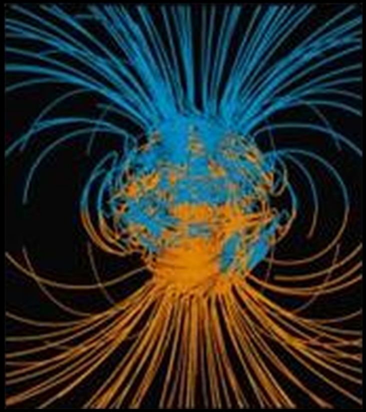


Phy2005
Applied Physics II
Spring 2017

Announcements:

January	19	F	**5**	Q3, 3, 4	19.1 - 19.5	charge, conductor/insulator, induced charge	pithballs, pingpong, electroscope
January	22	M	**6**	5, 9, 11, 12, 14,17, 19	19.6 - 19.7	Coulomb's law, superposition	
January	24	W	**7**	23, 27, 28, 31, 32, 37	19.8 - 19.12	E-field and electric potential	Faraday shielding, cell ph demo
January	26	F	**8**	40, 42, 48, 49	19.13 - 19.16	potential energy, motion of charge in E-field	van de graaff

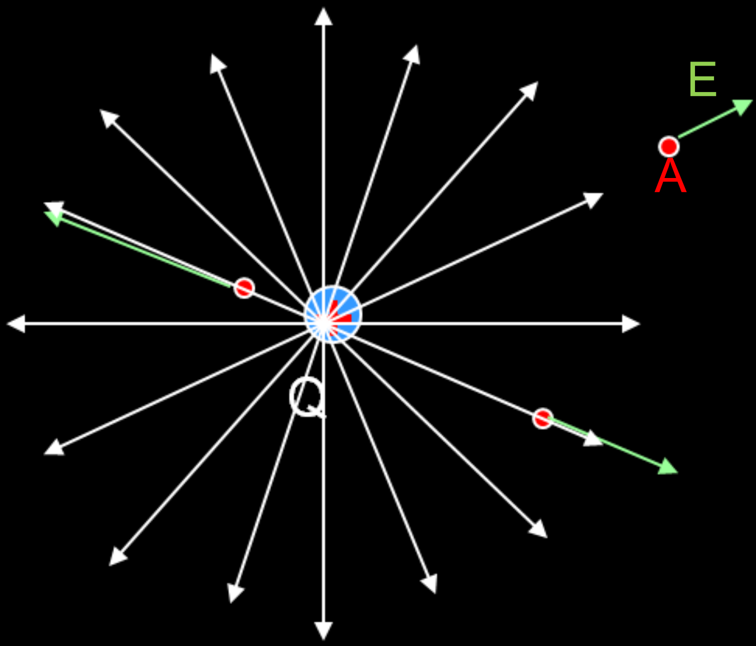
- Solutions to chapter 19 problems posted on HW page.

Last time: Electric fields

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

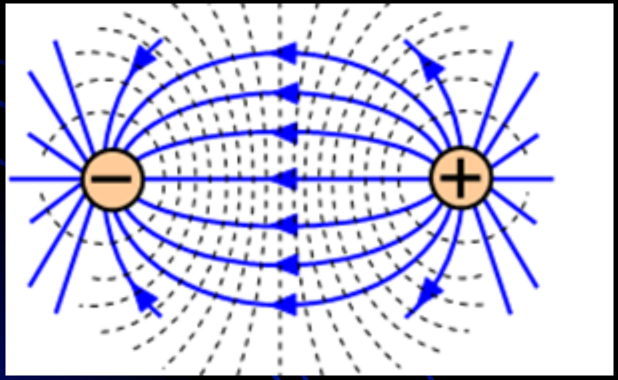
$$\vec{F}_E = q\vec{E}$$

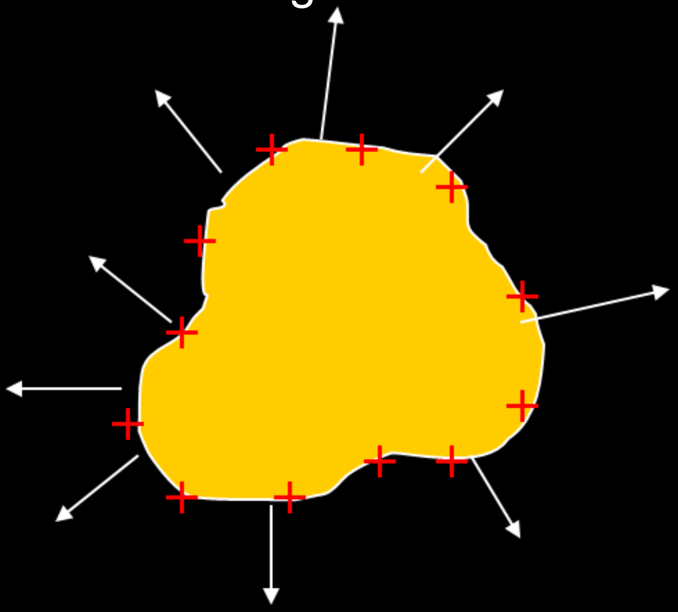
Today: Motion of charge in E-field, potential



