Convert quadratic standard form to vertex form using <u>completing the square</u>.

$$\boldsymbol{y = ax^2 + bx + c} \qquad \textbf{to} \qquad \boldsymbol{y = a(x-h)^2 + k}$$

Example: $\boldsymbol{y = 2x^2 + 5x - 12}$

1) Move existing c term to the other side of the equation

$$\begin{aligned} \boldsymbol{y} \quad &= \boldsymbol{2x^2 + 5x - 12} \\ \boldsymbol{+12} \quad & \qquad\qquad \boldsymbol{+\,12} \end{aligned}$$

$$\boldsymbol{y + 12 = 2x^2 + 5x}$$

2) Factor out a term from the right side of the equation

$$\boldsymbol{y + 12 = 2x^2 + 5x}$$
$$\boldsymbol{y + 12 = 2(x^2 + \tfrac{5}{2}x \qquad)}$$

3) Create a new c term, which is equal to $(\frac{1}{2}b)^2$, add this term inside the parentheses on the right side of the equation. Also add $a(\frac{1}{2}b)^2$ to the left side of the equation.

$$\boldsymbol{y + 12 = 2(x^2 + \tfrac{5}{2}x \qquad)} \qquad (\tfrac{1}{2}(\tfrac{5}{2}))^2 = (\tfrac{5}{4})^2 = \tfrac{25}{16} \qquad 2(\tfrac{25}{16}) = \tfrac{25}{8}$$
$$+\tfrac{25}{8} \qquad\qquad\qquad +\tfrac{25}{16}$$

$$\boldsymbol{y + \tfrac{121}{8} = 2(x^2 + \tfrac{5}{2}x + \tfrac{25}{16})}$$

4) Rewrite the trinomial as $(x + \frac{1}{2}b)^2$

$$\boldsymbol{y + \tfrac{121}{8} = 2(x^2 + \tfrac{5}{2}x + \tfrac{25}{16})}$$
$$\boldsymbol{y + \tfrac{121}{8} = 2(x + \tfrac{5}{4})^2}$$

5) Solve for y

$$\boldsymbol{y + \tfrac{121}{8} = 2(x + \tfrac{5}{4})^2}$$
$$\boldsymbol{-\tfrac{121}{8} \qquad\qquad -\tfrac{121}{8}}$$

$$\boldsymbol{y = 2(x + \tfrac{5}{4})^2 - \tfrac{121}{8}}$$