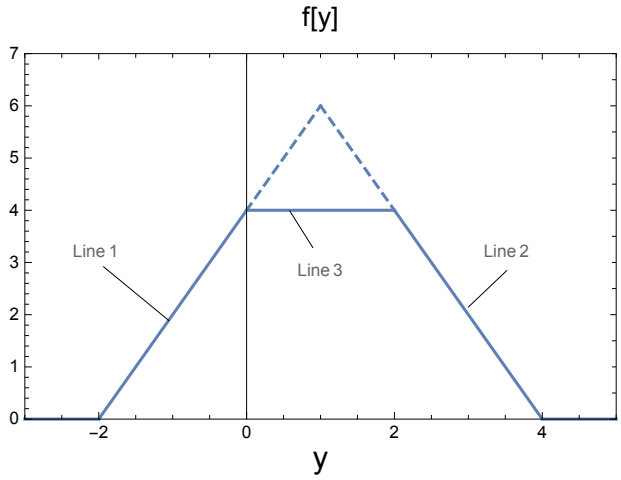
Problem 6

Problem Statement



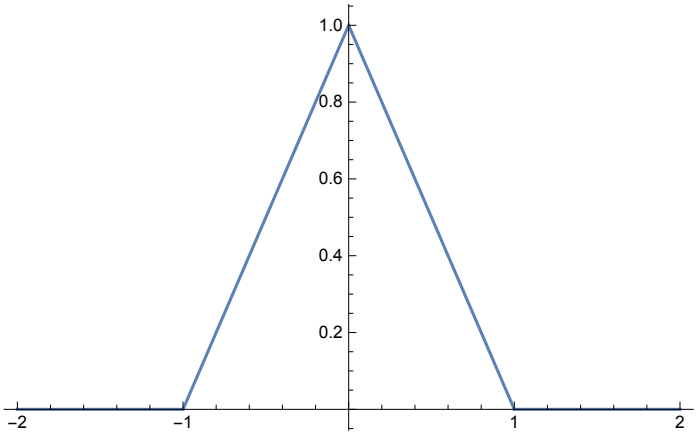
Write an equation for the solid blue lines in the above graph in terms of the difference of two tri functions

Compact Solution

Define and graph the tri function

In[•]:=
```
tri[x_] := { 1 - Abs[x]   Abs[x] ≤ 1
           { 0            True
Plot[tri[x], {x, -2, 2}]
```

Out[•]=



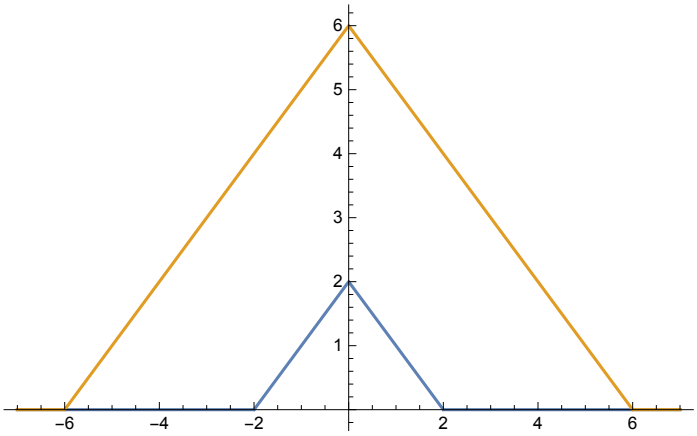
A function which describes the graph given in the problem is $f[x] = 6\,\mathrm{tri}\left[\frac{(x-1)}{3}\right] - 2\,\mathrm{tri}[(x-1)]$

Detailed Solution

The functions 2 tri$\left[\frac{x}{2}\right]$ and 6 tri[x/6] also have slopes of 2.

