Assigned Reading: Pg 30 - 33

FRAME OF REFERENCE (Ch. 2.1 - pg 30):

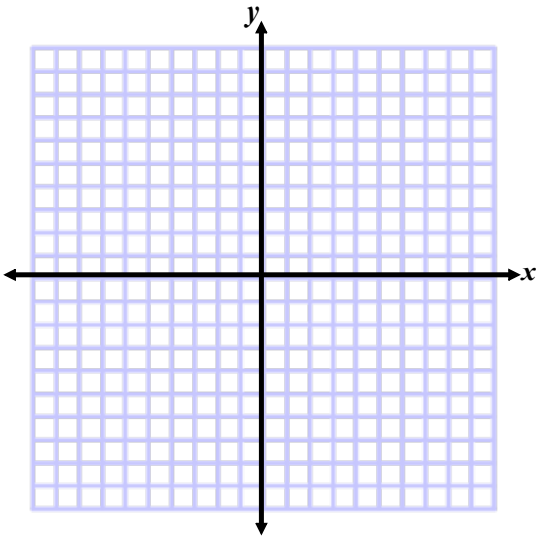
a subset of the physical world defined by an observer in which positions or motions can be discussed or compared. This can be stationary or moving.

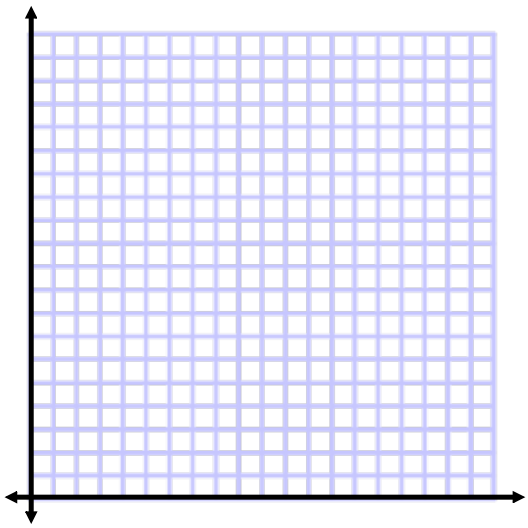
Ex. If you are in a stopped school bus and you walk towards the front of the bus you are moving with respect to others sitting in the bus, the floor of the bus and the ground.

If you are sitting in a moving school bus, you are NOT moving with respect to the floor of the bus, or others around you sitting down. You ARE moving with respect to the ground and landscape outside the bus.

Coordinate System

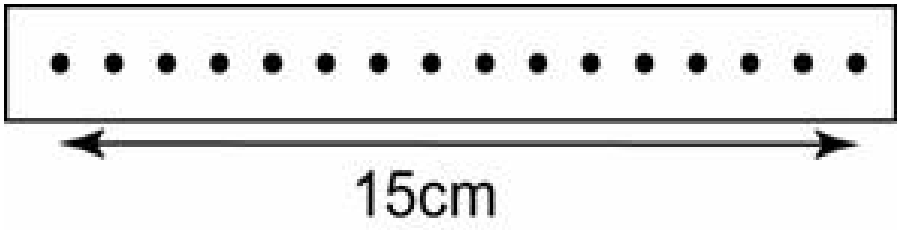
Used to describe an object's position and motion mathematically.

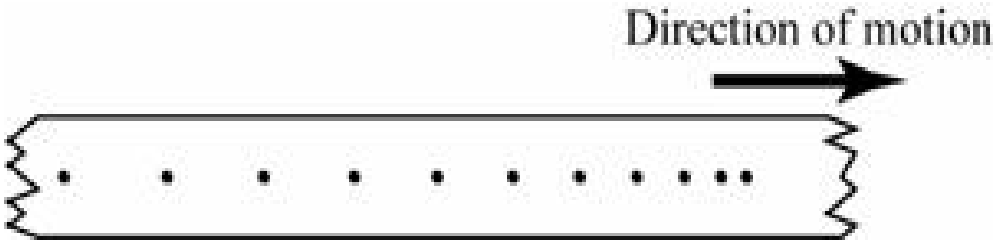


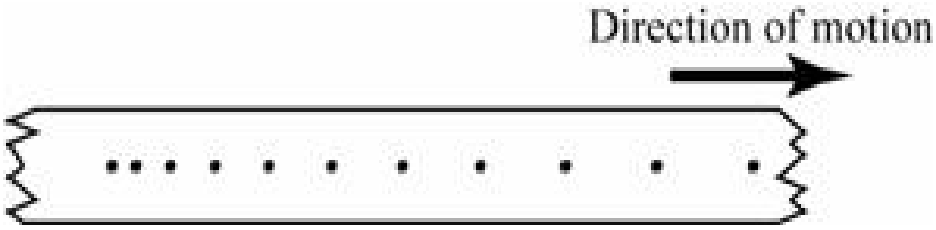


Visualizing Motion

The time interval is the same between each dot.







