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Positive charge distributed uniformly along y axis

nateastle #1 Aug 28, 2006

I have a physics question that states:
An amount of positive charge is distributed uniformly along the positive y-axis between y=o and y=a. A negative point charge -q lies on teh positive x=axis a distance r from the origin. Derive the x and y compontes of the force that the charge distribution exerts on Q exerts on q.

I have figured the y force to be: (Qqk/a)[(q/x)-(1/(a^2 +x^2)^1/2)] I did this by drawing out the graph and by doing an intgral from 0 to a on dfsin theta. Where theta is the angle where the line comes from the top of through a. I then used trig substitution to figure out what sin theta is. The

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Andrew Mason #2 Aug 29, 2006

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Science Advisor
Homework Helper

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I have figured the y force to be: (Qqk/a)[(q/x)-(1/(a^2 +x^2)^1/2)] I did this by drawing out the graph and by doing an intgral from 0 to a on dfsin theta. Where theta is the angle where the line comes from the top of through q. I then used trig substitution to figure out what sin theta is. The part that I am stuck on is how do I solve for the force on the X axis.

The force on q of a charge $dQ = \frac{Q}{a}dy$ is:

$$F = \frac{kq}{(r^2 + y^2)}dQ = \frac{kqQ}{a(r^2 + y^2)}dy$$

So the components of the Coulomb force on q would be:

$$F_x = \frac{kqQ}{a}\int_0^a \frac{1}{y^2 + r^2}cos\theta dy$$

$$F_y = \frac{kqQ}{a}\int_0^a \frac{1}{y^2 + r^2}sin\theta dy$$

where $sin\theta = y/\sqrt{y^2 + r^2}$ and $cos\theta = r/\sqrt{y^2 + r^2}$

Work out those integrals and you should get the right answer.

AM

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