Physics 100 – Sept. 12, 2007

- Recitations begin next week

Mon	1530-1730	Hylan 102
Wed	noon-1350	Hylan 203
Fri	1400-1600	Hylan 105

Ave Speed $\equiv \frac{\Delta x}{\Delta t}$ (no Direction)

Ave Velocity $\equiv \frac{\Delta x}{\Delta t}$ with direction information

Ave Acceleration $\equiv \frac{\Delta v}{\Delta t}$ (has a direction)

$x, v, a, t \rightsquigarrow$ Kinematic variables

Average vs. instantaneous

Newton's Laws

I: Law of Inertia

A body persists in its state of motion unless acted on by an external net Force.

II: Force Law

The acceleration of an object is proportional to the net force applied to it and inversely proportional to the mass of the object

$$\sum \vec{F} = m\vec{a}$$

III Law of Action and Reaction

For every Action there is an equal and opposite reaction

Newton's Laws + Kinematical definitions

Inertia

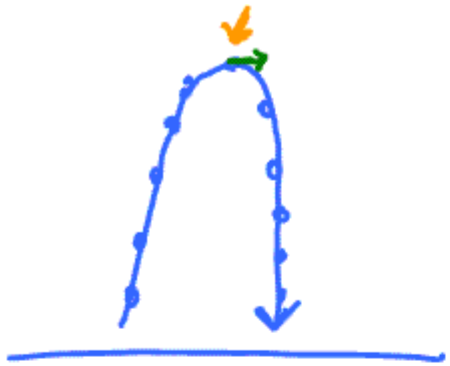
$F = ma$

Action - reaction

$V = \frac{\Delta x}{\Delta t}$

$a = \frac{\Delta V}{\Delta t}$

Allows us to make detailed calculations/predictions of how objects respond/move under the influence of forces



Battery tossed in air

$F = ma$

F same, a same all pts

Two stars a distance d apart
Star ① has mass m
Star ② has mass 4m

How does the gravitational attraction of Star ① for Star ② compare to the grav. attraction of Star ② for Star ①?

Action reaction forces the same

A particle accelerates uniformly from 30 m/s to 40 m/s in 5 s

Then moves at const speed of 40 m/s for 3 seconds.

What is the average speed of particle over the 8 second interval?

