

## Explanation of The Nautical Almanac *Daily Pages*

Refer to the next several pages

|    |   |
|----|---|
| 1  | Date and Time based on GMT/UT   |
| 2  | <b>Mer. pass-</b> meridian passage of Aries at the Prime Meridian- Greenwich- 0°. Time figure is GMT/UT.  |
| 3  | GHA <b>v</b> correction and Declination <b>d</b> correction. The amount to correct <b>v</b> and <b>d</b> for is determined by the minutes and seconds of time of the planet observation and is found in the <i>Increments and Corrections</i> pages of The Nautical Almanac.  |
| 4  | <b>m-</b> is the <i>magnitude</i> or brightness of the planet. A bright planet will have a <i>minus</i> sign beside the figure. A fainter planet will have no sign beside its magnitude figure.   |
| 5  | <b>Stars- SHA, Sidereal Hour Angle, and Declination.</b> 59 stars are listed. Typically, only 57 stars are used for navigational purposes in both Northern and Southern Hemispheres.  |
| 6  | <b>Mer. pass-</b> planet meridian passage time at the Prime Meridian- Greenwich- 0°. Time figure is GMT/UT.   |
| 7  | <b>SHA-</b> planet SHA. Planet SHA is calculated by subtracting Aries GHA from planet GHA. If planet GHA figure is less than Aries GHA, add 360° to planet GHA and then subtract Aries GHA.   |
| 8  | <b>Horizontal parallax-</b> for Venus and Mars.   |
| 9  | <b>SD-</b> Semi-diameter of the Sun. One half of the angular width of the Sun as observed on earth.   |
| 10 | <b>d-</b> the amount the declination of the Sun changes per hour.   |
| 11 | The Moon's GHA <b>v</b> correction. The amount to correct the Moon's GHA using <b>v</b> is determined by the minutes and seconds of time of the Moon's observation and is found in the <i>Increments and Corrections</i> pages of The Nautical Almanac.   |
| 12 | <b>SD-</b> Semi-diameter of the Moon. One half of the angular width of the Moon, as observed on earth.  |
| 13 | <p>The Moon's declination <b>d</b> correction. It's the amount of declination the Moon changes per hour. The amount to correct the Moon's declination using <b>d</b> is determined by the minutes and seconds of time of the Moon's observation and is found in the <i>Increments and Corrections</i> pages of The Nautical Almanac. The <b>d</b> correction is <i>algebraically</i> added.</p> <p>An easy way to determine whether to <i>add</i> or <i>subtract</i> the <b>d</b> correction found in the <i>Increments and Corrections</i> pages is by examining the Moon's declination trend in The Nautical Almanac. If the declination is increasing from the integral hour of the observation you made then add the <b>d</b> increment and increase the value of the declination. If the declination is decreasing from the integral hour of the observation you made then subtract the <b>d</b> increment and decrease the value of the declination. Make sure to put the <b>N</b> or <b>S</b> "back on" the corrected declination so you know which hemisphere the Moon's in.</p>  |
| 14 | <b>HP-</b> the angle between two lines, one from the center of the Moon to the center of the Earth, the other from the center of the Moon to the edge of the Earth. This angle is about 56', but it changes slightly from day to day as the distance to the Moon changes along its elliptical path around the Earth. <i>Source- starpath.com</i>  |
| 15 | <p><b>Sun- Eqn. of Time-</b> In its simplicity the Equation of Time is the difference between clock time and time seen on a Sundial. That is comparing "clock time", as a mechanical measurement of time, and the Sundial being time determined by the position of the Sun at any given hour. The figures listed are for GMT/UT at 00<sup>h</sup> and 12<sup>h</sup>. If you look at <b>Mer. Pass</b> just to the right of the <b>Eqn. of Time</b> you'll find, approximately, when the Sun crosses The Prime Meridian (at Greenwich). The figures in the 12<sup>h</sup> column indicate, approximately, how many minutes and seconds are subtracted, or added, to 12 to determine when Local Apparent Noon is at The Prime Meridian. You can calculate, approximately, when LAN is at your Longitude by adding, or subtracting the amount of time difference between you and Greenwich and the Equation of Time. An Equation of Time chart is provided in each almanac on TheNauticalAlmanac.com</p> <p><b>Example-</b> May 30, 2016. <b>Mer. Pass</b> is at UT 11:58. <b>12<sup>h</sup></b> is 02:25. This means <i>subtract</i> 2 minutes and 25 seconds from UT 12 to calculate when Meridian Passage is at Greenwich. So at W 075° meridian passage would occur at about- 12 hours + 5 hours <i>MINUS</i> 2 minutes and 25 seconds, or UT 16:57:35</p> |

