Notes for Quantum Mechanics

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Date[]
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{2005, 1, 19, 8, 17, 27.0594400}

{2004, 11, 23, 11, 31, 28.3195952}

psi0 = Exp[$\frac{-x^2}{2}$] / Sqrt[Sqrt[Pi]]

$$\frac{e^{-\frac{x^2}{2}}}{\sqrt[4]{\pi}}$$

psi1 = FullSimplify[$x * \%$ − $D[\%, x]$] / Sqrt[2 ∗ 1]

$$\frac{\sqrt{2}\, e^{-\frac{x^2}{2}}\, x}{\sqrt[4]{\pi}}$$

psi2 = FullSimplify[$x * \%$ − $D[\%, x]$] / Sqrt[2 ∗ 2]

$$\frac{e^{-\frac{x^2}{2}}\,(2\,x^2-1)}{\sqrt{2}\,\sqrt[4]{\pi}}$$

psi3 = FullSimplify[$x * \%$ − $D[\%, x]$] / Sqrt[2 ∗ 3]

$$\frac{e^{-\frac{x^2}{2}}\,x\,(2\,x^2-3)}{\sqrt{3}\,\sqrt[4]{\pi}}$$

```
psi4 = FullSimplify[x * % - D[%, x]] / Sqrt[2 * 4]
```

$$\frac{e^{-\frac{x^2}{2}} (4 (x^2 - 3) x^2 + 3)}{2 \sqrt{6} \sqrt[4]{\pi}}$$

```
psi5 = FullSimplify[x * % - D[%, x]] / Sqrt[2 * 5]
```

$$\frac{e^{-\frac{x^2}{2}} x (4 (x^2 - 5) x^2 + 15)}{2 \sqrt{15} \sqrt[4]{\pi}}$$

```
psi6 = FullSimplify[x * % - D[%, x]] / Sqrt[2 * 6]
```

$$\frac{e^{-\frac{x^2}{2}} (8 x^6 - 60 x^4 + 90 x^2 - 15)}{12 \sqrt{5} \sqrt[4]{\pi}}$$

```
psi7 = FullSimplify[x * % - D[%, x]] / Sqrt[2 * 7]
```

$$\frac{e^{-\frac{x^2}{2}} x (8 x^6 - 84 x^4 + 210 x^2 - 105)}{6 \sqrt{70} \sqrt[4]{\pi}}$$

```
psi8 = FullSimplify[x * % - D[%, x]] / Sqrt[2 * 8]
```

$$\frac{e^{-\frac{x^2}{2}} (16 x^8 - 224 x^6 + 840 x^4 - 840 x^2 + 105)}{24 \sqrt{70} \sqrt[4]{\pi}}$$

```
psi9 = FullSimplify[x * % - D[%, x]] / Sqrt[2 * 9]
```

$$\frac{e^{-\frac{x^2}{2}} x (8 (2 x^6 - 36 x^4 + 189 x^2 - 315) x^2 + 945)}{72 \sqrt{35} \sqrt[4]{\pi}}$$

```
psi10 = FullSimplify[x * % - D[%, x]] / Sqrt[2 * 10]
```

$$\frac{e^{-\frac{x^2}{2}} \left(2 x^2 \left(4 \left(4 x^6 - 90 x^4 + 630 x^2 - 1575\right) x^2 + 4725\right) - 945\right)}{720 \sqrt{7} \sqrt[4]{\pi}}$$

```
psi11 = FullSimplify[x * % - D[%, x]] / Sqrt[2 * 11]
```

$$\frac{e^{-\frac{x^2}{2}} x \left(32 x^{10} - 880 x^8 + 7920 x^6 - 27720 x^4 + 34650 x^2 - 10395\right)}{360 \sqrt{154} \sqrt[4]{\pi}}$$

```
psi12 = FullSimplify[x * % - D[%, x]] / Sqrt[2 * 12]
```

$$\frac{e^{-\frac{x^2}{2}} \left(4 \left(16 x^{10} - 528 x^8 + 5940 x^6 - 27720 x^4 + 51975 x^2 - 31185\right) x^2 + 10395\right)}{1440 \sqrt{231} \sqrt[4]{\pi}}$$

```
psi13 = FullSimplify[x * % - D[%, x]] / Sqrt[2 * 13]
```

$$\frac{e^{-\frac{x^2}{2}} x \left(4 \left(16 x^{10} - 624 x^8 + 8580 x^6 - 51480 x^4 + 135135 x^2 - 135135\right) x^2 + 135135\right)}{720 \sqrt{6006} \sqrt[4]{\pi}}$$

```
psi14 = FullSimplify[x * % - D[%, x]] / Sqrt[2 * 14]
```

$$\frac{e^{-\frac{x^2}{2}} \left(2 x^2 \left(2 \left(2 x^2 \left(16 x^8 - 728 x^6 + 12012 x^4 - 90090 x^2 + 315315\right) - 945945\right) x^2 + 945945\right) - 135135\right)}{10080 \sqrt{858} \sqrt[4]{\pi}}$$

```
psi15 = FullSimplify[x * % - D[%, x]] / Sqrt[2 * 15]
```

