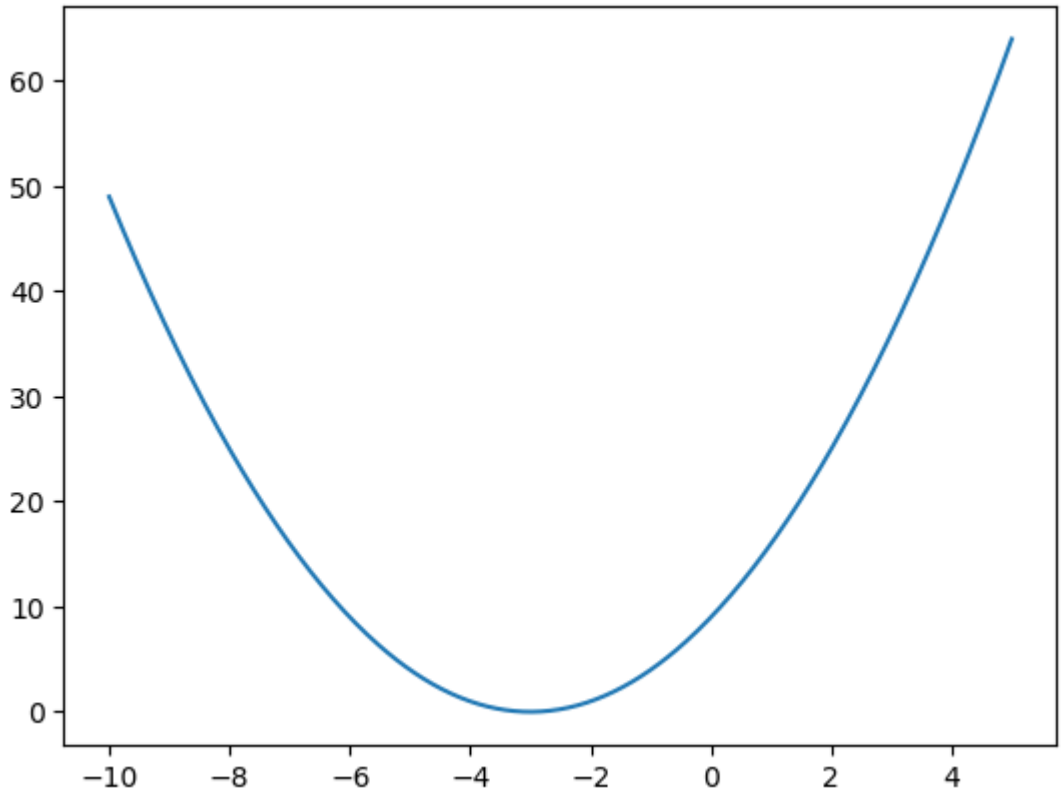
In [1]:
```
import numpy as np
import matplotlib.pyplot as plt
```

In [2]:
```
def gradient_descent(starting_x, learning_rate, num_iterations):
    x = starting_x
    x_history = [x]  # Store the history of x values
    y_history = [(x + 3)**2]  # Store the history of y values

    for i in range(num_iterations):
        gradient = 2 * (x + 3)
        x = x - learning_rate * gradient
        x_history.append(x)
        y_history.append((x + 3)**2)

    return x_history, y_history
```