In[244]:=
```
Plot[{2 tri[x/2], 6 tri[x/6]}, {x, -7, 7}]
```

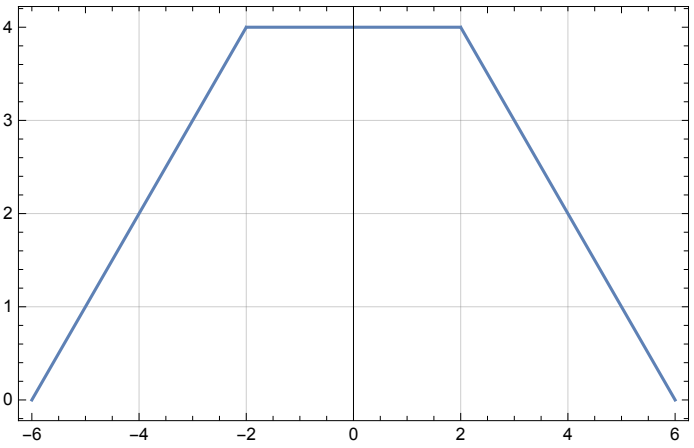
Out[244]=



The above graph suggests that taking the difference of these two functions may give us what we want. 6 tri$\left[\frac{x}{6}\right]$ − 2 tri$\left[\frac{x}{2}\right]$ has the correct shape for the desired function and also has the correct amplitude. However the base and peak are twice as wise as the target function.

In[242]:=
```
Plot[6 tri[x/6] - 2 tri[x/2], {x, -6, 6}, Frame → True, GridLines → Automatic]
```

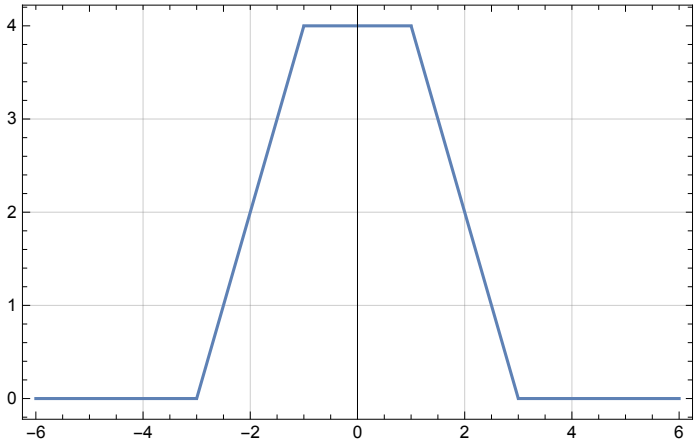
Out[242]=



Decrease the width of the function by replacing x by 2x. Now the width of the function at the base and at the peak are respectively 6 and 2 respectively and match the properties of the target function.

In[245]:=
```
Plot[6 tri[2 x / 6] - 2 tri[2 x / 2], {x, -6, 6}, Frame → True, GridLines → Automatic]
```

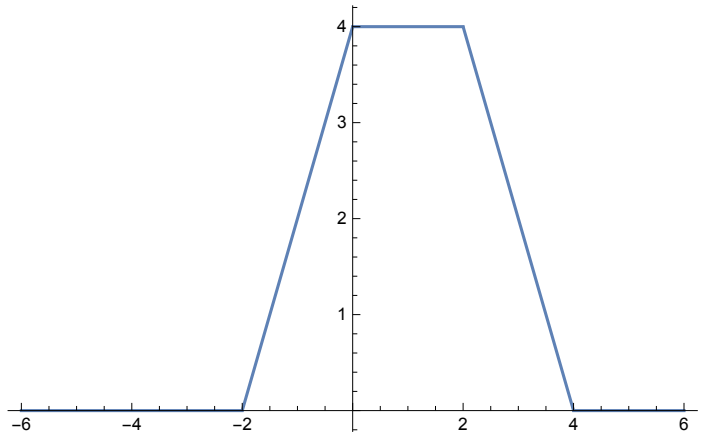
Out[245]=



Shift the above function one unit to the right and it should match the target function.

In[246]:=
```
Plot[6 tri[(x - 1) / 3] - 2 tri[(x - 1)], {x, -6, 6}]
```

Out[246]=



A function which describes the graph given in the problem is $f[x] = 6\,\text{tri}\left[\frac{(x-1)}{3}\right] - 2\,\text{tri}[(x-1)]$