

4.

Solution

To find the vertex, we look at the coefficients in the function $u(y) = ay^2 + by + c$ in this equation, $a = 3$ and $b = 3$

The first coordinate of the vertex has the formula: $\frac{-b}{2a}$ now, plugging into formula to get:

$$\frac{-b}{2a} = -\frac{3}{2(3)} = -\frac{1}{2}$$

$$\begin{aligned}\text{The second coordinate of the vertex is } u\left(-\frac{1}{2}\right) &= 3\left(-\frac{1}{2}\right)^2 + 3\left(-\frac{1}{2}\right) - 3 \\ &= -\frac{15}{4}\end{aligned}$$

Therefore, the vertex of the graph of f is $\left(-\frac{1}{2}, -\frac{15}{4}\right)$