Graph the parabola given by the quadratic equation in standard form:

$$y = -x^2 + x + 2$$

Step 1: Find the y-intercept. The value of the constant c in the standard form is the y-intercept; in this case it is $y = 2$.

Step 2: Find the x-intercepts by factoring. The coefficient of x^2 must be positive before factoring. Therefore, we first factor -1 from all three terms.

$$y = -x^2 + x + 2$$

$$= -\left(x^2 - x - 2\right)$$

Setting the result equal to zero gives this answer:

$$x^2 - x - 2 = 0$$

$$(x - 2)(x + 1) = 0$$

Therefore the intercepts are $x = 2$ and $x = -1$.

Step 3: Find the vertex. When the quadratic equation can be factored, the midpoint method is preferred over the complete-the-square method.

A quadratic function has a vertical line of symmetry that passes through the vertex. This means that any pair of points on the parabola that also intersect a *horizontal line* are equally distant from the axis of symmetry. In other words, the line of symmetry and the vertex are at the midpoint of the two x intercepts (and any other pair of symmetry points on the parabola).

Apply the midpoint formula:

$$k = \frac{x_1 + x_2}{2}$$

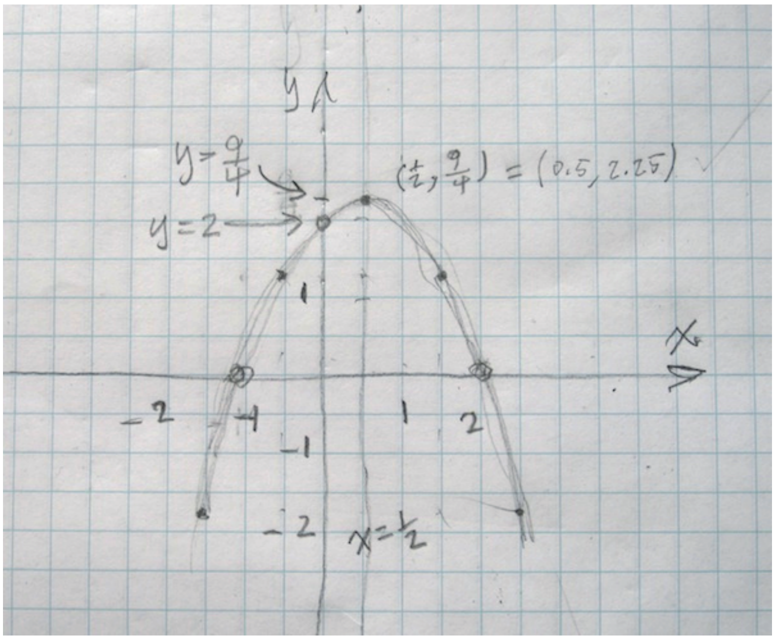
$$= \frac{2 + (-1)}{2}$$

$$= \frac{1}{2}$$

Therefore the x value for the vertex is $x = 1/2$. To find the y value for the vertex, substitute the x value into the quadratic equation (the factored form is usually easier).

$$
\begin{aligned}
y &= -\left(\frac{1}{2} - 2\right)\left(\frac{1}{2} + 1\right) \\
&= -\left(-\frac{3}{2}\right)\left(\frac{3}{2}\right) \\
&= \frac{9}{4}
\end{aligned}
$$

Therefore the coordinates of the vertex are $(\frac{1}{2}, \frac{9}{4})$.



The alternative method is to complete the square to find the vertex form of the quadratic equation. This is the best way to proceed if the quadratic is not factorable—that is, if the x intercepts are irrational numbers, or there are no x intercepts.

$$
\begin{aligned}
y &= -x^2 + x + 2 \\
&= -\left(x^2 - x\right) + 2 \\
&= -\left(x^2 - x + \frac{1}{4} - \frac{1}{4}\right) + 2 \\
&= -\left(x^2 - x + \frac{1}{4}\right) + \frac{1}{4} + 2
\end{aligned}
$$

$$= -\left(x - \frac{1}{2}\right)^2 + \frac{9}{4}$$

The vertex is located at $(\frac{1}{2}, \frac{9}{2})$ as above.

Step 4: Graphing. This parabola opens down because there is a negative sign in front of the x^2 term in standard form. Start graphing by locating the y-intercept, x-intercepts and vertex on the axes. Then, find additional points by using the step pattern and symmetry.

When the coefficient of the x^2 term is one: it's over one, down one; over two down four; over three, down nine. Use symmetry to find additional points on the other side of the line of symmetry.

This also verifies that the x-intercepts are correct.