Chapter 9 Problem 28 [†]

Given
$m_n = 1.0\ u$
$m_d = 2.0\ u$
$m_t = 3.0\ u$
$\vec{v}_n = \{28\hat{i} + 17\hat{j}\}Mm/s$
$\vec{v}_t = \{12\hat{i} + 20\hat{j}\}Mm/s$

Solution
Find the initial velocity of the deuteron.

The mass of tritium is the sum of the mass of the neutron and the deuteron atom. Therefore, the mass of the tritium is 3.0 u. During the collision any external forces are negligible and the momentum is conserved. Therefore,

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

$$\vec{p}_n + \vec{p}_d = \vec{p}_t$$

Solve for the momentum of the deuteron particle.

$$\vec{p}_d = \vec{p}_t - \vec{p}_n$$

Since momentum is mass times velocity, then

$$m_d\vec{v}_d = m_t\vec{v}_t - m_n\vec{v}_n$$

Solve for velocity of the deuteron

$$\vec{v}_d = \frac{m_t\vec{v}_t - m_n\vec{v}_n}{m_d}$$

Substitute in the provided values gives

$$\vec{v}_d = \frac{(3.0\ u)(\{12\hat{i} + 20\hat{j}\}Mm/s) - (1.0\ u)(\{28\hat{i} + 17\hat{j}\}Mm/s)}{2.0\ u}$$

$$\vec{v}_d = \frac{\{36\hat{i} + 60\hat{j} - 28\hat{i} - 17\hat{j}\}uMm/s)}{2.0\ u}$$

$$\vec{v}_d = \frac{\{8.0\hat{i} + 43\hat{j}\}uMm/s)}{2.0\ u}$$

$$\vec{v}_d = \{4.0\hat{i} + 21.5\hat{j}\}Mm/s$$

[†]Problem from Essential University Physics, Wolfson