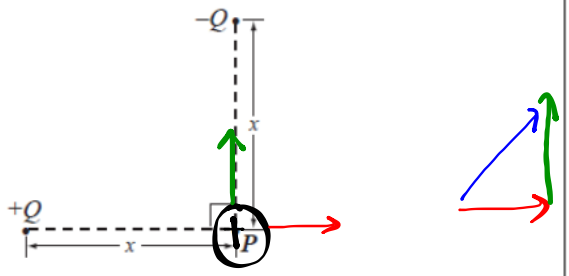
L03 - Coulomb's Law in 2-Dimensions

Use the following information to answer Q1:

Two point charges of equal magnitude, $+Q$ and $-Q$, are each placed at an equal distance, x, from point P, as shown below.



Q1: If a positive particle was placed at point P, in what direction would it feel a force?

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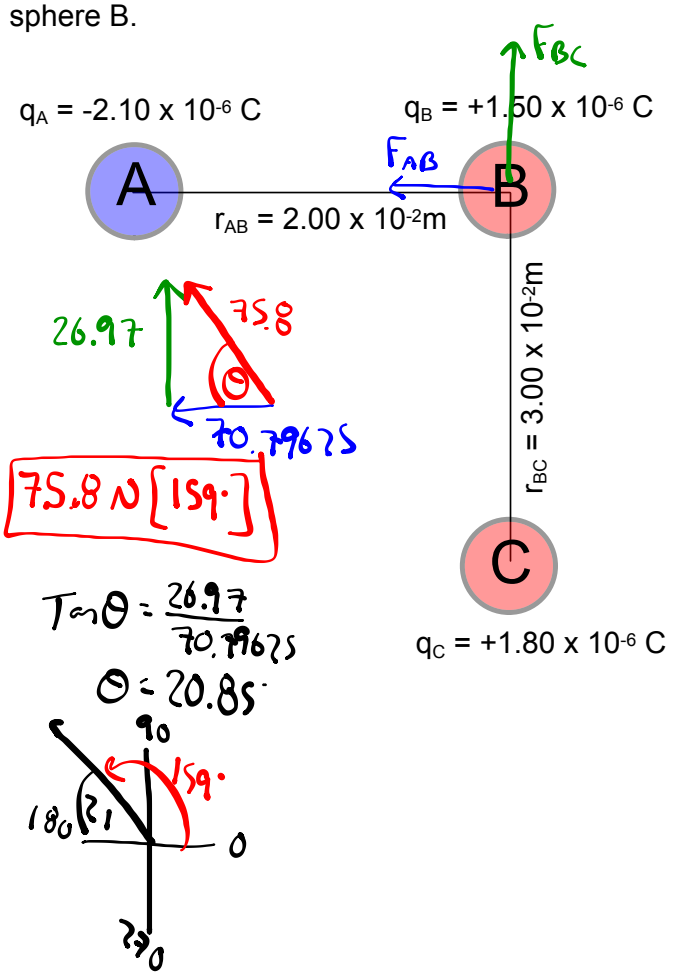
Q2: A small metal sphere A with a negative charge of 2.10 μC is 2.00 x 10^{-2} m to the left of sphere B with a positive charge of 1.50 μC. A third sphere C with a positive charge of 1.80 μC is situated 3.00 x 10^{-2} m directly below sphere B. Calculate the net electrostatic force on sphere B.



$F_{AB} = \frac{kq_Aq_B}{r^2} = \frac{(8.99\times10^9)(2.1\times10^{-6})(1.5\times10^{-6})}{(2.0\times10^{-2})^2}$

$= 70.79625\,N$

$F_{BC} = \frac{(8.99\times10^9)(1.5\times10^{-6})(1.8\times10^{-6})}{(3.0\times10^{-2})^2}$

