PHYS 435: Lecture 8

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To develop well posed problems of potential energy, we need

1. Cartesian Coordinates: $V(r)$ inside box and ∂V on box.
2. Spherical Coordinates: $V(r)$ inside and outside of sphere and ∂V on sphere.
3. Cylindrical Coordinates: $V(r)$ inside cylinder. ∂V on cylinder, and if finite surface, on caps.

We solve the box problem, finding $V(r)$ on the inside and $\nabla^2 V(r) = 0$ in the inside (no charges). Then guess

$$V(r) = X(x)Y(y)Z(z) \tag{1}$$

Then finding the laplacian, we yield

$$\frac{1}{X(x)}\partial_x^2 X(x) + \cdots = 0 \tag{2}$$

This implies

$$\frac{1}{X(x)}\partial_x^2 X(x) = a \tag{3}$$

$$\frac{1}{Y(y)}\partial_y^2 Y(y) = b \tag{4}$$

$$\frac{1}{Z(z)}\partial_z^2 Z(z) = c \tag{5}$$