

CHEM 190 and CHEM 290

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Spring 2001

Homework No. 5 Due May 10 in class

1. **Textbook Chapter 10 No. 1 parts (a)-(g)**
2. **Textbook Chapter 10 No. 10**
3. One way of describing symmetry operations is to specify what they do to the point (x, y, z) . If the axis of rotation is the z -axis, C_n sends (x, y, z) into $(x \cos 2\pi/n - y \sin 2\pi/n, x \sin 2\pi/n + y \cos 2\pi/n, z)$. C_n can be represented as a matrix such that

$$C_n \begin{pmatrix} x \\ y \\ z \end{pmatrix} = \begin{pmatrix} x \cos 2\pi/n - y \sin 2\pi/n \\ x \sin 2\pi/n + y \cos 2\pi/n \\ z \end{pmatrix}$$

Construct C_n , and also the matrix representing σ_h in

$$\sigma_h \begin{pmatrix} x \\ y \\ z \end{pmatrix} = \begin{pmatrix} x \\ y \\ -z \end{pmatrix}$$

Show explicitly that C_n and σ_h commute.

4. **Textbook Chapter 10 No. 21**
5. **Textbook Chapter 10 No. 43**
6. **Textbook Chapter 10 No. 59**
7. **Textbook Chapter 10 No. 60**
8. **Textbook Chapter 10 No. 67**
9. **Textbook Chapter 10 No. 69**

ONLY FOR CHEM 290 STUDENTS

1. Normalize the function $3 \cos^2 \theta - 1$ using spherical coordinates.
2. Find the Fourier series expansion for the function

$$f(x) = x^2, \quad -\pi < x < \pi.$$

Use this result by choosing x appropriately to evaluate

$$A \equiv \sum_{n=1}^{\infty} \frac{(-1)^n}{n^2}$$

and

$$B \equiv \sum_{n=1}^{\infty} \frac{1}{n^2}.$$

3. A triangular wave is represented by

$$f(x) = -x, \quad -\pi < x < 0, \quad f(x) = x, \quad 0 < x < \pi.$$

Show that $f(x)$ is represented by the Fourier series

$$f(x) = \frac{\pi}{2} - \frac{4}{\pi} \sum_{n \text{ odd}} \frac{\cos nx}{n^2}.$$

Plot the function and also the sum of 4, 6, and 10 terms of the series (again, you need a calculator or computer).