A frictional story

Teacher notes

underground mathematics

Why use this resource?

This resource explores the classic situation of a particle on a slope. Students have to draw diagrams and resolve forces, but are also provided with an opportunity to think about how friction varies when a particle is not moving and why the variation is linear. Students will be reminded that the frictional force acting on a particle is modelled by $F_r \leq \mu R$, which should help them avoid the misconception that $F_r = \mu R$ at all times.

Possible approach

It may initially look like a standard question, but the task of sketching a graph of friction against the force P is unusual. Students may be unsure what information they need to find, so allowing individual thinking time is important. As there are a number of different ways to think about the problem, it may then be beneficial for students to pair up to discuss their approaches and findings. This might include reflecting on what values students calculated. For example, did they calculate μ and θ, and did they need to?

It is preferable to not substitute in a numerical value for g, however students may choose to do so. To keep calculations simple, it is best if students use $g = 10$.

Key questions

- When is $F = \mu R$?
- What do you know about the particle when the value of P is between 20 and 40?
- When the particle is stationary, will there always be a frictional force acting on it?
- What assumptions are involved in the frictional model $F \leq \mu R$?

Possible support

Asking students to imagine, or describe in words, what forces are acting on the particle for different values of P, may help students to get a sense of what sort of answers they might expect and therefore, what the graph might look like.

Possible extension

- What would happen if P was not parallel to the plane? What changes and what stays the same?