79. (a) The transmission coefficient T for a particle of mass m and energy E that is incident on a barrier of height U and width L is given by

$$T = e^{-2kL} ,$$

where

$$k = \sqrt{\frac{8\pi^2 m(U-E)}{h^2}} .$$

For the proton,

$$\begin{aligned} k &= \sqrt{\frac{8\pi^2(1.6726\times10^{-27}\,\text{kg})(10\,\text{MeV}-3.0\,\text{MeV})(1.6022\times10^{-13}\,\text{J/MeV})}{(6.6261\times10^{-34}\,\text{J}\cdot\text{s})^2}} \\ &= 5.8082\times10^{14}\ \text{m}^{-1} , \end{aligned}$$

$kL = (5.8082\times10^{14}\,\text{m}^{-1})(10\times10^{-15}\,\text{m}) = 5.8082$, and

$$T = e^{-2\times5.8082} = 9.02\times10^{-6} .$$

The value of k was computed to a greater number of significant digits than usual because an exponential is quite sensitive to the value of the exponent. The mass of a deuteron is $2.0141\,\text{u} = 3.3454\times10^{-27}\,\text{kg}$, so

$$\begin{aligned} k &= \sqrt{\frac{8\pi^2(3.3454\times10^{-27}\,\text{kg})(10\,\text{MeV}-3.0\,\text{MeV})(1.6022\times10^{-13}\,\text{J/MeV})}{(6.6261\times10^{-34}\,\text{J}\cdot\text{s})^2}} \\ &= 8.2143\times10^{14}\ \text{m}^{-1} , \end{aligned}$$

$kL = (8.2143\times10^{14}\,\text{m}^{-1})(10\times10^{-15}\,\text{m}) = 8.2143$, and

$$T = e^{-2\times8.2143} = 7.33\times10^{-8} .$$

(b) Mechanical energy is conserved. Before the particles reach the barrier, each of them has a kinetic energy of 3.0 MeV and a potential energy of zero. After passing through the barrier, each again has a potential energy of zero, so each has a kinetic energy of 3.0 MeV.

(c) Energy is also conserved for the reflection process. After reflection, each particle has a potential energy of zero, so each has a kinetic energy of 3.0 MeV.