

Pub. No. 249 star sight reduction form					
Sight #	1	2			
Star	Alpheratz	Kochab			
DR. Latitude	N 40°	N 40°			
DR. Longitude	W 075°	W 075°			
Date	9/22/2016	9/21/2016			
UT	01:20:15	01:25:37			
Hs	84° 43'	80° 25'			
Index Error	+ 0° 01' (On)	+ 0° 01' (On)			
Hs – Index Error	84° 42'				
Dip	Using AH				
(AH / 2) = Ha	42° 21'				
ACT	-0° 1.1'				
Ho	42° 19.9'				
GHA γ	16° 19.6'				
GHA γ increment for minutes & seconds	5° 04.6'				
GHA γ	21° 24.2'				
AP λ	W 075° 24.2'				
LHA γ	306°				
Hc	43° 12'				
Zn	085°				
Intercept	0° 52' Away				

Star sight reduction

Ho 249 Vol. 1

Sight, Star, DR. Latitude, DR. Longitude

Form label	What is it?	Where to get it?	Figure
Sight #	Sight number	It's the sequential number of the sight you're taking. It's an orderly way of keeping track of the sights you make.	1
Star	The name of the star you're shooting	USNO Navigational Star Chart Alpheratz is located in the constellation Andromeda	Alpheratz
DR. Latitude	Dead Reckoning Latitude	DR. Latitude means <i>Ded Reckoning Latitude</i> and uses the integral degree of Latitude. It's the Latitude <i>you think you're closest to</i> based on your DR Log. Example- N 40° Note- DR Latitude is also, and often, referred to as Ap Latitude- <i>Assumed position Latitude</i> and is typically derived from your DR Log.	N 40°
DR. Longitude	Dead Reckoning Longitude	DR. Longitude means <i>Ded Reckoning Longitude</i> and is the integral degree of Longitude <i>you think you're closest to</i> based on your DR Log. Example- W 075° Note- DR Longitude is also, and often, referred to as Ap Longitude- <i>Assumed position Longitude</i> and is typically derived from your DR Log.	W 075°

"ded" Reckoning stands for "deduced reckoning" but is usually written *dead reckoning*

Date & Time

Form label	What is it?	Where to get it?	Figure
Date	The date based on Greenwich Time.	See Time below	September 22, 2016
Time	GMT Greenwich Mean Time also known as UT It's based on a 24 hour number.	The time based on Greenwich/Universal Time. Get the time in GMT/UT here- http://time.is/UTC Call NIST- 303-499-7111 Shortwave radio- WWV & WWVH 2.5, 5, 10, 15, 20 mHz. To figure GMT add or subtract the time difference between your time zone and Greenwich England. For the Eastern US during DST (Daylight Saving Time) add 4 hours to local time. During DST the new day begins at 8 PM local time. For the Eastern US during EST (Eastern Standard Time) add 5 hours to local time. During EST the new day begins at 7 PM local time.	01:20:15

Hs, IE, Dip, AH/2, ACT, Ho

Form label	What is it?	Where to get it?	Figure
Hs	Height of sextant	Height of sextant- the initial, uncorrected, sextant angle reading of the star you observed. The sextant measurement is from the sea horizon or an Artificial Horizon (AH) to the celestial body (star, Sun, planet, moon) in the sky.	84° 43'
Index Error	The amount of misalignment between the Index mirror and the Horizon mirror.	<p>Set the sextant to 0° 00.0° and look at a bright star. If you see only one star, or if they are side by side, there is no Index Error.</p> <p>If you see two of the same star one over top of the other there is Index Error (IE). To find the Index Error in this case turn the micrometer drum until both images of the star appear superimposed or side by side. Read the the amount of IE.</p> <p>If the IE is greater than 0° then the IE is <i>on the arc</i> and must be subtracted from the Hs.</p> <p>If the IE is less than 0° then the IE is <i>off the arc</i> and must be added to the Hs.</p> <p>In our example the IE is <i>on the arc</i> so it must be subtracted from the Hs.</p>	0° 01'
Hs- Index Error	Height of sextant minus the Index Error.	Subtract the Index Error from the Height of sextant.	(Hs) 84° 43' - 0° 01' 84° 42'
Dip	Dip is the amount of angle to subtract from the Hs when making an observation using the ocean's horizon. The amount to subtract is determined by the Height of your Eye above the water.	<p>Dip correction can be found on ALTITUDE CORRECTION TABLES 10° -90° —SUN, STARS, PLANETS on the right hand column of that table.</p> <p>In this example we're "on the hard" (on land) and using an Artificial Horizon (AH). There's no Dip correction required when using an Artificial Horizon (AH).</p> <p>ALTITUDE CORRECTION TABLES are attached at the end herein.</p>	When using an AH there is no need to correct for Dip.
(AH / 2)= Ha	Hs minus Index Error divided by 2 = Ha Ha means Height apparent.	Get the final figure from Hs minus Index Error (above) and divide it by 2. The result is the Ha or Height apparent.	84° 42' divided by 2 Ha= 42° 21'
ACT	Altitude Correction Table	<p>ALTITUDE CORRECTION TABLES are attached at the end herein.</p> <p>Use the ALTITUDE CORRECTION TABLES 10° -90° —SUN,STARS,PLANETS. For brevity these tables are referred to as ACT. Find the Ha correction for the star in the STARS AND PLANETS column. Find where the Ha of 42° 21' would approximately be located- between 40° 08' and 42° 44'.</p> <p>For stars the correction is always subtracted from the Ha figure.</p>	-0° 1.1'
Ho	Height observed	Subtract the star ACT (0° 1.1') from the Ha to arrive at the Ho (Height observed). After all of the above corrections Ho=42° 19.9' (round it up to 42° 20').	(Ha) 42° 21' (Act)-0° 1.1' Ho= 42° 20'

Getting GHA Aries

Form label	What is it?	Where to get it?	Figure
GHA γ	Greenwich Hour Angle Aries based on the integral hour and date of the sextant observation.	<p>The necessary portion of The Nautical Almanac is provided at the end of this file.</p> <p>You'll find the GHA γ in The Nautical Almanac daily pages for the date and time of the observation. The GHA γ figure is based only on the integral hour of the observation.</p> <p>Get The Nautical Almanac <i>daily pages</i> at TheNauticalAlmanac.com</p>	16° 19.6'
GHA γ increment for minutes & seconds	Greenwich Hour Angle Aries increment for the minutes and seconds of time of the sextant observation.	<p>The Nautical Almanac- <i>Increments & Corrections for Sun, Planets, Aries, Moon (the "yellow pages")</i> for the minutes and seconds of time of the observation. You can get the Increments & Corrections Table here- https://thenauticalalmanac.com/Increments & Corrections Table.pdf</p> <p>You can also use the GHA γ Increment from TABLE 4 -- GHA γ FOR THE YEARS 2011 – 2019 (the second page of TABLE 4)</p> <p>The second page of TABLE 4 is provided at the end of this file.</p>	5° 04.6'
GHA γ	Greenwich Hour Angle Aries total	Add the GHA γ integral hour figure to the GHA γ Increment figure. Round the final figure up or down.	$\begin{array}{r} 16^\circ 19.6' \\ + 5^\circ 04.6' \\ \hline 21^\circ 24.2' \end{array}$

Calculating LHA Aries

Form label	What is it?	Where to get it?	Figure
Ap λ	Assumed position Longitude	Combine the DR. Longitude figure with only the minutes (of arc) of the total GHA γ figure. The Ap λ figure will be used when plotting the LOP on the UPS.	DR Longitude W 075° Ap λ W075° 24.2'
LHA γ	Local Hour Angle Aries total	<p>To get the LHA γ subtract or add the Ap λ from/to the GHA γ total according to the following rules-</p> <p>In Western longitudes Subtract Ap λ from the GHA total. Ignore the minutes of GHA. In Western Longitudes if GHA is <i>less than</i> the Ap λ first add 360 to the GHA and then subtract the Ap λ from it.</p> <p>In Eastern longitudes Round up the GHA γ to next highest degree and add the DR. longitude integral degree to it. If the resulting figure is over 360 then subtract 360 from it.</p>	$\begin{array}{r} \text{GHA } \gamma \quad 21^\circ 24.2' \\ + 360^\circ \\ \hline 381^\circ 24.2' \\ \hline \\ - \text{Ap } \lambda \text{ W } 075^\circ 24.2' \\ \hline \text{LHA } \gamma = 306^\circ \end{array}$

$$\text{LHA } \gamma = 306^\circ$$

The LHA figure and DR. Latitude figure are both needed to find Hc and Zn in Pub. No. 249 Vol. 1

Finding Hc and Zn

Form label	What is it?	Where to get it?	Figure
Hc	Height computed	<p>The necessary portion of Pub. No. 249 Vol. 1 is provided at the end of this file.</p> <p>Hc is found in Pub. No. 249 Vol 1.</p> <p>To find Hc you need the DR. Latitude (N 40°) and the LHA γ (306°).</p> <p>Locate the LHA γ row of 306° on the sheet and move across until you see where the star, Alpheratz, intersects that row. Find Hc in the Hc column under Alpheratz</p>	Hc= 43° 12'
Zn	Azimuth number or Azimuth angle	<p>The necessary portion of Pub. No. 249 Vol. 1 is provided at the end of this file.</p> <p>Zn is the horizontal angle in degrees that points to the star from the Ap. λ.</p> <p>Approximately, and close enough for us, Zn is the horizontal angle that points to the star from where we took the sextant observation.</p> <p>Zn is based on True North and not magnetic North.</p> <p>Locate the LHA γ row of 306° on the sheet and move across until you see where the star, Alpheratz, intersects that row. Find Zn in the Zn column under Alpheratz</p>	Zn= 085°
Intercept	Intercept is the distance and direction the LOP (Line Of Position) is drawn from the Ap. λ	<p>The intercept is a mark on the azimuth line on the UPS. The length of the intercept is calculated by comparing Hc to Ho and subtracting the smaller of the two figures from the larger. Once the intercept is calculated and marked on the azimuth line, a 90° line will be drawn through the intercept. This will be the LOP.</p> <p>The direction of the intercept line must be determined and is drawn either <i>Away</i> or <i>Towards</i> the star on the azimuth line from the Ap λ of W 075° 24.2'.</p> <p>If Hc is greater than the Intercept point is <i>Away</i> from the Ap λ. If Ho is greater than the Intercept point is <i>Towards</i> the star beginning at the Ap λ.</p> <p>The UPS LOP plot is at the end of this file.</p>	Hc= 43° 12' Ho= 42° 20' Intercept= 0° 52'

Portrait 249- Further explanation.odt

/home/kd/MD/AAAA- CelNav C/Further Explanation/Ho 249/Portrait 249- Further explanation.odt

ALTITUDE CORRECTION TABLES 10°-90°—SUN, STARS, PLANETS

OCT.—MAR. SUN APR.—SEPT.				STARS AND PLANETS				DIP							
App.	Lower	Upper	Alt.	App.	Lower	Upper	Alt.	App.	Corr ⁿ	Additional	Ht. of	Corr ⁿ	Ht. of	Corr ⁿ	
	Limb	Limb			Limb	Limb					Eye		Eye		Eye
°	'	'	'	°	'	'	'	°	'	'	m	'	ft.	m	'
9 34	+10·8	-21·5		9 39	+10·6	-21·2		9 56			2·4	-2·8	8·0	1·0	-1·8
9 45	+10·9	-21·4		9 51	+10·7	-21·1		10 08	-5·3		2·6	-2·9	8·6	1·5	-2·2
9 56	+11·0	-21·3		10 03	+10·8	-21·0		10 20	-5·2	Jan. 1–Feb. 20	2·8	-3·0	9·2	2·0	-2·5
10 08	+11·1	-21·2		10 15	+10·9	-20·9		10 33	-5·1	°	3·0	-3·1	9·8	2·5	-2·8
10 21	+11·2	-21·1		10 27	+11·0	-20·8		10 46	-4·9	0 +0·2	3·2	-3·2	10·5	3·0	-3·0
10 34	+11·3	-21·0		10 40	+11·1	-20·7		11 00	-4·8	41 +0·1	3·4	-3·3	11·2	See table ←	
10 47	+11·4	-20·9		10 54	+11·2	-20·6		11 14	-4·7	Feb. 21–Dec. 31	3·6	-3·4	11·9		
11 01	+11·5	-20·8		11 08	+11·3	-20·5		11 29	-4·6	°	3·8	-3·5	12·6		
11 15	+11·6	-20·7		11 23	+11·4	-20·4		11 45	-4·5	0 +0·1	4·0	-3·6	13·3	m	'
11 30	+11·7	-20·6		11 38	+11·5	-20·3		12 01	-4·5	60	4·3	-3·7	14·1	20	-7·9
11 46	+11·8	-20·5		11 54	+11·6	-20·2		12 18	-4·4		4·5	-3·8	14·9	22	-8·3
12 02	+11·9	-20·4		12 10	+11·7	-20·1		12 35	-4·3	Jan. 1–May 2	4·7	-3·9	15·7	24	-8·6
12 19	+12·0	-20·3		12 28	+11·8	-20·0		12 54	-4·2	Dec. 17–Dec. 31	5·0	-4·0	16·5	26	-9·0
12 37	+12·1	-20·2		12 46	+11·9	-19·9		13 13	-4·0	°	5·2	-4·1	17·4	28	-9·3
12 55	+12·2	-20·1		13 05	+12·0	-19·8		13 33	-3·9	0 +0·1	5·5	-4·2	18·3		
13 14	+12·3	-20·0		13 24	+12·1	-19·7		13 54	-3·8	60	5·8	-4·3	19·1	30	-9·6
13 35	+12·4	-19·9		13 45	+12·2	-19·6		14 16	-3·7	May 3–June 26	6·1	-4·3	20·1	32	-10·0
13 56	+12·5	-19·8		14 07	+12·3	-19·5		14 40	-3·6	Oct. 26–Dec. 16	6·3	-4·4	21·0	34	-10·3
14 18	+12·6	-19·7		14 30	+12·4	-19·4		15 04	-3·5	°	6·6	-4·5	22·0	36	-10·6
14 42	+12·7	-19·6		14 54	+12·5	-19·3		15 30	-3·4	0 +0·2	6·9	-4·6	22·9	38	-10·8
15 06	+12·8	-19·5		15 19	+12·6	-19·2		15 57	-3·3	41 +0·1	7·2	-4·7	23·9		
15 32	+12·9	-19·4		15 46	+12·7	-19·1		16 26	-3·3	76	7·5	-4·8	24·9	40	-11·1
15 59	+13·0	-19·3		16 14	+12·8	-19·0		16 56	-3·2	June 27–Aug. 1	7·9	-4·9	26·0	42	-11·4
16 28	+13·1	-19·2		16 44	+12·9	-18·9		17 28	-3·1	Sept. 23–Oct. 25	8·2	-5·0	27·1	44	-11·7
16 59	+13·2	-19·1		17 15	+13·0	-18·8		18 02	-3·0	°	8·5	-5·1	28·1	46	-11·9
17 32	+13·3	-19·0		17 48	+13·1	-18·7		18 38	-2·9	34 +0·3	8·8	-5·2	29·2	48	-12·2
18 06	+13·4	-18·9		18 24	+13·2	-18·6		19 17	-2·8	60 +0·1	9·2	-5·3	30·4	ft. 2 — 1·4	
18 42	+13·5	-18·8		19 01	+13·3	-18·5		19 58	-2·6	80	9·5	-5·4	31·5	4	-1·9
19 21	+13·6	-18·7		19 42	+13·4	-18·4		20 42	-2·5	Aug. 2–Sept. 22	9·9	-5·5	32·7	6	-2·4
20 03	+13·7	-18·6		20 25	+13·5	-18·3		21 28	-2·4	°	10·3	-5·7	33·9	8	-2·7
20 48	+13·8	-18·5		21 11	+13·6	-18·2		22 19	-2·3	0 +0·4	10·6	-5·8	35·1	10	-3·1
21 35	+13·9	-18·4		22 00	+13·7	-18·1		23 13	-2·2	51 +0·3	11·0	-5·9	36·3		
22 26	+14·0	-18·3		22 54	+13·8	-18·0		24 11	-2·1	68 +0·1	11·4	-6·0	37·6	See table ←	
23 22	+14·1	-18·2		23 51	+13·9	-17·9		25 14	-2·0	83	11·8	-6·1	38·9		
24 21	+14·2	-18·1		24 53	+14·0	-17·8		26 22	-1·9		12·2	-6·2	40·1	ft.	,
25 26	+14·3	-18·0		26 00	+14·1	-17·7		27 36	-1·8		12·6	-6·3	41·5	70	-8·1
26 36	+14·4	-17·9		27 13	+14·2	-17·6		28 56	-1·7		13·0	-6·4	42·8	75	-8·4
27 52	+14·5	-17·8		28 33	+14·3	-17·5		30 24	-1·6		13·4	-6·5	44·2	80	-8·7
29 15	+14·6	-17·7		30 00	+14·4	-17·4		32 00	-1·5		13·8	-6·6	45·5	85	-8·9
30 46	+14·7	-17·6		31 35	+14·5	-17·3		33 45	-1·4		14·2	-6·7	46·9	90	-9·2
32 26	+14·8	-17·5		33 20	+14·6	-17·2		35 40	-1·3		14·7	-6·8	48·4	95	-9·5
34 17	+14·9	-17·4		35 17	+14·7	-17·1		37 48	-1·2		15·1	-6·9	49·8		
36 20	+15·0	-17·3		37 26	+14·7	-17·1		40 08	-1·1		15·5	-7·0	51·3	100	-9·7
38 36	+15·1	-17·2		39 50	+14·8	-17·0		42 44	-1·0		16·0	-7·1	52·8	105	-9·9
41 08	+15·2	-17·1		42 31	+14·9	-16·9		45 36	-0·9		16·5	-7·2	54·3	110	-10·2
43 59	+15·3	-17·0		45 31	+15·0	-16·8		48 47	-0·8		16·9	-7·3	55·8	115	-10·4
47 10	+15·4	-16·9		48 55	+15·1	-16·7		52 18	-0·7		17·4	-7·4	57·4	120	-10·6
50 46	+15·5	-16·8		52 44	+15·2	-16·6		56 11	-0·6		17·9	-7·5	58·9	125	-10·8
54 49	+15·6	-16·7		57 02	+15·3	-16·5		60 28	-0·5		18·4	-7·6	60·5		
59 23	+15·7	-16·6		61 51	+15·5	-16·3		65 08	-0·4		18·8	-7·7	62·1	130	-11·1
64 30	+15·8	-16·5		67 17	+15·6	-16·2		70 11	-0·3		19·3	-7·8	63·8	135	-11·3
70 12	+15·9	-16·4		73 16	+15·7	-16·1		75 34	-0·2		19·8	-7·9	65·4	140	-11·5
76 26	+16·0	-16·3		79 43	+15·8	-16·0		81 13	-0·1		20·4	-8·0	67·1	145	-11·7
83 05	+16·1	-16·2		86 32	+15·9	-15·9		87 03	0·0		20·9	-8·1	68·8	150	-11·9
90 00				90 00				90 00			21·4		70·5	155	-12·1

