In[1]:=
$$d[i\_] := \frac{i}{dx^2}\left(psi[[i+1]] - 2\,psi[[i]] + psi[[i-1]]\right) - i\,v[[i]] \times psi[[i]]$$

In[2]:=
$$d[j]$$

Out[2]=
$$\frac{i\left(psi[[-1+j]] - 2\,psi[[j]] + psi[[1+j]]\right)}{dx^2} - i\,psi[[j]]\,v[[j]]$$

$$k1 = d[i]$$

$$\frac{i\left(psi[[-1+i]] - 2\,psi[[i]] + psi[[1+i]]\right)}{dx^2} - i\,psi[[i]]\,v[[i]]$$

$$k1$$

$$\frac{i\left(psi[[-1+i]] - 2\,psi[[i]] + psi[[1+i]]\right)}{dx^2} - i\,psi[[i]]\,v[[i]]$$

$$d[i] + \frac{dt}{2}\,k1$$

$$\frac{i\left(psi[[-1+i]] - 2\,psi[[i]] + psi[[1+i]]\right)}{dx^2} - i\,psi[[i]]\,v[[i]] +$$

$$\frac{1}{2}\,dt\left(\frac{i\left(psi[[-1+i]] - 2\,psi[[i]] + psi[[1+i]]\right)}{dx^2} - i\,psi[[i]]\,v[[i]]\right)$$

$$\frac{i\left(psi[[-1+i]] - 2\,psi[[i]] + psi[[1+i]]\right)}{dx^2} - i\,psi[[i]]\,v[[i]] + \frac{1}{2}\,dt\left(\frac{i\left(d[-1+i] - 2\,d[i] + d[1+i]\right)}{dx^2} - i\,d[i]\,v[[i]]\right)$$

$$k2 = \frac{i\left(psi[[-1+i]] - 2\,psi[[i]] + psi[[1+i]]\right)}{dx^2} - i\,psi[[i]]\,v[[i]] +$$

$$\frac{1}{2}\,dt\left(-i\,v[[i]]\left(\frac{i\left(psi[[-1+i]] - 2\,psi[[i]] + psi[[1+i]]\right)}{dx^2} - i\,psi[[i]]\,v[[i]]\right) +$$

$$\frac{1}{dx^2}\,i\left(\frac{i\left(psi[[-2+i]] - 2\,psi[[-1+i]] + psi[[i]]\right)}{dx^2} +$$

$$\frac{i\left(psi[[i]] - 2\,psi[[1+i]] + psi[[2+i]]\right)}{dx^2} - i\,psi[[-1+i]]\,v[[-1+i]] -$$

$$2\left(\frac{i\left(psi[[-1+i]] - 2\,psi[[i]] + psi[[1+i]]\right)}{dx^2} - i\,psi[[i]]\,v[[i]]\right) - i\,psi[[1+i]]\,v[[1+i]]\Bigg)\Bigg)$$

$$\frac{i\left(psi[[-1+i]] - 2\,psi[[i]] + psi[[1+i]]\right)}{dx^2} - i\,psi[[i]]\,v[[i]] +$$

$$\frac{1}{2}\,dt\left(-i\,v[[i]]\left(\frac{i\left(psi[[-1+i]] - 2\,psi[[i]] + psi[[1+i]]\right)}{dx^2} - i\,psi[[i]]\,v[[i]]\right) + \frac{1}{dx^2}$$

$$i\left(\frac{i\left(psi[[-2+i]] - 2\,psi[[-1+i]] + psi[[i]]\right)}{dx^2} + \frac{i\left(psi[[i]] - 2\,psi[[1+i]] + psi[[2+i]]\right)}{dx^2} - i\,psi[[-1+i]]\right.$$

$$v[[-1+i]] - 2\left(\frac{i\left(psi[[-1+i]] - 2\,psi[[i]] + psi[[1+i]]\right)}{dx^2} - i\,psi[[i]]\,v[[i]]\right) - i\,psi[[1+i]]\,v[[1+i]]\Bigg)\Bigg)$$

$$d[i] + \frac{dt}{2}\,k2$$

$$\frac{\text{i}\left(\text{psi}[[-1+\text{i}]]-2\,\text{psi}[[\text{i}]]+\text{psi}[[1+\text{i}]]\right)}{\text{dx}^2}-$$

$$\text{i}\,\text{psi}[[\text{i}]]\,\text{v}[[\text{i}]]+\frac{1}{2}\,\text{dt}\left(\frac{\text{i}\left(\text{d}[-1+\text{i}]-2\,\text{d}[\text{i}]+\text{d}[1+\text{i}]\right)}{\text{dx}^2}-\text{i}\,\text{d}[\text{i}]\,\text{v}[[\text{i}]]+\right.$$

$$\frac{1}{2}\,\text{dt}\left(-\text{i}\,\text{v}[[\text{i}]]\left(\frac{\text{i}\left(\text{d}[-1+\text{i}]-2\,\text{d}[\text{i}]+\text{d}[1+\text{i}]\right)}{\text{dx}^2}-\text{i}\,\text{d}[\text{i}]\,\text{v}[[\text{i}]]\right)+\right.$$

$$\frac{1}{\text{dx}^2}\,\text{i}\left(\frac{\text{i}\left(\text{d}[-2+\text{i}]-2\,\text{d}[-1+\text{i}]+\text{d}[\text{i}]\right)}{\text{dx}^2}+\frac{\text{i}\left(\text{d}[\text{i}]-2\,\text{d}[1+\text{i}]+\text{d}[2+\text{i}]\right)}{\text{dx}^2}-\text{i}\,\text{d}[-1+\text{i}]\,\text{v}[[-1+\text{i}]]-\right.$$

$$\left.\left.\left.2\left(\frac{\text{i}\left(\text{d}[-1+\text{i}]-2\,\text{d}[\text{i}]+\text{d}[1+\text{i}]\right)}{\text{dx}^2}-\text{i}\,\text{d}[\text{i}]\,\text{v}[[\text{i}]]\right)-\text{i}\,\text{d}[1+\text{i}]\,\text{v}[[1+\text{i}]]\right)\right)\right)$$

$$\text{k3}=\frac{\text{i}\left(\text{psi}[[-1+\text{i}]]-2\,\text{psi}[[\text{i}]]+\text{psi}[[1+\text{i}]]\right)}{\text{dx}^2}-\text{i}\,\text{psi}[[\text{i}]]\,\text{v}[[\text{i}]]+$$

$$\frac{1}{2}\,\text{dt}\left(-\text{i}\,\text{v}[[\text{i}]]\left(\frac{\text{i}\left(\text{psi}[[-1+\text{i}]]-2\,\text{psi}[[\text{i}]]+\text{psi}[[1+\text{i}]]\right)}{\text{dx}^2}-\text{i}\,\text{psi}[[\text{i}]]\,\text{v}[[\text{i}]]\right)+\right.$$

$$\frac{1}{\text{dx}^2}\,\text{i}\left(\frac{\text{i}\left(\text{psi}[[-2+\text{i}]]-2\,\text{psi}[[-1+\text{i}]]+\text{psi}[[\text{i}]]\right)}{\text{dx}^2}+\right.$$

$$\frac{\text{i}\left(\text{psi}[[\text{i}]]-2\,\text{psi}[[1+\text{i}]]+\text{psi}[[2+\text{i}]]\right)}{\text{dx}^2}-\text{i}\,\text{psi}[[-1+\text{i}]]\,\text{v}[[-1+\text{i}]]-$$

$$\left.2\left(\frac{\text{i}\left(\text{psi}[[-1+\text{i}]]-2\,\text{psi}[[\text{i}]]+\text{psi}[[1+\text{i}]]\right)}{\text{dx}^2}-\text{i}\,\text{psi}[[\text{i}]]\,\text{v}[[\text{i}]]\right)-\text{i}\,\text{psi}[[1+\text{i}]]\,\text{v}[[1+\text{i}]]\right)+$$

$$\frac{1}{2}\,\text{dt}\left(-\text{i}\,\text{v}[[\text{i}]]\left(-\text{i}\,\text{v}[[\text{i}]]\left(\frac{\text{i}\left(\text{psi}[[-1+\text{i}]]-2\,\text{psi}[[\text{i}]]+\text{psi}[[1+\text{i}]]\right)}{\text{dx}^2}-\text{i}\,\text{psi}[[\text{i}]]\,\text{v}[[\text{i}]]\right)+\right.\right.$$

$$\frac{1}{\text{dx}^2}\,\text{i}\left(\frac{\text{i}\left(\text{psi}[[-2+\text{i}]]-2\,\text{psi}[[-1+\text{i}]]+\text{psi}[[\text{i}]]\right)}{\text{dx}^2}+\right.$$

$$\frac{\text{i}\left(\text{psi}[[\text{i}]]-2\,\text{psi}[[1+\text{i}]]+\text{psi}[[2+\text{i}]]\right)}{\text{dx}^2}-\text{i}\,\text{psi}[[-1+\text{i}]]\,\text{v}[[-1+\text{i}]]-2$$

$$\left.\left.\left(\frac{\text{i}\left(\text{psi}[[-1+\text{i}]]-2\,\text{psi}[[\text{i}]]+\text{psi}[[1+\text{i}]]\right)}{\text{dx}^2}-\text{i}\,\text{psi}[[\text{i}]]\,\text{v}[[\text{i}]]\right)-\text{i}\,\text{psi}[[1+\text{i}]]\,\text{v}[[1+\text{i}]]\right)\right)+$$

$$\frac{1}{dx^2}\,i\left(-i\,v[[-1+i]]\left(\frac{i\left(psi[[-2+i]]-2\,psi[[-1+i]]+psi[[i]]\right)}{dx^2}-i\,psi[[-1+i]]\,v[[-1+i]]\right)+\frac{1}{dx^2}\,i\left(\frac{i\left(psi[[-3+i]]-2\,psi[[-2+i]]+psi[[-1+i]]\right)}{dx^2}+\frac{i\left(psi[[-1+i]]-2\,psi[[i]]+psi[[1+i]]\right)}{dx^2}-i\,psi[[-2+i]]\,v[[-2+i]]-2\left(\frac{i\left(psi[[-2+i]]-2\,psi[[-1+i]]+psi[[i]]\right)}{dx^2}-i\,psi[[-1+i]]\,v[[-1+i]]\right)-i\,psi[[i]]\,v[[i]]\right)-i\,v[[1+i]]\left(\frac{i\left(psi[[i]]-2\,psi[[1+i]]+psi[[2+i]]\right)}{dx^2}-i\,psi[[1+i]]\,v[[1+i]]\right)-2\left(-i\,v[[i]]\left(\frac{i\left(psi[[-1+i]]-2\,psi[[i]]+psi[[1+i]]\right)}{dx^2}-i\,psi[[i]]\,v[[i]]\right)+\frac{1}{dx^2}\,i\left(i\left(\frac{i\left(psi[[-2+i]]-2\,psi[[-1+i]]+psi[[i]]\right)}{dx^2}+\frac{i\left(psi[[i]]-2\,psi[[1+i]]+psi[[2+i]]\right)}{dx^2}-i\,psi[[-1+i]]\,v[[-1+i]]-2\left(\frac{i\left(psi[[-1+i]]-2\,psi[[i]]+psi[[1+i]]\right)}{dx^2}-i\,psi[[i]]\,v[[i]]\right)-i\,psi[[1+i]]\,v[[1+i]]\right)+\frac{1}{dx^2}\,i\left(\frac{i\left(psi[[-1+i]]-2\,psi[[i]]+psi[[1+i]]\right)}{dx^2}+\frac{i\left(psi[[1+i]]-2\,psi[[2+i]]+psi[[3+i]]\right)}{dx^2}-i\,psi[[i]]\,v[[i]]-2\left(\frac{i\left(psi[[i]]-2\,psi[[1+i]]+psi[[2+i]]\right)}{dx^2}-i\,psi[[1+i]]\,v[[1+i]]\right)-i\,psi[[2+i]]\,v[[2+i]]\right)\right)\right)\right)$$

