

12. (a) Since the center of mass of the man-balloon system does not move, the balloon will move downward with a certain speed u relative to the ground as the man climbs up the ladder. The speed of the man relative to the ground is $v_g = v - u$. Thus, the speed of the center of mass of the system is

$$v_{\text{com}} = \frac{mv_g - Mu}{M + m} = \frac{m(v - u) - Mu}{M + m} = 0 .$$

This yields $u = mv/(M + m)$.

- (b) Now that there is no relative motion within the system, the speed of both the balloon and the man is equal to v_{com} , which is zero. So the balloon will again be stationary.