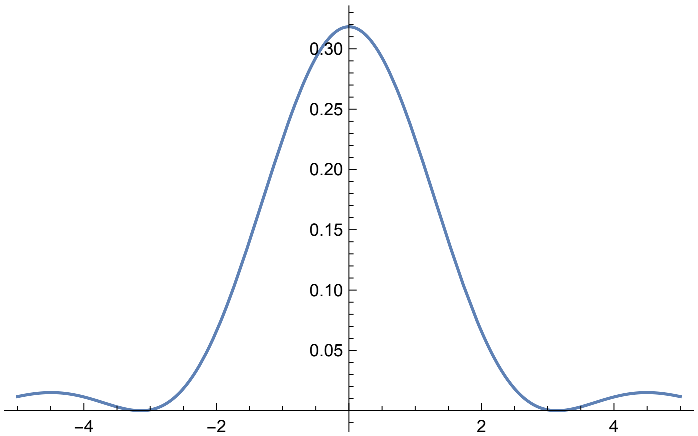
In[1]:=
```
(* we will do everything in terms of h-bar to make our life easier *)
hbar = 1;
P = 2;
psiX[x_] := (1 / x) * Sqrt[2 * hbar / (Pi * P)] * Sin[P * x / (2 * hbar)];
probX[x_] := psiX[x] * Conjugate[psiX[x]];
psiP[p_] :=
  Piecewise[{{0, p < -P / 2}, {1 / Sqrt[P], -P / 2 < p < P / 2}, {0, p > P / 2}}];
probP[p_] := psiP[x] * Conjugate[psiP[x]];
```

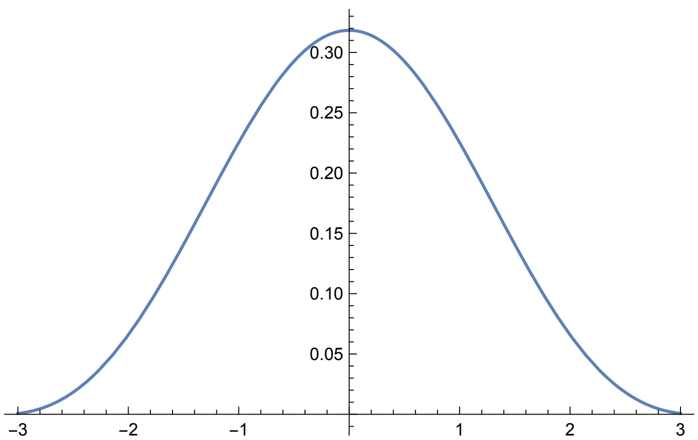
In[7]:=

In[8]:=
```
Plot[probX[x], {x, -5, 5}, PlotRange → All]
Plot[probX[x], {x, -3, 3}]
```

