PHYSICS 570 – Master's of Science Teaching

“Electricity”
Lecture 5 – Electric Field

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Course Goals – Physics

I hope at the end of this week you will know the difference between charge, current, electric field, potential, voltage, potential energy, power, resistivity and resistance and be able to teach these concepts.

Course Goals – Math

You will learn scientific notation, and how to calculate with it. CHECK!

You will learn about vectors and how to add them with pictures CHECK !
and "by components" NOT YET!

You will get GREAT applications for Trig., algebra, exponents and fractions

TODAY

Electric field … relation to Coulomb's law.

QUANTITY	SYMBOL	UNITS
Charge	q, Q	Coulomb (C)
Force	F	Newtons (N)
Current	I	Amperes (A) C/sec
Electric field	E	Newt/Coul
Potential	V	Volts (V) Joule/Coul
Potential Energy	U	Joules (Nt - m)
Work	W	Joules (Nt - m)

Electric Field

A vector-field that gives the force that would be felt by an infinitely small charge placed at every point.

$$\vec{F} = q\vec{E}$$

Units of E are Newtons/Coulomb

Electric Field Problem

A 3 coulomb charge is placed in a an electric field of E = 7 N/C.
What is the force on the charge? $\vec{F} = q\vec{E}$

You have an unknown electric field that exerts 2 milliNewtons to the East on a 0.03 Coulomb charge.

What force does it exert on a -0.5 Coulomb charge? What direction?

Why bother with Electric field (why not just use Coulomb's law?)

The electric field allows you to ignore the charges that made it.

The electric field travels at the speed of light so you can get the effect of a charge on a distant star.

Electric forces might be understandable without fields, but magnetic forces are a mess!

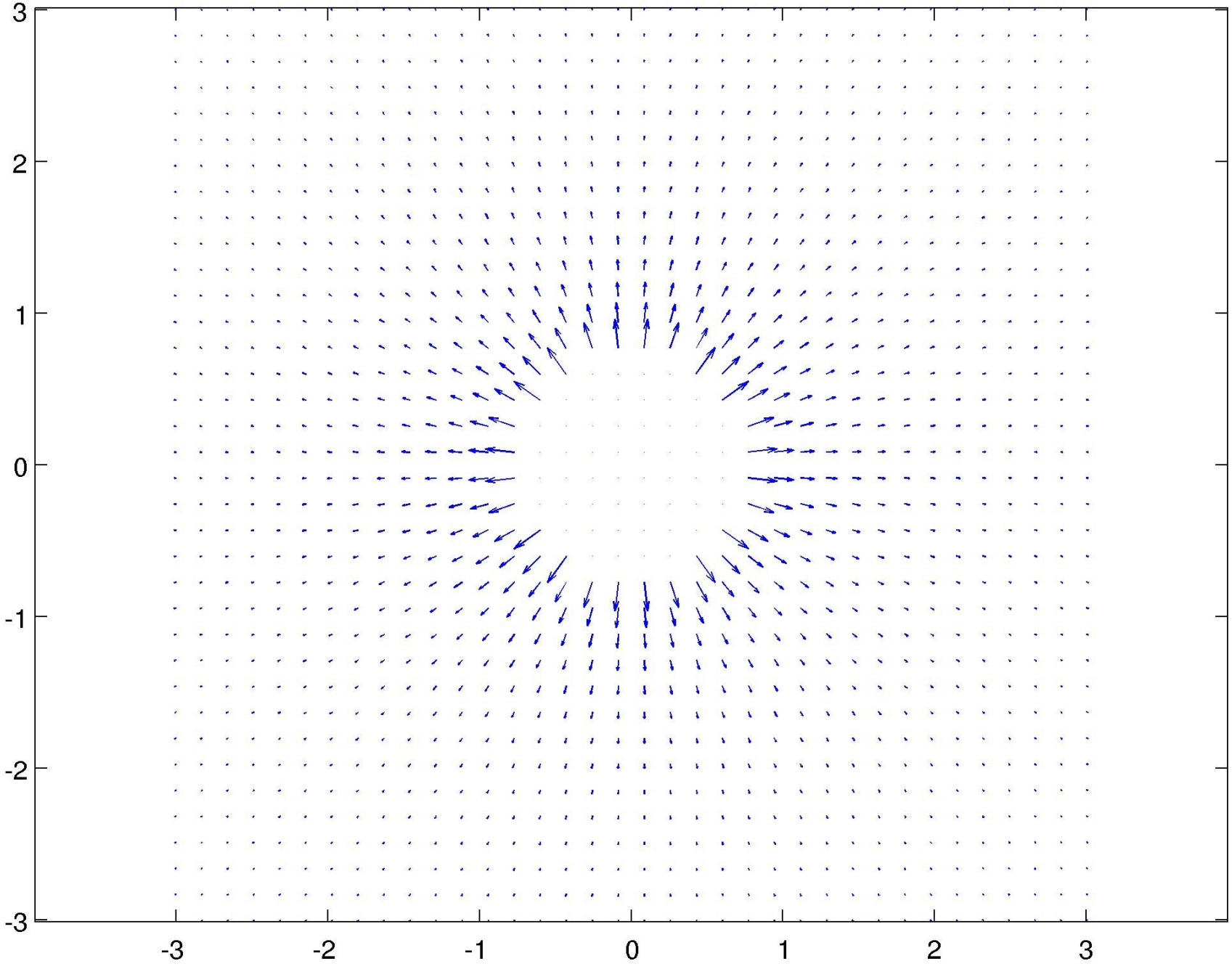
Principle of Superposition
How do we know it works?

