9.19: Numerical Solutions for the Two-Dimensional Harmonic Oscillator

Reduced mass: $\mu = 1$

Angular momentum: L = 2

Integration limit: $r_{max} = 5$

Force constant: k = 1

Energy guess: E = 3

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

Given

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

$$\psi = Odesolve(r, r_{max}, .001)$$

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