9.4.16

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Question

Find the roots of the following quadratic equation graphically:

$$2x^2 - 7x + 3 = 0$$

Solution

The parabola can be represented in vector form as:

$$\mathbf{x}^{\mathbf{T}} \begin{pmatrix} 1 & 0 \\ 0 & 0 \end{pmatrix} \mathbf{x} - \begin{pmatrix} 7/2 \\ 1/2 \end{pmatrix}^{T} \mathbf{x} + \frac{3}{2} = 0 \tag{1}$$

The y-axis can be represented in vector form as:

$$\mathbf{x} = \kappa \begin{pmatrix} 1 \\ 0 \end{pmatrix} \tag{2}$$

We need to find the intersection of this line with the parabola, which can be done by substituting equation (2) in (1):

Solution

$$\kappa \begin{pmatrix} 1 \\ 0 \end{pmatrix}^T \begin{pmatrix} 1 & 0 \\ 0 & 0 \end{pmatrix} \kappa \begin{pmatrix} 1 \\ 0 \end{pmatrix} - \begin{pmatrix} 7/2 \\ 1/2 \end{pmatrix}^T \kappa \begin{pmatrix} 1 \\ 0 \end{pmatrix} + \frac{3}{2} = 0 \tag{3}$$

$$2\kappa^2 - 7\kappa + 3 = 0 \tag{4}$$

$$(2\kappa - 1)(\kappa - 3) = 0 \tag{5}$$

$$\kappa = \frac{1}{2}, 3 \tag{6}$$

Therefore, the points of intersection *i.e.* the **roots** are $\begin{pmatrix} 0.5 \\ 0 \end{pmatrix}$ and $\begin{pmatrix} 3 \\ 0 \end{pmatrix}$.

Python Code

```
import matplotlib.pyplot as plt
import numpy as np

x = np.linspace(-10,15,100)
y = 2*x*x - 7*x + 3
zero = np.zeros(100)

fig = plt.figure(figsize = (6,6))
ax = fig.add_subplot(111)

plt.plot(x,y, label='$2x^2 - 7x + 3$')
ax.scatter(3,0, label='(3,0)',color='green')
ax.scatter(0.5,0, label = '(0.5,0)', color = 'red')
plt.plot(x,zero)
plt.legend()
plt.grid(True)
plt.show()
```

Figure

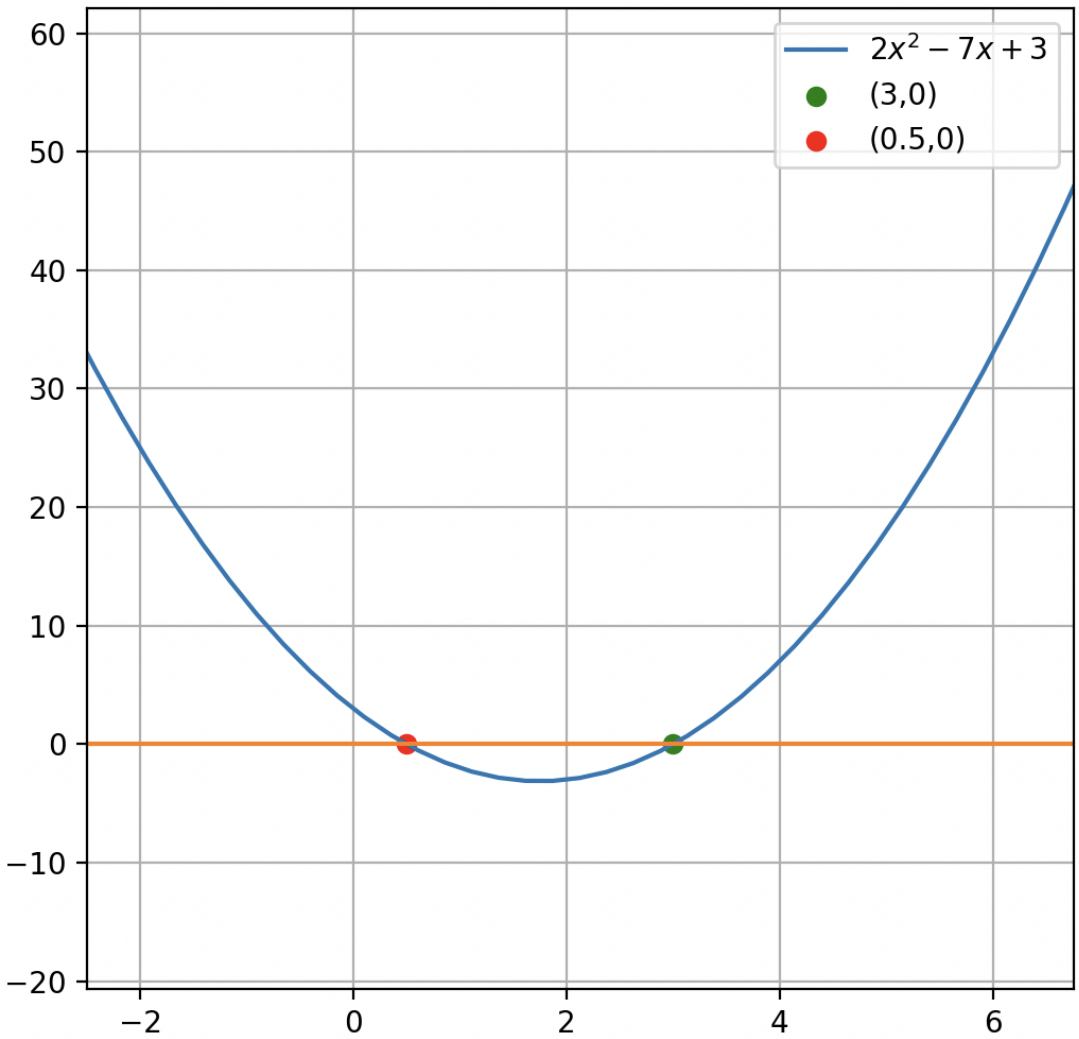

Figure: Plot