

```
In[1]:= create[f_] :=  $\frac{1}{\text{Sqrt}[2 \hbar m w]} (-\hbar D[f, x] + m w x f)$ 
```

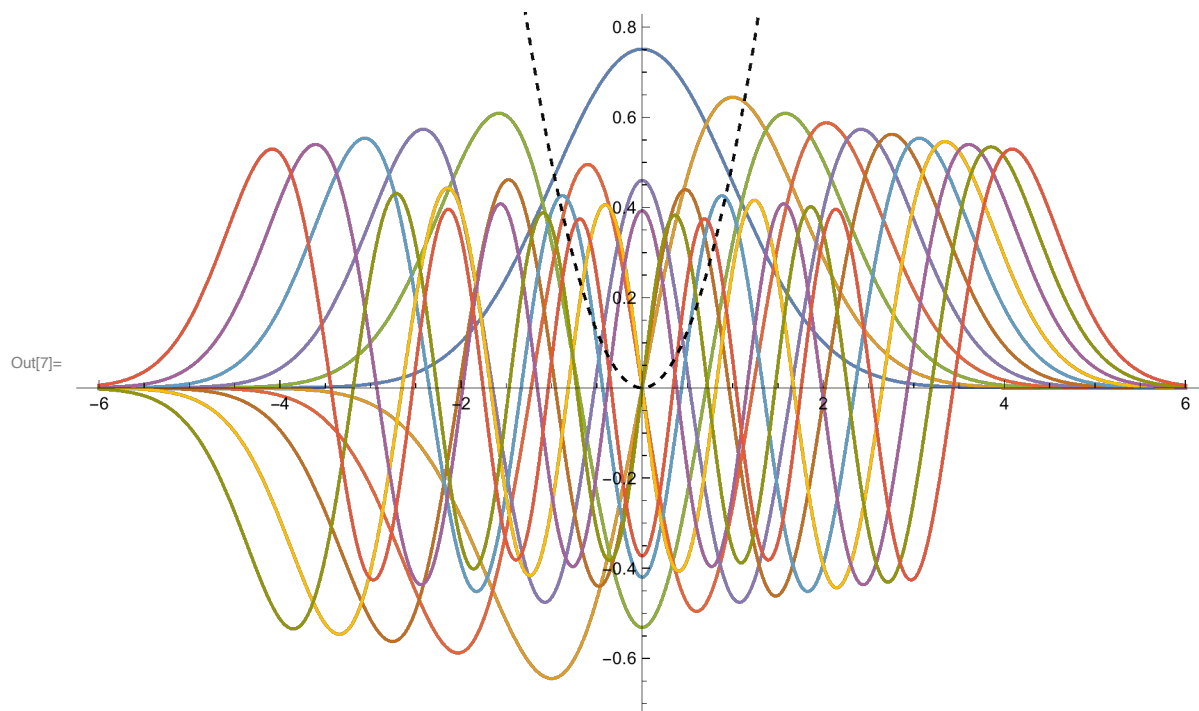
```
In[2]:= phi0 :=  $\left(m \frac{w}{\pi \hbar}\right)^{(1/4)} \text{Exp}\left[-m \frac{w}{2 \hbar} x^2\right]$ 
```

```
In[3]:= hbar = m = w = 1
```

```
Out[3]= 1
```

```
In[4]:= phin[n_] :=  $\frac{1}{\text{Sqrt}[n!]} \text{Nest}[\text{create}, \text{phi0}, n]$ 
```

```
In[7]:= Show[Plot[Evaluate[Table[phin[n], {n, 0, 10, 1}]], {x, -6, 6}, PlotRange -> Full],  
Plot[1/2 m w^2 x^2, {x, -5, 5}, PlotStyle -> Dashed, ColorFunction -> GrayLevel]]
```

