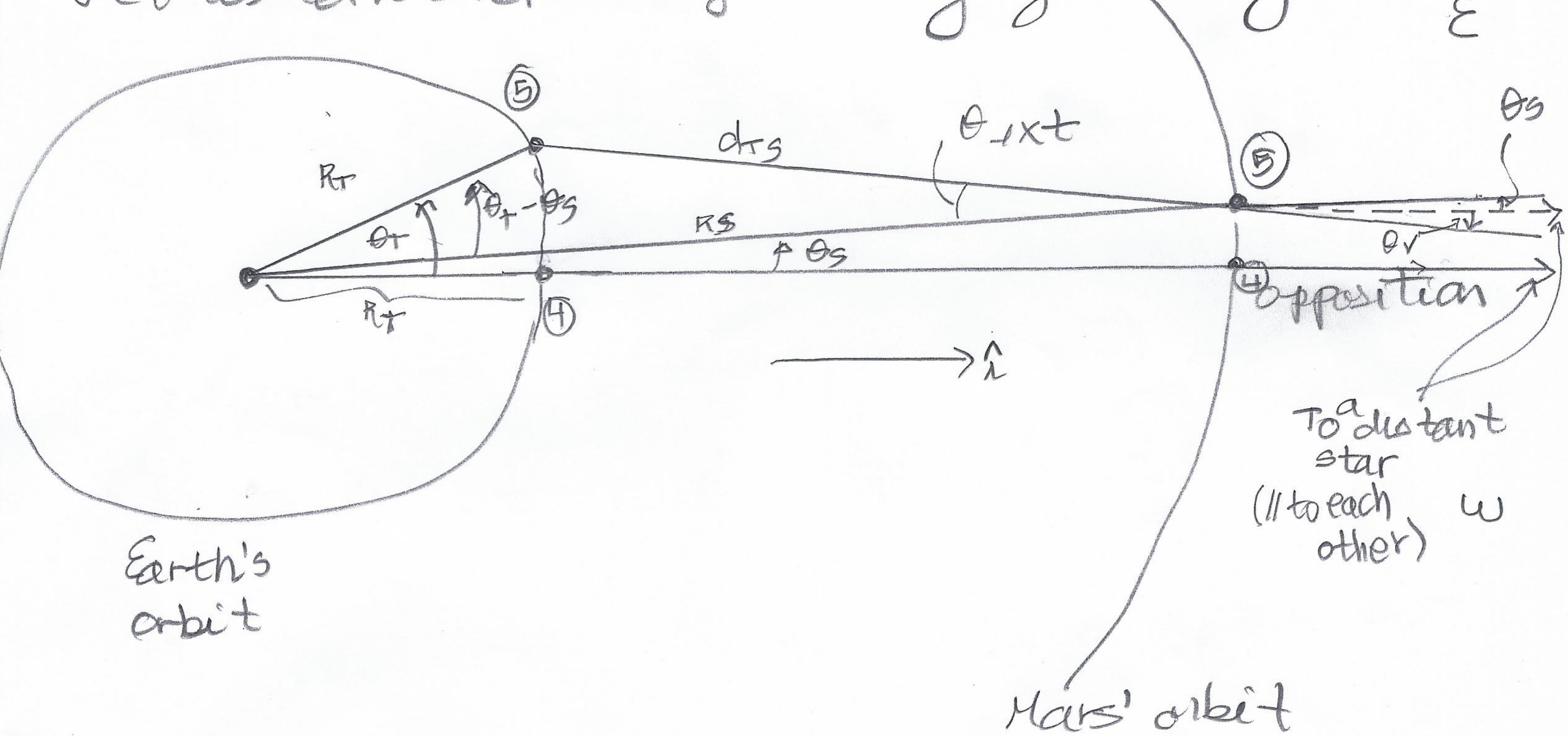
Retrograde Motion of Mars

(see fig 1.6 on C & O).

Let us consider the following geometry



We want θ_V, the angle directed from Earth to Mars wrt the distant stars (in this case, along $\hat{\imath}$

$$d_{TS} = \sqrt{R_T^2 + R_S^2 - 2R_T R_S \cos(\theta_T - \theta_S)}$$

$$\frac{\operatorname{sen}\theta_{ext}}{R_T} = \frac{\operatorname{sen}(\theta_T - \theta_S)}{d_{TS}} \Rightarrow$$

$$\operatorname{sen}\theta_{ext} = \frac{R_T \operatorname{sen}(\theta_T - \theta_S)}{d_{TS}} = \frac{\operatorname{sen}(\theta_T - \theta_S)}{\sqrt{R_T^2 + R_S^2 - 2R_T R_S \cos(\theta_T - \theta_S)}}$$

$$\theta_{ext} = \operatorname{sen}^{-1}(0/0)$$

Also, at 5, since θ_{ext} is opposite by the vertex to the angles involving θ_s and θ_v we have

$$\theta_v = \theta_{ext} - \theta_s = \sin^{-1}(\%) - \theta_s$$

Note that θ_{ext} and θ_s are all functions of time (with $t=0$ @ opposition), since

$$\theta_s = \frac{2\pi}{P_s} \cdot t \quad \text{and} \quad \theta_T = \frac{2\pi}{P_\oplus} \cdot t$$

The evolution of $\theta_v(t)$ is complex, not so simple...

challenge: Compute $\theta_v(t)$ and show the retrograde motion of Mars.
Give code + figure (or movie) $\Rightarrow$
grade 7 on Reading Test #1!