

Motion

3 HAVO - VWO TTO Physics

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General Information

Contact BXM

- Email: mbecx@mencia.nl
- Website: www.becxlibrary.nl
- Teams: Maarten Becx
- Classroom: C2.02

Structure

- Website info: This is the place where all the materials that you'll need for my lessons are located and stored. **Please notify me when something is missing or if there are any mistakes. Thank you!**
- Questions: Use email for important cases and teams for physics questions

Don't forget!

The universe is under no obligation to make sense to you. Dare to ask your questions!

Important information

List of materials

- Pen (Writing)
- Pencil (Drawing)
- Protractor (*Extra lineal*)
- Normal calculator (*Non-graphical and/or programmable*)
- Book; Polaris Physics, Chapter; Force and motion

Tips

- Use these slides for structure
- You are always allowed to draw and mark on the test. The paper with the questions will be handed in and has no influence on your mark. Your own answer sheet will be graded
- Make sure that you're always working carefully and structured
- You can always ask me for help! :)

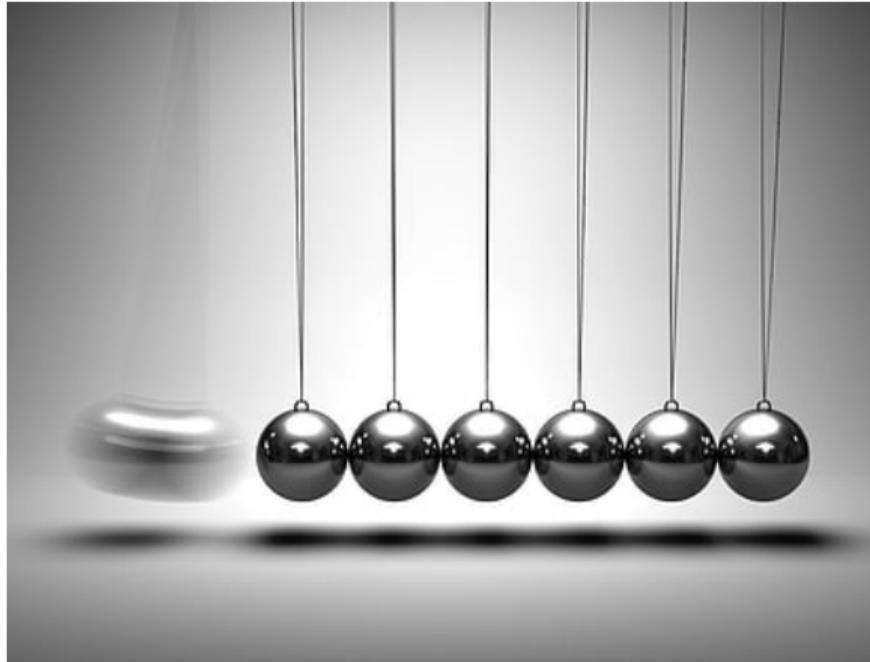


Figure: Moving ball captured

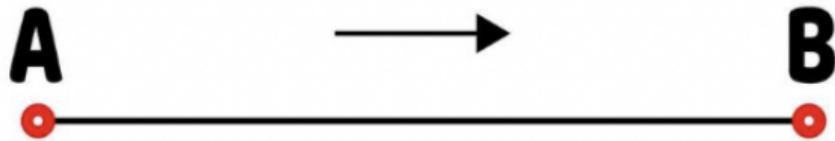


Figure: Straight line

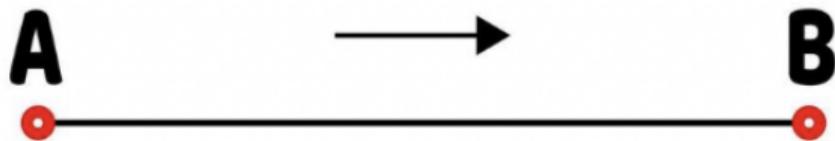


Figure: Straight line

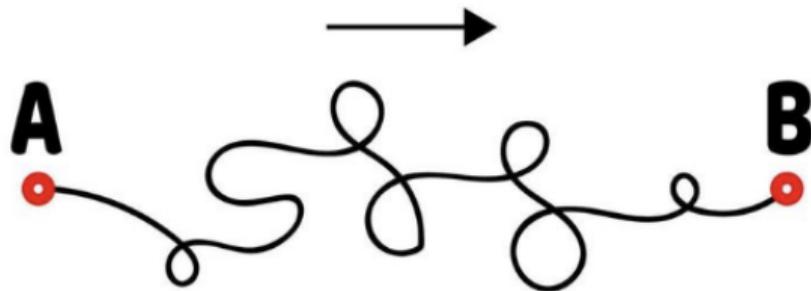


Figure: Tangled line

Recap; velocity

What do we know?

