Supplementary Information (SI) for Organic & Biomolecular Chemistry. This journal is © The Royal Society of Chemistry 2025

## Chiral 3,3'-diaroyl BINOL phosphoric acids: Syntheses and evaluation in asymmetric transfer hydrogenation, photophysical, and electrochemical studies

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S. No.	Details	Page No.
1	Synthesis of (R)-2,2'-dimethoxy-[1,1'-binaphthalene]-3,3'-	S2
	dicarboxylic acid (R)-9 from (R)-1	
2	UV-Vis absorption for compounds of ( <i>R</i> )-4a, 4g-4k	S2-S5
3	UV-Vis absorption for compounds of ( <i>R</i> )-8a, 8g-8k	S6-S8
4	Copies of <sup>1</sup> H, <sup>13</sup> C{ <sup>1</sup> H} NMR spectra of compounds ( <i>R</i> )-10h-10k	S9-S17
5	Copies of <sup>1</sup> H, <sup>13</sup> C{ <sup>1</sup> H} NMR spectra of compounds ( <i>R</i> )-11	S18-S19
6	Copies of <sup>1</sup> H, <sup>13</sup> C{ <sup>1</sup> H} NMR spectra of compounds ( <i>R</i> )-4a-4k	S20 to S42
7	Copies of <sup>1</sup> H, <sup>13</sup> C{ <sup>1</sup> H} NMR spectra of compounds ( <i>R</i> )-8a, 8g-8k	S43 to S59
8	Copies of <sup>1</sup> H, <sup>13</sup> C{ <sup>1</sup> H} NMR spectra of compounds 16a-16h	S60 to S75
9	HPLC chromatogram of compounds (R)-11, (R)-4a-4k, 16a-16h	S76 to S90

## **SUPPORTING INFORMATION**

1. Synthesis of (R)-2,2'-dimethoxy-[1,1'-binaphthalene]-3,3'-dicarboxylic acid, (R)-9



## 2. UV-Vis Absorption for compounds (R)-4a, 4g-4k, (R)-8a, 8g-8k

Spectroscopic measurements: UV-visible absorption spectra were recorded on Shimadzu UV-visible spectrophotometer in 1 cm optical length quartz cuvettes. Dichloromethane is used as a solvent for absorption measurements.



Figure S1. UV-vis absorption spectrum of (R)-4a







Figure S3. UV-vis absorption spectrum of (R)-4h







Figure S5. UV-vis absorption spectrum of (R)-4j







Figure S7. UV-vis absorption spectrum of (R)-8a



**S**6







Figure S11. UV-vis absorption spectrum of (R)-8j



Figure S12. UV-vis absorption spectrum of (R)-8k



Figure S13: <sup>1</sup>H-NMR spectra for compound (*R*)-**10h** 



Figure S14: <sup>13</sup>C{<sup>1</sup>H}-NMR spectra for compound (*R*)-**10h** 

PROTON CDCl3 {D:\CRR} KOPAL 1



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(R)-10i														======= NUC1 P1 PL1 SF01	CHANNEL f1 1H 11.42 usec -3.00 dB 400.1324710 MHz
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13	12	11	10	2.02 6	6.13 6.13 6.18 6.18	2.10 2.04 2	6	5	4	90 <u>9</u>	2	1	ppm		

Figure S15: <sup>1</sup>H-NMR spectra for compound (*R*)-**10**i

PROTON CDCl3 {D:\CRR} KOPAL 1

(R)-10i

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		CHANNEL fl            NUC1         1H           P1         11.42 usec           PL1         -3.00 dB           SF01         400.1324710 MHz
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Figure S17: <sup>13</sup>C{<sup>1</sup>H}-NMR spectra for compound (*R*)-**10i** 



Figure S18: <sup>1</sup>H-NMR spectra for compound (*R*)-10j

C13CPD CDCl3 {D:\CRR} KOPAL 1





Figure S19: <sup>13</sup>C{<sup>1</sup>H}-NMR spectra for compound (*R*)-**10**j

PROTON CDC13 {D:\CRR} KOPAL 1



Figure S20: <sup>1</sup>H-NMR spectra for compound (*R*)-**10k** 



Figure S21: <sup>13</sup>C{<sup>1</sup>H}-NMR spectra for compound (*R*)-**10k** 

PROTON CDCl3 {D:\CRR} CIF\_NMR 1





Figure S22: <sup>1</sup>H-NMR spectra for compound (*R*)-**11** 

C13CPD CDCl3 {D:\CRR} CIF\_NMR 1





Figure S23: <sup>13</sup>C{<sup>1</sup>H}-NMR spectra for compound (*R*)-**11** 

PROTON\_PU CDCl3 {D:\CRR} CIF\_NMR 1



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	11. 8.4 7.8							L7.2			Current NAME EXPNO PROCNO	Data Parameters MK-III-476-ZA 2 1
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( <i>R</i> )- <b>4a</b> O											P1 P1 P1 SF01	CHANNEL f1 ======= 1H 13.00 usec -2.00 dB 400.1324710 MHz
										K. Je	F2 - Pro SI SF WDW SSB LB GB FC	00.1324710 KM2 32768 400.1300095 MHz EM 0 0.30 Hz 0 1.00
13	12 11	l 10	6 2.08 2.08	2.299 2.299	<b>6</b>	5	4	3	2	1 ppn	ר ו	

Figure S24: <sup>1</sup>H-NMR spectra for compound (R)-4a





	155.23 138.15	137.37	129.75	117.63	77.47 77.16					Current NAME EXPNO PROCNO F2 - Acq Date Time INSTRUM PROBHD PULPROG TD SOLVENT NS DS SWH	Data Parameters MK-III-476-ZA 3 1 uisition Parameters 20211214 16.37 spect 5 mm BBO BB-1H zgpg30 65536 CDC13 512 4 24038.461 Hz
(R)-4a										FIDRES AQ RG DW DE TE D1 d11 DELTA TD0  NUC1 P1 PL1 SF01	0.366798 Hz 1.3631488 sec 322 20.800 usec 6.00 usec 300.0 K 2.00000000 sec 0.03000000 sec 1.89999998 sec 1 CHANNEL f1 ====== 13C 12.00 usec -2.00 dB 100.6228298 MHz
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200 180	160	140	120	100	80	60	40	20	ppm	GB PC	0 1.40

