

In Class Activity Plan

Week Two: Practice Constant Motion & Introduce Motion Maps, Develop Constant Acceleration Model

30 min

Week 2 – Activity Motion Maps Intro.doc

PURPOSE: Introduce Motion Maps; practice with representations

Goals for the students to focus on:

1. *Coordination of representations (Consistency between the p-t graph, the v-t graph, and the frame of reference)*
2. *Application of constant velocity model rules (see the instructor guide from Week 1)*
3. *Introduce Motion Maps (if not done previously)*
 - o *See Motion Maps.doc for more information (you can hand this out to students after the discussion if you like)*
 - o *Points (dots) represent position at a time*
 - o *Arrows represent velocity (speed and direction)*

Seed:

- *On #2 point out that you don't know the initial position from a v-t graph. Get two groups to put different initial positions.*

10 min

Whiteboard – Constant Motion Activity

Note: Assign individual groups to whiteboard their models for specific problems. Have two groups present that have different answers for #1 and two more groups #2.

1. What rules can you make about motion maps?
2. How do motion maps fit together with our other representations?
3. What do motion maps add to our model? What do we use them for and why?

20min

Board Meeting

PURPOSE: Share problem solutions, provide feedback on solutions.

- *Emphasize internal consistency within problem solution - This means both the instructor and students should look for the model for each group is consistent. Note that all groups doing a particular problem do not need to have identical solutions, they may vary by choice of reference frame, so it depends on how each group has chosen to model the situation.*
- *Importance of picking a reference frame/making assumptions – this must be included with your motion map*
- *Adding Motion Maps to our model now.*

120 min

Investigating Constant Acceleration Lab

PURPOSE: Extend graphs and motion maps to now include constant accelerated motion.

Logistic Notes:

- *Need to add acceleration graph to Logger Pro*
- *Hurry students through page 1 & 2, don't let them spend too much time here*
- *If the lab is too long for a single day, you may want to do a whiteboard discussion after page 8*
- *If graphs are too noisy, the instructor can do some examples with fan carts to get the point across. You can also use the "Trigger" settings on LoggerPro to help get clean data.*

Seed:

- Is it ok to throw out the noise in the data?
- Is acceleration actually constant?
- How are position graphs in trials 1-4 different (concavity)?
- Previously, the slope of the position vs. time graph gave the velocity, is this still true?
 - *Consider: How do we now modify this statement "The slope of the position vs. time graph equals the velocity"? (Answer: We have to insert "at any point")*
 - *This is where calculus representation becomes powerful – derivatives let us divide up a line into little chunks. Looking at derivative/slope at each little chunk*
- Are any of the trials 1-4 similar with respect to velocity graphs?
 - Can velocity be negative?
 - Can acceleration be negative?
 - Can you have a negative acceleration, but be speeding up?
 - Table of (1) Direction of Motion (2) Direction of acceleration and (3) Speeding up/Slowing down – *This makes a good summary board*

15 min

Whiteboard – Investigating Constant Acceleration Lab

PURPOSE: Summarize results from constant a investigation.

- What did you learn?
 - o *Note: "Learning" does not require evidence. Possible examples of learning statements:*
 - *Definitions*
 - *Using the equipment*
 - *Experimental technique (e.g. minimizing the error)*
- What rules can you make (and what evidence do you have to support those rules)?
 - o *Note: If you look ahead to the discussion section, as the instructor you'll want to make sure all of those rules appear on various whiteboards*
- What questions do you still have?

45 min

Board Meeting

PURPOSE: Establish consensus on defined terms, and rules for interpreting graphs and motion maps with constant acceleration.

Note: Today is a day that you will be in the center of the circle many times (thus, you may not want to wear a short skirt this day)

- Terms to define:
 - Acceleration must include:
 - Motion maps have changing lengths of arrows
 - Velocity-time graphs are straight lines, not necessarily horizontal
 - Get rid of deceleration
 - *Here you might ask what deceleration means, and you get multiple answers such as slowing down and negative acceleration, and then you point out this is not a helpful term*
- Rules – constant acceleration model
 - When constant acceleration, constant v rules don't apply
 - Which rules still apply?
 - Slope of position tells us velocity (*Note: derivative = slope of the tangent line*)
 - Area under the curve of velocity tells us the change in position (*This is the integral in our calculus language*)
 - Acceleration is the slope of velocity-time graph
 - Direction
 - $a = \Delta v / \Delta t$
 - $a = dv/dt$
 - Area under the curve of acceleration graph tells us change in velocity
 - $\Delta v = a \Delta t$
 - $dv = a dt \rightarrow \Delta v = \int a dt$
 - *make sure we are talking about what this math means, step by step, and how it is the same as the non-calculus versions*
 - In the Motion Maps the change in length of velocity vector is proportional to the acceleration
 - Chart of relation between direction of velocity, direction of acceleration, and speeding up/slowing down

Homework for Week 2:

1. Coordinating Motion Maps and Const. Vel
 - a. Practice using motion maps

- b. Understand and be able to use the new representation
- 2. Constant Acceleration Practice
 - a. Coordination of representations (Consistency between the p-t graph, the v-t graph, the a-t graph, motion map, and frame of reference)
 - b. Application of constant acceleration model rules