79. We refer to the particle in the first sentence of the problem statement as particle 2. Since the total momentum of the two particles is zero in S', it must be that the velocities of these two particles are equal in magnitude and opposite in direction in S'. Letting the velocity of the S' frame be v relative to S, then the particle which is at rest in S must have a velocity of $u'_1 = -v$ as measured in S', while the velocity of the other particle is given by solving Eq. 38-28 for u':

$$u'_2 = \frac{u_2 - v}{1 - u_2 v/c^2} = \frac{\left(\frac{c}{2}\right) - v}{1 - \left(\frac{c}{2}\right)\left(\frac{v}{c^2}\right)} \ .$$

Letting $u'_2 = -u'_1 = v$, we obtain

$$\frac{\left(\frac{c}{2}\right) - v}{1 - \left(\frac{c}{2}\right)\left(\frac{v}{c^2}\right)} = v \quad \Longrightarrow \quad v = c(2 \pm \sqrt{3}) \ \approx \ 0.27c$$

where the quadratic formula has been used (with the smaller of the two roots chosen so that $v \leq c$).