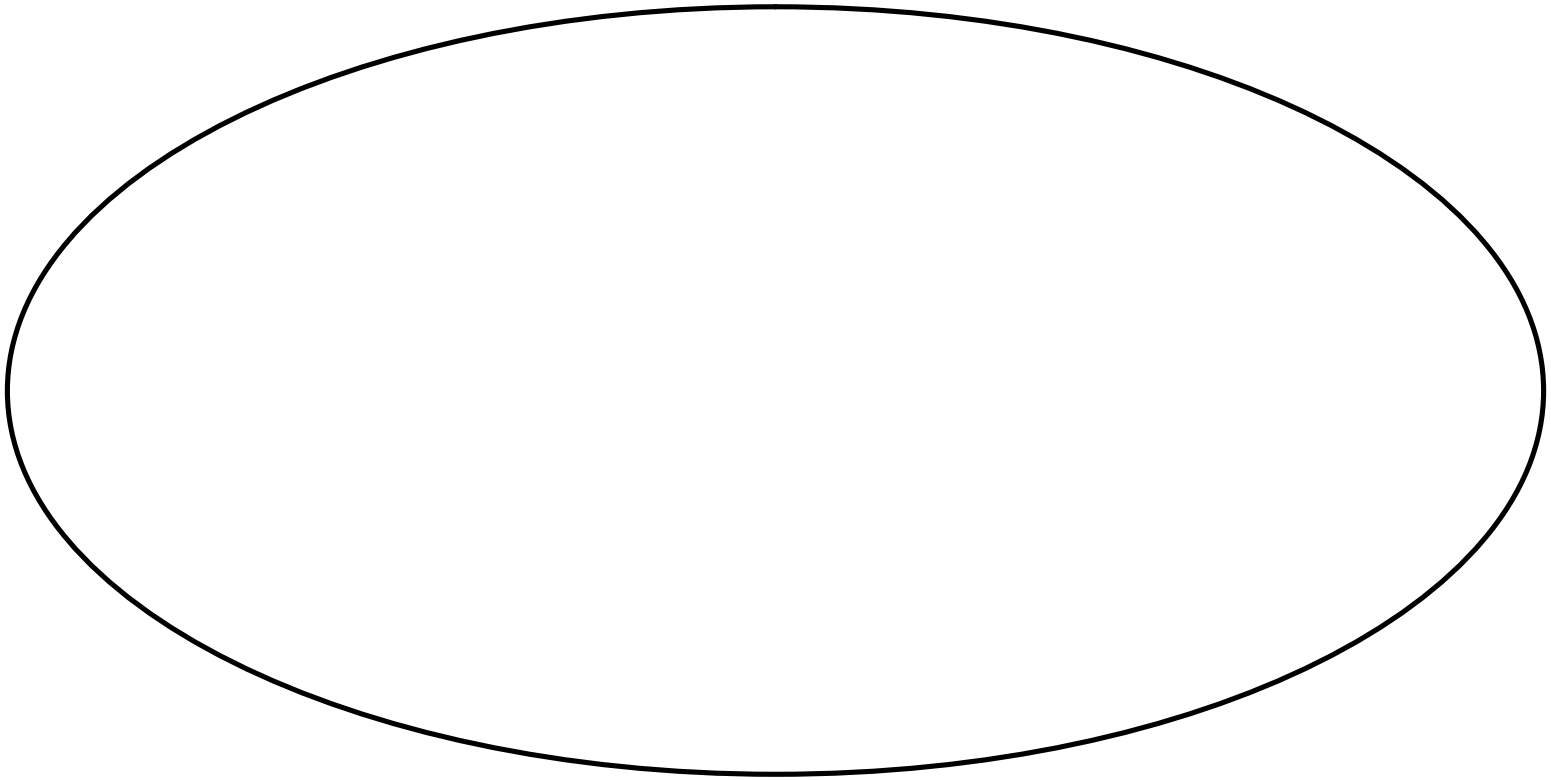
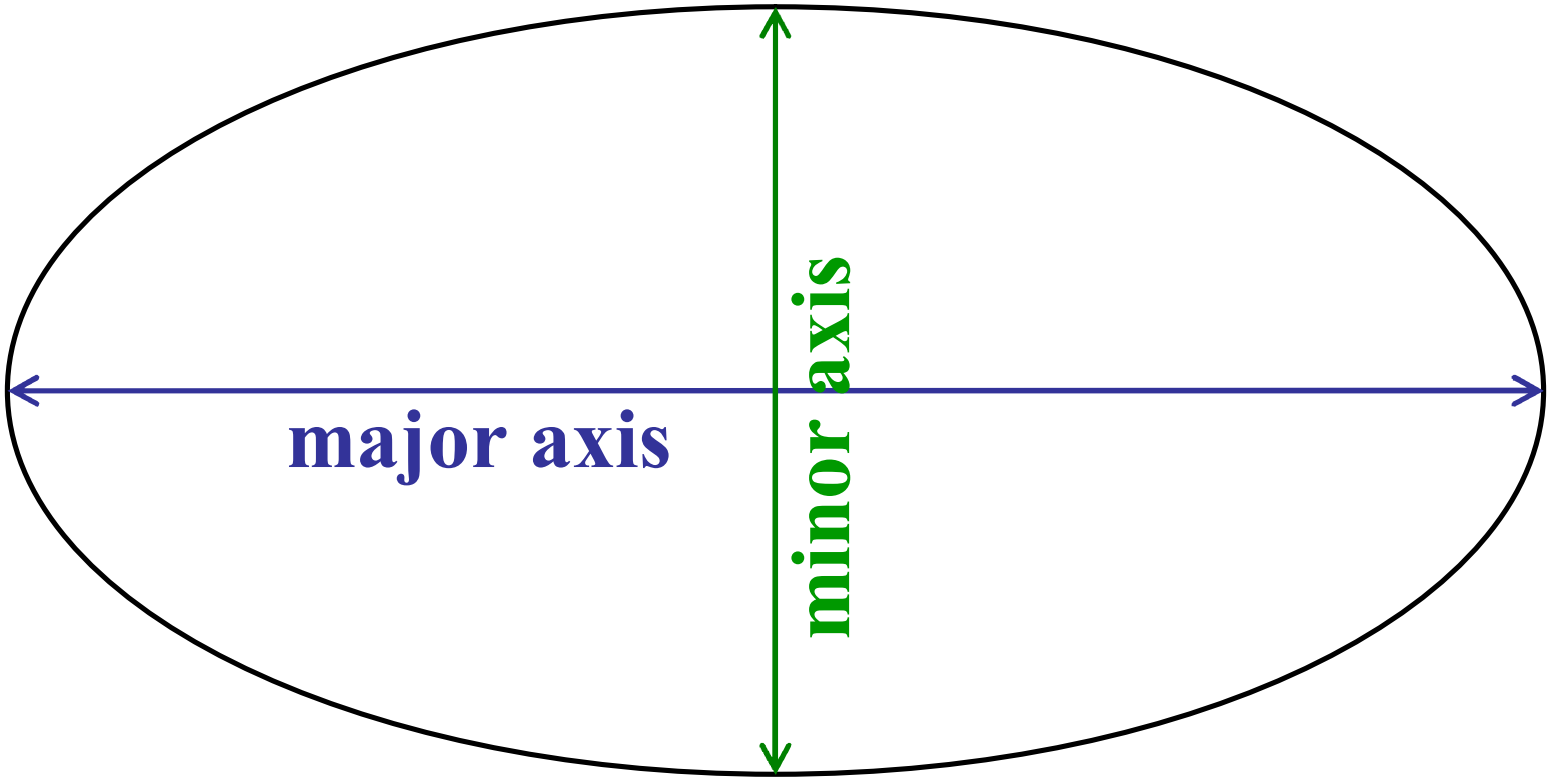
Ellipses