Kinematics - Describing Motion

Distance

- the separation between two points (how far an object has traveled)
- scalar quantity
- symbol: d
- units: nm, μm, cm, m, km, Mm, etc.

Position

- separation between an object and a reference point
- vector quantity
- symbol: $\vec{x}$
- units: cm, m, km, etc.

Note: Instantaneous position is the location of an object at an instant (at a single time, t)

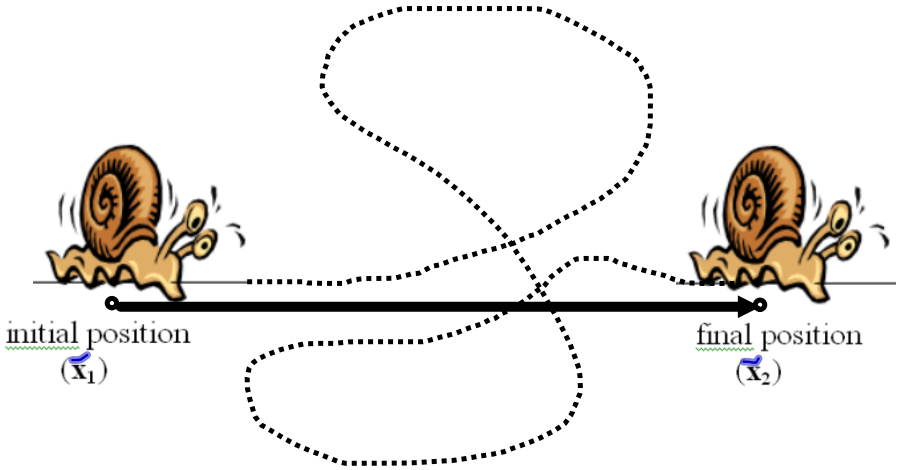
Displacement

- change in position (the difference between two positions)
- vector quantity
- symbol: $\Delta\vec{x}$

$$\Delta\vec{x} = \vec{x}_2 - \vec{x}_1$$

- units: cm, m, km, etc.

Snail - on his morning walk…



$$\Delta\vec{x} = \vec{x}_2 - \vec{x}_1$$

Time Interval

- the amount of time that passes between two instants of time
- symbol: Δt
- units: s, h
- scalar quantity

Speed

- the distance an object travels divided by the time interval during which the object was traveling (how fast an object is traveling)

$$\text{speed} = \frac{\text{distance}}{\Delta t}$$

- scalar quantity
- symbol: v
- units: cm/s, m/h, km/h, m/s

Note: ***Instantaneous speed*** is the speed at which an object is traveling at time, t.

(Average) Velocity

- describes how fast an object moves from one position to another ***and*** indicates the direction in which the object is travelling
- the rate of change of position or the displacement of an object over a time interval
- vector quantity
- symbol: $\vec{v}$
- units: cm/s, m/s, km/h, etc.

displacement

$$\vec{v} = \frac{\Delta \vec{x}}{\Delta t} = \frac{\vec{x}_2 - \vec{x}_1}{\Delta t}$$

(Average) Acceleration

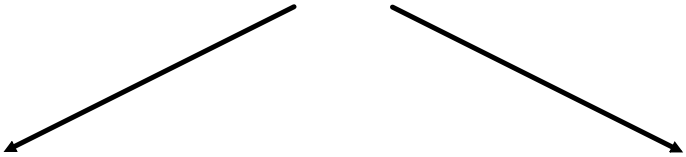
- the rate of change of velocity of an object over a time interval
- vector quantity
- symbol: $\vec{a}$
- units: m/s^2

$$\vec{a} = \frac{\Delta \vec{v}}{\Delta t} = \frac{\vec{v}_2 - \vec{v}_1}{\Delta t}$$

Homework:

1. Conceptual Problems bottom of pg 41.
2. Practice problem 2 pg 45.
3. Section Review 2.2 pg 46 #'s 1, 2, 3.
4. Read Section 2.3 pg 47 - 60.

Types of Motion



Uniform Motion
(velocity is constant in magnitude and direction)

Uniformly Accelerated Motion
(velocity is changing in magnitude/or direction)

Constant, Average and Instantaneous Velocity

Uniform Motion (Constant Velocity): the velocity of an object remains constant. Constant Velocity means magnitude and direction remain constant.

