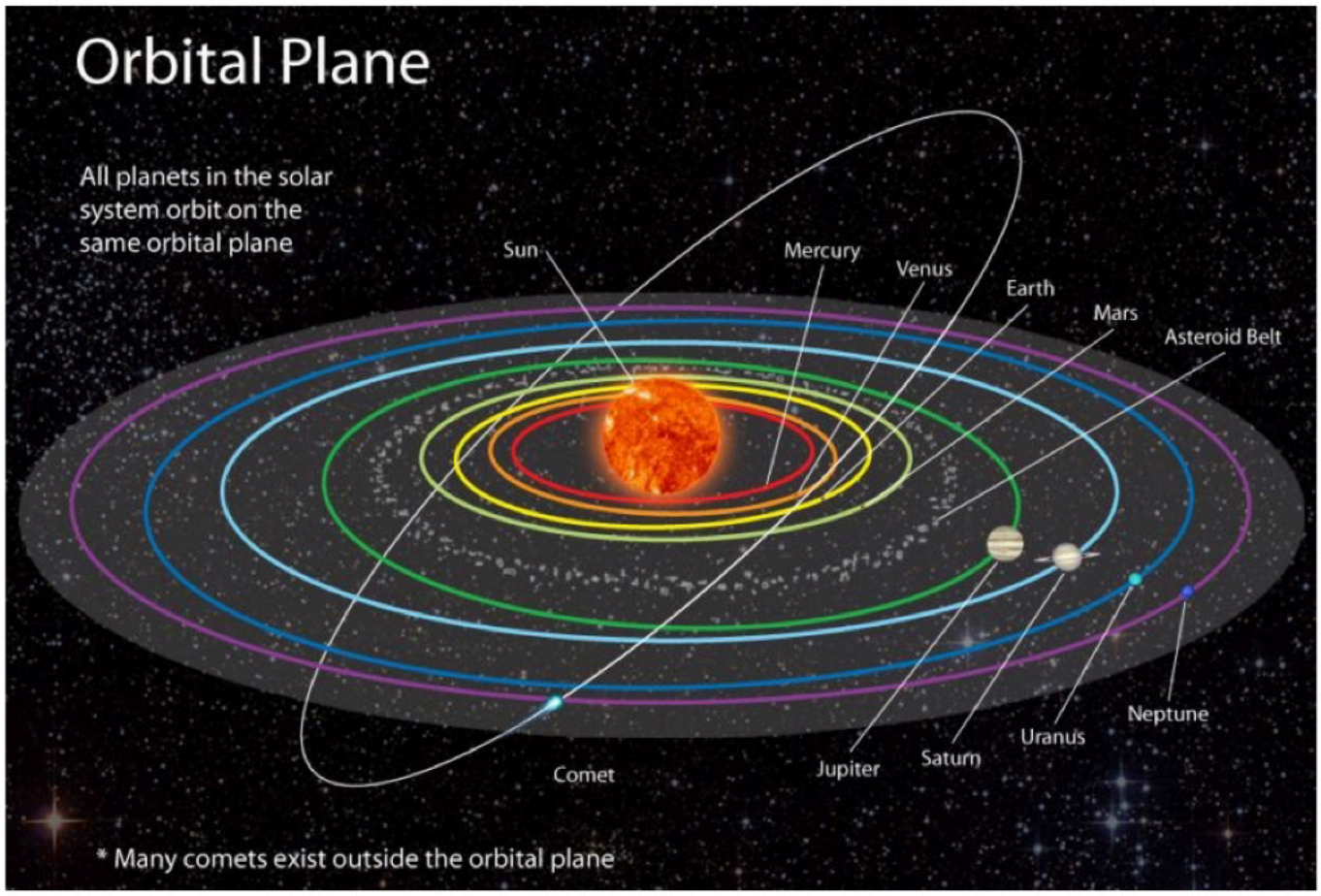
# Project #2: Internet-Based Project

Due: May 26, 2023, on Canvas

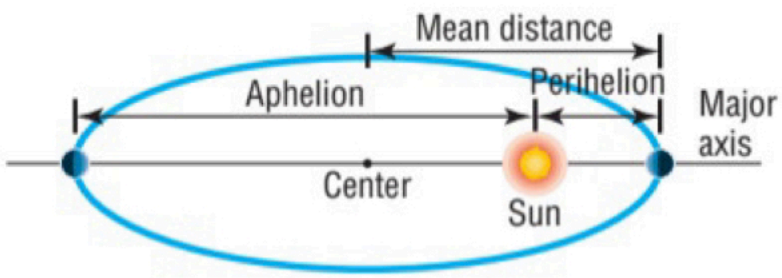
Calculating/Finding the Equation of the Orbit of (1) The Hale-Bopp Comet, (2) The Earth, and (3) another Planet in the Solar System.




The orbits of planets and some comets about the Sun are ellipses, with the Sun at one focus. The **aphelion** of a planet is its greatest distance from the Sun, and the **perihelion** is its shortest distance. The **mean distance** of a planet from the Sun is the length of the **semimajor axis** of the elliptical orbit.

EarthSky
When is the next great comet? | Space ...

Cosmic Pursuits
A Look Back at Comet Hale-Bopp - Cos...



1(2 pts each). Research the history of the Hale-Bopp Comet on the Internet. In particular, determine the aphelion and perihelion. Often these values are given in terms of astronomical units (AU). What is an astronomical unit? What is it equivalent to in miles? In kilometers? What is the orbital period of the Hale-Bopp Comet? When will it next be visible from Earth? How close does it come to Earth?

1AU = 92955807.3 mi or $9.296 \times 10^7$ miles  1AU = 149597870.7 km or $1.496 \times 10^8$

The orbital period of the Hale-Bopp Comet = 2533 years?

When will it next be visible from Earth? the year 4385

How close does it come to Earth? 120 000 000 miles

perihelion: 0.914 au = $1.367344 \times 10^8$ km

aphelion: 354 au = $5.29584 \times 10^{10}$ km

How to find *a*, *b,* and *c* through aphelion and perihelion? Explain.

