In [1]:
```
pip install sympy
```

```
Requirement already satisfied: sympy in c:\users\amold\anaconda3\lib\site-pac
kages (1.11.1)Note: you may need to restart the kernel to use updated package
s.

Requirement already satisfied: mpmath>=0.19 in c:\users\amold\anaconda3\lib\s
ite-packages (from sympy) (1.2.1)
```

In [11]:
```
import matplotlib as plot
import numpy as np
import sympy as sym
from matplotlib import pyplot
```

In [12]:
```
def objective(x):
    return (x+3)**2
```

In [13]:
```
def derivative(x):
    return 2*(x + 3)
```

In [14]:
```
def gradient_descent(alpha, start, max_iter):
    x_list = list()
    x= start;
    x_list.append(x)
    for i in range(max_iter):
        gradient = derivative(x);
    x = x - (alpha*gradient);
    x_list.append(x);
    return x_list
```

In [15]:
```
x = sym.symbols('x')
expr = (x+3)**2.0;
grad = sym.Derivative(expr,x)
print("{}".format(grad.doit()) )
grad.doit().subs(x,2)
```

```
2.0*(x + 3)**1.0
```

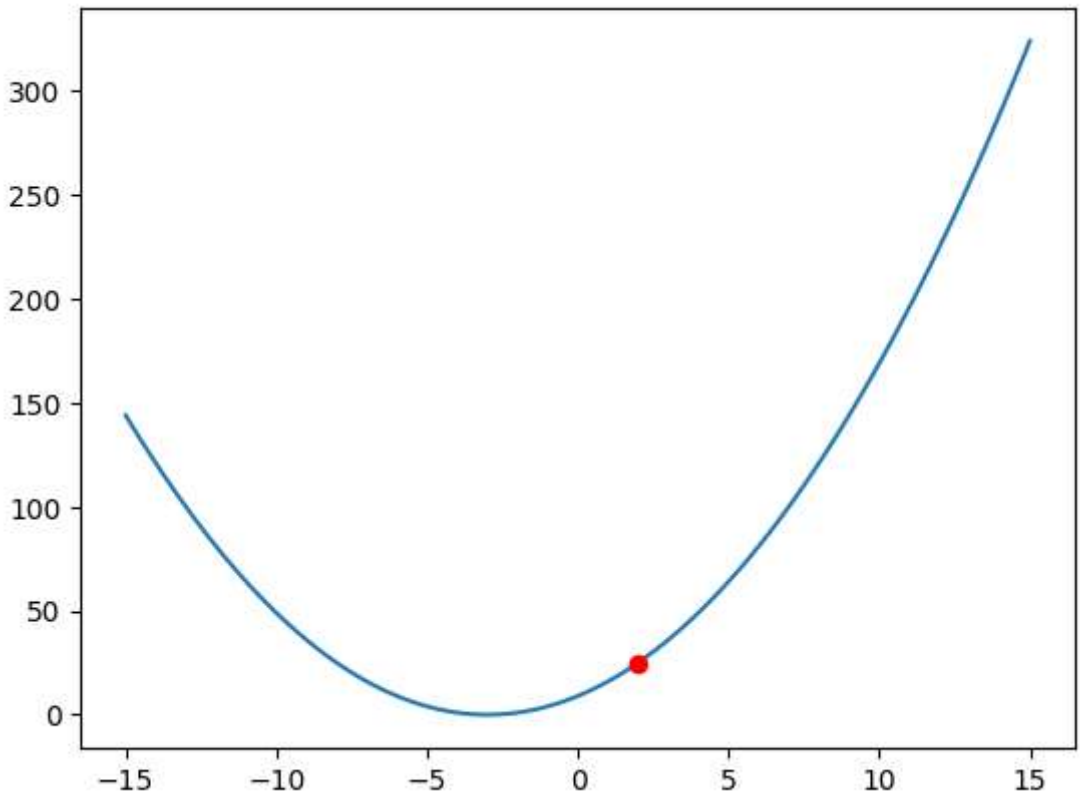
Out[15]: 10.0

In [18]:
```
def gradient_descent1(expr,alpha, start, max_iter):
    x_list = list()
    x = sym.symbols('x')
    grad = sym.Derivative(expr,x).doit()
    x_val= start;
    x_list.append(x_val)
    for i in range(max_iter):
        gradient = grad.subs(x,x_val);
        x_val = x_val - (alpha*gradient);
        x_list.append(x_val);
    return x_list
```

