Argon

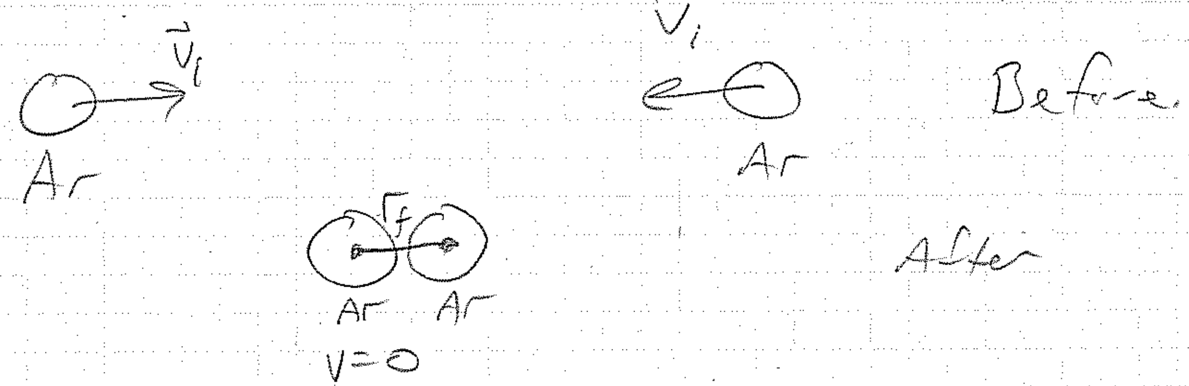
$r_{min} = 3.82 \times 10^{-10}\ m$

$\epsilon = 1.65 \times 10^{-21}\ J$

$$\left(\frac{40\,g}{mol}\right)\left(\frac{1\,kg}{1000\,g}\right)\left(\frac{1\,mol}{6.02 \times 10^{23}\ atoms}\right) = 6.64 \times 10^{-26}\ kg$$

When Ar atoms are far apart,

$v_i = 1 \times 10^{5}\ \frac{m}{s}$



$\Delta E = 0$

$\Delta K + \Delta U = 0$

$K_f - K_i + U_f - U_i = 0$

$r_i = \infty$ so $U_i = 0$

(Note that for $r_i = 1\,mm$, $U_i = -5 \times 10^{-60}\,J \approx 0$)

$K_f = 0$ at closest approach. So,

$K_i = U_f$

$K_{1i} + K_{2i} = U_f$

$2K_{1i} = U_f$

$K_{1i} = \frac{1}{2} m v_i^2$

$= \frac{1}{2}(6.64 \times 10^{-26}\,kg)(1 \times 10^{5}\,\frac{m}{s})^2$

$= 3.32 \times 10^{-16}\,J$

$\boxed{K_{tot} = 6.64 \times 10^{-16}\,J}$

$$U_f = \epsilon\left(\left(\frac{r_{min}}{r_f}\right)^{12} - \left(\frac{r_{min}}{r_f}\right)^{6}\right)$$

$$K_i = U_f$$

$$6.64\times10^{-16}\,J = 1.65\times10^{-21}\,J\left(\left(\frac{3.82\times10^{-10}\,m}{r}\right)^{12} - \left(\frac{3.82\times10^{-10}\,m}{r}\right)^{6}\right)$$

$$4.02\times10^{5} = \left(\left(\frac{3.82\times10^{-10}\,m}{r}\right)^{12} - \left(\frac{3.82\times10^{-10}\,m}{r}\right)^{6}\right)$$

$\boxed{r = 1.30\times10^{-10}\,m}$ using Wolfram Alpha