App. Alt. = Apparent altitude = Sextant altitude corrected for index error and dip.

September 21, 22 ,23 (Wed., Thu., Fri.)

Aries									Venus									Mars									Jupiter									Saturn									Stars								
Wed	GHA	GHA	Dec	GHA	Dec	GHA	Dec	GHA	Dec	GHA	Dec	GHA	Dec	GHA	Dec	GHA	Dec	GHA	Dec	SHA	Dec																																
0	0°18.0	155°19.9	-10°05.0	94°50.0	-25°54.0	177°35.7	0°01.1	110°41.9	-20°37.5	Alpheratz	357°40.8	29°11.1																																									
1	15°20.5	170°19.5	-10°06.2	109°50.7	-25°54.0	192°37.7	0°00.9	125°44.2	-20°37.6	Ankaa	353°13.2	-42°12.8																																									
2	30°23.0	185°19.1	-10°07.4	124°51.4	-25°54.0	207°39.7	0°00.6	140°46.5	-20°37.6	Schedar	349°37.3	56°37.7																																									
3	45°25.4	200°18.7	-10°08.6	139°52.1	-25°54.0	222°41.6	0°00.4	155°48.8	-20°37.6	Diphda	348°53.3	-17°53.6																																									
4	60°27.9	215°18.4	-10°09.8	154°52.8	-25°54.1	237°43.6	0°00.2	170°51.1	-20°37.6	Achernar	335°24.7	-57°09.0																																									
5	75°30.3	230°18.0	-10°11.0	169°53.5	-25°54.1	252°45.6	-0°00.0	185°53.4	-20°37.7	Hamal	327°58.0	23°32.4																																									
6	90°32.8	245°17.6	-10°12.2	184°54.2	-25°54.1	267°47.6	-0°00.2	200°55.7	-20°37.7	Polaris	316°26.0	89°19.8																																									
7	105°35.3	260°17.2	-10°13.4	199°54.9	-25°54.1	282°49.5	-0°00.4	215°58.0	-20°37.7	Akamar	315°16.4	-40°14.2																																									
8	120°37.7	275°16.8	-10°14.6	214°55.6	-25°54.1	297°51.5	-0°00.6	231°00.3	-20°37.8	Menkar	314°12.5	4°09.3																																									
9	135°40.2	290°16.4	-10°15.8	229°56.3	-25°54.2	312°53.5	-0°00.9	246°02.6	-20°37.8	Mirfak	308°36.8	49°54.9																																									
10	150°42.7	305°16.0	-10°17.0	244°57.0	-25°54.2	327°55.4	-0°01.1	261°04.9	-20°37.8	Aldebaran	290°46.7	16°32.4																																									
11	165°45.1	320°15.6	-10°18.2	259°57.7	-25°54.2	342°57.4	-0°01.3	276°07.3	-20°37.8	Rigel	281°09.9	-8°11.0																																									
12	180°47.6	335°15.3	-10°19.4	274°58.4	-25°54.2	357°59.4	-0°01.5	291°09.6	-20°37.9	Capella	280°31.1	46°00.6																																									
13	195°50.1	350°14.9	-10°20.6	289°59.1	-25°54.2	13°01.3	-0°01.7	306°11.9	-20°37.9	Bellatrix	278°29.6	6°21.8																																									
14	210°52.5	5°14.5	-10°21.8	304°59.8	-25°54.2	28°03.3	-0°01.9	321°14.2	-20°37.9	Elnath	278°09.8	28°37.1																																									
15	225°55.0	20°14.1	-10°23.1	320°00.5	-25°54.3	43°05.3	-0°02.1	336°16.5	-20°38.0	Alnilam	275°44.1	-1°11.5																																									
16	240°57.5	35°13.7	-10°24.3	335°01.2	-25°54.3	58°07.2	-0°02.4	351°18.8	-20°38.0	Betelgeuse	270°58.9	7°24.5																																									
17	255°59.9	50°13.3	-10°25.5	350°01.9	-25°54.3	73°09.2	-0°02.6	6°21.1	-20°38.0	Canopus	263°55.2	-52°42.1																																									
18	271°02.4	65°12.9	-10°26.7	5°02.6	-25°54.3	88°11.2	-0°02.8	21°23.4	-20°38.0	Sirius	258°31.7	-16°44.1																																									
19	286°04.8	80°12.5	-10°27.9	20°03.3	-25°54.3	103°13.1	-0°03.0	36°25.7	-20°38.1	Adara	255°10.9	-28°59.6																																									
20	301°07.3	95°12.1	-10°29.1	35°04.0	-25°54.3	118°15.1	-0°03.2	51°28.0	-20°38.1	Procyon	244°57.5	5°11.0																																									
21	316°09.8	110°11.8	-10°30.3	50°04.7	-25°54.3	133°17.1	-0°03.4	66°30.3	-20°38.1	Pollux	243°25.1	27°59.0																																									
22	331°12.2	125°11.4	-10°31.5	65°05.4	-25°54.4	148°19.1	-0°03.6	81°32.6	-20°38.2	Avior	234°17.4	-59°33.6																																									
23	346°14.7	140°11.0	-10°32.7	80°06.1	-25°54.4	163°21.0	-0°03.9	96°34.9	-20°38.2	Suhail	222°51.1	-43°29.9																																									
Mer.pass.:23:54									v-0.4 d-1.2 m-3.8									v0.7 d-0.0 m-0.1									v2.0 d-0.2 m-1.5									v2.3 d-0.0 m0.5																	
Thu									GHA									GHA									GHA									GHA																	
0	1°17.2	155°10.6	-10°33.9	95°06.8	-25°54.4	178°23.0	-0°04.1	111°37.2	-20°38.2	Regulus	207°41.4	11°53.2																																									
1	16°19.6	170°10.2	-10°35.1	110°07.5	-25°54.4	193°25.0	-0°04.3	126°39.5	-20°38.2	Dubhe	193°49.8	61°39.6																																									
2	31°22.1	185°09.8	-10°36.3	125°08.2	-25°54.4	208°26.9	-0°04.5	141°41.8	-20°38.3	Denebola	182°31.7	14°28.9																																									