Figure S25: <sup>13</sup>C{<sup>1</sup>H}-NMR spectra for compound (*R*)-**4a** 

PROTON\_PU CDCl3 {D:\CRR} CIF\_NMR 1

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Figure S26: <sup>1</sup>H-NMR spectra for compound (*R*)-4b

C13CPD CDCl3 {D:\CRR} CIF\_NMR 1



-200.45	-163.38 -155.07 -155.07 -137.07	7132.47 7132.47 7130.57 7130.17	-129.99 -127.01 -124.83 -124.17	-121.32 -117.60 -113.96	<pre>~77.48 -77.16</pre>	- 55.72			Current   NAME EXPNO PROCNO	Data Parameters MK-III-523-AA 2 1
									F2 - Acq Date_ Time INSTRUM PROBHD PULPROG TD SOLVENT NS DS SWH FIDRES AQ RG DW DE TE D1 d11 DELTA	uisition Parameters 20191016 22.36 spect 5 mm BBO BB-1H zgpg30 65536 CDC13 300 4 24038.461 Hz 0.366798 Hz 1.3631488 sec 362 20.800 usec 6.00 usec 291.8 K 2.0000000 sec 0.03000000 sec 1.8999998 sec
(R)-4b									TD0  NUC1 P1 PL1 SF01	1 CHANNEL f1 13C 9.95 usec -1.00 dB 100.6228298 MHz
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200 180	160	140	120	100	80	60	40	20 ppr		1.40

Figure S27: <sup>13</sup>C{<sup>1</sup>H}-NMR spectra for compound (*R*)-**4b** 



Figure S28: <sup>1</sup>H-NMR spectra for compound (*R*)-4c

C13CPD CDCl3 {D:\CRR} CIF\_NMR 1





Figure S29: <sup>13</sup>C{<sup>1</sup>H}-NMR spectra for compound (*R*)-4c



Figure S30: <sup>1</sup>H-NMR spectra for compound (*R*)-4d

C13CPD\_PU CDC13 {D:\CRR} CIF\_NMR 1 200.49 
 166.67

 164.14

 155.03

 137.32

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 δ N 81 -77.47 -77.15 -76.84 9 0 Current Data Parameters NAME MK-III-608-2 o o 117 116 115 EXPNO 3 PROCNO 1 F2 - Acquisition Parameters Date\_ 20211208 Time 14.13 INSTRUM spect PROBHD 5 mm BBO BB-1H PULPROG zgpg30 ΤD 65536 SOLVENT CDC13 NS 629 DS 4 SWH 24038.461 Hz 0.366798 Hz FIDRES 1.3631488 sec AO RĜ 40.3 DW 20.800 usec DE 6.00 usec ΤE 300.0 K D1 2.00000000 sec 0.03000000 sec d11 DELTA 1.89999998 sec TDO 1 (R)-4d ö ====== CHANNEL fl ======= NUC1 13C P112.00 usec PL1 -2.00 dB 100.6228298 MHz SF01 ====== CHANNEL f2 ====== CPDPRG[2 waltz16 NUC2 1 H PCPD2 90.00 usec PL12 14.81 dB PL13 120.00 dB -2.00 dB 400.1316005 MHz PL2 SF02 F2 - Processing parameters SI 32768 SF 100.6127623 MHz WDW ΕM SSB 0 LB1.00 Hz GB 0  $\mathbf{PC}$ 1.40 200 180 160 140 120 100 80 60 40 20 ppm

Figure S31: <sup>13</sup>C{<sup>1</sup>H}-NMR spectra for compound (*R*)-4d

S27



Figure S32: <sup>1</sup>H-NMR spectra for compound (*R*)-4e

C13CPD\_PU CDC13 {D:\CRR} CIF\_NMR 1



		155.07 139.04 137.46	136.43 136.43 131.22 130.50	120.33	117.76	$= \underbrace{77.47}_{77.16}$					Current NAME EXPNO PROCNO F2 - Acq Date_	Data Paramete MK-III-456 uisition Para 2021061	rs -F 2 1 meters 03
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											FIDRES	0.3667	98 Hz
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											D₩	20.80	)0 usec
0											DE	6.0	)0 usec
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											NUC2	1	LH
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200	180	160	140	120	100	80	<b>60</b>	40	20	ppm	PC	1.4	10

Figure S33: <sup>13</sup>C{<sup>1</sup>H}-NMR spectra for compound (*R*)-**4e** 

PROTON CDCl3 {D:\CRR} CIF\_NMR 1

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	.404 309 980	960 960 881 77	864 457	440 436 433	419 416 396	393 379 376 373	359 356 268 268	247						$\langle \times \rangle$
	11   8   7							. 4 ]					Current NAME EXPNO PROCNO	Data Parameters MK-III-457 1 1
	H Cf	=3 =3											F2 - Acq Date_ Time INSTRUM PROBHD PULPROG TD SOLVENT NS DS SWH FIDRES AQ RG DW DE TE D1 TD0	uisition Parameters 20191125 10.11 spect 5 mm BBO BB-1H zg30 65536 CDC13 16 2 8223.685 Hz 0.125483 Hz 3.9845889 sec 362 60.800 usec 6.00 usec 292.1 K 1.0000000 sec 1
<b>◆</b>													 NUC1 P1 PL1 SF01	CHANNEL fl ======= 1H 14.35 usec -1.00 dB 400.1324710 MHz
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12	11 (06)	10	9	2.00 5.99 8	2:11	6	5	4	3	2	1	ppm		

Figure S34: <sup>1</sup>H-NMR spectra for compound (R)-4f



—200.96	/155.10	//141.21 //137.61 //137.47	1133.66 130.75 130.40 129.84	127.05 125.76 125.72 125.12	L124.78 L124.57 L122.40 L122.51	$ \begin{array}{c}     ^{1}117.78 \\     \overline{77.48} \\     \overline{77.16} \\     \overline{77.16} \\     \overline{76.84} \\     \overline{76.84} \\   \end{array} $					Current NAME EXPNO PROCNO F2 - Acc	Data Parameters MK-III-457 2 1 guisition Parameters
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1											NUC2 PCPD2 PL12 PL13 PL2 SF02	1H 90.00 usec 14.95 dB 120.00 dB -1.00 dB 400.1316005 MHz
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200	180	160	140	120	100	80	60	40	20	ppm	GB PC	0 1.40