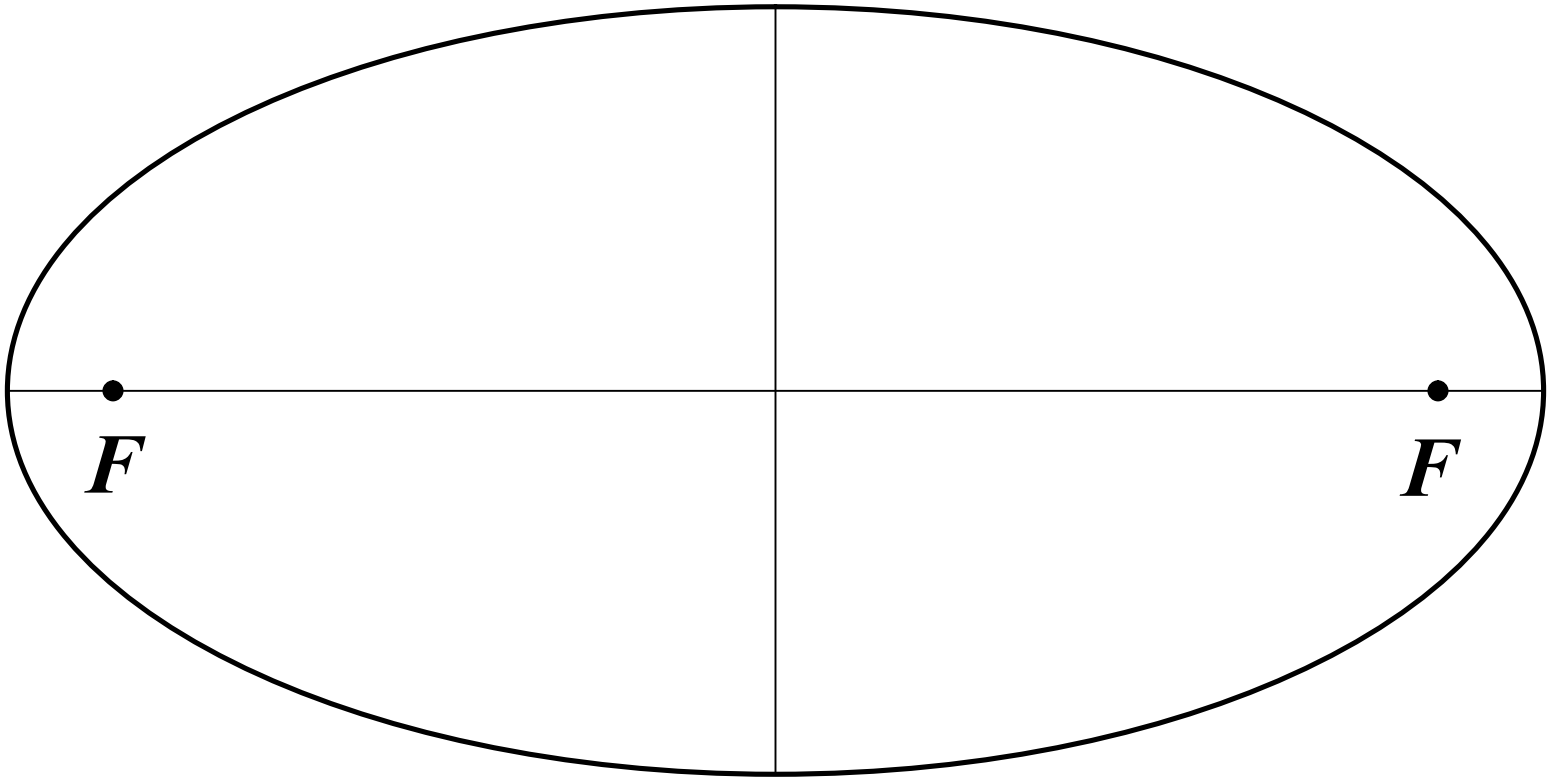
Focii, Axes, Eccentricity



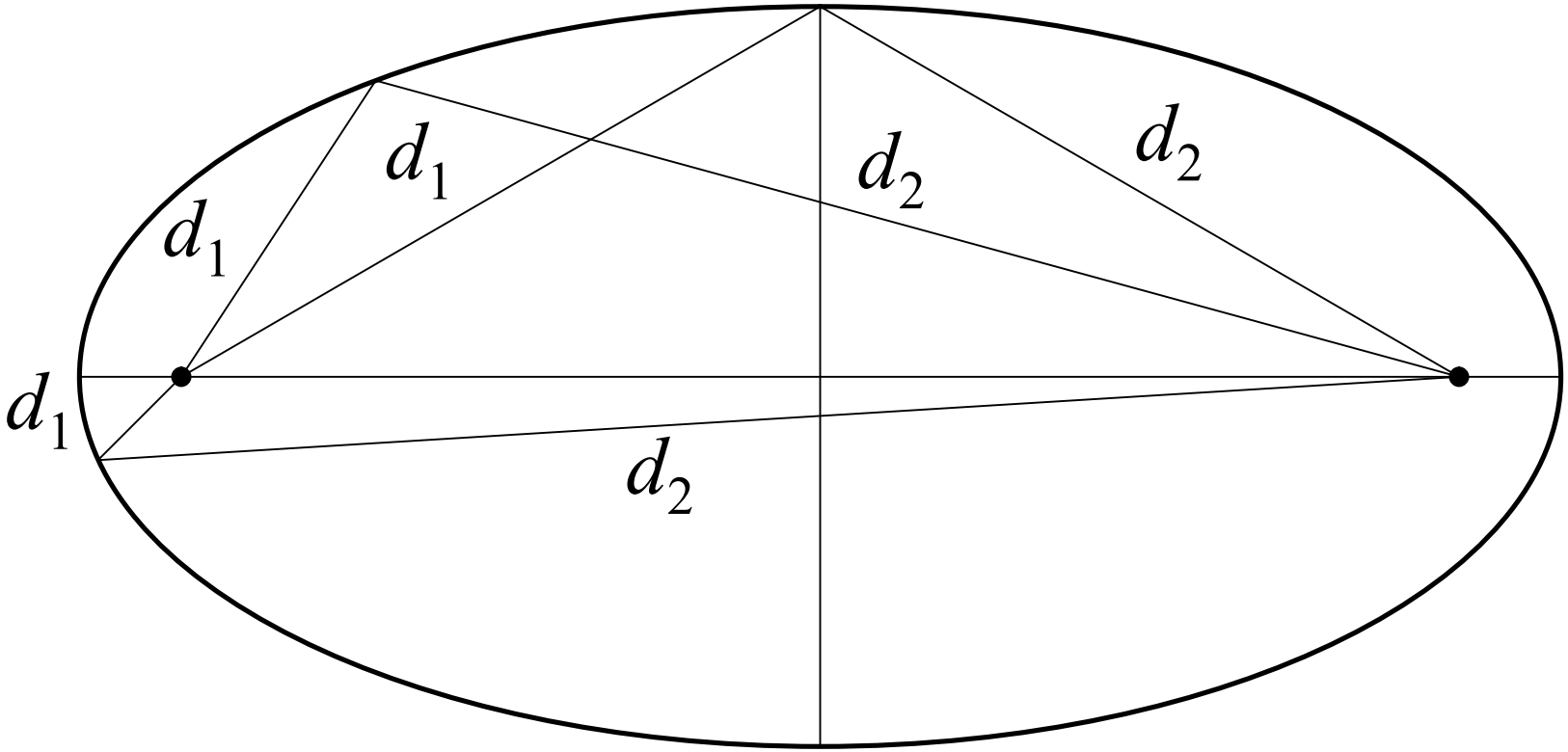
An ellipse is a unique oval shape
(not just *any* oval shape).



The “dimensions” of an ellipse are called the major axis and minor axis.

