Mon Jan 16, 2017

Introduction

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- Office SB 507
- Office hours: Friday 10 - 11 am or by appointment

Reminders

- WP quiz 0 is due today, quiz 1 on Wed Jan 18
- Lecture notes (info quiz)
- Labatorials start next week (check schedule), print a copy
- Group enrollment (D2L)

Last time

- Vectors and vector addition
- Practice Group Activity

This time

- Reminder about how to use Coulomb's Law
- TopHat questions about Coulomb's Law
- Using the superposition principle

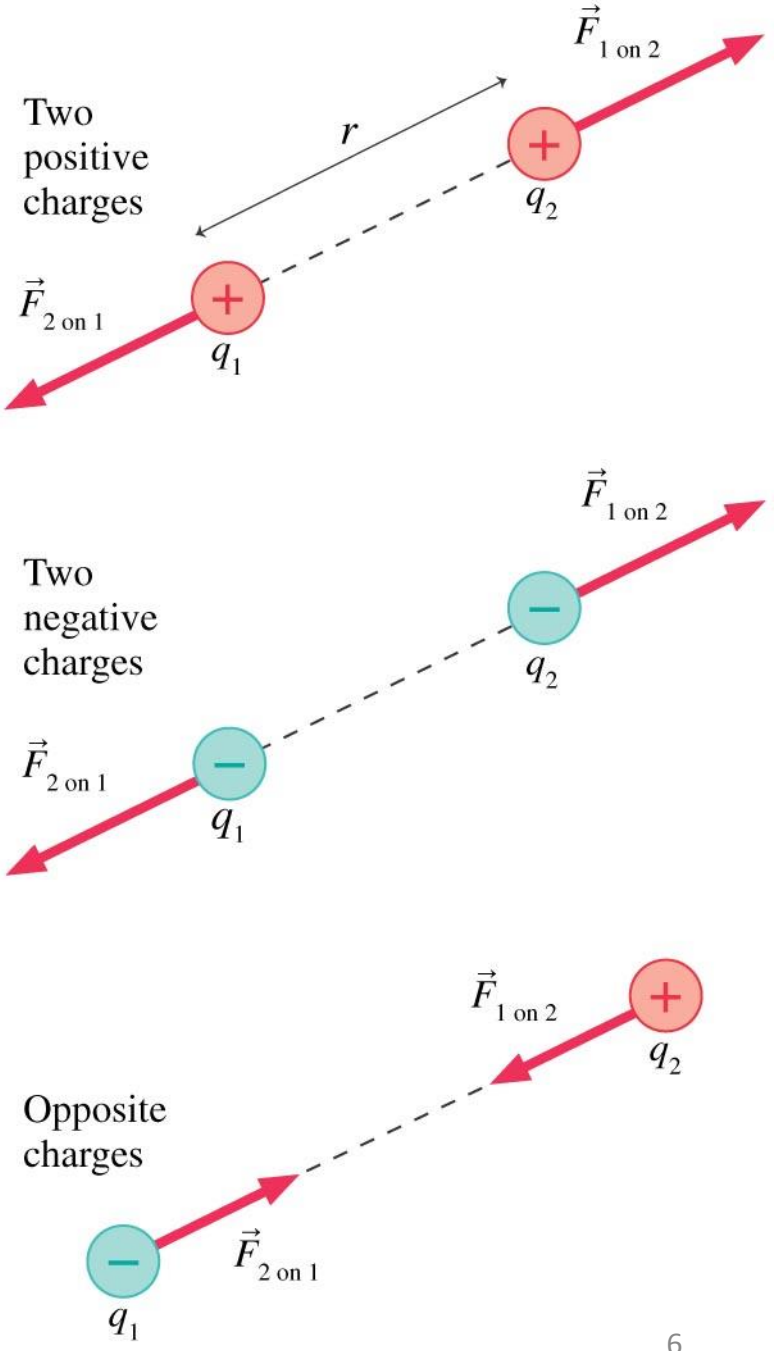
Coulomb's Law

There are only two kinds of charges:

positive and **negative**.

