

Physics Invention Sequences Users' Guide: Acceleration

ACCELERATION INVENTION SEQUENCE

Includes: *speeding up index (with interpolation), speeding up index (without interpolation – for PS level),*

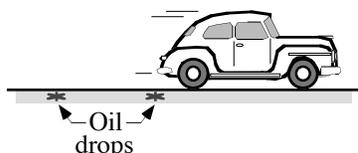
Teacher Notes: Students may be able to manipulate the kinematics equations after studying 1-d accelerated motion, but surprisingly few understand that the value of the acceleration tells them by how much the velocity is changing in each unit of time. This unit rate should be discussed in subsequent instruction as the students tackle this very challenging new quantity.

Levels: This sequence is appropriate for all levels, from middle school physical science through calculus-based physics. Middle school/physical science level students should use the second diagram; the interpolation involves too much cognitive load.

Speeding Up Index

Today you will look at another kind of index. Your task is to come up with a *speeding up index* for cars. You will see pictures of several cars on the next page, and you need to come up with one number to stand for each car's speeding up.

There is no watch or clock to tell you how long each car has been going. However, all the cars drip oil once every second. (They are not very good cars!) The speedometer reading tells you how fast the car is going when the oil drips.



This task might be a little harder than before!

Here is some additional information:

- A company always makes its cars speed up in the same way.
- We will not tell you how many companies there are.
- You must decide which cars are from the same company. They may look different!

To review:

- (1) Make a speeding up index for each car. A bigger index means a car speeds up more.
- (2) Decide how many companies there are.
- (3) To show the cars that are from the same company, draw a line that connects the cars.

Follow up questions:

1. Use everyday language to describe the specific information that the speeding up index tells you about the car's motion.
2. How many car companies are there? How do you know?
3. It can be easy to confuse *fast* with *speeding up quickly*, or *slow* with *speeding up slowly*. What is the difference? Use the following questions to help sort this out:
 - a) Which car is the fastest? Explain what "fastest" means.
 - b) How long will it take the fastest car to speed up by 75 mph?
 - c) Which car is the slowest? Explain what "slowest" means.
 - d) How fast will the slowest car be going 10 s after it starts?
 - e) Compare "fast" to "speeding up quickly" and "slow" to "speeding up slowly." Can a car be going fast and speed up slowly? Can a car be going slow and speed up quickly? Explain.