We will see that the field of a dipole is exactly what is predicted for a vector sum of charges.

This field is measurable through its equipotentials.

We will do that in lab.

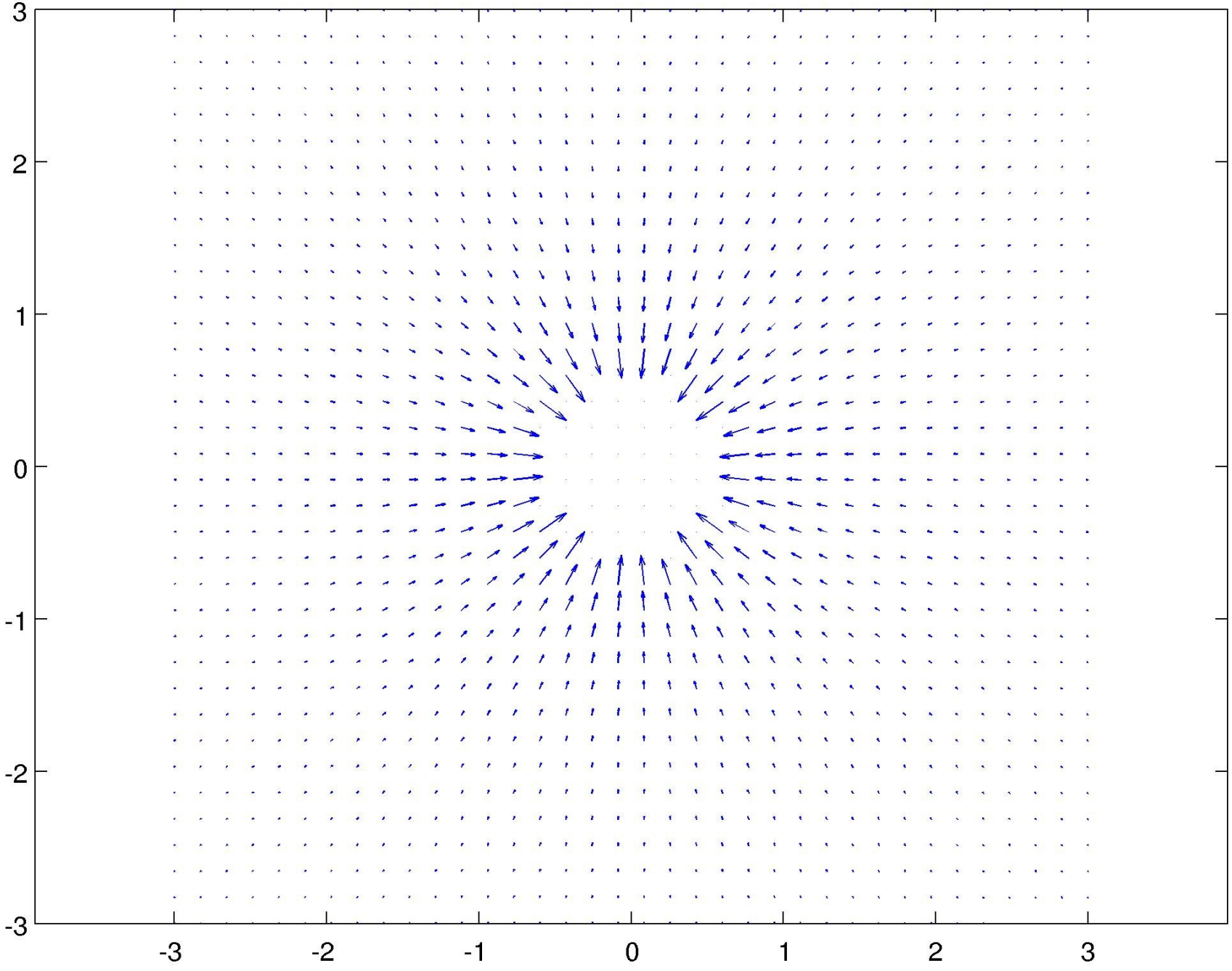
E-Field Around A Positive Charge



R. SONNENFELD

As of: 08- Jul-2013

E-Field Around A Negative Charge



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What is true about an electric field diagram?

[A] The field only exists where the vectors are drawn.

[B] The field is the same everywhere along each vector arrow.

[C] The field exists everywhere, you just can't draw vectors everywhere. The arrow tells you the field only at the tail of the arrow.

Principle of Superposition
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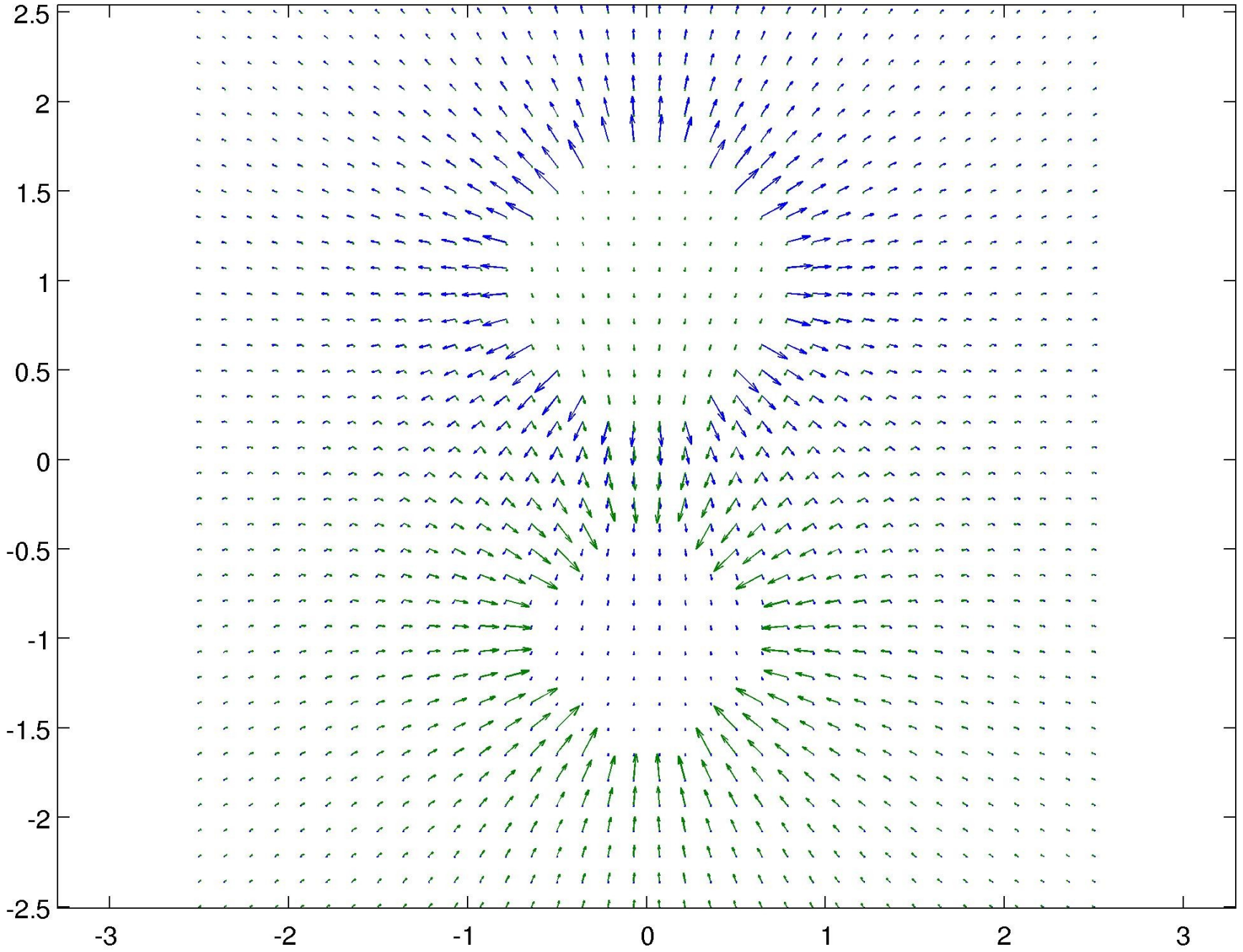
E-Field Around positive and negative charge



