$$V(r) = \frac{A}{r^{12}} - \frac{B}{r^{6}}$$ General form of the LJ potential

$$\frac{dV(r)}{r} = \frac{-12A}{r^{13}} + \frac{6B}{r^{7}} = -F(r)$$

$F(r_0) = 0$ as $r = r_0$ at equilibrium

$$\therefore \quad 0 = \frac{-12A}{r_0^{13}} + \frac{6B}{r_0^{7}}$$

$$\frac{12A}{r_0^{13}} = \frac{6B}{r_0^{7}} \Rightarrow B = \frac{2A}{r_0^{6}}$$

Also, $V(r_0) = -\varepsilon$

$$\therefore \quad V(r_0) = -\varepsilon = \frac{A}{r_0^{12}} - \frac{B}{r_0^{6}}$$

$$-\varepsilon = \frac{A}{r_0^{12}} - \frac{2A}{r_0^{12}}$$

$$\therefore \quad \varepsilon = \frac{A}{r_0^{12}} \Rightarrow \begin{aligned} A &= \varepsilon r_0^{12} \\ B &= 2\varepsilon r_0^{6} \end{aligned}$$

$$\therefore \quad V(r) = \varepsilon \left[\frac{r_0^{12}}{r^{12}} - \frac{2r_0^{6}}{r^{6}} \right]$$

Lots of different ways to do the algebra... can get A in terms of B, or ε and r_0 in terms of A + B (as we did in the lectures).