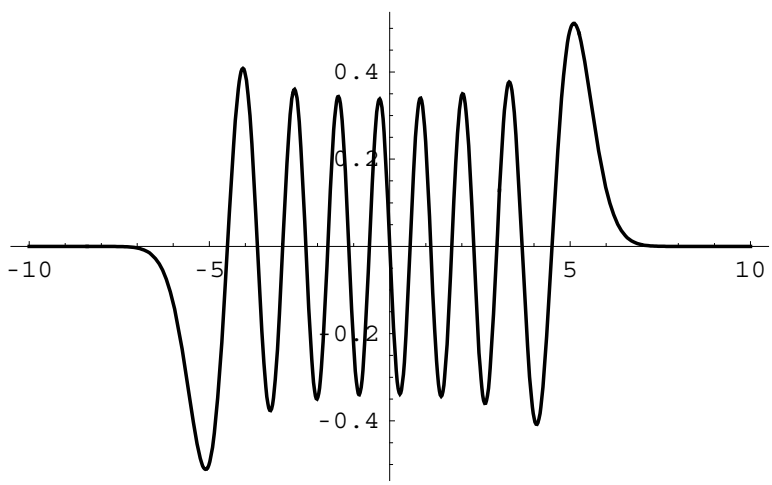
$$\frac{e^{-\frac{x^2}{2}} x \left(2 x^2 \left(2 \left(2 x^2 \left(2 \left(8 x^6 - 420 x^4 + 8190 x^2 - 75075\right) x^2 + 675675\right) - 2837835\right) x^2 + 4729725\right) - 2027025\right)}{30240 \sqrt{715} \sqrt[4]{\pi}}$$

```
psi16 = FullSimplify[x * % - D[%, x]] / Sqrt[2 * 16]
```

$$\frac{1}{120960\sqrt{1430}\,\sqrt[4]{\pi}}\left(e^{-\frac{x^2}{2}}\left(16\left(x^2\left(2\left(x^2\left(8\left(x^6-60x^4+1365x^2-15015\right)x^2+675675\right)-1891890\right)x^2+4729725\right)-2027025\right)x^2+2027025\right)\right)$$

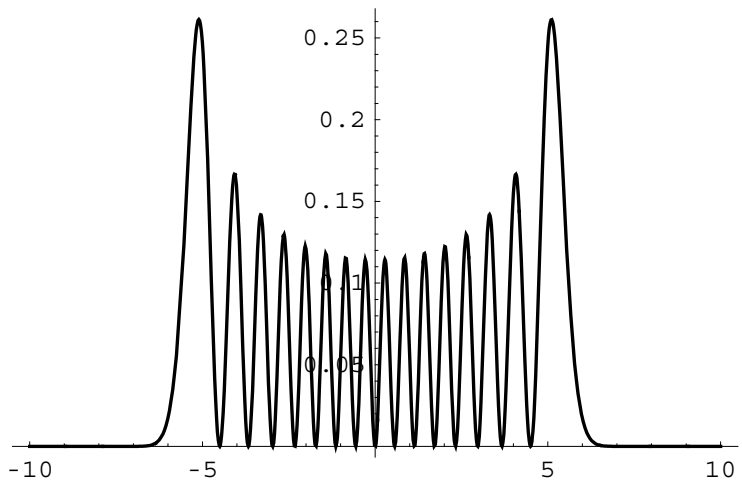
```
z[x_] := psi15
```

```
Plot[z[x], {x, -10., 10.}, PlotStyle → {{Thickness[0.005], RGBColor[0, 0, 0]}}]
```



- Graphics -

```
c = Plot[(z[x])^2, {x, -10., 10.},
  PlotStyle → {{Thickness[0.005], RGBColor[0, 0, 0]}}]
```



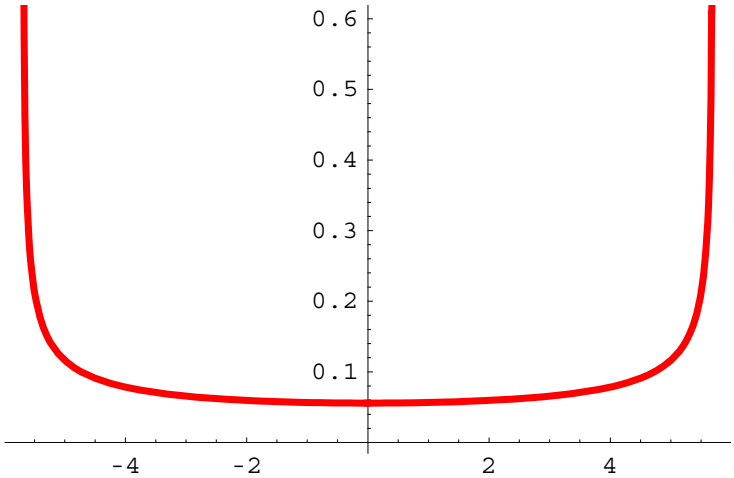
- Graphics -

$$b[x_] := \frac{1}{\text{Pi} * \text{Sqrt}(a^2 - x^2)}$$

$$a = 5.7$$

5.7

```
d = Plot[b[x], {x, -a, a}, PlotStyle → {{Thickness[0.01], RGBColor[1, 0, 0]}}]
```