- An object changes position when it is moving. This is the distance traveled x given in $[m]$
- To travel this distance you need a velocity v given in $[m/s]$
- The relation between distance and velocity shows us how long a certain motion (movement) will take. This is the time t given in $[s]$
- The Delta sign (Δ) is a symbol for difference; $x_{end} - x_{start}$

$$v = \frac{\Delta x}{\Delta t} \quad (1)$$

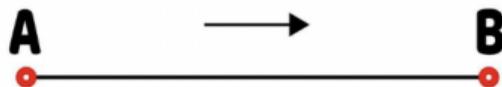


Figure: Straight line, constant motion



Question 1

You're cycling to school and halfway you notice that you're running late. You see a long straight road, so you can cycle faster. The road is 250 meter long and you're cycling with a velocity of $5,55 \text{ m/s}$. You can assume that you're cycling at a constant velocity. How long do you need to travel this road?



Recap; velocity

Question 1

You're cycling to school and halfway you notice that you're running late. You see a long straight road, so you can cycle faster. The road is 250 meter long and you're cycling with a velocity of $5,55 \text{ m/s}$. You can assume that you're cycling at a constant velocity. How long do you need to travel this road?

Answer question 1

- $x = 250 \text{ m}$
- $v = 5,55 \text{ m/s}$
- $v = \frac{\Delta x}{\Delta t} \rightarrow t = \frac{\Delta x}{\Delta v}$
- $t = \frac{250}{5,55} = 45 \text{ s}$



Recap; velocity

m/s and km/h

If the unites are not the same. You'll need to change the units following this rule:

$$10 \text{ m/s} = \frac{3600 * 10 \text{ m}}{3600 * 1 \text{ s}} = \frac{36000 \text{ m}}{3600 \text{ s}} = \frac{36 \text{ km}}{1 \text{ h}} = 36 \text{ km/h} \quad (2)$$

$$90 \text{ km/h} = \frac{90 \text{ km}}{1 \text{ h}} = \frac{90000 \text{ m}}{3600 \text{ s}} = 25 \text{ m/s} \quad (3)$$

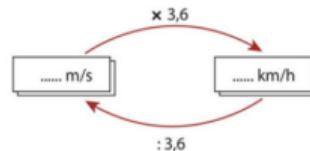


Figure: Rule

Formulas with velocity, distance and time

The given formulas:

$$v = \frac{\Delta x}{\Delta t} \quad (4)$$

$$x = \Delta v * \Delta t \quad (5)$$

$$t = \frac{\Delta x}{\Delta v} \quad (6)$$



Recap; Average velocity

What do we know?

You use the average velocity when you don't have a constant velocity. It doesn't matter if the velocity changes during the motion, you're calculating the average. You can still arrive on the preferred time when you're keeping the average velocity you need.

$$v_{avg} = \frac{\Delta x}{\Delta t} \quad (7)$$

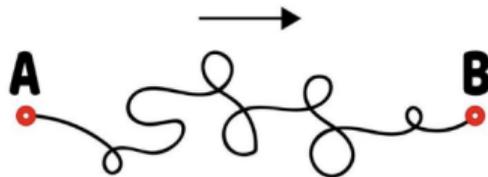


Figure: Tangled line

Recap; Average velocity

Definition

We can easily calculate the average velocity if we already know two velocities.

$$v_{avg} = \frac{v_{start} + v_{end}}{2} \quad (8)$$

In which

- v_{avg} is the average velocity given in $[m/s]$
- v_{start} is the velocity at the start or first point of the motion given in $[m/s]$
- v_{end} is the average velocity at the end or last point of the motion given in $[m/s]$



Question 2

The world record 100 meters running on the Olympic games, is on the name of Usain Bolt. He traveled this distance in 9,63 seconds. What was his average speed?