Put a charge q at pt. A, and it will experience an electric force F=qE

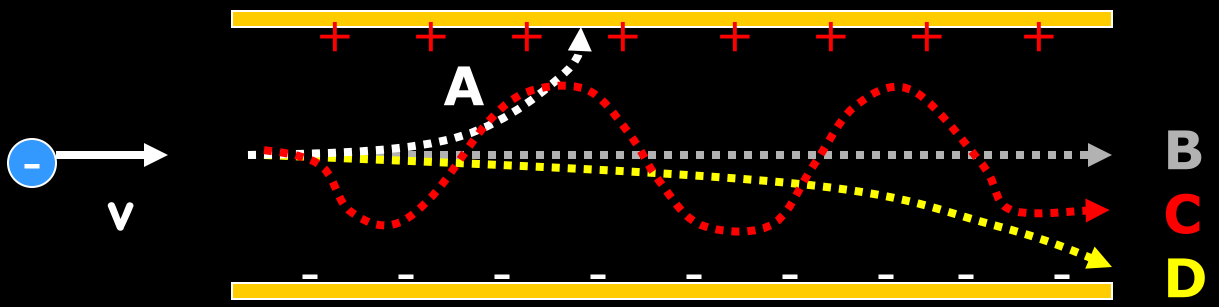
Electric field is perpendicular to a conducting surface



