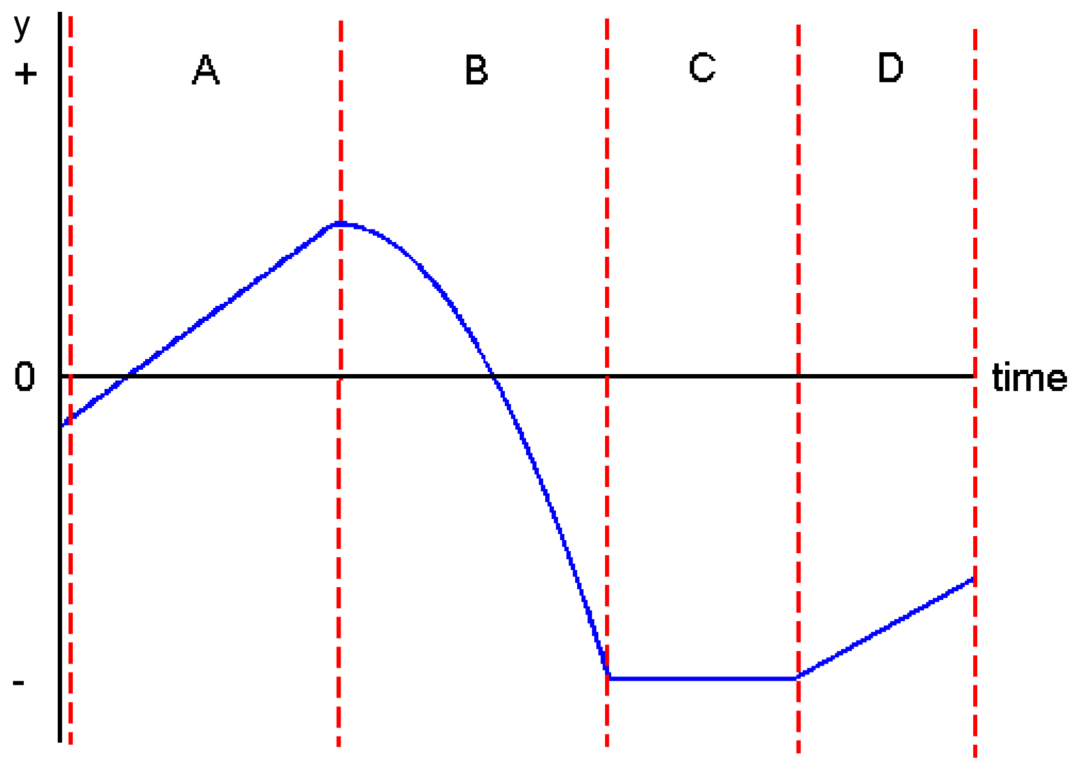
Physics 2211 GPS Week 2

Problem #1

The position of an object moving along the y-axis, as a function of time, is plotted in the adjacent diagram. For region D, answer the following series of questions. Once you have finished, answer these questions again for A, then C, and then B.



Note: Your instructor may ask you to describe the motion for each region. While doing this, use your hand to represent the object and move it according to the motion information given in that region. Be sure to define where, relative to your hand, the origin is located. The instructor may also ask you to imagine that your camera is taking snapshots of your hand (in equal intervals of time). If you place a dot a the center of your hand in snapshot, what would the pattern of dots together look like.

The object's **motion** is	A	B	C	D
in the $+y$ direction	X			X
in the $-y$ direction		X		
changing directions				
stationary			X	
unable to be determined with the given information				

The object's **speed** is	A	B	C	D
increasing		X		
decreasing				
constant	X			X
sometimes increasing and sometimes decreasing				
zero			X	
unable to be determined with the given information				

The object's **displacement** within a given region is	A	B	C	D
in the $+y$ direction	X			X
in the $-y$ direction		X		
changing directions				
zero			X	
unable to be determined with the given information				

The object's **velocity** is	A	B	C	D
in the $+y$ direction	X			X
in the $-y$ direction		X		
changing directions				
zero			X	
unable to be determined with the given information				

The object's **change in velocity** is	A	B	C	D
in the $+y$ direction				
in the $-y$ direction		X		
changing directions				
zero	X		X	X
unable to be determined with the given information				

Problem #2

Part 1: A proton traveling with a velocity of $< 700, 700, -700 >$ m/s and is located at $< 13, -4, 17 >$ m at a time $t = 0.8$ s. Assume the net force on the proton is zero.

(a) Find the velocity of the proton at time $t = 0.836$ s. (Hint: Use Newton's 2nd Law)

$$\vec{V}_f = \vec{V}_i + (\vec{F}_{net}/m)\,\Delta t \implies \vec{V}_f = \vec{V}_i \quad \text{b/c} \quad \vec{F}_{net} = 0$$

$$\Rightarrow \boxed{\vec{V}_f = \langle 700, 700, -700 \rangle \ m/s}$$

(b) Find the position of the proton at time $t = 0.836$ s.

$$\vec{r}_f = \vec{r}_i + \vec{V}_{Avg}\,\Delta t = \langle 13, -4, 17 \rangle + \langle 700, 700, -700 \rangle (0.836 - 0.8) =$$

$$= \langle 13, -4, 17 \rangle + (0.036) \langle 700, 700, -700 \rangle =$$

$$= \langle 13, -4, 17 \rangle + \langle 25.2, 25.2, -25.2 \rangle =$$

$$= \boxed{\langle 38.2, 21.2, -8.2 \rangle \ m}$$

(c) How can the proton be moving if the net force on the proton is zero? Explain briefly.

Newton's first law (inertia)

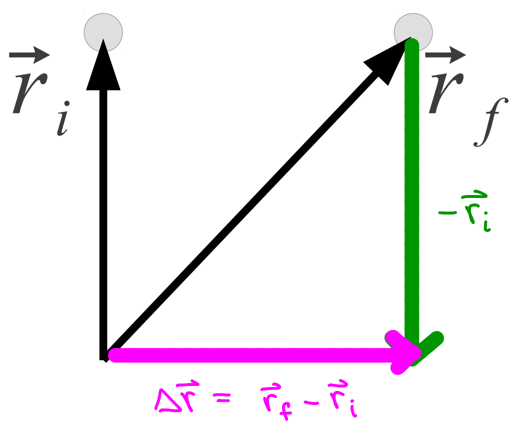
Problem #3

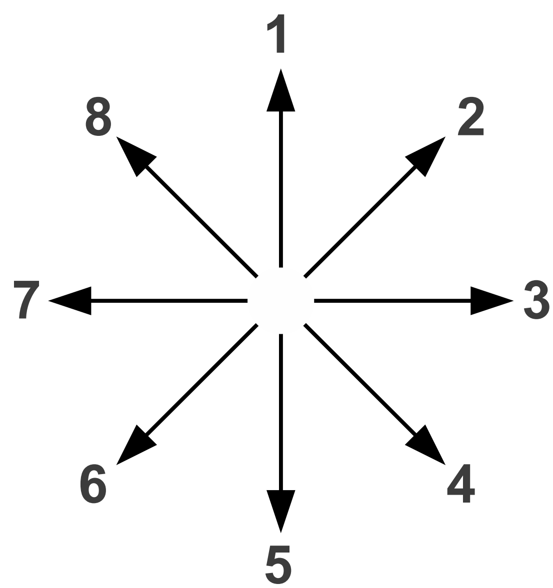
An object's initial position at $\vec{r}_i$ and final position at $\vec{r}_f$ are shown on the figure below. Using the numbered direction arrows shown, indicate (by number) which arrow best represents the direction of the quantities listed below. If the quantity has zero magnitude or if more information is needed to determine the direction, indicate using the corresponding number listed below.

The average velocity $\vec{v}_{avg}$ __3__ b/c $\vec{v}_{Avg} = \frac{\Delta \vec{r}}{\Delta t}$ and $\Delta\vec{r}$ points in direction 3

The displacement $\Delta\vec{r}$ __3__ see diagram

The change in velocity $\Delta\vec{v}$ __10__ b/c we don't know $\vec{v}_i$ or $\vec{v}_f$





9 zero magnitude
10 more info needed

An object's initial velocity $\vec{v}_i$ and final velocity $\vec{v}_f$ are shown below. Using the numbered direction arrows shown, indicate (by number) which arrow best represents the direction of the quantities listed below. If the quantity has zero magnitude or cannot be determined, indicate using the corresponding number listed below.

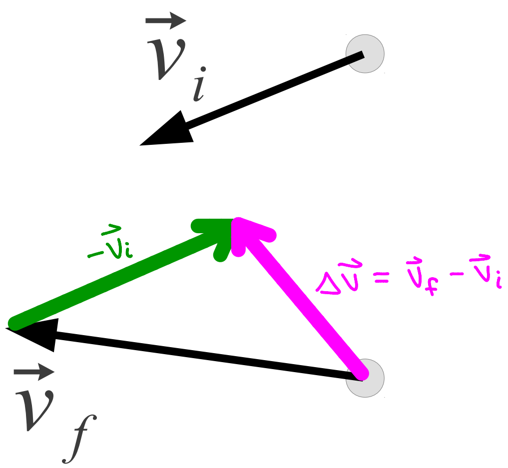
The initial position vector $\vec{r}_i$ __10__ b/c no position info is given

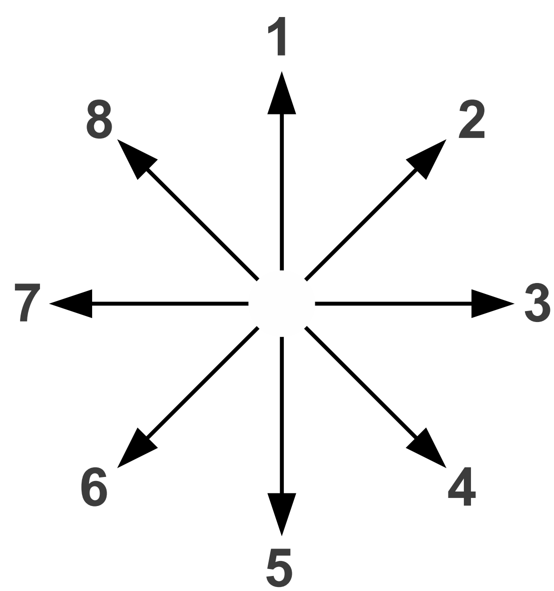
The change in velocity $\Delta\vec{v}$ __8__ see diagram

