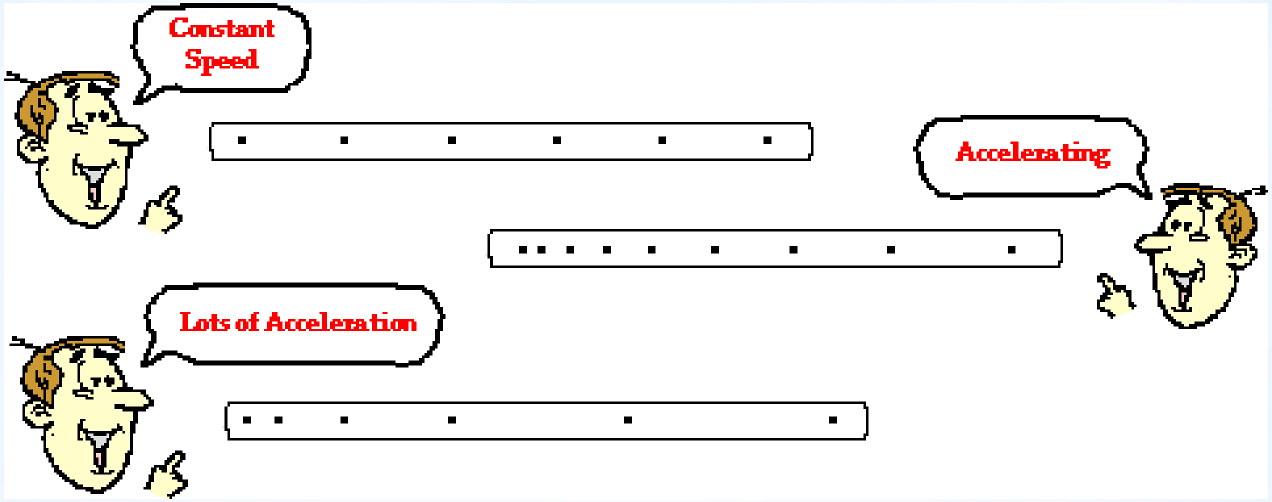
* Chapter 3 Accelerated Motion



*3.1 Acceleration

* Acceleration

* Acceleration – the rate at which an object's

  ____

$$\text{Ave. acceleration} = \frac{\Delta\,\text{velocity}}{\text{time}} = \frac{v_f - v_i}{t}$$

* EX: 9.8 m/s/s = 9.8 m/s^2

Acceleration

Acceleration

* Vector - ______________________ matters
* The sign of acceleration depends on:
  * Whether the object is ______________________ or ________________________
  * Whether the object is moving in ______________________________________
* EX: A car slowing down in the positive direction would have a negative acceleration.
* EX: A car slowing down in the negative direction would have a positive acceleration.

Acceleration

Example A

Time (s)	Velocity (m/s)
0	0
1	2
2	4
3	6
4	8

Example B

Time (s)	Velocity (m/s)
0	-8
1	-6
2	-4
3	-2
4	0

These are both examples of positive acceleration.

Example C

Time (s)	Velocity (m/s)
0	8
1	6
2	4
3	2
4	0

Example D

Time (s)	Velocity (m/s)
0	0
1	-2
2	-4
3	-6
4	-8

These are both examples of negative acceleration.

Acceleration

* **Constant Acceleration** means that the object's velocity is ______________________________ every time interval.

Accelerating Objects are Changing Their Velocity ...

... by a constant amount each second ...

Time (s)	Velocity (m/s)
0	0
1	4
2	8
3	12
4	16

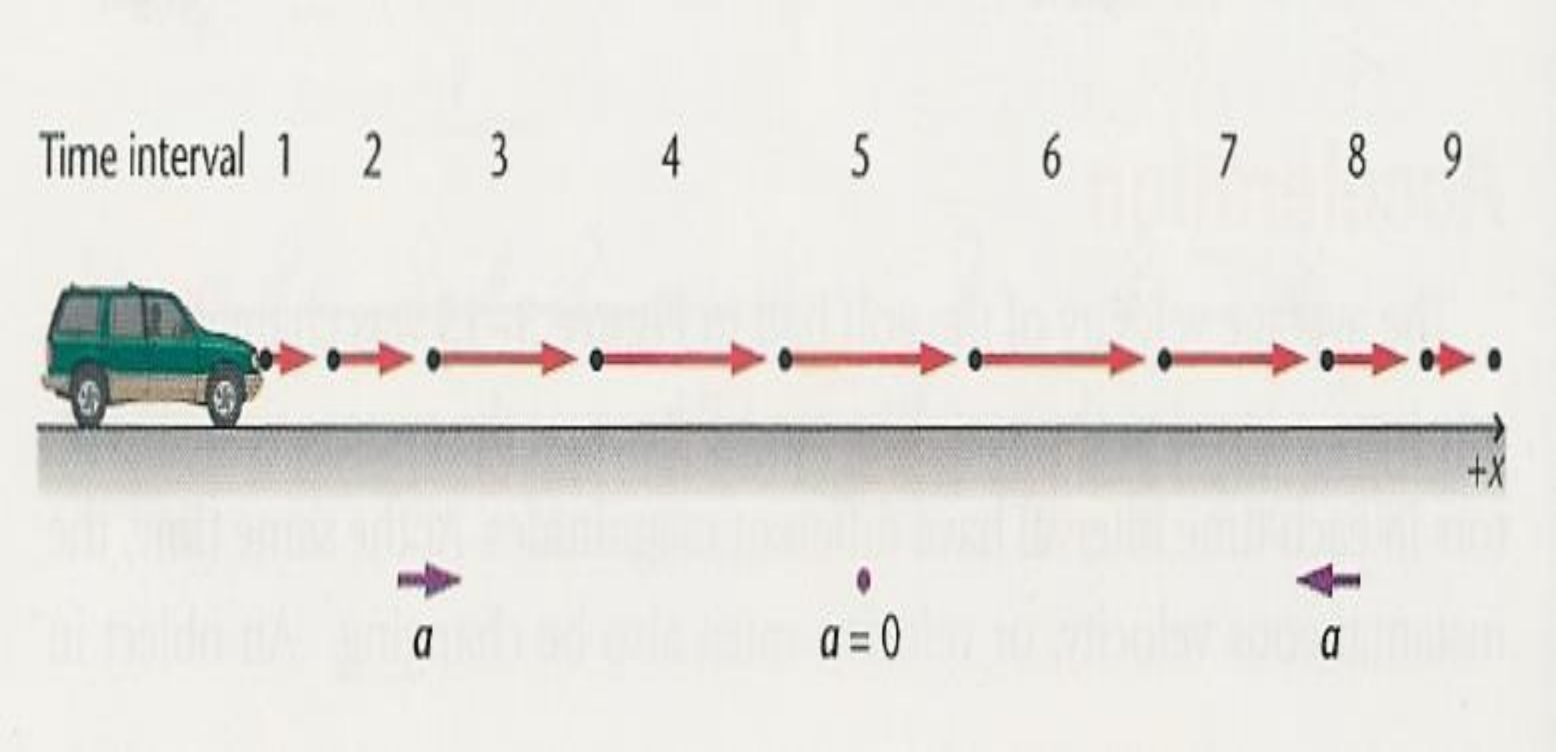
...in which case, it is referred to as a constant acceleration.

