Where did it land?

Teacher notes

Why use this resource?

When students begin to think about projectiles they often encounter specific problems that demand numerical solutions. The problem outlined in this resource asks students to think more deeply about how a projectile behaves, and in particular about the effect of the angle of projection on its horizontal displacement. Students are strongly encouraged to compare graphical representations to their algebraic work so as to get a feel for the situation and interpret their findings in terms of the original problem.

Preparation

In order to get the most from this resource students should know that a projectile follows a parabolic path and they should have some familiarity with equations of motion.

It is worth being aware that in order to rewrite the general equation for the horizontal displacement of the ball in this problem, students will need to notice the relationship $2\sin\alpha\cos\alpha = \sin 2\alpha$.

Possible approach

It may be productive to give students the opportunity to read and begin to grapple with the main problem for a short period of unstructured time before bringing the class together and using the "Some things to think about" questions to guide students to describe the landing position of the ball more precisely. A shared sketch diagram of the trajectory of the ball, such as that at the top of the Things you might have noticed page, may help students to identify the fixed and variable quantities in the problem.

It can be very informative to try out some specific cases before getting too worried about representing the problem algebraically. Three cases are suggested and explored in Things you might have noticed, but students should be encouraged to try as many cases as they feel necessary in order to get a feel for what's happening. As well as providing some additional practice working with the equations of motion, this should enable them to describe in words what is happening, and therefore what they expect to see in the resulting algebraic and graphical representations of the problem.

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Key questions

Embedded in the Things you might have noticed page are a number of carefully constructed questions that can be posed at key points in the journey through the problem.

- What do you expect the units of your answer to be?
- Do both sides of your formulae have the same units?

Possible support

Students may find it difficult to understand what the problem is asking them to do. Encouraging them to think about specific cases (such as those suggested in Things you might have noticed) as a way of helping them to get started is valuable.

Continually asking students to try to sketch the situation, or to represent their findings graphically can help them to interpret and see practical meaning in their calculations. A number of these diagrams are used in Things you might have noticed and can be shared with students along with the questions posed in chalk boxes.

Possible extension

Students could be prompted to consider how dimensional analysis can be used to confirm the validity of something for which they may have little or no intuition. This is highlighted at the bottom of the Things you might have noticed page.

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