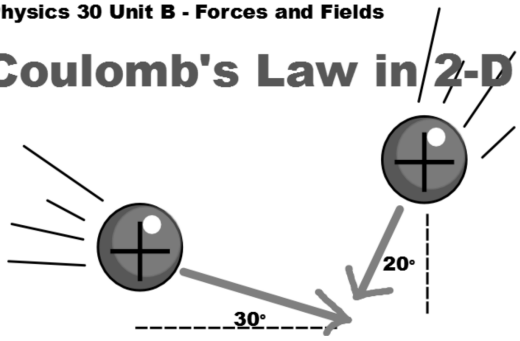
Physics 30 Unit B - Forces and Fields

Coulomb's Law in 2-D



POS Checklist

☐ determine, quantitatively, the magnitude and direction of the electric force on a point charge due to two or more other point charges in a plane.

Review:

ex) Two equally charged pith balls are 3.0 cm apart in air and repel each other with a force of 4.0 x 10^{-5} N. Find the charge on each ball.

$\vec{F}_e = \frac{kq_1q_2}{r^2}$

$4\times10^{-5}\,N = \frac{(8.99\times10^9\,N\cdot m^2/C^2)\,q^2}{(3\times10^{-2}\,m)^2}$

$q = 2.0\times10^{-9}\,C$

Diploma Question Alert!

Numerical Response

4. Two charged objects experience a force of 18.0 N when they are placed 5.00×10^{-2} m apart. If the charge on one object is 1.30×10^{-5} C, then the charge on the other object is $a.bc \times 10^{-d}$ C. The values of a, b, c, and d are _____, _____, _____, and _____.

(Record all **four digits** of your answer in the numerical-response section on the answer sheet.)

Ans: ☐

Diploma Question Alert! $\vec{F}_e = \frac{kq_1q_2}{r^2}$ $7.22\times10^{-2}\,N = \frac{(8.99\times10^9\,N\cdot m^2/C^2)(3.47\times)}{d^2}$

Numerical Response

7. A small object carrying a charge of 3.47 μC experiences an electric force of 7.22×10^{-2} N when placed at a distance, d, from a second, identically charged object. The value of d is _____ m.

Ans: 1.22 ☐

Numerical Response

8. The number of excess electrons on a ball that has a charge of -3.60×10^{-17} C, expressed in scientific notation, is $a.bc \times 10^{d}$. The values of a, b, c, and d are _____, _____, _____, and _____.

(Record all **four digits** of your answer in the numerical-response section on the answer sheet.)

$\frac{3.6\times10^{-17}\,C}{1.6\times10^{-19}\,C} =$

Ans: ☐

2D Analysis of Coulomb's Law

- The electric force is a vector, which means it can be added, subtracted or broken into x and y components like any other vector.

- Mind your negative signs (for direction only!!!)

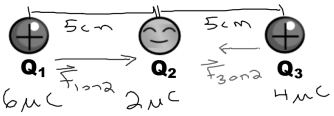
- Math + Physics = FUN!!!

Note: Enter the test charge!

A test charge is an imaginary object of set charge and negligable mass. It is used to determine the direction of the electric force at a particular position.

Example:

A test charge Q_2 ($q = 2.0\ \mu C$) is placed halfway between a charge $Q_1 = 6.0\ \mu C$ and a charge $Q_3 = 4.0\ \mu C$ which are 10 cm apart. Find the force on Q_2 and its direction.



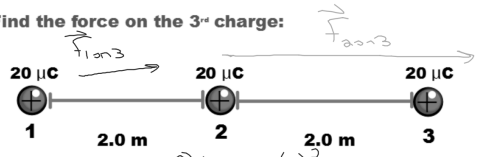
$\vec{F}_{net} = 14\ N$

$\vec{F}_{1on2} = \frac{(8.99\times10^{9}\ N\cdot m^2/C^2)(6\times10^{-6}\ C)(2\times10^{-6}\ C)}{(5\times10^{-2}\ m)^2} = 43.152\ N$

$\vec{F}_{3on2} = \frac{(8.99\times10^{9}\ N\cdot m^2/C^2)(4\times10^{-6}\ C)(2\times10^{-6}\ C)}{(5\times10^{-2}\ m)^2} = 28.768\ N$ ~~43.152N~~

Example:

Find the force on the 3rd charge:



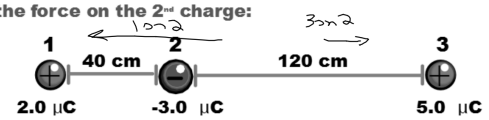
$\vec{F}_{1on3} = \frac{(8.99\times10^{9}\ N\cdot m^2/C^2)(20\times10^{-6}\ C)^2}{(4\ m)^2} = 0.22475\ N$

$\vec{F}_{2on3} = 4\times0.22475\ N = 0.899\ N$

$\vec{F}_{net} = 1.1\ N$

Example:

Find the force on the 2nd charge:



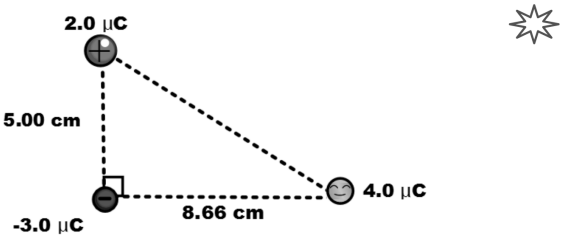
$\vec{F}_{1on2} = \frac{(8.99\times10^{9}\ N\cdot m^2/C^2)(2\times10^{-6}\ C)(3\times10^{-6}\ C)}{(0.4\ m)^2} = -0.3371\ N$

$\vec{F}_{3on2} = \frac{(8.99\times10^{9}\ N\cdot m^2/C^2)(5\times10^{-6}\ C)(3\times10^{-6}\ C)}{(1.2\ m)^2} = 0.0936\ N$

$\vec{F}_{net} = -0.241\ N$

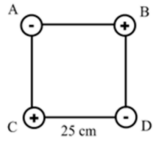
Example:

Find the net force acting on the test charge.



Use the following information to answer the next question.

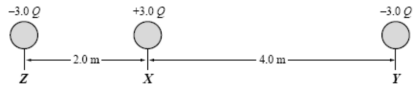
1. Four identical charged spheres, A, B, C and D, each with charges of magnitude 5.0×10^{-6} C, are placed on the corners of a square of side length 25 cm. If the two diagonally opposite charges are positive and the other two negative, as shown, calculate the net force acting on charge A.



Diploma Question Alert!

Use the following information to answer the next question.

Charged Spheres



The force exerted on sphere X by sphere Y has a magnitude of 6.0 N. A third sphere, Z, with a charge $-3.0\ Q$ is introduced, as shown in the diagram.

14. The magnitude of the **net** force on sphere X, due to spheres Y and Z, is

A. 9.0 N
B. 12 N
C. 18 N
D. 24 N

HW: Read page 532-537

Questions: 3-8