

1. Consider a particle whose wave function is

$$\psi(x) = \begin{cases} e^{-\alpha x}, & 0 \leq x < +\infty \\ 0, & x < 0 \end{cases}$$

- (a) Normalize the wave function.
- (b) Calculate  $\langle x \rangle$  and  $\langle x^2 \rangle$ .
- (c) What is the probability to find the particle between  $x = 0$  and  $x = 1/2\alpha$ ?

2. Open the following brackets:

$$\left( \frac{d}{dx} + \hat{x} \right)^3$$
$$\left( \frac{d}{dx} + \frac{1}{\hat{x}} \right)^3$$

3. The system is described by the wave function  $\psi(\varphi) = C(1 + \cos 3\varphi)$ , where  $\varphi$  is a polar angle. Find the normalization constant  $C$ .