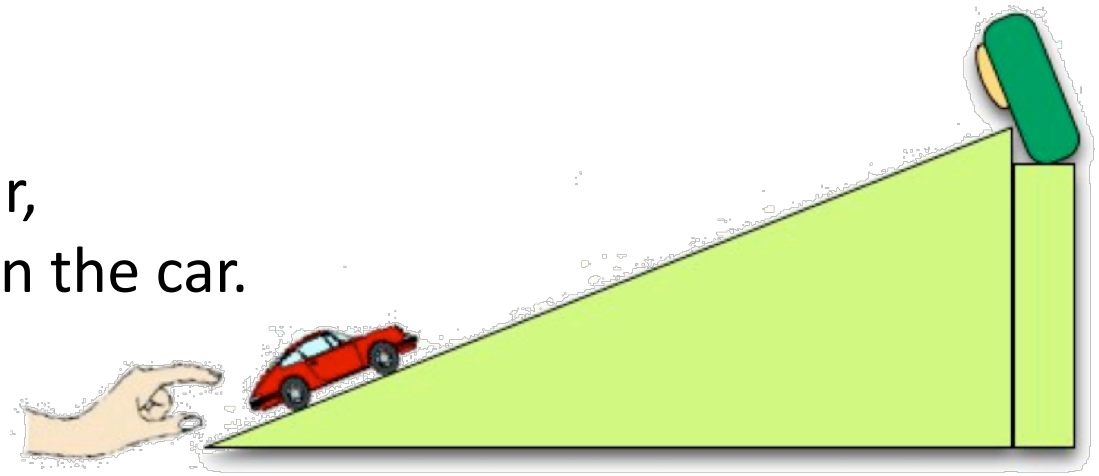
A small toy car is given a quick flick up a ramp by a demonstrator. As a result, the car rolls two-thirds of the way up a ramp and then back down (without being touched further). A sonic ranger at the top of the ramp detects the position of the car and infers its velocity and acceleration.

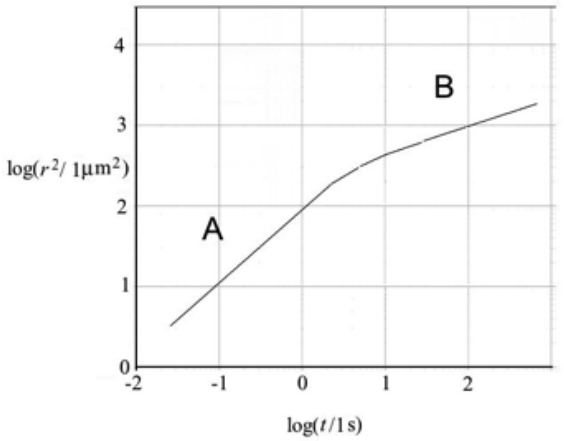
The sonic ranger begins recording data at a time $t = 0$ a moment after the flick. The car reaches its highest point at a time t_1, and has rolled back to the bottom of the ramp at a time t_2.

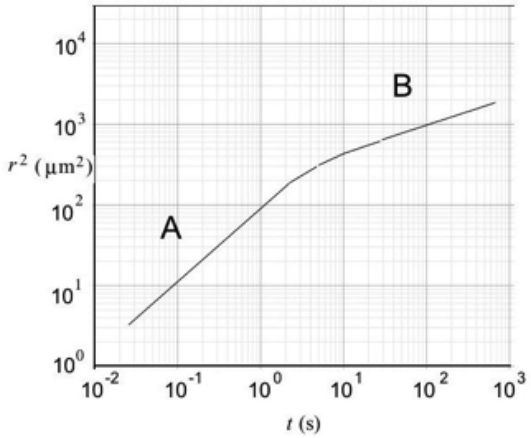
Assuming that you can ignore all resistive forces (friction and drag), plot what the sonic ranger would show for the

- position,
- velocity,
- acceleration of the car,
- the net force acting on the car.



A student in lab observes the motion of a bacterium with a video camera. His log-log plot of the square deviation is shown. The bacterium seems to have two distinct behaviors: for times shorter than 1 second (A) and for times longer than 10 seconds (B). What might be an appropriate hypothesis for what might be causing the two different behaviors?

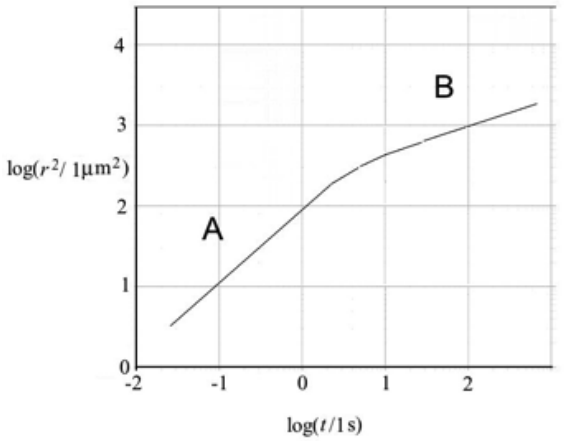


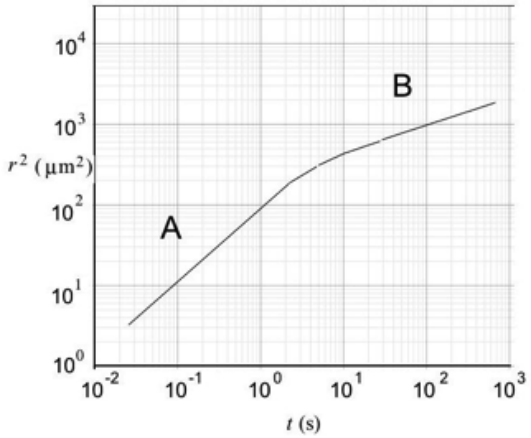


In region A:

1. The bacterium is moving purposefully in response to some chemical gradient.
2. The bacterium is moving at random in response to the thermal motion of its environment.
3. The bacterium is constrained in some way.
4. The bacterium is using its flagella (which work like propellers) to move at a constant velocity
5. The bacterium is accelerating in response to a force in a fixed direction.
6. None of these behaviors are consistent with that part of the graph.

A student in lab observes the motion of a bacterium with a video camera. His log-log plot of the square deviation is shown. The bacterium seems to have two distinct behaviors: for times shorter than 1 second (A) and for times longer than 10 seconds (B). What might be an appropriate hypothesis for what might be causing the two different behaviors?





In region B:

1. The bacterium is moving purposefully in response to some chemical gradient.
2. The bacterium is moving at random in response to the thermal motion of its environment.
3. The bacterium is constrained in some way.
4. The bacterium is using its flagella (which work like propellers) to move at a constant velocity
5. The bacterium is accelerating in response to a force in a fixed direction.
6. None of these behaviors are consistent with that part of the graph.