Figure S35: <sup>13</sup>C{<sup>1</sup>H}-NMR spectra for compound (*R*)-4f



Figure S36: <sup>1</sup>H-NMR spectra for compound (*R*)-4g

C13CPD\_PU CDCl3 {D:\CRR} CIF\_NMR 1



200	180		140	120	100	 80	60	40	20	ppm	SSB LB GB PC	0 1.00 Hz 0 1.40
											F2 - Prod SI SF WDW	cessing parameters 32768 100.6127564 MHz EM
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(R)-4g											======= NUC1 P1 PL1 SF01	CHANNEL f1
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—198.72	154.86 139.80	137.19 137.14 133.00 132.66	131.98	127.15	L124.36 L124.85 L124.34 L121.62	120.18 118.91 118.00 77.48	<sup>L</sup> 76.84				Current I NAME EXPNO PROCNO F2 - Acqu Date_ Time INSTRUM	Data Parameters MK-III-508-F 1 uisition Parameters 20210709 12.43 spect

Figure S37: <sup>13</sup>C{<sup>1</sup>H}-NMR spectra for compound (*R*)-**4**g



Figure S38: <sup>1</sup>H-NMR spectra for compound (*R*)-**4h** 



-206.84	155.20 138.38 138.16 138.16 132.35 1132.35 130.82	129.56 129.32 128.94 128.80 128.80 127.44 127.34	125.58 125.58 125.58 125.34 124.92	124.22 122.88 117.62 77.48	76.84			Current I NAME EXPNO PROCNO	ata Parameters MK-IV-802 2 1
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								D1	2.00000000 sec
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								PCPD2	90.00 used
								PLWZ DIW12	24.1849994/ W
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								SI	32768
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200	180 160	140 120	100	80	<b>60</b>	40	20 ppm		

## Figure S39: <sup>13</sup>C{<sup>1</sup>H}-NMR spectra for compound (*R*)-**4h**

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	.138 405 382 363 343 317 317 305 288	2259 2229 44444 5730 5668 5730 5668 5730 5730 5668 5730 5730 5730 5730 5730 5730 5730 5730	4456 4442 3379 2290 2273 2273 2273 2273		
					Current Data Parameters NAME MK-I-141-A1 EXPNO 1 PROCNO 1
					F2 - Acquisition Parameters         Date_       20170630         Time       14.20         INSTRUM       spect         PROBHD 5 mm DUL 13C-1         PULPROG       zg30         TD       65536         SOLVENT       CDC13         NS       16         DS       2         SWH       8223.685 Hz         FIDRES       0.125483 Hz         AQ       3.9845889 sec         RG       228         DW       60.800 usec         DE       6.00 usec         TE       293.2 K         D1       1.0000000 sec         TD0       1
				1	Employee         CHANNEL fl         fl         employee           NUC1         1H           P1         11.42 usec           PL1         -3.00 dB           SF01         400.1324710 MHz
			••••••••••••••••••••••••••••••••••••••		F2 - Processing parameters           SI         32768           SF         400.1300051 MHz           WDW         EM           SSB         0           LB         0.30 Hz           GB         0           PC         1.00
15 14	13 12 11	10 9 8 7 6 10 9 10 9 10 10 9 10 9 10 9 10	5 4 3	2 ppm	

Figure S40: <sup>1</sup>H-NMR spectra for compound (R)-4i
C13CPD CDCl3 {D:\CRR} KOPAL 1



204.58 	138.67 137.85 133.28 133.28	131.37 130.89 130.62 130.62 130.48	129.61 129.53 129.43 127.38	127.22 126.77 126.60 126.45	126.31 125.01 124.91 124.61	124.33 124.29 124.09 122.54	L117.68 77.48 77.16 77.16				Current NAME EXPNO PROCNO	Data Parameters MK-I-141-A1 2 1	
			n fru				-				F2 - Acq Date_ Time INSTRUM PROBHD FULPROG TD SOLVENT NS DS SWH FIDRES AQ RG DW DE TE D1 d11	11sition Parameter 20170630 14.36 spect 5 mm DUL 13C-1 zgpg30 65536 CDC13 256 4 24038.461 Hz 0.366798 Hz 1.3631488 se 57 20.800 us 6.00 us 293.5 K 2.0000000 se	z z z sec sec
(R)-4i											DELTA TDO NUC1 P1 PL1 SFO1	1.89999998 se 1 CHANNEL f1 ====== 13C 9.15 us 0 dB 100.6228298 MF	:c === ;ec Iz
											CPDPRG[2 NUC2 PCPD2 PL12 PL13 PL2 SF02	CHANNEL ±2 ====== waltz16 1H 90.00 us 14.90 dE 14.90 dE -3.00 dE 400.1316005 ME	sec 3 3 3 Hz
na ande kon na pangan padala kan da kajim di kan sur at ka Mana na pangangan pangan pangan di kajim kan pangan	n b) sta na na na na na na na na la ba Marina na ha Marina na n	ار های دوران و معرفی این و معرفی این از دارد. اروز و های در مراجع می از مارو می مراجع و می و مارو و می و مارو و بر و و و و می و می و می و می و می و می و	ایم این اور این اور این		, bil optisk frankriger de Alli i geler. Kan per skip popular an spira filosof	a sid schille ad by day of the pipeline strategy and the pipeline stra	nde handen ges kil fan het sen skil het het er se Neger in gesen van gevoer de gesen skil het er se Neger in gesen van de gesen skil het er sen skil het er sen s	gg a catalysia y day ga a sa sa sa sa sa Sg a catalysia y day ga a sa	lasti kasha sana alika si jawan Masi kasha ya mana kasha si jawan	land dan kari ji danan da Sana dan saya ng karang	F2 - FFO SI SF WDW SSB LB GB	32768 100.6127553 MH EM 0 1.00 Hz	J Iz Z
200	180	160	140	120	100	80	<b>60</b>	40	20	ppm	PC	1.40	

