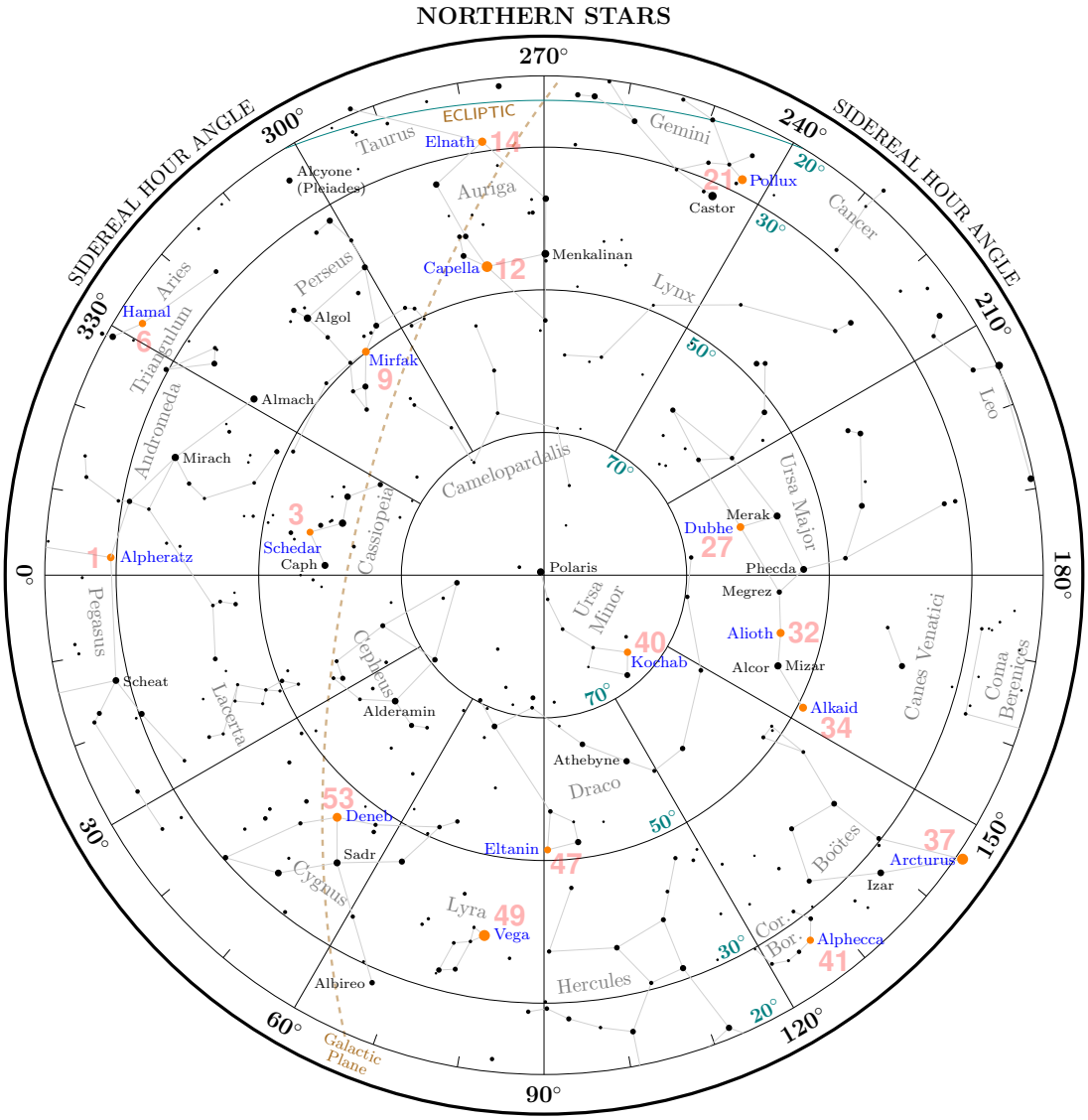
Generated using Ephem




# The Nautical Almanac

## 13.07.2022 - 18.07.2022

*Author:* Andrew Bauer
*Original concept from:* Enno Rodegerdts

August 29, 2022

## July 13, 14, 15 (Wed., Thu., Fri.)

| h | Aries | Venus | | Mars | | Jupiter | | Saturn | |
|---|---|---|---|---|---|---|---|---|---|
| Wed | GHA | GHA | Dec | GHA | Dec | GHA | Dec | GHA | Dec |
| 0 | 290°51.4 | 207°27.3 | N22°24.4 | 257°09.8 | N11°37.5 | 282°41.6 | N02°03.2 | 323°59.4 | S14°38.6 |
| 1 | 305°53.9 | 222°26.6 | 24.6 | 272°10.6 | 38.1 | 297°43.9 | 03.2 | 339°02.0 | 38.7 |
| 2 | 320°56.3 | 237°25.8 | 24.9 | 287°11.4 | 38.7 | 312°46.3 | 03.3 | 354°04.6 | 38.7 |
| 3 | 335°58.8 | 252°25.0 | ·· 25.1 | 302°12.2 | ·· 39.3 | 327°48.6 | ·· 03.3 | 9°07.2 | ·· 38.8 |
| 4 | 351°01.3 | 267°24.2 | 25.4 | 317°13.1 | 39.8 | 342°51.0 | 03.4 | 24°09.7 | 38.8 |
| 5 | 6°03.7 | 282°23.4 | 25.6 | 332°13.9 | 40.4 | 357°53.3 | 03.4 | 39°12.3 | 38.9 |
| 6 | 21°06.2 | 297°22.7 | N22°25.9 | 347°14.7 | N11°41.0 | 12°55.6 | N02°03.4 | 54°14.9 | S14°38.9 |
| 7 | 36°08.7 | 312°21.9 | 26.1 | 2°15.5 | 41.6 | 27°58.0 | 03.5 | 69°17.5 | 39.0 |
| 8 | 51°11.1 | 327°21.1 | 26.3 | 17°16.3 | 42.1 | 43°00.3 | 03.5 | 84°20.1 | 39.0 |
| 9 | 66°13.6 | 342°20.3 | ·· 26.6 | 32°17.1 | ·· 42.7 | 58°02.7 | ·· 03.6 | 99°22.7 | ·· 39.1 |
| 10 | 81°16.1 | 357°19.5 | 26.8 | 47°17.9 | 43.3 | 73°05.0 | 03.6 | 114°25.3 | 39.1 |
| 11 | 96°18.5 | 12°18.7 | 27.0 | 62°18.7 | 43.9 | 88°07.4 | 03.6 | 129°27.9 | 39.2 |
| 12 | 111°21.0 | 27°18.0 | N22°27.3 | 77°19.6 | N11°44.4 | 103°09.7 | N02°03.7 | 144°30.5 | S14°39.2 |
| 13 | 126°23.5 | 42°17.2 | 27.5 | 92°20.4 | 45.0 | 118°12.1 | 03.7 | 159°33.1 | 39.3 |
| 14 | 141°25.9 | 57°16.4 | 27.7 | 107°21.2 | 45.6 | 133°14.4 | 03.7 | 174°35.7 | 39.3 |
| 15 | 156°28.4 | 72°15.6 | ·· 27.9 | 122°22.0 | ·· 46.2 | 148°16.8 | ·· 03.8 | 189°38.3 | ·· 39.4 |
| 16 | 171°30.8 | 87°14.8 | 28.2 | 137°22.8 | 46.7 | 163°19.1 | 03.8 | 204°40.9 | 39.4 |
| 17 | 186°33.3 | 102°14.0 | 28.4 | 152°23.6 | 47.3 | 178°21.4 | 03.9 | 219°43.5 | 39.5 |
| 18 | 201°35.8 | 117°13.3 | N22°28.6 | 167°24.4 | N11°47.9 | 193°23.8 | N02°03.9 | 234°46.1 | S14°39.5 |
| 19 | 216°38.2 | 132°12.5 | 28.9 | 182°25.3 | 48.5 | 208°26.1 | 03.9 | 249°48.7 | 39.6 |
| 20 | 231°40.7 | 147°11.7 | 29.1 | 197°26.1 | 49.0 | 223°28.5 | 04.0 | 264°51.3 | 39.7 |
| 21 | 246°43.2 | 162°10.9 | ·· 29.3 | 212°26.9 | ·· 49.6 | 238°30.8 | ·· 04.0 | 279°53.9 | ·· 39.7 |
| 22 | 261°45.6 | 177°10.1 | 29.5 | 227°27.7 | 50.2 | 253°33.2 | 04.0 | 294°56.5 | 39.8 |
| 23 | 276°48.1 | 192°09.3 | 29.7 | 242°28.5 | 50.7 | 268°35.5 | 04.1 | 309°59.1 | 39.8 |
| Mer.pass. | 04:35 | $\nu$-0.8′ | $d$0.2′ | m-3.8 | $\nu$0.8′ | $d$0.6′ | m0.3 | $\nu$2.3′ | $d$0.0′ m-2.4 | $\nu$2.6′ | $d$-0.1′ m0.5 |

