

Compendium of Organic Synthetic Methods

Volume 6

MICHAEL B. SMITH

DEPARTMENT OF CHEMISTRY
UNIVERSITY OF CONNECTICUT
STORRS, CONNECTICUT

A Wiley-Interscience Publication

JOHN WILEY & SONS

New York • Chichester • Brisbane • Toronto • Singapore

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PREFACE

It has been sixteen years since Ian and Shuyen Harrison first published the *Compendium of Organic Synthetic Methods* to facilitate the search for functional group transformations in the formidable body of the original literature. In Volume 2 this concept was expanded to include difunctional compounds. Louis Hegedus and Leroy Wade carried on this important compilation in Volume 3 and Wade continued with Volumes 4 and 5. Volume 6 is intended to continue the Harrisons' stated purpose of "a comprehensive one-volume listing of synthetic methods as an intermediary between the chemist and the literature."

Compendium of Organic Synthetic Methods, Volume 6, presents the functional group transformations and difunctional compound preparations of 1983, 1984, 1985, and 1986. The classification schemes of the first five volumes have been followed but a new chapter has been added. Each literature citation now includes all authors and the text concludes with an Author Index. The new Chapter 15 classifies the oxides of nitrogen, sulfur, and selenium with section headings identical to Chapters 1–14. The difunctional compounds now appear in Chapter 16. The experienced user of the *Compendium* will require no special instructions for the use of the new oxides chapter or the complete volume.

Author citations and the Author Index have been included to facilitate literature searches and to follow the current work of a particular author. The citations should not prove obtrusive and will hopefully assist the synthetic community.

I wish to express my gratitude to Professor Michael Edwards who first suggested this project to me. I also wish to thank Professor Leon Ghosez who provided the facilities for a pleasant sabbatical leave, which allowed completion of the research for this text. My thanks to Tae Woo Kwon, Jennline Sheu, Royce Menezes, Chung Jen Wang, Paul Keusenkothen, and Young Chan Son who proofread parts of the manuscript and offered many helpful suggestions. I want to thank my wife Sarah and son Steven for their patience and moral support throughout this work.


MICHAEL B. SMITH

Storrs, Connecticut
June 1987

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ABBREVIATIONS

Ac	Acetyl = $\text{—C}\overset{\text{O}}{\parallel}\text{CH}_3$
acac	Acetylacetonate
AIBN	Azo- <i>bis</i> -isobutyronitrile
aq.	Aqueous
-B 	9-Borabicyclo[3.3.1]nonylboryl
9-BBN	9-Borabicyclo[3.3.1]nonane
Bn (Bz)	Benzyl = $\text{—CH}_2\text{Ph}$
Boc	<i>t</i> -Butoxycarbonyl = $\text{—C}\overset{\text{O}}{\parallel}\text{—O—}t\text{Bu}$
bpy (bipy)	2,2'-Bipyridyl
Bu	<i>n</i> -Butyl = $\text{—CH}_2\text{CH}_2\text{CH}_2\text{CH}_3$
CAM	Carboxamidomethyl
CAN	Cerric ammonium nitrate = $(\text{NH}_4)_2\text{Ce}(\text{NO}_3)_6$
c-	Cyclo-
cat.	Catalytic
CBZ	Carbobenzoxy = $\text{—C}\overset{\text{O}}{\parallel}\text{CH}_2\text{Ph}$
COD	1,5-Cyclooctadienyl
Cp	Cyclopentadienyl
Cy	Cyclohexyl
DABCO	1,4-Diazabicyclo[2.2.2]octane
dba	Dibenzylidene acetone
DBE	1,2-Dibromoethane = $\text{BrCH}_2\text{CH}_2\text{Br}$
DBN	1,8-Diazabicyclo[5.4.0]undec-7-ene
DBU	1,5-Diazabicyclo[4.3.0]non-5-ene
DCC	1,3-Dicyclohexylcarbodiimide = $\text{C}_6\text{H}_{13}\text{—N=C=N—C}_6\text{H}_{13}$
DCE	1,2-Dichloroethane = $\text{ClCH}_2\text{CH}_2\text{Cl}$
DDQ	2,3-Dichloro-5,6-dicyano-1,4-benzoquinone
DEA	Diethylamine = $\text{HN}(\text{CH}_2\text{CH}_3)_2$
DEAD	Diethylazodicarboxylate
Dibal-H	Diisobutylaluminum hydride
Diphos-4	1,4- <i>bis</i> -(Diphenylphosphino)butane
DMAP	4-Dimethylaminopyridine
DME	Dimethoxyethane
DMF	<i>N,N</i> -Dimethylformamide = HCNMe_2

dppe	1,2- <i>bis</i> -Diphenylphosphinoethane
dppf	<i>bis</i> -(Diphenylphosphine)ferrocene
dppp	1,3- <i>bis</i> -(Diphenylphospine)propane
dvb	Divinylbenzene
e ⁻	Electrolysis
ee	Enantiomeric excess
EE	Ethoxyethyl
Et	Ethyl = —CH ₂ CH ₃
EDA	Ethylenediamine = H ₂ NCH ₂ CH ₂ NH ₂
EDTA	Ethylenediaminetetraacetic acid
FMN	Flavin mononucleotide
fod	<i>tris</i> -(6,6,7,7,8,8,8)-Heptafluoro-2,2-dimethyl-3,5-octanedionate
Fp	Cyclopentadienylbiscarbonyliron
FVP	Flash vacuum pyrolysis
<i>hν</i>	Irradiation with light
1,5-HD	1,5-Hexadienyl
HMPA	Hexamethylphosphoramide = (Me ₃ N) ₃ P=O
HMPT	Hexamethylphosphorous triamide = (Me ₃ N) ₃ P
iPr	Isopropyl = —CH(CH ₃) ₂
LICA	Lithium cyclohexylisopropylamide
LDA	Lithium diisopropylamide = LiN(iPr) ₂
LTMP	Lithium 2,2,6,6-tetramethylpiperidide
mcpba	<i>meta</i> -Chloroperoxybenzoic acid
Me	Methyl = —CH ₃
MEM	β-Methoxyethoxymethyl = MeOCH ₂ CH ₂ OCH ₂ —
MOM	Methoxymethyl = MeOCH ₂ —
Ms	Methanesulfonyl = CH ₃ SO ₂ —
MTM	Methylthiomethyl = CH ₃ SCH ₂ —
NAD	Nicotinamide adenine dinucleotide
NADP	Sodium triphosphopyridine nucleotide
NBD	Norbornadiene
NBS	<i>N</i> -Bromosuccinimide
NCS	<i>N</i> -Chlorosuccinimide
Ni(R)	Raney nickel
Ⓟ	Polymeric backbone
PCC	Pyridinium chlorochromate
PDC	Pyridinium dichromate
PEG	Polyethylene glycol
Ph	Phenyl = —C ₆ H ₅
Pip	Piperidine = HN—CH ₂ CH ₂ CH ₂ CH ₂ CH ₂ —
Pr	<i>n</i> -Propyl = —CH ₂ CH ₂ CH ₃
Py	Pyridine = C ₆ H ₅ N
quant.	Quantitative yield
Red-Al	[(MeOCH ₂ CH ₂ O) ₂ AlH ₂]Na
TBAF	<i>n</i> -Bu ₄ N ⁺ F ⁻
TBHP	<i>t</i> -Butylhydroperoxide = Me ₃ COOH

