Astro HW 2

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2

2.1

2.1.1 a

$$d_{lim} = \frac{1au}{\tan(\frac{1}{20})} = 1145au$$

$$d_{proxC} \approx \frac{1au}{\tan(\frac{1}{360})} = 20626au$$

$$d_{proxC} > d_{lim}$$

2.1.2 b

$$d = \frac{1au}{\tan(.1 \times 10^{-3}/3600)} = 2062648062au$$

$$d_{pc} = \frac{2062648062au}{206266.372} \approx 9999.92pc$$

2.2

2.2.1 a

$$\theta_a = \omega_a \Delta t + \beta a$$

$$\theta_b = \omega_b \Delta t + \beta b$$

2.2.2 b

$$\omega_a \Delta t + \beta_a - \omega_b \Delta t - \beta_b = 2\pi$$

$$\omega_a \Delta t + \cancel{\beta_a} - \omega_b \Delta t - \cancel{\beta_b} = 2\pi$$

$$\omega_a \Delta t - \omega_b \Delta t = 2\pi$$

$$\omega_a (t_2 - t_1) - \omega_b (t_2 - t_1) = 2\pi$$

$$\frac{2\pi}{p_a}(t_2 - t_1) - \frac{2\pi}{p_b}(t_2 - t_1) = 2\pi$$

$$\frac{1}{p_a} - \frac{1}{p_b} = \frac{1}{p_{syn}}$$

2.2.3 c

$$\frac{1}{p_p} = \frac{1}{p_E} + \frac{1}{p_{syn}}$$

2.2.4 d

$$-\frac{1}{p_E} = \frac{1}{p_{syn}} - \frac{1}{p_p}$$

$$\frac{1}{p_E} = \frac{1}{p_p} - \frac{1}{p_{syn}}$$

2.2.5 e

$$\frac{1}{p_E} = \frac{1}{p_p} - \frac{1}{p_{syn}}$$

$$\frac{1}{p_{syn}} = \frac{1}{p_p} - \frac{1}{p_E}$$

$$\frac{1}{p_{syn}} = \lim_{P_p \to \infty} \frac{1}{p_p} - \frac{1}{p_E} \to \frac{1}{p_{syn}} = -\frac{1}{p_E}$$

if the superior planet has a very long orbital period, then the time of opposition will approach the period of the inferior planet.

2.2.6 f

$$\frac{1}{p_{syn}} = \frac{1}{p_E} - \lim_{P_p \to p_E} \frac{1}{p_p} \to \frac{1}{p_{syn}} = 0$$

2.2.7 g

$$\frac{1}{P_{syn}} = \frac{1}{365.256} - \frac{1}{1.881 * 365.256}$$

$$p_{syn} = 779.8 days$$

$$\frac{1}{P_{syn}} = \frac{1}{365.256} - \frac{1}{164.79 * 365.256}$$

$$p_{syn} = 367.23 days$$

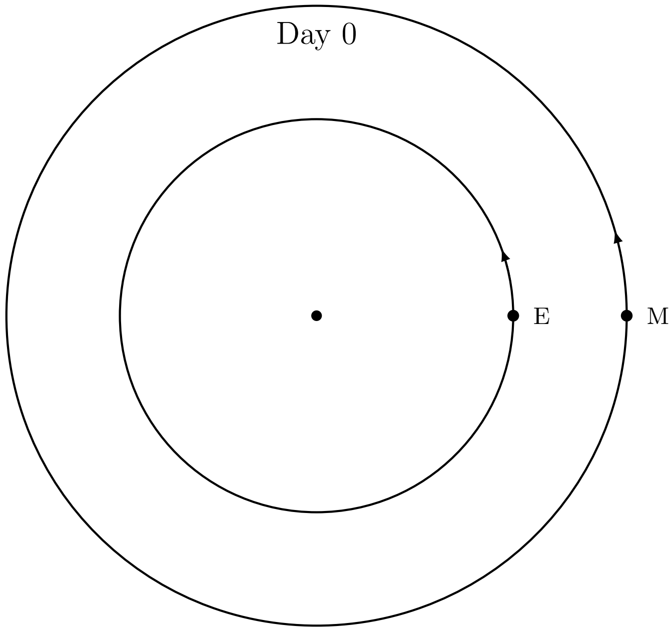
Yes, this makes sense. As we found from subsection e, if a superior planet has a much greater orbit period then the inferior (like Neptune), the period approaches that of the inferior.

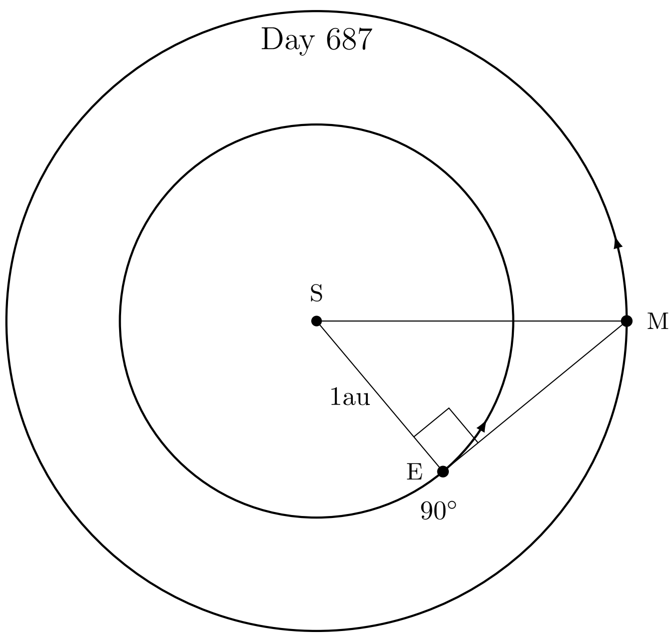
From part F we found that the closer two planets period are to one another, the greater P_{syn} becomes.

In this problem we see that with Neptune, a planet with much greater orbital period then Earth, P_{syn} is close to P_{earth}, whereas with Mars, P_{syn} has grown longer.

2.3

2.3.1 a





2.3.2 b

$$\frac{360}{365.25} = .9856deg/day$$

$$687 * .9856 = 677.125$$

$$677.125 - 360 = 317.125$$

$$360 - 317.125 = 42.874 = \theta_{\angle MSE}$$

$$180 - 42.874 - 90 = 47.125 = \theta_{\angle SME}$$

2.3.3 c

$$SM = D_{mars}$$

$$cos(42.874) = \frac{1}{SM}$$

$$SM = \frac{1}{\cos 42.874}$$

$$SM = 1.36$$

$$D_{mars} = 1.36AU$$

2.3.4 d

$$\arctan(\frac{3390}{5.236 \times 10^6}) \times 3600$$

$$13.35 \times 2$$

$$\theta_{arcsec} \approx 26.708$$

2.4

$$c = \frac{d}{dx}\frac{a}{cos\theta}$$

$$c(\theta) = a\frac{sin\theta}{cos\theta^2} \equiv a\frac{tan\theta}{cos\theta}$$

θ	$c(\theta)$
87	$\approx a364.58$
88	$\approx a820.5$
89	$\approx a3282.63$
89.8	$\approx a82069.992$