Guided Exploration: AR Model of an Electric Dipole

Group ID:		Date:
Student Name		
Members present		

Objective

To explore electric field lines and equipotential surfaces using an Augmented Reality (AR) electric dipole model.

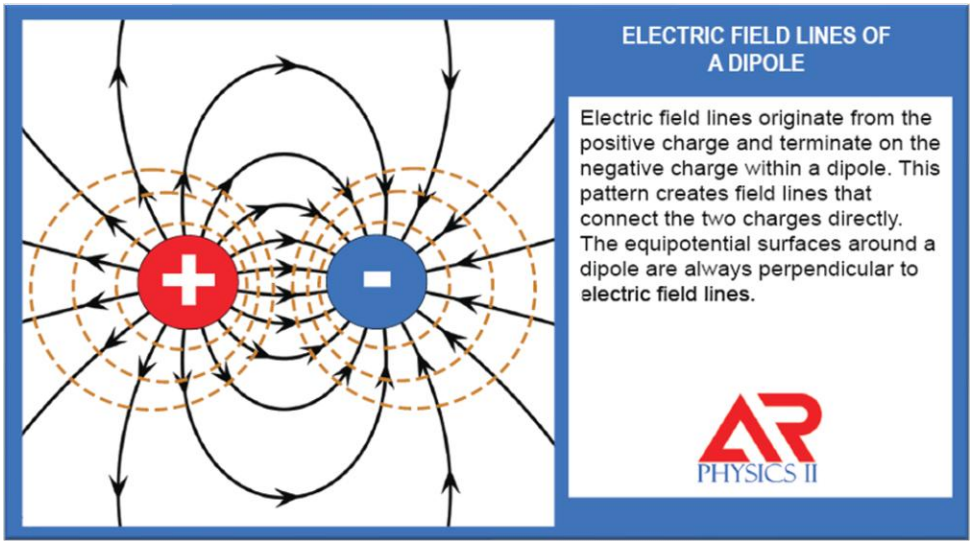
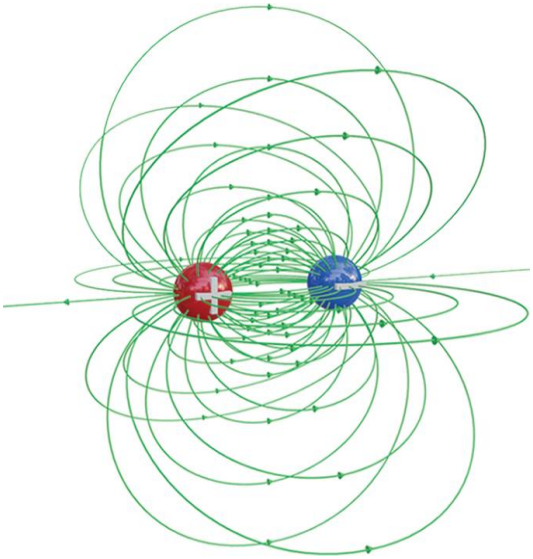


Figure 1: AR Marker for the 3D dipole model

Part A: Getting Started with the AR Dipole



1. Launching the Model
   - Open the AR app.
   - Scan the above marker
   - Move around to view the model from multiple angles.

2. What you should see
   - Positive (+) and negative (–) charges.
   - Electric field lines emerging from + and ending on the - charge
   - Equipotential surfaces surrounding the charges.

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Part B: Guided Exploration and discussions

3. Properties of the Electric Field Lines

- ☐ Rotate around the dipole. Observe the dipole from top view, sideways and facing an axis
- ☐ Observe where lines start and end.
- ☐ Compare the density of lines near the + charge, near the – charge and far away from the dipole. What does this indicate about the Electric field strength?

- ☐ Are the field lines perpendicular to the charge surfaces? (Yes/No)

Think Pair Share

Imagine you are a tiny positive test charge placed on an electric field line. How would you begin to move along that line? As you travel, picture yourself holding a small arrow that always represents the electric field vector at your exact location. How does this arrow change as you move, does it turn, does it grow or shrink, and what might those changes mean? Describe your journey and the behavior of the arrow to a friend as you move along the electric field line.

4. Properties of the Equipotential Surfaces

- ☐ Observe the equipotential surfaces around each charge.
- ☐ Are equipotential surfaces closer near charges? (YES / NO) What does the spacing indicate about the magnitude of the potential?

