**Rules for converting R & V to COEs on your Whiz Wheel**

To use your whiz wheel for COE calculations, **MUST** equal 0. If  you must calculate all COEs by hand.

**Semimajor Axis**

Using the equation for specific mechanical energy, you can solve for the semimajor axis,a



Where R and V are the magnitudes of the position and velocity vectors.

**Eccentricity**

The eccentricity vector can be calculated from only and  using the equation:

** **

The eccentricity of the orbit is equal to the magnitude of the eccentricity vector.

**THAT’S ALL THE EQUATIONS YOU NEED!!! Now, use your whiz wheel to find the other COEs.**

**Inclination & Right Ascension of the Ascending Node**

Plot your position on your whiz wheel. Once you have estimated the location of your satellite, look at your velocity vector. Take your pencil or finger and point it from your current location in the direction of velocity. Be sure your velocity vector follows the arrows showing direction of motion along the edge of the circular disk. If not, turn your orbital plane so that velocity and the direction of motion arrows match. Now you have the inclination of your orbit and your node vector is pointing to your ascending node.

**Argument of Perigee**

Remember, your eccentricity vector points to perigee. Plot where it points on your whiz wheel. Turn the elliptical disk to align perigee with this vector. Read your Argument of Perigee on the circular disk. An alternate method to determine where perigee is located is to compare the magnitude of your position vector to your semimajor axis. If the magnitude of the position vector is greater than your semimajor axis you are at apogee. If the magnitude of the position vector is smaller than your semimajor axis you are at perigee.

**True Anomaly**

Your position vector points to your current position. Read your true anomaly off the elliptical shaped disk.

Equatorial Plane

Apogee

Perigee

Earth

Orbital Plane

I

I Vector

n Vector

J