3	46°24.6	200°09.4	-10°37.4	140°08.8	-25°54.4	223°28.9	-0°04.7	156°44.1	-20°38.3	Gienah	175°50.3	-17°37.9																																									
4	61°27.0	215°09.0	-10°38.6	155°09.5	-25°54.4	238°30.9	-0°04.9	171°46.4	-20°38.3	Acrux	173°07.4	-63°11.4																																									
5	76°29.5	230°08.6	-10°39.8	170°10.2	-25°54.4	253°32.8	-0°05.1	186°48.7	-20°38.4	Gacrux	171°58.9	-57°12.3																																									
6	91°32.0	245°08.2	-10°41.0	185°10.9	-25°54.5	268°34.8	-0°05.4	201°51.0	-20°38.4	Alioth	166°19.4	55°52.4																																									
7	106°34.4	260°07.8	-10°42.2	200°11.6	-25°54.5	283°36.8	-0°05.6	216°53.4	-20°38.4	Spica	158°29.2	-11°14.7																																									
8	121°36.9	275°07.4	-10°43.4	215°12.3	-25°54.5	298°38.7	-0°05.8	231°55.7	-20°38.4	Alcaid	152°57.7	49°14.1																																									
9	136°39.3	290°07.0	-10°44.6	230°13.0	-25°54.5	313°40.7	-0°06.0	246°58.0	-20°38.5	Hadar	148°45.2	-60°27.1																																									
10	151°41.8	305°06.6	-10°45.8	245°13.7	-25°54.5	328°42.7	-0°06.2	262°00.3	-20°38.5	Menkent	148°05.3	-36°27.0																																									
11	166°44.3	320°06.3	-10°47.0	260°14.4	-25°54.5	343°44.6	-0°06.4	277°02.6	-20°38.5	Arcturus	145°53.9	19°06.3																																									
12	181°46.7	335°05.9	-10°48.2	275°15.1	-25°54.5	358°46.6	-0°06.6	292°04.9	-20°38.6	Rigil Kent.	139°49.1	-60°54.2																																									
13	196°49.2	350°05.5	-10°49.4	290°15.8	-25°54.5	13°48.6	-0°06.9	307°07.2	-20°38.6	Zubenelg.	137°03.2	-16°06.4																																									
14	211°51.7	5°05.1	-10°50.6	305°16.5	-25°54.5	28°50.5	-0°07.1	322°09.5	-20°38.6	Kochab	137°21.1	74°05.6																																									
15	226°54.1	20°04.7	-10°51.8	320°17.1	-25°54.5	43°52.5	-0°07.3	337°11.8	-20°38.7	Alphecca	126°09.4	26°39.9																																									
16	241°56.6	35°04.3	-10°53.0	335°17.8	-25°54.5	58°54.5	-0°07.5	352°14.1	-20°38.7	Antares	112°23.7	-26°27.9																																									
17	256°59.1	50°03.9	-10°54.2	350°18.5	-25°54.5	73°56.5	-0°07.7	7°16.4	-20°38.7	Atria	107°23.6	-69°03.4																																									
18	272°01.5	65°03.5	-10°55.4	5°19.2	-25°54.6	88°58.4	-0°07.9	22°18.7	-20°38.7	Sabik	102°10.1	-15°44.5																																									
19	287°04.0	80°03.1	-10°56.6	20°19.9	-25°54.6	104°00.4	-0°08.1	37°21.0	-20°38.8	Shaula	96°19.0	-37°06.8																																									
20	302°06.4	95°02.7	-10°57.7	35°20.6	-25°54.6	119°02.4	-0°08.4	52°23.3	-20°38.8	Rasalhague	96°04.5	12°33.3																																									
21	317°08.9	110°02.3	-10°58.9	50°21.3	-25°54.6	134°04.3	-0°08.6	67°25.6	-20°38.8	Etamin	90°45.1	51°29.7																																									
22	332°11.4	125°01.9	-11°00.1	65°22.0	-25°54.6	149°06.3	-0°08.8	82°27.9	-20°38.9	Kaus Aust.	83°40.8	-34°22.4																																									
23	347°13.8	140°01.5	-11°01.3	80°22.6	-25°54.6	164°08.3	-0°09.0	97°30.2	-20°38.9	Vega	80°37.4	38°48.4																																									
Mer.pass.:23:50									v-0.4 d-1.2 m-3.8									v0.7 d-0.0 m-0.0									v2.0 d-0.2 m-1.5									v2.3 d-0.0 m0.5																	
Fri									GHA									GHA									GHA									GHA																	
0	2°16.3	155°01.1	-11°02.5	95°23.3	-25°54.6	179°10.2	-0°09.2	112°32.5	-20°38.9	Venus	155°01.9	13:39																																									
1	17°18.8	170°00.7	-11°03.7	110°24.0	-25°54.6	194°12.2	-0°09.4	127°34.8	-20°38.9	Ankaa	94°32.0	17:40																																									
2	32°21.2	185°00.3	-11°04.9	125°24.7	-25°54.6	209°14.2	-0°09.6	142°37.1	-20°39.0	Schedar	130°32.0	12:08																																									
3	47°23.7	199°59.9	-11°06.1	140°25.4	-25°54.6	224°16.1	-0°09.9	157°39.4	-20°39.0	Diphda	125°32.0	16:35																																									
4	62°26.2	214°59.5	-11°07.3	155°26.1	-25°54.6	239°18.1	-0°10.1	172°41.7	-20°39.0	Achernar	120°31.7	21:31																																									
5	77°28.6	229°59.1	-11°08.4	170°26.7	-25°54.6	254°20.1	-0°10.3	187°44.0	-20°39.1	Hamal	115°21.3	29:31.9																																									
6	92°31.1	244°58.7	-11°09.6	185°27.4	-25°54.6	269°22.0	-0°10.5	202°46.3	-20°39.1	Polaris	110°30.9	28°10.6																																									
7	107°33.6	259°58.3	-11°10.8	200°28.1	-25°54.6	284°24.0	-0°10.7	217°48.6	-20°39.1	Alnilam	105																																										

