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### Tutorial 5

T5.1 Are the following problems central force problems?

- (a) A particle confined to a spherical box with  $V = 0$  for  $r \leq b$  and  $V = \infty$  for  $r > b$ .
- (b) Three dimensional harmonic oscillator with the classical Hamiltonian

$$H = \frac{p_x^2}{2m} + \frac{p_y^2}{2m} + \frac{p_z^2}{2m} + \frac{k_x x^2}{2} + \frac{k_y y^2}{2} + \frac{k_z z^2}{2}, \quad \text{Here } k_x = k_y = k_z$$

If they are central force problems, write down the corresponding radial equations.

T5.2 In the Hydrogen atom problem, by taking  $r$  as constant, one can model the molecular rotations. Find out the energy eigenvalues for this problem.

T5.3 In class, we saw that continuum levels and bound levels are possible for Hydrogen atom but we didn't talk about such a scenario for particle in infinite well and Harmonic oscillator problems. Explain why?