Electric field of a sphere with a cavity

Question: A radius sphere a is made of a non-auxiliary material that has a uniform volume load density. A spherical cavity of radius b is removed from the sphere that is a z-distance from the center of the sphere. Suppose a > z + b. What is the electric field in the cavity? Answer: The electric field inside the cavity will be the overlapping of the field due to the sphere without further cutting the field due to a cavity-sized sphere with a uniform load density of . The key to solving this problem is to calculate the electric field of each sphere in a different coordinate system. First, let's deal with the electric field of the large sphere of load density. To simplify the Gaussian Law, I'm going to use a spherical coordinate system with the origin in the center of the sphere. The coordinate system will be defined as: Now we can use the Gauss's Law to calculate the sphere's electric field. Since the electric field is radial: Now that we have calculated the electric field for the large sphere, we can calculate the field of the small load density sphere. Again, we'll use a spherical coordinate system with the origin in the center of the sphere. The coordinate system will be defined as: When we apply the Gaussian Law to the small sphere, we will then get to take the overlap of both electric fields. To do this, you'll have to relate the following coordinate systems. Using the simple vector addition, we found that . Also because, we can reduce this formula to: Add the electric field of the two spheres we're going to get: It's a little hard to understand what you're saying in the second half, but I think you have the right idea -- If you see the cavity as really a region that has charge density $-rho$ and $-rho$ (so add up to 0, which is what it really is) , can now be seen as two entire dielectric spheres, which can be easily resolved separately with the Gaussian Act. Pretend to be completely separate charge distributions that are not known to each other, and add them together. It'$E something I've always wanted to do. If the scenario you're describing is what I think it is, you can see that in the center of the large sphere, the E field of it is 0 (no closed charge) and the cavity's E field (the $--rho$) is nonzero, while at $x to $, the large sphere field is nonzero and the cavity field is 0 (no closed charge). So they can't be constant, as you seem to have. You can use the Tutorial Web Version link below to use this tutorial in your browser. Note that if you download the tutorial to your own computer (using the Download Tutorial link below) you should work on the tutorial in power point for the links to work (to go to another slide, for example, for the right suggestion for a multiple choice question when click on a particular option). Have fun! Below is a paired problem for additional practice: The problem paired tools used: the principle of overlap states that if a single excitation is broken down into few constituent components, the total response is the sum of responses to individual components. The use of the principle can be illustrated in the following electrostatic example. Radius sphere with an empty spherical cavity of a radius, has a positive volume load density The center of the cavity is at a distance from the center of the loaded sphere (Figure 1). Figure 1 - Sphere positively loaded with a off-center cavity According to the principle of overlap, the total field within the cavity can be found by adding individual fields of: A positively charged sphere ( ), completely filled with a radius. A negatively charged sphere ( ) whose size and position match the cavity (Fig. 2). Figure 2 - Representation of an empty volume by an overlap of two opposite load density domains Field of any isolated sphere, uniformly loaded inside at an r distance, can be calculated from the Gauss's Law: Which yields for a positive sphere: Y for a negative sphere: Where vectors and are as defined in Figure 3. Figure 3 - Relationship between the individual directions of the electric field and the vector representing cavity displacement Therefore, the total electric field in the cavity can be calculated as: Since the last equation, it can be concluded that the electric field in the cavity is constant with a direction and that its magnitude (for y) is the magnitude of the field depends only on the value of the load density and the distance by which the center of the cavity moves from the center of the sphere. Model Creation of an air domain In EMS, electromagnetic analysis requires modeling of surrounding aerial regions, because very often, a significant part of the electromagnetic field extends outside the parts of the simulated system. After the Solidworks part that represents the air domain has been imported into the assembly, all