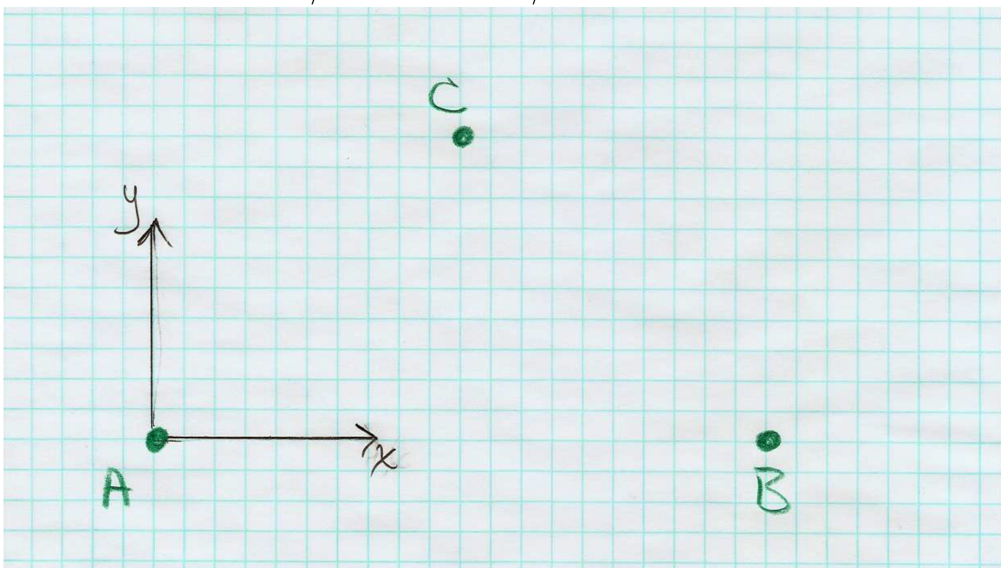
Physics 9 worksheet: electric forces.

Work with your neighbor. Ask me for help if you're stuck. Then we'll discuss & check work all together.

Particles A, B, C carry identical positive charges $q_A = q_B = q_C = +10\,\mu\text{C} = 1.0 \times 10^{-5}\,\text{C}$. Particle A is located at $(x_A, y_A) = (0, 0)$ meters. Particle B is at $(x_B, y_B) = (+2.0, 0.0)$ meters. Particle C is at $(x_C, y_C) = (+1.0, +1.0)$ meters. The angles $\angle_{CAB}$ and $\angle_{CBA}$ are both 45°. If you don't have a calculator, you can approximate $k = 9 \times 10^9\,\text{N}\,\text{m}^2/\text{C}^2 \approx 10^{10}\,\text{N}\,\text{m}^2/\text{C}^2$.

