Prob2619: A capacitor consists of 2 parallel plates of area A. Charge to V_0 & disconnect.

(a) How much does energy change if d_0 changes to d_1?

We know that $C_0 = \frac{e_0 A}{d}$ and therefore $U = \frac{1}{2}CV^2 = \frac{1}{2}Q^2 \frac{d}{e_0 A}$ is the initial energy in the capacitor.

Final energy is: $U' = \frac{1}{2}C'V'^2$ where $C' = \frac{e_0 A}{d_1}$ but in order to get V' need to use the fact that $Q_0 = C_0 V_0 = Q$ ' and therefore $V' = Q'/C' = Q_0/C'$

Thus $U' = \frac{1}{2}(\frac{d_1}{e_0 A})Q_0^2$ and $\Delta U = \frac{1}{2}(\frac{d_1 - d}{e_0 A})Q_0^2$

(b) How much work is done by external force to move the plate?

The above is the external work done

$$\Delta U$$

(c) Suppose the plates are connected to a battery as they are moved how much does energy change under these conditions?

The potential difference does not change but charge & capacitance change.

$$V = Q/C = const$$

There is a decrease in the stored energy since C decreases.