|                                   |   |
|-----------------------------------|---|
| 16                                | <b>Sun- Mer. Pass</b> just to the right of the <b>Eqn. of Time</b> is the approximate GMT/UT when the Sun crosses The Prime Meridian (at Greenwich) for that specific date.   |
| 17                                | <b>Moon- Mer. Pass-</b> is the approximate GMT/UT when the Moon crosses The Prime Meridian (at Greenwich) or The International Date Line for that specific date. <b>Upper</b> means the GMT/UT when the Moon crosses The Prime Meridian (Greenwich) and <b>Lower</b> means the GMT/UT when the Moon crosses The International Date Line (180°).   |
| 18                                | <b>Moon- Age-</b> this is the number of days past a new Moon. Typically, there are 29 days in a lunar month.<br><b>Moon- %-</b> the amount of the Moon's illumination. 100% would be a full moon. 49% would be about ½ of the Moon is illuminated. A 3 day range percentage is provided but only one graphic for the phase.   |
| 19*<br><i>see notes at bottom</i> | <b>(morning) Twilight- Naut.-</b> the approximate GMT/UT when morning Nautical Twilight begins. Nautical twilight is the time when the center of the sun is 12° below the horizon and the horizon is visible enough to be used for marine sextant observations. First locate your approximate Latitude in the <b>Lat.</b> column and then follow across horizontally to the right to find the time.     |
| 19*<br><i>see notes at bottom</i> | <b>(morning) Twilight- Civil-</b> the approximate GMT/UT of morning civil twilight starts when the geometric center of the sun is 6° below the horizon. First locate your approximate Latitude in the <b>Lat.</b> column and then follow across horizontally to the right to find the time.   |
| 19*<br><i>see notes at bottom</i> | <b>Sunrise-</b> the approximate GMT/UT when the Sun is 0° 50' (semi-diameter plus refraction) below the horizon. First locate your approximate Latitude in the <b>Lat.</b> column and then follow across horizontally to the right to find the time.  |
| 19*<br><i>see notes at bottom</i> | <b>(evening) Twilight- Naut.-</b> the approximate GMT/UT of when evening Nautical Twilight ends. Nautical twilight is the time when the center of the sun is 12° below the horizon and the horizon is no longer visible enough to be used for sextant observations. First locate your approximate Latitude in the <b>Lat.</b> column and then follow across horizontally to the right to find the time. |
| 19*<br><i>see notes at bottom</i> | <b>(evening) Twilight- Civil-</b> the approximate GMT/UT of evening civil twilight that ends when the geometric center of the sun is 6° below the horizon. First locate your approximate Latitude in the <b>Lat.</b> column and then follow across horizontally to the right to find the time.  |
| 19*<br><i>see notes at bottom</i> | <b>Sunset-</b> the approximate GMT/UT when the Sun is 0° 50' (semi-diameter plus refraction) below the horizon. First locate your approximate Latitude in the <b>Lat.</b> column and then follow across horizontally to the right to find the time.   |
| 20*<br><i>see notes at bottom</i> | <b>Moonrise-</b> the approximate GMT/UT when the Moon is about 0° 05' to 0° 10' below the horizon. First locate your approximate Latitude in the <b>Lat.</b> column and then follow across horizontally to the right to find the time under the specific day.   |
| 20*<br><i>see notes at bottom</i> | <b>Moonset-</b> the approximate GMT/UT when the Moon is about 0° 05' to 0° 10' below the horizon. First locate your approximate Latitude in the <b>Lat.</b> column and then follow across horizontally to the right to find the time under the specific day.  |

**\* Note-**

☐ means the Sun or Moon remains continuously above the horizon (in some cases twilight all night)

—:— can also mean twilight lasts all night

■ means the Sun or Moon remains continuously below the horizon.

—:— means Moon does not rise or set on that day but may have risen or set the previous day or following day.

**\* Note-** Time of Sunrise, Sunset, Moonrise, Moonset and twilight is based on GMT/UT of the event at 0° (Greenwich). To determine the GMT/UT time at your Longitude add or subtract the time difference between your AP Longitude and Greenwich.

Sunrise, Sunset and twilight figures can be considered as approximate LMT (Local Mean Time) of the phenomena.

January 01, 02 ,03 (Fri., Sat., Sun.)


