

## Answer on Question 64822, Physics, Other

### Question:

Julie throws a ball to her friend Sarah. The ball leaves Julie's hand a distance  $1.5\text{ m}$  above the ground with an initial speed of  $17\text{ m/s}$  at an angle  $34^\circ$ ; with respect to the horizontal. Sarah catches the ball  $1.5\text{ m}$  above the ground.

- 1) What is the horizontal component of the ball's velocity right before Sarah catches it?
- 2) What is the vertical component of the ball's velocity right before Sarah catches it?
- 3) What is the time the ball is in the air?
- 4) What is the distance between the two girls?

### Solution:

1) Let's find the horizontal component (or  $x$ -component) of the ball's velocity right before Sarah catches it (as the ball moves from Julie to Sarah, its horizontal component of velocity,  $v_{ix}$ , remains constant):

$$v_{ix} = v_i \cos \theta = 17 \frac{\text{m}}{\text{s}} \cdot \cos 34^\circ = 14.1 \frac{\text{m}}{\text{s}}.$$

2) Let's find the vertical component (or  $y$ -component) of the ball's velocity right before Sarah catches it (as the ball moves from Julie to Sarah, its vertical component of velocity right before Sarah catches it,  $v_{fy}$ , will have the same magnitude as at launch, but opposite direction):

$$v_{fy} = -v_{iy} = -v_i \sin \theta = -17 \frac{\text{m}}{\text{s}} \cdot \sin 34^\circ = -9.5 \frac{\text{m}}{\text{s}}.$$

The sign minus indicates that the vertical component of the ball's velocity directed downward.

3) At the maximum height the ball's velocity equal to zero, so we can write:

$$v_{fy} = v_{iy} + gt_{\max},$$

$$0 = v_{iy} + gt_{\max}.$$

From this formula we can obtain the time to reach the maximum height:

$$t_{max} = \frac{-v_{iy}}{g} = \frac{-9.5 \frac{m}{s}}{-9.8 \frac{m}{s^2}} = 0.97 s.$$

Then, we can find the total time of flight of the ball in the air:

$$t_{flight} = 2t_{max} = 2 \cdot 0.97 s = 1.94 s.$$

4) Finally, we can find the distance between the two girls:

$$x = v_{ix}t_{flight} = 14.1 \frac{m}{s} \cdot 1.94 s = 27.35 m.$$

**Answer:**

$$1) v_{fx} = 14.1 \frac{m}{s}.$$

$$2) v_{fy} = -9.5 \frac{m}{s}.$$

$$3) t_{flight} = 1.94 s.$$

$$4) x = 27.35 m.$$

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