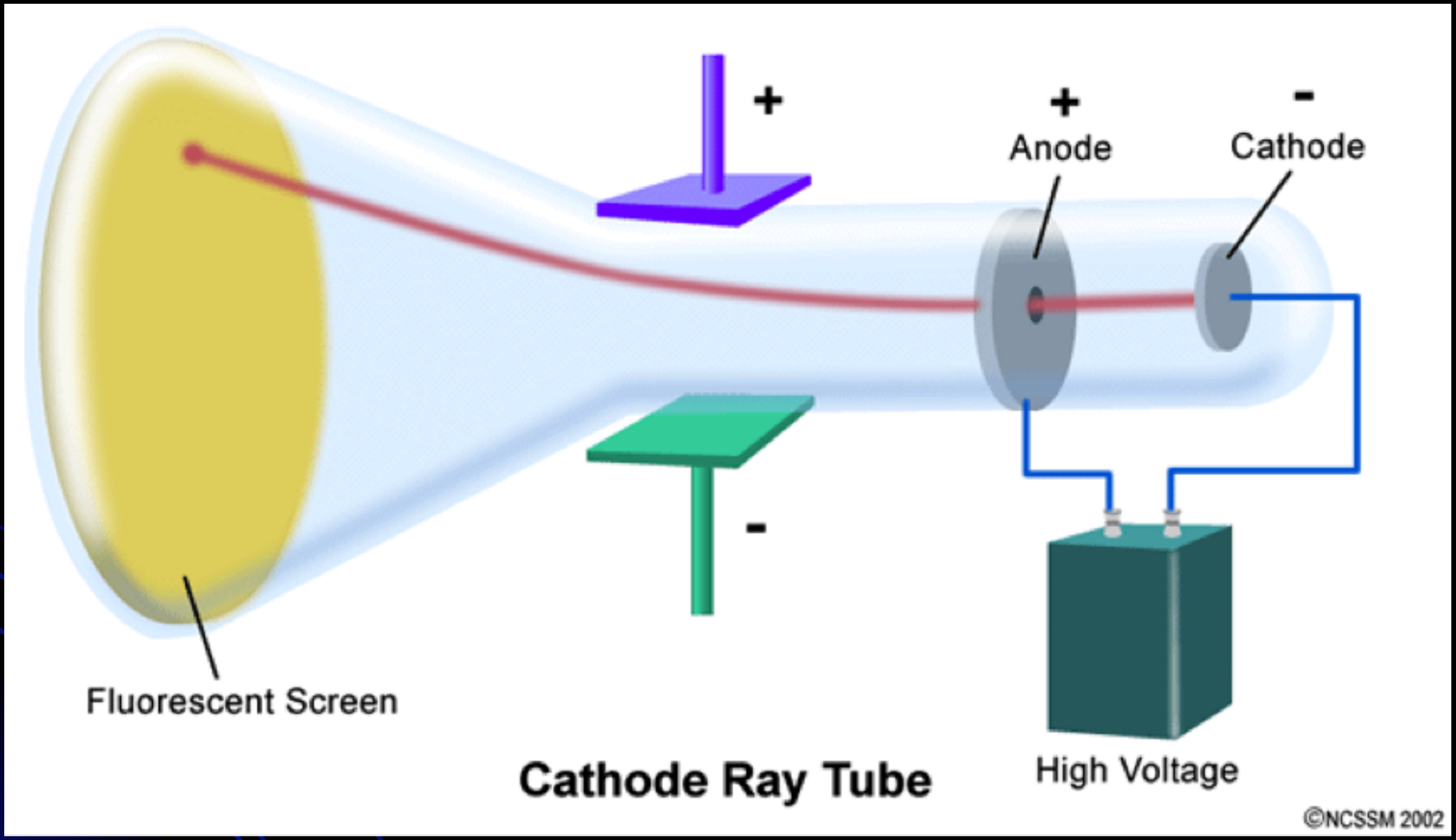


Electric field lines begin on + charges and end on - charges

Q1 Two parallel conducting plates are charged as shown in the figure. An electron is injected between the plates from the left side (see figure). Which curve describes the trajectory of the electron correctly?



1. A
2. B
3. C
4. D



http://www.dlt.ncssm.edu/TIGER/diagrams/structure/CRT-Plates640.gif

Potential Energy

Position or Condition

MECHANICAL ENERGY

Kinetic Energy

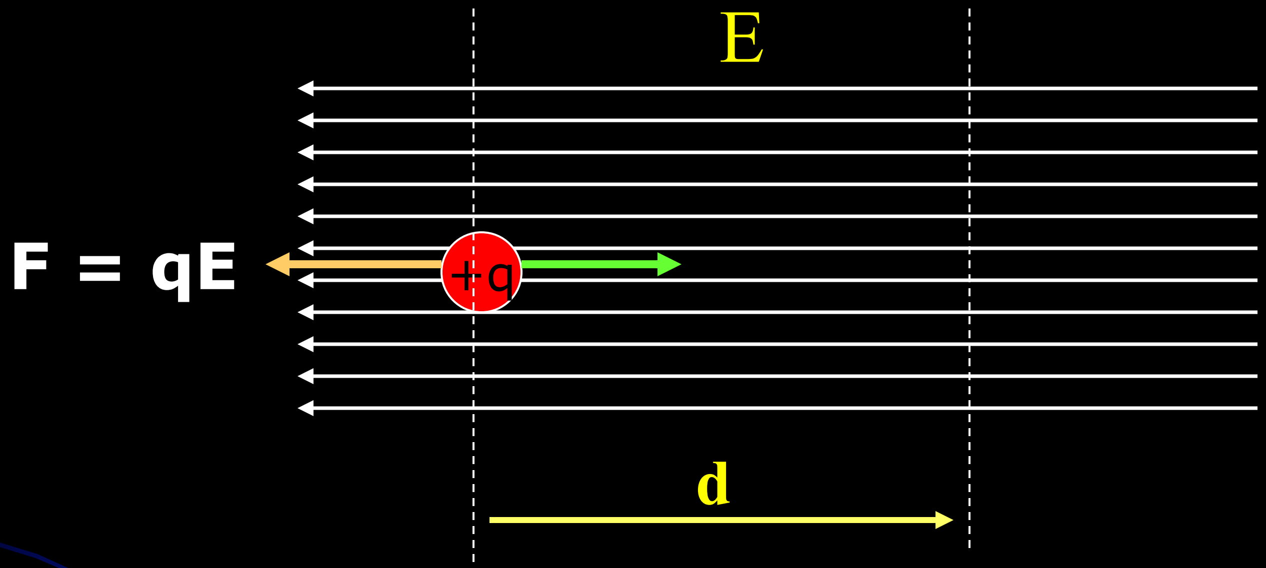
Motion $(mv^2/2)$

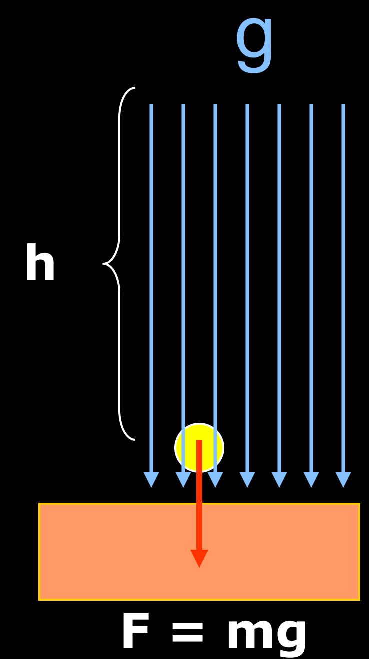
Work-Energy Theorem

The work of a net external force on an object is equal to the change in kinetic energy of that object

Electric Potential Energy (move the charge against the field with your hand)

Gravitational Potential Energy





Electric Potential Energy of the object increased by qEd.