1st 5 seconds

Ave speed during 5 sec $= \frac{30+40}{2} = 35$ m/s

$\text{dist}_{1-5} = (35 \text{ m/s})(5 \text{ s}) = 175 \text{ m}$

last 3 seconds

$\text{dist}_{5-8} = (40 \text{ m/s})(3 \text{ s}) = 120 \text{ m}$

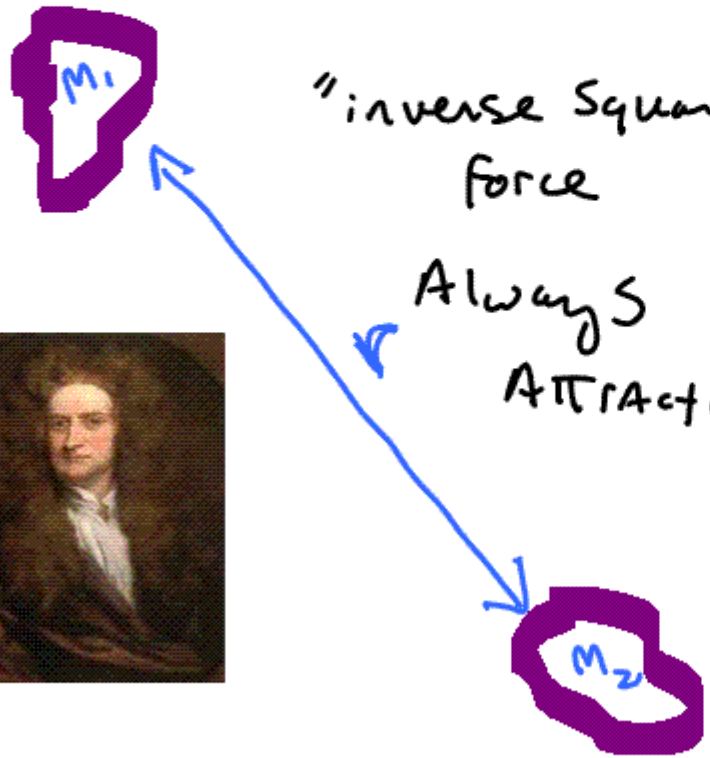
Tot dist $= 175 + 120 = 295$ m

Ave speed $= \frac{295}{8}$ m/s

Forces

gravitation

$$F_{grav} = \frac{G M_1 M_2}{r^2}$$



"inverse square" force

Always Attractive

Newton

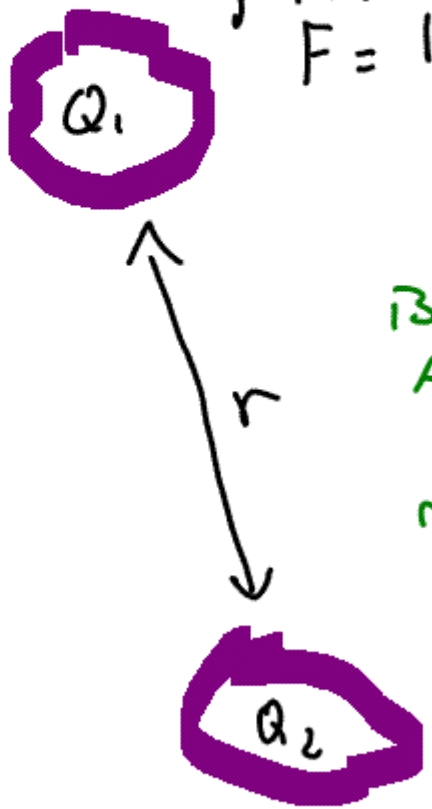
Electromagnetic force

Electric charge

\+ Positive

\- Negative

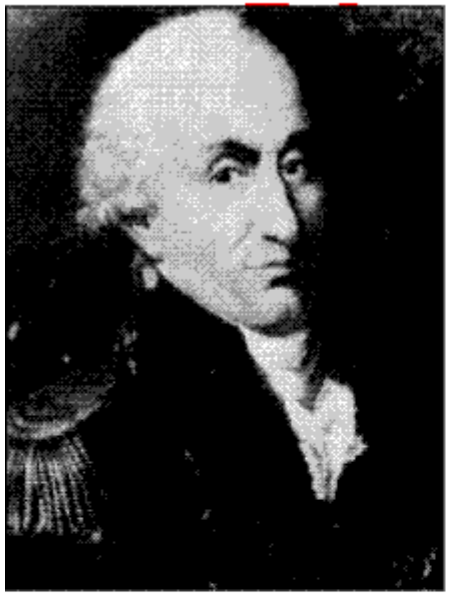
$$F = k \frac{Q_1 Q_2}{r^2}$$



Both Attractive + repulsive

Coulomb's

Electric force



Charles Coulomb
(1736-1806)

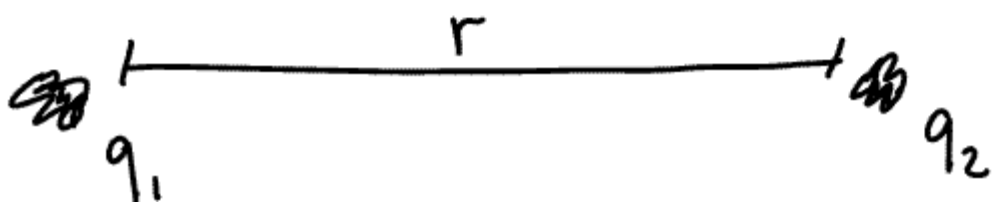
French military engineer

$\Rightarrow$ Coulomb's Law

$$F_{\text{electric force}} = k\frac{q_1 q_2}{r^2}$$

$q \equiv$ electric charge

$q_{1,2} = \pm \#$



"Field" concept

does M affect space where m sits such that m feels grav. force?