| Aries           |          |          | Venus            |          |          | Mars            |          |          | Jupiter         |     |     | Saturn          |     |             | Stars    |          |  |
|-----------------|----------|----------|------------------|----------|----------|-----------------|----------|----------|-----------------|-----|-----|-----------------|-----|-------------|----------|----------|--|
| Fri             | GHA      | GHA      | Dec              | GHA      | Dec      | GHA             | Dec      | GHA      | Dec             | GHA | Dec | GHA             | Dec | SHA         | Dec      |          |  |
| 0               | 100°32.5 | 181°58.1 | S23°38.5         | 318°04.0 | N18°45.1 | 131°37.2        | S13°36.5 | 275°29.9 | N00°18.5        |     |     |                 |     | Alpheratz   | 357°46.2 | 29°09.0  |  |
| 1               | 115°35.0 | 196°57.1 |                  | 333°06.8 | 45.4     | 146°39.2        | 36.4     | 290°32.3 | 18.5            |     |     |                 |     | Ankaa       | 353°18.1 | -42°15.2 |  |
| 2               | 130°37.4 | 211°56.1 |                  | 348°09.6 | 45.6     | 161°41.2        | 36.2     | 305°34.7 | 18.5            |     |     |                 |     | Schedar     | 349°43.6 | 56°35.9  |  |
| 3               | 145°39.9 | 226°55.1 | · · 38.2         | 3°12.4   | · · 45.8 | 176°43.2        | · · 36.0 | 320°37.1 | · · 18.5        |     |     |                 |     | Diphda      | 348°58.3 | -17°55.9 |  |
| 4               | 160°42.4 | 241°54.2 | 38.1             | 18°15.2  | 46.0     | 191°45.1        | 35.8     | 335°39.5 | 18.5            |     |     |                 |     | Achernar    | 335°28.3 | -57°11.3 |  |
| 5               | 175°44.8 | 256°53.2 | 38.0             | 33°18.1  | 46.2     | 206°47.1        | 35.7     | 350°41.9 | 18.5            |     |     |                 |     | Hamal       | 328°03.5 | 23°30.8  |  |
| 6               | 190°47.3 | 271°52.2 | S23°37.9         | 48°20.9  | N18°46.5 | 221°49.1        | S13°35.5 | 5°44.3   | N00°18.5        |     |     |                 |     | Polaris     | 318°47.1 | 89°18.8  |  |
| 7               | 205°49.8 | 286°51.3 | 37.8             | 63°23.7  | 46.7     | 236°51.1        | 35.3     | 20°46.7  | 18.5            |     |     |                 |     | Akamar      | 315°19.9 | -40°16.0 |  |
| 8               | 220°52.2 | 301°50.3 | 37.7             | 78°26.5  | 46.9     | 251°53.0        | 35.1     | 35°49.2  | 18.5            |     |     |                 |     | Menkar      | 314°17.5 | 4°07.8   |  |
| 9               | 235°54.7 | 316°49.3 | · · 37.6         | 93°29.4  | · · 47.1 | 266°55.0        | · · 35.0 | 50°51.6  | · · 18.4        |     |     |                 |     | Mirfak      | 308°43.7 | 49°54.0  |  |
| 10              | 250°57.2 | 331°48.4 | 37.5             | 108°32.2 | 47.3     | 281°57.0        | 34.8     | 65°54.0  | 18.4            |     |     |                 |     | Aldebaran   | 290°52.0 | 16°31.9  |  |
| 11              | 265°59.6 | 346°47.4 | 37.4             | 123°35.0 | 47.6     | 296°59.0        | 34.6     | 80°56.4  | 18.4            |     |     |                 |     | Rigel       | 281°14.1 | -8°11.4  |  |
| 12              | 281°02.1 | 1°46.4   | S23°37.3         | 138°37.9 | N18°47.8 | 312°00.9        | S13°34.4 | 95°58.8  | N00°18.4        |     |     |                 |     | Capella     | 280°37.8 | 46°00.6  |  |
| 13              | 296°04.5 | 16°45.5  | 37.2             | 153°40.7 | 48.0     | 327°02.9        | 34.3     | 111°01.2 | 18.4            |     |     |                 |     | Bellatrix   | 278°34.4 | 6°21.5   |  |
| 14              | 311°07.0 | 31°44.5  | 37.1             | 168°43.5 | 48.2     | 342°04.9        | 34.1     | 126°03.6 | 18.4            |     |     |                 |     | Elnath      | 278°15.5 | 28°37.0  |  |
| 15              | 326°09.5 | 46°43.5  | · · 37.0         | 183°46.4 | · · 48.5 | 357°06.8        | · · 33.9 | 141°06.0 | · · 18.4        |     |     |                 |     | Alnilam     | 275°48.6 | -1°11.7  |  |
| 16              | 341°11.9 | 61°42.6  | 36.9             | 198°49.2 | 48.7     | 12°08.8         | 33.7     | 156°08.4 | 18.4            |     |     |                 |     | Betelgeuse  | 271°03.7 | 7°24.5   |  |
| 17              | 356°14.4 | 76°41.6  | 36.8             | 213°52.0 | 48.9     | 27°10.8         | 33.6     | 171°10.8 | 18.4            |     |     |                 |     | Canopus     | 263°56.7 | -52°42.1 |  |
| 18              | 11°16.9  | 91°40.6  | S23°36.7         | 228°54.9 | N18°49.1 | 42°12.8         | S13°33.4 | 186°13.2 | N00°18.3        |     |     |                 |     | Sirius      | 258°35.5 | -16°43.6 |  |
| 19              | 26°19.3  | 106°39.6 | 36.5             | 243°57.7 | 49.4     | 57°14.7         | 33.2     | 201°15.7 | 18.3            |     |     |                 |     | Adara       | 255°14.1 | -28°59.2 |  |
| 20              | 41°21.8  | 121°38.7 | 36.4             | 259°00.6 | 49.6     | 72°16.7         | 33.0     | 216°18.1 | 18.3            |     |     |                 |     | Procyon     | 245°01.9 | 5°12.0   |  |