parts must be subtracted from it. To do this: Select the Air Part in the Solidworks Feature Tree Click Edit Component on the Solidworks Assembly tab on the Solidworks menu, click Insert/Molds/Cavities in the Cavity Feature Tree, select Loaded Sphere, and Cavity as Design Components Click OK . Figure 4 - 3D model of sphere with spherical cavity along with surrounding air domain The simulation is performed as the EMS electrostatic study. Air is used as a material for all parts. (To see how to assign materials, see the example capacitance of a multimaterial capacitor). Limit conditions To simulate the electric field, a load density limit condition must be assigned to the large sphere and a stress limit condition should be assigned to the face of the air region. To assign a load density to the Loaded sphere: In the EMS manger tree, right-click Load/Restriction , select Load Density, and then choose Volume. Click inside the Body Selection box, and then select the Loaded sphere. On the Load Density tab, type 1e-006. Click OK . To see how to assign 0 Volts to the face of the Air region, see the Force on a Capacitor sample. Results To display the variation of the electric field along the axis connecting the center of the Loaded sphere and the center of the cavity: In the EMS manger tree, under Results , right-click the Electric Field folder and select 2D Plot, and then choose Linear. The 2D Electric Field Properties Manager page appears. On the Select Points tab, select the start and end points. On the Number of Points tab, type 1000. Click OK . In the curve obtained (Figure 5), it is clear that the electric field in the cavity is constant, and its value is, which closely matches the theoretical result. The field in Figure 5 constantly increases with the radius until it encounters the cavity and then remains unchanged through the cavity (until). The field reaches its maximum point on the surface of the sphere ( ) and then falls with the radius square. Figure 5 - Electric field vs radius [1] I have : Spherical spoke x; The spherical conductor has an internal cubic cavity on side b; inside the cubic cavity we have a load and; the surface of the sphere has a load density of z; I need to calculate the electric field at some point g, where g>r; Task Equations Attempting an E-(1/4*pi*eo)*∫ p d(tao) á (1/4*pi*eo)*∫load(z) *radius(x)-2 * sin(theta) d(x) d(theta) d (phi) Will it work? Answers and answers You did not define point r, so it is not clear where g is. If g > x, then you can use gauss's Law. The shape of the cavity does not affect the electric field outside the spherical conductor. g is a point outside the sphere. so I use only E-y/4*pi*eo*x-2 or (1/4*pi*eo)*∫loaddensity(z) *radius(x)-2 * sin(theta) d(x) d(theta) d (phi) ??? my question is how do I use load density? Build a Gaussian surface of radius g. Use gauss's Law to say that the total electrical flow across the surface of the sphere is equal to the total closed load divided by 0. You know there's cargo and inside the cavity. You can then use the load density to find the additional load on the driver. Add and to that and you'll have the total attached. What about the electric field.... I'm so lost... what about the electric field.... I'm so lost... what do you think? What does the GaussIan Act do? How is it used when you have a spherical distribution? Gauss Gauss for a sphere is E- pR3 / (3eor2) that's all I have to do? gauss law for a sphere is E - pR3 / (3eor2) that's all I have to do? That's not Gauss's Law for a sphere. This is the electric field outside a uniformly charged volume load density sphere, the Gaussian Law for uniform spherical distribution says that the field outside the distribution is given by E (4 r2) - qenclosed / 0 where qenclosed is the load closed by a Gaussian radio r.E surface in this case is the electric field in the radius r. Reread my second post and do as I suggested to end this issue. I think I have a little bit 0 * E (4 r2) - qenclosed can then replace integral qenclose rho d tau and then take the derivative on both sides on the right? What makes the derivative take for you? You need to find the electric field. Find the amount of load that is attached, then solve for the electric field. E -integral rho d tau/((4'r2)*'0) sorry i simplify for E how I do the integral of rho d tau??? You can find the attached position without doing the integral. Just read the problem statement very carefully. the problem gave a number for the load density, so should I pull the number in front of the integral and make [tex]-int between 0 and x of 4 to pi r2 da [/tex] ?? If I can read your mathematical expression correctly, I can integrate the load density over the area. This is a surface integral, not a volume integral. Integral.

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