

# Key "Duluth Drive"

a) 28 miles

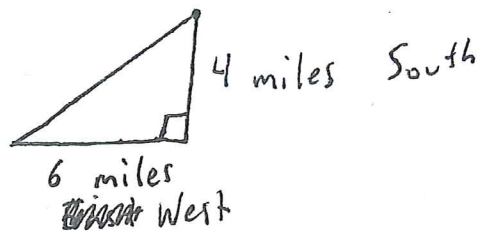
b) Armory to Perkins:  $\sqrt{4^2 + 6^2} = \sqrt{16 + 36} = \sqrt{52} \approx 7.21$  miles

Perkins to Cider:  $\sqrt{8^2 + 2^2} = \sqrt{64 + 4} = \sqrt{68} \approx 8.25$  miles

Cider to Armory:  $\sqrt{4^2 + 4^2} = \sqrt{16 + 16} = \sqrt{32} \approx 5.66$  miles

c)  $28 - (7.21 + 8.25 + 5.66) = 28 - 21.12 = \underline{6.88}$  miles shorter

d) Because North, South, East, and West are set at right angles to each other, the triangles formed are right. For example: 4 miles south and 6 miles West:



e)  $(-3, -2) = \left( \frac{0+(-6)}{2}, \frac{0+(-4)}{2} \right)$

f)  $d = \sqrt{(-3-0)^2 + (-2-0)^2} = \sqrt{(-3)^2 + (-2)^2} = \sqrt{9 + 4} = \sqrt{13}$  miles  
 $\approx 3.61$  miles