... or by a changing amount each second ...

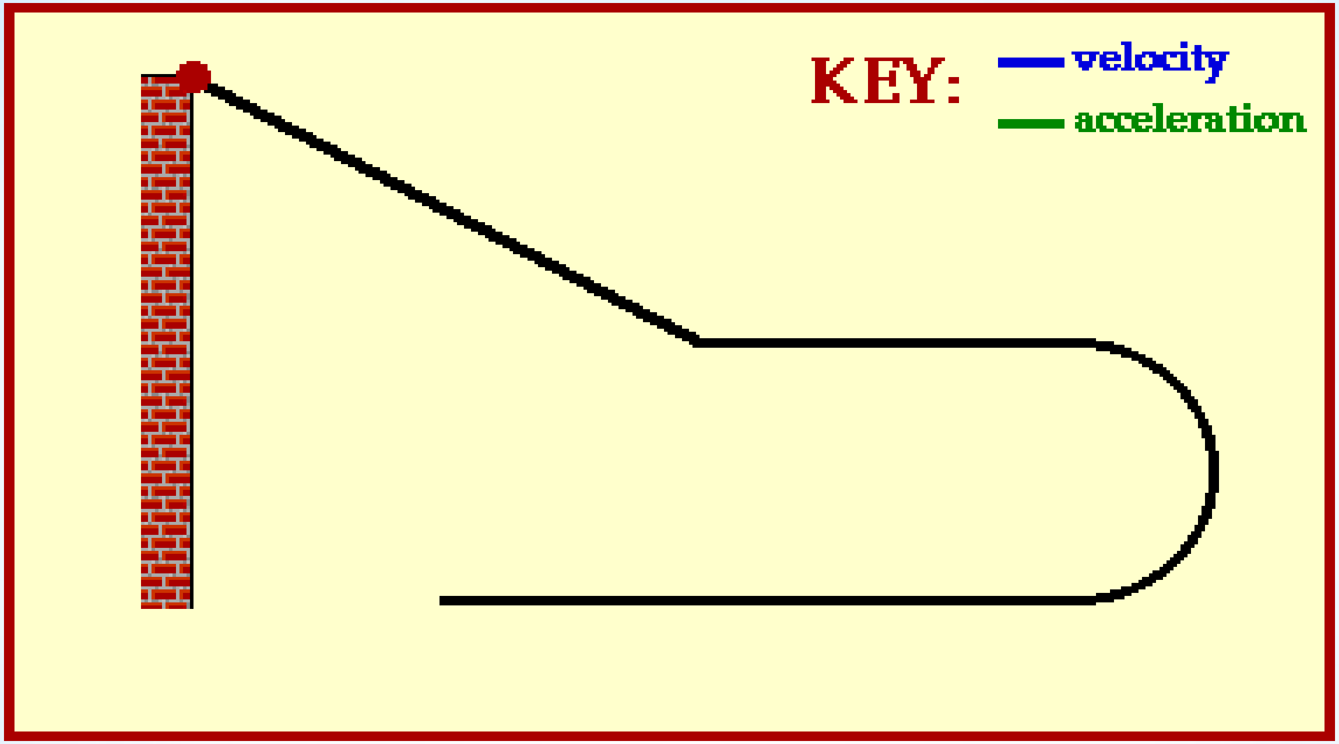
Time (s)	Velocity (m/s)
0	0
1	1
2	4
3	5
4	7

...in which case, it is referred to as a non-constant acceleration.

