

**ORBITAL ELEMENTS MODEL
Assembly Instructions**

I. Cut out Parts A, B, C, D, and E (See Fig. 1). Take extra care to ensure that the outer rim of part A is perfectly smooth and circular so that it will rotate freely inside part E.

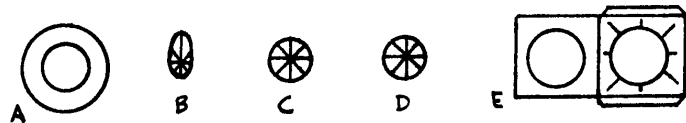


Figure 1

II. Bend two paper clips as shown in Fig. 2 and tape them to the back (blank) side of part C. The straightened part of the clips should line up with the \bar{n} vector and stick out 5/8 inches past the rim of part C. (Make sure the clips are taped securely and line up to form a single axis aligned with the \bar{n} vector.)

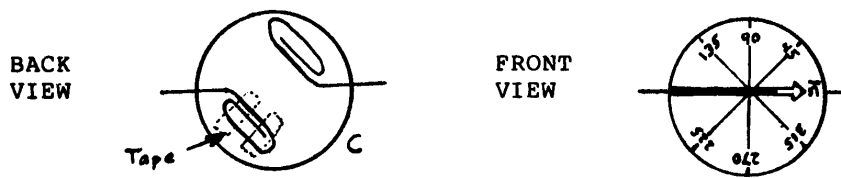


Figure 2

III. Glue part D onto the back of part C so that the numbers on each face line up. Press the two parts together so that they form a sandwich with the paper clips in between. (See Fig. 3).

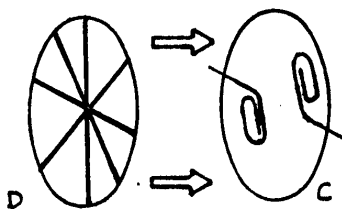


Figure 3

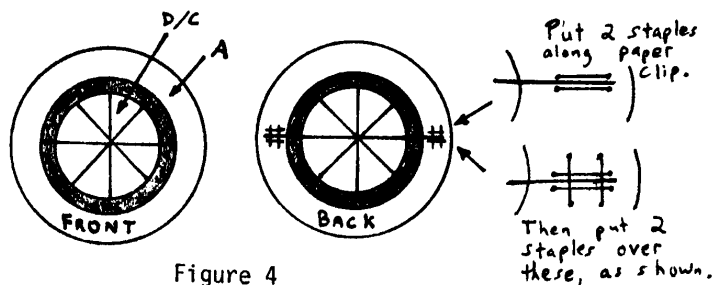


Figure 4

IV. Place assembly D/C inside the hole in part A so that the \bar{n} vector on D/C lines up with the line of nodes on A and both point in the same direction. Tape the ends of the paper clips to the BACK side of part A. (Place staples on each side of each paper clip where they are taped to part A. This is to keep the clips from sliding under the tape out of alignment with the line of nodes. (See Figure 4.)

V. Rotate assembly D/C about its paper clip axis until it is coplanar with part A and the arrow at the ascending node on D/C points counterclockwise. (See Fig. 5). Fasten part B through its focus to the center of assembly D/C using a thumb tack and a uniform insignia "frog".

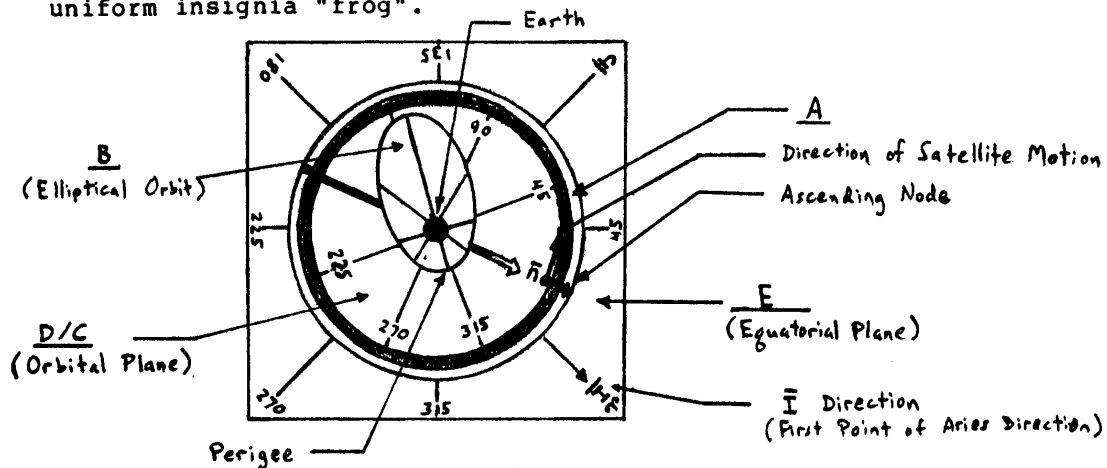


Figure 5

VI. Assemble envelope E. Insert assembly A/B/C/D into the envelope so that the lettering on both parts faces in the same direction. MAKE SURE IT WILL ROTATE SMOOTHLY INSIDE THE ENVELOPE BEFORE SEALING THE ENVELOPE! You may need to smooth the outer rim of part A to get it to turn freely in the envelope.

VII. Sit back and admire your new orbital elements model!

IX. Using Figure 5 and the definitions of orbital elements, found in Chapter V of the text, practice using the model. Try this example:

$$\begin{aligned}
 i &= 30^\circ \\
 \Omega &= 180^\circ \\
 \omega &= 90^\circ \\
 \nu_0 &= 270^\circ
 \end{aligned}$$

(Answer: The satellite is at the ascending node. The \bar{n} vector points away from the first point of Aries.)