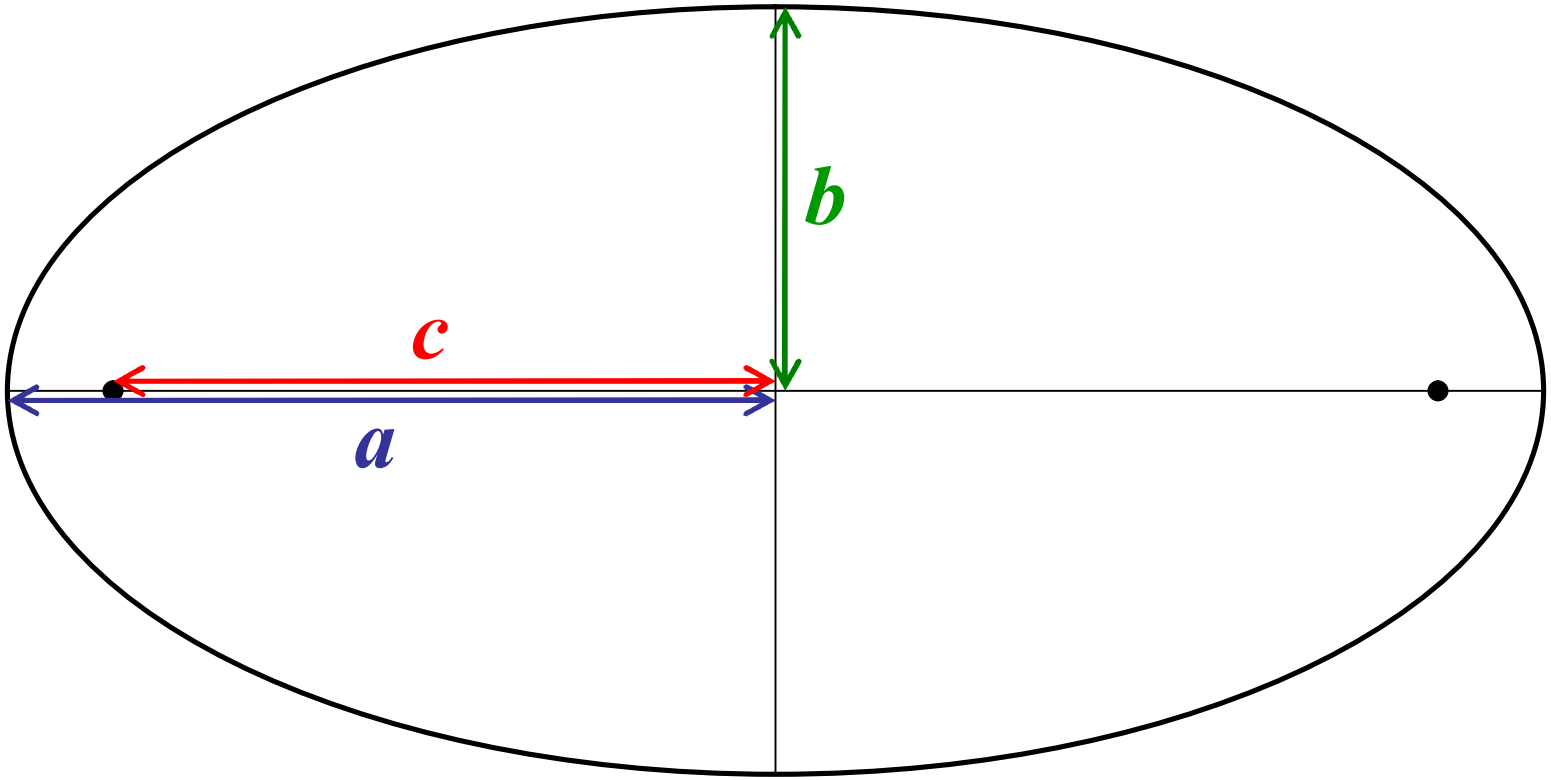


There are two unique points called focii.
Each focus is located on the major axis.



The sum of the distances to the focii is the same for any and every point on the ellipse.

