Mathematical Physics 1

Assignment 1

Due: March 13 (Thursday), 2014

Boas Chapter 1

Section 1: 12
Section 2: 2, 7, 8, 9
Section 4: 5, 7
Section 5: 2
Section 6: 13, 19, 28, 33, 34
Section 7: 3, 5
Section 9: 4, 8. 17
Section 10: 2, 14
Section 13: 2,
9, 19, 24, 36 (Do only parts (a) and (b).)
Section 15: 16, 19, 29
Section 16: 22, 23

1.2.5 The Legendre series $\sum_{j \text{ even}} u_j(x)$ satisfies the recurrence relations

$$u_{j+2}(x) = \frac{(j+1)(j+2) - l(l+1)}{(j+2)(j+3)} x^2 u_j(x),$$

in which the index j is even and l is some constant (but, in this problem, **not** a non-negative odd integer). Find the range of values of x for which this Legendre series is convergent. Test the endpoints.

1.3.7 Using binomial expansions, compare the three Doppler shift formulas:

(a) $\nu' = \nu\left(1 \mp \frac{v}{c}\right)^{-1}$ moving source;

(b) $\nu' = \nu\left(1 \pm \frac{v}{c}\right)$ moving observer;

(c) $\nu' = \nu\left(1 \pm \frac{v}{c}\right)\left(1 - \frac{v^2}{c^2}\right)^{-1/2}$ relativistic.

Note. The relativistic formula agrees with the classical formulas if terms of order v^2/c^2 can be neglected.

1.3.9 The relativistic sum w of two velocities u and v in the same direction is given by

$$\frac{w}{c} = \frac{u/c + v/c}{1 + uv/c^2}.$$

If

$$\frac{v}{c} = \frac{u}{c} = 1 - \alpha,$$

where $0 \leq \alpha \leq 1$, find w/c in powers of α through terms in α^3.