Q- How does the energy stored in a parallel plate capacitor change if:
a) The potential difference is doubled.
b) The separation between the plates is doubled with the capacitor remains connected to the battery.
c) The separation between the plates is doubled after it is disconnected from the battery.

a) The energy stored in a capacitor is given by $U = (1/2)CV^2$
As it is proportional to the square of potential difference across it hence if the potential difference doubled, it will result in increase in its energy **four** time the initial energy.

b) The capacitance of a capacitor is given by $C = \epsilon_0 A/d$
Thus the energy of the capacitor is given by

$$U = \frac{1}{2}\left(\frac{\epsilon_0 A}{d}\right)V^2$$

Now if the battery remains connected, the potential difference between the plates remains constant. In this case the energy is inversely proportional to the separation d between the plates hence if the distance between the plates is doubled it energy is **halved**.

c) If the battery is disconnected and the separation between the plates is changed, the potential difference between the plates will change but the charge on the plates remains the same. Thus we can write

$$U = \frac{1}{2}\,CV^2 = \frac{1}{2}\,C\,\left(\frac{Q}{C}\right)^2 = \frac{Q^2}{2C} = \frac{Q^2 d}{2\epsilon_0 A}$$

Thus in this case the energy of the capacitor is directly proportional to the separation between the plates.
Hence by doubling the plate separation after disconnecting the battery the energy will be **doubled**.