X – Intercepts Part 2

Determining the vertex from standard form:

a) \( y = x^2 + x - 2 \)
   \[ M: -2 \]
   \[ N: 2, -1 \]
   \[ \text{zeros: } -2 \text{ & } 1 \]

b) \( y = x^2 - 36 \)
   \[ M: -36 \]
   \[ N: 6, -6 \]

\[
\begin{align*}
\text{axis of symmetry: } & \frac{-2 + 1}{2} = -0.5 \\
\text{optimal value: } & y = (-0.5)^2 + (-0.5) - 2
\end{align*}
\]

\[
\begin{align*}
6 + (-6) &= 0 \\
6 &= \frac{-18}{-3} \\
y &= (0)^2 - 36 \\
y &= -36
\end{align*}
\]

\[
\begin{align*}
(0, -36)
\end{align*}
\]

c) \( y = 2x^2 + 16x + 30 \)
   \[ y = 2(\frac{x^2 + 8x + 15}{2}) \]
   \[ y = 2(\frac{x^2 + 3x + 5}{3}) \]
   \[ \text{vertex: } M: 15 \]
   \[ N: 3, 5 \]

\[
\begin{align*}
\frac{-3 + (-5)}{2} &= -4 \\
y &= 2(-4)^2 + 16(-4) + 30 \\
y &= -2
\end{align*}
\]

\[
\begin{align*}
(0, -36)
\end{align*}
\]

Solve by Factoring:

When you are asked to solve a quadratic it means you are solving for the value of \( x \).

To solve it needs to be equal to 0 and then you solve by factoring. (Remember once it is factored the solutions are the opposite sign of what is in brackets.)

a) \( x^2 + 7x + 12 = 0 \)
   \[ M: 12 \]
   \[ (x+3)(x+4) = 0 \]
   \[ x = -3 \]
   \[ N: 3, 4 \]
   \[ x = -4 \]

b) \( 3x^2 + 9x + 6 = 0 \)
   \[ M: 2 \]
   \[ A: 3 \]
   \[ N: 1, 2 \]
   \[ x = -1 \]
   \[ x = -2 \]

c) \( 5x^2 - 20x = 300 \)
   \[ 5(x^2 - 4x - 60) = 0 \]
   \[ x = 10 \]
   \[ x = -6 \]
Applications/Problem Solving

Example 1:
A bottle rocket is fired from the ground. Its height \( h \) is given by \( h = -5t^2 + 30t \), where \( t \) (in seconds) is the time since the object was fired.

a) How high is the rocket at \( t = 2s \)?

\[
h = -5(2)^2 + 30(2) \\
h = 40m
\]

b) When is the rocket on the ground?

\[
0 = -5t^2 + 30t \\
0 = -5t(t - 6) \\
t = 0 \quad t = 6
\]

After 6 seconds

c) When is the rocket 25 m off the ground?

\[
25 = -5t^2 + 30t \\
0 = -5t^2 + 30t - 25 \\
0 = -5(t^2 - 6t + 5) \\
0 = -5(t - 5)(t - 1) \\
t = 5 \quad t = 1
\]

d) What is the maximum height of the object?

\[
\text{Vertex} \\
\text{zeros} 0 \& 6 \\
\frac{t + b}{2} = \frac{3}{2} \\
h = -5(3)^2 + 30(3) \\
h = 45m
\]

e) Write the equation in vertex form.

\[
h = -5(t - 3)^2 + 45 \\
y = a(x-h)^2+k
\]