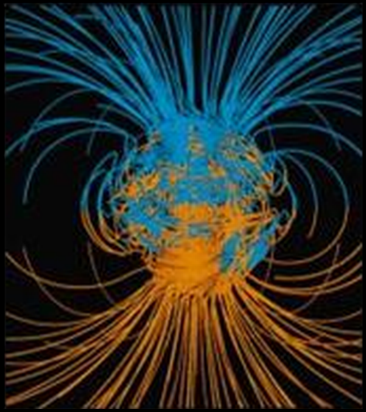


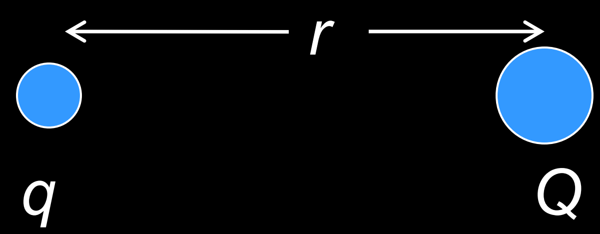
Phy2005
Applied Physics II
Spring 2017

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 Monday on HW page.

Last time: Coulomb's law



$$F_E = k\frac{q \cdot Q}{r^2}$$

Today: Electric fields

Coulomb force

$$F_E = k\frac{q \cdot Q}{r^2}$$

$k = 9 \times 10^{9}\ Nm^2/C^2$

can be repulsive and attractive!

Gravitational force

$$F_G = -G\frac{m_1 \cdot m_2}{r^2}$$

$G = 6.67 \times 10^{-11}\ Nm^2/kg^2$

can only be attractive!

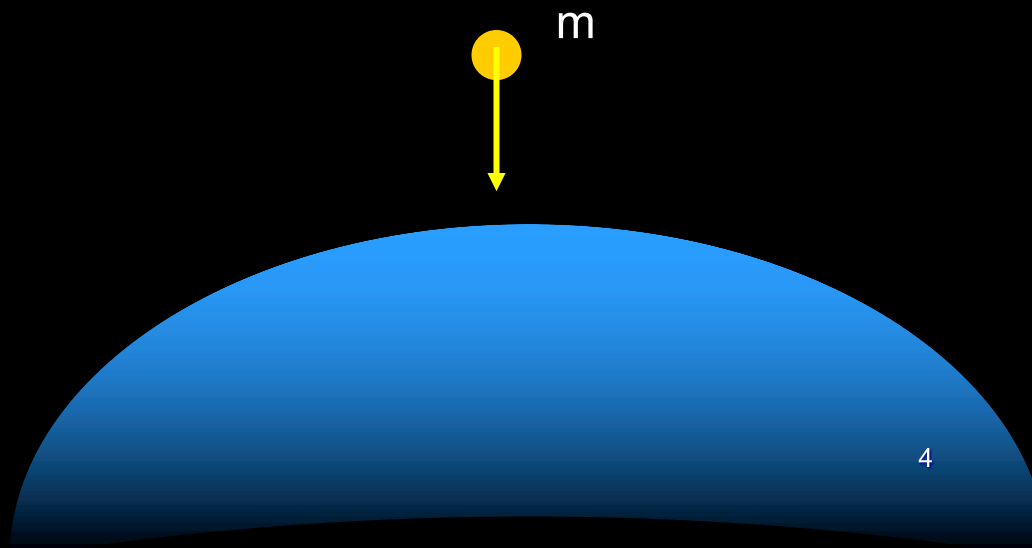
Non-contact forces
Action-at-a-distance forces
Conservative force

On the surface of the earth

$$F_G = -G\frac{m_E \cdot m}{r_E^{\;2}} = -mg$$

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

gravitational force acting on a unit mass
= gravitational field



- Similarly, we can define an electric field, E

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

Coulomb force on a (+) unit charge

- Force on a positive unit charge
  → the unit for E is N/C.
  We add forces on single charge, so E-field is also *superposable*!!!

