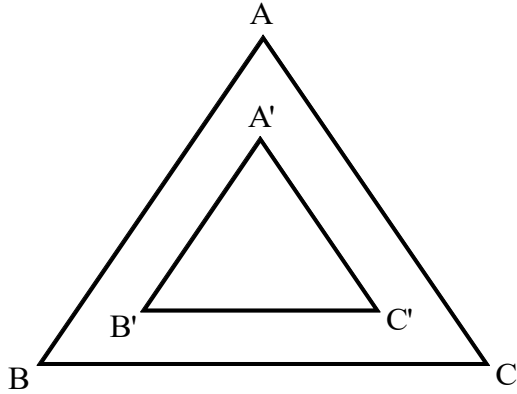Three point charges 1C, 2C and 3C are placed at the corners of an equilateral triangle of side 1 m. The work required by external agent to move these charges slowly to the corners of a smaller equilateral triangle of side 0.5 m is given by:

(A) $-9.9 \times 10^{10} J$ (B) Work depends on the path

(C) $-19.8 \times 10^{10} J$ (D) $9.9 \times 10^{10} J$

Solution

$$W_{Ext} = U_f - U_i$$

$$\therefore W_{Ext} = \frac{1}{4\pi \in_0} \left(\frac{1 \times 2}{0.5} + \frac{2 \times 3}{0.5} + \frac{3 \times 1}{0.5} \right) - \frac{1}{4\pi \in_0} \left(\frac{1 \times 2}{1} + \frac{2 \times 3}{1} + \frac{3 \times 1}{1} \right)$$

$$\therefore W_{Ext} = \frac{1}{4\pi \in_0} \left(1 \times 2 + 2 \times 3 + 3 \times 1 \right) = 9 \times 10^9 \times 11 = 9.9 \times 10^{10} J$$

Hence, (D)