In[1]:=
```
$Assumptions = {Element [n, Integers], n > 0}
```
Out[1]=
$$\{n \in \text{Integers}, n > 0\}$$

In[2]:=
```
u[n_, x_] = A Sin[n Pix]
```
Out[2]=
$$A\,\text{Sin}[n \pi x]$$

In[3]:=
```
Integrate[u[n, x]^2, {x, 0, 1}]
```
Out[3]=
$$\frac{A^2}{2}$$

In[4]:=
```
A = Sqrt[2]
```
Out[4]=
$$\sqrt{2}$$

In[5]:=
```
psi0[n_] = Sqrt[2] Integrate[u[n, x], {x, 0, 1/2}]
```
Out[5]=
$$\frac{4\,\text{Sin}\left[\frac{n\pi}{4}\right]^2}{n\pi}$$

In[10]:=
```
S[t_, x_] = Sum [Exp[-I n^2 Pi^2 t] psi0[n] u[n, x], {n, 1, 1000}];
```

In[11]:=
```
Plot[{Abs[S[0, x]]^2, Abs[S[0.02, x]]^2}, {x, 0, 1}]
```
Out[11]=