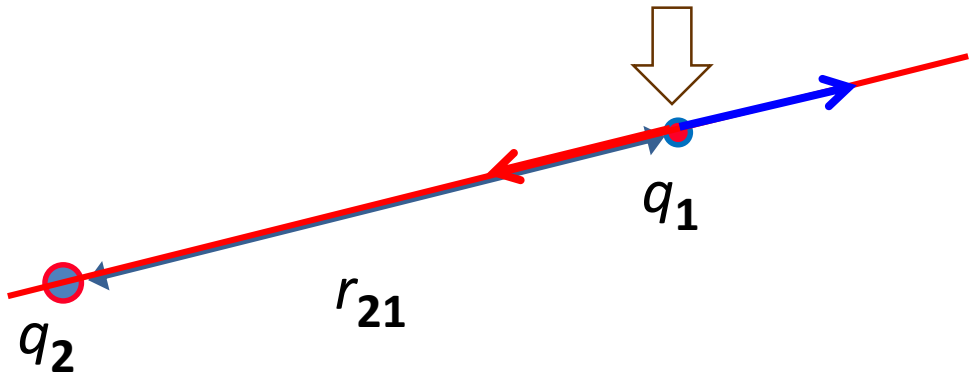
Charges of the **same** sign **repel** each other.

Charges of **opposite** sign **attract** each other.



Coulomb's Law

How to compute the magnitude and direction properly.



$$\left|\vec{F}_{21}\right| = K\frac{|q_1||q_2|}{r_{21}^2}$$

1) Find the distance between the charges.

2) Draw a line passing through the two charges.

3) The force on q_1 due to q_2 has its tail at location 1 and points either towards q_2 or away from q_2.

4) Pick the direction according to basic rule of charges:

Like charges repel, Opposite charges attract

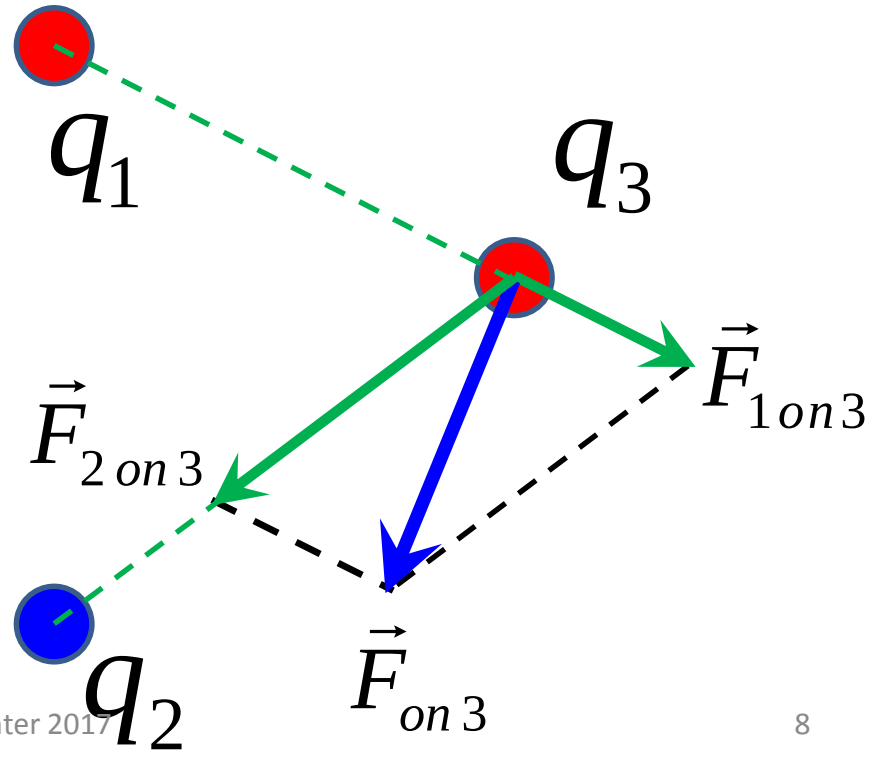
Superposition Principle

q_1 exerts a force $\vec{F}_{1\,on\,3}$ on q_3.

q_2 exerts a force $\vec{F}_{2\,on\,3}$ on q_3.

The total force on q_3 is the vector sum of the individual forces:

$$\vec{F}_{on\,3} = \vec{F}_{1\,on\,3} + \vec{F}_{2\,on\,3}$$

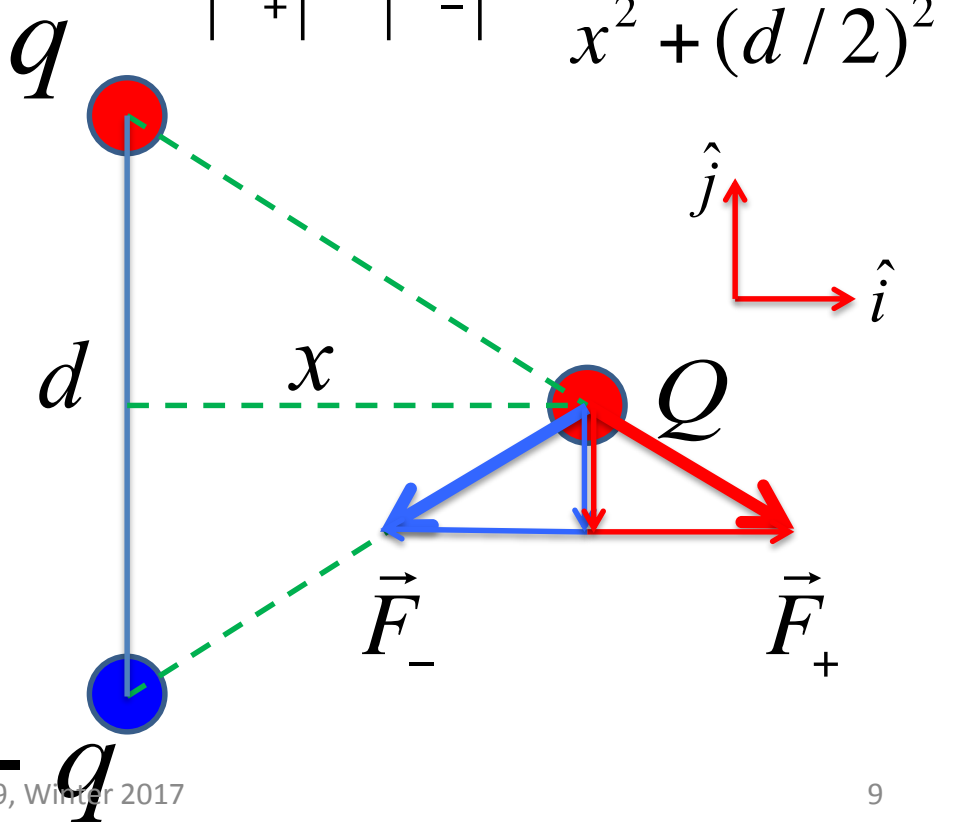


Example: force due to a dipole

A charge *Q* sits at a distance *x* on the axis perpendicular to the dipole. What is the force (magnitude and direction) it experiences?

$$\left|\vec{F}_+\right| = \left|\vec{F}_-\right| = \frac{KqQ}{x^2 + (d/2)^2}$$

FBD:



Horizontal components cancel.
Vertical components add.
SYMMETRY!

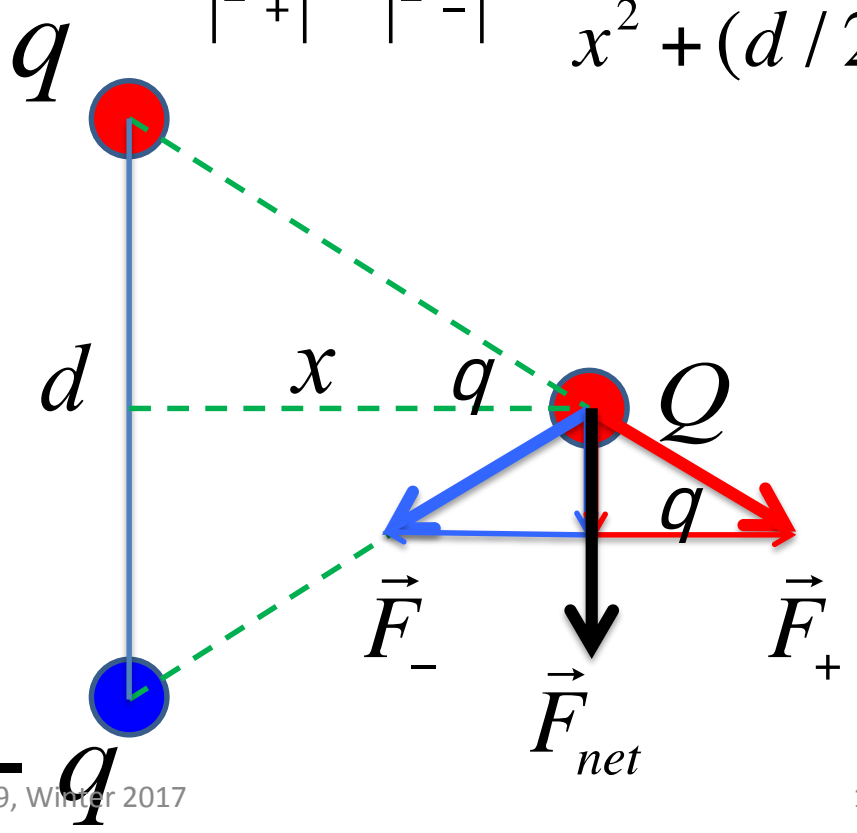
Example: force due to a dipole

$$\left|\vec{F}_{net}\right| = 2\left(\frac{KqQ}{x^2 + (d/2)^2}\right)\sin\theta$$