Non-Uniform Motion: means that the velocity is changing, either in magnitude or in direction.

Question: A physics book is moving across a table. Can the book have a

a) constant speed and a changing velocity?

b) constant velocity and a changing speed?

Question 2: A race car is travelling at a constant speed around a race track. Is this considered uniform motion?

TYPES OF VELOCITY (Ch 2.3)

1. Constant velocity: object travels the same distance for each unit of time.

When graphed on a displacement-time graph,it produces a straight diagonal up or down OR a straight horizontal line.

The slope of the graph equals the velocity.

2. Average velocity: is the ratio of the total displacement to the total time. If in the case of constant velocity it is also the average.

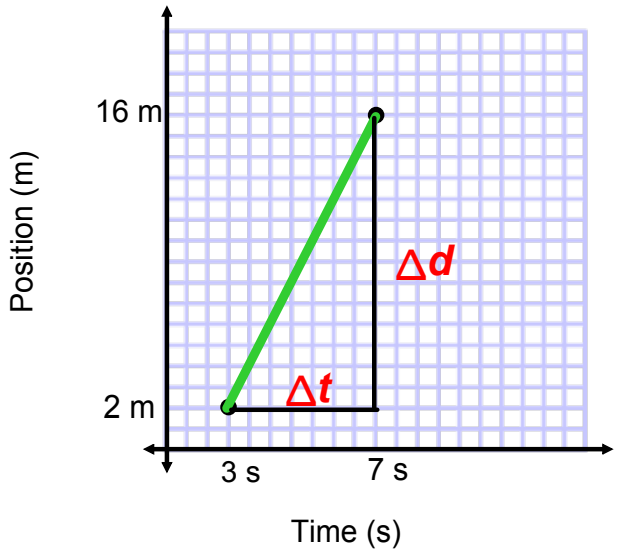
When graphed on a displacement-time graph,

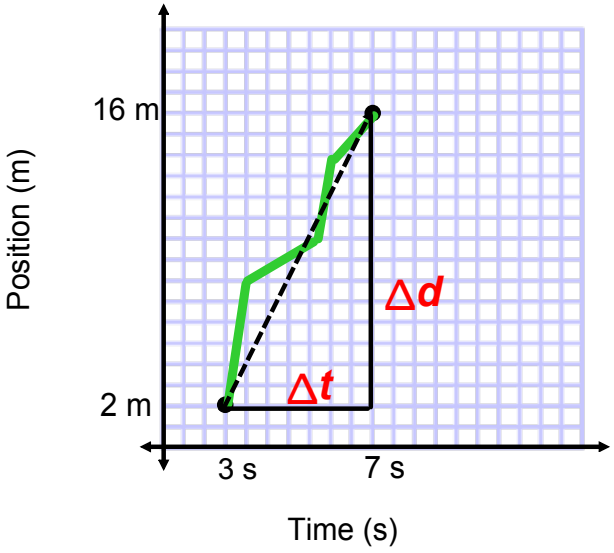
the slope of the line of best fit is equal to the

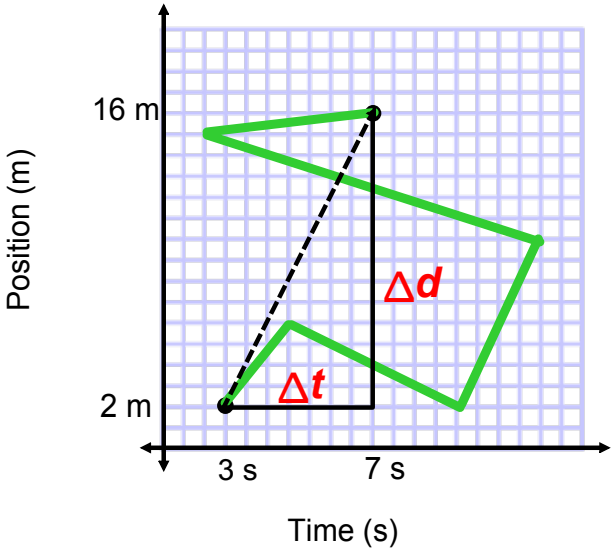
average velocity.

