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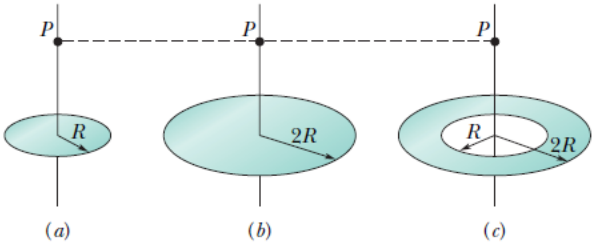
Siegen, 20/11/2019

Physics 1 for Nano: written Exercises 4

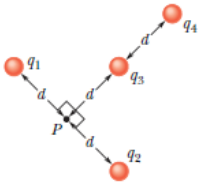
WS 2019 (sheet 4)
https://www.zahlen-kern.de/editor/

Exercise 19.



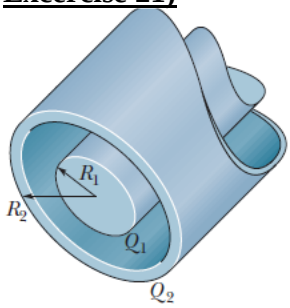
Calculate the magnitude of the electric field at point P for a disc with radius R, the disc with radius 2R and a ring with segment thickness R. The green areas should always carry the same charge Q

Exercise 20.



The four charges shown on left are fixed in place and have charges $q_1 = q_2 = +5e$, $q_3 = +3q$ and $q_4 = -12$ e. Distance d= 5µm. Calculate the magnitude of net electric field at point P due to the charges.

Excercise 21)



The section of a conducting cylindrical rod of radius R_1 = 1.3mm and length L= 11m is set inside a thin-walled coaxial conducting cylinder shell of radius R_2=10 R_1 and L= 11m. The net charge of the rod is $Q_1 = +3.4 \times 10^{-12}$ C; that on the shell is $Q_2 = -2.00\ Q_1$. What are the (a) magnitude E and (b) direction of E at radial distance $r_1 = 1.50\ R_2$ and $r_2 = 3.0\ R_2$? (c) What is the charge on the interior and exterior surface of the shell ?

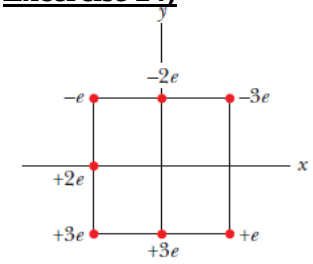
Exercise 22

A spherical shell with inner radius a= 10.0cm and outer radius b=2.0a carries an uniform volume charge density $\rho = 1.84 nC/m^3$. What is the magnitude at radial distance r=0, r= 0.5 a, r=a, r=1.5 a, r=b and r=3b?

Exercise 23.

Ernest Rutherford performed a historical experiment in order to explore the structure of atoms. He did shoot alpha particle (composed by 2 protons +2 neutrons) towards a gold foil (Z=79) in measured the angular distribution of the scattered alpha particles. It tuned out that most of the particles passed through without any change, a few did show a small angular displacement but very few were elastically reflected and returned straight back with respect to the initial direction. This evidenced that all mass of the atom is located within a small nucleus with radius of about 10fm. In the case of return one assume that the alpha particle come to rest if the kinetic energy of the particle equals the potential energy of the gold atom. Estimate the initial kinetic energy of the particle if the point of return is 10fm from the center of the gold atom. Hint: the position of the gold nucleus keeps fix.

Excercise 24)



Seven charged particles are fixed in place to form a square with edge length of 5.0 cm. How much work must we do to bring a particle of charge +6e initially at rest from infinite distance to the center of the square?

Note:

Exercises have to give back at lecture 25.11.19. It will be discussed in exercises hours at 126.11.19