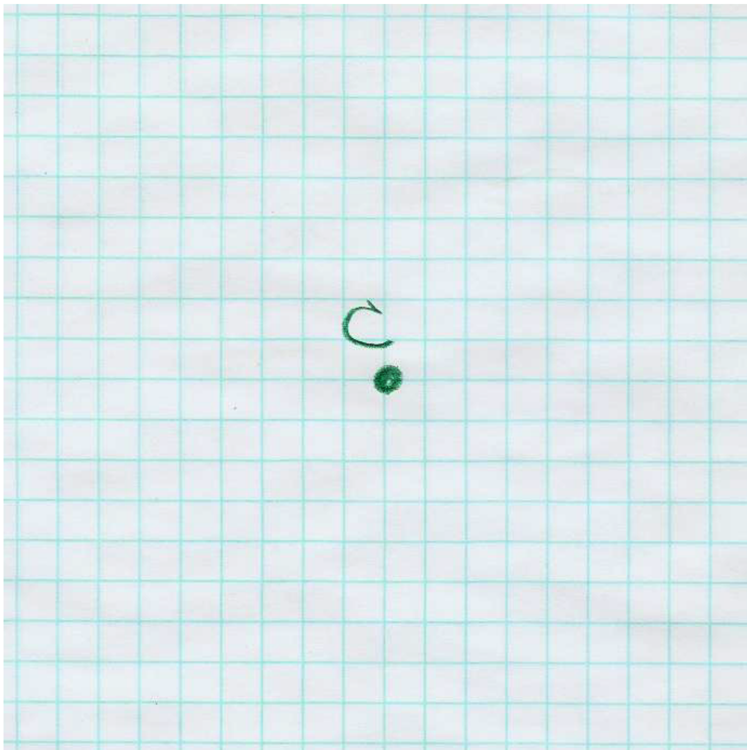


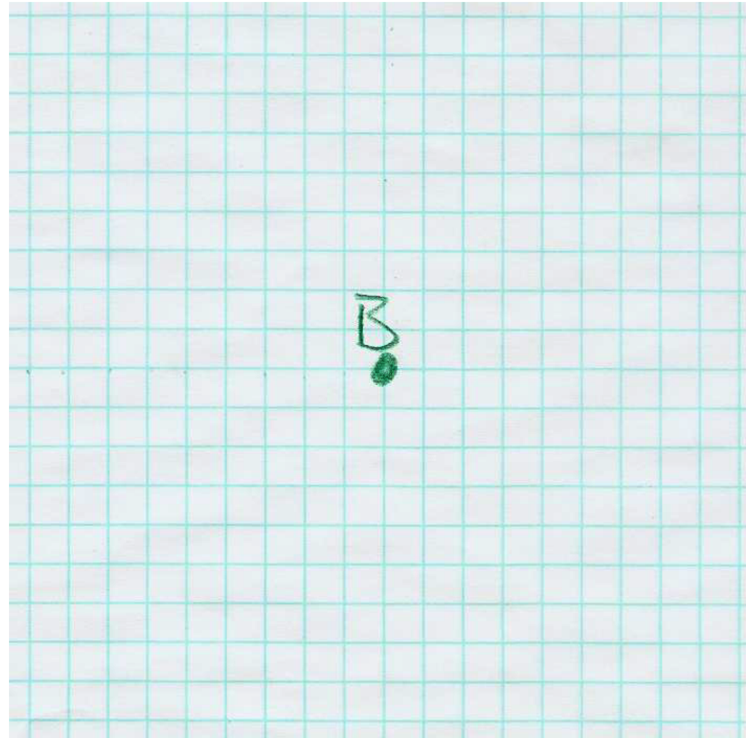
(1) What is the magnitude (in newtons) of the electric force between each pair of particles?

$F^E_{AB} =$ $\qquad$ $F^E_{AC} =$ $\qquad$ $F^E_{BC} =$

$F^E_{BA} =$ $\qquad$ $F^E_{CA} =$ $\qquad$ $F^E_{CB} =$

(2) Draw arrows for the two electric forces that are acting ON particle C. (The electric force exerted by A on C is written $\vec{F}^E_{AC}$. The electric force exerted by B on C is written $\vec{F}^E_{BC}$.) Then draw an arrow for the vector sum of forces (a.k.a. the "net force") acting on particle C, which is written $\sum \vec{F}^E_C$. To make it easier to compare results, choose the length of your arrows so that the grid size on your force diagram is 0.1 N. (Use the left grid below.)





(3) Now draw (above right) arrows for the forces acting on particle B and their vector sum. Again use a grid size of 0.1 N.

(4) Next, work out the Cartesian coordinates (F_x, F_y) for the forces acting on particle C and their vector sum.

$F^E_{AC,x} =$

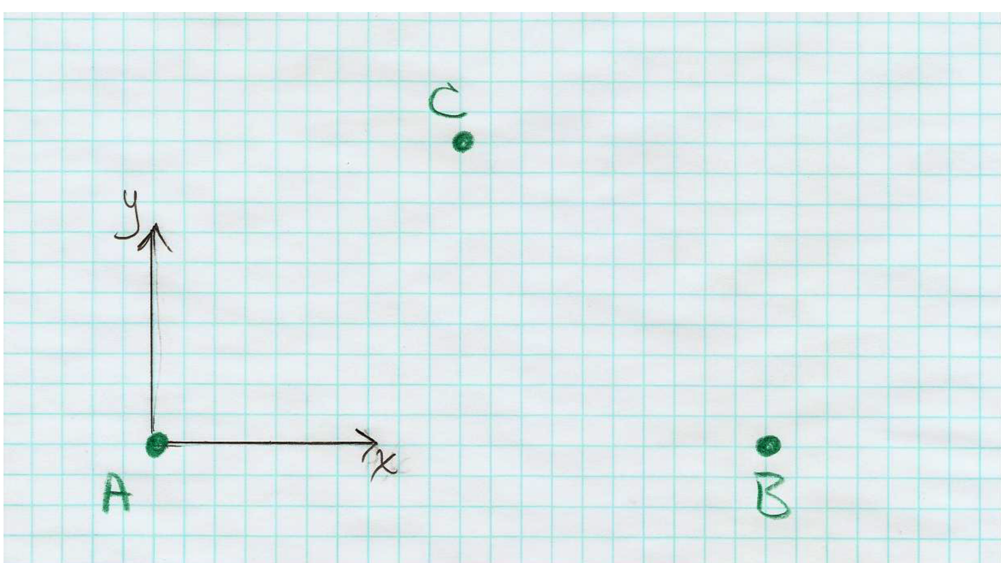
$F^E_{AC,y} =$

$F^E_{BC,x} =$

$F^E_{BC,y} =$

$\sum F^E_{C,x} =$

$\sum F^E_{C,y} =$



(5) Draw an arrow indicating the direction of the electric field $\vec{E}(P)$ at the point P given by $P_x = 1.0\,\mathrm{m}$, $P_y = 0.0\,\mathrm{m}$.

(6) Work out the Cartesian components (E_x, E_y) for the electric field $\vec{E}$ at the same point P.

If we let $\vec{E}_A$, $\vec{E}_B$, and $\vec{E}_C$ be the electric field created by particle A, by particle B, and by particle C, respectively, then the combined electric field is the vector sum of these individual electric fields:

$$\vec{E}(P) = \vec{E}_A(P) + \vec{E}_B(P) + \vec{E}_C(P) = \sum_i k \frac{q_i}{r_{iP}^2} \hat{r}_{iP}$$

$E_x(P) =$

$E_y(P) =$

(7) Using your answer for part (6) and the equation $\vec{F}^E = q\vec{E}$ for the force exerted by an electric field $\vec{E}$ on a particle of charge q, what is the net electric force (magnitude and direction) acting on a particle having charge $q = -1\,\mu\mathrm{C}$ and placed at point P ?

$F_x =$

$F_y =$