| 21              | 56°24.3  | 136°37.7 | · · 36.3         | 274°03.4 | · · 49.8 | 87°18.7         | · · 32.9 | 231°20.5 | · · 18.3        |     |     |                 |     | Pollux      | 243°30.3 | 28°00.0  |  |
| 22              | 71°26.7  | 151°36.7 | 36.2             | 289°06.3 | 50.0     | 102°20.7        | 32.7     | 246°22.9 | 18.3            |     |     |                 |     | Avior       | 234°18.6 | -59°32.4 |  |
| 23              | 86°29.2  | 166°35.8 | 36.1             | 304°09.1 | 50.3     | 117°22.6        | 32.5     | 261°25.3 | 18.3            |     |     |                 |     | Suhail      | 222°54.0 | -43°28.3 |  |
| Mer.pass.:17:14 |          |          | v-1.0 d0.1 m-3.8 |          |          | v2.8 d0.2 m-0.7 |          |          | v2.0 d0.2 m-2.0 |     |     | v2.4 d-0.0 m0.9 |     |             |          |          |  |
| Sat             | GHA      | GHA      | Dec              | GHA      | Dec      | GHA             | Dec      | GHA      | Dec             | GHA | Dec | GHA             | Dec |             |          |          |  |
| 0               | 101°31.7 | 181°34.8 | S23°36.0         | 319°12.0 | N18°50.5 | 132°24.6        | S13°32.3 | 276°27.7 | N00°18.3        |     |     |                 |     | Alphard     | 217°58.3 | -8°42.2  |  |
| 1               | 116°34.1 | 196°33.8 | 35.8             | 334°14.8 | 50.7     | 147°26.6        | 32.2     | 291°30.1 | 18.3            |     |     |                 |     | Regulus     | 207°45.9 | 11°54.9  |  |
| 2               | 131°36.6 | 211°32.9 | 35.7             | 349°17.7 | 51.0     | 162°28.6        | 32.0     | 306°32.5 | 18.3            |     |     |                 |     | Dubhe       | 193°54.2 | 61°41.4  |  |
| 3               | 146°39.0 | 226°31.9 | · · 35.6         | 4°20.5   | · · 51.2 | 177°30.5        | · · 31.8 | 321°34.9 | · · 18.3        |     |     |                 |     | Denebola    | 182°36.0 | 14°30.8  |  |
| 4               | 161°41.5 | 241°30.9 | 35.5             | 19°23.4  | 51.4     | 192°32.5        | 31.6     | 336°37.3 | 18.2            |     |     |                 |     | Gienah      | 175°54.9 | -17°35.9 |  |
| 5               | 176°44.0 | 256°30.0 | 35.3             | 34°26.2  | 51.6     | 207°34.5        | 31.5     | 351°39.8 | 18.2            |     |     |                 |     | Acrux       | 173°12.3 | -63°09.1 |  |
| 6               | 191°46.4 | 271°29.0 | S23°35.2         | 49°29.1  | N18°51.9 | 222°36.4        | S13°31.3 | 6°42.2   | N00°18.2        |     |     |                 |     | Gacrux      | 172°03.9 | -57°10.0 |  |
| 7               | 206°48.9 | 286°28.0 | 35.1             | 64°31.9  | 52.1     | 237°38.4        | 31.1     | 21°44.6  | 18.2            |     |     |                 |     | Alioth      | 166°22.8 | 55°53.9  |  |
| 8               | 221°51.4 | 301°27.1 | 34.9             | 79°34.8  | 52.3     | 252°40.4        | 30.9     | 36°47.0  | 18.2            |     |     |                 |     | Spica       | 158°34.0 | -11°12.9 |  |
| 9               | 236°53.8 | 316°26.1 | · · 34.8         | 94°37.7  | · · 52.6 | 267°42.4        | · · 30.8 | 51°49.4  | · · 18.2        |     |     |                 |     | Alcaid      | 153°00.9 | 49°15.4  |  |
| 10              | 251°56.3 | 331°25.1 | 34.7             | 109°40.5 | 52.8     | 282°44.3        | 30.6     | 66°51.8  | 18.2            |     |     |                 |     | Hadar       | 148°51.9 | -60°25.1 |  |
| 11              | 266°58.8 | 346°24.2 | 34.5             | 124°43.4 | 53.0     | 297°46.3        | 30.4     | 81°54.2  | 18.2            |     |     |                 |     | Menkent     | 148°10.8 | -36°25.1 |  |
| 12              | 282°01.2 | 1°23.2   | S23°34.4         | 139°46.3 | N18°53.3 | 312°48.3        | S13°30.2 | 96°56.6  | N00°18.2        |     |     |                 |     | Arcturus    | 145°58.0 | 19°07.9  |  |
| 13              | 297°03.7 | 16°22.2  | 34.3             | 154°49.1 | 53.5     | 327°50.2        | 30.1     | 111°59.1 | 18.2            |     |     |                 |     | Rigel Kent. | 139°55.6 | -60°52.4 |  |
| 14              | 312°06.1 | 31°21.3  | 34.1             | 169°52.0 | 53.7     | 342°52.2        | 29.9     | 127°01.5 | 18.2            |     |     |                 |     | Zubenelg.   | 137°08.4 | -16°05.0 |  |
| 15              | 327°08.6 | 46°20.3  | · · 34.0         | 184°54.9 | · · 54.0 | 357°54.2        | · · 29.7 | 142°03.9 | · · 18.1        |     |     |                 |     | Kochab      | 137°20.2 | 74°06.5  |  |
| 16              | 342°11.1 | 61°19.3  | 33.8             | 199°57.7 | 54.2     | 12°56.2         | 29.5     | 157°06.3 | 18.1            |     |     |                 |     | Alphecca    | 126°13.4 | 26°40.7  |  |
| 17              | 357°13.5 | 76°18.4  | 33.7             | 215°00.6 | 54.4     | 27°58.1         | 29.3     | 172°08.7 | 18.1            |     |     |                 |     | Antares     | 112°29.7 | -26°27.2 |  |
| 18              | 12°16.0  | 91°17.4  | S23°33.6         | 230°03.5 | N18°54.7 | 43°00.1         | S13°29.2 | 187°11.1 | N00°18.1        |     |     |                 |     | Atria       | 107°34.4 | -69°02.6 |  |
