Feb. 24

Velocity- Time Graphs

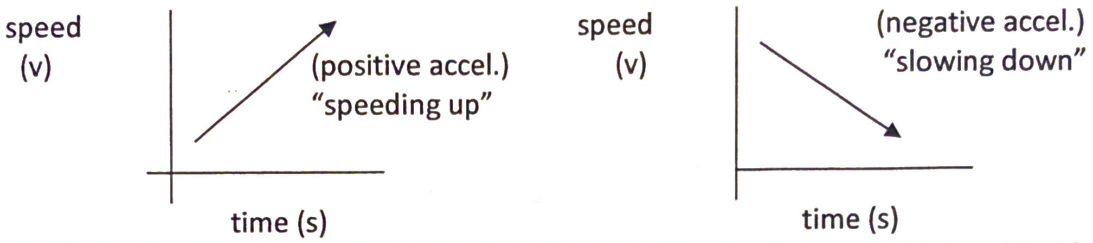
We have examined graphs that show us distance and displacement, but we can also plot speeds and velocities on graphs for both uniform or non-uniform motion. This gives us a quick impression of an object's motion for a given time period.

constant → changing

Speed-Time Graphs for Acceleration

We have learned that a distance-time graph tells us about the objects speed (by looking at its slope).

Acceleration is a description of the relationship between speed and time. On a speed-time graph the slope of the "line of best fit" gives us the acceleration of the object.



Recall: $a = \frac{\Delta v}{\Delta t} = \frac{v_2 - v_1}{t_2 - t_1} = \frac{\Delta y}{\Delta x} = \frac{\text{rise}}{\text{run}} = \text{slope}$

*A negative slope indicates that the object is slowing down.

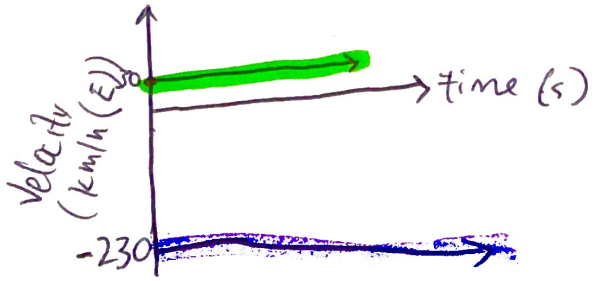
*A straight-line on a speed-time graph indicates that the object is moving with a constant acceleration (either positive or negative).

*A horizontal line on a speed-time graphs indicates constant speed (uniform motion)

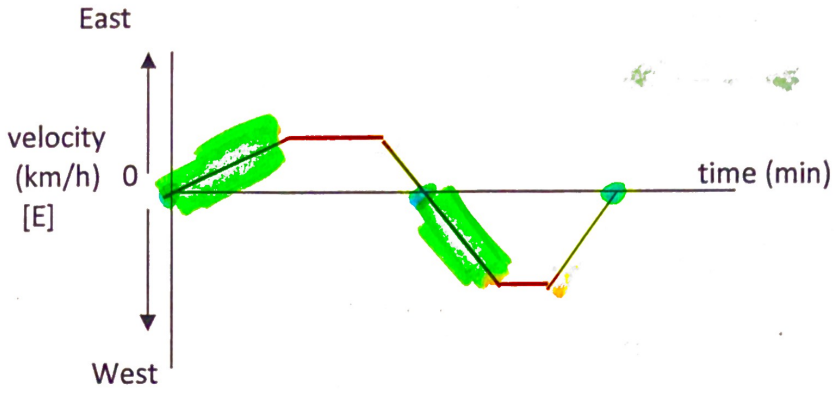
Velocity-Time Graphs

Velocity time graphs are similar to speed-time graphs in a variety of ways, but a main difference is that direction is now indicated (for both velocity and acceleration).

Since the two objects are traveling in different directions, one will be positive, the other negative (depending what direction we label the vertical axis).