Figure S41: <sup>13</sup>C{<sup>1</sup>H}-NMR spectra for compound (*R*)-**4**i

PROTON CDCl3 {D:\CRR} KOPAL 1





Figure S42: <sup>1</sup>H-NMR spectra for compound (*R*)-4j

C13CPD CDCl3 {D:\CRR} KOPAL 1





Figure S43: <sup>13</sup>C{<sup>1</sup>H}-NMR spectra for compound (*R*)-4j



Figure S44: <sup>1</sup>H-NMR spectra for compound (*R*)-4k



Figure S45: <sup>1</sup>H-NMR spectra for compound (*R*)-**4**k

C13CPD\_PU CDCl3 {D:\CRR} CIF\_NMR 1





Figure S46: <sup>13</sup>C{<sup>1</sup>H}-NMR spectra for compound (*R*)-**4**k

PROTON CDCl3 {D:\CRR} CIF\_NMR 1



	7.836 7.836 7.823 7.802	7.627 7.397 7.379 7.359 7.359 7.359 7.256	7.050 7.050	-7.010					Current NAME EXPNO PROCNO	Data Parameters MK-III-477-M 1 1
(R)-Ba									F2 - Acc Date_ Time INSTRUM PROBHD PULPROG TD SOLVENT NS DS SWH FIDRES AQ RG DW DE TE D1 TD0 ======= NUC1 P1 PL1 SF01 F2 - Pro SI SF WDW SSB LB	quisition Parameters         20201103         14.06         spect         5 mm BBO BB-1H         zg30         65536         CDC13         16         2         8223.685 Hz         0.125483 Hz         3.9845889 sec         228         60.800 usec         6.00 usec         300.0 K         1.00000000 sec         1         = CHANNEL f1 ===================================
		MM					<b>I</b>		PC	1.00
11 10	9	<b>2.09 2 1.91 2 1.91 2 1.91 2 1.91 2 1.91 1 1.91 1 1.91 1 1.91 1 1.91 1 1.91 1 1.91 1 1.91 1 1.91 1 1.91 1 1.91 1 1 1.91 1 1 1 1 1 1 1 1 1 </b>	6	5	4	3	2	1 pj	יייק ס <b>m</b>	

Figure S47: <sup>1</sup>H-NMR spectra for compound (*R*)-8a



Figure S48: <sup>13</sup>C{<sup>1</sup>H}-NMR spectra for compound (*R*)-**8a** 



				4.37					Current NAME EXPNO PROCNO	Data Parameters MK-III-477-M 2 1
									F2 - Acc Date Time INSTRUM PROBHD PULPROG TD SOLVENT NS DS SWH FIDRES AQ RG DW DE TE D1 d11 DELTA TD0	puisition Parameters 20201104 16.38 spect 5 mm BBO BB-1H zgpg30 65536 CDC13 16 4 64102.563 Hz 0.978127 Hz 0.5111808 sec 2050 7.800 usec 6.00 usec 300.0 K 2.0000000 sec 0.03000000 sec 1.89999998 sec
(R)-8a									NUC1 P1 PL1 SF01 CPDPRG[2 NUC2 PCPD2 PL12 PL13 PL2	CHANNEL f1
al for the test of the second states of	 <u>مەرەر مەرەر مەرەم مە</u> 60	د المراجع (مراجع المراجع المراجع 1	10111111000000000000000000000000000000		-20	-documents of the physical color	-80	DDM	SFO2 F2 - Prc SI SF WDW SSB LB GB PC	400.1316005 MHz accessing parameters 32768 161.9755930 MHz EM 0 1.00 Hz 0 1.40

Figure S49: <sup>31</sup>P-NMR spectra for compound (R)-8a



Figure S50: <sup>1</sup>H-NMR spectra for compound (*R*)-8g





Figure S51: <sup>13</sup>C{<sup>1</sup>H}-NMR spectra for compound (*R*)-**8g** 



	F2 - Acquisition Parameter Date_ 20241205 Time 12.19 h INSTRUM AVNec400NB-50596 PROBHD Z163739_0809 (	rs 76-F
$\begin{split} & F_3C + \int + $	$\begin{array}{cccccccc} & & & & & & & & & & & & & & & $	s Hz z

. 33

Figure S52: <sup>19</sup>F-NMR spectra for compound (R)-8g



Figure S53: <sup>1</sup>H-NMR spectra for compound (*R*)-**8h** 





6

Figure S54: <sup>1</sup>H{<sup>13</sup>C}-NMR spectra for compound (*R*)-**8h** 



$(R) \cdot Bh$						Current NAME EXPNO PROCNO F2 - Acq Date_ Time INSTRUM PROBHD PULPROG TD SOLVENT NS DS SWH FIDRES AQ RG DW DE TE D1 TD0 SF01 NUC1 F0 P1 F1 F1 F1 F1 F1 F1 F1 F1 F1 F1 F1 F1 F1	Data Parameters MK-IV-805-(R)-M 3 1 uisition Parameters 20241203 13.42 h AVNeo400NE-5059676-F Z163739_0809 ( 2g30 65536 DMSO 16 4 65789.474 Hz 2.007735 Hz 0.4980736 sec 101 7.600 usec 6.50 usec 298.8 K 2.00000000 sec 161.9674942 MHz 31P 2.67 usec 8.00 usec 43.69699860 W cessing parameters 32768 161.9755930 MHz EM 0 1.00 Hz
						F2 - Pro SI SF WDW SSB LB GB FC	cessing parameters 32768 161.9755930 MHz EM 0 1.00 Hz 0 1.40
en eine de mitte blie blie frieden, en stein	Lideo, e di site di la di la site di la setta di la 100	ndia dia amin'ny finitra amin'ny tanàna amin'ny tanàna I i i i i i i i i i i i i i i i i i i i	li o bala. Nome, Novel, contribue y los a doity, é in I I I I I I I I I I I I O	-50	-100	ppm	

Figure S55: <sup>31</sup>P-NMR spectra for compound (R)-8h



Figure S56: <sup>1</sup>H-NMR spectra for compound (*R*)-**8i** 





Figure S57: <sup>1</sup>H{<sup>13</sup>C}-NMR spectra for compound (*R*)-**8i** 

σ



NUC1 31E P0 2.67 P1 8.00 PLW1 43.69699860 F2 - Processing paramet	31P 2.67 usec 8.00 usec	:
F2 - Processing parameter	43.69699860 W	•
SI 32/68 SF 161.9755930 WDW EM SSB 0 LB 1.00 GB 0	ing parameters 32768 161.9755930 MHz EM 1.00 Hz	

