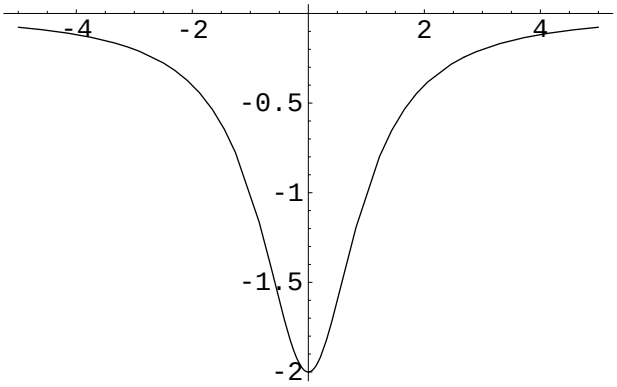
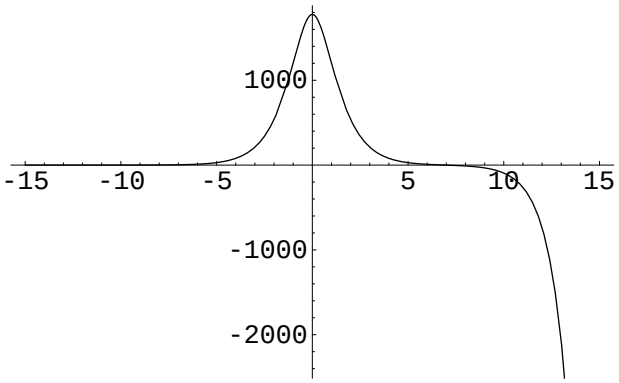
In[1]:=
```
(* deeper potential *)
(* ---------------- *)
v[x_] := -2 / (1 + x^2)
Plot[v[x], {x, -5, 5}]
```



Out[2]= - Graphics -

In[3]:=
```
(* plot solution for trial e *)
(* ------------------------- *)
plotsol[e_] :=
 Block[{x0 = 15}, sol = NDSolve[{-psi''[x] + (v[x] - e) * psi[x] == 0, psi[-x0] == 0.001,
     psi'[-x0] == 0.001}, psi, {x, -x0, x0}];
Plot[Evaluate[psi[x] /. sol], {x, -x0, x0}]]
```

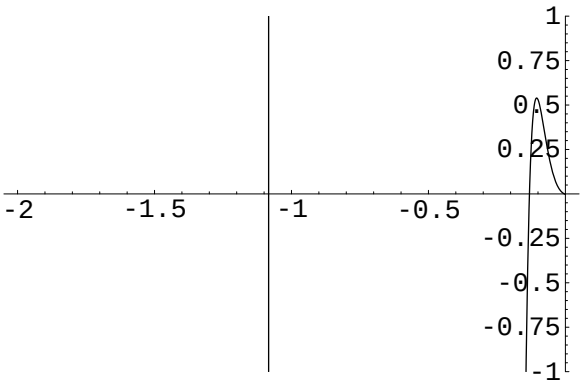
In[4]:=
```
plotsol[-1.08371]
```



Out[4]= - Graphics -

In[5]:=
```
(* shooting method *)
(* --------------- *)
shoot[e_] :=
 Block[{x0 = 15}, sol = NDSolve[{-psi''[x] + (v[x] - e) * psi[x] == 0, psi[-x0] == 0.001,
     psi'[-x0] == 0.001}, psi, {x, -x0, x0}];
psi[
    x0] /.
   sol]
```

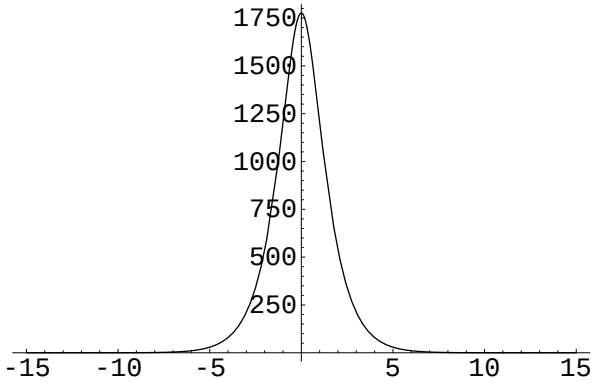
In[6]:=
```
Plot[shoot[e], {e, -2, 0}, PlotRange → {-1, 1}]
```



Out[6]= - Graphics -

In[7]:=
```
(* ground state *)
(* ------------ *)
Off[NDSolve::ndnum]
Off[FindRoot::frmp]
Off[ReplaceAll::reps]
e1 = e /. FindRoot[shoot[e] == 0, {e, -1.1, -1}]
plotsol[e1]
```

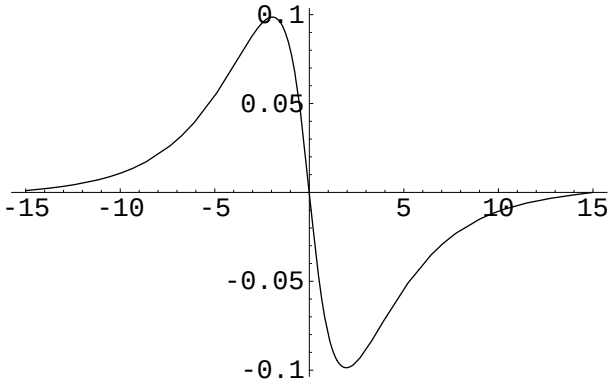
Out[10]= -1.08371



Out[11]= - Graphics -

In[12]:=
```
(* first excited state *)
(* ------------------- *)
e2 = e /. FindRoot[shoot[e] == 0, {e, -0.15, -0.05}]
plotsol[e2]
```

Out[12]= −0.131254



Out[13]= - Graphics -