

4.

## Solution

To find the vertex, we look at the coefficients in the function  $x(u) = au^2 + bu + c$   
in this equation,  $a = 1$  and  $b = 8$

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

$$\frac{-b}{2a} = -\frac{8}{2(1)} = -4$$

The second coordinate of the vertex is  $x(-4) = 1(-4)^2 + 8(-4) - 3$   
 $= -19$

Therefore, the vertex of the graph of  $f$  is  $(-4, -19)$