

$$H_s = 20^\circ 19', 2$$

$$\varepsilon = 4', 2$$

$$\text{Dip} = \underline{\underline{- 2', 5}} +$$

$$H_a = 20^\circ 20', 9$$

$$+ \text{sun correct. LL/UL} = \underline{\underline{+ 13', 6}} +$$

$$H_o = 20^\circ 34', 5$$

La Rochelle

Date 26/01/2022

UT 10h 40m 19s

$$\text{index error} = + 3'$$

$$+ \text{non adjust. error} = \underline{\underline{+ 1', 2}} +$$

$$\varepsilon = + 4', 2$$

$$L = 46^\circ 12' \text{ N}$$

$$G = 004^\circ 31' \text{ W}$$

Height of the eye = 2 m

☒ lower limb ☐ upper limb

$$\text{GHA} = 326^\circ 52', 8$$

$$+ pp = \underline{\underline{10^\circ 04', 8}} \quad \text{increment)$$

$$\text{GHA} = 336^\circ 57', 6$$

$$G = \underline{\underline{004^\circ 31'}} \text{ W} \quad G = \text{East} \rightarrow \text{add}$$

$$\text{LHA} = 332^\circ 26', 6 \quad G = \text{West} \rightarrow \text{subtract}$$

$$LHA < 180^\circ ; \text{ sun in the west; } P = LHA$$

$$LHA > 180^\circ ; \text{ sun in the east; } P = 360 - LHA$$

$$P = 27^\circ 33', 4$$

$$(d \uparrow \text{ or } \downarrow = 0', 6 \downarrow)$$

$$D = 18^\circ 40', 1 \text{ S}$$

$$\text{corr. } d = \underline{\underline{0', 4}}$$

$$D = 18^\circ 39', 7 \text{ S}$$

$$H_c = \arcsin (\sin (L : 46^\circ 12') \times \sin (D : - 18^\circ 39', 7)$$

$$+ \cos (L : 46^\circ 12') \times \cos (D : - 18^\circ 39', 7)$$

$$\times \cos (P : 27^\circ 33', 4))$$

$$H_c = 20^\circ 30', 8$$

$$Z = \arccos ((\sin (D : - 18^\circ 39', 7) - \sin (L : 46^\circ 12')$$

$$\times \sin (H_c : 20^\circ 30', 8)) \div (\cos (L : 46^\circ 12')$$

$$\times \cos (H_c : 20^\circ 30', 8))) = 152^\circ, 1$$

$$\text{☒ sun in the east } Z_v = Z \text{ / } \text{☐ sun in the west } Z_v = 360 - Z$$

$$Z_v = 152^\circ, 1$$

$$H_o = 20^\circ 34', 5$$

$$H_c = \underline{\underline{20^\circ 30', 8}} -$$

$$\text{intercept} = 3', 7$$

+ Intercept towards the sun

— Intercept away from the sun

$$\begin{aligned} H_s &= 50^\circ 43',8 \\ \varepsilon &= -2',2 \\ \text{Dip} &= \underline{\quad -3',6 \quad} + \end{aligned}$$

$$\begin{aligned} H_a &= 50^\circ 38,0' \\ + \text{sun correct. LL/UL} &= \underline{\quad +15',4 \quad} + \\ H_o &= \mathbf{50^\circ 53',4} \end{aligned}$$

Madagascar

Date 05 / 02 / 2022

UT 11h 55m 29s

$$\begin{aligned} \text{index error} &= -4' \\ + \text{non adjust. error} &= \underline{+1',8} + \\ \varepsilon &= -2',2 \end{aligned}$$

$L = 30^\circ 24' \text{ S}$

$G = 044^\circ 13' \text{ E}$

Height of the eye = 4 m

☒ lower limb ☐ upper limb

$$\begin{aligned} \text{GHA} &= 341^\circ 30',6 \\ + pp &= \underline{13^\circ 52',3} \quad \text{increment)} \end{aligned}$$

$$\begin{aligned} \text{GHA} &= 355^\circ 22',9 \quad G = \text{West} \rightarrow \text{subtract} \\ G &= \underline{044^\circ 13' \text{ E}} \quad G = \text{East} \rightarrow \text{add} \end{aligned}$$

