

ELECTROSTATICS CH 20

BEN FRANKLIN WAS A MAJOR INVESTIGATOR OF ELECTRICITY. HE THOUGHT IT WAS LIKE A FLUID. HE BELIEVED IT FLOWED FROM WHERE THERE WAS AN EXCESS AMOUNT (A POSITIVE QUANTITY) TO WHERE THERE WAS LESS. (A NEGATIVE AMOUNT)

BEN WAS WRONG, BUT THE LANGUAGE STUCK
WHICH IS WHY WE HAVE POSITIVE & NEGATIVE CHARGE

WE NOW KNOW ABOUT ATOMS. PROTONS CARRY A POSITIVE

CHARGE AND ARE IN THE NUCLEUS ALONG WITH NEUTRONS.

PROTONS CAN NOT BE REMOVED FROM THE NUCLEUS (THINK
ATOMIC BOMBS) AND WE DON'T CARE ABOUT NEUTRONS.

WHAT CONCERNS US ARE THE ELECTRONS THAT SURROUND THE NUCLEUS. SPECIFICALLY THE VALANCE ELECTRONS. ELECTRONS CARRY A NEGATIVE CHARGE. IF THE ELECTRONS ARE TIGHTLY BOUND TO THE ATOM THE MATERIAL IS AN INSULATOR, IF IT IS LOOSELY BOUND IT IS A CONDUCTOR.

ELECTRIC CHARGES CAUSE ELECTRIC FORCES.

CHARLES COULOMB DETERMINED THAT THE FORCE ARISING DUE TO A SEPERATION OF CHARGE IS

$$F_e = k \frac{q_A q_B}{r^2}$$

F_e = ELECTRIC FORCE (NEWTONS - N)

k = CONSTANT $9 \times 10^9 \frac{N \cdot m^2}{C^2}$

q = CHARGE (COULOMBS - C)

r = DISTANCE (METERS - m)

LIKE CHARGES REPEL ; UNLIKE ATTRACT

THE CHARGE ON A SINGLE ELECTRON (e^-) or
PROTON (e^+) IS 1.6×10^{-19} C. IT CAN BE
POSITIVE OR NEGATIVE. THE SIGN IS THE SIGN
OF THE CHARGE NOT THE NUMBER. *

EXAMPLE :

IF YOU HAVE $5.2 \times 10^{15} e^{-}$, HOW MUCH CHARGE IS THERE?

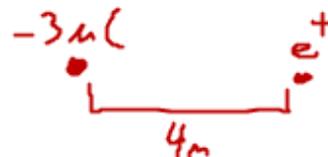
$$5.2 \times 10^{15} * 1.6 \times 10^{-19} C = 8.32 \times 10^{-4} C \quad (832 \mu C)$$

A COULOMB IS A HUGE UNIT SO μ (MICRO- 10^{-6}) IS OFTEN USED 

HINT: USE THE EE BUTTON ON YOUR CALCULATOR FOR $\times 10^x$

EXAMPLE :

A $-3\mu\text{C}$ AND A PROTON ARE SEPERATED BY
4 m. WHAT IS THE FORCE ON THE PROTON?



The diagram shows two small black dots representing charges. The left dot is labeled $-3\mu\text{C}$ and the right dot is labeled e^+ . A horizontal line with vertical end caps connects the two dots, and the number "4m" is written below the line.

$$F_c = \frac{k q_1 q_2}{r^2} = \frac{9 \times 10^9 \frac{\text{N}\cdot\text{m}^2}{\text{C}^2} (3 \times 10^{-6} \text{C}) (1.6 \times 10^{-19} \text{C})}{4^2 \text{m}^2}$$

NOTE: THE CHARGES ARE UNLIKE

SO THEY ATTRACT.

FORCE ON PROTON IS
TO THE LEFT.

$$= 2.7 \times 10^{-16} \text{ N}$$

NOTE: DROP THE SIGNS WHEN DOING
THE MATH.