$$\sin q = \frac{d/2}{\sqrt{x^2 + (d/2)^2}}$$

$$\left|\vec{F}_{net}\right| = \frac{KqQd}{\left(x^2 + (d/2)^2\right)^{3/2}}$$

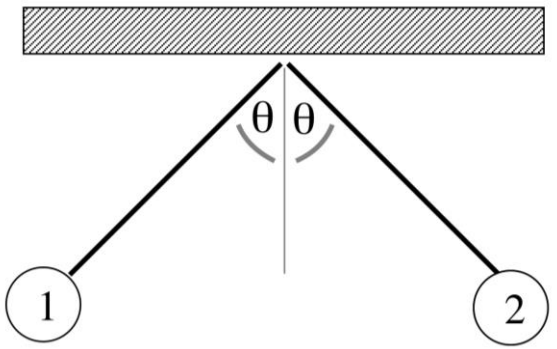
$$\left|\vec{F}_{+}\right| = \left|\vec{F}_{-}\right| = \frac{KqQ}{x^2 + (d/2)^2}$$



Direction: **downward**

TopHat Question: **JOIN CODE: 131299**

Two small **equal mass**, **insulating** balls are charged and hang on strings as shown:

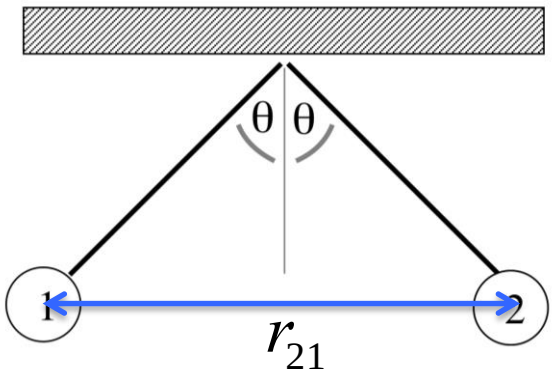


What can you say about the **signs** of the charges Q1 and Q2 on the two balls?

(A) Both charges are "**+**"
(B) Both charges are "**–**"
(C) Both charges must have opposite signs but we can't tell which is "**+**" and which is "**–**"
(D) Both charges must have the same sign but we can't tell if they're both "**+**", or both "**–**"

TopHat Question: **JOIN CODE: 131299**

Two small **equal mass**, **insulating** balls are charged and hang on strings as shown:



$$\left|\vec{F}_{21}\right| = K\frac{|Q_1||Q_2|}{r_{21}^2} = \left|\vec{F}_{12}\right|$$

What can you say about the **magnitudes** of the charges Q1 and Q2 on the two balls?

A: Q1 must equal Q2

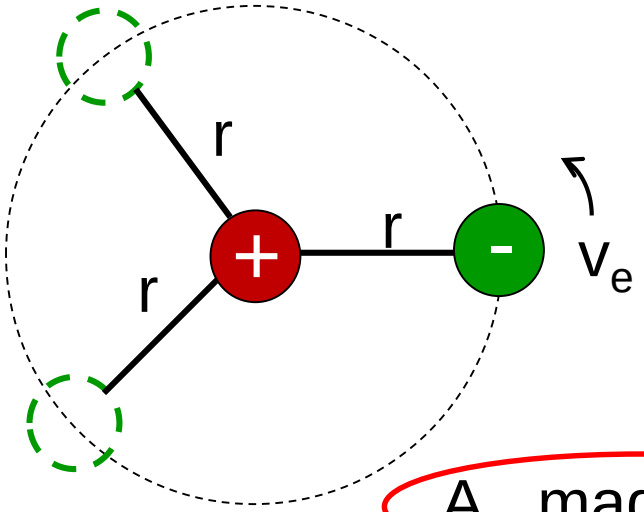
B: Q1 cannot equal Q2

C: Can't decide/not enough information.

TopHat Question: **JOIN CODE: 131299**

A negative point charge moves along a circular orbit around a positive point charge

Which aspect(s) of the electric force on the negative point charge will **remain constant** as it moves



A. magnitude
B. direction
C. magnitude and direction
D. neither magnitude nor direction