

Motion

Kinematics - the study of motion

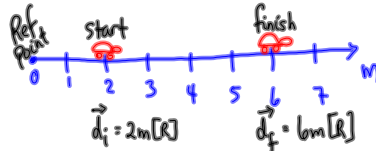
Scalar quantity - has size (magnitude) only <sup>10s</sup> <sup>15m</sup>

vector quantity - has size and direction <sup>25km[E]</sup> <sup>42g</sup> <sup>100mph [W]</sup>

position ( $\vec{d}$ ) - the location of the object  
(vector) with respect to a reference point  
 $d = 2\text{ km [E]}$  (of reference pt)

distance ( $\Delta d$ ) - how far the object has gone  
(scalar)  $\Delta d = 5\text{ km}$  (pedometer)

displacement ( $\Delta \vec{d}$ ) - change in position, where  
(vector) the object is now in relation to where it started

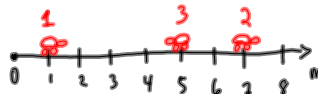


initial position  $d_i = 2\text{ m [R]}$

final position  $d_f = 6\text{ m [R]}$

distance travelled  $\Delta d = 4\text{ m}$

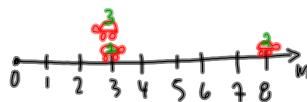
displacement  $\Delta \vec{d} = d_f - d_i$   
 $\Delta \vec{d} = 6\text{ m [R]} - 2\text{ m [R]}$   
 $\Delta \vec{d} = 4\text{ m [R]}$



What is the total distance travelled by the turtle?  
 $6\text{ m} + 2\text{ m} = \Delta d = 8\text{ m}$

What is the displacement of the turtle?

$$\Delta \vec{d} = 4\text{ m [R]} = \underset{d_f}{5\text{ m [R]}} - \underset{d_i}{1\text{ m [R]}}$$



What is the distance travelled?  $\Delta d = 10\text{ m}$

What is the displacement?  $\Delta \vec{d} = 0\text{ m}$

time ( $\Delta t$ ) ~ the time interval for the motion

(scalar)

$t_i$  - the initial time

$t_f$  - the final time

$$\Delta t = t_f - t_i$$

speed ( $v$ ) - the rate at which the <sup>scalar</sup> distance was covered  
(scalar)

cm/s m/s  
 km/h mi/h

Velocity ( $\vec{v}$ ) - the rate at which displacement occurred  
(vector)

5 cm/s [R] <sup>vector</sup>  
 10 km/h [E] 2 mi/h [up]

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4.56 s	19.71 s		+14.7 m	+3.1 m	
0 h	3.5 h		+12.0 km	+15.7 km	
	14.0 s	9.0 s	+13.1 m		+102.3 m
3 min		5 min		+14.8 cm	+9.1 cm

2. Solve the following problems.

(a) A runner is moving along a straight road. At a time of 0.62 s, the runner's position is +10.6 m. Later, at a time of 9.93 s, the runner's position is +73.9 m. Find the time interval and displacement for the runner.

$t_i$   $d_i$

$t_f$   $d_f$

$\Delta t$   $\Delta d$

$$\Delta t = t_f - t_i$$

$$\Delta t = 9.93\text{ s} - 0.62\text{ s}$$

$$\Delta d = d_f - d_i$$

$$\Delta d = +73.9 - 10.6\text{ m}$$

(b) A person is driving a car along a straight highway. The car's position at 9:00 a.m. is 13 km from home. Its position at 10:30 a.m. is 137 km from home. Find the time interval and displacement for this section of the journey.

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