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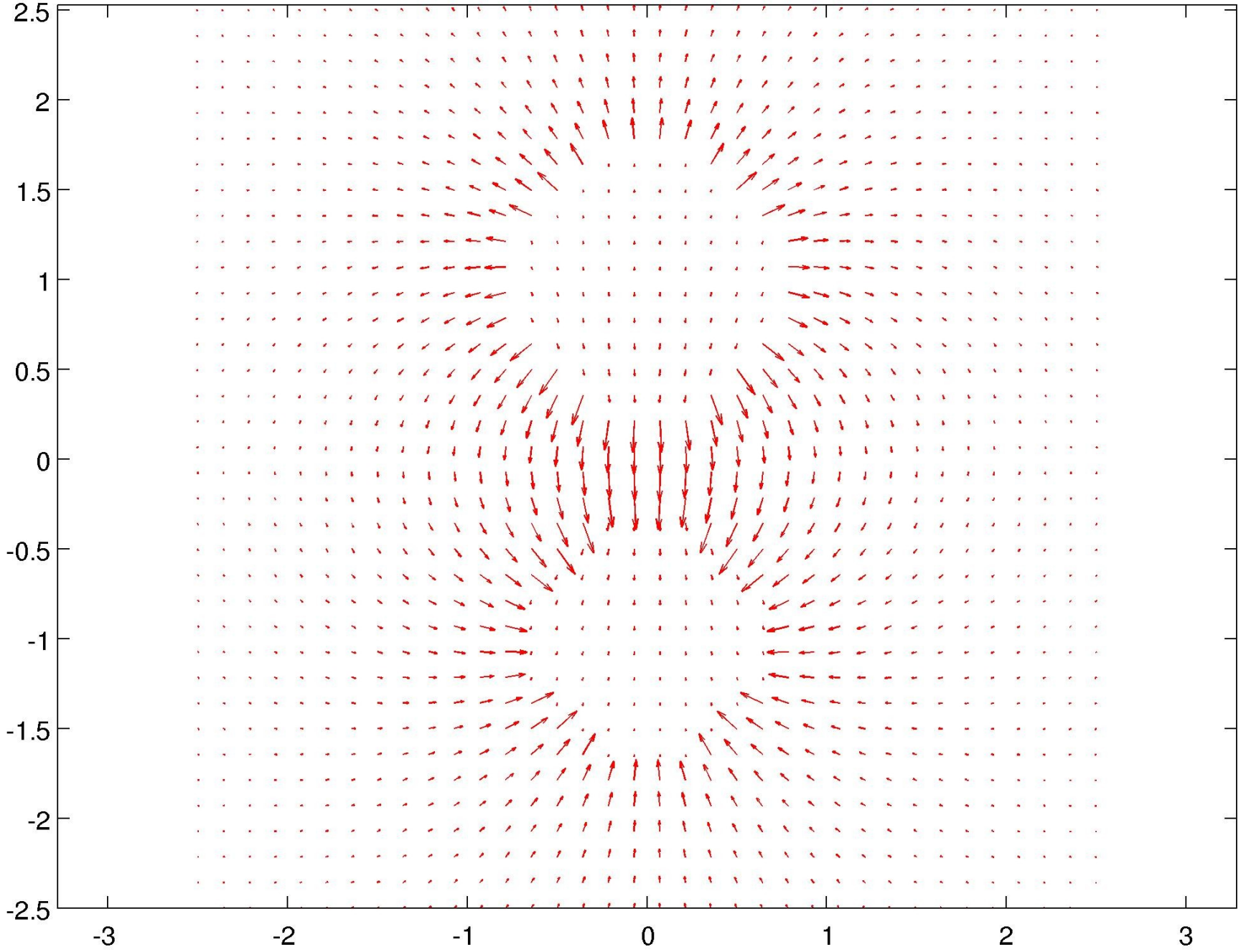
Resultant E-Field Around positive and negative charge



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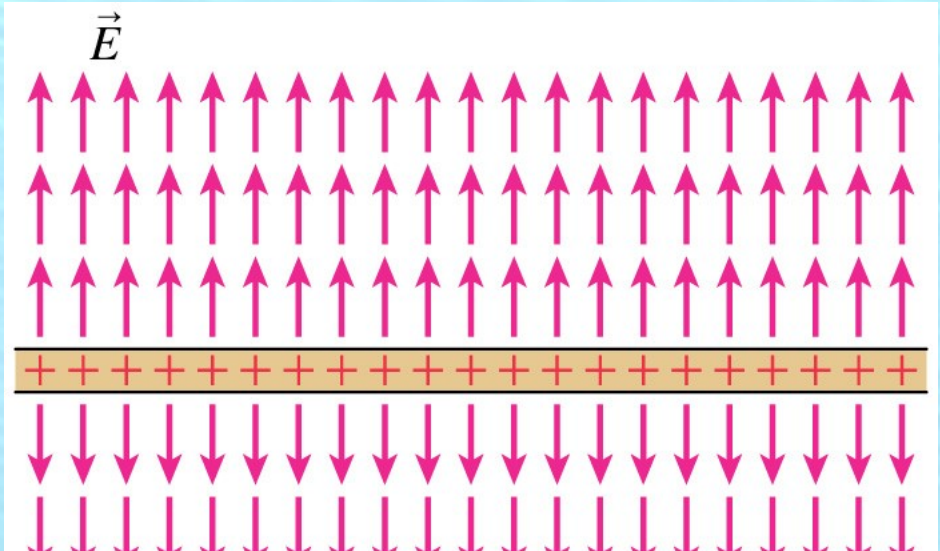
Two dipoles are attracted to eachother even though they are uncharged.

The water molecule is a dipole. It gives water a fairly high boiling point. It also makes ice float. It allows life on earth.

