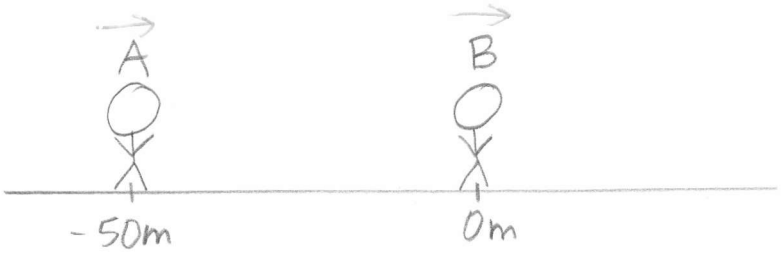
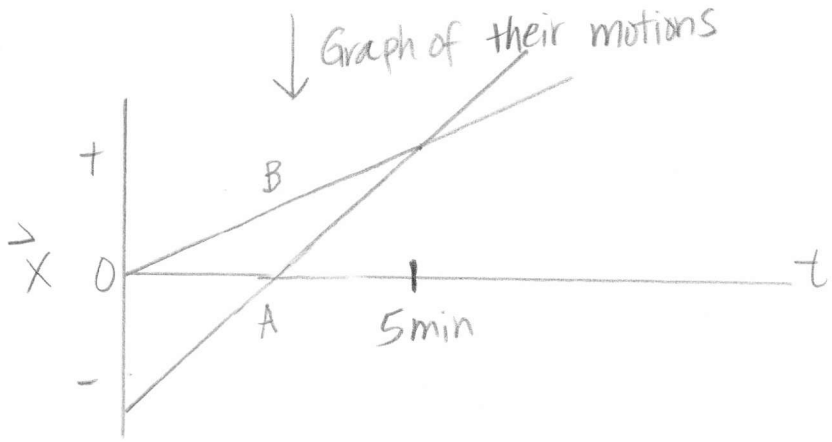
Mechanics Unit v-t graphs gpb video: Phys Std:

Review Question from d-t graph lesson:

- See the diagram to the right.
  a) Label each line on the graph as A or B
  b) Which person is walking with a faster pace?
  c) In which direction are they traveling?
  d) What happens at t=5 min?





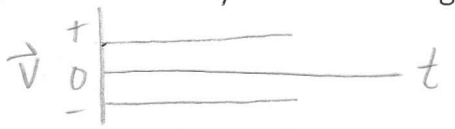
13a

- What does the slope of a v-t graph represent? $\frac{rise}{run} = \frac{\Delta \vec{v}}{t}$

- How do you tell if the object is at a constant speed or accelerating?

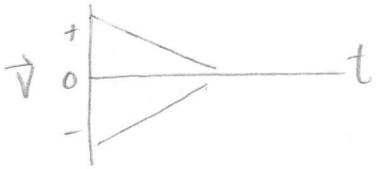
- Slope = rise/run = change in velocity/time = $\Delta \vec{v}/t$
- Slope = acceleration
  (the sign of the slope indicates the direction of acceleration)

- Constant $\vec{v}$: velocity doesn't change => FLAT LINE

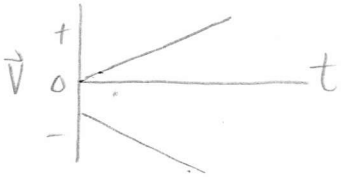


- Accelerating: velocity changes => STRAIGHT LINE if $\vec{v}$ changes at a constant rate; CURVED LINE if $\vec{v}$ changes at different rates

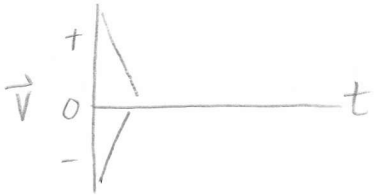
Slowing down (approaches 0):



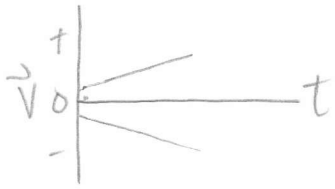
Speeding up (goes away from 0):



Slowing down quickly:



Speeding up slowly:



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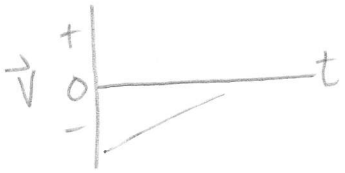
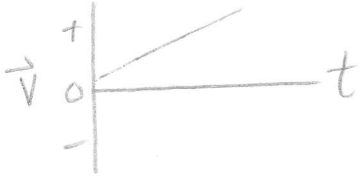
- How do you tell which direction the object is traveling?
  - The sign of velocity tells the direction, so see if the velocities are positive or negative looking at the axes.

