Computational Physics – HW #1

1. In a water purification process, one-nth of the impurity is removed in the first stage. In each succeeding stage, the amount of impurity removed is one-nth of that removed in the preceding stage. Show that if $n = 2$ the water can be made as pure as you like, but that if n=3, at least one-half of the impurity will remain no matter how many stages are used.

2. Find the limit of the sequence specified by

$$\frac{(n+1)^2}{\sqrt{3+5n^2+4n^4}} \tag{1}$$

   in the limit $n \to \infty$.

3. Find the Taylor series of

$$\frac{1}{\sqrt{1+x^4}} - \cos(x^2) \tag{2}$$

4. Find the limit

$$lim_{x\to 0}\frac{1-cos(x)}{x^2} \tag{3}$$

5. Problem 27 from section 1.15.

6. Assume a static universe in which the stars are unifomrely distributed. Divide all space into shells of constant thickness; the stars in any one shell by themselves subtend a solid angle of ω_o. *Allowing for the blocking out of distant stars by nearer stars*, show that the total net solid angle subtended by all stars, shells extending out to infinity, is exactly 4π (Which would imply that the night sky should be ablaze with light under these circumstances).