ABBREVIATIONS

xi

tBu	<i>t</i> -Butyl = $-\text{C}(\text{CH}_3)_3$
TEMPO	Tetramethylpiperidinyloxy free radical
TFA	Trifluoroacetic acid = CF_3COOH
TFAA	Trifluoroacetic anhydride = $\text{CF}_3\text{COCCH}_3$
Tf	Triflate = $-\text{OSO}_2\text{CF}_3$
THF	Tetrahydrofuran
THP	Tetrahydropyran
TMEDA	Tetramethylethylenediamine
TMS	Trimethylsilyl = $-\text{Si}(\text{CH}_3)_3$
TMP	2,2,6,6-Tetramethylpiperidine
Tol	Tolyl = 4- $\text{C}_6\text{H}_4\text{CH}_3$
Tr	Trityl = $-\text{CPh}_3$
TRIS	Triisopropylphenylsulfonyl
Ts (Tos)	Tosyl = <i>p</i> -toluenesulfonyl
»»»»)	Sonication

INDEX, MONOFUNCTIONAL COMPOUNDS

Sections—heavy type

Pages—light type

PREPARATION OF →

FROM ↘

	Acetylenes	Carboxylic acids, acid halides, anhydrides	Alcohols, phenols	Aldehydes	Alkyls, methylenes, aryls	Amides	Amines	Esters	Ethers, epoxides	Halides, sulfonates	Hydrides (RH)	Ketones	Nitriles	Olefins	Oxides
1	16	31	61	106	121	166	181	196							
2	8	19	67	139	165	205	239	248							
3	17	32	47	107	137	152	167	197							
4	19	34	49	109	124	139	154	169	184	199					
5	20	35	50	110	125	140	170	200	215						
6	10	26	57	115	148	168	186	216	256	273					
7	36			81	96	111	186								
8	22	52	82	112	127	142	157	172	217						
9	11	58	104	117	149	169	187	198	217						
10	23	38	53	68	83	98	113	128	158	173	203				
11	4	11	28	58	69	106	125	149	169	198	218	257			
12	39	54	69	114	129	144	159	174	204	219					
13	29	59	71	154	170	187	199	219	258	275					
14	25	40	55	100	115	130	145	160	175	190	205				
15	12	33	59	107	125	155	171	188	200	220	243	260			
16	26	56	71	101	116	146	176	191	206	221					
17	14	61	77	128	158	190	222	244	263	278					
18	27	42	57	72	87	102	117	132	147	162	177	192	207		
19	5	14	35	61	79	108	128	158	173	191	203	223	245	264	
20	28			73	88	103	118	163	178	193	208				
21	15			80	109	131	160	203	231	245	267				
22	29	44	59	74	89	104	119	134	149	179	209				
23	6	16	43	62	81	110	132	161	175	192	231				
24	30	45	60	75	90	105	120	135	150	165	180	195	210	225	
25	7	16	45	63	97	111	132	162	179	192	204	233	246	270	279

PROTECTION

Sect.	Pg.
Carboxylic acids	30A
Alcohols, phenols	45A
Aldehydes	60A
Amines	105A
Ethers	135A
Ketones	180A

Blanks in the table correspond to sections for which no additional examples were found in the literature.

INDEX, DIFUNCTIONAL COMPOUNDS

Sections—heavy type

Pages—light type

300 280	Acetylene	
301 281	312 291	Carboxylic acid
302 282	313 292	Alcohol
	323 307	Aldehyde
	324 310	Amide
	333 350	
	315 295	Amine
	325 311	
305 285	326 313	Ester
	335 351	
	343 361	Ether, epoxide
	350 374	
	317 299	Halide
	327 318	
	336 318	Ketone
	344 351	
307 286	345 300	Nitrite
	352 380	
308 287	346 301	Nitrate
	353 354	
309 288	347 302	Olefin
	354 355	
	369 381	Other
	372 401	
	370 370	Other
	373 448	
311 289	349 305	Other
	356 370	
	362 371	Other
	374 453	
	376 464	Other
	377 481	
	378 484	Other

Blanks in the table correspond to sections for which no additional examples were found in the literature.

INTRODUCTION

Relationship between Volume 6 and Previous Volumes. *Compendium of Organic Synthetic Methods, Volume 6* presents about 1100 examples of published methods for the preparation of monofunctional compounds, updating the 7000 in Volumes 1 through 5. In addition, Volume 6 contains about 900 examples of preparations of difunctional compounds and various functional groups, updating the sections introduced in Volume 2. For Chapters 1 through 14 the same systems of section and chapter numbering are used as in previous volumes. Chapter 15 is new and classifies the preparation of oxides of nitrogen (nitro compounds, nitrones, *N*-oxides, etc.), sulfur (sulf-oxides and sulfones), and selenium (selenoxides and Se dioxides) according to the scheme used for all other monofunctional compounds. Therefore, "Oxides from Acetylenes" appears as Section 211 and the chapter concludes with "Oxides from Miscellaneous Compounds", Section 225. The difunctional compounds now appear in Chapter 16 (Chapter 15 in Volumes 2 through 5) but the section numbers remain the same.

A minor change from previous volumes is the inclusion of thiols with all alcohol classifications and sulfides (thioethers) are classified with ethers. Both of these changes are reflected in the chapter titles, section titles, and citations. These changes do not alter the fundamental organization.

Each literature citation follows the notation used in previous volumes but is accompanied by a complete author list. The principal author(s) are denoted by an asterisk (*). Following Chapter 16 is an alphabetical listing of all authors (last name, initials).

Classification and Organization of Reactions Forming Monofunctional Compounds. Chemical transformations are classified according to the reacting functional group of the starting material and the functional group formed. Those reactions that give products with the same functional group form a chapter. The reactions in each chapter are further classified into sections on the basis of the functional group of the starting material. Within each section, reactions are loosely arranged in ascending order of year cited (1983–1986), although an effort has been made to put similar reactions together when possible. Review articles are collected at the end of each appropriate section.

The classification is unaffected by allylic, vinylic, or acetylenic unsaturation appearing in both starting material and product, or by increases or decreases

in the length of carbon chains; for example, the reactions $t\text{-BuOH} \rightarrow t\text{-BuCOOH}$, $\text{PhCH}_2\text{OH} \rightarrow \text{PhCOOH}$, and $\text{PhCH}=\text{CHCH}_2\text{OH} \rightarrow \text{PhCH}=\text{CHCOOH}$ would all be considered as preparations of carboxylic acids from alcohols. Conjugate reduction and alkylation of unsaturated ketones, aldehydes, esters, acids, and nitriles have been placed in category 74 (alkyls from olefins).

The terms hydrides, alkyls, and aryls classify compounds containing reacting hydrogens, alkyl groups, and aryl groups, respectively; for example, $\text{RCH}_2\text{-H} \rightarrow \text{RCH}_2\text{COOH}$ (carboxylic acids from hydrides), $\text{RMe} \rightarrow \text{RCOOH}$ (carboxylic acids from alkyls), $\text{RPh} \rightarrow \text{RCOOH}$ (carboxylic acids from aryls). Note the distinction between $\text{R}_2\text{CO} \rightarrow \text{R}_2\text{CH}_2$ (methylene from ketones) and $\text{RCOR}' \rightarrow \text{RH}$ (hydrides from ketones). Alkylations involving additions across double bonds are found in Section 74 (alkyls, methylenes, and aryls from olefins).

