

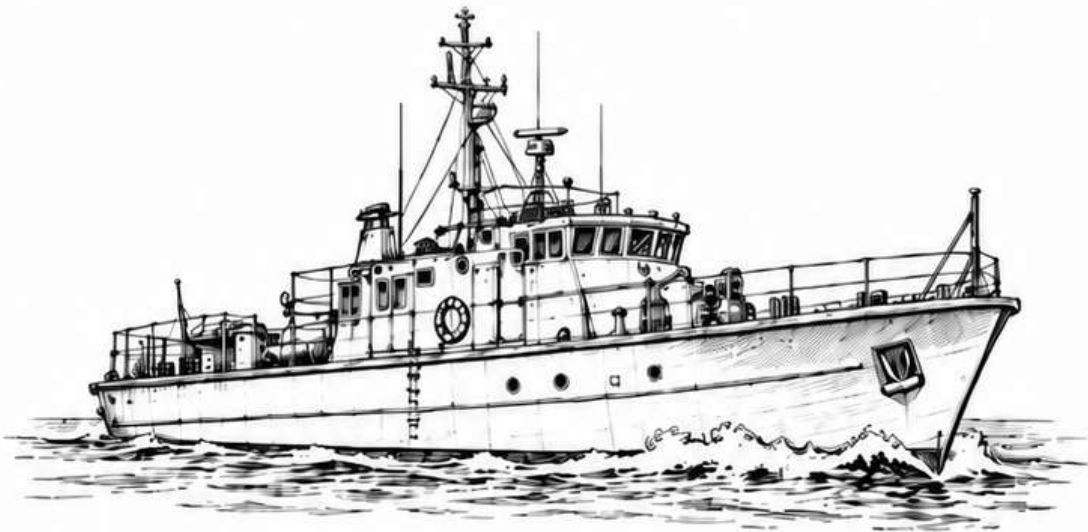


EXERCISE BOOKLET

HO 229

Marine

For 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

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

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

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

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

Assumed Latitude = ---° (VOLUME --- HO 229)
 LHA = ---°
 Sun's Declination = ---° Dec.Inc. = $\text{---}, \text{---}'$
 Assumed Longitude = $\text{---}^\circ \text{---}', \text{---}''$
☐ L/D same name / ☐ L/D contrary name

Hc	HO 229 d (altitude difference)	Z
$\text{---}^\circ \text{---}', \text{---}''$	$\text{---}, \text{---}'$	$\text{---}^\circ, \text{---}'$

$\frac{HO\ 229\ d \times Dec.\ Inc.}{60}$ or Interpolation Table HO 229 $\Rightarrow$ H corr. = $\text{---}, \text{---}'$

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

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

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

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 $H_o > Hc$ (+), Away from the sun if $H_o < Hc$ (-)

$H_s = 20^\circ 19', 2$ $\varepsilon = 4', 2$ $\text{Dip} = \underline{- 2', 5} +$ $H_a = 20^\circ 20', 9$ $+ \text{sun correct. LL/UL} = \underline{+ 13', 6} +$ $\mathbf{H_o = 20^\circ 34', 5}$ La Rochelle	Date 26/01/2022 UT 10h 40m 19s $\text{index error} = + 3'$ $+ \text{non adjust. error} = \underline{+ 1', 2} +$ $\varepsilon = + 4', 2$ $L = 46^\circ 12' \text{ N}$ $G = 004^\circ 31' \text{ W}$ Height of the eye = 2 m ☒ lower limb ☐ upper limb
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$\text{GHA} = 326^\circ 52', 8$ $+ pp = \underline{10^\circ 04', 8} \quad \text{increment)$ $\text{GHA} = 336^\circ 57', 6$ $G = \underline{004^\circ 31'} \text{ W} \quad G = \text{East} \rightarrow \text{add}$ $\text{LHA} = 332^\circ 26', 6 \quad G = \text{West} \rightarrow \text{subtract}$	(d ↑ or ↓ = 0', 6 ↓) <i>d nautical almanac</i> $D = 18^\circ 40', 1 \text{ S}$ $\text{corr. } d = \underline{0', 4}$ $\mathbf{D = 18^\circ 39', 7 \text{ S}}$
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Assumed Latitude = 46° N VOLUME 4 HO 229

LHA = 332°

Sun's Declination = 18° S Dec.Inc. = $39.7'$

Assumed Longitude = $004^\circ 57.6' \text{ W}$

☐ L/D same name / ☒ L/D contrary name

Hc	d (altitude difference)	Z	“LA ROCHELLE”
21°09.8'	(-) 56.2'	151.4°	

H corr. = $- 37.2'$ $\frac{d \times \text{Dec. Inc.}}{60}$ or Interpolation Table HO 229

Hc final = Hc +/- H corr. = $21^\circ 09.8' - 37.2' = 20^\circ 32.6$

Z = 151.4°

Zn = 151.4°

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°	$Z_n = 180^\circ + Z$

Intercept = Ho - Hc final = $20^\circ 34.5' - 20^\circ 32.6' = + 1.9'$

$H_s = 50^{\circ}43',8$
 $\varepsilon = -2',2$
 $Dip = -3',6 +$
 $H_a = 50^{\circ}38,0'$
 $+ \text{sun correct. LL/UL} = +15',4 +$
 $H_o = 50^{\circ}53',4$
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 = West $\rightarrow$ subtract
 $G = 044^{\circ}13' E$ G = East $\rightarrow$ 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 ou 3 HO 229
 Dec.Inc. = $50.7'$
☒ L/D same name / ☐ L/D contrary name