Summary of a Velocity-Time Graph:

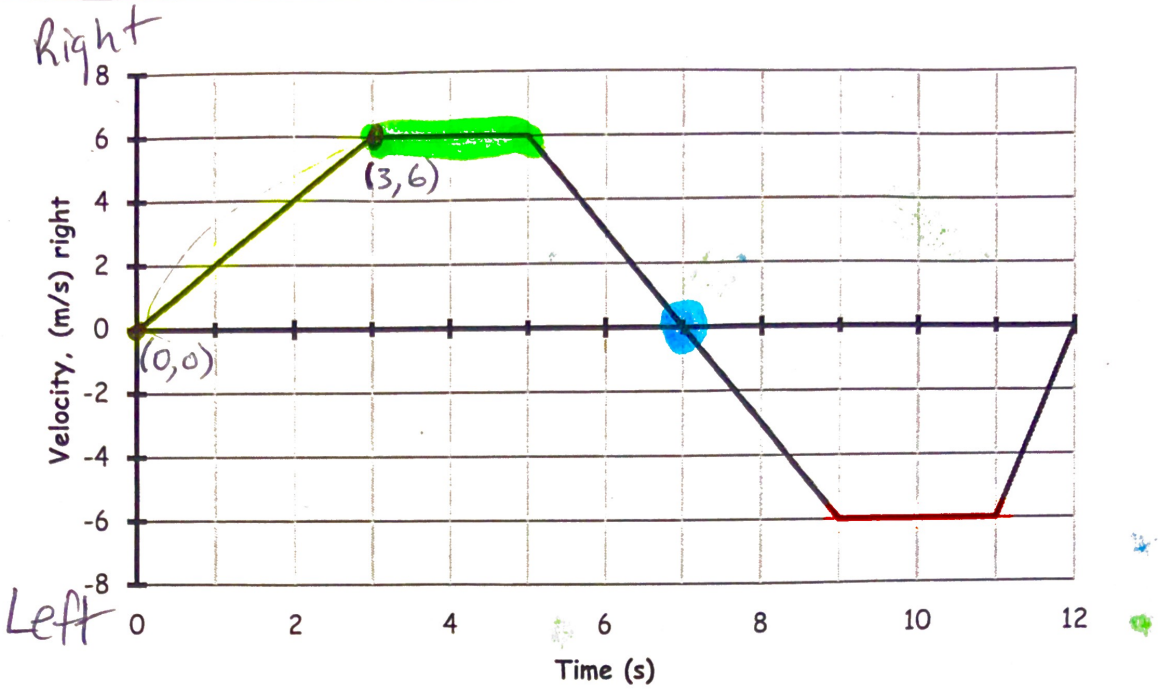


*If velocity = zero, the object is stopped.
*Straight horizontal line = constant velocity
*Sloping straight line = constant acceleration (+ or -) * positive means speeding up, negative means slowing down
*Curved line = non-uniform acceleration

The slope of the line gives us the acceleration! Slope = rise / run = $\Delta v / \Delta t = a$

$$\text{Slope} = \frac{\text{RISE}}{\text{RUN}} = \frac{\Delta v}{\Delta t} = a$$

Velocity-Time Graphs 1



a. At what time(s) is the object moving at a constant speed? 3-5s, 9-11s
horizontal line

b. What is the acceleration of the object during the first 3 s of the trip?

$$\text{Slope} = \frac{\text{Rise}}{\text{Run}} = \frac{\Delta y}{\Delta x} = \frac{y_f - y_i}{x_f - x_i} = \frac{6-0}{3-0} = \frac{6\,m/s}{3s} = 2\,m/s^2$$

c. What is the distance traveled from 3s to 5s?

d=?
v=6m/s
t=2s

$d = v \cdot t$
$= (v)(t) = (6\,m/s)(2s) = 12m$

d. What is occurring at 7s?

- The object has stopped.
- Stopped just a moment while it changes directions

e. What distance is traveled from 9 – 11 s?