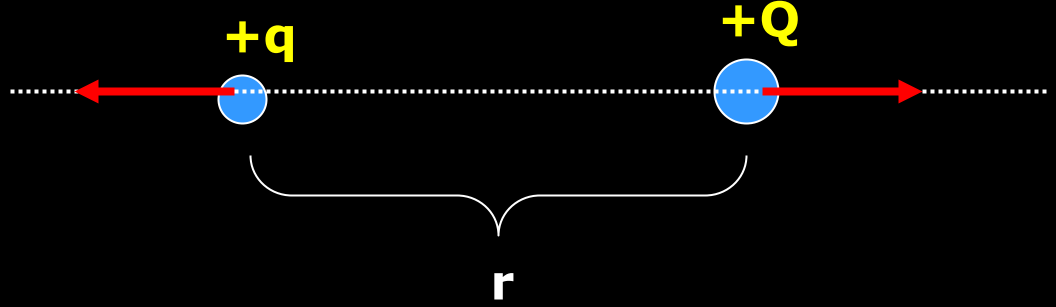
- If there is E-field somewhere, there is a force on a charge placed there !!!
  - (+)-charge feels force in the E-field direction.
  - (-)-charge feels *opposite* to E-field.

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

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

$$F_E = k\frac{q \cdot Q}{r^2}$$

k = 8.988 x 10^9 Nm^2/C^2
≈ 9.0 x 10^9 Nm^2/C^2



Electric field at +q produced by +Q

$$E = F_E / q = k\frac{Q}{r^2}$$

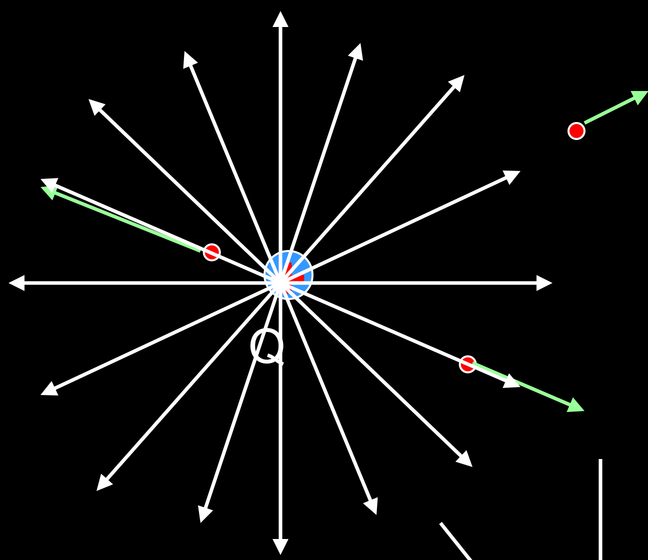
Electric field at +Q produced by +q

$$E = F_E / Q = k\frac{q}{r^2}$$

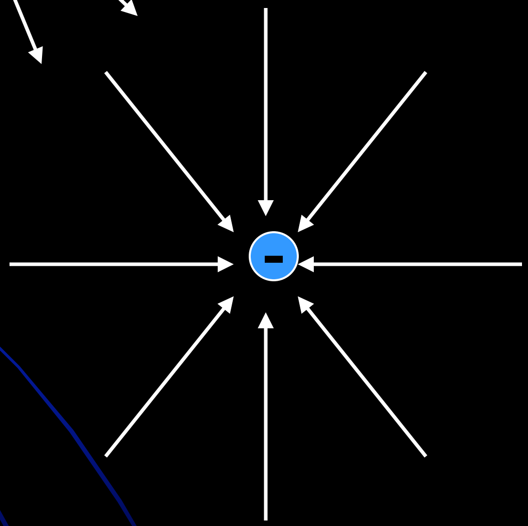
$$\vec{E} = \vec{F}_E / q$$

One can calculate E from a point-like charge Q at distance r from Q

$$E = k\frac{Q}{r^2}$$



E-field line: collection of lines representing strength and direction of E-field in space