* An object can have zero acceleration if:
  * It is at ______________
  * If it is traveling at a _______________________



*Acceleration Vectors

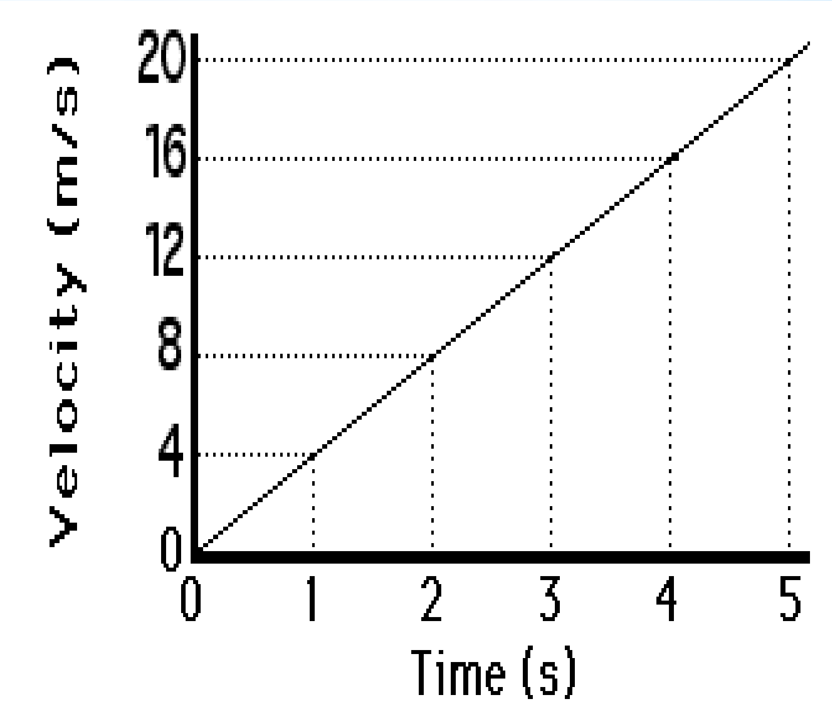


*Acceleration Vectors

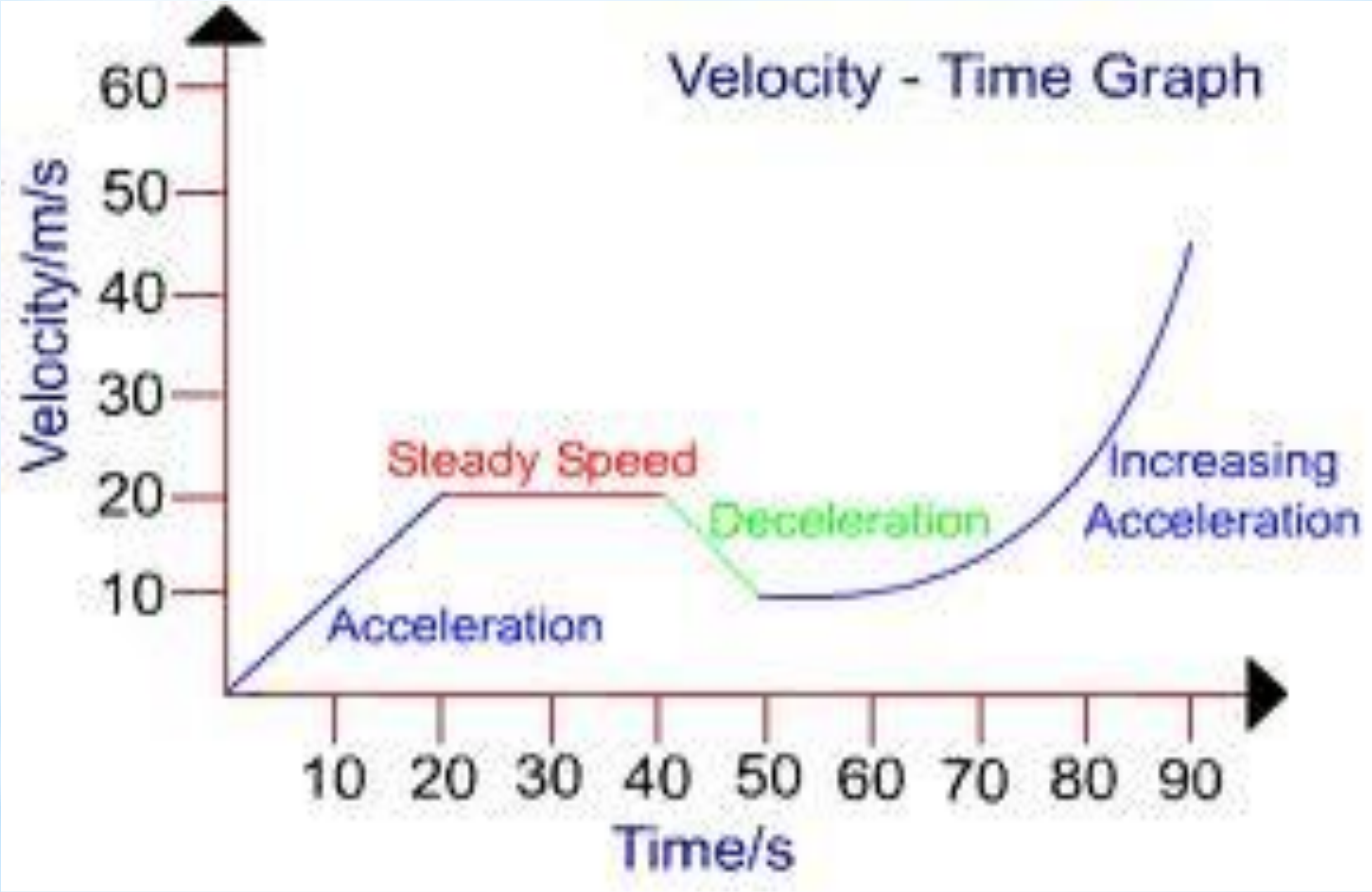
* A hockey player glides along the ice at a constant speed of 1.25 m/s in the positive direction onto a rough section of ice, which slows him. If he stops in 5 s, what is his acceleration (both magnitude and direction)?

