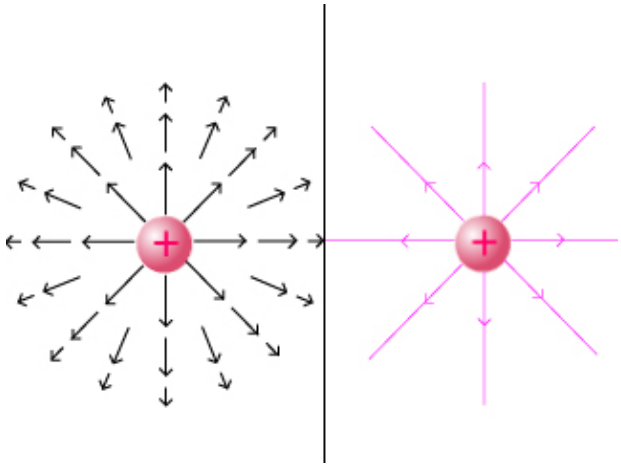
PHYSQ 126 Quiz 3 (29 janvier 2015 – sur Mastering Physics)

Visualizing Electric Fields

Electric field lines are a tool used to visualize electric fields. A field line is drawn beginning at a positive charge and ending at a negative charge. Field lines may also appear from the edge of a picture or disappear at the edge of the picture. Such lines are said to begin or end *at infinity*. The field lines are directed so that the electric field at any point is tangent to the field line at that point.

Fig 1 shows two different ways to visualize an electric field. On the left, vectors are drawn at various points to show the direction and magnitude of the electric field. On the right, electric field lines depict the same situation. Notice that, as stated above, the electric field lines are drawn such that their tangents point in the same direction as the electric field vectors on the left. Because of the nature of electric fields, field lines never cross. Also, the vectors shrink as you move away from the charge, and the electric field lines spread out as you move away from the charge. The spacing between electric field lines indicates the strength of the electric field, just as the length of vectors indicates the strength of the electric field. The greater the spacing between field lines, the weaker the electric field. Although the advantage of field lines over field vectors may not be apparent in the case of a single charge, electric field lines present a much less cluttered and more intuitive picture of more complicated charge arrangements.

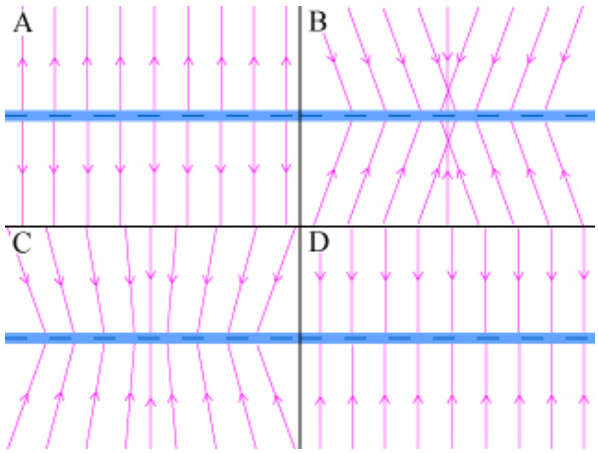
FIG 1



Part A

Which of the following panels (labelled A, B, C, and D) in Fig 2 correctly depicts the field lines from an infinite uniformly *negatively* charged sheet? Note that the sheet is being viewed edge-on in all pictures. Ans. D

FIG 2



Part B

In Fig 2, what is wrong with panel B? (Pick only those statements that apply to panel B.)

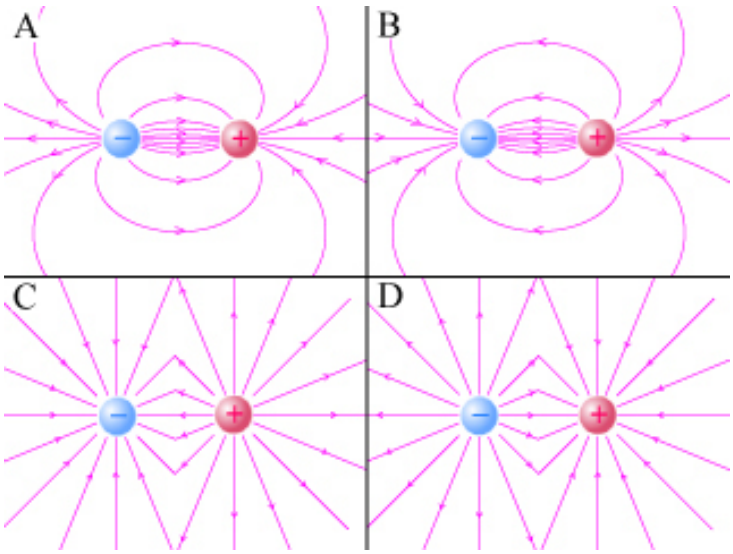
ANSWER:

- [x] Field lines cannot cross each other.
- [x] The field lines should be parallel because of the sheet's symmetry.
- [ ] The field lines should spread apart as they leave the sheet to indicate the weakening of the field with distance.
- [ ] The field lines should always end on negative charges or at infinity.

Part C

Which of the following panels (labelled A, B, C, and D) in Fig 3 shows the correct electric field lines for an electric dipole? Ans B

FIG 3



Part D

In Fig 3, what is wrong with panel D? (Pick only those statements that apply to panel D.)

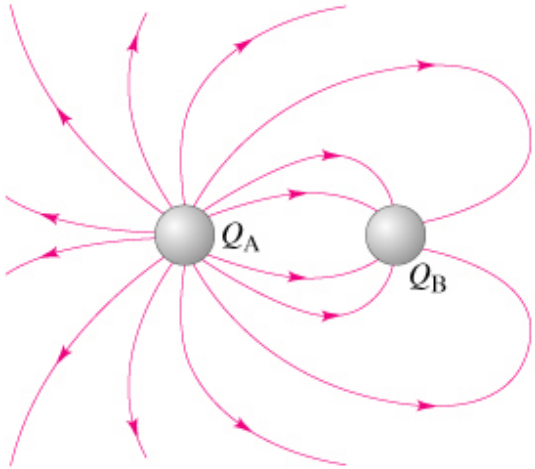
ANSWER:

- [ ] Field lines cannot cross each other.
- [ ] The field lines should turn sharply as you move from one charge to the other.
- [x] The field lines should be smooth curves.
- [x] The field lines should always end on negative charges or at infinity.

Part E

In Fig 4, the electric field lines are shown for a system of two point charges, Q_A and Q_B. Which of the following could represent the magnitudes and signs of Q_A and Q_B?

FIG 4



ANSWER:

- $Q_A = +q, Q_B = -q$
- $Q_A = +7q, Q_B = -3q$
- $Q_A = +3q, Q_B = -7q$
- $Q_A = -3q, Q_B = +7q$
- $Q_A = -7q, Q_B = +3q$