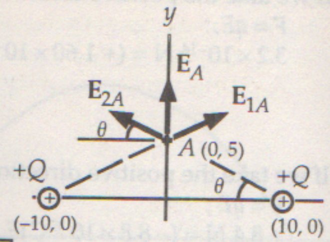
30. At point A, from the diagram, we see that the electric fields produced by the charges will have the same magnitude, and the resultant field will be up. We find the angle θ from

$\tan\theta = (0.050\text{ m})/(0.100\text{ m}) = 0.500,$ or $\theta = 26.6°.$



For the magnitudes of the individual fields we have

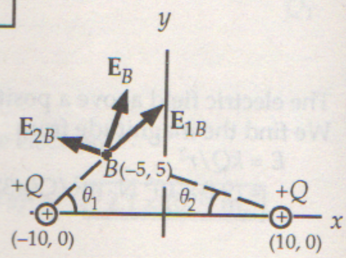
$E_{1A} = E_{2A} = kQ/r_A^2$
$= (9.0\times10^9\text{ N}\cdot\text{m}^2/\text{C}^2)(9.0\times10^{-6}\text{ C})/[(0.100\text{ m})^2 + (0.050\text{ m})^2]$
$= 6.48\times10^6\text{ N/C}.$

From the symmetry, the resultant electric field is

$E_A = 2E_{1A}\sin\theta = 2(6.48\times10^6\text{ N/C})\sin 26.6° =$ **5.8×10^6 N/C up.**

For point B we find the angles for the directions of the fields from

$\tan\theta_1 = (0.050\text{ m})/(0.050\text{ m}) = 1.00,$ or $\theta_1 = 45.0°.$
$\tan\theta_2 = (0.050\text{ m})/(0.150\text{ m}) = 0.333,$ or $\theta_2 = 18.4°.$



For the magnitudes of the individual fields we have

$E_{1B} = kQ/r_{1B}^2$
$= (9.0\times10^9\text{ N}\cdot\text{m}^2/\text{C}^2)(9.0\times10^{-6}\text{ C})/[(0.050\text{ m})^2 + (0.050\text{ m})^2]$
$= 1.62\times10^7\text{ N/C}.$

$E_{2B} = kQ/r_{2B}^2$
$= (9.0\times10^9\text{ N}\cdot\text{m}^2/\text{C}^2)(9.0\times10^{-6}\text{ C})/[(0.150\text{ m})^2 + (0.050\text{ m})^2] = 3.24\times10^6\text{ N/C}.$

For the components of the resultant field we have

$E_{Bx} = E_{1B}\cos\theta_1 - E_{2B}\cos\theta_2 = (1.62\times10^7\text{ N/C})\cos 45.0° - (3.24\times10^6\text{ N/C})\cos 18.4° = 8.38\times10^6\text{ N/C}$
$E_{By} = E_{1B}\sin\theta_1 - E_{2B}\sin\theta_2 = (1.62\times10^7\text{ N/C})\sin 45.0° - (3.24\times10^6\text{ N/C})\sin 18.4° = 1.25\times10^7\text{ N/C}.$

We find the direction from

$\tan\theta_B = E_{By}/E_{Bx} = (1.25\times10^7\text{ N/C})/(8.38\times10^6\text{ N/C}) = 1.49,$ or $\theta_1 = 56.2°.$

We find the magnitude from

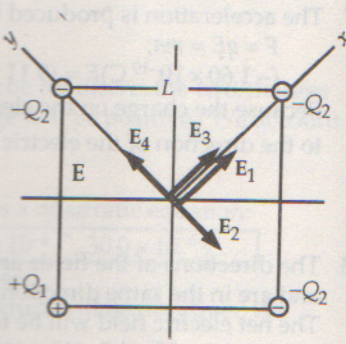
$E_B = E_{Bx}/\cos\theta_B = (8.38\times10^6\text{ N/C})/\cos 56.2° = 1.51\times10^7\text{ N/C}.$

Thus the field at point B is **1.5×10^7 N/C 56° above the horizontal.**

31. The directions of the individual fields will be along the diagonals of the square, as shown. We find the magnitudes of the individual fields:

$E_1 = kQ_1/(L/\sqrt{2})^2 = 2kQ_1/L^2$
$= 2(9.0\times10^9\text{ N}\cdot\text{m}^2/\text{C}^2)(45.0\times10^{-6}\text{ C})/(0.60\text{ m})^2 = 2.25\times10^6\text{ N/C}.$

$E_2 = E_3 = E_4 = kQ_2/(L/\sqrt{2})^2 = 2kQ_2/L^2$
$= 2(9.0\times10^9\text{ N}\cdot\text{m}^2/\text{C}^2)(31.0\times10^{-6}\text{ C})/(0.60\text{ m})^2 = 1.55\times10^6\text{ N/C}.$



From the symmetry, we see that the resultant field will be along the diagonal shown as the x-axis. For the net field, we have

$E = E_1 + E_3 = 2.25\times10^6\text{ N/C} + 1.55\times10^6\text{ N/C} = 3.80\times10^6\text{ N/C}.$

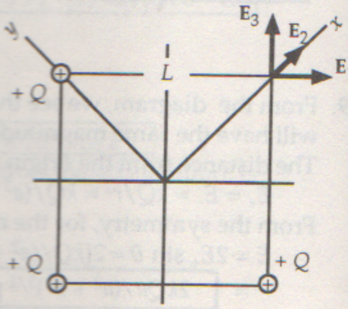
Thus the field at the center is

3.80×10^6 N/C away from the positive charge.

32. The directions of the individual fields are shown in the figure. We find the magnitudes of the individual fields:

$E_1 = E_3 = kQ/L^2$
$= (9.0\times10^9\text{ N}\cdot\text{m}^2/\text{C}^2)(2.80\times10^{-6}\text{ C})/(1.00\text{ m})^2 = 2.52\times10^4\text{ N/C}.$

$E_2 = kQ/(L\sqrt{2})^2 = \frac{1}{2}kQ_2/L^2$
$= \frac{1}{2}(9.0\times10^9\text{ N}\cdot\text{m}^2/\text{C}^2)(2.80\times10^{-6}\text{ C})/(1.00\text{ m})^2 = 1.26\times10^4\text{ N/C}.$



From the symmetry, we see that the resultant field will be along the diagonal shown as the x-axis. For the net field, we have

$E = 2E_1\cos 45° + E_2 = 2(2.52\times10^4\text{ N/C})\cos 45° + 1.26\times10^4\text{ N/C}$
$= 4.82\times10^4\text{ N/C}.$

Thus the field at the unoccupied corner is

4.82×10^4 N/C away from the opposite corner.