

The Language of Motion

PowerPoint 8.1

How would you describe the motion in each of the images below?



Motion of the something floating through space



Motion of the pucks



Motion of the cars

Size *does* matter, but so does direction

The size of a measurement or the amount (number).

Quantities that describe **magnitude** but do not include direction are called scalar quantities or ***scalars***.

Ex. I live 7 km from here.

Quantities that describe magnitude and also include direction are called vector quantities or ***vectors***.

Ex. I live **7 km east** from here.

Often written as 7km [E].

Time

Time, t , is classified as a scalar quantity.

Time interval, Δt , is also a scalar quantity.

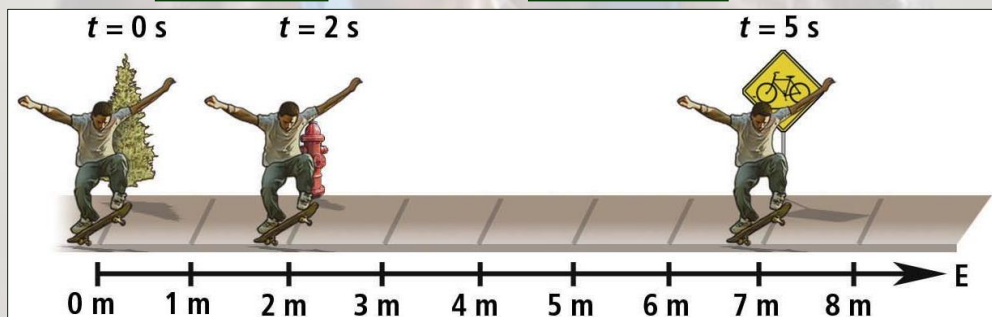
$$\text{Change in time} = \Delta t = t_f - t_i$$

Final time

initial time

The skateboarder passes the firehydrant at $t = 2$ s.

The skateboarder travels 5 m in the time interval,
 $\Delta t = (5 \text{ s}) - (2 \text{ s}) = 3 \text{ s}$.



Distance, Position, and Displacement – not the same thing

Distance, d , describes the length of a path between two points.

$$d = 9 \text{ m}$$

Position, \vec{d} , describes a specific point relative to a point of reference.

$$\vec{d} = 17 \text{ m to the right}$$

Displacement, $\Delta\vec{d}$, is the straight-line distance and direction from one point to another, and it describes a change in position.

$$\Delta\vec{d} = d_f - d_i = (-4 \text{ m}) - (17 \text{ m}) = -21 \text{ m}$$



Things to Remember

➤ Careful with + and - signs

Generally, + is Right, North, East, or Up R.U.N.E.

Generally, - is left, south, west, or down

Ex. If something moves from 9 m east to 8 m west, then the displacement is,

$$\Delta\vec{d} = \vec{d}_f - \vec{d}_i = (-8 \text{ m}) - (9 \text{ m}) = -17 \text{ m}$$

➤ Remember the appropriate units

For d , \vec{d} , and $\Delta\vec{d}$ units are in m or km.

For t and Δt units are in s or h.

SI units

The International System of units, Le système International d'unités, are the series of units most commonly utilized by the international scientific community.

Summary of Scalars and Vectors for Motion in 8.1

Measurement	Symbol	Scalar or Vector	SI Unit	What It Measures
distance	d	scalar	m, km	Length of path between two points
position	\vec{d}	vector	m, km	A specific point relative to a point of origin
displacement	$\Delta\vec{d}$	vector	m, km	The straight-line distance and direction from one point to another, final position minus the initial position
time	t	scalar	s, h	When an event occurs
time interval	Δt	scalar	s, h	Duration of an event

Uniform Motion, Motion Diagrams, and Position-Time Graphs

Objects in **uniform motion** travel equal displacement in equal time intervals.

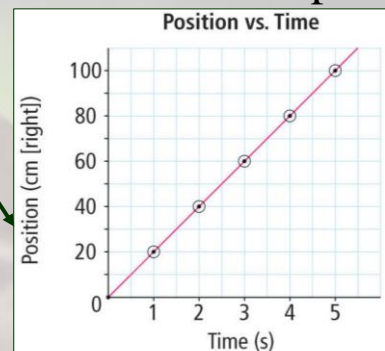
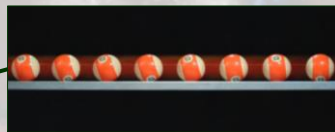
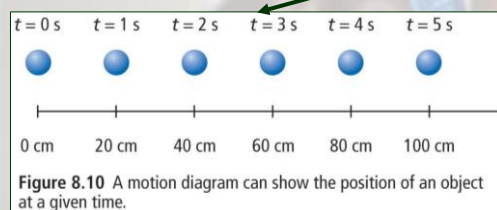


Figure 8.11 The uniform motion of the ball is shown as a straight line on a position-time graph.

A **motion diagram** visually shows an object position at a given time.

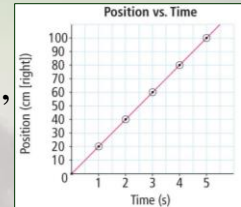
➤ helps with visualizing motion

A **position-time graph** shows an object's position during corresponding time intervals

➤ allows analysis of motion

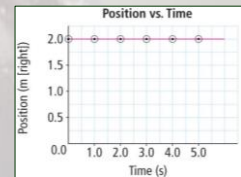
Slope of Position-Time Graphs

A **positive slope** indicates that position from the origin is increasing or that the object is travelling to the Right, Up, North, or East, RUNE.