| 19              | 27°18.5  | 106°16.5 | 33.4             | 245°06.4 | 54.9     | 58°02.1         | 29.0     | 202°13.5 | 18.1            |     |     |                 |     | Sabik       | 102°15.8 | -15°44.3 |  |
| 20              | 42°20.9  | 121°15.5 | 33.3             | 260°09.3 | 55.1     | 73°04.0         | 28.8     | 217°16.0 | 18.1            |     |     |                 |     | Shaula      | 96°25.8  | -37°06.6 |  |
| 21              | 57°23.4  | 136°14.5 | · · 33.1         | 275°12.1 | · · 55.4 | 88°06.0         | · · 28.6 | 232°18.4 | · · 18.1        |     |     |                 |     | Rasalhague  | 96°09.1  | 12°33.1  |  |
| 22              | 72°25.9  | 151°13.6 | 33.0             | 290°15.0 | 55.6     | 103°08.0        | 28.5     | 247°20.8 | 18.1            |     |     |                 |     | Eltanin     | 90°47.8  | 51°29.2  |  |
| 23              | 87°28.3  | 166°12.6 | 32.8             | 305°17.9 | 55.9     | 118°09.9        | 28.3     | 262°23.2 | 18.1            |     |     |                 |     | Kaus Aust.  | 83°47.5  | -34°22.8 |  |
| Mer.pass.:17:11 |          |          | v-1.0 d0.1 m-3.8 |          |          | v2.9 d0.2 m-0.8 |          |          | v2.0 d0.2 m-1.9 |     |     | v2.4 d-0.0 m0.9 |     |             |          |          |  |
| Sun             | GHA      | GHA      | Dec              | GHA      | Dec      | GHA             | Dec      | GHA      | Dec             | GHA | Dec | GHA             | Dec |             |          |          |  |
| 0               | 102°30.8 | 181°11.6 | S23°32.7         | 320°20.8 | N18°56.1 | 133°11.9        | S13°28.1 | 277°25.6 | N00°18.1        |     |     |                 |     | Jan 01 Fri  | SHA      | Mer.pass |  |
| 1               | 117°33.3 | 196°10.7 | 32.5             | 335°23.7 | 56.3     | 148°13.9        | 27.9     | 292°28.0 | 18.1            |     |     |                 |     | Venus       | 81°25.5  | 11:53    |  |
| 2               | 132°35.7 | 211°09.7 | 32.4             | 350°26.6 | 56.6     | 163°15.9        | 27.8     | 307°30.4 | 18.1            |     |     |                 |     | Mars        | 217°31.4 | 02:47    |  |
| 3               | 147°38.2 | 226°08.7 | · · 32.2         | 5°29.4   | · · 56.8 | 178°17.8        | · · 27.6 | 322°32.9 | · · 18.0        |     |     |                 |     | Jupiter     | 31°04.7  | 15:12    |  |
| 4               | 162°40.6 | 241°07.8 | 32.0             | 20°32.3  | 57.0     | 193°19.8        | 27.4     | 337°35.3 | 18.0            |     |     |                 |     | Saturn      | 174°57.4 | 05:37    |  |
| 5               | 177°43.1 | 256°06.8 | 31.9             | 35°35.2  | 57.3     | 208°21.8        | 27.2     | 352°37.7 | 18.0            |     |     |                 |     |             |          |          |  |
| 6               | 192°45.6 | 271°05.8 | S23°31.7         | 50°38.1  | N18°57.5 | 223°23.7        | S13°27.0 | 7°40.1   | N00°18.0        |     |     |                 |     | Jan 02 Sat  | SHA      | Mer.pass |  |
| 7               | 207°48.0 | 286°04.9 | 31.6             | 65°41.0  | 57.8     | 238°25.7        | 26.9     | 22°42.5  | 18.0            |     |     |                 |     | Venus       | 80°03.2  | 11:54    |  |
| 8               | 222°50.5 | 301°03.9 | 31.4             | 80°43.9  | 58.0     | 253°27.7        | 26.7     | 37°44.9  | 18.0            |     |     |                 |     | Mars        | 217°40.3 | 02:43    |  |
| 9               | 237°53.0 | 316°03.0 | · · 31.2         | 95°46.8  | · · 58.2 | 268°29.6        | · · 26.5 | 52°47.4  | · · 18.0        |     |     |                 |     | Jupiter     | 30°53.0  | 15:08    |  |
| 10              | 252°55.4 | 331°02.0 | 31.1             | 110°49.7 | 58.5     | 283°31.6        | 26.3     | 67°49.8  | 18.0            |     |     |                 |     | Saturn      | 174°56.1 | 05:33    |  |
| 11              | 267°57.9 | 346°01.0 | 30.9             | 125°52.6 | 58.7     | 298°33.6        | 26.2     | 82°52.2  | 18.0            |     |     |                 |     |             |          |          |  |
| 12              | 283°00.4 | 1°00.1   | S23°30.7         | 140°55.5 | N18°59.0 | 313°35.5        | S13°26.0 | 97°54.6  | N00°18.0        |     |     |                 |     | Jan 03 Sun  | SHA      | Mer.pass |  |
| 13              | 298°02.8 | 15°59.1  | 30.6             | 155°58.4 | 59.2     | 328°37.5        | 25.8     | 112°57.0 | 18.0            |     |     |                 |     | Venus       | 78°40.8  | 11:56    |  |
| 14              | 313°05.3 | 30°58.1  | 30.4             | 171°01.3 | 59.5     | 343°39.5        | 25.6     | 127°59.4 | 18.0            |     |     |                 |     | Mars        | 217°50.0 | 02:38    |  |
| 15              | 328°07.8 | 45°57.2  | · · 30.2         | 186°04.2 | · · 59.7 | 358°41.4        | · · 25.4 | 143°01.9 | · · 18.0        |     |     |                 |     | Jupiter     | 30°41.1  | 15:05    |  |
| 16              | 343°10.2 | 60°56.2  | 30.1             | 201°07.1 | 18°59.9  | 13              |          |          |                 |     |     |                 |     |             |          |          |  |

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2010 January 01 to Jan. 03

| Sun            |          |          |          |       |          |        | Moon      |       |             |           |           |             |             |   |       |       |  |  |  |  |  |
|----------------|----------|----------|----------|-------|----------|--------|-----------|-------|-------------|-----------|-----------|-------------|-------------|---|-------|-------|--|--|--|--|--|
| Fri            | GHA      | Dec      | GHA      | $\nu$ | Dec      | d      | HP        | Lat.  | Twilight    |           | Sunrise   | Sunset      | Twilight    |   | Naut. |       |  |  |  |  |  |
| 0              | 179°10.4 | S23°01.6 | 356°04.6 | 3.1'  | N23°30.0 | -7.2'  | 61.0'     | N 72° | Naut.       | 08:23     | 10:40     | ■           | ■           | 13:29   | 15:45 |       |  |  |  |  |  |
| 1              | 194°10.2 | 01.4     | 10°26.6  | 3.1'  | 23°22.7  | -7.3'  | 61.0'     |       | N 70°       | Civil     | 08:04     | 09:48       | ■           | ■   | 14:20 | 16:04 |  |  |  |  |  |
| 2              | 209°09.9 | 01.2     | 24°48.8  | 3.2'  | 23°15.3  | -7.5'  | 61.0'     |       |             | 68°       | 07:49     | 09:16       | ■           | ■   | 14:52 | 16:19 |  |  |  |  |  |
| 3              | 224°09.6 | · 01.0   | 39°11.0  | 3.2'  | 23°07.7  | -7.7'  | 61.0'     |       |             | 66°       | 07:37     | 08:52       | 10:26       | 13:42   | 15:16 | 16:31 |  |  |  |  |  |
| 4              | 239°09.3 | 00.8     | 53°33.3  | 3.3'  | 22°59.9  | -7.9'  | 61.1'     |       |             | 64°       | 07:26     | 08:34       | 09:48       | 14:20   | 15:35 | 16:42 |  |  |  |  |  |
| 5              | 254°09.0 | 00.6     | 67°55.6  | 3.4'  | 22°52.0  | -8.0'  | 61.1'     | 62°   |             | 07:17     | 08:18     | 09:22       | 14:46       | 15:50   | 16:51 |       |  |  |  |  |  |
| 6              | 269°08.7 | S23°00.4 | 82°18.0  | 3.4'  | N22°43.8 | -8.2'  | 61.1'     | N 58° | 60°         | 07:09     | 08:05     | 09:02       | 15:07       | 16:03   | 16:59 |       |  |  |  |  |  |
| 7              | 284°08.4 | 00.2     | 96°40.5  | 3.5'  | 22°35.6  | -8.4'  | 61.1'     |       | 58°         | 07:02     | 07:54     | 08:45       | 15:23       | 16:14   | 17:06 |       |  |  |  |  |  |
| 8              | 299°08.1 | 23°00.0  | 111°03.1 | 3.6'  | 22°27.1  | -8.5'  | 61.1'     |       | 56°         | 06:55     | 07:44     | 08:31       | 15:37       | 16:24   | 17:13 |       |  |  |  |  |  |
| 9              | 314°07.8 | 22°59.8  | 125°25.7 | 3.7'  | 22°18.5  | -8.7'  | 61.1'     |       | 54°         | 06:50     | 07:35     | 08:19       | 15:50       | 16:33   | 17:19 |       |  |  |  |  |  |
| 10             | 329°07.5 | 59.6     | 139°48.4 | 3.7'  | 22°09.7  | -8.9'  | 61.1'     |       | 52°         | 06:44     | 07:28     | 08:08       | 16:00       | 16:41   | 17:24 |       |  |  |  |  |  |
| 11             | 344°07.2 | 59.4     | 154°11.2 | 3.8'  | 22°00.8  | -9.0'  | 61.1'     | N 40° | 50°         | 06:39     | 07:20     | 07:58       | 16:10       | 16:48   | 17:29 |       |  |  |  |  |  |
| 12             | 359°06.9 | S22°59.2 | 168°34.0 | 3.9'  | N21°51.7 | -9.2'  | 61.1'     |       | 45°         | 06:28     | 07:05     | 07:38       | 16:30       | 17:03   | 17:40 |       |  |  |  |  |  |
| 13             | 14°06.6  | 59.0     | 182°57.0 | 4.0'  | 21°42.4  | -9.3'  | 61.1'     |       | 35°         | 06:18     | 06:52     | 07:22       | 16:46       | 17:17   | 17:50 |       |  |  |  |  |  |
| 14             | 29°06.3  | 58.8     | 197°20.0 | 4.1'  | 21°33.0  | -9.5'  | 61.1'     |       | 30°         | 06:09     | 06:40     | 07:08       | 17:00       | 17:28   | 18:00 |       |  |  |  |  |  |
| 15             | 44°06.0  | · 58.6   | 211°43.1 | 4.1'  | 21°23.4  | -9.6'  | 61.1'     |       | 20°         | 06:00     | 06:30     | 06:56       | 17:12       | 17:38   | 18:08 |       |  |  |  |  |  |
| 16             | 59°05.7  | 58.3     | 226°06.3 | 4.2'  | 21°13.7  | -9.8'  | 61.1'     | N 10° | 10°         | 05:44     | 06:11     | 06:35       | 17:33       | 17:57   | 18:24 |       |  |  |  |  |  |
| 17             | 74°05.5  | 58.1     | 240°29.5 | 4.3'  | 21°03.8  | -10.0' | 61.1'     |       | 0°          | 05:28     | 05:55     | 06:17       | 17:51       | 18:13   | 18:40 |       |  |  |  |  |  |
| 18             | 89°05.2  | S22°57.9 | 254°52.9 | 4.4'  | N20°53.8 | -10.1' | 61.1'     |       | 0°          | 05:12     | 05:38     | 06:00       | 18:08       | 18:30   | 18:56 |       |  |  |  |  |  |
| 19             | 104°04.9 | 57.7     | 269°16.3 | 4.5'  | 20°43.6  | -10.2' | 61.1'     |       | S 10°       | 04:53     | 05:20     | 05:43       | 18:25       | 18:48   | 19:15 |       |  |  |  |  |  |
| 20             | 119°04.6 | 57.5     | 283°39.8 | 4.6'  | 20°33.3  | -10.4' | 61.1'     |       | 20°         | 04:31     | 05:00     | 05:25       | 18:43       | 19:08   | 19:37 |       |  |  |  |  |  |
| 21             | 134°04.3 | · 57.3   | 298°03.5 | 4.7'  | 20°22.8  | -10.5' | 61.1'     | S 60° | 30°         | 04:03     | 04:36     | 05:03       | 19:05       | 19:32   | 20:05 |       |  |  |  |  |  |
| 22             | 149°04.0 | 57.1     | 312°27.2 | 4.8'  | 20°12.2  | -10.7' | 61.1'     |       | 35°         | 03:44     | 04:21     | 04:50       | 19:18       | 19:47   | 20:23 |       |  |  |  |  |  |
| 23             | 164°03.7 | 56.8     | 326°51.0 | 4.8'  | 20°01.5  | -10.8' | 61.1'     |       | 40°         | 03:22     | 04:03     | 04:36       | 19:32       | 20:05   | 20:46 |       |  |  |  |  |  |
