> *restart*;

> *with*(*orthopoly*);

$$[G, H, L, P, T, U] \quad (1)$$

> **(a) We define the QHO wavefunction using the Hermite polynomials**

Error, missing operator or `;`

> $qho := (n, x) \rightarrow \frac{1}{\sqrt{n! \cdot 2^n}} \cdot \sqrt{\frac{\text{beta}}{\sqrt{\text{Pi}}}} \cdot \exp\left(-\frac{1}{2} \cdot \beta^2 \cdot x^2\right) \cdot H(n, \text{beta} \cdot x)$

$$qho := (n, x) \rightarrow \frac{\sqrt{\frac{\beta}{\sqrt{\pi}}}\, e^{-\frac{1}{2}\beta^2 x^2}\, H(n, \beta x)}{\sqrt{n!\, 2^n}} \quad (2)$$

> $\text{beta} := \sqrt{\frac{m \cdot \text{omega}}{hbar}}$

$$\beta := \sqrt{\frac{m\,\omega}{hbar}} \quad (3)$$

> *assume*(*hbar* > 0, *m* > 0, omega > 0)

We can now check orthogonality by the usual method. Since the wavefunctions are real, the complex conjugates are just qho(n,x) so the probability density is

> $\int_{-infinity}^{infinity} qho(0, x)^2 \, dx$

$$1 \quad (4)$$

$$1 \quad (5)$$

> $\int_{-infinity}^{infinity} qho(1, x)^2 \, dx$

$$1 \quad (6)$$

> $\int_{-infinity}^{infinity} qho(2, x)^2 \, dx$

$$1 \quad (7)$$

> $\int_{-infinity}^{infinity} qho(3, x)^2 \, dx$

$$1 \quad (8)$$

> **(b) Orthogonality is easy to check as well, since we require the above integrals to be 0 whenever n != m, or**

Error, missing operator or `;`

> $\int_{-infinity}^{infinity} qho(0, x) \cdot qho(1, x) \, dx$

$$0 \tag{9}$$

> $\int_{-infinity}^{infinity} qho(0, x) \cdot qho(2, x) \, dx$

$$0 \tag{10}$$

> $\int_{-infinity}^{infinity} qho(0, x) \cdot qho(3, x) \, dx$

$$0 \tag{11}$$

> $\int_{-infinity}^{infinity} qho(1, x) \cdot qho(2, x) \, dx$

$$0 \tag{12}$$

> $\int_{-infinity}^{infinity} qho(3, x) \cdot qho(2, x) \, dx$

$$0 \tag{13}$$

>

Perfect!