

How far is it to Venus?

A basic geometry activity

Venus is closer to the sun than the earth. Because of this, it will only appear so far away from the sun. It can't be seen rising in the east as the sun is setting in the west, for example, because there is no place in Venus' orbit which places it behind us with respect to the sun.

Consider the diagram.

Since Venus is always closer to the sun than the earth, there is a limit to the size of the angle between the sun and Venus. This elongation angle reaches a maximum when Venus is in the position shown.

If the distance to the sun from the earth is known (call this E), then the distance from Venus (V) to the sun can be calculated using this relationship:

$$\cos(\text{angle}) = \text{opp/adj} = E \div V.$$

Thus, the distance to Venus is

$$V = E \cos(\text{maximum elongation angle}).$$

If the Earth-sun distance is defined to be 1 (astronomical unit), then the size of Venus' orbit compared to the earth's orbit is obtained.

Scale Drawings instead

If a scale drawing is made, you can get the size of Venus' orbit by measuring directly off of the picture.

1. For example, let the size of the Earth's orbit be a circle with a radius of 10 cm.
2. Draw a line between the earth and the sun.
3. Measure an angle upward (ccw) from this line, using the earth as a vertex, equal to the maximum elongation of Venus.
4. Draw a circle around the sun such that the circle just barely grazes the line you just drew at one point. This makes the line you drew tangent to the circle.
5. The radius of the circle is the size of Venus' orbit. Divide by 10 to put into AU's.
6. Multiply by 93,000,000 to convert the answer to miles, because 93,000,000 miles = 1 AU.

How to get the maximum elongation of Venus:

This web site http://www.fourmilab.ch/images/venus_daytime/ has maximum elongation data for Venus. The best approach is to average the values from several years. Venus' orbit is nearly circular, but Earth's is less so, and this is what causes the year-to-year variation.