$$\begin{aligned} \text{LHA} &= \\ 039^\circ 35',9 \end{aligned}$$

$LHA < 180^\circ$; sun in the west; $P = LHA$

$LHA > 180^\circ$; sun in the east; $P = 360 - LHA$

$$\mathbf{P = 039^\circ 35',9}$$

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

$$\begin{aligned} D &= 15^\circ 51',4 \text{ S} \\ \text{corr. } d &= \underline{0',7} \\ \mathbf{D} &= \mathbf{15^\circ 50',7 \text{ S}} \end{aligned}$$

$$H_c = \arcsin (\sin (L : -30^\circ 24') \times \sin (D : -15^\circ 50',7)$$

$$+ \cos (L : -30^\circ 24') \times \cos (D : -15^\circ 50',7)$$

$$\times \cos (P : 039^\circ 35',9))$$

$$\mathbf{H_c = 51^\circ 02'}$$

$$Z = \arccos ((\sin (D : -15^\circ 50',7) - \sin (L : -30^\circ 24')$$

$$\times \sin (H_c : 51^\circ 02')) \div (\cos (L : -30^\circ 24')$$

$$\times \cos (H_c : 51^\circ 02'))) = \mathbf{77^\circ,2}$$

$$\square \text{ sun in the east } Z_v = Z \quad / \quad \boxtimes \text{ sun in the west } Z_v = 360 - Z \quad \mathbf{Z_v = 282^\circ,8}$$

$$\begin{aligned} H_o &= 50^\circ 53',4 \\ - H_c &= \underline{51^\circ 02'} \\ \text{intercept} &= \mathbf{-8',6} \end{aligned}$$

+ Intercept towards the sun

— Intercept away from the sun

$$H_s = 36^\circ 54',1$$

$$\varepsilon = 2',7$$

$$\text{Dip} = \underline{\quad - 2',5 \quad} +$$

$$H_a = 36^\circ 54',3$$

$$+ \text{sun correct. LL/UL} = \underline{\quad - 14',7 \quad} +$$

$$H_o = 37^\circ 09',0$$

Perth

Date 16/08/2022

UT 07h 14m 35s

$$\text{index error} = +1'$$

$$+ \text{non adjust. error} = \underline{+ 1',7} +$$

$$\varepsilon = 2',7$$

$L = 27^\circ 25' \text{ S}$

$G = 106^\circ 39' \text{ E}$

Height of the eye = 2 m

☒ lower limb ☐ upper limb

$$\text{GHA} = 283^\circ 54',8$$

$$+ pp = \underline{3^\circ 38',8} \quad \text{increment)$$

$$\text{GHA} = 287^\circ 33',6 \quad G = \text{West} \rightarrow \text{subtract}$$

$$G = \underline{106^\circ 39' \text{ E}} \quad G = \text{East} \rightarrow \text{add}$$

$$\text{LHA} = 034^\circ 12',6$$

$$LHA < 180^\circ ; \text{ sun in the West; } P = LHA$$

$$LHA > 180^\circ ; \text{ sun in the East; } P = 360 - LHA$$

$$P = 034^\circ 12',6$$

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

$$D = 13^\circ 42',9 \text{ N}$$

$$\text{corr. } d = \underline{0',2 \downarrow}$$

$$D = 13^\circ 42',7 \text{ N}$$

$$H_c = \arcsin (\sin (L : - 27^\circ 25') \times \sin (D : 13^\circ 42',7)$$

$$+ \cos (L : - 27^\circ 25') \times \cos (D : 13^\circ 42',7)$$

$$\times \cos (P : 034^\circ 12',6))$$

$$H_c = 37^\circ 09',5$$

$$Z = \arccos ((\sin (D : 13^\circ 42',7) - \sin (L : - 27^\circ 25')$$

$$\times \sin (H_c : 37^\circ 09',5)) \div (\cos (L : - 27^\circ 25')$$

$$\times \cos (H_c : 37^\circ 09',5))) = 43^\circ,3$$

$$\square \text{ sun in the east } Z_v = Z \quad / \quad \boxtimes \text{ sun in the west } Z_v = 360 - Z \quad Z_v = 316^\circ,7$$

$$H_o = 37^\circ 09'$$

$$- H_c = \underline{37^\circ 09',5}$$

$$\text{intercept} = - 0',5$$

+ Intercept towards the sun
 — Intercept away from the sun

$$H_s = 27^\circ 31',6$$

$$\varepsilon = -1',5$$

$$\text{Dip} = \underline{\quad - 3',6 \quad} +$$

$$H_a = 27^\circ 26',5$$

$$+ \text{sun correct. LL/UL} = \underline{\quad - 14',5 \quad} +$$

$$\mathbf{H_o = 27^\circ 41',0}$$

San Francisco

Date 06 / 01 / 2022

UT 18h 34m 54s

$$\text{index error} = - 3'$$

$$+ \text{non adjust.error} = \underline{+ 1',5} +$$

$$\varepsilon = - 1',5$$

$L = 34^\circ 40' \text{ N}$

$G = 123^\circ 15' \text{ W}$

Height of the eye = 4 m

☒ lower limb ☐ upper limb

$$\text{GHA} = 088^\circ 31'$$

$$+ pp = \underline{8^\circ 43',5} \quad \text{increment)$$

$$\text{GHA} = 097^\circ 14',5 \quad G = \text{West} \rightarrow \text{subtract}$$

$$G = \underline{123^\circ 15' \text{ W}} \quad G = \text{East} \rightarrow \text{add}$$

$$\text{LHA} = 333^\circ 59',5$$

$$LHA < 180^\circ ; \text{ sun in the West; } P = LHA$$

$$LHA > 180^\circ ; \text{ sun in the East; } P = 360 - LHA$$

$$\mathbf{P = 026^\circ 00',5}$$

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

$$D = 22^\circ 25',9 \text{ S}$$

$$\text{corr. } d = \underline{\quad 0',2 \downarrow \quad}$$

$$\mathbf{D = 22^\circ 25',7 \text{ S}}$$

$$H_c = \arcsin (\sin (L : 34^\circ 40') \times \sin (D : - 22^\circ 25',7)$$

$$+ \cos (L : 34^\circ 40') \times \cos (D : - 22^\circ 25',7)$$

$$\times \cos (P : 026^\circ 00',5))$$

$$\mathbf{H_c = 27^\circ 47',5}$$

$$Z = \arccos ((\sin (D : - 22^\circ 25',7) - \sin (L : 34^\circ 40')$$

$$\times \sin (H_c : 27^\circ 47',5)) \div (\cos (L : 34^\circ 40')$$

$$\times \cos (H_c : 27^\circ 47',5))) = \mathbf{152^\circ,7}$$

$$\square \text{ sun in the east } Z_v = Z \text{ / } \square \text{ sun in the west } Z_v = 360 - Z \quad \mathbf{Z_v = 152^\circ,7}$$

$$H_o = 27^\circ 41'$$

$$- H_c = \underline{27^\circ 47',5}$$

$$\text{intercept} = \mathbf{- 6',5}$$

+ Intercept towards the sun
 — Intercept away from the sun

$$H_s = 52^\circ 18'$$

$$\varepsilon = 2',8$$

$$\text{Dip} = \underline{-2',5} +$$

$$H_a = 52^\circ 18',3$$

$$+ \text{sun correct. LL/UL} = \underline{15',3} +$$

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

Galapagos

Date 06 / 06 / 2022

UT 15h 58m 54s

$$\text{index error} = +1'$$

$$+ \text{non adjust. error} = \underline{+1',8} +$$

$$\varepsilon = 2',8$$

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

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

Height of the eye = 2 m

☒ lower limb ☐ upper limb

$$\text{GHA} = 045^\circ 18',9$$

$$+ pp = \underline{14^\circ 43',5} \quad (\text{increment})$$

$$\text{GHA} = 060^\circ 02',4 \quad G = \text{West} \rightarrow \text{subtract}$$

$$G = \underline{086^\circ 54' \text{ W}} \quad G = \text{East} \rightarrow \text{add}$$

