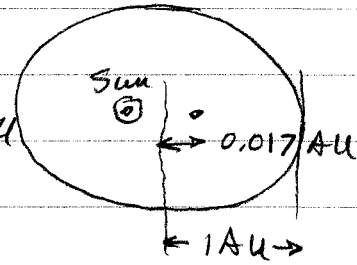


1. From fig,  $D_{\text{greatest}} = 1.017 \text{ AU}$

$$D_{\text{smallest}} = 1 - 0.017 = 0.973 \text{ AU}$$



2. a) Summer is when the north pole is tipped toward the sun; during winter, it is tipped away from the sun.

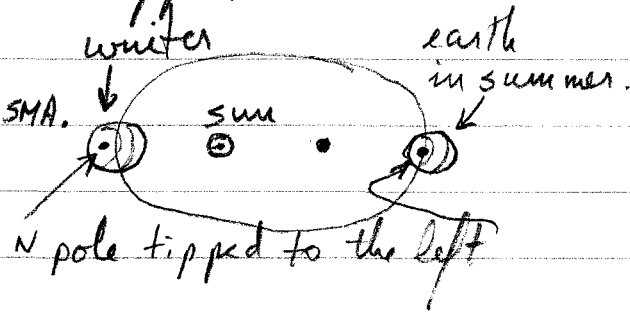
Horizontally exaggerated.

To make winter short, the earth must move more quickly during winter. According to K's 2<sup>nd</sup> law, the earth must be closer to the sun for that to happen.

3. a) K's 3<sup>rd</sup> law:  $P^2 = A^3$ . Solve to get the SMA.

$$A = P^{2/3} = 76^{2/3} = 17.9 \text{ AU}$$

As in problem #1, the dist from the center of the orbit to the sun is  $\epsilon A = 0.967 \times 17.9 \text{ AU}$ .



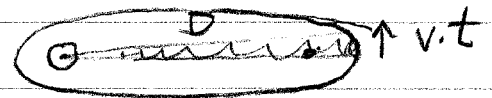
$$D_{\text{greatest}} = 17.9 + 0.967 \times 17.9 = 35 \text{ AU}$$

$$D_{\text{smallest}} = 17.9 (1 - 0.967) = 0.59 \text{ AU}$$

c) K's law of equal areas says

"Area swept out is the same." The area is  $\frac{1}{2} D \cdot v \cdot t$ , where  $v$  is speed and  $t$  is time.

$$D_g v_g t = D_s v_s t \Rightarrow \frac{v_s}{v_g} = \frac{D_g}{D_s} = \frac{35 \text{ AU}}{.59 \text{ AU}} = 60.$$



4. a) Orbit is smaller because the period is smaller. Use K's 3<sup>rd</sup> law

$$b) \text{ Use } P^2 = A^3. \quad A = P^{2/3} = 0.047 \text{ AU}$$