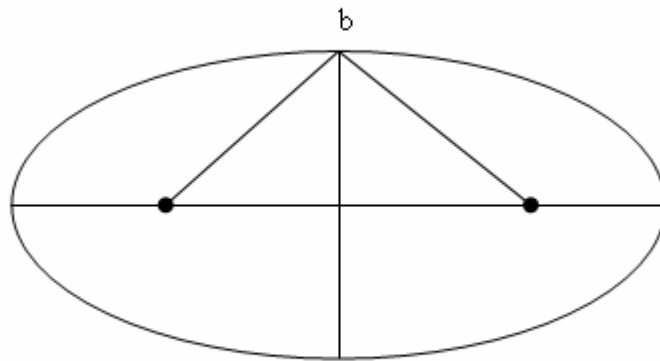


The Planet at B

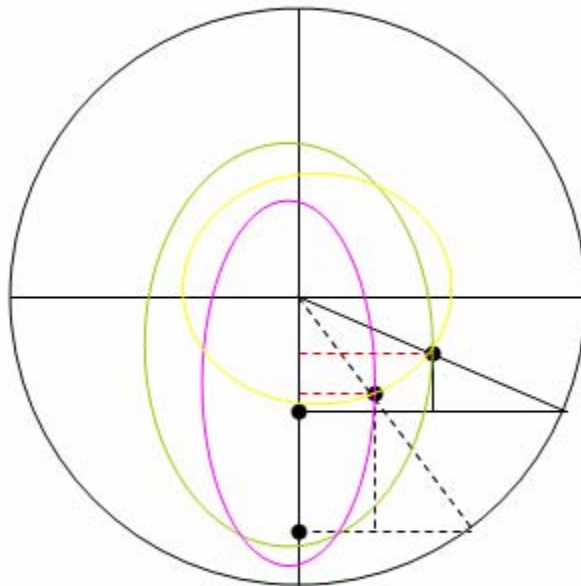
A major insight is available when the planet is in the position at the end of the semiminor axis of its orbit.

In this chapter we will show why this position is so important to the *a priori* explanation of the behavior of planets.



Recall that in Chapter 2 we showed that when the planet is at the top of the semimajor axis we arbitrarily for convenience say that it is at position b . We also showed in a previous chapter that at b , since the legs of the ellipse are equal, they must both equal the length of

the semimajor axis, a . Now that is the key fact that can be exploited by examining different ellipses that have the same length semimajor axis, a . These ellipses differ in their eccentricity. They will have different length semiminor axes. But they all have one critically important thing in common. For all these ellipses the planet is the same distance from the Sun when it is at position b . And that distance is equal to a , the semimajor axis. In the figure below there are two orbital paths of equal size semimajor axis. The focus containing the Sun is at the center of the diagram and is the first focus for both orbits. The second focus is farther away from the Sun for the orbit demarcated in pink compared to the focus of the orbit in green. The distance to the position b is denoted by a dashed red line for each orbit.



The hodograph lines are solid black for the orbit in green and dashed black for the orbit in pink. Note that in the figure above the distance to the planet from the Sun is the same for both orbits. The distance to position b from the semiminor axis differs - the length of the dashed red lines. The yellow circle (which is actually not truly circular on the diagram due to limitations of my graphing ability) is a line along which all the position b's would fall for all the orbits sharing the same semimajor axis. (The circular orbit would be included on this yellow line -

in fact it would represent that orbit but that is not relevant to our needs here.) What is important is that the distance to the Sun at position b is always the same in the hodograph above regardless of how eccentricly the second focus is placed.

Why is this so important? Because we know in a *priori* fashion from Chapter 21 that force varies inversely with the square of the distance. Now if the planets are all at the same distance from the Sun when they are at position b, then the force exerted upon them there is the same. We will use the knowledge that the force on these planets in this situation is equal to reveal how the planets must move. We will contrast this true motion with what the hodograph for elliptical orbits misleads us to believe. This will reveal to us the method for scaling the hodograph of the elliptical orbit - we already found the method of scaling hodographs for circular orbits in Chapter 26. Finally, once we know how to scale the hodograph for elliptical orbits all will fall into place. We will be able to glean from the hodograph enough information to demonstrate Kepler's Third Law for elliptical orbits and set up the Energy Equation for orbits, all in a *priori* fashion.

In the next chapter, let's see what the hodograph predicts about the behavior of the planet. After that we will see how reality differs from prediction.