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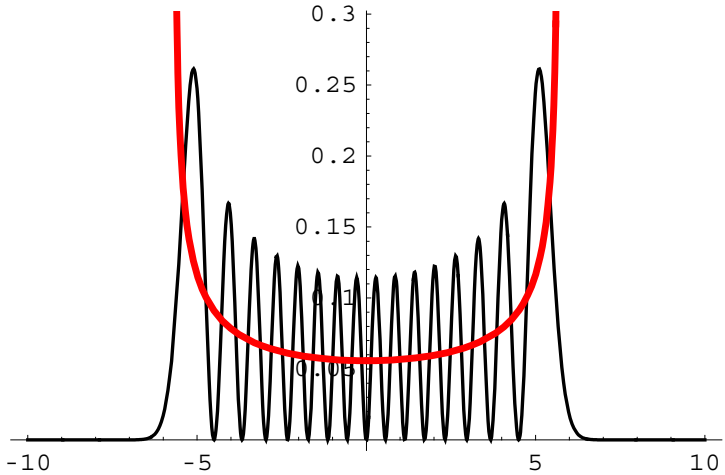
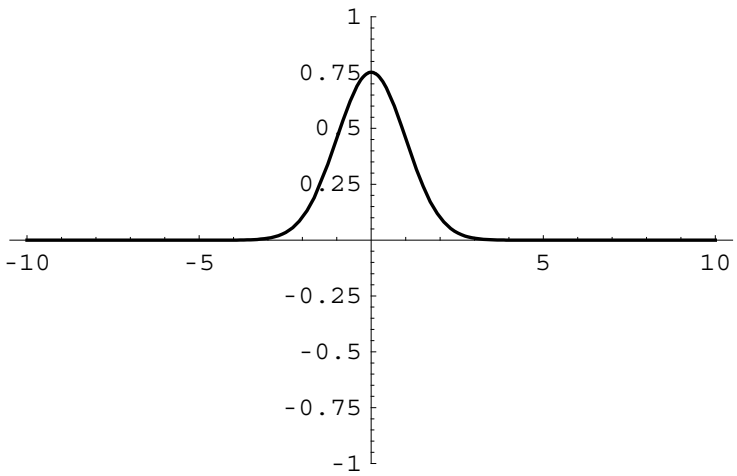
Show[*c*, *d*]



- Graphics -

***y*[x_] := psi0**

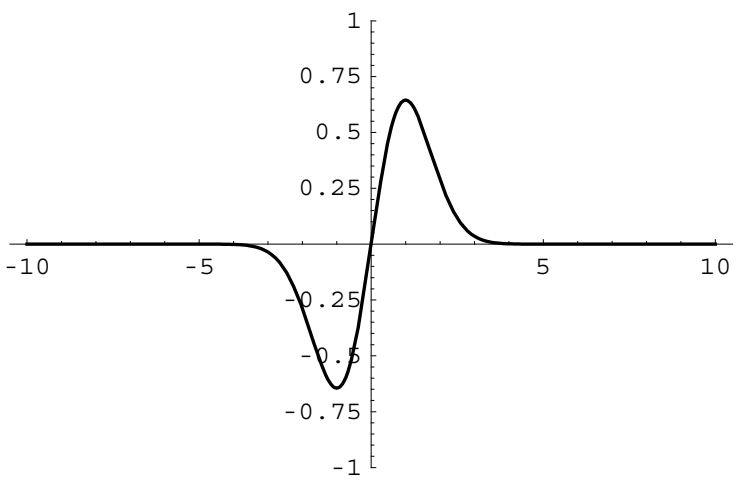
```
Plot[y[x], {x, -10., 10.}, PlotRange → {-1., 1.},
 PlotStyle → {{Thickness[0.005], RGBColor[0, 0, 0]}}]
```



- Graphics -

e[x_] := psi1

```
Plot[e[x], {x, -10., 10.}, PlotRange → {-1., 1.},
 PlotStyle → {{Thickness[0.005], RGBColor[0, 0, 0]}}]
```



