King Fahd University of Petroleum & Minerals

Physics Department

Phys212- Quiz#1

Name: Key ID#:

A rod of proper length 1.0 m is at rest in a reference frame S'. It lies in the (x',y') plane and makes an angle of 30° with the x' axis. If S' moves with a constant velocity v parallel to the x-axis of another frame S, what is the value of v if, as measured in S, the rod makes an angle 45° with the x-axis.

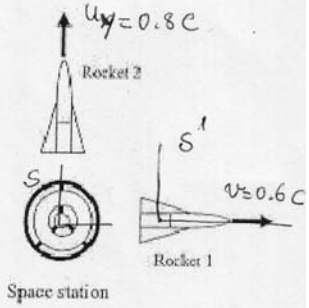
See your notes $\tan\theta = \gamma \tan\theta_p$ $\theta = 45°$ $\theta_p = 30°$

$$\gamma = \frac{\tan 45°}{\tan 30°} = \frac{1}{\sqrt{1-\frac{v^2}{c^2}}} = 1.732$$

$$1 - \frac{v^2}{c^2} = \frac{1}{(1.732)^2} \Rightarrow \frac{v^2}{c^2} = 1 - \frac{1}{(1.732)^2} = 0.67$$

$$v = \sqrt{0.67}\,c = \boxed{0.816\,c}\ m/s$$

Two rockets are leaving their space station along perpendicular paths, as seen measured by an observer on a stationary space station. Rocket 1 moves at 0.60c and rocket 2 moves at 0.80c, both relative to the space station. What is the velocity of rocket 2 as observed by rocket 1?



Rocket 1 $u_x = 0.6c$ $u_y = 0$

rocket 2 $u_x = 0$ $u_y = 0.8c$

Velocity of rocket 2 as observed by rocket 1:

$$u'_x = \frac{u_x - v}{1 - \frac{u_x v}{c^2}} = \frac{0 - 0.6c}{1 - 0} = -0.6c$$

$$u'_y = \frac{u_y}{\gamma\left[1 - \frac{u_x v}{c^2}\right]} = \frac{0.8c}{(1-0)}\sqrt{1-\frac{v^2}{c^2}}$$

$$= 0.8c\sqrt{1-(0.6)^2} = 0.64c$$

$$u' = \sqrt{(-0.6c)^2 + (0.64c)^2} = \boxed{0.877c}\ m/s$$