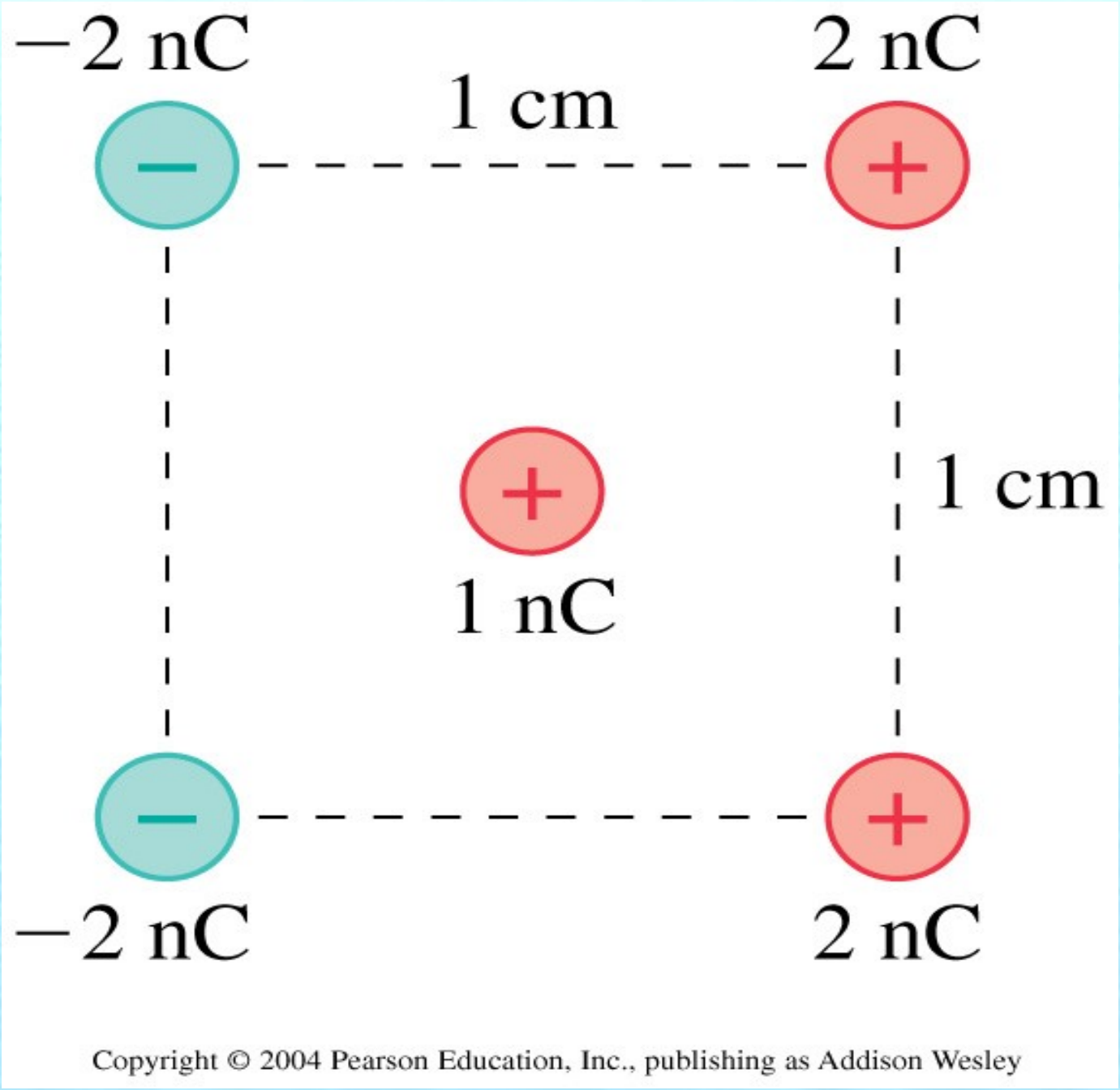
pHeT time...

Reproduce single charge and dipole field.