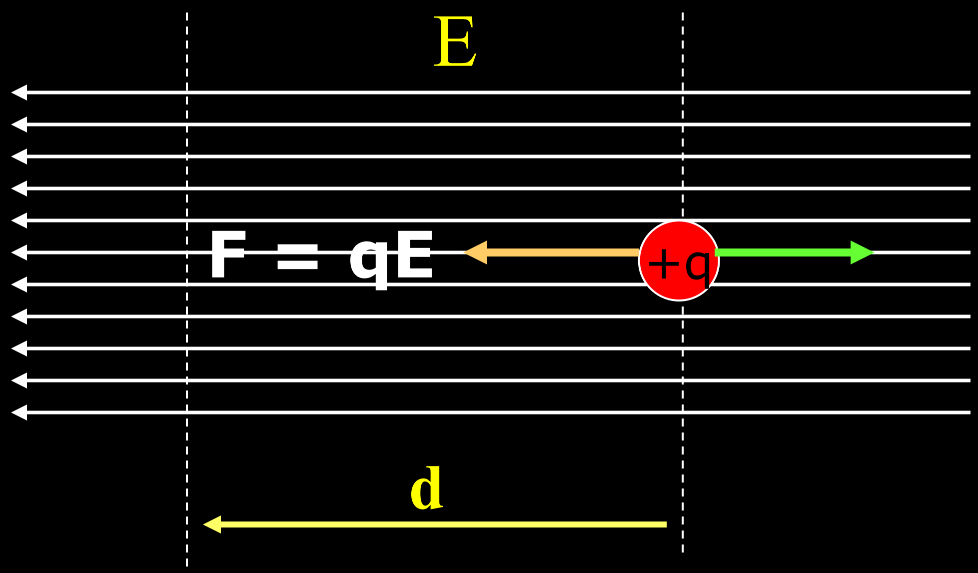
Gravitational Potential Energy of the object increased by mgh.

Ex 8-1 A +5 mC charge is moved against a uniform electric field of 2000 N/C by a distance of 10 m. What is the change in electrical potential energy of the charge?

ΔP.E. =qEd

= 100 J (increase)

Now move the charge the other way with your hand



Electric Potential Energy of the objected decreased by qEd.

Q: how much work is done by a) electric force b) pushing force?

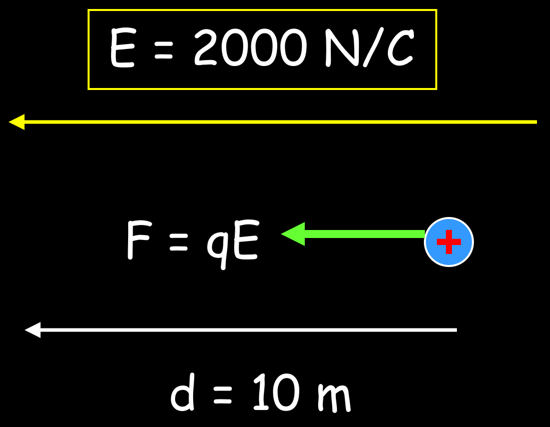
A: a) qEd b) -qEd

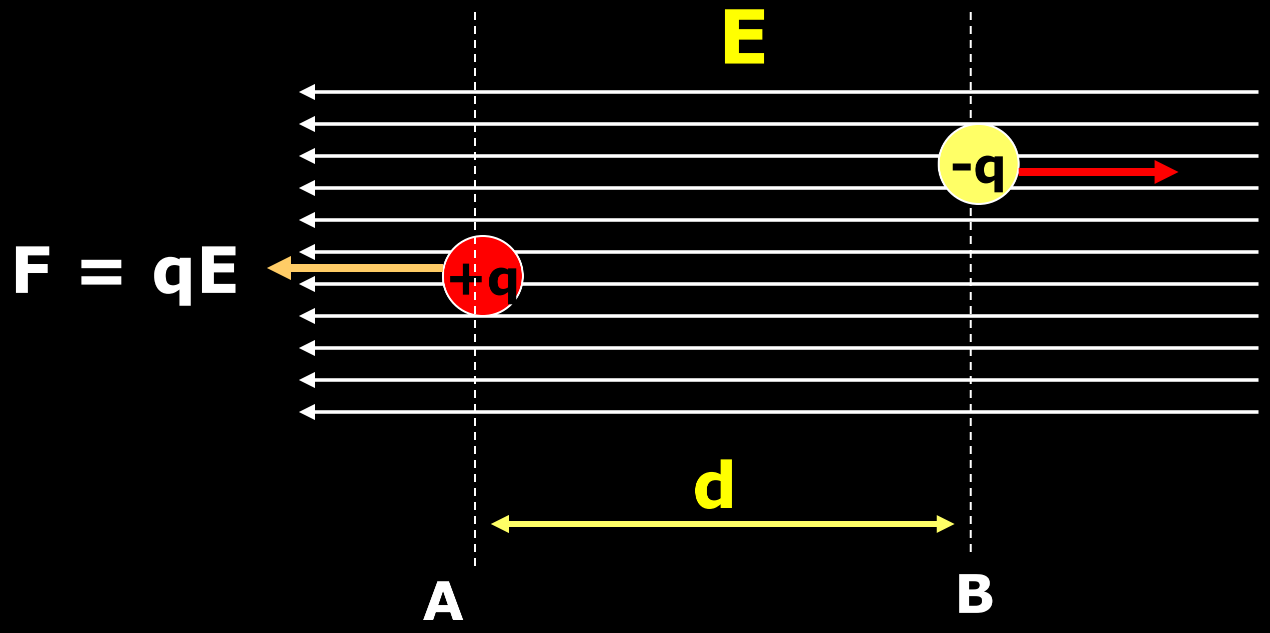
Note total work done is zero ⇒ kinetic energy same before & after!

Ex 8-2 A +5 mC charge was released in a uniform electric field of 2000 N/C and moves along the field line by 10 m. What is the net external force acting on the charge during the process? How much work was done by this force?

W = qEd = +100 J

(increase in kinetic energy)





<u>Potential energy</u> for +q increases A -> B.

However, **<u>potential energy</u>** for -q increases B -> A.

Electric Potential

(different from electric potential energy)