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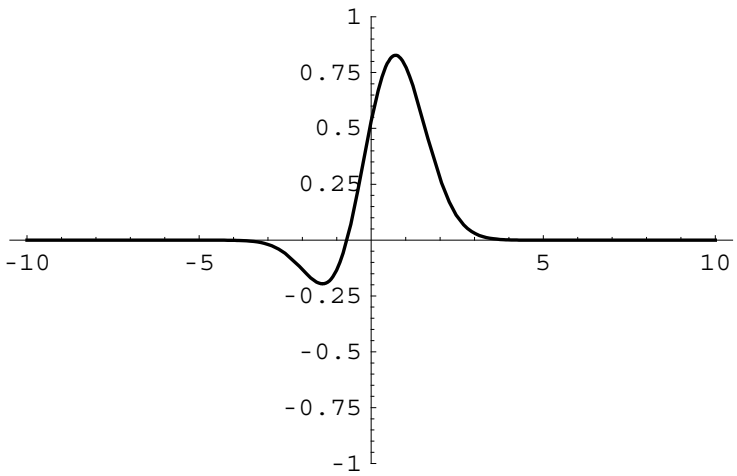
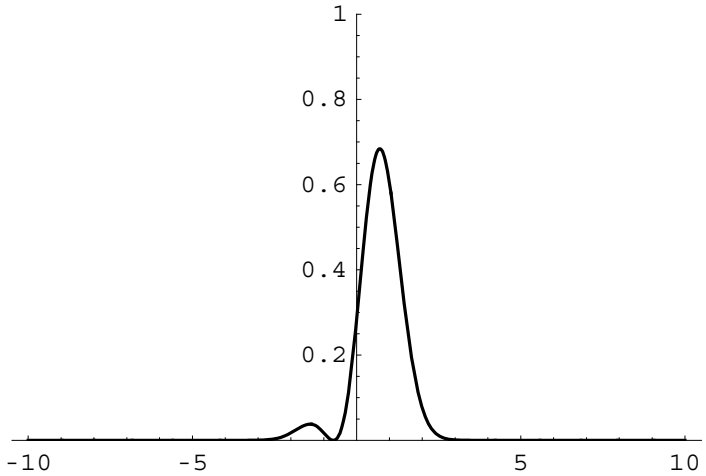
f[x_] := (psi0 + psi1) / Sqrt[2.]

```
Plot[f[x], {x, -10., 10.}, PlotRange → {-1., 1.},
 PlotStyle → {{Thickness[0.005], RGBColor[0, 0, 0]}}]
```