Figure S58: <sup>31</sup>P-NMR spectra for compound (R)-8i



Figure S59: <sup>1</sup>H-NMR spectra for compound (*R*)-**8j** 



Figure S60: <sup>13</sup>C{<sup>1</sup>H}-NMR spectra for compound (*R*)-**8j** 





Figure S61: <sup>31</sup>P-NMR spectra for compound (*R*)-**8**j



Figure S62: <sup>1</sup>H-NMR spectra for compound (*R*)-**8k** 

C13CPD CDCl3 {D:\CRR} KOPAL 1





Figure S63: <sup>1</sup>H{<sup>13</sup>C}-NMR spectra for compound (*R*)-**8k** 



Figure S64: <sup>1</sup>H-NMR spectra for compound **16a** 



	$\sim$ 144.93 144.85 129.42 128.70	127.56 127.02 126.66 121.01 117.28	~114.10	77.47 77.16					Current   NAME EXPNO PROCNO	Data Parameters MK-IV-886 2 1
the second secon									F2 - Acqu Date_ Time INSTRUM PROBHD PULPROG TD SOLVENT NS DS SWH FIDRES AQ RG DW DE TE D1 D11 TD0 SF01 NUC1 P0 P1 PLW1 SF02 NUC2 CPDPRG[2 PCPD2 PLW2 PLW13 F2 - Pro- SI	Lisition Parameters 20241105 17.11 h AVNeo400NB-5059676-P Z163739_0809 ( zgpg30 65536 CDC13 256 4 23809.524 Hz 0.726609 Hz 1.3762560 sec 101 21.000 usec 6.50 usec 298.2 K 1.0000000 sec 1 100.6228298 MHz 13C 2.67 usec 8.00 usec 91.39299774 W 400.1316005 MHz 1H waltz65 90.00 usec 24.18499947 W 0.18788880 W 0.09416986 W
alka da anti-al da da anti di matanda da d	Martin aldanie and Martin aldanie aldan		hen blev de redelet som sken te		Mathematical Program Mar	una ille de alta contracto da presenta de defe	n die fan die e fan die aan westingen	ale substitution and increased	WDW SSB LB GB PC	0 1.00 Hz 1.40
180 160	140	120	100	80	60	40	20	ppm		

Figure S65: <sup>13</sup>C{<sup>1</sup>H}-NMR spectra for compound **16a** 



Figure S66: <sup>1</sup>H-NMR spectra for compound **16b** 



	~	· · · · ·		10						
	Ä	6 0 4	10001	ð	00 V T	P 10	0 00			
	•			•	4 1 00	<b>∞</b> 4	Q 10			
	ရွှ	4 2 6	<b>P 0 1 P 4</b>	4			1.12		Current	Data Parameters
	믭		33333	3		66	5 3		NAME	MK-TV-873
	1 i i i i i i i i i i i i i i i i i i i	I V V		j'	くもう	C J	1.1		EXPNO	2
									PROCNO	1
	1	1 1	יזור דר <b>ר</b>		¥	Y	1.1		1100110	-
									$F^2 - Acc$	uisition Parameters
									Date	20240918
									Time	15 11 b
									INSTRUM	AVNeo400NB-5059676-P
									PROBHD	Z163739 0809 (
									PIILPROG	zapa <sup>30</sup>
									TD	65536
									SOLVENT	CDC13
									NS	146
									DS	4
									SWH	23809.524 Hz
									FIDRES	0.726609 Hz
									<b>A</b> O	1.3762560 sec
									RG	101
									DW	21.000 usec
$\wedge \wedge$									DE	6.50 usec
									TE	300.7 K
									D1	2.00000000 sec
	$\sim$								D11	0.03000000 sec
Č L T									TDO	1
יי נו					.lı				SF01	100,6228298 MHz
16b 💛									NUC1	130
100	00113								PO	2.67 usec
									P1	8.00 usec
									PLW1	91.39299774 W
									SFO2	400.1316005 MHz
									NUC2	1H
					1				CPDPRG[2	waltz65
									PCPD2	90.00 usec
									PLW2	24.18499947 W
									PLW12	0.18788880 W
									PLW13	0.09416986 W
									F2 - Pro	cessing parameters
									SI	32768
									SF	100.6127572 MHz
									WDW	EM
									SSB	0
									LB	1.00 Hz
									GB	0
					1				PC	1.40
an a	a an	and the second secon	سنبتهم أستسارته بمناجر كمريق الإقاليس	يقبد بسيانية ويقار ومصاعده ريدانهما	فمارها لنشاطه همر خانانها أأرأت بدأه والمتحد فاستر بالمتعاد	وتقلصا ويشره البناسة والمرجوعين والمالة	ب والإسطار الدين أن يتحصاف أن يتحدون المحتلة الالالات	أأذاعهم بالمعادين بتجريطا وسجعا ال		
180	160	140	120	100	80	60	40 20	ppm		
		140	120		~~	~~		PPIN		

Figure S67: <sup>13</sup>C{<sup>1</sup>H}-NMR spectra for compound **16b** 



Figure S68: <sup>1</sup>H-NMR spectra for compound **16c** 



	144.93 141.95 137.23 129.41	117.21		77.47 77.16 76.84	— 56.15		— 26.62 — 21.23	Current NAME EXPNO PROCNO	Data Parameters MK-IV-887 2 1
the second secon								F2 - Acc Date Time Time PROBHD PULPROG TD SOLVENT NS SWH FIDRES AQ RG DW DE TE D1 D11 TD0 SF01 NUC1 P0 P1 PLW1 SF02 NUC2 CPDPRG[2 PCPD2 PLW2 PLW12 FLW13 F2 - Pro SI SF WDW SSB LB GB PC	quisition Parameters         20241106         14.37 h         AVNec400NE-5059676-P         2163739_0809 (         zgpg30         65536         CDC13         256         4         23809.524 Hz         0.726609 Hz         1.3762560 sec         101         21.000 usec         6.50 usec         297.8 K         2.00000000 sec         0.3000000 sec         11         100.6228298 MHz         13C         2.67 usec         8.00 usec         91.3929774 W         400.1316005 MHz         1H         2         waltz65         90.00 usec         24.18499947 W         0.1878880 W         0.09416986 W         0         1.00.6127566 MHz         EM         0         1.00 Hz         0         1.00 Hz
180 160	140	120	100	80	60	40	20 p	pm	