| Thu | GHA | GHA | Dec | GHA | Dec | GHA | Dec | GHA | Dec |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 291°50.6 | 207°08.6 | N22°30.0 | 257°29.3 | N11°51.3 | 283°37.9 | N02°04.1 | 325°01.7 | S14°39.9 |
| 1 | 306°53.0 | 222°07.8 | 30.2 | 272°30.1 | 51.9 | 298°40.2 | 04.1 | 340°04.3 | 39.9 |
| 2 | 321°55.5 | 237°07.0 | 30.4 | 287°30.9 | 52.5 | 313°42.6 | 04.2 | 355°06.9 | 40.0 |
| 3 | 336°58.0 | 252°06.2 | ·· 30.6 | 302°31.8 | ·· 53.0 | 328°44.9 | ·· 04.2 | 10°09.5 | ·· 40.0 |
| 4 | 352°00.4 | 267°05.4 | 30.8 | 317°32.6 | 53.6 | 343°47.3 | 04.3 | 25°12.1 | 40.1 |
| 5 | 7°02.9 | 282°04.6 | 31.0 | 332°33.4 | 54.2 | 358°49.6 | 04.3 | 40°14.7 | 40.1 |
| 6 | 22°05.3 | 297°03.8 | N22°31.2 | 347°34.2 | N11°54.7 | 13°52.0 | N02°04.3 | 55°17.3 | S14°40.2 |
| 7 | 37°07.8 | 312°03.1 | 31.5 | 2°35.0 | 55.3 | 28°54.3 | 04.4 | 70°19.9 | 40.2 |
| 8 | 52°10.3 | 327°02.3 | 31.7 | 17°35.8 | 55.9 | 43°56.7 | 04.4 | 85°22.5 | 40.3 |
| 9 | 67°12.7 | 342°01.5 | ·· 31.9 | 32°36.6 | ·· 56.5 | 58°59.0 | ·· 04.4 | 100°25.1 | ·· 40.3 |
| 10 | 82°15.2 | 357°00.7 | 32.1 | 47°37.5 | 57.0 | 74°01.4 | 04.5 | 115°27.7 | 40.4 |
| 11 | 97°17.7 | 11°59.9 | 32.3 | 62°38.3 | 57.6 | 89°03.7 | 04.5 | 130°30.3 | 40.4 |
| 12 | 112°20.1 | 26°59.1 | N22°32.5 | 77°39.1 | N11°58.2 | 104°06.1 | N02°04.5 | 145°32.9 | S14°40.5 |
| 13 | 127°22.6 | 41°58.3 | 32.7 | 92°39.9 | 58.7 | 119°08.4 | 04.6 | 160°35.5 | 40.6 |
| 14 | 142°25.1 | 56°57.5 | 32.9 | 107°40.7 | 59.3 | 134°10.8 | 04.6 | 175°38.1 | 40.6 |
| 15 | 157°27.5 | 71°56.8 | ·· 33.1 | 122°41.5 | 11°59.9 | 149°13.2 | ·· 04.6 | 190°40.7 | ·· 40.7 |
| 16 | 172°30.0 | 86°56.0 | 33.3 | 137°42.3 | 12°00.4 | 164°15.5 | 04.7 | 205°43.3 | 40.7 |
| 17 | 187°32.5 | 101°55.2 | 33.5 | 152°43.2 | 01.0 | 179°17.9 | 04.7 | 220°45.9 | 40.8 |
| 18 | 202°34.9 | 116°54.4 | N22°33.7 | 167°44.0 | N12°01.6 | 194°20.2 | N02°04.7 | 235°48.5 | S14°40.8 |
| 19 | 217°37.4 | 131°53.6 | 33.9 | 182°44.8 | 02.1 | 209°22.6 | 04.8 | 250°51.1 | 40.9 |
| 20 | 232°39.8 | 146°52.8 | 34.1 | 197°45.6 | 02.7 | 224°24.9 | 04.8 | 265°53.7 | 40.9 |
| 21 | 247°42.3 | 161°52.0 | ·· 34.3 | 212°46.4 | ·· 03.3 | 239°27.3 | ·· 04.8 | 280°56.3 | ·· 41.0 |
| 22 | 262°44.8 | 176°51.2 | 34.5 | 227°47.2 | 03.8 | 254°29.6 | 04.9 | 295°58.9 | 41.0 |
| 23 | 277°47.2 | 191°50.4 | 34.7 | 242°48.1 | 04.4 | 269°32.0 | 04.9 | 311°01.5 | 41.1 |
| Mer.pass. | 04:31 | $\nu$-0.8′ | $d$0.2′ | m-3.8 | $\nu$0.8′ | $d$0.6′ | m0.3 | $\nu$2.3′ | $d$0.0′ m-2.4 | $\nu$2.6′ | $d$-0.1′ m0.5 |

| Fri | GHA | GHA | Dec | GHA | Dec | GHA | Dec | GHA | Dec |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 292°49.7 | 206°49.6 | N22°34.9 | 257°48.9 | N12°05.0 | 284°34.3 | N02°04.9 | 326°04.1 | S14°41.1 |
| 1 | 307°52.2 | 221°48.9 | 35.1 | 272°49.7 | 05.5 | 299°36.7 | 05.0 | 341°06.7 | 41.2 |
| 2 | 322°54.6 | 236°48.1 | 35.3 | 287°50.5 | 06.1 | 314°39.1 | 05.0 | 356°09.3 | 41.3 |
| 3 | 337°57.1 | 251°47.3 | ·· 35.5 | 302°51.3 | ·· 06.7 | 329°41.4 | ·· 05.0 | 11°12.0 | ·· 41.3 |
| 4 | 352°59.6 | 266°46.5 | 35.6 | 317°52.1 | 07.2 | 344°43.8 | 05.1 | 26°14.6 | 41.4 |
| 5 | 8°02.0 | 281°45.7 | 35.8 | 332°52.9 | 07.8 | 359°46.1 | 05.1 | 41°17.2 | 41.4 |
| 6 | 23°04.5 | 296°44.9 | N22°36.0 | 347°53.8 | N12°08.4 | 14°48.5 | N02°05.1 | 56°19.8 | S14°41.5 |
| 7 | 38°06.9 | 311°44.1 | 36.2 | 2°54.6 | 08.9 | 29°50.9 | 05.2 | 71°22.4 | 41.5 |
| 8 | 53°09.4 | 326°43.3 | 36.4 | 17°55.4 | 09.5 | 44°53.2 | 05.2 | 86°25.0 | 41.6 |
| 9 | 68°11.9 | 341°42.5 | ·· 36.6 | 32°56.2 | ·· 10.1 | 59°55.6 | ·· 05.2 | 101°27.6 | ·· 41.6 |
| 10 | 83°14.3 | 356°41.7 | 36.7 | 47°57.0 | 10.6 | 74°57.9 | 05.3 | 116°30.2 | 41.7 |
| 11 | 98°16.8 | 11°40.9 | 36.9 | 62°57.8 | 11.2 | 90°00.3 | 05.3 | 131°32.8 | 41.7 |
| 12 | 113°19.3 | 26°40.1 | N22°37.1 | 77°58.7 | N12°11.8 | 105°02.6 | N02°05.3 | 146°35.4 | S14°41.8 |
| 13 | 128°21.7 | 41°39.3 | 37.3 | 92°59.5 | 12.3 | 120°05.0 | 05.4 | 161°38.0 | 41.8 |
| 14 | 143°24.2 | 56°38.5 | 37.5 | 108°00.3 | 12.9 | 135°07.4 | 05.4 | 176°40.6 | 41.9 |
| 15 | 158°26.7 | 71°37.8 | ·· 37.6 | 123°01.1 | ·· 13.4 | 150°09.7 | ·· 05.4 | 191°43.2 | ·· 42.0 |
| 16 | 173°29.1 | 86°37.0 | 37.8 | 138°01.9 | 14.0 | 165°12.1 | 05.4 | 206°45.8 | 42.0 |
| 17 | 188°31.6 | 101°36.2 | 38.0 | 153°02.7 | 14.6 | 180°14.4 | 05.5 | 221°48.4 | 42.1 |
| 18 | 203°34.1 | 116°35.4 | N22°38.2 | 168°03.6 | N12°15.1 | 195°16.8 | N02°05.5 | 236°51.0 | S14°42.1 |
| 19 | 218°36.5 | 131°34.6 | 38.3 | 183°04.4 | 15.7 | 210°19.2 | 05.5 | 251°53.6 | 42.2 |
| 20 | 233°39.0 | 146°33.8 | 38.5 | 198°05.2 | 16.3 | 225°21.5 | 05.6 | 266°56.2 | 42.2 |
| 21 | 248°41.4 | 161°33.0 | ·· 38.7 | 213°06.0 | ·· 16.8 | 240°23.9 | ·· 05.6 | 281°58.8 | ·· 42.3 |
| 22 | 263°43.9 | 176°32.2 | 38.8 | 228°06.8 | 17.4 | 255°26.3 | 05.6 | 297°01.4 | 42.3 |
| 23 | 278°46.4 | 191°31.4 | 39.0 | 243°07.6 | 17.9 | 270°28.6 | 05.7 | 312°04.0 | 42.4 |
| Mer.pass. | 04:27 | $\nu$-0.8′ | $d$0.2′ | m-3.8 | $\nu$0.8′ | $d$0.6′ | m0.3 | $\nu$2.4′ | $d$0.0′ m-2.4 | $\nu$2.6′ | $d$-0.1′ m0.5 |