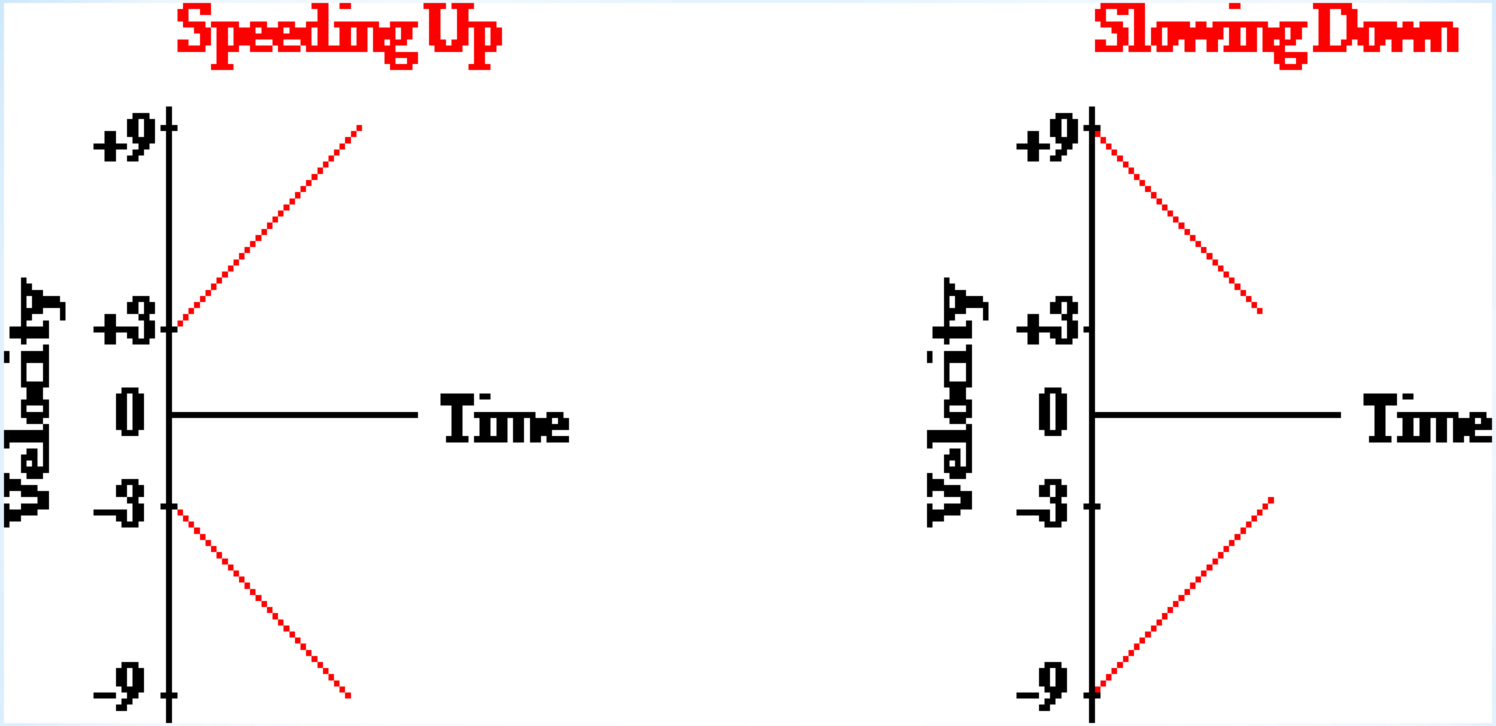
* EX: Determine the acceleration.

* The slope shows ________________________.
  * Straight line shows __________ __________________________.
  * Curved line shows ___________ __________________________.
  * A horizontal line shows ___________________________.
* The area between the curve and the horizontal axis is ________________.
* Pay attention to units.