Recap; Average velocity

Practice 2

The world record 100 meters running on the Olympic games, is held by the name of Usain Bolt. He traveled this distance in 9,63 seconds. What was his average speed?

Answer question 2

- $x = 100 \text{ m}$
- $t = 9,63 \text{ s}$
- $v_{end} = \frac{\Delta x}{\Delta t} = \frac{100}{9,63} = 10,38 \text{ m/s}$
- $v_{start} = 0 \text{ m/s}$
- $v_{avg} = \frac{v_{start} + v_{end}}{2}$
- $v_{avg} = \frac{0 + 10,38}{2} = 5,19 \text{ m/s}$



Recap; x,t- and v,t-diagrams

Motion

It is a motion when you're changing position (from A to B). Your velocity indicates how fast you're traveling and therefore the time that it takes.

Different motions

- **Accelerated uniform motion:** A motion where the velocity increases over time
- **Constant motion:** A motion where the velocity is constant over time
- **Decelerated uniform motion:** A motion where the velocity decreases over time



Recap; x,t- and v,t-diagrams

The rule

Constant motion: A motion where the velocity is constant over time

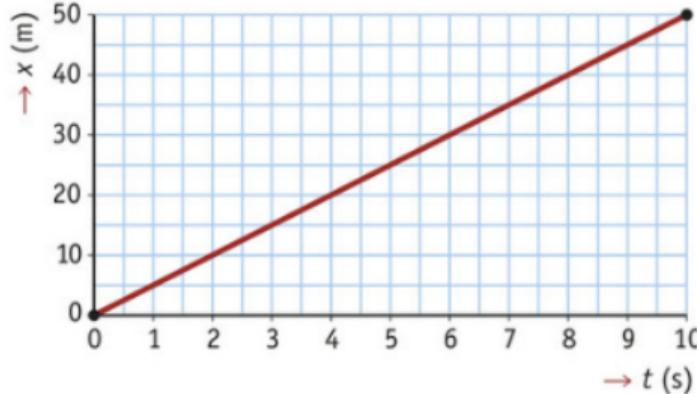


Figure: 2 (x,t)-diagram constant

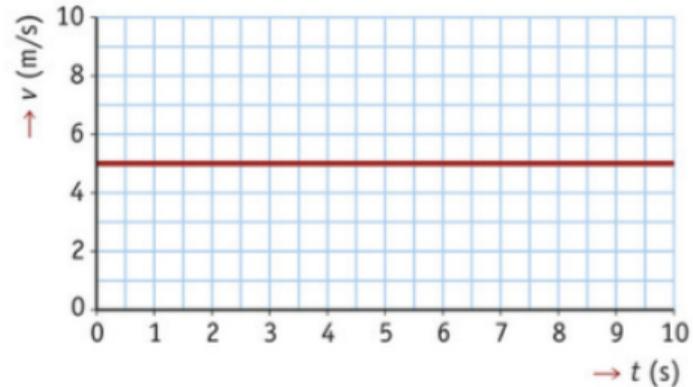


Figure: 3 (v,t)-diagram constant

Recap; x,t- and v,t-diagrams

The rule

Accelerated uniform motion: A motion where the velocity increases over time

