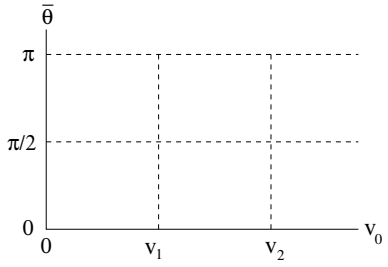
[mex239] Decay of particle: directions in lab frame II

A particle of mass M and velocity $\mathbf{v}_0$ (in the lab frame) decays into two particles of masses m_1, m_2 by releasing a total decay energy ϵ. Assume that mass-energy conversion is negligible ($M = m_1 + m_2$) and that the resulting momenta of the decay products are nonrelativistic.
(a) Calculate the angle $\bar{\theta} \doteq \bar{\theta}_1 + \bar{\theta}_2$ between the two emerging particles in the lab frame as a function of v_0, v_1, v_2 and θ_1, where $\theta_1, \theta_2 = \pi - \theta_1$ are the corresponding angles in the center-of-mass frame.
(b) Determine the range of $\bar{\theta}$ as a function of v_0 under the assumption that $v_1 < v_2$ on a map as follows:



Solution: