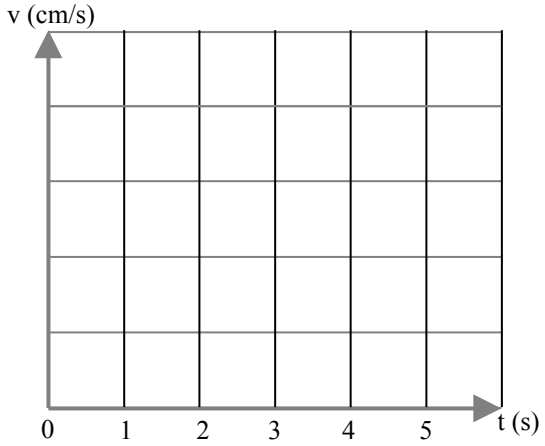
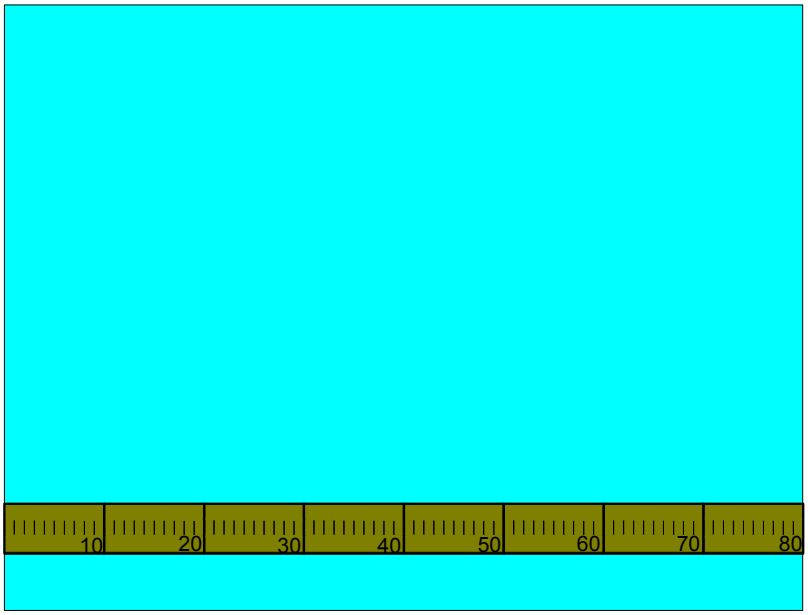
Physics Whiteboard Problems – Graphing Accelerating Objects

1. A mouse is sitting still eating some peanut butter, when it is startled by a porcupine, causing it to accelerate at 3cm/s^2. (a) Draw a quantitatively accurate velocity vs. time graph for the first five seconds of the mouse's motion. From this graph, determine the mouse's position at each second. Show your method with a visual aid and at least one sample calculation.

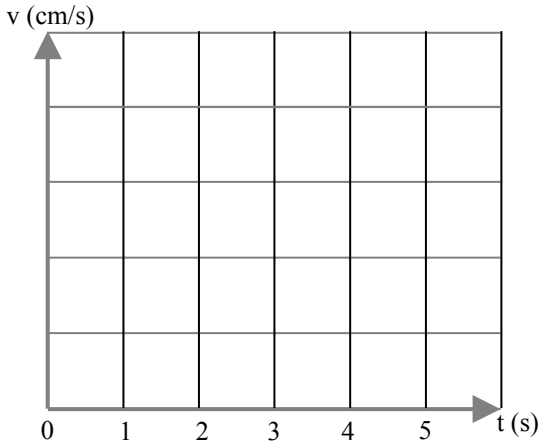


(b) Lay your meter stick longways on your whiteboard as shown below, then plot the position of the mouse at each second. *Don't spend the time to draw the meter stick. Just set it on the whiteboard, then plot the points!* (c) Add a velocity arrow at each point, using a scale of 1cm represents 1cm/s. (d) Add an acceleration arrow at each point, using a scale of 1cm represents 1cm/s^2. Arrows should start at or near the dot showing the mouse's position at that instant in time. Use half arrow-heads and a different color for acceleration arrows.

(e) Show how to obtain the velocity arrow for t = 3s by placing the velocity and acceleration arrows for t = 2s tail-to-head with each other. Draw your vector addition diagram to scale.



2. The mouse is already moving at 6cm/s when it spies some cheese, causing it to accelerate at $3cm/s^2$. (a) Draw a quantitatively accurate velocity vs. time graph for the first five seconds of the mouse's motion. From this graph, determine the mouse's position at each second. Show your method with a visual aid and at least one sample calculation.



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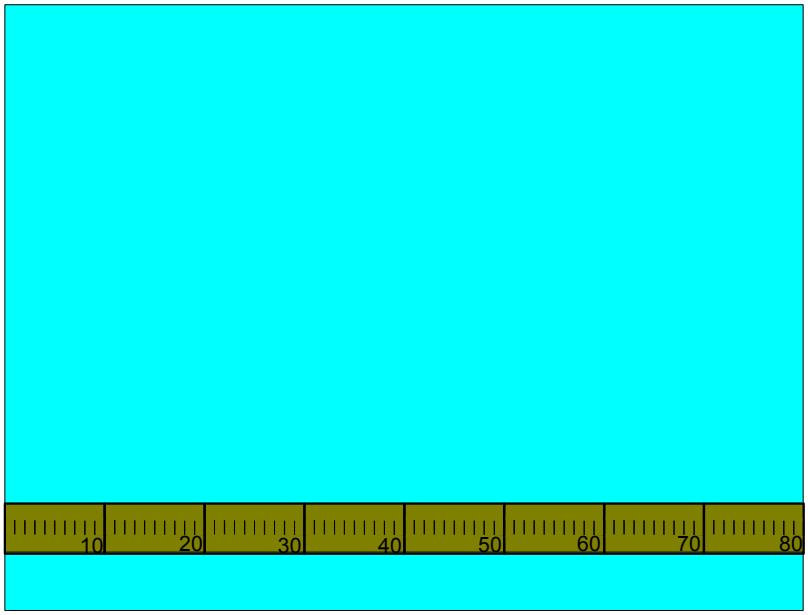
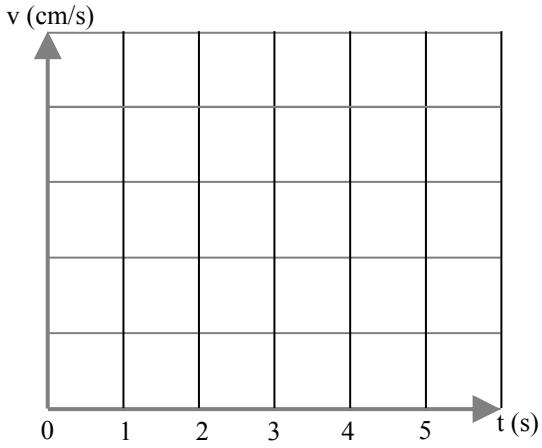
(e) Show how to obtain the velocity arrow for t = 4s by placing the velocity and acceleration arrows for t = 3s tail-to-head with each other. Draw your vector addition diagram to scale.



3. The mouse is traveling at 15cm/s when it sees a sleeping cat, so it stops running and slides with an acceleration of -3cm/s^2. (a) Draw a quantitatively accurate velocity vs. time graph for the first five seconds of the mouse's slide. From this graph, determine the mouse's position at each second. Show your method with a visual aid and at least one sample calculation.



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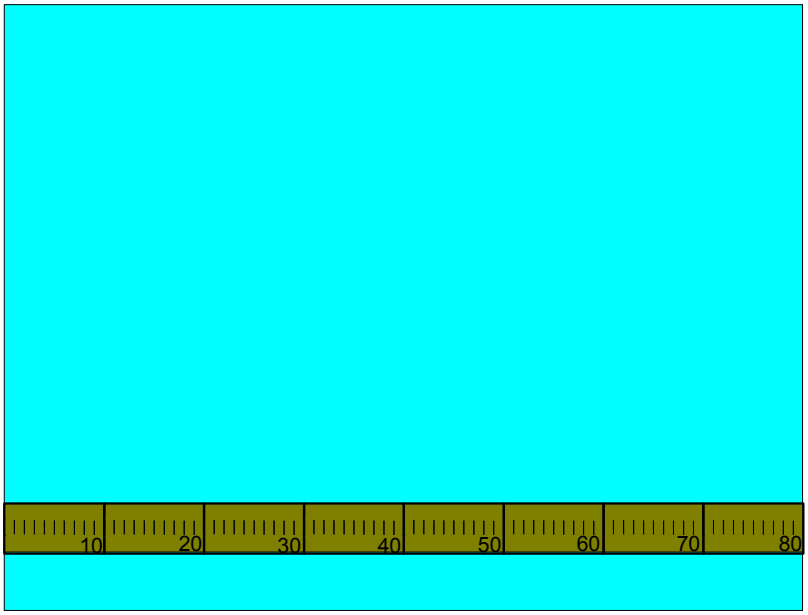
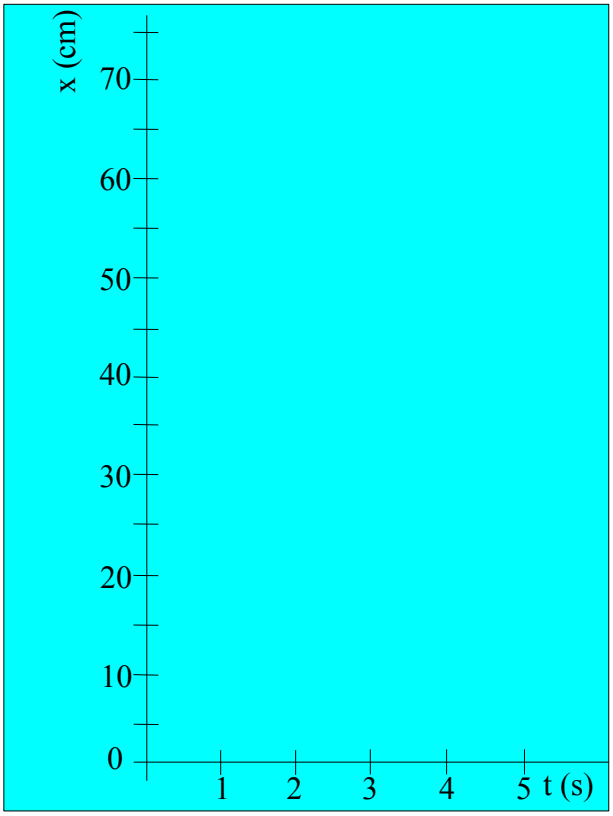
(e) Show how to obtain the velocity arrow for t = 3s by placing the velocity and acceleration arrows for t = 2s tail-to-head with each other. Draw your vector addition diagram to scale.



4. (a) Using your position and time data from the preceding three problems, plot the graph of position vs. time for each mouse. On your whiteboard, mark out a graph as shown below and put all three lines on one graph.



(b) Which graph shows the mouse slowing down? How could you tell just from the position vs. time graph?

(c) Which graphs show that the mouse is already moving at t = 0? How could you tell just from the position vs. time graph?

(d) Which graphs show the mouse speeding up? How could you tell just from the position vs. time graph?

5. Find the acceleration at t = 3s for each case. Show your work!