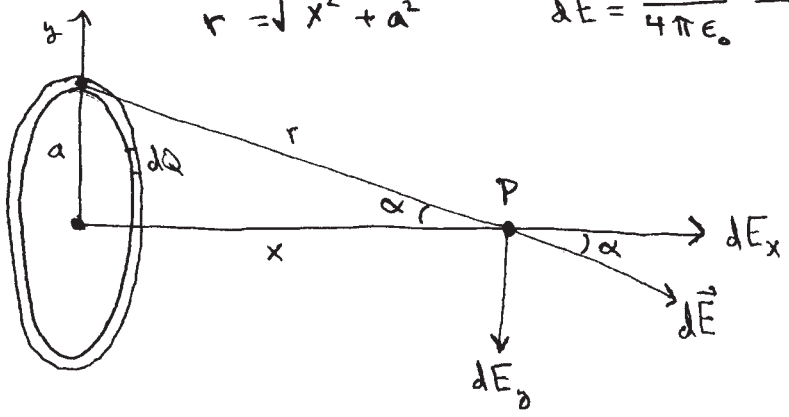
A Math Confidence Builder

Been away from math for a while? Never quite got your "math legs"? You shall overcome! Start with this... see all that hand-written stuff? ➡ Copy it. Just copy it. Don't try to figure it out, don't try to understand it, just copy it. Yes, draw the figure and all the funny arrow things too. Get a pencil, a blank piece of paper (something with no lines, like typing paper, is recommended) and be sure you have an eraser handy. You might have to try it a few times to get it right, but go ahead and hand-duplicate that stuff on the right exactly...

$r = \sqrt{x^2 + a^2}$ $\quad dE = \frac{1}{4\pi\epsilon_0}\frac{dQ}{r^2}$



Superposition of electric fields of a charged ring.

Every segment of the ring can be considered a point charge. Each segment has charge dQ. $d\vec{E}$ represents the electric field from any given segment.

$\sum d\vec{E}$ = The electric field at point P

$$dE = \frac{1}{4\pi\epsilon_0}\frac{dQ}{x^2+a^2} \qquad \cos\alpha = \frac{x}{r} = \frac{x}{(x^2+a^2)^{1/2}}$$

$$dE_x = dE\cos\alpha = \frac{1}{4\pi\epsilon_0}\frac{dQ}{x^2+a^2}\frac{x}{(x^2+a^2)^{1/2}} = \frac{1}{4\pi\epsilon_0}\frac{x\,dQ}{(x^2+a^2)^{3/2}}$$

$$E_x = \int \frac{1}{4\pi\epsilon_0}\frac{x\,dQ}{(x^2+a^2)^{3/2}}$$ ← Everything is a constant except dQ

since $E_y = E_z = 0$, $\vec{E} = E_x\vec{\imath} + E_y\vec{\jmath} + E_z\vec{k}$

$$\vec{E} = E_x\vec{\imath} = \frac{1}{4\pi\epsilon_0}\frac{Qx}{(x^2+a^2)^{3/2}}\vec{\imath}$$

As $x \to a$, $(x^2+a^2)^{3/2} \to a^3$, meaning

$$\vec{E} = \frac{1}{4\pi\epsilon_0}\frac{Qa}{a^3}\vec{\imath} \Rightarrow \vec{E} = \frac{1}{4\pi\epsilon_0}\frac{Q}{x^2}\vec{\imath}$$

So, what was that? It's either a science problem disguised as a math problem, or a math problem disguised as a science problem. "Calculus with meaning" basically... for folks who still think math has nothing to do with real life. Yes, in case you didn't know it, you just copied calculus.

More to the point, you just copied a derivation of a formula, a way of using previously discovered mathematical relationships to come up with new, more interesting ones — in this case, using things we (theoretically) already knew about electric fields generated by individual charged particles to come up with a way to calculate the total electric field of a ring-shaped object made up of charged particles. An equation is really just a kind of shorthand, meaning each one can be read just like a sentence... if you know the language.

For example, you could say, "The magnitude of the electric field in the x-direction equals the integral of 1 over 4 times pi epsilon-naught times x over the quantity x-squared plus a-squared to the three-halves power times dQ." Or, you could simply write

$$E_x = \frac{1}{4\pi\epsilon_0} \frac{x\, dQ}{(x^2 + a^2)^{3/2}}$$

If you're seriously trying to work out your math anxiety, at this point, you probably shouldn't worry too much about charged rings or electric fields. The big deal is that you just dealt with some math... big, complicated, difficult math. You confronted it and survived. Triumphed, even! Maybe you don't know what it means exactly, but you know it can't hurt you and you should now be suitably warmed-up to start learning, or re-learning, lots of meaningful math. A friendly advisor at a local community college might be an excellent place to visit for an idea of what your next step should be. Carry on!