- ☐ Are the equipotential surfaces perpendicular to the field lines? (YES/NO)

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Part C: Applying Knowledge (Near & Far Transfer)

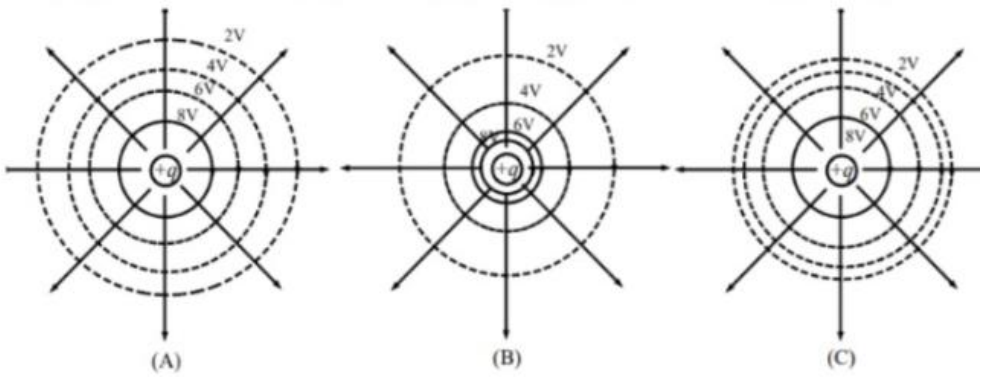
1) Electric field lines around a dipole:
    a) Start from the negative charge and end at the positive charge.
    b) Start from the positive charge and end at the negative charge.
    c) Form concentric loops around the dipole axis.
    d) Are perpendicular to the equipotential surfaces but do not cross them.

2) At any point in 3D space around the dipole, the electric field vectors are:
    a) Perpendicular to the dipole axis.
    b) Tangent to the equipotential surface at that point.
    c) Tangent to the electric field lines at that point.
    d) Parallel to the equipotential surface at that point.

3) Which of the following best describes the shape of equipotential surfaces around an electric dipole in 3D space?
    a) Concentric spheres centered at the midpoint of the dipole
    b) Planes perpendicular to the dipole axis
    c) 2D planes elongated along the dipole axis
    d) Curved surfaces that are perpendicular to the electric field lines at every point

4) If you move along an equipotential surface of a dipole in 3D, the electric potential:
    a) Remains constant
    b) Increases steadily
    c) Decreases steadily
    d) Alternates between high and low values

5) In the following figure, which one of the drawings correctly represent the equipotential surfaces of a point charge



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6) What does the spacing of electric field lines around a dipole indicate?

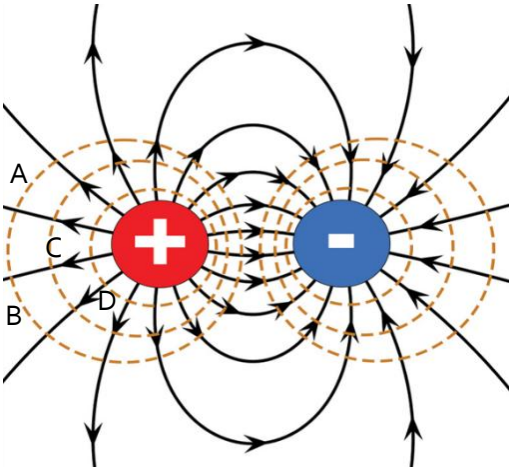
   a) The closer the lines, the stronger the electric field at that point.
   b) The wider the spacing, the stronger the electric field at that point.
   c) The spacing does not convey any information about the field strength.
   d) The spacing indicates the direction but not the magnitude of the field.

7) In 3D space, where is the electric field strength due to a dipole the strongest?

   a) Along the axis of the dipole (line connecting the charges).
   b) Perpendicular to the dipole axis in the equatorial plane.
   c) At the midpoint between the two charges.
   d) At a point equidistant from both charges but far from the dipole.

8) In the given figure to the right, the electric field strength is strongest at

   a) A
   b) B
   c) C
   d) D



9) The order of potential from largest to smallest

   a) D, C, B = A
   b) A, B, C, D
   c) B = C, A, D
   d) A = B, C, D

10) In the above given figure, the potential difference between points is minimum/zero between

   a) B and C
   b) B and D
   c) A and B
   d) C and D