aphelion + perihelion = 2a because they make up the major axis

a − perihelion = c

$a^2 = b^2 + c^2$  $b^2 = a^2 - c^2$  $b = \sqrt{7.241235 \times 10^{17}}$

$a = 2.65975672 \times 10^{10}$ km

$c = 2.69108328 \times 10^{10}$ km

$b = 2.690959301 \times 10^9$ km

2(10 pts each). Find the Equation of the orbit of the Hale-Bopp Comet and another planet in the Solar System. Use the *x*-axis as the major axis.

Hale-Bopp Comet

$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$

$\frac{x^2}{(2.65975672 \times 10^{10})^2} + \frac{y^2}{(2.690959301 \times 10^9)^2} = 1$

$\frac{x^2}{7.097733242 \times 10^{20}} + \frac{y^2}{7.241235505 \times 10^{18}} = 1$

$\boxed{\frac{x^2}{7.05 \times 10^{20}} + \frac{y^2}{7.24 \times 10^{18}} = 1}$

Venus

aphelion: 108939000 km

perihelion: 107477000 km

$a = 1.08208 \times 10^8$

$c = 7.31 \times 10^5$

$b = 1.082055308 \times 10^8$

$\frac{x^2}{(1.08208 \times 10^8)^2} + \frac{y^2}{(1.082055308 \times 10^8)^2} = 1$

$\frac{x^2}{1.170897126 \times 10^{16}} + \frac{y^2}{1.17084369 \times 10^{16}} = 1$

$\boxed{\frac{x^2}{1.17 \times 10^{16}} + \frac{y^2}{1.17 \times 10^{16}} = 1}$

3(10 pts each). The Hale-Bopp Comet has an orbit roughly perpendicular to Earth's. Find the Earth's orbit equation using the y-axis as the major axis.

aphelion : 152097597 km

perihelion: 147098450 km

$a = 1.495980235 \times 10^8$

$c = 2.4995735 \times 10^6$

$b = 1.495771399 \times 10^8$

$\frac{x^2}{(1.495771399 \times 10^8)^2} + \frac{y^2}{(1.495980235 \times 10^8)^2} = 1$