Out[8]=

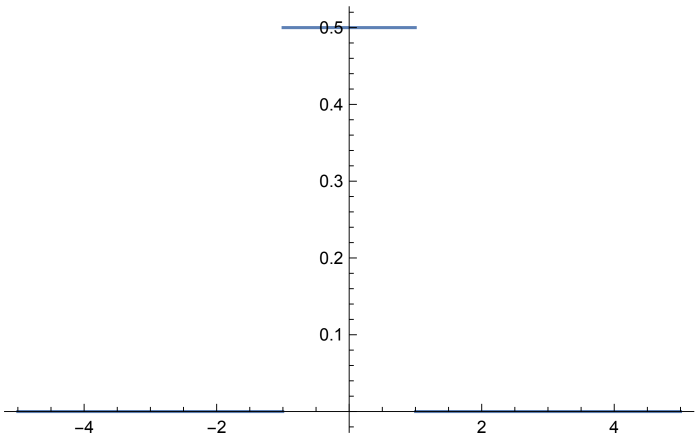


Out[9]=



In[13]:=
```
Plot[probP[x], {x, -5, 5}, PlotRange → All]
```

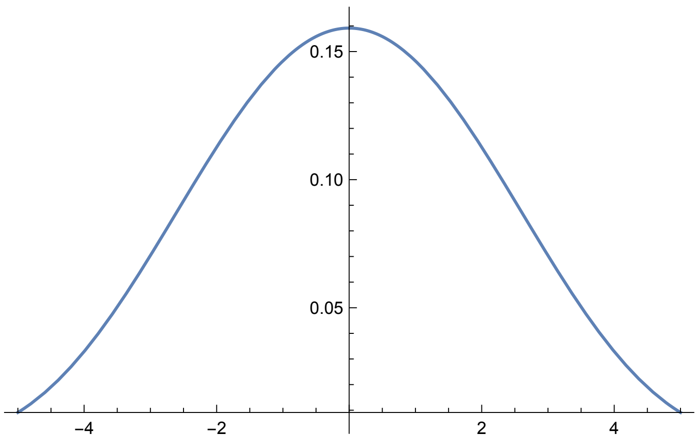
Out[13]=



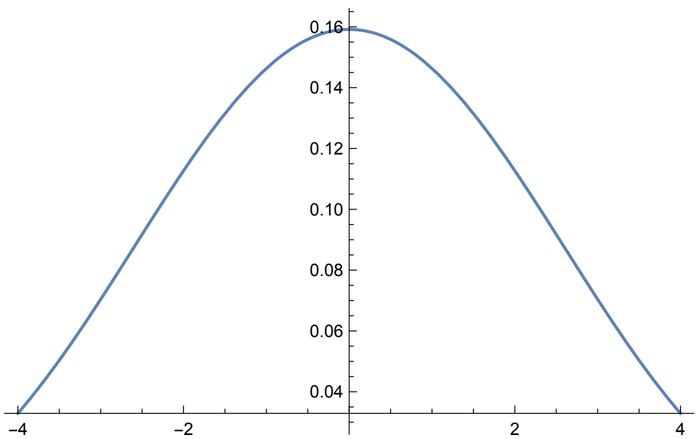

```
(* we can see from Out[9] that the first 0s will be at ±
   3hbar therefore we can guess that ∆x is about 3hbar. This is
   reasonable to do because this big curve is the majority of
   the probability so the particle will be found to have some x-
  value between the first 0s and thus the uncertainty in x is the
   width up to the 0s. This aligns with Heisenberg since the
   principle states the uncertainties have to be greater than or
   equal to hbar/2 and we can see with the plots above that ∆x =
 3*hbar and ∆p = hbar and so we do not violate the principle.*)
```

In[30]:=
```
P = 1;
psiX[x_] := (1 / x) * Sqrt[2 * hbar / (Pi * P)] * Sin[P * x / (2 * hbar)];
probX[x_] := psiX[x] * Conjugate[psiX[x]];
psiP[p_] :=
  Piecewise[{{0, p < -P / 2}, {1 / Sqrt[P], -P / 2 < p < P / 2}, {0, p > P / 2}}];
probP[p_] := psiP[x] * Conjugate[psiP[x]];
Plot[probX[x], {x, -5, 5}, PlotRange → All]
Plot[probX[x], {x, -4, 4}]
Plot[probP[x], {x, -5, 5}, PlotRange → All]
```

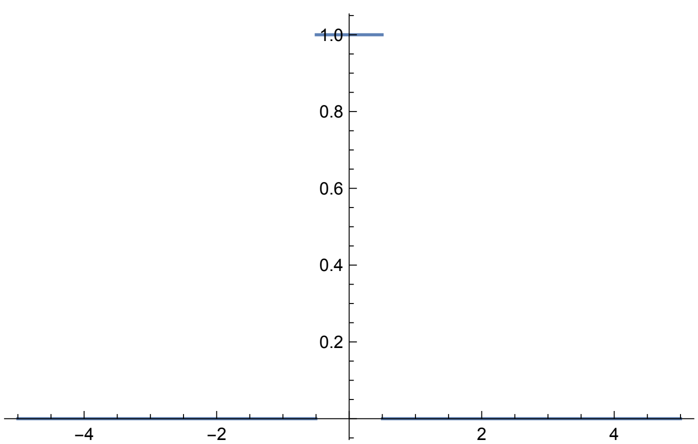
Out[35]=



Out[36]=



Out[37]=




```
(* we can see as we decrease P,
we increase △x (seen in Out[35] and Out[36]) and therefore
 decrease △p (seen in Out[37]. This behavior is expected due
   to Heisenberg's uncertainty principle *)
```