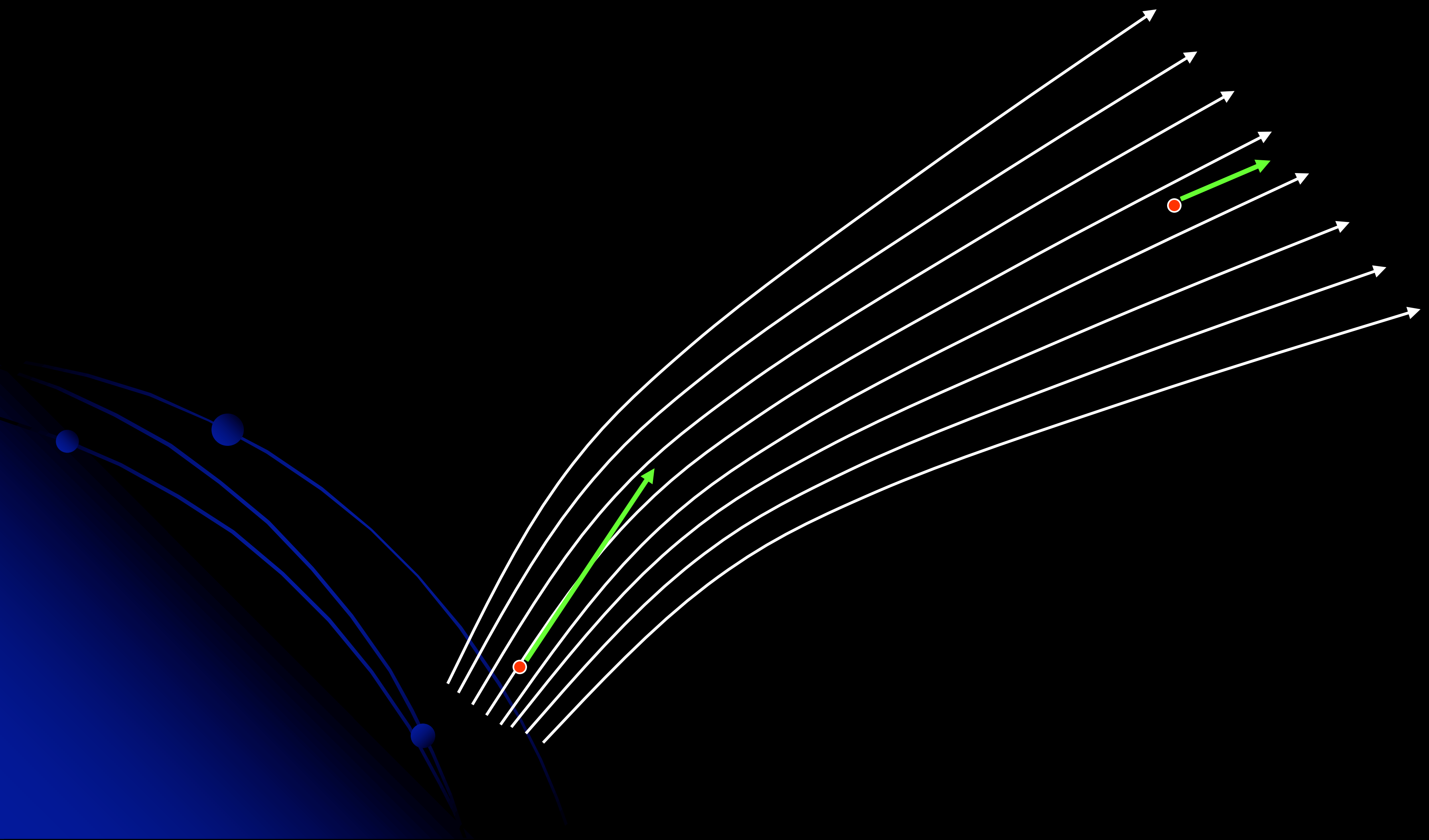


Direction of the field line = E-field direction

Density of the field lines = strength of E-field

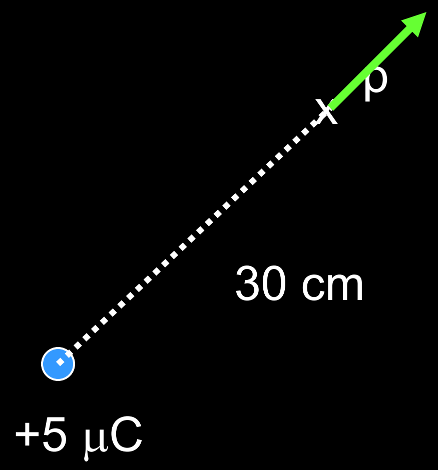
www.falstad.com/mathphysics.html

E field lines come out of (+) charges and end on (-) charges.



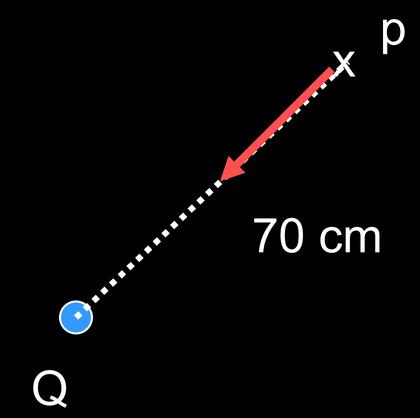
Ex 7-1 Calculation of electric field (I): Find the electric field at point p due to the +5 μC.

$E = 5.0 \times 10^5$ N/C