3. Instantaneous velocity: the velocity of an object at one instant of time.

To find its value from a displacement-time graph, the slope of the tangent at that instant of time must be found

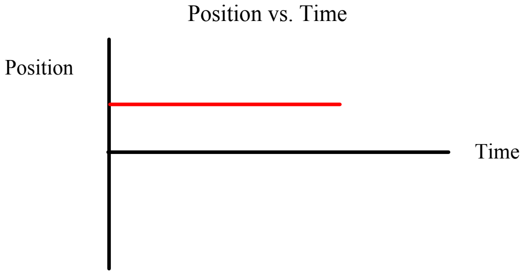


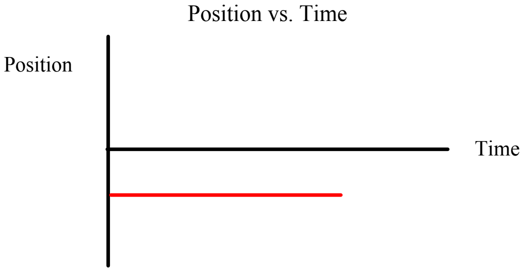


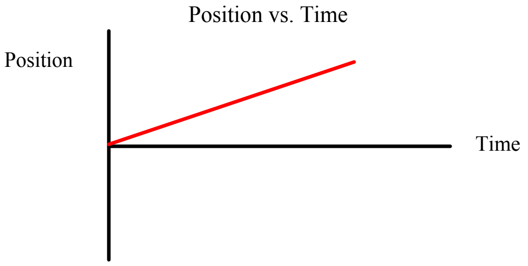


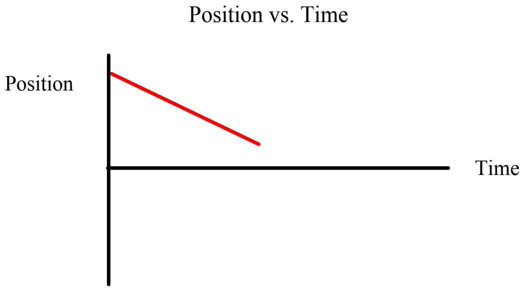
Worksheet: Interpreting D-T Graphs

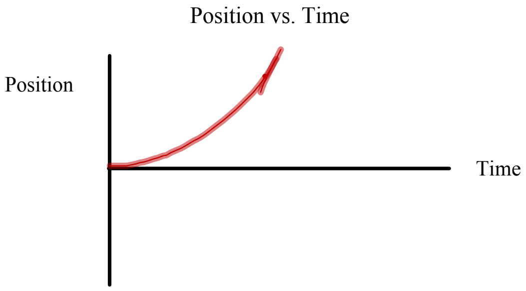
Position-Time Graphs

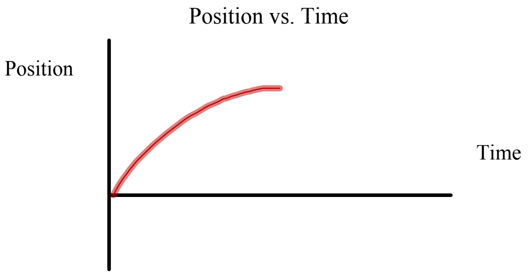








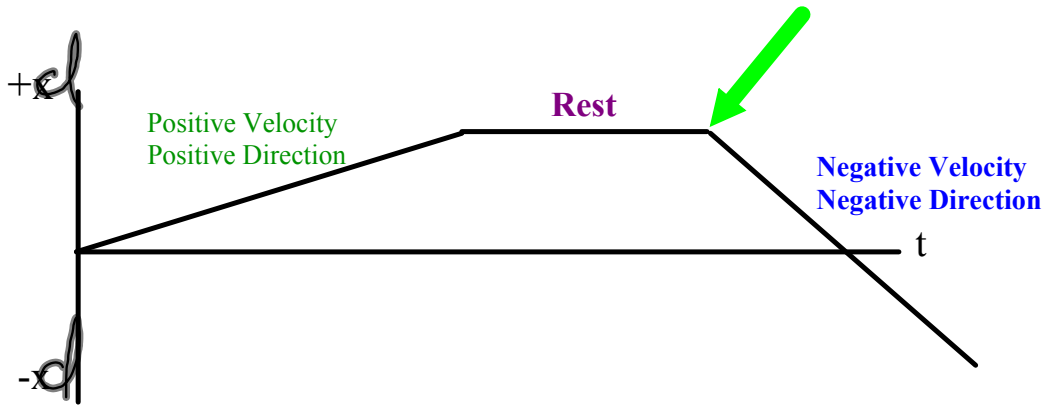




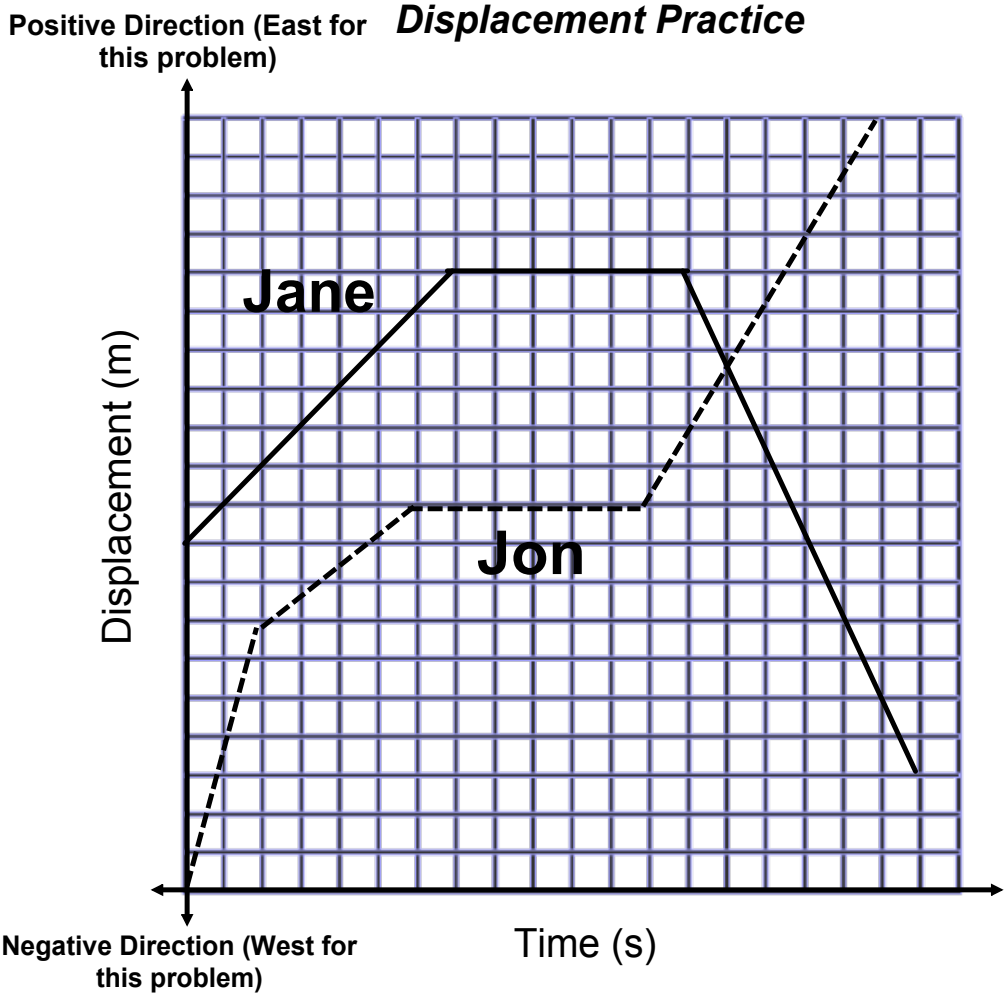
Position-Time Graphs

Direction of Motion

If the velocity of an object changes from positive to negative (or vice versa) it simply means that it has changed direction. On a position-time graph this occurs when the velocity changes signs.



Displacement Practice



a) What initial velocity did each person start off with? (Jane: 1 m/s [E]; Jon 3.5 m/s [E])

b) What was the final velocity of each person? (Jane 2.2 m/s [W]; Jon 1.6 m/s [E])

c) How long after the start did Jane change direction? (13 seconds)

d) At what time were both people at the same location? (14 seconds)

e) What was the total distance traveled by each person? (Jane 20 m; Jon 20 m)

f) What was the final displacement of each person? (Jane 6 m [W]; Jon 20 m [E])

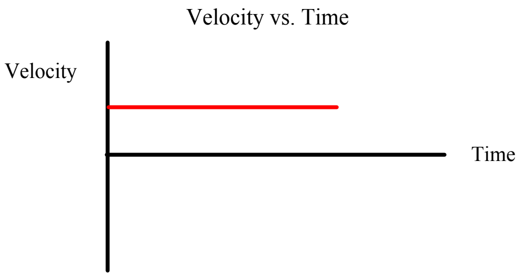
g) What was Jon's instantaneous speed at the 5.33 s mark? (0.75 m/s)

