LATEX PRACTICE

RAUL VILLALOBOS

Quiz Practice
Calculate probabilites and expectation values.

$\psi(x) = C\left(1 - x^2\right)$
for $0 \leq x \leq 1$
$= 0$ everywhere else

$\int |\psi(x)|^2 \, dx$
$\int \left|C\left(1 - x^2\right)\right|^2 dx$
$C^2 \int \left(1 - x^2\right)^2 dx$
$C^2 \int \left(1 - 2x^2 + x^4\right) dx$
$C^2 \left[x - \frac{2x^3}{3} + \frac{x^5}{5}\right]$

Find normalization
$C^2 \left[x - \frac{2x^3}{3} + \frac{x^5}{5}\right]_0^1 = 1$
$C^2 \left[\left(1 - \frac{2\times 1^3}{3} + \frac{1^5}{5}\right) - \left(0 - \frac{2\times 0^3}{3} + \frac{0^5}{5}\right)\right] = 1$
$C^2 \left[\left(1 - \frac{2}{3} + \frac{1}{5}\right) - (0)\right] = 1$
$C^2 \left(\frac{8}{15}\right) = 1$
$C^2 = \frac{15}{8}$
$C = \sqrt{\frac{15}{8}}$

Find expected pos
$\int x \, |\psi(x)|^2 \, dx$
$\int x \left|C\left(1 - x^2\right)\right|^2 dx$
$C^2 \int x \left(1 - x^2\right)^2 dx$
$C^2 \int x \left(1 - 2x^2 + x^4\right) dx$
$C^2 \int \left(x - 2x^3 + x^5\right) dx$
$C^2 \left[\frac{x^2}{2} - \frac{2x^4}{4} + \frac{x^6}{6}\right]$
$C^2 \left[\frac{x^2}{2} - \frac{x^4}{2} + \frac{x^6}{6}\right]$
$\frac{\frac{15}{8}}{2} \left[x^2 - x^4 + \frac{x^6}{3}\right]_0^1$

$$\frac{15}{16}\left[\left(1^2-1^4+\frac{1^6}{3}\right)-\left(0^2-0^4+\frac{0^6}{3}\right)\right]$$
$$\frac{15}{16}\left[\left(1-1+\frac{1}{3}\right)-(0)\right]$$
$$\frac{15}{16}\left(\frac{1}{3}\right)=\frac{5}{16}$$