

Canonical commutation relation in one dimension:

$$XP - PX = i\hbar$$

Let

$$X = x, \quad P = -i\hbar \frac{d}{dx}$$

Then

$$\begin{aligned}(XP - PX)\psi(x) &= XP\psi(x) - PX\psi(x) \\&= x \left( -i\hbar \frac{d}{dx} \psi(x) \right) + i\hbar \frac{d}{dx} (x\psi(x)) \\&= -i\hbar x \frac{d}{dx} \psi(x) + i\hbar \left( \frac{d}{dx} x \right) \psi(x) + i\hbar x \frac{d}{dx} \psi(x) \\&= i\hbar \psi(x)\end{aligned}$$

Eigenmath code:

```
X(f) = x f
P(f) = -i hbar d(f,x)
X(P(psi(x))) - P(X(psi(x)))
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Result:

$$i\hbar\psi(x)$$