

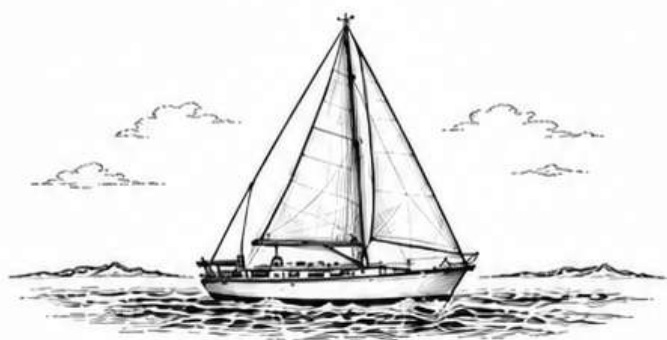


EXERCISE BOOKLET

HO 249 NP 303

For Cruising Sailors

Sun Sights Only



01 — La Rochelle
02 — Madagascar
03 — Perth
04 — San Francisco

05 — Galapagos
06 — Tokyo
07 — Pointe-à-Pitre
08 — Rotterdam

8 Fully Worked-Out Exercises

$H_s = \text{---}^\circ \text{---}' \text{---}''$
 $\epsilon = \text{---}' \text{---}''$
 $\text{Dip} = \text{---}' \text{---}'' +$
 $H_a = \text{---}^\circ \text{---}' \text{---}''$
 $+ \text{sun correct. LL/UL} = \text{---}' \text{---}'' +$
 $\mathbf{H_o} = \text{---}^\circ \text{---}' \text{---}''$

Date $\text{---} / \text{---} / \text{---}$
 UT $\text{---} \text{h} \text{---} \text{m} \text{---} \text{s}$
 $\text{index error} = \text{---}' \text{---}''$
 $+ \text{non adjust. error} = \text{---}' \text{---}'' +$
 $\epsilon = \text{---}' \text{---}''$
 $L = \text{---}^\circ \text{---}' \text{---}''$
 $G = \text{---}^\circ \text{---}' \text{---}''$
 Height of the eye = $\text{---} \text{m}$
☐ lower limb ☐ upper limb

$\text{GHA} = \text{---}^\circ \text{---}' \text{---}''$
 $+ pp = \text{---}^\circ \text{---}' \text{---}'' + \text{increment}$
 $\text{GHA} = \text{---}^\circ \text{---}' \text{---}''$
 $G = \text{---}^\circ \text{---}' \text{---}''$ $G = \text{East} \rightarrow \text{add}$
 $\text{LHA} = \text{---}^\circ \text{---}' \text{---}''$ $G = \text{West} \rightarrow \text{subtract}$

$(d \uparrow \text{ or } \downarrow = \text{---}' \text{---}'')$
 $d \text{ nautical almanac}$
 $D = \text{---}^\circ \text{---}' \text{---}''$
 $\text{corr. } d = \text{---}' \text{---}'' +$
 $\mathbf{D} = \text{---}^\circ \text{---}' \text{---}''$

Assumed Latitude = ---° (VOLUME --- HO 249)
 LHA = ---°
 Sun's Declination = ---° Dec. Inc. = $\text{---}, \text{---}'$
 Assumed Longitude = $\text{---}^\circ \text{---}', \text{---}''$
☐ L/D same name / ☐ L/D contrary name

Hc	HO 249 d (altitude difference)	Z
$\text{---}^\circ \text{---}'$	$\text{---}'$	---°

TABLE 5 or $\frac{HO\ 249\ d \times Dec.\ Inc.}{60} \Rightarrow H\ corr. = \text{---} \cdot \text{---}'$

$Hc\ final = Hc \ +/-\ H\ corr. = (\text{---}^\circ \text{---}') \ +/-\ (\text{---}, \text{---}') = \text{---}^\circ \text{---}', \text{---}''$

$Z = \text{---}^\circ$

$Z_n = \text{---}^\circ$

Latitude	LHA	Zn
Nord	LHA > 180°	$Z_n = Z$
	LHA < 180°	$Z_n = 360^\circ - Z$
Sud	LHA > 180°	$Z_n = 180^\circ - Z$
	LHA < 180°	$Z_n = 180^\circ + Z$

$\text{Intercept} = H_o - Hc\ final = (\text{---}^\circ \text{---}', \text{---}'') - (\text{---}^\circ \text{---}', \text{---}'') = \text{---}, \text{---}'$

