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University of Calgary
Winter semester 2006

PHYS 443: Quantum Mechanics I

Home assignment 5

Due March 14, 2006

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<u>Problem 5.1.</u> Ex. 2.30(b) from the lecture notes

<u>Problem 5.2.</u> Ex. 2.31 from the lecture notes

<u>Problem 5.3.</u>

a) Find the Fourier transform $\mathcal{F}[f]$ of the function $f(x) = \delta(x-1) + \delta(x+1)$.

b) Find the Fourier transform $\mathcal{F}[g]$ of the function $g(x) = e^{-x^2}$.

c) Find the convolution $(f * g)(x)$.

d) Find the Fourier transform $\mathcal{F}[f * g]$ by direct integration. Verify that $\mathcal{F}[f * g] = \mathcal{F}[f]\mathcal{F}[g]$.

<u>Problem 5.4.</u> Using the properties of the Fourier transform, find the following:

a) $\mathcal{F}[f]$, where $f(x) = 1$ for $-1 \leq x \leq 1$, and 0 otherwise.

b) $\mathcal{F}[\cos(x)]$

c) $\mathcal{F}[\sin(2x - 5)]$

d) $\mathcal{F}[e^{ik_0 x - (x-a)^2/2b^2}]$.

e) $\mathcal{F}[x^2 e^{-x^2}]$ (**Hint:** use the Fourier transform of a derivative and the expression for the Fourier transform of a Gaussian function.)