Electric Potential Difference

$\Delta\varepsilon$ = E-pot. Energy/charge

= qEd/q = Ed

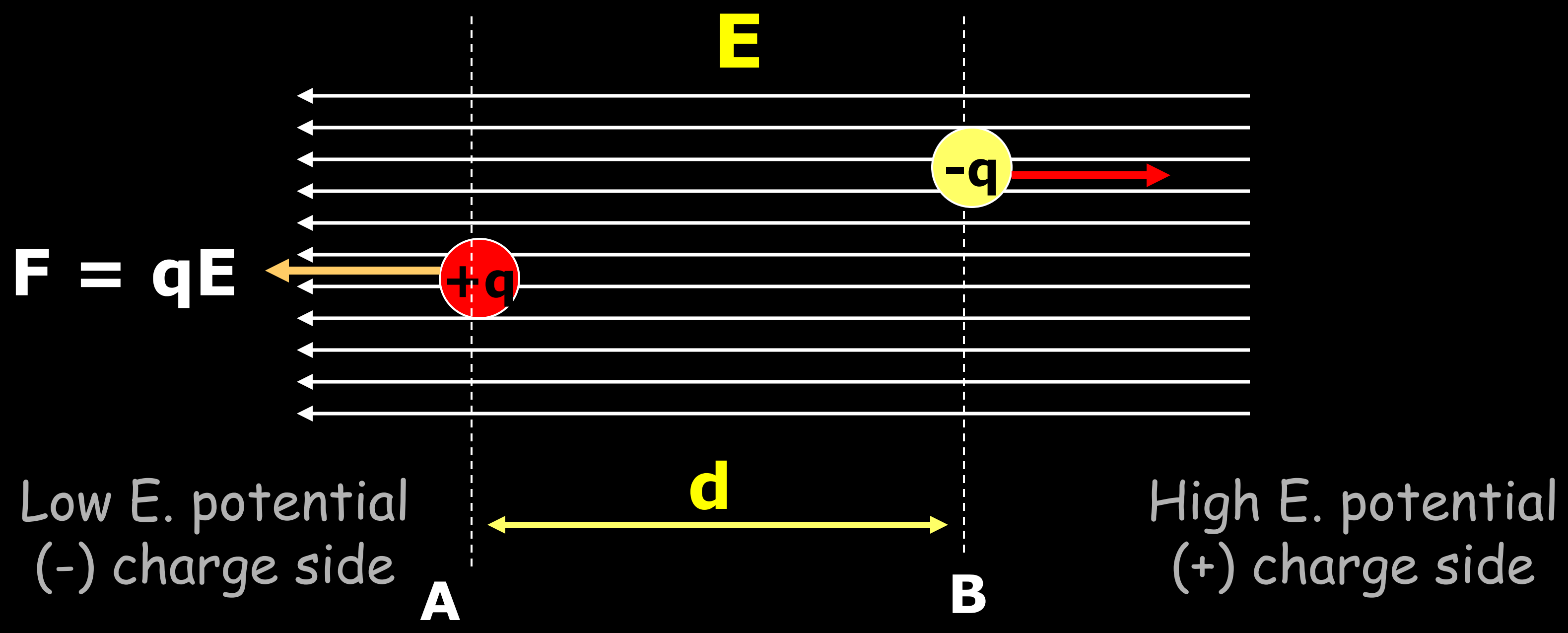
$[\varepsilon]$ = N.m/C

= J/C

= Volt

Electric potential has nothing to do with the type and size of the charge!

As you follow the electric field lines, the electric potential gets LOWER.



<u>Potential energy</u> for +q increases A -> B.

However, **<u>potential energy</u>** for -q increases B -> A.

Electric potential at B is higher than at A **for both.**

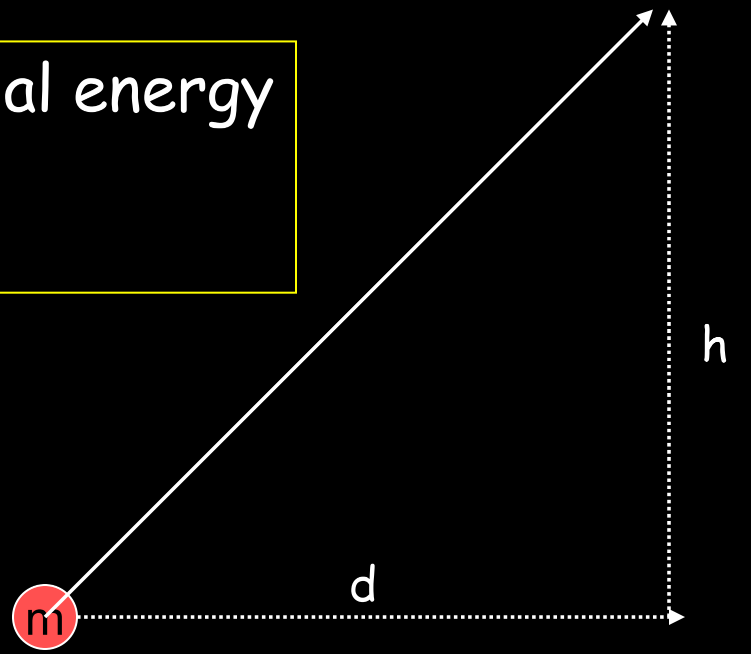
Comparison with GRAVITY

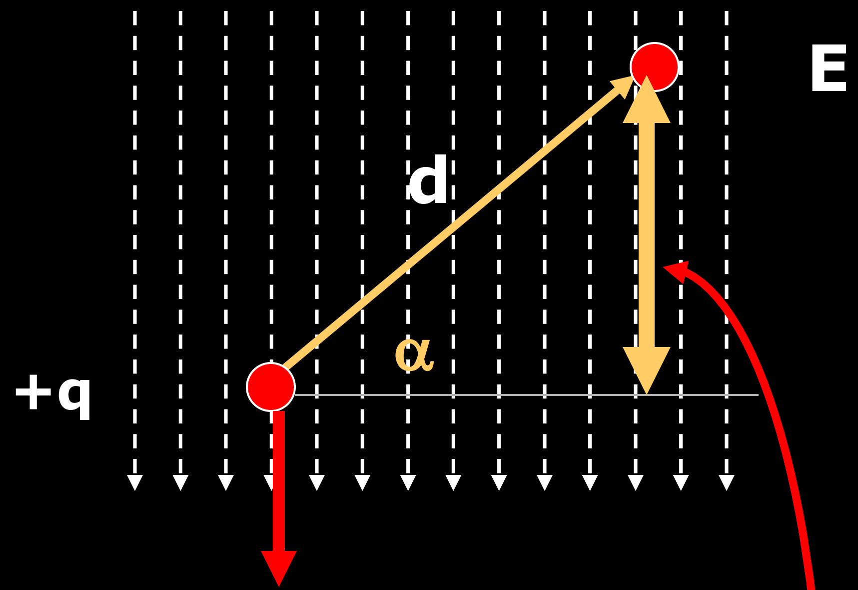
Gravitational (on the earth)	Electric
Mass, m (Kg) Only 1 type	Charge, Q (C) + and -
g (m/s^2=N/Kg)	E-field (N/C)
mgh (Nm = J) Potential energy	QEd (J) Potential energy
gh (Nm/Kg) Gravitational potential	Ed (Nm/C) Electric potential

Change in potential energy

$= (P.E.)_f - (P.E.)_i$

$= mgh$





How much does PE change here?