$F_{BC} = 26.97\,N$

26.97, 75.8, θ, 70.79625

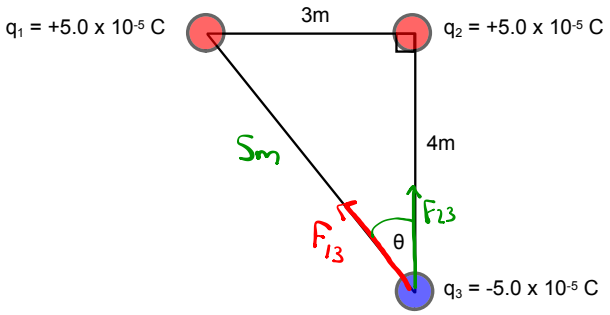
75.8 N [15°]

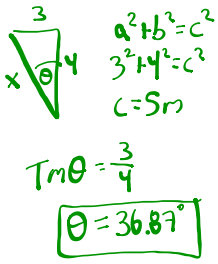
$\tan\theta = \frac{26.97}{70.79625}$

$\theta = 20.85°$

90, 159°, 180, 21, 0, 270

Q3: What is the net force (Magnitude and Direction) on q_3?





Step #1: Find sides of triangle (in meters).

Step #2: Find magnitude of forces.

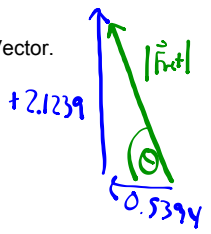
$F_{13} = \frac{(8.99\times10^9)(5.0\times10^{-5})(5.0\times10^{-5})}{5^2} = 0.899\,N$

$F_{23} = \frac{(8.99\times10^9)(5\times10^{-5})(5\times10^{-5})}{4^2} = 1.4046875\,N$

Step #3: Break each force into x- and y-components.

	x-comp	y-comp
F_{23} ↑	0	+1.4046875
$F_{13} = 0.899$, opp, adj, θ, 53.13°, 36.87°	−0.5394	+0.7192
	−0.5394	+2.1238875

Step #4: Reconstruct Net Force Vector.

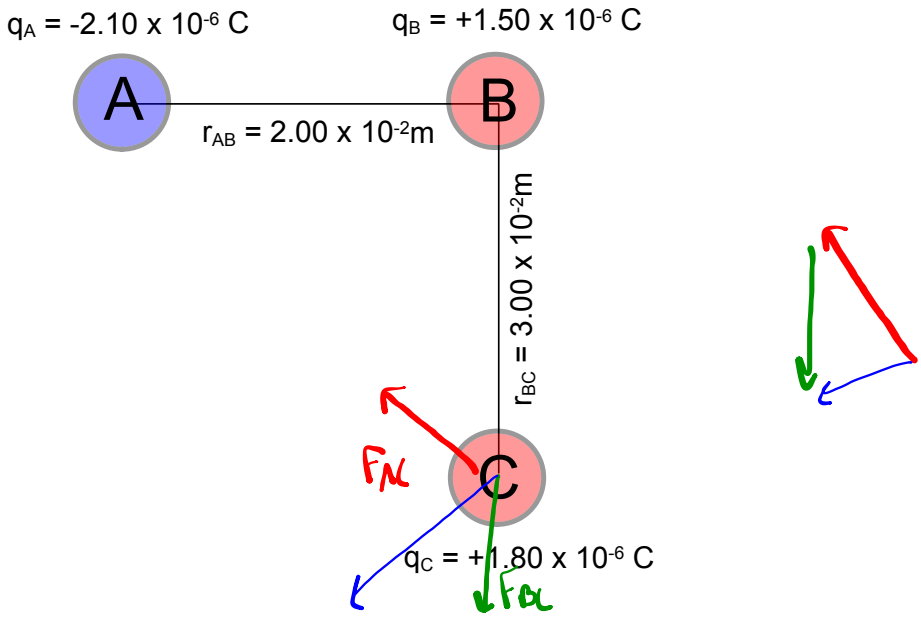


$|\vec{F}_{net}| = 2.19\,N$

$\theta = 76°$

$\vec{F}_{net} = 2.19\,N\,[104°]$ Polar

Q4: Using the same setup as Q2, calculate the net electrostatic force on sphere C.



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