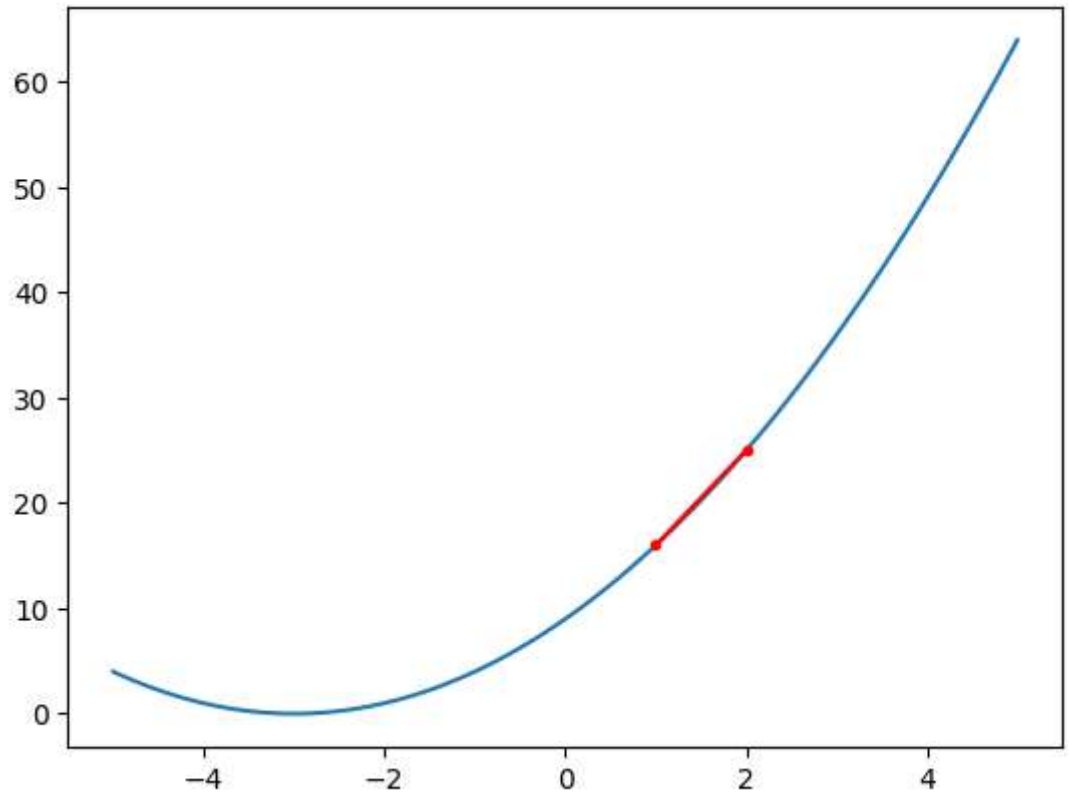
In [19]:
```
alpha = 0.1 #Step_size
start = 2 #Starting point
max_iter = 30 #Limit on iterations
x = sym.symbols('x')
expr = (x+3)**2; #target function
```

In [20]:
```
x_cordinate = np.linspace(-15,15,100)
pyplot.plot(x_cordinate,objective(x_cordinate))
pyplot.plot(2,objective(2),'ro')
```

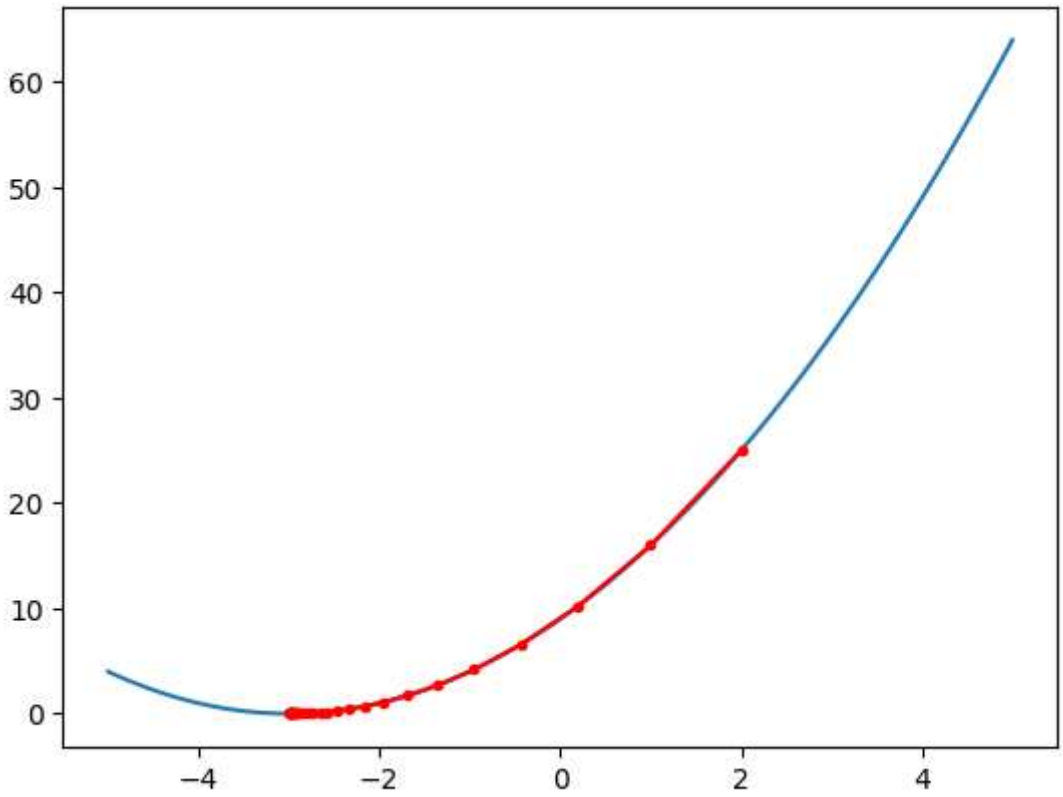
Out[20]:
```
[<matplotlib.lines.Line2D at 0x2019c27bc90>]
```



In [22]:
```
X = gradient_descent(alpha,start,max_iter)
x_cordinate = np.linspace(-5,5,100)
pyplot.plot(x_cordinate,objective(x_cordinate))
X_arr = np.array(X)
pyplot.plot(X_arr, objective(X_arr), '.-', color='red')
pyplot.show()
```



In [24]:
```
X= gradient_descent1(expr,alpha,start,max_iter)
X_arr = np.array(X)
x_cordinate = np.linspace(-5,5,100)
pyplot.plot(x_cordinate,objective(x_cordinate))
X_arr = np.array(X)
pyplot.plot(X_arr, objective(X_arr), '.-', color='red')
pyplot.show()
```



In [ ]:
```
```