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:

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

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:

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

Electric Field: Examples

• Electric field of a point charge **Q** or a sphere with the same charge (**outside**), at distance **R**:

$$E = \frac{kQ}{R^2}$$

• Electric field **inside** the **hollow** charged sphere is ZERO!

$$E = 0$$

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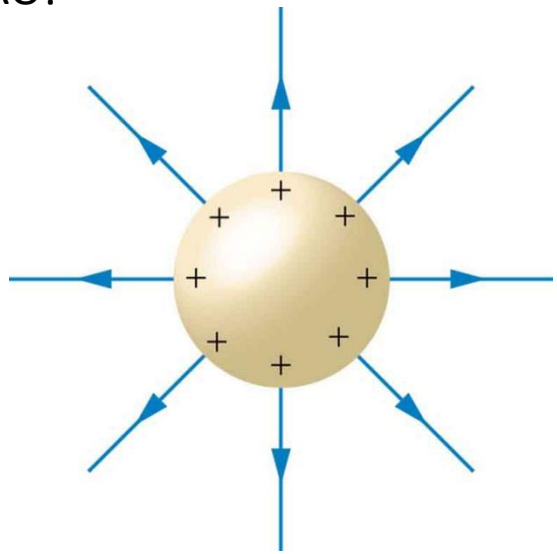
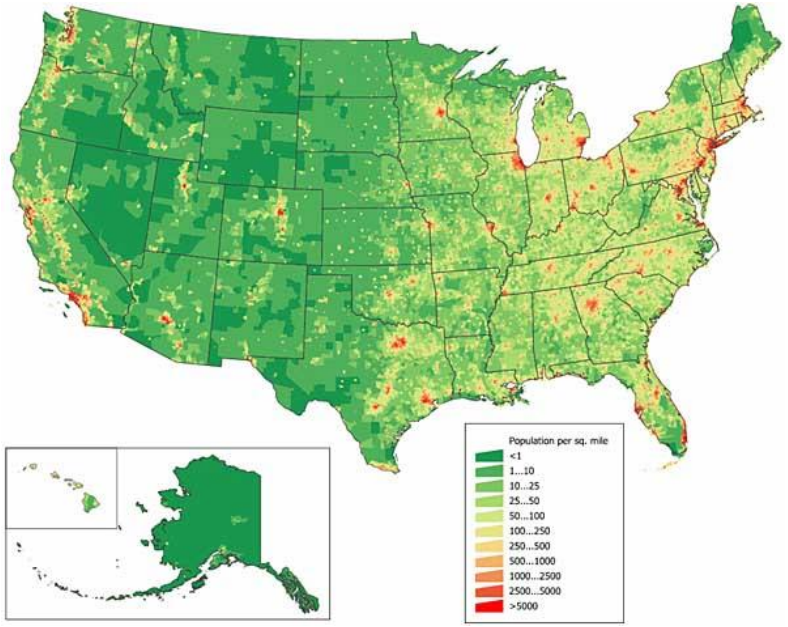


Homework 14

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.



Problem 2

Find the magnitude of the electric field E at the point half-way between two charges, $\mathbf{q_1}$ **=1nC** and $\mathbf{q_2}$ **=-3 nC** placed at distance **d=2 m** from each other. nC is nanoCoulomb.