Worksheet 2a: Understanding Charge Distributions

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README

"*How do I even start this problem?!*"
1) Take a deep breath 2) carefully read the question 3) draw and label figure and axes 4) identify unknown and knowns 5) write down relevant concepts and equations and 6) crunch the numbers!

1 Conceptual Questions

(a) Give examples of symmetric shapes and non-symmetric shapes.

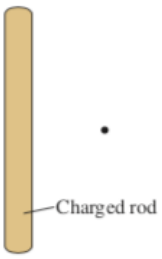
(b) When is the dipole approximation valid?

(c) Describe the dynamics of a dipole placed in a **uniform** electric field.

- Does it experience a force?
- Does it move? If so, how?

(d) At the dot, in what direction does the electric field point?

(e) What are ways to increase the magnitude of the electric field at the dot?



(f) Draw the electric field lines for the positively charged rod above.

(g) How much faster does the $\vec{E}$ field of a point charge decay compared to the $\vec{E}$ field of a charged-thin wire?

2 The Electric Field of a Continuous Distribution

(a) The electric field strength 10.0 cm away from a very long charged wire[1] is 2000 N/C. What is the electric field strength 5.0 cm from the wire?

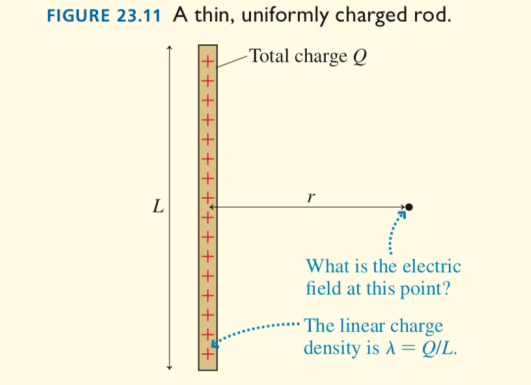
(b) The electric field strength 2.0 cm from the surface of a 10-cm-diameter metal ball[2] is 50,000 N/C. What is the total charge Q (in nC) on the metal ball?

[1] Look in text/notes to find relevant $\vec{E}$ field equation.
[2] See footnote 1.

3 Through the Wire

No notes or textbook this time! Show that the electric field $\vec{E}$ at point p a distance r above a wire of length L with total charge Q is:

$$\vec{E}(p) = \frac{1}{4\pi\epsilon} \int_{-\frac{L}{2}}^{\frac{L}{2}} \mathrm{d}x \; \frac{\lambda x}{(r^2 + x^2)^{\frac{3}{2}}} \; \hat{y}$$



`Hint 1`: See problem 1(a)
`Hint 2`: Use that one theorem by that one greek guy... Pythagoras!
`Hint 3`: There's a $\cos\theta$ in there at some point...
`Hint 4`: No more hints!