AP Physics Practice Test - Ch. 24 - Gauss' Law

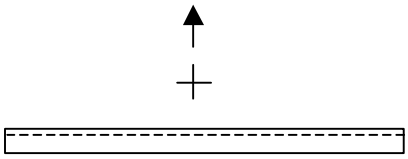
Draw diagrams showing Gaussian surfaces used. Name_____

$\varepsilon_0 = 8.85 \times 10^{-12}\ Nm^2/C^2$

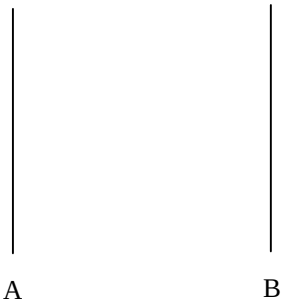
1. (a) Using Gauss's Law, derive the expression for the electric field, E, near a large positively charged conducting sheet. (Draw Gaussian surface) (b) What is the field 0.05 cm away from a 900 m^2 sheet that has a total charge of $+5 \times 10^{-4}$ C?

edge view

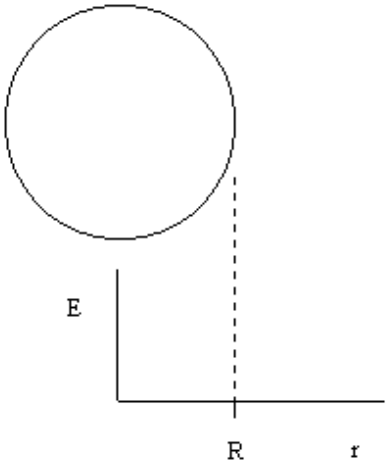
2. A proton ($q = 1.6 \times 10^{-19}$ C, $m = 1.67 \times 10^{-27}$ kg) is fired vertically at 10% of the speed of light ($c = 3 \times 10^8$ m/s) away from very close to a large negatively charged conducting horizontal metal plate ($\sigma = -5 \times 10^{-10}\ C/m^2$). How long before the proton returns to its starting point? Neglect the relatively small gravitational force.



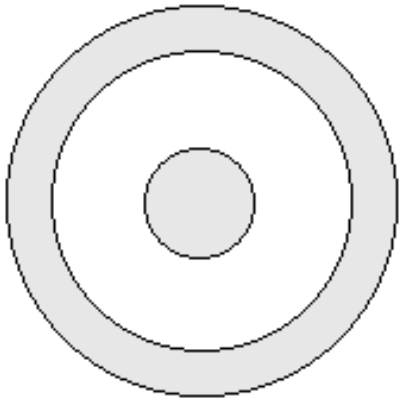
3. Two very large non-conducting sheets, A and B, with uniform surface charge densities of $\sigma_+ = +2$ uC/m^2 and $\sigma_- = -9$ uC/m^2. In each of the three regions, draw the field magnitude and direction acting individually on a positive test charge caused by (a) sheet A (b) sheet B. Calculate the total electric field E (c) to the left of the sheets (d) between the sheets (e) to the right of the sheets.



4. For a conducting hollow sphere of radius R = 25 cm, charged to Q = -2.5 x 10^{-6} C, use Gauss's law (draw Gaussian surfaces) to find the field (a) outside (b) inside. (c) Calculate E where R = 15 cm (d) Calculate E where R = 25 cm (e) Calculate E where R = 25 cm (f) On a graph, plot the field as a function of distance from center,.

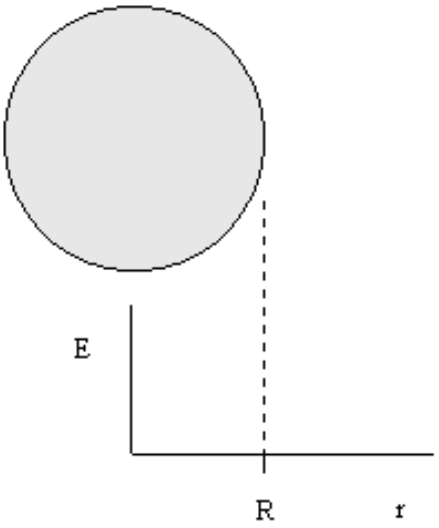


5. A conducting hollow spherical shell is charged to +10 Q. Inside it is another smaller hollow sphere charged to -6 Q. Use Gauss's law (draw Gaussian surfaces) to find the field: (a) at point a, inside the inner sphere (b) at point b, between the sphere and the shell (c) at point c, inside the outer shell (d) at point d, outside the outer shell. Also, find the charge (e) on the inside of the larger sphere (f) on the outside of the larger sphere.



6. (a) Using Gauss's Law, (draw Gaussian surface) derive the field, E, for points at a distance r from a long uniform line of charge, Q, whose length is L. (b) Find the field produced on a + test charge located 5 cm from the line of charge, L = 50 m, which carries a charge of 2.45×10^{-6} C.

7. For a solid insulating sphere, R = 20 cm, which is has a uniform volume charge density, $\rho = 6.5 \times 10^{-6}$ C/m^3, use Gauss's law to find the field for (a) r<R (b) r>R (c) On a graph (as in problem 4), plot the field as a function of distance from center, showing regions where r<R and r>R.



8. A hollow insulating spherical shell, with uniform volume charge density ρ , has inner radius *a* and outer radius *b*. (a) Write derive an expression for Q on the whole shell in terms of ρ , *a*, and *b*. Derive expressions for E where (b) r < a (c) a < r < b (d) r > b