Problem 9.58: neutron traveling at given $\vec{v}$ hits stationary He nucleus. Nucleus moves off at given angle θ_2 to $\vec{v}$ with velocity $\vec{v}_2$, neutron has final velocity $\vec{v}_1$, angle θ_1.

That is, we're given the incoming neutron velocity and the angle the hit nucleus moves off at.

We're now asked to find first the angle the neutron leaves at, then the neutron's final speed, then the He final speed.

Unless I'm missing something, you can't solve the problem in that order!

I would have thought the simplest *first* thing to find is the *last* thing asked: the He speed.

I choose that because the angle θ_2 between that velocity and the initial neutron velocity is the only angle I know, so combining energy conservation with momentum conservation

$$v^2 = v_1^2 + 4v_2^2, \quad \vec{v}_1 = \vec{v} - 4\vec{v}_2$$
$$v^2 = \left(\vec{v} - 4\vec{v}_2\right)^2 + 4v_2^2 = v^2 - 8vv_2\cos\theta_2 + 20v_2^2$$
$$v_2 = 0.4v\cos\theta_2$$

Then find v_1 from energy conservation, then, finally, the angle θ_1.

This is a good example of how much easier it is sometimes to work with vectors instead of all the component equations—try it!

I might go over finding v_2 this way in class on Wednesday.