The following examples illustrate the classification of some potentially confusing cases:

$\text{RCH}=\text{CHCOOH} \rightarrow \text{RCH}=\text{CH}_2$	Hydrides from carboxylic acids
$\text{RCH}=\text{CH}_2 \rightarrow \text{RCH}=\text{CHCOOH}$	Carboxylic acids from hydrides
$\text{ArH} \rightarrow \text{ArCOOH}$	Carboxylic acids from hydrides
$\text{ArH} \rightarrow \text{ArOAc}$	Esters from hydrides
$\text{RCHO} \rightarrow \text{RH}$	Hydrides from aldehydes
$\text{RCH}=\text{CHCHO} \rightarrow \text{RCH}=\text{CH}_2$	Hydrides from aldehydes
$\text{RCHO} \rightarrow \text{RCH}_3$	Alkyls from aldehydes
$\text{R}_2\text{CH}_2 \rightarrow \text{R}_2\text{CO}$	Ketones from methylenes
$\text{RCH}_2\text{COR} \rightarrow \text{R}_2\text{CHCOR}$	Ketones from ketones
$\text{RCH}=\text{CH}_2 \rightarrow \text{RCH}_2\text{CH}_3$	Alkyls from olefins
$\text{RBr} + \text{CH}=\text{CH} \rightarrow \text{RC}\equiv\text{CR}$	Acetylenes from halides; also acetylenes from acetylenes
$\text{ROH} + \text{RCOOH} \rightarrow \text{RCOOR}$	Esters from alcohols; also esters from carboxylic acids
$\text{RCH}=\text{CHCHO} \rightarrow \text{RCH}_2\text{CH}_2\text{CHO}$	Alkyls from olefins
$\text{RCH}=\text{CHCN} \rightarrow \text{RCH}_2\text{CH}_2\text{CN}$	Alkyls from olefins

How to Use the Book to Locate Examples of the Preparation or Protection of Monofunctional Compounds. Examples of the preparation of one functional group from another are located via the monofunctional index on p. xiii, which lists the corresponding section and page. Thus Section 1 contains examples of the preparation of acetylenes from other acetylenes; Section 2, acetylenes from carboxylic acids; and so forth.

Sections that contain examples of the reactions of a functional group are found in the horizontal rows of the index. Thus Section 1 gives examples of

the reactions of acetylenes that form acetylenes; Section 16, reactions of acetylenes that form carboxylic acids; and Section 31, reactions of acetylenes that form alcohols.

Examples of alkylation, dealkylation, homologation, isomerization, and transposition are found in Sections 1, 17, 33, and so on, lying close to a diagonal of the index. These sections correspond to such topics as the preparation of acetylenes from acetylenes; carboxylic acids from carboxylic acids; and alcohols, thiols, and phenols from alcohols, thiols, and phenols. Alkylations that involve conjugate additions across a double bond are found in Section 74 (alkyls, methylenes, and aryls from olefins).

Examples of name reactions can be found by first considering the nature of the starting material and product. The Wittig reaction, for instance is in Section 199 (olefins from aldehydes) and Section 207 (olefins from ketones). The aldol condensation can be found in the chapters on difunctional compounds in Section 324 (alcohol, thiol-aldehyde) and in Section 330 (alcohol, thiol-ketone).

Examples of the protection of acetylenes, carboxylic acids, alcohols, phenols, aldehydes, amides, amines, esters, ketones, and olefins are also indexed on p. xiii.

The pairs of functional groups alcohol, ester; carboxylic acid, ester; amine, amide; and carboxylic acid, amide can be interconverted by simple reactions. When a member of these groups is the desired product or starting material, the other member should, of course, also be consulted in the text.

The original literature must be used to determine the generality of reactions, although this is occasionally stated in the citation. This is only done in cases where such generality is stated clearly in the original citation. A reaction given in this book for a primary aliphatic substrate may also be applicable to tertiary or aromatic compounds. This book provides very limited experimental conditions or precautions and the reader is referred to the original literature before attempting a reaction. In no instance should the citation be taken as a complete experimental procedure. Not to refer to the original literature could be hazardous. The original papers usually yield a further set of references to previous work. Subsequent publications can be found by consulting the *Science Citation Index*.

Classification and Organization of Reactions Forming Difunctional Compounds. This chapter considers all possible difunctional compounds formed from the groups acetylene, carboxylic acid, alcohol, thiol, aldehyde, amide, amine, ester, ether, epoxide, thioether, halide, ketone, nitrile, and olefin. Reactions that form difunctional compounds are classified into sections on the basis of the two functional groups of the product. The relative positions

of the groups do not affect the classification. Thus preparations of 1,2-aminoalcohols, 1,3-aminoalcohols, and 1,4-aminoalcohols are included in a single section. Difunctional compounds that have an oxide as the second group are found in the monofunctional sections for the nonoxide functional group. Therefore, the nitroketone product of oxidation of a nitroalcohol is found in Section 168 (ketones from alcohols and thiols). Conversion of an oxide to another functional group is generally found in the "Miscellaneous" section, so conversion of a nitroalkane to an amine is found in Section 105 (amines from miscellaneous compounds). The following examples illustrate the application of this classification system:

<i>Difunctional Product</i>	<i>Section Title</i>
$RC\equiv C-C\equiv CR$	Acetylene-acetylene
$RCH(OH)COOH$	Carboxylic acid-alcohol
$RCH=CHOMe$	Ether-olefin
$RCHF_2$	Halide-halide
$RCH(Br)CH_2F$	Halide-halide
$RCH(OAc)CH_2OH$	Alcohol-ester
$RCH(OH)CO_2Me$	Alcohol-ester
$RCH=CHCH_2CO_2Me$	Ester-olefin
$RCH=CHOAc$	Ester-olefin
$RCH(OMe)CH_2SO_2CH_2CH_2OH$	Alcohol-ether

How to Use the Book to Locate Examples of the Preparation of Difunctional Compounds. The difunctional index on p. xiv gives the section and page corresponding to each difunctional product. Thus Section 327 (alcohol, thiol-ester) contains examples of the preparation of hydroxyesters; Section 323 (alcohol, thiol-alcohol, thiol) contains examples of the preparation of diols.

Some preparations of olefinic and acetylenic compounds from olefinic and acetylenic starting materials can, in principle, be classified in either the monofunctional or difunctional sections; for example, $RCH=CHBr \rightarrow RCH=CHCOOH$, carboxylic acids from halides (Section 25, monofunctional compounds) or carboxylic acid-olefin (Section 322, difunctional compounds). In such cases both sections should be consulted.

Reactions applicable to both aldehyde and ketone starting materials are in many cases illustrated by an example that uses only one of them.

Many literature preparations of difunctional compounds are extensions of the methods applicable to monofunctional compounds. Thus the reaction $RCI \rightarrow ROH$ can be extended to the preparation of diols by using the corre-

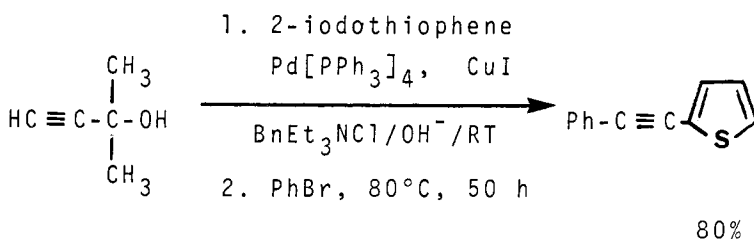
sponding dichloro compound as a starting material. Such methods are not fully covered in the difunctional sections.

The user should bear in mind that the pairs of functional groups alcohol, ester; carboxylic acids, ester; amine, amide; and carboxylic acid, amide can be interconverted by simple reactions. Compounds of the type $RCH(OAc)CH_2OAc$ (ester-ester) would thus be of interest to anyone preparing the diol $RCH(OH)CH_2OH$ (alcohol-alcohol).

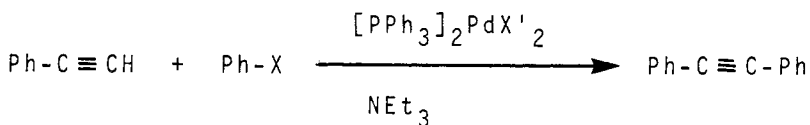
CHAPTER 1

PREPARATION OF ACETYLENES

SECTION 1: Acetylenes from Acetylenes



Carpita, A.; Lessi, A.; Rossi, R.* Synthesis, (1984), 571



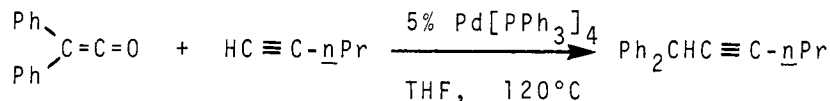
$\text{CHCl}_3\text{-CuI}$; X = I; X' = Ph, I 97%

Bumagin, N.A.; Ponomarev, A.B.; Beletskaya, I.P.

Bull Acad Sci USSR, (1984), **33**, 1433

DMF; X = Tf; X' = Cl, Cl 91%

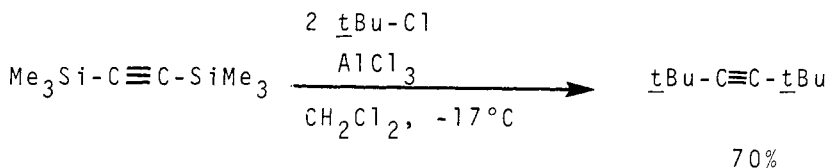
Chen, Q-Y.*; Yang, Z-Y. Tetrahedron Lett, (1986), **27**, 1171



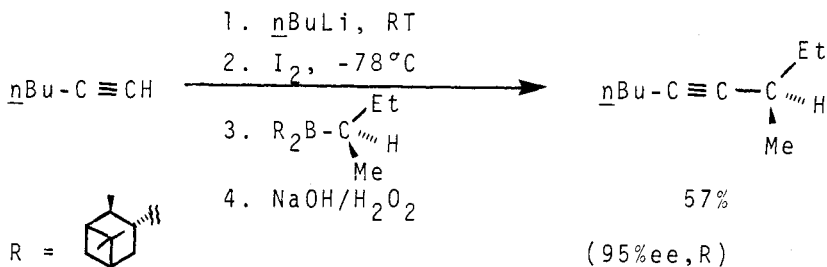
81%

Mitsudo, T.; Kadokura, M.; Watanabe, Y.*

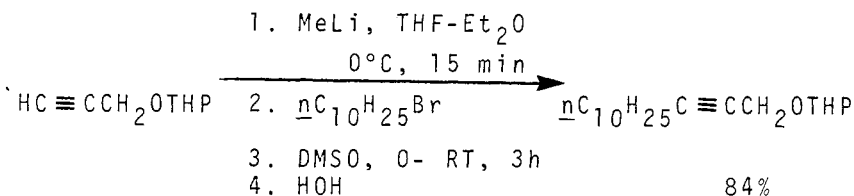
Tetrahedron Lett, (1985), **26**, 3697



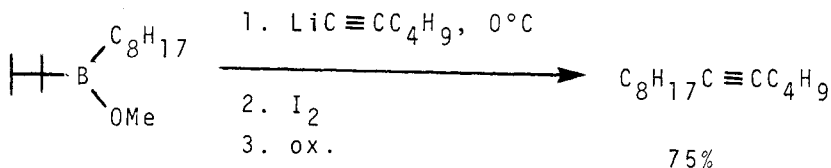
Capozzi, G.*; Ottana, R.; Romeo, G.; Marcuzzi, F.
Gazz Chim Ital, (1985), 115, 311



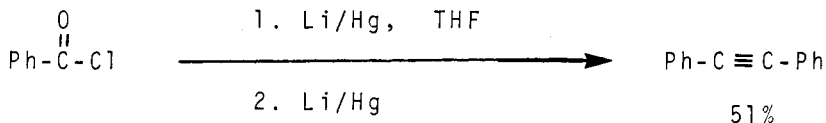
Brown, C.A.*; Desai, M.C.; Jadhav, P.K.
J Org Chem, (1986), 51, 162



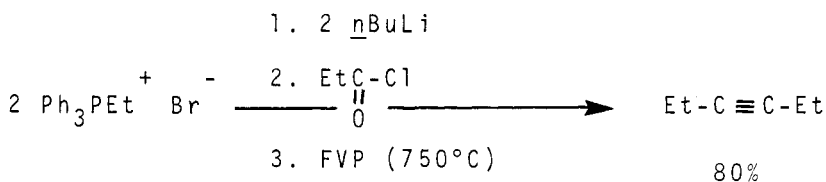
Chong, J.M.*; Wong, S. Tetrahedron Lett, (1986), 27, 5445



Sikorski, J.A.; Bhat, N.G.; Cole, T.E.; Wang, K.K.; Brown, H.C.*
J Org Chem, (1986), 51, 4521

SECTION 2: Acetylenes from Acid Derivatives

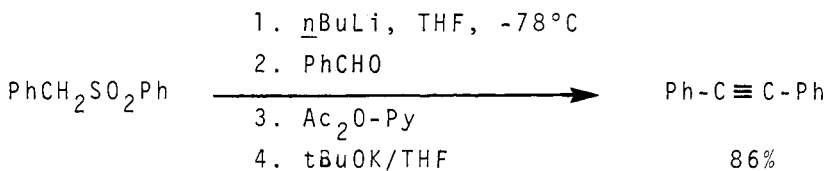
Horner, L.*; Dickerhof, K. Chem Ber, (1983), **116**, 1615



Aitken, R.A.*; Atherton, J.I. JCS Chem Comm, (1985), 1140

SECTION 3: Acetylenes from Alcohols and Thiols

No Additional Examples

SECTION 4: Acetylenes from Aldehydes

Mandai, T.*; Yanagi, T.; Araki, K.; Morisaki, Y.; Kawada, M.; Otera, J.

J Am Chem Soc, (1984), **106**, 3670

SECTION 5: Acetylenes from Alkyl, Methylenes, and Aryls

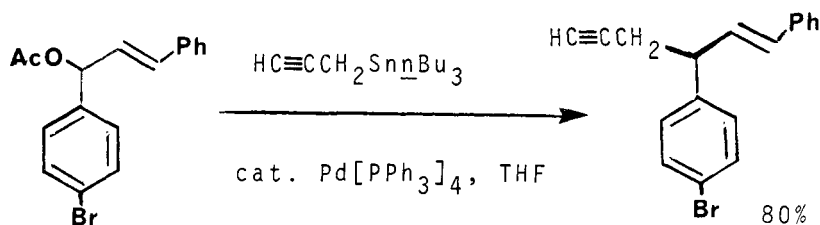
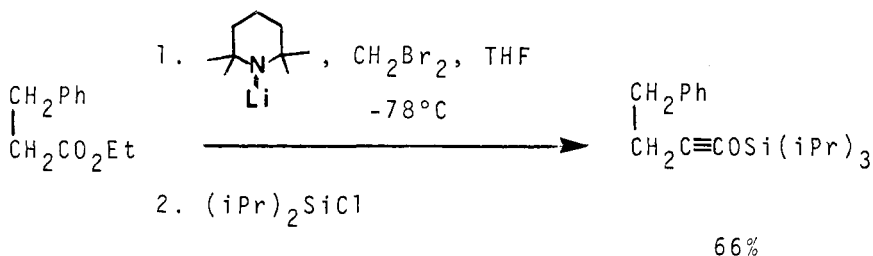
No Additional Examples