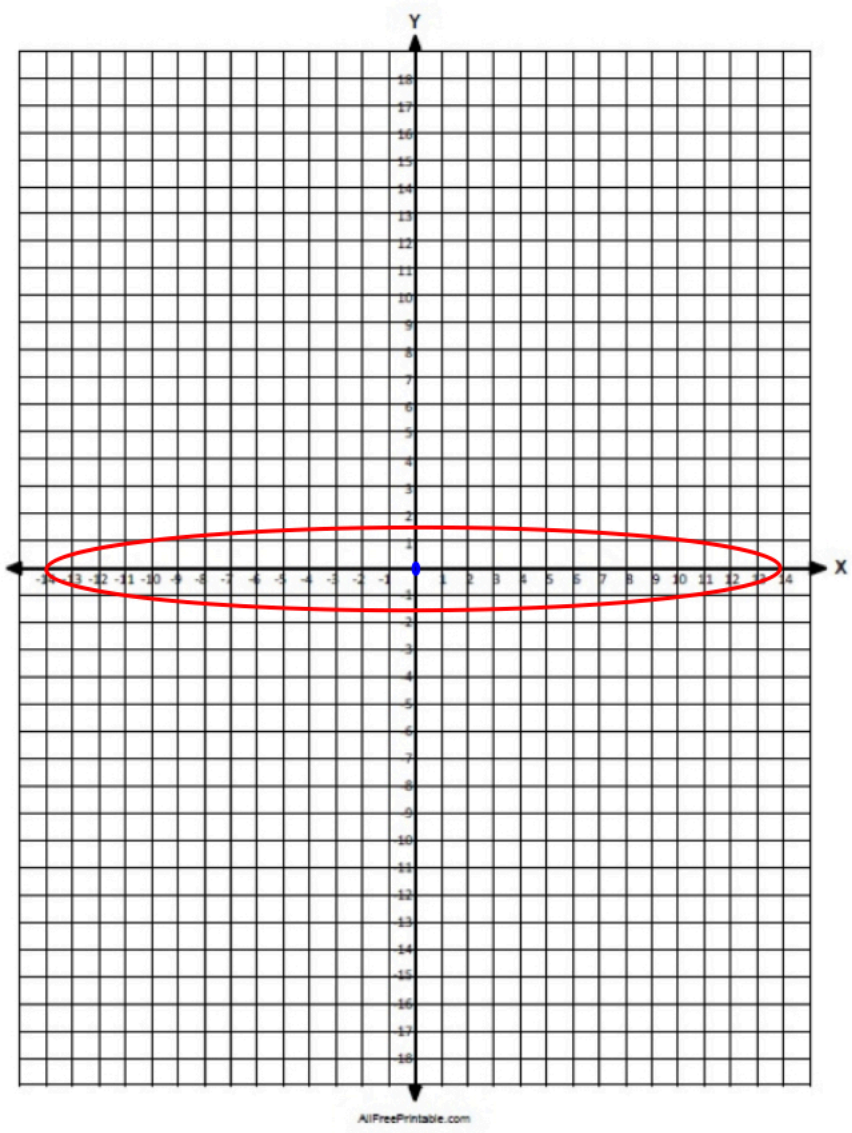
$\frac{x^2}{2.237332078 \times 10^{16}} + \frac{y^2}{2.237956864 \times 10^{16}} = 1$

$\frac{x^2}{2.24 \times 10^{16}} + \frac{y^2}{2.24 \times 10^{16}} = 1$

4(6 pts each). Graph the equations of the orbits of Hale-Bopp Comet and Earth on the same coordinate system. Based on the graphs, do the paths of the orbits intersect? Does this mean the Hale-Bopp Comet will collide with Earth?