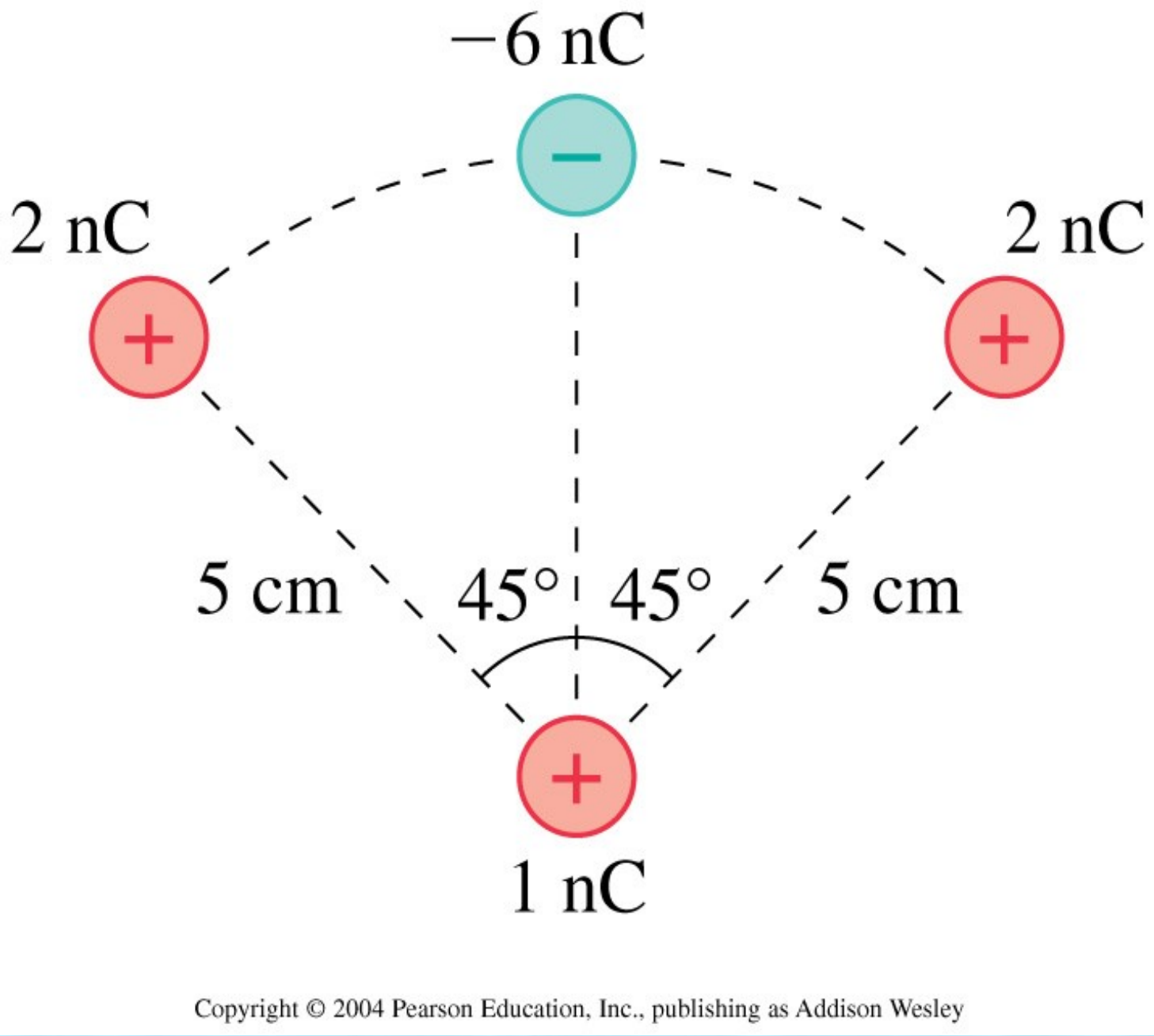
Convince yourself that a plane of charge gives this field.



Force and Field on 1 nC?



Force and Field on 1 nC?



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