

23. (a) One thing Einstein's relativity has in common with the more familiar (Galilean) relativity is the reciprocity of relative velocity. If Joe sees Fred moving at 20 m/s eastward away from him (Joe), then Fred should see Joe moving at 20 m/s westward away from him (Fred). Similarly, if we see Galaxy A moving away from us at  $0.35c$  then an observer in Galaxy A should see our galaxy move away from him at  $0.35c$ .
- (b) We take the positive axis to be in the direction of motion of Galaxy A, as seen by us. Using the notation of Eq. 38-28, the problem indicates  $v = +0.35c$  (velocity of Galaxy A relative to Earth) and  $u = -0.35c$  (velocity of Galaxy B relative to Earth). We solve for the velocity of B relative to A:

$$u' = \frac{u - v}{1 - uv/c^2} = \frac{(-0.35c) - 0.35c}{1 - (-0.35)(0.35)} = -0.62c$$

or  $u' = -1.87 \times 10^8 \text{ m/s}$ .