PROBLEM SET 3 SOLUTIONS
Physics 2021

1. α(old) = 7.2 deg α(new) = 15 deg

40,100 km x 7.2 deg = C(new) x 15 deg C(new) = 19,248 km

2. d = 7,000 AU α = 1 arcmin = 60 arcsec

D = α d / 206,265 = (60 arcsec) (7,000 AU) / (206,265 arcsec) = 2.0 AU

3. P = 0.6 yr Inferior Planet: 1/P = 1/E + 1/S

1/S = 1 / 0.6 - 1 / 1 = 1.67 - 1.00 = 0.67

S = 1.5 yr (Synodic periods are the same because alignments are similar.)

4. Earth-Sun distance = 1 AU Mars-Sun distance = 1.52 AU

Law of Sines: sin (90 deg) / 1.52 AU = sin (α deg) / 1.00 AU

sin (α deg) = (1 AU) / (1.52 AU) = 0.658

α deg = 41 deg

5. Synodic period = 115.88 days = 0.317 years

$P^{-1} = E^{-1} + S^{-1} = 1 + (0.317)^{-1} = 4.154$

P = 1 / 4.154 = 0.2407 years = 87.9 days

6. From one opposition to the next, the Earth must take one year to complete its orbit plus some additional time to catch up to the superior planet. The farther the superior planet is from the Sun, the slower it moves, so the additional time becomes less, causing oppositions to occur more frequently.

7. **Mercury takes longer to go from greatest western elongation to greatest eastern elongation because the orbital distance is greater. By checking the pairs of dates, the number of days from February 4 to April 16 (western to eastern) is greater than the number of days from April 16 to June 3 (eastern to western).**

8a. **The sidereal and solar days would become shorter, and the solar day would become more nearly equal to the sidereal day.**

8b. **The sidereal and solar days would both become longer and less similar in length.**

8c. **The synodic day would be shorter than the sidereal day.**