PHYS 1311: In Class Problems
Chapter 2, Set II
Jan. 23, 2018

Problem 1. A particle has velocity $\vec{v}\,' = \langle 0.6c, 0, 0\rangle$ in moving frame S', which has velocity $\vec{v}_0 = \langle 0.8c, 0, 0\rangle$ with respect to frame S. Using the Galilean velocity transformation, find the velocity of the particle $\vec{v}$ in frame S. What is wrong?

$\vec{V}' = \vec{V} - \vec{V}_0$

$\vec{V} = \vec{V}' + \vec{V}_0 = \langle 0.6c, 0, 0\rangle + \langle 0.8c, 0, 0\rangle$

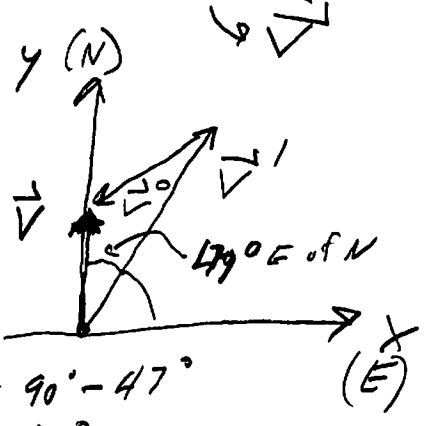
$\boxed{\vec{V} = \langle 1.4c, 0, 0\rangle}$ $|\vec{V}| > c$ which is in violation of special relativity

Problem 2. As two boats approach a marina, the velocity of boat 1 relative to boat 2 is 2.15 m/s in a direction 47.0° east of north. If boat 1 has a velocity that is 0.775 m/s due north, what is the velocity of boat 2?

$\vec{V}_0$

$\vec{V} = \vec{V}' + \vec{V}_0$

$\vec{V}$



$\vec{V} = \langle 0, 0.775, 0\rangle$ m/s = boat 1

$\vec{V}' = 2.15$ m/s 47° E of N

$\vec{V}_0$ = velocity of boat 2

$\vec{V}_0 = \vec{V} - \vec{V}'$

$\theta' = 90° - 47° = 43°$

$V_{0x} = V_x - V_x' = 0 - V'\cos\theta' = -2.15\frac{m}{s}\cos 43°$

$= -1.57$ m/s

$V_{0y} = V_y - V_y' = 0.775 - 2.15\sin 43° = -0.691$ m/s

$\boxed{\vec{V}_0 = \langle -1.57, -0.691, 0\rangle \text{ m/s}}$

$|\vec{V}_0| = \sqrt{1.57^2 + 0.691^2}$

$= \boxed{1.72 \text{ m/s}}$

$\theta_0 = \tan^{-1}\left(\frac{0.691}{1.57}\right) = \boxed{23.8° \text{ S of W}}$