M_x and M_y denote the atomic masses of the parent and the daughter nuclei respectively in a radioactive decay. The Q-value for a β^- decay is Q_1 and that for a β^+ decay is Q_2. If m_e denotes the mass of an electron, then which of the following statements is correct?

(a) $Q_1 = (M_x - M_y)\, c^2$ and $Q_2 = (M_x - M_y - 2m_e)c^2$
(b) $Q_1 = (M_x - M_y)\, c^2$ and $Q_2 = (M_x - M_y)c^2$
(c) $Q_1 = (M_x - M_y - 2m_e)\, c^2$ and $Q_2 = (M_x - M_y + 2\, m_e)c^2$
(d) $Q_1 = (M_x - M_y + 2m_e)\, c^2$ and $Q_2 = (M_x - M_y + 2\, m_e)c^2$

Correct option is A)

The masses of the β^+ and β^- are taken into account in both cases. What you are missing is the effect on the other electrons in the atom, because nuclei do not exist on their own during radioactivity. The values given for M_x, M_y are the **atomic** masses, not the masses of the bare nuclei.

In β^- decay the nucleus loses -ve charge, making it more +ve, so the electron cloud must **gain** an extra electron to keep the atom neutral. Overall 0 electrons have been lost by the atom : lose one + gain one = no change. So $Q = (M_x - M_y)$.

In β^+ decay the nucleus loses +ve charge, making it less +ve. The electron cloud must **lose** a -ve charge to keep the atom neutral. Overall 2 electrons have been lost by the atom : one from the nucleus, one from the cloud. So $q = (M_x - M_y - 2m)$.