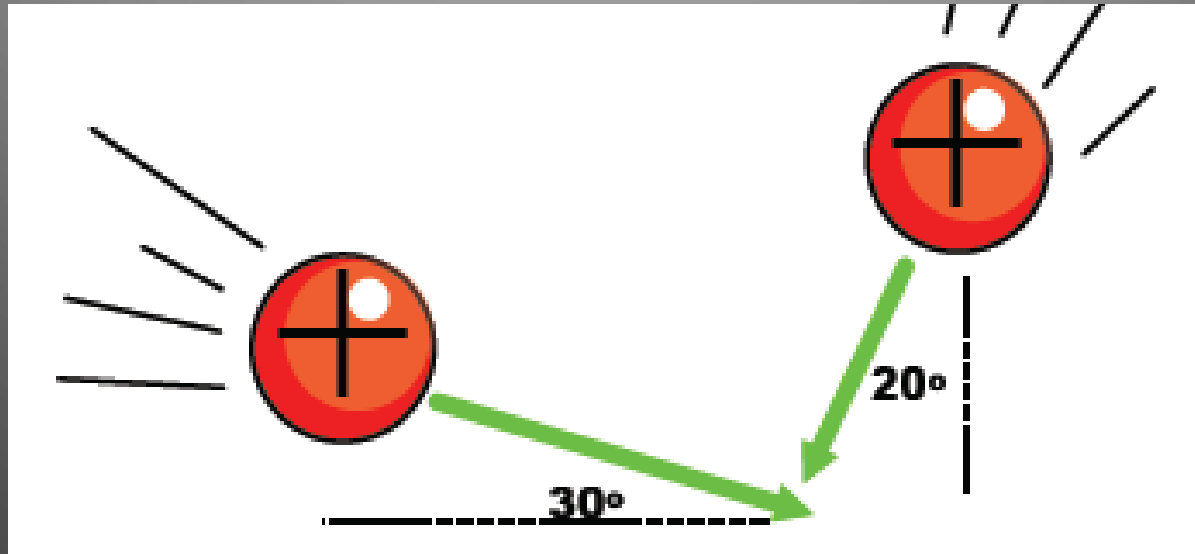# Coulomb's Law in 2D

Lesson 3

Objectives

- 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 4.0×10^{-5} N. Find the charge on each ball.

Diploma Question Alert!

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.)

Diploma Question Alert!

Numerical Response

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

(Record your **three-digit answer** in the numerical-response section on the answer sheet.)

Numerical Response

8. The number of excess electrons on a ball that has a charge of $-3.60 \times 10^{-17} \, C$, 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.)

Vector Nature 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!!!)**

Note: Enter the test charge!

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

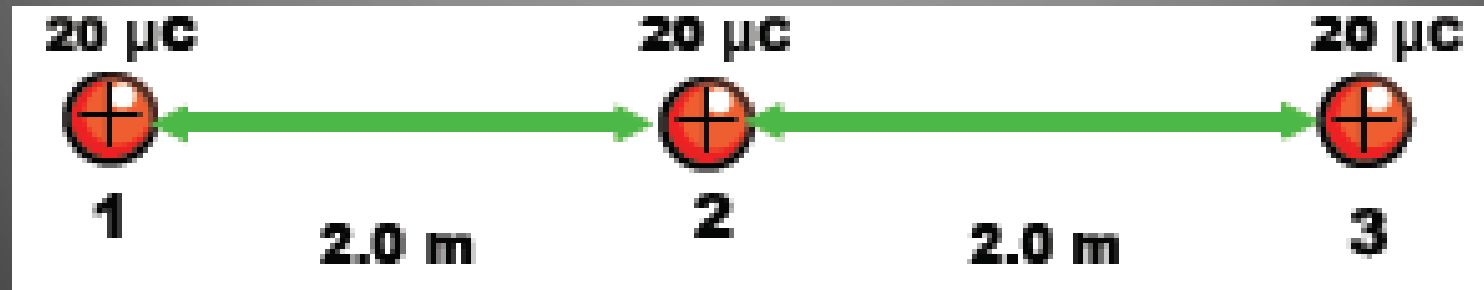- This is probably not what it looks like...

Example:

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

- **Step 1: Determine each electric force.**
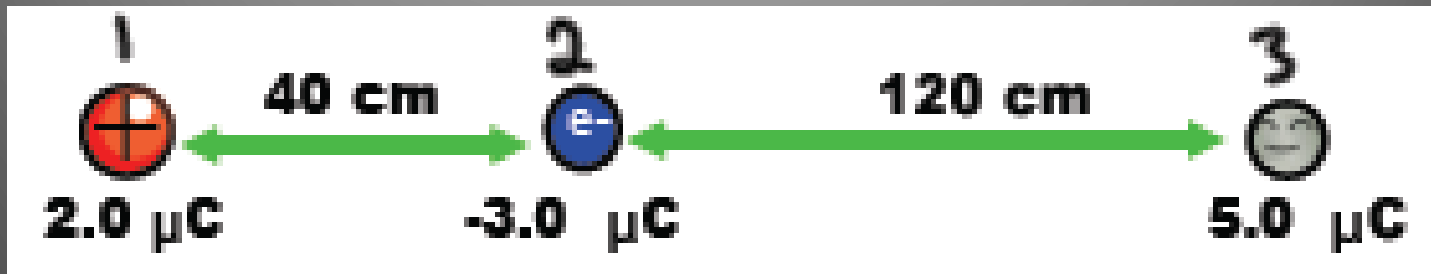