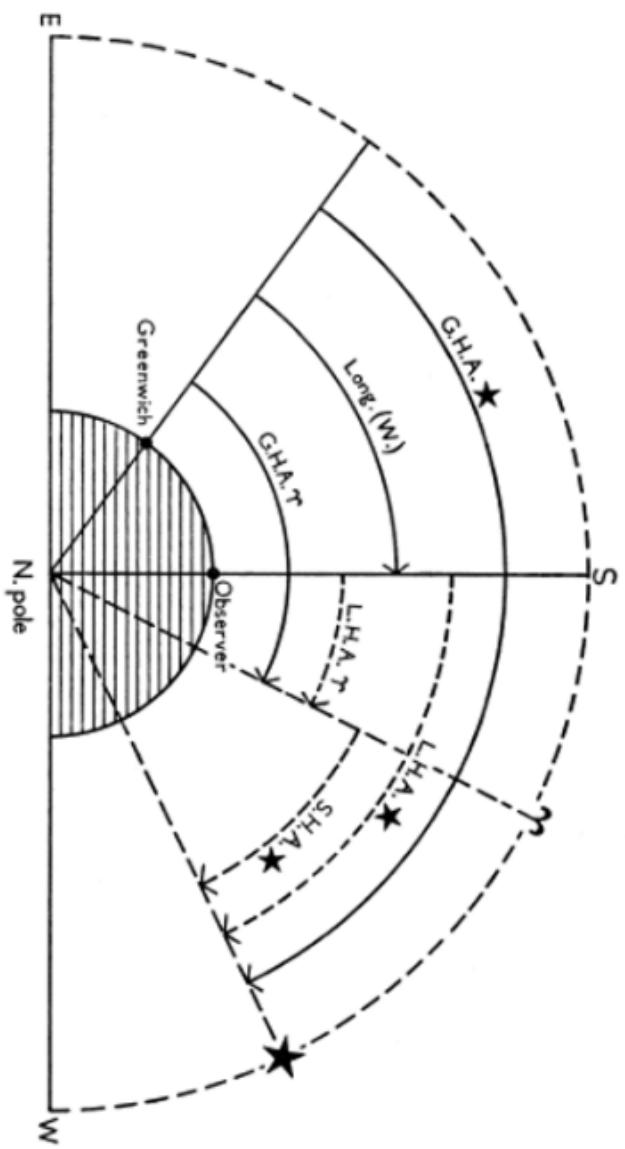
TABLE 4 — GHA γ FOR THE YEARS 2011-2019

c. INCREMENT OF GHA γ FOR MINUTES AND SECONDS

m	00 ^s	04 ^s	08 ^s	12 ^s	16 ^s	20 ^s	24 ^s	28 ^s		32 ^s	36 ^s	40 ^s	44 ^s	48 ^s	52 ^s	56 ^s	60 ^s	m
00	0 00	0 01	0 02	0 03	0 04	0 05	0 06	0 07	00	0 08	0 09	0 10	0 11	0 12	0 13	0 14	0 15	00
01	0 15	0 16	0 17	0 18	0 19	0 20	0 21	0 22	01	0 23	0 24	0 25	0 26	0 27	0 28	0 29	0 30	01
02	0 30	0 31	0 32	0 33	0 34	0 35	0 36	0 37	02	0 38	0 39	0 40	0 41	0 42	0 43	0 44	0 45	02
03	0 45	0 46	0 47	0 48	0 49	0 50	0 51	0 52	03	0 53	0 54	0 55	0 56	0 57	0 58	0 59	1 00	03
04	1 00	1 01	1 02	1 03	1 04	1 05	1 06	1 07	04	1 08	1 09	1 10	1 11	1 12	1 13	1 14	1 15	04
05	1 15	1 16	1 17	1 18	1 19	1 20	1 21	1 22	05	1 23	1 24	1 25	1 26	1 27	1 28	1 29	1 30	05
06	1 30	1 31	1 32	1 33	1 34	1 35	1 36	1 37	06	1 38	1 39	1 40	1 41	1 42	1 43	1 44	1 45	06
07	1 45	1 46	1 47	1 48	1 49	1 50	1 51	1 52	07	1 53	1 54	1 55	1 56	1 57	1 58	1 59	2 00	07
08	2 00	2 01	2 02	2 03	2 04	2 05	2 06	2 07	08	2 08	2 09	2 10	2 11	2 12	2 13	2 14	2 15	08
09	2 15	2 16	2 17	2 18	2 19	2 20	2 21	2 22	09	2 23	2 24	2 25	2 26	2 27	2 28	2 29	2 30	09
10	2 30	2 31	2 32	2 33	2 34	2 35	2 36	2 37	10	2 38	2 39	2 40	2 41	2 42	2 43	2 44	2 45	10
11	2 45	2 46	2 47	2 48	2 49	2 50	2 51	2 52	11	2 53	2 54	2 55	2 56	2 57	2 58	2 59	3 00	11
12	3 00	3 01	3 02	3 04	3 05	3 06	3 07	3 08	12	3 09	3 10	3 11	3 12	3 13	3 14	3 15	3 16	12
13	3 16	3 17	3 18	3 19	3 20	3 21	3 22	3 23	13	3 24	3 25	3 26	3 27	3 28	3 29	3 30	3 31	13
14	3 31	3 32	3 33	3 34	3 35	3 36	3 37	3 38	14	3 39	3 40	3 41	3 42	3 43	3 44	3 45	3 46	14
15	3 46	3 47	3 48	3 49	3 50	3 51	3 52	3 53	15	3 54	3 55	3 56	3 57	3 58	3 59	4 00	4 01	15
16	4 01	4 02	4 03	4 04	4 05	4 06	4 07	4 08	16	4 09	4 10	4 11	4 12	4 13	4 14	4 15	4 16	16
17	4 16	4 17	4 18	4 19	4 20	4 21	4 22	4 23	17	4 24	4 25	4 26	4 27	4 28	4 29	4 30	4 31	17
18	4 31	4 32	4 33	4 34	4 35	4 36	4 37	4 38	18	4 39	4 40	4 41	4 42	4 43	4 44	4 45	4 46	18
19	4 46	4 47	4 48	4 49	4 50	4 51	4 52	4 53	19	4 54	4 55	4 56	4 57	4 58	4 59	5 00	5 01	19
20	5 01	5 02	5 03	5 04	5 05	5 06	5 07	5 08	20	5 09	5 10	5 11	5 12	5 13	5 14	5 15	5 16	20
21	5 16	5 17	5 18	5 19	5 20	5 21	5 22	5 23	21	5 24	5 25	5 26	5 27	5 28	5 29	5 30	5 31	21
22	5 31	5 32	5 33	5 34	5 35	5 36	5 37	5 38	22	5 39	5 40	5 41	5 42	5 43	5 44	5 45	5 46	22
23	5 46	5 47	5 48	5 49	5 50	5 51	5 52	5 53	23	5 54	5 55	5 56	5 57	5 58	5 59	6 00	6 01	23
24	6 01	6 02	6 03	6 04	6 05	6 06	6 07	6 08	24	6 09	6 10	6 11	6 12	6 13	6 14	6 15	6 16	24
25	6 16	6 17	6 18	6 19	6 20	6 21	6 22	6 23	25	6 24	6 25	6 26	6 27	6 28	6 29	6 30	6 31	25
26	6 31	6 32	6 33	6 34	6 35	6 36	6 37	6 38	26	6 39	6 40	6 41	6 42	6 43	6 44	6 45	6 46	26
27	6 46	6 47	6 48	6 49	6 50	6 51	6 52	6 53	27	6 54	6 55	6 56	6 57	6 58	6 59	7 00	7 01	27
28	7 01	7 02	7 03	7 04	7 05	7 06	7 07	7 08	28	7 09	7 10	7 11	7 12	7 13	7 14	7 15	7 16	28
29	7 16	7 17	7 18	7 19	7 20	7 21	7 22	7 23	29	7 24	7 25	7 26	7 27	7 28	7 29	7 30	7 31	29
30	7 31	7 32	7 33	7 34	7 35	7 36	7 37	7 38	30	7 39	7 40	7 41	7 42	7 43	7 44	7 45	7 46	30
