

9.3: Particle in a Gravitational Field

The Unhindered Quantized Bouncing Particle

- Integration limit: $z_{max} = 3$
- Mass: $m = 2$
- Acceleration due to gravity: $g = 1$

The first 10 roots of the Airy function are as follows:

$a_1 = 2.33810$	$a_2 = 4.08794$	$a_3 = 5.52055$	$a_4 = 6.78670$	$a_5 = 7.94413$
$a_6 = 8.02265$	$a_7 = 10.04017$	$a_8 = 11.00852$	$a_9 = 11.93601$	$a_{10} = 12.82877$

Calculate energy analytically by selecting the appropriate Airy function root:

$$i = 1 \quad E = \frac{mg^2}{2} \frac{1}{3} a_1 \quad E = 2.338$$

Generate the associated wavefunction numerically: Potential energy: $V(z) = mgz$

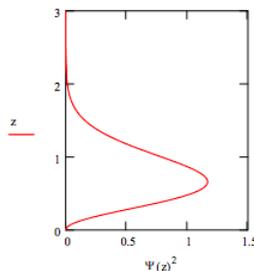
$$\text{Given } \frac{-1}{2 \cdot m} \frac{d^2}{dz^2} \psi(z) + V(z)\psi(z) \equiv E\psi(z)$$

$$\psi(0.0) = 0.0$$

$$\psi'(0.0) = 0.1$$

Given, $\psi = \text{Odesolve}(z, z_{max})$

$$\text{Normalize wavefunction: } \psi(z) = \frac{\psi(z)}{\sqrt{\int_0^{z_{max}} \psi(z)^2 dz}}$$



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