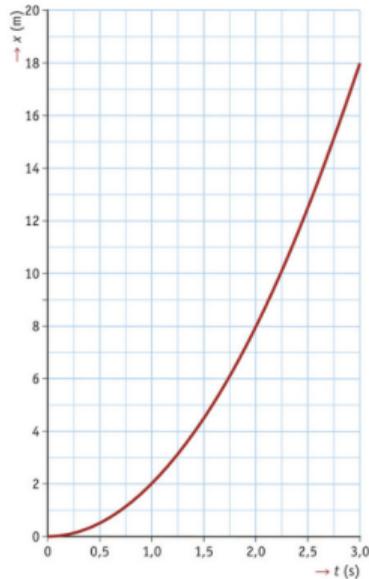


Figure: 4 (x,t)-diagram
accelerating

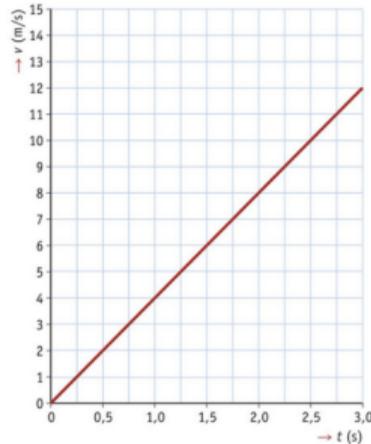


Figure: 5 (v,t)-diagram
accelerating

Recap; x,t- and v,t-diagrams

The rule

Decelerated uniform motion: A motion where the velocity decreases over time

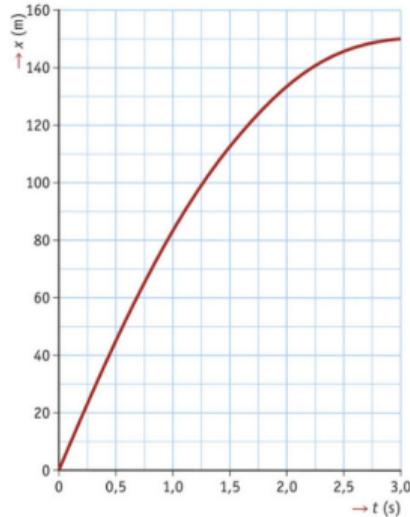


Figure: 6 (x,t)-diagram decreasing

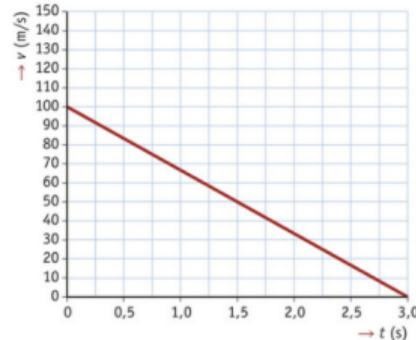


Figure: 7 (v,t)-diagram decreasing

Acceleration

Definition

To reach a certain velocity, there must be an acceleration in the same direction.

$$a = \frac{\Delta v}{\Delta t} \quad (9)$$

Where

- a is the acceleration in $[m/s^2]$
- v is the velocity in $[m/s]$
- t is the time in $[s]$



Area Method

Definition

To analyze a complete motion that consists of different types of motion, compute the **area of the graph under the curve**. These “parts” can then be added together.

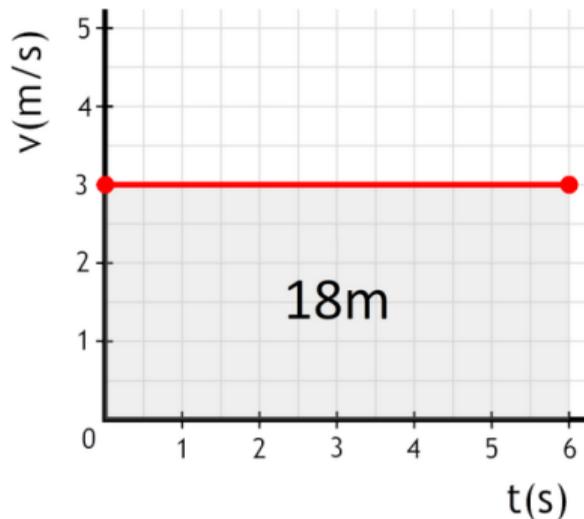


Figure: Uniform (constant) motion



Area Method

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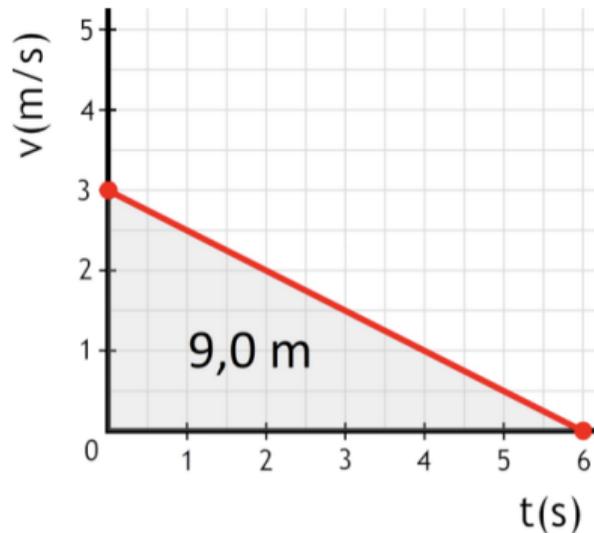


Figure: Uniformly decelerated motion

Area Method

Definition

To analyze a complete motion that consists of different types of motion, compute the **area of the graph under the curve**. These “parts” can then be added together.