Toward the Sun if $H_o > Hc\ final$ (+), Away from the Sun if $H_o < Hc\ final$ (-)

Intercept = $H_o - H_c = 20^{\circ}34.5' - 20^{\circ}33' = 1.5'$

$H_s = 50^\circ 43',8$
 $\varepsilon = -2',2$
 $Dip = -3',6 +$
 $H_a = 50^\circ 38',0$
 $+ \text{sun correct. LL/UL} = +15',4 +$
 $H_o = 50^\circ 53',4$
Madagascar

Date 05 / 02 / 2022
 UT 11h 55m 29s
 $index\ error = -4'$
 $+ non\ adjust.\ error = +1',8 +$
 $\varepsilon = -2',2$
 $L = 30^\circ 24' S$
 $G = 044^\circ 13' E$
 Height of the eye = 4 m
☒ lower limb ☐ upper limb

$GHA = 341^\circ 30',6$
 $+ pp = 13^\circ 52',3$ increment)
 $GHA = 355^\circ 22',9$ $G = \text{West} \rightarrow \text{subtract}$
 $G = 044^\circ 13' E$ $G = \text{East} \rightarrow \text{add}$
 $LHA = 039^\circ 35',9$

$(d \uparrow \text{ or } \downarrow = 0',8 \downarrow)$
 $d \text{ nautical almanac}$
 $D = 15^\circ 51',4 S$
 $corr.\ d = 0',7$
 $D = 15^\circ 50',7 S$

Assumed Latitude = $30^\circ S$
 LHA = 040°
 Sun's Declination = $15^\circ S$
 Assumed Longitude = $044^\circ 37',1 E$

VOLUME 2 HO 249

Dec.Inc. = $51'$

☒ L/D same name / ☐ L/D contrary name

Hc	d	Z	"MADAGASCAR"
	(altitude difference)		
$50^\circ 22'$	$29'$	103°	

H corr. = $25'$ (TABLE 5: **d** $\rightarrow$ horizontally and $\downarrow$ **Dec. Inc.** vertically.) or $\frac{d \times Dec.\ Inc.}{60}$

Hc = Hc +/- H corr. = $50^\circ 22' + 25' = 50^\circ 47'$

Z = 103°

Zn = 283°

Latitude	LHA	Zn
Nord	$LHA > 180^\circ$	$Z_n = Z$
	$LHA < 180^\circ$	$Z_n = 360^\circ - Z$
Sud	$LHA > 180^\circ$	$Z_n = 180^\circ - Z$
	$LHA < 180^\circ$	$Z_n = 180^\circ + Z$

Intercept = Ho - Hc = $50^\circ 53',4 - 50^\circ 47' = +6',4$

$H_s = 36^\circ 54',1$
 $\epsilon = 2',7$
 $Dip = -2',5 +$
 $H_a = 36^\circ 54',3$
 $+ \text{sun correct. LL/UL} = 14',7 +$
 $H_o = 37^\circ 09',0$
Perth

Date 16/08/2022
 UT 07h 14m 35s
 $index\ error = +1'$
 $+ non\ adjust.error = +1',7 +$
 $\epsilon = 2',7$
 $L = 27^\circ 25' S$
 $G = 106^\circ 39' E$
 Height of the eye = 2 m
☒ lower limb ☐ upper limb

$GHA = 283^\circ 54',8$
 $+ pp = 3^\circ 38',8$ increment)
 $GHA = 287^\circ 33',6$ G = West → subtract
 $G = 106^\circ 39' E$ G = East → add
 $LHA = 034^\circ 12',6$

$(d \uparrow \text{ or } \downarrow = 0',8 \downarrow)$
 $d \text{ nautical almanac}$
 $D = 13^\circ 42',9 N$
 $corr. d = 0',2 \downarrow$
 $D = 13^\circ 42',7 N$

Assumed Latitude = $27^\circ S$
 LHA = 034°
 Sun's Declination = $13^\circ N$
 Assumed Longitude = $106^\circ 26.4' E$

VOLUME 2 HO 249

Dec.Inc. = $43'$

☐ L/D same name / ☒ L/D contrary name

Hc	d (altitude difference)	Z	"PERTH"
$38^\circ 09'$	$-47'$	136°	

H corr. = $-34'$ (TABLE 5: **d** → horizontally and **Dec. Inc.** vertically.) or $\frac{d \times Dec. Inc.}{60}$