### Stars

| | SHA | Dec |
|---|---|---|
| Alpheratz | 357°36.8 | 29°12.7 |
| Ankaa | 353°09.1 | -42°10.8 |
| Schedar | 349°33.2 | 56°39.3 |
| Diphda | 348°49.3 | -17°51.7 |
| Achernar | 335°21.8 | -57°07.1 |
| Hamal | 327°53.6 | 23°34.0 |
| Polaris | 315°11.9 | 89°21.2 |
| Acamar | 315°13.5 | -40°12.7 |
| Menkar | 314°08.4 | 4°10.7 |
| Mirfak | 308°31.4 | 49°56.2 |
| Aldebaran | 290°42.2 | 16°33.2 |
| Rigel | 281°06.1 | -8°10.5 |
| Capella | 280°25.3 | 46°01.1 |
| Bellatrix | 278°25.4 | 6°22.2 |
| Elnath | 278°04.8 | 28°37.5 |
| Alnilam | 275°40.1 | -1°11.2 |
| Betelgeuse | 270°54.6 | 7°24.7 |
| Canopus | 263°53.8 | -52°42.3 |
| Sirius | 258°28.4 | -16°44.7 |
| Adhara | 255°07.9 | -29°00.1 |
| Procyon | 244°53.3 | 5°10.1 |
| Pollux | 243°20.2 | 27°58.4 |
| Avior | 234°16.2 | -59°34.9 |
| Suhail | 222°48.2 | -43°31.4 |
| Miaplacidus | 221°39.5 | -69°48.6 |
| Alphard | 217°50.1 | -8°45.3 |
| Regulus | 207°36.9 | 11°51.6 |
| Dubhe | 193°44.0 | 61°38.1 |
| Denebola | 182°27.2 | 14°27.0 |
| Gienah | 175°45.8 | -17°40.0 |
| Acrux | 173°02.5 | -63°13.6 |
| Gacrux | 171°54.0 | -57°14.5 |
| Alioth | 166°14.9 | 55°50.6 |
| Spica | 158°24.4 | -11°16.7 |
| Alkaid | 152°53.6 | 49°12.4 |
| Hadar | 148°38.7 | -60°29.1 |
| Menkent | 147°59.9 | -36°28.9 |
| Arcturus | 145°49.7 | 19°04.1 |
| Rigil Kent. | 139°42.9 | -60°55.9 |
| Kochab | 137°19.3 | 74°04.1 |
| Zuben'ubi | 136°58.1 | -16°08.1 |
| Alphecca | 126°05.3 | 26°38.5 |
| Antares | 112°18.1 | -26°28.9 |
| Atria | 107°13.6 | -69°04.2 |
| Sabik | 102°04.8 | -15°45.1 |
| Shaula | 96°12.8 | -37°07.2 |
| Rasalhague | 96°00.1 | 12°32.7 |
| Eltanin | 90°42.6 | 51°29.3 |
| Kaus Aust. | 83°34.8 | -34°22.4 |
| Vega | 80°34.2 | 38°48.3 |
| Nunki | 75°49.9 | -26°16.1 |
| Altair | 62°01.6 | 8°55.7 |
| Peacock | 53°08.4 | -56°39.7 |
| Deneb | 49°26.7 | 45°21.5 |
| Enif | 33°40.5 | 9°58.7 |
| Al Na'ir | 27°35.1 | -46°51.0 |
| Fomalhaut | 15°16.6 | -29°30.1 |
| Scheat | 13°47.0 | 28°12.1 |
| Markab | 13°31.7 | 15°19.5 |

| Jul 13 Wed | SHA | Mer.pass |
|---|---|---|
| Venus | 276°35.9 | 10:11 |
| Mars | 326°18.4 | 06:51 |
| Jupiter | 351°50.2 | 05:08 |
| Saturn | 33°07.9 | 02:24 |

| Jul 14 Thu | SHA | Mer.pass |
|---|---|---|
| Venus | 275°18.0 | 10:12 |
| Mars | 325°38.8 | 06:50 |
| Jupiter | 351°47.3 | 05:05 |
| Saturn | 33°11.2 | 02:19 |

| Jul 15 Fri | SHA | Mer.pass |
|---|---|---|
| Venus | 273°59.9 | 10:13 |
| Mars | 324°59.2 | 06:48 |
| Jupiter | 351°44.6 | 05:01 |
| Saturn | 33°14.4 | 02:15 |

| Horizontal parallax | |
|---|---|
| Venus: | 0.1 |
| Mars: | 0.1 |

| h | Sun | | Moon | | | | |
|---|---|---|---|---|---|---|---|
| Wed | GHA | Dec | GHA | $\nu$ | Dec | $d$ | HP |
| 0 | 178°33.8 | N21°51.4 | 10°13.1 | 0.7′ | S26°54.4 | 0.7′ | 61.3′ |
| 1 | 193°33.7 | 51.0 | 24°32.8 | 0.7′ | 26°53.7 | 0.9′ | 61.4′ |
| 2 | 208°33.6 | 50.7 | 38°52.6 | 0.7′ | 26°52.8 | 1.1′ | 61.4′ |
| 3 | 223°33.6 | ·· 50.3 | 53°12.3 | 0.7′ | 26°51.7 | 1.3′ | 61.4′ |
| 4 | 238°33.5 | 50.0 | 67°32.0 | 0.7′ | 26°50.3 | 1.5′ | 61.4′ |
| 5 | 253°33.4 | 49.6 | 81°51.8 | 0.8′ | 26°48.8 | 1.8′ | 61.4′ |
| 6 | 268°33.3 | N21°49.2 | 96°11.5 | 0.8′ | S26°47.0 | 2.0′ | 61.4′ |
| 7 | 283°33.3 | 48.9 | 110°31.3 | 0.8′ | 26°45.1 | 2.2′ | 61.4′ |
| 8 | 298°33.2 | 48.5 | 124°51.1 | 0.8′ | 26°42.9 | 2.4′ | 61.4′ |
| 9 | 313°33.1 | ·· 48.1 | 139°11.0 | 0.9′ | 26°40.5 | 2.6′ | 61.4′ |
| 10 | 328°33.1 | 47.8 | 153°30.8 | 0.9′ | 26°37.9 | 2.8′ | 61.4′ |
| 11 | 343°33.0 | 47.4 | 167°50.7 | 0.9′ | 26°35.0 | 3.0′ | 61.4′ |
| 12 | 358°32.9 | N21°47.0 | 182°10.7 | 1.0′ | S26°32.0 | 3.2′ | 61.4′ |
| 13 | 13°32.8 | 46.7 | 196°30.7 | 1.0′ | 26°28.7 | 3.5′ | 61.4′ |
| 14 | 28°32.8 | 46.3 | 210°50.7 | 1.1′ | 26°25.3 | 3.7′ | 61.4′ |
| 15 | 43°32.7 | ·· 45.9 | 225°10.8 | 1.1′ | 26°21.6 | 3.9′ | 61.4′ |
| 16 | 58°32.6 | 45.6 | 239°30.9 | 1.2′ | 26°17.7 | 4.1′ | 61.4′ |
| 17 | 73°32.6 | 45.2 | 253°51.1 | 1.2′ | 26°13.7 | 4.3′ | 61.4′ |
| 18 | 88°32.5 | N21°44.8 | 268°11.3 | 1.3′ | S26°09.4 | 4.5′ | 61.4′ |
| 19 | 103°32.4 | 44.4 | 282°31.6 | 1.4′ | 26°04.9 | 4.7′ | 61.3′ |
| 20 | 118°32.3 | 44.1 | 296°51.9 | 1.4′ | 26°00.2 | 4.9′ | 61.3′ |
| 21 | 133°32.3 | ·· 43.7 | 311°12.4 | 1.5′ | 25°55.3 | 5.1′ | 61.3′ |
| 22 | 148°32.2 | 43.3 | 325°32.9 | 1.6′ | 25°50.2 | 5.3′ | 61.3′ |
| 23 | 163°32.1 | 43.0 | 339°53.4 | 1.6′ | 25°44.9 | 5.5′ | 61.3′ |
| | SD = 15.7′ | $d$ = -0.4′ | SD = 16.7′ | | | | |
| Thu | GHA | Dec | GHA | $\nu$ | Dec | $d$ | HP |
| 0 | 178°32.1 | N21°42.6 | 354°14.1 | 1.7′ | S25°39.4 | 5.7′ | 61.3′ |
| 1 | 193°32.0 | 42.2 | 8°34.8 | 1.8′ | 25°33.7 | 5.9′ | 61.3′ |
| 2 | 208°31.9 | 41.8 | 22°55.6 | 1.9′ | 25°27.8 | 6.1′ | 61.3′ |
| 3 | 223°31.9 | ·· 41.4 | 37°16.4 | 2.0′ | 25°21.8 | 6.3′ | 61.3′ |
| 4 | 238°31.8 | 41.1 | 51°37.4 | 2.1′ | 25°15.5 | 6.5′ | 61.3′ |
| 5 | 253°31.7 | 40.7 | 65°58.5 | 2.1′ | 25°09.0 | 6.7′ | 61.3′ |
| 6 | 268°31.7 | N21°40.3 | 80°19.6 | 2.2′ | S25°02.4 | 6.8′ | 61.2′ |
| 7 | 283°31.6 | 39.9 | 94°40.8 | 2.3′ | 24°55.5 | 7.0′ | 61.2′ |
| 8 | 298°31.5 | 39.6 | 109°02.2 | 2.4′ | 24°48.5 | 7.2′ | 61.2′ |
| 9 | 313°31.5 | ·· 39.2 | 123°23.6 | 2.5′ | 24°41.3 | 7.4′ | 61.2′ |
| 10 | 328°31.4 | 38.8 | 137°45.1 | 2.6′ | 24°33.9 | 7.6′ | 61.2′ |
| 11 | 343°31.3 | 38.4 | 152°06.7 | 2.7′ | 24°26.3 | 7.8′ | 61.2′ |
| 12 | 358°31.3 | N21°38.0 | 166°28.5 | 2.8′ | S24°18.6 | 7.9′ | 61.2′ |
| 13 | 13°31.2 | 37.6 | 180°50.3 | 2.9′ | 24°10.6 | 8.1′ | 61.1′ |
| 14 | 28°31.1 | 37.3 | 195°12.3 | 3.1′ | 24°02.5 | 8.3′ | 61.1′ |
| 15 | 43°31.1 | ·· 36.9 | 209°34.3 | 3.2′ | 23°54.2 | 8.4′ | 61.1′ |
| 16 | 58°31.0 | 36.5 | 223°56.5 | 3.3′ | 23°45.8 | 8.6′ | 61.1′ |
| 17 | 73°30.9 | 36.1 | 238°18.7 | 3.4′ | 23°37.2 | 8.8′ | 61.1′ |
| 18 | 88°30.9 | N21°35.7 | 252°41.1 | 3.5′ | S23°28.4 | 9.0′ | 61.1′ |
| 19 | 103°30.8 | 35.3 | 267°03.6 | 3.6′ | 23°19.4 | 9.1′ | 61.0′ |
| 20 | 118°30.7 | 34.9 | 281°26.3 | 3.7′ | 23°10.3 | 9.3′ | 61.0′ |
| 21 | 133°30.7 | ·· 34.6 | 295°49.0 | 3.9′ | 23°01.1 | 9.4′ | 61.0′ |
| 22 | 148°30.6 | 34.2 | 310°11.9 | 4.0′ | 22°51.6 | 9.6′ | 61.0′ |
| 23 | 163°30.5 | 33.8 | 324°34.8 | 4.1′ | 22°42.0 | 9.7′ | 61.0′ |
| | SD = 15.7′ | $d$ = -0.4′ | SD = 16.7′ | | | | |
| Fri | GHA | Dec | GHA | $\nu$ | Dec | $d$ | HP |
| 0 | 178°30.5 | N21°33.4 | 338°57.9 | 4.2′ | S22°32.3 | 9.9′ | 60.9′ |
| 1 | 193°30.4 | 33.0 | 353°21.2 | 4.3′ | 22°22.4 | 10.0′ | 60.9′ |
| 2 | 208°30.3 | 32.6 | 7°44.5 | 4.5′ | 22°12.3 | 10.2′ | 60.9′ |
| 3 | 223°30.3 | ·· 32.2 | 22°08.0 | 4.6′ | 22°02.2 | 10.3′ | 60.9′ |
| 4 | 238°30.2 | 31.8 | 36°31.6 | 4.7′ | 21°51.8 | 10.5′ | 60.9′ |
| 5 | 253°30.2 | 31.4 | 50°55.3 | 4.8′ | 21°41.3 | 10.6′ | 60.8′ |
| 6 | 268°30.1 | N21°31.0 | 65°19.1 | 5.0′ | S21°30.7 | 10.8′ | 60.8′ |
| 7 | 283°30.0 | 30.6 | 79°43.1 | 5.1′ | 21°19.9 | 10.9′ | 60.8′ |
| 8 | 298°30.0 | 30.2 | 94°07.2 | 5.2′ | 21°09.0 | 11.0′ | 60.8′ |
| 9 | 313°29.9 | ·· 29.9 | 108°31.4 | 5.4′ | 20°58.0 | 11.2′ | 60.7′ |
| 10 | 328°29.8 | 29.5 | 122°55.8 | 5.5′ | 20°46.8 | 11.3′ | 60.7′ |
| 11 | 343°29.8 | 29.1 | 137°20.3 | 5.6′ | 20°35.6 | 11.4′ | 60.7′ |
| 12 | 358°29.7 | N21°28.7 | 151°44.9 | 5.7′ | S20°24.1 | 11.5′ | 60.7′ |
| 13 | 13°29.7 | 28.3 | 166°09.6 | 5.9′ | 20°12.6 | 11.7′ | 60.6′ |
| 14 | 28°29.6 | 27.9 | 180°34.5 | 6.0′ | 20°00.9 | 11.8′ | 60.6′ |
| 15 | 43°29.5 | ·· 27.5 | 194°59.5 | 6.1′ | 19°49.1 | 11.9′ | 60.6′ |
| 16 | 58°29.5 | 27.1 | 209°24.7 | 6.3′ | 19°37.2 | 12.0′ | 60.5′ |
| 17 | 73°29.4 | 26.7 | 223°49.9 | 6.4′ | 19°25.2 | 12.1′ | 60.5′ |
| 18 | 88°29.4 | N21°26.3 | 238°15.3 | 6.5′ | S19°13.0 | 12.3′ | 60.5′ |
| 19 | 103°29.3 | 25.9 | 252°40.8 | 6.7′ | 19°00.8 | 12.4′ | 60.5′ |
| 20 | 118°29.2 | 25.5 | 267°06.5 | 6.8′ | 18°48.4 | 12.5′ | 60.4′ |
| 21 | 133°29.2 | ·· 25.1 | 281°32.3 | 6.9′ | 18°36.0 | 12.6′ | 60.4′ |
| 22 | 148°29.1 | 24.6 | 295°58.2 | 7.0′ | 18°23.4 | 12.7′ | 60.4′ |
| 23 | 163°29.1 | 24.2 | 310°24.2 | 7.2′ | 18°10.7 | 12.8′ | 60.3′ |
| | SD = 15.7′ | $d$ = -0.4′ | SD = 16.6′ | | | | |

| Lat. | Twilight | | Sunrise | Sunset | Twilight | |
|---|---|---|---|---|---|---|
| | Naut. | Civil | | | Civil | Naut. |
| N 72° | ▭ | ▭ | ▭ | ▭ | ▭ | ▭ |
| N 70° | ▭ | ▭ | ▭ | ▭ | ▭ | ▭ |
| 68° | ▭ | ▭ | ▭ | ▭ | ▭ | ▭ |
| 66° | –:– | –:– | 01:31 | 22:37 | –:– | –:– |
| 64° | –:– | –:– | 02:13 | 21:57 | –:– | –:– |
| 62° | –:– | 00:41 | 02:40 | 21:30 | 23:23 | –:– |
| 60° | –:– | 01:42 | 03:02 | 21:09 | 22:28 | –:– |
| N 58° | –:– | 02:13 | 03:19 | 20:52 | 21:57 | –:– |
| 56° | 00:38 | 02:37 | 03:33 | 20:37 | 21:34 | 23:27 |
| 54° | 01:33 | 02:55 | 03:46 | 20:25 | 21:15 | 22:36 |
| 52° | 02:03 | 03:11 | 03:57 | 20:14 | 21:00 | 22:07 |
| 50° | 02:25 | 03:24 | 04:06 | 20:05 | 20:47 | 21:46 |
| 45° | 03:04 | 03:51 | 04:27 | 19:45 | 20:21 | 21:07 |
| N 40° | 03:31 | 04:11 | 04:43 | 19:28 | 20:00 | 20:40 |
| 35° | 03:52 | 04:28 | 04:57 | 19:15 | 19:44 | 20:19 |
| 30° | 04:09 | 04:42 | 05:09 | 19:03 | 19:30 | 20:02 |
| 20° | 04:36 | 05:05 | 05:29 | 18:43 | 19:07 | 19:36 |
| N 10° | 04:57 | 05:23 | 05:46 | 18:26 | 18:48 | 19:15 |
| 0° | 05:14 | 05:40 | 06:02 | 18:09 | 18:32 | 18:58 |
| S 10° | 05:30 | 05:56 | 06:18 | 17:54 | 18:16 | 18:42 |
| 20° | 05:44 | 06:12 | 06:35 | 17:37 | 18:00 | 18:27 |
| 30° | 05:59 | 06:29 | 06:55 | 17:17 | 17:43 | 18:13 |
| 35° | 06:07 | 06:38 | 07:06 | 17:06 | 17:34 | 18:05 |
| 40° | 06:15 | 06:49 | 07:19 | 16:53 | 17:23 | 17:57 |
| 45° | 06:24 | 07:01 | 07:34 | 16:38 | 17:11 | 17:48 |
| S 50° | 06:35 | 07:15 | 07:53 | 16:20 | 16:57 | 17:37 |
| 52° | 06:39 | 07:22 | 08:01 | 16:11 | 16:50 | 17:33 |
| 54° | 06:44 | 07:29 | 08:11 | 16:01 | 16:43 | 17:28 |
| 56° | 06:49 | 07:37 | 08:22 | 15:50 | 16:35 | 17:23 |
| 58° | 06:55 | 07:46 | 08:35 | 15:37 | 16:26 | 17:17 |
| S 60° | 07:02 | 07:56 | 08:50 | 15:22 | 16:16 | 17:11 |

| Lat. | Moonrise | | | Moonset | | |
|---|---|---|---|---|---|---|
| | Wed | Thu | Fri | Wed | Thu | Fri |
| N 72° | ▬ | ▬ | ▬ | ▬ | ▬ | ▬ |
| N 70° | ▬ | ▬ | ▬ | ▬ | ▬ | ▬ |
| 68° | ▬ | ▬ | ▬ | ▬ | ▬ | ▬ |
| 66° | ▬ | ▬ | 00:04<br>23:31 | ▬ | ▬ | 03:06 |
| 64° | 23:55 | 23:21 | 23:10 | ▬ | 01:01 | 03:49 |
| 62° | 22:45 | 22:52 | 22:53 | 00:24 | 02:11 | 04:17 |
| 60° | 22:09 | 22:29 | 22:39 | 01:13 | 02:46 | 04:39 |
| N 58° | 21:43 | 22:11 | 22:26 | 01:44 | 03:12 | 04:56 |
| 56° | 21:22 | 21:56 | 22:16 | 02:08 | 03:32 | 05:11 |
| 54° | 21:05 | 21:42 | 22:06 | 02:27 | 03:49 | 05:24 |
| 52° | 20:50 | 21:31 | 21:58 | 02:43 | 04:04 | 05:35 |
| 50° | 20:37 | 21:20 | 21:50 | 02:57 | 04:16 | 05:44 |
| 45° | 20:11 | 20:58 | 21:34 | 03:25 | 04:42 | 06:05 |
| N 40° | 19:50 | 20:41 | 21:21 | 03:48 | 05:02 | 06:22 |
| 35° | 19:32 | 20:26 | 21:09 | 04:06 | 05:19 | 06:35 |
| 30° | 19:17 | 20:13 | 20:59 | 04:22 | 05:34 | 06:48 |
| 20° | 18:51 | 19:51 | 20:42 | 04:49 | 05:59 | 07:08 |
| N 10° | 18:29 | 19:31 | 20:27 | 05:12 | 06:20 | 07:26 |
| 0° | 18:08 | 19:13 | 20:13 | 05:33 | 06:40 | 07:42 |
| S 10° | 17:48 | 18:55 | 19:58 | 05:55 | 06:59 | 07:58 |
| 20° | 17:25 | 18:35 | 19:43 | 06:17 | 07:20 | 08:16 |
| 30° | 16:59 | 18:13 | 19:25 | 06:44 | 07:44 | 08:35 |
| 35° | 16:44 | 17:59 | 19:15 | 07:00 | 07:58 | 08:47 |
| 40° | 16:26 | 17:44 | 19:03 | 07:18 | 08:15 | 09:00 |
| 45° | 16:05 | 17:26 | 18:49 | 07:39 | 08:34 | 09:15 |
| S 50° | 15:38 | 17:03 | 18:32 | 08:07 | 08:58 | 09:34 |
| 52° | 15:25 | 16:52 | 18:24 | 08:20 | 09:09 | 09:43 |
| 54° | 15:10 | 16:39 | 18:15 | 08:35 | 09:22 | 09:53 |
| 56° | 14:52 | 16:25 | 18:04 | 08:54 | 09:37 | 10:04 |
| 58° | 14:30 | 16:08 | 17:52 | 09:15 | 09:55 | 10:16 |
| S 60° | 14:02 | 15:47 | 17:39 | 09:43 | 10:16 | 10:31 |