SECTION 6: Acetylenes from Amides

No Additional Examples

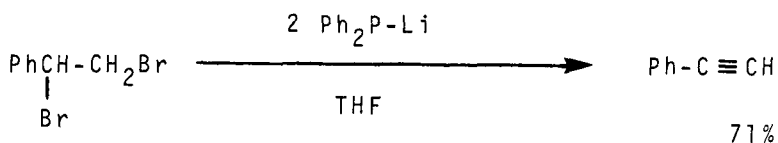
SECTION 7: Acetylenes from Amines

No Additional Examples

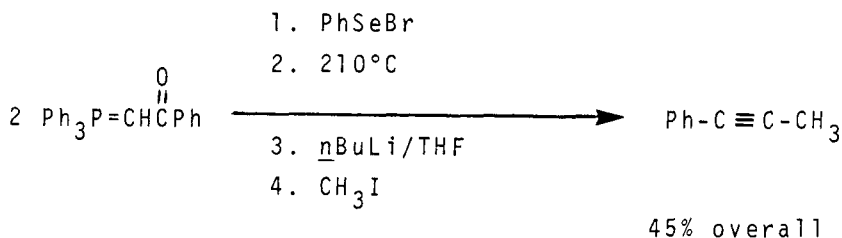
SECTION 8: Acetylenes from EstersKeinan, E.* , Peretz, M. J Org Chem, (1983), 48, 5302Kowalski, C.J.* , Lal, G.S., Haque, M.S.
J Am Chem Soc, (1986), 108, 7127

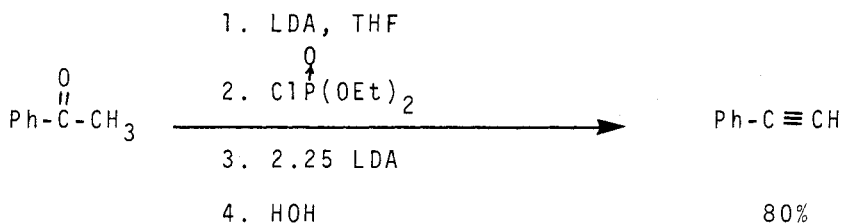
SECTION 9: Acetylenes from Ethers, Epoxides, and Thioethers

No Additional Examples

SECTION 10: Acetylenes from Halides and SulfonatesGillespie, D.G.; Walker, B.J.* JCS Perkin I, (1983), 1689SECTION 11: Acetylenes from Hydrides

No Additional Examples

For examples of the reaction $\text{RC}\equiv\text{CH} + \text{RC}\equiv\text{C}-\text{C}\equiv\text{CR}'$ see section 300 (Acetylene - Acetylene)SECTION 12: Acetylenes from KetonesBraga, A.L.; Comasseto, J.V.*; Petragnani, N.
Synthesis, (1984), 240

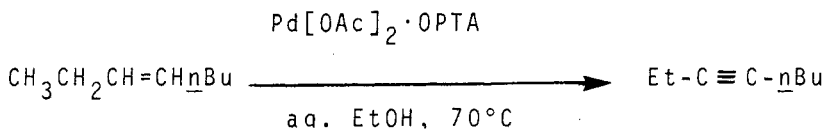


Negishi, E.*; King, A.O.; Tour, J.M. Org Syn, (1985), 64, 44

SECTION 13: Acetylenes from Nitriles

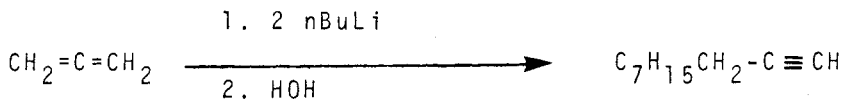
No Additional Examples

SECTION 14: Acetylenes from Olefins

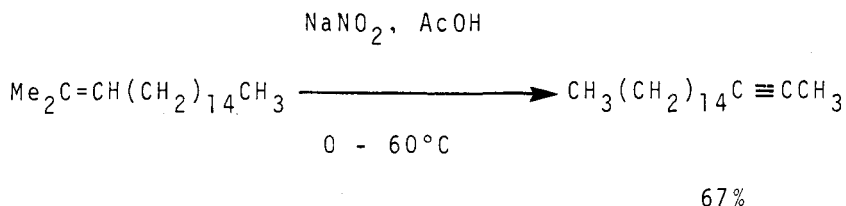


OPTA = oligo-p-phenyleneterephthalamide 98%

Cum, G.*; Gallo, R.; Ipasli, S.; Spadaro, A.
JCS Chem Comm, (1985), 1571

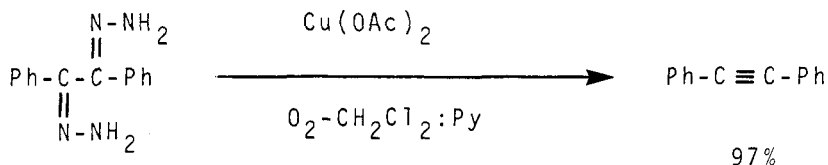


Hooz, J.*; Calzada, J.G.; McMaster, D.
Tetrahedron Lett, (1985), 26, 271 88%



Abidi, S.L.* Tetrahedron Lett., (1986), 27, 267

SECTION 15: Acetylenes from Miscellaneous Compounds



Tsuji, J.*; Kezuka, H.; Toshida, Y.; Takayanagi, H.; Yamamoto, K.

Tetrahedron, (1983), 39, 3279

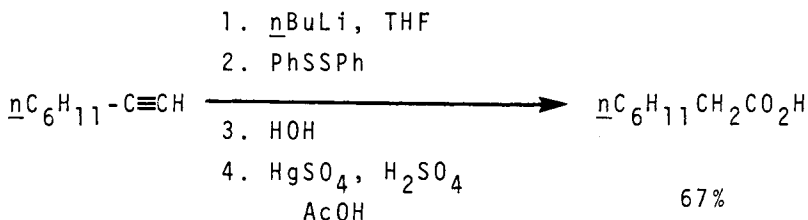
SECTION 15A: Protection of Acetylenes

No Additional Examples

CHAPTER 2

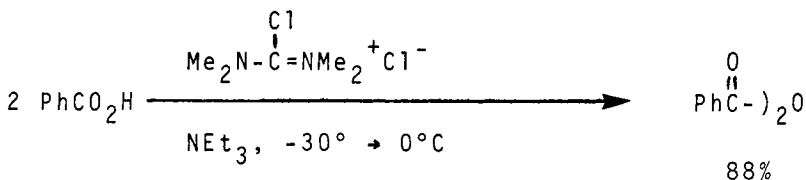
PREPARATION OF CARBOXYLIC ACIDS, ACID HALIDES, AND ANHYDRIDES

SECTION 16: Acid Derivatives from Acetylenes

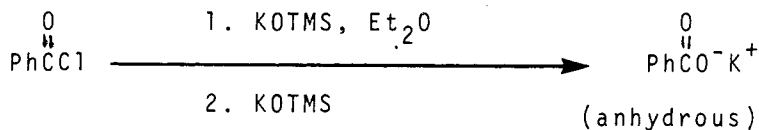


Abrams, S.R.* Can J Chem, (1983), 61, 2423

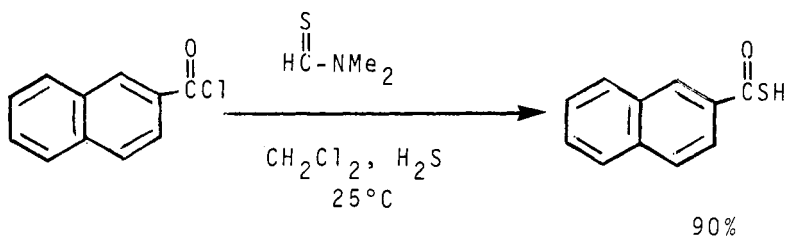
SECTION 17: Acid Derivatives from Acid Derivatives