| SD.=16.3 d=0.2 |          |          |          |       |          |        | S.D.=16.6 |       |             |           |           |             |             |   |       |       |  |  |  |  |  |
|                |          |          |          |       |          |        |           |       |             |           |           |             |             |   |       |       |  |  |  |  |  |
| Sat            | GHA      | Dec      | GHA      | $\nu$ | Dec      | d      | HP        | Lat.  | Fri         | Moonrise  | Sun       | Fri         | Moonset     | Sun   |       |       |  |  |  |  |  |
| 0              | 179°03.4 | S22°56.6 | 341°14.9 | 4.9'  | N19°50.6 | -11.0' | 61.1'     | N 72° | 15:25       | 18:36     | 18:36     | 12:34       | 11:20       |   |       |       |  |  |  |  |  |
| 1              | 194°03.1 | 56.4     | 355°38.8 | 5.0'  | 19°39.6  | -11.1' | 61.1'     | N 70° | 15:17       | 18:54     | 18:54     | 11:40       | 11:00       |   |       |       |  |  |  |  |  |
| 2              | 209°02.8 | 56.2     | 10°02.9  | 5.1'  | 19°28.4  | -11.2' | 61.1'     | 68°   | 13:46       | 16:49     | 19:08     | 12:05       | 11:07       |   |       |       |  |  |  |  |  |
| 3              | 224°02.5 | · 56.0   | 24°27.1  | 5.2'  | 19°17.1  | -11.4' | 61.1'     | 66°   | 14:49       | 17:12     | 19:19     | 11:00       | 10:42       |   |       |       |  |  |  |  |  |
| 4              | 239°02.2 | 55.7     | 38°51.4  | 5.3'  | 19°05.7  | -11.5' | 61.1'     | 64°   | 15:24       | 17:30     | 19:28     | 10:24       | 10:23       |   |       |       |  |  |  |  |  |
| 5              | 254°02.0 | 55.5     | 53°15.7  | 5.4'  | 18°54.2  | -11.6' | 61.1'     | 62°   | 15:49       | 17:45     | 19:36     | 09:58       | 10:07       |   |       |       |  |  |  |  |  |
| 6              | 269°01.7 | S22°55.3 | 67°40.2  | 5.5'  | N18°42.5 | -11.7' | 61.1'     | 60°   | 16:09       | 17:58     | 19:43     | 09:38       | 09:53       |   |       |       |  |  |  |  |  |
| 7              | 284°01.4 | 55.1     | 82°04.7  | 5.6'  | 18°30.7  | -11.9' | 61.1'     | N 58° | 16:25       | 18:08     | 19:49     | 09:21       | 09:42       |   |       |       |  |  |  |  |  |
| 8              | 299°01.1 | 54.8     | 96°29.4  | 5.7'  | 18°18.7  | -12.0' | 61.1'     | 56°   | 16:39       | 18:18     | 19:54     | 09:07       | 09:31       |   |       |       |  |  |  |  |  |
| 9              | 314°00.8 | · 54.6   | 110°54.1 | 5.8'  | 18°06.7  | -12.1' | 61.1'     | 54°   | 16:51       | 18:26     | 19:59     | 08:54       | 09:22       |   |       |       |  |  |  |  |  |
| 10             | 329°00.5 | 54.4     | 125°19.0 | 5.9'  | 17°54.5  | -12.2' | 61.1'     | 52°   | 17:01       | 18:33     | 20:03     | 08:43       | 09:14       |   |       |       |  |  |  |  |  |
| 11             | 344°00.2 | 54.2     | 139°43.9 | 6.0'  | 17°42.3  | -12.3' | 61.1'     | 50°   | 17:11       | 18:40     | 20:07     | 08:33       | 09:07       |   |       |       |  |  |  |  |  |
| 12             | 358°59.9 | S22°53.9 | 154°08.9 | 6.1'  | N17°29.9 | -12.5' | 61.1'     | 45°   | 17:30       | 18:54     | 20:15     | 08:13       | 08:51       |   |       |       |  |  |  |  |  |
| 13             | 13°59.6  | 53.7     | 168°34.1 | 6.2'  | 17°17.3  | -12.6' | 61.1'     | N 40° | 17:46       | 19:05     | 20:22     | 07:56       | 08:39       |   |       |       |  |  |  |  |  |
| 14             | 28°59.3  | 53.5     | 182°59.3 | 6.3'  | 17°04.7  | -12.7' | 61.0'     | 35°   | 17:59       | 19:15     | 20:28     | 07:41       | 08:28       |   |       |       |  |  |  |  |  |
| 15             | 43°59.1  | · 53.2   | 197°24.6 | 6.4'  | 16°52.0  | -12.8' | 61.0'     | 30°   | 18:11       | 19:23     | 20:33     | 07:29       | 08:18       |   |       |       |  |  |  |  |  |
| 16             | 58°58.8  | 53.0     | 211°50.1 | 6.5'  | 16°39.2  | -12.9' | 61.0'     | N 10° | 18:31       | 19:38     | 20:42     | 07:08       | 08:01       |   |       |       |  |  |  |  |  |
| 17             | 73°58.5  | 52.8     | 226°15.6 | 6.6'  | 16°26.2  | -13.0' | 61.0'     | 0°    | 18:48       | 19:51     | 20:50     | 06:49       | 07:46       |   |       |       |  |  |  |  |  |
| 18             | 88°58.2  | S22°52.6 | 240°41.2 | 6.7'  | N16°13.2 | -13.1' | 61.0'     | N 72° | 19:04       | 20:03     | 20:57     | 06:31       | 07:32       |   |       |       |  |  |  |  |  |
| 19             | 103°57.9 | 52.3     | 255°06.9 | 6.8'  | 16°00.0  | -13.2' | 61.0'     | S 10° | 19:20       | 20:14     | 21:05     | 06:14       | 07:18       |   |       |       |  |  |  |  |  |
| 20             | 118°57.6 | 52.1     | 269°32.7 | 6.9'  | 15°46.8  | -13.3' | 61.0'     | 20°   | 19:37       | 20:27     | 21:12     | 05:55       | 07:03       |   |       |       |  |  |  |  |  |
| 21             | 133°57.3 | · 51.9   | 283°58.7 | 7.0'  | 15°33.5  | -13.4' | 61.0'     | 30°   | 19:56       | 20:41     | 21:21     | 05:33       | 06:46       |   |       |       |  |  |  |  |  |
| 22             | 148°57.0 | 51.6     | 298°24.7 | 7.1'  | 15°20.0  | -13.5' | 61.0'     | 35°   | 20:07       | 20:50     | 21:26     | 05:20       | 06:35       |   |       |       |  |  |  |  |  |
| 23             | 163°56.7 | 51.4     | 312°50.8 | 7.2'  | 15°06.5  | -13.6' | 60.9'     | 40°   | 20:20       | 20:59     | 21:32     | 05:05       | 06:24       |   |       |       |  |  |  |  |  |
| SD.=16.3 d=0.2 |          |          |          |       |          |        | S.D.=16.7 |       |             |           |           |             |             |   |       |       |  |  |  |  |  |
