# HANDLING SMALL NUMBERS

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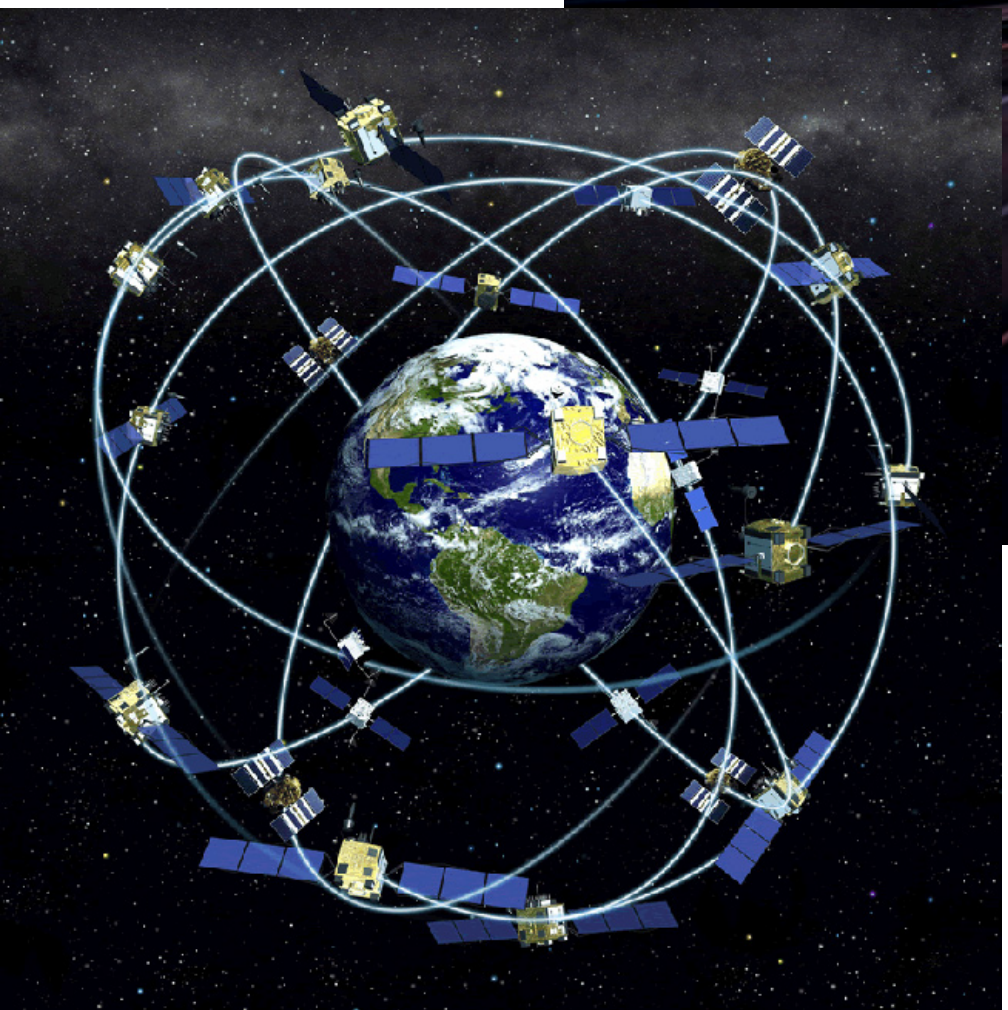
Supplementary Material for PHY1308 (General Physics - Electricity and Magnetism)

# ANNOUNCEMENTS

- Homework 4:
  - Due next Monday by 9am
- First Exam!
  - Sep. 24, in class
  - Covers topics from Homework 1-4 (Ch. 20-22)



DNA electrophoresis uses an electric field to separate genes in a DNA sample. The amount of separation of different sized genes can be used as a "DNA Fingerprint".

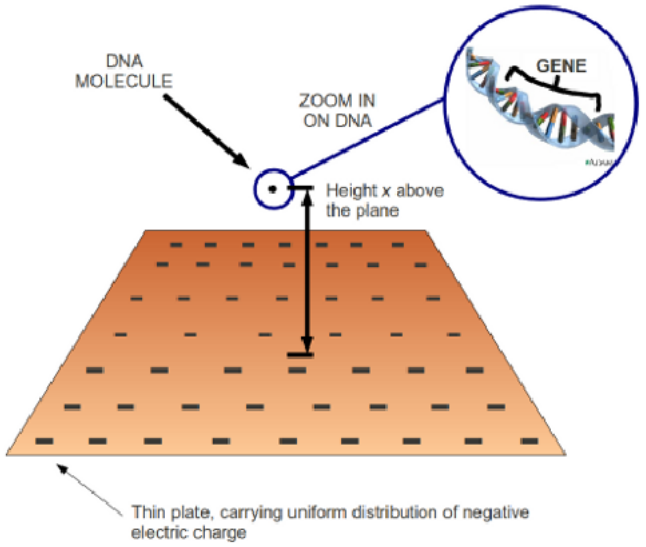
Consider such a setup, illustrated below. The source of the electric field in the setup is a negatively charged plate at the bottom of the device. Genes carry net negative charge, and are repelled by the negative charge on the plate. Genes come in different sizes (and thus different masses and charges) and move at different speeds in response to the electric field. Compared to the plate, however, genes are extremely tiny and from their perspective the plate extends infinitely in its plane.

**(1)** Treat the plate as a very thin sheet of uniformly distributed positive charge. If you were asked to use Gauss's Law,

$$\int_{surface} \vec{E} \cdot d\vec{A} = q_{enclosed}/\epsilon_0,$$

to determine the electric field a height $x$ above the plate . . .

- Based on the symmetry of the problem, draw 5 vectors representing the electric field $\vec{E}$ above the plane.
- Draw the Gaussian surface that you believe can be best used to solve the flux integral. *Explain why you chose this surface.*
- Draw 5 example vectors representing various $d\vec{A}$ at different locations on the surface.




**(2)** If a gene of electric charge $q = -3.4 \times 10^{-14}$C and mass $m = 6.0 \times 10^{-20}$kg is subjected to the electric field you drew above (whose strength is $E = 1.0 \times 10^{-13}$ N/C), how long does it take for the gene to move 1.0cm? One or more of the formulas below may be useful.

$$v = v_0 + at$$

$$x = x_0 + v_0 t + \frac{1}{2} a t^2$$