| Day | Sun | | | Moon | | |
|---|---|---|---|---|---|---|
| | Eqn.of Time | | Mer. | Mer.Pass. | | |
| | $00^h$ | $12^h$ | Pass | Upper | Lower | Age |
| | mm:ss | mm:ss | hh:mm | hh:mm | hh:mm | |
| 13 | 05:45 | 05:48 | 12:06 | –:– | 11:51 | 14(99%) |
| 14 | 05:52 | 05:55 | 12:06 | 00:24 | 12:56 | 15(100%) |
| 15 | 05:58 | 06:01 | 12:06 | 01:28 | 13:58 | 16(98%) |

## July 16, 17, 18 (Sat., Sun., Mon.)

| h | Aries | Venus | | Mars | | Jupiter | | Saturn | |
|---|---|---|---|---|---|---|---|---|---|
| Sat | GHA | GHA | Dec | GHA | Dec | GHA | Dec | GHA | Dec |
| 0 | 293°48.8 | 206°30.6 | N22°39.2 | 258°08.5 | N12°18.5 | 285°31.0 | N02°05.7 | 327°06.6 | S14°42.4 |
| 1 | 308°51.3 | 221°29.8 | 39.3 | 273°09.3 | 19.1 | 300°33.3 | 05.7 | 342°09.2 | 42.5 |
| 2 | 323°53.8 | 236°29.0 | 39.5 | 288°10.1 | 19.6 | 315°35.7 | 05.7 | 357°11.8 | 42.6 |
| 3 | 338°56.2 | 251°28.2 | ·· 39.7 | 303°10.9 | ·· 20.2 | 330°38.1 | ·· 05.8 | 12°14.4 | ·· 42.6 |
| 4 | 353°58.7 | 266°27.4 | 39.8 | 318°11.7 | 20.7 | 345°40.4 | 05.8 | 27°17.1 | 42.7 |
| 5 | 9°01.2 | 281°26.6 | 40.0 | 333°12.5 | 21.3 | 0°42.8 | 05.8 | 42°19.7 | 42.7 |
| 6 | 24°03.6 | 296°25.8 | N22°40.2 | 348°13.4 | N12°21.9 | 15°45.2 | N02°05.9 | 57°22.3 | S14°42.8 |
| 7 | 39°06.1 | 311°25.0 | 40.3 | 3°14.2 | 22.4 | 30°47.5 | 05.9 | 72°24.9 | 42.8 |
| 8 | 54°08.6 | 326°24.2 | 40.5 | 18°15.0 | 23.0 | 45°49.9 | 05.9 | 87°27.5 | 42.9 |
| 9 | 69°11.0 | 341°23.4 | ·· 40.6 | 33°15.8 | ·· 23.5 | 60°52.3 | ·· 05.9 | 102°30.1 | ·· 42.9 |
| 10 | 84°13.5 | 356°22.6 | 40.8 | 48°16.6 | 24.1 | 75°54.6 | 06.0 | 117°32.7 | 43.0 |
| 11 | 99°15.9 | 11°21.8 | 40.9 | 63°17.5 | 24.7 | 90°57.0 | 06.0 | 132°35.3 | 43.0 |
| 12 | 114°18.4 | 26°21.0 | N22°41.1 | 78°18.3 | N12°25.2 | 105°59.4 | N02°06.0 | 147°37.9 | S14°43.1 |
| 13 | 129°20.9 | 41°20.2 | 41.2 | 93°19.1 | 25.8 | 121°01.7 | 06.1 | 162°40.5 | 43.2 |
| 14 | 144°23.3 | 56°19.4 | 41.4 | 108°19.9 | 26.3 | 136°04.1 | 06.1 | 177°43.1 | 43.2 |
| 15 | 159°25.8 | 71°18.6 | ·· 41.5 | 123°20.7 | ·· 26.9 | 151°06.5 | ·· 06.1 | 192°45.7 | ·· 43.3 |
| 16 | 174°28.3 | 86°17.8 | 41.7 | 138°21.5 | 27.4 | 166°08.8 | 06.1 | 207°48.3 | 43.3 |
| 17 | 189°30.7 | 101°17.0 | 41.8 | 153°22.4 | 28.0 | 181°11.2 | 06.2 | 222°50.9 | 43.4 |
| 18 | 204°33.2 | 116°16.2 | N22°42.0 | 168°23.2 | N12°28.6 | 196°13.6 | N02°06.2 | 237°53.5 | S14°43.4 |
| 19 | 219°35.7 | 131°15.4 | 42.1 | 183°24.0 | 29.1 | 211°15.9 | 06.2 | 252°56.1 | 43.5 |
| 20 | 234°38.1 | 146°14.6 | 42.3 | 198°24.8 | 29.7 | 226°18.3 | 06.3 | 267°58.8 | 43.5 |
| 21 | 249°40.6 | 161°13.8 | ·· 42.4 | 213°25.6 | ·· 30.2 | 241°20.7 | ·· 06.3 | 283°01.4 | ·· 43.6 |
| 22 | 264°43.0 | 176°13.0 | 42.6 | 228°26.5 | 30.8 | 256°23.1 | 06.3 | 298°04.0 | 43.7 |
| 23 | 279°45.5 | 191°12.2 | 42.7 | 243°27.3 | 31.3 | 271°25.4 | 06.3 | 313°06.6 | 43.7 |
| | Mer.pass. 04:24 | $\nu$-0.8′ | $d$0.2′ m-3.8 | $\nu$0.8′ | $d$0.6′ m0.3 | $\nu$2.4′ | $d$0.0′ m-2.4 | $\nu$2.6′ | $d$-0.1′ m0.5 |

| Sun | GHA | GHA | Dec | GHA | Dec | GHA | Dec | GHA | Dec |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 294°48.0 | 206°11.4 | N22°42.8 | 258°28.1 | N12°31.9 | 286°27.8 | N02°06.4 | 328°09.2 | S14°43.8 |
| 1 | 309°50.4 | 221°10.6 | 43.0 | 273°28.9 | 32.4 | 301°30.2 | 06.4 | 343°11.8 | 43.8 |
| 2 | 324°52.9 | 236°09.8 | 43.1 | 288°29.7 | 33.0 | 316°32.5 | 06.4 | 358°14.4 | 43.9 |
| 3 | 339°55.4 | 251°09.0 | ·· 43.3 | 303°30.5 | ·· 33.6 | 331°34.9 | ·· 06.4 | 13°17.0 | ·· 43.9 |
| 4 | 354°57.8 | 266°08.2 | 43.4 | 318°31.4 | 34.1 | 346°37.3 | 06.5 | 28°19.6 | 44.0 |
| 5 | 10°00.3 | 281°07.4 | 43.5 | 333°32.2 | 34.7 | 1°39.7 | 06.5 | 43°22.2 | 44.0 |
| 6 | 25°02.8 | 296°06.6 | N22°43.7 | 348°33.0 | N12°35.2 | 16°42.0 | N02°06.5 | 58°24.8 | S14°44.1 |
| 7 | 40°05.2 | 311°05.8 | 43.8 | 3°33.8 | 35.8 | 31°44.4 | 06.5 | 73°27.4 | 44.2 |
| 8 | 55°07.7 | 326°05.0 | 43.9 | 18°34.6 | 36.3 | 46°46.8 | 06.6 | 88°30.0 | 44.2 |
| 9 | 70°10.2 | 341°04.2 | ·· 44.0 | 33°35.5 | ·· 36.9 | 61°49.1 | ·· 06.6 | 103°32.7 | ·· 44.3 |
| 10 | 85°12.6 | 356°03.4 | 44.2 | 48°36.3 | 37.4 | 76°51.5 | 06.6 | 118°35.3 | 44.3 |
| 11 | 100°15.1 | 11°02.6 | 44.3 | 63°37.1 | 38.0 | 91°53.9 | 06.6 | 133°37.9 | 44.4 |
| 12 | 115°17.5 | 26°01.8 | N22°44.4 | 78°37.9 | N12°38.5 | 106°56.3 | N02°06.7 | 148°40.5 | S14°44.4 |
| 13 | 130°20.0 | 41°01.0 | 44.6 | 93°38.7 | 39.1 | 121°58.6 | 06.7 | 163°43.1 | 44.5 |
| 14 | 145°22.5 | 56°00.2 | 44.7 | 108°39.6 | 39.6 | 137°01.0 | 06.7 | 178°45.7 | 44.5 |
| 15 | 160°24.9 | 70°59.4 | ·· 44.8 | 123°40.4 | ·· 40.2 | 152°03.4 | ·· 06.7 | 193°48.3 | ·· 44.6 |
| 16 | 175°27.4 | 85°58.6 | 44.9 | 138°41.2 | 40.7 | 167°05.8 | 06.8 | 208°50.9 | 44.7 |
| 17 | 190°29.9 | 100°57.8 | 45.0 | 153°42.0 | 41.3 | 182°08.1 | 06.8 | 223°53.5 | 44.7 |
| 18 | 205°32.3 | 115°57.0 | N22°45.2 | 168°42.8 | N12°41.8 | 197°10.5 | N02°06.8 | 238°56.1 | S14°44.8 |
| 19 | 220°34.8 | 130°56.2 | 45.3 | 183°43.7 | 42.4 | 212°12.9 | 06.8 | 253°58.7 | 44.8 |
| 20 | 235°37.3 | 145°55.4 | 45.4 | 198°44.5 | 42.9 | 227°15.3 | 06.9 | 269°01.4 | 44.9 |
| 21 | 250°39.7 | 160°54.6 | ·· 45.5 | 213°45.3 | ·· 43.5 | 242°17.6 | ·· 06.9 | 284°04.0 | ·· 44.9 |
| 22 | 265°42.2 | 175°53.8 | 45.6 | 228°46.1 | 44.0 | 257°20.0 | 06.9 | 299°06.6 | 45.0 |
| 23 | 280°44.7 | 190°52.9 | 45.7 | 243°46.9 | 44.6 | 272°22.4 | 06.9 | 314°09.2 | 45.0 |
| | Mer.pass. 04:20 | $\nu$-0.8′ | $d$0.1′ m-3.8 | $\nu$0.8′ | $d$0.6′ m0.3 | $\nu$2.4′ | $d$0.0′ m-2.4 | $\nu$2.6′ | $d$-0.1′ m0.5 |

