Vector Addition and Resolution

A small rubber-band-powered airplane can fly at a speed of 2.5 m/s in still air. If it flies into a 0.5 m/s headwind, what is its speed relative to the ground? What is its speed in a tailwind with the same magnitude?

1. Read and Understand

What information are you given?

Speed in still air = 2.5 m/s

Speed of headwind = 0.5 m/s

Speed of tailwind = 0.5 m/s

2. Plan and Solve

What unknown are you trying to calculate?

Speed relative to ground into headwind = ?

Speed relative to ground with tailwind = ?

What formula contains the given quantities and the unknown?

Into headwind:

Speed relative to ground = speed in still air – speed of headwind

= 2.5 m/s – 0.5 m/s

= 2.0 m/s

With tailwind:

Speed relative to ground = speed in still air + speed of tailwind

= 2.5 m/s + 0.5 m/s

= 3.0 m/s

3. Look Back and Check

Is your answer reasonable?

Yes, a headwind would cause the airplane's speed to decrease, while a tailwind would cause the speed to increase.

Math Practice

On a separate sheet of paper, solve the following problems.

1. A stream flows with a speed of 3.0 m/s relative to the shore. A kayaker paddles downstream with a speed of 1.5 m/s relative to the stream. What is the kayaker's speed relative to the shore?

2. A train travels at a speed of 25.0 m/s relative to the ground. If you walk to the back of the train at a speed of 0.5 m/s relative to the train, what is your speed relative to the ground?

3. Susan can row a boat at 4.0 m/s in still water. While trying to row directly across a river from west to east, Susan is pulled by a current flowing southward at 3.0 m/s. How fast does Susan row relative to the shore?

4. A bird flies at a speed of 9.0 m/s in still air. If the bird flies with a 12 m/s crosswind blowing, how fast does it travel relative to the ground?