The paths of the orbit don't intersect.
The Hale-Bopp comet will not collide with Earth

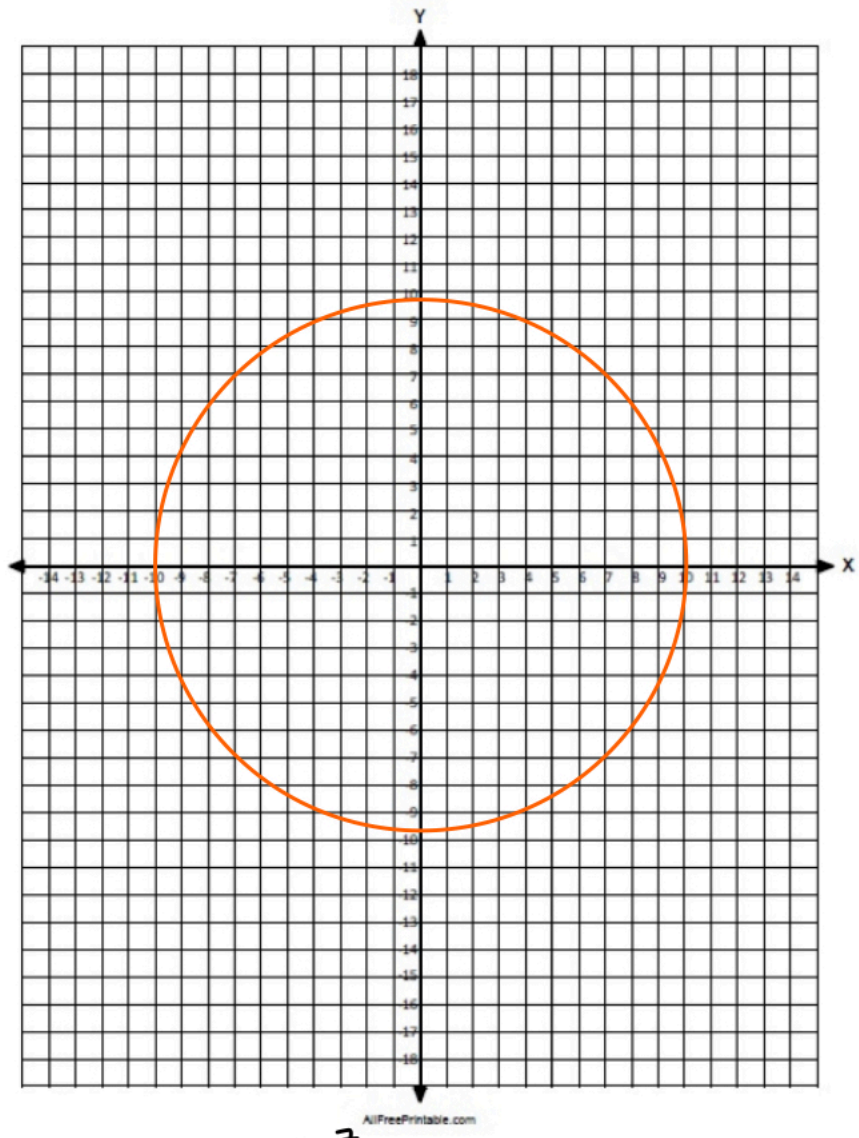
| Planets and Comet | Aphelion (km) | Perihelion (km) | $a$, $b$ and $c$ (km) | Equation of the Orbit |
|---|---|---|---|---|
| Hale-Bopp Comet | $5.296\times10^{10}$ | $1.367\times10^{8}$ | $a = 2.655\times10^{10}$<br>$b = 2.691\times10^{9}$<br>$c = 2.691\times10^{10}$ | $\frac{x^2}{7.05\times10^{20}} + \frac{y^2}{7.24\times10^{18}} = 1$ |
| Earth | 152097597 | 1470984 | $a = 1.496\times10^{8}$<br>$b = 1.496\times10^{8}$<br>$c = 2.500\times10^{6}$ | $\frac{x^2}{2.237\times10^{16}} + \frac{y^2}{2.238\times10^{16}} = 1$ |
| 2nd Planet<br>Venus | 108939000 | 107477000 | $a = 1.082\times10^{8}$<br>$b = 1.082\times10^{8}$<br>$c = 7.31\times10^{5}$ | $\frac{x^2}{1.1709\times10^{16}} + \frac{y^2}{1.1708\times10^{16}} = 1$ |




□ = $1.896\times10^{9}$ km

– Hale-Bopp Comet

– Earth




□ = $1.082\times10^{7}$ km

– Venus