Physics 109: Homework #1 Solutions

1.1 (a) 1×10^9, (a) 3×10^{-2}, (a) 3.1558×10^7, (a) 1.49×10^8.

1.2 Altitude = 45 degrees, azimuth = 225 degrees. Altitude = 90 degrees, azimuth = undefined.

1.3 Southern hemisphere of the celestial sphere. Star must rise in the southeast. It takes the star 8 hours to reach the zenith after rising.

1.4 Over the course of a month, the Moon would appear to wander over the sky much more than it actually does. It would come close to the north celestial pole (within 23.5 degrees) and then disappear below the horizon as it approached the south pole. The phases would depend on when in the year they were being observed. When the plane of the Moon's orbit was aligned with the direction to the Sun, then the Moon would undergo a complete cycle of phases during a month. However, six months later when the plane of the Moon's orbit was perpendicular to the direction toward the Sun, then only the quarter moon phase would be visible.

1.5 To make the seasonal temperature variations more extreme it would be necessary to increase the tilt of the Earth's axis with respect to the plane of the ecliptic. To make the variations less extreme, it would be necessary to reduce the tilt of the Earth's axis. For example if the celestial equator was exactly aligned with the ecliptic, then there would be no change in the noon-time altitude of the Sun throughout the year, so the solar illumination would be very nearly constant throughout the year and the seasopns would be minimized.