TEAM _____ Schneider – Univ2 – Spring 2007

HONORS TEAMWORK 05 "Daylight Saving Time already? {Note the SINGULAR use of "Saving"!}" – 03/09/07

Author _____ Name _____

Name _____ Name _____

(It is strongly suggested that you try to adopt some of the roles indicated {such as Recorder, Taskmaster, Gatekeeper, Devil's Advocate} – if roles are used, please indicate next to the names.)

Preparation – read over team roles and read through entire team project (individually) – *5 minutes*

Problem – ***45*** *minutes [Papers turned in after 10:55 won't be accepted.]*

Fortunately, charged rings are NOT affected by the Daylight Saving Time change – thus we are free to use them in physics problems – yeah! [*I strongly suggest you consult the "charged rings" physlet page (second to last physlet in the Electrostatics list on the main physlet page) – it is NOT necessary to do this project, but you will find it VERY useful. But, having said that – I strongly encourage you to do part A below BEFORE you look at the physlet page.*]

Consider two charged rings – both of equal positive charge and both of equal radii (for now) – separated by a distance **d** along the x axis. Note: NONE of these questions need to involve ANY numbers (other than relative size/distance comparisons) – everything should be able to be argued from a bigger/smaller positive/negative point of view.

a) Lightly sketch the electric field curves for each of the charged rings (either below, or on the other side of this sheet). Then darkly sketch the combined **electric field** curve for that system (the net electric field … that is, "add" the two graphs). (Your graphs should show "rough features", but don't worry if the numerical answers we get later don't quite match.)

b) There should be three "crossing points" (where the net electric field is zero). Justify (based on the original two fields) why those points might be there – conceptually. And indicate (on the sketch) the stable/unstable nature of these points (for, say, a positive charge). Be specific about the zeros "near" the rings – are they "inside" or "outside" of the system – and why?

c) If you change the charges of both rings (both increase or both decrease) – will that change your answer to B - explain?

d) If you change the radii of both rings (both increase or both decrease) – will that change your answer to B - explain?

e) Can you change the amount of one of the charges (so the charge magnitudes are different) – can you eliminate any of the zeros that are possible WITHOUT making one of the charges negative – explain how this can happen?

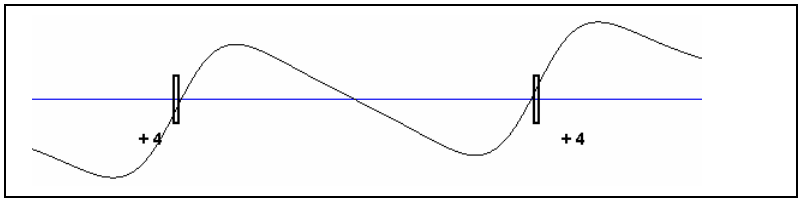
f) Suppose you had two equal magnitude but opposite sign charged rings (equal radii) – sketch this situation (similar to what you did with part A). How is this net field fundamentally different from your picture in part A – explain in detail (and pay particular attention to the zeros near the rings).

g) Consider the situation in F – but with one radii much larger than the other (and think about what happens to the shape of the E field curve of an individual ring as you increase the radius) – as one radius grows relative to the other – what effect does this have on the net E field of the system (consider points near the rings and far from the rings – or the system in general)?

Fortunately, charged rings are NOT affected by the Daylight Saving Time change – thus we are free to use them in physics problems – yeah! [*I strongly suggest you consult the "charged rings" physlet page (second to last physlet in the Electrostatics list on the main physlet page) – it is NOT necessary to do this project, but you will find it VERY useful. But, having said that – I strongly encourage you to do part A below BEFORE you look at the physlet page.*]

Consider two charged rings – both of equal positive charge and both of equal radii (for now) – separated by a distance **d** along the x axis. Note: NONE of these questions need to involve ANY numbers (other than relative size/distance comparisons) – everything should be able to be argued from a bigger/smaller positive/negative point of view.

a) Lightly sketch the electric field curves for each of the charged rings (either below, or on the other side of this sheet). Then darkly sketch the combined **electric field** curve for that system (the net electric field … that is, "add" the two graphs). (Your graphs should show "rough features", but don't worry if the numerical answers we get later don't quite match.)



b) There should be three "crossing points" (where the net electric field is zero). Justify (based on the original two fields) why those points might be there – conceptually. And indicate (on the sketch) the stable/unstable nature of these points (for, say, a positive charge). Be specific about the zeros "near" the rings – are they "inside" or "outside" of the system – and why?

Three total: One in center is easy – fields exactly equal in magnitude and opposite in direction.
Two near rings – field from each ring is at zero at the center of the ring … and positive on one side and negative on the other side of the center – but the field, from the other ring, has a particular direction at the center of the other ring. Take the left ring above … the E field from the left ring is negative to the left of the center and positive to the right of the center – the E field from the right ring, at the center of the left ring, is negative … thus, to find the net zero between them, you have to go to the right of the left ring (thus "inside") to have the small positive amount of left field cancel the small negative amount of right field.

c) If you change the charges of both rings (both increase or both decrease) – will that change your answer to B - explain?

NO – strengths of fields are directly proportional to the charge – if you change both the same those locations are in exactly the same place (and still "inside").

d) If you change the radii of both rings (both increase or both decrease) – will that change your answer to B - explain?

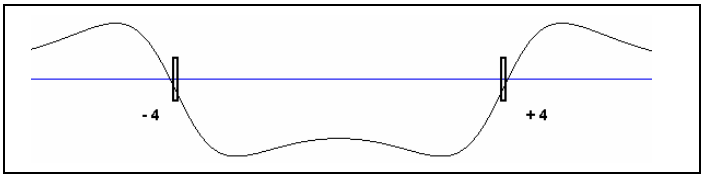
NO – they will still be "inside" for the reasons given in B – but they will change location slightly (closer or farther away) – but still inside.

e) Can you change the amount of one of the charges (so the charge magnitudes are different) – can you eliminate any of the zeros that are possible WITHOUT making one of the charges negative – explain how this can happen?

YES – they are both the same sign charge, but if the one on the right has a much larger charge .. then the negative field that extends toward the left ring could dominate the strength of the ring. This can eliminate two zeros – but the one near that strong ring would remain (and remain on the inside!).

f) Suppose you had two equal magnitude but opposite sign charged rings (equal radii) – sketch this situation (similar to what you did with part A). How is this net field fundamentally different from your picture in part A – explain in detail (and pay particular attention to the zeros near the rings).

Now zeros appear on the "outsides" of the rings – for similar reasons to that of part B – but not one in the middle (since both fields "agree" in the middle)



g) Consider the situation in F – but with one radii much larger than the other (and think about what happens to the shape of the E field curve of an individual ring as you increase the radius) – as one radius grows relative to the other – what effect does this have on the net E field of the system (consider points near the rings and far from the rings – or the system in general)?

As one radius grows – the effect of that particular ring is reduced – so the whole system starts looking more like just the other ring (smaller radius ring field would dominate the larger radius ring field).