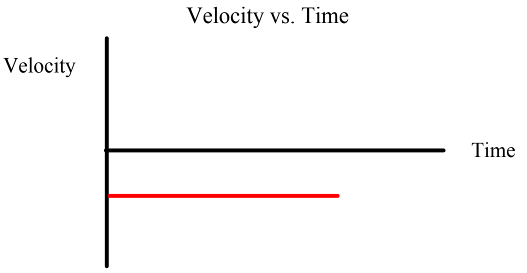
h) What was each person's average velocity for the entire trip? (Jane: 0.32 m/s [W]; Jon: 1.2 m/s [E])

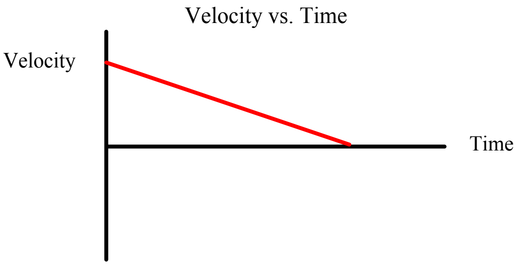
i) What was each person's average speed for the entire trip? (Jane: 1.05 m/s; Jon: 1.11 m/s)

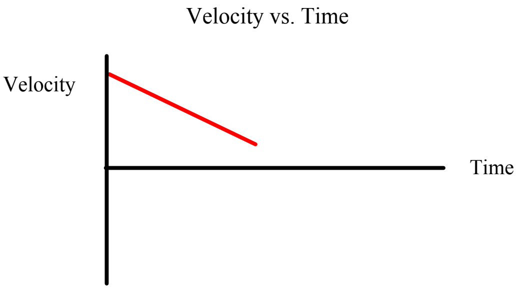
k) Sketch the graph of a third person who starts 2m [E] from the origin and runs 3 m/s [E] for three seconds, stc for two seconds, runs 2 m/s [W] for three seconds, and finally sprints 6 m/s [E] for two seconds.

