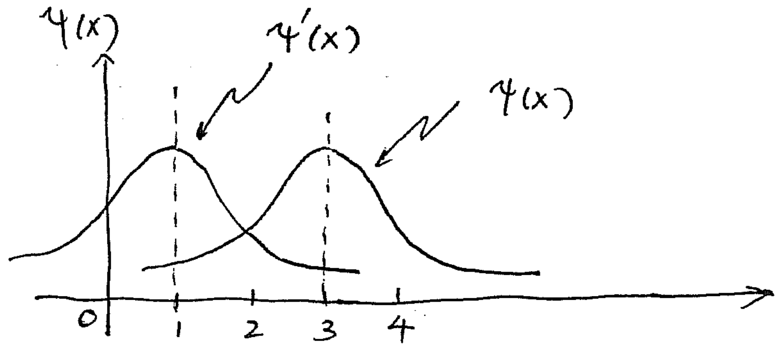
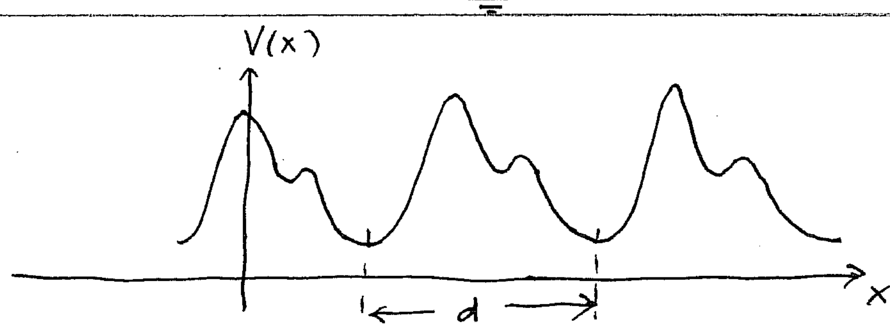
$\boxed{\text{P17.1}}$ $g(x) = x-2 \quad \therefore g^{-1}(x) = x+2$ (g is an element of the translation group)

$$\psi'(x) = \psi(g^{-1}(x)) = \psi(x+2) = Ae^{-\alpha(x+2-3)^2} = \boxed{Ae^{-\alpha(x-1)^2}}$$



$\boxed{\text{P17.2}}$



We need to show that $[H, g(n)] = 0$ for all n.

For all $\psi(x)$, $g(n)\psi(x) = \psi'(x) = \psi(g^{-1}(n)(x)) = \psi(x-nd)$.

$$\therefore g(n)V(x)g^{-1}(n)\psi(x) = g(n)\underbrace{V(x)}_{= V(x+nd)}\psi(x+nd)$$

$$= g(n)[V(x+nd)\psi(x+nd)] = V[g^{-1}(n)(x+nd)]\psi[g^{-1}(n)(x+nd)]$$

$$= V(x)\psi(x)$$

$$\therefore g(n)V(x)g^{-1}(n) = V(x) \quad \text{or} \quad [g(n), V(x)] = 0$$

$$g(n)\frac{p^2}{2m}\psi(x) = -\hbar^2\frac{g(n)}{2m}\frac{d^2\psi(x)}{dx^2} = \frac{-\hbar^2}{2m}\frac{d^2\psi(y)}{dy^2} \qquad (y \equiv x-nd)$$

$$\frac{p^2}{2m}g(n)\psi(x) = -\frac{\hbar^2}{2m}\frac{d^2}{dx^2}[g(n)\psi(x)] = -\frac{\hbar^2}{2m}\frac{d^2}{dx^2}\psi(\underbrace{x-nd}_{y}) = -\frac{\hbar^2}{2m}\frac{d^2\psi(y)}{dy^2}$$

$$\therefore \left[g(n), \frac{p^2}{2m}\right] = 0$$