Introduction to Astronomy

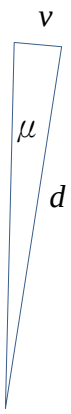
HW140303

due in one week

1. How far away is a star that has a proper motion of 0.08 arcseconds per year and a tangential velocity (proper motion) of 40 km/s? For a star at this distance, what would its tangential velocity have to be in order for it to exhibit the same proper motion as Barnard's star?

A: The relation of the proper motion (μ, in unit of arcsec/yr), tangential velocity (v, in unit of AU/yr), and distance (d, in unit of pc) is as shown,

$$d\,\mu \approx v.$$



Here v = 40 km/s = 40 km/s x 3 x 10^7 s/yr / 1.5 x 10^8 km/AU = 8 AU/yr

(a) So, d = 8 AU/yr / 0.08"/yr ~ 100 [pc]

(b) The proper motion of Barnard's star in RA and Declination is μ_α = − 0.799"/yr, and μ_δ = 10.338"/s (http://en.wikipedia.org/wiki/Barnard's_Star), yielding the total motion on the sky μ =10.369"/yr. So now $v=d\,\mu$ = 1036.9 AU/yr = 5184 km/s.