

Physics 834: Homework Set No. 1

Deadline – Wednesday, October 1, 2008

Problems 1-3: Jackson Problems 1.3, 1.4, 1.5 (each worth 10 points)

(In problem 1.3(b), the cylindrical surface is supposed to extend to infinity along the direction of the axis.)

Problem 4: Delta functions (10 pts.)

Similar to what we did in class, show that $\delta(x) = \lim_{\epsilon \rightarrow 0} \delta_\epsilon(x)$ by demonstrating that

(i) $\lim_{\epsilon \rightarrow 0} \delta_\epsilon(x) = 0$ for $x \neq 0$ and $\lim_{\epsilon \rightarrow 0} \delta_\epsilon(x=0) = \infty$

(ii) $\lim_{\epsilon \rightarrow 0} \left[\int_{-\infty}^{\infty} dx f(x) \delta_\epsilon(x) \right] = f(0)$

for the following functions:

$$\delta_\epsilon(x) = \frac{1}{\pi} \frac{\epsilon}{x^2 + \epsilon^2}, \tag{1}$$

$$\delta_\epsilon(x) = \frac{2}{\pi} \frac{\sin^2(x/2\epsilon)}{x^2/\epsilon}, \tag{2}$$

$$\delta_\epsilon(x) = \frac{e^{-|x|/\epsilon}}{2\epsilon}. \tag{3}$$

In (ii) you may use $f(x) = 1$ for simplicity.