Hc	d (altitude difference)	Z	"MADAGASCAR"
$50^{\circ} 22.4'$	$28.8'$	103.2°	

$H\ corr. = +24.3'$ $\frac{d \times Dec.\ Inc.}{60}$ or Interpolation Table HO 229

$Hc\ final = Hc \ +/-\ H\ corr. = 50^{\circ} 22.4' + 24.3' = 50^{\circ} 46.7'$

$Z = 103.2^{\circ}$

$Z_n = 283.2^{\circ}$

Latitude	LHA	Z_n
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 = $H_o - Hc\ final = 50^{\circ} 53.4' - 50^{\circ} 46.7' = +6.7'$

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

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

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

$(d \uparrow \text{ or } \downarrow = 0',8 \downarrow)$
d 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 229

Dec.Inc. = $42.7'$

☐ L/D same name / ☒ L/D contrary name

Hc	d (altitude difference)	Z	"PERTH"
$38^{\circ} 08.6'$	$- 46.6'$	136.1°	

$H\ corr. = - 33.2'$ $\frac{d \times Dec.\ Inc.}{60}$ or Interpolation Table HO 229

$Hc\ final = Hc\ +/-\ H\ corr. = 38^{\circ} 08.6' - 0^{\circ} 33.2' = 37^{\circ} 35.4'$

$Z = 136.1^{\circ}$

$Z_n = 316.1^{\circ}$

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

$Intercept = H_o - Hc\ final = 37^{\circ} 09.0' - 37^{\circ} 35.4' = - 26.4'$

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

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

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

$(d \uparrow \text{ or } \downarrow = 0',3 \downarrow)$
d 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 3 HO 229

Dec.Inc. = $25.7'$

☐ L/D same name / ☒ L/D contrary name

Hc	d (altitude difference)	Z	"SAN FRANCISCO"
$27^\circ 53.4'$	$-54.9'$	152.6°	

$H\ corr. = -23.5'$ $\frac{d \times Dec.\ Inc.}{60}$ or Interpolation Table HO 229

$Hc\ final = Hc\ +/-\ H\ corr. = 27^\circ 53.4' - 23.5' = 27^\circ 29.9'$

$Z = 152.6^\circ$

$Z_n = 152.6^\circ$

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

$Intercept = H_o - Hc\ final = 27^\circ 41.0' - 27^\circ 29.9' = +11.1'$

$$\begin{aligned} \text{Ha} &= 52^{\circ}18',3 \\ \underline{+ \text{sun correct. LL/UL}} &= \underline{15',3} + \\ \text{Ho} &= 52^{\circ}33',6 \end{aligned}$$

Galapagos

Date 06 / 06 / 2022

UT 15h 58m 54s

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

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

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

Height of the eye = 2 m

☒ lower limb ☐ upper limb

GHA = 045°18',9
+ *pp* = 14°43',5 increment)
GHA = 060°02',4 G = West → subtract
G = 086°54' W G = East → add
LHA = 333°08',4

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

D = 22°41', 5 N
corr. d = 0', 3 ↑
D = 22°41', 8 N

Assumed Latitude = 04° S
LHA = 333°
Sun's Declination = 22° N
Assumed Longitude = 087° 02.4' W

VOLUME 1 HO 229

$$\text{Dec. Inc.} = 41.8'$$
☐ L/D same name / ☒ L/D contrary name

Hc	d	Z	“GALAPAGOS”
	(altitude difference)		
52° 56.3'	– 40.0'	135.7°	

$$\text{H corr.} = -27.9' \quad \frac{d \times \text{Dec. Inc.}}{60} \quad \text{or Interpolation Table HO 229}$$

$$\mathbf{Hc\ final = Hc\ +/-\ H\ corr. = 52^{\circ}\ 56.3' - 27.9' = 52^{\circ}\ 28.4'}$$

$$Z = 135.7^\circ$$

Zn = 044.3°

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 = $H_o - H_c \text{ final} = 52^\circ 33.6' - 52^\circ 28.4' = + 5.2'$

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

Date 11 / 06 / 2022
 UT 08h 54m 01s
 $index\ error = +5'$
 $+ non\ adjust.\ error = +2' +$
 $\varepsilon = 7'$
 $L = 52^{\circ}08' N$
 $G = 003^{\circ}54' E$
 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 nautical almanac
 $D = 23^{\circ}05',4 N$
 $corr.\ d = 0',2 \uparrow$
 $D = 23^{\circ}05',6 N$

Assumed Latitude = $52^{\circ} N$ VOLUME 4 HO 229
 LHA = 317°
 Sun's Declination = $23^{\circ} N$ Dec.Inc. = $05.6'$
 Assumed Longitude = $003^{\circ} 24.5' E$
☒ L/D same name / ☐ L/D contrary name

Hc	d (altitude difference)	Z	"ROTTERDAM"
$46^{\circ} 15'$	$+ 47.5'$	114.8°	

H corr. = $+ 04.4'$ $\frac{d \times Dec.\ Inc.}{60}$ or Interpolation Table HO 229

Hc final = Hc +/- H corr. = $46^{\circ} 15' + 04.4' = 46^{\circ} 19.4'$

Z = 114.8°

Zn = 114.8°

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 final = $46^{\circ} 25.8' - 46^{\circ} 19.4' = + 6.4'$