Figure S69: <sup>13</sup>C{<sup>1</sup>H}-NMR spectra for compound **16c** 

7.252 7.252 7.252 7.2.252 7.2.251 7.2.251 7.2.251 7.2.251 7.2.251 7.2.251 7.2.251 7.2.251 7.2.251 7.2.251 7.2.251 7.2.251 7.2.251 7.2.252 7.2.552 7.2.252 7.2.552 7.2.552 7.2.552 7.2.552 7.5527 7.5527 7.5527 7.5527 7.5527 7.5577 7.55777 7.557777 7.557777777777	76.535 6.535 6.535 74.416 74.416 72.894 72.894 72.887 72.887 72.887 72.887 72.887 7339 7339 7339 7339 7339 7339 7339 7	72.72.72 72.715 72.698 72.114 72.114 72.105 72.101		BRUKER
$(f) = \begin{pmatrix} f \\ H \\ I \\ I$				Current Data Parameters NAME MK-IV-866-CH EXPNO 1 PROCNO 1 F2 - Acquisition Parameters Date_ 20240913 Time 15.32 h INSTRUM AVNe0400NB-5059676-P PROBHD Z163739_0809 ( PULPROG zg30 TD 65536 SOLVENT CDC13 NS 16 DS 2 SWH 8196.721 Hz FIDRES 0.250144 Hz AQ 3.9976959 sec RG 101 DW 61.000 usec DE 13.89 usec TE 298.6 K D1 1.00000000 sec TD0 1 SFO1 400.1324708 MHz NUC1 1H F0 2.67 usec P1 8.00 usec PLW1 24.18499947 W F2 - Processing parameters SI 65536 SF 400.1300138 MHz WDW EM SSB 0 LB 0.30 Hz GB 0 PC 1.00
11 10 9	<b>6 7 8 8 1 10 10 10 10 10 10 10</b>	5 4 90.1 90.1	3 2 1 ppm	

Figure S70: <sup>1</sup>H-NMR spectra for compound **16d** 



Figure S71: <sup>13</sup>C{<sup>1</sup>H}-NMR spectra for compound **16d** 



Figure S72: <sup>1</sup>H-NMR spectra for compound **16e** 



	<pre>144.51 143.45 133.10 133.10 129.43 108.79</pre>	- 128.02 - 128.02 - 127.08 - 120.91	×114.19	77.47 77.16 76.84	- 55 . 68	-310	-26.23		Current 1 NAME EXPNO	Data Parameter MK-IV-885	s 3 2
(f)									PROCNO F2 - Acqu Date_ Time INSTRUM PROBHD PULPROG TD SOLVENT NS SWH FIDRES AQ RG DW DE TE D1 D11 TD0 SF01 NUC1 P0 P1 PLW1 SF02 NUC2 CPDPRG[2 PCPD2 PLW2 PLW13 F2 - Proc SI SF WDW SSB LB GB PC	11sition Parama 20241105 16.05 16.05 AVNeo400NB-50 Z163739_0809 Zggg30 65536 CDC1: 200 4 23809.524 0.726609 1.3762560 2.5774 1.00000000 0.3800000 1.39299774 400.131600 1.3788886 0.0941698 20052761 100.612761 EN 0 1.00 0 1.40	L aters 5 5 5 5 5 5 5 5 5 5 5 5 5
180 160	140	120	100	80	60	40	20	ppm			

Figure S73:  $^{13}C{^{1}H}$ -NMR spectra for compound **16e** 



Figure S74: <sup>1</sup>H-NMR spectra for compound **16f** 



	8 R S	14.8.	8.0.0	8 H % H	48 16 84	51	<b>6</b> 0	56					
	142	129129129129	121121		77 77 76.	56.	31.	26.		Current 1 NAME	Data Para MK-IV	meters -899-S	
			VIII		×12	L L	L. L.	1 C		EXPNO		2	
							l.			PROCNO		1	
										$F_2 - Acq$	uisition J	Paramet	ers
										Date_	20	14 16	ъ
										INSTRUM	AVNeo400	NB-505	9676-P
										PROBHD	Z163739	0809 (	,,,,
										PULPROG	1100.00	zapa30	
										TD		65536	
										SOLVENT		CDC13	
										NS		256	
										DS		4	
										SWH	238	09.524	Hz
										FIDRES	0.	726609	Hz
										AQ	1.3	762560	sec
										RG		101	
										DW	;	21.000	usec
										DE		200 1	usec
										1E D1	2 00	300.1	R.
$\sim$										D11	0.03	000000	sec
										TDO	0.05	1	360
										SF01	100.6	228298	MHz
H 1 1										NUC1		13C	
										PO		2.67	usec
16 <del>1</del> ~ ~										P1		8.00	usec
										PLW1	91.39	299774	W
										SFO2	400.1	316005	MHz
										NUC2		1H	
										CPDPRG[2	W	altz65	
										PCPD2		90.00	usec
										PLW2	24.18	499947	W
										PLW12 DIM12	0.18	188880	W
										PTM12	0.09	410300	w
										F2 - Pro	cessing p	aramete	ers
										SI		32768	
										SF	100.6	127559	MHz
										WDW		EM	
						1	1	1		SSB	0		
										LB	•	1.00	Hz
		II								GB	U	1 40	
dina mbolika ya kasis kutuan kanimus di mutika Manakara di mutika a kutu kutua kutua.				an i San ann aite ann bhailte an aite an san stàite an ann an tair.					half a lite of the second s	PC		1.40	
	100								. )				
180	160	140	120	100	80	60	40	20	ppm				

Figure S75: <sup>13</sup>C{<sup>1</sup>H}-NMR spectra for compound **16f** 

. .



