# Chapter 2 notes for constant velocity

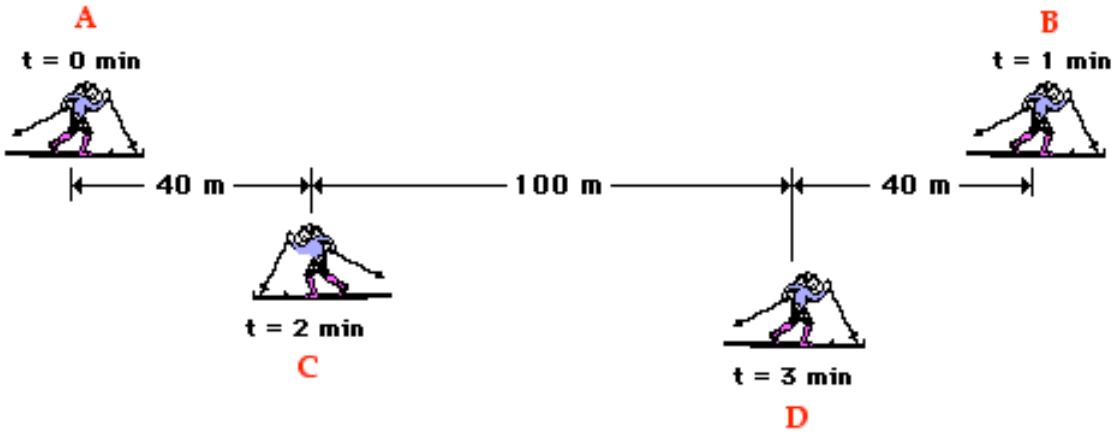
* **Scalars** are quantities which are fully described by a magnitude (or numerical value) alone.
* **Vectors** are quantities which are fully described by both a magnitude and a direction.
* **Distance** is a scalar quantity which refers to "how much ground an object has covered" during its motion.
* **Displacement** ($\Delta x$) is a vector quantity which refers to "how far out of place an object is"; it is the object's overall change in position.
* **Speed** is a scalar quantity which refers to "how fast an object is moving."

$$\text{Average Speed} = \frac{\text{Distance Traveled}}{\text{Time of Travel}}$$

***Velocity** is a vector quantity which refers to "the rate at which an object changes its position."

$$\text{Average Velocity} = \frac{\Delta \text{position}}{\text{time}} = \frac{\text{displacement}}{\text{time}}$$

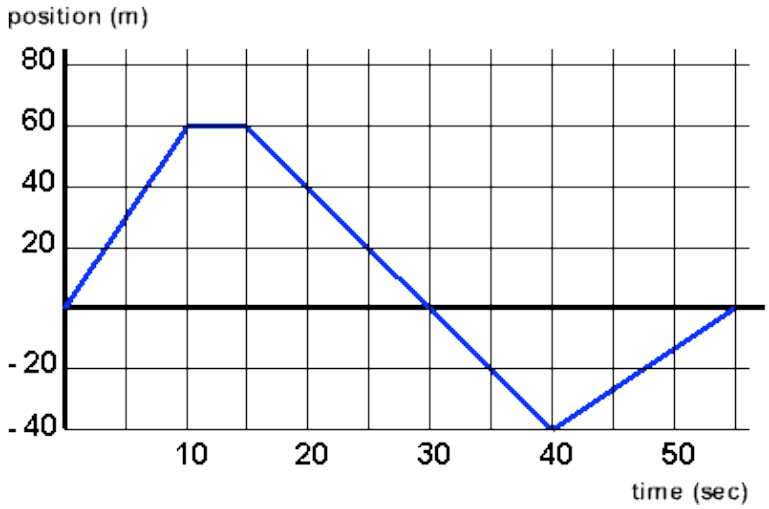
The following shows the path of a skier from A to B to C to D during a total time of 3 minutes



