9Adv

Chapter (4)

Chapter 4: forces in 1 dimension

PHYSICS

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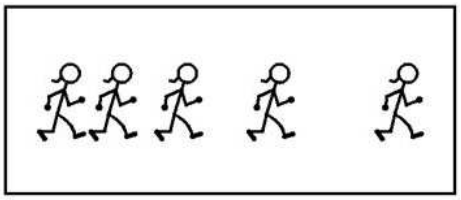
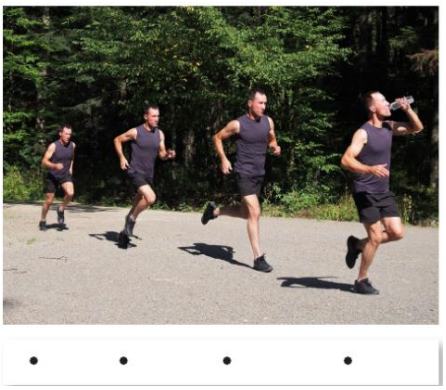
Carve your name on the moon!

Section 1

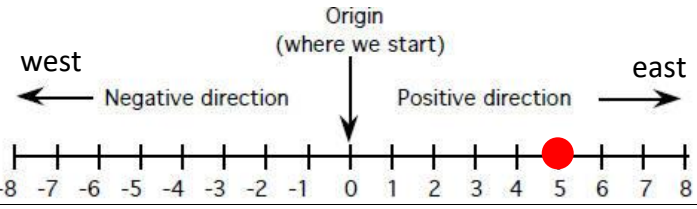
Motion diagram



Particle model



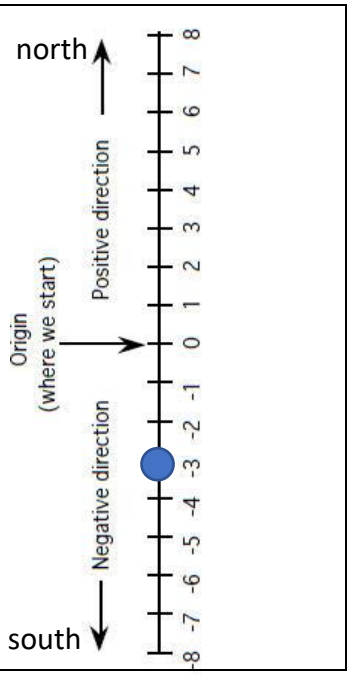
Section 2



To determine the position of anything we need a <u>coordinate system</u>
Like the one above or to the right.
Origin is the starting point for coordinate systems.

Position: the distance between any object and the origin with the direction.

Example:
the red point's position is 5 units east or +5
The position of the blue point is 3 units south or -3
Because the position has a magnitude (قيمة أو رقم) and a direction it is a ***<u>vector</u>*** quantity.

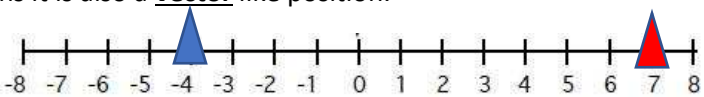


Time interval: $\Delta t = t_f - t_i$ because time has no direction time is a ***<u>scalar</u>*** quantity.

Displacement: $\Delta x = x_f - x_i$, ||| x_f: $final\ position$ ||| x_i: $initial\ position$

Because the displacement is the difference in positions it is also a **<u>vector</u>** like position.

Example:



The <u>position</u> of the red triangle is +7 cm (vector)

The <u>position</u> of the blue triangle is -4 cm (vector)

Find the <u>displacement</u> to go from **red** to **blue**: $\Delta x = x_f - x_i = (-4) - (7) = -13\ cm$ or 13 cm to the left ***<u>(vector)</u>***

Find the <u>displacement</u> to go from **blue** to **red**: $\Delta x = x_f - x_i = (7) - (-4) = +13\ cm$ or 13 cm to the right ***<u>(vector)</u>***

However, the <u>distance</u> between red and blue tringles is 13 cm (direction not important) so <u>distance</u> is a ***<u>scalar</u>***

So, distance = displacement without direction (without sign + or -)

The unit for distance and displacement is (meter or cm or mm ….)