Fujisawa, T.*; Tajima, K.; Sato, T.
Bull Chem Soc Jpn, (1983), 56, 3529



Laganis, E.D.*; Chenard, B.L.
Tetrahedron Lett, (1984), 25, 5831

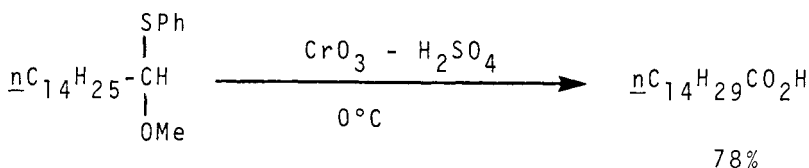


Kobayashi, Y.*; Itabashi, K.* Synthesis, (1985), 671

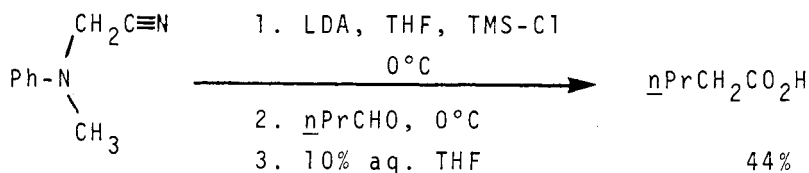
SECTION 18: Acid Derivatives from Alcohols and Thiols

No Additional Examples

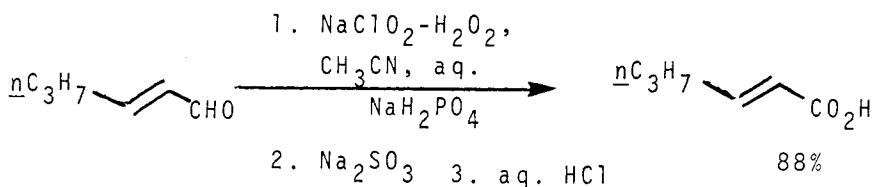
SECTION 19: Acid Derivatives from Aldehydes



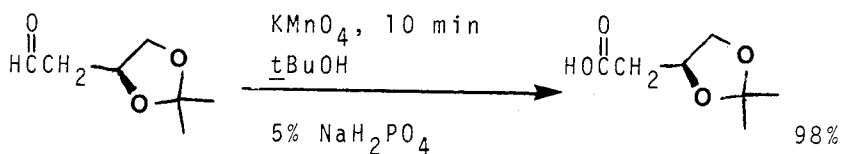
Mandai, T.; Hara, K.; Nakajima, T.; Kawada, M.; Otera, J.*
Tetrahedron Lett., (1983), **24**, 4993



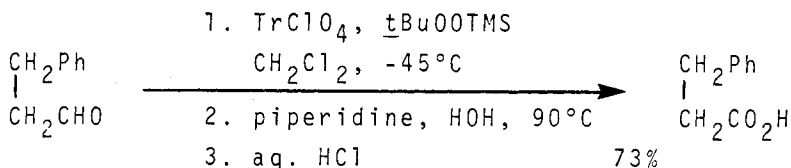
Takahashi, K.*; Shibasaki, K.; Agura, K.; Iida, H.
J Org Chem, (1983), **48**, 3566



Dalcanale, E.*; Mantanari, F.* J Org Chem, (1986), **51**, 567



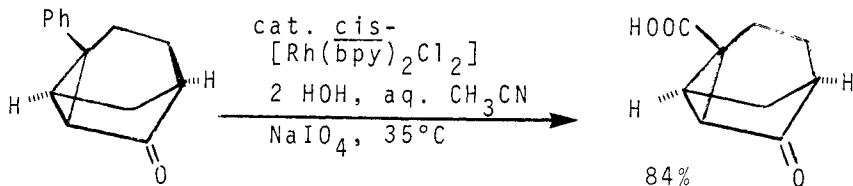
Abiko, A.; Roberts, J.C.; Takemasa, T.; Masamune, S.*
Tetrahedron Lett, (1986), **27**, 4537



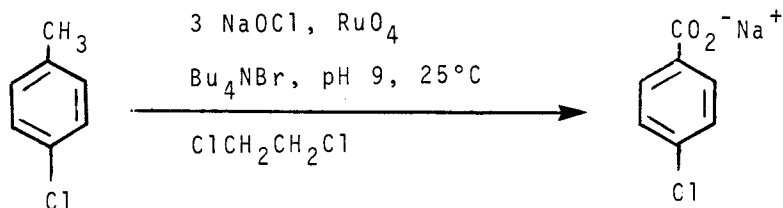
Mukaiyama, T.; Miyoshi, N.; Kato, J.; Ohshima, M.
Chem Lett, (1986), 1385

Related methods: Carboxylic Acids from Ketones (Section 27)
 Also via: Esters (Section 109)

SECTION 20: Acid Derivatives from Alkyl, Methylene, and Aryls



Chakraborti, A.K.; Ghatak, U.R.* JCS Perkin I, (1985), 2605

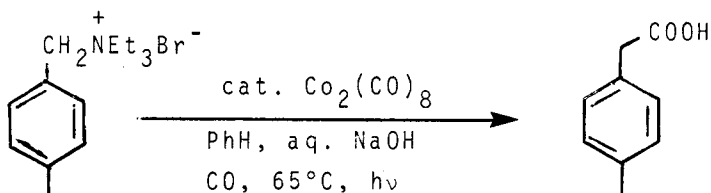


84%

Sasson, Y.*; Zappi, G.D.; Neumann, R.*

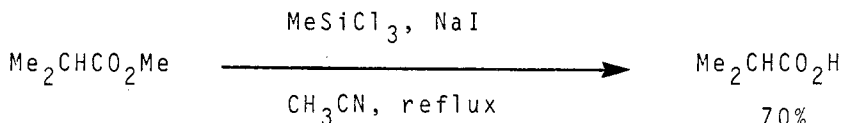
J Org Chem, (1986), 51, 2880SECTION 21: Acid Derivatives from Amides

No Additional Examples

SECTION 22: Acid Derivatives from Amines

85%

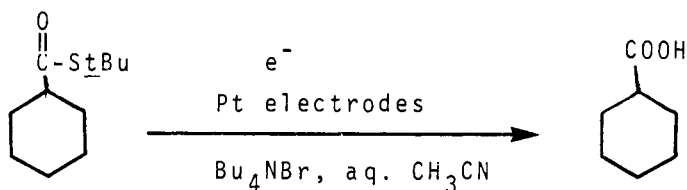
Brunet, J.J.; Sidot, C.; Caubere, P.*

J Org Chem, (1983), 48, 1919SECTION 23: Acid Derivatives from Esters

70%

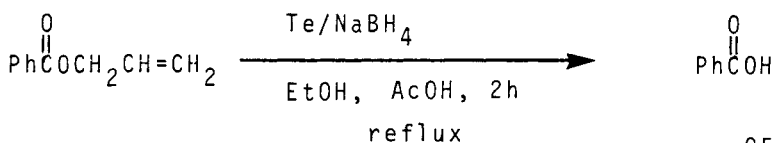
Olah, G.A.*; Husain, A.; Singh, B.P.; Mehrota, A.K.

J Org Chem, (1983), 48, 3667



94%

Kimura, M.; Matsubara, S.; Sawaki, Y.
JCS Chem Comm, (1984), 1619



95%

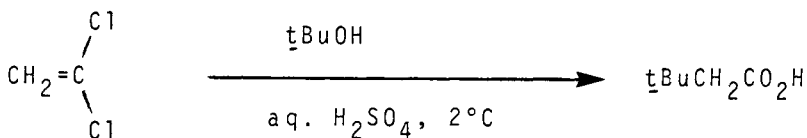
Shobara, N.; Shanmugam, P.* Ind J Chem B, (1986), **25B**, 658

Other reactions useful for the hydrolysis of esters may be found in Section 30A (Protection of Carboxylic Acids).