31	7 46	7 47	7 48	7 49	7 50	7 51	7 52	7 53	31	7 54	7 55	7 56	7 57	7 58	7 59	8 00	8 01	31
32	8 01	8 02	8 03	8 04	8 05	8 06	8 07	8 08	32	8 09	8 10	8 11	8 12	8 13	8 14	8 15	8 16	32
33	8 16	8 17	8 18	8 19	8 20	8 21	8 22	8 23	33	8 24	8 25	8 26	8 27	8 28	8 29	8 30	8 31	33
34	8 31	8 32	8 33	8 34	8 35	8 36	8 37	8 38	34	8 39	8 40	8 41	8 42	8 43	8 44	8 45	8 46	34
35	8 46	8 47	8 48	8 49	8 50	8 51	8 52	8 53	35	8 54	8 55	8 56	8 57	8 58	8 59	9 00	9 01	35
36	9 01	9 02	9 03	9 04	9 05	9 06	9 07	9 08	36	9 10	9 11	9 12	9 13	9 14	9 15	9 16	9 17	36
37	9 17	9 18	9 19	9 20	9 21	9 22	9 23	9 24	37	9 25	9 26	9 27	9 28	9 29	9 30	9 31	9 32	37
38	9 32	9 33	9 34	9 35	9 36	9 37	9 38	9 39	38	9 40	9 41	9 42	9 43	9 44	9 45	9 46	9 47	38
39	9 47	9 48	9 49	9 50	9 51	9 52	9 53	9 54	39	9 55	9 56	9 57	9 58	9 59	10 00	10 01	10 02	39
40	10 02	10 03	10 04	10 05	10 06	10 07	10 08	10 09	40	10 10	10 11	10 12	10 13	10 14	10 15	10 16	10 17	40
41	10 17	10 18	10 19	10 20	10 21	10 22	10 23	10 24	41	10 25	10 26	10 27	10 28	10 29	10 30	10 31	10 32	41
42	10 32	10 33	10 34	10 35	10 36	10 37	10 38	10 39	42	10 40	10 41	10 42	10 43	10 44	10 45	10 46	10 47	42
43	10 47	10 48	10 49	10 50	10 51	10 52	10 53	10 54	43	10 55	10 56	10 57	10 58	10 59	11 00	11 01	11 02	43
44	11 02	11 03	11 04	11 05	11 06	11 07	11 08	11 09	44	11 10	11 11	11 12	11 13	11 14	11 15	11 16	11 17	44
45	11 17	11 18	11 19	11 20	11 21	11 22	11 23	11 24	45	11 25	11 26	11 27	11 28	11 29	11 30	11 31	11 32	45
46	11 32	11 33	11 34	11 35	11 36	11 37	11 38	11 39	46	11 40	11 41	11 42	11 43	11 44	11 45	11 46	11 47	46
47	11 47	11 48	11 49	11 50	11 51	11 52	11 53	11 54	47	11 55	11 56	11 57	11 58	11 59	12 00	12 01	12 02	47
48	12 02	12 03	12 04	12 05	12 06	12 07	12 08	12 09	48	12 10	12 11	12 12	12 13	12 14	12 15	12 16	12 17	48
49	12 17	12 18	12 19	12 20	12 21	12 22	12 23	12 24	49	12 25	12 26	12 27	12 28	12 29	12 30	12 31	12 32	49
50	12 32	12 33	12 34	12 35	12 36	12 37	12 38	12 39	50	12 40	12 41	12 42	12 43	12 44	12 45	12 46	12 47	50
51	12 47	12 48	12 49	12 50	12 51	12 52	12 53	12 54	51	12 55	12 56	12 57	12 58	12 59	13 00	13 01	13 02	51
52	13 02	13 03	13 04	13 05	13 06	13 07	13 08	13 09	52	13 10	13 11	13 12	13 13	13 14	13 15	13 16	13 17	52
53	13 17	13 18	13 19	13 20	13 21	13 22	13 23	13 24	53	13 25	13 26	13 27	13 28	13 29	13 30	13 31	13 32	53
54	13 32	13 33	13 34	13 35	13 36	13 37	13 38	13 39	54	13 40	13 41	13 42	13 43	13 44	13 45	13 46	13 47	54
55	13 47	13 48	13 49	13 50	13 51	13 52	13 53	13 54	55	13 55	13 56	13 57	13 58	13 59	14 00	14 01	14 02	55
56	14 02	14 03	14 04	14 05	14 06	14 07	14 08	14 09	56	14 10	14 11	14 12	14 13	14 14	14 15	14 16	14 17	56
57	14 17	14 18	14 19	14 20	14 21	14 22	14 23	14 24	57	14 25	14 26	14 27	14 28	14 29	14 30	14 31	14 32	57
58	14 32	14 33	14 34	14 35	14 36	14 37	14 38	14 39	58	14 40	14 41	14 42	14 43	14 44	14 45	14 46	14 47	58
59	14 47	14 48	14 49	14 50	14 51	14 52	14 53	14 54	59	14 55	14 56	14 57	14 58	14 59	15 00	15 01	15 02	59