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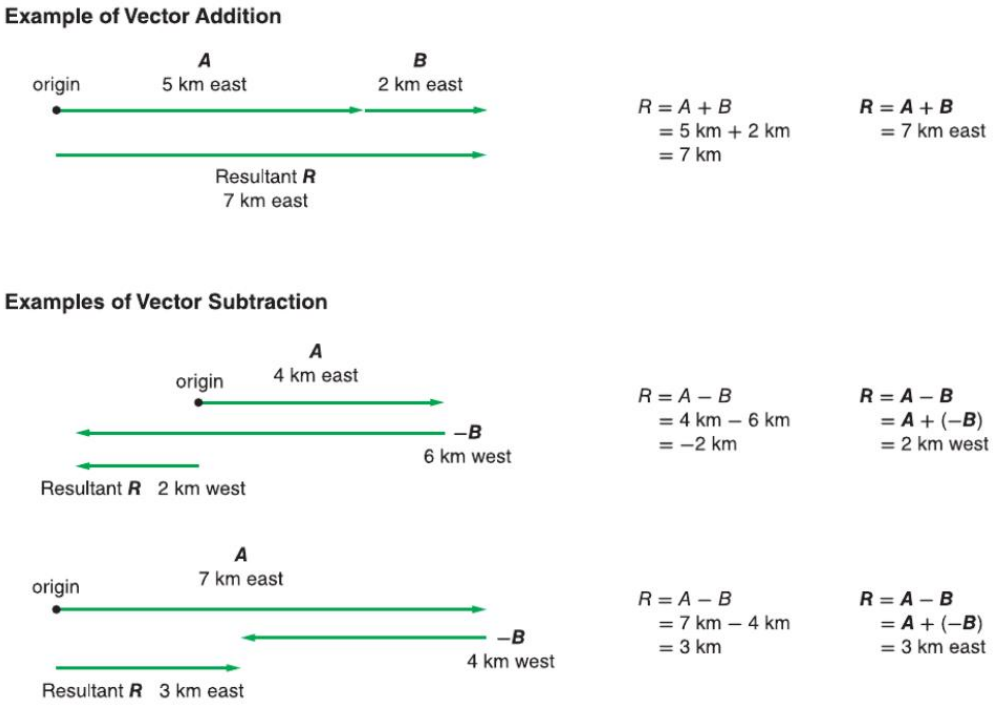
Vector addition:

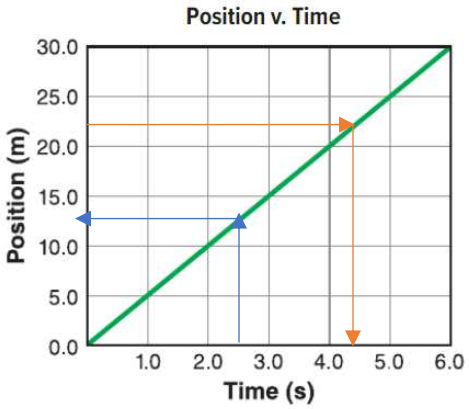


*Note: when we add or subtract Vectors then the answer is called the **resultant**

Section 3: position time graphs

Table 1 Position v. Time

Time (s)	Position (m)
0.0	0.0
1.0	5.0
2.0	10.0
3.0	15.0
4.0	20.0
5.0	25.0



What is the position at t=2 sec? answer: 10 m (from the table or the graph)

What is the position at t=2.5 sec? answer: 12.5m (blue arrows)

What is the time when the position is 22m? answer: 4.4 sec (red arrows)

What is the initial position of (A)? answer: 0m

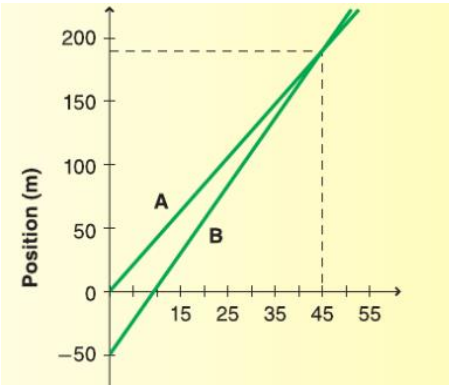
What is the initial position of (B)? answer: -50m

At what time do A & B meet? Answer: at 45 sec

What is the positions of A&B at this time? answer: 190m

What is the displacement of B between 0 and 45 sec?