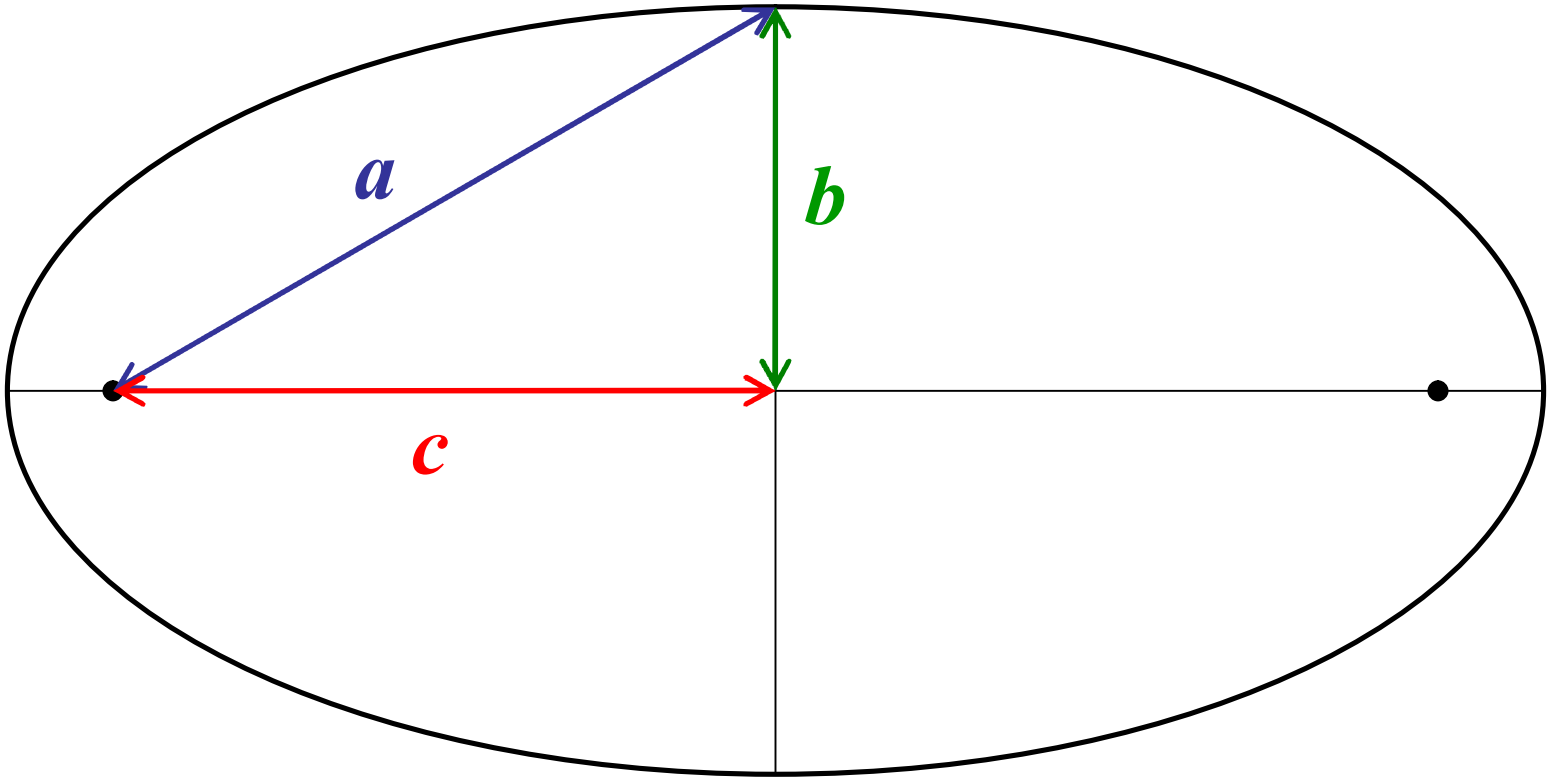
$$d_1 + d_2 = 2a = \text{constant}$$



a = semi-major axis

b = semi-minor axis

c = distance from center to focus