| Mon | GHA | GHA | Dec | GHA | Dec | GHA | Dec | GHA | Dec |
|---|---|---|---|---|---|---|---|---|---|
| 0 | 295°47.1 | 205°52.1 | N22°45.9 | 258°47.8 | N12°45.1 | 287°24.8 | N02°07.0 | 329°11.8 | S14°45.1 |
| 1 | 310°49.6 | 220°51.3 | 46.0 | 273°48.6 | 45.7 | 302°27.2 | 07.0 | 344°14.4 | 45.2 |
| 2 | 325°52.0 | 235°50.5 | 46.1 | 288°49.4 | 46.2 | 317°29.5 | 07.0 | 359°17.0 | 45.2 |
| 3 | 340°54.5 | 250°49.7 | ·· 46.2 | 303°50.2 | ·· 46.8 | 332°31.9 | ·· 07.0 | 14°19.6 | ·· 45.3 |
| 4 | 355°57.0 | 265°48.9 | 46.3 | 318°51.0 | 47.3 | 347°34.3 | 07.1 | 29°22.2 | 45.3 |
| 5 | 10°59.4 | 280°48.1 | 46.4 | 333°51.9 | 47.9 | 2°36.7 | 07.1 | 44°24.8 | 45.4 |
| 6 | 26°01.9 | 295°47.3 | N22°46.5 | 348°52.7 | N12°48.4 | 17°39.0 | N02°07.1 | 59°27.5 | S14°45.4 |
| 7 | 41°04.4 | 310°46.5 | 46.6 | 3°53.5 | 49.0 | 32°41.4 | 07.1 | 74°30.1 | 45.5 |
| 8 | 56°06.8 | 325°45.7 | 46.7 | 18°54.3 | 49.5 | 47°43.8 | 07.1 | 89°32.7 | 45.6 |
| 9 | 71°09.3 | 340°44.9 | ·· 46.8 | 33°55.2 | ·· 50.1 | 62°46.2 | ·· 07.2 | 104°35.3 | ·· 45.6 |
| 10 | 86°11.8 | 355°44.1 | 46.9 | 48°56.0 | 50.6 | 77°48.6 | 07.2 | 119°37.9 | 45.7 |
| 11 | 101°14.2 | 10°43.3 | 47.0 | 63°56.8 | 51.2 | 92°51.0 | 07.2 | 134°40.5 | 45.7 |
| 12 | 116°16.7 | 25°42.5 | N22°47.1 | 78°57.6 | N12°51.7 | 107°53.3 | N02°07.2 | 149°43.1 | S14°45.8 |
| 13 | 131°19.1 | 40°41.7 | 47.2 | 93°58.4 | 52.3 | 122°55.7 | 07.3 | 164°45.7 | 45.8 |
| 14 | 146°21.6 | 55°40.8 | 47.3 | 108°59.3 | 52.8 | 137°58.1 | 07.3 | 179°48.3 | 45.9 |
| 15 | 161°24.1 | 70°40.0 | ·· 47.4 | 124°00.1 | ·· 53.4 | 153°00.5 | ·· 07.3 | 194°51.0 | ·· 45.9 |
| 16 | 176°26.5 | 85°39.2 | 47.5 | 139°00.9 | 53.9 | 168°02.9 | 07.3 | 209°53.6 | 46.0 |
| 17 | 191°29.0 | 100°38.4 | 47.6 | 154°01.7 | 54.5 | 183°05.2 | 07.3 | 224°56.2 | 46.1 |
| 18 | 206°31.5 | 115°37.6 | N22°47.7 | 169°02.5 | N12°55.0 | 198°07.6 | N02°07.4 | 239°58.8 | S14°46.1 |
| 19 | 221°33.9 | 130°36.8 | 47.8 | 184°03.4 | 55.5 | 213°10.0 | 07.4 | 255°01.4 | 46.2 |
| 20 | 236°36.4 | 145°36.0 | 47.9 | 199°04.2 | 56.1 | 228°12.4 | 07.4 | 270°04.0 | 46.2 |
| 21 | 251°38.9 | 160°35.2 | ·· 48.0 | 214°05.0 | ·· 56.6 | 243°14.8 | ·· 07.4 | 285°06.6 | ·· 46.3 |
| 22 | 266°41.3 | 175°34.4 | 48.1 | 229°05.8 | 57.2 | 258°17.2 | 07.4 | 300°09.2 | 46.3 |
| 23 | 281°43.8 | 190°33.6 | 48.2 | 244°06.7 | 57.7 | 273°19.5 | 07.5 | 315°11.9 | 46.4 |
| | Mer.pass. 04:16 | $\nu$-0.8′ | $d$0.1′ m-3.8 | $\nu$0.8′ | $d$0.5′ m0.3 | $\nu$2.4′ | $d$0.0′ m-2.4 | $\nu$2.6′ | $d$-0.1′ m0.5 |

### Stars

| | SHA | Dec |
|---|---|---|
| Alpheratz | 357°36.7 | 29°12.7 |
| Ankaa | 353°09.0 | -42°10.8 |
| Schedar | 349°33.2 | 56°39.3 |
| Diphda | 348°49.3 | -17°51.7 |
| Achernar | 335°21.8 | -57°07.1 |
| Hamal | 327°53.5 | 23°34.0 |
| Polaris | 315°10.5 | 89°21.2 |
| Acamar | 315°13.5 | -40°12.7 |
| Menkar | 314°08.4 | 4°10.7 |
| Mirfak | 308°31.4 | 49°56.2 |
| Aldebaran | 290°42.2 | 16°33.2 |
| Rigel | 281°06.1 | -8°10.5 |
| Capella | 280°25.3 | 46°01.1 |
| Bellatrix | 278°25.4 | 6°22.2 |
| Elnath | 278°04.8 | 28°37.5 |
| Alnilam | 275°40.1 | -1°11.2 |
| Betelgeuse | 270°54.6 | 7°24.7 |
| Canopus | 263°53.8 | -52°42.3 |
| Sirius | 258°28.4 | -16°44.7 |
| Adhara | 255°07.8 | -29°00.1 |
| Procyon | 244°53.3 | 5°10.1 |
| Pollux | 243°20.2 | 27°58.4 |
| Avior | 234°16.2 | -59°34.9 |
| Suhail | 222°48.2 | -43°31.4 |
| Miaplacidus | 221°39.5 | -69°48.6 |
| Alphard | 217°50.1 | -8°45.3 |
| Regulus | 207°36.9 | 11°51.6 |
| Dubhe | 193°44.0 | 61°38.1 |
| Denebola | 182°27.2 | 14°27.0 |
| Gienah | 175°45.8 | -17°40.0 |
| Acrux | 173°02.6 | -63°13.6 |
| Gacrux | 171°54.0 | -57°14.5 |
| Alioth | 166°14.9 | 55°50.6 |
| Spica | 158°24.5 | -11°16.7 |
| Alkaid | 152°53.6 | 49°12.4 |
| Hadar | 148°38.8 | -60°29.1 |
| Menkent | 147°59.9 | -36°28.9 |
| Arcturus | 145°49.7 | 19°04.1 |
| Rigil Kent. | 139°42.9 | -60°55.9 |
| Kochab | 137°19.4 | 74°04.1 |
| Zuben'ubi | 136°58.1 | -16°08.1 |
| Alphecca | 126°05.3 | 26°38.5 |
| Antares | 112°18.1 | -26°28.9 |
| Atria | 107°13.7 | -69°04.2 |
| Sabik | 102°04.8 | -15°45.1 |
| Shaula | 96°12.8 | -37°07.2 |
| Rasalhague | 96°00.1 | 12°32.7 |
| Eltanin | 90°42.6 | 51°29.3 |
| Kaus Aust. | 83°34.8 | -34°22.4 |
| Vega | 80°34.2 | 38°48.3 |
| Nunki | 75°49.9 | -26°16.1 |
| Altair | 62°01.6 | 8°55.7 |
| Peacock | 53°08.3 | -56°39.7 |
| Deneb | 49°26.7 | 45°21.6 |
| Enif | 33°40.5 | 9°58.7 |
| Al Na'ir | 27°35.1 | -46°51.0 |
| Fomalhaut | 15°16.5 | -29°30.1 |
| Scheat | 13°46.9 | 28°12.2 |
| Markab | 13°31.7 | 15°19.5 |

