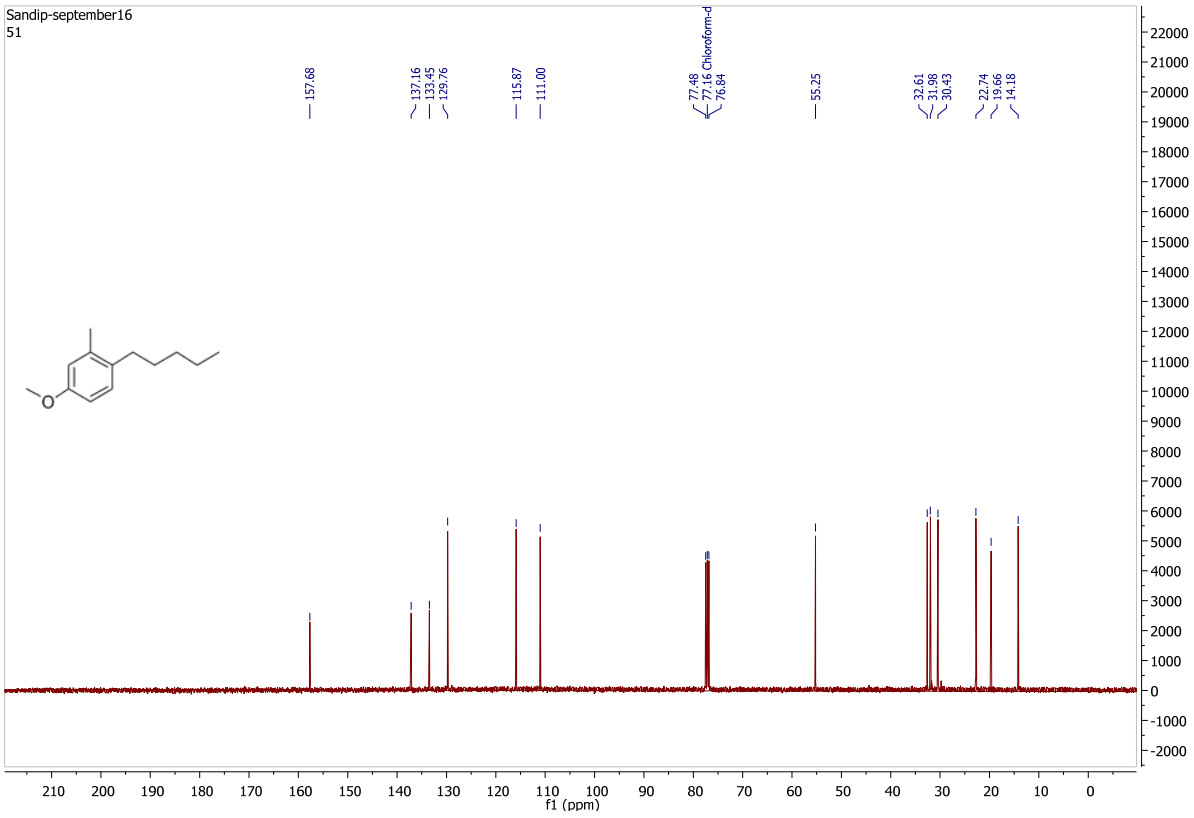
^{1}H and ^{13}C spectra of 2-heptyl-1,4-dimethoxybenzene (5i)



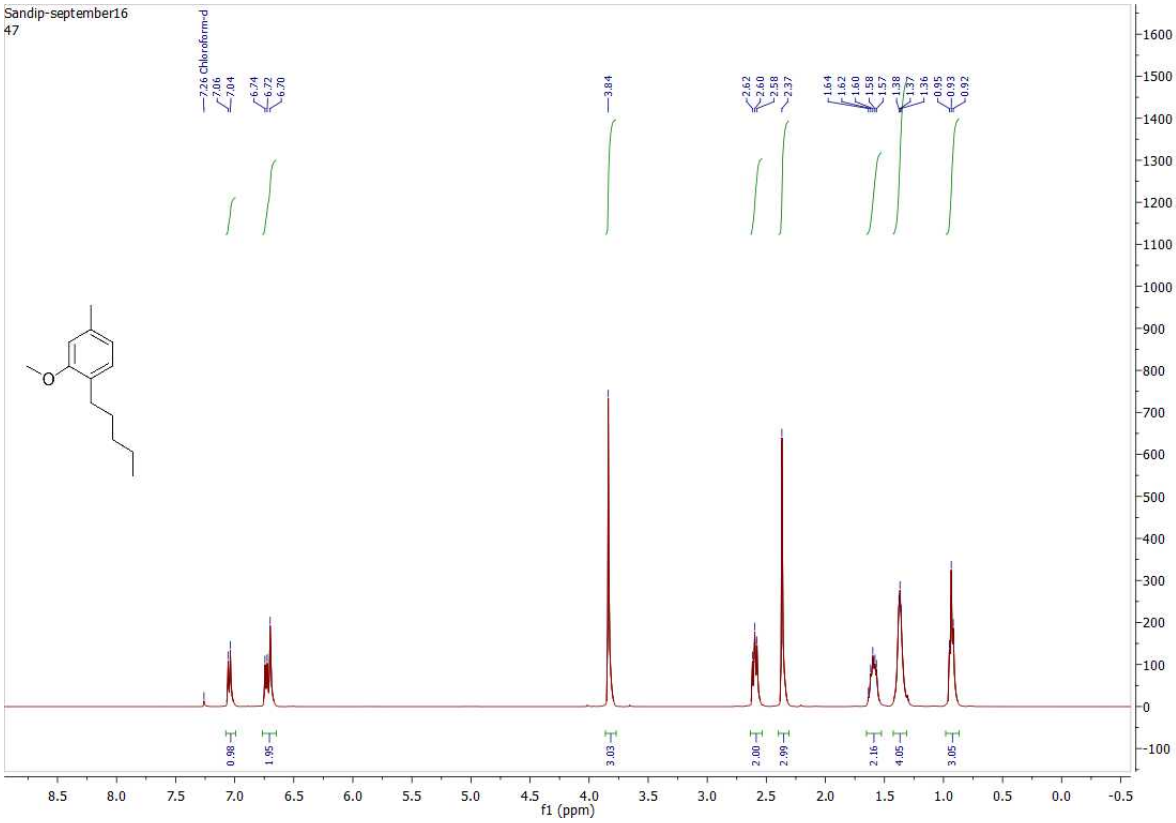