- **Step 2: Determine the total force on the testy.**

Example

- **Find the force on the 3rd charge:**
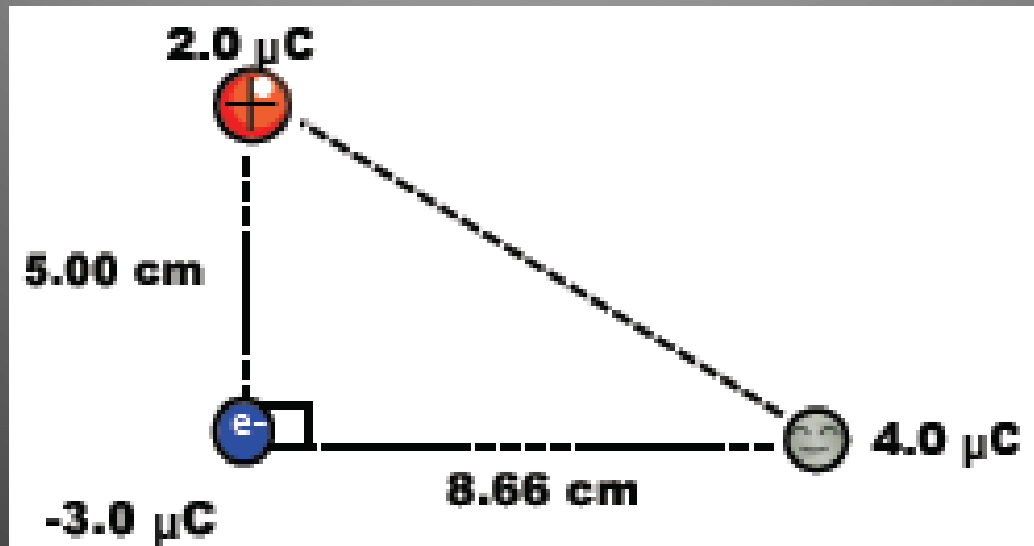
Example

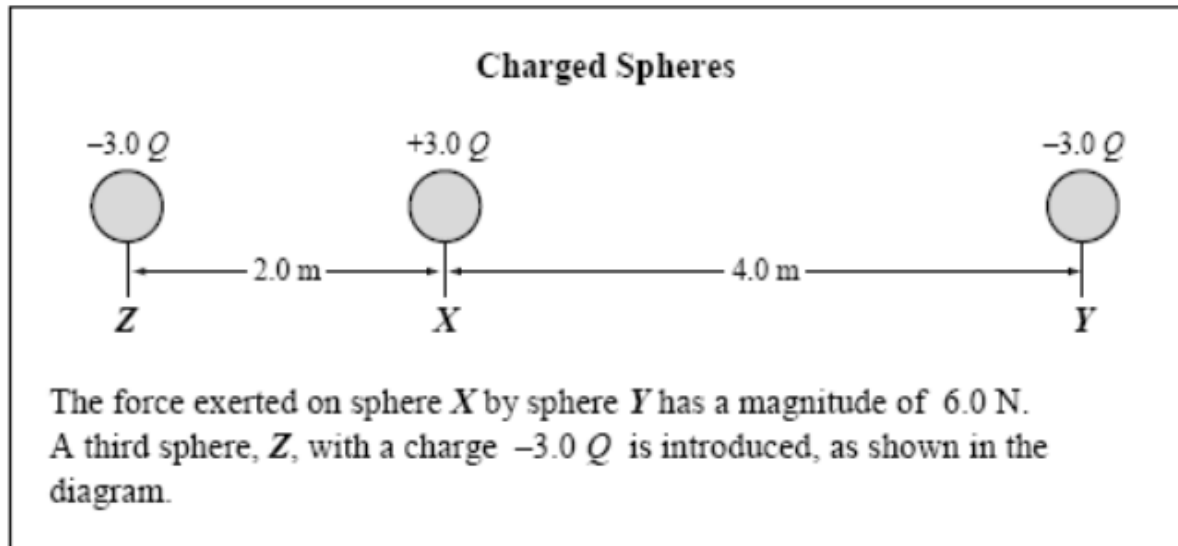- **Find the force on the 2nd charge:**

Example

- **Find the net force acting on the test charge.**

Diploma Question Alert!

Use the following information to answer the next question.

Charged Spheres

−3.0 Q   +3.0 Q   −3.0 Q

|←— 2.0 m —→|←————— 4.0 m —————→|

Z   X   Y

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