| Jul 16 Sat | SHA | Mer.pass |
|---|---|---|
| Venus | 272°41.8 | 10:15 |
| Mars | 324°19.6 | 06:47 |
| Jupiter | 351°42.1 | 04:57 |
| Saturn | 33°17.8 | 02:11 |

| Jul 17 Sun | SHA | Mer.pass |
|---|---|---|
| Venus | 271°23.4 | 10:16 |
| Mars | 323°40.1 | 06:46 |
| Jupiter | 351°39.8 | 04:53 |
| Saturn | 33°21.2 | 02:07 |

| Jul 18 Mon | SHA | Mer.pass |
|---|---|---|
| Venus | 270°05.0 | 10:17 |
| Mars | 323°00.6 | 06:44 |
| Jupiter | 351°37.7 | 04:50 |
| Saturn | 33°24.7 | 02:03 |

| Horizontal parallax | |
|---|---|
| Venus: | 0.1 |
| Mars: | 0.1 |

| h | Sun | | Moon | | | | |
|---|---|---|---|---|---|---|---|
| Sat | GHA | Dec | GHA | $\nu$ | Dec | $d$ | HP |
| 0 | 178°29.0 | N21°23.8 | 324°50.4 | 7.3′ | S17°57.9 | 12.9′ | 60.3′ |
| 1 | 193°28.9 | 23.4 | 339°16.7 | 7.4′ | 17°45.1 | 13.0′ | 60.3′ |
| 2 | 208°28.9 | 23.0 | 353°43.1 | 7.6′ | 17°32.1 | 13.1′ | 60.2′ |
| 3 | 223°28.8 | ·· 22.6 | 8°09.7 | 7.7′ | 17°19.0 | 13.2′ | 60.2′ |
| 4 | 238°28.8 | 22.2 | 22°36.3 | 7.8′ | 17°05.9 | 13.2′ | 60.2′ |
| 5 | 253°28.7 | 21.8 | 37°03.1 | 7.9′ | 16°52.6 | 13.3′ | 60.1′ |
| 6 | 268°28.6 | N21°21.4 | 51°30.1 | 8.1′ | S16°39.3 | 13.4′ | 60.1′ |
| 7 | 283°28.6 | 21.0 | 65°57.1 | 8.2′ | 16°25.9 | 13.5′ | 60.1′ |
| 8 | 298°28.5 | 20.6 | 80°24.3 | 8.3′ | 16°12.4 | 13.6′ | 60.0′ |
| 9 | 313°28.5 | ·· 20.2 | 94°51.6 | 8.4′ | 15°58.8 | 13.7′ | 60.0′ |
| 10 | 328°28.4 | 19.7 | 109°19.0 | 8.5′ | 15°45.1 | 13.7′ | 60.0′ |
| 11 | 343°28.4 | 19.3 | 123°46.6 | 8.7′ | 15°31.4 | 13.8′ | 59.9′ |
| 12 | 358°28.3 | N21°18.9 | 138°14.2 | 8.8′ | S15°17.6 | 13.9′ | 59.9′ |
| 13 | 13°28.2 | 18.5 | 152°42.0 | 8.9′ | 15°03.7 | 14.0′ | 59.9′ |
| 14 | 28°28.2 | 18.1 | 167°09.9 | 9.0′ | 14°49.8 | 14.0′ | 59.8′ |
| 15 | 43°28.1 | ·· 17.7 | 181°37.9 | 9.1′ | 14°35.7 | 14.1′ | 59.8′ |
| 16 | 58°28.1 | 17.3 | 196°06.1 | 9.3′ | 14°21.6 | 14.2′ | 59.8′ |
| 17 | 73°28.0 | 16.9 | 210°34.3 | 9.4′ | 14°07.5 | 14.2′ | 59.7′ |
| 18 | 88°28.0 | N21°16.4 | 225°02.7 | 9.5′ | S13°53.3 | 14.3′ | 59.7′ |
| 19 | 103°27.9 | 16.0 | 239°31.2 | 9.6′ | 13°39.0 | 14.3′ | 59.6′ |
| 20 | 118°27.9 | 15.6 | 253°59.8 | 9.7′ | 13°24.7 | 14.4′ | 59.6′ |
| 21 | 133°27.8 | ·· 15.2 | 268°28.5 | 9.8′ | 13°10.3 | 14.4′ | 59.6′ |
| 22 | 148°27.8 | 14.8 | 282°57.3 | 9.9′ | 12°55.8 | 14.5′ | 59.5′ |
| 23 | 163°27.7 | 14.3 | 297°26.2 | 10.0′ | 12°41.3 | 14.5′ | 59.5′ |
| | SD = 15.7′ | $d$ = -0.4′ | | SD = 16.5′ | | | |
| Sun | GHA | Dec | GHA | $\nu$ | Dec | $d$ | HP |
| 0 | 178°27.6 | N21°13.9 | 311°55.2 | 10.1′ | S12°26.8 | 14.6′ | 59.5′ |
| 1 | 193°27.6 | 13.5 | 326°24.4 | 10.2′ | 12°12.2 | 14.6′ | 59.4′ |
| 2 | 208°27.5 | 13.1 | 340°53.6 | 10.4′ | 11°57.5 | 14.7′ | 59.4′ |
| 3 | 223°27.5 | ·· 12.7 | 355°23.0 | 10.5′ | 11°42.9 | 14.7′ | 59.3′ |
| 4 | 238°27.4 | 12.2 | 9°52.4 | 10.6′ | 11°28.1 | 14.8′ | 59.3′ |
| 5 | 253°27.4 | 11.8 | 24°22.0 | 10.7′ | 11°13.3 | 14.8′ | 59.3′ |
| 6 | 268°27.3 | N21°11.4 | 38°51.6 | 10.8′ | S10°58.5 | 14.9′ | 59.2′ |
| 7 | 283°27.3 | 11.0 | 53°21.4 | 10.9′ | 10°43.7 | 14.9′ | 59.2′ |
| 8 | 298°27.2 | 10.5 | 67°51.3 | 11.0′ | 10°28.8 | 14.9′ | 59.2′ |
| 9 | 313°27.2 | ·· 10.1 | 82°21.2 | 11.1′ | 10°13.9 | 15.0′ | 59.1′ |
| 10 | 328°27.1 | 09.7 | 96°51.3 | 11.1′ | 09°58.9 | 15.0′ | 59.1′ |
| 11 | 343°27.1 | 09.3 | 111°21.4 | 11.2′ | 09°43.9 | 15.0′ | 59.0′ |
| 12 | 358°27.0 | N21°08.8 | 125°51.7 | 11.3′ | S09°28.9 | 15.0′ | 59.0′ |
| 13 | 13°27.0 | 08.4 | 140°22.0 | 11.4′ | 09°13.8 | 15.1′ | 59.0′ |
| 14 | 28°26.9 | 08.0 | 154°52.4 | 11.5′ | 08°58.8 | 15.1′ | 58.9′ |
| 15 | 43°26.9 | ·· 07.5 | 169°22.9 | 11.6′ | 08°43.7 | 15.1′ | 58.9′ |
| 16 | 58°26.8 | 07.1 | 183°53.5 | 11.7′ | 08°28.6 | 15.1′ | 58.8′ |
| 17 | 73°26.8 | 06.7 | 198°24.2 | 11.8′ | 08°13.4 | 15.2′ | 58.8′ |
| 18 | 88°26.7 | N21°06.2 | 212°55.0 | 11.9′ | S07°58.3 | 15.2′ | 58.8′ |
| 19 | 103°26.7 | 05.8 | 227°25.9 | 11.9′ | 07°43.1 | 15.2′ | 58.7′ |
| 20 | 118°26.6 | 05.4 | 241°56.8 | 12.0′ | 07°27.9 | 15.2′ | 58.7′ |
| 21 | 133°26.6 | ·· 04.9 | 256°27.8 | 12.1′ | 07°12.7 | 15.2′ | 58.6′ |
| 22 | 148°26.5 | 04.5 | 270°58.9 | 12.2′ | 06°57.4 | 15.2′ | 58.6′ |
| 23 | 163°26.5 | 04.1 | 285°30.1 | 12.3′ | 06°42.2 | 15.3′ | 58.6′ |
| | SD = 15.7′ | $d$ = -0.4′ | | SD = 16.2′ | | | |
| Mon | GHA | Dec | GHA | $\nu$ | Dec | $d$ | HP |
| 0 | 178°26.4 | N21°03.6 | 300°01.4 | 12.3′ | S06°26.9 | 15.3′ | 58.5′ |
| 1 | 193°26.4 | 03.2 | 314°32.7 | 12.4′ | 06°11.7 | 15.3′ | 58.5′ |
| 2 | 208°26.3 | 02.8 | 329°04.1 | 12.5′ | 05°56.4 | 15.3′ | 58.4′ |
| 3 | 223°26.3 | ·· 02.3 | 343°35.6 | 12.6′ | 05°41.1 | 15.3′ | 58.4′ |
| 4 | 238°26.2 | 01.9 | 358°07.2 | 12.6′ | 05°25.8 | 15.3′ | 58.4′ |
| 5 | 253°26.2 | 01.5 | 12°38.8 | 12.7′ | 05°10.6 | 15.3′ | 58.3′ |
| 6 | 268°26.1 | N21°01.0 | 27°10.5 | 12.8′ | S04°55.3 | 15.3′ | 58.3′ |
| 7 | 283°26.1 | 00.6 | 41°42.2 | 12.8′ | 04°40.0 | 15.3′ | 58.2′ |
| 8 | 298°26.0 | 21°00.1 | 56°14.1 | 12.9′ | 04°24.7 | 15.3′ | 58.2′ |
| 9 | 313°26.0 | 20°59.7 | 70°46.0 | 13.0′ | 04°09.4 | 15.3′ | 58.2′ |
| 10 | 328°26.0 | 59.3 | 85°17.9 | 13.0′ | 03°54.1 | 15.3′ | 58.1′ |
| 11 | 343°25.9 | 58.8 | 99°49.9 | 13.1′ | 03°38.8 | 15.3′ | 58.1′ |
| 12 | 358°25.9 | N20°58.4 | 114°22.0 | 13.1′ | S03°23.5 | 15.3′ | 58.0′ |
| 13 | 13°25.8 | 57.9 | 128°54.2 | 13.2′ | 03°08.3 | 15.3′ | 58.0′ |
| 14 | 28°25.8 | 57.5 | 143°26.4 | 13.3′ | 02°53.0 | 15.3′ | 58.0′ |
| 15 | 43°25.7 | ·· 57.0 | 157°58.6 | 13.3′ | 02°37.7 | 15.3′ | 57.9′ |
| 16 | 58°25.7 | 56.6 | 172°30.9 | 13.4′ | 02°22.5 | 15.2′ | 57.9′ |
| 17 | 73°25.6 | 56.2 | 187°03.3 | 13.4′ | 02°07.2 | 15.2′ | 57.8′ |
| 18 | 88°25.6 | N20°55.7 | 201°35.7 | 13.5′ | S01°52.0 | 15.2′ | 57.8′ |
| 19 | 103°25.5 | 55.3 | 216°08.2 | 13.5′ | 01°36.8 | 15.2′ | 57.8′ |
| 20 | 118°25.5 | 54.8 | 230°40.7 | 13.6′ | 01°21.6 | 15.2′ | 57.7′ |
| 21 | 133°25.5 | ·· 54.4 | 245°13.3 | 13.6′ | 01°06.4 | 15.2′ | 57.7′ |
| 22 | 148°25.4 | 53.9 | 259°45.9 | 13.7′ | 00°51.2 | 15.2′ | 57.6′ |
| 23 | 163°25.4 | 53.5 | 274°18.6 | 13.7′ | 00°36.1 | 15.1′ | 57.6′ |
| | SD = 15.7′ | $d$ = -0.4′ | | SD = 16.0′ | | | |