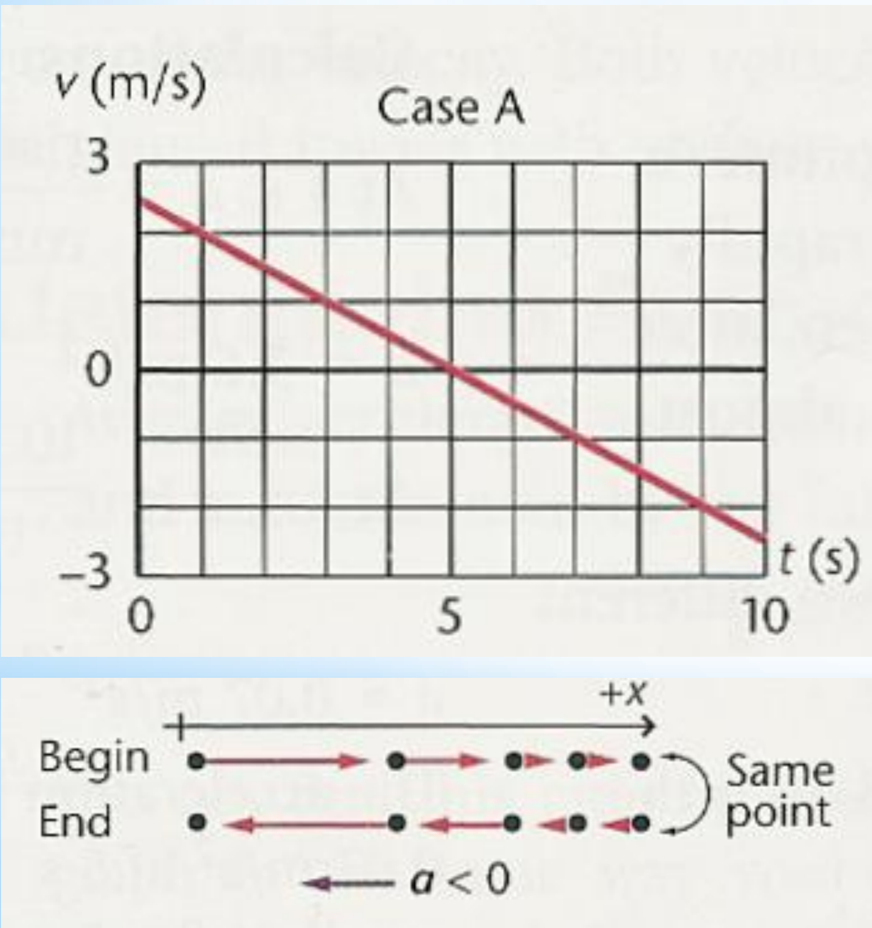
*Velocity-Time Graphs

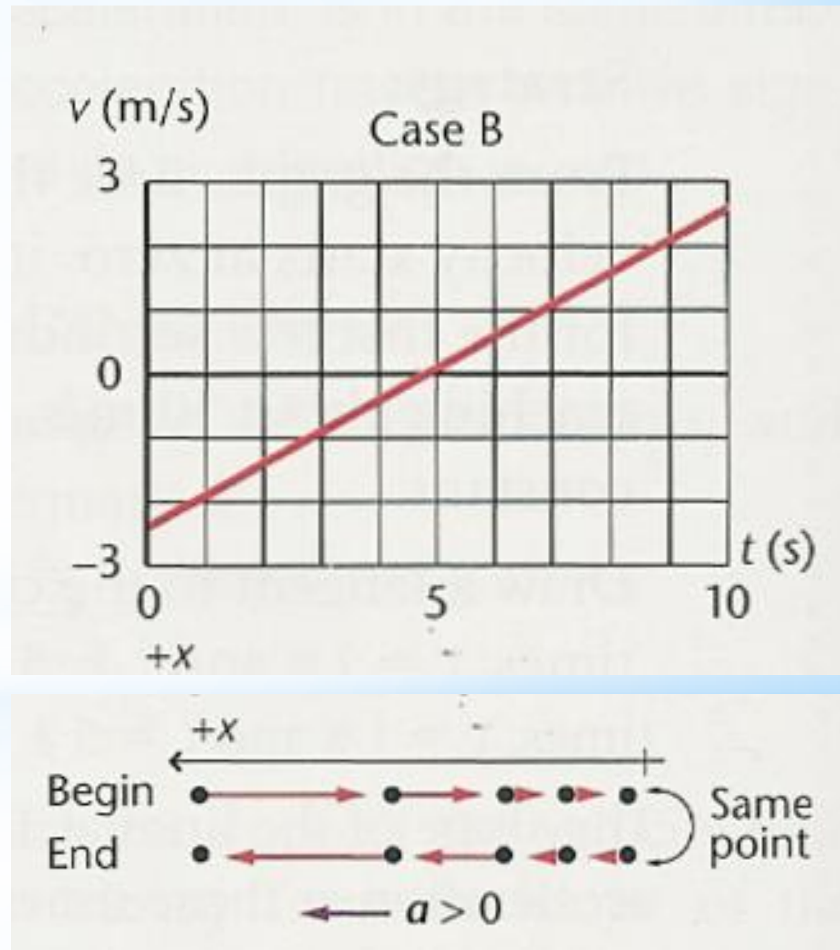

Velocity - Time Graph
Velocity/m/s
60
50
40
30
20
10
Steady Speed
Deceleration
Increasing
Acceleration
Acceleration
10
20
30
40
50
60
70
80
90
Time/s



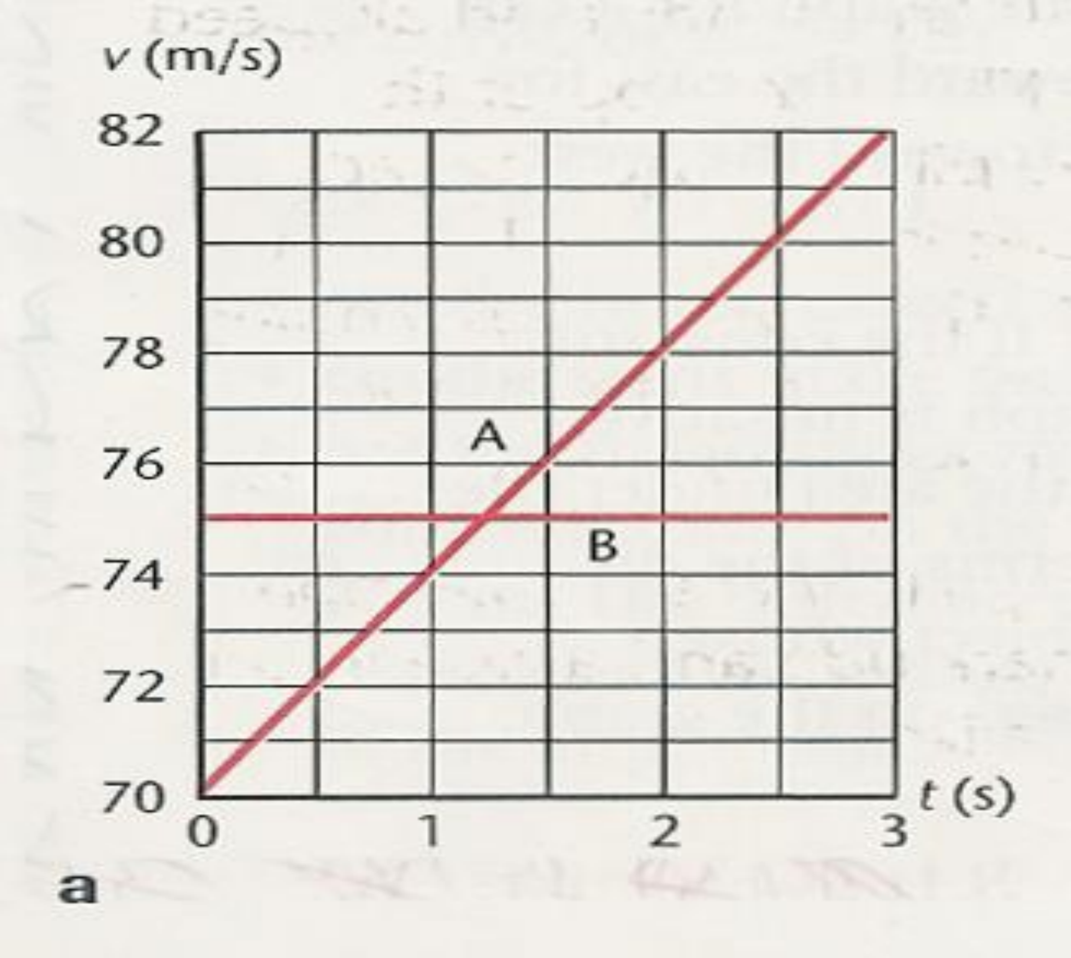
*Velocity-Time Graphs

* Same situation. Different coordinate systems.
* NOTE: Crossing x-axis means a change of direction.



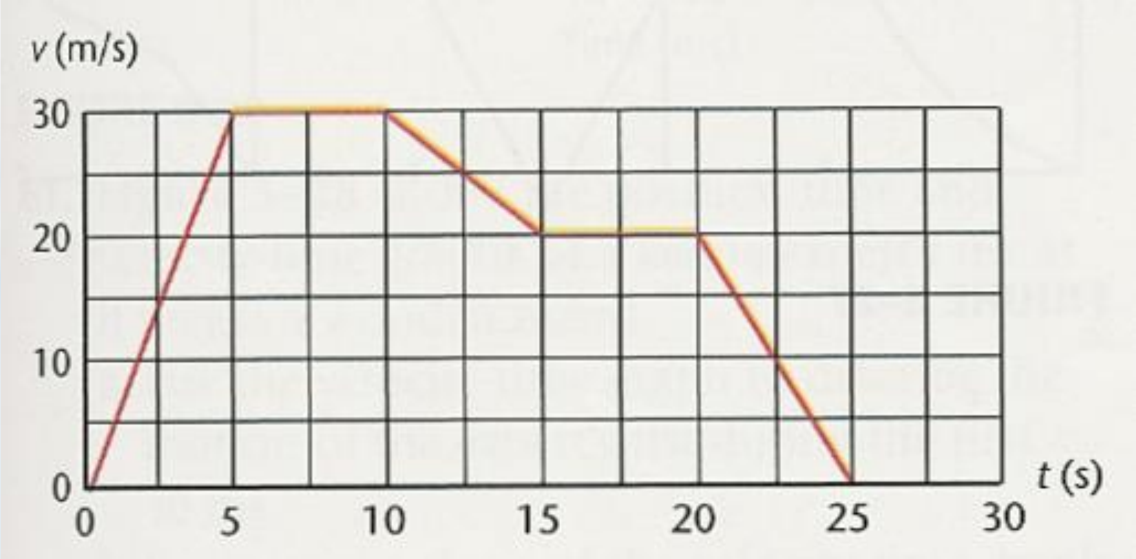


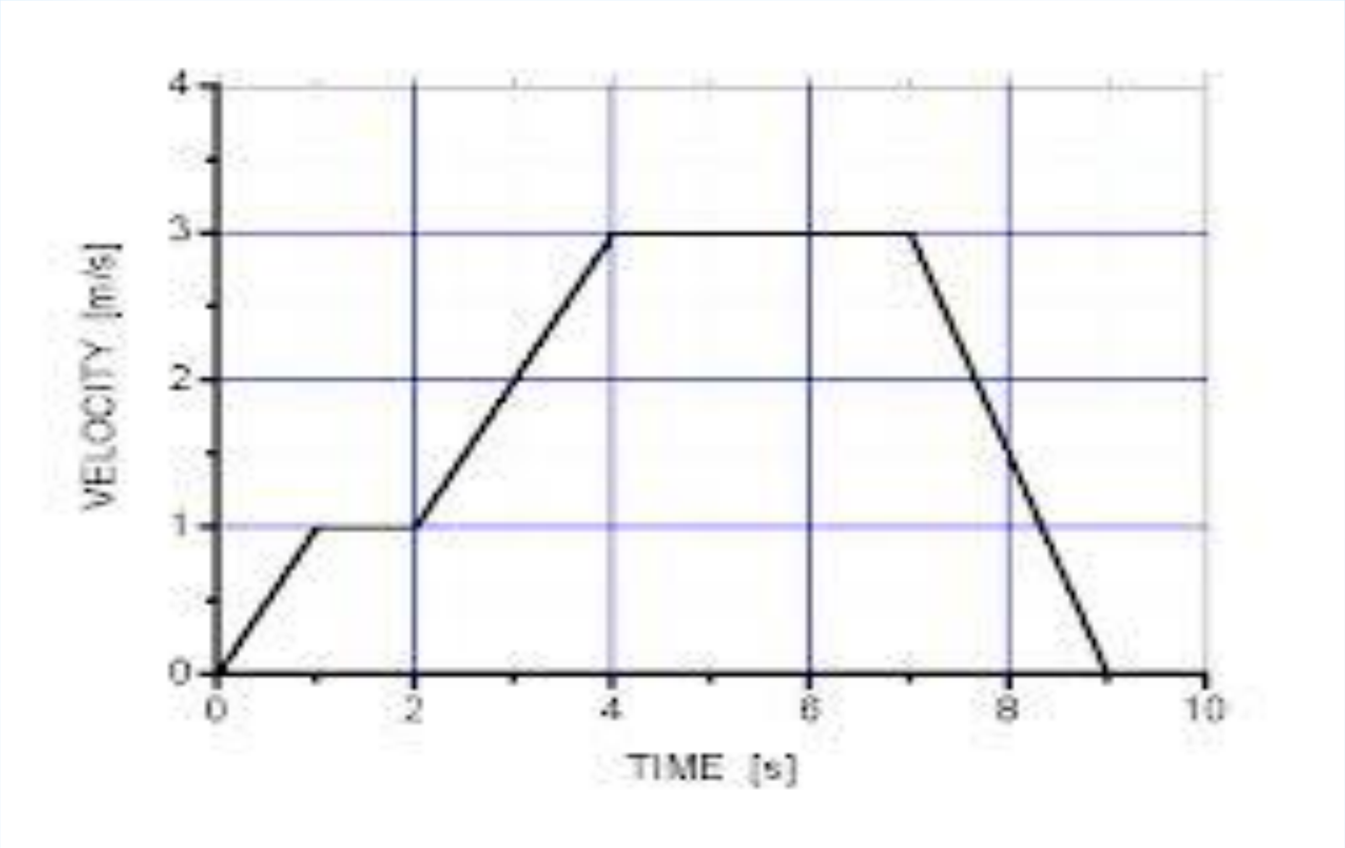
* Velocity-Time Graphs do not tell anything about the origin.