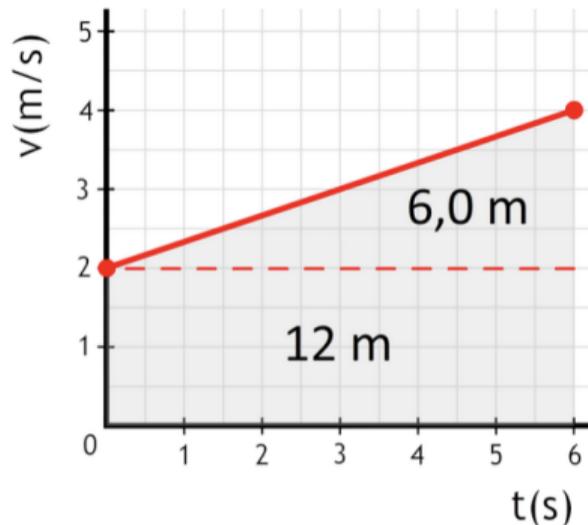


Figure: Uniformly accelerated motion with initial velocity

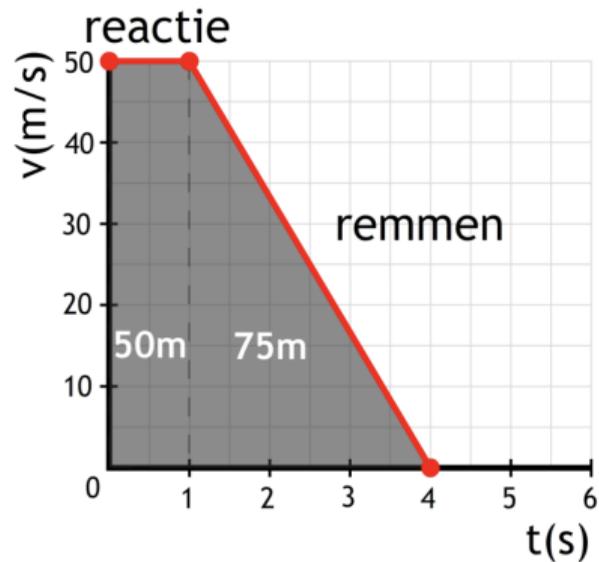


Figure: Example of a combination

Subjects; Motion	
KB1: Velocity and acceleration (average)	KB2: Velocity diagrams
<ul style="list-style-type: none">• $v = \frac{\Delta x}{\Delta t}$• $v_{avg} = \frac{v_1 + v_2}{2}$• $a = \frac{\Delta v}{\Delta t}$	<ul style="list-style-type: none">• x,t-diagram reading and drawing• Snelheid berekenen met een x,t-diagram• v,t-diagram lezen en tekenen• Versnelling berekenen met een v,t-diagram• Oppervlaktemethode v,t-diagram (alleen rechte grafieken)



Afsluiting Hoofdstuk; Beweging

Vaardigheden; Beweging		
V1: Wiskundige vaardigheden	V2: Systematische probleemaanpak	V3: Practicumvaardigheden (practica)
<ul style="list-style-type: none">● Eenheden omrekenen (snelheid, tijd)● Rekenen met schaal● Rekenen met formules● Grafieken lezen en tekenen	<ul style="list-style-type: none">● Gegeven, gevraagd, formule, uitwerking● Gegevens uit grafiek halen● Gegevens uit krachtenplaatjes halen	<ul style="list-style-type: none">● Kracht en beweging● Wet van Hooke● Momentenwet● Massa en liniaal



Toetsing; Beweging	
T1: Kracht en Beweging	T2: Practicum Moment
<ul style="list-style-type: none">• Summatief	<ul style="list-style-type: none">• Summatief