Example. The value of GHA γ for 2012 August 17 at 05^h 11^m 41^s UT is (a) 310° 00' + (b) 090° 59' + (c) 002° 55' = 043° 54'.

GHA LHA SHA diagram



The above diagram, showing the plane of the equator as seen from the north pole, illustrates the relationship between the Greenwich and local hour angles, and longitude and sidereal hour angle.

G.H.A. of Aries (α), Sun, Moon and planets are tabulated directly ; for these :
 L.H.A. = G.H.A. - W, longitude (+ E, longitude)

For the stars :

$$\begin{aligned} \text{G.H.A. *} &= \text{G.H.A.} \alpha + \text{S.H.A. *} \\ \text{L.H.A. *} &= \text{L.H.A.} \alpha + \text{S.H.A. *} \\ \text{L.H.A. *} &= \text{G.H.A.} \alpha + \text{S.H.A. *} - W, \text{longitude (+ E, longitude)} \end{aligned}$$

LAT 40°N

LAT 40°N

LHA Ψ	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn	LHA Ψ	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn		
0	34°0' 055	26°2' 090	31°1' 168	19°0' 194	26°8' 258	30°0' 297	27°3' 348	Kochab	♦Dubhe	REGULUS	PROCYON	♦SIRIUS	RIGEL	ALDEBARAN	♦Mirfak										
1	34 41 056	27 07 091	31 20 169	18 49 195	26 13 205	29 19 298	27 28 348		90 40°4' 037	28°45' 099	48°32' 167	32°16' 167	40°43' 195	60°24' 224	61°17' 303										
2	35 19 056	27 53 091	31 29 170	18 37 196	25 28 260	28 38 298	27 19 348		91 41 038	29 30 100	49 01 142	32 26 168	40 31 196	59 51 225	60 39 303										
3	35 57 057	28 38 092	31 36 171	18 24 197	24 42 261	27 58 299	27 10 349		92 41 038	30 16 100	49 29 143	32 35 169	40 18 197	59 18 227	60 00 303										
4	36 35 057	29 24 093	31 43 172	18 10 198	23 57 261	27 18 299	27 01 349		93 42 09 038	31 01 101	49 56 145	32 43 170	40 04 198	58 45 228	59 22 303										
5	37°4' 057	30°1' 083	31°4' 173	17°56' 199	23°12' 262	26°38' 300	26°52' 349		94 42 37 038	31 46 102	50 22 146	32 50 171	39 48 200	58 10 230	58 43 303										
6	37°53 058	30 56 094	31 54 174	17 41 199	22 26 263	25 58 300	26 44 349		95 43°0' 038	32 31' 102	50°48' 147	32°57' 173	39°33' 201	57°34' 231	58°04' 303										
7	38 32 058	31 42 095	31 58 175	17 25 200	21 40 263	25 18 301	26 35 350		96 43 34 038	33 16 103	51 12 149	33 02 174	39 16 202	56 58 232	57 26 303										
8	39 11 058	32 28 095	32 01 177	17 09 201	20 55 264	24 39 301	26 27 350		97 44 02 038	34 00 104	51 35 150	33 06 175	38 58 203	56 22 234	56 47 303										
9	39 50 058	33 14 096	32 04 178	16 52 202	20 09 265	25 39 301	26 19 350		98 44 31 038	34 45 105	51 57 152	33 10 176	38 39 205	55 44 245	55 09 303										
10	40°29' 059	33°59' 097	32°05' 179	16°34' 203	19°23' 265	23°20' 302	26°12' 351		99 44 59 038	35 29 106	51 99 153	33 13 177	38 20 206	55 06 236	55 30 303										
11	41 08 059	34 45 097	32 06 180	16 16 204	18 37 266	22 41 302	26 04 351		100 45°28' 038	36°13' 106	52°39' 155	33°15' 178	37°59' 207	54°28' 238	54°51' 303										
12	41 48 059	35 30 088	32 05 181	15 57 205	17 51 267	23 03 303	25 57 351		101 45 56 038	36 57 107	52 58 156	33 15 179	37 38 208	53 49 239	54 13 303										
13	42 27 060	36 16 099	32 04 182	15 38 205	17 06 267	21 24 303	25 50 351		102 46 24 038	37 41 108	53 16 158	33 15 181	37 16 209	53 09 240	53 34 303										
14	43 07 060	37 01 100	32 02 183	15 18 206	16 20 268	20 46 304	25 43 352		103 46 53 038	38 25 109	53 32 160	33 14 182	36 53 210	52 29 241	52 56 303										
15	♦CAPELLA	BETELGEUSE	RIGEL	♦Diphda	Enif	♦DENEB	Kochab	♦Dubhe	Denebola	♦REGULUS	SIRIUS	RIGEL	ALDEBARAN	Mirfak											
16	43°47' 060	17°0' 095	14°0' 114	31°59' 184	37°28' 249	43°33' 299	25°37' 352		105 31°23' 017	22°36' 090	39°51' 110	33°10' 184	36°05' 213	51°08' 243	51°30' 303										
17	44 27 060	17 45 095	14 46 114	31 55 186	36 45 250	42 52 299	25 30 352		106 31 36 017	23 22 090	40 34 111	33 06 185	35 39 214	50 26 244	51 00 303										
18	45 07 061	18 31 096	18 28 115	31 50 187	36 02 251	42 12 300	25 24 352		107 31 49 017	24 08 091	41 17 112	33 01 186	35 14 215	49 45 245	50 22 304										
19	46 27 061	19 17 097	16 09 116	31 44 188	35 18 251	41 32 300	25 18 353		108 32 03 017	24 54 092	41 59 113	32 56 187	34 47 216	49 03 246	49 44 304										
20	47°08' 062	20°48' 098	17°31' 117	31°30' 190	33°51' 253	40°13' 300	25°07' 353		109 32 16 017	25 40 092	42 44 114	32 50 189	34 19 217	48 21 247	49 06 304										
21	47 48 062	21 34 099	18 12 118	31 22 191	33 07 254	39 33 301	25 02 354		110 32°30' 017	26 26' 093	43°23' 115	32°42' 190	33°51' 218	47°38' 248	48°27' 304										
22	48 29 062	22 19 099	18 52 119	31 12 192	32 23 255	38 54 301	24 57 354		111 32 44 018	27 12 094	44 05 116	32 34 191	33 23 221	46 45 252	47 49 304										
23	49 09 062	23 04 100	19 32 120	31 02 193	31 28 255	38 15 301	24 52 354		112 32 58 018	27 58 094	44 46 117	32 25 192	32 53 220	46 12 250	47 11 304										
24	49 50 062	23 49 101	20 12 120	30 51 194	30 54 256	37 35 302	24 47 354		113 33 12 018	28 44 095	45 27 118	32 15 193	32 23 221	45 29 251	46 33 304										
25	50°31' 063	24°35' 101	20°52' 121	30°40' 195	30°09' 257	36°56' 302	24°43' 355		114 33 26 018	29 29 096	46 07 119	32 04 194	31 53 222	44 45 252	45 50 305										
26	51 12 063	25 20 102	21 31 122	30 27 197	29 24 258	36 18 302	24 39 355		115 33°41' 018	30°15' 096	46°47' 120	31°52' 195	31°52' 223	44°01' 253	45°18' 305										
27	51 53 063	26 04 103	22 10 123	30 13 198	28 39 259	35 39 303	24 35 355		116 33 55 018	31 01 097	47 27 121	31 40 196	30 50 224	43 17 254	44 40 305										
28	52 34 063	26 49 104	22 48 124	29 59 199	27 54 259	35 00 303	24 32 356		117 34 24 019	32 32 099	48 45 123	31 12 199	29 45 226	41 48 255	43 25 306										
29	53 15 064	27 34 104	23 26 124	29 44 200	27 09 260	34 22 303	24 28 356		119 34 39 019	33 17 099	49 23 124	30 57 200	30 57 227	41 04 256	42 48 306										
30	♦CAPELLA	BETELGEUSE	RIGEL	♦Diphda	Alpheratz	DENEB	Kochab	♦Dubhe	Denebola	♦REGULUS	SIRIUS	RIGEL	ALDEBARAN	CAPELLA											
31	53°56' 064	28°18' 105	24°04' 125	29°28' 201	64°54' 253	33°44' 304	24°25' 356		120 34°54' 019	34°02' 100	50°00' 126	30°41' 201	28°38' 228	40°19' 257	60°05' 295										
32	54 37 064	29 02 106	24 41 126	29 12 202	64 09 254	33 05 304	24 22 357		121 35 09 019	34 48 101	50 37 127	30 24 202	28 03 229	39 34 258	59 23 295										
33	55 19 064	29 47 107	25 18 127	28 54 203	63 25 255	32 27 305	24 19 357		122 35 24 019	35 33 101	51 14 128	30 07 203	27 28 230	38 49 259	58 42 295										
34	56 41 064	31 14 108	26 31 129	28 17 205	61 56 257	31 12 305	24 15 357		123 35 39 019	36 18 102	51 50 129	29 49 204	26 53 231	38 04 259	58 00 295										
35	57°23' 064	31°58' 109	27°06' 130	27°57' 206	61°11' 258	30°35' 306	24°13' 358		124 36°10' 020	37°47' 020	37°47' 104	53°00' 132	53°00' 132	29°40' 206	25°41' 232	36°34' 261	56°37' 296								
36	58 04 065	32 41 110	27 41 131	27 37 207	60 26 259	29 57 306	24 11 358		125 36 26 020	38 32 105	53 34 133	28 50 207	25 04 233	35 48 262	55 56 296										
37	58 46 065	33 24 111	28 16 131	27 16 208	59 41 260	29 20 306	24 05 358		126 36 41 020	39 16 105	54 07 134	28 28 208	24 27 234	35 03 262	55 15 296										
38	59 27 065	34 07 111	28 50 132	26 54 209	58 55 261	28 43 307	24 08 359		127 36 57 020	40 01 106	54 39 136	28 06 209	23 20 355	34 17 263	54 33 296										
39	60 09 065	34 50 112	29 23 129	27 31 207	58 10 262	28 07 307	24 06 309		128 37 13 020	40 45 107	55 11 137	27 44 210	23 12 236	33 32 264	53 52 296										
40	60°51' 065	35°32' 113	29°57' 134	26°08' 211	57°24' 262	27°30' 308	24°07' 359		129 37°29' 020	41°29' 108	53°42' 139	27°20' 211	22°34' 237	32°46' 264	53°11' 297										
41	61 32 065	36 14 114	30 30 135	25 44 212	56 39 253	26 54 308	24 06 000		130 37 44 022	42 12 109	56 11 140	25 56 212	21 55 237	32 00 265	52 30 297										
42	62 14 065	36 56 115	31 02 135	25 20 213	55 53 264	26 18 308	24 06 000		131 38 00 020	42 50 116	56 40 142	26 32 213	21 16 238	31 14 266	51 49 297										
43	62 55 065	37 38 116	31 33 137	24 54 214	55 07 265	25 42 309	24 06 00																		

