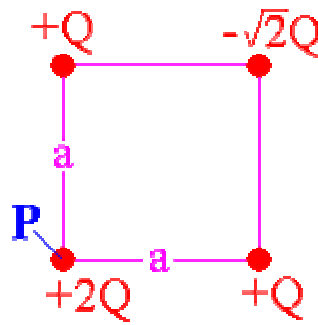
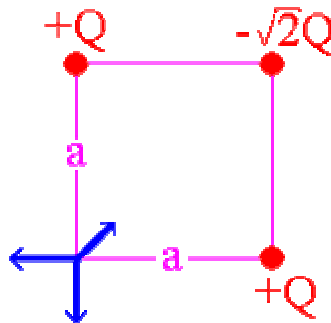


Example: What is the **direction** of \mathbf{E} experienced by the charge at point P?



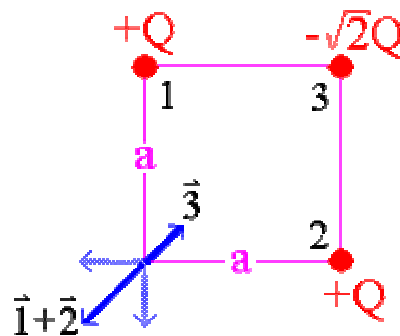
Solution:

Since we have been asked about the electric field experienced by the $+2Q$ charge, it may be treated as the positive test charge. The directions of the electric field contributions from the other three charges are indicated below:



Note that the magnitudes of the contributions from 1 and 2 are the same since charges 1 and 2 are the same. A direction has been assigned to the contribution from charge 3 [diagonally inward] but its magnitude relative to the others is not known until we evaluate it.

Recognizing that the resultant of the contributions from 1 and 2 points diagonally outward, as shown below, the solution to this question reduces to a determination of the relative magnitude of the contribution from charge 3 to the resultant of the contributions from 1 and 2.



The relationship for the electric field of a point charge:

$\mathbf{E} = k \frac{Q}{r^2} \hat{r}$ Thus the magnitude of the contribution from 1 (and 2) is

$$|\mathbf{E}_1| = |\mathbf{E}_2| = k \frac{Q}{a^2}$$

and the resultant is

$$|\mathbf{E}_1 + \mathbf{E}_2| = k \sqrt{2} \frac{Q}{a^2}$$

The magnitude of the contribution from 3 is

$$|\mathbf{E}_3| = k \frac{(\sqrt{2}Q)}{(\sqrt{2}a)^2} = k \frac{\sqrt{2}Q^2}{2a^2}$$

which is one-half that from 1 and 2 combined, so the relative contributions shown in the previous figure are correct and the direction of \mathbf{E} from all three contributions points diagonally outward (225 degrees or southwest).