31. We approximate the total distance by the number of revolutions times the circumference of the orbit corresponding to the average energy. This should be a good approximation since the deuteron receives the same energy each revolution and its period does not depend on its energy. The deuteron accelerates twice in each cycle, and each time it receives an energy of $qV = 80 \times 10^3\,\text{eV}$. Since its final energy is $16.6\,\text{MeV}$, the number of revolutions it makes is

$$n = \frac{16.6 \times 10^6\,\text{eV}}{2(80 \times 10^3\,\text{eV})} = 104 \ .$$

Its average energy during the accelerating process is $8.3\,\text{MeV}$. The radius of the orbit is given by $r = mv/qB$, where v is the deuteron's speed. Since this is given by $v = \sqrt{2K/m}$, the radius is

$$r = \frac{m}{qB}\sqrt{\frac{2K}{m}} = \frac{1}{qB}\sqrt{2Km} \ .$$

For the average energy

$$r = \frac{\sqrt{2(8.3 \times 10^6\,\text{eV})(1.60 \times 10^{-19}\,\text{J/eV})(3.34 \times 10^{-27}\,\text{kg})}}{(1.60 \times 10^{-19}\,\text{C})(1.57\,\text{T})} = 0.375\ \text{m} \ .$$

The total distance traveled is about $n2\pi r = (104)(2\pi)(0.375) = 2.4 \times 10^2\,\text{m}$.