SECTION 24: Acid Derivatives from Ethers, Epoxides, and Thioethers

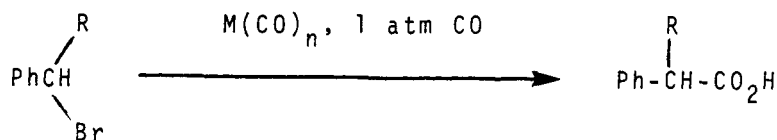
No Additional Examples

SECTION 25: Acid Derivatives from Halides and Sulfonates



90%

Randriamahefa, S.; Deschamps, P.; Gallo, R.*
Synthesis, (1985), 493

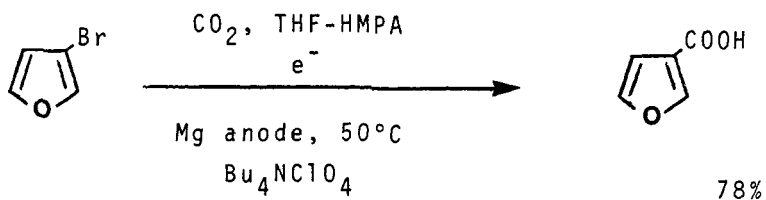


aq. benzene; R=H; M=Fe; n=5 75%

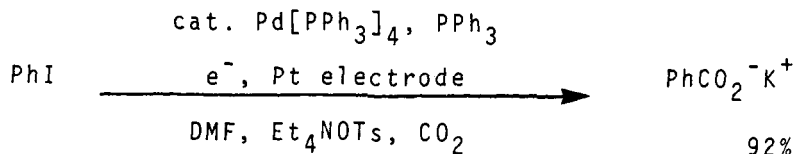
Tanguay, G.; Weinberger, B.; des Abbayes, H.*
Tetrahedron Lett., (1983), 24, 4005

EtOH/NaOH; R=Me; M=Co; n=4 80%

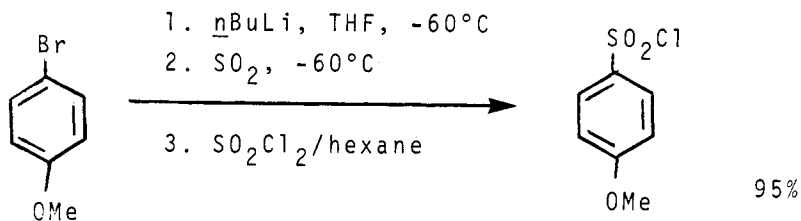
Francalanci, F.; Gardano, A.; Foa, M.
J Organomet Chem., (1985), 282, 277



Sock, O.; Troupel, M.; Perichon, J.
Tetrahedron Lett., (1985), 26, 1509

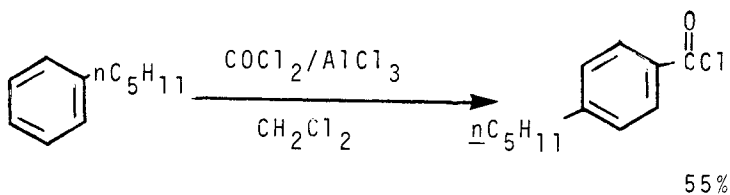


Torii, S.*; Tanaka, H.; Hamatani, T.; Morisaki, K.; Jutand, A.;
 Pfluger, F.; Fauvarque, J.-F.
Chem Lett., (1986), 169



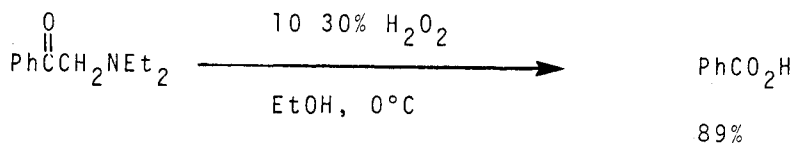
Hamada, T.*; Yonemitsu, O. Synthesis, (1986), 852

SECTION 26: Acid Derivatives from Hydrides

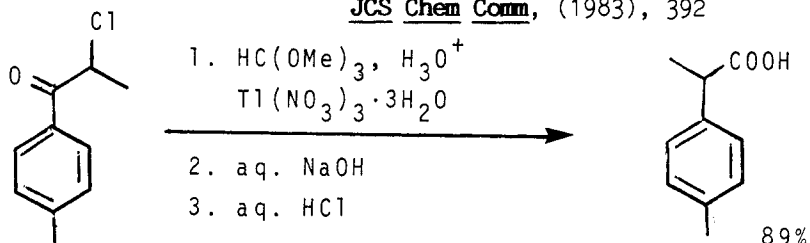


Neubert, M.E.; Fishel, D.L. Org Syn, (1983), 61, 8

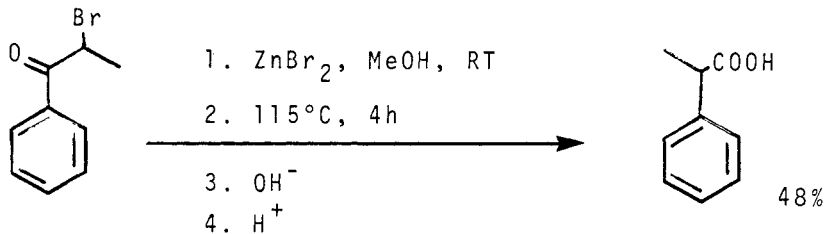
SECTION 27: Acid Derivatives from Ketones



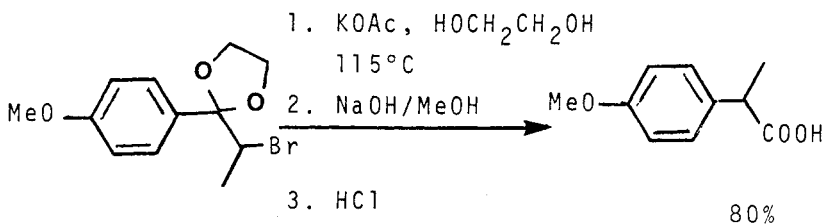
Wenkert, D.*; Eliasson, K.M.; Rudisill, D.
JCS Chem Comm, (1983), 392



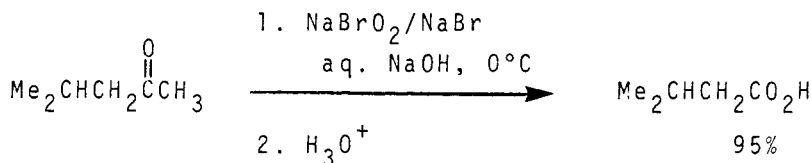
Fujii, K.; Nakao, K.; Yamauchi, T.* Synthesis, (1983), 444



