

31. Our notation is as follows: the mass of the motor is M ; the mass of the module is m ; the initial speed of the system is v_0 ; the relative speed between the motor and the module is v_r ; and, the speed of the module relative to the Earth is v after the separation. Conservation of linear momentum requires $(M + m)v_0 = mv + M(v - v_r)$. Therefore,

$$v = v_0 + \frac{Mv_r}{M + m} = 4300 \text{ km/h} + \frac{(4m)(82 \text{ km/h})}{4m + m} = 4.4 \times 10^3 \text{ km/h} .$$