

PHYS 301

HOMEWORK #5

Due : 20 Feb. 2013

1. What is the value of the product $\epsilon_{ijk} \epsilon_{ijk}$ where ϵ is the Levi-Civita permutation tensor?
2. Use summation notation to prove that $\nabla(fg) = f \nabla g + g \nabla f$ where f and g are scalar functions.
3. Consider the function $f(x) = x^3$ on $(-1, 1)$; find the Fourier coefficients for this function and then use Parseval's theorem to evaluate :

$$\sum_{n=1}^{\infty} \frac{1}{n^6}$$

You may (and should) use results from previous homework problems. You may use Mathematica to determine the expressions for the Fourier coefficients (including evaluating definite integrals and refining those results for integer values of n).

4. In this problem, you will write a short Mathematica program to estimate the square root of a number using Newton's Method. Your solution should make use of recursive relations and loop controls that we have studied in lab. Use the RandomInteger function in Mathematica to generate a number between 1, 000, 000 and 10, 000, 000; this will be the number whose square root you will find. Your initial estimate should be 1, and you will iterate until the n th estimate differs from the $(n - 1)$ st estimate by less than 0.001. Your output should show explicitly and clearly: a) the initial number, b) its square root, and c) how many iterations it took to produce that answer. Do not do any direct calculation of the square root using Sqrt or $N^{1/2}$ or similar functions. This question will be worth 30 points (all other questions on this homework assignment are worth 10 points each.)