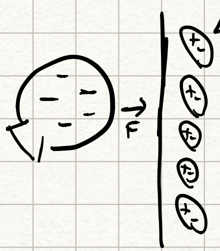
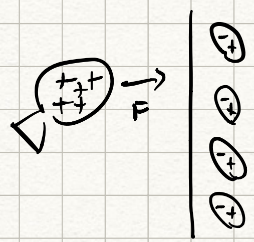
FORCES ON UNCHARGED OBJECTS

- rubbing balloon will make it stick on ceiling (uncharged).
  ↳ this is due to induced charge.

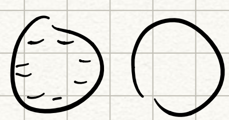
- in insulators, charges can shift back & forth a little when ∃ charge nearby.



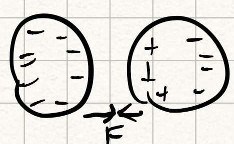


- this is not possible in a conductor. Charge will still be induced, but when touched e^- will → conductor if negatively charged or
  e^- will ← conductor if positively charged
  ↳ charge accumulation of surface of insulator

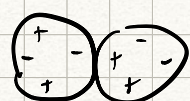
consider:



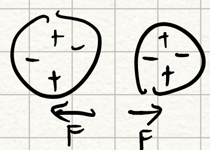
two conductors, 1 (-), 1 (/)
placed next to e.o.



induced charge causes attraction



once touched, charge transfer.



then they repel e.o.

Coulomb's Law

- we can know experientally that $F \propto \frac{1}{r^2}$ and $F \propto q$ and $F \propto Q$.
  Thus,

$$F_e = k\frac{|qQ|}{r^2}$$

similar to $F_g = G\frac{Mm}{r^2}$!!
↳ always attractive

force is always positive

$$K \simeq 8.988 \times 10^9 \ \frac{Nm^2}{C^2}$$

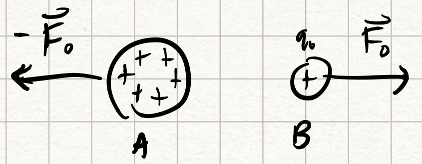
↳ this is related to speed of light in vacuum, $c = 2.9979 \times 10^{8}$ m/s

$$K = c^2 \cdot 10^{-7} \frac{N \cdot s^2}{C^2}$$

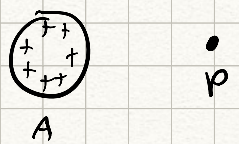
in SI units,

$$F = \frac{1}{4\pi\varepsilon_0}\left(\frac{|qQ|}{r^2}\right), \quad \text{where } K = \frac{1}{4\pi\varepsilon_0} \approx 9.0 \times 10^{9} \frac{Nm^2}{C^2}$$

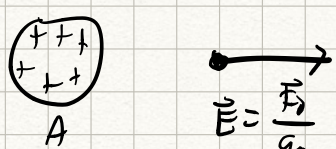
ELECTRIC FIELD



let B be a test charge



remove B
label former position as P



$\vec{E} = \frac{\vec{F}_0}{q_0}$

Body A has electric field at P
↳ how it communicates its presence

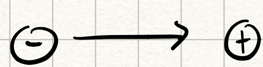
$$\vec{E} = \frac{\vec{F}}{q} = \frac{1}{4\pi\varepsilon_0}\frac{Q}{r^2}\hat{r}$$

- electric field points away if Q positive, into if Q negative.
  - ↳ towards lowest potential
  - ↳ think of negative potential as GPE under sea level.

$\vec{F} = q\vec{E}$ similar to $\vec{F}_g = m\vec{g}$!

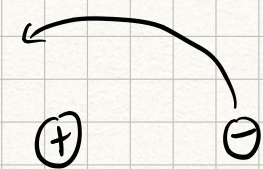
↳ only applicable to point charges!

ex1



what remains constant?

- [ ] magnitude
- [x] direction
- [ ] both
- [ ] neither



what remains constant?

- [x] magnitude
- [ ] direction
- [ ] both
- [ ] neither

★ think of magnitude of E as # lines
– larger radius, less condensed, less field.