Physics 4321/7305 | Professor Scalise
Homework Assignment #2 | Due: 12 September 2003

4321

1. Simplify these expressions:
   (a) $\int_{x=-\infty}^{+\infty} \delta(x)\sin(x)dx$
   (b) $\int_{x=-\infty}^{+\infty} \delta(x)\sin(t)dx$
   (c) $\int_{x=-\infty}^{+\infty} \delta(x-t)\sin(x)dx$
   (d) $\int_{x=-\infty}^{+\infty} \delta(x-t)\sin(x+t)dx$
   (e) $\int_{x=-\infty}^{+\infty} \delta(3x)\cos(x)dx$
   (f) $\int_{x=14}^{+\infty} \delta(3x)\cos(x)dx$
   (g) $\int_{x=-\infty}^{+\infty} \delta'(x)(3x^2+x+7)dx$, where the prime means derivative.
   (h) $\int_{x=-\infty}^{+\infty} \delta''(x)(3x^2+x+7)dx$
   (i) $\int_{x=-\infty}^{+\infty} \delta''(x+2)(3x^2+x+7)dx$
2. Use the Heavyside or step function $\theta(t)$ to define the graph of a square wave pulse of height 4 that begins at t=3 and ends at t=6.
3. Sketch the graph of $\int_{x'=-\infty}^{x}\left[\int_{x''=-\infty}^{x'}\delta(x'')dx''\right]dx'$ vs. x.

7305

1. If a and b are constants and $\delta^{(m)}$ means the m'th derivative of the delta function, show that $x^n\delta^{(m)}(x) =$
   (a) 0, if $m < n$
   (b) $(-1)^n n!\delta(x)$, if $m = n$
   (c) $\frac{(-1)^n m!}{(m-n)!}\delta^{(m-n)(x)}$, if $m > n$

   Don't forget that these distributions only make physical sense inside an integral and multiplied by a test function $f(x)$ with bounded support.

Bonus: Solve as much of the other class' assignment as you can.