I) Graphing a Position vs. Time Story

Recall that for a position vs. time graph any point on the graph represents an object’s displacement from the origin at that particular time. The slope of the graph at any point represents the velocity of the object, so straight line portions represent constant velocity. If the object is not moving it has a constant velocity of zero, represented by a horizontal line (slope of zero). Curved portions of the graph represent acceleration, since curved portions have a changing slope, and therefore a changing velocity.

A) For the following stories draw a graph of position vs. time (label your axes please!). Also label the portions of your graph that correspond to the lettered portions of the story. Draw the graphs on your own first, and then confer with your group to see if each graph makes sense. Are the differences between your graphs significant? Are the differences due to errors in interpretation or are they due to ambiguities in the stories?

1. A sprinter is at the starting line waiting for the starting gun (A). When the starting gun goes off the runner quickly accelerates to her maximum velocity (B). She maintains this constant velocity until the finish line (C). She then quickly slows, and stops to rest. (D)
2. You are driving at a constant velocity (with the windows down) (A). After a few moments, your physics homework flies out of the window (B)! You immediately (gently) brake to a stop and then put your car in reverse (C). You gently accelerate to a constant velocity and reverse along the shoulder to retrieve the paper (D), stopping when you reach the point at which it flew out of the window (E).

3. A snowboarder is cruising down the mountain at a constant velocity when she sees an extremely steep section approaching (A). She slows down to a stop and surveys the beautiful terrain below for a few moments (B). She then chooses her line, and barrels down the mountain, reaching a much higher magnitude velocity than before (C).
B) Creating a Story for a Position vs. Time Graph

On your own, choose one of the position vs. time graphs shown below. In the space provided, write a brief story describing the graph. Then read the story to your group members and see if they can identify the correct graph. Critique your stories and make sure they match the graph.
C) Graph Acting Challenge

In your group draw a graph of position vs. time that includes at minimum the following elements:
a section of time maintaining constant position, 2 sections of time with constant velocities. The 2
constant velocities must have different magnitudes, and some sections of your graph must have a
negative position and some must have a positive position. (Just for example, but make up your own:)

As a group, decide how the graph will be acted out. There will be a metronome available for timing.
Decide on one member of your group to act out the graph for the class, and have the actor practice a
few times before presenting. The actor (or group) can “narrate” as they see fit, so the viewers have an
idea what your story is. We will take time for ~3 groups to present to the whole class (we’ll start by
asking for volunteer groups, but will pick randomly if no one steps forward! Every group should be
prepared to present.) When it’s your turn, your group’s actor will act out their graph on the 1d
coordinate system provided at the front of the room, and the acting group will not reveal their graph.
The rest of the class will observe and attempt to draw the position vs. time graph that has been acted
out. Each student should draw their own graph individually first, and then confer with their group. The
acting group will then reveal their intended graph, and the whole class will collectively decide if the
actor accurately portrayed the graph.
II) Velocity vs time graphs.
For a velocity vs. time graph any point on the graph represents an object’s velocity at that particular time. Velocity can be positive (meaning “forward” motion, towards whichever direction you have defined as positive positions) or negative. Zero velocity means “at rest” (not necessarily “at the origin”!)

A) For each position vs. time graph draw a velocity vs. time graph below it

For each graph, confer with your group. Are the differences between your graphs significant? For each of the three graphs, describe the motion in words. Then trace out the motion with your finger on the table (or, act it out). Doing this while looking at (or thinking about) an x vs t graph is usually pretty straightforward. But, doing this while looking at/thinking about the corresponding v vs t graph can be a little subtler. Talk it through!)
Let’s do a few more: For each position vs. time graph draw a velocity vs. time graph below it.

And again:
- check with your neighbors
- describe all of three graphs in words,
- “trace out the motion” with your fingers on the table (or walking).
B) Let's return to the stories back in part 1, but now let's draw the graph of velocity vs. time. You may choose just one of the stories, (we reproduced them here for your convenience) It may be helpful to look at the x vs t graph you drew before as well to help you here!
- Label the portions of your graph that correspond to the lettered portions of the story.
- Draw the graphs on your own first, and then confer with your group to see if each graph makes sense. Are the differences between your graphs significant? Are the differences due to errors in interpretation or are they due to ambiguities in the stories?

(Pick one of these stories with your group, and then draw the velocity vs. time graph below. Label your axes, please!)

1. A sprinter is at the starting line waiting for the starting gun (A). When the starting gun goes off the runner quickly accelerates to her maximum velocity (B). She maintains this constant velocity until the finish line (C). She then quickly slows, and stops to rest. (D)

OR

2. You are driving at a constant velocity (with the windows down) (A). After a few moments, your physics homework flies out of the window (B)! You immediately (gently) brake to a stop and then put your car in reverse (C). You gently accelerate to a constant velocity and reverse along the shoulder to retrieve the paper (D), stopping when you reach the point at which it flew out of the window (E).

OR

3. A snowboarder is cruising down the mountain at a constant velocity when she sees an extremely steep section approaching (A). She slows down to a stop and surveys the beautiful terrain below for a few moments (B). She then chooses her line, and barrels down the mountain, reaching a much higher magnitude velocity than before (C).

If you have time – thinking about real life situations, add a SCALE to your vertical axis, i.e. come up with reasonable numerical values for the velocities on the axis, using SI metric units (m/s) Similarly, mark your time axis with reasonable times (in sec) for your plot too.