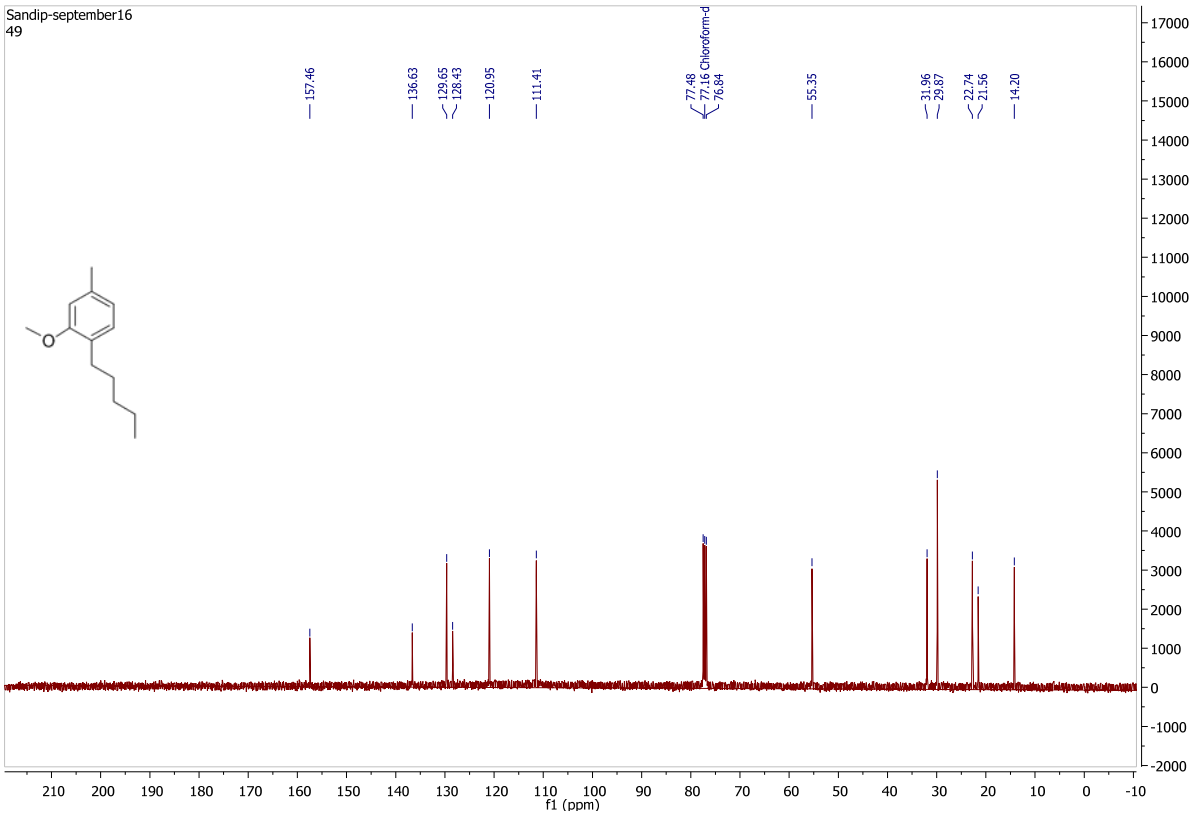
^{1}H and ^{13}C spectra of 4-methoxy-2-methyl-1-pentylbenzene (5j)