$$\frac{i\left(psi[[-1+i]]-2\,psi[[i]]+psi[[1+i]]\right)}{dx^2}-i\,psi[[i]]\,v[[i]]+$$

$$\frac{1}{2}\,dt\left(-i\,v[[i]]\left(\frac{i\left(psi[[-1+i]]-2\,psi[[i]]+psi[[1+i]]\right)}{dx^2}-i\,psi[[i]]\,v[[i]]\right)+\frac{1}{dx^2}\right.$$
$$i\left(\frac{i\left(psi[[-2+i]]-2\,psi[[-1+i]]+psi[[i]]\right)}{dx^2}+\frac{i\left(psi[[i]]-2\,psi[[1+i]]+psi[[2+i]]\right)}{dx^2}-i\,psi[[-1+i]]\right.$$
$$v[[-1+i]]-2\left(\frac{i\left(psi[[-1+i]]-2\,psi[[i]]+psi[[1+i]]\right)}{dx^2}-i\,psi[[i]]\,v[[i]]\right)-i\,psi[[1+i]]\,v[[1+i]]\Big)+$$
$$\frac{1}{2}\,dt\left(-i\,v[[i]]\left(-i\,v[[i]]\left(\frac{i\left(psi[[-1+i]]-2\,psi[[i]]+psi[[1+i]]\right)}{dx^2}-i\,psi[[i]]\,v[[i]]\right)+\right.$$
$$\frac{1}{dx^2}\,i\left(\frac{i\left(psi[[-2+i]]-2\,psi[[-1+i]]+psi[[i]]\right)}{dx^2}+\right.$$
$$\frac{i\left(psi[[i]]-2\,psi[[1+i]]+psi[[2+i]]\right)}{dx^2}-i\,psi[[-1+i]]\,v[[-1+i]]-$$
$$\left.2\left(\frac{i\left(psi[[-1+i]]-2\,psi[[i]]+psi[[1+i]]\right)}{dx^2}-i\,psi[[i]]\,v[[i]]\right)-i\,psi[[1+i]]\,v[[1+i]]\right)\Big)+$$
$$\frac{1}{dx^2}\,i\left(-i\,v[[-1+i]]\left(\frac{i\left(psi[[-2+i]]-2\,psi[[-1+i]]+psi[[i]]\right)}{dx^2}-i\,psi[[-1+i]]\,v[[-1+i]]\right)+\right.$$
$$\frac{1}{dx^2}\,i\left(\frac{i\left(psi[[-3+i]]-2\,psi[[-2+i]]+psi[[-1+i]]\right)}{dx^2}+\right.$$
$$\frac{i\left(psi[[-1+i]]-2\,psi[[i]]+psi[[1+i]]\right)}{dx^2}-i\,psi[[-2+i]]\,v[[-2+i]]-2$$
$$\left.\left(\frac{i\left(psi[[-2+i]]-2\,psi[[-1+i]]+psi[[i]]\right)}{dx^2}-i\,psi[[-1+i]]\,v[[-1+i]]\right)-i\,psi[[i]]\,v[[i]]\right)-$$
$$i\,v[[1+i]]\left(\frac{i\left(psi[[i]]-2\,psi[[1+i]]+psi[[2+i]]\right)}{dx^2}-i\,psi[[1+i]]\,v[[1+i]]\right)-$$
$$2\left(-i\,v[[i]]\left(\frac{i\left(psi[[-1+i]]-2\,psi[[i]]+psi[[1+i]]\right)}{dx^2}-i\,psi[[i]]\,v[[i]]\right)+\frac{1}{dx^2}\,i\right.$$
$$\left.\left(\frac{i\left(psi[[-2+i]]-2\,psi[[-1+i]]+psi[[i]]\right)}{dx^2}+\frac{i\left(psi[[i]]-2\,psi[[1+i]]+psi[[2+i]]\right)}{dx^2}-\right.\right.$$

$$i\,\text{psi}[[-1+i]]\,v[[-1+i]] - 2\left(\frac{i\left(\text{psi}[[-1+i]] - 2\,\text{psi}[[i]] + \text{psi}[[1+i]]\right)}{dx^2} - i\,\text{psi}[[i]]\,v[[i]]\right) - i\,\text{psi}[[1+i]]\,v[[1+i]]\Bigg)\Bigg) +$$

$$\frac{1}{dx^2}\,i\left(\frac{i\left(\text{psi}[[-1+i]] - 2\,\text{psi}[[i]] + \text{psi}[[1+i]]\right)}{dx^2} + \frac{i\left(\text{psi}[[1+i]] - 2\,\text{psi}[[2+i]] + \text{psi}[[3+i]]\right)}{dx^2} - i\,\text{psi}[[i]]\,v[[i]] - 2\left(\frac{i\left(\text{psi}[[i]] - 2\,\text{psi}[[1+i]] + \text{psi}[[2+i]]\right)}{dx^2} - i\,\text{psi}[[1+i]]\,v[[1+i]]\right) - i\,\text{psi}[[2+i]]\,v[[2+i]]\Bigg)\Bigg)\Bigg)\Bigg)$$

d[i] + dt k3

$$\frac{i\left(\text{psi}[[-1+i]] - 2\,\text{psi}[[i]] + \text{psi}[[1+i]]\right)}{dx^2} - i\,\text{psi}[[i]]\,v[[i]] + dt\left(\frac{i\left(d[-1+i] - 2\,d[i] + d[1+i]\right)}{dx^2} - i\,d[i]\,v[[i]] + \frac{1}{2}\,dt\left(-i\,v[[i]]\left(\frac{i\left(d[-1+i] - 2\,d[i] + d[1+i]\right)}{dx^2} - i\,d[i]\,v[[i]]\right) + \frac{1}{dx^2}\,i\left(\frac{i\left(d[-2+i] - 2\,d[-1+i] + d[i]\right)}{dx^2} + \frac{i\left(d[i] - 2\,d[1+i] + d[2+i]\right)}{dx^2} - i\,d[-1+i]\,v[[-1+i]] - 2\left(\frac{i\left(d[-1+i] - 2\,d[i] + d[1+i]\right)}{dx^2} - i\,d[i]\,v[[i]]\right) - i\,d[1+i]\,v[[1+i]]\right) + \frac{1}{2}\,dt\left(-i\,v[[i]]\left(-i\,v[[i]]\left(\frac{i\left(d[-1+i] - 2\,d[i] + d[1+i]\right)}{dx^2} - i\,d[i]\,v[[i]]\right) + \frac{1}{dx^2}\,i\left(\frac{i\left(d[-2+i] - 2\,d[-1+i] + d[i]\right)}{dx^2} + \frac{i\left(d[i] - 2\,d[1+i] + d[2+i]\right)}{dx^2} - i\,d[-1+i]\,v[[-1+i]] - 2\left(\frac{i\left(d[-1+i] - 2\,d[i] + d[1+i]\right)}{dx^2} - i\,d[i]\,v[[i]]\right) - i\,d[1+i]\,v[[1+i]]\right)\right) + \frac{1}{dx^2}\,i\left(-i\,v[[-1+i]]\left(\frac{i\left(d[-2+i] - 2\,d[-1+i] + d[i]\right)}{dx^2} - i\,d[-1+i]\,v[[-1+i]]\right) +$$

$$\frac{1}{dx^2}\,\text{i}\left(\frac{\text{i}\left(d[-3+i]-2\,d[-2+i]+d[-1+i]\right)}{dx^2}+\frac{\text{i}\left(d[-1+i]-2\,d[i]+d[1+i]\right)}{dx^2}-\text{i}\,d[-2+i]\,v[[-2+i]]-2\left(\frac{\text{i}\left(d[-2+i]-2\,d[-1+i]+d[i]\right)}{dx^2}-\text{i}\,d[-1+i]\,v[[-1+i]]\right)-\text{i}\,d[i]\,v[[i]]\right)-\text{i}\,v[[1+i]]\left(\frac{\text{i}\left(d[i]-2\,d[1+i]+d[2+i]\right)}{dx^2}-\text{i}\,d[1+i]\,v[[1+i]]\right)-2\left(-\text{i}\,v[[i]]\left(\frac{\text{i}\left(d[-1+i]-2\,d[i]+d[1+i]\right)}{dx^2}-\text{i}\,d[i]\,v[[i]]\right)+\frac{1}{dx^2}\,\text{i}\left(\frac{\text{i}\left(d[-2+i]-2\,d[-1+i]+d[i]\right)}{dx^2}+\frac{\text{i}\left(d[i]-2\,d[1+i]+d[2+i]\right)}{dx^2}-\text{i}\,d[-1+i]\,v[[-1+i]]-2\left(\frac{\text{i}\left(d[-1+i]-2\,d[i]+d[1+i]\right)}{dx^2}-\text{i}\,d[i]\,v[[i]]\right)-\text{i}\,d[1+i]\,v[[1+i]]\right)+\frac{1}{dx^2}\,\text{i}\left(\frac{\text{i}\left(d[-1+i]-2\,d[i]+d[1+i]\right)}{dx^2}+\frac{\text{i}\left(d[1+i]-2\,d[2+i]+d[3+i]\right)}{dx^2}-\text{i}\,d[i]\right)$$

$$v[[i]]-2\left(\frac{\text{i}\left(d[i]-2\,d[1+i]+d[2+i]\right)}{dx^2}-\text{i}\,d[1+i]\,v[[1+i]]\right)-\text{i}\,d[2+i]\,v[[2+i]]\Bigg)\Bigg)\Bigg)\Bigg)\Bigg)\Bigg)$$

$$k4=\frac{\text{i}\left(psi[[-1+i]]-2\,psi[[i]]+psi[[1+i]]\right)}{dx^2}-\text{i}\,psi[[i]]\,v[[i]]+dt\left(-\text{i}\,v[[i]]\left(\frac{\text{i}\left(psi[[-1+i]]-2\,psi[[i]]+psi[[1+i]]\right)}{dx^2}-\text{i}\,psi[[i]]\,v[[i]]\right)+\frac{1}{dx^2}\,\text{i}\left(\frac{\text{i}\left(psi[[-2+i]]-2\,psi[[-1+i]]+psi[[i]]\right)}{dx^2}+\frac{\text{i}\left(psi[[i]]-2\,psi[[1+i]]+psi[[2+i]]\right)}{dx^2}-\text{i}\,psi[[-1+i]]\,v[[-1+i]]-2\left(\frac{\text{i}\left(psi[[-1+i]]-2\,psi[[i]]+psi[[1+i]]\right)}{dx^2}-\text{i}\,psi[[i]]\,v[[i]]\right)-\text{i}\,psi[[1+i]]\,v[[1+i]]\right)+\frac{1}{2}\,dt\left(-\text{i}\,v[[i]]\left(-\text{i}\,v[[i]]\left(\frac{\text{i}\left(psi[[-1+i]]-2\,psi[[i]]+psi[[1+i]]\right)}{dx^2}-\text{i}\,psi[[i]]\,v[[i]]\right)+\right.\right.$$

$$\frac{1}{dx^2}\,\bar{\imath}\left(\frac{\bar{\imath}\left(\text{psi}[[-2+i]]-2\,\text{psi}[[-1+i]]+\text{psi}[[i]]\right)}{dx^2}+\right.$$
$$\frac{\bar{\imath}\left(\text{psi}[[i]]-2\,\text{psi}[[1+i]]+\text{psi}[[2+i]]\right)}{dx^2}-\bar{\imath}\,\text{psi}[[-1+i]]\,\text{v}[[-1+i]]-2$$
$$\left.\left(\frac{\bar{\imath}\left(\text{psi}[[-1+i]]-2\,\text{psi}[[i]]+\text{psi}[[1+i]]\right)}{dx^2}-\bar{\imath}\,\text{psi}[[i]]\,\text{v}[[i]]\right)-\bar{\imath}\,\text{psi}[[1+i]]\,\text{v}[[1+i]]\right)+$$
$$\frac{1}{dx^2}\,\bar{\imath}\left(-\bar{\imath}\,\text{v}[[-1+i]]\left(\frac{\bar{\imath}\left(\text{psi}[[-2+i]]-2\,\text{psi}[[-1+i]]+\text{psi}[[i]]\right)}{dx^2}-\bar{\imath}\,\text{psi}[[-1+i]]\,\text{v}[[-1+i]]\right)+\right.$$
$$\frac{1}{dx^2}\,\bar{\imath}\left(\frac{\bar{\imath}\left(\text{psi}[[-3+i]]-2\,\text{psi}[[-2+i]]+\text{psi}[[-1+i]]\right)}{dx^2}+\right.$$
$$\frac{\bar{\imath}\left(\text{psi}[[-1+i]]-2\,\text{psi}[[i]]+\text{psi}[[1+i]]\right)}{dx^2}-\bar{\imath}\,\text{psi}[[-2+i]]\,\text{v}[[-2+i]]-$$
$$2\left(\frac{\bar{\imath}\left(\text{psi}[[-2+i]]-2\,\text{psi}[[-1+i]]+\text{psi}[[i]]\right)}{dx^2}-\bar{\imath}\,\text{psi}[[-1+i]]\,\text{v}[[-1+i]]\right)-\bar{\imath}\,\text{psi}[[i]]$$
$$\left.\text{v}[[i]]\right)-\bar{\imath}\,\text{v}[[1+i]]\left(\frac{\bar{\imath}\left(\text{psi}[[i]]-2\,\text{psi}[[1+i]]+\text{psi}[[2+i]]\right)}{dx^2}-\bar{\imath}\,\text{psi}[[1+i]]\,\text{v}[[1+i]]\right)-$$
$$2\left(-\bar{\imath}\,\text{v}[[i]]\left(\frac{\bar{\imath}\left(\text{psi}[[-1+i]]-2\,\text{psi}[[i]]+\text{psi}[[1+i]]\right)}{dx^2}-\bar{\imath}\,\text{psi}[[i]]\,\text{v}[[i]]\right)+\frac{1}{dx^2}\right.$$
$$\bar{\imath}\left(\frac{\bar{\imath}\left(\text{psi}[[-2+i]]-2\,\text{psi}[[-1+i]]+\text{psi}[[i]]\right)}{dx^2}+\right.$$
$$\frac{\bar{\imath}\left(\text{psi}[[i]]-2\,\text{psi}[[1+i]]+\text{psi}[[2+i]]\right)}{dx^2}-\bar{\imath}\,\text{psi}[[-1+i]]\,\text{v}[[-1+i]]-$$
$$2\left(\frac{\bar{\imath}\left(\text{psi}[[-1+i]]-2\,\text{psi}[[i]]+\text{psi}[[1+i]]\right)}{dx^2}-\bar{\imath}\,\text{psi}[[i]]\,\text{v}[[i]]\right)-$$
$$\left.\left.\bar{\imath}\,\text{psi}[[1+i]]\,\text{v}[[1+i]]\right)\right)+\frac{1}{dx^2}\,\bar{\imath}\left(\frac{\bar{\imath}\left(\text{psi}[[-1+i]]-2\,\text{psi}[[i]]+\text{psi}[[1+i]]\right)}{dx^2}+\right.$$
$$\frac{\bar{\imath}\left(\text{psi}[[1+i]]-2\,\text{psi}[[2+i]]+\text{psi}[[3+i]]\right)}{dx^2}-\bar{\imath}\,\text{psi}[[i]]\,\text{v}[[i]]-$$

$$2\left(\frac{\text{i}\left(\text{psi}[\![\text{i}]\!]-2\,\text{psi}[\![1+\text{i}]\!]+\text{psi}[\![2+\text{i}]\!]\right)}{\text{dx}^2}-\text{i}\,\text{psi}[\![1+\text{i}]\!]\,\text{v}[\![1+\text{i}]\!]\right)-$$

$$\text{i}\,\text{psi}[\![2+\text{i}]\!]\,\text{v}[\![2+\text{i}]\!]\Bigg)\Bigg)+$$

$$\frac{1}{2}\,\text{dt}\left(-\text{i}\,\text{v}[\![\text{i}]\!]\left(-\text{i}\,\text{v}[\![\text{i}]\!]\left(-\text{i}\,\text{v}[\![\text{i}]\!]\left(\frac{\text{i}\left(\text{psi}[\![-1+\text{i}]\!]-2\,\text{psi}[\![\text{i}]\!]+\text{psi}[\![1+\text{i}]\!]\right)}{\text{dx}^2}-\text{i}\,\text{psi}[\![\text{i}]\!]\,\text{v}[\![\text{i}]\!]\right)+\right.\right.\right.$$

$$\frac{1}{\text{dx}^2}\,\text{i}\left(\frac{\text{i}\left(\text{psi}[\![-2+\text{i}]\!]-2\,\text{psi}[\![-1+\text{i}]\!]+\text{psi}[\![\text{i}]\!]\right)}{\text{dx}^2}+\right.$$

$$\frac{\text{i}\left(\text{psi}[\![\text{i}]\!]-2\,\text{psi}[\![1+\text{i}]\!]+\text{psi}[\![2+\text{i}]\!]\right)}{\text{dx}^2}-\text{i}\,\text{psi}[\![-1+\text{i}]\!]\,\text{v}[\![-1+\text{i}]\!]-$$

$$2\left(\frac{\text{i}\left(\text{psi}[\![-1+\text{i}]\!]-2\,\text{psi}[\![\text{i}]\!]+\text{psi}[\![1+\text{i}]\!]\right)}{\text{dx}^2}-\text{i}\,\text{psi}[\![\text{i}]\!]\,\text{v}[\![\text{i}]\!]\right)-$$

$$\left.\left.\text{i}\,\text{psi}[\![1+\text{i}]\!]\,\text{v}[\![1+\text{i}]\!]\right)\right)+\frac{1}{\text{dx}^2}\,\text{i}\left(-\text{i}\,\text{v}[\![-1+\text{i}]\!]\right.$$

$$\left.\left(\frac{\text{i}\left(\text{psi}[\![-2+\text{i}]\!]-2\,\text{psi}[\![-1+\text{i}]\!]+\text{psi}[\![\text{i}]\!]\right)}{\text{dx}^2}-\text{i}\,\text{psi}[\![-1+\text{i}]\!]\,\text{v}[\![-1+\text{i}]\!]\right)+\right.$$

$$\frac{1}{\text{dx}^2}\,\text{i}\left(\frac{\text{i}\left(\text{psi}[\![-3+\text{i}]\!]-2\,\text{psi}[\![-2+\text{i}]\!]+\text{psi}[\![-1+\text{i}]\!]\right)}{\text{dx}^2}+\right.$$

$$\frac{\text{i}\left(\text{psi}[\![-1+\text{i}]\!]-2\,\text{psi}[\![\text{i}]\!]+\text{psi}[\![1+\text{i}]\!]\right)}{\text{dx}^2}-\text{i}\,\text{psi}[\![-2+\text{i}]\!]\,\text{v}[\![-2+\text{i}]\!]-$$

$$2\left(\frac{\text{i}\left(\text{psi}[\![-2+\text{i}]\!]-2\,\text{psi}[\![-1+\text{i}]\!]+\text{psi}[\![\text{i}]\!]\right)}{\text{dx}^2}-\text{i}\,\text{psi}[\![-1+\text{i}]\!]\,\text{v}[\![-1+\text{i}]\!]\right)-$$

$$\left.\text{i}\,\text{psi}[\![\text{i}]\!]\,\text{v}[\![\text{i}]\!]\right)-\text{i}\,\text{v}[\![1+\text{i}]\!]\left(\frac{\text{i}\left(\text{psi}[\![\text{i}]\!]-2\,\text{psi}[\![1+\text{i}]\!]+\text{psi}[\![2+\text{i}]\!]\right)}{\text{dx}^2}-\right.$$

$$\left.\text{i}\,\text{psi}[\![1+\text{i}]\!]\,\text{v}[\![1+\text{i}]\!]\right)-2\left(-\text{i}\,\text{v}[\![\text{i}]\!]\left(\frac{\text{i}\left(\text{psi}[\![-1+\text{i}]\!]-2\,\text{psi}[\![\text{i}]\!]+\text{psi}[\![1+\text{i}]\!]\right)}{\text{dx}^2}-\right.\right.$$

$$\left.\left.\text{i}\,\text{psi}[\![\text{i}]\!]\,\text{v}[\![\text{i}]\!]\right)+\frac{1}{\text{dx}^2}\,\text{i}\left(\frac{\text{i}\left(\text{psi}[\![-2+\text{i}]\!]-2\,\text{psi}[\![-1+\text{i}]\!]+\text{psi}[\![\text{i}]\!]\right)}{\text{dx}^2}+\right.\right.$$

$$\frac{\text{i}\left(\text{psi}[[\text{i}]]-2\,\text{psi}[[1+\text{i}]]+\text{psi}[[2+\text{i}]]\right)}{\text{dx}^2}-\text{i}\,\text{psi}[[-1+\text{i}]]\,\text{v}[[-1+\text{i}]]-2\left(\frac{\text{i}\left(\text{psi}[[-1+\text{i}]]-2\,\text{psi}[[\text{i}]]+\text{psi}[[1+\text{i}]]\right)}{\text{dx}^2}-\text{i}\,\text{psi}[[\text{i}]]\,\text{v}[[\text{i}]]\right)-\text{i}\,\text{psi}[[1+\text{i}]]\,\text{v}[[1+\text{i}]]\Bigg)\Bigg)+\frac{1}{\text{dx}^2}\,\text{i}\left(\frac{\text{i}\left(\text{psi}[[-1+\text{i}]]-2\,\text{psi}[[\text{i}]]+\text{psi}[[1+\text{i}]]\right)}{\text{dx}^2}+\frac{\text{i}\left(\text{psi}[[1+\text{i}]]-2\,\text{psi}[[2+\text{i}]]+\text{psi}[[3+\text{i}]]\right)}{\text{dx}^2}-\text{i}\,\text{psi}[[\text{i}]]\,\text{v}[[\text{i}]]-2\left(\frac{\text{i}\left(\text{psi}[[\text{i}]]-2\,\text{psi}[[1+\text{i}]]+\text{psi}[[2+\text{i}]]\right)}{\text{dx}^2}-\text{i}\,\text{psi}[[1+\text{i}]]\,\text{v}[[1+\text{i}]]\right)-\text{i}\,\text{psi}[[2+\text{i}]]\,\text{v}[[2+\text{i}]]\Bigg)\Bigg)\Bigg)+\frac{1}{\text{dx}^2}\,\text{i}\left(-\text{i}\,\text{v}[[-1+\text{i}]]\left(-\text{i}\,\text{v}[[-1+\text{i}]]\left(\frac{\text{i}\left(\text{psi}[[-2+\text{i}]]-2\,\text{psi}[[-1+\text{i}]]+\text{psi}[[\text{i}]]\right)}{\text{dx}^2}-\text{i}\,\text{psi}[[-1+\text{i}]]\,\text{v}[[-1+\text{i}]]\right)+\frac{1}{\text{dx}^2}\,\text{i}\left(\frac{\text{i}\left(\text{psi}[[-3+\text{i}]]-2\,\text{psi}[[-2+\text{i}]]+\text{psi}[[-1+\text{i}]]\right)}{\text{dx}^2}+\frac{\text{i}\left(\text{psi}[[-1+\text{i}]]-2\,\text{psi}[[\text{i}]]+\text{psi}[[1+\text{i}]]\right)}{\text{dx}^2}-\text{i}\,\text{psi}[[-2+\text{i}]]\,\text{v}[[-2+\text{i}]]-2\left(\frac{\text{i}\left(\text{psi}[[-2+\text{i}]]-2\,\text{psi}[[-1+\text{i}]]+\text{psi}[[\text{i}]]\right)}{\text{dx}^2}-\text{i}\,\text{psi}[[-1+\text{i}]]\,\text{v}[[-1+\text{i}]]\right)-\text{i}\,\text{psi}[[\text{i}]]\,\text{v}[[\text{i}]]\Bigg)\Bigg)+\frac{1}{\text{dx}^2}\,\text{i}\left(-\text{i}\,\text{v}[[-2+\text{i}]]\left(\frac{\text{i}\left(\text{psi}[[-3+\text{i}]]-2\,\text{psi}[[-2+\text{i}]]+\text{psi}[[-1+\text{i}]]\right)}{\text{dx}^2}-\text{i}\,\text{psi}[[-2+\text{i}]]\,\text{v}[[-2+\text{i}]]\right)+\frac{1}{\text{dx}^2}\,\text{i}\left(\frac{\text{i}\left(\text{psi}[[-4+\text{i}]]-2\,\text{psi}[[-3+\text{i}]]+\text{psi}[[-2+\text{i}]]\right)}{\text{dx}^2}+\frac{\text{i}\left(\text{psi}[[-2+\text{i}]]-2\,\text{psi}[[-1+\text{i}]]+\text{psi}[[\text{i}]]\right)}{\text{dx}^2}-\text{i}\,\text{psi}[[-3+\text{i}]]\,\text{v}[[-3+\text{i}]]-$$

$$2\left(\frac{\text{i}\left(\text{psi}[[-3+\text{i}]]-2\,\text{psi}[[-2+\text{i}]]+\text{psi}[[-1+\text{i}]]\right)}{\text{dx}^2}-\text{i}\,\text{psi}[[-2+\text{i}]]\,\text{v}[[-2+\text{i}]]\right)-\text{i}\,\text{psi}[[-1+\text{i}]]\,\text{v}[[-1+\text{i}]]\Bigg)-$$

$$\text{i}\,\text{v}[[\text{i}]]\left(\frac{\text{i}\left(\text{psi}[[-1+\text{i}]]-2\,\text{psi}[[\text{i}]]+\text{psi}[[1+\text{i}]]\right)}{\text{dx}^2}-\text{i}\,\text{psi}[[\text{i}]]\,\text{v}[[\text{i}]]\right)-$$

$$2\left(-\text{i}\,\text{v}[[-1+\text{i}]]\left(\frac{\text{i}\left(\text{psi}[[-2+\text{i}]]-2\,\text{psi}[[-1+\text{i}]]+\text{psi}[[\text{i}]]\right)}{\text{dx}^2}-\text{i}\,\text{psi}[[-1+\text{i}]]\,\text{v}[[-1+\text{i}]]\right)+\frac{1}{\text{dx}^2}\,\text{i}\left(\frac{\text{i}\left(\text{psi}[[-3+\text{i}]]-2\,\text{psi}[[-2+\text{i}]]+\text{psi}[[-1+\text{i}]]\right)}{\text{dx}^2}+\frac{\text{i}\left(\text{psi}[[-1+\text{i}]]-2\,\text{psi}[[\text{i}]]+\text{psi}[[1+\text{i}]]\right)}{\text{dx}^2}-\text{i}\,\text{psi}[[-2+\text{i}]]\,\text{v}[[-2+\text{i}]]-2\left(\frac{\text{i}\left(\text{psi}[[-2+\text{i}]]-2\,\text{psi}[[-1+\text{i}]]+\text{psi}[[\text{i}]]\right)}{\text{dx}^2}-\text{i}\,\text{psi}[[-1+\text{i}]]\,\text{v}[[-1+\text{i}]]\right)-\text{i}\,\text{psi}[[\text{i}]]\,\text{v}[[\text{i}]]\right)\right)+$$

$$\frac{1}{\text{dx}^2}\,\text{i}\left(\frac{\text{i}\left(\text{psi}[[-2+\text{i}]]-2\,\text{psi}[[-1+\text{i}]]+\text{psi}[[\text{i}]]\right)}{\text{dx}^2}+\frac{\text{i}\left(\text{psi}[[\text{i}]]-2\,\text{psi}[[1+\text{i}]]+\text{psi}[[2+\text{i}]]\right)}{\text{dx}^2}-\text{i}\,\text{psi}[[-1+\text{i}]]\,\text{v}[[-1+\text{i}]]-2\left(\frac{\text{i}\left(\text{psi}[[-1+\text{i}]]-2\,\text{psi}[[\text{i}]]+\text{psi}[[1+\text{i}]]\right)}{\text{dx}^2}-\text{i}\,\text{psi}[[\text{i}]]\,\text{v}[[\text{i}]]\right)-\text{i}\,\text{psi}[[1+\text{i}]]\,\text{v}[[1+\text{i}]]\right)\right)-\text{i}\,\text{v}[[1+\text{i}]]$$

$$\left(-\text{i}\,\text{v}[[1+\text{i}]]\left(\frac{\text{i}\left(\text{psi}[[\text{i}]]-2\,\text{psi}[[1+\text{i}]]+\text{psi}[[2+\text{i}]]\right)}{\text{dx}^2}-\text{i}\,\text{psi}[[1+\text{i}]]\,\text{v}[[1+\text{i}]]\right)+\frac{1}{\text{dx}^2}\,\text{i}\left(\frac{\text{i}\left(\text{psi}[[-1+\text{i}]]-2\,\text{psi}[[\text{i}]]+\text{psi}[[1+\text{i}]]\right)}{\text{dx}^2}+\right.\right.$$

$$\frac{\mathrm{i}\left(\mathrm{psi}[\![1+\mathrm{i}]\!]-2\,\mathrm{psi}[\![2+\mathrm{i}]\!]+\mathrm{psi}[\![3+\mathrm{i}]\!]\right)}{\mathrm{dx}^2}-\mathrm{i}\,\mathrm{psi}[\![\mathrm{i}]\!]\,\mathrm{v}[\![\mathrm{i}]\!]-$$

$$2\left(\frac{\mathrm{i}\left(\mathrm{psi}[\![\mathrm{i}]\!]-2\,\mathrm{psi}[\![1+\mathrm{i}]\!]+\mathrm{psi}[\![2+\mathrm{i}]\!]\right)}{\mathrm{dx}^2}-\mathrm{i}\,\mathrm{psi}[\![1+\mathrm{i}]\!]\,\mathrm{v}[\![1+\mathrm{i}]\!]-\right.$$

$$\left.\mathrm{i}\,\mathrm{psi}[\![2+\mathrm{i}]\!]\,\mathrm{v}[\![2+\mathrm{i}]\!]\right)\Bigg)-2$$

$$\left(-\mathrm{i}\,\mathrm{v}[\![\mathrm{i}]\!]\left(-\mathrm{i}\,\mathrm{v}[\![\mathrm{i}]\!]\left(\frac{\mathrm{i}\left(\mathrm{psi}[\![-1+\mathrm{i}]\!]-2\,\mathrm{psi}[\![\mathrm{i}]\!]+\mathrm{psi}[\![1+\mathrm{i}]\!]\right)}{\mathrm{dx}^2}-\mathrm{i}\,\mathrm{psi}[\![\mathrm{i}]\!]\,\mathrm{v}[\![\mathrm{i}]\!]\right)+\right.\right.$$

$$\frac{1}{\mathrm{dx}^2}\,\mathrm{i}\left(\frac{\mathrm{i}\left(\mathrm{psi}[\![-2+\mathrm{i}]\!]-2\,\mathrm{psi}[\![-1+\mathrm{i}]\!]+\mathrm{psi}[\![\mathrm{i}]\!]\right)}{\mathrm{dx}^2}+\right.$$

$$\frac{\mathrm{i}\left(\mathrm{psi}[\![\mathrm{i}]\!]-2\,\mathrm{psi}[\![1+\mathrm{i}]\!]+\mathrm{psi}[\![2+\mathrm{i}]\!]\right)}{\mathrm{dx}^2}-\mathrm{i}\,\mathrm{psi}[\![-1+\mathrm{i}]\!]\,\mathrm{v}[\![-1+\mathrm{i}]\!]-$$

$$2\left(\frac{\mathrm{i}\left(\mathrm{psi}[\![-1+\mathrm{i}]\!]-2\,\mathrm{psi}[\![\mathrm{i}]\!]+\mathrm{psi}[\![1+\mathrm{i}]\!]\right)}{\mathrm{dx}^2}-\mathrm{i}\,\mathrm{psi}[\![\mathrm{i}]\!]\,\mathrm{v}[\![\mathrm{i}]\!]\right)-$$

$$\left.\left.\mathrm{i}\,\mathrm{psi}[\![1+\mathrm{i}]\!]\,\mathrm{v}[\![1+\mathrm{i}]\!]\right)\right)+\frac{1}{\mathrm{dx}^2}\,\mathrm{i}\left(-\mathrm{i}\,\mathrm{v}[\![-1+\mathrm{i}]\!]\right.$$

$$\left(\frac{\mathrm{i}\left(\mathrm{psi}[\![-2+\mathrm{i}]\!]-2\,\mathrm{psi}[\![-1+\mathrm{i}]\!]+\mathrm{psi}[\![\mathrm{i}]\!]\right)}{\mathrm{dx}^2}-\mathrm{i}\,\mathrm{psi}[\![-1+\mathrm{i}]\!]\,\mathrm{v}[\![-1+\mathrm{i}]\!]\right)+$$

$$\frac{1}{\mathrm{dx}^2}\,\mathrm{i}\left(\frac{\mathrm{i}\left(\mathrm{psi}[\![-3+\mathrm{i}]\!]-2\,\mathrm{psi}[\![-2+\mathrm{i}]\!]+\mathrm{psi}[\![-1+\mathrm{i}]\!]\right)}{\mathrm{dx}^2}+\right.$$

$$\frac{\mathrm{i}\left(\mathrm{psi}[\![-1+\mathrm{i}]\!]-2\,\mathrm{psi}[\![\mathrm{i}]\!]+\mathrm{psi}[\![1+\mathrm{i}]\!]\right)}{\mathrm{dx}^2}-\mathrm{i}\,\mathrm{psi}[\![-2+\mathrm{i}]\!]\,\mathrm{v}[\![-2+\mathrm{i}]\!]-$$

$$2\left(\frac{\mathrm{i}\left(\mathrm{psi}[\![-2+\mathrm{i}]\!]-2\,\mathrm{psi}[\![-1+\mathrm{i}]\!]+\mathrm{psi}[\![\mathrm{i}]\!]\right)}{\mathrm{dx}^2}-\right.$$

$$\left.\left.\mathrm{i}\,\mathrm{psi}[\![-1+\mathrm{i}]\!]\,\mathrm{v}[\![-1+\mathrm{i}]\!]\right)-\mathrm{i}\,\mathrm{psi}[\![\mathrm{i}]\!]\,\mathrm{v}[\![\mathrm{i}]\!]\right)-\mathrm{i}\,\mathrm{v}[\![1+\mathrm{i}]\!]$$

$$\left(\frac{\mathrm{i}\left(\mathrm{psi}[\![\mathrm{i}]\!]-2\,\mathrm{psi}[\![1+\mathrm{i}]\!]+\mathrm{psi}[\![2+\mathrm{i}]\!]\right)}{\mathrm{dx}^2}-\mathrm{i}\,\mathrm{psi}[\![1+\mathrm{i}]\!]\,\mathrm{v}[\![1+\mathrm{i}]\!]\right)-$$

$$2\left(-i\,v[[i]]\left(\frac{i\left(psi[[-1+i]]-2\,psi[[i]]+psi[[1+i]]\right)}{dx^2}-i\,psi[[i]]\,v[[i]]\right)+\frac{1}{dx^2}\,i\left(\frac{i\left(psi[[-2+i]]-2\,psi[[-1+i]]+psi[[i]]\right)}{dx^2}+\frac{i\left(psi[[i]]-2\,psi[[1+i]]+psi[[2+i]]\right)}{dx^2}-i\,psi[[-1+i]]\,v[[-1+i]]-2\left(\frac{i\left(psi[[-1+i]]-2\,psi[[i]]+psi[[1+i]]\right)}{dx^2}-i\,psi[[i]]\,v[[i]]\right)-i\,psi[[1+i]]\,v[[1+i]]\right)+\frac{1}{dx^2}\,i\left(\frac{i\left(psi[[-1+i]]-2\,psi[[i]]+psi[[1+i]]\right)}{dx^2}+\frac{i\left(psi[[1+i]]-2\,psi[[2+i]]+psi[[3+i]]\right)}{dx^2}-i\,psi[[i]]\,v[[i]]-2\left(\frac{i\left(psi[[i]]-2\,psi[[1+i]]+psi[[2+i]]\right)}{dx^2}-i\,psi[[1+i]]\,v[[1+i]]\right)-i\,psi[[2+i]]\,v[[2+i]]\right)\right)+\frac{1}{dx^2}$$

$$i\left(-i\,v[[i]]\left(\frac{i\left(psi[[-1+i]]-2\,psi[[i]]+psi[[1+i]]\right)}{dx^2}-i\,psi[[i]]\,v[[i]]\right)+\frac{1}{dx^2}\,i\left(\frac{i\left(psi[[-2+i]]-2\,psi[[-1+i]]+psi[[i]]\right)}{dx^2}+\frac{i\left(psi[[i]]-2\,psi[[1+i]]+psi[[2+i]]\right)}{dx^2}-i\,psi[[-1+i]]\,v[[-1+i]]-2\left(\frac{i\left(psi[[-1+i]]-2\,psi[[i]]+psi[[1+i]]\right)}{dx^2}-i\,psi[[i]]\,v[[i]]\right)-i\,psi[[1+i]]\,v[[1+i]]\right)-i\,v[[2+i]]\right)$$

$$\left(\frac{i\left(\text{psi}[[1+i]]-2\,\text{psi}[[2+i]]+\text{psi}[[3+i]]\right)}{dx^2}-i\,\text{psi}[[2+i]]\,v[[2+i]]\right)-$$
$$2\left(-i\,v[[1+i]]\left(\frac{i\left(\text{psi}[[i]]-2\,\text{psi}[[1+i]]+\text{psi}[[2+i]]\right)}{dx^2}-i\,\text{psi}[[1+i]]\,v[[1+i]]\right)+\right.$$
$$\frac{1}{dx^2}\,i\left(\frac{i\left(\text{psi}[[-1+i]]-2\,\text{psi}[[i]]+\text{psi}[[1+i]]\right)}{dx^2}+\right.$$
$$\frac{i\left(\text{psi}[[1+i]]-2\,\text{psi}[[2+i]]+\text{psi}[[3+i]]\right)}{dx^2}-$$
$$i\,\text{psi}[[i]]\,v[[i]]-2\left(\frac{i\left(\text{psi}[[i]]-2\,\text{psi}[[1+i]]+\text{psi}[[2+i]]\right)}{dx^2}-\right.$$
$$\left.i\,\text{psi}[[1+i]]\,v[[1+i]]\right)-i\,\text{psi}[[2+i]]$$
$$\left.\left.v[[2+i]]\right)\right)+\frac{1}{dx^2}\,i\left(\frac{i\left(\text{psi}[[i]]-2\,\text{psi}[[1+i]]+\text{psi}[[2+i]]\right)}{dx^2}+\right.$$
$$\frac{i\left(\text{psi}[[2+i]]-2\,\text{psi}[[3+i]]+\text{psi}[[4+i]]\right)}{dx^2}-i\,\text{psi}[[1+i]]$$
$$v[[1+i]]-2\left(\frac{i\left(\text{psi}[[1+i]]-2\,\text{psi}[[2+i]]+\text{psi}[[3+i]]\right)}{dx^2}-\right.$$
$$\left.\left.i\,\text{psi}[[2+i]]\,v[[2+i]]\right)-i\,\text{psi}[[3+i]]\,v[[3+i]]\right)\Big)\Big)\Big)\Big)\Big)\Big)$$
$$\frac{i\left(\text{psi}[[-1+i]]-2\,\text{psi}[[i]]+\text{psi}[[1+i]]\right)}{dx^2}-i\,\text{psi}[[i]]\,v[[i]]+$$
$$dt\left(-i\,v[[i]]\left(\frac{i\left(\text{psi}[[-1+i]]-2\,\text{psi}[[i]]+\text{psi}[[1+i]]\right)}{dx^2}-i\,\text{psi}[[i]]\,v[[i]]\right)+\frac{1}{dx^2}\right.$$
$$i\left(\frac{i\left(\text{psi}[[-2+i]]-2\,\text{psi}[[-1+i]]+\text{psi}[[i]]\right)}{dx^2}+\frac{i\left(\text{psi}[[i]]-2\,\text{psi}[[1+i]]+\text{psi}[[2+i]]\right)}{dx^2}-i\,\text{psi}[[-1+i]]\right.$$
$$v[[-1+i]]-2\left(\frac{i\left(\text{psi}[[-1+i]]-2\,\text{psi}[[i]]+\text{psi}[[1+i]]\right)}{dx^2}-i\,\text{psi}[[i]]\,v[[i]]\right)-i\,\text{psi}[[1+i]]\,v[[1+i]]\Big)+$$

$$\frac{1}{2}\,\mathrm{dt}\left(-i\,\mathrm{v}[\![\mathrm{i}]\!]\left(-i\,\mathrm{v}[\![\mathrm{i}]\!]\left(\frac{i\left(\mathrm{psi}[\![-1+\mathrm{i}]\!]-2\,\mathrm{psi}[\![\mathrm{i}]\!]+\mathrm{psi}[\![1+\mathrm{i}]\!]\right)}{\mathrm{dx}^2}-i\,\mathrm{psi}[\![\mathrm{i}]\!]\,\mathrm{v}[\![\mathrm{i}]\!]\right)+\right.\right.$$

$$\frac{1}{\mathrm{dx}^2}\,i\left(\frac{i\left(\mathrm{psi}[\![-2+\mathrm{i}]\!]-2\,\mathrm{psi}[\![-1+\mathrm{i}]\!]+\mathrm{psi}[\![\mathrm{i}]\!]\right)}{\mathrm{dx}^2}+\right.$$

$$\frac{i\left(\mathrm{psi}[\![\mathrm{i}]\!]-2\,\mathrm{psi}[\![1+\mathrm{i}]\!]+\mathrm{psi}[\![2+\mathrm{i}]\!]\right)}{\mathrm{dx}^2}-i\,\mathrm{psi}[\![-1+\mathrm{i}]\!]\,\mathrm{v}[\![-1+\mathrm{i}]\!]-$$

$$\left.\left.2\left(\frac{i\left(\mathrm{psi}[\![-1+\mathrm{i}]\!]-2\,\mathrm{psi}[\![\mathrm{i}]\!]+\mathrm{psi}[\![1+\mathrm{i}]\!]\right)}{\mathrm{dx}^2}-i\,\mathrm{psi}[\![\mathrm{i}]\!]\,\mathrm{v}[\![\mathrm{i}]\!]\right)-i\,\mathrm{psi}[\![1+\mathrm{i}]\!]\,\mathrm{v}[\![1+\mathrm{i}]\!]\right)\right)+$$

$$\frac{1}{\mathrm{dx}^2}\,i\left(-i\,\mathrm{v}[\![-1+\mathrm{i}]\!]\left(\frac{i\left(\mathrm{psi}[\![-2+\mathrm{i}]\!]-2\,\mathrm{psi}[\![-1+\mathrm{i}]\!]+\mathrm{psi}[\![\mathrm{i}]\!]\right)}{\mathrm{dx}^2}-i\,\mathrm{psi}[\![-1+\mathrm{i}]\!]\,\mathrm{v}[\![-1+\mathrm{i}]\!]\right)+\right.$$

$$\frac{1}{\mathrm{dx}^2}\,i\left(\frac{i\left(\mathrm{psi}[\![-3+\mathrm{i}]\!]-2\,\mathrm{psi}[\![-2+\mathrm{i}]\!]+\mathrm{psi}[\![-1+\mathrm{i}]\!]\right)}{\mathrm{dx}^2}+\right.$$

$$\frac{i\left(\mathrm{psi}[\![-1+\mathrm{i}]\!]-2\,\mathrm{psi}[\![\mathrm{i}]\!]+\mathrm{psi}[\![1+\mathrm{i}]\!]\right)}{\mathrm{dx}^2}-i\,\mathrm{psi}[\![-2+\mathrm{i}]\!]\,\mathrm{v}[\![-2+\mathrm{i}]\!]-2$$

$$\left(\frac{i\left(\mathrm{psi}[\![-2+\mathrm{i}]\!]-2\,\mathrm{psi}[\![-1+\mathrm{i}]\!]+\mathrm{psi}[\![\mathrm{i}]\!]\right)}{\mathrm{dx}^2}-i\,\mathrm{psi}[\![-1+\mathrm{i}]\!]\,\mathrm{v}[\![-1+\mathrm{i}]\!]\right)-i\,\mathrm{psi}[\![\mathrm{i}]\!]\,\mathrm{v}[\![\mathrm{i}]\!]\Bigg)-$$

$$i\,\mathrm{v}[\![1+\mathrm{i}]\!]\left(\frac{i\left(\mathrm{psi}[\![\mathrm{i}]\!]-2\,\mathrm{psi}[\![1+\mathrm{i}]\!]+\mathrm{psi}[\![2+\mathrm{i}]\!]\right)}{\mathrm{dx}^2}-i\,\mathrm{psi}[\![1+\mathrm{i}]\!]\,\mathrm{v}[\![1+\mathrm{i}]\!]\right)-$$

$$2\left(-i\,\mathrm{v}[\![\mathrm{i}]\!]\left(\frac{i\left(\mathrm{psi}[\![-1+\mathrm{i}]\!]-2\,\mathrm{psi}[\![\mathrm{i}]\!]+\mathrm{psi}[\![1+\mathrm{i}]\!]\right)}{\mathrm{dx}^2}-i\,\mathrm{psi}[\![\mathrm{i}]\!]\,\mathrm{v}[\![\mathrm{i}]\!]\right)+\frac{1}{\mathrm{dx}^2}\,i\right.$$

$$\left(\frac{i\left(\mathrm{psi}[\![-2+\mathrm{i}]\!]-2\,\mathrm{psi}[\![-1+\mathrm{i}]\!]+\mathrm{psi}[\![\mathrm{i}]\!]\right)}{\mathrm{dx}^2}+\frac{i\left(\mathrm{psi}[\![\mathrm{i}]\!]-2\,\mathrm{psi}[\![1+\mathrm{i}]\!]+\mathrm{psi}[\![2+\mathrm{i}]\!]\right)}{\mathrm{dx}^2}-\right.$$

$$i\,\mathrm{psi}[\![-1+\mathrm{i}]\!]\,\mathrm{v}[\![-1+\mathrm{i}]\!]-2\left(\frac{i\left(\mathrm{psi}[\![-1+\mathrm{i}]\!]-2\,\mathrm{psi}[\![\mathrm{i}]\!]+\mathrm{psi}[\![1+\mathrm{i}]\!]\right)}{\mathrm{dx}^2}-\right.$$

$$\left.\left.\left.i\,\mathrm{psi}[\![\mathrm{i}]\!]\,\mathrm{v}[\![\mathrm{i}]\!]\right)-i\,\mathrm{psi}[\![1+\mathrm{i}]\!]\,\mathrm{v}[\![1+\mathrm{i}]\!]\right)\right)+$$

$$\frac{1}{\mathrm{dx}^2}\,i\left(\frac{i\left(\mathrm{psi}[\![-1+\mathrm{i}]\!]-2\,\mathrm{psi}[\![\mathrm{i}]\!]+\mathrm{psi}[\![1+\mathrm{i}]\!]\right)}{\mathrm{dx}^2}+\frac{i\left(\mathrm{psi}[\![1+\mathrm{i}]\!]-2\,\mathrm{psi}[\![2+\mathrm{i}]\!]+\mathrm{psi}[\![3+\mathrm{i}]\!]\right)}{\mathrm{dx}^2}-\right.$$

$$i\,\text{psi}[\![i]\!]\,v[\![i]\!] - 2\left(\frac{i\left(\text{psi}[\![i]\!] - 2\,\text{psi}[\![1+i]\!] + \text{psi}[\![2+i]\!]\right)}{dx^2} - i\,\text{psi}[\![1+i]\!]\,v[\![1+i]\!]\right) - i\,\text{psi}[\![2+i]\!]\,v[\![2+i]\!]\Bigg)\Bigg) +$$

$$\frac{1}{2}\,dt\left(-i\,v[\![i]\!]\left(-i\,v[\![i]\!]\left(-i\,v[\![i]\!]\left(\frac{i\left(\text{psi}[\![-1+i]\!] - 2\,\text{psi}[\![i]\!] + \text{psi}[\![1+i]\!]\right)}{dx^2} - i\,\text{psi}[\![i]\!]\,v[\![i]\!]\right) + \frac{1}{dx^2}\right.\right.\right.$$

$$i\left(\frac{i\left(\text{psi}[\![-2+i]\!] - 2\,\text{psi}[\![-1+i]\!] + \text{psi}[\![i]\!]\right)}{dx^2} + \frac{i\left(\text{psi}[\![i]\!] - 2\,\text{psi}[\![1+i]\!] + \text{psi}[\![2+i]\!]\right)}{dx^2} -$$

$$i\,\text{psi}[\![-1+i]\!]\,v[\![-1+i]\!] - 2\left(\frac{i\left(\text{psi}[\![-1+i]\!] - 2\,\text{psi}[\![i]\!] + \text{psi}[\![1+i]\!]\right)}{dx^2} - i\,\text{psi}[\![i]\!]\,v[\![i]\!]\right) - i\,\text{psi}[\![1+i]\!]\,v[\![1+i]\!]\Bigg)\Bigg) +$$

$$\frac{1}{dx^2}\,i\left(-i\,v[\![-1+i]\!]\left(\frac{i\left(\text{psi}[\![-2+i]\!] - 2\,\text{psi}[\![-1+i]\!] + \text{psi}[\![i]\!]\right)}{dx^2} - i\,\text{psi}[\![-1+i]\!]\,v[\![-1+i]\!]\right) + \frac{1}{dx^2}\,i\left(\frac{i\left(\text{psi}[\![-3+i]\!] - 2\,\text{psi}[\![-2+i]\!] + \text{psi}[\![-1+i]\!]\right)}{dx^2} + \frac{i\left(\text{psi}[\![-1+i]\!] - 2\,\text{psi}[\![i]\!] + \text{psi}[\![1+i]\!]\right)}{dx^2} - i\,\text{psi}[\![-2+i]\!]\,v[\![-2+i]\!] - 2\left(\frac{i\left(\text{psi}[\![-2+i]\!] - 2\,\text{psi}[\![-1+i]\!] + \text{psi}[\![i]\!]\right)}{dx^2} - i\,\text{psi}[\![-1+i]\!]\,v[\![-1+i]\!]\right) - i\,\text{psi}[\![i]\!]\,v[\![i]\!]\right) - i\,v[\![1+i]\!]\left(\frac{i\left(\text{psi}[\![i]\!] - 2\,\text{psi}[\![1+i]\!] + \text{psi}[\![2+i]\!]\right)}{dx^2} - i\,\text{psi}[\![1+i]\!]\,v[\![1+i]\!]\right) - 2\left(-i\,v[\![i]\!]\left(\frac{i\left(\text{psi}[\![-1+i]\!] - 2\,\text{psi}[\![i]\!] + \text{psi}[\![1+i]\!]\right)}{dx^2} - i\,\text{psi}[\![i]\!]\,v[\![i]\!]\right) + \frac{1}{dx^2}\,i\left(\frac{i\left(\text{psi}[\![-2+i]\!] - 2\,\text{psi}[\![-1+i]\!] + \text{psi}[\![i]\!]\right)}{dx^2} + \frac{i\left(\text{psi}[\![i]\!] - 2\,\text{psi}[\![1+i]\!] + \text{psi}[\![2+i]\!]\right)}{dx^2} - i\,\text{psi}[\![-1+i]\!]\,v[\![-1+i]\!] -$$

$$2\left(\frac{i\left(\text{psi}[[-1+i]]-2\,\text{psi}[[i]]+\text{psi}[[1+i]]\right)}{dx^2}-i\,\text{psi}[[i]]\,v[[i]]\right)-$$

$$i\,\text{psi}[[1+i]]\,v[[1+i]]\Bigg)\Bigg)+\frac{1}{dx^2}\,i\left(\frac{i\left(\text{psi}[[-1+i]]-2\,\text{psi}[[i]]+\text{psi}[[1+i]]\right)}{dx^2}+$$

$$\frac{i\left(\text{psi}[[1+i]]-2\,\text{psi}[[2+i]]+\text{psi}[[3+i]]\right)}{dx^2}-i\,\text{psi}[[i]]\,v[[i]]-$$

$$2\left(\frac{i\left(\text{psi}[[i]]-2\,\text{psi}[[1+i]]+\text{psi}[[2+i]]\right)}{dx^2}-i\,\text{psi}[[1+i]]\,v[[1+i]]\right)-$$

$$i\,\text{psi}[[2+i]]\,v[[2+i]]\Bigg)\Bigg)\Bigg)+$$

$$\frac{1}{dx^2}\,i\left(-i\,v[[-1+i]]\left(-i\,v[[-1+i]]\left(\frac{i\left(\text{psi}[[-2+i]]-2\,\text{psi}[[-1+i]]+\text{psi}[[i]]\right)}{dx^2}-i\,\text{psi}[[\right.\right.\right.$$

$$\left.\left.\left.-1+i]]\,v[[-1+i]]\right)+\frac{1}{dx^2}\,i\left(\frac{i\left(\text{psi}[[-3+i]]-2\,\text{psi}[[-2+i]]+\text{psi}[[-1+i]]\right)}{dx^2}+\right.\right.$$

$$\frac{i\left(\text{psi}[[-1+i]]-2\,\text{psi}[[i]]+\text{psi}[[1+i]]\right)}{dx^2}-i\,\text{psi}[[-2+i]]\,v[[-2+i]]-$$

$$2\left(\frac{i\left(\text{psi}[[-2+i]]-2\,\text{psi}[[-1+i]]+\text{psi}[[i]]\right)}{dx^2}-i\,\text{psi}[[-1+i]]\,v[[-1+i]]\right)-$$

$$i\,\text{psi}[[i]]\,v[[i]]\Bigg)\Bigg)+\frac{1}{dx^2}\,i\left(-i\,v[[-2+i]]\right.$$

$$\left.\left(\frac{i\left(\text{psi}[[-3+i]]-2\,\text{psi}[[-2+i]]+\text{psi}[[-1+i]]\right)}{dx^2}-i\,\text{psi}[[-2+i]]\,v[[-2+i]]\right)+\right.$$

$$\frac{1}{dx^2}\,i\left(\frac{i\left(\text{psi}[[-4+i]]-2\,\text{psi}[[-3+i]]+\text{psi}[[-2+i]]\right)}{dx^2}+\right.$$

$$\frac{i\left(\text{psi}[[-2+i]]-2\,\text{psi}[[-1+i]]+\text{psi}[[i]]\right)}{dx^2}-i\,\text{psi}[[-3+i]]\,v[[-3+i]]-$$

$$2\left(\frac{i\left(\text{psi}[[-3+i]]-2\,\text{psi}[[-2+i]]+\text{psi}[[-1+i]]\right)}{dx^2}-\right.$$

$$
\begin{aligned}
&i\,\mathrm{psi}[[-2+i]]\,\mathrm{v}[[-2+i]]\Big) - i\,\mathrm{psi}[[-1+i]]\,\mathrm{v}[[-1+i]]\Big) - \\
&i\,\mathrm{v}[[i]]\left(\frac{i\left(\mathrm{psi}[[-1+i]] - 2\,\mathrm{psi}[[i]] + \mathrm{psi}[[1+i]]\right)}{\mathrm{dx}^2} - i\,\mathrm{psi}[[i]]\,\mathrm{v}[[i]]\right) - \\
&2\left(-i\,\mathrm{v}[[-1+i]]\left(\frac{i\left(\mathrm{psi}[[-2+i]] - 2\,\mathrm{psi}[[-1+i]] + \mathrm{psi}[[i]]\right)}{\mathrm{dx}^2} - i\,\mathrm{psi}[[-1+i]]\right.\right. \\
&\left.\mathrm{v}[[-1+i]]\right) + \frac{1}{\mathrm{dx}^2}\,i\left(\frac{i\left(\mathrm{psi}[[-3+i]] - 2\,\mathrm{psi}[[-2+i]] + \mathrm{psi}[[-1+i]]\right)}{\mathrm{dx}^2} + \right. \\
&\frac{i\left(\mathrm{psi}[[-1+i]] - 2\,\mathrm{psi}[[i]] + \mathrm{psi}[[1+i]]\right)}{\mathrm{dx}^2} - i\,\mathrm{psi}[[-2+i]]\,\mathrm{v}[[-2+i]] - \\
&2\left(\frac{i\left(\mathrm{psi}[[-2+i]] - 2\,\mathrm{psi}[[-1+i]] + \mathrm{psi}[[i]]\right)}{\mathrm{dx}^2} - i\,\mathrm{psi}[[-1+i]]\,\mathrm{v}[[-1+i]]\right) - \\
&\left.\left.i\,\mathrm{psi}[[i]]\,\mathrm{v}[[i]]\right)\right) + \frac{1}{\mathrm{dx}^2}\,i\left(\frac{i\left(\mathrm{psi}[[-2+i]] - 2\,\mathrm{psi}[[-1+i]] + \mathrm{psi}[[i]]\right)}{\mathrm{dx}^2} + \right. \\
&\frac{i\left(\mathrm{psi}[[i]] - 2\,\mathrm{psi}[[1+i]] + \mathrm{psi}[[2+i]]\right)}{\mathrm{dx}^2} - i\,\mathrm{psi}[[-1+i]]\,\mathrm{v}[[-1+i]] - \\
&2\left(\frac{i\left(\mathrm{psi}[[-1+i]] - 2\,\mathrm{psi}[[i]] + \mathrm{psi}[[1+i]]\right)}{\mathrm{dx}^2} - i\,\mathrm{psi}[[i]]\,\mathrm{v}[[i]]\right) - i\,\mathrm{psi}[[1+i]] \\
&\left.\left.\mathrm{v}[[1+i]]\right)\right) - i\,\mathrm{v}[[1+i]]\left(-i\,\mathrm{v}[[1+i]]\left(\frac{i\left(\mathrm{psi}[[i]] - 2\,\mathrm{psi}[[1+i]] + \mathrm{psi}[[2+i]]\right)}{\mathrm{dx}^2} - \right.\right. \\
&i\,\mathrm{psi}[[1+i]]\,\mathrm{v}[[1+i]]\Big) + \frac{1}{\mathrm{dx}^2}\,i\left(\frac{i\left(\mathrm{psi}[[-1+i]] - 2\,\mathrm{psi}[[i]] + \mathrm{psi}[[1+i]]\right)}{\mathrm{dx}^2} + \right. \\
&\frac{i\left(\mathrm{psi}[[1+i]] - 2\,\mathrm{psi}[[2+i]] + \mathrm{psi}[[3+i]]\right)}{\mathrm{dx}^2} - i\,\mathrm{psi}[[i]]\,\mathrm{v}[[i]] - \\
&2\left(\frac{i\left(\mathrm{psi}[[i]] - 2\,\mathrm{psi}[[1+i]] + \mathrm{psi}[[2+i]]\right)}{\mathrm{dx}^2} - i\,\mathrm{psi}[[1+i]]\,\mathrm{v}[[1+i]]\right) - \\
&\left.\left.i\,\mathrm{psi}[[2+i]]\,\mathrm{v}[[2+i]]\right)\right) -
\end{aligned}
$$

$$2\left(-i\,v[[i]]\left(-i\,v[[i]]\left(\frac{i\left(psi[[-1+i]]-2\,psi[[i]]+psi[[1+i]]\right)}{dx^2}-i\,psi[[i]]\,v[[i]]\right)+\right.\right.$$
$$\frac{1}{dx^2}\,i\left(\frac{i\left(psi[[-2+i]]-2\,psi[[-1+i]]+psi[[i]]\right)}{dx^2}+\right.$$
$$\frac{i\left(psi[[i]]-2\,psi[[1+i]]+psi[[2+i]]\right)}{dx^2}-i\,psi[[-1+i]]\,v[[-1+i]]-$$
$$\left.2\left(\frac{i\left(psi[[-1+i]]-2\,psi[[i]]+psi[[1+i]]\right)}{dx^2}-i\,psi[[i]]\,v[[i]]\right)-$$
$$\left.\left.i\,psi[[1+i]]\,v[[1+i]]\right)\right)+\frac{1}{dx^2}\,i\left(-i\,v[[-1+i]]\right.$$
$$\left.\left(\frac{i\left(psi[[-2+i]]-2\,psi[[-1+i]]+psi[[i]]\right)}{dx^2}-i\,psi[[-1+i]]\,v[[-1+i]]\right)+\right.$$
$$\frac{1}{dx^2}\,i\left(\frac{i\left(psi[[-3+i]]-2\,psi[[-2+i]]+psi[[-1+i]]\right)}{dx^2}+\right.$$
$$\frac{i\left(psi[[-1+i]]-2\,psi[[i]]+psi[[1+i]]\right)}{dx^2}-i\,psi[[-2+i]]\,v[[-2+i]]-$$
$$\left.2\left(\frac{i\left(psi[[-2+i]]-2\,psi[[-1+i]]+psi[[i]]\right)}{dx^2}-i\,psi[[-1+i]]\,v[[-1+i]]\right)-\right.$$
$$\left.i\,psi[[i]]\,v[[i]]\right)-i\,v[[1+i]]\left(\frac{i\left(psi[[i]]-2\,psi[[1+i]]+psi[[2+i]]\right)}{dx^2}-i\,psi[[\right.$$
$$\left.1+i]]\,v[[1+i]]\right)-2\left(-i\,v[[i]]\left(\frac{i\left(psi[[-1+i]]-2\,psi[[i]]+psi[[1+i]]\right)}{dx^2}-\right.\right.$$
$$\left.i\,psi[[i]]\,v[[i]]\right)+\frac{1}{dx^2}\,i\left(\frac{i\left(psi[[-2+i]]-2\,psi[[-1+i]]+psi[[i]]\right)}{dx^2}+\right.$$
$$\frac{i\left(psi[[i]]-2\,psi[[1+i]]+psi[[2+i]]\right)}{dx^2}-i\,psi[[-1+i]]\,v[[-1+i]]-$$
$$\left.2\left(\frac{i\left(psi[[-1+i]]-2\,psi[[i]]+psi[[1+i]]\right)}{dx^2}-\right.\right.$$

$$\imath\, \text{psi}[[i]]\, v[[i]] \Big) - \imath\, \text{psi}[[1+i]]\, v[[1+i]] \Big)\Big) +$$

$$\frac{1}{dx^2}\, \imath \left(\frac{\imath \left(\text{psi}[[-1+i]] - 2\, \text{psi}[[i]] + \text{psi}[[1+i]]\right)}{dx^2} + \right.$$

$$\frac{\imath \left(\text{psi}[[1+i]] - 2\, \text{psi}[[2+i]] + \text{psi}[[3+i]]\right)}{dx^2} -$$

$$\imath\, \text{psi}[[i]]\, v[[i]] - 2 \left(\frac{\imath \left(\text{psi}[[i]] - 2\, \text{psi}[[1+i]] + \text{psi}[[2+i]]\right)}{dx^2} - \right.$$

$$\left. \imath\, \text{psi}[[1+i]]\, v[[1+i]] \right) - \imath\, \text{psi}[[2+i]]\, v[[2+i]] \Big)\Big)\Big) +$$

$$\frac{1}{dx^2}\, \imath \left(-\imath\, v[[i]] \left(\frac{\imath \left(\text{psi}[[-1+i]] - 2\, \text{psi}[[i]] + \text{psi}[[1+i]]\right)}{dx^2} - \imath\, \text{psi}[[i]]\, v[[i]] \right) + \right.$$

$$\frac{1}{dx^2}\, \imath \left(\frac{\imath \left(\text{psi}[[-2+i]] - 2\, \text{psi}[[-1+i]] + \text{psi}[[i]]\right)}{dx^2} + \right.$$

$$\frac{\imath \left(\text{psi}[[i]] - 2\, \text{psi}[[1+i]] + \text{psi}[[2+i]]\right)}{dx^2} - \imath\, \text{psi}[[-1+i]]\, v[[-1+i]] -$$

$$2 \left(\frac{\imath \left(\text{psi}[[-1+i]] - 2\, \text{psi}[[i]] + \text{psi}[[1+i]]\right)}{dx^2} - \imath\, \text{psi}[[i]]\, v[[i]] \right) -$$

$$\left. \imath\, \text{psi}[[1+i]]\, v[[1+i]] \right) - \imath\, v[[2+i]]$$

$$\left(\frac{\imath \left(\text{psi}[[1+i]] - 2\, \text{psi}[[2+i]] + \text{psi}[[3+i]]\right)}{dx^2} - \imath\, \text{psi}[[2+i]]\, v[[2+i]] \right) -$$

$$2 \left(-\imath\, v[[1+i]] \left(\frac{\imath \left(\text{psi}[[i]] - 2\, \text{psi}[[1+i]] + \text{psi}[[2+i]]\right)}{dx^2} - \imath\, \text{psi}[[1+i]]\, v[[1+i]] \right) + \right.$$

$$\frac{1}{dx^2}\, \imath \left(\frac{\imath \left(\text{psi}[[-1+i]] - 2\, \text{psi}[[i]] + \text{psi}[[1+i]]\right)}{dx^2} + \right.$$

$$\frac{\imath \left(\text{psi}[[1+i]] - 2\, \text{psi}[[2+i]] + \text{psi}[[3+i]]\right)}{dx^2} - \imath\, \text{psi}[[i]]\, v[[i]] -$$

$$2\left(\frac{i\left(\text{psi}[[i]]-2\,\text{psi}[[1+i]]+\text{psi}[[2+i]]\right)}{dx^2}-i\,\text{psi}[[1+i]]\,v[[1+i]]\right)-$$

$$i\,\text{psi}[[2+i]]\,v[[2+i]]\Bigg)\Bigg)+\frac{1}{dx^2}\,i\left(\frac{i\left(\text{psi}[[i]]-2\,\text{psi}[[1+i]]+\text{psi}[[2+i]]\right)}{dx^2}+$$

$$\frac{i\left(\text{psi}[[2+i]]-2\,\text{psi}[[3+i]]+\text{psi}[[4+i]]\right)}{dx^2}-i\,\text{psi}[[1+i]]\,v[[1+i]]-$$

$$2\left(\frac{i\left(\text{psi}[[1+i]]-2\,\text{psi}[[2+i]]+\text{psi}[[3+i]]\right)}{dx^2}-i\,\text{psi}[[2+i]]\,v[[2+i]]\right)-$$

$$i\,\text{psi}[[3+i]]\,v[[3+i]]\Bigg)\Bigg)\Bigg)\Bigg)\Bigg)\Bigg)$$

k1

$$\frac{i\left(\text{psi}[[-1+i]]-2\,\text{psi}[[i]]+\text{psi}[[1+i]]\right)}{dx^2}-i\,\text{psi}[[i]]\,v[[i]]$$

Simplify[k1]

```
(I*(psi[[-1 + i]] + psi[[1 + i]] - psi[[i]]*(2 + dx^2*v[[i]])))/dx^2
```

Simplify[k2]

```
-((1/(2*dx^4))*(dt*psi[[-2 + i]] + 6*dt*psi[[i]] + 4*I*dx^2*psi[[i]] -
     4*dt*psi[[1 + i]] - 2*I*dx^2*psi[[1 + i]] + dt*psi[[2 + i]] +
     4*dt*dx^2*psi[[i]]*v[[i]] + 2*I*dx^4*psi[[i]]*v[[i]] -
     dt*dx^2*psi[[1 + i]]*v[[i]] + dt*dx^4*psi[[i]]*v[[i]]^2 -
     psi[[-1 + i]]*(4*dt + 2*I*dx^2 + dt*dx^2*v[[-1 + i]] + dt*dx^2*v[[i]]) -
     dt*dx^2*psi[[1 + i]]*v[[1 + i]]))
```

Simplify[k3]

```
(1/(4*dx^6))*(I*((-dt^2)*psi[[-3 + i]] - 15*dt^2*psi[[-1 + i]] -
     8*I*dt*dx^2*psi[[-1 + i]] + 4*dx^4*psi[[-1 + i]] + 20*dt^2*psi[[i]] +
     12*I*dt*dx^2*psi[[i]] - 8*dx^4*psi[[i]] - 15*dt^2*psi[[1 + i]] -
     8*I*dt*dx^2*psi[[1 + i]] + 4*dx^4*psi[[1 + i]] + 6*dt^2*psi[[2 + i]] +
     2*I*dt*dx^2*psi[[2 + i]] - dt^2*psi[[3 + i]] - 6*dt^2*dx^2*psi[[-1 + i]]*
      v[[-1 + i]] - 2*I*dt*dx^4*psi[[-1 + i]]*v[[-1 + i]] +
     dt^2*dx^2*psi[[i]]*v[[-1 + i]] - dt^2*dx^4*psi[[-1 + i]]*v[[-1 + i]]^2 -
     6*dt^2*dx^2*psi[[-1 + i]]*v[[i]] - 2*I*dt*dx^4*psi[[-1 + i]]*v[[i]] +
     16*dt^2*dx^2*psi[[i]]*v[[i]] + 8*I*dt*dx^4*psi[[i]]*v[[i]] -
     4*dx^6*psi[[i]]*v[[i]] - 6*dt^2*dx^2*psi[[1 + i]]*v[[i]] -
     2*I*dt*dx^4*psi[[1 + i]]*v[[i]] + dt^2*dx^2*psi[[2 + i]]*v[[i]] -
     dt^2*dx^4*psi[[-1 + i]]*v[[-1 + i]]*v[[i]] - dt^2*dx^4*psi[[-1 + i]]*v[[i]]^2 +
     6*dt^2*dx^4*psi[[i]]*v[[i]]^2 + 2*I*dt*dx^6*psi[[i]]*v[[i]]^2 -
     dt^2*dx^4*psi[[1 + i]]*v[[i]]^2 + dt^2*dx^6*psi[[i]]*v[[i]]^3 +
     dt*psi[[-2 + i]]*(6*dt + 2*I*dx^2 + dt*dx^2*v[[-2 + i]] + dt*dx^2*v[[-1 + i]] +
       dt*dx^2*v[[i]]) + dt^2*dx^2*psi[[i]]*v[[1 + i]] -
     6*dt^2*dx^2*psi[[1 + i]]*v[[1 + i]] - 2*I*dt*dx^4*psi[[1 + i]]*v[[1 + i]] +
     dt^2*dx^2*psi[[2 + i]]*v[[1 + i]] - dt^2*dx^4*psi[[1 + i]]*v[[i]]*v[[1 + i]] -
     dt^2*dx^4*psi[[1 + i]]*v[[1 + i]]^2 + dt^2*dx^2*psi[[2 + i]]*v[[2 + i]]))
```

Simplify[k4]

```
(1/(4*dx^8))*(dt^3*psi[[-4 + i]] + 28*dt^3*psi[[-2 + i]] +
    12*I*dt^2*dx^2*psi[[-2 + i]] - 4*dt*dx^4*psi[[-2 + i]] - 56*dt^3*psi[[-1 + i]] -
    30*I*dt^2*dx^2*psi[[-1 + i]] + 16*dt*dx^4*psi[[-1 + i]] +
    4*I*dx^6*psi[[-1 + i]] + 70*dt^3*psi[[i]] + 40*I*dt^2*dx^2*psi[[i]] -
    24*dt*dx^4*psi[[i]] - 8*I*dx^6*psi[[i]] - 56*dt^3*psi[[1 + i]] -
    30*I*dt^2*dx^2*psi[[1 + i]] + 16*dt*dx^4*psi[[1 + i]] + 4*I*dx^6*psi[[1 + i]] +
    28*dt^3*psi[[2 + i]] + 12*I*dt^2*dx^2*psi[[2 + i]] - 4*dt*dx^4*psi[[2 + i]] -
    8*dt^3*psi[[3 + i]] - 2*I*dt^2*dx^2*psi[[3 + i]] + dt^3*psi[[4 + i]] +
    8*dt^3*dx^2*psi[[-2 + i]]*v[[-2 + i]] + 2*I*dt^2*dx^4*psi[[-2 + i]]*v[[-2 + i]] -
    dt^3*dx^2*psi[[-1 + i]]*v[[-2 + i]] + dt^3*dx^4*psi[[-2 + i]]*v[[-2 + i]]^2 +
    8*dt^3*dx^2*psi[[-2 + i]]*v[[-1 + i]] + 2*I*dt^2*dx^4*psi[[-2 + i]]*v[[-1 + i]] -
    29*dt^3*dx^2*psi[[-1 + i]]*v[[-1 + i]] - 12*I*dt^2*dx^4*psi[[-1 + i]]*
     v[[-1 + i]] + 4*dt*dx^6*psi[[-1 + i]]*v[[-1 + i]] +
    8*dt^3*dx^2*psi[[i]]*v[[-1 + i]] + 2*I*dt^2*dx^4*psi[[i]]*v[[-1 + i]] -
    dt^3*dx^2*psi[[1 + i]]*v[[-1 + i]] + dt^3*dx^4*psi[[-2 + i]]*v[[-2 + i]]*
     v[[-1 + i]] + dt^3*dx^4*psi[[-2 + i]]*v[[-1 + i]]^2 -
    8*dt^3*dx^4*psi[[-1 + i]]*v[[-1 + i]]^2 - 2*I*dt^2*dx^6*psi[[-1 + i]]*
     v[[-1 + i]]^2 + dt^3*dx^4*psi[[i]]*v[[-1 + i]]^2 -
    dt^3*dx^6*psi[[-1 + i]]*v[[-1 + i]]^3 + 8*dt^3*dx^2*psi[[-2 + i]]*v[[i]] +
    2*I*dt^2*dx^4*psi[[-2 + i]]*v[[i]] - 29*dt^3*dx^2*psi[[-1 + i]]*v[[i]] -
    12*I*dt^2*dx^4*psi[[-1 + i]]*v[[i]] + 4*dt*dx^6*psi[[-1 + i]]*v[[i]] +
    64*dt^3*dx^2*psi[[i]]*v[[i]] + 32*I*dt^2*dx^4*psi[[i]]*v[[i]] -
    16*dt*dx^6*psi[[i]]*v[[i]] - 4*I*dx^8*psi[[i]]*v[[i]] -
    29*dt^3*dx^2*psi[[1 + i]]*v[[i]] - 12*I*dt^2*dx^4*psi[[1 + i]]*v[[i]] +
    4*dt*dx^6*psi[[1 + i]]*v[[i]] + 8*dt^3*dx^2*psi[[2 + i]]*v[[i]] +
    2*I*dt^2*dx^4*psi[[2 + i]]*v[[i]] - dt^3*dx^2*psi[[3 + i]]*v[[i]] +
    dt^3*dx^4*psi[[-2 + i]]*v[[-2 + i]]*v[[i]] + dt^3*dx^4*psi[[-2 + i]]*v[[-1 + i]]*
```

```
 v[[i]] - 8*dt^3*dx^4*psi[[-1 + i]]*v[[-1 + i]]*v[[i]] -
2*I*dt^2*dx^6*psi[[-1 + i]]*v[[-1 + i]]*v[[i]] + 2*dt^3*dx^4*psi[[i]]*v[[-1 + i]]*
 v[[i]] - dt^3*dx^6*psi[[-1 + i]]*v[[-1 + i]]^2*v[[i]] +
dt^3*dx^4*psi[[-2 + i]]*v[[i]]^2 - 8*dt^3*dx^4*psi[[-1 + i]]*v[[i]]^2 -
2*I*dt^2*dx^6*psi[[-1 + i]]*v[[i]]^2 + 30*dt^3*dx^4*psi[[i]]*v[[i]]^2 +
12*I*dt^2*dx^6*psi[[i]]*v[[i]]^2 - 4*dt*dx^8*psi[[i]]*v[[i]]^2 -
8*dt^3*dx^4*psi[[1 + i]]*v[[i]]^2 - 2*I*dt^2*dx^6*psi[[1 + i]]*v[[i]]^2 +
dt^3*dx^4*psi[[2 + i]]*v[[i]]^2 - dt^3*dx^6*psi[[-1 + i]]*v[[-1 + i]]*v[[i]]^2 -
dt^3*dx^6*psi[[-1 + i]]*v[[i]]^3 + 8*dt^3*dx^6*psi[[i]]*v[[i]]^3 +
2*I*dt^2*dx^8*psi[[i]]*v[[i]]^3 - dt^3*dx^6*psi[[1 + i]]*v[[i]]^3 +
dt^3*dx^8*psi[[i]]*v[[i]]^4 - dt^2*psi[[-3 + i]]*
 (8*dt + 2*I*dx^2 + dt*dx^2*v[[-3 + i]] + dt*dx^2*v[[-2 + i]] +
   dt*dx^2*v[[-1 + i]] + dt*dx^2*v[[i]]) - dt^3*dx^2*psi[[-1 + i]]*v[[1 + i]] +
8*dt^3*dx^2*psi[[i]]*v[[1 + i]] + 2*I*dt^2*dx^4*psi[[i]]*v[[1 + i]] -
29*dt^3*dx^2*psi[[1 + i]]*v[[1 + i]] - 12*I*dt^2*dx^4*psi[[1 + i]]*v[[1 + i]] +
4*dt*dx^6*psi[[1 + i]]*v[[1 + i]] + 8*dt^3*dx^2*psi[[2 + i]]*v[[1 + i]] +
2*I*dt^2*dx^4*psi[[2 + i]]*v[[1 + i]] - dt^3*dx^2*psi[[3 + i]]*v[[1 + i]] +
2*dt^3*dx^4*psi[[i]]*v[[i]]*v[[1 + i]] - 8*dt^3*dx^4*psi[[1 + i]]*v[[i]]*
 v[[1 + i]] - 2*I*dt^2*dx^6*psi[[1 + i]]*v[[i]]*v[[1 + i]] +
dt^3*dx^4*psi[[2 + i]]*v[[i]]*v[[1 + i]] - dt^3*dx^6*psi[[1 + i]]*v[[i]]^2*
 v[[1 + i]] + dt^3*dx^4*psi[[i]]*v[[1 + i]]^2 - 8*dt^3*dx^4*psi[[1 + i]]*
 v[[1 + i]]^2 - 2*I*dt^2*dx^6*psi[[1 + i]]*v[[1 + i]]^2 +
dt^3*dx^4*psi[[2 + i]]*v[[1 + i]]^2 - dt^3*dx^6*psi[[1 + i]]*v[[i]]*
 v[[1 + i]]^2 - dt^3*dx^6*psi[[1 + i]]*v[[1 + i]]^3 -
dt^3*dx^2*psi[[1 + i]]*v[[2 + i]] + 8*dt^3*dx^2*psi[[2 + i]]*v[[2 + i]] +
2*I*dt^2*dx^4*psi[[2 + i]]*v[[2 + i]] - dt^3*dx^2*psi[[3 + i]]*v[[2 + i]] +
dt^3*dx^4*psi[[2 + i]]*v[[i]]*v[[2 + i]] + dt^3*dx^4*psi[[2 + i]]*v[[1 + i]]*
 v[[2 + i]] + dt^3*dx^4*psi[[2 + i]]*v[[2 + i]]^2 -
dt^3*dx^2*psi[[3 + i]]*v[[3 + i]])
```