P.1.53 An Astronomical Unit (AU) is equal to the average distance from Earth to the Sun, about 92.9 X 10^6 miles. A parsec (pc) is the distance at which a length of 1 AU would subtend an angle of exactly 1 second of arc (Fig. 1.8). A light year (ly) is the distance that light, traveling through a vacuum with a speed of 186,000 miles/s, would cover in 1.0 year.
Express the Earth-Sun distance in (a) parsecs and (b) light years.

Problem 1.53 in the 10th Edition

Angle P = 1 arcsec
_____|1AU = s
D = 1 pc = 1 parsec

The Astronomical Unit, Parsec, and Light Year Problem:

Small Angles => sinα ≈ α in radian Measure if α is small.

1st Find the Parsec in miles and AU:

Let P = 1 arcsec = angle subtended by 1 AU from a distance of 1 Parsec

P = 1 arcsec = 1 arcsec(1arcmin/60arcsec)(1degree/60arcmin) = (1/60^2)degrees
= (1/60)(1/60)degrees(2π radians/360°) = 4.84814 X 10^{-6} Radians
= (1/206265 Radians)

P =also= s/D = AU/Parsec => D = s/P = 1AU/4.84814 X 10^{-6} Radians = 206,265 AU

=> D = 1 Parsec = 206,265 AU = 206,265 AU (92.9 X 10^6 miles)/AU = 19.2 X 10^{12} miles

Find The Light Year in miles:

Light Year = d = vt = [186,000 miles/sec]{1Year in seconds}
{1Year = [365.2422 days/year][24hr/day][60 min/hr][60 sec/min} = 3.155693 X 10^7 sec/year
=> d = [186,000 miles/sec]{3.155693 X 10^7 sec} = 5.87 X 10^{12} miles

Something Extra:
NOTE: [1 Parsec]/[1 Light Year] = [19.2 X 10^{12} miles]/5.87 X 10^{12} miles] = 3.26
=> 1 Parsec = 3.26 Light Years

The Answers to the Questions:

In Parsecs:
a) 1 AU = 1 AU[(1 Parsec)/(206,265 AU) = 4.84814 X 10^{-6} Parsecs => 4.84814 X 10^{-6} pc/AU = 1
Conversion Factor

In Light Years:
b) 1 AU = 1 AU[(92.9 X 10^6 miles)/AU][1 LY/(5.87 X 10^{12} miles)] = 1.58 X 10^{-5} LYs
=> 1.58 X 10^{-5} LYs/AU = 1
Conversion Factor

CHECK: 1.58 X 10^{-5} LYs/AU/[4.84814 X 10^{-6} pc/AU] = 3.26 LY/PS