Coulomb's Law - continued

Coulomb's Law. Two electric charges, q_1 and q_2 , at distance r, act onto each other with *electrostatic force* given by Coulomb's formula:

$$F = \frac{kq_1q_2}{r^2}; \qquad\qquad k = 9\cdot 10^9\,\frac{Nm^2}{C^2}$$

Here k is called Coulomb's constant. SI unit of electric charge is 1 Coulomb (1C), which is a very large charge.

- In Coulomb's formula, positive force corresponds to repulsion, negative- to attraction.
- Charges can be positive and negative. According to Coulomb's law, same-sign charges repel, opposite charges attract.

Electric Field

• A **Field** is a physical quantity that has certain value at any point of physical space (x,y,z), and time, t. In other words, it's a function defined in physical space & time.

• **Electric Field** = electric force acting on a probe charge q, divided by q:
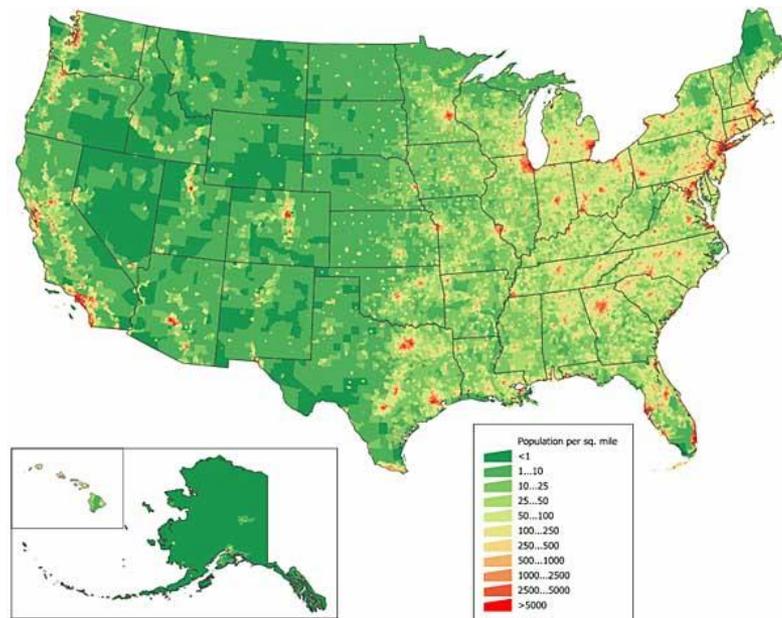
$$\vec{E} = \frac{\vec{F}_{elect}}{q}$$

• Once the electric field is known at certain point (x,y,z), one can find the electric force acting on any charge Q placed at that point:

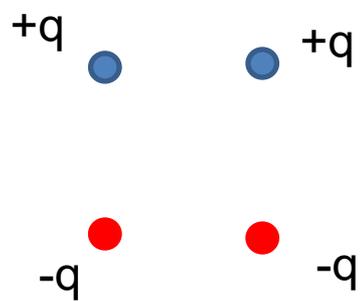$$\vec{F}_{elect} = Q\vec{E}$$

Homework

Problem 1

A map is an example of a 2D space. Give at least 2 examples of scalar and 2 examples of vector fields that can be defined in this space. All quantities should be measurable. For instance: human population per km^2 is a scalar field.
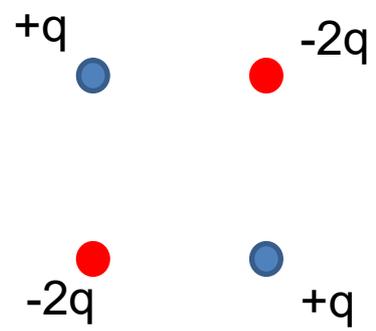

Population per sq. mile
<1
1...10
10...25
25...50
50...100
100...250
250...500
500...1000
1000...2500
2500...5000
>5000

Problem 2. For the following cases, sketch electric field lines:

a)

+q   ●   ●   +q

      ●   ●

-q   -q

b)

+q   -2q

-2q   +q

c)

-3q

+q +q