Announcements

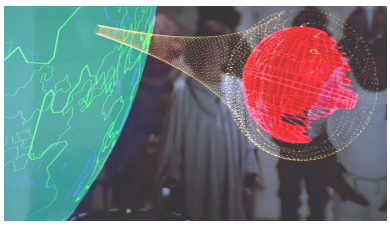
PRACTICE	LABS	TESTS
Practice Problems (1-8)	• Aluminum Can Interactive (RsVCP) • Electrostatic Force Interactive (RsVCP) • Electric Field Interactive (No RsVCP)	Unit 14 Test Thursday (5/9/19)

Electric Fields

14.2 I can define, analyze, and solve problems involving electric fields.

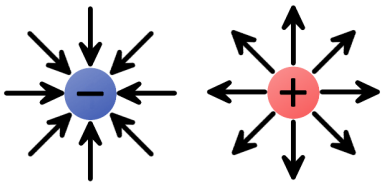
The Electric Field

An electrically charged object sets up a force field around it; this force field is known as an **electric field**.



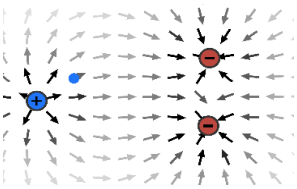
The Electric Field

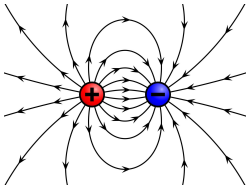
The direction of an electric field is away from a positive charge and toward a negative charge.



The Electric Field

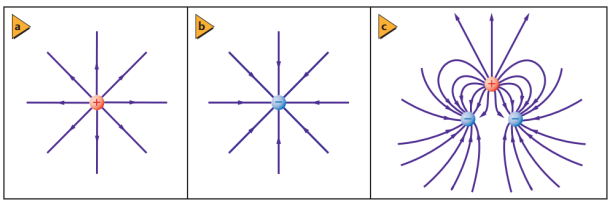
Electric fields have distinctive shapes and patterns depending on the charges involved.





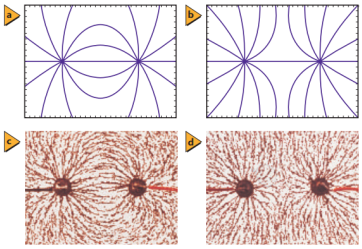
The Electric Field

Lines of force are drawn perpendicularly away from a positively charged object and into a negatively charged object.



The Electric Field

Lines of force between unlike charges (a, c) and between like charges (b, d) describe the behavior of a positively charged object in a field. The top figures are computer tracings of electric field lines.



$F_g = mg$

$g = \frac{F}{m}$

MAGNITUDE OF THE ELECTRIC FIELD

Place a small charged object at some location. If there is an electric force on it, then there is an electric field at that point. The charge on the object that is used to test the field, called the test charge, must be small enough that it doesn't affect other charges.

MAGNITUDE OF THE ELECTRIC FIELD

If a small positive charge q_o experiences a force of magnitude **F** at a given location, the magnitude of the electric field **E** at that location is

$$\text{magnitude of electric field} = \frac{\text{force on positive charge}}{\text{amount of charge}}$$

$$\mathbf{E} = \frac{\mathbf{F}}{q_o}$$

$\frac{k\frac{qq_o}{r^2}}{q_o}$

The Electric Field

$$\mathbf{E} = \frac{\mathbf{F}}{q_o}$$

Vector of Scalar	Units	Relationship
	$\frac{N}{C}$	F → Direct Prop. q → Inverse Prop.

The Electric Field

Table 21-1
Approximate Values of Typical Electric Fields

Field	Value (N/C)
Near a charged, hard-rubber rod	1×10^3
In a television picture tube	1×10^5
Needed to create a spark in air	3×10^6
At an electron's orbit in a hydrogen atom	5×10^{11}

MAGNITUDE OF THE ELECTRIC FIELD

In many practical situations you will be given the electric field **E** at a given location and asked to determine the force a charge q experiences at that location.

$$\mathbf{E} = \frac{\mathbf{F}}{q_o} \quad \Rightarrow \quad \boxed{\mathbf{F} = q\,\mathbf{E}}$$

force = amount of charge x electric field

UNIT 14: In-Class Problems

3. An electric field is measured using a positive test charge of 3.0 x 10^6 C. This test charge experiences a force of 0.12 N at an angle of 15° north of east. What are the magnitude and direction of the electric field strength at the location of the test charge?

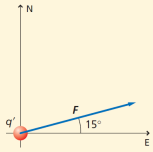
4. What is the electric field strength at a point that is 0.30 m to the right of a small sphere with a charge of -4.0 x 10^{-6} C?

UNIT 14: In-Class Problems

3. An electric field is measured using a positive test charge of 3.0 x 10^6 C. This test charge experiences a force of 0.12 N at an angle of 15° north of east. What are the magnitude and direction of the electric field strength at the location of the test charge?

Known:
$q' = +3.0\times10^{-6}$ C
$\boldsymbol{F}$ = 0.12 N at 15° N of E

Unknown:
$\boldsymbol{E}$ = ?



UNIT 14: In-Class Problems

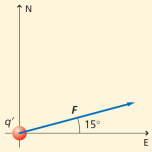
3. An electric field is measured using a positive test charge of 3.0 x 10^6 C. This test charge experiences a force of 0.12 N at an angle of 15° north of east. What are the magnitude and direction of the electric field strength at the location of the test charge?

Known:
$q' = +3.0\times10^{-6}$ C
$\boldsymbol{F}$ = 0.12 N at 15° N of E

Unknown:
$\boldsymbol{E}$ = ?

$$E = \frac{F}{q'} = \frac{0.12\text{ N}}{3.0\times10^{-6}\text{ N/C}} = 4.0\times10^4\text{ N/C}$$

Substitute $F = 0.12$ N, $q' = 3.0\times10^{-6}$ C



The force on the test charge and the electric field are in the same direction.

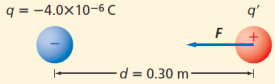
$\boldsymbol{E}$ = 4.0×10^4 N/C at 15° N of E

UNIT 14: In-Class Problems

4. What is the electric field strength at a point that is 0.30 m to the right of a small sphere with a charge of -4.0 x 10^6 C?

Known:
$q = -4.0\times10^{-6}$ C
d = 0.30 m

Unknown:
$\boldsymbol{E}$ = ?

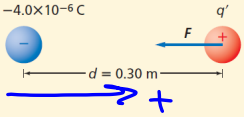


UNIT 14: In-Class Problems

4. What is the electric field strength at a point that is 0.30 m to the right of a small sphere with a charge of -4.0 x 10^6 C?

Known:
$q = -4.0\times10^{-6}$ C
d = 0.30 m

Unknown:
$\boldsymbol{E}$ = ?



$$E = \frac{F}{q'} = K\frac{qq'}{d^2q'} = K\frac{q}{d^2} = \left(9.0\times10^9\ \text{N}\cdot\text{m}^2/\text{C}^2\right)\frac{(-4.0\times10^{-6}\text{ C})}{(0.30\text{ m})^2} = -4.0\times10^5\text{ N/C}$$

Substitute $F = K\frac{qq'}{d^2}$

Substitute $K = 9.0\times10^9$ N·m²/C², $q = -4.0\times10^{-6}$ C, $d = 0.30$ m

$\boldsymbol{E}$ = 4.0×10^5 N/C toward the sphere, or to the left

PROBLEMS (11-15)