Giordano, C.*; Castaldi, G.; Uggeri, F.; Gurzoni, F.
Synthesis, (1985), 436

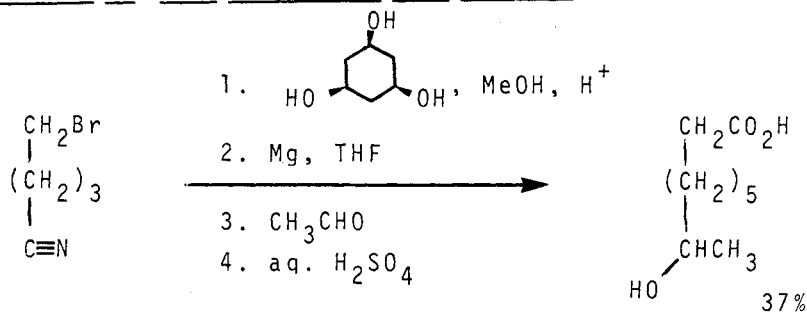


Castaldi, G.*; Giordano, C.; Uggeri, F. Synthesis, (1985), 505

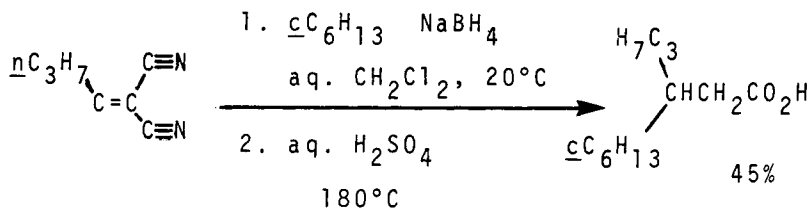


Kajigaeshi, S.*; Nakagawa, T.; Nagasaki, N.; Fujisaka, S.
Synthesis, (1985), 674

SECTION 28: Acid Derivatives from Nitriles

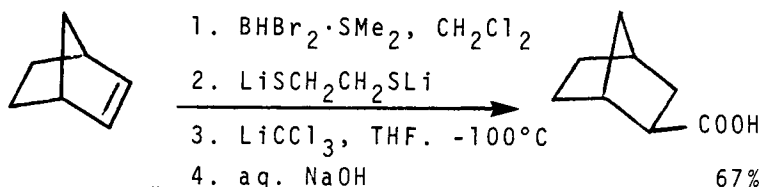


Voss, G.; Gerlach, H.* Helv Chim Acta, (1983), **66**, 2294

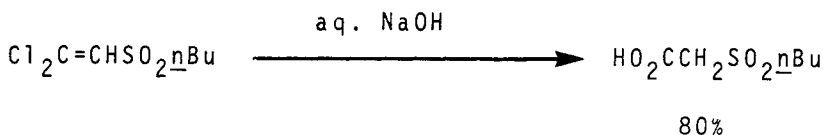


Giese, B.*; Harnisch, H.; Lachhein, S.
Synthesis, (1983), 733

SECTION 29: Acid Derivatives from Olefins



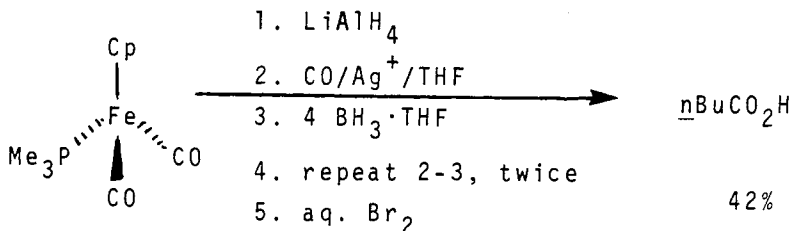
Brown, H.C.*; Imai, T. J Org Chem, (1984), 49, 892



Mirskova, A.N.; Kryukova, Yu.I.; Levkovskaya, G.G.; Guseva, S.A.; Voronkvo, M.G.

J Org Chem USSR, (1984), 20, 545

SECTION 30: Acid Derivatives from Miscellaneous Compounds



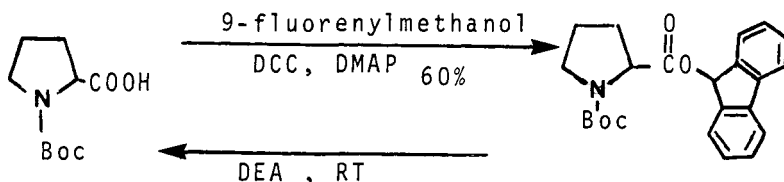
Brown, S.L.; Davies, S.G.* JCS Chem Comm, (1986), 84

Review: "Synthesis of Dithiocarboxylic Acids"

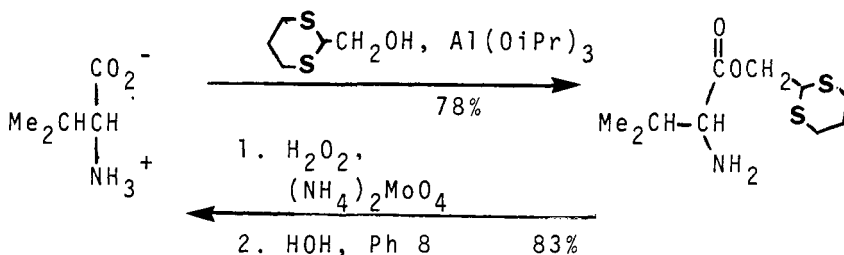
Ramadas, S.R.; Srinivasan, P.S.; Ramachandran, J.; Sastry, V.V.S.K.

Synthesis, (1983), 605

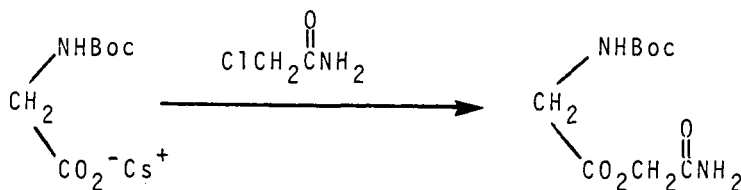
SECTION 30A: Protection of Carboxylic Acid Derivatives



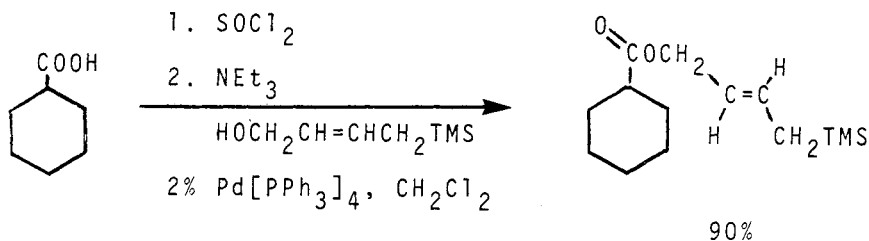
Kessler, H.*; Siegmeyer, R. Tetrahedron Lett., (1983), 24, 281



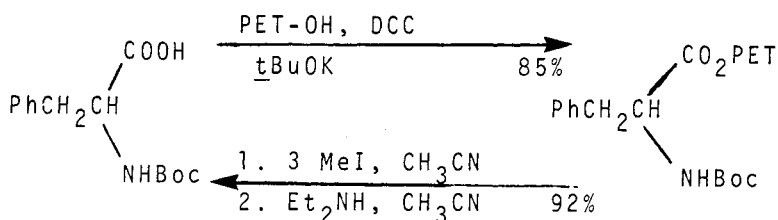
Kunz, H.*; Waldmann, H. Angew Chem Int Ed Engl., (1983), 22, 62



Martinez, J.*; Laur, J.; Castro, B. Tetrahedron Lett., (1983), 24, 5219 85%

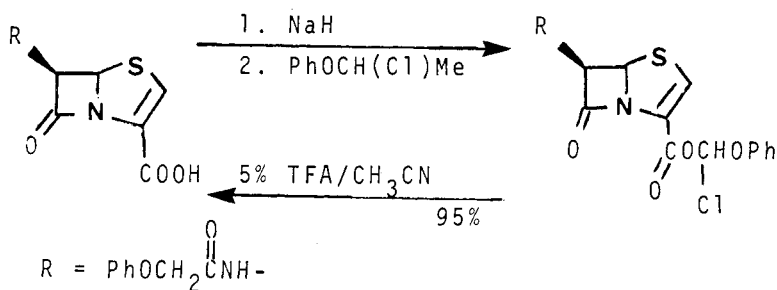


Mastalerz, H.* J Org Chem, (1984), 49, 4092



PET = 2(2-pyridyl)ethyl

Kessler, H.*; Becker, G.; Kagler, H.; Wolff, M.
Tetrahedron Lett., (1984), 25, 3971



Alpegiani, M.; Bedeschi, A.; Foglio, M.; Perrone, E.
Gazz Chim Ital., (1984), 114, 391

Other reactions useful for the protection of carboxylic acids are included in Section 107 (Esters from Carboxylic Acids and Acid Halides) and Section 23 (Carboxylic Acids from Esters).