$$\text{LHA} = 333^\circ 08',4$$

$LHA < 180^\circ$; sun in the West; $P = LHA$

$LHA > 180^\circ$; sun in the East; $P = 360 - LHA$

$$P = 026^\circ 51',6$$

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

$$D = 22^\circ 41',5 \text{ N}$$

$$\text{corr. } d = \underline{0',3} \uparrow$$

$$D = 22^\circ 41',8 \text{ N}$$

$$H_c = \arcsin (\sin (L : -03^\circ 58') \times \sin (D : 22^\circ 41',8)$$

$$+ \cos (L : -03^\circ 58') \times \cos (D : 22^\circ 41',8)$$

$$\times \cos (P : 026^\circ 51',6))$$

$$H_c = 52^\circ 35',7$$

$$Z = \arccos ((\sin (D : 22^\circ 41',8) - \sin (L : -03^\circ 58')$$

$$\times \sin (H_c : 52^\circ 35',7)) \div (\cos (L : -03^\circ 58')$$

$$\times \cos (H_c : 52^\circ 35',7))) = 43^\circ,3$$

☒ sun in the east $Z_v = Z$ / ☐ sun in the west $Z_v = 360 - Z$

$$Z_v = 43^\circ,3$$

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

$$- H_c = \underline{52^\circ 35',7}$$

$$\text{intercept} = -2',1$$

+ Intercept towards the sun

— Intercept away from the sun

$$H_s = 42^\circ 11',5$$

$$\varepsilon = 3',9$$

$$\text{Dip} = \underline{\quad - 3',6 \quad} +$$

$$H_a = 42^\circ 11',8$$

$$+ \text{sun correct. LL/UL} = \underline{\quad - 15',1 \quad} +$$

$$H_o = 42^\circ 26',9$$

Tokyo

Date 06 / 03 / 2022

UT 20h 16m 54s

$$\text{index error} = + 2'$$

$$+ \text{non adjust. error} = \underline{+ 1',9} +$$

$$\varepsilon = 3',9$$

$$L = 33^\circ 21' \text{ N}$$

$$G = 150^\circ 18' \text{ W}$$

Height of the eye = 4 m

☒ lower limb ☐ upper limb

$$\text{GHA} = 117^\circ 12',5$$

$$+ pp = \underline{4^\circ 13',5} \quad \text{increment)$$

$$\text{GHA} = 121^\circ 26',0 \quad G = \text{West} \rightarrow \text{subtract}$$

$$G = \underline{150^\circ 18' \text{ W}} \quad G = \text{East} \rightarrow \text{add}$$

$$\text{LHA} = 331^\circ 08',0$$

$$LHA < 180^\circ ; \text{ sun in the West; } P = LHA$$

$$LHA > 180^\circ ; \text{ sun in the East; } P = 360 - LHA$$

$$P = 028^\circ 52',0$$

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

$$D = 05^\circ 26',1 \text{ S}$$

$$\text{corr. } d = \underline{\quad - 0',3 \quad} \downarrow$$

$$D = 05^\circ 25',8 \text{ S}$$

$$H_c = \arcsin (\sin (L : 33^\circ 21') \times \sin (D : - 05^\circ 25',8)$$

$$+ \cos (L : 33^\circ 21') \times \cos (D : - 05^\circ 25',8)$$

$$\times \cos (P : 028^\circ 52',0))$$

$$H_c = 42^\circ 33'$$

$$Z = \arccos ((\sin (D : - 05^\circ 25',8) - \sin (L : 33^\circ 21')$$

$$\times \sin (H_c : 42^\circ 33')) \div (\cos (L : 33^\circ 21')$$

$$\times \cos (H_c : 42^\circ 33'))) = 139^\circ,3$$

$$\square \text{ sun in the east } Z_v = Z \text{ / } \square \text{ sun in the west } Z_v = 360 - Z \quad Z_v = 139^\circ,3$$