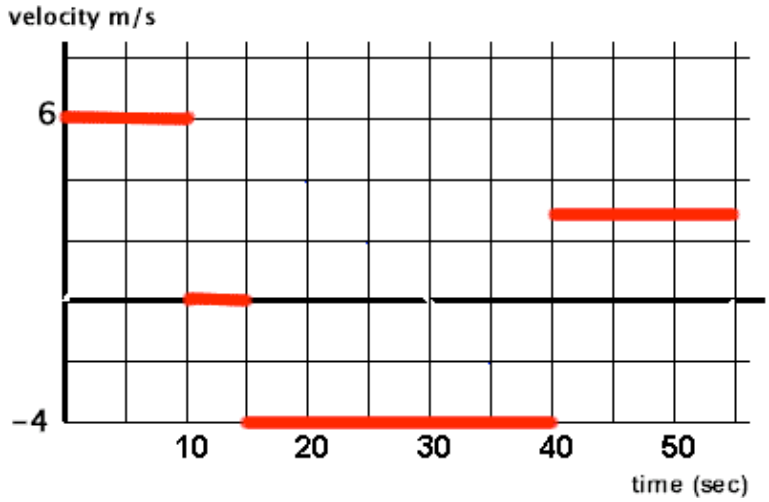

The skier covers a distance of (180 m + 140 m + 100 m) = 420 m and has a displacement of 140 m, rightward.

The skier has an average speed of (420 m) / (3 min) = 140 m/min and an average velocity of (140 m, right) / (3 min) = 46.7 m/min, right

**Making a velocity vs time graph from a position vs time graph**

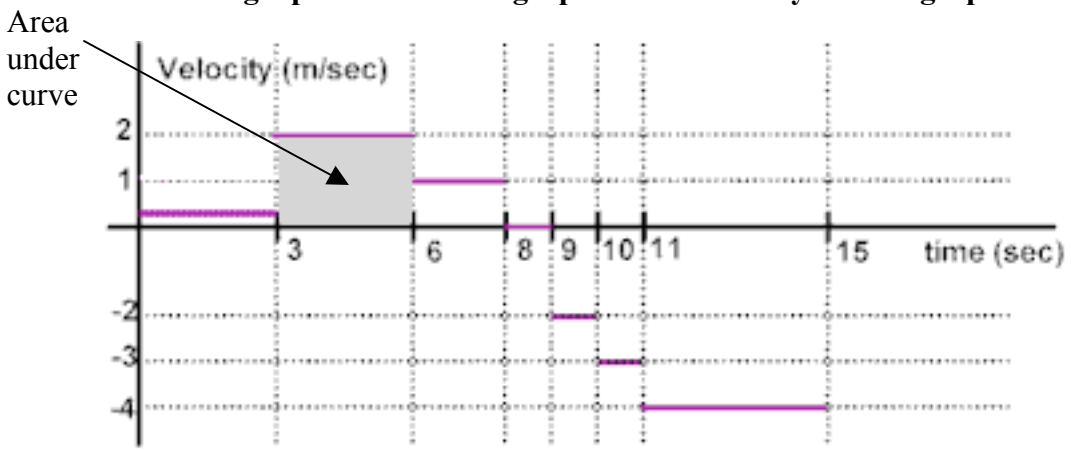



| **time interval** | **slope = average velocity** |
|---|---|
| 0s-10s | (60m – 0m)/(10s – 0s) = 6 m/s |
| 10s-15s | 0 m/s |
| 15s-40s | (-40m – 60m)/(40s –15s) = -100m/25s = - 4m/s |
| 40s-55s | (0m – -40m)/(55s – 40s) = 40m/15s = 2.7m/s |



