Electromagnetc Theory: PHYS330

Jordan Hanson

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Whittier College Department of Physics and Astronomy

Summary

Week 3 Summary

1. Laplace's Equation
    - One-dimension
    - Two-dimensions, three dimensions, uniqueness, boundaries
2. Separation of Variables: Boundary-value problems
    - Cartesian coordinates
    - Spherical coordinates
3. Multipole Expansions
    - Far-fields
    - Monopole and dipole terms
    - Electric Field of a Dipole

Laplace's Equation: One Dimension

Laplace's Equation: One dimension

Laplace's Equation in one dimension:

$$\frac{d^2V}{dx^2} = 0 \tag{1}$$

What is the solution?

$$V(x) = mx + b \tag{2}$$

What is the magnitude of the E-field?

- A: $V(x)$
- B: x
- C: b
- D: m

Laplace's Equation: One dimension

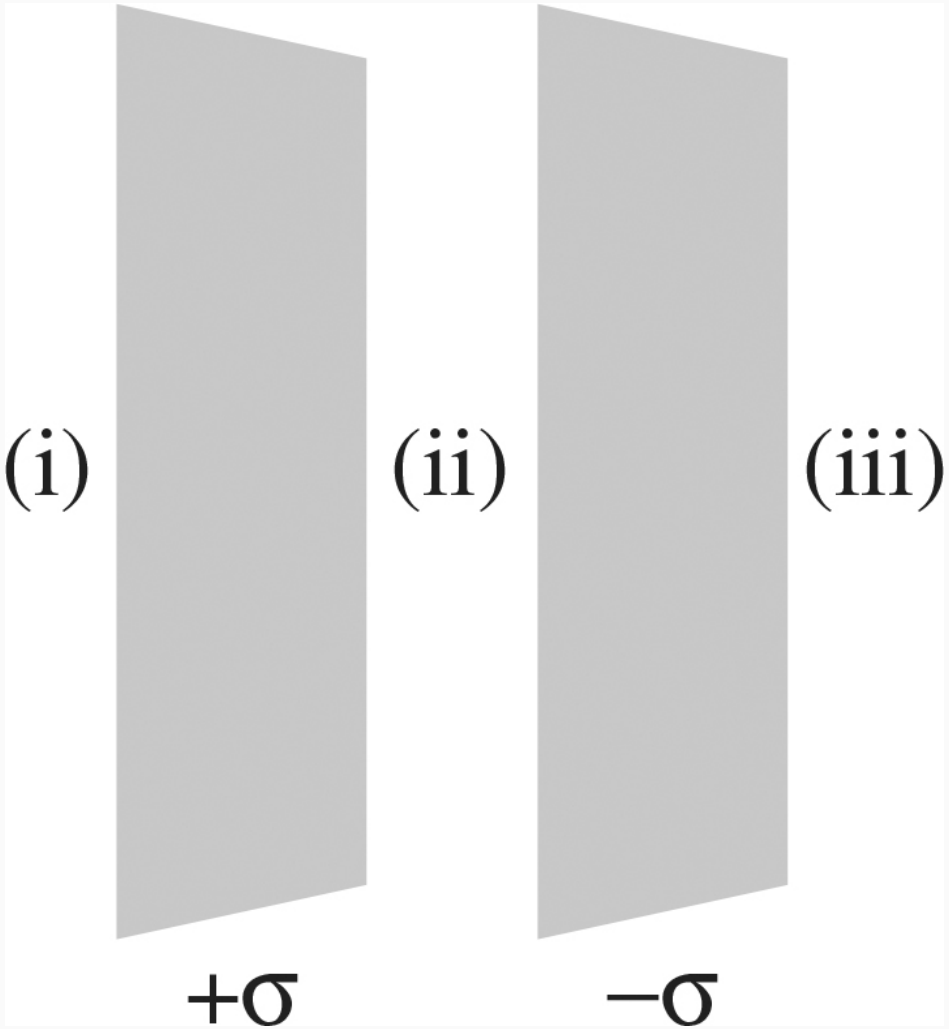

Figure 1: The setup of a parallel plate capacitor.

Laplace's Equation: One dimension

Suppose the negative side of the parallel plate capacitor is grounded, and the positive side is at a potential V_0. Let the separation between the plates be x_0. Further, let the positive plate occupy the yz plane, passing through the origin. Find the E-field magnitude and direction by solving Laplace's equation.

Laplace's Equation: One dimension

Show that the potential of a point charge at the origin satisfies Laplace's Equation for $r \neq 0$. *Use the form of the Laplacian in spherical coordinates.*

Conclusion

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