$$H_o = 42^\circ 26',9$$

$$- H_c = \underline{42^\circ 33'}$$

$$\text{intercept} = - 6',1$$

+ Intercept towards the sun

— Intercept away from the sun

$$H_s = 56^{\circ}17',5$$

$$\varepsilon = -0',4$$

$$\text{Dip} = -2',5 +$$

$$H_a = 56^{\circ}14',6$$

$$\underline{\text{sun correct. LL/UL}} = 15',3 +$$

$$H_o = 56^{\circ}29',9$$

Pointe -à- Pitre

Date 26 / 09 / 2022

UT 13h 54m 01s

$$\text{index error} = -2'$$

$$+ \text{ non adjust.error} = \underline{+1',6} +$$

$$\varepsilon = -0',4$$

$$L = 16^{\circ}34' \text{ N}$$

$$G = 059^{\circ}25' \text{ W}$$

Height of the eye = 2 m

☒ lower limb ☐ upper limb

$$\text{GHA} = 017^{\circ}10',2$$

$$+ pp = \underline{13^{\circ}30',3} \quad \text{increment)$$

$$\text{GHA} = 030^{\circ}40',5$$

G = West → subtract

$$G = \underline{059^{\circ}25',0} \text{ W}$$

G = East → add

$$\text{LHA} = 331^{\circ}15',5$$

$LHA < 180^{\circ}$; sun in the West; $P = LHA$

$LHA > 180^{\circ}$; sun in the East; $P = 360 - LHA$

$$P = 028^{\circ}44',5$$

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

$$D = 01^{\circ}21',8 \text{ S}$$

$$\text{corr. } d = \underline{0',9} \uparrow$$

$$D = 01^{\circ}22',7 \text{ S}$$

$$H_c = \arcsin (\sin (L : 16^{\circ}34') \times \sin (D : -01^{\circ}22',7)$$

$$+ \cos (L : 16^{\circ}34') \times \cos (D : -01^{\circ}22',7)$$

$$\times \cos (P : 028^{\circ}44',5))$$

$$H_c = 56^{\circ}26',3$$

$$Z = \arccos ((\sin (D : -01^{\circ}22',7) - \sin (L : 16^{\circ}34')$$

$$\times \sin (H_c : 56^{\circ}26',3)) \div (\cos (L : 16^{\circ}34')$$

$$\times \cos (H_c : 56^{\circ}26',3))) = 119^{\circ},6$$

☒ sun in the east $Z_v = Z$ / ☐ sun in the west $Z_v = 360 - Z$

$$Z_v = 119^{\circ},6$$

$$H_o = 56^{\circ}29',9$$

$$- H_c = \underline{56^{\circ}26',3}$$

$$\text{intercept} = + 3',3$$

+ Intercept towards the sun

— Intercept away from the sun

$$H_s = 46^{\circ}07',3$$

$$\varepsilon = 7'$$

$$\text{Dip} = \underline{\quad - 3',6 \quad} +$$

$$H_a = 46^{\circ}10',7$$

$$+ \text{sun correct. LL/UL} = \underline{\quad 15',1 \quad} +$$

$$H_o = 46^{\circ}25',8$$

Rotterdam

Date 11 / 06 / 2022

UT 08h 54m 01s

$$\text{index error} = + 5'$$

$$+ \text{non adjust. error} = \underline{+ 2'} +$$

$$\varepsilon = 7'$$

$$L = 52^{\circ}08' \text{ N}$$

$$G = 003^{\circ}54' \text{ E}$$

Height of the eye = 4 m

☒ lower limb ☐ upper limb

$$\text{GHA} = 300^{\circ}05',2$$

$$+ pp = \underline{13^{\circ}30',3} \quad \text{increment)$$

$$\text{GHA} = 313^{\circ}35',5$$

G = West → subtract

$$G = \underline{003^{\circ}54',0 \text{ E}}$$

G = East → add

$$\text{LHA} = 317^{\circ}29',5$$

$LHA < 180^{\circ}$; sun in the West; $P = LHA$

$LHA > 180^{\circ}$; sun in the East; $P = 360 - LHA$

$$P = 042^{\circ}30',5$$

$$(d \uparrow \text{ or } \downarrow = 0',2 \uparrow)$$

$$D = 23^{\circ}05',4 \text{ N}$$

$$\text{corr. } d = \underline{0',2 \uparrow}$$

$$D = 23^{\circ}05',6 \text{ N}$$

$$H_c = \arcsin (\sin (L : 52^{\circ}08') \times \sin (D : 23^{\circ}05',6)$$

$$+ \cos (L : 52^{\circ}08') \times \cos (D : 23^{\circ}05',6)$$

$$\times \cos (P : 042^{\circ}30',5))$$

$$H_c = 46^{\circ}32',5$$

$$Z = \arccos ((\sin (D : 23^{\circ}05',6) - \sin (L : 52^{\circ}08')$$

$$\times \sin (H_c : 46^{\circ}32',5)) \div (\cos (L : 52^{\circ}08')$$

$$\times \cos (H_c : 46^{\circ}32',5))) = 115^{\circ},4$$

☒ sun in the east $Z_v = Z$ / ☐ sun in the west $Z_v = 360 - Z$

$$Z_v = 115^{\circ},4$$

$$H_o = 46^{\circ}25',8$$

$$- H_c = \underline{46^{\circ}32',5}$$

$$\text{intercept} = - 6',7$$

+ Intercept towards the sun

— Intercept away from the sun