Ex 7-2 The value of E field at a distance of 70 cm from a tiny charged sphere is 3500 N/C and its direction is radially in toward the sphere. (1) The type of charge on the sphere? (2) If one put a +1 C charge at the position, what is the force acting on the charge? (3) What is the charge on the sphere?

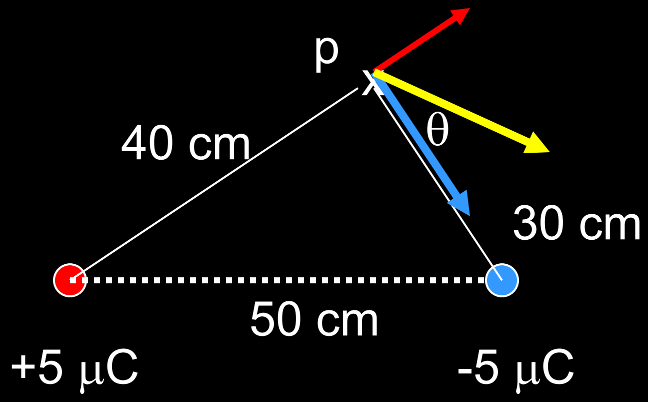
(1) negative charge
(2) 3500 N
(3) Q = -0.19 μC



Ex 7-3 Calculation of electric field (II): Find the electric field at point p due to the charges of +5 μC and -5 μC.

