Answer on Question #86422, Physics / Electromagnetism

Let the potential be 0 at infinity. Let's make an assumption that the 2q and q charges are at the opposite end of the line, this would be the minimum potential energy positions if the q charge was not included, and switching the q charge with either of the larger charges would only increase the potential energy.

Let r be the distance of the q charge from the 2q charge. Then the potential energy of the system is:

$$U = K\ (\ \frac{2q^2}{r} + \frac{q^2}{10-r} + \frac{2q^2}{10})$$

We can minimize this by taking the derivative with respect to r and setting it equal to 0:

$$0 = kq^2(\frac{-2}{r^2} + \frac{1}{(10-r)^2})$$

$$\frac{r^2}{2} = (10-r)^2$$

$$r = 20\ \pm 10\sqrt{2}$$

This has 2 solutions. However, we are only interested in solutions that lie along the 10 cm line (solutions where r is positive), so
$r = 20 - 10\sqrt{2}$

Which is indeed on the line and fulfils our intuition that the q charge should be closer to the 2q charge than the q charge.