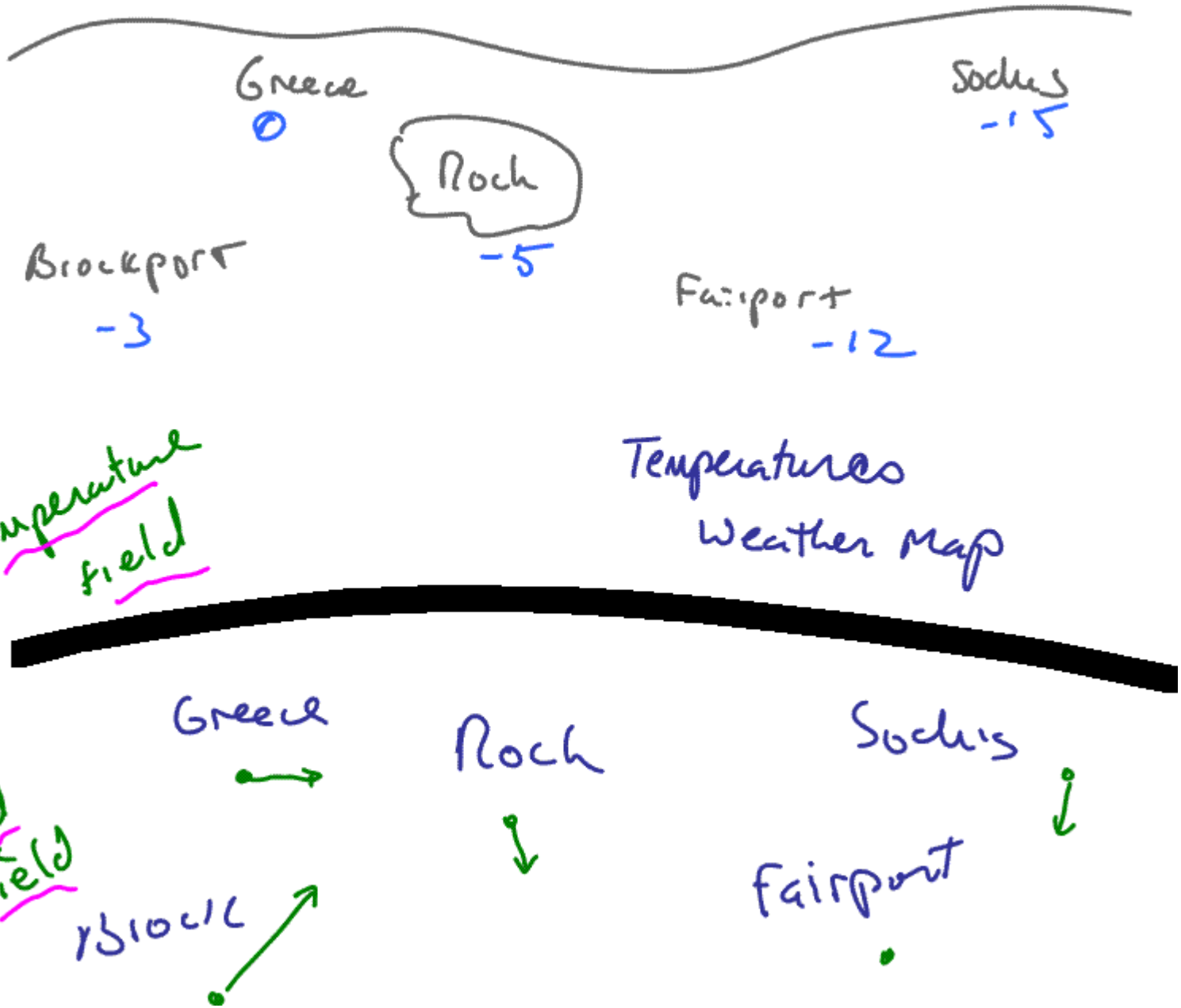
q

Q

does Q affect space where q sits such that q feels the electric force?

We pretend that a mass creates a gravitational "field" in space such that any mass placed at a given point in space would feel a gravitational force.

Similarly a charge creates an electric field at all points in space such that any charge encountering that electric field experiences a force.


Greece
0
Roch
-5
Sochi
-15
Brockport
-3
Fairport
-12
Temperature field
Temperatures
Weather map
Greece
Roch
Sochi
wind field
Brockport
Fairport

Gravitational Field

$\frac{F}{m}$ that a little test mass (m) would feel at that point

$F = \frac{GMm}{r^2}$ ⇒

$\text{field} \sim \frac{GM}{r^2}$