$\Delta PE = qE\ d\sin(\alpha)$

Potential difference is $\varepsilon = E\ d\ \sin(\alpha)$.

Important!!
Along lines perpendicular to E-field potential doesn't change

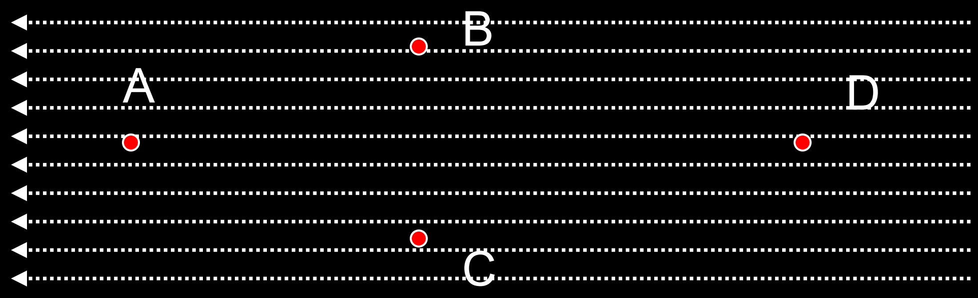
Top Hat Quiz Time

ACADEMIC HONESTY

Each student is expected to hold himself/herself to a high standard of academic honesty. Under the UF academic honesty policy. Violations of this policy will be dealt with severely. There will be no warnings or exceptions.

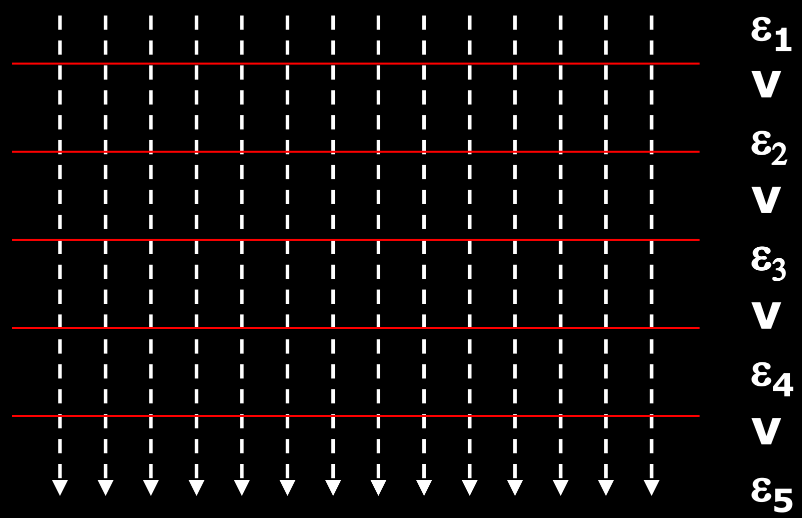
Have your phone ready!

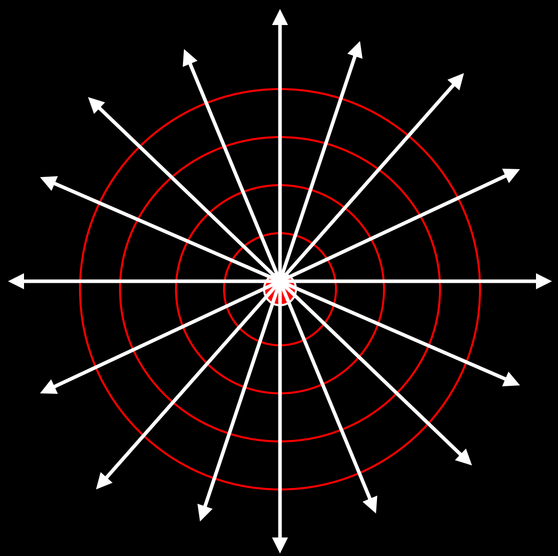
Q1 A -3 mC is placed in a uniform electric field at one of 4 possible positions A,B,C,D. Which of the following statements is wrong?

