

## 9.20: Numerical Solutions for the Three-Dimensional Harmonic Oscillator

Reduced mass:  $\mu = 1$

Angular momentum:  $L = 0$

Integration limit:  $r_{\max} = 6$

Force constant:  $k = 1$

Solve Schrödinger's equation numerically. Use Mathcad's ODE solve block:

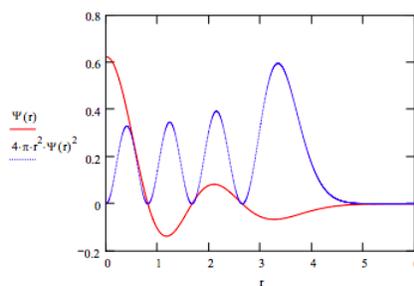
Given

$$\frac{-1}{2\mu} \frac{d^2}{dr^2} \psi(r) - \frac{1}{r\mu} \frac{d}{dr} \psi(r) + \left[ \frac{L(L+1)}{2\mu r^2} + \frac{1}{2} kr^2 \right] \psi(r) = E\psi(r) \quad \psi(.001) = 1 \quad \psi'(.001) = 0.1$$

$$\psi = \text{Odesolve}(r, r_{\max})$$

$$\psi(r) = \left( \int_0^{r_{\max}} \psi(r)^2 4\pi r^2 dr \right)^{-\frac{1}{2}} \psi(r)$$

Energy guess:  $E = 7.5$



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