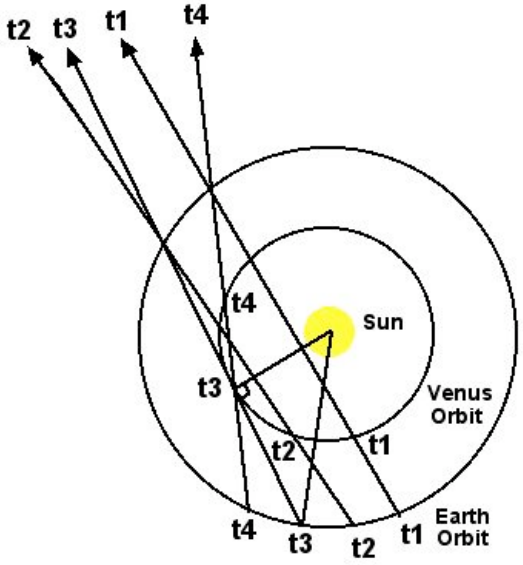
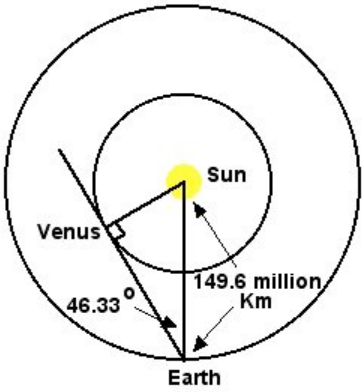
Using Trigonometry to Find Planetary Distances

Observing Venus as it moves throughout its orbit, there is a time where it seemingly reverses itself and moves backwards. The diagram below illustrates how this happens.



At the moment that it starts its reverse, the line of sight from Earth to Venus is tangent to the orbit of Venus about the sun. Since tangents to circles (and Venus's orbit is very close to a circle), are perpendicular to the radius of the circle, we can use this right angle triangle and some trigonometry to find out how far Venus is from the sun. The diagram below illustrates this.



If we computed that the angle between Venus, the Earth and the Sun was 49° , and if we are 149 597 888 km from the Sun, then how far is Venus from the Sun?

$$\sin 46.33^{o} = \frac{opposite}{hypotenuse}$$

$$0.723328792 = \frac{D}{149597888}$$

$$D = 0.723328792 \times 149597888$$

$$D = 108\ 208\ 460\ km$$

Thus Venus is about 108 208 460 Km from the sun.