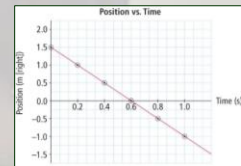


A **zero slope** indicates that the object is stationary.

This is also type of uniform motion.



A **negative slope** indicates that position from the origin is decreasing or that the object is travelling south, west, down, or to the left.



A More Complicated Position-Time Graph

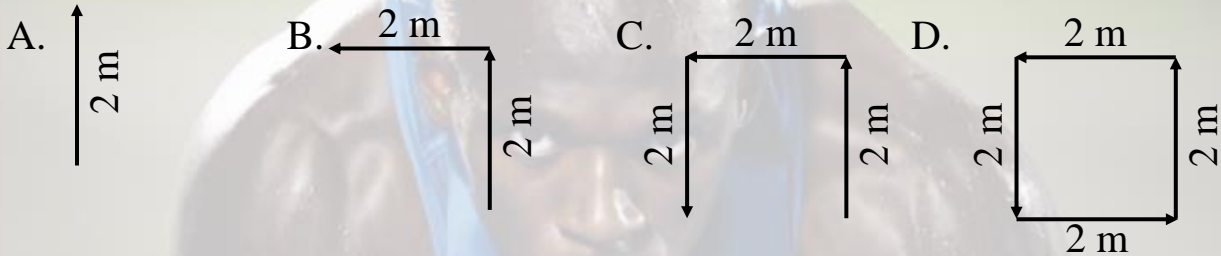
0 s to 6 s north 2 m
 6 s to 10 s stationary
 10 s to 12 s north 4 m
 12 s to 16 s south 6 m
 16 s to 18 s stationary
 18 s to 20 s south 2 m



Provincial Exam Question

Question

In which of the following situations is the displacement the greatest?



Answer

B.

For A, displacement is exactly 2 m.

For B, displacement is clearly > 2 m.

For C, the displacement is exactly 2 m.

For D, the displacement is 0 m.

Provincial Exam Question

Question

Which of the following units is associated with the Δd symbol in motion formulae?

- A. s
- B. m
- C. m/s
- D. m/s²

Answer

B.

The unit s is for time.

The unit m is for change in distance.

The unit m/s is for speed or velocity.

The units m/s² is for acceleration.

Summary

A **scalar** quantity has a magnitude, but no direction.

A **vector** quantity has a magnitude and a direction.

Scalar quantities

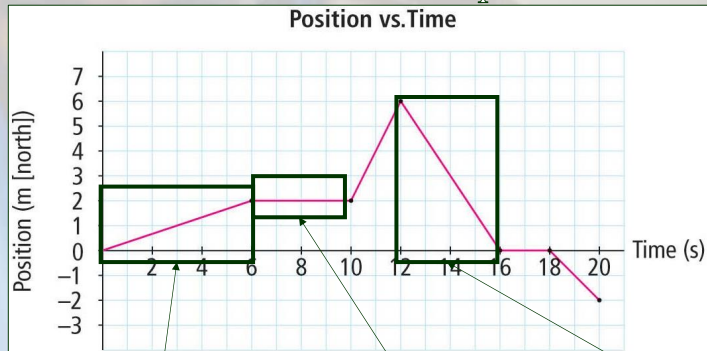
- Time, t
- Time interval, Δt
- Distance, d

Vector quantities

- Position, \vec{d}
- Displacement, $\Delta \vec{d}$

$\Delta \vec{d} = \vec{d}_f - \vec{d}_i$

Position-Time Graph

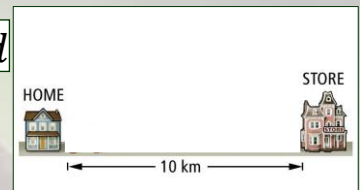


Displacement away from origin Stationary Displacement toward origin

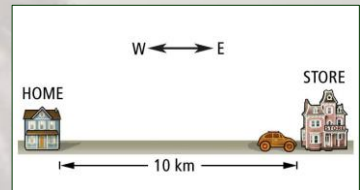
Distance, Position, and Displacement

No direction → Scalar → **Distance, d**

I drove my vehicle 10 km.
I drove my vehicle 10 km [E].



Direction → vector → **Position, \vec{d}**

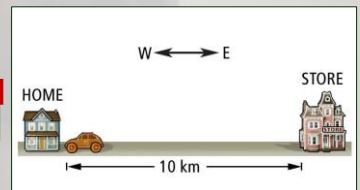


$\Delta \vec{d} = 0 \text{ m}$

This arrow indicates a vector.

I drove my vehicle 10 km east and then 10 km west.

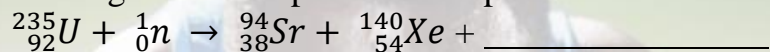
Direction → vector → **displacement, $\Delta \vec{d}$**



Provincial Exam Question

Question

Which of the following subatomic particles completes the nuclear reaction below?



- A. one proton
- B. two protons
- C. one neutron
- D. two neutrons

Answer

The total mass on the left is $235 + 1 = 236$, therefore the mass on the right must also be 236. The mass of whatever is missing must be $236 - 94 - 140 = 2$.

The total charge on the left is 92, therefore the total charge on the right must also be 92. The mass of whatever is missing must be $92 - 38 - 54 = 0$.

The option that has a mass of 2 and a charge of 0 is D.