LAT 40°N

LAT 40°N

LHA ♈	Hc	Zn	LHA ♉	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn	Hc	Zn										
180	17°48' 054	43°50' 090	54°05' 115	35°01' 154	52°46' 229	37°10' 278	21°25' 313	REGULUS	♦POLLUX	CAPELLA	270	16°39' 066	50°12' 134	22°27' 166	Nunki	♦ANTARES	ARCTURUS	♦Alkaid	Kochab								
181	18 25 054	44 36 090	54 46 117	35 21 155	51 21 130	52 11 200	20 51 313	52 1 230	52 0 198	20 18 314	271	17 21 066	50 46 135	22 37 122	20 03 202	37 16 244	44 56 304	49 16 342									
182	19 03 055	45 22 091	55 27 118	35 40 156	51 35 231	35 39 279	20 18 314	53 19 231	53 08 233	34 53 273	272	18 03 067	51 18 136	22 47 168	19 45 203	36 30 265	44 18 304	49 01 342									
183	19 40 055	46 08 092	50 08 119	33 58 157	50 59 233	34 53 273	20 18 314	53 19 233	53 08 233	34 53 273	273	18 45 067	51 50 138	22 50 169	19 27 204	35 45 266	43 40 304	48 47 341									
184	20 18 056	46 53 092	56 48 120	36 15 159	52 20 234	34 08 280	19 12 315	52 20 234	34 08 280	19 12 315	274	19 28 068	52 20 139	23 04 170	19 08 205	34 59 266	43 03 305	48 32 341									
185	20°56' 056	47°39' 093	57°27' 121	36°31' 160	49°45' 235	33°23' 280	18°39' 315	REGULUS	♦POLLUX	CAPELLA	275	20°11' 068	52°50' 141	23°12' 171	18°48' 206	34°13' 267	42°25' 305	48°17' 341									
186	21 35 057	48 25 094	58 06 123	36 47 161	49 07 236	32 38 281	18 07 316	36 47 161	49 07 236	32 38 281	276	20 53 069	53 18 142	23 18 172	18 28 207	33 27 268	41 47 305	48 02 341									
187	22 13 057	49 11 094	58 45 124	37 01 162	48 29 237	31 53 282	17 35 316	37 01 162	48 29 237	31 53 282	277	21 36 069	53 46 143	23 24 173	18 07 208	32 41 261	41 10 305	47 47 341									
188	22 52 058	49 57 095	59 22 125	37 15 163	47 50 238	31 08 282	17 03 316	37 15 163	47 50 238	31 08 282	278	22 19 070	54 13 145	23 29 174	17 45 208	31 55 269	40 32 306	47 32 341									
189	23 31 058	50 43 096	60 00 127	37 28 164	47 10 239	30 23 283	16 32 317	37 28 164	47 10 239	30 23 283	279	23 03 070	54 39 146	23 34 175	17 23 209	31 09 256	39 55 306	47 16 340									
190	24°10' 059	51°28' 097	60°06' 128	37°40' 166	46°31' 240	29°38' 283	16°00' 317	REGULUS	♦POLLUX	Dubhe	280	23°46' 071	55°04' 148	23°37' 176	17°00' 210	30°23' 270	39°18' 306	47°70' 340									
191	24 49 059	52 14 097	61 12 130	37 51 167	45 50 241	28 53 284	15 29 318	37 51 167	45 50 241	28 53 284	281	24 30 072	55 28 150	23 40 177	16 37 211	29 37 271	38 41 307	46 45 340									
192	25 29 060	53 00 098	61 47 131	38 01 168	45 10 242	28 09 284	14 59 318	38 01 168	45 10 242	28 09 284	282	25 13 072	55 50 151	23 42 178	16 13 212	28 51 271	38 04 307	46 29 340									
193	26 09 060	53 45 099	62 21 133	38 09 169	44 29 243	27 24 285	14 28 319	38 09 169	44 29 243	27 24 285	283	25 57 073	56 12 153	23 43 179	15 49 213	28 05 273	37 27 307	46 14 340									
194	26 49 060	54 30 100	62 54 135	38 17 171	43 48 244	26 40 285	13 58 319	38 17 171	43 48 244	26 40 285	284	26 41 073	56 32 155	23 44 180	15 24 213	27 19 273	36 51 307	45 58 340									
195	13°02' 041	27°29' 061	63°26' 136	38°24' 172	43°06' 245	25°55' 286	62°09' 331	REGULUS	♦POLLUX	Dubhe	285	27°25' 074	42°43' 118	56°52' 156	26°33' 273	36°14' 308	45°42' 340										
196	13 32 041	28 09 061	63 57 138	38 30 173	42 24 246	25 11 216	61 47 330	38 30 173	42 24 246	25 11 216	286	28 09 074	43 24 119	57 09 158	25 22 222	35 38 308	45 26 340										
197	14 02 042	28 49 062	64 28 140	38 35 174	41 42 247	24 27 287	61 24 329	38 35 174	41 42 247	24 27 287	287	28 53 075	44 04 120	57 26 160	25 02 275	35 02 308	45 10 339										
198	14 33 042	29 30 062	64 57 142	38 40 176	40 59 248	23 43 287	61 00 329	38 40 176	40 59 248	23 43 287	288	29 38 075	44 44 121	57 41 162	24 16 215	34 26 309	44 54 339										
199	15 04 043	30 11 063	65 24 144	38 43 177	40 17 249	23 00 288	60 36 328	38 43 177	40 17 249	23 00 288	289	30 22 076	45 23 122	57 55 163	23 30 276	33 50 309	44 37 339										
200	15°35' 043	30°52' 063	65°51' 145	38°45' 178	39°34' 250	22°16' 289	60°12' 328	38°45' 178	39°34' 250	22°16' 289	290	31°07' 076	46°02' 123	58°08' 165	54°13' 227	22°44' 276	33°14' 308	44°21' 339									
201	16 07 044	31 33 064	66 16 148	38 46 179	38 50 251	21 32 289	59 47 327	38 46 179	38 50 251	21 32 289	291	31 52 077	46 40 124	58 19 167	53 39 229	21 59 277	32 39 310	44 05 339									
202	16 39 044	32 14 064	66 40 150	38 46 181	39 07 252	20 49 290	59 22 327	38 46 181	39 07 252	20 49 290	292	32 36 077	47 18 125	58 28 169	53 04 230	21 13 278	32 03 310	43 49 339									
203	17 11 045	32 55 064	67 02 152	38 45 182	37 23 252	20 06 290	58 57 327	38 45 182	37 23 252	20 06 290	293	33 21 078	47 55 126	58 37 171	52 29 231	20 28 278	31 28 310	43 32 339									
204	17 43 045	33 37 065	67 23 155	38 43 183	36 29 253	19 23 291	58 32 326	38 43 183	36 29 253	19 23 291	294	34 06 078	48 34 128	58 43 173	51 52 232	19 42 278	33 03 311	43 16 339									
205	18°16' 046	34°19' 065	67°42' 157	38°39' 184	35°55' 254	18°40' 291	58°06' 326	38°39' 184	35°55' 254	18°40' 291	295	34°51' 079	49°08' 129	58°48' 175	51°16' 234	18°57' 279	30°18' 311	42°59' 339									
206	18 49 046	35 01 065	67 59 159	38 35 186	35 11 255	17 57 292	57 40 325	38 35 186	35 11 255	17 57 292	296	35 37 080	49 43 130	58 52 176	50 38 235	18 12 280	29 44 311	42 43 339									
207	19 22 046	35 43 066	68 14 162	38 30 187	34 26 256	17 55 292	57 14 325	38 30 187	34 26 256	17 55 292	297	36 22 080	50 18 131	58 54 178	50 01 236	17 26 278	29 09 312	42 27 339									
208	19 55 047	36 25 067	68 28 164	38 24 188	33 42 256	16 32 293	56 47 325	38 24 188	33 42 256	16 32 293	298	37 07 081	50 53 132	58 55 180	49 22 237	16 41 281	28 35 312	42 10 339									
209	20 29 047	37 07 067	68 39 167	38 17 257	32 57 257	15 50 294	56 20 324	38 17 257	32 57 257	15 50 294	299	37 52 081	51 26 134	58 54 182	48 43 238	15 56 282	28 01 312	41 54 339									
210	21°03' 048	37°49' 067	35°28' 104	14°54' 146	38°09' 191	32°12' 258	55°54' 324	REGULUS	♦POLLUX	Dubhe	300	18°11' 039	38°38' 082	51°59' 135	58°51' 184	48°04' 239	34°24' 278	41°21' 339									
211	21 37 048	38 32 068	36 12 105	15 19 146	38 00 192	31 27 259	55 27 324	38 00 192	31 27 259	55 27 324	301	18 40 040	39 23 082	52 31 136	58 47 186	47 24 240	33 39 278	41 21 339									
212	22 11 049	39 14 064	36 56 106	14 44 147	37 51 193	30 42 259	54 59 324	37 51 193	30 42 259	54 59 324	302	19 10 040	40 09 083	53 03 138	58 42 188	46 44 241	34 54 274	41 04 339									
213	22 46 049	39 57 069	37 41 107	14 19 111	37 40 194	29 57 260	54 39 323	37 40 194	29 57 260	54 39 323	303	19 40 040	40 58 083	53 33 139	58 35 190	46 04 242	34 08 279	40 48 339									
214	23 21 050	40 46 069	48 50 122	15 21 192	32 46 213	29 12 259	54 29 323	32 46 213	29 12 259	54 29 323	304	20 10 041	41 40 084	54 03 141	58 26 192	45 23 243	31 23 283	40 42 339									
215	23°56' 050	22°37' 097	49°29' 123	21°33' 163	32°21' 214	37°43' 256	46°3° 322	REGULUS	♦POLLUX	Dubhe	305	20°40' 041	42°26' 085	54°31' 142	58°16' 193	44°41' 244	30°38' 281	40°15' 339									
216	24 31 050	42 06 070	49 15 109	17 42 151	36 47 199	26 55 263	52 41 323	17 42 151	36 47 199	26 55 263	306	21 10 042	43 12 085	54 59 144	58 05 195	44 00 245	29 25 282	39 59 339									
217	25 07 051	42 49 070	49 35 110	17 42 151	36 47 199	26 55 263	52 41 323	17 42 151	36 47 199	26 55 263	307	21 41 042	43 58 086	55 26 145	57 52 197	43 18 246	29 07 282	39 43 339									
218	25 43 051	43 33 071	49 18 111	18 03 162	36 31 200	26 09 264	52 13 322	18 03 162	36 31 200	26 09 264	308	22 12 043	44 43 086	55 52 147	57 38 199	42 35 247	28 22 282	39 26 339									
219	26 18 052	44 16 07																									

