One windy day

Teacher notes

Why use this resource?

This task builds on the usual kind of projectile problem by adding in a constant acceleration in the horizontal direction. Students will thus have to handle constant acceleration in two dimensions, which leads naturally to parametric equations and curve sketching.

The situation being modelled is one that students should be able to visualise and the perhaps surprising results can readily be related back to the original context.

Preparation

If available, you might like to have graphing software accessible by students as they work on this problem. This would allow them to explore the parametric graphs for themselves.

You might choose to use the resource Where did it land? before tackling this task.

Possible approach

Students could usefully work in pairs or small groups and be encouraged to justify their ideas and results to one another at each stage of the problem.

The Warm-up can be used either to recap or to teach for the first time the standard techniques for projectile problems. It uses the same numbers as the main problem so is worth using as a lead-in even with students who are already fluent with the usual kind of problem.

In the main problem, encourage students to think about and sketch possible outcomes before revealing the algebraic problem that is under the 'Modelling' toggle.

As a modelling task, this problem gives opportunity for discussions about the suitability of the model and the assumptions being used, some of which are quite bold. Towards the end of the Solution there is some explanation of where this model comes from and what some alternative models might take into account.

Key questions

- What is the effect of gravity vertically? And horizontally?
- What is the effect of the wind vertically? And horizontally?
- Why are there two solutions to this quadratic? What do they correspond to in the original situation?
- How could you find the maximum value of that (quadratic) expression?
- What can you tell me about the curve described by these parametric equations?

Possible extension

Students could be challenged to try modelling this situation using an alternative model, such as one in which the acceleration is directly proportional to the difference in velocity between the ball and the air.

- Can they sketch a graph of horizontal velocity against time?
- Can they write down some equations of motion for this model?
- Is it possible to work out an equation for the trajectory?