

You have been able to get a part time job with a medical physics group investigating ways to treat inoperable brain cancer. One form of cancer therapy being studied uses slow neutrons to knock a particle (either a neutron or a proton) out of the nucleus of the atoms which make up cancer cells. The neutron knocks out the particle it collides with in an inelastic collision. The heavy nucleus essentially does not move in the collision. After a single proton or neutron is knocked out of the nucleus, the nucleus decays, killing the cancer cell. To test this idea, your research group decides to measure the change of internal energy of a nitrogen nucleus after a neutron collides with one of the neutrons in its nucleus and knocks it out. In the experiment, one neutron goes into the nucleus with a speed of  $2.0 \times 10^7$  m/s and you detect two neutrons coming out at angles of  $30^\circ$  and  $15^\circ$ . You can now calculate the change of internal energy of the nucleus.