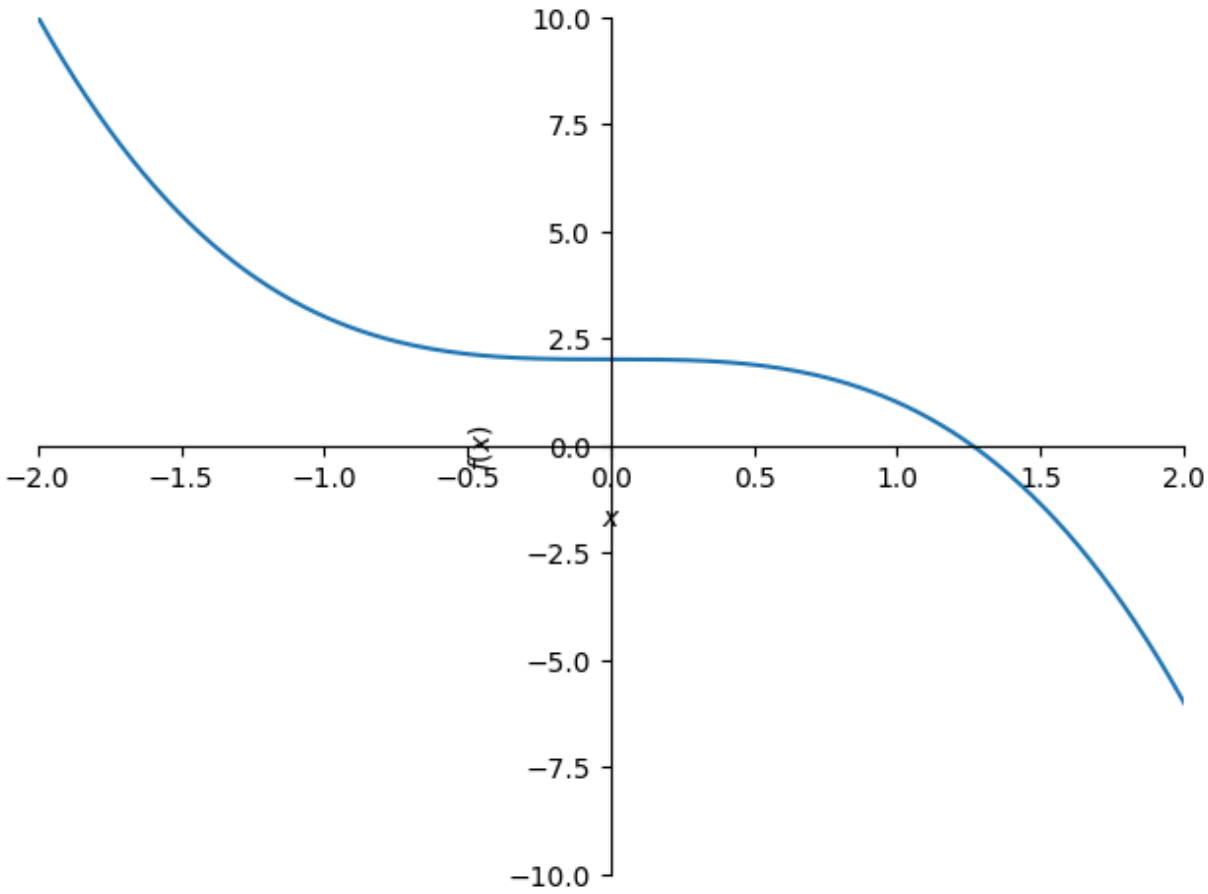
In [1]:
```
from __future__ import print_function
%matplotlib inline
#import ganymede
#ganymede.configure('uav.beaver.works')
import matplotlib.pyplot as plt
import numpy as np
import sympy as sym
sym.init_printing(use_latex = "mathjax")
```

Enter your name below and run the cell:

Individual cells can be run with `Ctrl` + `Enter`

In [ ]:
```
ganymede.name('YOUR NAME HERE')
def check(p):
    ganymede.update(p,True)
check(0)
```

In [2]:
```
x = sym.symbols('x')
expr = -x ** 3 + 2

sym.plot(expr, xlim=(-2, 2), ylim=(-10, 10));
```



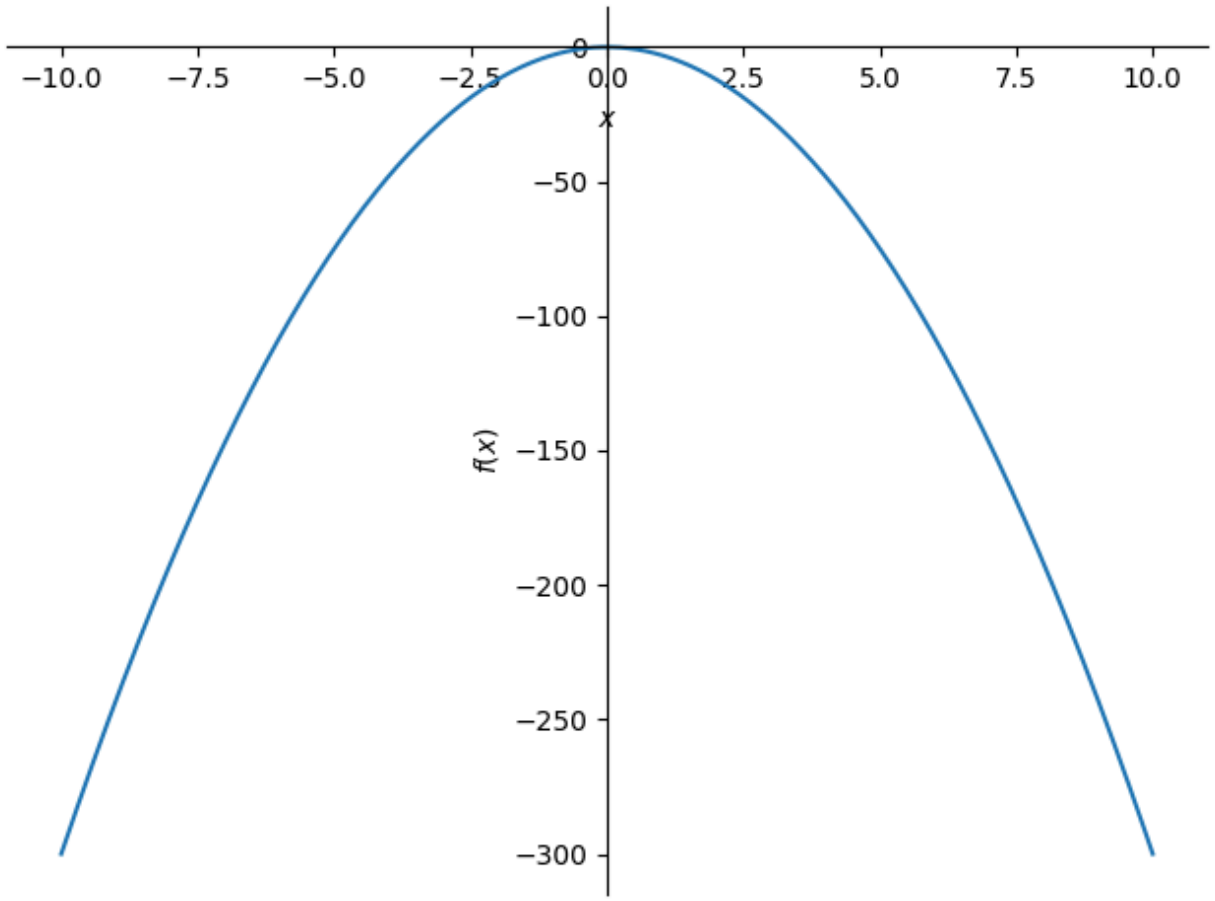
In [3]:
```
sym.Derivative(expr)
```

Out[3]: $\frac{d}{dx}\left(2 - x^3\right)$

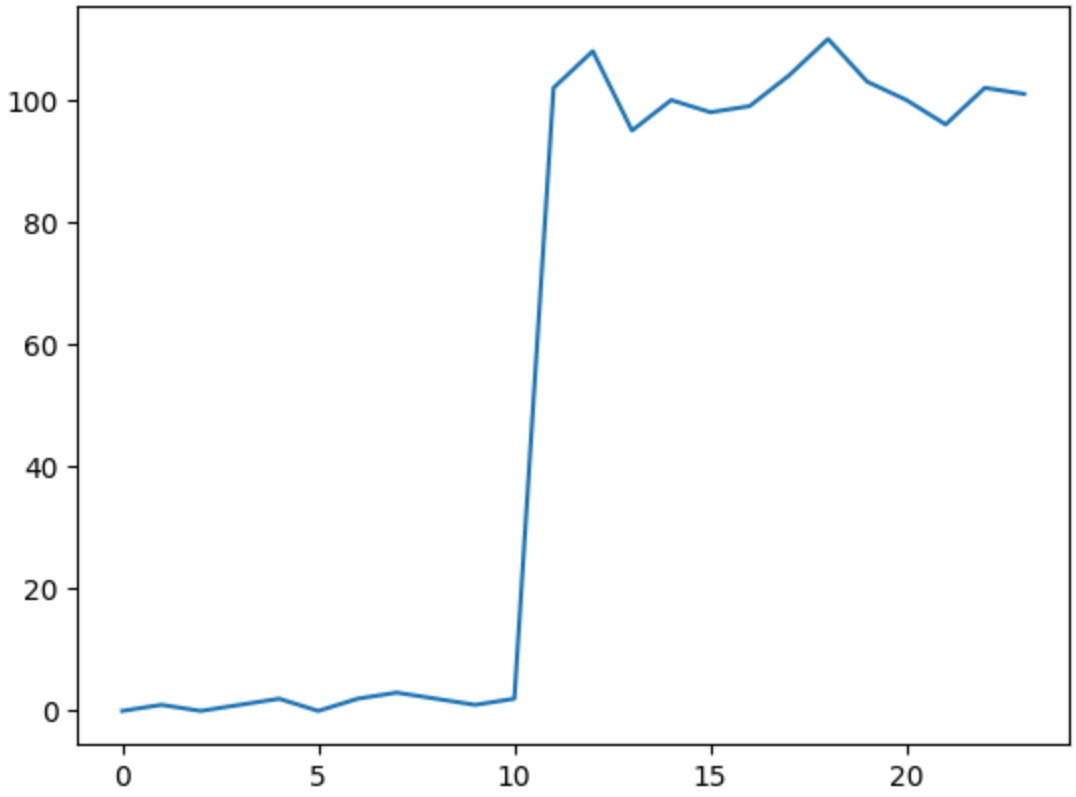
In [4]:
```
sym.Derivative(expr).doit()
```

Out[4]: $-3x^2$

In [5]:
```
sym.plot(sym.diff(expr));
```



In [6]:
```
ys = np.array([0, 1, 0, 1, 2, 0, 2, 3, 2, 1, 2, 102, 108,  95, 100,  98,  99, 

fig,ax = plt.subplots()
ax.plot([i for i in range(len(ys))], ys);
```



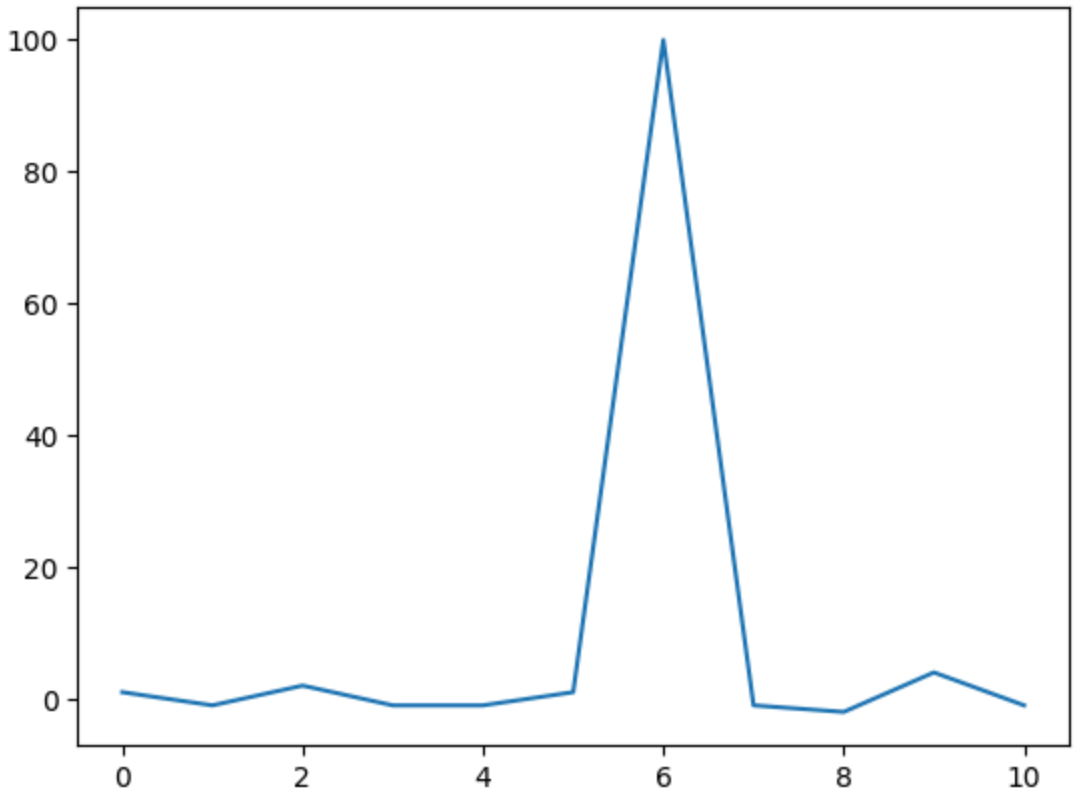
In [7]:
```
def make_windows(sequence, windowsize):
    positions = len(sequence) - windowsize + 1
    windows = []
    for i in range(positions):
        windows.append(sequence[i:i+windowsize])
    return windows

def print_padded_seq(seq):
    print("[", ",".join(["{:4d}".format(i) for i in seq]), ']')

def print_sliding_windows(seq, windowsize=3):
    windows = make_windows(seq, windowsize)
    for window in windows:
        print(",".join(["{:4d}".format(i) for i in window]))
```

In [9]:
```
series = [0, 1, 0, 2, 1, 0, 1, 101, 100, 98, 102, 101]
windowsize = 2

print_padded_seq(series)

print_sliding_windows(series, windowsize=windowsize)
```

```
[   0,   1,   0,   2,   1,   0,   1, 101, 100,  98, 102, 101 ]
   0,   1
   1,   0
   0,   2
   2,   1
   1,   0
   0,   1
   1, 101
 101, 100
 100,  98
  98, 102
 102, 101
```

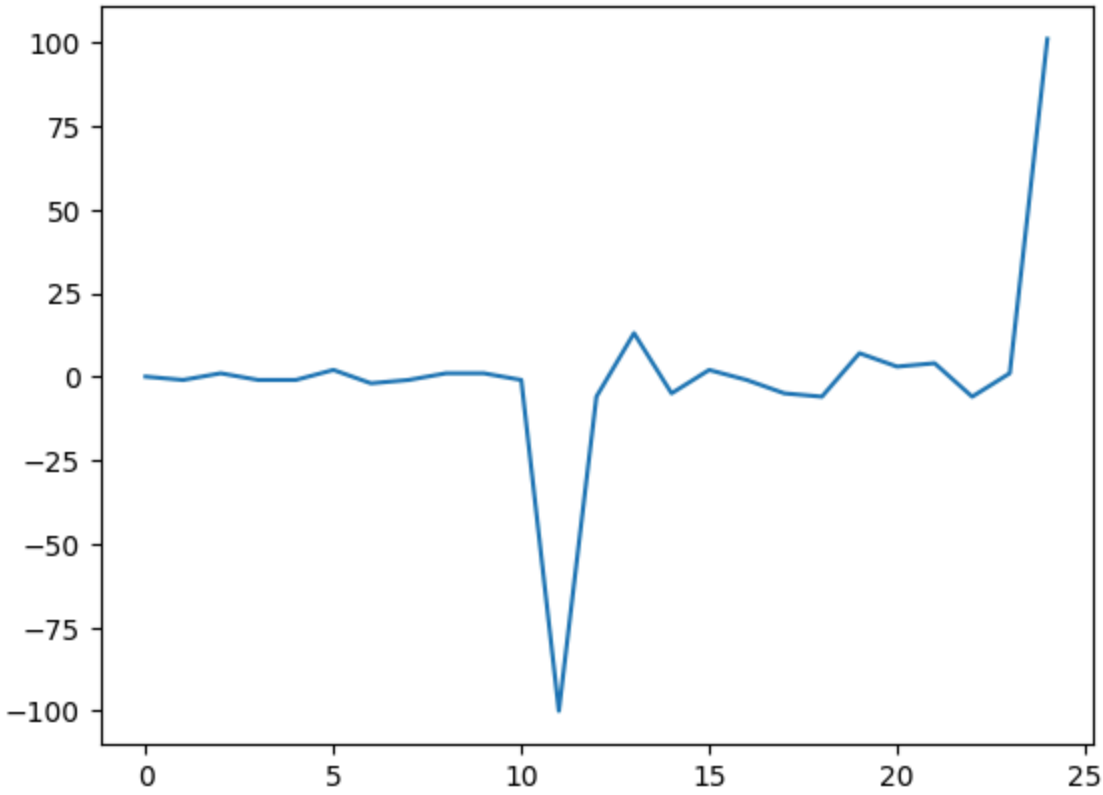
In [10]:
```
convolutions = []
kernel = np.array([-1,1])
for w in make_windows(series, windowsize=2):
    w = np.array(w)
    convolved = np.dot(w,kernel)
    convolutions.append(convolved)

plt.plot(convolutions)
```

Out[10]:
```
[<matplotlib.lines.Line2D at 0x1106d44f0>]
```



In [11]:
```
convolved = np.convolve([-1, 1], ys)

fig,ax = plt.subplots()
ax.plot([i for i, _ in enumerate(convolved)], convolved)
```

Out[11]:
```
[<matplotlib.lines.Line2D at 0x110fa0b20>]
```



Question: Why does the graph move up at the end?

This calculates the difference between each cell, and at the end it calculates the diff between the last and 0, which results in a large number