Hc = Hc +/- H corr. = $38^\circ 09' - 34' = 37^\circ 35'$

	Latitude	LHA	Zn
$Z = 136^\circ$	Nord	$LHA > 180^\circ$	$Z_n = Z$
		$LHA < 180^\circ$	$Z_n = 360^\circ - Z$
$Z_n = 316^\circ$	Sud	$LHA > 180^\circ$	$Z_n = 180^\circ - Z$
		$LHA < 180^\circ$	$Z_n = 180^\circ + Z$

Intercept = Ho - Hc = $37^\circ 09' - 37^\circ 35' = -26'$

$H_s = 27^\circ 31',6$
 $\varepsilon = -1',5$
 $Dip = -3',6 +$
 $H_a = 27^\circ 26',5$
 $+ \text{sun correct. LL/UL} = 14',5 +$
 $H_o = 27^\circ 41',0$
San Francisco

Date 06 / 01 / 2022
 UT 18h 34m 54s
 $index\ error = -3'$
 $+ non\ adjust.\ error = +1',5 +$
 $\varepsilon = -1',5$
 $L = 34^\circ 40' N$
 $G = 123^\circ 15' W$
 Height of the eye = 4 m
☒ lower limb ☐ upper limb

$GHA = 088^\circ 31'$
 $+ pp = 8^\circ 43',5$ increment)
 $GHA = 097^\circ 14',5$ G = West → subtract
 $G = 123^\circ 15' W$ G = East → add
 $LHA = 333^\circ 59',5$

$(d \uparrow \text{ or } \downarrow = 0',3 \downarrow)$
 $d \text{ nautical almanac}$
 $D = 22^\circ 25',9 S$
 $corr.\ d = 0',2 \downarrow$
 $D = 22^\circ 25',7 S$

Assumed Latitude = $35^\circ N$
 LHA = 334°
 Sun's Declination = $22^\circ S$
 Assumed Longitude = $123^\circ 14.5' W$

VOLUME 2 HO 249

Dec.Inc. = $26'$

☐ L/D same name / ☒ L/D contrary name

Hc	d	Z	"SAN FRANCISCO"
	(difference altitude)		
$27^\circ 53'$	$-54'$	153°	

H corr. = $-23'$ (TABLE 5: **d** → horizontally and ↓ **Dec. Inc.** vertically.) or $\frac{d \times Dec.\ Inc.}{60}$

Hc = Hc +/- H corr. = $27^\circ 53' - 23' = 27^\circ 30'$

	Latitude	LHA	Zn
$Z = 153^\circ$	Nord	$LHA > 180^\circ$	$Z_n = Z$
		$LHA < 180^\circ$	$Z_n = 360^\circ - Z$
Zn = 153°	Sud	$LHA > 180^\circ$	$Z_n = 180^\circ - Z$
		$LHA < 180^\circ$	$Z_n = 180^\circ + Z$

Intercept = Ho - Hc = $27^\circ 41' - 27^\circ 30' = +11'$

$$\begin{aligned} H_s &= 52^\circ 18' \\ \epsilon &= 2',8 \\ \text{Dip} &= \underline{-2',5} + \end{aligned}$$

$$\begin{aligned} H_a &= 52^\circ 18',3 \\ + \text{sun correct. LL/UL} &= \underline{15',3} + \end{aligned}$$

$$H_o = 52^\circ 33',6$$

Galapagos

Date 06 / 06 / 2022

UT 15h 58m 54s

$$\begin{aligned} \text{index error} &= +1' \\ + \text{non adjust.error} &= \underline{+1',8} + \\ \epsilon &= 2',8 \end{aligned}$$

$L = 03^\circ 58' \text{ S}$

$G = 086^\circ 54' \text{ W}$

Height of the eye = 2 m

☒ lower limb ☐ upper limb

$$\begin{aligned} \text{GHA} &= 045^\circ 18',9 \\ + pp &= \underline{14^\circ 43',5} \quad \text{increment) } \\ \text{GHA} &= 060^\circ 02',4 \quad G = \text{West} \rightarrow \text{subtract} \\ G &= \underline{086^\circ 54' \text{ W}} \quad G = \text{East} \rightarrow \text{add} \\ \text{LHA} &= 333^\circ 08',4 \end{aligned}$$