|                |          |          |          |       |          |        |           |       |             |           |           |             |             |   |       |       |  |  |  |  |  |
| Sun            | GHA      | Dec      | GHA      | $\nu$ | Dec      | d      | HP        | Day   | Sun         |           | Mer.      | Moon        |             | Age   |       |       |  |  |  |  |  |
| 0              | 178°56.5 | S22°51.1 | 327°17.0 | 7.3'  | N14°52.9 | -13.7' | 60.9'     | 1     | Eqn.of Time | 12h       | Mer. Pass | Mer.Pass.   | Lower       | 16-18   |       |       |  |  |  |  |  |
| 1              | 193°56.2 | 50.9     | 341°43.3 | 7.3'  | 14°39.2  | -13.7' | 60.9'     | 2     | 00h mm:ss   | 00h mm:ss | hh:mm     | Upper hh:mm | Lower hh:mm | 99-90%  |       |       |  |  |  |  |  |
| 2              | 208°55.9 | 50.7     | 356°09.7 | 7.4'  | 14°25.4  | -13.8' | 60.9'     | 3     | 03:18       | 03:32     | 12:04     | 00:16       | 12:48       |  |       |       |  |  |  |  |  |
| 3              | 223°55.6 | · 50.4   | 10°36.2  | 7.5'  | 14°11.6  | -13.9' | 60.9'     | 1     | 03:18       | 03:32     | 12:04     | 00:16       | 12:48       |   |       |       |  |  |  |  |  |
| 4              | 238°55.3 | 50.2     | 25°02.8  | 7.6'  | 13°57.6  | -14.0' | 60.9'     | 2     | 03:46       | 04:00     | 12:04     | 01:18       | 13:48       |   |       |       |  |  |  |  |  |
| 5              | 253°55.0 | 49.9     | 39°29.4  | 7.7'  | 13°43.6  | -14.1' | 60.9'     | 3     | 04:14       | 04:28     | 12:04     | 02:16       | 14:43       |   |       |       |  |  |  |  |  |
| 6              | 268°54.7 | S22°49.7 | 53°56.2  | 7.8'  | N13°29.5 | -14.1' | 60.8'     |       |             |           |           |             |             |   |       |       |  |  |  |  |  |
| 7              | 283°54.4 | 49.5     | 68°23.1  | 7.9'  | 13°15.3  | -14.2' | 60.8'     |       |             |           |           |             |             |   |       |       |  |  |  |  |  |
| 8              | 298°54.2 | 49.2     | 82°50.0  | 8.0'  | 13°01.1  | -14.3' | 60.8'     |       |             |           |           |             |             |   |       |       |  |  |  |  |  |
| 9              | 313°53.9 | · 49.0   | 97°17.1  | 8.1'  | 12°46.7  | -14.4' | 60.8'     |       |             |           |           |             |             |   |       |       |  |  |  |  |  |
| 10             | 328°53.6 | 48.7     | 111°44.2 | 8.2'  | 12°32.3  | -14.4' | 60.8'     |       |             |           |           |             |             |   |       |       |  |  |  |  |  |
| 11             | 343°53.3 | 48.5     | 126°11.4 | 8.3'  | 12°17.9  | -14.5' | 60.7'     |       |             |           |           |             |             |   |       |       |  |  |  |  |  |
| 12             | 358°53.0 | S22°48.2 | 140°38.8 | 8.4'  | N12°03.4 | -14.6' | 60.7'     |       |             |           |           |             |             |   |       |       |  |  |  |  |  |
| 13             | 13°52.7  | 48.0     | 155°06.2 | 8.5'  | 11°48.8  | -14.6' | 60.7'     |       |             |           |           |             |             |   |       |       |  |  |  |  |  |
| 14             | 28°52.4  | 47.7     | 169°33.7 | 8.5'  | 11°34.1  | -14.7' | 60.7'     |       |             |           |           |             |             |   |       |       |  |  |  |  |  |
| 15             | 43°52.2  | · 47.5   | 184°01.2 | 8.6'  | 11°19.4  | -14.7' | 60.7'     |       |             |           |           |             |             |   |       |       |  |  |  |  |  |
| 16             | 58°51.9  | 47.2     | 198°28.9 | 8.7'  | 11°04.7  | -14.8' | 60.6'     |       |             |           |           |             |             |   |       |       |  |  |  |  |  |
| 17             | 73°51.6  | 47.0     | 212°56.7 | 8.8'  | 10°49.8  | -14.8' | 60.6'     |       |             |           |           |             |             |   |       |       |  |  |  |  |  |
| 18             | 88°51.3  | S22°46.7 | 227°24.5 | 8.9'  | N10°35.0 | -14.9' | 60.6'     |       |             |           |           |             |             |   |       |       |  |  |  |  |  |
| 19             | 103°51.0 | 46.5     | 241°52.4 | 9.0'  | 10°20.0  | -14.9' | 60.6'     |       |             |           |           |             |             |   |       |       |  |  |  |  |  |
| 20             | 118°50.7 | 46.2     | 256°20.4 | 9.0'  | 10°05.1  | -15.0' | 60.6'     |       |             |           |           |             |             |   |       |       |  |  |  |  |  |
| 21             | 133°50.4 | · 46.0   | 270°48.5 | 9.1'  | 09°50.1  | -15.0' | 60.5'     |       |             |           |           |             |             |   |       |       |  |  |  |  |  |
| 22             | 148°50.2 | 45.7     | 285°16.7 | 9.2'  | 09°35.0  | -15.1' | 60.5'     |       |             |           |           |             |             |   |       |       |  |  |  |  |  |
| 23             | 163°49.9 | 45.5     | 299°44.9 | 9.3'  | 09°19.9  | -15.1' | 60.5'     |       |             |           |           |             |             |   |       |       |  |  |  |  |  |
| SD.=16.3 d=0.2 |          |          |          |       |          |        | S.D.=16.6 |       |             |           |           |             |             |   |       |       |  |  |  |  |  |
|                |          |          |          |       |          |        |           |       |             |           |           |             |             |   |       |       |  |  |  |  |  |