Bouncing to nothing

Teacher notes

Why use this resource?

This rich example is an application of a convergent series to a realistic situation. Students are guided through the problem which requires some equations of motion as well as work with a series. A model is given but students are expected to engage with the modelling process by considering the validity of the simplifying assumptions and verifying the theoretical results.

Possible approach

Students will probably benefit from working in pairs or small groups so they can discuss ideas of potential ways into the problem.

Once they have reached or are close to a solution, you might use a whole-class discussion to draw out the implications for the real world situation and to assess the validity of the model.

If time and space permit, you might consider doing some practical experiments.

Key questions

Sketching:

- What shape do you expect when you throw a ball?
- What do you think will happen after it bounces? What other information does the question give?
- Is each section going to be the same width?
- How far would that pattern continue?

The ball as a projectile:

- Can you find an equation to describe the vertical motion of the ball?

The sequence of bounces:

- If we know the time for the n^{th} section can you write the times as a sequence?
- Can you work out the sum of that series?

Modelling:

- What does that solution tell you about the original situation? Does that seem realistic?
- What assumptions have we made that might affect the outcome?

Possible support

Once they start the algebraic manipulation, students writing quantities as decimals may find it hard going and could be encouraged to rewrite expressions using fractions.

Students could be supported to work through the mechanics / projectile part of the problem, perhaps through a whole-class discussion, so they can focus more on the sequence / series aspects.

Possible extension

Some prompting questions are given at the end of the Solution.