The change in momentum $\Delta\vec{p}$ __8__ b/c $\vec{p} = m\vec{v}$, so $\Delta\vec{p} = m\Delta\vec{v}$

The acceleration $\vec{a}$ __8__ b/c $\vec{a} = \frac{\Delta\vec{v}}{\Delta t}$

The net force $\vec{F}_{net}$ __8__ b/c $\vec{F} = m\vec{a}$, or alternatively, $\vec{F} = \frac{\Delta\vec{p}}{\Delta t}$



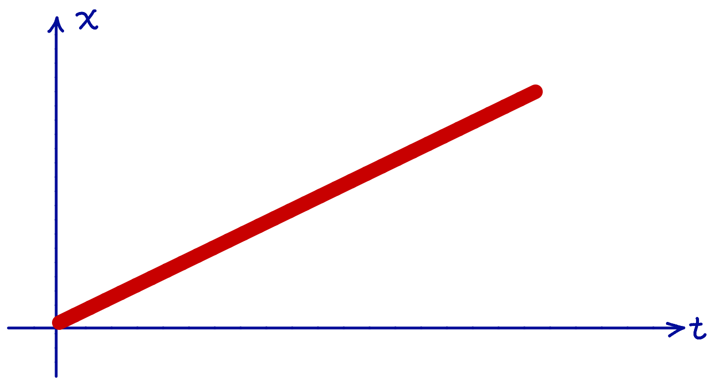


9 zero magnitude
10 more info needed

Problem #4

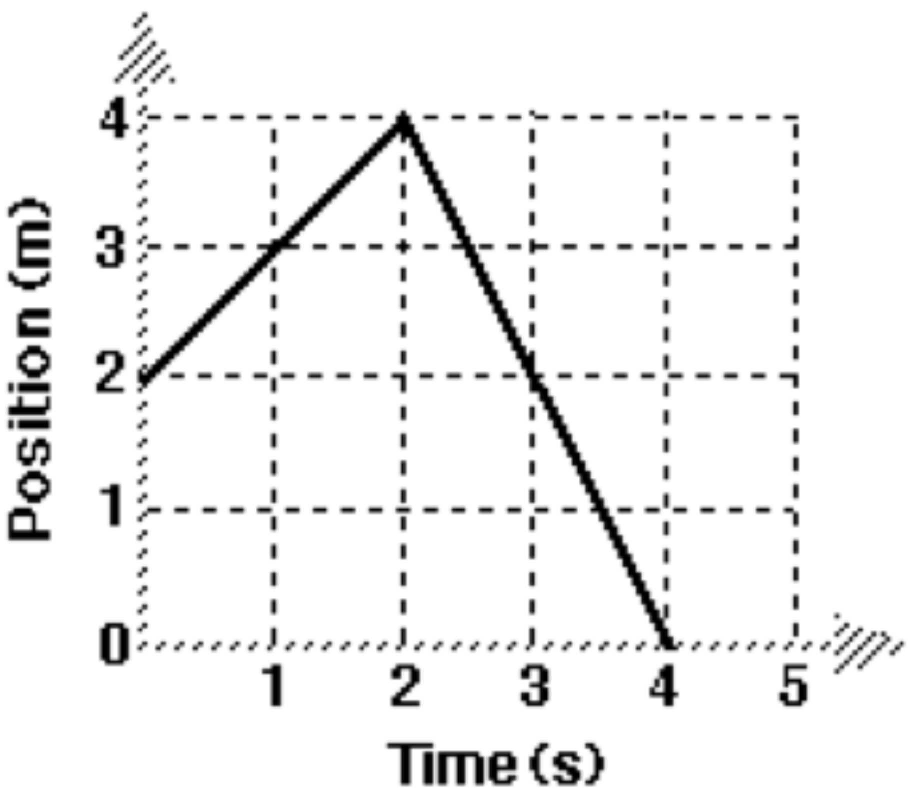
To complete this series of questions you will need the Lab 1 starter code, **2211-lab1start.py**. You can find this file on Canvas (look for Files, then the folder Lab Docs). Copy the contents of the starter code into a new program in your own GlowScript account.

(a) An object moves away from the origin at constant speed. Sketch, by hand, the position vs. time.



→ GlowScript

(b) For the following position vs. time graph, create a computational model based on Newton's 2nd Law (or, equivalently, the Momentum Principle) that correctly captures the described motion. Use your model to plot both the position vs. time and the velocity vs. time.



(c) An object moves away from the origin at a steady speed for 10s, reverses direction and moves back toward the origin at the same speed for 10s. Sketch, by hand, the position vs. time.