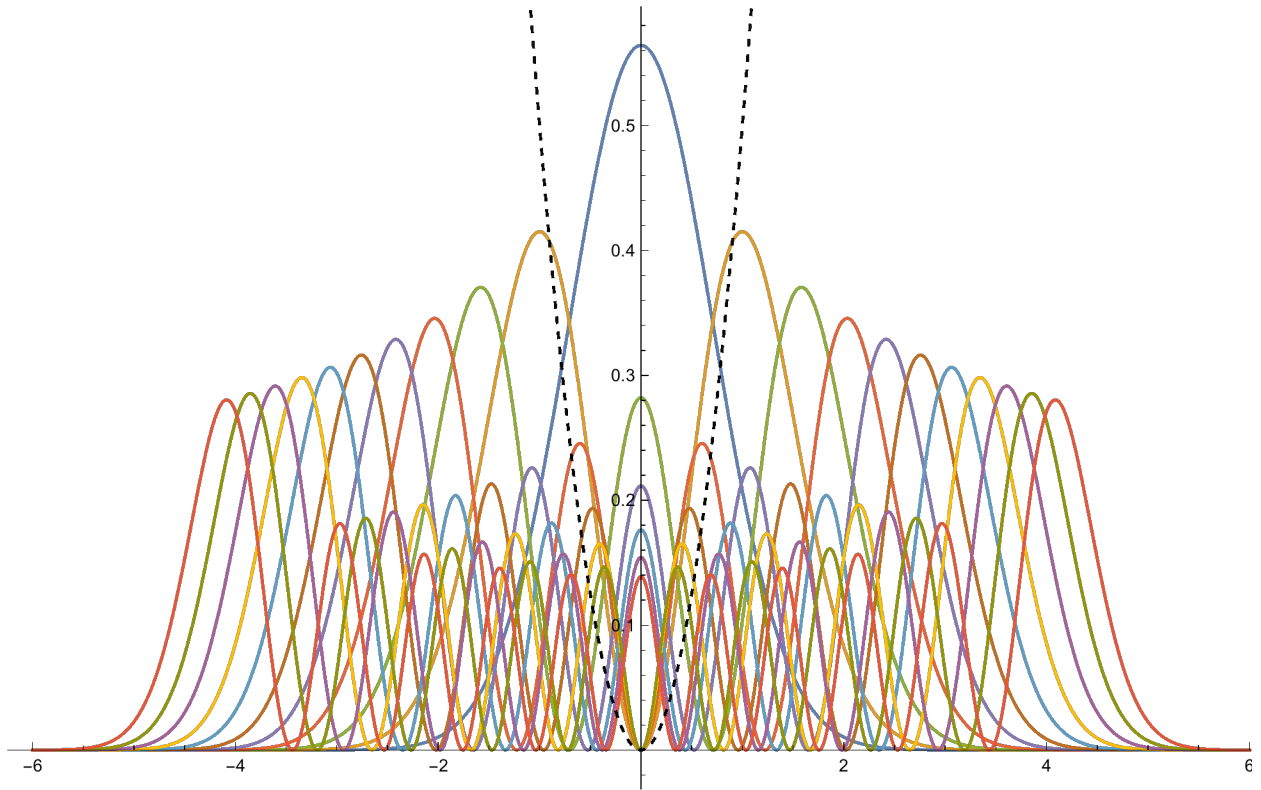


```

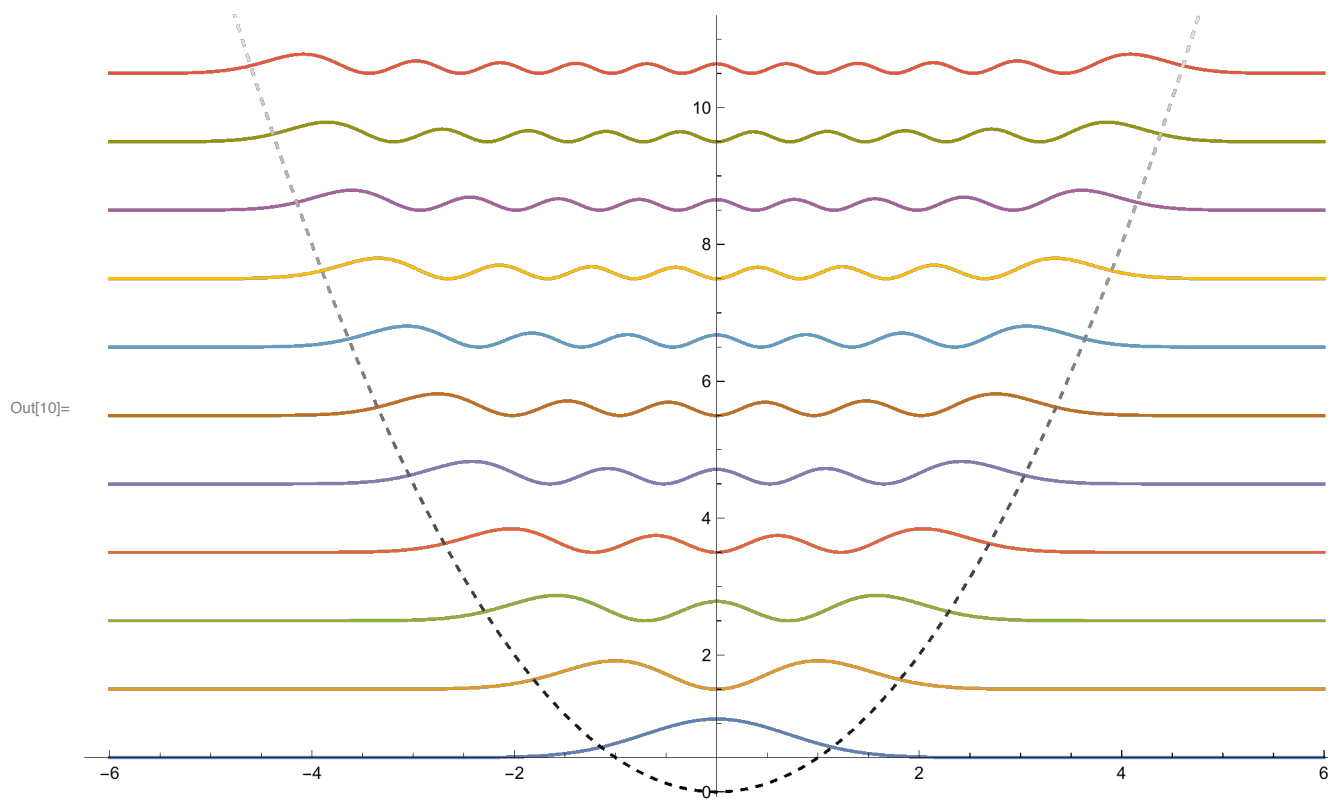
In[9]:= Show[Plot[Evaluate[Table[phin[n]^2, {n, 0, 10, 1}]], {x, -6, 6}, PlotRange -> Full],
  Plot[1/2 m w^2 x^2, {x, -5, 5}, PlotStyle -> Dashed, ColorFunction -> GrayLevel]]

