

The momentum operator is  $\hat{p} = -i\hbar \frac{\partial}{\partial x}$ .

1. Write down the momentum eigenvalue equation.

**Solution**

$$\hat{p} |p\rangle = p |p\rangle$$

$$\hat{p} \psi_p(x) = p \psi_p(x)$$

$$-i\hbar \frac{\partial}{\partial x} \psi_p(x) = p \psi_p(x)$$

2. Solve for the momentum eigenstates.

**Solution**

$$-i\hbar \frac{\partial}{\partial x} \psi_p(x) = p \psi_p(x)$$

$$\frac{\partial}{\partial x} \psi_p(x) = \frac{ip}{\hbar} \psi_p(x)$$

$$\rightarrow \psi_p(x) = Ae^{ipx/\hbar}$$