Answer: $\Delta x = x_f - x_i = (190) - (-50) = 240m$



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Section 4: How Fast (speed and velocity)

$v = \frac{\Delta x}{\Delta t} = \frac{x_f - x_i}{t_f - t_i} = \frac{displacement}{time\ interval}$ the velocity(v) is a ***vector*** quantity because the displacement is a ***vector***.

Because the displacement and distance have the same value (see last section) we can replace **displacement** (Δx) with the **distance** (d) but then we will find the **speed**(s) instead of the **velocity**(v).

$$v = \frac{\Delta x}{\Delta t} \quad \Rightarrow \quad s = \frac{d}{\Delta t}$$

Speed is ***scalar*** because **distance** is ***scalar***

Which means that the speed has the same value as velocity only **without** direction(or sign like + or -).

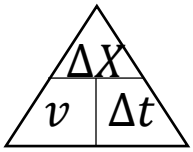
Another way to find the velocity is from (position time graph).

The slope(الميل) of the position time graph is the velocity.
x-axis >>>> time (t)
y-axis >>>> position (X)

$$m = \frac{\Delta y}{\Delta x} \quad \Rightarrow \quad v = \frac{\Delta X}{\Delta t}$$

The unit for velocity is (m/s)
Other units (cm/s, mm/s, km/hr, ft/s .....)
(distance/time)

$$v = \frac{\Delta X}{\Delta t}$$



So $\Delta x = v.\Delta t$

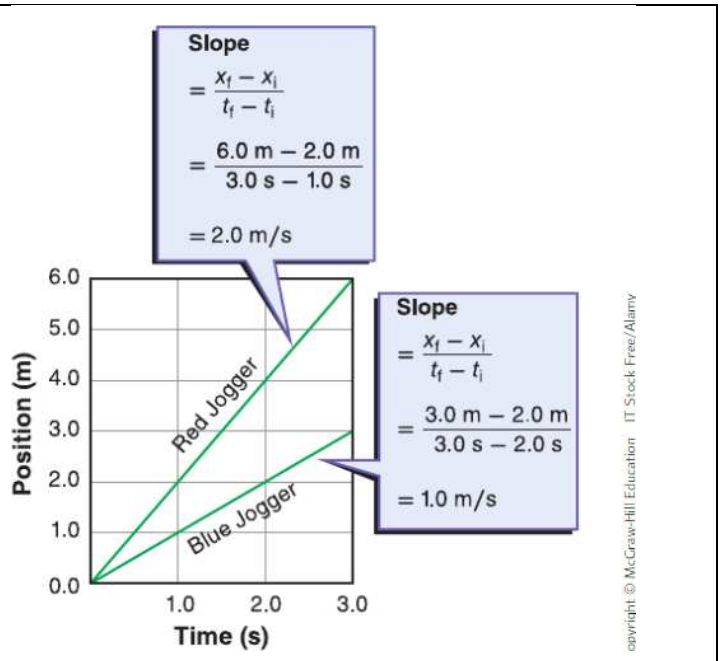
$x_f - x_i = v(t_f - t_i)$ if the initial time= 0

$$x_f - x_i = vt$$

Or

$$x_f = vt + x_i$$

See questions on pages: 48&51



Summary of equations and formulas:

No	Equation	notes
1	$\Delta t = t_f - t_i$	Time interval (if $t_i = 0\ then\ \Delta t\ becomes\ simply\ t$)
2	$\Delta x = x_f - x_i$	Displacement (we can use as distance if the direction is not important)
3	$v = \frac{\Delta X}{\Delta t}$	To find the velocity (if the direction is not important then: V ⟶ speed ΔX ⟶ distance
4	$x_f = vt + x_i$	Used to find the position at any time

Important note: equations 3 & 4 are only used if there is no acceleration (constant velocity, constant speed, a=0...)

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