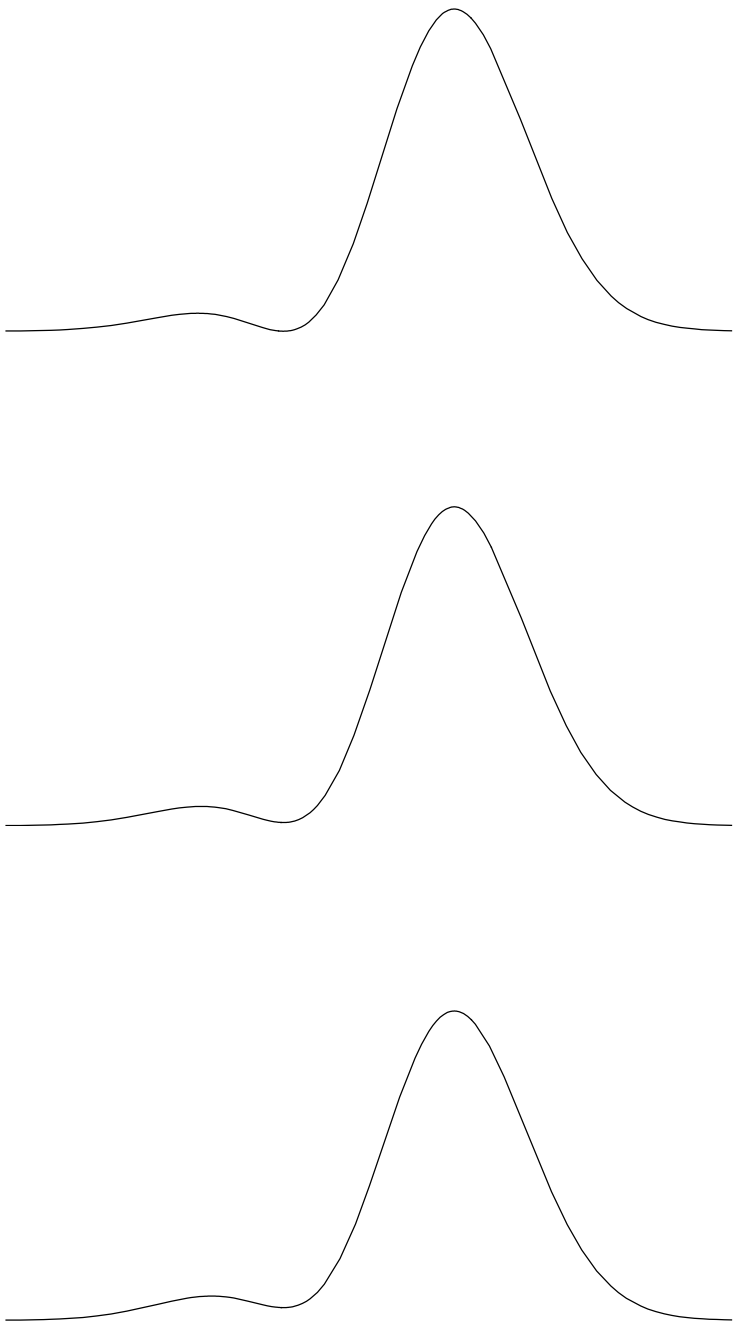
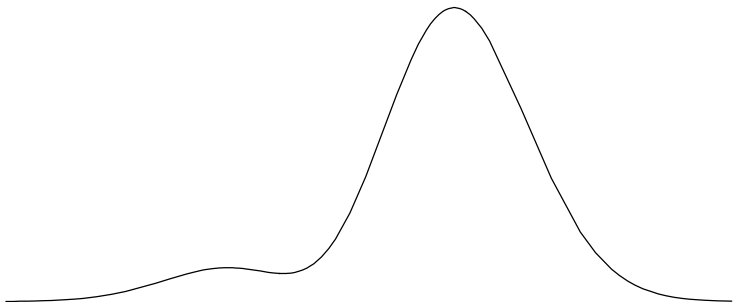
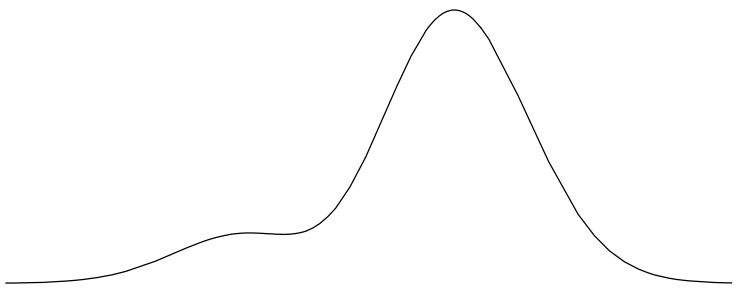
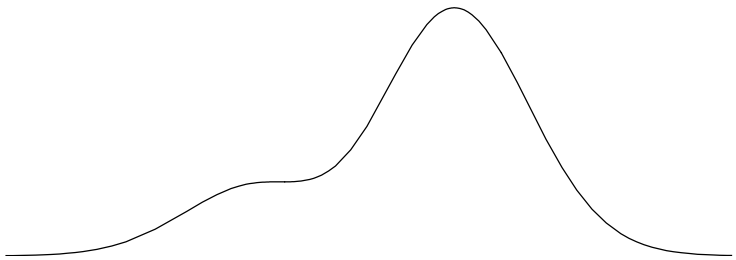
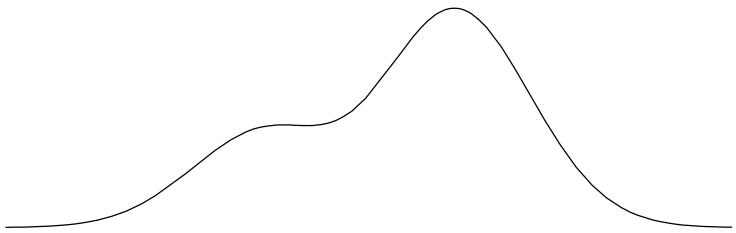
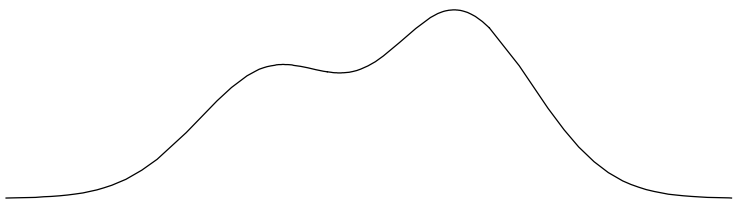
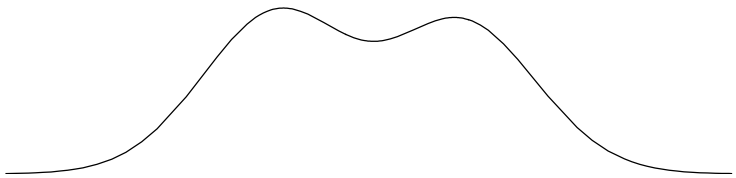
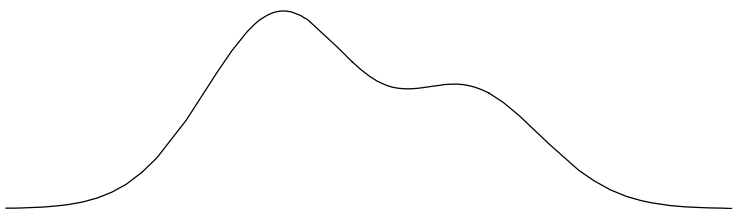
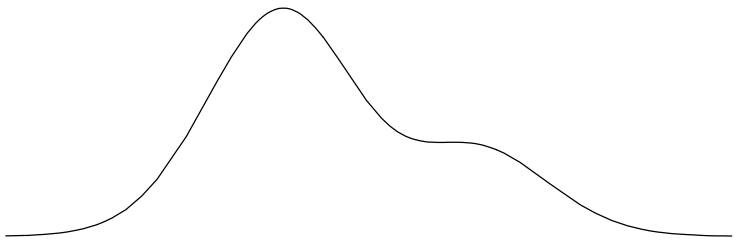
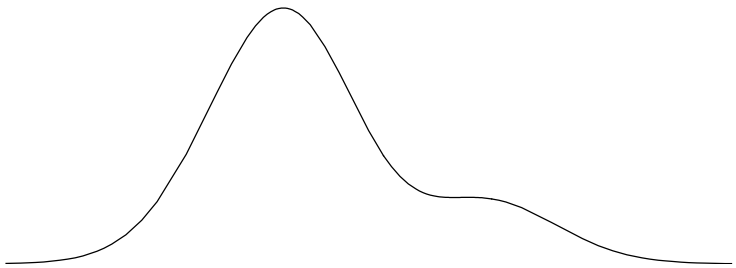
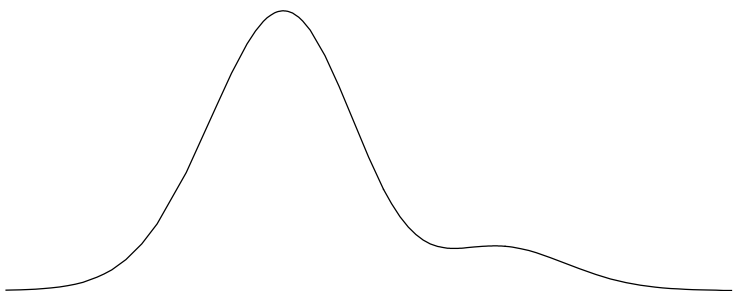