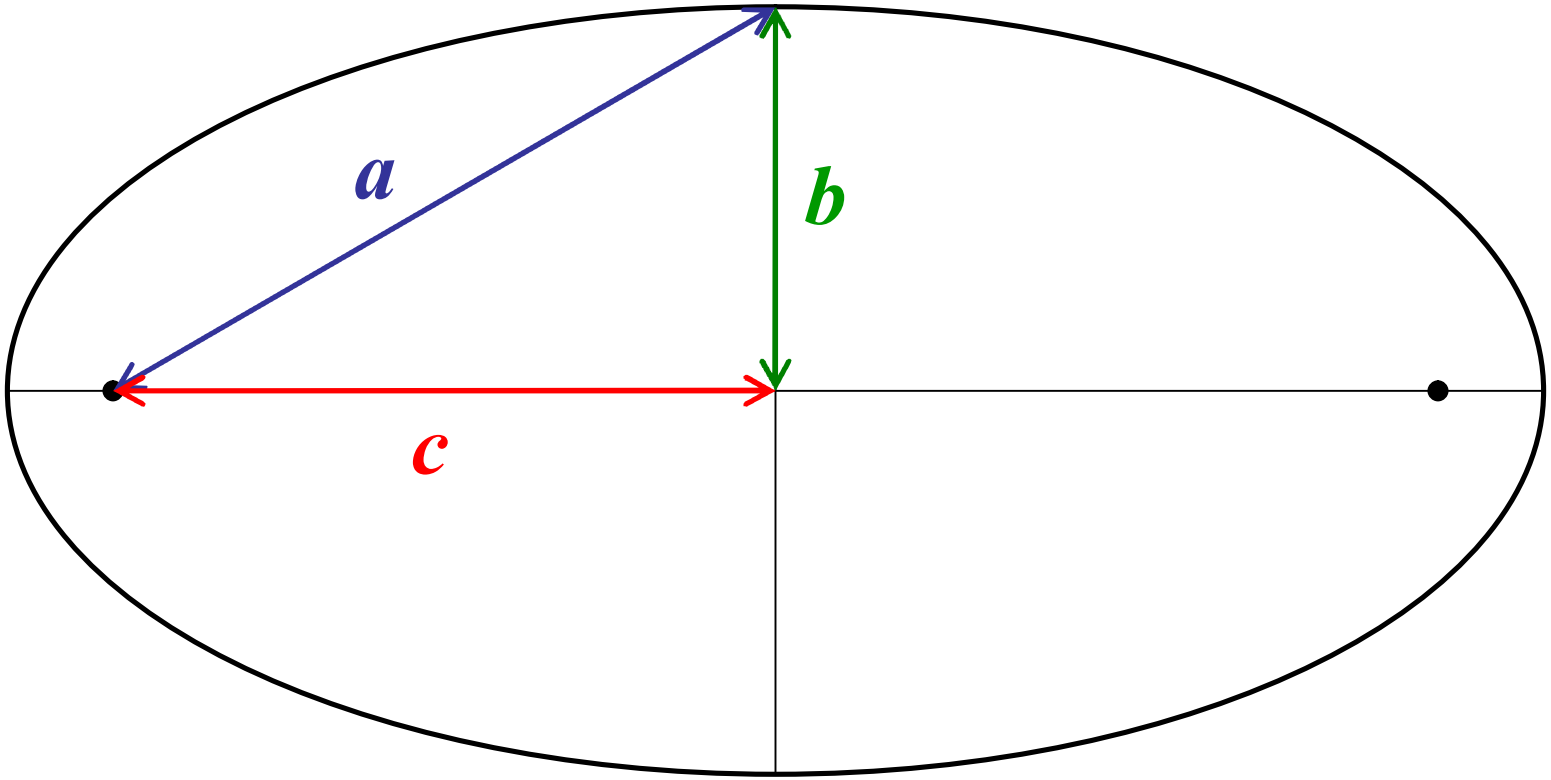


a = semi-major axis

b = semi-minor axis

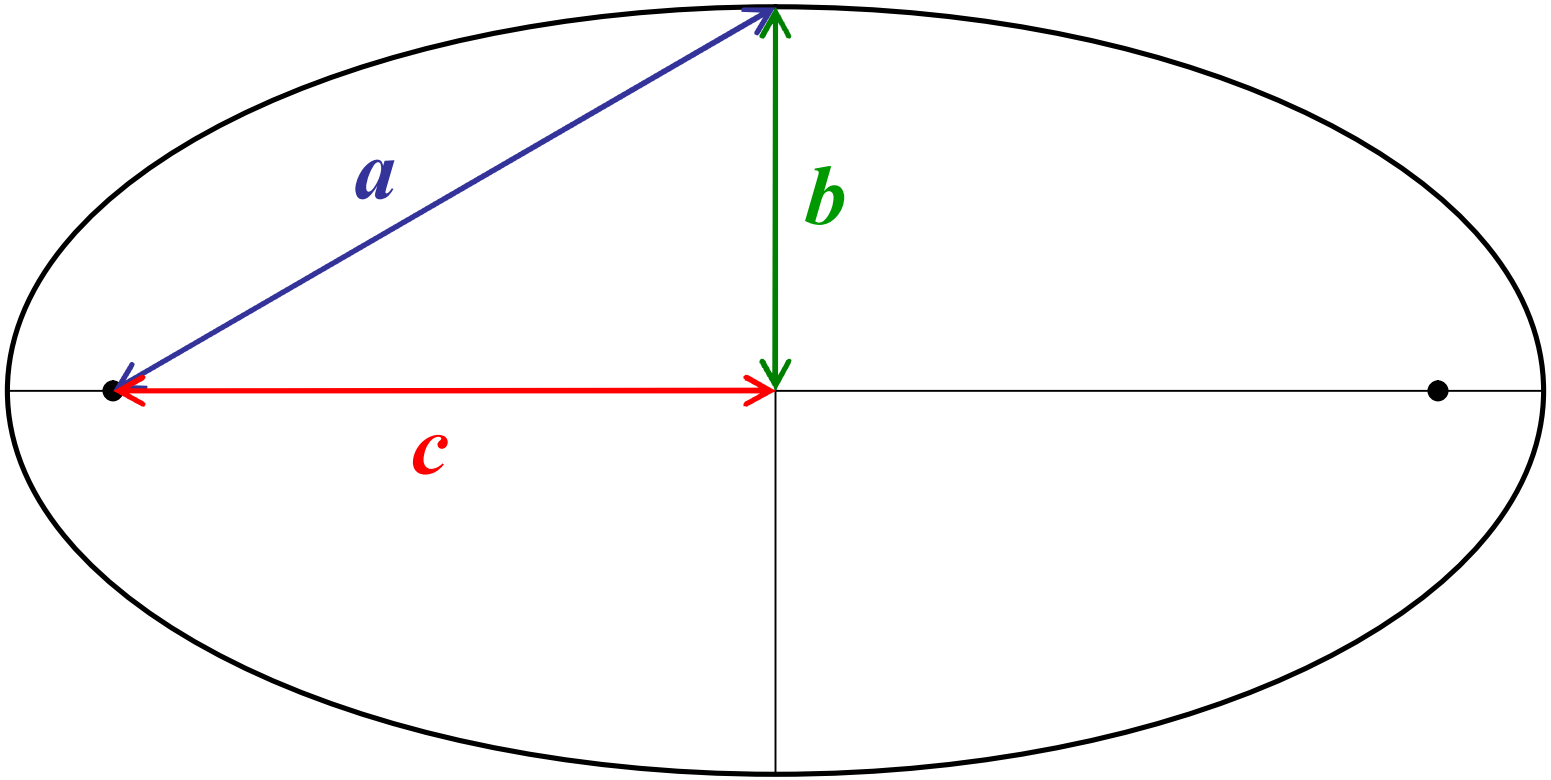