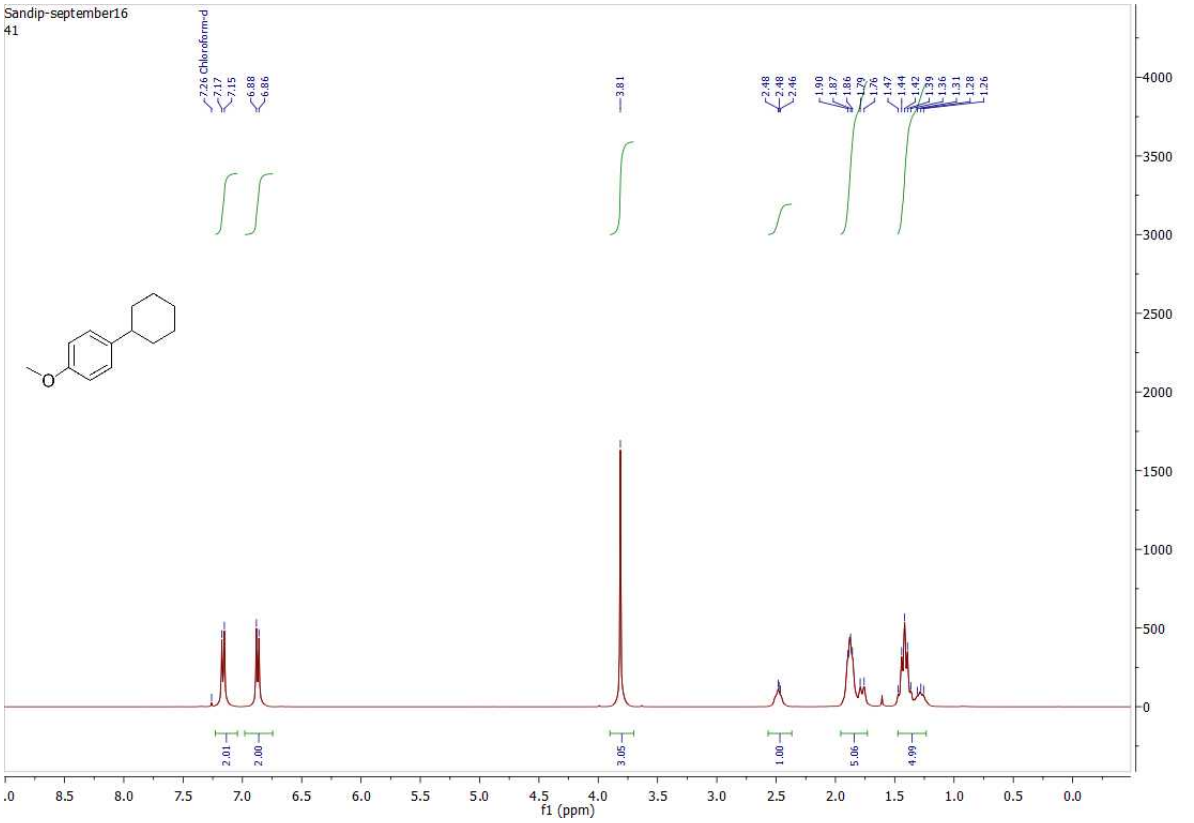


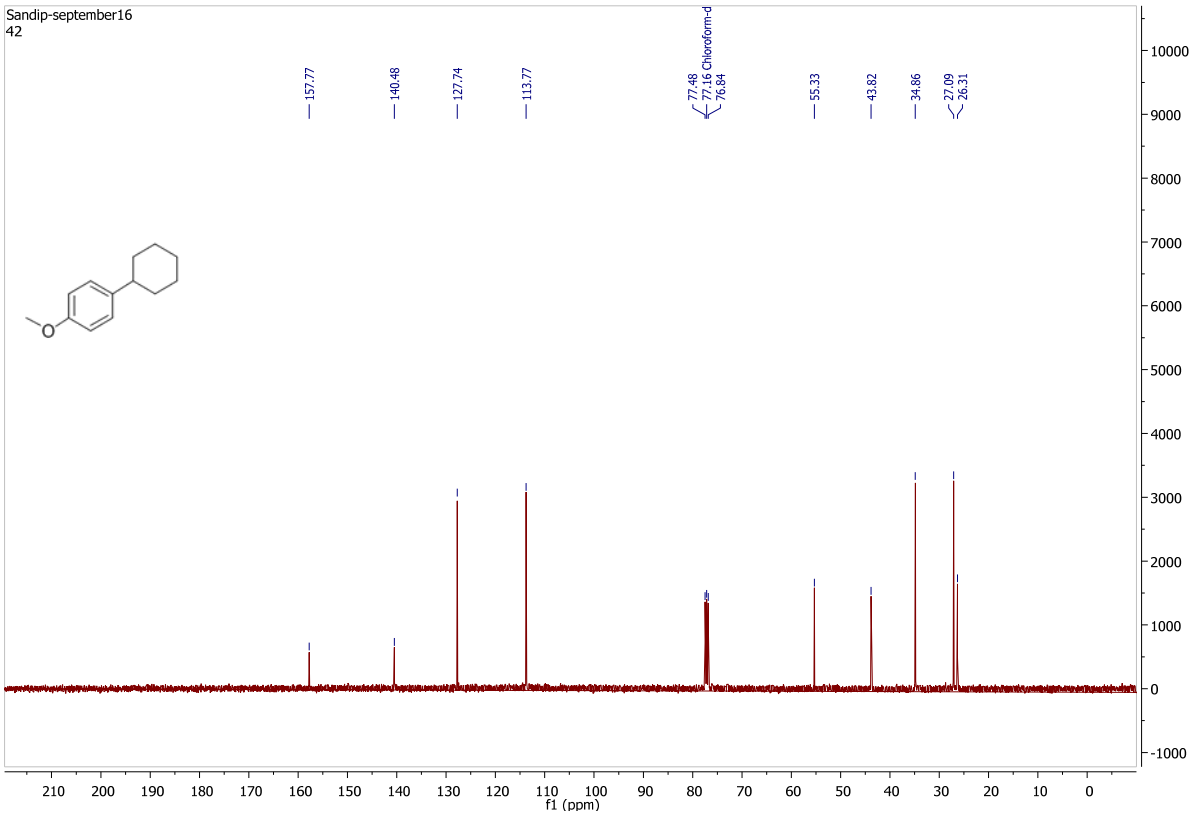
^{1}H and ^{13}C spectra of 2-methoxy-4-methyl-1-pentylbenzene (5k)





^{1}H and ^{13}C spectra of 1-cyclohexyl-4-methoxybenzene (5l)





^{1}H and ^{13}C spectra of 1-cyclopentyl-4-methoxybenzene (5m)