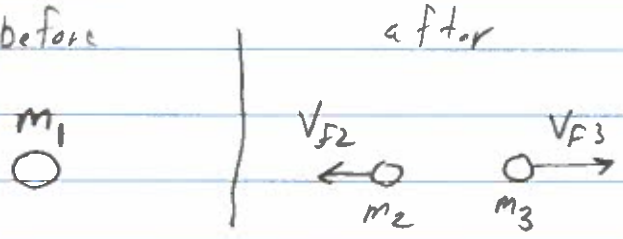
11.68

Problem

Example 9.60

10-9-08



Polonium ^{214}Po ← mass number

$(^1H, ^4He)$

$m_1 = 214u \qquad m_0 = 1u$

$= 214 m_0$

$^{214}Po \rightarrow {}^4He + {}^AX$

$^4He \Rightarrow m_2 = 4m_0$

Use conservation of momentum to get v_{f3}

$\vec{P}_i = \vec{P}_f$

→ must be along a single direction

$X \Rightarrow A = 214 - 4 = 210u$

number of protons and neutrons

$P_{ix} = P_{fx}$

$m_3 = 210 m_0$

$v_{i1} = 0, \quad v_{f2} = 1.42 \times 10^6 m/s = v_2$

what is it?

^{209}Po stable, extra ^5N

↳ ^{210}Pb

^{207}Pb stable $3 \times {}^1n$

$P_{1i} = P_{2f} + P_{3f}$

$m_1 v_{i1} = m_2 v_{f2} + m_3 v_{f3}$

$0 = m_2 v_2 + m_3 v_3 = \cancel{4 m_0}$

$v_3 = \frac{-m_2}{m_0} v_2 = \frac{-4 m_0}{210 m_0} v_2 = -\frac{2}{105} v_2 = -\frac{2}{105}(1.42 \times 10^6 m/s)$

$v_3 = -3.651 \times 10^5 m/s \Rightarrow$ recoil speed $|\vec{v}_3| = 3.66 \times 10^4 m/s$

$\ll |v_{He}|$

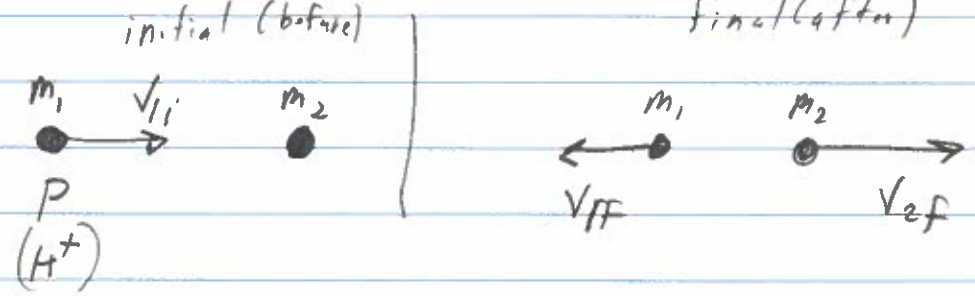
→ If don't along a single line, momentum is not conserved

→ Momentum (not velocity) of the two resulting particles have equal magnitudes and opposite directions

11.67

Example Problem 9.5

10-9-08



Proton, $m_1 = 1u = m_p$ $\quad u \equiv$ atomic mass unit $= 1.661 \times 10^{-27}$ kg

$m_p = 1.00$

$|\vec{v}_{1i}| = v_0 = 2.5 \times 10^6$ m/s $\Rightarrow \vec{v}_{1i} = v_0 \rightarrow$

$|\vec{v}_{1f}| = 0.75\, v_0$ $\qquad v_{1f} = -\frac{3v_0}{4}$ ←

$v_{2f} = 3.12 \times 10^5$ m/s $= v_2$, $\quad v_{2i} = 0$

- Use conservation of momentum, $\vec{P}_i = \vec{P}_f \Rightarrow P_{ix} = P_{fx}$

or $\sum_{k=1}^{2} P_{i,k,x} = \sum_{k=1}^{2} P_{f,k,x}$ (disp +)

or $P_{i1} + P_{i2} = P_{f1} + P_{f2}$, $\quad P = mv$

or $m_1 v_{i1} + m_2 v_{i2} = m_1 v_{f1} + m_2 v_{f2}$

or $m_0 v_0 + 0 = -m_0 \frac{3v_0}{4} + m_2 v_{f2}$, solve for m_2

$m_2 v_{f2} = m_0 v_0 + m_0 \frac{3v_0}{4} = \frac{7 m_0 v_0}{4}$

$m_2 = 7 m_0 \frac{v_0}{4 v_{f2}} = \frac{7(1u)}{4} \frac{(2.5 \times 10^6)}{(3.12 \times 10^5)} = 14.02\ u$

N, this one

14 N