1. The figure above shows a scattered particle (mass $m_1$) with velocity $v$ and angle $\theta$ as measured in the lab frame and velocity $u$ and angle $\chi$ as measured in the center of mass frame with $V$ denoting the velocity of the center of mass. Assuming that the collision of particle $m_1$ with the initially stationary particle $m_2$ is elastic, show that

$$\cos \theta = \frac{\cos \chi + \frac{m_1}{m_2}}{\sqrt{1 + 2 \frac{m_1}{m_2} \cos \chi + \left( \frac{m_1}{m_2} \right)^2}}$$

and

$$\tan \theta = \frac{\sin \chi}{\cos \chi + \frac{m_1}{m_2}}$$