

## 8.2: Opposition, Conjunction and Quadrature

Planets that are closer to the Sun than Earth (i.e. whose orbital radii are less than 1 AU), that is to say the planets Mercury and Venus, are *inferior planets*. (Any asteroids that may be found in such orbits are therefore inferior asteroids, and, technically, any spacecraft that are in solar orbits within that of the orbit of Earth could also be called inferior spacecraft, although it is doubtful whether this nomenclature would ever win general acceptance.) Other planets (i.e. Mars and beyond) are *superior planets*.

In figure VIII.1 I draw the orbits of Earth and of an inferior planet.

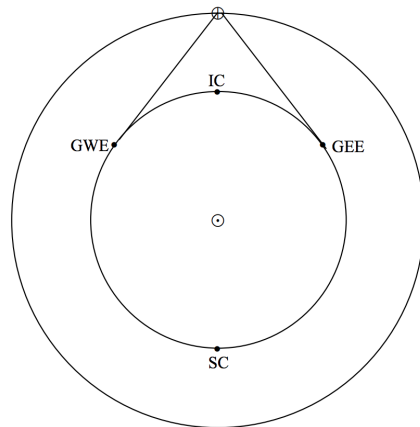


FIGURE VIII.1

The symbol  $\odot$  denotes the Sun and  $\oplus$  denotes Earth. At  $\text{IC}$ , the planet is at *inferior conjunction* with the Sun. At SC, it is at *superior conjunction* with the Sun. At GWE it is at *greatest western elongation* from the Sun. At GEE it is at *greatest eastern elongation*. It should be evident that the sine of the greatest elongation is equal to the radius of the planet's orbit in AU. Thus the radius of Venus's (almost circular) orbit is 0.7233 AU, and therefore its greatest elongation from the Sun is about  $46^\circ$ . Mercury's orbit is relatively eccentric ( $e = 0.2056$ ), so that its distance from the Sun varies from 0.3075 AU at perihelion to 0.4667 at aphelion. Consequently greatest elongations can be from  $18^\circ$  to  $28^\circ$ , depending on where in its orbit they occur.

In figure VIII.2 I draw the orbits of Earth and of a superior planet.

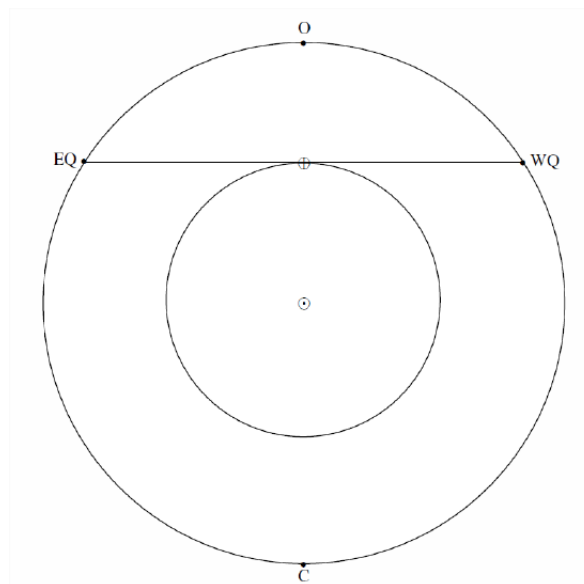


FIGURE VIII.2

At C, the planet is in *conjunction* with the Sun. At O it is in *opposition* to the Sun. The opposition point is very familiar to observers of asteroids. Its right ascension differs from that of the Sun by 12 hours, and it transits across the meridian at midnight local solar time. The points EQ and WQ are *eastern quadrature* and *western quadrature*.

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