| Lat. | Twilight | | Sunrise | Sunset | Twilight | |
|---|---|---|---|---|---|---|
| | Naut. | Civil | | | Civil | Naut. |
| N 72° | ▭ | ▭ | ▭ | ▭ | ▭ | ▭ |
| N 70° | ▭ | ▭ | ▭ | ▭ | ▭ | ▭ |
| 68° | ▭ | ▭ | ▭ | ▭ | ▭ | ▭ |
| 66° | –:– | –:– | 01:44 | 22:25 | –:– | –:– |
| 64° | –:– | –:– | 02:21 | 21:49 | –:– | –:– |
| 62° | –:– | 01:03 | 02:47 | 21:23 | 23:04 | –:– |
| 60° | –:– | 01:51 | 03:07 | 21:04 | 22:18 | –:– |
| N 58° | –:– | 02:21 | 03:24 | 20:47 | 21:50 | –:– |
| 56° | 00:58 | 02:43 | 03:38 | 20:34 | 21:28 | 23:09 |
| 54° | 01:42 | 03:00 | 03:50 | 20:22 | 21:11 | 22:28 |
| 52° | 02:09 | 03:15 | 04:00 | 20:11 | 20:56 | 22:01 |
| 50° | 02:30 | 03:28 | 04:10 | 20:02 | 20:44 | 21:41 |
| 45° | 03:07 | 03:54 | 04:29 | 19:42 | 20:18 | 21:04 |
| N 40° | 03:34 | 04:14 | 04:45 | 19:27 | 19:58 | 20:38 |
| 35° | 03:54 | 04:30 | 04:59 | 19:13 | 19:42 | 20:18 |
| 30° | 04:11 | 04:43 | 05:10 | 19:02 | 19:29 | 20:01 |
| 20° | 04:37 | 05:06 | 05:30 | 18:42 | 19:06 | 19:35 |
| N 10° | 04:58 | 05:24 | 05:47 | 18:25 | 18:48 | 19:15 |
| 0° | 05:15 | 05:40 | 06:03 | 18:10 | 18:32 | 18:58 |
| S 10° | 05:30 | 05:56 | 06:18 | 17:54 | 18:17 | 18:43 |
| 20° | 05:44 | 06:11 | 06:35 | 17:38 | 18:01 | 18:28 |
| 30° | 05:58 | 06:28 | 06:54 | 17:19 | 17:45 | 18:14 |
| 35° | 06:06 | 06:37 | 07:05 | 17:08 | 17:36 | 18:07 |
| 40° | 06:14 | 06:47 | 07:17 | 16:55 | 17:25 | 17:59 |
| 45° | 06:23 | 06:59 | 07:32 | 16:41 | 17:14 | 17:50 |
| S 50° | 06:33 | 07:13 | 07:50 | 16:23 | 17:00 | 17:40 |
| 52° | 06:37 | 07:19 | 07:59 | 16:14 | 16:53 | 17:36 |
| 54° | 06:42 | 07:26 | 08:08 | 16:05 | 16:46 | 17:31 |
| 56° | 06:47 | 07:34 | 08:19 | 15:54 | 16:39 | 17:26 |
| 58° | 06:52 | 07:43 | 08:31 | 15:42 | 16:30 | 17:21 |
| S 60° | 06:58 | 07:52 | 08:45 | 15:28 | 16:21 | 17:15 |

| Lat. | Moonrise | | | Moonset | | |
|---|---|---|---|---|---|---|
| | Sat | Sun | Mon | Sat | Sun | Mon |
| N 72° | 01:45 | 00:06<br>23:24 | 22:52 | 03:32 | 07:02 | 09:26 |
| N 70° | 00:35<br>23:44 | 23:15 | 22:51 | 04:40 | 07:21 | 09:32 |
| 68° | 23:27 | 23:07 | 22:50 | 05:16 | 07:36 | 09:37 |
| 66° | 23:13 | 23:01 | 22:50 | 05:41 | 07:48 | 09:41 |
| 64° | 23:02 | 22:55 | 22:49 | 06:01 | 07:58 | 09:44 |
| 62° | 22:52 | 22:50 | 22:48 | 06:17 | 08:06 | 09:47 |
| 60° | 22:43 | 22:46 | 22:48 | 06:30 | 08:13 | 09:50 |
| N 58° | 22:36 | 22:42 | 22:48 | 06:41 | 08:20 | 09:52 |
| 56° | 22:29 | 22:39 | 22:47 | 06:51 | 08:25 | 09:54 |
| 54° | 22:23 | 22:36 | 22:47 | 06:59 | 08:30 | 09:56 |
| 52° | 22:18 | 22:33 | 22:47 | 07:07 | 08:35 | 09:58 |
| 50° | 22:13 | 22:31 | 22:46 | 07:14 | 08:39 | 09:59 |
| 45° | 22:02 | 22:25 | 22:46 | 07:28 | 08:47 | 10:03 |
| N 40° | 21:53 | 22:21 | 22:45 | 07:40 | 08:55 | 10:05 |
| 35° | 21:46 | 22:17 | 22:45 | 07:50 | 09:01 | 10:08 |
| 30° | 21:39 | 22:13 | 22:44 | 07:59 | 09:06 | 10:10 |
| 20° | 21:27 | 22:07 | 22:44 | 08:14 | 09:15 | 10:13 |
| N 10° | 21:17 | 22:02 | 22:43 | 08:27 | 09:24 | 10:16 |
| 0° | 21:07 | 21:57 | 22:43 | 08:39 | 09:31 | 10:19 |
| S 10° | 20:57 | 21:51 | 22:42 | 08:51 | 09:38 | 10:22 |
| 20° | 20:47 | 21:46 | 22:42 | 09:04 | 09:46 | 10:25 |
| 30° | 20:35 | 21:40 | 22:41 | 09:18 | 09:55 | 10:28 |
| 35° | 20:28 | 21:36 | 22:41 | 09:27 | 10:00 | 10:30 |
| 40° | 20:20 | 21:32 | 22:41 | 09:36 | 10:06 | 10:32 |
| 45° | 20:10 | 21:27 | 22:40 | 09:47 | 10:12 | 10:34 |
| S 50° | 19:59 | 21:21 | 22:40 | 10:00 | 10:20 | 10:37 |
| 52° | 19:54 | 21:19 | 22:39 | 10:06 | 10:24 | 10:38 |
| 54° | 19:48 | 21:16 | 22:39 | 10:13 | 10:28 | 10:40 |
| 56° | 19:41 | 21:13 | 22:39 | 10:21 | 10:32 | 10:41 |
| 58° | 19:34 | 21:09 | 22:39 | 10:29 | 10:37 | 10:43 |
| S 60° | 19:26 | 21:05 | 22:38 | 10:38 | 10:42 | 10:45 |

| Day | Sun | | | Moon | | |
|---|---|---|---|---|---|---|
| | Eqn.of Time | | Mer. | Mer.Pass. | | |
| | $00^h$ | $12^h$ | Pass | Upper | Lower | Age |
| | mm:ss | mm:ss | hh:mm | hh:mm | hh:mm | |
| 16 | 06:04 | 06:07 | 12:06 | 02:26 | 14:53 | 17(93%) |
| 17 | 06:09 | 06:12 | 12:06 | 03:19 | 15:44 | 18(85%) |
| 18 | 06:14 | 06:17 | 12:06 | 04:08 | 16:31 | 19(76%) |