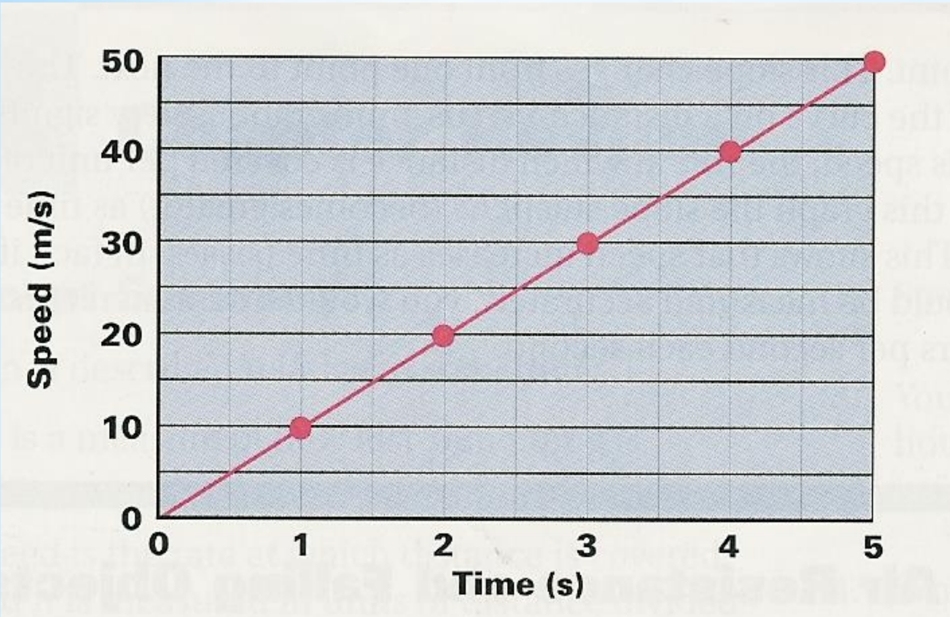
➢ Refer to the motion graph below to find

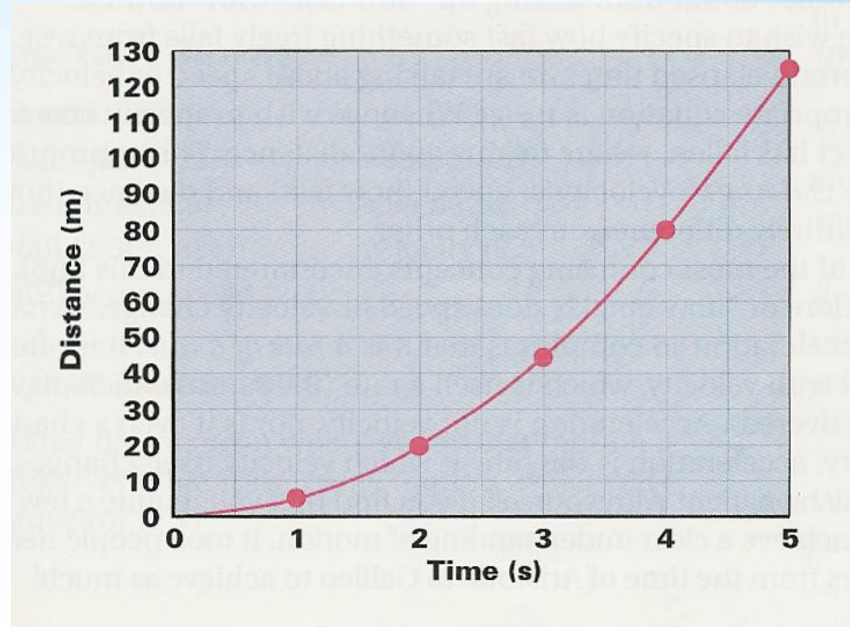
1. The time interval(s) for positive acceleration
2. The time interval(s) for negative acceleration
3. The time interval(s) for constant velocity
4. The time interval(s) for zero acceleration
5. At what time(s) does the car appear to be at rest?
6. At what time(s) does the car turn around and move in the opposite direction?





