Physics Workshop
Kinematics in 1-D
Suggested Checkpoint Questions with Answers

- Checkpoint following 1:

1. What exactly is the relationship between speed and velocity?

- Checkpoint following 2:

1. How do you find the instantaneous velocity of the car by looking at the position graph?
2. Show explicitly how you would find the slope of the tangent line to the x-t graph at some instant.

- Checkpoint following 3:

1. You are finding the average acceleration of this car. What do you suppose its actual acceleration looks like as a function of time?
2. What do you think is responsible for making the car go forward?

- Checkpoint following 4:

1. How could you determine how far the object went from the position graph? How could you determine this distance using equations?
2. Sketch the acceleration versus time graph for this object.

- Checkpoint following 5:

1. Sketch the velocity versus time graph for Smoky's motion.
2. Sketch the velocity versus time graph for an object that is simply dropped from some height to the ground. What does this graph have in common with the previous one?
3. Is it possible to analyze Smoky's up and down motion without breaking it up into an upward part and then a downward part? Why or why not?

Answers to checkpoint questions:

- Checkpoint following 1:

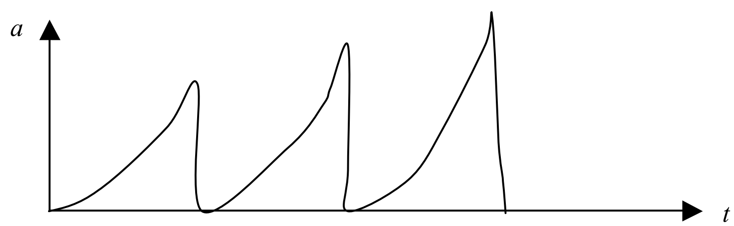
1. Speed simply measures how fast something is moving, but velocity also takes into consideration the direction of the motion. One way of putting it is that speed is the magnitude of velocity.

- Checkpoint following 2:

1. You look at the slope of the line that's tangent to the curve at a given time.
2. Students should draw the tangent line and then demonstrate how to find its slope by calculating the rise over run.

- Checkpoint following 3:

1. What do you suppose its actual acceleration looks like as a function of time? The actual acceleration is certainly not constant, but varies depending on how fast the engine is turning over. The actual graph might look something like this:



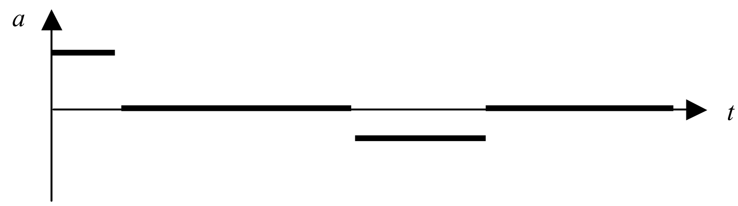
where the peaks represent the maximum power just before shifting gears.

2. The answer is friction from the road pushing the car forward. Common responses of "the engine", "the drive shaft" and so forth can be met with the question "What would happen if the car were on a slippery surface?"

- Checkpoint following 4:

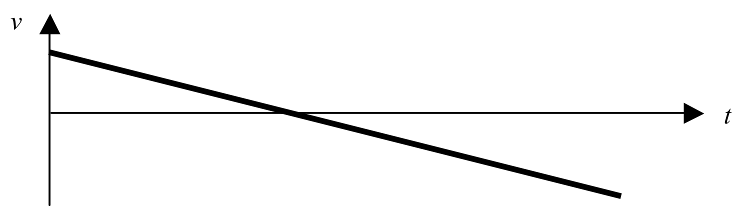
1. The displacement is the area under the velocity curve, which in this case is the sum of two triangles and a rectangle. With a little care, you can convince students that the triangular areas represent displacements of the form $\frac{1}{2} at^2$, and the rectangular area represents a displacement of the form vt. This can lead to a discussion of integration or simply of a graphical meaning of the kinematics equations, depending on the audience.

2. The graph is shown below. The nonzero accelerations are 2 m/s^2 and –1 m/s^2.

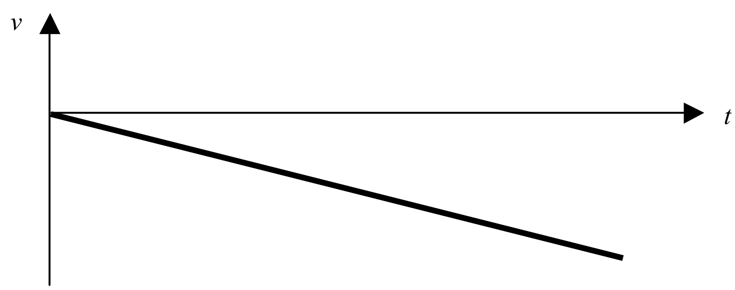


- Checkpoint following 5:

1. The graph is shown below.



2. Note that the slopes are identical; it's just the initial velocity that changes. This shows how velocity and acceleration (its slope) are decoupled.



3. Yes, in this case one can analyze Smoky's up and down motion without breaking it up into an upward part and then a downward part. The reason is that his acceleration is the same (and constant) for that entire motion. As long as acceleration remains constant, the equations for motion with constant acceleration can be used continuously.