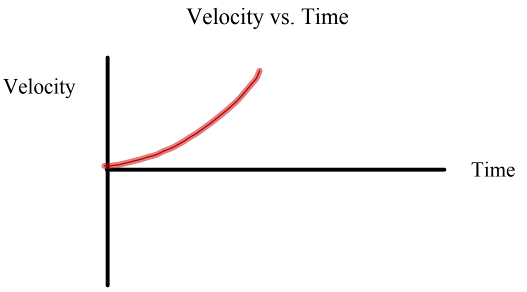
Velocity-Time Graphs

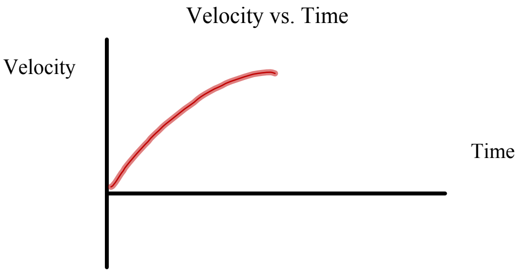






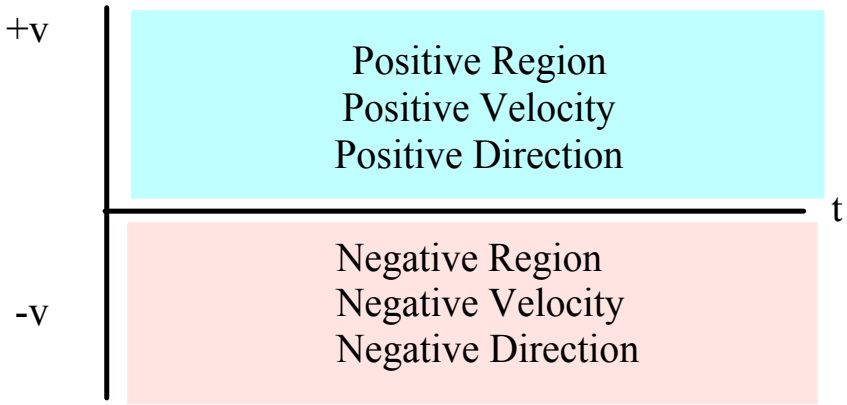




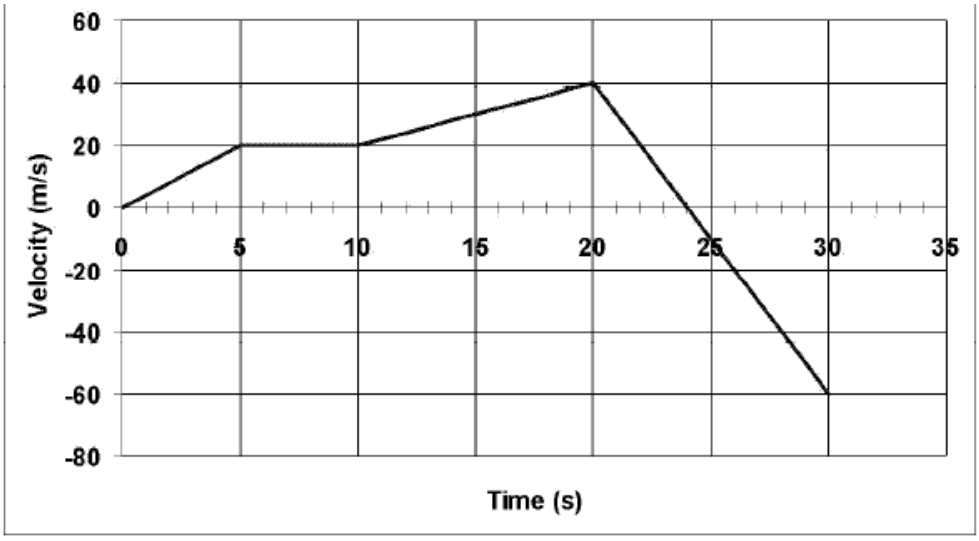


Velocity-Time Graphs

Direction of Motion



If the graph line crosses over the time axis from the positive region to the negative region (or vice versa), then the object has changed directions.


60
40
20
0
-20
-40
-60
-80
0
5
10
15
20
25
30
35
Velocity (m/s)
Time (s)

A car starts at rest and accelerates to 25 m/s in 6.5 s.
a) What was the average acceleration of the car?
b) What was the distance covered in that time?

An object is moving at 55 m/s [E] and undergoes an acceleration of 2.5 m/s^2 [W] for 10s.
a) What is the final velocity of the car?
b) What distance was covered in that time?

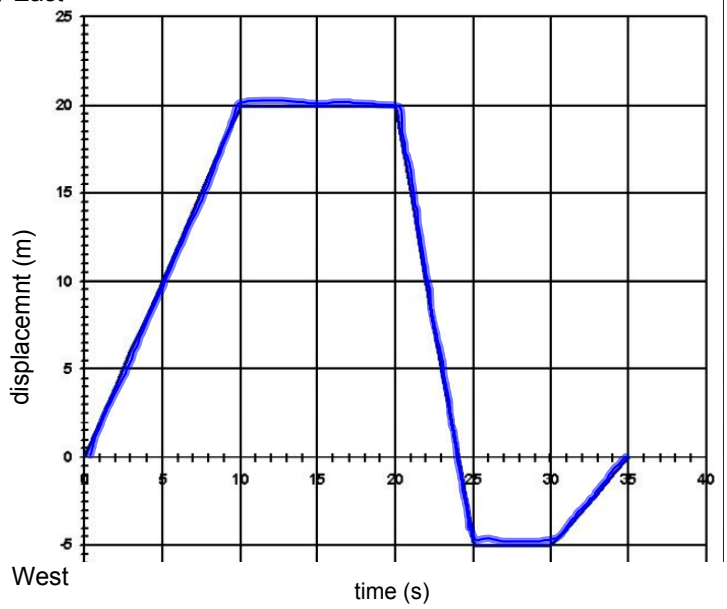
An object is moving at 55 m/s [E] and undergoes an acceleration of -2.5 m/s^2 [E] for 40s.
a) What distance was covered in that time?
b) What was the displacement of the object in that time?

More Practice & Review

1) Use a scale diagram to find the resultant of 90 km [W35°S], 60 km [E], and 70km [W75°N]

2) Calculate the resultant of 58 m [N], 12 m [S], 45 m [E], and 112 m [W]. (81.3m [W34°N])

3) East



(a) What was the instantaneous velocity at *t* = 7.25 s? (2.0m/s E)

(b) What was the displacement at t = 35 s? (0.0m)

