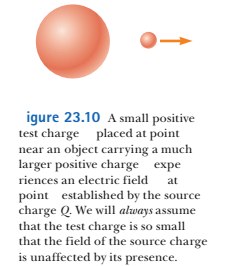
LECTURE 2



ELECTRIC FIELD

Coulomb’s Law:

E is an electric field

E is an electric field exerted on a test charge, per unit charge

Electric field in SI system is measured in *newton/coulomb* units: N/C

Electric field is a fundamental concept – not limited by Coulomb’s Law

E field can be produced by a single charge, or by many charges, or by moving permanent magnet, or by light (light is an electromagnetic wave).

The test charge serves as a *detector* of the electric field: an electric field exists at a point if a test charge at that point experiences an electric force.

If an arbitrary charge *q* is placed in an electric field **E**, it experiences an electric force given by**:**

The direction of an electric field:

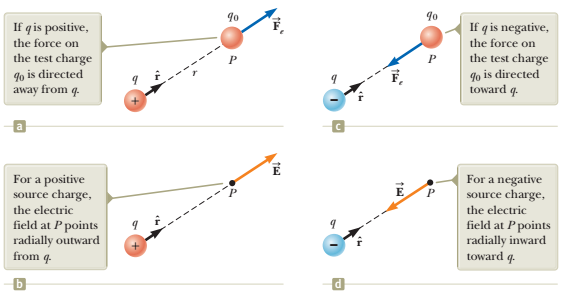


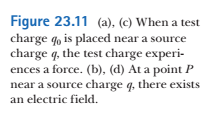
where **r**^ is a unit vector directed from *q* toward *q*0

The electric field is defined by: ,

hence







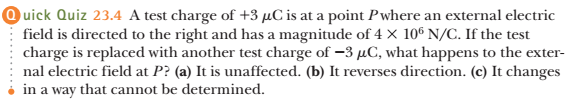
a distribution of charges: q1, q2, q3 …

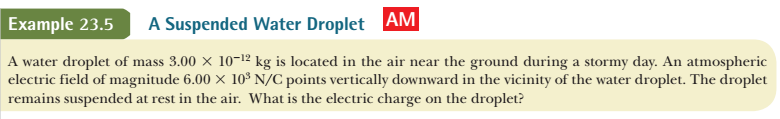
we add qtest

Coulomb’s Law :

The electric field in the location of qtest: E = F/qtest







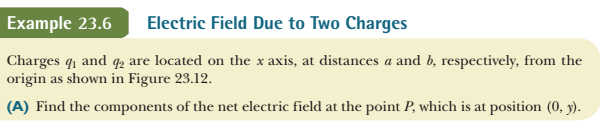
electric force: E\*q (upward)

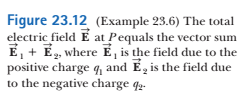
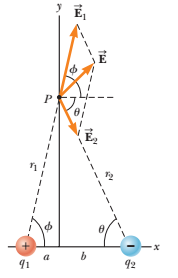
force of gravity: mg (downward)

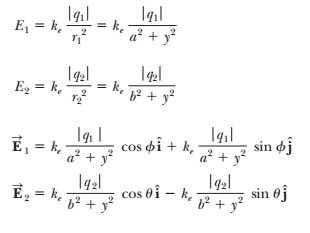
balance condition: Eq = -mg

q = - mg/E =

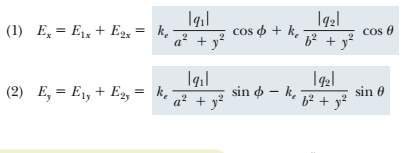


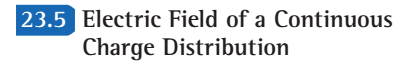


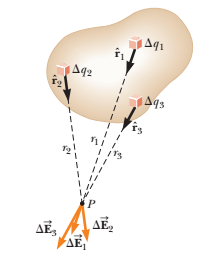
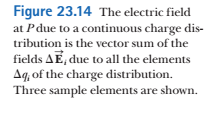


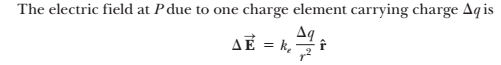










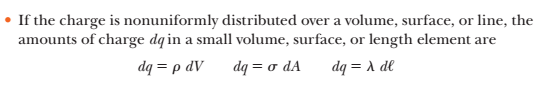
:

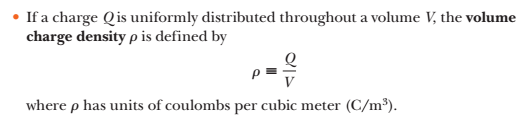


for continuous distribution of charge:

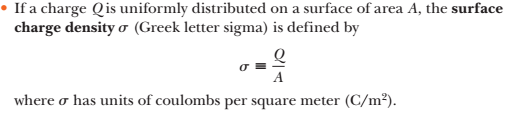


Nonuniform charge distributions:

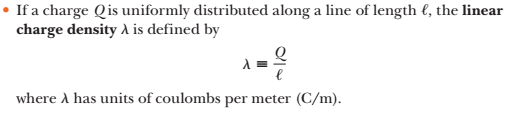
**Volume charge density**:



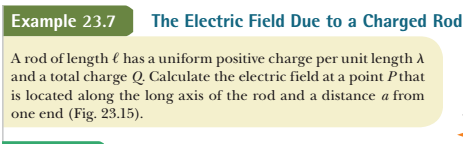
**Surface charge density**:

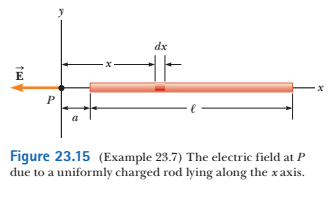


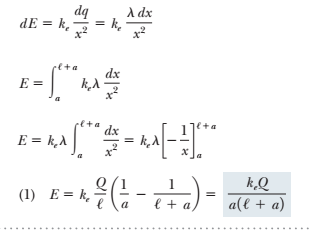
**Linear charge density:**



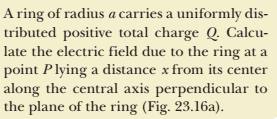
Examples:

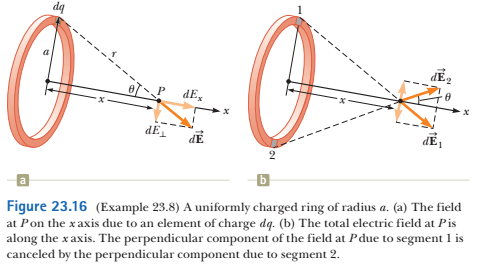


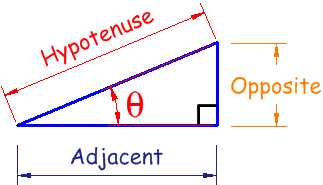


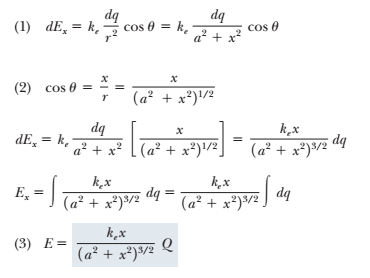


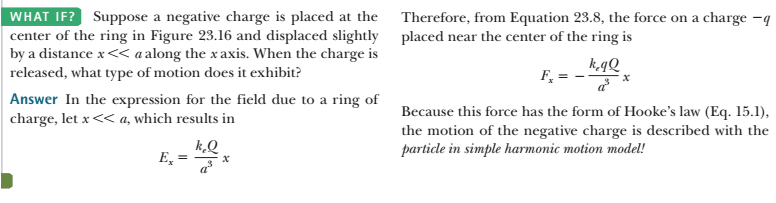


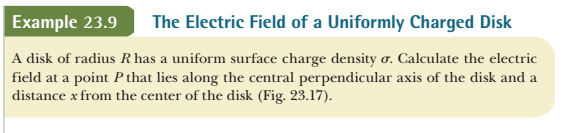


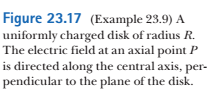
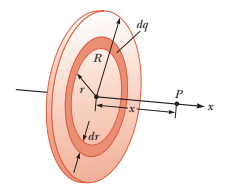


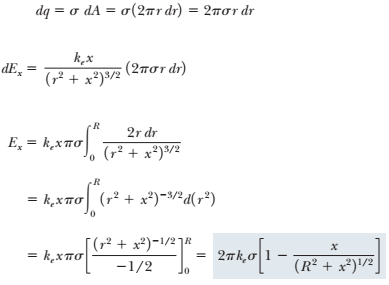












for x>> R: E = k Q/ x2

for x<<R:



for R -> infinity:

