

Assignment No. 5

Physics 2P20

Due November 20, 2023

1. An artillery shell is fired at an angle of elevation of 60° with initial speed v_0 . At the uppermost part of its trajectory, the shell bursts into two equal fragments, one of which moves directly upward, relative to the ground, with initial speed of $v_0/2$. What is the direction and speed of the other fragment immediately after the burst?
2. A proton of mass m_p with initial velocity \vec{v}_0 collides with a helium atom, mass $4m_p$, that is initially at rest. If the proton leaves the point of impact at an angle of 45° with the original line of motion, find the final velocities of each particle. Assume that the collision is perfectly elastic.
3. An inverted garbage can of weight W is suspended in air by a water fountain from a geyser. The water shoots up from the ground with a speed v_0 at a constant rate dm/dt . Assume that the water “particles” undergo an elastic collision with the garbage can. Find the height at which the garbage can rides.
This is essentially Problem 4.23 from *Kleppner and Kolenkow, 2nd edition*.
4. *Kleppner and Kolenkow, 2nd edition*, Problem 6.16 (converting between C.o.M. and Lab frames).
5. *Kleppner and Kolenkow, 2nd edition*, Problem 5.12 (Lennard-Jones potential).