```

Out[9]=

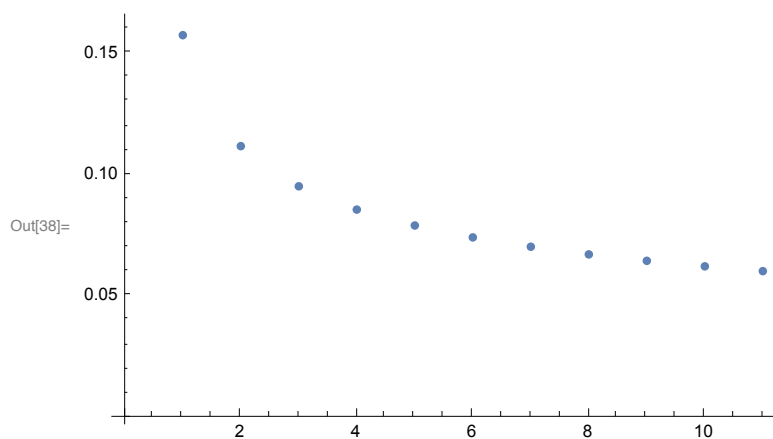


```
In[10]:= Show[Plot[Evaluate[Table[phin[n]^2 + (n + 1/2) hbar w, {n, 0, 10, 1}]],
  {x, -6, 6}, PlotRange -> Full],
  Plot[1/2 m w^2 x^2, {x, -5, 5}, PlotStyle -> Dashed, ColorFunction -> GrayLevel]]
```



```
In[16]:= limit[n_] := Solve[1/2 m w^2 x^2 == (n + 1/2) hbar w, x]
  limitSet := Table[limit[n], {n, 0, 10, 1}]
```

```
In[38]:= ListPlot[
  Table[N[1 - Integrate[phin[n]^2, {x, -Sqrt[1 + 2 n], Sqrt[1 + 2 n]}]], {n, 0, 10, 1}]]
```



In[34]:= **Part[limitSet, 4]**

Out[34]= $\left\{\left\{x \rightarrow -\sqrt{7}\right\}, \left\{x \rightarrow \sqrt{7}\right\}\right\}$

In[35]:= **limitSet**

Out[35]= $\left\{\left\{\left\{x \rightarrow -1\right\}, \left\{x \rightarrow 1\right\}\right\}, \left\{\left\{x \rightarrow -\sqrt{3}\right\}, \left\{x \rightarrow \sqrt{3}\right\}\right\}, \left\{\left\{x \rightarrow -\sqrt{5}\right\}, \left\{x \rightarrow \sqrt{5}\right\}\right\}, \right.$
 $\left.\left\{\left\{x \rightarrow -\sqrt{7}\right\}, \left\{x \rightarrow \sqrt{7}\right\}\right\}, \left\{\left\{x \rightarrow -3\right\}, \left\{x \rightarrow 3\right\}\right\}, \left\{\left\{x \rightarrow -\sqrt{11}\right\}, \left\{x \rightarrow \sqrt{11}\right\}\right\}, \right.$
 $\left.\left\{\left\{x \rightarrow -\sqrt{13}\right\}, \left\{x \rightarrow \sqrt{13}\right\}\right\}, \left\{\left\{x \rightarrow -\sqrt{15}\right\}, \left\{x \rightarrow \sqrt{15}\right\}\right\}, \right.$
 $\left.\left\{\left\{x \rightarrow -\sqrt{17}\right\}, \left\{x \rightarrow \sqrt{17}\right\}\right\}, \left\{\left\{x \rightarrow -\sqrt{19}\right\}, \left\{x \rightarrow \sqrt{19}\right\}\right\}, \left\{\left\{x \rightarrow -\sqrt{21}\right\}, \left\{x \rightarrow \sqrt{21}\right\}\right\}\right\}$

In[39]:= **Table[N[1 - Integrate[phin[n]^2, {x, -Sqrt[1 + 2 n], Sqrt[1 + 2 n]}]], {n, 0, 10, 1}]**

Out[39]= {0.157299, 0.11161, 0.0950694, 0.0854829, 0.0789264,
0.0740342, 0.0701809, 0.0670313, 0.0643863, 0.0621191, 0.0601438}