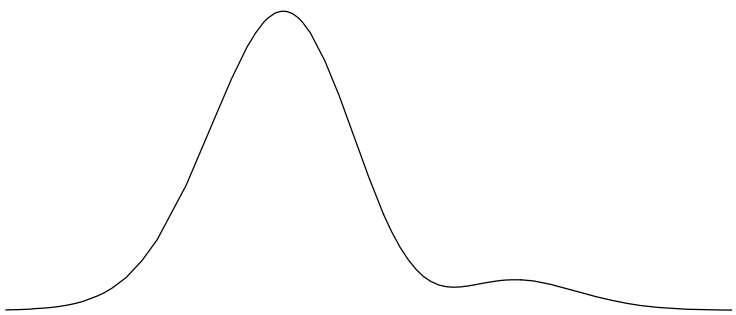
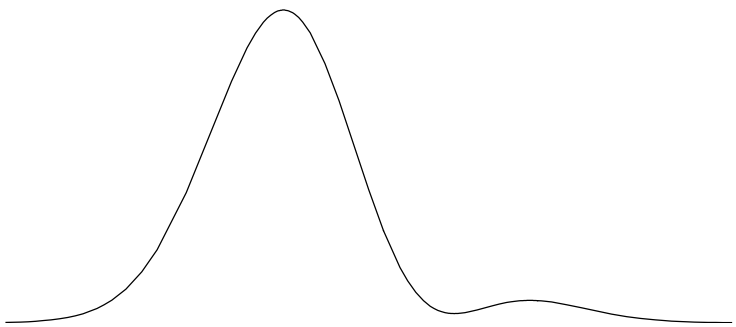
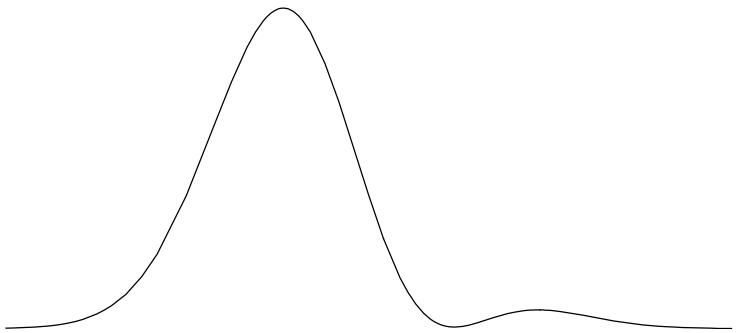
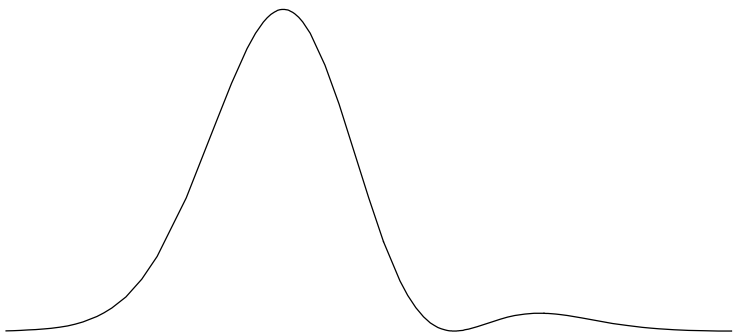
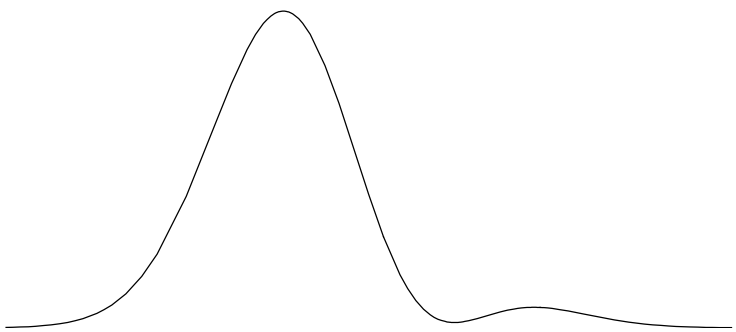
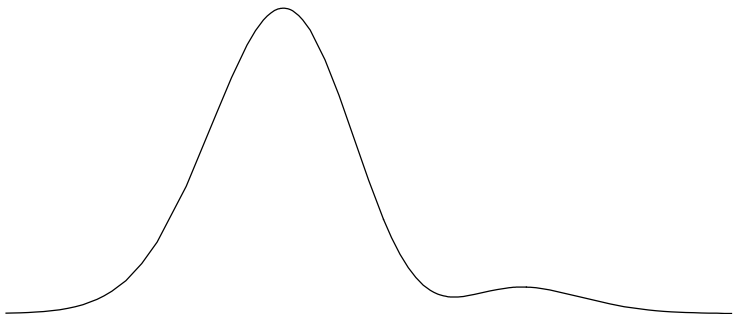
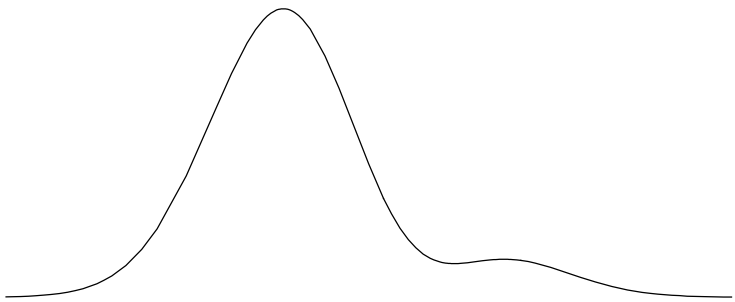
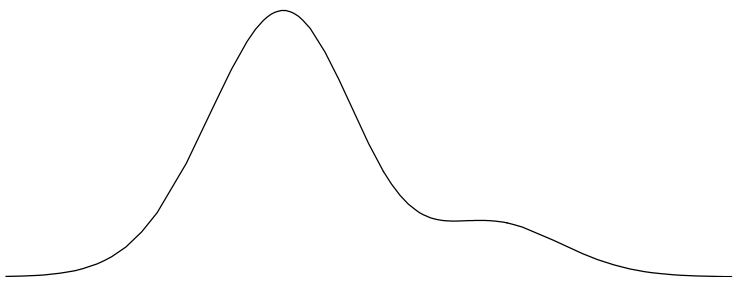
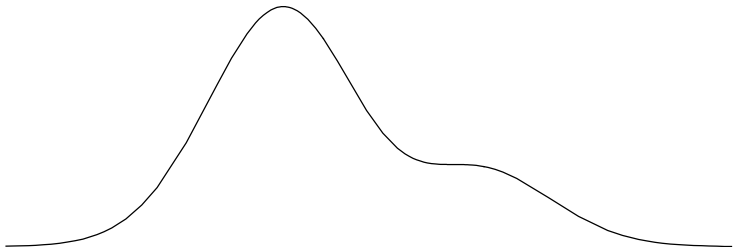
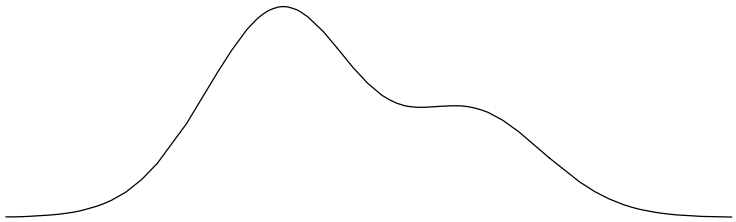
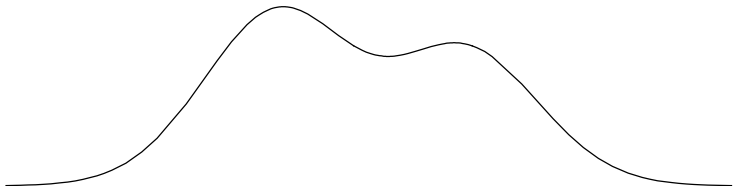
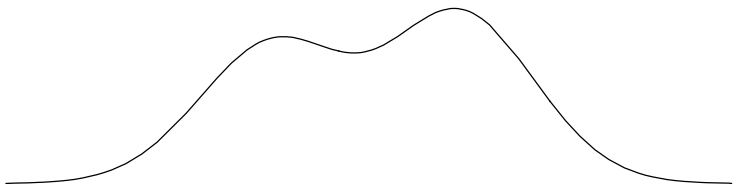