c = distance from center to focus

note: $a^2 = b^2 + c^2$



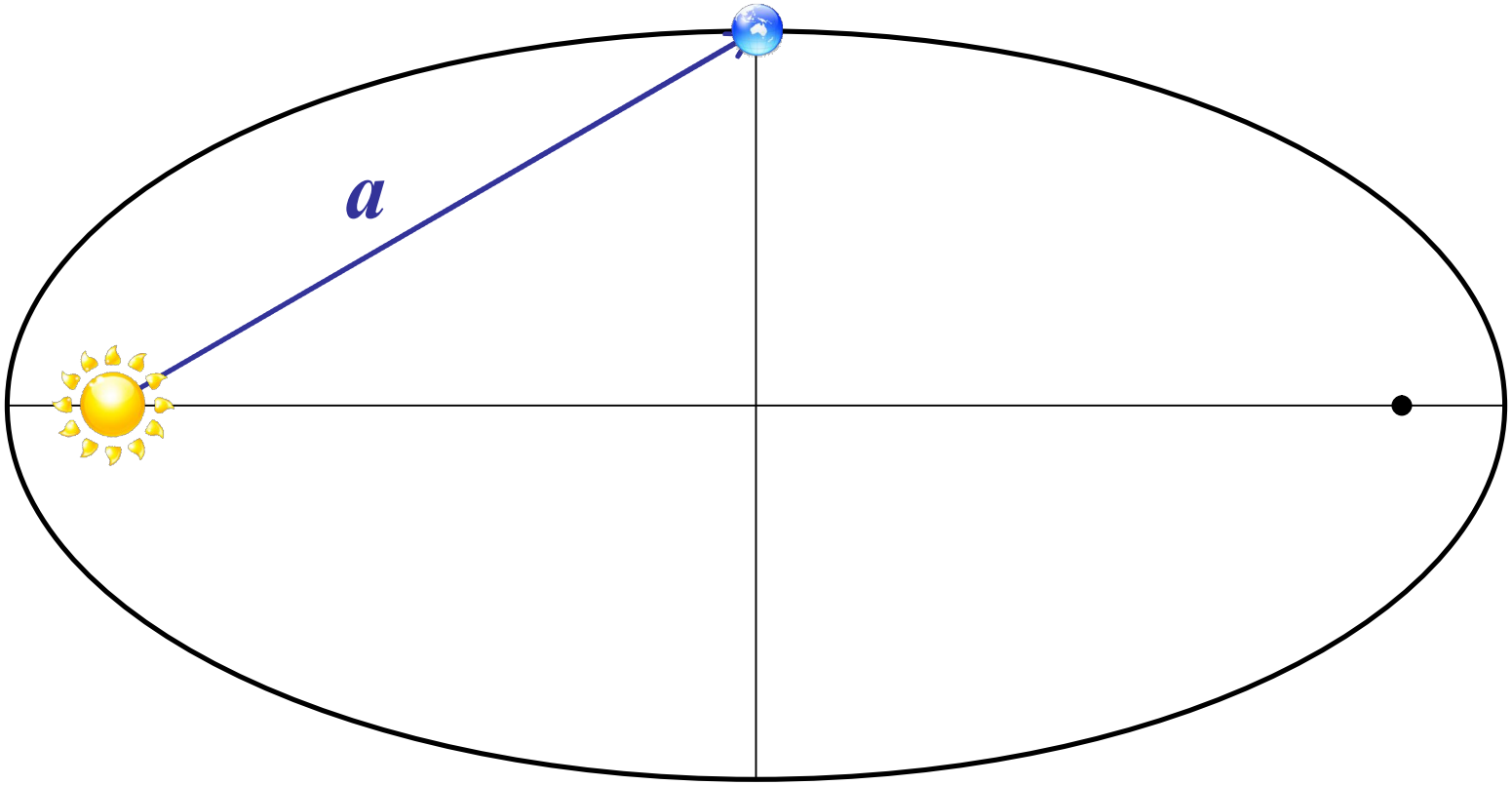
The eccentricity, e, of the ellipse:

$$e = \frac{c}{a}$$

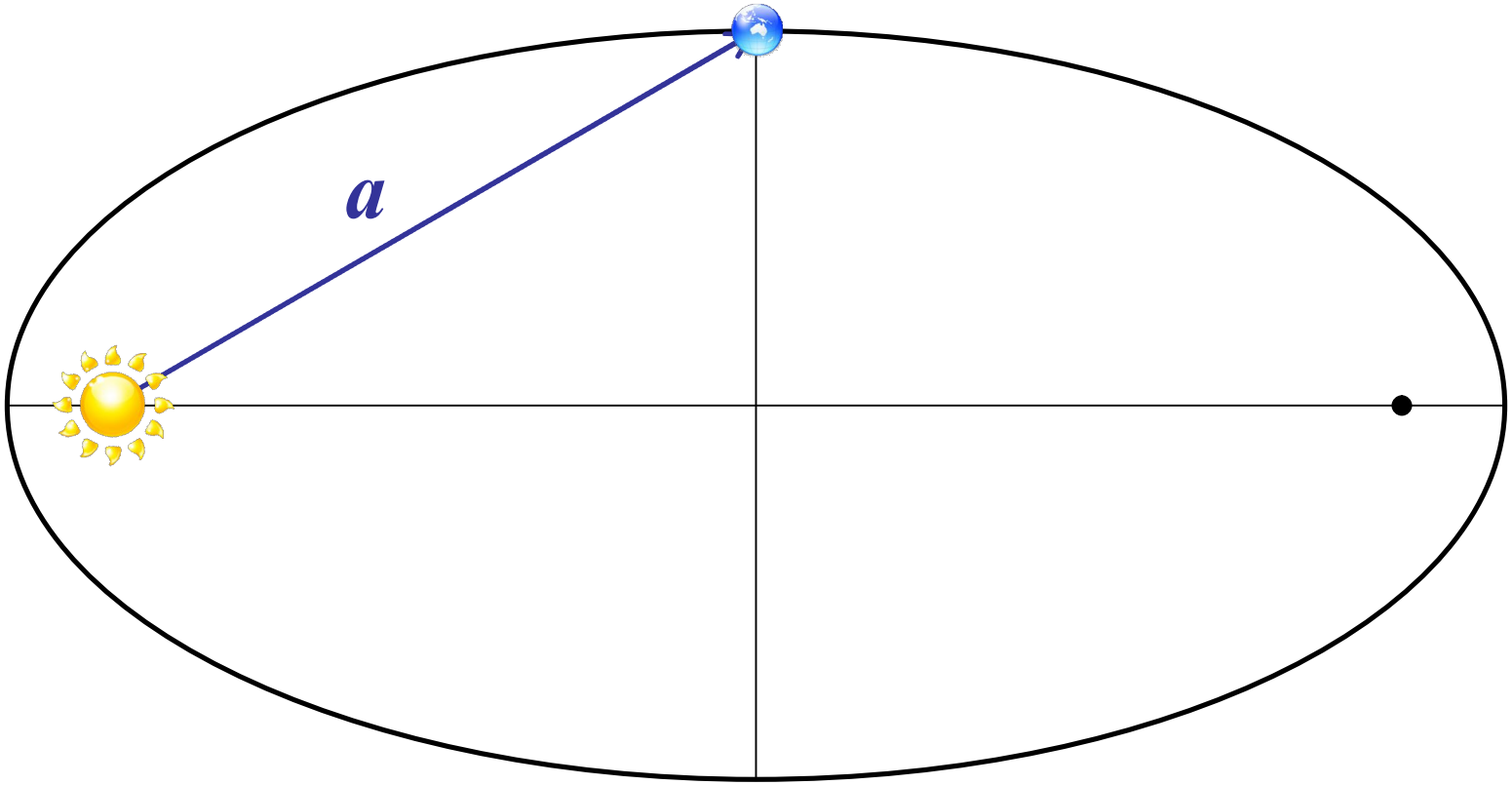


$0 < e < 1$

The value of e relates to how elongated the ellipse is and how far off-center the focii are located.

