Phys 208 – Homework (HW 07) – SP13 (Due Monday, February 11, 2013)

Problems: 2.12.25, 2.12.32, 2.14.1, 2.14.12

Answers: 2.14.1 $1+i\pi$ 2.14.12 $-i\,e^{-\pi/2}$

HW 7.1 The total energy radiated by a blackbody is given by

$$E_T = \int_0^\infty \rho_\lambda d\lambda = \int_0^\infty \frac{8\pi hc}{\lambda^5}\frac{d\lambda}{e^{hc/\lambda kT}-1} \quad .$$

a) Let $x = \dfrac{hc}{\lambda kT}$ and show that $E_T = \dfrac{2\pi k^4}{h^3c^2}T^4\displaystyle\int_0^\infty \frac{x^3}{e^x-1}dx$.

b) Expand $\dfrac{1}{e^x-1}$ and integrate term-by-term to evaluate the integral $I = \displaystyle\int_0^\infty \frac{x^3}{e^x-1}dx$ as a series.

c) Sum the first three terms to obtain a numerical value for *I*. Compare your result to the actual answer, which is $\dfrac{\pi^4}{15}$. You will need to use the Laplace transform of a power, $\displaystyle\int_0^\infty x^n e^{-ax}\,dx = \frac{n!}{a^{n+1}}$. This is known as the Stefan-Boltzmann Law, i.e., $E_T = (\text{constant})T^4$.

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Phys 208 – Homework (HW08) – SP13 (Due Wednesday, February 13, 2013)

Problems: 2.14.16, 2.14.18, 2.17.8, 2.17.13, 2.17.14

Answers: 2.14.16 $e^{-\pi/3}$ 2.17.8 -1

Phys 208 – Homework (HW09) – SP13 (Due Friday, February 15, 2013)

Problems: 2.17.26, 2.17.30, 2.17.32, 2.16.11

2.16.12 The equation should read $\left(\displaystyle\sum_{n=0}^\infty r^{2n}\cos(n\theta)\right)^2 + \left(\displaystyle\sum_{n=0}^\infty r^{2n}\sin(n\theta)\right)^2$.