Transformed E&M I materials

Electric Field, Coulomb's Law
(Griffiths Chapter 2)

STUDENT DIFFICULTIES

Setting up integrals

- Script-r notation is difficult for most throughout the course – both remembering what it means (though that gets better quickly with use) and writing it in terms of known variables in the problem (which is always difficult).
    - Students will often revert to the most recent form of script-r that they have seen without addressing the specific geometry of the situation.
    - Students may not see the utility of the script-r notation and thus have trouble manipulating it in different contexts.
- Setting up the integral is challenging. They can calculate the integral once it is written down, but they are still very shaky on translating the physical situation into a mathematical form, such as the correct line, area, or volume differentials.
    - These integrals of continuous charge distributions are a place where student difficulties with connecting the math and the physical situation become very apparent. See the math resources document for more on these difficulties.
- Students may try to uses Gauss' law in situations where Coulomb's law is appropriate. This is particularly common for symmetric shapes (such as a disk or sphere) that have non-uniform charge distributions.

Curvilinear coordinates

- Spherical and cylindrical coordinates are also used for the first time in this section. Students have seen this material before but a refresher is helpful. By the end of the course, some students still didn't know how to recognize when cylindrical coordinates were appropriate.

Charge densities

- Writing charge densities as delta functions is challenging for students (see Chapter 1 notes on student difficulties).
    - Not writing charge densities as delta-functions can lead to students having difficulties knowing which volume/area/line element is appropriate leading to issues of taking a volume integral of a surface charge distribution.
- Students don't grasp the difference between the idealization of a "smeared-out" charge density (like σ) and a point charge. Most said that E goes to infinity as you approach a disk of charge with a charge density σ.