(d ↑ or ↓ = 0',3 ↑)
d nautical almanac

$$\begin{aligned} D &= 22^\circ 41',5 \text{ N} \\ \text{corr. } d &= \underline{0',3 \uparrow} \\ \mathbf{D} &= 22^\circ 41',8 \text{ N} \end{aligned}$$

Assumed Latitude = 04° S
LHA = 333°
Sun's Declination = 22° N
Assumed Longitude = $087^\circ 02.4' \text{ W}$

VOLUME 2 HO 249

Dec.Inc. = $42'$

☐ L/D same name / ☒ L/D contrary name

Hc	d (altitude difference)	Z	"GALAPAGOS"
$52^\circ 56'$	$-40'$	136°	

$$H \text{ corr.} = -28' \quad (\text{TABLE 5: } \mathbf{d} \rightarrow \text{horizontally and } \downarrow \mathbf{Dec. Inc.} \text{ vertically.}) \text{ or } \frac{d \times \text{Dec. Inc.}}{60}$$

$$\mathbf{Hc} = Hc \pm H \text{ corr.} = 52^\circ 56' - 28' = 52^\circ 28'$$

Z = 136°	Latitude	LHA	Zn
	Nord	LHA > 180°	Z _n = Z
		LHA < 180°	Z _n = 360° - Z
	Zn = 044°	Sud	LHA > 180°
LHA < 180°			Z _n = 180° + Z

$$\mathbf{Intercept} = H_o - H_c = 52^\circ 33.6' - 52^\circ 28' = +5.6'$$

$$\begin{aligned} Ha &= 42^{\circ}11',8 \\ \underline{+ \textit{sun correct. LL/UL}} &= \underline{15',1} + \\ Ho &= 42^{\circ}26',9 \end{aligned}$$

Tokyo

Date 06 / 03 / 2022

UT 20h 16m 54s

$$\begin{aligned} & \text{index error} = + 2' \\ + \text{non adjust.error} &= \frac{+ 1',9}{\varepsilon = 3',9} + \end{aligned}$$

$L = 33^{\circ}21' \text{ N}$
 $G = 150^{\circ}18' \text{ W}$

Height of the eye = 4 m

⊗ *lower limb* □ *upper limb*

GHA = 117°12',5
+ *pp* = 4°13',5 increment)
GHA = 121°26',0 G = West → subtract
G = 150°18' W G = East → add
LHA = 331°08',0

(d ↑ or ↓ = 1' ↓)
d nautical almanac

D = 05°26',1 S
corr. d = 0',3 ↓
D = 05°25',8 S

Assumed Latitude = 33° N
LHA = 331°
Sun's Declination = 05° S
Assumed Longitude = 150° 26.0' W

VOLUME 2 HO 249

Dec.Inc. = 26'

☐ L/D same name / ☒ L/D contrary name

Hc	d	Z	“TOKYO”
	(altitude difference)		
43° 06 ‘	– 50’	139°	

$$\text{H corr.} = -22' \quad (\text{TABLE 5: } \mathbf{d} \rightarrow \text{horizontally and } \downarrow \mathbf{Dec. Inc.} \text{ vertically.}) \text{ or } \frac{d \times \text{Dec. Inc.}}{60}$$

$$\mathbf{Hc} = Hc \text{ +/- } H \text{ corr.} = 43^{\circ} 06' - 22' = 42^{\circ} 44'$$

	Latitude	LHA	Zn
Z = 139°	Nord	LHA > 180°	Z _n = Z
		LHA < 180°	Z _n = 360° - Z
Zn = 139°	Sud	LHA > 180°	Z _n = 180° - Z
		LHA < 180°	Z _n = 180° + Z

$$\text{Intercept} = H_o - H_c = 42^\circ 26.9' - 42^\circ 44' = -17.1'$$

$H_s = 56^\circ 17',5$
 $\varepsilon = -0',4$
 $Dip = -2',5 +$
 $H_a = 56^\circ 14',6$
 $\text{sun correct. LL/UL} = 15',3 +$
 $H_o = 56^\circ 29',9$
Pointe -à- Pitre

Date 26 / 09 / 2022
 UT 13h 54m 01s
 $index\ error = -2'$
 $+ non\ adjust.error = +1',6 +$
 $\varepsilon = -0',4$

 $L = 16^\circ 34' N$
 $G = 059^\circ 25' W$
 Height of the eye = 2 m
☒ lower limb ☐ upper limb