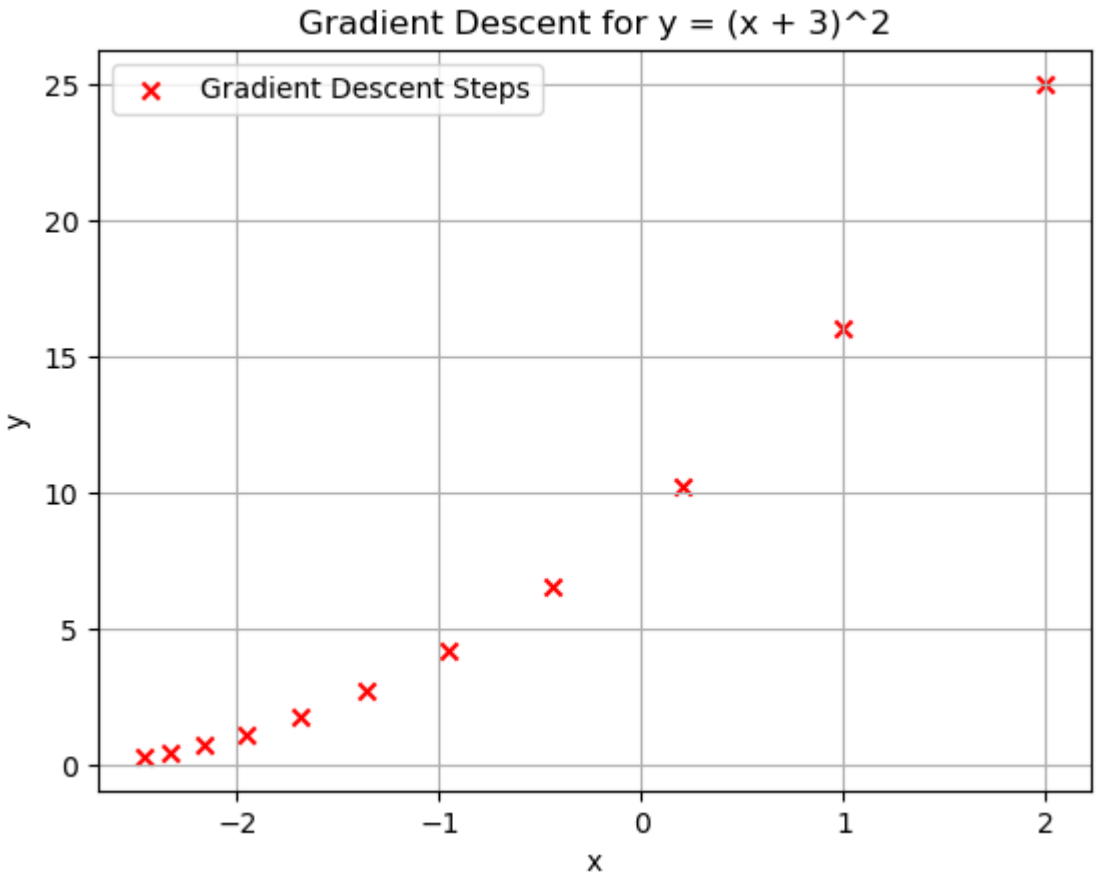
In [3]:
```
starting_x = 2
learning_rate = 0.1
num_iterations = 10

x_history, y_history = gradient_descent(starting_x, learning_rate, num_iteratic
```

In [4]:
```
# Plot the function y = (x + 3)^2
x_vals = np.linspace(-10, 5, 400)
y_vals = (x_vals + 3)**2
plt.plot(x_vals, y_vals, label='y = (x + 3)^2')
```

Out[4]: [<matplotlib.lines.Line2D at 0x14046916990>]



In [5]:
```
# Plot the gradient descent steps
plt.scatter(x_history, y_history, color='red', marker='x', label='Gradient Desc

plt.xlabel('x')
plt.ylabel('y')
plt.title('Gradient Descent for y = (x + 3)^2')
plt.legend()
plt.grid(True)
plt.show()
```



In [ ]:

In [4]:
```
x=2
lr=0.01
prec=0.000001
prev_step_size=1
max_iter=10000
iters=0
gf=lambda x:(x+3)**2
```

In [5]:
```
gd=[]
while prec<prev_step_size and iters<max_iter:
    prev=x
    x=x-lr*gf(prev)
    prev_step_size=abs(x-prev)
    iters+=1
    print("Iterations:",iters,"value:",x)
    gd.append(x)
```

```
Iterations: 9225 value: -2.989190547791055
Iterations: 9226 value: -2.9891917162336257
Iterations: 9227 value: -2.9891928844236055
Iterations: 9228 value: -2.9891940523610763
Iterations: 9229 value: -2.98919522004612
Iterations: 9230 value: -2.9891963874788186
Iterations: 9231 value: -2.9891975546592535
Iterations: 9232 value: -2.989198721587507
Iterations: 9233 value: -2.9891998882636606
Iterations: 9234 value: -2.9892010546877956
Iterations: 9235 value: -2.989202220859994
Iterations: 9236 value: -2.9892033867803374
Iterations: 9237 value: -2.9892045524489075
Iterations: 9238 value: -2.9892057178657856
Iterations: 9239 value: -2.9892068830310534
Iterations: 9240 value: -2.9892080479447927
Iterations: 9241 value: -2.989209212607084
Iterations: 9242 value: -2.9892103770180096
Iterations: 9243 value: -2.9892115411776508
Iterations: 9244 value: -2.9892127050860884
```

