M99M.2—Two Repulsive Particles

Problem

There are two particles A and B with a repulsive potential,

$$U(r) = \frac{a}{r^2}$$

between them. Particle A has mass M and particle B has mass $2M$. Suppose particle A is shot at velocity v towards a stationary particle B with impact parameter b. Find the deflection angle of particle A after the collision.

Remark: the question can be solved exactly, however an answer incorporating a constant defined by a dimensionless integral is also acceptable (explain your derivation).