Figure S76: <sup>1</sup>H-NMR spectra for compound **16g**


		. 90	.40 .82 .12 .13		47 15 83		29	26 72 74			
			/ / 129 1216 1117		$\overbrace{77}^{77}.$		47.	/ 30. / 26. / 22.		Current NAME EXPNO PROCNO	Data Parameters MK-IV-891-PACEMIC 2 1
NH H H 16g										F2 - Acq Date_ Time INSTRUM PROBHD PULPROG TD SOLVENT NS SWH FIDRES AQ RG DW DE TE D1 D11 TD0 SF01 NUC1 P0 P1 PLW1 SF02 CPDPRG[2 PCPD2 PLW2 PLW12 PLW13 F2 - Pro SI SF WTW	uisition Parameters 20241129 15.23 h AVNeo400NB-5059676-P Z163739_0809 ( zgpg30 65536 CDC13 256 4 23809.524 Hz 0.726609 Hz 1.3762560 sec 101 21.000 usec 6.50 usec 298.6 K 2.00000000 sec 1 100.6228298 MHz 13C 2.67 usec 8.00 usec 91.39299774 W 400.1316005 MHz 1H waltz65 90.00 usec 24.18499947 W 0.18788880 W 0.09416986 W cessing parameters 32768 100.6127570 MHz EM
					0					WDW SSB LB GB PC	0 1.00 Hz 0 1.40
180	160	140	120	100		60	40	مىسىرىغانىساندىيانىپ 1 20	ppm		

Figure S77: <sup>13</sup>C{<sup>1</sup>H}-NMR spectra for compound **16g** 



Figure S78: <sup>1</sup>H-NMR spectra for compound **16h** 



		86	38 53 17 17		894		r m	99	ოო		
		144.	/ / 129. / 126. / 1117. / 114.		77.4 77.1 76.8	 51 A		28.2 26.5		Current NAME EXPNO PROCNO	Data Parameters MK-IV-892-RACMK 2 1
NH H 16h	~									F2 - Acq Date Time INSTRUM PROBHD PULPROG TD SOLVENT NS SWH FIDRES AQ RG DW DE TE D1 D11 TD0 SF01 NUC1 P0 P1 PLW1 SF02 NUC2 CPDPRG[2 PCPD2 PLW2 PLW13	uisition Parameters 20241203 12.58 h AVNeo400NB-5059676-P Z163739_0809 ( zgpg30 65536 CDC13 256 4 23809.524 Hz 0.726609 Hz 1.3762560 sec 101 21.000 usec 6.50 usec 299.8 K 2.00000000 sec 0.0300000 sec 1 100.6228298 MHz 13C 2.67 usec 8.00 usec 91.39299774 W 400.1316005 MHz 1H waltz65 90.00 usec 24.1849947 W 0.18788880 W 0.09416986 W
										F2 - Pro SI SF WDW SSB LB GB PC	cessing parameters 32768 100.6127564 MHz EM 0 1.00 Hz 0 1.40
180	160	140	120	100	80	60	40		20 ppn	ר <b>ח</b>	

Figure S79: <sup>13</sup>C{<sup>1</sup>H}-NMR spectra for compound **16h** 

## HPLC analysis report

### Department of Chemistry Pondicherry University

### <Chromatogram>

### (±)-3,3'-Bis(N,N'-dimethyl dimethoxy carbamate)BINOL, (±)-11



(R)-3.3'-Bis(N	N'-dimethy	dimethoxy	carbamate)	BINOL.	(R)-11

100.000

Total

MK-III-473 (IA, HE,IPA, 80,20) 1.0 mL.lcd



D:\Data\KARTHICK\3,3'-DIACYL BINOLS\432\MK-III-432 (IA, HE, IPA, 80, 20) 1.0 mL.lcd

## HPLC analysis report

### Department of Chemistry Pondicherry University

### <Chromatogram>

### (±)-3,3'-Bis(phenyl methanone)BINOL, (±)-4a

### MK-IV-815 (IA, H,IPA,80,20) 1.0 mL001.lcd



PDA C	h1 254nm	
Peak#	Ret. Time	Area%
1	6.742	50.291
2	12.432	49.709
Total		100.000

### (R)-3,3'-Bis(phenyl methanone)BINOL, (R)-4a





D:\Data\KARTHICK\3,3'-DIACYL BINOLS\467\MK-IV-815 (IA, H,IPA,80,20) 1.0 mL001.lcd

# HPLC analysis report

### Department of Chemistry Pondicherry University

### <Chromatogram>

(±)-3,3'-Bis(p-tolyl methanone)BINOL, (±)-4c



PDAC	n'i 254nm	
Peak#	Ret. Time	Area%
1	5.766	50.040
2	16.289	49.960
Total		100.000

(R)-3,3'-Bis(p-tolyl methanone)BINOL, (R)-4c



D:\Data\KARTHICK\3,3'-DIACYL BINOLS\454\MK-III-454\_1 (IA, H,IPA,60,40) 1.0 mL001.lcd

1000

0

5.0

8.202

10.0

7.5

## HPLC analysis report

### Department of Chemistry Pondicherry University

### <Chromatogram>

(±)-3,3'-Bis(4-Fluoro phenyl methanone)BINOL, (±)-4d



 Peak#
 Ret. Time
 Area%

 1
 8.202
 3.440

 2
 18.936
 96.560

 Total
 100.000

<Peak Table>

OH

15.0

(R)-4d <sup>"</sup>O

12.5

PDA Ch1 254nm

D:\Data\KARTHICK\3,3'-DIACYL BINOLS\455\MK-III-455 (IA, H,IPA,80,20) 1.0 mL004.lcd

17.5

20.0

22.5

25.0 min

# HPLC analysis report

### Department of Chemistry Pondicherry University

### <Chromatogram>

### (±)-3,3'-Bis(4-chlorophenyl methanone)BINOL, (±)-4e



PDA C	h1 254nm	
Peak#	Ret. Time	Area%
1	8.962	50.849
2	31.677	49.151
Total		100.000

### (R)-3,3'-Bis(4-chlorophenyl methanone)BINOL, (R)-4e





D:\Data\KARTHICK\3,3'-DIACYL BINOLS\456\MK-III-456\_1 (IA, H,IPA,80,20) 1.0 mL.lcd

## HPLC analysis report

### Department of Chemistry Pondicherry University

### <Chromatogram>

### (±)-3,3'-Bis(4-CF3 phenyl methanone)BINOL, (±)-4f



### (R)-3,3'-Bis(4-CF3 phenyl methanone)BINOL, (R)-4f





# HPLC analysis report

### Department of Chemistry Pondicherry University

### <Chromatogram>

### (±)-3,3'-Bis(bis 3,5-CF<sub>3</sub> phenyl methanone)BINOL, (±)-4g

#### MK-IV-458 (OD-H, H,IPA,95,5) 1.0 mL006.lcd mAU 1000 PDA Multi 1 254nm,4nm CE 750 5.459 500 (±)-4q 30.204 250 F₃C CF 0 20 10 15 25 30 35 5 min <Peak Table>

PDA C	h1 254nm	
Peak#	Ret. Time	Area%
1	5.459	51.636
2	30.204	48.364
Total		100.000

### (R)-3,3'-Bis(bis 3,5-CF<sub>3</sub> phenyl methanone)BINOL, (R)-4g

MK-IV-508\_1 (OD-H, H,IPA,95,5) 1.0 mL008.lcd



D:\Data\KARTHICK\3,3'-DIACYL BINOLS\458\MK-IV-458 (OD-H, H,IPA,95,5) 1.0 mL006.lcd

# HPLC analysis report

### Department of Chemistry Pondicherry University

### <Chromatogram>

(±)-(phenyl) 1,2,3,4-tetrahydroquinoline, (±)-16a



### (S)-(phenyl) 1,2,3,4-tetrahydroquinoline, (S)-16a

#### MK-IV-881 (chiral)\_1 (OD-H,H,IPA,95,05) 0.6 ML003.lcd



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### <Chromatogram>

(±)-(4-Methoxyphenyl)-1,2,3,4-tetrahydroquinoline, (±)-16b

MK-IV-873\_1 (OD-H,H,IPA,90,10) 0.6 ML003.lcd mAU 4000 PDA Multi 1 254nm,4nm 3000 14.109 N OCH-22.824  $(\pm)-16b$ 2000 1000 0 15.0 17.5 20.0 22.5 25.0 12.5 min

<Peak Table>

PDA C	h1 254nm	
Peak#	Ret. Time	Area%
1	14.109	50.422
2	22.824	49.578
Total		100.000

#### (S)-(4-Methoxyphenyl)-1,2,3,4-tetrahydroquinoline, (S)-16b





25.0 min

# **HPLC** analysis report

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### <Chromatogram>

(±)-(4-Methyphenyl)-1,2,3,4-tetrahydroquinoline, (±)-16c



<Peak Table>

PDA C	h1 254nm	
Peak#	Ret. Time	Area%
1	13.434	50.678
2	22.429	49.322
Total		100.000

#### (S)-(4-Methylphenyl)-1,2,3,4-tetrahydroquinoline, (S)-16c

MK-IV-887(chiral)\_1 (OD-H,H,IPA,90,10) 0.5 ML005.lcd



D:\Data\KARTHICK\2-PHENYL QUINOLINE\MK-IV-887\MK-IV-887 1 (OD-H,H,IPA,90,10) 0.5 ML003.lcd

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### <Chromatogram>

(±)-(4-Bromophenyl)-1,2,3,4-tetrahydroquinoline, (±)-16d

MK-IV-866\_racemic (OD-H,H,IPA,90,10) 0.6 ML001.lcd



PDA C	h1 254nm	
Peak#	Ret. Time	Area%
1	14.595	46.191
2	29.629	53.809
Total		100.000

#### (S)-(4-Bromophenyl)-1,2,3,4-tetrahydroquinoline, (S)-16d

MK-IV-866 (OD-H,H,IPA,90,10) 0.6 ML.lcd mAU PDA Multi 1 254nm,4nm 3000 14.744 N 2000 B (S)-**16d** 30.603 1000 0 12.5 15.0 17.5 20.0 22.5 25.0 27.5 30.0 32.5 35.0 min <Peak Table> PDA Ch1 254nm Peak# Ret. Time Area% 14.744 76.029 1 2 30.603 23.971

100.000

Total

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**LabSolutions** 

### Department of Chemistry Pondicherry University

### <Chromatogram>

(±)-(4-Chlorophenyl)-1,2,3,4-tetrahydroquinoline, (±)-16e



#### (S)-(4-Chlorophenyl)-1,2,3,4-tetrahydroquinoline, (S)-16e

MK-IV-888 (chiral)\_1 (OD-H,H,IPA,90,10) 0.6 ML003.lcd



D:\Data\KARTHICK\2-PHENYL QUINOLINE\MK-IV-888\MK-IV-888 (chiral)\_1 (OD-H,H,IPA,90,10) 0.6 ML003.lcd

### **HPLC LabSolutions** analysis report

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mAU

### **Department of Chemistry** Pondicherry University

### <Chromatogram>

(±)-(2-Naphthyl)-1,2,3,4-tetrahydroquinoline, (±)-16f

#### MK-IV-889 (racemic)\_1 (OD-H,H,IPA,10,10) 0.6 ML003.lcd



<Peak Table>

PDA C	h1 254nm	
Peak#	Ret. Time	Area%
1	19.716	48.313
2	35.701	51.687
Total		100.000

### (S)-(2-Naphthyl)-1,2,3,4-tetrahydroquinoline, (S)-16f

#### MK-IV-889 (chiral)\_1 (OD-H,H,IPA,10,10) 0.6 ML004.lcd



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**LabSolutions** 

### Department of Chemistry Pondicherry University

### <Chromatogram>

(±)-(2-Methyl)-1,2,3,4-tetrahydroquinoline, (±)-16g



2 12.228	49.445
Total	100.000

(S)-(2-Methyl)-1,2,3,4-tetrahydroquinoline, (S)-16g





D:\Data\KARTHICK\2-PHENYL QUINOLINE\MK-IV-891\MK-IV-891\_1 (OJ-H,H,IPA,95,05) 1.0 ML003.lcd

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**LabSolutions** 

### Department of Chemistry Pondicherry University

### <Chromatogram>

(±)-(2-Propyl)-1,2,3,4-tetrahydroquinoline, (±)-16h



#### (S)-(2-Propyl)-1,2,3,4-tetrahydroquinoline, (S)-16h

Total

100.000



D:\Data\KARTHICK\2-PHENYL QUINOLINE\MK-IV-892\MK-IV-892 (racemic) (OJ-H,H,IPA,95,05) 1.0 ML003.lcd