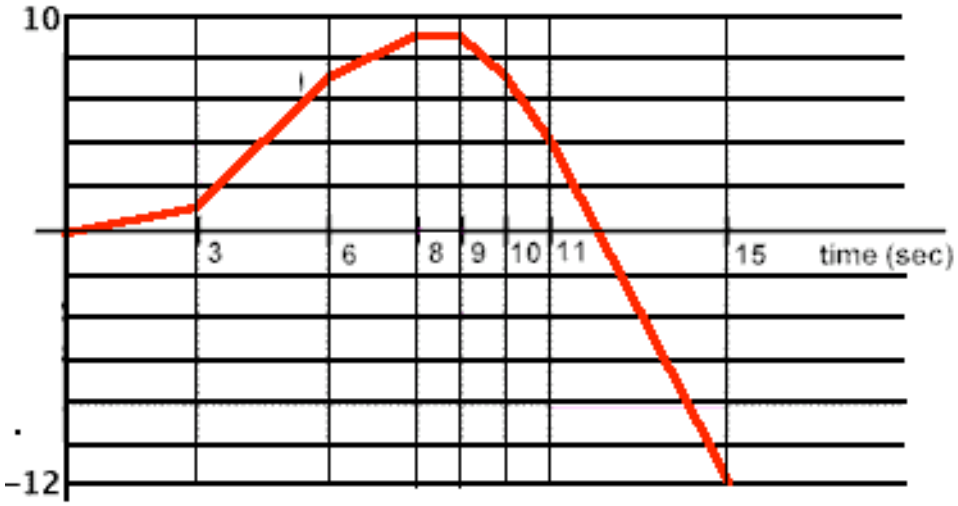

total distance = 60m + 0m + 100m + 40m = 200 m
total displacement ($\Delta x = x_f - x_i$) = (+60m) + 0m + (-100m) + (+40m) = 0m
average speed = distance/time = 200m/55s = 3.6 m/s
average velocity $v_{ave} = \Delta x/t = 0$ m/s

**Making a position vs time graph from a velocity vs time graph**




| **time interval** | **area under curve = displacement** | **cumulative displacement** |
|---|---|---|
| 0s-3s | (3s)(+0.33m/s) = +1m | +1m |
| 3s-6s | (3s)(+2m/s) = +6m | +7m |
| 6s-8s | (2s)(+1m/s) = +2m | +9m |
| 8s-9s | 0m | +9m |
| 9s-10s | (1s)(-2m/s) = -2m | +7m |
| 10s-11s | (1s)(-3m/s) = -3m | +4m |
| 11s-15s | (4s)(-4m/s)= -16 m | -12m |

**displacement (m)**

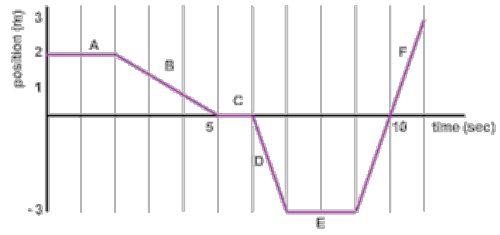
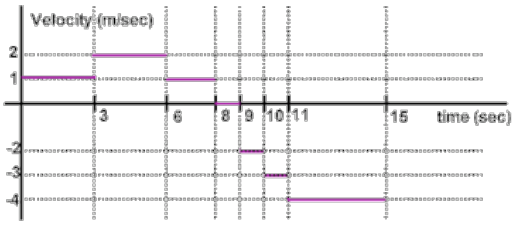



total distance = 1m + 6m + 2m + 0m + 2m + 3m + 16m = 30 m
total displacement, Δx (see above) 12 m, negative
average speed = distance/time = 30m/15s = 2 m/s
average velocity $v_{ave}$ = Δx/t = -12m/15s = 0.8 m/s, negative

Physics online LAB

Resource Lesson

# Comparing Constant Velocity Graphs of Position-Time & Velocity-Time

| | Position-Time Graphs | Velocity-Time Graphs |
|---|---|---|
| |   |   |
| **direction of motion** | sloped up, positive direction<br>sloped down, negative direction | 1st quadrant, positive direction<br>4th quadrant, negative direction |
| **instantaneous velocity** | slope of line, including + or - | height of line, including + or - |
| **instantaneous speed** | absolute value of the slope, always positive | absolute value of the height, always positive |
| **at rest** | flat line segments where position remains the same | flat line segments coincident with the x-axis<br>showing a velocity of zero |
| **distance traveled** | track the changes in the height of each line during the time interval requested, always + | calculate the areas under each line segment during the time interval requested, always + |
| **net displacement** | compare the y-values of the starting and ending points, subtract $y_{final} - y_{initial}$ | calculate the cumulative areas<br>paying attention to + and - areas |
| **instantaneous position** | height of a line segment at a specific time | cumulative displacement when given a starting position |
| **average speed** | total distance / total time | total distance / total time |
| **average velocity** | net displacement / total time<br>slope of a secant connecting the starting and ending points | net displacement / total time |