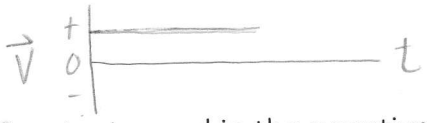
Negative direction:



Positive direction:



1. Constant speed in the positive direction:



$\vec{a} = 0$

2. Constant speed in the negative direction:

$\vec{a} = 0$

3. Gaining speed in the positive direction:

→ ⊕ quadrant

away from 0

$\vec{a}$ is ⊕

4. Gaining speed in the negative direction:

$\vec{a}$ is ⊖

5. Slowing down in the positive direction:

toward 0

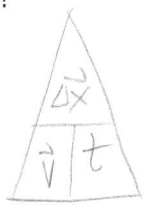
$\vec{a}$ is ⊖

6. Slowing down in the negative direction:

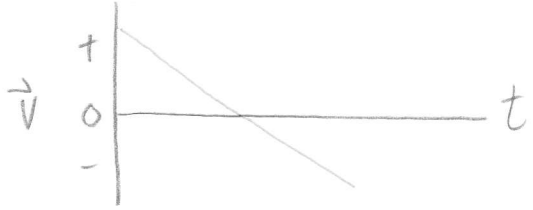
$\vec{a}$ is ⊕

- The line crosses quadrants (i.e. from + to -)

- How do you tell if an object changed direction?



Ex: Traveling in the positive direction slowing down, then stopping for an instant to change direction, then speeds back up again



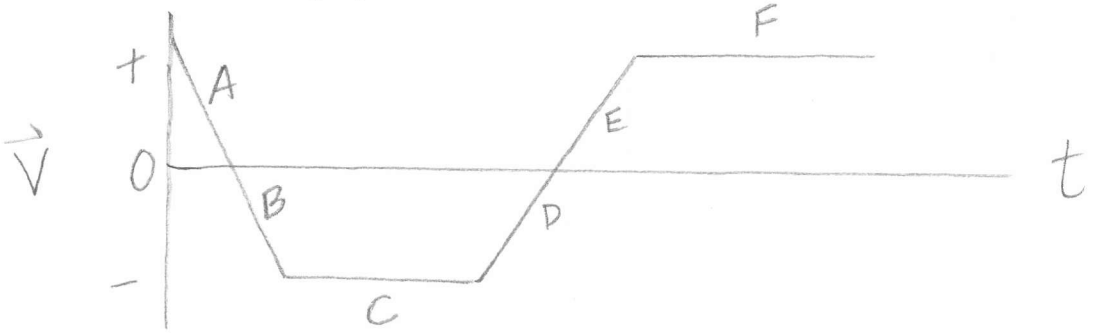
- How do you determine the displacement of an object?

$\Delta\vec{x} = \vec{v} \cdot t$
= height · base

- Area under the curve = displacement

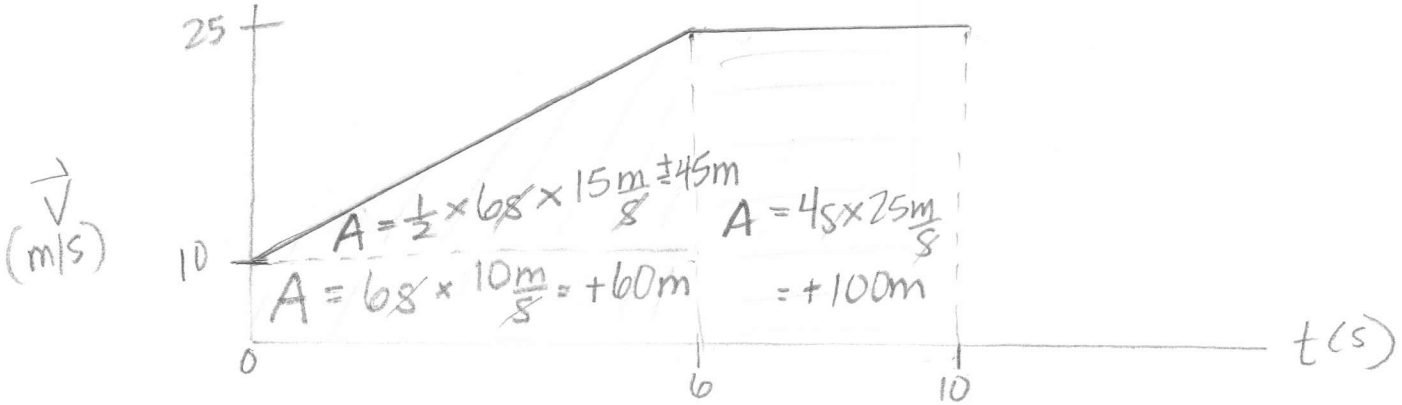
triangle = $\frac{1}{2}$ · base · height
rectangle = b · h
trapezoid = $\left(\frac{b_1 + b_2}{2}\right)h$

Look at the v-t graph below:



a) Which letter(s) represent(s) a changing velocity? A, B, D, E
b) Slowing down? toward 0 ⇒ A & D
c) Speeding up? away from 0 ⇒ B & E
d) Positive velocity? + quadrant ⇒ A, E, F
e) Negative velocity? − quadrant ⇒ B, C, D
f) Constant, positive acceleration? st. line with + slope ⇒ D & E
g) Constant, negative acceleration? st. line with − slope ⇒ A & B
h) Constant velocity? 0 slope ⇒ flat line ⇒ C & F

Look at the $\vec{v}$-t graph below:



a) Calculate the acceleration during the first 6 seconds. Include direction.
b) What is the displacement for the first 6 seconds? $+45m + {}^{+}60m = \boxed{+105m}$
c) What is the displacement for the last 4 seconds? $\boxed{+100m}$
d) What is the total displacement for the entire trip? $^{+}105m + {}^{+}100m = \boxed{+205m}$

(a) slope = $\vec{a} = \frac{\text{rise}}{\text{run}} = \frac{+15m/s}{6s} = \boxed{+2.5\ m/s/s}$