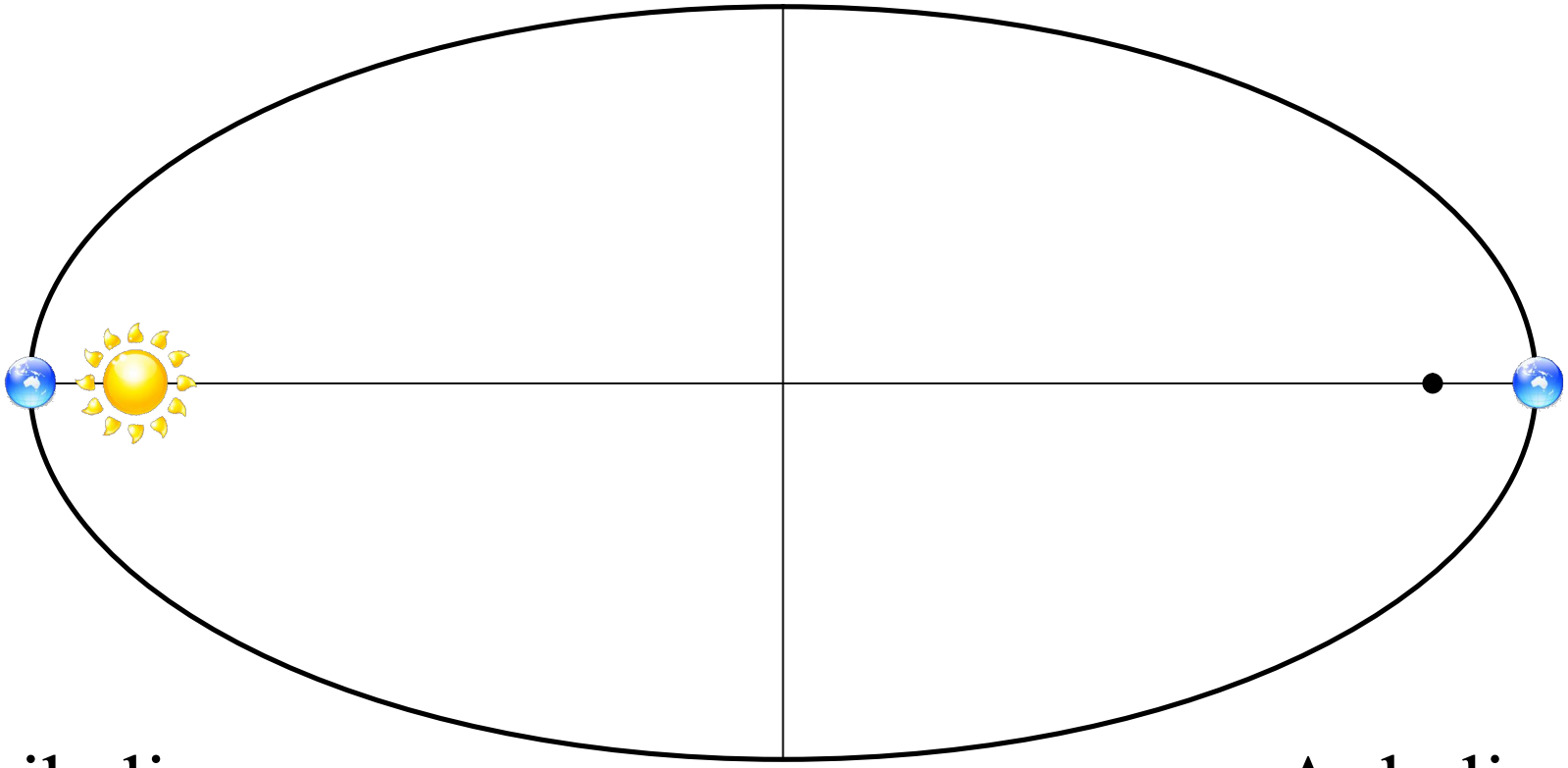


As applied to Kepler's Laws:
Sun is at one focus
Semi-major axis = average distance from Sun



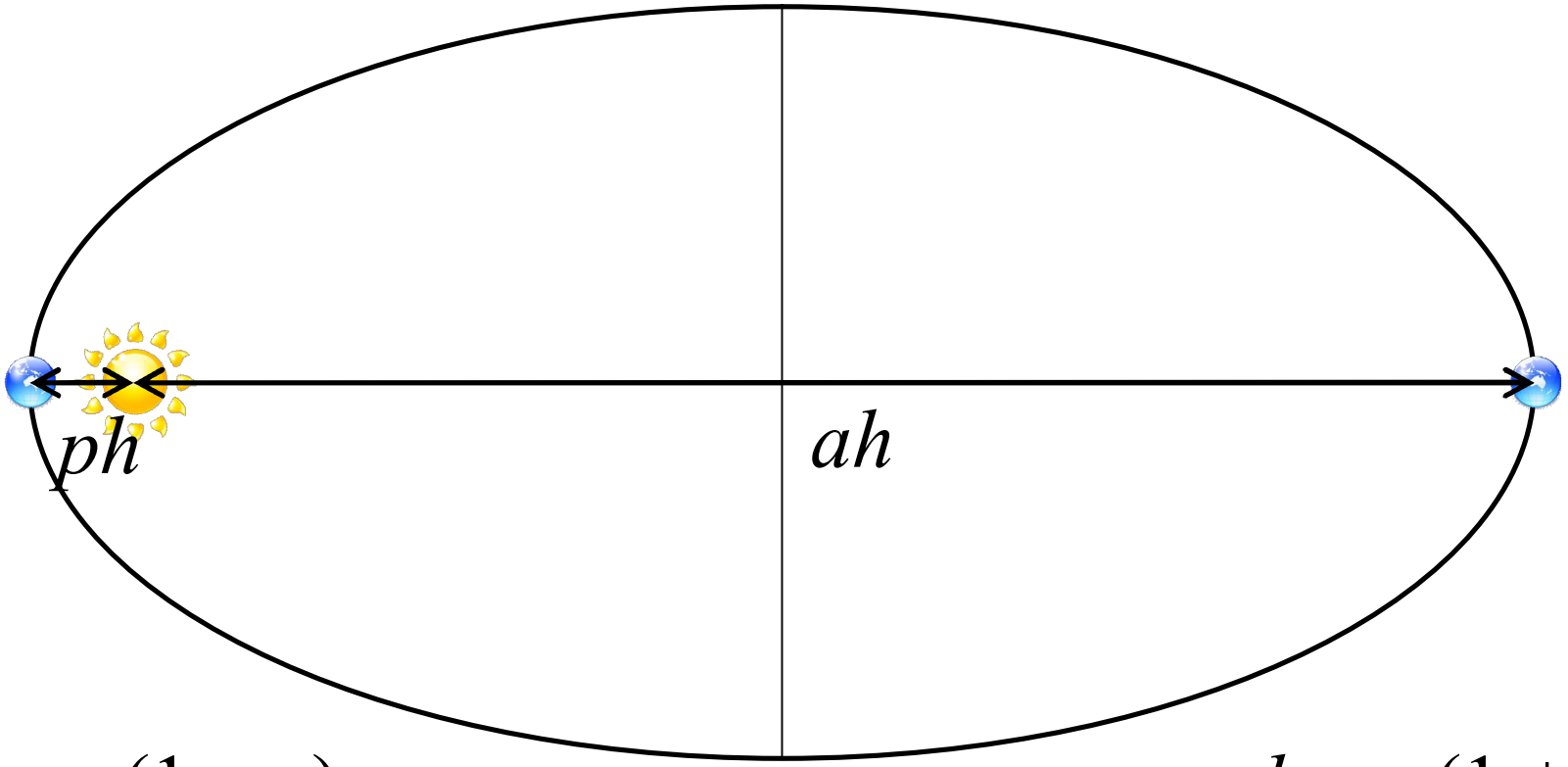
Note: the average distance from the Sun to the Earth is known as an "astronomical unit" or A.U.

For Earth, $a = 1$ A.U.



Perihelion =
point in orbit
closest to Sun

Aphelion =
point in orbit
farthest from Sun



$ph = a(1 - e)$

$ah = a(1 + e)$

These formulas give the least and greatest distances from the Sun in terms of the average distance and the eccentricity.