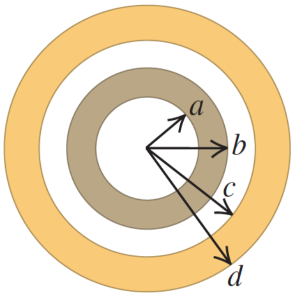
1. **Electric force within the Nucleus** *(YF 13th ed. 21.80)*. Typical dimensions of atomic nuclei are of the order of $10^{-15}m$ $(1fm)$. (a) If two protons in a nucleus are $2.0fm$ apart, find the magnitude of the electric force each one exerts on the other. Would this force be large enough for a person to feel? (b) Since the protons repel each other so strongly, why don't they shoot out of the nucleus?

2. **Concentric Spherical Shells** *(YF 13th ed. 22.47)*. In the figure below, the inner shell has total charge $+2q$, and the outer shell has charge $+4q$. (a) Calculate the electric field (magnitude and direction) in terms of q and the distance r from the common center of the two shells for (i) $r < a$; (ii) $a < r < b$; (iii) $b < r < c$; (iv) $c < r < d$; (v) $r > d$. Show your results in a graph of the radial component of $\vec{\mathbf{E}}$ as a function of r. (b) What is the total charge on the (i) inner surface of the small shell; (ii) outer surface of the small shell; (iii) inner surface of the large shell; (iv) outer surface of the large shell?



3. **Self-Energy of a Sphere of Charge** *(YF 13th ed. 23.71).* A solid sphere of radius R contains a total charge Q distributed uniformly throughout its volume. Find the energy needed to assemble this charge by bringing infinitesimal charges from far away. This energy is called the "self-energy" of the charge distribution. (Hint: After you have assembled a charge q in a sphere of radius r how much energy would it take to add a spherical shell of thickness dr having charge dq? Then integrate to get the total energy.)