Chapter 33   Problem 36 [†]

Given
$v = 0.70c$
$u' = 0.40c$

Solution
Find the speed of the faster ship in the earth's reference frame.

Let the primed reference frame, S', be the frame of the slower space ship and the unprimed reference frame, S, be the frame of the earth. When performing the velocity addition, we need to consider the relativistic correction incorporated in the formula

$$u = \frac{u' + v}{1 + u'v/c^2} = \frac{0.40c + 0.70c}{1 + (0.40c)(0.70c)/c^2} = 0.859c$$

In the earth's frame of reference the faster ship is travelling at 85.9% of the speed of light.

(Note: There might be some confusion about which frame to associate with the earth and which with the slower ship. Notice that the formulas given in the book for going from u to u' and from u' to u are the same except for the addition and subtraction sign. Just realize that for this problem the second ship was faster. Therefore, its speed should be the sum of the slower ship speed and the faster ship's speed with respect to the slower. In this case you use the formula with the addition sign.)