*What are the accelerations and displacements.





*Comparing Graphs

* 3.2 Motion with Constant Acceleration

*Kinematics (Motion) Equations

* Note:
* Pay attention to signs.
* $d = \Delta d = d_f - d_i$
* Every time the acceleration changes, you must treat it as a new part in the problem.

Kinematics (Motion) Equations

*EX:

* Consider a car that moves with a constant velocity of 5 m/s for 5 seconds and then accelerates to a final velocity of 15 m/s over the next 5 seconds.
* What acceleration does the car have?
* How far does the car travel in 10 s?

*EX:

* Vera Side is traveling down the highway at 45 m/s. Vera looks ahead and observes an accident which results in a pileup in the middle of the road. By the time Vera slams on the brakes, she is 50 m from the pileup. She slows at a rate of -15 m/s_2. Will Vera hit the cars in the pileup?

* EX:

* An engineer is designing the runway of an airport. Of the planes which will use the airport, the lowest acceleration rate is 3 m/s^2 and the lowest take-off speed is 65 m/s. What is the minimum allowed length of the runway?

* EX:

* A bullet moving at 367 m/s enters a lump of clay. The bullet goes into the clay a distance of 0.0621 m.
  * Determine the acceleration of the bullet while moving into the clay. Assume uniform acceleration.
  * Determine the bullet's stopping time.

*EX:

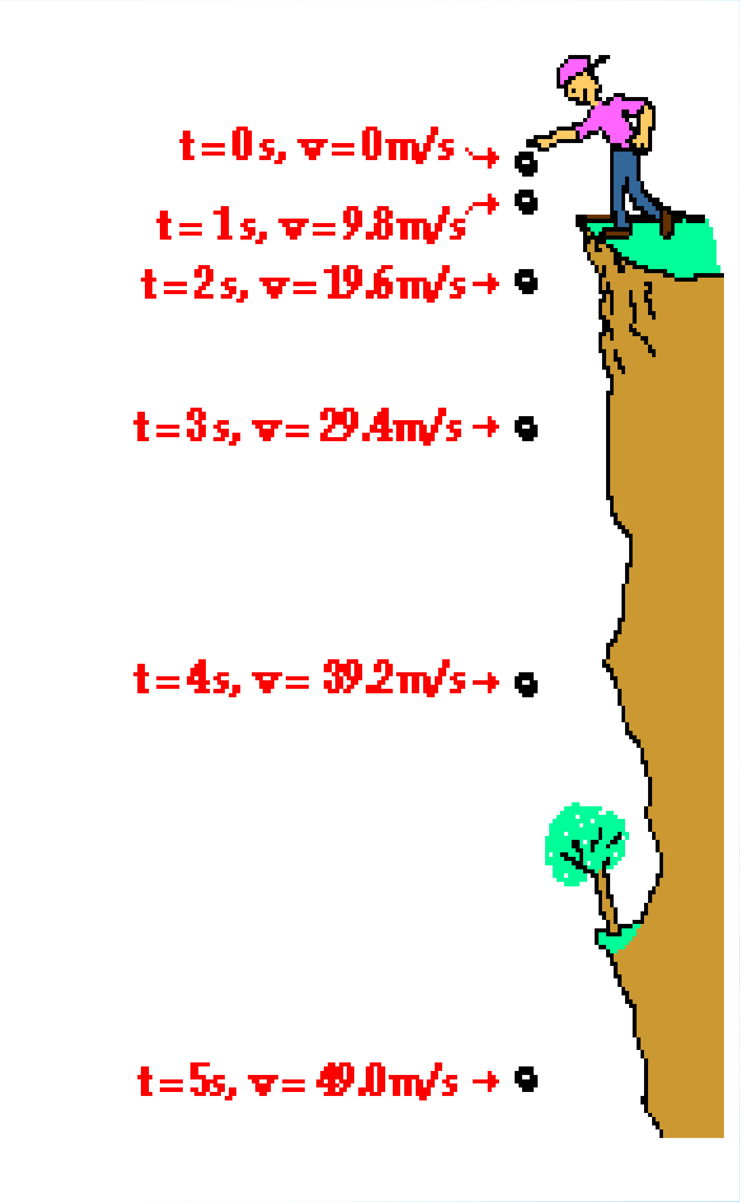
* A cat runs 2 m/s for 3 s, then slows to a stop with an acceleration of -0.80 m/s^2. What is the cat's displacement during this motion?

* 3.3 Free Fall

Free Fall

* An object in free fall is falling under the sole influence ___________________________.
* Two important characteristics':
* 1) No ____________________________________.
* 2) Downward acceleration of _______________.

* With no air resistance, ALL objects accelerate at the same rate ($9.8m/s^2$) – no matter what their mass is.
* Objects will only fall at different accelerations if there is air resistance to consider.



Free Fall

Free Fall Summary

* Free fall acceleration: _______________
* Dropped: ___________________
* If an object is projected upward:
  * At its max height, velocity is _____________
  * "g" stays _______________ throughout the entire motion
  * _______________when the object returns to the same height.

*EX:

* The observation deck of a skyscraper is 420 m above the street. Determine the time required for a dropped penny to free fall from the deck to the street.

*EX:

* A baseball is popped straight up into the air and has a hang-time of 6.25 s. how high does the ball go?

*EX:

* With what speed in mi/hr must an object be thrown to reach a height of 91.5 m (equivalent to one football field)? Assume negligible air resistance.

*EX:

* If Mr. Wade has a vertical leap of 1.29 m, what is his take-off speed and hang-time?