$E_t = 5.73 \times 10^5$ N/C

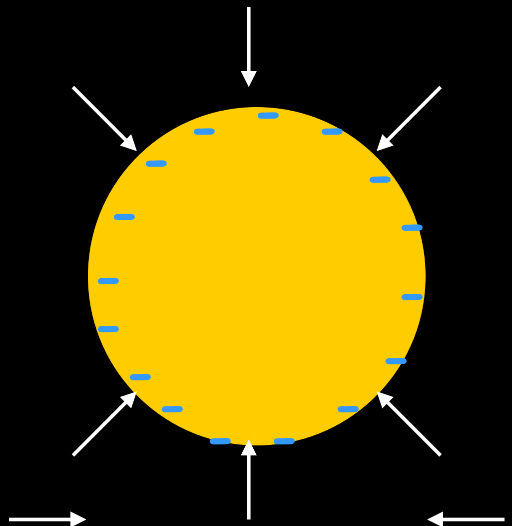
$\tan\theta = 0.56$, $\theta = 29.3°$



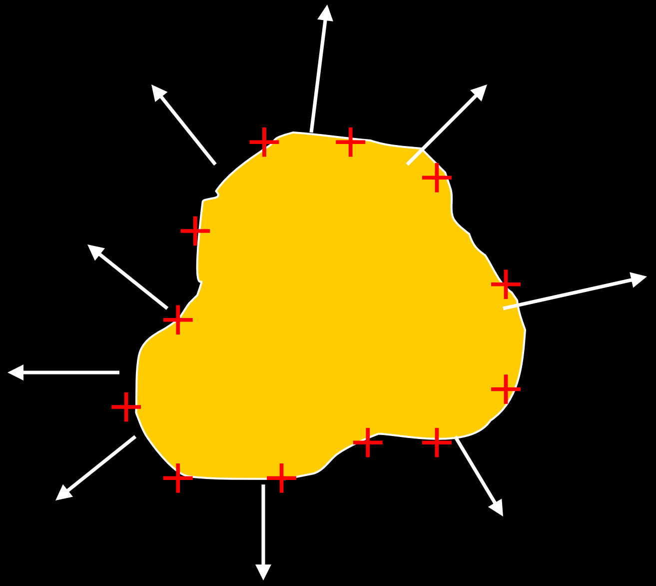
E field lines when more than two charges are present?