$GHA = 017^\circ 10',2$
 $+ pp = 13^\circ 30',3$ increment)
 $GHA = 030^\circ 40',5$ $G = \text{West} \rightarrow \text{subtract}$
 $G = 059^\circ 25',0 W$ $G = \text{East} \rightarrow \text{add}$
 $LHA = 331^\circ 15',5$

$(d \uparrow \text{ or } \downarrow = 1' \uparrow)$
 $d \text{ nautical almanac}$

 $D = 01^\circ 21',8 S$
 $corr. d = 0',9 \uparrow$
 $D = 01^\circ 22',7 S$

Assumed Latitude = $17^\circ N$
 LHA = 331°
 Sun's Declination = $01^\circ S$
 Assumed Longitude = $059^\circ 40.5' W$

VOLUME 2 HO 249

Dec.Inc. = $23'$

☐ L/D same name / ☒ L/D contrary name

Hc	d (altitude difference)	Z	"POINTE A PITRE"
$56^\circ 13'$	$-33'$	119°	

H corr. = $-13'$ (TABLE 5: **d** $\rightarrow$ horizontally and $\downarrow$ **Dec. Inc.** vertically.) or $\frac{d \times Dec. Inc.}{60}$

Hc = Hc +/- H corr. = $56^\circ 13' - 13' = 56^\circ$

	Latitude	LHA	Zn
$Z = 119^\circ$	Nord	$LHA > 180^\circ$	$Z_n = Z$
		$LHA < 180^\circ$	$Z_n = 360^\circ - Z$
$Z_n = 119^\circ$	Sud	$LHA > 180^\circ$	$Z_n = 180^\circ - Z$
		$LHA < 180^\circ$	$Z_n = 180^\circ + Z$

Intercept = Ho - Hc = $56^\circ 29.9' - 56^\circ = +29.9'$

$H_s = 46^{\circ}07',3$
 $\epsilon = 7'$
 $Dip = -3',6 +$
 $H_a = 46^{\circ}10',7$
 $+ \text{sun correct. LL/UL} = 15',1 +$
 $H_o = 46^{\circ}25',8$
Rotterdam

Date 11 / 06 / 2022
 UT 08h 54m 01s
 $index\ error = +5'$
 $+ non\ adjust.\ error = +2' +$
 $\epsilon = 7'$
 $L = 52^{\circ}08' N$
 $G = 003^{\circ}54' E$
 Height of the eye = 4 m
☒ lower limb ☐ upper limb

$GHA = 300^{\circ}05',2$
 $+ pp = 13^{\circ}30',3$ increment)
 $GHA = 313^{\circ}35',5$ G = West → subtract
 $G = 003^{\circ}54',0 E$ G = East → add
 $LHA = 317^{\circ}29',5$

$(d \uparrow \text{ or } \downarrow = 0',2 \uparrow)$
 $d \text{ nautical almanac}$
 $D = 23^{\circ}05',4 N$
 $corr. d = 0',2 \uparrow$
 $D = 23^{\circ}05',6 N$

Assumed Latitude = $52^{\circ} N$
 LHA = 317°
 Sun's Declination = $23^{\circ} N$
 Assumed Longitude = $003^{\circ} 24.5' E$

VOLUME 3 HO 249

Dec.Inc. = $06'$

☒ L/D same name / ☐ L/D contrary name

Hc	d	Z	"ROTTERDAM"
	(altitude difference)		
$46^{\circ} 15'$	$+ 48'$	115°	

H corr. = $+5'$ (TABLE 5: **d** → horizontally and **Dec. Inc.** vertically.) or $\frac{d \times Dec. Inc.}{60}$

Hc = Hc +/- H corr. = $46^{\circ} 15' + 5.0' = 46^{\circ} 20'$

	Latitude	LHA	Zn
$Z = 115^{\circ}$	Nord	$LHA > 180^{\circ}$	$Z_n = Z$
		$LHA < 180^{\circ}$	$Z_n = 360^{\circ} - Z$
$Z_n = 115^{\circ}$	Sud	$LHA > 180^{\circ}$	$Z_n = 180^{\circ} - Z$
		$LHA < 180^{\circ}$	$Z_n = 180^{\circ} + Z$

Intercept = Ho - Hc = $46^{\circ} 25.8' - 46^{\circ} 20.0' = + 5.8'$