d=?
v=6m/s
t=2s

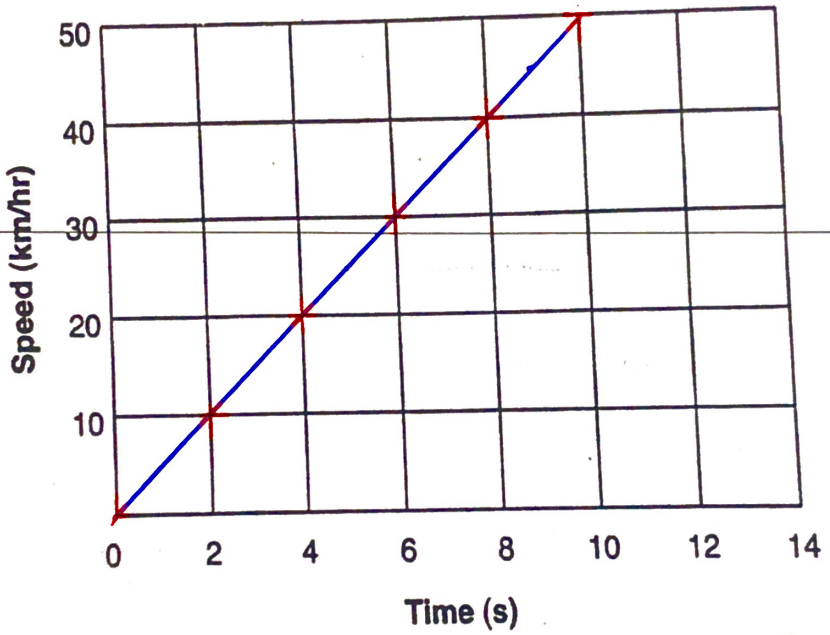
$d = (v)(t)$
$= (6\,m/s)(2) = 12m$

f. What does the negative mean? going in the negative direction (left)

Graphing Speed vs. Time

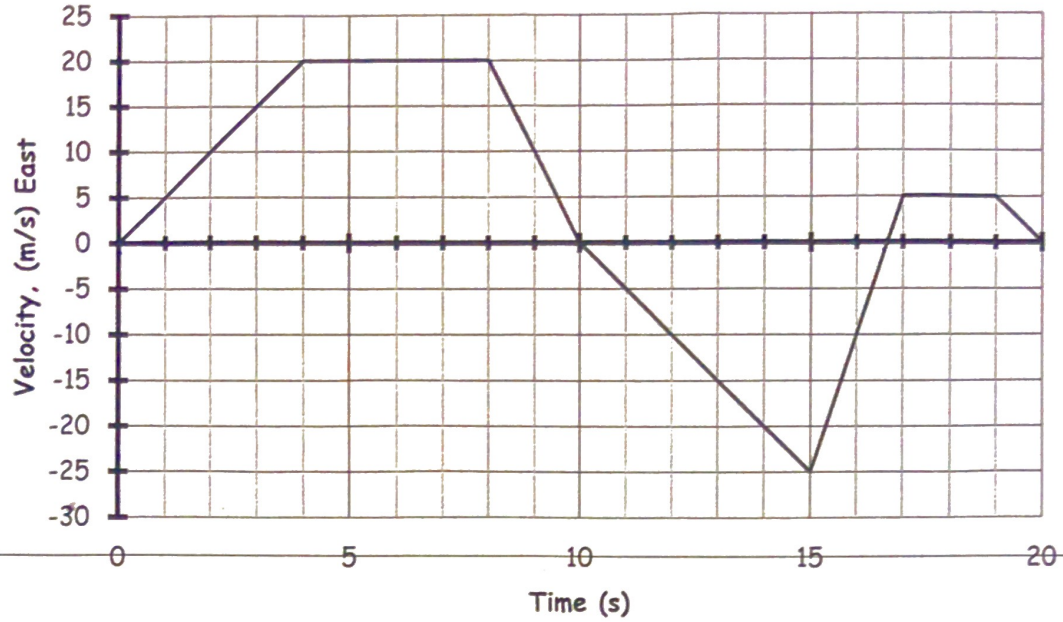
Plot the following data on the graph and answer the questions below.

Speed (km/hr)	Time (s)
0.0	0
10.0	2
20.0	4
30.0	6
40.0	8
50.0	10



1. As time increases, what happens to the speed? remains constant
2. What is the speed at 5 s? 25km/h
3. Assuming constant acceleration, what would be the speed at 14 s? 70km/h
4. At what time would the object reach a speed of 45 km/hr? 9s
5. What is the object's acceleration? a = 5km/h/s
6. What would the shape of the graph be if a speed of 50.0 km/hr is maintained from 10 s to 20 s? ✓ horizontal line
7. Based on the information in Problem 6, calculate the acceleration from 10 s to 20 s. 0m/s² or 0 km/h/s (no acceleration)

Velocity-Time Graphs - Practice



a. What is the acceleration during the first 4 seconds of the trip?

$5 m/s^2$

b. When, if ever, is the object stopped? $t = 10$, $t = 16.5s$, $t = 20s$

c. When does the object travel to the west? 10s to 16.5s

d. How far does the object travel during the time from 4 s to 8 s?

$d = 80m$ to the east

~~e.~~ What is the average speed of the object during the first 8 seconds?

IGNORE