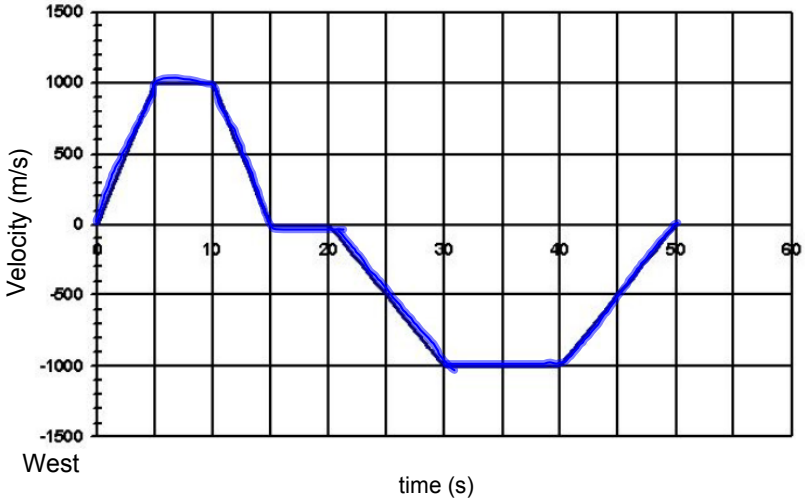
(c) What was the distance travelled during the 35 s trip? (50m)

(d) What was the average speed for the entire trip? (1.43m/s) Average velocity? (0.0m/s)

(e) What was the instantaneous velocity at *t* = 21.83 s? (-5.0m/s)

(f) What was the average velocity for the first 25 s? (-0.2m/s)

4) East



(a) Determine the displacement and distance traveled. (disp = -10000m) (dist = 30000m)

(b) Determine the average speed and velocity. (Spd = 600 m/s) (Vel = -200 m/s)

(c) What was the instantaneous acceleration at *t* = 42.3 s? (100m/s^2) at *t* = 24.8 s? (-100m/s^2)

5) A car accelerates from rest to 32 m/s [E] in 12.5 s. (a) Find the average acceleration. (b) What distance is does this car cover in that time? (acc = 2.56 m/s^2 E; dist = 200 m)

6) A plane lands with a velocity of 47 m/s [E]. It takes 17 s to stop. (a) What was the average acceleration of the plane? (b) What distance was required to stop? (acc = -2.76 m/s^2; dist = 400 m)

7) A police car initially at 27.8 m/s [E] accelerates at 1.39 m/s^2 [E] for 8.9 s. (a) What is the final velocity of the car? (b) What distance was covered during the acceleration? (V_f = 40.2 m/s; dist = 303 m)

8) A car traveling at 25 m/s [E] accelerates to 10 m/s [E] in 5.0 s. (a) What is the acceleration of the car? (b) What distance was covered in that time? (c) What distance is need to come to a stop assuming the acceleration is constant? (hint: find the time needed to come to a stop first) (-3.0 m/s^2 [E]; dist = 87.5 m; dist to stop = 104 m/s)

Direction of Acceleration and Velocity

Rule of Thumb

When an object is slowing down, the direction of the acceleration is in the opposite direction of the object's motion.

Page 63 - Conceptual Problems
- Use Figures 2.19 and 2.20

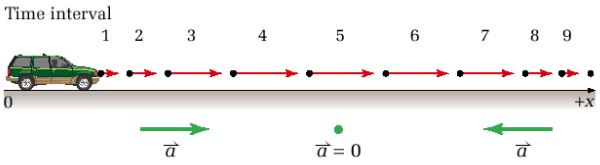


Figure 2.19 When the van is moving in a positive direction but slowing

Images in figure	Direction of velocity vector	Direction of acceleration vector	Description of motion
Figure 2.19 Van is moving in the positive direction.			
1-2-3	positive	positive	speeding up in positive direction
4-5-6			
7-8-9			
Figure 2.20 Van is moving in the negative direction			
1-2-3			
4-5-6			
7-8-9	negative	positive	slowing down in negative direction

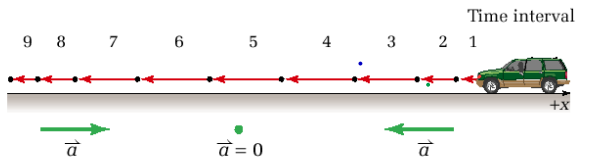
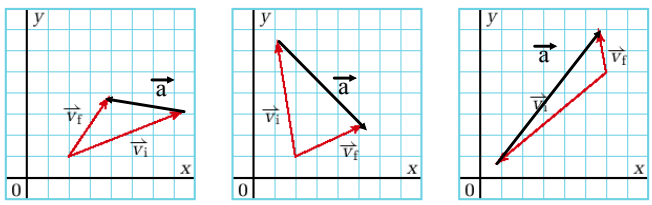


Figure 2.20 When the van is moving in a negative direction and slowing down, the direction of acceleration is positive.



Page 62 - MISCONCEPTION
Deceleration and Negative Acceleration
They Don't Mean the Same Thing