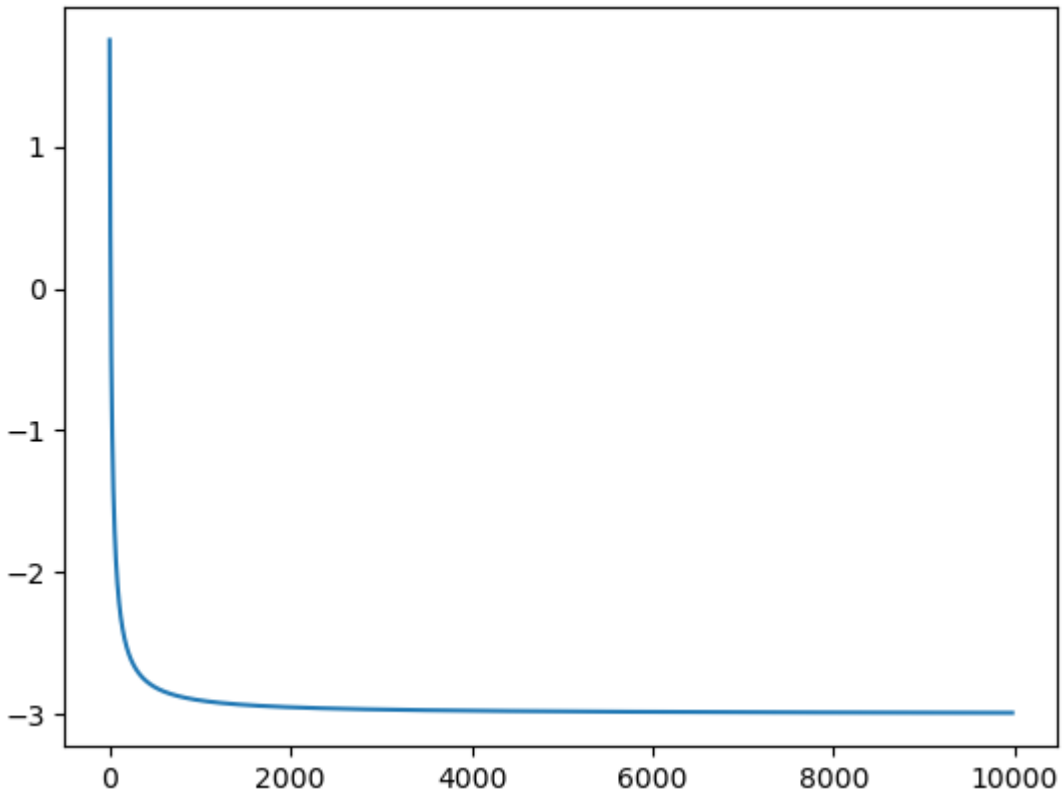
In [6]:
```
print("local minima:",x)
```

```
local minima: -2.990001240409911
```

In [7]:
```
import matplotlib.pyplot as plt
```

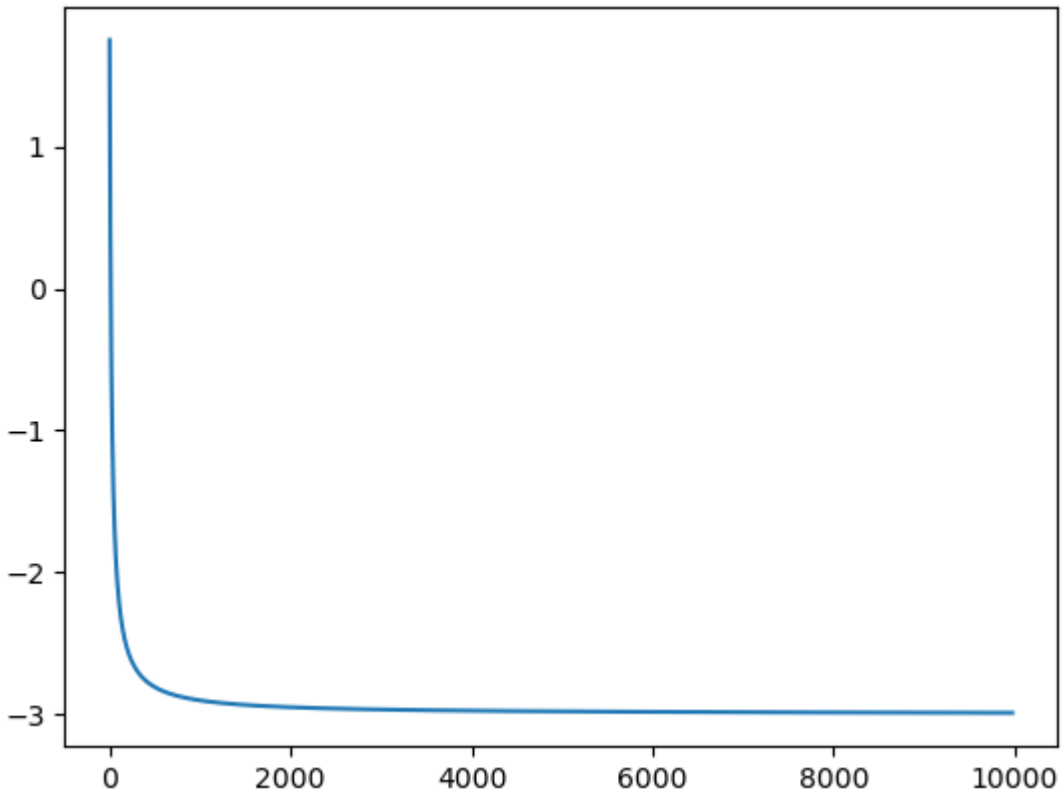
In [8]:
```
plt.plot(gd)
```

Out[8]:
```
[<matplotlib.lines.Line2D at 0x20bcd134550>]
```



In [10]:
```
plt.plot(range(9975),gd)
```

Out[10]:
```
[<matplotlib.lines.Line2D at 0x20bd1d8de90>]
```



In [11]:
```
print('ok')
```

```
ok
```

In [ ]:
```

```