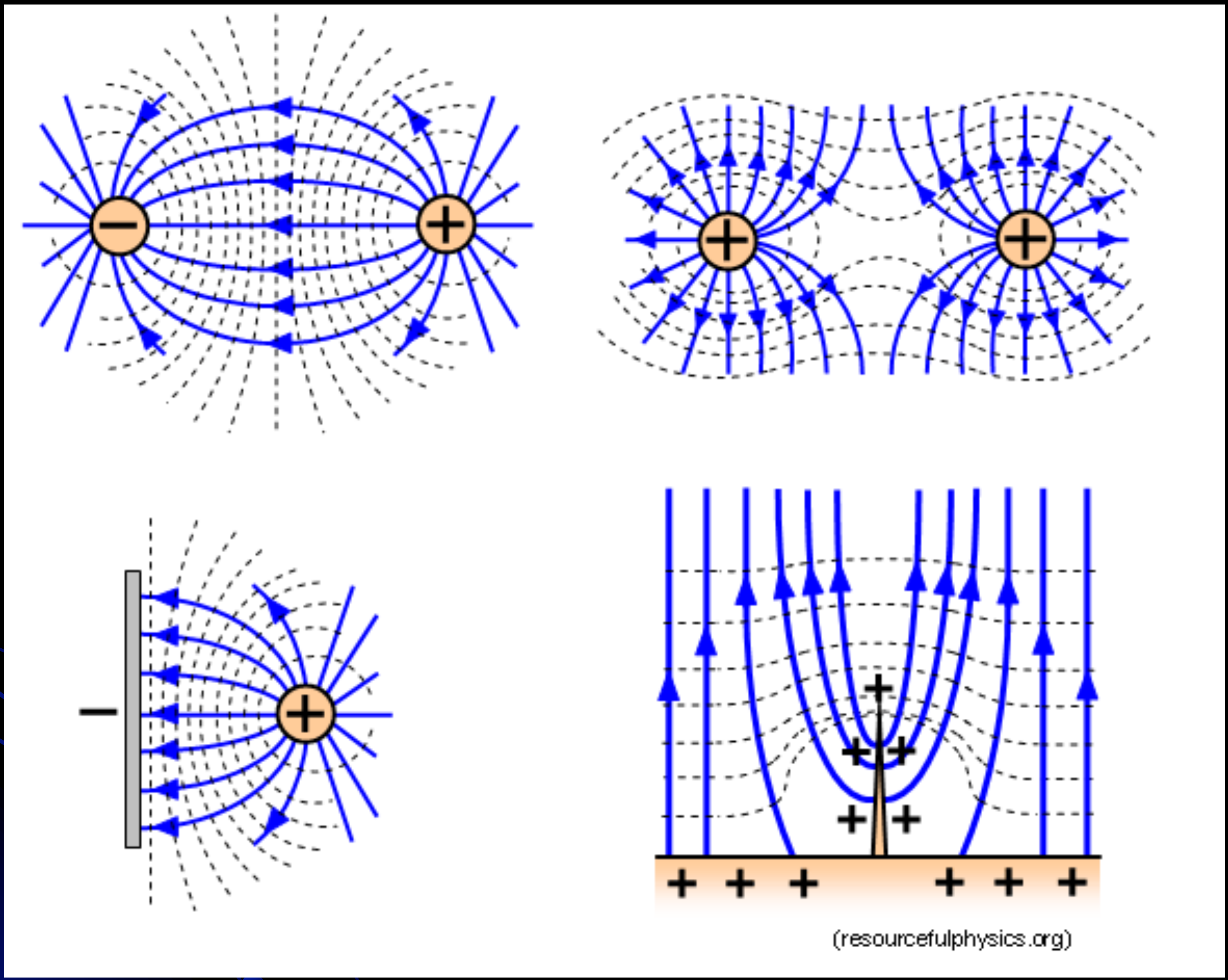
www.falstad.com/mathphysics.html

Electric field near a charged conductor

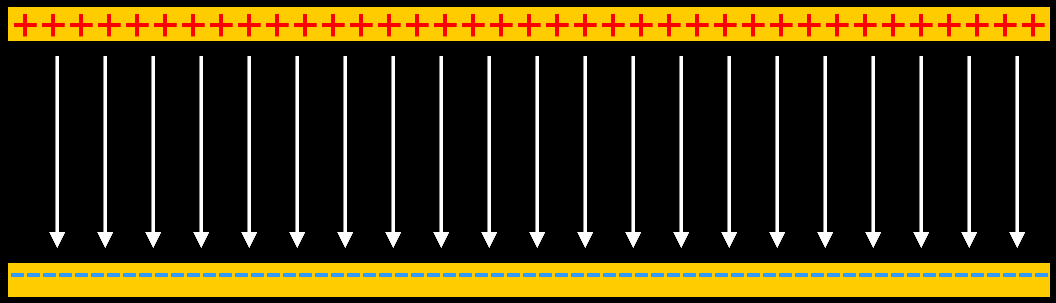


Excess charges reside on the surface of a conductor.
E field lines are perpendicular to the surface.
No E-field inside conductors.




(resourcefulphysics.org)

Uniform Parallel E-field



Charge is uniformly distributed on the surface.
Electric field comes out perpendicular to the surface of (+) charged surface.
Electric field enters perpendicular to the surface of (-) charged surface.

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 What is the unit of an electric field?

(1) m/s
(2) N/s
(3) $m.kg/s^2$
(4) $(kg.m/s^2)/C$
(5) C/m^2

Q2 A +5.0 μC point charge is placed at a point in the presence of a uniform electric field. The force acting on the charge is in the north direction with a magnitude of 5 N. Which of the following statements is wrong?

(1) The uniform field is pointing north.

(2) If a -5.0 μC charge is placed at the same position, the uniform electric field points to south.

(3) If a -5.0 μC charge is placed at the same position, the force acting on the charge is 5 N to the south.

(4) If one doubles the amount of charge, the force would be doubled, too.

(5) The strength of the uniform electric field is 10^6 N/C.

Demos

- Van de Graaf generator
- Electric field simulators