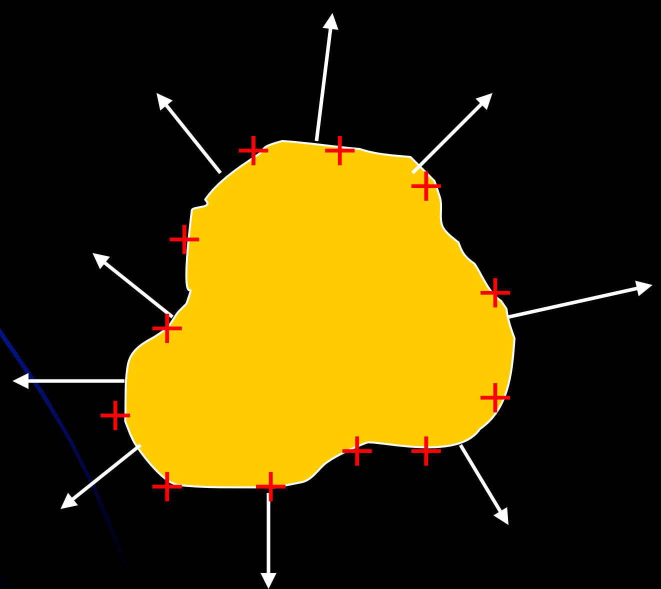


(1) At all positions, the charge feels a force to the right.
(2) The electric potential at C is higher than at A.
(3) The electric potential energy at B is the same as at C.
(4) When the charge is moved from A to D, the electric potential energy decreases.
(5) If the charge is released at D, it will move to the left.

Equipotential Line







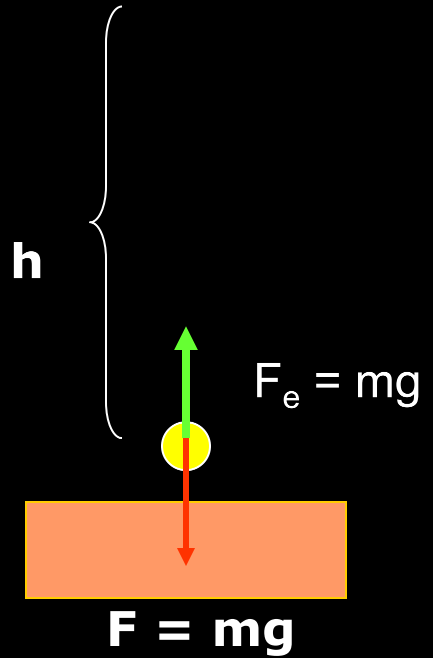
Surface of conductor
||
Equipotential surface

Work, Energy, and Conservation

$$W_e = \Delta K.E. + \Delta P.E.$$

$$\Delta P.E. = -W_c$$

W_e: work done by any forces other than conservative force
such as lifting force, friction, contact force,…
W_c: work done by conservative forces
such as electrostatic force, gravitational force

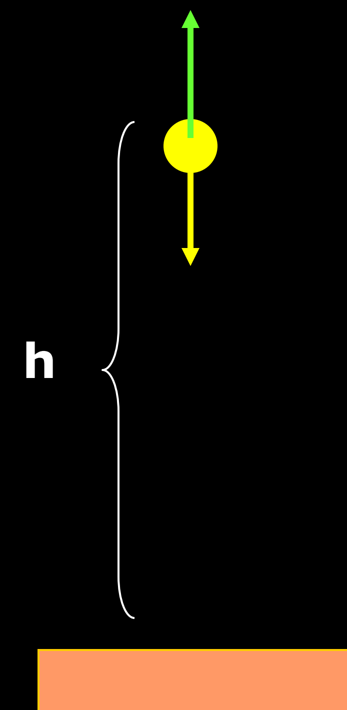


ΔP.E. = $-W_c$ = $-(-mgh)$ = mgh (increase)
$W_e = F_e h = mgh$

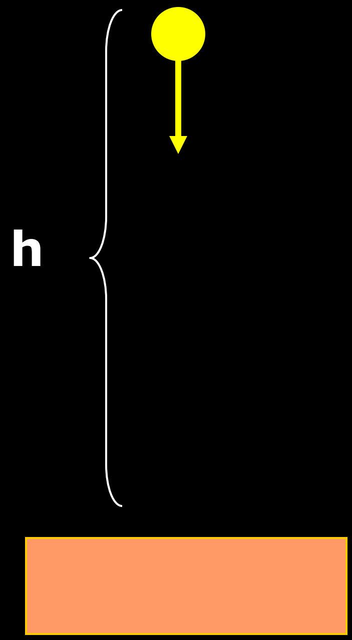
W_e = ΔK.E. + ΔP.E. = mgh
ΔK.E. = 0 (no change)

ΔP.E. = $-W_c$ = $-(mgh)$ = $-mgh$ (decrease)
$W_e = -F_e h = -mgh$

W_e = ΔK.E. + ΔP.E. = $-mgh$
ΔK.E. = 0 (no change)



free fall



$$\Delta P.E. = -W_{ff} = -(mgh) = -mgh \text{ (decrease)}$$

$$\Delta K.E. = -\Delta P.E. = mgh \text{ (increase)}$$

$$W_e = \Delta K.E. + \Delta P.E. = 0$$