

# STATIC ELECTRICITY

## Static Electricity

- Charge that is not passed through circuit when two objects together

## Electric Force

- Interaction with matter in object, kg charge how far or not in electric charge - movement of electrons



As  $Q$  goes up, force  $\rightarrow$  vs charge, goes more vs charge  
 Charge  $Q$ : measures how much object will interact with electric/magnetic fields  
 charge measured in coulombs (C)

- $1 \text{ C} = 1 \text{ amp} \cdot \text{sec}$
- $1 \text{ C} = 6.24 \times 10^{18} \text{ electrons}$



- Protons and electrons have charge of:

$$q_p = 1.602 \times 10^{-19} \text{ C}$$

- conductor material which is easily able to carry electric charge  
 insulator material which is unable to carry electric charge  
 when charges pass through insulators, they build up (stop moving)

- static electricity involves insulators

Example: hair sticking up

Atoms are neutral, no charge, cancel out when electrons rubbed on hair,  $e^-$  rubbed off hair and on balloon



balloon is insulator,  $e^-$  don't re-distribute

so  $e^-$  rub into hair, balloon, gain  $\rightarrow$  vs charge

hair losing  $e^-$ , gains  $\rightarrow$  vs charge

$\rightarrow$  vs charge, balloon, vs charged, hair

attracted to hair

so balloon pulled closer than hair, hair is attracted to it

so hair is attracted to it



- in examples:

electric force acting on object due to other and

electric force acting on hair due to balloon

electric force,  $F$ , has cause attraction/repulsion between 2 charged objects

size of electrical force depends on charge ( $q$ ), electrical field,  $E$

$$F = Eq$$

## Electric Fields

- source charges charge that creates electric field around it

source of charge

electric field area around charged object

area of space where other charged particles are affected



- creating electric fields

how big electric field is

how it affects charge around



we look to show shape of field

most electric fields are radial (parallel lines)

or radial from charge (center of isolated line)

- direction of other charges are attracted or repelled

direction they move when affected by electric field

direction way the charge would move if put into field

in space pointing away

$\rightarrow$  surrounding single charge/object



- stronger the closer lines are

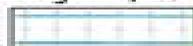
stronger field, greater ability to attract particles in range

stronger  $E$  units:  $\text{N/C}$

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

## Uniform Electric Fields

- field has same strength everywhere  
 charge will be attracted same level in any other place  
 straight parallel, evenly spaced



- eg: two metal plates,  $+$  and  $-$

plates are source charge of electric field between metal plates

force vs charge in uniform field related by  $vs$  plate, arrow from  $+$  to  $-$

- voltage:

2 metal plates make charge between plates move

to create field between plates is giving energy to charge in motion

voltage when charges gain or lose energy

if energy is lost, gain energy  $\rightarrow$  vs plate

if energy is lost, losing energy  $\rightarrow$  vs plate



## Electric Potential Energy

- all electric potential energy  
 how much charge wants to move when placed in electric field  
 depends on where positioned, how big field is

potential energy of charge (Q) placed in electric field (E) at distance (d):

$$PE = Eqd$$

symbol:  $Q$  against vs plate

As seen as lost energy to vs plate

electric potential energy was converted into kinetic energy

potential energy of charge (Q) placed in electric field (E) at distance (d):

$$\Delta U_p = Eqd$$

kinetic energy: energy of movement

- size of electric potential energy on charge in electric field depends on:

charge in electric field, change in potential

no distance between charges, change electric field strength,  $E$

distance between charges,  $d$

charge,  $Q$

size of charge,  $Q$

no bigger charge has electric field more



## Velocity

- if no friction, electrical potential energy = kinetic energy

$$\Delta U_p = K_e$$

1. calc electrical potential energy

2. calc kinetic energy

3. calc  $v_e = \sqrt{2K_e/m}$  to find velocity



## Work

- giving largest electric force vs charge to vs plate

to energy must be put in

put work, move charge from plate to plate to create vs, transfer more electrical energy

center amount of energy to move charged particle between charges to create vs, potential

symbol:  $W$

unit: Joules, J

As particle is moved further from charges attracted to,  $W$  vs  $d$



## Millikan Oil Drop

- Robert Millikan noticed that the procedure, size of charge on electron  
 was an integer multiple charged plates had surrounding object's  
 charged electron field to hold oil droplets, work drop falling due to gravity,  
 when stop and start, force of gravity, electric force



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**Marco Casella**



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