Answer to Essential Question 1.6: If you lined up all six vectors in the same direction, you would end up 34 paces away from the starting point. When the vectors point in the same direction (and only in this case) you can add their magnitudes. 10 + 5 + 6 + 7 + 4 + 2 = 34 paces.

1-7 The Quadratic Formula

EXAMPLE 1.7 – Solving a quadratic equation

Sometime, such as in some projectile-motion situations, we will have to solve a quadratic equation, such as $2.0x^2 = 7.0 + 5.0x$. Try solving this yourself before looking at the solution.

SOLUTION

The usual first step is to write this in the form $ax^2 + bx + c = 0$, with all the terms on the left side. In our case we get: $2.0x^2 - 5.0x - 7.0 = 0$.

We could graph this on a computer or a calculator to find the values of *x* (if there are any) that satisfy the equation; we could try factoring it out to find solutions; or we can use the quadratic formula to find the solution(s). Let's try the quadratic formula:

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}.$$ (Equation 1.4: **The quadratic formula**)

In our example, with $a = 2.0$, $b = -5.0$, and $c = -7.0$, the two solutions work out to:

$$x_1 = \frac{-b + \sqrt{b^2 - 4ac}}{2a} = \frac{+5.0 + \sqrt{25 + 56}}{4.0} = \frac{+5.0 + 9.0}{4.0} = +3.5$$, with appropriate units.

$$x_2 = \frac{-b - \sqrt{b^2 - 4ac}}{2a} = \frac{+5.0 - \sqrt{25 + 56}}{4.0} = \frac{+5.0 - 9.0}{4.0} = -1.0$$, with appropriate units.

These values agree with the graph of the function shown in Figure 1.13. The graph crosses the *x*-axis at two points, at $x = -1$ and also at $x = +3.5$.

Related End-of-Chapter Exercises: 36, 46.

Essential Question 1.7: Could you have a quadratic equation in the form $ax^2 + bx + c = 0$ that had no solutions for *x* (at least, no real solutions)? If so, what would happen when you tried to solve for *x* using the quadratic formula? What would the graph look like?

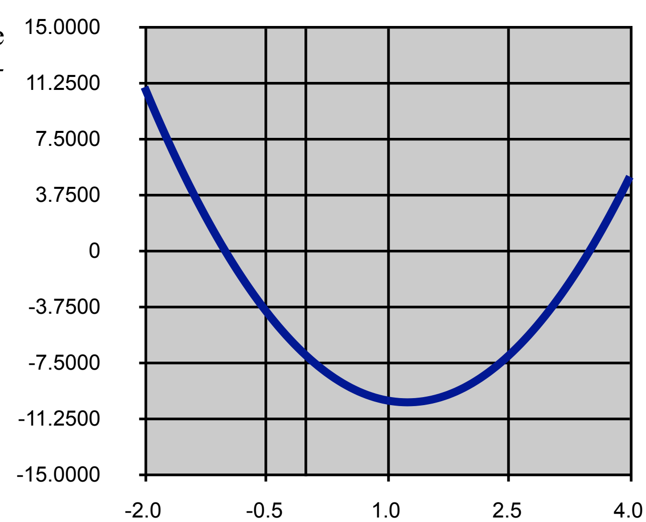

Figure 1.13: A graph of the quadratic equation $2.0x^2 - 5.0x - 7.0 = 0$, for Example 1.7.