

Advanced Quantum Mechanics II

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Problem Set 6

Please answer the following questions and provide us by the first of the class on Farvardin 14.

1. We consider a particle of mass m trapped in a central potential given by

$$V(r) = \begin{cases} 0 & 0 < r < a \\ -V_0 & a < r < b \\ 0 & b < r \end{cases} \quad (1)$$

Find the quantum stationary states of this system.

2. Show that the Helmholtz equation¹,

$$\nabla^2 \psi + k^2 \psi = 0, \quad (2)$$

is separable in spherical coordinates if k^2 is

$$k^2 = f(r) + \frac{g(\theta)}{r^2} + \frac{h(\phi)}{r^2 \sin^2 \theta}. \quad (3)$$

¹Notice that the Schrödinger Eq. is a special case of this