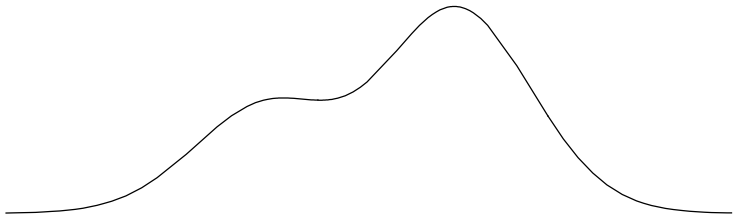
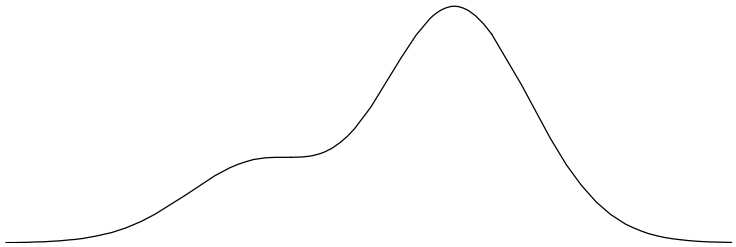
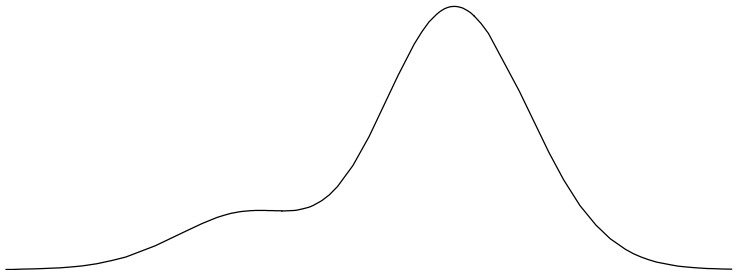
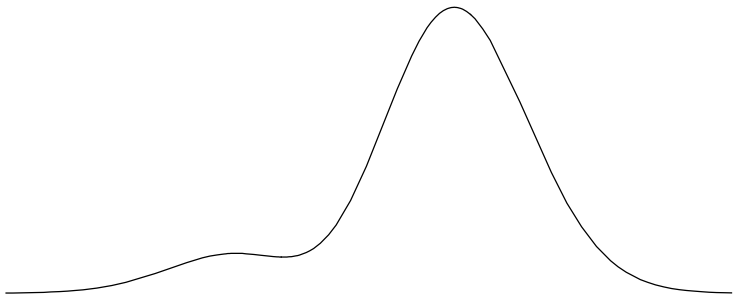
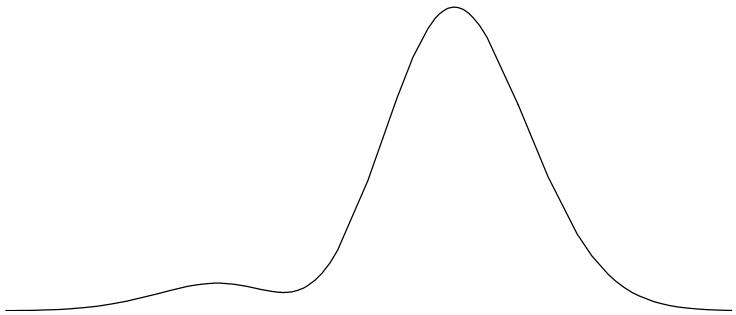
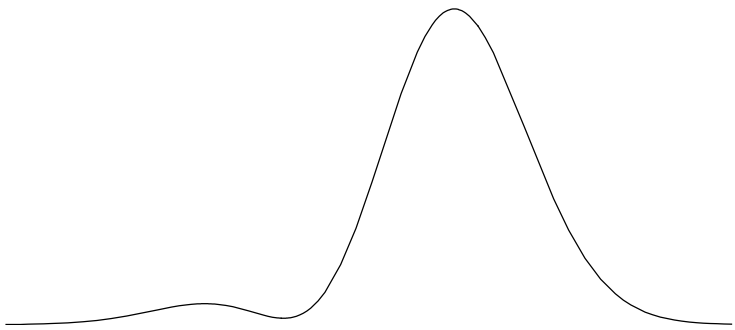
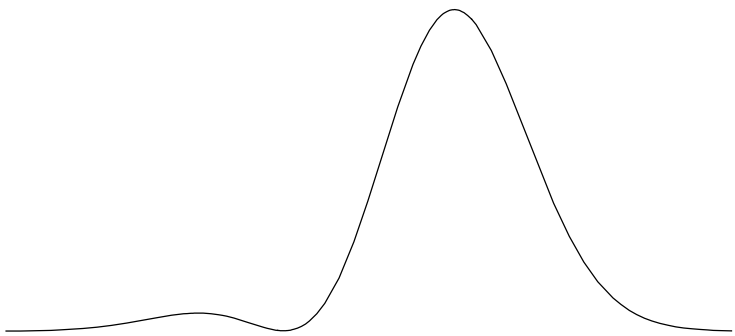


- Graphics -

```
c = Plot[f[x]^2, {x, -10., 10.}, PlotRange → {0., 1.},
  PlotStyle → {{Thickness[0.005], RGBColor[0, 0, 0]}}]
```



- Graphics -

$$f[x_, t_] := \mathrm{Re}\left[\left(\mathrm{psi0} * \mathrm{Exp}\left[I * \left(\frac{1}{2}\right) * t\right] + \mathrm{psi1} * \mathrm{Exp}\left[I * \left(1 + \frac{1}{2}\right) * t\right]\right) * \left(\mathrm{psi0} * \mathrm{Exp}\left[-I * \left(\frac{1}{2}\right) * t\right] + \mathrm{psi1} * \mathrm{Exp}\left[-I * \left(1 + \frac{1}{2}\right) * t\right]\right) \Big/ 2.\right]$$

```
Do[Plot[f[x, t], {x, -3, 3}, Axes → False, PlotRange → {0, 1.0}], {t, 0, 2 * Pi, .2}]
```