A particle of mass $m$ is subject to the one-dimensional harmonic oscillator potential. Write down the first three normalised eigenfunctions $ψ\_{n}(x)$ and the corresponding eigenvalues.

Initially the wavefunction is in a mixed state of the form
$$ψ\left(x\right)=\left(\frac{1}{7α\sqrt{π}}\right)^{{1}/{2}}e^{-{x^{2}}/{2α^{2}}}\left(\frac{3x^{2}}{α^{2}}+\frac{x}{α}-\frac{3}{2}+\sqrt{2}\right)$$

where$ α=\sqrt{{ℏ}/{mω}}$. Let $ψ(x)$ be written in terms of the normalised eigenfunctions of the harmonic oscillator
$$ψ\left(x\right)=\sum\_{n=0}^{\infty }c\_{n}ψ\_{n}\left(x\right).$$

Calculate the coefficients$ c\_{n}$. Hence determine the possible outcomes $E\_{n}$ and associated probabilities of a measurement of the particle’s energy. What will the energy be after making a measurement?