Problem P1:

An object of mass m_1 moving at velocity v_1 scatters elastically from an object of mass m_2, initially at rest. Find the maximum scattering angle, θ_1, if $m_1 = 2m_2$.

Problem P2:

Consider the elastic scattering of two particles, both with the same mass, m. In the laboratory frame, one particle (the projectile) has an initial velocity of v_1 while the other (the target) is initially at rest.

a) Find the velocity of the CM frame.

b) Find a formula for the total kinetic energy in the CM frame in terms of the lab kinetic energy, $T_{\text{lab}} = \frac{1}{2}mv_1^2$.

c) Find an expression for the angle θ_1 of the scattered projectile (in the lab frame) in terms of the CM scattering angle Θ.

d) Find an expression for the angle θ_2 of the recoiling target particle (in the lab frame) in terms of the CM scattering angle Θ.

e) Show that $\theta_1 + \theta_2 = \pi/2$.

f) Find an expression for the kinetic energy of the scattered projectile (in the lab) in terms of θ_1 and T_{lab}.

g) Find an expression for the kinetic energy of the recoiling target (in the lab) in terms of θ_2 and T_{lab}.