Reading Quiz 3 for Electromagnetic Theory (PHYS330)

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Abstract

A summary of content covered in chapter 3 (so far) of Introduction to Electrodynamics.

1 Discussions about Vectors (Prelude to Fourier's Trick)

1. Let $\vec{v} = a\hat{x} + b\hat{y} + c\hat{z}$. Which of the following is equal to c?

   - A: $\vec{v} \cdot \vec{v} - |\vec{v}|$
   - B: $\vec{v} \cdot \hat{z}$
   - C: $\hat{x} \cdot \vec{v}$
   - D: $\sqrt{\vec{v}^2}$

2. Let $\vec{x} = \sum_{i=1}^{n} c_i \hat{x}_i$ be an n-dimensional vector and the set of $\hat{x}_i$ represent orthonormal basis vectors. How do you obtain the coefficient c_7?

   - A: $\hat{x}_i \cdot \vec{x}$
   - B: $n = 7$
   - C: $\hat{x} \cdot \vec{x}$
   - D: $\hat{x}_7 \cdot \vec{x}$

3. Suppose we are trying to develop the Fourier series for a function $f(x)$. Recall the definition of a Fourier series:

$$f(x) = \frac{a_0}{2} + \sum_{n=1}^{\infty} a_n \sin(nx) + b_n \cos(nx) \tag{1}$$

   However, the function we are trying to model is $f(x) = \sin(3x)$. Write down all coefficients in the Fourier series from $n = 0$ to $n = \infty$.

2 Fourier's Trick and Boundary Value Problems

1. If $V(x, y, z) \to 0$ as $y \to \infty$, which of the following cannot be part of the solution for $V(x, y, z)$?

   - A: $Y(y) = e^{-ky}$
   - B: $Y(y) = \sinh(x)$
   - C: $Y(y) = 1/y^2$
   - D: $Y(y) = e^{-ky^2}$

2. Below is Eq. 3.50 from section 3.3 of the text, with $V_0(y, z) = V_0$:

$$C_{n,m} = \frac{4V_0}{ab} \int_0^a \int_0^a \sin(n\pi y/a) \sin(n\pi z/a) dy dz \tag{2}$$

   Reproduce the result in Eq. 3.51 for $C_{n,m}$.